

MIL-STD-198E

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SUPERSEDING

MIL-STD-198D

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MILITARY STANDARD CAPACITORS, SELECTION AND USE OF



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MIL-STD-198E

DEPARTMENT OF DEFENSE
Washington, DC 20301

Capacitors, Selection and Use of

MIL-STD-198E

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Electronics Command, Attn: DELET-R-S, Fort Monmouth, NJ 07703, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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FOREWORD

This standard provides selected standard capacitors for use in the design of military equipment.

The application information and performance characteristics contained in this standard are offered for guidance and are not to be considered as mandatory. Additional application information will be added when coordinated with the three military departments.

Additional sections of this standard will be developed as the standard capacitors of a given specification family are selected and coordinated with the three military departments.

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401	Capacitors, Variable, Ceramic Dielectric (Specification MIL-C-81) - - - - -	401.1
402	Capacitors, Variable (Piston Type, Tubular Trimmer) (Specification MIL-C-14409) - - - - -	402.1
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FOR ARMY AND AIR FORCE USE ONLY NOT FOR NAVY USE	
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903 Capacitors, Chip, Multiple Layer, Fixed, Ceramic Dielectric, Established Reliability (Specification MIL-C-55681) - - - - -	903.1

CROSS REFERENCE
(Specification Number to Section Number)

MIL-C-5 - - - - -	102
MIL-C-20- - - - -	902
MIL-C-62- - - - -	201
MIL-C-81- - - - -	401
MIL-C-10950 - - - - -	101
MIL-C-11015 - - - - -	301
MIL-C-14409 - - - - -	402
MIL-C-19978 - - - - -	801
MIL-C-23183 - - - - -	501
MIL-C-23269 - - - - -	601
MIL-C-39001 - - - - -	602
MIL-C-39003 - - - - -	701
MIL-C-39006 - - - - -	702
MIL-C-39014 - - - - -	901
MIL-C-39018 - - - - -	202 and 704
MIL-C-39022 - - - - -	802
MIL-C-55365 - - - - -	703
MIL-C-55514 - - - - -	803
MIL-C-55681 - - - - -	903
MIL-C-83421 - - - - -	804

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CROSS REFERENCE TO
SECTION CHANGES OR DELETIONS

From MIL-STD-198D	To MIL-STD-198E
300 - - - - -	Deleted
301 (MIL-C-12889) - - - - -	Deleted
400 - - - - -	300
401 - - - - -	301
500 - - - - -	400
501 - - - - -	401
600 - - - - -	500
601 - - - - -	501
700 - - - - -	600
701 - - - - -	601
800 - - - - -	700
801 - - - - -	701
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1000 - - - - -	900
1001 - - - - -	901
1002 - - - - -	902
1003 - - - - -	903

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Cross Reference
Style to Specification

STYLE	SPECIFICATION	DESCRIPTION	CLASS	STATUS	REPLACEMENT
CA	12889	Paper, By-Pass	Non-ER	I	19978
CB	10950	Mica, Button, Feed-Thru	Non-ER	A	
CC	20	Ceramic, Encap., Temp. Comp.	Non-ER	PI	CCR
CCR	20	Ceramic, Encap., Temp., Comp.	ER	A	
CDR	55681	Ceramic, Chip	ER	A	
CE	62	Aluminum Electrolytic	Non-ER	PI	39018
CFR	55514	Plastic, Non-Herm. Sealed	ER	A	
CG	23183	Vacuum or Gas, Variable	Non-ER	A	
CH	18312	Metallized Paper, or Plastic	Non-ER	I	39022
CHR	39022	Metallized Plastic, Herm. Sealed	ER	A	
CJ	3871	Aluminum, Motor Start	Non-ER	C	EIARS-463
CK	11015	Ceramic, Encapsulated	Non-ER	PI	39014
CKR	39014	Ceramic, Encapsulated	ER	A	
CKS	123	Ceramic, Encapsulated and Chip	Hi-Rel	A	
CL	3965	Tantalum, Foil and Wet Slug	Non-ER	I	39006
CLR	39006	Tantalum, Foil and Wet Slug	ER	A	
CM	5	Mica, Molded, Silvered, andRF	Non-ER	PI	39001
CMR	39001	Mica, Silvered	ER	A	
CMS	87164	Mica, Silvered	Hi-Rel	A	
CN	91	Paper, Non-Metal Cases	Non-ER	A	55514
CP	25	Paper, Herm. Sealed	Non-ER	I	19978
CPV	14157	Paper or Plastic, Herm. Sealed	Non-ER	C	19978
CQ	19978	Paper or Plastic, Herm. Sealed	Non-ER	I	CQR
CQR	19978	Paper or Plastic, Herm. Sealed	ER	A	
CRH	83421	Metallized Plastic, Herm. Sealed	ER	A	
CRL	83500	Tantalum, Wet Slug	Non-ER	A	
Cs	26655	Tantalum, Solid, Herm. Sealed	Non-ER	c	39003
CSR	39003	Tantalum, Solid, Herm. Sealed	ER	A	
CSS	39003	Tantalum, Solid, Herm. Sealed	Hi-Rel	A	
CT	92	Air, Variable	Non-ER	A	
CTM	27287	Plastic, Non-Metal Case	Non-ER		55514
CU	39018	Aluminum Electrolytic	Non-ER	PI	CUR
CUR	39018	Aluminum Electrolytic	ER	A	
CV	81	Ceramic, Variable	Non-ER	A	
CWR	55365	Tantalum, Solid, Chip	ER	A	
CX	49137	Tantalum, Solid, Non-Herm. Sealed	Non-ER	A	
CY	11272	Glass	Non-ER	I	23269
CYR	23269	Glass	ER	A	
CZ	11693	Metallized Paper or Plastic F. T.	Non-ER	I	CZR
CZR	11693	Metallized Paper or Plastic F. T.	ER	A	
PC	14409	Piston Trimmer	Non-ER	A	

A = Active for design
C = Cancelled
I = Inactive for design
PI = Partially Inactive for design

This cross reference is for general information only; some styles are not preferred standards and therefore not included in this standard.

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1. SCOPE

1.1 Scope. This standard consists of the following:

- (a) selected standard capacitor types, detailed by sections, chosen jointly by the Departments of the Army, the Navy, and the Air Force for use in the design and manufacture of military equipment under the jurisdiction of the Departments.
- (b) Guides for the choice and application of capacitors for use in military equipment.

Detailed requirements for capacitors listed in this standard are covered in the applicable specification (see 2.1). When it has been determined that circuit requirements cannot be met by using capacitor styles or characteristics listed in this standard, the design engineer shall, with the approval of the cognizant military activity, select from the applicable capacitor specification styles or characteristics not listed herein.

1.2 Purpose of standard:

- (a) To provide the equipment designer with a selection of standard capacitors for use in most military applications.
- (b) To control and minimize the variety of capacitors used in military equipment in order to facilitate logistic support of the equipment in the field.
- (c) To outline criteria pertaining to the use, choice, and application of capacitors in military equipment.

1.3 Notice to users. This standard was written to aid in the selection of standard capacitors. The information contained herein is believed to be correct; however, the Government assumes no liability whatsoever for any inaccuracies. Contractors are cautioned to evaluate the requirements and part numbers in the individual specification sheets. MIL-STD-198 is intended as a guide only; see section 2 for a list of the applicable procurement specifications.

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2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-C-5	Capacitors, Fixed, Mica Dielectric, General Specification For.
MIL-C-20	Capacitors, Fixed, Ceramic Dielectric (Temperature Compensating), Established and Non-Established Reliability, General Specification For.
MIL-C-62	Capacitors, Fixed, Electrolytic (DC, Aluminum, Dry Electrolyte, Polarized), General Specification For.
MIL-C-81	Capacitors, Variable, Ceramic Dielectric, General Specification For.
MIL-C-10950	Capacitors, Fixed, Mica Dielectric, Button Style, General Specification For.
MIL-C-11015	Capacitors, Fixed, Ceramic Dielectric (General Purpose), General Specification For.
MIL-C-14409	Capacitors, Variable (Piston Type, Tubular Trimmer), General Specification For.
MIL-C-19978	Capacitors, Fixed, Plastic (or Paper-Plastic) Dielectric, (Hermetically Sealed in Metal, Ceramic, or Glass Cases), Established and Non-Established Reliability, General Specification For.
MIL-C-23183	Capacitors, Fixed or Variable, Vacuum or Gas Dielectric, General Specification For.
MIL-C-23269	Capacitors, Fixed, Glass Dielectric, Established Reliability, General Specification For.
MIL-C-39001	Capacitors, Fixed, Mica Dielectric, Established Reliability, General Specification For.
MIL-C-39003	Capacitors, Fixed, Electrolytic (Solid Electrolyte), Tantalum, Established Reliability, General Specification For.
MIL-C-39006	Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte), Tantalum, Established Reliability, General Specification For.
MIL-C-39014	Capacitors, Fixed, Ceramic Dielectric (General Purpose), Established Reliability, General Specification For.
MIL-C-39018	Capacitors, Fixed, Electrolytic (Aluminum Oxide), Established Reliability and Non-Established Reliability, General Specification For.
MIL-C-39022	Capacitors, Fixed, Metallized, Paper-Plastic Film, or Plastic Film Dielectric, Direct and Alternating Current, (Hermetically Sealed in Metal Cases), Established Reliability, General Specification For.

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MILITARY - Continued

- MIL-C-55365 - Capacitors, Chip, Fixed, Tantalum, Established Reliability, General Specification For.
- MIL-C-55514 - Capacitors, Fixed, Plastic (or Metallized Plastic) Dielectric, DC or DC-AC, in Nonmetal Cases, Established Reliability, General Specification For.
- MIL-C-55681 - Capacitors, Chip, Multiple Layer, Fixed, Unencapsulated, Ceramic Dielectric, Established Reliability, General Specification For.
- MIL-C-83421 - Capacitors, Fixed, Supermetallized Plastic Film Dielectric, (DC, AC, or DC and AC), Hermetically Sealed in Metal Cases, Established Reliability, General Specification For.

(Copies of specifications, standard, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

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3. DEFINITIONS

3.1 Rating and design application terms. A list of common terms used in the rating and design application of capacitors is as follows:

- (a) Ambient temperature. Average or mean temperature of the medium (air, gas, liquid, etc.) surrounding an object.
- (b) Anode. Positive electrode of a capacitor.
- (c) Capacitance. Property of a capacitor which determines its ability to store electrical energy when a given voltage is applied, measured in farads, microfarads, or picofarads.
- (d) Capacitance tolerance. The part manufacturer's guaranteed maximum deviation (expressed in percent) from the specified nominal value at standard (or stated) environmental conditions.
- (e) Capacitive reactance. Opposition offered to the flow of an alternating or pulsating current by capacitance, measured in ohms.
- (f) Capacitor. Electronic component part consisting essentially of two conducting surfaces separated by an insulating (dielectric) material. A capacitor stores electrical energy, blocks the flow of direct current, and permits the flow of alternating or pulsating current to a degree dependent on the capacitance and the frequency.
 - (1) Capacitor, liquid-filled. A capacitor in which a liquid impregnant occupies substantially all of the case volume not required by the capacitor element and its connections. (Space may be allowed for the expansion of the liquid under temperature variations.)
 - (2) Capacitor, liquid-impregnated. A capacitor in which a liquid impregnant is dominantly contained within the foil- and paper-winding, but does not occupy substantially all of the case volume.
 - (3) Capacitor, temperature-compensating. A capacitor whose capacitance varies with temperature in a known and predictable manner.
- (g) Cathode. Negative electrode of a capacitor.
- (h) DC Leakage (DCL). Stray direct current of relatively small value which flows through or across the surface of solid or liquid insulation when a voltage is impressed across the insulation.
- (i) Dielectric. The insulating material (e.g.) air, paper, mica, oil, etc.) between the plates of a capacitor.
- (j) Dielectric absorption. Property of an imperfect dielectric whereby all electric charges within the body of the material caused by an electric field are not returned to the field.
- (k) Dielectric constant. Property of a dielectric material that determines how much electrostatic energy can be stored per unit volume when unit voltage is applied. (It is the ratio of the capacitance of a capacitor filled with a given dielectric to that of the same capacitor having a vacuum dielectric.)
- (l) Dielectric strength. Maximum voltage that a dielectric material can withstand without rupturing. (The value obtained for the dielectric strength will depend on the thickness of the material and on the method and conditions of test.)

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- (m) Dissipation factor (DF). The ratio of resistance to reactance, measured in percent.
- (n) Electrolyte. Current-conducting solution (liquid or solid) between two electrodes or plates of a capacitor at least one of which is covered by a dielectric film.
- (o) Equivalent series resistance (ESR). The square root of the difference between the impedance squared and the reactance squared.
- (p) Flashpoint of impregnant. The temperature to which the impregnant (liquid or solid) must be heated in order to give off sufficient vapor to form a flammable mixture.
- (q) Impedance (Z). Total opposition offered to the flow of an alternating or pulsating current, measured in ohms. (Impedance is the vector sum of the resistance and the capacitive reactance, i.e., the complex ratio of voltage to current.)
- (r) Impregnant. A substance, usually liquid, used to saturate paper dielectric and to replace the air between its fibers. (Impregnation increases the dielectric strength and the dielectric constant of the assembled capacitor.)
- (s) Insulation resistance (IR). Direct current resistance between two conductors that are separated by an insulating material.

NOTE: Capacitors are commonly subjected to two insulation resistance tests. One test determines the insulation resistance from terminal to terminal while the other test determines the insulation resistance from one or more terminals to the exterior case or insulating sleeve.

- (t) Power factor (PF). The ratio of resistance to impedance, measured in percent.
- (u) Quality factor (Q). The ratio of capacitive reactance to resistance.
- (v) Radio interference. Undesired conducted or radiated electrical disturbances, including transients, which may interfere with the operation of electrical or electronic communications equipment or other electronic equipment.
- (w) Ripple voltage (or current). The ac component of a uni-directional voltage or current (the ac component is small in comparison with the dc component).
- (x) Stability. The ability of a part to resist changes of characteristic values and (or) coefficients.
- (y) Surge voltage (or current). Transient variation in the voltage or current at a point in the circuit; a voltage or current of large magnitude and short duration caused by a discontinuity in the circuit.
- (z) Temperature coefficient (TC). Change in capacitance of a capacitor per degree change in temperature. It may be positive, negative, or zero and is usually expressed in parts per million per degree Celsius (ppm/°C).

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4. GENERAL REQUIREMENTS

4.1 Choice of capacitor types. The variety of capacitor types used in any particular equipment shall be the minimum necessary to obtain satisfactory performance. Where more than one type of capacitor may be used in a given application (i.e., molded mica or glass types), consideration should be given to cost and availability (use of strategic materials, multiple sources, etc.). The capacitors identified in this standard meet all the criteria for standard types (see 1.1 and 4.4 and Table I).

4.1.1 Reliability. Where quantitative reliability requirements are specified as part of the equipment requirements and are such that the use of parts with established reliability is dictated, such parts shall be selected from the established reliability sections of this standard.

4.1.2 Qualified sources. After a preliminary selection of the desired capacitor has been made, reference should be made to the applicable qualified products list for listing of qualified sources.

4.2 Item identification. A type designation for any capacitor referenced herein may be constructed as indicated in the example given in the applicable section. The part number assignments, where applicable, shall be as specified in the individual capacitor specification.

4.3 Conflict of requirements. In the event of conflict between technical requirements of capacitors described in this standard and the applicable specification, the specification shall govern; however, this standard will be up-dated concurrently to reflect specification changes.

4.4 Criteria for inclusion in this standard. The criteria for the inclusion of capacitor types in this standard are as follows:

- (a) The capacitor shall be the best type available for general use in military equipment.
- (b) Coordinated military specifications shall be available (see 2.1).
- (c) Capacitors shall be in or shall have been in production.
- (d) Where possible, only capacitors that will remain in this standard for a minimum of 1 year shall be included.

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5. DETAILED REQUIREMENTS

5.1 The detailed requirements for standard capacitor types are contained in the applicable specification and the applicable section of this standard.

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TABLE 1. Capacitor types

DIELECTRIC	APPLICABLE SPECIFICATION	CAPACITANCE			DC rated voltage (Volts)
		Range	Tolerance	Stability after 2,000 hours life test	
GLASS					
Fixed - - - - -	MIL-C-23269(ER)	.5 to 10,000 pF	±.25 pF to 5%	±.5% or 0.5 pF whichever is greater	100, 300, 500
Variable- - - - -	MIL-C-14409	0.3 to 1.2 pF thru 1 to 120 pF	---	Cap. change vs rotation: <10%	125 to 1,250
MICA					
Button style- - - - -	MIL-C-10950	.5 to 2,400 pF	±1, ±2, ±5, or ±10%	<1% or .5 pF whichever is greater	500
General purpose - - - - -	MIL-C-5	.47 to 27,000 pF	±1, ±2, or ±5%	<5% or 1 pF whichever is greater	300 to 2,500
	MIL-C-39001(ER)	1 to 91,000 pF	±.5 pF, ±1, ±2, or ±5%	<1% or 1 pF whichever is greater	50 to 500
ELECTROLYTIC					
Aluminum- - - - -	MIL-C-62	1 to 1,000 μF	±10, +50	±15%	1400 & 450
Tantalum (nonsolid) - - - - -	MIL-C-39006(ER)	.1 to 1,200 μF	±15, +30, +50, +75, ±5% to ±20%	<15%	16 to 450
Tantalum (solid)- - - - -	MIL-C-39003(ER)	.0023 to 330 μF	±5, ±10, or ±20%	<2%	16 to 100
Aluminum oxide- - - - -	MIL-C-39018(ER)	.68 to 220,000 μF	±10, +30, +50, +75	<15%	15 to 350
Tantalum (solid) chip - - - - -	MIL-C-55365(ER)	.068 to 100 μF	±5, ±10, or ±20%	---	13 to 50
PAPER-PLASTIC					
Polycarbonate - - - - -	MIL-C-19978(ER)	.001 to 1 μF	±5 or ±10%	<6%	150 to 600
Paper & polyethylene terephthalate - - - - -	MIL-C-19978(ER)	.001 to 1 μF	±2, ±5, or ±10%	<6%	1200 to 1,000
Plastic or metallized plastic - - - - -	MIL-C-55514(ER)	.001 to 50 μF	±1, ±2, ±5, or ±10%	<5%	150 to 600
Polyethylene terephthalate - - - - -	MIL-C-19978(ER)	.001 to 10 μF	±2, ±5, or ±10%	<6%	130 to 1,000
Metallized polycarbonate - - - - -	MIL-C-83421(ER)	.001 to 22 μF	±.25, ±.5, ±1, ±2, ±5, or ±10%	<2%	130 to 400
Metallized paper & polyethylene terephthalate- - - - -	MIL-C-39022(ER)	.01 to 10 μF	±10 or ±20%	<10%	1600 & 80 to 400 Vrms
CERAMIC					
Fixed, general purpose- - - - -	MIL-C-11015	2.2 to 15,000 pF	±10, ±20	<20%	1500
	MIL-C-39014(ER)	1.0 to 1,000,000 pF	±.5 pF, ±1, ±5, ±10 or ±20	<20%	1,600 to 1,600
Temp compensating - - - - -	MIL-C-20 (ER)	1.0 to 68,000 pF	±.1 pF, ±.25 pF, ±.5 pF ±1%, ±2%, ±5% or ±10%	±3% or .5 pF whichever is greater	150 to 200
Variable- - - - -	MIL-C-81	1.5 to 7 thru 15 to 60 pF	---	---	200 to 500
Fixed, chip - - - - -	MIL-C-55681(ER)	.10 to 180,000 pF	±.1 pF, ±.25 pF, ±.5 pF, ±1%, ±2, ±5, ±10, or ±20%	---	150 & 100
GAS or VACUUM					
Variable- - - - -	MIL-C-23183	15 to 750 thru 150 to 3,000 pF	---	---	12 & 3 kV

1/ Where "C" = Capacitance and "V" = Voltage.

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available by dielectric.

Operating temperature (in °C)	TEMPERATURE Temperature coefficient (in % or ppm/°C)	RELATIVE COST FOR EQUIV CV 1/ RATING	RELATIVE SIZE		DISSIPATION FACTOR (%)		
			Varies as	For equiv CV rating	60 Hz	1,000 Hz	1 MHz
-55 to +125	±140 ±25, 105 ±25, or 0 ±25	Medium	CV ²	Large	---	<.001	---
-65 or -55 to +125 or +150	±20, ±50, ±75, ±100, ±150, +50 -0, and +50 ±50	Medium high	C	Large	---	---	---
-55 to +85 or +150	±100, -20 to +100, ±60, and Not specified	Medium high	CV ²	Large	---	<.17	<1.2
-55 to +125 or +150	0 to +70, -20 to +100, ±100, ±200, and Not specified	Medium low	CV ²	Large	---	<.18	<.12
-55 to +125 or +150	0 to +70, -20 to +100, and ±200	Medium low	CV ²	Large	---	<.1	<1,000
-40 to +85	Capacitance drops from 30 to 60% at -40°C	Medium	CV	Very small	---	15 to 18% at 120 Hz; varies with V	---
-55 to +85, derated to +125	Capacitance drops from 12 to 50% at -55°C	High	CV	Very small	---	10 to 32% at 120 Hz; varies with C and V	---
-55 to +85, derated to +125	Capacitance drops 10% max at -55°C	Medium	CV	Very small	---	3 to 8% at 120 Hz; varies with V	---
-40 to -85, derated to +125	---	Medium	CV	Very small	---	10 to 35% at 120 Hz; varies with C and V	---
-55 to +125	---	Medium	CV	Very small	---	4 to 10% at 120 Hz; varies with V	---
-55 to +125	Capacitance change ±2% at -55°C	High	CV ²	Large	<.1	<.1	Higher
-65 to +125	±10%	High	CV ²	Medium large	<.1	<.1	---
-55 to +85 or +125	---	Medium	CV ²	Small	---	<2.0	---
-65 to +85	-7 to +5%	High	CV ²	Small	<.6	<.6	---
-65 to +100	-2.5% to +1.2%	Medium	CV ²	Small	<.15	<.15	---
-55 to +85 or +125	Capacitance drops <10% at -55°C	Medium	CV ²	Small	---	<1	---
-55 to +85 or +125	Capacitance change <+30, -80% at -55°C	Very low	CV ² +k	Small	---	<2.5	<2.5
-55 to +85 or +125	Capacitance change <+30, -80% at -55°C	Very low	CV ² +k	Small	---	<2.5	<2.5
-55 to +125	0 ±30, 0 ±60	Very low	CV ² +k	Small	---	0.15	<.10
-55 to +85	Capacitance change <-4.5, +2% at -55°C	Medium low	CV ² +k	Large	---	---	0.2
-55 to +125	0 ±30 or 0 ±15	Low	CV	Small	---	<2.5	<2.5
-55 to +85	---	High	---	Large	---	<0.001	---

6. GENERAL APPLICATION INFORMATION

6.1 General. The application information contained herein is designed to help the engineer select the capacitors he will specify (application information pertaining to specific capacitor types is contained in the applicable sections). As with other types of components, the most important thing a user must decide is which of the numerous types of capacitors will be best for use in the military equipment he is designing. Proper selection in its broadest sense is the first step in building reliable equipment. To select properly the capacitors to be used, the user must know as much as possible about the types from which he can choose. He should know their advantages and disadvantages; their behavior under various environmental conditions; their construction; and their effect on circuits and the effect of circuits on them. He should know what makes capacitors fail. He should also have an intimate working knowledge of the applicable military specification.

6.1.1 Capacitor usage. Capacitors are used as energy-storage components to accumulate energy through long periods of time and to discharge the energy over longer or shorter periods. Parallel RC circuits will maintain bias on the grid of a tube for long periods and, as in filter circuits, will smooth out pulsating direct current. By-pass capacitors are used to prevent the flow of direct current without impeding the flow of alternating current and the attenuate low frequency currents while permitting higher frequency currents to pass. In combination with resistors, capacitors are used to reduce radio interference caused by arcing contacts, and to increase the operational life of the contacts.

6.1.2 Capacitor types. Capacitors of the types widely used in electronic equipment can be grouped into one of six basic types; namely, (1) glass and mica, (2) electrolytic, (3) paper and plastic, (4) ceramic, (5) air, and (6) vacuum. These basic types differ from each other in size, cost, capacitance, and general characteristics. Some are better than others for a particular purpose; no one type has all of the best characteristics. The choice among them, therefore, depends on the requirements, both initial and long-term, the environment in which they must exist, and numerous other factors. The designer must realize that the summaries of the general characteristics contained in table I are relative, not absolute, and that all the requirements of a particular application must be taken into consideration and compared with the advantages and disadvantages of each of the several types before a final choice is made.

6.2 Environmental effects on characteristics and life. The characteristics and life of all capacitors are dependent on the environments to which capacitors are exposed. Effects of various environmental conditions on capacitors are as follows:

6.2.1 Temperature:

- (a) The temperature at which the dielectric operates is a function of the ambient temperature in which the capacitor is located; the heat which is radiated or conducted to the capacitor; the internal heating of the capacitor due to I^2R losses in the conductors and dielectric; the physical construction and thermal conductivity of the materials inside the capacitors; the transfer of heat internally by conduction and convection to the container; and the heat lost from the container by convection, conduction, and radiation.
- (b) The insulation resistance decreases as the temperature increases. The power factor is a complex function of temperature. With polarized dielectrics, temperature-frequency combinations exist where there are large increases in power factor. This may not present any difficulties at low temperatures, since internal heating will raise the dielectric temperature and lower the power factor. An increase in power factor at high temperatures may cause thermal instability and must be considered.
- (c) The capacitance of polarized dielectrics is a complex function of temperature, voltage, and frequency; nonpolarized dielectrics exhibit less change than polarized materials. It is to be noted that as the ambient temperature is decreased, many dielectrics will exhibit a very large decrease in capacitance with a relatively small change in temperature.

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The increased power factor at this temperature may raise the dielectric temperature sufficiently to recover the lost capacitance; however, it must be considered that when the capacitor is initially energized while at low temperatures, the capacitance will be a small percentage of its nominal value, and if the internal heating is effective, the thermal time constant of the capacitor must be considered. A change in the distance between the conductors and the effective area of the conductor due to dimensional changes will cause a change in capacitance.

- (d) The dielectric strength of the dielectric decreases as the temperature increases.
- (e) The life of a capacitor, in general, decreases with an increase in temperature. Life as a function of operating temperature is a complex function and should be determined from life-test data. In the absence of this data, the familiar 10-C rule for a chemical reaction may be used as a rough approximation. This rule states that the life decreases by a factor of two for each 10 C rise in temperature. This rule, however, should never be used outside of the temperature range specified by the manufacturer, since chemical reactions of an entirely different nature may take place at extreme temperatures. This rule should not be applied to liquid and gaseous dielectric without further investigation.
- (f) The operating temperature and changes in temperature also affect the mechanical structure in which the dielectric is housed. The terminal seals utilizing elastic materials or gaskets may leak due to the set temperature characteristics. The expansion and contraction of materials with different thermal coefficients may cause leaks at joints. Electrolysis effects in glass terminals increase as the temperature increases. The increase in internal pressure of liquids and gases may cause leaks. A decrease in internal pressure due to the lowering of the temperature may cause internal arc-over.
- (g) If the capacitor is operated in the vicinity of a component operating at high temperature, the flashpoint of the impregnant should be considered.

6.2.2 Pressure:

- (a) The dielectric strength of gases is a function of pressure, temperature, frequency, and humidity. Hermetically-sealed units must have terminals designed to operate satisfactorily at the required pressure.
- (b) The heat loss by convection of a capacitor is a function of pressure and must be considered.
- (c) Reduced pressure may produce leaks in hermetically-sealed units. An increase in pressure on the container of rolled capacitors in rectangular containers may increase the capacitance by decreasing the distance between the conductors.

6.2.3 Shock and vibration. The capacitors and mounting brackets, when applicable, must be of a design which will withstand the shock and vibration requirements of the particular application.

6.2.4 Moisture. Moisture in the dielectric will decrease the dielectric strength, life, and insulation resistance, and increase the power factor of the capacitor. In general, capacitors which operate in high humidities should be hermetically sealed. The effect of moisture on pressure contacts which are not gas-tight may result in a high resistance or open contact.

6.2.5 Aging. Capacitor aging is a term used to describe the negative, logarithmic capacitance change that takes place in ceramic capacitors with time. As one might expect, the more stable dielectrics have the lowest aging rates.

Temperature compensating dielectrics, such as MIL-C-20 and MIL-C-55681 components with a characteristic of 0 ± 30 ppm/ $^{\circ}$ C, over the operating temperature range of -55° to $+125^{\circ}$ C, do not appear to age at all; however, all ceramic capacitors with high dielectric constants display an aging characteristic.

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General purpose dielectrics - particularly those with a capacitance change of ± 15 percent (or greater) over the -55° to $+125^{\circ}\text{C}$ operating temperature range - comprise this high dielectric constant family and represent the group we are concerned with.

High K ceramic dielectrics with a barium-titanate formula exhibit a phenomenon known as Curie Point crystal-phase transformation. Simply stated, most of the tiny crystals that make up the ceramic micro-structure are of cubic symmetry at a temperature of 120°C and above. Below 120°C , these same crystals take on a tetragonal shape. The specific relationship between this crystal-phase transformation and aging is not clearly understood, but it is known that they are directly related. As the crystals change from cubic to tetragonal shape, stresses are set up in the dielectric and are subsequently relieved gradually. This electrical "aging" phenomenon seems to follow the same logarithmic patterns observed in mechanical models of stress relief. Each time the capacitor is heated to approximately 120°C (Curie Point), all of the negative capacitance change that may have taken place is recovered. Upon cooling, the aging cycle begins again. This recovery process is commonly referred to as "de-aging". The entire process of aging and de-aging is predictable and can be repeated infinitely.

Another important parameter that affects capacitor aging is the application of polarizing voltage. The application of a dc voltage approximately equal to the capacitor's rating will cause an abrupt negative capacitance change; however, when the voltage is removed, the capacitor does not return to its original polarized value. If this exercise were performed on a capacitor with a known aging characteristic and the results were plotted, the resultant curves would resemble those in figure 1.

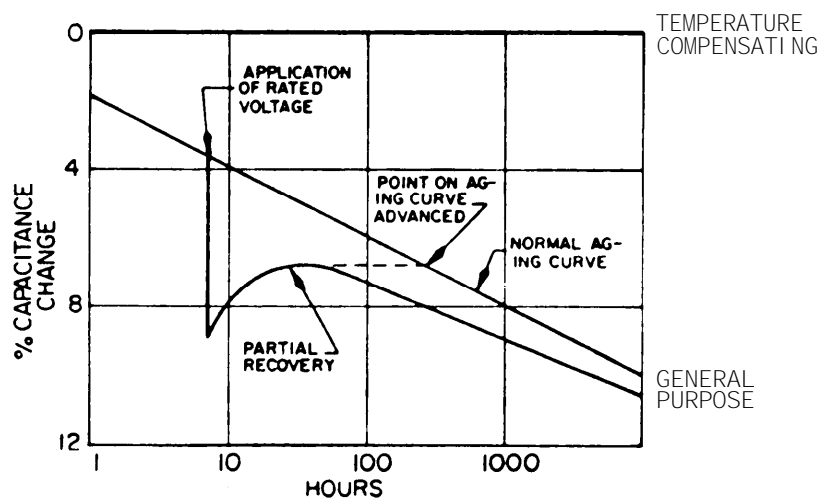


FIGURE 1. Capacitor aging curves.

The dc voltages and subsequent dielectric polarization of the capacitor micro-structure serve to relieve some of the stresses in the dielectric. This moves the point on the aging curve forward approximately 1.5 decades.

Most general purpose state-of-the-art dielectrics found in industry have aging rates varying from 1.5 percent to 4 percent.

In summary, the following points should be kept in mind when dealing with the phenomenon of ceramic capacitor aging:

- (a) The process is completely repeatable and predictable.
- (b) Capacitance change is negative and logarithmic in respect to time.
- (c) Application of dc bias can move a point on the curve forward in time.

This wide capacitance change, as a result of "shelf" aging and temperature cycling, illustrates why tight-tolerance high K ceramics are not common in the electronics industry.

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6.2.6 Capacitor tests. The average component is a complex device. For this reason it is impossible for manufacturer to guarantee an exact minimum life of an individual capacitor; for example, under any given circuit or environmental condition of usage, all he can do is to provide statistical guides as to the probable minimum life or reliability of the unit when considered as a member of a large family of units.

6.2.7 Capacitor misuse. A capacitor may fail when subjected to environmental or operational conditions for which the capacitor was not designed or manufactured. The designer must have a clear picture of the safety factors built into the units, of the safety factors he adds of his own accord, and of the numerous effects of circuit and environmental conditions on the parameters. It is not enough to know only the capacitance and the voltage rating. It is important to know to what extent the capacitance varies with environment; how much the internal resistance of the capacitor varies with temperature, current, voltage, or frequency; of the effects of all of these factors on insulation resistance, breakdown voltage, and other basic capacitor characteristics which are not essential to the circuit but which do invariably accompany the necessary capacitance.

6.3 Principal applications. Some of the principal applications of the various types of capacitors are shown in table II.

6.4 Capacitor selection. The designer, in selecting a capacitor type for a particular function to be performed, must weigh numerous factors before coming to a final decision. Selection normally starts with the most important characteristic for the application, then selecting and compromising other characteristics.

6.4.1 Selection factors. The most important of these factors are noted below with some of the reasons why these factors are important.

6.4.1.1 Temperature effects:

- (a) Capacitance:
 - (1) By variations in dielectric constant.
 - (2) By changing conductor area or spacing.
- (b) Leakage current, through change in specific resistance.
- (c) Breakdown voltage at high temperatures and effect of frequency on heating.
- (d) Current rating, when affected by heating.
- (e) Oil, gas, or electrolyte leakage through seals.

6.4.1.2 Humidity effects:

- (a) Leakage current.
- (b) Breakdown voltage.
- (c) Effect on power factor or Q.

6.4.1.3 Barometric pressure effects:

- (a) Breakdown voltage.
- (b) Oil, gas, or electrolyte leakage through seals.

TABLE II. Principal applications.

MILITARY SPECIFICATION	Established/Reliability	Capacitor Type	APPLICATION																			
			Blocking	Buffering	By-passing	Coupling	Filtering	Tuning	Temperature Compensating	Trimming	Motor starting	Timing	Noise suppression									
MIL-C-5	-	Mica																				
MIL-C-20	x	Ceramic	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MIL-C-62	-	Aluminum																				
MIL-C-81	-	Ceramic Trimmer																				
MIL-C-10950	-	Mica			x																	
MIL-C-11015	-	Ceramic																				
MIL-C-14409	-	Piston Trimmer																				
MIL-C-19978	-	Plastic																				
MIL-C-23183	-	Vacuum																				
MIL-C-23269	-	Glass																				
MIL-C-39001	-	Mica																				
MIL-C-39003	-	Solid Tantalum																				
MIL-C-39006	-	Wet Tantalum																				
MIL-C-39014	-	Ceramic																				
MIL-C-39018	-	Aluminum																				
MIL-C-39022	-	Met. Plastic																				
MIL-C-55365	-	Solid Tantalum, Chip																				
MIL-C-55514	-	Plastic																				
MIL-C-55681	-	Ceramic, Chip																				
MIL-C-83421	-	Met. Plastic																				

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6.4.1.4 Applied voltage effects:

- (a) Leakage current.
- (b) Heating and its accompanying effects.
- (c) Breakdown of dielectric; effect of frequency.
- (d) Corona.
- (e) Insulation to case or chassis.

6.4.1.5 Vibration:

- (a) Capacitance change through mechanical vibration.
- (b) Mechanical distortion of elements, terminals, or case.

6.4.1.6 Current:

- (a) Effect on internal temperature rise and life of capacitor.
- (b) Ability of conductors to carry currents from a thermal viewpoint.

6.4.1.7 Life. Affected by all environmental and circuit conditions.6.4.1.8 Stability. Also affected by all environmental and circuit conditions.6.4.1.9 Retrace. After a capacitance change.6.4.1.10. Size, volume, cost, and mounting method.

6.4.2 Capacitor selection chart. Table III lists the capacitor styles available in each specification represented in this standard. The data given is approximate and is meant as an aid in selecting capacitors only. The configuration drawing is not exact in all cases.

6.5 Application data. The following should be considered in the selection and use of a capacitor type:

- (a) The capacitance tolerance that the circuit designer uses in order to design a circuit which will operate satisfactorily for the desired time requires (1) acceptable tolerances according to specification; (2) capacitance-temperature characteristics; (3) capacitance-voltage characteristics; (4) retrace characteristics; (5) capacitance-frequency characteristics; (6) dielectric absorption; (7) capacitance as a function of pressure, vibration, and shock; and (8) capacitor aging in the circuit and shelf storage.
- (b) Capacitance between the capacitor terminals and case may be a consideration, as will stray capacitance and leakage currents. The terminal connected to the outside conductor is often identified by the manufacturer so that the circuit can minimize these effects.
- (c) The capacitance-temperature characteristic can be compensated for by using more than one type of capacitor to obtain the required capacitance. The characteristics of other circuit components may also be used for compensation.
- (d) The peak voltage which is applied to the capacitor should not exceed the rating in the applicable specification. The safety factor between the peak applied voltage, the test voltage, and the breakdown voltage is of a statistical nature. The same peak voltage, in general, may decrease with (1) aging, (2) an increase in temperature, (3) an increase of area of dielectric, (4) higher frequencies of applied voltage, (5) a decrease in pressure, or (6) the entrance of moisture into the capacitor. In many

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applications, it is necessary to derate the capacitor from the specified voltage to provide the desired performance for the required time. It is to be emphasized that short-duration transient voltages cannot be neglected in capacitor applications.

- (e) The use of the self-healing properties of certain types of capacitors may not be desirable in circuits where intermittent failures and noise would be troublesome. Some types are not self-healing at low voltages.
- (f) Operation of capacitors above the corona-starting voltage will reduce the life and will produce noise. Liquid-impregnated dielectrics have a higher corona-starting voltage than dry solid dielectrics.
- (g) When a capacitor is operated at high voltages above ground, and when it is insulated from ground with supplementary insulation, one terminal should be connected to the case, since the division of voltage depends on capacitance between capacitor rolls and case and the capacitance between case and chassis.
- (h) The peak charge and discharge currents must be considered on the basis of the time constant of the circuit.
- (i) Internal heating and ambient temperature must be considered.
- (j) To determine the surface temperature rise of a capacitor, multiply the volt-amperes supplied to the unit by the power factor. This gives the watts lost in the capacitor. Dividing the watts lost by the surface area in square inches and referring to figure 2 will give the approximate surface temperature rise.

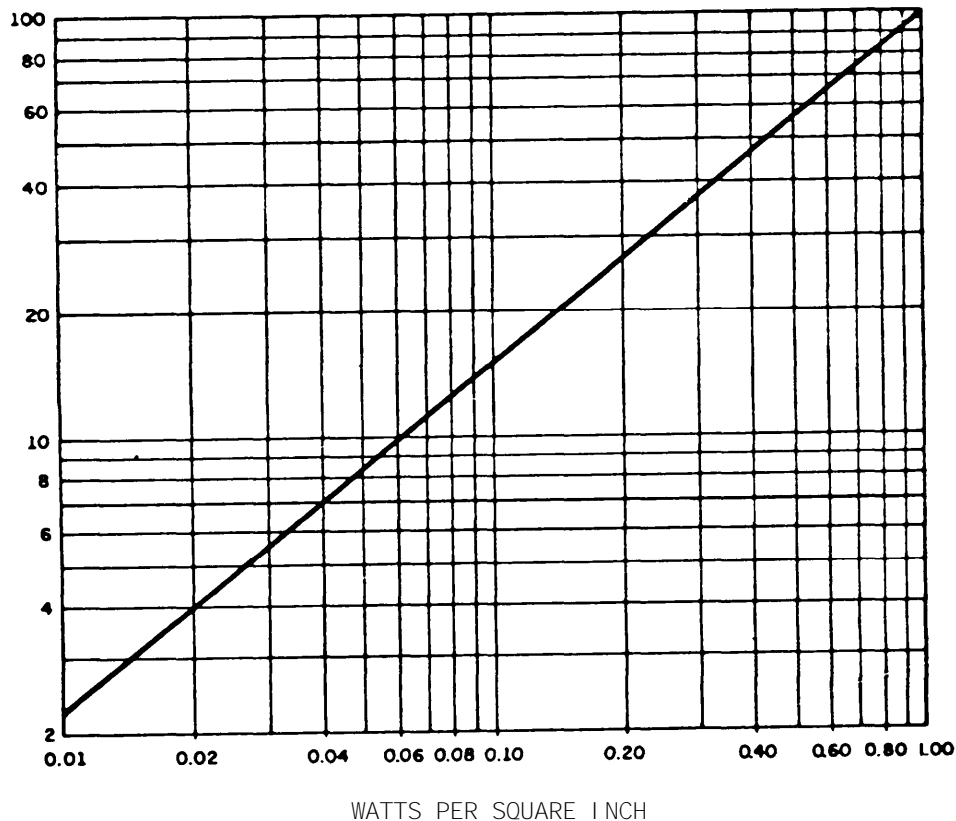


FIGURE 2. Temperature rise as a function of watts per square-inch-power dissipation.

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- (k) Environmental conditions such as humidity, pressure, corrosive atmospheres, fungus growth, shock, and vibration must be considered.
- (l) The insulation resistance must be considered, especially at high temperatures.
- (m) In series operation on dc, balancing resistors should be considered.
- (n) The effective inductance of a large capacitor can be reduced by shunting it with a small capacitor.
- (o) The inductance of various types of capacitors varies over wide limits.
- (p) Since capacitors have inductance, the operation of capacitors in parallel in circuits with fast rise times or transients may result in transient oscillations.
- (q) Poor electrical contacts may open at low voltages and be noisy.
- (r) The stored energy in capacitors can be dangerous to personnel and equipment and suitable precautions should be taken.
- (s) Extended-foil paper capacitors are generally considered superior to inserted-tab types, having less inductance and less series-contact resistance. These are important factors in low voltage applications and in low signal-to-noise-ratio circuits.
- (t) Oil-or acid-filled units should not be subjected to severe mechanical stresses. Leakage of the fluid can destroy the capacitor together with adjacent components.
- (u) Liquid-filled units should not be used inverted because internal corona may result.
- (v) Nonhermetically-sealed capacitors may be previous to moisture by the process of "breathing."
- (w) Capacitors for ac and pulse operation require special ratings and tests; these are not covered in most military specifications.

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7. SUPPLEMENTAL INFORMATION

7.1 Failure rates:

7.1.1 Failure rate levels. The established reliability (ER) specifications provide for the establishment of failure rate levels through a life test at maximum rated conditions. The failure rate levels (in percent per 1,000 hours) are based only on the maximum rated life test. Failure rate levels referenced in this standard range from 1.0 to 0.001 percent per 1,000 hours and may be considered applicable over the time period specified in the applicable specification.

NOTE: Due to the reliability requirements of these specifications, processes and controls utilized in manufacturing the ER capacitors are necessarily more stringent than those required for non-ER items. MIL-STD-790, "Reliability Assurance Program for Electronic Parts Specifications," provides for monitoring and documentation for requirements.

7.1.2 True product failure rates. The applicable ER specification provides failure rate qualification sampling plans computed on the basis of 60- and 90-percent confidence levels and lot-by-lot acceptance procedures which give an adequate assurance that the qualified failure rate is being maintained. The true product failure rate of lots offered for acceptance will, on the average, be better than the certified level, since the supplier must maintain a lower average failure rate in order to obtain and retain qualification. For example: Using a confidence level of 90 percent (see figure 3), a supplier must supply parts with 0.022 percent to 0.282 percent failure rates, depending upon the number of allowable failures, in order to have 95-percent of his lots accepted. By the same token, at the "M" (1.0 percent) level, there is a 90-percent probability that the manufacturer will lose his qualification if he supplies parts with a failure rate of 1.0 percent. Figure 4 indicates the true product failure rate for a 60-percent confidence level.

7.2 Metric equivalents. The metric equivalent dimensions provided in each section are for general information only. These metric dimensions are rounded off to the nearest .01 millimeter (mm) and are based upon 1 inch = 25.4 mm.

7.3 International standardization agreements. Certain specifications (see table III) contain provisions which term the basis for international standardization agreements. Any proposed changes (amendment, revision, or cancellation) which would violate or affect the international standardization agreement concerned are effected as provided in the specification.

Custodians:
 Army - ER
 Navy - EC
 Air Force - 11

Preparing activity:
 Army - ER

(Project 5910-1447)

Review activities:
 Army - MU
 Navy - AS, OS
 Air Force - 17, 85
 DLA - ES

User activities:
 Navy - CG, MC
 Air Force - 19

Agent:
 DLA - ES

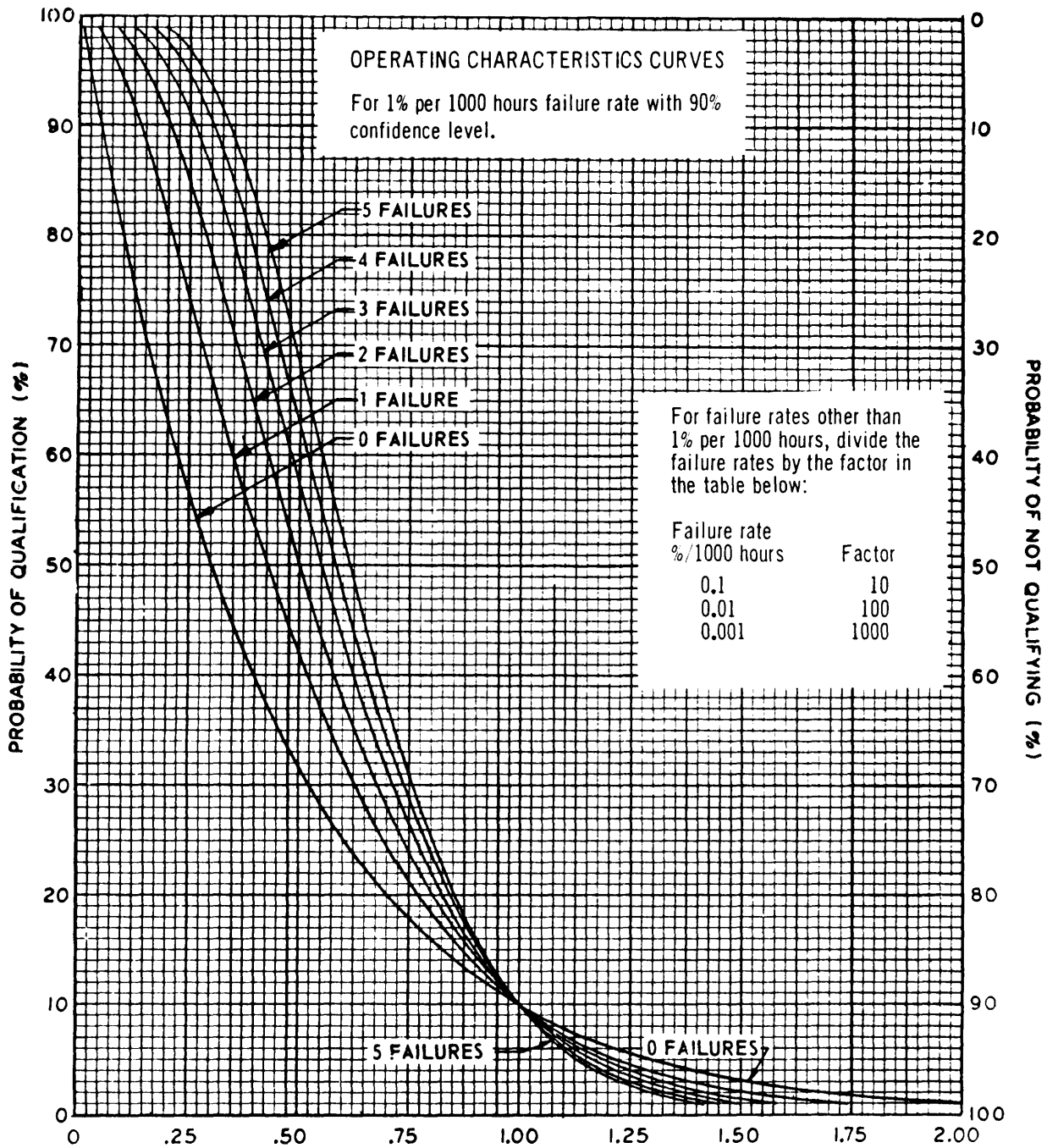


FIGURE 3. True product failure rates (90-percent confidence level).

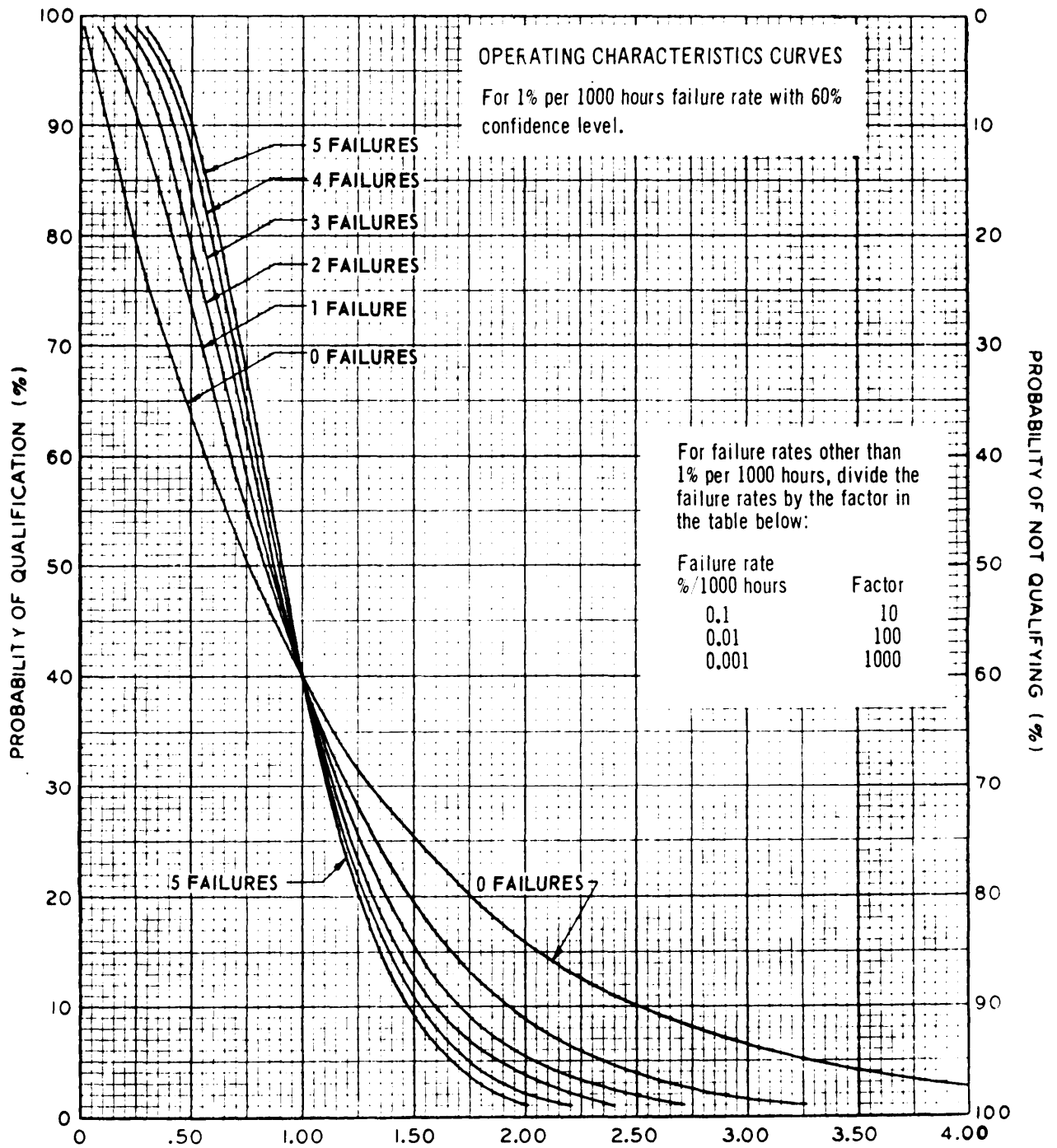





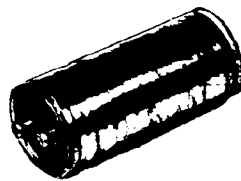





FIGURE 4. True product failure rates (60-percent confidence level).

TABLE III. Capacitor selection chart.

Section	Type	Style referenced in standard	Capacitance range (pF)	Capacitance tolerance (%)	DC rated voltage (Volts)	Operating temp range (-55° to + °C)	Temperature coefficient (ppm/°C)	Q or DF	Maximum body dimensions (inches)			Equivalent NATO type	NEPR no.	Configuration
									Length	Width	Thickness or diameter			
FIXED, MICA														
(101) MIL-C-10950	Fixed, Mica Dielectric, Button Style	CB50	5 to 1,500	1, 2, 5, or 10%	500	85	See 1/ See 1/ ±60 or ±100 ±60 or ±100 ±60 or ±100 ±60 or ±100 ±60 or ±100 ±60 or ±100 See 1/ ±60 or ±100 ±60 or ±100	See section 101	.826		.790	NCM62 NCM56 NCM57 NCM60 NCM63 NCM64 NCM65 NCM58 NCM59 NCM61	12	 CB50  CB55, 56, 57
		CB55	5 to 470	1, 2, 5, or 10%	500	150			.755	.515				
		CB56	680 to 1,000	1, 2, or 10%	500	150			.780	.515				
		CB57	1,200 to 2,400	1, 2, or 10%	500	150			.860	.515				
		CB60	15 to 470	1, 2, 5, or 10%	500	150			.835	.510				
		CB61	680 to 1,000	1, 2, or 10%	500	150			.860	.510				
		CB62	1,200 to 2,400	1, 2, or 10%	500	150			.940	.510				
		CB65	5 to 470	1, 2, 5, or 10%	500	150			.711	.515				
		CB66	680 to 1,000	1, 2, or 10%	500	150			.737	.515				
		CB67	1,200 to 2,400	1, 2, or 10%	500	150			.815	.515				
(102) MIL-C-5	Fixed, Mica Dielectric	CM15	430 to 510	1 or 2%	500	150	±200, -20 to +200, 0 to +70 Not specified Not specified	See section 102	.547	.313	.219	NCM01 NCM02 NCM03 NCM04	1	 CM15.20, 30, 35  CM45, 50
		CM20	560 to 1,000	1 or 2%	500	150			.796	.469	.219			
		CM30	1,100 to 3,300	1 or 2%	500	150			.859	.859	.281			
		CM35	3,600 to 15,000	1 or 2%	300 or 500	125 to 150			.859	.859	.359			
		CM45	47 to 1,800	5%	2,500	150			2.282	1.156	.359			
		CM50	2,200 to 27,000	5%	600, 1,200, or 2,500	150			2.282	1.156	.453			
FIXED, ELECTROLYTIC														
(201) MIL-C-62	Fixed, Electrolytic (Dry Electrolytic), Aluminum	CE13	1 to 68	-10, +50	400 & 450	-40° to +85°C	31 to 262 390 to 1006	218 to 22,000 15 to 100	1.311 to 3.811		.655 to 1.155	NEC01	80	 CE13  CE71
		CE71	150 to 1,000	-10, +50	450	-40° to +85°C			4.219	1.438 to 3.063				
(202) MIL-C-39018	Fixed, Electrolytic (Aluminum Oxide)	CU15	3.9 to 680 .68 to 33	-10, +30, -10, +75 -10, +30, -10, +50	7 to 75 100 to 250	85, derated to 125°C	25° 85° 125° 4-24 12-72 12-72 8-36 12-108 12-108	4.4 to 510 61 to 3,000	.969 to 2.781 .969 to 2.781		.304 & .398 .304 & .398	NCU02 NCU02	59	CU15 (see CE13 above)
FIXED, CERAMIC														
(301) MIL-C-11015	Fixed, Ceramic-Dielectric, General Purpose	CK60	2.2 to 1,500	10 or 20%	500 & 1,000	85 & 125	>200,000	>150,000	.310		.160	NCC46 NCC48 NCC49	14	 CK60 thru 69  CK70  CK80
		CK62	22 to 6,800	10 or 20%	500 & 1,000	85 & 125	>200,000	>150,000	.590		.160			
		CK63	680 to 10,000	10 or 20%	500 & 1,000	85 & 150	>200,000	>150,000	.690		.160			
		CK64	510 to 3,900	20%	1,600	85	>200,000	>150,000	.770		.207			
		CK65	4,700	20%	1,600	85	>200,000	>150,000	.830		.207			
		CK66	5,600	20%	1,600	85	>200,000	>150,000	.930		.207			
		CK67	6,800 & 7,500	20%	1,600	85	>200,000	>150,000	.990		.207			
		CK68	10,000	20%	1,600	85	>200,000	>150,000	1.090		.370			
		CK69	15,000	20%	1,600	85	>200,000	>150,000	1.150		.370			
		CK70	10 to 1,500	10 or 20%	500 & 1,000	85	>20,000	>3,000	.781		.327			
		CK80	10 to 1,500	10 or 20%	500	85	>20,000	>3,000	.781		.327			

1/ Temperature coefficient is ±60, ±100, -20 to +100, and not specified.

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Table III. Capacitor selection chart - Continued.




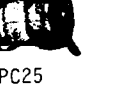
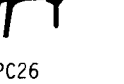








Section	Type	Style referenced in standard	Capacitance		Capacitance change from 25°C				Q or DF	DC rated voltage (Volts)	Operating temp. range (°C)	Temperature coefficient (ppm/°C)	Maximum body dimensions (inches)			Equivalent NATO type	NEPR no.	
			Min (pF)	Max (pF)	At -55°C		At 85°C						Length	Width	Thickness or diameter			
					Min (Percent)	Max (Percent)	Min (Percent)	Max (Percent)										
VARIABLE																		
(401) MIL-C-81	Variable, Ceramic Dielectric	CV11	1.5	7.0	-4.5	+2.0	-2.5	+2.0	<.2%	500	-55 to +85		.87	.67	.406			
			3.0	12.0	-4.5	+2.0	-2.5	+2.0	<.2%	500	-55 to +85		.87	.67	.406			
			4.5	25.0	-4.5	+2.0	-2.5	+2.0	<.2%	500	-55 to +85		.87	.67	.406			
			3.0	13.0	-1.0	+3.5	-2.5	-0.5	<.2%	500	-55 to +85		.87	.67	.406			
			5.0	20.0	-1.0	+3.5	-2.5	-0.5	<.2%	500	-55 to +85		.87	.67	.406			
			4.0	30.0	-1.0	+6.5	-4.0	-1.0	<.2%	500	-55 to +85		.87	.67	.406			
			7.0	45.0	-1.0	+6.5	-4.0	-1.0	<.2%	500	-55 to +85		.87	.67	.406			
			2.0	6.0	+1.5	+7.0	-5.0	-1.5	<.2%	500	-55 to +85		.87	.67	.406			
			4.0	30.0	+1.5	+7.0	-5.0	-1.5	<.2%	500	-55 to +85		.87	.67	.406			
			7.0	45.0	+1.5	+7.0	-5.0	-1.5	<.2%	500	-55 to +85		.87	.67	.406			
			1.5	7.0	-4.5	+2.0	-2.5	+2.0	<.2%	500	-55 to +85		.87	.67	.406			
			3.0	12.0	-4.5	+2.0	-2.5	+2.0	<.2%	500	-55 to +85		1.33	.91	.406			
		4.5	20.0	-4.5	+2.0	-2.5	+2.0	<.2%	500	-55 to +85		1.33	.91	.406				
		3.0	13.0	-1.0	+3.5	-2.5	-0.5	<.2%	500	-55 to +85		1.33	.91	.406				
		5.0	20.0	-1.0	+3.5	-2.5	-0.5	<.2%	500	-55 to +85		1.33	.91	.406				
		4.0	30.0	-1.0	+6.5	-4.0	-1.0	<.2%	500	-55 to +85		1.33	.91	.406				
		7.0	45.0	-1.0	+6.5	-4.0	-1.0	<.2%	500	-55 to +85		1.33	.91	.406				
		5.0	30.0	+1.5	+7.0	-5.0	-1.5	<.2%	500	-55 to +85		1.33	.91	.406				
		7.0	45.0	+1.5	+7.0	-5.0	-1.5	<.2%	500	-55 to +85		1.33	.91	.406				
		2.0	8.0	-4.5	+2.0	-2.5	+2.0	<.2%	350	-55 to +85		.33	.39	.406				
		5.5	18.0	-4.5	+2.0	-2.5	+2.0	<.2%	350	-55 to +85		.33	.39	.406				
		2.5	11.0	-1.0	+3.5	-2.5	-0.5	<.2%	350	-55 to +85		.33	.39	.406				
		7.0	25.0	-1.0	+3.5	-2.5	-0.5	<.2%	350	-55 to +85		.33	.39	.406				
		3.0	10.0	-1.0	+6.5	-4.0	-1.0	<.2%	350	-55 to +85		.33	.39	.406				
		8.0	25.0	-1.0	+6.5	-4.0	-1.0	<.2%	350	-55 to +85		.33	.39	.406				
		3.0	15.0	+1.5	+7.0	-5.0	-1.5	<.2%	200	-55 to +85		.33	.39	.406				
		9.0	35.0	+1.5	+7.0	-5.0	-1.5	<.2%	200	-55 to +85		.33	.39	.406				
		15.0	60.0	+3.0	+14.0	-10.0	-3.0	<.2%	200	-55 to +85		.33	.39	.406				
(402) MIL-C-14409	Variable (Piston Type, Tubular Trimmer)	PC17	1.0	5.5					> 1,000	250	-55 to +125	+50	.420		.328			
			1.0	8.5					> 650	250	-55 to +125	+50	.565		.328			
		1.5	10					> 800	250	-55 to +125	+150	.370		.328				
		1.5	20					> 800	250	-55 to +125	+150	.440		.328				
		1.5	30					> 800	250	-55 to +125	+150	.520		.328				
		1.5	40					> 800	250	-55 to +125	+150	.630		.328				
		0.8	10					> 5,000	250	-55 to +125	50 +50	.546		.313				
		0.8	14					> 3,000	125	-55 to +125	50 +50	.546		.313				
		0.8	10					> 5,000	250	-55 to +125	50 +50	.546		.313				
		0.8	14					> 3,000	125	-55 to +125	50 +50	.546		.313				
		0.3	1.2					> 5,000	500	-55 to +125	+50	.240		.110				
		0.4	2.5					> 4,000	500	-55 to +125	+50	.240		.156				
		0.6	4.5					> 3,000	500	-55 to +125	+50	.329		.156				
		0.8	8.0					> 1,500	500	-55 to +125	+75	.495		.156				
		0.6	6.0					> 10,000	250	-55 to +125	+50	.536		.236				
		0.8	10					> 5,000	250	-55 to +125	+50	.545		.279				
		1.0	14					> 3,000	250	-55 to +125	+50	.545		.279				
		1.0	20					> 1,500	250	-55 to +125	+50	.757		.279				
		0.6	6.0					> 10,000	250	-55 to +125	+50	.541		.236				
		0.8	10					> 5,000	250	-65 to +125	+20	.578		.297				
		1.0	14					> 3,000	250	-65 to +125	+20	.578		.297				
		1.0	20					> 1,500	250	-65 to +125	+20	.801		.297				
		1.0	30					> 800	250	-55 to +125	+50	.969		.297				
		0.6	3.5					> 10,000	250	-55 to +125	+50	.558		.161				
		0.6	5.0					> 7,500	250	-55 to +125	+50	.558		.161				
		1.5	14					> 3,000	250	-65 to +125	+20	.563		.297				









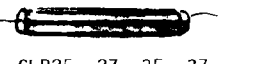
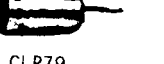




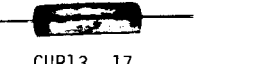


Table III. Capacitor selection chart - Continued.

Section	Type	Style referenced in standard	Capacitance		Capacitance change from 25°C				Q or DF	DC rated voltage (Volts)	Operating temp. range (°C)	Temperature coefficient (ppm/°C)	Maximum body dimensions (inches)			Equivalent NATO type	NEPR no.	CONFIGURATION
			Min (pF)	Max (pF)	At -55°C		At 85°C						Length	Width	Thickness or diameter			
					Min (Percent)	Max (Percent)	Min (Percent)	Max (Percent)										
VARIABLE																		
(402) MIL-C-14409	Variable (Piston Type, Tubular Trimmer)	PC38	0.6	1.8					>1,500	750	-55 to +150	+50, -0	.718				 PC39  PC38, 48  PC40  PC43  PC42 PC52	
			0.6	5.5					>1,500	1,250	-55 to +150	+50, -0	.984			.328		
		PC39	0.6	9.5					>1,500	1,250	-55 to +150	+50, -0	1.421			.328		
			0.8	16.0					>1,500	1,250	-55 to +150	+50, -0	2.015			.328		
		PC40	1.0	16.0					> 750	1,000	-55 to +125	+150	.812			.328		
			1.0	36.0					> 550	1,000	-55 to +125	+150	1.046			.328		
		PC42	1.0	52.0					> 350	1,000	-55 to +125	+150	1.265			.328		
			1.0	75.0					> 250	1,000	-55 to +125	+150	1.515			.328		
		PC43	1.0	120.0					> 250	1,000	-55 to +125	+50	2.109			.328		
			0.6	1.8					>1,500	750	-55 to +150	+50, -0	.672			.328		
		PC48	0.6	5.5					>1,500	750	-55 to +150	+50, -0	.922			.328		
			0.6	9.5					>1,500	750	-55 to +150	+50, -0	1.359			.328		
		PC52	0.6	16.0					>1,500	750	-55 to +150	+50, -0	1.969			.328		
			0.6	1.8					>1,500	750	-55 to +150	+50, -0	.656			.312		
		PC39	0.6	5.5					>1,500	1,250	-55 to +150	+50, -0	.922			.312		
			0.8	9.5					>1,500	1,250	-55 to +150	+50, -0	1.359			.312		
		PC42	0.8	16.0					>1,500	1,250	-55 to +150	+50, -0	1.953			.312		
			1.0	16.0					> 750	1,000	-55 to +125	+150	.796			.328		
		PC43	1.0	36.0					> 550	1,000	-55 to +125	+150	1.031			.328		
			1.0	52.0					> 350	1,000	-55 to +125	+150	1.250			.328		
		PC48	1.0	75.0					> 250	1,000	-55 to +125	+150	1.484			.328		
			1.0	120.0					> 250	1,000	-55 to +125	+50	2.093			.328		
		PC52	0.8	5.5					>1,000	750	-55 to +125	+50	.718			.328		
			0.8	11.0					> 900	1,250	-55 to +125	+50	.954			.328		
		PC39	0.8	16.0					> 800	1,250	-55 to +125	+100	1.171			.328		
			0.8	23.0					> 700	1,250	-55 to +125	+100	1.421			.328		
		PC42	1.0	38.0					> 500	1,250	-55 to +125	+100	2.015			.328		
0.8	5.5						>1,000	750	-55 to +125	+50	.656			.312				
PC48	0.8	11.0					> 900	1,250	-55 to +125	+50	.906			.312				
	0.8	16.0					> 800	1,250	-55 to +125	+100	1.109			.312				
PC52	0.8	23.0					> 700	1,250	-55 to +125	+100	1.359			.312				
	0.8	38.0					> 500	1,250	-55 to +125	+100	1.953			.312				

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TABLE III. Capacitor selection chart - Continued.

Section	Type	Style referenced in standard	Capacitance range (pF)	Capacitance tolerance (%)	DC rated voltage (Volts)	Operating temp. range (-55° to + °C)	Temperature coefficient (ppm/°C)	DC leakage (µA)			Maximum body dimensions (inches)			Equivalent NATO type	NEPR no.	CONFIGURATION
								+25°C	+85°C	+125°C	Length	Width	Thickness or diameter			
FIXED, and VARIABLE																
(501) MIL-C-23183	Variable, Gas or Vacuum Dielectric, Ceramic Envelope	CG60	5 to 750 7 to 1,000 20 to 2,000 50 to 3,000	10% 10% 10% 10%	3 kV 3 kV 2 kV 2 kV	85 85 85 85		10 10 10 10			8.000 7.938 8.438 8.375					 CG60
FIXED, GLASS and MICA, ER																
(601) MIL-C-23269	Fixed, Glass Dielectric, Established Reliability (FR: 1.0 to .001)	CYR10 CYR15 CYR20 CYR30 CYR13 CYR17 CYR22 CYR32 CYR41 CYR51 CYR52 CYR53	.5 to 270 270 to 1,200 1,500 to 4,700 5,600 to 10,000 .5 to 270 330 to 1,000 1,200 to 1,800 2,200 to 5,600 .5 to 1,000 1 to 560 620 to 1,000 1,100 to 2,400	.25 pF to 5% 1 or 5% 1 or 5% 1 or 5% .25 pF to 5% 1 or 5% 1 or 5% 1 or 5% .25 pF to 5% .25 pF to 5% 2 or 5% 1, 2, or 5%	300 & 500 300 & 500 300 & 500 300 & 500 300 & 500 300 & 500 300 300 & 500 100 300 300 300	125 125 125 125 125 125 125 125 125 125 125 125	140 ±25 140 ±25 140 ±25 140 ±25 105 ±25 105 ±25 105 ±25 105 ±25 0 ±25 140 ±25 140 ±25 140 ±25				.391 .516 .796 .828 .422 .531 .828 .844 .315 .305 .305 .505	.203 .297 .469 .828 .235 .328 .500 .859 .815 .210 .310 .310	.109 .156 .188 .188 .203 or .266 .281 .203 or .266 .281 .115 to .215 .120 .120 .120			 CYR10, 15, 20, 30  CYR13, 17, 22, 32  CYR52, 53  CYR41, 51
(602) MIL-C-39001	Fixed, Mica Dielectric, Established Reliability (FR: 1.0 to .001)	CMR03 CMR04 CMR05 CMR06 CMR07 CMR08	1 to 400 1 to 390 1 to 390 430 to 4,700 5,100 to 20,000 22,000 to 91,000	.5 pF, 2 or 5% .5 pF, 1, 2, or 5% .5 pF, 1, 2, or 5% 1, 2, or 5% 1, 2, or 5% 1, 2, or 5%	50 to 300 100, 300, or 500 500 500 500 100, 300, or 500	125 150 150 150 150 150	±200, 0 to +70 -20 to +100 0 to +70 0 to +70 0 to +70				.270 .360 to .390 .450 to .470 .640 to .700 .780 to .830 1.420 to 1.500	.190 to .250 .330 to .380 .360 to .400 .510 to .580 .860 to .920 .880 to .940	.110 to .190 .190 to .220 .170 to .220 .200 to .350 .280 to .450 .310 to .500	NCM09 NCM05 NCM06 NCM07 NCM08	1	 CMR03, 04, 05, 06, 07, 08
FIXED, ELECTROLYTIC, ER																
(701) MIL-C-39003	Fixed, Solid Electrolyte, Tantalum, Established Reliability (FR: 1.0 to .001)	CSR13 CSR91 CSR21	.0047 to 330 µF .0023 to 160 µF 5.6 to 330 µF	5, 10, or 20% 10 or 20% 5, 10, or 20%	6 to 100 6 to 100 6 to 50	85, derated to 125 85, derated to 125 85, derated to 125		.3-10 .3-10 2.2-10	5-200 145-200	6.3-250 56-250	.317 to .817 .606 to 1.581 .717 to .817	.151 to .367 .171 to .386 .305 to .367	NCS02	17	 CSR13, 21  CSR91	
(702) MIL-C-39006	Fixed, Nonsolid Electrolyte, Tantalum, Established Reliability (FR: 1.0 to .001)	CLR25 CLR27 CLR35 CLR37 CLR79	1 to 580 µF .5 to 350 µF .15 to 160 µF .1 to 100 µF 1.7 to 1,200 µF	-15: +30, +50, +75 -15: +30, +50, +75 15 or 20% 15 or 20% 5, 10, or 20%	15 to 150 15 to 150 15 to 450 15 to 375 6 to 125	85, derated to 125 85, derated to 125 85, derated to 125 85, derated to 125 95, derated to 125		2-10 2-10 1-50 1-50 1-10	4-100 4-100 2-1000 2-325 2-40	4-100 4-100 2-1000 2-325 2-40	.875 to 2.937 .875 to 2.937 .875 to 2.937 .875 to 2.937 .608 to 1.217	.219 to .406 .219 to .406 .219 to .406 .219 to .406 .219 to .406	NCL01 NCL02 NCL03 NCL04	16	 CLR25, 27, 35, 37  CLR79	
(703) MIL-C-55365	Chip, Fixed, Tantalum, Established Reliability (FR: 1.0 to .001)	CWR02 CWR03 CWR04 CWR06	.1 to 100 µF .068 to 100 µF .068 to 100 µF .1 to 100 µF	5, 10, or 20% 5, 10, or 20% 5, 10, or 20% 5, 10, or 20%	3 to 50 3 to 50 3 to 50 4 to 50	125 125 125 125		1.5-9.4 1-9.4 1-9.4 1-5	5-94 10-94 10-94 10-50	6.3-120 15-141 15-141 12-60	.190 to .315 .185 to .325 .185 to .325 .115 to .300	.070 to .175 .110 to .190 .075 to .200 .065 to .165	.060 to .150 .075 to .200 .075 to .200 .065 to .125			 CWR02  CWR03  CWR04  CWR06
(704) MIL-C-39018	Fixed, Electrolytic (Aluminum Oxide) Established Reliability (FR 1.0 to .001)	CUR13 CUR13 CUR17 CUR19 CUR71 CUR91	8.2 to 1,000 µF 2.2 to 56 µF 47 to 12,000 µF 10 to 470 µF 50 to 16,000 µF 68 to 4,100 µF 210 to 220,000 µF	-10, +30; -10, +75 -10, +30; -10, +50 -10, +30; -10, +75 -10, +30; -10, +50 -10, +75 -10, +50 -10, +50	7 to 100 150 to 250 7 to 75 100 to 250 5 to 200 200 to 350 5 to 150	85, derated to 125 85, derated to 125 105 105 105 85 105		2-10 2-20 29-196 25-171 150-204 1.23- 1.45 mA 1.24- 12.09 mA	12-60 12-120 1174-1195 150-722 300-1220 1.38- 8.20 mA 12.13- 18.9 mA 2/	12-60 2/ 12-120 2/ 12-120 2/ 150-722 300-1220 2/ 300-1220 2/ 1.38- 8.20 mA 12.13- 18.9 mA 2/	1.969 to 2.719 1.969 to 2.719 1.156 to 3.656 1.156 to 3.656 1.843 to 3.843 2.187 to 5.687 2.187 to 5.687 2.187 to 5.687	.304 & .398 .304 & .398 .648 to 1.023 .648 to 1.023 1.843 to 3.843 2.187 to 5.687 2.187 to 5.687	.060 to .150 .075 to .200 .075 to .200 .065 to .125 1.406 to 3.031 1.406 to 3.031	NCU01 NCU01 NCU03 NCU03	59	 CUR13, 17  CUR71, 91  CUR19

2/ +105°C.

TABLE III. Capacitor selection chart - Continued.

Section	Type	Style referenced in standard	Capacitance range (μF)	Capacitance tolerance (%)	DC rated voltage (Volts)	Operating temp range (-55° to + °)	Insulation resistance (in megohms)		Maximum body dimensions (inches)			Equivalent NATO type	NEPR no.	CONFIGURATION
							At 25°C	At high ambient temp	Length	Width	Thickness or diameter			
FIXED, PAPER-PLASTIC or PLASTIC, ER														
(801) MIL-C-19978	Fixed, Plastic (or Paper-Plastic) Dielectric, Established Reliability (FR: 1.0 to .001)	CQR07	.001 to 1.0	5 or 10%	50 to 600	125	>150,000	>5,000	.843 to 2.780		.237 to 1.062			
		CQR09	.001 to 1.0	2, 5, or 10%	200 to 1,000	-65 to +125°C	> 25,000	>250	.843 to 2.530		.297 to 1.062			
		CQR12	.001 to 1.0	2, 5, or 10%	200 to 1,000	-65 to +125°C	> 25,000	>250	.843 to 2.530		.297 to 1.062			
		CQR13	.001 to 1.0	2, 5, or 10%	200 to 1,000	-65 to +125°C	> 25,000	>250	.843 to 2.530		.462 to 1.062			
		CQR29	.001 to 10	2, 5, or 10%	30 to 1,000	-65 to +85°C	>100,000	>25,000	.561 to 2.811		.237 to 1.062			
(802) MIL-C-39022	Fixed, Metallized Dielectric, DC and AC, Established Reliability (FR: 1.0 to .001)	CHR09	.01 to 2.2	10 or 20%	600	85	>25,000	>3,000	.937 to 2.750		.376 to 1.064			
		CHR49	.10 to 10	10%	80 to 400 (rms)	85	>2,000	>10	1.000 to 2.750		.376 to 1.064			
(803) MIL-C-55514	Fixed, Plastic (or Metallized Plastic) Dielectric, DC, Established Reliability (FR: 1.0 to .001)	CFR02	.001 to 1.0	1, 2, 5, or 10%	100 to 600	85 & 125	>500,000	>10,000	.500 to 2.687		.203 to 1.212			
		CFR04	.001 to 1.0	1, 2, 5, or 10%	50 to 400	85 & 125	>500,000	>1,000	.450 to 2.593	.310 to 1.001	.140 to .722			
		CFR05	.001 to 50	1, 2, 5, or 10%	50 to 400	85	>500,000	>7,000	.434 to 1.966	.230 to 1.265	.140 to .812			
		CFR06	.001 to 50	1, 2, 5, or 10%	50 to 400	85	>500,000	>35,000	.434 to 1.966	.230 to 1.265	.140 to .812			
		CFR12	.001 to .15	1, 2, 5, or 10%	25 to 300	85 & 125	>500,000	>7,000	.210	.200	.100			
(804) MIL-C-83421	Fixed, Metallized Plastic Dielectric, DC, AC or DC and AC, Established Reliability (FR: 1.0 to .001)	CRH01	.001 to 22	.25, .5, 1, 2, 5, or 10%	30	-65 to +100	> 150,000	>2,000	.530 to 1.905		.190 to .690			
		CRH02	.001 to 10	.25, .5, 1, 2, 5, or 10%	50	-65 to +100	> 300,000	>4,000	.530 to 1.905		.190 to .690			
		CRH03	.001 to 10	.25, .5, 1, 2, 5, or 10%	100	-65 to +100	> 300,000	>10,000	.530 to 2.405		.190 to 1.020			
		CRH04	.001 to 3.9	.25, .5, 1, 2, 5, or 10%	200	-65 to +100	> 800,000	>10,000	.592 to 2.405		.190 to 1.020			
		CRH05	.001 to 2	.25, .5, 1, 2, 5, or 10%	400	-65 to +100	>1,500,000	>20,000	.592 to 2.405		.190 to 1.020			
FIXED, CERAMIC, ER														
(901) MIL-C-39014	Fixed, Ceramic, Dielectric, Established Reliability (FR: 1.0 to .001)	CKR05	10 to 100,000	10 & 20%	50, 100, or 200	125	>100,000	>10,000	.200	.200	.100	NCC61 NCC62 NCC65 NCC70 NCC72 NCC73	14	
		CKR06	1,200 to 1,000,000	10 & 20%	50, 100, or 200	125	> 10,000	> 1,000	.300	.300	.100			
		CKR11	10 to 10,000	10 & 20%	50 & 100	125	>100,000	>10,000	.170		.100			
		CKR12	5,600 to 47,000	10 & 20%	50 & 100	125	>100,000	>10,000	.260		.100			
		CKR14	12,000 to 100,000	10 & 20%	50 & 100	125	>100,000	>10,000	.400		.150			
		CKR15	56,000 to 100,000	10 & 20%	100	125	>100,000	>10,000	.520		.265			
		CKR22	1 to 100,000	.5 pF, 1, 5, 10 or 20%	50, 100, or 200	125	>100,000	>10,000	.280	.135	.098			
		CKR23	560 to 220,000	1, 5, 10, or 20%	50, 100, or 200	125	>100,000	>10,000	.280	.162	.098			
(902) MIL-C-20	Fixed, Ceramic Dielectric (Temperature Compensating), Established Reliability (FR: 1.0 to .001)	CCR05	1 to 8.2	.1, .25 & .5 pF	200	125	0 ±60	>100,000	>10,000	.200	.200	.100		
		CCR06	10 to 3,300	1, 2 or 5%	50, 100, or 200	125	0 ±30	>100,000	>10,000	.200	.200	.100		
		CCR07	390 to 18,000	1, 2 or 5%	50, 100, or 200	125	0 ±30	>100,000	>10,000	.300	.300	.100		
		CCR08	2,200 to 100,000	1, 2 or 5%	50, 100, or 200	125	0 ±30	>100,000	>10,000	.500	.500	.150		
		CCR75	3,900 to 68,000	.1, .25, .5 pF, 1, 2, or 5%	50, 100, or 200	125	0 ±30	>100,000	>10,000	.500	.500	.250		
		CCR76	1 to 8.2	.1, .25, or .5 pF	200	125	0 ±60	>100,000	>10,000	.170		.100		
		CCR77	10 to 680	1, 2 or 5%	50, 100, or 200	125	0 ±30	>100,000	>10,000	.170		.100		
		CCR78	82 to 1,000	1, 2 or 5%	50, 100, or 200	125	0 ±30	>100,000	>10,000	.260		.100		
(903) MIL-C-55681	Fixed, Chip, Multiple Layer, Ceramic Dielectric, Established Reliability (FR: 1.0 to .001)	CDR01	10 to 180,000	5, 10, or 20%	50 & 100	125		>100,000	>1,000	.095	.065	.055		
		CDR02	10 to 180,000	5, 10, or 20%	50 & 100	125		>100,000	>1,000	.195	.065	.055		
		CDR03	10 to 180,000	5, 10, or 20%	50 & 100	125		>100,000	>1,000	.195	.095	.080		
		CDR04	10 to 180,000	5, 10, or 20%	50 & 100	125		>100,000	>1,000	.195	.140	.080		
		CDR11	.1 to 1,000	.1, .25, .5 pF, 1, 2, 5, or 10%	50	125	0 ±30 or 90 ±20	>100,000	>10,000	.070	.070	.057		
		CDR12	.1 to 1,000	.1, .25, .5 pF, 1, 2, 5, or 10%	50	125	0 ±30 or 90 ±20	>100,000	>10,000	.080	.070	.057		
CDR13	.1 to 5,100	.1, .25, .5 pF, 1, 2, 5, or 10%	50, 100, 200, 300 & 500	50, 100, 200, 300 & 500	125	0 ±30 or 90 ±20	>100,000	>10,000	.130	.130	.102			
												CDR14	.1 to 5,100	.1, .25, .5 pF, 1, 2, 5, or 10%

3A

MIL-STD-198E

SECTION 100

CAPACITORS, FIXED, MICA DIELECTRIC

<u>Section</u>	<u>Applicable specification</u>
101	Capacitors, Fixed, Mica Dielectric, Button Style- - - MIL-C-10950
102	Capacitors, Fixed, Mica Dielectric - - - - - - - - - - - - - MIL-C-5

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SECTION 101

CAPACITORS, FIXED, MICA DIELECTRIC, BUTTON STYLE

STYLES CB50, CB55, CB56, CB57, CB60, CB61, CB62, CB65, CB66, AND CB67

(APPLICABLE SPECIFICATION: MIL-C-10950)

1. SCOPE. This section covers button-style, mica-dielectric, fixed capacitors enclosed in metal cases.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are small, high-quality units intended for use at frequencies up to 500 megahertz (MHz). Their principal uses are in tuned circuits, and in coupling and by-passing applications in VHF and UHF circuits. These capacitors are very stable with time and have high reliability in circuits where ambient conditions can be closely controlled to reduce failure from silver-ion migration. Due to this silver-ion migration, silvered-mica capacitors should not be used under dc voltage stresses when combined with exposure to continuous high temperature and humidity conditions for extended periods. Silver-ion migration can occur in a few hours when silvered-mica capacitors are simultaneously exposed to dc voltage stresses, humidity, and high temperatures.

2.2 Construction. These capacitors are composed of a stack of silvered-mica sheets connected in parallel. This assembly is encased in a metal case with a high potential terminal connected through the center of the stack. The other terminal is formed by this metal case connected at all points around the outer edge of the electrodes. This design permits the current to fan out in a 360-degree pattern from the center terminal providing the shortest RF current path between the center terminal and chassis. The internal inductance is thus kept small. The use of relatively heavy and short terminals results in minimum external inductance associated permanently with the capacitor. The units are then welded and hermetically glass sealed with the exception of style CB50, which is resin sealed.

2.3 Voltage rating. These capacitors have a dc rated voltage of 500 volts. The dc voltage given is for continuous operation throughout the operating temperature range. At higher frequencies, the operating conditions are usually limited by the ac current rather than the voltage.

2.4 Operating temperature range. Except for style CB50, which has an operating temperature range of -55° to $+85^{\circ}\text{C}$ all styles covered in this section are suitable for operation from -55° to $+150^{\circ}\text{C}$.

2.5 Mounting. It is recommended that the capacitor body of styles CB55, CB56, and CB57 have adequate heat sink during mounting operation with high temperature solder.

2.6 Temperature coefficient and capacitance drift. Except for the **5-pF** units, these capacitors have a temperature coefficient of $\pm 100\text{ppm}/^{\circ}\text{C}$, -20 to $+100\text{ppm}/^{\circ}\text{C}$, and -60 to $+60\text{ppm}/^{\circ}\text{C}$ with a capacitance drift of 0.3 percent or 0.3 pF (whichever is greater), $\pm(0.1\text{ percent} + 0.1\text{ pF})$ and $\pm(0.1\text{ percent} + 0.1\text{ pF})$, respectively. The 5-pF units do not have a specified temperature coefficient and capacitance drift.

2.7 Dissipation factor (DF). DF is measured at room temperature at a frequency of 1 MHz for capacitance values of 1,000 pF or less and 1 kilohertz for capacitance values greater than 1,000 pF. DF versus capacitance limits are shown on figure 101-1.

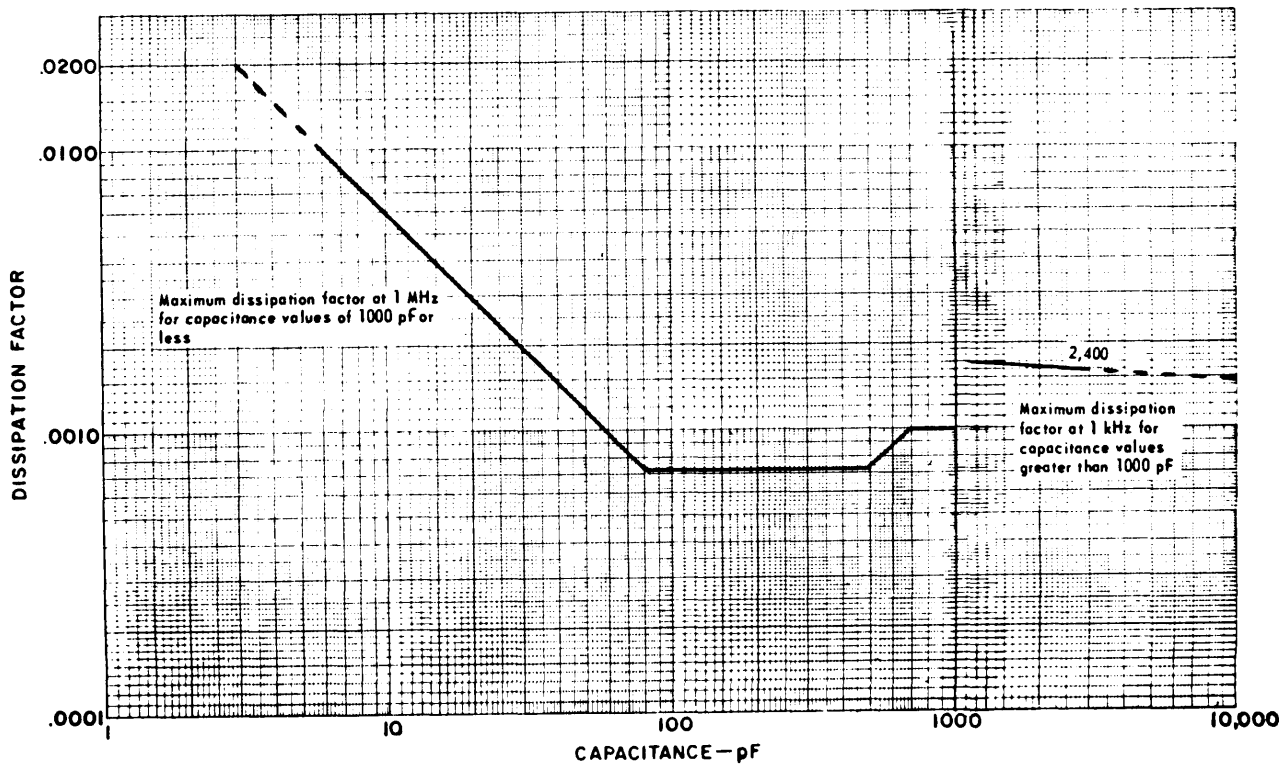


FIGURE 101-1. Dissipation factor vs capacitance.

2.8 Insulation resistance. The insulation resistance will be greater than the value shown on figure 101.2

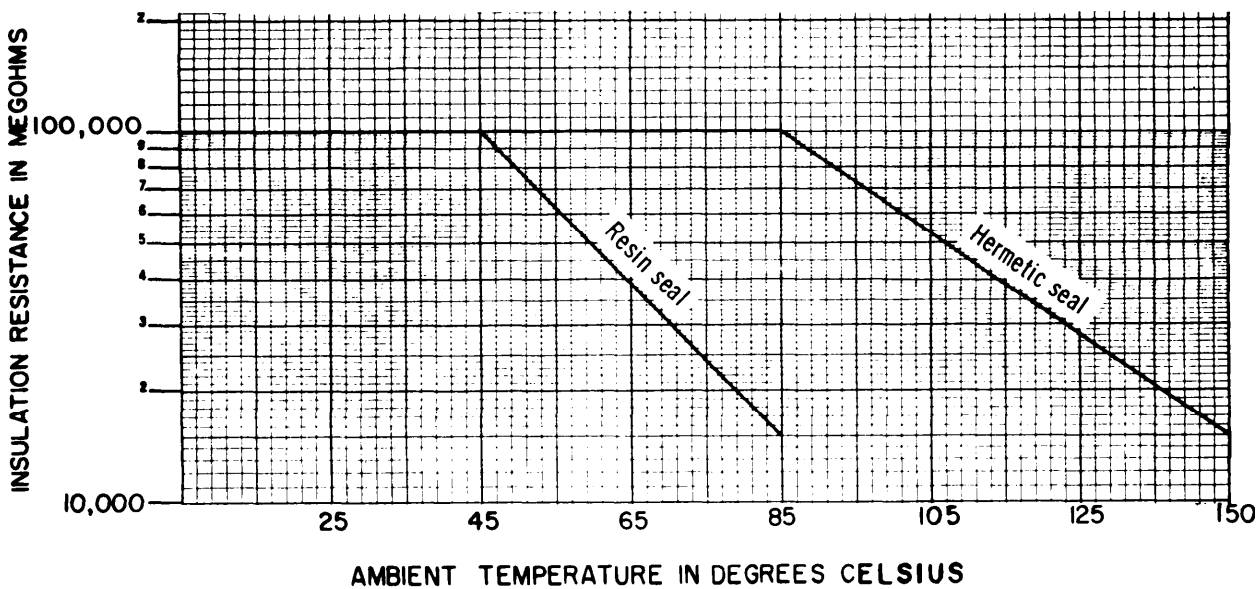


FIGURE 101-2. Insulation resistance vs temperature.

3. ITEM IDENTIFICATION (see figures 101-3 and 101-4).

3.1 Part number. The part number is used for describing the capacitors as shown in figure 101-3.

STYLE - The two-letter symbol "CB" identifies button-style, mica-dielectric, fixed capacitors; the two-digit number identifies the shape, dimensions, and operating temperature range.

TERMINAL ASSEMBLY - The single-letter symbol identifies the terminal assembly as follows:

Symbol	Terminal assembly
P - - - - -	Single L
R - - - - -	Double L

CHARACTERISTIC - The single-letter symbol identifies the relative stability of the capacitor with temperature change as follows:

Symbol	Temperature coefficient (ppm/°C)	Capacitance drift
B - -	Not specified	Not specified
D - -	-100 to +100	0.3% or 0.3 pF, whichever is greater
E - -	-20 to +100	±(0.1% + 0.1 pF)
F - -	-60 to +60	±(0.1% + 0.1 pF)

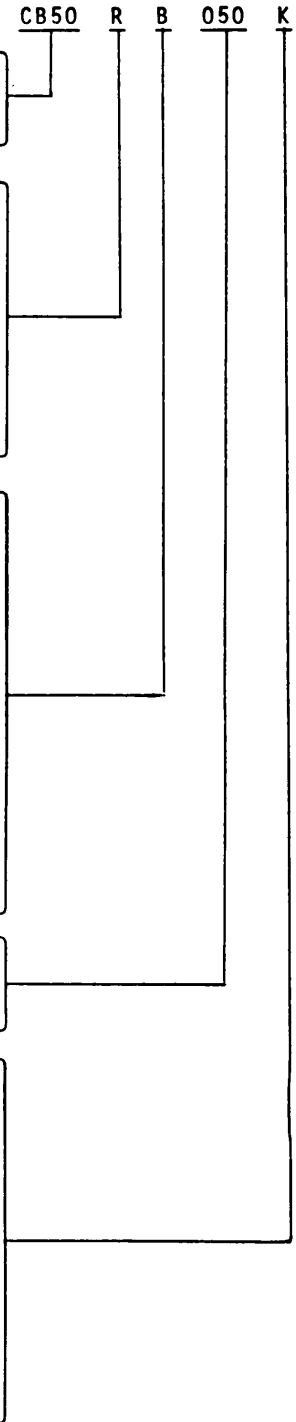
CAPACITANCE - The three-digit number identifies the nominal capacitance value, expressed in picofarads (pF); the first two digits represent significant figures and the last digit specifies the number of zeros to follow.

CAPACITANCE TOLERANCE - The single-letter symbol identifies the capacitance tolerance as follows:

Symbol	Capacitance tolerance Percent (±)
F - - -	1
G - - -	2
J - - -	5
K - - -	10

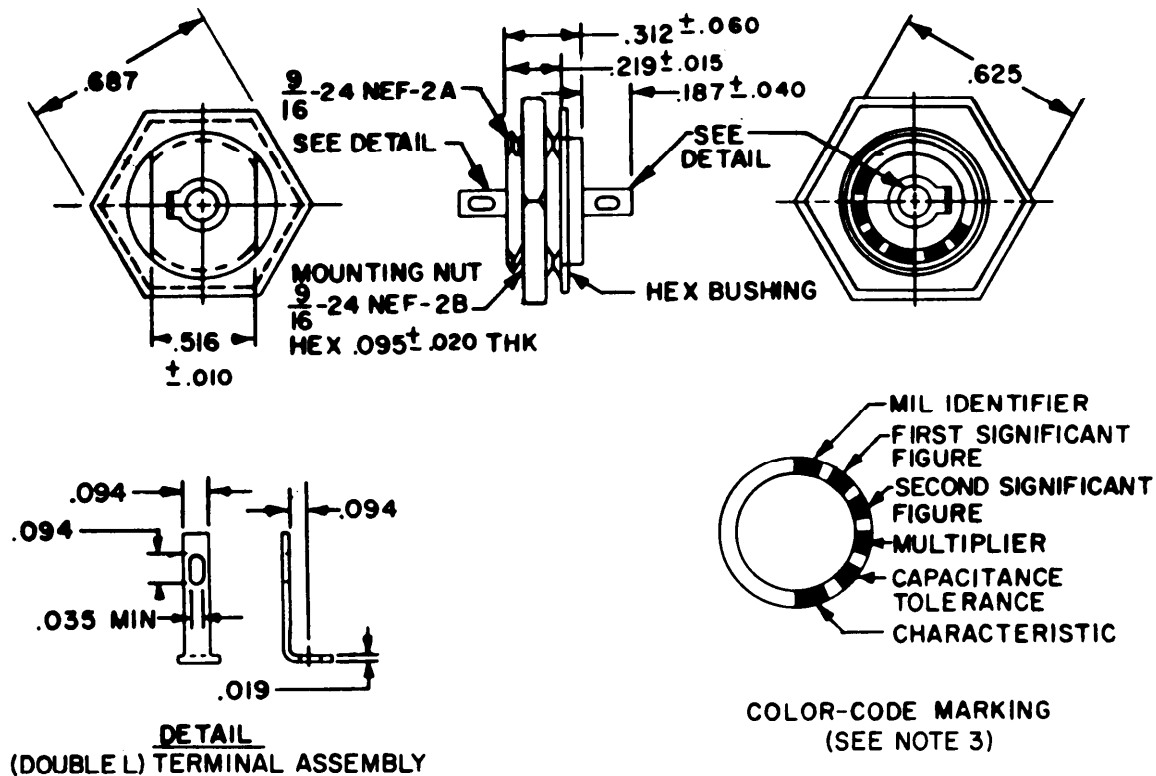
FIGURE 101-3. Part number example.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 101-4.



STYLE CB50

NATO TYPE DESIGNATION NCM62 (PER NEPR NO. 12)



INCHES	MM	INCHES	MM
.010	.25	.094	2.39
.015	.38	.095	2.41
.019	.48	.187	4.75
.020	.51	.219	5.56
.035	.89	.312	7.92
.040	1.02	.516	13.11
.060	1.52	.625	15.88
		.687	17.45

NOTES:

1. Unless otherwise specified, tolerance is ±.005 (.13 mm).
2. All dimensions are exclusive of sealing compound and color code.
3. Color-coded section does not exceed 240 degrees.

FIGURE 101-4. Button style, mica dielectric, fixed capacitors.

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STANDARD CAPACITORS

STYLE CB50 (MIL-C-10950/4)

DOUBLE L TERMINAL ASSEMBLY (SYMBOL R) -- DC RATED VOLTAGE 500 VOLTS --
OPERATING TEMPERATURE RANGE -55° TO + 85° C

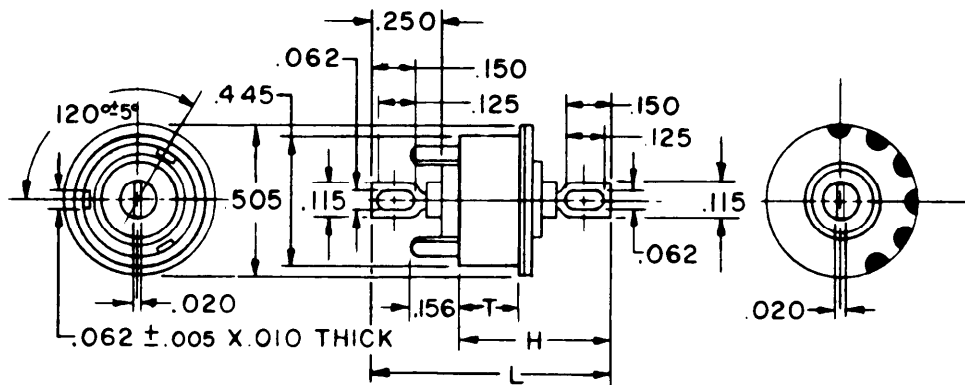
Part number ^{1/}	Capacitance	Characteristic available at capacitance tolerance			
		±1% (F)	±2% (G)	±5% (J)	±10% (K)
	<u>pF</u>				
CB50RB050K	5				B
CB50RD100K	10				D
CB50RD120K	12				D
CB50RD150K	15				D
CB50RD180K	18				D
CB50RD220-	22			D	D
CB50RD270-	27			D	D
CB50RD330-	33			D	D
CB50RD390-	39			D	D
CB50RD470-	47			D	D
CB50R-560-	56	D, E	D, E		D
CB50R-680-	68	D, E	D, E		D
CB50R-820-	82	D, E	D, E		D
CB50R-101-	100	D, E	D, E		D
CB50R-121-	120	D, E	D, E		D
CB50R-151-	150	D, E	D, E		D
CB50R-181-	180	D, E	D, E		D
CB50R-221-	220	D, E	D, E		D
CB50R-271-	270	D, E	D, E		D
CB50R-331-	330	D, E	D, E		D
CB50R-391-	390	D, E	D, E		D
CB50R-471-	470	D, E	D, E		D
CB50R-561-	560	D, E	D, E		D
CB50R-681-	680	D, E	D, E		D
CB50R-821-	820	D, E	D, E		D
CB50R-102-	1,000	D, E	D, E		D
CB50R-122-	1,200	D, E	D, E		D
CB50R-152-	1,500	D, E	D, E		D

^{1/} Where applicable, the complete part number will include additional letter symbols to indicate characteristic and capacitance tolerance.

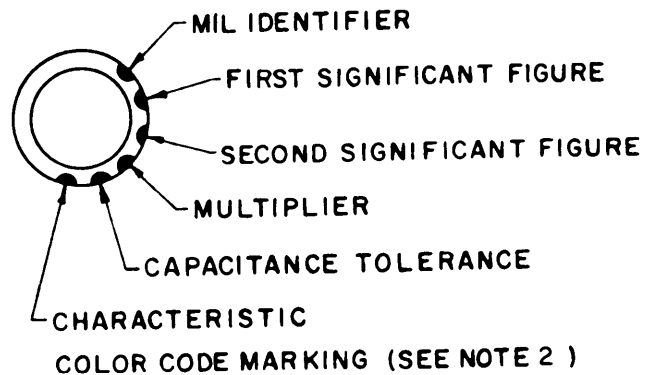
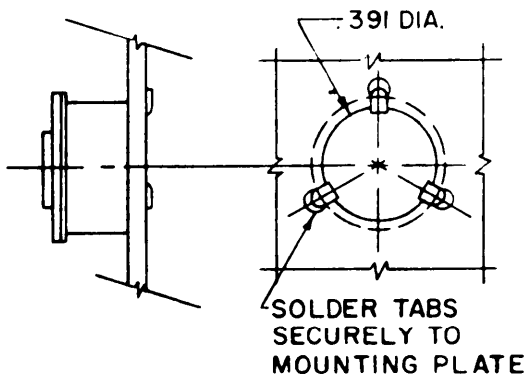
FIGURE 101-4. Button style, mica dielectric, fixed capacitors - Continued.

101 (MIL-C-10950)

STYLES CB55, CB56, AND CB57



Standard style	Dimensions (inches)			NATO type designation (per NEPR No. 12)
	$L \pm .045(1.14)$	$H \pm .030(.76)$	$T \pm .015(.38)$	
CB55	.710 (18.03)	.415 (10.54)	.100 (2.54)	NCM56
CB56	.735 (18.67)	.440 (11.18)	.125 (3.18)	NCM57
CB57	.815 (20.70)	.515 (13.08)	.205 (5.21)	NCM60



MOUNTING SKETCH

NOTES:

1. Unless otherwise specified, tolerance is $\pm .010$ (.25 mm).
2. Color-coded section does not exceed 240°.

INCHES	MM	INCHES	MM
.005	.13	.150	3.81
.010	.25	.156	3.96
.020	.51	.250	6.35
.062	1.57	.391	9.93
.115	2.92	.445	11.30
.125	3.18	.505	12.83

FIGURE 101-4. Button style, mica dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLES CB55, CB56, AND CB57 (MIL-C-10950/8)

DOUBLE L TERMINAL ASSEMBLY (SYMBOL R) -- DC RATED VOLTAGE 500 VOLTS --
OPERATING TEMPERATURE RANGE -55° TO +150°C

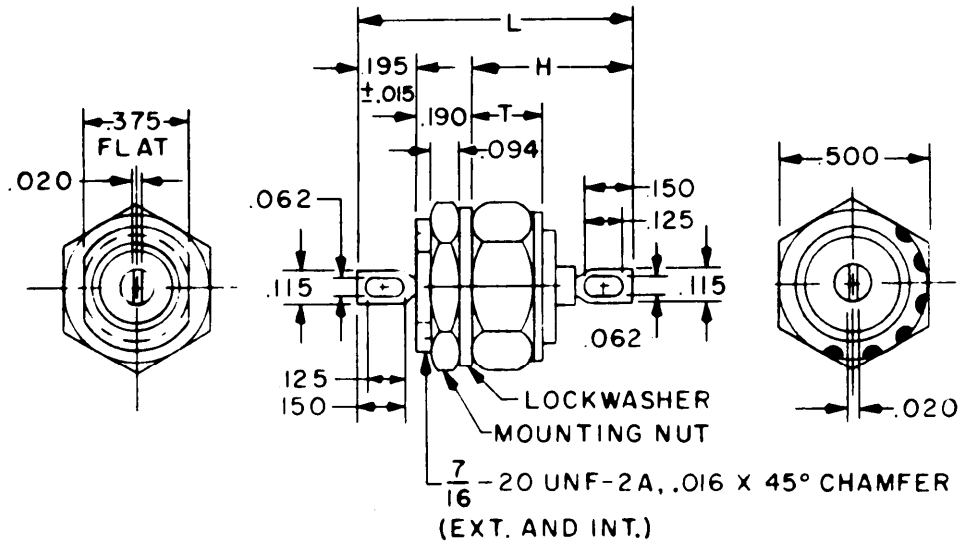
Part number ^{1/}	Capacitance	Characteristic available at capacitance tolerance			
		±1% (F)	±2% (G)	±5% (J)	±10% (K)
	<u>pF</u>				
CB55RB050K	5				B
CB55R-100K	10				D
CB55R-150K	15				D
CB55R-220-	22			D	D
CB55R-330-	33			D	D
CB55R-470-	47			D	D
CB55R-680-	68	D,F	D,F		D
CB55R-101-	100	D,F	D,F		D
CB55R-151-	150	D,F	D,F		D
CB55R-221-	220	D,F	D,F		D
CB55R-331-	330	D,F	D,F		D
CB55R-471-	470	D,F	D,F		D
CB56R-681-	680	D,F	D,F		D
CB56R-821-	820	D,F	D,F		D
CB56R-102-	1,000	D,F	D,F		D
CB57R-122-	1,200	D,F	D,F		D
CB57R-152-	1,500	D,F	D,F		D
CB57R-182-	1,800	D,F	D,F		D
CB57R-222-	2,200	D,F	D,F		D
CB57R-242-	2,400	D,F	D,F		D

^{1/} Where applicable, the complete part number will include additional letter symbols to indicate characteristic and capacitance tolerance.

FIGURE 101-4. Button style, mica dielectric, fixed capacitors -Continued.

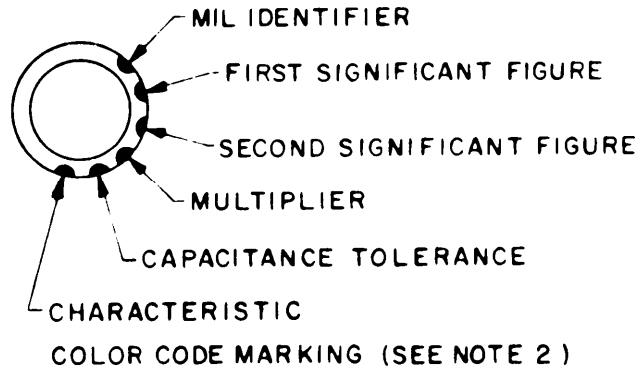
101 (MIL-C-10950)

STYLES CB60, CB61, AND CB62



Standard style	Dimensions (inches)			NATO type designation (per NEPR No. 12)
	L (Ref)	H ± .030 (.76)	T ± .015 (.38)	
CB60	.790 (20.07)	.405 (10.29)	.125 (3.18)	NCM 63
CB61	.815 (20.70)	.430 (10.92)	.150 (3.81)	NCM 64
CB62	.895 (22.73)	.510 (12.95)	.230 (5.84)	NCM 65

INCHES	MM	INCHES	MM
.015	.38	.125	3.18
.016	.41	.150	3.81
.020	.51	.190	4.83
.062	1.57	.195	4.95
.094	2.39	.375	9.53
.115	2.92	.500	12.70



NOTES:

1. Unless otherwise specified, tolerance is ±.010 (.25 mm).
2. Color-coded section does not exceed 240°.

FIGURE 101-4. Button style, mica dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLES CB60, CB61, AND CB62 (MIL-C-10950/7)

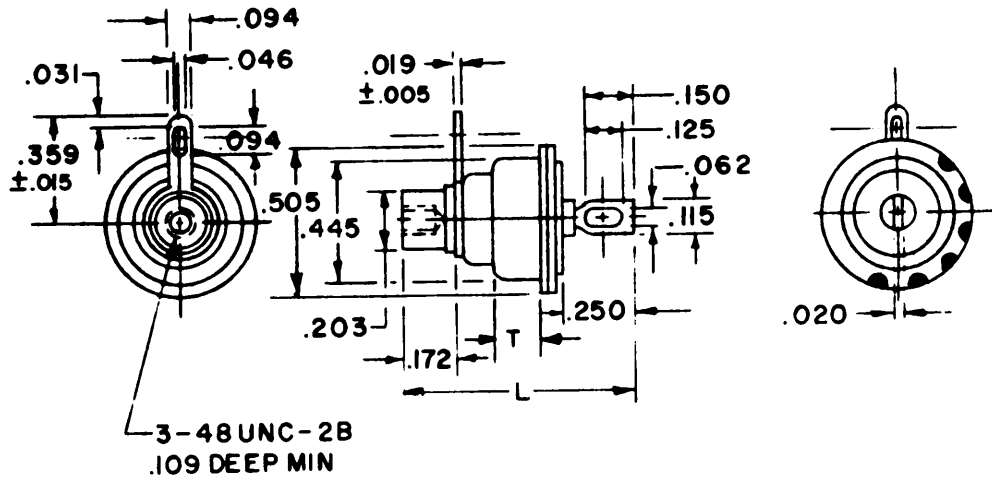
DOUBLE L TERMINAL ASSEMBLY (SYMBOL R) -- DC RATED VOLTAGE 500 VOLTS --
OPERATING TEMPERATURE RANGE -55° TO +150°C

Part number <u>1/</u>	Capacitance	Characteristic available at capacitance tolerance			
		±1% (F)	±2% (G)	±5% (J)	±10% (K)
	<u>pF</u>				
CB60R-050K	5				B
CB60R-100K	10				D
CB60R-150K	15				D
CB60R-220-	22			D	D
CB60R-330-	33			D	D
CB60R-470-	47			D	D
CB60R-680-	68	D, F	D, F		D
CB60R-101-	100	D, F	D, F		D
CB60R-151-	150	D, F	D, F		D
CB60R-221-	220	D, F	D, F		D
CB60R-331-	330	D, F	D, F		D
CB60R-471-	470	D, F	D, F		D
CB61R-681-	680	D, F	D, F		D
CB61R-821-	820	D, F	D, F		D
CB61R-102-	1,000	D, F	D, F		D
CB62R-122-	1,200	D, F	D, F		D
CB62R-152-	1,500	D, F	D, F		D
CB62R-182-	1,800	D, F	D, F		D
CB62R-222-	2,200	D, F	D, F		D
CB62R-242-	2,400	D, F	D, F		D

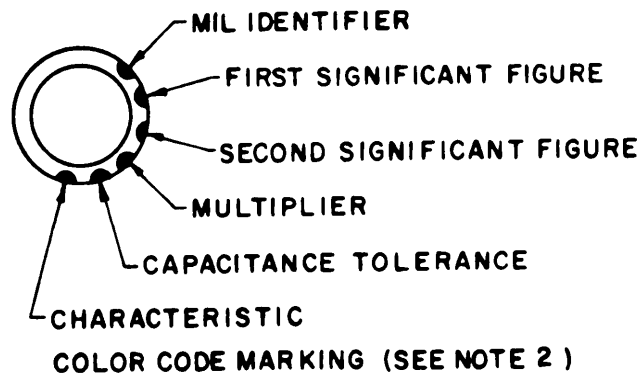
1/ The complete part number will include additional letter symbols to indicate characteristic and capacitance tolerance.

FIGURE 101-4. Button style, mica dielectric, fixed capacitors - Continued.

STYLES CB65, CB66, AND CB67



Standard style	Dimensions(inches)		NATO type designation (per NEPR No. 12)
	L±.045(1.14)	T±.015(.38)	
CB65	.666 (16.92)	.074 (1.88)	NCM58
CB66	.692 (17.58)	.100 (2.54)	NCM59
CB67	.770 (19.56)	.178 (4.52)	NCM61



NOTES:

1. Unless otherwise specified, tolerance is ±.010 (25 mm).
2. Color-coded section does not exceed 2400.

INCHES	MM	INCHES	MM
.005	.13	.115	2.92
.015	.38	.125	3.18
.019	.48	.150	3.81
.020	.51	.172	4.37
.031	.79	.203	5.16
.046	1.17	.250	6.35
.062	1.57	.359	9.12
.094	2.39	.445	11.30
.109	2.77	.505	12.83

FIGURE 101-4. Button style, mica dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLES CB65, CB66, AND CB67 (MIL-C-10950/9)

SINGLE L TERMINAL ASSEMBLY (SYMBOL P) -- DC RATED VOLTAGE 500 VOLTS --
OPERATING TEMPERATURE RANGE -55° TO +150°C

Part number ^{1/}	Capacitance	Characteristic available at capacitance tolerance			
		±1% (F)	±2% (G)	±5% (J)	±10% (K)
	<u>pF</u>				
CB65PB050K	5				B
CB65PD100K	10				D
CB65PD150K	15				D
CB65PD200J	20			D	
CB65PD220-	22			D	D
CB65PD330-	33			D	D
CB65PD470-	47			D	D
CB65P-680	68	D,F	D,F	D,F	D
CB65P-101-	100	D,F	D,F	D,F	D
CB65P-151-	150	D,F	D,F	D,F	D
CB65P-221-	220	D,F	D,F	D,F	D
CB65P-331-	330	D,F	D,F	D,F	D
CB65P-471-	470	D,F	D,F	D,F	D
CB66P-681-	680	D,F	D,F	D,F	D
CB66P-821-	820	D,F	D,F	D,F	D
CP66P-102-	1,000	D,F	D,F	D,F	D
CB67P-122-	1,200	D,F	D,F	D,F	D
CB67P-152-	1,500	D,F	D,F	D,F	D
CB67P-182-	1,800	D,F	D,F	D,F	D
CB67P-222-	2,200	D,F	D,F	D,F	D
CB67P-242-	2,400	D,F	D,F	D,F	D

^{1/} Where applicable, the complete part number will include additional letter symbols to indicate characteristic and capacitance tolerance.

FIGURE 101-4. Button style, mica dielectric, fixed capacitors -Continued.

MIL-STD-198E

SECTION 102

CAPACITORS, FIXED, MICA DIELECTRIC

STYLES CM15, CM20, CM30, CM35, CM45, AND CM50

(APPLICABLE SPECIFICATION: MIL-C-5)

1. SCOPE. This section covers mica-dielectric, fixed capacitors enclosed in case suitably protected against high humidity.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are designed for use in circuits requiring precise high frequency filtering, bypassing, and coupling. They are used where close impedance limits are essential with respect to temperature, frequency, and aging -- such as in tuned circuits which control frequency, reactance, or phase. These capacitors are also useful as padders in tuned circuits, as secondary capacitance standards, and as fixed-tuning capacitors at high frequencies. They can also be employed in delay lines and stable low-power networks.

Due to the inherent characteristics of the dielectric (i.e., high insulation resistance and high breakdown voltage, low power factor, low inductance, and low dielectric absorption), these mica capacitors are inexpensive, small, and readily available and have good stability and high reliability.

2.2 Construction. Muscovite mica is the most commonly used material. It has a dielectric constant between 6.5 and 8.5 and can be split into thin sheets; it is nonporous and does not readily absorb moisture. Protection from moisture is provided to obtain high-capacitance stability and low losses. The two techniques used to form the capacitors covered in this section are by stacking the mica sheets through the silvered-mica process or by the use of tin-lead foil to separate the mica sheets. The molded units referenced in this section are fixed terminal capacitors; styles CM45 and CM50 employ the use of tin-lead foil.

Terminals are attached to the mica stacks by the use of pressure clips which have been solder-coated for maximum mechanical strength.

The molded case is made of a polyester material which also exhibits high insulation resistance and high resistance to moisture absorption and transmission. The molded case also imparts rigidity to the capacitor in the event the capacitor is subjected to vibration or shock.

2.3 Voltage rating. The dc voltage ratings are for continuous operation throughout the operating temperature range. At higher frequencies, the operating conditions are usually limited by the ac current rather than the voltage. Voltage ratings range from 300 to 2,500 volts. In addition to the limitations of operation placed on the capacitor by operating temperature range and ac current at high frequencies, the following conditions should be adhered to:

(a) Barometric pressure:

- (1) Up to and including 1,200 volts (except 600 volts, style CM50) --- 0.315 inch of mercury (100,000 feet) up to normal atmospheric pressure.
- (2) Above 1,200 volts (and 600 volts, style CM50) --- 3.44 inches of mercury (50,000 feet) up to normal atmospheric pressure.

(b) Relative humidity --- Up to 80 percent.

2.4 Operating temperature range. Style CM35 capacitors above 10,000 pF are suitable for operation over a temperature range of -55° to +125°C; all other styles are suitable for operation over a temperature range of -55° to +150°C.

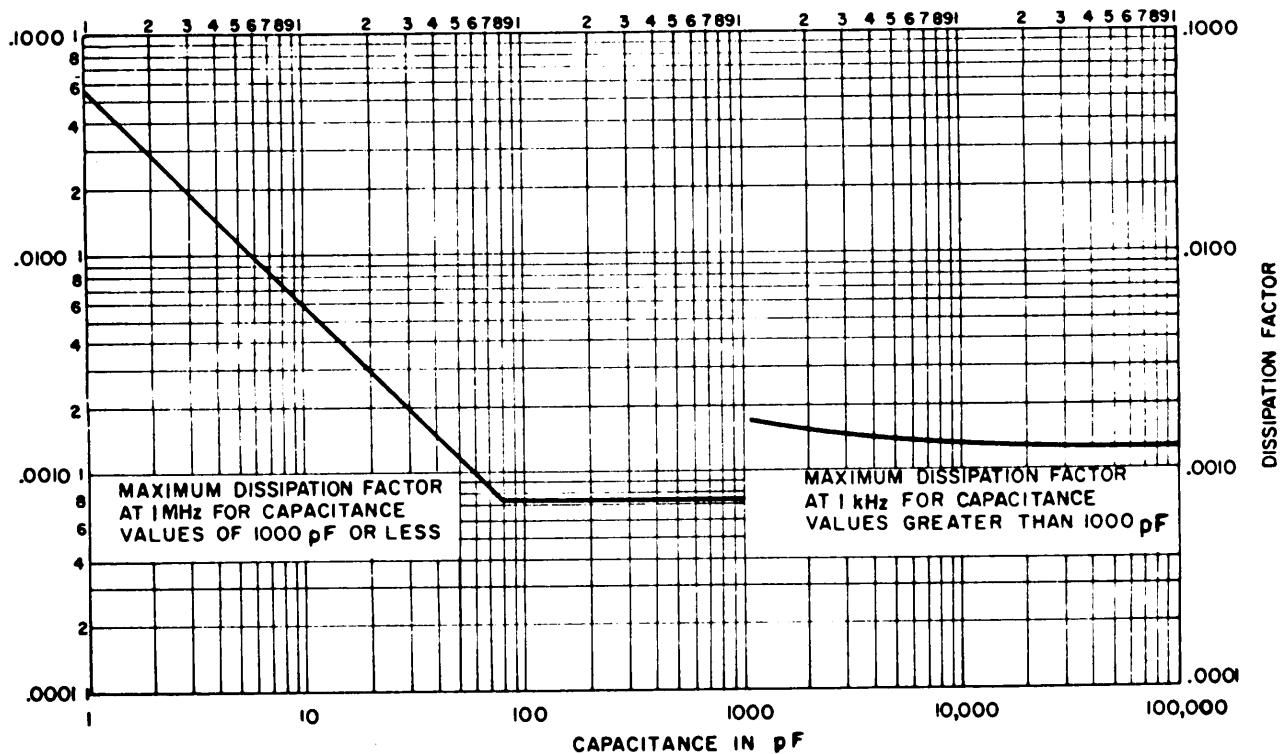
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2.5 Temperature coefficient and capacitance drift. The temperature coefficient and capacitance drift available in each style are as shown in table 102-1.

TABLE 102-1. Temperature coefficient and capacitance drift.

Style	Symbol	Temperature coefficient ppm/°C	Cap. drift
CM15, CM20, CM30, and CM35	C E F	-200 to +200 -20 to +100 0 to +70	$\pm(0.5\% + 0.1 \text{ pF})$ $\pm(0.1\% + 0.1 \text{ pF})$ $\pm(0.05\% + 0.1 \text{ pF})$
CM45 and CM50	B	Not specified	Not specified

2.6 Dissipation factor. The maximum dissipation factor will not exceed the values shown on figure 102-1.

FIGURE 102-1. Dissipation factor.

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3. ITEM IDENTIFICATION (see figures 102-2 and 102-3).

3.1 Type designation. The type designation is used for identifying and describing the capacitors as shown in figure 102-2.

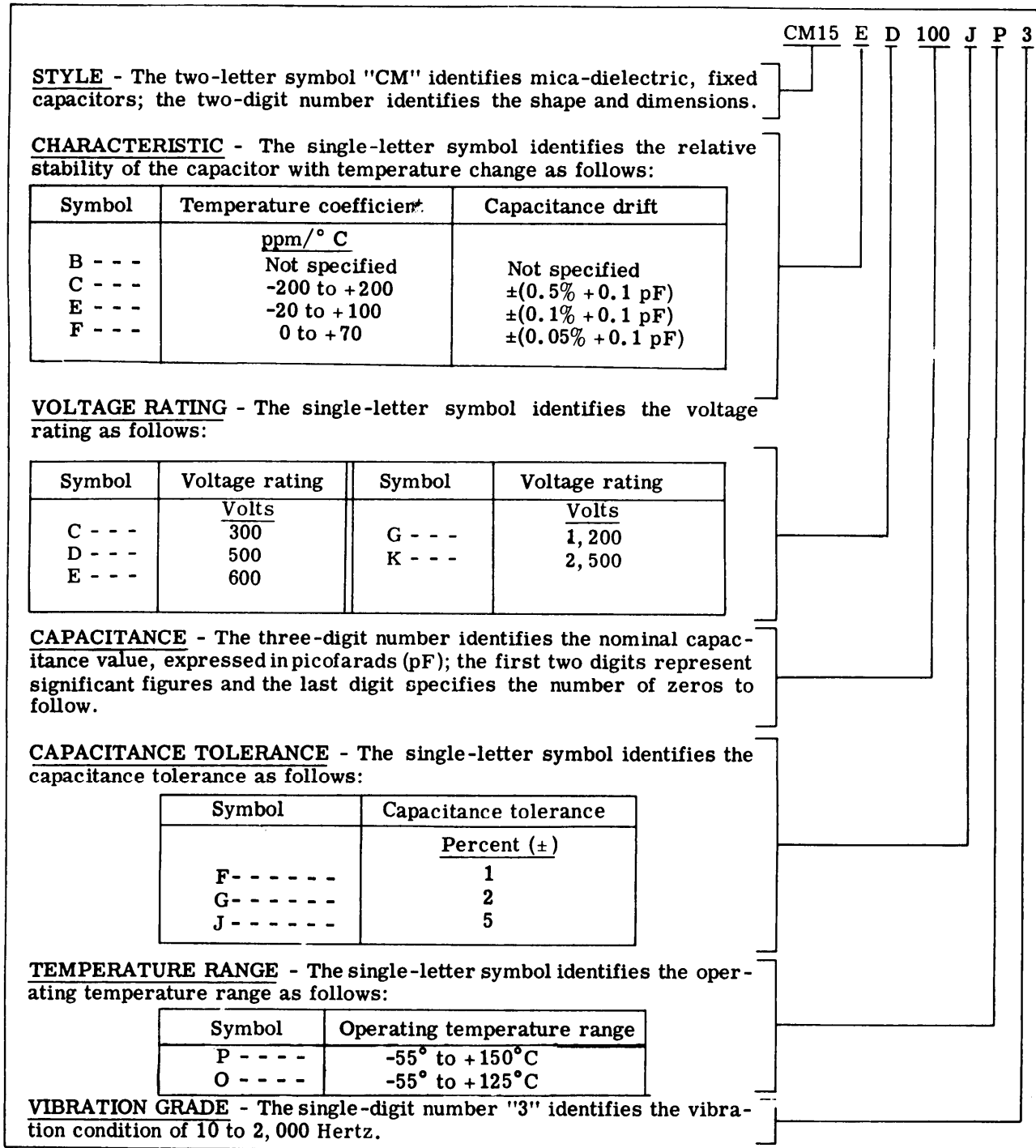
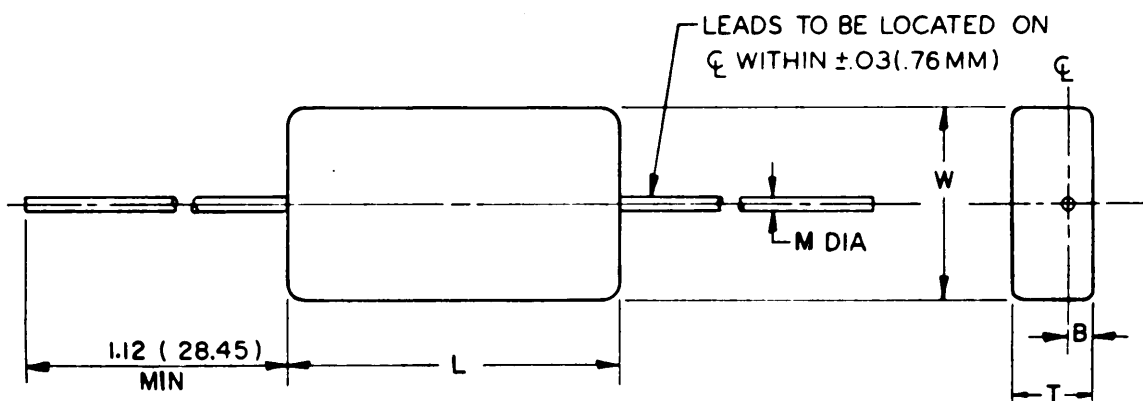


FIGURE 102-2. Type designation example.

3.2 Standard capacitors. The standard capacitors available in this section are as shown in figure 102-3.

STYLES CM15, CM20, CM30, AND CM35



Stand- ard style	Dimensions (inches)																NATO type designation (per NEPR No. 1)
	B		M				L				W				T		
	Min		$\pm .002$ In	$\pm .05$ MM	Min		Max		Min		Max		Min		Max		
	In	MM			In	MM	In	MM	In	MM	In	MM	In	MM			
CM15	.06	1.52	.025 (#22AWG)	.64	.48	12.19	.55	13.97	.27	6.86	.31	7.87	.14	3.56	.22	5.59	NCM01
CM20	.06	1.52	.032 (#20AWG)	.81	.67	17.02	.79	20.07	.41	10.41	.47	11.94	.16	4.06	.22	5.59	NCM02
CM30	.08	2.03	.040 (#18AWG)	1.02	.77	19.56	.86	21.84	.77	19.56	.86	21.84	.23	5.84	.28	7.11	NCM03
CM35	.08	2.03	.040 (#18AWG)	1.02	.77	19.56	.86	21.84	.77	19.56	.86	21.84	.28	7.11	.36	9.14	NCM04

FIGURE 102-3. Mica dielectric fixed capacitors.

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STANDARD CAPACITORS

STYLES CM15, CM20, CM30, AND CM35

DC RATED VOLTAGE 500 VOLTS -- OPERATING TEMPERATURE RANGE -55° TO +150°C --
CAPACITANCE TOLERANCE ± 1 AND ± 2 PERCENT

Style	Type designation	Capacitance available with characteristic	
		Characteristics C, E, and F	
CM15	CM15-D431--3	430	
	CM15-D471--3	470	
	CM15-D511--3	510	
		<u>pF</u>	
CM20	CM20-D561--3	560	
	CM20-D621--3	620	
	CM20-D681--3	680	
	CM20-D751--3	750	
	CM20-D821--3	820	
	CM20-D911--3	910	
	CM20-D102--3	1,000	
CM30	CM30-D112--3	1,100	
	CM30-D122--3	1,200	
	CM30-D132--3	1,300	
	CM30-D152--3	1,500	
	CM30-D162--3	1,600	
	CM30-D182--3	1,800	
	CM30-D202--3	2,000	
	CM30-D222--3	2,200	
	CM30-D242--3	2,400	
	CM30-D272--3	2,700	
	CM30-D302--3	3,000	
	CM30-D332--3	3,300	
CM35	CM35-D362--3	3,600	
	CM35-D392--3	3,900	
	CM35-D432--3	4,300	
	CM35-D472--3	4,700	
	CM35-D512--3	5,100	
	CM35-D562--3	5,600	
	CM35-D682--3	6,800	
	CM35-D822--3	8,200	
	CM35-C103--3	10,000	1/
	CM35-C113--3	11,000	1/ 2/
	CM35-C123--3	12,000	1/ 2/
	CM35-C133--3	13,000	1/ 2/
	CM35-C153--3	15,000	1/ 2/

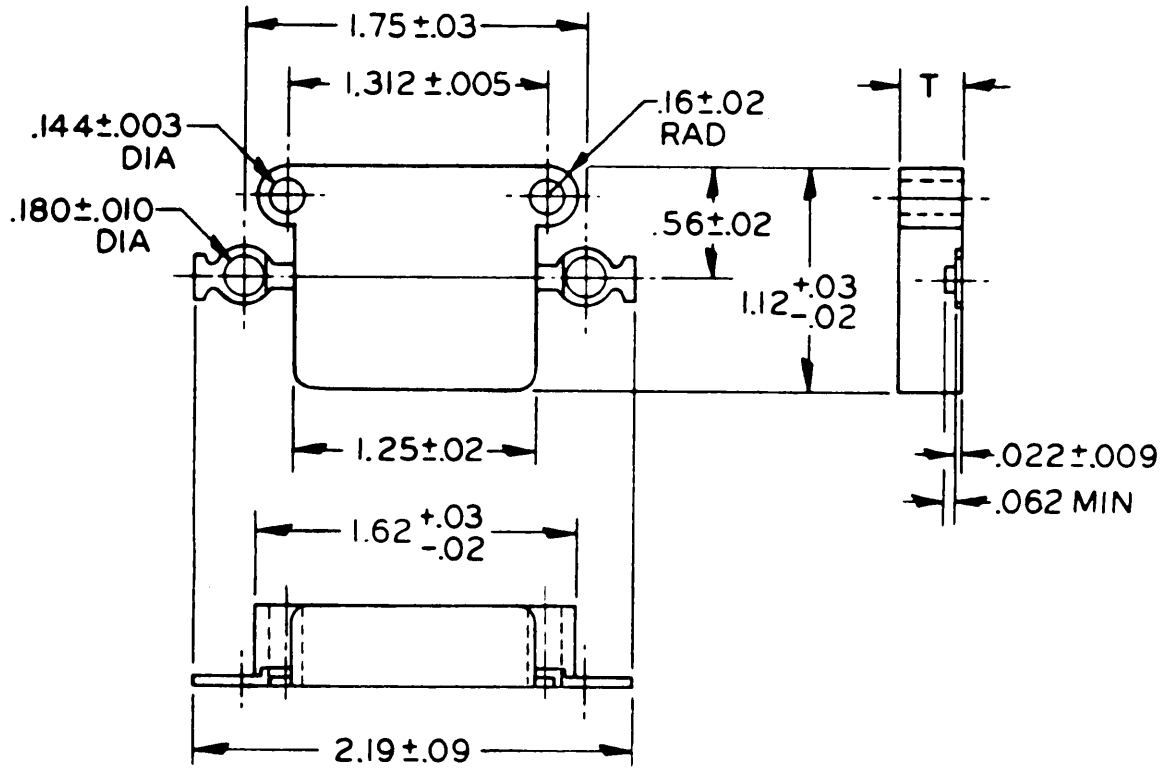
1/ DC working voltage is 300 volts.

2/ Maximum operating temperature is +125°C.

FIGURE 102-3. Mica dielectric, fixed capacitors - Continued.

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STYLES CM45 AND CM50



Standard style	Dimension (inches)
	T +.03 (.76) -.02 (.51)
CM45	.33 (8.38)
CM50	.42 (10.67)

INCHES	MM	INCHES	MM
.003	.08	.16	4.06
.005	.13	.180	4.57
.009	.23	.56	14.22
.010	.25	1.12	28.45
.02	.51	1.25	31.75
.022	.56	1.312	33.32
.03	.76	1.62	41.15
.062	1.57	1.75	44.45
.09	2.29	2.19	55.63
.144	3.66		

FIGURE 102-3. Mica dielectric fixed capacitors -Continued.

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STANDARD CAPACITORS
1/ STYLES CM45 AND CM50

OPERATING TEMPERATURE RANGE -55° TO +150°C -- TEMPERATURE COEFFICIENT
 AND CAPACITANCE DRIFT, NOT SPECIFIED -- CAPACITANCE TOLERANCE ± 5 PERCENT

Style	Type designation	Capacitance	DC rated voltage
		<u>pF</u>	<u>Volts</u>
CM45	CM45BK470--3	47	2,500
	CM45BK560--3	56	2,500
	CM45BK680--3	68	2,500
	CM45BK820--3	82	2,500
	CM45BK101--3	100	2,500
	CM45BK121--3	120	2,500
	CM45BK151--3	150	2,500
	CM45BK181--3	180	2,500
	CM45BK221--3	220	2,500
	CM45BK271--3	270	2,500
	CM45BK331--3	330	2,500
	CM45BK391--3	390	2,500
	CM45BK471--3	470	2,500
	CM45BK561--3	560	2,500
	CM45BK681--3	680	2,500
	CM45BK821--3	820	2,500
	CM45BK102--3	1,000	2,500
CM45BK122--3	1,200	2,500	
CM45BK152--3	1,500	2,500	
CM45BK182--3	1,800	2,500	
CM50	CM50BK222--3	2,200	2,500
	CM50BK272--3	2,700	2,500
	CM50BK332--3	3,300	2,500
	CM50BK392--3	3,900	2,500
	CM50BK472--3	4,700	2,500
	CM50BG562--3	5,600	1,200
	CM50BG682--3	6,800	1,200
	CM50BG822--3	8,200	1,200
	CM50BG103--3	10,000	1,200
	CM50BE123--3	12,000	600
	CM50BE153--3	15,000	600
	CM50BE183--3	18,000	600
	CM50BE223--3	22,000	600
	CM50BE273--3	27,000	600

1/ Styles CM45 and CM50 capacitors are not to be used in Air Force applications where altitudes of 50,000 feet may be exceeded.

FIGURE 102-3. Mica dielectric, fixed capacitors - Continued.

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SECTION 200

CAPACITORS, FIXED, ELECTROLYTIC

Section

Applicable specification

201. Capacitors, Fixed, Electrolytic (Dry Electrolyte),
DC, Aluminum, Polarized - - - - - MIL-C-62

**NOT FOR NAVY OR USAF
USE IN NEW DESIGN**

202. Capacitors, Fixed, Electrolytic (Aluminum Oxide) - - - MIL-C-39018

**USAF AIRBORNE APPLICATIONS REQUIRE
PRIOR APPROVAL BY PROCURING ACTIVITY**

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SECTION 201

CAPACITORS, FIXED, ELECTROLYTIC (DRY ELECTROLYTE), DC, ALUMINUM, POLARIZED
STYLES CE13 AND CE71
(APPLICABLE SPECIFICATION: MIL-C-62)

NOT FOR NAVY OR USAF
USE IN NEW DESIGN

1. SCOPE. This section covers single-section polarized, electrolytic (dry electrolyte), aluminum, dc, fixed capacitors.

2. APPLICATION INFORMATION.

2.1 Use. Aluminum electrolytic capacitors provide the smallest volume, mass, and cost per microfarad of any type of capacitor with the exception of the tantalum electrolytic capacitor.

These capacitors are not suitable for airborne equipment applications since they should not be subjected to low barometric pressure and low temperatures at high altitudes. These aluminum electrolytic capacitors can be derated only for a short period since derating for any length of time may result in the necessity for re-forming. Even though they have vents designed to open at dangerous pressures, explosions can occur because of gas pressure or a spark ignition of free oxygen and hydrogen liberated at the electrodes. Provisions should be made to protect surrounding parts.

These capacitors are generally used where low frequency, pulsating, dc signal components are to be filtered out, such as in B power supplies up to 450 dc rated volts, at such points as plate and screen connections to B+, and as cathode by-pass capacitors in self-biasing circuits. These capacitors are designed for applications where accuracy of capacitance is relatively unimportant.

As a rule, for selection of cathode by-pass capacitors, a ratio of bias resistance to by-pass reactance of about 10 to 1 is allowed. Ratios up to 20 to 1 may be used in high-fidelity-amplifier work or where space and economical considerations permit. Electrolytic capacitors provide the equipment designer with an unusually lightweight unit of high capacitance in a compact container.

2.2 Construction. The capacitor consists of aluminum foil rolled onto a porous spacer. The foil is approximately 0.003 to 0.005-inch thick. The spacer is impregnated with an electrolyte and separates the anode and cathode. The electrolyte is usually an aqueous solution of ammonium borate, boric acid, and glycol.

The metal cases are provided with an insulating sleeve which has an insulation resistance of at least 100 megohms.

It should be noted that the insulation resistance refers to the sleeve and not to the resistance between the terminals and the case. For style CE71 capacitors, the circuit diagram shows an indeterminate resistance between the negative terminal and the case since the electrolyte cannot be completely isolated. For proper performance, the case of all styles should be considered to be at the same potential as the negative terminal. The negative terminal is shorted to the case on style CE13 capacitors.

2.3 Voltage rating. The thickness of the oxide film which is formed both initially on the foil and during the forming operations on the completed capacitor determines the maximum peak or surge voltage which may be applied. The dc rated voltages for capacitors listed in this section are 400 and 450 volts. For maximum reliability and long life, the dc rated voltage should not be more than approximately 80 percent of full rating so that surges can be kept within the full-rated voltage. The time of surge-voltage application should not be more than 30 seconds every 10 minutes.

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2.4 Operating temperature range. These capacitors are suitable for operation over a temperature range of -40° to $+85^{\circ}\text{C}$ at rated voltage.

2.5 Surge voltage. The surge voltages given in figure 201-1 are voltages which the capacitor may withstand for short periods. This includes transients and surges due to applying voltage to a piece of cold electronic gear.

2.6 Polarity. These capacitors should be used only in dc circuits with polarity properly observed. If ac components are present, the sum of the peak ac voltage plus the applied dc voltage must not exceed the dc rating. The peak ac value should also be less than the applied dc voltage in order that polarity may be maintained even on negative peaks. Capacitors which have been subjected to voltage reversal should be discarded.

2.7 DC Leakage. Aluminum electrolytic capacitors have poor resistance-temperature characteristics. As the temperature is raised, the breakdown voltage decreases and the leakage current increases.

2.8 High temperature. In planning the location of the capacitors with respect to other component parts, careful consideration should be given to the proximity of the capacitors to transformers, electron tubes, and high-current resistors because of the usual temperature rise involved in these components. Continued operation at temperatures above the normal rating will cause a permanent decrease in capacitance and an increase in series resistance.

2.9 Low temperature. The performance of these capacitors at subzero temperatures is mainly affected by the increase in series resistance and by a decrease in capacitance. These changes do not persist with the return of normal temperature conditions. At -40°C , these capacitors retain approximately 50 to 80 percent of their initial capacitance.

2.10 Maximum root-mean-square (rms) ripple current. When these capacitors are used for input-filtering purposes, the rms ripple (at $+85^{\circ}\text{C}$ and 120 Hz) should not exceed the value calculated from the following equation:

$$I_r = k \sqrt{C}$$

Where: I_r = Maximum rms ripple current in milliamperes.
 k = See table 201-1.
 C = Nominal capacitance in microfarads.

TABLE 201-1. Values of "k".

Style	DC rated voltage	Case dia (in.)	"k"
CE13	400 and 450	Any	30

When operated at a frequency different from 120 Hz or at a temperature different from $+85^{\circ}\text{C}$, the value obtained from the equation should be multiplied by the appropriate value given in table 201-11.

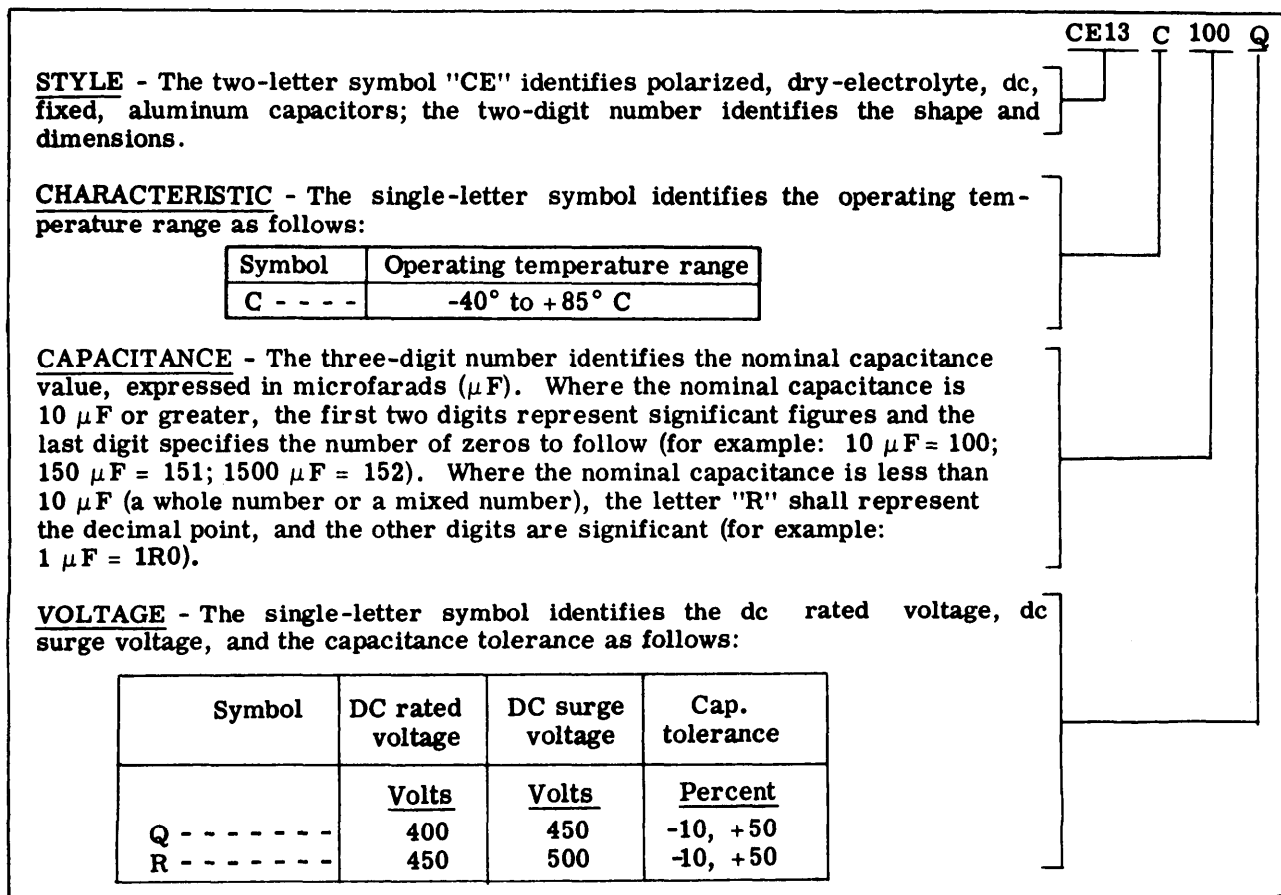
2.11 Cleaning solvents. Recommended solvents include all those free of halogen or halogen groups, such as toluene, methanol, methyl cellosolve, alkinox and water, and naphtha. Chlorinated or fluorinated hydrocarbon solvents are prohibited.

TABLE 201-11. Ripple current multipliers.

Frequency (Hz)	Multipliers				
	+85° C	+65° C	+55° C	+45° C	+40° C and below
60	0.8	1.2	1.6	2.2	3.0
120	1.0	1.5	2.0	2.8	3.0
Above 120	1.1	1.7	2.2	3.0	3.0

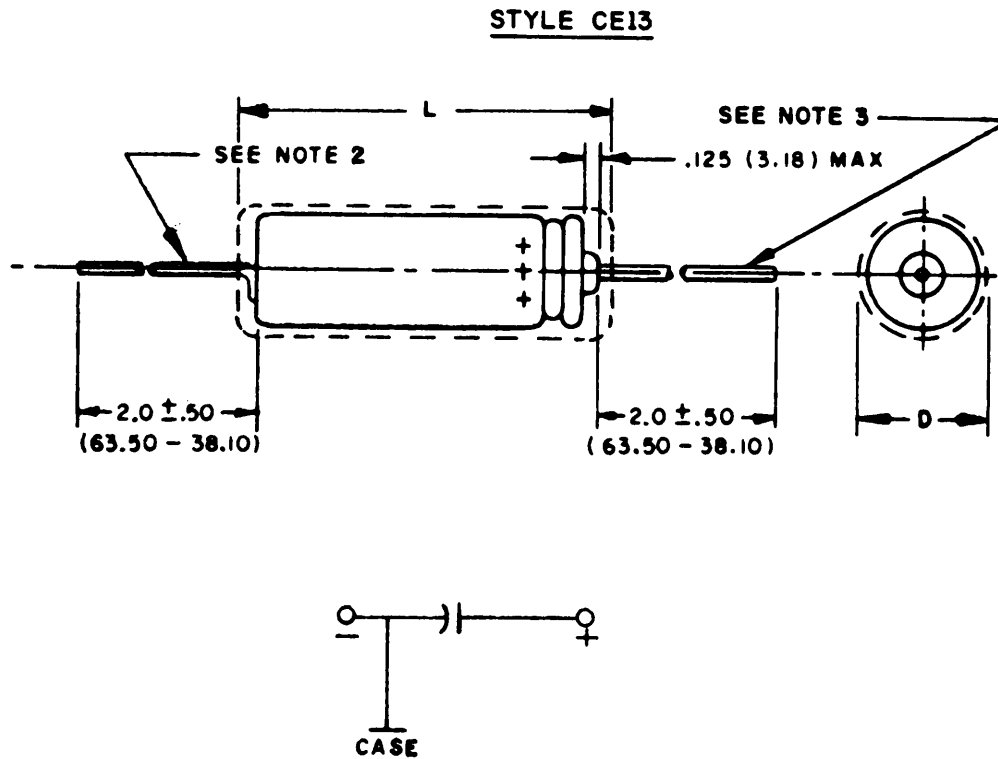
3. ITEM IDENTIFICATION (see figures 201-1 and 201-2).

3.1 Type designation. The type designation is used for describing the capacitors as shown in figure 201-1.

FIGURE 201-1. Type designation example.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 201-2.

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NOTES:

1. These capacitors are not intended to be mounted by their leads. They are provided with a supplementary means of mounting such as a tangential bracket or wraparound bands.
2. The negative lead need not be offset.
3. Leads are $.032 \pm .002$ (.81 ± .05 mm) inch (20 AWG) for units with a diameter of $.625$ (15.88 mm) inch or less and $.040 \pm .002$ (1.02 ± .05 mm) inch (18 AWG) for units with a diameter greater than $.625$ (15.88 mm) inch.

FIGURE 201-2. Electrolytic (dry electrolyte), aluminum, fixed capacitors.

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STANDARD CAPACITORS

STYLE CE13

OPERATING TEMPERATURE RANGE -40° TO +85°C

Type designation	DC rated voltage	Cap.	Cap. tolerance	DC leakage current	DF	Max impedance	Case dimensions	
							L	D
	Volts	μ F	Percent	μ A	Percent	Ohms	Inches	Inches
							+.186 (4.72)	+.155 (3.94)
							-.062 (1.57)	-.031 (.79)
CE13C100Q	400	10	-10, +50	95	17	1,480	1.125 (28.58)	0.875 (22.23)
CE13C150Q		15	-10, +50	116	17	986	2.625 (66.68)	0.625 (15.88)
CE13C470Q		47	-10, +50	203	17	314	3.125 (79.38)	0.875 (22.23)
CE13C680Q		68	-10, +50	248	17	218	3.125 (79.38)	1.000 (15.40)
CE13C1R0R	450	1.0	-10, +50	31	17	22,000	1.125 (28.58)	0.500 (12.70)
CE13C100R		10	-10, +50	100	17	2,000	2.625 (66.68)	0.625 (15.88)
CE13C150R		15	-10, +50	123	17	1,465	2.125 (53.98)	0.750 (19.05)
CE13C220R		22	-10, +50	149	17	1,000	2.125 (53.98)	0.875 (22.23)
CE13C330R		33	-10, +50	182	17	666	2.125 (53.98)	1.000 (25.40)
CE13C470R		47	-10, +50	217	17	468	2.625 (66.68)	1.000 (25.40)
CE13C680R		68	-10, +50	262	17	323	3.625 (92.08)	1.000 (25.40)

FIGURE 201-2. Electrolytic (dry electrolyte) aluminum fixed capacitors - Continued.

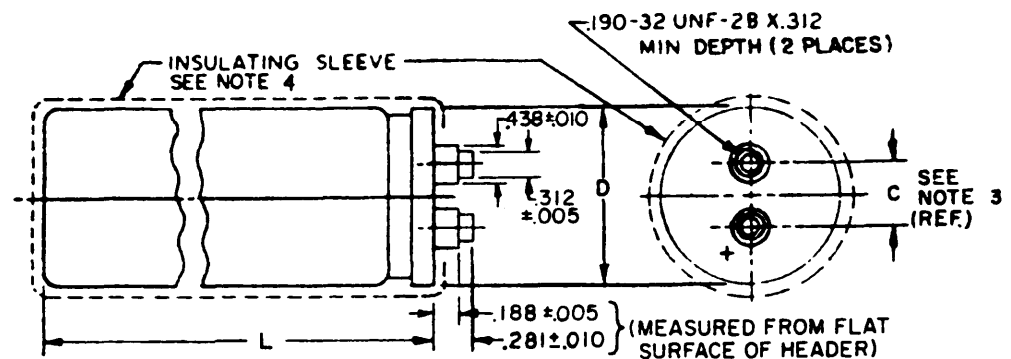
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STANDARD CAPACITORS

STYLE CE71

OPERATING TEMPERATURE RANGE -40° TO +85°C

Type designation	DC rated voltage	Cap.	Cap. tolerance	DC leakage current	DF	Max impedance	Case dimensions	
							L	D
	Volts	μF	Percent	μA	Percent	Ohms	Inches	Inches
CE71C151R	450	150	-10, +50	390	16	100	4.125 (104.78)	1.375 (34.93)
CE71C331R		330	-10, +50	577	16	45	4.125 (104.78)	2.000 (50.80)
CE71C681R		680	-10, +50	829	16	22	4.125 (104.78)	2.500 (63.50)
CE71C102R		1,000	-10, +50	1,006	18	15	4.125 (104.78)	3.000 (76.20)



NOTES:

- Capacitors are mounted by means of a wraparound foot-type bracket.
- There is an indeterminate resistance between the metal case and the negative terminal.
- "C" dimension is as follows:

- .500 for case diameter 1.375.
- .875 for case diameter 2.000.
- 1.125 for case diameter 2.500.
- 1.250 for case diameter 3.000.

- Insulating sleeve thickness does not exceed .016 inch and overlaps the ends of the capacitor body.

FIGURE 201-2. Electrolytic (dry electrolyte), aluminum, fixed capacitors - Continued.

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SECTION 202

CAPACITORS. FIXED, ELECTROLYTIC (ALUMINUM OXIDE)
STYLE CU15

(APPLICABLE SPECIFICATION: MIL-C-39018)

USAF AIRBORNE APPLICATIONS REQUIRE
PRIOR APPROVAL BY PROCURING ACTIVITY

1. SCOPE . This section covers nonpolarized, electrolytic (aluminum oxide), fixed capacitors enclosed in metal cases, suitably protected against high humidity.

2. APPLICATION INFORMATION.

2.1 Use. Aluminum electrolytic capacitors are intended for use in filter, coupling, and by-pass applications where large capacitance values are required in small cases and where excesses of capacitance over the nominal value can be tolerated.

Aluminum electrolytic capacitors provide the smallest volume, mass, and cost per microfarad of any type of capacitor with the exception of the tantalum electrolytic capacitor.

These capacitors are not recommended for airborne equipment applications since they should not be subjected to low barometric pressure and low temperatures at high altitudes. These aluminum electrolytic capacitors can be derated only for a short period since derating for any length of time may result in the necessity for re-forming. Even though they have vents designed to open at dangerous pressures, explosions can occur because of gas pressure or a spark ignition of free oxygen and hydrogen liberated at the electrodes. Provisions should be made to protect surrounding parts.

These capacitors are generally used where low frequency, pulsating, dc signal components are to be filtered out, and as cathode by-pass capacitors in self-biasing circuits. These capacitors are designed for applications where accuracy of capacitance is relatively unimportant.

As a rule, for selection of emitter by-pass capacitors, a ratio of bias resistance to by-pass reactance of about 10 to 1 is allowed. Ratios up to 20 to 1 may be used in high-fidelity-amplifier work or where space and economical considerations permit. Electrolytic capacitors provided the equipment designer with an unusually lightweight unit of high capacitance in a compact container.

2.2 Construction. The construction of these capacitors is basically the same as that specified in Section 201 (MIL-C-62). However, advancements in the manufacture of aluminum electrolytic capacitors have made possible an increased foil purity, improved oxide system, and an increase in etch ratios. Other contributing factors to the advancement in the manufacture of aluminum capacitors are an improved capacitor seal and the development of an electrolyte with a non-aqueous base.

The metal cases for these capacitors are provided with an insulating sleeve which has an insulation resistance of at least 100 megohms.

It should be noted that the insulation resistance refers to the sleeve and not to the resistance between the terminals and the case. The circuit diagram for style CU15 capacitors shows an indeterminate resistance between the outer-foil terminal and the case since the electrolyte cannot be completely isolated. For safer performance, the insulating sleeve should remain over the case for all applications.

2.3 Voltage rating. The thickness of the oxide film which is formed both initially on the foil and during the forming operations on the completed capacitor determines the maximum peak or surge voltage which may be applied. For maximum reliability and long life, the dc working voltage should not be more than approximately 80 percent of full rating so that surges can be kept within the full -rated working voltage. The time of surge-voltage application should not be more than 30 seconds every 10 minutes.

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Style CU15 capacitors cover a voltage range of 7 to 250 Vdc at 85°C derated to 5 to 200 Vdc at 125°C.

2.4 Operating temperature range. Style CU15 capacitors are suitable for operation over a temperature range of -55° to + 85°C, derated to +125°C.

2.5 Derating. Style CU15 capacitors may be voltage derated in order to operate at temperatures up to +125° + 125°C. The percent of derating varies from approximately 20 to 33 percent depending on the particular voltage rating involved.

2.6 Seal. Even though these capacitors have vents designed to open at dangerous pressures, explosions can occur because of gas pressure or a spark ignition of free oxygen and hydrogen liberated at the electrodes. Provisions should be made to protect surrounding parts.

2.7 Surge voltage. The surge voltage is the maximum voltage to which the capacitor should be subjected under any condition. This includes transients and peak ripple at the highest line voltage.

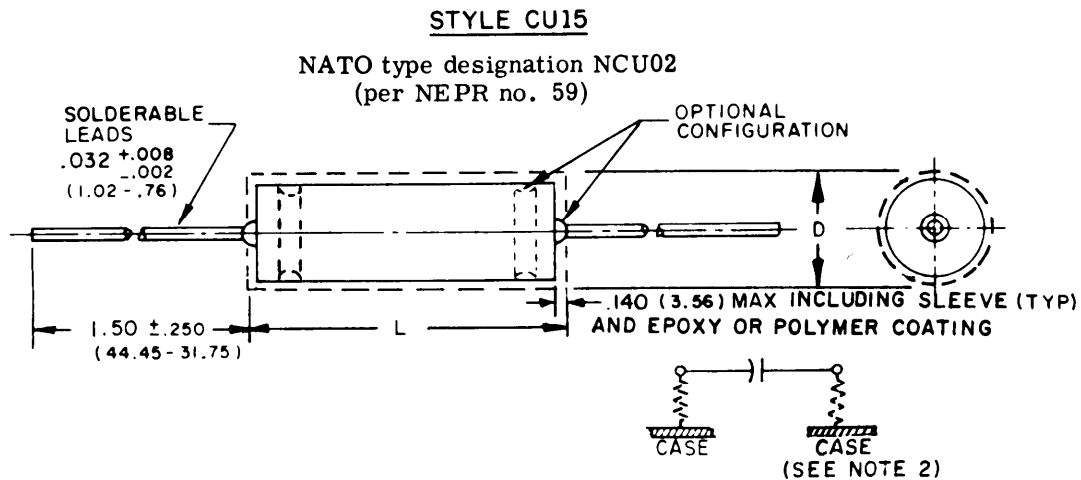
2.8 Polarization. Nonpolarized capacitors, style CU15, should be used in applications where reversal of potential occurs. Polarized capacitors, styles CUR13, CUR17, CUR19, CUR71, and CUR91 (see Section 704) should be used only in dc circuits with polarity properly observed. If ac components are present, the sum of the peak ac voltage plus the applied dc voltage must not exceed the dc rating. The peak ac value should also be less than the applied dc voltage so that polarity may be maintained, even on negative peaks, to avoid overheating and damage.

2.9 Cleaning solvents. Recommended solvents include all those free of halogen or halogen groups, such as toluene, methanol, methyl cellosolve, alkinox and water, and naphtha. Chlorinated or fluorinated hydrocarbon solvents are prohibited.

3. ITEM IDENTIFICATION

3.1 Standard capacitors. The standard capacitors available in this Section are shown in figure 202-1. (The figure gives the electrical characteristics, case sizes, and Military part numbers of capacitors which are standard for design.)

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Case size	Dimensions	
	Style CU15, insulated	
	$L \pm .031$ (.79)	$D \pm .023$ (.58) $-.015$ (.38)
A0	.938(23.83)	.281(7.14)
A7	1.438(36.53)	.375(9.53)
A8	2.125(53.98)	.375(9.53)
A9	2.750(69.85)	.375(9.53)

NOTES:

1. These capacitors are not intended to be mounted by their leads.
2. There is an indeterminate resistance between the outer-foil terminal and case.

FIGURE 202-1. Electrolytic (aluminum oxide), fixed capacitors.

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STANDARD CAPACITORS
STYLE CU15 (MIL-C-39018/2)OPERATING TEMPERATURE RANGE -55° TO + 85°C, DERATED TO
+125° C -- NONPOLARIZED, INSULATED

Capacitance value	DC rated voltage		DC surge voltage		ESR		Maximum impedance at -55°C and 120 Hz	DC leakage		Case code	Dash number M39018/02-		
	85°C	125°C	85°C	125°C	25°C	85°C and 125°C		25°C	85°C and 125°C		Style CU15		
	Capacitance tolerance		-10+30	-10+50	-10+75								
μF	Volts		Volts		Ω		Ω	μA					
47	7	5	10	7	5.64	7.05	64	4	12	A0	0601	---	0701
220	7	5	10	7	1.21	1.51	14	10	30	A7	0602	---	0702
470	7	5	10	7	0.56	0.71	6.4	10	48	A8	0603	---	0703
680	7	5	10	7	0.39	0.49	4.4	24	72	A9	0604	---	0704
39	10	7	15	10	6.80	8.50	77	4	12	A0	0605	---	0705
180	10	7	15	10	1.47	1.84	17	10	30	A7	0606	---	0706
330	10	7	15	10	0.80	1.00	9.1	16	48	A8	0607	---	0707
470	10	7	15	10	0.56	0.71	6.4	24	72	A9	0608	---	0708
33	15	10	20	15	8.04	10.05	91	4	12	A0	0609	---	0709
120	15	10	20	15	2.21	2.76	25	9	27	A7	0610	---	0710
150	15	10	20	15	1.77	2.21	20	10	30	A7	0611	---	0711
270	15	10	20	15	0.98	1.23	11	16	48	A8	0612	---	0712
390	15	10	20	15	0.68	0.85	7.7	24	72	A9	0613	---	0713
15	30	20	40	30	17.68	22.10	130	5	15	A0	0614	---	0714
56	30	20	40	30	4.74	5.92	36	9	27	A7	0615	---	0715
68	30	20	40	30	3.90	4.88	30	10	30	A7	0616	---	0716
120	30	20	40	30	2.21	2.76	17	15	45	A8	0617	---	0717
150	30	20	40	30	1.77	2.21	13	16	48	A8	0618	---	0718
180	30	20	40	30	1.47	1.84	11	24	72	A9	0619	---	0719
0.8	50	40	60	50	19.50	39.01	300	6	18	A0	0620	---	0720
27	50	40	60	50	4.91	9.82	74	10	30	A7	0621	---	0721
56	50	40	60	50	2.37	4.74	36	16	48	A8	0622	---	0722
82	50	40	60	50	1.62	3.23	23	24	72	A9	0623	---	0723
3.9	75	60	90	75	34.01	68.01	510	7	21	A0	0624	---	0724
15	75	60	90	75	8.84	17.68	130	10	30	A7	0625	---	0725
18	75	60	90	75	7.37	14.74	110	11	33	A7	0626	---	0726
39	75	60	90	75	3.40	6.80	51	16	48	A8	0627	---	0727
56	75	60	90	75	2.37	4.74	36	24	72	A9	0628	---	0728
2.2	100	75	125	100	60.29	120.57	910	8	12	A0	0629	0729	---
12	100	75	125	100	11.05	22.10	170	16	48	A7	0630	0730	---
22	100	75	125	100	6.03	12.06	91	18	54	A8	0631	0731	---
33	100	75	125	100	4.02	8.04	61	24	84	A9	0632	0732	---
1.8	150	100	175	125	73.68	147.37	1100	10	30	A0	0633	0733	---
5.6	150	100	175	125	23.68	47.37	360	14	42	A7	0634	0734	---
8.2	150	100	175	125	16.17	32.35	230	16	48	A7	0635	0735	---
12	150	100	175	125	11.05	22.10	170	18	54	A8	0636	0736	---
15	150	100	175	125	8.84	17.68	130	20	60	A8	0637	0737	---
22	150	100	175	125	6.03	12.06	91	28	84	A9	0638	0738	---
15	200	150	225	175	8.84	17.68	130	32	96	A9	0642	0742	---
0.68	250	200	275	225	195.04	390.09	3000	14	42	A0	0643	0743	---
3.3	250	200	275	225	40.19	80.38	610	22	66	A7	0644	0744	---
6.8	250	200	275	225	19.50	39.01	300	26	78	A8	0645	0745	---
10	250	200	275	225	13.26	26.53	200	36	108	A9	0646	0746	---

FIGURE 202-1. Electrolytic (aluminum oxide), fixed capacitors - Continued.

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SECTION 300

CAPACITORS, FIXED, CERAMIC DIELECTRIC

Section	Applicable specification
301. Capacitors, Fixed, Ceramic Dielectric (General Purpose) - - - - -	MIL-C-11015

MIL-STD-198E

SECTION 301

CAPACITORS, FIXED, CERAMIC DIELECTRIC (GENERAL PURPOSE)

STYLES CK60, CK62 THRU CK70, AND CK80

(APPLICABLE SPECIFICATION: MIL-C-11015)

1. SCOPE. This section covers ceramic dielectric, fixed capacitors designed for general-purpose use: ceramic feed-through and stand-off types.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are primarily designed for use where a small physical size with comparatively large electrical capacitance and high insulation resistance is required. Ceramic capacitors are substantially smaller than paper or mica units of the same capacitance and voltage rating. General-purpose ceramic capacitors are not intended for precision use but are suitable for use as by-pass, filter, and noncritical coupling elements in high-frequency circuits where appreciable changes in capacitance, caused by temperature variations, can be tolerated. These units are not recommended for use directly in frequency-determining circuits. Typical recommended applications include resistive-capacitive coupling for audio and radio frequency, RF and intermediate frequency cathode bypass, automatic volume control filtering, tone compensation, volume-control RF bypass, antenna coupling, and audio-plate RF bypass. All of these applications are of the type where dissipation factor is not critical, and moderate changes due to temperature, voltage, and frequency variations do not affect the proper functioning of the circuit. For example: A cathode bypass for 100 megahertz (MHz), having a nominal capacitance of 680 picofarads (pF), will give a capacitive reactance of 2.34 ohms. Since this reactance is very small compared with the cathode resistor, there would be no measurable effect on the 2.34-ohm value if the capacity should change by several percent due to a temperature variation, nor would a dissipation factor of 4 percent be noticeable.

Disk and thin-plated subminiature types are extremely compact and have an inherent low-series inductance due to their construction. The placement of the leads facilitates making close-coupled low-inductance connections and these capacitors are suitable for printed-circuit applications. High insulation resistance allows these capacitors to be used in vacuum-tube grid circuits; their extremely low leakage and small physical size make them suitable for use in transistor circuitry.

During circuit design, consideration should be given to the changes in dielectric constant caused by temperature, electric field intensity, applied frequency, and shelf aging.

2.1.1 Humid operating conditions. Ceramic dielectric materials are nonhygroscopic, effectively impermeable, and have practically no moisture absorption even after considerable exposure to humid conditions. Thus, these units are intended to operate, through their full temperature range, at relative humidities up to 95 percent.

2.2 Construction. A ceramic capacitor consists of a ceramic dielectric on which a thin metallic film, usually silver, has been fired at very high temperatures. Terminal leads are attached to the electrodes by a pressure contact or by soldering. Ceramic capacitors are encapsulated to protect the dielectric from the environment and to electrically insulate the capacitor. The disk types are covered by an insulating resin, plastic, or ceramic; the thin-plated subminiature types may be in dipped, molded, or preformed cases. The stand-off and feed-through units are made of ceramic tubes modified for their required mounting. Because the constituent materials have molecular polar moments, the dielectric constants of some mixes reach hundreds (even thousands), of times the value of paper, mica, and plastic films. This results in ceramics having the largest capacitance-to-size ratios of all high-resistance dielectrics.

301 (MIL-C-11015)

2.3 Voltage rating. These capacitors are available in a wide voltage range which varies with the capacitor style. The voltage range varies from 500 volts dc to 1,600 volts dc.

2.4 Rated temperature. The rated temperature (range) varies with the style as shown on figure 301-2.

2.5 Soldering. Care should be used in soldering the leads. Excessive heat may damage the encapsulation and weaken the electrode to terminal lead contact. Sudden changes in temperature, such as those experienced in soldering, can crack the encapsulation or the ceramic dielectric. Leads should not be bent close to the case nor should any strain be imposed on the capacitor body to avoid fracturing the encapsulation or ceramic dielectric.

2.6 Dissipation factor. For the recommended applications, the dissipation factor is negligibly low. The power factor decreases as temperature is increased; this provides an advantage where operation above room temperature is required.

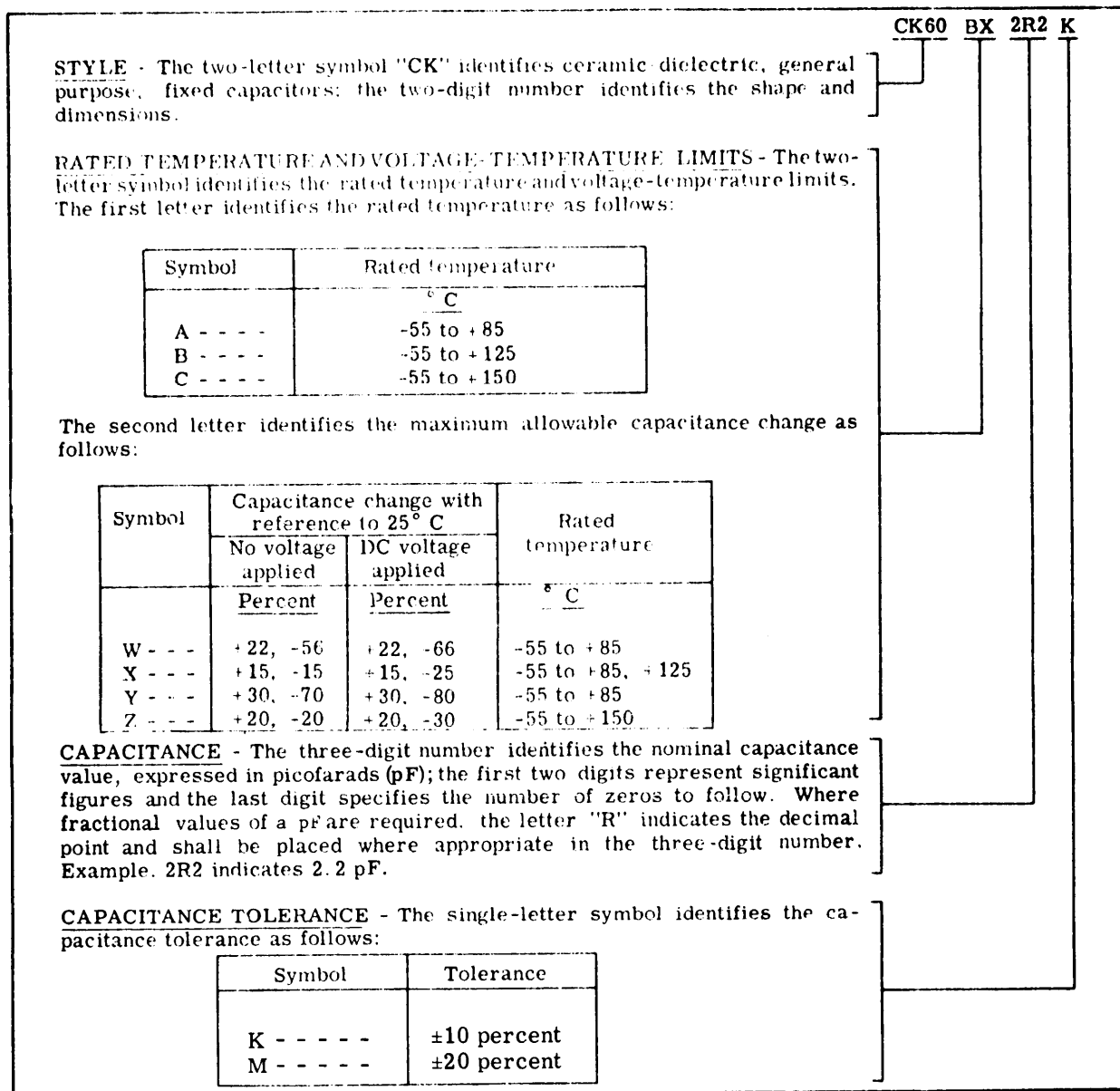
2.7 Dielectric strength. Design engineers are advised not to put disk types where case insulation will be subjected to sustained potentials in excess of 750 volts dc or periodic potentials over 1,250 volts peak. Supplementary insulation should be provided where these values are exceeded.

2.8 Capacitance as a function of operating conditions. The dielectric constant of these capacitors exhibits a considerable dependence on field strength. Large variations in capacitance may be experienced with changes in ac or dc voltages. The dielectric constant may decrease with time and may be as low as 75 percent of the original value after 1,000 hours. The dielectric constant is dependent on frequency and decreases as the frequency is increased; it also decreases with temperature.

2.9 Silver migration. When the silver electrodes in the ceramic capacitor are exposed to high humidities and high dc potentials, silver ion migration may take place and short circuit capacitors after relatively short periods of time. Excessive moisture during periods of storage should be avoided since the encapsulation material may absorb moisture and silver ion migration may occur when the capacitors are later put into service.

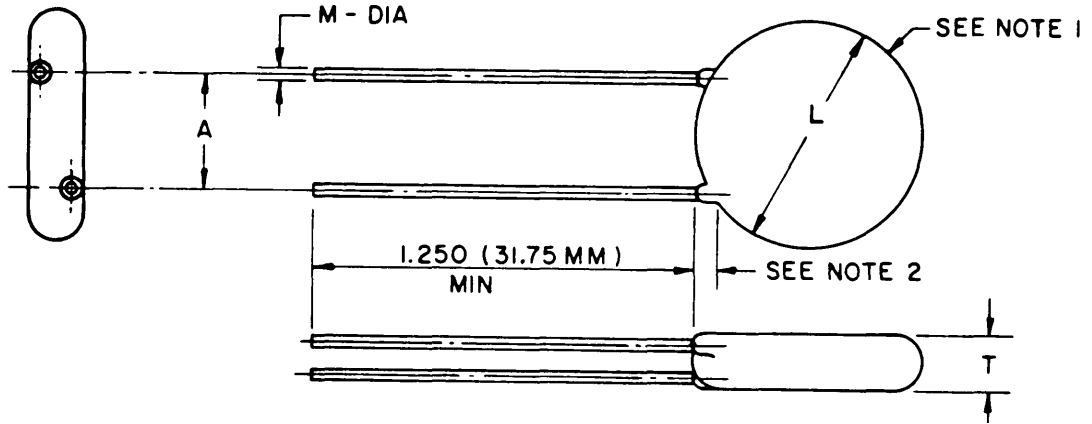
3. ITEM IDENTIFICATION (see figures 301-1 and 301-2).

3.1 Type designation. The type designation is used for identifying and describing the capacitors as shown in figure 301-1.

FIGURE 301-1. Type designation example.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 301-2.

STYLES CK60. CK62. CK63. CK64. CK65. CK66. CK67. CK68. AND CK69



Style	L		T ±.040 (1.02)		A		M +.004 (.10) -.001 (.03)	
	Inches	MM	Inches	MM	Inches	MM	Inches	MM
CK60	.280 ±.030	7.11 ± .76	.120	3.05	.250 ±.062	6.35 ±1.52	.025	.64
CK62	.550 ±.040	13.97 ±1.02	.120	3.05	.375 ±.062	9.53 ±1.52	.025	.64
CK63	.660 ±.030	16.76 ± .76	.120	3.05	↑	↑	.032	.81
CK64	.730 ±.040	18.54 ± .76	.167	4.24	↑	↑	↑	↑
CK65	.790 ±.040	20.07 ±1.02	.167	4.24	↑	↑	↑	↑
CK66	.890 ±.040	22.61 ±1.02	.167	4.24	↑	↑	↑	↑
CK67	.950 ±.040	24.13 ±1.02	.167	4.24	↑	↑	↑	↑
CK68	1.050 ±.040	26.67 ±1.02	.330	8.38	↓	↓	↓	↓
CK69	1.110 ±.040	28.19 ±1.02	.330	8.38	.375 ±.062	9.53 ±1.52	.032	.81

NOTES:

1. Body configuration shown as maximum envelope; shape is optional.
2. Insulating coating does not extend more than .125 (3.18 mm) along lead wires, measured from a tangent to the coating surface drawn perpendicular to the lead wires.

FIGURE 301-2. Ceramic dielectric (general purpose), fixed capacitors.

STANDARD CAPACITORS

TSTYLES CK60, CK62, CK63, CK64, CK65, CK66, CK67, CK68, AND CK69

Type designation	Capacitance	DC rated voltage	Rated temperature and voltage temperature limits			Capacitance tolerance
			Temperature	Cap. change with reference to 25°C		
				No voltage applied	500 V applied	
	pF	Volts	-55° to + °C	Percent	Percent	Percent (±)
CK60BX2R2K	2.2	1,000	125	±15	+15, -25	10
CK60BX3R3K	3.3	1,000	125	±15	+15, -25	10
CK60BX4R7K	4.7	1,000	125	±15	+15, -25	10
CK60BX6R8K	6.8	1,000	125	±15	+15, -25	10
CK60BX100K	10	1,000	125	±15	+15, -25	10
CK60BX150K	15	1,000	125	±15	+15, -25	10
CK60BX220K	22	1,000	125	±15	+15, -25	10
CK60BX330K	33	1,000	125	±15	+15, -25	10
CK60BX470K	47	1,000	125	±15	+15, -25	10
CK60BX680K	68	1,000	125	±15	+15, -25	10
CK60BX101K	100	1,000	125	±15	+15, -25	10
CK60BX151K	150	500	125	±15	+15, -25	10
CK60AX221K	220	1,000	85	±15	+15, -25	10
CK60AX331K	330	500	85	±15	+15, -25	10
CK60AX471K	470	500	85	±15	+15, -25	10
CK60AW681M	680	1,000	85	+22, -56	+22, -66	20
CK60AW102M	1,000	1,000	85	+22, -56	+22, -66	20
CK60AW152M	1,500	500	85	+22, -56	+22, -66	20
CK62AY220M	22	1,500	85	+30, -70	+30, -80	20
CK62AY470M	47	1,500	85	+30, -70	+30, -80	20
CK62AY101M	100	1,500	85	+30, -70	+30, -80	20
CK62AY221M	220	1,500	85	+30, -70	+30, -80	20
CK62AY471M	470	1,500	85	+30, -70	+30, -80	20
CK62BX821K	820	500	125	±15	+15, -25	10
CK62BX102K	1,000	500	125	±15	+15, -25	10
CK62BX152K	1,500	500	125	±15	+15, -25	10
CK62AW222K	2,200	500	85	+22, -56	+22, -66	10
CK62AW332M	3,300	500	85	+22, -56	+22, -66	20
CK62AW682M	6,800	500	85	+22, -56	+22, -66	20
CK63CZ681K	680	500	150	±20	+22, -30	10
CK63AW472M	4,700	1,000	85	+22, -56	+22, -66	20
CK63AW103M	10,000	500	85	+22, -56	+22, -66	20
CK64AW511M	510	1,600	85	+22, -56	+22, -66	20
CK64AW681M	680	1,600	85	+22, -56	+22, -66	20
CK64AW821M	820	1,600	85	+22, -56	+22, -66	20
CK64AW102M	1,000	1,600	85	+22, -56	+22, -66	20
CK64AW152M	1,500	1,600	85	+22, -56	+22, -66	20
CK64AW222M	2,200	1,600	85	+22, -56	+22, -66	20
CK64AW332M	3,300	1,600	85	+22, -56	+22, -66	20
CK64AW392M	3,900	1,600	85	+22, -56	+22, -66	20
CK65AW472M	4,700	1,600	85	+22, -56	+22, -66	20
CK66AW562M	5,600	1,600	85	+22, -56	+22, -66	20
CK67AW682M	6,800	1,600	85	+22, -56	+22, -66	20
CK67AW752M	7,500	1,600	85	+22, -56	+22, -66	20
CK68AW103M	10,000	1,600	85	+22, -56	+22, -66	20
CK69AW153M	15,000	1,600	85	+22, -56	+22, -66	20

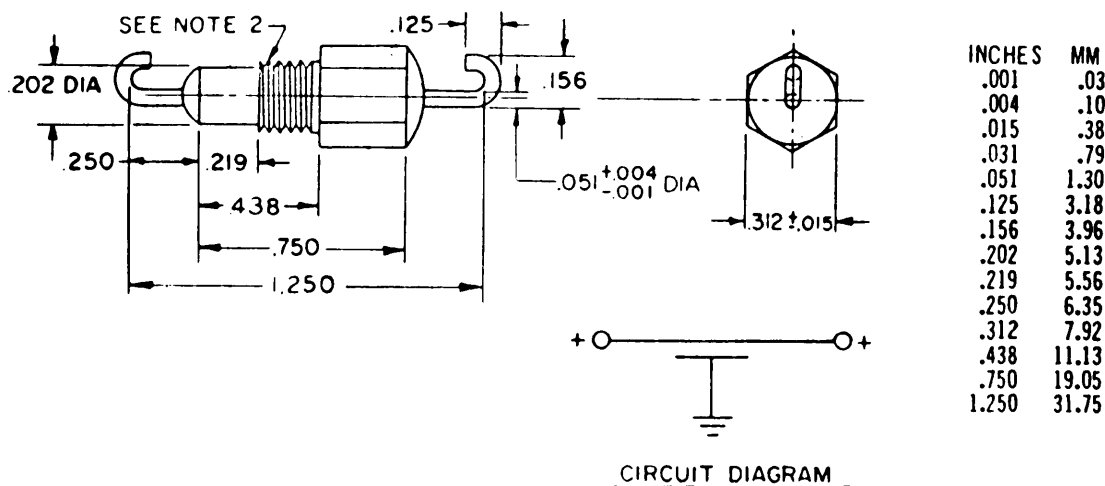
FIGURE 301-2. Ceramic dielectric (general purpose), fixed capacitors - Continued.

STANDARD CAPACITORS

STYLE CK70

RATED TEMPERATURE -55° TO +85°C

Type designation	Capacitance	DC rated voltage	Voltage-temperature limits		Capacitance tolerance
			Cap. change with reference to 25°C		
			No voltage applied	500 V applied	
	pF	Volts	Percent	Percent	Percent (±)
CK70AX100K	10	1,000	±15	+15, -25	10
CK70AX330K	33	1,000	±15	+15, -25	10
CK70AX470K	47	1,000	±15	+15, -25	10
CK70AX680K	68	1,000	±15	+15, -25	10
CK70AX101K	100	1,000	±15	+15, -25	10
CK70AX471K	470	500	±15	+15, -25	10
CK70AX681K	680	500	±15	+15, -25	10
CK70AW102M	1,000	500	+22, -56	+22, -66	20
CK70AW152M	1,500	500	+22, -56	+22, -66	20



NOTES:

1. Unless otherwise specified, tolerance is ± .031 (.79 mm).
2. Threaded portion is 1/4-28UNF-2A and extends to within .047 (1.19 mm) of the shoulder.
3. A nut and an internal-tooth lockwasher are supplied with each capacitor.

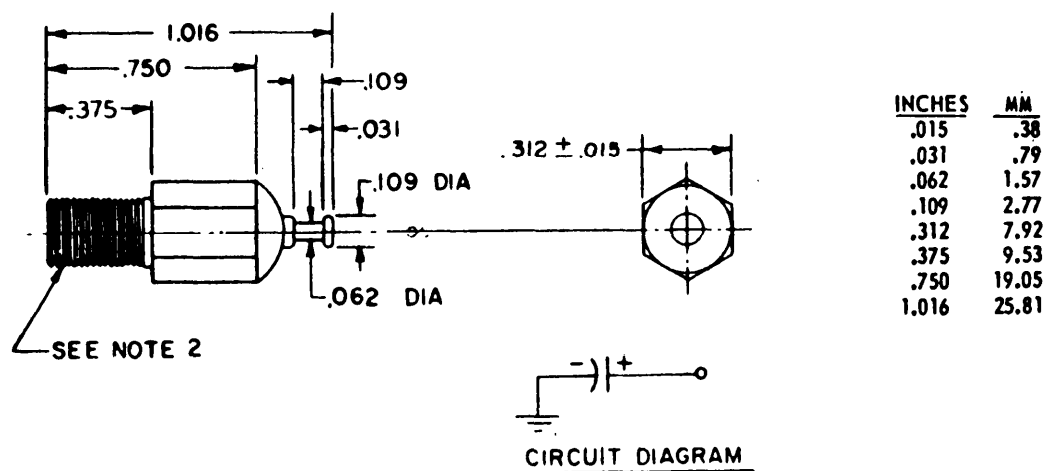
FIGURE 301-2. Ceramic dielectric (general purpose), fixed capacitors - Continued.

STANDARD CAPACITORS

STYLE CK80

RATED TEMPERATURE -55° TO +85°C -- DC RATED VOLTAGE 500 VOLTS

Type designation	Capacitance	Voltage-temperature limits		Capacitance tolerance
		Cap. change with reference to 25°C		
		No voltage applied	500 V applied	
	pF	Percent	Percent	Percent (±)
CK80AX100K	10	±15	+15, -25	10
CK80AX330K	33	±15	+15, -25	10
CK80AX470K	47	±15	+15, -25	10
CK80AX680K	68	±15	+15, -25	10
CK80AX101K	100	±15	+15, -25	10
CK80AX471K	470	±15	+15, -25	10
CK80AX681K	680	±15	+15, -25	10
CK80AW102M	1,000	+22, -56	+22, -66	20
CK80AW152M	1,500	+22, -56	+22, -66	20



NOTES:

1. Unless otherwise specified, tolerance is $\pm .031$ (.79 mm).
2. Threaded portion is 1/4-28UNF-2A and extends to within .047 (1.19 mm) of the shoulder.
3. A nut and an internal-tooth lockwasher are supplied with each capacitor.

FIGURE 301-2. Ceramic dielectric (general purpose), fixed capacitors - Continued.

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SECTION 400

CAPACITORS, VARIABLE (TRIMMER)

<u>Section</u>	<u>Applicable specification</u>
401. Capacitors, Variable, Ceramic Dielectric - - - - -	MIL-C-81
402. Capacitors, Variable (Piston Type, Tubular Trimmer)-----	MIL-C-14409

400 (CONTENTS)

MIL-STD-198E

SECTION 401

CAPACITORS, VARIABLE, CERAMIC DIELECTRIC

STYLES CV11, CV21, AND CV31

(APPLICABLE SPECIFICATION: MIL-C-81)

1. SCOPE. This section covers ceramic-dielectric, variable capacitors.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are small-sized trimmer capacitors designed for use where fine tuning adjustments are periodically required during the life of the equipment. Normally they are used for trimming and coupling in such circuits as intermediate frequency, radio-frequency, oscillator, phase shifter, and discriminator stages. Because of their low mass, these units are relatively stable against shock and vibration which tend to cause changes in capacitance. Where a higher order of stability is required, air trimmers should be used. The minimum capacitance of these capacitors is not greater than the minimum value specified; however, the minimum capacitance value may be less than the minimum value specified. The maximum capacitance is not less than that specified and not greater than 50 percent more than the maximum value specified. Capacitance and adjustment are relatively linear.

2.2 Construction. Each unit consists of a single stator and a single rotor for each section, made of ceramic material impregnated with transformer or silicone oil. Pure silver is fired and burnished on the top of the base of the stator in a half-moon pattern. The rotor, usually of titanium dioxide, has pure silver contact points. The contact surfaces of both the stator and the rotor are ground and lapped flat, thus eliminating air space variations with temperature.

The principle of operation is similar to that of an air-dielectric tuning capacitor where the overlap of the stator and rotor determines the capacitance; in these units, the ceramic dielectric replaces the air dielectric. Rotors may be rotated continuously; full capacitance change occurs during each rotation. The approximate maximum capacitance point is indicated on the capacitor.

2.3 Voltage rating. DC voltage ratings (from sea level to an altitude of 100,000 feet) are as follows:

CV11 and CV21	- 500 volts.
CV31	- 200 and 350 volts.

2.4 Operating temperature range. These capacitors are suitable for operation over a temperature range of -55° to +85° C.

2.5 Mounting. These capacitors may be mounted close to a metal panel with little increase in capacitance. To avoid cracking or chipping of the ceramic mounting base, a resilient mounting (or mounting surface spacer) should be used.

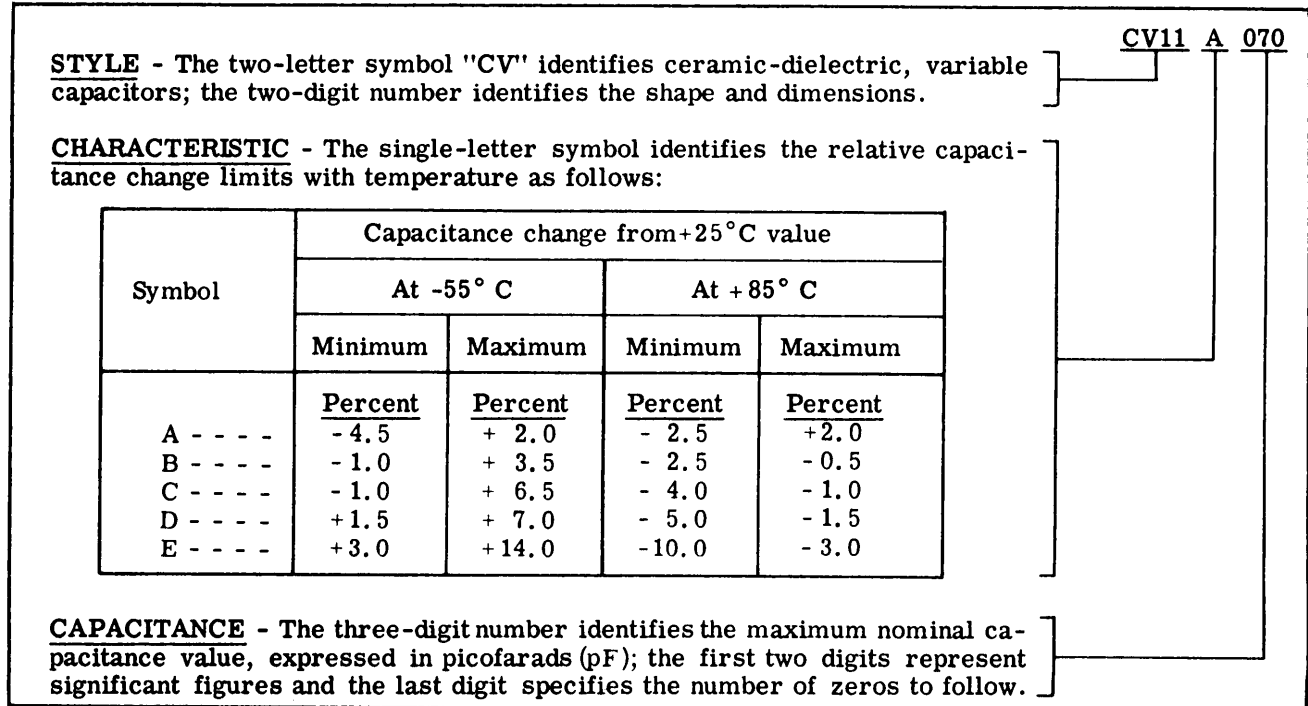
2.6 Capacitance change with temperature. When measurements are made after the capacitors have reached thermal stability at each temperature setting (at a frequency between 0.1 and 1.2 megahertz (MHz)), and with the capacitor set at 80 to 90 percent of maximum capacity, the changes of nominal capacitance from the value measured at +25° C may vary from -4.5 to +14.0 percent at -55° C or -10.0 to +2.0 percent at +85.0 ± 0.1° C.

Since the temperature sensitivity is nonlinear over the capacitance range and varies greatly between units, these capacitors should not be designed into circuits as temperature compensating units.

The capacitance drift remains within 0.50 pF.

3. ITEM IDENTIFICATION (see figures 401-1 and 401-2).

3.1 Type designation. The type designation is used for identifying and describing the capacitors as shown in figure 401-1.

FIGURE 401-1. Type designation example.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 401-2.

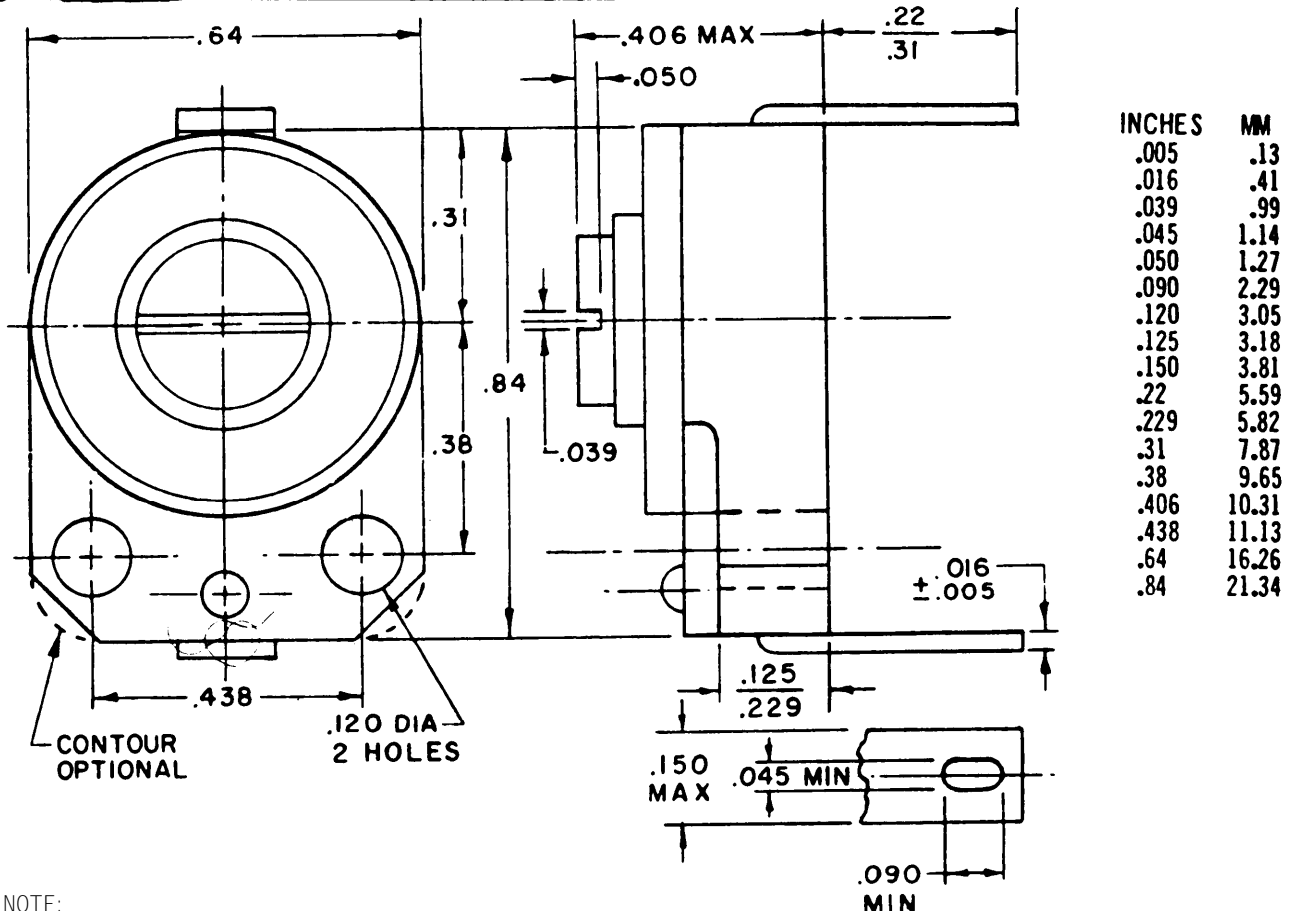
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STANDARD CAPACITORS

STYLE CV11

DC RATED VOLTAGE 500 VOLTS

Type designation	Capacitance		Characteristic				Symbol
			Capacitance change from 25°C value				
			At -55°C		At +85°C		
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
	pF	pF	Percent	Percent	Percent	Percent	
CV11A070	1.5	7.0	-4.5	+2.0	-2.5	+2.0	A
CV11A120	3.0	12.0	-4.5	+2.0	-2.5	+2.0	A
CV11A250	4.5	25.0	-4.5	+2.0	-2.5	+2.0	A
CV11B130	3.0	13.0	-1.0	+3.5	-2.5	-0.5	B
CV11B200	5.0	20.0	-1.0	+3.5	-2.5	-0.5	B
CV11C300	4.0	30.0	-1.0	+6.5	-4.0	-1.0	C
CV11C450	7.0	45.0	-1.0	+6.5	-4.0	-1.0	C
CV11D060	2.0	6.0	+1.5	+7.0	-5.0	-1.5	D
CV11D300	4.0	30.0	+1.5	+7.0	-5.0	-1.5	D
CV11D450	7.0	45.0	+1.5	+7.0	-5.0	-1.5	D



NOTE:

Unless otherwise specified, tolerances are $\pm .03$ (.76 mm) and $\pm .010$ (.25 mm).

FIGURE 401-2. Ceramic dielectric variable capacitors.

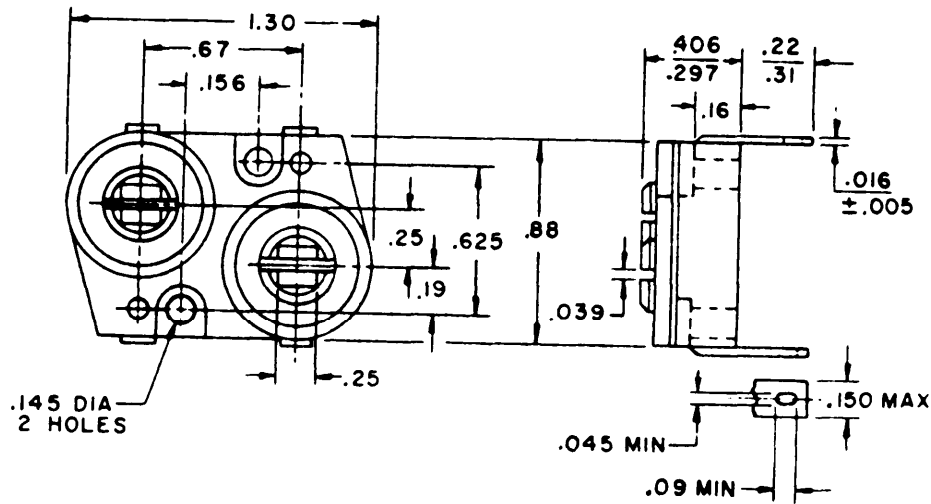
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STANDARD CAPACITORS

STYLE CV21

DC RATED VOLTAGE 500 VOLTS

Type designation	Capacitance		Characteristic				Symbol
			Capacitance change from 25°C value				
			At -55°C		At +85°C		
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
	pF	pF	Percent	Percent	Percent	Percent	
CV21A070	1.5	7.0	-4.5	+2.0	-2.5	+2.0	A
CV21A120	3.0	12.0	-4.5	+2.0	-2.5	+2.0	A
CV21A200	4.5	20.0	-4.5	+2.0	-2.5	+2.0	A
CV21B130	3.0	13.0	-1.0	+3.5	-2.5	-0.5	B
CV21B200	5.0	20.0	-1.0	+3.5	-2.5	-0.5	B
CV21C300	4.0	30.0	-1.0	+6.5	-4.0	-1.0	C
CV21C450	7.0	45.0	-1.0	+6.5	-4.0	-1.0	C
CV21D300	5.0	30.0	+1.5	+7.0	-5.0	-1.5	D
CV21D450	7.0	45.0	+1.5	+7.0	-5.0	-1.5	D



NOTE:

Unless otherwise specified, tolerances are ±.03 (.76 mm) and ±.010 (.25 mm).

INCHES	MM	INCHES	MM	INCHES	MM
.005	.13	.156	3.96	.31	7.87
.016	.41	.16	4.06	.406	10.31
.039	.99	.19	4.83	.625	15.88
.045	1.14	.22	5.59	.67	17.02
.09	2.29	.25	6.35	.88	22.35
.145	3.68	.297	7.54	.130	33.02
.150	3.81				

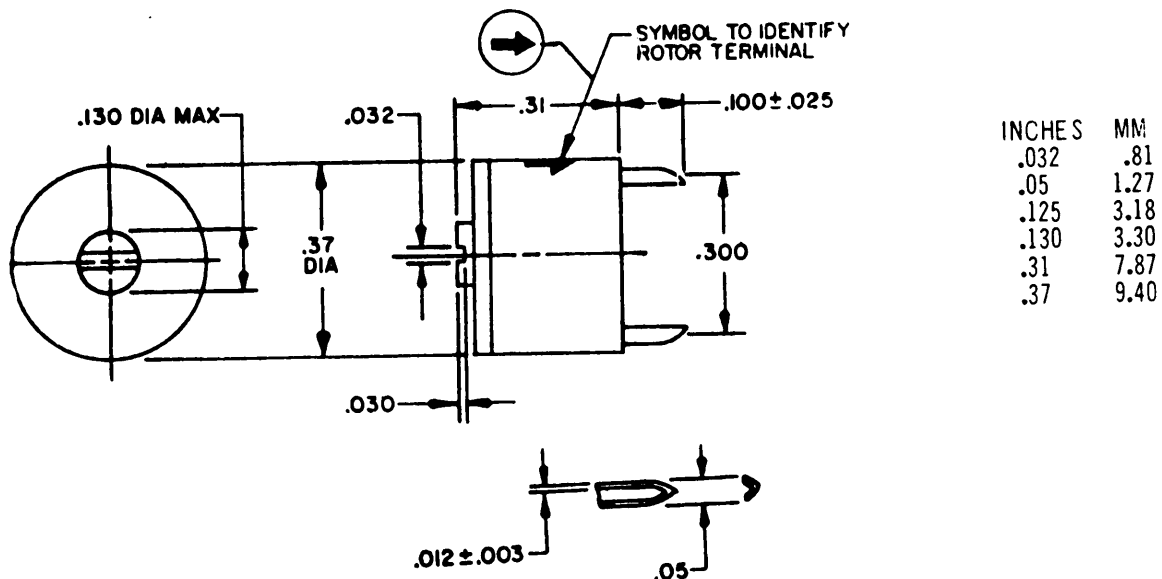
FIGURE 401-2. Ceramic dielectric variable capacitors - Continued.

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STANDARD CAPACITORS

STYLE CV31

Type designation	Capacitance		DC rated voltage	Characteristic				Symbol
				Capacitance change from 25°C value				
	Minimum	Maximum		At -55°C		At +85°C		
	pF	pF	Volts	Percent	Percent	Percent	Percent	
CV31A080	2.0	8.0	350	-4.5	+2.0	-2.5	+2.0	A
CV31A180	5.5	18.0	350	-4.5	+2.0	-2.5	+2.0	A
CV31B110	2.5	11.0	350	-1.0	+3.5	-2.5	-0.5	B
CV31B250	7.0	25.0	350	-1.0	+3.5	-2.5	-0.5	B
CV31C100	3.0	10.0	350	-1.0	+6.5	-4.0	-1.0	C
CV31C250	8.0	25.0	350	-1.0	+6.5	-4.0	-1.0	C
CV31D150	3.0	15.0	200	+1.5	+7.0	-5.0	-1.5	D
CV31D350	9.0	35.0	200	+1.5	+7.0	-5.0	-1.5	D
CV31E600	15.0	60.0	200	+3.0	+14.0	-10.0	-3.0	E



NOTE:

Unless otherwise specified, tolerances are $\pm .02$ (.51 mm) and $\pm .010$ (.25 mm).

FIGURE 401-2. Ceramic dielectric variable capacitors - Continued.

MIL-STD-198E

SECTION 402

CAPACITORS, VARIABLE (PISTON TYPE, TUBULAR TRIMMER)
PC17, PC18, PC19, PC21, PC22, PC23, PC24, PC25, PC26,
PC30, PC32, PC38, PC39, PC40, PC42, PC43, PC48, and PC52
(APPLICABLE SPECIFICATION: MIL-C-14409)

1. SCOPE. This section covers sealed, piston-type, tubular trimmer, variable capacitors.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are small-sized, tubular-trimmer, variable capacitors designed or use where fine tuning adjustments are periodically required during the life of the equipment. Normally they are used for trimming and coupling in such circuits as intermediate frequency, radio-frequency, oscillator, phase shifter, and discriminator stages. Because of their low mass, these units are relatively stable against shock and vibration which tend to cause changes in capacitance. Capacitance change versus rotation is linear within ± 10 percent. Backlash is virtually nonexistent except on styles PC39 and PC43 which have a maximum backlash of 2 percent.

2.2 Construction. Styles PC19, PC25, PC26, PC30, and PC32 capacitors are rated at constructed of a series of concentric circular metal bands which interleaf and are variable by adjustment of the related depth of the interface. All other style capacitors are constructed of glass, quartz, sapphire, or alumina dielectric cylinders and metal tuning pistons. A portion of the cylinder is plated with metal to form the stator and the metal piston, controlled by a tuning screw, acts as the rotor for these variable capacitors. The overlap of the stator and rotor determines the capacitance. The self-contained piston within the dielectric cylinder functions as a low inductance coaxial assembly.

2.3 Voltage ratings. Styles PC25, PC26, PC30, and PC32 capacitors are rated at 250 V dc; styles PC21, PC22, PC23, and PC24 capacitors are rated at 500 V dc; styles PC38, PC42, PC48, and PC52 capacitors are rated at 750 and 1,250 V dc; styles PC39 and PC43 capacitors are rated at 1,000 V dc.

2.4 Operating temperature range. Styles PC21, PC22, PC23, PC24, PC25, PC26, PC30, PC32, PC39, PC40, PC43, PC48, PC52 capacitors are suitable for operation over a temperature range of -55°C to $+125^{\circ}\text{C}$; styles PC38 and PC42 capacitors over a temperature range of -55° to $+150^{\circ}\text{C}$.

3. ITEM IDENTIFICATION (see figures 402-1 and 402-2).

3.1 Type designation. The type designation is used for identifying and describing the capacitors as shown in figure 402-1.

STYLE - The two-letter symbol "PC" identifies tubular trimmer, piston-type, variable capacitors; the two-digit number identifies the shape of the capacitor.

CHARACTERISTIC - The single-letter symbol identifies the characteristic as follows:

Symbol	Operating temp. range	Temperature coefficient	Capacitance drift
	<u>°C</u>	<u>PPM/°C</u>	
G - - -	-55 to +125	0 ±150	±.5%
H - - -	-55 to +125	0 ±100	±.04 pF
J - - -	-55 to +125	0 ±50	±.02 pF
K - - -	-55 to +125	0 ±75	±.03 pF
L - - -	-55 to +125	+50 ±50	±.01 pF
Q - - -	-55 to +150	0 +50, -0	±.01 pF
T - - -	-65 to +125	0 ±20	±.01 pF

CAPACITANCE - The three-digit number identifies the maximum nominal capacitance value, expressed in picofarads (pF); the first two digits represent significant figures and the last digit specifies the number of zeros to follow. Where fractional values of a pF are required, the letter, letter "R" represents the decimal point. For example: 1R8 indicates 1.8 pF.

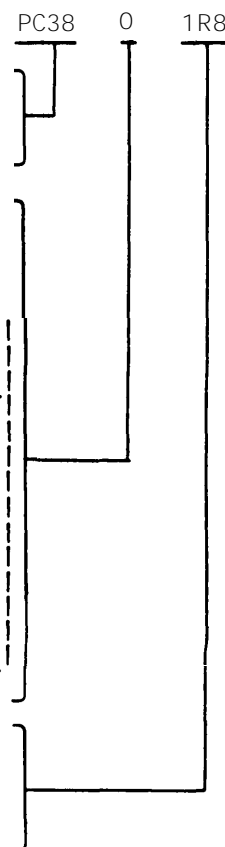


FIGURE 402-1. Type designation example.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 402-2.

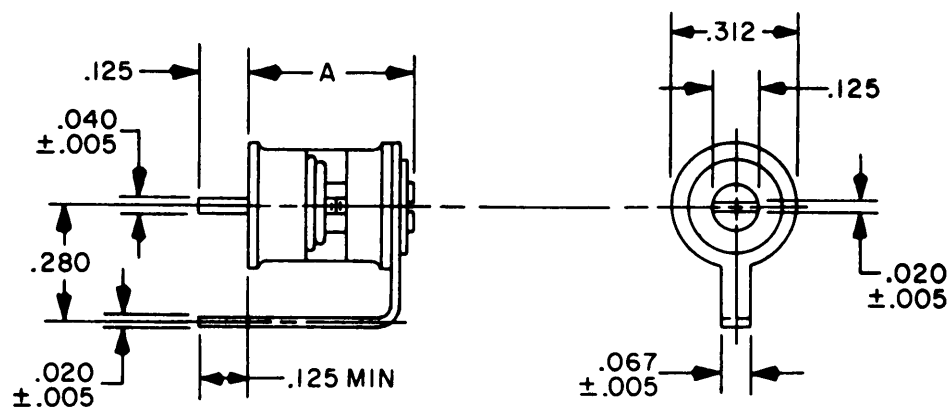
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC17 (MIL-C-14409/17)

OPERATING TEMPERATURE RANGE -55°C TO +125°C -- DC RATED VOLTAGE 250 VOLTS --
 TEMPERATURE COEFFICIENT 0 ±50 PPM/°C 0 ± 150 PPM/°C

Type designation	Capacitance range		Q minimum	Dimensions A ±.030
	Min	Max		
	pF	pF		
PC17J5R5	1.0	5.5	1,000	.390
PC17J8R5	1.0	8.5	650	.535
PC17G100	1.5	10	800	.340
PC17G200	1.5	20	800	.410
PC17G300	1.5	30	800	.490
PC17G400	1.5	40	800	.600



INCHES	MM	INCHES	MM
0.005	0.13	0.067	1.70
0.020	0.51	0.125	3.18
0.040	1.02	0.280	7.11
		0.312	7.92

NOTE:

Unless otherwise specified, tolerance is ± .016 (.41 mm).

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors.

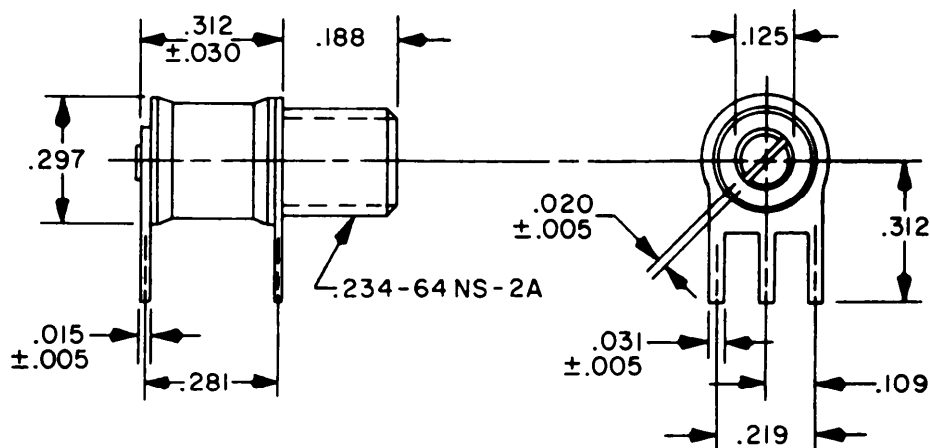
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC18 (MIL-C-14409/18)

OPERATING TEMPERATURE RANGE -55°C TO +125°C -- DC RATED VOLTAGE 125 AND 250 VOLTS -- TEMPERATURE COEFFICIENT 50 ± 50 PPM/°C

Type designation	Capacitance range		Voltage rating	Q minimum
	Min	Max		
PC18L100	pF	pF	250	5,000
PC18L140	0.8	10	125	3,000
	0.8	14		



INCHES		MM		INCHES		MM	
0.005	0.13	0.109	2.77	0.234	5.94		
0.015	0.38	0.125	3.18	0.281	7.14		
0.020	0.51	0.188	4.78	0.297	7.54		
0.030	0.76	0.211	5.36	0.312	7.92		
0.031	0.78	0.219	5.56				

NOTES:

1. Unless otherwise specified, tolerance is ± .016 (.41 mm).
2. Solder, if used, shall be high temperature solder having a melting point of 300 +50, -5°C.

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors - Continued.

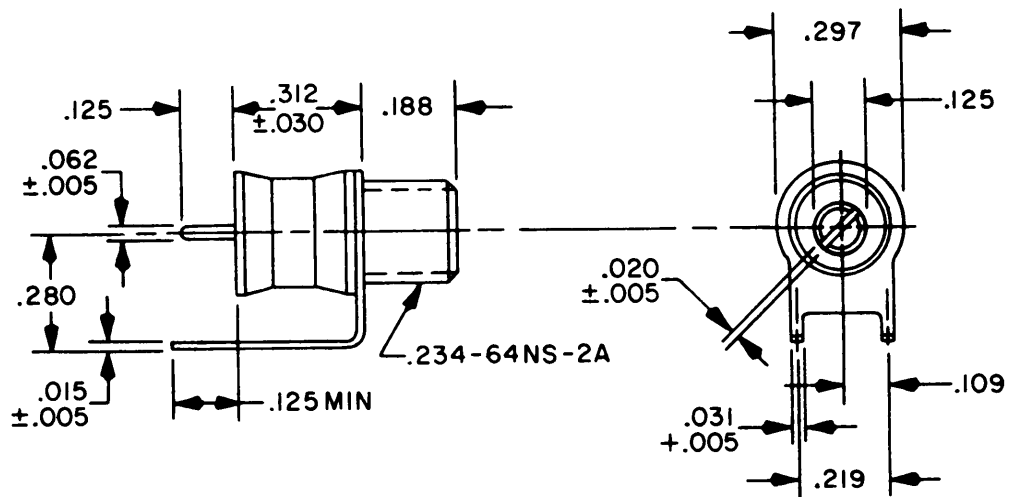
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC19 (MIL-C-14409/19)

OPERATING TEMPERATURE RANGE -55°C TO +125°C -- DC RATED VOLTAGE 125 AND 250 VOLTS -- TEMPERATURE COEFFICIENT 50 ± 50 PPM/°C

Type designation	Capacitance range		Voltage rating	Q minimum
	Min	Max		
PC19L100	<u>pF</u> 0.8	<u>pF</u> 10	250	5,000
PC19L140	0.8	14	125	3,000



INCHES	MM	INCHES	MM	INCHES	MM
0.005	0.13	0.062	1.57	0.219	5.56
0.015	0.38	0.109	2.77	0.234	5.94
0.020	0.51	0.125	3.18	0.280	7.11
0.030	0.76	0.188	4.78	0.297	7.54
0.031	0.78	0.211	5.36	0.312	7.92

NOTES:

1. Unless otherwise specified, tolerance is ±.016 (.41 mm).
2. Solder, if used, shall be high temperature solder having a melting point of 300 +50, -5 c.

FIGURE 402-2. Piston-type tubular trimmer variable capacitors - Continued.

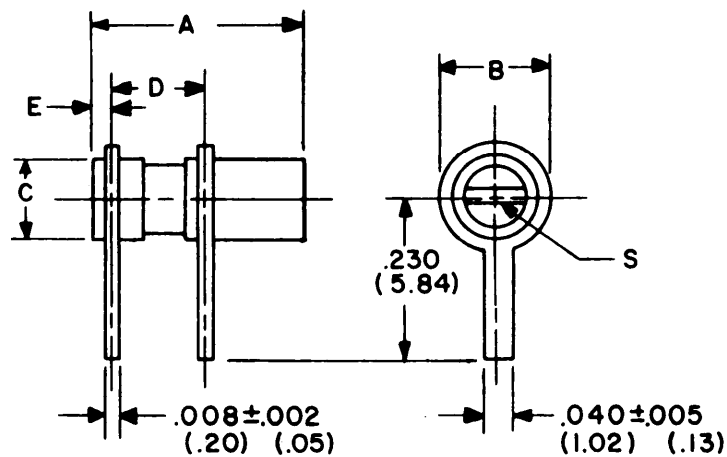
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC21 (MIL-C-14409/16)

OPERATING TEMPERATURE RANGE -55°C TO +125°C -- DC RATE VOLTAGE 500 VOLTS --
 TEMPERATURE COEFFICIENT 0 ± 50 PPM/°C AND 0 ± 75 °C

Type designation	Capacitance range		Q	Capacitance drift	Dimensions								
	Min	Max			Min	A (Max)	B	C $\pm .005$ (.13)	D $\pm .010$ (.25)	E $\pm .010$ (.25)	S		
											Depth $\pm .005$ (.13)	Width $\pm .005$ (.13)	Length $\pm .005$ (.13)
PC21J1R2	pF .3	pF 1.2	5,000	pF .02	.240 (6.10)	.094 (2.39)	.075 (1.90)	.082 (2.08)	.014 (.36)	.020 (.51)	.010 (.25)	.045 (1.14)	
PC21J2R5	.4	2.5	4,000	.02	.240 (6.10)	.140 (3.56)	.118 (3.00)	.082 (2.08)	.014 (.36)	.018 (.46)	.015 (.38)	.075 (1.90)	
PC21J4R5	.6	4.5	3,000	.02	.329 (8.36)	.140 (3.56)	.118 (3.00)	.130 (3.30)	.034 (.86)	.018 (.46)	.015 (.38)	.075 (1.90)	
PC21K080	.8	8.0	1,500	.04	.495 (12.57)	.140 (3.56)	.118 (3.00)	.250 (6.35)	.036 (.91)	.018 (.46)	.015 (.38)	.075 (1.90)	



NOTE:

Unless otherwise specified, tolerance is $\pm .016$ (.41 mm).

FIGURE 402-2. Piston-type tubular trimmer variable capacitors - Continued.

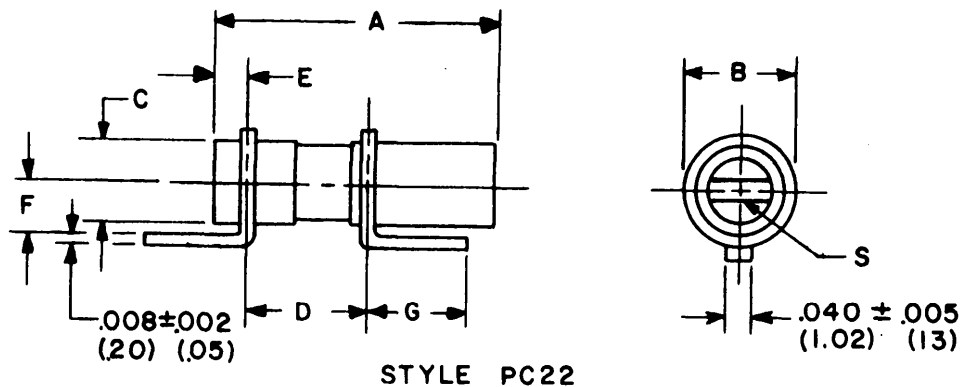
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STANDARD CAPACITORS

STYLE PC22 (MIL-C-14409/16)

OPERATING TEMPERATURE RANGE -55°C TO +125°C -- DC RATED VOLTAGE 500 VOLTS --
 TEMPERATURE COEFFICIENT 0 ± 50 PPM/°C AND 0 ± 75 PPM/°C

Type designation	Capacitance range		Q Min	Capacitance drift	Dimensions									
	Min	Max			A (Max)	B	C $\pm .005$ (.13)	D $\pm .010$ (.25)	E $\pm .010$ (.25)	F	G	S		
												Depth $\pm .005$ (.13)	Width $\pm .005$ (.13)	Length $\pm .005$ (.13)
PC22J1R2	.3	1.2	5,000	.02	.240 (6.10)	.094 (2.39)	.075 (1.90)	.082 (2.08)	.014 (.36)	.047 (1.19)	.183 (4.65)	.020 (.51)	.010 (.25)	.045 (1.14)
PC22J2R5	.4	2.5	4,000	.02	.240 (6.10)	.140 (3.56)	.118 (3.00)	.082 (2.08)	.014 (.36)	.070 (1.78)	.160 (4.06)	.018 (.46)	.015 (.38)	.075 (1.90)
PC22J4R5	.6	4.5	3,000	.02	.329 (8.36)	.140 (3.56)	.118 (3.00)	.130 (3.30)	.034 (.86)	.070 (1.78)	.160 (4.06)	.018 (.46)	.015 (.38)	.075 (1.90)
PC22K080	.8	8.0	1,500	.04	.495 (12.57)	.140 (3.56)	.118 (3.00)	.250 (6.35)	.036 (.91)	.070 (1.78)	.160 (4.06)	.018 (.46)	.015 (.38)	.075 (1.90)



NOTE:

Unless otherwise specified, tolerance is $\pm .016$ (.41 mm).

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors - Continued.

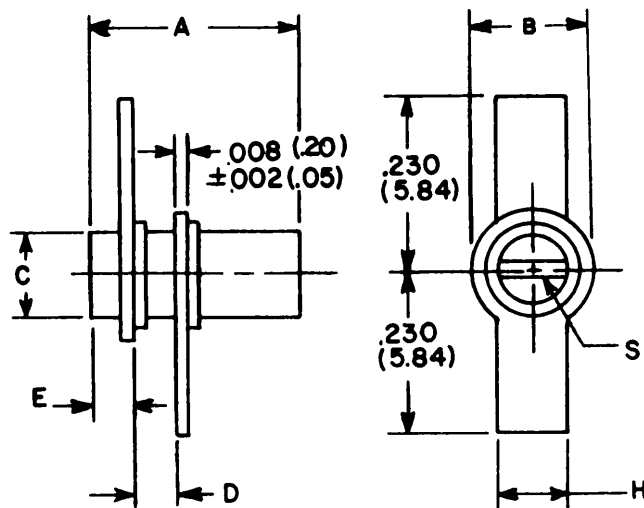
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STANDARD CAPACITORS

STYLE PC23 (MIL-C-14409/16)

OPERATING TEMPERATURE RANGE -55°C TO +125°C -- DC RATED VOLTAGE 500 VOLTS --
 TEMPERATURE COEFFICIENT 0 ±50 PPM/°C AND 0 ±75 PPM/°C

Type designation	Capacitance range		Q	Capacitance drift	Dimensions								
	Min	Max			A	B	C	D	E	H	S		
											Depth	Width	Length
			Min		(Max)			±.005 (.13)	±.010 (.25)	±.010 (.25)	±.005 (.13)	±.005 (.13)	±.005 (.13)
PC23J1R2	.3	1.2	5,000	.02	.240 (6.10)	.094 (2.39)	.075 (1.90)	.056 (1.42)	.018 (.46)	.040 (1.02)	.020 (.51)	.010 (.25)	.045 (1.14)
PC23J2R5	.4	2.5	4,000	.02	.240 (6.10)	.140 (3.56)	.118 (3.00)	.056 (1.42)	.018 (.46)	.093 (2.36)	.018 (.46)	.015 (.38)	.075 (1.90)
PC23J4R5	.6	4.5	3,000	.02	.329 (8.36)	.140 (3.56)	.118 (3.00)	.060 (1.52)	.060 (1.52)	.093 (2.36)	.018 (.46)	.015 (.38)	.075 (1.90)
PC23K080	.8	8.0	1,500	.04	.495 (12.57)	.140 (3.56)	.118 (3.00)	.05 (1.3)	.148 (3.76)	.093 (2.36)	.018 (.46)	.015 (.38)	.075 (1.90)



NOTE:

Unless otherwise specified, tolerance is ±.016 (.41 mm).

FIGURE 402-2. Piston-type tubular trimmer variable capacitors - Continued.

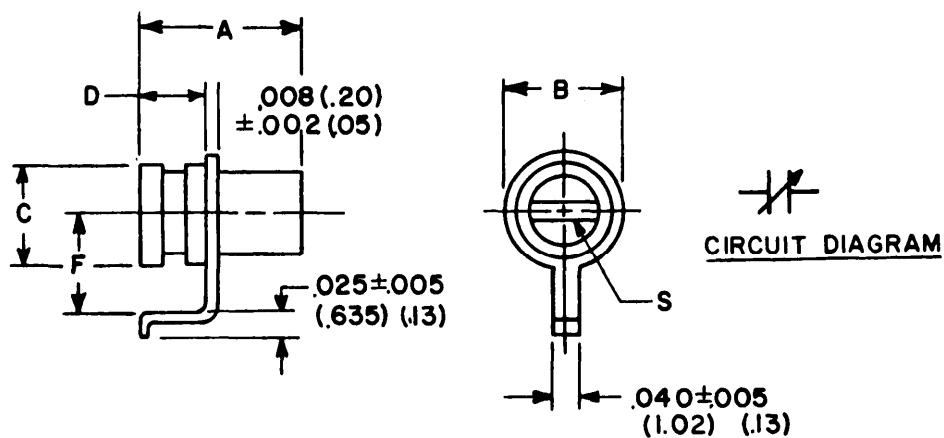
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC24 (MIL-C-14409/16)

OPERATING TEMPERATURE RANGE -55°C TO +125°C -- DC RATED VOLTAGE 500 VOLTS --
 TEMPERATURE COEFFICIENT 0 ±50 PPM/°C AND 0 ± 75°C

Type designation	Capacitance range		Q	Capacitance drift	Dimensions								
	Min	Max			Min	A (Max)	B	C ±.005 (.13)	D ±.010 (.25)	F	S		
											Depth ±.005 (.13)	Width ±.005 (.13)	Length ±.005 (.13)
PC24J1R2	.3	1.2	5,000	.02	.240 (6.10)	.094 (2.39)	.075 (1.90)	.09 (2.3)	.075 (1.90)	.020 (.51)	.010 (.25)	.045 (1.14)	
PC24J2R5	.4	2.5	4,000	.02	.240 (6.10)	.140 (3.56)	.118 (3.00)	.09 (2.3)	.110 (2.79)	.018 (.46)	.015 (.38)	.075 (1.90)	
PC24J4R5	.6	4.5	3,000	.02	.329 (8.36)	.140 (3.56)	.118 (3.00)	.16 (4.1)	.110 (2.79)	.018 (.46)	.015 (.38)	.075 (1.90)	
PC24K080	.8	8.0	1,500	.04	.495 (12.57)	.140 (3.56)	.118 (3.00)	.25 (6.4)	.110 (2.79)	.018 (.46)	.015 (.38)	.075 (1.90)	



NOTE:

Unless otherwise specified, tolerance is ±.016 (.41 mm).

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors - Continued.

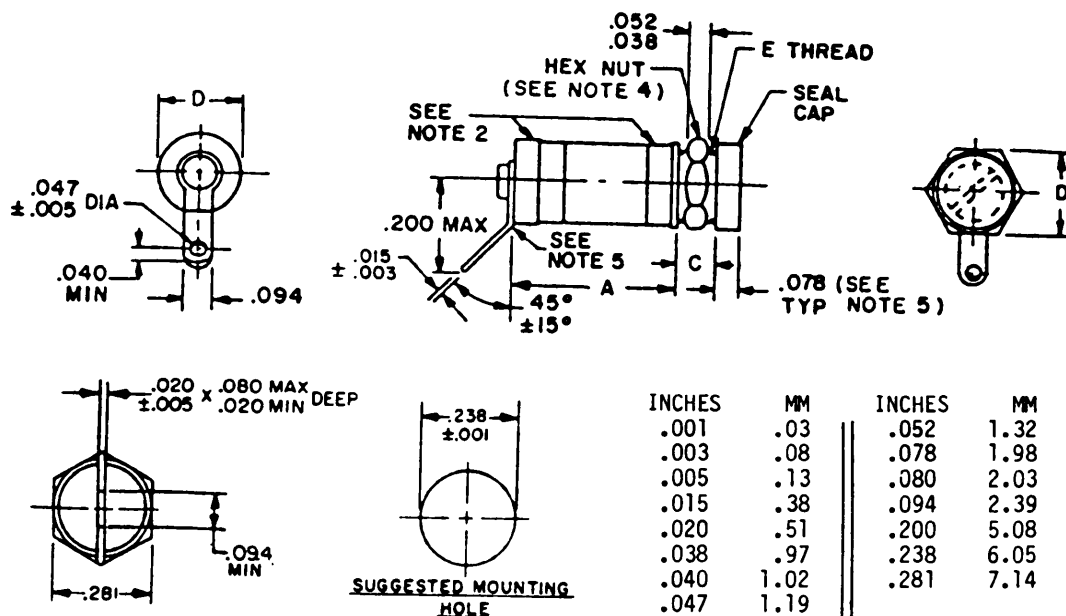
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STANDARD CAPACITORS

STYLE PC25 (MIL-C-14409/12)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- DC RATED VOLTAGE 250 VOLTS --
 TEMPERATURE COEFFICIENT ± 50 PPM/°C

Type designation	Capacitance range		Q Min	Dimensions				
	Min	Max		A	B	C	D	E
	pF	pF		$\pm .020$ (.51)	$\pm .020$ (.51)	$\pm .016$ (.41)		
PC25J060	0.6	6.0	10,000	.281 (7.14)	.203 (5.16)	.141 (3.58)	.220 (5.59)	.190-64 UNS-2A
PC25J100	0.8	10.0	5,000	.288 (7.32)	.196 (4.98)	.118 (3.00)	.281 (7.14)	.234-64 UNS-2A
PC25J140	1.0	14.0	3,000	.288 (7.32)	.196 (4.98)	.125 (3.18)	.281 (7.14)	.234-64 UNS-2A
PC25J200	1.0	20.0	1,500	.500 (12.70)	.196 (6.15)	.125 (4.17)	.281 (7.14)	.234-64 UNS-2A



NOTES:

- Unless otherwise specified, tolerance is $\pm .016$ (.41 mm).
- Solder if used, shall be high temperature solder having a melting point of 300°C +50°C -5°C.
- Bend-point of terminal at turret shall be within the radius of the turret cap; for style PC25T060, terminal may be perpendicular to body, .225 inches (5.72 mm) maximum length.
- Round nut shall be furnished on parts with .190-64 thread.
- Seal cap shall be .062 (1.57 mm) typical for parts with .190-64 thread.

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors - Continued.

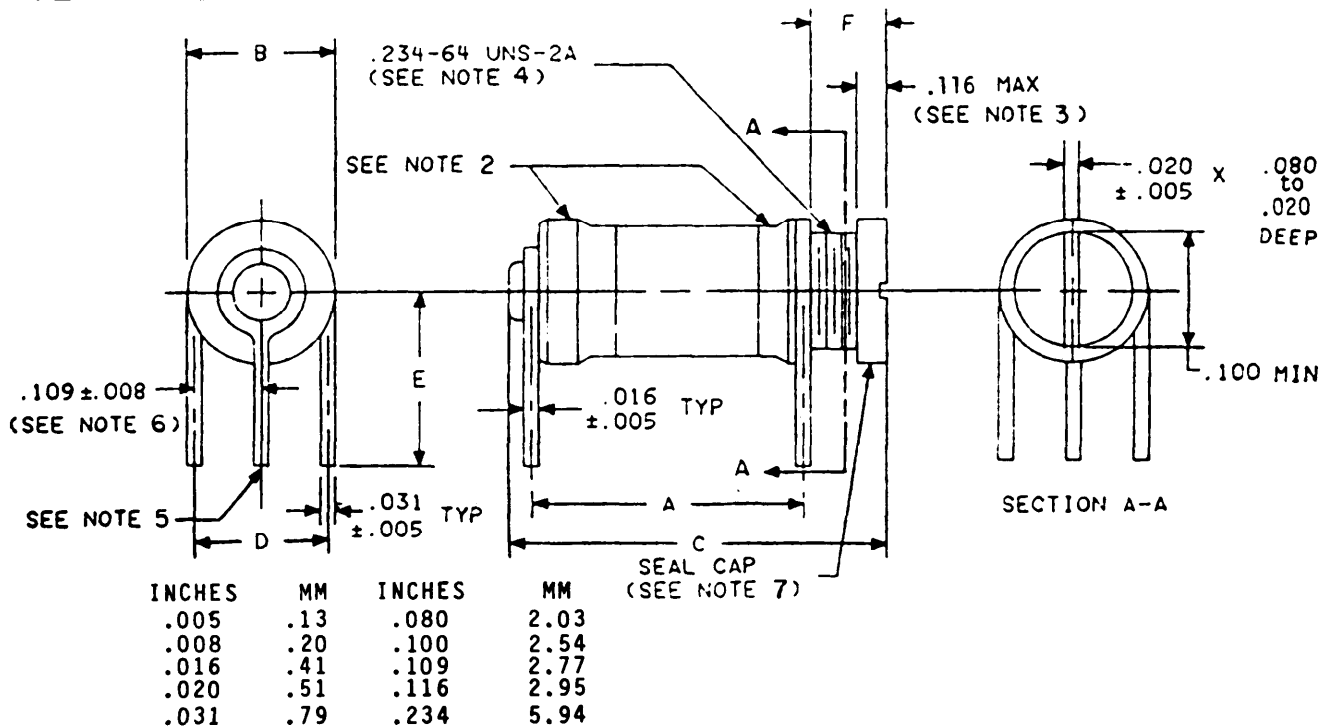
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC26 (MIL-C-14409/13)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- DC RATED VOLTAGE 250 VOLTS --
 TEMPERATURE COEFFICIENT ± 50 PPM/°C AND ± 20 PPM/°C

Type designation	Capacitance range		Q Min	Dimensions					
	Min	Max		A	B	C	D	E	F
				$\pm .025$ (.64)		max			
PC26J060	0.6	6.0	10,000	.266 (6.76)	.220 (5.59)	.541 (13.74)	.156 (3.96)	.250 (6.35)	.240 (6.10)
PC26T100	0.8	10.0	5,000	.297 (7.54)	.281 (7.14)	.578 (14.68)	.219 (5.56)	.312 (7.92)	.211 (5.36)
PC26T140	1.0	14.0	3,000	.297 (7.54)	.281 (7.14)	.578 (14.68)	.219 (5.56)	.500 (12.70)	.218 (5.54)
PC26T200	1.0	20.0	1,500	.562 (14.27)	.281 (7.14)	.801 (20.35)	.219 (5.56)	.500 (12.70)	.196 (4.98)
PC26J300	1.0	30.0	800	.750 (19.05)	.281 (7.14)	.969 (24.61)	.219 (5.56)	.500 (12.70)	.196 (4.98)



NOTES:

1. Unless otherwise specified, tolerance is $\pm .016$ (.41 mm).
2. If solder is used, the soldering of the turret cap to the cylinder, and of the cylinder to the base and to the base leads shall be accomplished with a high temperature solder having a melting point of 300°C +50°C, -5°C.
3. For type PC26J060, dimension shall be $.094 \pm .005$ (2.39 mm \pm .13 mm).
4. For type PC26J060, thread shall be .190-64 UNS-2A.
5. For type PC26J300 two terminals shall be used of same size and length as front terminals.
6. For type PC26J060, dimension shall be $.078 \pm .008$ (1.95 \pm .20 mm).
7. Seal cap shall be slotted.

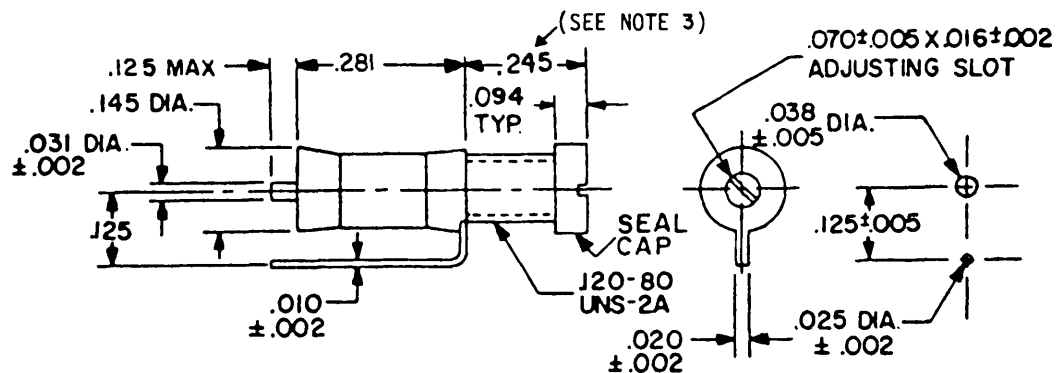
FIGURE 402-2. Piston-type tubular trimmer, variable capacitors - Continued.

STANDARD CAPACITORS

STYLE PC30 (MIL-C-14409/15)

OPERATING TEMPERATURE RANGE -55° TO $+125^{\circ}\text{C}$ -- DC RATED TO 250 VOLTS --
 TEMPERATURE COEFFICIENT ± 50 PPM/ $^{\circ}\text{C}$

Type designation	Capacitance range		Q Min
	Min	Max	
	<u>pF</u>	<u>pF</u>	
PC30J3R5	0.6	3.5	10,000
PC30J5R0	0.6	5.0	7,500



INCHES	MM	INCHES	MM
.002	.05	.070	1.78
.005	.13	.094	2.39
.010	.25	.120	3.05
.016	.41	.125	3.18
.020	.51	.145	3.68
.025	.64	.245	6.22
.031	.79	.281	7.14
.038	.97		

NOTES:

1. Unless otherwise specified, tolerance is $\pm .016$.
2. Seal cap shall be slotted.
3. For type PC30J5R0, this dimension shall be .280 (7.11).

FIGURE 402-2. Piston-type tubular trimmer variable capacitors - Continued.

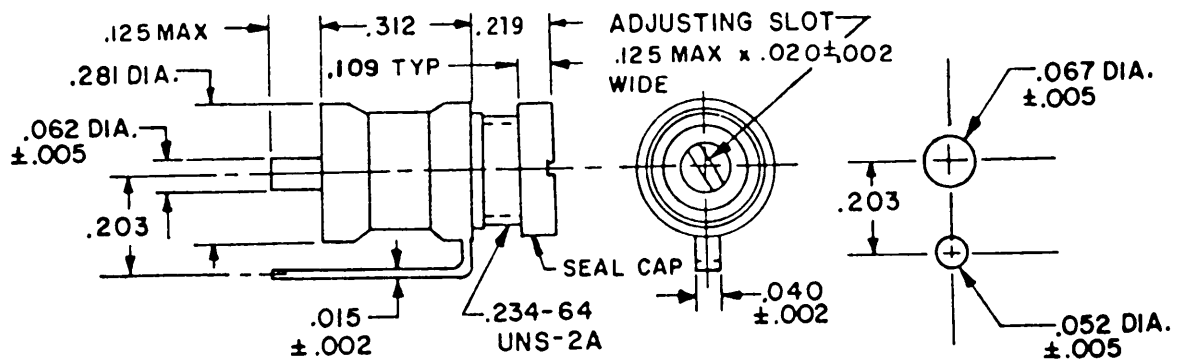
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC32

OPERATING TEMPERATURE RANGE -55° TO $+125^{\circ}\text{C}$ -- DC RATED TO 250 VOLTS --
 TEMPERATURE COEFFICIENT ± 20 PPM/ $^{\circ}\text{C}$

Type designation	Capacitance range		Q Min
	Min	Max	
PC32T140	pF 1.5	pF 14.0	3,000



INCHES	MM	INCHES	MM
.002	.05	.109	2.77
.005	.13	.125	3.18
.015	.38	.203	5.17
.020	.51	.219	5.56
.040	1.02	.234	6.22
.052	1.32	.281	7.14
.062	1.57	.312	7.92
.067	1.70		

NOTES:

1. Unless otherwise specified, tolerance is $\pm .016$ (.41).
2. Seal cap shall be slotted.

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors - Continued.

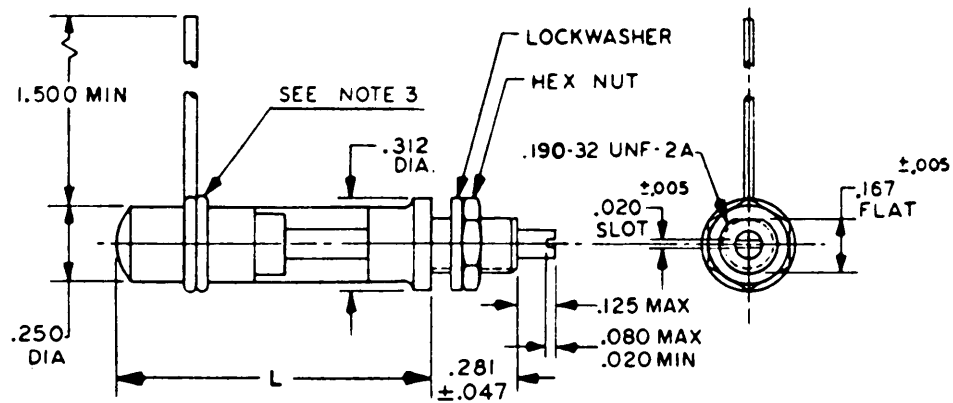
MIL-STD-198E

STANDARD CAPACITORS

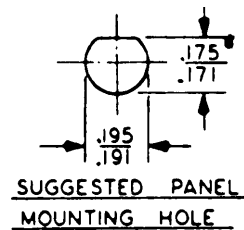
STYLES PC38 AND PC48

OPERATING TEMPERATURE RANGE -55° TO + 150° C (PC38) AND -55° TO + 125° C (PC48)

Style	Capacitance		DC rated voltage	Q	Temperature coefficient	Capacitance drift	Dimension	Wire size (AWG)
	Min	Max					L ± .031 (.79 mm)	
	pF	pF	Volts		ppm/° C	pF	Inches	
PC38	.6	1.8	750	1,500	+50, -0	.01	.359 (9.12)	24
	.6	5.5	1,250	1,500	+50, -0	.01	.625 (15.88)	22
	.6	9.5	1,250	1,500	+50, -0	.01	1.062 (26.97)	22
	.8	16.0	1,250	1,500	+50, -0	.01	1.656 (42.06)	22
PC48	.8	5.5	750	1,000	±50	.02	.359 (9.12)	24
	.8	11.0	1,250	900	±50	.02	.594 (15.09)	22
	.8	16.0	1,250	800	±100	.04	.812 (20.62)	22
	.8	23.0	1,250	700	±100	.04	1.062 (26.97)	22
	1.0	38.0	1,250	500	±100	.04	1.656 (42.06)	22



INCHES	MM	INCHES	MM
.005	.13	.175	4.45
.020	.51	.191	4.85
.047	1.19	.195	4.95
.080	2.03	.250	6.35
.125	3.18	.281	7.14
.167	4.24	.312	7.92
.171	4.34	1.500	38.10



NOTES:

1. Unless otherwise specified, tolerance is ±.016 (.41 mm).
2. The flat on the mounting bushing extends to the mounting surface of the shoulder.
3. There are a minimum of one and one-half turns of wire around the body. These turns of wire are completely soldered to the body.

FIGURE 402-2. piston-type, tubular trimmer, variable capacitors - Continued.

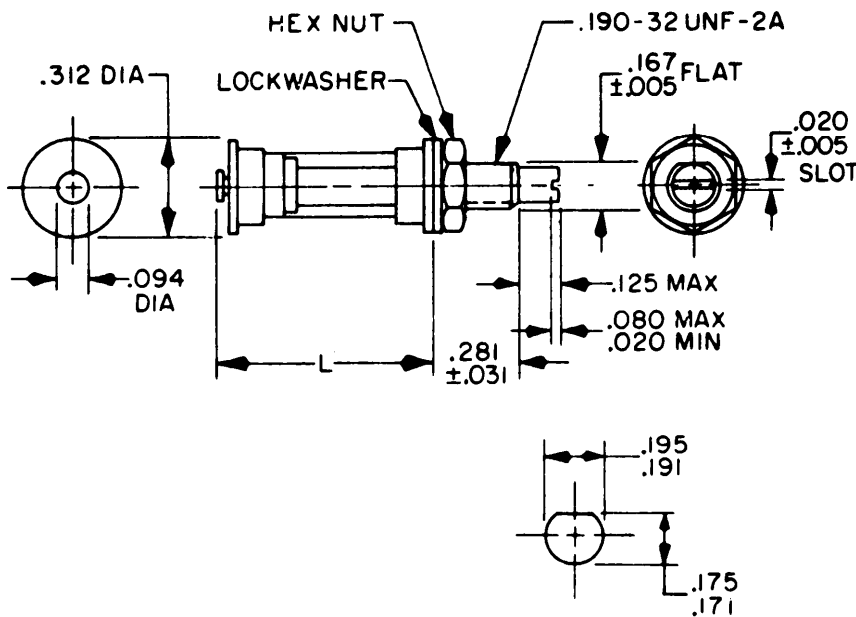
MI L-STD-198E

STANDARD CAPACITORS

STYLE PC39

OPERATING TEMPERATURE RANGE -55° TO + 125°C -- DC RATED VOLTAGE 1,000 VOLTS

Capacitance		Q (Min)	Dimension	Temperature coefficient
Minimum	Maximum		L ± .031 (.79 mm)	
pF	pF		Inches	ppm/°C
1.0	16	750	.469 (11.91)	±150
1.0	36	550	.703 (17.86)	±150
1.0	52	350	.922 (23.42)	±150
1.0	75	250	1.172 (29.77)	±150
1.0	120	250	1.766 (44.86)	±50



INCHES	MM
.005	.13
.020	.51
.031	.79
.080	2.03
.094	2.39
.125	3.18
.167	4.24
.171	4.34
.175	4.45
.191	4.85
.195	4.95
.281	7.14
.312	7.92

SUGGESTED PANEL MOUNTING HOLE

NOTES:

1. Unless otherwise specified, tolerance is ±.016 (.41 mm).
2. The flat on the mounting bushing extends to the mounting surface or the shoulder.
3. The turret cap is soldered to the cylinder with high temperature solder having a minimum melting point of 232°C.

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors - Continued.

402 (MI L-C-14409)

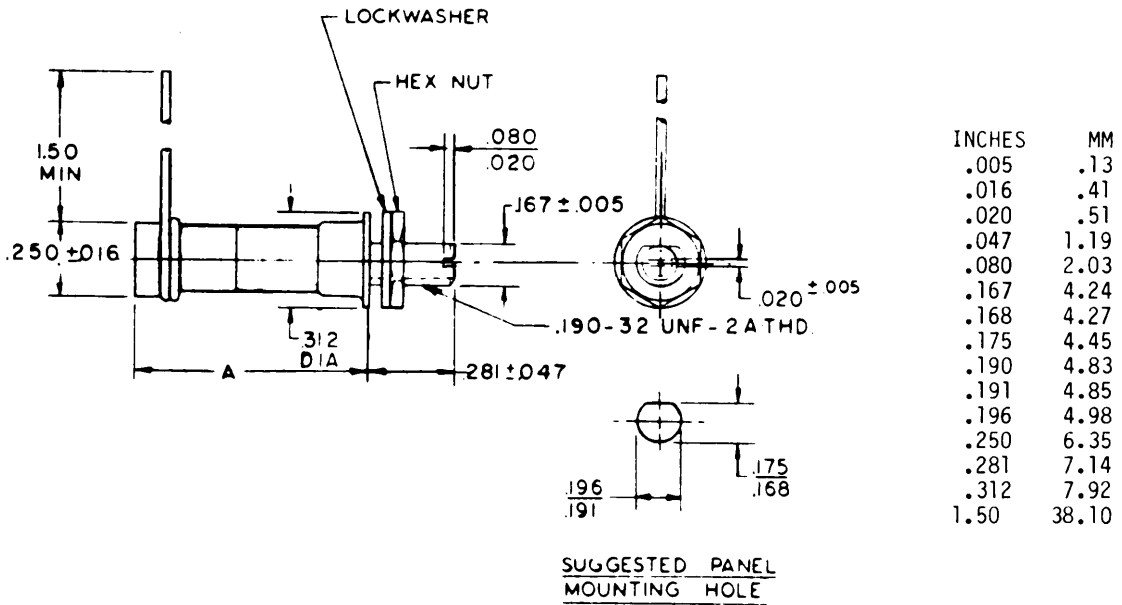
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC40

OPERATING TEMPERATURE RANGE -55° TO +150°C -- DC RATED VOLTAGE 750 VOLTS --
 TEMPERATURE COEFFICIENT +50, -0

Type designation	Capacitance		Dimension A +.047, -.031 (+1.19, -.79)	Q
	Min	Max		
	pF	pF		
PC40Q1R5	0.6	1.8	.297 (7.54)	1,500
PC40Q5R5	0.6	5.5	.547 (13.89)	1,500
PC40Q9R5	0.6	9.5	.984 (24.99)	1,500
PC40Q160	0.8	16.0	1.594 (40.49)	1,500



NOTE: Unless otherwise specified, tolerance is ±.016 (.41 mm).

FIGURE 502-2. Piston type, tubular trimmer, variable capacitors - Continued.

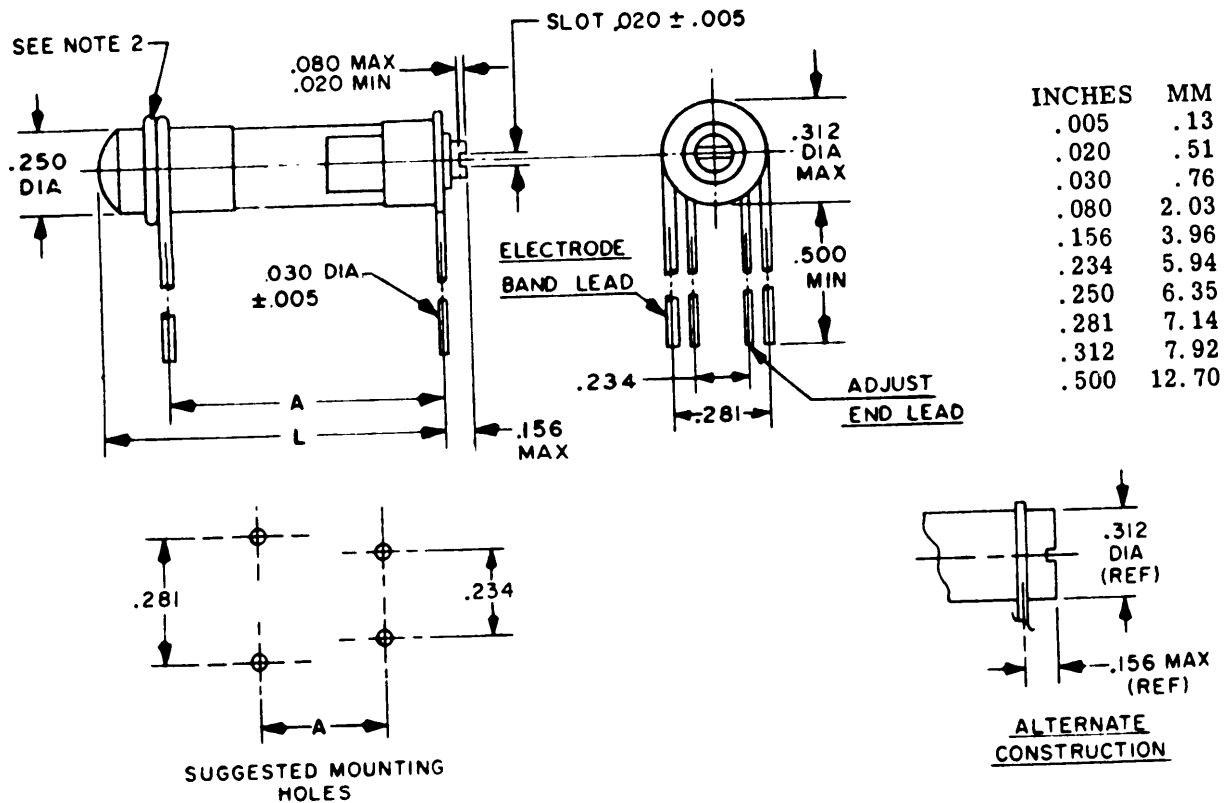
MI L-STD-198E

STANDARD CAPACITORS

STYLES PC42 AND PC52

OPERATING TEMPERATURE RANGE -55° TO + 150° C (PC42) AND -55° TO +125° C (PC52)

Style	Capacitance		DC rated voltage	Q	Temperature coefficient	Capacitance drift	Dimensions		Wire size (AWG)
	Min	Max					A ± .031 (.79)	L (max)	
	pF	pF	Volts		ppm/° C	pF	Inches	Inches	
PC42	.6	1.8	750	1,500	+50, -0	.01	.500 (12.70)	.656 (16.66)	24
	.6	5.5	1,250	1,500	+50, -0	.01	.703 (17.86)	.922 (23.42)	22
	.6	9.5	1,250	1,500	+50, -0	.01	1.016 (25.81)	1.359 (34.52)	22
	.8	16.0	1,250	1,500	+50, -0	.01	1.469 (37.31)	1.953 (49.61)	22
PC52	.8	5.5	750	1,000	±50	.02	.500 (12.70)	.656 (16.66)	24
	.8	11.0	1,250	900	±50	.02	.703 (17.86)	.906 (23.07)	22
	.8	16.0	1,250	800	±100	.04	.844 (21.44)	1.109 (28.17)	22
	.8	23.0	1,250	700	±100	.04	1.016 (25.81)	1.359 (34.52)	22
	.8	38.0	1,250	500	±100	.04	1.469 (37.31)	1.953 (49.61)	22



NOTES:

1. Unless otherwise specified, tolerance is ±.016 (.41 mm).
2. There are a minimum of one and one-half turns of wire around the body. These turns of wire are completely soldered to the body.
3. This style capacitor is designed for printed-circuit mounting.

FIGURE 402-2. Piston-type, tubular trimmer, variable capacitors - Continued.

402 (MI L-C-14409)

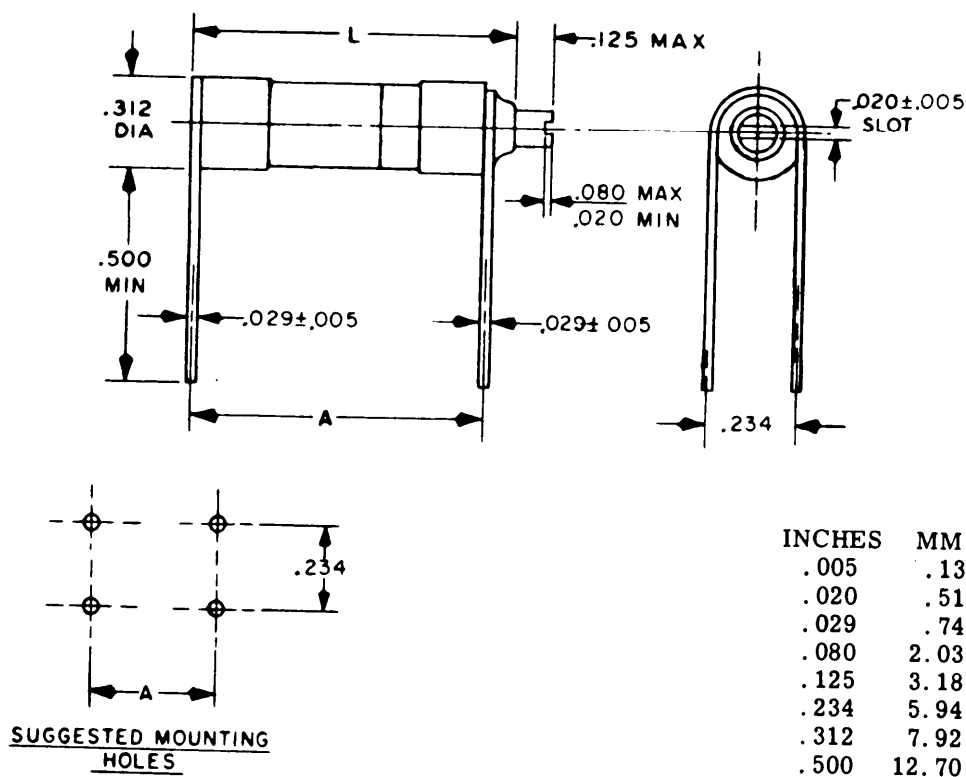
MIL-STD-198E

STANDARD CAPACITORS

STYLE PC43

OPERATING TEMPERATURE RANGE -55° TO +125°C -- DC RATED VOLTAGE 1,000 VOLTS

Capacitance		Dimensions		Q (Min)	Temperature coefficient
Minimum	Maximum	L ± .062 (1.57)	A ± .062 (1.57)		
pF	pF	Inches	Inches		ppm/°C
1.0	16.0	.734 (18.64)	.688 (17.48)	750	±150
1.0	36.0	.969 (24.61)	.922 (23.42)	550	±150
1.0	52.0	1.188 (30.18)	1.141 (28.98)	350	±150
1.0	75.0	1.422 (36.12)	1.375 (34.93)	250	±150
1.0	120.0	2.031 (51.59)	1.984 (50.39)	250	±50



NOTES:

1. Unless otherwise specified, tolerance is ±.016(.41 mm).
2. This style capacitor is designed for printed-circuit mounting.

FIGURE 402-2. Piston-type tubular trimmer variable capacitors - Continued.

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SECTION 500

CAPACITORS, VARIABLE, GAS OR VACUUM DIELECTRIC

Section

Applicable specification

501. Capacitors, Variable, Gas or Vacuum Dielectric,
Ceramic Envelope- - - - -

MIL-C-23183

MIL-STD-198E

SECTION 501

CAPACITORS, VARIABLE, GAS OR VACUUM DIELECTRIC, ENVELOPE
STYLE CG60

(APPLICABLE SPECIFICATION: MIL-C-23183)

1. SCOPE. This section covers gas or vacuum dielectric, variable capacitors
2. APPLICATION INFORMATION.

2.1 Use. These capacitors are intended for use in high voltage applications. The voltage indicated for capacitors in this section is the 60-hertz test voltage at maximum capacity. This is the absolute safe maximum voltage the unit will withstand before breakdown occurs. The breakdown voltage is greater at capacities less than maximum, becoming as much as 300 percent greater at minimum capacity for lower voltage units. The breakdown voltage at radiofrequencies is the same for low frequencies up to about 2.5 megahertz (MHz), and becomes about 10 percent lower at 30 MHz. The continuous duty operating voltage of these capacitors is dependent on the frequency involved, (lower for high frequency), the percentage of the capacitor in use, and the duty cycle. The continuous duty rf rating of these capacitors is arbitrarily defined as that voltage and current that will bring the unit up to a steady 85°C without cooling. These capacitors will operate safely at a uniform temperature as high as 125 C and may be operated even higher under special conditions. It can be seen that the rating is quite conservative. The rating can further be increased by additional cooling such as blowers, large conductors to act as heat sinks, water cooling, etc. For example, water-cooled variables are available with current ratings that are four times normal. Care must be observed not to apply excessive strain on units by the use of large conductors. Forced-air cooling must be applied uniformly to prevent heat strains. The dissipation factor is very low, due to the dielectric and the heavy copper construction. The dielectric has very low losses even at very high frequencies. The heavy copper construction minimizes stray inductance and provides an excellent heat sink. Due to their low losses, and high heat dissipating capabilities, these capacitors will handle exceptionally high continuous currents at very high frequencies. Due to their rugged construction, they will withstand repeated heavy current overloads for short duty cycles, as long as the peak voltage is not exceeded. At high frequencies and high capacities, due to the low capacitive reactance, the continuous duty current will usually be reached at a voltage below the maximum rated voltage. Likewise at low frequencies and low capacities, due to the capacitive reactance, the maximum voltage will often be reached before the rated current.

2.2 Capacitance change versus rotation. The capacitance change versus rotation is shown in figure 501.1.

3. ITEM IDENTIFICATION (see figures 501-2 and 501-3).

3.1 Type designation. The type designation is used for identifying and describing the capacitors as shown in figure 501-2.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 501-3.

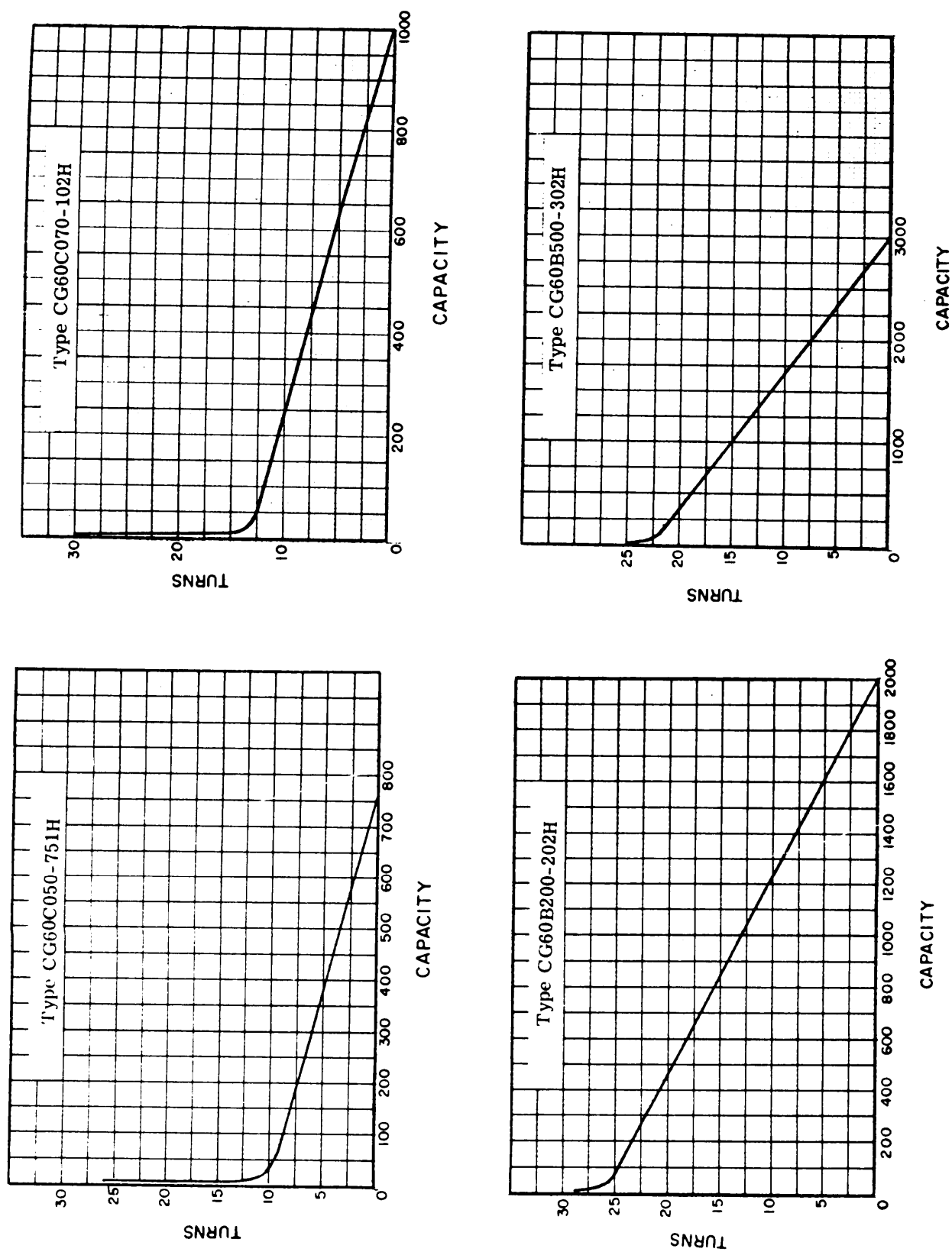
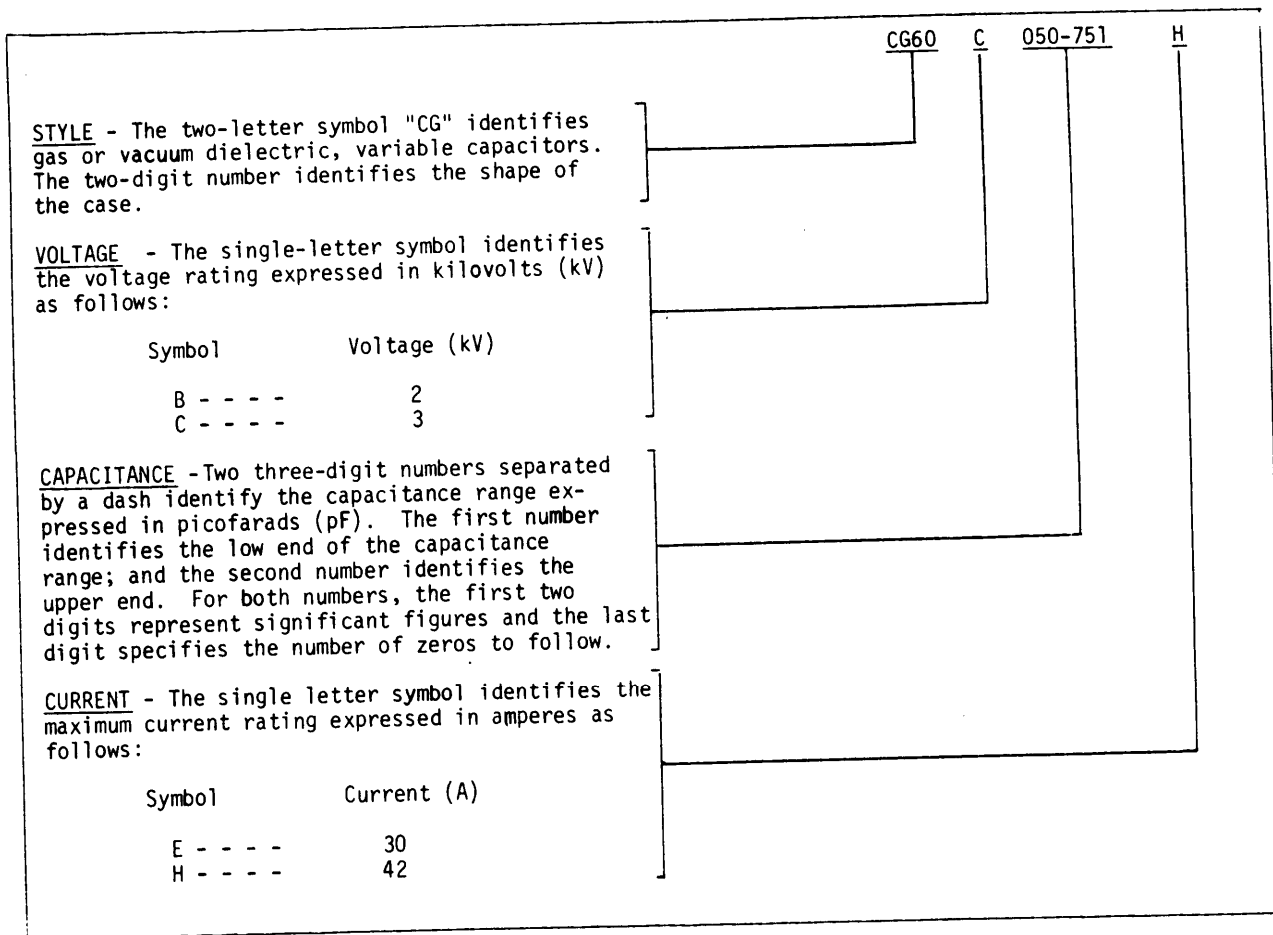


FIGURE 501.1. Capacitance versus rotation.

MI L-STD-198E

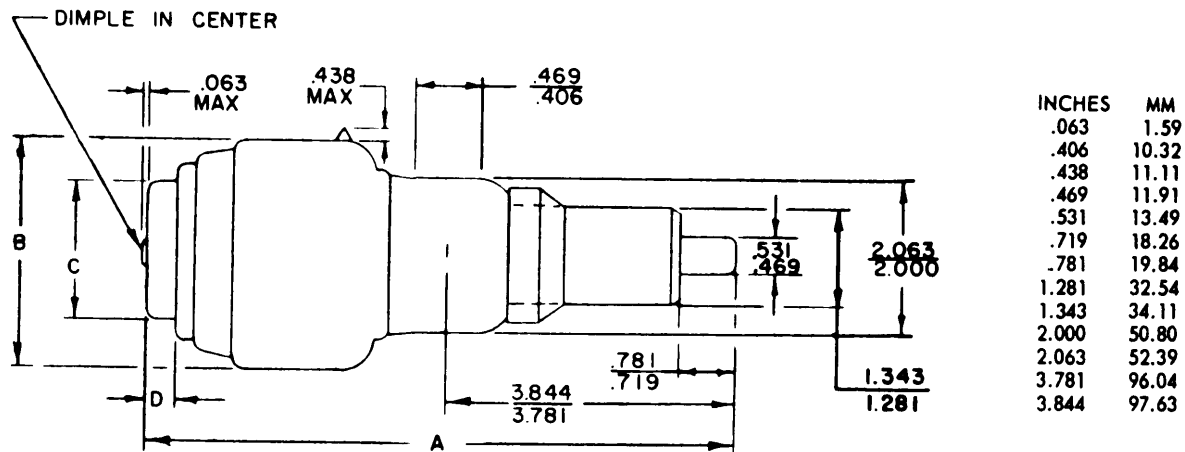
FIGURE 501-2. Type designation example.

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STANDARD CAPACITORS

STYLE CG60 (MIL-C-23183/5)

OPERATING TEMPERATURE RANGE -55° TO + 85° C -- RATED CURRENT 42 AMPERES RMS



Type designation	Voltage peak	Capacitance range	Dimensions							
			A		B		C		D	
			Min	Max	Min	Max	Min	Max	Min	Max
CG60C050-751H	3	5-750	7.500 (190.50)	8.000 (203.20)	2.938 (74.61)	3.063 (77.79)	1.781 (45.24)	1.844 (46.83)	.344 (8.73)	.406 (10.32)
CG60C070-102H	3	7-1,000	7.438 (188.91)	7.938 (201.61)	2.938 (74.61)	3.063 (77.79)	1.781 (45.24)	1.844 (46.83)	.344 (8.73)	.406 (10.32)
CG60B200-202H	2	20-2,000	8.063 (204.79)	8.438 (214.31)	2.938 (74.61)	3.063 (77.79)	2.000 (50.80)	2.063 (52.89)	.344 (8.73)	.406 (10.32)
CG60B500-302H	2	50-3,000	8.000 (203.20)	8.375 (212.73)	3.438 (87.31)	3.563 (90.49)	2.000 (50.80)	2.063 (52.89)	.719 (18.26)	.781 (19.84)

FIGURE 501-3. Gas or vacuum dielectric, ceramic envelope, variable capacitors.

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SECTION 600

CAPACITORS, FIXED, GLASS AND MICA DIELECTRIC, ESTABLISHED RELIABILITY

Section

Applicable specification

601. Capacitors, Fixed, Glass Dielectric, Established Reliability-----	MIL-C-23269
602. Capacitors, Fixed, Mica Dielectric, Established Reliability-----	MIL-C-39001

MIL-STD-198E

SECTION 601

CAPACITORS, FIXED, GLASS DIELECTRIC, ESTABLISHED RELIABILITY
STYLES CYR10, CYR13, CYR15, CYR17, CYR20, CYR22, CYR30, CYR32, CYR41, CYR51,
CYR52, AND CYR53

(APPLICABLE SPECIFICATION: MIL-C-23269)

1. SCOPE. This section covers established reliability, glass dielectric, fixed capacitors enclosed in glass or vitreous enamel cases, suitably protected against environmental conditions. These capacitors have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on full rated voltage at +125° C.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are intended for use in any equipment where known orders of reliability required, and are primarily designed as a substitute for mica-dielectric capacitors as a step toward conservation of critical mica. They are effective substitutes for mica-dielectric capacitors and can be employed for many applications where mica-dielectric capacitors are used, provided consideration is given to the differences in temperature coefficient and dielectric loss. They are capable of withstanding environmental conditions of shock, vibration, acceleration, extreme moisture, vacuum, extended life of 30,000 hours and more, and high operating temperatures such as experienced in missile-borne and space electronic equipment.

2.2 Construction. Glass-dielectric capacitors are composed of alternate layers of glass ribbon and the electrode material. After assembly, the units are sealed together by high temperature and pressure to form a rugged monolithic block. Since the terminal leads are fused to the glass case, the seal cannot be broken without destroying the capacitor. Although these capacitors are of monolithic structure, they are not necessarily hermetically sealed since the coefficient of thermal expansion of the terminals does not match that of the case. These construction features add up to the following advantages:

- (a) Fixed temperature coefficient.
- (b) High insulation resistance.
- (c) Low dielectric absorption.
- (d) Readily used where miniaturization is demanded.
- (e) Ability to operate in environments involving high humidity and high temperatures.

2.2.1 Physical size. The physical size of the glass-dielectric capacitor is smaller than, or approximates very closely, the size of the "postage-stamp" type mica-dielectric capacitor.

2.3 Rated voltage. These capacitors are rated at 100, 300, or 500 volts depending upon capacitance value and style.

2.4 Operating temperature range. These units are suitable for operation over a temperature range of -55° to +125° C.

2.5 Temperature coefficient and capacitance drift. These capacitors are available in three temperature coefficients. For the axial-lead capacitors, the temperature coefficient is 140 +25 ppm/°C or 0 ±25 ppm/°C (for style CYR41). For the axial-radial lead capacitors, the temperature coefficient is 105 ±25 ppm/°C. The capacitance drift is ±0.1 percent or 0.1 pF, whichever is greater, for all capacitors.

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2.6 Shock. Glass capacitors are resistant to high G loads but they are susceptible to damage from mild mechanical shocks.

2.7 Q. Glass-dielectric capacitors exhibit a much higher Q over a wider capacitance range than mica-dielectric capacitors. (See figure 601-1.)

2.8 Failure-rate level determination. The curves presented on figure 601-2 are the best engineering approximation of the reliability characteristics (random failures) for these capacitors when employed repeatedly, within their specification ratings, in complex electronic equipment. These reliability characteristics are based on ground-level severity experience. Failures are considered to be opens, shorts, or radical departures from initial characteristics. The failures are considered to be occurring in an unpredictable manner and in too short a period of time to permit detection through normal preventive maintenance. The curves shown on figure 601-2 are based on "catastrophic failures" and will differ from the failure rates established in the specification, since the established failure rates are based on "parametric failures" over long term life tests at rated conditions. **As indicated, these curves are the best estimates based on "catastrophic failures";** however, they can provide an estimate of the relative effect of operating under conditions other than rated.

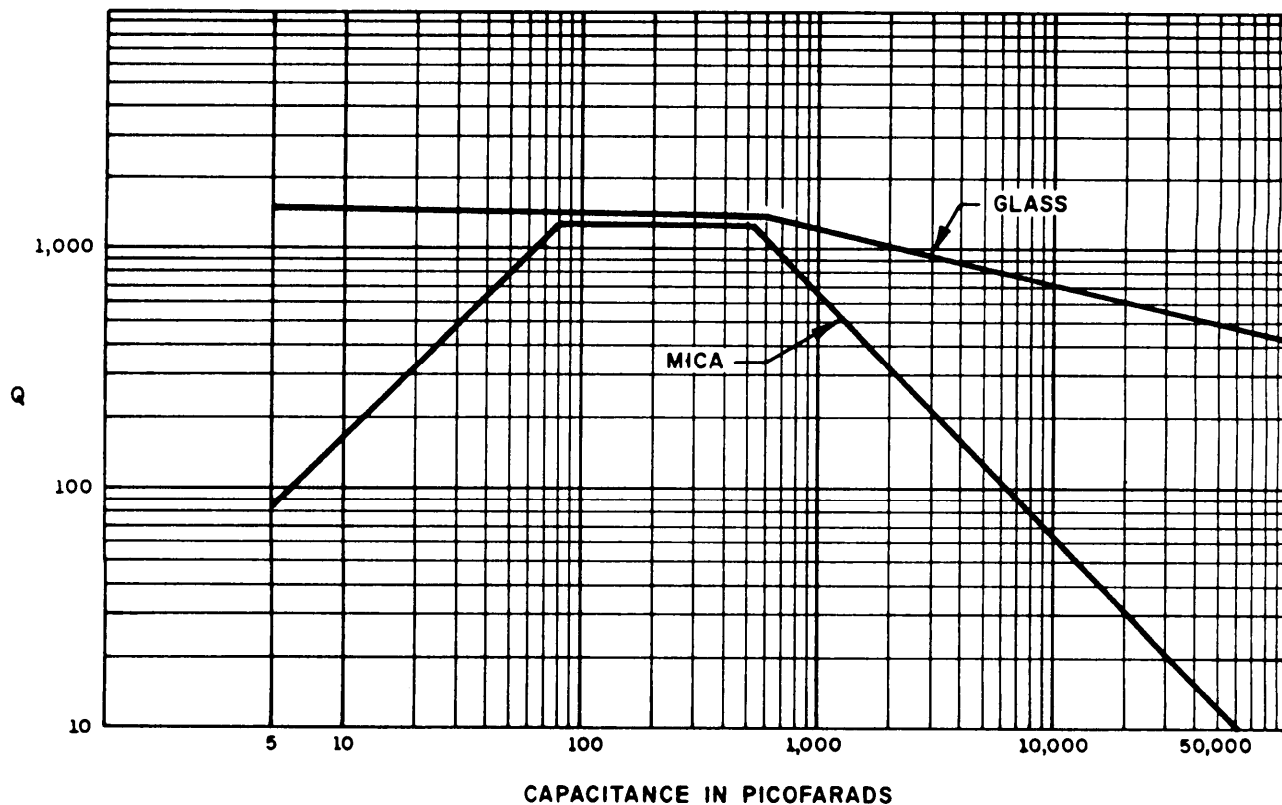


FIGURE 601-1. Capacitance and Q at 1MHz.

MIL-C-198E

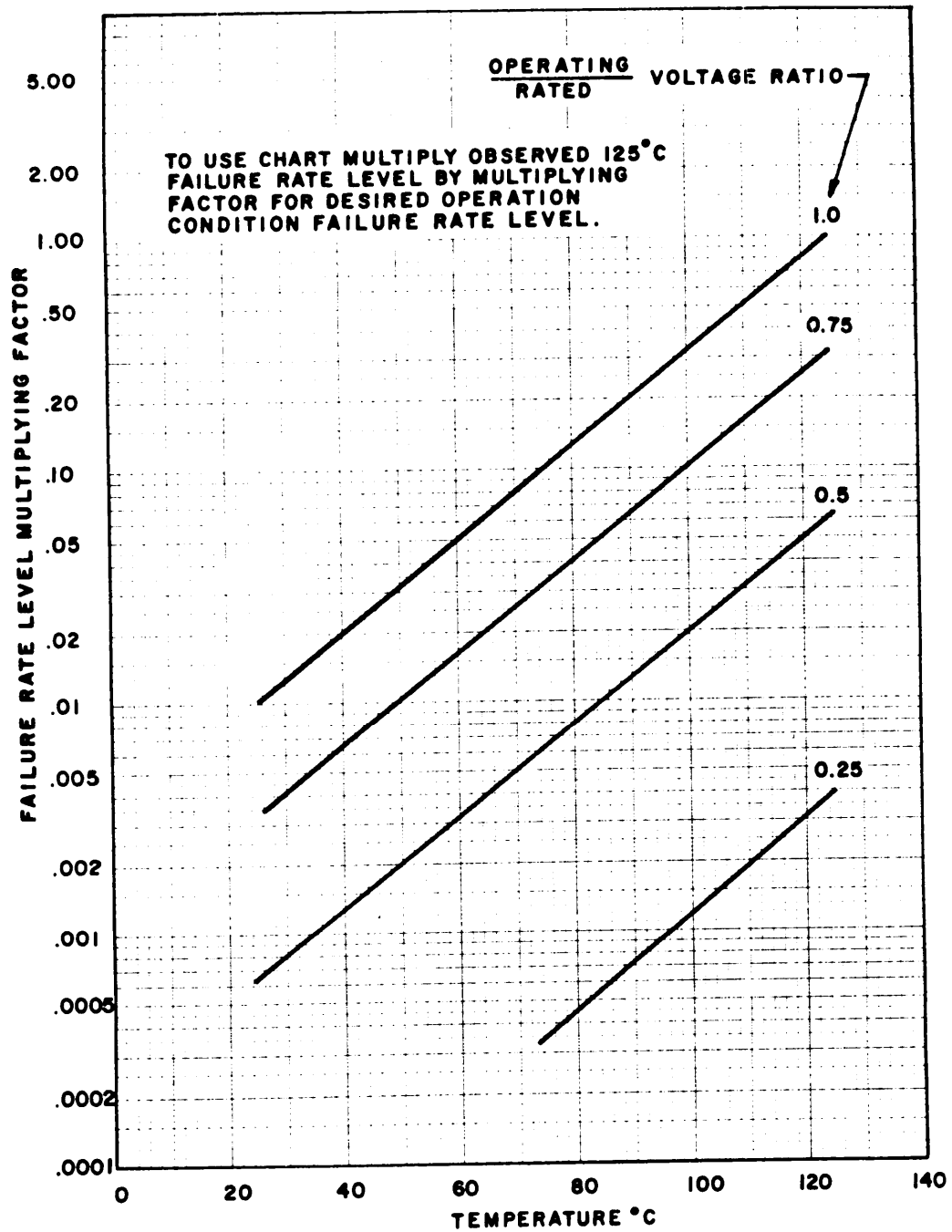


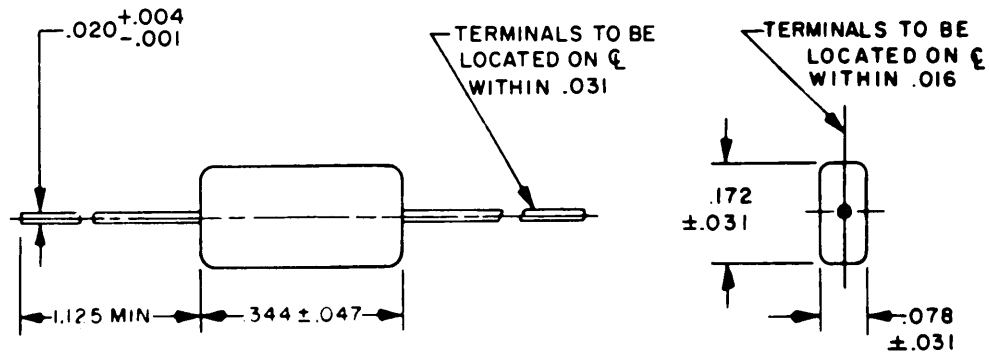
FIGURE 601-2. Failure rate level curves.

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3. ITEM IDENTIFICATION.

3.1 Standard capacitors. The standard capacitors available in this Section are shown in figure 601-3. (The figure gives the electrical characteristics, case sizes, failure rate levels, and Military part numbers of capacitors which are standard for design.)

STYLE CYR10



INCHES	MM
.001	.03
.004	.10
.016	.41
.020	.51
.031	.79
.047	1.19
.078	1.98
.172	4.37
.344	8.74
1.125	28.58

FIGURE 601-3. B Established reliability, glass dielectric, fixed capacitors.

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STANDARD CAPACITORS

STYLE CYR10 (MIL-C-23269/1)

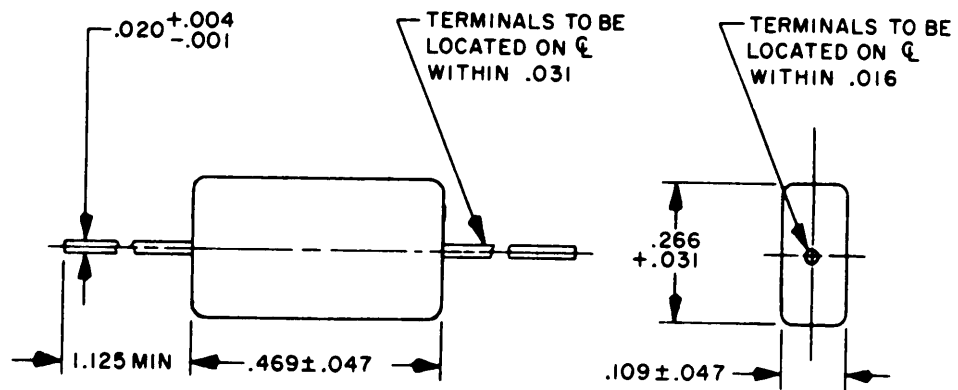
OPERATING TEMPERATURE RANGE -55° TO +125°C -- TEMPERATURE COEFFICIENT
 140 ± 25 PPM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/01-			
			FR level in %/1,000 hours			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
pF	volts, dc					
0.5	500	±0.25 pF	3001	4001	5001	6001
1.0	↑	±0.25 pF	3002	4002	5002	6002
1.5		±0.25 pF	3003	4003	5003	6003
2.2		±0.25 pF	3004	4004	5004	6004
2.7		±0.25 pF	3006	4006	5006	6006
3.3		±0.25 pF	3009	4009	5009	6009
3.6		±0.25 pF	3010	4010	5010	6010
3.9		±0.25 pF	3012	4012	5012	6012
4.7		±0.25 pF	3015	4015	5015	6015
5.6		±0.25 pF	3017	4017	5017	6017
5.6		±5%	3018	4018	5018	6018
6.8		±0.25 pF	3021	4021	5021	6021
6.8		±5%	3022	4022	5022	6022
8.2		±0.25 pF	3025	4025	5025	6025
8.2		±5%	3026	4026	5026	6026
10		±0.25 pF	3029	4029	5029	6029
10		±5%	3030	4030	5030	6030
12		±0.25 pF	3033	4033	5033	6033
12		±5%	3034	4034	5034	6034
15		±2%	3037	4037	5037	6037
15		±5%	3038	4038	5038	6038
18		±2%	3041	4041	5041	6041
18		±5%	3042	4042	5042	6042
22		±2%	3045	4045	5045	6045
22		±5%	3046	4046	5046	6046
27		±1%	3049	4049	5049	6049
27		±5%	3051	4051	5051	6051
33		±1%	3055	4055	5055	6055
33		±5%	3057	4057	5057	6057
39		±1%	3061	4061	5061	6061
39		±5%	3063	4063	5063	6063
47		±1%	3067	4067	5067	6067
47		±5%	3069	4069	5069	6069
56		±1%	3073	4073	5073	6073
56		±5%	3075	4075	5075	6075
68		±1%	3079	4079	5079	6079
68		±5%	3081	4081	5081	6081
82		±1%	3085	4085	5085	6085
82		±5%	3087	4087	5087	6087
100		±1%	3091	4091	5091	6091
100		±5%	3093	4093	5093	6093
120		±1%	3097	4097	5097	6097
120		±5%	3099	4099	5099	6099
150		±1%	3103	4103	5103	6103
150		±5%	3105	4105	5105	6105
180		±1%	3109	4109	5109	6109
180	500	±5%	3111	4111	5111	6111
220	300	±1%	3115	4115	5115	6115
220	300	±5%	3117	4117	5117	6117
270	300	±1%	3121	4121	5121	6121
270	300	±5%	3123	4123	5123	6123

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

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STYLE CYR15



INCHES	MM
.001	.03
.004	.10
.016	.41
.020	.51
.031	.79
.047	1.19
.109	2.77
.266	6.76
.469	11.91
1.125	28.58

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CYR15 (MIL-C-23269/2)

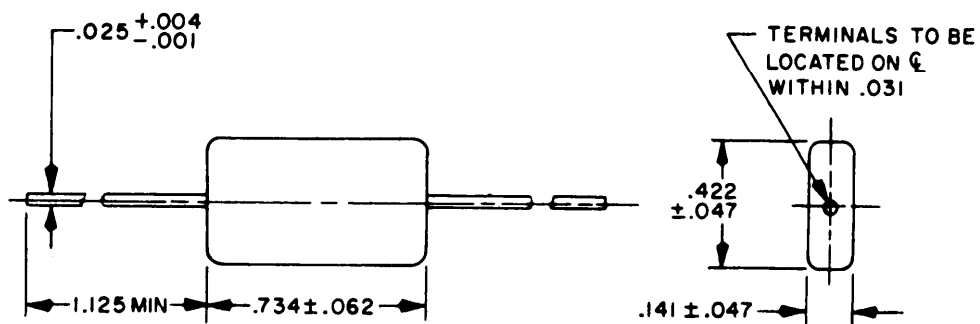
OPERATING TEMPERATURE RANGE -55° TO + 125°C -- TEMPERATURE COEFFICIENT
 140 ± 25 PPM/°C -- CAPACITANCE DRIFT 0. 1% OR 0. 1 PF, WHICHEVER IS GREATER

Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/02 - FR level in %/1,000 hours			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
<u>pF</u>	<u>volts, dc</u>					
270	500 ▲	±1%	3007	4007	5007	6007
270		±5%	3009	4009	5009	6009
330		±1%	3013	4013	5013	6013
330		±5%	3015	4015	5015	6015
390		±1%	3019	4019	5019	6019
390		±5%	3021	4021	5021	6021
470	▼	±1%	3025	4025	5025	6025
470	500	±5%	3027	4027	5027	6027
560	300	±1%	3031	4031	5031	6031
560	▲	±5%	3033	4033	5033	6033
680		±1%	3037	4037	5037	6037
680		±5%	3039	4039	5039	6039
820		±1%	3043	4043	5043	6043
820		±5%	3045	4045	5045	6045
1,000		±1%	3049	4049	5049	6049
1,000		±5%	3051	4051	5051	6051
1,200	▼	±1%	3055	4055	5055	6055
1,200	300	±5%	3057	4057	5057	6057

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

601 (MIL-C-23269)

STYLE CYR20



INCHES	MM
.001	.03
.004	.10
.025	.64
.031	.79
.047	1.19
.062	1.57
.141	3.58
.422	10.72
.734	18.64
1.125	28.58

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

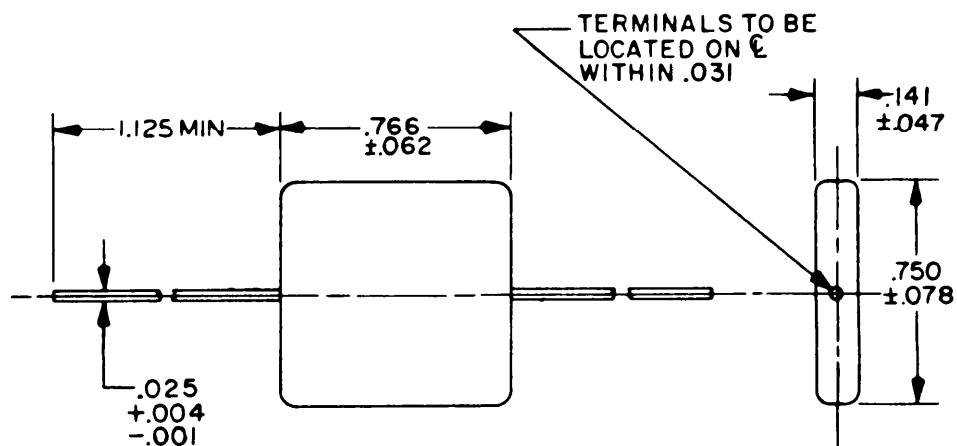
STYLE CYR20 (MIL-C-23269/3)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- TEMPERATURE COEFFICIENT
 140 ±25 PPM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/03 - FR level in %/1,000 hours			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
<u>pF</u>	<u>volts, dc</u>					
1,500	500	±1%	3031	4031	5031	6031
1,500	↑	±5%	3033	4033	5033	6033
1,800	↑	±1%	3037	4037	5037	6037
1,800	↑	±5%	3039	4039	5039	6039
2,200	↑	±1%	3043	4043	5043	6043
2,200	↑	±5%	3045	4045	5045	6045
2,700	↑	±1%	3049	4049	5049	6049
2,700	↑	±5%	3051	4051	5051	6051
3,300	↓	±1%	3055	4055	5055	6055
3,300	500	±5%	3057	4057	5057	6057
3,900	300	±1%	3061	4061	5061	6061
3,900	300	±5%	3063	4063	5063	6063
4,700	300	±1%	3067	4067	5067	6067
4,700	300	±5%	3069	4069	5069	6069

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

STYLE CYR30



INCHES	MM
.001	.03
.004	.10
.025	.64
.031	.79
.047	1.19
.062	1.57
.078	1.98
.141	3.58
.750	19.05
.766	19.46
1.125	28.58

601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CYR30 (MIL-C-23269/4)

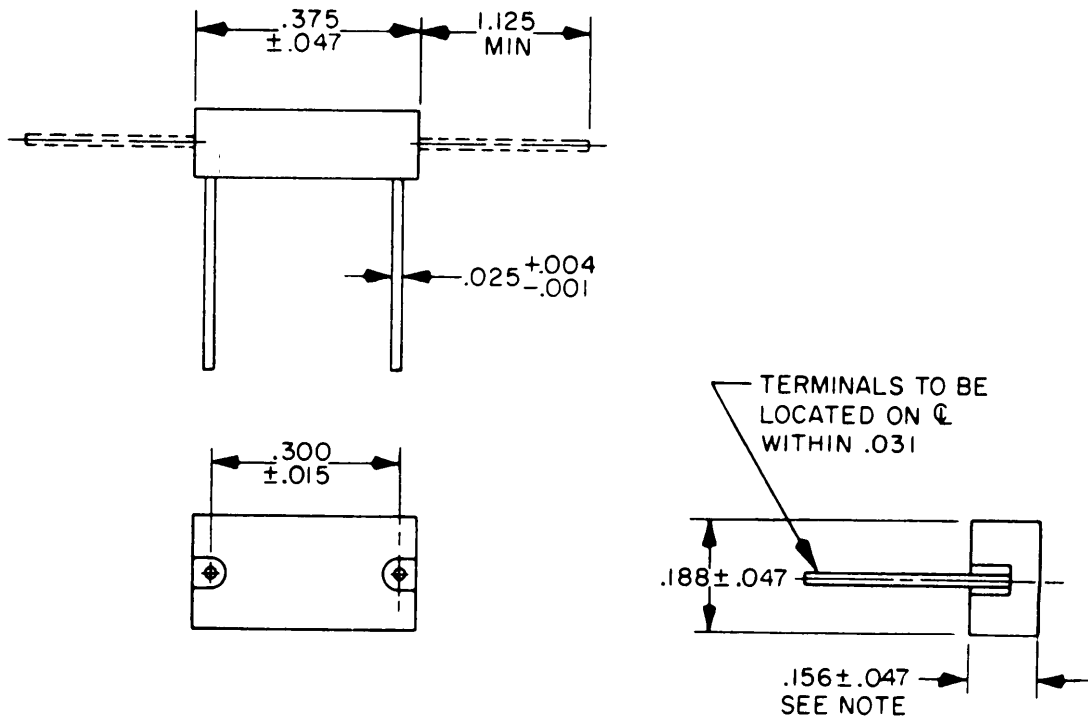
OPERATING TEMPERATURE RANGE -55° TO + 125°C -- TEMPERATURE COEFFICIENT
 140 ± 25 PPM/° -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/04 - FR level in %/1,000 hours			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
<u>nF</u>	<u>volts, dc</u>					
5.6	500	±1%	3016	4016	5016	6016
5.6	500	±5%	3018	4018	5018	6018
6.8	300	±1%	3022	4022	5022	6022
6.8	↑	±5%	3024	4024	5024	6024
8.2	↑	±1%	3028	4028	5028	6028
8.2	↓	±5%	3030	4030	5030	6030
10.0	↓	±1%	3034	4034	5034	6034
10.0	300	±5%	3036	4036	5036	6036

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STYLE CYR13



INCHES	MM	INCHES	MM
.001	.03	.188	4.78
.004	.10	.219	5.56
.015	.38	.300	7.62
.025	.64	.375	9.53
.047	1.19	1.125	28.58
.156	3.96		

NOTE:

For capacitance values above 130 pF, this dimension is $.219 \pm .047$.

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

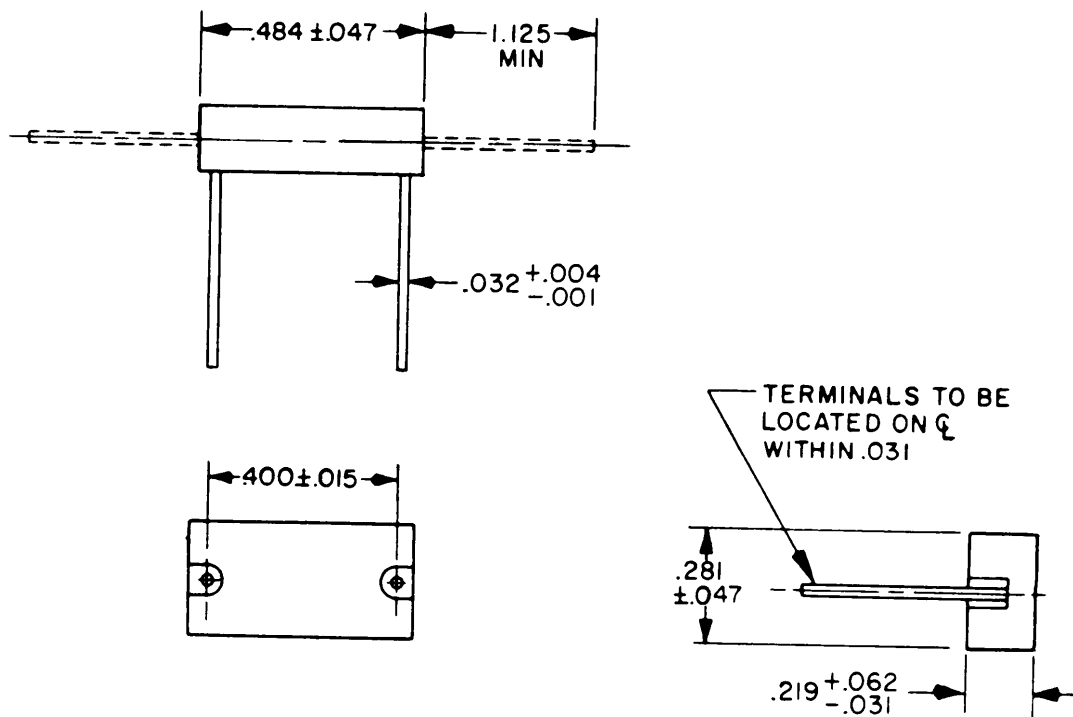
STYLE CYR13 (MIL-C-23269/5)

OPERATING TEMPERATURE RANGE -55° To + 125°C -- TEMPERATURE COEFFICIENT
 105 ± 25 PPM°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/05 - FR level in %/1,000 hours			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
<u>pF</u>	<u>volts, dc</u>					
0.5	500	±0.25 pF	3001	4001	5001	6001
1.0	↑	±0.25 pF	3002	4002	5002	6002
1.5		±0.25 pF	3003	4003	5003	6003
2.2		±0.25 pF	3004	4004	5004	6004
2.7		±0.25 pF	3006	4006	5006	6006
3.3		±0.25 pF	3009	4009	5009	6009
3.6		±0.25 pF	3010	4010	5010	6010
3.9		±0.25 pF	3012	4012	5012	6012
4.7		±0.25 pF	3015	4015	5015	6015
5.6		±0.25 pF	3017	4017	5017	6017
5.6		±5%	3018	4018	5018	6018
6.8		±0.25 pF	3021	4021	5021	6021
6.8		±5%	3022	4022	5022	6022
8.2		±0.25 pF	3025	4025	5025	6025
8.2		±5%	3026	4026	5026	6026
10		±0.25 pF	3029	4029	5029	6029
10		±5%	3030	4030	5030	6030
12		±0.25 pF	3033	4033	5033	6033
12		±5%	3034	4034	5034	6034
15		±2%	3037	4037	5037	6037
15		±5%	3038	4038	5038	6038
18		±2%	3041	4041	5041	6041
18		±5%	3042	4042	5042	6042
22		±2%	3045	4045	5045	6045
22		±5%	3046	4046	5046	6046
27		±1%	3049	4049	5049	6049
27		±5%	3051	4051	5051	6051
33		±1%	3055	4055	5055	6055
33		±5%	3057	4057	5057	6057
39		±1%	3061	4061	5061	6061
39		±5%	3063	4063	5063	6063
47		±1%	3067	4067	5067	6067
47		±5%	3069	4069	5069	6069
56		±1%	3073	4073	5073	6073
56		±5%	3075	4075	5075	6075
68		±1%	3079	4079	5079	6079
68		±5%	3081	4081	5081	6081
82		±1%	3085	4085	5085	6085
82		±5%	3087	4087	5087	6087
100		±1%	3091	4091	5091	6091
100		±5%	3093	4093	5093	6093
120		±1%	3097	4097	5097	6097
120		±5%	3099	4099	5099	6099
150		±1%	3103	4103	5103	6103
150		±5%	3105	4105	5105	6105
180		±1%	3109	4109	5109	6109
180	500	±5%	3111	4111	5111	6111
220	300	±1%	3115	4115	5115	6115
220	300	±5%	3117	4117	5117	6117
270	300	±1%	3121	4121	5121	6121
270	300	±5%	3123	4123	5123	6123

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

STYLE CYR17



INCHES	MM	INCHES	MM	INCHES	MM
.001	.03	.032	.81	.281	7.14
.004	.10	.047	1.19	.400	10.16
.015	.38	.062	1.57	.484	12.29
.031	.79	.219	5.56	1.125	28.58

FIGURE 601-3. Established reliability glass dielectric fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CYR17 (MIL-C-23269/6)

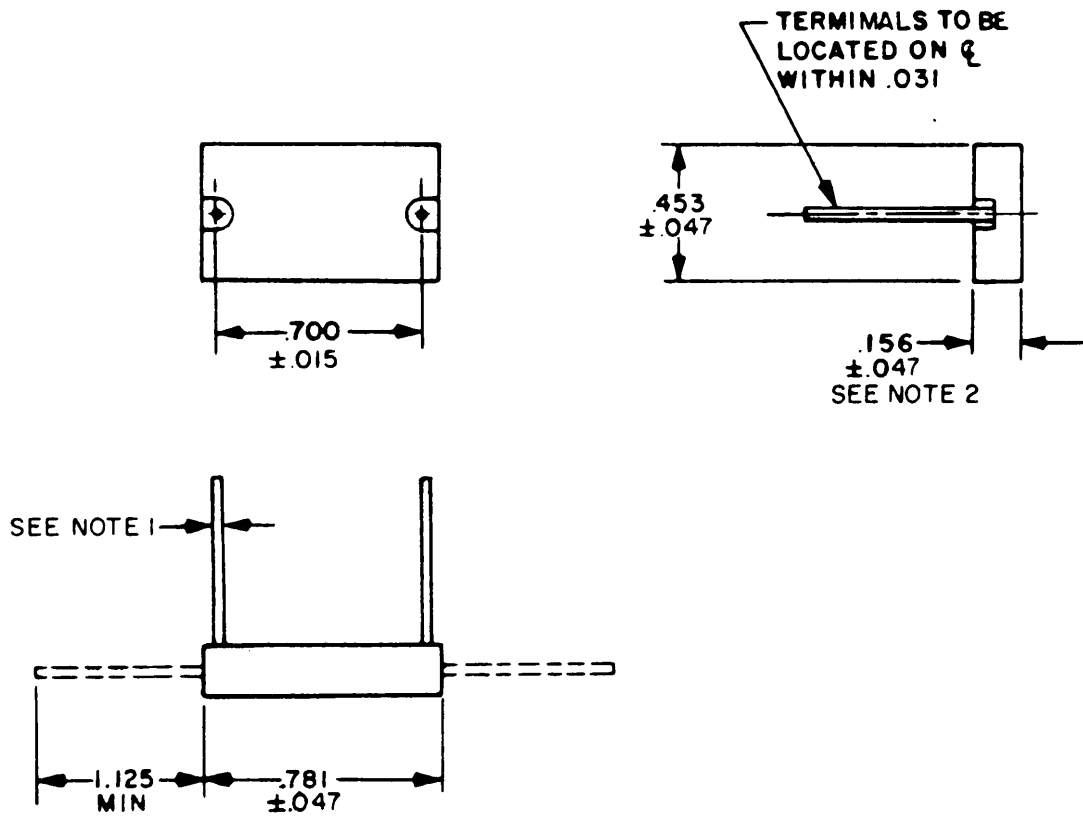
OPERATING TEMPERATURE RANGE -55° To + 125°C -- TEMPERATURE COEFFICIENT
 105 ± 25 PPM/°C CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/06-			
			M (1.0)	FR level in %/1,000 hours		
			P (0.1)	R (0.01)	S (0.001)	
<u>pF</u>	<u>volts, dc</u>					
330	500	±1%	3013	4013	5013	6013
330	↑	±5%	3015	4015	5015	6015
390	↑	±1%	3019	4019	5019	6019
390	↑	±5%	3021	4021	5021	6021
470	↓	±1%	3025	4025	5025	6025
470	500	±5%	3027	4027	5027	6027
560	300	±1%	3031	4031	5031	6031
560	↑	±5%	3033	4033	5033	6033
680	↑	±1%	3037	4037	5037	6037
680	↑	±5%	3039	4039	5039	6039
820	↑	±1%	3043	4043	5043	6043
820	↑	±5%	3045	4045	5045	6045
1,000	↓	±1%	3049	4049	5049	6049
1,000	300	±5%	3051	4051	5051	6051

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STYLE CYR22



INCHES	MM	INCHES	MM	INCHES	MM	INCHES	MM
.001	.03	.032	.81	.156	3.96	.700	17.78
.004	.10	.037	.94	.219	5.56	.781	19.84
.015	.38	.047	1.19	.453	11.51	1.125	28.58

NOTES:

- Lead diameter is $\begin{matrix} +.004 \\ -.001 \end{matrix}$ for 1,200 and 1,500 pF capacitors values, and $\begin{matrix} +.004 \\ -.037 \end{matrix}$ for 1,800 pF capacitance value.
- Dimension is $.219 \pm .047$ for 1,600 pF capacitance value.

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CYR22 (MIL-C-23269/7)

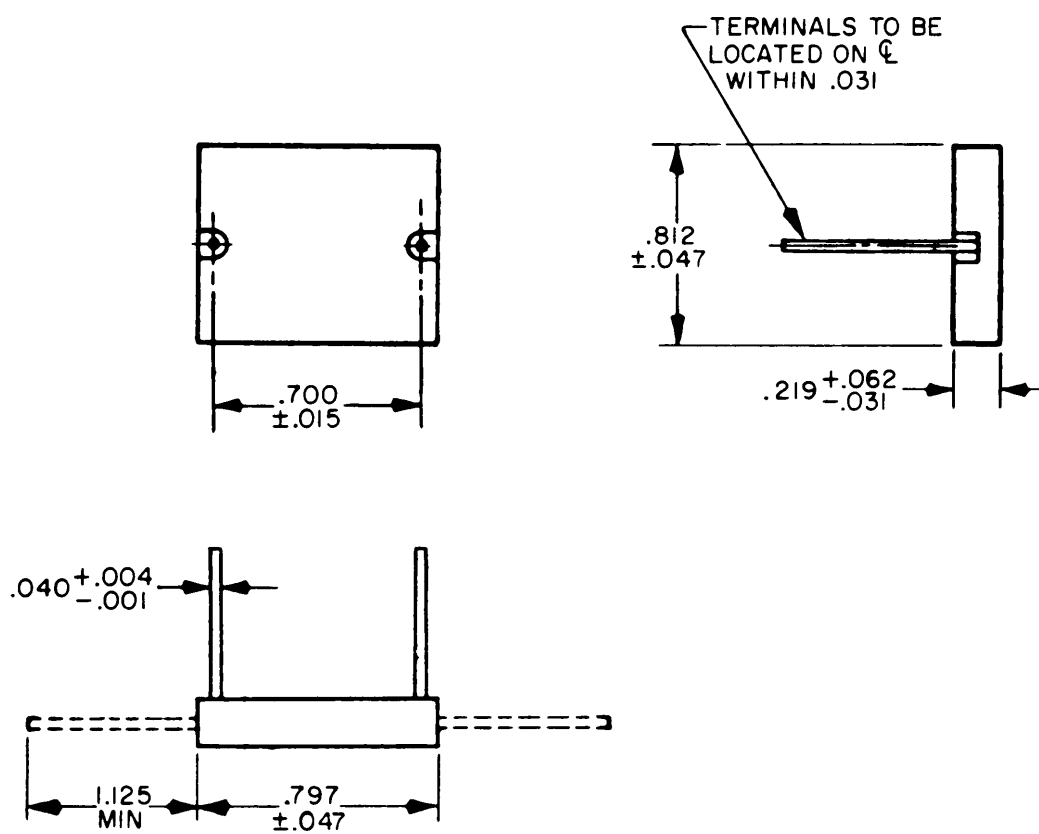
OPERATING TEMPERATURE RANGE -55° TO + 125°C -- TEMPERATURE COEFFICIENT
 105 ± 25 PPM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/07-			
			FR level in %/1,000 hours			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
<u>pF</u>	<u>volts, dc</u>					
1,200	300	±1%	3028	4028	5028	6028
1,200	↑	±5%	3030	4030	5030	6030
1,500	↑	±1%	3034	4034	5034	6034
1,500	↓	±5%	3036	4036	5036	6036
1,800	↓	±1%	3040	4040	5040	6040
1,800	300	±5%	3042	4042	5042	6042

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

601 (MIL-C-23269)

STYLE CYR32



INCHES	MM	INCHES	MM	INCHES	MM	INCHES	MM
.001	.03	.031	.79	.219	5.56	.812	20.52
.004	.10	.040	1.02	.700	17.78	1.125	28.58
.015	.38	.047	1.19	.797	20.24		
		.062	1.57				

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CYR32 (MIL-C-23269/8)

OPERATING TEMPERATURE RANGE -55° TO + 125°C -- TEMPERATURE COEFFICIENT
 105 ± 25 PPM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

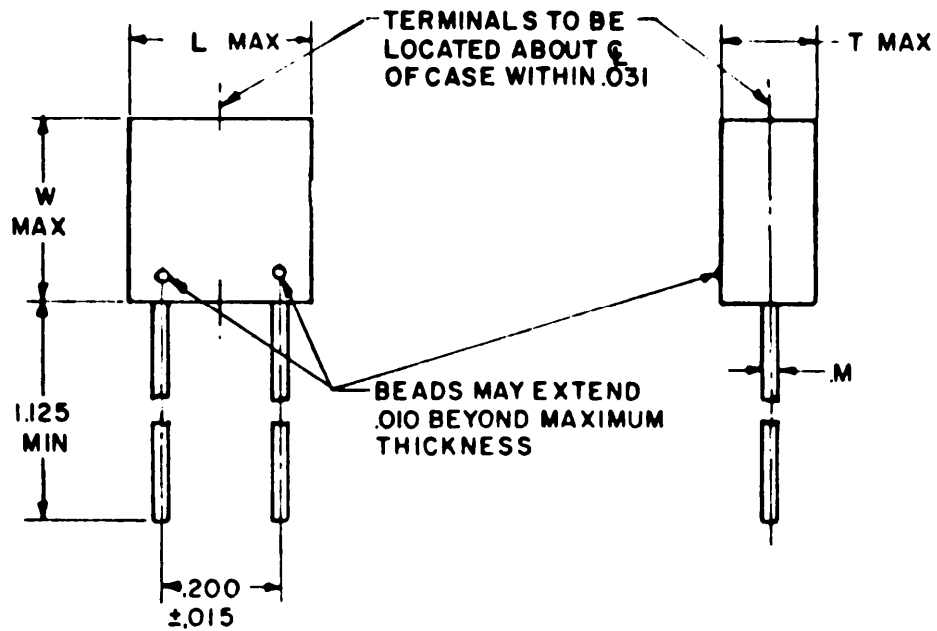
Capacitance value	DC rated voltage	Capacitance tolerance	Dash number M23269/08- FR level in %/1,000 hours			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
nF	volts, dc					
2.2	500	±1%	3022	4022	5022	6022
2.2	↑	±5%	3024	4024	5024	6024
2.7	↑	±1%	3028	4028	5028	6028
2.7	↑	±5%	3030	4030	5030	6030
3.3	↓	±1%	3034	4034	5034	6034
3.3	500	±5%	3036	4036	5036	6036
3.9	300	±1%	3040	4040	5040	6040
3.9	↑	±5%	3042	4042	5042	6042
4.7	↑	±1%	3046	4046	5046	6046
4.7	↑	±5%	3048	4048	5048	6048
5.6	↓	±1%	3052	4052	5052	6052
5.6	300	±5%	3054	4054	5054	6054

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

601 (MIL-C-23269)

MIL-STD-198E

STYLE CYR41



	Dimensions			
	M	L max	W max	T max
CYR41	+ .004	.315	.315	.115 (0.5 thru 470 pF)
	.025			.165 (560 and 680 pF)
	- .001			.215 (820 and 1000 pF)

INCHES	MM	INCHES	MM
.001	.03		.115 2.92
.004	.13		.165 4.19
.010	.25		.200 5.08
.015	.38		.215 5.46
.025	.64		.315 8.00
.031	.79		1.125 28.58

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CYR41 (MIL-C-23269/9)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- TEMPERATURE COEFFICIENT
 0 ±25 PPM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

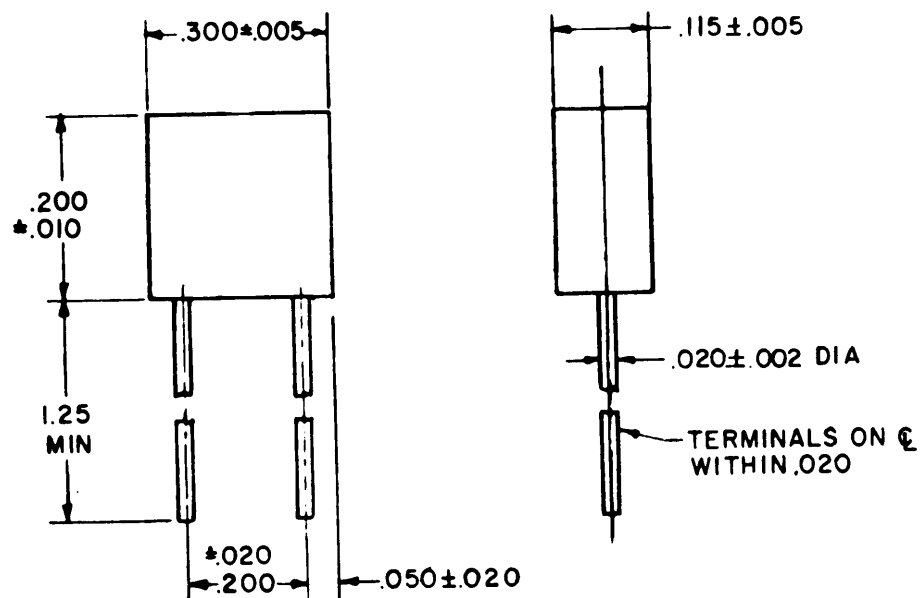
Cap. (pF)	Rated voltage (volts, dc)	Capacitance tolerance	Dash number M23269/09- FR level in %/1,000 hrs			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
0.5	100 ↑	±0.25 pF	3001	4001	5001	6001
1.5		3002	4002	5002	6002	
2.7		3003	4003	5003	6003	
3.3		3004	4004	5004	6004	
3.9		3005	4005	5005	6005	
4.7		3006	4006	5006	6006	
5.6		3007	4007	5007	6007	
6.8		±0.25 pF	3008	4008	5008	6008
6.8			±5%	3009	4009	5009
8.2		±0.25 pF	3010	4010	5010	6010
8.2		±5%	3011	4011	5011	6011
10		±0.25 pF	3012	4012	5012	6012
10		±5%	3013	4013	5013	6013
12		±0.25 pF	3014	4014	5014	6014
12		±5%	3015	4015	5015	6015
15		±0.25 pF	3016	4016	5016	6016
15		±2%	3017	4017	5017	6017
15		±5%	3018	4018	5018	6018
18		±0.25 pF	3019	4019	5019	6019
18		±2%	3020	4020	5020	6020
18		±5%	3021	4021	5021	6021
22		±0.25 pF	3022	4022	5022	6022
22		±2%	3023	4023	5023	6023
22		±5%	3024	4024	5024	6024
27		±1%	3025	4025	5025	6025
27		±2%	3026	4026	5026	6026
27		±5%	3027	4027	5027	6027
33		±1%	3028	4028	5028	6028
33		±2%	3029	4029	5029	6029
33		±5%	3030	4030	5030	6030
39	±1%	3031	4031	5031	6031	
39	±2%	3032	4032	5032	6032	
39	±5%	3033	4033	5033	6033	
47	±1%	3034	4034	5034	6034	
47	±2%	3035	4035	5035	6035	
47	±5%	3036	4036	5036	6036	
56	±1%	3037	4037	5037	6037	
56	±2%	3038	4038	5038	6038	
56	±5%	3039	4039	5039	6039	
68	±1%	3040	4040	5040	6040	
68	±2%	3041	4041	5041	6041	
68	±5%	3042	4042	5042	6042	
82	±1%	3043	4043	5043	6043	
82	±2%	3044	4044	5044	6044	
82	±5%	3045	4045	5045	6045	
100	±1%	3046	4046	5046	6046	
100	±2%	3047	4047	5047	6047	
100	±5%	3048	4048	5048	6048	
120	±1%	3049	4049	5049	6049	
120	±2%	3050	4050	5050	6050	
120	±5%	3051	4051	5051	6051	

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

601 (MIL-C-23269)

MIL-STD-198E

STYLE CYR51



INCHES	MM
.002	.05
.005	.13
.010	.25
.020	.51
.050	1.27
.115	2.92
.200	5.08
.300	7.62
1.25	31.75

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CYR51 (MIL-C-23269/10)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- TEMPERATURE COEFFICIENT
140 ±25 PPM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF, WHICHEVER IS GREATER

Cap. (pF)	Rated voltage (volts, dc)	Capacitance tolerance	Dash number M23269/10- FR level in %/1,000 hrs			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
1	300	± 0.25 pF	3001	4001	5001	6001
1.5		3002	4002	5002	6002	
2.2		3003	4003	5003	6003	
2.7		3004	4004	5004	6004	
3.0		3005	4005	5005	6005	
3.3		3006	4006	5006	6006	
3.6		3007	4007	5007	6007	
3.9		3008	4008	5008	6008	
4.3		3009	4009	5009	6009	
4.7		3010	4010	5010	6010	
5.1		± 0.25 pF	3011	4011	5011	6011
5.1			± 5%	3012	4012	5012
5.6		± 0.25 pF	3013	4013	5013	6013
5.6		± 5%	3014	4014	5014	6014
6.2		± 0.25 pF	3015	4015	5015	6015
6.2		± 5%	3016	4016	5016	6016
6.8		± 0.25 pF	3017	4017	5017	6017
6.8		± 5%	3018	4018	5018	6018
7.5		± 0.25 pF	3019	4019	5019	6019
7.5		± 5%	3020	4020	5020	6020
8.2		± 0.25 pF	3021	4021	5021	6021
8.2		± 5%	3022	4022	5022	6022
9.1		± 0.25 pF	3023	4023	5023	6023
9.1		± 5%	3024	4024	5024	6024
10		± 0.25 pF	3025	4025	5025	6025
10		± 5%	3026	4026	5026	6026
11		± 0.25 pF	3027	4027	5027	6027
11		± 5%	3028	4028	5028	6028
12		± 0.25 pF	3029	4029	5029	6029
12		± 5%	3030	4030	5030	6030
13		± 0.25 pF	3031	4031	5031	6031
13		± 2%	3032	4032	5032	6032
13		± 5%	3033	4033	5033	6033
15		± 0.25 pF	3034	4034	5034	6034
15		± 2%	3035	4035	5035	6035
15		± 5%	3036	4036	5036	6036
16		± 0.25 pF	3037	4037	5037	6037
16		± 2%	3038	4038	5038	6038
16		± 5%	3039	4039	5039	6039
18		± 0.25 pF	3040	4040	5040	6040
18		± 2%	3041	4041	5041	6041
18		± 5%	3042	4042	5042	6042
20		± 0.25 pF	3043	4043	5043	6043
20		± 2%	3044	4044	5044	6044
20		± 5%	3045	4045	5045	6045
22		± 0.25 pF	3046	4046	5046	6046
22		± 2%	3047	4047	5047	6047
22		± 5%	3048	4048	5048	6048
24	± 0.25 pF	3049	4049	5049	6049	
24	± 2%	3050	4050	5050	6050	
24	± 5%	3051	4051	5051	6051	

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

601 (MIL-C-23269)

MI L-STD-198E

STANDARD CAPACITORS

STYLE CYR51 (MI L-C-23269/10) - Continued

Cap. (pF)	Rated voltage (volts, dc)	Capacitance tolerance	Dash number M23269/10- FR level in %/1,000 hrs			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
27	300	± 1%	3052	4052	5052	6052
27		± 2%	3053	4053	5053	6053
27		± 5%	3054	4054	5054	6054
30		± 1%	3055	4055	5055	6055
30		± 2%	3056	4056	5056	6056
30		± 5%	3057	4057	5057	6057
33		± 1%	3058	4058	5058	6058
33		± 2%	3059	4059	5059	6059
33		± 5%	3060	4060	5060	6060
36		± 1%	3061	4061	5061	6061
36		± 2%	3062	4062	5062	6062
36		± 5%	3063	4063	5063	6063
39		± 1%	3064	4064	5064	6064
39		± 2%	3065	4065	5065	6065
39		± 5%	3066	4066	5066	6066
43		± 1%	3067	4067	5067	6067
43		± 2%	3068	4068	5068	6068
43		± 5%	3069	4069	5069	6069
47		± 1%	3070	4070	5070	6070
47		± 2%	3071	4071	5071	6071
47		± 5%	3072	4072	5072	6072
51		± 1%	3073	4073	5073	6073
51		± 2%	3074	4074	5074	6074
51		± 5%	3075	4075	5075	6075
56		± 1%	3076	4076	5076	6076
56		± 2%	3077	4077	5077	6077
56		± 5%	3078	4078	5078	6078
62		± 1%	3079	4079	5079	6079
62		± 2%	3080	4080	5080	6080
62		± 5%	3081	4081	5081	6081
68		± 1%	3082	4082	5082	6082
68		± 2%	3083	4083	5083	6083
68		± 5%	3084	4084	5084	6084
75		± 1%	3085	4085	5085	6085
75		± 2%	3086	4086	5086	6086
75		± 5%	3087	4087	5087	6087
82		± 1%	3088	4088	5088	6088
82		± 2%	3089	4089	5089	6089
82		± 5%	3090	4090	5090	6090
91		± 1%	3091	4091	5091	6091
91		± 2%	3092	4092	5092	6092
91		± 5%	3093	4093	5093	6093
100		± 1%	3094	4094	5094	6094
100		± 2%	3095	4095	5095	6095
100		± 5%	3096	4096	5096	6096
110	± 1%	3097	4097	5097	6097	
110	± 2%	3098	4098	5098	6098	
110	± 5%	3099	4099	5099	6099	
120	± 1%	3100	4100	5100	6100	
120	± 2%	3101	4101	5101	6101	
120	± 5%	3102	4102	5102	6102	

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

601 (MI L-C-23269)

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STANDARD CAPACITORS

STYLE CYR51 (MIL-C-23269/10) - Continued

Cap. (pF)	Rated voltage (volts, dc)	Capacitance tolerance	Dash number M23269/10- FR level in %/1,000 hrs			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
130	300 ↑	±1%	3103	4103	5103	6103
130		±2%	3104	4104	5104	6104
130		±5%	3105	4105	5105	6105
150		±1%	3106	4106	5106	6106
150		±2%	3107	4107	5107	6107
150		±5%	3108	4108	5108	6108
160		±1%	3109	4109	5109	6109
160		±2%	3110	4110	5110	6110
160		±5%	3111	4111	5111	6111
180		±1%	3112	4112	5112	6112
180		±2%	3113	4113	5113	6113
180		±5%	3114	4114	5114	6114
200		±1%	3115	4115	5115	6115
200		±2%	3116	4116	5116	6116
200		±5%	3117	4117	5117	6117
220		±1%	3118	4118	5118	6118
220		±2%	3119	4119	5119	6119
220		±5%	3120	4120	5120	6120
240		±1%	3121	4121	5121	6121
240		±2%	3122	4122	5122	6122
240		±5%	3123	4123	5123	6123
270		±1%	3124	4124	5124	6124
270		±2%	3125	4125	5125	6125
270		±5%	3126	4126	5126	6126
300		±1%	3127	4127	5127	6127
300		±2%	3128	4128	5128	6128
300		±5%	3129	4129	5129	6129
330		±1%	3130	4130	5130	6130
330		±2%	3131	4131	5131	6131
330		±5%	3132	4132	5132	6132
360		±1%	3133	4133	5133	6133
360		±2%	3134	4134	5134	6134
360		±5%	3135	4135	5135	6135
390		±1%	3136	4136	5136	6136
390		±2%	3137	4137	5137	6137
390		±5%	3138	4138	5138	6138
430		±1%	3139	4139	5139	6139
430		±2%	3140	4140	5140	6140
430		±5%	3141	4141	5141	6141
470		±1%	3142	4142	5142	6142
470		±2%	3143	4143	5143	6143
470		±5%	3144	4144	5144	6144
510		±1%	3145	4145	5145	6145
510		±2%	3146	4146	5146	6146
510		±5%	3147	4147	5147	6147
560		±1%	3148	4148	5148	6148
560		±2%	3149	4149	5149	6149
560		±5%	3150	4150	5150	6150

FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CYR52 (MIL-C-23269/10)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- TEMPERATURE COEFFICIENT
 140 ±25PM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1 PF,
 WHICHEVER IS GREATER

Cap. (pF)	Rated voltage (volts, dc)	Capacitance tolerance	Dash number M23269/10- FR level in %/1,000 hrs			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
620	300 ↑ ↓ 300	±1%	3201	4201	5201	6201
620		±2%	3202	4202	5202	6202
620		±5%	3203	4203	5203	6203
680		±1%	3204	4204	5204	6204
680		±2%	3205	4205	5205	6205
680		±5%	3206	4206	5206	6206
750		±1%	3207	4207	5207	6207
750		±2%	3208	4208	5208	6208
750		±5%	3209	4209	5209	6209
820		±1%	3210	4210	5210	6210
820		±2%	3211	4211	5211	6211
820		±5%	3212	4212	5212	6212
910		±1%	3213	4213	5213	6213
910		±2%	3214	4214	5214	6214
910		±5%	3215	4215	5215	6215
1,000		±1%	3216	4216	5216	6216
1,000		±2%	3217	4217	5217	6217
1,000		±5%	3218	4218	5218	6218

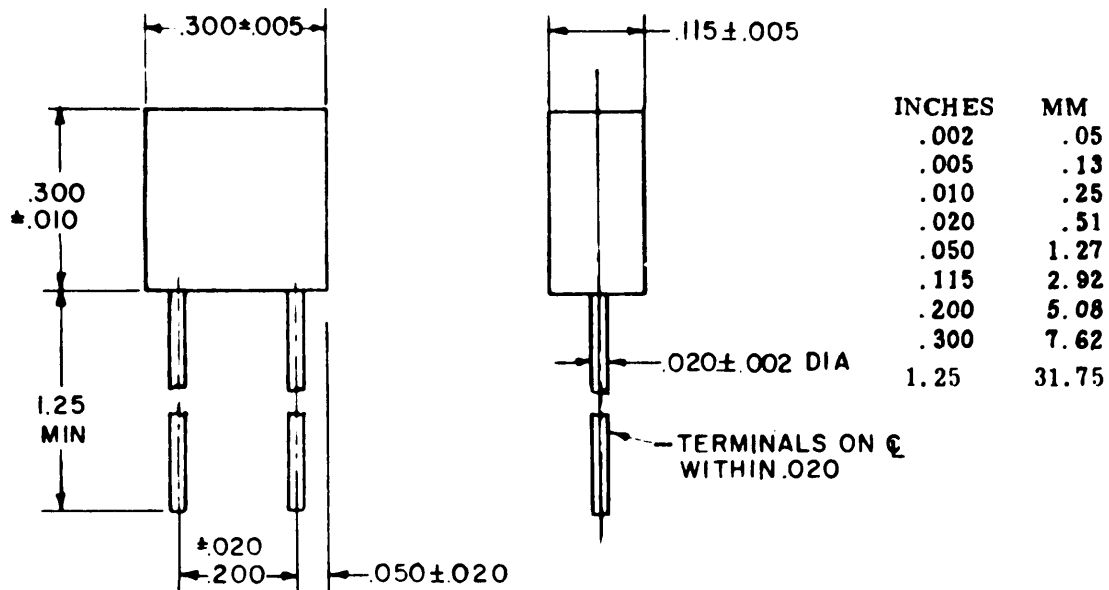


FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CYR53 (MIL-C-23269/10)

OPERATING TEMPERATURE RANGE -550 TO + 1250 C -- TEMPERATURE COEFFICIENT
 140 ±25 PPM/°C -- CAPACITANCE DRIFT 0.1% OR 0.1PF,
 WHICHEVER IS GREATER

Cap. (pF)	Rated voltage (volts, dc)	Capacitance tolerance	Dash number M23269/10- FR level in %/1,000 hrs			
			M (1.0)	P (0.1)	R (0.01)	S (0.001)
1,100	300	± 1%	3301	4301	5301	6301
1,100		± 2%	3302	4302	5302	6302
1,100		± 5%	3303	4303	5303	6303
1,200		± 1%	3304	4304	5304	6304
1,200		± 2%	3305	4305	5305	6305
1,200		± 5%	3306	4306	5306	6306
1,300		± 1%	3307	4307	5307	6307
1,300		± 2%	3308	4308	5308	6308
1,300		± 5%	3309	4309	5309	6309
1,500		± 1%	3310	4310	5310	6310
1,500		± 2%	3311	4311	5311	6311
1,500		± 5%	3312	4312	5312	6312
1,600		± 1%	3313	4313	5313	6313
1,600		± 2%	3314	4314	5314	6314
1,600		± 5%	3315	4315	5315	6315
1,800		± 1%	3316	4316	5316	6316
1,800		± 2%	3317	4317	5317	6317
1,800		± 5%	3318	4318	5318	6318
2,000		± 1%	3319	4319	5319	6319
2,000		± 2%	3320	4320	5320	6320
2,000		± 5%	3321	4321	5321	6321
2,200		± 1%	3322	4322	5322	6322
2,200		± 2%	3323	4323	5323	6323
2,200		± 5%	3324	4324	5324	6324
2,400		± 1%	3325	4325	5325	6325
2,400		± 2%	3326	4326	5326	6326
2,400		± 5%	3327	4327	5327	6327

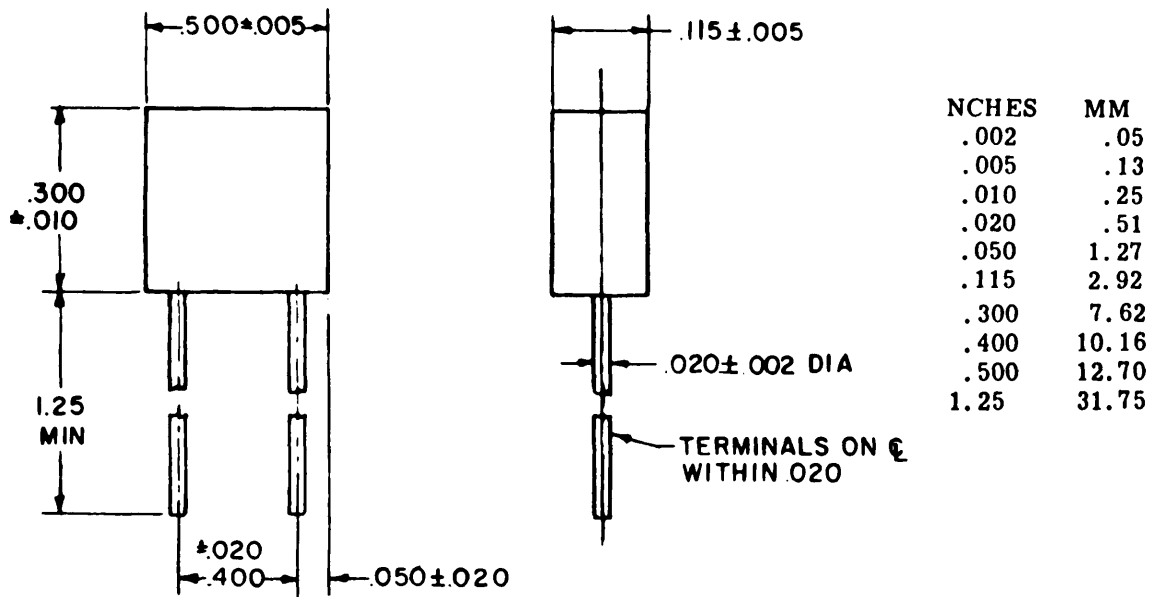


FIGURE 601-3. Established reliability, glass dielectric, fixed capacitors - Continued.

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SECTION 602

CAPACITORS, FIXED, MICA DIELECTRIC, ESTABLISHED RELIABILITY
STYLES CMR03, CMR04, CMR05, CMR06, CMR07, AND CMR08
(APPLICABLE SPECIFICATION: MIL-C-39001)

1. SCOPE. This section covers established reliability, mica dielectric, fixed capacitors. These capacitors have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on full rated voltage at + 125° C or + 150° C, as applicable.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are intended for use in any equipment where known orders of reliability are required. They will experience failures at a rate depending almost exclusively upon the manner in which they are used; e.g., (1) with the temperature remaining constant, the capacitor life is inversely proportional to the 8th power of the applied dc voltage, or (2) with the dc voltage remaining constant, life decreases approximately 50 percent for every 10°C rise in temperature. These capacitors have a life expectancy of 50,000 hours, or more, at rated conditions.

2.2 Construction. The construction details for these capacitors are as described in Section 102.

2.3 Rated voltage. These capacitors are rated at 50, 100, 300, or 500 volts.

2.4 Operating temperature range. These capacitors are suitable for operation over a temperature range of -55° to + 125° (or +150° C).

2.5 Failure-rate level determination. The curves presented on figure 602-1 are the best engineering approximation of the reliability characteristics (random failures) for these capacitors when employed repeatedly, within their specification ratings, in complex electronic equipment. These reliability characteristics are based on ground-level severity experience. Failures are considered to be opens, shorts, or radical departures from initial characteristics. The failures are considered to be occurring in an unpredictable manner and in too short a period of time to permit detection through normal preventive maintenance. The curves shown on this figure are based on "catastrophic failures" and will differ from the failure rates established in the specification, since the established failure rates are based on "parametric failures" over long term life tests at rated conditions. As indicated, these curves are the best estimates based on "catastrophic failures"; however, they can provide an estimate of the relative effect of operating under conditions other than rated.

2.6 General. For additional application information, see Section 102.

3. ITEM IDENTIFICATION (see figures 602-2 and 602-3).

3.1 Type designation. The type designation is used for identifying and describing the capacitors as shown in figure 602-2.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 602-3.

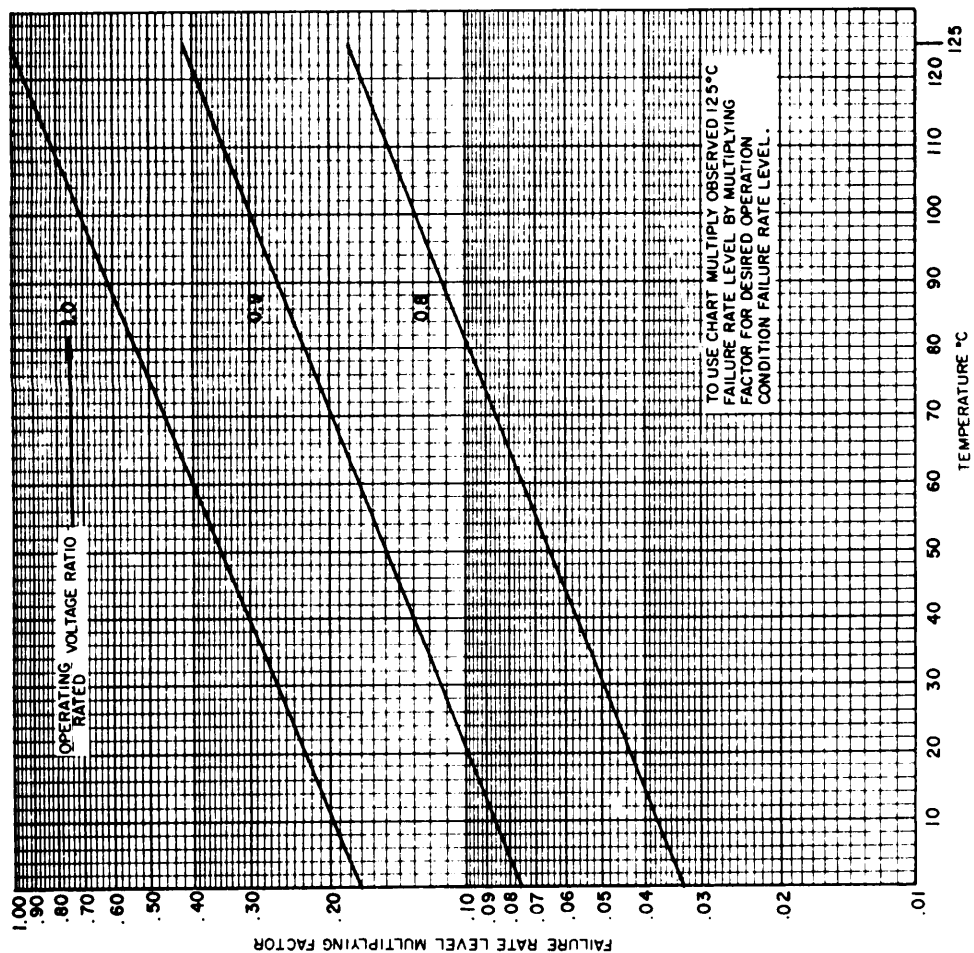
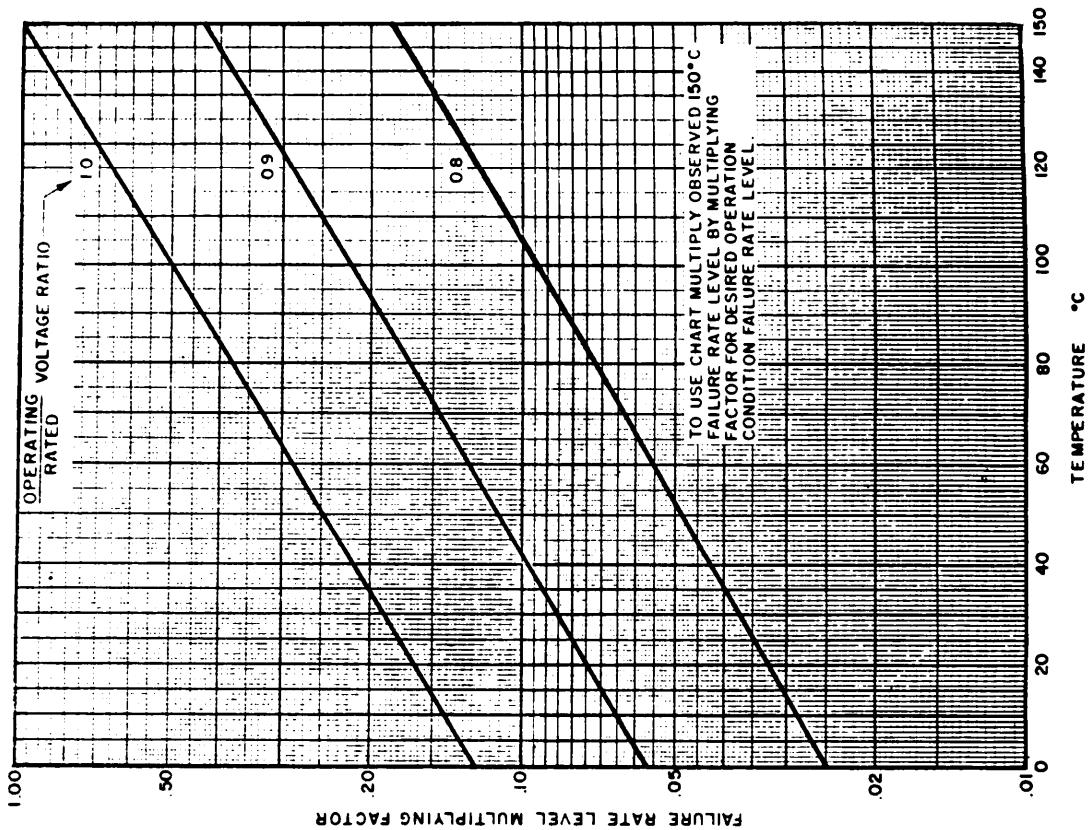


FIGURE 602-1. Failure rate level curves.

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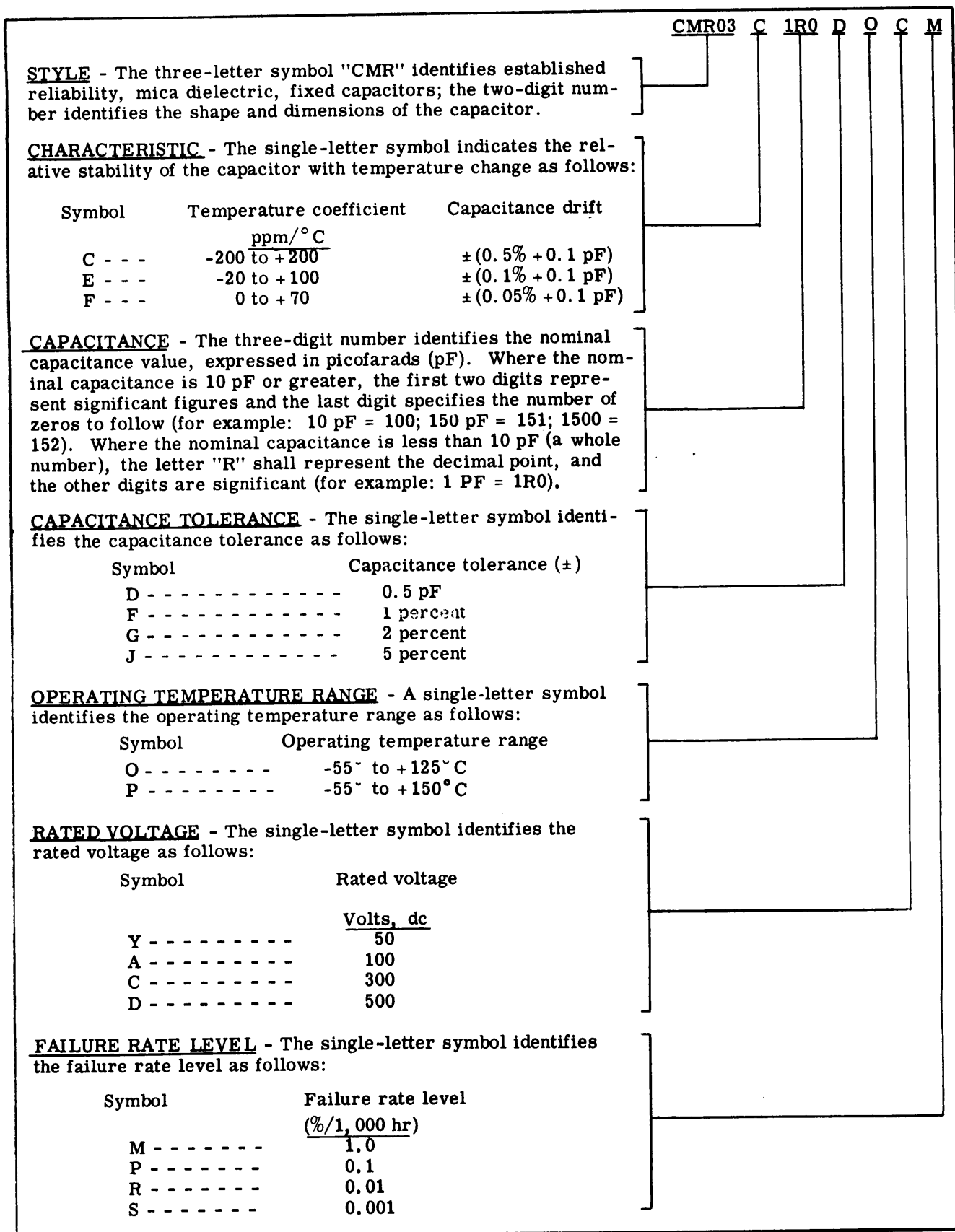
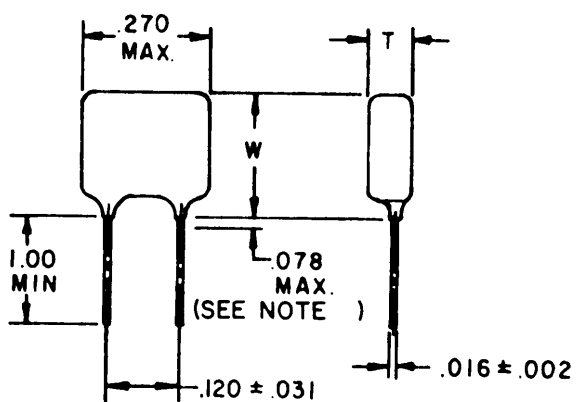


FIGURE 602-2. Type designation example.

602 (MI L-C-39001)

MI L-STD-198E

STYLE CMR03



NOTE:
This area may not be solderable as it may be covered by a clear epoxy or resinous coating.

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors.

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STANDARD CAPACITORS

STYLE CMR03 (MI L-C-39001/5)

OPERATING TEMPERATURE RANGE -55°C TO +125°C

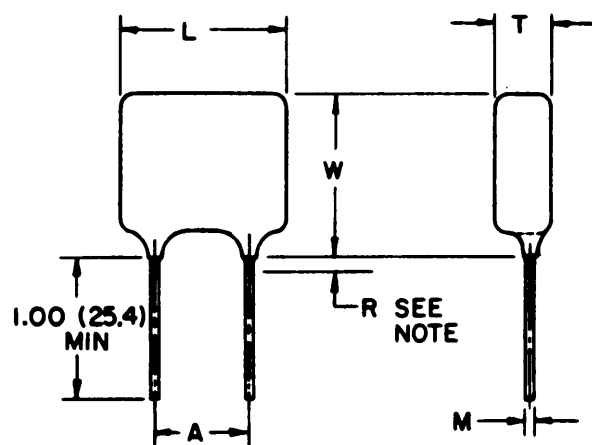
Type designation ^{1/}	Cap. value	DC rated voltage	Capacitance tolerance available	Dimension (in inches)						
				W maximum			T maximum			
				300V	100V	50V	300V	100V	50V	
	pF	volts								
CMR03C1R0DOC-	1.0	300	D	.190	---	---	.110	---	---	---
CMR03C1R5DOC-	1.5	"	"	"	---	---	"	---	---	---
CMR03C2R0DOC-	2.0	"	"	"	---	---	"	---	---	---
CMR03C2R5DOC-	2.5	"	"	"	---	---	"	---	---	---
CMR03C3R0DOC-	3.0	"	"	"	---	---	"	---	---	---
CMR03C3R5DOC-	3.5	"	"	"	---	---	"	---	---	---
CMR03C4R0DOC-	4.0	"	"	"	---	---	"	---	---	---
CMR03C4R5DOC-	4.5	"	"	"	---	---	"	---	---	---
CMR03C5R0DOC-	5.0	"	"	"	---	---	"	---	---	---
CMR03C6R0DOC-	6.0	"	"	"	---	---	"	---	---	---
CMR03C7R0DOC-	7.0	"	"	"	---	---	"	---	---	---
CMR03C8R0DOC-	8.0	"	"	"	---	---	"	---	---	---
CMR03C9R0DOC-	9.0	"	"	"	---	---	"	---	---	---
CMR03C100DOC-	10	"	"	"	---	---	"	---	---	---
CMR03C110DOC-	11	"	"	"	---	---	"	---	---	---
CMR03C120DOC-	12	"	"	"	---	---	"	---	---	---
CMR03C150DO--	15	300, 100	"	"	.190	---	.120	.110	---	---
CMR03C180DO--	18	300, 100	"	.200	"	---	"	.110	---	---
CMR03E200DO--	20	300, 100	"	"	"	---	"	.110	---	---
CMR03E220DO--	22	300, 100, 50	"	"	"	.190	"	.120	.110	---
CMR03E240DO--	24	"	"	"	"	"	"	"	"	---
CMR03E270-0--	27	"	G, J	"	"	"	.130	"	"	---
CMR03E300-0--	30	"	"	"	.200	"	"	"	"	---
CMR03E330-0--	33	"	"	"	"	"	"	"	"	---
CMR03E360-0--	36	"	"	.210	"	"	"	"	"	---
CMR03E390-0--	39	"	"	"	"	"	"	"	.120	---
CMR03E430-0--	43	"	"	"	"	"	.140	"	"	---
CMR03E470-0--	47	"	"	"	"	"	.140	.130	"	---
CMR03E510-0--	51	"	"	"	"	"	.140	.130	"	---
CMR03E560JO--	56	"	J	.220	"	"	.150	.130	"	---
CMR03E620JO--	62	"	"	.220	.210	.200	.150	.130	"	---
CMR03E680JO--	68	"	"	.220	"	"	.150	.140	"	---
CMR03E750JO--	75	"	"	.230	"	"	.160	.140	"	---
CMR03E820JO--	82	"	"	.230	"	"	.160	.140	"	---
CMR03F910JO--	91	"	"	.230	"	"	.170	.140	.130	---
CMR03F101JO--	100	"	"	.240	.220	"	.180	.150	"	---
CMR03F111JO--	110	"	"	.240	.220	"	.180	.150	"	---
CMR03F121JO--	120	"	"	.250	.220	"	.190	.160	"	---
CMR03F131JO--	130	100, 50	"	---	.230	.210	---	.160	"	---
CMR03F151JO--	150	"	"	---	.230	"	---	.170	.140	---
CMR03F161JO--	160	"	"	---	.240	"	---	.170	.140	---
CMR03F171JO--	170	"	"	---	.240	"	---	.180	.140	---
CMR03F181JO--	180	"	"	---	.240	"	---	.180	.140	---
CMR03F201JO--	200	"	"	---	.250	.220	---	.190	.150	---
CMR03F221JOY-	220	50	"	---	---	.220	---	---	.150	---
CMR03F241JOY-	240	"	"	---	---	.220	---	---	.160	---
CMR03F271JOY-	270	"	"	---	---	.230	---	---	.160	---
CMR03F301JOY-	300	"	"	---	---	.230	---	---	.170	---
CMR03F331JOY-	330	"	"	---	---	.240	---	---	.180	---
CMR03F361JOY-	360	"	"	---	---	.240	---	---	.180	---
CMR03F391JOY-	390	"	"	---	---	.250	---	---	.190	---
CMR03F401JOY-	400	"	"	---	---	.250	---	---	.190	---

^{1/} Where applicable, the complete type designation will include additional letter symbols to indicate the electric rated voltage, capacitance tolerance, and failure rate level.

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors - Continued.

MI L-STD-198E

STYLES CMR04, CMR05, CMR06, CMR07, AND CMR08



NOTE:

The R dimension may not be solderable as it may be covered by clear epoxy or resinous coating.

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors.

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Capacitance range (pF)	L		T		W. max	R. max	A Spacing (.031(.79))	M. Dia (.002(.05))
	Min	Max	Min	Max				
STYLE CMR04								
1 to 24, incl	.300 (7.62)	.360 (9.14)	.100(2.54)	.190 (4.83)	.330 (8.38)	.125(3.18)	.150 (3.81)	.016 (.36)
27	.300 (7.62)	.370 (9.40)	.100(2.54)	.190 (4.83)	.330 (8.38)	.125(3.18)	.150 (3.81)	.016 (.36)
30 to 68, incl	.300 (7.62)	.370 (9.40)	.100(2.54)	.190 (4.83)	.340 (8.64)	.125(3.18)	.150 (3.81)	.016 (.36)
75	.300 (7.62)	.370 (9.40)	.110(2.79)	.200 (5.08)	.340 (8.64)	.125(3.18)	.150 (3.81)	.016 (.36)
82	.300 (7.62)	.370 (9.40)	.110(2.79)	.200 (5.08)	.350 (8.89)	.125(3.18)	.150 (3.81)	.016 (.36)
91 to 100, incl	.300 (7.62)	.370 (9.40)	.110(2.79)	.200 (5.08)	.350 (8.89)	.125(3.18)	.150 (3.81)	.016 (.36)
110 to 120, incl	.300 (7.62)	.380 (9.65)	.110(2.79)	.200 (5.08)	.350 (8.89)	.125(3.18)	.150 (3.81)	.016 (.36)
130	.300 (7.62)	.380 (9.65)	.110(2.79)	.200 (5.08)	.360 (9.14)	.125(3.18)	.150 (3.81)	.016 (.36)
150 to 160, incl	.300 (7.62)	.380 (9.65)	.120(3.05)	.210 (5.33)	.360 (9.14)	.125(3.18)	.150 (3.81)	.016 (.36)
180	.300 (7.62)	.390 (9.91)	.120(3.05)	.210 (5.33)	.370 (9.40)	.125(3.18)	.150 (3.81)	.016 (.36)
200 to 390, incl	.300 (7.62)	.390 (9.91)	.140(3.56)	.220 (5.59)	.380 (9.65)	.125(3.18)	.150 (3.81)	.016 (.36)
STYLE CMR05								
1 to 62, incl	.400(10.16)	.450(11.43)	.090(2.29)	.170 (4.32)	.360 (9.14)	.125(3.18)	.225 (5.72)	.025 (.64)
68 to 82, incl	.400(10.16)	.450(11.43)	.095(2.30)	.180 (4.57)	.360 (9.14)	.125(3.18)	.225 (5.72)	.025 (.64)
91 to 100, incl	.400(10.16)	.460(11.68)	.095(2.30)	.180 (4.57)	.360 (9.14)	.125(3.18)	.225 (5.72)	.025 (.64)
110 to 130, incl	.400(10.16)	.460(11.68)	.095(2.30)	.180 (4.57)	.370 (9.40)	.125(3.18)	.225 (5.72)	.025 (.64)
150 to 180, incl	.400(10.16)	.460(11.68)	.110(2.79)	.190 (4.83)	.370 (9.40)	.125(3.18)	.225 (5.72)	.025 (.64)
200	.400(10.16)	.460(11.68)	.110(2.79)	.190 (4.83)	.380 (9.65)	.125(3.18)	.225 (5.72)	.025 (.64)
220 to 240, incl	.400(10.16)	.460(11.68)	.110(2.79)	.200 (5.08)	.380 (9.65)	.125(3.18)	.225 (5.72)	.025 (.64)
270 to 330, incl	.400(10.16)	.470(11.94)	.110(2.79)	.210 (5.33)	.390 (9.91)	.125(3.18)	.225 (5.72)	.025 (.64)
360 to 390, incl	.400(10.16)	.470(11.94)	.120(3.05)	.220 (5.59)	.400(10.16)	.125(3.18)	.225 (5.72)	.025 (.64)
STYLE CMR06								
430 to 470, incl	.550(13.97)	.640(16.26)	.090(2.29)	.200 (5.08)	.510(12.95)	.141(3.58)	.350 (8.89)	.032 (.81)
510 to 620, incl	.560(14.22)	.650(16.51)	.090(2.29)	.200 (5.08)	.510(12.95)	.141(3.58)	.350 (8.89)	.032 (.81)
680 to 910, incl	.560(14.22)	.650(16.51)	.100(2.54)	.210 (5.33)	.510(12.95)	.141(3.58)	.350 (8.89)	.032 (.81)
1000 to 1100, incl	.560(14.22)	.650(16.51)	.110(2.79)	.220 (5.59)	.520(13.21)	.141(3.58)	.350 (8.89)	.032 (.81)
1200 to 1300, incl	.570(14.48)	.660(16.78)	.110(2.79)	.220 (5.59)	.520(13.21)	.141(3.58)	.350 (8.89)	.032 (.81)
1500	.570(14.48)	.660(16.78)	.120(3.05)	.230 (5.84)	.520(13.21)	.141(3.58)	.350 (8.89)	.032 (.81)
1600	.570(14.48)	.660(16.78)	.120(3.05)	.230 (5.84)	.530(13.46)	.141(3.58)	.350 (8.89)	.032 (.81)
1800 to 2000, incl	.580(14.73)	.670(17.02)	.130(3.30)	.240 (6.10)	.530(13.46)	.141(3.58)	.350 (8.89)	.032 (.81)
2200	.580(14.73)	.670(17.02)	.140(3.56)	.250 (6.35)	.530(13.46)	.141(3.58)	.350 (8.89)	.032 (.81)
2400	.580(14.73)	.670(17.02)	.150(3.81)	.260 (6.60)	.540(13.72)	.141(3.58)	.350 (8.89)	.032 (.81)
2700	.590(14.99)	.680(17.27)	.160(4.06)	.270 (6.86)	.540(13.72)	.141(3.58)	.350 (8.89)	.032 (.81)
3000	.590(14.99)	.680(17.27)	.170(4.32)	.280 (7.11)	.550(13.97)	.141(3.58)	.350 (8.89)	.032 (.81)
3300	.590(14.99)	.680(17.27)	.180(4.57)	.290 (7.37)	.550(13.97)	.141(3.58)	.350 (8.89)	.032 (.81)
3600	.590(14.99)	.680(17.27)	.190(4.83)	.300 (7.62)	.560(14.22)	.141(3.58)	.350 (8.89)	.032 (.81)
3900	.600(15.24)	.690(17.53)	.200(5.08)	.310 (7.87)	.560(14.22)	.141(3.58)	.350 (8.89)	.032 (.81)
4300	.600(15.24)	.690(17.53)	.220(5.59)	.330 (8.38)	.570(14.48)	.141(3.58)	.350 (8.89)	.032 (.81)
4700	.610(15.49)	.700(17.78)	.220(5.59)	.350 (8.89)	.580(14.73)	.141(3.58)	.350 (8.89)	.032 (.81)
STYLE CMR07								
5100	.680(17.27)	.780(19.81)	.150(3.81)	.280 (7.11)	.860(21.84)	.141(3.58)	.425(10.80)	.040(1.02)
5600 to 6200, incl	.680(17.27)	.780(19.81)	.150(3.81)	.290 (7.37)	.870(22.10)	.141(3.58)	.425(10.80)	.040(1.02)
6800	.680(17.27)	.780(19.81)	.150(3.81)	.300 (7.62)	.870(22.10)	.141(3.58)	.425(10.80)	.040(1.02)
7500	.690(17.53)	.790(20.07)	.150(3.81)	.310 (7.87)	.880(22.35)	.141(3.58)	.425(10.80)	.040(1.02)
8200	.690(17.53)	.790(20.07)	.150(3.81)	.320 (8.13)	.880(22.35)	.141(3.58)	.425(10.80)	.040(1.02)
9100	.690(17.53)	.790(20.07)	.150(3.81)	.330 (8.38)	.880(22.35)	.141(3.58)	.425(10.80)	.040(1.02)
10,000	.700(17.78)	.800(20.32)	.200(5.08)	.340 (8.64)	.890(22.61)	.141(3.58)	.425(10.80)	.040(1.02)
11,000	.700(17.78)	.800(20.32)	.200(5.08)	.350 (8.89)	.890(22.61)	.141(3.58)	.425(10.80)	.040(1.02)
12,000	.700(17.78)	.800(20.32)	.200(5.08)	.360 (9.14)	.890(22.61)	.141(3.58)	.425(10.80)	.040(1.02)
13,000	.710(18.03)	.810(20.57)	.200(5.08)	.370 (9.40)	.890(22.61)	.141(3.58)	.425(10.80)	.040(1.02)
15,000	.710(18.03)	.810(20.57)	.250(6.35)	.390 (9.91)	.900(22.86)	.141(3.58)	.425(10.80)	.040(1.02)
16,000	.720(18.29)	.820(20.83)	.250(6.35)	.410(10.41)	.900(22.86)	.141(3.58)	.425(10.80)	.040(1.02)
18,000	.720(18.29)	.820(20.83)	.250(6.35)	.430(10.92)	.910(23.11)	.141(3.58)	.425(10.80)	.040(1.02)
20,000	.730(18.54)	.830(21.08)	.250(6.35)	.450(11.43)	.920(23.37)	.141(3.58)	.425(10.80)	.040(1.02)
STYLE CMR08								
22,000	1.300(33.02)	1.420(36.07)	.180(4.57)	.310 (7.87)	.880(22.35)	.141(3.58)	1.050(26.67)	.040(1.02)
24,000	1.310(33.27)	1.430(36.32)	.180(4.57)	.320 (8.13)	.880(22.35)	.141(3.58)	1.050(26.67)	.040(1.02)
27,000	1.320(33.53)	1.430(36.32)	.180(4.57)	.330 (8.38)	.880(22.35)	.141(3.58)	1.050(26.67)	.040(1.02)
30,000	1.330(33.78)	1.440(36.58)	.180(4.57)	.350 (8.89)	.890(22.61)	.141(3.58)	1.050(26.67)	.040(1.02)
33,000	1.330(33.78)	1.440(36.58)	.180(4.57)	.360 (9.14)	.890(22.61)	.141(3.58)	1.050(26.67)	.040(1.02)
36,000	1.340(34.04)	1.450(36.83)	.180(4.57)	.380 (9.65)	.900(22.86)	.141(3.58)	1.050(26.67)	.040(1.02)
39,000	1.340(34.04)	1.450(36.83)	.220(5.59)	.400(10.16)	.900(22.86)	.141(3.58)	1.050(26.67)	.040(1.02)
43,000	1.350(34.29)	1.460(37.08)	.225(5.72)	.420(10.67)	.910(23.11)	.141(3.58)	1.050(26.67)	.040(1.02)
47,000	1.360(34.54)	1.470(37.34)	.250(6.35)	.450(11.43)	.910(23.11)	.141(3.58)	1.050(26.67)	.040(1.02)
51,000	1.370(34.80)	1.480(37.59)	.250(6.35)	.470(11.94)	.920(23.37)	.141(3.58)	1.050(26.67)	.040(1.02)
56,000	1.350(34.29)	1.460(37.08)	.225(5.72)	.420(10.67)	.910(23.11)	.141(3.58)	1.050(26.67)	.040(1.02)
62,000	1.360(34.54)	1.470(37.34)	.250(6.35)	.450(11.43)	.920(23.37)	.141(3.58)	1.050(26.67)	.040(1.02)
68,000	1.370(34.80)	1.480(37.59)	.260(6.60)	.470(11.94)	.920(23.37)	.141(3.58)	1.050(26.67)	.040(1.02)
75,000	1.360(34.54)	1.470(37.34)	.240(6.10)	.440(11.18)	.910(23.11)	.141(3.58)	1.050(26.67)	.040(1.02)
82,000	1.370(34.80)	1.480(37.59)	.310(7.87)	.460(11.68)	.920(23.37)	.141(3.58)	1.050(26.67)	.040(1.02)
91,000	1.390(35.31)	1.500(38.10)	.340(8.64)	.500(12.70)	.940(23.88)	.141(3.58)	1.050(26.67)	.040(1.02)

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors. - Continued

602 (MIL-C-39001)

MIL-STD-198E

STANDARD CAPACITORS

STYLES CMR04, CMR06, CMR07, AND CMR08 (MIL-C-39001/5),
OPERATING TEMPERATURE RANGE -55°C TO +150°C

Style	Type designation 1/	Capacitance value	DC rated voltage	Capacitance tolerance available
		<u>pF</u>	<u>volts</u>	
CMR04	CMR04C1R0DPD-	1.0	500	D
	CMR04C1R5DPD-	1.5	500	D
	CMR04C2R0DPD-	2.0	500	D
	CMR04C2R5DPD-	2.5	500	D
	CMR04C3R0DPD-	3.0	500	D
	CMR04C3R5DPD-	3.5	500	D
	CMR04C4R0DPD-	4.0	500	D
	CMR04C4R5DPD-	4.5	500	D
	CMR04C5R0DPD-	5.0	500	D
	CMR04C6R0DPD-	6.0	500	D
	CMR04C7R0DPD-	7.0	500	D
	CMR04C8R0DPD-	8.0	500	D
	CMR04C9R0DPD-	9.0	500	D
	CMR04C10DPD-	10	500	D
	CMR04C120JPD-	12	500	J
	CMR04C150JPD-	15	500	J
	CMR04C180JPD-	18	500	J
	CMR04E200JPD-	20	500	J
	CMR04E220JPD-	22	500	J
	CMR04E240JPD-	24	500	J
	CMR04E270-PD-	27	500	GJ
	CMR04E300-PD-	30	500	GJ
	CMR04E330-PD-	33	500	GJ
	CMR04E360-PD-	36	500	GJ
	CMR04E390-PD-	39	500	GJ
	CMR04E430-PD-	43	500	GJ
	CMR04E470-PD-	47	500	GJ
	CMR04E510-PD-	51	500	FGJ
	CMR04E560-PD-	56	500	FGJ
	CMR04E620-PD-	62	500	FGJ
	CMR04E680-PD-	68	500	FGJ
	CMR04E750-PD-	75	500	FGJ
	CMR04E820-PD-	82	500	FGJ
	CMR04F910-PD-	91	500	FGJ
	CMR04F101-PD-	100	500	FGJ
	CMR04F111-PD-	110	500	FGJ
	CMR04F121-PD-	120	500	FGJ
	CMR04F131-PD-	130	500	FGJ
	CMR04F151-PD-	150	500	FGJ
	CMR04F161-PD-	160	500	FGJ
	CMR04F181-PD-	180	500	FGJ
CMR04F201-PD-	200	500	FGJ	
CMR04F221-PD-	220	500	FGJ	
CMR04F241-PD-	240	500	FGJ	
CMR04F271-PC-	270	300	FGJ	
CMR04F301-PC-	300	300	FGJ	
CMR04F331-PA-	330	100	FGJ	
CMR04F361-PA-	360	100	FGJ	
CMR04F391-PA-	390	100	FGJ	

See footnote at end of figure.

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CMR04, CMR05, CMR06, CMR07, AND CMR08 (MIL-C-39001/5)
 OPERATING TEMPERATURE RANGE -55°C TO +150°C - Continued

Style	Type designation <u>1/</u>	Capacitance value	DC rated voltage	Capacitance tolerance available
		<u>pF</u>	<u>volts</u>	
CMR05	CMR05C1R0DPD-	1.0	500	D
	CMR05C1R5DPD-	1.5	500	D
	CMR05C2R0DPD-	2.0	500	D
	CMR05C2R5DPD-	2.5	500	D
	CMR05C3R0DPD-	3.0	500	D
	CMR05C3R5DPD-	3.5	500	D
	CMR05C4R0DPD-	4.0	500	D
	CMR05C4R5DPD-	4.5	500	D
	CMR05C5R0DPD-	5.0	500	D
	CMR05C6R0DPD-	6.0	500	D
	CMR05C7R0DPD-	7.0	500	D
	CMR05C8R0DPD-	8.0	500	D
	CMR05C9R0DPD-	9.0	500	D
	CMR05C10DPD-	10	500	D
	CMR05C120JPD-	12	500	J
	CMR05C150JPD-	15	500	J
	CMR05C180JPD-	18	500	J
	CMR05E200JPD-	20	500	J
	CMR05E220JPD-	22	500	J
	CMR05E240JPD-	24	500	J
	CMR05E270-PD-	27	500	GJ
	CMR05E300-PD-	30	500	GJ
	CMR05E330-PD-	33	500	GJ
	CMR05E360-PD-	36	500	GJ
	CMR05E390-PD-	39	500	GJ
	CMR05E430-PD-	43	500	GJ
	CMR05E470-PD-	47	500	GJ
	CMR05E510-PD-	51	500	FGJ
	CMR05E560-PD-	56	500	FGJ
	CMR05E620-PD-	62	500	FGJ
	CMR05E680-PD-	68	500	FGJ
	CMR05E750-PD-	75	500	FGJ
	CMR05E820-PD-	82	500	FGJ
	CMR05F910-PD-	91	500	FGJ
	CMR05F101-PD-	100	500	FGJ
	CMR05F111-PD-	110	500	FGJ
	CMR05F121-PD-	120	500	FGJ
	CMR05F131-PD-	130	500	FGJ
	CMR05F151-PD-	150	500	FGJ
	CMR05F161-PD-	160	500	FGJ
	CMR05F181-PD-	180	500	FGJ
	CMR05F201-PD-	200	500	FGJ
	CMR05F221-PD-	220	500	FGJ
CMR05F241-PD-	240	500	FGJ	
CMR05F271-PC-	270	500	FGJ	
CMR05F301-PC-	300	500	FGJ	
CMR05F331-PA-	330	500	FGJ	
CMR05F361-PA-	360	500	FGJ	
CMR05F391-PA-	390	500	FGJ	

See footnote at end of figure.

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CMR04, CMR06, CMR07, AND CMR08 (MIL-C-39001/5),
 OPERATING TEMPERATURE RANGE -55°C TO +150°C - Continued

Style	Type designation 1/	Capacitance value	DC rated voltage	Capacitance tolerance available
		<u>pF</u>	<u>volts</u>	
CMR06	CMR06F431-PD-	430	500	FGJ
	CMR06F471-PD-	470	500	FGJ
	CMR06F511-PD-	510	500	FGJ
	CMR06F561-PD-	560	500	FGJ
	CMR06F621-PD-	620	500	FGJ
	CMR06F681-PD-	680	500	FGJ
	CMR06F751-PD-	750	500	FGJ
	CMR06F821-PD-	820	500	FGJ
	CMR06F911-PD-	910	500	FGJ
	CMR06F102-PD-	1,000	500	FGJ
	CMR06F112-PD-	1,100	500	FGJ
	CMR06F122-PD-	1,200	500	FGJ
	CMR06F132-PD-	1,300	500	FGJ
	CMR06F152-PD-	1,500	500	FGJ
	CMR06F162-PD-	1,600	500	FGJ
	CMR06F182-PD-	1,800	500	FGJ
	CMR06F202-PD-	2,000	500	FGJ
	CMR06F222-PD-	2,200	500	FGJ
	CMR06F242-PD-	2,400	500	FGJ
	CMR06F272-PD-	2,700	500	FGJ
	CMR06F302-PD-	3,000	500	FGJ
	CMR06F332-PD-	3,300	500	FGJ
	CMR06F362-PD-	3,600	500	FGJ
	CMR06F392-PD-	3,900	500	FGJ
CMR06F432-PD-	4,300	500	FGJ	
CMR06F472-PD-	4,700	500	FGJ	
CMR07	CMR07F512-PD-	5,100	500	FGJ
	CMR07F562-PD-	5,600	500	FGJ
	CMR07F622-PD-	6,200	500	FGJ
	CMR07F682-PD-	6,800	500	FGJ
	CMR07F752-PD-	7,500	500	FGJ
	CMR07F822-PD-	8,200	500	FGJ
	CMR07F912-PD-	9,100	500	FGJ
	CMR07F103-PD-	10,000	500	FGJ
	CMR07F113-PD-	11,000	500	FGJ
	CMR07F123-PD-	12,000	500	FGJ
	CMR07F133-PD-	13,000	500	FGJ
	CMR07F153-PD-	15,000	500	FGJ
	CMR07F163-PD-	16,000	500	FGJ
	CMR07F183-PD-	18,000	500	FGJ
CMR07F203-PD-	20,000	500	FGJ	

See footnote at end of figure.

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors - Continued.

(MIL-C-39001)

MIL-STD-198E

STANDARD CAPACITORS

STYLES CMR04, CMR05, CMR06, CMR07, AND CMR08 (MIL-C-39001/5),
 OPERATING TEMPERATURE RANGE -55°C TO +150°C - Continued

Style	Type designation ^{1/}	Capacitance value	DC rated voltage	Capacitance tolerance available
		<u>pF</u>	<u>volts</u>	
CMR08	CMR08F223-PD-	22,000	500	FGJ
	CMR08F243-PD-	24,000	500	FGJ
	CMR08F273-PD-	27,000	500	FGJ
	CMR08F303-PD-	30,000	500	FGJ
	CMR08F333-PD-	33,000	500	FGJ
	CMR08F363-PD-	36,000	500	FGJ
	CMR08F393-PD-	39,000	500	FGJ
	CMR08F433-PD-	43,000	500	FGJ
	CMR08F473-PD-	47,000	500	FGJ
	CMR08F513-PD-	51,000	500	FGJ
	CMR08F563-PC-	56,000	300	FGJ
	CMR08F623-PC-	62,000	300	FGJ
	CMR08F683-PC-	68,000	300	FGJ
	CMR08F753-PA-	75,000	100	FGJ
	CMR08F823-PA-	82,000	100	FGJ
	CMR08F913-PA-	91,000	100	FGJ

^{1/} Where applicable, the complete type designation will include additional letter symbols to indicate the dc rated voltage, capacitance tolerance, and failure rate level.

FIGURE 602-3. Established reliability, mica dielectric, fixed capacitors - Continued.

MIL-STD-198E

SECTION 700

CAPACITORS, FIXED, ELECTROLYTIC, ESTABLISHED RELIABILITY

<u>Section</u>	<u>Applicable specification</u>
701. Capacitors, Fixed, Electrolytic (Solid Electrolyte), Tantalum, Established Reliability - - - - -	MIL-C-39003
702. Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte), Tantalum, Established Reliability - - - - -	MIL-C-39006
703. Capacitors, Chip, Fixed, Tantalum, Established Reliability - - - - -	MIL-C-55365
704. Capacitors, Fixed, Electrolytic (Aluminum Oxide), Established Reliability - - - - -	MIL-C-39018

USAF AIRBORNE APPLICATIONS REQUIRE
PRIOR APPROVAL BY PROCURING ACTIVITY

MI L-STD-198E

SECTION 701

CAPACITORS, FIXED, ELECTROLYTIC (SOLID ELECTROLYTE),
TANTALUM, ESTABLISHED RELIABILITY

STYLES CSR13, CSR91, AND CSR21

(APPLICABLE SPECIFICATION: MIL-C-39003)

1. SCOPE. This section covers established reliability, insulated, tantalum, solid-electrolyte, fixed capacitors, hermetically sealed in metal cases. These capacitors have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 60 percent confidence level and are based on operation at full rated voltage at +85°C. When properly derated, these units will operate at +125°C.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are intended for use in equipment where a known order of reliability is required. These electrolytic capacitors are the most stable and most reliable electrolytic available, having a longer life characteristic than any of the other electrolytic capacitors. Because of their passive electrolyte being solid and dry, these capacitors are not temperature-sensitive; they have a lower capacitance-temperature characteristic than any of the other electrolytic capacitors. Their limitations are the relatively high leakage current, limited voltage range available (6 to 100 volts), and maximum allowable reverse voltage of 15 percent of the rated dc voltage at +25°C to 1 percent at +125°C. CSR13 and CSR91 style capacitors are generally used where low-frequency pulsating dc components are to be bypassed or filtered out.

CSR21 style capacitors provide more stable capacitance, equivalent series resistance, and impedance than other tantalum capacitors at high frequency. They have heavier ripple current ratings than other types which make them particularly suitable for applications such as output filtering for switching regulator power supplies. Such uses require low impedance in series with the capacitors (see figure 701.4). Solid tantalum capacitors are used in electronic equipment where large capacitance values are required, where space is at a premium, and where there are significant quantities of shock and vibration. These capacitors are mainly designed for filter, by-pass, coupling, blocking, energy storage, and other low voltage dc applications (such as transistor circuit in missile, computer, and aircraft electronic equipment) where stability, size, weight, and shelf life are important factors. When designing transistor, timing, phase shifting, and vacuum-tube grid circuits, the dissipation factor and power factor should be taken into consideration. For bypassing resistors, a ratio of bias resistance to capacitive reactance of 10 to 1 is usually allowed. Ratios up to 20 to 1 may be used in high-fidelity amplifier work or where space and economical considerations permit. In circuits where linear amplification is required, the amount of capacitive reactance shunting a cathode resistor will depend on the percentage of degenerative feedback desired.

These capacitors are available as polarized and nonpolarized types. Polarized types should have their cases at the same potential as the negative lead; they should be used only in dc circuits with polarity observed. Nonpolarized types should be used where reversal of potential occurs.

2.2 Construction. A porous tantalum pellet or wire serves as the anode of a solid tantalum capacitor. The surfaces of the anode are electrochemically converted to an oxide of tantalum which serves as the dielectric. These surfaces are coated with an oxide semiconductor which is the working electrolyte in solid form. This oxide semiconductor establishes contact with all of the complex surfaces of the anodized pellet and is capable of healing imperfections of the tantalum oxide dielectric film.

NOTE: In high impedance circuits, momentary breakdowns (if present) will self-heal; however, in low impedance circuits, their self-healing characteristics under momentary breakdown of the dielectric film will be nonexistent. The large currents in low impedance circuits will cause permanent damage to the capacitor.

2.3 Voltage rating. These capacitors have a voltage rating over a range of 6 to 100 volts.

2.4 Operating temperature range. These capacitors are suitable for operation over a temperature range of -55° to $+85^{\circ}\text{C}$.

2.5 Voltage derating. When properly derated, these units may be operated over a temperature range of -55°C to $+125^{\circ}\text{C}$. The derated voltage at $+125^{\circ}\text{C}$ is approximately 66 percent of the full rated voltage.

2.6 Reverse voltage. These capacitors are capable of withstanding peak voltages in the reverse direction equal to 15 percent of their dc rating at $+25^{\circ}\text{C}$; 10 percent at $+55^{\circ}\text{C}$; 5 percent at $+85^{\circ}\text{C}$; and 1 percent at $+125^{\circ}\text{C}$.

2.7 Permissible ripple voltage. These capacitors may be operated with an impressed ripple (ac) voltage provided the capacitors do not exceed their heat-dissipation limits. Total heat-dissipation limits depend on the ambient operating temperature and the operating frequency. For example, A 10- μf capacitor of any voltage may be operated at 1.9 Vrms, 120 Hz, 25°C , or at 0.75 volts rms, 120 Hz, 125°C . (See figure 701-1.) When this same capacitor is subjected to a ripple frequency of 1,000 Hz; the permissible ripple voltage must be reduced by the ratio of permissible ac at 120 Hz (see figure 701-2) as follows: 1.9 times 0.47/1.9 equals 0.47 Vrms at 25°C , 1,000 Hz; or 0.75 times 0.47/1.9 equals 0.19 Vrms at 125°C , 1,000 Hz. The sum of the applied dc bias voltage and the peak of the ac ripple voltage should not exceed the dc rated voltage for the applicable ambient temperature. Permissible ac voltage determined from figures 701-1 and 701-2 may be applied when the dc voltage is zero or near zero, provided the negative [real pf] of the ac voltage does not exceed the allowable reverse voltage limits of 1 percent of the rated voltage at $+125^{\circ}\text{C}$. For CSR21 capacitors, ripple voltage is more often limited by restraints on reversal of voltage. Ripple current limitations are more significant because the degradation mode is thermal and must not be allowed to exceed the maximum levels specified for each rating, frequency, and ambient temperature. Figures 701-1 and 701-2 should be used with caution with regard to CSR21.

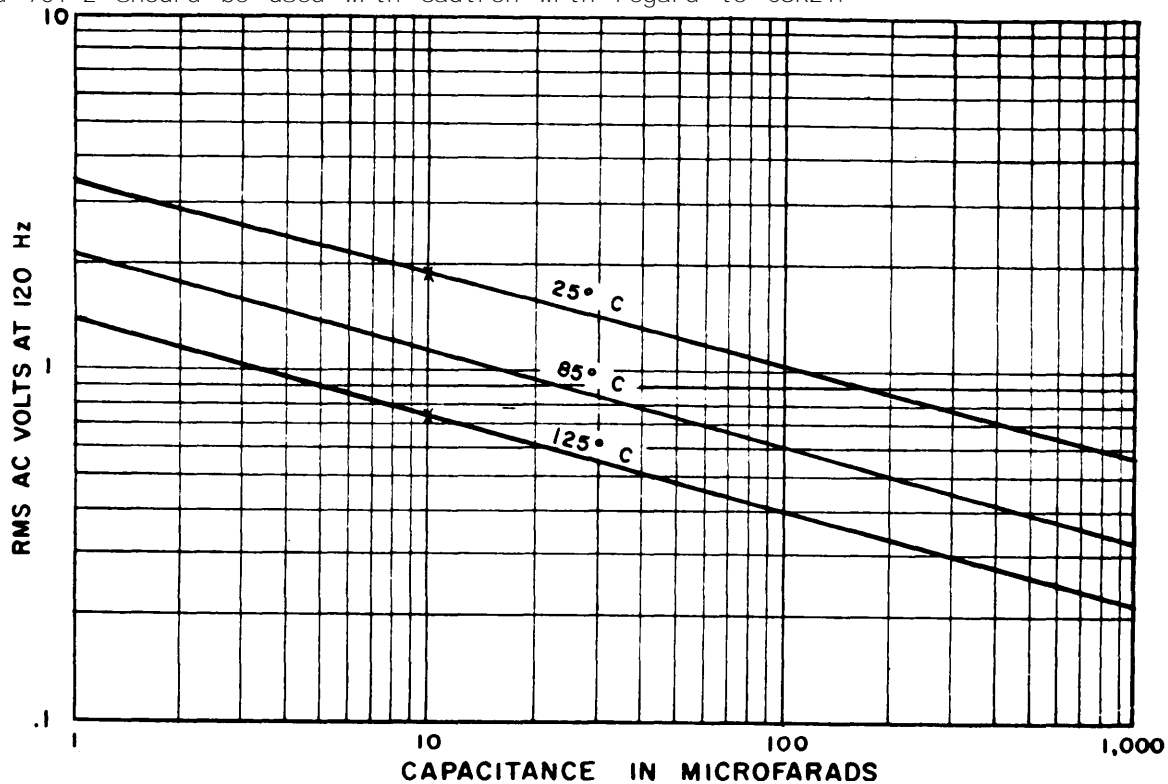


FIGURE 701-1. Permissible ripple voltage versus capacitance and ambient temperature at 120 Hz. 701 (MIL-C-39003)

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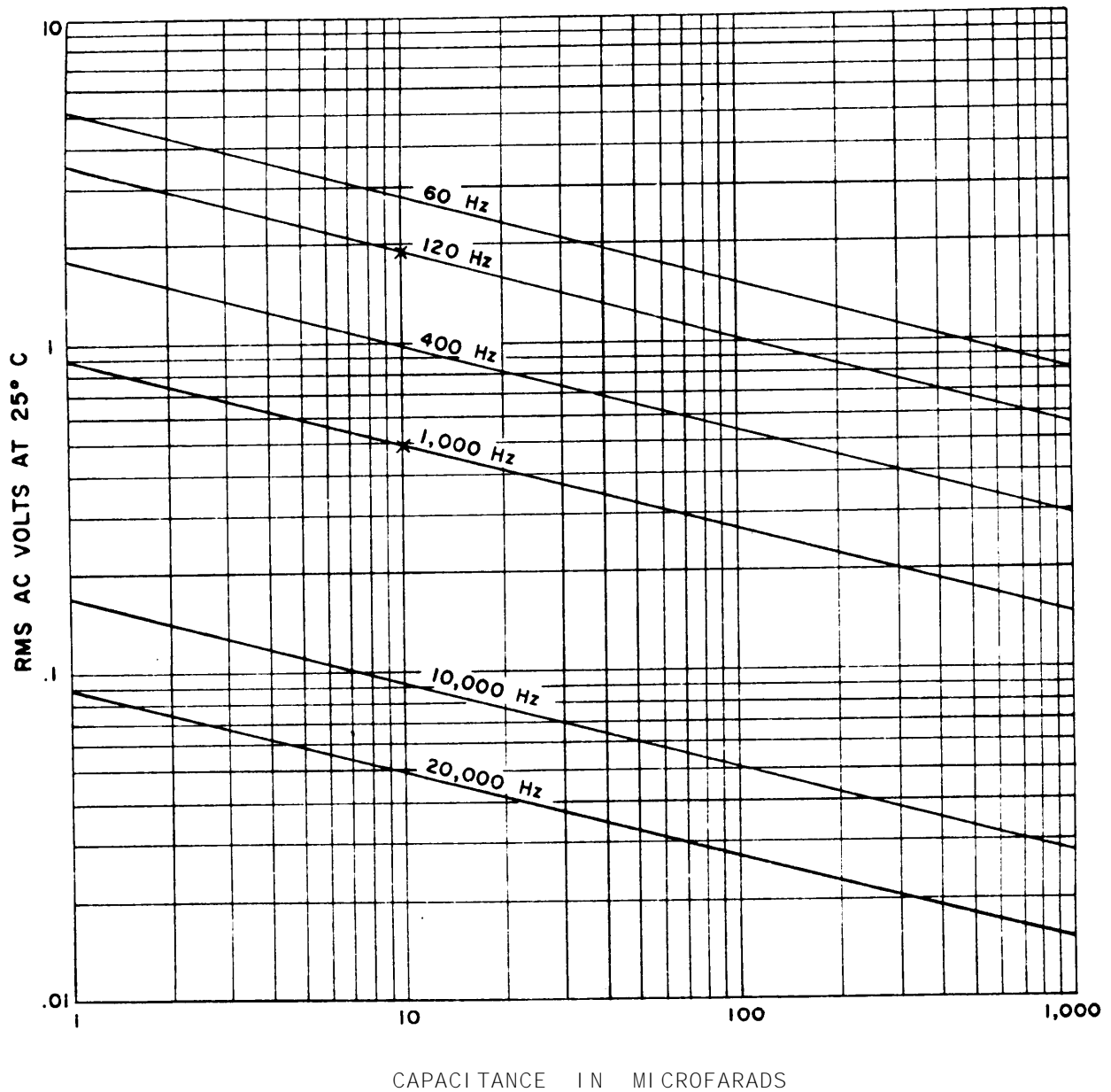


FIGURE 701-2. Permissible ripple voltage versus capacitance and frequency at 25° C.

2.8 Series and parallel networks:

2.8.1 Series. It is recommended that when these capacitors are connected in series, the maximum voltage across the network should not be greater than the lowest voltage rating of any capacitor in the network, or that voltage divider resistors be used to prevent over voltage on one or more units of the series capacitor group.

2.8.2 Parallel. To obtain a higher capacitance than can be obtained from a single capacitor, a number of units may be connected in parallel. However, the sum of the peak ripple and the applied dc voltage should not exceed the dc working voltage of the unit with the lowest voltage rating. The connecting leads of the parallel network should be large enough to carry the combined currents without reducing the effective capacitance due to series lead resistance.

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2.9 Dielectric absorption. Dielectric absorption may be observed by the reappearance of potential across the capacitor after it has been shorted and the short removed. This characteristic is important in RC timing circuits, triggering systems, and phase-shift networks. The curves shown on figure 701-3 were established by charging capacitors for 1 hour at rated voltage and then discharging them through a dead short for 1 minute.

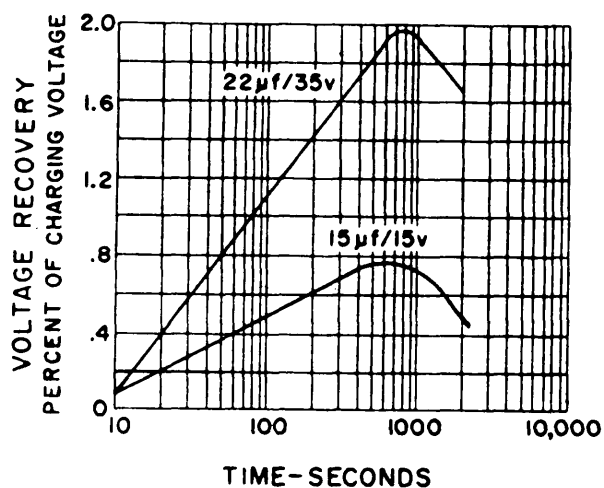


FIGURE 701-3. Typical dielectric absorption of solid-electrolyte tantalum capacitors at 25°C.

Voltage recovery was measured with a high-impedance electrometer at the intervals given on the curves. Increasing the ambient temperature shifts the curves to the left and decreases the amplitude but does not affect the shape. Shortening charge time, lengthening discharge time, or decreasing charging voltage results in reduction of the peak amplitude of the curve, but has little effect on its shape or relative position.

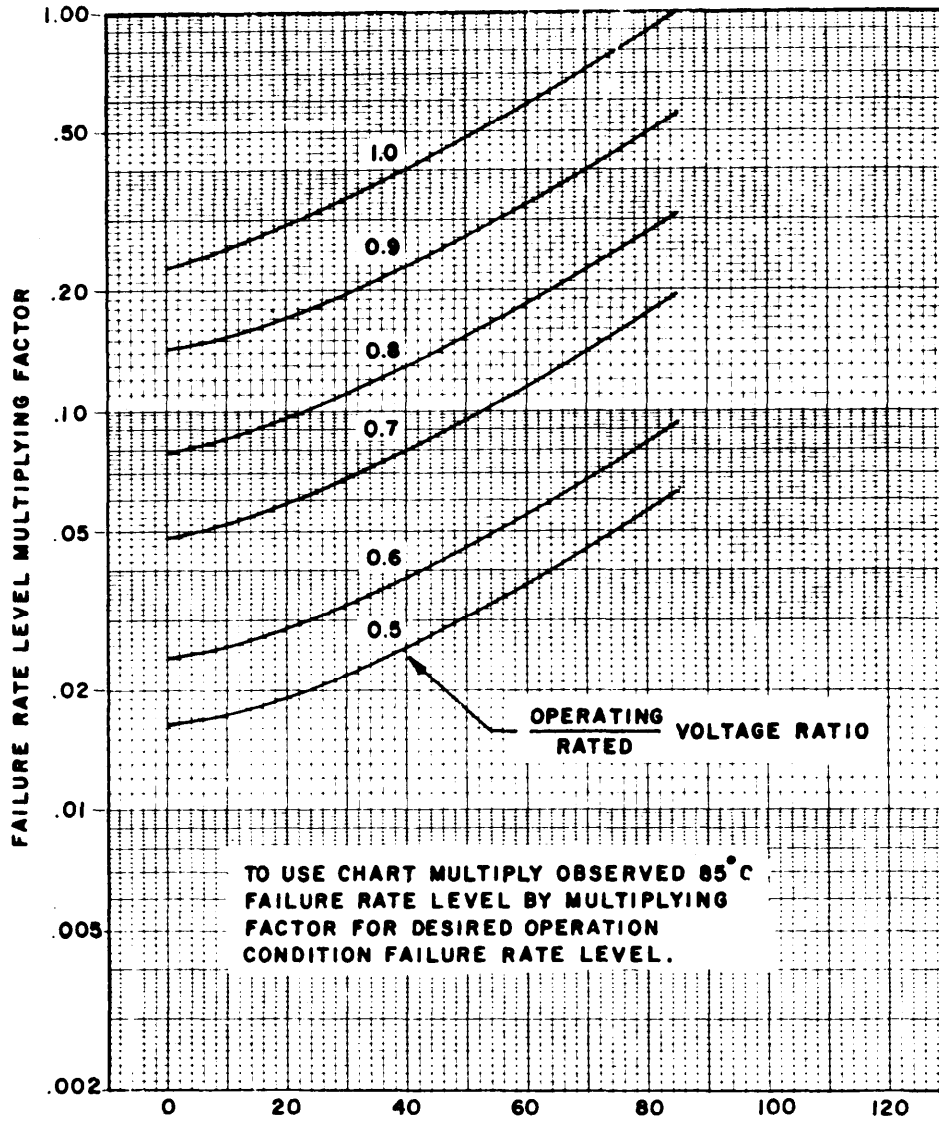
2.10 Comparison with aluminum electrolytic. Tantalum solid electrolytic capacitors differ from aluminum electrolytics in several important aspects; namely, substantially indefinite shelf life, superior low temperature characteristics, complete freedom from electrolyte leakage, and higher operating temperatures. However, because tantalum electrolytic capacitors generally are more costly than aluminum electrolytic capacitors, consideration should be given to the use of aluminum electrolytic capacitors if their performance characteristics and physical sizes are suitable and if the application will permit.

2.11 Mounting. Supplementary mounting means should be used where the application of these capacitors involves vibration frequencies above 55 Hz.

2.12 Increased reliability. Failure rate is a function of temperature, applied voltage, and circuit impedance. Increased reliability may be obtained by derating the temperature and applied voltage and increasing circuit impedances.

DC leakage current increases when either voltage or temperature is increased; the rate of increase is greater at the higher values of voltage and temperature. A point can be reached where the dc leakage current will avalanche and attain proportions that will permanently damage the capacitor. Consequently, capacitors should never be operated above their rated temperature and rated voltage for that temperature.

By increasing the circuit impedance, the leakage current is reduced. In life testing the solid tantalum capacitor, the capacitance and dissipation factor are very stable over long periods of time and hence are not a suitable measure of deterioration. Leakage current variation is a better indicator of capacitor condition. In the life test in MIL-C-39003, a maximum impedance of 3 ohms is allowed. It is recommended that a minimum circuit impedance of 3 ohms per applied volt (1.5 ohms per volt for CSR21) be utilized to attain improved reliability.



NOTE:
multiply the value read from figure 701-4 by the following applicable multiplying factor:

Styles CSR13 and CSR91		Style CSR21	
Circuit impedance Ohms/volt	Multiplying factor	Circuit impedance Ohms/volt	Multiplying factor
3 or greater	1.0	1.5 or greater	1.0
2	1.4	1	1.4
1	2.8	.5	2.8
0.9	2.9	.45	2.9
0.8	3.2	.4	3.2
0.6	4.0	.3	4.0
0.5	4.5	.25	4.5
0.4	5.1	.20	5.1
0.3	6.1	.15	6.1
0.2	7.5	.1	7.5
0.15	9.0	.075	9.0
0.10	12.0	.05	12.0

FIGURE 701-4. Failure rate level curves.

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2.13 Failure-rate level determination. The curves presented on figure 701-4 are the best engineering approximation of the reliability characteristics (random failures) for these capacitors when employed repeatedly, within their specification ratings, in complex electronic equipment. These reliability characteristics are based on ground-level severity experience. Failures are considered to be opens, shorts, or radical departures from initial characteristics. The failures are considered to be occurring in an unpredictable manner and in too short a period of time to permit detection through normal preventive maintenance. The curves shown on figure 701-4 are based on "catastrophic failures" and will differ from the failure rates established in the specification, since the established failure rates are based on "parametric failures" over long term life tests at rated conditions. Figure 701-4 has been extracted from MIL-HDBK-217, "Reliability Stress and Failure Rate Data for Electronic Equipment." The curves have been modified from their original version in that the ordinate has been normalized in order to provide multiplier factors in place of discrete failure rate levels and in order that the multiplying factor for a failure rate at rated conditions is unity. As indicated, these curves are the best estimates based on "catastrophic failures"; however, they can provide an estimate of the relative effect of operating under conditions other than rated.

2.14 General. When additional experience and data are obtained relative to the reliability of these units, such information will be added herein.

3. ITEM IDENTIFICATION.

3.1 Standard capacitor. The standard capacitors available in this section are shown in figure 701-5. (The figure gives the electrical characteristics, case sizes, failure rate levels, and Military part numbers which are standard for design.)

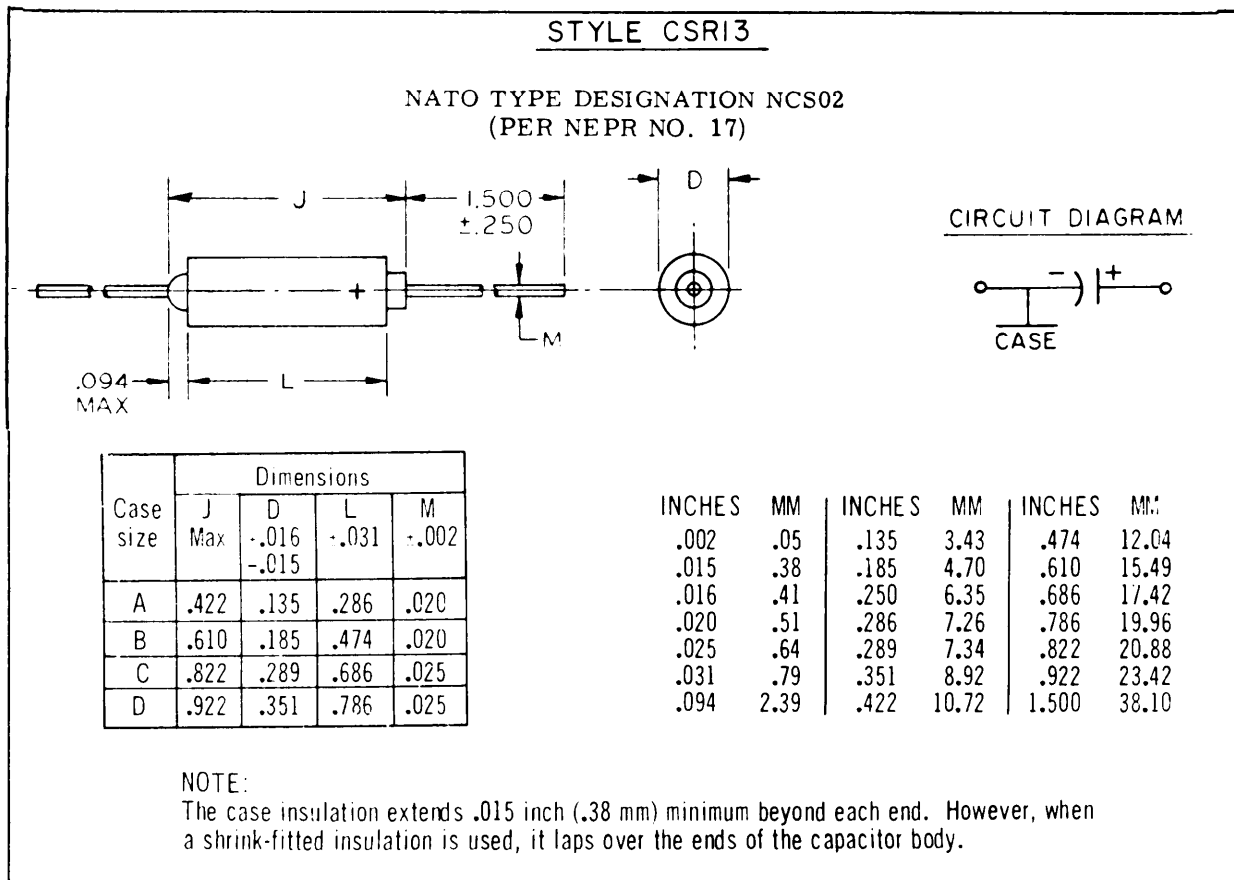


FIGURE 701-5. Established reliability tantalum solid electrolyte fixed capacitors.

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STANDARD CAPACITORS
STYLE CSR13 (MIL-C-39003/1)

OPERATING TEMPERATURE RANGE -55°C TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage at			Dissipation factor at		Case size	Dash number M39003/01 - Failure rate level (%/1,000 hr)				
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)	
volts	μF	percent	μA	μA	μA	percent	percent						
6	5.6	5	.3	6.0	7.5	4	4	A	5001	5201	5401	5601	
6	5.6	10	.3	6.0	7.5	4	4	A	2241	2481	2721	2961	
6	6.8	5	.3	6.0	7.5	6	6	A	5002	5202	5402	5602	
6	6.8	10	.3	6.0	7.5	6	6	A	2242	2482	2722	2962	
6	6.8	20	.3	6.0	7.5	6	6	A	2243	2483	2723	2963	
6	47.0	5	1.5	24.0	30.0	6	6	B	5003	5203	5403	5603	
6	47.0	10	1.5	24.0	30.0	6	6	B	2244	2484	2724	2964	
6	47.0	20	1.5	24.0	30.0	6	6	B	2245	2485	2725	2965	
6	56.0	5	1.5	24.0	30.0	6	6	B	5004	5204	5404	5604	
6	56.0	10	1.5	24.0	30.0	6	6	B	2246	2486	2726	2966	
6	150.0	5	4.5	90.0	113.0	8	8	C	5005	5205	5405	5605	
6	150.0	10	4.5	90.0	113.0	8	8	C	2247	2487	2727	2967	
6	150.0	20	4.5	90.0	113.0	8	8	C	2248	2488	2728	2968	
6	180.0	5	5.5	110.0	138.0	8	8	C	5006	5206	5406	5606	
6	180.0	10	5.5	110.0	138.0	8	8	C	2249	2489	2729	2969	
6	270.0	5	6.5	130.0	163.0	8	8	D	5007	5207	5407	5607	
6	270.0	10	6.5	130.0	163.0	8	8	D	2250	2490	2730	2970	
6	330.0	5	7.5	150.0	188.0	8	8	D	5008	5208	5408	5608	
6	330.0	10	7.5	150.0	188.0	8	8	D	2251	2491	2731	2971	
6	330.0	20	7.5	150.0	188.0	8	8	D	2252	2492	2732	2972	
10	3.9	5	.3	6.0	7.5	4	4	A	5009	5209	5409	5609	
10	3.9	10	.3	6.0	7.5	4	4	A	2253	2493	2733	2973	
10	4.7	5	.4	7.0	8.8	4	4	A	5010	5210	5410	5610	
10	4.7	10	.4	7.0	8.8	4	4	A	2254	2494	2734	2974	
10	4.7	20	.4	7.0	8.8	4	4	A	2255	2495	2735	2975	
10	27.0	5	2.0	40.0	50.0	6	6	B	5011	5211	5411	5611	
10	27.0	10	2.0	40.0	50.0	6	6	B	2256	2496	2736	2976	
10	33.0	5	2.5	50.0	63.0	6	6	B	5012	5212	5412	5612	
10	33.0	10	2.5	50.0	63.0	6	6	B	2257	2497	2737	2977	
10	33.0	20	2.5	50.0	63.0	6	6	B	2258	2498	2738	2978	
10	39.0	5	2.5	50.0	63.0	6	6	B	5013	5213	5413	5613	
10	39.0	10	2.5	50.0	63.0	6	6	B	2259	2499	2739	2979	
10	82.0	5	4.0	80.0	100.0	6	6	C	5014	5214	5414	5614	
10	82.0	10	4.0	80.0	100.0	6	6	C	2260	2500	2740	2980	
10	100.0	5	5.0	100.0	125.0	8	8	C	5015	5215	5415	5615	
10	100.0	10	5.0	100.0	125.0	8	8	C	2261	2501	2741	2981	
10	100.0	20	5.0	100.0	125.0	8	8	C	2262	2502	2742	2982	
10	120.0	5	6.0	120.0	150.0	8	8	C	5016	5216	5416	5616	
10	120.0	10	6.0	120.0	150.0	8	8	C	2263	2503	2743	2983	
10	180.0	5	9.0	180.0	226.0	8	8	D	5017	5217	5417	5617	
10	180.0	10	9.0	180.0	226.0	8	8	D	2264	2504	2744	2984	
10	220.0	5	10	200.0	250.0	8	8	D	5018	5218	5418	5618	
10	220.0	10	10	200.0	250.0	8	8	D	2265	2505	2745	2985	
10	220.0	20	10	200.0	250.0	8	8	D	2266	2506	2746	2986	
15	2.7	5	.3	6.0	7.5	4	4	A	5019	5219	5419	5619	
15	2.7	10	.3	6.0	7.5	4	4	A	2267	2507	2747	2987	
15	3.3	5	.4	8.0	10.0	4	4	A	5020	5220	5420	5620	
15	3.3	10	.4	8.0	10.0	4	4	A	2268	2508	2748	2988	
15	3.3	20	.4	8.0	10.0	4	4	A	2269	2509	2749	2989	
15	18.0	5	2.0	35.0	44.0	6	6	B	5021	5221	5421	5621	

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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STANDARD CAPACITORS
STYLE CSR13 (MIL-C-39003/1) - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage at			Dissipation factor at		Case size	Dash number M39003/01- Failure rate level (%/1,000 hr)				
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)	
volts	μF	percent	μA	μA	μA	percent	percent						
15	18.0	10	2.0	35.0	44.0	6	6	B	2270	2510	2750	2990	
15	22.0	5	2.0	40.0	50.0	6	6	B	5022	5222	5422	5622	
15	22.0	10	2.0	40.0	50.0	6	6	B	2271	2511	2751	2991	
15	22.0	20	2.0	40.0	50.0	6	6	B	2272	2512	2752	2992	
15	56.0	5	4.0	80.0	100.0	6	6	C	5023	5223	5423	5623	
15	56.0	10	4.0	80.0	100.0	6	6	C	2273	2513	2753	2993	
15	68.0	5	5.0	100.0	125.0	6	6	C	5024	5224	5424	5624	
15	68.0	10	5.0	100.0	125.0	6	6	C	2274	2514	2754	2994	
15	68.0	20	5.0	100.0	125.0	6	6	C	2275	2515	2755	2995	
15	120.0	5	9.0	180.0	226.0	8	8	D	5025	5225	5425	5625	
15	120.0	10	9.0	180.0	226.0	8	8	D	2276	2516	2756	2996	
15	150.0	5	10.0	200.0	250.0	8	8	D	5026	5226	5426	5626	
15	150.0	10	10.0	200.0	250.0	8	8	D	2277	2517	2757	2997	
15	150.0	20	10.0	200.0	250.0	8	8	D	2278	2518	2758	2998	
20	1.2	5	.3	6.0	7.5	4	4	A	5027	5227	5427	5627	
20	1.2	10	.3	6.0	7.5	4	4	A	2279	2519	2759	2999	
20	1.5	5	.3	6.0	7.5	4	4	A	5028	5228	5428	5628	
20	1.5	10	.3	6.0	7.5	4	4	A	2280	2520	2760	3000	
20	1.5	20	.3	6.0	7.5	4	4	A	2281	2521	2761	3001	
20	1.8	5	.3	6.0	7.5	4	4	A	5029	5229	5429	5629	
20	1.8	10	.3	6.0	7.5	4	4	A	2282	2522	2762	3002	
20	2.2	5	.4	8.0	10.0	4	4	A	5030	5230	5430	5630	
20	2.2	10	.4	8.0	10.0	4	4	A	2283	2523	2763	3003	
20	2.2	20	.4	8.0	10.0	4	4	A	2284	2524	2764	3004	
20	8.2	5	1.0	20.0	25.0	6	6	B	5031	5231	5431	5631	
20	8.2	10	1.0	20.0	25.0	6	6	B	2285	2525	2765	3005	
20	10.0	5	1.5	30.0	38.0	6	6	B	5032	5232	5432	5632	
20	10.0	10	1.5	30.0	38.0	6	6	B	2286	2526	2766	3006	
20	10.0	20	1.5	30.0	38.0	6	6	B	2287	2527	2767	3007	
20	12.0	5	1.8	35.0	44.0	6	6	B	5033	5233	5433	5633	
20	12.0	10	1.8	35.0	44.0	6	6	B	2288	2528	2768	3008	
20	15.0	5	2.0	40.0	50.0	6	6	B	5034	5234	5434	5634	
20	15.0	10	2.0	40.0	50.0	6	6	B	2289	2529	2769	3009	
20	15.0	20	2.0	40.0	50.0	6	6	B	2290	2530	2770	3010	
20	27.0	5	2.5	50.0	63.0	6	6	C	5035	5235	5435	5635	
20	27.0	10	2.5	50.0	63.0	6	6	C	2291	2531	2771	3011	
20	33.0	5	3.5	70.0	88.0	6	6	C	5036	5236	5436	5636	
20	33.0	10	3.5	70.0	88.0	6	6	C	2292	2532	2772	3012	
20	33.0	20	3.5	70.0	88.0	6	6	C	2293	2533	2773	3013	
20	39.0	5	4.0	80.0	100.0	6	6	C	5037	5237	5437	5637	
20	39.0	10	4.0	80.0	100.0	6	6	C	2294	2534	2774	3014	
20	47.0	5	4.5	90.0	113.0	6	6	C	5038	5238	5438	5638	
20	47.0	10	4.5	90.0	113.0	6	6	C	2295	2535	2775	3015	
20	47.0	20	4.5	90.0	113.0	6	6	C	2296	2536	2776	3016	
20	56.0	5	5.5	110.0	138.0	6	6	D	5039	5239	5439	5639	
20	56.0	10	5.5	110.0	138.0	6	6	D	2297	2537	2777	3017	
20	68.0	5	7.0	140.0	175.0	6	6	D	5040	5240	5440	5640	
20	68.0	10	7.0	140.0	175.0	6	6	D	2298	2538	2778	3018	
20	68.0	20	7.0	140.0	175.0	6	6	D	2299	2539	2779	3019	
20	82.0	5	8.0	160.0	200.0	6	6	D	5041	5241	5441	5641	

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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STANDARD CAPACITORS
STYLE CSR13 (MIL-C-39003/1) - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage at			Dissipation factor at		Case size	Dash number M39003/01- Failure rate level (%/1,000 hr)			
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)
volts	μF	percent	μA	μA	μA	percent	percent					
20	82.0	10	8.0	160.0	200.0	6	6	D	2300	2540	2780	3020
20	100.0	5	10	200.0	250.0	8	8	D	5042	5242	5442	5642
20	100.0	10	10	200.0	250.0	8	8	D	2301	2541	2781	3021
20	100.0	20	10	200.0	250.0	8	8	D	2302	2542	2782	3022
35	5.6	5	1.3	25.0	32.0	4	4	B	5043	5243	5443	5643
35	5.6	10	1.3	25.0	32.0	4	4	B	2303	2543	2783	3023
35	6.8	5	1.5	30.0	38.0	6	6	B	5044	5244	5444	5644
35	6.8	10	1.5	30.0	38.0	6	6	B	2304	2544	2784	3024
35	6.8	20	1.5	30.0	38.0	6	6	B	2305	2545	2785	3025
35	22.0	5	4.0	80.0	100.0	6	6	C	5045	5245	5445	5645
35	22.0	10	4.0	80.0	100.0	6	6	C	2306	2546	2786	3026
35	22.0	20	4.0	80.0	100.0	6	6	C	2307	2547	2787	3027
35	27.0	5	4.5	90.0	113.0	6	6	D	5046	5246	5446	5646
35	27.0	10	4.5	90.0	113.0	6	6	D	2308	2548	2788	3028
35	33.0	5	5.5	110.0	138.0	6	6	D	5047	5247	5447	5647
35	33.0	10	5.5	110.0	138.0	6	6	D	2309	2549	2789	3029
35	33.0	20	5.5	110.0	138.0	6	6	D	2310	2550	2790	3030
35	39.0	5	7.0	140.0	175.0	6	6	D	5048	5248	5448	5648
35	39.0	10	7.0	140.0	175.0	6	6	D	2311	2551	2791	3031
35	47.0	5	8.0	160.0	200.0	6	6	D	5049	5249	5449	5649
35	47.0	10	8.0	160.0	200.0	6	6	D	2312	2552	2792	3032
35	47.0	20	8.0	160.0	200.0	6	6	D	2313	2553	2793	3033
50	.0047	5	↑	5.0	6.3	2	4	A	5050	5250	5450	5650
50	.0047	10	↑	5.0	6.3	2	4	A	2314	2554	2794	3034
50	.0047	20	↑	5.0	6.3	2	4	A	2315	2555	2795	3035
50	.0056	5	↑	5.0	6.3	2	4	A	5051	5251	5451	5651
50	.0056	10	↑	5.0	6.3	2	4	A	2316	2556	2796	3036
50	.0068	5	↑	5.0	6.3	2	4	A	5052	5252	5452	5652
50	.0068	10	↑	5.0	6.3	2	4	A	2317	2557	2797	3037
50	.0068	20	↑	5.0	6.3	2	4	A	2318	2558	2798	3038
50	.0082	5	↑	5.0	6.3	2	4	A	5053	5253	5453	5653
50	.0082	10	↑	5.0	6.3	2	4	A	2319	2559	2799	3039
50	.01	5	↑	5.0	6.3	2	4	A	5054	5254	5454	5654
50	.01	10	↑	5.0	6.3	2	4	A	2320	2560	2800	3040
50	.01	20	↑	5.0	6.3	2	4	A	2321	2561	2801	3041
50	.012	5	↑	5.0	6.3	2	4	A	5055	5255	5455	5655
50	.012	10	↑	5.0	6.3	2	4	A	2322	2562	2802	3042
50	.015	5	↑	5.0	6.3	2	4	A	5056	5256	5456	5656
50	.015	10	↑	5.0	6.3	2	4	A	2323	2563	2803	3043
50	.015	20	↑	5.0	6.3	2	4	A	2324	2564	2804	3044
50	.018	5	↑	5.0	6.3	2	4	A	5057	5257	5457	5657
50	.018	10	↑	5.0	6.3	2	4	A	2325	2565	2805	3045
50	.022	5	↑	5.0	6.3	2	4	A	5058	5258	5458	5658
50	.022	10	↑	5.0	6.3	2	4	A	2326	2566	2806	3046
50	.022	20	↑	5.0	6.3	2	4	A	2327	2567	2807	3047
50	.027	5	↑	5.0	6.3	2	4	A	5059	5259	5459	5659
50	.027	10	↑	5.0	6.3	2	4	A	2328	2568	2808	3048
50	.033	5	↑	5.0	6.3	2	4	A	5060	5260	5460	5660
50	.033	10	↑	5.0	6.3	2	4	A	2329	2569	2809	3049
50	.033	20	↑	5.0	6.3	2	4	A	2330	2570	2810	3050

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
STYLE CSR13 (MIL-C-39003/1) - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage at			Dissipation factor at		Case size	Dash number M39003/01- Failure rate level (%/1,000 hr)			
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)
volts	μF	percent	μA	μA	μA	percent	percent					
50	.039	5	.3	5.0	6.3	2	4	A	5061	5261	5461	5661
50	.039	10	↑	↑	↑	2	4	A	2331	2571	2811	3051
50	.047	5	↑	↑	↑	2	4	A	5062	5262	5462	5662
50	.047	10	↑	↑	↑	2	4	A	2332	2572	2812	3052
50	.047	20	↑	↑	↑	2	4	A	2333	2573	2813	3053
50	.056	5	↑	↑	↑	2	4	A	5063	5263	5463	5663
50	.056	10	↑	↑	↑	2	4	A	2334	2574	2814	3054
50	.068	5	↑	↑	↑	2	4	A	5064	5264	5464	5664
50	.068	10	↑	↑	↑	2	4	A	2335	2575	2815	3055
50	.068	20	↑	↑	↑	2	4	A	2336	2576	2816	3056
50	.082	5	↑	↑	↑	2	4	A	5065	5265	5465	5665
50	.082	10	↑	↑	↑	2	4	A	2337	2577	2817	3057
50	.1	5	↑	↑	↑	2	4	A	5066	5266	5466	5666
50	.1	10	↑	↑	↑	2	4	A	2338	2578	2818	3058
50	.1	20	↑	↑	↑	2	4	A	2339	2579	2819	3059
50	.12	5	↑	↑	↑	2	4	A	5067	5267	5467	5667
50	.12	10	↑	↑	↑	2	4	A	2340	2580	2820	3060
50	.15	5	↑	↑	↑	2	4	A	5068	5268	5468	5668
50	.15	10	↑	↑	↑	2	4	A	2341	2581	2821	3061
50	.15	20	↑	↑	↑	2	4	A	2342	2582	2822	3062
50	.18	5	↑	↑	↑	2	4	A	5069	5269	5469	5669
50	.18	10	↑	↑	↑	2	4	A	2343	2583	2823	3063
50	.22	5	↑	↑	↑	2	4	A	5070	5270	5470	5670
50	.22	10	↑	↑	↑	2	4	A	2344	2584	2824	3064
50	.22	20	↑	↑	↑	2	4	A	2345	2585	2825	3065
50	.27	5	↑	↑	↑	2	4	A	5071	5271	5471	5671
50	.27	10	↑	↑	↑	2	4	A	2346	2586	2826	3066
50	.33	5	↑	↑	↑	2	4	A	5072	5272	5472	5672
50	.33	10	↑	↑	↑	2	4	A	2347	2587	2827	3067
50	.33	20	↑	↑	↑	2	4	A	2348	2588	2828	3068
50	.39	5	↑	↑	↑	2	4	A	5073	5273	5473	5673
50	.39	10	↑	↑	↑	2	4	A	2349	2589	2829	3069
50	.47	5	↑	↑	↑	2	4	A	5074	5274	5474	5674
50	.47	10	↑	↑	↑	2	4	A	2350	2590	2830	3070
50	.47	20	↑	↑	↑	2	4	A	2351	2591	2831	3071
50	.56	5	↑	↑	↑	2	4	A	5075	5275	5475	5675
50	.56	10	↑	↑	↑	2	4	A	2352	2592	2832	3072
50	.68	5	↑	↑	↑	2	4	A	5076	5276	5476	5676
50	.68	10	↑	↑	↑	2	4	A	2353	2593	2833	3073
50	.68	20	↑	↑	↑	2	4	A	2354	2594	2834	3074
50	.82	5	↓	↓	↓	2	4	A	5077	5277	5477	5677
50	.82	10	↓	↓	↓	2	4	A	2355	2595	2835	3075
50	1.0	5	.4	8.0	10.0	2	4	A	5078	5278	5478	5678
50	1.0	10	.4	8.0	10.0	2	4	A	2356	2596	2836	3076
50	1.0	20	.4	8.0	10.0	2	4	A	2357	2597	2837	3077
50	1.2	5	.4	9.0	11.0	4	4	B	5079	5279	5479	5679
50	1.2	10	.4	9.0	11.0	4	4	B	2358	2598	2838	3078
50	1.5	5	.6	12.0	15.0	4	4	B	5080	5280	5480	5680
50	1.5	10	.6	12.0	15.0	4	4	B	2359	2599	2839	3079
50	1.5	20	.6	12.0	15.0	4	4	B	2360	2600	2840	3080

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
STYLE CSR13 (MIL-C-39003/1) - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage at			Dissipation factor at		Case size	Dash number M39003/01- Failure rate level (%/1,000 hr)			
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)
volts	μF	percent	μA	μA	μA	percent	percent					
50	1.8	5	.7	14.0	18.0	4	4	B	5081	5281	5481	5681
50	1.8	10	.7	14.0	18.0	4	4	B	2361	2601	2841	3081
50	2.2	5	.8	17.0	22.0	4	4	B	5082	5282	5482	5682
50	2.2	10	.8	17.0	22.0	4	4	B	2362	2602	2842	3082
50	2.2	20	.8	17.0	22.0	4	4	B	2363	2603	2843	3083
50	2.7	5	1.0	20.0	25.0	4	4	B	5083	5283	5483	5683
50	2.7	10	1.0	20.0	25.0	4	4	B	2364	2604	2844	3084
50	3.3	5	1.2	25.0	32.0	4	4	B	5084	5284	5484	5684
50	3.3	10	1.2	25.0	32.0	4	4	B	2365	2605	2845	3085
50	3.3	20	1.2	25.0	32.0	4	4	B	2366	2606	2846	3086
50	3.9	5	1.5	30.0	38.0	4	4	B	5085	5285	5485	5685
50	3.9	10	1.5	30.0	38.0	4	4	B	2367	2607	2847	3087
50	4.7	5	1.7	35.0	44.0	4	4	B	5086	5286	5486	5686
50	4.7	10	1.7	35.0	44.0	4	4	B	2368	2608	2848	3088
50	4.7	20	1.7	35.0	44.0	4	4	B	2369	2609	2849	3089
50	5.6	5	2.2	45.0	56.0	4	4	C	5087	5287	5487	5687
50	5.6	10	2.2	45.0	56.0	4	4	C	2370	2610	2850	3090
50	6.8	5	2.2	45.0	56.0	6	6	C	5088	5288	5488	5688
50	6.8	10	2.2	45.0	56.0	6	6	C	2371	2611	2851	3091
50	6.8	20	2.2	45.0	56.0	6	6	C	2372	2612	2852	3092
50	8.2	5	2.5	50.0	63.0	6	6	C	5089	5289	5489	5689
50	8.2	10	2.5	50.0	63.0	6	6	C	2373	2613	2853	3093
50	10.0	5	2.5	50.0	63.0	6	6	C	5090	5290	5490	5690
50	10.0	10	2.5	50.0	63.0	6	6	C	2374	2614	2854	3094
50	10.0	20	2.5	50.0	63.0	6	6	C	2375	2615	2855	3095
50	12.0	5	3.0	60.0	75.0	6	6	C	5091	5291	5491	5691
50	12.0	10	3.0	60.0	75.0	6	6	C	2376	2616	2856	3096
50	15.0	5	4.0	80.0	100.0	6	6	C	5092	5292	5492	5692
50	15.0	10	4.0	80.0	100.0	6	6	C	2377	2617	2857	3097
50	15.0	20	4.0	80.0	100.0	6	6	C	2378	2618	2858	3098
50	18.0	5	4.5	90.0	113.0	6	6	C	5093	5293	5493	5693
50	18.0	10	4.5	90.0	113.0	6	6	C	2379	2619	2859	3099
50	22.0	5	5.5	110.0	138.0	6	6	D	5094	5294	5494	5694
50	22.0	10	5.5	110.0	138.0	6	6	D	2380	2620	2860	3100
50	22.0	20	5.5	110.0	138.0	6	6	D	2381	2621	2861	3101
75	.1	5	.3	5.0	6.3	2	4	A	5095	5295	5495	5695
75	.1	10	↑	↑	↑	2	4	A	2382	2622	2862	3102
75	.1	20	↑	↑	↑	2	4	A	2383	2623	2863	3103
75	.12	5	↑	↑	↑	2	4	A	5096	5296	5496	5696
75	.12	10	↑	↑	↑	2	4	A	2384	2624	2864	3104
75	.15	5	↑	↑	↑	2	4	A	5097	5297	5497	5697
75	.15	10	↑	↑	↑	2	4	A	2385	2625	2865	3105
75	.15	20	↑	↑	↑	2	4	A	2386	2626	2866	3106
75	.18	5	↑	↑	↑	2	4	A	5098	5298	5498	5698
75	.18	10	↑	↑	↑	2	4	A	2387	2627	2867	3107
75	.22	5	↑	↑	↑	2	4	A	5099	5299	5499	5699
75	.22	10	↑	↑	↑	2	4	A	2388	2628	2868	3108
75	.22	20	↑	↑	↑	2	4	A	2389	2629	2869	3109
75	.27	5	↓	↓	↓	2	4	A	5100	5300	5500	5700
75	.27	10	↓	↓	↓	2	4	A	2390	2630	2870	3110

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CSR13 (MIL-C-39003/1) - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage at			Dissipation factor at		Case size	Dash number M39003/01- Failure rate level (%/1,000 hr)			
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)
volts	μF	percent	μA	μA	μA	percent	percent					
75	.33	5	.3	5.0	6.3	2	4	A	5101	5301	5501	5701
75	.33	10	↑	↑	↑	2	4	A	2391	2631	2871	3111
75	.33	20	↑	↑	↑	2	4	A	2392	2632	2872	3112
75	.39	5	↑	↑	↑	2	4	A	5102	5302	5502	5702
75	.39	10	↑	↑	↑	2	4	A	2393	2633	2873	3113
75	.47	5	↑	↑	↑	2	4	A	5103	5303	5503	5703
75	.47	10	↑	↑	↑	2	4	A	2394	2634	2874	3114
75	.47	20	↑	↑	↑	2	4	A	2395	2635	2875	3115
75	.56	5	↑	↑	↑	2	4	A	5104	5304	5504	5704
75	.56	10	↑	↑	↑	2	4	A	2396	2636	2876	3116
75	.68	5	↑	↑	↑	2	4	A	5105	5305	5505	5705
75	.68	10	↑	↑	↑	2	4	A	2397	2637	2877	3117
75	.68	20	↑	↑	↑	2	4	A	2398	2638	2878	3118
75	.82	5	↓	↓	↓	2	4	B	5106	5306	5506	5706
75	.82	10	↓	↓	↓	2	4	B	2399	2639	2879	3119
75	1.0	5	.4	5.0	6.3	2	4	B	5107	5307	5507	5707
75	1.0	10	.4	↓	↓	2	4	B	2400	2640	2880	3120
75	1.0	20	.4	↓	↓	2	4	B	2401	2641	2881	3121
75	1.2	5	.4	5.0	6.3	4	4	B	5108	5308	5508	5708
75	1.2	10	.4	5.0	6.3	4	4	B	2402	2642	2882	3122
75	1.5	5	.6	10.0	13.0	4	4	B	5109	5309	5509	5709
75	1.5	10	.6	10.0	13.0	4	4	B	2403	2643	2883	3123
75	1.5	20	.6	10.0	13.0	4	4	B	2404	2644	2884	3124
75	1.8	5	.7	10.0	13.0	4	4	B	5110	5310	5510	5710
75	1.8	10	.7	10.0	13.0	4	4	B	2405	2645	2885	3125
75	2.2	5	.8	15.0	19.0	4	4	B	5111	5311	5511	5711
75	2.2	10	.8	15.0	19.0	4	4	B	2406	2646	2886	3126
75	2.2	20	.8	15.0	19.0	4	4	B	2407	2647	2887	3127
75	2.7	5	1.0	15.0	19.0	4	4	B	5112	5312	5512	5712
75	2.7	10	1.0	15.0	19.0	4	4	B	2408	2648	2888	3128
75	3.3	5	1.2	20.0	25.0	4	4	B	5113	5313	5513	5713
75	3.3	10	1.2	20.0	25.0	4	4	B	2409	2649	2889	3129
75	3.3	20	1.2	20.0	25.0	4	4	B	2410	2650	2890	3130
75	3.9	5	1.5	20.0	25.0	4	4	B	5114	5314	5514	5714
75	3.9	10	1.5	20.0	25.0	4	4	B	2411	2651	2891	3131
75	4.7	5	3.0	60.0	75.0	4	4	C	5115	5315	5515	5715
75	4.7	10	3.0	60.0	75.0	4	4	C	2412	2652	2892	3132
75	4.7	20	3.0	60.0	75.0	4	4	C	2413	2653	2893	3133
75	5.6	5	3.0	60.0	75.0	4	4	C	5116	5316	5516	5716
75	5.6	10	3.0	60.0	75.0	4	4	C	2414	2654	2894	3134
75	6.8	5	5.0	100.0	125.0	6	6	C	5117	5317	5517	5717
75	6.8	10	↑	↑	↑	6	6	C	2415	2655	2895	3135
75	6.8	20	↑	↑	↑	6	6	C	2416	2656	2896	3136
75	8.2	5	↑	↑	↑	6	6	C	5118	5318	5518	5718
75	8.2	10	↑	↑	↑	6	6	C	2417	2657	2897	3137
75	10.0	5	↑	↑	↑	6	6	C	5119	5319	5519	5719
75	10.0	10	↑	↑	↑	6	6	C	2418	2658	2898	3138
75	10.0	20	↑	↑	↑	6	6	C	2419	2659	2899	3139
75	12.0	5	↓	↓	↓	6	6	D	5120	5320	5520	5720
75	12.0	10	↓	↓	↓	6	6	D	2420	2660	2900	3140

FIGURE 701-5. Established reliability, tantalum solid electrolyte fixed capacitors - Continued.

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 STANDARD CAPACITORS
 STYLE CSR13 (MIL-C-39003/1) - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage at			Dissipation factor at		Case size	Dash number M39003/01 - Failure rate level (%/1,000 hr)				
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)	
volts	μF	percent	μA	μA	μA	percent	percent						
75	15.0	5	7.0	140.0	175.0	6	6	D	5121	5321	5521	5721	
75	15.0	10	7.0	140.0	175.0	6	6	D	2421	2661	2901	3141	
75	15.0	20	7.0	140.0	175.0	6	6	D	2422	2662	2902	3142	
100	.0047	5	.3	5.0	6.3	2	4	A	5122	5322	5522	5722	
100	.0047	10	↑	↑	↑	2	4	A	2423	2663	2903	3143	
100	.0047	20	↑	↑	↑	2	4	A	2424	2664	2904	3144	
100	.0056	5	↑	↑	↑	2	4	A	5123	5323	5523	5723	
100	.0056	10	↑	↑	↑	2	4	A	2425	2665	2905	3145	
100	.0068	5	↑	↑	↑	2	4	A	5124	5324	5524	5724	
100	.0068	10	↑	↑	↑	2	4	A	2426	2666	2906	3146	
100	.0068	20	↑	↑	↑	2	4	A	2427	2667	2907	3147	
100	.0082	5	↑	↑	↑	2	4	A	5125	5325	5525	5725	
100	.0082	10	↑	↑	↑	2	4	A	2428	2668	2908	3148	
100	.01	5	↑	↑	↑	2	4	A	5126	5326	5526	5726	
100	.01	10	↑	↑	↑	2	4	A	2429	2669	2909	3149	
100	.01	20	↑	↑	↑	2	4	A	2430	2670	2910	3150	
100	.012	5	↑	↑	↑	2	4	A	5127	5327	5527	5727	
100	.012	10	↑	↑	↑	2	4	A	2431	2671	2911	3151	
100	.015	5	↑	↑	↑	2	4	A	5128	5328	5528	5728	
100	.015	10	↑	↑	↑	2	4	A	2432	2672	2912	3152	
100	.015	20	↑	↑	↑	2	4	A	2433	2673	2913	3153	
100	.018	5	↑	↑	↑	2	4	A	5129	5329	5529	5729	
100	.018	10	↑	↑	↑	2	4	A	2434	2674	2914	3154	
100	.022	5	↑	↑	↑	2	4	A	5130	5330	5530	5730	
100	.022	10	↑	↑	↑	2	4	A	2435	2675	2915	3155	
100	.022	20	↑	↑	↑	2	4	A	2436	2676	2916	3156	
100	.027	5	↑	↑	↑	2	4	A	5131	5331	5531	5731	
100	.027	10	↑	↑	↑	2	4	A	2437	2677	2917	3157	
100	.033	5	↑	↑	↑	2	4	A	5132	5332	5532	5732	
100	.033	10	↑	↑	↑	2	4	A	2438	2678	2918	3158	
100	.033	20	↑	↑	↑	2	4	A	2439	2679	2919	3159	
100	.039	5	↑	↑	↑	2	4	A	5133	5333	5533	5733	
100	.039	10	↑	↑	↑	2	4	A	2440	2680	2920	3160	
100	.047	5	↑	↑	↑	2	4	A	5134	5334	5534	5734	
100	.047	10	↑	↑	↑	2	4	A	2441	2681	2921	3161	
100	.047	20	↑	↑	↑	2	4	A	2442	2682	2922	3162	
100	.056	5	↑	↑	↑	2	4	A	5135	5335	5535	5735	
100	.056	10	↑	↑	↑	2	4	A	2443	2683	2923	3163	
100	.068	5	↑	↑	↑	2	4	A	5136	5336	5536	5736	
100	.068	10	↑	↑	↑	2	4	A	2444	2684	2924	3164	
100	.068	20	↑	↑	↑	2	4	A	2445	2685	2925	3165	
100	.082	5	↑	↑	↑	2	4	A	5137	5337	5537	5737	
100	.082	10	↑	↑	↑	2	4	A	2446	2686	2926	3166	
100	.1	5	↑	↑	↑	2	4	A	5138	5338	5538	5738	
100	.1	10	↑	↑	↑	2	4	A	2447	2687	2927	3167	
100	.1	20	↑	↑	↑	2	4	A	2448	2688	2928	3168	
100	.12	5	↑	↑	↑	2	4	A	5139	5339	5539	5739	
100	.12	10	↑	↑	↑	2	4	A	2449	2689	2929	3169	
100	.15	5	↓	↓	↓	2	4	A	5140	5340	5540	5740	
100	.15	10	↓	↓	↓	2	4	A	2450	2690	2930	3170	

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

701 (MIL-C-39003)

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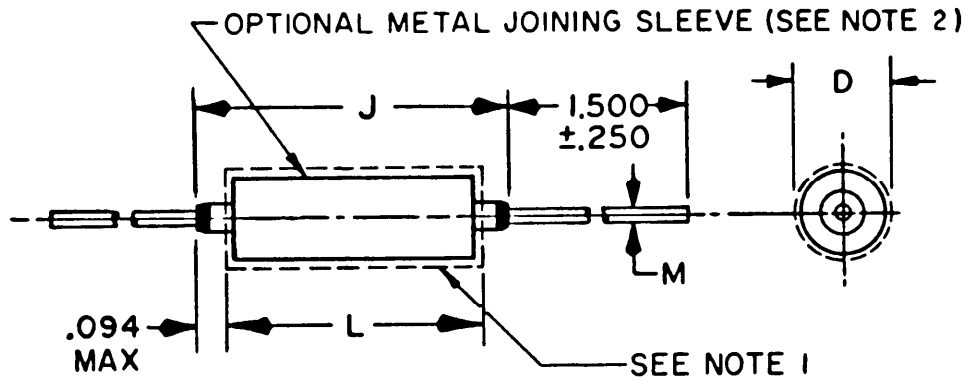
STANDARD CAPACITORS
 STYLE CSR13 (MIL-C-39003/1) - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

DC rated voltage	Cap. (nom)	Cap. tolerance	DC leakage			Dissipation factor at		Case size	Dash number M39003 01- Failure rate level (%/1,000 hr)			
			+25°C	+85°C	+125°C	-55°C +25°C	+85°C +125°C		M (1.0)	P (0.1)	R (0.01)	S (0.001)
volts	μF	percent	μA	μA	μA	percent	percent					
100	.15	20	.3	5.0	6.3	2	4	A	2451	2691	2931	3171
100	.18	5	↑	↑	↑	2	4	A	5141	5341	5541	5741
100	.18	10	↑	↑	↑	2	4	A	2452	2692	2932	3172
100	.22	5	↑	↑	↑	2	4	A	5142	5342	5542	5742
100	.22	10	↑	↑	↑	2	4	A	2453	2693	2933	3173
100	.22	20	↑	↑	↑	2	4	A	2454	2694	2934	3174
100	.27	5	↑	↑	↑	2	4	A	5143	5343	5543	5743
100	.27	10	↑	↑	↑	2	4	A	2455	2695	2935	3175
100	.33	5	↑	↑	↑	2	4	A	5144	5344	5544	5744
100	.33	10	↑	↑	↑	2	4	A	2456	2696	2936	3176
100	.33	20	↑	↑	↑	2	4	A	2457	2697	2937	3177
100	.39	5	↑	↑	↑	2	4	A	5145	5345	5545	5745
100	.39	10	↑	↑	↑	2	4	A	2458	2698	2938	3178
100	.47	5	↑	↑	↑	2	4	A	5146	5346	5546	5746
100	.47	10	↑	↑	↑	2	4	A	2459	2699	2939	3179
100	.47	20	↑	↑	↑	2	4	A	2460	2700	2940	3180
100	.56	5	↑	↑	↑	2	4	A	5147	5347	5547	5747
100	.56	10	↑	↑	↑	2	4	A	2461	2701	2941	3181
100	.68	5	↑	↑	↑	2	4	B	5148	5348	5548	5748
100	.68	10	↑	↑	↑	2	4	B	2462	2702	2942	3182
100	.68	20	.3	5.0	6.3	2	4	B	2463	2703	2943	3183
100	.82	5	.4	5.0	6.3	2	4	B	5149	5349	5549	5749
100	.82	10	.4	5.0	6.3	2	4	B	2464	2704	2944	3184
100	1.0	5	.5	5.0	6.3	2	4	B	5150	5350	5550	5750
100	1.0	10	.5	5.0	6.3	2	4	B	2465	2705	2945	3185
100	1.0	20	.5	5.0	6.3	2	4	B	2466	2706	2946	3186
100	1.2	5	.5	5.0	6.3	4	4	B	5151	5351	5551	5751
100	1.2	10	.5	5.0	6.3	4	4	B	2467	2707	2947	3187
100	1.5	5	.7	10.0	13.0	4	4	B	5152	5352	5552	5752
100	1.5	10	.7	10.0	13.0	4	4	B	2468	2708	2948	3188
100	1.5	20	.7	10.0	13.0	4	4	B	2469	2709	2949	3189
100	1.8	5	.7	10.0	13.0	4	4	B	5153	5353	5553	5753
100	1.8	10	.7	10.0	13.0	4	4	B	2470	2710	2950	3190
100	2.2	5	.9	15.0	19.0	4	4	B	5154	5354	5554	5754
100	2.2	10	.9	15.0	19.0	4	4	B	2471	2711	2951	3191
100	2.2	20	.9	15.0	19.0	4	4	B	2472	2712	2952	3192
100	2.7	5	1.1	15.0	19.0	4	4	B	5155	5355	5555	5755
100	2.7	10	1.1	15.0	19.0	4	4	B	2473	2713	2953	3193
100	3.3	5	1.5	30.0	38.0	6	6	C	5156	5356	5556	5756
100	3.3	10	1.5	30.0	38.0	6	6	C	5157	5357	5557	5757
100	3.3	20	1.5	30.0	38.0	6	6	C	5158	5358	5558	5758
100	3.9	5	1.5	30.0	38.0	6	6	C	5159	5359	5559	5759
100	3.9	10	1.5	30.0	38.0	6	6	C	5160	5360	5560	5760
100	4.7	5	2.5	50.0	63.0	6	6	C	5161	5361	5561	5761
100	4.7	10	2.5	50.0	63.0	6	6	C	5162	5362	5562	5762
100	4.7	20	2.5	50.0	63.0	6	6	C	5163	5363	5563	5763
100	5.6	5	2.5	50.0	63.0	6	6	C	5164	5364	5564	5764
100	5.6	10	2.5	50.0	63.0	6	6	C	5165	5365	5565	5765
100	6.8	5	2.5	50.0	63.0	6	6	C	5166	5366	5566	5766
100	6.8	10	2.5	50.0	63.0	6	6	C	5167	5367	5567	5767
100	6.8	20	2.5	50.0	63.0	6	6	C	5168	5368	5568	5768

FIGURE 701-5. Established reliability, tantalum, solid electrolyte,
 fixed capacitors - Continued.

STYLE CSR91 (MIL-C-39003/4)



Case size	Dimensions			
	L ±.031	D +.010 -.015	M ±.002	J Max
W	.575	.161	.020	.750
X	.955	.207	.020	1.130
Y	1.350	.314	.025	1.525
Z	1.550	.376	.025	1.725

INCHES	MM	INCHES	MM	INCHES	MM
.002	.05	.161	4.09	.955	24.26
.010	.25	.207	5.26	1.130	28.70
.015	.38	.250	6.35	1.350	34.29
.020	.51	.314	7.98	1.500	38.10
.025	.64	.376	9.55	1.525	38.74
.031	.79	.575	14.61	1.550	39.37
.094	2.39	.750	19.05	1.725	43.82

NOTES:

1. The case insulation shall extend .015(.38 mm) minimum beyond each end. However, when a shrink-fitted insulation is used, it shall lap over the ends of the capacitor body.
2. Two style CSR13 capacitors placed "back-to-back" (negative terminal -to-negative terminal).

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CSR91 (MIL-C-39003/4)

OPERATING TEMPERATURE RANGE -55° TO +85°C (DERATED TO +125°C)

Rated voltage	Capacitance (nom)	Capacitance tolerance	DC leakage (max) +25°C	Dissipation factor (max) +25°C	Case size	Dash number			
						Failure rate level (%/1,000 hr)			
Volts, NP	μF	percent	μA	percent		M(1.0)	P(0.1)	R(0.01)	S(0.001)
6	2.8	10	.3	4	W	0221	0441	0661	0881
6	3.4	10	.3	6	W	0222	0442	0662	0882
6	3.4	20	.3	6	W	0223	0443	0663	0883
6	23.0	10	1.5	6	X	0224	0444	0664	0884
6	23.0	20	1.5	6	X	0225	0445	0665	0885
6	28.0	10	1.5	6	X	0226	0446	0666	0886
6	75.0	10	4.5	8	Y	0227	0447	0667	0887
6	75.0	20	4.5	8	Y	0228	0448	0668	0888
6	90.0	10	5.5	8	Y	0229	0449	0669	0889
6	130.0	10	6.5	8	Z	0231	0451	0671	0891
6	160.0	10	7.5	8	Z	0233	0453	0673	0893
6	160.0	20	7.5	8	Z	0234	0454	0674	0894
10	1.9	10	.3	4	W	0235	0455	0675	0895
10	2.3	10	.4	4	W	0236	0456	0676	0896
10	2.3	20	.4	4	W	0237	0457	0677	0897
10	13.0	10	2.0	6	X	0238	0458	0678	0898
10	16.0	10	2.5	6	X	0239	0459	0679	0899
10	16.0	20	2.5	6	X	0240	0460	0680	0900
10	19.0	10	2.5	6	X	0241	0461	0681	0901
10	41.0	10	4.0	6	Y	0242	0462	0682	0902
10	50.0	10	5.0	8	Y	0243	0463	0683	0903
10	50.0	20	5.0	8	Y	0244	0464	0684	0904
10	60.0	10	6.0	8	Y	0245	0465	0685	0905
10	90.0	10	9.0	8	Z	0247	0467	0687	0907
10	110.0	10	10.0	8	Z	0248	0468	0688	0908
10	110.0	20	10.0	8	Z	0249	0469	0689	0909
15	1.3	10	.3	4	W	0250	0470	0690	0910
15	1.6	10	.4	4	W	0251	0471	0691	0911
15	1.6	20	.4	4	W	0252	0472	0692	0912
15	9.0	10	2.0	6	X	0253	0473	0693	0913
15	11.0	10	2.0	6	X	0254	0474	0694	0914
15	11.0	20	2.0	6	X	0255	0475	0695	0915
15	28.0	10	4.0	6	Y	0256	0476	0696	0916
15	34.0	10	5.0	6	Y	0257	0477	0697	0917
15	34.0	20	5.0	6	Y	0258	0478	0698	0918
15	60.0	10	9.0	8	Z	0259	0479	0699	0919
15	75.0	10	10.0	8	Z	0260	0480	0700	0920
15	75.0	20	10.0	8	Z	0261	0481	0701	0921
20	.6	10	.3	4	W	0262	0482	0702	0922
20	.75	10	.3	4	W	0263	0483	0703	0923
20	.75	20	.3	4	W	0264	0484	0704	0924
20	.9	10	.3	4	W	0265	0485	0705	0925
20	1.1	10	.4	4	W	0266	0486	0706	0926
20	1.1	20	.4	4	W	0267	0487	0707	0927
20	4.1	10	1.0	6	X	0268	0488	0708	0928
20	5.0	10	1.5	6	X	0269	0489	0709	0929
20	5.0	20	1.5	6	X	0270	0490	0710	0930

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CSR91 (MIL-C-39003/4) - Continued

Rated voltage	Capacitance (nom)	Capacitance tolerance	DC leakage (max) +25°C	Dissipation factor (max) +25°C	Case size	Dash number			
						Failure rate level (%/1,000 hr)			
						M(1.0)	P(0.1)	R(0.01)	S(0.001)
Volts, NP	μF	percent	μA	percent					
20	6.0	10	1.8	6	X	0271	0491	0711	0931
20	7.5	10	2.0	6	X	0272	0492	0712	0932
20	7.5	20	2.0	6	X	0273	0493	0713	0933
20	13	10	2.5	6	Y	0274	0494	0714	0934
20	16	10	3.5	6	Y	0275	0495	0715	0935
20	16	20	3.5	6	Y	0276	0496	0716	0936
20	19	10	4.0	6	Y	0277	0497	0717	0937
20	23	10	4.5	6	Y	0278	0498	0718	0938
20	23	20	4.5	6	Y	0279	0499	0719	0939
20	28	10	5.5	6	Z	0280	0500	0720	0940
20	34	10	7.0	6	Z	0281	0501	0721	0941
20	34	20	7.0	6	Z	0282	0502	0722	0942
20	41	10	8.0	6	Z	0283	0503	0723	0943
20	50	10	10.0	8	Z	0284	0504	0724	0944
20	50	20	10.0	8	Z	0285	0505	0725	0945
35	2.8	10	1.3	4	X	0289	0509	0729	0949
35	3.4	10	1.5	6	X	0290	0510	0730	0950
35	3.4	20	1.5	6	X	0291	0511	0731	0951
35	11.0	10	4.0	6	Y	0292	0512	0732	0952
35	11.0	20	4.0	6	Y	0293	0513	0733	0953
35	13.0	10	4.5	6	Z	0294	0514	0734	0954
35	16.0	10	5.5	6	Z	0295	0515	0735	0955
35	16.0	20	5.5	6	Z	0296	0516	0736	0956
35	19.0	10	7.0	6	Z	0297	0517	0737	0957
35	23.0	10	8.0	6	Z	0298	0518	0738	0958
35	23.0	20	8.0	6	Z	0299	0519	0739	0959
50	.0023	10	.3	2	W	1171	1241	1311	1381
50	.0023	20	.3	2	W	1172	1242	1312	1382
50	.0028	10	.3	2	W	1173	1243	1313	1383
50	.0034	10	.3	2	W	1174	1244	1314	1384
50	.0034	20	.3	2	W	1175	1245	1315	1385
50	.0041	10	.3	2	W	1176	1246	1316	1386
50	.005	10	.3	2	W	1177	1247	1317	1387
50	.005	20	.3	2	W	1178	1248	1318	1388
50	.006	10	.3	2	W	1179	1249	1319	1389
50	.0075	10	.3	2	W	1180	1250	1320	1390
50	.0075	20	.3	2	W	1181	1251	1321	1391
50	.009	10	.3	2	W	1182	1252	1322	1392
50	.011	10	.3	2	W	1183	1253	1323	1393
50	.011	20	.3	2	W	1184	1254	1324	1394
50	.013	10	.3	2	W	1185	1255	1325	1395
50	.016	10	.3	2	W	1186	1256	1326	1396
50	.016	20	.3	2	W	1187	1257	1327	1397
50	.019	10	.3	2	W	1188	1258	1328	1398
50	.023	10	.3	2	W	1189	1259	1329	1399
50	.023	20	.3	2	W	1190	1260	1330	1400
50	.028	10	.3	2	W	1191	1261	1331	1401
50	.034	10	.3	2	W	1192	1262	1332	1402
50	.034	20	.3	2	W	1193	1263	1333	1403
50	.041	10	.3	2	W	1194	1264	1334	1404

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CSR91 (MIL-C-39003/4) - Continued

Rated voltage	Capacitance (nom)	Capacitance tolerance	DC leakage (max) +25°C	Dissipation factor (max) +25°C	Case size	Dash number			
						Failure rate level (%/1,000 hr)			
						M(1.0)	P(0.1)	R(0.01)	S(0.001)
Volts, NP	μF	percent	μA	percent					
50	.05	10	.3	2	W	1195	1265	1335	1405
50	.05	20	.3	2	W	1196	1266	1336	1406
50	.06	10	.3	2	W	1197	1267	1337	1407
50	.075	10	.3	2	W	1198	1268	1338	1408
50	.075	20	.3	2	W	1199	1269	1339	1409
50	.09	10	.3	2	W	1200	1270	1340	1410
50	.11	10	.3	2	W	1201	1271	1341	1411
50	.11	20	.3	2	W	1202	1272	1342	1412
50	.13	10	.3	2	W	1203	1273	1343	1413
50	.16	10	.3	2	W	1204	1274	1344	1414
50	.16	20	.3	2	W	1205	1275	1345	1415
50	.19	10	.3	2	W	1206	1276	1346	1416
50	.23	10	.3	2	W	1207	1277	1347	1417
50	.23	20	.3	2	W	1208	1278	1348	1418
50	.28	10	.3	2	W	1209	1279	1349	1419
50	.34	10	.3	2	W	1210	1280	1350	1420
50	.34	20	.3	2	W	1211	1281	1351	1421
50	.41	10	.3	2	W	0300	0520	0740	0960
50	.50	10	.4	4	W	0301	0521	0741	0961
50	.50	20	.4	4	W	0302	0522	0742	0962
50	.60	10	.4	4	X	1212	1282	1352	1422
50	.75	10	.6	4	X	2001	2101	2201	2301
50	.75	20	.6	4	X	2002	2102	2202	2302
50	.90	10	.7	4	X	1215	1285	1355	1425
50	1.1	10	.8	4	X	1216	1286	1356	1426
50	1.1	20	.8	4	X	1217	1287	1357	1427
50	1.3	10	1.0	4	X	1218	1288	1358	1428
50	1.6	10	1.2	4	X	1219	1289	1359	1429
50	1.6	20	1.2	4	X	1220	1290	1360	1430
50	1.9	10	1.5	4	X	1221	1291	1361	1431
50	2.3	10	1.7	4	X	1222	1292	1362	1432
50	2.3	20	1.7	4	X	1223	1293	1363	1433
50	2.8	10	2.2	4	Y	1224	1294	1364	1434
50	3.4	10	2.2	6	Y	1225	1295	1365	1435
50	3.4	20	2.2	6	Y	1226	1296	1366	1436
50	4.1	10	2.5	6	Y	1227	1297	1367	1437
50	5.0	10	2.5	6	Y	1228	1298	1368	1438
50	5.0	20	2.5	6	Y	1229	1299	1369	1439
50	6.0	10	3.0	6	Y	0303	0523	0743	0963
50	7.5	10	4.0	6	Y	0304	0524	0744	0964
50	7.5	20	4.0	6	Y	0305	0525	0745	0965
50	9.0	10	4.5	6	Y	0306	0526	0746	0966
50	11.0	10	5.5	6	Z	0307	0527	0747	0967
50	11.0	20	5.5	6	Z	0308	0528	0748	0968
75	.34	10	.3	2	W	0309	0529	0749	0969
75	.34	20	.3	2	W	0310	0530	0750	0970
75	.41	10	.3	2	X	2008	2108	2208	2308
75	.50	10	.4	2	X	2009	2109	2209	2309
75	.50	20	.4	2	X	2010	2110	2210	2310
75	.60	10	.4	4	X	2011	2111	2211	2311

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CSR91 (MIL-C-39003/A) - Continued

Rated voltage	Capacitance (nom)	Capacitance tolerance	DC leakage (max) +25°C	Dissipation factor (max) +25°C	Case size	Dash number			
						Failure rate level (%/1,000 hr)			
						M(1.0)	P(0.1)	R(0.01)	S(0.001)
Volts, NP	μF	percent	μA	percent					
75	.75	10	.6	4	X	2012	2112	2212	2312
75	.75	20	.6	4	X	2013	2113	2213	2313
75	.90	10	.7	4	X	2014	2114	2214	2314
75	1.1	10	.8	4	X	2015	2115	2215	2315
75	1.1	20	.8	4	X	2016	2116	2216	2316
75	1.3	10	1.0	4	X	2017	2117	2217	2317
75	1.6	10	1.2	4	X	0311	0531	0751	0971
75	1.6	20	1.2	4	X	0312	0532	0752	0972
75	1.9	10	1.5	4	X	0313	0533	0753	0973
75	2.3	10	3.0	4	Y	2003	2103	2203	2303
75	2.3	20	3.0	4	Y	2004	2104	2204	2304
75	2.8	10	3.0	6	Y	2005	2105	2205	2305
75	3.4	10	5.0	6	Y	2006	2106	2206	2306
75	3.4	20	5.0	6	Y	2007	2107	2207	2307
75	4.1	10	5.0	6	Y	0314	0534	0754	0974
75	5.0	10	5.0	6	Y	0315	0535	0755	0975
75	5.0	20	5.0	6	Y	0316	0536	0756	0976
75	6.0	10	5.0	6	Z	0317	0537	0757	0977
75	7.5	10	7.0	6	Z	0318	0538	0758	0978
75	7.5	20	7.0	6	Z	0319	0539	0759	0979
100	.0023	10	.3	2	W	0320	0540	0760	0980
100	.0023	20	.3	2	W	0321	0541	0761	0981
100	.0028	10	.3	2	W	0322	0542	0762	0982
100	.0034	10	.3	2	W	0323	0543	0763	0983
100	.0034	20	.3	2	W	0324	0544	0764	0984
100	.0041	10	.3	2	W	0325	0545	0765	0985
100	.005	10	.3	2	W	0326	0546	0766	0986
100	.005	20	.3	2	W	0327	0547	0767	0987
100	.006	10	.3	2	W	0328	0548	0768	0988
100	.0075	10	.3	2	W	0329	0549	0769	0989
100	.0075	20	.3	2	W	0330	0550	0770	0990
100	.009	10	.3	2	W	0331	0551	0771	0991
100	.011	10	.3	2	W	0332	0552	0772	0992
100	.011	20	.3	2	W	0333	0553	0773	0993
100	.013	10	.3	2	W	0334	0554	0774	0994
100	.016	10	.3	2	W	0335	0555	0775	0995
100	.016	20	.3	2	W	0336	0556	0776	0996
100	.019	10	.3	2	W	0337	0557	0777	0997
100	.023	10	.3	2	W	0338	0558	0778	0998
100	.023	20	.3	2	W	0339	0559	0779	0999
100	.028	10	.3	2	W	0340	0560	0780	1000
100	.034	10	.3	2	W	0341	0561	0781	1001
100	.034	20	.3	2	W	0342	0562	0782	1002
100	.041	10	.3	2	W	0343	0563	0783	1003
100	.05	10	.3	2	W	0344	0564	0784	1004
100	.05	20	.3	2	W	0345	0565	0785	1005
100	.06	10	.3	2	W	0346	0566	0786	1006
100	.075	10	.3	2	W	0347	0567	0787	1007
100	.075	20	.3	2	W	0348	0568	0788	1008
100	.09	10	.3	2	W	0349	0569	0789	1009
100	.11	10	.3	2	W	0350	0570	0790	1010
100	.11	20	.3	2	W	0351	0571	0791	1011

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors. - Continued.

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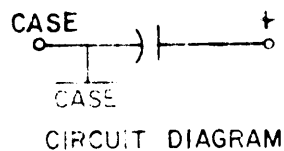
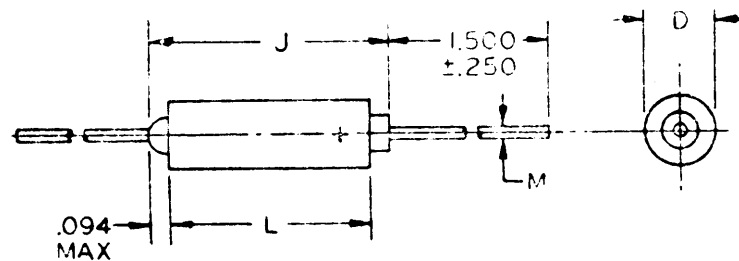
STANDARD CAPACITORS

STYLE CSR91 (MIL-C-39003/4) - Continued

Rated voltage	Capacitance (nom)	Capacitance tolerance	DC leakage (max) +25°C	Dissipation factor (max) +25°C	Case size	Dash number			
						Failure rate level (%/1,000 hr)			
						M(1.0)	P(0.1)	R(0.01)	S(0.001)
<u>Volts, NP</u>	<u>μF</u>	<u>percent</u>	<u>μA</u>	<u>percent</u>					
100	.13	10	.3	2	W	0352	0572	0792	1012
100	.16	10	.3	2	W	0353	0573	0793	1013
100	.16	20	.3	2	W	0354	0574	0794	1014
100	.19	10	.3	2	W	0355	0575	0795	1015
100	.23	10	.3	2	W	0356	0576	0796	1016
100	.23	20	.3	2	W	0357	0577	0797	1017
100	.28	10	.3	2	W	0358	0578	0798	1018
100	.34	10	.3	2	X	0359	0579	0799	1019
100	.34	20	.3	2	X	0360	0580	0800	1020
100	.41	10	.4	2	X	0361	0581	0801	1021
100	.50	10	.5	2	X	0362	0582	0802	1022
100	.50	20	.5	2	X	0363	0583	0803	1023
100	.60	10	.5	4	X	0364	0584	0804	1024
100	.75	10	.7	4	X	0365	0585	0805	1025
100	.75	20	.7	4	X	0366	0586	0806	1026
100	.90	10	.7	4	X	0367	0587	0807	1027
100	1.1	10	.9	4	X	0368	0588	0808	1028
100	1.1	20	.9	4	X	0369	0589	0809	1029
100	1.3	10	1.1	4	X	0370	0590	0810	1030

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

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Case Size	Dimensions			
	L ±.031	D ±.016 -.015	M ±.002	J Max
C	.686	.289	.025	.822
D	.786	.351	.025	.922

INCHES	MM	INCHES	MM	INCHES	MM
.002	.05	.094	2.39	.786	19.96
.015	.38	.250	6.35	.822	20.88
.016	.41	.289	7.34	.922	23.42
.025	.64	.351	8.92	1.500	38.10
.031	.79	.686	17.42		

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.
3. The case insulation shall extend .015 (.38 mm) minimum beyond each end. However, when a shrink-fitted insulation is used, it shall lap over the ends of the capacitor body.
4. Lead length may be a minimum of 1 inch long for use in tape and reel automatic insertion equipment, when specified.

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitors - Continued.

STANDARD CAPACITORS

STYLE CSR21 (MIL-C-39003/9)

OPERATING TEMPERATURE RANGE -55°C TO +85°C (DERATED TO +125°C)

DC rated voltage	Capacitance	Capacitance tolerance	DC leakage at			Dissipation factor	ESR	Ripple current	Derated ripple current	Case size	Part No. M39003/09- Failure rate level for (%1,000 hrs)			
			+25°C	+85°C	+125°C						M	P	R	S
Volts	µF	Percent	µA	µA	µA	Percent	Ohms	A	A		1.0	0.1	0.01	0.001
6	150	5	4.5	90	113	10	.065	3.3	2.0	C	0001	0101	0201	0301
6	150	10	4.5	90	113	10	.065	3.3	2.0	C	0002	0102	0202	0302
6	150	20	4.5	90	113	10	.065	3.3	2.0	C	0003	0103	0203	0303
6	180	5	5.5	110	138	10	.060	3.4	2.4	C	0004	0104	0204	0304
6	180	10	5.5	110	138	10	.060	3.4	2.4	C	0005	0105	0205	0305
6	270	5	6.5	130	163	10	.050	4.1	3.4	D	0006	0106	0206	0306
6	270	10	6.5	130	163	10	.050	4.1	3.4	D	0007	0107	0207	0307
6	330	5	7.5	150	188	12	.045	4.3	3.8	D	0008	0108	0208	0308
6	330	10	7.5	150	188	12	.045	4.3	3.8	D	0009	0109	0209	0309
6	330	20	7.5	150	188	12	.045	4.3	3.8	D	0010	0110	0210	0310
10	82	5	4	80	100	8	.085	2.9	1.8	C	0011	0111	0211	0311
10	82	10	4	80	100	8	.085	2.9	1.8	C	0012	0112	0212	0312
10	100	5	5	100	125	8	.075	3.0	2.2	C	0013	0113	0213	0313
10	100	10	5	100	125	8	.075	3.0	2.2	C	0014	0114	0214	0314
10	100	20	5	100	125	8	.075	3.0	2.2	C	0015	0115	0215	0315
10	120	5	5	120	150	8	.070	3.2	2.5	C	0016	0116	0216	0316
10	120	10	6	120	150	8	.070	3.2	2.5	C	0017	0117	0217	0317
10	180	5	9	180	226	8	.060	3.7	3.4	D	0018	0118	0218	0318
10	180	10	9	180	226	8	.060	3.7	3.4	D	0019	0119	0219	0319
10	220	5	10	200	250	10	.055	3.9	3.4	D	0020	0120	0220	0320
10	220	10	10	200	250	10	.055	3.9	3.4	D	0021	0121	0221	0321
10	220	20	10	200	250	10	.055	3.9	3.4	D	0022	0122	0222	0322
15	56	5	4	80	100	6	.100	2.6	1.8	C	0023	0123	0223	0323
15	56	10	4	80	100	6	.100	2.6	1.8	C	0024	0124	0224	0324
15	68	5	5	100	125	6	.095	2.7	2.2	C	0025	0125	0225	0325
15	68	10	5	100	125	6	.095	2.7	2.2	C	0026	0126	0226	0326
15	68	20	5	100	125	6	.095	2.7	2.2	C	0027	0127	0227	0327
15	120	5	9	180	226	8	.070	3.5	2.8	D	0028	0128	0228	0328
15	120	10	9	180	226	8	.070	3.5	2.8	D	0029	0129	0229	0329
15	150	5	10	200	250	8	.065	3.6	3.1	D	0030	0130	0230	0330
15	150	10	10	200	250	8	.065	3.6	3.1	D	0031	0131	0231	0331
15	150	20	10	200	250	8	.065	3.6	3.1	D	0032	0132	0232	0332
20	27	5	2.5	50	63	5	.145	2.2	1.2	C	0033	0133	0233	0333
20	27	10	2.5	50	63	5	.145	2.2	1.2	C	0034	0134	0234	0334
20	33	5	3.5	70	88	5	.130	2.3	1.4	C	0035	0135	0235	0335
20	33	10	3.5	70	88	5	.130	2.3	1.4	C	0036	0136	0236	0336
20	33	20	3.5	70	88	5	.130	2.3	1.4	C	0037	0137	0237	0337
20	39	5	4.0	80	100	5	.120	2.4	1.7	C	0038	0138	0238	0338
20	39	10	4.0	80	100	5	.120	2.4	1.7	C	0039	0139	0239	0339
20	47	5	4.5	90	113	6	.110	2.5	1.8	C	0040	0140	0240	0340
20	47	10	4.5	90	113	6	.110	2.5	1.8	C	0041	0141	0241	0341
20	47	20	4.5	90	113	6	.110	2.5	1.8	C	0042	0142	0242	0342

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitor - Continued.

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STANDARD CAPACITORS

STYLE CSR21 (MIL-C-39003/9) - Continued

OPERATING TEMPERATURE RANGE -55°C TO +85°C (DERATED TO +125°)

DC rated voltage	Capaci- tance μF	Capaci- tance tolerance	DC leakage at		Dissipation factor 1 kHz +25°C	ESR 100 kHz +25°C (max)	Ripple current 40 kHz 25°C (max)	Derated ripple current 1 kHz 25°C (max)	Case size	Part No. M39003/09- Failure rate level for (%1,000 hrs)				
			+25°C	+85°C						+125°C	M	P	R	S
<u>Volts</u>	<u>μF</u>	<u>Percent</u>	<u>μA</u>	<u>μA</u>	<u>Percent</u>	<u>Ohms</u>	<u>A</u>	<u>A</u>		<u>1.0</u>	<u>0.1</u>	<u>0.01</u>	<u>0.001</u>	
20	56	5	5.5	110	6	.100	2.9	2.2	D	0043	0143	0243	0343	
20	56	10	5.5	110	6	.100	2.9	2.2	D	0044	0144	0244	0344	
20	68	5	7	140	6	.095	3.0	2.4	D	0045	0145	0245	0345	
20	68	10	7	140	6	.095	3.0	2.4	D	0046	0146	0246	0346	
20	68	20	7	140	6	.095	3.0	2.4	D	0047	0147	0247	0347	
20	82	5	8	160	6	.085	3.1	2.5	D	0048	0148	0248	0348	
20	82	10	8	160	6	.085	3.1	2.5	D	0049	0149	0249	0349	
20	100	5	10	200	8	.075	3.3	2.5	D	0050	0150	0250	0350	
20	100	10	10	200	8	.075	3.3	2.5	D	0051	0151	0251	0351	
20	100	20	10	200	8	.075	3.3	2.5	D	0052	0152	0252	0352	
35	22	5	4	80	4	.160	2.1	1.5	C	0053	0153	0253	0353	
35	22	10	4	80	4	.160	2.1	1.5	C	0054	0154	0254	0354	
35	22	20	4	80	4	.160	2.1	1.5	C	0055	0155	0255	0355	
35	27	5	4.5	90	4	.145	2.4	1.9	D	0056	0156	0256	0356	
35	27	10	4.5	90	4	.145	2.4	1.9	D	0057	0157	0257	0357	
35	33	5	5.5	110	5	.130	2.5	1.9	D	0058	0158	0258	0358	
35	33	10	5.5	110	5	.130	2.5	1.9	D	0059	0159	0259	0359	
35	33	20	5.5	110	5	.130	2.5	1.9	D	0060	0160	0260	0360	
35	39	5	7	140	5	.120	2.6	2.0	D	0061	0161	0261	0361	
35	39	10	7	140	5	.120	2.6	2.0	D	0062	0162	0262	0362	
35	47	5	8	160	5	.110	2.7	2.2	D	0063	0163	0263	0363	
35	47	10	8	160	5	.110	2.7	2.2	D	0064	0164	0264	0364	
35	47	20	8	160	5	.110	2.7	2.2	D	0065	0165	0265	0365	
50	5.6	5	2.2	45	3	.300	1.5	.6	C	0066	0166	0266	0366	
50	5.6	10	2.2	45	3	.300	1.5	.6	C	0067	0167	0267	0367	
50	6.8	5	2.2	45	3	.275	1.6	.7	C	0068	0168	0268	0368	
50	6.8	10	2.2	45	3	.275	1.6	.7	C	0069	0169	0269	0369	
50	6.8	20	2.2	45	3	.275	1.6	.7	C	0070	0170	0270	0370	
50	8.2	5	2.5	50	3	.250	1.6	.9	C	0071	0171	0271	0371	
50	8.2	10	2.5	50	3	.250	1.6	.9	C	0072	0172	0272	0372	
50	10	5	2.5	50	3	.230	1.7	1.1	C	0073	0173	0273	0373	
50	10	10	2.5	50	3	.230	1.7	1.1	C	0074	0174	0274	0374	
50	10	20	2.5	50	3	.230	1.7	1.1	C	0075	0175	0275	0375	
50	12	5	3	60	3	.210	1.8	1.3	C	0076	0176	0276	0376	
50	12	10	3	60	3	.210	1.8	1.3	C	0077	0177	0277	0377	
50	15	5	4	80	3	.190	1.9	1.4	C	0078	0178	0278	0378	
50	15	10	4	80	3	.190	1.9	1.4	C	0079	0179	0279	0379	
50	15	20	4	80	3	.190	1.9	1.4	C	0080	0180	0280	0380	
50	18	5	4.5	90	4	.175	2.0	1.4	C	0081	0181	0281	0381	
50	18	10	4.5	90	4	.175	2.0	1.4	C	0082	0182	0282	0382	
50	22	5	5.5	110	4	.160	2.3	1.7	D	0083	0183	0283	0383	
50	22	10	5.5	110	4	.160	2.3	1.7	D	0084	0184	0284	0384	
50	22	20	5.5	110	4	.160	2.3	1.7	D	0085	0185	0285	0385	

FIGURE 701-5. Established reliability, tantalum, solid electrolyte, fixed capacitor - Continued.

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APPLICATION NOTES:

1. Rated ripple current is the rms value of the maximum allowable alternating current of a specified frequency, at which the capacitor may be operated continuously at a specified temperature. Derated ripple current for ambient temperature in accordance with the curve given on figure 701-6.
2. For derating for frequency, use the derated ripple currents at 1 kHz given in table I. Below 1 kHz these same currents are applicable provided the peak ac voltage does not result in voltage reversal or exceeding the rated dc voltage. Between 1 kHz and 40 kHz the ripple current may be interpolated linearly with frequency. The ripple current at 40 kHz is applicable at and above 40 kHz.
3. Although CSR21 capacitors are rated to operate with the specified levels of rms ripple current, they are basically polar devices. Care must be exercised to assure that sufficient dc bias is applied to prevent ac voltage reversal in excess of specified reverse voltage ratings.
4. When two or more CSR21 capacitors are used in parallel, ripple current may not divide equally as a result of unequal ESR'S of the capacitors. It is imperative that each capacitor be operated within the specified limit of rms ripple current.

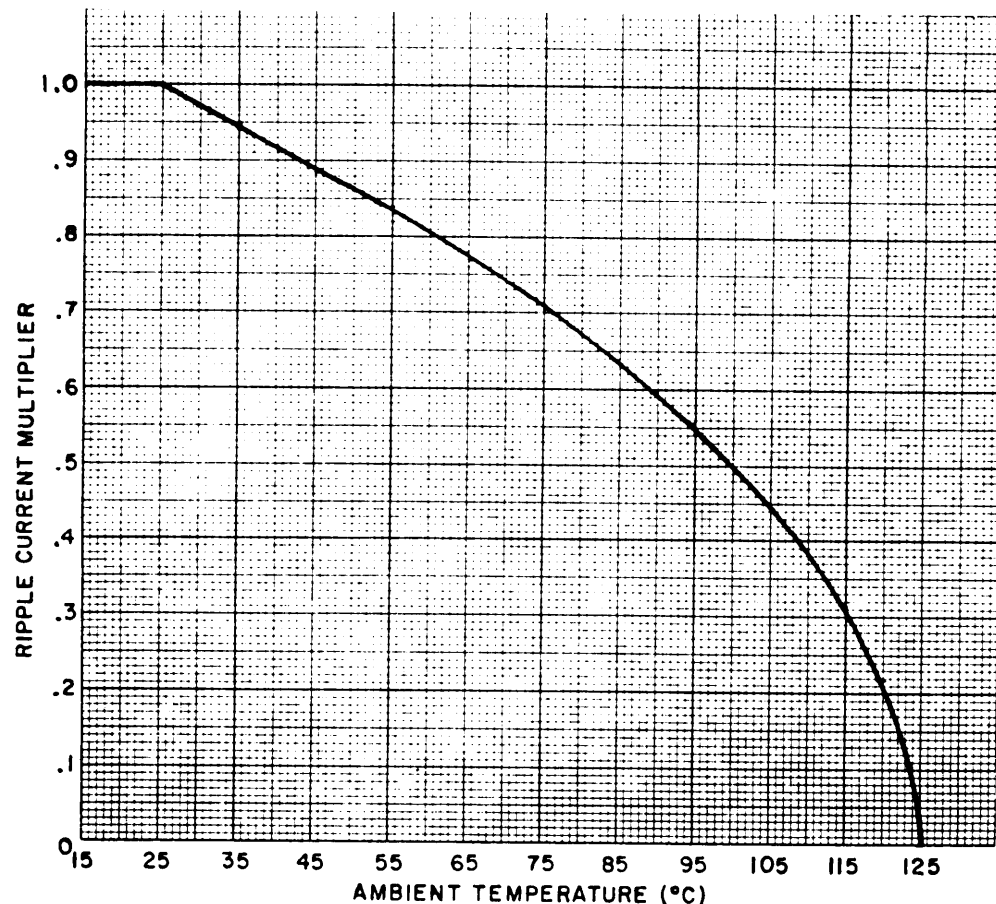


FIGURE 701-6. Ripple current derating with respect to temperature.

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SECTION 702

CAPACITORS, FIXED, ELECTROLYTIC (NONSOLID ELECTROLYTE),
TANTALUM, ESTABLISHED RELIABILITY

STYLES CLR25, CLR27, CLR35, CLR37, AND CLR79

(APPLICABLE SPECIFICATION: MIL-C-39006)

1. SCOPE. This section covers established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors (insulated), polarized and nonpolarized, capacitors covered by this section have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 60 percent confidence level and are based on full rated voltage at 85°C.

2. APPLICATION INFORMATION.

2.1 Use. The use of these capacitors is determined by the two basic types of tantalum (foil and sintered slug) employed in their construction.

2.1.1 Foil types. The foil types are the most versatile of all electrolytic capacitors. They are available in plain or etched foil and in polarized or nonpolarized construction, which makes them suitable for many applications; however, the foil types are limited by their great variation of characteristics and design tolerances. They are not suitable for timing or precision circuits due to several factors leading to very wide design tolerances. Because of the difference in construction, etched-foil types have as much as 10 times the capacitance per unit area as the plain-foil types for a given size; therefore, the etched-foil type is generally the better choice between the two. In some cases the plain-foil type is a more desirable choice since it will withstand approximately 30 percent higher ripple current, has better capacitance-temperature characteristics, and has low power factor.

2.1.1.1 Polarized (styles CLR25 and CLR35). The polarized foil types are essentially used where low-frequency pulsating dc components are to be bypassed or filtered out and for other uses in electronic equipment where large capacitance values are required and comparatively wide capacitance tolerances can be tolerated. When used for low-frequency coupling in vacuum-tube and transistor circuits, allowance should be made for the leakage current. This leakage current could cause improper positive bias to be applied across the grid circuits or excessive base, emitter, or collector currents. These polarized capacitors should be used only in dc circuits with polarity properly observed. If ac components are present, the sum of the peak ac voltage plus the applied dc voltage must not exceed the dc voltage rating. The peak ac voltage should also be less than the applied dc voltage so that polarity may be maintained, even on negative peaks, to avoid overheating and damage. Even though those units rated at 6 volts and above can withstand a maximum of 3 volts in the reverse direction, it is recommended that they not be used in circuits where this reversal is repetitious. Examples of where these units may be used are (1) in power supplies in which up to 300 volts dc are applied to the filter input (2) at plate and screen circuit decoupling connection points, and (3) for cathode resistor by-pass circuits. When used as cathode by-pass capacitors, a ratio of bias resistance to capacitive reactance of 10 to 1 is allowed. Ratios up to 20 to 1 may be used in high-fidelity amplifier work or where space and economical considerations permit. In circuits where linear amplification is required, the amount of capacitive reactance shunting a cathode resistor will depend on the percentage of degenerative feedback desired.

2.1.1.2 Nonpolarized (styles CLR27 and CLR37). The nonpolarized types are primarily suitable for ac applications or where dc voltage reversals occur. of these uses are in (1) tuned low-frequency circuits, (2) phasing of low voltage ac (3) computer circuits where reversal of dc voltage occurs, and (4) servo systems.

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2.1.2 Sintered slug type (style CLR79). These capacitors are limited to low voltage applications. Their primary use is in low voltage power supply filtering circuits. Their low leakage current (lowest of all the tantalum types) is not appreciable below +85°C; and at ordinary operating temperatures is comparable to good quality paper capacitors, yet they are much smaller in size. Style CLR79 capacitors are for dc applications only; however, they will withstand up to 3 volts of reverse bias.

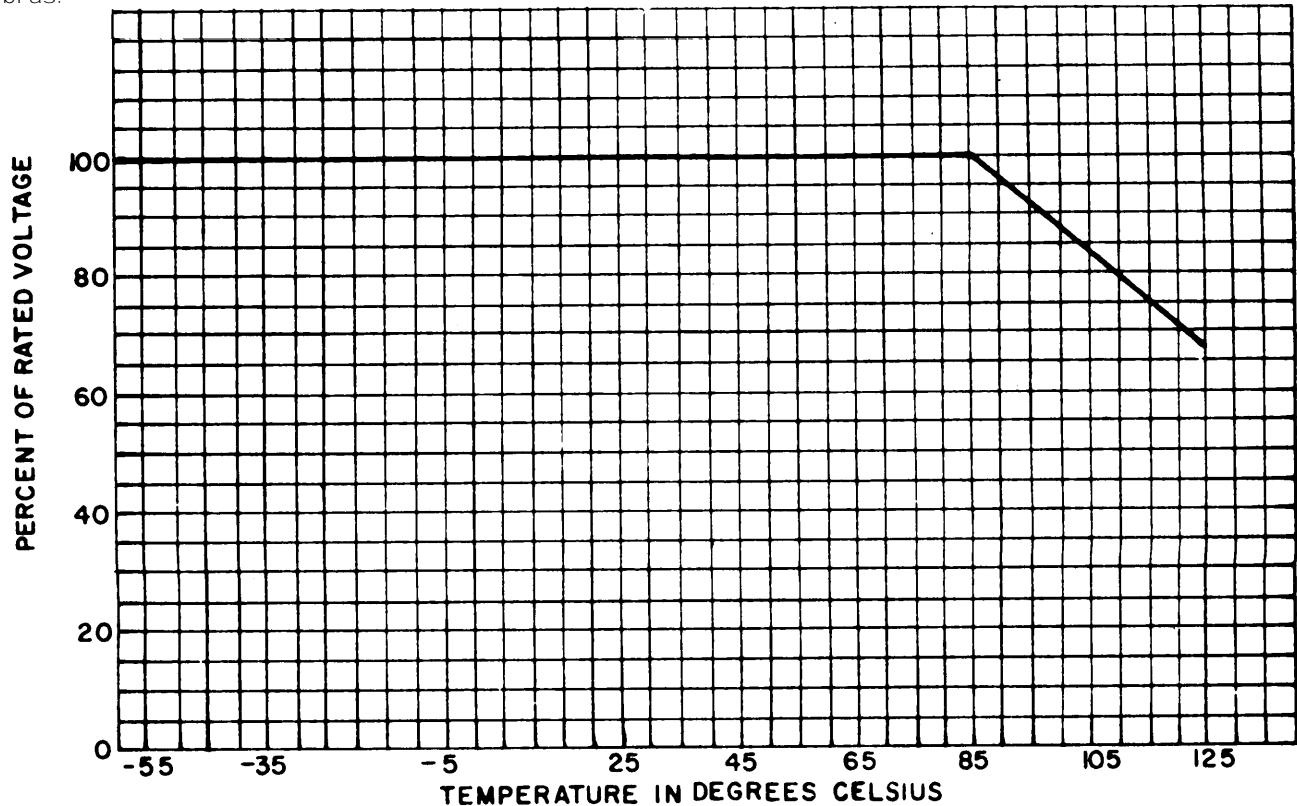


FIGURE 702-1. Voltage derating with temperature.

2.2 Construction:

2.2.1 Foil types. These capacitors consist of a tantalum foil, acting as the anode, which is electromechanically treated to form a layer of tantalum oxide dielectric. Porous spacer material is used to form a conventional cylindrical capacitor section with axial tantalum wires on either end. The section is impregnated with a suitable electrolyte (usually a weak acid or base) and then sealed in a suitable container. Solderable leads were welded to the tantalum leads.

2.2.2 Sintered-slug types. These capacitors consist of a sintered-slug, acting as the anode, which is electrochemically treated to form a layer of tantalum oxide dielectric.

2.3 Physical size comparison:

2.3.1 With paper capacitors. These capacitors may utilize only 15 percent of the area normally required by a paper capacitor of the same capacitance value.

2.3.2 With aluminum electrolytic capacitors. The larger the dielectric constant the larger the capacitance which can be realized in a given space, thus a size advantage can be realized since the dielectric constant of tantalum oxide film is approximately 24 as compared to 8 for an aluminum oxide. Because of differences in foil and paper-thickness requirements, the actual size ratio will vary with different capacitances and voltage ratings and may be much more than 2:1 in favor of the tantalum capacitor.

2.4 Voltage ratings. The maximum dc rated voltages for styles included in this section are shown in table 702-1.

TABLE 702-1. Voltage ratings.

Style	Anode	Voltage range Volts
CLR25	Etched foil	15 to 150
CLR27	Etched foil	15 to 150
CLR35	Plain foil	15 to 450
CLR37	Plain foil	15 to 375
CLR79	Sintered	6 to 125

2.5 Operating temperature range (with full rated voltage applied). These capacitors are suitable for operation over a temperature range of -55°C to $+85^{\circ}\text{C}$.

2.6 Derating. These capacitors may be operated up to $+125^{\circ}\text{C}$ when properly voltage derated (see figure 702-1).

2.7 Series and parallel applications:

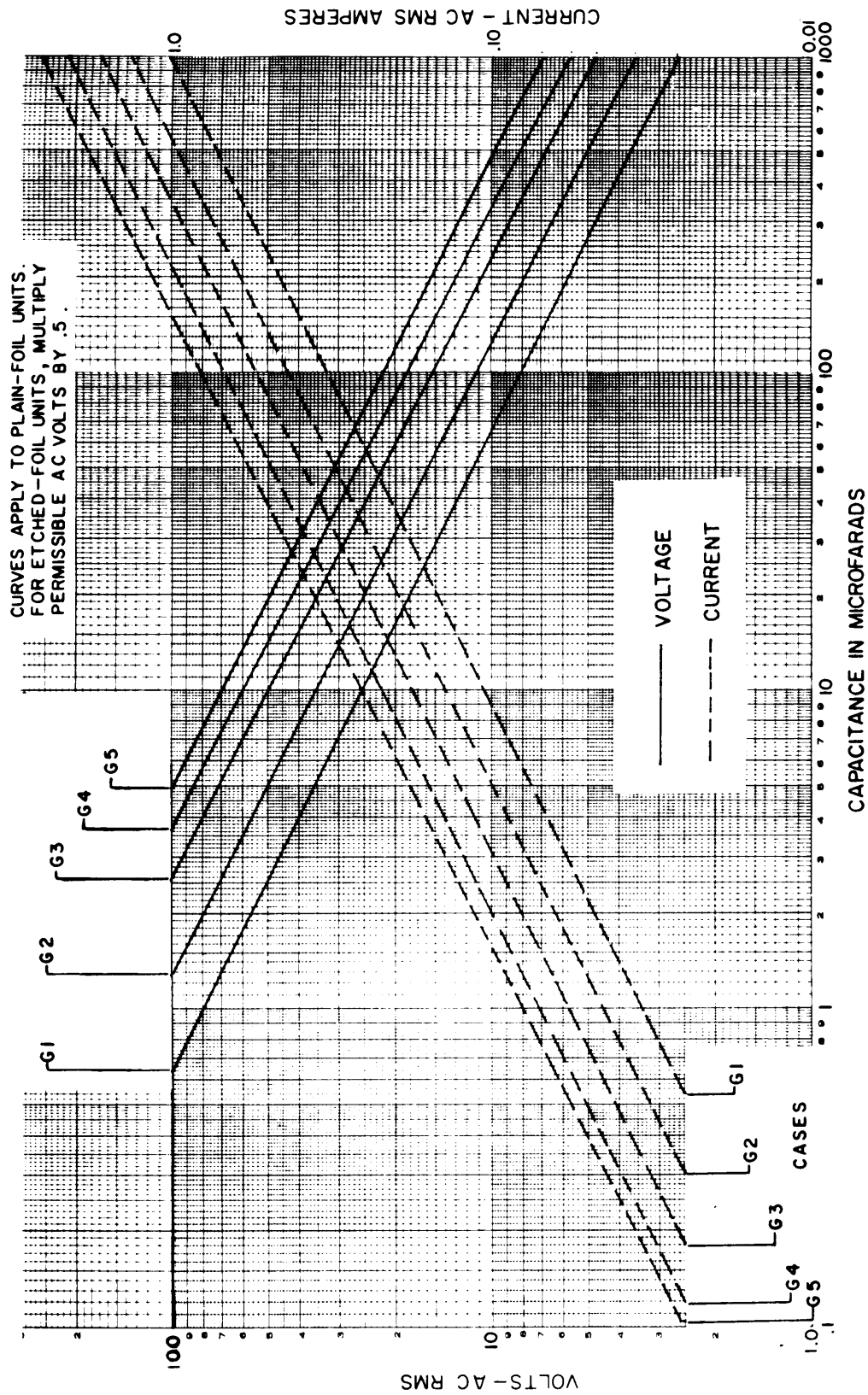
2.7.1 Series operation. Whenever tantalum capacitors are connected in series for higher voltage operation, a resistor should be paralleled across each unit. Unless a shunt resistor is used, the dc rated voltage can easily be exceeded on the capacitor in the series network with the lowest dc leakage current. To prevent capacitor destruction, a resistance value not exceeding a certain maximum should be used; this value will depend on capacitance, average dc leakage, and capacitor construction. For example: For style CLR79, size T1 units will require a maximum resistance, in megohms, equal to 3.4 divided by the square root of the capacitance (in μF); size T2, $5.2/\sqrt{C}$; size T3, $6.5/\sqrt{C}$; and size T4, $7.5/\sqrt{C}$. Plain-foil types use $5/C$ and etched-foil use $15/C$.

2.7 Parallel operation. To obtain a higher capacitance than can be obtained from a single capacitor, a number of units may be connected in parallel. However the sum of the peak ripple and the applied dc voltage should not exceed the dc rated voltage. The connecting leads of the parallel network should be large enough to carry the combined currents without reducing the effective capacitance due to series lead resistance.

2.8 Stability and life. Tantalum electrolytic capacitors have excellent life and shelf life characteristics. Life, at higher temperatures than with aluminum electrolytic, will show a comparatively lower decrease in capacitance. voltage applied, more than 10,000 hours of life can be expected at $+85^{\circ}\text{C}$. All styles may be expected to operate at least 2,000 hours at $+85^{\circ}\text{C}$ with less than 10 percent loss of capacitance.

Because the more stable tantalum oxide film is less subject to dissolving the surrounding electrolyte than the film in an aluminum capacitor, shelf life of the tantalum unit is much longer, and less re-forming is required. After storage for long periods, the re-forming current is low and the time is comparatively short; it may be expected to take less than 10 minutes. These properties are affected by the storage temperature to a significant degree, being excellent at temperatures from -55°C to $+25^{\circ}\text{C}$; good at $+65^{\circ}\text{C}$; and relatively poor at $+85^{\circ}\text{C}$.

Some style CLR25 capacitors may exhibit capacitance change and dissipation factor changes when exposed to low dc bias levels (0 to 2.2 volts dc). Care should be exercised when applications require these voltage levels.



NOTE: See page 702.10, 702.12, 702.14, or 702.16 for case size definitions.

FIGURE 702-2. Maximum allowable ripple voltage for styles CLR25, 27, 35, and 37.

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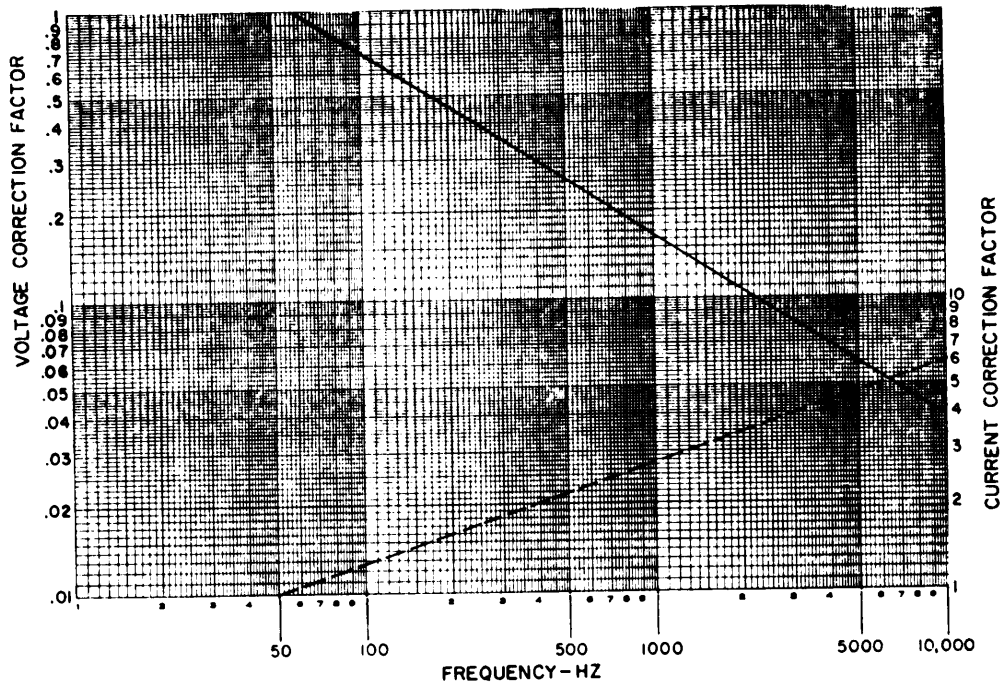


FIGURE 702-3. Correction factor for maximum allowable ripple voltage/current vs frequency for tantalum foil capacitors.

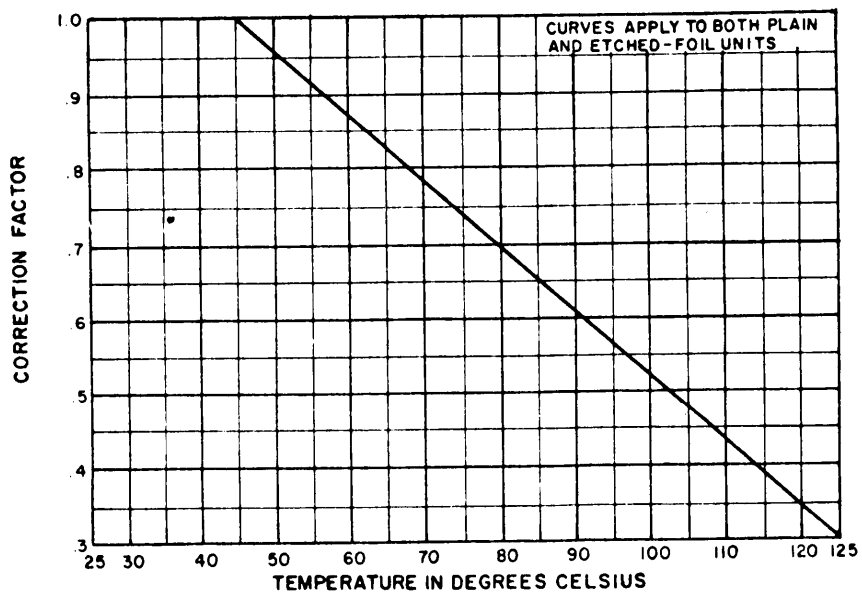


FIGURE 702.4. Correction factor for maximum allowable ripple voltage/current vs temperature for tantalum foil capacitors.

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2.9 AC ripple. Tantalum foil capacitors are the only electrolytic capacitors capable of operating continuously on unbiased ac voltages. The ac ripple capability curves on figures 702-2 and 702-3 are applicable for unbiased ac voltages on nonpolar units, and biased ac ripple voltages on polar units. Peak ac voltages up to 150 volts are permissible provided that the dc voltage rating is not exceeded. **The only** limitation is the I^2R heating effect. Due to higher power factor, etched foil capacitors have only half the ac capability of plain foil capacitors.

2.9.1 Foil types. Figure 702-2 indicates the maximum allowable rms voltage or current for tubular plain foil capacitors. For tubular etched foil types, use one-half the values shown on figure 702-2. All values referenced indicate allowable voltages and currents at +25°C and 60 Hz.

To determine ac capability at some other frequency, multiply the voltage or current values obtained from figure 702-2 by a correction value from figure 702-3.

To determine ac capability at some other temperature, multiply the voltage or current value from figures 702-2 and 702-3, if applicable, by a correction value from figure 702-4.

2.9.2 Sintered slug type. To determine ac capability of style CLR79 capacitors at some other frequency or temperature, multiply the current values obtained from figure 702-10 by the correction value from table 702-11.

2.9.3 Complex wave-shapes. When complex ripple wave-shapes are involved, they on should be measured on an oscilloscope or by some other method which will give the peak rating. These capacitors should be limited to operation at ripple frequencies between 60 and 10,000 Hz (above 10,000 Hz, effective capacitance rapidly drops off). At frequencies of only a few hundred kHz, these tantalum units act as practically pure resistance.

2.10 Failure-rate level determination (foil units only). The curves presented on figure 702-8 are the best engineering approximation of the reliability characteristics (random failures) for foil capacitors when employed repeatedly, within their specification ratings, in complex electronic equipment. These reliability characteristics are based on ground-level severity experience. Failures are considered to be opens, shorts, or radical departures from initial characteristics. The failures are considered to be occurring in an unpredictable manner and in too short a period of time to permit detection through normal preventive maintenance. The curves shown on figure 702-8 are based on "catastrophic failures" and will differ from the failure rates established in the specification, since the established failure rates are based on "parametric failures" over long term life tests at rated conditions. This figure has been extracted from MIL-HDBK-217, "Reliability Stress and Failure Rate Data for Electronic Equipment." The curves have been modified from their original version in that the ordinate has been normalized in order to provide multiplier factors in place of discrete failure rate levels and in order that the multiplying factor for a failure rate at rated conditions is unity. As indicated, these curves are the best estimates based on "catastrophic failures"; however they can provide an estimate of the relative effect of operating under conditions other than rated.

3. ITEM IDENTIFICATION

3.1 Standard capacitors. The standard capacitors available in this section are shown on figure 702-9. (The figure gives the electrical characteristics, case sizes, failure rate levels, and military part numbers which are standard for design.)

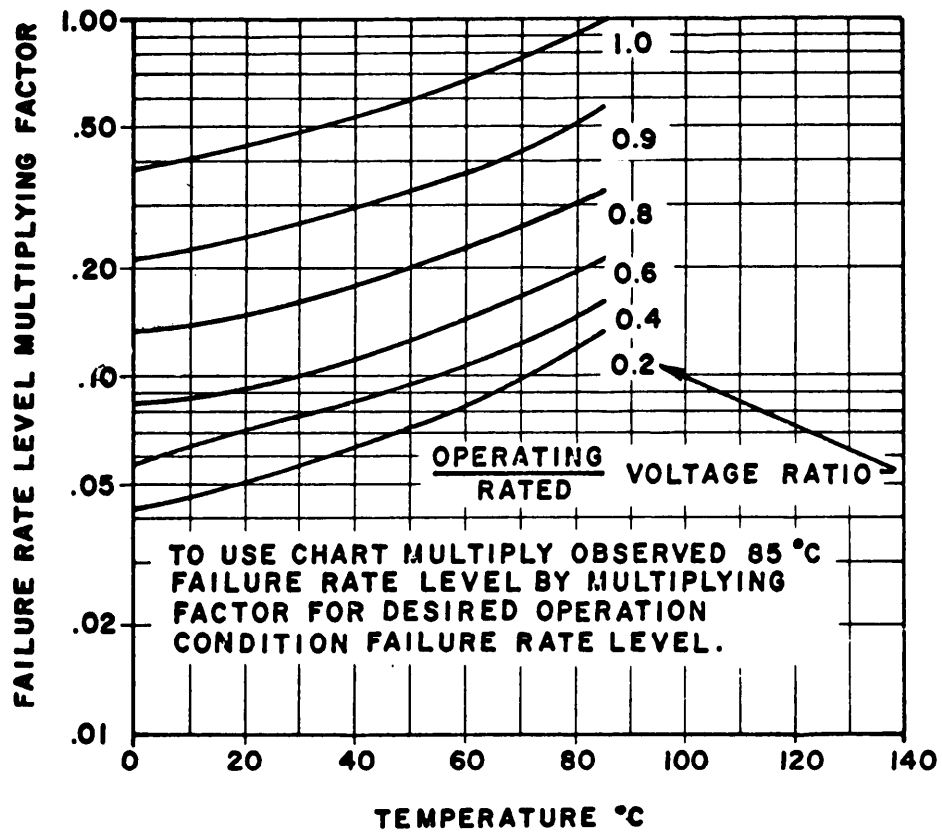
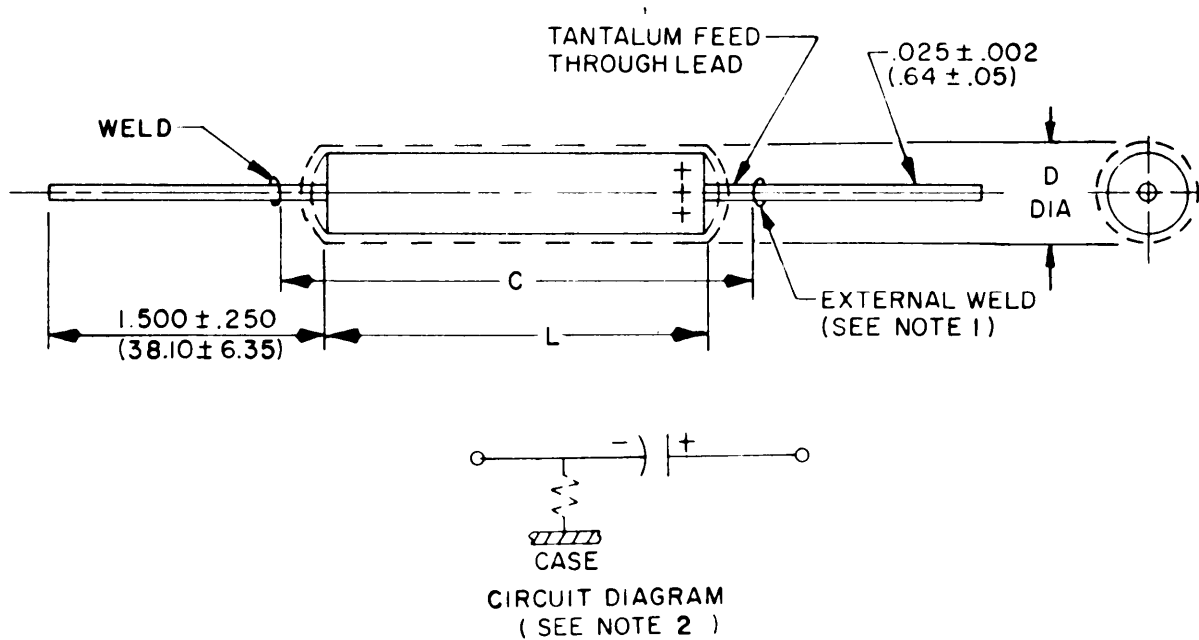


FIGURE 702-8. Failure rate level curves.

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STYLE CLR25



Case size	Dimensions		
	L $+ .187(4.75)$ $-.031(.79)$	D $+ .031(.79)$ $-.016(.41)$	C Max
G1	.688 (17.48)	.188 (4.78)	1.188 (30.18)
G2	.969 (24.61)	.281 (7.14)	1.469 (37.31)
G3	1.438 (36.53)	.375 (9.53)	1.938 (49.23)
G4	2.125 (53.98)	.375 (9.53)	2.625 (66.68)
G5	2.750 (69.85)	.375 (9.53)	3.250 (82.55)

NOTES:

1. The weld is not enclosed in the end seal.
2. There is an indeterminate resistance between the metal case and the negative terminal.

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors.

STANDARD CAPACITORS

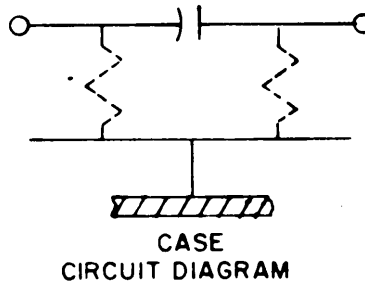
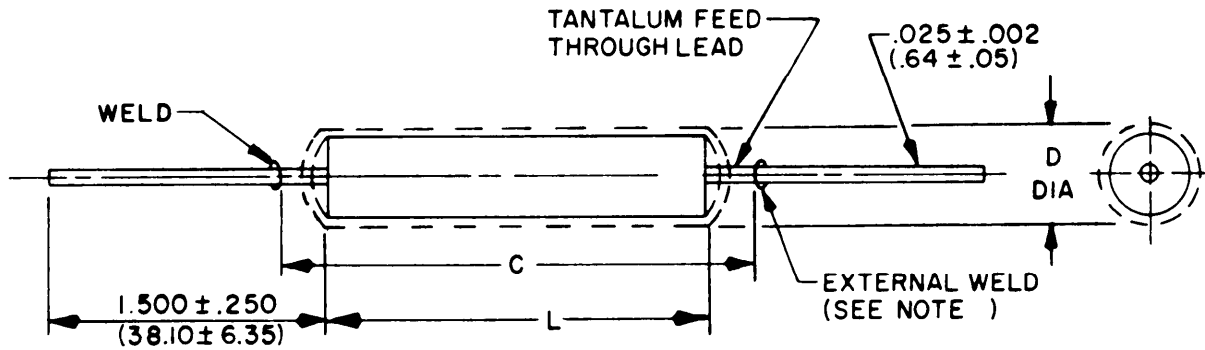
STYLE CLR25 (MIL-C-39006/1)

POLARIZED, ETCHED FOIL -- OPERATING TEMPERATURE RANGE -55°C TO +85°C (VOLTAGE DERATED TO +125°C)

Rated voltage (85°C)	Cap. μF	Cap. tolerance %	DC leakage (max)		Derated voltage (125°C)	Surge voltage (85°C)	Impedance (max)	Case size	Part No. M39006/01- Failure rate level for			
			25°C	125°C					M(1.0)	P(0.1)	R(0.01)	S(0.001)
HERMETICALLY SEALED												
Vdc			μA	μA	Vdc	Vdc	Ohms					
15	15.0	+75, -15	2	4	10	17.2	220	G1	3307	3314	3321	3328
15	60.0	+75, -15	2	10	10	17.2	55	G2	3030	3059	3088	3117
15	200.0	+75, -15	3	40	10	17.2	17	G3	3031	3060	3089	3118
15	400.0	+75, -15	6	80	10	17.2	9	G4	3032	3061	3090	3119
15	580.0	+75, -15	9	100	10	17.2	6	G5	3033	3062	3091	3120
25	10.0	+75, -15	2	4	15	28.8	330	G1	3308	3315	3322	3329
25	40.0	+75, -15	2	13	15	28.8	83	G2	3034	3063	3092	3121
25	120.0	+75, -15	3	40	15	28.8	27	G3	3035	3064	3093	3122
25	250.0	+75, -15	6	80	15	28.8	13	G4	3036	3065	3094	3123
25	350.0	+75, -15	10	100	15	28.8	10	G5	3037	3066	3095	3124
50	4.5	+50, -15	2	4	30	57.5	730	G1	3310	3317	3324	3331
50	18.0	+50, -15	2	13	30	57.5	180	G2	3042	3071	3100	3129
50	60.0	+50, -15	3	40	30	57.5	55	G3	3043	3072	3101	3130
50	75.0	+50, -15	4	70	30	57.5	52	G3	3201	3203	3204	3205
50	100.0	+50, -15	4	75	30	57.5	33	G4	3045	3074	3103	3132
50	150.0	+50, -15	5	100	30	57.5	22	G5	3046	3075	3104	3133
75	3.0	+50, -15	2	4	50	86.2	1000	G1	3311	3318	3325	3332
75	12.0	+50, -15	2	13	50	86.2	270	G2	3047	3076	3105	3134
75	30.0	+50, -15	3	34	50	86.2	110	G3	3048	3077	3106	3135
75	70.0	+50, -15	6	80	50	86.2	47	G4	3049	3078	3107	3136
75	100.0	+50, -15	10	100	50	86.2	33	G5	3050	3079	3108	3137
100	2.0	+30, -15	2	4	65	115.0	1600	G1	3312	3319	3326	3333
100	8.0	+30, -15	2	12	65	115.0	410	G2	3051	3080	3109	3138
100	25.0	+30, -15	2.5	37	65	115.0	130	G3	3052	3081	3110	3139
100	50.0	+30, -15	5	75	65	115.0	66	G4	3053	3082	3111	3140
100	70.0	+30, -15	7	100	65	115.0	47	G5	3054	3083	3112	3141
150	1.0	+30, -15	2	4	100	172.0	3000	G1	3313	3320	3327	3334
150	4.0	+30, -15	2	13	100	172.0	750	G2	3055	3084	3113	3142
150	13.0	+30, -15	3	30	100	172.0	250	G3	3056	3085	3114	3143
150	25.0	+30, -15	5	80	100	172.0	130	G4	3057	3086	3115	3144
150	36.0	+30, -15	8	100	100	172.0	94	G5	3058	3087	3116	3145

FIGURE 702-9. Established reliability, tantalum, electrolytic (non-solid electrolyte), fixed capacitors - Continued.

STYLE CLR 27



Case size	Dimensions		
	L +.187(4.75) -.031(.79)	D +.031(.79) -.016(.41)	C Max
G1	.688 (17.48)	.188 (4.78)	1.188 (30.18)
G2	.969 (24.61)	.281 (7.14)	1.469 (37.31)
G3	1.438 (36.53)	.375 (9.53)	1.938 (49.23)
G4	2.125 (53.98)	.375 (9.53)	2.625 (66.68)
G5	2.750 (69.85)	.375 (9.53)	3.250 (82.55)

NOTE: The weld is not enclosed in the end seal.

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

STANDARD CAPACITORS

STYLE CLR27 (MIL-C-39006/2)

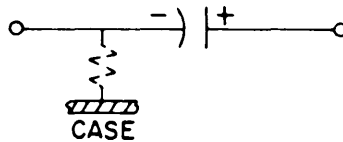
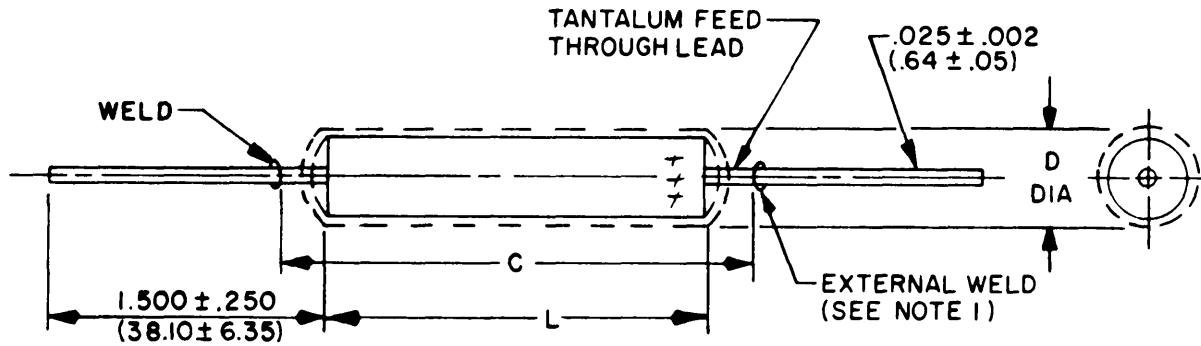
NONPOLARIZED, ETCHED FOIL -- OPERATING TEMPERATURE RANGE -55°C TO +85°C (VOLTAGE DERATED TO +125°C)

Rated voltage (85°C)	Cap. μF	Cap. tolerance	DC leakage (max)		Derated voltage (125°C)	Surge voltage (85°C)	Impedance (max)	Case size	Part No. M39006/02- Failure rate level for			
			25°C	85°C & 125°C					M(1.0)	P(0.1)	R(0.01)	S(0.001)
HERMETICALLY SEALED												
Vdc			μA	μA	Vdc	Vdc	Ohms					
15	10	+75, -15	2	4	10	17.2	339	G1	2507	2514	2521	2528
15	40	+75, -15	2	10	10	17.2	85	G2	1228	1256	1284	1312
15	120	+75, -15	3	40	10	17.2	27	G3	1229	1257	1285	1313
15	250	+75, -15	6	80	10	17.2	14	G4	1230	1258	1286	1314
15	350	+75, -15	9	100	10	17.2	10	G5	1231	1259	1287	1315
25	5	+75, -15	2	4	15	28.8	680	G1	2508	2515	2522	2529
25	20	+75, -15	2	13	15	28.8	170	G2	1232	1260	1288	1316
25	70	+75, -15	3	40	15	28.8	49	G3	1233	1261	1289	1317
25	140	+75, -15	6	80	15	28.8	24	G4	1234	1262	1290	1318
25	200	+75, -15	10	100	15	28.8	17	G5	1235	1263	1291	1319
50	2.5	+50, -15	2	4	30	57.5	1335	G1	2510	2517	2524	2531
50	10	+50, -15	2	13	30	57.5	339	G2	1240	1268	1296	1324
50	30	+50, -15	3	40	30	57.5	113	G3	1241	1269	1297	1325
50	60	+50, -15	4	75	30	57.5	57	G4	1242	1270	1298	1326
50	80	+50, -15	5	100	30	57.5	41	G5	1243	1271	1299	1327
75	1.5	+50, -15	2	4	50	86.2	2255	G1	2511	2518	2525	2532
75	6	+50, -15	2	13	50	86.2	560	G2	1244	1272	1300	1328
75	15	+50, -15	3	34	50	86.2	226	G3	1245	1273	1301	1329
75	35	+50, -15	5	80	50	86.2	97	G4	1246	1274	1302	1330
75	50	+50, -15	10	100	50	86.2	68	G5	1247	1275	1303	1331
100	1	+30, -15	2	4	65	115.0	3385	G1	2512	2519	2526	2533
100	4	+30, -15	2	13	65	115.0	845	G2	1248	1276	1304	1332
100	12	+30, -15	3	37	65	115.0	283	G3	1249	1277	1305	1333
100	25	+30, -15	5	75	65	115.0	135	G4	1250	1278	1306	1334
100	35	+30, -15	7	100	65	115.0	97	G5	1251	1279	1307	1335
150	0.5	+30, -15	2	4	100	172.0	6780	G1	2513	2520	2527	2534
150	2	+30, -15	2	13	100	172.0	1693	G2	1252	1280	1308	1336
150	6	+30, -15	3	30	100	172.0	656	G3	1253	1281	1309	1337
150	12	+30, -15	5	80	100	172.0	283	G4	1254	1282	1310	1338
150	18	+30, -15	8	100	100	172.0	188	G5	1255	1283	1311	1339

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

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STYLE CLR 35

CIRCUIT DIAGRAM
(SEE NOTE 2)

Case size	Dimensions		
	L +.187(4.75) -.031(.79)	D +.031(.79) -.016(.41)	C Max
G1	.688 (17.48)	.188 (4.78)	1.188 (30.18)
G2	.969 (24.61)	.281 (7.14)	1.469 (37.31)
G3	1.438 (36.53)	.375 (9.53)	1.938 (49.23)
G4	2.125 (53.98)	.375 (9.53)	2.625 (66.68)
G5	2.750 (69.85)	.375 (9.53)	3.250 (82.55)

NOTES:

1. The weld is not enclosed in the end seal.
2. There is an indeterminate resistance between the metal case and the negative terminal.

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

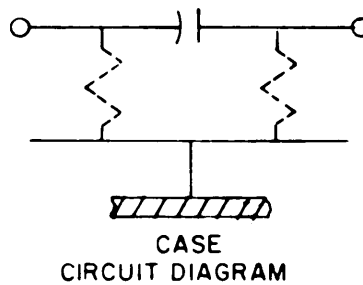
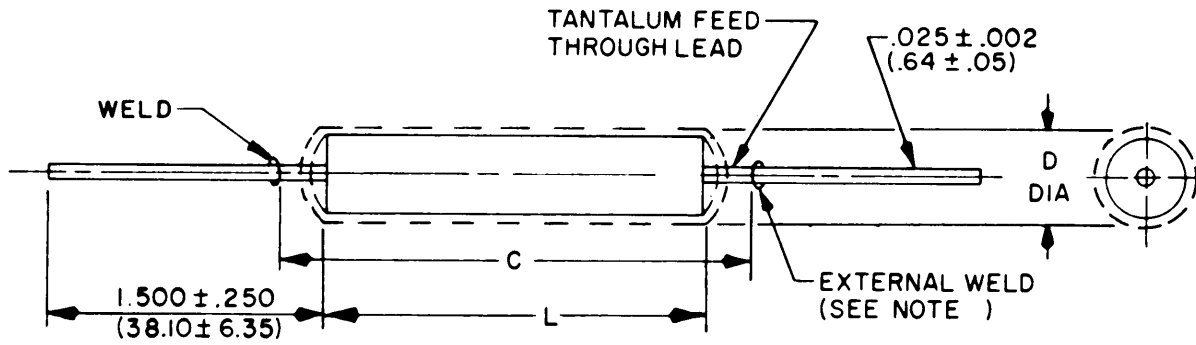
STYLE CLR35 (MIL-C-39006/3)
 POLARIZED, PLAIN FOIL -- OPERATING TEMPERATURE RANGE -55°C TO +85°C (VOLTAGE DERATED TO +125°C)

Rated voltage (85°C)	Cap. μF	Cap. tolerance	DC leakage (max)		Derated voltage (125°C)	Surge voltage (85°C)	Impedance (max)	Case size	Part No. M39006/03 - Failure rate level for			
			25°C	85°C					M(L.O)	P(O.I)	R(O.OI)	
HERMETICALLY SEALED												
15	4.5	± 20	1	2	10	17.2	495	G1	2712	2724	2736	2748
15	18.0	± 20	2	4	10	17.2	125	G2	1349	1398	1447	1496
15	55.0	± 20	2	10	10	17.2	41	G3	1350	1399	1448	1497
15	110.0	± 20	4	20	10	17.2	20	G4	1351	1400	1449	1498
15	160.0	± 20	5	30	10	17.2	14	G5	1352	1401	1450	1499
25	3.0	± 20	1	2	15	28.8	744	G1	2713	2725	2737	2749
25	12.0	± 20	2	4	15	28.8	186	G2	1353	1402	1451	1500
25	35.0	± 20	2	10	15	28.8	64	G3	1354	1403	1452	1501
25	70.0	± 20	4	20	15	28.8	32	G4	1355	1404	1453	1502
25	100.0	± 20	6	30	15	28.8	23	G5	1356	1405	1454	1503
50	1.5	± 20	1	4	30	57.5	1487	G1	2715	2727	2739	2751
50	6.0	± 20	2	6	30	57.5	372	G2	1362	1411	1460	1509
50	20.0	± 20	2	13	30	57.5	112	G3	1363	1412	1461	1510
50	40.0	± 20	4	26	30	57.5	56	G4	1364	1413	1462	1511
50	55.0	± 20	6	38	30	57.5	41	G5	1365	1414	1463	1512
75	1.0	± 20	1	4	50	86.2	2232	G1	2716	2728	2740	2752
75	4.0	± 20	2	6	50	86.2	558	G2	1366	1415	1464	1513
75	14.0	± 20	2	13	50	86.2	159	G3	1367	1416	1465	1514
75	28.0	± 20	4	26	50	86.2	80	G4	1368	1417	1466	1515
75	40.0	± 20	6	38	50	86.2	56	G5	1369	1418	1467	1516
100	0.8	± 20	1	3.5	65	115.0	2790	G1	2717	2729	2741	2753
100	3.0	± 20	2	6	65	115.0	743	G2	1370	1419	1468	1517
100	10.0	± 20	2	13	65	115.0	223	G3	1371	1420	1469	1518
100	20.0	± 20	3	25	65	115.0	112	G4	1372	1421	1470	1519
100	30.0	± 20	6	38	65	115.0	74	G5	1373	1422	1471	1520
150	0.5	± 20	2	4	100	172.0	4454	G1	2718	2730	2742	2754
150	2.0	± 20	2	6	100	172.0	1115	G2	1374	1423	1472	1521
150	7.0	± 20	3	13	100	172.0	319	G3	1375	1424	1473	1522
150	14.0	± 20	4	26	100	172.0	159	G4	1376	1425	1474	1523
150	20.0	± 20	6	38	100	172.0	112	G5	1377	1426	1475	1524
200	0.35	± 15	4	25	150	230.0	5577	G1	2719	2731	2743	2755
200	1.5	± 15	8	32	150	230.0	1300	G2	1378	1427	1476	1525
200	5.0	± 15	16	64	150	230.0	400	G3	1379	1428	1477	1526
200	10.0	± 15	28	100	150	230.0	200	G4	1380	1429	1478	1527
200	15.0	± 15	40	160	150	230.0	130	G5	1381	1430	1479	1528
300	0.27	± 15	6	40	200	345.0	9000	G1	2721	2733	2745	2757
300	1.0	± 15	10	50	200	345.0	2250	G2	1386	1435	1484	1533
300	3.0	± 15	20	100	200	345.0	750	G3	1387	1436	1485	1534
300	7.0	± 15	35	175	200	345.0	322	G4	1388	1437	1486	1535
300	10.0	± 15	50	250	200	345.0	225	G5	1389	1438	1487	1536
375	0.22	± 15	6	80	300	431.0	11800	G1	2722	2734	2746	2758
375	0.82	± 15	10	100	250	431.0	2810	G2	1390	1439	1488	1537
375	2.7	± 15	20	225	250	431.0	900	G3	1391	1440	1489	1538
375	5.6	± 15	35	375	250	431.0	450	G4	1392	1441	1490	1539
375	8.2	± 15	50	500	250	431.0	281	G5	1393	1442	1491	1540
450	0.15	± 15	8	120	300	518.0	21400	G1	2723	2735	2747	2759
450	0.56	± 15	10	150	300	518.0	5350	G2	1394	1443	1492	1541
450	2.2	± 15	20	400	300	518.0	1600	G3	1395	1444	1493	1542
450	3.9	± 15	35	800	300	518.0	800	G4	1396	1445	1494	1543
450	6.8	± 15	50	1000	300	518.0	535	G5	1397	1446	1495	1544

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

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STYLE CLR37



Case size	Dimensions		
	L +.187(4.75) -.031(.79)	D +.031(.79) -.016(.41)	C Max
G1	.688 (17.48)	.188 (4.78)	1.188 (30.18)
G2	.969 (24.61)	.281 (7.14)	1.469 (37.31)
G3	1.438 (36.53)	.375 (9.53)	1.938 (49.23)
G4	2.125 (53.98)	.375 (9.53)	2.625 (66.68)
G5	2.750 (69.85)	.375 (9.53)	3.250 (82.55)

NOTE: The weld is not enclosed in the end seal.

FIGURE 702-9. Established reliability, tantalum electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

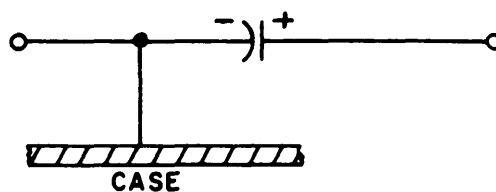
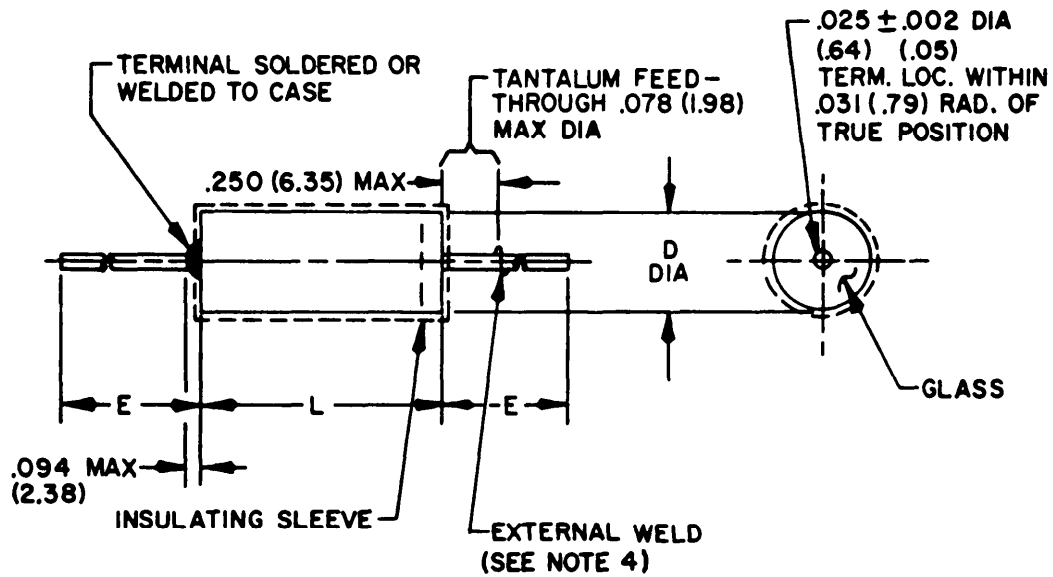
STYLE CLR37 (MIL-C-39006/4)
 NONPOLARIZED, PLAIN FOIL -- OPERATING TEMPERATURE RANGE -55°C TO +85°C (VOLTAGE DERATED TO +125°C)

Rated voltage (85°C)	Cap. μF	Cap. tolerance	DC leakage (max)		Derated voltage (125°C)	Surge voltage (85°C)	Impedance (max)	Case size	Part No. M39006/04- Failure rate level for		
			25°C	85°C & 125°C					M(I.O)	P(O.I)	R(O.OI)
HERMETICALLY SEALED											
Vdc			μA	μA	Vdc	Vdc	Ohms				
15	2.5	+20	1	2	10	17.2	893	G1	2711	2722	2733
15	10.0	+20	2	4	10	17.2	223	G2	1245	1290	1335
15	35.0	+20	2	10	10	17.2	64	G3	1246	1291	1336
15	70.0	+20	4	20	10	17.2	32	G4	1247	1292	1337
15	100.0	+20	5	30	10	17.2	23	G5	1248	1293	1338
25	1.5	+20	1	3	15	28.8	1487	G1	2712	2723	2734
25	6.0	+20	2	6	15	28.8	372	G2	1249	1294	1339
25	20.0	+20	2	10	15	28.8	112	G3	1250	1295	1340
25	40.0	+20	4	20	15	28.8	56	G4	1251	1296	1341
25	60.0	+20	5	30	15	28.8	37	G5	1252	1297	1342
50	0.8	+20	1	4	30	57.5	2790	G1	2714	2725	2736
50	3.0	+20	2	6	30	57.5	743	G2	1257	1302	1347
50	10.0	+20	2	12	30	57.5	223	G3	1258	1303	1348
50	20.0	+20	4	24	30	57.5	112	G4	1259	1304	1349
50	30.0	+20	6	36	30	57.5	75	G5	1260	1305	1350
75	0.5	+20	1	4	50	86.2	4460	G1	2715	2726	2737
75	2.0	+20	2	6	50	86.2	1115	G2	1261	1306	1351
75	7.0	+20	2	13	50	86.2	319	G3	1262	1307	1352
75	14.0	+20	4	24	50	86.2	159	G4	1263	1308	1353
75	20.0	+20	6	36	50	86.2	112	G5	1264	1309	1354
100	0.4	+20	1	3.5	65	115.0	5580	G1	2716	2727	2738
100	1.5	+20	2	6	65	115.0	1487	G2	1265	1310	1355
100	5.0	+20	2	13	65	115.0	446	G3	1266	1311	1356
100	10.0	+20	4	24	65	115.0	223	G4	1267	1312	1357
100	15.0	+20	6	36	65	115.0	149	G5	1268	1313	1358
150	0.25	+20	1	4	100	172.0	8909	G1	2718	2729	2740
150	1.0	+20	2	6	100	172.0	2227	G2	1269	1314	1359
150	3.5	+20	3	13	100	172.0	638	G3	1271	1316	1361
150	7.0	+20	4	24	100	172.0	319	G4	1272	1317	1362
150	10.0	+20	6	36	100	172.0	223	G5	1273	1318	1363
200	0.15	+20	4	25	150	230.0	14000	G1	2719	2730	2741
200	0.75	+20	8	32	150	230.0	2700	G2	1274	1319	1364
200	2.5	+15	16	64	150	230.0	800	G3	1275	1320	1365
200	7.5	+15	28	112	150	230.0	400	G4	1276	1321	1366
300	0.12	+15	40	160	150	230.0	260	G5	1277	1322	1367
300	0.47	+15	4	25	200	345.0	17500	G1	2720	2731	2742
300	1.5	+15	10	50	200	345.0	4500	G2	1282	1327	1372
300	3.3	+15	20	100	200	345.0	1500	G3	1283	1328	1373
300	4.7	+15	35	175	200	345.0	643	G4	1284	1329	1374
375	0.1	+15	50	250	200	345.0	450	G5	1285	1330	1375
375	0.39	+15	8	80	250	431.0	23500	G1	2721	2732	2743
375	1.2	+15	10	100	250	431.0	5620	G2	1286	1331	1376
375	2.2	+15	20	225	250	431.0	1880	G3	1287	1332	1377
375	3.9	+15	35	250	250	431.0	900	G4	1288	1333	1378
375	3.9	+15	50	325	250	431.0	562	G5	1289	1334	1379

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

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STYLE CLR79



CIRCUIT DIAGRAM

Case	Dimensions		
	L +.155 (3.94) -.016 (.41)	D +.031 (.79) -.016 (.41)	E ±.250 (6.35)
T1	.453 (11.51)	.188 (4.78)	1.500 (38.10)
T2	.641 (16.28)	.281 (7.14)	2.250 (57.15)
T3	.766 (19.46)	.375 (9.52)	2.250 (57.15)
T4	1.062 (26.97)	.375 (9.52)	2.250 (57.15)

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.
3. Metric equivalents are in parentheses.
4. The weld is not enclosed in the end seal.

FIGURE 702-9. Established reliability, tantalum electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

STANDARD CAPACITORS

STYLE CLR79 (MIL-C-39006/22)
TANTALUM ANODE AND CATHODE

POLARIZED SINTERED SLUG--OPERATING TEMPERATURE RANGE -55°C TO +85°C (VOLTAGE DERATED TO 125°C)

1/ Rated voltage (85°C)	Cap. µF	Cap. toler- ance	DC leakage (max)		Dissi- pation factor (max)	Derated voltage (125°C)	Surge voltage (+85°C)	Impedance (max)	Capacitance change at		2/ Max 85°C 40 kHz ripple current mA rms	Case size	Failure rate level for		Part No. M39006/22-	
			25°C µA	125°C µA					-55°C	+125°C			M(1.0)	R(0.01)		S(0.001)
6	30	±20	1	2	9	4	6.9	100	-40	+10.5	820	T1	0001	0221	0441	0661
	30	±10			9			100		+10.5	820		0002	0222	0442	0662
	30	±5			9			100		+10.5	820		0003	0223	0443	0663
	68	±20			15			60		+14	960		0004	0224	0444	0664
	68	±10			15			60			960		0005	0225	0445	0665
	68	±5			15			60			960		0006	0226	0446	0666
	140	±20			21			40			1200	T2	0007	0227	0447	0667
	140	±10			21			40			1200		0008	0228	0448	0668
	140	±5			21			40			1200		0009	0229	0449	0669
	270	±20			45			25	-44	+17.5	1375	T3	0010	0230	0450	0670
	270	±10			45			25		+20	1375		0011	0231	0451	0671
	270	±5			45			25		+17.5	1375		0012	0232	0452	0672
	330	±20			36			20		+14	1800		0013	0233	0453	0673
	330	±10			36			20		+16	1800		0014	0234	0454	0674
	330	±5			36			20		+16	1800		0015	0235	0455	0675
	560	±20			55			25	-64	+17.5	1900		0016	0236	0456	0676
	560	±10			55			25		+17.5	1900		0017	0237	0457	0677
	560	±5			55			25		+17.5	1900		0018	0238	0458	0678
	1200	±20			90			20	-64	+17.5	1900	T4	0019	0239	0459	0679
	1200	±10			90			20		+25	2265		0020	0240	0460	0680
	1200	±5			90			20		+25	2265		0021	0241	0461	0681
8	25	±20			7.5		9.2	100	-40	+10.5	820	T1	0022	0242	0462	0682
	25	±10			7.5			100		+10.5	820		0023	0243	0463	0683
	25	±5			7.5			100		+10.5	820		0024	0244	0464	0684
	56	±20			14			59		+14	900		0025	0245	0465	0685
	56	±10			14			59		+14	900		0026	0246	0466	0686
	56	±5			14			59		+14	900		0027	0247	0467	0687
	120	±20			20			50	-44	+17.5	1220	T2	0028	0248	0468	0688
	120	±10			20			50			1220		0029	0249	0469	0689
	120	±5			20			50			1220		0030	0250	0470	0690
	220	±20			37			30			1320		0031	0251	0471	0691
	220	±10			37			30			1320		0032	0252	0472	0692
	220	±5			37			30			1320		0033	0253	0473	0693
	290	±20			34			25	-64		1745	T3	0034	0254	0474	0694
	290	±10			34			25			1745		0035	0255	0475	0695
	290	±5			34			25			1745		0036	0256	0476	0696
	430	±20			46			1825			1825		0037	0257	0477	0697
	430	±10			46			1825			1825		0038	0258	0478	0698

See footnotes at end of figure.

FIGURE 702-9. Established reliability, tantalum, electrolytic (non-solid electrolyte), fixed capacitors - Continued.

STANDARD CAPACITORS
STYLE CLR79 (MIL-C-39006/22) - Continued

Rated voltage (85°C)	Cap. tolerance	Cap. (µF)	DC leakage (75°C) µA	DC leakage (85°C) µA	Dissipation factor (max)	Derated voltage (125°C) Vdc	Surge voltage (+85°C) Vdc	Impedance (max) Ohms	Capacitance change at		2/Max 85°C 40 kHz ripple current mA rms	Case size	Part No. M39006/22- Failure rate level for (1/1,000 hr)			
									-55°C	+85°C			+125°C	M(1.0)	P(0.1)	R(0.01)
8	+20	850	4	16	60	5	9.2	22	-80	+25	2330	T4	0039	0259	0479	0699
8	+10	850	4	16	60	5	9.2	22	-80	+25	2330	T4	0040	0260	0480	0700
10	+20	20	1	2	6	7	11.5	17.5	-32	+10.5	820	T1	0041	0261	0481	0701
20	+10	20	1	2	6	7	11.5	17.5	-32	+10.5	820	T1	0042	0262	0482	0702
20	+5	20	1	2	6	7	11.5	17.5	-32	+10.5	820	T1	0043	0263	0483	0703
47	+20	47	1	4	13	10	17.2	100	-36	+14	855	T2	0044	0264	0484	0704
47	+10	47	1	4	13	10	17.2	100	-36	+14	855	T2	0045	0265	0485	0705
100	+20	100	4	16	15	10	17.2	60	-40	+16	855	T2	0046	0266	0486	0706
100	+10	100	4	16	15	10	17.2	60	-40	+16	1200	T2	0047	0267	0487	0707
100	+5	100	4	16	15	10	17.2	60	-40	+16	1200	T2	0048	0268	0488	0708
180	+20	180	7	28	33	40	17.2	40	-40	+16	1200	T2	0049	0269	0489	0709
180	+10	180	7	28	33	40	17.2	40	-40	+16	1300	T2	0050	0270	0490	0710
180	+5	180	7	28	33	40	17.2	40	-40	+16	1300	T2	0051	0271	0491	0711
180	+20	180	7	28	33	40	17.2	40	-40	+16	1300	T2	0052	0272	0492	0712
250	+10	250	10	40	44	10	17.2	30	-40	+16	1720	T3	0053	0273	0493	0713
250	+5	250	10	40	44	10	17.2	30	-40	+16	1720	T3	0054	0274	0494	0714
390	+20	390	4	16	44	25	17.2	25	-64	+17.5	1720	T3	0055	0275	0495	0715
390	+10	390	4	16	44	25	17.2	25	-64	+17.5	1800	T3	0056	0276	0496	0716
390	+5	390	4	16	44	25	17.2	25	-64	+17.5	1800	T3	0057	0277	0497	0717
750	+20	750	4	16	44	25	17.2	25	-64	+17.5	1800	T3	0058	0278	0498	0718
750	+10	750	4	16	44	25	17.2	25	-64	+17.5	2360	T4	0059	0279	0499	0719
15	+20	15	1	2	5	10	17.2	155	-24	+10.5	2360	T4	0060	0280	0500	0720
15	+10	15	1	2	5	10	17.2	155	-24	+10.5	780	T1	0061	0281	0501	0721
15	+5	15	1	2	5	10	17.2	155	-24	+10.5	780	T1	0062	0282	0502	0722
33	+20	33	4	16	10	10	17.2	90	-28	+14	780	T1	0063	0283	0503	0723
33	+10	33	4	16	10	10	17.2	90	-28	+14	820	T1	0064	0284	0504	0724
33	+5	33	4	16	10	10	17.2	90	-28	+14	820	T1	0065	0285	0505	0725
70	+20	70	4	16	13	10	17.2	75	-28	+14	820	T1	0066	0286	0506	0726
70	+10	70	4	16	13	10	17.2	75	-28	+14	1150	T2	0067	0287	0507	0727
70	+5	70	4	16	13	10	17.2	75	-28	+14	1150	T2	0068	0288	0508	0728
120	+20	120	7	28	25	10	17.2	50	-32	+16	1150	T2	0069	0289	0509	0729
120	+10	120	7	28	25	10	17.2	50	-32	+16	1230	T2	0070	0290	0510	0730
170	+20	170	10	40	35	10	17.2	50	-32	+16	1230	T2	0071	0291	0511	0731
170	+10	170	10	40	35	10	17.2	50	-32	+16	1480	T3	0072	0292	0512	0732
170	+5	170	10	40	35	10	17.2	50	-32	+16	1480	T3	0073	0293	0513	0733
270	+20	270	16	60	43	10	17.2	30	-56	+17.5	1480	T3	0074	0294	0514	0734
270	+10	270	16	60	43	10	17.2	30	-56	+17.5	1500	T3	0075	0295	0515	0735
270	+5	270	16	60	43	10	17.2	30	-56	+17.5	1500	T3	0076	0296	0516	0736
270	+5	270	16	60	43	10	17.2	30	-56	+17.5	1500	T3	0077	0297	0517	0737
270	+5	270	16	60	43	10	17.2	30	-56	+17.5	1500	T3	0078	0298	0518	0738

See footnotes at end of figure.

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

STANDARD CAPACITORS

STYLE CLR79 (MIL-C-39006/22) - Continued

Rated voltage (85°C)	Cap. μF	Cap. tolerance	DC leakage (max) 25°C μA	DC leakage (max) 125°C μA	Dissipation factor (max)	Derated voltage (125°C) Vdc	Surge voltage (+85°C) Vdc	Impedance (max) Ohms	Capacitance change at		Z/Max 85°C 40 kHz ripple current mA rms	Case size	Part No. M39006/22- Failure rate level for			
									-55°C	+85°C			M(T.O)	P(0.1) R(0.01) S(0.001)		
Vdc		\pm	μA	μA	\pm	Vdc	Vdc	Ohms	\pm	\pm	mA rms		M(T.O)	P(0.1)	R(0.01)	S(0.001)
15	540	+20	6	24	40	10	17.2	23	-80	+25	2300	T4	0079	0299	0519	0739
15	540	+10	6	24	40	10	17.2	23	-80	+25	2300	T4	0080	0300	0520	0740
25	10	+20	1	2	4	15	28.8	220	-16	+9	715	T1	0081	0301	0521	0741
10	10	+10	1	2	4	15	28.8	220	-16	+9	715	T1	0082	0302	0522	0742
10	10	+5	1	2	4	15	28.8	220	-16	+9	715	T1	0083	0303	0523	0743
22	22	+20	2	6	7	20	10.5	140	-20	+12	800	T2	0084	0304	0524	0744
22	22	+10	2	6	7	20	10.5	140	-20	+12	800	T2	0085	0305	0525	0745
22	22	+5	2	6	7	20	10.5	140	-20	+12	800	T2	0086	0306	0526	0746
50	50	+20	11	70	11	70	28	70	-28	+15	1130	T2	0087	0307	0527	0747
50	50	+10	11	70	11	70	28	70	-28	+15	1130	T2	0088	0308	0528	0748
50	50	+5	11	70	11	70	28	70	-28	+15	1130	T2	0089	0309	0529	0749
100	100	+20	10	10	21	50	17.2	50	-32	+25	1215	T3	0090	0310	0530	0750
100	100	+10	10	10	21	50	17.2	50	-32	+25	1215	T3	0091	0311	0531	0751
100	100	+5	10	10	21	50	17.2	50	-32	+25	1215	T3	0092	0312	0532	0752
120	120	+20	2	6	25	38	34.5	38	-32	+25	1420	T4	0093	0313	0533	0753
120	120	+10	2	6	25	38	34.5	38	-32	+25	1420	T4	0094	0314	0534	0754
120	120	+5	2	6	25	38	34.5	38	-32	+25	1420	T4	0095	0315	0535	0755
180	180	+20	6	18	28	32	34.5	32	-48	+25	1460	T4	0096	0316	0536	0756
180	180	+10	6	18	28	32	34.5	32	-48	+25	1460	T4	0097	0317	0537	0757
180	180	+5	6	18	28	32	34.5	32	-48	+25	1460	T4	0098	0318	0538	0758
350	350	+20	7	28	35	24	34.5	24	-70	+25	1970	T4	0099	0319	0539	0759
350	350	+10	7	28	35	24	34.5	24	-70	+25	1970	T4	0100	0320	0540	0760
350	350	+5	7	28	35	24	34.5	24	-70	+25	1970	T4	0101	0321	0541	0761
8	8	+20	1	2	4	20	34.5	275	-16	+8	640	T1	0102	0322	0542	0762
8	8	+10	1	2	4	20	34.5	275	-16	+8	640	T1	0103	0323	0543	0763
8	8	+5	1	2	4	20	34.5	275	-16	+8	640	T1	0104	0324	0544	0764
15	15	+20	5	5	7	175	34.5	175	-20	+10.5	660	T2	0105	0325	0545	0765
15	15	+10	5	5	7	175	34.5	175	-20	+10.5	660	T2	0106	0326	0546	0766
15	15	+5	5	5	7	175	34.5	175	-20	+10.5	660	T2	0107	0327	0547	0767
40	40	+20	5	5	12	65	34.5	65	-24	+15	1025	T2	0108	0328	0548	0768
40	40	+10	5	5	12	65	34.5	65	-24	+15	1025	T2	0109	0329	0549	0769
40	40	+5	5	5	12	65	34.5	65	-24	+15	1025	T2	0110	0330	0550	0770
68	68	+20	8	8	15	60	34.5	60	-28	+15	1195	T3	0111	0331	0551	0771
68	68	+10	8	8	15	60	34.5	60	-28	+15	1195	T3	0112	0332	0552	0772
68	68	+5	8	8	15	60	34.5	60	-28	+15	1195	T3	0113	0333	0553	0773
100	100	+20	2	12	17	40	34.5	40	-28	+12	1450	T3	0114	0334	0554	0774
100	100	+10	2	12	17	40	34.5	40	-28	+12	1450	T3	0115	0335	0555	0775
100	100	+5	2	12	17	40	34.5	40	-28	+12	1450	T3	0116	0336	0556	0776

See footnotes at end of figure.

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

STANDARD CAPACITORS

STYLE CLR79 (MIL-C-39006/22) - Continued

1/ Rated voltage (85°C)	Cap. μF	Cap. toler- ance	DC leakage (max)		Dissipa- tion factor (max)	Derated voltage (125°C)	Surge voltage (+85°C)	Impedance (max)	Capacitance change at		Z/Max 85°C 40 kHz ripple current mA rms	Case size	Failure rate level for (%/1,000 hr)		Part No. M39006/22-	
			25°C μA	85°C & 125°C μA					-55°C	+125°C			M(1.0)	P(0.1)		R(0.01)
30	150	*20	2	18	23	20	35.5	35	-48	+13	1525	T3	0.116	0.336	0556	0776
	150	*10	2	18	23	20	35.5	35	-48	+13	1525	T3	0.117	0.337	0557	0777
	150	*5	2	18	23	20	35.5	35	-48	+13	1525	T3	0.118	0.338	0558	0778
	300	*20	8	32	31	30	57.5	25	-60	+25	1950	T4	0.119	0.339	0559	0779
	300	*10	8	32	31	30	57.5	25	-60	+25	1950	T4	0.120	0.340	0560	0780
	5	*20	1	2	3	30	57.5	400	-16	+5	580	T1	0.121	0.341	0561	0781
	5	*10	1	2	3	30	57.5	400	-16	+5	580	T1	0.122	0.342	0562	0782
	5	*5	1	2	3	30	57.5	400	-16	+5	580	T1	0.123	0.343	0563	0783
	10	*20	3	12	5	20	30	250	-24	+8	640		0.124	0.344	0564	0784
	10	*10	3	12	5	20	30	250	-24	+8	640		0.125	0.345	0565	0785
	10	*5	3	12	5	20	30	250	-24	+8	640		0.126	0.346	0566	0786
	25	*20	5	20	9	30	57.5	95	-20	+10.5	950	T2	0.127	0.347	0567	0787
	25	*10	5	20	9	30	57.5	95	-20	+10.5	950	T2	0.128	0.348	0568	0788
	25	*5	5	20	9	30	57.5	95	-20	+10.5	950	T2	0.129	0.349	0569	0789
	47	*20	9	36	13	30	57.5	70	-28	+13	1065		0.130	0.350	0570	0790
	47	*10	9	36	13	30	57.5	70	-28	+13	1065		0.131	0.351	0571	0791
	47	*5	9	36	13	30	57.5	70	-28	+13	1065		0.132	0.352	0572	0792
	60	*20	2	12	12	40	57.5	45	-16	+10.5	1285	T3	0.133	0.353	0573	0793
	60	*10	2	12	12	40	57.5	45	-16	+10.5	1285	T3	0.134	0.354	0574	0794
	60	*5	2	12	12	40	57.5	45	-16	+10.5	1285	T3	0.135	0.355	0575	0795
	82	*20	16	64	15	30	57.5	27	-32	+13	1400		0.136	0.356	0576	0796
	82	*10	16	64	15	30	57.5	27	-32	+13	1400		0.137	0.357	0577	0797
	82	*5	16	64	15	30	57.5	27	-32	+13	1400		0.138	0.358	0578	0798
	160	*20	8	32	17	40	57.5	27	-50	+25	1900	T4	0.139	0.359	0579	0799
	160	*10	8	32	17	40	57.5	27	-50	+25	1900	T4	0.140	0.360	0580	0800
	160	*5	8	32	17	40	57.5	27	-50	+25	1900	T4	0.141	0.361	0581	0801
	4	*20	1	2	2.8	30	57.5	550	-16	+5	525		0.142	0.362	0582	0802
	4	*10	1	2	2.8	30	57.5	550	-16	+5	525		0.143	0.363	0583	0803
	4	*5	1	2	2.8	30	57.5	550	-16	+5	525		0.144	0.364	0584	0804
	8.2	*20	4	16	4	40	57.5	275	-24	+8	625		0.145	0.365	0585	0805
	8.2	*10	4	16	4	40	57.5	275	-24	+8	625		0.146	0.366	0586	0806
	8.2	*5	4	16	4	40	57.5	275	-24	+8	625		0.147	0.367	0587	0807
	20	*20	5	20	7	30	57.5	105	-16	+10.5	930	T2	0.148	0.368	0588	0808
	20	*10	5	20	7	30	57.5	105	-16	+10.5	930	T2	0.149	0.369	0589	0809
	20	*5	5	20	7	30	57.5	105	-16	+10.5	930	T2	0.150	0.370	0590	0810
	39	*20	9	36	12	30	57.5	90	-28	+8	1015		0.151	0.371	0591	0811
	39	*10	9	36	12	30	57.5	90	-28	+8	1015		0.152	0.372	0592	0812
	39	*5	9	36	12	30	57.5	90	-28	+8	1015		0.153	0.373	0593	0813
	50	*20	2	12	11	30	57.5	50	-16	+10.5	1270	T3	0.154	0.374	0594	0814
	50	*10	2	12	11	30	57.5	50	-16	+10.5	1270	T3	0.155	0.375	0595	0815
	50	*5	2	12	11	30	57.5	50	-16	+10.5	1270	T3	0.155	0.375	0595	0815

See footnotes at end of figure.

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

STANDARD CAPACITORS
STYLE CLR79 (MIL-C-39006/22) - Continued

1/ Rated voltage (85°C)	Cap. μF	Cap. toler- ance	DC Leakage (max)		Dissip- ation factor (max)	Derated voltage (125°C)	Surge voltage (+85°C)	Impedance (max)	Capacitance change at			2/ Max 85°C 40 kHz ripple current	Case size	Failure rate level for			Part No. M39006/22-
			25°C	85°C & 125°C					-55°C	+85°C	+125°C			M(1.0)	P(0.1)	R(0.01)	
60	68	*20	2	16	13	40	69.0	50	-32	+10.5	+12	1365	T3	0156	0376	0596	0816
	68	*10	2	16	13	40	69.0	50	-32	+10.5	+12	1365	T3	0157	0377	0597	0817
	68	*5	2	16	13	40	69.0	50	-32	+10.5	+12	1365	T3	0158	0378	0598	0818
	140	*20	8	32	16	50	86.2	28	-40	+20	+20	1850	T4	0159	0379	0599	0819
	140	*10	8	32	16	50	86.2	28	-40	+20	+20	1850	T4	0160	0380	0600	0820
	75	*20	1	2	2.5	50	86.2	650	-16	+5	+6	525	T1	0161	0381	0601	0821
	75	*10	1	2	2.5	50	86.2	650	-16	+5	+6	525	T1	0162	0382	0602	0822
	3.5	*5	2	16	13	40	69.0	50	-32	+10.5	+12	1365	T3	0163	0383	0603	0823
	3.5	*5	2	16	13	40	69.0	50	-32	+10.5	+12	1365	T3	0164	0384	0604	0824
	6.8	*20	3	12	6	65	86.2	300	-20	+8	+9	610	T2	0165	0385	0605	0825
	6.8	*10	3	12	6	65	86.2	300	-20	+8	+9	610	T2	0166	0386	0606	0826
	6.8	*5	3	12	6	65	86.2	300	-20	+8	+9	610	T2	0167	0387	0607	0827
	15	*20	5	16	8	65	86.2	150	-16	+5	+6	890	T2	0168	0388	0608	0828
	15	*10	5	16	8	65	86.2	150	-16	+5	+6	890	T2	0169	0389	0609	0829
	15	*5	5	16	8	65	86.2	150	-16	+5	+6	890	T2	0170	0390	0610	0830
	33	*20	10	10	10	65	86.2	90	-24	+10.5	+15	1000	T3	0171	0391	0611	0831
	33	*10	10	10	10	65	86.2	90	-24	+10.5	+15	1000	T3	0172	0392	0612	0832
	33	*5	10	10	10	65	86.2	90	-24	+10.5	+15	1000	T3	0173	0393	0613	0833
	40	*20	2	12	9	65	86.2	60	-16	+5	+6	1250	T3	0174	0394	0614	0834
	40	*10	2	12	9	65	86.2	60	-16	+5	+6	1250	T3	0175	0395	0615	0835
	40	*5	2	12	9	65	86.2	60	-16	+5	+6	1250	T3	0176	0396	0616	0836
	56	*20	17	17	11	65	86.2	29	-28	+15	+15	1335	T4	0177	0397	0617	0837
	56	*10	17	17	11	65	86.2	29	-28	+15	+15	1335	T4	0178	0398	0618	0838
	56	*5	17	17	11	65	86.2	29	-28	+15	+15	1335	T4	0179	0399	0619	0839
	110	*20	9	36	12	65	86.2	29	-35	+20	+20	1850	T4	0180	0400	0620	0840
	110	*10	9	36	12	65	86.2	29	-35	+20	+20	1850	T4	0181	0401	0621	0841
	100	*20	1	2	2	65	86.2	950	-16	+7	+8	505	T1	0182	0402	0622	0842
	100	*10	1	2	2	65	86.2	950	-16	+7	+8	505	T1	0183	0403	0623	0843
	100	*5	1	2	2	65	86.2	950	-16	+7	+8	505	T1	0184	0404	0624	0844
	4.7	*20	4	16	3	65	86.2	500	-16	+5	+6	565	T2	0185	0405	0625	0845
	4.7	*10	4	16	3	65	86.2	500	-16	+5	+6	565	T2	0186	0406	0626	0846
	4.7	*5	4	16	3	65	86.2	500	-16	+5	+6	565	T2	0187	0407	0627	0847
	11	*20	4	16	5	65	86.2	105	-16	+5	+6	835	T2	0188	0408	0628	0848
	11	*10	4	16	5	65	86.2	105	-16	+5	+6	835	T2	0189	0409	0629	0849
	11	*5	4	16	5	65	86.2	105	-16	+5	+6	835	T2	0190	0410	0630	0850
	22	*20	9	36	8	65	86.2	100	-16	+5	+6	965	T3	0191	0411	0631	0851
	22	*10	9	36	8	65	86.2	100	-16	+5	+6	965	T3	0192	0412	0632	0852
	22	*5	9	36	8	65	86.2	100	-16	+5	+6	965	T3	0193	0413	0633	0853
	30	*20	12	48	7.5	65	86.2	80	-20	+5	+6	1240	T3	0194	0414	0634	0854
	30	*10	12	48	7.5	65	86.2	80	-20	+5	+6	1240	T3	0195	0415	0635	0855
	30	*5	12	48	7.5	65	86.2	80	-20	+5	+6	1240	T3	0196	0416	0636	0856
	43	*20	17	68	8.5	65	86.2	70	-20	+5	+6	1335	T3	0196	0416	0636	0856

See footnotes at end of figure.

STANDARD CAPACITORS
STYLE CLR79 (MIL-C-39006/22) - Continued

I/ Rated voltage (85°C)	Cap. μF	Cap. toler- ance	DC leakage (max)		Dissi- pation factor (max)	Derated voltage (125°C)	Surge voltage (+85°C)	Impedance (max)	Capacitance change at		Z/ Max 85°C 40 kHz ripple current	Case size	Part No. M39006/22- Failure rate level for (S/1,000 hr)		
			25°C μA	185°C & 125°C μA					-55°C	+85°C			M(1.0)	P(0.1)	R(0.01)
100	43	+10	2	17	8.5	65	115	70	-20	+8	1335	T3	0417	0637	0857
	43	+5	2	17	8.5	65	115	70	-20	+8	1335	T3	0418	0638	0858
	86	+20	9	36	10	85	144	30	-25	+15	1800	T4	0419	0639	0859
	1.7	+20	1	2	2	85	144	30	-25	+15	1800	T4	0420	0640	0860
	1.7	+10	1	2	2	85	144	1250	-16	+8	415	T1	0421	0641	0861
	1.7	+5	1	2	2	85	144	1250	-16	+8	415	T1	0422	0642	0862
	3.6	+20	3	3	3	85	144	600	-16	+8	415	T1	0423	0643	0863
	3.6	+10	3	3	3	85	144	600	-16	+8	415	T1	0424	0644	0864
	3.6	+5	3	3	3	85	144	600	-16	+8	415	T1	0425	0645	0865
	9	+20	5	5	5	85	144	240	-16	+8	415	T1	0426	0646	0866
	9	+10	5	5	5	85	144	240	-16	+8	415	T1	0427	0647	0867
	9	+5	5	5	5	85	144	240	-16	+8	415	T1	0428	0648	0868
	14	+20	7	7	6	85	144	167	-16	+8	415	T1	0429	0649	0869
	14	+10	7	7	6	85	144	167	-16	+8	415	T1	0430	0650	0870
	14	+5	7	7	6	85	144	167	-16	+8	415	T1	0431	0651	0871
	18	+20	2	9	5	85	144	129	-16	+8	415	T1	0432	0652	0872
	18	+10	2	9	5	85	144	129	-16	+8	415	T1	0433	0653	0873
	18	+5	2	9	5	85	144	129	-16	+8	415	T1	0434	0654	0874
	25	+20	13	13	6	85	144	93	-16	+8	415	T1	0435	0655	0875
	25	+10	13	13	6	85	144	93	-16	+8	415	T1	0436	0656	0876
	25	+5	13	13	6	85	144	93	-16	+8	415	T1	0437	0657	0877
	56	+20	10	40	6.5	85	144	32	-25	+20	1800	T4	0438	0658	0878
	56	+10	10	40	6.5	85	144	32	-25	+20	1800	T4	0439	0659	0879
	56	+5	10	40	6.5	85	144	32	-25	+20	1800	T4	0440	0660	0880

I/ Reverse voltage rating at 85°C is 3 Vdc, and at 125°C it is 2 Vdc.

Z/ For ripple current limits at various temperatures, voltages, and frequencies, see table 802-II.

FIGURE 702-9. Established reliability, tantalum, electrolytic (nonsolid electrolyte), fixed capacitors - Continued.

STANDARD CAPACITORS
 STYLE CLR79 (MIL-C-39006/22) - Continued

TABLE 702-11. Ripple current multipliers vs frequency, temperature, and applied peak voltage.

Frequency of applied ripple current	120 Hz			800 Hz			1 kHz			10 kHz			40 kHz			100 kHz								
	Ambient still air			Ambient still air			Ambient still air			Ambient still air			Ambient still air			Ambient still air								
	≤55°C	85°C	105°C	125°C	≤55°C	85°C	105°C	125°C	≤55°C	85°C	105°C	125°C	≤55°C	85°C	105°C	125°C	≤55°C	85°C	105°C	125°C				
% of rated peak voltage	.60	.39	--	--	.71	.43	--	--	.72	.45	--	--	.88	.55	--	--	1.0	.63	--	--	1.1	.69	--	
	.60	.46	--	--	.71	.55	--	--	.72	.55	--	--	.88	.67	--	--	1.0	.77	--	--	1.1	.85	--	
	.60	.52	.35	--	.71	.62	.42	--	.72	.62	.42	--	.88	.76	.52	--	1.0	.87	.59	--	1.1	.96	.65	
	.60	.58	.44	--	.71	.69	.52	--	.72	.70	.52	--	.88	.85	.64	--	1.0	.97	.73	--	1.1	1.07	.80	
≤ 66 Z/3%	.60	.60	.46	.27	.71	.71	.55	.32	.72	.72	.55	.32	.88	.88	.68	.40	1.0	1.0	.77	.45	1.1	1.1	.85	.50

MIL-STD-198E

SECTION 703

CAPACITORS, CHIP, FIXED, TANTALUM, ESTABLISHED RELIABILITY

STYLES CWR02, CWR03, CWR04, AND CWR06

(APPLICABLE SPECIFICATION: MIL-C-55365)

1. SCOPE. This specification covers established reliability, tantalum, fixed, chip capacitors. Capacitors covered by this section have failure rate levels ranging from 1.0 percent to 0.001 percent per 1,000 hours. These failure rate levels are established at a 60-percent confidence level and are based on full rated voltage at +85°C.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are primarily intended for use in thick and thin film hybrid circuits for filter, bypass, coupling, and other applications where the alternating current (ac) component is small compared to the direct current (dc) rated voltage and where supplemental moisture protection is available.

2.2 Construction. A porous tantalum slab serves as the anode. The surfaces of the anode are electrochemically converted to an oxide of tantalum which serves as the dielectric. These surfaces are coated with an oxide semiconductor which is the working electrolyte in solid form.

2.3 Voltage rating. These capacitors have a dc voltage rating over a range of 3 to 50 volts at 85°C.

2.4 Operating temperature range. These capacitors are suitable for operation over a temperature range of -55° to +125°C.

2.5 Voltage derating. The derated voltage at +125°C is approximately 55 percent of the full rated voltage.

2.6 Mounting. These capacitors are designed for mounting by reflow solder or conductive epoxy on circuit substrates.

3. ITEM IDENTIFICATION.

3.1 Type designation. The type designation is used for describing the capacitors as shown in the type designation example on following page.

3.2 Standard Capacitors. The standard capacitors available in this section are shown in figure 703-1.

703 (MIL-C-55365)

STYLE The three-letter symbol "CWR" identifies established reliability, tantalum, fixed, chip capacitors and the number identifies the design of the capacitor.

VOLTAGE - A single-letter symbol identifies the voltage (rated, derated, and surge) as follows:

Symbol	Voltage (volts, dc)		
	Rated (85°C)	Derated (125°C)	Surge (85°C)
B	3	2.0	4.0
C	4	2.7	5.0
D	6	4.0	8.0
F	10	7.0	13.0
H	15	10.0	20.0
J	20	13.0	26.0
K	25	17.0	32.0
L	30	20.0	39.0
M	35	23.0	46.0
N	50	33.0	65.0

TERMINATION FINISH - A single-letter symbol identifies termination finish as follows:

Symbol	Termination finish
A- - - - -	Solder-coated nickel
B- - - - -	Gold
C- - - - -	Solder-coated gold
D- - - - -	Solder-coated alloy 725

CAPACITANCE - The three-digit number identifies the NOMINAL CAPACITANCE VALUE, expressed in picofarads (pF). The first two digits represent significant figures and the last digit specifies the number of zeros to follow. (Example: 10 μ F = 106; 100 μ F = 107.)

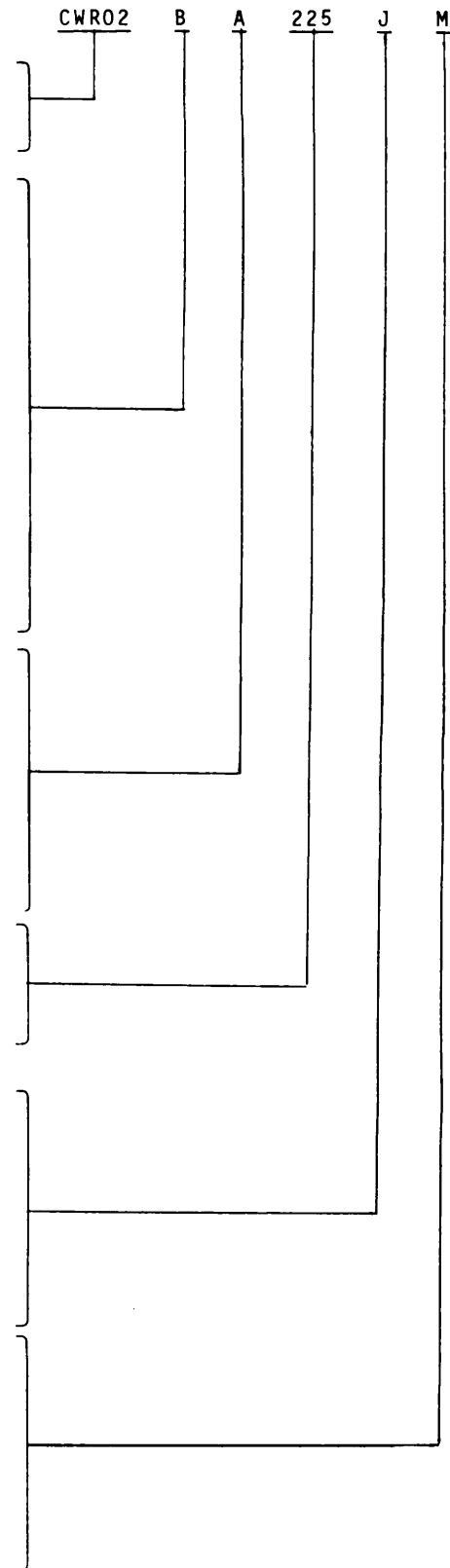
CAPACITANCE TOLERANCE - A single-letter symbol identifies the capacitance tolerance as follows:

Symbol	Capacitance tolerance
	Percent (\pm)
J- - - - -	5
K- - - - -	10
M- - - - -	20

FAILURE RATE LEVEL - A single-letter symbol identifies the failure rate level as follows:

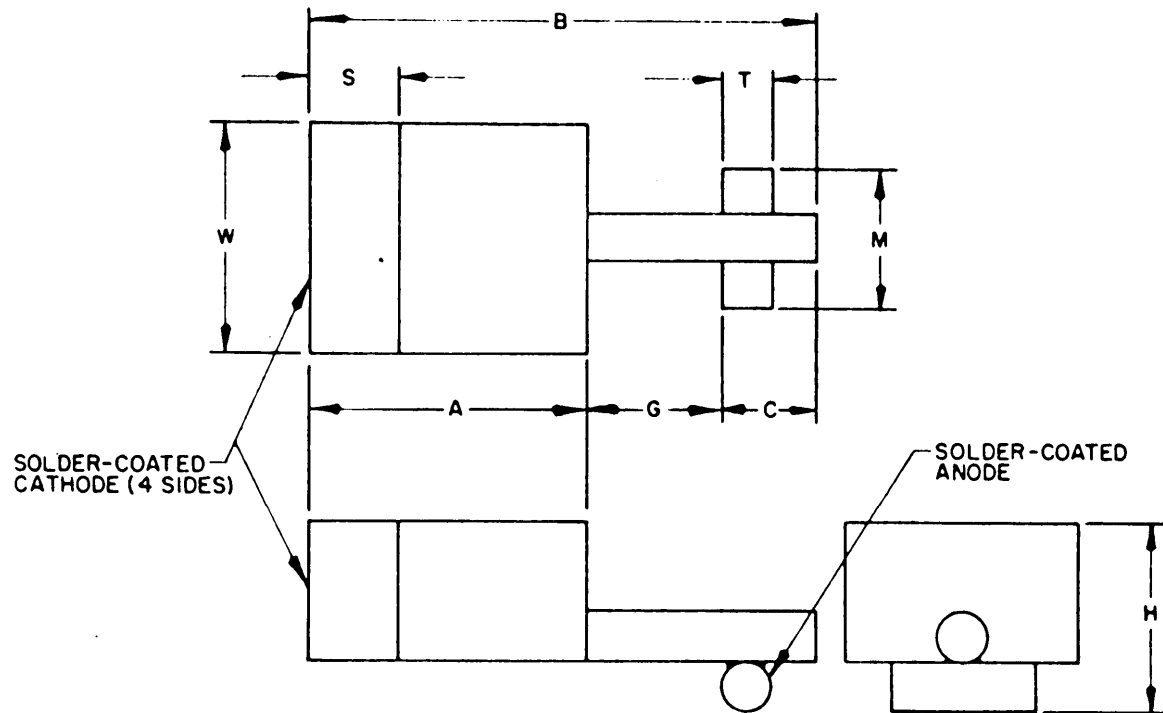
Symbol	FR level
	%/1,000 hr
M- - - - -	1.0
P- - - - -	0.1
R- - - - -	0.01
S- - - - -	0.001

TYPE DESIGNATION EXAMPLE.



MIL-STD-198E

STYLE CWR02



Case size	B	W	A	S	G	T	C	M	H
A	.165 ± .025 (4.19 ± .64)	.060 ± .010 (1.52 ± .25)	.085 ± .015 (2.16 ± .38)	.045 ± .020 (1.14 ± .51)	.050 ± .025 (1.27 ± .64)	.025 ± .015 (.64 ± .38)	.055 ± .010 (1.40 ± .25)	.060 ± .010 (1.52 ± .25)	.050 ± .010 (1.27 ± .25)
B	.180 ± .025 (4.57 ± .64)	.110 ± .010 (2.79 ± .25)	.105 ± .015 (2.67 ± .38)	.060 ± .025 (1.52 ± .64)	.050 ± .025 (1.27 ± .64)	.025 ± .010 (.64 ± .25)	.050 ± .010 (1.27 ± .25)	.060 ± .010 (1.52 ± .25)	.050 ± .010 (1.27 ± .25)
C	.225 ± .025 (5.72 ± .64)	.150 ± .010 (3.81 ± .25)	.150 ± .015 (3.81 ± .38)	.090 ± .040 (2.29 ± 1.02)	.050 ± .025 (1.27 ± .64)	.025 ± .010 (.64 ± .25)	.050 ± .010 (1.27 ± .25)	.070 ± .020 (1.78 ± .51)	.065 ± .015 (1.65 ± .38)
D	.280 ± .025 (7.11 ± .64)	.160 ± .010 (4.06 ± .25)	.200 ± .015 (5.08 ± .38)	.130 ± .050 (3.30 ± 1.27)	.050 ± .025 (1.27 ± .64)	.025 ± .015 (.64 ± .38)	.055 ± .010 (1.40 ± .25)	.070 ± .020 (1.78 ± .51)	.095 ± .015 (2.41 ± .38)
E	.290 ± .025 (7.37 ± .64)	.160 ± .015 (4.06 ± .38)	.205 ± .015 (5.21 ± .38)	.130 ± .055 (3.30 ± 1.40)	.050 ± .025 (1.27 ± .64)	.030 ± .015 (.76 ± .38)	.060 ± .010 (1.52 ± .25)	.070 ± .020 (1.78 ± .51)	.135 ± .015 (3.43 ± .38)

FIGURE 703-1. Established reliability, tantalum, fixed, ship capacitors (encapsulated and unencapsulated).

703 (MIL-C-55365)

MIL-STD-198E

STANDARD CAPACITORS

STYLE CWRO2 (MIL-C-5536/1)

OPERATING TEMPERATURE RANGE -55° TO +125° -- TERMINATION
FINISH A -- CAPACITANCE TOLERANCE ± 5 , ± 10 , OR ± 20 PERCENT

Type designation	DC rated voltage (85°C)	Cap. (nom)	DC leakage (max)			Dissipation factor (max)			Case size
			+25°C	+85°C	+125°C	+25°C	+85°C +125°C	-55°C	
	Volts	μF	μA	μA	μA	%	%	%	
CWRO2BA225--	3	2.2	1.0	10	12.5	4	6	8	A
CWRO2BA475--	3	4.7	1.0	10	12.5	4	6	8	A
CWRO2BA156--	3	15.0	1.0	10	12.5	6	8	10	C
CWRO2BA476--	3	47.0	2.8	28	35	6	8	10	D
CWRO2CA335--	4	3.3	.5	5	6.3	6	8	10	A
CWRO2CA475--	4	4.7	.5	5	6.3	6	8	10	A
CWRO2CA685--	4	6.8	1.0	10	12.5	6	8	10	B
CWRO2CA106--	4	10.0	1.0	10	12.5	6	9	12	B
CWRO2CA156--	4	15.0	1.0	10	12.5	6	9	12	C
CWRO2CA336--	4	33.0	2.0	20	25	6	9	12	C
CWRO2CA486--	4	68.0	3.0	30	37.5	6	9	12	D
CWRO2CA107--	4	100.0	3.0	30	37.5	6	9	12	E
CWRO2DA155--	6	1.5	.5	5	6.3	4	6	8	A
CWRO2DA225--	6	2.2	.5	5	6.3	6	8	10	A
CWRO2DA335--	6	3.3	1.0	10	12.5	4	6	8	A
CWRO2DA475--	6	4.7	1.0	10	12.5	6	8	10	B
CWRO2DA685--	6	6.8	1.0	10	12.5	6	8	10	B
CWRO2DA106--	6	10.0	1.0	10	12.5	6	9	12	C
CWRO2DA226--	6	22.0	2.0	20	25	6	9	12	C
CWRO2DA336--	6	33.0	3.0	30	37.5	6	8	10	D
CWRO2DA476--	6	47.0	3.0	30	37.5	6	9	12	D
CWRO2DA686--	6	68.0	3.0	30	37.5	6	9	12	E
CWRO2FA105--	10	1.0	.5	5	6.3	4	6	8	A
CWRO2FA155--	10	1.5	.5	5	6.3	6	8	10	A
CWRO2FA225--	10	2.2	1.0	10	12.5	4	6	8	A
CWRO2FA335--	10	3.3	1.0	10	12.5	6	8	10	B
CWRO2FA475--	10	4.7	1.0	10	12.5	6	8	10	B
CWRO2FA685--	10	6.8	1.0	10	12.5	6	8	10	C
CWRO2FA156--	10	15.0	2.0	20	25	6	9	12	C
CWRO2FA206--	10	20.0	3.0	30	37.5	6	9	12	D
CWRO2FA226--	10	22.0	3.0	30	37.5	6	8	10	D
CWRO2FA336--	10	33.0	3.0	30	37.5	6	9	12	D
CWRO2FA476--	10	47.0	3.0	30	37.5	6	8	10	E
CWRO2HA684--	15	.68	.5	5	6.3	4	6	8	A
CWRO2HA105--	15	1.0	.5	5	6.3	4	6	8	A
CWRO2HA155--	15	1.5	.5	5	6.3	6	8	10	A
CWRO2HA225--	15	2.2	1.0	10	12.5	6	8	10	B
CWRO2HA335--	15	3.3	1.0	10	12.5	6	9	12	B
CWRO2HA475--	15	4.7	1.0	10	12.5	6	8	10	C
CWRO2HA106--	15	10.0	2.0	20	25	6	9	12	C
CWRO2HA226--	15	22.0	3.0	30	37.5	6	9	12	D
CWRO2HA336--	15	33.0	3.0	30	37.5	6	9	12	E
CWRO2JA334--	20	.33	.5	5	6.3	4	6	8	A
CWRO2JA474--	20	.47	.5	5	6.3	4	6	8	A
CWRO2JA684--	20	.68	.5	5	6.3	4	6	8	A
CWRO2JA105--	20	1.0	1.0	10	12.5	4	6	8	A
CWRO2JA155--	20	1.5	1.0	10	12.5	6	8	10	B
CWRO2JA225--	20	2.2	1.0	10	12.5	4	6	8	B
CWRO2JA335--	20	3.3	1.0	10	12.5	6	8	10	C

FIGURE 703-1. Established reliability, tantalum, fixed, ship capacitors
(encapsulated and unencapsulated) - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CWR02 (MIL-C-55365/1) - Continued.

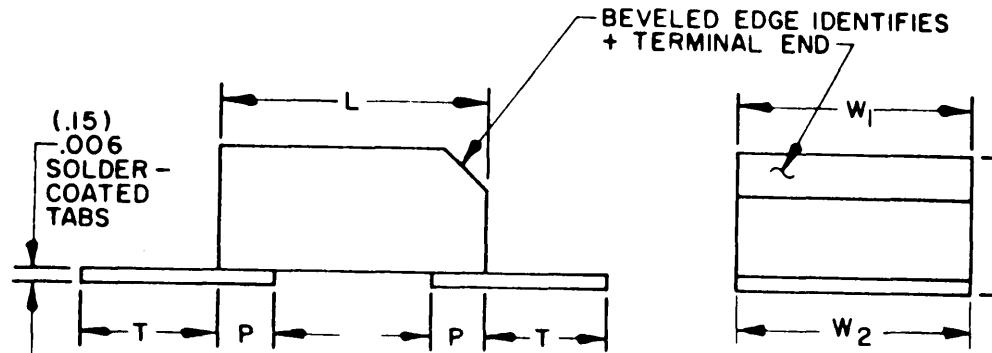
OPERATING TEMPERATURE RANGE -55° TO +125°C -- TERMINATION
FINISH A -- CAPACITANCE TOLERANCE ±5, ±10, OR ±20 PERCENT

Type designation	DC rated voltage (85°C)	Cap. (nom)	DC leakage (max)			Dissipation factor (max)			Case size
			+25°C	+85°C	+125°C	+25°C	+85°C +125°C	-55°C	
	Volts	μF	μA	μA	μA	%	%	%	
CWR02JA475--	20	4.7	1.9	19	24	4	6	8	C
CWR02JA685--	20	6.3	2.0	20	25	6	8	10	C
CWR02JA106--	20	10.0	3.0	30	37.5	6	9	12	D
CWR02JA156--	20	15.0	3.0	30	37.5	6	9	12	D
CWR02JA226--	20	22.0	3.0	30	37.5	6	9	12	E
CWR02KA474--	25	.47	.5	5	6.3	4	6	8	A
CWR02KA684--	25	.68	.5	5	6.3	4	6	8	A
CWR02KA105--	25	1.0	1.0	10	12.5	4	6	8	B
CWR02KA155--	25	1.5	1.0	10	12.5	6	8	10	B
CWR02KA225--	25	2.2	1.0	10	12.5	6	8	10	C
CWR02KA335--	25	3.3	2.0	20	25	6	8	10	C
CWR02KA475--	25	4.7	2.0	20	25	6	8	10	C
CWR02KA685--	25	6.8	3.0	30	37.5	6	9	12	D
CWR02KA106--	25	10.0	3.0	30	37.5	6	9	12	E
CWR02LA474--	30	.47	1.0	10	12.5	4	6	8	B
CWR02LA684--	30	.68	1.0	10	12.5	4	6	8	B
CWR02LA155--	30	1.5	1.0	10	12.5	6	8	10	C
CWR02LA335--	30	3.3	2.0	20	25	6	8	10	D
CWR02LA685--	30	6.8	3.0	30	37.5	6	8	10	E
CWR02MA104--	35	.10	.5	5	6.3	4	6	8	A
CWR02MA224--	35	.22	.5	5	6.3	4	6	8	A
CWR02MA334--	35	.33	.5	5	6.3	4	6	8	A
CWR02MA474--	35	.47	1.0	10	12.5	4	6	8	B
CWR02MA684--	35	.68	1.0	10	12.5	4	6	8	B
CWR02MA105--	35	1.0	1.0	10	12.5	4	6	8	C
CWR02MA155--	35	1.5	1.1	11	14	4	6	8	C
CWR02MA225--	35	2.2	2.0	20	25	6	8	10	C
CWR02MA335--	35	3.3	2.3	23	29	4	6	8	D
CWR02MA475--	35	4.7	3.0	30	37.5	6	8	10	D
CWR02MA685--	35	6.8	3.0	30	37.5	6	8	10	E
CWR02NA104--	50	.10	.5	5	6.3	4	6	8	A
CWR02NA154--	50	.15	.5	5	6.3	4	6	8	A
CWR02NA224--	50	.22	1.0	10	12.5	4	6	8	A
CWR02NA334--	50	.33	1.0	10	12.5	4	6	8	B
CWR02NA474--	50	.47	1.0	10	12.5	4	6	8	B
CWR02NA684--	50	.68	2.0	20	25	4	6	8	C
CWR02NA105--	50	1.0	2.0	20	25	4	6	8	C
CWR02NA155--	50	1.5	2.0	20	25	6	8	10	C
CWR02NA225--	50	2.2	3.0	30	37.5	6	8	10	D
CWR02NA335--	50	3.3	3.0	30	37.5	6	8	10	D
CWR02NA475--	50	4.7	3.0	30	37.5	6	8	10	E

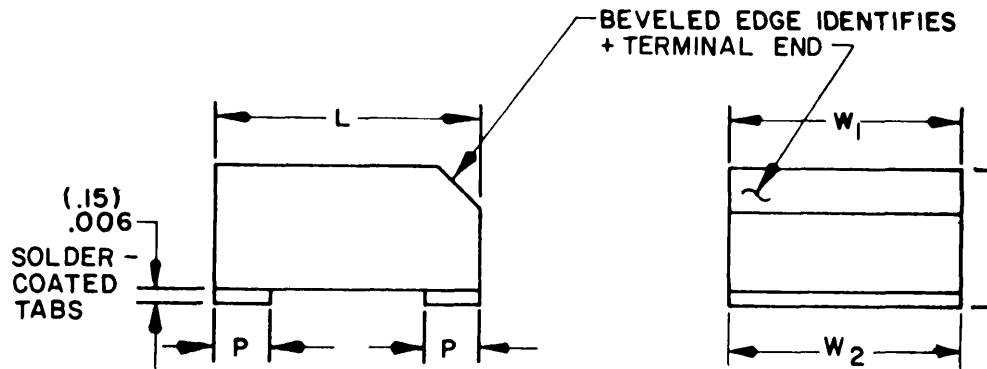
FIGURE 703-1. Established reliability, tantalum, fixed, chip capacitors
(encapsulated and unencapsulated) - Continued.

MIL-STD-198E

STYLE CWRO3 (ENCAPSULATED)



STYLE CWRO4



	L	(CASE) W ₁	(TABS) W ₂	H	P	T
CASE SIZE	±.005 (.13)	±.010 (.25)	±.010 (.25) -.005 (.13)	±.005 (.13)	±.010 (.25)	±.010 (.25)
A	.180 (4.57)	.100 (2.54)	.090 (2.29)	.070 (1.78)	.030 (.76)	.150 (3.81)
B	.180 (4.57)	.100 (2.54)	.090 (2.29)	.100 (2.54)	.030 (.76)	.150 (3.81)
C	.320 (8.13)	.180 (4.57)	.170 (4.32)	.070 (1.78)	.050 (1.27)	.110 (2.79)
D	.320 (8.13)	.180 (4.57)	.170 (4.32)	.100 (2.54)	.050 (1.27)	.110 (2.79)
E	.320 (8.13)	.180 (4.57)	.170 (4.32)	.195 (4.95)	.050 (1.27)	.110 (2.79)

FIGURE 703-1. Established reliability, tantalum, fixed, ship capacitors (encapsulated and unencapsulated) - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CWRO1 AND CWRO4 (MIL-C-55365/2)

OPERATING TEMPERATURE RANGE -55° TO +125° -- TERMINATION
FINISH D -- CAPACITANCE TOLERANCE \pm , ± 10 , OR ± 20 PERCENT

Type designation	DC rated voltage (85°C)	Cap. (nom)	DC leakage (max)			Dissipation factor (max)			Case size
			+25°C	+85°C	+125°C	+25°C	+85°C +125°C	-55°C	
	Volts	μ F	μ A	μ A	μ A	%	%	%	
CWRO-BD185--	3	1.8	1.0	10	15	4	6	8	A
CWRO-BD225--	3	2.2	1.0	10	15	4	6	8	A
CWRO-BD395--	3	3.9	1.0	10	15	4	6	8	B
CWRO-BD475--	3	4.7	1.0	10	15	4	6	8	B
CWRO-BD126--	3	12.0	1.0	10	15	6	8	10	C
CWRO-BD156--	3	15.0	1.0	10	15	6	8	10	C
CWRO-BD396--	3	39.0	2.3	23	35	6	8	10	D
CWRO-BD476--	3	47.0	2.8	28	42	6	8	10	D
CWRO-BD826--	3	82.0	4.9	49	74	8	10	12	E
CWRO-BD107--	3	100.0	6.0	60	90	8	10	12	E
CWRO-DD125--	6	1.2	1.0	10	15	4	6	8	A
CWRO-DD155--	6	1.5	1.0	10	15	4	6	8	A
CWRO-DD275--	6	2.7	1.0	10	15	4	6	8	B
CWRO-DD335--	6	3.3	1.0	10	15	4	6	8	B
CWRO-DD825--	6	8.2	1.0	10	15	6	8	10	C
CWRO-DD106--	6	10.0	1.2	12	18	6	8	10	C
CWRO-DD276--	6	27.0	3.2	32	48	6	8	10	D
CWRO-DD336--	6	33.0	4.0	40	60	6	8	10	D
CWRO-DD566--	6	56.0	6.7	67	101	8	10	12	E
CWRO-DD686--	6	68.0	8.2	82	123	8	10	12	E
CWRO-FD824--	10	0.82	1.0	10	15	4	6	8	A
CWRO-FD105--	10	1.0	1.0	10	15	4	6	8	A
CWRO-FD155--	10	1.5	1.0	10	15	4	6	8	B
CWRO-FD185--	10	1.8	1.0	10	15	4	6	8	B
CWRO-FD225--	10	2.2	1.0	10	15	4	6	8	B
CWRO-FD565--	10	5.6	1.1	11	17	4	6	8	C
CWRO-FD685--	10	6.8	1.4	14	21	6	8	10	C
CWRO-FD126--	10	12.0	2.4	24	36	6	8	10	D
CWRO-FD156--	10	15.0	3.0	30	45	6	8	10	D
CWRO-FD186--	10	18.0	3.6	36	54	6	8	10	D
CWRO-FD226--	10	22.0	4.4	44	66	6	8	10	D
CWRO-FD336--	10	33.0	6.6	66	99	6	8	10	E
CWRO-FD396--	10	39.0	7.8	78	117	6	8	10	E
CWRO-FD476--	10	47.0	9.4	94	141	6	8	10	E
CWRO-HD564--	15	0.56	1.0	10	15	4	6	8	A
CWRO-HD684--	15	0.68	1.0	10	15	4	6	8	A
CWRO-HD125--	15	1.2	1.0	10	15	4	6	8	B
CWRO-HD395--	15	3.9	1.2	12	18	4	6	8	C
CWRO-HD475--	15	4.7	1.4	14	21	4	6	8	C
CWRO-HD825--	15	8.2	2.5	25	38	6	8	10	D
CWRO-HD106--	15	10.0	3.0	30	45	6	8	10	D
CWRO-HD276--	15	27.0	8.1	81	122	6	8	10	E
CWRO-JD274--	20	0.27	1.0	10	15	4	6	8	A
CWRO-JD334--	20	0.33	1.0	10	15	4	6	8	A
CWRO-JD394--	20	0.39	1.0	10	15	4	6	8	A
CWRO-JD474--	20	0.47	1.0	10	15	4	6	8	A
CWRO-JD564--	20	0.56	1.0	10	15	4	6	8	B
CWRO-JD684--	20	0.68	1.0	10	15	4	6	8	B
CWRO-JD824--	20	0.82	1.0	10	15	4	6	8	B

FIGURE 703-1. Established reliability, tantalum, fixed, shop capacitors
(encapsulated and unencapsulated) - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CWRO3 AND CWRO4 (MIL-C-55365/2) - Continued

OPERATING TEMPERATURE RANGE -55° TO +125°C -- TERMINATION
FINISH D -- CAPACITANCE TOLERANCE ±5, ±10, OR ±20 PERCENT

Type designation	DC rated voltage (85°C)	Cap. (nom)	DC leakage (max)			Dissipation factor (max)			Case size
			+25°C	+85°C	+125°C	+25°C	+85°C	+125°C	
			Volts	μF	μA	μA	μA	%	
CWRO-JD105--	20	1.0	1.0	10	15	4	6	8	B
CWRO-JD185--	20	1.8	1.0	10	15	4	6	8	C
CWRO-JD225--	20	2.2	1.0	10	15	4	6	8	C
CWRO-JD275--	20	2.7	1.1	11	17	4	6	8	C
CWRO-JD335--	20	3.3	1.3	13	20	4	6	8	C
CWRO-JD475--	20	4.7	1.9	19	29	4	6	8	D
CWRO-JD565--	20	5.6	2.2	22	33	4	6	8	D
CWRO-JD685--	20	6.8	2.7	27	41	6	8	10	D
CWRO-JD126--	20	12.0	4.8	48	72	6	8	10	E
CWRO-JD156--	20	15.0	6.0	60	90	6	8	10	E
CWRO-JD186--	20	18.0	7.2	72	108	6	8	10	E
CWRO-JD226--	20	22.0	8.8	88	132	6	8	10	E
CWRO-MD104--	35	0.10	1.0	10	15	4	6	8	A
CWRO-MD124--	35	0.12	1.0	10	15	4	6	8	A
CWRO-MD154--	35	0.15	1.0	10	15	4	6	8	A
CWRO-MD184--	35	0.18	1.0	10	15	4	6	8	A
CWRO-MD224--	35	0.22	1.0	10	15	4	6	8	A
CWRO-MD274--	35	0.27	1.0	10	15	4	6	8	B
CWRO-MD334--	35	0.33	1.0	10	15	4	6	8	B
CWRO-MD394--	35	0.39	1.0	10	15	4	6	8	B
CWRO-MD474--	35	0.47	1.0	10	15	4	6	8	B
CWRO-MD824--	35	0.82	1.0	10	15	4	6	8	C
CWRO-MD105--	35	1.0	1.0	10	15	4	6	8	C
CWRO-MD125--	35	1.2	1.0	10	15	4	6	8	C
CWRO-MD155--	35	1.5	1.1	11	17	4	6	8	C
CWRO-MD185--	35	1.8	1.3	13	20	4	6	8	D
CWRO-MD225--	35	2.2	1.5	15	23	4	6	8	D
CWRO-MD275--	35	2.7	1.9	19	29	4	6	8	D
CWRO-MD335--	35	3.3	2.3	23	35	4	6	8	D
CWRO-MD395--	35	3.9	2.7	27	41	4	6	8	D
CWRO-MD475--	35	4.7	3.3	33	50	4	6	8	E
CWRO-MD565--	35	5.6	3.9	39	59	4	6	8	E
CWRO-MD685--	35	6.8	4.8	48	72	6	8	10	E
CWRO-MD825--	35	8.2	5.7	57	86	6	8	10	E
CWRO-MD106--	35	10.0	7.0	70	105	6	8	10	E
CWRO-ND683--	50	0.068	1.0	10	15	4	6	8	A
CWRO-ND823--	50	0.082	1.0	10	15	4	6	8	A
CWRO-ND104--	50	0.10	1.0	10	15	4	6	8	B
CWRO-ND124--	50	0.12	1.0	10	15	4	6	8	B
CWRO-ND154--	50	0.15	1.0	10	15	4	6	8	B
CWRO-ND184--	50	0.18	1.0	10	15	4	6	8	B
CWRO-ND224--	50	0.22	1.0	10	15	4	6	8	C
CWRO-ND274--	50	0.27	1.0	10	15	4	6	8	C
CWRO-ND334--	50	0.33	1.0	10	15	4	6	8	C
CWRO-ND394--	50	0.39	1.0	10	15	4	6	8	C
CWRO-ND474--	50	0.47	1.0	10	15	4	6	8	C
CWRO-ND564--	50	0.56	1.0	10	15	4	6	8	C
CWRO-ND684--	50	0.68	1.0	10	15	4	6	8	C
CWRO-ND824--	50	0.82	1.0	10	15	4	6	8	D

FIGURE 703-1. Established reliability, tantalum, fixed chip capacitors (encapsulated and unencapsulated) - Continued.

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STANDARD CAPACITORS

STYLE CWRO3 AND CWRO4 (MIL-C-55365/2) - Continued

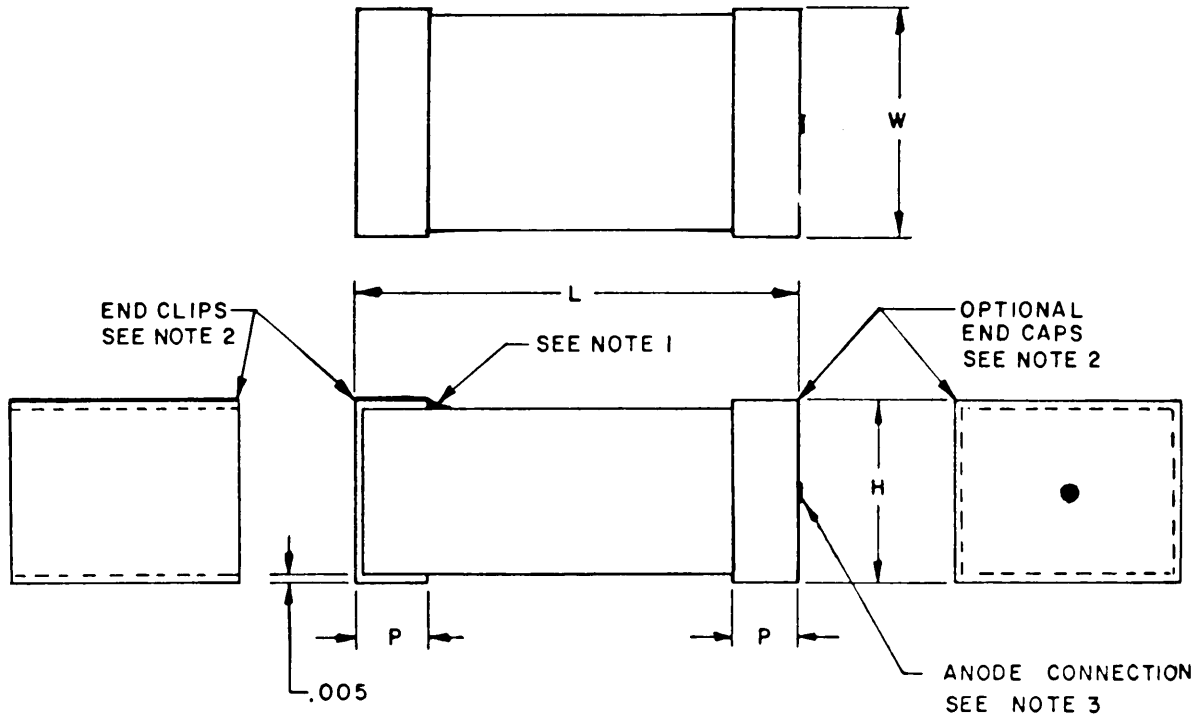
OPERATING TEMPERATURE RANGE -55° TO +125°C -- TERMINATION
FINISH -- CAPACITANCE TOLERANCE ± 5 , ± 10 , OR ± 20 PERCENT

Type designation	DC rated voltage (85°C)	Cap. (nom)	DC leakage (max)			Dissipation factor (max)			Case size
			+25°C	+85°C	+125°C	+25°C	+85°C	+125°C	
			μA	μA	μA	%	%	%	
	<u>Volts</u>	μF							
CWRO-ND105--	50	1.0	1.0	10	15	4	6	8	D
CWRO-ND125--	50	1.2	1.2	12	18	4	6	8	D
CWRO-ND155--	50	1.5	1.5	15	23	4	6	8	D
CWRO-ND185--	50	1.8	1.8	18	27	4	6	8	E
CWRO-ND225--	50	2.2	2.2	22	33	4	6	8	E
CWRO-ND275--	50	2.7	2.7	27	41	4	6	8	E
CWRO-ND335--	50	3.3	3.3	33	50	4	6	8	E

FIGURE 703-1. Established reliability, tantalum, fixed, chip capacitors
(encapsulated and unencapsulated) - Continued.

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STYLE CWR06



Case size	L ±.015 (.38)	W ±.015 (.38)	H ±.015 (.38)	P ±.005 (.13)
A	.100 (2.54)	.050 (1.27)	.050 (1.27)	.030 (.76)
B	.150 (3.81)	.050 (1.27)	.050 (1.27)	.030 (.76)
C	.200 (5.08)	.050 (1.27)	.050 (1.27)	.030 (.76)
D	.150 (3.81)	.100 (2.54)	.050 (1.27)	.030 (.76)
E	.200 (5.08)	.100 (2.54)	.050 (1.27)	.030 (.76)
F	.220 (5.59)	.135 (3.43)	.070 (1.78)	.030 (.76)
G	.265 (5.59)	.110 (2.79)	.110 (2.79)	.050 (1.27)
H	.285 (7.24)	.150 (3.81)	.110 (2.79)	.050 (1.27)

NOTES:

1. Cathode terminal may be epoxy coated on one surface for polarity identification.
2. Anode and cathode terminals may be three sided clips or five sided caps; however, terminals shall be the same on both ends of the same chip.
3. The anode terminal shall be identified by the riser wire connection, which may extend the case size .015 (.38 mm) maximum.
4. These capacitors are designed for mounting by dip soldering, thermocompression bonding, reflow soldering, or other conventional means.
5. When solder coated terminations are required, add .015 (.38 mm) to dimensions.

FIGURE 703-1. Established reliability, tantalum, fixed, chip capacitors (encapsulated and unencapsulated) - Continued.

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STANDARD CAPACITORS

STYLE CWR06 (MIL-C-55365/4)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- TERMINATION
FINISH A, B, OR C -- CAPACITANCE TOLERANCE ±5, ±10, OR ±20 PERCENT

Type designation	DC rated voltage (85°C)	Cap. (nom)	DC leakage (max)			Dissipation factor (max)		
			+25°C	+85°C	+125°C	+25°C	+85°C +125°C	-55°C
			Volts	μF	μA	μA	μA	%
CWR06C-225--	4	2.2	1.0	10	12	6	8	8
CWR06C-475--	4	4.7	1.0	10	12	6	8	8
CWR06C-685--	4	6.8	1.0	10	12	6	8	8
CWR06C-106--	4	10.0	1.0	10	12	8	8	10
CWR06C-156--	4	15.0	1.0	10	12	8	10	12
CWR06C-336--	4	33.0	2.0	20	24	8	10	12
CWR06C-686--	4	68.0	3.0	30	36	10	12	12
CWR06C-107--	4	100.0	4.0	40	48	10	12	12
CWR06D-155--	6	1.5	1.0	10	12	6	8	8
CWR06D-335--	6	3.3	1.0	10	12	6	8	8
CWR06D-475--	6	4.7	1.0	10	12	6	8	8
CWR06D-685--	6	6.8	1.0	10	12	6	8	8
CWR06D-106--	6	10.0	1.0	10	12	8	10	12
CWR06D-226--	6	22.0	2.0	20	24	8	10	12
CWR06D-476--	6	47.0	3.0	30	36	10	12	12
CWR06D-686--	6	68.0	4.0	40	48	10	12	12
CWR06F-105--	10	1.0	1.0	10	12	6	8	8
CWR06F-225--	10	2.2	1.0	10	12	6	8	8
CWR06F-335--	10	3.3	1.0	10	12	6	8	8
CWR06F-475--	10	4.7	1.0	10	12	6	8	8
CWR06F-685--	10	6.8	1.0	10	12	6	8	8
CWR06F-156--	10	15.0	2.0	20	24	8	8	10
CWR06F-336--	10	33.0	3.0	30	36	10	12	12
CWR06F-476--	10	47.0	5.0	50	60	10	12	12
CWR06H-684--	15	.68	1.0	10	12	6	8	8
CWR06H-155--	15	1.5	1.0	10	12	6	8	8
CWR06H-225--	15	2.2	1.0	10	12	6	8	8
CWR06H-335--	15	3.3	1.0	10	12	6	8	8
CWR06H-475--	15	4.7	1.0	10	12	6	8	8
CWR06H-106--	15	10.0	2.0	20	24	6	8	8
CWR06H-226--	15	22.0	4.0	40	48	8	8	10
CWR06H-336--	15	33.0	5.0	50	60	8	8	10
CWR06J-474--	20	.47	1.0	10	12	6	8	8
CWR06J-684--	20	.68	1.0	10	12	6	8	8
CWR06J-105--	20	1.0	1.0	10	12	6	8	8
CWR06J-155--	20	1.5	1.0	10	12	6	8	8
CWR06J-225--	20	2.2	1.0	10	12	6	8	8
CWR06J-335--	20	3.3	1.0	10	12	6	8	8
CWR06J-685--	20	6.8	2.0	20	24	6	8	8
CWR06J-156--	20	15.0	3.0	30	36	6	8	8
CWR06J-226--	20	22.0	4.0	40	48	6	8	8
CWR06K-334--	25	.33	1.0	10	12	6	8	8
CWR06K-684--	25	.68	1.0	10	12	6	8	8
CWR06K-105--	25	1.0	1.0	10	12	6	8	8
CWR06K-155--	25	1.5	1.0	10	12	6	8	8
CWR06K-225--	25	2.2	1.0	10	12	6	8	8
CWR06K-475--	25	4.7	2.0	20	24	6	8	8
CWR06K-685--	25	6.8	2.0	20	24	6	8	8
CWR06K-106--	25	10.0	3.0	30	36	6	8	8
CWR06K-156--	25	15.0	4.0	40	48	6	8	8

FIGURE 403-1. Established reliability, tantalum, fixed, ship capacitors (encapsulated and unencapsulated) - Continued.

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STANDARD CAPACITORS

STYLE CWR06 (MIL-C-55365/4) - Continued

OPERATING TEMPERATURE RANGE -55° TO +125°C -- TERMINATION
FINISH A, B, OR C -- CAPACITANCE TOLERANCE ±5, ±10, OR ±20 PERCENT

Type designation	DC rated voltage (85°C)	Cap. (nom)	DC Leakage (max)			Dissipation factor (max)			Case size
			+25°C	+85°C	+125°C	+25°C	+85°C +125°C	-55°C	
	Volts	μF	μA	μA	μA	%	%	%	
CWR06M-224--	35	.22	1.0	10	12	6	8	8	A
CWR06M-474--	35	.47	1.0	10	12	6	8	8	B
CWR06M-684--	35	.68	1.0	10	12	6	8	8	C
CWR06M-155--	35	1.5	1.0	10	12	6	8	8	E
CWR06M-335--	35	3.3	1.0	10	12	6	8	8	F
CWR06M-475--	35	4.7	2.0	20	24	6	8	8	G
CWR06M-685--	35	6.8	3.0	30	36	6	8	8	H
CWR06N-104--	50	.10	1.0	10	12	6	8	8	A
CWR06N-154--	50	.15	1.0	10	12	6	8	8	A
CWR06N-224--	50	.22	1.0	10	12	6	8	8	B
CWR06N-334--	50	.33	1.0	10	12	6	8	8	B
CWR06N-474--	50	.47	1.0	10	12	6	8	8	C
CWR06N-684--	50	.68	1.0	10	12	6	8	8	D
CWR06N-105--	50	1.0	1.0	10	12	6	8	8	E
CWR06N-155--	50	1.5	1.0	10	12	6	8	8	F
CWR06N-225--	50	2.2	2.0	20	24	6	8	8	F
CWR06N-335--	50	3.3	2.0	20	24	6	8	8	G
CWR06N-475--	50	4.7	3.0	30	36	6	8	8	H

FIGURE 703-1. Established reliability, tantalum, fixed, chip capacitors (encapsulated and unencapsulated) - Continued.

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SECTION 704

CAPACITORS, FIXED, ELECTROLYTIC (ALUMINUM OXIDE), ESTABLISHED RELIABILITY

STYLES CUR13, CUR17, CUR19, CUR71, AND CUR91

(APPLICABLE SPECIFICATION: MIL-C-39018)

USAF AIRBORNE APPLICATIONS REQUIRE
PRIOR APPROVAL BY PROCURING ACTIVITY

1. SCOPE. This section covers established reliability, aluminum oxide, electrolytic, fixed capacitors, insulated and polarized. Capacitors covered by this section have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 60-percent confidence level and are maintained at a 10-percent producer's risk and are based on full rated voltage at 85°C.

2. APPLICATION INFORMATION.

2.1 Use. Aluminum electrolytic capacitors are intended for use in filter, coupling, and by-pass applications where large capacitance values are required in small cases and where excesses of capacitance over the nominal value can be tolerated. For polarized capacitors, the applied ac peak voltage should never exceed the applied dc voltage; the sum of the applied ac peak and dc voltages should never exceed the dc working voltage.

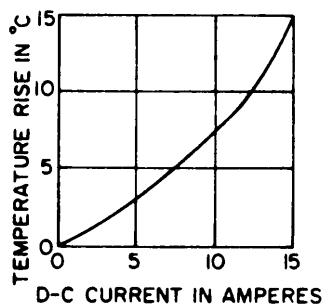
Aluminum electrolytic capacitors provide the smallest volume, mass, and cost per microfarad of any type of capacitor with the exception of the tantalum electrolytic capacitor.

These capacitors are nonhermetically sealed and are not recommended for airborne equipment applications since they should not be subjected to low barometric pressure and low temperatures at high altitudes. All units are designed to provide operation to .2 inches of mercury (80,000 feet altitude), operating temperatures as low as -55°C, and shelf life of 10 years or greater. These aluminum electrolytic capacitors can be derated only for a short period since derating for any length of time may result in the necessity for re-forming. Even though they have vents designed to open at dangerous pressures, explosions can occur because of gas pressure or a spark ignition of free oxygen and hydrogen liberated at the electrodes. Provisions should be made to protect surrounding parts.

These capacitors are generally used where low frequency, pulsating, dc signal components are to be filtered out, such as in B power supplies up to 350 dc working volts, at such points as plate and screen connections to B+, and as cathode by-pass capacitors in self-biasing circuits. These capacitors are designed for applications where accuracy of capacitance is relatively unimportant.

As a rule, for selection of emitter by-pass capacitors, a ratio of bias resistance to by-pass reactance of about 10 to 1 is allowed. Ratios up to 20 to 1 may be used in high-fidelity-amplifier work or where space and economical considerations permit. Electrolytic capacitors provide the equipment designer with an unusually lightweight unit of high capacitance in a compact container. Failure mode of these types is typically gradual loss of capacity and increased dissipation factor at life times beyond the 10,000 hour 85°C life.

The 4-terminal axial leaded capacitor is designed for high frequency applications where low equivalent series resistance, inductance, and impedance are required. The advantage of 4-terminal construction over 2-terminal construction is that the impedance decreases above 10 kHz. Unlike 2-terminal capacitors, the dc current flows through the capacitor and contributes to the operating temperature. The temperature rise (T_r) due to the dc current may be determined from figure 704-1. The ability of the external leads to carry the desired current should be taken into consideration. Lead length and heat sink qualities of the printed circuit board and capacitor will affect the current capability.

FIGURE 704-1. DC current vs temperature rise.

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2.2 Construction. The construction of these capacitors is basically the same as that specified in Section 201 (MIL-C-62). However, advancements in the manufacture of aluminum electrolytic capacitors have made possible an increased foil purity, improved oxide system, and an increase in etch ratios. Other contributing factors to the advancement in the manufacture of aluminum capacitors are an improved capacitor seal and the development of an electrolyte with a non-aqueous, non-acid base.

The metal cases for these capacitors are provided with an insulating sleeve which has an insulation resistance of at least 100 megohms and will withstand 2000 volts dc minimum without breakdown.

It should be noted that the insulation resistance refers to the sleeve and not to the resistance between the terminals and the case. The circuit diagram for styles CUR19, CUR71, and CUR91 capacitors shows an indeterminate resistance between the outer-foil terminal and the case since the electrolyte cannot be completely isolated. For safer performance, the insulating sleeve should remain over the case for all applications. The negative terminal is shorted to the case on styles CUR13 and CUR17 capacitors.

2.3 Voltage rating. The thickness of the oxide film which is formed both initially on the foil and during the forming operations on the completed capacitor determines the maximum peak or surge voltage which may be applied. For maximum reliability and long life, the dc working voltage should not be more than approximately 80 percent of full rating so that surges can be kept within the full-rated working voltage. The time of surge-voltage application should not be more than 30 seconds every 10 minutes.

Styles CUR13 and CUR17 have a 3-volt reverse voltage characteristic for units rated 10 volts or greater. Styles CUR19, CUR71, and CUR91 have a 1.5-volt reverse voltage characteristic.

TABLE 704-1. DC voltage.

Style	DC voltage range -55° to +85°C	Derated dc voltage range at +125°C	DC surge voltage range -55° to 85°C	Derated dc surge voltage at +125°C
CUR13	7 to 350	5 to 275	10 to 375	7 to 300
CUR17	7 to 350 <u>1/</u>	_____	10 to 375	_____
CUR19	5 to 200 <u>1/</u>	_____	7 to 250	_____
CUR71	5 to 350 <u>2/</u>	_____	7 to 400	_____
CUR91	5 to 150 <u>1/</u>	_____	7 to 200	_____

1/ DC voltage range -55° to +105°C, not derated to +125°C,

2/ DC voltage range -55° to +85°C, not derated to +125°C.

2.4 Operating temperature range. Style CUR13 capacitors are suitable for operation over a temperature range of -55° to +85°C, derated to +125°C. Styles CUR17, CUR19, and CUR91 capacitors are designed to operate over a temperature range of -55° to +105°C. Style CUR71 capacitors are suitable for operation over a temperature range of -55° to +85°C.

2.5 Derating. Style CUR13 capacitors may be voltage derated in order to operate at temperatures up to +125°C. The percent of derating varies from approximately 20 to 33 percent depending on the particular voltage rating involved.

2.6 Surge voltage. The surge voltage is the maximum voltage to which the capacitor should be subjected under any condition. This includes transients and peak ripple at the highest line voltage.

2.7 Seal. The capacitors listed in this standard are supplied using nonhermetic seals and even though these capacitors have vents designed to open at dangerous pressures, explosions can occur because of gas pressure or a spark ignition of free oxygen and hydrogen liberated at the electrodes. Provisions should be made to protect surrounding parts.

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2.8 Polarization. Nonpolarized capacitors, style CU15 (Section 202), should be used in applications where reversal of potential occurs. Polarized capacitors, styles CUR13, CUR17, CUR19, CUR71, and CUR91 should be used only in dc circuits with polarity properly observed. If ac components are present, the sum of the peak ac voltage plus the applied dc voltage must not exceed the dc rating. The peak ac value should also be less than the applied dc voltage so that polarity may be maintained, even on negative peaks, to avoid overheating and damage.

2.9 Ripple voltage. The maximum permissible ripple voltages can be determined from figure 704-2 and table 704-11. The curves in figure 704-1 are based on operation at 60 Hz and 25°C. The appropriate multiplier from table 704-1 should be used where operation at other frequencies or temperatures is desired. Operation of these capacitors outside the limits of 60 to 10,000 Hz is not recommended.

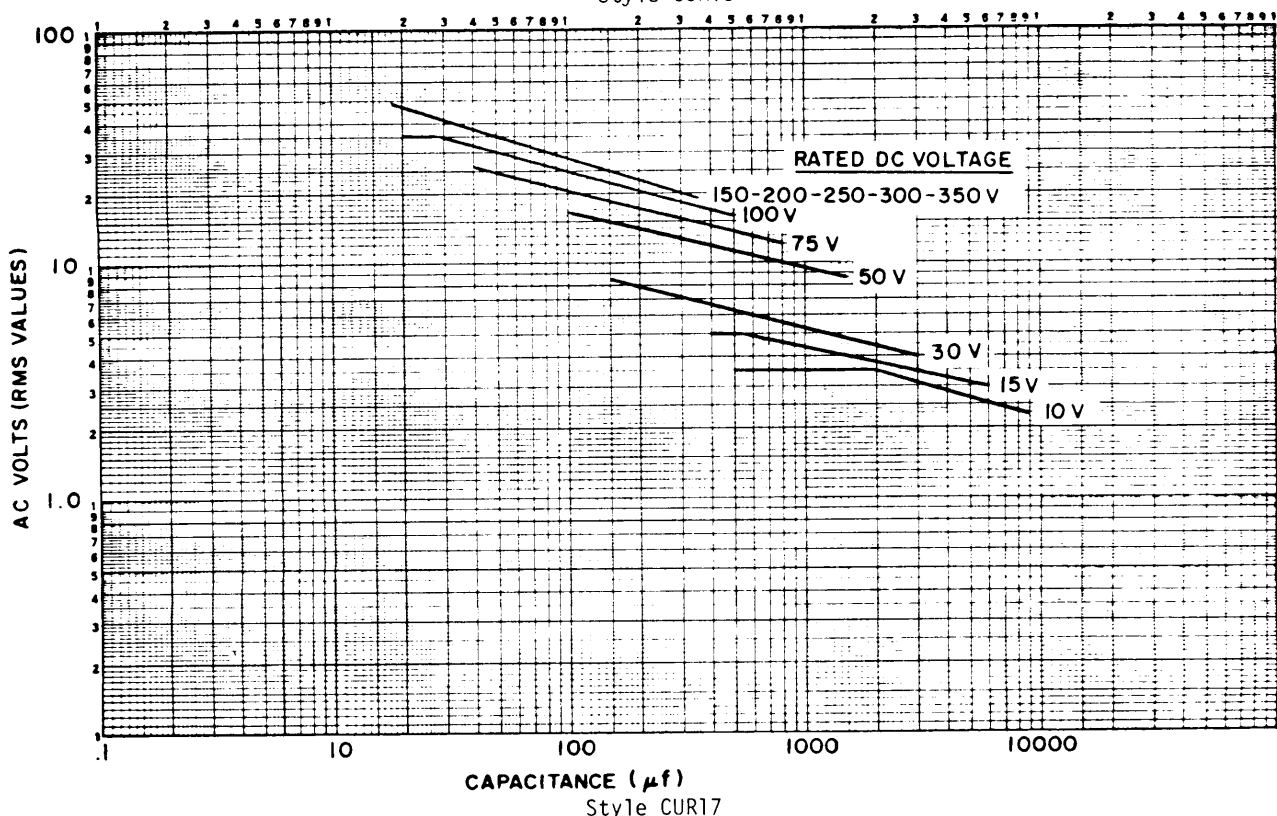
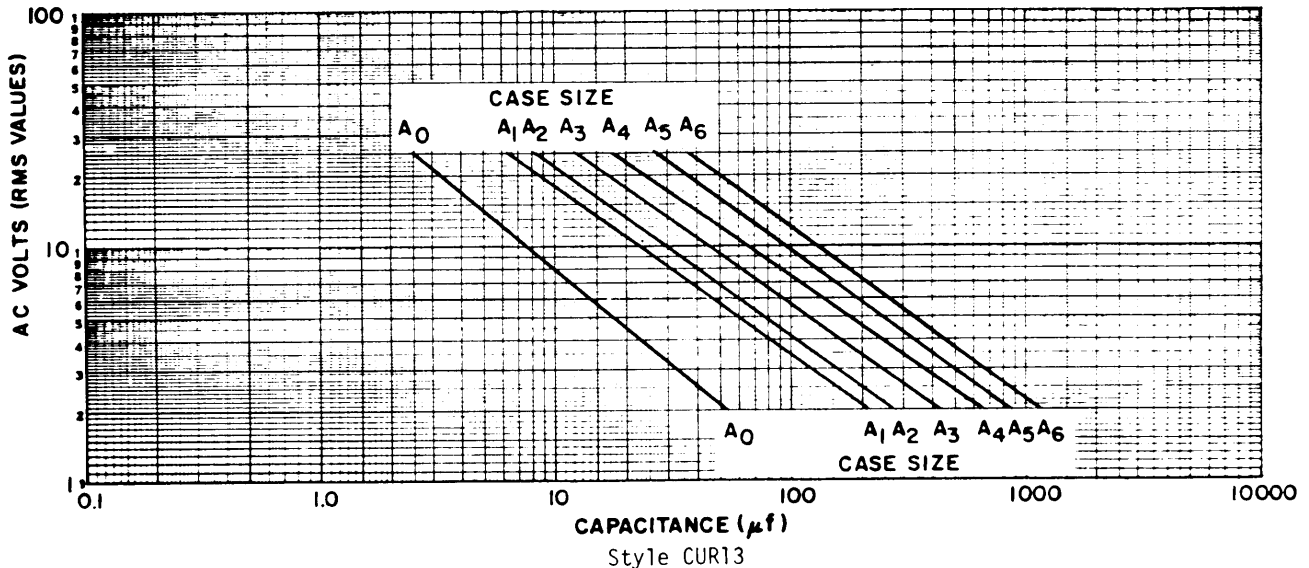


FIGURE 704-2. Maximum permissible ac voltage (rms).

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TABLE 704-II. Ripple voltage multipliers.

Frequency (Hz)	Multiplier									
	+25°C		+45°C		+65°C		+85°C		+125°C	
	CUR13	CUR17	CUR13	CUR17	CUR13	CUR17	CUR13	CUR17	CUR13	CUR17
60	1.0	1.0	0.86	0.9	0.7	0.7	0.53	0.5	0.4	---
120	0.66	0.6	.57	.54	.46	.42	.35	.3	.26	---
400	.3	.2	.26	.18	.21	.14	.16	.1	.12	---
1,000	.17	.08	.15	.072	.12	.056	.09	.04	.068	---
10,000	.034	.008	.029	.007	.024	.006	.018	.004	.014	---

2.10 Ripple currents. For capacitors covered by MIL-C-39018/1 (CUR13) and MIL-C-39018/3 (CUR17), the maximum permissible ripple current at 120 Hz and 85°C is shown in the rating table. The appropriate multiplier from the following table should be used to determine permissible ripple where operation at other temperatures or frequencies is desired.

Operation of these capacitors outside the limits of 60 Hz to 100 kHz is not recommended.

TABLE 704-III. Multipliers CUR13 and CUR17 capacitors.

Temperature	Multiplier	Frequency	Multiplier		
			0 - 60V	61 - 200V	201 - 350V
25°C, 45°C - -	1.4	60 Hz - - - -	0.85	0.83	0.80
65°C - - - -	1.2	120 Hz - - - -	1.0	1.0	1.0
85°C - - - -	1.0	400 Hz - - - -	1.1	1.15	1.3
1/ 125°C - - - -	0.3	1 - 100 kHz - - -	1.15	1.2	1.4

1/ Not applicable to style CUR17.

For capacitors covered by MIL-C-39018/7 (CUR19), the rms ripple current which will result in a 10°C internal temperature rise (T_r), over the frequency range of 10 kHz to 1 MHz, is tabulated in the rating table. For other temperature rises and frequencies, the 10 kHz - 1 MHz ripple currents may be multiplied by the factors shown in table 704-IV.

TABLE 704-IV. Factors for determining ripple currents at various frequencies.

Frequency	Temperature rise					
	5°C	10°C	15°C	20°C	25°C	30°C
60 Hz	0.35	0.50	0.65	0.75	0.85	1.00
120 Hz	.45	.65	.80	.95	1.10	1.30
400 Hz	.50	.75	.95	1.10	1.30	1.50
1 kHz	.55	.80	1.00	1.15	1.35	1.60
10 kHz - 1 MHz	.65	1.00	1.25	1.45	1.70	2.00

The operating temperature (T_c) is determined by obtaining the sum of the ambient temperature (T_A), the temperature rise due to the ripple current (T_r), and the temperature rise due to the dc current (T_L).

$$T_c = T_A + T_r + T_L$$

The sum should not exceed the maximum rated temperature (+105°C).

Maximum ripple current at 120 Hz and 85°C for type CUR71 capacitors is shown in the rating table.

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Maximum ripple current for type CUR91 capacitors is shown for 85°C and 120 Hz in the rating table. Use the multipliers from table 704-V to determine permissible ripple at other temperatures and frequencies.

TABLE 704-V. Multipliers for CUR91 capacitors.

Temperature	Multiplier	Frequency	Multiplier	
			5 - 50V	75-150V
25°C - - -	2.0	50 Hz - - - - -	0.85	0.80
45°C - - -	1.7	60 Hz - - - - -	0.90	0.83
65°C - - -	1.4	100 Hz - - - - -	0.99	0.95
85°C - - -	1.0	120 Hz - - - - -	1.0	1.0
105°C - - -	0.3	400 Hz - - - - -	1.05	1.15
		1 kHz - 20 kHz - - -	1.10	1.20

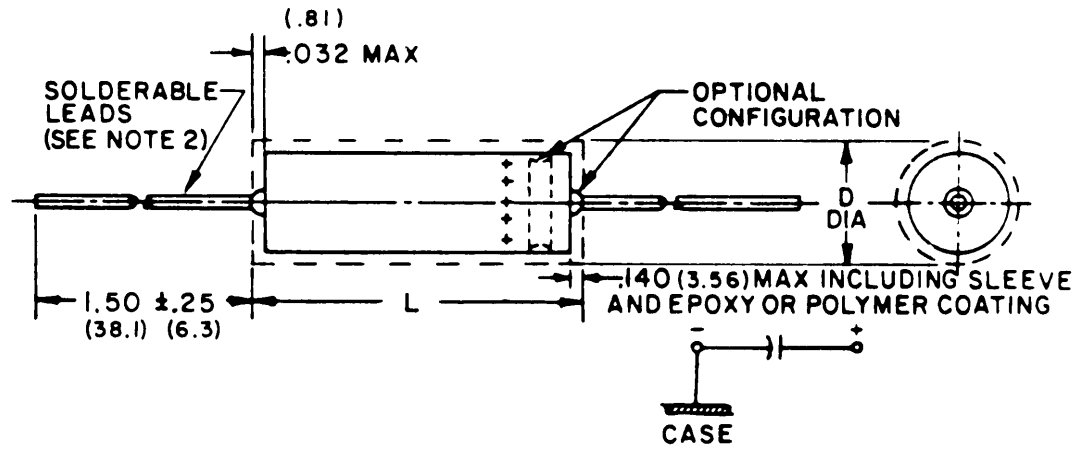
2.11 Cleaning solvents. Recommended solvents include all those free of halogen or halogen groups, such as toluene, methanol, methyl cellosolve, alkinox and water, and naphtha. Chlorinated or fluorinated hydrocarbon solvents are prohibited.

3. ITEM IDENTIFICATION.

3.1 Standard capacitors. The standard capacitors available in this Section are shown in figure 704-3. (The figure gives the electrical characteristics, case sizes, and Military part numbers of capacitors which are standard for design.)

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Style CUR13

NATO type designation NCU01
(per NEPR no. 59)

Case size	Dimensions	
	Style CUR13, insulated	
	$L \pm .031 (.79)$	$D +.023 (.58)$ $-.015 (.38)$
A0	.938 (23.83)	.281 (7.14)
A1	.938 (23.83)	.375 (9.53)
A2	1.125 (28.58)	
A3	1.375 (34.93)	
A4	1.625 (41.28)	
A5	2.188 (55.58)	
A6	2.688 (68.28)	

NOTES:

1. These capacitors are not intended to be mounted by their leads.
2. Solderable leads $.032 (.81) \text{ DIA} \pm .008 (.20) -.002 (.05)$

FIGURE 704-3. Electrolytic (aluminum oxide) fixed capacitors.

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STANDARD CAPACITORS
STYLE CUR13 (MIL-C-39018/1)OPERATING TEMPERATURE RANGE -55° TP+85°C, DERATED TO
+125°C -- POLARIZED, INSULATED

Capacitance value	DC rated voltage		DC surge voltage		ESR		Maximum impedance at -55°C and 120 Hz	DC leakage		Maximum AC ripple current 120 Hz at 85°C	Case code	Dash number 2/ M39018/01-			
	85°C	125°C	85°C	125°C	25°C	85°C and 125°C		25°C	85°C and 125°C			Capacitance tolerance			
												-10+30	-10+50	-10+75	
μF	Volts		Volts		Ω		Ω	μA		mA					
220	7	5	10	7	1.21	1.51	20	3	18	290	3/	A1	1001--	---	1101-
270	7	5	10	7	.98	1.23	17	3	18	360	3/	A2	1002--	---	1102-
390	7	5	10	7	.68	.85	12	4	24	520	3/	A3	1003--	---	1103-
560	7	5	10	7	.47	.59	8	5	30	750	3/	A4	1004--	---	1104-
820	7	5	10	7	.32	.40	5.5	7	42	1100	3/	A5	1005--	---	1105-
1000	7	5	10	7	.27	.33	4.5	10	60	1350	3/	A6	1006--	---	1106-
100	10	7	15	10	2.65	3.32	38	2	12	285	3/	A0	1007--	---	1107-
180	10	7	15	10	1.47	1.84	25	3	18	438	3/	A1	1008--	---	1108-
220	10	7	15	10	1.21	1.51	20	3	18	527	3/	A2	1009--	---	1109-
330	10	7	15	10	.80	1.00	14	4	24	696	3/	A3	1010--	---	1110-
470	10	7	15	10	.56	.71	9.6	5	30	892	3/	A4	1011--	---	1111-
680	10	7	15	10	.39	.49	6.6	7	42	1210		A5	1012--	---	1112-
820	10	7	15	10	.32	.40	5.5	10	60	1490		A6	1013--	---	1113-
68	15	10	20	15	3.90	4.86	66	2	12	181	3/	A0	1014--	---	1114-
82	15	10	20	15	3.23	4.04	55	2	12	219	3/	A0	1015--	---	1115-
150	15	10	20	15	1.77	2.21	30	3	18	400		A1	1016--	---	1116-
180	15	10	20	15	1.47	1.84	25	3	18	475		A2	1017--	---	1117-
270	15	10	20	15	.98	1.23	17	4	24	628		A3	1018--	---	1118-
390	15	10	20	15	.68	.85	12	5	30	810		A4	1019--	---	1119-
560	15	10	20	15	.47	.59	8	7	42	1100		A5	1020--	---	1120-
680	15	10	20	15	.39	.49	6.6	10	60	1320		A6	1021--	---	1121-
33	30	20	40	30	8.04	10.05	91	2	12	164		A0	1022--	---	1122-
47	30	20	40	30	5.64	7.05	64	2	12	196		A0	1023--	---	1123-
82	30	20	40	30	3.23	4.04	36	3	18	297		A1	1024--	---	1124-
100	30	20	40	30	2.65	3.33	30	3	18	353		A2	1025--	---	1125-
120	30	20	40	30	2.21	2.76	25	4	24	419		A3	1026--	---	1126-
150	30	20	40	30	1.77	2.21	20	4	24	470		A3	1027--	---	1127-
220	30	20	40	30	1.20	1.51	14	5	30	607		A4	1028--	---	1128-
330	30	20	40	30	.80	1.00	9.1	7	42	848		A5	1029--	---	1129-
390	30	20	40	30	.68	.85	7.7	10	60	1000		A6	1030--	---	1130-
22	50	40	60	50	9.04	15.07	140	2	12	134		A0	1031--	---	1131-
33	50	40	60	50	5.03	10.05	91	3	18	188		A1	1032--	---	1132-
47	50	40	60	50	4.23	7.05	64	3	18	243		A2	1033--	---	1133-
56	50	40	60	50	3.55	5.92	54	4	24	286		A3	1034--	---	1134-
68	50	40	60	50	2.92	4.88	44	4	24	315		A3	1035--	---	1135-
100	50	40	60	50	1.99	3.32	30	5	30	410		A4	1036--	---	1136-
150	50	40	60	50	1.33	2.21	20	7	42	571		A5	1037--	---	1137-
180	50	40	60	50	1.11	1.84	17	10	60	680		A6	1038--	---	1138-

See footnotes at end of tabulation.

FIGURE 701-4. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
STYLE CUR13 (MIL-C-39018/1) - ContinuedOPERATING TEMPERATURE RANGE -55° TO +85°C, DERATED TO
+125°C -- POLARIZED, INSULATED

Capacitance value	DC rated voltage		DC surge voltage		ESR		Maximum impedance at -55°C and 120 Hz	DC leakage		Maximum 1/ AC ripple current 120 Hz at 85°C	Case code	Dash number 2/ M39018/01- Capacitance tolerance		
	85°C	125°C	85°C	125°C	25°C	85°C and 125°C		25°C	85°C and 125°C			-10+30	-10+50	-10+75
	μF	Volts		Volts		Ω		Ω	μA			mA		
12	75	60	90	75	16.58	27.63	250	2	12	96	A0	1039--	---	1139-
22	75	60	90	75	9.04	15.07	140	3	18	153	A1	1040--	---	1140-
33	75	60	90	75	6.03	10.05	91	3	18	204	A2	1041--	---	1141-
47	75	60	90	75	4.27	7.05	64	4	24	262	A3	1042--	---	1142-
68	75	60	90	75	2.92	4.88	44	5	30	337	A4	1043--	---	1143-
100	75	60	90	75	1.99	3.32	30	7	42	506	A5	1044--	---	1144-
120	75	60	90	75	1.65	2.76	25	10	60	555	A6	1045--	---	1145-
8.2	100	75	125	100	24.26	40.44	360	2	12	82	A0	1046--	---	1146-
12	100	75	125	100	16.59	27.63	250	3	18	109	A1	1047--	---	1147-
15	100	75	125	100	13.26	22.10	200	3	18	137	A2	1048--	---	1148-
22	100	75	125	100	9.04	15.07	140	4	24	179	A3	1049--	---	1149-
33	100	75	125	100	6.03	10.05	91	5	30	235	A4	1050--	---	1150-
47	100	75	125	100	4.23	7.05	64	7	42	319	A5	1051--	---	1151-
68	100	75	125	100	2.92	4.88	44	10	60	417	A6	1052--	---	1152-
4.7	150	100	175	125	28.22	56.44	640	2	12	69	A0	1053--	1153-	---
5.6	150	100	175	125	23.68	47.37	540	2	12	75	A0	1054--	1154-	---
8.2	150	100	175	125	16.17	32.35	360	3	18	105	A1	1055--	1155-	---
12	150	100	175	125	11.05	22.10	250	3	18	137	A2	1056--	1156-	---
18	150	100	175	125	7.37	14.74	170	4	24	182	A3	1057--	1157-	---
22	150	100	175	125	6.03	12.06	140	5	30	214	A4	1058--	1158-	---
33	150	100	175	125	4.02	8.04	91	7	42	300	A5	1059--	1159-	---
56	150	100	175	125	2.37	4.74	54	10	60	423	A6	1060--	1160-	---
3.3	200	150	225	175	40.30	80.38	500	4	24	63	A0	1061--	1161-	---
3.9	200	150	225	175	34.01	68.02	500	4	24	68	A0	1089--	1189-	---
5.6	200	150	225	175	23.68	47.37	333	6	36	86	A1	1062--	1162-	---
8.2	200	150	225	175	16.17	32.35	250	6	36	113	A2	1063--	1163-	---
12	200	150	225	175	11.05	22.10	154	8	48	148	A3	1064--	1164-	---
15	200	150	225	175	8.84	17.68	118	10	60	177	A4	1065--	1165-	---
27	200	150	225	175	4.91	9.82	77	14	84	271	A5	1066--	1166-	---
39	200	150	225	175	3.40	6.80	51	20	120	353	A6	1067--	1167-	---
2.2	250	200	275	225	60.45	120.57	910	4	24	58	A0	1068--	1168-	---
3.3	250	200	275	225	40.19	80.38	910	4	24	70	A0	1090--	1190-	---
5.6	250	200	275	225	23.68	47.37	540	6	36	86	A1	1069--	1169-	---
6.8	250	200	275	225	19.50	39.01	440	6	36	103	A2	1070--	1170-	---
10	250	200	275	225	13.26	26.53	300	8	48	125	A3	1071--	1171-	---
12	250	200	275	225	11.05	22.10	250	10	60	159	A4	1072--	1172-	---
22	250	200	275	225	6.03	12.06	140	14	84	245	A5	1073--	1173-	---
27	250	200	275	225	4.91	9.82	110	20	120	294	A6	1074--	1174-	---

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide) fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
STYLE CUR13 (MIL-C-39018/1) - ContinuedOPERATING TEMPERATURE RANGE -55° TO +85°C, DERATED TO
+125°C -- POLARIZED, INSULATED

Capacitance value	DC rated voltage		DC surge voltage		ESR		Maximum impedance at -55°C and 120 Hz	DC leakage		Maximum AC ripple current 120 Hz at 85°C	Case code	Dash number 2/ M39018/01-		
	85°C	125°C	85°C	125°C	25°C	85°C and 125°C		25°C	85°C and 125°C			Capacitance tolerance		
												-10+30	-10+50	-10+75
μF	Volts		Volts		Ω		Ω	μA		mA				
1.5	300	225	325	250	132.66	221.05	1300	16	96	42	A0	1075--	1175-	---
2.2	300	225	325	250	90.43	150.71	1300	16	96	51	A0	1091--	1191-	---
3.9	300	225	325	250	51.01	85.02	640	20	120	71	A1	1076--	1176-	---
4.7	300	225	325	250	42.33	70.55	640	20	120	78	A1	1092--	1192-	---
5.6	300	225	325	250	35.53	59.21	440	22	132	84	A2	1077--	1177-	---
8.2	300	225	325	250	24.26	40.44	370	24	144	110	A3	1078--	1178-	---
10	300	225	325	250	19.89	33.16	300	26	156	130	A4	1079--	1179-	---
16	300	225	325	250	12.43	20.72	200	30	180	185	A5	1080--	1180-	---
18	300	225	325	250	11.05	18.42	170	36	216	217	A6	1081--	1181-	---
1.0	350	275	375	300	199.0	331.57	2000	20	120	35	A0	1082--	1182-	---
3.3	350	275	375	300	60.29	100.42	910	26	156	59	A1	1083--	1183-	---
3.9	350	275	375	300	51.01	85.02	770	28	168	70	A2	1084--	1184-	---
5.6	350	275	375	300	35.53	59.21	540	32	192	90	A3	1085--	1185-	---
6.8	350	275	375	300	29.26	48.76	440	34	204	107	A4	1086--	1186-	---
10	350	275	375	300	19.89	33.16	300	38	228	148	A5	1087--	1187-	---
12	350	275	375	300	16.58	27.63	250	42	252	174	A6	1088--	1188-	---

1/ The ripple current values shown are representative values not supported by test data.

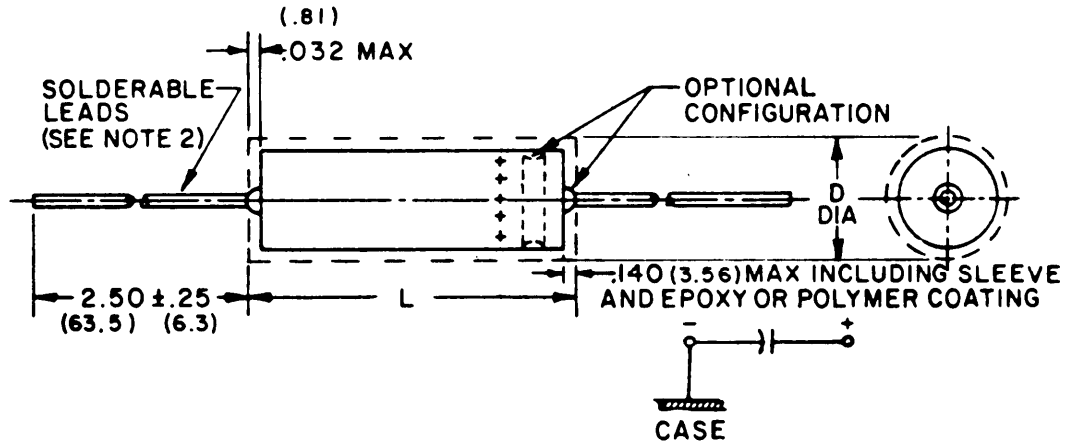
2/ The last letter in dash number will indicate FR level symbol ("M", "P", "R", or "S").

3/ Maximum current due to voltage limitations.

FIGURE 704-3. Electrolytic (aluminum oxide) fixed capacitors - Continued.

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Style CUR17

NATO type designation NCU03
(Per NEPR no. 59)

Case code	Dimensions	
	$L \pm .031$ (.79)	$D + .023$ (.58) $-.015$ (.38)
D1	1.125 (28.58)	.625 (15.88)
D2	1.125 (28.58)	.750 (19.05)
D3	1.125 (28.58)	.875 (22.23)
D4	1.625 (41.28)	.625 (15.88)
D5	1.625 (41.28)	.750 (19.05)
D6	1.625 (41.28)	.875 (22.23)
D7	1.625 (41.28)	1.000 (25.40)
E1	2.125 (53.98)	.625 (15.88)
E2	2.125 (53.98)	.750 (19.05)
E3	2.125 (53.98)	.875 (22.23)
E4	2.125 (53.98)	1.000 (25.40)
E5	2.625 (66.68)	.625 (15.88)
E6	2.625 (66.68)	.750 (19.05)
E7	2.625 (66.68)	.875 (22.23)
F1	2.625 (66.68)	1.000 (25.40)
F2	3.125 (79.38)	.625 (15.88)
F3	3.125 (79.38)	.875 (22.23)
F4	3.125 (79.38)	1.000 (25.40)
F5	3.625 (92.08)	.750 (19.05)
F6	3.625 (92.08)	.875 (22.23)
F7	3.625 (92.08)	1.000 (25.40)

NOTES:

1. These capacitors are not intended to be mounted by their leads.
2. For .625 inch diameter cases, the leads are .032 (.81) DIA $+ .008$ (.20) $- .002$ (.05). For all other cases the leads are .040 (1.02) DIA $+ .008$ $- .002$.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
STYLE CUR17 (MIL-C-39018/3)OPERATING TEMPERATURE RANGE -55° TO +105°C -- POLARIZED
INSULATED

Capacitance value	DC rated voltage at 85°C	DC surge voltage 85°C	ESR		Maximum impedance at -55°C and 120 Hz	DC leakage		Maximum 1/ AC ripple current 120 Hz at 85°C	Case code	Dash number 2/ M39018/03- Style CUR17		
			25°C	105°C		25°C	85°C			Capacitance tolerance		
										-10+30	-10+50	-10+75
μF	Volts	Volts	Ω	Ω	Ω	μA	mA					
680	7	10	.78	.98	5	30	183	489	D1	1201-	---	1301-
1,000	7	10	.53	.66	9.3	35	212	644	D2	1202-	---	1302-
1,500	7	10	.35	.44	6.2	43	259	885	D4	1203-	---	1303-
2,200	7	10	.24	.30	4.2	50	300	1220	E1	1204-	---	1304-
3,300	7	10	.16	.20	2.9	66	396	1520	D6	1205-	---	1305-
4,700	7	10	.11	.14	2.0	75	450	1930	D7	1206-	---	1306-
6,800	7	10	.08	.10	1.3	90	540	2930	F5	1207-	---	1307-
10,000	7	10	.05	.07	.93	111	670	3850	F4	1208-	---	1308-
12,000	7	10	.04	.06	.77	127	764	4510	F7	1209-	---	1309-
470	10	15	.99	1.13	8.5	35	212	454	D1	1210-	---	1310-
1,000	10	15	.46	.53	4.0	50	300	807	D4	1211-	---	1311-
1,500	10	15	.31	.35	2.7	61	367	1130	E1	1212-	---	1312-
2,200	10	15	.21	.24	1.8	70	424	1390	D6	1213-	---	1313-
3,300	10	15	.14	.16	1.2	93	558	1950	E3	1214-	---	1314-
4,700	10	15	.10	.11	.85	110	663	2750	F5	1215-	---	1315-
6,800	10	15	.07	.08	.59	127	764	3570	F6	1216-	---	1316-
8,200	10	15	.06	.06	.50	150	900	4180	F7	1217-	---	1317-
390	15	20	.85	1.02	10	38	232	478	D1	1218-	---	1318-
680	15	20	.49	.59	5.9	49	296	689	D2	1219-	---	1319-
1,000	15	20	.33	.40	4.0	61	367	1060	E1	1220-	---	1320-
1,500	15	20	.22	.27	2.7	75	450	1420	E2	1221-	---	1321-
2,200	15	20	.15	.18	1.8	86	519	1890	E6	1222-	---	1322-
3,300	15	20	.10	.12	1.2	114	687	2380	E4	1223-	---	1323-
4,700	15	20	.07	.07	0.8	136	821	3420	F6	1224-	---	1324-
6,800	15	20	.05	.06	0.60	156	936	4360	F7	1225-	---	1325-
150	30	40	2.21	2.65	27	33	201	296	D1	1226-	---	1326-
220	30	40	1.51	1.81	14	47	284	390	D2	1227-	---	1327-
330	30	40	1.00	1.21	12	51	307	536	D4	1228-	---	1328-
470	30	40	.71	.85	10	54	328	609	D3	1229-	---	1329-
680	30	40	.44	.59	6.0	69	418	957	E5	1230-	---	1330-
1,000	30	40	.33	.40	4.0	86	519	1230	E3	1231-	---	1331-
1,500	30	40	.22	.27	2.7	110	663	1680	E7	1232-	---	1332-
2,200	30	40	.15	.18	1.8	122	734	2350	F6	1233-	---	1333-
2,700	30	40	.12	.15	1.5	136	821	2560	F4	1234-	---	1334-
100	50	60	1.33	3.98	26	37	222	241	D1	1235-	---	1335-
150	50	60	.88	2.65	15	46	276	322	D2	1236-	---	1336-
220	50	60	.60	1.81	13	55	335	417	D3	1237-	---	1337-
330	50	60	.40	1.21	8.1	66	396	580	D5	1238-	---	1338-
470	50	60	.28	.84	5.6	79	474	619	E2	1239-	---	1339-
680	50	60	.20	.59	3.9	90	540	946	D7	1240-	---	1340-
1,000	50	60	.13	.40	2.7	111	670	1300	E4	1241-	---	1341-
1,500	50	60	.09	.27	1.8	147	883	1920	F4	1242-	---	1342-
1,800	50	60	.07	.22	1.5	196	1,196	2260	F7	1299-	---	1399-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

704 (MIL-C-39018)

MIL-STD-198E

STANDARD CAPACITORS
STYLE CUR17 (MIL-C-39018/3) - ContinuedOPERATING TEMPERATURE RANGE -55° TO +105°C -- POLARIZED
INSULATED

Capacitance value	DC rated voltage at 85°C	DC surge voltage 85°C	ESR		Maximum impedance at -55°C and 120 Hz	DC leakage		Maximum 1/ AC ripple current 120 Hz at 85°C	Case code	Dash number 2/ M39018/03- Style CUR17 Capacitance tolerance		
			25°C	105°C		25°C	85°C			-10+30	-10+50	-10+75
			Ω	Ω		μA	mA					
47	75	90	2.82	8.47	57	29	174	166	D1	1243-	---	1343-
68	75	90	1.95	5.85	39	37	225	217	D2	1244-	---	1344-
100	75	90	1.33	3.98	27	43	259	281	D3	1245-	---	1345-
150	75	90	.88	2.65	18	53	318	391	D5	1246-	---	1346-
220	75	90	.60	1.81	13	68	410	540	E2	1247-	---	1347-
330	75	90	.40	1.21	8.1	80	483	781	E7	1248-	---	1348-
470	75	90	.28	.84	5.7	91	551	1010	F3	1249-	---	1349-
680	75	90	.20	.59	3.9	110	662	1290	F4	1250-	---	1350-
820	75	90	.16	.49	3.2	122	734	1520	F7	1251-	---	1351-
22	100	125	6.03	18.09	125	25	150	113	D1	1252-	1352-	---
47	100	125	2.82	8.47	57	33	201	180	D2	1253-	1353-	---
68	100	125	1.95	5.85	39	40	241	232	D3	1254-	1354-	---
100	100	125	1.33	3.98	27	50	300	389	F2	1255-	1355-	---
150	100	125	.88	2.65	18	61	367	444	D7	1256-	1356-	---
220	100	125	.60	1.81	13	79	474	613	E4	1257-	1357-	---
330	100	125	.40	1.21	8.1	93	563	906	F6	1258-	1358-	---
470	100	125	.28	.84	5.6	171	670	1150	F7	1259-	1359-	---
18	150	175	7.37	22.10	150	25	155	113	D1	1260-	1360-	---
33	150	175	4.02	12.06	81	36	217	180	D4	1261-	1361-	---
47	150	175	2.82	8.47	57	41	246	232	D3	1262-	1362-	---
68	150	175	1.95	5.85	39	49	296	389	E5	1263-	1363-	---
100	150	175	1.33	3.98	27	61	367	444	D7	1264-	1364-	---
150	150	175	.88	2.65	18	77	464	613	E7	1265-	1365-	---
220	150	175	.60	1.81	12	86	519	906	F1	1266-	1366-	---
330	150	175	.40	1.21	8.0	114	687	1150	F7	1267-	1367-	---
15	200	225	8.84	26.53	180	27	164	103	D1	1268-	1368-	---
33	200	225	4.02	12.06	81	41	244	170	D3	1269-	1369-	---
47	200	225	2.82	8.47	57	47	284	192	E1	1270-	1370-	---
68	200	225	1.95	5.85	39	59	354	304	E5	1271-	1371-	---
100	200	225	1.33	3.98	27	70	424	362	D7	1272-	1372-	---
150	200	225	.88	2.65	18	86	519	528	E4	1273-	1373-	---
220	200	225	.60	1.81	12	109	657	627	F4	1274-	1374-	---
270	200	225	.49	1.47	9.8	120	722	966	F7	1275-	1375-	---
10	250	275	13.26	39.79	250	25	150	96	D1	1276-	1376-	---
20	250	275	6.63	19.89	125	35	210	131	D4	1277-	1377-	---
33	250	275	4.02	12.06	80	45	270	212	E5	1278-	1378-	---
39	250	275	3.40	10.20	65	50	300	240	F2	1279-	1379-	---
68	250	275	1.95	5.85	40	67	402	299	D7	1280-	1380-	---
82	250	275	1.62	4.85	35	80	480	374	E4	1281-	1381-	---
120	250	275	1.11	3.32	25	94	564	548	F6	1282-	1382-	---
180	250	275	.74	2.21	15	111	666	712	F7	1283-	1383-	---

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
 STYLE CUR17 (MIL-C-39018/3) - Continued

OPERATING TEMPERATURE RANGE -55° TO +105°C -- POLARIZED
 INSULATED

Capacitance value	DC rated voltage at 85°C	DC surge voltage 85°C	ESR		Maximum impedance at -55°C and 120 Hz	DC leakage		Maximum AC ripple current 120 Hz at 85°C	Case code	Dash number ^{2/} M39018/03- Style CUR17		
			25°C	105°C		25°C	85°C			Capacitance tolerance		
										-10+30	-10+50	-10+75
μF	Volts	Volts	Ω		Ω	μA		mA				
8.2	300	325	24.26	48.52	320	25	150	69	D1	1284-	1384-	---
15	300	325	13.26	26.53	170	35	210	114	D4	1285-	1385-	---
27	300	325	7.37	14.74	93	48	288	166	D5	1286-	1386-	---
47	300	325	4.23	8.47	54	63	378	275	E6	1287-	1387-	---
68	300	325	2.93	5.85	37	77	462	355	E7	1288-	1388-	---
82	300	325	2.43	4.85	31	87	522	423	F3	1289-	1389-	---
120	300	325	1.66	3.32	21	96	576	547	F6	1290-	1390-	---
150	300	325	1.33	2.65	17	112	672	650	F7	1291-	1391-	---
5.6	350	375	35.53	71.05	450	25	150	57	D1	1292-	1392-	---
20	350	375	9.95	19.89	125	42	252	150	E1	1293-	1393-	---
27	350	375	7.37	14.74	93	53	318	208	F2	1294-	1394-	---
47	350	375	4.23	8.47	54	66	396	248	D7	1295-	1395-	---
56	350	375	3.55	7.11	45	75	450	332	E7	1296-	1396-	---
82	350	375	2.43	4.25	31	86	516	422	F3	1297-	1397-	---
120	350	375	1.66	3.32	21	112	672	581	F7	1298-	1398-	---

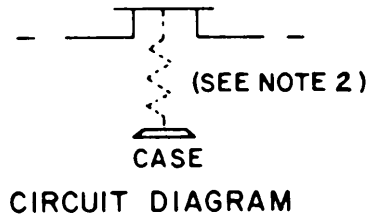
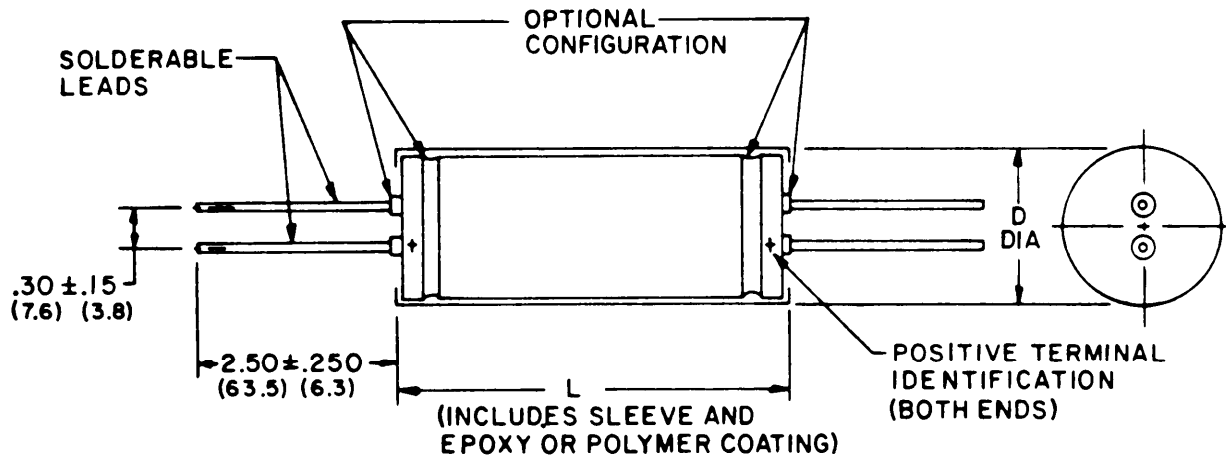
^{1/} The ripple current values shown are representative values not supported by test data.

^{2/} The last letter in the dash number will indicate the applicable FR level symbol (M, P, R, or S).

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

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Style CUR19



Case size	Insulated dimensions			Typical weight (GRAMS)
	L		D	
	Min	Max	Max dia	
H1	1.625 (41.28)	1.843 (46.81)	.785	20.3
H2	2.125 (53.98)	2.343 (59.51)	.785	26.8
H3	2.625 (66.68)	2.843 (72.21)	.785	33.2
H4	3.125 (79.38)	3.343 (84.91)	.785	39.7
H5	3.625 (92.08)	3.843 (97.61)	.785	45.9
J1	1.625 (41.28)	1.843 (46.81)	.910	26.9
J2	2.125 (53.98)	2.343 (59.51)	.910	36.2
J3	2.625 (66.68)	2.843 (72.21)	.910	45.4
J4	3.125 (79.38)	3.343 (84.91)	.910	55.0
J5	3.625 (92.08)	3.843 (97.61)	.910	64.0
K1	1.625 (41.28)	1.843 (46.81)	1.035	34.3
K2	2.125 (53.98)	2.343 (59.51)	1.035	45.9
K3	2.625 (66.68)	2.843 (72.21)	1.035	57.2
K4	3.125 (79.38)	3.343 (84.91)	1.035	68.5
K5	3.625 (92.08)	3.843 (97.61)	1.035	81.9

NOTES:

1. These capacitors are not intended to be mounted by their leads.
2. There is an indeterminate resistance between the metal case and the negative terminal s.
3. Solderable leads $.040$ (1.02) $+ .008$ (.20) $- .002$ (.05) DIA.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
 STYLE CUR19 (MIL-C-39018/7)
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED
 CAPACITANCE TOLERANCE -10 TO +75%

DC rated voltage 105°C	Capacitance	DC surge voltage	ESR(Max) 120 Hz, 25°C	Impedance (Max) 25°C 10 kHz- 1 MHz	DC leakage		RMS ripple current 1/ 10°C rise 10 kHz-1 MHz	Case size	Dash number High 2/ frequency vibration
					25°C	85°C & 105°C			
Volts	μF	Volts	Ohms	Ohms	μA		Amperes		
5	2,400	7	0.146	0.110	55	330	1.50	H 1	0201-
5	3,300	7	0.106	0.080	64	390	1.80	H 2	0202-
5	3,700	7	0.095	0.071	68	410	1.90	J 1	0203-
5	4,400	7	0.080	0.060	74	440	2.50	H 3	0204-
5	5,000	7	0.070	0.053	80	480	2.50	J 2	0205-
5	5,700	7	0.062	0.047	85	510	3.10	H 4	0206-
5	6,700	7	0.052	0.039	92	550	3.20	J 3	0207-
5	7,200	7	0.049	0.037	95	570	3.50	K 2	0208-
5	8,800	7	0.040	0.030	105	630	4.00	J 4	0209-
5	10,000	7	0.035	0.026	112	670	4.60	K 3	0210-
5	13,000	7	0.027	0.020	128	770	5.60	K 4	0211-
5	16,000	7	0.022	0.017	142	850	7.00	K 5	0212-
7.5	2,000	10	0.175	0.130	61	370	1.40	H 1	0213-
7.5	3,000	10	0.117	0.087	75	450	1.80	J 1	0214-
7.5	3,800	10	0.093	0.070	85	510	2.40	H 3	0215-
7.5	4,400	10	0.080	0.059	91	550	2.40	J 2	0216-
7.5	4,800	10	0.073	0.055	95	570	2.40	K 1	0217-
7.5	5,000	10	0.070	0.053	97	580	3.00	H 4	0218-
7.5	5,800	10	0.061	0.046	105	630	3.10	J 3	0219-
7.5	6,200	10	0.057	0.043	108	650	3.30	K 2	0220-
7.5	7,500	10	0.047	0.035	119	710	3.80	J 4	0221-
7.5	9,000	10	0.039	0.029	130	780	4.40	K 3	0222-
7.5	11,000	10	0.032	0.024	144	860	5.30	K 4	0223-
7.5	14,000	10	0.025	0.019	162	970	6.60	K 5	0224-
10	1,700	15	0.195	0.144	65	390	1.30	H 1	0225-
10	2,300	15	0.144	0.107	76	460	1.70	H 2	0226-
10	2,600	15	0.127	0.094	81	490	1.70	J 1	0227-
10	3,000	15	0.110	0.082	87	520	2.20	H 3	0228-
10	3,600	15	0.092	0.068	95	570	2.20	J 2	0229-
10	4,100	15	0.081	0.060	101	605	2.80	H 4	0230-
10	4,800	15	0.069	0.051	110	660	2.90	J 3	0231-
10	5,100	15	0.065	0.048	113	680	3.20	K 2	0232-
10	6,300	15	0.053	0.039	126	760	3.60	J 4	0233-
10	7,500	15	0.044	0.033	137	820	4.10	K 3	0234-
10	9,700	15	0.034	0.025	156	940	5.00	K 4	0235-
10	12,000	15	0.028	0.021	173	1040	6.20	K 5	0236-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
 STYLE CUR19 (MIL-C-39018/7) -CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C - POLARIZED, INSULATED
 CAPACITANCE TOLERANCE -10 TO +75%

DC rated voltage 105°C	Capaci- tance	DC surge voltage	ESR(Max) 120 Hz, 25°C	Impedance (Max) 25°C 10 kHz - 1 MHz	DC leakage		RMS ripple current 1/ 10°C rise 10 kHz-1 MHz	Case size	Dash number High 2/ frequency vibration
					25°C	85°C & 105°C			
Volts	μF	Volts	Ohms	Ohms	μA		Amperes		
16	1,400	20	0.207	0.149	75	450	1.20	H 1	0237-
16	1,900	20	0.153	0.110	87	520	1.60	H 2	0238-
16	2,100	20	0.138	0.100	92	550	1.60	J 1	0239-
16	2,700	20	0.107	0.077	104	620	2.00	J 2	0240-
16	3,400	20	0.085	0.061	117	700	2.60	H 4	0241-
16	4,200	20	0.069	0.050	130	780	2.90	K 2	0242-
16	5,200	20	0.056	0.041	144	860	3.30	J 4	0243-
16	6,100	20	0.048	0.035	156	940	3.90	K 3	0244-
16	6,400	20	0.046	0.033	162	970	4.10	J 5	0245-
16	8,000	20	0.036	0.026	179	1070	4.70	K 4	0246-
16	10,000	20	0.029	0.021	200	1200	5.90	K 5	0247-
20	1,200	25	0.240	0.170	78	470	1.20	H 1	0248-
20	1,800	25	0.160	0.110	95	570	1.50	J 1	0249-
20	2,200	25	0.132	0.092	105	630	2.00	H 3	0250-
20	2,400	25	0.120	0.084	110	660	1.90	J 2	0251-
20	2,900	25	0.100	0.070	120	720	2.50	H 4	0252-
20	3,400	25	0.085	0.060	130	780	2.60	J 3	0253-
20	3,700	25	0.078	0.055	136	820	2.70	K 2	0254-
20	4,500	25	0.064	0.045	150	900	3.30	J 4	0255-
20	5,300	25	0.055	0.039	163	980	3.50	K 3	0256-
20	7,000	25	0.042	0.030	187	1120	4.50	K 4	0257-
20	8,600	25	0.034	0.024	204	1220	5.50	K 5	0258-
25	900	30	0.320	0.224	75	450	1.05	H 1	0259-
25	1,200	30	0.240	0.168	87	520	1.40	H 2	0260-
25	1,600	30	0.180	0.126	100	600	1.75	H 3	0261-
25	2,000	30	0.145	0.102	111	670	1.90	J 2	0262-
25	2,500	30	0.116	0.081	125	750	2.40	K 2	0263-
25	2,800	30	0.103	0.072	132	790	3.00	J 3	0264-
25	3,600	30	0.080	0.056	150	900	3.25	K 3	0265-
25	4,700	30	0.062	0.043	171	1030	4.00	K 4	0266-
25	5,700	30	0.051	0.036	189	1130	4.65	K 5	0267-
30	700	40	0.380	0.262	72	430	1.00	H 1	0268-
30	900	40	0.295	0.204	82	490	1.25	H 2	0269-
30	1,300	40	0.204	0.141	99	590	1.70	H 3	0270-
30	1,600	40	0.165	0.114	110	660	1.75	J 2	0271-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-1898E

STANDARD CAPACITORS
 STYLE CUR19 (MIL-C-39018/7) - CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C - POLARIZED, INSULATED
 CAPACITANCE TOLERANCE -10 TO +75%

DC rated voltage 105°C	Capacitance	DC surge voltage	ESR(Max) 120 Hz, 25°C	Impedance (Max) 25°C 10 kHz- 1 MHz	DC leakage		RMS ripple current 1/ 10°C rise 10 kHz-1 MHz	Case size	Dash number High 2/ frequency vibration
					25°C	85°C &105°C			
Volts	μF	Volts	Ohms	Ohms	μA		Amperes		
30	2,000	40	0.133	0.092	122	730	2.25	K 2	0272-
30	2,200	40	0.120	0.083	128	770	2.35	J 3	0273-
30	2,800	40	0.095	0.066	145	870	3.00	K 3	0274-
30	3,000	40	0.088	0.061	150	900	2.90	J 4	0275-
30	3,600	40	0.074	0.051	164	980	3.60	K 4	0276-
30	4,500	40	0.059	0.041	184	1100	4.40	K 5	0277-
40	550	50	0.480	0.322	74	440	0.90	H 1	0278-
40	700	50	0.380	0.255	84	500	1.15	H 2	0279-
40	900	50	0.295	0.197	95	570	1.20	J 1	0280-
40	1,200	50	0.220	0.147	110	660	1.55	J 2	0281-
40	1,500	50	0.175	0.117	120	720	2.05	K 2	0282-
40	1,700	50	0.155	0.104	130	780	2.15	J 3	0283-
40	2,300	50	0.115	0.077	150	900	2.60	J 4	0284-
40	2,900	50	0.091	0.061	170	1020	3.40	K 4	0285-
40	3,600	50	0.074	0.050	189	1130	4.10	K 5	0286-
50	300	75	0.430	0.280	61	370	0.93	H 1	0287-
50	400	75	0.325	0.212	71	430	1.15	H 2	0288-
50	530	75	0.245	0.160	82	490	1.25	J 1	0289-
50	700	75	0.185	0.120	94	560	1.60	J 2	0290-
50	870	75	0.150	0.098	104	620	2.10	K 2	0291-
50	1,000	75	0.130	0.085	112	670	2.15	J 3	0292-
50	1,200	75	0.108	0.070	122	730	2.80	K 3	0293-
50	1,600	75	0.081	0.053	141	850	3.40	K 4	0294-
50	2,000	75	0.065	0.042	159	950	4.25	K 5	0295-
75	200	100	0.650	0.384	64	380	0.78	H 1	0296-
75	260	100	0.500	0.295	70	420	1.00	H 2	0297-
75	350	100	0.370	0.218	81	490	1.10	J 1	0298-
75	450	100	0.290	0.171	92	550	1.40	J 2	0299-
75	570	100	0.230	0.136	103	620	1.85	K 2	0300-
75	650	100	0.200	0.118	110	660	1.95	J 3	0301-
75	850	100	0.153	0.090	126	760	2.25	J 4	0302-
75	1,000	100	0.130	0.077	137	820	2.95	K 4	0303-
75	1,300	100	0.100	0.059	156	940	3.55	K 5	0304-
100	130	125	1.000	0.530	57	340	0.70	H 1	0305-
100	170	125	0.765	0.405	65	390	0.90	H 2	0306-
100	230	125	0.565	0.300	76	460	0.93	J 1	0307-
100	300	124	0.435	0.230	86	520	1.20	J 2	0308-
100	380	125	0.340	0.180	97	580	1.55	K 2	0309-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS
 STYLE CUR19 (MIL-C-39018/7) - CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED
 CAPACITANCE TOLERANCE -10 TO +75%

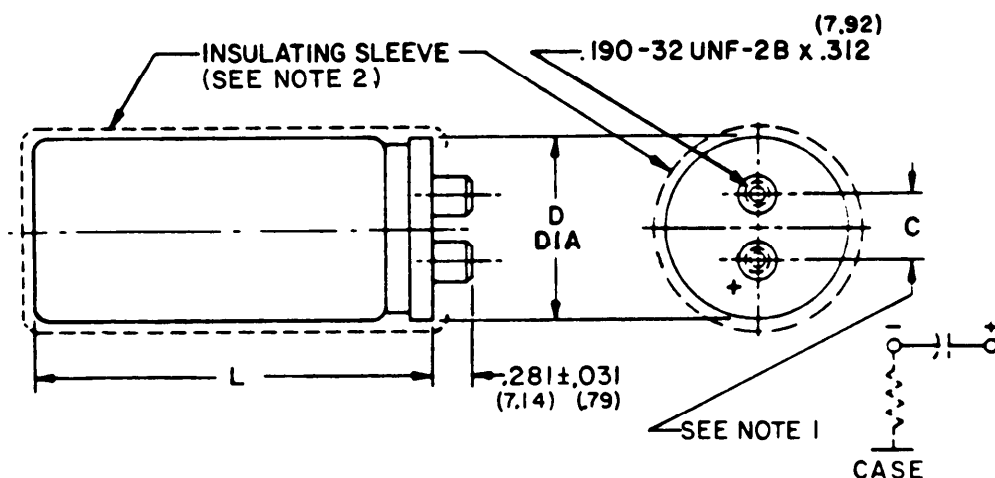
DC rated voltage 105°C	Capaci- tance	DC surge voltage	ESR(Max) 120 Hz, 25°C	Impedance (Max) 25°C 10 kHz- 1 MHz	DC leakage		RMS ripple current 1/ 10°C rise 10 kHz-1 MHz	Case size	Dash number High 2/ frequency vibration
					25°C	85°C & 105°C			
Volts	μF	Volts	Ohms	Ohms	μA		Amperes		
100	430	125	0.300	0.159	104	620	1.60	J 3	0310-
100	550	125	0.235	0.125	118	710	2.10	K 3	0311-
100	700	125	0.185	0.098	132	790	2.65	K 4	0312-
100	850	125	0.150	0.080	147	880	3.15	K 5	0313-
150	70	200	1.850	0.780	51	310	0.65	H 1	0314-
150	90	200	1.450	0.610	58	350	0.80	H 2	0315-
150	120	200	1.080	0.455	67	400	0.83	J 1	0316-
150	150	200	0.860	0.362	75	450	1.10	K 1	0317-
150	200	200	0.650	0.273	87	520	1.40	K 2	0318-
150	300	200	0.430	0.181	106	640	1.80	J 4	0319-
150	380	200	0.340	0.143	120	720	2.35	K 4	0320-
150	470	200	0.280	0.096	133	800	2.85	K 5	0321-
200	50	250	2.600	0.780	50	300	0.60	H 1	0322-
200	85	250	1.530	0.460	65	390	0.75	J 1	0323-
200	100	250	1.300	0.390	71	430	0.95	J 2	0324-
200	150	250	0.865	0.259	87	520	1.25	J 3	0325-
200	200	250	0.650	0.195	100	600	1.67	K 3	0326-
200	250	250	0.520	0.156	112	670	1.90	J 5	0327-
200	320	250	0.405	0.122	126	760	2.50	K 5	0328-

- 1/ The ripple current values shown are representative values not supported by test data.
 See figure 704-1 and table 704-IV for temperature and frequency factors.
 2/ The last letter in the dash number will indicate FR level (M, P, R or S).

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

MIL-STD-198E

Style CUR71



Case code	Dimensions		Case code	Dimensions	
	L ±.062 (1.57)	D ±.031 (.79)		L ±.062 (1.57)	D ±.031 (.79)
A0	2.125 (53.98)	1.375 (34.93)	E1	5.125 (130.18)	2.000 (50.80)
B0	3.125 (79.38)	1.375 (34.93)	B2	3.125 (79.38)	2.500 (63.60)
C0	4.125 (104.78)	1.375 (34.93)	C2	4.125 (104.78)	2.500 (63.60)
D0	4.625 (117.48)	1.375 (34.93)	D2	4.625 (117.48)	2.500 (63.60)
E0	5.125 (130.18)	1.375 (34.93)	E2	5.125 (130.18)	2.500 (63.60)
F0	5.625 (142.88)	1.375 (34.93)	C3	4.125 (104.78)	3.000 (76.20)
A1	2.125 (53.98)	2.000 (50.80)	D3	4.625 (117.48)	3.000 (76.20)
B1	3.125 (79.38)	2.000 (50.80)	E3	5.125 (130.18)	3.000 (76.20)
C1	4.125 (104.78)	2.000 (50.80)	F3	5.625 (142.88)	3.000 (76.20)
D1	4.625 (117.48)	2.000 (50.80)			

NOTES:

- "C" dimension is .500 (12.70 mm) for case diameter of 1.375 (34.93 mm); .875 (22.23 mm) +.015 (.38mm) -.078 (1.98 mm) for case diameter of 2.000 (50.80 mm); 1.125 (28.58 mm) ±.016 (.41 mm) for case diameter of 2.5 (63.5 mm); and 1.250 (31.75 mm) ±.016 (.41 mm) for case diameter of 3.0 (76.2 mm).
- Insulating sleeve thickness does not exceed .016 (.41mm) and overlaps the ends of the capacitor body.
- These capacitors are to be mounted by means of a wraparound, foot-type bracket.

FIGURE 704-3. Electrolytic (aluminum oxide) fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CUR71 (MIL-C-39018/4) - Continued

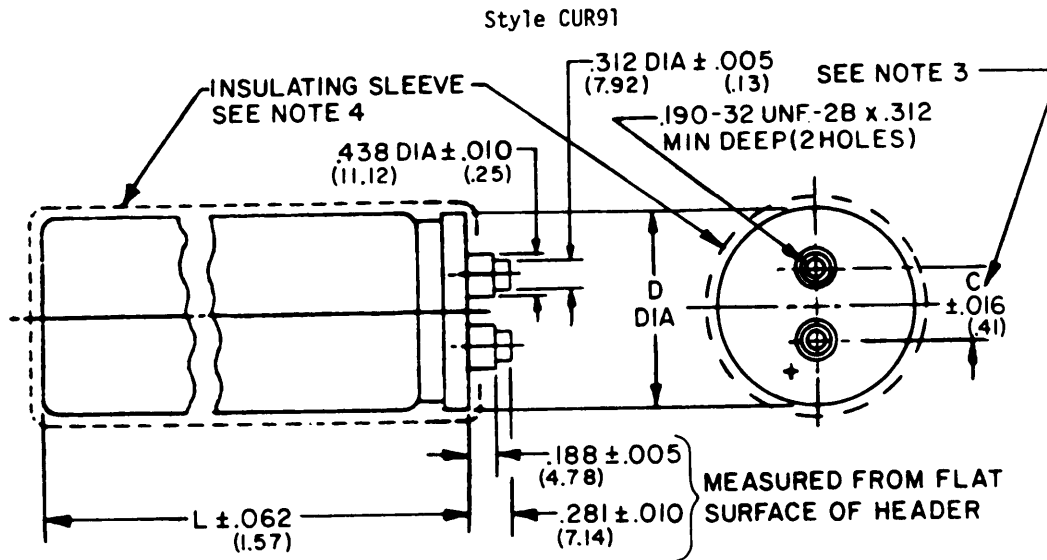
OPERATING TEMPERATURE RANGE -55° TO +85°C -- POLARIZED, INSULATED --
CAPACITANCE TOLERANCE -10, +50%

DC rated voltage at 85°C	Capacitance	DC surge voltage 85°C	Equivalent series resistance		Maximum impedance at -55°C and 120 Hz	DC leakage		Maximum AC ripple current 1/ 120 Hz at 85°C	Case code	Part No. M39018/04- 2/
			25°C	85°C		25°C	85°C			
Volts	μF	Volts	Ω		Ω	mA		Amps		
200	150	250	1.000	1.500	18.30	.26	1.56	.66	A0	2219-
200	220	250	.700	1.000	12.80	.31	1.86	1.00	B0	2220-
200	330	250	.480	.680	8.30	.39	2.34	1.50	A1	2221-
200	470	250	.320	.480	5.80	.46	2.76	1.54	C0	2222-
200	680	250	.230	.320	4.00	.55	3.30	1.97	E0	2223-
200	1,000	250	.200	.230	2.70	.72	4.02	2.74	C1	2224-
200	1,500	250	.130	.150	1.70	.82	4.92	3.20	E1	2225-
200	2,200	250	.090	.100	1.35	1.00	6.00	5.40	D2	2226-
200	3,300	250	.060	.070	.90	1.20	7.20	7.00	D3	2227-
200	4,100	250	.048	.065	.72	1.36	8.20	8.70	F3	2228-
250	100	300	1.300	2.000	27.50	.24	1.44	.60	A0	2229-
250	220	300	.600	.900	12.50	.35	2.10	1.10	A1	2230-
250	330	300	.400	.600	8.30	.43	2.58	1.40	C0	2231-
250	470	300	.420	.450	5.80	.51	3.06	1.90	B1	2232-
250	680	300	.300	.310	4.00	.62	3.72	2.50	C1	2233-
250	1,000	300	.200	.210	2.70	.75	4.50	3.00	D1	2234-
250	1,500	300	.130	.140	1.70	.92	5.52	3.70	C2	2235-
250	2,200	300	.090	.110	1.20	1.10	6.60	5.20	C3	2236-
250	3,300	300	.060	.075	.83	1.45	8.17	7.70	F3	2237-
300	100	350	1.300	1.850	27.50	.26	1.56	.60	A0	2238-
300	150	350	.900	1.250	18.30	.32	1.92	.90	B0	2239-
300	220	350	.600	.850	12.50	.41	2.32	1.10	C0	2240-
300	330	350	.480	.560	8.30	.50	2.83	1.40	B1	2242-
300	470	350	.340	.400	5.80	.60	3.38	2.00	C1	2243-
300	680	350	.250	.270	4.00	.68	4.08	2.60	B2	2244-
300	1,000	350	.170	.190	2.70	.82	4.92	3.50	C2	2245-
300	1,500	350	.130	.130	1.70	1.00	6.00	4.20	C3	2246-
300	2,200	350	.090	.100	1.70	1.22	7.28	5.80	E3	2247-
300	3,400	350	.080	.090	.90	1.43	8.00	6.70	F3	2249-
350	68	400	2.300	2.700	40.70	.23	1.38	.50	A0	2250-
350	150	400	1.100	1.250	18.30	.34	2.04	.97	A1	2251-
350	220	400	.700	.800	12.80	.42	2.52	1.10	C0	2252-
350	330	400	.480	.560	8.30	.54	3.06	1.40	C0	2253-
350	470	400	.340	.400	5.80	.61	3.66	2.10	C1	2254-
350	680	400	.230	.270	4.00	.78	4.39	3.30	C2	2255-
350	1,000	400	.160	.180	2.70	.89	5.34	4.00	E2	2256-
350	1,500	400	.130	.140	1.70	1.08	6.48	5.00	D3	2257-
350	1,800	400	.110	.120	1.50	1.19	7.13	5.70	E3	2258-
350	2,200	400	.090	.100	1.20	1.40	7.90	6.70	F3	2259-

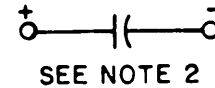
1/ The ripple current values shown are representative values not supported by test data.

2/ The last letter in the dash number will indicate FR level (M, P, R or S).

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Case size	Bare case dimensions	
	D ± .031	L ± .062
AA	1.375 (34.93)	2.125 (53.98)
AB	↓	3.125 (79.38)
AC		4.125 (104.78)
AD		4.625 (117.48)
AE		5.125 (130.18)
AF		5.625 (142.88)
BB	2.000 (50.80)	3.125 (79.38)
BC	↓	4.125 (104.78)
BD		4.625 (117.48)
BE		5.125 (130.18)
BF		5.625 (142.88)
CB		2.500 (63.50)
CC	↓	4.125 (104.78)
CD		4.625 (117.48)
CE		5.125 (130.18)
CF		5.625 (142.88)
DC		3.000 (76.20)
DD	↓	4.625 (117.48)
DE		5.125 (130.18)
DF		5.625 (142.88)



NOTES:

- Capacitors are mounted by means of a wraparound, footed-type bracket.
- There is an indeterminate resistance between the metal case and the negative terminal.
- "C" dimension is .500 (12.70 mm) for case diameter of 1.375 (34.93 mm); .875 (22.23 mm) for case diameter of 2.000 (50.80 mm); 1.125 (28.58 mm) for case diameter of 2.500 (63.50 mm); and 1.250 (31.75 mm) for case diameter of 3.000 (76.20 mm).
- Insulating sleeve thickness shall not exceed .016 (.41 mm) and shall overlap the ends of the capacitor body.

FIGURE 704-3. Electrolytic (aluminum oxide) fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CUR91 (MIL-C-39018/6)
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED --
 CAPACITANCE TOLERANCE -10. +50%

DC rated voltage @ 105°C	Capacitance (nom)	DC surge voltage @ 105°C	ESR(Max)	Impedance (max) @ -55°C (120 Hz)	DC leakage (max)		Maximum AC ripple current 1/120 Hz @ 85°C	Case size	Dash number 2/
					25°C	105°C			
<u>Volts</u>	<u>μF</u>	<u>Volts</u>	<u>Ohms</u>	<u>Ohms</u>	<u>mA</u>		<u>Amperes</u>		
5	8,000	7	.045	1.28	0.30	2.70	6.0	AA	0001-
5	17,000	7	.029	0.61	0.44	3.96	8.0	AB	0002-
5	25,000	7	.023	0.41	0.53	4.77	9.2	AC	0003-
5	29,000	7	.018	0.36	0.57	5.13	10.4	AD	0004-
5	34,000	7	.015	0.31	0.62	5.58	11.6	AE	0005-
5	37,000	7	.013	0.28	0.65	5.85	12.2	AF	0006-
5	40,000	7	.019	0.28	0.67	6.03	12.6	BB	0007-
5	60,000	7	.014	0.19	0.82	7.38	15.1	BC	0008-
5	67,000	7	.013	0.17	0.87	7.83	16.3	CB	0009-
5	70,000	7	.012	0.16	0.89	8.01	16.3	BD	0010-
5	80,000	7	.012	0.14	0.95	8.55	16.6	BE	0011-
5	90,000	7	.010	0.13	1.00	9.00	16.9	BF	0012-
5	100,000	7	.010	0.12	1.06	9.54	19.1	CC	0013-
5	110,000	7	.010	0.11	1.11	9.99	21.5	CD	0014-
5	130,000	7	.009	0.10	1.21	10.90	23.0	CE	0015-
5	150,000	7	.008	.091	1.30	11.70	23.8	CF	0016-
5	150,000	7	.010	.091	1.30	11.70	24.1	DC	0017-
5	170,000	7	.010	.091	1.38	12.40	24.7	DD	0018-
5	200,000	7	.009	.084	1.50	13.50	26.6	DE	0019-
5	220,000	7	.008	.084	1.57	14.10	26.8	DF	0020-
10	5,000	15	.045	0.84	0.34	3.06	6.0	AA	0021-
10	10,000	15	.028	0.42	0.47	4.23	8.2	AB	0022-
10	15,000	15	.022	0.28	0.58	5.22	9.4	AC	0023-
10	17,000	15	.018	0.25	0.62	5.58	10.4	AD	0024-
10	20,000	15	.015	0.21	0.67	6.03	11.4	AE	0025-
10	22,000	15	.015	0.19	0.70	6.30	12.2	AF	0026-
10	24,000	15	.020	0.18	0.73	6.57	12.2	BB	0027-
10	37,000	15	.016	0.12	0.91	8.21	14.6	BC	0028-
10	42,000	15	.016	0.11	0.97	8.75	16.0	CB	0029-
10	43,000	15	.013	0.10	0.98	8.85	15.4	BD	0030-
10	48,000	15	.012	.093	1.04	9.35	16.3	BE	0031-
10	55,000	15	.011	.081	1.11	9.99	16.8	BF	0032-
10	64,000	15	.011	.069	1.20	10.8	19.0	CC	0033-
10	75,000	15	.010	.060	1.30	11.7	21.5	CD	0034-
10	86,000	15	.009	.054	1.39	12.5	22.2	CE	0035-
10	94,000	15	.014	.051	1.45	13.1	20.0	DC	0036-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide) fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CUR91 (MIL-C-39018/6) - CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED --
 CAPACITANCE TOLERANCE -10, +50%

DC rated voltage @ 105°C	Capaci- tance (nom)	DC surge voltage @ 105°C	ESR(Max)	Impedance (max) @ -55°C (120 Hz)	DC leakage (max)		Maximum AC ripple current ^{1/} 120 Hz @ 85°C	Case size	Dash number 2/
					25°C	105°C			
<u>Volts</u>	<u>μF</u>	<u>Volts</u>	<u>Ohms</u>	<u>Ohms</u>	<u>mA</u>		<u>Amperes</u>		
10	96,000	15	.010	.051	1.47	13.2	23.0	CF	0037-
10	110,000	15	.010	.048	1.57	14.1	22.7	DD	0038-
10	120,000	15	.010	.045	1.64	14.8	23.4	DE	0039-
10	140,000	15	.010	.042	1.77	16.0	24.2	DF	0040-
15	4,000	20	.043	1.04	0.37	3.31	6.5	AA	0041-
15	8,000	20	.025	0.52	0.52	4.68	8.7	AB	0042-
15	12,000	20	.024	0.35	0.64	5.73	9.0	AC	0043-
15	14,000	20	.019	0.30	0.69	6.19	10.7	AD	0044-
15	16,000	20	.017	0.26	0.74	6.61	12.0	AE	0045-
15	18,000	20	.016	0.23	0.78	7.01	13.6	AF	0046-
15	20,000	20	.018	0.22	0.82	7.39	13.0	BB	0047-
15	30,000	20	.014	0.14	1.00	9.05	15.2	BC	0048-
15	35,000	20	.011	0.12	1.09	9.78	17.1	BD	0049-
15	40,000	20	.010	0.11	1.16	10.5	18.2	BE	0050-
15	42,000	20	.012	0.11	1.19	10.7	18.2	CB	0051-
15	45,000	20	.010	.096	1.23	11.1	19.5	BF	0052-
15	51,000	20	.010	.087	1.31	11.8	20.7	CC	0053-
15	59,000	20	.010	.075	1.41	12.7	21.8	CD	0054-
15	68,000	20	.009	.066	1.51	13.6	23.1	CE	0055-
15	76,000	20	.008	.060	1.60	14.4	24.5	CF	0056-
15	76,000	20	.010	.060	1.60	14.4	23.1	DC	0057-
15	89,000	20	.009	.054	1.73	15.6	25.7	DD	0058-
15	100,000	20	.009	.051	1.84	16.5	26.6	DE	0059-
15	110,000	20	.008	.048	1.93	17.3	27.5	DF	0060-
20	2,800	30	.044	1.47	0.35	3.19	6.1	AA	0061-
20	5,100	30	.026	0.81	0.48	4.31	8.5	AB	0062-
20	8,600	30	.020	0.48	0.62	5.60	9.9	AC	0063-
20	10,000	30	.019	0.41	0.67	6.04	11.0	AD	0064-
20	11,000	30	.017	0.37	0.70	6.33	11.7	AE	0065-
20	13,000	30	.016	0.32	0.76	6.88	12.0	AF	0066-
20	20,000	30	.013	0.21	0.95	8.54	15.4	BC	0067-
20	23,000	30	.013	0.18	1.02	9.16	15.8	BD	0068-
20	24,000	30	.016	0.17	1.04	9.35	16.0	CB	0069-
20	26,000	30	.012	0.16	1.08	9.73	16.5	BE	0070-
20	30,000	30	.012	0.14	1.16	10.5	17.2	BF	0071-
20	37,000	30	.012	0.11	1.29	11.6	18.8	CC	0072-
20	43,000	30	.011	0.10	1.39	12.5	19.9	CD	0073-
20	47,000	30	.010	.090	1.45	13.1	21.2	CE	0074-
20	54,000	30	.012	.081	1.56	14.0	22.0	DC	0075-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CUR91 (MIL-C-39018/6) - CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED --
 CAPACITANCE TOLERANCE -10, +50%

DC rated voltage @ 105°C	Capacitance (nom)	DC surge voltage @ 105°C	ESR(Max)	Impedance (max) @ -55°C (120 Hz)	DC leakage (max)		Maximum AC ripple current 1/ 120 Hz @ 85°C	Case size	Dash number 2/
					25°C	105°C			
<u>Volts</u>	<u>μF</u>	<u>Volts</u>	<u>Ohms</u>	<u>Ohms</u>	<u>mA</u>		<u>Amperes</u>		
20	55,000	30	.009	.078	1.57	14.2	22.6	CF	0076-
20	63,000	30	.009	.069	1.68	15.2	24.5	DD	0077-
20	73,000	30	.009	.063	1.81	16.3	25.9	DE	0078-
20	82,000	30	.008	.057	1.92	17.3	26.5	DF	0079-
25	2,500	40	.050	1.64	0.38	3.38	5.7	AA	0080-
25	5,500	40	.031	0.75	0.56	5.00	7.7	AB	0081-
25	7,500	40	.021	0.55	0.65	5.85	9.6	AC	0082-
25	8,700	40	.020	0.47	0.70	6.30	10.0	AD	0083-
25	10,000	40	.019	0.41	0.75	6.75	11.0	AE	0084-
25	11,000	40	.018	0.37	0.79	7.08	12.0	AF	0085-
25	17,000	40	.015	0.25	0.98	8.80	14.5	BC	0086-
25	20,000	40	.012	0.21	1.06	9.54	16.1	BD	0087-
25	20,000	40	.011	0.21	1.06	9.54	16.8	CB	0088-
25	23,000	40	.011	0.18	1.14	10.2	16.8	BE	0089-
25	25,000	40	.011	0.17	1.19	10.7	17.4	BF	0090-
25	30,000	40	.011	0.14	1.30	11.7	19.6	CC	0091-
25	35,000	40	.010	0.12	1.40	12.6	20.7	CD	0092-
25	40,000	40	.009	0.11	1.50	13.5	22.1	CE	0093-
25	44,000	40	.015	0.10	1.57	14.2	19.4	DC	0094-
25	45,000	40	.009	.093	1.59	14.3	23.2	CF	0095-
25	52,000	40	.009	.081	1.71	15.4	25.5	DD	0096-
25	60,000	40	.009	.072	1.84	16.5	26.5	DE	0097-
25	67,000	40	.008	.066	1.94	17.5	27.5	DF	0098-
30	2,200	45	.054	1.86	0.39	3.47	5.5	AA	0099-
30	4,400	45	.033	0.93	0.54	4.90	7.5	AB	0100-
30	6,600	45	.025	0.62	0.67	6.00	8.8	AC	0101-
30	7,700	45	.020	0.53	0.72	6.49	9.7	AD	0102-
30	8,800	45	.019	0.47	0.77	6.94	11.5	AE	0103-
30	9,900	45	.017	0.41	0.82	7.36	11.7	AF	0104-
30	10,000	45	.020	0.41	0.82	7.39	12.0	BB	0105-
30	15,000	45	.015	0.28	1.00	9.06	14.3	BC	0106-
30	17,000	45	.014	0.24	1.07	9.64	15.1	BD	0107-
30	18,000	45	.016	0.23	1.10	9.92	15.8	CB	0108-
30	20,000	45	.012	0.21	1.16	10.5	15.9	BE	0109-
30	22,000	45	.012	0.19	1.22	11.0	17.0	BF	0110-
30	26,000	45	.012	0.16	1.32	11.9	18.6	CC	0111-
30	30,000	45	.010	0.14	1.42	12.8	20.3	CD	0112-
30	34,000	45	.010	0.12	1.51	13.6	21.0	CE	0113-
30	38,000	45	.015	0.11	1.60	14.4	19.2	DC	0114-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CUR91 (MIL-C-39018/6) - CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED --
 CAPACITANCE TOLERANCE -10, +50%

DC rated voltage @ 105°C	Capacitance (nom)	DC surge voltage @ 105°C	ESR (Max)	Impedance (max) @ -55°C (120 Hz)	DC leakage (max)		Maximum AC ripple current 1/ 120 Hz @ 85°C	Case size	Dash number 2/
					25°C	105°C			
Volts	μF	Volts	Ohms	Ohms	mA		Amperes		
30	39,000	45	.010	0.11	1.62	14.6	21.8	CF	0115-
30	45,000	45	.010	.093	1.74	15.7	23.3	DD	0116-
30	52,000	45	.009	.081	1.87	16.9	25.3	DE	0117-
30	58,000	45	.008	.075	1.98	17.8	27.0	DF	0118-
40	1,800	55	.065	2.28	0.40	3.62	5.0	AA	0119-
40	3,700	55	.038	1.11	0.58	5.19	8.0	AB	0120-
40	5,500	55	.033	0.75	0.70	6.33	9.2	AC	0121-
40	6,400	55	.023	0.64	0.76	6.83	10.7	AD	0122-
40	7,400	55	.020	0.56	0.82	7.34	11.6	AE	0123-
40	8,200	55	.018	0.50	0.86	7.73	12.4	AF	0124-
40	9,000	55	.019	0.46	0.90	8.10	12.4	BB	0125-
40	13,000	55	.016	0.32	1.08	9.73	14.7	BC	0126-
40	15,000	55	.014	0.28	1.16	10.5	16.0	BD	0127-
40	15,000	55	.014	0.28	1.16	10.5	16.8	CB	0128-
40	18,000	55	.013	0.23	1.27	11.5	17.9	BE	0129-
40	19,000	55	.011	0.22	1.31	11.8	18.1	BF	0130-
40	22,000	55	.011	0.19	1.41	12.7	19.6	CC	0131-
40	25,000	55	.010	0.17	1.50	13.5	21.0	CD	0132-
40	28,000	55	.009	0.15	1.59	14.3	22.3	CE	0133-
40	32,000	55	.009	0.13	1.70	15.3	22.2	DC	0134-
40	33,000	55	.010	0.13	1.72	15.5	23.1	CF	0135-
40	37,000	55	.010	0.11	1.82	16.4	24.2	DD	0136-
40	43,000	55	.009	0.10	1.97	17.7	25.5	DE	0137-
40	48,000	55	.008	.090	2.08	18.7	27.1	DF	0138-
50	1,400	75	.077	1.94	0.40	3.57	4.6	AA	0139-
50	2,900	75	.037	0.94	0.57	5.14	7.7	AB	0140-
50	4,400	75	.027	0.64	0.70	6.33	8.8	AC	0141-
50	5,100	75	.024	0.53	0.76	6.82	9.9	AD	0142-
50	5,800	75	.021	0.47	0.81	7.27	10.9	AE	0143-
50	6,600	75	.020	0.41	0.86	7.76	11.5	AF	0144-
50	9,000	75	.018	0.30	1.00	9.05	13.0	BC	0145-
50	11,000	75	.017	0.25	1.11	10.0	15.2	BD	0146-
50	12,000	75	.016	0.23	1.16	10.5	16.4	CB	0147-
50	13,000	75	.014	0.21	1.21	10.9	16.1	BE	0148-
50	15,000	75	.012	0.18	1.30	11.7	16.8	BF	0149-
50	17,000	75	.012	0.16	1.38	12.4	19.1	CC	0150-
50	20,000	75	.010	0.14	1.50	13.5	20.4	CD	0151-
50	22,000	75	.009	0.12	1.57	14.2	21.6	CE	0152-
50	25,000	75	.009	0.11	1.68	15.1	22.4	CF	0153-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CUR91 (MIL-C-39018/6) - CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED --
 CAPACITANCE TOLERANCE -10, +50%

DC rated voltage @ 105°C	Capaci- tance (nom)	DC surge voltage @ 105°C	ESR(Max)	Impedance (max) @ -55°C (120 Hz)	DC leakage (max)		Maximum AC ripple current 1/ 120 Hz @ 85°C	Case size	Dash number 2/
					25°C	105°C			
<u>Volts</u>	<u>μF</u>	<u>Volts</u>	<u>Ohms</u>	<u>Ohms</u>	<u>mA</u>		<u>Amperes</u>		
50	25,000	75	.013	0.11	1.68	15.1	20.7	DC	0154-
50	30,000	75	.011	0.10	1.84	16.5	22.5	DD	0155-
50	34,000	75	.010	.082	1.96	17.6	24.0	DE	0156-
50	39,000	75	.009	.072	2.09	18.9	26.4	DF	0157-
75	820	100	.128	3.28	0.30	2.69	4.0	AA	0158-
75	1,600	100	.068	1.68	0.41	3.70	6.6	AB	0159-
75	2,300	100	.048	1.17	0.52	4.68	7.7	AC	0160-
75	2,600	100	.044	1.03	0.55	4.96	8.6	AD	0161-
75	3,000	100	.039	0.90	0.58	5.23	9.3	AE	0162-
75	3,300	100	.035	0.81	0.64	5.73	10.3	AF	0163-
75	3,700	100	.033	0.73	0.66	5.96	10.0	BB	0164-
75	5,400	100	.021	0.50	0.81	7.30	12.9	BC	0165-
75	5,700	100	.021	0.48	0.86	7.76	13.9	CB	0166-
75	6,200	100	.020	0.44	0.87	7.84	13.4	BD	0167-
75	7,100	100	.018	0.38	0.92	8.27	14.2	BE	0168-
75	7,900	100	.017	0.30	0.99	8.90	15.1	BF	0169-
75	8,500	100	.015	0.32	1.06	9.50	16.7	CC	0170-
75	10,000	100	.013	0.27	1.14	10.3	18.6	CD	0171-
75	11,000	100	.011	0.25	1.22	11.0	19.8	CE	0172-
75	13,000	100	.010	0.21	1.29	11.6	20.6	CF	0173-
75	13,000	100	.015	0.21	1.27	11.4	19.4	DC	0174-
75	15,000	100	.013	0.18	1.36	12.3	20.7	DD	0175-
75	17,000	100	.012	0.16	1.48	13.3	22.1	DE	0176-
75	19,000	100	.010	0.14	1.54	13.8	23.7	DF	0177-
100	410	150	.200	6.58	0.24	2.13	3.5	AA	0178-
100	810	150	.105	3.33	0.34	3.02	4.8	AB	0179-
100	1,200	150	.074	2.25	0.42	3.82	6.3	AC	0180-
100	1,400	150	.065	1.93	0.45	4.05	7.3	AD	0181-
100	1,500	150	.058	1.79	0.47	4.27	7.8	AE	0182-
100	1,700	150	.053	1.59	0.50	4.48	8.2	AF	0183-
100	1,900	150	.048	1.42	0.52	4.68	9.0	BB	0184-
100	2,800	150	.033	0.97	0.64	5.73	10.8	BC	0185-
100	2,900	150	.045	0.74	0.69	6.19	9.8	CB	0186-
100	3,200	150	.029	0.84	0.69	6.19	12.0	BD	0187-
100	3,600	150	.026	0.76	0.73	6.61	13.0	BE	0188-
100	4,100	150	.023	0.66	0.76	6.88	13.8	BF	0189-
100	4,400	150	.025	0.62	0.84	7.52	13.4	CC	0190-
100	5,100	150	.022	0.53	0.90	8.10	14.0	CD	0191-
100	5,900	150	.020	0.46	0.96	8.64	15.5	CE	0192-
100	6,500	150	.018	0.42	1.02	9.16	17.6	DC	0193-

See footnotes at end of tabulation.

FIGURE 704-3. Electrolytic (aluminum oxide), fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CUR91 (MIL-C-39018/6) - CONTINUED
 OPERATING TEMPERATURE RANGE -55 TO +105°C -- POLARIZED, INSULATED --
 CAPACITANCE TOLERANCE -10, +50%

DC rated voltage @ 105°C	Capacitance (nom)	DC surge voltage @ 105°C	ESR(Max)	Impedance (max) @ -55°C (120 Hz)	DC leakage (max)		Maximum AC ripple current ^{1/} 120 Hz @ 85°C	Case size	Dash number ^{2/}
					25°C	105°C			
<u>Volts</u>	<u>μF</u>	<u>Volts</u>	<u>Ohms</u>	<u>Ohms</u>	<u>mA</u>		<u>Amperes</u>		
100	6,600	150	.017	0.41	1.00	9.06	16.5	CF	0194-
100	7,600	150	.017	0.36	1.11	10.0	18.2	DD	0195-
100	8,700	150	.016	0.31	1.16	10.5	18.9	DE	0196-
100	9,500	150	.015	0.29	1.23	11.1	19.6	DF	0197-
150	210	200	.510	12.8	0.24	2.16	1.10	AA	0198-
150	380	200	.280	7.08	0.34	3.09	1.90	AB	0199-
150	550	200	.194	4.88	0.41	3.70	2.60	AC	0200-
150	640	200	.168	4.18	0.49	4.37	3.30	AE	0201-
150	720	200	.140	3.72	0.51	4.62	3.60	AF	0202-
150	900	200	.130	2.98	0.52	4.68	3.60	BB	0203-
150	1,300	200	.100	2.08	0.64	5.73	4.60	BC	0204-
150	1,400	200	.090	1.92	0.66	5.96	5.20	CB	0205-
150	1,700	200	.075	1.08	0.71	6.40	6.20	BE	0206-
150	1,900	200	.060	1.42	0.76	6.82	6.70	BF	0207-
150	2,100	200	.054	1.28	0.82	7.39	7.10	CC	0208-
150	2,800	200	.044	0.96	0.95	8.59	9.10	CE	0209-
150	3,100	200	.037	0.86	1.00	9.06	9.60	CF	0210-
150	3,100	200	.038	0.86	1.02	9.21	9.50	DC	0211-
150	4,200	200	.030	0.64	1.16	10.5	11.5	DE	0212-
150	4,700	200	.026	0.58	1.23	11.1	12.2	DF	0213-

^{1/} The ripple current values shown are representative values not supported by test data.
 See table 704-V for frequency and temperature factors.

^{2/} The last letter in the dash number will indicate FR level (M, P, R or S).

FIGURE 704-3. Electrolytic (aluminum oxide) fixed capacitors - Continued.

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SECTION 800

CAPACITORS, FIXED, PAPER-PLASTIC OR PLASTIC DIELECTRIC,
ESTABLISHED RELIABILITY

<u>Section</u>	<u>Applicable specification</u>
801. Capacitors, Fixed, Plastic (or Paper-Plastic) Dielectric, (Hermetically Sealed in Metal Cases), Established Reliability - - - - -	MIL-C-19978
802. Capacitors, Fixed, Metallized, Paper Plastic Film or Plastic Film Dielectric, Direct and Alternating Current (Hermetically Sealed in Metal Cases), Established Reliability- - - - -	MIL-C-39022
803. Capacitors, Fixed, Plastic (or Metallized Plastic) Dielectric, DC, In Nonmetal Cases, Established Reliability - - - - -	MIL-C-55514
FOR ARMY AND AIR FORCE USE ONLY NOT FOR NAVY USE	
804. Capacitors, Fixed, Supermetallized, plastic Film Dielectric, (DC, AC, or DC and AC), Hermetically Sealed n Metal Cases. Established Reliability - - - - -	MIL-C-83421

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SECTION 801

CAPACITORS, FIXED, PLASTIC (OR PAPER-PLASTIC) DIELECTRIC,
(HERMETICALLY SEALED IN METAL CASES), ESTABLISHED RELIABILITY

STYLES CQR07, CQR09, CQR12, CQR13, CQR29, CQR32, AND CQR33

(APPLICABLE SPECIFICATION: MIL-C-19978)

1. SCOPE. This section covers established reliability, plastic (or paper-plastic) dielectric, fixed capacitors, hermetically sealed in metal cases. These capacitors have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on operation at maximum rated voltage and maximum rated temperature.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are designed for use in circuit applications requiring high insulation resistance, low dielectric absorption, or low loss factor over wide temperature ranges, and where the ac component of the impressed voltage is small with respect to the dc voltage rating.

NOTE: These capacitors may be used where an ac component is present provided that (1) the sum of the dc voltage and the peak ac voltage does not exceed the dc voltage rating or (2) the peak ac voltage does not exceed 20 percent of the dc voltage rating at 60 Hz, 15 percent at 120 Hz, or 1 percent at 10,000 Hz. Where heavy transient or pulse currents are encountered, the requirements of MIL-C-19978 are not sufficient to guarantee satisfactory performance, and due allowance must therefore be made in the selection of a capacitor.

2.1.1 Polyethylene terephthalate (characteristic M capacitors). Characteristic M capacitors are intended for high-temperature applications similar to those served by hermetically-sealed paper capacitors, but where high insulation resistance at the upper temperature limits is required.

2.1.2 Paper and polyethylene terephthalate (characteristic K capacitors). Characteristic K capacitors are intended for applications where high insulation resistance is necessary.

2.1.3 Polycarbonate (characteristic Q capacitors). Characteristic Q capacitors are intended for applications where minimum capacitance changes with temperature are required; these capacitors are especially suitable for use in tuned and precision timing circuits.

2.2 Construction. The present drive towards miniaturization, closer electrical tolerances, and higher operating temperatures is being met by the use of thin plastic-film dielectrics in the construction of capacitors. The greatest advantage of plastic-film dielectrics over natural dielectrics (such as paper and mica) is that the plastic film is a synthetic that can be made to meet specific requirements (such as thickness of dielectric and high heat resistance). Many plastic-film capacitors are not impregnated but are wound and encased "dry." Plastic dielectric capacitors have insulation resistance values far in excess of those for paper capacitors and, since they are nonabsorbent, their moisture characteristics are superior to those of mica.

There are several types of plastic films available for use as a capacitor dielectric. They may be used individually or in a combination with other films and with paper in order to obtain the compromised advantages of the specific electrical characteristics of each individual film. The more common films include polyethylene terephthalate and polycarbonate. When properly applied, plastic dielectric films lead to the solution of many special capacitor problems.

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Capacitors using polyethylene terephthalate film as the dielectric are perhaps the most common of the plastic film types on the market today. **Some manufacturers use only on sheet of plastic film** for those with low voltage ratings whereas at least two sheets of paper are used unconventional paper types. The principal advantage of polyethylene terephthalate dielectric capacitors is the high order of insulation resistance values available over the dielectric's temperature range of -55° to $+125^{\circ}\text{C}$; however, for military applications, the high temperature limit is $+85^{\circ}\text{C}$. Polyethylene terephthalate dielectric capacitors have an insulation resistance that is normally about 100,000 megohms per microfarad at room temperature and about 25,000 megohms per microfarad at $+85^{\circ}\text{C}$. These insulation resistance values decrease considerably when polyethylene terephthalate dielectric capacitors are impregnated. **However, a higher volt per mil rating is possible by impregnation and the possibility of corona and catastrophic failures due to pin holes in the dielectric are minimized.**

2.3 DC voltage ratings. The voltage ratings for these capacitors vary over a range of 30 to 1,000 volts.

2.4 Operating temperature range. Characteristic M capacitors are suitable for operation over a temperature range of -65° to $+85^{\circ}\text{C}$; characteristic Q capacitors are suitable for operation over a temperature range of -55° to $+125^{\circ}\text{C}$; characteristic K capacitors are suitable for operation over a temperature range of -65° to $+125^{\circ}\text{C}$.

2.5 Barometric pressure (flashover) for metal-cased tubular capacitors. The dc voltage that may be applied to metal-cased tubular capacitors at altitudes other than 80,000 feet may be obtained from figure 801-1, except that the dc voltage rating must not be exceeded.

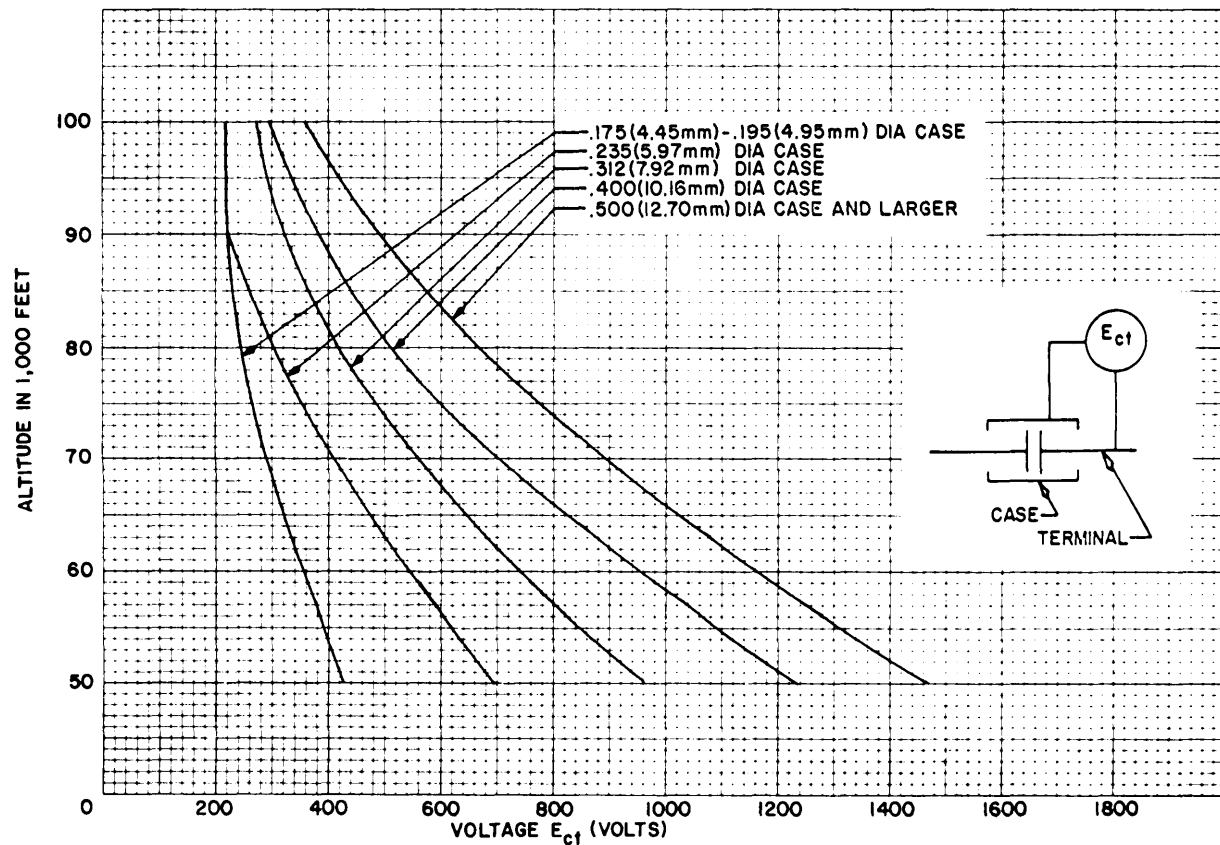


FIGURE 801-1. Permissible operating voltage at altitudes other than 80,000 feet.

3. ITEM IDENTIFICATION (see figures 801-2 and 801-3).

3.1 Significant part number. A significant part number is used for describing the capacitors as shown in figure 801-2.

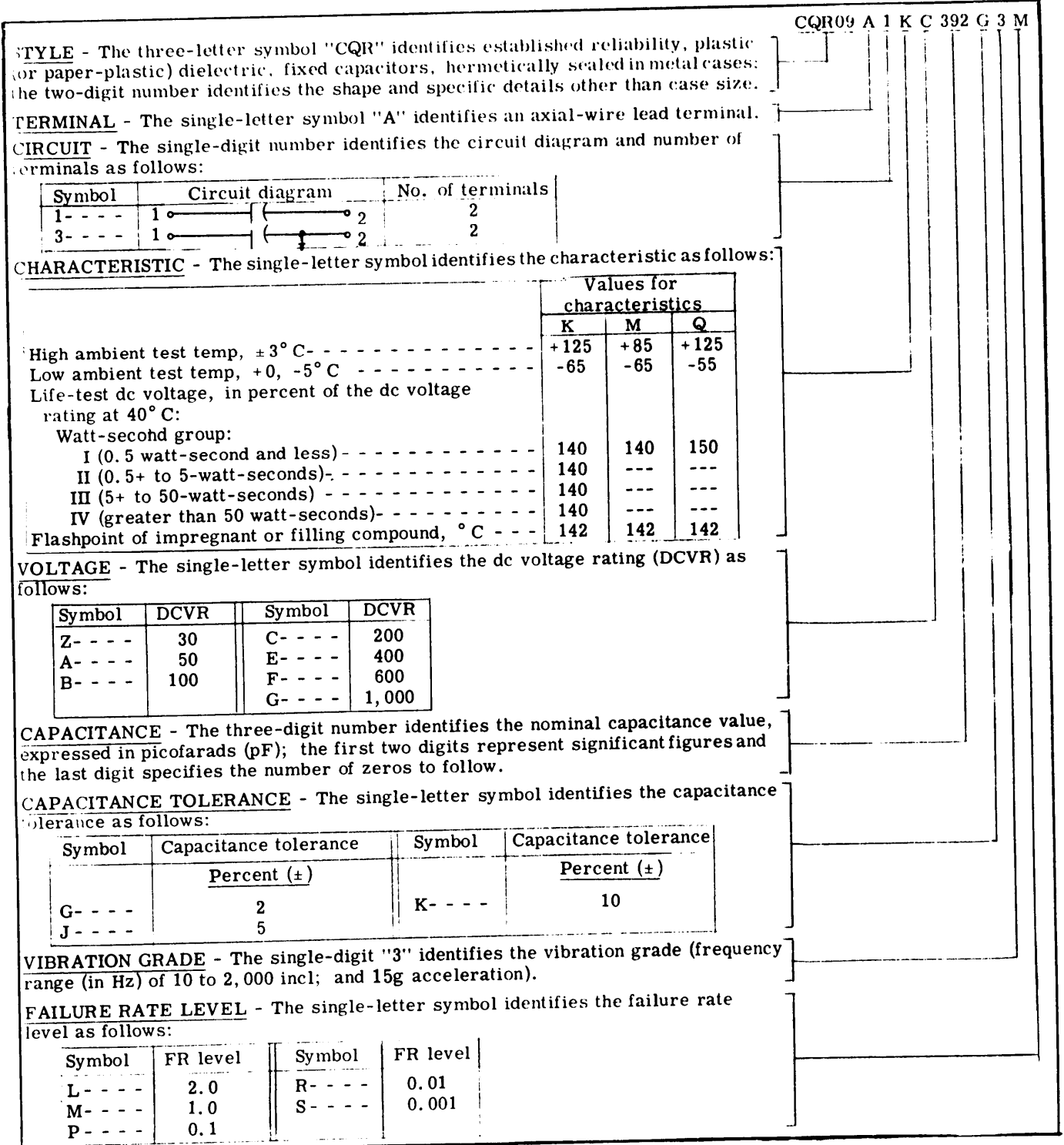
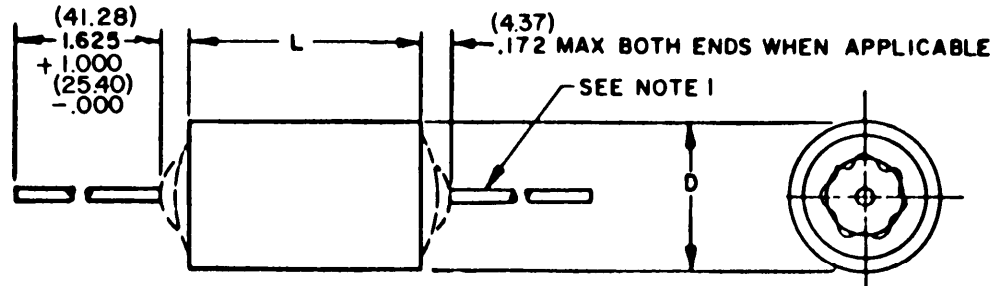


FIGURE 801-2. Significant part number example.

3.2 Standard capacitors. The standard capacitors available in this section are shown on figure 801-3.

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STYLE CQR07

NOTES:

1. Leads are of tinned solid wire, .020 (.51) for cases .175 (4.45) and .195 (4.95) in diameter; .025 (.64) for cases .235 (5.97) and .312 (7.92) diameter; and .032 (.81) for cases .400 (10.16) diameter and above. Tolerance on all lead wire diameters is $+0.004$ (.10), -0.001 (.03).
2. Capacitors with dimension L of 1.562 (39.67) or D of .562 (14.27) and larger, are not intended to be supported by their leads. These capacitors are provided with a supplementary means of mounting, such as a wrap-around band.

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors.

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STANDARD CAPACITORS

STYLE CQR07 (MIL-C-19978/8)

CIRCUIT DIAGRAM 1 OR 3 POLYCARBONATE DIELECTRIC (CHARACTERISTIC Q) --
 CAPACITANCE TOLERANCE ± 5 OR ± 10 PERCENT --
 OPERATING TEMPERATURE RANGE -55° TO $+125^{\circ}\text{C}$

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)							
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)					
			Circuit 1	Circuit 3						
	<u>Volts</u>	<u>μF</u>								
CQR07A-QA392-3-	50	.0039	.750 (19.05)	.688 (17.48)	.175 (4.45)					
CQR07A-QA472-3-		.0047			.175 (4.45)					
CQR07A-QA562-3-		.0056			.195 (4.95)					
CQR07A-QA682-3-		.0068			.195 (4.95)					
CQR07A-QA393-3-		.039			.875 (22.23)	.812 (20.62)	.312 (7.92)			
CQR07A-QA473-3-		.047					.312 (7.92)			
CQR07A-QA563-3-		.056					.400 (10.16)			
CQR07A-QA683-3-		.068								
CQR07A-QA823-3-		.082								
CQR07A-QA104-3-		.1								
CQR07A-QA124-3-		.12					1.375 (34.93)	1.312 (33.32)		
CQR07A-QA154-3-		.15					1.375 (34.93)	1.312 (33.32)		
CQR07A-QA184-3-		.18					1.125 (28.58)	1.062 (26.97)	.562 (14.27)	
CQR07A-QA224-3-		.22					1.125 (28.58)	1.062 (26.97)		
CQR07A-QA274-3-		.27					1.375 (34.93)	1.312 (33.32)		
CQR07A-QA334-3-		.33					1.375 (34.93)	1.312 (33.32)		
CQR07A-QA394-3-		.39					1.875 (47.63)	1.812 (46.02)		
CQR07A-QA474-3-		.47								
CQR07A-QA564-3-		.56							.670 (17.02)	
CQR07A-QA684-3-		.68							.670 (17.02)	
CQR07A-QA824-3-		.82							.750 (19.05)	
CQR07A-QA105-3-		1.0							.750 (19.05)	
CQR07A-QB222-3-		100					.0022	.750 (19.05)	.688 (17.48)	.175 (4.45)
CQR07A-QB272-3-							.0027			.175 (4.45)
CQR07A-QB332-3-	.0033		.175 (4.45)							
CQR07A-QB392-3-	.0039		.195 (4.95)							
CQR07A-QB472-3-	.0047		.195 (4.95)							
CQR07A-QB562-3-	.0056		.235 (5.97)							
CQR07A-QB682-3-	.0068									
CQR07A-QB822-3-	.0082									
CQR07A-QB103-3-	.01									
CQR07A-QB183-3-	.018		.875 (22.23)	.812 (20.62)	.312 (7.92)					
CQR07A-QB223-3-	.022									
CQR07A-QB273-3-	.027									
CQR07A-QB333-3-	.033									
CQR07A-QB393-3-	.039									
CQR07A-QB473-3-	.047									
CQR07A-QB563-3-	.056				1.125 (28.58)	1.062 (26.97)				
CQR07A-QB683-3-	.068									
CQR07A-QB823-3-	.082									
CQR07A-QB104-3-	.1									
CQR07A-QB124-3-	.12				1.375 (34.93)	1.312 (33.32)	.562 (14.27)			
CQR07A-QB154-3-	.15				1.375 (34.93)	1.312 (33.32)				
CQR07A-QB184-3-	.18				1.625 (41.28)	1.562 (39.67)				
CQR07A-QB224-3-	.22									
CQR07A-QB274-3-	.27						.670 (17.02)			
CQR07A-QB334-3-	.33					.670 (17.02)				

See footnote at end of tabulation

FIGURE 801-3. Established reliability plastic (or paper-plastic)
dielectric, fixed capacitors - Continued.

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STANDARD) CAPACITORS

STYLE CQR07 (MIL-C-19978/8) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYCARBONATE; DIELECTRIC (CHARACTERISTIC Q) --
 CAPACITANCE TOLERANCE ± 5 OR ± 10 PERCENT --
 OPERATING TEMPERATURE RANGE -55° TO $+125^{\circ}$ C

Significant part number 1	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L $+.155$ (3.94) $-.031$ (.79)		D $+.062$ (1.57) $-.005$ (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR07A-QB394-3-	100	.39	1.875 (47.63)	1.812 (46.02)	.750 (19.05)
CQR07A-QB474-3-		.47	1.875 (47.63)	1.812 (46.02)	↓
CQR07A-QB564-3-		.56	2.375 (60.33)	2.312 (58.72)	↓
CQR07A-QB684-3-		.68	2.375 (60.33)	2.312 (58.72)	↓
CQR07A-QB824-3-		.82	1.875 (47.63)	1.812 (46.02)	1.000 (25.40)
CQR07A-QB105-3-		1.0	1.875 (47.63)	1.812 (46.02)	1.000 (25.40)
CQR07A-QC102-3-	200	.001	.750 (19.05)	.688 (17.48)	.175 (4.45)
CQR07A-QC122-3-		.0012	↓	↓	.195 (4.95)
CQR07A-QC152-3-		.0015	↓	↓	↓
CQR07A-QC182-3-		.0018	↓	↓	↓
CQR07A-QC222-3-		.0022	↓	↓	↓
CQR07A-QC272-3-		.0027	↓	↓	.235 (5.97)
CQR07A-QC332-3-		.0033	↓	↓	.235 (5.97)
CQR07A-QC822-3-		.0082	.875 (22.23)	.812 (20.62)	.312 (7.92)
CQR07A-QC103-3-		.01	↓	↓	↓
CQR07A-QC123-3-		.012	↓	↓	↓
CQR07A-QC153-3-		.015	↓	↓	↓
CQR07A-QC183-3-		.018	↓	↓	.400 (10.16)
CQR07A-QC223-3-		.022	↓	↓	↓
CQR07A-QC273-3-		.027	1.125 (28.58)	1.062 (26.97)	↓
CQR07A-QC333-3-		.033	↓	↓	↓
CQR07A-QC393-3-		.039	↓	↓	↓
CQR07A-QC473-3-		.047	↓	↓	↓
CQR07A-QC563-3-		.056	↓	↓	.500 (12.70)
CQR07A-QC683-3-		.068	↓	↓	.500 (12.70)
CQR07A-QC823-3-		.082	↓	↓	.562 (14.27)
CQR07A-QC104-3-		.1	↓	↓	↓
CQR07A-QC124-3-		.12	1.875 (47.63)	1.812 (46.02)	↓
CQR07A-QC154-3-		.15	↓	↓	↓
CQR07A-QC184-3-		.18	↓	↓	.670 (17.02)
CQR07A-QC224-3-		.22	↓	↓	.670 (17.02)
CQR07A-QC274-3-		.27	2.125 (53.98)	2.062 (52.37)	.750 (19.05)
CQR07A-QC334-3-		.33	2.125 (53.98)	2.062 (52.37)	.750 (19.05)
CQR07A-QC394-3-		.39	1.875 (47.63)	1.812 (46.02)	1.000 (25.40)
CQR07A-QC474-3-		.47	1.875 (47.63)	1.812 (46.02)	↓
CQR07A-QC564-3-		.56	2.125 (53.98)	2.062 (52.37)	↓
CQR07A-QC684-3-	.68	2.125 (53.98)	2.062 (52.37)	↓	
CQR07A-QE122-3-	400	.0012	.750 (19.05)	.688 (17.48)	.235 (5.97)
CQR07A-QE152-3-		.0015	.750 (19.05)	.688 (17.48)	.235 (5.97)
CQR07A-QE392-3-		.0039	.875 (22.23)	.812 (20.62)	.312 (7.92)
CQR07A-QE472-3-		.0047	↓	↓	↓
CQR07A-QE562-3-		.0056	↓	↓	↓
CQR07A-QE682-3-		.0068	↓	↓	↓
CQR07A-QE822-3-		.0082	↓	↓	.400 (10.16)
CQR07A-QE103-3-		.01	↓	↓	↓
CQR07A-QE123-3-		.012	1.125 (28.58)	1.062 (26.97)	↓
CQR07A-QE153-3-		.015	1.125 (28.58)	1.062 (26.97)	↓

See footnote at end of tabulation.

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

801 (MIL-C-19978)

801.6

MIL-STD-198E

STANDARD CAPACITORS

STYLE CQR07 (MIL-C-19978/8) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYCARBONATE; DIELECTRIC (CHARACTERISTIC Q) --
CAPACITANCE TOLERANCE ± 5 OR ± 10 PERCENT --
OPERATING TEMPERATURE RANGE -55° TO $+125^{\circ}\text{C}$

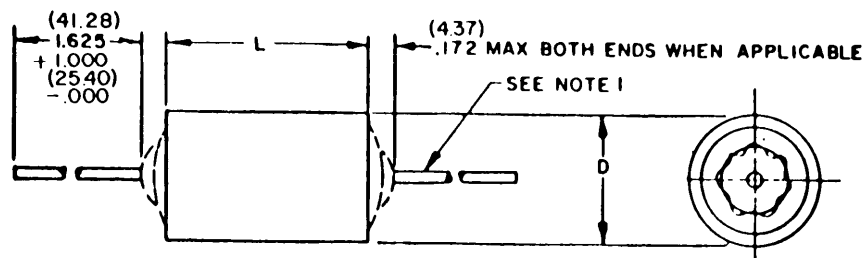
Significant part number ^{1/}	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L + .155 (3.94) - .031 (.79)		D + .062 (1.57) - .005 (.13)
			Circuit 1	Circuit 3	
	Volts	μF			
CQR07A-QE183-3-	400	.018	1.375 (34.93)	1.312 (33.32)	.400 (10.16)
CQR07A-QE223-3-		.022	1.375 (34.93)	1.312 (33.32)	.400 (10.16)
CQR07A-QE273-3-		.027	1.125 (28.58)	1.062 (26.97)	.500 (12.70)
CQR07A-QE333-3-		.033			.500 (12.70)
CQR07A-QE393-3-		.039			.562 (14.27)
CQR07A-QE473-3-		.047			
CQR07A-QE563-3-		.056	1.375 (34.93)	1.312 (33.32)	
CQR07A-QE683-3-		.068	1.375 (34.93)	1.312 (33.32)	
CQR07A-QE823-3-		.082	1.625 (41.28)	1.562 (39.67)	.670 (17.02)
CQR07A-QE104-3-		.1	1.625 (41.28)	1.562 (39.67)	.670 (17.02)
CQR07A-QE124-3-		.12	2.125 (53.98)	2.062 (52.37)	.750 (19.05)
CQR07A-QE154-3-		.15	2.125 (53.98)	2.062 (52.37)	
CQR07A-QE184-3-		.18	2.625 (66.68)	2.562 (65.07)	
CQR07A-QE224-3-		.22	2.625 (66.68)	2.562 (65.07)	
CQR07A-QE274-3-		.27	2.125 (53.98)	2.062 (52.37)	1.000 (25.40)
CQR07A-QE334-3-		.33	2.125 (53.98)	2.062 (52.37)	
CQR07A-QE394-3-		.39	2.625 (66.68)	2.562 (65.07)	
CQR07A-QE474-3-		.47	2.625 (66.68)	2.562 (65.07)	
CQR07A-QF102-3-	600	.001	.750 (19.05)	.688 (17.48)	.235 (5.97)
CQR07A-QF122-3-		.0012	.875 (22.23)	.812 (20.62)	.312 (7.92)
CQR07A-QF152-3-		.0015			
CQR07A-QF182-3-		.0018			
CQR07A-QF222-3-		.0022			
CQR07A-QF272-3-		.0027			
CQR07A-QF332-3-		.0033			
CQR07A-QF392-3-		.0039			.400 (10.16)
CQR07A-QF472-3-		.0047			
CQR07A-QF562-3-		.0056	1.125 (28.58)	1.062 (26.97)	
CQR07A-QF682-3-		.0068			
CQR07A-QF822-3-		.0082			
CQR07A-QF103-3-		.01			
CQR07A-QF123-3-		.012			.500 (12.70)
CQR07A-QF153-3-		.015			.500 (12.70)
CQR07A-QF183-3-		.018			.562 (14.27)
CQR07A-QF223-3-		.022			
CQR07A-QF273-3-		.027	1.375 (34.93)	1.312 (33.32)	
CQR07A-QF333-3-		.033	1.375 (34.93)	1.312 (33.32)	
CQR07A-QF393-3-		.039	1.625 (41.28)	1.562 (39.67)	
CQR07A-QF473-3-		.047			
CQR07A-QF563-3-		.056			.670 (17.02)
CQR07A-QF683-3-		.068			.670 (17.02)
CQR07A-QF823-3-		.082	1.875 (47.63)	1.812 (46.02)	.750 (19.05)
CQR07A-QF104-3-		.1			.750 (19.05)
CQR07A-QF124-3-		.12			1.000 (25.40)
CQR07A-QF154-3-		.15			
CQR07A-QF184-3-		.18	2.625 (66.68)	2.562 (65.07)	
CQR07A-QF224-3-		.22	2.625 (66.68)	2.562 (65.07)	

^{1/} Complete part number includes additional symbols to indicate circuit (1 or 3); capacitance tolerance (J or K); and failure rate level (M, P, R, or S).

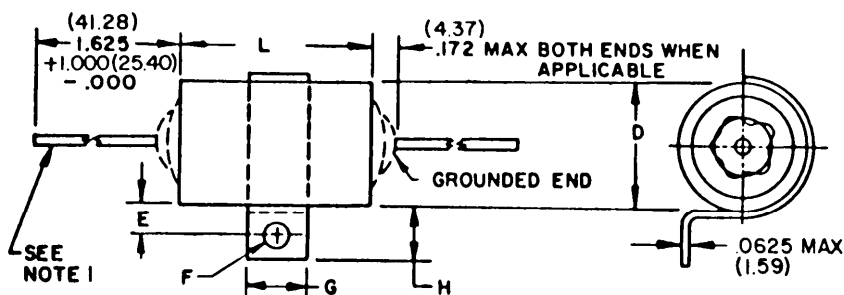
FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

STYLES CQR09, CQR12, AND CQR13

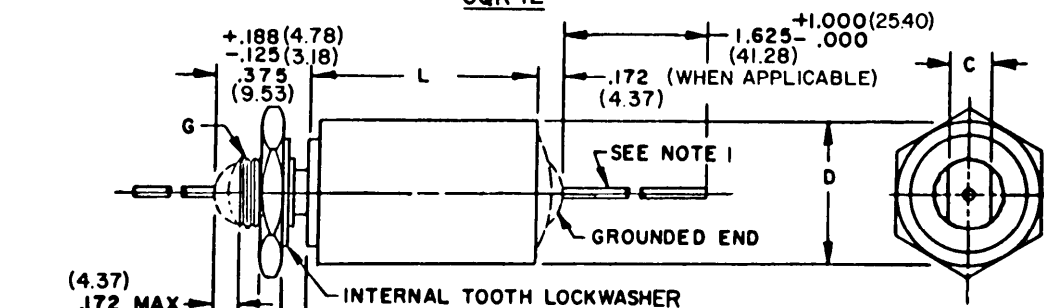


CQR 09 (SEE NOTE 2)



Case dimension D	H ±.062 (1.57)	G ±.062 (1.57)	E ±.031 (.79)	F ±.005 (.13)
Less than .500 (12.70)	.312 (7.92)	.250 (6.35)	.188 (4.78)	.144 (3.66)
.500 (12.70) and up	.438 (11.13)	.500 (12.70)	.250 (6.35)	.156 (3.96)

CQR 12



Case dimension D	C ±.005 (.13)	G
.562 (14.27) or less	.250 (6.35)	.312 (7.92)-24UNF-2A
.670 (17.02)	.375 (9.53)	.438 (11.13)-28UNEF-2A
.750 (19.05) and up	.437 (11.10)	.500 (12.70)-28UNEF-2A

NOTES:

1. On styles CQR09 and CQR12, leads are of tinned solid wire, .025 (.64) for cases .235 (5.97) and .312 (7.92) in diameter and .032 (.81) for cases .400 (10.16) diameter and above; on style CQR13, leads are of tinned solid wire, .032 (.81). Tolerance on all lead wire diameters is +.004 (.10), -.001 (.03).
2. Capacitors with dimension L of 1.562 (39.67) or D of .562 (14.27) and larger, are not intended to be supported by their leads. These capacitors are provided with a supplementary means of mounting, such as wrap-around band.
3. Mounting nuts and lockwashers are supplied.

FIGURE 801.3 Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198F

STANDARD CAPACITORS

STYLES CQR09 (MIL-C-19978/9) AND CQR12 (MIL-C-19978/10)

CIRCUIT DIAGRAM 10R 3 -- PAPER AND POLYETHYLENE TEREPHTHALATE DIELECTRIC
(CHARACTERISTIC K) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+125^{\circ}$ C

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	Volts	μ F			
CQR--A-KC392-3-	200	.0039	.750 (19.05)	.688 (17.48)	.235 (5.97)
CQR--A-KC472-3-		.0047			
CQR--A-KC562-3-		.0056			
CQR--A-KC682-3-		.0068			
CQR--A-KC183-3-		.018	.875 (22.23)	.812 (20.62)	.312 (7.92)
CQR--A-KC223-3-		.022			
CQR--A-KC273-3-		.027			
CQR--A-KC333-3-		.033			
CQR--A-KC393-3-		.039			.400 (10.16)
CQR--A-KC473-3-		.047			
CQR--A-KC563-3-		.056			
CQR--A-KC683-3-		.068			
CQR--A-KC823-3-		.082	1.125 (28.58)	1.062 (26.97)	
CQR--A-KC104-3-		.10	1.125 (28.58)	1.062 (26.97)	
CQR--A-KC124-3-		.12	1.375 (34.93)	1.312 (33.32)	
CQR--A-KC154-3-		.15	1.375 (34.93)	1.312 (33.32)	
CQR--A-KC184-3-		.18	1.125 (28.58)	1.062 (26.97)	.562 (14.27)
CQR--A-KC224-3-		.22	1.125 (28.58)	1.062 (26.97)	
CQR--A-KC274-3-		.27	1.375 (34.93)	1.312 (33.32)	
CQR--A-KC334-3-		.33	1.375 (34.93)	1.312 (33.32)	
CQR--A-KC394-3-	.39	1.625 (41.28)	1.562 (39.67)		
CQR--A-KC474-3-	.47				
CQR--A-KC564-3-	.56			.670 (17.02)	
CQR--A-KC684-3-	.68			.670 (17.02)	
CQR--A-KC824-3-	.82	2.125 (53.98)	2.062 (52.37)	.750 (19.05)	
CQR--A-KC105-3-	1.000	2.125 (53.98)	2.062 (52.37)	.750 (19.05)	
CQR--A-KE272-3-	400	.0027	.750 (19.05)	.688 (17.48)	.235 (5.97)
CQR--A-KE332-3-		.0033	.750 (19.05)	.688 (17.48)	.235 (5.97)
CQR--A-KE123-3-		.012	.875 (22.23)	.812 (20.62)	.312 (7.92)
CQR--A-KE153-3-		.015			.312 (7.92)
CQR--A-KE273-3-		.027			.400 (10.16)
CQR--A-KE333-3-		.033			
CQR--A-KE393-3-		.039	1.125 (28.58)	1.062 (26.97)	
CQR--A-KE473-3-		.047	1.125 (28.58)	1.062 (26.97)	
CQR--A-KE563-3-		.056	1.375 (34.93)	1.312 (33.32)	
CQR--A-KE683-3-		.068	1.375 (34.93)	1.312 (33.32)	
CQR--A-KE823-3-		.082	1.125 (28.58)	1.062 (26.97)	.562 (14.27)
CQR--A-KE104-3-		.10	1.125 (28.58)	1.062 (26.97)	
CQR--A-KE124-3-		.12	1.375 (34.93)	1.312 (33.32)	
CQR--A-KE154-3-		.15	1.375 (34.93)	1.312 (33.32)	
CQR--A-KE184-3-		.18	1.625 (41.28)	1.562 (39.67)	
CQR--A-KE224-3-		.22			
CQR--A-KE274-3-		.27			.670 (17.02)
CQR--A-KE334-3-		.33			.670 (17.02)
CQR--A-KE394-3-		.39	2.125 (53.98)	2.062 (52.37)	.750 (19.05)
CQR--A-KE474-3-		.47	2.125 (53.98)	2.062 (52.37)	.750 (19.05)

See footnote at end of tabulation.

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

801 (MIL-C-19978)

MIL-STD-198E

STANDARD CAPACITORS

STYLES CQR09 (MIL-C-19978/9) AND CQR12 (MIL-C-19978/10) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- PAPER AND POLYETHYLENE TEREPHTHALATE DIELECTRIC
(CHARACTERISTIC K) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+125^{\circ}\text{C}$

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR--A-KF102-3-	600	.0010	.750 (19.05)	.688 (17.48)	.235 (5.97)
CQR--A-KF122-3-		.0012	↓	↓	↓
CQR--A-KF152-3-		.0015			
CQR--A-KF182-3-		.0018			
CQR--A-KF222-3-		.0022			
CQR--A-KF272-3-		.0027	.875 (22.23)	.812 (20.62)	.312 (7.92)
CQR--A-KF332-3-		.0033	↓	↓	↓
CQR--A-KF392-3-		.0039			
CQR--A-KF472-3-		.0047			
CQR--A-KF562-3-		.0056			
CQR--A-KF682-3-		.0068			
CQR--A-KF822-3-		.0082			
CQR--A-KF103-3-		.010			
CQR--A-KF123-3-		.012			.400 (10.16)
CQR--A-KF153-3-		.015			↓
CQR--A-KF183-3-		.018			↓
CQR--A-KF223-3-		.022			↓
CQR--A-KF273-3-		.027	1.125 (28.58)	1.062 (26.97)	↓
CQR--A-KF333-3-		.033	1.125 (28.58)	1.062 (26.97)	↓
CQR--A-KF393-3-		.039	1.375 (34.93)	1.312 (33.32)	↓
CQR--A-KF473-3-		.047	1.375 (34.93)	1.312 (33.32)	↓
CQR--A-KF563-3-		.056	1.125 (28.58)	1.062 (26.97)	.562 (14.27)
CQR--A-KF683-3-		.068	1.125 (28.58)	1.062 (26.97)	↓
CQR--A-KF823-3-		.082	1.375 (34.93)	1.312 (33.32)	↓
CQR--A-KF104-3-		.10	1.375 (34.93)	1.312 (33.32)	↓
CQR--A-KF124-3-		.12	1.625 (41.28)	1.562 (39.67)	↓
CQR--A-KF154-3-		.15			↓
CQR--A-KF184-3-		.18			.670 (17.02)
CQR--A-KF224-3-		.22			.670 (17.02)
CQR--A-KF274-3-		.27	2.125 (53.98)	2.062 (52.37)	.750 (19.05)
CQR--A-KF334-3-		.33	2.125 (53.98)	2.062 (52.37)	↓
CQR--A-KF394-3-		.39	2.375 (60.33)	2.312 (58.72)	↓
CQR--A-KF474-3-		.47	2.375 (60.33)	2.312 (58.72)	↓
CQR--A-KG102-3-	1000	.0010	.875 (22.23)	.812 (20.62)	.400 (10.16)
CQR--A-KG122-3-		.0012	↓	↓	↓
CQR--A-KG152-3-		.0015			
CQR--A-KG182-3-		.0018			
CQR--A-KG222-3-		.0022			
CQR--A-KG272-3-		.0027			
CQR--A-KG332-3-		.0033			
CQR--A-KG392-3-		.0039			
CQR--A-KG472-3-		.0047			
CQR--A-KG562-3-		.0056			
CQR--A-KG682-3-		.0068			
CQR--A-KG822-3-		.0082			
CQR--A-KG103-3-		.010			

See footnote at end of tabulation.

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CQR09 (MIL-C-19978/9) AND CQR12 (MIL-C-19978/10) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- PAPER AND POLYETHYLENE TEREPHTHALATE DIELECTRIC
(CHARACTERISTIC K) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+125^{\circ}$ C

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR--A-KG123-3-	1000 ↓	.012	1.125 (28.58)	1.062 (26.97)	.400 (10.16)
CQR--A-KG153-3-		.015	1.125 (28.58)	1.062 (26.97)	
CQR--A-KG183-3-		.018	1.375 (34.93)	1.312 (33.32)	
CQR--A-KG223-3-		.022	1.375 (34.93)	1.312 (33.32)	
CQR--A-KG273-3-		.027	1.125 (28.58)	1.062 (26.97)	.562 (14.27)
CQR--A-KG333-3-		.033	1.125 (28.58)	1.062 (26.97)	
CQR--A-KG393-3-		.039	1.375 (34.93)	1.312 (33.32)	
CQR--A-KG473-3-		.047	1.375 (34.93)	1.312 (33.32)	
CQR--A-KG563-3-		.056	1.625 (41.28)	1.562 (39.67)	
CQR--A-KG683-3-		.068			
CQR--A-KG823-3-		.082			.670 (17.02)
CQR--A-KG104-3-		.10			
CQR--A-KG124-3-		.12	1.875 (47.63)	1.812 (46.02)	
CQR--A-KG154-3-		.15	1.875 (47.63)	1.812 (46.02)	
CQR--A-KG184-3-		.18	2.125 (53.98)	2.062 (52.37)	.750 (19.05)
CQR--A-KG224-3-		.22			.750 (19.05)
CQR--A-KG274-3-		.27			1.000 (25.40)
CQR--A-KG334-3-		.33			
CQR--A-KG394-3-		.39	2.375 (60.33)	2.312 (58.72)	
CQR--A-KG474-3-		.47	2.375 (60.33)	2.312 (58.72)	

1/ Complete part number includes additional symbols to indicate style (09 or 12); circuit (1 or 3); capacitance tolerance (G, J, or K); and failure rate level (M, P, R, or S).

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CQR13 (MIL-C-19978/11)

CIRCUIT DIAGRAM 10R3 -- PAPER AND POLYETHYLENE TEREPHTHALATE
 DIELECTRIC (CHARACTERISTIC K) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+125^{\circ}$ C

Significant part number <u>1/</u>	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR13A-KC392-3-	200	.0039	.750 (19.05)	.688 (17.48)	.400 (10.16)
CQR13A-KC472-3-		.0047	↓	↓	↓
CQR13A-KC562-3-		.0056	↓	↓	↓
CQR13A-KC682-3-		.0068	↓	↓	↓
CQR13A-KC183-3-		.018	.875 (22.23)	.812 (20.62)	↓
CQR13A-KC223-3-		.022	↓	↓	↓
CQR13A-KC273-3-		.027	↓	↓	↓
CQR13A-KC333-3-		.033	↓	↓	↓
CQR13A-KC393-3-		.039	↓	↓	↓
CQR13A-KC473-3-		.047	↓	↓	↓
CQR13A-KC563-3-		.056	↓	↓	↓
CQR13A-KC683-3-		.068	↓	↓	↓
CQR13A-KC823-3-		.082	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KC104-3-		.10	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KC124-3-		.12	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KC154-3-		.15	1.375 (34.93)	1.312 (33.32)	.562 (14.27)
CQR13A-KC184-3-		.18	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KC224-3-		.22	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KC274-3-		.27	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KC334-3-		.33	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KC394-3-	.39	1.625 (41.28)	1.562 (39.67)	↓	
CQR13A-KC474-3-	.47	↓	↓	↓	
CQR13A-KC564-3-	.56	↓	↓	.670 (17.02)	
CQR13A-KC684-3-	.68	↓	↓	.670 (17.02)	
CQR13A-KC824-3-	.82	2.125 (53.98)	2.062 (52.37)	.750 (19.05)	
CQR13A-KC105-3-	1.000	2.125 (53.98)	2.062 (52.37)	.750 (19.05)	
CQR13A-KE272-3-	400	.0027	.750 (19.05)	.688 (17.48)	.400 (10.16)
CQR13A-KE332-3-		.0033	.750 (19.05)	.688 (17.48)	↓
CQR13A-KE123-3-		.012	.875 (22.23)	.812 (20.62)	↓
CQR13A-KE153-3-		.015	↓	↓	↓
CQR13A-KE273-3-		.027	↓	↓	↓
CQR13A-KE333-3-		.033	↓	↓	↓
CQR13A-KE393-3-		.039	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KE473-3-		.047	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KE563-3-		.056	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KE683-3-		.068	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KE823-3-		.082	1.125 (28.58)	1.062 (26.97)	.562 (14.27)
CQR13A-KE104-3-		.10	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KE124-3-		.12	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KE154-3-		.15	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KE184-3-		.18	1.625 (41.28)	1.562 (39.67)	↓
CQR13A-KE224-3-		.22	↓	↓	↓
CQR13A-KE274-3-		.27	↓	↓	.670 (17.02)
CQR13A-KE334-3-		.33	↓	↓	.670 (17.02)
CQR13A-KE394-3-		.39	2.125 (53.98)	2.062 (52.37)	.750 (19.05)
CQR13A-KE474-3-		.47	2.125 (53.98)	2.062 (52.37)	.750 (19.05)

See footnote at end of tabulation.

FIGURE 801-3. Established reliability, plastic (or paper-plastic)
dielectric, fixed capacitors - Continued.

801 (MIL-C-19978)

801.12

MIL-STD-198E

STANDARD CAPACITORS

STYLE CQR13 (MIL-C-19978/11) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- PAPER AND POLYETHYLENE TEREPHTHALATE DIELECTRIC
(CHARACTERISTIC) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+125^{\circ}\text{C}$

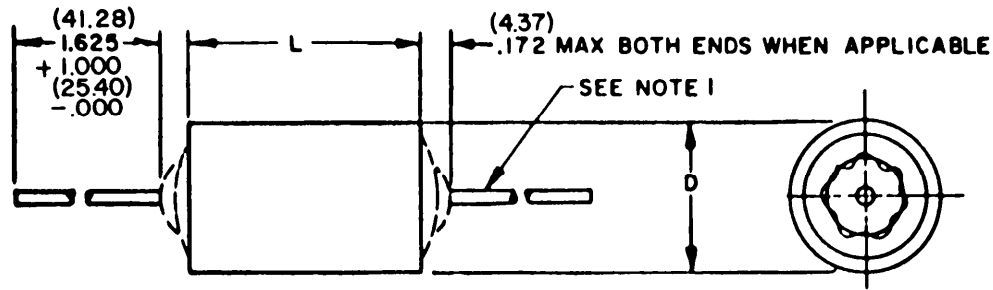
Significant part number <u>1</u> /	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)			
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)	
			Circuit 1	Circuit 3		
	<u>Volts</u>	<u>μF</u>				
CQR13A-KF102-3-	600 ↓	.0010	.750 (19.05)	.688 (17.48)	.400 (10.16)	
CQR13A-KF122-3-		.012	↓	↓	↓	
CQR13A-KF152-3-		.0015	↓	↓	↓	
CQR13A-KF182-3-		.0018	↓	↓	↓	
CQR13A-KF222-3-		.0022	↓	↓	↓	
CQR13A-KF272-3-		.0027	↓	.875 (22.23)	.812 (20.62)	↓
CQR13A-KF332-3-		.0033	↓	↓	↓	↓
CQR13A-KF392-3-		.0039	↓	↓	↓	↓
CQR13A-KF472-3-		.0047	↓	↓	↓	↓
CQR13A-KF562-3-		.0056	↓	↓	↓	↓
CQR13A-KF682-3-		.0068	↓	↓	↓	↓
CQR13A-KF822-3-		.0082	↓	↓	↓	↓
CQR13A-KF103-3-		.010	↓	↓	↓	↓
CQR13A-KF123-3-		.012	↓	↓	↓	↓
CQR13A-KF153-3-		.015	↓	↓	↓	↓
CQR13A-KF183-3-		.018	↓	↓	↓	↓
CQR13A-KF223-3-		.022	↓	↓	↓	↓
CQR13A-KF273-3-		.027	↓	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KF333-3-		.033	↓	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KF393-3-		.039	↓	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KF473-3-		.047	↓	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KF563-3-		.056	↓	1.125 (28.58)	1.062 (26.97)	.562 (14.27)
CQR13A-KF683-3-		.068	↓	1.125 (28.58)	1.062 (26.97)	↓
CQR13A-KF823-3-		.082	↓	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KF104-3-		.10	↓	1.375 (34.93)	1.312 (33.32)	↓
CQR13A-KF124-3-		.12	↓	1.625 (41.28)	1.562 (39.67)	↓
CQR13A-KF154-3-		.15	↓	↓	↓	↓
CQR13A-KF184-3-	.18	↓	↓	↓	.670 (17.02)	
CQR13A-KF224-3-	.22	↓	↓	↓	.670 (17.02)	
CQR13A-KF274-3-	.27	↓	2.125 (53.98)	2.062 (52.37)	.750 (19.05)	
CQR13A-KF334-3-	.33	↓	2.125 (53.98)	2.062 (52.37)	↓	
CQR13A-KF394-3-	.39	↓	2.375 (60.33)	2.312 (58.72)	↓	
CQR13A-KF474-3-	.47	↓	2.375 (60.33)	2.312 (58.72)	↓	
CQR13A-KG184-3-	1000 ↓	.18	2.125 (53.98)	2.062 (52.37)	↓	
CQR13A-KG224-3-		.22	↓	↓	↓	
CQR13A-KG274-3-		.27	↓	↓	↓	
CQR13A-KG334-3-		.33	↓	↓	↓	
CQR13A-KG394-3-		.39	↓	2.375 (60.33)	2.312 (58.72)	1.000 (25.40)
CQR13A-KG474-3-		.47	↓	2.375 (60.33)	2.312 (58.72)	↓

1/ Complete part number includes additional symbols to indicate circuit (1 or 3); capacitance tolerance (G, J, or K); and failure rate level (M, P, R, or S).

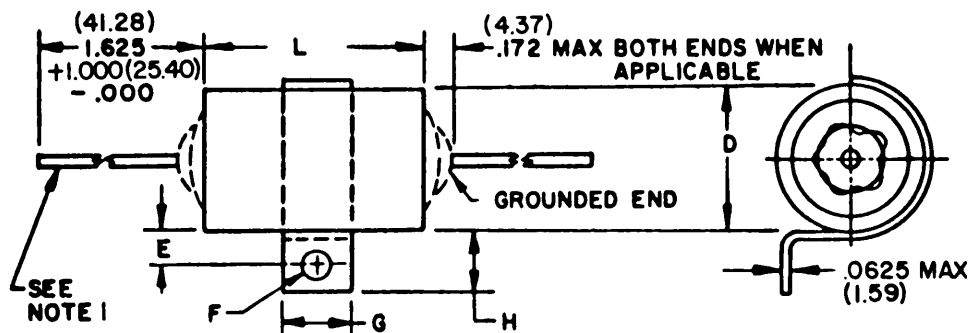
FIGURE 801-3. Established reliability plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

STYLES CQR29 AND CQR32



CQR 29 (SEE NOTE 2)



Case dimension D	H $\pm .062$ (1.57)	G $\pm .062$ (1.57)	E $\pm .031$ (.79)	F $\pm .005$ (.13)
Less than .500 (12.70)	.312 (7.92)	.250 (6.35)	.188 (4.78)	.144 (3.66)
.500 (12.70) and up	.438 (11.13)	.500 (12.70)	.250 (6.35)	.156 (3.96)

CQR 32

NOTES:

- Leads are of tinned solid wire, .020 (.51) for cases .175 (4.45) and .195 (4.95) in diameter; .025 (.64) for cases .235 (5.07) and .312 (7.92) diameter; and .032 (.81) for cases .400 (10.16) diameter and above. Tolerance on all lead wire diameters is $+.004$ (.10), $-.001$ (.03).
- Capacitors with dimension L of 1.562 (39.67) or D of .562 (14.27) and larger, are not intended to be supported by their leads. These capacitors are provided with a supplementary means of mounting, such as a wrap-around band.

FIGURE 801.3 Established reliability plastic (or paper-plastic) dielectric fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CQR29 (MIL-C-19978/13) AND CQR32 (MIL-C-19978/14)

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
 (CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}\text{C}$

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR--A-MZ155-3-	30	1.5	1.625 (41.28)	1.531 (38.89)	.562 (14.27)
CQR--A-MZ225-3-		2.2	1.875 (47.63)	1.781 (45.24)	.670 (17.02)
CQR--A-MZ335-3-		3.3	1.875 (47.63)	1.781 (45.24)	.750 (19.05)
CQR--A-MZ475-3-		4.7	2.625 (66.68)	2.531 (64.29)	.750 (19.05)
CQR--A-MZ685-3-		6.8	2.125 (53.98)	2.031 (51.59)	1.000 (25.40)
CQR--A-MZ106-3-		10.0	2.375 (60.33)	2.281 (57.94)	1.000 (25.40)
CQR--A-MA102-3-	50	.0010	.500 (12.70)	.406 (10.31)	.175 (4.45)
CQR--A-MA122-3-		.0012			
CQR--A-MA152-3-		.0015			
CQR--A-MA182-3-		.0018			
CQR--A-MA222-3-		.0022			
CQR--A-MA272-3-		.0027			
CQR--A-MA332-3-		.0033			
CQR--A-MA392-3-		.0039			
CQR--A-MA472-3-		.0047			
CQR--A-MA562-3-		.0056			
CQR--A-MA682-3-		.0068			
CQR--A-MA822-3-		.0082			
CQR--A-MA103-3-		.010			
CQR--A-MA123-3-		.012			.235 (5.97)
CQR--A-MA153-3-		.015			
CQR--A-MA183-3-		.018			
CQR--A-MA223-3-		.022			
CQR--A-MA273-3-		.027			.312 (7.92)
CQR--A-MA333-3-		.033			
CQR--A-MA393-3-		.039			
CQR--A-MA473-3-		.047			
CQR--A-MA563-3-		.056		.562 (14.27)	.468 (11.89)
CQR--A-MA683-3-		.068		.562 (14.27)	.468 (11.89)
CQR--A-MA124-3-		.12		.875 (22.23)	.781 (19.84)
CQR--A-MA154-3-		.15			
CQR--A-MA184-3-		.18			.400 (10.16)
CQR--A-MA224-3-		.22			
CQR--A-MA274-3-		.27			
CQR--A-MA334-3-		.33		1.000 (25.40)	.906 (23.01)
CQR--A-MA394-3-		.39		1.125 (28.58)	1.031 (26.19)
CQR--A-MA474-3-		.47		1.125 (28.58)	1.031 (26.19)
CQR--A-MA564-3-		.56		1.375 (34.93)	1.281 (32.54)
CQR--A-MA684-3-		.68		1.375 (34.93)	1.281 (32.54)
CQR--A-MA824-3-	.82		1.125 (28.58)	1.031 (26.19)	
CQR--A-MA105-3-	1.0		1.125 (28.58)	1.031 (26.19)	
CQR--A-MA125-3-	1.2		1.375 (34.93)	1.281 (32.54)	
CQR--A-MB125-3-	100	1.2	1.625 (41.28)	1.531 (38.89)	.670 (17.02)
CQR--A-MB155-3-		1.5	1.625 (41.28)	1.531 (38.89)	.670 (17.02)
CQR--A-MB185-3-		1.8	1.625 (41.28)	1.531 (38.89)	.670 (17.02)

See footnote at end of tabulation

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CQR29 (MIL-C-19978/13) AND CQR32 (MIL-C-19978/14) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
 (CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}$ C

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)			
			L + .155 (3.94) -.031 (.79)		D + .062 (1.57) -.005 (.13)	
			Circuit 1	Circuit 3		
	<u>Volts</u>	<u>μF</u>				
CQR--A-MB225-3-	100 ↓	2.2	1.875 (47.63)	1.781 (45.24)	.750 (19.05)	
CQR--A-MB275-3-		2.7	2.125 (53.98)	2.031 (51.59)	.750 (19.05)	
CQR--A-MB335-3-		3.3	2.375 (60.33)	2.281 (57.94)	.750 (19.05)	
CQR--A-MB395-3-		3.9	1.875 (47.63)	1.781 (45.24)	1.000 (25.40)	
CQR--A-MB475-3-		4.7	2.125 (53.98)	2.031 (51.59)		
CQR--A-MB565-3-		5.6	2.375 (60.33)	2.281 (57.94)		
CQR--A-MB685-3-		6.8	2.625 (66.68)	2.531 (64.29)		
CQR--A-MC102-3-		200 ↓	.0010	.750 (19.05)	.656 (16.66)	.175 (4.45)
CQR--A-MC122-3-	.0012					
CQR--A-MC152-3-	.0015					
CQR--A-MC182-3-	.0018					
CQR--A-MC222-3-	.0022					
CQR--A-MC272-3-	.0027					
CQR--A-MC332-3-	.0033					
CQR--A-MC392-3-	.0039					
CQR--A-MC472-3-	.0047					
CQR--A-MC562-3-	.0056					
CQR--A-MC682-3-	.0068					
CQR--A-MC822-3-	.0082					
CQR--A-MC103-3-	.010					
CQR--A-MC123-3-	.012			.719 (18.26)	.625 (15.88)	.195 (4.95)
CQR--A-MC153-3-	.015					.195 (4.95)
CQR--A-MC183-3-	.018					.235 (5.97)
CQR--A-MC223-3-	.022					
CQR--A-MC273-3-	.027					
CQR--A-MC333-3-	.033					
CQR--A-MC393-3-	.039					.312 (7.92)
CQR--A-MC473-3-	.047					
CQR--A-MC563-3-	.056			.844 (21.44)	.750 (19.05)	
CQR--A-MC683-3-	.068					
CQR--A-MC823-3-	.082					
CQR--A-MC104-3-	.10					
CQR--A-MC124-3-	.12			.812 (20.62)	.719 (18.26)	.400 (10.16)
CQR--A-MC154-3-	.15			.812 (20.62)	.719 (18.26)	
CQR--A-MC184-3-	.18			1.062 (26.97)	.969 (24.61)	
CQR--A-MC224-3-	.22			1.062 (26.97)	.969 (24.61)	
CQR--A-MC274-3-	.27			1.250 (31.75)	1.156 (29.36)	
CQR--A-MC334-3-	.33			1.250 (31.75)	1.156 (29.36)	
CQR--A-MC394-3-	.39			1.188 (30.17)	1.094 (27.79)	.500 (12.70)
CQR--A-MC474-3-	.47		1.188 (30.17)	1.094 (27.79)	.500 (12.70)	
CQR--A-MC564-3-	.56		1.375 (34.93)	1.281 (32.54)	.562 (14.27)	
CQR--A-MC684-3-	.68		1.375 (34.93)	1.281 (32.54)		
CQR--A-MC824-3-	.82		1.875 (47.63)	1.781 (45.24)		
CQR--A-MC105-3-	1.0		1.875 (47.63)	1.781 (45.24)		

See footnote at end of tabulation.

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CQR29 (MIL-C-19978/13) AND CQR32 (MIL-C-19978/14) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
 (CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}$ C

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L +.155 (3.94) -.031 (.79)		D +.062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR--A-ME102-3-	400	.0010	.812 (20.62)	.719 (18.26)	.235 (5.97)
CQR--A-ME122-3-		.0012			
CQR--A-ME152-3-		.0015			
CQR--A-ME182-3-		.0018			
CQR--A-ME222-3-		.0022			
CQR--A-ME272-3-		.0027			
CQR--A-ME332-3-		.0033			
CQR--A-ME392-3-		.0039			
CQR--A-ME472-3-		.0047			
CQR--A-ME562-3-		.0056			
CQR--A-ME682-3-		.0068			
CQR--A-ME822-3-		.0082			
CQR--A-ME103-3-		.010			
CQR--A-ME123-3-		.012			
CQR--A-ME153-3-		.015			
CQR--A-ME183-3-		.018			
CQR--A-ME223-3-		.022			
CQR--A-ME273-3-		.027			
CQR--A-ME333-3-		.033			
CQR--A-ME393-3-		.039			
CQR--A-ME473-3-		.047			
CQR--A-ME563-3-		.056			
CQR--A-ME683-3-		.068			
CQR--A-ME823-3-		.082			
CQR--A-ME104-3-		.10			
CQR--A-ME124-3-		.12			
CQR--A-ME154-3-		.15			
CQR--A-ME184-3-		.18			
CQR--A-ME224-3-		.22			
CQR--A-ME274-3-		.27			
CQR--A-ME334-3-		.33			
CQR--A-ME394-3-		.39			
CQR--A-ME474-3-		.47			
CQR--A-ME564-3-	.56				
CQR--A-ME684-3-	.68				
CQR--A-ME824-3-	.82				
CQR--A-ME105-3-	1.0				
CQR--A-MF102-3-	600	.0010	.812 (20.62)	.719 (18.26)	.235 (5.97)
CQR--A-MF122-3-		.0012			
CQR--A-MF152-3-		.0015			
CQR--A-MF182-3-		.0018			
CQR--A-MF222-3-		.0022			
CQR--A-MF272-3-		.0027			
CQR--A-MF332-3-		.0033			
CQR--A-MF392-3-		.0039			
CQR--A-MF472-3-		.0047			
CQR--A-MF562-3-		.0056			
CQR--A-MF682-3-		.0068			

See footnote at end of tabulation.

FIGURE 801-3. Established reliability plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CQR29 (MIL-C-19978/13) AND CQR32 (MIL-C-19978/14) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
 (CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}\text{C}$

Significant part number <u>1/</u>	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L + .155 (3.93) -.031 (.79)		D + .062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR--A-MF822-3-	600	.0082	1.062 (26.97)	.969 (24.61)	.312 (7.92)
CQR--A-MF103-3-		.010	1.062 (26.97)	.969 (24.61)	.312 (7.92)
CQR--A-MF123-3-		.012	.938 (23.72)	.844 (21.44)	.400 (10.16)
CQR--A-MF153-3-		.015	.938 (23.72)	.844 (21.44)	
CQR--A-MF183-3-		.018	1.062 (26.97)	.969 (24.61)	
CQR--A-MF223-3-		.022	1.062 (26.97)	.969 (24.61)	
CQR--A-MF273-3-		.027	1.312 (33.32)	1.219 (30.96)	
CQR--A-MF333-3-		.033	1.312 (33.32)	1.219 (30.96)	
CQR--A-MF393-3-		.039	1.562 (39.67)	1.469 (37.31)	
CQR--A-MF473-3-		.047	1.562 (39.67)	1.469 (37.31)	
CQR--A-MF563-3-		.056	1.250 (31.75)	1.156 (29.36)	.562 (14.27)
CQR--A-MF683-3-		.068	1.250 (31.75)	1.156 (29.36)	
CQR--A-MF823-3-		.082	1.500 (38.10)	1.406 (35.71)	
CQR--A-MF104-3-		.10	1.500 (38.10)	1.406 (35.71)	
CQR--A-MF124-3-		.12	1.875 (47.63)	1.781 (45.24)	
CQR--A-MF154-3-		.15			
CQR--A-MF184-3-		.18			.670 (17.02)
CQR--A-MF224-3-		.22			.670 (17.02)
CQR--A-MF274-3-		.27	2.125 (53.98)	2.031 (51.59)	.750 (19.05)
CQR--A-MF334-3-		.33	2.125 (53.98)	2.031 (51.59)	
CQR--A-MF394-3-		.39	2.625 (66.68)	2.531 (64.29)	
CQR--A-MF474-3-		.47	2.625 (66.68)	2.531 (64.29)	
CQR--A-MF564-3-		.56	2.125 (53.98)	2.031 (51.59)	1.000 (25.40)
CQR--A-MF684-3-		.68	2.125 (53.98)	2.031 (51.59)	1.000 (25.40)
CQR--A-MG102-3-	1000	.0010	.938 (23.72)	.844 (21.44)	.312 (7.92)
CQR--A-MG122-3-		.0012			
CQR--A-MG152-3-		.0015			
CQR--A-MG182-3-		.0018			
CQR--A-MG222-3-		.0022			
CQR--A-MG272-3-		.0027			
CQR--A-MG332-3-		.0033			
CQR--A-MG392-3-		.0039			.400 (10.16)
CQR--A-MG472-3-		.0047			
CQR--A-MG562-3-		.0056	1.062 (26.97)	.969 (24.61)	
CQR--A-MG682-3-		.0068	1.062 (26.97)	.969 (24.61)	
CQR--A-MG822-3-		.0082	1.312 (33.32)	1.219 (30.96)	
CQR--A-MG103-3-		.010	1.312 (33.32)	1.219 (30.96)	
CQR--A-MG123-3-		.012	1.562 (39.67)	1.469 (37.31)	
CQR--A-MG183-3-		.018	1.562 (39.67)	1.469 (37.31)	
CQR--A-MG223-3-		.022	1.250 (31.75)	1.156 (29.36)	.562 (14.27)
CQR--A-MG273-3-		.027	1.250 (31.75)	1.156 (29.36)	
CQR--A-MG333-3-		.033	1.500 (38.10)	1.406 (35.71)	
CQR--A-MG393-3-		.039	1.875 (47.63)	1.781 (45.24)	
CQR--A-MG473-3-		.047	1.875 (47.63)	1.781 (45.24)	

See footnote at end of tabulation.

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLES CQR29 (MIL-C-19978/13) AND CQR32 (MIL-C-19978/14) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
 (CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 , OR
 ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}\text{C}$

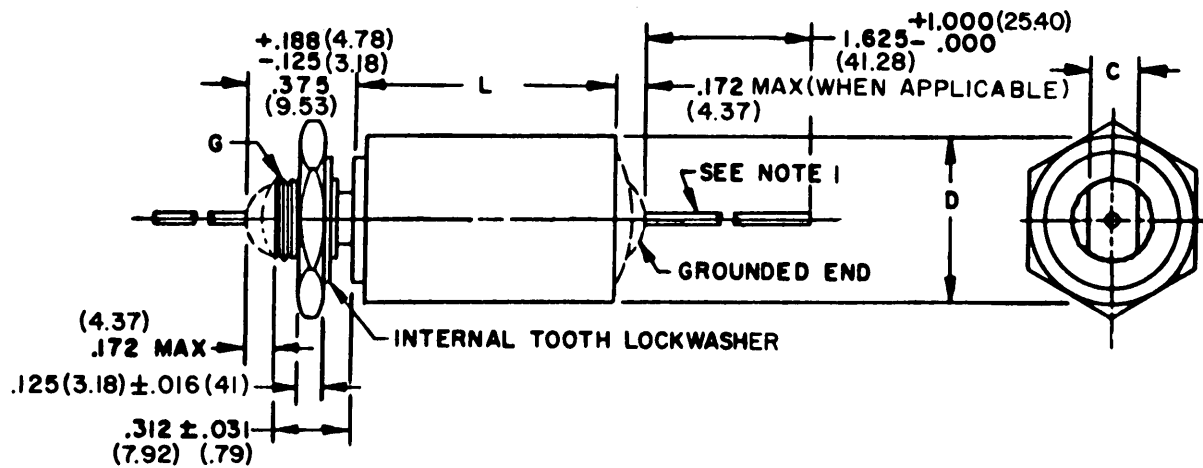
Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L +.155 (3.91) -.031 (.79)		D +.062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR--A-MG563-3-	1000 ↓	.056	1.875 (47.63)	1.781 (45.24)	.670 (17.02)
CQR--A-MG683-3-		.068	1.875 (47.63)	1.781 (45.24)	.670 (17.02)
CQR--A-MG823-3-		.082	2.125 (53.98)	2.031 (51.59)	.750 (19.05)
CQR--A-MG104-3-		.10	2.125 (53.98)	2.031 (51.59)	.750 (19.05)
CQR--A-MG124-3-		.12	1.875 (47.63)	1.781 (45.24)	1.000 (25.40)
CQR--A-MG154-3-		.15	1.875 (47.63)	1.781 (45.24)	
CQR--A-MG184-3-		.18	2.375 (60.33)	2.281 (57.94)	
CQR--A-MG224-3-		.22	2.375 (60.33)	2.281 (57.94)	

1/ Complete part number includes additional symbols to indicate style (29 or 32); circuit (1 or 3); capacitance tolerance (G, J, or K); and failure rate level (M, P, R, or S).

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

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STYLE COR33



Case dimension D	C \pm .005 (.13)	G
.562 (14.27) or less	.250 (6.35)	.312 (7.92)-24UNF-2A
.670 (17.02)	.375 (9.53)	.438 (11.13)-28UNEF-2A
.750 (19.05) and up	.437 (11.10)	.500 (12.70)-28UNEF-2A

NOTES:

1. Leads are of tinned solid wire, $.032$ (.81), $+0.004$ (.10), -0.001 (.03).
2. Mounting nuts and lockwashers are supplied.

FIGURE 801.3 Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CQR33 (MIL-C-19978/15) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
 (CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 ,
 OR ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}$ C

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)		
			L +.155 (3.94) -.031 (.79)		D +.062 (1.57) -.005 (.13)
			Circuit 1	Circuit 3	
	<u>Volts</u>	<u>μF</u>			
CQR33A-MB225-3-	100	2.2	1.875 (47.63)	1.781 (45.24)	.750 (19.05)
CQR33A-MB275-3-		2.7	2.125 (53.98)	2.031 (51.59)	.750 (19.05)
CQR33A-MB335-3-		3.3	2.375 (60.33)	2.281 (57.94)	.750 (19.05)
CQR33A-MB395-3-		3.9	1.875 (47.63)	1.781 (45.24)	1.000 (25.40)
CQR33A-MB475-3-		4.7	2.125 (53.98)	2.031 (51.59)	
CQR33A-MB565-3-		5.6	2.375 (60.33)	2.281 (57.94)	
CQR33A-MB685-3-		6.8	2.625 (66.68)	2.531 (64.29)	
CQR33A-MC102-3-	200	.0010	.750 (19.05)	.656 (16.66)	.400 (10.16)
CQR33A-MC122-3-		.0012			
CQR33A-MC152-3-		.0015			
CQR33A-MC182-3-		.0018			
CQR33A-MC222-3-		.0022			
CQR33A-MC272-3-		.0027			
CQR33A-MC332-3-		.0033			
CQR33A-MC392-3-		.0039			
CQR33A-MC472-3-		.0047			
CQR33A-MC562-3-		.0056			
CQR33A-MC682-3-		.0068			
CQR33A-MC822-3-		.0082			
CQR33A-MC103-3-		.010			
CQR33A-MC123-3-		.012		.719 (18.26)	.625 (15.88)
CQR33A-MC153-3-		.015			
CQR33A-MC183-3-		.018			
CQR33A-MC223-3-		.022			
CQR33A-MC273-3-		.027			
CQR33A-MC333-3-		.033			
CQR33A-MC393-3-		.039			
CQR33A-MC473-3-		.047			
CQR33A-MC563-3-		.056		.844 (21.44)	.750 (19.05)
CQR33A-MC683-3-		.068			
CQR33A-MC823-3-		.082			
CQR33A-MC104-3-		.10			
CQR33A-MC124-3-		.12		.812 (20.62)	.719 (18.26)
CQR33A-MC154-3-		.15		.812 (20.62)	.719 (18.26)
CQR33A-MC184-3-		.18		1.062 (26.97)	.969 (24.61)
CQR33A-MC224-3-		.22		1.062 (26.97)	.969 (24.61)
CQR33A-MC274-3-		.27		1.250 (31.75)	1.156 (29.36)
CQR33A-MC334-3-		.33		1.250 (31.75)	1.156 (29.36)
CQR33A-MC394-3-		.39		1.188 (30.17)	1.094 (27.79)
CQR33A-MC474-3-	.47		1.188 (30.17)	1.094 (27.79)	
CQR33A-MC564-3-	.56		1.375 (34.93)	1.281 (32.54)	
CQR33A-MC684-3-	.68		1.375 (34.93)	1.281 (32.54)	
CQR33A-MC824-3-	.82		1.875 (47.63)	1.781 (45.24)	
CQR33A-MC105-3-	1.0		1.875 (47.63)	1.781 (45.24)	

See footnote at end of tabulation.

FIGURE 801-3. Established reliability plastic (or paper-plastic) dielectric fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CQR33 (MIL-C-19978/15) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
(CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 ,
OR ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}\text{C}$

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)			
			L $+ .155$ (3.94) $- .031$ (.79)		D $+ .062$ (1.57) $.005$ (.13)	
			Circuit 1	Circuit 3		
	<u>Volts</u>	<u>μF</u>				
CQR33A-ME102-3-	400	.0010	.812 (20.62)	.719 (18.26)	.400 (10.16)	
CQR33A-ME122-3-		.0012				
CQR33A-ME152-3-		.0015				
CQR33A-ME182-3-		.0018				
CQR33A-ME222-3-		.0022				
CQR33A-ME272-3-		.0027				
CQR33A-ME332-3-		.0033				
CQR33A-ME392-3-		.0039				
CQR33A-ME472-3-		.0047				
CQR33A-ME562-3-		.0056		.938 (23.72)	.844 (21.44)	
CQR33A-ME682-3-		.0068				
CQR33A-ME822-3-		.0082				
CQR33A-ME103-3-		.010				
CQR33A-ME123-3-		.012				
CQR33A-ME153-3-		.015				
CQR33A-ME183-3-		.018		1.062 (26.97)	.969 (24.61)	
CQR33A-ME223-3-		.022		1.062 (26.97)	.969 (24.61)	
CQR33A-ME273-3-		.027		.938 (23.72)	.844 (21.44)	
CQR33A-ME333-3-		.033		.938 (23.72)	.844 (21.44)	
CQR33A-ME393-3-		.039		1.062 (26.97)	.969 (24.61)	
CQR33A-ME473-3-		.047		1.062 (26.97)	.969 (24.61)	
CQR33A-ME563-3-		.056		1.250 (31.75)	1.156 (29.36)	
CQR33A-ME683-3-		.068		1.250 (31.75)	1.156 (29.36)	
CQR33A-ME823-3-		.082		1.562 (39.67)	1.469 (37.31)	
CQR33A-ME104-3-		.10		1.562 (39.67)	1.469 (37.31)	
CQR33A-ME124-3-		.12		1.231 (32.54)	1.188 (30.17)	.562 (14.27)
CQR33A-ME154-3-		.15		1.281 (32.54)	1.188 (30.17)	
CQR33A-ME184-3-		.18		1.531 (38.89)	1.438 (36.53)	
CQR33A-ME224-3-		.22		1.531 (38.89)	1.438 (36.53)	
CQR33A-ME274-3-		.27		1.906 (48.41)	1.812 (46.02)	
CQR33A-ME334-3-		.33				
CQR33A-ME394-3-		.39				.670 (17.02)
CQR33A-ME474-3-		.47				.670 (17.02)
CQR33A-ME564-3-	.56		2.156 (54.76)	2.062 (52.37)	.750 (19.05)	
CQR33A-ME684-3-	.68		2.156 (54.76)	2.062 (52.37)		
CQR33A-ME824-3-	.82		2.656 (67.46)	2.562 (65.07)		
CQR33A-ME105-3-	1.0		2.656 (67.46)	2.562 (65.07)		
CQR33A-MF102-3-	600	.0010	.812 (20.62)	.719 (18.26)	.400 (10.16)	
CQR33A-MF122-3-		.0012				
CQR33A-MF152-3-		.0015				
CQR33A-MF182-3-		.0018				
CQR33A-MF222-3-		.0022				
CQR33A-MF272-3-		.0027				
CQR33A-MF332-3-		.0033		.938 (23.72)	.844 (21.44)	
CQR33A-MF392-3-		.0039				
CQR33A-MF472-3-		.0047				
CQR33A-MF562-3-		.0056				
CQR33A-MF682-3-		.0068				

See footnote at end of tabulation.

FIGURE 801-3. Established reliability plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CQR33 (MIL-C-19978/15) - CONTINUED

CIRCUIT DIAGRAM 1 OR 3 -- POLYETHYLENE TEREPHTHALATE DIELECTRIC
(CHARACTERISTIC M) -- CAPACITANCE TOLERANCE ± 2 , ± 5 ,
OR ± 10 PERCENT -- OPERATING TEMPERATURE RANGE -65° TO $+85^{\circ}\text{C}$

Significant part number 1/	DC voltage rating	Capacitance (nom)	Case dimensions (in inches)			
			L $+ .155$ (3.94) $- .031$ (.79)		D $+ .082$ (1.57) $- .005$ (.13)	
			Circuit 1	Circuit 3		
	<u>Volts</u>	<u>μF</u>				
CQR33A-MF822-3-	600	.0082	1.062 (26.97)	.969 (24.61)	.400 (10.16)	
CQR33A-MF103-3-		.010	1.062 (26.97)	.969 (24.61)		
CQR33A-MF123-3-		.012	.938 (23.72)	.844 (21.44)		
CQR33A-MF153-3-		.015	.938 (23.72)	.844 (21.44)		
CQR33A-MF183-3-		.018	1.062 (26.97)	.969 (24.61)		
CQR33A-MF223-3-		.022	1.062 (26.97)	.969 (24.61)		
CQR33A-MF273-3-		.027	1.312 (33.32)	1.219 (30.96)		
CQR33A-MF333-3-		.033	1.312 (33.32)	1.219 (30.96)		
CQR33A-MF393-3-		.039	1.562 (39.67)	1.469 (37.31)		
CQR33A-MF473-3-		.047	1.562 (39.67)	1.469 (37.31)		
CQR33A-MF563-3-		.056	1.250 (31.75)	1.156 (29.36)	.562 (14.27)	
CQR33A-MF683-3-		.068	1.250 (31.75)	1.156 (29.36)		
CQR33A-MF823-3-		.082	1.500 (38.10)	1.406 (35.71)		
CQR33A-MF104-3-		.10	1.500 (38.10)	1.406 (35.71)		
CQR33A-MF124-3-		.12	1.875 (47.63)	1.781 (45.24)		
CQR33A-MF154-3-		.15				
CQR33A-MF184-3-		.18				.670 (17.02)
CQR33A-MF224-3-		.22				.670 (17.02)
CQR33A-MF274-3-		.27	2.125 (53.98)	2.031 (51.59)		.750 (19.05)
CQR33A-MF334-3-		.33	2.125 (53.98)	2.031 (51.59)		
CQR33A-MF394-3-		.39	2.625 (66.68)	2.531 (64.29)		
CQR33A-MF474-3-		.47	2.625 (66.68)	2.531 (64.29)		
CQR33A-MF564-3-		.56	2.125 (53.98)	2.031 (51.59)	1.000 (25.40)	
CQR33A-MF684-3-		.68	2.125 (53.98)	2.031 (51.59)	1.000 (25.40)	
CQR33A-MG823-3-		1000	.082	2.125 (53.98)	2.031 (51.59)	.750 (19.05)
CQR33A-MG104-3-	.10		2.125 (53.98)	2.031 (51.59)	.750 (19.05)	
CQR33A-MG124-3-	.12		1.875 (47.63)	1.781 (45.24)	1.000 (25.40)	
CQR33A-MG154-3-	.15		1.875 (47.63)	1.781 (45.24)		
CQR33A-MG184-3-	.18		2.375 (60.33)	2.281 (57.94)		
CQR33A-MG224-3-	.22		2.375 (60.33)	2.281 (57.94)		

1/ Complete part number includes additional symbols to indicate circuit (1 or 3); capacitance tolerance (G, J, or K); and failure rate level (M, P, R, or S).

FIGURE 801-3. Established reliability, plastic (or paper-plastic) dielectric, fixed capacitors - Continued.

MIL-STD-198E

SECTION 802

CAPACITORS, FIXED, METALLIZED, PAPER PLASTIC FILM OR PLASTIC FILM DIELECTRIC, DIRECT AND ALTERNATING CURRENT (HERMETICALLY SEALED IN METAL CASE), ESTABLISHED RELIABILITY

STYLES CHR09 AND CHR49

(APPLICABLE SPECIFICATION: MIL-C-39022)

1. SCOPE. This section covers established reliability, metallized dielectric (paper-plastic or plastic), fixed capacitors, hermetically sealed in metal cases. These capacitors have failure rate levels ranging from 1.0 percent to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on full rated voltage at the maximum rated temperature.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are primarily intended for use in power supply filter circuits, bypass applications, and other applications where the ac component of voltage is small with respect to the dc voltage rating and where occasional periods of low insulation resistance and momentary breakdowns can be tolerated.

NOTE: These capacitors may be used where an ac component is present provided that (1) the sum of the dc voltage and the peak ac voltage does not exceed the dc voltage rating, and (2) the ac voltage does not exceed 20 percent of the dc voltage rating or the value calculated from the following formula, whichever is smaller:

$$V_p \text{ AC.} = \sqrt{\frac{(T_{dc} - T) A e}{\pi f C D}}$$

Where: **Vp. AC.** = Peak value of ac component.

f = Frequency in Hertz of ac component.

D = 2 (maximum DF at applicable high test temperature).

C = Nominal capacitance in farads.

A = Exposed capacitor case surface area in square centimeters (cm), exclusive of portion occupied by terminal mountings.

T_{dc} = Applicable high test temperature in degrees Celsius.

T = Maximum ambient operating temperature expected within equipment containing capacitor.

e = Convection coefficient in watts per cm²/°C. (The value of "e" is approximately equal to 0.0006.)

2.2 Construction. The construction of metallized plastic capacitors differs from conventional plastic capacitors in that instead of having separate layers of metal foil (capacitor plates) and plastic dielectric, the metal comprising the capacitor plates is imposed directly on one side of the plastic dielectric by means of a metallizing process. This technique results in an overall size reduction for metallized plastic capacitors when compared to conventional plastic-foil capacitor types of equal ratings. This space saving is the outstanding feature of the metallized plastic capacitor. A 200-volt metallized plastic capacitor has 0.75 the volume of the conventional plastic construction; at 600 volts, this ratio increases to 0.8; above 600 volts, the metallized plastic capacitor provides no size advantage.

Another advantage resulting from the metallizing technique is that the capacitors are self-healing. The metallic film imposed on the plastic is very thin and if breakdown occurs, a tiny area of the thin film surrounding the breakdown point burns away, leaving the capacitor operable, but with a slightly reduced capacitance. In conventional plastic-foil type (where the foil is thicker), sustained conduction can occur on a breakdown causing a large area of the plastic surrounding the breakdown to be carbonized resulting in a permanent short-circuit.

802 (MIL-C-39022)

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The breakdown of the metallized plastic capacitor can be either of two types: i.e., (1) a complete breakdown lasting for only a moment (momentary breakdown) or (2) a sharp reduction in insulation resistance lasting for an extended period of time, but eventually returning to normal (period of low insulation). The general characteristics of the metallized plastic type, aside from the breakdowns, are similar to the conventional plastic type except for a significantly lower insulation resistance, approximately in the order of 10 to 1.

2.3 DC and ac voltage ratings. Style CHR09 capacitors have a voltage rating of 600 volts dc; style CHR49 capacitors have voltage ratings from 80 + 400 volts ac, depending upon capacitance value and case size.

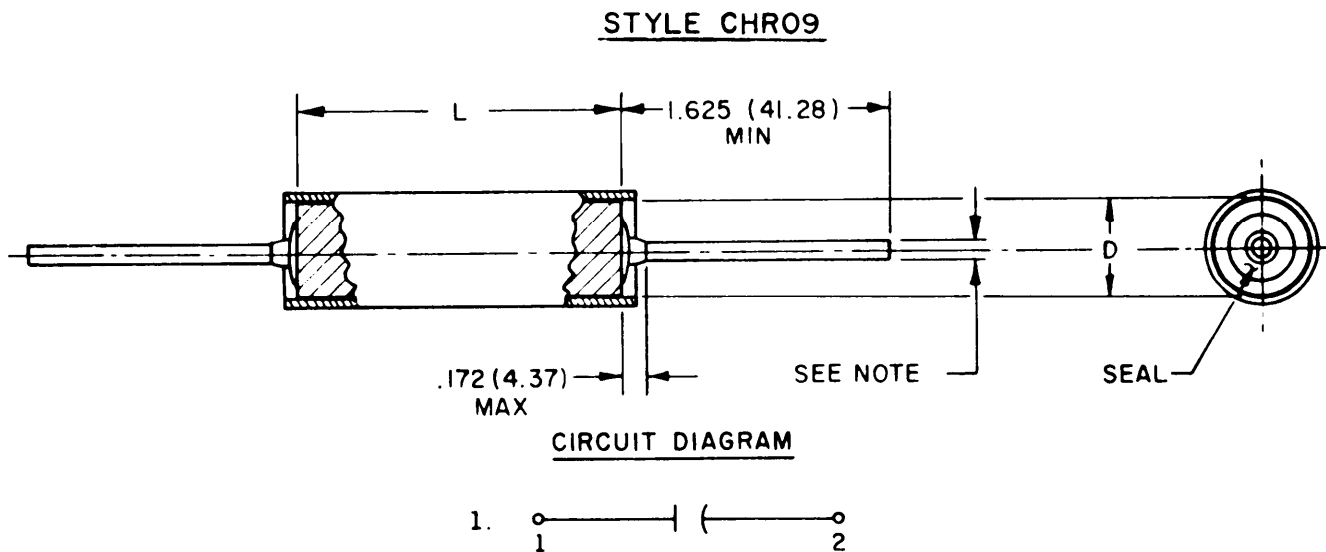
2.4 Operating temperature range. Styles CHR09 and CHR49 capacitors are suitable for operation over a temperature range of -55° +85 C.°

2.5 Prevention of corona. All metal parts, fittings, conductors, and attachments which operate at higher potential than other adjacent parts of the housing, should be carefully finished in order to insure that all sharp corners and edges are removed to minimize the possibility of corona discharge. Parts, from which the removal of sharp corners and edges would be impractical, such as conductors, should be spaced in such a manner as to prevent harmful corona discharges.

2.6 Mounting. Capacitors with dimension L or D of 1.375 or 0.672 inches, respectively, and greater, should not be supported by their leads. These capacitors should be provided with a supplementary means for mounting, such as a tangential bracket.

3. ITEM IDENTIFICATION

3.1 Standard capacitors. The standard capacitors available in this section are shown in figure 802.1. (The figure gives the electrical characteristics, failure rate levels, and Military part numbers which are standard for design.)



NOTE:

- .020 ± .002 for case diameters of .175 (4.45 mm) and .195 (4.95 mm)
- .025 ± .002 for case diameters of .235 (5.97 mm) and .312 (7.92 mm)
- .032 ± .002 for case diameters of .400 (10.16 mm) and over.

FIGURE 802-1. Established reliability, metallized paper (or polyester film) dielectric fixed capacitors.

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STANDARD CAPACITORS

STYLE CHRO9 (MIL-C-39022/1)

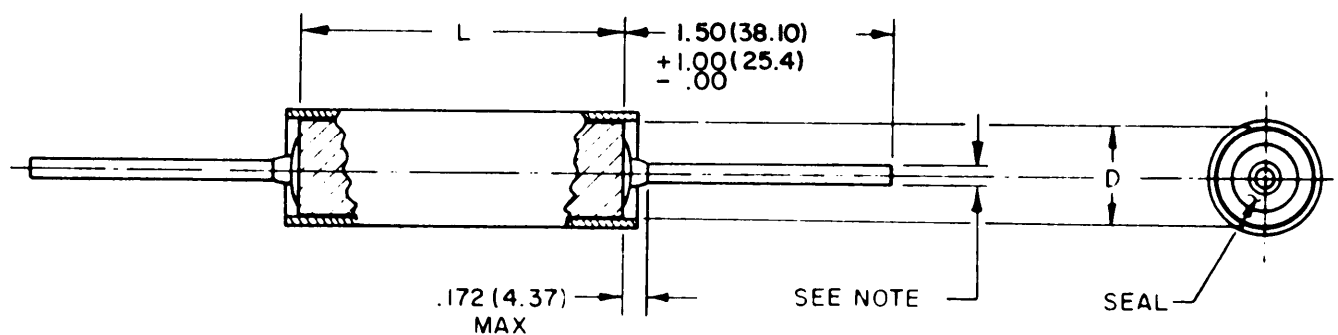
AXIAL-WIRE LEAD -- CIRCUIT DIAGRAM 1 -- OPERATING TEMPERATURE
RANGE -55° TO +85°C -- DC RATED VOLTAGE 600 VOLTS

Capacitance value μ F	Capacitance tolerance Percent	Dimensions, nominal (inches)		Dash number M39022/01-			
		L	D	Failure rate level for (% 1,000 hr)			
		+0.125 (3.18) -0.062 (1.57)	+0.064 (1.63) -0.031 (0.79)	M (1.0)	P (0.1)	R (0.01)	S (0.001)
0.010	10	0.812	0.312	1473	1733	1993	2253
0.010	20	0.812	0.312	1474	1734	1994	2254
0.022	10	0.812	0.312	1477	1737	1997	2257
0.022	20	0.812	0.312	1478	1738	1998	2258
0.047	10	1.125	0.400	1481	1741	2001	2261
0.047	20	1.125	0.400	1482	1742	2002	2262
0.10	10	1.125	0.500	1485	1745	2005	2265
0.10	20	1.125	0.500	1486	1746	2006	2266
0.15	10	1.125	0.562	1509	1769	2029	2289
0.15	20	1.125	0.562	1510	1770	2030	2290
0.22	10	1.375	0.562	1489	1749	2009	2269
0.22	20	1.375	0.562	1490	1750	2010	2270
0.47	10	1.625	0.670	1493	1753	2013	2273
0.47	20	1.625	0.670	1494	1754	2014	2274
1.0	10	1.844	1.000	1497	1757	2017	2277
1.0	20	1.844	1.000	1498	1758	2018	2278
1.5	10	1.875	1.000	1501	1761	2021	2281
1.5	20	1.875	1.000	1502	1762	2022	2282
2.2	10	2.625	1.000	1505	1765	2025	2285
2.2	20	2.625	1.000	1506	1766	2026	2286

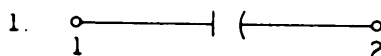
FIGURE 802-1. Established reliability, metallized paper (or polyester film) dielectric, fixed capacitors - Continued.

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STYLE CHR49
(UNINSULATED)



CIRCUIT DIAGRAM



NOTE:

.032 ± .002 for case diameters of .312 (7.92 mm)
.040 ± .002 for case diameters of .400 (10.16 mm) and over.

FIGURE 802-1. Established reliability, metallized paper (or polyester film) dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CHR49 (MI L-C-39022/7)

AXIAL-WIRE LEAD -- CIRCUIT DIAGRAM 1 -- OPERATING
TEMPERATURE RANGE -55° TO +85°C

Capacitance value	AC rated voltage	Capacitance tolerance	Dimensions, nominal (inches)		Dash number M39022/07-			
					Failure rate level for (% 1,000 hr)			
			L	D	M (1.0)	P (0.1)	R (0.01)	S (0.001)
μ F	volts (RMS)	Percent	+.125 (3.18) -.062 (1.57)	+.064 (1.63) -.031 (0.79)				
10.00	80	10	2.625	1.000	1043	1073	1103	1133
6.80	110	"	1.875	1.000	1042	1072	1102	1132
4.70	130	"	2.375	0.750	1041	1071	1101	1131
3.30	140	"	1.875	0.750	1040	1070	1100	1130
2.20	150	"	1.625	0.670	1039	1069	1099	1129
1.50	155	"	1.625	0.562	1038	1068	1098	1128
0.01	165	"	0.875	0.312	1031	1061	1091	1121
0.15	165	"	1.125	0.312	1032	1062	1092	1122
0.22	165	"	0.875	0.400	1033	1063	1093	1123
0.33	165	"	1.125	0.400	1034	1064	1094	1124
0.47	165	"	1.375	0.400	1035	1065	1095	1125
0.68	165	"	1.125	0.562	1036	1066	1096	1126
1.00	165	"	1.375	0.562	1037	1067	1097	1127
2.20	200	"	2.625	1.000	1052	1082	1112	1142
1.50	235	"	1.875	1.000	1051	1081	1111	1141
1.00	270	"	2.125	0.750	1050	1080	1110	1140
0.68	290	"	1.875	0.750	1049	1079	1109	1139
0.10	300	"	1.125	0.500	1044	1074	1104	1134
0.15	300	"	1.375	0.562	1045	1075	1105	1135
0.22	300	"	1.625	0.562	1046	1076	1106	1136
0.33	300	"	1.875	0.562	1047	1077	1107	1137
0.47	300	"	1.625	0.670	1048	1078	1108	1138
0.68	350	"	2.375	1.000	1182	1202	1222	1242
0.47	370	"	1.875	1.000	1181	1201	1221	1241
0.33	380	"	2.375	0.750	1183	1203	1223	1243
0.22	385	"	1.875	0.670	1180	1200	1220	1240
0.12	390	"	1.625	0.670	1178	1198	1218	1238
0.15	390	"	1.625	0.670	1179	1199	1219	1239
0.010	400	"	1.125	0.312	1171	1191	1211	1231
0.015	400	"	1.125	0.400	1172	1192	1212	1232
0.022	400	"	1.125	0.400	1173	1193	1213	1233
0.033	400	"	1.375	0.400	1174	1194	1214	1234
0.047	400	"	1.125	0.562	1175	1195	1215	1235
0.068	400	"	1.375	0.562	1176	1196	1216	1236
0.10	400	"	1.625	0.562	1177	1197	1217	1237

FIGURE 802-1. Established reliability, metallized paper (or polyester film) dielectric, fixed capacitors - Continued.

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SECTION 803

CAPACITORS, FIXED, PLASTIC (OR METALLIZED PLASTIC) DIELECTRIC, DC,
IN NONMETAL CASES, ESTABLISHED RELIABILITY

STYLES CFR02, CFR04, CFR05, CFR06, AND CFR12

(APPLICABLE SPECIFICATION: MIL-C-55514)

FOR ARMY AND AIR FORCE USE ONLY
NOT FOR NAVY USE

1. SCOPE. This section covers established reliability, plastic (or metallized plastic) dielectric, fixed capacitors, **enclosed in nonmetal cases. These capacitors** have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on operation at maximum rated voltage and maximum rated temperature.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are designed for use in circuit applications requiring high insulation resistance, low dielectric absorption, or low loss factor over wide temperature ranges, and where the ac component of the impressed voltage is small with respect to the dc voltage rating.

For military applications, in view of their limited long term moisture resistant characteristics, these capacitors should be used in potted or encapsulated circuit packaging systems. In addition, the life of the capacitors specified herein is primarily dependent upon the operating temperature and applied voltage. They should not be used above rated voltage or temperature.

NOTE: These capacitors may be used where an ac component is present provided that (1) the sum of the dc voltage and the peak ac voltage does not exceed the dc voltage rating or (2) the peak ac voltage does not exceed 20 percent of the dc voltage rating a 60 Hz; 15 percent at 120 Hz; or 1 percent at 10,000 Hz. Where heavy transient or pulse currents are encountered, **the requirements of MIL-C-55514 are not sufficient to guarantee satisfactory performance, and due allowance must therefore be made in the selection of a capacitor.**

2.1.1 Polyethylene terephthalate. **These capacitors are intended for high-temperature applications similar to those served by hermetically-sealed paper capacitors, but where high insulation resistance at the upper temperature limits is required.**

2.1.2 Polycarbonate. These capacitors are intended for applications where minimum capacitance changes with temperature are required; **they are especially suitable for use in tuned and precision timing circuits.**

2.2 Construction.

2.2.1 Plastic film. The present drive towards miniaturization, closer electrical tolerances, and higher operating temperatures is being met by the use of thin plastic-film dielectrics in the construction of capacitors. **The greatest advantage of plastic-film dielectrics over natural dielectrics (such as paper and mica) is that the plastic film is a synthetic that can be made to meet specific requirements (such as thickness of dielectric and high heat resistance). Many plastic-film capacitors are not impregnated but are wound and encased "dry." Plastic dielectric capacitors have insulation resistance values far in excess of those for paper capacitors and since they are nonabsorbent, their moisture characteristics are superior to those of mica.**

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There are several types of plastic films available for use as a capacitor dielectric. They may be used individually or in a combination with other films in order to obtain the compromised advantages of the specific electrical characteristics of each individual film. The more common films include polyethylene terephthalate and polycarbonate. When properly applied, plastic dielectric films lead to the solution of many special capacitor problems.

2.2.2 Metallized plastic. The construction of metallized plastic capacitors differs from conventional plastic capacitors in that instead of having separate layers of metal foil (capacitor plates) and plastic dielectric, **the metal comprising the capacitor plates** is imposed directly on one side of the plastic dielectric by means of a metallizing process. This technique results in an overall size reduction for metallized plastic capacitors when compared to conventional plastic-foil capacitor types of equal ratings. This space saving is the outstanding feature of the metallized plastic capacitor.

Another advantage resulting from the metallizing technique is that the capacitors are self-healing. The metallic film imposed on the plastic is very thin and if breakdown occurs, a tiny area of the thin film surrounding the breakdown point burns away, leaving the capacitor operable, but with a slightly reduced capacitance. In the conventional plastic-foil type (where the foil is thicker), **sustained conduction can occur on a** breakdown causing a large area of the plastic surrounding the breakdown to be carbonized resulting in a permanent short-circuit.

The breakdown of the metallized plastic capacitor can be either of two types; i.e., (1) a complete breakdown lasting for only a moment (momentary breakdown) or (2) a sharp reduction in insulation resistance lasting for an extended period of time, but eventually returning to normal (period of low insulation). **The general characteristics** of the metallized plastic type, aside from the breakdowns, are similar to the conventional plastic type except for a significantly lower insulation resistance, approximately in the order of 10 to 1.

2.3 DC voltage ratings. The voltage ratings for these capacitors vary over a range of 50 to 600 volts.

2.4 Operating temperature range. Characteristics M and N capacitors are suitable for operation over a temperature range of -55° to $+85^{\circ}\text{C}$; characteristics Q, R, and S capacitors are suitable for operation over a temperature range of -65° to $+125^{\circ}\text{C}$.

2.5 Mounting. Capacitors covered by this specification should be mounted by a bracket or clamp, or they should be potted when vibration or shock are likely to be encountered in service. When a bracket or clamp is used, care should be taken to assure that the capacitor body is not deformed.

3. ITEM IDENTIFICATION (see figures 803-1 and 803-2).

3.1 Significant part number. A significant part number is used for describing the capacitors as shown in figure 803-1.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 803-2.

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CFR02 A M C 682 J M

STYLE - The style is identified by the three-letter symbol "CFR" followed by a two-digit number.

TERMINAL - The terminal is identified by a single letter as follows:
 A - - - - - Axial wire-lead
 R - - - - - Radial wire-lead

CHARACTERISTIC - The characteristic is identified by a single letter as follows:

Symbol	Dielectric material	Electrode	Operating temp. range
M - - - - -	Polyethylene terephthalate	Foil	-55° to +85°C
N - - - - -	Polyethylene terephthalate	Metallized	-55° to +85°C
Q - - - - -	Polycarbonate	Foil	-55° to +125°C *
R - - - - -	Polycarbonate	Metallized	-55° to +125°C *
S - - - - -	Poly-para-xylylene	Foil	-55° to +125°C *

*For operation at +125°C, characteristics Q, R, and S capacitors shall be voltage derated.

VOLTAGE - The rated voltage is for operation at +85°C and is identified by a single letter as follows:

Symbol	Rated voltage	Symbol	Rated voltage
A - - - - -	50 Vdc	F - - - - -	600 Vdc
B - - - - -	100 Vdc	G - - - - -	75 Vdc
C - - - - -	200 Vdc	H - - - - -	150 Vdc
D - - - - -	300 Vdc	J - - - - -	25 Vdc
E - - - - -	400 Vdc	K - - - - -	250 Vdc

NOTE: Voltage derating at high ambient temperatures is dependent on the characteristic as follows: Characteristics M and N are rated for +85°C only; characteristic Q capacitors shall be derated by 1/3 for +125°C operation; and characteristics R and S capacitors shall be derated by 1/2 for +125°C operation.

CAPACITANCE - The nominal capacitance value expressed in picofarads (pF) is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow.

CAPACITANCE TOLERANCE - The capacitance tolerance is identified by a single letter as follows:

F - - - - - ± 1 percent
 G - - - - - ± 2 percent
 J - - - - - ± 5 percent
 K - - - - - ±10 percent

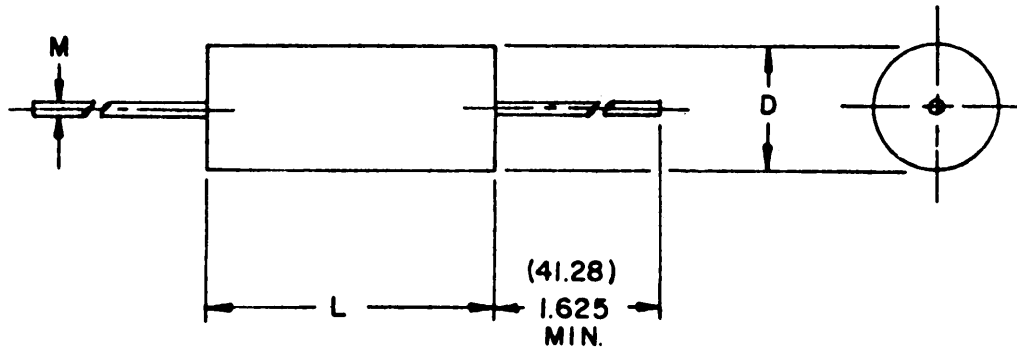
FAILURE RATE LEVEL - The failure rate level is identified by a single letter as follows:

M - - - - - 1.0
 P - - - - - 0.1
 R - - - - - 0.01
 S - - - - - 0.001

FIGURE 803-1. Significant part number example.

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INCHES	MM	INCHES	MM
.03	.76	.250	6.35
.031	.79	.251	6.38
.046	1.17	.499	12.67
.062	1.57	.500	12.70

NOTES:

1. Tolerance on dimension "D" is $\pm .031$ (on diameters of .250 inch and below); $\pm .046$ (on diameters of .251 through .499 inch); and $\pm .062$ (on diameters of .500 inch and above).
2. Leads are of solid wire and are located on centerline within $\pm .062$ but not less than .03 from edge of capacitor.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CFR02

CHARACTERISTIC M CAPACITORS						
Type designation	Capacitance	Rated voltage (at 85° C)	Capacitance tolerance available	Dimensions (in inches)		
				D	L + .062(1.57)	M + .005(.13) - .003(.08)
	μF	volts, dc				
CFR02AMB682--	.0068	100	G, J, K ↑ ↓ G, J, K	.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMB822--	.0082	100		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMB103--	.010	100		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMB123--	.012	100		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AMB153--	.015	100		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AMB183--	.018	100		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AMB223--	.022	100		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AMB273--	.027	100		.203 (5.16)	.688(17.48)	.025(.64)
CFR02AMB333--	.033	100		.203 (5.16)	.688(17.48)	.025(.64)
CFR02AMB393--	.039	100		.250 (6.35)	.688(17.48)	.025(.64)
CFR02AMB473--	.047	100		.250 (6.35)	.688(17.48)	.025(.64)
CFR02AMB563--	.056	100		.250 (6.35)	.812(20.62)	.025(.64)
CFR02AMB683--	.068	100		.250 (6.35)	.812(20.62)	.025(.64)
CFR02AMB823--	.082	100		.297 (7.54)	.812(20.62)	.025(.64)
CFR02AMB104--	.10	100		.297 (7.54)	.812(20.62)	.025(.64)
CFR02AMB124--	.12	100		.360 (9.14)	.812(20.62)	.032(.81)
CFR02AMB154--	.15	100		.360 (9.14)	.812(20.62)	.032(.81)
CFR02AMB184--	.18	100		.329 (8.36)	1.188(30.18)	.025(.64)
CFR02AMB224--	.22	100		.329 (8.36)	1.188(30.18)	.025(.64)
CFR02AMB274--	.27	100		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AMB334--	.33	100		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AMB394--	.39	100		.485(12.32)	1.188(30.18)	.032(.81)
CFR02AMB474--	.47	100		.485(12.32)	1.188(30.18)	.032(.81)
CFR02AMB564--	.56	100		.500(12.70)	1.562(39.67)	.032(.81)
CFR02AMB684--	.68	100		.500(12.70)	1.562(39.67)	.032(.81)
CFR02AMB824--	.82	100		.548(13.92)	1.562(39.67)	.032(.81)
CFR02AMB105--	1.00	100		.548(13.92)	1.562(39.67)	.032(.81)
CFR02AMC102--	.0010	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC122--	.0012	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC152--	.0015	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC182--	.0018	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC222--	.0022	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC272--	.0027	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC332--	.0033	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC392--	.0039	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC472--	.0047	200		.172 (4.37)	.438(11.13)	.025(.64)
CFR02AMC562--	.0056	200		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AMC682--	.0068	200		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AMC822--	.0082	200		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AMC103--	.010	200		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AMC123--	.012	200	.203 (5.16)	.688(17.48)	.025(.64)	
CFR02AMC153--	.015	200	.203 (5.16)	.688(17.48)	.025(.64)	
CFR02AMC183--	.018	200	.234 (5.94)	.688(17.48)	.025(.64)	
CFR02AMC223--	.022	200	.234 (5.94)	.688(17.48)	.025(.64)	
CFR02AMC273--	.027	200	.250 (6.35)	.812(20.62)	.025(.64)	
CFR02AMC333--	.033	200	.250 (6.35)	.812(20.62)	.025(.64)	
CFR02AMC393--	.039	200	.266 (6.76)	.812(20.62)	.025(.64)	
CFR02AMC473--	.047	200	.266 (6.76)	.812(20.62)	.025(.64)	
CFR02AMC563--	.056	200	.297 (7.54)	.812(20.62)	.025(.64)	

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors -Continued.

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STANDARD CAPACITORS

STYLE CFR02 - Continued

CHARACTERISTIC M CAPACITORS						
Type designation	Capacitance	Rated voltage (at 85° C)	Capacitance tolerance available	Dimensions (in inches)		
				D	L + .062(1.57)	M ⁺ .005(.13) - .003(.08)
	μ F	volts, dc				
CFR02AMC683--	.068	200	G, J, K ↑ ↓ G, J, K	.297 (7.54)	.812(20.62)	.025(.64)
CFR02AMC823--	.082	200		.329 (8.36)	1.062(26.97)	.025(.64)
CFR02AMC104--	.10	200		.329 (8.36)	1.062(26.97)	.025(.64)
CFR02AMC124--	.12	200		.390 (9.91)	1.062(26.97)	.032(.81)
CFR02AMC154--	.15	200		.390 (9.91)	1.062(26.97)	.032(.81)
CFR02AMC184--	.18	200		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AMC224--	.22	200		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AMC274--	.27	200		.500(12.70)	1.188(30.18)	.032(.81)
CFR02AMC334--	.33	200		.500(12.70)	1.188(30.18)	.032(.81)
CFR02AMC394--	.39	200		.516(13.11)	1.562(39.67)	.032(.81)
CFR02AMC474--	.47	200		.516(13.11)	1.562(39.67)	.032(.81)
CFR02AMC564--	.56	200		.630(16.00)	1.688(42.48)	.032(.81)
CFR02AMC684--	.68	200		.630(16.00)	1.688(42.48)	.032(.81)
CFR02AMC824--	.82	200		.695(17.65)	1.875(47.63)	.032(.81)
CFR02AMC105--	1.00	200		.695(17.65)	1.875(47.63)	.032(.81)
CFR02AME182--	.0018	400		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AME222--	.0022	400		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AME272--	.0027	400		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AME332--	.0033	400		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AME392--	.0039	400		.203 (5.16)	.688(17.48)	.025(.64)
CFR02AME472--	.0047	400		.203 (5.16)	.688(17.48)	.025(.64)
CFR02AME562--	.0056	400		.250 (6.35)	.688(17.48)	.025(.64)
CFR02AME682--	.0068	400		.250 (6.35)	.688(17.48)	.025(.64)
CFR02AME822--	.0082	400		.250 (6.35)	.812(20.62)	.025(.64)
CFR02AME103--	.010	400		.250 (6.35)	.812(20.62)	.025(.64)
CFR02AME123--	.012	400		.266 (6.76)	.812(20.62)	.025(.64)
CFR02AME153--	.015	400		.266 (6.76)	.812(20.62)	.025(.64)
CFR02AME183--	.018	400		.313 (7.95)	.812(20.62)	.025(.64)
CFR02AME223--	.022	400		.313 (7.95)	.812(20.62)	.025(.64)
CFR02AME273--	.027	400		.360 (9.14)	.812(20.62)	.032(.81)
CFR02AME333--	.033	400		.360 (9.14)	.812(20.62)	.032(.81)
CFR02AME393--	.039	400		.360 (9.14)	1.062(26.97)	.032(.81)
CFR02AME473--	.047	400		.360 (9.14)	1.062(26.97)	.032(.81)
CFR02AME563--	.056	400		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AME683--	.068	400		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AME823--	.082	400		.485(12.32)	1.188(30.18)	.032(.81)
CFR02AME104--	.10	400		.485(12.32)	1.188(30.18)	.032(.81)
CFR02AME124--	.12	400		.500(12.70)	1.562(39.67)	.032(.81)
CFR02AME154--	.15	400		.500(12.70)	1.562(39.67)	.032(.81)
CFR02AME184--	.18	400		.586(14.88)	1.562(39.67)	.032(.81)
CFR02AME224--	.22	400		.586(14.88)	1.562(39.67)	.032(.81)
CFR02AME274--	.27	400		.681(17.30)	1.688(42.48)	.032(.81)
CFR02AME334--	.33	400		.681(17.30)	1.688(42.48)	.032(.81)
CFR02AME394--	.39	400		.750(19.05)	1.875(47.63)	.032(.81)
CFR02AME474--	.47	400		.750(19.05)	1.875(47.63)	.032(.81)

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors -Continued.

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STANDARD CAPACITORS

STYLE CFR02 - Continued

CHARACTERISTIC M CAPACITORS						
Type designation	Capacitance	Rated voltage (at 85° C)	Capacitance tolerance available	Dimensions (in inches)		
				D	L ± .062(1.57)	M ⁺ .005(.13) M ⁻ .003(.08)
	μF	volts, dc				
CFR02AME564--	.56	400	G, J, K ↑ ↓ G, J, K	.940(23.88)	2.125(53.98)	.032(.81)
CFR02AME684--	.68	400		1.020(25.91)	2.375(60.33)	.032(.81)
CFR02AME824--	.82	400		1.150(29.21)	2.375(60.33)	.032(.81)
CFR02AME105--	1.00	400		1.150(29.21)	2.625(66.68)	.032(.81)
CFR02AMF102--	.0010	600		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AMF122--	.0012	600		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AMF152--	.0015	600		.172 (4.37)	.688(17.48)	.025(.64)
CFR02AMF182--	.0018	600		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AMF222--	.0022	600		.188 (4.78)	.688(17.48)	.025(.64)
CFR02AMF272--	.0027	600		.203 (5.16)	.688(17.48)	.025(.64)
CFR02AMF332--	.0033	600		.203 (5.16)	.688(17.48)	.025(.64)
CFR02AMF392--	.0039	600		.250 (6.35)	.688(17.48)	.025(.64)
CFR02AMF472--	.0047	600		.250 (6.35)	.688(17.48)	.025(.64)
CFR02AMF562--	.0056	600		.250 (6.35)	.812(20.62)	.025(.64)
CFR02AMF682--	.0068	600		.250 (6.35)	.812(20.62)	.025(.64)
CFR02AMF822--	.0082	600		.266 (6.76)	.812(20.62)	.025(.64)
CFR02AMF103--	.010	600		.266 (6.76)	.812(20.62)	.025(.64)
CFR02AMF123--	.012	600		.313 (7.95)	.812(20.62)	.025(.64)
CFR02AMF153--	.015	600		.313 (7.95)	.812(20.62)	.025(.64)
CFR02AMF183--	.018	600		.360 (9.14)	.812(20.62)	.032(.81)
CFR02AMF223--	.022	600		.360 (9.14)	.812(20.62)	.032(.81)
CFR02AMF273--	.027	600		.360 (9.14)	1.062(26.97)	.032(.81)
CFR02AMF333--	.033	600		.360 (9.14)	1.062(26.97)	.032(.81)
CFR02AMF393--	.039	600		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AMF473--	.047	600		.390 (9.91)	1.188(30.18)	.032(.81)
CFR02AMF563--	.056	600		.485(12.32)	1.188(30.18)	.032(.81)
CFR02AMF683--	.068	600		.485(12.32)	1.188(30.18)	.032(.81)
CFR02AMF823--	.082	600		.500(12.70)	1.562(39.67)	.032(.81)
CFR02AMF104--	.10	600		.500(12.70)	1.562(39.67)	.032(.81)
CHARACTERISTIC Q CAPACITORS						
CFR02AQB102--	.0010	100	F, G, J, K ↑ ↓ F, G, J, K	.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQB122--	.0012	100		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQB152--	.0015	100		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQB182--	.0018	100		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQB222--	.0022	100		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQB272--	.0027	100		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQB332--	.0033	100		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQB392--	.0039	100		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQB472--	.0047	100		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQB562--	.0056	100		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQB682--	.0068	100		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQB822--	.0082	100		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQB103--	.010	100		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQB123--	.012	100		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQB153--	.015	100		.312 (7.92)	.453(11.51)	.025(.64)
CFR02AQB183--	.018	100		.328 (8.33)	.453(11.51)	.025(.64)

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors -Continued.

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STANDARD CAPACITORS

STYLE CFR02 - Continued

CHARACTERISTIC Q CAPACITORS						
Type designation	Capacitance	Rated voltage (at 85° C)	Capacitance tolerance available	Dimensions (in inches)		
				D	L ± .062(1.57)	M ⁺ .005(.13) - .003(.08)
	μF	volts, dc				
CFR02AQB223--	.022	100	F, G, J, K	.266 (6.76)	.750(19.05)	.025(.64)
CFR02AQB273--	.027	100	↑	.281 (7.14)	.750(19.05)	.025(.64)
CFR02AQB333--	.033	100		.297 (7.54)	.750(19.05)	.025(.64)
CFR02AQB393--	.039	100		.312 (7.92)	.750(19.05)	.025(.64)
CFR02AQB473--	.047	100		.328 (8.33)	.750(19.05)	.025(.64)
CFR02AQB563--	.056	100		.359 (9.12)	.750(19.05)	.032(.81)
CFR02AQB683--	.068	100		.391 (9.93)	.750(19.05)	.032(.81)
CFR02AQB823--	.082	100		.359 (9.12)	.875(22.23)	.032(.81)
CFR02AQB104--	.100	100		.406(10.31)	.875(22.23)	.032(.81)
CFR02AQB124--	.12	100		.422(10.72)	.875(22.23)	.032(.81)
CFR02AQB154--	.15	100		.468(11.89)	.875(22.23)	.032(.81)
CFR02AQB184--	.18	100		.406(10.31)	1.219(30.96)	.032(.81)
CFR02AQB224--	.22	100		.453(11.51)	1.219(30.96)	.032(.81)
CFR02AQB274--	.27	100		.484(12.29)	1.219(30.96)	.032(.81)
CFR02AQB334--	.33	100		.516(13.11)	1.219(30.96)	.032(.81)
CFR02AQB394--	.39	100		.549(13.94)	1.219(30.96)	.032(.81)
CFR02AQB474--	.47	100		.625(15.88)	1.219(30.96)	.032(.81)
CFR02AQB564--	.56	100		.688(17.48)	1.219(30.96)	.032(.81)
CFR02AQB684--	.68	100		.641(16.29)	1.594(40.49)	.032(.81)
CFR02AQB824--	.82	100		.688(17.48)	1.594(40.49)	.032(.81)
CFR02AQB105--	1.00	100		.719(18.26)	1.594(40.49)	.032(.81)
CFR02AQC102--	.0010	200		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQC122--	.0012	200		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQC152--	.0015	200		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQC182--	.0018	200		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQC222--	.0022	200		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQC272--	.0027	200		.231 (5.87)	.453(11.51)	.025(.64)
CFR02AQC332--	.0033	200		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQC392--	.0039	200		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQC472--	.0047	200		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQC562--	.0056	200		.281 (7.14)	.453(11.51)	.025(.64)
CFR02AQC682--	.0068	200		.312 (7.92)	.453(11.51)	.025(.64)
CFR02AQC822--	.0082	200		.231 (5.87)	.750(19.05)	.025(.64)
CFR02AQC103--	.010	200		.250 (6.35)	.750(19.05)	.025(.64)
CFR02AQC123--	.012	200		.266 (6.76)	.750(19.05)	.025(.64)
CFR02AQC153--	.015	200		.281 (7.14)	.750(19.05)	.025(.64)
CFR02AQC183--	.018	200		.312 (7.92)	.750(19.05)	.025(.64)
CFR02AQC223--	.022	200		.328 (8.33)	.750(19.05)	.025(.64)
CFR02AQC273--	.027	200		.359 (9.12)	.750(19.05)	.032(.81)
CFR02AQC333--	.033	200		.391 (9.93)	.750(19.05)	.032(.81)
CFR02AQC393--	.039	200		.359 (9.12)	.875(22.23)	.032(.81)
CFR02AQC473--	.047	200		.391 (9.93)	.875(22.23)	.032(.81)
CFR02AQC563--	.056	200		.422(10.72)	.875(22.23)	.032(.81)
CFR02AQC683--	.068	200		.453(11.51)	.875(22.23)	.032(.81)
CFR02AQC823--	.082	200		.500(12.70)	.875(22.23)	.032(.81)
CFR02AQC104--	.10	200		.438(11.13)	1.219(30.96)	.032(.81)
CFR02AQC124--	.12	200		.469(11.91)	1.219(30.96)	.032(.81)
CFR02AQC154--	.15	200	F, G, J, K	.516(13.11)	1.219(30.96)	.032(.81)

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors -Continued.

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STANDARD CAPACITORS

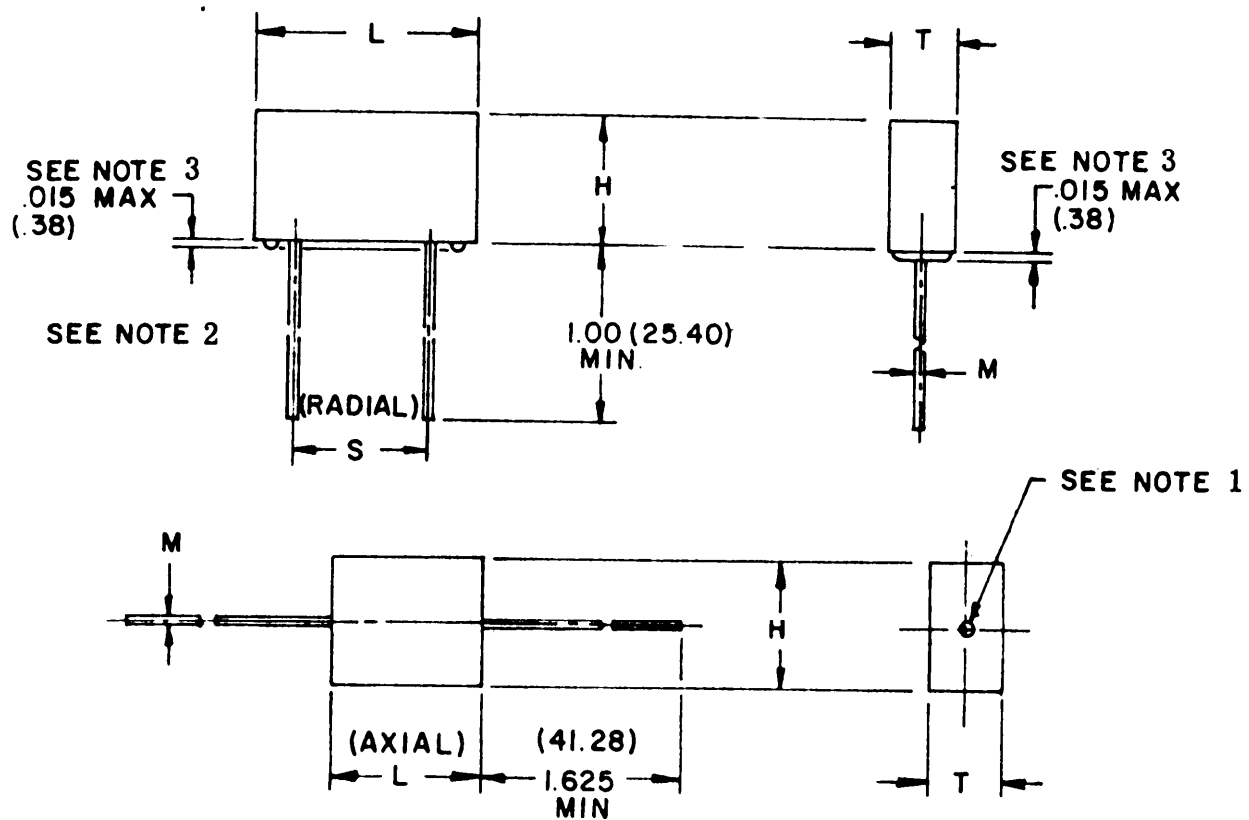
STYLE CFR02 - Continued

CHARACTERISTIC Q CAPACITORS							
Type designation	Capacitance	Rated voltage (at 85° C)	Capacitance tolerance available	Dimensions (in inches)			
				D	L ± .062(1.57)	M ⁺ .005(.13) - .003(.08)	
	<u>μF</u>	<u>volts, dc</u>					
CFR02AQC184--	.18	200	F, G, J, K	.547(13.89)	1.219(30.96)	.032(.81)	
CFR02AQC224--	.22	200	↑ ↓	.625(15.88)	1.219(30.96)	.032(.81)	
CFR02AQC274--	.27	200		.594(15.09)	1.594(40.49)	.032(.81)	
CFR02AQC334--	.33	200		.641(16.29)	1.594(40.49)	.032(.81)	
CFR02AQC394--	.39	200		.688(17.48)	1.594(40.49)	.032(.81)	
CFR02AQC474--	.47	200		.734(18.64)	1.594(40.49)	.032(.81)	
CFR02AQC564--	.56	200		.797(20.24)	1.594(40.49)	.032(.81)	
CFR02AQC684--	.68	200		.859(21.82)	1.594(40.49)	.032(.81)	
CFR02AQC824--	.82	200		.859(21.82)	1.844(46.84)	.032(.81)	
CFR02AQC105--	1.00	200		F, G, J, K	.938(23.83)	1.844(46.84)	.032(.81)

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors -Continued.

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STYLE CFR04



NOTES:

1. Leads are of solid wire and are located on centerline within $\pm .062$ (1.57 mm) but not less than .03 (.76 mm) from edge of capacitor.
2. Symmetry of centerline of leads with respect to end of case is within $\pm .010$ (.25 mm).
3. Stand-off is not applicable to characteristics "M" and "O"; it is optional for characteristic "S".

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric. In nonmetal cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

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Case Size	Dimension				
	H \pm .030 (.76)	$\frac{1}{L}$ \pm .015 (.38)	T \pm .015 (.38)	S \pm .005 (.13)	M \pm .002 (.05)
A	.280 (7.11)	.500 (12.70)	.125 (3.18)	.400 (10.16)	.020 (.51)
B	.375 (9.53)	.500 (12.70)	.195 (4.95)	.400 (10.16)	.025 (.64)
D	.471 (11.96)	.500 (12.70)	.234 (5.94)	.400 (10.16)	.032 (.81)
E	.411 (10.44)	.800 (20.32)	.178 (4.52)	.700 (17.78)	.032 (.81)
F	.475 (12.07)	.800 (20.32)	.244 (6.20)	.700 (17.78)	.032 (.81)
G	.531 (13.49)	.800 (20.32)	.291 (7.39)	.700 (17.78)	.032 (.81)
H	.569 (14.45)	1.130 (28.70)	.328 (8.33)	1.000 (25.40)	.032 (.81)
I	.971 (24.66)	1.130 (28.70)	.707 (17.96)	1.000 (25.40)	.032 (.81)
J	.375 (9.53)	.600 (15.24)	.295 (15.24)	.500 (12.70)	.025 (.64)
K	.375 (9.53)	.750 (17.05)	.500 (12.70)	.650 (16.51)	.025 (.64)
L	.375 (9.53)	1.000 (25.40)	.600 (15.24)	.900 (22.86)	.032 (.81)
M	.375 (9.53)	1.500 (38.10)	.600 (15.24)	1.400 (35.56)	.032 (.81)
N	.550 (13.97)	1.500 (38.10)	.600 (15.24)	1.400 (35.56)	.032 (.81)

$\frac{1}{L}$ Add+.030 (.76) inch for overall length of axial-wire lead capacitors.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - continued.

STANDARD CAPACITORS

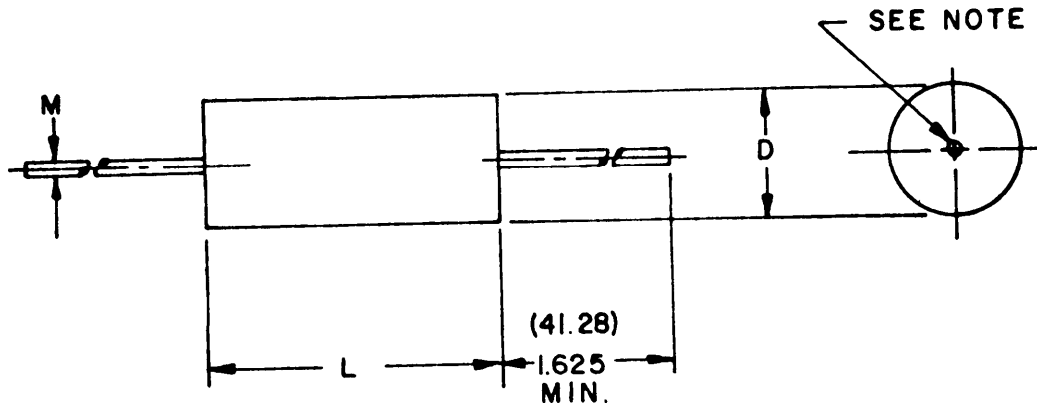
STYLE CFR04

Type designation	Capacitance	Case size letter (see table for dimensions)					
		M		Q		S	
		Capacitance tolerance available G, J, K		Capacitance tolerance available F, G, J, K		Capacitance tolerance available F, G, J, K	
		Rated voltage at 85° C					
	μF	200v	400v	100v	200v	400v	50v
CFR04---102--	.0010	-	D	-	-	D	A
CFR04---122--	.0012	-	D	-	-	D	A
CFR04---152--	.0015	-	D	-	-	D	A
CFR04---182--	.0018	-	D	-	-	D	A
CFR04---222--	.0022	-	D	-	-	D	A
CFR04---272--	.0027	-	D	-	-	D	A
CFR04---332--	.0033	-	D	-	-	D	A
CFR04---392--	.0039	-	D	-	-	D	A
CFR04---472--	.0047	-	D	-	-	D	A
CFR04---562--	.0056	-	D	-	D	E	A
CFR04---682--	.0068	-	D	-	D	E	A
CFR04---822--	.0082	-	D	-	D	E	A
CFR04---103--	.010	D	E	-	D	F	A
CFR04---123--	.012	D	E	-	D	F	B
CFR04---153--	.015	D	E	D	E	F	B
CFR04---183--	.018	D	F	D	E	F	B
CFR04---223--	.022	D	F	D	E	G	B
CFR04---273--	.027	D	F	E	F	G	B
CFR04---333--	.033	E	G	E	F	H	B
CFR04---393--	.039	E	G	E	G	H	B
CFR04---473--	.047	E	G	E	G	H	J
CFR04---563--	.056	F	H	F	G	H	J
CFR04---683--	.068	F	H	F	G	I	J
CFR04---823--	.082	F	H	F	H	I	J
CFR04---104--	.100	F	H	G	H	I	J
CFR04-SA124--	.12	NOT AVAILABLE IN CHARACTERISTICS M AND Q					J
CFR04-SA154--	.15						J
CFR04-SA184--	.18						K
CFR04-SA224--	.22						L
CFR04-SA274--	.27						L
CFR04-SA334--	.33						L
CFR04-SA394--	.39						L
CFR04-SA474--	.47						L
CFR04-SA564--	.56						M
CFR04-SA684--	.68						M
CFR04-SA824--	.82	N					
CFR04-SA105--	1.00	N					

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued

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STYLE CFR05



INCHES	MM	INCHES	MM
.03	.76	.203	5.16
.031	.79	.251	6.38
.046	1.17	.491	12.47
.062	1.57	.509	12.93

NOTE:

Leads are of solid wire and are located on centerline within $\pm .062$ but not less than .03 from edge of capacitor.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

CHARACTERISTIC R CAPACITORS						
Type designation 1/	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)		
				D 2/	L ±.050 (1.27)	M 3/ axial
	μF	volts, dc				
CFR05ARA102--	.0010	50	F, G, J, K	.150 (3.81)	.400 (10.16)	.020 (.51)
CFR05ARA122--	.0012	50	"	.150 "	.400 "	.020 "
CFR05ARA152--	.0015	50	"	.150 "	.400 "	.020 "
CFR05ARA182--	.0018	50	"	.150 "	.400 "	.020 "
CFR05ARA222--	.0022	50	"	.150 "	.400 "	.020 "
CFR05ARA272--	.0027	50	"	.150 "	.400 "	.020 "
CFR05ARA332--	.0033	50	"	.150 "	.400 "	.020 "
CFR05ARA392--	.0039	50	"	.150 "	.400 "	.020 "
CFR05ARA472--	.0047	50	"	.150 "	.400 "	.020 "
CFR05ARA562--	.0056	50	"	.150 "	.400 "	.020 "
CFR05ARA682--	.0068	50	"	.150 "	.400 "	.020 "
CFR05ARA822--	.0082	50	"	.150 "	.400 "	.020 "
CFR05ARA103--	.010	50	"	.150 "	.400 "	.020 "
CFR05ARA123--	.012	50	"	.150 "	.400 "	.020 "
CFR05ARA153--	.015	50	"	.150 "	.400 "	.020 "
CFR05ARA183--	.018	50	"	.150 "	.400 "	.020 "
CFR05ARA223--	.022	50	"	.150 "	.400 "	.020 "
CFR05ARA273--	.027	50	"	.150 "	.400 "	.020 "
CFR05ARA333--	.033	50	"	.150 "	.400 "	.020 "
CFR05ARA393--	.039	50	"	.150 "	.400 "	.020 "
CFR05ARA473--	.047	50	"	.150 "	.400 "	.020 "
CFR05ARA563--	.056	50	"	.150 "	.400 "	.020 "
CFR05ARA683--	.068	50	"	.150 "	.400 "	.020 "
CFR05ARA823--	.082	50	"	.150 "	.400 "	.020 "
CFR05ARA104--	.10	50	"	.150 "	.400 "	.020 "
CFR05ARA124--	.12	50	"	.150 "	.400 "	.020 "
CFR05ARA154--	.15	50	"	.160 (4.06)	.400 "	.020 "
CFR05ARA184--	.18	50	"	.150 (3.81)	.530 (13.46)	.020 "
CFR05ARA224--	.22	50	"	.150 (3.81)	.530 "	.020 "
CFR05ARA274--	.27	50	"	.160 (4.06)	.530 "	.020 "
CFR05ARA334--	.33	50	"	.180 (4.57)	.530 "	.020 "
CFR05ARA394--	.39	50	"	.190 (4.83)	.530 "	.020 "
CFR05ARA474--	.47	50	"	.200 (5.08)	.530 "	.020 "
CFR05ARA564--	.56	50	"	.220 (5.59)	.530 "	.020 "
CFR05ARA684--	.68	50	"	.240 (6.10)	.530 "	.020 "
CFR05ARA824--	.82	50	"	.260 (6.60)	.530 "	.020 "
CFR05ARA105--	1.00	50	"	.280 (7.11)	.530 "	.020 "
CFR05ARA125--	1.20	50	"	.260 (6.60)	.680 (17.27)	.020 "
CFR05ARA155--	1.50	50	"	.280 (7.11)	.680 (17.27)	.020 "
CFR05ARA185--	1.80	50	"	.290 (7.37)	.780 (19.81)	.020 "
CFR05ARA205--	2.00	50	"	.300 (7.62)	.780 "	.020 "
CFR05ARA255--	2.5	50	"	.340 (8.64)	.780 "	.020 (.51)
CFR05ARA305--	3.0	50	"	.370 (9.40)	.780 "	.025 (.64)
CFR05ARA355--	3.5	50	"	.400 (10.16)	.780 "	.025 "
CFR05ARA405--	4.0	50	"	.370 (9.40)	.950 (24.13)	.025 "
CFR05ARA455--	4.5	50	"	.390 (9.91)	.950 (24.13)	.025 "
CFR05ARA505--	5.0	50	"	.360 (9.14)	1.170 (28.73)	.025 "
CFR05ARA605--	6.0	50	"	.390 (9.91)	1.170 "	.025 "
CFR05ARA805--	8.0	50	"	.450 (11.43)	1.170 "	.025 "
CFR05ARA106--	10.0	50	"	.500 (12.70)	1.170 "	.032 (.81)
CFR05ARA126--	12.0	50	"	.540 (13.72)	1.170 "	.032 "
CFR05ARA156--	15.0	50	"	.600 (15.24)	1.170 "	.032 "
CFR05ARA186--	18.0	50	"	.580 (14.73)	1.450 (36.83)	.032 "
CFR05ARA206--	20.0	50	"	.610 (15.49)	1.450 (36.83)	.032 "
CFR05ARA256--	25.0	50	"	.580 (14.73)	1.900 (48.20)	.032 "
CFR05ARA306--	30.0	50	"	.610 (15.49)	1.900 "	.032 "
CFR05ARA356--	35.0	50	"	.660 (16.76)	1.900 "	.032 "
CFR05ARA406--	40.0	50	"	.700 (17.78)	1.900 "	.032 "
CFR05ARA506--	50.0	50	"	.780 (19.81)	1.900 "	.032 "

See footnotes at end of tabulation.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued

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STANDARD CAPACITORS

STYLE CFR05 - Continued

CHARACTERISTIC R CAPACITORS						
Type 1/ designation	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)		
				D 2/	L ±.050 (1.27)	M 3/ Axial
	μF	volts, dc				
CFR05ARB102--	.0010	100	F,G,J,K	.150(3.81)	.400(10.16)	.020(.51)
CFR05ARB122--	.0012	100	"	.150 "	.400 "	.020 "
CFR05ARB152--	.0015	100	"	.150 "	.400 "	.020 "
CFR05ARB182--	.0018	100	"	.150 "	.400 "	.020 "
CFR05ARB222--	.0022	100	"	.150 "	.400 "	.020 "
CFR05ARB272--	.0027	100	"	.150 "	.400 "	.020 "
CFR05ARB332--	.0033	100	"	.150 "	.400 "	.020 "
CFR05ARB392--	.0039	100	"	.150 "	.400 "	.020 "
CFR05ARB472--	.0047	100	"	.150 "	.400 "	.020 "
CFR05ARB562--	.0056	100	"	.150 "	.400 "	.020 "
CFR05ARB682--	.0068	100	"	.150 "	.400 "	.020 "
CFR05ARB822--	.0082	100	"	.150 "	.400 "	.020 "
CFR05ARB103--	.010	100	"	.150 "	.400 "	.020 "
CFR05ARB123--	.012	100	"	.150 "	.400 "	.020 "
CFR05ARB153--	.015	100	"	.150 "	.400 "	.020 "
CFR05ARB183--	.018	100	"	.150 "	.400 "	.020 "
CFR05ARB223--	.022	100	"	.150 "	.400 "	.020 "
CFR05ARB273--	.027	100	"	.150 "	.400 "	.020 "
CFR05ARB333--	.033	100	"	.150 "	.400 "	.020 "
CFR05ARB393--	.039	100	"	.150 "	.400 "	.020 "
CFR05ARB473--	.047	100	"	.150 "	.400 "	.020 "
CFR05ARB563--	.056	100	"	.160(4.06)	.400 "	.020 "
CFR05ARB683--	.068	100	"	.180(4.57)	.400 "	.020 "
CFR05ARB823--	.082	100	"	.150(3.81)	.530(13.46)	.020 "
CFR05ARB104--	.10	100	"	.160(4.06)	.530 "	.020 "
CFR05ARB124--	.12	100	"	.170(4.32)	.530 "	.020 "
CFR05ARB154--	.15	100	"	.190(4.83)	.530 "	.020 "
CFR05ARB184--	.18	100	"	.200(5.08)	.530 "	.020 "
CFR05ARB224--	.22	100	"	.220(5.59)	.530 "	.020 "
CFR05ARB274--	.27	100	"	.240(6.10)	.530 "	.020 "
CFR05ARB334--	.33	100	"	.260(6.60)	.530 "	.020 "
CFR05ARB394--	.39	100	"	.290(7.37)	.530 "	.020 "
CFR05ARB474--	.47	100	"	.260(6.60)	.680(17.27)	.020 "
CFR05ARB564--	.56	100	"	.290(7.37)	.680(17.27)	.020 "
CFR05ARB684--	.68	100	"	.290(7.37)	.780(19.81)	.020 "
CFR05ARB824--	.82	100	"	.310(7.87)	.780 "	.020 "
CFR05ARB105--	1.00	100	"	.340(8.64)	.780 "	.020 "
CFR05ARB125--	1.20	100	"	.370(9.40)	.780 "	.025(.64)
CFR05ARB155--	1.50	100	"	.370(9.40)	.950(24.13)	.025 "
CFR05ARB185--	1.80	100	"	.400(10.16)	.950(24.13)	.025 "
CFR05ARB205--	2.00	100	"	.380(9.65)	1.170(28.73)	.025 "
CFR05ARB255--	2.5	100	"	.420(10.67)	1.170 "	.025 "
CFR05ARB305--	3.0	100	"	.450(11.43)	1.170 "	.025 "
CFR05ARB355--	3.5	100	"	.480(12.19)	1.170 "	.032(.81)
CFR05ARB405--	4.0	100	"	.520(13.21)	1.170 "	.032 "
CFR05ARB455--	4.5	100	"	.550(13.97)	1.170 "	.032 "
CFR05ARB505--	5.0	100	"	.580(14.73)	1.170 "	.032 "
CFR05ARB605--	6.0	100	"	.620(15.75)	1.170 "	.032 "
CFR05ARB805--	8.0	100	"	.630(16.00)	1.450(36.83)	.032 "
CFR05ARB106--	10.0	100	"	.640(16.26)	1.700(43.18)	.032 "
CFR05ARB126--	12.0	100	"	.650(16.51)	1.900(48.20)	.032 "
CFR05ARB156--	15.0	100	"	.720(18.29)	1.900(48.20)	.032 "
CFR05ARB186--	18.0	100	"	.780(19.81)	1.900(48.20)	.032 "
CFR05ARB206--	20.0	100	"	.820(20.83)	1.900(48.20)	.032 "

See footnotes at end of tabulation.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CFR05 - Continued

CHARACTERISTIC R CAPACITORS						
Type 1/ designat ^{ion}	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)		
				D 2/	L ±.062 (1.57)	M 3/ Axial
	μF	volts, dc				
CFR05ARC103--	.010	200	F,G,J,K	.176(4.47)	.469(11.91)	.025(.64)
CFR05ARC123--	.012	200	"	.187(4.75)	.469(11.91)	.025 "
CFR05ARC153--	.015	200	"	.203(5.16)	.469(11.91)	.025 "
CFR05ARC183--	.018	200	"	.217(5.51)	.469(11.91)	.025 "
CFR05ARC223--	.022	200	"	.235(5.97)	.469(11.91)	.025 "
CFR05ARC273--	.027	200	"	.255(6.48)	.469(11.91)	.025 "
CFR05ARC333--	.033	200	"	.277(7.04)	.469(11.91)	.025 "
CFR05ARC393--	.039	200	"	.298(7.57)	.469(11.91)	.025 "
CFR05ARC473--	.047	200	"	.313(7.95)	.469(11.91)	.025 "
CFR05ARC563--	.056	200	"	.244(6.20)	.656(16.66)	.025 "
CFR05ARC683--	.068	200	"	.264(6.71)	.656(16.66)	.025 "
CFR05ARC823--	.082	200	"	.285(7.24)	.656(16.66)	.025 "
CFR05ARC104--	.10	200	"	.310(7.87)	.656(16.66)	.025 "
CFR05ARC124--	.12	200	"	.366(9.30)	.656(16.66)	.032(.81)
CFR05ARC154--	.15	200	"	.304(7.72)	.781(19.84)	.025(.64)
CFR05ARC184--	.18	200	"	.329(8.36)	.781(19.84)	.032(.81)
CFR05ARC224--	.22	200	"	.359(9.12)	.781(19.84)	.032 "
CFR05ARC274--	.27	200	"	.393(9.98)	.781(19.84)	.032 "
CFR05ARC334--	.33	200	"	.431(10.95)	.781(19.84)	.032 "
CFR05ARC394--	.39	200	"	.363(9.22)	1.031(26.19)	.032 "
CFR05ARC474--	.47	200	"	.395(10.03)	1.031(26.19)	.032 "
CFR05ARC564--	.56	200	"	.427(10.85)	1.031(26.19)	.032 "
CFR05ARC684--	.68	200	"	.467(11.86)	1.031(26.19)	.032 "
CFR05ARC824--	.82	200	"	.509(12.93)	1.031(26.19)	.032 "
CFR05ARC105--	1.00	200	"	.574(14.58)	1.031(26.19)	.032 "
CFR05ARC125--	1.20	200	"	.624(15.85)	1.031(26.19)	.032 "
CFR05ARC155--	1.50	200	"	.520(13.21)	1.531(38.89)	.032 "
CFR05ARC185--	1.80	200	"	.579(14.71)	1.531(38.89)	.032 "
CFR05ARC205--	2.00	200	"	.607(15.42)	1.531(38.89)	.032 "
CFR05ARC255--	2.5	200	"	.670(17.02)	1.531(38.89)	.032 "
CFR05ARC305--	3.0	200	"	.727(18.47)	1.531(38.89)	.032 "
CFR05ARC355--	3.5	200	"	.779(19.79)	1.531(38.89)	.032 "
CFR05ARC405--	4.0	200	"	.828(21.03)	1.531(38.89)	.032 "
CFR05ARC455--	4.5	200	"	.796(20.22)	1.781(45.24)	.032 "
CFR05ARC505--	5.0	200	"	.835(21.21)	1.781(45.24)	.032 "
CFR05ARC755--	7.5	200	"	.870(22.10)	2.281(57.94)	.032 "
CFR05ARC106--	10.0	200	"	.995(25.27)	2.281(57.94)	.032 "

See footnotes at end of tabulation.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in onmental cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CFR05 - Continued

CHARACTERISTIC R CAPACITORS						
Type 1/ designat ion	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)		
				D 2/	L ±.062 (1.57)	M 3/ Axial
	μF	volts, dc				
CFR05ARE103--	.010	400	F, G, J, K	.301(7.65)	.469(11.91)	.025(.64)
CFR05ARE123--	.012	400	"	.325(8.26)	.469(11.91)	.032(.81)
CFR05ARE153--	.015	400	"	.251(6.38)	.656(16.66)	.025(.64)
CFR05ARE183--	.018	400	"	.270(6.86)	.656(16.66)	.025 "
CFR05ARE223--	.022	400	"	.294(7.47)	.656(16.66)	.025 "
CFR05ARE273--	.027	400	"	.321(8.15)	.656(16.66)	.032(.81)
CFR05ARE333--	.033	400	"	.350(8.89)	.656(16.66)	.032 "
CFR05ARE393--	.039	400	"	.377(9.58)	.656(16.66)	.032 "
CFR05ARE473--	.047	400	"	.335(8.51)	.781(19.84)	.032 "
CFR05ARE563--	.056	400	"	.367(9.32)	.781(19.84)	.032 "
CFR05ARE683--	.068	400	"	.395(10.03)	.781(19.84)	.032 "
CFR05ARE823--	.082	400	"	.429(10.90)	.781(19.84)	.032 "
CFR05ARE104--	.10	400	"	.367(9.32)	1.031(26.19)	.032 "
CFR05ARE124--	.12	400	"	.399(10.13)	1.031(26.19)	.032 "
CFR05ARE154--	.15	400	"	.441(11.20)	1.031(26.19)	.032 "
CFR05ARE184--	.18	400	"	.479(12.17)	1.031(26.19)	.032 "
CFR05ARE224--	.22	400	"	.414(10.52)	1.531(38.89)	.032 "
CFR05ARE274--	.27	400	"	.451(11.46)	1.531(38.89)	.032 "
CFR05ARE334--	.33	400	"	.491(12.47)	1.531(38.89)	.032 "
CFR05ARE394--	.39	400	"	.529(13.44)	1.531(38.89)	.032 "
CFR05ARE474--	.47	400	"	.590(14.99)	1.531(38.89)	.032 "
CFR05ARE564--	.56	400	"	.638(16.21)	1.531(38.89)	.032 "
CFR05ARE684--	.68	400	"	.695(17.65)	1.531(38.89)	.032 "
CFR05ARE824--	.82	400	"	.757(19.23)	1.531(38.89)	.032 "
CFR05ARE105--	1.00	400	"	.828(21.03)	1.531(38.89)	.032 "
CFR05ARE125--	1.20	400	"	.901(22.89)	1.531(38.89)	.032 "
CFR05ARE155--	1.50	400	"	.909(23.09)	1.781(45.24)	.032 "
CFR05ARE185--	1.80	400	"	.989(25.12)	1.781(45.24)	.032 "
CFR05ARE205--	2.00	400	"	1.039(26.39)	1.781(45.24)	.032 "
CFR05ARE255--	2.5	400	"	.995(25.27)	2.281(57.94)	.032 "
CFR05ARE305--	3.0	400	"	1.084(27.53)	2.281(57.94)	.032 "
CFR05ARE355--	3.5	400	"	1.166(29.62)	2.281(57.94)	.032 "
CFR05ARE405--	4.0	400	"	1.242(31.55)	2.281(57.94)	.032 "
CFR05ARE455--	4.5	400	"	1.236(31.39)	2.531(64.29)	.032 "
CFR05ARE505--	5.0	400	"	1.300(33.02)	2.531(64.29)	.032 "

1/ The complete type designation will include additional symbols to indicate capacitance tolerance and failure rate level.

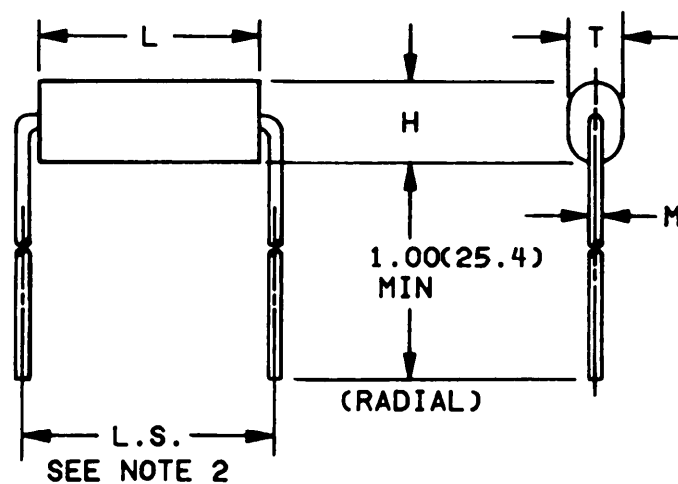
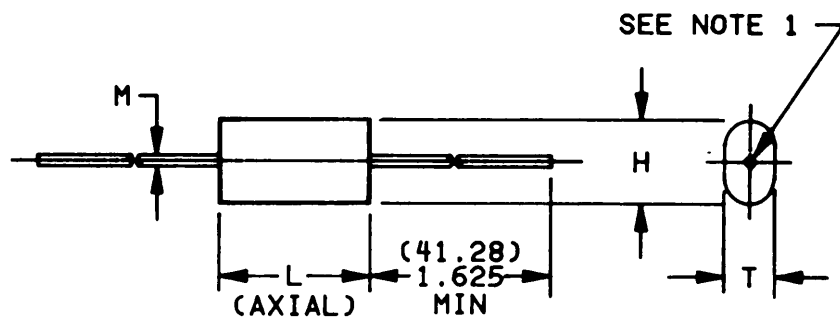
2/ Tolerances for dimension "D" are ±.031 (.79 mm) for 0.250 inch-diameter (6.35 mm) and below; ±.046 (1.17 mm) for 0.251 (6.38 mm) through 0.499 (12.67 mm) inch-diameters; and ±.062 (1.57 mm) for 0.500 inch-diameters (12.70 mm) and above.

3/ Tolerances for dimension "M" are ±.002 (.01 mm) on .040 (1.02 mm); +.005 (.13 mm), -.003 (.08 mm) on .032 (.81 mm) and .025 (.64 mm); and +.004 (.10 mm), -.001 (.03 mm) on .020 (.51 mm) and .016 (.41 mm).

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

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NOTES:

1. Leads shall be of solid wire and located on centerline within $\pm .062$ (1.57 mm) but not less than $.030$ (0.76 mm) from edge of capacitor.
2. L. S. shall be $(L + 2M) \pm .030$.

FIGURE 803-2. Established reliability plastic (or metallized plastic) dielectric in nonmetal cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CFR06 - Continued

CHARACTERISTIC R CAPACITORS							
Type designation	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)			M 3/ Radial and axial
				T	H	L	
	μF	volts, dc		$\pm .050(1.27)$	$\pm .050(1.27)$	$\pm .050(1.27)$ $-.005(.13)$	
CFR06-RA102--	.0010	50	F, G, J, K	.090(2.29)	.180(4.57)	.384(9.75)	.016(.41)
CFR06-RA122--	.0012	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA152--	.0015	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA182--	.0018	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA222--	.0022	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA272--	.0027	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA332--	.0033	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA392--	.0039	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA472--	.0047	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA562--	.0056	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA682--	.0068	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA822--	.0082	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA103--	.010	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA123--	.012	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA153--	.015	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA183--	.018	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA223--	.022	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA273--	.027	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA333--	.033	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA393--	.039	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA473--	.047	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA563--	.056	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA683--	.068	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA823--	.082	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA104--	.10	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA124--	.12	50	"	.090 "	.180 "	.384 "	.016 "
CFR06-RA154--	.15	50	"	.100(2.54)	.200(5.08)	.384 "	.016 "
CFR06-RA184--	.18	50	"	.090(2.29)	.180(4.57)	.514(13.06)	.016 "
CFR06-RA224--	.22	50	"	.090(2.29)	.180(4.57)	.514(13.06)	.016 "
CFR06-RA274--	.27	50	"	.100(2.54)	.190(4.83)	.514(13.06)	.016 "
CFR06-RA334--	.33	50	"	.110(2.79)	.210(5.33)	.510(12.95)	.020(.51)
CFR06-RA394--	.39	50	"	.130(3.30)	.220(5.59)	.510(12.95)	.020(.51)
CFR06-RA474--	.47	50	"	.140(3.56)	.240(6.10)	.510(12.95)	.020(.51)

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

See footnotes at end of figure.

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STANDARD CAPACITORS

STYLE CFR06 - Continued

CHARACTERISTIC R CAPACITORS							
Type designation 4/	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)			M 3/ Radial and axial
				T	H	L	
	μF	volts, dc		±.050(1.27)	±.050(1.27)	+.050(1.27) -.005(.13)	
CFR06-RA564--	.56	50	F, G, J, K	.160(4.06)	.250(6.35)	.510(12.95)	.020(.51)
CFR06-RA684--	.68	50	"	.180(4.57)	.270(6.86)	.510 "	.020 "
CFR06-RA824--	.82	50	"	.200(5.08)	.290(7.37)	.510 "	.020 "
CFR06-RA105--	1.00	50	"	.220(5.59)	.320(8.13)	.510 "	.020 "
CFR06-RA125--	1.20	50	"	.200(5.08)	.290(7.37)	.660(16.76)	.020 "
CFR06-RA155--	1.50	50	"	.220(5.59)	.320(8.13)	.660(16.76)	.020 "
CFR06-RA185--	1.80	50	"	.230(5.84)	.320(8.13)	.760(19.30)	.020 "
CFR06-RA205--	2.00	50	"	.240(6.10)	.340(8.64)	.760(19.30)	.020 "
CFR06-RA255--	2.50	50	"	.280(7.11)	.370(9.40)	.760(19.30)	.020 "
CFR06-RA305--	3.00	50	"	.310(7.87)	.410(10.41)	.755(19.18)	.025(.64)
CFR06-RA355--	3.50	50	"	.340(8.64)	.430(10.92)	.755(19.18)	.025 "
CFR06-RA405--	4.00	50	"	.310(7.87)	.400(10.16)	.925(23.50)	.025 "
CFR06-RA455--	4.50	50	"	.330(8.38)	.420(10.67)	.925(23.50)	.025 "
CFR06-RA505--	5.00	50	"	.250(6.35)	.420(10.67)	1.145(29.08)	.025 "
CFR06-RA605--	6.00	50	"	.280(7.11)	.450(11.43)	1.145(29.08)	.025 "
CFR06-RA805--	8.00	50	"	.340(8.64)	.500(12.70)	1.145(29.08)	.025 "
CFR06-RA106--	10.00	50	"	.390(9.91)	.560(14.22)	1.138(28.91)	.032(.81)
CFR06-RA126--	12.00	50	"	.430(10.92)	.600(15.24)	1.138(28.91)	.032 "
CFR06-RA156--	15.00	50	"	.490(12.45)	.660(16.76)	1.138(28.91)	.032 "
CFR06-RA186--	18.00	50	"	.470(11.94)	.640(16.26)	1.418(36.02)	.032 "
CFR06-RA206--	20.00	50	"	.500(12.70)	.670(17.02)	1.418(36.02)	.032 "
CFR06-RA256--	25.00	50	"	.500(12.70)	.670(17.02)	1.868(47.45)	.032 "
CFR06-RA306--	30.00	50	"	.560(14.22)	.730(18.54)	1.868 "	.032 "
CFR06-RA356--	35.00	50	"	.590(14.99)	.760(19.30)	1.868 "	.032 "
CFR06-RA406--	40.00	50	"	.660(16.76)	.830(21.08)	1.868 "	.032 "
CFR06-RA506--	50.00	50	"	.750(19.05)	.910(23.11)	1.868 "	.032 "

See footnotes at end of figure.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued

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STANDARD CAPACITORS

STYLE CFR06 - Continued

CHARACTERISTIC R CAPACITORS							
Type designation 4/	Capacitance (nom)	Rated voltage (at 85 C)	Capacitance tolerance available	Dimensions (in inches)			M 3/ Radial and axial
				T	H	L	
	μF	volts, dc	F, G, J, K	$\pm .050(1.27)$	$\pm .050(1.27)$	$+.050(1.27)$ $-.005(.13)$	
CFR06-RB102--	.0010	100		.090(2.29)	.180(4.57)	.384(9.75)	.016(.41)
CFR06-RB122--	.0012	100		.090	.180	.384	.016
CFR06-RB152--	.0015	100		.090	.180	.384	.016
CFR06-RB182--	.0018	100		.090	.180	.384	.016
CFR06-RB222--	.0022	100		.090	.180	.384	.016
CFR06-RB272--	.0027	100		.090	.180	.384	.016
CFR06-RB332--	.0033	100		.090	.180	.384	.016
CFR06-RB392--	.0039	100		.090	.180	.384	.016
CFR06-RB472--	.0047	100		.090	.180	.384	.016
CFR06-RB562--	.0056	100		.090	.180	.384	.016
CFR06-RB682--	.0068	100		.090	.180	.384	.016
CFR06-RB822--	.0082	100		.090	.180	.384	.016
CFR06-RB103--	.010	100		.090	.180	.384	.016
CFR06-RB123--	.012	100		.090	.180	.384	.016
CFR06-RB153--	.015	100		.090	.180	.384	.016
CFR06-RB183--	.018	100		.090	.180	.384	.016
CFR06-RB223--	.022	100		.090	.180	.384	.016
CFR06-RB273--	.027	100		.090	.180	.384	.016
CFR06-RB333--	.033	100		.090	.180	.384	.016
CFR06-RB393--	.039	100		.090	.180	.384	.016
CFR06-RB473--	.047	100		.090	.180	.384	.016
CFR06-RB563--	.056	100		.100(2.54)	.190(4.83)	.384	.016
CFR06-RB683--	.068	100		.110(2.79)	.210(5.33)	.384	.016
CFR06-RB823--	.082	100		.090(2.29)	.180(4.57)	.514(13.06)	.016
CFR06-RB104--	.10	100		.100(2.54)	.190(4.83)	.514(13.06)	.016
CFR06-RB124--	.12	100		.110(2.79)	.200(5.08)	.514(13.06)	.016
CFR06-RB154--	.15	100		.120(3.05)	.220(5.59)	.510(12.95)	.020(.51)
CFR06-RB184--	.18	100		.140(3.56)	.230(5.84)	.510	.020
CFR06-RB224--	.22	100		.160(4.06)	.250(6.35)	.510	.020
CFR06-RB274--	.27	100		.180(4.57)	.280(7.11)	.510	.020
CFR06-RB334--	.33	100		.200(5.08)	.300(7.62)	.510	.020
CFR06-RB394--	.39	100		.230(5.84)	.320(8.13)	.510	.020

See footnotes at end of figure.

FIGURE 803-2. Established reliability plastic, plastic (or metallized plastic) dielectric in nonmetal cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CFR06 - Continued

CHARACTERISTIC R CAPACITORS							
Type designation 4/	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)			
				T	H	L	M 3/ axial
	μF	volts, dc		$\pm .050(1.27)$	$\pm .050(1.27)$	$+.050(1.27)$ $-.005(.13)$	
CFR06-RB474--	.47	100	F, G, J, K	.200(5.08)	.300(7.62)	.660(16.76)	.020(.51)
CFR06-RB564--	.56	100	"	.230(5.84)	.320(8.13)	.660(16.76)	.020 "
CFR06-RB684--	.68	100	"	.230(5.84)	.320(8.13)	.760(19.30)	.020 "
CFR06-RB824--	.82	100	"	.250(6.35)	.350(8.89)	.760(19.30)	.020 "
CFR06-RB105--	1.00	100	"	.280(7.11)	.380(9.65)	.760(19.30)	.020 "
CFR06-RB125--	1.20	100	"	.310(7.87)	.410(10.41)	.755(19.18)	.025(.64)
CFR06-RB155--	1.50	100	"	.310(7.87)	.400(10.16)	.925(23.50)	.025 "
CFR06-RB185--	1.80	100	"	.340(8.64)	.430(10.92)	.925(23.50)	.025 "
CFR06-RB205--	2.00	100	"	.270(6.86)	.440(11.18)	1.145(29.08)	.025 "
CFR06-RB255--	2.50	100	"	.310(7.87)	.480(12.19)	1.145(29.08)	.025 "
CFR06-RB305--	3.00	100	"	.350(8.89)	.510(12.95)	1.138(28.91)	.032(.81)
CFR06-RB355--	3.50	100	"	.380(9.65)	.550(13.97)	1.138 "	.032 "
CFR06-RB405--	4.00	100	"	.410(10.41)	.580(14.73)	1.138 "	.032 "
CFR06-RB455--	4.50	100	"	.440(11.18)	.610(15.49)	1.138 "	.032 "
CFR06-RB505--	5.00	100	"	.470(11.94)	.630(16.00)	1.138 "	.032 "
CFR06-RB605--	6.00	100	"	.520(13.21)	.680(17.27)	1.138 "	.032 "
CFR06-RB805--	8.00	100	"	.530(13.46)	.690(17.53)	1.418(36.02)	.032 "
CFR06-RB106--	10.00	100	"	.540(13.72)	.700(17.78)	1.668(42.37)	.032 "
CFR06-RB126--	12.00	100	"	.540(13.72)	.700(17.78)	1.868(47.45)	.032 "
CFR06-RB156--	15.00	100	"	.610(15.49)	.780(19.81)	1.868 "	.032 "
CFR06-RB186--	18.00	100	"	.680(17.27)	.840(21.34)	1.868 "	.032 "
CFR06-RB206--	20.00	100	"	.720(18.29)	.880(22.35)	1.868 "	.032 "

See footnotes at end of figure.

FIGURE 803-2. Established reliability plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continue.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CFR06 - Continued

CHARACTERISTIC N CAPACITORS							
Type designation 4/	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)			M 3/ Radial and axial
				T	H	L	
	μF	<u>volts, dc</u>		$\pm .062(1.57)$	$\pm .062(1.57)$	$+.094(2.39)$ $-.062(1.57)$	
CFR06-NC103--	.010	200	G, J, K	.125(3.18)	.187(4.75)	.418(10.62)	.020(.51)
CFR06-NC123--	.012	200	"	.140(3.56)	.203(5.16)	.418 "	.020(.51)
CFR06-NC153--	.015	200	"	.140(3.56)	.218(5.54)	.418 "	.020(.51)
CFR06-NC183--	.018	200	"	.156(3.96)	.234(6.94)	.418 "	.020(.51)
CFR06-NC223--	.022	200	"	.171(4.34)	.250(6.35)	.418 "	.020(.51)
CFR06-NC273--	.027	200	"	.187(4.75)	.250(6.35)	.418 "	.020(.51)
CFR06-NC333--	.033	200	"	.187(4.75)	.265(6.73)	.418 "	.020(.51)
CFR06-NC393--	.039	200	"	.140(3.56)	.250(6.35)	.542(13.77)	.020(.51)
CFR06-NC473--	.047	200	"	.156(3.96)	.265(6.73)	.542 "	.020(.51)
CFR06-NC563--	.056	200	"	.171(4.34)	.281(7.14)	.542 "	.020(.51)
CFR06-NC683--	.068	200	"	.187(4.75)	.296(7.52)	.542 "	.020(.51)
CFR06-NC823--	.082	200	"	.203(5.16)	.312(7.92)	.542 "	.020(.51)
CFR06-NC104--	.10	200	"	.218(5.54)	.328(8.33)	.538(13.67)	.025(.64)
CFR06-NC124--	.12	200	"	.250(6.35)	.359(9.12)	.538(13.67)	.025(.64)
CFR06-NC154--	.15	200	"	.265(6.73)	.390(9.91)	.538(13.67)	.025(.64)
CFR06-NC184--	.18	200	"	.218(5.54)	.343(8.71)	.663(16.84)	.025(.64)
CFR06-NC224--	.22	200	"	.234(5.94)	.375(9.53)	.663(16.84)	.025(.64)
CFR06-NC274--	.27	200	"	.265(6.73)	.421(10.69)	.663(16.84)	.025(.64)
CFR06-NC334--	.33	200	"	.281(7.14)	.468(11.89)	.656(16.66)	.032(.81)
CFR06-NC394--	.39	200	"	.312(7.92)	.484(12.29)	.656(16.66)	.032(.81)
CFR06-NC474--	.47	200	"	.343(8.71)	.515(13.08)	.656(16.66)	.032(.81)
CFR06-NC564--	.56	200	"	.312(7.92)	.484(12.29)	.906(23.01)	.032(.81)
CFR06-NC684--	.68	200	"	.328(8.33)	.515(13.08)	.906 "	.032(.81)
CFR06-NC824--	.82	200	"	.359(9.12)	.562(14.27)	.906 "	.032(.81)
CFR06-NC105--	1.00	200	"	.390(9.91)	.578(14.68)	.906 "	.032(.81)
CFR06-NC125--	1.20	200	"	.375(9.53)	.531(13.49)	1.218(30.94)	.032(.81)
CFR06-NC155--	1.50	200	"	.406(10.31)	.578(14.68)	1.218 "	.032(.81)
CFR06-NC185--	1.80	200	"	.406(10.31)	.556(16.66)	1.218 "	.032(.81)
CFR06-NC225--	2.20	200	"	.406(10.31)	.718(18.24)	1.218 "	.032(.81)
CFR06-NC335--	3.30	200	"	.453(11.51)	.765(19.43)	1.468(37.29)	.032(.81)
CFR06-NC395--	3.90	200	"	.500(12.70)	.890(22.61)	1.468(37.29)	.032(.81)
CFR06-NC475--	4.70	200	"	.575(14.61)	.906(23.01)	1.718(43.64)	.032(.81)
CFR06-NC106--	10.00	200	"	.750(19.05)	1.203(30.56)	1.872(47.55)	.040(1.02)

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

See footnotes at end of figure.

CHARACTERISTIC N CAPACITORS							
Type designation	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)			M 3/ Radial and axial
				T	H	L	
	μF	volts, dc		$\pm .062(1.57)$	$\pm .062(1.57)$	$+.094(2.39)$ $-.062(1.57)$	
CFR06-NC103--	.010	200	G, J, K	.125(3.18)	.187(4.75)	.418(10.62)	.020(.51)
CFR06-NC123--	.012	200	"	.140(3.56)	.203(5.16)	.418 "	.020(.51)
CFR06-NC153--	.015	200	"	.140(3.56)	.218(5.54)	.418 "	.020(.51)
CFR06-NC183--	.018	200	"	.156(3.96)	.234(6.94)	.418 "	.020(.51)
CFR06-NC223--	.022	200	"	.171(4.34)	.250(6.35)	.418 "	.020(.51)
CFR06-NC273--	.027	200	"	.187(4.75)	.250(6.35)	.418 "	.020(.51)
CFR06-NC333--	.033	200	"	.187(4.75)	.265(6.73)	.418 "	.020(.51)
CFR06-NC393--	.039	200	"	.140(3.56)	.250(6.35)	.542(13.77)	.020(.51)
CFR06-NC473--	.047	200	"	.156(3.96)	.265(6.73)	.542 "	.020(.51)
CFR06-NC563--	.056	200	"	.171(4.34)	.281(7.14)	.542 "	.020(.51)
CFR06-NC683--	.068	200	"	.187(4.75)	.296(7.52)	.542 "	.020(.51)
CFR06-NC823--	.082	200	"	.203(5.16)	.312(7.92)	.542 "	.020(.51)
CFR06-NC104--	.10	200	"	.218(5.54)	.328(8.33)	.538(13.67)	.025(.64)
CFR06-NC124--	.12	200	"	.250(6.35)	.359(9.12)	.538(13.67)	.025(.64)
CFR06-NC154--	.15	200	"	.265(6.73)	.390(9.91)	.538(13.67)	.025(.64)
CFR06-NC184--	.18	200	"	.218(5.54)	.343(8.71)	.663(16.84)	.025(.64)
CFR06-NC224--	.22	200	"	.234(5.94)	.375(9.53)	.663(16.84)	.025(.64)
CFR06-NC274--	.27	200	"	.265(6.73)	.421(10.69)	.663(16.84)	.025(.64)
CFR06-NC334--	.33	200	"	.281(7.14)	.468(11.89)	.656(16.66)	.032(.81)
CFR06-NC394--	.39	200	"	.312(7.92)	.484(12.29)	.656(16.66)	.032(.81)
CFR06-NC474--	.47	200	"	.343(8.71)	.515(13.08)	.656(16.66)	.032(.81)
CFR06-NC564--	.56	200	"	.312(7.92)	.484(12.29)	.906(23.01)	.032(.81)
CFR06-NC684--	.68	200	"	.328(8.33)	.515(13.08)	.906 "	.032(.81)
CFR06-NC824--	.82	200	"	.359(9.12)	.562(14.27)	.906 "	.032(.81)
CFR06-NC105--	1.00	200	"	.390(9.91)	.578(14.68)	.906 "	.032(.81)
CFR06-NC125--	1.20	200	"	.375(9.53)	.531(13.49)	1.218(30.94)	.032(.81)
CFR06-NC155--	1.50	200	"	.406(10.31)	.578(14.68)	1.218 "	.032(.81)
CFR06-NC185--	1.80	200	"	.406(10.31)	.656(16.66)	1.218 "	.032(.81)
CFR06-NC225--	2.20	200	"	.406(10.31)	.718(18.24)	1.218 "	.032(.81)
CFR06-NC335--	3.30	200	"	.453(11.51)	.765(19.43)	1.468(37.29)	.032(.81)
CFR06-NC395--	3.90	200	"	.500(12.70)	.890(22.61)	1.468(37.29)	.032(.81)
CFR06-NC475--	4.70	200	"	.575(14.61)	.906(23.01)	1.718(43.64)	.032(.81)
CFR06-NC106--	10.00	200	"	.750(19.05)	1.203(30.56)	1.872(47.55)	.040(1.02)

See footnotes at end of figure.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CFR06 - Continued

CHARACTERISTICS OF CAPACITORS									
Type designation	Capacitance (nom)	Rated voltage (at 85°C)	Capacitance tolerance available	Dimensions (in inches)			M 3/ Radial and axial		
				T	H	L			
	μ F	volts, dc		\pm .062(1.57)	\pm .062(1.57)	\pm .094(2.39) -.062(1.57)			
CFR06-NE103--	.010	400	G, J, K	.140(3.56)	.265(6.73)	.668(17.48)	.020(.51)		
CFR06-NE123--	.023	400	"	.156(3.96)	.281(7.14)	.668 "	.020(.51)		
CFR06-NE153--	.015	400	"	.171(4.34)	.296(7.52)	.668 "	.020(.51)		
CFR06-NE183--	.018	400	"	.187(4.75)	.312(7.92)	.668 "	.020(.51)		
CFR06-NE223--	.022	400	"	.203(5.16)	.312(7.92)	.668 "	.020(.51)		
CFR06-NE273--	.027	400	"	.234(5.94)	.343(8.71)	.663(16.84)	.025(.64)		
CFR06-NE333--	.033	400	"	.250(6.35)	.375(9.53)	.663(16.84)	.025(.64)		
CFR06-NE393--	.039	400	"	.218(5.54)	.296(7.52)	.913(23.19)	.025(.64)		
CFR06-NE473--	.047	400	"	.218(5.54)	.328(8.33)	.913 "	.025(.64)		
CFR06-NE563--	.056	400	"	.234(5.94)	.375(9.53)	.913 "	.025(.64)		
CFR06-NE683--	.068	400	"	.234(5.94)	.421(10.69)	.913 "	.025(.64)		
CFR06-NE823--	.082	400	"	.265(6.73)	.453(11.51)	.913 "	.025(.64)		
CFR06-NE104--	.10	400	"	.296(7.52)	.484(12.29)	.906(23.01)	.032(.81)		
CFR06-NE124--	.12	400	"	.312(7.92)	.531(13.94)	.906(23.01)	.032(.81)		
CFR06-NE154--	.15	400	"	.343(8.71)	.562(14.27)	.906(23.01)	.032(.81)		
CFR06-NE184--	.18	400	"	.281(7.14)	.531(13.49)	1.218(30.94)	.032(.81)		
CFR06-NE224--	.22	400	"	.296(7.52)	.562(14.27)	1.218(30.94)	.032(.81)		
CFR06-NE274--	.27	400	"	.343(8.71)	.546(13.87)	1.468(37.29)	.032(.81)		
CFR06-NE334--	.33	400	"	.359(9.12)	.593(15.06)	1.468 "	.032(.81)		
CFR06-NE394--	.39	400	"	.390(9.91)	.671(17.04)	1.468 "	.032(.81)		
CFR06-NE474--	.47	400	"	.406(10.31)	.718(18.24)	1.468 "	.032(.81)		
CFR06-NE564--	.56	400	"	.406(10.31)	.812(20.62)	1.468 "	.032(.81)		
CFR06-NE684--	.68	400	"	.421(10.69)	.890(22.61)	1.468 "	.032(.81)		
CFR06-NE824--	.82	400	"	.500(12.70)	.781(19.84)	1.718(43.64)	.032(.81)		
CFR06-NE105--	1.00	400	"	.515(13.08)	.875(22.23)	1.718(43.64)	.032(.81)		
CFR06-NE125--	1.20	400	"	.546(13.87)	1.000(25.40)	1.718(43.64)	.032(.81)		
CFR06-NE155--	1.50	400	"	.562(14.27)	1.125(28.58)	1.710(43.43)	.040(1.02)		
CFR06-NE185--	1.80	400	"	.671(17.04)	1.125(28.58)	1.710 "	.040(1.02)		
CFR06-NE225--	2.20	400	"	.765(19.43)	1.125(28.58)	1.710 "	.040(1.02)		
CFR06-NE335--	3.30	400	"	.875(22.23)	1.406(35.71)	1.710 "	.040(1.02)		

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

1/ The complete type designation will include additional symbols to indicate capacitance tolerance and failure rate level.

2/ Tolerances for dimension "D" are \pm .031 (.79 mm) for 0.250 inch-diameter (6.35 mm) and below; \pm .046 (1.17 mm) for 0.251 (6.38 mm) through 0.499 (12.67 mm) inch-diameters; and \pm .062 (1.57 mm) for 0.500 inch-diameters (12.70 mm) and above.

3/ Tolerances for dimension "M" are \pm .002 (.01 mm) on .040 (1.02 mm); \pm .005 (.13 mm), \pm .003 (.08 mm) on .032 (.81 mm) and .025 (.64 mm); and \pm .004 (.10 mm), \pm .001 (.03 mm) on .020 (.51 mm) and .016 (.41 mm).

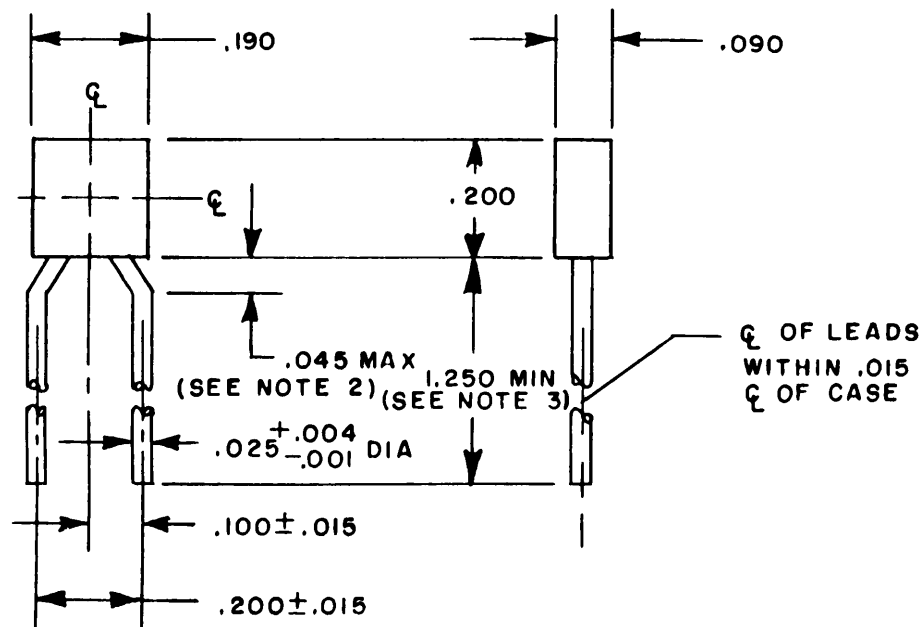
4/ The complete type designation will include additional symbols to indicate terminal configuration, capacitance tolerance, and failure rate level.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CFR12

NOT FOR NAVY OR AIR FORCE USE FOR ARMY USE ONLY
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INCHES	MM	INCHES	MM
.001	.03	.090	2.29
.004	.10	.100	2.54
.015	.38	.190	4.83
.025	.64	.200	5.08
.045	1.14	1.250	31.75

NOTES:

1. Unless otherwise specified, tolerance is $\pm .010$ (.25 mm).
2. For flush mounting .078 (1.98 mm) printed-circuit hole diameter is required to clear shoulder.
3. Lead length may be a minimum of 1 inch long for use in tape and reel packaging, when specified in the ordering data.
4. Dimensions are in inches.
5. Metric equivalents are given for general information only.

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CFR12 - Continued

Type designation	Capacitance	Rated voltage @ 85°C	Cap tolerance	Type designation	Capacitance	Rated voltage @ 85°C	Cap tolerance
		volts, dc				volts, dc	
CFR12RRJ104--	.10	25	F,J,K	CFR12RRH822--	.0082	150	F,J,K
CFR12RRJ823--	.082	"	"	CFR12RRH682--	.0068	150	"
CFR12RRJ683--	.068	"	"	CFR12RRC562--	.0056	200	"
CFR12RRA563--	.056	50	"	CFR12RRC472--	.0047	"	"
CFR12RRA473--	.047	"	"	CFR12RRC392--	.0039	"	"
CFR12RRA393--	.039	"	"	CFR12RRK332--	.0033	250	"
CFR12RRA333--	.033	"	"	CFR12RRK272--	.0027	"	"
CFR12RRG273--	.027	75	"	CFR12RRK222--	.0022	"	"
CFR12RRG223--	.022	75	"	CFR12RRK182--	.0018	"	"
CFR12RRB183--	.018	100	"	CFR12RRK152--	.0015	"	"
CFR12RRB153--	.015	"	"	CFR12RRK122--	.0012	"	"
CFR12RRB123--	.012	"	"	CFR12RRK102--	.0010	"	"
CFR12RRB103--	.010	"	"				

FIGURE 803-2. Established reliability, plastic (or metallized plastic) dielectric, in nonmetal cases, fixed capacitors - Continued.

MIL-STD-198E

SECTION 804

CAPACITORS, FIXED, SUPERMETALLIZED, PLASTIC FILM
DIELECTRIC, (DC, AC, OR DC AND AC), HERMETICALLY
SEALED IN METAL CASES, ESTABLISHED RELIABILITY

STYLES CRH01, CRH02, CRH03, CRH04, AND CRH05

(APPLICABLE SPECIFICATION: MIL-C-83421)

1. SCOPE This section covers established reliability, metallized, plastic film dielectric, fixed capacitors, hermetically sealed in metal cases. These capacitors have failure rate levels ranging from 1.0 percent to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on full rated voltage at the maximum rated temperature.

2. APPLICATION INFORMATION.

2.1 Use. Capacitors covered by this specification are primarily intended for use in circuit applications which require non-polar behaviour, relatively high insulation resistance, low dielectric absorption, low capacitance change with temperature, and low capacitance drift over the temperature range. Styles covered by this specification are rated for continuous operation under ac sinusoidal conditions in addition to continuous operation under dc conditions. These capacitors can exhibit periods of low insulation resistance and should only be used in circuits that can tolerate occasional momentary breakdowns. They should not be used in high impedance, low voltage applications.

2.2 Constriction. Metallized plastic film capacitors differ from plastic foil types which have separate layers of metal foil (capacitor plates) and plastic dielectric. The metal comprising the metallized capacitor plates is a thin conductive coating on one side of the plastic dielectric by means of a metallizing process. This technique results in an overall size reduction for metallized plastic capacitors when compared to plastic foil capacitors of equal voltage rating and capacitance value. Typically, a 1 MF, 50 volts dc metallized polycarbonate capacitor will occupy approximately one third the volume of a similar polycarbonate foil capacitor.

Another advantage resulting from the metallizing technique is that the capacitors are self-healing. Generally, the voltage breakdown occurs through a small hole or thin spot in the dielectric with the fault current melting away the conductive metal coating adjacent to the fault area. After clearing, the capacitors will continue to operate normally with the possibility of reduced insulation resistance, increased dielectric absorption and no significant change to capacitance value or dissipation factor. Clearing will occur only if there is sufficient energy available from the circuit and/or stored in the capacitor. Minimum stored energy in the range of 100 to 500 microjoules is recommended to insure clearing. Applications for these capacitors should be limited to circuits that will provide sufficient energy to insure clearing and are insensitive to momentary breakdowns (clearing actions). In the conventional plastic-foil types (where the foil is thicker), sustained conduction can occur on a breakdown causing a large area of the plastic surrounding the breakdowns to be carbonized resulting in a permanent short-circuit.

The breakdown of the metallized plastic capacitor can be either of two types; i.e., (1) a complete breakdown lasting for only a moment (momentary breakdown) or (2) a sharp reduction in insulation resistance lasting for an extended period of time, but eventually returning to normal (period of low insulation). The general characteristics of the metallized plastic type, aside from the breakdowns, are similar to the conventional plastic type except for a significantly lower insulation resistance, approximately in the order of 10 to 1.

2.3 Voltage rating.

2.3.1 DC voltage ratings. DC ratings are 30 Vdc to 400 Vdc from -55°C to +100°C.

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2.3.2 AC voltage rating. ratings are 22 Vrms to 240 Vrms at 400 Hz from -55°C to +100°C. Maximum ac current for each capacitor value and rating is shown in the table of figure 804-1, in the 40 KHz column. Operation at frequencies above the below 40 KHz is permissible provided the rms voltage limit at 400 Hz or the rms current limit at 40 KHz is not exceeded.

2.3.3 Voltage derating above 100°C. For operation beyond +100°C and up to +125°C, derated ac and dc voltage linearly from 100 percent at +100°C to 50 percent at +125°C.

2.3.4 Combined dc and ac voltage. The combined dc and ac peak voltage should not exceed the dc rating of the capacitor.

2.4 Temperature range

2.4.1 Storage. Storage temperature range is -65°C to +125°C.

2.4.2 Operating. Operating temperature range is -55°C to +125°C with voltage derating (see 2.3.3).

2.5 Prevention of corona. All metal parts, fittings, conductors, and attachments which operate at higher potential than other adjacent parts of the housing, should be carefully finished in order to insure that all sharp corners and edges are removed to minimize the possibility of corona discharge. Parts, from which the removal of sharp corners and edges would be impractical, such as conductors, should be spaced in such a manner as to prevent harmful corona discharges.

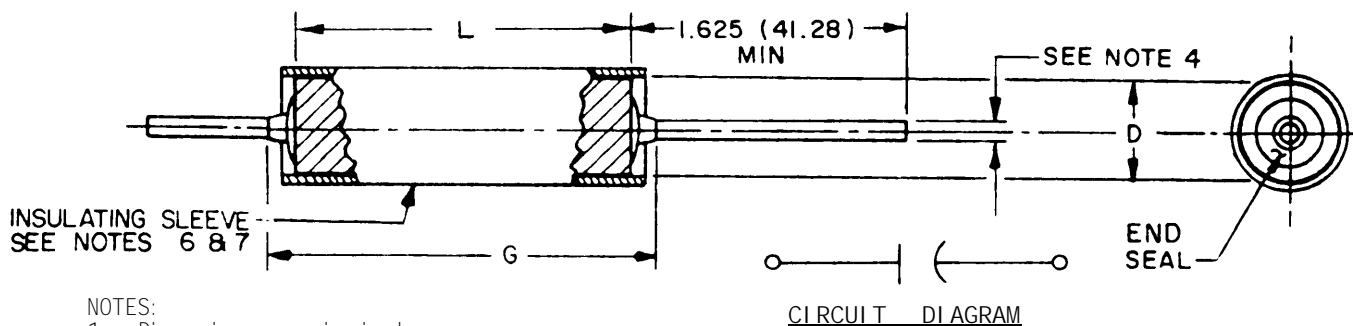
2.6 Mounting. Capacitors with dimension L or D of 1.375 or 0.670 inches, respectively, and greater, should not be supported by their leads. These capacitors should be provided with a supplementary means for mounting, such as a tangential bracket.

3. ITEM IDENTIFICATION.

3.1 Standard capacitors. The standard capacitors available in this section are shown on figure 804-1. (The figure gives the electrical characteristics, failure rate levels, and military part numbers which are standard for design.)

STYLES CRH01, CRH02, CRH03, CRH04, and CRH05

(MIL-C-83421/1)



NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only and are based upon 1.00 inch = 25.4 mm.
3. Metric equivalents are in parentheses.
4. $.025 \pm .002$ for case diameters of $.312$ (7.92 mm) and less.
 $.032 \pm .002$ for case diameters of $.400$ (10.16 mm) and $.500$ (12.70 mm).
 $.040 \pm .002$ for case diameters of $.562$ (14.27 mm) and over.
5. See table I for additional dimensions.
6. Insulating sleeve shall extend beyond the capacitor body. Insulating sleeve thickness shall not exceed $.005$ (.13 mm) inch.
7. Plastic insulating sleeve shall be transparent; marking shall be applied to the capacitor case.
8. Lead length may be a minimum of one inch for use in tape and reel packaging, when specified in the ordering data.

FIGURE 804-1. Established reliability, metalized plastic dielectric, fixed capacitors.

STANDARD CAPACITORS
Style CRH01 (MIL-C-83421/1)

Capacitance value (nom) (in μ F)	Dimensions 1/ (in inches with mm in parentheses)		Dash number 2/		AC ratings (for sinusoidal operation from -65°C to +100°C) 3/								
	L ± .030 (.76)	D ± .020 (.51) - .000	Capacitance tolerance value (in %)		0 to .4 kHz		At 4 kHz		At 40 kHz				
			±0.25	±0.5	±1.0	±2.0	±5.0	±10.0	Volts	Current (in A)	Volts	Current (in A)	
0.001	0.500 (12.70)	0.170 (4.32)	1001-	1002-	1003-	1004-	1005-	1006-	22.0	.001	22.0	.004	.006
0.0012			1007-	1008-	1009-	1010-	1011-	1012-					.007
0.0015			1013-	1014-	1015-	1016-	1017-	1018-					.008
0.0018			1019-	1020-	1021-	1022-	1023-	1024-					.010
0.002			1025-	1026-	1027-	1028-	1029-	1030-					.011
0.0022			1031-	1032-	1033-	1034-	1035-	1036-					.012
0.0027			1037-	1038-	1039-	1040-	1041-	1042-					.015
0.0033			1043-	1044-	1045-	1046-	1047-	1048-					.018
0.0039			1049-	1050-	1051-	1052-	1053-	1054-					.021
0.0047			1055-	1056-	1057-	1058-	1059-	1060-					.026
0.005			1061-	1062-	1063-	1064-	1065-	1066-					.028
0.0056			1067-	1068-	1069-	1070-	1071-	1072-					.031
0.0058			1073-	1074-	1075-	1076-	1077-	1078-					.037
0.0082			1079-	1080-	1081-	1082-	1083-	1084-					.045
0.01			1085-	1086-	1087-	1088-	1089-	1090-					.055
0.012			1091-	1092-	1093-	1094-	1095-	1096-					.066
0.015			1097-	1098-	1099-	1100-	1101-	1102-					.082
0.018			1103-	1104-	1105-	1106-	1107-	1108-					.10
0.02			1109-	1110-	1111-	1112-	1113-	1114-					.11
0.022			1115-	1116-	1117-	1118-	1119-	1120-					.12
0.027	0.562 (14.27)		1121-	1122-	1123-	1124-	1125-	1126-					.15
0.033			1127-	1128-	1129-	1130-	1131-	1132-					.18
0.039			1133-	1134-	1135-	1136-	1137-	1138-					.22
0.047			1139-	1140-	1141-	1142-	1143-	1144-					.26
0.05			1145-	1146-	1147-	1148-	1149-	1150-					.28
0.056			1151-	1152-	1153-	1154-	1155-	1156-					.31
0.068	0.687 (17.45)		1157-	1158-	1159-	1160-	1161-	1162-					.37
0.082			1163-	1164-	1165-	1166-	1167-	1168-					.45
0.1		0.193 (4.90)	1169-	1170-	1171-	1172-	1173-	1174-					.55
0.12		0.193 (4.90)	1175-	1176-	1177-	1178-	1179-	1180-					.66
0.15	0.562 (14.27)	0.235 (5.97)	1181-	1182-	1183-	1184-	1185-	1186-					.83
0.18	0.687 (17.45)	0.235 (5.97)	1187-	1188-	1189-	1190-	1191-	1192-					1.00
0.20	0.687 (17.45)	0.235 (5.97)	1187-	1188-	1189-	1190-	1191-	1192-					1.00

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

STANDARD CAPACITORS
Style CRH01 (MIL-C-83421/1) - Continued

Capacitance Value (in μ F)	Dimensions I/ (in inches with mm in parentheses)		Dash number Z/ Capacitance tolerance value (in %)	AC ratings (for sinusoidal operation from 65°C to +100°C) $\frac{3}{2}$					
	L ± .030 (.76)	G, max		0 to .4 kHz		At 4 kHz		At 40 kHz	
				Volts	Current (in A)	Volts	Current (in A)	Volts	Current (in A)
0.22	0.687(17.45)	0.235(5.97)	0.887(22.53)	1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-1210-1211-1212-1213-1214-1215-1216-1217-1218-1219-1220-1221-1222-1223-1224-1225-1226-1227-1228-1229-1230-1231-1232-1233-1234-1235-1236-1237-1238-1239-1240-1241-1242-1243-1244-1245-1246-1247-1248-1249-1250-1251-1252-1253-1254-1255-1256-1257-1258-1259-1260-1261-1262-1263-1264-1265-1266-1267-1268-1269-1270-1271-1272-1273-1274-1275-1276-1277-1278-1279-1280-1281-1282-1285-1286-1287-1288-1289-1290-1291-1292-1293-1294-1295-1296-1297-1298-1299-1300-1301-1302-1303-1304-1305-1306-1313-1314-1315-1316-1319-1320-1321-1322-1323-1324-1325-1326-1327-1328-1329-1330-1331-1332-1333-1334-1335-1336-1337-1338-1339-1340-1341-1342-1343-1344-1345-1346-1347-1348-1349-1350-1351-1352-1353-1354-1355-1356-1357-1358-1359-1360-1361-1362-1363-1364-1365-1366-1367-1368-1369-1370-1371-1372-	22.0	.012	.12	18.5	1.02
0.27					.015	.15	17.0	1.15	
0.33					.018	.18	16.0	1.32	
0.39					.021	.21	15.0	1.46	
0.47		0.312(7.92)			.026	.26	14.0	1.65	
0.50					.028	.28	13.5	1.69	
0.56					.031	.31	12.9	1.81	
0.68					.037	.37	12.0	2.04	
0.82	0.813(20.65)		1.013(25.73)		.045	.45	10.0	2.05	
1.0					.055	.55	8.4	2.10	
1.2					.066	.66	7.2	2.15	
1.5	0.400(10.16)				.082	.82	5.8	2.17	
1.8					.099	.99	4.8	2.20	
2.0					.110	1.10	4.4		
2.2					.12	1.21	4.0		
2.7	1.063(27.00)		1.263(32.08)		.15	1.49	3.3		
3.0	1.063(27.00)		1.263(32.08)		.17	1.65	2.9		
3.3	1.063(27.00)		1.263(32.08)		.18	1.82	2.7		
3.9	1.375(34.93)	0.400(10.16)	1.575(40.01)		.21	2.14	2.3		
4.7		0.500(12.70)			.26	2.20	1.9		
5.0		0.500(12.70)			.28	18.7	1.8		
5.6		0.500(12.70)			.31	15.7	1.6		
6.8		0.562(14.27)			.37	13.0	1.3		
8.0					.44	11.0	1.1		
8.2					.45	10.7	1.1		
10.0					.55	8.8	.88		
12.0	1.875(47.63)		2.075(52.71)		.66	7.3	.73		
15.0		0.562(14.27)			.83	5.9	.59		
20.0		0.670(17.02)			1.10	4.4	.44		
22.0		0.670(17.02)			1.21	4.0	.40		

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS
Style CRH02 (MIL-C-83421/1)
50 VOLTS (DC RATING)

Capacitance value (nom) (in μF)	Dimensions I/ D (in inches with mm in parentheses)		G, max	Dash number 2/ Capacitance tolerance value (in %)		AC ratings (for sinusoidal operation from 65°C to +100°C) 3/ 0 to 4 KHZ 4 KHZ AT 4 KHZ AT 40 KHZ						
	L ±.030(.76)	±.020(.51) -.000		±0.25 ±0.5 2003- 2009- 2014- 2019- 2025- 2031- 2037- 2043- 2049- 2055- 2061- 2067-	±1.0 ±2.0 2004- 2010- 2016- 2021- 2027- 2033- 2039- 2045- 2051- 2057- 2063- 2069-	±5.0 ±10.0 2005- 2011- 2017- 2023- 2029- 2035- 2041- 2047- 2053- 2059- 2065- 2071-	Volts 36.0	Current (in A)	Volts 36.0	Current (in A)	Volts 36.0	Current (in A)
0.001	0.500(12.70)	0.170(4.32)	0.700(17.78)	2001- 2002- 2003- 2004- 2005- 2006- 2007- 2008- 2009- 2010- 2011- 2012- 2013- 2014- 2015- 2016- 2017- 2018- 2019- 2020- 2021- 2022- 2023- 2024- 2025- 2026- 2027- 2028- 2029- 2030- 2031- 2032- 2033- 2034- 2035- 2036- 2037- 2038- 2039- 2040- 2041- 2042- 2043- 2044- 2045- 2046- 2047- 2048- 2049- 2050- 2051- 2052- 2053- 2054- 2055- 2056- 2057- 2058- 2059- 2060- 2061- 2062- 2063- 2064- 2065- 2066- 2067- 2068- 2069- 2070- 2071- 2072- 2073- 2074- 2075- 2076- 2077- 2078- 2079- 2080- 2081- 2082- 2083- 2084- 2085- 2086- 2087- 2088- 2089- 2090- 2091- 2092- 2093- 2094- 2095- 2096- 2097- 2098- 2099- 2100- 2101- 2102- 2103- 2104- 2105- 2106- 2107- 2108- 2109- 2110- 2111- 2112- 2113- 2114- 2115- 2116- 2117- 2118- 2119- 2120- 2121- 2122- 2123- 2124- 2125- 2126- 2127- 2128- 2129- 2130- 2131- 2132- 2133- 2134- 2135- 2136- 2137- 2138- 2139- 2140- 2141- 2142- 2143- 2144- 2145- 2146- 2147- 2148- 2149- 2150- 2151- 2152- 2153- 2154- 2155- 2156- 2157- 2158- 2159- 2160- 2161- 2162- 2163- 2164- 2165- 2166- 2167- 2168- 2169- 2170- 2171- 2172- 2173- 2174- 2175- 2176- 2177- 2178- 2179- 2180- 2181- 2182- 2183- 2184- 2185- 2186- 2187- 2188- 2189- 2190- 2191- 2192- 2193- 2194- 2195- 2196- 2197- 2198- 2199- 2200- 2201- 2202- 2203- 2204- 2205- 2206- 2207- 2208- 2209- 2210- 2211- 2212- 2213- 2214- 2215- 2216- 2217- 2218- 2219- 2220- 2221- 2222- 2223- 2224- 2225- 2226- 2227- 2228- 2229- 2230- 2231- 2232- 2233- 2234- 2235- 2236- 2237- 2238- 2239- 2240- 2241- 2242- 2243- 2244- 2245- 2246- 2247- 2248- 2249- 2250- 2251- 2252- 2253- 2254- 2255- 2256- 2257- 2258- 2259- 2260- 2261- 2262- 2263- 2264- 2265- 2266- 2267- 2268- 2269- 2270- 2271- 2272- 2273- 2274- 2275- 2276- 2277- 2278- 2279- 2280- 2281- 2282- 2283- 2284- 2285- 2286- 2287- 2288- 2289- 2290- 2291- 2292- 2293- 2294- 2295- 2296- 2297- 2298- 2299- 2300- 2301- 2302- 2303- 2304- 2305- 2306- 2307- 2308- 2309- 2310- 2311- 2312- 2313- 2314- 2315- 2316- 2317- 2318- 2319- 2320- 2321- 2322- 2323- 2324- 2325- 2326- 2327- 2328- 2329- 2330- 2331- 2332- 2333- 2334- 2335- 2336- 2337- 2338- 2339- 2340- 2341- 2342- 2343- 2344- 2345- 2346- 2347- 2348- 2349- 2350- 2351- 2352- 2353- 2354- 2355- 2356- 2357- 2358- 2359- 2360- 2361- 2362- 2363- 2364- 2365- 2366- 2367- 2368- 2369- 2370- 2371- 2372- 2373- 2374- 2375- 2376- 2377- 2378- 2379- 2380- 2381- 2382- 2383- 2384- 2385- 2386- 2387- 2388- 2389- 2390- 2391- 2392- 2393- 2394- 2395- 2396- 2397- 2398- 2399- 2400- 2401- 2402- 2403- 2404- 2405- 2406- 2407- 2408- 2409- 2410- 2411- 2412- 2413- 2414- 2415- 2416- 2417- 2418- 2419- 2420- 2421- 2422- 2423- 2424- 2425- 2426- 2427- 2428- 2429- 2430- 2431- 2432- 2433- 2434- 2435- 2436- 2437- 2438- 2439- 2440- 2441- 2442- 2443- 2444- 2445- 2446- 2447- 2448- 2449- 2450- 2451- 2452- 2453- 2454- 2455- 2456- 2457- 2458- 2459- 2460- 2461- 2462- 2463- 2464- 2465- 2466- 2467- 2468- 2469- 2470- 2471- 2472- 2473- 2474- 2475- 2476- 2477- 2478- 2479- 2480- 2481- 2482- 2483- 2484- 2485- 2486- 2487- 2488- 2489- 2490- 2491- 2492- 2493- 2494- 2495- 2496- 2497- 2498- 2499- 2500- 2501- 2502- 2503- 2504- 2505- 2506- 2507- 2508- 2509- 2510- 2511- 2512- 2513- 2514- 2515- 2516- 2517- 2518- 2519- 2520- 2521- 2522- 2523- 2524- 2525- 2526- 2527- 2528- 2529- 2530- 2531- 2532- 2533- 2534- 2535- 2536- 2537- 2538- 2539- 2540- 2541- 2542- 2543- 2544- 2545- 2546- 2547- 2548- 2549- 2550- 2551- 2552- 2553- 2554- 2555- 2556- 2557- 2558- 2559- 2560- 2561- 2562- 2563- 2564- 2565- 2566- 2567- 2568- 2569- 2570- 2571- 2572- 2573- 2574- 2575- 2576- 2577- 2578- 2579- 2580- 2581- 2582- 2583- 2584- 2585- 2586- 2587- 2588- 2589- 2590- 2591- 2592- 2593- 2594- 2595- 2596- 2597- 2598- 2599- 2600- 2601- 2602- 2603- 2604- 2605- 2606- 2607- 2608- 2609- 2610- 2611- 2612- 2613- 2614- 2615- 2616- 2617- 2618- 2619- 2620- 2621- 2622- 2623- 2624- 2625- 2626- 2627- 2628- 2629- 2630- 2631- 2632- 2633- 2634- 2635- 2636- 2637- 2638- 2639- 2640- 2641- 2642- 2643- 2644- 2645- 2646- 2647- 2648- 2649- 2650- 2651- 2652- 2653- 2654- 2655- 2656- 2657- 2658- 2659- 2660- 2661- 2662- 2663- 2664- 2665- 2666- 2667- 2668- 2669- 2670- 2671- 2672- 2673- 2674- 2675- 2676- 2677- 2678- 2679- 2680- 2681- 2682- 2683- 2684- 2685- 2686- 2687- 2688- 2689- 2690- 2691- 2692- 2693- 2694- 2695- 2696- 2697- 2698- 2699- 2700- 2701- 2702- 2703- 2704- 2705- 2706- 2707- 2708- 2709- 2710- 2711- 2712- 2713- 2714- 2715- 2716- 2717- 2718- 2719- 2720- 2721- 2722- 2723- 2724- 2725- 2726- 2727- 2728- 2729- 2730- 2731- 2732- 2733- 2734- 2735- 2736- 2737- 2738- 2739- 2740- 2741- 2742- 2743- 2744- 2745- 2746- 2747- 2748- 2749- 2750- 2751- 2752- 2753- 2754- 2755- 2756- 2757- 2758- 2759- 2760- 2761- 2762- 2763- 2764- 2765- 2766- 2767- 2768- 2769- 2770- 2771- 2772- 2773- 2774- 2775- 2776- 2777- 2778- 2779- 2780- 2781- 2782- 2783- 2784- 2785- 2786- 2787- 2788- 2789- 2790- 2791- 2792- 2793- 2794- 2795- 2796- 2797- 2798- 2799- 2800- 2801- 2802- 2803- 2804- 2805- 2806- 2807- 2808- 2809- 2810- 2811- 2812- 2813- 2814- 2815- 2816- 2817- 2818- 2819- 2820- 2821- 2822- 2823- 2824- 2825- 2826- 2827- 2828- 2829- 2830- 2831- 2832- 2833- 2834- 2835- 2836- 2837- 2838- 2839- 2840- 2841- 2842- 2843- 2844- 2845- 2846- 2847- 2848- 2849- 2850- 2851- 2852- 2853- 2854- 2855- 2856- 2857- 2858- 2859- 2860- 2861- 2862- 2863- 2864- 2865- 2866- 2867- 2868- 2869- 2870- 2871- 2872- 2873- 2874- 2875- 2876- 2877- 2878- 2879- 2880- 2881- 2882- 2883- 2884- 2885- 2886- 2887- 2888- 2889- 2890- 2891- 2892- 2893- 2894- 2895- 2896- 2897- 2898- 2899- 2900- 2901- 2902- 2903- 2904- 2905- 2906- 2907- 2908- 2909- 2910- 2911- 2912- 2913- 2914- 2915- 2916- 2917- 2918- 2919- 2920- 2921- 2922- 2923- 2924- 2925- 2926- 2927- 2928- 2929- 2930- 2931- 2932- 2933- 2934- 2935- 2936- 2937- 2938- 2939- 2940- 2941- 2942- 2943- 2944- 2945- 2946- 2947- 2948- 2949- 2950- 2951- 2952- 2953- 2954- 2955- 2956- 2957- 2958- 2959- 2960- 2961- 2962- 2963- 2964- 2965- 2966- 2967- 2968- 2969- 2970- 2971- 2972- 2973- 2974- 2975- 2976- 2977- 2978- 2979- 2980- 2981- 2982- 2983- 2984- 2985- 2986- 2987- 2988- 2989- 2990- 2991- 2992- 2993- 2994- 2995- 2996- 2997- 2998- 2999- 3000- 3001- 3002- 3003- 3004- 3005- 3006- 3007- 3008- 3009- 3010- 3011- 3012- 3013- 3014- 3015- 3016- 3017- 3018- 3019- 3020- 3021- 3022- 3023- 3024- 3025- 3026- 3027- 3028- 3029- 3030- 3031- 3032- 3033- 3034- 3035- 3036- 3037- 3038- 3039- 3040- 3041- 3042- 3043- 3044- 3045- 3046- 3047- 3048- 3049- 3050- 3051- 3052- 3053- 3054- 3055- 3056- 3057- 3058- 3059- 3060- 3061- 3062- 3063- 3064- 3065- 3066- 3067- 3068- 3069- 3070- 3071- 3072- 3073- 3074- 3075- 3076- 3077- 3078- 3079- 3080- 3081- 3082- 3083- 3084- 3085- 3086- 3087- 3088- 3089- 3090- 3091- 3092- 3093- 3094- 3095- 3096- 3097- 3098- 3099- 3100- 3101- 3102- 3103- 3104- 3105- 3106- 3107- 3108- 3109- 3110- 3111- 3112- 3113- 3114- 3115- 3116- 3117- 3118- 3119- 3120- 3121- 3122- 3123- 3124- 3125- 3126- 3127- 3128- 3129- 3130- 3131- 3132- 3133- 3134- 3135- 3136- 3137- 3138- 3139- 3140- 3141- 3142- 3143- 3144- 3145- 3146- 3147- 3148- 3149- 3150- 3151- 3152- 3153- 3154- 3155- 3156- 3157- 3158- 3159- 3160- 3161- 3162- 3163- 3164- 3165- 3166- 3167- 3168- 3169- 3170- 3171- 3172- 3173- 3174- 3175- 3176- 3177- 3178- 3179- 3180- 3181- 3182- 3183- 3184- 3185- 3186- 3187- 3188- 3189- 3190- 3191- 3192- 3193- 3194- 3195- 3196- 3197- 3198- 3199- 3200- 3201- 3202- 3203- 3204- 3205- 3206- 3207- 3208- 3209- 3210- 3211- 3212- 3213- 3214- 3215- 3216- 3217- 3218- 3219- 3220- 3221- 3222- 3223- 3224- 3225- 3226- 3227- 3228- 3229- 3230- 3231- 3232- 3233- 3234- 3235- 3236- 3237- 3238- 3239- 3240- 3241- 3242- 3243- 3244- 3245- 3246- 3247- 3248- 3249- 3250- 3251- 3252- 3253- 3254- 3255- 3256- 3257- 3258- 3259- 3260- 3261- 3262- 3263- 3264- 3265- 3266- 3267- 3268- 3269- 3270- 3271- 3272- 3273- 3274- 3275- 3276- 3277- 3278- 3279- 3280- 3281- 3282- 3283- 3284- 3285- 3286- 3287- 3288- 3289- 3290- 3291- 3292- 3293- 3294- 3295- 3296- 3297- 3298- 3299- 3300- 3301- 3302- 3303- 3304- 3305- 3306- 3307- 3308- 3309- 3310- 3311- 3312- 3313- 3314- 3315- 3316- 3317- 3318- 3319- 3320- 3321- 3322- 3323- 3324- 3325- 3326- 3327- 3328- 3329- 3330- 3331- 3332- 3333- 3334- 3335- 3336- 3337- 3338- 3339- 3340- 3341- 3342- 3343- 3344- 3345- 3346- 3347- 3348- 3349- 3350- 3351- 3352- 3353- 3354- 3355- 3356- 3357- 3358- 3359- 3360- 3361- 3362- 3363- 3364- 3365- 3366- 3367- 3368- 3369- 3370- 3371- 3372- 3373- 3374- 3375- 3376- 3377- 3378- 3379- 3380- 3381- 3382- 3383- 3384- 3385- 3386-<								

STANDARD CAPACITORS
Style CRH02 (MIL-C-83421/1) - Continued

Capacitance value (nom) (in μ F)	Dimensions I/ D (in inches with mm in parentheses)		G, max	Dash number Z/ Capacitance tolerance value (in μ)			AC ratings (for sinusoidal operation from 0 to .4 kHz 65°C to +100°C)					
	L+.030(.76) +.020(.51) -.000	0.235(5.97) 0.235(5.97) 0.312(7.92) 0.687(17.45) 0.813(20.65) 0.47 0.56 0.82 1.0 1.2 1.5 1.8 2.0 2.2 2.7 3.0 3.3 4.9 4.7 5.0 5.6 6.8 8.0 8.2 10.0		1.013(25.73) 1.013(25.73) 0.887(22.53) 1.013(25.73) 0.400(10.16) 1.263(32.08) 0.500(12.70) 1.325(33.66) 1.575(40.01) 0.562(14.27) 0.670(17.02) 1.875(47.63) 1.325(33.66) 1.375(34.93)	±0.25 ±0.5 ±1.0 ±2.0 ±5.0 ±10.0			At 4 kHz Volts Current (in A)				
					At 40 kHz Volts Current (in A)							
0.20	0.813(20.65)	0.235(5.97)	1.013(25.73)	2193-2199	2196-2199	2197-2198	2198-2204	36.0	.018	.18	24.0	1.20
0.22	0.813(20.65)	0.235(5.97)	1.013(25.73)	2200-2205	2201-2205	2203-2204	2204-2210		.020	.20	23.0	1.27
0.27	0.687(17.45)	0.312(7.92)	0.887(22.53)	2206-2211	2207-2211	2209-2210	2210-2216		.024	.24	19.0	1.28
0.33	0.687(17.45)	0.312(7.92)	0.887(22.53)	2212-2217	2213-2217	2215-2216	2216-2222		.030	.30	18.0	1.48
0.39	0.813(20.65)	0.235(5.97)	1.013(25.73)	2218-2223	2219-2223	2221-2222	2222-2228		.035	.35	17.0	1.66
0.47				2224-2229	2225-2229	2227-2228	2228-2234		.042	.42	15.7	1.85
0.50				2230-2235	2231-2235	2233-2234	2234-2240		.045	.45	15.2	1.90
0.56				2236-2241	2237-2241	2239-2240	2240-2246		.050	.50	14.4	2.01
0.68				2242-2247	2243-2247	2245-2246	2246-2252		.061	.61	14.0	2.38
0.82	1.063(27.00)		1.263(32.08)	2248-2253	2249-2253	2251-2252	2252-2258		.074	.74	12.0	2.46
1.0				2254-2259	2255-2259	2257-2258	2258-2264		.090	.90	10.0	2.50
1.2				2260-2265	2261-2265	2263-2264	2264-2270		.11	1.08	9.1	2.73
1.5				2266-2271	2267-2271	2269-2270	2270-2276		.14	1.35	7.7	2.90
1.8				2272-2277	2273-2277	2275-2276	2276-2282		.16	1.62	6.6	3.00
2.0	1.125(28.58)	0.500(12.70)	1.325(33.66)	2278-2283	2279-2283	2281-2282	2282-2288		.18	1.80	6.2	3.10
2.2	1.125(28.58)	0.500(12.70)	1.325(33.66)	2284-2289	2285-2289	2287-2288	2288-2294		.20	1.98	5.8	3.20
2.7	1.375(34.93)		1.575(40.01)	2290-2295	2291-2295	2293-2294	2294-2300		.24	2.43	5.0	3.34
3.0				2296-2301	2297-2301	2299-2300	2300-2306		.27	2.70	4.5	3.40
3.3				2302-2307	2303-2307	2305-2306	2306-2312		.30	2.97	4.2	3.50
4.9				2308-2313	2309-2313	2311-2312	2312-2318		.35	3.51	3.7	3.60
4.7				2314-2319	2315-2319	2317-2318	2318-2324		.42	3.60	3.1	
5.0				2320-2325	2321-2325	2323-2324	2324-2330		.45	29.0	2.9	
5.6				2326-2331	2327-2331	2329-2330	2330-2336		.50	26.0	2.6	
6.8	1.875(47.63)		2.075(52.71)	2332-2337	2333-2337	2335-2336	2336-2342		.61	21.2	2.1	
8.0				2338-2343	2339-2343	2341-2342	2342-2348		.72	18.0	1.8	
8.2				2344-2349	2345-2349	2347-2348	2348-2354		.74	17.6	1.8	
10.0				2350-2355	2351-2355	2353-2354	2354-2360		.90	14.4	1.4	

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

STANDARD CAPACITORS
Style CRH03 (MIL-C-83421/1)

100 VOLTS (DC RATING)

Capacitance value (nom) (in μ F)	Dimensions I/ (in inches with mm in parentheses)		Dash number 2/				AC ratings (for sinusoidal operation from 0 to .4 kHz 65°C to +100°C) 3/							
	L+.030(.76)	G, max +.020(.51) -.000	Capacitance tolerance value (in %)		Dash number 2/		0 to .4 kHz		At 4 kHz		At 40 kHz			
			+0.25	+0.5	+1.0	+2.0	+5.0	+10.0	Volts	Current (in A)	Volts	Current (in A)	Volts	Current (in A)
0.001	0.500(12.70)	0.170(4.32)	3001-	3002-	3003-	3004-	3005-	3006-	60.0	.001	60.0	.002	60.0	.015
0.0012			3007-	3008-	3009-	3010-	3011-	3012-				.002		.018
0.0015			3013-	3014-	3015-	3016-	3017-	3018-				.002		.022
0.0018			3019-	3020-	3021-	3022-	3023-	3024-				.003		.027
0.002			3025-	3026-	3027-	3028-	3029-	3030-				.003		.030
0.0022			3031-	3032-	3033-	3034-	3035-	3036-				.003		.033
0.0027			3037-	3038-	3039-	3040-	3041-	3042-				.004		.041
0.0033			3043-	3044-	3045-	3046-	3047-	3048-				.005		.050
0.0039			3049-	3050-	3051-	3052-	3053-	3054-				.006		.058
0.0047			3055-	3056-	3057-	3058-	3059-	3060-				.007		.071
0.005			3061-	3062-	3063-	3064-	3065-	3066-				.008		.075
0.0056			3067-	3068-	3069-	3070-	3071-	3072-				.008		.084
0.0068	0.562(14.27)	0.762(19.35)	3073-	3074-	3075-	3076-	3077-	3078-				.010		.10
0.0082	0.562(14.27)	0.762(19.35)	3079-	3080-	3081-	3082-	3083-	3084-				.012		.12
0.01	0.687(17.45)	0.887(22.53)	3085-	3086-	3087-	3088-	3089-	3090-		.002		.015		.15
0.012			3091-	3092-	3093-	3094-	3095-	3096-		.002		.018		.18
0.015			3097-	3098-	3099-	3100-	3101-	3102-		.002		.022		.22
0.018			3103-	3104-	3105-	3106-	3107-	3108-		.003		.027		.26
0.02	0.193(4.90)		3109-	3110-	3111-	3112-	3113-	3114-		.003		.030		.28
0.022			3115-	3116-	3117-	3118-	3119-	3120-		.003		.033		.29
0.027			3121-	3122-	3123-	3124-	3125-	3126-		.004		.041		.34
0.033			3127-	3128-	3129-	3130-	3131-	3132-		.005		.050		.41
0.039	0.235(5.97)		3133-	3134-	3135-	3136-	3137-	3138-		.006		.059		.47
0.047			3139-	3140-	3141-	3142-	3143-	3144-		.007		.070		.55
0.050			3145-	3146-	3147-	3148-	3149-	3150-		.008		.075		.58
0.056			3151-	3152-	3153-	3154-	3155-	3156-		.008		.084		.64
0.068	0.813(20.65)	1.013(25.73)	3157-	3158-	3159-	3160-	3161-	3162-		.010		.10		.71
0.082	0.687(17.45)	0.887(22.53)	3163-	3164-	3165-	3166-	3167-	3168-		.012		.12		.78
0.10	0.687(17.45)	0.887(22.53)	3169-	3170-	3171-	3172-	3173-	3174-		.015		.15		.90
0.12	0.687(17.45)	0.887(22.53)	3175-	3176-	3177-	3178-	3179-	3180-		.018		.18		1.05
0.15	0.813(20.65)	1.013(25.73)	3181-	3182-	3183-	3184-	3185-	3186-		.022		.23		1.24
0.18	0.813(20.65)	1.013(25.73)	3187-	3188-	3189-	3190-	3191-	3192-		.027		.27		1.40

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

STANDARD CAPACITORS
Style CRH03 (MIL-C-83421/1) - Continued
100 VOLTS (DC RATING)

Capacitance value (nom) (in µF)	Dimensions I/ (in inches with mm in parentheses)		Dash number Z/	AC ratings (for sinusoidal operation from 0 to 4 kHz)							
	L*.030(.76)	D +.020(.51) -.000		G, max	Capacitance tolerance value (in %)		Volts Current (in A)		Volts Current (in A)		
					±0.25	±1.0	±2.0	±5.0	±10.0	At 4 kHz	At 40 kHz
0.20	0.813(20.65)	0.312(7.92)	1.013(25.73)	3193-3194	3195-3196	3197-3198	60.0	.030	.30	30.0	1.50
0.22	0.813(20.65)	0.312(7.92)	1.013(25.73)	3199-3200	3201-3202	3203-3204	60.0	.033	.33	27.0	1.50
0.27	1.063(27.00)	0.400(10.16)	1.263(32.08)	3205-3206	3207-3208	3209-3210	60.0	.041	.41	24.0	1.62
0.33				3211-3212	3213-3214	3215-3216	60.0	.050	.50	23.0	1.90
0.39				3217-3218	3219-3220	3221-3222	60.0	.058	.58	22.0	2.15
0.47				3223-3224	3225-3226	3227-3228	60.0	.071	.71	21.0	2.47
0.5				3229-3230	3231-3232	3233-3234	60.0	.075	.75	20.0	2.50
0.56				3235-3236	3237-3238	3239-3240	60.0	.084	.84	19.0	2.64
0.68	1.125(28.58)	0.500(12.70)	1.325(33.66)	3241-3242	3243-3244	3245-3246	60.0	.10	1.02	16.0	2.72
0.82		0.500(12.70)		3247-3248	3249-3250	3251-3252	60.0	.12	1.23	14.0	2.67
1.00		0.562(14.72)		3253-3254	3255-3256	3257-3258	60.0	.15	1.50	12.0	3.00
1.20		0.562(14.72)		3259-3260	3261-3262	3263-3264	60.0	.18	1.80	11.0	3.25
1.50	1.375(34.93)	0.562(14.72)	1.575(40.01)	3265-3266	3267-3268	3269-3270	60.0	.23	2.26	10.0	3.75
2.0	1.375(34.93)	0.670(17.02)	1.575(40.01)	3271-3272	3273-3274	3275-3276	60.0	.30	3.00	8.1	4.10
2.2	1.375(34.93)	0.670(17.02)	1.575(40.01)	3277-3278	3279-3280	3281-3282	60.0	.33	3.31	7.5	4.12
2.7	1.875(47.63)		2.075(52.71)	3283-3284	3285-3286	3287-3288	60.0	.41	4.05	6.5	4.40
3.0				3289-3290	3291-3292	3293-3294	60.0	.45	4.51	6.0	4.51
3.3				3295-3296	3297-3298	3299-3300	60.0	.50	55.0	5.5	4.55
3.9		0.750(19.05)		3301-3302	3303-3304	3305-3306	60.0	.59	49.0	5.0	4.90
4.7				3313-3314	3315-3316	3317-3318	60.0	.71	43.0	5.00	5.00
5.0				3319-3320	3321-3322	3323-3324	60.0	.75	40.0	4.0	
5.6				3325-3326	3327-3328	3329-3330	60.0	.84	36.0	3.6	
6.8	2.375(60.33)	1.000(25.40)	2.575(65.41)	3331-3332	3333-3334	3335-3336	60.0	1.02	29.0	3.0	
8.0				3337-3338	3339-3340	3341-3342	60.0	1.20	25.0	2.5	
8.2				3343-3344	3345-3346	3347-3348	60.0	1.23	24.4	2.4	
10.0				3349-3350	3351-3352	3353-3354	60.0	1.50	20.0	2.0	

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

MI L-STD-198E

STANDARD CAPACITORS
Style CRH04 (MIL-C-83421/1)
200 VOLTS (DC RATING)

Capacitance value (in μ F)	Dimensions I/ (in inches with mm in parentheses)		Dash number 2/ Capacitance tolerance value (in %)	AC ratings (for sinusoidal operation from 65°C to +100°C)					
	L \pm .030(.76)	D + .020(.51) - .000		G, max	0 to .4 kHz		At 4 kHz		
					Volts	Current (in A)		Volts	Current (in A)
0.001	0.562(14.27)	0.170(4.32)	0.762(19.35)	120.0	.001	120.0	.003	80.0	.020
0.0012				4005-4006-					
0.0015				4007-4008-					
0.0018				4009-4010-					
0.002				4011-4012-					
0.0022				4013-4014-					
0.0027				4015-4016-					
0.0033				4017-4018-					
0.0039				4019-4020-					
0.0047				4021-4022-					
0.005				4023-4024-					
0.0056				4025-4026-					
0.0068				4027-4028-					
0.0082				4029-4030-					
0.01				4031-4032-					
0.012				4033-4034-					
0.015				4035-4036-					
0.018				4037-4038-					
0.02				4039-4040-					
0.027				4041-4042-					
0.033				4043-4044-					
0.039				4045-4046-					
0.047				4047-4048-					
0.056				4049-4050-					
0.068				4051-4052-					
0.10				4053-4054-					
0.12				4055-4056-					
0.15				4057-4058-					
				4059-4060-					
				4061-4062-					
				4063-4064-					
				4065-4066-					
				4067-4068-					
				4069-4070-					
				4071-4072-					
				4073-4074-					
				4075-4076-					
				4077-4078-					
				4079-4080-					
				4081-4082-					
				4083-4084-					
				4085-4086-					
				4087-4088-					
				4089-4090-					
				4091-4092-					
				4093-4094-					
				4095-4096-					
				4097-4098-					
				4099-4100-					
				4101-4102-					
				4103-4104-					
				4105-4106-					
				4107-4108-					
				4109-4110-					
				4111-4112-					
				4113-4114-					
				4115-4116-					
				4117-4118-					
				4119-4120-					
				4121-4122-					
				4123-4124-					
				4125-4126-					
				4127-4128-					
				4129-4130-					
				4131-4132-					
				4133-4134-					
				4135-4136-					
				4137-4138-					
				4139-4140-					
				4141-4142-					
				4143-4144-					
				4145-4146-					
				4147-4148-					
				4149-4150-					
				4151-4152-					
				4153-4154-					
				4155-4156-					
				4157-4158-					
				4159-4160-					
				4161-4162-					
				4163-4164-					
				4165-4166-					
				4167-4168-					
				4169-4170-					
				4171-4172-					
				4173-4174-					
				4175-4176-					
				4177-4178-					
				4179-4180-					
				4181-4182-					
				4183-4184-					
				4185-4186-					

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS
Style CRH04 (MIL-C-83421/1) - Continued
200 VOLTS (DC RATING)

Capacitance value (nom) (in μ F)	Dimensions (in inches with mm in parentheses)		Dash number	AC ratings (for sinusoidal operation from 65°C to +100°C)						
	L	D		G, max	0 to 4 kHz		At 4 kHz		At 40 kHz	
					Volts	Current (in A)	Volts	Current (in A)	Volts	Current (in A)
	± 0.030 (.76)	± 0.020 (.51) -.000		Capacitance tolerance value (in %)		Capacitance tolerance value (in %)		Capacitance tolerance value (in %)		
				± 0.25	± 0.5	± 1.0	± 2.0	± 5.0	± 10.0	
0.18	1.375(34.93)	10.400(10.16)	1.575(40.01)	4187-4189	4188-4190	4191-4192	4193-4196	4197-4198	4199-4204	
0.20		0.400(10.16)		4195-4201	4196-4202	4203-4204	4205-4208	4209-4210	4211-4216	
0.22		0.400(10.16)		4212-4213	4214-4215	4216-4217	4218-4221	4222-4223	4224-4226	
0.27		0.500(12.70)		4227-4231	4232-4233	4234-4235	4236-4237	4238-4240	4241-4243	
0.33				4244-4248	4249-4250	4251-4252	4253-4254	4255-4256	4257-4258	
0.39				4259-4261	4262-4263	4264-4265	4266-4267	4268-4270	4271-4273	
0.47				4274-4277	4278-4279	4280-4281	4282-4283	4284-4285	4286-4287	
0.56				4288-4289	4290-4291	4292-4293	4294-4295	4296-4297	4298-4300	
0.68				4301-4302	4303-4304	4305-4306	4307-4308	4309-4310	4311-4312	
0.82	1.875(47.63)	0.562(14.27)	2.075(52.71)	4313-4315	4316-4317	4318-4319	4320-4321	4322-4323	4324-4325	
1.0				4326-4327	4328-4329	4330-4331	4332-4333	4334-4335	4336-4337	
1.2				4338-4339	4340-4341	4342-4343	4344-4345	4346-4347	4348-4349	
1.5				4350-4351	4352-4353	4354-4355	4356-4357	4358-4359	4360-4361	
1.8				4362-4363	4364-4365	4366-4367	4368-4369	4370-4371	4372-4373	
2.0				4374-4375	4376-4377	4378-4379	4380-4381	4382-4383	4384-4385	
2.2				4386-4387	4388-4389	4390-4391	4392-4393	4394-4395	4396-4397	
2.5				4398-4399	4400-4401	4402-4403	4404-4405	4406-4407	4408-4409	
2.7				4410-4411	4412-4413	4414-4415	4416-4417	4418-4419	4420-4421	
3.0				4422-4423	4424-4425	4426-4427	4428-4429	4430-4431	4432-4433	
3.3				4434-4435	4436-4437	4438-4439	4440-4441	4442-4443	4444-4445	
3.9	2.375(60.33)	1.000(25.40)	2.575(65.41)	4446-4447	4448-4449	4450-4451	4452-4453	4454-4455	4456-4457	

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

STANDARD CAPACITORS
Style CRH05 (MIL-C-83421/1)
400 VOLTS (DC RATING)

Capacitance Value (nom) (in μ F)	Dimensions 1/ (in inches with mm in parentheses)		Dash number 2/	AC ratings (for sinusoidal operation from 0 to 4 kHz 65°C to +100°C) 3/										
	L*.030(.76)	D +.020(.51) -.000		G, max	Capacitance tolerance value (in %)		Volts Current (in A)		Volts Current (in A)					
					\pm 0.25	\pm 0.5	\pm 1.0	\pm 2.0	\pm 5.0	\pm 10.0	At 4 kHz	At 40 kHz		
0.001	0.562(14.27)	0.193(4.90)	0.762(19.35)	5001-	5002-	5003-	5004-	5005-	5006-	240.0	.001	.006	100.0	.025
0.0012				5007-	5008-	5009-	5010-	5011-	5012-		.001	.007		.030
0.0015				5013-	5014-	5015-	5016-	5017-	5018-		.001	.009		.037
0.0018				5019-	5020-	5021-	5022-	5023-	5024-		.001	.011		.045
0.002				5025-	5026-	5027-	5028-	5029-	5030-		.001	.012		.050
0.0022				5031-	5032-	5033-	5034-	5035-	5036-		.001	.013		.055
0.0027		0.235(5.97)		5037-	5038-	5039-	5040-	5041-	5042-		.002	.016		.068
0.0033				5043-	5044-	5045-	5046-	5047-	5048-		.002	.020		.083
0.0039				5049-	5050-	5051-	5052-	5053-	5054-		.002	.023		.097
0.0047				5055-	5056-	5057-	5058-	5059-	5060-		.003	.028		.12
0.005				5061-	5062-	5063-	5064-	5065-	5066-		.003	.030		.13
0.0056				5067-	5068-	5069-	5070-	5071-	5072-		.003	.034		.14
0.0068	0.687(17.45)		0.887(22.53)	5073-	5074-	5075-	5076-	5077-	5078-		.004	.041		.17
0.0082				5079-	5080-	5081-	5082-	5083-	5084-		.005	.049		.21
0.01				5085-	5086-	5087-	5088-	5089-	5090-		.006	.060		.25
0.012				5091-	5092-	5093-	5094-	5095-	5096-		.007	.072		.30
0.015	0.813(20.65)		1.013(20.65)	5097-	5098-	5099-	5100-	5101-	5102-		.009	.090	94.0	.35
0.018		0.312(7.92)		5103-	5104-	5105-	5106-	5107-	5108-		.011	.11	90.0	.41
0.02				5109-	5110-	5111-	5112-	5113-	5114-		.012	.12	88.0	.44
0.022				5115-	5116-	5117-	5118-	5119-	5120-		.013	.13	85.0	.47
0.027				5121-	5122-	5123-	5124-	5125-	5126-		.016	.16	81.0	.55
0.033				5127-	5128-	5129-	5130-	5131-	5132-		.020	.20	78.0	.65
0.039				5133-	5134-	5135-	5136-	5137-	5138-		.023	.23	75.0	.73
0.047		0.400(10.16)		5139-	5140-	5141-	5142-	5143-	5144-		.028	.28	71.0	.83
0.050				5145-	5146-	5147-	5148-	5149-	5150-		.030	.30	70.0	.88
0.056				5151-	5152-	5153-	5154-	5155-	5156-		.034	.34	67.5	.95
0.068	1.063(27.00)		1.263(32.08)	5157-	5158-	5159-	5160-	5161-	5162-		.041	.41	60.0	1.02
0.082				5163-	5164-	5165-	5166-	5167-	5168-		.049	.49	50.0	1.03
0.10	1.063(27.00)		1.263(32.08)	5169-	5170-	5171-	5172-	5173-	5174-		.060	.60	46.0	1.20
0.12											.072	.72	44.5	1.34

See footnotes at end of figure.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

STANDARD CAPACITORS
Style CRH05 (MIL-C-83421/1) - Continued

Capacitance value (nom) (in μF)	Dimensions 1/ (in inches with mm in parentheses)		Dash number 2/	AC ratings (for sinusoidal operation from 0 to 4 kHz 65°C to $+100^\circ\text{C}$) 3/										
	L*.030(.76)	G, max		Capacitance tolerance value (in μF)		Volts (in A)		Current (in A)						
				+0.25	+0.5	+1.0	+2.0	+5.0	+10.0	At 4 kHz	At 40 kHz			
0.15	1.375(34.93)	0.400(10.16)	1.575(40.01)	5175-5277-	5176-5278-	4177-5279-	5178-5280-	5179-5281-	5180-5282-	240.0	.090	.83	40.0	1.50
0.18		0.500(12.70)		5181-5187-	5182-5188-	5183-5189-	5184-5190-	5185-5191-	5186-5192-		.11	.12	38.0	1.70
0.20		0.500(12.70)		5193-5199-	5194-5200-	5195-5201-	5196-5202-	5197-5203-	5198-5204-		.13	.16	37.0	1.85
0.22		0.500(12.70)		5205-5211-	5206-5212-	5207-5213-	5208-5214-	5209-5215-	5210-5216-		.20	.23	35.0	1.93
0.27		0.582(14.77)		5217-5223-	5218-5224-	5219-5225-	5220-5226-	5221-5227-	5222-5228-		.28	.30	33.0	2.24
0.33				5229-5235-	5230-5236-	5231-5237-	5232-5238-	5233-5239-	5234-5240-		.34	.41	32.0	2.65
0.39		1.875(47.63)	2.075(52.71)	5241-5247-	5242-5248-	5243-5249-	5244-5250-	5245-5251-	5246-5252-		.49	.60	31.0	3.14
0.47				5253-5259-	5254-5260-	5255-5261-	5256-5262-	5257-5263-	5258-5264-		.50	.72	30.0	3.75
0.50				5265-5266-	5266-5267-	5267-5268-	5268-5269-	5269-5270-	5270-5271-		.72	.90	29.0	4.05
0.56		0.750(19.05)									.60	.83	26.0	4.50
0.68		0.750(19.05)									.60	.83	23.4	4.80
0.82		0.750(19.05)									.60	.83	20.8	5.20
1.0		1.000(25.40)									.60	.83	18.3	5.50
1.2		2.375(60.33)	2.575(65.41)								.60	.83	16.0	6.00
1.5		2.375(60.33)	2.575(65.41)								.60	.83	15.0	6.80
1.8		2.375(60.33)	2.575(65.41)								.60	.83	14.0	7.00
2.0		2.375(60.33)	2.575(65.41)								.60	.83	14.0	7.00

1/ Dimensions are bare case sizes (see figure 804-1).

2/ The complete dash number will include the applicable FR level symbol (M, P, K, or S) as a suffix.

3/ For operation to $+125^\circ\text{C}$, linearly derate from 100 percent at $+100^\circ\text{C}$ to 50 percent at $+125^\circ\text{C}$.

FIGURE 804-1. Established reliability, metallized plastic dielectric, fixed capacitors - Continued.

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SECTION 900

CAPACITORS, FIXED, CERAMIC DIELECTRIC, ESTABLISHED RELIABILITY

<u>Section</u>	<u>Applicable specification</u>
901. Capacitors, Fixed, Ceramic Dielectric (General Purpose), Established Reliability - - - - -	MIL-C-39014
902. Capacitors, Fixed, Ceramic Dielectric (Temperature Compensating), Established Reliability - - - - -	MIL-C-20
903. Capacitors, Chip, Multiple Layer, Fixed, Ceramic Dielectric, Established Reliability - - - - -	MIL-C-55681

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SECTION 901

CAPACITORS, FIXED, CERAMIC DIELECTRIC, (GENERAL PURPOSE), ESTABLISHED RELIABILITY
STYLES CKR05, CKR06, CKR11, CKR12, CKR14, CKR15, CKR22, AND CKR23

(APPLICABLE SPECIFICATION: MIL-C-39014)

1. SCOPE. This section covers established reliability, general purpose, ceramic dielectric, insulated, fixed capacitors. These capacitors have failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on operation at full rated voltage at the maximum rated temperature.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are primarily designed for use where a small physical size with comparatively large electrical capacitance and high insulation resistance is required. Ceramic capacitors are substantially smaller than paper or mica units of the same capacitance and voltage rating. General-purpose ceramic capacitors are not intended for precision use but are suitable for use as by-pass, filter, and non-critical coupling elements in high-frequency circuits where appreciable changes in capacitance, caused by temperature variations, can be tolerated. These units are not recommended for use directly in frequency-determining circuits. Typical recommended applications include resistive-capacitance coupling for audio and radio frequency, RF and intermediate frequency cathode bypass, automatic volume control filtering, tone compensation, volume-control RF bypass, antenna coupling, and audio-plate RF bypass. All of these applications are of the type where dissipation factor is not critical, and moderate changes due to temperature, voltage, and frequency variations do not affect the proper functioning of the circuit. For example: An emitter bypass for 100 megahertz (MHz), having a nominal capacitance of 680 picofarads (pF), will give a capacitance reactance of 2.34 ohms. Since this reactance is very small compared with the emitter resistor, there would be no measurable effect on the 2.34-ohm value if the capacity should change by several percent due to a temperature variation, nor would a dissipation of 4 percent be noticeable.

Disk and thin-plated subminiature types are extremely compact and have an inherent low-series inductance due to their construction. The placement of the leads facilitates making close-coupled low-inductance connections and these capacitors are suitable for printed-circuit applications. High insulation resistance allows these capacitors to be used in vacuum-tube grid circuits; their extremely low leakage and small physical size make them suitable for use in transistor circuitry.

During circuit design, consideration should be given to the changes in dielectric constant caused by temperature, electric field intensity, applied frequency, and shelf aging.

2.1.1 Humid operating conditions. Ceramic dielectric materials are nonhygroscopic, effectively impermeable, and have practically no moisture absorption even after considerable exposure to humid conditions. Thus, these units are intended to operate, through their full temperature range, at relative humidities up to 95 percent. Nevertheless, the termination materials under moisture conditions are subject to ionic migration which can cause capacitor failure (see 2.8).

2.2 Construction. A ceramic capacitor consists of a ceramic dielectric on which a thin metallic film, usually silver, has been fired at very high temperatures. Terminal leads are attached to the electrodes by a pressure contact or by soldering. Ceramic capacitors are encapsulated to protect the dielectric from the environment and to electrically insulate the capacitor. The disk types are covered by an insulating resin, plastic, or ceramic; the thin-plated subminiature types may be in dipped, molded, or performed cases. The feed-through units are made of ceramic tubes modified for their required mounting. Because the constituent materials have molecular polar moments, the dielectric constants of some mixes reach hundreds (even thousands), of times the value of paper, mica, and plastic films. This results in ceramics having the largest capacitance-to-size ratios of all high-resistance dielectrics.

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2.3 DC voltage rating. These capacitors are available in a wide voltage range which varies with the capacitor style. The voltage range varies from 50 volts dc to 200 volts dc.

2.4 Soldering. Care should be used in soldering the leads. Excessive heat may damage the encapsulation and weaken the electrode to terminal lead contact. Sudden changes in temperature, such as those experienced in soldering, can crack the encapsulation or the ceramic dielectric. Leads should not be bent close to the case nor should any strain be imposed on the capacitor body to avoid fracturing the encapsulation or ceramic dielectric.

2.5 Dissipation factor. For the recommended applications, the dissipation factor is negligibly low. The power factor decreases as temperature is increased; this provides an advantage where operation above room temperature is required.

2.6 Case insulation. It is not intended that the case insulation be subjected to sustained voltage in excess of 150 percent of the dc rated voltage of the capacitor. Supplementary insulation should be provided where the case may come in contact with higher voltage.

2.7 Capacitance as a function of operating conditions. The dielectric constant of these capacitors exhibits a considerable dependence on field strength. Large variations in capacitance may be experienced with changes in ac or dc voltages. The dielectric constant may decrease with time and may be as low as 75 percent of the original value after 1,000 hours. The dielectric constant is dependent on frequency and decreases as the frequency is increased; it also decreases with temperature.

2.8 Silver migration. When silver electrodes in the ceramic capacitor are exposed to high humidities and high dc potentials, silver ion migration may take place and short circuit capacitors after relatively short periods of time. Excessive moisture during periods of storage should be avoided since the encapsulation material may absorb moisture and silver ion migration may occur when the capacitors are later put into service.

2.9 Operating temperature range. These capacitors are suitable for operation over a temperature range of -55° to $+125^{\circ}\text{C}$.

2.10 Failure-rate level determination. The curves presented on figure 901-1 are the best engineering approximation of the reliability characteristics (random failures) for these capacitors when employed repeatedly, within their specification ratings, in complex electronic equipment. These reliability characteristics are based on ground-level severity experience. Failures are considered to be opens, shorts, or radical departures from initial characteristics. The failures are considered to be occurring in an unpredictable manner and in too short a period of time to permit detection through normal preventive maintenance. The curves shown on figure 901-1 are based on "catastrophic failures" and will differ from the failure rates established in the specification, since the established failure rates are based on "parametric failures" over long term life tests at rated conditions. This figure has been extracted from MIL-HDBK-217, "Reliability Stress and Failure Rate Data for Electronic Equipment." The curves have been modified from their original versions in that the ordinate has been normalized in order to provide multiplier factors in place of discrete failure rate levels and in order that the multiplying factor for a failure rate at rated conditions is unity. As indicated, these curves are the best estimates based on "catastrophic failure"; however, they can provide an estimate of the relative effect of operating under conditions other than rated.

3. ITEM IDENTIFICATION

3.1 Standard capacitors. The standard capacitors available in this section are shown in figure 901-2. (The figure gives the electrical characteristics, failure rate levels, and Military part numbers which are standard for design.)

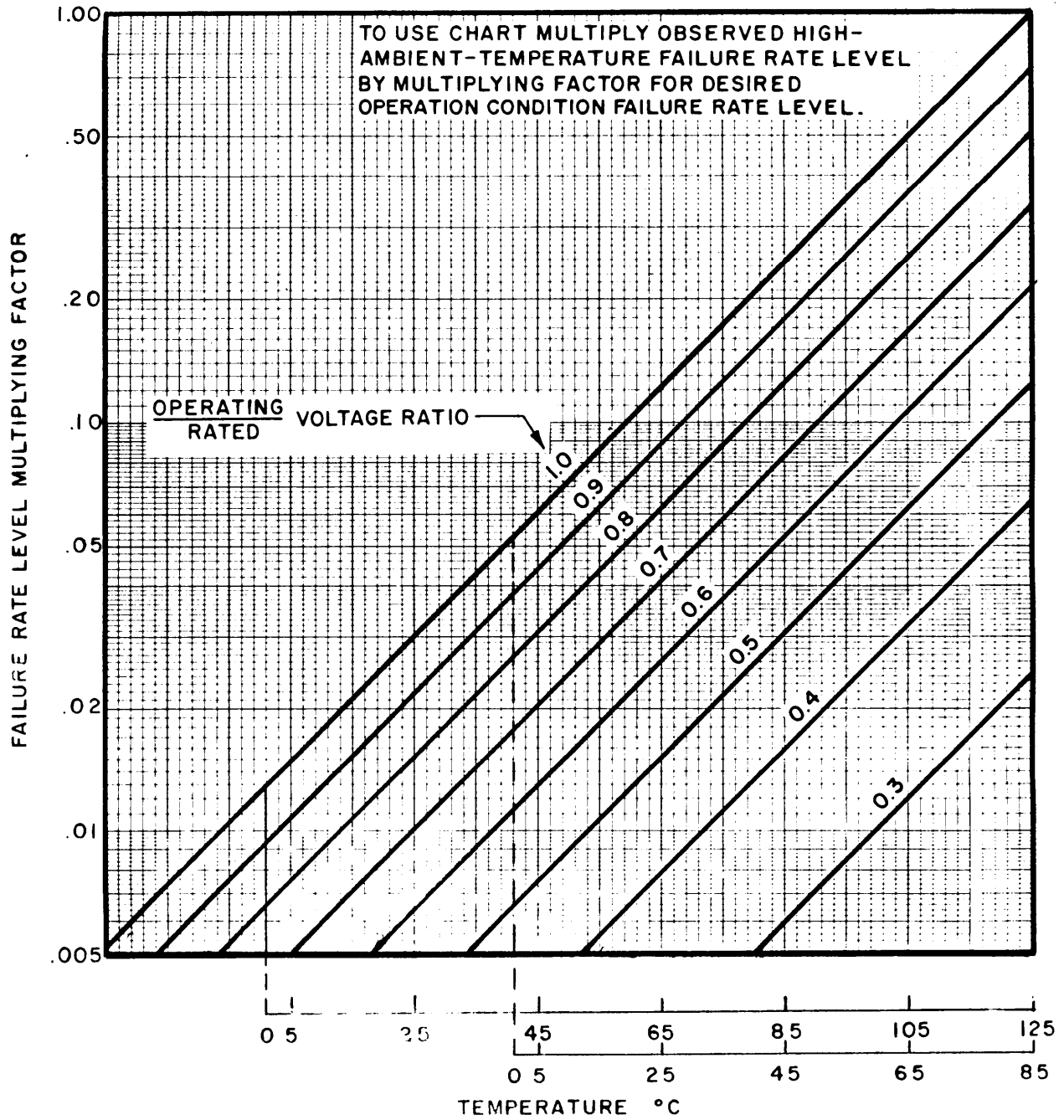


FIGURE 901-1. Failure rate level curves.

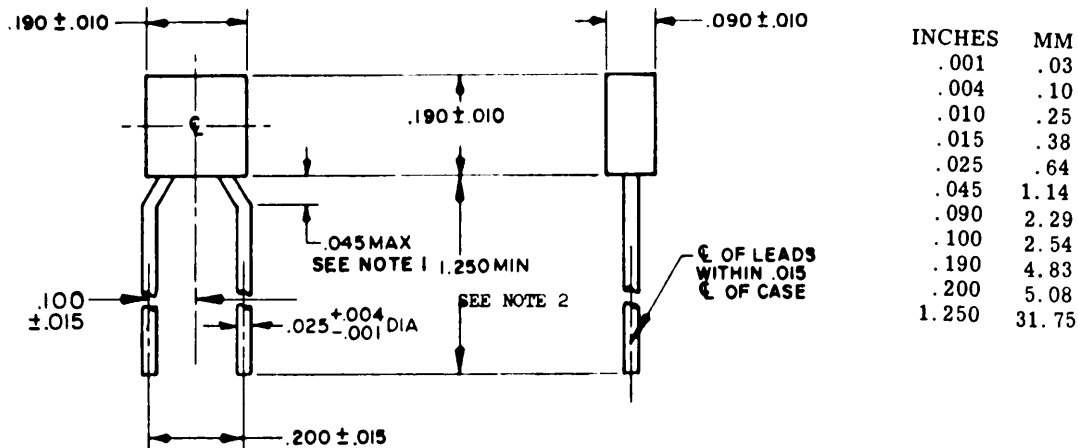
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STANDARD CAPACITORS

STYLE CKR05 (MIL-C-39014/1)

NATO TYPE DESIGNATION: NCC61

OPERATING TEMPERATURE RANGE -55° TO $+125^{\circ}\text{C}$ -- VOLTAGE TEMPERATURE LIMITS
(CAP. CHANGE WITH REFERENCE TO $+125^{\circ}\text{C}$) ± 15 PERCENT WITH ZERO VOLTS APPLIED
AND $+25$, -25 PERCENT WITH DC RATED VOLTAGE APPLIED



NOTES:

- For flush mounting, a .078(1.98 mm) printed-circuit-hole diameter is required to clear shoulder.
- Lead length may be minimum of one inch long for use in tape and reel automatic insertion equipment, when specified.

DC rated voltage	Capacitance value	Capacitance tolerance	Part number M39014/01-			
			Failure rate level in % 1,000 hours			
			1.0(M)	0.1(P)	0.01(R)	0.001(S)
volts	pF	percent				
200	10	± 10	1201	1241	1281	1321
	10	± 20	1202	1242	1282	1322
	12	± 10	1203	1243	1283	1323
	15	± 10	1204	1244	1284	1324
	15	± 20	1205	1245	1285	1325
	18	± 10	1206	1246	1286	1326
	22	± 10	1207	1247	1287	1327
	22	± 20	1208	1248	1288	1328
	27	± 10	1209	1249	1289	1329
	33	± 10	1210	1250	1290	1330
	33	± 20	1211	1251	1291	1331
	39	± 10	1212	1252	1292	1332
	47	± 10	1213	1253	1293	1333
	47	± 20	1214	1254	1294	1334
	56	± 10	1215	1255	1295	1335
	68	± 10	1216	1256	1296	1336
	68	± 20	1217	1257	1297	1337
	82	± 10	1218	1258	1298	1338
	100	± 10	1219	1259	1299	1339
	100	± 20	1220	1260	1300	1340
120	± 10	1221	1261	1301	1341	
150	± 10	1222	1262	1302	1342	
150	± 20	1223	1263	1303	1343	
180	± 10	1224	1264	1304	1344	
220	± 10	1225	1265	1305	1345	

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors.

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STANDARD CAPACITORS

STYLE CKR05 (MIL-C-39014/1) -Continued

OPERATING TEMPERATURE RANGE -55° TO +125°C -- VOLTAGE TEMPERATURE LIMITS (CAP. CHANGE WITH REFERENCE TO +25°C) ±15 PERCENT WITH ZERO VOLTS APPLIED AND +15, -25 PERCENT WITH DC RATED VOLTAGE APPLIED

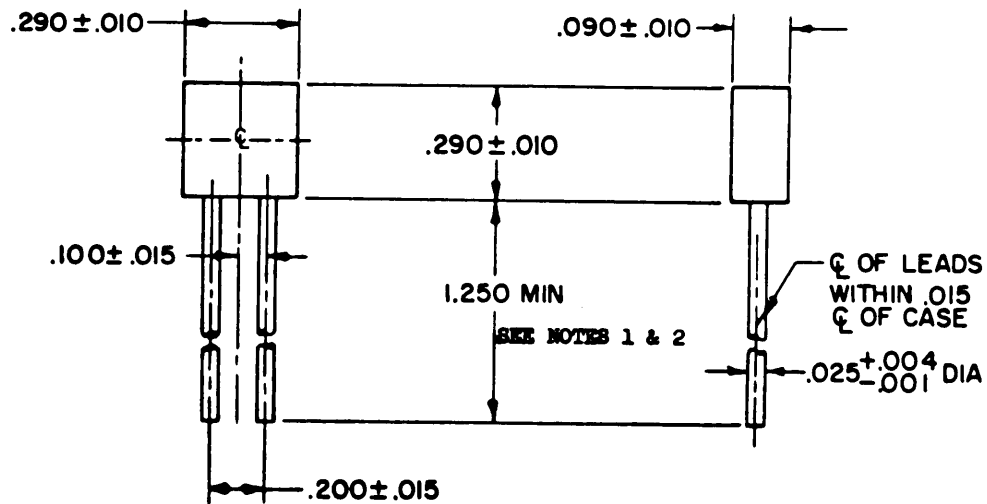
DC rated voltage	Capacitance value	Capacitance tolerance	Part number M39014/01-				
			Failure rate level in % 1,000 hours				
			1.0(M)	0.1(P)	0.01(R)	0.001(S)	
<u>volts</u> 200	<u>pF</u>	<u>percent</u>					
↓	220	±20	1226	1266	1306	1346	
	270	±10	1227	1267	1307	1347	
	330	±10	1228	1268	1308	1348	
	330	±20	1229	1269	1309	1349	
	390	±10	1230	1270	1310	1350	
	470	±10	1231	1271	1311	1351	
	470	±20	1232	1272	1312	1352	
	560	±10	1233	1273	1313	1353	
	680	±10	1234	1274	1314	1354	
	680	±20	1235	1275	1315	1355	
	820	±10	1236	1276	1316	1356	
	1,000	±10	1237	1277	1317	1357	
	1,000	±20	1238	1278	1318	1358	
	↓	1,200	±10	1239	1279	1319	1359
		1,500	±10	1240	1280	1320	1360
		1,500	±20	1441	1481	1521	1561
1,800		±10	1442	1482	1522	1562	
2,200		±10	1443	1483	1523	1563	
2,200		±20	1444	1484	1524	1564	
2,700		±10	1445	1485	1525	1565	
3,300		±10	1446	1486	1526	1566	
3,300		±20	1447	1487	1527	1567	
3,900		±10	1448	1488	1528	1568	
4,700		±10	1449	1489	1529	1569	
4,700		±20	1450	1490	1530	1570	
5,600		±10	1451	1491	1531	1571	
6,800		±10	1452	1492	1532	1572	
6,800		±20	1453	1493	1533	1573	
↓		8,200	±10	1454	1494	1534	1574
	10,000	±10	1455	1495	1535	1575	
	10,000	±20	1456	1496	1536	1576	
	↓	12,000	±10	1457	1497	1537	1577
		15,000	±10	1458	1498	1538	1578
		15,000	±20	1459	1499	1539	1579
		18,000	±10	1460	1500	1540	1580
		22,000	±10	1461	1501	1541	1581
		22,000	±20	1462	1502	1542	1582
		27,000	±10	1463	1503	1543	1583
		33,000	±10	1464	1504	1544	1584
		33,000	±20	1465	1505	1545	1585
		39,000	±10	1466	1506	1546	1586
		47,000	±10	1467	1507	1547	1587
		47,000	±20	1468	1508	1548	1588
		56,000	±10	1469	1509	1549	1589
68,000		±10	1470	1510	1550	1590	
68,000		±20	1471	1511	1551	1591	
82,000		±10	1472	1512	1552	1592	
100,000	±10	1473	1513	1553	1593		
100,000	±20	1474	1514	1554	1594		

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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STYLE CKR06

NATO TYPE DESIGNATION: NCC62



INCHES	MM
.001	.03
.004	.10
.010	.25
.015	.38
.025	.64
.090	2.29
.100	2.54
.200	5.08
.290	7.37
1.250	31.75

NOTES:

1. For flush mounting, a .078 (1.98 mm) minimum printed-circuit-hole diameter is required to clear shoulder.
2. Lead length may be a minimum of one inch long for use in tape and reel automatic insertion equipment, when specified.

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

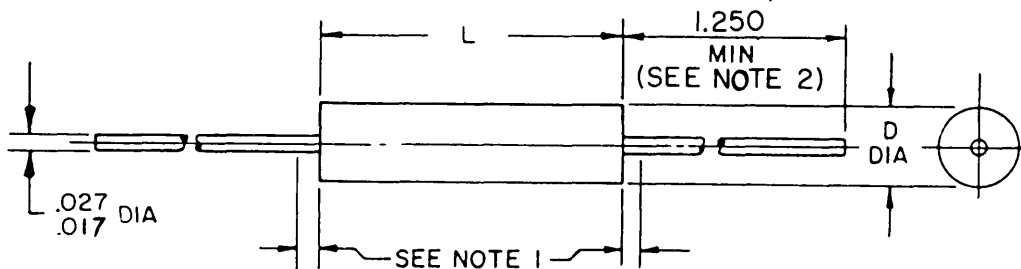
STYLE CKR06 (MIL-C-39014/2)

OPERATING TEMPERATURE RANGE -55° TO + 125°C -- VOLTAGE TEMPERATURE LIMITS
 (CAP. CHANGE WITH REFERENCE TO +25°C) ±15 PERCENT WITH ZERO VOLTS APPLIED
 AND +15, -25 PERCENT WITH DC RATED VOLTAGE APPLIED

DC rated voltage	Capacitance value	Capacitance tolerance	Part number M39014/02 -			
			Failure rate level in % 1,000 hours			
			1.0(M)	0.1(P)	0.01(R)	0.001(S)
<u>volts</u>	<u>pF</u>	<u>percent</u>				
200 ↓	1,200	±10	1201	1241	1281	1321
	1,500	±10	1202	1242	1282	1322
	1,500	±20	1203	1243	1283	1323
	1,800	±10	1204	1244	1284	1324
	2,200	±10	1206	1246	1286	1326
	2,200	±20	1207	1247	1287	1327
	2,700	±10	1208	1248	1288	1328
	3,300	±10	1209	1249	1289	1329
	3,300	±20	1210	1250	1290	1330
	3,900	±10	1211	1251	1291	1331
	4,700	±10	1212	1252	1292	1332
	4,700	±20	1213	1253	1293	1333
	5,600	±10	1214	1254	1294	1334
	6,800	±10	1215	1255	1295	1335
	6,800	±20	1216	1256	1296	1336
	8,200	±10	1217	1257	1297	1337
	10,000	±10	1218	1258	1298	1338
	10,000	±20	1219	1259	1299	1339
	100 ↓	12,000	±10	1231	1271	1311
15,000			1220	1260	1300	1340
18,000			1221	1261	1301	1341
22,000			1222	1262	1302	1342
27,000			1232	1272	1312	1352
33,000			1223	1263	1303	1343
39,000			1224	1264	1304	1344
47,000			1225	1265	1305	1345
56,000			1226	1266	1306	1346
68,000			1227	1267	1307	1347
82,000			1229	1269	1309	1349
100,000		1230	1270	1310	1350	
50 ↓	120,000		1233	1273	1313	1353
	150,000		1234	1274	1314	1354
	180,000		1235	1275	1315	1355
	220,000		1236	1276	1316	1356
	270,000		1237	1277	1317	1357
	330,000		1238	1278	1318	1358
	390,000		1239	1279	1319	1359
	470,000		1240	1280	1320	1360
	560,000		1404	1408	1412	1416
	680,000		1405	1409	1413	1417
	820,000		1406	1410	1414	1418
1,000,000		1407	1411	1415	1419	

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

STYLES CKR11, CKR12, CKR14, AND CKR15
 NATO TYPE DESIGNATIONS: NCC75, 72 & 73



Style	Dimensions		
	L	D	C
CKR11	.160 ±.010	.090 ±.010	.019 ±.002
CKR12	.250 ±.010	.090 ±.010	.019 ±.002
CKR14	.390 ±.010	.140 ±.010	.025 ±.002
CKR15	.500 ±.020	.250 ±.015	.025 ±.002

INCHES	MM	INCHES	MM
.002	.05	.090	2.29
.010	.25	.140	3.56
.015	.38	.160	4.06
.019	.42	.250	6.35
.020	.51	.390	9.91
.025	.64	.500	12.70
.027	.69	1.250	31.75

NOTE:

1. Nonconductive material does not extend beyond .010 (.25 mm) from end of capacitor body.
2. Lead length may be a minimum of one inch long for use in tape and reel automatic insertion equipment, when specified.

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

CKR12, CKR14, AND CKR15 (MIL-C-39014/5)

OPERATING TEMPERATURE RANGE -55° TO +125°C -- VOLTAGE TEMPERATURE LIMITS
(CAP. CHANGE WITH REFERENCE TO +25°C) ±15 PERCENT WITH ZERO VOLTS APPLIED
AND +15, -25 PERCENT WITH DC RATED VOLTAGE APPLIED

Style	DC rated voltage	Capacitance value	Capacitance tolerance	Part number M39014/05-			
				Failure rate level in % 1,000 hours			
				1.0(M)	0.1(P)	0.01(R)	0.001(S)
	<u>volts</u>	<u>pF</u>	<u>percent</u>				
CKR11	100	10	± 10	2601	2801	2001	2201
		10	± 20	2602	2802	2002	2202
		12	± 10	2603	2803	2003	2203
		15	± 10	2604	2804	2004	2204
		15	± 20	2605	2805	2005	2205
		18	± 10	2606	2806	2006	2206
		22	± 10	2607	2807	2007	2207
		22	± 20	2608	2808	2008	2208
		27	± 10	2609	2809	2009	2209
		33	± 10	2610	2810	2010	2210
		33	± 20	2611	2811	2011	2211
		39	± 10	2612	2812	2012	2212
		47	± 10	2613	2813	2013	2213
		47	± 20	2614	2814	2014	2214
		56	± 10	2615	2815	2015	2215
		68	± 10	2616	2816	2016	2216
		68	± 20	2617	2817	2017	2217
		82	± 10	2618	2818	2018	2218
		100	± 10	2619	2819	2019	2219
		100	± 20	2620	2820	2020	2220
		120	± 10	2621	2821	2021	2221
		150	± 10	2622	2822	2022	2222
		150	± 20	2623	2823	2023	2223
		180	± 10	2624	2824	2024	2224
		220	± 10	2625	2825	2025	2225
		220	± 20	2626	2826	2026	2226
		270	± 10	2627	2827	2027	2227
		330	± 10	2628	2828	2028	2228
		330	± 20	2629	2829	2029	2229
		390	± 10	2630	2830	2030	2230
		470	± 10	2631	2831	2031	2231
		470	± 20	2632	2832	2032	2232
		560	± 10	2633	2833	2033	2233
		680	± 10	2634	2834	2034	2234
		680	± 20	2635	2835	2035	2235
		820	± 10	2636	2836	2036	2236
		1,000	± 10	2637	2837	2037	2237
		1,000	± 20	2638	2838	2038	2238
		1,200	± 10	2639	2839	2039	2239
		1,500	± 10	2640	2840	2040	2240
1,500	± 20	2641	2841	2041	2241		
1,800	± 10	2642	2842	2042	2242		
2,200	± 10	2643	2843	2043	2243		
2,200	± 20	2644	2844	2044	2244		
2,700	± 10	2645	2845	2045	2245		
3,300	± 10	2646	2846	2046	2246		
3,300	± 20	2647	2847	2047	2247		
3,900	± 10	2648	2848	2048	2248		
4,700	± 10	2649	2849	2049	2249		
4,700	± 20	2650	2850	2050	2250		

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric,
fixed capacitors - Continued.

901 (MIL-C-39014)

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STANDARD CAPACITORS

STYLES CKR11, CKR12, CKR14, CKR14, AND CKR15 (MIL-C-39014/5) - Continued

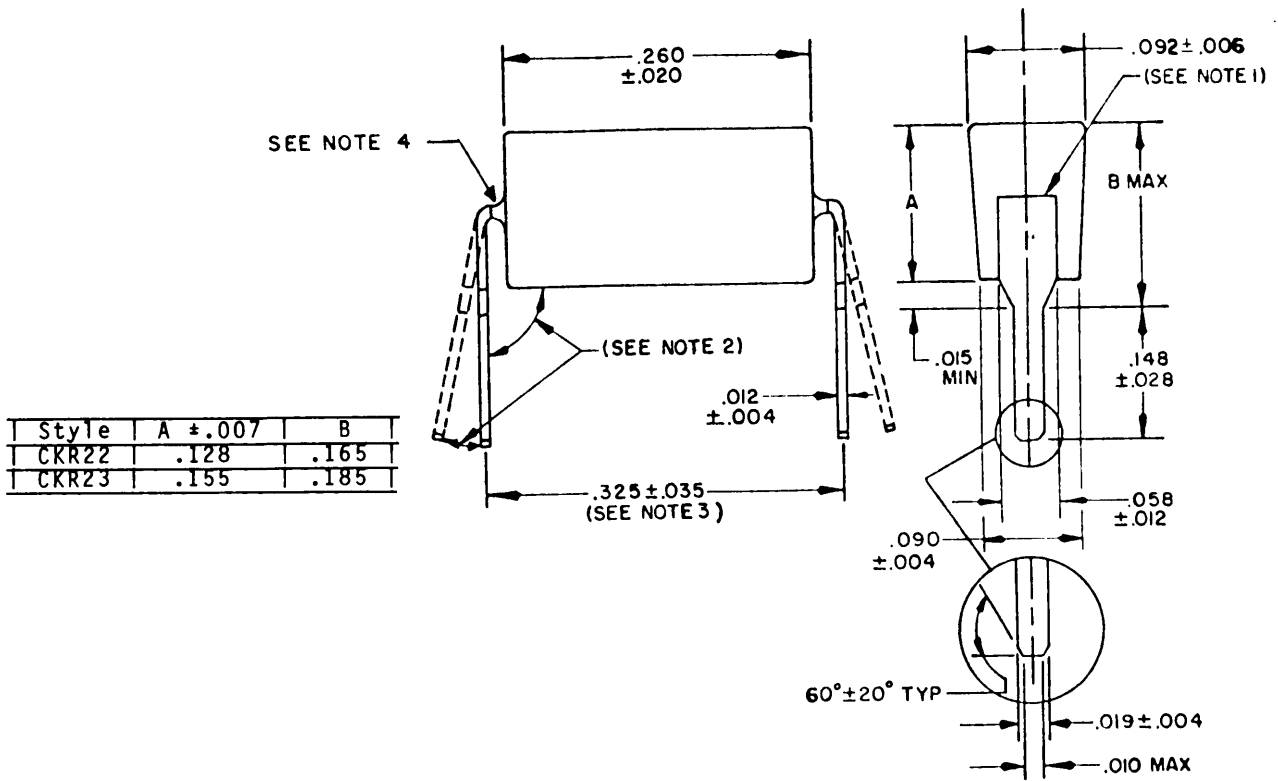
OPERATING TEMPERATURE RANGE -55° TO +125°C -- VOLTAGE TEMPERATURE LIMITS
 (CAP. CHANGE WITH REFERENCE TO +25°C) ±15 PERCENT WITH ZERO VOLTS APPLIED
 AND +15, -25 PERCENT WITH DC RATED VOLTAGE APPLIED

Style	DC rated voltage	Capacitance value	Capacitance tolerance	Part number M39014/05 -					
				Failure rate level in $\%$ 1,000 hours					
				1.0(M)	0.1(P)	0.01(R)	0.001(S)		
CKR11	50 ↓	5,600	±10	2651	2851	2051	2251		
		6,800	±10	2652	2852	2052	2252		
		6,800	±20	2653	2853	2053	2253		
		8,200	±10	2654	2854	2054	2254		
		10,000	±10	2655	2855	2055	2255		
		10,000	±20	2656	2856	2056	2256		
		CKR12	100 ↓ 50 ↓	5,600	±10	2657	2857	2057	2257
				6,800	±10	2658	2858	2058	2258
6,800	±20			2659	2859	2059	2259		
8,200	±10			2660	2860	2060	2260		
10,000	±10			2661	2861	2061	2261		
10,000	±20			2662	2862	2062	2262		
12,000	±10			2663	2863	2063	2263		
15,000	±10			2664	2864	2064	2264		
CKR14	100 ↓ 50 ↓	15,000	±20	2665	2865	2065	2265		
		18,000	±10	2666	2866	2066	2266		
		22,000	±10	2667	2867	2067	2267		
		22,000	±20	2668	2868	2068	2268		
		27,000	±10	2669	2869	2069	2269		
		33,000	±10	2670	2870	2070	2270		
		33,000	±20	2671	2871	2071	2271		
		39,000	±10	2672	2872	2072	2272		
		47,000	±10	2673	2873	2073	2273		
		47,000	±20	2674	2874	2074	2274		
		12,000	±10	2675	2875	2075	2275		
		15,000	±10	2676	2876	2076	2276		
		15,000	±20	2677	2877	2077	2277		
		18,000	±10	2678	2878	2078	2278		
CKR15	100 ↓ 50 ↓	22,000	±10	2679	2879	2079	2279		
		22,000	±20	2680	2880	2080	2280		
		27,000	±10	2681	2881	2081	2281		
		33,000	±10	2682	2882	2082	2282		
		33,000	±20	2683	2883	2083	2283		
		39,000	±10	2684	2884	2084	2284		
		47,000	±10	2685	2885	2085	2285		
		47,000	±20	2686	2886	2086	2286		
		56,000	±10	2687	2887	2087	2287		
		68,000	±10	2688	2888	2088	2288		
CKR15	100 ↓	68,000	±20	2689	2889	2089	2289		
		82,000	±10	2690	2890	2090	2290		
		100,000	±10	2691	2891	2091	2291		
		100,000	±20	2692	2892	2092	2292		
		56,000	±10	2706	2906	2106	2306		
		68,000	±10	2707	2907	2107	2307		
		68,000	±20	2708	2908	2108	2308		
82,000	±10	2709	2909	2109	2309				
100,000	±10	2710	2910	2110	2310				
100,000	±20	2711	2911	2111	2311				

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS
 STYLE CKR22 AND CKR23



Style	A $\pm .007$	B
CKR22	.128	.165
CKR23	.155	.185

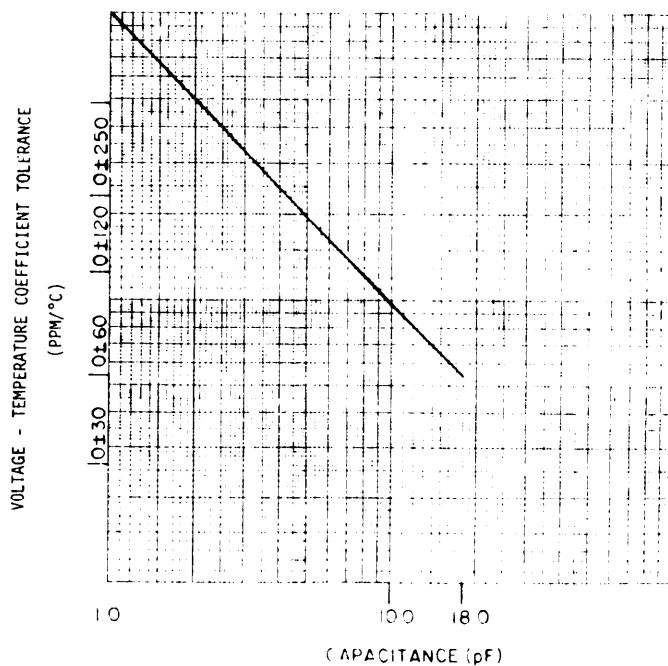
INCHES	MM	INCHES	MM
.004	.10	.090	2.29
.006	.15	.092	2.34
.007	.18	.128	3.25
.010	.25	.148	3.76
.012	.30	.155	3.94
.015	.38	.165	4.19
.019	.48	.185	4.70
.020	.51	.260	6.60
.028	.71	.283	7.19
.035	.89	.320	8.13
.058	1.47	.325	8.26

NOTES:

1. Leads shall be centered within $\pm .005$ inches (.13 mm).
2. The angle shall be $95^\circ \pm 10 - 5^\circ$.
3. The distance between the centers of the mounting holes will be $.300 \pm .010$ inches (7.62 \pm .25 mm).
4. Nonconductive material shall not extend beyond .030 inches (.76 mm) from the edge of the capacitor body.

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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MIL-STD-198E

STANDARD CAPACITORS

STYLE CKR22

OPERATING TEMPERATURE RANGE -55° TO +125°C

Dash number				Capacitance (pF)	Capacitance tolerance	DC rated voltage (volts)
Failure rate level (%/1,000 hours)						
1.0(M)	0.1(P)	0.01(R)	0.001(S)			
Style CKR22, see figure 901-2 for voltage-temperature limits below 20 pF						
0001	0301	0601	0901	1.0	D	200
0004	0304	0604	0904	1.2	D	"
0007	0307	0607	0907	1.5	D	"
0010	0310	0610	0910	1.8	D	"
0013	0313	0613	0913	2.2	D	"
0016	0316	0616	0916	2.7	D	"
0019	0319	0619	0919	3.3	D	"
0022	0322	0622	0922	3.9	D	"
0025	0325	0625	0925	4.7	D	"
0028	0328	0628	0928	5.6	D	"
0031	0331	0631	0931	6.8	D	"
0034	0334	0634	0934	8.2	D	"
0037	0337	0637	0937	10	D	"
0038	0338	0638	0938	10	J	"
0039	0339	0639	0939	10	K	"
0040	0340	0640	0940	12	D	"
0041	0341	0641	0941	12	J	"
0042	0342	0642	0942	12	K	"
0043	0343	0643	0943	15	D	"
0044	0344	0644	0944	15	J	"
0045	0345	0645	0945	15	K	"
0046	0346	0646	0946	18	D	"
0047	0347	0647	0947	18	J	"
0048	0348	0648	0948	18	K	"
Style CKR22, Voltage-temperature limits of 0 ±30 ppm/°C.						
0049	0349	0649	0949	22	D	200
0050	0350	0650	0950	22	J	"
0051	0351	0651	0951	22	K	"
0052	0352	0652	0952	27	D	"
0053	0353	0653	0953	27	J	"
0054	0354	0654	0954	27	K	"
0055	0355	0655	0955	33	D	"
0056	0356	0656	0956	33	J	"
0057	0357	0657	0957	33	K	"
0058	0358	0658	0958	39	D	"
0059	0359	0659	0959	39	J	"
0060	0360	0660	0960	39	K	"
0061	0361	0661	0961	47	D	"
0062	0362	0662	0962	47	J	"
0063	0363	0663	0963	47	K	"
0064	0364	0664	0964	56	D	"
0065	0365	0665	0965	56	J	"
0066	0366	0666	0966	56	K	"
0067	0367	0667	0967	68	F	"
0068	0368	0668	0968	68	J	"
0069	0369	0669	0969	68	K	"
0070	0370	0670	0970	82	F	"
0071	0371	0671	0971	82	J	"
0072	0372	0672	0972	82	K	"

FIGURE 907-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CKR22 - Continued

OPERATING TEMPERATURE RANGE -55°C TO +125°C

Dash number				Capacitance (pF)	Capacitance tolerance	DC rated voltage (volts)
Failure rate level (%/1,000 hours)						
1.0(M)	0.1(P)	0.01(R)	0.001(S)			
Style CKR22, Voltage-temperature limits of 0 ±30 ppm/°C. - Continued						
0073	0373	0673	0973	100	F	200
0074	0374	0674	0974	100	J	"
0075	0375	0675	0975	100	K	"
0076	0376	0676	0976	120	F	"
0077	0377	0677	0977	120	J	"
0078	0378	0678	0978	120	K	"
0079	0379	0679	0979	150	F	"
0080	0380	0680	0980	150	J	"
0081	0381	0681	0981	150	K	"
0082	0382	0682	0982	180	F	"
0083	0383	0683	0983	180	J	"
0084	0384	0684	0984	180	K	"
0085	0385	0685	0985	220	F	"
0086	0386	0686	0986	220	J	"
0087	0387	0687	0987	220	K	"
0088	0388	0688	0988	270	F	"
0089	0389	0689	0989	270	J	"
0090	0390	0690	0990	270	K	"
0091	0391	0691	0991	330	F	"
0092	0392	0692	0992	330	J	"
0093	0393	0693	0993	330	K	"
0094	0394	0694	0994	390	F	"
0095	0395	0695	0995	390	J	"
0096	0396	0696	0996	390	K	"
0097	0397	0697	0997	470	F	"
0098	0398	0698	0998	470	J	"
0099	0399	0699	0999	470	K	"
0100	0400	0700	1000	560	F	100
0101	0401	0701	1001	560	J	"
0102	0402	0702	1002	560	K	"
0103	0403	0703	1003	680	F	"
0104	0404	0704	1004	680	J	"
0105	0405	0705	1005	680	K	"
0106	0406	0706	1006	820	F	"
0107	0407	0707	1007	820	J	"
0108	0408	0708	1008	820	K	"
0109	0409	0709	1009	1,000	F	"
0110	0410	0710	1010	1,000	J	"
0111	0411	0711	1011	1,000	K	"
0112	0412	0712	1012	1,200	F	"
0113	0413	0713	1013	1,200	J	"
0114	0414	0714	1014	1,200	K	"
0115	0415	0715	1015	1,500	F	"
0116	0416	0716	1016	1,500	J	"
0117	0417	0717	1017	1,500	K	"
0118	0418	0718	1018	1,800	F	"
0119	0419	0719	1019	1,800	J	"
0120	0420	0720	1020	1,800	K	"
0121	0421	0721	1021	2,200	F	"
0122	0422	0722	1022	2,200	J	"
0123	0423	0723	1023	2,200	K	"

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLE CKR22 - Continued

OPERATING TEMPERATURE RANGE -55°C TO +125°

Dash number				Capacitance (pF)	Capacitance tolerance	DC rated voltage (volts)
Failure rate level (%/1,000 hours)						
1.0(M)	0.1(P)	0.01(R)	0.001(S)			
Style CKR22, Voltage-temperature limits of 0 ±30 ppm/°C. - Continued						
0124	0424	0724	1024	2,700	F	50
0125	0425	0725	1025	2,700	J	"
0126	0426	0726	1026	2,700	K	"
0127	0427	0727	1027	3,300	F	"
0128	0428	0728	1028	3,300	J	"
0129	0429	0729	1029	3,300	K	"
0130	0430	0730	1030	3,900	F	"
0131	0431	0731	1031	3,900	J	"
0132	0432	0732	1032	3,900	K	"
0133	0433	0733	1033	4,700	F	"
0134	0434	0734	1034	4,700	J	"
0135	0435	0735	1035	4,700	K	"
0136	0436	0736	1036	5,600	F	"
0137	0437	0737	1037	5,600	J	"
0138	0438	0738	1038	5,600	K	"
0139	0439	0739	1039	6,800	F	"
0140	0440	0740	1040	6,800	J	"
0141	0441	0741	1041	6,800	K	"
0142	0442	0742	1042	8,200	F	"
0143	0443	0743	1043	8,200	J	"
0144	0444	0744	1044	8,200	K	"
0145	0445	0745	1045	10,000	F	"
0146	0446	0746	1046	10,000	J	"
0147	0447	0747	1047	10,000	K	"
Style CKR22, Voltage-temperature limits of ±15% (and +15%, -25%)						
0148	0448	0748	1048	270	K	200
0149	0449	0749	1049	330	K	"
0150	0450	0750	1050	330	M	"
0151	0451	0751	1051	390	K	"
0152	0452	0752	1052	470	K	"
0153	0453	0753	1053	470	M	"
0154	0454	0754	1054	560	K	"
0155	0455	0755	1055	680	K	"
0156	0456	0756	1056	680	M	"
0157	0457	0757	1057	820	K	"
0158	0458	0758	1058	1,000	K	100
0159	0459	0759	1059	1,000	M	"
0160	0460	0760	1060	1,200	K	"
0161	0461	0761	1061	1,500	K	"
0162	0462	0762	1062	1,500	M	"
0163	0463	0763	1063	1,800	K	"
0164	0464	0764	1064	2,200	K	"
0165	0465	0765	1065	2,200	M	"
0166	0466	0766	1066	2,700	K	"
0167	0467	0767	1067	3,300	K	"
0168	0468	0768	1068	3,300	M	"
0169	0469	0769	1069	3,900	K	"
0170	0470	0770	1070	4,700	K	"

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CKR22 - Continued

OPERATING TEMPERATURE RANGE -55° TO +125°C

Dash number Failure rate level (%/1,000 hours)				Capacitance (pF)	Capacitance tolerance	DC rated voltage (volts)
1.0(M)	0.1(P)	0.01(R)	0.001(S)			
Style CKR22, Voltage-temperature limits of ±15% (and +15%, -25%) - Continued						
0171	0471	0771	1071	4,700	M	100
0172	0472	0772	1072	5,600	K	"
0173	0473	0773	1073	6,800	K	"
0174	0474	0774	1074	6,800	M	"
0175	0475	0775	1075	8,200	K	"
0176	0476	0776	1076	10,000	K	"
0177	0477	0777	1077	10,000	M	"
0178	0478	0778	1078	12,000	K	50
0179	0479	0779	1079	15,000	K	"
0180	0480	0780	1080	15,000	M	"
0181	0481	0781	1081	18,000	K	"
0182	0482	0782	1082	22,000	K	"
0183	0483	0783	1083	22,000	M	"
0184	0484	0784	1084	27,000	K	"
0185	0485	0785	1085	33,000	K	"
0186	0486	0786	1086	33,000	M	"
0187	0487	0787	1087	39,000	K	"
0188	0488	0788	1088	47,000	K	"
0189	0489	0789	1089	47,000	M	"
0190	0490	0790	1090	56,000	K	"
0191	0491	0791	1091	68,000	K	"
0192	0492	0792	1092	68,000	M	"
0193	0493	0793	1093	82,000	K	"
0194	0494	0794	1094	100,000	K	"
0195	0495	0795	1095	100,000	M	"

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CKR23

OPERATING TEMPERATURE RANGE -55°C TO +125°C

Dash number Failure rate level (%/1,000 hours)				Capacitance (pF)	Capacitance tolerance	DC rated voltage (volts)
1.0(M)	0.1(P)	0.01(R)	0.001(S)			
Style CKR23, Voltage-temperature limits of 0 ±30 ppm/°C						
0258	0558	0858	1158	560	F	200
0259	0559	0859	1159	560	J	"
0260	0560	0860	1160	560	K	"
0261	0561	0861	1161	680	F	"
0262	0562	0862	1162	680	J	"
0263	0563	0863	1163	680	K	"
0264	0564	0864	1164	820	F	"
0265	0565	0865	1165	820	J	"
0266	0566	0866	1166	820	K	"
0267	0567	0867	1167	1,000	F	"
0268	0568	0868	1168	1,000	J	"
0269	0569	0869	1169	1,000	K	"
0270	0570	0870	1170	1,200	F	"
0271	0571	0871	1171	1,200	J	"
0272	0572	0872	1172	1,200	K	"
0273	0573	0873	1173	2,700	F	100
0274	0574	0874	1174	2,700	J	"
0275	0575	0875	1175	2,700	K	"
0276	0576	0876	1176	3,300	F	"
0277	0577	0877	1177	3,300	J	"
0278	0578	0878	1178	3,300	K	"
0279	0579	0879	1179	4,700	F	50
0280	0580	0880	1180	4,700	J	"
0281	0581	0881	1181	4,700	K	"
0282	0582	0882	1182	5,600	F	"
0283	0583	0883	1183	5,600	J	"
0284	0584	0884	1184	5,600	K	"
0285	0585	0885	1185	6,800	F	"
0286	0586	0886	1186	6,800	J	"
0287	0587	0887	1187	6,800	K	"
0288	0588	0888	1188	8,200	F	"
0289	0589	0889	1189	8,200	J	"
0290	0590	0890	1190	8,200	K	"
0291	0591	0891	1191	10,000	F	"
0292	0592	0892	1192	10,000	J	"
0293	0593	0893	1193	10,000	K	"
Style CKR23, Voltage-temperature limits of +15% and +15, -25% - Continued.						
0196	0496	0796	1096	1,000	K	200
0197	0497	0797	1097	1,000	M	"
0198	0498	0798	1098	1,200	K	"
0199	0499	0799	1099	1,500	K	"
0200	0500	0800	1100	1,500	M	"
0201	0501	0801	1101	1,800	K	"
0202	0502	0802	1102	2,200	K	"
0203	0503	0803	1103	2,200	M	"
0204	0504	0804	1104	2,700	K	"
0205	0505	0805	1105	3,300	K	"
0206	0506	0806	1106	3,300	M	"

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLE CKR23 - Continued

OPERATING TEMPERATURE RANGE -55° TO +125°C

Dash number				Capacitance (pF)	Capacitance tolerance	DC rated voltage (volts)
Failure rate level (%/1,000 hours)						
1.0(M)	0.1(P)	0.01(R)	0.001(S)			
Style CKR23, Voltage-temperature limits of +15% and +15, -25% - Continued.						
0207	0507	0807	1107	3,900	K	200
0208	0508	0808	1108	4,700	K	"
0209	0509	0809	1109	4,700	M	"
0210	0510	0810	1110	5,600	K	"
0211	0511	0811	1111	6,800	K	"
0212	0512	0812	1112	6,800	M	"
0213	0513	0813	1113	8,200	K	"
0214	0514	0814	1114	10,000	K	"
0215	0515	0815	1115	10,000	M	"
0216	0516	0816	1116	12,000	K	100
0217	0517	0817	1117	15,000	K	"
0218	0518	0818	1118	15,000	M	"
0219	0519	0819	1119	18,000	K	"
0220	0520	0820	1120	22,000	K	"
0221	0521	0821	1121	22,000	M	"
0222	0522	0822	1122	27,000	K	"
0223	0523	0823	1123	33,000	K	"
0224	0524	0824	1124	33,000	M	"
0225	0525	0825	1125	39,000	K	"
0226	0526	0826	1126	47,000	K	"
0227	0527	0827	1127	47,000	M	"
0228	0528	0828	1128	56,000	K	"
0229	0529	0829	1129	68,000	K	"
0230	0530	0830	1130	68,000	M	"
0231	0531	0831	1131	82,000	K	"
0232	0532	0832	1132	100,000	K	"
0233	0533	0833	1133	100,000	M	"
0234	0534	0834	1134	120,000	K	50
0235	0535	0835	1135	150,000	K	"
0236	0536	0836	1136	150,000	M	"
0237	0537	0837	1137	180,000	K	"
0238	0538	0838	1138	220,000	K	"
0239	0539	0839	1139	220,000	M	"

FIGURE 901-2. Established reliability, general purpose, ceramic dielectric, fixed capacitors - Continued.

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SECTION 902

CAPACITORS, FIXED, CERAMIC DIELECTRIC (TEMPERATURE COMPENSATING), ESTABLISHED RELIABILITY STYLES CCR05, CCR06, CCR07, CCR08, CCR75, CCR76, CCR77, AND CCR78

(APPLICABLE SPECIFICATION: MIL-C-20)

1. SCOPE. This section covers established reliability, ceramic dielectric, fixed capacitors having zero temperature characteristics. These capacitors have failure rate levels of 1.0 and 0.1 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on operation at maximum rated voltage at the maximum rated temperature.

2. APPLICATION INFORMATION.

2.1 Use. These capacitors are designed for use primarily where compensation is needed to counteract reactive changes, caused by temperature variations, in other circuit components. However, they can be used in any precision-type circuit where their characteristics are suitable. Ceramic capacitors are substantially smaller than paper or mica units of the same capacitance and voltage rating. They can be used where mica or paper capacitors have too wide a capacitance tolerance. The lead placement makes ceramic capacitors suitable for printed-circuit use.

By using these units, frequency drift in radio frequency, oscillator, and intermediate frequency (IF) circuits due to temperature effects can be compensated individually in each circuit. In IF stages where the frequency variation is uniform, satisfactory operation can be obtained by designing the temperature-compensating capacitor into the oscillator circuit. RF circuit reactive changes caused by temperature variations cannot be compensated for in the oscillator circuit; in these cases, and where more critical tuning accuracy is required, it is necessary that compensating capacitors be inserted directly into each circuit.

In RF circuits tuned by a variable capacitor, a shunt compensating capacitor of low value and high compensating characteristics may be used. In slug-tuned circuits, the total capacitance required can be provided by using a compensating capacitor having the desired temperature coefficient. In oscillator circuits, more linear tuning can be obtained by using proper temperature coefficients in both the series and the shunt capacitances of the tank circuit.

High insulation resistance makes these capacitors well suited to coupling applications between plate and grid circuits of electron tubes. Extremely low leakage and small physical size make them suitable for transistor circuit design. They are also useful in filter and by-pass circuits.

If possible, the temperature-time curve of the selected capacitor should be the exact opposite of the temperature-time curve of the coil (or other component) being stabilized. Combinations of different capacitance values and temperature coefficients can give more precise compensation than can be obtained from a single capacitor. Full consideration should be given to the physical placement of compensating, and compensated for, components. Locations near hot transistors will cause much greater reactive variations than spots adjacent to a cool, external chassis.

Ceramic dielectrics are frequency sensitive; both the capacitance and the capacitance change with temperature will be different at different measuring frequencies. For extremely accurate compensation, the units should be measured at the proposed operating frequency.

2.1.1 Humid operating conditions. Ceramic dielectric materials are nonhygroscopic, effectively impermeable, and have practically no moisture absorption even after considerable exposure to humid conditions.

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2.2 Construction. Physically, the most common types of temperature-compensating, ceramic-dielectric capacitors are small monolithic tubular and rectangular types covered by insulating resin, plastic, or ceramic. Because the constituent materials have molecular polar moments, the dielectric constants of some mixes reach hundreds (even thousands) of times the value of paper, mica, and plastic films. This results in ceramic-dielectric capacitors having the largest capacitance-to-size ratios of all high-resistance dielectrics.

2.3 Rated voltage. These capacitors have voltage ratings of 50, 100, and 200 volts.

2.4 Operating temperature range. These capacitors are suitable for operation over a temperature range of -55° to +125°C.

2.5 Temperature coefficient. Mixes of different temperature coefficients are made by varying the percentages of high-K dielectrics (such as titanium dioxide) in the low-loss ceramic. The temperature coefficient becomes increasingly more negative with the increase in dielectric constant. For example:

<u>Material</u>	<u>K</u>	<u>Temperature coefficient</u>
Titanium dioxide	85	-750
Low-loss ceramic	6	+100

As a consequence, for any given size of capacitor, the relative capacitance will be high with a high negative temperature coefficient, and vice versa. With present day manufacturing methods, a high degree of reproducibility is obtained for the coefficients listed in this section.

The temperature coefficients are not linear with respect to temperature. Measurements taken at +25°C and +85°C will show a change of value which, when divided by 60 (the temperature differential), does not represent the change in capacitance to be expected for each degree change in temperature. The coefficient is therefore not exactly expressible by a single number.

2.6 Dielectric strength. It is recommended that supplementary insulation be used where the capacitor body will normally contact parts with a potential difference of more than 750 volts.

3. ITEM IDENTIFICATION (see figures 902-1 and 902-2).

3.1 Type designation. The type designation is used for identifying and describing the capacitors as shown in figure 902-1.

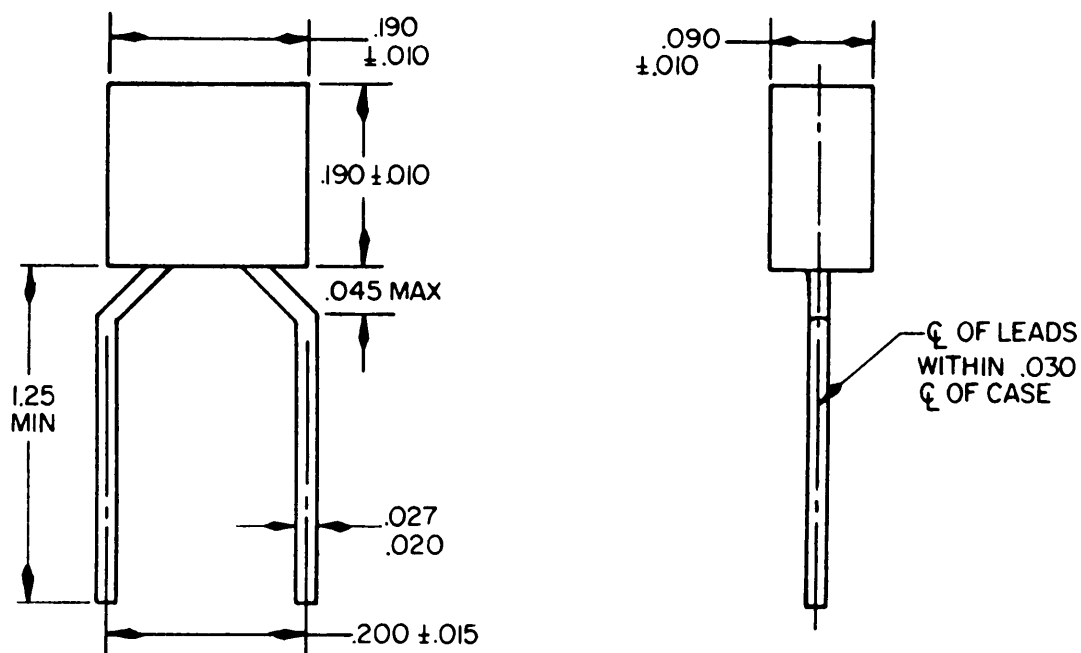
3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 902-2.

										CCR05	CG	561	G	M
<p>STYLE - The three-letter symbol "CCR" identifies established reliability, ceramic-dielectric, temperature-compensating, fixed capacitors; the two-digit number identifies the shape and dimensions.</p>														
<p>CHARACTERISTIC - The two-letter symbol identifies the characteristic. The first letter identifies the nominal temperature coefficient and the second letter identifies the tolerance envelope for the temperature coefficient as follows:</p>														
Symbol	Nominal temperature coefficient	Approximate tolerance envelope for temperature coefficient	Permissible capacitance change from capacitance at 25°C in ppm											
			At -55°C		At +85°C		At +125°C							
			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
	ppm/°C	ppm (±)												
CG- - -	0	30	4,300	-2,200	1,700	-1,800	3,000	-3,000						
CH- - -	0	60	7,300	-4,400	3,600	-3,600	6,000	-6,000						
<p>CAPACITANCE - The three-digit number identifies the nominal capacitance value, expressed in picofarads (pF); the first two digits represent significant figures and the last digit specifies the number of zeros to follow. For fractional values and values less than 10 pF, the letter "R" is used to indicate the decimal point and the succeeding digit(s) of the group shall represent significant figure(s). Example OR5 indicates 0.5 pF; 1R0 indicates 1.0 pF.</p>														
<p>CAPACITANCE TOLERANCE - The single-letter symbol identifies the capacitance tolerance as follows:</p>														
Symbol		Capacitance tolerance												
		(±)												
B - - - - -		0.1 pF												
C - - - - -		0.25 pF												
D - - - - -		0.5 pF												
F - - - - -		1 percent												
G - - - - -		2 percent												
J - - - - -		5 percent												
K - - - - -		10 percent												
<p>FAILURE RATE LEVEL - The single-letter symbol identifies the failure rate level as follows:</p>														
Symbol		Failure rate level												
		(%/1,000 hr)												
M - - - - -		1.0												
P - - - - -		0.1												
R - - - - -		0.01												
S - - - - -		0.001												

FIGURE 902-1. Type designation example.

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STYLE CCR05



INCHES	MM
.010	.25
.015	.38
.020	.51
.027	.69
.030	.76
.045	1.14
.090	2.29
.190	4.83
.200	5.09
1.25	31.75

FIGURE 902-2. Established reliability, ceramic dielectric (temperature compensating), fixed capacitors.

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STANDARD CAPACITORS

STYLE CCR05

OPERATING TEMPERATURE RANGE -55°C TO +125°C --
 FAILURE RATE LEVEL M (1.0%), P (0.1%), R (0.01%), OR S (0.001%)

Type designation ^{1/}	Rated voltage	Nom. cap.	Cap. tol.	Type designation ^{1/}	Rated voltage	Nom. cap.	Cap. tol.
	(volts,dc)	(pF)			(volts,dc)	(pF)	
CCR05CH1R0--	200	1.0	CD	CCR05CG680--	200	68	FGJ
CCR05CH1R2--	200	1.2	CD	CCR05CG820--	200	82	FGJ
CCR05CH1R5--	200	1.5	CD	CCR05CG101--	200	100	FGJ
CCR05CH1R8--	200	1.8	CD	CCR05CG121--	200	120	FGJ
CCR05CH2R2--	200	2.2	CD	CCR05CG151--	200	150	FGJ
CCR05CH2R7--	200	2.7	BCD	CCR05CG181--	200	180	FGJ
CCR05CH3R3--	200	3.3	BCD	CCR05CG221--	200	220	FGJ
CCR05CH3R9--	200	3.9	BCD	CCR05CG271--	200	270	FGJ
CCR05CH4R7--	200	4.7	BCD	CCR05CG331--	200	330	FGJ
CCR05CH5R6--	200	5.6	BCD	CCR05CG361--	100	360	FGJ
CCR05CH6R8--	200	6.8	BCD	CCR05CG391--	100	390	FGJ
CCR05CH8R2--	200	8.2	BCD	CCR05CG471--	100	470	FGJ
CCR05CH100--	200	10	FGJ	CCR05CG561--	100	560	FGJ
CCR05CG120--	200	12	FGJ	CCR05CG681--	100	680	FGJ
CCR05CG150--	200	15	FGJ	CCR05CG821--	100	820	FGJ
CCR05CG180--	200	18	FGJ	CCR05CG102--	100	1,000	FGJ
CCR05CG220--	200	22	FGJ	CCR05CG122--	100	1,200	FGJ
CCR05CG270--	200	27	FGJ	CCR05CG152--	100	1,500	FGJ
CCR05CG330--	200	33	FGJ	CCR05CG182--	100	1,800	FGJ
CCR05CG390--	200	39	FGJ	CCR05CG222--	50	2,200	FGJ
CCR05CG470--	200	47	FGJ	CCR05CG272--	50	2,700	FGJ
CCR05CG560--	200	56	FGJ	CCR05CG332--	50	3,300	FGJ

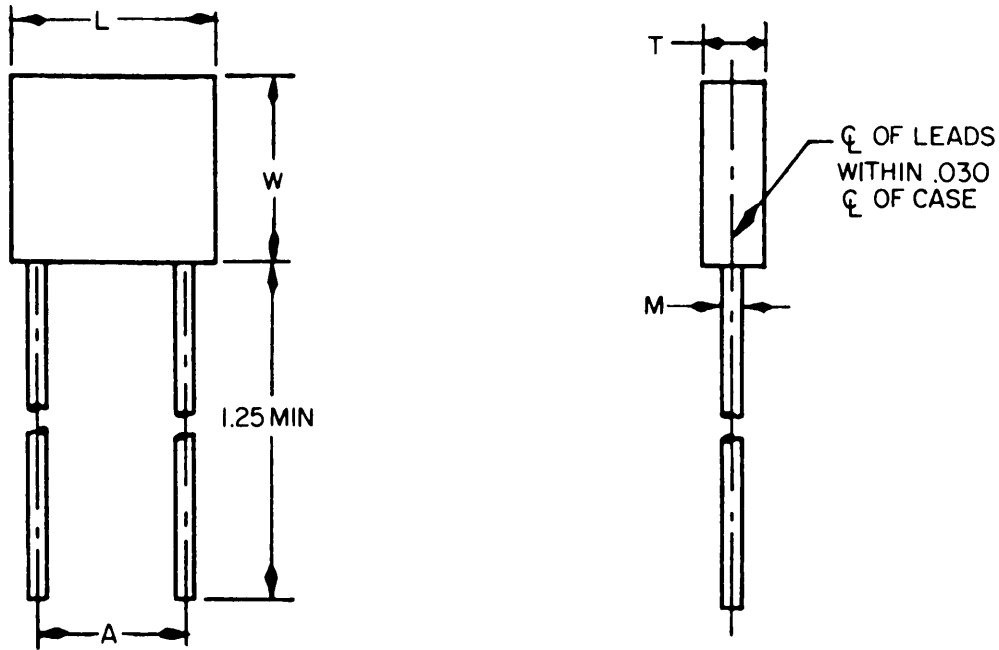
^{1/} Complete type designation will include additional symbols to indicate capacitance tolerance and failure rate level.

FIGURE 902-2. Established reliability, ceramic dielectric (temperature compensating), fixed capacitors - Continued.

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STYLES CCR06, CCR07, AND CCR08



INCHES	MM	INCHES	MM
.001	.03	.090	2.29
.004	.10	.140	3.56
.010	.25	.200	5.08
.015	.38	.240	6.10
.020	.51	.290	7.37
.025	.64	.400	10.16
.027	.69	.480	12.19
.030	.76	1.25	31.75

Standard style	Dimension (inches)				
	L	W	T ± .010	A	M
CCR06	.290 ± .010	.290 ± .010	.090	.200 ± .015	.020 to .027
CCR07	.480 ± .020	.480 ± .020	.140	.400 ± .020	.025 ^{+.004} _{-.001}
CCR08	.480 ± .020	.480 ± .020	.240	.400 ± .020	.025 ^{+.004} _{-.001}

FIGURE 902-2. Established reliability, ceramic dielectric (temperature compensating), fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLES CCR06, CCR07, AND CCR08

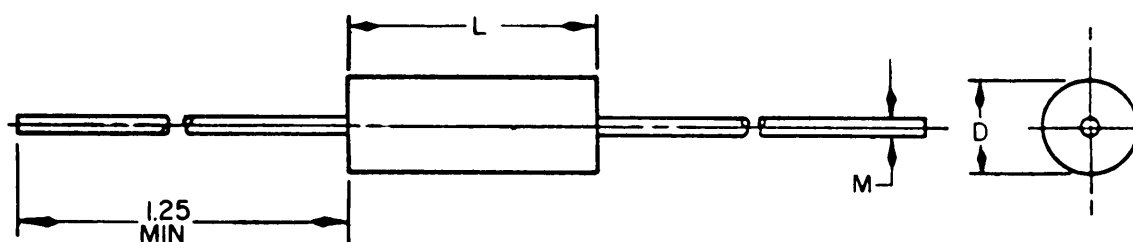
OPERATING TEMPERATURE RANGE -55°C TO +125°C -- TEMPERATURE COEFFICIENT
 0 ±30 PPM/°C (CHARACTERISTIC CG) -- FAILURE RARE LEVEL M (1.0%), P (0.01%),
 R (0.01%) OR S (0.001%)

Type designation ^{1/}	Rated voltage (volts, dc)	Nom. cap. (pF)	Cap. tol.	Type designation ^{1/}	Rated voltage (volts, dc)	Nom. cap. (pF)	Cap. tol.
STYLE CCR06							
CCR06CG391--	200	390	FGJ	CCR06CG272--	100	2,700	FGJ
CCR06CG471--	200	470	FGJ	CCR06CG332--	100	3,300	FGJ
CCR06CG561--	200	560	FGJ	CCR06CG392--	100	3,900	FGJ
CCR06CG681--	200	680	FGJ	CCR06CG472--	100	4,700	FGJ
CCR06CG821--	200	820	FGJ	CCR06CG512--	50	5,100	FGJ
CCR06CG102--	200	1,000	FGJ	CCR06CG562--	50	5,600	FGJ
CCR06CG122--	200	1,200	FGJ	CCR06CG682--	50	6,800	FGJ
CCR06CG152--	200	1,500	FGJ	CCR06CG822--	50	8,200	FGJ
CCR06CG182--	200	1,800	FGJ	CCR06CG103--	50	10,000	FGJ
CCR06CG222--	100	2,200	FGJ	CCR06CG123--	50	12,000	FGJ
				CCR06CG153--	50	15,000	FGJ
				CCR06CG183--	50	18,000	FGJ
STYLE CCR07							
CCR07CG222--	200	2,200	FGJ	CCR07CG183--	50	18,000	FGJ
CCR07CG272--	200	2,700	FGJ	CCR07CG223--	50	22,000	FGJ
CCR07CG332--	200	3,300	FGJ	CCR07CG273--	50	27,000	FGJ
CCR07CG392--	200	3,900	FGJ	CCR07CG333--	50	33,000	FGJ
CCR07CG472--	200	4,700	FGJ	CCR07CG393--	50	39,000	FGJ
CCR07CG562--	100	5,600	FGJ	CCR07CG473--	50	47,000	FGJ
CCR07CG682--	100	6,800	FGJ	CCR07CG563--	50	56,000	FGJ
CCR07CG822--	100	8,200	FGJ	CCR07CG683--	50	68,000	FGJ
CCR07CG103--	100	10,000	FGJ	CCR07CG823--	50	82,000	FGJ
CCR07CG123--	100	12,000	FGJ	CCR07CG104--	50	100,000	FGJ
CCR07CG153--	50	15,000	FGJ				
STYLE CCR08							
CCR08CG392--	200	3,900	GJK	CCR08CG183--	100	18,000	GJK
CCR08CG472--	200	4,700	GJK	CCR08CG563--	50	56,000	GJK
CCR08CG153--	100	15,000	GJK	CCR08CG683--	50	68,000	GJK

1/ Complete type designation will include additional symbols to indicate capacitance tolerance and failure rate level.

FIGURE 902-2. Established reliability, ceramic dielectric (temperature compensation), fixed capacitors - Continued.

STYLES CCR75, CCR76, CCR77, AND CCR78



INCHES	MM	INCHES	MM
.001	.03	.090	2.29
.005	.13	.140	3.56
.010	.25	.160	4.06
.015	.38	.250	6.35
.016	.41	.390	9.91
.020	.51	.500	12.70
.027	.69	1.25	31.75

Standard style	Dimension (inches)		
	L	D	M
CCR75	.160 ± .010	.090 ± .010	.016 ^{+.005} _{-.001}
CCR76	.250 ± .010	.090 ± .010	.015 to .027
CCR77	.390 ± .010	.140 ± .010	.015 to .027
CCR78	.500 ± .020	.250 ± .015	.015 to .027

FIGURE 902-2. Established reliability, ceramic dielectric (temperature compensating), fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLES CCR75, CCR76, CCR77, AND CCR78

OPERATING TEMPERATURE RANGE -55°C TO +125°C --
 FAILURE RATE LEVEL M (1.0%), P (0.01%), R (0.01%) OR S (0.001%)

Type designation $\frac{1}{/}$	Rated voltage (volts, dc)	Nom. cap. (pF)	Cap. tol.	Type designation $\frac{1}{/}$	Rated voltage (volts, dc)	Nom. cap. (pF)	Cap. tol.
STYLE CCR75							
CCR75CG1R0--	200	1.0	BC	CCR75CG330--	200	33	FGJ
CCR75CG1R2--	200	1.2	BC	CCR75CG390--	200	39	FGJ
CCR75CG1R5--	200	1.5	BC	CCR75CG470--	200	47	FGJ
CCR75CG1R8--	200	1.8	BC	CCR75CG560--	200	56	FGJ
CCR75CG2R2--	200	1.2	BC	CCR75CG680--	200	68	FGJ
CCR75CG2R7--	200	2.7	BCD	CCR75CG820--	100	82	FGJ
CCR75CG3R3--	200	3.3	BCD	CCR75CG101--	100	100	FGJ
CCR75CG3R9--	200	3.9	BCD	CCR75CG121--	100	120	FGJ
CCR75CG4R7--	200	4.7	BCD	CCR75CG151--	100	150	FGJ
CCR75CG5R6--	200	5.6	BCD	CCR75CG181--	100	180	FGJ
CCR75CG6R8--	200	6.8	BCD	CCR75CG221--	100	220	FGJ
CCR75CG8R2--	200	8.2	BCD	CCR75CG271--	50	270	FGJ
CCR75CG100--	200	10	FGJ	CCR75CG331--	50	330	FGJ
CCR75CG120--	200	12	FGJ	CCR75CG391--	50	390	FGJ
CCR75CG150--	200	15	FGJ	CCR75CG471--	50	470	FGJ
CCR75CG180--	200	18	FGJ	CCR75CG561--	50	560	FGJ
CCR75CG220--	200	22	FGJ	CCR75CG681--	50	680	FGJ
CCR75CG270--	200	27	FGJ				
STYLE CCR76							
CCR76CG820--	200	82	FGJ	CCR76CG471--	100	470	FGJ
CCR76CG101--	200	100	FGJ	CCR76CG561--	100	560	FGJ
CCR76CG121--	200	120	FGJ	CCR76CG681--	100	680	FGJ
CCR76CG271--	100	270	FGJ	CCR76CG821--	50	820	FGJ
CCR76CG331--	100	330	FGJ	CCR76CG102--	50	1,000	FGJ
CCR76CG391--	100	390	FGJ				

See footnote at end of figure.

FIGURE 902-2. Established reliability, ceramic dielectric (temperature compensting), fixed capacitors - Continued.

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STANDARD CAPACITORS

STYLES CCR75, CCR76, CCR77, AND CCR78 - Continued

OPERATING TEMPERATURE RANGE -55°C TO +125°C --
FAILURE RATE LEVEL M (1.0%), P (0.01%), R (0.01%) OR S (0.001%)

Type designation ^{1/}	Rated voltage (volts, dc)	Nom. cap. (pF)	Cap. tol.	Type designation ^{1/}	Rated voltage (volts, dc)	Nom. cap. (pF)	Cap. tol.
STYLE CCR77							
CCR77CG151--	200	150	FGJ	CCR77CG821--	100	820	FGJ
CCR77CG181--	200	180	FGJ	CCR77CG102--	100	1,000	FGJ
CCR77CG221--	200	220	FGJ	CCR77CG122--	100	1,200	FGJ
CCR77CG271--	200	270	FGJ	CCR77CG152--	100	1,500	FGJ
CCR77CG331--	200	330	FGJ	CCR77CG182--	100	1,800	FGJ
CCR77CG391--	200	390	FGJ	CCR77CG222--	100	2,200	FGJ
CCR77CG471--	200	470	FGJ	CCR77CG272--	50	2,700	FGJ
CCR77CG561--	200	560	FGJ	CCR77CG332--	50	3,300	FGJ
CCR77CG681--	200	680	FGJ	CCR77CG392--	50	3,900	FGJ
CCR77CG751--	100	750	FGJ	CCR77CG472--	50	4,700	FGJ
CCR77CG821--	100	820	FGJ	CCR77CG562--	50	5,600	FGJ
CCR77CG911--	100	910	FGJ				
STYLE CCR78							
CCR78CG821--	200	820	FGJ	CCR78CG562--	100	5,600	FGJ
CCR78CG102--	200	1,000	FGJ	CCR78CG682--	100	6,800	FGJ
CCR78CG122--	200	1,200	FGJ	CCR78CG822--	100	8,200	FGJ
CCR78CG152--	200	1,500	FGJ	CCR78CG103--	100	10,000	FGJ
CCR78CG182--	200	1,800	FGJ	CCR78CG123--	100	12,000	FGJ
CCR78CG222--	200	2,200	FGJ	CCR78CG153--	50	15,000	FGJ
CCR78CG272--	200	2,700	FGJ	CCR78CG183--	50	18,000	FGJ
CCR78CG332--	200	3,300	FGJ	CCR78CG223--	50	22,000	FGJ
CCR78CG392--	100	3,900	FGJ	CCR78CG273--	50	27,000	FGJ
CCR78CG472--	100	4,700	FGJ				

^{1/} Complete type designation will include additional symbols to indicate capacitance tolerance and failure rate level.

FIGURE 902-2. Established reliability, ceramic dielectric (temperature compensating), fixed capacitors - Continued.

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SECTION 903

CAPACITORS, CHIP, MULTIPLE LAYER, FIXED, CERAMIC DIELECTRIC, ESTABLISHED RELIABILITY

STYLES CDR01, CDR02, CDR03, AND CDR04

(APPLICABLE SPECIFICATION: MIL-C-55681)

1. SCOPE. This section covers established reliability, ceramic dielectric, multiple layer, fixed chip capacitors. These capacitors have failure rate levels of 1.0 to 0.001 percent per 1,000 hours. The failure rate levels are established at a 90-percent confidence level and are based on operation at maximum rated voltage at the maximum rated temperature.

2. APPLICATION INFORMATION.

2.1 Use. Ceramic chip capacitors are intended to be used in thin or thick film hybrid circuits; therefore, they are not replaceable.

2.1.1 Ambient operating conditions. Designers are cautioned to give consideration to the change in dielectric constant with temperature, shelf aging, and electric-field intensity, and should recognize that the insulation resistance may vary with humidity and organic contamination of the ceramic chip surfaces.

2.2 Metallized terminations. It should be noted that when pure silver is used for the terminations, silver migration between the terminations may occur under conditions of simultaneous application of high humidity and dc voltage. This produces a troublesome electrical leakage path across the capacitor chip. Addition of about 20 percent of palladium to the silver to form an alloy will retard the tendency toward silver migration. Complete overcoating of the silver termination by the lead-tin bonding solder also will retard the tendency toward silver migration. Addition of about 3 percent of silver to the lead-tin bonding solder will tend to reduce the leaching of the silver from a silver termination during the solder bonding operation.

2.3 Effect on mounting reliability. Voltage temperature limits, resistance to thermal shock, and reliability may be affected as a result of mounting on substrates with dissimilar coefficients of expansion from capacitor material. Care should be taken in the selection of substrate material.

3. ITEM IDENTIFICATION (see figures 903-1 and 903-2).

3.1 Type designation. The type designation is used for identifying the capacitors as shown in figure 903-1.

3.2 Standard capacitors. The standard capacitors available in this section are shown in figure 903-2.

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STYLE - The three-letter symbol "CDR" identifies established reliability, ceramic dielectric, fixed chip capacitors; the two-digit number identifies the dimensions.

RATED TEMPERATURE AND VOLTAGE-TEMPERATURE LIMITS - The two-letter symbol identifies the rated temperature and voltage-temperature limits. The first letter "B" indicates the rated temperature of -55°C to $+125^{\circ}\text{C}$; the second letter identifies the voltage-temperature limits as follows:

Symbol	Capacitance change with reference to 25°C	
	Steps A to D incl of table X	Steps E to G incl of table X
G - - - -	90 \pm 20 ppm/ $^{\circ}\text{C}$	90 \pm 20 ppm/ $^{\circ}\text{C}$
P - - - -	0 \pm 30 ppm/ $^{\circ}\text{C}$	0 \pm 30 ppm/ $^{\circ}\text{C}$
X - - - -	+15 -15 percent	+15 -25 percent

CAPACITANCE - The three-digit number identifies the nominal capacitance value, expressed in picofarads (pF); the first two digits represent significant figures and the last digit specifies the number of zeros to follow. When the nominal value is less than 10 pF, the letter "R" shall be used to indicate the decimal point and the succeeding digit(s) of the group shall represent significant figure(s).

RATED VOLTAGE - The single-letter symbol identifies the dc rated voltage as follows:

Symbol	DC rated voltage
A - - - -	50
B - - - -	100
C - - - -	200

CAPACITANCE TOLERANCE - The single-letter symbol identifies the capacitance tolerance as follows:

Symbol	Capacitance tolerance (\pm)
B - - - - -	.10 pF
C - - - - -	.25 pF
D - - - - -	.50 pF
F - - - - -	1 percent
G - - - - -	2 percent
J - - - - -	5 percent
K - - - - -	10 percent
M - - - - -	20 percent

TERMINATION FINISH - The single-letter symbol identifies the termination finish as follows:

Symbol	Finish
M	Palladium-Silver
H	Silver-Nickel-Gold
P	Silver-Copper-Gold
Q	Palladium-Gold
S	Solder coated, final
T	Silver
U	Base metallization: Barrier metal, solder coated. 1/
W	Base metallization: Barrier metal, tinned (tin or tin/lead alloy).

1/ Solder shall have a melting point of 200°C or less.

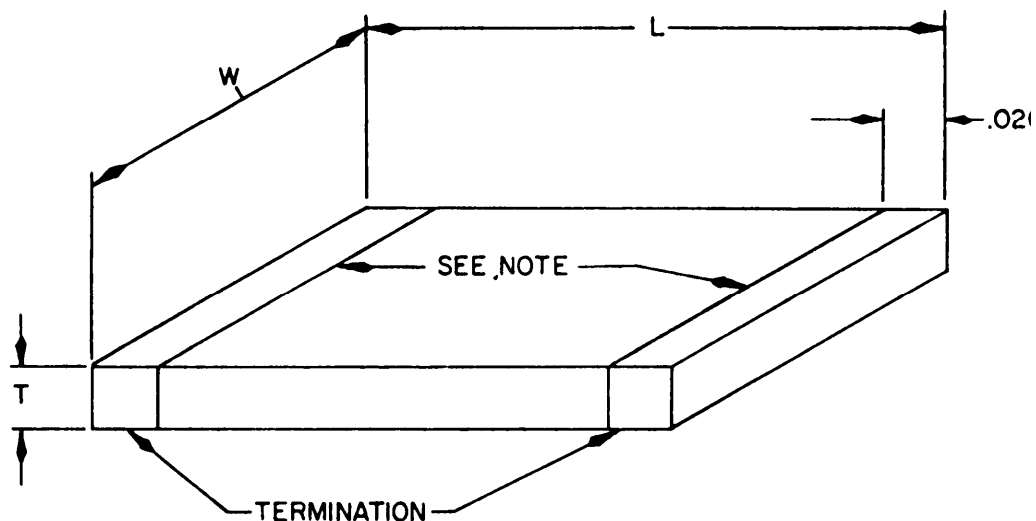
FAILURE RATE LEVEL - The single letter symbol identifies the failure rate level as follows:

Symbol	Failure rate level (%/1,000 hr)
M - - - -	1.0
P - - - -	0.1
R - - - -	0.01
S - - - -	0.001

FIGURE 903-1. Type designation example.

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STYLES CDR01, CDR02, CDR03, AND CDR04



Standard style	Dimension (inches)				INCHES	MM
	L ± .015	W ± .015	T			
			Min.	Max.		
CDR01	.080	.050	.020	.055	.010	.25
CDR02	.180	.050	.020	.055	.015	.38
CDR03	.180	.080	.020	.080	.020	.51
CDR04	.180	.125	.020	.080	.030	.76
					.050	1.27
					.055	1.40
					.080	2.03
					.125	3.18
					.180	4.57

NOTE: For style CDR01, termination width shall be .010 inch minimum; uncovered band width shall be .030 inch minimum.

FIGURE 903.2 Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors.

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STANDARD CAPACITORS

STYLES CDR01, CDR02, CDR03, AND CDR04

OPERATING TEMPERATURE RANGE -55° TO +125°C

Type designation ^{1/}	Capacitance	Capacitance tolerance	Rated temperature and voltage-temperature limits	Rated voltage
	pF			volts, dc
CDR01BP100B---	10	J, K	BP	100
CDR01BP120BJ--	12	J	BP	100
CDR01BP150B---	15	J, K	BP	100
CDR01BP180BJ--	18	J	BP	100
CDR01BP220B---	22	J, K	BP	100
CDR01BP270BJ--	27	J	BP	100
CDR01BP330B---	33	J, K	BP	100
CDR01BP390BJ--	39	J	BP	100
CDR01BP470B---	47	J, K	BP	100
CDR01BP560BJ--	56	J	BP	100
CDR01BP680B---	68	J, K	BP	100
CDR01BP820BJ--	82	J	BP	100
CDR01BP101B---	100	J, K	BP	100
CDR01B-121B---	120	J, K	BP, BX	100
CDR01B-151B---	150	J, K	BP, BX	100
CDR01B-181B---	180	J, K	BP, BX	100
CDR01BX221B---	220	K, M	BX	100
CDR01BX271BK--	270	K	BX	100
CDR01BX331B---	330	K, M	BX	100
CDR01BX391BK--	390	K	BX	100
CDR01BX471B---	470	K, M	BX	100
CDR01BX561BK--	560	K	BX	100
CDR01BX681B---	680	K, M	BX	100
CDR01BX821BK--	820	K	BX	100
CDR01BX102B---	1,000	K, M	BX	100
CDR01BX122BK--	1,200	K	BX	100
CDR01BX152B---	1,500	K, M	BX	100
CDR01BX182BK--	1,800	K	BX	100
CDR01BX222B---	2,200	K, M	BX	100
CDR01BX272BK--	2,700	K	BX	100
CDR01BX332B---	3,300	K, M	BX	100
CDR01BX392AK--	3,900	K	BX	50
CDR01BX472A---	4,700	K, M	BX	50
CDR02BP221B---	220	J, K	BP	100
CDR02BP271BJ--	270	J	BP	100
CDR02BX392BK--	3,900	K	BX	100
CDR02BX472B---	4,700	K, M	BX	100
CDR02BX562BK--	5,600	K	BX	100
CDR02BX682B---	6,800	K, M	BX	100
CDR02BX822BK--	8,200	K	BX	100
CDR02BX103B---	10,000	K, M	BX	100
CDR02BX123AK--	12,000	K	BX	50
CDR02BX153A---	15,000	K, M	BX	50
CDR02BX183AK--	18,000	K	BX	50
CDR02BX223A---	22,000	K, M	BX	50

See footnote at end of tabulation.

FIGURE 903-2. Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors - Continued.

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STANDARD CAPACITORS

SYLES CDR01, CDR02, CDR03, AND CDR04 - CONTINUED

OPERATING TEMPERATURE RANGE -55° TO +125°C

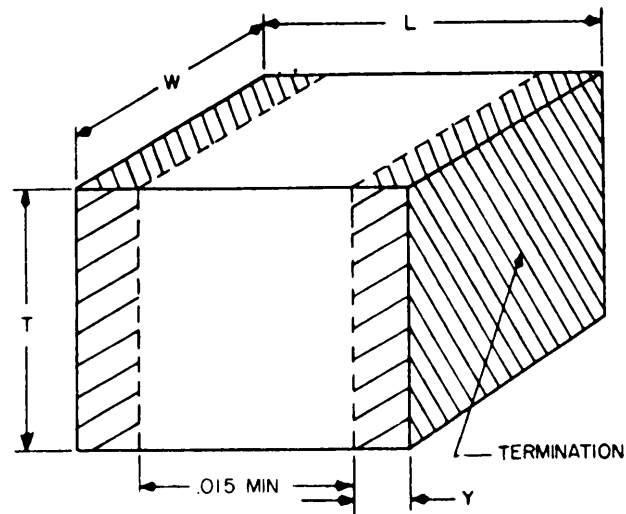
Type designation ^{1/}	Capacitance	Capacitance tolerance	Rated temperature and voltage-temperature limits	Rated voltage
	<u>pF</u>			<u>volts, dc</u>
CDR03BP331B---	330	J, K	BP	100
CDR03BP391BJ--	390	J	BP	100
CDR03BP471B---	470	J, K	BP	100
CDR03BP561BJ--	560	J	BP	100
CDR03BP681B---	680	J, K	BP	100
CDR03BP821BJ--	820	J	BP	100
CDR03BP102B---	1,000	J, K	BP	100
CDR03BX123BK--	12,000	K	BX	100
CDR03BX153B---	15,000	K, M	BX	100
CDR03BX183BK--	18,000	K	BX	100
CDR03BX223B---	22,000	K, M	BX	100
CDR03BX273BK--	27,000	K	BX	100
CDR03BX333B---	33,000	K, M	BX	100
CDR03BX393AK--	39,000	K	BX	50
CDR03BX473A---	47,000	K, M	BX	50
CDR03BX563AK--	56,000	K	BX	50
CDR03BX683A---	68,000	K, M	BX	50
CDR04BP122BJ--	1,200	J	BP	100
CDR04BP152B---	1,500	J, K	BP	100
CDR04BP182BJ--	1,800	J	BP	100
CDR04BP222B---	2,200	J, K	BP	100
CDR04BP272BJ--	2,700	J	BP	100
CDR04BP332B---	3,300	J, K	BP	100
CDR04BX393BK--	39,000	K	BX	100
CDR04BX473B---	47,000	K, M	BX	100
CDR04BX563BK--	56,000	K	BX	100
CDR04BX823AK--	82,000	K	BX	50
CDR04BX104A---	100,000	K, M	BX	50
CDR04BX124AK--	120,000	K	BX	50
CDR04BX154A---	150,000	K, M	BX	50
CDR04BX184AK--	180,000	K	BX	50

1/ Complete type designation will include additional symbols to indicate capacitance tolerance, termination finish, and failure rate level, as applicable.

FIGURE 903-2. Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors - Continued.

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STYLES CDR11, CDR12, CDR13, AND CDR14



INCHES	MM
.005	.13
.010	.25
.015	.38
.020	.51
.028	.71
.055	1.40
.057	1.45
.058	1.47
.102	2.59
.110	2.79

DIMENSIONS					
Style	L	W	T		Y
			Min	Max	
CDR11	.055 ±.015	.055 ±.015	.028	.057	.010 - .005 ±.010
CDR12	.055 ±.025	.055 ±.015	.028	.057	.010 - .005 ±.010
CDR13	.110 ±.020	.110 ±.020	.058	.102	.015 ±.010
CDR14	.110 -.020 +.035	.110 ±.020	.058	.102	.015 ±.010

FIGURE 903-2. Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors.

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STANDARD CAPACITORS

STYLES CDR11 AND CDR12
 OPERATING TEMPERATURE RANGE -55°C TO +125°C

Type designation ^{1/}	Capacitance	Capacitance tolerance	Rated temperature and voltage-temperature limits	Rated voltage
	<u>pF</u>			<u>volts, dc</u>
CDR1-B-OR1AB--	0.1	B	BG, BP	50
CDR1-B-OR2AB--	0.2	B	"	"
CDR1-B-OR3A---	0.3	B,C	"	"
CDR1-B-OR4A---	0.4	B,C	"	"
CDR1-B-OR5A---	0.5	B,C,D	"	"
CDR1-B-OR6A---	0.6	"	"	"
CDR1-B-OR7A---	0.7	"	"	"
CDR1-B-OR8A---	0.8	"	"	"
CDR1-B-OR9A---	0.9	"	"	"
CDR1-B-1R0A---	1.0	"	"	"
CDR1-B-1R1A---	1.1	"	"	"
CDR1-B-1R2A---	1.2	"	"	"
CDR1-B-1R3A---	1.3	"	"	"
CDR1-B-1R4A---	1.4	"	"	"
CDR1-B-1R5A---	1.5	"	"	"
CDR1-B-1R6A---	1.6	"	"	"
CDR1-B-1R7A---	1.7	"	"	"
CDR1-B-1R8A---	1.8	"	"	"
CDR1-B-1R9A---	1.9	"	"	"
CDR1-B-2R0A---	2.0	"	"	"
CDR1-B-2R1A---	2.1	"	"	"
CDR1-B-2R2A---	2.2	"	"	"
CDR1-B-2R4A---	2.4	"	"	"
CDR1-B-2R7A---	2.7	"	"	"
CDR1-B-3R0A---	3.0	"	"	"
CDR1-B-3R3A---	3.3	"	"	"
CDR1-B-3R6A---	3.6	"	"	"
CDR1-B-3R9A---	3.9	"	"	"
CDR1-B-4R3A---	4.3	"	"	"
CDR1-B-4R7A---	4.7	"	"	"
CDR1-B-5R1A---	5.1	"	"	"
CDR1-B-5R6A---	5.6	"	"	"
CDR1-B-6R2A---	6.2	"	"	"
CDR1-B-6R8A---	6.8	B,C,J,K	"	"
CDR1-B-7R5A---	7.5	"	"	"
CDR1-B-8R2A---	8.2	"	"	"
CDR1-B-9R1A---	9.1	"	"	"
CDR1-B-100A---	10	F,G,J,K	"	"
CDR1-B-110A---	11	"	"	"
CDR1-B-120A---	12	"	"	"
CDR1-B-130A---	13	"	"	"
CDR1-B-150A---	15	"	"	"
CDR1-B-160A---	16	"	"	"
CDR1-B-180A---	18	"	"	"
CDR1-B-200A---	20	"	"	"
CDR1-B-220A---	22	"	"	"
CDR1-B-240A---	24	"	"	"
CDR1-B-270A---	27	"	"	"

^{1/} See footnote at end of tabulation.

FIGURE 903-2. Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors - Continued.

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STANDARD CAPACITORS

STYLES CDR11 AND CDR12 - Continued
 OPERATING TEMPERATURE RANGE -55°C TO +125°C

Type designation ^{1/}	Capacitance	Capacitance tolerance	Rated temperature and voltage-temperature limits	Rated voltage
	pF			volts, dc
CDR1-B-300A---	30	F,G,J,K	BG, BP	50
CDR1-B-330A---	33	"	"	"
CDR1-B-360A---	36	"	"	"
CDR1-B-390A---	39	"	"	"
CDR1-B-430A---	43	"	"	"
CDR1-B-470A---	47	"	"	"
CDR1-B-510A---	51	"	"	"
CDR1-B-560A---	56	"	"	"
CDR1-B-620A---	62	"	"	"
CDR1-B-680A---	68	"	"	"
CDR1-B-750A---	75	"	"	"
CDR1-B-820A---	82	"	"	"
CDR1-B-910A---	91	"	"	"
CDR1-B-101A---	100	"	"	"
CDR1-BP111A---	110	"	BP	"
CDR1-BP121A---	120	"	"	"
CDR1-BP131A---	130	"	"	"
CDR1-BP151A---	150	"	"	"
CDR1-BP161A---	160	"	"	"
CDR1-BP181A---	180	"	"	"
CDR1-BP201A---	200	"	"	"
CDR1-BP221A---	220	"	"	"
CDR1-BP241A---	240	"	"	"
CDR1-BP271A---	270	"	"	"
CDR1-BP301A---	300	"	"	"
CDR1-BP331A---	330	"	"	"
CDR1-BP361A---	360	"	"	"
CDR1-BP391A---	390	"	"	"
CDR1-BP431A---	430	"	"	"
CDR1-BP471A---	470	"	"	"
CDR1-BP511A---	510	"	"	"
CDR1-BP561A---	560	"	"	"
CDR1-BP621A---	620	"	"	"
CDR1-BP681A---	680	"	"	"
CDR1-BP751A---	750	"	"	"
CDR1-BP821A---	820	"	"	"
CDR1-BP911A---	910	"	"	"
CDR1-BP102A---	1,000	"	"	"

^{1/} Complete type designation will include additional symbols to indicate style, voltage-temperature limits, capacitance tolerance (where applicable), termination finish (M for style CDR11, and S, U or W for style CDR12) and failure rate level.

FIGURE 903-2. Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors - Continued.

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STANDARD CAPACITORS

STYLES CDR13 AND CDR14
OPERATING TEMPERATURE RANGE -55°C TO +125°C

Type designation 1/	Capacitance	Capacitance tolerance	Rated temperature and voltage-temperature limits	Rated voltage
	pF			volts, dc
CDR1-B-OR1EB--	0.1	B	BG, BP	500
CDR1-B-OR2EB--	0.2	B	"	"
CDR1-B-OR3E---	0.3	B,C	"	"
CDR1-B-OR4E---	0.4	B,C	"	"
CDR1-B-OR5E---	0.5	B,C,D	"	"
CDR1-B-OR6E---	0.6	"	"	"
CDR1-B-OR7E---	0.7	"	"	"
CDR1-B-OR8E---	0.8	"	"	"
CDR1-B-OR9E---	0.9	"	"	"
CDR1-B-1R0E---	1.0	"	"	"
CDR1-B-1R1E---	1.1	"	"	"
CDR1-B-1R2E---	1.2	"	"	"
CDR1-B-1R3E---	1.3	"	"	"
CDR1-B-1R4E---	1.4	"	"	"
CDR1-B-1R5E---	1.5	"	"	"
CDR1-B-1R6E---	1.6	"	"	"
CDR1-B-1R7E---	1.7	"	"	"
CDR1-B-1R8E---	1.8	"	"	"
CDR1-B-1R9E---	1.9	"	"	"
CDR1-B-2R0E---	2.0	"	"	"
CDR1-B-2R1E---	2.1	"	"	"
CDR1-B-2R2E---	2.2	"	"	"
CDR1-B-2R4E---	2.4	"	"	"
CDR1-B-2R7E---	2.7	"	"	"
CDR1-B-3R0E---	3.0	"	"	"
CDR1-B-3R3E---	3.3	"	"	"
CDR1-B-3R6E---	3.6	"	"	"
CDR1-B-3R9E---	3.9	"	"	"
CDR1-B-4R3E---	4.3	"	"	"
CDR1-B-4R7E---	4.7	"	"	"
CDR1-B-5R1E---	5.1	"	"	"
CDR1-B-5R6E---	5.6	"	"	"
CDR1-B-6R2E---	6.2	"	"	"
CDR1-B-6R8E---	6.8	B,C,J,K	"	"
CDR1-B-7R5E---	7.5	"	"	"
CDR1-B-8R2E---	8.2	"	"	"
CDR1-B-9R1E---	9.1	"	"	"
CDR1-B-100E---	10	F,G,J,K	"	"
CDR1-B-110E---	11	"	"	"
CDR1-B-120E---	12	"	"	"
CDR1-B-130E---	13	"	"	"
CDR1-B-150E---	15	"	"	"
CDR1-B-160E---	16	"	"	"
CDR1-B-180E---	18	"	"	"
CDR1-B-200E---	20	"	"	"
CDR1-B-220E---	22	"	"	"
CDR1-B-240E---	24	"	"	"
CDR1-B-270E---	27	"	"	"

1/ See footnote at end of tabulation.

FIGURE 903-2. Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CDR13 AND CDR14 - Continued
 OPERATING TEMPERATURE RANGE -55°C TO +125°C

Type designation 1/	Capacitance	Capacitance tolerance	Rated temperature and voltage-temperature limits	Rated voltage
	<u>pF</u>			<u>volts, dc</u>
CDR1-B-300E---	30	F,G,J,K	BG, BP	500
CDR1-B-330E---	33	"	"	"
CDR1-B-360E---	36	"	"	"
CDR1-B-390E---	39	"	"	"
CDR1-B-430E---	43	"	"	"
CDR1-B-470E---	47	"	"	"
CDR1-B-510E---	51	"	"	"
CDR1-B-560E---	56	F,G,J,K,M	"	"
CDR1-B-620E---	62	"	"	"
CDR1-B-680E---	68	"	"	"
CDR1-B-750E---	75	"	"	"
CDR1-B-820E---	82	"	"	"
CDR1-B-910E---	91	"	"	"
CDR1-B-101E---	100	"	"	"
CDR1-B-111D---	110	"	"	300
CDR1-B-121D---	120	"	"	"
CDR1-B-131D---	130	"	"	"
CDR1-B-151D---	150	"	"	"
CDR1-B-161D---	160	"	"	"
CDR1-B-181D---	180	"	"	"
CDR1-B-201D---	200	"	"	"
CDR1-B-221C---	220	"	"	200
CDR1-B-241C---	240	"	"	"
CDR1-B-271C---	270	"	"	"
CDR1-B-301C---	300	"	"	"
CDR1-B-331C---	330	"	"	"
CDR1-B-361C---	360	"	"	"
CDR1-B-391C---	390	"	"	"
CDR1-B-431C---	430	"	"	"
CDR1-B-471C---	470	"	"	"
CDR1-B-511B---	510	"	"	100
CDR1-B-561B---	560	"	"	"
CDR1-B-621B---	620	"	"	"
CDR1-B-681A---	680	"	"	50
CDR1-B-751A---	750	"	"	"
CDR1-B-821A---	820	"	"	"
CDR1-B-911A---	910	"	"	"
CDR1-B-102A---	1,000	"	"	"
CDR1-BP112A---	1,100	"	BP	"
CDR1-BP122A---	1,200	"	"	"
CDR1-BP132A---	1,300	"	"	"
CDR1-BP152A---	1,500	"	"	"
CDR1-BP162A---	1,600	"	"	"
CDR1-BP182A---	1,800	"	"	"

See footnote at end of tabulation.

FIGURE 903-2. Established reliability, ceramic dielectric, multiple layer, fixed chip capacitors - Continued.

MIL-STD-198E

STANDARD CAPACITORS

STYLES CDR13 AND CDR14 - Continued
 OPERATING TEMPERATURE RANGE -55°C TO +125°C

Type designation <u>1/</u>	Capacitance	Capacitance tolerance	Rated temperature and voltage-temperature limits	Rated voltage
	<u>pF</u>			<u>volts, dc</u>
CDR1-BP202A---	2,000	F,G,J,K,M	BP	50
CDR1-BP222A---	2,200	"	"	"
CDR1-BP242A---	2,400	"	"	"
CDR1-BP272A---	2,700	"	"	"
CDR1-BP302A---	3,000	"	"	"
CDR1-BP332A---	3,300	"	"	"
CDR1-BP362A---	3,600	"	"	"
CDR1-BP392A---	3,900	"	"	"
CDR1-BP432A---	4,300	"	"	"
CDR1-BP472A---	4,700	"	"	"
CDR1-BP502A---	5,000	"	"	"
CDR1-BP512A---	5,100	"	"	"

1/ Complete type designation will include additional symbols to indicate style, voltage-temperature limits, capacitance tolerance (where applicable), termination finish (M for style CDR13 and S, U or W for style CDR14) and failure rate level.

FIGURE 903-2. Established reliability, ceramic dielectric multiple layer, fixed chip capacitors - Continued.

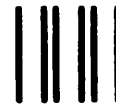
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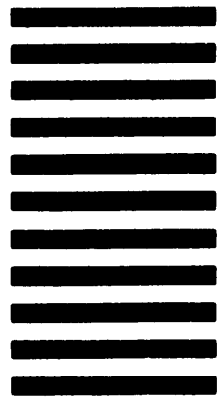
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