

MIL-STD-1665  
NOTICE 4  
16 January 1984

MILITARY STANDARD  
TEST EQUIPMENT FOR THE  
STANDARD ELECTRONIC MODULES PROGRAM

TO ALL HOLDERS OF MIL-STD-1665:

1. THE FOLLOWING PAGES OF MIL-STD-1665 HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
1	20 January 1978	Reprinted without change	20 January 1978
11	16 January 1984	11	20 January 1978
1	16 January 1984	1	20 January 1978
2	20 January 1978	Reprinted without change	20 January 1978
5	16 January 1984	5	19 November 1980
6	16 January 1984	6	20 March 1980
J04-1	20 January 1978	Reprinted without change	20 January 1978
J04-2	16 January 1984	J04-2	20 January 1978
V04-1	16 January 1984	V04-1	20 January 1978
W05-1	16 January 1984	W05-1	20 January 1978

2. The following pages are to be added:

NEW PAGE	DATE
G11-1	16 January 1984
G11-2	16 January 1984
J04-3	16 January 1984
W08-1	16 January 1984

3. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

4. Holders of MIL-STD-1665 will verify that additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with the appended pages is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or canceled.

Custodians:  
Army - ER  
Navy - EC  
Air Force - 85

Preparing activity:  
Navy - EC

Agent:  
OLA - ES

Review activities:  
Army - AT  
Navy - AS, SH  
Air Force - 13, 17, 19  
DLA - ES

(Project 5963-0025)

User activities:  
Army - MI  
Navy -  
Air Force -

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**SUPERSEDING**  
**(See 6.2)**

**MILITARY STANDARD**

**TEST EQUIPMENT**  
**FOR THE**  
**STANDARD ELECTRONIC MODULES PROGRAM**



**FSC 5963**

MIL-STD-1665  
16 January 1984

DEPARTMENT OF DEFENSE  
WASHINGTON, D.C. 20301

Test Equipment for the Standard Electronic Modules Program

MIL-STD-1665

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: Naval Electronic Systems Command, ATTN: ELEX 8111, Washington, D.C. 20363 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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1. SCOPE

1.1 Scope. This standard establishes the capabilities of electronic test equipment needed for testing of Standard Electronic Modules (as specified in MIL-M-28787). It specifies equipment performance parameters and lists representative test equipment.

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.

SPECIFICATION

MILITARY

MIL-M-28787 - Modules, Standard Electronic, General Specification For.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 Not applicable.

4. GENERAL REQUIREMENTS

4.1 Substitution of equivalent equipment. With the concurrence of the procuring activity, equipment other than that listed herein may be used provided that the substitute equipment has capabilities and performance characteristics at least equal to the listed equipment with respect to test data to be taken. Tests shall be performed as required to verify correlation between the substitute and the listed equipment.

4.2 Significance of asterisk. Test equipment marked with an asterisk (\*) shall be considered as reference equipment to be used in the event of conflicting data.

4.3 Arrangement of data and requirements. The requirements and pertinent data pertaining to the specific equipment are arranged as follows:

TITLE - - - - -	Lists the item number referenced and specified in detail specifications, tests, etc., and the generic name of the equipment.
TYPE OF EQUIPMENT - - - - -	Generic name of the equipment.
FUNCTION PERFORMED- - - - -	Defines types of tests within the capability of the equipment.
SPECIFICATIONS- - - - -	This section lists the performance parameters and specifications required for the equipment.
EQUIPMENT MEETING ALL SPECIFICATIONS- - - - -	This section lists specific equipment by manufacturer's name or trade name and model number that complies with or surpasses the minimum requirements listed under specifications.

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EQUIPMENT MEETING SPECIFICATIONS  
WITH EXCEPTIONS - - - - -

This section lists specific test equipment by manufacturer's name or trade name and model number, together with deviations from the specification, and other pertinent information. Except for the specified deviations, the equipment complies with the specification requirements. The term "exceptions" is construed to mean only those deviations which limit the measurement capability of the equipment.

4.4 General purpose test equipment. Miscellaneous test equipment suitable for general bench testing, and for incorporation in factory production testing equipment, is listed and described under item number designations in the remainder of this document.

4.5 Test equipment application criteria. The choice of test equipment to perform a given measurement should be determined on the basis of the following application criteria. The detailed requirements for maintenance and calibration of inspection and test equipment are defined in MIL-M-28787.

4.5.1 Parameter. The parameter to be measured determines the family of test equipment (ac voltmeters, ohmmeters, frequency meters, etc.) which should be investigated for a specific instrument to perform the measurement.

4.5.2 Range. This criteria determines the qualitative range that the instrument must have in order to measure the magnitude of the parameter.

4.5.3 Accuracy. Once the type of instrument and range have been determined, it is necessary to consider the measurement accuracy required. The accuracy required is a function of the specified parameter tolerance and the required ratio of that tolerance to the test equipment accuracy. The ratio of specification tolerance to test equipment accuracy shall be 10:1 for tolerances of 3 percent or greater and at least 4:1 for tolerances of less than 3 percent.

4.5.4 Other selection criteria. After the necessary considerations of test equipment parameter, range and accuracy have been made, the final selection of a particular manufacturer's instrument is determined as a matter of judgement and compromise of the following:

- a. Secondary features of the instrument.
- b. Multiple usage to satisfy the requirements of other item numbers.
- c. Effect of the instrument on the parameter being measured.
- d. Cost.

4.6 Specifying new test equipment. This document is not intended to be a catalog of manufacturer's general purpose test equipment. Therefore, potential users and contributors to this document, when specifying equipment for the testing of an electronic module, should attempt to restrict their choice to the item numbered equipment in this document. If a suitable test equipment item cannot be found in this document, the user should evaluate his requirements and search for a suitable commercial instrument. After finding a suitable instrument the user should make a written request to the SEMP-QAA to have his test equipment requirements incorporated under an item number in this document.

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ITEM G11  
GENERATOR, RF SIGNAL

TYPE OF EQUIPMENT - - - - - RF signal generator

FUNCTION PERFORMED- - - - - Provides accurate (stable) variable frequency and amplitude sine waves.

SPECIFICATIONS

Frequency

Range- - - - - 1 MHz to 520 MHz.  
Resolution - - - - - 1 kHz.  
Accuracy - - - - -  $\pm 0.001$  percent.  
Stability- - - - -  $< 0.2$  ppm/hour.  
Programmability- - - - - Frequency is programmable via rear-panel input connector.

Amplitude

Power level range- - - - -  $+13$  dBm to  $-127$  dBm (1V to 0.1  $\mu$ V into 50 $\Omega$ ).  
Total level accuracy - - - - -  $\pm 1.5$  dB ( $+13$  to  $-7$  dBm).  
 $\pm 1.95$  dB ( $-7$  to  $-77$  dBm).  
 $\pm 2.75$  dB ( $-77$  to  $-137$  dBm).  
Level flatness - - - - -  $\pm 1$  dB.  
Leakage- - - - -  $< 1$   $\mu$ V is induced in a two-turn, 2.5 cm diameter loop which is held 2.5 cm away from the front surface. (Loop feeds a 50 ohm receiver).

Spectral purity

Harmonic output- - - - -  $> 26$  dB below signal.  
Subharmonics - - - - - None detectable.  
Non-harmonics- - - - -  $> 55$  dB below signal for fundamental and non-harmonics  $< 350$  MHz.  
 $> 35$  dB below signal for fundamental and non-harmonics  $> 350$  MHz.  
Residual AM- - - - -  $> 65$  dB below carrier (50 Hz to 15 kHz post detection noise bandwidth).  
Residual FM- - - - -  $< 200$  Hz (50 Hz to 15 kHz post detection noise bandwidth).

Amplitude modulation (for carrier  $\leq +30$  dBm)

Frequency  
Internal - - - - - 400 Hz and 1 kHz  $\pm 5$  percent.  
External - - - - - 25 Hz to 20 kHz.  
Range- - - - - 0 to 90 percent.  
Modulation indicator accuracy- - - - -  $\pm$  (5 percent of reading  $\pm 5$  percent).  
Distortion - - - - -  $< 3$  percent to 70 percent AM (5 percent to 90 percent AM) at 1 kHz.

Frequency modulation

Frequency  
Internal - - - - - 400 Hz and 1 kHz,  $\pm 5$  percent.  
External - - - - - 50 Hz to 25 kHz.  
Deviation peak - - - - -

Center frequency ( $f_c$ )	Maximum Peak Deviation $\Delta f_{pk}$	
	Rates $\geq 60$ Hz	Rates $< 60$ Hz
0.1-123.5 MHz	99 kHz	1600 x Rate
123.5-247 MHz	25 kHz	400 x Rate
247-494 MHz	50 kHz	800 x Rate
494-990 MHz	99 kHz	1600 x Rate

$\Delta f_{pk}$  FM not specified for  $f_c - \Delta f_{pk} < 100$  kHz.



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Accuracy - - - - -	±500 Hz to 10 kHz. ±5 kHz to 100 kHz.
Distortion - - - - -	<2 percent for 10 kHz to 100 kHz deviations at 1 kHz. <4 percent for 3 kHz to 10 kHz deviations at 1 kHz.
Specified operating range - - - - -	25°C ±5°C.

EQUIPMENT MEETING ALL SPECIFICATIONS

Manufacturer- - - - -	Hewlett Packard Model 8656A.
Manufacturer- - - - -	Wavetek Model 3001.

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## ITEM J04

## GENERATOR, PULSE

TYPE OF EQUIPMENT - - - - - Pulse generator.

FUNCTION PERFORMED- - - - - Generator of single pulses on pulse trains with controlled parameters.

SPECIFICATIONS

Modes of operation- - - - - Internal, external trigger, gate, manual (one-shot pushbutton) single pulse (pulse 1 only), delayed pulse (pulse 2 only), double pulse.

Frequency data

Pulse repetition rate (PRR)- - - - - 1 Hz to 25 MHz (at reduced amplitudes). Higher effective (PRR) in double pulse mode. At least 3 MHz repetition rate at 100 V. Continuously variable.

Frequency jitter - - - - - 0.1 percent of period  $\pm 0.5$  ns.

Pulse width data

Range - - - - - 20 ns to 500 ms less than 25 V; 20 ns to 5 ms @ 50 V; 30 ns to 0.1 ms @ 100 V.

Variation- - - - - Continuously variable; independent range and vernier control for pulse 1 and pulse 2.

Stability- - - - - 0.1 percent of setting  $\pm 0.5$  ns.

Pulse delay data

Range- - - - - 15 ns to 500 ms (pulse 2 position with respect to leading edge of pulse 1). 45 ns to 500 ms, pulse 2 position with respect to sync.

Variation- - - - - Continuously variable.

Stability- - - - - 0.1 percent of setting  $\pm 0.5$  ns.

Control- - - - - (Double pulse mode) controls pulse 1 to pulse 2 spacing.

Delayed pulse mode - - - - - Controls delay of output with respect to sync out and trigger in pulse 2 only output.

Input data

Gate/trigger input - - - - - May be gated or trigger at rates to 25 MHz.

Internal sync- - - - - Internal clock may be synchronized by an external pulse; frequency ratio to 100:1 may be used to sync.

Threshold- - - - - -2 V to +2 V; continuously variable through zero.

Sensitivity- - - - - Less than 0.1 V, 5 ns or wider input.

Impedance- - - - - Low (50 $\Omega$ ) or high (225 $\Omega$ ) switch selector.

Slope- - - - - Positive or negative; switch selector.

Delays - - - - - Trigger to sync, less than 15 ns; trigger to output less than 60 ns; sync to output, 45 ns.

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Output data - - - - -	Output source impedance 50 $\Omega$ (voltage source) or 850 $\Omega$ (current source). Positive or negative pulse polarity.
Amplitude	
Current mode - - - - -	$\pm 10$ mA to $\pm 2$ A.
Source impedance - - - - -	850 $\Omega$ .
Maximum voltage - - - - -	110 V into open circuit.
Voltage mode - - - - -	$\pm 20$ mV to $\pm 100$ V from 50 $\Omega$ . ( $\pm 10$ mV to 50 V into 50 $\Omega$ .)
Duty cycle - - - - -	10 percent @ 2 A, 0.1 ms maximum width; high duty cycles for gated bursts; 50 percent @ 1 A, 5 ms maximum width; 100 percent @ 0.5 A and below; no duty cycle limitation below 25 V.
Overload protection - - - - -	Operates into open or short circuit. Protection fully automatic. May drive inductive or capacitive loads.
Waveshape data	
Rise time- - - - -	Less than 10 ns to greater than 50 ms; continuously variable.
Fall time- - - - -	Less than 10 ns to greater than 50 ms; continuously variable.
Linearity- - - - -	2 percent nonlinearity in rise time/fall time over 10 percent to 90 percent amplitude, any range.
Overshoot- - - - -	Less than 5 percent of amplitude, maximum, of each range.
Distortion - - - - -	Preshoot, undershoot, droop or other waveform anomalies less than 5 percent at full output.
Baseline offset data.	
Range- - - - -	-100 mA to +100 mA; -5 V to +5 V into 50 $\Omega$ ; continuously variable.
Control- - - - -	ON-OFF and continuous variation through zero. Baseline control not affected by output amplitude setting.
Sync output data	
Repetition rate- - - - -	Same as clock frequency or trigger frequency.
Amplitude- - - - -	+1 V into 50 $\Omega$ .
Width- - - - -	5 ns, minimum.
Rise/fall time - - - - -	Less than 2 ns.

## EQUIPMENT MEETING ALL SPECIFICATIONS

Manufacturer- - - - - Chronetics Model PG-13A, pulse generator.

EQUIPMENT MEETING SPECIFICATIONS  
WITH EXCEPTIONS AS NOTED

Manufacturer- - - - - Hewlett Packard Model 214B.  
Exceptions - - - - -  
1. Only one pulse output.  
2. Frequency data.  
Pulse repetition rate:  
10 Hz to 10 MHz (at reduced  
amplitudes). At least 4 MHz  
repetition rate on all amplitude  
ranges.

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3. Pulse width data.  
Range:  
25 ns to 10 ms on all ranges.
4. Pulse delay data.  
Range:  
100 ns to 10 ms pulse 1 with respect to pulse 2 (double pulse mode). 60 ns to 10 ms output with respect to trigger.
5. Input data.  
Gate/trigger input:  
May be gated or trigger at rates to 10 MHz.  
Internal sync - no synchronization of internal trigger available.  
Sensitivity - less than 0.5 V pp, 10 ns or wider input.  
Impedance - 10 k $\Omega$  nominal.
6. Output data.  
Output source impedance fixed 50 ohm on ranges up to 10 V.  
Selectable 50 ohm nominal or high impedance on 30 V and 100 V ranges.
7. Amplitude.  
Current mode not available.  
Voltage mode 300 mV to 50 V into 50 $\Omega$  from 50 $\Omega$ .  
Duty cycle -  $\geq$ 10 percent maximum for 30-100 V ranges;  $\geq$ 50 percent maximum for other ranges.
8. Transition time -  $\leq$ 15 ns, not adjustable.
9. Offset - not adjustable.

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ITEM V04

VOLTMETER, DC

TYPE OF EQUIPMENT - - - - - Digital dc voltmeter.  
FUNCTION PERFORMED- - - - - DC voltage measurement.

SPECIFICATIONS

Range - - - - - 1.0000 V full scale  $\pm 20$  percent  
over-range.  
10.000 V full scale  $\pm 20$  percent over-  
range.  
100.000 V full scale  $\pm 20$  percent over-  
range.  
1,000.0 V full scale.

Accuracy- - - - -  $\pm 0.01$  percent of reading  $\pm 0.01$  percent  
of full scale; above 500 V  $\pm 0.01$  percent  
of reading  $\pm 0.027$  percent of full scale.

Resolution- - - - - 100  $\mu$ V (1 V range).

Input impedance - - - - - 1 V: > 1,000 M $\Omega$ .  
10 V: > 1,000 M $\Omega$ .  
100 V: > 10 M $\Omega$ .  
1,000 V: > 10 M $\Omega$ .

Temperature coefficient - - - - -  $\pm 0.002$  percent of reading  $\pm 0.008$  percent  
of full scale/ $^{\circ}$ C.

Voltage coefficient - - - - -  $\pm 0.00005$  percent/V if input exceeds  
500 V.

Temperature range - - - - -  $+5^{\circ}$ C to  $+45^{\circ}$ C.

Normal mode rejection - - - - - >30 dB at 60 Hz.  
>40 dB at 120 Hz.  
>50 dB at 400 Hz.

EQUIPMENT MEETING ALL SPECIFICATIONS

Manufacturer - - - - - Fairchild Model 7000 Digital Multimeter.

EQUIPMENT MEETING SPECIFICATIONS  
WITH EXCEPTIONS AS NOTED

Manufacturer- - - - - Fluke Model 8600 Digital Multimeter.  
Exceptions - - - - - Accuracy  $\pm 0.02$  percent of reading  $\pm 0.005$   
percent of full scale; on 1,000 V scale  
 $\pm 0.04$  percent of reading  $\pm 0.01$  percent  
of full scale.

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ITEM W08

## VOLTMETER, RF

TYPE OF EQUIPMENT - - - - - RF voltmeter.

FUNCTION PERFORMED- - - - - Measures high frequency ac voltages  
(true rms <30 mV, indication  
proportional to peak >30 mV).

## SPECIFICATIONS

Voltage range - - - - - 1 mV rms full scale to 3 V rms full  
scale in 1, 3, 10 sequence (8 ranges).

Frequency range - - - - - Calibrated 10 kHz to 2.4 GHz.

Accuracy- - - - - ± (1 percent full scale +1 percent  
reading) 10 kHz to 150 MHz  
± (1 percent full scale +3 percent  
reading) 150 MHz to 700 MHz.  
1 mV to 300 mV scales: ± (1 percent  
full scale +7 percent reading) 700 MHz  
to 1.2 GHz.  
1 V to 3 V scales: ± (1 percent full  
scale +10 percent) 700 MHz to 1.2 GHz.

Input impedance - - - - -	10 mV range	3 V range	
max	100 kHz	100 kΩ min 2.8 pF max	1 MΩ min 1.8 pF
	1 MHz, 10 MHz 100 MHz	100 kΩ min 5 kΩ min	1 MΩ min 50 kΩ min
Crest factor- - - - -	420 to 42 on 1 mV scale. 42 to 14 on 3 mV scale. 14 to 4.2 on 10 mV scale. 4.2 to 1.4 on 30 mV scale.		

## EQUIPMENT MEETING ALL SPECIFICATIONS

Manufacturer- - - - - Ballantine Model 3440A with option 40.  
Boonton Models 9200, 92R, or 9280.