NOTICE OF CHANGE

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MIL-HDBK-179(ER)
NOTICE 1
30 September 1994

MILITARY HANDBOOK
MICROCIRCUIT APPLICATION HANDBOOK

TO ALL HOLDERS OF MIL-HDBK-179(ER):

1. THE FOLLOWING PAGES OF MIL-HDBK-179(ER) HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
i	30 Sep 1994	i	25 October 1993
ii	30 Sep 1994	ii	25 October 1993
iii	30 Sep 1994	iii	25 October 1993
iv	30 Sep 1994	New	----------
v	30 Sep 1994	New	----------
vi	30 Sep 1994	New	----------
16	25 Oct 1994	16	reprinted without change
17	30 Sep 1994	17	25 October 1993
18	30 Sep 1994	18	25 October 1993
19	30 Sep 1994	19	25 October 1993

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

3. Holders of MIL-HDBK-179(ER) will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military handbook is completely revised or canceled.

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AMSC N/A FSC 5962

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FOREWORD

1. This military handbook is approved for use by the US Army Research Laboratory, Electronics and Power Sources Directorate, Department of the Army, and is available 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: Director, US Army Research Laboratory, Electronics and Power Sources Directorate, ATTN: AMSRL-EP-RD, Fort Monmouth, New Jersey 07703-5601, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. Commercial/industrial and commercial (consumer) microelectronic devices, often having advantages in cost, size, weight, performance and availability, have attracted widespread attention for government and military applications. This handbook takes a major deviation from traditional procurement guidelines by assisting military departments and associated contractors in the selection of commercial/industrial, commercial (consumer), and traditional military microcircuits for military equipments. The document gives greater flexibility and responsibility in selecting devices based on cost-effective performance, designed-in reliability, and high quality for a given application. A critically important factor in the selection of a supplier of commercial/industrial or commercial (consumer) quality microcircuits is KNOW YOUR SUPPLIER! Does the supplier have in-line process controls, SPC, incoming material control, in-line process monitors, continuous periodic testing, etc? Does he incorporate Best Commercial Practices? These are some of the questions that Figure 1. Microelectronic selection criteria spread sheet is seeking to answer.

4. The handbook introduces two non-military quality systems, commercial/ industrial quality and commercial (consumer) quality. Although there are many combinations of component quality systems and operating temperature ranges in actual use, these two "systems," as defined in the handbook, represent two very common application situations. Commercial/industrial quality components are normally purchased to an industry (e.g., user) specification and will normally be specified for operation over an extended temperature range such as -40° to 125°C. Commercial/ industrial quality components are currently used in many industrial computer, automotive, telecommunication, avionics and instrumentation applications. Commercial (consumer) quality components are normally purchased to a vendor specification and will be specified over a more limited temperature range such as 0° to 70°C. Commercial (consumer) quality components are used in low-cost driven markets such as video games, VCRs, etc. For military applications, where commercial/industrial quality or commercial (consumer) quality devices meet quality, reliability and operating temperature requirements, a substantial cost savings may be realized by procuring to these quality systems.

5. The handbook uses the term "BEST COMMERCIAL PRACTICES" (BCPs) extensively. The use of this term in connection with microcircuit technology has the potential

for creating some confusion. The casual reader might tend to identify BCP with commercial (consumer) quality components described in paragraph 4 above. However, the authors of this handbook believe the term "Best Commercial Practices," as used by the Defense Science Board and others, better fits the commercial/industrial quality system discussed above. Therefore, this handbook uses BCP in association with those components designed, processed, assembled, screened, tested and packaged on high volume lines for industrial customers with requirements for high quality, high reliability and low cost. Although BCP will primarily be associated with commercial/industrial quality parts in the handbook, it should be noted that the military's Qualified Manufacturers' List (QML) program was developed to accommodate BCP to reduce cost and accelerate insertion of new technology.

6. Assurance of highest generic quality and reliability of military, commercial/industrial and commercial (consumer) microcircuits is obtained through the application of BCP systems. The commercial/industrial quality devices are available from mature process lines, which have been qualified by a high volume user and have demonstrated high quality and reliability. Economy-of-scale is realizable because validation cost is amortized over the large number of parts procured. Commercial/industrial BCP parts are predominately plastic encapsulated and produced in high volume. Although the high volume users of industrial BCP parts require a small variety of part types, the application of "structural similarity" may significantly increase the number of qualified part types regardless of the quality system employed (e.g. commercial/industrial or Qualified Manufacturers' List). The military application of dual use technology is becoming a reality, and plastic encapsulated microcircuits (PEMs) will be part of that trend.

7. Development of this Microcircuit Application Handbook was recommended to the Office of the Under Secretary of Defense by the Department of Defense (DoD) Defense Science Board (DSB). The DSB made recommendations for a significant change in procurement directed towards increasing DoD's usage of the device manufacturers' best commercial components and practices. Following the DSB recommendations, the Office of the Assistant Secretary of Defense for Production Resources, Standardization Program Division (OASD-MMD/SPD), requested that the US Army Research Laboratory prepare this handbook as an aid in the selection of commercial/military microcircuit components for military equipments. To accomplish the task a military and industry working group, consisting of the three military departments, the Defense Logistics Agency (DLA), system integrators and device manufacturers, was formed. The following organizations played a significant role in the development of this document:

Department of Defense:	US Army Research Laboratory/EPSD
	US Air Force Rome Laboratory (RL)
	US Naval Weapons Support Center Crane
	Defense Electronics Supply Center
Industry:	Texas Instruments
	National Semiconductor
	GTE Government Systems

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5. SELECTION GUIDANCE

5.1 Selection guidance. Devices should be selected according to the guidance provided in table III and applicable guidance provided herein.

5.2 Selection criteria for commercial (consumer) and commercial/industrial quality product (figure 1). Figure 1 and its companion guide, the Selection Criteria Guide (see 5.2.1), is to be used in equipment procurement solicitations. Use of commercial (consumer) devices or commercial/industrial devices requires completion, submission and approval of the spread sheet depicted in figure 1. The spread sheet is to be used to assess the acceptability of proposed microcircuits for system application and to rate equipment manufacturer on their knowledge of the technology proposed. It is the equipment manufacturer's statement of assurance of microcircuit reliability in the proposed system application.

5.2.1 Selection criteria spread sheet guide. The information required in each data item of the spread sheet is explained in a. through j. The descriptions are typical inputs which could meet the data item requirements. Additional inputs which will meet the intent of the data item should be included.

a. Part type and number: Description of device: microprocessor, memory; controller, amplifier, etc. Identification of part through catalog number, Standard Military Drawing (SMD), Source Control Drawing (SCD), etc, with accompanying drawing containing package outline, temperature range, power capability, etc.

b. End item applications: What equipment has this device (part number) been used in, preferably equipment manufactured by the equipment manufacturer? If this is not available, then verifiable data from other government or commercial equipment applications. Applicable information would include number of parts used and use history in these systems.

c. Volume sold per year: An approximate number per year sold by the supplier over the past five years. This will provide an indication of the maturity of the device.

d. Experience factor: This would support category b. above if the equipment manufacturer had used this device in another application. Data could include types of devices used (SMT, DIP, etc), experience at board assembly, and field reliability.

e. Reject rate: If this part has been used before, what has been the incoming or assembly first test experience? Has cause of reject been determined and is it device design or process related? Vendor outgoing final test data will be acceptable.

f. Reliability assurance: How will the equipment manufacturer assure the microcircuit will meet the end item use (reliability) requirement? An approach which implements diagnostics of stress tested parts and field failure returns with feedback to correct problems in design or processing is a technique to assure product reliability. Correct device selection for the circuit design implemented is mandatory. A QML methodology at each assembly operation will assure the greatest quality, highest yield and lowest defect rate. Assessment could be based on possible failure mechanisms and how the supplier and user will assure any impact is

eliminated. PCMs (process control monitors) and SECs (standard evaluation circuits) are test devices used as process control monitors and process validation circuits respectively. CADMP (computer aided design of microelectronic packages) is a software program to assure reliability of a packaged assembly at initial design.

g. Use environment: What is the specific end item this device will be used in? What will be the environmental extremes the device will be subjected to and the frequency of these stresses (cycles per year) if applicable. How have these conditions been addressed in category f. above?

h. Derating: Has the equipment manufacturer's circuit designer provided adequate margin (safety factor) between worst case circuit design and device specification performance limits? Provide comparison of design factors and specification limits.

i. Purchased to which qualification system: Provide the qualification system identification to which the microcircuit will be procured. If an accepted military or industry standard, indication of system is the only requirement. If not standard or changes to a standard proposed then detail documentation is required.

j. Proposed additional assurance: This category will be for the identification of added value screening or sampled testing required to assure meeting system requirements. Further assurances from the supplier such as certificate of compliance and warranty.

5.3 Plastic encapsulated microcircuit (PEM) requirements. PEMs selected for use in military systems should, at a minimum, be capable of passing electricals following testing identified in table II. Additionally, issues discussed in paragraph 7.4 should be considered when using PEMs in military equipment. The LTPD (lot tolerance percent defective) with zero acceptance number will be 3 for industrial and 5 for commercial. These data should be generated from continuous periodic tests.

Table II. Minimum acceptance tests for industrial/commercial quality systems 1/

Quality System	THB 2/	HAST 3/	TEMP CYCLE 4/
Commercial/Industrial Quality	1000 hrs	250 hrs	500 cycles
Commercial (Consumer) Quality	250 hrs	96 hrs	100 cycles

1/ The test data supplied will be data generated from in-house qualification or customer required testing. These are typical number of hours and cycles.
2/ Temperature Humidity Bias (THB) Test Method EIA JESD 22-A101.
3/ Highly Accelerated Stress Test (HAST) Test Method EIA JESD 22-A110, Condition C.
4/ MIL-STD-883, Test Method 1010, Condition B.

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FIGURE I. Microelectronic selection criteria spread sheet per vendor 1/

Part Type and Number	End Item Applications	Volume Sold Per Year	Experience Factor	Reject Rate
Microprocessor SNJ XXYY	IBM PC Ford Radio AN/PRC-70, etc			o Past experience o Vendor assurance o at incoming or PCB level
Reliability Assurance	**Use Environment**	**Derating**	**Purchased to Qual System**	**Proposed Additional Assurance**
o PCM o SEC o Life test-need test conditions o Failure rate calculation o CADMP o Failure mechanism o Field data	o Aircraft, tank, etc o Temperature, RH, temperature cycle, vibration, shock, etc for each environment	o Worst case operating electrical conditions (1% of spec limits)	o Vendor self-audit o ISO-9000 o QML o Delco o Details required	o Screens o QCI o Certificate of compliance o Warranty o Rad-hard

1/ used with the Microelectronic Selection Criteria Guide (see 5.2.1)

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TABLE III. Multiple entry matrix. [1/]

Environment	Category 1 Protected	Category 2 Normal	Category 3 Normal	Category 4 Harsh	Category 5 Hostile	Category S Space
Special issues	Readily accessible to maintenance	High volume Readily repairable	Inhabited A/C area Ground mobile	Uninhabited A/C Extreme temperatures	High shock Extreme temperatures	
Typical systems	Off-the-shelf NDI	Air traffic control Ground radar Communication facilities Ground fire control	Cockpit NAV/COM Ground mobile Most shipboard	Some avionics High G/not shock Some shipboard	Tactical missiles, munitions	Space, strategic missiles
Critical trade-off concerns	Controlled environment, air conditioned	Uncontrolled temperature, moderate vibration	Extreme pressure, vibration, temperature and moisture	Extreme pressure, vibration, temperature and moisture	Extreme pressure, vibration, temperature and moisture	
Typical temperature	0°to +70°C	-40°to +85°C	-55°to +125°C	-55°to +125°C	-55°to +125°C	-55°to +125°C
Comparable MIL-HDBK-217 environments	Quasi G_B	G_B, G_F	G_M, M_P, N_S, N_{BS}, N_H, N_U, N_{UU}, A_{IC}, A_{IT}, A_{IB}, A_{IA}, A_{IF}, A_{RW}	A_{UC}, A_{UT}, A_{UB}, A_{UA}, A_{UF}	U_{SL}, M_L, M_{FF}, M_{FA}	S_F
Preferred quality system	QML JQA [2/] Industrial [3/ 4/] Commercial [3/ 4/] Class M	QML JQA [2/] Industrial [3/ 4/] Class M	QML JQA [2/] Industrial [3/4/] Class M	QML JQA [2/] Class M	QML JQA [2/] Class M	QML Class V
Preferred procurement document	SMD CID [5/]	SMD CID	SMD CID	SMD	SMD	SMD
Alternate procurement document	SCD	SCD	SCD	SCD	SCD	SCD

[1/] Inclusion of a device, technology, or supplier in a particular standard does not relieve the user of the responsibility for determining application suitability. *The devices, technologies, and suppliers included in the* standards have met certain reliability and performance requirements deemed suitable, in general, for usage in a military application. The user is cautioned to examine specific technical, life-cycle, and programmatic considerations when selecting from these standards.

[2/] This is a proposed commercial/industrial quality system. When published and adopted by the DoD it could be used for indicated system environments.

[3/] Use of commercial (consumer) devices or commercial/industrial devices (other than JQA) requires completion, submission and approval of the Microelectronic Selection Criteria Spread Sheet (see 5.2, figure 1). Recommendations for approval or disapproval of devices (based on spread sheet information) will be made by the Military Parts Control Advisory Group. The Program Manager/System Program Office has final approval authority.

[4/] Plastic encapsulated devices must meet the minimum requirements specified in 5.3 and table II.

[5/] Commercial Item Descriptions (CIDs) are to be used for commercial (consumer) and commercial/industrial product.

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