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MIL-STD-1364J (NAVY)
7 OCTOBER 1991
SUPERSEDING
MIL-STD-1364H (NAVY)
29 NOVEMBER 1989

MILITARY STANDARD
GENERAL PURPOSE
ELECTRONIC TEST EQUIPMENT



AMSC N4790

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FSC 6625

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FOREWORD

1. This military standard is approved for use by the Department of the Navy 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: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 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 identifies standard General Purpose Electronic Test Equipment (GPETE), GPETE support items (GSI), and General Use Portable Electrical Equipment (GUPEE) which have been determined to be suitable for Navy use and for which the Naval Sea Systems Command (NAVSEA) exercises material support responsibility by management of item entry. This standard also establishes uniform procedures for submission of applications to procure nonstandard GPETE.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-T-28800 - Test Equipment for Use With Electrical and Electronic Equipment, General Specification for

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATIONS

DOD Cataloging Handbook H4/H8	- Section B Commercial and Government Entity (CAGE)
NAVAIR 16-1-525	- Preferred Avionics Common Support Equipment
NAVSEA OD 45845	- Metrology Requirements List (METRL)
NAVSEA ST000-AA- IDX-010-PEETE	- Index for Support Requirements of Shipboard Electronic, Electrical, IC, Weapons, and Reactors Systems (TE Index)
NAVSUP P-4000	- Navy Management Data List (Master Cross Reference List)

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NAVSUP P-485 - Afloat Supply Procedures
 SPCC MIAPL - Master Index of Allowance Parts List/
 Allowance Equipment List

(Copies of DOD Cataloging Handbook H4/H8 are available from the Commander, Defense Logistic Services Center, Battle Creek, MI 49017-3084. Copies of NAVAIR 16-1-525, NAVSEA OD 45845 and ST000-AA-IDX-010-PEETE, NAVSUP P-4000 and P-485, and SPCC MIAPL are available from the Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 GPETE. GPETE is electronic test equipment capable of generating, modifying, or measuring a range of electronic functions to test two or more systems or equipment of basically different design.

3.1.1 Standard GPETE. Standard GPETE is GPETE preferred for acquisition listed in Appendix A.

3.1.2 Nonstandard GPETE. Nonstandard GPETE is any GPETE item not listed in Appendix A. Application procedures of 5.4 apply for acquisition of these items.

3.2 GSI. GSI is the complement of equipment, supplemental to GPETE, which is necessary to facilitate a complete test measurement capability. GSI includes ratio transformers, couplers, decade capacitors, adapters, attenuators, dummy loads, filters, terminations, oscilloscope probes, noise sources, and so forth.

3.3 GUPEE. GUPEE is test equipment normally associated with evaluating, monitoring, and troubleshooting electrical generators, motors, and power distribution systems. GUPEE includes portable ammeters, voltmeters, single and polyphase wattmeters, phase-sequence indicators, frequency meters, and so forth.

3.4 GPETE master group (GMG). A GMG is a five-character code that identifies instrument requirements within a generic family of equipment. The first three characters identify the generic family.

3.5 NAVSEA subcategory (SCAT). A SCAT code is a four-digit numeric code used by NAVSEA to identify a range of measurement requirements by functional category. Test equipment is assigned to SCAT codes in the 4000 to 4999 series.

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3.6 GPETE initial outfitting. GPETE initial outfitting is GPETE acquired to satisfy requirements for newly installed prime systems.

3.7 GPETE supply support. GPETE supply support is GPETE acquired to satisfy the Navy's replenishment program.

3.8 Emergent GPETE. Emergent GPETE is unplanned, unprogrammed, 7Z COG items for initial outfitting; not replenishment or turn-ins.

4. GENERAL REQUIREMENTS

4.1 Selection of GPETE. This standard contains purchase descriptions for GPETE and associated typical models which are planned for acquisition to fill the bulk of electronic test equipment applications Navy-wide. Cross-references needed to identify older or previous GPETE to current electronic test equipment applications may be found in NAVSEA ST000-AA-IDX-010-PEETE (TE Index) for NAVSEA and shore activities, and NAVAIR 16-1-525 for NAVAIR activities.

4.2 Nonstandard equipment. Approval for acquisition of nonstandard GPETE must be fully justified (see 5.4). Nonstandard application procedures also apply for other configurations and modifications of standard GPETE in order to identify and document new or expanded test procedures. Applications are required for GPETE mainframes and plug-ins when acquired separately, as well as self-contained units intended to augment the operational capability of GPETE such as modulators, tracking generators, and so forth. Applications for nonstandard GSI and GUPEE are not required but users are encouraged to submit applications for guidance purposes.

5. DETAILED REQUIREMENTS

5.1 Guidance for use. Naval activities initiating or specifying requirements for GPETE, GSI, and GUPEE shall select standard models listed herein using guidance obtained from the following appendixes.

5.1.1 Appendix A. Standard equipment index. This appendix lists standard GPETE, GSI, and GUPEE in noun name sequence referenced to GMG code, SCAT code, and national stock number (NSN). The commercial and Government entity (CAGE) code specified in DOD H4-2 is listed with each commercial model. A page number is listed which indexes the Appendix D purchase description to the referenced model.

5.1.2 Appendix B. SCAT to GMG code. Many documents, including the TE Index, cite the NAVSEA SCAT code to identify the family group of a particular test equipment application. Appendix B identifies the GMG code and its head of family (standard model) for each relevant SCAT code. Previous to preferred model cross-referencing is found by using this appendix in conjunction with the TE Index.

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5.1.3 Appendix C. GPETE configurations. Many commercial, off-the-shelf GPETE models are provided to the Navy with configuration numbers assigned which are not found in the manufacturers' catalogs. Appendix C was compiled to assist the user with identification of these models and their components. This appendix is sorted by the configuration number and lists model numbers of mainframes, plug-ins, their options, and major accessories.

5.1.4 Appendix D. Purchase descriptions. Appendix D contains technical acquisition specifications for standard GPETE, GSI, and GUPEE. This appendix is arranged in noun name sequence. The specifications reflect the known minimum technical requirements of the Navy and are not necessarily those of the standard models listed in Appendix A. Accordingly, each model should be considered typical as alternate manufacturers may be selected to deliver substitute models using these specifications for qualification.

5.1.4.1 GMG code revision letter. Each Appendix D purchase description is identified by a five-character GMG code followed by a revision letter. Because of changing test requirements for new and evolving prime systems and modernized test methods, the revision letter is necessary to identify updated issues of the purchase description used for solicitation. The current GMG code revision letter may be found in the MIL-STD-1364 GPETE, GSI, and GUPEE Status List (see 5.2). Details of modifications noted by revision letter changes can be obtained from the NAVSEA Test and Monitoring Systems (TAMS) Division or from the GPETE Bulletin Board System (BBS) (see 5.5).

5.1.4.2 Environmental classification. The approximate severity of environmental conditions in which the test equipment item is capable of being operated and stored may be determined from the type, class, and style characteristics found in the purchase description and as defined in MIL-T-28800.

5.2 GPETE, GSI, and GUPEE status list. Guidance to interim additions and deletions of standard test equipment is provided in the GPETE, GSI, and GUPEE Status List between revisions of MIL-STD-1364. This status list is issued semi-annually in April and October by the Naval Electronic Systems Engineering Activity (NESEA), St. Inigoes, MD 20684-0010. Direct inquiries to Code 2261. The status list is alternately available from the GPETE BBS (see 5.5) which is updated quarterly.

5.3 Acquisition of test equipment. Users shall not interpret this document as authority to acquire GPETE, GSI, or GUPEE on a sole-source basis. Acquisition shall be in accordance with federal acquisition regulations and maximum competition between manufacturers shall be sought. Specific details for requisitioning GPETE are contained in NAVSUP P-485 and type commander directives.

5.3.1 GPETE initial outfitting deficiencies. New or increased allowances of 7Z Cog GPETE are not to be requisitioned by the requiring activity except as authorized below by the emergent GPETE requirement

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program. Initial outfitting deficiencies of GPETE will be determined by TAMS managers. These deficiencies are consolidated by the NAVSEA TAMS Division for acquisition.

5.3.2 Emergent GPETE acquisition program. Extensive time is required to coordinate and budget for Navy-wide 7Z Cog GPETE assets. A three-year acquisition process is normal for programmed buys. To allow for non-programmed, time-critical acquisition of 7Z Cog GPETE, the emergent GPETE acquisition program was established.

5.3.2.1 Application procedures. Requesting activities shall coordinate their acute GPETE needs with their type commander who, in turn, shall coordinate allowancing data with respective TAMS managers. The requesting activity shall submit a funded requisition with a routing identifier of P90 to the Commanding Officer, Naval Electronic Systems Engineering Activity, Code 2261, St. Inigoes, MD 20684-0010. Requisitions by message may be submitted to NAVELXSYSENGACT St Inigoes, MD. The subject line should state: GPETE MILSTRIP. Requirements for nonstandard 7Z Cog GPETE must be submitted in accordance with the nonstandard GPETE application procedure (see 5.4) prior to submission of the requisition.

5.3.2.2 Program responsibilities. Upon receipt of a funded requisition, NESEA personnel will verify requirements with the respective TAMS manager. A control number will be assigned to an approved requisition which will then be forwarded to Navy Ships Parts Control Center (SPCC). SPCC personnel will report the status to the requesting activity, procure the GPETE item, and, upon receipt, ship the item to the requestor. A disapproved requisition or a requisition submitted directly to the SPCC will be cancelled and returned to the requesting activity.

5.3.3 GPETE supply support procedures. GPETE supply support procedures apply when a GPETE item designated in NAVSEA ST000-AA-IDX-010-PEETE as a standard item, substitute standard, or limited standard is to be turned in. As directed in NAVSUP P-485, a survey report will be completed on missing or unserviceable GPETE and, in turn, an Issue Release Receipt Document, DD Form 1348 will be prepared for the replacement item. Carcass turn-in credit is applicable for standard and substitute standard GPETE. When a limited standard item is turned in, users are charged the standard price for the replacement GPETE because repair of the carcass is no longer cost effective. If an obsolescent or obsolete item is to be surveyed and replaced, the replacement item falls under the GPETE initial outfitting program. Report the deficiency to your type commander for subsequent submission to NAVSEA TAMS Division for acquisition.

5.4 Nonstandard GPETE application procedure. When a Navy activity determines it has a unique measurement requirement and needs to acquire nonstandard GPETE, the applicant shall evaluate criteria specified in a and b below for planning purposes. The Navy activity must narrow its nonstandard GPETE selection to best meet the logistics and performance criteria cited above below. Once this is done, the activity must fill out a nonstan-

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standard GPETE application in accordance with DID DI-MISC-80056 (see 6.2) and submit it to NESEA (Code 2261).

a. Logistics consideration. The ideal selected nonstandard GPETE is a model currently in the Navy inventory, has spare parts support, and an instrument calibration procedure (ICP) listed in NAVSEA OD 45845 Metrology Requirements List (METRL). Existence in Navy inventory may be found by consulting publications listed in NAVSUP P-4000. Provisioning support information is available from the SPCC MIAPL.

b. Performance consideration. The ideal selected nonstandard GPETE is suitable for use in the intended environment. Environmental type, class, and style characteristics of the nonstandard GPETE may be identified through the use of MIL-T-28800.

5.4.1 Application Review. NESEA personnel will review each nonstandard GPETE application within 10 working days from the date of receipt. A nonstandard GPETE control number will be assigned to each application and referenced in all correspondence. Each nonstandard GPETE application will be evaluated for approval based on the application data, technical justification, and life-cycle cost. An item previously selected and proven in an equivalent system test application will be considered as a substitute to minimize proliferation.

5.4.2 Application approval. Applicants will be advised by NAVSEA (Code 04DS) in writing of application approval or disapproval. Upon receipt of the nonstandard GPETE application review package from NESEA (Code 2261), NAVSEA (Code 04DS) forwards a letter within 10 working days that either approves or disapproves the application. Nonstandard GPETE application approvals shall be interpreted as granting authority to deviate from the standard GPETE models listed in Appendix A. Authority to initiate an acquisition and expend funds is beyond the scope of NAVSEA authority. SPCC procures all approved 7Z and 1H cognizance standard and nonstandard GPETE, GSI, and GUPEE unless they grant local procurement authority. Other items are procured by the agency assigned cognizance.

5.4.3 Life-cycle support. The activity desiring the nonstandard GPETE will be responsible for developing new life-cycle support including Instrument Calibration Procedure (ICP) development and provisioning. The activity should contact the Naval Weapons Assessment Center (Code 3112C), Comm (714) 273-5361 or AV 933-5361 to coordinate the development and funding of the ICP. To determine provisioning and its associated cost, contact the Naval Sea Logistics Center (Code 416), Comm (717) 790-3246 or AV 430-3246. Under no circumstances shall nonstandard GPETE be placed on the Ships Portable Electrical/Electronic Test Equipment Requirements List (SPETERL) for any Navy ship before the requirements for an ICP and provisioning are investigated.

5.4.4 Term of approval. A nonstandard GPETE application approval will be valid for one year from the issue date except when based on specific

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out-year projections. Contact NESEA (Code 2261), Comm (301) 862-8288 or Autovon 326-3512 extension 8288, if the approval period will expire prior to acquisition initiation and an extension is required. The applicant shall stipulate the reason for the extension request and specify the extension period required.

5.4.5 Application disapproval. Nonstandard GPETE applications will be disapproved by NAVSEA (Code 04DS) when they are incomplete or not technically justified. The applicant will be notified in writing and will be given the reason for the application disapproval.

5.4.6 Resubmission after disapproval. If a nonstandard GPETE application has been disapproved by NAVSEA (Code 04DS) and the applicant wishes to reapply, the new application shall include cited omissions or additional justification as described in the disapproval letter. The applicant may contact NESEA (Code 2261) for clarification or questions.

5.4.7 Nonstandard GPETE requisitioning requirements. The control number shall be referenced in the remarks portion of any funded requisitions for nonstandard GPETE. Requisitions shall be submitted in accordance with the GPETE initial outfitting acquisition procedures (see 5.3).

5.5 GPETE BBS. Because of printing and mailing cost restrictions, distribution of the GPETE, GSI, and GUPEE Status List is limited. The status list may be obtained from the GPETE user's conference on the GPETE BBS at NESEA. This BBS also maintains updated revisions of purchase descriptions and other pertinent GPETE matters. The BBS may be contacted via 1200-9600 baud phone modem at (301) 862-8048. Access to the GPETE conference is normally granted one working day following initial registration. To register, complete the initial quick registration form and then complete the new user registration by accessing the "door2" mode. Inquiries, suggestions, or comments concerning electronic test equipment may also be made through this service (see 6.3).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This standard applies to all direct Navy acquisition and procurement through contractors and subcontractors for standard and nonstandard GPETE, GSI, and GUPEE. The standard GPETE, GSI, and GUPEE identified herein should be cited in all planning and support documents which specify electronic and electrical test equipment.

6.2 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Description (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the

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requirements of the specific acquisition. To insure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirements for a DD Form 1423.

<u>Referenced Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
5.4	DI-MISC-80056	Request for approval of nonstandard general purpose electronic test equipment	----

The above DID's were those cleared as of the data of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.3 User inquiries. Navy test equipment users are invited to contact NAVSEA TAMS Division concerning new or modified test methods and troubleshooting procedures which would require changes to the minimum technical requirements specified in the appendix D purchase descriptions. Please identify the prime system under test and details of the test procedure, including copies of technical manual pages, maintenance requirement cards, and other pertinent documentation.

6.4 Listing inquiries. The Navy need for GPETE, GSI, and GUPEE is a function of the specific test and measurement capabilities required to maintain and repair weapon systems and ancillary subsystems. The standard electronic and electrical test instruments listed in this document were extensively tested and evaluated in consideration of current and projected GPETE requirements. Manufacturers' inquiries relative to a product which can lead to significant operational improvements and economy are welcome.

Inquiries should be addressed to Naval Sea Systems Command, Test and Monitoring Systems (TAMS) Division, Washington, DC 20362-5101. Provide full descriptive information, a technical manual, support availability, and test data in accordance with MIL-T-28800.

Indicate why the item should be listed and supply supporting information concerning a known or projected Navy measurement requirement. Identify the particular weapon system, measurement setup, and, where possible, the user activity.

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6.5 Subject term (key word) listing.

Applications
Commercial and government entity (CAGE)
Emergent GPETE acquisition program
GPETE
GSI
GUPEE
Instrument calibration procedure (ICP)
Item entry
GPETE initial outfitting
GPETE master group (GMG)
GPETE supply support
National stock number
Nonstandard
Subcategory (SCAT)
Support items
Test and monitoring systems (TAMS)

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project No. 6625-NB 30)

Review activities:
Navy - AS, SA

User activities:
Navy - OS, CG, YD, EC, MC, TD, NO, OM

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APPENDIX A

Standard Equipment Index

Item Name Description (see note)	CAGE Model	GMG Code	SCAT Code NSN	Ap D Page
AMMETER, CLAMP-ON U 1000A ac/dc, 330 kW, 660 Vac	89536 801-KW	AMCAA-A	+4226	33
ANALYZER, DISTORTION P 10 Hz to 100 kHz	38047 3501-0100	ANONP-D	4344 726625-01-260-9228	35
ANALYZER, LOGIC P 16 channel, 100 MHz clock	57062 K100-D+K100-D/488	AN4MM-C	+4032 726625-01-136-8482	36
ANALYZER, NETWORK P 5 Hz to 200 MHz, polar/smith	28480 3577B-001-002-E01	AN2FM-C	726625-01-330-8266	38
P 100 MHz to 18 GHz, scalar	28480 8757E-S20	AN2NT-C	4475 726625-01-282-9398	40
P 110 MHz to 18 GHz, vector	28480 8410C+8411A+8412B	AN2MM-B	4980 726625-01-237-1154	41
ANALYZER, POWER U 600V, 125A, 100 kW, PF -1 to +1, 3 phase	23207 8000+CT-150(3)+RSC-B	ANZAT-A		1/
ANALYZER, SIGNATURE P TTL/CMOS 16 bit	28480 5006A-40-H01	ANSAA-C	+4028 726625-01-235-0392	42
ANALYZER, SPECTRUM P 5 Hz to 50 kHz, 1 Hz RBW	28480 3580A-002	AN1FM-C	4333 726625-01-170-6877	44
P 5 Hz to 50 kHz, 1 Hz RBW, rackmount	28480 3580A-002-003	AN1FI-C	+4333 726625-01-170-6876	44
P 100 Hz to 1.8 GHz, 10 Hz RBW	80009 495P-39	AN1KL-D	4341 726625-01-234-0485	46
P 100 Hz to 1.8 GHz w/tracking generator	TO BE DETERMINED	AN1KM-D		46
P 50 kHz to 40 GHz, 100 Hz RBW	28480 8562A-E51	AN1NZ-D	4338 726625-01-259-1060	50
ANALYZER, SPECTRUM, REAL TIME P 10 Hz to 100 kHz	28480 3561A-001	AN3RT-B	726625-01-245-0141	53
ANALYZER, WAVE P 15 Hz to 50 kHz	28480 3581A	AN5NN-A	4734 726625-01-012-7669	55
ATTENUATOR, STEP S 50 ohms, 12 dB/1 dB steps, dc to 1 GHz	28480 355C	AT4AN-A	4662 9N5985-00-437-6443	57
S 50 ohms, 69 dB/1 dB steps, dc to 18 GHz	93459 AF-117A-69-34	AT4GN-A	4898 9N6625-01-063-9297	57
S 50 ohms, 120 dB/10 dB steps, dc to 1 GHz	28480 355D	AT4UN-A	4672 9N5985-00-957-1860	57
S 75 ohms, 101 dB/1 dB steps, dc to 1.5 GHz	80138 849	AT4NN-A	+4666	57
S 90 ohms, 100 dB/1 dB steps, dc to 500 MHz	57646 M602	AT4KN-A	4665 725985-01-248-2973	57
S 600 ohms, 110 dB/1 dB steps, dc to 1 MHz	28057 VT-790G	AT4RQ-A	4668	57
ATTENUATOR, VARIABLE, COAXIAL S 0 to 120 dB, 100 MHz to 4 GHz, 300W	82316 0874-9577	AT6TM-A	4697 9Y5985-00-623-0255	58
BRIDGE, IMPEDANCE, RADIO FREQUENCY P 2 to 30 MHz	19482 01B2	BR3FN-B	4459 726625-00-433-8507	59
BRIDGE, RLC P 10 nF to 0.1F	OPK96 1689-9016	BROFW-D	4454 726625-01-221-9453	60
P 12 megohms, 1200H, 1200 uF	OPK96 1659-9700	BROMN-C	4457 726625-01-063-6829	62
BRIDGE, SYNCHRO/RESOLVER, DECADE P 400 Hz operation	07342 540/S3161	BR2NN-D	+4463 726625-01-334-5054	63

Notes: Letter preceding description indicates the Model classification. P = GPETE S = GSI U = GUPEE.
+ = This model has been proposed to fill this SCAT requirement but has not been assigned at time of printing.
Verify before using.

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APPENDIX A

Standard Equipment Index

Noun Name Description (see note)	CAGE Model	GNG Code	SCAT Code MSN	Ap D Page
CALIBRATOR, RANGE, RADAR				
P 50 to 5000 PPS, 1000 to 100000 yards	28975 210E	TS9NN-D	+4491 7Z6625-00-427-5157	64
CAPACITOR, DECADE				
S 50 pF to 1.11115 uF in 100 pF steps	0PK96 1412-9410	CP1MN-A	4624 1M6625-00-465-6861	65
COUNTER, ELECTRONIC				
P DC to 500 MHz, CW	28480 53348-030-H05	CO0FM-E	4296 7Z6625-01-271-0224	66
P 10 Hz to 18 GHz, CW	28480 53508-001-H03	CO0MN-C	4294 7Z6625-01-251-9860	69
P 10 Hz to 40 GHz, CW	28480 53528-001-H03	CO0MM-C	+4295 7Z6625-01-250-9635	71
P 300 MHz to 18 GHz, CW/pulse	34257 585-5802	CO0PC-D	7Z6625-01-252-4242	73
COUPLER, DIRECTIONAL, COAXIAL				
S 20 dB, dual, 0.1 to 2 GHz, 50W	28480 7780	DC1JJ-A	4692 9M5985-00-239-3215	75
S 22 dB, dual, 2 to 18 GHz, 50W	28480 116920	DC1NN-A	4695 9M5985-01-024-3832	75
CURVE TRACER				
P With SCR mount	80009 577515E	TE5NN-C	4559 7Z6625-01-018-8204	76
P 20A pulse, 1600V	80009 F57702	TE5GN-C	+4559 7Z6625-00-202-3475	79
DETECTOR, RF, FIXED, COAXIAL				
S 0.01 to 18 GHz, 200 mW	28480 84708	DE2YN-A	4352 9M6625-01-046-7045	81
S 0.01 to 18 GHz, 200 mW	28480 84708-012	DE2AB-A	4353 9M6625-01-047-9121	81
S 0.01 to 18 GHz, 200 mW	28480 84738	DE2NN-A	9M6625-01-080-2791	81
DETECTOR, VOLTAGE				
U 24 to 1500 Vac	16734 300CC	DEVAA-A		82
DIVIDER, POWER				
S DC to 18 GHz, 1W	93459 1506A	DP1NN-A	4679 9V6625-00-261-5033	83
DIVIDER, VOLTAGE				
S Up to 10 kV dc	89536 80E-10	DR2FL-A	4791 9M6625-00-459-3219	84
DUMMY LOAD, COAXIAL				
S DC to 1 GHz, 2.5 kW, 50 ohms	91161 B-1576	DL1EY-A	4658 9M5985-00-792-9928	85
S DC to 3 GHz, 600W, 50 ohms	70998 8404	DL1JN-B	4683 1M6625-01-150-1897	86
S DC to 4 GHz, 150W, 50 ohms	70998 8135	DL1SN-A	4948 9M6625-00-773-7311	87
ECHO BOX				
P 8.5 GHz to 9.6 GHz	52212 86-18210	EBOOM-C	4278 7Z6625-01-134-9979	88
GENERATOR, FUNCTION				
P 0.001 Hz to 13 MHz, +/- 5 PPM	28480 3325B-001-002-910/H03	GE7TC-E	+4386 7Z6625-01-330-8215	89
P .0001 Hz to 20 MHz, normal and dbl pulse	23338 145-S620	GE7MM-E	4405 7Z7050-01-079-9576	91
P 0.2 Hz to 3 MHz, normal, burst & pulse	88865 1400	GE7TB-B	4417 7Z6625-01-145-2800	93
GENERATOR, NOISE				
P 5 Hz to 5 MHz	0PK96 1390-9702	GE3FN-B	4420 7Z6625-00-799-8999	94
P 150 kHz to 10 MHz	MIL SG-354/U	GE3MN-A	4419 1M6625-00-664-1146	96

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Noun Name Description (see note)	CAGE	Model	GMG Code	SCAT Code	NSN	Ap D Page
* GENERATOR,PULSE						
P 10 Hz to 1 MHz, 17 ns risetime, 100V	52542	114A	GE2NN-D	4409	726625-00-041-0095	97
P 300 Hz to 50 MHz, 10 ns risetime, 5V	89536	PM 5712/08	GE2NP-F	4412	726625-01-193-3545	98
GENERATOR,PULSED CARRIER						
P 10 MHz to 120 MHz	80138	50708	GE8NN-B		726625-00-788-0311	99
GENERATOR,SIGNAL,CW						
P 250 kHz to 250 MHz, Constant amplitude	80009	SG503+TM501	GE0TK-C	4932	726625-01-134-9999	101
GENERATOR,SIGNAL,MICROWAVE						
P 12 to 18 GHz, AM/FM/square wave/pulse	28821	957A	GEAMJ-A	4361	726625-01-203-5002	102
GENERATOR,SIGNAL,RADIO FREQUENCY						
P 500 kHz to 1024 MHz, AM/FM, ext. PM	89536	6080A/AM	GEBJC-A	4370	726625-01-285-9218	104
GENERATOR,SWEEP						
P 1 MHz to 1000 MHz	34280	1801C-50	GE1RS-B	4395	725895-01-255-3183	108
P 1 MHz to 2500 MHz	34280	2002A-200	GE1CM-A	4378	726625-01-134-9920	110
P 10 MHz to 20 GHz, int sq, ext FM/pulse	28480	8350B-N51	GE1RU-C		726625-01-231-4977	112
P 10 MHz to 26.5 GHz, int sq, ext FM/pulse	28480	83595A-N20	GE1RX-C		725895-01-297-8626	115
P 10 MHz to 40 GHz, int sq, ext FM/pulse	28480	83597A-N21	GE1RT-C		726625-01-311-9124	118
GENERATOR,TIME MARK						
P 0.1 us to 5s	50423	6130A MOD32	GE4NN-A	+4407	726625-01-282-7137	121
GENERATOR,TWO TONE						
P 20 Hz to 20 kHz	21793	9083M	GE6NF-D	+4350	726625-01-322-4228	122
GENERATOR/ANALYZER,DISTORTION,TTY						
P 37.5 to 9600 baud	14031	2002-08+CC-19	TSCNG-E	4587	726625-01-093-7594	123
INDICATOR,MOTOR ROTATION						
U 3 phase	04237	150	MHRAL-A	4083		125
INDICATOR,PHASE SEQUENCE						
U 3 phase, 400 Hz	85914	K6	MPSBA-A	4082	6625-00-825-1030	126
U 3 phase, 60 Hz	85914	K7	MPSBB-A	4076	9N6625-00-243-3132	126
METER,FREQUENCY						
P 960 MHz to 4.0 GHz, coaxial	60203	3301A	FR0MM-C	4725	726625-01-260-6934	127
P 3.7 GHz to 12.4 GHz, coaxial	60203	3303A	FR0MT-C	4726	726625-01-223-9916	128
METER,GAIN/PHASE						
P 10 Hz to 100 kHz	28480	3575A-001	GP0NN-C	4189	726625-01-016-5966	129
METER,GRID DIP						
P 100 kHz to 940 MHz	57646	159 COMBINATION	GDOAN-A	+4509	726625-01-097-5275	130
METER,IMPEDANCE,VECTOR						
P 500 kHz to 108 MHz	28480	4193A	VOZMW-A	4443	726625-01-225-0087	131

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Item Name Description (see note)	CAGE	Model	GMG Code	SCAT Code MSN	Ap D Page
METER, L-C P 1000 uF, 10M	33347	LC101	LCMAB-C	+4456 7Z6625-01-321-3993	132
METER, MODULATION P FM/AM, carrier frequency 30 to 1000 MHz	04901	8210-01-S/3	MDOWN-A	4262 7Z6625-01-284-8256	133
METER, NOISE FIGURE P 5 MHz-18 GHz, 1F meas range 10-200 MHz	28480	8970B-E20	NFONN-C	4329 7Z6625-01-311-1704	134
P 5 MHz-40 GHz, 1F meas range 10-200 MHz	28480	8970B-E21	NFONT-B	+4329 7Z6625-01-311-7549	136
METER, PHASE JITTER P 0 to 30 Degrees, 5X	50319	48-M-20	PJMNN-B	4570 7Z6625-01-202-1346	137
MULTIMETER, DIGITAL P 3-1/2 digit, 0.5% dc accuracy	89536	77/BN	MJ2CX-D	+4245 1H6625-01-336-3372	138
P 3-1/2 digit, 0.1% dc accuracy	89536	27/AN	MJ2CA-C	4237 1H6625-01-234-8248	139
U 3-1/2 digit, 1 kV trms, frequency, CF > 3:1	89536	87	MJ2GT-C	1H6625-01-312-2930	141
P 4-1/2 digit, 0.06% dc accuracy	80164	175AV/175B	MJ2JM-E	4212 7Z6625-01-310-6232	143
P 5-1/2 digit, 0.015% dc accuracy, ac trms	89536	8840A/AA	MJ2QM-F	4211 7Z6625-01-238-2000	145
MULTIPLIER, FREQUENCY, DOUBLER P Output frequency 18 to 40 GHz	58900	840-18-01	D00AN-B	4394 7Z6625-01-238-1986	147
P Output frequency 26 to 40 GHz	58900	840-01	D00AN-A	4394 7Z6625-01-236-5280	149
OHMMETER, MEGA U 100 Megohms, 500V		TO BE DETERMINED	OH0NQ-B	+4452	151
P 1k to 100T ohms, 1 KV max test voltage	0PK96	1644-9701	OH0NM-F	4449 7Z6625-00-867-6628	152
P 50k to 100G ohms, 500 volts maximum	0PK96	1863-9700	OH0NF-B	4448 7Z6625-00-001-8060	153
OHMMETER, MICRO U 5 microhms - 20 ohms, 5 uohms resolution	07239	247000	OHUAB-A	4445 7Z6625-01-125-3471	154
OHMMETER, MILLI U 0.002 ohms to 1.9 ohms, 0.1 Vac, 0.2 mA	01014	T477W	OHMAA-A	6625-01-119-2023	155
OSCILLOSCOPE P 1 MHz ungrounded	80009	F5202A1 MOD WP	OS0TN-B	+4311 7Z6625-01-224-4521	156
P 1 MHz ungrounded, rackmount, X-Y	80009	F5202A2 MOD WR	OS0TM-B	+4311 7Z6625-01-235-2822	158
P 10 MHz portable, battery power	80009	222A	OS0RS-D	+4305 7Z6625-01-304-1744	160
P 100 MHz	80009	2246-1Y	OS0HP-B	4308 7Z6625-01-260-6908	161
P 100 MHz rackmount	80009	2246-2R	OS0HR-B	+4308 7Z6625-01-263-5932	163
P 200 MHz ac/dc power	80009	F3801A2 MOD YE	OS0MO-F	4307 7Z6625-01-271-9845	165
OSCILLOSCOPE, DIGITIZING P 400 MHz, 100 MSA/S, repetitive	28480	54504A-E01/910	OD1AF-B	4309 7Z6625-01-304-1743	167
OSCILLOSCOPE, STORAGE P 60 MHz, differential	80009	F4203A1	OSSMG-B	7Z6625-01-202-1388	169
POWER SUPPLY, DC P 0 to 40 Vdc, 0 to 5A	28480	6266B	PS1BA-A	4042 9G6130-00-137-0167	171
P 0 to 40 Vdc, 0 to 25A	49956	DCR40-25B	PS1BN-B	4792 1H6130-01-040-9808	172
P 0 to 50 Vdc, 0 to 1.5A	61993	PAD55-3L	PS1FN-B	+4115 1H6130-01-337-3517	173

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Noun Name Description (see note)	CAGE Model	GMG Code	SCAT Code NSN	Ap D Page
POWER SUPPLY, DC (continued)				
P 0 to 100 Vdc, 0 to 0.75A	28480 6299A	PS1NN-B	4040 466130-00-406-5695	174
P 0 to 150 Vdc, 0 to 12A	49956 DCR150-12B	PS1MN-B	+4051 1H6625-01-136-3178	175
P 0 to 300 Vdc, 0 to 3A	89022 TCR-300S-3-1	PS1TN-A	+4129 1H6625-01-178-9498	176
P 0 to 500 Vdc, 0 to 400 mA	06179 HV 350-1A-SPB-906	PS1VN-C	4114 726625-01-233-7141	177
PROBE, CURRENT				
S 1 mA to 10A, ac/dc, requires oscilloscope	80009 AM 503S	PRCAA-B	4235 726625-01-303-1930	178
PROBE, VOLTAGE				
S AC/DC, 40 kV, 1000:1 voltage divider	89536 BOK-40	PRVAA-A	4242 9H6625-01-193-1006	
RECORDER, STRIP CHART, MULTIPLE CHANNEL				
P Dual channel	96795 15-6327-575965	RDOMN-B	4325 726625-01-250-0088	179
RECORDER, X-Y				
P 0.5 mV/cm to 5 V/cm	62614 WX 2400-1L	RXONP-F	+4324	181
REFLECTOMETER, FREQUENCY DOMAIN				
P 2 MHz to 1 GHz	01220 5220M	FDRKP-B	4473 726625-01-274-4590	183
REFLECTOMETER, TIME DOMAIN				
P 0 to 2000 feet	80009 1502B-03-04 MOD NB	TDRNN-E	4298 726625-01-284-4833	184
P 1 to 3000 feet, handheld, LCD	07239 CFL 510	TDRBD-A	+4298	185
P 0 to 25,000 feet	80009 15038-03-04 MOD NB	TDRND-E	4298 726625-01-304-1390	186
P 32 to 492 ft/cm, 5 kV	19482 PRH-1	TDRNM-A	4474 726625-00-165-5755	187
REFLECTOMETER, TIME DOMAIN, FIBER OPTIC				
P 1300 nm, 10 km, FC connector, multimode	63380 MH920A/MH952A	TDFAA-C	726625-01-304-1740	188
REGULATOR, LINE				
S IN = 115V, 57-63 Hz. OUT = 103-127V, 50A	13850 1571-9831	RACAA-A	4802 966110-00-087-4771	190
RESISTOR, DECADE				
S 0 to 1, 111, 110 ohms, 1 ohm increments	0PK96 1433-9724	RE1GY-C	4636 726625-00-031-3521	191
S 1 to 999,999 ohms, 1 ohm increment, 225W	12697 240C	RE1GT-A	4635 1H6625-00-585-4915	192
SYNTHESIZER, FREQUENCY				
P 30 Hz to 200 kHz, 600 ohms bal and unbal	28480 8904A-006	FSNFT-D	+4358 726625-01-335-4440	193
P 1 kHz to 140 MHz, AM	TO BE DETERMINED	FSNFU-A	+4363	195
P 20 Hz to 20 kHz	82199 SPWH	FSNFR-C	4391 726625-01-222-1565	197
P 10 kHz to 110 MHz, AM/FM	28480 8660D-E54	FSNSC-A	726625-01-266-4825	199
P 10 kHz to 520 MHz, AM/FM	89536 6060A/AM	FSNFV-A	4362 726625-01-222-5007	201
P 100 kHz to 1300 MHz, AM/FM/ext pulse	28480 8660D-E52	FSNSA-C	726625-01-266-4823	204
P 1 MHz to 1300 MHz	TO BE DETERMINED	FSNSD-A		207
P 1 MHz to 1300 MHz	TO BE DETERMINED	FSNSE-A		209
P 1 MHz to 2600 MHz, AM/FM/PM	28480 8660D-E53	FSNSB-B	726625-01-266-4824	211
P 50 MHz to 8 GHz	58900 600/.01-8-03	FSNSF-F	726625-01-264-9281	214
P 50 MHz to 26 GHz, SQ/PM	58900 1026-01	FSNTP-C	4385 726625-01-136-8602	217
P 5.4 GHz to 12.5 GHz, SQ/PM	58900 600/6-12	FSNLA-C	4376 726625-01-250-9594	220
P 8 GHz to 20 GHz	58900 600/8-20	FSNTU-A		223
P 10 GHz to 18 GHz	58900 600/10-18 CONFIG15B	FSNTT-A	726625-01-273-1259	226

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Noun Name Description (see note)	CAGE	Model	GNM Code	SCAT Code	MSN	Ap D Page
TACHOMETER,ELECTRONIC						
U 50 to 10,000 RPM, contact and photocell	7P458	DT-205B+200		TC1AA-A	+4270	229
TERMINATION,COAXIAL						
S 2W, dc to 18 GHz, 50 ohms, N(m)	28480	909A-012		TM1RL-A	4594 9N5985-00-422-4852	230
S 10W, dc to 18 GHz, 50 ohms, N(m)	99899	3758NM		TM1FM-A	4685 1H5985-00-368-7198	230
S 40W, dc to 12.4 GHz, 50 ohms, N(f)	99899	3768NF		TM1FN-A	4684 9N5985-00-241-3518	230
TEST SET,COUNTERMEASURE						
P 50 MHz to 40 GHz, SQ/PM	58900	1026-007		TSXAA-C	4384 726625-01-133-6004	231
TEST SET,ELECTRICAL						
U 150A, 50-600 degrees F, 1 kV trms, freq	89536	87+Y8100+80TK+80TK-2A,3A		TS1AA-A		141
TEST SET,ELECTRON TUBE						
P Automated	MIL	AM/USH-118B		TE0GN-B	4548 726625-00-803-4376	241
P Roll chart	MIL	TV-7D/U		TE0NN-B	4552 726625-00-076-1600	241
TEST SET,ENVELOPE DELAY,TELECOM						
P 200 Hz to 4 kHz	42161	520B3-17+8220-0500-53		TS0NN-D	4571 726625-01-198-1511	242
TEST SET,INSULATION						
P 10 kVac and 25 kVdc	25284	ND125/10182		TE4GN-C	4453 726625-01-158-5316	245
TEST SET,LOGIC						
P TTL/CMOS logic troubleshooting probe	28480	545A		TS3NF-A	4035 9N6625-01-047-7309	246
P TTL/CMOS probe, pulser, clip	28480	5021A		TS3NM-B	4034 6625-01-133-3504	247
P TTL/CMOS probe, pulser, clip, 1 tracer	28480	5023A		TS3NT-B	4034 9N6625-01-072-5084	249
TEST SET,LORAN						
P 0 to 99,999 us delay	60621	650T		TS7NN-B	+4364 726625-00-915-3352	251
TEST SET,MEASURING,POWER						
P 20 Hz to 20 kHz, 0.1 mW to 20W	09553	893C		WA1CN-C	4953 726625-01-282-9397	252
P 2 MHz to 520 MHz, thru-line	70998	4410-025		WA1MA-A	4958 726625-01-199-9387	253
P 30 MHz - 1 GHz, 5/15/50/150W, terminated	70998	6454		WA1SJ-B	4959 9N6625-00-086-9998	254
TEST SET,MEASURING,POWER,ELECTRONIC						
P 100 kHz to 4.2 GHz	04901	4220-S/4		WA0FW-F	4957 726625-01-310-0802	255
P 10 MHz to 18 GHz	04901	4220-S/3		WA0FV-G	4957 726625-01-311-3742	257
P 10 MHz to 40 GHz	28480	432A-E42		WA0FR-D	4957 726625-01-132-7800	259
P 100 MHz to 18 GHz, peak power	28821	1018B		WA0XK-F	4940 726625-01-063-3086	261
TEST SET,MEASURING,RADIATION HAZARD						
P 10 MHz to 40 GHz	99899	70040		RH0NR-E	4019 726625-01-244-5780	262
P 300 MHz to 40 GHz	99899	70039		RH0NP-E	4019 726625-01-244-5781	262
TEST SET,MEASURING,RIFI						
P 10 kHz to 30 MHz, GPIB	63380	ML428N		F10AJ-C	+4434	264
P 10 kHz to 30 MHz, GPIB	82199	ESM3+ESN2-105		F10AL-A	4425 726625-01-170-4247	267
P 1 MHz to 18 GHz	88869	NM-67N		F10AY-A	726625-01-221-9445	270
P 20 MHz to 1 GHz	82199	ESV+ESV-105		F10AK-A	+4425 726625-01-170-4248	272
P 20 MHz to 1 GHz, GPIB	82199	ESVP+ESV-105		F10AM-A	+4425 726625-01-170-4249	275

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Noun Name Description (see note)	CAGE Model	GMG Code	SCAT Code	NSN	Ap D Page
TEST SET, MEASURING, SWR					
P 500 kHz to 1.2 GHz	04423 TRK-54A	TS2FF-A	4471	726625-00-397-4199	278
P 1 kHz, square wave	28480 415E-001	TS2MN-B	4470	726625-01-014-3802	280
TEST SET, OPTICAL LOSS					
P 1300 nm, FC, ST, SMA, D4 + Biconic conn.	TO BE DETERMINED	TSZAA-A			281
TEST SET, RADAR					
P 8.5 to 9.6 GHz	28480 8685A	TS5MM-D	4523	726625-01-215-9239	283
TEST SET, RADIO					
P 400 kHz to 1 GHz w/internal oscilloscope	TO BE DETERMINED	TSMNN-B	+4345		285
P 243 MHz emergency radio	28480 5334A-010-030-H06-910	TSMRB-B		726625-01-196-8119	288
TEST SET, RECORDER, TAPE					
P 50 Hz to 16 kHz	55792 6500-1676	FTOAN-B	4266	726625-01-066-7481	289
P 1.69 to 432 kHz, fixed frequency	55792 83008-W	FTOGN-B	4267	726625-01-205-0789	291
TEST SET, SEMICONDUCTOR					
P Go/no-go and parameter testing	34160 5110	TE1NA-E	4557	726625-01-206-5398	294
U 10 to 2000V, 0.05 to 2A, hi-power SCRs	0RXM5 PST 2000	TE1MC-A			1/
TEST SET, SONAR					
P Noise X-Y recorder	F6130 DEBB-1A	TS6FN-C	4116	726625-01-222-5319	296
P Probe, acoustic	19074 624A	TS6MN-C	4441	726625-00-086-1148	300
TEST SET, TRANSMISSION, TELECOM					
P 50 Hz to 110 kHz	42161 704A2-01	TSTTM-C	4573	726625-01-304-1741	301
TEST SET, WHITE NOISE, TELECOM					
P 12 kHz to 12.36 MHz	09553 0A-2090B-SA1194	TSNWP-B	4996	726625-01-154-3664	302
TESTER, BIT ERROR RATE, TELECOM					
P 50 to 2400 baud	14031 2350-02	TSENN-A		726625-01-096-8614	304
P 50 BPS to 12.928 MBPS	61141 FIREBERD MC6000N	TSENA-F	+4590	726625-01-304-1742	305
TESTER, ELECTRICAL SAFETY					
U 120 Vac, 50 to 60 Hz, 2 or 3 wire	07239 235303	TESAA-A	+4547	726625-01-205-0761	307
TESTER, HIGH CURRENT					
U 0.6 kVA, overload up to 300% for relays	00426 MS-2	THCAA-A	4640	726625-01-205-0761	308
TESTER, RELAY, TELECOM					
P Sigma series 7 and 72	78277 4513	TS4NN-B	4545	726625-01-067-0770	309
TESTER, SEMICONDUCTOR, IN CIRCUIT					
P Component tester	57705 TRACKER 2000	TE2NR-E	+4553	726625-01-258-2893	310
P With IC comparator	57705 TRACKER 2000-HSR410	TE2NS-E	+4553	726625-01-274-4662	311
TESTER, SURGE COMPARISON					
U 0 to 5 kVac, 0 to 30A	54605 ST106E	TSUAA-B	+4543		312

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Noun Name Description (see note)	CAGE Model	GAG Code	SCAT Code NSN	Ap D Page
TESTER,VOLTAGE U 24 to 600 Vac	25778 1410	TEVAA-A	4075 9W6625-00-132-1196	313
TRANSFORMER,AUTO S 50 to 60 Hz, single phase, 120V, 10A	13850 W10MT3A	TR1AN-A	4656 9G6120-00-054-7794	314
TRANSFORMER,ISOLATION S 50 Hz to 10 kHz	88869 SPX-3031	TR3YN-A	4660 1H5950-01-040-0282	315
TRANSFORMER,RATIO S 30 to 1000 Hz, 0.1 PPM resolution	88869 M-1012A	TR4JH-B	+4643 1H6625-01-206-2974	316
VOLTMETER,ANALOG,ELECTRONIC P 5 Hz to 10 MHz, 0 dBm = 1 mV/600 ohms P 10 Hz-10 MHz, trms, 0 dBm = 1mV/600 ohms P 20 Hz to 4 MHz, 0 dBV = 1V/1 kilohm P 10 kHz to 1.2 GHz, RF	85711 MV-912A-BP-SC1 50423 323-07 MOD 40 50423 3056A MOD98 50423 3440A-MOD113	VO1JG-F VO1OM-C VO1CF-D VO1LM-C	4206 7Z6625-01-287-6242 4205 7Z6625-01-311-7544 4195 7Z6625-01-286-3572 4200 7Z6625-01-286-2888	317 318 319 320
VOLTMETER,DIFFERENTIAL P AC/DC P DC to 1.1 kV P AC trms, 5 Hz to 1 MHz	89536 893A 89536 895A 89536 931B-01	VO2JH-D VO2CF-B VO2QH-D	4208 7Z6625-00-488-4039 4207 7Z6625-00-393-2527 4219 7Z6625-00-422-3241	322 324 326
VOLTMETER,FREQUENCY SELECTIVE P 15 Hz to 50 kHz P 50 Hz to 30 MHz P 1 kHz to 3 MHz	28480 3581C 28480 3586C 18410 6041	VO6NP-B VO6NM-A VO6NB-A	4734 7Z6625-01-146-3558 4218 7Z6625-01-096-1726 4220 7Z6625-01-239-4953	328 330 332
VOLTMETER,PHASE ANGLE P 400 Hz P Variable frequency, 50 Hz to 25 kHz	07342 213C-400HZ 07342 321-S3254	VO8FN-C VO8MR-D	4202 7Z6625-00-435-2192 4204 7Z6625-01-150-6059	334 336
VOLTMETER,VECTOR P 1 MHz to 1 GHz, digital display	28480 8508A-S01	VO4NN-A	+4232 7Z6625-01-310-5497	338

1/ A purchase description for this item is under development and will be made available on the GPETE bulletin board when completed.

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APPENDIX B

SCAT to GMG Code

SCAT	GMG	CAGE	Model	Noun Name	Description	Ap D Page
4019	RHOWP-E	99899	70039	T/S,MEASG,RAD HAZ	300 MHz to 40 GHz	262
4019	RHOWR-E	99899	70040	T/S,MEASG,RAD HAZ	10 MHz to 40 GHz	262
4020	See 5.4			AMPLIFIER	4 to 10 GHz	
+4028	ANSAA-C	28480	5006A-40-H01	ANALYZER,SIGNATURE	TTL/CMOS 16 bit	42
+4032	AN4MM-C	57062	K100-D+K100-D/488	ANALYZER,LOGIC	16 channel, 100 MHz clock	36
4034	TS3MM-B	28480	5021A	T/S,LOGIC	TTL/CMOS probe, pulser, clip	247
4034	TS3MT-B	28480	5023A	T/S,LOGIC	TTL/CMOS probe, pulser, clip, I tracer	249
4035	TS3MF-A	28480	545A	T/S,LOGIC	TTL/CMOS logic troubleshooting probe	246
4040	PS1MM-B	28480	6299A	POWER SUPPLY,DC	0 to 100 Vdc, 0 to 0.75A	174
4042	PS1BA-A	28480	6266B	POWER SUPPLY,DC	0 to 40 Vdc, 0 to 5A	171
+4051	PS1MM-B	49956	DCR150-12B	POWER SUPPLY,DC	0 to 150 Vdc, 0 to 12A	175
4059	See 5.4			AMMETER,DC	0.25% 2,5,20A - See Model 87	
4075	TEVAA-A	25778	1410	TESTER,VOLTAGE	24 to 600 Vac	313
4076	MPSBB-A	85914	K7	INDICATOR,PHASE SEQ	3 phase, 60 Hz	126
4078	See 5.4			METER,FREQ,REED	55 TO 75 HZ - See Model 87	
4079	See 5.4			METER,FREQ,SQ WAVE	400 HZ - See Model 87	
4080	See 5.4			METER,FREQUENCY	120V,56 TO 64 HZ -See Model 87	
4081	See 5.4			METER,FREQUENCY	120V,395 TO 405 HZ-See Model 87	
4082	MPSBA-A	85914	K6	INDICATOR,PHASE SEQ	3 phase, 400 Hz	126
4083	MNRAL-A	04237	150	INDICATOR,MOTOR ROT	3 phase	125
4114	PS1VM-C	06179	HV 350-1A-SPB-906	POWER SUPPLY,DC	0 to 500 Vdc, 0 to 400 mA	177
+4115	PS1FN-B	61993	PAD55-3L	POWER SUPPLY,DC	0 to 50 Vdc, 0 to 1.5A	173
4116	TS6FN-C	F6130	DEBB-1A	T/S,SONAR	Noise X-Y recorder	296
+4129	PS1TN-A	89022	TCR-300S-3-1	POWER SUPPLY,DC	0 to 300 Vdc, 0 to 3A	176
4189	GPONN-C	28480	3575A-001	METER,GAIN/PHASE	10 Hz to 100 kHz	129
4195	VO1CF-D	50423	3056A MOD98	VOLTMETER,ANLG,ELEX	20 Hz to 4 MHz, 0 dBm = 1V/1 kilohm	319
4200	VO1WN-C	50423	3440A-MOD113	VOLTMETER,ANLG,ELEX	10 kHz to 1.2 GHz, RF	320
4202	VOBFN-C	07342	213C-400HZ	VOLTMETER,PHS ANGLE	400 Hz	334
4204	VOBMR-D	07342	321-S3254	VOLTMETER,PHS ANGLE	Variable frequency, 50 Hz to 25 kHz	336
4205	VO1GN-C	50423	323-07 MOD 40	VOLTMETER,ANLG,ELEX	10 Hz-10 MHz,trms,0 dBm = 1mV/600 ohms	318
4206	VO1JG-F	85711	MV-912A-BP-SC1	VOLTMETER,ANLG,ELEX	5 Hz to 10 MHz, 0 dBm = 1 mV/600 ohms	317
4207	VO2CF-B	89536	895A	VOLTMETER,DIFF	DC to 1.1 kV	322
4208	VO2JN-D	89536	893A	VOLTMETER,DIFF	AC/DC	324
4211	MU2QM-F	89536	8840A/AA	MULTIMETER,DIGITAL	5-1/2 digit, 0.015% dc accuracy, ac trms	145
4212	MU2JM-E	80164	175AV/175B	MULTIMETER,DIGITAL	4-1/2 digit, 0.06% dc accuracy	143
4213	See 5.4			METER,TEMP	-50 TO 1000 F - See T/S,ELECTRICAL	
4218	VO6MM-A	28480	3586C	VOLTMETER,FREQ SEL	50 Hz to 30 MHz	330
4219	VO2GN-D	89536	931B-01	VOLTMETER,DIFF	AC trms, 5 Hz to 1 MHz	326
4220	VO6NB-A	18410	6041	VOLTMETER,FREQ SEL	1 kHz to 3 MHz	332
+4226	AMCAA-A	89536	801-KV	AMMETER,CLAMP-ON	1000A ac/dc, 330 kW, 660 Vac	33
4227	See 5.4			AMMETER,CLAMP-ON,DC	100A - See TEST SET,ELECTRICAL	
4228	See 5.4	13648	AX+75/150 HEADS	AMMETER,CLAMP-ON	150A - See TEST SET,ELECTRICAL	
+4232	VO4NN-A	28480	8508A-SD1	VOLTMETER,VECTOR	1 MHz to 1 GHz, digital display	338
4235	PRCAA-B	80009	AM 503S	PROBE,CURRENT	1 mA to 10A,ac/dc,requires oscilloscope	178
4236	See 5.4			AMMETER,CLAMP-ON,AC	1000A - See Models 801-KV & 87	
4237	MU2CA-C	89536	27/AM	MULTIMETER,DIGITAL	3-1/2 digit, 0.1% dc accuracy	139
4239	See 5.4			VOLT-AMMETER,DC	1kV/100MA 100UV - 1kV, 1PICO - 0.1 AMP	
4242	PRVAA-A	89536	80K-40	PROBE VOLTAGE	AC/DC, 40 kV, 1000:1 voltage divider	
4243	See 5.4			ANALYZER,POWER	V,A,W,PF-600V,125A,100KV-See Model 8000+	
4244	See 5.4			MULTIMETER,VOM	VOM, ac/dc,5kVac,4kVdc - See Model 27/AM	
+4245	MU2CX-D	89536	77/BH	MULTIMETER,DIGITAL	3-1/2 digit, 0.5% dc accuracy	138
4246	See 5.4			VOLTMETER,AC	0 to 750 V, 0.5%	
4262	MDONN-A	04901	8210-01-S/3	METER,MODULATION	FM/AM, carrier frequency 30 to 1000 MHz	133
4266	FTOAN-B	55792	6500-1676	T/S,RECORDER,TAPE	50 Hz to 16 kHz	289

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4267	FT06H-B	55792	83008-W	T/S,RECORDER,TAPE	1.69 to 432 kHz, fixed frequency	291
4269	See 5.4			FREQ METER,COAX	1 MW - 1 WATT, 0.5 MHz/div	
+4270	TC1AA-A	7P458	DT-205B+200	TACHOMETER,ELEX	50 to 10,000 RPM, contact and photocell	229
4276	See 5.4			ECHO BOX	1.2 TO 1.4 GHz	
4277	See 5.4		TS-270B/UP	ECHO BOX	2.6 TO 3.0 GHz	
4278	EBOOM-C	52212	86-18210	ECHO BOX	8.5 GHz to 9.6 GHz	88
4279	See 5.4			ECHO BOX	8.9 TO 9.6 GHz	
4289	See 5.4			FREQ METER,COAX	2.4 TO 3.4 GHz	
4293	See 5.4			FREQ COUNTER	0.1 Hz TO 1MHz - See Model 5334B-030-N05	
4294	COOMN-C	28480	5350B-001-N03	COUNTER,ELECTRONIC	10 Hz to 18 GHz, CW	69
+4295	COOMN-C	28480	5352B-001-N03	COUNTER,ELECTRONIC	10 Hz to 40 GHz, CW	71
4296	COOPH-E	28480	5334B-030-N05	COUNTER,ELECTRONIC	DC to 500 MHz, CW	66
4298	TDRMN-E	80009	1502B-03-04 MOD NB	REFLECTOMETER,TD	0 to 2000 feet	184
4298	TDRND-E	80009	1503B-03-04 MOD NB	REFLECTOMETER,TD	0 to 25,000 feet	186
+4298	TDRND-A	07239	CFL 510	REFLECTOMETER,TD	1 to 3000 feet, handheld, LCD	185
4299	See 5.4			STROBOTAC	100 TO 12000 RPM,TACH-See Model DT-205B+	
4304	See 5.4			OSCILLOSCOPE,TV SYS	15 MHz, CCTV - See Model 2246-1Y	
+4305	OSORS-D	80009	222A	OSCILLOSCOPE	10 MHz portable, battery power	160
4306	See 5.4			OSCILLOSCOPE, GPIB	100MHz,4 trace -See Model 54504A-E01/910	
4307	OBONO-F	80009	F3801A2 MOD YE	OSCILLOSCOPE	200 MHz, ac/dc power	165
4308	OBONP-B	80009	2246-1Y	OSCILLOSCOPE	100 MHz	161
+4308	OBONR-B	80009	2246-2R	OSCILLOSCOPE	100 MHz, rackmount	163
4309	OD1AF-B	28480	54504A-E01/910	SCOPE,DIGITIZING	400 MHz, 100 MSA/S, repetitive	167
+4311	OBOTN-B	80009	F5202A1 MOD WP	OSCILLOSCOPE	1 MHz ungrounded	156
+4311	OBOTN-B	80009	F5202A2 MOD WR	OSCILLOSCOPE	1 MHz ungrounded, rackmount, X-Y	158
4314	See 5.4			OSCILLOSCOPE,M/F	500 MHz, .7nsec, requires plug-ins	
+4324	RXONP-F	62614	MX 2400-1L	RECORDER,X-Y	0.5 mV/cm to 10 V/cm	181
4325	RDONN-D	96795	15-6327-575965	RCDR,STP CNT,MLT CH	Dual channel	179
4329	NFONN-C	28480	8970B-E20	METER,NOISE FIGURE	5 MHz-18 GHz, IF meas range 10-200 MHz	134
+4329	NFONT-B	28480	8970B-E21	METER,NOISE FIGURE	5 MHz-40 GHz, IF meas range 10-200 MHz	136
4333	AN1FH-C	28480	3580A-002	ANALYZER,SPECTRUM	5 Hz to 50 kHz, 1 Hz RBW	44
+4333	AN1FI-C	28480	3580A-002-003	ANALYZER,SPECTRUM	5 Hz to 50 kHz, 1 Hz RBW, rackmount	44
4338	AN1NZ-D	28480	8562A-E51	ANALYZER,SPECTRUM	50 kHz to 40 GHz, 100 Hz RBW	50
4341	AN1KL-D	80009	495P-39	ANALYZER,SPECTRUM	100 Hz to 1.8 GHz, 10 Hz RBW	46
4342	See 5.4			GENERATOR,TWO TONE	2 MHz to 32 MHz, two tone	
4344	ANONP-D	38047	3501-0100	ANALYZER,DISTORTION	10 Hz to 100 kHz	35
+4345	TSMMN-B		TO BE DETERMINED	T/S,RADIO	400 kHz to 1 GHz w/internal oscilloscope	285
+4350	GE6NF-D	21793	9083N	GENERATOR,TWO TONE	20 Hz to 20 kHz	122
4352	DE2YN-A	28480	8470B	DET,RF,FXD,COAX	0.01 to 18 GHz, 200 mW, APC-7	81
4353	DE2AB-A	28480	8470B-012	DET,RF,FXD,COAX	0.01 to 18 GHz, 200 mW, M(m)	81
4355	See 5.4			OSCILLATOR	10 Hz to 500 Hz - See Model 145-S620	
+4358	FSNFT-D	28480	8904A-006	SYNTHESIZER,FREQ	30 Hz to 200 kHz, 600 ohms bal and unbal	193
4361	GEANJ-A	28821	957A	GENERATOR,SIG,UMAVE	12 to 18 GHz, AM/FM/square wave/pulse	102
4362	FSNFA-A	89536	6060A/AM	SYNTHESIZER,FREQ	10 kHz to 520 MHz, AM/FM	201
+4363	FSNFU-A		TO BE DETERMINED	SYNTHESIZER,FREQ	1 kHz to 140 MHz, AM	195
+4364	TS7MN-B	60621	650T	T/S,LORAN	0 to 99,999 us delay	251
4366	See 5.4			GENERATOR,SIGNAL,RF	4 MHz to 400 MHz - See Model 6080A/AM	
4367	See 5.4			SYNTHESIZER,FREQ	252 kHz to 1030 MHz - See Model 6080A/AM	
4370	GEBJC-A	89536	6080A/AM	GENERATOR,SIGNAL,RF	500 kHz to 1024 MHz, AM/FM, ext. PM	104
4372	See 5.4			GENERATOR, AM/PM	400 MHz to 1 GHz - See Model 6080A/AM	
4373	See 5.4			GENERATOR, SQ/PM	1.0 to 2.4 GHz - See Model 600/.01-8-03	
4374	See 5.4			GENERATOR, SQ/PM	1.8 to 4.5 GHz. - See Model 600/.01-8-03	
4375	See 5.4			GENERATOR,SIG,UMAVE	2.3 to 6.5 GHz - See Model 600/.01-8-03	
4376	FSMLA-C	58900	600/6-12	SYNTHESIZER,FREQ	6 to 12 GHz, SQ/PM	220

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4377	See 5.4		GENERATOR,SQ/PM	10 to 15 GHz - See 600/10-18 CONFIG158	
4378	GE1CM-A	34280 2002A-200	GENERATOR,SWEEP	1 MHz to 2500 MHz	110
4379	See 5.4		GENERATOR,SWEEP	400 to 450 MHz	
4383	See 5.4		GENERATOR,SQ/PM	15 to 21 GHz. - See Model 1026-01	
4384	TSXAA-C	58900 1026-007	T/S,COUNTERMEASURE	50 MHz to 40 GHz, SQ/PM	231
4385	FSNTP-C	58900 1026-01	SYNTHESIZER,FREQ	50 MHz to 26 GHz, SQ/PM	217
+4386	GE7TC-E	28480 3325B-001-002-910/H03	GENERATOR,FUNCTION	0.001 Hz to 13 MHz, +/- 5 PPM	89
4390	See 5.4		OSCILLATOR,TEST	10 Hz to 10 MHz	
4391	FSNFR-C	82199 SPNH	SYNTHESIZER,FREQ	20 Hz to 20 kHz	197
4394	DOOAM-A	58900 840-01	MLTPLR,FREQ,DBLR	Output frequency 26 to 40 GHz	149
4394	DOOAM-B	58900 840-18-01	MLTPLR,FREQ,DBLR	Output frequency 18 to 40 GHz	147
4395	GE1RS-B	34280 1801C-50	GENERATOR,SWEEP	1 MHz to 1000 MHz	108
4402	See 5.4		GENERATOR,PULSE	300 Hz - 50 MHz, See Model PM 5712/08	
4403	See 5.4		GENERATOR,FUNCTION	0.0005Hz to 5MHz, 1% FREQ - See 145-S620	
4404	See 5.4		GENERATOR,FUNCTION	0.01 Hz to 1 MHz - See Model 145-S620	
4405	GE7MH-E	23338 145-S620	GENERATOR,FUNCTION	0.0001 Hz to 20MHz, normal and dbl pulse	91
+4407	GE4MH-A	50423 6130A MOD32	GENERATOR,TIME MARK	0.1 us to 5s	121
4409	GE2MH-D	52542 114A	GENERATOR,PULSE	10 Hz to 1 MHz, 17 ns risetime, 100V	97
4412	GE2MP-F	89536 PM 5712/08	GENERATOR,PULSE	300 Hz to 50 MHz, 10 ns risetime, 5V	98
4416	See 5.4		GENERATOR,SQ WAVE	1 Hz to 1 MHz, 75 ohm	
4417	GE7TB-B	88865 1400	GENERATOR,FUNCTION	0.2 Hz to 3 MHz, normal, burst and pulse	93
4418	See 5.4		NOISE SOURCE,SMA	14 to 25 dB, 18 GHz	
4419	GE3MH-A	MIL SQ-354/U	GENERATOR,NOISE	150 kHz to 10 GHz	96
4420	GE3FH-B	OPK96 1390-9702	GENERATOR,NOISE	5 Hz to 5 MHz	94
4421	TSNMP-B	09553 TF-20918	GENERATOR, NOISE	12kHz - 12MHZ - Part of OA-20908-SA1194	
4424	TSNMP-B	09553 TF-20928	RECEIVER, NOISE	12kHz - 12MHZ - Part of OA-20908-SA1194	
+4425	F10AK-A	82199 ESV+ESV-105	T/S,MEASURING,RIFI	20 MHz to 1 GHz	272
+4425	F10AM-A	82199 ESV+ESV-105	T/S,MEASURING,RIFI	20 MHz to 1 GHz, GPIB	275
4433	See 5.4		TEST SET,EMI	10 kHz to 250 kHz	
4434	F10AL-A	82199 ESH3+ESH2-105	T/S,MEASURING,RIFI	10 kHz to 30 MHz, GPIB	267
+4434	F10AJ-C	63380 ML428N	T/S,MEASURING,RIFI	10 kHz to 30 MHz, GPIB	264
4441	TS6MH-C	19074 624A	T/S,SONAR	Probe, acoustic	300
4443	VOZMH-A	28480 4193A	METER,IMPED,VECTOR	500 kHz to 108 MHz	131
4444	See 5.4		METER,VECTOR Z	30 Hz to 40 kHz, .5 to 100 kHz	
4445	OHUAB-A	07239 247000	OHMMETER,MICRO	5 microhms - 20 ohms, 5 uohms resolution	154
4447	See 5.4		BRIDGE,RESISTANCE	1 M ohm to 0.1 ohm, 0.15%	
4448	OHOMF-B	OPK96 1863-9700	OHMMETER,MEGA	50k to 100G ohms, 500 volts maximum	153
4449	OHOMM-F	OPK96 1644-9701	OHMMETER,MEGA	1k to 100T ohms,1 KV max test voltage	152
4451	See 5.4		MEGOhmmETER	0 to 5 kV, 100 G ohm, 2%	
+4452	OHOMO-B	TO BE DETERMINED	OHMMETER,MEGA	100 Megohms, 500V	151
4453	TE4GH-C	25284 MD125/10182	T/S,INSULATION	10 kVac and 25 kVdc	245
4454	BROFW-D	OPK96 1689-9016	BRIDGE,RLC	10 nF to 0.1F	60
+4456	LCMAB-C	33347 LC101	METER,L-C	1000 uF, 10M	132
4457	BROMN-C	OPK96 1659-9700	BRIDGE,RLC	12 megohms, 1200H, 1200 uF	62
4459	BR3FN-B	19482 OIB2	BRIDGE,IMPEDANCE,RF	2 to 30 MHz	59
+4463	BR2NH-D	07342 540/S3161	BRIDGE,SYN/RES,DEC	400 Hz operation	63
4464	See 5.4		SIMUL,SYNCRO/RESOLV	60/400/10kHz,359.999deg,.001% resolution	
4470	TS6MH-B	28480 415E-001	T/S,MEASURING,SWR	1 kHz, square wave	280
4471	TS2FF-A	04423 TRK-54A	T/S,MEASURING,SWR	500 kHz to 1.2 GHz	278
4473	FORKP-B	01228 5220M	REFLECTOMETER,FD	2 MHz to 1 GHz	183
4474	TDRNM-A	19482 PRN-1	REFLECTOMETER,TD	32 to 492 ft/cm, 5 kV	187
4475	ANZNT-C	28480 8757E-S20	ANALYZER,NETWORK	100 MHz to 18 GHz, scaler	40
4480	See 5.4		AMPLIFIER	20 & 40dB, 10Hz-1MHz, 10M Z in, 50 Z out	
4482	See 5.4		AMPLIFIER	30 dB, 140 MHz to 180 MHz, 50 ohm in/out	

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SCAT	GMG	CAGE	Model	Noun Name	Description	Ap D Page
4483	See 5.4			AMPLIFIER	250 W, 125 v, 20Hz to 2KHz, 1 phase	
4484	See 5.4			AMPLIFIER	20 & 40dB, 1KHz-150MHz, BNC(f), 50 Z in/out	
+4491	TS9NN-D	28975	210E	CALIBRATOR, RNG, RDR	50 to 5000 PPS, 1000 to 100000 yards	64
4503	See 5.4			FREQ METER, COAX	0.5 to 1.5 GHz, 3MHz/div, .5 mw to 250 mw	
+4509	GDOAN-A	57646	159 COMBINATION	METER, GRID DIP	100 kHz to 940 MHz	130
4523	TS5MM-D	28480	8685A	T/S, RADAR	8.5 to 9.6 GHz	283
+4543	TSUAA-B	54605	ST106E	TESTER, SURGE COMP	0 to 5 kVac, 0 to 30A	312
4545	TS4MM-B	78277	4513	TESTER, RELAY, TLM	Sigma series 7 and 72	309
+4547	TESAA-A	07239	235303	TESTER, ELEC SAFETY	120 Vac, 50 to 60 Hz, 2 or 3 wire	307
4548	TEOGN-B	MIL	AM/USM-118B	T/S, ELECTRON TUBE	Automated	241
4552	TEONN-B	MIL	TV-7D/U	T/S, ELECTRON TUBE	Roll chart	241
+4553	TE2NR-E	57705	TRACKER 2000	TSTR, SEMICOND, INCKT	Component tester	310
+4553	TE2NS-E	57705	TRACKER 2000-HSR410	TSTR, SEMICOND, INCKT	With IC comparator	311
4557	TE1MA-E	34160	5110	T/S, SEMICONDUCTOR	Go/no-go and parameter testing	294
4558	See 5.4			TESTER, CRYSTAL		
4559	TESNN-C	80009	577515E	CURVE TRACER	With SCR mount	76
+4559	TESGN-C	80009	F577D2	CURVE TRACER	20A pulse, 1600V	79
4570	PJMMN-A	50319	48-M-20	METER, PHASE JITTER	0 to 30 Degrees, 5X	137
4571	TS0NN-D	42161	520B3-17+8220-0500-53	T/S, ENV DLY, TLM	200 Hz to 4 kHz	242
4572	See 5.4			TESTER, TELCOM DATA	40 Hz - 60 kHz, 135, 600, 900 Z	
4573	TSTTM-C	42161	704A2-01	T/S, XMSN, TLM	50 Hz to 110 kHz	301
4574	See 5.4			TEST SET, VU & NOISE	3 kHz to 15 kHz, 600, 900 Z	
4580	See 5.4			TESTER, TLM	50Hz-560kHz, 135, 600, 900 Z - See 704A2-01	
4585	See 5.4			TTY DIST GENERATOR	0-49%, 37.5-2.4KB, 5, 6, 7, 8BIT-See 2002-08+	
4586	See 5.4			TTY DIST ANALYZER	0-49%, 37.5-2.4KB, 5, 6, 7, 8BIT-See 2002-08+	
4587	TSCNG-E	14031	2002-08+CC-19	GEN/ANLZR, DISTN, TTY	37.5 to 9600 baud	123
4589	See 5.4			TESTER, BIT ERROR	200 KBPS, 76 to 9600 BPS	
+4590	TSENA-F	61141	FIREBERD MC6000M	TESTER, BIT E/R, TLM	50 BPS to 12.928 MBPS	304
4591	See 5.4			TESTER, BIT ERROR	50 MBPS and total error count	
4594	TM1RL-A	28480	909A-012	TERMINATION, COAXIAL	2W, dc to 18 GHz, 50 ohms, N(m)	230
4624	CP1MM-A	0PK96	1412-9410	CAPACITOR, DECADE	50 pF to 1.1115 uF in 100 pF steps	65
4635	RE1GT-A	12697	240C	RESISTOR, DECADE	1 to 999,999 ohms, 1 ohm increment, 225U	192
4636	RE1GY-C	0PK96	1433-9724	RESISTOR, DECADE	0 to 1,111,110 ohms, 1 ohm increments	191
4640	THCAA-A	00426	MS-2	TESTER, HIGH CURRENT	0.6 kVA, overload up to 300% for relays	308
+4643	TR4JN-B	88869	M-1012A	TRANSFORMER, RATIO	30 to 1000 Hz, 0.1 PPM resolution	316
4650	See 5.4			TRANSFORMER, RATIO	50 Hz to 10 kHz with phase inversion	
4656	TR1AM-A	13850	W10NT3A	TRANSFORMER, AUTO	50 to 60 Hz, single phase, 120V, 10A	314
4658	DL1EY-A	91161	B-1576	DUMMY LOAD, COAXIAL	DC to 1 GHz, 2.5 kW, 50 ohms	85
4660	TR3YN-A	88869	SPX-3031	TRANSFORMER, ISLM	50 Hz to 10 kHz	315
4661	See 5.4			ATTENUATOR, STEP	101dB/1dB, 50 Z, dc-1GHz-See AF-117A-69-34	
4662	AT4AN-A	28480	355C	ATTENUATOR, STEP	50 ohms, 12 dB/1 dB steps, dc to 1 GHz	57
4663	See 5.4			ATTENUATOR, STEP	11dB/1dB step, 0-10GHz -See AF-117A-69-34	
4665	AT4KN-A	57646	M602	ATTENUATOR, STEP	90 ohms, 100 dB/1 dB steps, dc to 500 MHz	57
+4666	AT4NN-A	80138	849	ATTENUATOR, STEP	75 ohms, 101 dB/1 dB steps, dc to 1.5 GHz	57
4668	AT4RQ-A	28057	VT-790G	ATTENUATOR, STEP	600 ohms, 110 dB/1 dB steps, dc to 1 MHz	57
4672	AT4UN-A	28480	355D	ATTENUATOR, STEP	50 ohms, 120 dB/10 dB steps, dc to 1 GHz	57
4679	DP1NN-A	93459	1506A	DIVIDER, POWER	DC to 18 GHz, 1W	83
4683	DL1JN-B	70998	8404	DUMMY LOAD, COAXIAL	DC to 3 GHz, 600W, 50 ohms	86
4684	TM1FN-A	99899	3768NF	TERMINATION, COAXIAL	40W, dc to 12.4 GHz, 50 ohms, N(f)	230
4685	TM1FM-A	99899	3758NM	TERMINATION, COAXIAL	10W, dc to 18 GHz, 50 ohms, N(m)	230
4692	DC1JJ-A	28480	778D	COUPLER, DURL, COAX	20 dB, dual, 0.1 to 2 GHz, 50W	75
4695	DC1NN-A	28480	11692D	COUPLER, DURL, COAX	22 dB, dual, 2 to 18 GHz, 50W	75
4697	AT6TN-A	82316	0874-9577	ATTENUATOR, VAR, COAX	0 to 120 dB, 100 MHz to 4 GHz, 300W	58
4709	See 5.4			VOLTMETER, AC/DC	0.25%, 150, 300, 750V	

Note: + = This model has been proposed to fill this SCAT requirement but has not been assigned at time of printing. Verify before using.

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APPENDIX B

SCAT to GMG Code

SCAT	GMG	CAGE	Model	Noun Name	Description	Ap D Page
4711	See 5.4			AMMETER,DC	0.25%, .01UA to 1A - See Model 87(verify)	
4725	FR0MM-C	60203	3301A	METER,FREQUENCY	960 MHz to 4.0 GHz, coaxial	127
4726	FR0MT-C	60203	3303A	METER,FREQUENCY	3.7 GHz to 12.4 GHz, coaxial	128
4734	AN5NN-A	28480	3581A	ANALYZER,WAVE	15 Hz to 50 kHz	55
4734	V06NP-B	28480	3581C	VOLTMETER,FREQ SEL	15 Hz to 50 kHz	328
4791	DR2FL-A	89536	80E-10	DIVIDER,VOLTAGE	Up to 10 kV dc	84
4792	PS1BN-B	49956	DCR40-25B	POWER SUPPLY,DC	0 to 40 Vdc, 0 to 25A	172
4802	RACAA-A	13850	1571-9831	REGULATOR,LINE	1W = 115V, 57-63 Hz. OUT = 103-127V, 50A	190
4898	AT4GN-A	93459	AF-117A-69-34	ATTENUATOR,STEP	50 ohms, 69 dB/1 dB steps, dc to 18 GHz	57
4932	GE0TK-C	80009	SG503+TM501	GENERATOR,SIGNAL,CW	250 kHz to 250 MHz, Constant amplitude	101
4940	WAOXX-F	28821	10188	T/S,MEASG,PMR,ELEX	100 MHz to 18 GHz, peak power	261
4948	DL1SN-A	70998	8135	DUMMY LOAD,COAXIAL	DC to 4 GHz, 150W, 50 ohms	87
4951	See 5.4			POWER METER,THRULIN	5kW-2 to 30MHz,250W-5kW 200-400MHz	
4953	WA1CN-C	09553	893C	T/S,MEASURING,POWER	20 Hz to 20 kHz, 0.1 mW to 20W	252
4956	See 5.4			POWER METER,PEAK	5 kW,960 to 1250MHz -See 10188+Attenuatr	
4957	WAOFV-G	04901	4220-S/3	T/S,MEASG,PMR,ELEX	10 MHz to 18 GHz	257
4957	WAOFU-F	04901	4220-S/4	T/S,MEASG,PMR,ELEX	100 kHz to 4.2 GHz	255
4957	WAOFR-D	28480	432A-E42	T/S,MEASG,PMR,ELEX	10 MHz to 40 GHz	259
4958	WA1MA-A	70998	4410-025	T/S,MEASURING,POWER	2 MHz to 520 MHz, thru-line	253
4959	WA1SJ-B	70998	6154	T/S,MEASURING,POWER	30 MHz - 1 GHz, 5/15/50/150W, terminated	254
4980	AN2MM-B	28480	8410C+8411A+8412B	ANALYZER,NETWORK	110 MHz to 18 GHz, vector	41
4995	FIOAY-A	88869	NM-67N	T/S,MEASURING,RIFI	1 MHz to 18 GHz	270
4996	TSNWP-B	09553	0A-2090B-SA1194	T/S,WHT NOISE,TLCM	12kHz to 12.36MHz (Actual SCAT = 4996ALT)	302

Note: + = This model has been proposed to fill this SCAT requirement but has not been assigned at time of printing.
Verify before using.

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APPENDIX C

GPETE Configurations

CAGE	Model	Consists of:
34280	1002-200	200 = Options A2 & A4, D151 ext RF detector
57705	1005B-1S	1S = Switch between A & B channels
28821	1018B-S5165	S5165 = Rear output, internal mod for calibration
28821	1018B-S5190	S5190 = 8 foot RF input cable
28821	1018B-S5253	S5253 = Calibration oscillator to 1018A, 2 mode kits
23338	1038-S5294	1038-D14+1038-H13+(2)1038-V12+(3)13782, 5 & 50 ft cables
23338	1038R	1038-D14A+1038-H10+(2)15176
23338	1038S	1038-D14A-04+1038-H10+(2)15176+15237
23338	1038V	1038-D14A+1038-H11+1038-V12+1038-V13+(2)13782
04901	1130-11-S3	11 = 400 Hz high pass, S3 = Ext demod for AM signals
28480	1200A-C16	C16 = X-Y operation, probes, BNC adapters
24655	1232-AP2	AP2 = Rechargeable NiCad batteries
28480	140A-E15	E15 = 140A+1415A-H08-H09, case, accessories
23338	145-S1021	S1021 = ET1, rear symmetry switch
23338	145-S574	S574 = Protection for output circuitry
23338	145-S620	S620 = Symmetry switch
23338	145-S872	S872 = ET1
96795	15-6327-575965	15-6327-57, min/sec event, rear switches, ruggedized
80009	1502B-03-04 MOD NB	NB = Silver oxide battery
80009	1503-01-04-76	76 = P7 phosphor
80009	1503B-03-04 MOD NB	NB = Silver oxide ROM battery
28480	1551A-005	005 = 180F+1815A+1816A+1108A+10164B-C05
28480	1551A-020	020 = 180F+1801F-020+1821F-020
28480	1551A-021	021 = 180F+1801F-021+1821F-021+10164B-021
28480	1551B-023	023 = 180ER+1801F+1821F+10164A-C02
28480	1551B-025	025 = 180ER-021+1801F-021+1821F-021+10164A-C02
28480	1553A-005	005 = 181A+1815A+1816A+1108A
28480	1553A-C01	C01 = 181A+1801F+1821F, 10004B probes
23338	157-S131	S131 = 100 ohm sync output impedance
23338	157-S131A	S131A = Special markings for Hughes drawings
23338	157-S134	S134 = Special BCD coding
23338	157-S233	S233 = Special rack mount, paint, decals, slides
28480	1570A-H02	H02 = 140A+1405A-H06+1421A, accessories
28480	1570B-H01	H01 = 140B-007+1415A-007+1415A-H08-H09
23338	159-S553 OPT 005	S553 OPT 005 = rack, mount, slides, paint, 05 = GPIB cable
82199	1605E-L	1105E-L+1020A
82199	1606E-N	1106E-N+1020T Navy version modulator
82199	1607-M4	1107-M4+1001A-M4
82199	1607E-N	1107E+1020A OPT N
82199	1608-M4	1108-M4+1001A-M4
82199	1608E-N	1108E+1020A
54778	164B-B1	G1 = 164B+180A-470+270A-470+271A-30
54778	164B-G2	G2 = 164B+180A-52+180A-148+180A-470+180A-1000+270A-30
54778	164B-G3	G3 = 164B+181A-250+270A-30
54778	164B-G4	G4 = 164B+181A-250+181A-1000+160B-600
28480	1707A-020	020 = Vertical output jack
28480	1707B OPT 12 + 20	12 = Battery pack, 20 = Vertical output jack
28480	1725A-H14	H14 = Environmentalized, front cover
28480	1725A-H23	H23 = 1725A-H14, ET1
28480	1741A-H09	H09 = EMI mod, line filter, metal contrast screen
28480	1741A-H14	H14 = Increased CRT writing rate
80164	175AV/175B	AV = Average responding, 175B = Battery package
28480	180A-E02	E02 = 180A-C02+1801A-H02+1821A-H02+10164AM
28480	180A-E05	E05 = 230V, CRT RFI, Z-axis & front BNC, del sweep amp
28480	180D-H05	H05 = Old style cord, line filter, metal contrast screen
28480	180ER-E02	E02 = 180ERN+1801E+1821E+10164A-C02
28480	181A-E12	E12 = 181A-A33+1801F-021+1821F-021

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APPENDIX C

GPETE Configurations

CAGE	Model	Consists of:
28480	181T-C33	C33 = Louver and front panel covers
28480	19806-150-860	150 = 1950 plug-in, 860 = Digital waveform storage
14031	2002-08+CC-19	CC-19 = Carrying case
34280	2002A-200	200 = Opt A3 (1, 10, 50, & 100 MHz harmonic markers)
28480	200CDR-C10	C10 = Rear output terminals in parallel with front
9N770	2020-S4-24	S4-24 = S4A-1, accessory probes and adapters
28480	204C-001-H20	H20 = Var output greater than 23 dB, Opt 02 (battery pwr)
28480	204C-H20	H20 = Var output greater than 23 dB, Opt 02 (battery pwr)
28480	204C-H39	H39 = Rear panel output connectors, no sync output
07342	213C-S2387	S2387 = 400 Hz input frequency
28480	214A-C97	C97 = 22 inch Jonathan i10 00-22-2
28480	214A-H01	H01 = Modified trigger
28480	214B-H27	H27 = ETI
07342	214C-S1168	S1168 = 400, 800, 4.8 kHz, & 9.6 kHz input frequencies
07342	214C-S1490	S1490 = 60, 400, & 10 kHz input, 1:1 output signal
07342	214C-S2344	S2344 = 60 & 400 Hz input frequencies
80009	2236-YA	YA = EMI, silver oxide ROM battery, probes
80009	2246 MOD A	MOD A = EMI, front override interface, probes, assay pouch
80009	2246-1Y	1Y = EMI, silver oxide ROM battery, accessories
80009	2246-2R	2R = 2246-1Y, rack mount accessory
07342	225-S2762	S2762 = 60, 400, 800, 9.6 kHz & 10 kHz input frequencies
80009	2335-1R	1R = 2335 rack mount
14031	2350-02	02 = 115/230 Vac operation
80009	2465-11-YA	YA = ETI, probes, extra manual
80009	2465-11-YC	YC = ETI, rear probe power, probes
80009	2465A-11-YC	YC = ETI, probes
80009	2465B-11 WB	WB = Silver oxide battery, probes
80009	2465CTS	CTS = GPIB interface, probes, extra manual
11837	2500E+1325	1325 = AC, rechargeable batteries
89536	27/AN	AN = 85 RF+80K-40+TL 70
80009	2710-01-03-14-33	01=300Hz RBW 03=GPIB 14=1,10,100kHz,1MHz RBW filt 33=cover
80009	2754P-W5	W5 = Silver oxide batteries
34280	3000-200	200 = FM deviation, reverse power protection
34280	3001-SP691	SP691 = 1 & 5 kHz mod, FM dev to 500 kHz, ext FM TO 100 kHz
50423	300N-U7	U7 = low pass 1 kHz filter
50423	3015A MOD92	MOD92 = Ruggedized, upper freq = 6 MHz
50423	3015A MOD95	MOD95 = Battery/ac, 4 MHz upper freq, 0 dB=1 mV/600 ohms
50423	30288 MOD163	MOD163 = 30288 Opt 5, 20, 24H, RF probe
50423	30288 MOD164	MOD164 = 30288 Opt 5, 20, 24H, RF/dc HV probes
50423	30288 MOD168	MOD168 = 30288 Opt 5, 20, 24H, RF/dc HV probes
50423	30288 MOD171	MOD171 = 30288 Opt 5, 20, 24H, RF probe, divider, tee
50423	30288 MOD172	MOD172 = 30288 Opt 5, 20, 24H, RF/dc HV probes
50423	30288 MOD20-05	MOD 20-05 = Panel meter, rechargeable batteries
50423	30288-24H	24H = 10 mV dc range with 100 uV resolution
50423	30368 MOD968	MOD968 = Environmentalized
05535	3045A MOD04	MOD 04 = Parallel read inputs
05535	3045A MOD05	MOD 05 = Internal rechargeable battery
05535	3045A MOD10	MOD 10 = Constant input capacitance
05535	3045A MOD16	MOD 16 = Side mounted carrying handle
05535	3045A MOD30	MOD 30 = Top dB scale
50423	3056A MOD A37	MOD A37 = 1 kHz low pass filter
05535	3056A MOD04	MOD 04 = Parallel read inputs
05535	3056A MOD05	MOD 05 = Internal rechargeable battery
05535	3056A MOD10	MOD 10 = Constant input capacitance
05535	3056A MOD16	MOD 16 = Side mounted carrying handle
50423	3056A MOD38	MOD38 = AC/Battery, 4 MHz upper freq, 0 dB = 1 V
50423	3056A MOD98	MOD98 = 0 dBV scale (1V at 1 kilohm)

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APPENDIX C

GPETE Configurations

CAGE	Model	Consists of:
50423	3056A OPT 04	OPT 04 = Rear BNC connector
50423	311-U9	U9 = Linear meter scale
28480	3200B-E02	E02 = 13515A frequency doubler probe
50423	320A-S2	S2 = Rack mount
50423	320A-U38	U38 = 2 time constants
07342	321-S3254	S3254 = Isolated ref/signal input, rear connectors
50423	323-06 MOD40	MOD40 = Environmentalized
50423	323-07 MOD 40	07 = AC only, MOD 40 = Environmentalized
50423	323-20 MOD40	20 = AC/battery, MOD40 = Environmentalized
50423	323-21 MOD40	21 = AC only, MOD40 = Environmentalized
50423	323L-20 MOD 40	MOD 40 = Environmentalized
28480	3325A-001-002-H37-910	H37 = ETI
28480	3325B-001-002-H03-910	H03 = Schematics included in tech manual
28480	3325B-E02	E02 = 3325B-001-002-910
28480	333A-C10	C10 = Rear panel I/O terminals in parallel with front
28480	334A-H05	H05 = 30 kHz low pass filter, add 10 dB to meter
28480	3400A-C10	C10 = 300V range from 3-10 MHz is 8 percent
28480	3400A-C85	C85 = No feet/handles, dBV scale (90 dBV=1V), special paint
28480	3400A-H65	H65 = Linear 20 dB scale, input terminals in rear
28480	3400A-J79	J79 = 2Hz to 10MHz, -20dB to 0dB log, floating input
28480	340B-H01	H01 = Input frequencies of 15 and 60 MHz
28480	340B-H05	H05 = Input frequencies of 21.4 and 60 MHz
28480	340B-H09	H09 = Input frequencies of 30 and 45 MHz
28480	340B-H39	H39 = Input frequencies of 15 and 30 MHz
28480	340BR-H25	H25 = Input frequencies of 27.7 and 60.0 MHz
28480	342A-H24	H24 = 30 to 200 MHz frequency modifications
28480	342A-H67	H67 = Input frequencies of 21.4, 30, 60, 105 & 160 MHz
28480	342A-J30	J30 = Input frequencies of 21.4, 30, 60, 120 & 160 MHz
28480	342A-P46	P46 = Input frequencies of 21.4, 27.7, 30, 60, 70 & 160 MHz
28480	342A-R16	R16 = Input frequencies of 12, 15, 21.4, 60 & 160 MHz
50423	3440A-MOD110	MOD110 = No remote programming, 34401A
50423	3440A-MOD112	MOD112 = 7 kHz TO 1.2 GHz probe, 34401A
50423	3440A-MOD113	MOD113 = 10 kHz TO 1.2 GHz probe, 34410A
38047	3501-0100	3501A Navy version
38047	3501-01000	3501 Opt 04
28480	3550B-C24	C24 = Rack mount
28480	3551A-C01	C01 = Rack mount
28480	3551A-C05	C05 = Convertible rack mount
28480	3551A-H27	H27 = 11 inch rack mount, rear ac power, ac only, ETI
28480	355C-C08	C08 = N(f) connectors
28480	355D-C08	C08 = N(f) connectors
28480	3577A-E01	E01 = 3577A+35677A+35678A+35679A+11850A
28480	3577B-001-002-E01	E01 = 35677A+35678A+35679A+11850C
28480	3580A-C05	C05 = Rack mount
28480	3581A-H37	H37 = ETI
28480	3722A-H01	H01 = Additional binary output
28480	400GL-C01	C01 = Ground isolation from input connectors
11332	4017C/1	476+N4240A, attenuator set
11332	4017C/1-003	476+N4204A, attenuator set
11332	4017C/1-004	476+A4240A+A4240C, attenuator set
11332	4017C/1-005	476+N4240A+K4240C+A4240C, attenuator set
11332	4017C/2	476+440B-1
11332	4037	476-5+N4240A+K4240C-5+A4240C-5, case
28480	415E-E09	E09 = 415E-001+809C+H810C+X810B+X444A+816-22+447B
28480	415E-H05	H05 = 100 Hz input frequency
28480	415E-H12	H12 = 2500 Hz input frequency
28480	415E-H22	H22 = Opt 002 front & rear inputs, C15 fungus proofing

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APPENDIX C

GPETE Configurations

CAGE	Model	Consists of:
28480	415E-M39	M39 = Additional 0.005 VWSR scale, 0.025 dB scale
04901	4200-S21	S21 = 4E and 6E sensors, ETI
04901	4220-S/3	S/3 = 4E and 9E sensors, case, cables, 2 manuals
04901	4220-S/4	S/4 = 6E and 9E sensors, case, cables, 2 manuals
70998	43 TYPE I	43, 8 elements (5W TO 5 kW)
70998	43 TYPE II	43, 6 elements (5W TO 50W)
70998	43 TYPE III	43, 20 elements (10W TO 1 kW)
28480	431B-E18	E18 = 2 foot sensor cable
28480	431B-M21	M21 = 6 inputs
28480	431C-C15	C15 = Environmentalized
28480	431C-E15	E15 = 2 foot sensor cable
28480	431C-E30	E30 = 431CF-C32+478A-C32
28480	432A-E18	E18 = 432A with 2 foot sensor cable
28480	432A-E30	E30 = 432A-001+478A+K486A+AS-3, case, 2 manuals
28480	432A-E40	E40 = 432A-M52+8487B, case
28480	432A-E41	E41 = 432A+8478B+K486A, case
28480	432A-E42	E42 = 432A-K26+8478B+K486A+R486A, case
28480	432A-M21	M21 = Push-to-turn zero control
28480	432A-M27	M27 = 3 inputs
28480	435A-E12	E12 = 435A+8481A+8484A+11076A, case
28480	435B-C06	C06 = No feet, caution label, 2-sided scale
28480	435B-E12	E12 = 435B+8481A+8484A, case
28480	435B-E19	E19 = 435B+8482A+8482H, case
28480	435B-E25	E25 = 435B+8481A+8484A+11708A, case
28480	435B-E27	E27 = 435B+8482A+8482H, case
28480	435B-E30	E30 = 435B-001-C06+8481A+8484A, case
70998	4410-025	025 = SWR chart and detector elements 4410-4, 5, 6, 7
28480	461A-M12	M12 = Special test (not more than -3 dB at 460 MHz)
28480	461A-M62	M62 = 461A built to 462A specs
80009	465 MOD WY	MOD WY = ETI
80009	465M MOD WY	MOD WY = ETI
80009	465M-49	49 = Tri-service AN/USM-425(V)1
80009	466-04-MOD WX	WX = ETI, fast CRT, accessories
11332	476-5	Power meter for 11332 4037 system
50319	48-M-20	M-20 = Extra manual
80009	491 MOD 139L	MOD 139L = 10 MHz to 2000 MHz
80009	491 MOD 139M	MOD 139M = 1.5 GHz to 40 GHz
28480	4934A-E01	E01 = Opt 001, rack mount kit
80009	495P-39	39 = silver oxide RAM battery, cables, CRT filter
28480	5006A-40-M01	M01 = ETI
42161	520B2-17	520B2+500B, rack mount kit, metal case
42161	520B3-14	520B3+500B, fiberglass case
42161	520B3-17+8220-0500-53	520B3+500B, rack kit, w/o env delay, P/AR, impulse noise
28480	5245L-C37	C37 = Nonmercury nixies
28480	5245L-E67	E67 = Nonmercury nixies, 5253B+5257A+5266A
28480	5245L-E72	E72 = C37+5245L+5253B+5262A
28480	5245L-M12	M12 = 50 TO 1000 Hz ac line power
28480	5245L-M60	M60 = Modified for RFI protection
28480	5245L-M61	M61 = 50 to 400 Hz ac, no BCD output
28480	5245L-M78	M78 = Rotron fan for VWSR, 50 to 400 cps operation
28480	5245L-M96	M96 = 50 to 400 Hz ac line power
28480	5245L-M97	M97 = Opt C37, M61
28480	5245L-J45	J45 = 50 to 1000 Hz ac power, remote reset, 200k period
28480	5245L-J54	J54 = Modified for RFI, waterproofed front panel
28480	5245L-J58	J58 = Crystal aging rate of less than 1 part in 10E9/day
28480	5245L-M54	M54 = Fiberglass dripproof case, RFI, 50 to 400 Hz fan
28480	5245L-M11	M11 = RFI modification, Jonathan slides

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APPENDIX C

GPETE Configurations

CAGE	Model	Consists of:
28480	5245M-H37	H37 = M54 modification and nonmercury nixie tubes
28480	5248L-E03	E03 = H03-5248L, H03-5267A
28480	5248L-H03	H03 = RF1, fungus proofing, 50-400 Hz, rear input
28480	5328A-E42	E42 = Cover, extender cards, spares, H42
28480	5328A-H03-H99	H03 = BCD out, remote prog, H99 = 5328A-096, improved EMI
28480	5328A-H42	H42 = Opt 010, 011, 030, 041
28480	5328A-H99	H99 = Opt 010, 011, 030, 041
28480	5328AF/096	USAF version, Opt 010, 011, 030, 041
28480	5334A-010-030-H06-910	H06 = 10857A radio beacon interface
28480	5334B-030-H05	H05 = Hi stbl time, handles, 200V input protection
28480	5334R	5334A-010-030+10857A radio beacon interface
28480	5342A-001-002-E03	E03 = Tilt-bail handle
28480	5342A-E03	E03 = Tilt-bail handle
28480	5345A-012	012 = HP-1B
28480	5345A-E29	E29 = 5345A+5355A+5356A
28480	5350B-001-H03	H03 = ET1
28480	5352B-001-H03	H03 = ET1, 001 = high stability time base
07342	540-20-S1635	S1635 = 60, 400, and 10 kHz input frequencies
07342	540-S3161	S3161 = 1:1 output transformer ratio
31637	5440C-G1-01-03-05-06	G1 = 115V, 01 = 65 dBm input sens, 03-05-06 = 5 MHz-40 GHz
31637	5440C-G1-03	G1 = 115V, 03 = 5 MHz to 18 GHz noise source
28480	54501A-E01	E01 = Front panel power switch, probes
34257	545A-W10-02-08	W10 = TCXO, EMI shielding
34257	545A-W10-08	W10 = TCXO, EMI shielding
34257	548A-W10-06-08+590-91	W10 = TCXO, EMI, 08 = GPIB, 590 = EXT CABLE, 91 = SENSOR
80009	577515E	577D+177, SCR pkg(A1002,A1003,A1004,A1009,U35-5028-00)
34257	585-5802-Y09	Y09 = ET1, 5802 = 0.3 TO 1 GHz
58900	600/10-18 CONFIG158	CONFIG 158 = OPT 03 (1 KHZ RES), 06 (HI STBL TIME)
20747	604M-P025526-RAT604M-10	P025526 = paint color, RAT604M-10 = baud rate option
28480	608E-C80	C80 = Nontilting rack slides
50423	6130A MOD32	MOD32 = Deleted nsec markers
28480	6259B-026	026 = 115 Vac 10% input line voltage
28480	626A-H12	H12 = 60 to 400 Hz fan
28480	628A-H12	H12 = 50 to 400 Hz ac line power
55792	6500-1676	1676 = Configuration A frequency modifications
28480	651B-H06	H06 = 75 ohm output (0 dBm = 1 mW into 600 ohms)
28480	652A-H02	H02 = 75 ohm output, dBm scale (1 mW into 75 ohms)
28480	652A-S01	S01 = 30 inch 50 ohm cable
99899	70028	8616+8662B+8623C+8562+8633
99899	70039	8616+8623D+8699
99899	70040	8616+8623D+8633+8652+8662B+8699
28480	7034A-127	127 = (2)17171A
28480	7402A-159	159 = 7402A-003+(2)17401A
28480	7402A-168	168 = (2)17401A
89536	77/AN	AN = Model 77 with Navy specifications
80009	7704A MOD 129G	129G = Special output jack
89536	8000A/BU	BU = Battery power, test switch, ac to 100 kHz
89536	8000A/MAS	MAS = AC measurements set up for medical requirements
89536	8000A/MTR	MTR = Front panel analog meter
04901	8210-01-S3	S3 = Alkaline battery for RAM
89536	823AR/AF	R/AF = Front/rear input, special paint
89536	825A/AG	AG = Zener diode reference
28480	8350B-N40	N40 = 8350B+83595A-002+83572A-H37, H37 = 06, 7 dBm
28480	8350B-N41	N41=8350B-913+83595A-002+11869A+83572A-H37, 37 = 06, 7 dBm
28480	8350B-N42	N42 = 8350B+83522A
28480	8350B-N43	N43 = 8350B+83522A-002-004, rear RF output jacks
28480	8350B-N44	N44 = 8350B+83525A+83545A

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GPETE Configurations

CAGE	Model	Consists of:
28480	83508-N45	N45 = 83508+83545A
28480	83508-N46	N46 = 83508+83550A
28480	83508-N47	N47 = 83508+83592B-002
28480	83508-N48	N48 = 83508+83570A
28480	83508-N49	N49 = 83508+83597A
28480	83508-N50	N50 = 83508+83596A
28480	83508-N51	N51 = 83508-913+83592B-002
28480	83508-N52	N52 = 83508-913+83595A-002
28480	83508-N59	N59 = 83508-913+83595A-002+83572A-H38, H38 = 01, 06, 7 dB
28480	83508-N60	N60 = 83508+83570A+83592B-002
28480	83508-N67	N67 = 83508+11667A
28480	83572A-H37	H37 = Opt 006, high power output, square wave modulator
28480	83572A-H38	H38 = 83508+83572A-H37, H37 = int pulse, square wave mod
28480	83595A-N20	N20 = 83508-913+83595A-H20, H20 = Navy spec attenuator
28480	83597A-N21	N21 = 83508-913+83597A-H21, H21 = Navy spec attenuator, R281A
28480	8403A-002	002 = 8731B (800 to 2400 MHz)
28480	8403A-004-M09	004 = 8432B+8403A-M09, variable delay pulse
28480	8403A-008	008 = 8403A+8734B (7 to 12.4 GHz)
28480	8405A-C80	C80 = Fixed slide rails
28480	8405A-E10	E10 = 11570A, linear volts scale
28480	8405A-E15	E15 = 8405A-002-910+11570A, linear dB scale
28480	8405A-E24	E24 = ETI, linear volts scale, 11567A+10216A+10218A
28480	8405A-E25	E25 = ETI, linear dB scale, 11567A+10216A+10218A
28480	8407A-E30	E30 = 8407A+8413A+8601A+11652A, transmission/reflection kit
28480	8407A-E31	E31 = 8407A+8412A+8601A+11652A, transmission/reflection kit
28480	8410B-E75	E75 = 8410B+8411A+8413A+8470A
28480	8410C-E75	E75 = 8410+ 8411A+8413A+8470A
28480	8444A-059	059 = Compatibility w/85588+8565A+8568A+8569A+8554A+8555A
28480	8444A-H39	H39 = 1st LO input on rear panel, Opt 059
34280	8501-S5455	S5455 = 8501, EMI, GPIB, 3 sensors, cables, covers
28480	8553B-E01	E01 = 141T+8553B-H05+8552A-H02, 75 ohm system
28480	8553B-E03	E03 = 141T-908+8553B+8552B
28480	8553B-E29	E29 = 8553B+8552B+141T
28480	8553B-E30	E30 = 141T-908+8553B+8552B+8443A
28480	8553B-E31	E31 = 141T+8553B+8552B+8443A
28480	8554B-E29	E29 = 141T+8554B+8552B
28480	8554B-E30	E30 = 141T+8554B+8552B+8444A
28480	8554B-E31	E31 = 141T+8554B+8552B+8444A
28480	8555A-E12	E12 = 140T+8555A+8552B
28480	8555A-E29	E29 = 141T+8555A+8552B
28480	8555A-E31	E31 = 141T+8555+ 8552B+8445B
28480	8555A-E75	E75 = 141T+8555A+8552B+11517A+11518A+11519A+11520A
28480	8555A-H11	H11 = Amplified 50 MHz IF out with 8552B-H11
28480	8556A-E27	E27 = 141T+8556A+8552B
28480	8556A-E29	E29 = 141T+8556A+8552B
28480	8559A-E15	E15 = 8559A+853A
28480	8559A-E36	E36 = 8559A+180TR-908
28480	8559A-E50	E50 = 8553A, ETI, 2nd manual
28480	8559A-H37	H37 = ETI, 2nd manual
28480	8562A-E50	H50 = Silver oxide ROM battery, 11970K,A,Q,U, 85620A
28480	8562A-E51	E51 = 11970A+11970K, silver oxide ROM battery, SMA cables
28480	8562B-462	462 = Impulse bandwidths for EMI measurements
28480	8566A-E02	E02 = 50 and 75 ohm RF inputs
28480	8568B-462/910	462 = Special impulse bandwidth
89536	8600A-01/529	01 = Battery and ac power, 529 = GPIB
28480	8601A-H11	H11 = 01, 03, line fuses, 10503A, N to BNC, 6 ft cable
28480	8614A-C25	C25 = OSM-RTO output, rear FM TNC, ext FM has 50 ohms to grd

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CAGE	Model	Consists of:
28480	8614A-E08	E08 = 8614A+8403A-002
28480	8614A-H16	H16 = Uncalibrated output, improved attenuator specs
28480	8616A-E16	E16 = 8616A+8403A-004-H09
28480	86241A-H13	H13 = Output 20mW, on/off ratio -16dB, harmonics reduction
28480	86260A-H40	H40 = 11 dBm output power
28480	86290B-H08	H08 = 2 to 12 GHz 10 dBm, 12 to 22 GHz 3 dBm output
28480	86290B-H13	H13 = 13 dBm output power
28480	86342A-H25	H25 = 10 dBm output power at 8621B-100
28480	8644A-K01	K01 = Two component-level repair manuals
28480	8660C-E11	E11 = 8660C-100+86602B+86631B
28480	8660C-E29	8660C-1-5-100+86601A+86602B+86603A-2+86631B+86633B+86634B
28480	8660C-E44	8660C-1-5-100-910+86601A+86603A-2+86631B+86633B+86634B
28480	8660D-E52	E52 = 8660D-01-03-05-100+86602B+86631B+86632B+86633B
28480	8660D-E53	E53 = 8660D-01-03-05-100+86603A-002+86633B+86634A
28480	8660D-E54	E54 = 8660D-01-03-05-100+86601A+86632B
28480	8660D-E55	E55 = 8660D-01-03-05-100+86602B+86631B
28480	8660D-E56	E56 = 8660D-01-02-05-100+86602B+86633B
28480	8660D-E57	E57 = 8660D-1-3-5-100+86601A+86603A+86632B
28480	8660D-E58	E58 = 8660D-001-003-005-100+86601A+86603B
28480	8660D-E59	E59 = 8660D-1-3-5-100+86603A+86632B+86634A
28480	8660D-E63	8660D-1-3-5-100-910+86601A-910+86603A-02-910+86632B-910
28480	8660D-E64	E64 = 8660D-01-03-05-100-910+86601+86603A-002+86632B+86633B
28480	8684D-H21	H21 = 10 dBm output, APC-7, 70 dB attenuator
28480	8684D-H24	H24 = 10 dBm output, APC-7, 70 dB atten, 400 Hz power
28480	8685A	8684B+435B+8481A+537A
28480	8690A-E17	E17 = 8690A+8691A-H26+8692A-1-H26+8693A-001+8694A-001
28480	8694B-H01	H01 = 7 to 12.4 GHz, Opt 200 15 mW output power
28480	8721A-H01	H01 = 2 watts input on load port only, others 0.9W max
28480	8755A-E57	E57 = 182T+8755A+(3)11664A+11665A+11679A+11679B
28480	8755B-E57	E57 = 182T+8755B+(3)11664A+11665B+11679A+11679B
28480	8755C-E44	E44=182T+8755C+(3)11667B/E+(3)11664C+8750A+R422A+K422A
28480	8755C-E57	E57 = 182T+8755C+(3)11664A+11665B+11679A+11679B
28480	8756A-E40	E40 = 8756A+11664B+(2)11664C+(3)11170C+10833A+85023
28480	8756A-E45	E45 = 8756A+(3)11664E+(3)11664C+(3)R422A+(3)K422A
28480	8756A-E57	E57 = 8756A+(3)11664A+11665B+11679A+11679B
28480	8757A-M45	M45 = 8757E-S20
28480	8757E-S20	S20 = 8757E+(3)11667A+85027C+11664A+8491B-010
89536	8000A/MTR	MTR = Analog meter, battery test switch
89536	8800A/AA	AA = Extended frequency response
89536	8840A/AA	AA = Opt 09 TRMS converter
28480	8901A-E01	E01 = 8901A-002-010-908+11715A-908
28480	8902A-E02	E02 = 8902A-002-908-910+11722A
28480	8902A-E04	E04 = 8672A-001-915-916+11793A-H04+11792A-001-H04+71B
28480	8903B-050	050 = 400 Hz high pass filter
89536	8922A/AB	AB = Front/rear sig in, ext dc power, 0 dB = 1V/1 kilohm
28480	8970B-E20	E20 = 8970B+346B
28480	8970B-E21	E21 = 8970B+346B+346C+R347B
04901	91DA-S5	S5 = Calibrated in dBm
04901	91H-S7	S7 = 50 to 400 Hz line power, dBm scale
04901	9200B-01B	01B = GPIB
04901	92A-S2	S2 = Rear input, carrying handle, ruggedized
04901	92A-S2-1	S2-1 = Environmentalized, 91-12 RF probe, 91-8B BNC
04901	92B-S5	S5 = 9126A kit(91-6C+91-7C+91-14A+91-15A+91-18A), ruggedized
04901	92E-S5	S5 = 952011-1 kit(91-6C+91-7C+91-14A+91-15A+91-18A)
89536	931B	TRMS voltmeter to 1100V
89536	931B/AB	AB = Rear BNC only
28821	957A	A = ETI, 15 min warmup, 0 to 55 degrees C

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GPETE Configurations

CAGE	Model	Consists of:
93459	9675-200	430-08+438AP+432AP+433AP+434AP+435AP-1+436+437+(4)4301+4302B
80009	AM 503S	AM 503+TM 502A+A6302, tool box panel
82199	ESN2+ESN2-105	ESN2-105 = Antenna package
82199	ESN3+ESN2-105	Programmable, ESN2-105 = Antenna package
82199	ESV+ESV-105	ESV-105 = Antenna package
82199	ESVP+ESV-105	Programmable, ESV-105 = Antenna package
80009	F2601A1	TR 503+TM 503, blank panel, cables, adapter
80009	F2603A1	TR 503+DC 509-01+DP 501+TM 504-02, cables, adapters
80009	F2604A1	TR 503+DC 503A+TM 503-02, cables, adapter
80009	F3801A1	2465+1106+1107, probes, accessory pouch
80009	F3801A1 MOD YE	2465A+1106+1107, probes, CRT filters
80009	F3801A2 MOD YE	2465B+1106+1107, probes
80009	F4001A1	468H rack mounted, probes, adapters, CRT filters
80009	F4002A1	2335 ruggedized, rack mount kit, probes, CRT filters
80009	F4201A2	R7633-03+7A26+7B53A+7D13, cable, CRT filters
80009	F4202A1	7603-03+7A13+7A18A+7B53A
80009	F4203A1	7613-03+7A13+7A26+7B53A, cable, probes
80009	F4203A1 MOD FE	7613-03+7A13+7A26+7B53A, probes, cable, CRT filters
80009	F4203A2	R7613-03+7A13+7A26+7B53A, cable, CRT filters
80009	F4204A1	7904A-03+7A29+(2)7A16A+7B92A, probes, CRT filter
80009	F4204A1 MOD FE	7904-03+(2)7A16+7A29+7B92A MOD FE, probes
80009	F4206A1	7603+(2)7A16A+7B53A, probes, cable, CRT filter
80009	F4207A1	7613-01+(2)7B11+7T11+(2)S4+S52, cables, adapters
80009	F4208A1	R7613+7A15A+7B53A, cable
80009	F4209A1	7613+7A26+7B53A, cable
80009	F4211A1	7904A+(2)7A29+7B10+7B15, probes, adapter
80009	F475T4	475-04-07 ruggedized, 1106 battery pack, probes
80009	F5202A1 MOD WP	5110+(2)5A21N+5B10N, probes
80009	F5202A2 MOD WR	R5110 MOD WP+(2)5A21N+5B10N+MOD 817 rear inputs
80009	F5203A1	5440-01+(2)5A48+5B42, probes
80009	F5204A1	5440+5A48+5B42+1101A1, probes, accessories
80009	F5204A2	R5440+5A48+5B42, probes, accessories
80009	F577D2	577D2+177+A1005+A1007
80009	F6001A1	AM 503+TM 502A+A6302, cable
80009	F7511A1	SC 502+TM 503+1105, probes, tool box plug-in
80009	F7613A1	7613-01-03-05+(2)7A15A+7B53A, probes, CRT filter
80009	F7904D2	7904-03+7A19+(2)7A16A+7B92A, probes
25284	HD125/10182	10182 = 2 manuals
85711	MV-912A-BP-SC1	BP = Binding post input jacks, SC1 = Linear dB scale
88869	NM-67N	NM67+96001+95209-1
09553	QA-20908-SA1194	TF 2091B+TF 2092B+SA1194 filters
89536	PM 5712/080	080 = Handle, EMI protection, Navy manual
94990	R2001D/0010/HS	0010 = Alkaline battery, HS = Hi stab oscillator
82199	SPN + SPN-Z1	SPN-Z1 = Balanced 600 ohm balun
57705	TRACKER 2000-HSR410	2000+HSR410 switching unit
62614	WR-3101-2S	2S = (2)AL-3101+TR-201

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AMCAA-A

AMMETER, CLAMP-ON

1. **GENERAL.** This application requires a clamp-on current/power probe capable of measuring ac and dc current and ac power.
2. **CLASSIFICATION.** Type III, Class 3, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Multimeter compatibility.** The equipment shall be compatible with multimeters that have the following specifications.
 - 3.1.1 **Input connectors.** 19 mm (0.75 in) spaced banana jacks.
 - 3.1.2 **Input impedance.** ≥ 1 megohm, 100 pF.
 - 3.2 **Scaling range.** 1 mV/A and 1 mV/kW.
 - 3.3 **Electrical measurement specifications.** See table I.

TABLE I. Electrical Measurement Specifications

<u>FUNCTION</u>	<u>MEASUREMENT RANGE</u>	<u>ACCURACY</u>
DC Current	1 to 1,000A	1 to 700A, 2% + 2A 700 to 1,000A, 3%
AC Current	1 to 1,000A	1 to 500A dc to 62 Hz, 2% + 2A 62 to 440 Hz, 6% + 2A 500 to 700A dc to 62 Hz, 3% 62 to 440 Hz, 7% 700 to 1,000A dc to 62 Hz, 6% 62 to 440 Hz, 8%
AC Power	0.5 to 330 kW	48 to 62 Hz 3.5% + 500W (pwr factor > 0.5) 390 to 410 Hz 4% + 500W (pwr factor > 0.9)

- 3.4 **Crest factor.** 3.0 minimum.
- 3.5 **Temperature coefficient.** 6% x specification allowed for every °C outside range of 18 to 28°C.
- 3.6 **Heating limitation.** 5 minutes operating time for 120 A-kHz current-frequency product.
4. **TRANSIT CASE.** The Style P transit case shall provide protection for all components of the probe assembly.
5. **POWER SOURCE.** MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 100 hours of operation before replacement. The nominal power source requirements are not invoked.

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6. WEIGHT. 1 kg (2.2 lb) maximum.

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ANONP-D

ANALYZER, DISTORTION

1. **GENERAL.** This procurement requires an analyzer capable of measuring distortion on ac waveforms.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CHARACTERISTICS.** The equipment shall be capable of performing harmonic distortion measurements within the minimum parameters and accuracies specified below.
 - 3.1 **Distortion measurement characteristics.**
 - 3.1.1 **Fundamental frequency range.** 10 Hz to 100 kHz. Accuracy: $\pm 5\%$ of setting.
 - 3.1.2 **Distortion ranges.** Selectable ranges from 0.1% to 100%.
 - 3.1.3 **Distortion accuracy.** $\pm 12\%$ FS or less for all distortion ranges.
 - 3.1.4 **Internal distortion.** 0.06% or less of total harmonic distortion.
 - 3.1.5 **Automatic nulling.** Automatic nulling capability shall be provided.
 - 3.1.6 **AM on RF carriers.** The instrument shall be capable of distortion measurements of the AM on RF carriers from 550 kHz to 1.6 MHz. The modulating signal shall be within the frequency range of 20 Hz to 20 kHz.
 - 3.1.7 **Internal AM distortion.** 1% maximum of total harmonic distortion for 3 to 8 V_{rms} carriers modulated up to 30%.
 - 3.1.8 **Maximum AM input.** 40V peak-to-peak.
 - 3.1.9 **Filter.** A selectable high-pass filter shall be provided with at least 3 dB rejection at 400 Hz and at least 40 dB rejection at 60 Hz.
 - 3.2 **Voltmeter measurement characteristics.**
 - 3.2.1 **Voltage measurement range.** 1 mv to 200V.
 - 3.2.2 **Voltmeter frequency range.** 10 Hz to 100 KHz.
 - 3.2.3 **Voltmeter accuracy.** $\pm 5\%$ fs.
 - 3.3 **DC isolation.** The signal ground shall be isolated to ± 30 Vdc from the external chassis.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 4W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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AN4NM-C

ANALYZER, LOGIC

1. **GENERAL.** This procurement requires a multichannel timing and state analyzer that can record and display logic signals and data from digital circuitry. The analyzer shall have specific probing and recording capabilities for an IEEE 488.1 logic interface.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of both synchronous and asynchronous data domain and time domain recording of parallel digital signals as specified below. All specifications contained below shall be measured at the probe or lead tip used for connection to the unit under test.
 - 3.1 **Time domain.** A timing format of at least 16 channels shall be recorded and displayed. Horizontal expansion capabilities shall be provided to display a portion of the total memory for more detailed examination. A positionable cursor that identifies recorded data words and time positions shall be provided. The triggering event shall be marked or annotated on the timing display. Operator assignment of the displayed channel order shall be provided.
 - 3.2 **Data domain.** Displays of recorded data in binary, octal, and hexadecimal bases shall be provided.
 - 3.3 **Display.** Cathode ray tube. Minimum usable viewing area: 100 mm (4 in) high by 120 mm (5 in) wide.
 - 3.4 **Signal inputs.** The analyzer shall be provided with a minimum of 20 separate signal input channels including probes, pods, cables, and other required accessories.
 - 3.4.1 **Data channels.** The analyzer shall have a minimum capability of receiving, recording, and displaying parallel data words of at least 16 bits in the timing and data domains, and shall be expandable to at least 32 bits.
 - 3.4.2 **Trigger channels.** The analyzer shall have at least two trigger qualifier input channels.
 - 3.4.3 **Clock channels.** The analyzer shall have an external clock input and a clock qualifier input channel.
 - 3.4.4 **Input RC.** 1 megohm minimum shunted by 8 pF or less.
 - 3.4.5 **Threshold.** The logic analyzer shall perform as specified when used to analyze TTL circuitry. The TTL threshold shall be $1.5 \pm 0.1V$. The equipment shall be provided with a variable threshold, adjustable to within $\pm 0.15V$ from $-6.4V$ or less to at least $+6.3V$. High and low true logic polarity shall be selectable for each channel.
 - 3.4.6 **Maximum input.** $\pm 30 Vdc$ referenced to ground.
 - 3.4.7 **Input modes.**
 - 3.4.7.1 **Sample mode.** The detected logic level present on each probe and at each clock transition shall be stored in the sample mode.
 - 3.4.7.2 **Latch mode.** Whenever multiple transitions occur between two successive clock intervals, the state opposite that stored during the previous clock interval shall be stored on the next clock. A glitch memory with corresponding glitch markers on the display may satisfy this requirement.

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3.4.7.3 **Minimum pulse.** In the timing and state modes, when the logic analyzer threshold is set for TTL in the latch or glitch modes, the equipment shall detect a 5 ns pulse with a level that changes from less than +0.25V to any amplitude from +2V to +5V and then returning to less than +0.25V. Detection shall also be provided for a 5 ns pulse with a level that changes from +2V to +0.83V or less and returning to +2V.

3.5 **Internal clock.** An internal clock with selectable periods from 10 ns or less to at least 50 ms shall be provided.

3.6 **External clock.** DC to at least 50 MHz with selectable positive and negative edge active modes. Minimum clock pulse width: 10 ns or less.

3.6.1 **Setup and hold time.** 12 ns or less.

3.7 **Memory.** At least 250 data word samples. A second memory of equal depth shall be provided for comparing word samples and searching for specific word occurrences within the recording memory.

3.8 **Self-check.** A self-check function that verifies operation of all basic functions shall be provided.

3.9 **Interface probing.** The equipment shall be provided with a probing accessory and all required cables that allow the analyzer to record bidirectional data flow and the associated management signals required for IEEE 488.1 digital interface operation.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 400W.

5. **WEIGHT.** 30 kg (66 lb) maximum.

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AN2FM-C

ANALYZER, NETWORK

1. **GENERAL.** This procurement requires a network analyzer with polar and Smith chart displays.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of magnitude, phase, and delay measurements within the minimum specifications identified below.
 - 3.1 **Display characteristics.** A dual-trace display shall be provided with a usable display area of 9.5 cm x 12 cm.
 - 3.1.1 **Graticules.** Selectable polar and Smith chart.
 - 3.1.2 **Resolution.**
 - a. **Magnitude:** 0.01 dB/div.
 - b. **Phase:** 0.01 deg/div.
 - c. **Real and imaginary:** 0.1 nV/div.
 - d. **Group delay:** 0.01 ns/div.
 - 3.2 **Source characteristics.**
 - 3.2.1 **Source frequency range.** 5 Hz to 200 MHz.
 - 3.2.2 **Source frequency resolution.** 0.001 Hz or less.
 - 3.2.3 **Output level range.** -49 to 15 dBm.
 - 3.2.4 **Source impedance.** 50 ohms nominal.
 - 3.2.5 **Output connector.** Type N(f).
 - 3.2.6 **Source sweep mode.** Selectable single, continuous, and manual sweep modes shall be provided.
 - 3.2.6.1 **Log and linear sweep frequency range.** 5 Hz to 200 MHz.
 - 3.2.6.2 **Log and linear sweep frequency span.** 0.01 Hz to 200 MHz.
 - 3.2.6.3 **Sweep time.**
 - a. **Log:** 200 ms/span to 6,500 s/span.
 - b. **Linear:** 100 ms/span to 6,500 s/span.
 - 3.2.6.4 **Sweep trigger modes.** Free run, line, and external sweep trigger modes shall be provided.
 - 3.3 **Receiver characteristics.**
 - 3.3.1 **Receiver frequency range.** 5 Hz to 200 MHz.
 - 3.3.2 **Input R.** Selectable 50 ohms and 1 megohm nominal.

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3.3.3 Receiver input connectors. Type N(f) for channel A, channel B, and reference.

3.3.4 Input magnitude range. -80 dBm to 0 dBm with a resolution bandwidth of 1 kHz.

3.3.5 Phase range. $\pm 180^\circ$.

3.3.6 Resolution bandwidths. 1 kHz, 100 Hz, and 10 Hz.

3.3.7 Dynamic accuracy. As specified in table I.

TABLE I. Dynamic Accuracy

Input Level Relative to Full Scale Input	Magnitude	Phase
-10 to 0 dB	± 0.04 dB	$\pm 0.4^\circ$
-60 to -10 dB	± 0.05 dB	$\pm 0.5^\circ$
-80 to -60 dB	± 0.15 dB	$\pm 1.5^\circ$
-100 to -80 dB	± 0.75 dB	$\pm 7.5^\circ$

3.4 S-parameter characteristics.

3.4.1 S-parameter frequency range. 100 Hz to 200 MHz.

3.4.2 Test port impedance. 50 ohms nominal, type N(f).

3.5 Remote operation. Digital interface in accordance with MIL-T-28800.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 600W.

5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

Configuration A: AN2NT-C
Configuration B: AN2NV-C

ANALYZER, NETWORK

1. **GENERAL.** This procurement requires a scalar network analyzer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of absolute power and power ratio measurements within the minimum specifications identified below. A display of VSWR or a chart for converting return loss and reflection coefficient to VSWR shall be provided.
 - 3.1 **Frequency range.**
 - 3.1.1 **Configuration A:** 100 MHz to 18 GHz.
 - 3.1.2 **Configuration B:** 100 MHz to 40 GHz.
 - 3.2 **Dynamic range.** -50 dBm to 10 dBm.
 - 3.3 **Input channels.** Channel A, channel B, and a reference channel. Ratio measurement capabilities shall be provided for channel A to reference and channel B to reference.
 - 3.4 **Resolution.** Selectable resolutions such as 0.2, 0.5, 1, 5, and 10 dB per division shall be provided.
 - 3.5 **Display offset.** ± 59 dB for each channel. Resolution: 0.1 dB.
 - 3.6 **Frequency response.** ± 1 dB or less.
 - 3.7 **Accuracy.** ± 1.1 dB, excluding mismatch and frequency response errors, for inputs that are 10 to 50 dB from the reference.
 - 3.8 **Impedance.** 50 ohms nominal.
 - 3.9 **VSWR.** Configuration A: 1.92 maximum. Configuration B: 1.7 maximum.
 - 3.10 **Display.** The equipment shall contain a rectangular graphic display of no less than 76 mm (3 in) X 102 mm (4 in). The horizontal and vertical centerlines shall be marked in 0.2 division sub-increments and one division cardinal increments. In lieu of division increments the equipment may be provided with positionable markers that provide a readout of frequency and amplitude.
 - 3.11 **External input.** The equipment shall be provided with an external sweep input compatible with a 0 to 10V ramp signal such that the ramp will cause a full-screen horizontal deflection of the CRT beam.
4. **ACCESSORIES.** Shielded open, shielded short, 50 ohm termination, 10 dB pad, 50 ohm power splitter, detectors (2 ea), and return loss bridge.
 - 4.1 **Connectors.** Configuration A: Type N. Configuration B: Connectors shall allow 100 MHz to 40 GHz operation.
5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 125W.
6. **WEIGHT.** 30 kg (66 lb) maximum.

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APPENDIX D

AN2MM-B

ANALYZER, NETWORK

1. **GENERAL.** This procurement requires a vector network analyzer capable of measuring transmission and reflection parameters on a swept frequency and CW basis with readouts of attenuation, gain, phase shift, reflection coefficient, return loss, and impedance.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring transmission and reflection parameters on a swept frequency or CW basis within the minimum ranges, accuracies, and limits specified below.
 - 3.1 **Converter.** An rf converter shall be provided as part of the equipment and shall be capable of processing rf input signals for presentation by the display within the parameters and accuracies specified below.
 - 3.1.1 **Frequency range.** 110 MHz to 18 GHz.
 - 3.1.2 **Input impedance.** 50 ohms nominal. SWR: 2.0 maximum from 110 MHz to 6 GHz, 3.0 maximum from 6 to 18 GHz.
 - 3.1.3 **Channel isolation.** 60 dB minimum from 110 MHz to 12.4 GHz, 50 dB minimum from 12.4 to 18 GHz.
 - 3.1.4 **Magnitude range.**
 - 3.1.4.1 **Reference channel power range.** -35 dBm to -18 dBm from 110 MHz to 12.4 GHz, -25 dBm to -18 dBm from 12.4 to 18 GHz.
 - 3.1.4.2 **Test channel power range.** -75 dBm to -10 dBm from 110 MHz to 12.4 GHz, -68 dBm or less to at least -10 dBm from 12.4 to 18 GHz.
 - 3.1.4.3 **Maximum RF input.** 50 mW.
 - 3.1.4.4 **IF gain control.** The IF gain control shall have a range of at least 69 dB in 10 dB and 1 dB steps with a maximum cumulative error of ± 0.2 dB.
 - 3.1.5. **Phase measurement range.** 0° to 360°.
 - 3.2 **Display.** A display shall be provided to display relative amplitude in dB and relative phase in degrees between reference and test channel inputs versus frequency.
 - 3.2.1 **Amplitude Display range.** 80 dB minimum. Accuracy: ± 0.08 dB per dB from midscreen.
 - 3.2.2 **Phase display range.** $\pm 180^\circ$. Accuracy: $\pm 0.065^\circ$ per degree from mid screen.
 - 3.2.2.1 **Phase offset.** The phase offset shall not exceed 0.3° per 20° step and shall not exceed 3° for a 360° change.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 190W.
5. **WEIGHT.** 47 kg (104 lb) maximum.

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APPENDIX D

ANSAA-C

ANALYZER, SIGNATURE

1. **GENERAL.** This procurement requires a solid-state, four digit signature analyzer controllable via an IEEE STD 488-1978 General Purpose Interface Bus.

2. **CLASSIFICATION.** Type III, Class 6, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

2.1 **Electromagnetic interference requirements.** The requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.

3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of signature analysis within the clock, data, start, and stop specifications contained below. All specifications contained below shall be measured at the point of connection to the unit under test.

3.1 **Signature generation.** The signature displayed shall be identical to the signature generated by a 16-bit shift register with feedback given by the boolean logic equation:

SHIFT
REGISTER - [SIGNAL INPUT] • [(BIT 11 • BIT 15) • (BIT 6 • BIT 8)]
INPUT

a. The SIGNAL INPUT refers to the serial data accessed by the probe and selected by the control signals.

b. The BIT numbers refer to a shift register with 16 bits numbered from 0 to 15. BIT 0 receives the SHIFT REGISTER INPUT, and each clock pulse shifts the data one bit toward BIT 15, the most significant bit.

c. The symbol • refers to the exclusive OR operation (or half-adder).

3.2 **Signature data specifications.** The signature analyzer shall be provided with a probe for data acquisition from the unit under test.

3.2.1 **Data thresholds.** The data threshold for a logic one shall be $2 \pm 0.4V$ and the threshold for a logic zero shall be $0.8 \pm 0.3V$. Voltages above the logic one threshold shall be interpreted as a logic one and voltages below the logic zero threshold shall be interpreted as a logic zero.

3.2.2 **Data input setup time.** 15 ns or less relative to the active clock edge.

3.2.3 **Hold time.** Zero, relative to the active clock edge.

3.2.4 **Data input pulse width.** The minimum detectable data pulse width shall be 15 ns or less.

3.2.5 **Data input overload protection.** The data input overload protection shall be at least 150 Vdc continuous or 140 Vrms for one minute.

3.3 **Clock, start, and stop signal specifications.**

3.3.1 **Clock, start, and stop thresholds.** The clock, start, and stop thresholds shall be $1.4 \pm 0.6V$. The analyzer shall interpret voltages above the threshold as logic one and voltages below the threshold as logic zero. A means shall be provided to reverse the interpretation of either or both thresholds. When the interpretation is reversed, voltages above the threshold shall be interpreted as logic zero and voltages below the threshold as logic one.

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3.3.2 Clock, start, and stop overload protection. The clock, start, and stop overload protection shall be at least 20 Vdc.

3.3.3 Maximum clock frequency. 20 MHz or greater.

3.3.4 Minimum clock pulse width. 15 ns or less.

3.4 Input RC. 47 kilohms minimum shunted by 15 pF or less. The analyzer inputs shall pull tri-state buses either high or low.

3.5 Signature display. The signature display shall be composed of four alphanumeric characters.

3.5.1 Signature display decoding. The signature displayed shall be identical to a signature obtained by decoding the shift register bits as follows. The contents of the shift register may be considered as a binary number with bit zero as the least significant bit. The displayed signature is obtained by decoding the binary number as a hexadecimal number and making the following substitutions in the hexadecimal numbers. The hexadecimal B is displayed as C, C as F, D as H, E as P, and F as U.

3.6 Remote operation. Digital interface in accordance with MIL-T-28800.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 65W.

5. WEIGHT. 10 kg (22 lb) maximum.

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APPENDIX D

Configuration A: AN1FH-C

Configuration B: AN1FI-C

ANALYZER, SPECTRUM

1. **GENERAL.** This procurement requires a low-frequency, digital storage spectrum analyzer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. For Configuration B, the Style E convertible/rackmountable requirements are invoked.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of signal analysis within the minimum limits, ranges, and accuracies specified below.
 - 3.1 **Frequency characteristics.**
 - 3.1.1 **Frequency range.** 5 Hz to 50 kHz with an unbalanced input, 300 Hz to 4 kHz with a balanced input.
 - 3.1.2 **Frequency display accuracy.** ± 3.5 Hz.
 - 3.1.3 **Frequency display resolution.** 1 Hz or less.
 - 3.1.4 **Stability.** ± 10 Hz/hour.
 - 3.1.5 **Bandwidth.** Selectable bandwidths from 1 Hz to 300 Hz.
 - 3.1.5.1 **Bandwidth accuracy.** $\pm 15\%$.
 - 3.1.5.2 **Shape factor.** 10:1 maximum for all bandwidths.
 - 3.2 **Amplitude characteristics.** The minimum amplitude characteristics shall be as specified in table I.

TABLE I. Amplitude Range and Accuracy

<u>Amplitude Parameters</u>	<u>Log Mode</u>	<u>Linear Mode</u>
Range	30 to -150 dBm	20V to 100 nV
Frequency response	± 0.5 dB	$\pm 5\%$
Display accuracy	± 2 dB	$\pm 2\%$
Input attenuator accuracy	± 0.3 dB	$\pm 3\%$
Reference level accuracy:		
Most sensitive range	± 1 dB	$\pm 10\%$
All other ranges	± 1 dB	$\pm 3\%$

- 3.2.1 **Dynamic range.** 80 dB minimum.
- 3.2.2 **Noise sidebands.** 7 dB/Hz minimum when a 1 Hz bandwidth is selected.
- 3.2.3 **Spurious responses.** 80 dB below the input reference level.
- 3.2.4 **Power line-related spurious responses.** 80 dB below the input reference and no greater than 0.1 μ V.

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3.2.5 Overload indicator. An input overload indication shall be provided.

3.2.6 Internal calibrator. An internal calibration signal shall be provided to verify the full scale amplitude and frequency indication.

3.3 Sweep characteristics.

3.3.1 Linear frequency span. Selectable from 50 Hz/div to 50 kHz/div.

3.3.2 Linear sweep time. Selectable from 0.1 s/div to 2000 s/div.

3.3.3 Sweep linearity. $\pm 1\%$.

3.3.4 Log sweep. Frequency span: 20 Hz to 43 kHz. Sweep time: 5s.

3.3.5 Sweep modes.

a. Repetitive: Continuously sweeps the specified band.

b. Single: Sweep occurs one time.

c. Reset: Sets to the start frequency of the sweep.

d. Manual: Sweep position is controlled by the operator.

e. Zero scan: Displays the time varying signal at the center or start frequency within the selected bandwidth.

3.3.6 Sweep error indicator. An indication of a sweep speed that is too fast to capture the full response shall be provided.

3.4 Input characteristics.

3.4.1 Impedance. 1 megohm or greater shunted by 40 pF or less for unbalanced circuits, 600 ohms $\pm 10\%$ for balanced circuits.

3.4.2 Maximum input. ± 100 Vdc, 50 Vrms.

3.5 Output characteristics.

3.5.1 Tracking generator. A tracking generator output shall be provided.

3.5.2 X-Y recorder. An X-Y recorder output and pen lift control shall be provided.

3.6 Digital storage. The equipment shall be provided with digital storage capable of concurrently displaying stored spectrum and input spectrum.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 40W.

5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

Configuration A: AN1KL-D
 Configuration B: AN1KM-D

ANALYZER, SPECTRUM

1. **GENERAL.** Configuration A: This procurement requires a portable spectrum analyzer. Configuration B: This procurement requires a portable spectrum analyzer with a tracking generator.
2. **CLASSIFICATION.** Type III, Class 3, Style C, and Color R in accordance with MIL-T-28800 for shipboard applications. The tilt-bail handle requirement is invoked. When an external tracking generator is provided for Configuration B, the generator shall meet the Type III, Class 5, Style E, and Color R requirements of MIL-T-28800.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of spectrum analysis within the following minimum specifications.
 - 3.1 **Frequency specifications.**
 - 3.1.1 **Center frequency range.** 100 Hz to 1.8 GHz.
 - 3.1.2 **Center frequency accuracy.** $\pm[20\%$ of span/div or resolution bandwidth, whichever is greater, $+ (\text{center frequency} \times 0.000015) + 25$ Hz for spans ≤ 2 MHz, and $+ 15$ kHz for spans > 2 MHz].
 - 3.1.3 **Center frequency tuning resolution.** 1% or less of the selected span.
 - 3.1.4 **Frequency stability.** After a 1 hour warmup, the frequency drift shall not exceed 50 Hz per minute of sweep time for spans of 100 kHz or less.
 - 3.1.5 **Frequency readout resolution.** 1% or less of selected resolution bandwidth or 1 Hz, whichever is greater. This resolution may be provided by the signal counter (see 3.1.7.1).
 - 3.1.6 **Delta frequency.** A mode of operation shall be provided wherein the frequency readout indicates the frequency difference of two independently variable markers.
 - 3.1.6.1 **Delta frequency readout resolution.** 1 Hz or less. This resolution may be provided by the signal counter (see 3.1.7.1).
 - 3.1.6.2 **Delta frequency accuracy.** $\pm 1\%$ of total span.
 - 3.1.7 **Signal counter.** The equipment shall be capable of counting signals within the specified frequency range. Accuracy of indication: $\pm[(\text{marker frequency} \times \text{reference frequency error}) + 50 \text{ Hz} + 1 \text{ LSD}]$. Reference frequency error: $1.5 \times 10E-5$ or less.
 - 3.1.7.1 **Signal counter resolution.** Selectable from 1 Hz to 1 MHz.
 - 3.2 **Span modes.** A mode shall be provided wherein the full specified frequency range for each band is displayed. A mode shall be provided wherein the CRT horizontal axis is calibrated in time instead of frequency. A method for selecting spans shall be provided wherein the total span of the horizontal graticule area shall be selectable from 100 Hz to 1 GHz typically with seven ranges in a 1,2,5 sequence.
 - 3.2.1 **Span to resolution bandwidth ratio.** Selection of the total span and resolution bandwidth shall be such that a total span to resolution bandwidth ratio of 10:1 is achievable for any resolution bandwidth setting. This may be accomplished by manual or automatic means.

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3.2.2 Span accuracy. $\pm 5\%$ of the selected span over the center 80% of the graticule area.

3.3 Residual FM. 5 Hz peak-to-peak maximum in 20 ms for zero span.

3.4 Resolution bandwidth. Selectable from 10 Hz to 1 MHz.

3.4.1 Resolution bandwidth accuracy. $\pm 20\%$ of the selected bandwidth. The 1 MHz bandwidth shall be within $\pm 25\%$ and the 10 Hz or less bandwidths shall be within $\pm 30\%$.

3.4.2 Video filter. Selectable band-stop filters shall be provided within a frequency range of 1 Hz to 3 kHz.

3.5 Input specifications.

3.5.1 Input impedance. 50 ohms nominal. 1.5:1 maximum VSWR with 10 dB or more input attenuation selected.

3.5.2 Maximum input. 30 dBm continuous and 75W peak for 1 μ s or greater with 20 dB or more attenuation selected. Input connector shall be type N(f).

3.6 Display dynamic range. 80 dB at 10 dB/div, 16 dB at 2 dB/div, and eight divisions in the linear mode.

3.6.1 Display accuracy. 0.1 dB per dB with a maximum of ± 2 dB in the log mode, and $\pm 5\%$ in the linear mode.

3.6.2 Display flatness. When measured with 10 dB of selected input attenuation and referenced to the internal calibrator frequency, the displayed flatness shall not exceed ± 1.5 dB.

3.7 Distortion.

3.7.1 Residual noise. Spurious responses with no signal input:

- a. 100 Hz to 500 Hz: -65 dBm.
- b. 500 Hz to 200 kHz: -85 dBm or less.
- c. 200 kHz to 1.8 GHz: -90 dBm or less.

3.7.2 Harmonic distortion. At least 60 dB below the carrier for a signal mixer level of -40 dBm.

3.7.3 Third-order intermodulation products. Signal input mixer level of -30 dBm:

- a. 100 Hz to 10 MHz: at least 64 dB below the carrier.
- b. 10 MHz to 1.8 GHz: at least 70 dB below the carrier.

3.8 Shape factor. 15:1 measured between the 3 and 60 dB points.

3.9 Noise sidebands. The noise sidebands shall be at least -100 dBc/Hz at offsets from a 1 GHz carrier of 30 x resolution bandwidth with resolution bandwidths of 1 kHz or greater.

3.10 Vertical display modes. Log 10 dB/div, log 2 dB/div, and linear V.

3.10.1 Input attenuator. 0 dB to 60 dB in 10 dB steps. Attenuator accuracy: ± 1.8 dB.

3.10.2 Reference level range. -117 dBm to 30 dBm for log modes and 2.24 μ V to 7V in the linear mode. The reference level shall be adjustable in increments of 0.25 dB or less for the log mode and to one division or less in the linear mode.

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- 3.10.3 IF gain. ± 1 dB for any 10 dB change in the reference level.
- 3.11 Sweep time. 200 μ s to 50s in zero span mode. Accuracy: $\pm 20\%$ of setting. Internal and auto sweep modes shall be provided.
- 3.12 Trigger. Internal, external, free run, and single sweep triggering modes shall be provided.
- 3.13 Digital storage. Digital storage shall be provided with selectable modes that compare and subtract two signals, and save maximum signal values and noise-average spectral displays. The digital storage function shall be capable of storing and displaying at least eight spectrums including the readout measurement parameters. When batteries are required for digital storage circuitry, they shall have a useful life of at least 12 months under normal operating conditions within the operating temperature range.
- 3.14 Markers. The equipment shall provide frequency and amplitude markers using one marker for absolute measurements and two markers for relative measurements. Marker positioning will provide a readout of frequency and amplitude of any point, or the difference in amplitude or frequency between two points, along a displayed spectrum.
- 3.14.1 Marker amplitude accuracy. At the reference level, the marker amplitude uncertainty shall not exceed ± 2 dB in log mode and $\pm 5\%$ in linear mode. The total uncertainty shall degrade to no more than 6.8 dB at maximum deviation from the reference level.
- 3.15 CRT specifications. A display with an internal graticule of at least 8 x 10 divisions shall be provided. The display shall provide a readout of center frequency, span or span/div, resolution bandwidth, vertical scale factor, reference level, marker readout of frequency and amplitude, video filter selection, and RF attenuation. The CRT display area shall be at least 6.5 cm (2.56 in) high by 7.5 cm (2.95 in) wide.
- 3.16 Outputs. Outputs for an internal calibrator signal, an X-Y recorder, a penlift control, and a tracking generator shall be provided.
- 3.17 Reference input. Frequency: 10 MHz. Amplitude range: -2 to 10 dBm.
- 3.18 Calibrator signal accuracies. ± 0.3 dB for amplitude, ± 10 ppm for frequency.
- 3.19 Remote operation. Digital interface in accordance with MIL-T-28800.
- 3.20 Tracking generator. Configuration B equipment shall be provided with a tracking generator that meets the following specifications.
- 3.20.1 Frequency range. 300 kHz to 1.8 GHz.
- 3.20.2 Output level. 0 dBm.
- 3.20.3 Attenuation range. 60 dB in 10 and 1 dB steps.
- 3.20.4 Flatness. ± 2.25 dB.
- 3.20.5 Dynamic Range. 95 dB.
- 3.20.6 Residual FM. 50 Hz peak-to-peak.
- 3.20.7 Output impedance. 50 ohms nominal.
- 3.20.8 Spurious outputs. -20 dBc.
- 3.20.9 Accessories. All accessories necessary for proper tracking generator operation shall be supplied with the equipment.

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4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Maximum power consumption: 250W.

5. **WEIGHT.** Configuration A: 20 kg (44 lb) maximum. Configuration B with an internal tracking generator: 21 kg (46 lb) maximum. When an external tracking generator is provided for Configuration B, neither unit shall exceed 20 kg (44 lb).

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APPENDIX D

AN1NZ-D

ANALYZER, SPECTRUM

1. **GENERAL.** This procurement requires a portable spectrum analyzer. The equipment shall be capable of IEEE Std 488-1978 digital bus control and data transfer, digital storage, and marker-aided relative and absolute frequency and amplitude measurements of microwave and RF signals.

2. **CLASSIFICATION.** Type III, Class 3, Style C, and Color R in accordance with MIL-T-28800 for shipboard applications with the following exceptions:

- a. The digital readout shall be designed for use at arms length.
- b. The tilt-bail handle requirement is invoked.

3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of spectrum analysis within the following minimum specifications. When specified, N is the number of the harmonic component of the local oscillator.

3.1 Frequency specifications.

3.1.1 Frequency range. 50 kHz to 40 GHz.

3.1.2 Frequency accuracy. $\pm[5\% \text{ of span} + 15\% \text{ of resolution bandwidth} + 250 \text{ Hz} + (\text{center frequency} \times 0.000015)]$.

3.1.3 Frequency stability. 300 Hz X N drift per minute of sweep time for spans of 1 MHz or less.

3.1.4 Frequency readout resolution. 1% or less of selected span or 1 kHz, whichever is greater.

3.1.5 Delta frequency range. A mode of operation shall be provided wherein the frequency readout indicates the frequency difference of two independently variable markers.

3.1.5.1 Delta frequency readout resolution. 100 Hz or less.

3.1.5.2 Delta frequency accuracy. $\pm 1\%$ of total span.

3.1.6 Center frequency tuning resolution. 0.1 divisions or less of the selected span or 200 Hz, whichever is greater.

3.1.7 Signal counter. The equipment shall be capable of counting signals within the frequency range specified in 3.1.1. Accuracy of indication: $\pm[(\text{marker frequency} \times \text{reference frequency error}) + (50 \text{ Hz} \times N) + 1 \text{ LSD}]$. Reference frequency error: 1.5×10^{-5} or less.

3.1.7.1 Signal counter resolution. Selectable from 1 Hz to 1 MHz.

3.2 Span modes. A mode shall be provided wherein the full specified frequency range for each band is displayed. A mode shall be provided wherein the CRT horizontal axis is calibrated in time instead of frequency. A method for selecting spans shall be provided wherein the total span of the horizontal graticule area shall be selectable from 2.5 kHz to 1 GHz typically with seven ranges in a 1,2,5 sequence.

3.2.1 Span to resolution bandwidth ratio. The selecting of the total span and resolution bandwidth shall be such that a total span to resolution bandwidth ratio of 10:1 is achievable for any span setting. This may be accomplished by manual or automatic means.

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3.2.2 Span accuracy. $\pm 5\%$ of the selected span over the center 80% of the graticule area.

3.3 Residual FM. 50 Hz x N peak-to-peak maximum in 20 ms for zero span.

3.4 Resolution bandwidth. Selectable from 100 Hz to 1 MHz.

3.4.1 Resolution bandwidth accuracy. $\pm 20\%$ of the selected bandwidth. The 1 MHz bandwidth shall be within $\pm 25\%$ and the 100 Hz or less bandwidths shall be within $\pm 30\%$.

3.4.2 Video filter. Selectable band-stop filters shall be provided within a frequency range of 300 Hz or less to at least 3 kHz.

3.5 Input specifications.

3.5.1 Input impedance. 50 ohms nominal. With 10 dB or more input attenuation selected, the VSWR shall not exceed 2.3:1 for frequencies to at least 18 GHz.

3.5.2 Maximum input. 30 dBm continuous and 75W peak when using Type N connectors with 20 dB or more attenuation selected. The maximum input for waveguide: 20 dBm continuous.

3.6 Display dynamic range. 80 dB at 10 dB/div, 16 dB at 2 dB/div, and eight divisions in the linear mode.

3.6.1 Display accuracy. ± 2 dB at 10 dB/div, ± 1.5 dB at 2 dB/div, and $\pm 5\%$ in the linear mode.

3.6.2 Display flatness. When measured with 10 dB of selected input attenuation and referenced to the internal calibrator frequency, the displayed flatness shall be ± 6 dB for frequencies to at least 18 GHz.

3.7 Spurious response specifications.

3.7.1 Residual. Spurious response: -90 dBm with no input signal applied from 0 to 6.46 GHz. The response shall degrade to no worse than -70 dBm at 26.5 GHz.

3.7.2 Distortion. Spurious harmonic distortion shall be at least 60 dB below the carrier for a signal input mixer level of -40 dBm or less up to 18 GHz. Third-order intermodulation products shall be at least 70 dB below the carrier for a signal input mixer level of -30 dBm or less.

3.8 Input noise sensitivity. -90 dBm or less when a 100 Hz resolution bandwidth and 0 dB attenuation are selected.

3.9 Shape factor. 15:1 or less at the 3 dB and 60 dB points.

3.10 Noise sidebands. The noise sidebands shall be at least -100 to 20 Log N dBc/Hz at offsets from the carrier of 30 x resolution bandwidth with resolution bandwidths of 1 kHz or greater.

3.11 Vertical display modes. Log 10 dB/div, Log 2 dB/div, and Linear V.

3.11.1 Input attenuator range. 0 dB to 60 dB in 10 dB steps. Attenuator accuracy: ± 1.8 dB per 10 dB steps to a maximum of 3.5 dB.

3.11.2 Reference level range. -117 dBm to 30 dBm for log modes and 2.24 μ V to 7V in the linear mode. The reference level shall be adjustable in increments of 0.25 dB or less for the log mode and to one division or less in the linear mode.

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3.11.3 IF gain variation. ± 1 dB maximum for any 10 dB change in the reference level.

3.12 Sweep. Sweep time: selectable from 50 μ s to 50s in zero span mode. Accuracy: $\pm 20\%$ of setting. Internal and auto sweep modes shall be provided.

3.13 Trigger. Internal, external, free run, and single sweep triggering modes shall be provided.

3.14 Digital storage. Digital storage shall be provided with selectable modes that compare and subtract two signals, and save maximum signal values and noise-average spectral displays. The digital storage function shall be capable of storing and displaying at least eight spectrums including the readout measurement parameters. When batteries are required for digital storage circuitry, they shall have a useful life of at least 12 months under normal operating conditions within the operating temperature range.

3.15 Markers. The equipment shall provide frequency and amplitude markers using one marker for absolute measurements and two markers for relative measurements. Marker positioning will provide a readout of frequency and amplitude of any point, or the difference in amplitude or frequency between two points, along a displayed spectrum.

3.16 CRT specifications. A display with an internal graticule of at least 8 x 10 divisions shall be provided. The display shall provide a readout of center frequency, span or span/div, resolution bandwidth, vertical scale factor, reference level, marker readout of frequency and amplitude, video filter selection, and rf attenuation. The display area shall be at least 6.5 cm (2.6 in) high by 7.5 cm (3 in) wide.

3.17 Outputs. Outputs for an internal calibrator signal, an X-Y recorder, a pen-lift control, and a tracking generator shall be provided. A local oscillator and mixer outputs shall also be provided.

3.18 Reference input. Frequency: 10 MHz. Amplitude range: -2 to 10 dBm.

3.19 Calibrator signal accuracies. ± 0.3 dB for amplitude, ± 10 ppm for frequency.

3.20 Remote operation. Digital interface in accordance with MIL-T-28800.

3.21 Internal preselection. Internal preselection shall be provided.

3.22 Mixer waveguide flanges. UG-595/U and UG-599/U.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Maximum power consumption: 250W.

5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

AN3RT-B

ANALYZER, SPECTRUM, REAL TIME

1. **GENERAL.** This procurement requires a spectrum analyzer with the capability of measuring absolute amplitude and frequency characteristics of audio and RF signals.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. The convertible/rackmountable requirement is invoked.

3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of spectrum analysis within the minimum specifications contained below.

3.1 Frequency specifications.

a. Real time: 10 Hz to 3 kHz.

b. Spectrum analysis: 10 Hz to 100 kHz.

3.1.1 Frequency accuracy. 0.1% FS.

3.1.2 Frequency resolution.

a. Normal: 400 lines.

b. Expanded (zoom): At least 32 times. Zoom operation permits selected resolution expansion of the baseband resolution around a desired frequency.

3.1.3 Filters.

a. Anti-aliasing: 96 dB/octave rolloff.

b. 1/3 octave: Shall meet ANSI S1.11-1966 Class III.

3.2 Input amplitude specifications.

3.2.1 Input amplitude range. 15 mVrms to 10 Vrms. Accuracy: $\pm 5\%$ FS.

3.2.2 Maximum input without damage. 30 Vrms or greater.

3.2.3 Input RC. 1 megohm or greater shunted by 200 pF or less.

3.2.4 Dynamic range. 70 dB.

3.2.5 Frequency response. ± 1 dB or less.

3.2.6 Input overload indicator. The overload indicator threshold shall be between 95% and 110% FS.

3.3 Memory. The equipment shall be provided with a means of storing and recalling up to 32 signal traces.

3.4 Outputs. The equipment shall be provided with outputs for a plotter or X-Y recorder.

3.5 Handle. A tilt bail handle in accordance with MIL-T-28800 may be provided.

3.6 Display dimensions. 101.6 mm (4 in) by 69.8 mm (2-3/4 in) minimum.

3.7 Rackmounting. The equipment shall be contained in a Style E enclosure for portability and shall be provided with a conversion kit which will allow

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rackmounting in accordance with the convertible/rackmountable requirements of MIL-T-28800.

3.8 Digital interface. A digital interface is required in accordance with MIL-T-28800.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 350W.

5. WEIGHT. 20 kg (44 lb) maximum.

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AN5NN-A

ANALYZER, WAVE

1. **GENERAL.** This procurement requires a wave analyzer that resolves and measures the amplitude and frequency of spectral components.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of performing spectral analysis within the minimum specifications identified below.
 - 3.1 **Frequency specifications.**
 - 3.1.1 **Frequency range.** 15 Hz to 50 kHz.
 - 3.1.2 **Frequency display resolution.** 1 Hz or less.
 - 3.1.3 **Frequency accuracy.** ± 3.5 Hz.
 - 3.1.4 **Frequency stability.** ± 10 Hz per hour after a warm-up time of not more than 1 hour.
 - 3.1.5 **Automatic frequency control.** The automatic frequency control (AFC) hold-in range shall be at least ± 800 Hz. An indication of an unlocked condition shall be provided.
 - 3.2 **Amplitude specifications.**
 - 3.2.1 **Amplitude range.** 100 nV to 30 Vrms.
 - 3.2.2 **Amplitude display.** Digital or mirror-backed analog meter.
 - 3.2.3 **Amplitude accuracy.** Log: ± 2 dB. Linear: $\pm 4\%$ of indication.
 - 3.2.4 **Dynamic range.** 80 dB minimum. An indication of input amplifier overload shall be provided.
 - 3.2.5 **Noise sidebands.** 70 dB down 10 bandwidths away from the CW input signal.
 - 3.2.6 **Calibrator.** An internal calibrator capable of verifying the amplitude accuracy to at least $\pm 1.5\%$ shall be provided.
 - 3.3 **Sweep specifications.**
 - 3.3.1 **Resolution bandwidth.** Selectable from 3 Hz to 300 Hz.
 - 3.3.2 **Scan width.** Selectable from 50 Hz to 50 kHz.
 - 3.3.3 **Sweep time.** Selectable from 0.1s to 2,000s.
 - 3.3.4 **Sweep modes.** Repetitive, triggered single sweep, and manual sweep modes shall be provided.
 - 3.3.5 **Sweep error light.** A light that indicates when a sweep rate is too fast to capture the full response shall be provided.
 - 3.4 **Input specifications.**
 - 3.4.1 **Input RC.** 1 megohm or greater shunted by 40 pF or less.
 - 3.4.2 **Maximum input without damage.**

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- a. ± 100 Vdc or Vrms on the 0.2V and higher ranges.
 - b. ± 50 Vdc or Vrms on the 0.1V and lower ranges.
- 3.4.3 Input connector. Female banana.
- 3.5 Outputs.
- a. Tracking generator: An output for use with a compatible tracking generator.
 - b. X-Y recorder: Outputs shall include vertical and horizontal drives. Pen lift control shall be provided.
4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 12W.
5. WEIGHT. 20 kg (44 lb) maximum.

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CONFIGURATION A: AT4AN-A
 CONFIGURATION B: AT4UN-A
 CONFIGURATION C: AT4GN-A
 CONFIGURATION D: AT4NN-A
 CONFIGURATION E: AT4KN-A
 CONFIGURATION F: AT4RQ-A

ATTENUATOR, STEP

1. **GENERAL.** This procurement requires a step attenuator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified in table 1.

TABLE I. Specifications

	A	B	C	D	E	F
Frequency Range	dc-1 GHz	dc-1 GHz	dc-18 GHz	dc-1.5 GHz	dc-0.5 GHz	dc-0.01 GHz
Attenuation Range	0-12 dB 1 dB step	0-120 dB 10 dB step	0-69 dB 1 dB step	0-101 dB 1 dB step	0-100 dB 1 dB step	0-110 dB 1 dB step
Maximum SWR	1.5	1.5	1.6	1.5	1.5	---
Accuracy	± 0.35 dB	± 3 dB	± 1.9 dB	± 0.5 dB	± 0.25 dB	± 0.5 dB
Continuous Power Rating	0.5W	0.5W	2W	3W	0.5W	1W
Impedance (ohms)	50	50	50	75	90	600
Connector	BNC(f)	BNC(f)	N(f-m)	BNC(f)	BNC(f)	Binding Posts

4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** 1.4 kg (3 lb) maximum.

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AT6TN-A

ATTENUATOR, VARIABLE, COAXIAL

1. **GENERAL.** This procurement requires a variable, coaxial attenuator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Frequency range.** 10 MHz to 4 GHz.
 - 3.2 **Attenuation range.** -9 to 120 dB.
 - 3.3 **Attenuation accuracy.** $\pm(0.015 \times \text{difference in scale readings} + 0.2)$ dB.
 - 3.4 **Insertion loss.** 30.4 ± 2 dB at 0 dB setting, 17 ± 2 dB at -9 dB setting.
 - 3.5 **Maximum SWR.** 1.12.
 - 3.6 **Continuous power rating.** A. input power: 300W at 1 GHz
B. output power: 0.5W
 - 3.7 **Connectors.** G874.
 - 3.8 **Nominal impedance.** 50 ohms.
4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** 0.6 (1.3 lb) maximum.

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APPENDIX D

BR3FN-B

BRIDGE, IMPEDANCE, RF

1. **GENERAL.** This procurement requires a thru-line impedance bridge designed for the measurement of operating impedances in HF antenna networks.
2. **CLASSIFICATION.** Type III, Class 5, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of measuring resistance and reactance within the frequency range and to the power level specified below.
 - 3.1 **Frequency range.** 2 MHz to 30 MHz.
 - 3.2 **Reactance range.** -600 to +600 ohms. Accuracy: $\pm(5\%$ of indication + 1 ohm).
 - 3.3 **Resistance range.** -400 to +400 ohms. Accuracy: $\pm(5\%$ of indication + 1 ohm).
 - 3.4 **Power level.** The maximum thru-line power capability shall be at least 1 kW with a VSWR not to exceed 3:1.
 - 3.5 **Null indicator.** The equipment shall be provided with an internal RF detector, sensitivity control, and null indicating meter. A differential meter amplifier shall provide increased meter sensitivity for low-level signals.
 - 3.6 **Output.** An output connector shall be provided for use with an external detector.
4. **POWER SOURCE.** MIL-T-28800 internal dc power source requirements are invoked. The batteries shall be of a commercially available type and provide 400 hours of operation over a 12-month period before replacement. The nominal power source requirements are not invoked.
5. **WEIGHT:** 20 kg (44 lb) maximum.

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BROFW-D

BRIDGE, RLC

1. **GENERAL.** This procurement requires a portable, self-contained, solid-state capacitance meter capable of measuring capacitance values, dissipation factors, and dc voltage.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be equipped with an internal test generator, an internal dc bias supply, and a front-panel indicator for determining capacitance, dissipation factor, and bias voltage values. Measurement capabilities shall be within the minimum ranges and accuracies specified below. Accuracy statements are specified at 23°C. All adjacent ranges shall overlap by at least 10%.

3.1 **Capacitance.** Range: 10 nF to 0.1F.

3.1.1 **Capacitance measurement accuracy.** See table I.

TABLE I. Capacitance Accuracy

<u>RANGE</u>	<u>% OF READING</u>	<u>+</u>	<u>% FS</u>
10 nF	1.0 + 0.9 X D rdg		0.2
100 nF	0.5 + 0.5 X D rdg		0.1
1 uF to 1 mF	0.4 + 0.5 X D rdg		0.05
10 mF	1.0 + 0.5 X D rdg		0.05
100 mF	1.5 + 0.5 X D rdg		0.5
0.1F	2.5 + 0.5 X D rdg		1.0

D rdg: reading of dissipation factor

3.1.1.1 **Temperature coefficient, capacitance.** ± 5 ppm/°C maximum, referenced to 23°C.

3.2 **Dissipation factor.** Range: 1 to 10. Resolution: 0.01.

3.2.1 **Dissipation factor accuracy.** See table II.

TABLE II. Dissipation Factor Accuracy

<u>RANGE</u>	<u>% OF READING</u>	<u>+</u>	<u>% FS</u>
10 nF	1.5 + 0.5 X DF rdg	0.2 X CFS/C rdg + 0.3	
100 nF to 1 mF	1.5 + 0.2 X DF rdg	0.2 X CFS/C rdg + 0.3	
10 mF	1.5 + 0.2 X DF rdg	0.2 X CFS/C rdg + 0.5	
100 mF, 1F	1.5 + 0.2 X DF rdg	0.2 X CFS/C rdg + 3.0	

DF rdg: indicated dissipation factor
 CFS: full scale of C range setting
 C rdg: indicated capacitance

3.2.1.1 **Temperature coefficient, dissipation factor.** 2 ppm/°C + ((3 ppm/°C) X (frequency in kHz)) maximum, referenced to 23°C.

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3.3 Bias voltage. The equipment shall be provided with an internal dc bias voltage source of at least 2 volts. The capability of operating with an external source of at least 50 Vdc shall be provided.

3.4 Internal test generator. Frequency: 120 Hz. Amplitude: 1.5 Vrms maximum.

4. ACCESSORIES. The equipment shall be provided with precision test lead sets capable of all configurations required for each measurement function specified above.

5. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 70W.

6. WEIGHT. 10 kg (22 lb) maximum.

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BROMN-C

BRIDGE, RLC

1. **GENERAL.** This procurement requires a self-contained analog or digitally indicating impedance bridge capable of making precision measurements of resistance, capacitance, and inductance.
2. **CLASSIFICATION.** Type III, Class 6, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of resistance, capacitance, and inductance measurements as specified below. D is defined as dissipation factor and Q as storage factor.
 - 3.1 **Resistance measurement.** Range: 10 milliohms to 10 megohms. Resolution: 0.01% of full scale. Accuracy: $\pm(0.1\% \text{ of reading} + 0.01\% \text{ of full scale})$.
 - 3.2 **Capacitance measurement.** Range: 10 pF to 1,000 uF. Resolution: 0.01% of full scale. Accuracy: $\pm(0.2\% \text{ of reading} + 0.01\% \text{ of full scale} + (1.0\% \times D))$.
 - 3.3 **Inductance measurement.** Range: 1,000 uH to 1,000H. Resolution: 0.01% of full scale. Accuracy: $\pm(0.2\% + 0.01\% \text{ of full scale} + (1.2\%/Q))$.
 - 3.4 **Test lead terminals.** The test lead terminals shall be isolated from both earth ground and the instrument chassis.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 50W.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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BR2NN-D

BRIDGE, DECADE, SYNCHRO/RESOLVER

1. **GENERAL.** This procurement requires a synchro/resolver bridge in a rack-mount configuration for use with 400 Hz signals.
2. **CLASSIFICATION.** Type III, Class 5, Style F, and Color R in accordance with MIL-T-28800 for shipboard applications except power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring and simulating phase-oriented voltage signals used in synchro and servo systems. A display in terms of degree angle displacement within the minimum ranges, accuracies, and sensitivities specified below shall be provided.
 - 3.1 **Angular range.** 0° to 360°.
 - 3.1.1 **Angular accuracy.** ± 2 seconds of arc at 400 Hz.
 - 3.1.2 **Angular resolution.** 0.0001°.
 - 3.2 **Frequency.** 400 Hz $\pm 5\%$.
 - 3.3 **Maximum input voltage.** 150 Vrms, without damage.
 - 3.4 **Error voltage gradient.** 0.55 x Es uV/arc second minimum. Accuracy: $\pm 1\%$ (Es is the synchro error voltage).
 - 3.5 **Input impedance.** 0.5 megohm or greater in synchro mode, 0.75 megohm $\pm 10\%$ in resolver mode.
 - 3.6 **Transformation ratio.** 1:1 $\pm 1\%$.
 - 3.7 **Isolation.** The equipment inputs and outputs shall be isolated from each other and from the case ground and shall be capable of withstanding a 1 kV peak potential difference between isolated windings and the case. Electrostatic shielding shall be provided between primary and secondary windings. Sine and cosine outputs shall be electrically isolated for operation in the resolver mode.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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TS9NN-D

CALIBRATOR, RANGE, RADAR

1. GENERAL. This procurement requires a solid-state, radar range calibrator.
2. CLASSIFICATION. Type III, Class 5, Style C, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. OPERATIONAL REQUIREMENTS. The equipment shall be capable of providing marker pulses at preselected spacings for introduction into the video line of a radar display system within the minimum ranges and accuracies specified below.
 - 3.1 Marker output.
 - 3.1.1 Ranges. 1,000, 2,000, 10,000, 20,000, and 100,000 yds.
 - 3.1.2 Accuracy. $\pm 0.01\%$ of range.
 - 3.1.3 Amplitude. Variable from 0 to $\pm 3.5V$ into 75 ohms.
 - 3.1.4 Pulse width. Continuously variable from 0.1 us to 2 us into 75 ohms.
 - 3.2 Trigger output.
 - 3.2.1 Repetition rate. Variable from 50 pps to 5,000 pps.
 - 3.2.2 Trigger amplitude. Variable from $\pm 1V$ to $\pm 10V$ into 75 ohms.
 - 3.2.3 Trigger delay. Variable from 0 to ± 2 us.
 - 3.2.4 Trigger pulse width. 0.3 us ± 0.05 us.
 - 3.3 Source impedance. Switch selectable 75 ohm and 1,000 ohm loads for trigger and marker outputs.
 - 3.4 External trigger input. Required amplitude range: 2.5V to 20V into 75 ohms.
 - 3.5 Connectors. BNC(f).
4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 5W.
5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

CPLMN-A

CAPACITOR, DECADE

1. **GENERAL.** This procurement requires a decade capacitor.
2. **CLASSIFICATION.** Type III, Class 5, Style E and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Capacitance range.** 50 pF to 1.1115 uF in 100 pF steps.
 - 3.2 **Accuracy.** $\pm(0.5\% + 5 \text{ pF})$ at 1 kHz.
 - 3.3 **Maximum voltage.** 500V peak for frequencies up to 30 kHz.
 - 3.4 **Frequency characteristics.** The effective capacitance shall not deviate from the nominal capacitance by more than 1% from 1 to 30 kHz.
 - 3.5 **Terminals.** Four binding posts with grounding links.
4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** 4.6 kg (10 lb) maximum.

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COOFM-E

COUNTER, ELECTRONIC

1. **GENERAL.** This procurement requires a dc to 500 MHz, solid-state, universal electronic counter capable of IEEE 488-1978 digital bus operation.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of frequency, period, period average, time interval, and ratio measurements as specified below.
 - 3.1 **Time base.** Frequency: 10 MHz.
 - 3.1.1 **Aging rate.** $\pm 5 \times 10^{-10}$ /day after a 24-hour stabilization period.
 - 3.1.2 **Oscillator adjustment range.** ± 10 Hz.
 - 3.1.3 **External standard input.** The equipment shall be capable of operation from an external 10 MHz frequency standard with an amplitude of 1 V_{rms} into 50 ohms. The load RC at the external standard input port shall be 1 kilohm or more paralleled by 30 pF or less.
 - 3.2 **Display.**
 - 3.2.1 **Measurement units.** MHz, kHz, Hz, s, ms, and us.
 - 3.3 **Gate lamp.** A front-panel display device shall indicate gate operation.
 - 3.4 **Hold.** The equipment shall provide a means of holding the displayed reading indefinitely.
 - 3.5 **Reset.** A manual reset control that initiates a new measurement cycle shall be provided.
 - 3.6 **Self-check.** A self-check function that verifies operation of the frequency measurement mode shall be provided.
 - 3.7 **Input characteristics.** Three input channels shall be provided.
 - 3.7.1 **Input impedance.** Channels A and B: 1 megohm or greater. Channel C: 50 ohms nominal.
 - 3.7.2 **Common input.** Channels A and B shall have provisions for selection of common or separate inputs. When common input is selected, a signal applied to one channel shall be internally routed to both channels.
 - 3.7.3 **Attenuators.** Channels A and B shall each be provided with selection of X1 and X10 attenuation.
 - 3.7.4 **Sensitivity.** The channel C sensitivity shall be 15 mV_{rms} or less from 90 to 500 MHz. The channels A and B sensitivity shall be as follows:
 - a. 25 mV_{rms} or less up to 35 MHz.
 - b. 50 mV_{rms} or less from 35 MHz to 100 MHz.
 - c. 140 mV peak-to-peak or less for pulse measurement.
 - 3.7.5 **Damage level.** See table I.

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TABLE I. Damage level

<u>Channel</u>	<u>Attenuator Setting</u>	<u>Frequency Range</u>	<u>Input Voltage</u>
A and B	X1	0 to 3.5 kHz	200V (dc + peak ac)
		3.5 to 100 kHz	$5 \times 10^5 \text{ Vrms}$ Hz
		100 kHz to 100 MHz	5 Vrms
A and B	X10	0 to 35 kHz	200V (dc + peak ac)
		35 kHz to 1 MHz	$5 \times 10^6 \text{ Vrms}$ Hz
		1 to 100 MHz	50 Vrms
C	X1	90 to 500 MHz	5 Vrms

3.7.6 Protection. Channel C input shall be protected from input overloads. Protective devices designed to permanently open the circuit to comply with this requirement shall be replaceable from the front panel.

3.7.7 Coupling. Channels A and B: ac and dc. Channel C: ac.

3.7.8 Triggering.

3.7.8.1 Trigger slope. Channels A and B shall have independent selection of triggering for both the positive and negative slopes of the input signal.

3.7.8.2 Trigger level. Channels A and B shall have independent selection of any trigger level $\pm 2.5V$ times the attenuator setting. Channel C triggering shall occur at 0V nominal. An indication of the trigger points shall be provided.

3.7.8.3 Trigger error. The maximum allowable trigger error shall be less than 2 times the peak noise voltage divided by the signal slew rate (in volts/second).

3.7.9 Arming. Operator arming capability shall be provided for any measurement. When arming is activated, the measurement channel (A, B, or C) shall be allowed to initiate the measurement only upon application of an arming signal to the arm input. Removal of the arming signal shall not hinder the measurement in progress.

3.8 Frequency characteristics. The equipment shall automatically measure and directly indicate the signal frequency. The equipment shall properly measure sine wave and pulse signals that have a pulse width of at least 5 ns for channels A and B and at least 1 ns for channel C. The frequency composing a burst signal when the burst length is at least 11 ms for channels A, B, and C shall be directly measurable with no other signal connections to the counter necessary.

3.8.1 Frequency range. Channels A and B: dc to 100 MHz. Channel C: 100 to 500 MHz.

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- 3.8.2 Frequency accuracy. \pm resolution \pm time base error x frequency.
- 3.8.3 Frequency resolution. 0.1 Hz to 1 MHz.
- 3.9 Time interval characteristics. The equipment shall measure and directly indicate the time interval between signals.
- 3.9.1 Time interval range. 0.1 us to 1,000s.
- 3.9.2 Pulse width. 25 ns minimum.
- 3.9.3 Time interval accuracy. \pm resolution \pm time base error \pm trigger timing error.
- 3.9.4 Time interval resolution. 10 ns to 1s.
- 3.10 Time interval average or high resolution characteristics. The equipment shall provide increased resolution for time interval measurements. Averaging may be used to achieve time resolution.
- 3.11 Period characteristics. The equipment shall measure and directly indicate the period and the period average of signals.
- 3.11.1 Period range. 10 ns to 1000s.
- 3.11.2 Period accuracy. The period measurement accuracy shall be within \pm (time base error + resolution) x the period.
- 3.11.3 Period resolution. The period resolution shall be from 10 ns to 1s for a single period and 1 ps to 100 ns for period averaging.
- 3.12 Ratio characteristics. The equipment shall measure and directly indicate the ratio and ratio average of two signals below identified as f1 and f2 where f1 is the signal applied to the decimal counters through channel B and f2 is the frequency used as a gating signal through channel A.
- 3.12.1 Ratio range. 1 Hz to 100 MHz.
- 3.12.2 Ratio accuracy. \pm (least significant digit + B trigger error/gate time) x the ratio.
- 3.13 Output. The equipment shall be provided with a 10 MHz standard frequency output.
- 3.14 Remote operation. Digital interface in accordance with MIL-T-28800.
4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 150W.
- 4.1 Time-base power. The equipment shall be provided with a power control position wherein only the time base oscillator and oven are energized.
5. WEIGHT. 20 kg (44 lb) maximum.

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COOMN-C

COUNTER, ELECTRONIC

1. **GENERAL.** This procurement requires a high accuracy microwave frequency counter with IEEE Std 488.1 bus control and data transfer capability.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL CAPABILITIES.** The equipment shall be capable of measurements within the minimum ranges, specifications and accuracies detailed below.
 - 3.1 **Internal time base.** Frequency: 10 MHz. Adjustment range: $\pm 1 \times 10E-6$. Setability: $1 \times 10E-10$.
 - 3.1.1 **Aging rate.** $\pm 5 \times 10E-10$ /day maximum.
 - 3.1.2 **Stability during power change.** $\pm 1 \times 10E-7$ for 10% change in line voltage.
 - 3.1.3 **Temperature-related stability.** Frequency variation shall not exceed $\pm 3 \times 10E-8$ over the operating temperature range.
 - 3.1.4 **Time base output.** 10 MHz at 1 Vrms minimum into 50 ohms. A rear panel BNC(f) type connector shall be provided.
 - 3.2 **External standard input.** The equipment shall be capable of operating with an external 10 MHz 0.5 Vrms frequency standard.
 - 3.3 **Sample rate.** Variable from 100 ms to 5s and hold.
 - 3.4 **Reset.** A manual reset control shall be provided to initiate a new measurement cycle regardless of sample rate control setting.
 - 3.5 **Self check.** A self check function shall be provided.
 - 3.6 **Input characteristics.** One high impedance and one or more low impedance inputs shall be provided. For the purposes of this description, the high impedance input will be referred to as channel A and the low impedance input(s) as channel B.
 - 3.6.1 **Frequency range.** Channel A: 20 Hz to 20 MHz. Channel B: 10 MHz to 18 GHz.
 - 3.6.2 **Sensitivity.**

TABLE I. Sensitivity

Frequency Range	Minimum Sensitivity
20 Hz - 20 MHz	25 mVrms
20 MHz - 1 GHz	-20 dBm
1 - 12.4 GHz	-30 dBm
12.4 - 18 GHz	-25 dBm

- 3.6.3 **Input impedance.** High impedance input: 1 megohm shunted by 70 pF nominal. Low impedance input: 50 ohms nominal.
- 3.6.4 **Maximum input.** Channel A: 100 Vrms with an allowable derating factor of 6 dB per octave above 1 kHz down to 3.0 Vrms. Channel B: +7 dBm.

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3.6.5 **Amplitude discrimination.** The larger of two or more signals shall be counted when there is at least 20 dB amplitude difference between signals from 500 MHz to 18 GHz.

3.6.6 **FM tolerance.** Maximum deviation: 20 MHz. Maximum rate: 10 MHz.

3.7 **Resolution.** 1 Hz.

3.8 **Measurement accuracy.** ± 1 count \pm time base error.

3.9 **Remote operation.** Digital interface in accordance with MIL-T-28800.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 100W.

5. **WEIGHT.** 15 kg (33 lb) maximum.

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COOMM-C

COUNTER, ELECTRONIC

1. **GENERAL.** This procurement requires a high accuracy microwave frequency counter with IEEE Std 488.1 bus control and data transfer capability.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL CAPABILITIES.** The equipment shall be capable of measurements within the minimum ranges, specifications and accuracies detailed below.

3.1 **Internal time base.** Frequency: 10 MHz. Adjustment range: $\pm 1 \times 10E-6$. Setability: $1 \times 10E-10$.

3.1.1 **Aging rate.** $\pm 5 \times 10E-10$ /day maximum.

3.1.2 **Stability during power change.** $\pm 1 \times 10E-7$ for 10% change in line voltage.

3.1.3 **Temperature-related stability.** Frequency variation shall not exceed $\pm 3 \times 10E-8$ over the operating temperature range.

3.1.4 **Time base output.** 10 MHz at 1 Vrms minimum into 50 ohms. A rear panel BNC(f) type connector shall be provided.

3.2 **External standard input.** The equipment shall be capable of operating with an external 10 MHz 0.5 Vrms frequency standard.

3.3 **Sample rate.** Variable from 100 ms to 5s and hold.

3.4 **Reset.** A manual reset control shall be provided to initiate a new measurement cycle regardless of sample rate control setting.

3.5 **Self check.** A self check function shall be provided.

3.6 **Input characteristics.** One high impedance and one or more low impedance inputs shall be provided. For the purposes of this description, the high impedance input will be referred to as channel A and the low impedance input(s) as channel B.

3.6.1 **Frequency range.** Channel A: 10 Hz to 20 MHz. Channel B: 10 MHz to 40 GHz.

3.6.2 **Sensitivity.**

TABLE I. Sensitivity

Frequency Range	Minimum Sensitivity
20 Hz - 20 MHz	25 mVrms
20 MHz - 1 GHz	-20 dBm
1 - 12.4 GHz	-30 dBm
12.4 - 18 GHz	-25 dBm
18 - 26.5 GHz	-15 dBm
26.5 - 40 GHz	-15 dBm

3.6.3 **Input impedance.** High impedance input: 1 megohm shunted by 70 pF nominal. Low impedance input: 50 ohms nominal.

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3.6.4 **Maximum input.** Channel A: 100 Vrms with an allowable derating factor of 6 dB per octave above 1 kHz down to 3.0 Vrms. Channel B: +7 dBm.

3.6.5 **Amplitude discrimination.** The larger of two or more signals shall be counted when there is at least 20 dB amplitude difference between signals from 500 MHz to 40 GHz.

3.6.6 **FM tolerance.** Maximum deviation: 20 MHz. Maximum rate: 10 MHz.

3.7 **Resolution.** 1 Hz.

3.8 **Measurement accuracy.** ± 1 count \pm time base error.

3.9 **Remote operation.** Digital interface in accordance with MIL-T-28800.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 100W.

5. **WEIGHT.** 15 kg (33 lb) maximum.

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APPENDIX D

COOPC-D

COUNTER, ELECTRONIC

1. **GENERAL.** This procurement requires a solid-state, microwave pulse counter capable of IEEE Std 488-1978 digital bus control and data transfer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of CW and pulsed frequency measurements as specified below.
 - 3.1 **Time base.** Frequency: 10 MHz. Adjustment range: $\pm 1 \times 10E-6$.
 - 3.1.1 **Aging rate.** $\pm 3 \times 10E-7$ per month.
 - 3.1.2 **Stability during power change.** $\pm 1 \times 10E-7$ for a 10% line voltage change from nominal.
 - 3.2 **Display.** An electronic digital display shall be provided.
 - 3.2.1 **Measurement units.** GHz, MHz, and kHz.
 - 3.3 **Gate lamp.** A front-panel display device shall indicate gate operation.
 - 3.4 **Hold.** The equipment shall provide a means of holding the displayed reading indefinitely, independent of the gate time or resolution control.
 - 3.5 **Reset.** A manual reset control that initiates a new measurement cycle shall be provided.
 - 3.6 **Self-check.** A self-check function that verifies operation of the frequency measurement mode shall be provided.
 - 3.7 **Input characteristics.** Impedance: 50 ohms nominal.
 - 3.7.1 **Dynamic range.** -10 dBm to +5 dBm.
 - 3.7.2 **Maximum input.** +25 dBm peak.
 - 3.8 **Frequency characteristics.** The equipment shall automatically measure and directly indicate sine wave and pulsed signal frequencies.
 - 3.8.1 **Frequency range.** 300 MHz to 18 GHz.
 - 3.8.2 **Frequency accuracy.** The frequency measurement accuracy shall be within:
 - a. CW: \pm resolution \pm time base error.
 - b. Pulse: ± 500 kHz or less for 200 ns pulses, improving to ± 150 kHz or less for a 1 μ s, or wider, pulse.
 - 3.8.3 **Frequency resolution.** 10 kHz or less.
 - 3.8.4 **Pulse measurement specifications.** The equipment shall be capable of measuring the frequency of pulse modulated carriers with a PRF in the range of 50 Hz to 11 kHz and a pulse width of 200 ns to 1 μ s.
 - 3.9 **Output.** The equipment shall be provided with a 10.0 MHz reference output.
 - 3.10 **Remote operation.** Digital interface in accordance with MIL-T-28800.

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4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 250W.

4.1 **Time base power.** When equipped with a temperature stabilized oscillator, the equipment shall be provided with a power control position wherein only the time base oscillator and oven are energized.

5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

Configuration A: DCLJJ-A
 Configuration B: DCLNN-A

COUPLER, DIRECTIONAL, COAXIAL

1. **GENERAL.** This procurement requires a coaxial directional coupler.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.

TABLE I. Specifications

<u>Configuration</u>	<u>A</u>	<u>B</u>
Frequency range	0.1-1 GHz	2-18 GHz
Coupling factor	20 \pm 1.5 dB	22 \pm 1 dB
Directivity	30 dB	24 dB
Maximum SWR	1.1	1.4
Maximum line loss	0.8 dB	1.5 dB
Connectors:		
Primary line	N(f, f)	N(m, f,)
Auxiliary	Dual N(f, f)	Single N(f)

- 3.1 Continuous power rating. 50W.
- 3.2 Nominal impedance. 50 ohms.
4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** 1.4 kg (3 lb) maximum.

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APPENDIX D

TE5NN-C

CURVE TRACER

1. **GENERAL.** This procurement requires a general purpose, solid-state curve tracer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of providing voltages, currents, and CRT displays as specified below.
 - 3.1 **Collector supply modes.** AC (line frequency), positive full-wave rectified, negative full-wave rectified, positive dc, and negative dc.
 - 3.2 **Voltage.** The voltage shall be variable to the maximum peak volts selected, and the continuous and peak current shall be in accordance with table I.

TABLE I. Maximum Peak Current

	<u>Max Peak Volts. Open Circuit</u>				
	<u>6.5V</u>	<u>25V</u>	<u>100V</u>	<u>400V</u>	<u>1600V</u>
Continuous Current	10A	2.5A	0.6A	0.15A	0.04A
Pulse Current	20A	5A	1.25A	0.30A	0.08A

- 3.3 **Series resistance.** Series resistances shall be provided to maintain maximum peak power to the device under test when changing voltage ranges.
- 3.4 **Step generator.**
 - 3.4.1 **Current mode range.** 50 nA/step to 200 mA/step. A X0.1 control shall be provided to extend the range.
 - 3.4.2 **Voltage mode range.** 50 mV/step to 2 V/step. A X0.1 control shall be provided to extend the range.
 - 3.4.3 **Accuracy.** $\pm 4\%$ of full scale.
 - 3.4.4 **Step rate.** 1X, 2X, or 4X line frequency.
 - 3.4.5 **Pulsed steps.** Pulsed steps of approximately 300 us shall be provided.
 - 3.4.6 **Step and offset polarity.** The equipment shall be provided with a control to invert the polarity of the step generator output.
 - 3.4.7 **Offset.** The equipment shall be provided with a means of continuously offsetting a set of steps to either ADD or OPPOSE. The maximum range of the offset shall be 10 full amplitude steps.
 - 3.4.8 **Step family.** The step family shall be repetitive or single family.
 - 3.4.9 **Number of steps.** 1 to 10 full amplitude steps and up to approximately 95 steps when using the STEP X0.1 multiplier.
- 3.5 **Deflection controls.**
 - 3.5.1 **Display accuracies.** The display accuracy shall be a percentage of the highest on-screen value as specified in table II.

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TABLE II. Display Accuracy

<u>Display Mode</u>	<u>Normal</u>	<u>Magnified</u>
Vertical Collector Current	3% \pm 1 nA	4% \pm 1 nA
Horizontal Collector Volts	3%	4%
Horizontal Base Volts	3%	4%
Horizontal Step Generator	4%	5%

3.5.2 Vertical deflection factor. 2 nA/div to 2 A/div. A X10 magnifier shall be provided.

3.5.3 Horizontal deflection factor.

a. Collector volts: 50 mV/div to 200 V/div. A X10 magnifier shall be provided.

b. Base volts: 50 mV/div to 2 V/div. A X10 magnifier shall be provided.

c. Step generator: 1 step/div. A X10 magnifier shall be provided.

3.5.4 Automatic positioning. The equipment shall be provided with a means of automatically positioning the trace (or spot) when the collector supply polarity is changed from the test fixture.

3.5.5 Display invert. The equipment shall be provided with a control capable of inverting the display and repositioning the trace.

3.5.6 Display filter. The equipment shall be provided with a selectable, low-pass filter to reduce vertical noise for high sensitivity measurements.

3.6 Standard test fixture. The equipment shall be provided with a test fixture with the following outputs and capabilities:

a. Comparison test.

b. A variable -12 to +12 Vdc bias supply output.

c. External front panel jacks permitting access to the step generator output and the device under test base and emitter.

3.7 Turn-off time adapter. The equipment shall be provided with a turn-off time adapter, as an integral part or as a plug-in, with the following capabilities and characteristics:

a. Anode current: 5A. Accuracy: \pm 3% of indication +8 mA.

b. Commutation interval: 5 μ s to 105 μ s. Accuracy: \pm 3% of indication + 0.2 μ s.

c. Gate current: 0 to 80 mA. Accuracy: \pm 4 mA.

3.8 CRT.

3.8.1 CRT controls. Intensity, focus, trace rotation, and beam finder.

3.8.2 CRT dimensions. Rectangular with an 8 x 10 division display area.

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4. **ACCESSORIES.** The following accessories shall be provided with the equipment:

- a. Transistor adapter for bipolar transistor and MOS FETs.
- b. Axial lead diode adapter with Kelvin sensing terminals.
- c. Protective shield for test connection area.

5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 155W.

6. **WEIGHT.** 24 kg (53 lb) maximum.

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APPENDIX D

TE5GN-C

CURVE TRACER

1. **GENERAL.** This procurement requires a general purpose, solid-state curve tracer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of providing voltages, currents, and CRT displays as specified below.
 - 3.1 **Collector supply modes.** AC (line frequency), positive full-wave rectified, negative full-wave rectified, positive dc, and negative dc.
 - 3.2 **Voltage.** The voltage shall be variable to the maximum peak volts selected, and the continuous and peak current shall be in accordance with table I.

TABLE I. Maximum Peak Current

	<u>Max Peak Volts. Open Circuit</u>				
	<u>6.5V</u>	<u>25V</u>	<u>100V</u>	<u>400V</u>	<u>1600V</u>
Continuous Current	10A	2.5A	0.6A	0.15A	0.04A
Pulse Current	20A	5A	1.25A	0.30A	0.08A

- 3.3 **Series resistance.** Series resistances shall be provided to maintain maximum peak power to the device under test when changing voltage ranges.
- 3.4 **Step generator.**
 - 3.4.1 **Current mode range.** 50 nA/step to 200 mA/step. A X0.1 control shall be provided to extend the range.
 - 3.4.2 **Voltage mode range.** 50 mV/step to 2 V/step. A X0.1 control shall be provided to extend the range.
 - 3.4.3 **Accuracy.** $\pm 4\%$ of full scale.
 - 3.4.4 **Step rate.** 1X, 2X, or 4X line frequency.
 - 3.4.5 **Pulsed steps.** Pulsed steps of approximately 300 us shall be provided.
 - 3.4.6 **Step and offset polarity.** The equipment shall be provided with a control to invert the polarity of the step generator output.
 - 3.4.7 **Offset.** The equipment shall be provided with a means of continuously offsetting a set of steps to either ADD or OPPOSE. The maximum range of the offset shall be 10 full amplitude steps.
 - 3.4.8 **Step family.** The step family shall be repetitive or single family.
 - 3.4.9 **Number of steps.** 1 to 10 full amplitude steps and up to approximately 95 steps when using the STEP X0.1 multiplier.
- 3.5 **Deflection controls.**
 - 3.5.1 **Display accuracies.** The display accuracy shall be a percentage of the highest on-screen value as specified in table II.

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TABLE II. Display Accuracy

<u>Display Mode</u>	<u>Normal</u>	<u>Magnified</u>
Vertical Collector Current	3% \pm 1 nA	4% \pm 1 nA
Horizontal Collector Volts	3%	4%
Horizontal Base Volts	3%	4%
Horizontal Step Generator	4%	5%

3.5.2 Vertical deflection factor. 2 nA/div to 2 A/div. A X10 magnifier shall be provided.

3.5.3 Horizontal deflection factor.

a. Collector volts: 50 mV/div to 200 V/div. A X10 magnifier shall be provided.

b. Base volts: 50 mV/div to 2 V/div. A X10 magnifier shall be provided.

c. Step generator: 1 step/div. A X10 magnifier shall be provided.

3.5.4 Automatic positioning. The equipment shall be provided with a means of automatically positioning the trace (or spot) when the collector supply polarity is changed from the test fixture.

3.5.5 Display invert. The equipment shall be provided with a control capable of inverting the display and repositioning the trace.

3.5.6 Display filter. The equipment shall be provided with a selectable, low-pass filter to reduce vertical noise for high sensitivity measurements.

3.6 Standard test fixture. The equipment shall be provided with a test fixture with the following outputs and capabilities:

a. Comparison test.

b. A variable -12 to +12 Vdc bias supply output.

c. External front panel jacks permitting access to the step generator output and the device under test base and emitter.

3.7 CRT.

3.7.1 CRT controls. Intensity, focus, trace rotation, and beam finder.

3.7.2 CRT dimensions. Rectangular with an 8 x 10 division display area.

4. ACCESSORIES. The following accessories shall be provided with the equipment:

a. Transistor adapter for bipolar transistor and MOS FETs.

b. Axial lead diode adapter with Kelvin sensing terminals.

c. Protective shield for test connection area.

5. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 155W.

6. WEIGHT. 24 kg (53 lb) maximum.

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APPENDIX D

Configuration A: DE2YN-A
Configuration B: DE2AB-A
Configuration C: DE2NN-A

DETECTOR, RF, COAXIAL

1. **GENERAL.** This procurement requires a RF Coaxial Detector.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Frequency range.** 0.01-18 GHz.
 - 3.2 **Frequency response.** ± 0.6 dB.
 - 3.3 **Maximum SWR.** 1.5.
 - 3.4 **Low level.** 0.5 mV/uW
 - 3.5 **Continuous power rating.** 200 mW.
 - 3.6 **Input connector.** Configuration A: APC-7. Configuration B: N(m).
Configuration C: 3.5mm (m).
4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** .23 kg (0.5 lb) maximum.

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APPENDIX D

DEVAA-A

DETECTOR, VOLTAGE

1. **GENERAL.** This procurement requires a hand-held ac voltage detector that detects voltages without making electrical contact.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall detect ac voltages in accordance with the following minimum specifications.
 - 3.1 **Voltage range.** 25 to 1,500V.
 - 3.2 **Charging rate.** 1 uF/s.
 - 3.3 **Indicator.** Audible tone.
4. **POWER SOURCE.** MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 100 hours of operation before replacement. The nominal power source requirements are not invoked.
5. **DIMENSIONS.** 0.45 kg (1 lb) maximum.

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APPENDIX D

DP1NN-A

DIVIDER, POWER

1. **GENERAL.** This procurement requires a three-port, resistive, coaxial power divider.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. The Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum specifications set forth below.
 - 3.1 **Frequency range.** dc to 18 GHz.
 - 3.2 **Nominal impedance.** 50 ohms.
 - 3.3 **Maximum VSWR.** 1.35.
 - 3.4 **Phase difference.** $\pm 2\%$ maximum.
 - 3.5 **Maximum input power.** 1W continuous, 1 kW peak for 5 msec.
 - 3.6 **Connectors.** Input: N(m), Output: N(f).
4. **POWER SOURCE.** The power source requirements are not invoked.
5. **WEIGHT.** 0.5 kg (1.1 lb) maximum.

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APPENDIX D

DR2FL-A

DIVIDER, VOLTAGE

1. **GENERAL.** This procurement requires a voltage divider.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of voltage division within the minimum ranges and accuracies detailed below.
 - 3.1 **Measurement range.** 0 to 10 kV dc.
 - 3.2 **Division ratios.** 1,000:1 and 10,000:1.
 - 3.3 **Accuracy.** $\pm 0.1\%$ into digital voltmeter input impedance of 10 megohms or greater.
4. **ACCESSORIES.** The equipment shall be provided with safety-designed test leads in accordance with MIL-T-28800.
5. **WEIGHT.** 5 kg (11 lb) maximum.

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APPENDIX D

DL1EY-A

DUMMY LOAD, COAXIAL

1. **GENERAL.** This procurement requires a portable, RF, coaxial dummy load.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800. Power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall terminate an RF signal source in accordance with the specifications set forth below.
 - 3.1 **Frequency range.** DC to 1 GHz minimum.
 - 3.2 **Input impedance.** 50-ohms nominal.
 - 3.3 **Power dissipation.** 2.5 kW continuous and 3 kW for a minimum of 2 hours.
 - 3.4 **VSWR.** 1.1:1 maximum.
 - 3.5 **Connector.** LC female (UG-287B/U) with a cap attached to the equipment.
4. **DIMENSIONS.** 283 mm (11.5 in) high, 203 mm (8 in) wide, and 635 mm (25 in) deep, maximum.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

DL1JN-B

DUMMY LOAD, COAXIAL

1. **GENERAL.** This procurement requires a portable, coaxial dummy load.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall terminate an RF signal source in accordance with the specifications set forth below.
 - 3.1 **Frequency range.** DC to 3 GHz minimum.
 - 3.2 **Input impedance.** 50 ohm nominal.
 - 3.3 **VSWR.**
 - a. 1.1:1 maximum from dc to 1 GHz
 - b. 1.35:1 maximum from 1 to 3 GHz
 - 3.4 **Power rating.** 600W continuously and 900W for 0.25 hour at 23°C.
 - 3.5 **Connector.** Type N(f) (UG-57B/U). A protective cap shall be provided.
4. **WEIGHT.** 10 kg (22 lb) maximum.

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APPENDIX D

DL1SN-A

DUMMY LOAD, COAXIAL

1. **GENERAL.** This procurement requires a coaxial dummy load.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Continuous power rating.** 150W.
 - 3.2 **Frequency range.** dc to 4 GHz.
 - 3.3 **Maximum SWR.** 1.3.
 - 3.4 **Connector.** N(f).
 - 3.5 **Nominal impedance.** 50 ohms.
4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** 2.7 kg (6 lbs) maximum.

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APPENDIX D

EBOQM-C

ECHO BOX

1. **GENERAL.** This procurement requires a portable, hand-tuned, low-loss, high-Q echo box for use in performance testing and maintenance of radars.
2. **CLASSIFICATION.** Type III, Class 5, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications. The electromagnetic interference requirements are not invoked.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of radar performance testing within the minimum specifications identified below.
 - 3.1 **Ring time measurements.**
 - 3.1.1 **Frequency range.** 8.5 to 9.6 GHz.
 - 3.1.2 **Ring time.** The equipment shall be capable of generating a ring time equivalent to 5,000 yards when used with a radar set with the following parameters:
 - a. Receiver sensitivity: -120 dBm.
 - b. Transmitter peak power: 250 kW.
 - c. PRF: 1,000 Hz.
 - d. Pulse width: 0.5 us.
 - e. Directional coupler: 25 dB.
 - f. Coaxial cable loss: 3.6 dB.
 - 3.1.3 **Ring time sensitivity.** Charts shall be provided with the equipment to express the ring time sensitivity in terms of yards of ring time lost per decibel lost.
 - 3.1.4 **Resonant cavity Q.** 80,000 minimum.
 - 3.2 **Wavemeter operation.** Frequency range: 8.5 to 9.6 GHz. Accuracy: ± 2 MHz.
 - 3.2.1 **Indicating meter.** The equipment shall be provided with an analog meter for use in determining the mode of operation and frequency.
 - 3.3 **Input impedance.** 50 ohms nominal.
4. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

GE7TC-E

GENERATOR, FUNCTION

1. **GENERAL.** This procurement requires a frequency synthesizer operable via the IEEE-488.1 digital bus.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating sine, square, triangle, and ramp waveforms, and providing internal and external FM and AM within the minimum parameters specified below.
 - 3.1 **Output.** The frequency and amplitude ranges of the various waveforms shall be continuously variable in accordance with the following:
 - a. 0.001 Hz to 13 MHz for sine and 10 MHz for square waveforms with 10V peak-to-peak output.
 - b. 0.001 Hz to 1 MHz for sine and square waveforms from 10V to 40V peak-to-peak output.
 - c. 0.001 Hz to 10 kHz for triangle and ramp waveforms.
 - 3.1.1 **Sine and square waveforms:**
 - a. Into 50 ohms: 1 MHz to 13 MHz, 1 mV to 10V.
 - b. Into 500 ohms: 1 mHz to 1 MHz, 1 mV to 40V.
 - 3.1.2 **Triangle and ramp waveforms:**
 - a. Into 50 ohms: 1 mHz to 10 kHz, 1 mV to 10V.
 - 3.1.3 **Frequency accuracy.** ± 5 ppm or less of the selected value for the temperature range of 20°C to 30°C.
 - 3.1.4 **Frequency resolution.** 0.001 Hz or less.
 - 3.1.5 **Stability.** $\pm 5 \times 10E-8$ or less per week.
 - 3.1.6 **Distortion.** The distortion for a 50 ohm output impedance shall be less than:
 - a. -60 dBc or -90 dBm, whichever is greater, for all spurious outputs.
 - b. 30 dB below the fundamental frequency above 0.1 Hz for all harmonically-related signals.
 - 3.1.7 **Level accuracy.** The peak-to-peak accuracy of the various waveforms shall be in accordance with table I.
 - 3.1.8 **Level resolution.** 0.03% or less of range.

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TABLE I. Level Accuracy

	<u>Sine</u>	<u>Square</u>	<u>Triangle and Ramp</u>
Into 50 Ohms			
1 MHz to 10 kHz	0.2 dB	2.2%	6.2%
10 kHz to 100 kHz	0.2 dB	2.2%	----
100 kHz to 13 MHz	0.4 dB	13.6%	----
Into 500 Ohms			
10 Hz to 10 kHz	2%	2%	----
10 kHz to 1 MHz	10%	10%	----

3.2 Sweep capabilities. 0.1 second to 1,000 seconds linear and logarithmic sweep times with single and continuous sweep modes.

3.3 Sine wave amplitude modulation. 0 to 100% with a modulation frequency range of dc to 50 kHz.

3.4 Remote operation.

- a. Digital interface in accordance with MIL-T-28800.
- b. Digital interface in accordance with EIA RS-232C.

3.5 Internal modulation source.

3.5.1 Frequency range.

- a. Sine: 0.1 Hz to 10 kHz.
- b. Square: 0.1 Hz to 2 kHz.

3.5.2 Amplitude range. 0.1V to 12V peak-to-peak.

3.6 Reference input. Frequency: 10 MHz. Amplitude range: 0 to 20 dBm.

3.7 DC offset. $\pm 5V$.

4. POWER SOURCE. MIL-T-2880 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 120W.

5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

GE7NM-E

GENERATOR, FUNCTION

1. **GENERAL.** This procurement requires a function generator.
2. **CLASSIFICATION.** Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **FUNCTIONAL CAPABILITIES.** The equipment shall be capable of generating specified outputs within the minimum ranges, levels, and accuracies specified below. When multiple bands are provided, adjacent bands shall overlap. The accuracies specified refer to the typical full-range values stated below.
 - 3.1 **Frequency range.** 0.0001 Hz to 20 MHz for all functions.
 - 3.1.1 **Frequency accuracy.** $\pm 3\%$ of full range on all bands below 10 MHz and $\pm 5\%$ of full range on bands of 10 MHz and greater.
 - 3.2 **Output voltage.** The variable output voltage across a 50 ohm load shall be as follows:
 - a. Sine, square, triangle, and pulse functions: 15V peak-to-peak minimum.
 - b. Positive square function: +7.5V minimum.
 - c. Negative square function: -7.5V minimum.
 - 3.2.1 **Frequency response.** The output amplitude change for sine and sine-related waveforms shall not exceed ± 3 dB throughout the specified frequency range.
 - 3.3 **Harmonics.** Up to 2 MHz: 34 dB below fundamental. 2 to 20 MHz: 26 dB below fundamental.
 - 3.3.1 **Total harmonic distortion.** Above 2 MHz: 26 dB maximum. Below 2 MHz: 34 dB maximum.
 - 3.4 **Square wave characteristics.**
 - a. Rise time: 20 ns maximum.
 - b. Fall time: 20 ns maximum.
 - c. Symmetry: $\pm 1\%$ from 0.001 Hz to 200 kHz.
 - 3.5 **Pulse output characteristics.** The equipment shall be provided with normal, delay, and double-pulse outputs.
 - a. Rise time: 20 ns maximum.
 - b. Fall time: 20 ns maximum.
 - c. Width: Continuously variable between 25 ns to 1 ms.
 - d. Delay: Continuously variable between 50 ns to 10 ms.
 - 3.6 **Inputs and outputs.** The equipment shall be provided with the following inputs and outputs:
 - a. Voltage control input: An external 0 to 2V input shall cause a frequency change of at least 1,000:1.

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b. Trigger and gate input: Signal generation shall be controlled with an external 1V to ± 10 V peak-to-peak input.

c. Generator control output: A 0 to 2V signal into 600 ohms proportional to the frequency of the generator.

d. Sync output: A synchronous TTL-level pulse capable of driving a 50 ohm load.

3.7 Controls.

3.7.1 Output attenuator. 60 dB output attenuator with 20 dB steps and a 20 dB vernier. Attenuator accuracy: ± 0.3 dB/20 dB step below 2 MHz and ± 2 dB/20 dB step from 2 MHz to 20 MHz.

3.7.2 DC offset. A dc voltage control shall provide ± 7.5 V dc offset for sine, square, triangle, and pulse outputs.

3.7.3 Symmetry control. Shall allow for continuously-adjustable symmetry of all waveforms from at least 1:19 to 19:1.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 60W.

5. WEIGHT. 20 kg (44 lb) maximum.

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GE7TB-B

GENERATOR, FUNCTION

1. **GENERAL.** This procurement requires a general purpose, solid-state, sweep function generator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of producing sine, square, triangle, positive pulse, and negative pulse waveforms with sweep and burst operation. The equipment shall operate within the minimum modes, ranges, and accuracies specified below. Specifications shall apply at maximum output.
 - 3.1 **Frequency range.** 0.2 Hz to 3 MHz.
 - 3.1.1 **Frequency accuracy.** $\pm 20\%$ of indication.
 - 3.1.2 **Frequency response.** ± 1 dB maximum for sine-wave outputs.
 - 3.1.3 **Sine-wave distortion.** 3% maximum.
 - 3.1.4 **Rise and fall times.** 40 ns or less for square and pulse waveforms when the equipment is terminated into 50 ohms.
 - 3.1.5 **Triangle linearity.** 95% minimum.
 - 3.2 **Amplitude control.** Adjustable 5 mV to 10V peak-to-peak into 50 ohms.
 - 3.3 **Impedance.** 50 ohms $\pm 5\%$.
 - 3.4 **Sweep function.**
 - 3.4.1 **Start and stop frequencies.** The sweep function start and stop frequencies shall be independently settable throughout the selected range.
 - 3.4.2 **Sweep duration.** Variable from 1 ms to 100s.
 - 3.5 **Trigger and gate.** Manual trigger, external trigger, and external gating capability shall be provided.
 - 3.6 **Pulse width.** 160 ns to 2.5s with a repetition rate adjustable from 0.01 Hz to 1 kHz.
 - 3.7 **External voltage control.** The capability shall be provided to proportionally vary the output frequency by application of a voltage.
 - 3.8 **Offset.** The capability shall be provided to vary the waveform about ground to at least ± 10 volts peak. Peak ac plus dc offset shall be at least ± 10 volts.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 120W.

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APPENDIX D

GE3FN-B

GENERATOR, NOISE

1. **GENERAL.** This procurement requires an instrument capable of generating random noise at uniform levels from 5 Hz to 5 MHz.

2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The relative humidity requirement is limited to 95% noncondensating.
- b. The operating and nonoperating altitude requirements are not invoked.
- c. The electromagnetic interference requirements of MIL-T-28800 are not invoked.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating random noise signals within the specifications and accuracies contained herein.

3.1 Output frequency. 5 Hz to 5 MHz.

3.1.1 Ranges. 3 selectable by filter.

3.1.1.1 5 Hz to 20 kHz.

3.1.1.2 5 Hz to 500 kHz.

3.1.1.3 5 Hz to 5 MHz.

3.2 Output voltage. Max open-circuit voltage > 1V.

3.2.1 Range. Continuously variable from 30 μ V to 3V.

3.2.2 Spectrum level uniformity.

3.2.2.1 ± 1 dB (20 Hz to 20 kHz).

3.2.2.2 ± 3 dB (20 Hz to 500 kHz).

3.2.2.3 ± 8 dB (500 kHz to 5 MHz).

3.2.3 Level indicator. Meter.

3.2.3.1 Range. 0-5 Vrms.

3.2.3.2 Scale/Multiplying factors. Min 500 μ V; max 5V.

3.2.3.3 Accuracy. $\pm 3\%$ to 100 kHz; $\pm 10\%$ to 5 MHz.

3.3 Output impedance.

3.3.1 Max output. 900 Ω $\pm 10\%$.

3.3.2 Attenuated output. 200 Ω $\pm 10\%$.

4. **GENERAL REQUIREMENTS.**

4.1 Power source. 115 or 230 Vac $\pm 10\%$, single phase 50, 60, and 400 Hz $\pm 10\%$, 50W max.

4.2 Dimensions. The total volume shall not exceed 16,000 cm³ (975 in³).

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4.3 **Weight.** The overall weight of the unit shall be nominally 10 kg (22 lbs).

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GE3MN-A

GENERATOR, NOISE

1.0 GENERAL. This procurement requires a self-contained, battery operated, portable noise generator capable of generating RF noise radiation over the frequency range of 150 kHz to 10 MHz.

2.0 CLASSIFICATION. The equipment described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The EMI requirement is not invoked.
- e. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency range. At least 150 kHz to 10 MHz.

3.2 Maximum effective distance. 9.14m (30 ft).

4.0 GENERAL REQUIREMENTS.

4.1 Power. Internal battery, (average life - 50 hours).

4.2 Dimensions. The total volume of the unit shall nominally not exceed 432 cubic in (7,076 cc).

4.3 Weight. The total weight of the unit shall not exceed 10 lbs (4.5 kg).

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APPENDIX D

GE2NN-D

GENERATOR, PULSE

1. **GENERAL.** This procurement requires a pulse generator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **PULSE GENERATION REQUIREMENTS.** The minimum requirements below shall apply to both single or double pulse mode operations and shall include positive or negative outputs. All pulse specifications are applicable into a 50 ohm load.
 - 3.1 **Pulse amplitude.** 0.3V to 100V peak-to-peak.
 - 3.2 **Pulse rise and fall times.** 17 ns or less.
 - 3.3 **Pulse aberrations.** 5% maximum for preshoot and overshoot, 6% maximum for droop and top variations.
 - 3.4 **Pulse width.** 50 ns to 10 ms.
 - 3.4.1 **Pulse width jitter.** 0.1% maximum of selected width.
 - 3.5 **Pulse repetition rate.** 10 Hz to 1 MHz.
 - 3.6 **Maximum pulse duty cycle.** 50% for output amplitudes below 10V, 25% from 10V to 20V, and 10% from 20V to 100V. A duty cycle limit indicator shall be provided.
 - 3.7 **Minimum double pulse spacing.** 1 us or 25% of the upper limit of the pulse width range setting, whichever is greater.
 - 3.8 **Delayed and advanced pulse range.** 0 to 10 ms.
 - 3.9 **Synchronized output.** A trigger output that is synchronized with the generated pulse shall be provided.
 - 3.10 **Gated operation.** The equipment shall operate normally during the time interval of an input gate signal with an amplitude of at least 500 mv.
 - 3.11 **External trigger.** The instrument shall be triggerable from an external trigger source as follows:
 - a. **Amplitude:** 0.5V to 40V into 1 megohm.
 - b. **Repetition rates:** 1 MHz and less.
 - 3.12 **Output protection.** The equipment shall be provided with protection against a shorted or open output.
 - 3.13 **Connectors.** BNC(f).
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 360W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

GE2NP-F

GENERATOR, PULSE

1. **GENERAL.** This procurement requires a general purpose pulse generator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum ranges and accuracies specified below. The requirements shall apply to both positive and negative outputs.
 - 3.1 **Pulse amplitude range.** 0.5V to 5V peak-to-peak into a 50 ohm load.
 - 3.2 **Pulse rise/fall times.** 10 ns or less.
 - 3.3 **Pulse aberrations.** $\pm(5\%$ maximum of pulse amplitude +100 mV) into 50 ohms.
 - 3.4 **Pulse width.** Variable from 100 ns to 5 ms.
 - 3.4.1 **Pulse width jitter.** 0.1% +50 ps of the selected pulse width value.
 - 3.5 **Pulse repetition rate.** Variable from 300 Hz to 50 MHz.
 - 3.6 **Synchronized output.** A trigger output that is synchronized with the generated pulse shall be provided.
 - 3.7 **External trigger.** Amplitude: $\pm 1.5V$. Width: 12 ns.
 - 3.8 **Output protection.** The equipment shall be provided with protection against both a shorted and open output.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 75W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

GE8NN-B

GENERATOR, PULSED CARRIER

1.0 GENERAL. This procurement requires a solid-state RF generator providing pulsed RF, video pulses or CW outputs.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.

3.0 OPERATIONAL REQUIREMENTS.

3.1 Carrier frequency range. At least 10 to 120 MHz.

3.1.1 Accuracy. $\pm 1\%$ of dial indication.

3.2 Output amplitude.

3.2.1 CW. 0.5 Vrms minimum into 50 ohms.

3.2.2 Pulsed RF. 0.5 Vrms minimum into 50 ohms.

3.2.3 Video pulse. $\pm 3\text{V}$ peak minimum into 50 ohms.

3.3 Attenuator.

3.3.1 Range. At least 100 dB in 1 dB steps.

3.3.2 Accuracy. ± 0.1 dB/step.

3.3.3 VSWR. 1.2:1.

3.4 Pulse characteristics.

3.4.1 Rate. 50 pps to 5 kpps.

3.4.2 On/Off ratio. At least 70 dBc.

3.4.3 Width. Variable, 100 ns to 100 us.

3.4.4 Rise and fall time. Less than 20 ns for video pulse, and less than 10 ns for pulsed RF.

3.4.5 Sync output. At least 2.0V peak into 10 kilohms with 20 ns rise time, and at least 35 ns ahead of the pulsed RF.

3.5 External inputs.

3.5.1 Trigger. Pulses at least 2V peak, and at least 50 Hz to 5 kHz.

3.5.2 Modulation. Pulses at least 2V peak, and at least 50 Hz to 5 kHz.

3.5.3 Oscillator. At least 1 Vrms, 10 to 120 MHz.

4.0 GENERAL SPECIFICATIONS.

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4.1 **Power.** 115/230 Vac (10%, 50/60 Hz, 30W maximum).

4.2 **Dimensions.** The total volume of the unit shall be nominally 33,233 cubic cm (2028 cubic in).

4.3 **Weight.** 13.2 kg (29 lbs) nominal.

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GEOTK-C

GENERATOR, SIGNAL, CW

1. **GENERAL DESCRIPTION.** This procurement requires a solid-state, CW Signal Generator capable of generating a constant amplitude sine wave with a variable frequency range of 250 kHz to 250 MHz.

2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The relative humidity requirement is limited to 95% noncondensating.
- b. The operating and nonoperating altitude requirements are not invoked.
- c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
- d. The warm-up time is extended to one hour.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 **Frequency characteristics.**

- 3.1.1 **Frequency range.** At least 250 kHz to 250 MHz.
- 3.1.2 **Resolution.** At least 3-digit display.
- 3.1.3 **Accuracy.** ± 0.7 of least significant digit for indicated frequency.
- 3.1.4 **Spectral purity** (equal to or better than limits specified below).
 - 3.1.4.1 **Harmonics.** 2nd harmonic at least -35 dBc, 3rd and higher harmonics at least -40 dBc.

3.2 **Output characteristics.**

- 3.2.1 **Range.** At least 5.0 mV to 5.5 Vp-p into 50-ohm termination.
- 3.2.2 **Accuracy.** Within at least 5% of indicated amplitude (50 kHz reference).
- 3.2.3 **Flatness** (peak to peak, 50 kHz reference). At least $\pm 1.5\%$ from 250 kHz to 100 MHz; at least $\pm 3\%$ from 100 to 250 MHz.
- 3.2.4 **Output impedance/connector.** 50 Ω ; BNC type connector.

4. **GENERAL REQUIREMENTS.**

- 4.1 **Power.** 115/230 Vac $\pm 10\%$, 50, 60, or 400 Hz $\pm 10\%$, 250 VA maximum.
- 4.2 **Dimensions.** The total volume shall not exceed 5,867 cm³ (358 in³).
- 4.3 **Weight.** The overall weight shall not exceed 4.5 kg (10 pounds).

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GEAMJ-A

GENERATOR, SIGNAL

1.0 GENERAL. This procurement requires a solid state, microwave signal generator capable of generating signals over the frequency range of 12 to 18 GHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is 15 minutes.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Frequency range. At least 12 to 18 GHz.

3.1.2 Frequency resolution. At least 10 MHz.

3.1.3 Frequency accuracy. At least $\pm 1\%$ of reading at maximum power and $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

3.1.4 Frequency stability. At $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ (equal to or better than limits specified below).

3.1.4.1 Short term. Frequency drift less than ± 1 pp $10\text{E}4$ for 5 minutes.

3.1.4.2 Long term. Frequency drift less than ± 6.7 pp $10\text{E}4$ for 1 hour.

3.1.5 Temperature drift. Less than 0.4% total change over 0 to 50°C temperature range.

3.1.6 Spectral purity.

3.1.6.1 Harmonic level. At least -20 dB.

3.1.6.2 Spurious. At least -55 dBc.

3.1.6.3 Residual FM. Less than 15 kHz peak (measured at 50 Hz to 15 kHz BW).

3.2 Output characteristics.

3.2.1 Range. At least +7 to -18 dBm.

3.2.2 Level control. Continuous over at least a 25 dB range.

3.2.3 Output impedance. 50 ohms nominal.

3.2.4 Output connector. Type N female.

3.3 Modulation characteristics.

3.3.1 Amplitude modulation (AM).

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3.3.1.1 Internal (square wave).

3.3.1.1.1 Rate. Variable, at least 20 Hz to 5 kHz.

3.3.1.1.2 On/Off ratio. Greater than 25 dB.

3.3.1.1.3 Rise/Fall time. 5 us maximum.

3.3.1.2 External.

3.3.1.2.1 Rate. At least 20 Hz to 50 kHz.

3.3.1.2.2 Input level. 0 to $\pm 10V$.

3.3.1.2.3 On/Off ratio. Greater than 25 dB.

3.3.1.2.4 Rise/Fall time. 5 us maximum.

3.3.2 Frequency modulation (FM).

3.3.2.1 Internal (sawtooth).

3.3.2.1.1 Deviation. ± 5 MHz.

3.3.2.1.2 Rate. At least 10 Hz to 5 kHz.

3.3.2.2 External.

3.3.2.2.1 Deviation. ± 5 MHz.

3.3.2.2.2 Rate. At least dc to 50 kHz.

3.3.2.2.3 Input. Less than $\pm 5V$ for 5 MHz deviation.

4.0 GENERAL REQUIREMENTS.

4.1 Power source. 115 or 230 Vac $\pm 10\%$, single phase, at line frequencies of 50/60 Hz $\pm 10\%$, 20W maximum.

4.2 Dimensions. The total volume of the unit shall not exceed 2,800 cubic in (46,000 cubic cm).

4.3 Weight. The overall weight of the unit shall not exceed 8.75 pounds (4 kg).

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GEBJC-A

GENERATOR, SIGNAL, RADIO FREQUENCY

1.0 GENERAL DESCRIPTION. This procurement requires a solid-state, signal generator covering the frequency range of 0.5 to 1024 MHz; output level continuously adjustable from +13 to -137 dBm; CW operation, internal AM/FM and external AM/FM and Pulse modulation capabilities.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- e. The warm-up time is extended to two hours.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics. (Where F = RF output frequency).

3.1.1 Range. At least 0.5 to 1,024 MHz.

3.1.2 Resolution. 1 Hz.

3.1.3 Accuracy. Same as time base.

3.1.4 Stability (after 2 hour warm-up).

3.1.4.1 Internal standard. Less than 5 pp 10E8/h (at 25°C ±5°C after warm-up).

3.1.4.2 External standard. Stability of external standard.

3.1.4.2.1 Input frequency. Accepts either 5 or 10 MHz inputs.

3.1.4.2.2 Level. Greater than 0.5 Vrms and less than 2.0 Vrms.

3.1.4.3 Standard output. 10 MHz into 50 ohms; level greater than 0 dBm nominal; BNC female connector.

3.1.4.4 Temperature. Less than 10 ppm (0°C to 50°C).

3.1.5 Spectral purity (equal to or better than limits specified below).

3.1.5.1 Harmonics/Subharmonics. -30 dBc (output level less than +7 dBm).

3.1.5.2 Nonharmonics/Spurious. -100 dBc (signals more than ±15 kHz from carrier).

3.1.5.3 Power line spurious. Less than -40 dBc (signals within ±15 kHz of carrier).

3.1.5.4 Phase noise (1 Hz BW at 20 kHz offset from carrier).

3.1.5.4.1 At least -130 dBc/Hz (F less than 512 MHz).

3.1.5.4.2 At least -124 dBc/Hz (F greater than 512 MHz).

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3.1.5.5 Residual FM. Less than 20 Hz rms (50 Hz to 15 kHz post detection bandwidth).

3.1.5.6 Residual AM. Less than -80 dBc (50 Hz to 15 kHz post detection bandwidth).

3.1.6 RF leakage. Less than 1 μ V into 50 ohms (-107 dBm) (using 2-turn, 1 inch diameter loop at least 1 inch from any surface, with output connector terminated in 50 ohms).

3.2 Output characteristics.

3.2.1 Range. +13 to -137 dBm.

3.2.2 Accuracy (indicated output level vs externally measured level). ± 1.5 dB (+13 to -117 dBm); ± 3 dB (-117 to -137 dBm).

3.2.3 Flatness (output variation measured at +10 dBm). ± 1.0 dB (peak-peak variation less than 2 dB).

3.2.4 Display (digital). Output level selectable in units of either power (dBm) or volts into 50 ohms.

3.2.4.1 Resolution. At least 0.1 dB.

3.2.5 Output impedance. 50 ohms nominal.

3.2.6 Connector. Type N female.

3.2.6.1 VSWR less than 1.5:1 for output levels less than -10 dBm.

3.2.6.2 VSWR less than 2.5:1 for output levels greater than -10 dBm.

3.2.7 Reverse power protection. Resettable RF circuit breaker capable of withstanding inputs up to 50W.

3.3 Modulation characteristics.

3.3.1 Amplitude modulation (AM). (Where F = RF output frequency).

3.3.1.1 Internal AM.

3.3.1.1.1 Rate (3 dB bandwidth). At least 10 Hz to 100 kHz variable (synthesized from frequency reference).

3.3.1.1.2 Depth. 0 to 99% (output levels below 0 dBm).

3.3.1.1.2.1 Display/Resolution. Digital 0-99% with 1% resolution.

3.3.1.1.2.2 Accuracy. $\pm 7\%$ (measured vs indicated depth at 1 kHz rate).

3.3.1.1.3 Distortion. Less than 5% (at 50% depth; 0.1, 1, and 10 kHz rate).

3.3.1.1.4 Incidental FM. Less than 200 Hz (at 50% depth; 1 kHz rate).

3.3.1.2 External AM.

3.3.1.2.1 Rates (3 dB bandwidth).

3.3.1.2.1.1 Variable from 10 Hz to 5 kHz (0.5 MHz less than F less than 10 MHz).

3.3.1.2.1.2 Variable from 10 Hz to 10 kHz (10 MHz less than F less than 150 MHz).

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- 3.3.1.2.1.3 Variable from 10 Hz to 100 kHz (F greater than 150 MHz).
- 3.3.1.2.2 Depth. 0 to 99%.
- 3.3.1.2.3 Distortion. Less than 5% (at 50% depth; 0.1 and 1.0 kHz rates).
- 3.3.1.2.4 Sensitivity. 1.0 volt peak into 600 ohms produces depth selected within $\pm 10\%$.
- 3.3.2 Frequency modulation (FM).
- 3.3.2.1 Internal FM.
- 3.3.2.1.1 Rate. At least 10 Hz to 100 kHz variable (synthesized from frequency reference).
- 3.3.2.1.2 Deviation (at 0.1, 1 and 50 kHz rates).
- 3.3.2.1.2.1 At least 0 to 1 kHz (F less than 1 MHz).
- 3.3.2.1.2.2 At least 0 to 10 kHz (1 MHz less than F less than 32 MHz).
- 3.3.2.1.2.3 At least 0 to 100 kHz (32 MHz less than F less than 128 MHz).
- 3.3.2.1.2.4 At least 0 to 1 MHz (F greater than 128 MHz).
- 3.3.2.1.3 Display/Resolution. Digital in kHz with 1 kHz resolution.
- 3.3.2.1.4 Accuracy. $\pm 5\% + 10$ Hz (measured vs indicated deviation at 1 kHz).
- 3.3.2.1.5 Distortion. Less than 5% (at 0.1, 5, 50 kHz rates).
- 3.3.2.1.5.1 Deviation less than 20 kHz. Less than 2% (at 1 kHz rate).
- 3.3.2.1.6 Incidental AM. Less than 1% (at 100 kHz deviation at 1 kHz rate).
- 3.3.2.2 External FM (same as 3.3.2.1 internal FM except as noted below).
- 3.3.2.2.1 Rate. At least dc to 100 kHz.
- 3.3.2.2.2 Sensitivity. 1 volt peak into 600 ohms produces desired deviation within $\pm 10\%$.
- 3.3.2.2.3 Input impedance. 600 ohms $\pm 10\%$.
- 3.3.3 External pulse modulation (for outputs above 10 MHz).
- 3.3.3.1 Rate (PRF). At least 50 Hz to 50 kHz.
- 3.3.3.2 Pulse width (PW). Minimum pulse width shall be at least 5 us.
- 3.3.3.3 On/Off ratio. Greater than 35 dB.
- 3.3.3.4 Rise/Fall time. Less than 1 us.
- 3.3.4 Synthesized audio oscillator.
- 3.3.4.1 Frequency range/waveform. 10 Hz to 100 kHz/sinewave.
- 3.3.4.1.1 Resolution. At least 10 Hz.
- 3.3.4.2 Output level. Adjustable, at least 0 to 1 Vrms.
- 3.3.4.3 Output impedance. 600 ohms $\pm 10\%$.

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3.3.4.4 Distortion. Less than 2%.

4.0 GENERAL REQUIREMENTS.

4.1 Power source. 115 and 230 Vac $\pm 10\%$, single phase, 50, 60, 400 Hz $\pm 10\%$, 250 VA maximum.

4.2 Dimensions. The units total volume shall not exceed 2,700 cubic in (44,300 cc).

4.3 Weight. The overall weight of the unit shall be nominally less than 60 pounds (27.3 kg).

4.4 Remote operation. The unit shall be capable of remote operation via IEEE-488 bus interface. It shall operate as a talker or listener such that all functions except the power on/off switch are controllable and shall have as a minimum the following subset of GPIB commands: AH1, SH1, T6, L4, SR1, RL1, DC1, DT1.

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GE1RS-B

GENERATOR, SWEEP

1. **GENERAL.** This procurement requires a sweep/signal generator capable of generating signals over the frequency range of 1 MHz to 1 GHz.

2. **CLASSIFICATION.** The sweep/signal generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The relative humidity requirement is limited to 95% noncondensating.
- b. The operating and nonoperating altitude requirements are not invoked.
- c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
- d. The warm-up time is extended to one hour.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 **Frequency characteristics.**

3.1.1 **Frequency range.** At least 1 MHz to 1 GHz.

3.1.2 **Frequency drift (CW).** Less than 100 kHz/5 minutes after one hour warm-up at 25°C ±5°C.

3.1.3 **Frequency accuracy.** At least ±10 MHz.

3.1.4 **Spectral purity** (equal to or better than the limits specified below).

3.1.4.1 **Harmonics.** -30 dBc.

3.1.4.2 **Nonharmonics.** -30 dBc.

3.1.4.3 **Residual FM.** Less than 20 kHz p-p.

3.2 **Output characteristics.**

3.2.1 **Range.** Continuously variable from at least +8 to -80 dBm.

3.2.2 **Attenuator accuracy.** ±0.5 dB to 500 MHz; ±1.0 dB to 1 GHz.

3.2.3 **Flatness.** At least ±0.25 dB, 1 MHz to 1 GHz.

3.2.4 **Impedance/Connector.** 50Ω; type BNC female.

3.3 **Sweep characteristics.**

3.3.1 **Sweep time.** Continuously variable from 10 ms to 100s.

3.3.2 **Sweep trigger modes.** Recurring, single sweep, manual and line lock

3.3.3 **Sweep width.** 200 kHz to 1 GHz.

3.3.4 **Markers.**

3.3.4.1 **Steps.** At least 1, 10, 50 and 100 MHz.

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3.3.4.2 Accuracy. At least 0.005% of specified frequency.

3.3.4.3 Amplitude. Continuously variable from 1 mV to 1 V p-p.

3.3.4.4 Width. Variable in at least 4 steps from 15 to 400 kHz.

4. GENERAL REQUIREMENTS.

4.1 Power. 115/230 Vac $\pm 10\%$, single phase, 50 to 400 Hz, 20W maximum.

4.2 Dimensions. The total volume of the unit shall not exceed 10,734 cm³ (655 in³).

4.3 Weight. The total weight of the unit shall not exceed 9.1 kg (20 lbs).

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GE1CM-A

GENERATOR, SWEEP

1.0 GENERAL. This procurement requires a sweep generator capable of generating signals over a frequency range of 1 MHz to 2.5 GHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.
- d. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Frequency range. At least 1 MHz to 2.5 GHz.

3.1.2 Frequency drift (after 1 hour warm-up at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$).

3.1.2.1 1 to 1500 MHz. Less than 250 kHz/h.

3.1.2.2 1500 to 2500 MHz. Less than 500 kHz/h.

3.1.3 Frequency accuracy (CW).

3.1.3.1 1 to 500 MHz. At least ± 10 MHz.

3.1.3.2 500 to 2500 MHz. At least ± 20 MHz.

3.1.4 Spectral purity (equal to or less than the limits specified below).

3.1.4.1 Harmonics. -20 dBc from 1 to 10 MHz; -30 dBc from 10 MHz to 2.5 GHz.

3.1.4.2 Nonharmonics. -35 dBc.

3.1.4.3 Residual FM. Less than 20 kHz p-p.

3.2 Output characteristics.

3.2.1 Range. At least -77 to $+13$ dBm; continuously variable.

3.2.2 VSWR. Less than 1.5:1 (10 dB attenuation minimum).

3.2.3 Accuracy. At least ± 1.0 dB from $+13$ dBm to -20 dBm with an additional ± 0.3 dB/10 dB step below -20 dBm.

3.2.4 Flatness. Less than ± 0.5 dB at 0 dBm.

3.2.5 Impedance/Connector. 50 ohms; type N female.

3.3 Sweep characteristics.

3.3.1 Frequency range. 1 MHz to 2,500 MHz.

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- 3.3.2 Sweep time. At least 10 ms to 100s; continuously adjustable.
- 3.3.3 Sweep trigger modes. Repetitive, single, external trigger, manual and line lock sweep.
- 3.3.4 Markers.
 - 3.3.4.1 Steps. At least 1, 10, 50, 100 MHz.
 - 3.3.4.2 Accuracy. At least .005% of setting.
 - 3.3.4.3 Width. Adjustable from 15 to 400 kHz.
- 3.4 Modulation characteristics.
 - 3.4.1 Internal.
 - 3.4.1.1 Square wave. At least 1 kHz.
 - 3.4.2 External.
 - 3.4.2.1 Frequency modulation.
 - 3.4.2.1.1 Rate. 50 Hz to 10 kHz.
 - 3.4.2.1.2 FM deviation. 0 to at least 50 MHz.
 - 3.4.2.2 Amplitude modulation.
 - 3.4.2.2.1 Range. At least DC to 10 kHz.
 - 3.4.2.2.2 Depth. At least 10 to 90%.
 - 3.4.2.2.3 Sensitivity. Less than 1V p-p for 10% modulation.
- 4.4 GENERAL REQUIREMENTS.
 - 4.1 Power. 115/230 Vac $\pm 10\%$, single phase, 50, 60 or 400 Hz, 60 VA.
 - 4.2 Dimensions. The total unit volume shall not exceed 1,250 cubic in (20,450 cc).
 - 4.3 Weight. The total weight of the unit shall not exceed 23 lb (10.5 kg).

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APPENDIX D

GE1RU-C

GENERATOR, SWEEP

1. **GENERAL.** These salient characteristics describe a microwave sweep generator covering a frequency range of 10 MHz to 20 GHz employing no more than one plug-in and one mainframe.
2. **CLASSIFICATION.** The sweep generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:
 - a. **Humidity.** Relative humidity is limited to 95% noncondensating.
 - b. **Altitude.** Not required
 - c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
 - d. **400 Hz Power Source.** Not required
 - e. The equipment warm-up period is increased to 1 hour.
3. **OPERATIONAL CHARACTERISTICS.**
 - 3.1 **Frequency characteristics.**
 - 3.1.1 **Frequency range.** 10 MHz to 20 GHz; a maximum of one plug-in or RF output is allowed.
 - 3.1.2 **Frequency resolution.** The displayed frequency resolution shall be at least 1 MHz.
 - 3.1.3 **Frequency accuracy.** Measured accuracy within ± 10 MHz at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
 - 3.1.4 **Frequency stability** (less than the limits specified below).
 - 3.1.4.1 **Temperature.** ± 1 MHz/ $^{\circ}\text{C}$ (over 0 to 50°C operating range).
 - 3.1.4.2 **Line voltage.** ± 200 kHz ($\pm 10\%$ line voltage variation about 115 Vac).
 - 3.1.4.3 **Warm-up.** ± 1 MHz/10 minutes after 1 hour warm-up.
 - 3.1.5 **Residual FM in CW mode.** Less than 10 kHz peak (measured in 50 Hz to 15 kHz bandwidth).
 - 3.1.6 **Spectral purity** (at least the limits specified below).
 - 3.1.6.1 **Harmonics/Subharmonics.** -20 dBc.
 - 3.1.6.2 **Spurious/Nonharmonics.** -25 dBc.
 - 3.2 **Output characteristics.**
 - 3.2.1 **Output connector.** Type N.
 - 3.2.1.1 **VSWR.** Less than 2:1.
 - 3.2.2 **Output level.** +7 dBm leveled (minimum value of maximum leveled output).
 - 3.2.3 **Output level adjustment range.** At least 60 dB.

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- 3.2.4 Output display. Digital readout of output power level specified in 3.2.3; resolution 0.1 dB.
- 3.2.5 Level accuracy. ± 1.5 dB (displayed level vs measured output level).
- 3.2.6 Output level variation. ± 1.0 dB.
- 3.2.7 Attenuator error. Maximum attenuator error shall be less than ± 3.3 dB.
- 3.3 Modulation characteristics.
 - 3.3.1 Amplitude modulation (AM).
 - 3.3.1.1 Internal AM (square wave).
 - 3.3.1.1.1 Rate. 1 kHz and 27.8 kHz.
 - 3.3.1.1.2 On/Off ratio. Greater than 30 dB.
 - 3.3.1.2 External AM (square wave or pulse).
 - 3.3.1.2.1 Rate. 10 Hz to 50 kHz.
 - 3.3.1.2.2 Input levels. TTL compatible.
 - 3.3.1.2.3 Sensitivity. 1 dB/V, maximum input 15V.
 - 3.3.2 Frequency modulation (FM).
 - 3.3.2.1 External FM.
 - 3.3.2.1.1 Deviation. At least 0 to ± 7 MHz.
 - 3.3.2.1.2 Rate. 10 Hz to 100 kHz.
 - 3.3.2.1.3 Sensitivity. Greater than 5 MHz/V.
- 3.4 Sweep characteristics.
 - 3.4.1 Range. 10 MHz to 20 GHz.
 - 3.4.2 Sweep function. Start/Stop, CW, ΔF , Marker.
 - 3.4.3 Trigger modes. Internal (automatic), Line, External, Single, Manual.
 - 3.4.4 Frequency markers. At least 5; both amplitude and frequency.
 - 3.4.5 Sweep output. 0 to 10V ± 0.5 V, direct coupled, coincident with the swept RF output.
 - 3.4.6 Sweep time. Adjustable from at least 10 msec to 99 sec over any portion of the band.
- 3.5 Displays (digital).
 - 3.5.1 Frequency. Start/Stop, CW, CF/ ΔF (4 digits).
 - 3.5.2 Marker/Time. Marker frequency or sweep time (3 digits).
 - 3.5.3 Output level. Output signal level in dBm (3 digits).
- 4. GENERAL REQUIREMENTS.
 - 4.1 Power. 115 or 230 Vac $\pm 10\%$, single phase, 50 or 60 Hz, 400W maximum.

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4.2 Dimensions. Less than 32,774 cm³ (2,000 in³); maximum height allowable 15.24 cm (6 in) including feet.

4.3 Weight. Less than 27.3 kg (60 lbs).

4.4 Local operation. All front panel control settings shall be storable in non-volatile memory for future recall.

4.5 Remote programming. The generator shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having at least the following subset of bus functions: AH1, L4, SH1, T6, SR1, DC1, and RL1.

4.6 Diagnostics. Functional self-test and trouble shooting shall be accomplished using front panel controlled diagnostic functions.

4.7 Rackmountable.

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GEIRX-C

GENERATOR, SWEEP

1.0 GENERAL. These salient characteristics describe a microwave sweep generator covering a frequency range of 10 MHz to 26.5 GHz, employing no more than one plug-in and one mainframe.

2.0 CLASSIFICATION. The sweep generator described herein shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine and shore applications with the following modifications and exceptions:

- a. Non-operating temperature: -40°C to $+70^{\circ}\text{C}$.
- b. Temperature/humidity: Non-condensating.
- c. Altitude: Not required.
- d. The Electromagnetic Interference requirements of MIL-T-28800() are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
- e. 400 Hz Power Source: Not required.
- f. The equipment warm-up period is increased to 1 hour.

3.0 OPERATIONAL CHARACTERISTICS.

3.1 Frequency characteristics.

3.1.1 Range: 10 MHz to 26.5 GHz; a maximum of one plug-in or RF output is allowed.

3.1.2 Resolution: At least 1 MHz.

3.1.3 Accuracy: In CW mode, measured accuracy within ± 20 MHz at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

3.1.4 Stability (less than the limits specified below).

3.1.4.1 Temperature: ± 1 MHz/ $^{\circ}\text{C}$ (over 0-50 $^{\circ}\text{C}$ operating range).

3.1.4.2 Line voltage: ± 200 kHz ($\pm 10\%$ line voltage variation about 115 Vac).

3.1.4.3 Warm-up: ± 1 MHz/10 minutes after 1 hour warm-up.

3.1.5 Residual FM in CW mode: Less than 15 kHz peak (measured in 50 Hz to 15 kHz bandwidth).

3.1.6 Spectral purity (at least the limits specified below).

3.1.6.1 Harmonics/Sub-harmonics: < -20 dBc.

3.1.6.2 Spurious/Non-harmonics: < -25 dBc [10 MHz to 2.4 GHz] and < -50 dBc [2.4 to 26.5 GHz].

3.2 Output characteristics.

3.2.1 Connector: Ruggedized coaxial (SMA compatible); VSWR less than 2.0:1.

3.2.2 Maximum leveled output: $> +7$ dBm [10 MHz to 18 GHz], $> +1$ dBm [18 to 26 GHz].

3.2.3 Level adjustment range: At least 55 dB.

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- 3.2.4 Display: Digital readout; resolution 0.1 dB.
- 3.2.5 Level accuracy: ± 2.0 dB (displayed level vs measured output level).
- 3.2.6 Flatness: ± 1.5 dB.
- 3.2.7 Attenuator error: $< \pm 3.3$ dB.
- 3.3 Modulation characteristics.
 - 3.3.1 Amplitude modulation (AM).
 - 3.3.1.1 Internal AM (square wave).
 - 3.3.1.1.1 Rate: 1 kHz and 27.8 kHz.
 - 3.3.1.1.2 On/Off ratio: Greater than 30 dB.
 - 3.3.1.2 External AM (square wave or pulse).
 - 3.3.1.2.1 Rate: 10 Hz to 50 kHz.
 - 3.3.1.2.2 Input levels: TTL compatible.
 - 3.3.1.2.3 Sensitivity: 1 dB/V, maximum input 15V.
 - 3.3.2 Frequency modulation (FM).
 - 3.3.2.1 External FM.
 - 3.3.2.1.1 Deviation: At least 0 to ± 7 MHz.
 - 3.3.2.1.2 Rate: At least 10 Hz to 100 kHz.
 - 3.3.2.1.3 Sensitivity: Greater than 5 MHz/V.
- 3.4 Sweep characteristics.
 - 3.4.1 Range: 10 MHz to 26.5 GHz.
 - 3.4.2 Sweep function: Start/Stop, CW, ΔF , Marker.
 - 3.4.3 Trigger modes: Internal (automatic), Line, External, Single.
 - 3.4.4 Markers: At least 5; both amplitude and frequency.
 - 3.4.5 Sweep output: 0 to 10 V ± 0.5 V, direct coupled, coincident with the swept RF output.
 - 3.4.6 Sweep time: At least 10 msec to 33.5 sec.
- 3.5 Displays (digital).
 - 3.5.1 Frequency: Start/Stop, CW, CF/ ΔF (4 digits minimum).
 - 3.5.2 Marker/Time: Marker frequency or sweep time (3 digits minimum).
 - 3.5.3 Output level: Output signal level in dBm (3 digits minimum).
- 4.0 GENERAL REQUIREMENTS.
 - 4.1 Power: 115 or 230 Vac $\pm 10\%$, 50/60 Hz, 400 W maximum.
 - 4.2 Dimensions: Less than 36,052 cubic cm (2200 cubic in); maximum height allowable 153 mm (6 in) including feet.

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4.3 Weight: Less than 27.3 kg (60 lbs).

4.4 Local operation: All front panel control settings shall be storable in non-volatile memory for future recall.

4.5 Remote control: Instrument must be capable of operating via the IEEE-488 interface bus and shall provide the capability to talk and listen.

4.6 Diagnostics: Functional self-test and trouble shooting shall be accomplished using front panel controlled diagnostic functions.

4.7 Rackmountable.

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APPENDIX D

GEI RT-C

GENERATOR, SWEEP

1. **GENERAL.** These salient characteristics describe a microwave sweep generator covering a frequency range of 10 MHz to 40 GHz employing no more than two plug-in heads and one mainframe.

2. **CLASSIFICATION.** The sweep generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine and shore applications with the following modifications and exceptions:

a. Nonoperating temperature: -40°C to $+70^{\circ}\text{C}$.

b. Temperature/humidity: Noncondensating.

c. Altitude: Not required.

d. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.

e. The equipment warm-up period is increased to 1 hour.

3. OPERATIONAL REQUIREMENTS.

3.1 Frequency characteristics.

3.1.1 Frequency range. 10 MHz to 40 GHz; a maximum of two plug-ins or RF outputs allowed.

3.1.2 Frequency resolution. The displayed frequency resolution shall be at least 1 MHz.

3.1.3 Frequency accuracy (measured at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$). ± 20 MHz from 10 MHz to 40 GHz.

3.1.4 Frequency stability (less than the limits specified below).

3.1.4.1 Temperature (over 0 - 50°C operating range). ± 1 MHz/ $^{\circ}\text{C}$ from 10 MHz to 20 GHz and ± 2 MHz/ $^{\circ}\text{C}$ from 20 to 40 GHz.

3.1.4.2 Line voltage ($\pm 10\%$ line voltage variation about 115 Vac). ± 200 kHz from 10 MHz to 20 GHz and ± 400 kHz from 20 to 40 GHz.

3.1.4.3 Warm-up (1 hour after power turn-on). ± 1 MHz/10 minutes from 10 MHz to 20 GHz and ± 4 MHz/10 minutes from 20 to 40 GHz.

3.1.5 Residual FM in CW mode (measured in 50 Hz to 15 kHz bandwidth). Less than 15 kHz peak for frequencies below 20 GHz and less than 20 kHz peak for frequencies from 20 to 40 GHz.

3.1.6 Spectral purity (at least the limits specified below).

3.1.6.1 Harmonics/Subharmonics. -25 dBc for frequencies from 10 MHz to 2.4 GHz, -40 dBc for frequencies from 2.4 to 26.5 GHz and -20 dBc for frequencies from 26.5 to 40 GHz.

3.1.6.2 Spurious/Nonharmonics. -25 dBc for frequencies from 10 MHz to 2.4 GHz and -50 dBc for frequencies from 2.4 to 40 GHz.

3.2 Output characteristics.

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3.2.1 Output connectors. Ruggedized coaxial (SMA compatible); VSWR <2:1 for frequencies from 10 MHz to 26.5 GHz and WR 28 waveguide or ruggedized coaxial, SMA compatible; VSWR <2.5:1 for frequencies above 26.5 GHz.

3.2.2 Output level (minimum value of maximum leveled output). +2 dBm leveled for frequencies from 10 MHz to 18.6 GHz and 0 dBm leveled for frequencies from 18.6 to 40 GHz.

3.2.3 Output level adjustment range. 60 dB for frequencies from 10 MHz to 40 GHz.

3.2.4 Output display. Digital readout of output power level; resolution 0.1 dB.

3.2.5 Level accuracy (displayed level vs measured output level, measured at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$). From ± 2.0 dB for frequencies from 10 MHz to 40 GHz internally leveled.

3.2.6 Output level variation. ± 1.5 dB for frequencies from 10 MHz to 40 GHz leveled.

3.2.7 Attenuator error. Maximum attenuator error shall be less than ± 2.0 dB (10 MHz to 40 GHz).

3.3 Modulation characteristics.

3.3.1 Amplitude modulation (AM).

3.3.1.1 Internal AM (square wave).

3.3.1.1.1 Rate. 1 kHz and 27.8 kHz.

3.3.1.1.2 On/Off ratio. Greater than 20 dB.

3.3.1.2 External AM.

3.3.1.2.1 Rate. 10 Hz to 50 kHz.

3.3.1.2.2 Input impedance. Nominally less than 30 k Ω .

3.3.1.2.3 Amplitude control. At least 13 dB.

3.3.1.2.4 Maximum input. 15V.

3.3.2 Frequency modulation (FM).

3.3.2.1 External FM.

3.3.2.1.1 Deviation. 0 to ± 7 MHz for frequencies from 10 MHz to 40 GHz.

3.3.2.1.2 Rate. 10 Hz to 100 kHz.

3.3.2.1.3 Sensitivity. Greater than 5 MHz/V.

3.4 Sweep characteristics.

3.4.1 Range. 10 MHz to 40 GHz.

3.4.2 Sweep function. Start/Stop, CW, ΔF , Marker.

3.4.3 Trigger modes. Internal (automatic), line, external, single.

3.4.4 Frequency markers. At least 5; both amplitude and frequency.

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3.4.5 Sweep time. Adjustable from at least 150 msec to 99 sec over any portion of the band.

3.5 Displays (digital).

3.5.1 Frequency. Start/Stop, CW, CF/ΔF (4 digits).

3.5.2 Marker/Time. Marker frequency or sweep time (3 digits).

3.5.3 Output level. Output signal level in dBm (3 digits).

4. GENERAL REQUIREMENTS.

4.1 Power. 115 Vac, 50/60 Hz $\pm 10\%$, 400W.

4.2 Dimensions. Less than 2,000 cubic in (32,744 cubic cm); maximum height allowable 153 mm (6 inches) including feet.

4.3 Weight. Less than 65 lbs (29.5 kg).

4.4 Local operation. All front panel control settings shall be storable in non-volatile memory for future recall.

4.5 Remote programming. Instrument must be capable of operating via the IEEE interface bus and shall provide the capability to talk and listen.

4.6 Diagnostics. Functional self-test and troubleshooting shall be accomplished using front panel controlled diagnostic functions.

4.7 Rackmountable.

4.8 Accessories.

4.8.1 If coaxial output connector is not SMA compatible, adapter to SMA is required.

4.8.2 If output is coaxial to 40 GHz, coaxial to WR-28 waveguide adapter for 26 to 40 GHz is required.

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APPENDIX D

GE4NN-A

GENERATOR, TIME MARK

1. **GENERAL.** This procurement requires a general purpose time mark generator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating calibrated outputs within the minimum ranges and accuracies specified below.
 - 3.1 **Calibrated marker ranges.** 0.1 μ s to 5s. The marker pulse shall have a base width typically 10% of pulse interval for markers from 1 μ s/div to at least 5 s/div and a base width typically 30% of pulse interval for markers below 1 μ s/div.
 - 3.1.1 **Marker amplitude.** 500 mV peak-to-peak minimum into 50 ohms.
 - 3.2 **Calibrated trigger ranges.** 100 ns to 1s in decade steps. The trigger shape shall be a fast rise square wave with leading edge coincident with time marks.
 - 3.2.1 **Trigger rise time.** 3 ns maximum into 50 ohms.
 - 3.2.2 **Trigger amplitude.** 500 mV peak minimum into 50 ohms.
 - 3.2.3 **Trigger aberrations.** Overshoot and pre-swing shall be less than 2% and the flatness of the waveform shall be $\pm 0.5\%$ or less of trigger amplitude.
 - 3.3 **Internal reference frequency stability.** 75 ppm per month within an operating temperature range of 20°C to 50°C.
 - 3.4 **External reference input.** The equipment shall be capable of specified operation during use of an external reference frequency standard.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 35W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

GE6NF-D

GENERATOR, TWO-TONE

1. **GENERAL.** This procurement requires a solid-state, two-tone signal generator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be provided with two independent oscillators, each variable in frequency and amplitude. The equipment shall be provided with a method to monitor the level of each signal and to combine the two oscillator signals into one composite output. The composite signal shall be adjustable by means of a built-in attenuator. Except where indicated, the minimum characteristics identified below shall apply both to the individual oscillators and to the composite signal.
 - 3.1 **Frequency range.** 20 Hz to 20 kHz.
 - 3.1.1 **Frequency accuracy.** $\pm(1\% + 0.2 \text{ Hz})$.
 - 3.1.2 **Frequency response.** $\pm 0.5 \text{ dB}$.
 - 3.2 **Intermodulation distortion.** 60 dB below the signal level.
 - 3.3 **Harmonic distortion.** 0.05% maximum from 63 Hz to 6.3 kHz and 0.1% over the remaining specified frequency range.
 - 3.4 **Hum.** 66 dB below the output signal.
 - 3.5 **Output impedance.** 600 ohms nominal.
 - 3.6 **Output attenuator.** 0 dB to 70 dB in 1 dB steps. Attenuator accuracy: $\pm(1\% + 0.2 \text{ dB})$.
 - 3.7 **Output level.** Continuously adjustable from -25 dBm to +15 dBm.
 - 3.8 **Level monitor.** dBm and voltage readout. Accuracy: $\pm 5\% \text{ FS}$.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. 400 Hz operation is not required. Maximum power consumption: 15W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

TSCNG-E

GENERATOR/ANALYZER, DISTORTION, TTY

1. **GENERAL.** This procurement requires a rackmountable, modular type distortion test set capable of generating, measuring, and analyzing data and teletypewriter signals.

2. **CLASSIFICATION.** Type III, Class 5, Style FG, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of accepting inputs (analyzer) and providing outputs (generator) over a range of 37.5 to 9 500 baud for the message forms, pattern types, and modes of operation specified below. The following specific baud rates shall be included in both the generator and analyzer: 37.5, 45.5, 50, 61.12, 74.2, 100, 110, and 75×2^n where n is an integer from 0 to 7.

3.1 **Analyzer input signals.** The equipment shall be capable of accepting both high level and low level signals. This interface may be provided by the use of bridging and series inputs.

3.1.1 **Bridging input.** The bridging input, for low level signals (0.5 to 25 Vdc polar), shall have an impedance of 47 to 68 kilohms. This input shall be provided with a switch-selectable input filter for use with data rates of 75 baud or less.

3.1.2 **Series input.** High level signals: 20 to 60 mA neutral, 20 to 30 mA polar. This input shall have a means of reversing the polarity of the incoming signal.

3.1.3 **Inputs.** 5, 6, 7, and 8 level codes, either synchronous or asynchronous.

3.1.3.1 **Synchronous operation.** The equipment shall be provided with a means of phase locking internal timing with the incoming signal.

3.1.3.2 **Asynchronous operation.** The equipment shall have a single-unit start as well as stop selections at intervals of 1.0, 1.5, and 2.0 units.

3.1.4 **External frequency input.** The equipment shall be capable of operation from an external frequency source.

3.2 **Analyzer distortion measurements.** The equipment shall analyze and indicate, in percentage, the following distortions:

a. **Bias or end distortion:** The equipment shall indicate the average of either bias or end distortion, as selected, and whether it is marking or spacing.

b. **Total, early, late distortion:** The equipment shall provide a peak distortion reading for all space-to-mark and mark-to-space transitions and shall select the total (all), early, or late distortion transitions. Peak distortion measurements shall be retained on the equipment display until the distortion being monitored increases or until a selected automatic (3 to 5 seconds nominal) or manual reset is initiated.

3.2.1 **Parity.** The equipment shall have odd and even parity check capability.

3.2.2 **Type display.** The equipment shall be provided with a D'Arsonval type meter capable of reading percent distortion in 1% increments over a range of 0 to at least 49%.

3.2.3 **Display accuracy.** $\pm 2\%$ FS.

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3.2.4 **Signal state.** The equipment shall be provided with an input signal indicator.

3.2.5 **Mark-space distortion.** The equipment shall be provided with marking and spacing distortion indicators.

3.3 **Generator, output functions.** The generator shall be capable of producing synchronous and asynchronous 5, 6, 7, or 8 level code. Asynchronous operation shall have single-unit start as well as stop selections at intervals of 1.0, 1.5, and 2.0 units.

3.3.1 **Data generation.** The equipment shall be capable of generating the following selectable test data messages.

- a. Standard "Fox" message (ITA2 and ASCII).
- b. Selected programmed characters (1 to at least 4).
- c. Message and selected characters.
- d. Steady mark.
- e. Steady space.
- f. 1:1 continuous reversal.

3.3.2 **Output keying.** The equipment shall be provided with the following output capabilities:

- a. Low level polar (6V ((1V).
- b. High level, fully isolated polar and neutral keyer rated for a nominal 100 to 270V at 40 to 70 mA.

3.3.3 **Distortion.** The equipment shall be capable of generating the following distortion in 1% increments over a range of at least 0 to 49%:

- a. Marking bias.
- b. Spacing bias.
- c. Switching bias.
- d. Marking end.
- e. Spacing end.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 100W.

5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

MMRAL-A

INDICATOR, MOTOR ROTATION

1. **GENERAL.** This procurement requires a motor rotation indicator for three-phase motors.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall indicate motor rotation in accordance with the following minimum specifications.
 - 3.1 **Rotation indicators.** ABC and CBA.
 - 3.2 **Leads.** Color coded alligator clips.
4. **POWER SOURCE.** MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 100 hours of operation before replacement. The nominal power source requirements are not invoked.
5. **WEIGHT.** 0.45 kg (1 lb) maximum.

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Configuration A: MPSBA-A

Configuration B: MPSBB-A

INDICATOR, PHASE SEQUENCE

1. **GENERAL.** This procurement requires a phase sequence indicator.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall indicate three-phase sequence rotation in accordance with the following minimum specifications.
 - 3.1 **Frequency.** Configuration A and B frequencies shall be as follows.
 - 3.1.1 **Configuration A.** 400 Hz nominal.
 - 3.1.2 **Configuration B.** 60 Hz nominal.
 - 3.2 **Maximum voltage.** 700 Vac.
 - 3.3 **Phase rotation.** ABC and ACB.
 - 3.4 **Leads.** Color coded insulated alligator clips. Configuration A and B shall be as follows.
 - 3.4.1 **Configuration A.** Color coded insulated alligator clips.
 - 3.4.2 **Configuration B.** Insulated alligator clips with the following color codes: A Black, B White, and C Red.
4. **POWER SOURCE.** MIL-T-28800 power source requirements are not invoked. The equipment shall derive source power from the circuit under test.
5. **WEIGHT.** 0.5 kg (1 lb) maximum.

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APPENDIX D

FROMM-C

METER, FREQUENCY

1. **GENERAL.** This procurement requires a direct-reading, coaxial-line frequency meter.
2. **CLASSIFICATION.** Type III, Class 6, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. The power source and EMI requirements are not invoked.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of measuring frequencies within the minimum ranges and specifications detailed below.
 - 3.1 **Frequency range.** 0.96 to 4.2 GHz.
 - 3.1.1 **Resolution.** 2 MHz.
 - 3.2 **Accuracy.** $\pm 0.22\%$ from 0.96 to 1.0 GHz and $\pm 0.17\%$ from 1.0 to 4.2 GHz.
 - 3.3 **RF absorption.** 1 dB minimum at resonance.
 - 3.4 **Insertion loss.** 2 dB maximum off-resonance.
 - 3.5 **SWR.** 2.0:1 off-resonance.
 - 3.6 **Connectors.** Type N(f).
4. **WEIGHT.** 4.5 kg (10 lb) maximum.

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APPENDIX D

FROMT-C
METER, FREQUENCY

1. **GENERAL.** This procurement requires a direct-reading, coaxial-line frequency meter.
2. **CLASSIFICATION.** Type III, Class 6, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. The power source and EMI requirements are not invoked.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of measuring frequencies within the minimum ranges and specifications detailed below.
 - 3.1 Frequency range. 3.7 to 12.4 GHz.
 - 3.1.1 Resolution. 10 MHz.
 - 3.2 Accuracy. $\pm 0.17\%$.
 - 3.3 RF absorption. 1 dB minimum at resonance.
 - 3.4 Insertion loss. 2 dB maximum off-resonance.
 - 3.5 SWR. 2.0:1 off-resonance.
 - 3.6 Connectors. Type N(f).
4. **WEIGHT.** 4.5 kg (10 lb) maximum.

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APPENDIX D

GPONN-C

METER, GAIN/PHASE

1. **GENERAL.** This procurement requires a general purpose, solid-state ac voltmeter capable of measuring gain, loss, and phase angles in degrees.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring gain, loss, and phase angle within the minimum parameters, accuracies, and limits specified below.
 - 3.1 **Frequency range.** 10 Hz to 100 kHz.
 - 3.2 **Amplitude functions.** Log A, Log B, and Log B/A (ratio).
 - 3.2.1 **Log A and Log B functions.** When either the Log A or Log B function is selected, the equipment shall measure the logarithmic amplitude of the corresponding input signal in dBV (1 Vrms = 0 dBV).
 - 3.2.1.1 **Log A and Log B range and accuracy.** -74 dBV to 26 dBV. Resolution: 0.1 dBV. Accuracy: ± 1.3 dBV from 10 Hz to 100 kHz.
 - 3.2.2 **Log B/A function.** When the Log B/A function is selected, the equipment shall measure the relative amplitude between the two input signals in dB, irrespective of frequency difference.
 - 3.2.2.1 **Log B/A range.** -100 dB to 100 dB. Resolution: 0.1 dB.
 - 3.3 **Phase function.** Range: 360° (-180° to +180°). Resolution: 1°. Accuracy: $\pm 2^\circ$ at -30 dBV from 100 Hz to 12 kHz.
 - 3.3.1 **Phase function input levels.** The equipment shall be capable of performing phase angle measurements between any two input signals that differ by less than 100 dB.
 - 3.4 **Input characteristics.**
 - 3.4.1 **Input RC.** 1 megohm shunted by 30 pF, nominal.
 - 3.4.2 **Maximum input without damage.** 20 Vrms or ± 40 Vdc.
 4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 40W.
 5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

GDOAN-A

METER, GRID DIP

1. **GENERAL.** This procurement requires an oscillator-type grid dip meter capable of determining the frequency of resonant circuits.
2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of measuring the frequency of resonant circuits over a frequency range of 100 kHz or less to at least 940 MHz.
 - 3.1 **Accuracy.** $\pm 2\%$ of indicated value.
 - 3.2 **Output.** The equipment shall be capable of radiating an RF signal over the specified frequency range. Amplitude modulation capabilities shall be provided as follows:
 - a. **Internal:** Internal modulation shall be provided.
 - b. **External:** External modulation capability shall be from 20 Hz or less to at least 20 kHz.
 - 3.2.1 **Audio monitor.** A headphone jack for audio monitoring shall be provided.
 - 3.3 **Meter.** The equipment shall be provided with an analog meter that has a taut-band movement for resonance indications.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 30W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

VOZNW-A

METER, IMPEDANCE, VECTOR

1. **GENERAL.** This procurement requires a general-purpose vector impedance meter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITY.** The equipment shall be capable of impedance magnitude and phase angle measurement within the minimum ranges and accuracies specified below.
 - 3.1 **Frequency range.** 0.5 MHz to 108 MHz.
 - 3.1.1 **Frequency accuracy.** $\pm 2\%$ of indication.
 - 3.2 **Impedance range.** 1 ohm to 100 kilohms.
 - 3.2.1 **Impedance accuracy.** $\pm 3\%$ of reading.
 - 3.2.2 **Impedance resolution.** 200 milliohm.
 - 3.3 **Phase angle range.** 360°.
 - 3.3.1 **Phase angle accuracy.** $\pm 3.2^\circ$.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 150W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

LCMAB-C

METER, L-C

1. **GENERAL.** This procurement requires a portable, self-contained, inductance-capacitance meter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring inductance and capacitance within the minimum ranges, accuracies, and specifications identified below.
 - 3.1 **Display.** The equipment shall be provided with a front panel display indicator for capacitance and inductance values in accordance with MIL-T-28800.
 - 3.1.1 **Resolution.** Three significant digits.
 - 3.2 **Capacitance measurement range.** 1 pF to 1,000 uF.
 - 3.2.1 **Capacitance measurement accuracy.** $\pm 1\%$ of indication ± 1 pF \pm two counts of the least significant digit.
 - 3.2.2 **Leakage testing voltage.** 3 to 600 Vdc.
 - 3.3 **Inductance measurement range.** 1 uH to 10H.
 - 3.3.1 **Inductance measurement accuracy.** $\pm 2\%$ of indication \pm two counts of the least significant digit.
 - 3.3.2 **Ring test.** The equipment shall be capable of ring testing using an excitation pulse of nominally 7V peak.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 100W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

MDONN-A

METER, MODULATION

1. **GENERAL.** This procurement requires a modulation meter capable of performing FM deviation and AM depth measurements.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of performing FM and AM measurements within the minimum ranges, sensitivities, and accuracies specified below.
 - 3.1 **RF carrier range.** 30 MHz to 1 GHz.
 - 3.2 **AM and FM frequency range.** 50 Hz to 30 kHz.
 - 3.3 **Sensitivity.** 25 mVrms or less.
 - 3.3.1 **Maximum input.** 3 Vrms.
 - 3.3.2 **Input impedance.** 50 ohms nominal.
 - 3.4 **Frequency modulation.**
 - 3.4.1 **Peak deviation ranges.** 1.5 to 125 kHz.
 - 3.4.2 **Peak deviation accuracy.** $\pm(2\% \text{ FS} + 1\% \text{ of indication})$ at a 1 kHz modulation frequency.
 - 3.4.3 **Residual FM noise.** The residual FM noise shall not exceed -46 dB over the frequency range of 30 MHz to at least 250 MHz. Referenced to 10 kHz peak deviation, the noise level shall be measured at the AF output with a 3 kHz filter. Residual FM noise shall not increase more than 6 dB per octave above 250 MHz.
 - 3.4.4 **AM rejection.** For simultaneous amplitude and frequency modulation, the additional deviation error for FM shall be less than 250 Hz when the AM depth is 80% or less and the modulating frequency is within the range of 300 Hz to 3 kHz.
 - 3.5 **Amplitude modulation.**
 - 3.5.1 **AM depth range.** 30% to 100% FS.
 - 3.5.2 **AM accuracy.** $\pm 4\%$ FS for a modulating frequency of 1 kHz.
 - 3.6 **IF output.** An IF output shall be provided.
 - 3.7 **AF output.** An AF output shall be provided.
 - 3.7.1 **AF output distortion.** 1% or less for AM depths up to 80% at input levels less than 50 mV and 0.5% for FM deviations up to ± 100 kHz.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 15W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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NFONN-C

METER, NOISE FIGURE

1. **GENERAL.** This procurement requires a solid-state noise figure meter capable of making accurate noise figure and gain/loss measurements on any receiving system and/or any two-port device in the frequency range of 10 MHz to 18 GHz with IF down conversion to a frequency range of 10 MHz to 1600 MHz.

2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

a. The relative humidity requirement is limited to 95% noncondensating.

b. The operating and nonoperating altitude requirements are not invoked.

c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring and directly indicating both noise figure and gain/loss in dB within the specifications and accuracies contained herein.

3.1 **Frequency.** (F = Tuned frequency) .

3.1.1 **Range.** Tunable at least from 10 MHz to 1600 MHz.

3.1.1.1 **RF input connector.** Type-N female.

3.1.1.2 **VSWR.** < 1.7.

3.1.2 **Bandwidth.** 4 - 5 MHz (nominal).

3.1.3 **Tuning accuracy.** (10°C to 40°C) < $\pm(1\%$ of F + 1 MHz) (F < 500 MHz) < ± 6 MHz (F > 500 MHz).

3.1.4 **Display.** Digital readout.

3.1.4.1 **Resolution.** At least 1 MHz.

3.1.5 **Frequency resolution.** At least 1 MHz.

3.2 **Measurement range.** (F = Noise Figure, Y = Y factor, T_e = Effective Temperature).

3.2.1 **Noise figure (NF).** At least 0 to 25 dB (with automatic second stage correction).

3.2.1.1 **Resolution.** At least 0.01 dB.

3.2.1.2 **Instrumentation accuracy.** < ± 0.15 dB (ENR 14 to 16).

3.2.1.3 **Display.** F (dB) / Y (dB) / T_e

3.2.2 **Gain/Loss (G/L).** At least -20 to +40 dB.

3.2.2.1 **Resolution.** At least 0.1 dB.

3.2.2.2 **Accuracy.** < ± 0.25 dB.

3.3 **Output signals.**

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- 3.3.1 Noise source drive voltage. $28 \pm 1V$ (BNC female).
- 3.3.2 Recorder outputs.
 - 3.3.2.1 X-axis. At least 0 to 5V nominal (BNC female).
 - 3.3.2.2 Y-axis. At least 0 to 5V nominal (BNC female).
 - 3.3.2.3 Z-axis. TTL levels (BNC female), pen lift when using X-Y plotter; blanking with oscilloscope.
- 3.4 Noise source. (f - Measurement frequency).
 - 3.4.1 Drive voltage. $28.0 \pm 0.1V$.
 - 3.4.1.1 Connector. BNC female.
 - 3.4.2 Frequency range. 10 MHz to 18 GHz (one device).
 - 3.4.3 ENR. At least 12 dB (uncertainty $< \pm 0.4$ dB worst case) [$f < 18$ GHz].
 - 3.4.3.1 Calibration data of ENR vs Freq supplied for each noise source.
 - 3.4.3.2 Number of data points. > 10 (across range of noise source) [$f < 18$ GHz].
 - 3.4.4 Maximum SWR. < 1.3 [$f < 18$ GHz].
- 4. GENERAL REQUIREMENTS.
 - 4.1 Power source. 115 or 230 Vac $\pm 10\%$, single phase 60 Hz $\pm 10\%$, less than 200 VA.
 - 4.2 Dimensions. The total volume shall not exceed $29,170 \text{ cm}^3$ ($1,780 \text{ in}^3$).
 - 4.3 Weight. The overall weight shall be nominally 15.9 kg (35 lbs).
 - 4.4 Remote operation. The unit will be capable of remote operation via IEEE-488() bus interface. It shall operate as a talker or listener such that all functions except the power on/off switch are controllable, and shall have as a minimum the following subset of GPIB commands: AH1, SH1, T6, L4, SR1, RL1, PP0, DC1, DT1.

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NFONT-B

METER, FIGURE, NOISE

1.0 GENERAL. This procurement requires a portable, solid-state, ruggedized noise figure meter capable of making noise figure/sensitivity measurements on microwave receiving systems with a frequency range from 5 MHz to 40 GHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of measuring and directly indicating noise figure in dB within the specifications and accuracies contained herein.

3.1 Measurement frequency range. At least 5 MHz to 40 GHz.

3.2 Measurement range. The noise figure measurement range shall be at least 2 to 30 dB.

3.2.1 Resolution. The resolution of the noise figure indication shall be at least 0.1 dB.

3.3 Noise source. The noise source must have the capabilities of providing at least 5 dB and/or 15 dB excess noise ratios within ± 1.0 dB over the entire frequency range.

3.4 Accuracy. The overall accuracy of the noise figure indication, including meter, noise source, and any attenuators required, shall be within ± 2.0 dB when compared with a comparable Y-factor measurement.

3.5 IF input. The input shall be linear, nonsaturating band-limited noise with the following minimum characteristics:

3.5.1 Frequency. At least 10 to 200 MHz.

3.5.2 Sensitivity. At least -65 dBm.

3.5.3 AGC range. At least 40 dB.

3.6 Plotter outputs. The equipment shall provide an output capable of driving the Y channel of a standard X-Y analog plotter to produce a plot of noise figure across the frequency range under test when the X channel is driven by a ramp proportional to frequency.

4.0 GENERAL REQUIREMENTS.

4.1 Dimensions. The total volume of the unit shall not exceed 24,600 cubic cm (1,500 cubic in).

4.2 Weight. The overall weight of the unit (including noise source/accessories) shall not exceed 18.2 kg (40 pounds).

4.3 Power. 115/230 Vac $\pm 10\%$, 50/60 or 400 Hz, 150 VA maximum.

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PJMNN-B

METER, PHASE JITTER

1. **GENERAL.** This procurement requires a phase jitter meter designed to meet IEEE Std 743-1984 specifications.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall measure and indicate phase jitter on voiceband transmissions within the following minimum specifications.
 - 3.1 **Input characteristics.**
 - 3.1.1 **Input frequency range.** 990 Hz to 1,030 Hz.
 - 3.1.2 **Input signal level.** -40 dbm to +10 dBm.
 - 3.1.3 **Input impedance.** 600 ohms and 900 ohms nominal.
 - 3.2 **Output characteristics.**
 - 3.2.1 **Output frequency.** Shall be between 1002 Hz and 1020 Hz.
 - 3.2.2 **Output signal level.** -40 dBm to 0 dBm.
 - 3.2.3 **Output impedance.** 600 ohms nominal.
 - 3.3 **Displays.** Peak-to-peak phase jitter, input level, output level, and input frequency.
 - 3.3.1 **Phase jitter indication.** 0° to 30°. Accuracy: $\pm 5\%$ of indication $\pm 0.2^\circ$ or less.
 - 3.3.2 **Input and output level indication.** -20 dBm to 0 dBm within 1 dB.
 - 3.3.3 **Frequency indication range.** 990 Hz to 1,030 Hz.
 - 3.4 **Phase and amplitude hits.** The equipment shall detect and totalize phase and amplitude transients that exceed preset thresholds for 4 ms.
 - 3.4.1 **Phase hit threshold.** Selectable from 5° to 45° in 5° steps. Accuracy: $\pm 10\%$ of setting $\pm 0.5^\circ$ or less.
 - 3.4.2 **Amplitude hit threshold.** Settings of ± 1 , 2, 3, and 6 dB shall be provided. Accuracy: ± 0.5 dB.
 - 3.4.3 **Timer.** Continuous and up to 15 minutes timed.
 - 3.5 **Weighting characteristics.** The equipment shall be provided with filters that allow measurement of jitter frequencies from 20 Hz to 300 Hz in accordance with IEEE Std 743-1984.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 50W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

MU2CX-D

MULTIMETER, DIGITAL

1. **GENERAL.** This procurement requires a portable, hand-held multimeter.
2. **CLASSIFICATION.** Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800. The handle requirement is not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be provided with autoranging capabilities and a memory function which captures and holds a reading for display. The equipment shall be capable of measurements within the minimum ranges and specifications detailed below.
 - 3.1 **DC voltage.** Range: 5 mV to 1 kV. Accuracy: $\pm(0.5\%$ of reading + 1 count). Input resistance: 10 megohms minimum.
 - 3.2 **AC voltage.** Range: 100 mV to 750V. Accuracy: $\pm(2\%$ of reading + 5 counts). Frequency range: 45 Hz to 500 Hz up to 5V, 45 Hz to 1 kHz from 5V to 750V. Input RC: 10 megohms or greater shunted by 100 pF or less. The meter shall be average responding and RMS indicating.
 - 3.3 **DC current.** Range: 10 mA to 10A. Accuracy: $\pm(2\%$ of reading + 3 counts).
 - 3.4 **AC current.** Range: 10 mA to 10A. Accuracy: $\pm(3\%$ of reading + 2 counts). Frequency range: 45 Hz to 1 kHz.
 - 3.5 **Resistance.** Range: 0.1 ohms to 20 megohms. Accuracy: $\pm(2\%$ of reading + 1 count).
 - 3.6 **Overload protection.** DC volts function: 500 Vdc or ac on lowest range, 1,000 Vdc or 750 Vac on all other ranges. AC volts function: 1,000 Vdc or 750 Vrms. Current functions: 200% of full scale value on mA ranges, 15A on 10A range. Resistance: 500 Vdc or ac.
 - 3.7 **Display.** A 3-1/2 digit display that is readable at "arms length" shall be provided. A bar graph or analog indicator shall be provided for peak and null interpretation.
4. **ACCESSORIES.** The equipment shall be provided with safety-designed test leads in accordance with MIL-T-28800. A protective case or holster that allows storage of test leads shall be provided.
5. **POWER SOURCE.** MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 12 months of operation before replacement. The nominal power source requirements are not invoked.
6. **DIMENSIONS.** 178 mm (7 in) high, 80 mm (3.15 in) wide, and 45 mm (1.8 in) deep, nominal.
7. **WEIGHT.** 0.45 kg (1.0 lb) maximum.

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MU2CA-C

MULTIMETER, DIGITAL

1. **GENERAL.** This procurement requires a digital, handheld, ruggedized multimeter with high-voltage and RF probes.
2. **CLASSIFICATION.** Type III, Class 2, Style A, and Color V in accordance with MIL-T-28800 with the following exceptions:
- The operating temperature range is reduced to -15°C to 55°C.
 - The handle requirement is not invoked.
 - The transit drop height is reduced to 18 inches.
 - The equipment may be provided in a coverless Style A enclosure but contained in a Style P transit case.
3. **MEASUREMENT CAPABILITIES.** The equipment shall have a 3-1/2 digit display supplemented with a bar-graph type peaking and nulling display and be capable of measuring resistance, voltage, and current within the minimum ranges and accuracies specified below. The equipment shall be average responding and rms indicating.
- 3.1 **Voltage measurement.** Range: 500 mV to 1,000V full scale. Resolution: 0.1% of range. Accuracy: See table I.

TABLE I. Accuracies (20 to 30°C)

<u>Function</u>	<u>Range</u>	<u>* Accuracies ±(% of Input + No. of Counts)</u>
DC Volts	All	0.1 + 1
AC Volts		
50 Hz to 2 kHz	All	0.5 + 3
2 kHz to 20 kHz	All	4.0 + 10
20 kHz to 70 kHz	200 mV to 20V	6.0 + 10
Ohms	200 ohms to 1 megohm	0.2 + 1
	1 megohm to 10 megohms	1.0 + 1
DC Current	All	0.8 + 2
AC Current		
40 Hz to 1 kHz	All	1.5 + 2

*After a response time of 4 seconds for ac, 2 seconds for dc, and 10 seconds for ohms.

- 3.1.1 **Noise rejection.** DC: Common mode: 100 dB at dc, 50, and 60 Hz with a 1 kilohm unbalanced input. Normal mode: 60 dB at 50 and 60 Hz.
- 3.2 **Resistance measurement.** Range: 1 kilohm to 10 megohms full scale. Resolution: 0.1% of range. Accuracy: See table I.
- 3.3 **Current measurement.** Range: 400 uA to 2A full scale. Resolution: 0.1% of range. Accuracy: See table I.
- 3.4 **Temperature coefficient.** All functions: $\pm(0.1 \times \text{the specified accuracy}/^\circ\text{C})$.

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3.5 Maximum input. AC: 500 Vdc or 1 kVrms. DC: 1 kV (dc + peak ac).
Ohms: 130 Vrms on 1 kilohm range and below.

3.6 Inputs. The equipment shall have at least two female banana input terminals. The low terminal shall be capable of withstanding voltage potentials of 500 Vdc above or below ground potential. If the instrument operates from nominal and alternate dc power, a third female banana input terminal for ground connection shall be provided.

3.6.1 Input impedance. AC volts: 1 megohm shunted by 200 pF nominal. DC volts: 10 megohms nominal.

3.7 Display. The following indicators are required: Input overload, battery state, and polarity.

3.8 ACCESSORIES. The equipment shall be provided with safety-designed test leads in accordance with MIL-T-28800. Other accessories shall be as specified in 3.8.1 and 3.8.2.

3.8.1 DC high voltage probe. A dc high voltage probe shall be provided to extend the dc voltage measuring capability to at least 5 kV. The total accuracy shall be within $\pm 2\%$ of input + 1 count.

3.8.2 RF probe. An RF probe shall be provided to extend the frequency range for ac voltage measurements from 70 kHz to 450 MHz. The voltage range shall be from 0.25 to 30V. The accuracy shall be within ± 1 dB for frequencies from 70 kHz to 200 MHz and ± 3 dB above 200 MHz.

4. POWER SOURCE. MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 12 months of operation before replacement. The nominal power source requirements are not invoked.

5. DIMENSIONS. The multimeter shall be 56 mm (2.2 in) high, 95 mm (3.75 in) wide, and 203 mm (8 in) deep, nominal.

6. WEIGHT. 0.9 kg (2 lb) maximum.

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APPENDIX D

Configuration A: MU2QT-C
MULTIMETER, DIGITAL

Configuration B: TS1AA-A
TEST SET, ELECTRICAL

1. **GENERAL.** This procurement requires a hand-held, true rms, digital multimeter with frequency counting capability. Configuration B additionally requires two temperature probes, a current probe, and a transit case as specified in 4.1 through 5.
2. **CLASSIFICATION.** The equipment shall be as classified in 2.1 and 2.2 for shipboard applications. The transit drop test is invoked in accordance with MIL-T-28800. The drop height shall be 122 cm (48 in).
 - 2.1 Configuration A. Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800.
 - 2.2 Configuration B. Type III, Class 3, Style EP, and Color R in accordance with MIL-T-28800.
3. **PERFORMANCE REQUIREMENTS.** The equipment shall be capable of measuring voltage, current, resistance, and frequency within the minimum specifications detailed below. The equipment shall respond to and display the true rms value of ac signals. Configuration B equipment shall also be capable of measuring temperature to 316°C (600°F) and current to 200A.
 - 3.1 Voltage measurement. Range: 500 mV to 1,000V full scale. Maximum resolution: 0.1 mV. Accuracy: dc: $\pm(0.1\%$ of reading + 1 digit), ac: $\pm(1\%$ of reading + 4 digits) from 50 Hz to 5 kHz and 0 to 1,000 Vrms, $\pm(2\%$ of reading + 4 digits) from 5 kHz to 20 kHz and 0 to 400 Vrms.
 - 3.1.1 Noise rejection. DC: normal mode: >60 dB at 50 or 60 Hz, common mode: >120 dB at dc, 50 or 60 Hz. AC: common mode >60 dB at dc to 60 Hz.
 - 3.2 Current measurement. Range: 500 uA to 10A full scale, ac and dc. AC frequency range: 45 Hz to 2 kHz. Maximum resolution: 0.1 uA. Accuracy: dc: $\pm(0.2\%$ of reading + 2 digits), ac: $\pm(1.0\%$ of reading + 2 digits). Overload protection: 1A on uA and mA ranges, 15A on amp ranges.
 - 3.3 Resistance measurement. Range: 0 to 1 megohms full scale. Maximum resolution: 0.1 ohm. Accuracy: $\pm(1.0\%$ of reading + 5 digits). Overload protection: 500 Vrms.
 - 3.4 Crest factor. 3.0 minimum.
 - 3.5 Frequency measurement. Range: 1.0 Hz to 200 kHz. Minimum pulse width: 2 us. Maximum resolution: 0.01 Hz. Accuracy: $\pm(0.005\%$ of reading + 1 digit).
 - 3.6 Resolution and display. A 3-1/2 digit backlit display with an analog bar graph for peaking and nulling shall be provided.
 - 3.7 Memory. The equipment shall be capable of capturing and holding a reading for display and of storing and displaying the minimum, maximum and average of all readings taken over an indefinite period of time. The equipment shall give an audible indication when a new minimum or maximum value has been recorded. In addition, the equipment shall be capable of displaying the difference between a reading stored in memory and any subsequent readings.
 - 3.8 Indicators. The required indicators are input overload and polarity.

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4. ACCESSORIES. The equipment shall be provided with safety-designed test leads in accordance with MIL-T-28800. A shock absorbing protective holster with a flexible stand device shall also be provided.

4.1 Immersion probe. Configuration B equipment shall be provided with an immersion probe in accordance with the following specifications.

4.1.1 Temperature range. 0° to 316°C (32 to 600°F).

4.1.2 Accuracy. $\pm 2.2^\circ\text{C}$ from 0° to 275°C and $\pm 0.75\%$ of indication from 275 to 316°C.

4.2 Surface probe. Configuration B equipment shall be provided with a surface probe in accordance with the following specifications.

4.2.1 Temperature range. 0° to 260°C (32 to 500°F).

4.2.2 Accuracy. $\pm 1.1^\circ\text{C}$.

4.3 Current probe. Configuration B equipment shall be provided with a dc and ac clamp-on current probe in accordance with the following specifications.

4.3.1 Ranges. 20A and 200A.

4.3.2 Accuracy. DC to 200 Hz, $\pm 2\%$ of range. 200 Hz to 1 kHz, add $\pm 3\%$ of reading for readings below 100A and $\pm 6\%$ of reading for readings above 100A.

4.3.3 Clamp size. The clamp shall be capable of encompassing conductors up to but no larger than 1.9 cm (0.75 in).

5. TRANSIT CASE. The Style P transit case shall provide protection for all components of the Configuration B equipment.

6. POWER SOURCE. MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 500 hours of operation before replacement. A battery state indicator is required in accordance with MIL-T-28800. The nominal power source requirements are not invoked.

7. DIMENSIONS. The multimeter shall be 56 mm (2.2 in) high, 100 mm (3.94 in) wide, and 203 mm (8 in) long, nominal. The Configuration B transit case shall be 102 mm (4 in) high, 457 mm (18 in) wide, and 381 mm (15 in) long, nominal.

8. WEIGHT. Configuration A: 1.0 kg (2.2 lb) maximum. Configuration B: 4.5 kg (10 lb) maximum.

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APPENDIX D

MU2JM-E

MULTIMETER, DIGITAL

1. **GENERAL.** This procurement requires a portable 4-1/2 digit multimeter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of measuring ac and dc voltages, ac and dc current, and resistance within the minimum ranges and accuracies specified below.
 - 3.1 **Voltage measurements.** Range: 200 mV to 1,000 Vdc and 750 Vac full scale. The meter shall be average responding and rms indicating in ac mode.
 - 3.1.1 **Voltage accuracy.** AC and dc voltage measurement accuracies specified in table I shall apply after a measurement (response) time not to exceed 1.5 seconds for ac and 1 second for dc.

TABLE I. Accuracies (15 to 35°C after 30 min. warm-up)

<u>Function</u>	<u>Range</u>	<u>1 Year Accuracies</u> <u>±(% input + No. of counts)</u>
<u>DC Volts</u>	All	0.06 + 3
<u>AC Volts (5% to 100% of range) (V x Hz less than 2 x 10E7)</u>		
30 Hz - 50 Hz	All except 750V	0.8 + 30
50 Hz - 10 kHz	All except 750V	0.3 + 20
10 kHz - 50 kHz	All except 750V	0.8 + 30
50 kHz - 70 kHz	200 mV	0.8 + 100
50 kHz - 70 kHz	2, 20, 200V	1.5 + 15
50 Hz - 10 kHz	750V	0.5 + 8
<u>DC Current</u>	All Ranges	0.2 + 3
<u>AC Current (5% to 100% of range)</u>		
30 Hz - 50 Hz	All	1.0 + 30
50 Hz - 2 kHz	2A	1.2 + 20
50 Hz - 10 kHz	All except 2A	1.0 + 20
<u>Ohms</u>	All	0.4 + 2

3.1.2 **Voltage temperature coefficient.** DC: $\pm(0.004\%$ of reading + 0.001% of FS)/°C maximum. AC: $\pm(0.02\%$ of reading + 0.005% of FS)/°C maximum.

3.1.3 **Noise rejection.** DC mode: 90 dB for CMR and 60 dB for NMR at 50 and 60 Hz. CMR is specified with a 1 kilohm unbalanced input.

3.1.4 **Voltage function maximum input.** All ac and dc voltage ranges: 1,000V and 2 x 10E7 volts x hertz in ac.

3.2 **Current measurements.** Range: 10 mA to 2A FS, ac and dc, in selectable ranges.

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3.2.1 **Current accuracy.** The alternating and direct current measurement accuracy parameters specified in table I shall apply after a measurement (response) time not to exceed one second.

3.2.2 **Current temperature coefficient.** DC: $\pm(0.005\%$ of reading + 0.001% of FS)/°C maximum. AC: $\pm(0.02\%$ of reading + 0.005% of FS)/°C maximum.

3.2.3 **Current function input protection.** All alternating and direct current ranges: 2A. Protection above this current level shall be provided by a fuse or resettable circuit breaker.

3.3 **Resistance measurement.** Range: 200 ohms to 20 megohms full scale.

3.3.1 **Resistance accuracy.** The resistance measurement accuracy parameters specified in table I shall apply after a measurement (response) time not to exceed one second throughout selectable ranges below 20 megohms and four seconds throughout the 20 megohm range.

3.3.2 **Resistance temperature coefficient.** $\pm(0.1\%$ of reading + 0.001% of FS)/°C maximum.

3.3.3 **Open-circuit voltage.** 5V maximum.

3.3.4 **Current through the unknown resistance.** 1 mA maximum.

3.3.5 **Resistance function input protection.** 250 Vdc or 250 Vrms.

3.4 **Controls and displays.**

3.4.1 **Controls.** The equipment shall be provided with manual selection for all ranges specified above and an internal battery status test or indication.

3.4.2 **Displays.** The equipment shall be provided with a digital readout and an indication of excess input level.

3.4.3 **Automatic features.** The equipment shall be provided with automatic ranging except in current functions, automatic polarity selection for all dc functions, and automatic zeroing for all functions.

3.5 **Inputs.**

3.5.1 **Common input floating voltage level.** 1,000V (dc + peak ac) referenced to case ground.

3.5.2 **Input impedance.** DC: 10 megohms. AC input RC: 1 megohm with no more than 100 pF shunt capacitance.

3.6 **Test leads.** Test leads that are designed for operator protection against hazardous potentials in accordance with MIL-T-28800 are required.

4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.

4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 20W.

4.2 **DC internal power source:** Internal batteries and charger are required. Minimum operating time shall be 6 hours following a maximum recharge time of 16 hours.

5. **WEIGHT.** 5 kg (11 lb) maximum.

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MU2QM-F

MULTIMETER, DIGITAL

1. **GENERAL.** This procurement requires a solid-state, 5-1/2 digit, true rms multimeter designed for laboratory and field use.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITIES.** The equipment shall be capable of measuring ac and dc voltages and resistances within the ranges and accuracies specified below. The equipment shall respond to the true rms value of ac signals.
 - 3.1 **Voltage measurements.** The minimum full-range ac and dc voltage measurement capability shall be as follows:
 - a. AC: 2 to 700V in selectable ranges with a sensitivity and resolution of at least 10 uV on the lowest range.
 - b. DC: ± 0.2 to 1,000V in selectable ranges with a sensitivity and resolution of at least 1 uV on the lowest range. Polarity shall be automatically sensed and displayed.
 - 3.1.1 **Voltage accuracy.** The ac and dc voltage accuracies shall be within those specified in table I after a measurement time (response time) not to exceed three seconds.

TABLE I. Accuracies

<u>Function</u>	<u>Range</u>	<u>Accuracies</u> $\pm(_\% \text{ Reading} + _\# \text{ of Counts})$
<u>DC Volts</u>	200 mV to 1,000V	0.015 + 5
<u>AC Volts</u>		
50 to 100 Hz	2 to 700V	0.4 + 100
100 Hz to 20 kHz	2 to 700V	0.3 + 75
<u>Ohms</u>	All except 20M	0.1 + 10
	20M	0.5 + 10

- 3.1.2 **Voltage accuracy temperature coefficient.** The temperature coefficients shall not exceed those specified in table II.

TABLE II. Temperature Coefficients

<u>Function</u>	<u>Range</u>	<u>Coefficients</u> $\pm(_\% \text{ Input} + _\# \text{ of Counts})/^{\circ}\text{C}$
<u>DC Volts</u>	200 mV to 1,000V	0.007 + 3
<u>AC Volts</u>		
50 Hz to 20 kHz	2 to 700V	0.05 + 20
<u>Ohms</u>	200 ohms to 20 20 megohms	0.02 + 5

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3.1.3 Noise rejection. The dc input noise rejection ratios shall be as specified below:

- a. CMR: 110 dB at dc, 50 and 60 Hz with 1 kilohm in either input lead.
- b. NMR: 30 dB at 50 and 60 Hz.

3.1.4 Maximum input. Dc volts ranges: 1,000 Vdc or peak ac. AC volts ranges: 700 Vrms, 1,000V peak or $2 \times 10E7$ volts-hertz product, whichever is less.

3.2 Resistance measurements. The full range resistance measurement capability shall be from 200 ohms to 20 megohms in selectable ranges.

3.2.1 Resistance accuracy. The resistance accuracies shall be within those specified in table I after a measurement time (response time) not to exceed four seconds.

3.2.2 Resistance accuracy temperature coefficient. The temperature coefficients shall not exceed those specified in table II.

3.2.3 Open-circuit voltage. 13V maximum.

3.2.4 Current through the unknown resistance. 2 mA maximum.

3.2.5 Resistance input protection. All resistance ranges shall have input protection from applied voltages of at least 250 Vrms.

3.3 Controls and displays.

3.3.1 Controls. The equipment shall be provided with manual ranging for all functions.

3.3.2 Displays. The equipment shall be provided with the following displays:

- a. Excess input indication.
- b. Digital readout: A 5-1/2 digit LED, LCD, or a vacuum fluorescent display.

3.3.3 Automatic features. The equipment shall be provided with automatic ranging and automatic dc polarity indication.

3.4 Inputs. The equipment shall have two input terminals for voltage measurements and four input terminals for resistance measurements. The common input terminal shall be capable of withstanding voltage potentials of ± 500 Vdc referenced to ground potential.

3.4.1 Input impedance.

- a. AC voltage function: At least 1 megohm shunted by 100 pF or less.
- b. Dc voltage function: At least 10 megohms on all ranges.

3.5 Digital interface. A digital interface is required in accordance with MIL-T-28800.

4. ACCESSORIES. The equipment shall be provided with safety-designed banana plug test leads in accordance with MIL-T-28800.

5. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 20W.

6. WEIGHT. 5 kg (11 lb) maximum.

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APPENDIX D

DOOAN-B

MULTIPLIER, FREQUENCY, DOUBLER

1.0 GENERAL DESCRIPTION. This procurement requires a solid-state, frequency doubler/tripler capable of producing 18 to 26 GHz (2X) and 26 to 40 GHz (3X) signals from any 8.6 to 13.4 GHz signal source. The instrument shall provide a controllable output to at least +5 dBm in the (2X) mode and to at least -3 dBm in the (3X) mode reproducing sweep or modulation as defined by the input source.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of doubling or tripling input frequencies within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Input. 8.6 to 13.4 GHz; -2 to +5 dBm.

3.1.2 Output range. 18 to 26 GHz for (2X) mode; 26 to 40 GHz for (3X) mode.

3.1.3 Output resolution. Two times the resolution of the input frequency for the (2X) mode and three times the resolution of the input frequency for the (3X) mode.

3.1.4 Output accuracy and stability. Two times the accuracy and stability of the input frequency for the (2X) mode and three times the accuracy and stability of the input frequency for the (3X) mode.

3.2 Output characteristics.

3.2.1 Level. At least +5 dBm for (2X) mode; at least -3 dBm for (3X) mode.

3.2.2 Leveled range. At least -15 to +5 dBm adjustable in at least 1.0 dB steps with at least -2 dBm input level in the 2X mode; at least -15 to -3 dBm adjustable in at least 1.0 dB steps with at least -2 dBm input level in the 3X mode.

3.2.3 Accuracy and flatness. At least ± 3.0 dB for (2X) mode and at least ± 3.0 dB for (3X) mode between 0 and 50°C.

3.2.4 Impedance. 50 ohms nominal.

3.2.5 Output connector. WR-42 WG waveguide with UG-595/U type flange for the (2X) mode and WR-28 WG waveguide with UG-599/U type flange for the (3X) mode.

3.2.5.1 VSWR. Less than or equal to 2:1.

3.2.6 Input connector. Type WPM-3(f).

3.3 Spectral purity.

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3.3.1 Harmonics/Subharmonics. Less than -20 dBc.

3.3.2 Spurious. Less than -40 dBc.

3.4 Modulation compliance.

3.4.1 Frequency modulation. Follows input with 2 times the deviation for the (2X) mode and 3 times the deviation for the (3X) mode.

3.4.2 Pulse/Square wave modulation. Follows input with PRF of 100 Hz to 1 MHz; minimum pulse width of 0.1 μ s.

4.0 GENERAL REQUIREMENTS.

4.1 Dimensions. The total volume of the unit shall not exceed 8,702 cubic cm (531 cubic in).

4.2 Weight. The overall weight of the unit shall not exceed 4.0 kg (8.8 lbs).

4.3 Power source. 115/230 Vac $\pm 10\%$, 60 or 400 Hz $\pm 10\%$, 25W maximum.

4.4 Remote operation. Instrument shall be capable of operating via the IEEE-488 interface bus and providing the capability to talk and listen.

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DOOAM-A

MULTIPLIER, FREQUENCY, DOUBLER

1.0 GENERAL DESCRIPTION. This procurement requires a solid-state, frequency doubler capable of producing 26 to 40 GHz signals from any 13 to 20 GHz signal source. The instrument shall provide a controllable output to at least +5 dBm reproducing sweep or modulation as defined by the input source.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of doubling frequencies within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Input. 13 to 20 GHz; -2 to +5 dBm.

3.1.2 Output range. 26 to 40 GHz.

3.1.3 Output resolution. Two times the resolution of the input frequency.

3.1.4 Output accuracy and stability. Two times the accuracy and stability of the input frequency.

3.2 Output characteristics.

3.2.1 Level. At least +5 dBm.

3.2.2 Leveled range. At least -15 to +5 dBm adjustable in 0.1 dB steps with at least -2 dBm input level.

3.2.3 Accuracy and flatness. At least ± 3.5 dB at 0 to 50°C .

3.2.4 Impedance. 50 ohms nominal.

3.2.5 Output connector. WR-28 WG waveguide with UG-599/U type flange.

3.2.5.1 VSWR. Less than or equal to 2:1.

3.2.6 Input connector. Type WPM-3 female.

3.3 Spectral purity.

3.3.1 Harmonics/Subharmonics. Less than -20 dBc.

3.3.2 Spurious. Less than -20 dBc.

3.4 Modulation compliance.

3.4.1 Frequency modulation. Follows input with 2 times deviation.

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3.4.2 Pulse/Square wave modulation: Follows input with PRF of 100 Hz to 1 MHz; minimum pulse width of 0.1 us.

4.0 GENERAL REQUIREMENTS.

4.1 Power source. 115/230 Vac $\pm 10\%$, single phase, 50, 60 or 400 Hz $\pm 10\%$.

4.1.1 Input power. The maximum power required for operation shall not exceed 25 watts.

4.2 Dimensions. The total volume of the unit shall not exceed 531 cubic in (8,702 cubic cm).

4.3 Weight. The overall weight of the unit shall not exceed 8.8 pounds (4.0 kg).

4.4 Remote operation: Instrument shall be capable of operating via the IEEE-488 interface bus and shall provide the capability to talk and listen.

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APPENDIX D

OHONQ-B

OHMMETER, MEGA

1. **GENERAL.** This procurement requires a hand-held, battery powered, electrical insulation tester for use in determining insulation resistance of electrical circuits, motor windings, antenna transmission lines, and system components.
2. **CLASSIFICATION.** Type III, Class 3, Style ES, and Color R in accordance with MIL-T-28800 for shipboard applications with the following exceptions.
 - a. The handle requirement is not invoked.
 - b. The electromagnetic interference requirements are not invoked.
 - c. The transit drop test is invoked with a drop height of 122 cm (48 in).
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Test voltages.** Selectable 250, 500, and 1,000 Vdc. Accuracy: $\pm 10\%$ into 20 megohms.
 - 3.2 **Insulation test range.** 500 kilohms to 200 megohms. Accuracy: $\pm 3\%$ of reading.
 - 3.3 **Display.** LCD: 3 digits minimum. 9 mm (0.35 in.) digit height minimum.
 - 3.3.1 **Battery monitor.** The equipment shall monitor battery status and indicate a low battery condition.
 - 3.4 **Safety operation.** The equipment shall provide a visible indication when leads are connected to voltages in excess of 30 Vrms, 60 Vdc, and 24.8 Vdc interrupted at a rate of 24 to 200 Hz.
 - 3.4.1 **Circuit discharge.** The circuit under test shall be automatically discharged upon completion of an insulation test. The internal discharge load shall be less than 500 kilohms.
 - 3.5 **Voltmeter operation.** The equipment shall provide voltmeter operation for 0 to 600 Vac and 0 to 350 Vdc. Accuracy: $\pm 5\%$ full scale.
 - 3.6 **Ohmmeter operation.** 0 to 200 ohms $\pm 5\%$ of reading.
 - 3.7 **Accessories.** Two 1m (40 in.) test leads with probes and detachable insulated spring clips.
4. **POWER SOURCE.** MIL-T-28800 dc internal power source requirements are invoked in lieu of nominal power source requirements. Batteries shall be of a commercially available type and shall provide 12 months of normal operation before replacement is required.
5. **DIMENSIONS AND WEIGHT.** 203 mm (8 in.) high x 96.5 mm (3.8 in.) wide x 51 mm (2 in.) deep nominal. 1 kg (2.2 lb) with batteries installed.

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OHONM-F

OHMMETER, MEGA

1. **GENERAL.** This procurement requires a portable, precision, self-contained megohm bridge to measure and directly indicate resistance.
2. **CLASSIFICATION.** Type III, Class 5, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications except the operating altitude requirement is limited to 1,829m (6,000 ft).
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of resistance measurements within the minimum ranges, accuracies, and sensitivities specified below.
 - 3.1 **Test voltages.** Range: 10 Vdc to 1,000 Vdc in selectable increments. Accuracy: $\pm(3\% + 0.5V)$.
 - 3.1.1 **Short-circuit current limit.** 15 mA maximum from 10 to 50V, and 10 mA maximum above 50V.
 - 3.2 **Resistance measurement.** Range: 1 megohm to 100 teraohms.
 - 3.2.1 **Resistance measurement accuracy.**
 - a. 1 megohm to 1 teraohm: $\pm 1\%$ of indication.
 - b. 1 teraohm to 10 teraohms: $\pm 2\%$ of indication.
 - c. 10 teraohms to 100 teraohms: $\pm 10\%$ of indication.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 25W.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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OHONF-B

OHMMETER, MEGA

1. **GENERAL.** This procurement requires a self-contained megohmmeter capable of measuring and directly indicating resistance.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications except relative humidity requirements are limited to 75 \pm 5%.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of providing output voltages and resistance measurements within the minimum ranges, accuracies, and sensitivities specified below.
 - 3.1 **Test voltages.** Range: 50 Vdc to 500 Vdc.
 - 3.1.1 **Voltage accuracy.** \pm 3% of indication.
 - 3.1.2 **Short-circuit current.** 6 mA maximum.
 - 3.2 **Resistance measurement.** Range: At 50V output - 50 kilohms to 10 gigohms. Above 50V output - 1 megohm to 100 gigohms.
 - 3.2.1 **Resistance accuracy.** \pm 10% of indication.
 - 3.3 **Indicating meter.** Resistance scale length: 76.2 mm (3 in) minimum. Resistance scale resolution: see 3.2.1. An instrument that has a digital indicator with equal or better resistance resolution and accuracy is acceptable.
 - 3.4 **Voltage warning indicator.** The equipment shall be provided with a front panel display to indicate the presence of voltage at the equipment terminals.
 - 3.5 **Terminals.** The equipment input shall be equipped with guard, ground, and floating terminals to permit measurement of grounded or ungrounded two or three-terminal components.
4. **ACCESSORIES.** Shielded test leads compatible with the equipment input terminals and terminated with insulated spring-loaded clips shall be provided.
5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 30W.
6. **WEIGHT.** 10 kg (22 lb) maximum.

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OHUAB-A

OHMMETER, MICRO

1. **GENERAL.** This procurement requires a digitally indicating low resistance ohmmeter for measuring resistive loads and resistance in inductive circuits such as transformers and motor windings.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications except EMI requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall make resistance measurements using the 4-wire Kelvin method over the minimum ranges and accuracies specified below.
 - 3.1 **Resistance measurement range.** 0 to 20 ohms typically in five ranges.
 - 3.1.1 **Resistance accuracy.** $\pm(0.25\%$ of reading + 1 count).
 - 3.1.2 **Resolution.** 1 microhm up to a reading of 2 milliohms to no more than 10 milliohms at a reading of 20 ohms.
 - 3.2 **Test current.** 10A maximum.
 - 3.3 **Display.** 3-1/2 digit. The display shall indicate battery condition and overrange.
 - 3.4 **Input protection.** 1V peak to peak.
4. **ACCESSORIES.** Kelvin clip leads or hand spikes with 2.1m (7 ft) cables.
5. **POWER SOURCE.** The equipment shall be powered by one of the following in accordance with MIL-T-28800.
 - a. **Nominal power source requirements.** Operation at 400 Hz is not required. Maximum power consumption is 120W.
 - b. **Internal dc source with charger.** The equipment shall provide at least 1 hour of continuous operation at a test current of 10A following a maximum battery charge time of 14 hours.
6. **WEIGHT.** 10 kg (22 lb) maximum.

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OHMAA-A

OHMMETER, MILLI

1. **GENERAL.** This procurement requires a digital ac milliohmmeter designed to measure electrical contact and bonding resistances.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring resistance in accordance with the following minimum specifications.
 - 3.1 **Measurement range.** 2 milliohms to 1.9 ohms.
 - 3.2 **Measurement accuracy.** 1% of indication.
 - 3.3 **Display resolution.** 3-1/2 digits.
 - 3.4 **Output.** 0.1 Vac, 200 mA maximum.
 - 3.5 **Output frequency.** Within the range of 40 to 80 Hz.
 - 3.6 **Leads.** 4-wire Kelvin leads with alligator clips.
4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.
 - 4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 150W.
 - 4.2 **DC internal power source.** Internal batteries and charger are required. Minimum operating time shall be eight hours following a maximum recharge time of 16 hours.
5. **WEIGHT.** 2 kg (4.4 lb) maximum.

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APPENDIX D

OSOTN-B

OSCILLOSCOPE

1. **GENERAL.** This procurement requires a general purpose, portable, dual-trace, differential input oscilloscope.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications identified below.
 - 3.1 **Vertical amplifiers.** The vertical channel(s) shall be provided with a selectable front panel input to accept either differential or single-ended inputs on all ranges. Unless otherwise specified below, requirements apply to two identical channels with or without probes attached.
 - 3.1.1 **Vertical deflection factor.** 0.1 mV/div to 20 V/div continuously variable between calibrated steps. An uncalibrated condition indicator is required.
 - 3.1.2 **Vertical bandwidth.** DC to 500 kHz.
 - 3.1.2.1 **Bandwidth limiting.** Provisions shall be made to limit the vertical bandwidth to approximately 10 kHz.
 - 3.1.3 **Common mode rejection ratio (CMRR).**

Range	CMRR	Coupling	Frequency
0.1 mV	100 dB	dc	dc to 10 kHz
0.2V	40 dB	dc	dc to 10 kHz
20V	25 dB	dc	dc to 10 kHz
 - 3.1.4 **Maximum input.** $\pm 350\text{V}$ (dc + peak ac) on the 0.5 V/div range and above and at least $\pm 10\text{V}$ (dc + peak ac) on the 0.2 V/div range and below.
 - 3.1.5 **Display modes.** Channel A, channel B, A and B (chop or alternate), and A vs B.
 - 3.1.6 **Isolation between channels.** 80 dB, minimum, at 500 kHz.
- 3.2 **X-Y operation.** The equipment shall be capable of X-Y operation.
- 3.3 **Time base.**
 - 3.3.1 **Sweep.** Range: 1 $\mu\text{s}/\text{div}$ to 5 s/div continuously variable between calibrated steps. An uncalibrated condition indicator is required. Accuracy: $\pm 3\%$. A X10 magnifier shall be provided. Accuracy: $\pm 5\%$.
 - 3.3.2 **Triggering modes.** Free-run, normal, and single sweep.
 - 3.3.3 **Trigger sources.** Line, internal, and external.
 - 3.3.4 **Trigger sensitivity.** Internal: 0.5 division or less from 50 Hz to 500 kHz. External: 0.2V peak-to-peak or less from 50 Hz to 1 MHz.

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3.3.5 Trigger level and slope. The trigger level and slope shall permit selection of triggering at any point on the displayed waveform or on an external trigger of up to $\pm 100V$.

3.4 Horizontal amplifier.

3.4.1 Horizontal bandwidth. DC to 300 kHz.

3.4.2 Horizontal deflection factor. 0.1 V/div to 1 V/div continuously variable between calibrated steps. An uncalibrated condition indicator is required.

3.4.3 Horizontal maximum input. $\pm 350V$ (dc + peak ac).

3.5 Calibrator. The equipment shall be provided with an internally generated calibrator square-wave output that has an amplitude accuracy within $\pm 1\%$.

3.6 CRT. The CRT shall have an 8 x 10 division display area with no less than 0.8 cm/div. The horizontal and vertical centerlines shall be marked in 0.2 subdivision increments and in 1 division cardinal increments. The graticule shall be of the internal, nonparallax type.

3.6.1 CRT controls and adjustments. Focus, beam finder, trace rotation, and intensity.

4. ACCESSORIES. One accessory pouch, two 10:1 probes, and two dual BNC to triple banana plug adapters.

5. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 150W.

6. WEIGHT. 20 kg (44 lb) maximum.

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OSOTM-B

OSCILLOSCOPE

1. **GENERAL.** This procurement requires a general purpose, portable, dual-trace, differential input oscilloscope.
2. **CLASSIFICATION.** Type III, Class 5, Style F, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications identified below.
- 3.1 **Vertical amplifiers.** The vertical channel(s) shall be provided with a selectable front panel input to accept either differential or single-ended inputs on all ranges. Unless otherwise specified below, requirements apply to two identical channels with or without probes attached.
- 3.1.1 **Vertical deflection factor.** 0.1 mV/div to 20 V/div continuously variable between calibrated steps. An uncalibrated condition indicator is required.
- 3.1.2 **Vertical bandwidth.** DC to 500 kHz.
- 3.1.2.1 **Bandwidth limiting.** Provisions shall be made to limit the vertical bandwidth to approximately 10 kHz.
- 3.1.3 **Common mode rejection ratio (CMRR).**

TABLE I. CMRR vs Frequency

<u>Range</u>	<u>CMRR</u>	<u>Coupling</u>	<u>Frequency</u>
0.1 mV	100 dB	dc	dc to 10 kHz
0.2V	40 dB	dc	dc to 10 kHz
20V	25 dB	dc	dc to 10 kHz

- 3.1.4 **Maximum input.** $\pm 350V$ (dc + peak ac) on the 0.5 V/div range and above and at least $\pm 10V$ (dc + peak ac) on the 0.2 V/div range and below.
- 3.1.5 **Display modes.** Channel A, channel B, A and B (chop or alternate), and A vs B.
- 3.1.6 **Isolation between channels.** 80 dB, minimum, at 500 kHz.
- 3.2 **X-Y operation.** The equipment shall be capable of X-Y operation.
- 3.3 **Time base.**
- 3.3.1 **Sweep.** Range: 1 us/div to 5 s/div continuously variable between calibrated steps. An uncalibrated condition indicator is required. Accuracy: $\pm 3\%$. A X10 magnifier shall be provided. Accuracy: $\pm 5\%$.
- 3.3.2 **Triggering modes.** Free-run, normal, and single sweep.
- 3.3.3 **Trigger sources.** Line, internal, and external.
- 3.3.4 **Trigger sensitivity.** Internal: 0.5 division or less from 50 Hz to 500 kHz. External: 0.2V peak-to-peak or less from 50 Hz to 1 MHz.

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3.3.5 **Trigger level and slope.** The trigger level and slope shall permit selection of triggering at any point on the displayed waveform or on an external trigger of up to $\pm 100V$.

3.4 **Horizontal amplifier.**

3.4.1 **Horizontal bandwidth.** DC to 300 kHz.

3.4.2 **Horizontal deflection factor.** 0.1 V/div to 1 V/div continuously variable between calibrated steps. An uncalibrated condition indicator is required.

3.4.3 **Horizontal maximum input.** $\pm 350V$ (dc + peak ac).

3.5 **Calibrator.** The equipment shall be provided with an internally generated calibrator square-wave output that has an amplitude accuracy within $\pm 1\%$.

3.6 **CRT.** The CRT shall have an 8 x 10 division display area with no less than 0.8 cm/div. The horizontal and vertical centerlines shall be marked in 0.2 subdivision increments and in 1 division cardinal increments. The graticule shall be of the internal, nonparallax type.

3.6.1 **CRT controls and adjustments.** Focus, beam finder, trace rotation, and intensity.

4. **ACCESSORIES.** One accessory pouch, two 10:1 probes, and two dual BNC to triple banana plug adapters.

5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 150W.

6. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

OSORS-D

OSCILLOSCOPE

1. **GENERAL.** This procurement requires a general purpose, portable, battery powered, dual-trace oscilloscope.

2. **CLASSIFICATION.** Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the following minimum accuracies, limits, and specifications.

3.1 **Vertical system.** Unless otherwise specified, the specifications detailed below apply to two independent vertical inputs. The inputs shall be isolated from the equipment chassis and the opposite channel. The equipment shall have integral probes. The design shall be such that the operator cannot come into contact with input common at the equipment.

3.1.1 **Bandwidth.** DC to 10 MHz.

3.1.2 **Deflection factor.** 5 mV/div to 50 V/div. Accuracy: $\pm 3\%$ of six major graticule divisions.

3.1.3 **Maximum input voltage.** 400V (dc + peak ac).

3.1.4 **Vertical modes.** Channel 1, channel 2, alternate, chop, and add. Provision made for inverting channel 2.

3.1.5 **Input impedance.** 1 megohm, nominal.

3.2 **Horizontal system.**

3.2.1 **Time base.** Range: 1 μ s/div to 200 ms/div. Accuracy: $\pm 3\%$ of eight major graticule divisions.

3.2.2 **Triggering.** Internal and external triggering shall be provided. Sensitivity: 0.5 division internal, 150 mV external, from dc to 5 MHz, decreasing to 1.5 divisions internal, 500 mV external, at 10 MHz.

3.3 **Display.** Usable display area: Eight vertical by ten horizontal divisions with an internal graticule ruled in 0.2-inch, or larger, squares and subdivided in 0.2 division increments along the center axes. If a liquid crystal display is provided, it shall have backlighting capability.

4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.

4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 50W.

4.2 **DC internal power source:** A charger and internal batteries are required. Minimum operating time shall be 2 hours following a maximum recharge time of 16 hours.

5. **DIMENSIONS.** 127 mm (5 in) high, 229 mm (9 in) wide, and 356 mm (14 in) deep.

6. **WEIGHT.** 5 kg (11 lb) maximum.

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OSOHP-B

OSCILLOSCOPE

1. **GENERAL.** This procurement requires a portable, general purpose oscilloscope.

2. **CLASSIFICATION.** Type III, Class 3, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications. A tilt-bail handle is required.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications detailed below.

3.1 **Vertical amplifiers.** The requirements specified below apply to two identical vertical channels. The capability of inverting the signal polarity of at least one channel shall be provided by manipulation of a front-panel control.

3.1.1 **Bandwidth.** DC to 100 MHz. AC low frequency roll-off: 10 Hz or less.

3.1.1.1 **Bandwidth limiting.** A control shall be provided to limit high frequency interference.

3.1.2 **Deflection factor.** Range: 5 mV/div to 5 V/div continuously variable between calibrated steps. An uncalibrated condition indicator is required.

3.1.2.1 **DC accuracy.** ± 0.2 divisions.

3.1.3 **Overload protection.** At any vertical range setting, ac or dc coupled: $\pm 250V$ (dc + peak ac) to 2 kHz, $\pm 10V$ (dc + peak ac) to 1 MHz, and $\pm 5V$ (dc + peak ac) to 100 MHz.

3.1.4 **Common mode rejection ratio.** 20 dB at 50 MHz.

3.1.5 **Display modes.** Channel A, channel B, channels A and B simultaneously, and add.

3.1.6 **X-Y operation.** Bandwidth: 2 MHz. Phase difference: 3° maximum at 100 kHz.

3.2 **Horizontal deflection.**

3.2.1 **Sweep modes.** Normal, delayed, and intensified. (Intensified is not required of digitizing oscilloscopes.)

3.2.2 **Sweep trigger modes.** Normal, automatic, and single.

3.2.3 **Main time base.** Range: 0.05 us/div to 0.5 s/div continuously variable between calibrated steps. An uncalibrated condition indicator is required. Accuracy: $\pm 3\%$ of setting.

3.2.4 **Delayed time base.** Range: 0.05 us/div to 20 ms/div continuously variable between calibrated steps. An uncalibrated condition indicator is required. Accuracy: $\pm 3\%$ of setting.

3.2.5 **Intensification.** A control shall be provided to intensify that part of the sweep controlled by the main time base that is to expand to full screen display in the delayed time base mode. (This function is not required of digitizing oscilloscopes.)

3.2.6 **Horizontal triggering.**

3.2.6.1 **Trigger source.** Channel A, channel B, composite, or external.

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3.2.6.2 Trigger sensitivity.

a. Internal (except chop mode): 0.35 division peak-to-peak from dc to 25 MHz decreasing to 1 division peak-to-peak at 100 MHz.

b. External: 50 mV peak-to-peak from dc to 25 MHz decreasing to 150 mV peak-to-peak at 100 MHz.

3.2.6.3 External trigger maximum input. $\pm 250V$ (dc + peak ac) at 1 kHz or less.

3.2.6.4 Trigger coupling. DC, ac, low frequency reject, and high frequency reject.

3.2.7 Sweep expansion. A X10 sweep expansion (horizontal magnifier) control for the main and delayed time bases shall be provided. Accuracy: $\pm 5\%$ of the time base setting.

3.2.8 Horizontal position. A horizontal position control shall be provided to move the left end of the trace to the right past the center graticule and the right end of the trace to the left past the center graticule. This specification shall apply in both the X1 and X10 horizontal magnifier position. (This function is not required of digitizing oscilloscopes.)

3.3 Calibrator. A square wave calibrator signal shall be provided through a front-panel connector that is compatible with at least one type of supplied probe tip. The calibrator voltage shall be regulated to within $\pm 1\%$ when loaded by 1 megohm paralleled by 25 pF or less. The calibrator signal shall have a rise time not to exceed 1 us and shall have protection from damage when grounded.

3.4 CRT display. A CRT display shall be provided that has a minimum useful scan area of ten divisions wide by eight divisions high. A division shall equal at least 0.8 cm.

3.4.1 Graticule. An internal graticule shall be provided. The cardinal axes shall be ruled in 0.2 major division increments.

3.4.2 CRT controls and adjustments. Focus, intensity, beam finder, astigmatism, and trace rotation for analog oscilloscopes. Intensity only for digitizing oscilloscopes.

3.4.3 Z-axis input. An input shall be provided to permit intensity modulation of the display within a range of dc to at least 10 MHz.

4. ACCESSORIES. Two 10:1 voltage divider probes, two 1:1 voltage probes, and a probe tip kit for each probe.

4.1 Accessory pouch. An attached accessory pouch may be used for storage of all supplied accessories in lieu of front cover storage.

5. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 250W.

6. WEIGHT. 20 kg (44 lb) maximum.

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OSOHR-B

OSCILLOSCOPE

1. **GENERAL.** This procurement requires a portable, general purpose oscilloscope.
2. **CLASSIFICATION.** Type III, Class 5, Style F, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications detailed below.
 - 3.1 **Vertical amplifiers.** The requirements specified below apply to two identical vertical channels. The capability of inverting the signal polarity of at least one channel shall be provided by manipulation of a front-panel control.
 - 3.1.1 **Bandwidth.** DC to 100 MHz. AC low frequency roll-off: 10 Hz or less.
 - 3.1.1.1 **Bandwidth limiting.** A control shall be provided to limit high frequency interference.
 - 3.1.2 **Deflection factor.** Range: 5 mV/div to 5 V/div continuously variable between calibrated steps. An uncalibrated condition indicator is required.
 - 3.1.2.1 **DC accuracy.** ± 0.2 divisions.
 - 3.1.3 **Overload protection.** At any vertical range setting, ac or dc coupled: $\pm 250V$ (dc + peak ac) to 2 kHz, $\pm 10V$ (dc + peak ac) to 1 MHz, and $\pm 5V$ (dc + peak ac) to 100 MHz.
 - 3.1.4 **Common mode rejection ratio.** 20 dB at 50 MHz.
 - 3.1.5 **Display modes.** Channel A, channel B, channels A and B simultaneously, and add.
 - 3.1.6 **X-Y operation.** Bandwidth: 2 MHz. Phase difference: 3° maximum at 100 kHz.
 - 3.2 **Horizontal deflection.**
 - 3.2.1 **Sweep modes.** Normal, delayed, and intensified. (Intensified is not required of digitizing oscilloscopes.)
 - 3.2.2 **Sweep trigger modes.** Normal, automatic, and single.
 - 3.2.3 **Main time base.** Range: 0.05 us/div to 0.5 s/div continuously variable between calibrated steps. An uncalibrated condition indicator is required. Accuracy: $\pm 3\%$ of setting.
 - 3.2.4 **Delayed time base.** Range: 0.05 us/div to 20 ms/div continuously variable between calibrated steps. An uncalibrated condition indicator is required. Accuracy: $\pm 3\%$ of setting.
 - 3.2.5 **Intensification.** A control shall be provided to intensify that part of the sweep controlled by the main time base that is to expand to full screen display in the delayed time base mode. (This function is not required of digitizing oscilloscopes.)
 - 3.2.6 **Horizontal triggering.**
 - 3.2.6.1 **Trigger source.** Channel A, channel B, composite, or external.

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3.2.6.2 Trigger sensitivity.

a. Internal (except chop mode): 0.35 division peak-to-peak from dc to 25 MHz decreasing to 1 division peak-to-peak at 100 MHz.

b. External: 50 mV peak-to-peak from dc to 25 MHz decreasing to 150 mV peak-to-peak at 100 MHz.

3.2.6.3 External trigger maximum input. $\pm 250V$ (dc + peak ac) at 1 kHz or less.

3.2.6.4 Trigger coupling. DC, ac, low frequency reject, and high frequency reject.

3.2.7 Sweep expansion. A X10 sweep expansion (horizontal magnifier) control for the main and delayed time bases shall be provided. Accuracy: $\pm 5\%$ of the time base setting.

3.2.8 Horizontal position. A horizontal position control shall be provided to move the left end of the trace to the right past the center graticule and the right end of the trace to the left past the center graticule. This specification shall apply in both the X1 and X10 horizontal magnifier position. (This function is not required of digitizing oscilloscopes.)

3.3 Calibrator. A square wave calibrator signal shall be provided through a front-panel connector that is compatible with at least one type of supplied probe tip. The calibrator voltage shall be regulated to within $\pm 1\%$ when loaded by 1 megohm paralleled by 25 pF or less. The calibrator signal shall have a rise time not to exceed 1 μs and shall have protection from damage when grounded.

3.4 CRT display. A CRT display shall be provided that has a minimum useful scan area of ten divisions wide by eight divisions high. A division shall equal at least 0.8 cm.

3.4.1 Graticule. An internal graticule shall be provided. The cardinal axes shall be ruled in 0.2 major division increments.

3.4.2 CRT controls and adjustments. Focus, intensity, beam finder, astigmatism, and trace rotation for analog oscilloscopes. Intensity only for digitizing oscilloscopes.

3.4.3 Z-axis input. An input shall be provided to permit intensity modulation of the display within a range of dc to at least 10 MHz.

4. ACCESSORIES. Two 10:1 voltage divider probes, two 1:1 voltage probes, and a probe tip kit for each probe.

4.1 Accessory pouch. An accessory pouch shall be provided for storage of all supplied accessories.

5. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 250W.

6. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

OSOMO-F

OSCILLOSCOPE

1. **GENERAL.** This procurement requires a general purpose, portable, solid-state, dual-trace oscilloscope.
2. **CLASSIFICATION.** Type III, Class 3, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications. A tilt bail handle is required.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum ranges, accuracies, limits, and specifications identified below. A digitizing oscilloscope is acceptable for this application provided that it can duplicate the desired display of an acceptable analog oscilloscope. If a digitizing oscilloscope is provided, and said unit never enters an uncalibrated condition, indicators are not required.
 - 3.1 **Vertical system.** Unless otherwise specified below, requirements apply to two identical channels with or without probes attached. A control shall be provided to invert the waveform through at least one of the channels. Bandwidth and rise time measurements are specified with the equipment driven from a terminated 50 ohm source at the vertical inputs.
 - 3.1.1 **Bandwidth.** dc to 200 MHz minimum. AC low frequency roll off: 100 Hz or less with X10 probe.
 - 3.1.1.1 **Bandwidth limiting.** A provision shall be made to limit high-frequency interference.
 - 3.1.2 **Vertical deflection factor.** 2 mV/div to 5 V/div continuously variable between calibrated steps. Deflection accuracy: $\pm 3\%$. An uncalibrated condition indicator is required.
 - 3.1.3 **Display mode selector.** The vertical mode switch(es) shall select channel 1, channel 2, alternate, and chop modes.
 - 3.1.4 **Maximum input voltages.** At any vertical range setting: 250V (dc + peak ac) and 500V (peak-to-peak ac at 1 kHz or less).
 - 3.1.5 **Input Impedance.** 1 megohm shunted by 15 pF, nominal, switchable to 50 ohms $\pm 1\%$.
 - 3.2 **X-Y operation.** Operation shall be through the vertical input channels. Range: 2 mV/div to 5 V/div. Accuracy: $\pm 3\%$. Bandwidth: dc to 3 MHz. Maximum phase difference between channels: 1° from dc to 1 MHz and 3° from 1 to 2 MHz.
 - 3.3 **Horizontal display modes.** The horizontal display mode switch(es) shall select A only, A Intensified, and B Delayed.
 - 3.3.1 **Time base A.** Time base A sweep rates shall be from 10 ns/div to 0.5 s/div in calibrated steps. A X10 magnifier shall be provided.
 - 3.3.2 **Time base B.** Time base B sweep rates shall be from 10 ns/div to 50 ms/div in calibrated steps.
 - 3.3.3 **Time bases A and B accuracy.** Unmagnified mode: $\pm 2\%$. Magnified mode: $\pm 3\%$.
 - 3.3.4 **Calibrated sweep delay.** Variable from 50 ns/div to 0.5 s/div. Accuracy: $\pm 1\%$.
 - 3.3.5 **Variable time control.** The time bases shall be continuously variable between each step. An uncalibrated condition indicator is required.

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3.4 Triggering. Time bases A and B shall be capable of internal and external triggering.

3.4.1 Time base A triggering modes. Time base A shall have normal, automatic, and single sweep trigger modes.

3.4.2 Time base A triggering sources. Time base A shall have normal, channel 1, channel 2, line, and external trigger sources.

3.4.3 Time base B triggering modes. Time base B trigger modes shall be automatic and triggered.

3.4.4 Time base B triggering sources. Time base B shall have normal, channel 1, channel 2, and external trigger sources.

3.4.5 Time base A and B trigger coupling. DC, AC, low-frequency rejection, and high frequency rejection.

3.4.6 Time base A and B trigger sensitivity. 0.7 vertical division or less internal or 50 mV or less external from dc to 40 MHz, decreasing to 1.5 vertical divisions internal or 250 mV external at 400 MHz.

3.4.7 Trigger level and slope. Selection of triggering at any point on the displayed waveform shall be provided.

3.4.8 Maximum external trigger input. $\pm 20V$ or 40V peak-to-peak. External trigger damage level: 250V (dc + peak ac) minimum.

3.4.9 Trigger hold-off: A variable trigger hold-off control shall be provided for the A time base.

3.5 Amplitude calibrator. A calibrator signal shall be provided through a front-panel connector and shall have protection from damage when grounded. Accuracy: $\pm 1\%$ into 1 megohm.

3.6 CRT. The CRT shall have an 8 x 10 division display area with no less than 0.8 cm/div. The horizontal and vertical centerlines shall be marked in 0.2 subdivision increments and in 1 division cardinal increments. The graticule shall be of the internal, nonparallax type.

4. ACCESSORIES. Two X10 probes, one accessory pouch, and one grounding post shall be furnished with each oscilloscope.

5. POWER SOURCE. MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.

5.1 Nominal power source. Operation at 400 Hz is not required. Maximum power consumption: 400W.

5.2 DC internal power source: Internal batteries and charger are required. Minimum operating time shall be 1 hour following a maximum recharge time of 16 hours.

6. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

OD1AF-B

OSCILLOSCOPE, DIGITIZING

1. **GENERAL.** This procurement requires a digital storage oscilloscope.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring, displaying, and storing waveforms within the minimum ranges, specifications, and accuracies detailed below.
 - 3.1 **Vertical system.** The equipment shall be capable of simultaneous and synchronous acquisition, measurement, display and storage of two inputs.
 - 3.1.1 **Bandwidth.** DC to 400 MHz for repetitive signals. AC coupled low frequency roll-off: 100 Hz or less.
 - 3.1.1.1 **Bandwidth limit.** At least one input shall have a selectable low-pass filter to reduce high-frequency interference.
 - 3.1.2 **Sensitivity.** 5 mV/div to 5 V/div.
 - 3.1.2.1 **Effective bits.** 6 minimum.
 - 3.1.2.2 **Accuracy.** $\pm 2\%$ of full scale.
 - 3.1.3 **Display modes.** Channel 1 only, channel 2 only, or both channels simultaneously.
 - 3.1.4 **Maximum vertical input.** At any vertical deflection factor: $\pm 250\text{V}$ (dc + peak ac) at frequencies up to 10 kHz.
 - 3.1.5 **Input impedance.** 1 megohm paralleled by 20 pF, nominal.
 - 3.1.6 **Waveform math.** The equipment shall be capable of performing addition, subtraction, and channel 1 vs channel 2 on the input signals. The equipment shall be capable of inverting at least one of the input signals.
 - 3.2 **Horizontal system.**
 - 3.2.1 **Resolution.** 500 points per channel minimum.
 - 3.2.2 **Sample rate.** 100 megasamples per channel per second.
 - 3.2.3 **Time base range.** 5 ns/div to 5 s/div. Accuracy: $\pm 0.1\%$.
 - 3.2.4 **Delay.** Pre-trigger: 7/8 screen. Post trigger: 10 divisions minimum.
 - 3.2.5 **Trigger sensitivity.** 0.5 division or less (dc to 100 MHz), 1 division or less (100 to 400 MHz). Minimum trigger pulse width: 3 ns.
 - 3.2.6 **Time base expansion.** The equipment shall be capable of simultaneously displaying a reference sweep and an expanded portion of that sweep. The expansion ratio shall range from 1:1 to 20:1 or greater.
 - 3.3 **Parametric measurements.** The equipment shall be capable of automatically measuring and displaying the following parameters of the displayed signal: period, frequency, width (+ and -), rise time, fall time, peak (+ and -), peak-to-peak, and rms amplitude. Rise and fall times shall be measured between the proximal and distal points, and width shall be measured between the mesial points of pulse waveforms. Pulse parameters shall be as defined in IEEE Standard 194-1977, "Standard Pulse Terms and Definitions."

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3.4 **CRT.** The signal display grid shall measure at least 76 mm (3 in) x 95 mm (3.75 in). The display grid shall be ruled in eight vertical and ten horizontal divisions with the center axes subdivided in 0.2 division increments.

3.5 **Automatic setup.** The equipment shall be equipped with a single push-button control that will initiate automatic adjustment of the vertical and horizontal deflection factors and trigger level for an optimized display of the input signals. This function shall operate with signals exceeding 1% duty cycle and frequencies of 50 Hz.

3.6 **Waveform storage.** The equipment shall be capable of storing not less than four waveforms with associated vertical and horizontal settings in nonvolatile memory.

3.7 **Digital interface.** A digital interface is required in accordance with MIL-T-28800.

4. **ACCESSORIES.** Two X10 and two X1 probes with cables approximately 1.5m (4.9 ft) long.

5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 400W.

6. **WEIGHT.** 13.6 kg (30 lb) maximum.

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APPENDIX D

OSSMG-B

OSCILLOSCOPE, STORAGE

1. **GENERAL.** This procurement requires a general-purpose, dual-trace, storage oscilloscope with a dual time base and differential capabilities.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications contained below.

3.1 **Vertical system.** The oscilloscope vertical system shall consist of two identical input channels with differential and comparator capability.

3.1.1 **Bandwidth.** DC to 50 MHz. AC coupled low-frequency roll off: 10 Hz or less.

3.1.2 **Deflection factor.** 5 mV/div to 5 V/div continuously variable between calibrated steps. Accuracy: $\pm 1.5\%$ of setting. An uncalibrated condition indicator is required.

3.1.2.1 **Maximum input voltages.**

a. DC coupled: 1 V/div to 5 V/div; $\pm 500\text{V}$ (dc + peak ac at 1 kHz) derating to no less than $\pm 40\text{V}$ (dc + peak ac at 1 kHz).

b. AC coupled: $\pm 500\text{V}$. (dc + peak ac at 1 kHz).

3.1.2.2 **Common mode rejection ratio.** The common mode rejection ratio shall be at least 20,000 to 1 from dc to 100 kHz.

3.1.3 **Comparison voltage.** An internal comparison voltage source is required. Range: 0 to 10V positive and negative. Resolution: 4 digits. Accuracy: $\pm(0.1\%$ of setting + 3 mV).

3.2 **Horizontal system.**

3.2.1 **Main sweep.** 50 ns/div to 5 s/div continuously variable between calibrated steps. Accuracy: $\pm 4.0\%$ of setting. An uncalibrated condition indicator is required.

3.2.2 **Main triggering.** The equipment shall be provided with selectable main trigger modes of auto, normal, and single sweep. Selectable couplings of AC, AC-LF reject, AC-HF reject, and DC shall be provided. Selectable trigger sources of internal, line, external, and external divided by 10 shall be provided.

3.2.2.1 **Auto and normal mode sensitivity.**

a. AC selected: 0.3 division internal or 100 mV external from 30 Hz to 10 MHz and 1.5 divisions internal or 500 mV external from 10 MHz to 100 MHz.

b. AC-HF reject selected: 0.3 division internal or 100 mV external from 30 Hz to 50 kHz.

c. DC selected: 0.3 division internal or 100 mV external from DC to 10 MHz and 1.5 divisions internal or 500 mV external from 10 MHz to 100 MHz.

d. AC-LF reject selected: Internal 0.3 div, 30 kHz to 10 MHz and 1.5 div, 10 MHz to 100 MHz; external 100 mV, 150 kHz to 10 MHz and 500 mV, 10 MHz to 100 MHz.

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3.2.2.2 Internal trigger jitter. The internal trigger jitter shall not exceed 1 ns at 75 MHz.

3.2.2.3 External trigger. The trigger level range shall be at least $\pm 1.5V$ in the external position and $\pm 15V$ in the external divided-by-10 position. The inputs shall withstand 500V (dc + peak ac).

3.3 CRT display.

3.3.1 Automatic focus. Automatic focusing shall eliminate the need for manual focusing of the display with changes in intensity following an initial adjustment.

3.3.2 Beam finder. A beam finder control shall permit display centering while limiting the display to the graticule area.

3.3.3 CRT storage display. The equipment shall be capable of variable persistence to extend viewing time to 15s minimum.

3.4 Outputs.

3.4.1 Calibrator. A calibrator signal shall be provided through a front-panel connector that is compatible with the specified probes. The calibrator voltage shall be regulated to within $\pm 1\%$ at $15^{\circ}C$ to $35^{\circ}C$ and when loaded by the specified vertical amplifiers. The calibrator shall have protection from damage when grounded.

3.5 Probes. Two X1 probes shall be provided and shall be compatible with the vertical amplifiers specified.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 200W.

5. WEIGHT. 20 kg (44 lbs) maximum.

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APPENDIX D

PS1BA-A

POWER SUPPLY, DC

1. **GENERAL.** This procurement requires a constant-voltage, constant-current dc power supply.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
 - 2.1 **Electromagnetic interference requirements.** The requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications set forth below.
 - 3.1 **Output voltage and current.** Continuously adjustable from 0 to 40 Vdc, 0 to 5A.
 - 3.1.1 **Load regulation.** For no-load to full-load excursions: 0.01% + 200 uV voltage regulation, 0.02% + 500 uA current regulation.
 - 3.1.2 **Line regulation.** For line-voltage variations of $\pm 10\%$ or greater: 0.01% + 200 uV voltage regulation, 0.02% + 500 uA current regulation.
 - 3.1.3 **Ripple and noise.** 200 uVrms or 10 mV peak-to-peak maximum.
 - 3.1.4 **Temperature coefficient.** For any one degree C change in the ambient temperature: 0.01% + 200 uV voltage regulation, 0.01% + 1 mA current regulation.
 - 3.1.5 **Drift.** For eight hours with constant line, load, and ambient temperature: 0.03% + 500 mV voltage regulation, 0.03% + 3 mV current regulation.
 - 3.2 **Indicator.** Output voltage and current. Accuracy: $\pm 2\%$ FS.
 - 3.3 **Connectors.** Three-way front-panel binding posts for positive output, negative output, and chassis ground connections.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 330W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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PS1BN-B

POWER SUPPLY, DC

1. **GENERAL.** This procurement requires a constant-voltage, constant-current dc power supply.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications set forth below.
 - 3.1 **Output voltage and current.** Continuously adjustable from 0 to 30 Vdc, 0 to 15A.
 - 3.1.1 **Load regulation.** For no-load to full-load excursions: 40 mV voltage regulation, 200 mA current regulation.
 - 3.1.2 **Line regulation.** For line-voltage variations of $\pm 10\%$ or greater: 20 mV voltage regulation, 200 mA current regulation.
 - 3.1.3 **Ripple and noise.** 90 mVrms or 500 mV peak-to-peak maximum.
 - 3.1.4 **Temperature coefficient.** For any one degree C change in the ambient temperature: 17 mV voltage regulation, 75 mA current regulation.
 - 3.1.5 **Drift.** For eight hours with constant line, load, and ambient temperature: $0.1\% + 20$ mV voltage regulation, 250 mA current regulation.
 - 3.2 **Indicators.** Output voltage and current. Accuracy: $\pm 2\%$ FS.
 - 3.3 **Connectors.** Three-way front-panel binding posts for positive output, negative output, and chassis ground connections.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 2 kW.
5. **WEIGHT.** 33 kg (72 lb) maximum.

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APPENDIX D

PS1FN-B

POWER SUPPLY, DC

1. **GENERAL.** This procurement requires a constant-voltage, constant-current dc power supply.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications set forth below.
 - 3.1 **Output voltage and current.** Continuously adjustable from 0 to 50 Vdc, 0 to 1.5A.
 - 3.1.1 **Load regulation.** For no-load to full-load excursions: 0.01% + 1 mV voltage regulation, 0.05% + 1 mA current regulation.
 - 3.1.2 **Line regulation.** For line-voltage variations of $\pm 10\%$ or greater: 0.01% + 1 mV voltage regulation, 0.05% + 1 mA current regulation.
 - 3.1.3 **Ripple and noise.** 500 uVrms or 25 mV peak-to-peak maximum.
 - 3.1.4 **Temperature coefficient.** For any one degree C change in the ambient temperature: 0.02% + 0.5 mV voltage regulation, 0.03% + 0.3 mA current regulation.
 - 3.1.5 **Drift.** For eight hours with constant line, load, and ambient temperature: 0.1% + 2.5 mV voltage regulation, 0.1% + 7.5 mA current regulation.
 - 3.2 **Indicator.** Output voltage and current. Accuracy: $\pm 2\%$ FS.
 - 3.3 **Connectors.** Three-way front or rear-panel binding posts for positive output, negative output, and chassis ground connections.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 500W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

PS1HN-B

POWER SUPPLY, DC

1. **GENERAL.** This procurement requires a constant-voltage, constant-current dc power supply.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications set forth below.
 - 3.1 **Output voltage and current.** Continuously adjustable from 0 to 100 Vdc, 0 to 0.75A.
 - 3.1.1 **Load regulation.** For no-load to full-load excursions: 0.01% + 2 mV voltage regulation, 0.01% + 250 uA current regulation.
 - 3.1.2 **Line regulation.** For line-voltage variations of $\pm 10\%$ or greater: 0.01% + 2 uV voltage regulation, 0.01% + 250 uA current regulation.
 - 3.1.3 **Ripple and noise.** 200 uVrms or 1 mV peak-to-peak maximum.
 - 3.1.4 **Temperature coefficient.** For any one degree C change in the ambient temperature: 0.01% + 200 uV voltage regulation, 0.02% + 0.4 mA current regulation.
 - 3.1.5 **Drift.** For eight hours with constant line, load, and ambient temperature: 0.03% + 500 mV voltage regulation, 0.01% + 2 mA current regulation.
 - 3.2 **Indicator.** Output voltage and current. Accuracy: $\pm 2\%$ FS.
 - 3.3 **Connectors.** Three-way front-panel binding posts for positive output, negative output, and chassis ground connections.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 140W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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PS1MN-B

POWER SUPPLY, DC

1. **GENERAL.** This procurement requires a constant-voltage, constant-current dc power supply.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications set forth below.
 - 3.1 **Output voltage and current.** Continuously adjustable from 0 to 150 Vdc, 0 to 2A.
 - 3.1.1 **Load regulation.** For no-load to full-load excursions: 120 mV voltage regulation, 32 mA current regulation.
 - 3.1.2 **Line regulation.** For line-voltage variations of $\pm 10\%$ or greater: 60 mV voltage regulation, 25 mA current regulation.
 - 3.1.3 **Ripple and noise.** 300 mVrms or 500 mV peak-to-peak maximum.
 - 3.1.4 **Temperature coefficient.** For any one degree C change in the ambient temperature: 56 mV voltage regulation, 8 mA current regulation.
 - 3.1.5 **Drift.** For eight hours with constant line, load, and ambient temperature: $0.1\% + 60$ mV voltage regulation, 25 mA current regulation.
 - 3.2 **Indicators.** Output voltage and current. Accuracy: $\pm 2\%$ FS.
 - 3.3 **Connectors.** Three-way front-panel binding posts for positive output, negative output, and chassis ground connections.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 2 kW.
5. **WEIGHT.** 41 kg (90 lb) maximum.

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APPENDIX D

PS1TN-A

POWER SUPPLY, DC

1. **GENERAL.** This procurement requires a constant-voltage, constant-current dc power supply.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Output voltage and current.** Continuously adjustable from 0 to 300 Vdc, 0 to 3A.
 - 3.1.1 **Load regulation.** For no-load to full-load excursions: 300 mV voltage regulation, 3 mA current regulation.
 - 3.1.2 **Line regulation.** For line-voltage variations of $\pm 10\%$ or greater: 300 mV voltage regulation, 3 mA current regulation.
 - 3.1.3 **Ripple and noise.** 250 mVrms.
 - 3.1.4 **Temperature coefficient.** For any one degree C change in the ambient temperature: 60 mV voltage regulation, 0.9 mA current regulation.
 - 3.1.5 **Drift.** For eight hours with constant line, load, and ambient temperature: $\pm 0.05\%$ of set voltage indication.
 - 3.2 **Indicators.** Output voltage and current. Accuracy: $\pm 2\%$ fs.
 - 3.3 **Connectors.** Three-way front-panel binding posts for positive output, negative output, and chassis ground connections.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 2 kW.
5. **WEIGHT.** 29 kg (64 lb) maximum.

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PS1VN-C

POWER SUPPLY, DC

1. **GENERAL.** This procurement requires a portable, constant voltage, dc power supply.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications identified below.
 - 3.1 **Output voltage.** 0 to 500 Vdc.
 - 3.1.1 **Output voltage regulation.** 0.01% of output or 1 mV, whichever is greater, for 9% line variations or 100% load variations.
 - 3.1.2 **Output voltage ripple and noise.** 1 mVrms maximum.
 - 3.1.4 **Output voltage stability.** $\pm 0.06\%$ or 6 mV, whichever is greater, for eight hours with constant line load conditions.
 - 3.2 **Output current.** 0 to 400 mA.
 - 3.3 **Output voltage and current indicators.** $\pm 2\%$ accuracy.
 - 3.4 **Output connectors.** Insulated binding posts for positive output, negative output, and chassis ground.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 500W.
5. **WEIGHT.** 21 kg (46 lb) maximum.

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PRCAA-B

PROBE, CURRENT

1. **GENERAL.** This procurement requires a clamp-on dc ammeter or current probe accessory.
2. **CLASSIFICATION.** Type III, Class 5, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring direct current within the minimum ranges and accuracies detailed below. The equipment may be a stand-alone unit or an accessory or group of accessories that can be used in conjunction with either a digital voltmeter or an oscilloscope.
 - 3.1 Measurement range. 1 mA to 10A.
 - 3.2 Accuracy. $\pm 3\%$ of full scale.
 - 3.3 Probe aperture. 0.15 in. minimum, 0.25 in. maximum.
4. **POWER SOURCE.** MIL-T-28800 nominal or dc internal power source requirements as detailed below.
 - 4.1 Nominal power source. Operation at 400 Hz is not required. Maximum power consumption: 300W.
 - 4.2 DC internal power source: Internal batteries and charger are required. Minimum operating time shall be 8 hours following a maximum recharge time of 16 hours.
 - 4.2.1 Alternate dc internal power source. The batteries shall be of a commercially available type and provide 12 months of operation before replacement.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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RDOMN-B

RECORDER, OSCILLOGRAPHIC

1.0 GENERAL. This procurement requires a high performance two-channel oscillographic recorder with input ranges from 1.0 mV/division to 5.0 V/division in a 1, 2, 5 sequence.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.

3.0 OPERATIONAL REQUIREMENTS.

3.1 Input channels. Two analog channels are required.

3.2 Chart description. Two 40 mm (minimum) wide channels are required with 40 divisions (minimum) full scale and with time lines every 2 mm.

3.3 Chart speeds. At least 4 selectable speeds to include 5, 25, 125, and 500 mm/sec are required.

3.4 Chart speed accuracy. The chart speed accuracy shall be $\pm 5\%$ plus power line frequency variations at all temperatures across the range.

3.5 Plug-in preamplifiers. If plug-in preamplifiers are used, they shall be interchangeable without recalibration.

3.6 Input ranges. The recorder shall provide at least 12 input ranges from 1.0 mV/div to 5.0 V/div in a 1, 2, 5 sequence with a continuous vernier between ranges.

3.7 Input resistance. A 1 megohm (minimum) input resistance is required.

3.8 Maximum allowable input. The maximum allowable input voltage shall be at least 230 Vdc (or Vrms).

3.9 Common mode voltage. The common mode voltage shall be at least 250 Vdc or peak ac on 500 mV/div range and above.

3.10 Event marker/timer. An event marker and a timer are required. Event markers shall be capable of being operated from the front panel or rear terminal via contact closure or TTL level. Timer marks shall be in uniform intervals of at least 1/sec, 6/min, 1/min, and 6/hour.

3.11 Frequency response. For 10 divisions deflection, the frequency response shall be flat within $\pm 2\%$ to 100 Hz and a maximum of 3 dB down at 125 Hz.

3.12 Pen. The writing system shall produce a clear, concise trace at a maximum width of 0.5 mm. Either thermal printing or a fiber tipped pen may be used. At maximum chart speed, the resulting recording shall be a permanent, blot-proof, smudge-proof presentation of the data.

3.13 Paper take up. The recorder must have a paper take-up reel.

4.0 GENERAL SPECIFICATIONS.

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- 4.1 Dimensions. 254 mm x 432 mm x 280 mm (10 in x 17 in x 11 in) nominal
- 4.2 Weight. 15.9 kg (35 lbs) nominal.
- 4.3 Power. 115/230 Vac $\pm 10\%$, 50/60 Hz, 190 VA maximum.

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APPENDIX D

RXONP-F

RECORDER, X-Y

1.0 GENERAL. This procurement requires a high performance X-Y recorder which will accept paper sizes no larger than 216 x 280 mm (8-1/2 x 11 in).

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

a. The Electromagnetic Interference requirements of MIL-T-28800() are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 10 GHz), and RS03.

3.0 OPERATIONAL REQUIREMENTS.

3.1 Main frame.

3.1.1 Paper size: The writing surface shall accommodate paper sizes of 216 x 280 mm (8-1/2 x 11 in) or smaller.

3.1.2 Paper holddown: The paper holddown shall be of the electrostatic type or pinch rollers in order to accommodate various paper sizes and to require no periodic maintenance other than cleaning.

3.1.3 Pens: A fast drying, disposable fiber tipped pen shall be used in the writing system.

3.1.4 Zero set: Zero reference shall be capable of being placed anywhere on the writing area.

3.1.5 Writing speed: Shall be at least 1,300 mm/second (51.2 in/second).

3.1.6 Linearity: Shall be $\pm 0.15\%$ of full scale or better.

3.1.7 Resettability: Shall be better than $\pm 0.2\%$ full scale.

3.1.8 Pen lift: Local and remote control via contact closure or TTL level.

3.1.9 Range vernier: The range vernier shall be a continuous adjustment overlapping adjacent ranges, and shall be lockable.

3.2 DC preamplifiers.

3.2.1 X-Y input ranges: Shall be at least 0.5 mV/cm to 5 V/cm.

3.2.2 X-Y inputs: Floating signal pairs shall be available through front panel or rear connectors. Input shall be capable of being operated up to ± 200 Vdc with respect to chassis ground.

3.2.3 Accuracy: Shall be $\pm 0.3\%$ of full scale or better.

3.2.4 Input impedance: The input impedance shall be a constant 1 Megohm (or greater) on all ranges.

3.2.5 Common mode rejection: The common mode rejection shall be 100 dB minimum for dc and 90 dB minimum for ac.

3.3 Internal time base: An internal time base capability is required for Y-T applications in plotting a single input versus the internal time reference.

3.3.1 Sweep times: Shall include a minimum of four settings over a range of at least 1.25 to 25 sec/in.

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3.3.2 Accuracy: At least $\pm 3.0\%$ of full scale.

3.3.3 Linearity: At least $\pm 1.0\%$ of full scale.

4.0 GENERAL REQUIREMENTS.

4.1 Power: 115/230 Vac $\pm 10\%$ single phase, 50, 60 or 400 Hz, 150 VA maximum.

4.2 Dimensions: W 500 mm; D 350 mm; H 150 mm (19.6 in x 13.7 in x 5.9 in).
maximum.

4.3 Weight: 11 kg (24.5 lb) maximum.

MIL-STD-1364J

APPENDIX D

FDRKP-B

REFLECTOMETER, FREQUENCY DOMAIN

1. **GENERAL.** This procurement requires a swept-frequency reflectometer capable of characterizing faults in coaxial and waveguide transmission lines.
2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of characterizing transmission lines with a single measurement as specified below. Hard-copy printouts of distance-to-fault with associated line loss and VSWR vs. frequency shall be provided.
 - 3.1 **Frequency range.** 2 MHz to 1 GHz.
 - 3.2 **Impedance.** 50 ohms nominal.
 - 3.3 **VSWR accuracy.**
 - a. 5% maximum for indicated values of 1.1 to 1.99.
 - b. 10% maximum for indicated values of 2 or higher.
 - 3.4 **Sweep rate.** 25 ms nominal.
 - 3.5 **Sweep increments.** 5% or less of the specified frequency range.
 - 3.6 **Foreign signal rejection.** A means shall be provided wherein harmonics and foreign signals that are within 10% of the operating frequency, and have an amplitude of 17 dBm or less for distance-to-fault measurements and 0 dBm or less for VSWR vs. frequency measurements, are rejected from the characterization process.
 - 3.7 **Distance-to-fault and line loss mode.** The equipment shall measure and indicate the distance to each fault in a transmission line, the line loss, and VSWR associated with each fault.
 - 3.7.1 **Dynamic range.** RF output level: 0 dBm nominal. Dynamic range: 80 dB.
 - 3.7.2 **Location accuracy.**
 - a. ± 1.5 ft maximum for distances of 150 ft and greater.
 - b. $\pm 1\%$ maximum for distances less than 150 ft.
 - 3.7.3 **Overload indication.** When the input exceeds 17 dBm, the equipment shall provide the operator with an overload indication. Maximum input: 30 dBm.
 - 3.8 **VSWR vs. frequency mode.** A mode shall be provided where the equipment will measure and indicate VSWR vs. frequency.
 - 3.8.1 **Dynamic range.** 30 dB or greater.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 75W.
5. **WEIGHT.** 21.4 kg (47 lb) maximum.

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APPENDIX D

TDRNN-E

REFLECTOMETER, TIME DOMAIN

1. **GENERAL.** This procurement requires a portable, self-contained cable tester to identify and locate cable faults. An internal Y-T chart recorder is required.
2. **CLASSIFICATION.** Type III, Class 3, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications. A tilt-bail handle is required.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications detailed below. Unless otherwise specified, the specifications apply to both configurations.
 - 3.1 **Test signal.** The equipment shall be capable of generating a test signal that is sufficient for all required measurement parameters.
 - 3.2 **Vertical system.** The vertical system shall be directly calibrated in reflection coefficient (ρ). A front-panel gain adjustment shall enable the operator to establish a reference level by comparison with a 50 ohm $\pm 1\%$ termination.
 - 3.2.1 **Deflection factor.** 5 millirhos/div to 500 millirhos/div. Accuracy: $\pm 3\%$ of full scale.
 - 3.3 **Horizontal system.** The horizontal system shall be calibrated in feet.
 - 3.3.1 **Measurement range.** 0 to 2,000 feet.
 - 3.3.1.1 **Distance scale selector.** A control shall be provided for feet/division selection.
 - 3.3.1.2 **Distance to fault.** A distance-to-fault indicator is required. Resolution: 0.2 in. Accuracy: $\pm(2\%$ of reading + 0.05 ft.) from 0 to 100 ft., $\pm(2\%$ of reading + 1 digit) from 100 to 2,000 ft.
 - 3.3.2 **Dielectric selector.** Range: 0.55 to 1.
 - 3.4 **Display.** Oscillographic presentation. The display shall have an internal graticule with 8 vertical and 10 horizontal divisions, with subdivision markings of 0.2 division on the cardinal axes.
 - 3.5 **Chart recorder.** A Y-T chart recorder shall be provided to record the displayed signal. The recorder shall operate from the internal power source of the equipment. Accuracy: see 3.2.1 and 3.3.1.2.
 - 3.6 **Accessories.** One 50 ohm precision termination ($\pm 1.0\%$) and one precision 50-ohm cable for operation verification shall be provided with the equipment.
4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.
 - 4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 25W.
 - 4.2 **DC internal power source.** Internal batteries and charger are required. Minimum operating time shall be 5 hours following a maximum recharge time of 20 hours.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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APPENDIX D

TDRBD-A

REFLECTOMETER, TIME DOMAIN

1. **GENERAL.** This procurement requires a hand-held, solid-state, time domain reflectometer that operates from a self-contained, replaceable dc power source.
2. **CLASSIFICATION.** Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of locating cable faults within the minimum ranges and accuracies specified below. The equipment shall be usable on coaxial, power distribution, and instrumentation cables.
 - 3.1 **Range.** 1 to 3,000 ft. Velocity of propagation (V_p): 0.25 to 0.95.
 - 3.1.1 **Accuracy.** $\pm 3\%$ of range.
 - 3.2 **Display.** The equipment display shall be readable at "arm's length" in accordance with MIL-T-28800 and indicate, as a minimum, the full-scale range, distance to fault, V_p factor, a graphic depiction of the cable response, and a low battery indication.
 - 3.3 **Overload protection.** 250 Vac.
4. **ACCESSORIES.** Test leads and a carrying case.
5. **POWER SOURCE.** MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 12 months of operation before replacement. The nominal power source requirements are not invoked.
6. **DIMENSIONS.** 254 mm (10 in) high, 127 mm (5 in) wide, and 63.5 mm (2.5 in) deep, maximum.
7. **WEIGHT.** 1.5 kg (3.3 lb) maximum.

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APPENDIX D

TDRND-E

REFLECTOMETER, TIME DOMAIN

1. **GENERAL.** This procurement requires a portable, self-contained cable tester to identify and locate cable faults. An internal Y-T chart recorder is required.
2. **CLASSIFICATION.** Type III, Class 3, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications. A tilt-bail handle is required.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications detailed below. Unless otherwise specified, the specifications apply to both configurations.
 - 3.1 **Test signal.** The equipment shall be capable of generating a test signal that is sufficient for all required measurement parameters.
 - 3.2 **Vertical system.** The vertical system shall be directly calibrated in dB. A front-panel gain adjustment shall enable the operator to establish a reference level by comparison with a 50 ohm $\pm 1\%$ termination.
 - 3.2.1 **Deflection factor.** 0 dB/div to 60 dB/div. Accuracy: $\pm 3\%$ of full scale.
 - 3.3 **Horizontal system.** The horizontal system shall be calibrated in feet.
 - 3.3.1 **Measurement range.** 0 to 25,000 feet in RG-8A/U cable.
 - 3.3.1.1 **Distance scale selector.** A control shall be provided for feet/division selection.
 - 3.3.1.2 **Distance to fault.** A distance-to-fault indicator is required. Resolution: 2.0 in. Accuracy: $\pm(2\%$ of reading + 0.2 ft.) from 0 to 10 ft., $\pm(2\%$ of reading + 1 ft.) from 10 to 25,000 ft.
 - 3.3.2 **Dielectric selector.** Range: 0.55 to 1.
 - 3.4 **Display.** Oscillographic presentation. The display shall have an internal graticule with 8 vertical and 10 horizontal divisions, with subdivision markings of 0.2 division on the cardinal axes.
 - 3.5 **Chart recorder.** A Y-T chart recorder shall be provided to record the displayed signal. The recorder shall operate from the internal power source of the equipment. Accuracy: see 3.2.1 and 3.3.1.2.
 - 3.6 **Accessories.** One 50 ohm precision termination ($\pm 1.0\%$) and one precision 50-ohm cable for operation verification shall be provided with the equipment.
4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.
 - 4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 25W.
 - 4.2 **DC internal power source.** Internal batteries and charger are required. Minimum operating time shall be 5 hours following a maximum recharge time of 20 hours.
5. **WEIGHT.** 10 kg (22 lb) maximum.

MIL-STD-1364J

APPENDIX D

TDRNM-A

REFLECTOMETER, TIME DOMAIN

1. **GENERAL.** This procurement requires a pulse reflectometer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operating within the following limits and minimum specifications.
 - 3.1 **Pulse amplitude.** Adjustable from 0.1V to 5 kV into 50 ohms $\pm 10\%$.
 - 3.2 **Pulse width.** Typically 30 ns.
 - 3.3 **Output connectors.** The equipment shall be provided with a female N type connector for pulse output and a female BNC type connector for oscilloscope display of the pulse.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 40W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

TDFAA-C

REFLECTOMETER, TIME DOMAIN, FIBER OPTIC

1.0 GENERAL. This procurement requires a portable, general purpose, solid state, programmable optical time domain reflectometer (OTDR) capable of measuring faults and splices in multimode optical fiber cables at wavelengths of 1300 nanometers (nm). The OTDR shall be capable of performing calibrated optical attenuation and distance measurements.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine and shore applications with the following modifications and exceptions:

a. The non-operating temperature requirement is limited to the range of -40°C to +65°C.

b. The operating temperature requirement is limited to the range of 0°C to +40°C.

c. The Electromagnetic Interference requirements of MIL-T-28800 are limited to CE01 (-20 dB), CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 10 GHz), and RS03.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of making measurements within the parameters and accuracies specified herein.

3.1 Light source.

3.1.1 Wavelength: 1300 nm ± 30 nm.

3.1.2 Plug-In module: Light source shall be interchangeable as plug-in module without need to disassemble mainframe.

3.1.3 Connector: FC type.

3.1.4 Pulse widths: At least 3 widths.

3.1.4.1 Minimum PW: 3 nsec or less.

3.1.5 Pulse recovery time (dead zone): 10 m maximum.

3.2 Vertical axis: Attenuation/Loss Parameters.

3.2.1 Scale factor.

3.2.1.1 Minimum: 0.5 dB/div or less.

3.2.1.2 Maximum: 4.0 dB/div or more.

3.2.2 Dynamic range: 10 dB.

3.2.3 Resolution: 0.02 dB or better.

3.2.4 Measurement modes:

Loss between 2 points
Loss by least squares approximation
Loss per unit length

3.3 Horizontal axis: Distance Measurement.

3.3.1 Range: At least 15 / 40 km.

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3.3.2 Accuracy: $\pm [1.0 \text{ m} + 2 \times 10^{-5} \times D]$ [D - measured distance in meters]

3.3.3 Resolution: FS/500 [FS - full scale distance in meters].

3.3.4 Index of refraction.

3.3.4.1 Range: 1.4000 to 1.6000.

3.3.4.2 Resolution: 0.0001.

3.4 Signal averaging. Noise reduction shall be provided by sequential averaging of fiber signature trace. Parameters of 3.2 and 3.3 shall be achieved within two minutes of signal averaging.

3.5 Display. OTDR shall present the data from measurements in a graphical and alphanumeric form simultaneously.

3.5.1 Graphical: CRT visual observation of fiber characteristic in dB on the vertical axis verses fiber distance in meters on the horizontal axis. Trace shall show entire characteristic or a magnified portion of range.

3.5.2 Alphanumeric: Integral part of graphical display. The following parameters shall be displayed:

- | | |
|-------------------------------------|--------------------------------------|
| (1) Date | (8) Marker Distance |
| (2) Title (manual entry) | (9) Pulse Width |
| (3) Distance Range | (10) Index of Refraction |
| (4) Horizontal Scale (m/div) | (11) Distance between Markers (m/km) |
| (5) Vertical Scale (dB/div) | (12) Splice Loss (dB) |
| (6) Horizontal Trace Start Distance | (13) Loss between Markers (dB) |
| (7) Wavelength | (14) Fiber Loss (dB/km) |

Note: Alphanumeric data must appear with data recalled from storage.

3.5.2.2 Markers/Cursors: At least two movable on-screen indicators, capable of being positioned at any point on graphical trace with resolution of 1.0 m.

3.5.2.3 Loss measurement.

3.5.2.3.1 2 point: Loss in dB between any two points (markers).

3.5.2.3.2 Slope: Fiber loss per unit distance (dB/km).

3.5.2.4 Averaging status indicator: Indicator shall provide current status of signal averaging.

3.5.3 Hardcopy printout: A hard copy duplicate of the complete CRT data screen shall be available from an internal printer/plotter.

4.0 GENERAL REQUIREMENTS.

4.1 Power source: 115 and 230 Vac $\pm 10\%$, single phase, at frequencies of 50 and 60 Hz $\pm 10\%$; and 400 Hz $\pm 10\%$ at 115 Vac only, 250 watts maximum.

4.2 Dimensions: Portable less than 200 mm (H); 350 mm (W); 450 mm (D).

4.3 Weight: The overall weight of the unit with one plug-in shall not exceed 20 kg (44 lbs).

4.4 Remote operation: The unit will be capable of remote operation via IEEE-488() bus interface. It shall operate as a talker or listener such that all functions except the power on/off switch are controllable and shall have as a minimum the following subset of GPIB commands: AH1, SH1, T6, L4, SR1, RL1, DC1, DT1.

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APPENDIX D

RACAA-A

REGULATOR, LINE

1. **GENERAL.** This procurement requires a single-phase line voltage regulator.
2. **CLASSIFICATION.** Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. The convertible/rackmountable requirement is invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of regulating power line voltages in accordance with the following minimum specifications.
 - 3.1 **Output specifications.**
 - 3.1.1 **Voltage.** 103 to 127 Vac continuously adjustable.
 - 3.1.2 **Current rating.** 50A irrespective of load conditions.
 - 3.1.3 **Correction rate.** 42 msec + 25 msec/1V change.
 - 3.1.4 **Regulation.** $\pm 0.25\%$ of output voltage setting.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked except operation at 50 and 400 Hz is not required and the operating voltage range is limited to 103.5 to 126.5V. Maximum power consumption: 6 kW.
5. **WEIGHT.** 25 kg (55 lb) maximum.

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Configuration A: RE1GF-C
 Configuration B: RE1KJ-C
 Configuration C: RE1GM-C
 Configuration D: RE1DN-C
 Configuration E: RE1GY-C
 Configuration F: RE1KT-C
 Configuration G: RE1AN-C
 Configuration H: RE1DY-C

RESISTOR, DECADE

1. **GENERAL.** This procurement requires a decade resistor unit.
2. **CLASSIFICATION.** Type III, class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. The power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall provide selectable resistance values within the ranges, accuracy, voltage and power handling capabilities detailed below.
 - 3.1 Resistance range. See table I.
 - 3.2 Resistance step. See table I.

TABLE I. Resistance Range

CONFIGURATION	RESISTANCE RANGE (IN OHMS)	RESISTANCE STEP (IN OHMS)	MAXIMUM POWER PER STEP (WATTS)
A	1-11,110	1	0.5
B	10-111,100	10	0.5
C	1-111,110	1	0.5
D	0.1-111,111	0.1	0.25
E	1-1,111,110	1	0.5
F	10-11,111,100	10	0.5
G	0.01-111,111.1	0.01	0.16
H	0.1-1,111,111	0.1	0.25

- 3.3 **Accuracy.** $\pm(0.02\%$ of indicated value + the zero resistance value). Zero resistance: 0.002 ohm/decade at dc.
- 3.4 **Maximum power.** See table I.
- 3.5 **Temperature coefficient.** ± 20 ppm/ $^{\circ}$ C maximum.
- 3.6 **Connectors.** Binding posts with 18.75 mm (3/4 in) spacing. Resistance terminals must be isolated from case. A shield terminal is required.
4. **WEIGHT.** 3.9 kg (8.5 lb) maximum.

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RE1GT-A
RESISTOR, DECADE

1. **GENERAL.** This procurement requires a high voltage decade resistor.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below.
 - 3.1 **Resistance range.** 1 to 999,999 ohms.
 - 3.2 **Accuracy.** $\pm 5\%$ of reading.
 - 3.3 **Maximum power.** 225W per decade.
 - 3.4 **Maximum input voltage.** 1000 Vdc, 660 Vac.
 - 3.5 **Maximum current.** See table I.

TABLE I. Maximum Current

Decade Step	1-ohm	10-ohm	100-ohm	1-kilohm	10-kilohm	100-kilohm
Maximum Current	5A	1.5A	0.5A	0.15A	0.05	0.0005A

- 3.6 **Connectors.** Binding posts with 18.75 mm (3/4 in) spacing. Resistance terminals must be isolated from case. A shield terminal is required.
4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** 9.1 kg (20.0 lb) maximum.

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APPENDIX D

FSNFT-D

SYNTHESIZER, FREQUENCY

1. **GENERAL.** This procurement requires a programmable and synthesized audio frequency generator capable of generating low distortion sine wave signals over a frequency range of 30 Hz to 200 kHz.

2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -20°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.
- d. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01(-20 dB), CE03, CS01, CS02 (0.5 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14kHz to 1 GHz), and RS03.
- e. The warm-up time is extended to one hour.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 **Frequency characteristics.** (F = Output frequency).

3.1.1 **Range.** At least 30 Hz to 200 kHz (600 Ω balanced & unbalanced output).

3.1.2 **Resolution.** At least 0.1 Hz (F < 1 kHz); at least 1 Hz (F < 10 kHz); at least 10 Hz (F < 200 kHz).

3.1.3 **Stability.**

3.1.3.1 **Internal.** Better than ± 2 pp 10^5 /hr (after 1 hr warm-up).

3.1.3.2 **External.** Equal to the external frequency standard.

3.1.3.2.1 **External reference.** 1, 5 or 10 MHz signal, TTL compatible.

3.1.4 **Spectral purity (sine wave output).** (ΔF = offset from output frequency).

3.1.4.1 **Distortion.** < 0.3% (10 Vrms for 300Hz < F < 200 kHz), < 0.5% (1 Vrms for 30 Hz < F < 300 Hz).

3.1.4.2 **Power line.** < -45 dBc (ΔF < 300 Hz for F < 100 kHz).

3.1.4.3 **Nonharmonics.** < -55 dBc (ΔF > 300 Hz for F < 100 kHz).

3.2 **Output characteristics.**

3.2.1 **Sine wave output.**

3.2.1.1 **Amplitude.**

3.2.1.1.1 At least 50 mVrms to 10 Vrms (into matched 600 Ω load)

3.2.1.2 **Impedance.**

3.2.1.2.1 600 Ω $\pm 10\%$ (at 1 kHz) balanced & unbalanced.

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- 3.2.1.2 Voltage accuracy. $\pm 12\%$ (30 Hz < F < 100 kHz; matched load).
- 3.2.1.3 Flatness. ± 1 dB (F < 100 kHz); +1, -4 dB (F < 200 kHz) (1 kHz ref).
- 3.2.1.4 Display. Digital; at least 3 digits.
 - 3.2.1.4.1 Units. At least volts.
 - 3.2.1.4.2 Resolution. 0.1 dB minimum.
- 3.2.1.5 Connector. Binding post or compatible.
- 4. GENERAL REQUIREMENTS.
 - 4.1 Power. 115 and 230 Vac $\pm 10\%$, 50 and 60 Hz, 90W maximum.
 - 4.2 Dimensions. The total volume of the unit shall not exceed 900 in³ (14,750 cm³).
 - 4.3 Weight. The total weight of the unit shall not exceed 15 lbs (6.8 kg).
 - 4.4 Remote control. Unit must be controllable via the IEEE-488 interface bus; as a minimum, all front panel functions (except AC power) must be remotely controllable when the unit operates as a listener on the bus.

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FSNFU-A

SYNTHESIZER, FREQUENCY

1.0 GENERAL. This procurement requires a stable RF synthesizer capable of generating signals over the frequency range of 1 kHz to 140 MHz with internal and external modulation capabilities.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.
- d. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Frequency range. At least 1 kHz to 140 MHz.

3.1.2 Frequency resolution. At least 1 Hz.

3.1.3 Frequency accuracy. At least $\pm 1 \times 10^{-5}$ after a one hour warm-up or equal to external reference.

3.1.4 Spectral purity (equal to or better than the limits specified below).

3.1.4.1 Harmonics. -30 dBc.

3.1.4.2 Nonharmonics. -65 dBc.

3.1.4.3 Phase noise. Less than -120 dBc/Hz measured 20 kHz from the carrier.

3.2 Output characteristics.

3.2.1 Power output range. At least +19 to -127 dBm for CW and FM operation and at least +13 to -127 dBm for AM operation.

3.2.2 Output level resolution. At least 1 dB over the entire output range.

3.2.3 Power output accuracy. At least ± 1.5 dB from +19 to -40 dBm with an additional ± 0.1 dB/step for levels below -40 dBm.

3.2.4 Impedance/Connector. 50 ohms; type BNC(f).

3.2.4.1 VSWR. Better than 1.5:1 for output levels less than 0 dBm.

3.3 Modulation characteristics.

3.3.1 Amplitude modulation (AM).

3.3.1.1 Internal.

3.3.1.1.1 Rates. At least 400 Hz and 1 kHz.

3.3.1.1.2 Depth. At least 1 to 90% modulation with less than 3% distortion.

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3.3.1.2 External.

3.3.1.2.1 Rates. Variable from 20 Hz to 15 kHz minimum.

3.3.1.2.2 Depth. At least 1 to 90% modulation with less than 3% distortion.

3.3.2 Frequency modulation (FM).

3.3.2.1 Internal.

3.3.2.1.1 Rates. At least 400 Hz and 1 kHz.

3.3.2.1.2 FM deviation. 0 Hz to at least 1% of the carrier for frequencies below 20 MHz; 0 Hz to at least 199 kHz for carrier frequencies above 20 MHz.

3.3.2.2 External.

3.3.2.2.1 Rates. Variable from 20 Hz to 20 kHz minimum.

3.3.2.2.2 FM deviation. 0 Hz to at least 1% of the carrier for frequencies below 20 MHz; 0 Hz to at least 199 kHz for carrier frequencies above 20 MHz.

4.0 GENERAL REQUIREMENTS.

4.1 Power. 115/230 Vac $\pm 10\%$, 50/60 Hz, 120 VA maximum.

4.2 Dimensions. The total volume of the unit shall not exceed 4,347 cubic in (71,235 cubic cm).

4.3 Weight. The total weight of the unit shall not exceed 50 lbs (23 kg).

4.4 Remote programming. The generator shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having at least the following subset of bus functions: AH1, L4, SH1, T6, SR1, DC1 and RL1.

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APPENDIX D

FSNFR-C

SYNTHESIZER, FREQUENCY

1.0 GENERAL. This procurement requires a programmable audio frequency generator capable of generating low distortion, high amplitude level, sine and square wave signals over a frequency range of 20 Hz to 20 kHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

a. The Electromagnetic Interference requirements of MIL-T-28800 are limited to CE01(-20 dB), CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14kHz to 10 GHz), and RS03.

b. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Range: At least 20 Hz to 20 kHz.

3.1.2 Resolution: Digital; at least 4 digits.

3.1.3 Stability.

3.1.3.1 Internal: Better than ± 2 pp 10^5 /h (after 1 h warm-up).

3.1.3.2 External: Equal to the external frequency standard.

3.1.3.2.1 External reference: 1, 5 or 10 MHz signal, TTL compatible.

3.1.4 Spectral purity (equal to or better than the limits specified below).

3.1.4.1 Harmonics: -40 dBc.

3.1.4.2 Nonharmonics: -65 dBc.

3.1.4.3 Distortion: Less than 0.5% from 50 Hz to 20 kHz at 1 W; less than 1% from 20 Hz to 20 kHz at 3 W.

3.2 Output characteristics.

3.2.1 Sine wave output.

3.2.1.1 Amplitude (sine): 10 mV to 42 Vrms.

3.2.1.2 Impedance: 600 ohms $\pm 10\%$.

3.2.1.3 Accuracy: At least $\pm 5\%$ of indication at 1 kHz.

3.2.1.4 Flatness: ± 1 dB (1 kHz ref).

3.2.1.5 Display: Digital in units of volts/millivolts.

3.2.1.6 Resolution: 3 digits.

3.2.1.7 Connector: Type BNC female.

3.2.2 Squarewave output: TTL levels, positive.

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3.2.2.1 Rise/Fall Time: Less than 50 ns.

4.0 GENERAL REQUIREMENTS.

4.1 Power: 115/230 Vac $\pm 10\%$, 50/60 Hz, 100 watts maximum.

4.2 Dimensions: The total volume of the unit shall not exceed 16,400 cm³ (1000 in³).

4.3 Weight: The total weight of the unit shall not exceed 6.8 kg (15 lb).

4.4 Remote control: Unit must be controllable via the IEEE-488() interface bus; as a minimum, all front panel functions (except AC power) must be remotely controllable when the unit operates as a listener on the bus.

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APPENDIX D

FSNSC-A

SYNTHESIZER, FREQUENCY

1.0 **GENERAL.** This procurement requires a programmable synthesized signal generator employing no more than two plug-ins and covering a frequency range of 10 kHz to 110 MHz.

2.0 **CLASSIFICATION.** The synthesized signal generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for the Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is extended to 72 hours.

3.0 **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 **Frequency characteristics.**

3.1.1 **Frequency range.** At least 10 kHz to 110 MHz.

3.1.2 **Frequency resolution.** 1 Hz; digital readout.

3.1.3 **Frequency stability.**

3.1.3.1 **Internal.** At least $\pm 3 \times 10^{-9}$ /day.

3.1.3.2 **External.** Equal to external standard frequency stability.

3.1.4 **Spectral purity.**

3.1.4.1 **Harmonics/Subharmonics.** At least -25 dBc.

3.1.4.2 **Nonharmonics/Spurious.** At least -50 dBc.

3.1.4.3 **Single sideband phase noise.** Less than -100 dBc/Hz at 10 kHz offset.

3.1.5 **Reference frequency.**

3.1.5.1 **Internal reference oscillator.** 10 MHz.

3.1.5.2 **External reference oscillator.** 5 or 10 MHz, 0.5 to 2.0 Vrms into 170 ohms.

3.2 **Output characteristics.**

3.2.1 **Range.** +10 to -140 dBm.

3.2.2 **Accuracy.** 2.0 dB over entire range.

3.2.3 **Flatness.** ± 1.0 dB.

3.2.4 **Digital sweep.** Auto, single, or manual operation with selectable speeds 0.1, 1.0 or 50 seconds.

3.3 **Modulation characteristics.**

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3.3.1 Amplitude modulation.

3.3.1.1 Internal.

3.3.1.1.1 Rate. At least 400 Hz and 1 kHz $\pm 5\%$.

3.3.1.1.2 Depth. At least 0 to 90%.

3.3.1.1.3 Accuracy. $\pm 5\%$ of full scale.

3.3.1.1.4 Distortion. Less than 5% at 50% depth and 1 kHz rate.

3.3.1.2 External.

3.3.1.2.1 Rate. At least 20 Hz to 50 kHz for carrier frequencies > 4 MHz; 20 Hz to 5 kHz for carrier frequencies < 4 MHz and > 0.4 MHz; 0 Hz to 100 Hz for carrier frequencies < 0.4 MHz

3.3.1.2.2 Depth. At least 0 to 90%.

3.3.1.2.3 Accuracy. $\pm 5\%$ of full scale.

3.3.1.2.4 Distortion. Less than 5% at 50% depth and 1 kHz rate.

3.3.1.2.5 Input impedance. 600 ohms.

3.3.2 Frequency modulation.

3.3.2.1 Internal.

3.3.2.1.1 Rate. At least 400 Hz and 1 kHz $\pm 5\%$.

3.3.2.1.2 Deviation. At least 0 to 1 MHz.

3.3.2.1.3 Accuracy. $\pm 5\%$ of full scale.

3.3.2.2 External.

3.3.2.2.1 Rate. At least dc to 1 MHz.

3.3.2.2.2 Deviation. At least 0 to 1 MHz.

3.3.2.2.3 Distortion. Less than 3% for deviation < 1 MHz, at rates < 20 kHz.

3.3.2.2.4 Input impedance. 600 ohms.

4.0 GENERAL REQUIREMENTS.

4.1 Power. 115/230 Vac $\pm 10\%$, 50/60 or 400 Hz $\pm 10\%$, 350W maximum.

4.2 Dimensions. The total volume of the unit shall not exceed 46,342 cubic cm (2,828 cubic in) with a maximum height of 185 mm (7.25 in).

4.3 Weight. The total weight of the unit shall not exceed 30 kg (66 lbs).

4.4 Remote control. Instrument must be capable of operating via the IEEE-488 interface bus and shall provide the capability to talk and listen.

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APPENDIX D

FSNFV-A

SYNTHESIZER, FREQUENCY

1.0 GENERAL DESCRIPTION. This procurement requires a solid-state, synthesized signal generator covering the frequency range of 10 kHz to 520 MHz; output level continuously adjustable from +13 to -127 dBm; CW operation or AM/FM capability from either an internal or external source. In addition it shall have a deviation meter capable of measuring FM deviation on externally applied input signals from 30 to 500 MHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensing.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Frequency range. At least 10 kHz to 520 MHz.

3.1.2 Frequency resolution. Minimum resolution at least 10 Hz; digital readout.

3.1.3 Frequency accuracy. Same as reference.

3.1.4 Reference.

3.1.4.1 Internal. 10 MHz, less than 0.5 ppm per hour after 1 hour warm-up.

3.1.4.2 External. Accepts 10 MHz TTL compatible.

3.1.5 Spectral purity (equal to or better than limits specified below).

3.1.5.1 Harmonics/Sub-Harmonics. -26 dBc from 10 kHz to 10 MHz; -30 dBc from 10 to 520 MHz.

3.1.5.2 Non-harmonics/Spurious. -35 dBc.

3.1.5.3 Residual FM (50 Hz to 15 kHz post detection bandwidth). Less than 200 Hz peak.

3.1.5.4 Residual AM (50 Hz to 15 kHz post detection bandwidth). At least -60 dBc.

3.2 Output characteristics.

3.2.1 Range. +13 to -127 dBm (1V to 0.1 uV).

3.2.2 Accuracy. ±2.5 dB of actual measured output level.

3.2.3 Display (digital).

3.2.3.1 Units. Both dBm and volts.

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- 3.2.3.2 Resolution. 0.1 dB or better.
- 3.2.4 Output impedance. 50 ohms.
 - 3.2.4.1 Connector. Type N(f).
 - 3.2.4.2 SWR. Less than 1.3 at RF outputs below -10 dBm.
- 3.3 Modulation characteristics.
 - 3.3.1 Amplitude modulation (AM).
 - 3.3.1.1 Internal AM.
 - 3.3.1.1.1 Rate. At least 400 Hz and 1 kHz; both $\pm 5\%$.
 - 3.3.1.1.2 Depth. 0 to 99%; display accurate to within $\pm 6\%$.
 - 3.3.1.1.3 Distortion. Less than 5% at 50% depth and 1 kHz rate.
 - 3.3.1.2 External AM.
 - 3.3.1.2.1 Rates. 10 Hz to 20 kHz.
 - 3.3.1.2.2 Depth. 0 to 99%.
 - 3.3.1.2.3 Distortion. Less than 5% at 50% depth and 1 kHz rate.
 - 3.3.1.2.4 Input level. Less than 10 V peak-to-peak into 600 ohms.
 - 3.3.2 Frequency modulation (FM).
 - 3.3.2.1 Internal FM.
 - 3.3.2.1.1 Rate. At least 400 Hz and 1 kHz; both $\pm 5\%$.
 - 3.3.2.1.2 FM deviation. 0 to 500 kHz peak.
 - 3.3.2.1.2.1 Ranges. At least 0 to 50 kHz for carrier frequencies between 0.1 and 5 MHz; at least 0 to 500 kHz for carrier frequencies above 5 MHz.
 - 3.3.2.1.3 Deviation error. $\pm 5\%$ of deviation at 1 kHz (excluding residual FM).
 - 3.3.2.2 External FM.
 - 3.3.2.2.1 Rates. 50 Hz to 100 kHz.
 - 3.3.2.2.2 FM deviation. 0 to 500 kHz peak.
 - 3.3.2.2.2.1 Ranges. At least 0 to 50 kHz for carrier frequencies between 0.1 and 5 MHz; at least 0 to 500 kHz for carrier frequencies above 5 MHz.
 - 3.3.2.2.3 Deviation error. $\pm 5\%$ of deviation at 1 kHz (excluding residual FM).
 - 3.3.2.2.4 Input level. Less than 10V peak-to-peak into 600 ohms.
- 3.4 FM deviation meter.
 - 3.4.1 Frequency input range. 30 to 500 MHz.
 - 3.4.2 Input signal level. 15 mV to 5V rms.
 - 3.4.3 Input impedance. 50 ohms.

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3.4.4 Measurement range. 0 to 500 kHz.

3.4.4.1 Polarity. Selectable positive or negative.

3.4.4.2 Modulation rate. 100 Hz to 8 kHz.

3.4.4.3 Accuracy. 6% of full scale from 100 Hz to 8 kHz.

4.0 GENERAL REQUIREMENTS.

4.1 Power source. 115 or 230 Vac $\pm 10\%$, single phase, 50, 60 or 400 Hz.

4.2 Input power. The maximum power required for operation shall not exceed 100W.

4.3 Remote operation. Instrument shall be capable of operating via the IEEE-488 interface bus and shall provide the capability to talk and listen.

4.4 Dimensions. The total volume of the unit shall not exceed 2,270 cubic in (37,200 cubic cm) with a maximum height of 6.0 inches.

4.5 Weight. The overall weight of the unit shall not exceed 40 pounds (18.2 kg).

4.6 RF leakage. Less than 1 μ V when measured with a 2 turn, 1 inch diameter loop held 1 inch from any surface using a 50 ohm input receiver.

4.7 Reverse power protection. Resettable RF circuit breaker up to inputs of 50W.

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APPENDIX D

FSNSA-C

SYNTHESIZER, FREQUENCY

1. **GENERAL.** This procurement requires a programmable synthesized signal generator covering a frequency range of 100 kHz to 2 GHz with internal and external modulation capabilities.
2. **CLASSIFICATION.** The synthesized signal generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for the Navy shipboard, submarine, and shore applications with the following exceptions:
 - a. The relative humidity requirement is limited to 95% noncondensating.
 - b. The operating and nonoperating altitude requirements are not invoked.
 - c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.5 to 100 MHz), CS06, RE01 (relaxed 20 dB; back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
 - d. The warm-up time is extended to 2 hours.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.
 - 3.1 **Frequency characteristics.** F = carrier frequency.
 - 3.1.1 **Range.** At least 100 kHz to 2 GHz.
 - 3.1.2 **Resolution.** At least 1 Hz.
 - 3.1.3 **Stability (CW mode).**
 - 3.1.3.1 **Internal.** $< \pm 2 \text{ pp } 10^9/\text{hr.}$
 - 3.1.3.2 **Temperature.** $< 1 \text{ pp } 10^7 \text{ } 0\text{-}50^\circ\text{C.}$
 - 3.1.3.3 **External.** Equal to external standard frequency stability.
 - 3.1.4 **Spectral purity.** (level $\leq 8 \text{ dBm}$).
 - 3.1.4.1 **Harmonics/Subharmonics.** At least -30 dBc (F < 1 GHz) at least -25 dBc (> 1 GHz).
 - 3.1.4.2 **NonHarmonics/Spurious.** At least -90 dBc (>15 kHz from carrier).
 - 3.1.4.3 **Signal sideband phase noise.** $\leq -120 \text{ dBc/Hz}$ (at 20 kHz offset).
 - 3.1.4.4 **Residual AM.** $< 0.1\% \text{ rms}$ (300 Hz to 3 kHz BW).
 - 3.1.4.5 **Residual FM.** $< 10 \text{ Hz rms}$ (50 Hz to 15 kHz BW).
 - 3.1.5 **Frequency sweep.**
 - 3.1.5.1 **Type.** Linear, stepped.
 - 3.1.5.2 **Sweep width.** At least 10 kHz to 1 GHz.
 - 3.1.5.3 **Step size.** At least 1 Hz to 10 MHz.
 - 3.1.5.4 **Modes.** Manual, auto.
 - 3.1.6 **Reference frequency.**

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- 3.1.6.1 Internal. 10 MHz.
- 3.1.6.1.1 Output level. > 0.1 Vrms into 50 ohm BNC female connector.
- 3.1.6.2 External. 5 or 10 MHz.
- 3.1.6.2.1 Input level. > 0.5 Vrms into 50 ohm BNC female connector.
- 3.2 Output characteristics.
- 3.2.1 Range. +13 to -127 dBm.
- 3.2.2 Accuracy. Within ± 1.5 dB.
- 3.2.2.1 Resolution. 0.1 dB.
- 3.2.3 Flatness. ± 1 dB (measured at 0 dBm).
- 3.2.4 Output impedance/connector. 50-ohm; Type-N.
- 3.2.4.1 VSWR. < 2 (Level < 0 dBm).
- 3.2.5 Reverse power protection.
- 3.2.5.1 Max CW power. 25W.
- 3.2.5.2 Max dc voltage. 25V.
- 3.3 Modulation characteristics. (F = carrier frequency) Any simultaneous combination of AM, FM, or pulse.
- 3.3.1 Amplitude modulation (AM). (Level \leq 0 dBm.)
- 3.3.1.1 Internal AM. (F > 10 MHz.)
- 3.3.1.1.1 Rate. At least 20 Hz to 50 kHz synthesized.
- 3.3.1.1.2 Depth. 0 to 99%.
- 3.3.1.1.3 Accuracy. $\pm 7\%$ of selected depth (< 90% depth @1 kHz).
- 3.3.1.1.4 Distortion. $\leq 5\%$ (50% depth @1 kHz).
- 3.3.1.1.5 Incidental ϕ M. < 0.3 radians (30% depth @ 1 kHz), (50 Hz to 15 kHz BW).
- 3.3.1.2 External AM. (F > 10 MHz.)
- 3.3.1.2.1 Rate. At least 20 Hz to 50 kHz.
- 3.3.1.2.2 Depth. 0 to 99%.
- 3.3.1.2.3 Sensitivity. < 1 Vpk (produce selected depth within 10%).
- 3.3.1.2.4 Distortion. $\leq 5\%$ (50% depth @ 1 kHz).
- 3.3.1.2.5 Input impedance. 600 Ω .
- 3.3.2 Frequency modulation (FM). (ΔF = FM deviation).
- 3.3.2.1 Internal FM. (F > 10 MHz.)
- 3.3.2.1.1 Rate. At least 20 Hz to 100 kHz synthesized.
- 3.3.2.1.2 Deviation. At least 0 to 100 kHz.

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- 3.3.2.1.3 Accuracy. $\pm 6\%$ of set value + 20 Hz (50 Hz to 25 kHz rate).
- 3.3.2.1.4 Distortion. $\leq 3\%$ [$\Delta F = 20$ kHz @ 1 kHz].
- 3.3.2.2 External FM. ($F > 10$ MHz).
- 3.3.2.2.1 Rate. At least DC to 100 kHz.
- 3.3.2.2.2 Deviation. At least 0 to 100 kHz.
- 3.3.2.2.3 Distortion. $\leq 3\%$ ($\Delta F = 20$ kHz @ 1 kHz).
- 3.3.2.2.4 Incidental AM. $< 1\%$ ($\Delta F = 20$ kHz @ 1 kHz), (50 Hz to 15 kHz BW).
- 3.3.2.2.5 Input impedance. 600 Ω .
- 3.3.3 Pulse modulation (PM).
- 3.3.3.1 External PM [$F > 10$ MHz].
- 3.3.3.1.1 Rate. At least 20 Hz to 1 MHz.
- 3.3.3.1.2 Level Accuracy. $\leq \pm 2$ dB.
- 3.3.3.1.3 Min Pulse Width. < 500 nsec.
- 3.3.3.1.4 ON/OFF ratio. > 80 dB.
- 3.3.3.1.5 Rise/Fall Time. < 100 nsec.
- 3.3.3.1.6 Level. > 3 Vpk ON; < 1 Vpk OFF.
- 3.3.3.1.7 Input Impedance. 50 ohms or 600 ohms.
- 3.3.4 Internal Modulation Source (Synthesized).
- 3.3.4.1 Rates. 1 Hz to 100 kHz.
- 3.3.4.2 Accuracy/Stability. Same as reference.
- 3.3.4.3 Resolution. At least 3 digits.
- 3.3.4.4 Level. 0 to 2 Vpeak.
- 3.3.4.5 Output Impedance. 600 ohms.
- 4. GENERAL REQUIREMENTS
- 4.1 Power. 115/230 Vac $\pm 10\%$, single phase, 50-60 Hz $\pm 5\%$, 400 VA maximum.
- 4.2 Dimensions. The total volume of the unit shall not exceed 49200 cm³ (3000 in³).
- 4.3 Weight. The total weight of the unit shall not exceed 31.8 kg (70 lbs).
- 4.4 Remote Programming. The generator shall be capable of being remotely controlled via the IEEE-488() interface bus, operating as both a talker and listener, having at least the following subset of bus functions: AH1, L4, SH1, T6, SR1, DC1, and RL1.

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FSNSD-A

SYNTHESIZER, FREQUENCY

1.0 GENERAL. This procurement requires a programmable synthesized signal generator employing no more than two RF and two modulation plug-ins, covering a frequency range of 1 MHz to 1.3 GHz with external AM and external pulse modulation.

2.0 CLASSIFICATION. The synthesized signal generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for the Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is extended to 72 hours.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics. (F - carrier frequency.)

3.1.1 Frequency range. At least 1 MHz to 1.3 GHz.

3.1.2 Frequency resolution. 1 Hz.

3.1.3 Frequency stability.

3.1.3.1 Internal. At least $\pm 3 \times 10E-9$ /day.

3.1.3.2 External. Equal to external standard frequency stability.

3.1.4 Spectral purity.

3.1.4.1 Harmonics/Subharmonics. Greater than -30 dBc.

3.1.4.2 Nonharmonics/Spurious. At least -50 dBc.

3.1.4.3 Single sideband phase noise. Less than -100 dBc/Hz at 10 kHz offset.

3.1.5 Reference frequency.

3.1.5.1 Internal reference oscillator. 10 MHz.

3.1.5.2 External reference oscillator. 5 or 10 MHz, 0.5 to 2.0 Vrms into 170 ohms.

3.2 Output characteristics.

3.2.1 Range. +10 to -146 dBm.

3.2.2 Accuracy. ± 1.5 dB to -76 dBm, ± 2.0 dB to -146 dBm.

3.2.3 Flatness. Less than ± 1.0 dB.

3.2.4 Digital sweep. Auto, single, or manual operation with selectable speeds 0.1, 1.0 or 50 seconds.

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3.3 Modulation characteristics.

3.3.1 Amplitude modulation (AM).

3.3.1.1 Internal AM. None.

3.3.1.2 External AM.

3.3.1.2.1 Rate. At least 0 to 5 kHz less than 10 MHz, 20 Hz to 50 kHz greater than 10 MHz.

3.3.1.2.2 Depth. At least 0 to 90%.

3.3.1.2.3 Accuracy. $\pm 10\%$ full scale.

3.3.1.2.4 Distortion. Less than 5% at 50% depth and 1 kHz rate.

3.3.1.2.5 Input impedance. 600 ohms.

3.3.2 Pulse modulation.

3.3.2.1 Internal pulse modulation. None.

3.3.2.2 External pulse modulation.

3.3.2.2.1 Input impedance. 50 ohms.

3.3.2.2.2 Pulse rise/fall time. 50 ns.

3.3.2.2.3 ON/OFF ratio. Greater than 40 dB.

4.0 GENERAL REQUIREMENTS.

4.1 Power. 115/230 Vac $\pm 10\%$, single phase, 50, 60 or 400 Hz $\pm 10\%$, 350W maximum.

4.2 Dimensions. The total volume of the unit shall not exceed 2,828 cubic in (46,342 cc) with a maximum height of 7.25 in.

4.3 Weight. The total weight of the unit shall not exceed 66 lbs (30 kg).

4.4 Remote programming. The generator shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having at least the following subset of bus functions: AH1, L4, SH1, T6, SR1, DC1, and RL1.

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APPENDIX D

FSNSE-A

SYNTHESIZER, FREQUENCY

1.0 GENERAL. This procurement requires a programmable synthesized signal generator employing no more than two plug-ins and covering a frequency range of 1 MHz to 1.3 GHz.

2.0 CLASSIFICATION. The synthesized signal generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for the Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is extended to 72 hours.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Frequency range. At least 1 MHz to 1.3 GHz.

3.1.2 Frequency resolution. 1 Hz; digital readout.

3.1.3 Frequency stability.

3.1.3.1 Internal. At least $\pm 3 \times 10^{-9}/\text{day}$.

3.1.3.2 External. Equal to external standard frequency stability.

3.1.4 Spectral purity.

3.1.4.1 Harmonics/Subharmonics. At least -25 dBc.

3.1.4.2 Nonharmonics/Spurious. At least -50 dBc.

3.1.4.3 Single sideband phase noise. Less than -90 dBc/Hz at 10 kHz offset.

3.1.5 Reference frequency.

3.1.5.1 Internal reference oscillator. 10 MHz.

3.1.5.2 External reference oscillator. 5 or 10 MHz, 0.5 to 2.0 Vrms into 170 ohms.

3.2 Output characteristics.

3.2.1 Range. +10 to -140 dBm.

3.2.2 Accuracy. ± 2.0 dB over entire range.

3.2.3 Flatness. ± 1.0 dB.

3.2.4 Digital sweep. Auto, single, or manual operation with selectable speeds 0.1, 1.0 or 50 seconds.

3.3 Modulation characteristics.

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3.3.1 Amplitude modulation.

3.3.1.1 Internal.

3.3.1.1.1 Rate. At least 400 Hz and 1 kHz $\pm 5\%$.

3.3.1.1.2 Depth. At least 0 to 90%.

3.3.1.1.3 Accuracy. $\pm 10\%$ of full scale.

3.3.1.1.4 Distortion. Less than 5% at 50% depth and 1 kHz rate.

3.3.1.2 External.

3.3.1.2.1 Rate. At least 20 Hz to 50 kHz for carrier frequencies >10 MHz; at least 20 Hz to 5 kHz for carrier frequencies <10 MHz.

3.3.1.2.2 Depth. At least 0 to 90%.

3.3.1.2.3 Accuracy. $\pm 10\%$ of full scale.

3.3.1.2.4 Distortion. Less than 5% at 50% depth and 1 kHz rate.

3.3.1.2.5 Input impedance. 600 ohms.

3.3.2 Frequency modulation.

3.3.2.1 Internal.

3.3.2.1.1 Rate. At least 400 Hz and 1 kHz $\pm 5\%$.

3.3.2.1.2 Deviation. At least 0 to 100 kHz.

3.3.2.1.3 Accuracy. $\pm 5\%$ of full scale.

3.3.2.2 External.

3.3.2.2.1 Rate. At least 20 Hz to 100 kHz.

3.3.2.2.2 Deviation. At least 0 to 100 kHz.

3.3.2.2.3 Distortion. Less than 3% for dev <100 kHz, at rates <20 kHz.

3.3.2.2.4 Input impedance. 600 ohms.

4.0 GENERAL REQUIREMENTS.

4.1 Power. 115/230 Vac $\pm 10\%$, 50/60 or 400 Hz $\pm 10\%$, 350W maximum.

4.2 Dimensions. The total volume of the unit shall not exceed 46,342 cubic cm (2,828 cubic in) with a maximum height of 185 mm (7.25 in).

4.3 Weight. The total weight of the unit shall not exceed 30 kg (66 lbs).

4.4 Remote control. Instrument must be capable of operating via the IEEE-488 interface bus and shall provide the capability to talk and listen.

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APPENDIX D

FSNSB-B

SYNTHESIZER, FREQUENCY

1. **GENERAL.** This procurement requires a programmable synthesized signal generator employing no more than two plug-ins and covering a frequency range of 1 MHz to 2.6 GHz.

2. **CLASSIFICATION.** The synthesized signal generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for the Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The relative humidity requirement is limited to 95% noncondensating.
- b. The operating and nonoperating altitude requirements are not invoked.
- c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
- d. The warm-up time is extended to 72 hours.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Frequency range. At least 1 MHz to 2.6 GHz.

3.1.2 Frequency resolution. 1 Hz below 1.3 GHz, 2 Hz above 1.3 GHz; digital readout.

3.1.3 Frequency stability.

3.1.3.1 Internal. At least $\pm 3 \times 10^{-9}$ /day.

3.1.3.2 External. Equal to external standard frequency stability.

3.1.4 Spectral purity.

3.1.4.1 Harmonics/Subharmonics. At least -30 dBc below 1.3 GHz, -20 dBc above 1.3 GHz.

3.1.4.2 NonHarmonics/Spurious. At least -55 dBc.

3.1.4.3 Signal sideband phase noise. Less than -100 dBc/Hz at 10 kHz offset.

3.1.5 Reference frequency.

3.1.5.1 Internal reference oscillator. 10 MHz.

3.1.5.2 External reference oscillator. 5 or 10 MHz, 0.5 to 2.0 V_{rms} into 170Ω.

3.2 Output characteristics.

3.2.1 Range. +10 to -136 dBm below 1.3 GHz; +7 to -136 dBm above 1.3 GHz.

3.2.2 Accuracy. ± 2.5 dB for level > -70 dBm; ± 3.5 dB for level < -70 dBm.

3.2.3 Flatness. ± 2.0 dB.

3.2.4 Output connector. Type N.

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- 3.2.4.1 Impedance. 50 Ω .
- 3.2.4.2 VSWR. < 2:1 (Output level < 0 dBm).
- 3.2.5 Digital sweep. Auto, single, or manual operation with selectable speeds 0.1, 1.0 or 50 seconds.
- 3.3 Modulation characteristics. F = RF center frequency.
 - 3.3.1 Amplitude modulation.
 - 3.3.1.1 Internal.
 - 3.3.1.1.1 Rate. At least 400 Hz and 1 kHz $\pm 5\%$.
 - 3.3.1.1.2 Depth. At least 0 to 90% (F < 1.3 GHz); 0 to 50% (F > 1.3 GHz).
 - 3.3.1.1.3 Accuracy. $\pm 10\%$ of full scale.
 - 3.3.1.1.4 Distortion. Less than 5% at 50% depth and 1 kHz rate.
 - 3.3.1.2 External.
 - 3.3.1.2.1 Rate. At least 20 Hz to 10 kHz.
 - 3.3.1.2.2 Depth. At least 0 to 90% (F < 1.3 GHz); 0 to 50% (F > 1.3 GHz).
 - 3.3.1.2.3 Accuracy. $\pm 10\%$ of full scale.
 - 3.3.1.2.4 Distortion. Less than 5% at 50% depth and 1 kHz rate.
 - 3.3.1.2.5 Input impedance. 600 Ω .
 - 3.3.2 Frequency modulation.
 - 3.3.2.1 Internal.
 - 3.3.2.1.1 Rate. At least 400 and 1 kHz $\pm 5\%$.
 - 3.3.2.1.2 Deviation. At least 0 to 100 kHz (F < 1.3 GHz); 0 to 200 kHz (F > 1.3 GHz).
 - 3.3.2.1.3 Accuracy. $\pm 5\%$ of full scale.
 - 3.3.2.2 External.
 - 3.3.2.2.1 Rate. At least 20 Hz to 100 kHz.
 - 3.3.2.2.2 Deviation. At least 0 to 100 kHz (F < 1.3 GHz); 0 to 200 kHz (F > 1.3 GHz).
 - 3.3.2.2.3 Distortion. Less than 3% for dev < 200 kHz, at rates < 20 kHz.
 - 3.3.2.2.4 Input impedance. 600 Ω .
 - 3.3.3 Phase modulation.
 - 3.3.3.1 Internal.
 - 3.3.3.1.1 Rate. At least 400 Hz and 1 kHz $\pm 5\%$.
 - 3.3.3.1.2 Deviation. At least 0 to 100° (F < 1.3 GHz); 0 to 200° (F > 1.3 GHz).
 - 3.3.3.1.3 Accuracy. $\pm 5\%$ of full scale.

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- 3.3.3.1.4 Distortion. Less than 5% at 50° deviation and 1 kHz rate.
- 3.3.3.2 External.
 - 3.3.3.2.1 Rate. At least dc to 1 MHz ($F < 100$ MHz); dc to 5 MHz ($F > 100$ MHz).
 - 3.3.3.2.2 Deviation. At least 0 to 100° below 1.3 GHz; 0 to 200° above 1.3 GHz.
 - 3.3.3.2.3 Accuracy. $\pm 10\%$ of full scale.
 - 3.3.3.2.4 Distortion. Less than 5% at 50° deviation and 100 kHz rate.
 - 3.3.3.2.5 Input impedance. 50 Ω .

4. GENERAL REQUIREMENTS.

- 4.1 Power. 115/230 Vac $\pm 10\%$, single phase, 50, 60 or 400 Hz $\pm 10\%$, 350W maximum.
- 4.2 Dimensions. The total volume shall not exceed 46,342 cm³ (2,828 in³) with a maximum height of 18.415 cm (7.25 in).
- 4.3 Weight. The total weight shall not exceed 30 kg (66 lbs).
- 4.4 Remote programming. The generator shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having at least the following subset of bus functions: AH1, L4, SH1, T6, SR1, DC1, and RL1.

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APPENDIX D

FSNSF-F

SYNTHESIZER, FREQUENCY

1.0 GENERAL. This procurement requires a stable microwave signal generator capable of generating signals over the frequency range of 50 MHz to 8 GHz with internal and external modulation capabilities.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

a. The Electromagnetic Interference requirements of MIL-T-28800() are limited to CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE02 (14 kHz to 10 GHz), and RS03.

b. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Range: At least 50 MHz to 8 GHz.

3.1.2 Resolution: At least 1 kHz; digital readout.

3.1.3 Accuracy: Equal to reference standard (CW mode).

3.1.4 Stability (equal to or better than limits specified below).

3.1.4.1 Internal: Less than 1 part in 10^6 /h at $25^\circ\text{C} \pm 5^\circ\text{C}$ after one hour warmup.

3.1.4.2 External: Equal to external standard.

3.1.4.3 Temperature: Less than ± 2 parts in 10^5 change over 0 to 50°C .

3.1.5 Residual modulation (CW mode in 50 Hz to 15 kHz detection BW).

3.1.5.1 FM: Less than 150 Hz rms.

3.1.5.2 AM: Less than 0.15% pk.

3.1.6 Spectral purity (F = carrier frequency).

3.1.6.1 Harmonics: < -30 dBc.

3.1.6.2 Power line/Fan rotation related harmonics: < -30 dBc (< 1 kHz from carrier).

3.1.6.3 Non-harmonics/Spurious: < -55 dBc (≥ 10 kHz from carrier).

3.1.6.4 Phase noise: < -80 dBc/Hz (10 kHz offset from carrier).

3.2 Output characteristics.

3.2.1 Range: +10 to -90 dBm leveled (minimum).

3.2.2 Accuracy: ± 2.0 dB for output levels from +10 dBm to -50 dBm; additional 0.1 dB/10 dB step for levels below -50 dBm.

3.2.3 Display/Resolution: Digital display; minimum resolution of 0.1 dB.

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- 3.2.4 Flatness: ± 1.0 dB measured at an output level of +10 dBm.
- 3.2.5 Impedance/Connector: 50 ohms; type-N female connector.
 - 3.2.5.1 VSWR: $< 2:1$ [Level ≤ 0 dBm].
- 3.2.6 Reverse power protection: The generator shall be capable of accepting the following signal levels at its output connector without resulting damage.
 - 3.2.6.1 Average power: 1 watt.
 - 3.2.6.2 Peak power: 2 kW [$2.3 \text{ GHz} < F < 8.0 \text{ GHz}$].
- 3.3 Modulation characteristics.
 - 3.3.1 Pulse modulation.
 - 3.3.1.1 Internal.
 - 3.3.1.1.1 Rate (PRF): 50 Hz to 50 kHz.
 - 3.3.1.1.2 Width (PW): 0.1 to 10.0 μs .
 - 3.3.1.1.3 Rise/Fall Times: < 50 ns.
 - 3.3.1.1.4 ON/OFF Ratio: ≥ 80 dB.
 - 3.3.1.1.5 Delay: 50 nsec to 100 ms.
 - 3.3.1.1.5.1 Accuracy: $\leq 20\%$ of setting.
 - 3.3.1.1.5.2 Sync pulse output: TTL compatible; rise time less than 50 ns.
 - 3.3.1.1.5.3 Video pulse output: TTL compatible; width corresponds to PW control setting.
 - 3.3.1.1.6 External trigger input: TTL compatible; at least 100 Hz to 50 kHz; provides sync rate for pulse modulation.
 - 3.3.1.2 External.
 - 3.3.1.2.1 Rate (PRF): 50 Hz to 50 kHz.
 - 3.3.1.2.2 Width (PW): $> 0.1 \mu\text{s}$.
 - 3.3.1.2.3 Video output: TTL compatible pulse; same PW and PRF as external input pulse.
 - 3.3.1.2.4 Pulse input: TTL compatible.
 - 3.3.2 Amplitude (Can be used simultaneously with pulse modulation).
 - 3.3.2.1 Internal AM.
 - 3.3.2.1.1 Rate: At least 400 Hz and 1 kHz.
 - 3.3.2.1.2 Depth: 0 to 70% minimum.
 - 3.3.2.1.3 Accuracy: Less than 10%.
 - 3.3.2.2 External AM.
 - 3.3.2.2.1 Rate: At least 10 Hz to 10 kHz.
 - 3.3.2.2.2 Depth: 0 to 70% minimum.

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3.3.2.2.3 Sensitivity: At least 70%/V.

3.3.3 Frequency modulation (FM) (F - carrier freq; ΔF - peak freq deviation).

3.3.3.1 Internal FM.

3.3.3.1.1 Rate: At least 400 Hz and 1 kHz.

3.3.3.1.2 FM Deviation: ≤ 1 kHz to at least 30 kHz peak [$F \leq 30$ MHz], ≤ 1 kHz to at least 100 kHz peak [30 MHz $\leq F \leq 500$ MHz], ≤ 1 kHz to at least 1 MHz peak [500 MHz $\leq F \leq 1$ GHz], ≤ 1 kHz to at least 2 MHz peak [$F \geq 1$ GHz].

3.3.3.1.3 FM Accuracy: $\pm 10\%$ ($\Delta F \geq 50$ kHz); $\pm 20\%$ ($5 \leq \Delta F < 50$ kHz).

3.3.3.1.4 Distortion: $\leq 10\%$ [$\Delta F=300$ kHz @ 10 kHz].

3.3.3.1.5 Incidental AM: $\leq 0.2\%$ (50 Hz - 15 kHz BW) [$\Delta F = 20$ kHz @ 1 kHz].

3.3.3.2 External FM.

3.3.3.2.1 Rates: At least 1 kHz to 100 kHz.

3.3.3.2.2 FM Deviation: ≤ 1 kHz to at least 30 kHz peak [$F \leq 30$ MHz], ≤ 1 kHz to at least 100 kHz peak [30 MHz $\leq F \leq 500$ MHz], ≤ 1 kHz to at least 1 MHz peak [500 MHz $\leq F \leq 1$ GHz], ≤ 1 kHz to at least 2 MHz peak [$F \geq 1$ GHz].

3.3.3.2.3 FM Accuracy: $\pm 10\%$ ($\Delta F \geq 50$ kHz); $\pm 20\%$ ($5 \leq \Delta F < 50$ kHz).

3.3.3.2.4 Distortion: $\leq 5\%$ [$\Delta F=300$ kHz @ 10 kHz].

4.0 GENERAL REQUIREMENTS.

4.1 Power: 115/230 Vac $\pm 10\%$ single phase, 50, 60 or 400 Hz, 250 watts maximum.

4.2 Dimensions: The total volume shall not exceed 46,000 cm³ (2,800 in³).

4.3 Weight: The overall weight shall not exceed 27.3 kg (75 lb).

4.4 Remote operation: The unit will be capable of remote operation via IEEE-488() bus interface. It shall operate as a talker or listener such that all functions except the power on/off switch are controllable, and shall have as a minimum the following subset of GPIB commands: AH1, SH1, T6, L4, SR1, RL1, DC1, DT1.

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APPENDIX D

FSNTP-C

SYNTHESIZER, FREQUENCY

1.0 GENERAL. This procurement requires an all solid state, synthesized, wideband microwave signal generator covering a frequency range of 50 MHz to 26.5 GHz and including the ability to measure external frequencies* and external power levels. Plug-ins are NOT acceptable for any portion of this equipment.

2.0 CLASSIFICATION. The signal generator described herein shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine and shore applications with the following modifications and exceptions:

a. The Electromagnetic Interference requirements of MIL-T-28800() are limited to CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE02 (14 kHz to 10 GHz), and RS03.

b. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS.

3.1 Frequency characteristics.

3.1.1 Range: 50 MHz to 26.5 GHz.

3.1.2 Resolution: The displayed frequency resolution shall be at least 1 kHz.

3.1.3 Accuracy (CW mode): Same as reference standard.

3.1.4 Stability: Less than 1 pp 109/h after one hour warm-up.

3.1.5 Spectral purity (at least the limits specified below).

3.1.5.1 Harmonics/Sub-harmonics: At least -55 dBc.

3.1.5.2 Non-harmonics/Spurious: At least -55 dBc.

3.1.5.3 Phase noise: At least -70 dBc/Hz at an offset 20 kHz.

3.1.5.4 Residual FM (BW = 50 Hz to 15 kHz), < 200 Hz rms [F < 2 GHz], < 400 Hz rms [F > 2 GHz].

3.1.6 Reference frequency.

3.1.6.1 Internal reference output: 10 MHz; > 0.5 Vrms into 50 ohms.

3.1.6.2 External reference input: 10 MHz; > 0.2 Vrms into 50 ohms.

3.1.6.3 External reference output: 10 MHz; > 0.5 Vrms into 50 ohms.

3.1.7 Frequency lock indicator: A light shall be provided which shall indicate that the output frequency is phase locked to the reference frequency.

3.2 Output characteristics (L = Output level in dBm).

3.2.1 Impedance/Connector: 50 ohms/precision 3.5 mm male or female (SMA compatible).

3.2.1.1 VSWR: Less than 2:1 [L < 0 dBm].

3.2.2 Level: -99 dBm to +10 dBm leveled.

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3.2.3 Resolution: 0.1 dBm in a digital readout.

3.2.4 Accuracy (displayed level vs measured output level) ± 1.0 dB from 0.05 to 18 GHz; ± 2.0 dB from 18 to 26.5 GHz [L > -40 dBm] Additional ± 0.2 dB/10 dB step [L < -40 dBm]

3.2.5 Level control indicator: A light shall be provided which shall indicate that the output signal level is under active control of the feedback circuit in the leveling loop. An unlevelled indication on this display shall mean that the output amplitude is unlevelled regardless of the actual amplitude measured at the output.

3.3 Modulation characteristics.

3.3.1 Pulse modulation (internal).

3.3.1.1 Rate: 10 Hz to 1 MHz.

3.3.1.2 Width: 0.1 μ s to 100 ms.

3.3.1.3 Rise/Fall Time: Less than 25 ns.

3.3.1.4 Overshoot/Undershoot/Ringing: ± 2.0 dB maximum.

3.3.1.5 Settling time: ± 1.0 dB of the final value within 100 ns.

3.3.1.6 On/Off ratio: Greater than 80 dB.

3.3.2 Pulse modulation (external).

3.3.2.1 Rate: 10 Hz to 1 MHz.

3.3.2.2 Width: 0.1 μ s to 100 ms.

3.3.2.3 Triggering: Rising or falling edge.

3.3.2.4 Sync output: Modulation waveform, TTL compatible.

3.4 Digital sweep characteristics.

3.4.1 Range: 50 MHz to 26.5 GHz.

3.4.2 Step size: 1 kHz or less to 100 MHz.

3.4.3 Step time: Variable, 1 step/10 ms to at least 1 step/sec.

3.4.4 Ramp output: 0 to 10 volts, proportional to the frequency between selected sweep limits.

3.4.5 Output flatness: Within ± 1.0 dB to 18 GHz; ± 2.0 dB from 18 to 26.5 GHz.

3.4.6 Sweep mode: Auto (continuous), single, single step, reset.

3.4.7 Sweep trigger: External input for triggering sweep, TTL compatible.

3.4.8 Pen lift: TTL compatible output, high level during retrace.

3.5 Power meter.

3.5.1 Frequency range: 50 MHz to 26.5 GHz.

3.5.2 External measurement range: +10 dBm to -30 dBm.

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3.5.3 Accuracy (indicated power level vs externally measured level): ± 1.0 dB (+10 dBm to -10 dBm); ± 2.0 dB (-10 dBm to -30 dBm).

3.5.4 Display (digital): 3.5 digits minimum.

3.5.4.1 Resolution: 0.1 dB minimum for all power readings.

3.5.5 Input connector: Precision 3.5 mm male or female (SMA compatible).

3.6 Frequency counter.*

3.6.1 Input range: At least 100 MHz to 26.5 GHz.

3.6.2 Resolution: At least 100 Hz.

3.6.3 Sensitivity: -25 dBm to 18 GHz; -20 dBm from 18 to 26.5 GHz.

3.6.4 Mode: CW or Pulsed RF Input.

3.6.4.1 Minimum PW for pulsed RF input: 0.5 μ s.

3.6.5 Accuracy: (CW) At least 1 ppm.

3.6.6 Input impedance: 50 ohms nominal.

3.6.7 Input connector: Precision 3.5 mm male or female (SMA compatible).

4.0 GENERAL REQUIREMENTS.

4.1 Power: 115/230 Vac $\pm 10\%$ single phase 50, 60 or 400 Hz, 350 watts maximum.

4.2 Volume: Less than 65,548 cm³ (4,000 in³).

4.3 Weight: Less than 29.55 kg (65 lb).

4.4 Remote control: The generator shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having at least the following subset of bus functions: AH1, L4, SH1, T6, SR1, DC1 and RL1. Control of the following parameters is required:

Output Frequency	External Power Measure
Output Amplitude (-99 to +10 dBm)	External Frequency Measure
Sweep Function	Modulation: 1 μ s PW; 1 kHz PRF
Frequency Lock Status	Amplitude Level Status

5.0 ACCESSORIES. The following list of accessories shall be provided with each equipment.

5.1 One Gore-tex GMCA 190-1265 or equivalent coaxial cable, 6 ft long, with male precision 3.5 mm SMA compatible connectors or equivalent on each end.

5.2 One Gore-tex GMCA 190-1265 or equivalent coaxial cable, 18 in long, with male precision 3.5 mm SMA compatible connectors or equivalent on each end.

5.3 One male to female adapter with precision 3.5 mm SMA compatible connector or equivalent.

5.4 One female to female adapter with precision 3.5 mm SMA compatible connector or equivalent.

* Frequency counter may be supplied as a separate piece of equipment; however, weight and volume restrictions apply to signal generator packages only.

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FSNLA-C

SYNTHESIZER, FREQUENCY

1. **GENERAL.** This procurement requires a stable microwave signal generator capable of generating signals over the frequency range of 5.4 GHz to 12.5 GHz with internal and external AM, FM, and pulse modulation with delay capabilities.
2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:
 - a. The relative humidity requirement is limited to 95% noncondensing.
 - b. The operating and nonoperating altitude requirements are not invoked.
 - c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
 - d. The warm-up time is extended to one hour.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.
 - 3.1 **Frequency characteristics.**
 - 3.1.1 **Frequency range.** At least 5.4 GHz to 12.5 GHz.
 - 3.1.2 **Frequency resolution.** Minimum resolution at least 1 kHz; digital readout.
 - 3.1.3 **Frequency accuracy.** Equal to accuracy of reference standard (CW mode).
 - 3.1.4 **Frequency stability (equal to or better than limits specified below).**
 - 3.1.4.1 **Internal.** Less than 1 part in 10^9 /hr at $25^\circ\text{C} \pm 5^\circ\text{C}$ after one hour warmup.
 - 3.1.4.2 **External.** Equal to external standard frequency stability.
 - 3.1.4.3 **Temperature.** Less than ± 2 parts in 10^5 change over 0 to 50°C temperature range.
 - 3.1.5 **Residual modulation (CW mode in 50 Hz to 15 kHz detection BW).**
 - 3.1.5.1 **FM.** Less than 200 Hz rms.
 - 3.1.5.2 **AM.** Less than 0.3% pk.
 - 3.1.6 **Spectral purity.**
 - 3.1.6.1 **Harmonics.** < -30 dBc.
 - 3.1.6.2 **Power line/fan rotation related harmonics.** < -30 dBc (< 1 kHz from carrier).
 - 3.1.6.3 **Nonharmonics/Spurious.** < -55 dBc (≥ 10 kHz from carrier).
 - 3.1.6.4 **Phase noise.** < -75 dBc/Hz at 10 kHz offset from carrier.
 - 3.2 **Output characteristics.**

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- 3.2.1 Range. +10 to -120 dBm (minimum).
- 3.2.2 RF output. Leveled output shall be available at +10 dBm or less.
- 3.2.3 Accuracy. ± 2 dB for output levels from +10 dBm to -50 dBm; additional 0.1 dB/10 dB step for levels below -50 dBm.
- 3.2.4 Display/Resolution. Digital display; minimum resolution of 0.1 dB.
- 3.2.5 Flatness. ± 1 dB measured at an output level of +10 dBm.
- 3.2.6 Impedance/Connector. 50-ohm type-N female connector.
 - 3.2.6.1 VSWR. $< 2:1$ (at levels < 0 dBm).
- 3.2.7 Reverse power protection. The generator shall be capable of accepting the following signal levels at its output connector without resulting damage.
 - 3.2.7.1 Average power. 5W.
 - 3.2.7.2 Peak power. 2 kW (widths $< 10 \mu\text{s}$).
- 3.3 Modulation characteristics.
 - 3.3.1 Pulse modulation.
 - 3.3.1.1 Internal.
 - 3.3.1.1.1 Rate (PRF). At least 50 Hz to 50 kHz.
 - 3.3.1.1.2 Width (PW). 0.1 to 10 μs .
 - 3.3.1.1.3 Rise and fall times. Less than 50 ns.
 - 3.3.1.1.4 ON/OFF ratio. Greater than 80 dB.
 - 3.3.1.1.5 Delay. At least 50 ns to 100 ms; accuracy 20% of setting.
 - 3.3.1.1.5.1 Sync pulse output. TTL compatible; rise time less than 50 ns.
 - 3.3.1.1.5.2 Video pulse output. TTL compatible; width corresponds to PW control setting.
 - 3.3.1.1.6 External trigger input. TTL compatible; at least 100 Hz to 50 kHz, provides sync rate for pulse modulation.
 - 3.3.1.2 External.
 - 3.3.1.2.1 Rate (PRF). At least 50 Hz to 50 kHz.
 - 3.3.1.2.2 Width (PW). Greater than 0.1 μs .
 - 3.3.1.2.3 Video output. TTL compatible pulse; same PW and PRF as external input pulse.
 - 3.3.1.2.4 Pulse input. TTL compatible.
 - 3.3.2 Amplitude modulation (AM) (level ≤ 0 dBm).
 - 3.3.2.1 Internal AM.
 - 3.3.2.1.1 Rate. At least 400 Hz and 1 kHz.
 - 3.3.2.1.2 Depth. 0 to 90% minimum.

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- 3.3.2.1.3 Accuracy. $\pm 10\%$ of setting (50% depth @ 1 kHz).
- 3.3.2.1.4 Distortion. $\leq 10\%$ (50% depth @ 1 kHz).
- 3.3.2.1.5 Incidental FM. ≤ 200 Hz rms (0.5 - 15 kHz BW) 50% depth @ 1 kHz.
- 3.3.2.1.6 Residual AM (AM mode). $\leq 0.3\%$ pk (0.5 - 15 kHz BW) 0% depth @ 1 kHz.
- 3.3.2.2 External AM.
 - 3.3.2.2.1 Rates. At least 10 Hz to 10 kHz.
 - 3.3.2.2.2 Depth. 0 to 90% minimum.
 - 3.3.2.2.3 Distortion. $\leq 10\%$ 50% depth @ 1 kHz.
- 3.3.3 Frequency modulation (FM). (F = carrier freq / ΔF = peak freq deviation.)
 - 3.3.3.1 Internal FM.
 - 3.3.3.1.1 Rate. At least 400 Hz and 1 kHz.
 - 3.3.3.1.2 FM deviation. 0 to at least 1 MHz peak.
 - 3.3.3.1.3 FM accuracy. $\pm 10\%$.
 - 3.3.3.1.4 Incidental AM. $\leq 0.2\%$ (50 Hz - 15 kHz BW) ($\Delta F=20$ kHz @ 1 kHz).
 - 3.3.3.1.5 Residual FM (FM mode). ≤ 1.5 kHz rms (0.5 - 15 kHz BW) ($\Delta F=0$ kHz @ 1 kHz).
 - 3.3.3.2 External FM.
 - 3.3.3.2.1 Rates. At least 20 Hz to 100 kHz.
 - 3.3.3.2.2 FM deviation. 0 to at least 1 MHz peak.
 - 3.3.3.2.3 FM accuracy. $\pm 10\%$ ($\Delta F \geq 10$ kHz).
 - 3.3.3.2.4 Distortion. $\leq 5\%$ ($\Delta F=300$ kHz @ 50 kHz).
- 4. GENERAL REQUIREMENTS.
 - 4.1 Power source. 115 and 230 Vac $\pm 10\%$, single phase, at line frequencies of 50, 60, and 400 Hz within $\pm 10\%$, 250 VA maximum.
 - 4.2 Dimensions. The total volume shall not exceed 46,000 cm³ (2,800 in³).
 - 4.3 Weight. The overall weight shall not exceed 34.1 kg (75 lbs).
 - 4.4 Remote operation. The unit will be capable of remote operation via IEEE-488() bus interface. At a minimum it shall operate as a listener such that all major functions except the power on/off switch are controllable and shall have as a minimum the following subset of GPIB commands: AH1, SH1, L4.

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FSNTU-A

SYNTHESIZER, FREQUENCY

1. **GENERAL.** This procurement requires a stable microwave signal generator capable of generating signals over the frequency range of 8 GHz to 20 GHz with internal and external AM, FM, and Pulse modulation with delay capabilities.

2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

a. The Electromagnetic Interference requirements of MIL-T-28800() are limited to CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE02 (14 kHz to 10 GHz), and RS03.

b. The warm-up time is extended to one hour.

3.0 **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 **Frequency Characteristics.**

3.1.1 **Range:** At least 8.0 GHz to 20.0 GHz.

3.1.2 **Resolution:** At least 1 kHz; digital readout.

3.1.3 **Accuracy:** Equal to reference standard (CW mode).

3.1.4 **Stability:** (Equal to or better than limits specified below).

3.1.4.1 **Internal:** Less than 1 part in $10^9/h$ at $25^\circ\text{C} \pm 5^\circ\text{C}$ after one hour warmup.

3.1.4.2 **External:** Equal to external standard.

3.1.4.3 **Temperature:** Less than ± 2 parts in 10^5 change over 0 to 50°C .

3.1.5 **Residual modulation:** (CW mode in 50 Hz to 15 kHz detection BW).

3.1.5.1 **FM:** Less than 300 Hz rms.

3.1.5.2 **AM:** Less than 0.3% pk.

3.1.6 **Spectral Purity:**

3.1.6.1 **Harmonics:** < -55 dBc.

3.1.6.2 **Power line/Fan rotation related harmonics:** < -40 dBc (< 1 kHz from carrier).

3.1.6.3 **Non-harmonics/Spurious:** < -55 dBc (≥ 10 kHz from carrier).

3.1.6.4 **Phase Noise:** < -70 dBc/Hz (10 kHz offset from carrier).

3.2 **Output Characteristics:** (F = Output Frequency).

3.2.1 **Range:** +10 to -90 dBm (minimum) [F < 18 GHz], +7 to -90 dBm (minimum) [F > 18 GHz].

3.2.2 **RF Output:** Leveled output +10 dBm or less [F < 18 GHz], +7 dBm [F > 18 GHz].

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- 3.2.3 Accuracy: ± 1.5 dB for output levels from +10 dBm to -50 dBm; additional 0.1 dB/10 dB step for levels below -50 dBm.
- 3.2.4 Display/Resolution: Digital display; minimum resolution of 0.1 dB.
- 3.2.5 Flatness: ± 1.5 dB measured at an output level of +10 dBm.
- 3.2.6 Impedance/Connector: 50 ohms; type-N female connector or SMA.
- 3.2.6.1 VSWR: $< 2.5:1$ [at levels < 0 dBm].
- 3.2.7 Reverse Power Protection: The generator shall be capable of accepting the following signal levels at its output connector without resulting damage.
- 3.2.7.1 Average Power: 4 watts [F < 12 GHz]; 1 watt [F > 12 GHz].
- 3.2.7.2 Peak Power: 3.5 kW [F < 12 GHz] [Widths < 10 μ s].
- 3.3 Modulation Characteristics:
- 3.3.1 Pulse Modulation:
- 3.3.1.1 Internal:
- 3.3.1.1.1 Rate (PRF): At least 100 Hz to 1 MHz.
- 3.3.1.1.2 Width (PW): 0.1 to 10.0 μ s.
- 3.3.1.1.3 Rise/Fall Times: Less than 25 ns.
- 3.3.1.1.4 ON/OFF Ratio: Greater than 80 dB.
- 3.3.1.1.5 Delay: At least 100 ns to 100 ms; accuracy: $\pm 20\%$ of setting.
- 3.3.1.1.5.1 Sync Pulse Output: TTL compatible; rise time less than 50 ns.
- 3.3.1.1.5.2 Video Pulse Output: TTL compatible; width corresponds to PW control setting.
- 3.3.1.1.6 External Trigger Input: TTL compatible; at least 100 Hz to 50 kHz, provides sync rate for pulse modulation.
- 3.3.1.2 External:
- 3.3.1.2.1 Rate (PRF): At least 100 Hz to 1 MHz.
- 3.3.1.2.2 Width (PW): Greater than 0.1 μ s.
- 3.3.1.2.3 Video Output: TTL compatible pulse; same PW and PRF as external input pulse.
- 3.3.1.2.4 Pulse Input: TTL compatible.
- 3.3.2 Amplitude Modulation (AM): (Can be used simultaneously with pulse modulation).
- 3.3.2.1 External:
- 3.3.2.1.1 Rate: At least 0.1 - 10 kHz.
- 3.3.2.1.2 Depth: 0 to 70% minimum.
- 3.3.2.1.3 Sensitivity: At least 70%/V.

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3.3.3 Frequency Modulation (FM): (F - carrier freq / ΔF - peak freq deviation).

3.3.3.1 Internal FM:

3.3.3.1.1 Rate: At least 1 kHz to 100 kHz.

3.3.3.1.2 FM Deviation: At least 10 kHz to 1 MHz peak.

3.3.3.1.3 FM Accuracy: $\pm 20\%$.

3.3.3.1.4 Incidental AM: $\leq 7\%$ (50 Hz - 15 kHz BW) [ΔF - 100 kHz @ 10 kHz].

3.3.3.2 External FM:

3.3.3.2.1 Rates: At least 1 kHz to 1 MHz.

3.3.3.2.2 FM Deviation: At least 10 kHz to 1 MHz peak.

3.3.3.2.3 FM Accuracy: $\pm 20\%$.

3.3.3.2.4 Distortion: $\leq 10\%$ [ΔF - 100 kHz @ 10 kHz].

4. GENERAL REQUIREMENTS.

4.1 Power: 115/230 Vac $\pm 10\%$ single phase, 50, 60 or 400 Hz, 250 VA maximum.

4.2 Dimensions: The total volume shall not exceed 39,400 cm³ (2,400 in³).

4.3 Weight: The overall weight shall not exceed 22.7 kg (50 lb).

4.4 Remote Operation: The unit will be capable of remote operation via IEEE-488() bus interface. At a minimum it shall operate as a listener such that all major functions except the power on/off switch are controllable and shall have as a minimum the following subset of GPIB commands: AHL, SHL, L4.

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FSNTT-A

SYNTHESIZER, FREQUENCY

1.0 GENERAL. This procurement requires a stable microwave signal generator capable of generating signals over the frequency range of 10 to 18 GHz with internal and external modulation capabilities.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.
- d. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Frequency characteristics.

3.1.1 Frequency range. At least 10 to 18 GHz.

3.1.2 Frequency resolution. Minimum resolution at least 1 kHz; digital readout.

3.1.3 Frequency accuracy. Indicated frequency shall be with ± 1 kHz plus the measured offset of the time base when measured on an external counter.

3.1.4 Frequency stability (equal to or better than limits specified below).

3.1.4.1 Internal. Better than 1 part in 10^9 /hour after one hour warmup.

3.1.4.2 External. Equal to external standard frequency stability.

3.1.5 Residual FM (CW mode in 50 Hz to 15 kHz detection BW). Less than 1.0 kHz peak.

3.1.6 Spectral purity (equal to or better than limits specified below).

3.1.6.1 Harmonics. All harmonically related outputs shall be at least -45 dBc.

3.1.6.2 Nonharmonics/Spurious. At least -55 dBc at frequencies greater than 1 kHz from carrier.

3.1.6.3 Phase noise. At least -65 dBc/Hz at 10 kHz offset from carrier.

3.2 Output characteristics.

3.2.1 Range. +10 to -110 dBm (minimum).

3.2.2 RF output. Leveled output shall be at least +10 dBm.

3.2.3 Accuracy. ± 2.5 dB of the actual measured output level, +10 to -110 dBm.

3.2.4 Display/Resolution. Digital display; minimum resolution of 0.1 dB.

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- 3.2.5 Flatness. ± 1.0 dB measured at an output level of +10 dBm.
- 3.2.6 Impedance/Connector. 50 ohms; type-N female connector.
 - 3.2.6.1 VSWR. The maximum VSWR of the output connector shall be no greater than 2:1.
- 3.2.7 Reverse power protection. The generator shall be capable of accepting the following signal levels at its output connector without resulting damage.
 - 3.2.7.1 Average power. 2W.
 - 3.2.7.2 Peak power. 100W peak for pulse widths of less than 1 microsecond.
- 3.3 Modulation characteristics.
 - 3.3.1 Pulse modulation.
 - 3.3.1.1 Internal.
 - 3.3.1.1.1 Pulse rate (PRF). At least 100 Hz to 50 kHz.
 - 3.3.1.1.2 Pulse width (PW). 0.1 to 10.0 microseconds.
 - 3.3.1.1.3 Rise and fall times. Less than 50 nanoseconds.
 - 3.3.1.1.4 ON/OFF ratio. Greater than 80 dB.
 - 3.3.1.1.5 Delay. At least 100 nanoseconds to 10 milliseconds; accuracy 20% of setting.
 - 3.3.1.1.5.1 Sync pulse output. TTL compatible; risetime less than 50 nanoseconds.
 - 3.3.1.1.5.2 Video pulse output. TTL compatible; width corresponds to PW control setting.
 - 3.3.1.1.2 External.
 - 3.3.1.1.3.1 Pulse rate. At least 100 Hz to 50 kHz.
 - 3.3.1.1.3.2 Pulse width. Greater than 0.1 microseconds.
 - 3.3.2 Amplitude modulation (AM).
 - 3.3.2.1 Internal AM (squarewave).
 - 3.3.2.1.1 Rate. At least 1 kHz.
 - 3.3.2.2 External AM.
 - 3.3.2.2.1 Rates. At least 10 Hz to 10 kHz.
 - 3.3.2.2.2 Depth. At least 0 to 70%.
 - 3.3.2.2.3 Distortion. Less than 10% at 50% depth and 1 kHz rate.
 - 3.3.3 Frequency modulation (FM).
 - 3.3.3.1 Internal FM.
 - 3.3.3.1.1 Rate. At least 100 Hz to 50 kHz.
 - 3.3.3.1.2 FM deviation. At least 1 MHz peak locked or unlocked; unlock center frequency shift less than 1%.

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3.3.3.2 External FM.

3.3.3.2.1 Rates. At least 100 Hz to 50 kHz.

3.3.3.2.2 FM deviation. At least 1 MHz peak locked or unlocked; unlock center frequency shift less than 1%.

4.0 General requirements.

4.1 Power source. 115 or 230 Vac $\pm 10\%$, single phase, 50, 60, and 400 Hz within $\pm 10\%$.

4.2 Input power. The maximum power required for operation shall not exceed 200W.

4.3 Dimensions. The units total volume shall not exceed 1,800 cubic in (29,500 cubic cm).

4.4 Weight. The overall weight of the unit shall not exceed 50 pounds (22.7 kg).

4.5 Remote operation. Instrument shall be capable of operating via the IEEE-488 interface bus, and provide capability to talk and listen.

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APPENDIX D

TC1AA-A

TACHOMETER, ELECTRONIC

1. **GENERAL.** This procurement requires a digital tachometer that makes contact and noncontact measurements.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring and displaying angular velocity in accordance with the following minimum specifications.
 - 3.1 **Units of measure.** Revolutions per minute, second, and hour.
 - 3.2 **Measurement distance.** 12 in minimum.
 - 3.3 **Accuracy of indication.** $\pm 0.025\%$ ± 1 LSD.
 - 3.4 **Memory.** Last reading, maximum, minimum, and average.
4. **POWER SOURCE.** MIL-T-28800 dc internal power source requirements are invoked. The batteries shall be of a commercially available type and provide 100 hours of operation before replacement. The nominal power source requirements are not invoked.
- 5 **WEIGHT.** 0.9 kg (2 lb) maximum.

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Configuration A: TM1RL-A
 Configuration B: TM1FM-A
 Configuration C: TM1FN-A

TERMINATION, COAXIAL

1. **GENERAL.** This procurement requires a coaxial termination.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Electromagnetic interference requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall operate within the minimum ranges and accuracies specified below:

TABLE I. Specifications

<u>Configuration</u>	<u>A</u>	<u>B</u>	<u>C</u>
Frequency range	dc-18 GHz	dc-18 GHz	dc-12.4 GHz
Maximum SWR	1.3	1.05	1.1
Continuous power rating	2W	10W	40W
Connectors	N(m)	N(m)	N(f)

- 3.1 **Nominal impedance.** 50 ohms.
4. **POWER SOURCE.** Power source requirements are not invoked.
5. **WEIGHT.** 0.3 kg (0.7 lb) maximum.

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APPENDIX D

TSXAA-C

TEST SET COUNTERMEASURE

The following purchase description describes the individual units which make up an all solid state Wideband Electronic Countermeasures Test Set with a frequency range of 50 MHz to 40 GHz. The units are as follows:

1. Synthesized Microwave Signal Generator (50 MHz to 26.5 GHz)
2. System Controller
3. Countermeasures Test Set Accessories
4. Wideband Microwave Frequency Extender
5. Digital Voltmeter

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APPENDIX D

WIDEBAND MICROWAVE SIGNAL GENERATOR

1.0 GENERAL. This procurement requires an all solid state, synthesized, wideband microwave signal generator covering a frequency range of 50 MHz to 26.5 GHz and including the ability to measure external frequencies* and external power levels. Plug-ins are NOT acceptable for any portion of this equipment. Additionally, it should be capable of driving and controlling the output of a 26-40 GHz frequency extender.

2.0 CLASSIFICATION. The signal generator described herein shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

a. The Electromagnetic Interference requirements of MIL-T-28800() are limited to CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE02 (14 kHz to 10 GHz), and RS03.

b. The warm-up time is extended to one hour.

3.0 OPERATIONAL REQUIREMENTS.

Note: FE means operating in Frequency Extension mode.

3.1 Frequency characteristics.

3.1.1 Range: 50 MHz to 26.5 GHz.

3.1.1.1 FE: 26-40 GHz.

3.1.2 Resolution: The displayed frequency resolution shall be at least 1 kHz.

3.1.2.1 FE: At least 2 kHz.

3.1.3 Accuracy (CW mode): Same as reference standard.

3.1.4 Stability: Less than 1 pp 10⁹/h after one hour warmup.

3.1.5 Spectral purity (at least the limits specified below).

3.1.5.1 Harmonics/Sub-harmonics: At least -55 dBc.

3.1.5.2 Non-harmonics/Spurious: At least -55 dBc.

3.1.5.3 Phase noise: At least -70 dBc/Hz at an offset 20 kHz.

3.1.5.4 Residual FM (BW = 50 Hz to 15 kHz), < 200 Hz rms [F < 2 GHz], < 400 Hz rms [F > 2 GHz].

3.1.6 Reference frequency.

3.1.6.1 Internal reference output: 10 MHz; 0.5 Vrms into 50 ohms.

3.1.6.2 External reference input: 10 MHz; 0.2 Vrms into 50 ohms.

3.1.6.3 External reference output: 10 MHz; 0.5 Vrms into 50 ohms.

3.1.7 Lock indicator: A light shall be provided which shall indicate that the output frequency is phase locked to the reference frequency.

3.2 Output characteristics (L = Output level in dBm).

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3.2.1 Impedance/Connector: 50 ohms / precision 3.5 mm male or female (SMA compatible).

3.2.1.1 VSWR: Less than 2:1 [L < 0 dBm].

3.2.2 Level: -99 dBm to +10 dBm leveled.

3.2.3 Resolution: 0.1 dBm in a digital readout.

3.2.4 Accuracy (displayed level vs measured output level). ± 1.0 dB from 0.05 to 18 GHz; ± 2.0 dB from 18 to 26.5 GHz [L > -40 dBm]. Additional ± 0.2 dB/10 dB step [L < -40 dBm].

3.2.5 Level control indicator: A light shall be provided which shall indicate that the output signal level is under active control of the feedback circuit in the leveling loop. An unlevelled indication on this display shall mean that the output amplitude is unlevelled regardless of the actual amplitude measured at the output.

3.3 Modulation characteristics.

3.3.1 Pulse modulation (internal).

3.3.1.1 Rate: 10 Hz to 1 MHz.

3.3.1.2 Width: 0.1 μ s to 100 ms.

3.3.1.3 Rise/Fall Time: Less than 25 ns.

3.3.1.4 Overshoot/Undershoot/Ringing: ± 2.0 dB maximum.

3.3.1.5 Settling time: ± 1.0 dB of the final value within 100 ns.

3.3.1.6 On/Off ratio: Greater than 80 dB.

3.3.2 Pulse modulation (external).

3.3.2.1 Rate: 10 Hz to 1 MHz.

3.3.2.2 Width: 0.1 μ s to 100 ms.

3.3.2.3 Triggering: Rising or falling edge.

3.3.2.4 Sync output: Modulation waveform, TTL compatible.

3.4 Digital sweep characteristics.

3.4.1 Range: 50 MHz to 26.5 GHz.

3.4.2 Step size: 1 kHz or less to 100 MHz.

3.4.3 Step time: Variable, 1 step/10 ms to at least 1 step/sec.

3.4.4 Ramp output: 0 to 10 volts, proportional to the frequency between selected sweep limits.

3.4.5 Output flatness: Within ± 1.0 dB to 18 GHz; ± 2.0 dB from 18 to 26.5 GHz.

3.4.6 Sweep mode: Auto (continuous), single, single step, reset.

3.4.7 Sweep trigger: External input for triggering sweep, TTL compatible.

3.4.8 Pen lift: TTL compatible output, high level during retrace.

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3.5 Power meter.

3.5.1 Frequency range: 50 MHz to 26.5 GHz.

3.5.2 External measurement range: +10 dBm to -30 dBm.

3.5.3 Accuracy (indicated power level vs externally measured level): ± 1.0 dB (+10 dBm to -10 dBm); ± 2.0 dB (-10 dBm to -30 dBm).

3.5.4 Display (digital): 3.5 digits minimum.

3.5.4.1 Resolution: 0.1 dB minimum for all power readings.

3.5.5 Input connector: Precision 3.5 mm male or female (SMA compatible).

3.6 Frequency counter *.

3.6.1 Input range: At least 100 MHz to 26.5 GHz.

3.6.2 Resolution: At least 100 Hz.

3.6.3 Sensitivity: -25 dBm to 18 GHz; -20 dBm from 18 to 26.5 GHz.

3.6.4 Mode: CW or pulsed RF input.

3.6.4.1 Minimum PW for pulsed RF input: 0.5 μ s.

3.6.5 Accuracy: At least 1 ppm.

3.6.6 Input impedance: 50 ohms nominal.

3.6.7 Input connector: Precision 3.5 mm male or female (SMA compatible).

4.0 GENERAL REQUIREMENTS.

4.1 Power: 115/230 Vac $\pm 10\%$ single phase, 50, 60 or 400 Hz, 350 watts maximum.4.2 Volume: Less than 65,548 cm³ (4000 in³).

4.3 Weight: Less than 29.1 kg (64 lb).

4.4 Remote programming: The generator shall be capable of being remotely controlled via a RS-232 interface, operating as both a talker and listener, having control of at least the following parameters is required.

Output Frequency	External Power Measure
Output Amplitude (-99 to +5 dBm)	External Frequency Measure
Sweep Function	Modulation: 1 usec PW; 1 kHz PRF
Frequency Lock Status	Amplitude Level Status

4.4.1 In FE mode: Capable of controlling external frequency and amplitude of frequency extender via external cable.

5.0 ACCESSORIES: The following list of accessories shall be provided with each equipment.

5.1 Microwave coaxial cables.

5.1.1 One Gore-tex GMCA 190-1265 or equivalent coaxial cable, 24 ft long, with male precision 3.5 mm SMA compatible connectors or equivalent on each end.

5.1.2 One Gore-tex GMCA 190-1265 or equivalent, 6 ft long, with male precision 3.5 mm SMA compatible connectors or equivalent on each end.

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5.1.3 One Gore-tex GMCA 190-1265 or equivalent, 18 in long, with male precision 3.5 mm SMA compatible connectors or equivalent on each end.

5.2 Interface cables.

5.2.1 (2) RS-232, male one end, female other end, 50 ft length.

5.2.2 (2) RS-232, male one end, female other end, 25 ft length.

5.2.3 FE (1) Source-to-Frequency Extender connection cable, male both ends, 25 ft length.

5.3 Adapters.

5.3.1 One male to female adapter with precision 3.5 mm SMA compatible connector or equivalent.

5.3.2 One female to female adapter with precision 3.5 mm SMA compatible connector or equivalent.

* Frequency counter may be supplied as a separate piece of equipment; however, weight and volume restrictions apply to signal generator packages only.

SYSTEM CONTROLLER

1.0 GENERAL DESCRIPTION. This procurement requires a computer/system controller capable of interfacing with external instruments in both IEEE-488 and RS-232 bus configurations. In addition the controller must possess the following internal features: (1) typewriter keyboard with separate numeric pad, (2) screen for display of program interface with operator, (3) hardcopy printer for permanent output of test results, (4) memory device (tape or disc) for storage of data and programs.

2.0 CLASSIFICATION. The requirements of MIL-T-28800() are hereby waived for this device. The following operating conditions are imposed:

a. The operating temperature requirement is limited to the range of 15°C to 35°C and the non-operating temperature requirement is limited to the range of 0°C to 50°C.

3.0 OPERATIONAL REQUIREMENTS.

3.1 Storage (capacity and medium).

3.1.1 RAM: At least 32 kbytes.

3.1.2 Mass: Magnetic; at least 200 kbytes Amplitude Level Status.

3.2 Language.

3.2.1 HP enhanced basic.

3.2.2 Compatibility: Must be compatible with previously prepared software.

3.3 Printer (hardcopy output).

3.3.1 Type: Thermal with bidirectional printing head; ink is not acceptable.

3.3.2 Line length: At least 32 characters.

3.3.3 Character size: At least 10 point.

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3.4 Operator interface.

3.4.1 Display.

3.4.1.1 Type: CRT or LCD.

3.4.1.2 Size: 103 cm² (16 in²) minimum.

3.4.1.3 Lines: 16 minimum.

3.4.1.3.1 Length: 32 characters minimum.

3.4.1.4 Graphics: At least 256 x 196 pixels.

3.4.2 Keyboard: Full size typewriter-like alphanumeric with separate numeric keypad.

3.4.3 Special function keys: At least 8 available; function to be defined by operator.

3.4.4 Built-in debugging facilities.

3.5 Features.

3.5.1 IEEE-488() interface: Capable of communicating with external instruments as both talker and listener.

3.5.2 RS-232 serial interface (with male connector): Capable of communicating with external instruments as both talker and listener.

3.5.3 Clock: Built in system clock.

3.5.3.1 Timers: At least 3 independent timers.

3.5.4 Expansion capability: A minimum of four ports for interfacing and expansion.

3.5.5 Full self-test capability.

4.0 GENERAL REQUIREMENTS.

4.1 Power source: 115/230 Vac $\pm 10\%$ single phase, 50, 60 or 400 Hz, 50 VA maximum.4.2 Dimensions: The total volume of the unit shall not exceed 40967 cm³ (2500 in³).

4.3 Weight: The overall weight of the unit shall be less than 11.4 kg (25 lb).

5.0 ACCESSORIES.

5.1 ROM-drawer: Holds up to 6 external ROMs.

5.2 I/O ROM.

5.3 Advanced programming ROM.

COUNTERMEASURES TEST SET ACCESSORIES

1.0 GENERAL DESCRIPTION. These accessories are required for use with the CMTS in order to permit radiated measurements to be performed using the system.

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2.0 CLASSIFICATION. The requirements of MIL-T-28800() are hereby waived for these accessories.

3.0 OPERATIONAL REQUIREMENTS.

3.1 Test antennas.

3.1.1 Spiral antenna (0.3 to 1 GHz): Antenna Corp of America M/N 3127-RC-N.

3.1.1.1 Antenna mount adapter (Giga-tronics Stock #198CF02600).

3.1.2 Horn antenna, ridged waveguide (1 to 12.4 GHz): American Electronic Lab M/N H1479.

3.1.3 Horn antenna, ridged waveguide (2 to 18 GHz): American Electronic Lab M/N H1498-T.

3.1.4 Horn antenna (18 to 26.5 GHz): Narda M/N 638.

3.1.4.1 Antenna mount adapter (A&T Technical Services M/N 81995 00 0002 29).

3.1.5 Standard gain horn (26 to 40 GHz): Scientific Atlanta M/N 12A-26.

3.2 Adapters.

3.2.1 TNC (M) to SMA (F): Midwest Microwave M/N 2686.

3.2.2 Type N (M) to SMA (F): Omni Spectra M/N 3082-2240-00.

3.2.3 Waveguide-to-coax adapter (18 to 26.5 GHz): Omni Spectra M/N 2000-6-256.

3.3 Fixed Attenuators.

3.3.1 Waveguide WR-28.

3.3.1.1 15 dB

3.3.1.2 20 dB

3.3.1.3 30 dB

3.4 Antenna mounting hardware case.

3.4.1 Part #81995-00-002: Used to physically attach test antennas to existing superstructure when performing radiated systems testing.

3.5 Shipping/Carrying/Storage cases.

3.5.1 Cases.

4 Giga-tronics PCCO 01001
1 Giga-tronics PCCO 02001

3.5.2 Case Liners.

1 Giga-tronics PCCL 01001
1 Giga-tronics PCCL 01002
1 Giga-tronics PCCL 01003
1 Giga-tronics PCCL 01004
1 Giga-tronics PCCL 02001

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WIDEBAND MICROWAVE FREQUENCY EXTENDER

1.0 GENERAL DESCRIPTION. This procurement requires an all solid state, synthesized, microwave frequency extender covering the frequency range of 26 to 40 GHz using input frequencies of 13 to 20 GHz at +5 to -7 dBm. The output level of the extended frequency shall be variable from at least +5 to -15 dBm leveled.

2.0 CLASSIFICATION. The frequency extender described herein shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications.

3.0 OPERATIONAL REQUIREMENTS.**3.1 Frequency characteristics.**

3.1.1 Output frequency range: At least 26 to 40 GHz.

3.1.2 Input frequency range: At least 13 to 20 GHz.

3.1.3 Output frequency resolution: 2 times the resolution of the input frequency.

3.1.4 Output frequency accuracy: Same as the input frequency.

3.1.5 Output frequency stability: Input stability degraded by factor of 2.

3.1.6 Spectral purity.

3.1.6.1 Harmonics/Sub-harmonics: At least -20 dBc.

3.1.6.2 Non-Harmonics/Spurious: At least -20 dBc.

3.1.7 Frequency display: The output frequency shall be displayed directly on the extender's front panel or remotely on its driving source synthesizer.

3.2 Output characteristics.

3.2.1 Output level: -15 dBm to +5 dBm leveled for input levels of at least -2 dBm.

3.2.2 Output level resolution: 0.1 dBm.

3.2.3 Output level display: The output level shall be displayed directly on the extender's front panel or remotely on its driving source synthesizer.

3.2.4 Output level control.

3.2.4.1 Local operation: The output level of the frequency extender shall be controllable from the unit's front panel when operating under manual control. An indicator shall be provided indicating the leveled status of the output of the extender.

3.2.4.2 Remote operation: The output level of the frequency extender shall be controllable from the signal generator.

3.2.5 Output level accuracy: ± 2.5 dB.

3.2.6 Output level flatness: ± 2.5 dB.

3.2.7 Output connector: WR-28 WG waveguide with type UG-599/U flange.

3.2.7.1 Impedance: 50 Ω nominal.

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- 3.2.7.2 VSWR: Less than 2:1 worst case.
- 3.2.8 Input connector: Precision 3.5 mm male or female (SMA compatible).
- 3.3 Modulation characteristics.
 - 3.3.1 Pulse/Square wave modulation.
 - 3.3.1.1 Rate: 100 Hz to 50 kHz minimum.
 - 3.3.1.2 Width: 0.1 to 10 μ sec minimum.
- 4.0 GENERAL REQUIREMENTS.
 - 4.1 Power: 115/230 Vac \pm 10% single phase, 50, 60 or 400 Hz, 20 watts maximum.
 - 4.2 Volume: Less than 9850 cm³ (600 in³).
 - 4.3 Weight: The overall weight of the unit shall not exceed 4.5 kg (10 lb).
 - 4.4 Interface control: Level must be remotely controllable through the synthesized, wideband microwave signal generator driving source via an external cable.

DIGITAL VOLTMETER

- 1.0 GENERAL DESCRIPTION. This procurement requires an all solid state, true rms, digital voltmeter for use with the Countermeasures Test Set.
- 2.0 CLASSIFICATION. The voltmeter described herein shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine and shore applications.
- 3.0 OPERATIONAL REQUIREMENTS.
 - 3.1 Measurement ranges.
 - 3.1.1 DC voltage: 0 to \pm 300V.
 - 3.1.1.1 Resolution: At least 1 mV for 20V full scale reading.
 - 3.1.2 AC voltage: 50 μ V to 300V (true rms).
 - 3.1.2.1 Frequency response: 10 Hz to 10 MHz.
 - 3.1.2.2 Resolution: At least 1 mV for 20V full scale reading.
 - 3.2 Input connector: Binding posts (balanced) or BNC female (unbalanced).
 - 3.2.1 Input impedance: At least 1 M Ω shunted by < 50 pF.
 - 3.2.2 Common mode rejection: > 80 dB for ac; > 120 dB for dc.
 - 3.3 Measurement rate: At least 2 or more readings/sec.
 - 3.4 Accuracy.
 - 3.4.1 DC: Within \pm 0.5% of range selected.
 - 3.4.2 AC: Within \pm 2% of range selected.
 - 3.4.2.1 Maximum crest factor: 4

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3.5 Display: At least 4 1/2 digit display.

3.5.1 Units: Volts ac and dc.

4.0 GENERAL REQUIREMENTS.

4.1 Power: 115/230 Vac $\pm 10\%$ single phase, 50, 60 or 400 Hz, 40 VA maximum.

4.2 Dimensions: 25.4 cm x 35.56 cm x 10.16 cm (10 in x 14 in x 4 in).

4.2.1 Volume: 9200 cm.³ (560 in³).

4.3 Weight: 4.5 kg (10 lb) maximum.

4.4 Remote operation: All front panel functions controllable via IEEE-488() interface bus.

4.4.1 Talker function: Unit capable of sending readings via IEEE-488() to system controller.

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Configuration A: TEOGN-B

Configuration B: TEONN-B

TEST SET, ELECTRON TUBE

1. **GENERAL.** This procurement requires a portable test set for evaluating electron tube characteristics.
2. **CLASSIFICATION.** Type III, Class 5, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of evaluating operational capabilities of low and medium power electronic tubes under test conditions which simulate actual operating conditions. Configuration A equipment shall use an automated technique such as punched card programming to facilitate testing. Operator-adjustable test parameters shall be provided for Configuration B equipment.
 - 3.1 **Tube types.** The equipment shall be capable of testing diodes (gas regulators, detectors, rectifiers, etc.), triodes, tetrodes, pentodes, hexodes, heptodes, and thyratrons. Provisions are required for checking large 4, 5, 6, and 7 pin tubes, 8 pin octal and loctal tubes, 9 pin jumbo, 7 and 9 pin miniature, 7 pin in-line, and octal subminiature tubes.
 - 3.2 **General performance requirements.** The test set shall be capable of performing the following tests: shorts between any tube elements, heater-to-cathode leakage, gas, grid emission, cathode activity, transconductance, and plate current.
4. **ACCESSORIES.** When punched-card programming is used in Configuration A equipment, the tester shall include at least 50 blank test cards, a hand punch to program blank test cards, tube testing cards, and self-test and calibration cards. Configuration B equipment shall be provided with a chart, manual, or other means of providing switch setup information for each tube type.
5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 250W for Configuration A and 50W for Configuration B.
6. **WEIGHT.** 25 kg (55 lb) maximum, not including tube test cards.

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APPENDIX D

TSDNN-D

TEST SET, ENVELOPE DELAY, TELECOM

1. **GENERAL.** This procurement requires an envelope delay test set containing a digital storage oscilloscope.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of circuit quality measurement of voice band transmission networks within the minimum parameters and accuracies specified below.
 - 3.1 **Transmitter output level.** Adjustable from -39 dBm to +9 dBm in 1 dB steps.
 - 3.1.1 **Holding tone.** 1.004 kHz within ± 0.1 Hz.
 - 3.1.2 **Carrier frequency range.** 200 Hz to 4 kHz. Selectable modulation frequencies of 25 Hz and 83.3 Hz shall provide up to 50% modulation.
 - 3.1.3 **Oscillator tuning.** Manual, single sweep, and auto sweep. The sweep rate shall be variable up to at least one second.
 - 3.1.4 **Distortion tones.**
 - a. **Pair A:** Centered at 860 Hz, 6 Hz apart.
 - b. **Pair B:** Centered at 1.38 kHz, 16 Hz apart.
 - 3.1.5 **Output impedance.** Selectable 600 ohms and 900 ohms nominal.
 - 3.1.6 **Harmonic distortion.** 0.5% or less of the fundamental amplitude.
 - 3.2 **Receiver.**
 - 3.2.1 **Frequency range.** 200 Hz to 4 kHz.
 - 3.2.2 **Input level.** -50 dBm to +9 dBm.
 - 3.2.3 **Input impedance.**
 - a. **Bridged:** Greater than 25 kilohms.
 - b. **Terminated:** 600 ohms and 900 ohms nominal.
 - 3.3 **Level measurement.**
 - 3.3.1 **Dynamic range.** 59.9 dB.
 - 3.3.2 **Level measurement accuracy.** ± 0.2 dB from +9 dBm to -40 dBm.
 - 3.3.3 **Level measurement resolution.** 0.1 dB or less.
 - 3.4 **Noise measurement.** Noise-with-tone and idle noise measurement capabilities shall be provided.
 - 3.4.1 **Filters.** C-message and 3 kHz filter weighting shall be provided. A notch filter from 995 Hz to 1.025 kHz referenced at -50 dB or greater shall be provided.
 - 3.4.2 **Receiver range.** 99 dBm to 20 dBm.

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- 3.4.3 Noise measurement resolution. 1 dB or less.
- 3.5 Phase jitter.
 - 3.5.1 Holding tone range. 990 Hz to 1.03 kHz.
 - 3.5.2 Phase jitter bandwidth. 20 Hz to 300 Hz.
 - 3.5.3 Phase jitter measurement range. 0° to 30° peak-to-peak.
 - 3.5.4 Phase jitter accuracy. 5% \pm 0.2° of indication.
- 3.6 Distortion. The equipment shall be capable of nonlinear second and third order distortion measurements.
 - 3.6.1 Distortion measurement range. 10 dB to 55 dB.
 - 3.6.2 Distortion accuracy. \pm 1 dB.
 - 3.6.3 Distortion measurement resolution. 1 dB or less.
- 3.7 Envelope delay.
 - 3.7.1 Envelope delay measurement range.
 - a. \pm 6 ms with 50% modulation at 83.3 Hz.
 - b. \pm 10 ms with 50% modulation at 25 Hz.
 - 3.7.2 Envelope delay measurement accuracy. \pm 1.75 ms over the range of 500 Hz to 3.2 kHz.
 - 3.7.3 Sync control. The equipment shall be provided with a variable sync control to adjust the internal modulation reference to the modulating source frequency at the far end of two-wire circuits.
- 3.8 Hit measurements. The equipment shall be capable of gain and phase transient variations, impulse noise, and signal dropout measurements.
 - 3.8.1 Timer. Selectable ranges of 5 minutes, 15 minutes, and continuous shall be provided.
 - 3.8.2 Count rate. 7 per second minimum.
 - 3.8.3 Count range. 0 to 9,999.
 - 3.8.4 Hit duration. The equipment shall sense hits of a width of 4 ms or greater.
 - 3.8.5 Dropout. The equipment shall sense dropouts of 4 ms or greater. The dropout threshold value shall be adjustable to a constant value of 12 dB below the input level setting.
 - 3.8.6 Phase hit threshold. Adjustable in 5° increments from 5° to 45°.
 - 3.8.7 Gain hit threshold. Adjustable in 1 dB increments from \pm 1 dB to \pm 6 dB.
 - 3.8.8 Impulse threshold. Adjustable in 1 dB increments from 99 dB_rn to 40 dB_rn.
- 3.9 Peak to average ratio (PAR).
 - 3.9.1 Display range. 0 to 120 PAR units.
 - 3.9.2 PAR measurement accuracy. \pm 4 PAR units.

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3.10 Oscilloscope. The equipment shall contain a dual memory storage oscilloscope.

3.10.1 Display controls. Focus, intensity, astigmatism, and graticule illumination controls shall be provided.

3.10.2 Memory selection. A minimum of three memory positions shall be provided, typically memory A, memory B, and memories A and B.

3.10.3 Mode selection. The following mode positions shall be provided:

- a. Clear: Selected memory is reset.
- b. Load: Selected memory is loaded with the response signal.
- c. Input: Input signals are displayed in real time.
- d. Memory: Display is derived from the selected memory.
- e. Input and memory: Both the selected memory and the real time input are displayed.
- f. Dynamic: Both A and B memories are displayed. B memory is also updated continuously by the input signal.

3.11 Outputs. The equipment shall be provided with outputs for external display, recording, and equipment control as follows. Hit counter outputs shall be buffered and TTL compatible.

- a. Gain hit.
- b. Phase hit.
- c. Impulse.
- d. Dropout.
- e. Phase jitter.
- f. X-Y plotter, $\pm 2V$ full scale.
- g. X-Y axis for CRT display.

3.11.1 Monitor. The equipment shall be provided with an internally mounted monitor speaker.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 50W.

5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

TE4GN-C

TEST SET, INSULATION

1. **GENERAL.** This procurement requires an ac and dc tester capable of testing insulation dielectric strength by applying high voltage to a test sample and measuring the resulting leakage current.
2. **CLASSIFICATION.** Type III, Class 6, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of providing ac and dc test voltage outputs and shall monitor voltages and currents within the minimum ranges, accuracies, and sensitivities specified below.
 - 3.1 **Test voltages.** 0 to 10 kVac, 0V to 25 kVdc, continuously adjustable.
 - 3.2 **Breakdown leakage current.** 5 mA maximum at any test voltage.
 - 3.3 **Voltage monitor.** The equipment shall be provided with a meter to indicate the test voltage. Range: 0 to 25 kV in two or more ranges. Accuracy: $\pm 2\%$ of range.
 - 3.4 **Current monitor.** The equipment shall be provided with a meter for monitoring output current. Range: 0 to 5 mA in two or more ranges. Accuracy: $\pm 2\%$ of range.
 - 3.5 **Overload circuit.** The equipment shall be provided with a current overload circuit that has a continuously adjustable sensitivity range of 50 μ A or less to a maximum breakdown current of 5 mA.
 - 3.5.1 **Failure indication.** An audible and visible indication of test item insulation breakdown shall be provided.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 575W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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TS3NF-A

TEST SET, LOGIC

1. **GENERAL.** This procurement requires a hand-held logic troubleshooting probe capable of indicating logic levels in transistor-transistor-logic (TTL) and complimentary metal-oxide semiconductor (CMOS) logic circuits.
2. **CLASSIFICATION.** Type III, Class 5, Style E and Color R in accordance with MIL-T-28800 except the nominal power source requirements are not invoked.
3. **Operational requirements.** The probe shall be capable of in-circuit logic level analysis of TTL and CMOS circuits within the minimum parameters detailed below.
 - 3.1 **Logic levels.**
 - A. **TTL:**
 1. Logic ONE: 1.8 to 2.4V peak.
 2. Logic ZERO: 0.4 to 1V peak.
 - B. **CMOS: 3 to 10 Vdc supply**
 1. Logic ONE: $0.7 \times V_{\text{supply}} \pm 0.5 \text{ Vdc}$.
 2. Logic ZERO: $0.3 \times V_{\text{supply}} \pm 0.5 \text{ Vdc}$.
 - C. **CMOS: 10 to 18 Vdc supply**
 1. Logic ONE: $0.7 \times V_{\text{supply}} \pm 1.0 \text{ Vdc}$.
 2. Logic ZERO: $0.3 \times V_{\text{supply}} \pm 1.0 \text{ Vdc}$.
 - 3.2 **Pulse width.** 10 ns minimum. A pulse stretching feature shall be provided to allow viewing of narrow pulses.
 - 3.3 **Pulse repetition frequency limit.** TTL: 80 MHz. CMOS: 40 MHz.
 - 3.4 **Impedance.** 25 kilohms.
 - 3.5 **Display.** The probe shall indicate logic highs, logic lows, open and short circuits, and excessive input levels by means of a light.
 - 3.6 **Probe overload protection.** 120V continuous from dc to 1 KHz.
 4. **POWER.** The probe shall be powered by the circuit under test. Overvoltage protection: $\pm 25 \text{ Vdc}$ for 1 minute.
 5. **WEIGHT.** 1 kg (2.2 lb) maximum.

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TS3NM-B

TEST SET, LOGIC

1. **GENERAL.** This procurement requires a self-contained, solid-state logic troubleshooting kit capable of detecting and analyzing in-circuit logic failures. The kit shall be able to inject pulses into logic circuitry and monitor the level transitions. The kit shall consist of a logic probe, logic pulser, and a dual-in-line package (DIP) monitor clip.
2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 except nominal power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The probe, pulser, and monitor clip shall be capable of in-circuit logic level analysis of transistor-transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) logic within the minimum ranges and accuracies specified below.
 - 3.1 **Logic probe.**
 - 3.1.1 **TTL logic levels.**
 - a. Logic one: 1.8 to 2.4 volts peak.
 - b. Logic zero: 0.4 to 1 volt peak.
 - 3.1.2 **CMOS logic levels.**
 - 3.1.2.1 **3 to 10 Vdc supply.**
 - a. Logic one: (0.7 X supply voltage) $\pm 0.5V$
 - b. Logic zero: (0.3 X supply voltage) $\pm 0.5V$
 - 3.1.2.2 **10 to 18 Vdc supply.**
 - a. Logic one: (0.7 X supply voltage) $\pm 1V$
 - b. Logic zero: (0.3 X supply voltage) $\pm 1V$
 - 3.1.3 **Probe pulse width.** Minimum detectable pulse width: 10 ns or less. A pulse-stretching feature shall be provided to cause a flashing light during pulse activity.
 - 3.1.4 **Pulse repetition frequency limit.** 80 MHz for TTL and 40 MHz for CMOS.
 - 3.1.5 **Probe impedance.** 25 kilohms minimum.
 - 3.1.6 **Probe display.** The logic probe display shall be capable of indicating the following conditions via a light:
 - a. Normal logic levels (HI-LOW).
 - b. Pulse activity.
 - c. Open and short circuits.
 - d. Excessive and inadequate levels.
 - 3.1.7 **Probe overload protection.** 120V continuous from dc to 1 kHz.
 - 3.1.8 **Power.** The logic probe shall be powered by the circuit under test. Overvoltage protection: ± 25 Vdc for 1 minute.
 - 3.2 **Logic pulser.** The pulser shall automatically drive circuits connected to it to their opposite state. Operational parameters shall be as detailed below.
 - 3.2.1 **Output current.** 0.65A for TTL and 0.1A for CMOS.

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3.2.2 Pulse width. 0.5 us for TTL and 5 us for CMOS.

3.2.3 Pulse voltages. TTL: high - 3V or greater, low - 0.8V or less. CMOS: high - supply voltage minus 1 Vdc or greater, low - 0.5V or less.

3.2.4 Pulser impedance. Less than 2 ohms when active and more than 1 megohm when off.

3.2.5 Pulser power. The logic pulser shall be powered by the circuit under test. Overvoltage protection: ± 25 Vdc for 1 minute.

3.3 Logic clip. The logic clip shall be compatible with DIP integrated circuits of up to 16 pins and have a state indicator for each pin.

3.3.1 Input. Turn-on threshold: $(0.4 \pm 0.06 \text{ Vdc}) \times$ supply voltage or greater for logic high indication.

3.3.2 Clip overload protection. 30 Vdc for one minute.

3.3.3 Power. The clip shall be powered by the DIP under test that provides 4 to 18 Vdc across any two pins.

4. WEIGHT. 1.4 kg (3 lb) maximum.

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TS3NT-B

TEST SET, LOGIC

1. **GENERAL.** This procurement requires a self-contained, solid-state logic troubleshooting kit capable of detecting and analyzing in-circuit logic failures. The kit shall be able to inject pulses into logic circuitry and monitor the level transitions. The kit shall consist of a logic probe, logic pulser, and a dual-in-line package (DIP) monitor clip, current tracer, and a logic comparator.
2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 except nominal power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The probe, pulser, and monitor clip shall be capable of in-circuit logic level analysis of transistor-transistor logic (TTL) and complementary metal oxide semiconductor (CMOS) logic within the minimum ranges and accuracies specified below.
 - 3.1 **Logic probe.**
 - 3.1.1 **TTL logic levels.**
 - a. Logic one: 1.8 to 2.4 volts peak.
 - b. Logic zero: 0.4 to 1 volt peak.
 - 3.1.2 **CMOS logic levels.**
 - 3.1.2.1 **3 to 10 Vdc supply.**
 - a. Logic one: (0.7 X supply voltage) $\pm 0.5V$
 - b. Logic zero: (0.3 X supply voltage) $\pm 0.5V$
 - 3.1.2.2 **10 to 18 Vdc supply.**
 - a. Logic one: (0.7 X supply voltage) $\pm 1V$
 - b. Logic zero: (0.3 X supply voltage) $\pm 1V$
 - 3.1.3 **Probe pulse width.** Minimum detectable pulse width: 10 ns or less. A pulse-stretching feature shall be provided to cause a flashing light during pulse activity.
 - 3.1.4 **Pulse repetition frequency limit.** 80 MHz for TTL and 40 MHz for CMOS.
 - 3.1.5 **Probe impedance.** 25 kilohms minimum.
 - 3.1.6 **Probe display.** The logic probe display shall be capable of indicating the following conditions via a light:
 - a. Normal logic levels (HI-LOW).
 - b. Pulse activity.
 - c. Open and short circuits.
 - d. Excessive and inadequate levels.
 - 3.1.7 **Probe overload protection.** 120V continuous from dc to 1 kHz.
 - 3.1.8 **Power.** The logic probe shall be powered by the circuit under test. Overvoltage protection: ± 25 Vdc for 1 minute.
 - 3.2 **Logic pulser.** The pulser shall automatically drive circuits connected to it to their opposite state. Operational parameters shall be as detailed below.
 - 3.2.1 **Output current.** 0.65A for TTL and 0.1A for CMOS.

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- 3.2.2 Pulse width. 0.5 us for TTL and 5 us for CMOS.
- 3.2.3 Pulse voltages. TTL: high - 3V or greater, low - 0.8V or less. CMOS: high - supply voltage minus 1 Vdc or greater, low - 0.5V or less.
- 3.2.4 Pulser impedance. Less than 2 ohms when active and more than 1 megohm when off.
- 3.2.5 Pulser power. The logic pulser shall be powered by the circuit under test. Overvoltage protection: ± 25 Vdc for 1 minute.
- 3.3 Logic clip. The logic clip shall be compatible with DIP integrated circuits of up to 16 pins and have a state indicator for each pin.
- 3.3.1 Input. Turn-on threshold: $(0.4 \pm 0.06 \text{ Vdc}) \times$ supply voltage or greater for logic high indication.
- 3.3.2 Clip overload protection. 30 Vdc for one minute.
- 3.3.3 Power. The clip shall be powered by the DIP under test that provides 4 to 18 Vdc across any two pins.
- 3.4 Current tracer.
- 3.4.1 Sensitivity. Range: 1 mA to 1A.
- 3.4.2 Frequency response. 10 MHz.
- 3.4.3 Current transition detection. Risetime: 200 ns or less at 1 mA, degrading to 200 us or less at 1A.
- 3.4.4 Power. The tracer shall be powered by the circuit under test. Overvoltage protection: ± 25 Vdc for 1 minute.
- 3.5 Logic comparator. The logic comparator shall be TTL compatible and clip onto a 14 or 16 pin DIP. It shall compare the operation of a paralleled, good integrated circuit (IC) of the same type inserted into a reference board.
- 3.5.1 Sensitivity. 1.4 Vdc or 200 ns or greater pulse timing errors between compared IC pins.
- 3.5.2 Frequency limit. 3 MHz or greater.
- 3.5.3 Comparator display. The logic comparator shall use a logic level indicator for each IC pin. An error existing for at least 200 ns shall be stretched and displayed for at least 0.1 second.
- 3.5.4 Comparator overload protection. The logic comparator shall be able to withstand a voltage range at any pin of -1 to +7 Vdc.
- 3.5.5 Comparator power. The logic comparator shall be powered by the circuit under test.
- 3.5.6 Accessories. The logic comparator shall be provided with the following accessories:
- a. At least 10 reference boards.
 - b. A manually programmable socket board.
 - c. A test board for verification of proper operation.
4. WEIGHT. 1.4 kg (3 lb) maximum.

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APPENDIX D

TS7NN-B

TEST SET, LORAN

1. **GENERAL.** This procurement requires a test set that generates master and slave pulses synchronized with the repetition rate of any C or CS LORAN station.
2. **CLASSIFICATION.** Type III, Class 6, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of LORAN signal generation within the minimum specifications identified below.
 - 3.1 **Frequency.** Selectable frequencies of 100 kHz, 1,850 kHz, 1,900 kHz, and 1,950 kHz shall be provided. Accuracy: $\pm 0.001\%$.
 - 3.2 **Attenuator range.** 0 dB to 60 dB in 10 dB steps. Accuracy: $\pm(1\%$ of reading + 0.1 dB).
 - 3.3 **Output level range.** 5 μVrms to 5 mVrms into 50 ohms. Additionally, an uncalibrated output with a typical 1 Vrms level, regardless of the attenuator setting, shall be provided.
 - 3.4 **Pulse delay.** 0 to 99,999 μs . Accuracy: $\pm 1 \mu\text{s}$.
 - 3.5 **Pulse rate.** Adjustable repetition interval from 29,300 to 100,000 μs .
 - 3.6 **Connectors.** BNC female.
 - 3.7 **Antenna.** A switch shall be provided to permit the output signal to be radiated by an integral antenna.
4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.
 - 4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 35W.
 - 4.2 **DC internal power source.** Internal batteries and charger are required. Minimum operating time shall be 2 hours following a maximum recharge time of 14 hours.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

WALCN-C

TEST SET, MEASURING, POWER

1. **GENERAL.** This procurement requires a true rms power measuring test set for use in the audio range.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications except the power source requirements are not invoked.
3. **MEASUREMENT CAPABILITY.** The equipment shall be capable of measuring output power, output impedance, and frequency characteristics of audio frequency devices within the minimum ranges, accuracies, and sensitivities specified below.
 - 3.1 **Frequency range.** 20 Hz to 20 kHz.
 - 3.2 **Power measurement range.** 0.1 mW to 20W.
 - 3.2.1 **Power measurement accuracy.**
 - a. ± 1.5 dB from 20 to 30 Hz.
 - b. ± 1.0 dB from 30 to 50 Hz and from 6 to 10 kHz.
 - c. ± 0.5 dB from 50 Hz to 6 kHz.
 - d. ± 5 dB from 10 to 20 kHz.
 - 3.3 **Impedance.** 2.5 ohms to 20 kilohms.
 - 3.3.1 **Impedance accuracy.** At full-scale voltage:
 - a. $\pm 15\%$ from 20 to 70 Hz.
 - b. $\pm 7\%$ from 70 Hz to 2.5 kHz.
 - c. $\pm 7\%$ from 2.5 to 5 kHz for impedances of less than 10 kilohms.
 - d. $\pm 50\%$ from 5 to 20 kHz.
 - 3.4 **Display.** The equipment display shall indicate power in watts and dBm. If a digital display is used, an analog meter shall also be incorporated for tuning purposes.
4. **WEIGHT.** 10 kg (22 lb) maximum.

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APPENDIX D

WALMA-A

TEST SET, MEASURING, POWER

1. **GENERAL.** This procurement requires an in-line power measuring test set capable of measuring incident and reflected power levels in watts.
2. **CLASSIFICATION.** Type III, Class 3, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications. The power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring incident and reflected power within the minimum power levels, frequency ranges, and accuracies specified below.
 - 3.1 **Power.** The power measurement capability shall be as specified in table I.

TABLE I. Frequency and Power

<u>Frequency Range</u>	<u>Incident and Reflected Power Ranges</u>
2 to 30 MHz	10W to 10 kW
25 to 520 MHz	1 W to 1 kW

- 3.1.1 **Accuracy.** $\pm 5\%$ of reading.
- 3.2 **Maximum input without damage.** 120% of the selected power range.
- 3.3 **Input and output connectors.** The equipment shall be equipped with a Type N(f) input connector and a Type N(m) output connector.
- 3.4 **Insertion VSWR.** 1.2:1 maximum.
- 3.5 **Transit case.** The Style P transit case shall store all components of the power measuring test set.
4. **WEIGHT.** 20 kg (44 lb) maximum.

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WA1SJ-B

TEST SET, MEASURING, POWER

1. **GENERAL.** This procurement requires a portable, terminated, RF power measuring set.
2. **CLASSIFICATION.** Type III, Class 5, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications except the power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring and dissipating RF power within the frequency range, power levels, and accuracies specified below.
 - 3.1 **Frequency range.** 30 MHz to 1,000 MHz.
 - 3.2 **Power measurement and dissipation.** 150W continuous.
 - 3.2.1 **Power measurement accuracy.** $\pm 5\%$ of full scale up to 500 MHz, $\pm 20\%$ of full scale above 500 MHz.
 - 3.2.2 **Power derating.** $1\%/^{\circ}\text{C}$ maximum from 40°C to 50°C .
 - 3.3 **Connector.** Type N female.
 - 3.4 **Input impedance.** 50 ohms nominal.
 - 3.5 **VSWR.** 1.15 maximum.
4. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

WAOFW-F

TEST SET, MEASURING, POWER, ELECTRONIC

1. **GENERAL.** This procurement requires a test set capable of measuring RF signal power levels.
2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The test set shall respond to the average power and indicate the RMS power of CW and pulsed RF signals throughout the power and frequency ranges and within the minimum accuracies specified below.
 - 3.1 **Test set power range.** -25 dBm (3 uW) to +35 dBm (3W) full scale.
 - 3.2 **Test set frequency range.** 100 kHz to 4.2 GHz.
 - 3.3 **Power meter.** An analog indicating meter with a taut-band movement and mirror-backed scales or a digital indicating meter that has at least 4½ digits of resolution, an analog peaking meter, and the capability of averaging up to 128 measurements.
 - 3.3.1 **Power meter stability.** The power meter shall drift no more than ±1.5% of full scale from zero set on the most sensitive range irrespective of the power sensor configuration, within 5 minutes of zero set in a non-averaging mode of operation.
 - 3.3.2 **Zero set.** When automatic zeroing is not a function of the instrument, the power meter shall be provided with a control that permits zero adjustment.
 - 3.3.3 **Power reference.** The power meter shall be provided with an internal power reference for adjusting the instrument to match the sensitivity of multiple power sensors. The power reference shall be 1 mW ±1.2% for one year throughout the specified temperature range.
 - 3.3.4 **Calibration factor control.** An operator control that permits instrument compensation for the calibration factor of each power sensor configuration shall be provided.
 - 3.3.5 **Recorder output.** The power meter shall be provided with a recorder-compatible output linearly proportional to the indicated power on each range.
 - 3.3.6 **Instrumentation Accuracy.** ±1% of full scale on all ranges.
 - 3.4 **Power sensor.** Thermocouple-type sensors are required.
 - 3.4.1 **Impedance.** 50 ohms, nominal.
 - 3.4.1.1 **Maximum SWR.** 1.6:1 from 100 to 300 kHz and 1.3:1 from 300 kHz to 4.2 GHz.
 - 3.4.2 **Overload protection.** The power sensor shall be capable of withstanding the maximum power inputs specified in table I.

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TABLE I. Maximum Power Inputs

<u>Sensor Power Range</u>	<u>Maximum Power Input</u>
Up to 100 mW	300 mW average 15W peak 30 W-us pulse energy
100 mW to 3W	3.5W average 100W peak 100 W-us pulse energy

3.4.2.1 **Overload indication.** The meter shall indicate an overrange condition when the rms power level exceeds the operating range of the sensor.

3.4.3 **Interconnecting cable length.** 1.5 meters (5 ft) minimum.

3.4.4 **Calibration factor graph.** The power sensors shall be provided with a graph of calibration factor versus frequency mounted on the power sensor housing. The graph shall be compatible with the control specified in 3.4.4.

3.4.5 **Calibration factor uncertainty.** $\pm 2.0\%$ from 100 kHz to 4.0 GHz.

3.4.6 **Connector types.** Type N(m).

3.5 **Pulsed RF measurement requirements.** All sensors shall respond to the average power of pulsed RF signals with the following pulse parameters:

- a. Minimum pulse width: 5 us or less.
- b. Duty cycle range: 0.1% or less to 100%.
- c. Pulse repetition frequency range: 30 Hz to 500 kHz.
- d. Peak power level not more than 20 dB above the continuous wave (cw) measurement upper limit of the sensors.
- e. RMS power levels between the upper cw power limit of thermocouple sensors and within 5 dB of the appropriate lower measurement limit of the sensors.

4. **TRANSIT CASE.** The Style P transit case shall provide protection for all components of the power measuring test set.

5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 25W.

6. **WEIGHT.** 15 kg (33 lb) maximum.

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WAOFV-G

TEST SET, MEASURING, POWER, ELECTRONIC

1. **GENERAL.** This procurement requires a test set capable of measuring RF signal power levels.
2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The test set shall respond to the average power and indicate the RMS power of CW and pulsed RF signals throughout the power and frequency ranges and within the minimum accuracies specified below.
 - 3.1 **Test set power range.** -60 dBm (1 nW) to +20 dBm (100 mW) full scale.
 - 3.2 **Test set frequency range.** 10 MHz to 18 GHz.
 - 3.3 **Power meter.** An analog indicating meter with a taut-band movement and mirror-backed scales or a digital indicating meter that has at least 4½ digits of resolution, an analog peaking meter, and the capability of averaging up to 128 measurements.
 - 3.3.1 **Power meter stability.** The power meter shall drift no more than ±1.5% of full scale from zero set on the most sensitive range irrespective of the power sensor configuration, within 5 minutes of zero set in a non-averaging mode of operation.
 - 3.3.2 **Zero set.** When automatic zeroing is not a function of the instrument, the power meter shall be provided with a control that permits zero adjustment.
 - 3.3.3 **Power reference.** The power meter shall be provided with an internal power reference for adjusting the instrument to match the sensitivity of multiple power sensors. The power reference shall be 1 mW ±1.2% for one year throughout the specified temperature range.
 - 3.3.4 **Calibration factor control.** An operator control that permits instrument compensation for the calibration factor of each power sensor configuration shall be provided.
 - 3.3.5 **Recorder output.** The power meter shall be provided with a recorder-compatible output linearly proportional to the indicated power on each range.
 - 3.3.6 **Instrumentation Accuracy.** ±1% of full scale on all ranges.
 - 3.4 **Power sensor.** A thermocouple-type sensor is required for the -25 to +20 dBm range. A diode-type sensor is required for the -60 to -20 dBm range.
 - 3.4.1 **Impedance.** 50 ohms, nominal.
 - 3.4.1.1 **Maximum SWR.** 1.4:1
 - 3.4.2 **Overload protection.** The power sensor shall be capable of withstanding the maximum power inputs specified in table I.

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APPENDIX D

TABLE I. Maximum Power Inputs

<u>Sensor Power Range</u>	<u>Maximum Power Input</u>
1 nW to 10 uW	200 mW average 200 mW peak
10 uW to 100 mW	300 mW average 15W peak 30 W-us pulse energy

3.4.2.1 **Overload indication.** The meter shall indicate an overrange condition when the rms power level exceeds the operating range of thermocouple sensors or the square law region of diode sensors.

3.4.3 **Interconnecting cable length.** 1.5 meters (5 ft) minimum.

3.4.4 **Calibration factor graph.** The power sensors shall be provided with a graph of calibration factor versus frequency mounted on the power sensor housing. The graph shall be compatible with the control specified in 3.4.4.

3.4.5 **Calibration factor uncertainty.** $\pm 2.0\%$ from 10 MHz to 8.0 GHz, $\pm 4\%$ from 8.0 to 18.0 GHz.

3.4.6 **Connector types.** Type N(m).

3.5 **Pulsed RF measurement requirements.** All sensors shall respond to the average power of pulsed RF signals with the following pulse parameters:

a. Minimum pulse width: 5 us or less.

b. Duty cycle range: 0.1% or less to 100%.

c. Pulse repetition frequency range: 30 Hz to 500 kHz.

d. Peak power level not higher than the square-law region upper limit of diode sensors or 20 dB above the continuous wave (cw) measurement upper limit of thermocouple sensors.

e. RMS power levels between the upper cw power limit of thermocouple sensors and within 5 dB of the appropriate lower measurement limit of the sensors.

4. **TRANSIT CASE.** The Style P transit case shall provide protection for all components of the power measuring test set.

5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 25W.

6. **WEIGHT.** 15 kg (33 lb) maximum.

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APPENDIX D

WAOFR-D

TEST SET, MEASURING, POWER, ELECTRONIC

1. **GENERAL.** This procurement requires a test set capable of measuring RF signal power levels.
2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The test set shall respond to the average power and indicate the RMS power of CW and pulsed RF signals throughout the power and frequency ranges and within the minimum accuracies specified below.
 - 3.1 Test set power range. -20 dBm (10 uW) to +20 dBm (100 mW) full scale.
 - 3.2 Test set frequency range. 10 MHz to 40 GHz.
 - 3.3 Power meter. An analog indicating meter with a taut-band movement and mirror-backed scales or a digital indicating meter that has at least 4½ digits of resolution, an analog peaking meter, and the capability of averaging up to 128 measurements.
 - 3.3.1 Power meter stability. The power meter shall drift no more than $\pm 1.5\%$ of full scale from zero set on the most sensitive range irrespective of the power sensor configuration, within 5 minutes of zero set in a non-averaging mode of operation.
 - 3.3.2 Zero set. When automatic zeroing is not a function of the instrument, the power meter shall be provided with a control that permits zero adjustment.
 - 3.3.3 Power reference. The power meter shall be provided with an internal power reference for adjusting the instrument to match the sensitivity of multiple power sensors. The power reference shall be 1 mW $\pm 1.2\%$ for one year throughout the specified temperature range.
 - 3.3.4 Calibration factor control. An operator control that permits instrument compensation for the calibration factor of each power sensor configuration shall be provided.
 - 3.3.5 Recorder output. The power meter shall be provided with a recorder-compatible output linearly proportional to the indicated power on each range.
 - 3.3.6 Instrumentation Accuracy. $\pm 1\%$ of full scale on all ranges.
 - 3.4 Power sensor. Thermocouple-type sensors are required.
 - 3.4.1 Impedance. 50 ohms, nominal.
 - 3.4.1.1 Maximum SWR. 1.4:1
 - 3.4.2 Overload protection. The power sensor shall be capable of withstanding the maximum power inputs specified in table I.

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APPENDIX D

TABLE I. Maximum Power Inputs

<u>Sensor Power Range</u>	<u>Maximum Power Input</u>
1 nW to 10 uW	200 mW average 200 mW peak
10 uW to 100 mW	300 mW average 15W peak 30 W-us pulse energy

3.4.2.1 **Overload indication.** The meter shall indicate an overrange condition when the rms power level exceeds the operating range of thermocouple sensors or the square law region of diode sensors.

3.4.3 **Interconnecting cable length.** 1.5 meters (5 ft) minimum.

3.4.4 **Calibration factor graph.** The power sensors shall be provided with a graph of calibration factor versus frequency mounted on the power sensor housing. The graph shall be compatible with the control specified in 3.4.4.

3.4.5 **Calibration factor uncertainty.** $\pm 2.0\%$ from 10 MHz to 8.0 GHz, $\pm 4\%$ from 8.0 to 18.0 GHz, and $\pm 5.5\%$ from 18.0 to 40.0 GHz.

3.4.6 **Connector types.** Type N(m) for 10 MHz to 18 GHz sensors. Coaxial or waveguide for 18 to 40 GHz sensors. If sensors with coaxial connectors are provided for the 18 to 40 GHz frequency range, WR-42 and WR-28 coax to waveguide adapters shall also be provided.

3.5 **Pulsed RF measurement requirements.** All sensors shall respond to the average power of pulsed RF signals with the following pulse parameters:

- a. Minimum pulse width: 5 us or less.
- b. Duty cycle range: 0.1% or less to 100%.
- c. Pulse repetition frequency range: 30 Hz to 500 kHz.
- d. Peak power level not more than 20 dB above the continuous wave (cw) measurement upper limit of the sensors.
- e. RMS power levels between the upper cw power limit of thermocouple sensors and within 5 dB of the appropriate lower measurement limit of the sensors.

4. **TRANSIT CASE.** The Style P transit case shall provide protection for all components of the power measuring test set.

5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 25W.

6. **WEIGHT.** 15 kg (33 lb) maximum.

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APPENDIX D

WAOXK-F

TEST SET, MEASURING, POWER, ELECTRONIC

1. **GENERAL.** This procurement requires an RF peak power measuring set.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITY.** The equipment shall be capable of measuring peak power at the center of a specific pulse in a pulse train, and the pulse width at the 3 dB points of a pulse envelope, within the minimum frequency and power ranges, and with the modulation characteristics specified below.
 - 3.1 **Modulation.** The equipment shall be capable of measuring signals with RF modulation rates of 25 pps to 10,000 pps, and with pulse widths of 1.0 μ s to 1 ms.
 - 3.2 **Power meter.** An analog indicating meter with a taut-band movement and mirror-backed scales or a digital indicating display with a resolution of 3-1/2 digits shall be provided.
 - 3.2.1 **Resolution.** 2% of full scale.
 - 3.3 **Trigger.** The equipment shall have internal and external trigger modes.
 - 3.3.1 **Trigger delay range.** 0 to 200 ms. Resolution: 0.1 ns. Accuracy: $\pm(0.01\%$ of delay + 1 ns).
 - 3.3.2 **External trigger.** Level: TTL. Connector type: BNC(f).
 - 3.4 **Calibration factor control.** A calibrated control that permits compensation for the frequency response of the power sensor is required.
 - 3.5 **Power sensor.**
 - 3.5.1 **Frequency range.** 100 MHz to 18 GHz.
 - 3.5.2 **Peak power range.** -20 dBm to +20 dBm.
 - 3.5.3 **Overload protection.** 200 mW peak.
 - 3.5.4 **Voltage standing wave ratio (VSWR).** 1.15 from 100 MHz to 2.0 GHz, 1.25 from 2.0 to 12.4 GHz, and 1.4 from 12.4 to 18.0 GHz.
 - 3.5.5 **Connector.** Type N(m).
 - 3.5.6 **Interconnecting cable length.** 1.2 meters (4 ft).
 - 3.5.7 **Calibration factor graph.** The power sensor shall be provided with a graph of calibration factor versus frequency mounted on the power sensor housing. The graph shall be compatible with the control specified in 3.3.
 - 3.6 **Accuracy.** $\pm 10\%$ of full scale.
 - 3.7 **Output.** The equipment shall have an output proportional to the detected RF envelope. Risetime: 50 ns or less. Impedance: 50 ohms, nominal.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 40W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

Configuration A: RHONP-E
 Configuration B: RHONR-E

TEST SET, MEASURING, RADIATION HAZARD

1. **GENERAL.** This procurement requires a true rms, isotropic, broadband, hand-held, radiation hazard meter.
2. **CLASSIFICATION.** Type III, Class 3, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** Both equipment configurations shall be capable of operation within CW fields or compound CW and pulse modulated fields within the minimum accuracies and limits specified below.
 - 3.1 **Electric field.**
 - 3.1.1 **E field frequency range.** 300 kHz to 40 GHz.
 - 3.1.2 **E field measurement range.** 1 mW per square cm to 100 mW per square cm.
 - 3.2 **Magnetic field.** Magnetic field measurements are not required of Configuration A equipment.
 - 3.2.1 **H field frequency range.** 300 kHz to 300 MHz for Configuration B.
 - 3.2.2 **H field measurement range.** 1 mW per square cm to 100 mW per square cm for Configuration B.
 - 3.3 **Accuracy.** ± 3 dB or better excluding ellipticity and isotropic errors. Use of calibration charts or other correction methods are acceptable to meet this requirement.
 - 3.4 **Response time.** The typical response time for Configuration A and Configuration B shall be one second. Configuration B shall be provided with an additional response time selection of typically 3 seconds.
 - 3.5 **Recorder output.** The equipment shall provide a dc voltage proportional to the meter indication for use with a recorder.
 - 3.6 **Peak hold control.** A selectable mode shall be provided that will indicate and hold the maximum value of the field intensity until reset.
 - 3.7 **Power density alarm.** An audible power density alarm shall be adjustable for any percentage of full scale.
 - 3.8 **Probes.**
 - a. Configuration A: The equipment shall be provided with no more than two probes to cover the required E field frequency and measurement ranges (see 3.1.1 and 3.1.2).
 - b. Configuration B: The equipment shall be provided with no more than two probes to cover the required E field frequency and measurement ranges (see 3.1.1 and 3.1.2) and two probes to cover the required H field frequency and measurement ranges (see 3.2.1 and 3.2.2).
 - 3.8.1 **Maximum power.** E field measurements: 1W per square cm for CW and 300W per square cm for peak power. H field measurements: 300 mW per square cm for CW and 300W per square centimeter for peak power.
- 3.9 **Display.** An analog meter which displays in mW per square cm shall be provided.

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3.9.1 Display resolution. 5% or less of full scale.

3.10 Battery check. An indication of battery condition shall be provided.

3.11 Operational check source. The equipment shall be provided with an RF source used to determine proper operation of the system.

3.12 Transit case. One transit case shall be provided which shall be capable of storing all equipment.

4. POWER SOURCE. MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.

4.1 Nominal power source. Operation at 400 Hz is not required. Maximum power consumption: 60W.

4.2 DC internal power source: Internal batteries and charger are required. Minimum operating time shall be 40 hours following a maximum recharge time of 40 hours.

5. WEIGHT. 20 kg (44 lb) maximum including transit case, 4.5 kg (10 lb) maximum when configured for operation.

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FIOAJ-C

TEST SET, MEASURING, RIFI

1. **GENERAL.** This procurement requires a portable, solid state interference analyzer/receiver with synthesized local oscillator capable of detecting RF signals over the frequency range of 10 kHz to 30 MHz.
2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:
 - a. The nonoperating temperature requirement is limited to the range of -25°C to $+70^{\circ}\text{C}$ without batteries, -10°C to $+60^{\circ}\text{C}$ with batteries.
 - b. The relative humidity requirement is limited to 95% noncondensating.
 - c. The operating and nonoperating altitude requirements are not invoked.
 - d. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
 - e. The warm-up time is extended to 30 minutes.
3. **OPERATIONAL REQUIREMENTS.** This equipment shall be capable of demodulating AM, FM, and pulse modulated signals over its measurement frequency range.
 - 3.1 **Frequency characteristics.**
 - 3.1.1 **Range.** 10 kHz to 30 MHz.
 - 3.1.2 **Display.** Digital (5 digits minimum).
 - 3.1.2.1 **Resolution.** At least 1 kHz.
 - 3.1.3 **Resolvable frequency.** At least 100 Hz.
 - 3.1.4 **Accuracy.**
 - 3.1.4.1 **Internal reference.** $\pm 2 \times 10^{-5} + 50$ Hz (max error ± 650 Hz at 30 MHz).
 - 3.1.4.2 **External reference.** Dependent on stability of external reference.
 - 3.1.4.2.1 **Input.** 5/10 MHz, 1 Vrms into 50 Ω .
 - 3.2 **Level measurement.**
 - 3.2.1 **Dynamic range.** At least 135 dB.
 - 3.2.1.1 **Maximum input.** At least 110 dB μ V (3 dBm).
 - 3.2.2 **Display.** Digital and/or analog in units of at least dB μ V.
 - 3.2.2.1 **Resolution.** Minimum resolution of at least 1 dB over entire level range.
 - 3.2.3 **Accuracy.** ± 1.5 dB of actual level (average value measurement of signals > 0 dB μ V).
 - 3.2.4 **IF bandwidths (at least).**
 - 3.2.4.1 **Minimum.** 200 Hz.

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3.2.4.2 Maximum. 9 kHz.

3.2.5 Sensitivity (CW signal) $S+N/N = 3$ dB. At least -20 dB μ V.

3.2.6 Input impedance. 50Ω .

3.2.6.1 VSWR. Less than 1.5:1 for levels < 100 dB μ V.

3.2.6.2 Connector. BNC (female).

3.2.7 Calibration. IF gain adjusted to stored, nonvolatile correction factors when CAL is activated.

3.2.8 Detector functions. Average, peak, peak with programmable hold.

3.3 Extraneous signals.

3.3.1 Local oscillator emission. Less than 25 dB μ V with input connector terminated in 50Ω .

3.3.2 IF rejection. > 80 dB.

3.3.3 Image rejection. > 70 dB.

3.3.4 Cross-modulation. A 100 dB μ V signal with 30% AM at 1 kHz spaced > 100 kHz away from a received signal of 20 dB μ V shall produce less than 3% AM on the received signal.

3.4 Outputs.

3.4.1 Tracking generator.

3.4.1.1 Level. At least -30 dBm.

3.4.1.2 Frequency. Receiver's tuned frequency.

3.4.1.3 Output. 50 -ohm, BNC female connector.

3.4.1.4 Accuracy. $\pm 2 \times 10^{-5} + 50$ Hz (max error ± 650 Hz at 30 MHz).

3.4.2 Intermediate frequency (IF). For connection to oscilloscope.

3.4.3 AM. Demodulated amplitude modulation signal.

3.4.4 FM. Demodulated frequency modulation.

3.4.5 Recorder. At least 1 volt full scale; level proportional to detected signal.

4. GENERAL REQUIREMENTS.

4.1 Power source. 115 and 230 Vac $\pm 10\%$, 50, 60, or 400 Hz, 75 VA maximum.

4.1.2 Direct current. 11 to 14V at 2A nominal or less.

4.2 Volume. The total volume shall not exceed $54,077$ cm³ ($3,300$ in³).

4.3 Weight. The total weight including battery pack shall not exceed 22.7 kg (50 lb).

5. ACCESSORIES.

5.1 Rod antenna. (9 kHz to 30 MHz).

5.2 Loop antenna. (9 kHz to 30 MHz).

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5.3 Tripod.

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FIOAL-A

TEST SET, MEASURING, RIFI

1.0 GENERAL. This procurement requires a portable, solid state interference analyzer/receiver with synthesized local oscillator capable of detecting RF signals over the frequency range of 10 kHz to 30 MHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -25°C to +70°C without batteries; -10°C to +60°C with batteries.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.
- d. The warm-up time is extended to 30 minutes.

3.0 OPERATIONAL REQUIREMENTS. This equipment shall be capable of demodulating AM, FM, or pulse modulated signals over its measurement frequency range. With its wide dynamic range and tracking generator, it is capable of selective voltage and two-port measurements.

3.1 Frequency characteristics.

3.1.1 Range. 10 kHz to 30 MHz.

3.1.2 Display. Digital (6 digits minimum).

3.1.3 Resolution. At least 100 Hz.

3.1.4 Accuracy.

3.1.4.1 Internal reference. $\pm 2 \times 10^{-5} + 50$ Hz (max error ± 650 Hz at 30 MHz).

3.1.4.2 External reference. Dependent on stability of external reference.

3.1.4.2.1 Input. 5/10 MHz, 1 Vrms into 50 ohms.

3.1.5 Frequency scan. Tuning of receiver may be automatically swept over a range of frequencies by specifying start, stop, and step frequency size.

3.2 Level measurement.

3.2.1 Dynamic range. At least 150 dB.

3.2.1.1 Maximum input. At least 130 dBuV (23 dBm).

3.2.2 Display. Digital and/or analog in units of at least dBuV, dBm, and uV.

3.2.2.1 Analog resolution. Minimum resolution of 1 dB over entire level range.

3.2.2.1.1 Scale ranges. 20 dB and 40 dB minimum.

3.2.2.2 Digital resolution. Minimum resolution of 0.1 dB over entire level range.

3.2.3 Accuracy. ± 1.5 dB of actual level (average value measurement of signals > 0 dBuV).

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3.2.4 IF bandwidths (at least).

3.2.4.1 Minimum. 200 Hz.

3.2.4.2 Maximum. 10 kHz.

3.2.5 Sensitivity (CW signal) $S+N/N = 3$ dB. At least -20 dBuV.

3.2.6 Input impedance. 50 ohms.

3.2.6.1 VSWR. Less than 1.5:1 for levels <100 dBuV.

3.2.6.2 Connector. BNC(f).

3.2.7 Calibration.

3.2.7.1 Automatic. IF gain adjusted to stored, non-volatile correction factors when IF BW changed.

3.2.7.2 Manual. IF gain adjusted to stored, non-volatile correction factors when CAL key depressed on front panel.

3.2.8 Detector functions. Average, peak, peak with programmable hold.

3.3 Extraneous signals.

3.3.1 Local oscillator emission. Less than 25 dBuV with input connector terminated in 50 ohms.

3.3.2 IF rejection. >100 dB.

3.3.3 Image rejection. >100 dB.

3.3.4 Cross modulation. A 100 dBuV signal with 30% AM at 1 kHz spaced >100 kHz away from a received signal of 20 dBuV shall produce less than 3% AM on the received signal.

3.4 Outputs.

3.4.1 Tracking generator.

3.4.1.1 Level. At least -30 dBm.

3.4.1.2 Frequency. Receiver's tuned frequency.

3.4.1.3 Output. 50 ohm, BNC connector.

3.4.2 Intermediate frequency. For connection to oscilloscope.

3.4.3 AM. Demodulated amplitude modulation signal.

3.4.4 FM. Demodulated frequency modulation.

3.4.5 X-Y plotter. Outputs capable of driving an X-Y plotter.

3.4.6 Pen lift. Signal shall lift plotter pen during retrace.

4.0 GENERAL REQUIREMENTS.

4.1 Power.

4.1.1 Alternating current. 115/230 Vac $\pm 10\%$, 50, 60, or 400 Hz, 120 VA maximum.

4.1.2 Direct current. 22-32 Vdc, 4A maximum.

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4.2 **Volume.** The total volume of the unit shall not exceed 3969 cubic in (65,040 cubic cm).

4.3 **Weight.** The total weight of the unit shall not exceed 50 lb (22.7 kg).

4.4 **Remote programming.** The receiver shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having the following subset of bus functions: AH1, LA, SH1, T5, SR1, PP1, DC1, DT1, and RL1.

5.0 **ACCESSORIES.**

5.1 **HFH 2-Z1.** Rod antenna (9 kHz to 30 MHz).

5.2 **HFH 2-Z2.** Loop antenna (9 kHz to 30 MHz).

5.3 **HFU-Z.** Tripod.

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APPENDIX D

FIOAY-A

TEST SET, MEASURING, RIFI

1.0 GENERAL. This procurement requires a portable, solid state interference analyzer/receiver capable of detecting an RF output over the range of 1 to 18 GHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.
- d. The warm-up time is extended to 30 minutes.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall have RF preselection with a minimum selectivity of 12 dB/octave and be capable of detecting an RF signal within the parameters and accuracies specified herein.

3.1 RF frequency.

3.1.1 Range. At least 1 to 18 GHz in no more than 5 overlapping bands.

3.1.2 Accuracy. At least $\pm 1\%$ of the actual detected RF frequency when the receiver is properly tuned to the incoming signal.

3.1.3 Capture range. At least 50% of the IF bandwidth selected with the Automatic Frequency Control (AFC) activated.

3.1.4 Stability (AFC off).

3.1.4.1 Short term. Less than or equal to 1 pp 10E5; 15 minute warm-up, 25°C, time period 10 seconds.

3.1.4.2 Long term. Less than or equal to 5 pp 10E5; 30 minute warm-up, 25°C, time period 5 minutes.

3.2 Voltage measurement.

3.2.1 Range. At least 120 dB (1.0 uV to 1.0 V).

3.2.2 Attenuator. At least 0 to 60 dB in 10 dB steps.

3.2.3 Accuracy. Within ± 2 dB of actual detected CW signals above +40 dBuV; ± 3 dB for levels below 40 dBuV.

3.2.4 Sensitivity. For $(S+N)/N = 3$ dB.

3.2.4.1 Narrowband. Less than or equal to 7 dBuV (-100 dBm) for BW less than or equal to 100 kHz.

3.2.4.2 Wideband. Less than or equal to 27 dBuV (-80 dBm) for BW less than or equal to 10 MHz.

3.2.5 Calibrator. The unit shall have an internal calibrator of the impulse generator type.

3.2.6 Input connector. 50 ohms nominal; precision type N.

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3.2.6.1 VSWR. 2:1 typical; 3:1 maximum.

3.3 Sweep capability. The frequency to which the receiver is tuned shall be capable of being swept in a linear manner over any portion of the frequency range in any frequency band.

3.3.1 Band sweep. Repetitive or single sweep over the entire band selected.

3.3.2 Sector sweep. Sweep width is controllable from 0.1% to 10% of the frequency range in any frequency band.

3.4 Extraneous signals.

3.4.1 IF rejection. Equal to or greater than 80 dB.

3.4.2 Image rejection. Equal to or greater than 60 dB.

3.4.3 Spurious rejection. Equal to or greater than 60 dB.

3.4.4 Local oscillator emission. Equal to or less than -70 dBm at the RF input connector when terminated into 50 ohms.

3.5 Detector functions. The unit shall provide detector functions of carrier, peak and slideback peak calibrated in rms equivalent.

3.6 Outputs. All outputs are into minimum impedance of 1 kilohm unless otherwise specified.

3.6.1 Local oscillator. At least -20 dBm into 50 ohms.

3.6.2 Horizontal. The unit shall provide a dc coupled output which varies from 0 to at least 1.0 V, whose voltage is proportional to the frequency being swept in either the "band" or "sector" mode.

3.6.3 Vertical. The unit shall provide a dc coupled output which varies from 0 to at least 1.0 V, whose voltage is proportional to either the log or the linear displacement of the peak, average or slideback detector used.

3.6.4 Blanking. The unit shall provide a retrace blanking pulse whose polarity is selectable.

3.6.5 Video. FM, linear and log.

3.6.6 Audio. AM and FM.

3.6.7 X-Y plotter. Outputs capable of driving an X-Y plotter shall be provided.

3.6.8 Pen lift. A TTL compatible voltage or contact closure shall be provided to lift the plotter pen during retrace.

4.0 GENERAL REQUIREMENTS.

4.1 Power. 115/230 Vac $\pm 10\%$, 50/60 Hz, 170W maximum.

4.2 Dimensions. The equipment shall be rack mountable and shall occupy a volume not to exceed 2,750 cubic in (45,065 cubic cm).

4.3 Weight. The total weight of the unit shall not exceed 66 lbs (30 kg).

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FIOAK-A

TEST SET, MEASURING, RIFI

1.0 GENERAL. This procurement requires a portable, solid state interference analyzer/receiver with synthesized local oscillator capable of detecting RF signals over the frequency range of 20 MHz to 1 GHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -25°C to +70°C without batteries; -10°C to +60°C with batteries.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.
- d. The warm-up time is extended to 30 minutes.

3.0 OPERATIONAL REQUIREMENTS. This equipment shall be capable of demodulating AM, FM, or pulse modulated signals over its measurement frequency range. With its wide dynamic range and tracking generator, it is capable of selective voltage and two-port measurements.

3.1 Frequency characteristics.

3.1.1 Range. 20 MHz to 1.0 GHz.

3.1.2 Display. Digital (6 digits minimum).

3.1.3 Resolution. At least 1 kHz.

3.1.4 Accuracy.

3.1.4.1 Internal reference. $\pm 1 \times 10^{-5}$ (max error ± 10 MHz at 1000 MHz).

3.1.4.2 External reference. Dependent on stability of external reference.

3.1.4.2.1 Input. 5/10 MHz, 1 Vrms into 50 ohms.

3.2 Level measurement.

3.2.1 Dynamic range. At least 140 dB.

3.2.1.1 Maximum input. At least 130 dBuV (23 dBm).

3.2.2 Display. Digital and/or analog in units of at least dBuV, dBm, and uV.

3.2.2.1 Analog resolution. Minimum resolution of 1 dB over entire level range.

3.2.2.1.1 Scale ranges. 20 dB and 40 dB minimum.

3.2.2.2 Digital resolution. Minimum resolution of 0.1 dB over entire level range.

3.2.3 Accuracy. ± 1.5 dB of actual level (average value measurement of signals > 20 dBuV).

3.2.4 IF bandwidths (at least).

3.2.4.1 Minimum. 7.5 kHz.

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- 3.2.4.2 Maximum. 1 MHz.
- 3.2.5 Sensitivity (CW signal) $S+N/N = 3$ dB. At least -7 dBuV.
- 3.2.7 Input impedance. 50 ohms.
 - 3.2.7.1 VSWR:. Less than 1.5:1 for levels <100 dBuV.
 - 3.2.7.2 Connector. Type N(f).
- 3.2.8 Calibration.
 - 3.2.8.1 Automatic. IF gain adjusted to stored, nonvolatile correction factors when new frequency and IF BW are set.
 - 3.2.8.2 Manual. IF gain adjusted to stored, nonvolatile correction factors when CAL key is depressed on front panel.
- 3.2.9 Detector functions. Average, peak, peak with programmable hold.
- 3.3 Extraneous signals.
 - 3.3.1 Local oscillator emission. Less than 25 dBuV with input connector terminated in 50 ohms.
 - 3.3.2 IF rejection. >80 dB.
 - 3.3.3 Image rejection. >80 dB.
 - 3.3.4 Desensitization. <1 dB (interfering signal >2 MHz away and level of 110 dBuV).
- 3.4 Outputs.
 - 3.4.1 Tracking generator.
 - 3.4.1.1 Level. At least -20 dBm.
 - 3.4.1.2 Frequency. Receiver's tuned frequency.
 - 3.4.1.3 Output. 50 ohm, type N connector.
 - 3.4.2 Intermediate frequency. For connection to oscilloscope.
 - 3.4.3 AM. Demodulated amplitude modulation signal.
 - 3.4.4 FM. Demodulated frequency modulation.
 - 3.4.5 X-Y plotter. Outputs capable of driving an X-Y plotter.
 - 3.4.6 Pen lift. Signal shall lift plotter pen during retrace.
- 4.0 GENERAL REQUIREMENTS.
 - 4.1 Power.
 - 4.1.1 Alternating current. 115/230 Vac $\pm 10\%$, 50, 60, or 400 Hz, 120 VA maximum.
 - 4.1.2 Direct current. 24 Vdc, 4A maximum.
 - 4.2 Volume. The total volume of the unit shall not exceed 3,969 cubic in (65,040 cubic cm).
 - 4.4 Weight. The total weight of the unit shall not exceed 60 lb (27.2 kg).

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5.0 ACCESSORIES.

- 5.1 HUF-Z1. Broadband 20 to 80 MHz dipole antenna.
- 5.2 HL023 A1. Broadband log-periodic 80 to 1,300 MHz antenna.
- 5.3 HFU-Z. Tripod.
- 5.4 HFUZ. Mast for tripod.
- 5.5 HFU 2-25. RF cable (7 meters).

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APPENDIX D

FIOAM-A

TEST SET, MEASURING, RIFI

1.0 GENERAL. This procurement requires a programmable, portable, solid state interference analyzer/receiver with synthesized local oscillator capable of detecting RF signals over the frequency range of 20 MHz to 1 GHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The nonoperating temperature requirement is limited to the range of -25°C to +70°C without batteries; -10°C to +60°C with batteries.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirement is not invoked.
- d. The warm-up time is extended to 30 minutes.

3.0 OPERATIONAL REQUIREMENTS. This equipment shall be capable of demodulating AM, FM or pulse modulated signals over its measurement frequency range. With its wide dynamic range and tracking generator, it is capable of selective voltage and two-port measurements.

3.1 Frequency characteristics.

3.1.1 Range. 20 MHz to 1.0 GHz.

3.1.2 Display. Digital (6 digits minimum).

3.1.3 Resolution. At least 1 kHz.

3.1.4 Accuracy.

3.1.4.1 Internal reference. $\pm 1 \times 10^{-5}$ (max error ± 10 MHz at 1.0 GHz).

3.1.4.2 External reference. Dependent on stability of external reference.

3.1.4.2.1 Input. 5/10 MHz, 1 Vrms into 50 ohms.

3.1.5 Frequency scan. Tuning of receiver may be automatically swept over a range of frequencies by specifying Start, Stop, and Step frequency size.

3.2 Level measurement.

3.2.1 Dynamic range. At least 140 dB.

3.2.1.1 Maximum input. At least 130 dBuV (23 dBm).

3.2.2 Display. Digital and/or analog in units of at least dBuV, dBm, and uV.

3.2.2.1 Analog resolution. Minimum resolution of 1 dB over entire level range.

3.2.2.1.1 Scale ranges. 20 dB and 40 dB minimum.

3.2.2.2 Digital resolution. Minimum resolution of 0.1 dB over entire level range.

3.2.3 Accuracy. ± 2.0 dB of actual level (average value measurement of signals > 20 dBuV).

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3.2.4 IF bandwidths (at least).**3.2.4.1 Minimum.** 7.5 kHz.**3.2.4.2 Maximum.** 1 MHz.**3.2.5 Sensitivity (CW signal) S+N/N = 3 dB.** At least -7 dBuV.**3.2.7.1 VSWR.** Less than 1.5:1 for levels <100 dBuV.**3.2.7.2 Connector.** Type N(f)**3.2.8 Calibration.****3.2.8.1 Automatic.** IF gain adjusted to stored, nonvolatile correction factors when new frequency and IF BW are set.**3.2.8.2 Manual.** IF gain adjusted to stored, nonvolatile correction factors when CAL key is depressed on front panel.**3.2.9 Detector functions.** Average, peak, peak with programmable hold.**3.3 Extraneous signals.****3.3.1 Local oscillator emission.** Less than 25 dBuV with input connector terminated in 50 ohms.**3.3.2 IF Rejection.** >80 dB.**3.3.3 Image rejection.** >80 dB.**3.3.4 Desensitization.** <1 dB (interfering signal >2 MHz away and level of 110 dBuV).**3.4 Outputs.****3.4.1 Tracking Generator.****3.4.1.1 Level.** At least -20 dBm.**3.4.1.2 Frequency.** Receiver's tuned frequency.**3.4.1.3 Output.** 50 ohm, type N connector.**3.4.2 Intermediate frequency.** 50 ohm output of IF frequency.**3.4.3 AM.** Demodulated amplitude modulation signal; impedance <600 ohms.**3.4.4 FM:** Demodulated frequency modulation; impedance <600 ohms.**3.4.5 X-Y plotter.** Outputs capable of driving an X-Y plotter.**3.4.6 Pen lift.** Signal shall lift plotter pen during retrace.**4.0 GENERAL REQUIREMENTS.****4.1 Power.****4.1.1 Alternating current.** 115/230 Vac $\pm 10\%$, 50, 60, or 400 Hz, 120 VA maximum.**4.1.2 Direct current.** 22-32 Vdc, 4A maximum.**4.2 Volume.** The total volume of the unit shall not exceed 3969 cubic in (65040 cubic cm).

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4.3 Weight. The total weight of the unit shall not exceed 65 lb (29.5 kg).

4.4 Remote programming. The receiver shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having the following subset of bus functions: AH1, L4, SH1, T5, SR1, P1, DC1, DT1, and RL1.

5.0 ACCESSORIES.

5.1 HUF-Z1. Broadband 20-80 MHz dipole antenna.

5.2 HLO23 A1. Broadband log-periodic 80-1300 MHz antenna.

5.3 HFU-Z. Tripod.

5.4 HFUZ. Mast for tripod.

5.5 HFU 2-Z5. RF cable (7 meters).

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APPENDIX D

TS2FF-A

TEST SET, MEASURING, SWR

1.0 GENERAL. This procurement requires a VSWR measuring test set consisting of an impedance comparator, two matched terminations and six mismatched terminations. The test set, when used with a sweep generator and an oscilloscope, will provide a direct display of VSWR vs. frequency. The comparator provides an ALC output for signal generators with ALC inputs. The terminations provide accurate calibrated VSWR standards from 1:1 to 2:1.

2.0 CLASSIFICATION. The generator described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to $+70^{\circ}\text{C}$.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of operating within the parameters and accuracies specified herein.

3.1 Impedance comparator.

3.1.1 Frequency range. At least 0.05 to 1,200 MHz.

3.1.2 Bridge accuracy. $\pm 1\%$ of VSWR measurement.

3.1.3 Impedance. 50 ohms.

3.1.4 Connectors.

3.1.4.1 RF input. Type N female.

3.1.4.2 Z1Z2. Type N female.

3.1.4.3 Output. Type BNC female.

3.1.4.4 ALC. Type BNC female.

3.1.5 VSWR output time constant. At least 10 usec.

3.1.6 VSWR and ALC output polarity. Negative.

3.1.7 Maximum power output. At least 0.5W.

3.2 Terminations and mismatches.

3.2.1 Frequency range. 0 to 3 GHz.

3.2.2 Reference impedance. Nominally 50 ohms.

3.2.3 VSWR accuracy. 5% of VSWR value.

3.2.4 Power rating. 1W maximum.

3.2.5 Connectors. Type N male.

4.0 GENERAL REQUIREMENTS.

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4.1 **Dimensions.** The total volume of the test set shall not exceed 105 cubic in (1,720 cc).

4.2 **Weight.** The total weight of the unit shall not exceed 5 lbs (2.3 kg).

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TS2MN-B

TEST SET, MEASURING, SWR

1. **GENERAL.** This procurement requires a tuned 1 kHz voltmeter/amplifier, calibrated in dB and SWR to be used with square law detectors and slotted lines. The equipment shall also be capable of operating from either an ac line or portable dc power source.

2. **CLASSIFICATION.** The tuned voltmeter described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The relative humidity requirement is limited to 95% noncondensating.
- b. The operating and nonoperating altitude requirements are not invoked.
- c. The EMI requirement is not invoked.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring signals within the parameters and accuracies specified herein.

3.1 **Frequency characteristics.**

3.1.1 **Tuned frequency.** 1 kHz.

3.1.2 **Bandwidth.** At least 15 Hz to 120 Hz.

3.2 **Measurement characteristics.**

3.2.1 **Dynamic range.** At least 70 dB.

3.2.2 **Attenuator accuracy.** ± 0.05 dB/10 dB step.

3.3 **Input impedance characteristics.**

3.3.1 **Unbiased range.** At least 50 to 200 Ω .

3.3.2 **High impedance.** 2.5 k Ω to 10 k Ω .

3.3.3 **Bolometer.** Low or high current into 200 Ω .

3.4 **Output for driving X-Y recorder.** At least 0 to 1 Vdc.

3.4.1 **Source impedance.** 1,000 Ω .

3.4.2 **Connector.** BNC female.

3.5 **Meter scales (calibrated for square-law detectors).**

3.5.1 **SWR.** At least 2 ranges, 1 to 4 and 3.2 to 10.

3.5.2 **dB.** At least 0 to 10.

4. **GENERAL REQUIREMENTS.**

4.1 **Power.** 115/230 Vac $\pm 10\%$, single phase, 50, 60 or 400 Hz $\pm 10\%$, 5 VA maximum, or rechargeable battery for portable operation, at least 24 hours continuous operation per charge.

4.2 **Dimensions.** The total volume shall not exceed 8,700 cm³ (530 in³).

4.3 **Weight.** The total weight shall not exceed 4.1 kg (9 lb).

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TSZAA-A

TEST SET, OPTICAL LOSS

1. **GENERAL.** This procurement requires a lightweight optical loss test set. It may be used as a power meter, loss test set, or optical source.
2. **CLASSIFICATION.** The optical loss test set described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for the Navy shipboard, submarine, and shore applications with the following exceptions:
 - a. The relative humidity requirement is limited to 95% noncondensating.
 - b. The operating and nonoperating altitude requirements are not invoked.
 - c. The electromagnetic interference requirements of MIL-T-28800 are limited to CE01, CE03, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.
 - d. The warm-up time for source stability is 5 minutes.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of performing optical loss measurements and generating optical signals within the parameters and accuracies specified herein.
 - 3.1 **Optical loss (power meter).**
 - 3.1.1 **Wavelength range.** At least 800-1650 nm.
 - 3.1.2 **Measurement range.** 0 to -70 dBm.
 - 3.1.2.1 **Auto range selection with hold range feature.**
 - 3.1.3 **Accuracy.** $\pm 5\%$ (Level > -20 dBm @ 1,300 nm).
 - 3.1.4 **Display.** Digital.
 - 3.1.4.1 **Parameters.** (1) Power level in dBm/W; (2) wavelength in nm; (3) low battery indicator.
 - 3.1.4.2 **Type.** LCD (backlit).
 - 3.1.4.3 **Resolution.** At least 4 digits for power/0.01 dB.
 - 3.1.5 **Input connector.** Interfaces for at least FC, ST, SMA, Biconic, D4.
 - 3.1.6 **Averaging ON/OFF.** Capability to average more than one reading.
 - 3.2 **Optical source (plug-in replaceable).**
 - 3.2.1 **Wavelength.** 1300 \pm 40 nm (multimode).
 - 3.2.1.1 **Bandwidth.** < 150 nm.
 - 3.2.2 **Output power.** > -25 dBm (into 50/125 μ m).
 - 3.2.2.1 **Level stability.** < 0.3 dB (0 - 50°C).
 - 3.2.3 **Output connector.** Interfaces for at least FC, ST, SMA, Biconic, and D4.
4. **GENERAL REQUIREMENTS.**
 - 4.1 **Power.** DC battery for portable operation.

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4.1.1 DC operating time:

4.1.1.1 Power meter mode. At least 10 hours.

4.1.1.2 Loss mode. At least 4 hours.

4.1.2 AC operation. External adapter provides DC to input jack. AC Voltage. 115/230 $\pm 10\%$.

4.1.3 Auto power OFF. Automatic turn off if no key pressed.

4.1.3.1 Time interval. At least 5 min; less than 10 min.

4.2 Dimensions. Less than 20.32 cm (8 in) height; 10.16 cm (4 in) width; 5.08 cm (2 in) depth.

4.3 Weight. 1 kg (2.2 lbs) max (including source, sensor, and batteries).

4.4 Transit case. A protective carrying case shall be provided for transporting the test set.

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TS5MM-D

TEST SET, RADAR

1. **GENERAL.** This procurement requires a portable, self-contained radar test set.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of testing radar transmitters and receivers within the minimum specifications identified below.
 - 3.1 **Radar transmitters.**
 - 3.1.1 **Input frequency.** The test set shall be capable of measuring radar transmitter signal frequency over the following ranges and accuracies:
 - a. Frequency range: 8.5 to 9.6 GHz.
 - b. Frequency accuracy: ± 4 MHz.
 - c. Resolution: 10 MHz or less.
 - d. Pulse width and prf: The equipment shall operate with the pulse width and prf combinations identified in table I.

TABLE I. Pulse Width and prf Combinations.

<u>Pulse Width in us</u>	<u>prf in pps</u>
0.1	1,200
0.4	1,060
0.8	400
2.0	500
2.0	300

- 3.1.2 **Input power.** The test set shall be capable of measuring radar transmitter power.
 - a. Peak pulse power: 0 dBm to 65 dBm.
 - b. CW power: 0 dBm to 30 dBm.
 - c. Power measurement accuracy: ± 1 dB.
 - d. Power measurement resolution: 0.2 dB or less.
- 3.2 **Radar receivers.**
 - 3.2.1 **Minimum discernible signal (MDS).** The test set shall be capable of measuring and indicating radar receiver MDS.
 - a. MDS frequency range: 8.5 GHz to 9.6 GHz.
 - b. MDS measurement range: 0 dBm to -85 dBm.
 - c. MDS measurement accuracy: ± 2 dB.
 - d. MDS measurement resolution: 0.1 dB

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3.2.2 RF trigger. The test set shall be capable of triggering from an RF signal that has the following characteristics:

- a. Peak power range: 15 dBm peak to 65 dBm peak.
- b. Pulse width: 0.1 us to 6 us.
- c. Pulse repetition frequency: 300 pps to 1,500 pps.

3.2.3 RF trigger delay. 50 us to 1 ms continuously adjustable.

3.3 Connectors. N(f).

3.4 Impedance. 50 ohms nominal.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 225W.

5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

TSMNN-B

TEST SET, RADIO

1. **GENERAL.** This procurement requires a portable radio test set for use with radio receiving and transmitting equipment.

2. **CLASSIFICATION.** Type III, Class 3, Style C, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **FUNCTIONAL REQUIREMENTS.** The equipment shall be capable of signal generation, monitoring, amplitude level and frequency measurement, power measurement, modulation analysis, and receiver signal-to-noise measurement, within the minimum specifications identified below.

3.1 RF signal generator.

3.1.1 Generator frequency range. 400 kHz to 999.99 MHz tuneable in increments of 100 Hz.

3.1.2 Generator frequency accuracy. Equal to the master oscillator (see 3.9).

3.1.3 Residual FM. 100 Hz rms from 300 Hz to 3 kHz.

3.1.4 Generator output power. Adjustable from -127 dBm to -20 dBm. Accuracy: ± 4 dB.

3.1.5 Generator spectral purity. -15 dBc for harmonics, -35 dBc for all other spurious signals.

3.1.6 Modulation. FM and AM from internal source, external source, and supplied microphone.

3.1.6.1 Frequency modulation.

3.1.6.1.1 Modulation deviation. 0 to 25 kHz peak from 400 kHz to 999.99 MHz.

3.1.6.1.2 Modulation frequency response. 20 Hz to 10 kHz.

3.1.6.2 Amplitude modulation.

3.1.6.2.1 AM frequency response. 100 Hz to 10 kHz.

3.1.6.2.2 Percentage of modulation range. 0 to 70% with modulating frequencies from 100 Hz to 5 kHz.

3.2 RF signal monitor.

3.2.1 Monitor frequency range. 1.5 MHz to 999.99 MHz.

3.2.2 Monitor frequency accuracy. Equal to master oscillator (see 3.9).

3.2.3 Monitor input sensitivity. For 10 dB EIA SINAD: 5.0 μ V.

3.2.4 Beat frequency oscillator. A beat frequency oscillator that provides an audible carrier indication shall be provided.

3.2.5 Monitor frequency error measurement. The monitor shall indicate the difference in frequency between a signal under test and a predetermined value entered by the operator.

3.2.5.1 Monitor frequency error measurement range. ± 10 kHz or greater.

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- 3.2.5.2 Monitor frequency error measurement resolution. 10 Hz or less.
- 3.2.6 Monitor FM deviation range. 0 to 25 kHz peak deviation. Accuracy: $\pm 7.5\%$ plus the peak residual FM at modulation frequencies of 30 Hz to 10 kHz.
- 3.2.7 Monitor AM percentage range. 0 to 100%. Accuracy: $\pm 8\%$ FS at modulation frequencies of 300 Hz to 10 kHz.
- 3.2.8 Monitor signal strength measurement. A means shall be provided to measure the relative level of off-the-air signals received by an antenna supplied with the instrument.
- a. Frequency range: 3 MHz to 999.99 MHz.
 - b. Level range. -100 dBm to +10 dBm.
- 3.3 RF wattmeter. An RF wattmeter and load shall be provided to measure the power generated by units under test, and to terminate a 50-ohm system with an SWR of 1.5 or less.
- a. Power range. 1W to 50W.
 - b. Accuracy. $\pm 20\%$ of indication.
 - c. Load. The RF load shall be capable of terminating 100W for at least one minute.
- 3.3.1 Wattmeter over-temperature protection. An over-temperature warning shall be provided.
- 3.4 Duplex generator. A duplex generator function or other means shall be provided to test equipment transmitting and receiving simultaneously on frequencies offset from each other.
- 3.4.1 Duplex frequency offset. 0 to ± 10 MHz with a resolution of 10 kHz.
 - 3.4.2 Duplex output level. -50 dBm minimum into a 50-ohm load.
 - 3.4.3 Duplex generator deviation. The carrier shall be capable of being frequency modulated at deviations from 0 to 20 kHz peak.
 - 3.4.4 Duplex generator frequency response. 20 Hz to 10 kHz at 3 dB.
- 3.5 Oscilloscope. An oscilloscope function shall be provided to monitor the modulation characteristics of AM and FM signals.
- 3.5.1 Oscilloscope display size. At least five square inches.
 - 3.5.2 Oscilloscope frequency response. DC to 6 kHz.
 - 3.5.3 Oscilloscope vertical input ranges. 10 mV to 10 V/div.
 - 3.5.4 Oscilloscope horizontal sweep rate. 100 us/div to 20 ms/div.
- 3.6 Frequency counter. A frequency counter function shall be provided to measure audio frequencies.
- 3.6.1 Counter frequency range. 20 Hz to 10 kHz with a resolution of 1 Hz. Accuracy: ± 2 counts.
- 3.7 AF signal generator. An audio frequency signal generator shall be provided to generate the tones required by various two-tone signaling systems.
- 3.7.1 AF generator frequency range. 10 Hz to 20 kHz with a resolution of 1 Hz.

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- 3.7.2 AF generator output level. 2.5 Vrms minimum into 600 ohms.
- 3.8 SINAD meter. A means shall be provided to measure the sensitivity of a receiver with respect to the ratio of the signal plus noise and distortion to noise and distortion.
- 3.8.1 SINAD meter frequency. The equipment shall provide a test signal modulated by 1 kHz to the receiver under test.
- 3.8.2 SINAD meter input range. 0.5 Vrms to 10 Vrms.
- 3.8.3 SINAD meter measurement range. 1 dB to 20 dB. Accuracy: ± 1.5 dB at 12 dB SINAD.
- 3.9 Master oscillator frequency accuracy. 2 ppm.
- 3.9.1 Oscillator aging stability. ± 2 ppm per year.
- 3.9.2 Oscillator temperature stability. 0 to 55°C: ± 1 ppm.
- 3.10 Loudspeaker. The equipment shall contain an internal loudspeaker.
- 3.11 Remote operation. The equipment shall be provided with a digital interface in accordance with MIL-T-28800.
4. POWER SOURCE. MIL-T-28800 nominal and dc external power source requirements are invoked as detailed below.
- 4.1 Nominal power source. Operation at 400 Hz is not required. Maximum power consumption: 300W.
- 4.2 DC external power source. 11-18 Vdc, 120W maximum.
5. WEIGHT. 21 kg (46 lb) maximum.

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APPENDIX D

TSMRB-B

TEST SET, RADIO

1. **GENERAL.** This procurement requires a solid-state radio test set for emergency beacon radios.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of carrier frequency, swept pulse modulating frequency, and average pulsed-rf power measurements as specified below.
 - 3.1 **Frequency measurements.**
 - 3.1.1 **Carrier frequency.** 243 MHz $\pm 0.003\%$, sweep modulated.
 - 3.1.2 **Pulse modulating frequencies.** The equipment shall be capable of measuring swept pulse modulating frequencies of 200 Hz to 1.5 kHz ± 0.1 Hz.
 - 3.2 **Power measurement.** The equipment shall be capable of measuring average pulsed-RF power within a range of 100 mW to 400 mW. Accuracy: $\pm(10\%$ of reading + 5 mW).
 - 3.3 **Display.** The equipment shall be provided with an indicator capable of displaying power and frequency with the following resolutions:
 - a. Power: 2 mW.
 - b. Carrier frequency: 1 kHz.
 - c. Modulating frequency: 0.01 Hz
 - 3.4 **Input Impedance.** AC coupled, 50 ohms nominal.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 150W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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FTOAN-B

TEST SET, TAPE RECORDER

1.0 GENERAL. This procurement requires a tape recorder test set capable of indicating satisfactory, marginal and unsatisfactory operation of tape recorders with a frequency response of 50 Hz to 16 kHz.

2.0 CLASSIFICATION. The equipment shall meet the requirements of MIL-T-28800(), Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The 400 Hz power requirement is not invoked.
- b. The vibration and shock pulse requirements are not invoked.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of generating signals within the parameters and accuracies specified herein.

3.1 Test modes.

- 3.1.1 Low frequency: Checks lower band edge (referenced to 1 kHz).
- 3.1.2 High frequency: Checks upper band edge (referenced to 1 kHz).
- 3.1.3 Distortion: Checks third order harmonics (referenced to 1 kHz).
- 3.1.4 Flutter: Checks flutter of 1 kHz referenced signal.
- 3.1.5 Signal-to-noise: Indicates signal-to-noise ratio (referenced to 1 kHz).
- 3.1.6 Self test: Verifies operation of functional tests.

3.2 Outputs:

- 3.2.1 Microphone: 100 μ V to 1 mVrms, internally adjustable.
- 3.2.2 Line: 100 mV to 1 Vrms, internally adjustable.
- 3.2.3 Distortion: 0.1% second harmonic and 0.1% third harmonic.

3.3 Frequencies.

- 3.3.1 Configuration A: 300 Hz, 1 kHz and 3 kHz composite signal.
- 3.3.2 Configuration B: 100 Hz, 1 kHz and 8 kHz composite signal.
- 3.3.3 Configuration C: 50 Hz, 1 kHz and 16 kHz composite signal.

3.4 Output impedance.

- 3.4.1 Microphone: Less than 1 ohm.
- 3.4.2 Line: Less than 600 ohms.

3.5 Input.

- 3.5.1 Level: 100 mV to 1 Vrms, adjustable.
 - 3.5.1.1 Reference set: Maximum levels; 25 Vrms, 200 Vdc or 50V peak.
- 3.5.2 Impedance: 100 kohms shunted by less than 100 pF.

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3.6 Function tests.

3.6.1 Distortion: Calibration range 1 to 3%.

3.6.2 Flutter: Calibration range 0.15 to 3% rms.

3.6.2.1 Bandwidth: 0.5 Hz to 100 Hz unweighted and damped.

3.6.3 Signal-to-noise ratio: Calibration range -20 to -50 dB.

4.0 GENERAL SPECIFICATIONS.

4.1 Power: 115 or 230 Vac $\pm 10\%$, 50 to 60 Hz, 1 VA maximum.

4.2 Dimensions: 140 mm (H) x 273 mm (W) x 305 mm (D), (5.5 in x 10.75 in x 12 in).

4.3 Weight: 4.5 kg (10 lb) maximum.

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FTOGN-B

TEST SET, TAPE RECORDER

1.0 GENERAL. This procurement requires a flutter meter capable of measuring long term drift and instantaneous flutter in the recording and/or reproducing speed of magnetic tape recording/reproducing systems. The unit shall contain an integral wave analyzer tunable from 0.5 Hz to 60 kHz.

2.0 CLASSIFICATION. The tape recorder test set described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following exceptions:

- a. The nonoperating temperature requirement is limited to the range of -40°C to +70°C.
- b. The relative humidity requirement is limited to 95% noncondensating.
- c. The operating and nonoperating altitude requirements are not invoked.

3.0 OPERATIONAL REQUIREMENTS. The equipment shall be capable of measuring signals within the parameters and accuracies specified herein.

3.1 Test signal input.

3.1.1 Frequency ranges. At least 1.69, 3.38, 6.75, 13.5, 27, 54, 108, 216 and 432 kHz.

3.1.2 Input level. 20 mV to 2 Vrms.

3.1.3 Input impedance. 100 kilohms, unbalanced.

3.2 Drift measurement meter.

3.2.1 Frequency range. At least dc to 0.7 Hz $\pm 20\%$ FAST and dc to 0.2 Hz $\pm 20\%$ SLOW.

3.2.2 Test range. At least ± 0.03 to $\pm 10\%$ full scale.

3.2.3 Meter accuracy. At least $\pm 5\%$ full scale.

3.3 Flutter measurement meter.

3.3.1 Bandwidth. At least 313 Hz to 20 kHz.

3.4 Indicating modes.

3.4.1 Peak to peak. To 1 standard deviation (random peaks occurring less than 32% of the time) corresponding to twice the rms value of truly random flutter, 2 standard deviations (random peaks occurring less than 5% of the time) corresponding to IRIG standard measurement if the flutter processes are truly random with a Gaussian amplitude distribution, and to 3 standard deviations (random peaks occurring less than 0.3% of the time excluded) corresponding to true peak-to-peak flutter.

3.4.2 Test range. At least 0.01 to 10% full scale.

3.4.3 Meter accuracy. At least $\pm 5\%$ full scale at 100 Hz.

3.5 Internal test oscillator.

3.5.1 Accuracy. Crystal controlled to at least $\pm 0.1\%$ of the selected frequency.

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- 3.5.2 Output voltage. At least 1 Vrms $\pm 10\%$.
- 3.5.3 Impedance. 50 ohms unbalanced.
- 3.6 Drift modulator output (BNC).
 - 3.6.1 Frequency range. -3 dB down at 30 Hz $\pm 20\%$ and -3 dB at greater than 0.7 Hz in FAST and SLOW.
 - 3.6.2 Output voltage. At least ± 0.1 V for full scale meter indication.
 - 3.6.3 Impedance. 1 kilohms unbalanced.
 - 3.6.4 Bandwidth. Less than 1 dB at 10 Hz and -3 dB at 30 Hz.
 - 3.6.5 Accuracy. At least $\pm 3\%$ of full scale at dc.
- 3.7 Flutter demodulator output (BNC).
 - 3.7.1 Frequency ranges. At least -3 dB from less than 0.2 Hz to 313 Hz, 625 Hz, 1.25 kHz, 2.5 kHz, 5 kHz, 10 kHz, and 20 kHz.
 - 3.7.2 Response. At least ± 0.5 dB from 2 Hz to 60% BW and at least ± 1.0 dB from 1 Hz to 80% BW.
 - 3.7.3 Attenuation. Less than 22 dB at 2 times BW.
 - 3.7.4 Output voltage. At least 0.1V p-p full scale meter indication.
 - 3.7.5 Impedance. 600 ohms unbalanced.
 - 3.7.6 Accuracy. At least $\pm 3\%$ of full scale at 100 Hz.
- 3.8 Equivalent internal instrumentation noise. Less than 0.005% p-p.
- 3.9 External meter input.
 - 3.9.1 Frequency. Less than ± 1 dB from 2 Hz to 20 kHz.
 - 3.9.2 Impedance. 2.5 kilohms unbalanced.
 - 3.9.3 Sensitivity. 1 mV to 1V p-p full scale.
 - 3.9.4 Accuracy. At least $\pm 5\%$ of full scale at 100 Hz.
- 3.10 Wave Analyzer.
 - 3.10.1 Frequency range. 0.5 Hz to 20 kHz continuously tunable.
 - 3.10.2 Accuracy. At least $\pm 10\%$ from 0.5 Hz to 50 Hz and at least $\pm 5\%$ from 50 Hz to 20 kHz.
 - 3.10.3 Response. At least ± 1.5 dB.
 - 3.10.4 Bandwidth. At least 3 dB down at $\pm 5\%$ of selected frequency and at least 20 dB down at 0.5 and 2 times the selected frequency.
 - 3.10.5 Output voltage. At least 1.2V p-p.
 - 3.10.6 Impedance. 1 kohms.
- 4.0 GENERAL REQUIREMENTS.
 - 4.1 Dimensions. The total volume of the unit shall not exceed 25,300 cubic cm (1,544 cubic in) with maximum height 89 mm (3.5 in).

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- 4.2 **Weight.** The total weight of the unit shall not exceed 9.1 kg (20 lbs).
- 4.3 **Power.** 115/230 Vac $\pm 10\%$, 50 to 60 Hz $\pm 10\%$, 25W maximum.

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TE1NA-E

TEST SET, SEMICONDUCTOR

1. **GENERAL.** This procurement requires a solid-state, semiconductor analyzer capable of both in-circuit GO/NO-GO testing and out-of-circuit parameter testing.

2. **CLASSIFICATION.** Type III, Class 5, Style EP, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum accuracies, limits, and specifications identified below.

3.1 **In-circuit.** The equipment shall be capable of testing semiconductors in a circuit with circuit power removed, providing an indication of an operative (GO) or inoperative (NO-GO) condition. If tests are conducted within the shunt limitations specified below, the GO/NO-GO test indication shall be valid regardless of semiconductor to equipment test lead orientation. Correct test lead orientation may be required to obtain the following:

a. The base lead identification and proper operating polarity of an operative device.

b. The type of failure of an inoperative device, such as an open or short, and the junction involved.

3.1.1 **Shunt limits.** The equipment shall be capable of in-circuit testing of diodes and transistors with the following shunt limits:

Resistance: 180 ohms or greater
Capacitance: 5 uF or less

3.2 **Out-of-circuit.** The equipment shall be provided with out-of-circuit dynamic transistor parameter measurement capabilities as follows:

a. Beta, from 0 to 500.

b. Collector-to-base leakage current of 1 uA to 5 mA with a resolution of 200 nA on the most sensitive range.

3.2.1 **Accuracy.** $\pm 10\%$ of indication.

3.2.2 **Bias current range.** Bias currents for low and high power transistors shall be provided.

3.3 **Indicators.** The equipment shall include a meter having a linear scale or scales such that parameter values are defined in an ascending left-to-right sequence, or an equivalent digital display. For analog meters, front-panel meter zeroing shall be provided. GO/NO-GO information shall be conveyed by visual indicators and shall include a selectable audio indicating mode.

3.4 **Test sockets.** The equipment shall be provided with front-panel-mounted transistor test sockets for TO-3, TO-5, and TO-66 case configurations.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 25W.

5. **TRANSIT CASE.** The Style P transit case shall store all components of the semiconductor test set.

6. **ACCESSORIES.** The following accessories shall be provided with the equipment:

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a. One set of color coded clip-on test leads at least 0.457m (1.5 ft) long.

b. One spares kit consisting of replacement fuses, replacement lamp assemblies (if applicable), spare semiconductor sockets, and any required calibration components.

7. **WEIGHT.** 5 kg (11 lb) maximum.

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TS6FN-C

TEST SET, SONAR

1. **GENERAL.** This procurement requires a portable, self contained sonar test set capable of measuring both noise and coherent signals detected by shipboard sonar. The detected signals will be displayed and plotted as a function of bearing or time. The equipment shall also have a built-in tape cassette recorder capable of storing measurements made by the sonar noise recorder.

2. **CLASSIFICATION.** The equipment shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following modifications and exceptions:

- a. The relative humidity requirement is limited to 95% noncondensating.
- b. The operating and nonoperating altitude requirements are not invoked.
- c. The EMI requirement is not invoked.
- d. The warm-up time is extended to one hour.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of performing within the parameters and accuracies specified herein.

3.1 Y-Axis (signal channel).

3.1.1 **Voltage range.** 1 μ Vrms (-120 dB) to 7 Vrms (17 dB) with a maximum crest factor of 5.

3.1.2 **Dynamic range.** Selectable to be 60 dB or 120 dB; full scale from -60 dB to +20 dB in 1 dB steps

3.1.3 **Input impedance.** Greater than or equal to 1 M Ω shunted by no more than 50 pF.

3.1.4 **Frequency response.** \pm 1 dB from 500 Hz to 15 kHz with constant amplitude signal applied to the input probe.

3.1.4.1 **High pass filter.** With 18 dB/octave roll-off.

3.1.4.2 **Low pass filter.** With 12 dB/octave roll-off.

3.1.5 **Linearity.** Within 0.5 dB over the 120 dB measurement range from 500 Hz to 15 kHz.

3.1.6 **Resolution.** 0.2 dB or better.

3.1.7 **Equivalent noise input.** With input terminated with 1 k Ω the noise measured will be less than 2 μ Vrms.

3.1.8 **Time constants.** Selectable at 10 or 100 msec.

3.1.9 **Overshoot.** The Y-axis overshoot shall be 1 dB or less for a 10 dB level change.

3.1.10 **Pen writing speed.** At least 150 dB/sec at the 10 msec time constant and 15 dB/sec at the 100 msec time constant.

3.2 X-Axis.

3.2.1 **Operating modes.** The equipment shall be capable of operating as a function of time and as a function of bearing with the equipment driving the sonar synchro system.

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3.2.2 Bearing ranges.

3.2.2.1 360°. Full scale equals 360°, origin selectable at any bearing in 1° steps.

3.2.2.2 72°. Full scale equals 72°, origin selectable at any bearing in 1° steps.

3.2.3 Sweep.

3.2.3.1 Bearing mode. Full scale sweep times of 30, 60 or 120 sec in either normal or expanded mode.

3.2.3.2 Time mode. Full scale sweep times of 12, 30, 60 or 120 sec in either normal or expanded mode.

3.2.3.3 Halt and reverse. The equipment shall have the capability to halt, reverse direction and continue the sweep, in either the bearing or time mode.

3.2.4 Return time. The pen return time shall not exceed 12 sec.

3.2.5 Synchro output. The synchro output shall operate into 1-speed or 36-speed sonar synchro system, 115V reference, 90V line to line, at 400 Hz; 1.5 VA per stator, maximum. The reference and signal leads must be fuse protected against over current or over voltage conditions.

3.2.5.1 Synchro output interface. The synchro output interface cable must be capable of direct connection for the following sonar system configurations.

3.2.5.1.1 Cable A. Cable must be at least 10 feet long with eight single conductors of at least 18 inches in length terminated with pin jacks with the following connections:

	Pin Signal
A	1X-S1
B	1X-S2
C	1X-S3
D	36X-S1
E	36X-S2
F	36X-S3
G	R2
H	R1

3.2.5.1.2 Cable B. Cable must be at least 10 feet long terminated with a MS3106A-18-1P connector with the following connections:

	Pin Signal
A	1X-S1
B	1X-S2
C	1X-S3
D	36X-S1
E	36X-S2
F	36X-S3
G	R2
H	R1

3.2.5.1.3 Cable C. Cable must be at least 10 feet long terminated with a MS3106A-18-1P connector with the following connections:

	Pin Signal
A	1X-S3
B	1X-S2
C	1X-S1
D	36X-S3
E	36X-S2

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F 36X-S1
G R1
H R2

- 3.2.6 Accuracy. $\pm 1^\circ$ for the 360° range and $\pm 0.3^\circ$ for the 72° expanded range
- 3.2.7 Resolution. 0.2° or better in the bearing modes; 15 msec or better for the fastest speed in the time mode; 60 msec or better for the slowest speed in the time mode.
- 3.3 Recorder paper and pen.
- 3.3.1 Paper type. Preprinted single sheet with degrees and decibels scales
- 3.3.2 Paper holddown. Positive paper holddown must be provided.
- 3.3.3 Paper positioning. Guide lines shall be provided for accurately positioning recording paper.
- 3.3.4 Pen type. Disposable cartridge with fiber tip.
- 3.4 Tape recorder built-in cassette type.
- 3.4.1 Tape speed. At least 10 inches/second.
- 3.4.2 Data format. Each record will correspond to one sweep of the X-axis and consist of one set of parameters followed by the measured data.
- 3.4.3 Tape capacity. At least 30 records (sweeps) per cassette.
- 3.4.4 Read/Store time. Less than 10 seconds after starting point is found.
- 3.4.5 Search speed. At least 40 inches/second.
- 3.4.6 Cassette. Magnetic tape shall be in cassette format and capable of operating from 0°C to $+55^\circ\text{C}$.
- 3.4.7 File identification. Access to the files shall be controlled by operator entry of a file number. New data will be recorded at the end of the last record or in place of a previous file identified by the operator.
- 3.5 Built-In testing.
- 3.5.1 Self-Test. An automatic self test function shall be provided.
- 3.5.2 Adjustments. The pen shall be capable of being set to origin and full scale of each axis under operator control for internal adjustments.
- 3.6 Displays and controls.
- 3.6.1 Display. 20 character minimum, alphanumeric readout; used for dialogue with the operator, display of entry data and display of measurement data.
- 3.6.2 Keyboard. The recorder shall be provided with either a keypad or push buttons for data entry as necessary to operate the equipment.
- 3.6.3 Trigger output. A TTL pulse for triggering other equipments shall be provided on the front panel to indicate when a recording is started.
4. GENERAL REQUIREMENTS.
- 4.1 Power. 115/230 Vac $\pm 10\%$, 50/60 Hz, 200W maximum.
- 4.2 Dimensions. The total volume shall not exceed $63,910\text{ cm}^3$ ($3,900\text{ in}^3$).

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4.3 **Weight.** The total weight shall not exceed 27.3 kg (60 lbs).

4.4 **Remote control.** The generator shall be capable of being remotely controlled via the IEEE-488 interface bus, operating as both a talker and listener, having at least the following subset of bus functions. AH1, L4, SH1, T6, SR1, DC1, and RL1.

4.5 **Connections.** All external connections shall be keyed to prevent accidental or improper connection.

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TS6MN-C

TEST SET, SONAR

1. **GENERAL.** This procurement requires a three frequency, fixed tuned or tunable, solid-state receiving set including a plug-in microphone with headset, sound concentrator and contact probe for use with a hydrophone as an acoustical, out of the water, detection device for surfaced submarine sonar tests. The unit must be portable, self contained and battery operated.
2. **CLASSIFICATION.** The test set described herein shall meet the requirements of MIL-T-28800, Type III, Class 5, Style E, Color R for Navy shipboard, submarine, and shore applications with the following exceptions:
 - a. The relative humidity requirement is limited to 95% noncondensating.
 - b. The operating and nonoperating altitude requirements are not invoked.
 - c. The EMI requirement is not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring signals within the parameters and accuracies specified herein.
 - 3.1 **Operating frequencies.** At least 28 kHz, 45 kHz and 205 kHz.
 - 3.2 **Bandwidth.** At least 4 kHz at the -3 dB point and 10 kHz at the -20 dB point.
 - 3.3 **Audible indicator.** The test set must be capable of generating an audio tone with the pitch and intensity directly proportional to the level of received signal. The frequency of the audio tone should be nominally 1 kHz.
 - 3.4 **Receive sensitivity.** The input sensitivity shall be at least -20 dB, where the 0 dB reference is equal to the acoustic pressure of 1 microbar measured at a distance of 1 yard from the acoustical source.
 - 3.5 **Phone jack.** The equipment shall be provided with an audio output phone panel jack for monitoring the audio output via a headset provided with the equipment.
 - 3.6 **Carrying case.** A carrying case shall be provided for storing all components of the test set.
4. **GENERAL REQUIREMENTS.**
 - 4.1 **Power.** Battery operated in accordance with MIL-T-28800 requirements.
 - 4.2 **Dimensions.** The total volume shall be nominally 23,204 cm³ (1,416 in³).
 - 4.3 **Weight.** The total weight shall be nominally 4.3 kg (9.5 lbs).
 - 4.4 **Battery operating life.** The batteries shall be either rechargeable with at least a 40 hour operating life (recharge time less than 24 hours) or non-rechargeable batteries capable of 150 hours of intermittent service.

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TSTTM-C

TEST SET, TRANSMISSION TELECOM

1. **GENERAL.** This procurement requires a telecommunications test set capable of performing measurements on voice, program, and data circuits.
2. **CLASSIFICATION.** Type III, Class 5, Style D, and Color R in accordance with MIL-T-28800 for shipboard applications. The convertible/rackmountable requirement is invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall measure noise, noise-with-tone, noise-to-ground (from 50 to 110 dBrn), signal-to-noise ratio, impulse noise, and P/AR. C-message, program, 3 kHz, and 15 kHz flat frequency weighting shall be provided for noise measurements. The equipment shall measure received tone level and frequency while simultaneously transmitting a tone level. The equipment shall perform all measurements within the minimum specifications identified in ANSI/IEEE Standard 743-1984 with the exception of the miscellaneous and environmental requirements which shall be governed by MIL-T-28800. Additional requirements are invoked below.
 - 3.1 **Frequency range.** 50 Hz to 110 kHz.
 - 3.2 **Impedances.** 135, 600, and 900 ohms.
 - 3.2.1 **Connections.** Audio jack input and output connectors and dial terminals for connecting a lineman's handset.
 - 3.3 **Display.** Digital readouts for input and output frequencies and levels shall be provided.
 - 3.4 **Monitor.** A built-in speaker with volume control shall be provided to vary speaker output level of received or transmitted signals.
 - 3.5 **Rackmounting.** The equipment shall be contained in a Style D enclosure for portability and shall be provided with a conversion kit which will allow rackmounting in accordance with the convertible/rackmountable requirements of MIL-T-28800.
4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.
 - 4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 50W.
 - 4.2 **DC internal power source.** Internal batteries and charger are required. Minimum operating time shall be 3 hours following a maximum recharge time of 14 hours.
5. **WEIGHT.** 6.8 kg (15 lb) maximum.

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TSNNP-B

TEST SET, WHITE NOISE, TELECOM

1. **GENERAL.** This procurement requires a solid-state white noise test set capable of measuring intermodulation and noise in wideband telecommunications systems.
2. **CLASSIFICATION.** Type III, Class 6, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring intermodulation and noise in wideband telecommunications systems within the minimum parameters and accuracies specified below.
 - 3.1 **Noise generator.**
 - 3.1.1 **Noise generator bandwidth.** 12 kHz to 12.36 MHz.
 - 3.1.2 **Maximum output.** 20 dBm or greater into 75 ohms.
 - 3.1.3 **Noise output reference level.** Adjustable to -12.5 dBm/kHz with filters installed.
 - 3.1.4 **Automatic level control.** The automatic level control shall maintain the output level within 0 dB and -0.25 dB when filters are switched.
 - 3.1.5 **Attenuators.** The coarse and fine attenuators shall meet the following specifications:
 - a. **Coarse:** -40 dBm to 20 dBm, selectable in 5 dB steps above 0 dBm and 10 dB steps below 0 dBm. The accuracy of setting shall be $\pm 0.5\%$ ± 0.1 dB.
 - b. **Fine:** 0 dB to 11 dB, selectable in 1 dB steps. The accuracy of setting shall be $\pm 0.5\%$.
 - 3.1.6 **Indicator.** The equipment shall be provided with an analog meter or digital meter that has a peak and null indicator. The meter shall have scale ranges of 1 to -1 dBm in 0.2 dB increments and -1 to -3 dBm in 1 dB increments. The accuracy of the meter shall be within ± 0.3 dB.
 - 3.1.7 **Output impedance.** 75 ohms nominal.
 - 3.2 **Noise receiver.**
 - 3.2.1 **Receiver range.** 12 kHz to 12.4 MHz.
 - 3.2.2 **Sensitivity.** -120 dBm when referenced to an effective bandwidth of 2.2 kHz.
 - 3.2.3 **Input attenuator.** The input attenuator shall be directly calibrated in power ratio and in pW of noise power per 3.1 kHz bandwidth. The range, accuracy, and impedance shall be in accordance with the following:
 - a. **Range:** 0 dB to 91 dB, controlled in 10 dB and 1 dB steps.
 - b. **Accuracy:** $\pm 0.5\%$ ± 0.1 dB.
 - c. **Impedance:** 75 ohms nominal.
 - 3.2.4 **Noise source.** The equipment shall be provided with an internal standardizing noise source that generates over the band of 10 kHz to 13 MHz and in accordance with the following:

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a. Level: 1 pW (-90 dBm) per 3.1 kHz bandwidth. The noise level shall not vary by more than ± 0.25 dB.

b. Accuracy: ± 0.5 dB at 1 pW per 3.1 kHz bandwidth.

3.2.5 Local oscillator. The equipment shall be provided with receptacles for plug-in oscillator boards. The output and RC shall be in accordance with the following:

a. Output: 0.15 to 0.35 Vrms.

b. RC: 1.5 kilohms or greater paralleled by 75 pF or less.

3.2.6 External local oscillator input. The external local oscillator input shall have the following characteristics:

a. Required level: 0.3 Vrms $\pm 20\%$.

b. RC: 6 kilohms or greater paralleled by 60 pF or less.

3.3 Filters and local oscillators. The equipment shall be provided with bandpass filters, band-stop filters, and local oscillators that have the following center frequencies.

a. 70 kHz

b. 534 kHz

c. 1.248 MHz

d. 3.886 MHz

3.4 Low-pass filter. The low-pass filter shall have a cut off frequency of 108 kHz.

3.4.1 Low-pass filter rejection. At least 25 dB down for frequencies 10% above cut off frequency.

3.5 High-pass filter. The high-pass filter shall have a cut off frequency of 60 kHz.

3.5.1 High-pass filter rejection. At least 25 dB down for frequencies 20% below cut off frequency.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 75W.

5. WEIGHT. 34 kg (75 lb) maximum.

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TSENN-A

TESTER, BIT ERROR RATE, TELECOM

1. **GENERAL.** This procurement requires a bit error rate test set capable of indicating data errors in bit streams.
2. **CLASSIFICATION.** Type III, Class 5, Style C, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of injecting and counting bit errors in a known data stream within the parameters and accuracies specified below.
 - 3.1 **Output message forms.**
 - a. **Random:** Three pseudorandom test messages of 63, 511, and 2,047 bits.
 - b. **Reversals:** A 1:1 reversal signal.
 - c. **Mark:** A steady mark output.
 - d. **Space:** A steady space output.
 - 3.2 **Displays.**
 - 3.2.1 **Error count display.** 2-1/2 digit numerical readout.
 - 3.2.2 **Excess indicator.** An excess indicator shall be provided for error counts that exceed the error count display capability.
 - 3.2.3 **Sync loss indicator.** A synchronization loss indicator shall be provided.
 - 3.3 **Modem.** The equipment shall be provided with switch-activated modem handshaking capabilities.
 - 3.4 **Speeds.** The equipment shall be provided with the following crystal-controlled speeds:
 - a. 50, 75, 110, 135, 150, 300, 600, 1,200, 1,800, 2,000, and 2,400 baud.
 - b. 50 kilobits and less with a modem-supplied clock.
 - 3.5 **External timing.** Operation from an external timing input shall be provided.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 6W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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Configuration A: TSEMA-F
 Configuration B: TSENA-F

TESTER, BIT ERROR RATE, TELECOM

1. **GENERAL.** This procurement requires a bit error rate tester for digital communications capable of IEEE STD 488.1-1987 digital bus control.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. The convertible/rackmountable requirement is invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall have the capability of detecting serial data errors on data transmissions having rates up to 12.928 Mbps. Configuration B equipment shall also be capable of T1 jitter testing. The equipment shall be capable of full duplex operation and shall meet the requirements specified below.
 - 3.1 **Bit error testing.**
 - 3.1.1 **Clock frequency.** 50 Hz to 12.928 MHz continuously selectable.
 - 3.1.1.1 **Clock stability and accuracy.** ± 5 ppm.
 - 3.1.2 **Synchronous rates.** 50 bps to 12.928 Mbps.
 - 3.1.3 **Asynchronous requirements.**
 - 3.1.3.1 **Rates.** 50 bps to 20 kbps.
 - 3.1.3.2 **Codes.** ASCII, BAUDOT.
 - 3.1.3.3 **Levels.** 5, 6, 7, and 8 bits.
 - 3.1.3.4 **Parity.** Even, odd, and none.
 - 3.1.3.5 **Stop bits.** Selectable 1 or 2.
 - 3.1.4 **Test results.** Bit errors, bit-error-rate, block errors, block-error-rate, errored seconds, error-free seconds, percent error-free seconds, availability, bipolar violations, excess zero detection.
 - 3.1.5 **Block size.** 100 bits to 1×10^6 bits.
 - 3.1.6 **Test period.** 1s to 24 hours with 1s resolution and continuous mode.
 - 3.1.7 **Test patterns and messages.** 63 bits to 2E20-1 bit pseudorandom. Selectable fixed patterns of all marks and 1:1 shall also be provided. Messages: Fox and one user-programmable message up to 256 characters.
 - 3.1.8 **Signal monitoring.** Monitor ports or other means shall be provided to monitor data and clock to and from the device under test.
 - 3.1.9 **Error insertion.** Single error.
 - 3.1.10 **Interfaces.**
 - 3.1.10.1 **MIL-STD-188-114.** The equipment shall be provided with balanced and unbalanced NRZ data interfaces conforming to MIL-STD-188-114. A 37-pin connector in accordance with EIA Standard RS-449 shall be provided. A 37-pin to 25-pin adapter shall also be provided in accordance with EIA Standard RS-449.

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3.1.10.2 **RS-232.** The equipment shall be provided with an NRZ data and printer interface conforming to EIA Standard RS-232.

3.1.10.3 **T1.** The Configuration B equipment shall be provided with a RZ data interface dedicated to testing 1.544 Mb/s data rates.

3.1.10.3.1 **Coding.** Binary Eight Zero Substitution (B8ZS) and Alternate Mark Inversion (AMI).

3.1.10.3.2 **Impedance.** Terminated or bridged.

3.1.10.4 **Remote control.** A digital interface in accordance with MIL-T-28800 shall be provided.

3.2 **Jitter testing.** The Configuration B equipment shall be capable of generating and testing phase jitter in accordance with MIL-STD-188-323.

3.3 **Rackmounting.** The equipment shall be contained in a Style E enclosure for portability and shall be provided with a conversion kit which will allow rackmounting in accordance with the convertible/rackmountable requirements of MIL-T-28800.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 110W.

5. **WEIGHT.** 20 kg (44 lb) maximum.

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TESAA-A

TESTER, ELECTRICAL SAFETY

1. **GENERAL.** This procurement requires an electrical safety tester designed to test for hazardous shock potentials of electrical equipment.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of testing electrical equipment for shock hazard conditions within the minimum specifications identified below. Tests shall include ground continuity, leakage current, short circuits, and insulation breakdown.
 - 3.1 **Ground continuity.** The equipment shall test ground conductor integrity at a minimum of 25A.
 - 3.2 **Leakage.** The equipment shall test leakage current on devices that have the ground connection opened.
 - 3.3 **Short circuits.** The equipment shall detect a short circuit in the equipment, power cord, and power switch.
 - 3.4 **Insulation breakdown.** Power cord insulation integrity shall be tested at a minimum potential of 0.5 kV at 20 mA or less.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 500W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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THCAA-A

TESTER, HIGH CURRENT

1. **GENERAL.** This procurement requires a high current test set designed to test overload relays, circuit breakers, trip devices, current transformers and panel board ammeters.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum specifications outlined below. The equipment shall be provided with a built-in digital ammeter and timer.
 - 3.1 **Current rating.** 750A minimum.
 - 3.2 **Voltage rating.** 120V minimum.
 - 3.3 **Ammeter.** 3-1/2 digits.
 - 3.3.1 **Range.** 0 to 750A.
 - 3.3.2 **Accuracy.** $\pm 1\%$ of reading ± 1 digit.
 - 3.3.3 **Memory.** The ammeter shall be provided with a memory to measure and hold maximum short duration current readings.
 - 3.4 **Timer.** The timer shall start when the output is energized and stop when the device-under-test actuates.
 - 3.4.1 **Range.** 0 to 1,000s.
 - 3.4.2 **Accuracy.** $\pm 0.005\%$ of reading ± 1 digit.
 - 3.5 **Accessories.** Timer control circuit leads and high current leads.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 1200W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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TS4NN-B

TESTER, RELAY, TELECOM

1. **GENERAL.** This procurement requires a relay test set capable of testing high speed polar relays of the type commonly used in teleprinter equipment.
2. **CLASSIFICATION.** Type III, Class 6, Style E, and Color R for Navy applications in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The test set shall be capable of measuring sensitivity, contact circuit bias, contact circuit break time, and insulation resistance (hipot).
 - 3.1 **Output signal.** 30 to 60 Vdc for oscilloscope viewing of contact performance.
 - 3.1.1 **Signal distortion.** The output signal shall not distort when connected to oscilloscopes having an input RC of 1 megohm or greater shunted by 100 pF or less.
 - 3.2 **Test socket.** Octal socket wired for Sigma Series 72 and Series 7 teleprinter relays.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 40W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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TE2NR-E

TEST SET, SEMICONDUCTOR

1. **GENERAL.** This procurement requires a solid-state test set that presents a voltage versus current display of electronic components under test.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of displaying on a CRT the electronic signature of discrete and integrated circuit semiconductor junctions, capacitance, inductance, and resistance in and out of circuit.
 - 3.1 **Display.** The equipment shall be provided with an integral CRT display. Controls for vertical and horizontal sweep position and brightness shall be provided.
 - 3.2 **Input channels.** The equipment shall be provided with channels A and B, and alternating A and B.
 - 3.3 **Test signal.** An internally generated transformer-coupled sine wave test signal shall be provided.
 - 3.3.1 **Frequencies.** Line frequency, 400 Hz and 2 kHz.
 - 3.4 **Gate signal generator.** The equipment shall be provided with a variable pulse/dc generator as detailed below.
 - 3.4.1 **Output level.** -5V to +5V.
 - 3.4.2 **Duty cycle.** 0% (dc) to 50%.
 - 3.4.3 **Current limit.** 50 mA maximum.
 - 3.4.4 **Synchronization.** The pulse signal shall be synchronized with the sine wave test signal.
 - 3.4.5 **Number of outputs.** 2.
 - 3.5 **Accessories.** Safety-designed test probes in accordance with MIL-T-28800 and other test leads necessary for comparison testing shall be provided.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 50 and 400 Hz is not required. Maximum power consumption: 20W.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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TE2NS-E

TEST SET, SEMICONDUCTOR

1. **GENERAL.** This procurement requires a solid-state test set that presents a voltage versus current display of electronic components under test.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of displaying on a CRT the electronic signature of discrete and integrated circuit semiconductor junctions, capacitance, inductance, and resistance in and out of circuit.
 - 3.1 **Display.** The equipment shall be provided with an integral CRT display. Controls for vertical and horizontal sweep position and brightness shall be provided.
 - 3.2 **Input channels.** The equipment shall be provided with channels A and B, and alternating A and B.
 - 3.3 **Test signal.** An internally generated transformer-coupled sine wave test signal shall be provided.
 - 3.3.1 **Frequencies.** Line frequency, 400 Hz and 2 kHz.
 - 3.4 **Gate signal generator.** The equipment shall be provided with a variable pulse/dc generator as detailed below.
 - 3.4.1 **Output level.** -5V to +5V.
 - 3.4.2 **Duty cycle.** 0% (dc) to 50%.
 - 3.4.3 **Current limit.** 50 mA maximum.
 - 3.4.4 **Synchronization.** The pulse signal shall be synchronized with the sine wave test signal.
 - 3.4.5 **Number of outputs.** 2.
 - 3.5 **Comparator.** The equipment shall be capable of alternately presenting voltage versus current displays of two integrated circuits as specified below.
 - 3.5.1 **Comparison modes.** The equipment shall allow for manual and automatic comparison at a rate variable from once per second or less to at least eight times per second.
 - 3.5.2 **Pin selection.** The equipment shall be capable of comparing integrated circuits that have 6 pins or less to at least 40 in dual in-line packages (DIPS). Each pin shall be operator selectable as a reference.
 - 3.6 **Accessories.** Safety-designed test probes in accordance with MIL-T-28800 and other test leads necessary for comparison testing shall be provided.
 - 3.6.1 **DIP clips.** The equipment shall be provided with 40-pin and 16-pin DIP clips for in-circuit testing of integrated circuits.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 50 and 400 Hz is not required. Maximum power consumption: 20W.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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TSUAA-B

TESTER, SURGE COMPARISON

1. **GENERAL.** This procurement requires a surge comparison tester capable of testing the windings of ac and dc motors and generators.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall test turn-to-turn, coil-to-coil, coil-to-ground, and phase-to-phase insulation. In addition, the equipment shall be provided with a dc high potential capability to at least 5 kV and shall be capable of testing three-phase devices.
 - 3.1 **Surge test.**
 - 3.1.1 **Output voltage.** Adjustable to 5 kV.
 - 3.1.2 **Current rating.** 0 to 30A.
 - 3.1.3 **Display.** 8 x 10 division oscillographic display for viewing comparison waveforms.
 - 3.2 **DC high potential test.**
 - 3.2.1 **Output voltage.** 5 kV minimum.
 - 3.2.2 **Maximum current.** 5 mA.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 120W.
5. **WEIGHT.** 20 kg (44 lb) maximum.

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TEVAA-A

TESTER, VOLTAGE

1. **GENERAL.** This procurement requires a prod-type voltage tester.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall indicate the presence of ac voltages within the minimum ranges and accuracies specified below.
 - 3.1 **Measurement range.** 24 to 600 Vac.
 - 3.2 **Frequency.** 25 to 60 Hz.
 - 3.3 **Indication.** Neon lamp. A nominal numeric indication of the voltage level shall also be provided.
 - 3.4 **Probes.** The equipment shall be provided with safety-designed test leads in accordance with MIL-T-28800.
4. **POWER SOURCE.** The nominal power source requirements are not invoked. Power for the equipment shall be derived from the circuit under test.
5. **DIMENSIONS.** 203 mm (8 in) high, 102 mm (4 in) wide, and 39 mm (1.5 in) deep, maximum.
6. **WEIGHT.** 0.45 kg (1 lb) maximum.

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TRIAN-A

TRANSFORMER, AUTO

1. **GENERAL.** This procurement requires a single-phase autotransformer with meters for monitoring output voltage and current.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the minimum specifications listed below.
 - 3.1 Output voltage. 0 to 140V with over range capability.
 - 3.2 Rated continuous current output. 10A.
 - 3.3 Meter ranges (FS). Voltage: 150V. Current: 2A and 10A.
 - 3.3.1 Meter accuracy. $\pm 3\%$ FS.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 1.6 kW.
5. **WEIGHT.** 9 kg (20 lb) maximum.

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TR3YN-A

TRANSFORMER, ISOLATION

1. **GENERAL.** This procurement requires an isolation transformer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of operation within the following minimum specifications.
 - 3.1 **Turns ratio.** 1 to 1.
 - 3.1.1 **Ratio accuracy.** 0.005% at 400 Hz.
 - 3.2 **Frequency range.** 50 Hz to 5 kHz.
 - 3.3 **Input impedance.** 250 kilohms at 400 Hz.
 - 3.4 **Maximum input voltage.** $0.35f$ where f is frequency in Hz.
4. **POWER SOURCE.** The power source requirements are not invoked.
5. **WEIGHT.** 8 kg (3.6 lb) maximum.

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TR4JN-B

TRANSFORMER, RATIO

1. **GENERAL.** This procurement requires a precision series-decade type ratio transformer.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications. Power source requirements are not invoked.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of voltage divisions for sinusoidal waveforms within the specifications set forth below.
 - 3.1 **Frequency range.** 30 Hz to 1 kHz.
 - 3.2 **Ratio range.** -0.111111 to 1.111111.
 - 3.3 **Ratio accuracy.** 1 ppm + (0.5 ppm/ratio).
 - 3.4 **Range overlap.** 10% minimum.
 - 3.5 **Terminal linearity.** 1 ppm maximum. The terminal linearity is defined as the series impedance of the equipment versus the indicated ratio as the ratio is varied over its entire range.
 - 3.6 **Output impedance.** 5 ohms shunted by 350 μ H.
 - 3.7 **Maximum input.** (2.5 x frequency in Hz) V_{rms} or 350V maximum.
4. **WEIGHT.** 20 kg (44 lb) maximum.

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APPENDIX D

VOLJG-F

VOLTMETER, ANALOG, ELECTRONIC

1. **GENERAL.** This procurement requires a solid-state, average responding, rms indicating, analog ac voltmeter.
2. **CLASSIFICATION.** Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of measuring ac voltages within the minimum ranges, accuracies, and sensitivities specified below. The meter shall respond to the average value of the input signal and shall be calibrated in rms volts and decibels.
 - 3.1 **Frequency range.** 10 Hz to 2 MHz.
 - 3.2 **Voltage measurement.** Range: 1 mV to 300V full scale. Resolution: 1% of full scale.
 - 3.2.1 **Voltage measurement accuracy.** $\pm 2\%$ of indication.
 - 3.3 **Decibel measurement.** Range: -70 dBm to 52 dBm. Resolution: 0.1 dB. 0 dBm - 1mW referenced to 600 ohms.
 - 3.3.1 **Decibel measurement accuracy.** ± 0.2 dB of indication.
 - 3.4 **Input.** The equipment shall be provided with a three-terminal, banana-jack input on 19.05 mm (3/4 in) centers. The equipment shall be capable of input isolation of at least ± 500 V (dc + peak ac) above ground.
 - 3.4.1 **Input RC.** 2 megohms shunted by 60 pF, nominal.
 - 3.4.2 **Maximum input.** 300 Vdc and 500 Vrms (not additive) on any range.
 - 3.5 **Indicator.** A meter shall be provided with a taut-band movement having mirrored, linear dB and logarithmic voltage scales. A digital voltage and dB indicator with equivalent resolution capabilities along with an analog indicator designed for peaking and nulling is acceptable for this application.
4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.
 - 4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 10W.
 - 4.2 **DC internal power source.** Internal batteries and charger are required. Minimum operating time shall be 8 hours following a maximum recharge time of 16 hours.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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APPENDIX D

VOIQN-C

VOLTMETER, ANALOG, ELECTRONIC

1. **GENERAL.** This procurement requires a solid-state, true rms analog ac voltmeter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of measuring ac voltages within the minimum ranges, accuracies, and sensitivities specified below. The meter shall respond to and indicate the true rms value of the input signal in volts and decibels.
 - 3.1 **Frequency range.** 10 Hz to 10 MHz.
 - 3.2 **Voltage measurement.** Range: 2 mV to 300V full scale in multiple ranges with a resolution of 10 uV on the most sensitive range.
 - 3.2.1 **Voltage measurement accuracy.** $\pm 2\%$ of indication at 200 kHz and no worse than $\pm 5\%$ throughout the specified frequency range.
 - 3.3 **Decibel measurement.** Range: -70 to +52 dBm in 10 dB steps with a resolution of 0.1 dB. Zero decibels shall equal 1 mW referenced to 600 ohms.
 - 3.3.1 **Decibel measurement accuracy.** ± 0.2 dB of indication at 200 kHz and no worse than ± 0.5 dB throughout the specified frequency range.
 - 3.4 **Crest factor.** 6:1 at full scale.
 - 3.5 **Input RC.** 1 megohm minimum shunted by 40 pF or less.
 - 3.6 **Maximum input.** 500 Vdc or 350 Vrms on any range.
 - 3.7 **Indicator.** A meter shall be provided with a taut-band movement having mirrored, linear dB and logarithmic voltage scales. A digital voltage and dB indicator with equivalent resolution capabilities along with an analog indicator designed for peaking and nulling is acceptable for this application.
 - 3.8 **Input connector.** BNC(f).
 - 3.9 **Output.** The equipment shall be provided with a dc output proportional to the meter voltage indication.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 10W.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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APPENDIX D

VO1CF-D

VOLTMETER, ANALOG, ELECTRONIC

1. **GENERAL.** This procurement requires a portable, solid-state analog rms voltmeter.
2. **CLASSIFICATION.** Type III, Class 3, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of measuring rms voltage within the minimum specifications and accuracies specified below. The meter shall respond to the average value of the input signal and shall be calibrated in rms volts and decibels.
 - 3.1 **Frequency range.** 20 Hz to 4 MHz.
 - 3.2 **Voltage range.** 0.1 mV to 1 kV full scale.
 - 3.2.1 **Voltage accuracy.** $\pm 2\%$ of indication.
 - 3.3 **Decibel measurement.** Range: -80 to +60 dB where 0 dB equals 1V.
 - 3.4 **Input RC.** 10 megohms shunted by 30 pF, nominal.
 - 3.5 **Maximum input.** 300 Vdc or 1 kVrms.
 - 3.6 **Floating input.** The signal ground must be isolated to at least ± 300 Vdc + peak ac from chassis ground.
 - 3.7 **Output amplifier.** An output proportional to the meter voltage indication shall be provided.
 - 3.7.1 **Output level.** 1 Vrms, open circuit, for full-scale meter deflection (0.5 Vrms into 600 ohms).
 - 3.7.2 **Output impedance.** 600 ohms.
 - 3.8 **Filter.** 100 kHz low-pass, switchable.
 - 3.9 **Noise.** The noise referred to input when terminated with 1 kilohm shall not exceed 5 uV with low-pass filtering and 30 uV without filtering.
 - 3.10 **Meter.** The meter shall have a taut-band movement and mirror-backed scales. The uppermost scale shall be linear dB with 0 dB equalling 1 Vrms. A logarithmic rms volts scale shall be provided. A digital indicating meter is not acceptable for this application.
4. **POWER SOURCE.** MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.
 - 4.1 **Nominal power source.** Operation at 400 Hz is not required. Maximum power consumption: 5W.
 - 4.2 **DC internal power source:** Internal batteries and charger are required. Minimum operating time shall be 8 hours following a maximum recharge time of 16 hours. A front-panel battery state indicator is required.
5. **WEIGHT.** 10 kg (22 lb) maximum.

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APPENDIX D

VOLWN-C

VOLTMETER, ANALOG, ELECTRONIC

1. **GENERAL.** This procurement requires a portable, solid-state, true rms, RF millivoltmeter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring RF signal levels within the minimum ranges and accuracies specified below.
 - 3.1 **Voltage and power measurement.** The equipment shall be capable of measuring RF signals from 100 μ V to 3V and power measurements from -60 to +23 dBm. Ranges above 30 mV may be provided via the use of a 100:1 voltage divider.
 - 3.1.1 **Frequency.** Range: 10 kHz to 1.2 GHz.
 - 3.1.2 **Accuracy.** $\pm 1\%$ of full scale plus the accuracy of indication specified in table I.

TABLE I. Accuracy.

<u>Frequency Range</u>	<u>Accuracy of Indication</u>
10 kHz to 100 MHz	$\pm 1.5\%$
100 MHz to 1 GHz	$\pm 6.5\%$
1 GHz to 1.2 GHz	$\pm 11.5\%$

- 3.2 **VSWR.** 1.2:1 maximum.
- 3.3 **Crest factor.** The equipment shall be capable of measuring voltages with crest factors (low to full scale) of at least 12 to 4 on each range except for 30 mV and 3V ranges which shall allow measurements of voltages with crest factors of at least 7 to 1.4.
- 3.4 **Maximum input without damage.** 10 Vac or ± 100 Vdc on all ranges.
- 3.5 **Zero control.** The equipment shall be provided with automatic or manual zero control.
- 3.6 **Meter display.** The equipment shall be provided with a taut-band movement type meter with a knife edge pointer and a mirror-backed scale. The meter shall be provided with two linear scales, typically 0 to 10 and 0 to 3 and one logarithmic scale of -10 to +3 dBm.
4. **ACCESSORIES.** The following accessories shall be provided with the equipment:
 - a. Unterminated BNC adapter.
 - b. 100:1 voltage divider.
 - c. 50 ohm BNC adapter.
 - d. RF probe.
 - e. Removable probe tip.
 - f. Type N tee.
 - g. Type N 50 ohm termination.
 - h. Accessory case.
5. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 8W.

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6. WEIGHT. 10 kg (22 lb) maximum.

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VO2JN-D

VOLTMETER, DIFFERENTIAL

1. **GENERAL.** This procurement requires a solid-state differential and conventional voltmeter capable of measuring ac and dc voltages.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R for Navy applications in accordance with MIL-T-28800 for shipboard applications. The relative humidity requirement is limited to 70% above 25°C and 80% below 25°C.

3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of measuring ac and dc voltages in differential and conventional voltmeter modes within the ranges, accuracies, and sensitivities specified below. The equipment shall be average responding with an rms indication of ac signals.

3.1 **Differential voltmeter mode.** Ranges: AC - 1 mV to 1,100V. DC - 10 μ V to 1,100V.

3.1.1 **Null ranges.** See table I.

TABLE I. Null Ranges

<u>Input Ranges</u>	<u>Null Ranges</u>
1V	0.001, 0.01, 0.1V
10V	0.001*, 0.01, 0.1, 1V
100V	0.01*, 0.1, 1, 10V
1,000V	0.1*, 1, 10, 100V
* dc null range only	

3.1.2 **Resolution.** 10 μ V or 10 ppm of range.

3.1.3 **Differential mode frequency range.** 5 Hz to 100 kHz. From 5 Hz to 20 kHz, the voltmeter shall measure voltages of 0.001 to 1,100 Vrms. From 20 kHz to 100 kHz, the measurement range shall be 0.001 to 110 Vrms.

3.1.4 **Differential mode ac accuracy.** See table II.

TABLE II. AC Accuracy (10 to 40°C)

<u>Frequency Range</u>	<u>VAC Limits</u>	<u>AC Accuracy (% of Input)</u>
5 Hz to 10 Hz	0.001 to 1,100	$\pm(1\% + 250 \mu\text{V})$
10 Hz to 20 Hz	0.001 to 1,100	$\pm(0.5\% + 100 \mu\text{V})$
20 Hz to 50 Hz	0.001 to 1,100	$\pm(0.15\% + 25 \mu\text{V})$
50 Hz to 20 kHz	0.001 to 110	$\pm(0.1\% + 25 \mu\text{V})$
50 Hz to 20 kHz	110 to 1,100	$\pm 0.15\%$
20 kHz to 50 kHz	0.001 to 110	$\pm(0.15\% + 25 \mu\text{V})$
50 kHz to 100 kHz	0.1 to 110	$\pm 0.5\%$

Note: Additional ac voltage inaccuracy due to temperature coefficient shall not exceed $\pm 0.004\%/^{\circ}\text{C}$ over the temperature ranges of 0°C to 10°C and 40°C to 50°C.

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3.1.5 Differential mode dc accuracy. $\pm(0.02\%$ of input + 0.001% of range + 10 uV) from 10°C to 40°C. Additional dc voltage inaccuracy due to temperature coefficient shall not exceed $\pm 0.0015\%/^{\circ}\text{C}$ over the temperature ranges of 0°C to 10°C and 40°C to 50°C.

3.1.6 DC differential mode stability. The drift of the indicated voltage with respect to the measured input reference value shall not exceed the limits specified in table III.

TABLE III. DC Differential Mode Stability

<u>Any Period of:</u>	<u>PPM of Input</u>
60 minutes	10
24 hours	20
30 days	40
1 year	90

3.1.7 Differential mode input RC and resistance. The ac input RC shall be at least 1 megohm shunted by less than 20 pF on all ranges. The dc input resistance at null shall exceed 100 megohms.

3.2 Conventional voltmeter mode. Range: AC - 1 mV to 1,100V. DC - 10 uV to 1,100V.

3.2.1 Conventional mode frequency range. 5 Hz to 100 kHz. From 5 Hz to 20 kHz, the voltmeter shall measure voltages of 0.1 to 1,100 Vrms. From 20 to 100 kHz, the voltmeter shall measure voltages of 0.1 to 100 Vrms.

3.2.2 Conventional mode accuracy. $\pm 3\%$ of full scale.

3.2.3 Conventional input RC and resistance. The ac input RC shall be no less than 1 megohm shunted by no more than 20 pF on all ranges. The dc input resistance shall be at least 100 megohms on the 0.1, 1, 10, 100, and 1,000V ranges and at least 10 megohms on the 0.001 and 0.1V ranges.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 10W.

5. WEIGHT. 10 kg (20 lb) maximum.

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APPENDIX D

VO2CF-B

VOLTMETER, DIFFERENTIAL

1. **GENERAL.** This procurement requires a solid-state differential and conventional voltmeter capable of measuring dc voltages.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **MEASUREMENT REQUIREMENTS.** The equipment shall be capable of measuring dc voltages in differential and conventional voltmeter modes within the minimum ranges, accuracies, and sensitivities specified below.

3.1 Differential voltmeter mode. Range: 10 μ V to 1,100V.

3.1.1 Null ranges. See table I.

TABLE I. Null Ranges

<u>Input Ranges</u>	<u>Null Ranges</u>
1V	0.0001, 0.001, 0.01, 0.1V
10V	0.0001, 0.001, 0.01, 0.1, 1V
100V	0.001, 0.01, 0.1, 1, 10V
1,000V	0.01, 0.1, 1, 10, 100V

3.1.2 Resolution. 1 μ V or 0.1 ppm of range, whichever is greater.

3.1.3 Differential mode dc accuracy. $\pm(0.005\%$ of input + 5 μ V) over the temperature range of 13°C to 33°C. Additional dc voltage inaccuracy due to temperature coefficient shall not exceed $\pm 0.00035\%/^{\circ}$ C over the temperature ranges of 0°C to 13°C and 33°C to 50°C.

3.1.4 DC differential mode stability. The drift of the indicated voltage with respect to the measured input reference value shall not exceed the limits specified in table II.

TABLE II. DC Differential Mode Stability

<u>Period</u>	<u>PPM of Input</u>
60 minutes	5
24 hours	8
60 days	13

3.1.5 Differential mode input resistance. The dc input resistance at null shall exceed 100 megohms.

3.2 Conventional voltmeter mode. Range: 10 μ V to 1,100V.

3.2.1 Conventional mode accuracy. $\pm 3\%$ of full scale.

3.2.2 Conventional mode input resistance. The dc input resistance shall be at least 100 megohms on the 0.1, 1, 10, 100, and 1,000V ranges, 10 megohms on the 0.01V range, and 1 megohm on the 0.001 and 0.0001V ranges.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 15W.

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5. WEIGHT. 10 kg (22 lb) maximum.

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VO2QN-D

VOLTMETER, DIFFERENTIAL

1. **GENERAL.** This procurement requires a solid-state, true rms ac differential and conventional voltmeter.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of true rms voltage measurement as a differential and conventional voltmeter within the minimum ranges and specifications detailed below.

3.1 **Differential mode.**

3.1.1 **Voltage range.** 0 to 1,100 volts in multiple ranges.

3.1.2 **Frequency range.** 5 Hz to 1 MHz.

3.1.3 **Accuracy.**

TABLE I. Differential Voltage Accuracy

<u>Frequency</u>	<u>Range</u>	<u>Accuracy (% of input)</u>
5 to 30 Hz	0.01V to 1,100V	±0.2%
30 Hz to 50 kHz (midband)	0.01V to 500V	±(0.05% + 0.005% of range)
30 Hz to 50 kHz	500V to 1,100V	±0.1%
20 to 50 kHz	500V to 1,100V	±0.15%
50 to 100 kHz	0.01V to 1,100V	±0.2%
100 to 200 kHz	0.01V to 1,100V	±0.5%
200 to 500 kHz	0.01V to 1,100V	±1.0%
500 kHz to 1 MHz	0.01V to 1,100V	±3.0%

3.1.4 **Crest factor.** The equipment shall respond to signals with crest factors up to 10:1.

3.1.5 **Null ranges.** The equipment shall be provided with null ranges as listed in table II, which are expressed as end scale percentage deviation from the dialed voltage.

TABLE II. Differential Null Ranges

<u>Range</u>	<u>Value of Each Scale Division</u>
10.1%	0.2%
3.0%	0.1%
1.0%	0.02%
0.3%	0.01%
0.1%	0.002%

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3.1.6 Accuracy temperature coefficient.

TABLE III. Temperature Coefficient

<u>Frequency</u>	<u>Temperature Coefficient (/°C)</u>
50 to 30 Hz	±0.025%
30 Hz to 30 kHz	±0.0025%
30 to 50 kHz	±0.004%
50 to 200 kHz	±0.01%
200 kHz to 1 MHz	±0.03%

3.2 Conventional mode.

3.2.1 Voltage range. 0 to 1,100 volts in multiple ranges.

3.2.2 Frequency range. 5 Hz to 2 MHz.

3.2.3 Accuracy. 10 Hz to 500 kHz: ±3% full scale. 5 Hz to 10 Hz and 500 kHz to 2 MHz: ±8% full scale.

3.2.4 Crest factor. 10:1 at full scale increasing to 30:1 at 1/3 scale.

3.3 Input.

3.3.1 Input RC. 1 megohm, minimum, shunted by less than 8 pF.

3.3.2 Overload protection. 1,500V peak, 1,000 Vrms, or a volts-hertz product of 1×10^8 , whichever is less, applied continuously within any range.

3.4 Controls and displays.

3.4.1 Readout display. The equipment shall have a front panel deviation meter and a five-digit readout with automatic decimal point location.

3.4.2 Controls. The equipment shall be provided with power source, range, and mode selectors.

3.5 Short term stability. The short term stability of the equipment shall be better than 0.005% per hour and 0.02% per day.

4. POWER SOURCE. MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.

4.1 Nominal power source. Operation at 400 Hz is not required. Maximum power consumption: 25W.

4.2 DC internal power source: Internal batteries and charger are required. Minimum operating time shall be 20 hours following a maximum recharge time of 16 hours.

4.3 Power selection: The equipment shall be provided with a means for manual selection of the following power modes of operation: battery charging during line operation, line operate, off, battery check, and battery operate.

5. WEIGHT. 10 kg (22 lb) maximum.

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APPENDIX D

V06NP-B

VOLTMETER, FREQUENCY SELECTIVE

1. **GENERAL.** This procurement requires a frequency selective voltmeter for telecommunications measurements.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of performing spectral analysis within the specifications identified below.

3.1 Frequency specifications.

3.1.1 Frequency range. 15 Hz to 50 kHz.

3.1.2 Frequency display resolution. 1 Hz or less.

3.1.3 Frequency accuracy. ± 3.5 Hz.

3.1.4 Stability. The frequency stability shall be within ± 10 Hz per hour after a warm-up time of not more than one hour.

3.1.5 Automatic frequency control. The equipment shall be provided with automatic frequency control. Hold-in range shall be at least ± 800 Hz. An indication of an unlocked condition shall be provided.

3.2 Amplitude specifications.

3.2.1 Amplitude range. 100 nV to 30 Vrms.

3.2.2 Amplitude display. Digital or mirror-backed analog meter.

3.2.3 Amplitude accuracy. Log: ± 2 dB, Linear: $\pm 4\%$.

3.2.4 Dynamic range. 80 dB minimum.

3.2.5 Noise sidebands. 70 dB down 10 bandwidths away from the CW input signal.

3.2.6 Calibrator. An internal calibrator capable of verifying the amplitude accuracy to at least $\pm 1.5\%$ shall be provided.

3.3 Sweep specifications.

3.3.1 Resolution bandwidth. Selectable from 3 Hz to 300 Hz.

3.3.2 Scan width. Selectable from 50 Hz to 50 kHz.

3.3.3 Sweep time. Selectable from 0.1s to 2,000s.

3.3.4 Sweep modes. Repetitive, single scan, manual.

3.3.5 Sweep error light. A sweep error light shall be provided which indicates that a sweep rate is too fast to capture the full response.

3.4 Input specifications.

3.4.1 Unbalanced input RC. 1 megohm or greater shunted by 40 pF or less.

3.4.2 Balanced bridged impedance. 10 kilohms nominal.

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3.4.3 **Balanced terminated impedance.** Selectable between 600 ohms or 900 ohms nominal.

3.4.4 **Maximum input.**

a. ± 100 Vdc or Vrms on the 0.2V and higher ranges.

b. ± 50 Vdc or Vrms on the 0.1V and lower ranges.

3.4.5 **Input connector.** The equipment input connector shall mate with a WECO 310 plug.

3.5 **Outputs.** Tracking generator and X-Y recorder with pen lift control outputs shall be provided.

4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 12W.

5. **WEIGHT.** 20 kg (44 lb) maximum.

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V06NM-A

VOLTMETER, FREQUENCY SELECTIVE

1. **GENERAL.** This procurement requires a frequency-selective voltmeter with a high impedance probe.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT CAPABILITY.** The equipment shall be provided with signal level measuring capability within the minimum ranges, bandwidths, and accuracies specified below.
 - 3.1 **Frequency range.** 50 Hz to 30 MHz with 50 and 75 ohm unbalanced inputs and 100 Hz to 108 kHz with a 600 ohm balanced input.
 - 3.1.1 **Tuning.** Frequency tuning shall be accomplished by entering the frequency directly on the equipment keyboard or by coarse and fine manual controls.
 - 3.1.2 **Frequency accuracy.** $\pm 1 \text{ Hz} \times 10E-5$ per year).
 - 3.1.3 **Frequency display resolution.** 1 Hz or less.
 - 3.1.4 **Bandwidths.** Three selectable bandwidths, typically 20 Hz, 400 Hz, and 3.1 kHz shall be provided. The bandwidth rejection limits shall be as specified in table I.

TABLE I. Bandwidth Rejection Limits

<u>3 dB Rejection</u>	<u>60 dB Rejection</u>
20 Hz ± 2 Hz	20 Hz ± 90 Hz
400 Hz ± 40 Hz	400 Hz ± 1.1 kHz
3.1 kHz ± 310 Hz	3.1 kHz ± 1.85 kHz

- 3.2 **Amplitude.**
 - 3.2.1 **Amplitude measurement range.** +20 dBm to -120 dBm.
 - 3.2.2 **Amplitude display resolution.** 0.01 dBm or less.
 - 3.2.3 **Level accuracy.** ± 1 dB for selective measurements, ± 2 dB for wideband measurements.
- 3.3 **Spurious responses.**
 - 3.3.1 **Image rejection.** 80 dBc or more between 100 MHz and 132 MHz.
 - 3.3.2 **IF rejection.** 80 dBc or more below 60 kHz and 60 dBc or more above 60 kHz.
 - 3.3.3 **Harmonic distortion.** 75 dB below full scale in the low distortion mode of operation above 4 kHz.
 - 3.3.4 **Intermodulation distortion.** 78 dB below full scale over the offset range of 7 kHz to 1 MHz, with both tones less than 10 MHz.

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3.4 Demodulated audio output. A demodulated audio output shall be provided with an output level of 0 dBm when terminated into a 600 ohm load.

3.5 Input impedance. Operator selectable 50 and 75 ohms using BNC connectors and 600 ohms using 3 banana jacks (high, low, and ground).

3.5.1 Unbalanced input impedance.

- a. 50 ohms $\pm 7\%$.
- b. 75 ohms $\pm 7\%$.

3.5.2 Balanced input impedance. 600 ohms $\pm 12\%$.

3.5.3 High impedance probe. The equipment shall be provided with a probe that has the following characteristics:

- a. Frequency response: 50 Hz to 30 MHz.
- b. Input RC: 10 Megohms or greater shunted by 10 pF or less.
- c. Attenuation ratios: 10:1 $\pm 5\%$, 100:1 $\pm 5\%$.
- d. Maximum input: 10:1 $\pm 300V$ (dc + peak ac), 100:1 $\pm 500V$ (dc + peak ac); dc component not to exceed 200V.

3.6 Tuning meter. An analog meter shall be included as part of the amplitude measurement display for tuning purposes.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 150W.

5. WEIGHT. 20 kg (44 lb) maximum.

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APPENDIX D

VO6NB-A

VOLTMETER, FREQUENCY SELECTIVE

1. **GENERAL.** This procurement requires a frequency selective voltmeter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **REQUIRED CHARACTERISTICS.** The equipment shall be capable of signal level measurements within the minimum ranges, accuracies, and selectivities specified below.
 - 3.1 **Selectivity.** Selectable narrow, wide, and flat bandwidths shall be provided.
 - a. **Narrow:** 80 Hz at -3 dB, less than 200 Hz at -60 dB.
 - b. **Wide:** 3.1 kHz at -3 dB, less than 6.3 kHz at -60 dB.
 - c. **Flat:** At least 1 kHz to 3 MHz.
 - 3.2 **Input system compatibility.** Selectable 50, 75, 135, and 600 ohm inputs shall be provided. The 50 and 75 ohm inputs may be configured for unbalanced operation only.
 - 3.3 **Input level.** -100 to 20 dBm when the narrow or wide mode is selected and -50 to 20 dBm when the flat mode is selected.
 - 3.3.1 **Input impedance.** For each compatible system, referenced to a frequency of 100 kHz, selectable terminating and minimum bridging input impedances shall be provided as listed in table I.

TABLE I. Input Impedance

<u>System</u>	<u>Terminating</u>	<u>Bridging (unbalanced)</u>	<u>Bridging (balanced)</u>
50	50 $\pm 1\%$	1.7k	NA
75	75 $\pm 1\%$	2.0k	NA
135	135 $\pm 1\%$	3.8k	3.8k
600	600 $\pm 1\%$	NA	4.5k

Note: All values are in ohms.

- 3.3.2 **Amplitude accuracy.** ± 0.5 dB.
- 3.4 **Frequency range.** 1 kHz to 3 MHz.
 - 3.4.1 **Frequency indicator.** An indicator that continuously displays the tuned frequency of the equipment shall be provided. Resolution: 100 Hz.
 - 3.4.2 **Frequency accuracy.** $\pm(100 \text{ Hz} + 1 \text{ count})$.
- 3.5 **Bridging loss.** The bridging loss for each system impedance within the frequency limits specified shall not exceed the values shown in table II.
- 3.6 **Spurious response.** Direct IF and image frequency rejection: 70 dB minimum.

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3.7 Indicators. The indicators shall include a digital frequency readout and a mirror-backed scale amplitude meter. A 3-1/2 digit digital readout with a supplemental analog peaking meter may be used for amplitude readout.

TABLE II. Bridging Loss

<u>System Impedance</u>	<u>Frequency Limits</u>	<u>Bridging Loss</u>
600 ohms	3 to 500 kHz	0.5 dB
	500 to 620 kHz	1.0 dB
135 ohms	10 kHz to 1 MHz	0.25 dB
	1 to 2.8 MHz	0.5 dB
	2.8 to 3 MHz	0.75 dB
50, 75 ohms	10 kHz to 3 MHz	0.25 dB

3.8 Calibrator. An internal source shall be provided for operator verification of equipment frequency and level measurement operation.

3.9 Audio output. An output for monitoring AM and upper and lower sideband audio shall be provided.

4. POWER SOURCE. MIL-T-28800 nominal and dc internal power source requirements are invoked as detailed below.

4.1 Nominal power source. Operation at 400 Hz is not required. Maximum power consumption: 40W.

4.2 DC internal power source: Internal batteries and charger are required. Minimum operating time shall be 4 hours following a maximum recharge time of 16 hours.

5. WEIGHT. 20 kg (44 lb) maximum.

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VO8FN-C

VOLTMETER, PHASE ANGLE

1. **GENERAL.** This procurement requires a general purpose, self-contained, phase-sensitive voltmeter.

2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.

3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring the true phase angle between two alternating voltages, the absolute fundamental amplitude, and the in-phase and quadrature phase amplitudes of alternating voltages. The equipment shall also function as a conventional voltmeter.

3.1 **Frequency ranges.** 380 to 420 Hz for measurement of phase angle, fundamental voltage, in-phase voltage, and quadrature voltage. 10 Hz to 100 kHz as a conventional voltmeter.

3.2 **Phase angle range.** 0° to 360°.

3.3 **Voltage ranges.** 0.3 mV to 300V full scale.

3.4 **Phase angle accuracy.** $\pm 1.0^\circ$.

3.5 **Voltage accuracy.** $\pm 2\%$ of full scale from 380 to 420 Hz. The accuracy of conventional voltage measurements shall be within those values specified in table I.

TABLE I. Voltage Accuracy

<u>Frequency Range</u>	<u>Accuracy (% of full scale)</u>
10 Hz to 20 Hz	± 5
20 Hz to 50 kHz	± 2
50 kHz to 100 kHz	± 5

3.6 **Input requirements.** The signal input channel shall be switchable for isolated (transformer coupled) or direct coupling.

3.6.1 **Reference input impedance.** 300 kilohms minimum at 400 Hz and 100 kilohms minimum below 400 Hz.

3.6.2 **Signal input impedance.** 300 kilohms at 400 Hz in the isolation transformer mode and 10 megohms minimum shunted by 75 pF in the direct mode.

3.6.3 **Reference input level.** 1.5 to 200 Vac 380 to 420 Hz.

3.6.4 **Signal input levels.** 0 to 300 Vac.

3.6.5 **Maximum signal input levels.** Direct mode: 300 Vac + 400 Vdc. Isolated mode: 1 Vdc + (300 Vac or 0.75 times the input frequency).

3.6.6 **Harmonic rejection.** Both the reference input channel and the signal input channel shall be provided with the following rejection of harmonics in the transformer-coupled mode:

- a. Phase-sensitive modes: 55 dB minimum from 380 to 420 Hz.
- b. Fundamental mode: 20 dB minimum from 380 to 420 Hz.

3.7 **Displays.**

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3.7.1 Phase angle display. Resolution: 0.2°.

3.7.2 Voltage display. Resolution: $\pm 0.2\%$ of full scale.

4. POWER SOURCE. MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 15W.

5. WEIGHT. 20 kg (44 lb) maximum.

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VO8MR-D

VOLTMETER, PHASE ANGLE

1. **GENERAL.** This procurement requires a general purpose, self-contained, wideband phase angle voltmeter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **OPERATIONAL REQUIREMENTS.** The equipment shall be capable of measuring the true phase angle between two alternating voltages, the absolute fundamental amplitude without the presence of reference voltage, and the in-phase and quadrature-phase amplitude of alternating voltage over the frequency range specified below. The equipment shall be capable of measuring the in-phase and quadrature nulls of the input signal, and shall have the capability of phase shifting the reference 360° . The equipment shall function as a conventional voltmeter measuring the total voltage over the specified frequency range.
 - 3.1 **Frequency range.** 50 Hz to 25 kHz.
 - 3.2 **Phase angle range.** 0° to 360° .
 - 3.3 **Voltage range.** 300 μ V to 300 Vrms full scale.
 - 3.4 **Signal channels.**
 - 3.4.1 **Reference channel.** The reference signal channel shall be isolated from the equipment chassis and the input signal channel. Reference signal range: 150 mVrms to 150 Vrms.
 - 3.4.2 **Input channel.** The signal channel shall be isolated from the equipment chassis and the reference signal channel. Input signal range: 1 mVrms to 300 Vrms.
 - 3.5 **Harmonic rejection.** 45 dB minimum.
 - 3.6 **Phase accuracy.** $\pm 0.5^\circ$ from 50 Hz to 17 kHz, $\pm 0.8^\circ$ from 17 kHz to 25 kHz.
 - 3.7 **Voltage accuracy.** $\pm 2\%$ of full scale.
 - 3.8 **Input RC.**
 - 3.8.1 **Reference channel.** 1 megohm or greater paralleled by 100 pF or less.
 - 3.8.2 **Signal channel.** 1 megohm or greater paralleled by 100 pF or less.
 - 3.9 **Nulling sensitivity.** 3 μ V or less for in-phase and quadrature modes.
 - 3.10 **Readout devices.**
 - 3.10.1 **Phase angle readout device.** The phase angle shall be displayed in degrees on either an analog meter, calibrated dial(s), or on an equivalent digital display. Resolution: 0.5° or better.
 - 3.10.2 **Voltage readout device.** The voltage shall be displayed on a zero-centered meter or an equivalent digital display. The space between zero and full scale on the most sensitive range shall have at least 30 equally spaced divisions. If a digital display is provided, polarity identification and an analog meter for use in nulling shall be provided. The null meter shall be at least equivalent to a panel meter having a scale length of 2 inches.
4. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 80W.

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5. **WEIGHT.** 20 kg (44 lb) maximum.

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VO4NN-A

VOLTMETER, VECTOR

1. **GENERAL.** This procurement requires a two-channel vector voltmeter.
2. **CLASSIFICATION.** Type III, Class 5, Style E, and Color R in accordance with MIL-T-28800 for shipboard applications.
3. **MEASUREMENT REQUIREMENTS.** The equipment shall measure voltage vectors by magnitude and phase within the minimum ranges, accuracies, and limits specified below.
 - 3.1 **Input characteristics.**
 - 3.1.1 **Frequency range.** 1 MHz to 1 GHz.
 - 3.1.2 **Isolation.** 80 dB minimum.
 - 3.1.3 **Input RC.** 0.1 megohm or greater shunted by 2.5 pF or less. It shall be possible to convert the input to a 50-ohm impedance without the use of adapters. The 50-ohm input connector shall be type N.
 - 3.1.4 **Voltage range.** The equipment shall be capable of measuring as a minimum the following voltages:
 - a. Channel A: 1.5 mV to 1 Vrms: 1 MHz to 10 MHz.
300 uV to 1 Vrms: 10 MHz to 500 MHz.
500 uV to 1 Vrms: 500 MHz to 1 GHz.
 - b. Channel B: 20 uV to 1 Vrms.
 - 3.1.5 **Maximum input.** AC: 2V peak. DC: $\pm 50V$.
 - 3.2 **Voltmeter characteristics.**
 - 3.2.1 **Voltmeter display.** A digital readout that displays rms voltage and dB shall be provided. An analog meter that has linear rms voltage and log dB scales is considered acceptable.
 - 3.2.2 **Voltmeter ranges.** Selectable from 100 uV to 1 Vrms in 10 dB steps.
 - 3.2.3 **Absolute voltage accuracy.**
 - a. $\pm 4\%$: 1 to 100 MHz.
 - b. $\pm 8\%$: 100 to 400 MHz.
 - c. $\pm 14\%$: 400 MHz to 1 GHz.
 - 3.2.4 **Voltage ratio accuracy.**
 - a. ± 0.2 dB for -60 to 0 dB ranges from 1 to 200 MHz.
 - b. ± 0.2 dB for -60 to -10 dB ranges from 200 MHz to 1 GHz.
 - c. ± 0.5 dB for -70 and +10 dB ranges from 1 to 200 MHz.
 - d. ± 0.5 dB for -70 and 0 dB ranges from 200 MHz to 1 GHz.
 - e. ± 1.5 dB for +10 dB range from 200 MHz to 1 GHz.
 - 3.2.5 **Residual noise.** The residual noise shall be 10 uV or less as indicated on the meter.

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3.2.6 3 dB bandwidth. 1 kHz or less.

3.3 Phasemeter characteristics.

3.3.1 Phase range. The zero-centered phase range meter shall provide end-scale ranges of $\pm 180^\circ$, $\pm 60^\circ$, $\pm 18^\circ$, and $\pm 6^\circ$. A digital phase indicator with a 3-1/2-digit display is considered acceptable.

3.3.2 Resolution. 0.2° or less.

3.3.3 Meter offset. $\pm 180^\circ$ in 10° steps.

3.3.4 Phase accuracy. $\pm 1.0^\circ$ at a single frequency with equal voltage at Channels A and B.

3.3.5 Phase accuracy versus voltage. Phase accuracy versus voltage shall be in accordance with table I.

TABLE I. Phase Accuracy Versus Voltage

ACCESSORY	PHASE ACCURACY	VOLTAGE RANGE CHANNEL A	VOLTAGE RANGE CHANNEL B	FREQUENCY MHz
50-ohm Type N	$\pm 3^\circ$	1.5 mV to 300 mV	100 μ V to 300 mV	1-10
	$\pm 3^\circ$	300 μ V to 300 mV	100 μ V to 300 mV	10-500
	$\pm 3^\circ$	500 μ V to 100 mV	100 μ V to 100 mV	500-1,000
10:1 Divider	$\pm 4^\circ$	1.5 mV to 3V	1 mV to 3V	1-10
	$\pm 4^\circ$	1 mV to 3V	1 mV to 3V	10-100
Isolator	$\pm 6^\circ$	1.5 mV to 300 mV	100 μ V to 300 mV	1-10
	$\pm 6^\circ$	300 μ V to 300 mV	100 μ V to 300 mV	10-200

Note: The phase accuracy is added to the specified single-frequency accuracy when the voltages at Channels A and B are not equal.

3.4 Recorder outputs. Recorder outputs for the voltmeter and phasemeter shall be provided.

4. REMOTE OPERATION. Digital interface in accordance with MIL-T-28800.

5. ACCESSORIES. The following accessories shall be furnished with the equipment:

- a. Two 50-ohm feedthrough tees.
- b. Two 10:1 dividers.

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- c. Two isolators.
 - d. Two BNC adapters.
 - e. Ground clips.
 - f. Replacement probe tips.
 - g. One 50-ohm power splitter.
 - h. Two 50-ohm terminations.
 - i. One type N(m) shorting plug.
6. **POWER SOURCE.** MIL-T-28800 nominal power source requirements are invoked. Operation at 400 Hz is not required. Maximum power consumption: 40W.
7. **WEIGHT.** 20 kg (44 lb) maximum.

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3. DOCUMENT TITLE GENERAL PURPOSE ELECTRONIC TEST EQUIPMENT			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
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