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MILITARY STANDARD

TEST REQUIREMENTS DOCUMENT, PREPARATION OF

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DEPARTMENT OF THE NAVY
NAVAL ELECTRONIC SYSTEMS COMMAND
WASHINGTON, DC 20360

Test Requirements Document,
Preperation Of

MIL-STD-1345B(NAVY)

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 anv pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Electronic Systems Command (ELEX-5043), Washinaton, DC 20360, by usinq the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

FOREWARD

1. Information about the technical characteristics of, and the measurement techniques applicable to, the prime equipment to attain and verify the specified equipment performance will be furnished by this standard for use by Naval activities. The purpose of this standard is to provide this information in a uniform or standardized manner.

2. The featured elements of the standard are:

a. Unit Under Test (UUT) requirements
b. Minimum test requirements data
c. Test requirements data documentation

3. Three appendices are included to substantially augment the instructions presented in the standard:

a. Appendix A standardizes minimum essential test requirements data to be presented on the standard form of the test requirements document.
b. Appendix B specifies documentation of test requirements which, when satisfied, will provide a standard data package.
c. Appendix C specifies the recommended of failure rate data on standard forms.

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1. SCOPE

1.1 Scope. This standard establishes the requirements for the preparation and acceptance of a Test Requirements Document (TRD) necessary for the specification, implementation, and maintenance of testing requirements for a system, subsystem, assemblv, subassemblv or Special Purpose Electronic Test Equipment (SPETE) herein referred to as the Unit Under Test (UUT). The standard identifies reference documents, establishes general and detailed requirements standardizing test requirements data and documentation, and detailed procedures for entering test requirements data on standard forms.

1.2 Applicability. The standard test requirements and data when documented constitute a TRD which specifies the tests and test conditions required to test and fault isolate a UUT. The data package shall be suitable for the follcwing:

a. Writing a test program or procedure
b. Determination of test equipment, tools, and test fixtures required to support a UUT at any level of maintenance
c. Development of abbreviated test language for all systems (ATLAS) specifications and procedures
d. Analysis of UUT readiness and maintenance requirements

The TRD provides the data needed to select or design the test equipment (manual or automated) to test the UUT, design the interface device (ID) to connect the UUT and the test equipment, and develop the procedures to test, align and fault isolate the UUT and the ID. When Automatic Test Equipment (ATE) is used, a portion of the procedures, such as, functional test and fault isolation, are in the form of a test program which automatically controls the ATE during execution of the tests. The UUT is usually a quick disconnectable, repairable item removed from the prime equipment system.

2. REFERENCED DOCUMENTS

2.1 Government documents. The following documents, of the issue listed in the Department of Defense Index of Specifications and Standards (DoDISS) and its supplements, form a part of this document to the extent specified herein. The date of the applicable DoDISS and supplements thereto shall be as specified in the solicitation.

SPECIFICATIONS

MILITARY

DoD-D-1000	Drawings, Engineering And Associated Lists
MIL-M-38784	Manual, Technical, General Style And Format Requirements

STANDARDS

MILITARY

MIL-STD-12	Abbreviations For Use On Drawings, Specifications, Standards And In Technical Documents
DoD-STD-100	Engineering Drawing Practices
MIL-STD-196	Joint Electronics Type Designation System
MIL-STD-280	Definitions Of Item Levels, Item Exchangeability, Models, And Related Terms
MIL-STD-1309	Definitions Of Terms For Test, Measurement And Diagnostic Equipment
MIL-STD-1364	Standard General Purpose Electronic Test Equipment
MIL-STD-1387	Procedures For Submission Of Application For Approval Of Non-Standard General Purpose Electronic Test Equipment

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

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

Y32.14-1973	Graphic Symbols For Logic Diagrams (Two-State Devices)

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

200-1975	Reference Designations For Electrical And Electronic Parts And Equipments
315-1975	Graphic Symbols For Electrical And Electronics Diagrams (Including Reference Designation Class Designation Letters)
416-1976	ATLAS Language Specification

(Application for copies should be addressed to the Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, NY 10017.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. DEFINITIONS

3.1 Definitions. The meaning of terms shall be in accordance with MIL-STD-280 and MIL-STD-1309 except for the terms defined herein.

3.1.1 Align and alignment procedures. UUT oriented step-by-step procedures required to adjust a circuit, equipment, or system so that their functions are properly synchronized or the relative positions are properly oriented. For example, trimmers, pads, or variable inductors in tuned circuits are adjusted to give a desired response for fixed tuned equipment or to provide tracking for tuneable equipment.

3.1.2 Fault location procedures. UUT oriented techniques used to locate a malfunction within a UUT. Techniques will be provided to locate faulty connections, maladjustment of controls, mistuning of tuned circuitry, and defective circuits (that is, voltage controlled oscillator (VCO), amplifier, microcircuit).

3.1.3 Test program. A sequence of instructions arranged in logical order which procedurally implement UUT test requirements. In most cases, these instructions take the form of a digital computer program stored on magnetic tape or disk and are intended for use on a specific automatic test equipment system. A test program may be test procedures written in the language (such as BASIC, MIRTEST, HPL, ADAPTED ATLAS) of and recorded on the MEDIA (such as paper tape, magnetic disc) of an ATE so as to cause the ATE to automatically test a particular UUT.

3.1.4 Test program set (TPS). A TPS is defined as test programs, interface devices operator initiated procedures, and supporting documentation (that is, test program (TP) source data, interface device (ID) schematics, parts lists, and drawings, and the information required to analyze and correct problems in the TPS) required to initiate and execute a given test program, and an interface device peculiar to the given test program which is required to provide a compatible electronic or mechanical interface between the unit being tested and the test system. A TPS contains items needed to test a particular UUT using a particular ATE. These items include a test adaptor, test program, and test instructions. The test adaptor connects the UUT to the ATE during the test program execution. The test adaptor may become a UUT when the adaptor is also tested. This test adaptor is an Interface Device (ID). The test instructions may explain and identify how to test and fault isolate the UUT using the test adapter or ID, the test program and the ATE. These test instructions should provide supplementary data needed to fault isolate, such as, fault look-up tables, fault dictionary, list of faults the test program cannot detect, part location drawings, schematics, and UUT parts list.

3.1.5 Test requirement. The stimulus, measurement, power, loads, and any special test equipment or procedure essential to validate proper operation of a device in accordance with some predetermined design control or product specification definition.

3.1.6 Test validation. A process in the production of a test program by which the correctness of the program is assured by running it on the automatic test equipment (ATE) together with the UUT. The validation process completely exercises the test program to identify program errors; for example, run time errors, procedure errors, and other errors or omissions inhibiting test program performance.

3.1.7 Test verification. A short, precise test to determine that a test program is error-free. A typical verification test is a GO/NO-GO test applied to a Known Good Board (KGB).

3.1.8 Unit. As defined in MIL-STD-1309.

4. GENERAL REQUIREMENTS

4.1 TRD. Test requirements developed in accordance with this standard shall describe each UUT and delineate diagnostic procedures to align, fault locate, and validate correct operation of each UUT, by presenting specific test requirements data on standard forms. This information when documented shall be constituted to form a data package entitled the TRD.

4.2 UUT description information and documentation. Each UUT shall be described in detail which clearly sets forth its form, fit, and function parameters. The descriptions shall supply minimum data requirements or measurement parameters (see Appendix A) and shall be documented using standard forms (see Appendix B).

4.3 UUT diagnostic test information and documentation. Diagnostic test procedures shall be developed to align, fault locate, and validate correct operation of each UUT. These procedures shall emphasize diagnostic test verification, fault isolation, and UUT alignment requirements. Information prescribed shall be documented using the specified standard forms (see Appendix B).

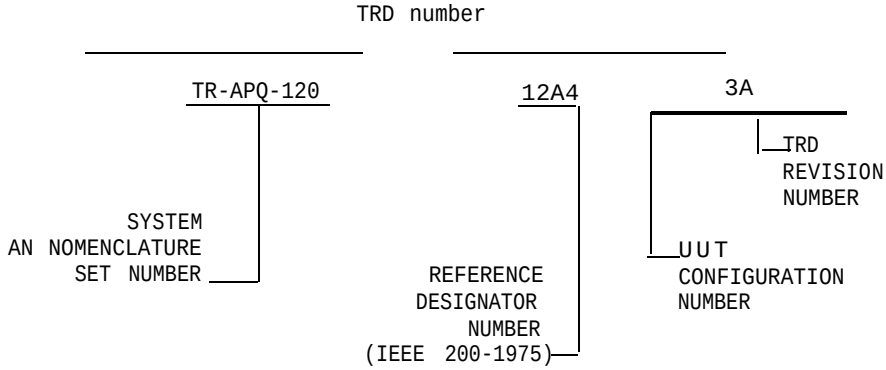
5. DETAILED REQUIREMENTS

5.1 Introduction. This standard establishes requirements necessary to:

a. Describe the form, fit, and function of the UUT (system, subsystem, assembly, and subassembly)
b. Delineate UUT diagnostic test procedures required to fault locate, align, and verify operation of the UUT
c. Assess compliance of the UUT against the UUT specification requirements for maintainability and testability

5.2 TRD identification and summary information. The contractor shall develop identification and summary information for each UUT.

5.2.1 TRD identification number. A TRD identification number shall be assigned to each UUT. This number shall consist of the prefix TR followed by the system AN nomenclature set number, which shall be in accordance with MIL-STD-196, the UUT reference designation number, and a number designating the UUT configuration (this number identifies the latest re-engineered configuration) and TRD revision. The reference designation number shall be in accordance with IEEE 200-1975. Where the TRD applies to more than one reference designator item or UUT, configurations of all UUTs supported shall be provided on the configuration-related data sheet. The following is an example of a TRD assignment:



Standard heading information consisting of the TRD number, and TRD revision number, along with the page number, total number of pages, and date of submittal shall be required for all forms specified herein.

5.2.2 TRD cover sheet. The UUT description section of the TRD shall be identified by a cover sheet of standard format. This sheet shall identify the UUT by name, nomenclature, and shall identify the name of the pertinent contractor, manufacturer, and preparer (see FIGURE 1, Appendix B).

5.2.3 Approval sheet. The approval sheet shall be used for recording the name, title, and organization of the person or persons approving the TRD (see FIGURE 2, Appendix B).

5.2.4 Revision summary sheet. The revision summary sheet shall be used for recording all revisions made to the TRD or its parts (see FIGURE 3, Appendix B). Each revision shall be identified by the following information:

a. Page number
b. Revision letter
c. Approved
d. Date
e. UUT configuration number
f. Engineering change proposal(s) (ECP)
g. Reason for change

5.2.5 UUT data summary sheet. The data summary sheet shall be used for listing all documents, referenced by figure number, contained in the TRD. These documents shall be cross--referenced to the UUT configuration and shall be identified by document number and revision date. The documents listed applicable to a particular TRD shall be identified by appropriate notation in the data applicability column. A column for explanatory remarks is also provided see (FIGURE 4, Appendix B).

5.3 Minimum data requirements. UUT test requirements shall include the minimum data requirements or measurement parameters specified in Appendix A. On occasion, these minimum requirements may require augmentation to satisfy unique test data requirements of particular UUTS.

5.4 UUT descriptive information. The contractor shall describe the equipment or system to be tested. This information shall be utilized to describe system and equipment UUTs and to verify UUT operation. The UUT description of the TRD shall be composed of the information contained in the following documentation:

a. Theory of operation sheet
b. Operating instructions sheet
c. UUT drawings information
d. UUT operational, safety, and power requirements sheet
e. UUT interface definition

5.4.1 Theory of operation sheet. The theory of operation of the UUT shall be described. The description shall include those timing diagrams, waveform drawings, and other engineering data needed to acquire a basic and detailed understanding of the operation of the UUT in its intended service environment. Follow-on sheets shall be used as necessary (see FIGURES 5 and 6, Appendix B).

5.4.2 Operating instructions sheet. Detailed operating instructions shall be prepared for UUTs whose performance is dependent upon operator interaction. Follow-on sheets shall be used as necessary (see FIGURES 7 and 8, Appendix B).

5.4.3 UUT drawings cover sheet. All drawings, schematics, diagrams, and parts lists supplied for the TRD shall be indexed by a UUT drawings cover sheet. The form shall identify the type document, revision number, date of revision, UUT configuration, and TRD page number (see FIGURE 9, Appendix B). UUT drawings shall be prepared in accordance with DoD-STD-1OO and DoD-D-1OOO and supplied as specified by the UUT specifications or by the governing procurement contract. Required type drawings shall include the following:

a. Outline drawings
b. Unit (main) drawings
c. Detail and subassembly drawings
d. Module and subassembly schematics
e. Specification control drawings
f. Connection wiring diagrams
g. Logic diagrams
h. Functional block diagrams
i. Parts list cross index
j. Family tree

5.4.3.1 Module and subassembly schematics. A schematic shall be provided for each module and subassembly showing the clrcuitry contained within each module and subassembly. Each schematic and logic diagram shall indicate level and frequency of each input and output signal, the reference designator for each part and test point, exact marking for each terminal on each part. Tracking of the reference designators is required among the drawings, schematics, and block diagrams. In addition, specifications are required to identify all integrated circuits (IC’s) or other microcircuits (MC). A sample subassembly schematic is shown in FIGURE 10, Appendix B.

5.4.3.2 Specification control drawings. Specification control drawings shall be provided for all nonstandard parts.

5.4.3.3 Connection and wiring diagrams. Wiring diagrams shall be provided to show the actual physical wiring arrangement. Wire running lists or tables, when specified, shall be used to supplement wiring diagrams. This requirement covers printed circuit layouts. Each layout shall be detailed sufficiently to locate each of its components, junctions, and terminals. Photographs of layouts are acceptable documentation if they show the detail required.

5.4.3.4 Logic diagrams. Detailed logic diagrams shall be in accordance with ANSI Y32.14-1973.

5.4.3.5 Functional block diagrams. Functional block diagrams shall be prepared for each UUT. The diagrams shall identify parameters and associated signal tolerances at the external and internal interfaces shown. FIGURE 11, Appendix B, presents a sample functional block diagram.

5.4.3.6 Parts list cross index. A parts list shall be provided which lists the component parts of each assembly or subassembly. The components shall be identified by the reference designator and manufacturer's part number used on the assembly or subassembly drawings. The parts shall be cross-referenced to the manufacturer's part number and code identification number.

5.4.3.7 Family tree. The UUT family tree shall be included as a part of the UUT source data package. It shall be submitted with the TRD. The family tree shall identify each functional module and subassembly. The family tree shall be utilized to enable proper part number and configuration accountability of all UUT subassemblies and modules requiring test requirement definition and test program analysis.

5.4.4 Operational and safety requirements. The contractor shall determine the operational and safety requirements of each UUT. These requirements shall be recorded on the form shown in FIGURE 12, Appendix B. Items with common requirements shall be added. Each requirement listed shall be identified by page number, drawing number, UUT configuration, and explanatory remarks, if necessary. As a part of this effort the contractor shall identify the following:

a. Required operating conditions. All conditions required for proper and safe operation shall be specified. These shall include cooling air, hydraulic pressure, or pneumatic pressure source requirements.
b. Safety requirements. Special precautions and instructions regarding personnel and equipment protection in the presence of high voltages, radio frequency (RF) radiation, and so forth, shall be identified.
c. Handling and maintenance requirements. The need for special handling and maintenance requirements shall be identified.

5.4.5 UUT power requirements. UUT power requirements shall be defined and recorded consistent with the format shown in FIGURE 13, Appendix B. All UUT power source requirements, including alternating current (AC) and direct current (DC), shall be specified. These requirements include voltages, tolerances, maximum load, frequency and tolerances, ground returns, and ripple limits on DC voltages. When three-phase power is required, the line-to-line voltage or line-to-neutral voltage shall be identified. Finally, maximum allowable line-to-line imbalance and percent distortion shall be specified.

5.4.6 UUT interface definition. The contractor shall identify the mechanical and electrical interface requirements of each UUT. FIGURE 14, Appendix B, sheets 1 and 2, shall be utilized to indicate the UUT mechanical and electrical interface requirements.

5.4.6.1 UUT connector identification (FIGURE 14, sheet 1). All UUT connectors shall be identified by connector reference designation and part number, and UUT manufacturer and manufacturer's part number such that all connectors and pin designations on both the schematics and drawings may be identified and correlated. The part number shall also be included for each corresponding mating connector.

5.4.6.2 Mounting, holding and support fixtures (FIGURE 14, sheet 1). Descriptive data shall be provided for all fixtures which are mandatory for proper operation of the UUT. These data shall include page number, drawinq number, UUT configuration, and manufacturer.

5.4.6.3 Pneumatic, hydraulic, and cooling fixtures (FIGURE 14, sheet 1). Descriptive data shall be provided for all fittings, fixtures, and adapters required to connect pneumatic, hydraulic, and cooling sources to the UUT. Dimensioned drawings shall be included when the data necessary to design fixtures are not readily available or apparent on outline and other drawings specified herein. Special materials required for fixtures (for example, nonmagnetic materials) shall be specified. Items shall be identified by page number, drawing number, UUT configuration, and manufacturer.

5,4.6.4 Electrical interface (FIGURE 14, sheet 2). Every pin of each connector of the UUT shall be listed. Data required for each pin shall lnclude the pin designation (for example, input, output, no connection, and so forth), signal name or mnemonic, and descriptive data sufficient to define each signal of the interface. Abbreviated lists may be used when appropriate (for example, large digital interfaces). Descriptive data shall indicate the following, as applicable:

a. Minimum wire size for mating connection
b. Maximum wire length for mating connection
c. Wire or coaxial type for mating connection
d. Shielding requirements for mating connection
e. Detailed definition of signal characteristics including tolerances
f. Grounding requirements for matinq connection
g. Separation of circuits for mating connection
h. Twisted pair of twisted multiples requirements for matinq connection
i. Impedance matching and load requirements including allowable voltage standing wave ratio (VSWR)
j. Other

Where interfaces differ due to a change in operational mode, the requirements shall be specified to identify specific functional interface requirements with each different mode.

5.5 UUT input/output (1/0) nodal information (screening). The contractor shall describe a) the required stimuli to the inputs to the UUT, b) the outputs of the UUT. c) the relationship between the inputs and outputs of the UUT (that is, timing, voltage gain), d) the input and output tolerances, e) the step-by-step procedures required to activate the UUT inputs and monitor the UUT outputs, and f) nodal information for subassemblies containing analog and digital circuitry indicating the input and output characteristics of electronic functions (that is, oscillators, amplifiers, mixers, filters, integrated circuits). The contractor shall utilize the figures specified in 5.5.1 through 5.5.4 in preparing I/O and nodal requirements for each UUT.

5.5.1 ATLAS test requirements versus UUT performance characteristics. The form (see FIGURE 15, Appendix B) shall be used to record nodal test requirements. Each analog test requirement shall be detailed on a separate sheet and be stated in English and ATLAS. ATLAS statements shall conform to IEEE 416-1976. The performance specification paraqraph that describes the function being covered by this requirement shall be referenced on this sheet. The ATLAS area at the bottom of the sheet shall also be used for digital requirements when required.

5.5.2 Manually generated digital test requirements. The form (see FIGURE 16, and 40.15, Appendix B) shall be used for the documentation of manually generated digital test requirements.

5.5.3 Automatic test program generation (ATPG) system information sheet. The contractor utilizing automatic test equipment to test and check-out UUT's shall provide the following:

a. Identification of the ATE type and the software development methods used in preparing test programs.
b. Copies of all the original "source listings" of the test sequence. These shall be in the original test language and include any macrosequences or subroutines.
c. Listings or "state tables" of the UUT responses to the test sequence.
d. Description of the test language defining the effect of each unique instruction.
e. Identification and description of any translators, assemblers, or post processors which may be used to derive the final test program.
f. Descriptions of UUT interface adaptors pursuant to paragraph 5.6.2.4.

Information shall be provided in the detail necessary to identify the ATPG system employed, its characteristics, key attributes, derivation, and source (see FIGURE 19, Appendix B). Additional information related to software features should include:

a. Simulation of UUT
b. Automatic generation of the test pattern
c. Analysis of the test pattern ability to initialize and to exercise the UUT.
d. Automatic simulation of various types of fault in the UUT.
e. Automatic analysis of the ability of the test patterns to detect and resolve the simulated faults.
f. Automatic translation of the test patterns into a test program in the language of a particular digital tester.
g. Automatic recording of the test program onto the input media of the digital tester.
h. Automatic development of the fault dictionary which is compatible with the fault signatures displayed by the digital tester.
i. Automatic development of transition counts compatible with the transition count capability of a particular digital tester. Provide a listing of the input data fed into the ATPG system to develop the test program, such as, UUT circuit description, initialization patterns, test patterns, I.C. models.

5.5.4 General UUT test constraints. Test constraints data shall be made a part of the TRD under the general UUT test constraints cover sheet. The general UUT test constraints cover sheet shall be used to identify and index general procedures and special precautions. General test constraints shall be developed with consideration for the effects or the potential effects of these constraints. Special precautions shall be specified to assure that proper data needed for initialization of conditions at the input or output terminals or at connections is identified to assure the testing readiness of the UUT. All general procedures and special precautions listed on this cover sheet are referenced by TRD page number (see FIGURE 20, Appendix B).

5.6 Diagnostic test procedures. The contractor shall develop diagnostic test procedures for each UUT. The diagnostic test procedures shall specify the step-by-step routines necessary to verify current performance of each UUT and to locate causes of malfunctions in each UUT.

5.6.1 Diagnostic test procedure applicability. The contractor shall develop diagnostic procedures in accordance with TABLE I.

TABLE I. Diagnostic test procedures.

UUT type	Diagnostic procedure required
System	Performance, alignment, fault location to next lower subsystem or assembly
Subsystem	Performance, alignment, fault location to next lower subsystem or assembly
Assembly	Performance, alignment, fault location to subassembly
Subassembly	Performance, alignment, fault location to integrated circuit (IC); electronic function (VCO), mixer, filter

5.6.2 Diagnostic procedure format. The contractor shall develop diagnostic procedure formats in accordance with FIGURES 16 and 19 through 29.

5.6.2.1 Detailed test requirements information. Each test to be conducted shall be detailed on a separate test requirements information sheet, continued when required on a continuation sheet, and detailed on a test requirements functional flow chart, test requirements diagnostic flow chart, and a UUT test diagram.

5.6.2.1.1 Detailed test requirements information sheets. Test stimuli and measurements shall be specified and ATLAS statements shall conform to IEEE 416-1976, ATLAS language specification. Continuation sheets shall be used when additional space is required to-specify essential information (see FIGURE 21A, Sheets 1 and 2, Appendix B).

5.6.2.1.2 Test requirements functional flow chart. Test requirements functions shall be presented in an end-to-end sequence. Functions of the sequence shall be identified in English language (see FIGURE 21B, Appendix B).

5.6.2.1.3 Test requirements diagnostic flow chart. Test procedure for a UUT shall be flow charted using ATLAS statements. The flow chart shall present all processes, variables, branches, parallel operations, exists and subroutines as they apply. Each block-shall correspond to related block on FIGURE 216 (see FIGURE 21C, Appendix B).

5.6.2.1.4 UUT test requirements test diagram. Test diagrams shall delineate each stimulus signal path by connector-pin through the circuit under test to the output pin. All existing test points in the signal path shall be called out. Multiple tests may be covered by a single test diagram provided the only change from one test to subsequent test is a change in the parameters of the stimuli signal and response signal, or both. The test diagram shall depict the sensitized information path through each circuit involved and its interaction with all ancillary stimulus signals present at the time of test (see FIGURE 21D, Appendix B).

5.6.2.2 Test set-up diagrams. The contractor shall prepare test set-up diagrams for each UUT test procedure. The test set-up diagram shall detail the interconnection of the UUT with the ID and the ID with testers to be employed. These diagrams shall define the point application for input and output connections and all points of measurement. All grounds, including those routinely connected, shall be shown. Requirements for the use of ungrounded test equipment shall be identified and safety procedures to prevent shock hazard shall be defined. Organization, layout, and symbols used shall be in accordance with DoD-D-1OOO and MIL-M-38784 (see FIGURES 22 and 23, Appendix B).

5.6.2.3 Test equipment and tool list. The contractor shall provide a recommended test equipment and support equipment list lncluding the prime equipment (UUTS) measured parameters. Ranges of parameters measured and tolerances shall be listed. The highest and lowest values and closest tolerance of each parameter shall be provided. The contractor shall identify general purpose electronic test equipment (GPETE) in accordance with MIL-STD-1364, nonstandard GPETE, or SPETE. The use of SPETE and nonstandard GPETE shall be justified in accordance with MIL-STD-1387 (see FIGURE 24, sheets 1 and 2, Appendix B). Sheet 1 shall be used for the test equipment list. Sheet 2 consists of a tool list where each test procedure shall identify the appropriate tools required to perform the tests.

5.6.2.4 Test fixture information. Data and documentation descriptive of test fixtures which are required to obtain measurement data shall be specified as follows:

a. Test fixture parts list. This list shall be composed of a complete parts list using commercially available manufacturer's part numbers. Contractor's internal part numbers are not acceptable for piece part listing unless the contractor is also the-manufacturer. A sample test fixture parts list is shown in FIGURE 25, Appendix B.
b. Test fixture schematic. The contractor shall prepare a schematic diagram which shall show the electrical connections and pin designations. This diagram shall facilitate tracing the circuit and its function (see FIGURE 26, Appendix B).
c. Test fixture drawings. The contractor shall prepare test fixture drawings which shall consist of pictorial diagrams including the panel layout and the construction drawings required to build the test fixture. Sample forms shall be as shown in FIGURES 27 through 29 of Appendix B.

5.6.2.5 Development of test requirements information. The following shall be utilized in the development of diagnostic test requirements information:

a. Initialization requirements, such as power sequence, warmup, initialization, conditioning, adjustments, and so forth, shall be specified for each UUT and for each applicable UUT test. UUT tests may relay on initialization by previous test set-ups, if desired. Test procedures which are time consuming should, whenever practical, permit independent operation of tests rather than predicate all tests on previous operations.
b. Diagnostic tests shall ignore extremely remote failure modes, for example, carbon resistors shorting. Failure modes considered shall include the following:

Component	Prime failure mode
Capacitors	Short or open
Resistors	Open
Transformers	Short or open
Coils (fixed and variable, including relay coils)	Short or open
Diodes	Short or open
Transistors	Short or open
Relays	Open contacts Shorted contacts
Integrated circuits or hybrid circuits	Any terminal at permanent logic 1 level or at permanent logic 0 level

c. A single fault or failure mode shall be assumed when a NO-GO is encountered.
d. Standard engineering terms, symbols (in accordance with IEEE 315-1975), abbreviations (in accordance with MIL-STD-12), and designations (in accordance with IEEE 200-1975) shall be used. Special cases not to be overlooked shall include the meaning of high and low out-of-tolerance conditions for a zero volt measurement and a negative volt measurement.
e. Stimuli that vary in discrete or incremental steps shall be specified in lieu of continuously variable stimuli if possible. The steps specified shall be as large as is consistent with the minimum test requirements.
f. The additon of external feedback loops to the UUT to simulate the environment in which the UUT normally operates shall be avoided and open loop tests made whenever possible. The external interconnection of elements on the UUT shall be avoided when these elements can be individually tested.
g. All test points specified on the detailed test requirement information sheet shall be identifiable on the UUT schematic.
h. If a test point and a connector pin are electrically common, the connector pin shall be identified.

i. Only the power and stimulus required to perform a test shall be applied during the test. If adherence to this requirement causes an active device on the UUT to be paretically powered or unnecessarily lengthens the test time due to warm-up requirements, it is permissible to add the power necessary to fully power the device.

j. Some characteristics of the UUT input signals may not be critical, that is, any value within a specified range may be used for test purposes. An allowable range shall be specified for these noncritical characteristics instead of a specific value. If an output characteristic is a function of an input characteristic for which a range is specified, then the relationship between the input and output characteristics shall be specified. An example of these requirements is the test of a linear amplifier. The input voltage amplitude is a noncritical characteristic and may be specified as O to 10 volts. The output voltage, because it is a function of the input voltage,
an amplification of 5+2 percent).

k. Complex output waveforms shall be avoided whenever possible. The complexity of an output waveform may frequently be reduced by the proper selection of the input signals and still permit adequate testing of the UUT. A number of simple waveform tests is preferable to one complex waveform test.

l. UUT loads shall be specified in terms of impedance required.

m. When a test requires stimuli with tolerances of less than one percent, the possibility of using a ratio (output to input) test shall be considered. If a ratio test is used, the additional information necessary to conduct a ratio test shall be specified in the supplemental data section.

n. Time or phase-dependent relationships, if applicable, shall be defined using diagrams as needed. If the exact value of an input or output is not known, a range shall be specified.

o. Individual test requirements such as loads and impedance-matching terminations shall include nominal values, power ratings, VSWR, and so forth. Complex loads shall be specified in standard engineering units.

p. All relevant characteristics of each waveform shall be included. Only the characteristic to be checked shall appear in the measured value data section of the detailed test requirement information sheet; all others, in the supplemental data section. Each waveform which cannot be specified by an ATLAS statement shall be specified in pictorial illustrations. Nonrepetitive waveforms shall be identified.

q. Tolerances for every prime characteristic shall be specified. The upper and lower tolerance limits shall be specified in the same units as the characteristic. Such terminology as less than or greater than shall be avoided when significant high or low limits can be specified. The expressions open circuit and short circuit may be used if defined.

r. The UUT output inpedance at the test point(s) with respect to the signal return(s) and the impedance seen by the UUT inputs shall be specified for all tests.

s. Any critical or unusual test requirement not self-evident elsewhere shall be defined. Such requirements may include susceptibility to noise or transients, time delays before making measurements, signal and power lead characteristics, and so forth.

t. All adjustments that may correct a NO-GO condition or optimize a critical parameter shall be defined.

u. The specification of AC voltages shall include a notation of root-mean-square (rms), peak, or peak-to-peak, and shall always include frequency. Percent distortion shall be included when significant.

v. Normally, pulsewidth measurements shall be specified at the 50 percent amplitude level. When deviation from this is required, the amplitude levels shall be specified.

w. Rise and fall times shall normally be specified between 10 percent and 90 percent levels. When deviation from this is required, the amplitude levels shall be specified.

x. Spikes, overshoots, noise levels, and DC levels shall be identified and illustrated.

y. Waveforms shall include a sync signal reference, if possible.
z. Resistance measurements involving semiconductor devices shall include polarity requirements and the current at which the semiconductor impedance was determined.
aa. Measurements that require longer than the standard measurement delay for stabilization after input insertion or other action shall be specified in the individual test specification sheets.
bb. Certain component failure or degradation may not be readily detectable during performance testing, such as failure of power input filters and relay coil noise suppressors. The TRD shall include tests to ensure that all such items are checked.
cc. 1/0 test requirements shall be specified at the UUT interface.
dd. Measurement data shall be identified on the detailed test requirement information sheet as being derived either empirically or by calculations based on design specifications.
ee. When more than one component is identified for possible replacement, they shall be listed in their most probable order of failure.
ff. Failure of monostable multivibrator to generate pulse of proper width. An indication is required.
gg. Failure of ROM to generate correct data at every unique address. An indication should be provided.
hh. Failure of microprocessor to execute proper instruction. An indication should be provided.
ii. Programmed logic array (PLA) should interpret input data properly. An indication is required to assure this is being done.

5.7 UUT failure data. Failure data, expressed as rates of failure, sufficiently comprehensive to trace failure through all significant levels of the UUT, shall be recorded in the manner specified in Appendix C. The data required consist of failure rates, fault data, fault isolation data, and fault ambiguity group data. The following forms of Appendix C specify UUT failure data:

a. FIGURE 31. The failure index sheet shall be used to record the prime failure modes of all inputs and outputs of each next lower assembly of the UUT (see 40.1, Appendix C).
b. TABLE II. TABLE II shall be used to document failure data descriptive of the failure characteristics of all levels of a system hierarchy (see 40.2.1, Appendix C).
c. TABLE III. TABLE III shall be used for the documentation of summary failure rate data for all ambiguity groups (see 40.2.2, Appendix C).
d. TABLE IV. TABLE IV shall be used to document detectable insertable faults, detectable destructive faults, and nondetectable faults (see 40.2.3, Appendix C).

5.8 UUT performance specification and test requirements matrix. The contractor shall establish a number trail of specifications, test requirements, and test numbers to correlate Pertinent Military specifications with contractor prepared desire specifications. UUT drawinqs, UUT test requirements, and UUT tests. FIGURE 30 (Appendix B, sheets 1 and 2) shall be used to record the information.

5.9 Quality assurance provisions. Inspection of TRD shall be specified by the procuring activity and contract ordering documentation. The procuring activity has the option to verify the TRD documentation as a part of the TRD review and approval. This verification of the final TRD may be performed at the contractor’s facility or at a Navy

6. NOTES

6.1 Contract data requirements. The following Data Item Description (DID) shall be utilized if the procuring agent desires to order data that are generated from having invoked pertinent work tasks that are established within this standard. These data shall be specified on the Contract Data Requirements List (DD Form 1423).

Paragraph	Data requirement	Applicable DID
5.2, 5.4, 5.5, 5.6, 5.7, and 5.8	Document, Test Requirements	DI-T-2181

6.2 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Review activities:
Navy-AS,YD,OS,MC

User activities:
Navy-

Preparing activity:
NAVY-EC
(Project MISC-ND 39)

APPENDIX A

MINIMUM DATA REQUIREMENTS

10. SCOPE

10.1 Scope. UUT test requirements shall include the data requirements specified in this appendix. These requirements are minimum requirements and additional data may be required to adequately describe UUT testing requirements. The requirements specified in Section 20 are minimum requirements in detail, emphasizing the data items that shall be included in TRD documentation.

20. DETAILED REQUIREMENTS

20.1 Minimum data requirements categories. Minimum data requirements categories shall be as specified in 20.1.1 through 20.1.9.

20.1.1 Power sources. Power sources shall be as specified in 20.1.1.1 and 20.1.l.2.

20.1.1.1 DC power sources. DC power sources shall specify the following:

		Units
a.	Nominal voltage (if constant voltage is specified)	volts
b.	Voltage tolerance (if nominal voltage is specified)	+ volts or percent
c.	Current-maximum- (if nominal voltage is specified)	Amperes
d.	Current-nominal (if constant current is specified)	Amperes
e.	Current tolerance (if nominal current is specified)	+ amperes or percent
f.	Voltage-maximum (if constant current is specified)	volts
g"	Load impedance 1/ NOTE: Significant inductive or capacitive characteristics should be indicated.	Ohms

1/ Only one need be specified for a resistive load.

20.1.1.1.1 DC power sources shall specify the following, if critical to UUT:

		Units
a.	Ripple	Volts rms
b.	Noise	Volts peak-to-peak

20.1.1.1.2 DC power sources shall specify load changes if not adequately specified in 20.1.1.1.1 and 20.1.1.1.2. Critical transient response is a typical example.

20.1.1.2 AC power source

20.1.1.2.1 AC power shall specify the following:

	Units
a. Nominal voltage (if constant AC voltage is specified)	Volts AC
b. Voltage tolerance (if nominal voltage is specified)	± volts or percent
c. Voltage maximum (if constant AC is specified)	Volts
d. Nominal frequency	hertz (hz)
e. Frequency tolerance	± Hz or percent
f. Current-maximum (if nominal voltage is specified)	Amperes
g. Current nominal (if constant AC is specified)	Amperes AC (rms. peak-to-peak, and so forth)
h. Current tolerance (if nominal current is specified)	± amperes or percent
i. Load impedance	Ohms
j. Voltage imbalance (if nominal voltage is specified)	Volts or percent
k. Current imbalance (each phase) (if nominal current is specified).	Amperes or percent

20.1.1.2.2 AC power sources shall specify the following if critical to UUT:

	Units
a. Maximum distortion (total harmonic)	Percent
b. Phase-to-phase angle	Degrees
c. Phase-to-phase angle tolerance	± degrees or ± percent
d. Phase-to-reference angle	Degrees
e. Phase-to-reference angle tolerance	± degrees or ± percent

20.1.2 Analog stimuli.

20.1.2.1 Sinusoidal stimuli.

20.1.2.1.1 Sinusoidal stimuli shall specify the following:

	Units
a. Voltage and power magnitude	Volts, watts, decibels referred to one milliwatt (dBm)
b. Voltage and power magnitude tolerance	± volts , percent, watts, dBm
c. Frequency-nominal	Hz
d. Frequency tolerance	± Hz or percent
e. Load impedance of UUT at nominal frequency	Ohms
f. Offset level of average value	Volts

20.1.2.1.2 Sinusoidal stimuli shall specify the following, if required by UUT:

a. Modulation:
   1. Modulation type
   2. Modulation frequency(ies) or rates
   3. Modulation percentage or waveshape
   4. Carrier power and voltage level during modulation on and off ratios
   5. Modulation pulse shapes
   6. Pulse repetition frequency
   7. Modulaticn index
b. Noise levels, distortion (total harmonic)
c. Maximum VSWR
d. Phase angle to reference phase

20.1.2.2 Pulse stimuli.

20.1.2.2.1 Pulse stimuli shall specify the following:

		Units
a.	Amplitude	volts
b.	Amplitude tolerance	± volts or ± percent
c.	Pulse repetition frequency	Hz
d.	Pulse repetition frequency tolerance	+ Hz or percent
e.	Pulse width (50 percent amplitude)	Seconds
f.	Pulse width tolerance	Seconds or percent
g.	Pulse rise time (10 percent to 90 percent)	Seconds
h.	Pulse rise time tolerance	± seconds or ± percent
i.	Pulse fall time (90 percent to 10 percent)	Seconds
j.	Pulse fall time tolerance	± seconds or ± percent
k.	Pulse mode (continuous, single pulse, and so forth)	
1.	Load impedance of UUT (at specified frequency)	Ohms
m.	Offset of signal value closest to ground	Volts

20.1.2.2.2 Pulse stimuli shall specify the following, if required by UUT:

a. Synchronization characteristics stating parameters specified in 20.1.2.2.1 for reference signal(s) pulse timing data between signals
   NOTE: A timing diagram shall be included if more than two signals must be simultaneously synchronized
b. Modulation of pulse trains or continuous pulses.

20.1.2.3 Synchro and resolver stimuli.

		Units
a.	Three-wire synchro or four-wire resolver	
b.	Frequency	Hz
c.	Frequency tolerance	+ Hz or percent
d.	Stator voltage	Volts
e.	Stator voltage tolerance	± volts or percent
f.	Angular output	Degrees
g.	Angular output tolerance	± Degrees or percent
h.	Load impedance of UUT (at specified frequency)	Ohms
i.	Load imbalance (at specified frequency)	Ohms
j.	Reference signal:	
	1. Amplitude	Volts rms
	2. Amplitude tolerance	Volts rms or percent
	3. Maximum current	Amperes

20.1.2.3.2 Synchro and resolver stimuli shall specify the following if critical to UUT:

a. Maximum quadrature component

20.1.2.4 Waveform stimuli.

20.1.2.4.1 Waveform stimuli shall specify the following:

		Units
a.	Waveshape description of type NOTE: Any waveshape which cannot be specified by an ATLAS signal noun shall be specified by the noun drawing and be accompanied by a detailed drawing identifying all required parameters.	
b.	Amplitude	Volts peak-to-peak
c.	Amplitude tolerance	+ volts or percent
d.	Offset from zero	volts
e.	Offset tolerance	+ volts or percent
f.	Required matching impedance	Ohms
g.	Period	Seconds
h.	Period tolerance	± seconds or percent
i.	Duration	Seconds
j.	Duration tolerance	± seconds or percent

20.1.2.4.2 Waveform stimuli shall specify the following if required by UUT:

a. Synchronization:
   1. Timing relationships
   2. Reference signal amplitude
   3. Reference signal rise time
   4. Reference signal width
b. Modulation:
   1. Carrier characteristics
c. Symmetry
d. Peculiar signal termination requirements

20.1.2.5 Time delayed stimuli.

20.1.2.5.1 Time delayed stimuli shall specify the following:

		Units
a.	Delay period	Seconds
b.	Delay period tolerance	± seconds or 1 percent
c.	Characteristics of time reference signal from UUT or to UUT: 1. Amplitude 2. Rise time 3. Width 4. Source or load impedance of UUT	
d.	Characteristics of delayed signal to UUT: 1. Amplitude 2. Rise time 3. Width 4. Load impedance of UUT	

20.1.3 Digital stimuli. Where practical, real-time operating conditions should not be specified when it is possible to perform a comprehensive and adequate test of the UUT under simpler conditions of time, frequency, or synchronization.

20.1.3.1 Serial data stimuli shall specify the followlng:

		Units
a.	Logic O voltage	volts
b.	Logic O voltage tolerance	± volts or percent
c.	Logic 1 voltage	volts
d.	Logic 1 voltage tolerance	± volts or percent
e.	Minimum current sink requirement	Amperes
f.	Minimum current source requirement	Amperes
g.	Characteristic impedance	Ohms
h.	Pulse class return-to-zero (RZ), non-return to zero (NRZ), and so forth	
i.	Bit pulse repetition frequency (PRF) (clock rate)	Hz
j.	Bit PRF tolerance	± Hz or percent
k.	Bit rise and fall time (rein and max)	seconds
l.	Word length	Bits
m.	Pattern of bits required	
n.	Simultaneity with other serial or parallel digital inputs NOTE : Include timing diagram if more than two simultaneous input channels are required	
o.	Synchronization requirements (reference signal from UUT or external source):	
	1. Amplitude	volts
	2. Width	Seconds
	3. Rise and fall time	Seconds
	4. PRF	Hz
	5. Characteristic impedance	Ohms
	6. Skew	± seconds or percent

20.1.3.2 Parallel data stimuli

20.1.3.2.1 Parallel data stimuli shall specify the following:

a. All which is specified for serial data stimuli
b. Number of words in sequence

20.1.4 Pressure stimuli.

20.1.4.1 Pressure stimuli shall specify the following:

		Units
a.	Absolute pressure	Millimeters (mm) (inches (in) of mercury (mm (in) Hg)
b.	Absolute pressure stability:	
	1. Short term	nun (in) of mercury per minute (mm (in) Hg/min)
	2. Long term	mm (in) of mercury per hour (mm (in) Hg/hr)
c.	Absolute pressure tolerance	+mm (in) Hg or precent
d.	Leakage rate	mm (in) Hg/min
e.	Maximum rate of absolute pressure change	mm (in) Hg/min
f.	Range of rate of absolute pressure change	mm (in) Hg/min
g.	Absolute pressure rate tolerance	mm (in) Hg/min
h.	Absolute pressure range	mm (in) Hg
i	Maximum volume to be pressurized (need not be specified in ATLAS)	Cubic mm (in) (cu mm (in))

20.1.E Analog measurement.

20.1.5.1 DC voltage measurement.

20.1.5.1.1 DC voltage measurement shall specify the following:

		Units
a.	Magntude and polarity	± volts
b.	Magnitude tolerance	± volts or percert
c.	Impedance of UUT signal source NOTE: Significant inductive or capacitive characteristics should be so indicated	Ohms
d.	Offset of return from 0 volts Note: For reties of CC signals, the data specified herein shall be provided for each signal in addition to the nominal expected value of the ratio ant its tolerance.	Volts

20.1.5.2 AC voltage measurement.

20.1.5.2.1 AC voltage measurement shall specificy the following:

		Units
a.	Frequency of signal	Hz
b.	Expected magnitude	Volts (rms or average)
c.	Allowable tolerance	± volts or percent
d.	Impedance cf UUT signal source	Ohms
e.	DC offset of average value from O volts NOTE: For ratios of AC signals or offset signals, the data specified herein shall be provided for tack signal in addition to the ncminal expected value of the ratio and its tolerence.	Volts

20.1.5.3 Phase angle measurement.

20.1.5.3.1 Phase angle measurement shall specify the following:

		Units
a.	Frequency	Hz
b.	Frequency tolerarce	± Hz or percent
c.	Amplitude (two signals;	Volts
d.	Amplitude tolerance	± volts or percent
e.	Expected angle	Degrees
f.	Expected angle tolerance	Degrees
g.	Source impedance of UUT (two signals)	Ohms
h.	DC component(s)	Volts

20.1.5.4 Frequency measurement.

20.1.5.4.1 Frequency measurement shall specify the following:

		Units
a.	Frequency of signal	Hz
b.	Expected magnitude	volts (rms average)

c.	Allowable tolerance	± volts or percent
d.	Impedance of UUT signal source	Ohms
e.	DC offset of average value from O volts Note: For ratios of AC signals or offset signals, the data specified herein shall be provided for each signal in addition to the nominal expected value of the ratio and its tolerance.	volts

20.1.5.5 Time period measurement.

20.1.5.5.1 Time period measurement shall specify the following:

		Units
a.	Expected frequency	Hz
b.	Expected frequency tolerance	± Hz or percent
c.	Maximum peak voltage(s)	Volts
d.	Maximum peak-to-peak voltage(s)	Volts
e.	Impedance of UUT source(s)	Ohms
f.	Edge(s) used as reference(s) and slope(s) (leading or trailing)	
g.	Rise time (nonsinusoidal)	Seconds
h.	Width (nonsinusoidal)	Seconds
i.	Maximum acceptable shunt capacitance for other than coaxial connection	Pulse frequency (PF)

20.1.5.6 Power (average RF) measurement,

20.1.5.6.1 Power (average RF) measurement shall specify the following:

		Units
a.	Amplitude	Watts dBm
b.	Amplitude tolerance	+ watts, percent dBm, decibels referred to one watt (dBw)
c.	VSWR (ratio)	None
d.	Frequency (nominal)	Hz
e.	Impedance of UUT source	Ohms
f,	Maximum voltage	volts
g.	Maximum peak-to-peak voltage	volts

20.1.5.7 Waveform measurements. For complex waveforms, the use of the ATLAS noun drawing is recommended.

20.1.5.7.1 Amplitude measurements.

20.1.5.7.1.1 Amplitude measurements shall specify the following:

		Units
a.	Expected amplitude	Volts (peak)
b.	Expected amplitude tolerance	± volts or percent
c.	Maximum possible amplitude	Volts
d.	Maximum peak-to-peak voltage	Volts
e.	PRF	Hz
f.	PRF tolerance	+ Hz or percent
g.	Required matching impedance	Ohms
h.	DC offset of lowest value from O volts	volts
i.	Synchronization signal, if available - same data as specified in a through h for signal to be measured	

20.1.5.7.2 Rise fall time measurements.

20.1.5.7.2.1 Rise fall time measurements shall specify the following:

		Units
a.	All which is specified for amplitude measurements (see 20.1.5.7.1)	
b.	Expected rise and fall time (measured from 10 percent to 90 percent amplitude or for specified voltage levels)	Seconds
c.	Tolerance	± seconds or percent
d.	Slope of measured edge (positive or negative going)	

20.1.5.7.3 Time measurements.

20.1.5.7.3.1 Time measurements shall specify the following:

a. All which is specified for amplitude measurements (see 20.1.5.7.1)

		Units
b.	Expected time	Seconds
c*	Expected time tolerance (Measured at 10 percent, 50 percent, or 90 percent amplitude or for specified voltage levels)	± Seconds or percent

20.1.5.7.4 Resistance measurements.

20.1.5.7.4.1 Resistance measurements shall specify the following:

a. Expected value
b. Expected value tolerance

20.1.5.7.4.2 Resistance measurements shall specify the following, if required:

		Units
a.	Current flow maximum through unknown	Amperes
b.	Polarity requirements	
c.	Maximum excitation voltage	Volts

20.1.5.7.5 Distortion measurements.

20.1.5.7.5.1 Distortion measurements shall specify the following:

		Units
a.	Waveshape 1. Any waveshape which cannot be specified by an ATLAS statement shall be specified by a detailed drawing. 2. If other than sinusoidal, distortion criteria shall be defined.	
b.	Fundamental frequency	Hz
c.	Fundamental frequency tolerance	+ Hz or percent
d.	Impedance of UUT source	Ohms
e.	Amplitude - maximum	Volts rms
f.	Amplitude peak-to-peak	volts
g.	Expected percent distortion	Percent
h.	Expected percent distortion tolerance	± percent

20.1.5.7.6 Synchro or resolver measurements.

20.1.5.7.6.1 Synchro or resolver measurements shall specify the following:

		Units
a.	Identity (synchro or resolver)	
b.	Voltage	volts
c.	Voltage tolerance	± volts or percent
d.	Frequency	Hz
e.	Frequency tolerance	± Hz or percent
f.	Expected angular position	Degrees
g.	Expected angular position tolerance	± degrees or percent
h.	Impedance of UUT source (line-to-line)	Ohms

20.1.6 Pressure measurement.

20.1.6.1 Pressure measurement shall specify the following:

		Units
a.	Static or differential	
b.	Expected value	mm (in) Hg

20.1.7 Digital measurement.

20.1.7.1 Serial measurement.

20.1.7.1.1 Logic levels verification.

20.1.7.1.1.1 Logic levels verification shall specify the following:

		Units
a.	Logic O voltage	volts
b.	Logic O tolerance	+ volts or percent
c.	Logic 1 voltage	volts
d.	Logic 1 tolerance	+ volts or percent
e.	Characteristic impedance of source	Ohms
f.	Current source and sink requirements	Amperes

20.1.7.1.2 Built-in-test (BIT) patterns evaluation.

20.1.7.1.2.1 BIT patterns evaluation shall specify the following:

a. BIT rates
b. Pulse class (RZ, NRZ, and so forth)
c. BIT width
d. Logic level
e. Currents source and sink
f. Synchronization requirements 2/:
   1. Reference signal
   2. Amplitude
   3. Width
   4. Rise time
   5. PRF
   6. Source impedance
   7. Maximum skew
g. Expected BIT pattern or word - Expressed in 1 or O format 2/
h. Simultaneity with other UUT outputs-
   Note: Include timing diagram if more than two simultaneous input channels are required.

2/ Normally a separate test of the same data, as required.

20.1.7.1.3 Propagation delay.

20.1.7.1.3.1 Propagation delay shall specify the following:

		Units
a.	BIT and pulse characteristics as specified in logic level verification and BIT pattern evaluation (sss 20.1.7.1.2)	
b.	Expected delay	Seconds
c.	Expected delay tolerance	± seconds or percent

20.1.7.2 Parallel measurement.

20.1.7.2.1 Logic level verification.

20.1.7.2.1.1 Logic level verification shall specify all which is required for serial signal logic level verification (see 20.1.7.l.l.1).

20.1.7.2.2 BIT pattern evaluation.

20.1.7.2.2.1 BIT pattern evaluation shall specify all which is required for serial signal BIT pattern evaluation, except for pulse class (see 20.1.7.1.2.1).

20.1.7.2.3 Propagation delay.

20.1.7.2.3.1 Propagation delay shall specify all which is required for serial signal propagation delay (see 20.1.7.l.3.1).

20.1.8 Impedance measurement.

20.1.8.1 Electronic elements.

20.1.8.1.1 Electronic elements shall specify the following:

		Units
a.	Expected impedance	Ohms
b.	Tolerance of impedance	± ohms
c.	Frequency at which impedance is measured	Hz
d.	Power rating - average, peak	Watts, vars
e.	Nonlinear characteristic, if required (maybe specified by drawing)	

20.1.9 Mechanical measurements.

20.1.9.1 Mechanical measurements shall specify the following, as required:

a. Angular position
b. Spatial position
c. Torque
d. Angular velocity
e. Pneumatic and hydraulic factors
f. Others

APPENDIX B

TEST REQUIREMENTS DATA AND DOCUMENTATION

10. SCOPE

10.1 Scope. This appendix specifies the preparation of standard forms for the documentation of test requirements data (see Section 5).

20. REFERENCED DOCUMENTS

20.1 Government documents. The following document, of the issue listed in the Department of Defense Index of Specifications and Standards (DoDISS) and its supplements, forms a part of this appendix to the extent specified herein. The date of the applicable DoDISS and supplements thereto shall be as specified in the solicitation.

SPECIFICATIONS

MILITARY

MIL-M-24308/1	Connector, Socket Contacts, General Purpose, Class G, Solder Type

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

30. GENERAL REQUIREMENTS

30.1 Data requirements. UUT test requirements shall include minimum data requirements (see Appendix A).

40. DETAILED REQUIREMENTS

40.1 Detailed requirements. The detailed requirements (see Section 5), shall be documented using the forms specified herein. The detailed documentation requirements specified herein also explain how the forms shall be prepared except in those cases wherein preparation of the forms is evident. For example, all forms require standard heading information, the content of many forms shall be identified by column and row headings and only pertinent portions of the forms shall be filled in for particular UUTS.

40.2 TRD cover sheet. (See FIGURE 1 and 5.2.2).

40.3 Approval sheet. (See FIGURE 2 and 5.2.3).

40.4 Revision summary sheet. (See FIGURE 3 and 5.2.4).

40.5 UUT data summary sheet. (See FIGURE 4 and 5.2.5).

40.6 Theory of operation sheet. (See FIGURES 5 and 6, and 5.4.1).

40.7 Operating instructions sheet. (See FIGURES 7 and 8, and 5.4.2).

40.8 UUT drawings cover sheet. (See FIGURE 9 and 5.4.3).

40.9 Subassembly schematic. (See FIGURE 10 and 5.4.3.1).

40.10 Functional block diagram. (See FIGURE 11 and 5.4.3.5).

40.11 UUT operational and safety requirements. (See FIGURE 12 and 5.4.4),

40.12 UUT power requirements. (See FIGURE 13 and 5.4.5).

40.13 UUT interface definition. (See FIGURE 14, sheets 1 and 2, and 5.4.6). Sheet 1 presents mechanical interface requirements. Sheet 2 presents requirements for electrical interface.

40.14 ATLAS test requirements versus UUT performance characteristics. (See FIGURE 15 and 5.5.1).

40.15 Manually generated digital test requirements. (See FIGURE 16). There are three primary digital test requirements data areas on this form for specifying pattern data, timing data, and parametric data, respectively. In addition, the form presents general data characteristics, and a table for detailing alignment or replacement test results. These areas are specified in 40.15.1 through 40.15.8.2.1.

40.15.1 Data characteristics. The table (see FIGURE 16) correlates test requirements with detailed test requirements data and identifies the type of data transmission required by the UUT, for example, stimulus or response, parallel or serial, RZ NRZ.

40.15.2 Alignment or replacement action. This part of the form, located in the lower right corner, is specified for detailing corrective action to be taken. It supplements the data recorded in the results columns of the pattern data matrix specified in 40.15.3 through 40.15.8.2.1.

40.15.3 Pattern data. The pattern data area consists of a 33 by 33 matrix for recording serial or parallel pattern data, identified as appropriate by row or column headings. The three right columns of the pattern data matrix define the branching from results of tests. In all cases, parallel data 1/0 pins are identified by column headings (at the top of the pattern data matrix) and serial data 1/0 pins are identified by two headings (at the left of the pattern data matrix) as appropriate. A particular cell of the pattern data matrix contains a parallel data BIT (1/0 pin identified by column) unless a serial data 1/0 pin is identified in the row heading on the left. Parallel and serial data may not be mixed in a single row of this matrix. This flexibility allows the matrix to be used to describe the following 1/0 combinations:

a. Parallel input and output data
b. Parallel input and serial output data
c. Serial input and parallel output data
d. Serial input and output data

40.15.4 Codes. C, P, F, and No. are the codes for connectors (C), pins (P), function (F), and pattern (BIT) numbers (No.). This code shall be used to identify function and I/O connection for data entries, and shall be used similarly for the identification of both parallel and serial pattern data. The coding of both parallel and serial data shall comply with the table codes shown in the lower left corner of FIGURE 16 (sheet 2 of 2).

40.15.5 Results. The columns under Results, on the right side of the matrix, shall be used for branching directions to be executed on GO or NO-GO decisions. Under Go To shall be entered the required condition for branching, that is, GO or NO-GO. A number indicating the branching destination, which may be a test number (TN), a pattern number (PN), an align or replace number (AN), or a page number (PG) in the next column shall be entered. The far right column shall be used to complete the identification of the branch destination. AN shall be detailed by the table on the bottom right of the form as specified in 40.15.2.

40.15.6 Timing data. This data area is designed to graphically record waveforms and provide a relative description of timing, clocks, and other control signals not readily specified in the pattern data matrix. The table also provides for the identification of the zero time reference signal and the time per division. The form is organized to provide 1/0 signal identification in a manner similar to the pattern data matrix. The zero time reference and the time division data shall be entered in the spaces assigned below the matrix portion of the form.

40.15.7 Parametric data. This data area supplements pattern and timing data by providing for the recording of numerical data specifying start and stop times and states, pulsewidth and repetition frequencies, high and low voltages, and explanatory information. The four left columns shall be used for I/O signal identification (C, P, F, and No.) as specified in 40.15.4. In the recording of data on this form, pulsewidth and pulse repetition frequency shall be interpreted as BIT width and BIT rate, respectively.

40.15.8 Preparation examples. The requirements specified in 40.15.8.1 through 40.15.8.2.1 outline two examples to guide the preparation of the Digital Test Requirements Sheet correlated with FIGURES 17 and 18.

40.15.8.1 Preparation (see FIGURE 17).

40.15.8.1.1 Pattern data. Pattern data shall be entered in the top matrix of the form as either 1 or O. The data shall be appropriately coded (C, P, F, and No.) in accordance with the table code located in the lower left corner of the data sheet as specified for the coding of both row and column headings. This example reads serial data in (on pin J1-36) and parallel data out as a parallel word (on J1, pin 6, 10, 25, 27, 30, 32, 34, and 40). Row 5 identifies the stimulus data entered serially. Row 6 identifies the parallel response data pattern. The Results column, on the far right of the matrix, defines branching instruction. In this example, a NO-GO requires branching to test No. 106.

40.15.8.1.2 Timing data. The example of timing data graphically represents digital waveforms. The four left columns of the timing data area shall be used for entering code identification of test requirements functions; for example, F (flag) pin 1, L (lockout) pin 8, R (request) pin 14, and AK (acknowledge) pin 16. The codes are convenience codes arbitrarily selected to make assignments identify the function and 1/0 connection of the waveforms drawn in the body of the table. The bottom line states that the zero time reference signal shall be Flag, pin 1, and the time per division shall be 500 nanoseconds (ns) for this test. Timing shall be read horizontally when using this table. Quantified data which cannot be presented graphically shall be recorded in the parametric data table shown on FIGURE 17.

40.15.8.1.3 Data-clock-control line parametric data. This table expands upon data specified in 40.15.8.1.1 and 40.15.8.1.2 by recording parametric data which cannot be presented graphically. The four left columns, (C, P, F, and No.) shall be used in the same way as in the preparation of the timing data form. The start and stop columns contain the start and stop times with respect to zero time reference and the corresponding logic states of the signals. The pulsewidth and PRF columns shall be used for entering BIT width and rate, respectively. The level columns record the logic 1 and logic O steady-state voltages. The final column shall be used for explanatory information specifying test requirements data functions correlated with the timing data section.

40.15.8.2 Preparation (see FIGURE 18). This example illustrates the use of the Digital Test Requirements Sheet for recording pattern data for the UUT configured with three parallel I/O pins and a serial I/O pin. The UUT I/O connections are system related to connection J1.

40.15.8.2.1 Pattern data. Pattern data shall be entered as either 1 or O appropriately coded as C, P, F, and No. In this example, parallel control data shall be applied through J1 pins 1, 2, and 3 to initialize the test. The data shall be shown as zeros in the cells formed by columns Jl, pins 13 and row identifiers F (function), ST (stimulus) and No. 1 (number). Next, serial stimulus pattern shall be applied to J1, P4. Following this action, the UUT mode control shall be changed from logic O to logic 1 and J1, pin 2. The final action is to read out the serial pattern at J1, P4.

40.16 ATPG system information sheet. (See FIGURE 19 and 5.5.3).

40.17 General UUT test constraints. (See FIGURE 20 and 5.5.4).

40.18 Detailed test requirements information sheets. (See FIGURES 21A, B, C, and D.) UUT detailed test requirements data shall be separately documented for each test to be performed (see 5.6.2.3).

40.19 Manual test set-up diagram. (See FIGURE 22 and 5.6.2.4).

40.20 Automatic test set-up diagram. (See FIGURE 23 and 5.6.2.4).

40.21 Test equipment and tool list. (See FIGURE 24, sheets 1 and 2 and 5.6.2.5). Test equipment shall be listed on sheet 1. Sheet 2 shall be used for the tool list.

40.22 Test fixture parts list. (See FIGURE 25 and 5.6.2.6).

40.23 Test fixture schematic. (See FIGURE 26 and 5.6.2.6).

40.24 Test fixture panel marking drawing. (See FIGURE 27 and 5.6.2.6).

40.25 Test fixture panel drilling drawing. (See FIGURE 28 and 5.6.2.6).

40.26 Test fixture cabinet hole location drawing. (See FIGURE 29 and 5.6.2.6).

40.27 UUT performance specification and test requirements matrix. (See FIGURE 30, sheets 1 and 2 and 5.8).

TRD NO. _____ PAGE _____ OF _____

REV NO. _____ DATE _____

COVER SHEET

TRD

DATA AND DOCUMENTATION

_____

UUI NAME

UUT CONTRACTOR UNIT NO. _____

UUT CONTRACTOR PART NO. _____

UUT MANUFACTURER _____

UUT MANUFACTURER PART NO. _____

UUT CONTRACT NO. _____

TRD CONTRACTOR _____

TRD PREPARER _____

TRD CONTRACT NO. _____

FIGURE 1. TRD cover sheet.

TRD. NO _____ PAGE _____ OF _____

REV NO. _____ DATE _____

APPROVALS FOR TEST REQUIREMENTS DATA FOR

DEVELOPMENTAL DOCUMENTATION AND NONPROCEDURAL

TEST REQUIREMENTS DATA

	NAME	TITLE	ORGANIZATION
APPROVED BY:			

FIGURE 2. Approval sheet.

REVISION SUMMARY SHEET

TRD NO. _____ PAGE _____ of _____

REV. NO. _____ DATE _____

PAGE NO.	REV. LTR.	APPROVED	DATE	UUT CONFIGURATION	ECP NO.	REASON FOR CHANGE

FIGURE 3. Revision summary sheet.

TRD No. _____ Page 1 of 4

Rev No._ _ Date _____

UUT Configuration Analog _____ Digital _____ Hybrid

UUT data summary sheet

Data	MIL-STD-1345 (figure)	Data applicability	Doc. Number	Doc. Rev. Date	Remarks
	Appendix B				
1. Theory of operation	5				
2. Operating Instructions	7				
3. Drawings:	9				
Outline drawings					
Unit main drawings					
Detail and Subassembly drawings					
Module and subassembly Schematics	10				
Specification Control drawings					
Connection Wire diagrams					
Logic diagrams					
Functional block diagrams	11				
Parts list Cross index Family tree					
4. UUT Operational and safety requirements	12				
Cooling Requirements					

FIGURE 4. UUT data summary sheet (sheet 1 of 4).

TRD No. _____ Page 2 of 4

Rev No. _____ Date _____

UUT configuration Analog _____ Digital _____ Hybrid _____

UUT data summary sheet

Data	MIL-STD-1345 (figure)	Data appli-cability	Doc Number	Doc. Rev. Date	Remarks
Hydraulic pressure requirements					
Pneumatic ource requirements					
Safety requirements					
Handling, Maintenance requirements					
Other					
5. Power requirements	13				
AC power requirements					
DC Power requirements					
6. UUT interface	14				
Support fixtures					
Pneumatic fixtures					
Hydraulic fixtures					
Cooling fixtures					
Electrical interface					
7. UUT Input/Output Nodal data					

FIGURE 4. UUT data summary sheet (sheet 2 of 4).

TRD No. _____ Page ____3 of 4___

Rev No. _____ Date _____

UUT configuration Analog _____ Digital _____ Hybrid _____

UUT data summary sheet

Data	M1L-STD-1345 (figure)	Data appli-cability	Doc. Number	Doc. Rev. Date	Remarks
Atlas test requirement vs UUT performance Characteristics	15				
Manually generated digital test require-ments	16				
Automatic test Program generation	19				
UUT test constraints	20				
8. Diagnostic Test Procedures:					
Manually generated digital test require-ments	16				
Automatic test program generation	19				
UUT test Constraints	20				
Detailed test require-ments	21				
Manual test set-up diagram	22				
Automatic test set-up diagram	23				
Test equipment and tool list	24				

FIGURE 4. UUT data summary sheet (sheet 3 of 4).

TRD No._____ Page 4 of 4

Rev No._____ Date._____

UUT Configuration Analog_____ Digital_____ Hybrid_____

UUT data Summary Sheet

Data	MIL-STD-1345 (figure)	Data Applicability	Doc. Number	Doc. Rev. Date	Remarks
Test fixture parts list	25				
Test fixture Schematic	26				
Test fixture panel Marking drawing	27				
Test fixture panel drilling drawing	28				
Test fixture Cabinet hole location drawing	29				
9. UUT performance Specification and test requirements	30				
	Appendix C				
10. UUT failure data:					
Failure rate index	31				
Functional block diagram	32				
Schematic, electrical diagram	33				
Primary failure modes	34				
UUT failure data	Table II				
Failure rate and fault isolation ambiguity group	Table III				
Detectable insertable faults	Table IV				

FIGURE 4. UUT data summary sheet (sheet 4 of 4).

UUT theory of operation sheet.

TRD NO. _____ PAGE__ OF _____

REV NO. _____ DATE _____

UUT PART NO. _____

Document	Document Number	Document Revision Date	UUT configuration Analog digital hybrid	Page
Theory of operation Performance specification				

Description:

FIGURE 5. UUT theory of operation sheet.

Follow-on sheet
to
theory of operation sheet

TRD NO. _____ PAGE ___ OF _____

REV NO. _____ DATE _____

UUT PART NO. _____

Description: (continued)

FIGURE 6. Follow-on sheet to theory of operation sheet.

UUT operating instructions sheet

TRD NO. _____ PAGE____OF _____

REV NO. _____ DATE _____

UUT PART NO. _____

Document	Document number	Revision date	UUT configuration Analog digital hybrid	Page
Operating instructions				
Performance specification				

Description:

FIGURE 7. UUT operating instructions sheet.

Follow-on sheet
to
operating instructions sheet

TRD NO. _____ PAGE ____ OF _____

REV NO. _____ DATE _____

UUT PART NO. _____

Description: (continued)

FIGURE 8. Follow-on sheet to operating instructions sheet.

UUT DRAWINGS COVER SHEET

TRD NO. _____ PAGE _____ OF _____

REV NO. _____ DATE _____

UUT PART NO. _____

DRAWING DESCRIPTION	DOCUMENT NUMBER	REVISION DATE	UUT CONFIGURATION	PAGE
Outline drawings				
Unit main assembly awings				
Detail and subassembly drawings				
Module and subassembly schematics				
Connection or wiring diagrams				
Logic diagrams				
Functional block diagrams				
Parts list and cross index				
Family tree				

FIGURE 9. UUT drawings cover sheet.

TRD NO. _____

REV. NO, _____

PAGE ____ OF _____

DATE _____

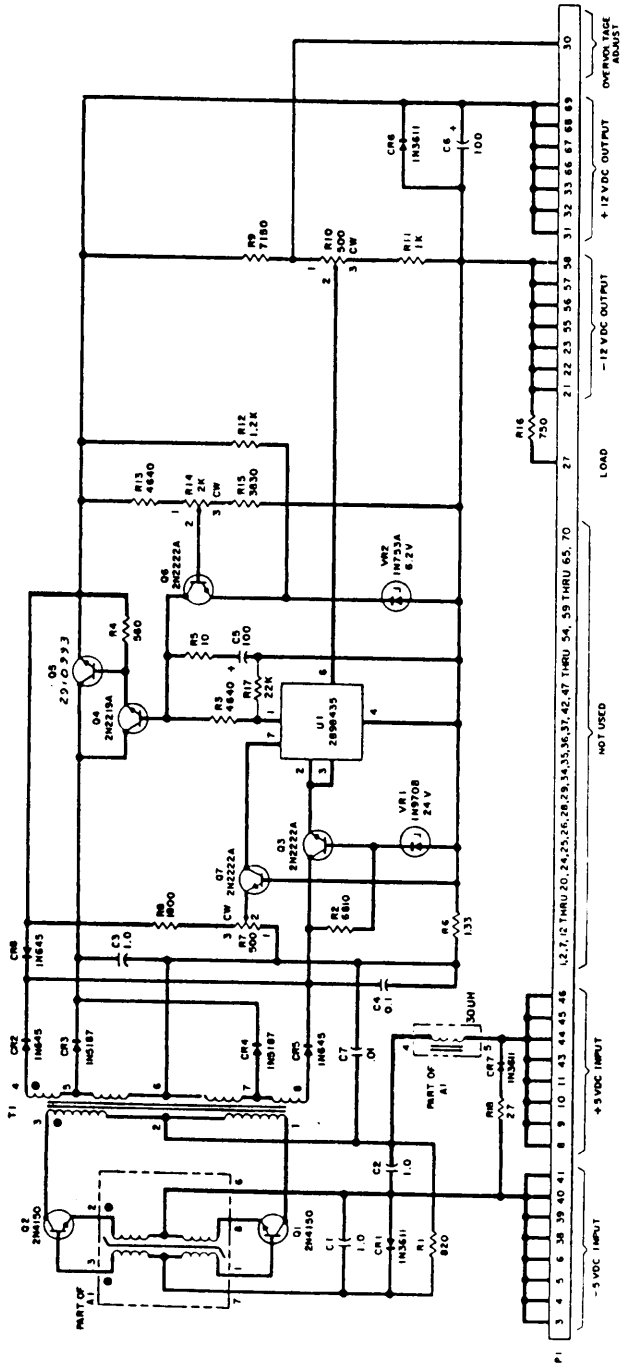
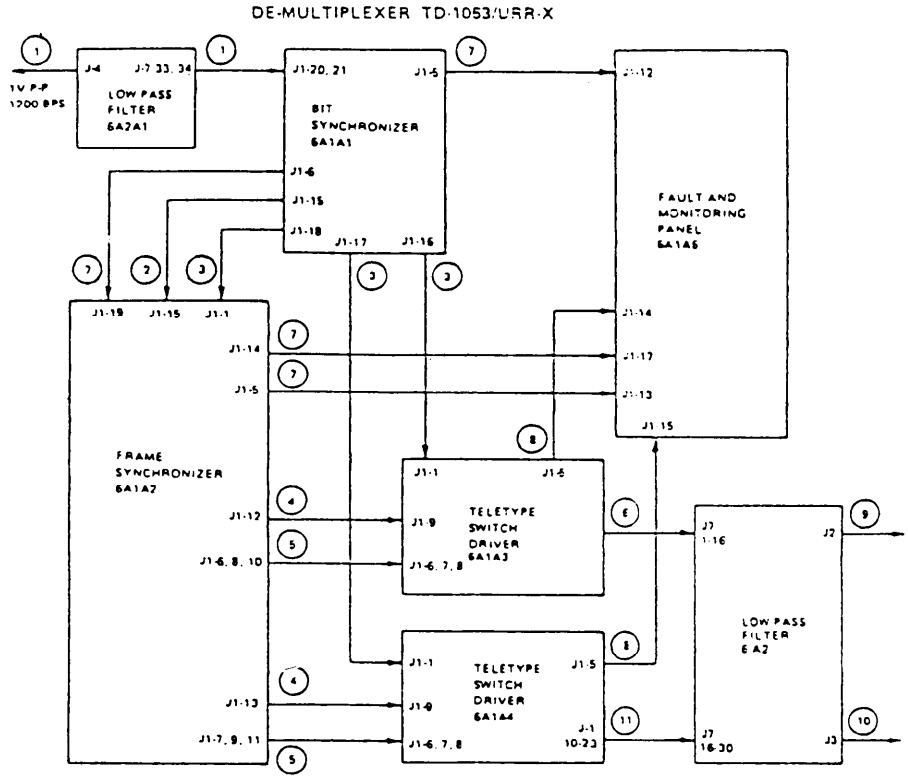


FIGURE 10. Schematic diagram (sample).

PAGE _____ OF _____

TRD No. _____
Rev. No. _____

DATE _____



(1) 16 CHANNELS TIME DIVISION MULTIPLEXED DATA FROM DEMODULATOR A5-J6
(2) 1200 Hz CORRECTED CLOCK, 4.5V P.P SQUARE WAVE
(3) DECODED DATA, 3.5V P-P
(4) ENABLE SIGNAL, 3.5V P-P
(5) DECOMMUTATION SIGNALS, 3.5V P.P
(6) 8 CHANNELS TELETYPE DATA. SWITCH CLOSURE AT 75 BITS/SEC
(7) FAULT INDICATION SIGNAL FAULT - +3.5VDC, NO FAULT . 0 VDC
(8) FAULT INDICATION SIGNAL FAULT - +2 VDC. NO FAULT . -4 VDC
(9) 8 CHANNELS TELETYPE DATA. 75 BITS/SEC TO PRINTERS 1-8
(10) 7 CHANNELS TELETYPE DATA. 75 BITS/SEC TO PRINTERS, 9-15
(11) 7 CHANNELS TELETYPE DATA SWITCH CLOSURE AT 75 BITS/SEC

FIGURE 11. Functional block diagram (sample).

UUT operational and safety requirements

TRD NO. _____ Page _____ of _____

Rev No. _____ Date _____

UUT Part No. _____ UUT configuration:

UUT weight _____ Analog _____
Digital _____
Hybrid _____

Requirement: The contractor shall separately document each of the following categories of UUT requirements:

a. Cooling requirements

b. Hydraulic pressure requirements

c. Safety requirements

d. Handling maintenance requirements

(Each requirement listed shall be identified by page number, drawing number, UUT configuration, and explanatory remarks, if necessary.)

FIGURE 12. UUT operational and safety requirements.

UUT POWER REQUIREMENTS

TRD No. _____ PAGE ____ OF _____

REV No. _____ DATE _____

UUT PART No. _____

AC POWER REQUIREMENTS

SOURCE / PARAMETER	#1	#2	#3	#4	#5	#6
VOLTAGE						
VOLTAGE TOLERANCE						
FREQUENCY						
FREQUENCY TOLERANCE						
MAXIMUM CURRENT						
PHASE AND REFERENCE						
CONNECTOR OR PIN HI						
CONNECTOR OR PIN LO						

DC POWER REQUIREMENTS

SOURCE / PARAMETER	#1	#2	#3	#4	#5	#6
VOLTAGE AND POLARITY						
VOLTAGE TOLERANCE						
CURRENT						
RIPPLE PERIODIC AND RANDOM VARIATION (PART)						
CONNECTOR OR PIN HI						
CONNECTOR OR PIN LO						

FIGURE 13. UUT power requirements.

UUT INTERFACE DEFINITION

UUT NAME _____ TRD NO. _____ PAGE____OF _____

UUT P/N _____ REV. _____ DATE _____

UUT CONFIG. _____

UUT REF. DES. _____

UUT CONN. REF.	UUT CONNECTOR PART NUMBER	MFR.	MFR. PART NUMBER	MATING CONN. PART NUMBER	WIRE LIST PGE. NO.

MOUNTING, HOLDING, SUPPORT FIXTURES

IDENTIFICATION (NOMENCLATURE)	PAGE NO.	DWG. NO.	MANUFACTURER

PNEUMATIC, HYDRAULIC, AND COOLING FIXTURES

IDENTIFICATION (NOMENCLATURE)	PAGE NO.	DWG. NO.	MANUFACTURER

FIGURE 14. UUT interface definition (sheet 1 of 2).

UUT INTERFACE DEFINITION

UUT NAME _____ TRD NO. _____ PAGE ___ OF _____

UUT P/N _____ REV _____ DATE _____

UUT CONFIG. _____

UUT REF. DES. _____

CONN-PIN	PIN DESIGNATION	SIGNAL NAME	DESCRIPTIVE DATA

FIGURE 14. UUT interface definition (sheet 2 of 2).

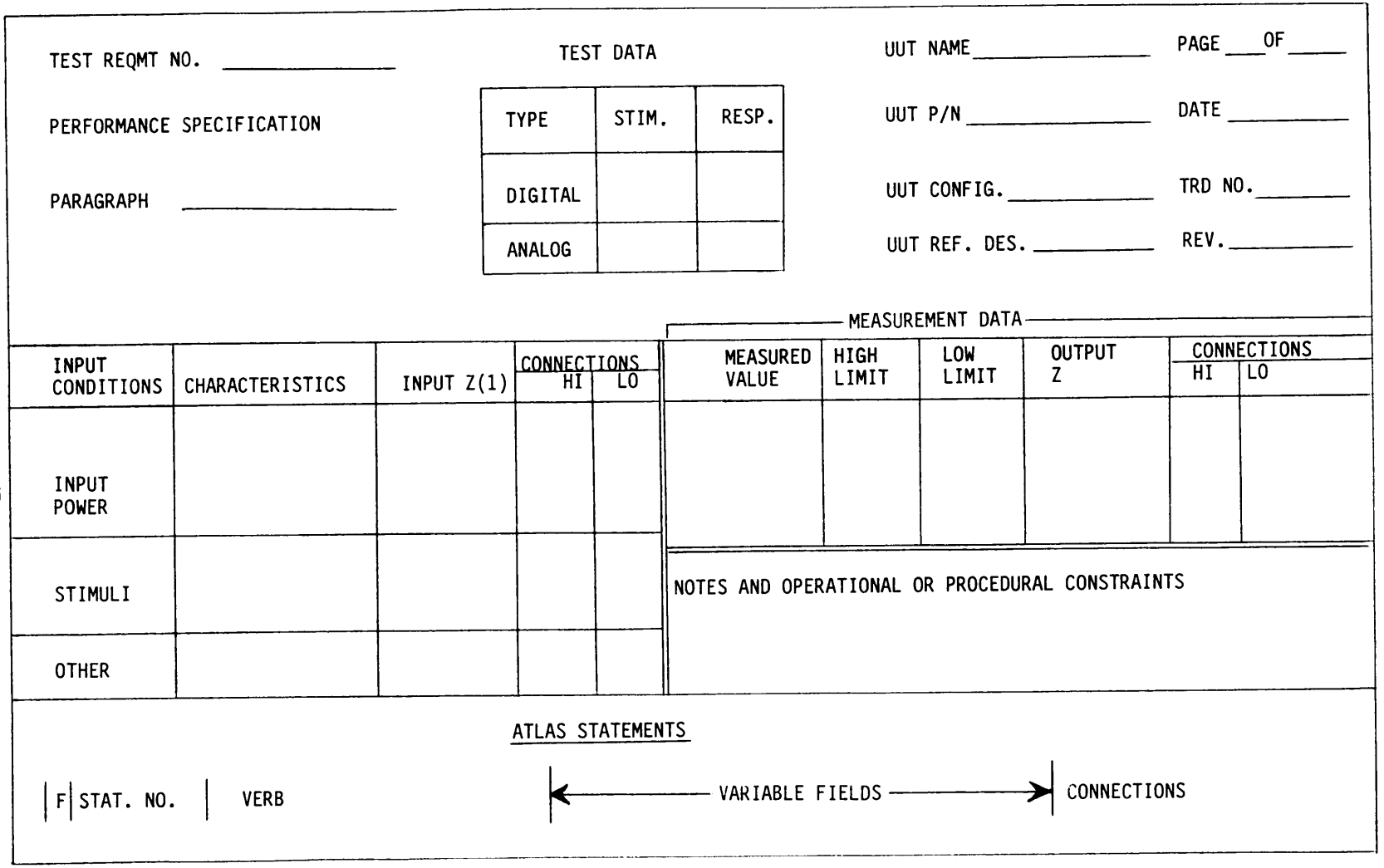


FIGURE 15. ATLAS test requirements versus performance specification characteristics.

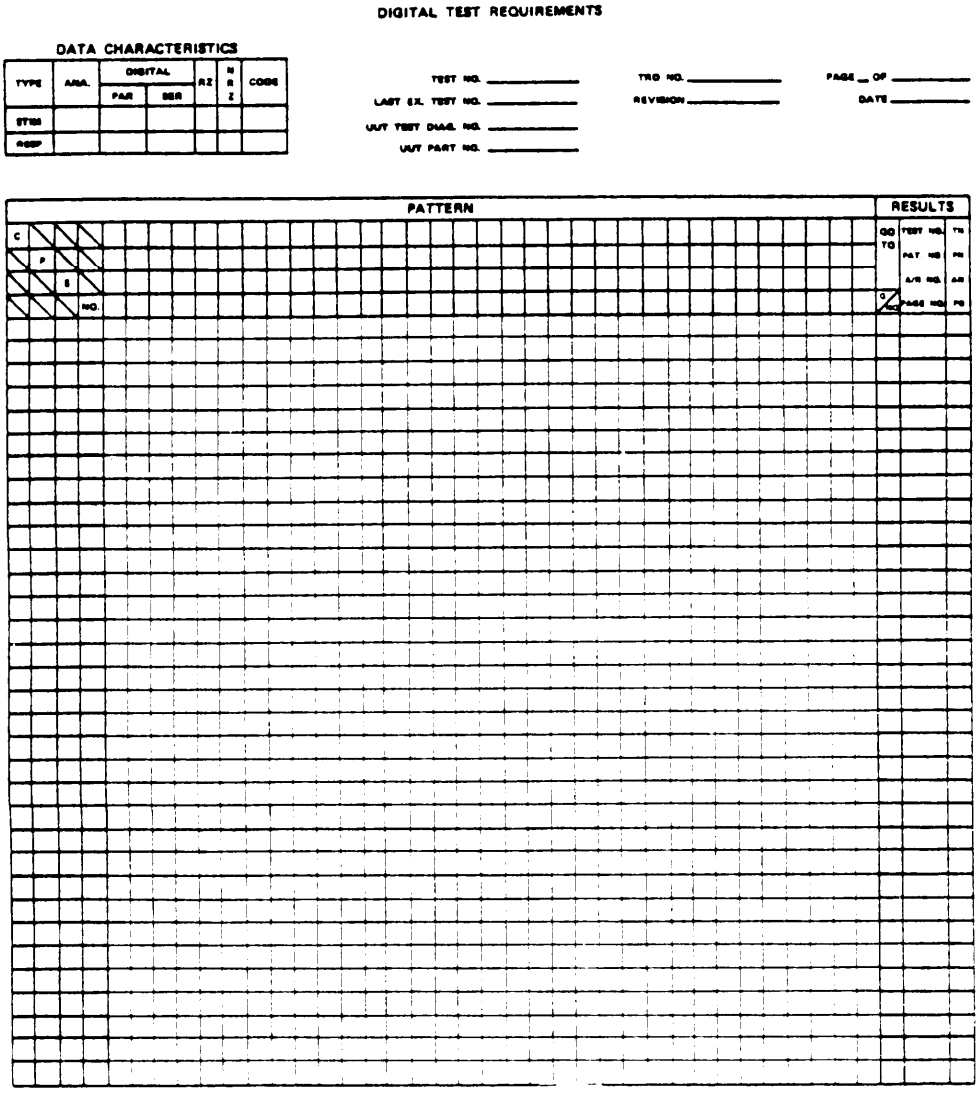
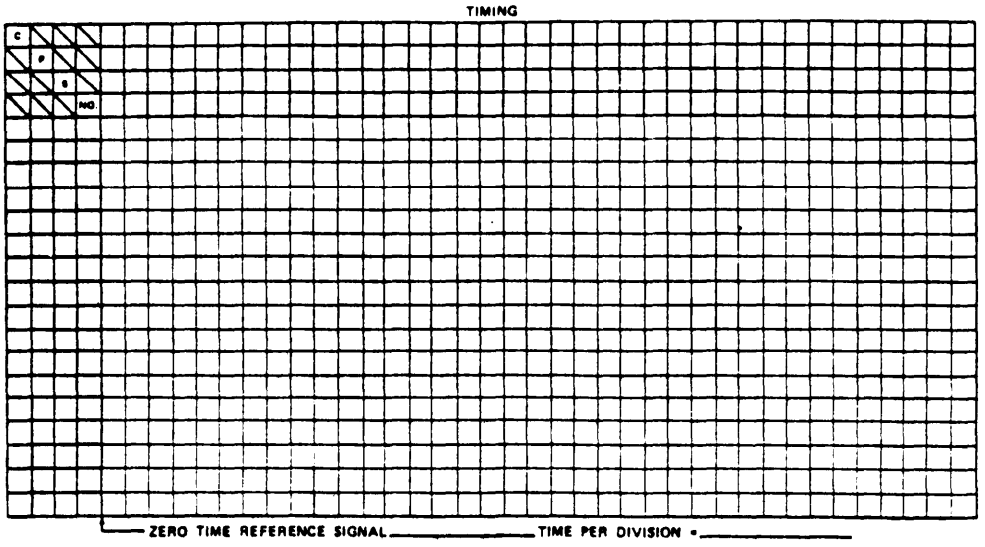


FIGURE 16. Manually generated digital test requirements (sheet 1 of 2).



DATA – CLOCK – CONTROL LINE PARAMETRIC DATA

C	P	S	NO.	START		STOP		PULSE WIDTH	PRP	LEVEL		NOTES
				TIME	STATE	TIME	STATE			HIGH	LOW	

TABLE CODE

C = CONNECTOR NO.
P = PIN NO.
NO. = PATTERN OR BIT NO., CONTROL LINE, SIGNATURE, OR REFERENCE FOR S, WHERE

S = ST (STIMULUS PATTERN) } PATTERN
S = R (RESPONSE PATTERN) } PATTERN
S = M (MASK PATTERN) } PATTERN
S = CL (CLOCK) } TIMING
S = CT (CONTROL LINE) } TIMING
S = D (DATA) } TIMING

ALIGNMENT/REPLACEMENT ACTION

A/R NO.	ACTION	A/R NO.	ACTION	A/R NO.	ACTION

FIGURE 7

FIGURE 16. Manually generated digital test requirements (sheet 2 of 2).

DIGITAL TEST REQUIREMENTS

DATA CHARACTERISTICS

TYPE	ANA.	DIGITAL PAR	DIGITAL SER	RZ	NRZ	CODE
STIM			X	X		
RESP		X				

TEST NO _____ TRD NO _____ PAGE __ OF __
LAST EX. TEST NO _____ REVISION _____ DATE __
UUT TEST DIAG NO _____
UUT PART NO _____

PATTERN

C	P	S	NO.	J1 6	J1 10	J1 25	J1 27	J1 30	J1 32	J1 34	J1 40
J1 36		St	1	1	1	0	0	1	1	0	0
		R	1	0	0	1	1	0	0	1	1
			MSB								LSB

RESULTS

GO TO	TEST NO	TN
	PAT NO	PN
	A/R NO	AN
G NG	PAGE NO	PG
NC	106	

TIMING

C
P
S
NO
J1 1 CT F
J1 8 CT L
J1 14 CT R
J1 16 CT AK
J1 15 CL
J1 21 D

ZERO TIME REFERENCE SIGNAL FLAG TIME PER DIVISION = 500 ns

DATA – CLOCK – CONTROL LINE PARAMETRIC DATA

C	P	S	NO.	START TIME	START STATE	STOP TIME	STOP STATE	PULSE WIDTH	PRF	LEVEL		NOTES
J1	1	CT	F	ZERO REF.	HIGH	3 S				3.5±1.2	0.8V	F - FLAG
J1	8	CT	L	0.8 S	HIGH	12 S				"	"	L - LOCKOUT
J1	14	CT	R	0.5 S	HIGH	9 S				"	"	R - REQUEST
J1	16	CT	AK	1±0.1 S	HIGH	9.5 S				"	"	AK - ACKNOWLEDGE
J1	18	CL		1.5 S	HIGH	REQUEST LOW	LOW	500 ns	1 MHE	"	"	CLOCK

FIGURE 17. Example of a digital test requirements sheet.

EXAMPLE OF A DIGITAL TEST REQUIREMENTS SHEET FOR

RECORDING PATTERN DATA

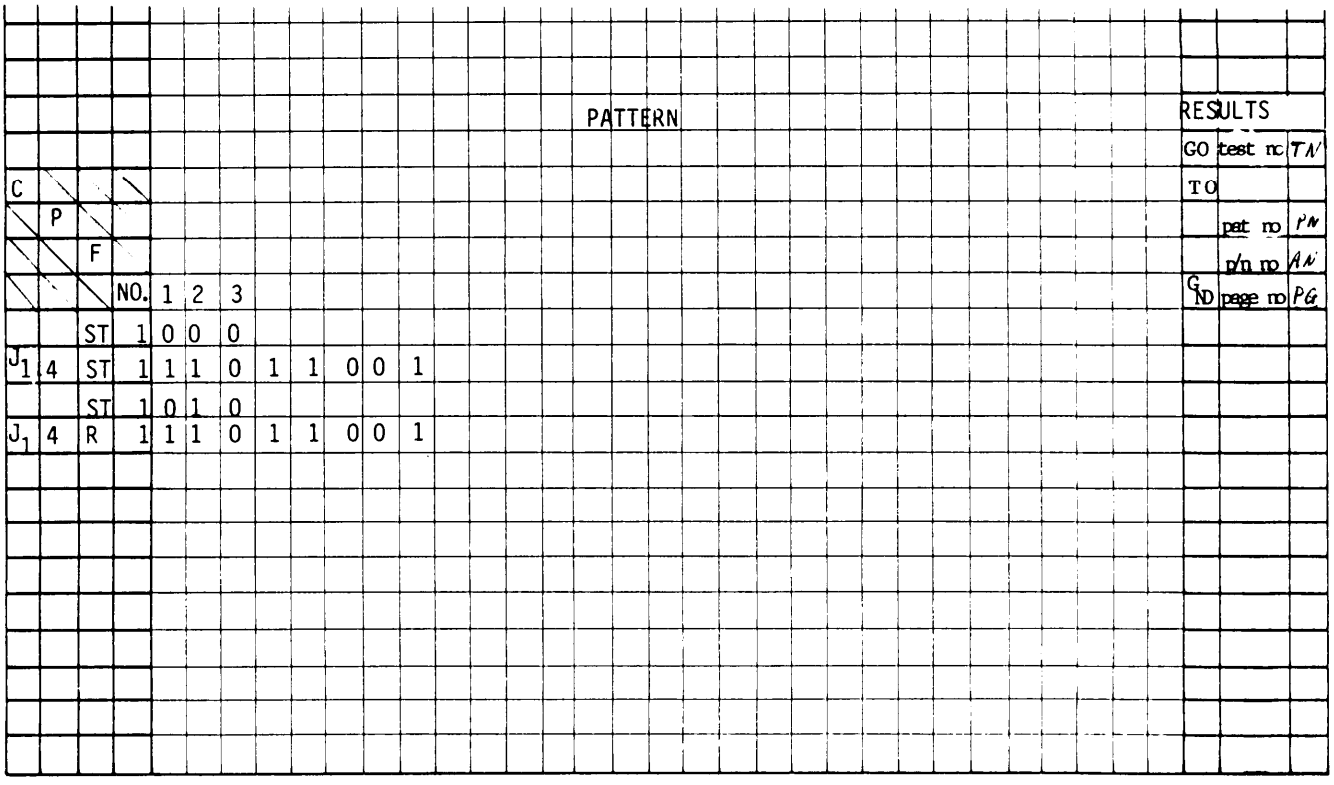


FIGURE 18. Example of a digital test requirements sheet for recording pattern data.

UUT NAME _____ TRD NO. _____ PAGE ___ OF _____

UUT P/N _____ REV _____ LATE _____

UUT CONFIG. _____

UUT REF. DES _____

STIMULUS DATA	RESPONSE DATA	FAULT ISOLATION
PSEUDO RANDOM ☐	TRANSITION COUNT ☐	XGB GUIDED PROBE ☐
COMPUTER AIDED (SIMULATION) ☐	KGB COMPARISON ☐	KGB DATA DICTIONARY ☐
MANUAL ☐	SIMULATION ☐	SIMULATION DATA DICTIONARY ☐
		SIMULATION GP ☐
CODE	E TO E TEST TIME	

ITEM NAME	CONTRACTOR	MFR PART NO.	DOCUMENTATION
SIMULATOR			
TEST EQUIPMENT			
INTERFACE ADAPTER			
SOFTWARE			
TESTER ACCESSORIES			
PERIPHERALS			

FIGURE 19. ATPG system information sheet.

GENERAL UUT TEST CONSTRAINTS COVER SHEET

TRD NO. _____ PAGE _____ OF _____

REV NO. _____ DATE _____

GENERAL PROCEDURE	NONE	SEE PAGE
VISUAL INSPECTION	0	
RESTART OR RETEST INSTRUCTIONS	0	
STANDARD MEASUREMENT DELAY REQUIREMENTS	0	
GENERAL PRECAUTIONS	0	
PRETEST INSTRUCTIONS	0	
ALIGNMENT PROCEDURES	0	

SPECIAL PRECAUTIONS	NONE	SEE PAGE
LEAD LENGTH	0	
SEPARATION	0	
SHIELDING	0	
GROUNDING	0	
TRANSIENTS, POWER SEQUENCE	0	
LOAD MATCHING, VSWR	0	
OTHER	0	

FIGURE 20. General UUT test constraints cover sheet.

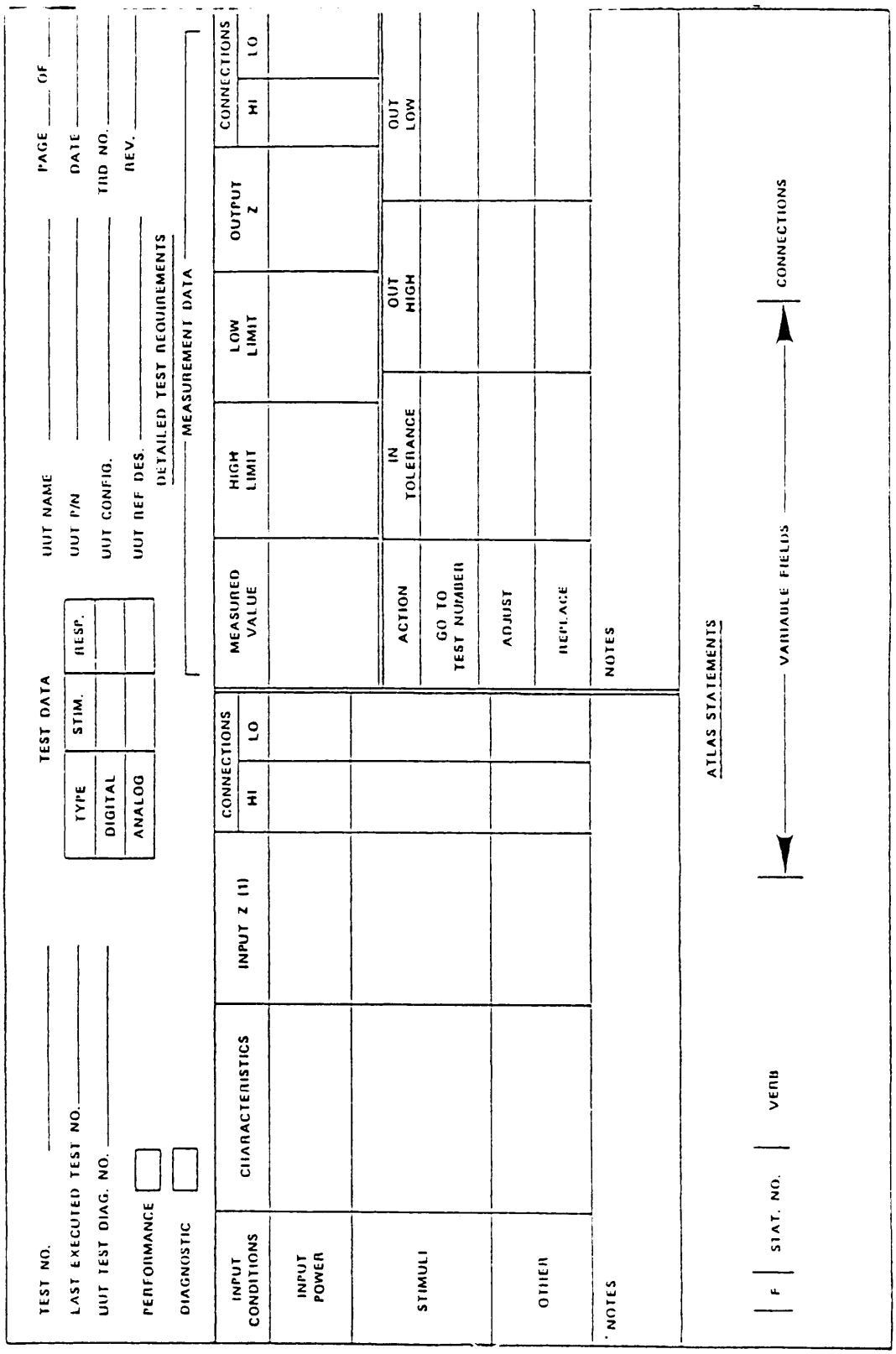


FIGURE 21A. Detailed test requirements information sheets (sheet 1 of 2).

TEST NO. _____ UUT NAME _____ PAGE ___ OF _____

LAST EXECUTED TEST NO. _____ UUT P/N _____ DATE _____

UUT TEST DIAGRAM NO. _____ UUT CONFIG. _____ TRD NO. _____

UUT REF DES. _____ REV. _____

PERFORMANCE ☐

DIAGNOSTIC ☐

DETAILED TEST REQUIREMENT INFORMATION CONTINUATION SHEET

FIGURE 21A. Detailed test requirements information sheets (sheet 2 of 2).

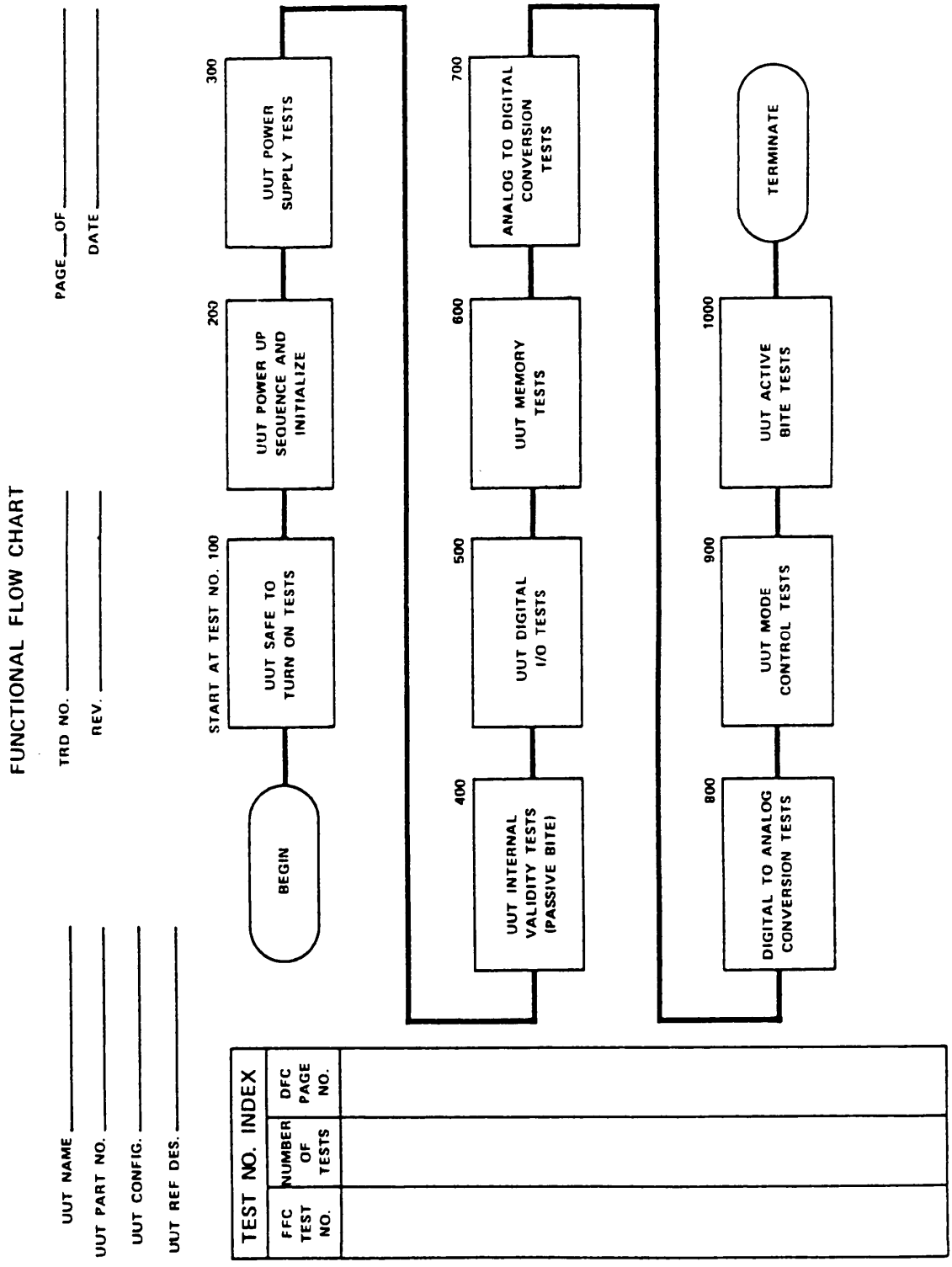


FIGURE 21B. Test requirements functional flow chart.

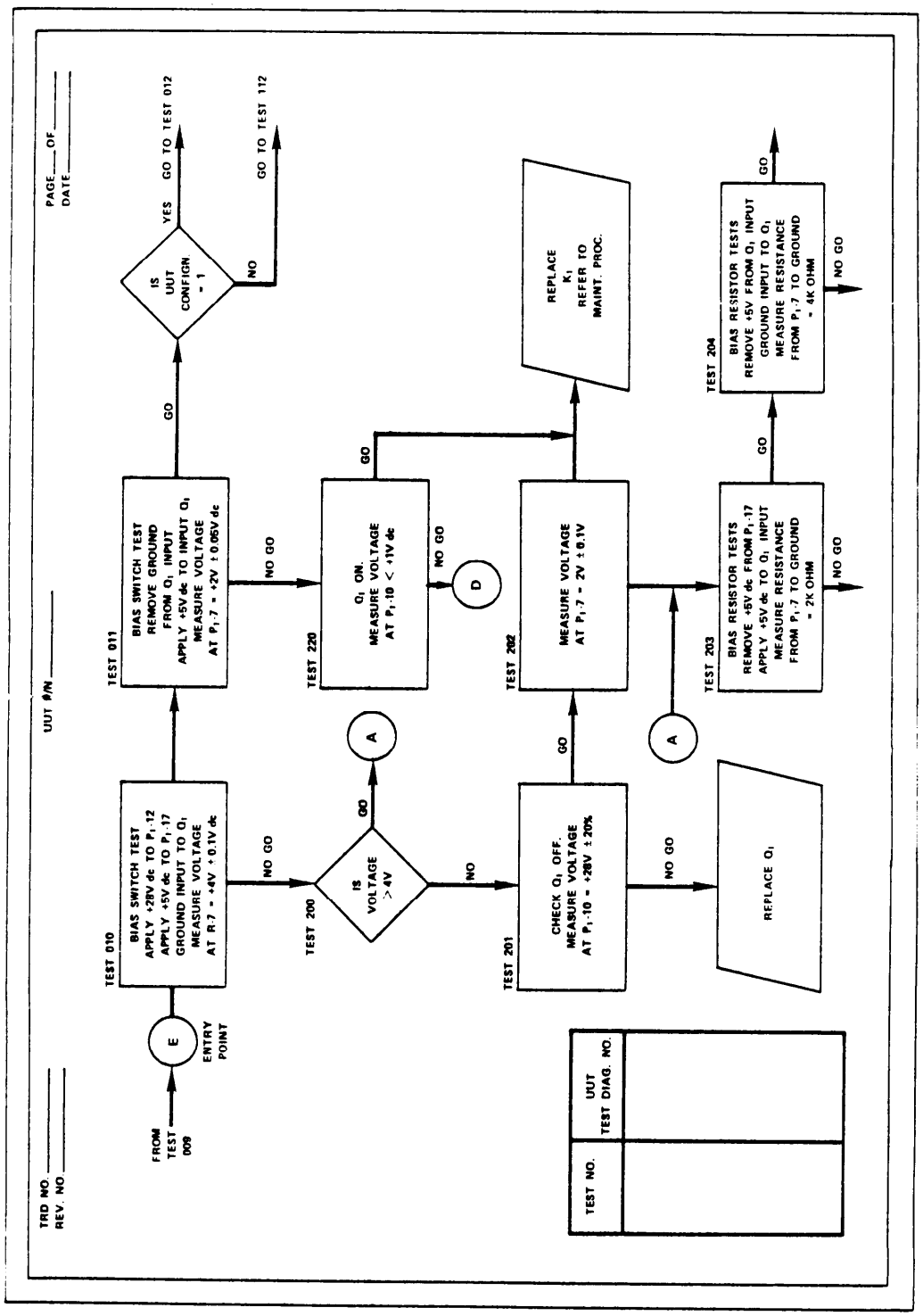


FIGURE 21C. Test requirements diagnostic flow chart.

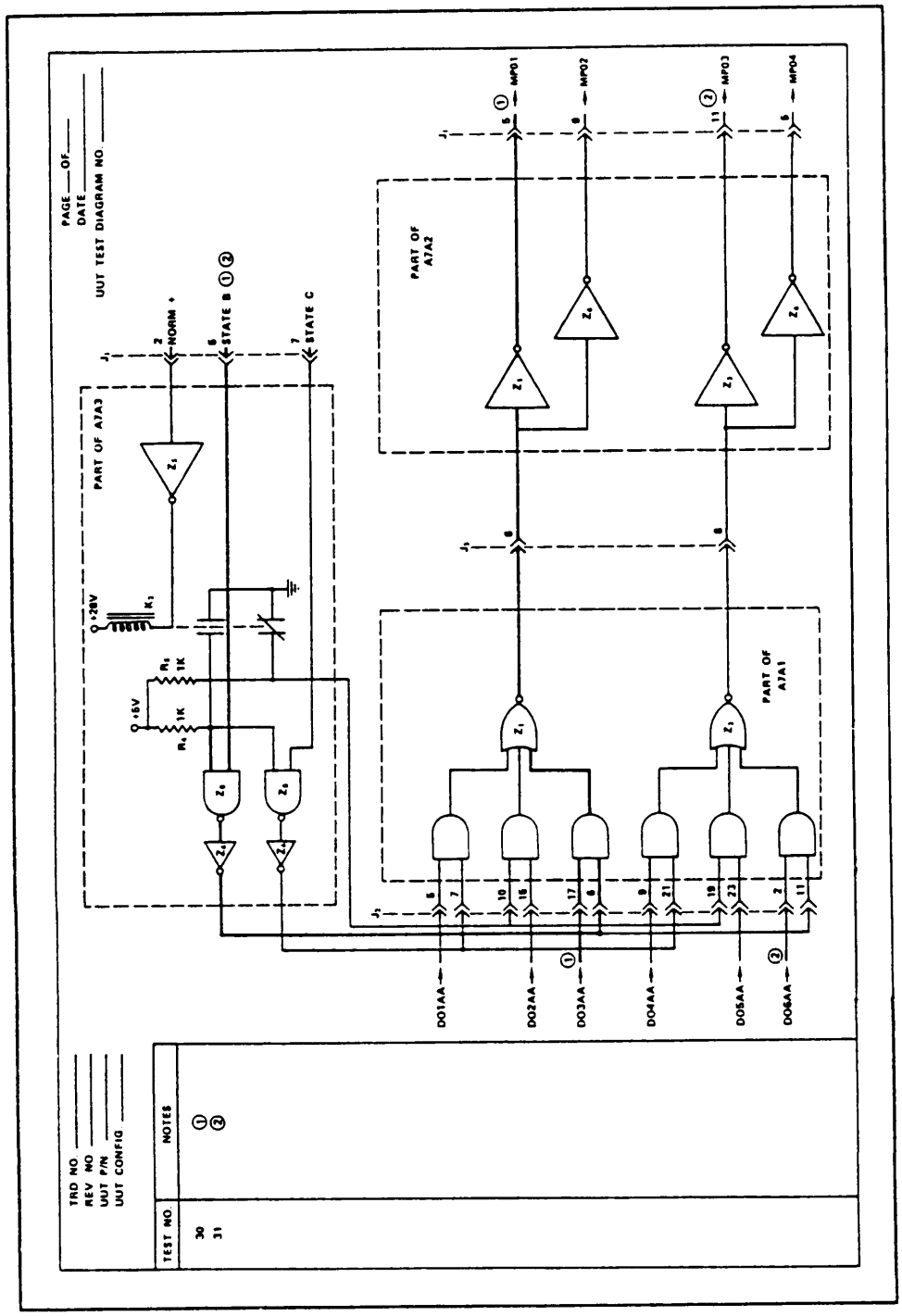


FIGURE 21D. UUT test requirements, test diagram.

TRD NO. _____ PAGE_____ OF_____

REV. NO. _____ DATE_____

Manual Test Set-up Diagram

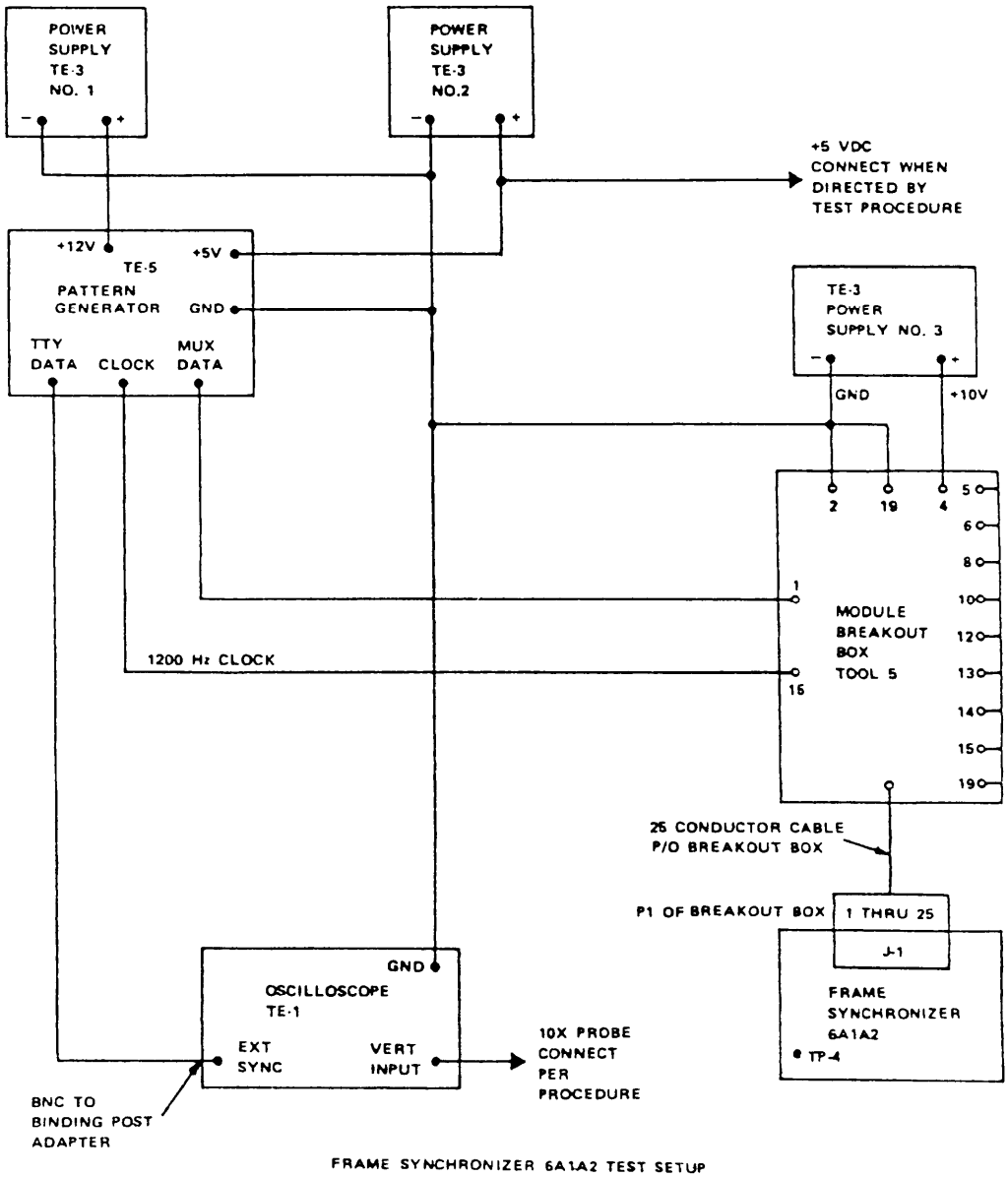


FIGURE 22. Manual test set-up diagram.

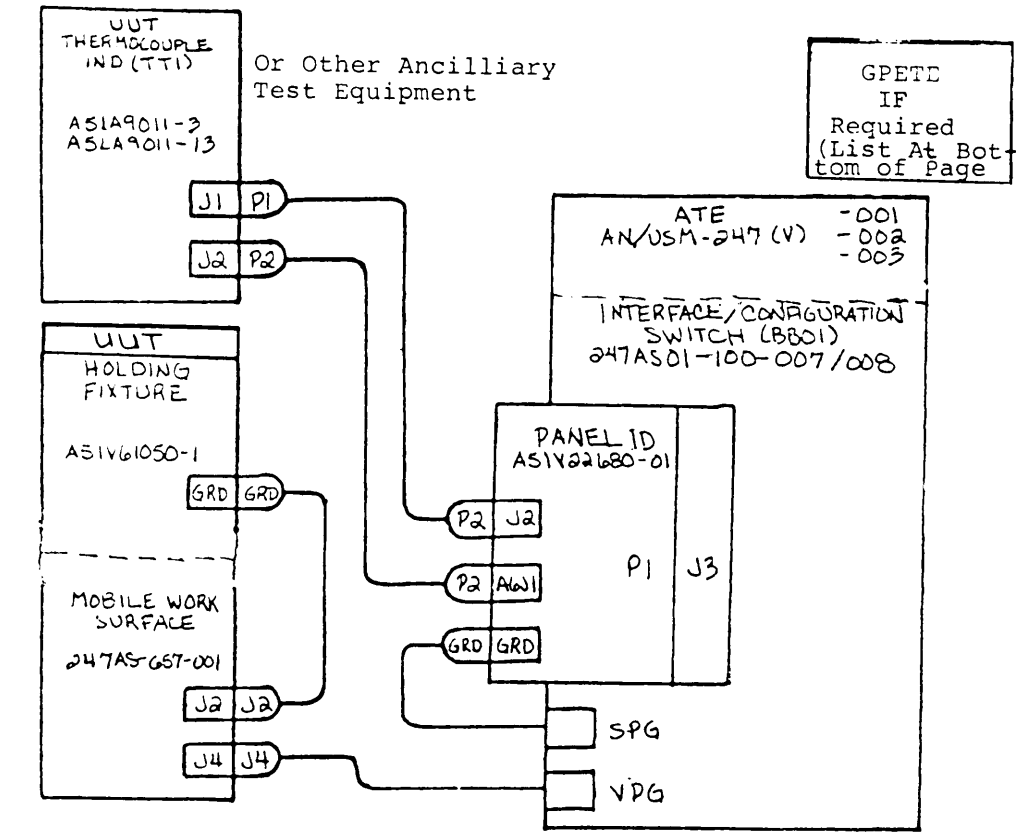
TRD No. _____

Rev. No. _____

Page _____ of _____

Date _____

Automatic Test Set-up Diagram (Sample)



NOTES:

1. INTERCONNECTION IS IDENTICAL FOR THE THERMOCOUPLE TEMPERATURE IND. CONFIGURATION LEVELS:
   A51A90011-3
   A51A90011-13
2. IDENTIFICATION CABLES AND GROUND STRAPS:
   W2A51A21072-1 - A51A9011-3-J1-A51V22680-01-J2
   W4A51V21074-1-A51A9011-13-J2-A51V22680-01-A6J1
   GS1A51U24056-1-A51V61050-1-GND-247AS-657-001-J2
   GS2A51U24058-1-247AS-657-001-J4-247AS01-100-007/008-VPG
   GS3A51U24057-1-A51V22680-01-GND-247AS01-100-007/008SPG
3. CONNECTOR MATING AND KEYING CONVENTION PER APPLIANCE ID DWG/SPEC.

FIGURE 23. Automatic test set-up diagram.

FED No. ________ Page ___ of ___

Rev. Date ________ Date ________

TEST EQUIPMENT LIST

Item	Name	Qty	Item Identification	Test Equipment Type				UUT	Tolerances
						C.PETE			
				ATE	SPETE	STD	Non Std	Measurement Parameters	

FIGURE 24. Test equipment and tool list (sheet 1 of 2).

TRD NO. _____ PAGE ___ OF _____

REV. NO. _____ DATE _____

TOOL LIST (SAMPLE)

Item	Name	Qty.	Item identification
1.	Test probe, oscillator	1	Part of AN/USM281
2.	Adapter	1	BNC male to banana binding post, OS276 170S, or equal
3.	Patch cord	13	121.92 centimeters (cm)(4 feet (ft)) of test lead wire with stack-up banana plug on each end, OS276 B-48, or equal
4.	Patch cord	1	20.32 cm (8 inches(in)) of test lead wire with stack-up banana plug on each end, 9S276 B-8, or equal
5.	Breakout box	1	test fixture 70328 MBB-S

FIGURE 24. Test equipment and tool list (sheet 2 of 2).

TEST FIXTURE PARTS LIST
(SAMPLE)

For: 37-Pin Breakout Box

TRD NO. _____ Page ____ of _____

Rev. No. _____ Date: _____

Qty	Item	Description
1	Utility case	16 gauge aluminum, 15.24 cm (6 in) by 22.86 cm (9 in) by 12.70cm (5 in), 02954 AC-695, or equal
1	Connector	27 contact, MIL-M-24308/l-4
121.92 cm Cable (4 ft.)		37 conductor, stranded, 20 gauge, 92194 5226, or equal
1	Cord set	3 conductor, AWG 18, type SV cable, 182.88cm (6 ft) long, 92194 775, or equal
1	Grommet	Rubber, for 1.905 cm (0.75 in) hole; 83339 2186, or equal
1	Strain relief	For SV cord, 83330 939, or equal
1	Banana jack	Black, insulated 83330 256, or equal
2	Banana jack	Red, insulated, 83330 256, or equal
29	Banana jack	White, insulated, 83330 256, or equal
1	Switch	Toggle, DPST, 115V, 1OA, ST52K
1	Indicator light	Red, 115 V, neon type, 83330 1916, or equal

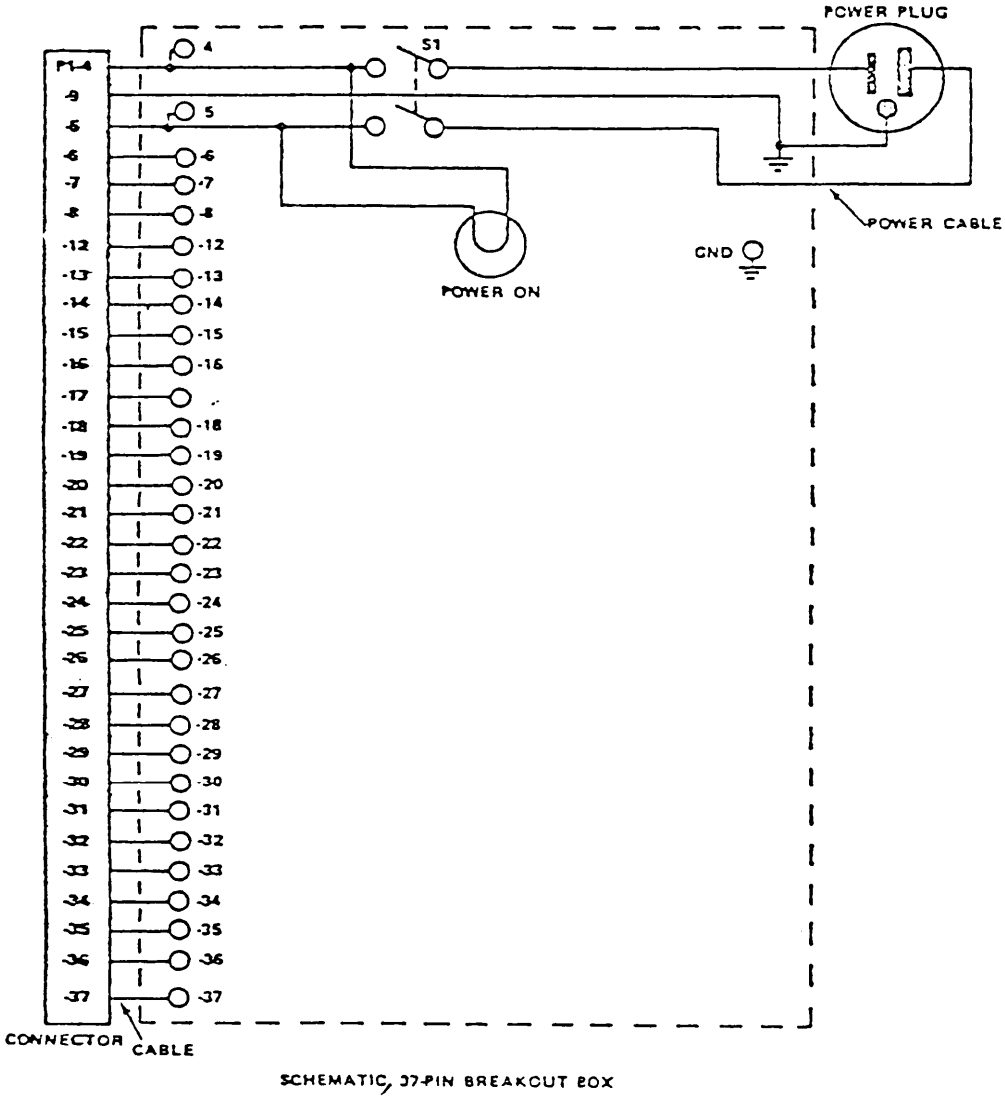
FIGURE 25. Test fixture parts list.

TEST FIXTURE SCHEMATIC
(SAMPLE;

FOR: 37-Pin Breakout Box

TRD No.: _____ Page ____ of _____

REV. No.: _____ Date: _____



SCHEMATIC, 37-PIN BREAKOUT BOX

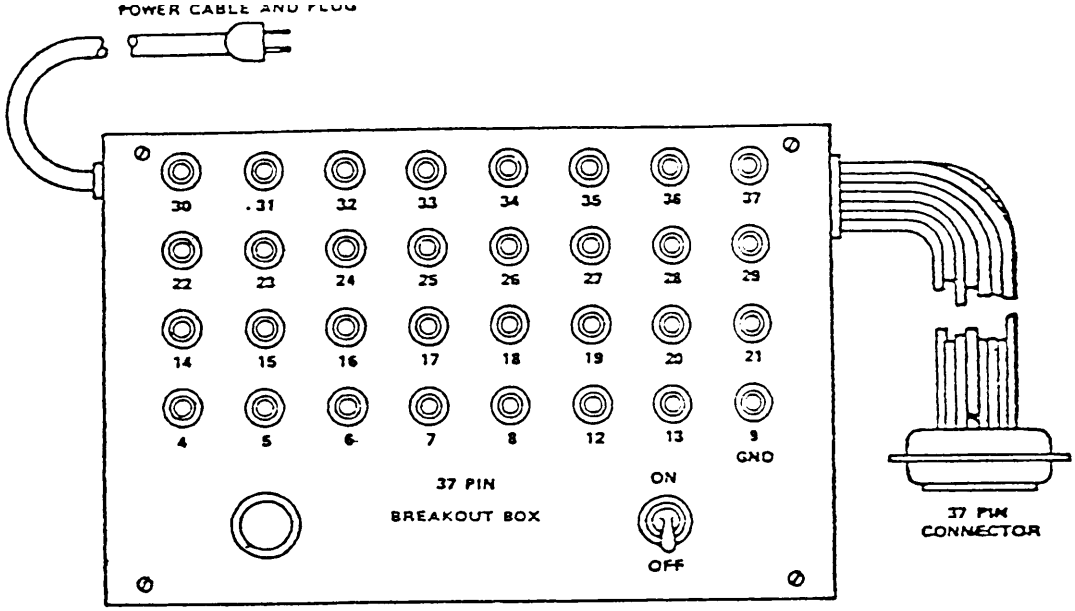
FIGURE 26. Test fixture schematic.

TEST FIXTURE PANEL MARKING DRAWING

FOR: 37-Pin Breakout Box

TRD No.: _____ Page ____ of _____

REV. No.: _____ Date: _____



Example of test fixture pictorial diagram

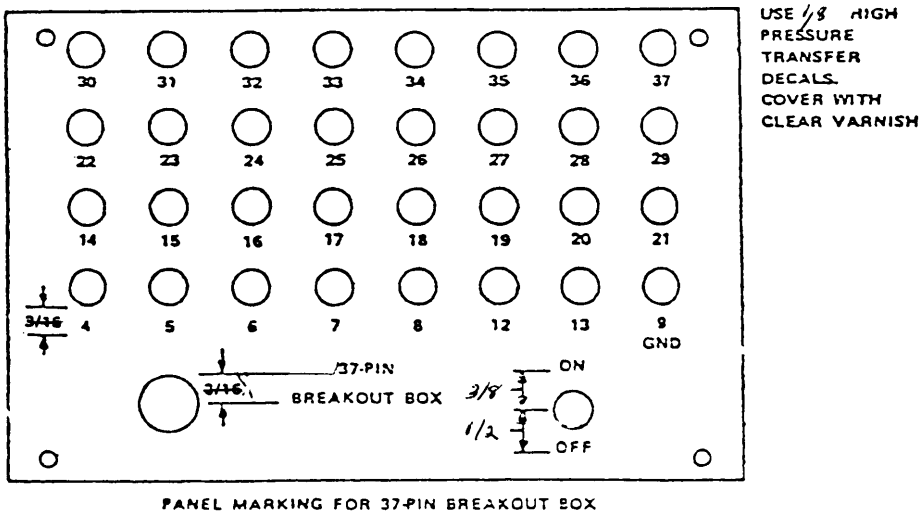


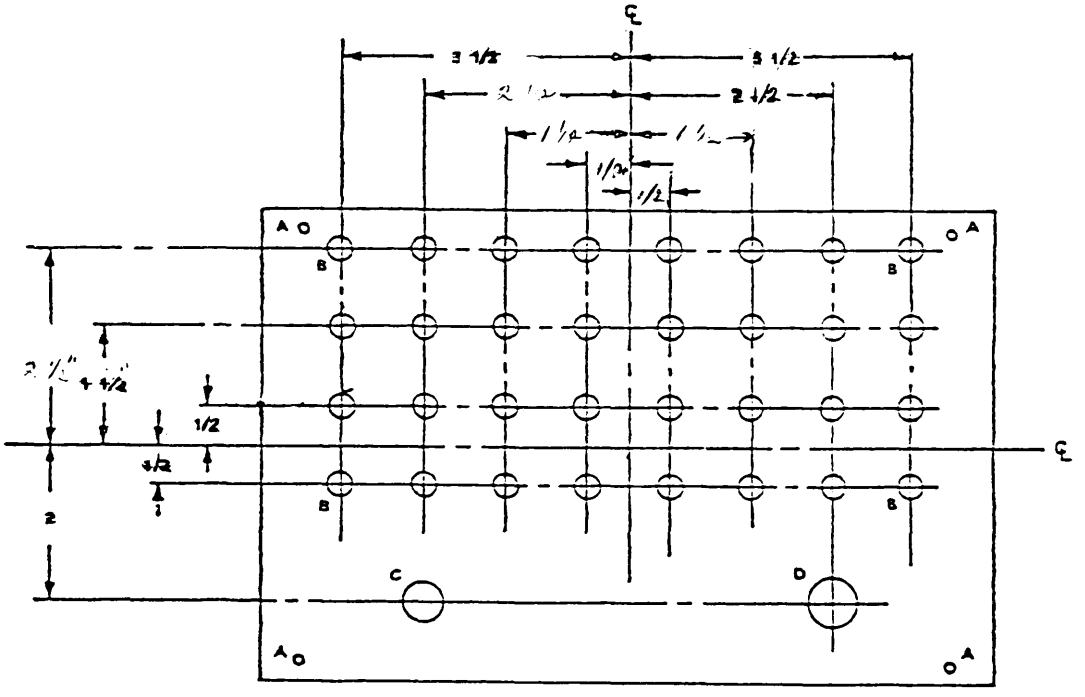
FIGURE 27. Test fixture panel marking drawing.

TEST PANEL DRILLING DRAWING
(SAMPLE)

FOR: 37-Pin Breakout Box

TRD NO.: _____ Page _____ of _____

REV. No.: _____ Date: _____



NOTES:

1. A-4 holes 1/8″ dia (existing panel mtg holes)
2. B-34 holes 5/16″ dia ± 0.010″
3. C-1 hole 15/32″ dia ± 0.012"
4. D-1 hole 1/2″ dia ± 0.020″
5. Tolerance: ± .032 unless otherwise specified herein
6. Material: Cover of aluminum utility case, 02954 AC-695
7. Scale: Approximately 2:1

FIGURE 28. Test fixture panel drilling drawing.

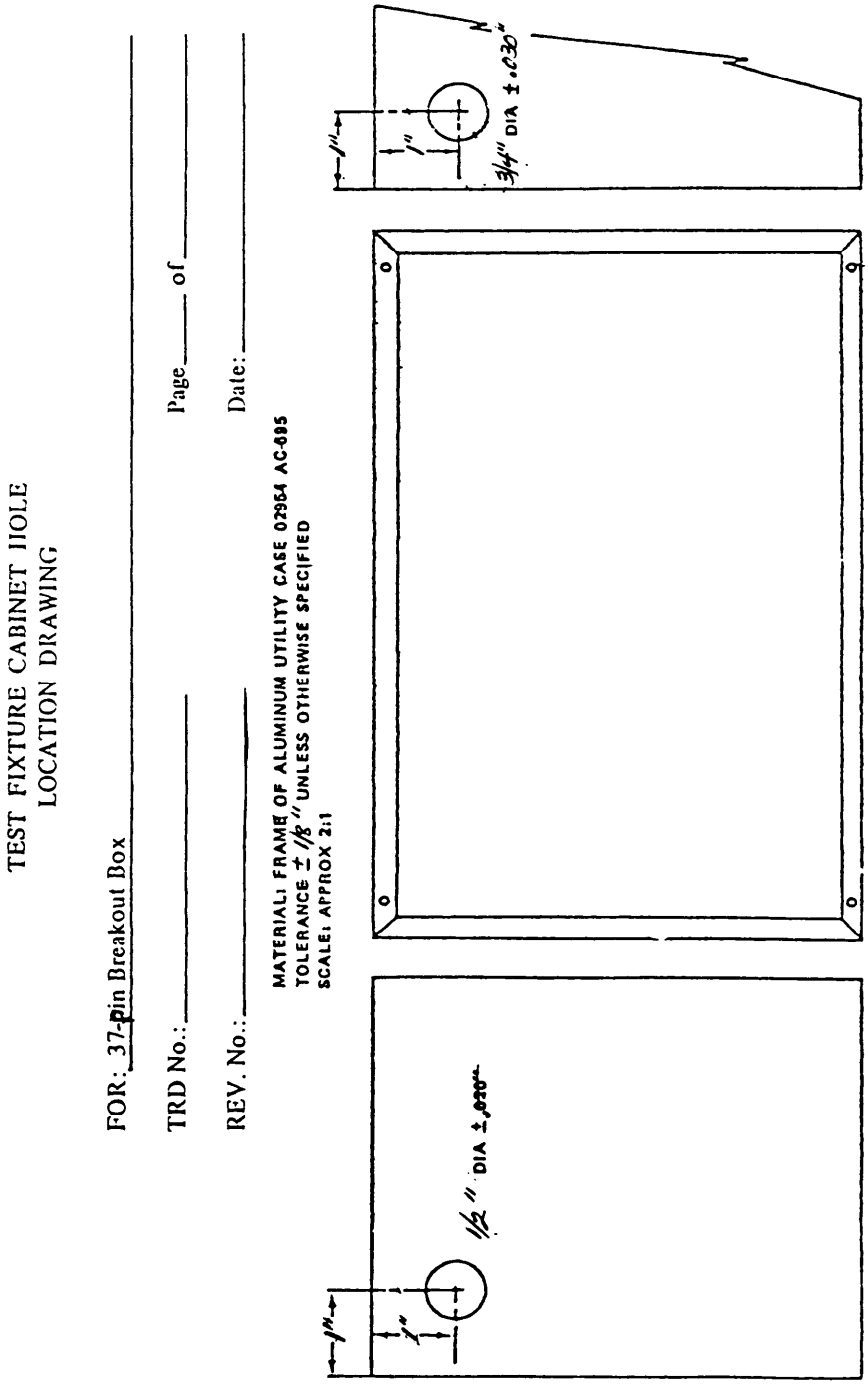


FIGURE 29. Test fixture cabinet hole location drawing.

UUT Performance Specification Test Requirements Matrix

TRD No. _____ Page____of _____

Rev. No. _____ Date _____

UUT P/N UUT config. _____

UUT test requirement number	UUT performance specification (Number and paragraph)				

FIGURE 30. UUT performance specification test requirements matrix (sheet 1 of 2).

UUT Performance Specification
Test Requirements Matrix

TRD No. _____

Rev. No. _____

UUT P/N _____

Page ____ of _____

Date _____

UUT test req. number	UUT performance requirements and test numbers								UUT drawing No.
	Test No.								
		Test No.							
			Test No.						
				Test No.					
					Test No.				
						Test No.			
							Test No.		

FIGURE 30. UUT performance specification test requirements matrix (sheet 2 of 2).

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APPENDIX C

APPLICATION OF UUT FAILURE RATE DATA

10. SCOPE

10.1 Scope. This appendix specifies the methodology by which UUT component failure rate data shall be collected and utilized. The data collected are required to provide a basis for the evaluation of the achievement of test program design goals. It is an essential input to the formulation of a TPS. The categories of data documented shall consist of UUT failure data, fault data, and ambiguity group summary data.

20. REFERENCED DOCUMENTS

20.1 Government documents. The following document, of the issue listed in the Department of Defense Index of Specifications and Standards (DoDISS) and its supplements, forms a part of this appendix to the extent specified herein. The date of the applicable DoDISS and supplements thereto shall be as specified in the solicitation.

HANDBOOKS

MILITARY

MIL-HDBK-217 Reliability Prediction Of Electronic Equipment

(Copies of handbooks required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

30. GENERAL REQUIREMENTS

30.1 Data requirements. The principal use of the data shall be as inputs to the development of TPS which shall be used for that purpose in conjunction with other information and data. It also serves to provide a basis for a decision evaluating achievement early in the TPS design program and outlining corrective action when required. Although the significance of these data is important, it does not relieve a TPS developer (for example, contractor) of the responsibility of validating a TPS by fault insertion or other acceptable means of validation or verification. The tabulated data covered by this appendix shall be properly considered engineering design data which may be utilized for the design and the monitoring and evaluation of a TPS during its development.

40. DETAILED REQUIREMENTS

40.1 Failure index sheet. A failure index shall be provided as a part of the test requirements. The failure index shall list the prime failure modes of all inputs and outputs of each next lower assembly of the UUT. Each entry shall be identified as a detectable, nondetectable, or nonfunctional failure mode. Nondetectable and nonfunctional failure modes shall be identified and justified on the basis that the failure will not affect any higher assembly. A nondetectable failure mode is a failure mode that cannot be detected by any functional test. A nonfunctional failure mode is a failure mode that can be detected by a functional test, but no repair action is required because failure will not affect the performance in any higher assembly in any operating mode under specified service environmental conditions. Each detectable failure mode shall be referenced to the appropriate end-to-end test designed to detect the failure (see FIGURE 31).

40.2 Failure rate tables. The failure rate data tables shall be as specified in 40.2.1 through 40.2.3.

40.2.1 UUT failure data (see TABLE II). The data recorded in TABLE II shall be UUT component failure rate data in accordance with MIL-HDBK-217. The data required shall be failure data descriptive of the failure characteristics of all levels of a system hierarchy. The data should assure failure rate traceability from the system level down through subsystems and modules, including reparable components.

40.2.2 Failure rate and fault isolation croup summary (see TABLE III). TABLE III is the standard form specified for the documentation of failure rate and fault isolation data descriptive of ambiguity groups. TABLE III is a summary of the data tabulated in TABLE IV (parts A through C). TABLE III compilation requires that TABLE IV data be summarized in five standard ways. The five standard ways shall be as specified in 40.2.2.1 through 40.2.2.5.

40.2.2.1 λ_T Sum of the total lambda (rate). λ_T shall be obtained by summing all the individual failure rates (that is, $\sum_{i=1}^{n} \lambda_i$) from TABLE IV for a UUT and entering that number in the first row of TABLE III.

40.2.2.2 λ_{TA} Sum of total lambda minus the nondetects. λ_{TA} shall be obtained by summing all the individual failure rates (that is, $\sum_{i=1}^{n} \lambda_i$) from TABLE IV for a UUT and subtracting from that number the failure rates for all of the nondetectable faults (that is, $\lambda_T - \lambda_A$) conditions found in the data recorded in part C of TABLE IV.

40.2.2.3 Sum of lambda in percent of groups ≤ 4. $\frac{\sum \lambda^4}{\lambda_{TA}}$ shall be obtained by summing the failure rates for all ambiguity groups with a group code of A shown in TABLE IV and dividing that number by λ_{TA}.

40.2.2.4 Sum of lambda in percent of >4 and ≤ 8. $\frac{\sum \lambda^8}{\lambda_{TA}}$ shall be obtained by summing the failure rates for all ambiguity groups with a group code of B shown in TABLE IV and dividing that number by λ_{TA}.

40.2.2.5 Sum of lambda in percent of groups >8 and ≤ 10. $\frac{\sum \lambda^{10}}{\lambda_{TA}}$ shall be obtained by summing the failure rates for all ambiguity groups with a group code of C shown in TABLE IV and dividing that number by λ_{TA}.

40.2.3 Fault data (see TABLE IV). TABLE IV is a composite table consisting of three principal parts (parts A through C). The parts are used for recording detectable insertable faults, detectable destructive faults, and nondetectable faults, respectively. Each of the parts shall be as specified in 40.2.3.1 through 40.2.3.3. Parts A and B have identical formats. Part C shall be limited to numbering, designation, and failure modes of nondetectable faults. The right hand column of each of the forms shall be used for explanatory comments. The coding of information for entry within parts A and B shall be the same. The codes are listed at the bottom of each form. All of the forms shown in TABLE IV are designed to provide a standard format for the documentation of data needed to account for each component of a UUT in terms of their failure modes and fault categorization.

40.2.3.1 Detectable insertable faults (see TABLE IV, part A). TABLE IV, part A, shall be organized into 11 columns and the required number of rows to identify all of the faults of this category for the UUT. The column headings of this form are identical to the column headings in TABLE IV, part B. In each instance the column headings are self-identifying and require no further explanation.

40.2.3.2 Detectable destructive faults (see TABLE IV, part B). This category of faults shall be documented in the same way as detectable insertable faults (see 40.2.3.1). Only the data entered is unique to this fault category.

40.2.3.3 Nondetectable faults (see TABLE IV, part C). A nondetectable fault is a fault which by definition cannot be detected by a functional test. Part C differs from parts A and B in that it does not contain ambiguity group designation and descriptive data. Part C is primarily concerned with the identification and the failure rates of nondetectable failures.

40.3 Utilization of UUT failure rate data. A functional flow block diagram and a schematic diagram of a typical UUT subject page for this appendix is shown in FIGURES 32 and 33. FIGURE 34 identifies component types and-primary failure modes likely to appear in the data tables. TABLE IV, parts A, B, and C are the basis for TABLE 111. TABLE 111 summarizes data of utility to the decision process and the continued development of the TPS. This is accomplished by analysis of the data registered in TABLE III. For example, analysis of the meaning of the data contained in completed TABLE III, reveals that 90.88 percent of the insertable detectable faults can be fault-isolated to four or fewer components of the UUT.

FAILURE INDEX SHEET

REF. DESIGNATION	PIN CONN.	SIGNAL NAME	SIGNAL TYPE	FAILURE MODE	FAILURE TYPE	TEST NUMBER OR COMMENT
1A12	23	CLOCK A	OUTPUT	SA1	DETECT	101200
1A12	23	CLOCK A	OUTPUT	SA0	DETECT	101200
1A12	24	SYNC	OUTPUT	SA1	DETECT	151600
1A12	24	SYNC	OUTPUT	SA0	DETECT	151200
1A12	25	HDG LSB	INPUT	SA1	NONDETECT	NOT USED
1A12	25	HDG LSB	INPUT	SA0	NONDETECT	NOT USED

FIGURE 31. Failure index sheet.

TABLE II. UUT failure data.

FAILURE RATE DATA FORM

DATE _____ SHEET NO. _____

SYSTEM _____ EQUIPMENT _____ UNIT _____ MODULE _____

OPERATING CONDITION _____

PART IDENTIFICATION					4	5	6	7	8	9	10	11	12
1 ASSEMBLY OR BOARD CODE	2 SUB-ASSEMBLY OR BOARD CODE	3 REFERENCE DESIG. LTRS	NUMBER CODE	LTR	PART TYPE OR PART DRAWING NUMBER	FAILURE RATE FIGURE	ELECTRICAL AND MECHANICAL STRESS RATIO	TEMP (°C)	FAILURE RATE CON-TROLLED TEST CONDITION	ADJUSTMENT FACTOR	APPLICATION K-FACTOR	APPLICATION FAILURE RATE	NOTES

TABLE III. Failure rate and fault isolation ambiguity group summary.

UUT P/N_____	DATE_____
λ_T (SUM OF TOTAL LAMBDA)	_____
λ_{TA} (SUM OF TOTAL LAMBDA MINUS THE NONDETECTS)	_____
$\frac{\Sigma\lambda\ 4}{\lambda_{TA}}$ (SUM OF THE LAMBDAS IN PERCENT OF GROUPS ≤ 4)	_____
$\frac{\Sigma\lambda\ 8}{\lambda_{TA}}$ (SUM OF THE LAMBDAS IN PERCENT OF GROUPS >4 and ≤ 8)	_____
$\frac{\Sigma\lambda\ 10}{\lambda_{TA}}$ (SUM OF THE LAMBDAS IN PERCENT OF GROUPS >8 and ≤ 10)	_____
λ_T (SUM OF TOTAL LAMBDA)	9.5720
λ_{TA} (SUM OF TOTAL LAMBDA MINUS THE NONDETECTS)	9.2631
$\frac{\Sigma\lambda\ 4}{\lambda_{TA}}$ (SUM OF THE LAMBDAS IN PERCENT OF GROUPS ≤ 4)	90.88 percent
$\frac{\Sigma\lambda\ 8}{\lambda_{TA}}$ (SUM OF THE LAMBDAS IN PERCENT OF GROUPS >4 AND ≤ 8)	10.12 percent
$\frac{\Sigma\lambda\ 10}{\lambda_{TA}}$ (SUM OF THE LAMBDAS IN PERCENT OF GROUPS >8 AND ≤ 10)	0 percent

TABLE IV. Detectable insertable faults (part A).

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FAIL. FEATURES	COMMENTS

λi Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable insertable faults (part A). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
1	C10	SHORT	0.000050	0150	C1, C10	0.0222	$5x10^{-6}$	A		
2	C1	SHORT	0.000200	0150	C1, C10	0.9777	0.00023	A		
3	C9	SHORT	0.000025	0200	C9	1.0000	$2.5x10^{-6}$	A		
4	C5	SHORT	0.00220	0250	C5	1.0000	0.00023	A		
5	C6	SHORT	0.00115	0300	C6	1.0000	0.00012	A		
6	C7	SHORT	0.00075	0350	C7	1.0000	0.00008	A		
7	C1	OPEN	0.002200	0400	C1, R18	0.9905	0.00023	A		
8	R18	OPEN	0.000021	0400	C1, R18	0.0095	$2.2x10^{-6}$	A		
9	C5	OPEN	0.00220	0450	C5,C6,R19	0.6526	0.00023	A		

λ_i Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable insertable faults (part A). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
10	C6	OPEN	0.00115	0450	C5,C6,R19	0.3411	0.00012	A		
11	R19	OPEN	0.000021	0450	C5,C6,R19	0.0062	2.2×10^{-6}	A		
12	C7	OPEN	0.00075	0500	C7,R20	0.9728	0.000078	A		
13	R20	OPEN	0.000021	0500	C7,R20	0.0272	2.2×10^{-6}	A		
14	R16	OPEN	0.000021	0600	R16	1.0000	2.2×10^{-6}	A		
15	L1	OPEN	0.200000	0650	L1	1.0000	0.02089	A		
16	L2	OPEN	0.200000	0700	L2	1.00000	0.02089	A		
17	R17	OPEN	0.000021	0750	R17,R21	0.5000	2.2×10^{-6}	A		
18	R21	OPEN	0.000021	0750	R17,R21	0.5000	2.2×10^{-6}	A		

λ_i Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable insertable faults (part A). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
19	FL1	OPEN THRU	1.50000	0775	FL1, R3	1.0000	0.15671	A		
20	R3	OPEN	0.000021	0775	FL1, R3	0.0000	2.2×10^{-6}	A		
21	FL 1	SHORT	1.50000	0780	FL1	1.0000	0.15671	A		
22	R6	OPEN	0.004500	0870	R7, R6	0.0012	0.00047	A		
23	R7	OPEN	3.680000	0870	R7,R6	0.9988	0.38445	A		
24	R9	OPEN	0.000021	0870	R9,Q4,R1	0.0004	2.2×10^{-6}	A		
25	Q4	OPEN	0.04875	0870	R9,Q4,R1	0.9992	0.00509	A		
26	R1	OPEN	0.000021	0870	R9,Q4,R1	0.0004	2.2×10^{-6}	A		
27	C12	OPEN	0.01495	0900	C12	1.0000	0.00156	A		

λ_i Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable insertable faults (part #). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN SPECIFICITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
28	AR1	OPEN	0.003007	0965	AR1, R12	0.0007	0.00096	A		PIN 3 OPEN (LIFT RE)
29	R13	OPEN	0.000021	0965	AR1, R12	0.0003	2.8×10^{-4}	A		
30	Q3	SHORT	0.095800	0965	Q3, Q1, P5	0.2639	0.00580	A		COLL-EMITTER
31	Q3	SHORT	0.095800	0965	Q3, Q1, P5	0.2637	0.00580	A		COLL-BASE
32	C	OPEN	0.0045	0965	Q3, Q1, P5	0.0214	0.00047	A		
33	Q1	SHORT	0.09500	0965	Q3, Q1, P5	0.4513	0.00292	A		COLL-BASE
34	Q1	SHORT	0.09500	0965	Q1, Q2, Q5, Q4	0.2090	0.00292	A		COLL-EMITTER
35	Q1	SHORT	0.09500	0965	Q1, Q2, Q5 Q4	0.2090	0.00292	A		COLL-BASE
36	Q2	SHORT	0.0875	0965	Q2, Q1, Q5, Q4	0.1078	0.00309	A		COLL-EMITTER

λ_i Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable insertable faults (part A). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda i}{G}$	$\frac{\lambda i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
37	Q2	SHORT	0.04875	0965	Q1,Q2,C5,C4	0.1072	0.00509	A		COLL-BASE
38	C4	SHORT	0.00460	0965	Q1,Q2,C5,C4	0.0101	0.00048	A		SAME AS Q1 C-SHORT
39	Q5	SHORT	0.08125	0965	Q1,Q2,C5,C4	0.1787	0.00849	A		COLL-EMITTER
40	Q5	SHORT	0.08125	0965	Q1,Q2,C5,C4	0.1787	0.00849	A		COLL-BASE
41	C2	OPEN	0.00050	1000	C2,C12,R12,Q4	0.0078	0.00005	A		
42	C12	SHORT	0.01495	1000	C2,C12,R12,Q4	0.2328	0.00156	A		
43	R12	OPEN	0.000021	1000	C2,C12,R12,Q4	0.0003	2.2×10^{-6}	A		
44	Q4	SHORT	0.04875	1000	C2,C12,R12,C4	0.7590	0.00509	A		COLL-BASED
45	AR1	OPEN	0.066667	1005	AR1,R14,C11	0.4984	0.00696	A		PIN 2

λi Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable insertable faults (part A). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
46	AR1	OPEN	0.066667	1005	AR1,R14,C11	0.4984	0.00696	A		
47	C11	SHORT	0.000021	1005	AR1,R14,C11	0.0016	2.2×10^{-6}	A		
48	R14	OPEN	0.000021	1005	AR1,R14,C11	0.0016	2.2×10^{-6}	A		PIN 6
49	Q1	SHORT	0.09500	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.1288	0.00992	B		BASE-EMITTER
50	Q1	OPEN	0.09500	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.1288	0.00992	B		EMITTER
51	Q1	OPEN	0.09500	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.1288	0.00992	B		BASE
52	Q1	OPEN	0.09500	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.1288	0.00992	B		COLLECTOR
53	Q2	OPEN	0.04875	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.0661	0.00509	B		EMITTER
54	Q2	OPEN	0.04875	1020	Q1,Q2.Q4,Q5 R2,R11,C3	0.0661	0.00509	B		BASE

λ_i Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable destructive faults (part B.)

PREPARED BY_____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS

λ_i Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable destructive faults (part b). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda i}{G}$	$\frac{\lambda i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
55	Q4	OPEN	0.0487	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.0661	0.00509	B		BASE
56	Q4	OPEN	0.0487	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.0661	0.00509	B		COLLECTOR
57	Q5	OPEN	0.08125	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.1101	0.00849	B		EMITTER
58	Q5	OPEN	0.08125	1020	Q1,Q2,Q4,Q5 R2,R11,C3	0.1101	0.00849	B		BASE
59	R2	OPEN	0.000021	1020	Q1,Q2,Q4,Q5 R2,R11,C3	$3x10^{-5}$	$2.2x10^{-6}$	B		
60	R11	OPEN	0.000021	1020	Q1,Q2,Q4,Q5 R2,R11,C3	$3x10^{-5}$	$2.2x10^{-6}$	B		
61	Q3	SHORT	0.055500	1020	R4,LR1,C2,C3	0.1505	0.00580	A		BASE-EMITTER
62	Q3	OPEN	0.055500	1020	R4,LR1,C2,C3	0.1504	0.00580	A		EMITTER

λi
G Group failure rate
T UUT failure rate

Group code
$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable destructive faults (part B). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda_i}{G}$	$\frac{\lambda_i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
63	Q3	OPEN	0.055500	1020	R4,LR1,C2,Q3	0.1505	0.00580	A		BASE
64	Q3	OPEN	0.055500	1020	R4,LR1,C2,Q3	0.1504	0.00580	A		COLLECTOR
65	R4	OPEN	0.000021	1020	R4,LR1,C2,Q3	0.0001	2.2×10^{-6}	A		
66	CR1	SHORT	0.14625	1020	R4,LR1,C2,Q3	0.3966	0.01531	A		
67	C2	SHORT	0.00050	1020	R4,LR1,C2,Q3	0.0013	0.00005	A		
68	R15	OPEN	0.000021	1050	R15	1.0000	2.2×10^{-6}	A		
69	C4	OPEN	0.00460	1150	C4,C3,R8 R10,Q4,Q2	0.0230	0.00048	B		
70	C3	OPEN	0.000025	1150	C4,C3,R8 R10,Q4,Q2	0.0001	5×10^{-6}	B		

λ_i Component failure rate
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Detectable destructive faults (part B). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	TEST NO.	COMPONENTS IN AMBIGUITY GROUP	$\frac{\lambda i}{G}$	$\frac{\lambda i}{T}$	GROUP CODE	FIELD FAILURES	COMMENTS
71	R8	OPEN	0.000021	1150	C4,C3,R8 R10,Q4,Q2	0.0001	$2x10^{-6}$	B		SAME AS Q4 EM open
72	R10	OPEN	0.000021	1150	C4,C3,R8 R10,Q4,Q2	0.0001	$2x10^{-6}$	B		
73	Q4	OPEN	0.04875	1150	C4,C3,R8 R10,Q4,Q2	0.2442	0.00509	B		EMITTER
74	Q4	SHORT	0.04875	1150	C4,C3,R8 R10,Q4,Q2	0.2442	0.00509	B		COLL-EM, SHORT
75	Q2	SHORT	0.04875	1150	C4,C3,R8 R10,Q4,Q2	0.2442	0.00509	B		BASE-EM, SHORT
76	Q2	OPEN	0.04875	1150	C4,C3,R8 R10,Q4,R8	0.2442	0.00509	B		COLLECTOR OPEN
77	C3	SHORT	0.000025	1020	Q1,Q2,Q4,Q5 R2,R11,C3	$3x10^{-5}$	$2.6x10^{-6}$	B		DAMAGED Q1 DURING F/I DEVELOPMENT

λi Component failure rate ω
G Group failure rate
T UUT failure rate

Group code

$1 \leq A \leq 4$ failures
$4 < B \leq 8$ failures
$8 < C \leq 10$ failures

TABLE IV. Nondetectable faults (part C).

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	PRIMARY FAILURE MODE	FAILURE RATE	FIELD FAILURES	COMMENTS

TABLE IV. Nondetectable faults (part C). (Continued)

PREPARED BY _____ FAULT LIST FOR UUT P/N _____ DATE _____

FAULT NO.	REF. DESIG.	FAILURE MODE	FAILURE RATE	FIELD FAILURES	COMMENTS
78	C8	OPEN	0.000025	NONE NOTED	NONINVERTING INPUT BYPASS CAP, NOT NECESSARY SINCE AR1 IS CONFIGURED AS AN INTEGRATOR
79	C8	SHORTED	0.000025	NONE NOTED	NO DC OFFSET CHANGE NOTED AT P1-A2 WITH C8 SHORTED
80	C9	OPEN	0.000025	NONE NOTED	HI FREQ SUPPLY FICTER, IN PARALLEL WITH LARGE ELECTROLYTIC CAP
81	C10	OPEN	0.000025	NONE NOTED	SAME AS C9
82	C11	OPEN	0.00021	NONE NOTED	FREQUENCY COMPENSATION CAP IS NOT NECESSARY SINCE AR1 CKT IS CONFIGURED AS AN INTEGRATOR
83	Q5	BASE-EM SHORT	0.08125	NONE NOTED	GAIN LOSS WITHIN R7 ADJ RANGE
84	Q5	COLL OPEN	0.08125	NONE NOTED	GAIN LOSS WITHIN R7 ADJ RANGE
85	CR1	OPEN	0.14625	NONE NOTED	PROTECTS Q1 BASE-EMITTER IN EVENT OF Q3 C-E OPEN

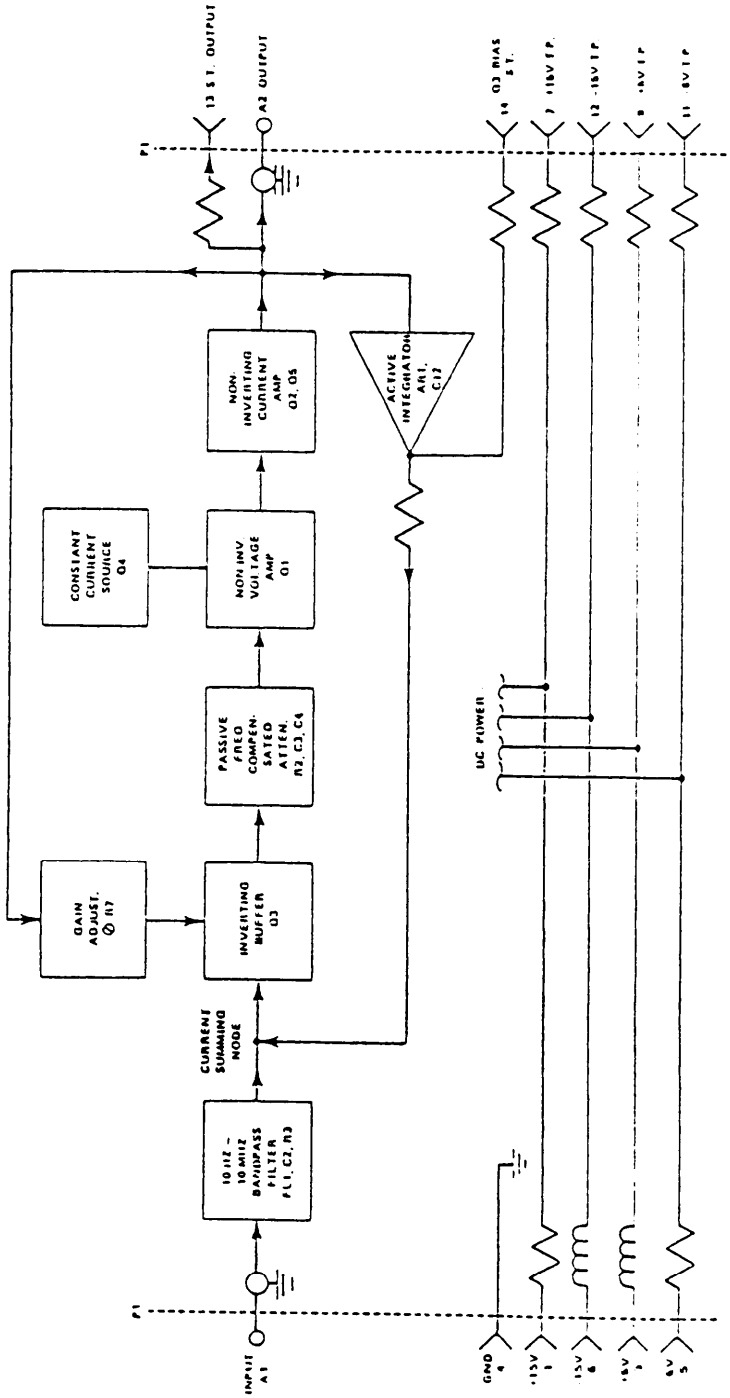

FIGURE 32. Functional block diagram for tracking output No. 2.

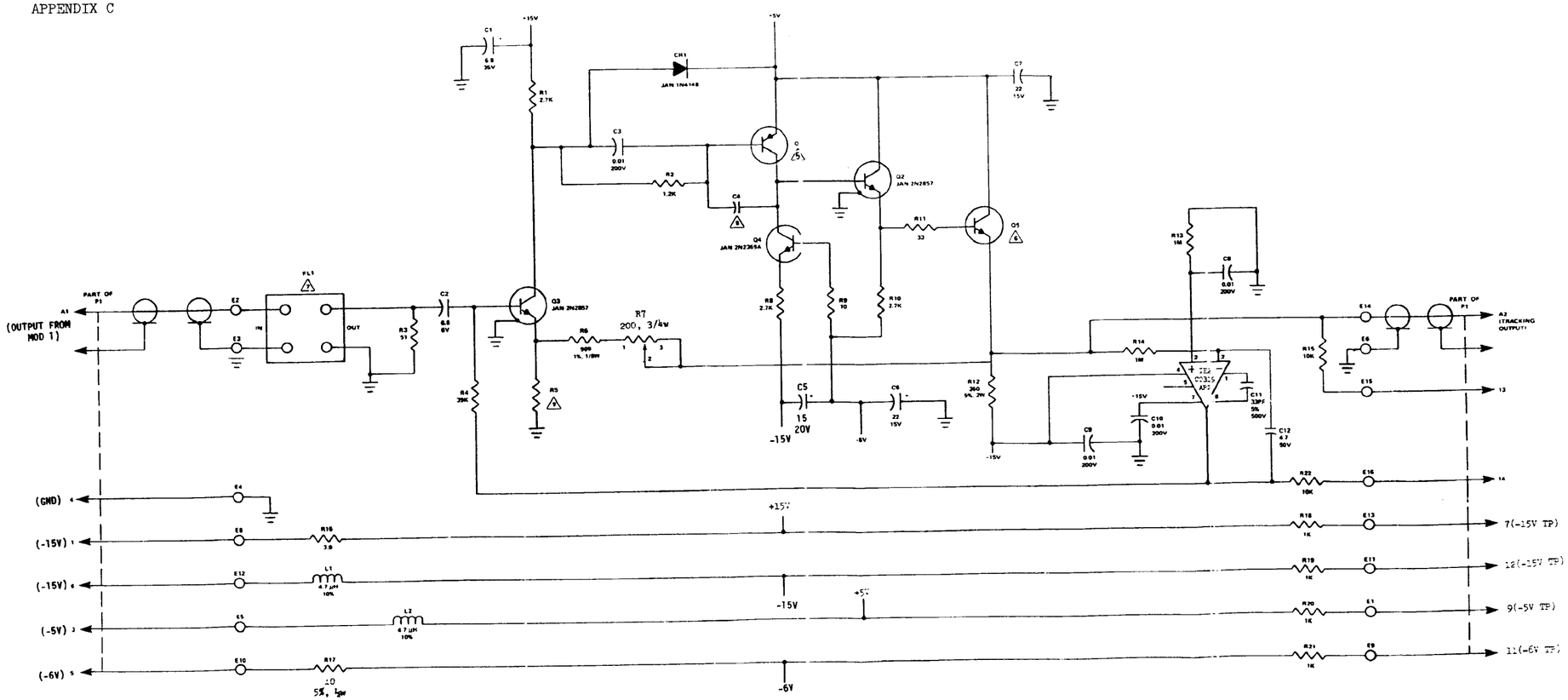

FIGURE 33. Schematic, electrical diagram tracking output No. 2.

PRIMARY FAILURE MODES

COMPONENT	TYPE	PRIMARY FAILURE MODE
Capacitor	Electrolytic (solid tantalum)	Short Open
	Ceramic	Short Open
Resistor, fixed	Carbon fixed film	Open
	Carbon composition	Open
	Wire wound	Open
Resistor, variable	Composition	Open
	Wire wound	Open
Transformer	Low Power (<5W)	Negative drift
	Medium power (≥5W; 10W)	Open
Coils fixed and variable		Open
Diodes (silicon)	General purpose	Short Open
	Power rectifier	Short Open
Zener reference diodes		Short
Transistor (silicon)		Short Open
Relays (hermetically sealed)	5 amps contacts 1-20 VDC coil	Open contacts
Integrated circuits	Linear and digital	Output at permanent high level or at permanent low level

FIGURE 34. Primary failure modes.

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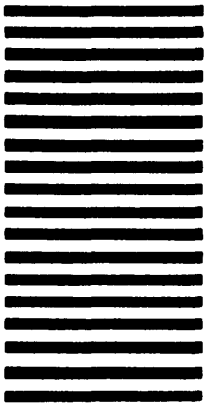

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