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COUNTERMEASURES DISPENSING SYSTEM BQM-34E.(U)
JAN 75 W WOLNY N62269-74-C-0654
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Test Procedure Report

D12408(1/75)

COUNTERMEASURES DISPENSING SYSTEM
BQM-34E

Contract N62269-74-C-0654
Data Item A002

Submitted to

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~~LUNDY ELECTRONICS & SYSTEMS, INC.~~

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This technical report contains test procedures for qualifying the AN/ALE-44 Countermeasures Dispensing System.

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Test Equipment	Controller	Arming
Module Function	Sequencer	Reset
Environmental Tests	Module	
System Acceptance	Simulator	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The object of this report is to document the definition of tests and equipment to be utilized for the functional, environmental, and system acceptance testing of the AN/ALE-44 countermeasures dispensing system.

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TABLE OF CONTENTS

1.0 SCOPE

This document defines the type of tests and procedures to be utilized for functional, environmental and system acceptance testing of the BQM-34A/E Chaff Flare Dispensing Set. The dispensing set to be tested is an improved modified version of an existing design. The elements of this set are two structural housings (pods) modified for increased bending strength normal to the longitudinal axis.

Each pod houses two countermeasure modules which have been modified for easier loading. The breech plate has also been redesigned and provisions for simpler attachment of the modules to the pod have been included. A completely new sequencer switch for firing countermeasure units is mounted in the center section of each pod and both pods are connected to a new controller unit, mounted in the aircraft which carries the pod set.

Accordingly, tests to be performed on this dispenser set will consist of a functional bench test of the sequencer switches to verify switching action.

A functional bench test of the control unit will be performed to verify each of the various pulse rates, pulse duration, pulse separation and pulse level for each selectable dispensing mode on the unit. A module assembly will be tested with chaff units and squibs installed and fired to verify the ability of the breech plate to resist squib firing forces and contain squib cases.

Environmental tests will be conducted on the control unit and a sequencer.

An acceptance test of the system will be performed with the system components assembled and interconnected as they would be when installed on the aircraft.

2.0 TYPES OF TEST AND PROCEDURE

The types of test and procedure are described below along with test equipment to be used and the abbreviations and terms used.

2.1 List of Test Equipment

Test Equipment	Characteristics Required
DC Power Supply	Regulated 0-30 VDC, 25 amp minimum
Oscilloscope	Dual trace, storage type with sweep range within 1 ms to 1 sec/cm; amplification range of .1 v/cm to 10 v/cm.
Recorder	Strip recorder with a minimum of 5 input channels.

Special Test Equipment

Simulator, Sequencer, LTC-484

Simulator, Safety Switch

Expendable Test Equipment

Chaff Round, RR-129, FSN 5865-929-6095-NW20

Impulse Cartridge, Quantic Industries, Model 1627-3, FSN 1377-249-9433-M197.

Whatman No. 1, 2 or 5, 5.5cm diameter filter paper.

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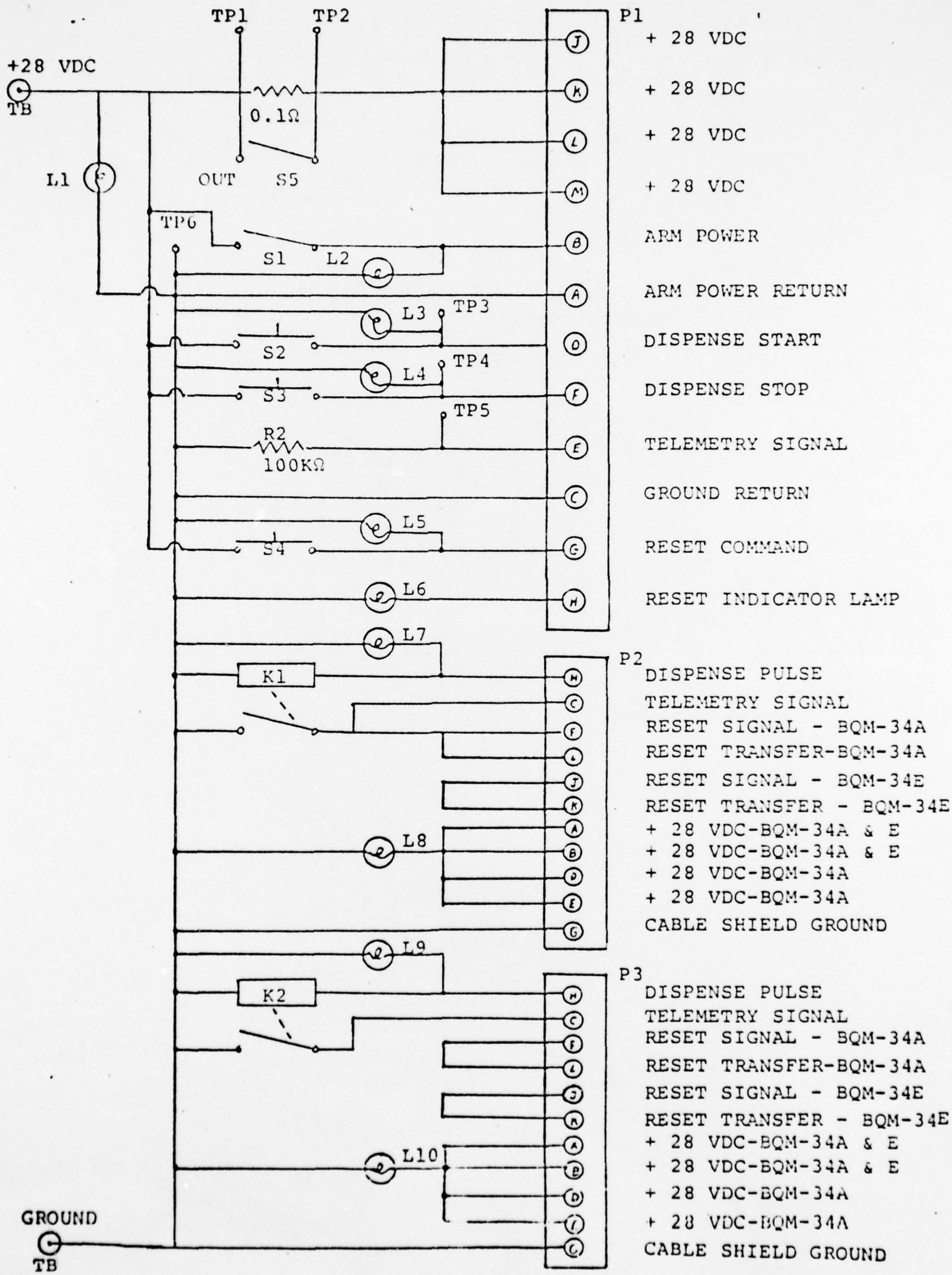
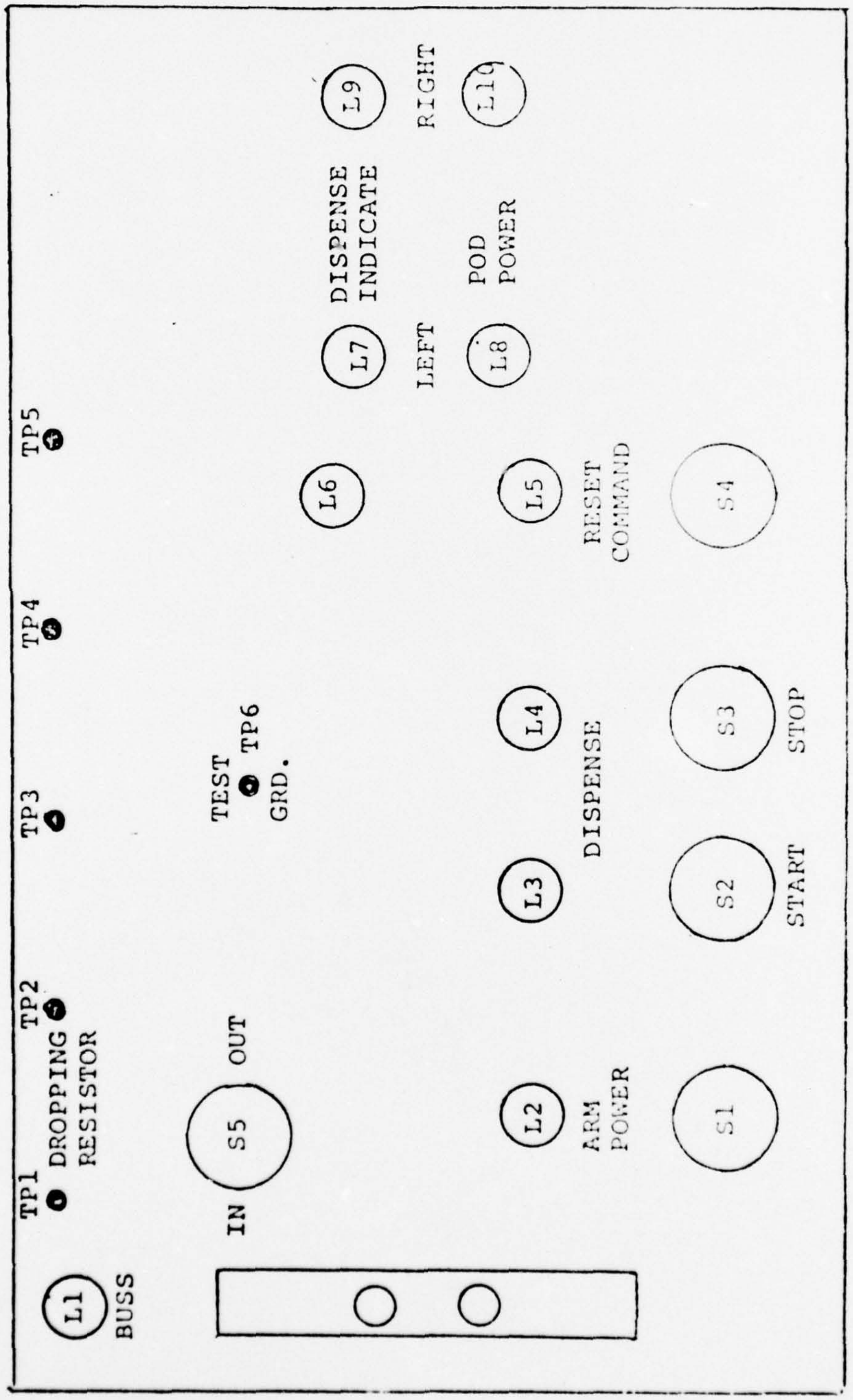
Test Box LTC-484 Nomenclature and Instructions
(See Attached Schematic and Panel Layout)

Control Switch	Indicator Lamp	Test Point	Comments
--	L1	--	Indicates +28VDC Power Buss Energized
S1 (Arm Power)	L2	--	Arm Power ON/OFF Control
S2 Start	L3	TP3 (0, +28VDC)	Start Dispense Command
S3 Stop	L4	TP4 (0, +28VDC)	Stop Dispense Command
S4 Reset	L5 & L6	--	Reset Command - L5 (ON), Reset Completed - L6 Flash ON/OFF
S5 In/Out	--	TPL, TP2 Voltage Scale Factor = 0.1 1 Amp ie 1V = 10 amps	When "IN" A 0.1 Ω Resistor is placed in the power line to monitor squib firing current across TP1 to TP2. When "OUT" TP1 shorted to TP2.
--	L7 & L8	--	Simulate left hand sequencer L7 - dispense pulse L8 - arm power on
--	L9 & L10	--	Simulate right hand sequencer L9 - dispense pulse L10 - arm power on
--	--	TP5	Telemetry output 10K Ω source impedance indicates dispense pulse and mode by voltage level for dispense pulse time period. No dispense - 4.7V ± 5% level Single dispense mode - 2.35V ± 5% pulse level Dual dispense mode - 1.57 ± 5% pulse level

LTC-484 SIMULATOR SCHEMATIC



<u>LTC-484 SIMULATOR SWITCH, LAMP, TEST POINT LAYOUT</u>



Notes:

1. Start Switch (S2) is used to initiate any dispense sequence of 1, 2, 4, 8 or C group of dispense pulses. The Controller will shut itself off when the quantity setting is satisfied. The start switch must be released and recycled on to start a subsequent dispense sequence.

2. Stop Switch (S3) is used to stop any dispense sequence at any point during its ON cycle. It must be placed in the OFF position before any start command can be initiated.

3. Reset Switch (S4) is used to reset the sequencer units located in the Left Hand and Right Hand pods. The reset operation can only take place when the Pod Safety Pins are positioned in the hole provided in the pod center section. To reset, hold the reset button on until reset is accomplished, indicated by Lamp L6 flashing at the reset drive rate. When using the simulated sequencer in the test box, the reset signal is routed directly through so that Lamp L6 will flash immediately to indicate that reset drive is present.

4. Current monitor resistor switch (S5) provides a 0.1 ohm resistor to be placed in the power line to monitor squib (real or simulated) firing current pulses across TP1 and TP2 (floating contacts). It allows for scope or recorder monitoring of current, pulse width, pulse rate, and sequence count. This monitoring information together with TP3 (start command, TP4 stop command, and TP5 telemetry), provides the total of testing information needed to check out the system, partial system, and/or Controller.

2.2 List of Abbreviations and Terms

	Abbreviation or Term	Definition
1.	Controller	BQM-34 System Control Box, Lundy P/N 39-1167
2.	Sequencer	BQM-34 System Sequencer, Lundy P/N 39-1166
3.	Module	BQM-34 System Module Assembly, P/N 39-1169
4.	Simulator	Sequencer and Pod Simulator, LTC-484
5.	Safety Switch Simulator	Device for simulating Pod Safety Switch and Reset Indicator
6.	Bursts/Sec.	The number of pulses generated each second by the Controller for a given setting
7.	Bursts/Seq.	The total number of dispensing pulses generated by a preselected Controller setting during each dispensing sequence
8.	Single Mode	Controller setting whereby one round only is dispensed alternately from Pod to Pod as well as module to module
9.	Dual Mode	Controller setting whereby two rounds are dispensed from, one each from each Pod
10.	Seq./Test	Sequences per test or the number of times a test with specified Controller settings is repeated during each test cycle
11.	Squib	Impulse cartridge utilized to discharge chaff round contents
12.	Chaff Round	RR-129/AL Chaff Countermeasures unit

13.	Pod	The housing in which a Sequencer and two modules are mounted and interconnected
14.	System	BQM-34 system consisting of a Controller and two pods each containing a Sequencer and two Modules

2.3 Functional Bench Test of Sequencer, P/N 39-1138

2.3.1 Requirements

2.3.1.1 The purpose of the test is to verify that the Sequencer will respond correctly to all of the operational signals from the Controller.

2.3.1.2 The Sequencer design parameters are as follows:

a) The sequencer Stepping Switch will select and fire module squibs at rate equivalent to the pulse rate transmitted from the Controller.

b) The odd numbered Sequencer Stepping Switch positions will consecutively fire the squibs in Module A with the #1 position firing the first squib in Module A and the even numbered Sequencer Stepping Switch positions will consecutively fire the squibs in Module B with the #2 position firing the first squib in Module B.

2.3.1.3 The test shall be performed at room ambient conditions.

2.3.2 Test Setup

a) Connect Controller, Sequencer and test equipment as shown in Figure 1.

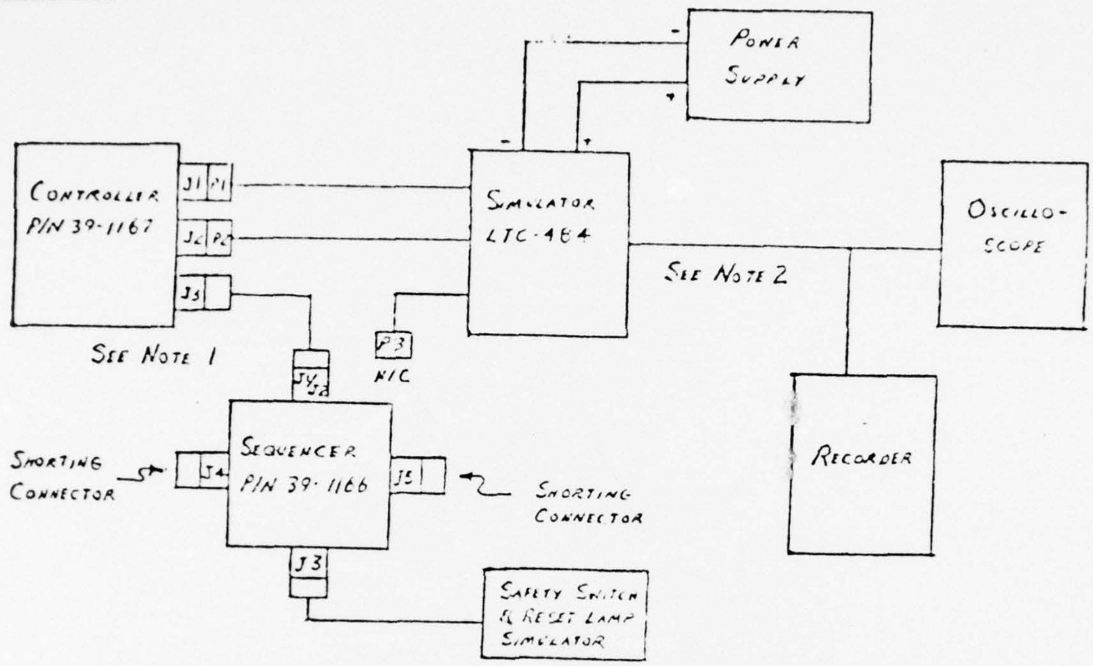


Figure 1

NOTE 1

Diagram depicts hookup when evaluating Sequencer for Right Hand Pod. When evaluating Left Hand Pod Sequencer the following connection changes apply:

Controller J2 connected to Sequencer J1/J2 using W1.

Controller J3 connected to Simulator P3.

Sequencer P2 disconnected.

NOTE 2

Monitoring equipment will be connected to all five Simulator Test Point, TP1, TP2, TP3, TP4 and TP5.

b) Verify that all Controller switches are in the most counterclockwise position.

c) Verify that all Simulator switches are in the OFF or OUT position as is applicable.

d) Verify that Shorting Connectors are firmly seated on Sequencer Connectors J4 and J5.

e) Verify that Safety Switch Simulator Toggle Switch is in the SAFE position.

f) Adjust recorder and/or oscilloscope to appropriate input settings as is applicable for each test signal to be monitored.

2.3.3 <u>Arming, Reset and Safety Verification</u>

a) Turn power supply on, adjust for 22.5 VDC and verify application of power to Simulator Buss Power Lamp L1.

b) Activate Controller circuits by placing Simulator Arm Power in the ON position illuminating Lamp L2.

c) Activate Controller reset circuits by depressing and holding Simulator Reset Command Switch S4 illuminating Lamp L5.

d) Verify reset completion as indicated by flashing of reset light on Safety Switch Simulator at the reset pulse rate.

e) Verify reset pulse rate and pulse width from Simulator Test Point TP5.

f) Release Reset Command Switch S4.

g) Set Controller Bursts/Seq. Selector on 8, Bursts/Sec. Selector on 1, and Mode Selector on Single.

h) Place the Simulator Dropping Resister Switch S5 in the IN position.

i) Momentarily depress Simulator Sta Dispense Switch S2.

j) Verify that in simulated safe condition no power was applied to Sequencer squib firing circuit as indicated by reading across Simulator Test Points TP1 and TP2 of approximately .3 volts (3 amps).

NOTE 3

As only one Sequencer is being tested, the verification voltage can only be observed on every other dispense pulse.

k) At end of above test cycle, place the Safety Switch Simulator Toggle Switch in the ARM position.

l) Depress and hold Simulator Reset Command Switch S4 for 5 seconds.

m) Verify that Safety Switch Simulator Reset Lamp does not illuminate indicating Sequencer did not reset.

n) Return Safety Switch Simulator to the SAFE condition and reset Sequencer per Steps 2.3.3, c) and f).

o) Place Simulator Arm Power Switch S1 in the OFF position and Safety Switch Simulator in ARM condition.

p) Momentarily depress Simulator Dispense Start Switch S2.

q) Verify from Simulator Test Point TP3 that the dispense command pulse was a minimum of 10 milliseconds duration and that Sequencer did not function as indicated by no reading across Simulator Test Points TP1 and TP2.

r) Return Simulator Arm Power Switch S1 to ON position, all Controller Switches to the most counterclockwise position, and Safety Switch Simulator to SAFE condition.

s) Verify that Sequencer is still reset by depressing Simulator Reset Command Switch S4. Sequencer Reset Lamp on Safety Switch Simulator should immediately begin flushing.

2.3.4 Functional Test

2.3.4.1 Sequencer functional testing will consist of twenty test cycles using voltage and Controller mode, bursts per second and bursts per sequence settings set forth in Table I.

2.3.4.2 Prior to performing Cycles 11 through 20 repeat at 30 VDC the arming and safing verifications as set forth in Steps a) through r) under paragraph 2.3.3.

2.3.4.3 Perform the following for each Cycle set forth in Table I.

a) Set power supply voltage and Controller settings as prescribed for the test cycle.

b) Verify that Simulator Arm Power Switch S1 is on, Simulator Dropping Resistor is switched in, and that Sequencer is reset.

c) Place Safety Switch Simulator Toggle Switch in the ARM position.

d) Momentarily depress Simulator Dispense Start Switch S2.

e) Verify the following parameters and functions:

1) Dispense start pulse width and amplitude from Simulator Test Point TP3.

2) Dispense pulse rate, pulse width, pulse amplitude, and number per sequence across Simulator Test Points TP1/TP2.

3) Dispense mode as indicated by telemetry voltage from Simulator Test Point TP5.

4) Verify proper sequencing as reflected by pulses originating from TP1/TP2 at a rate equal to the Controller setting when in the Dual mode and equal to 1/2 the setting in Single mode and having an amplitude of about 1 VDC (10 amps).

f) Repeat steps d) and e) above the number of times set forth in Table I under the heading Seq./Test.

g) When Table I sets forth Bursts/Seq. operation as Continuous (C), perform the following additional tests.

h) After initiating the dispense start pulse and a minimum of sixteen dispense pulses have occurred, momentarily depress the Simulator Dispense Stop Switch S3.

i) Verify through telemetry voltage from TP5 that dispense pulsing has stopped.

j) Upon completion of each cycle place the Safety Switch Simulator Toggle Switch in the SAFE position and reset Sequencer as set forth in steps c) through f) under paragraph 2.3.3.

k) Upon completion of all test cycles, place all Controller Switches in the most counterclockwise position, all Simulator Switches in the OFF or OUT position, and turn off system power.

2.4 <u>Functional Bench Test of Controller, P/N 39-1155</u>

2.4.1 <u>Requirements</u>

2.4.1.1 The purpose of the test is to verify that Controller operation conforms to design requirements.

TABLE I

VOLTAGE AND CONTROLLER SETTINGS FOR SEQUENCER FUNCTIONAL TEST

CYCLE #	VDC	MODE	BURSTS/SEC	BURST/SEQ.	SEQ/TEST
1	22.5	D	1/2	2	16
2	22.5	S	1/2	8	8
3	22.5	D	1	1	16
4	22.5	S	1	4	16
5	22.5	D	1	C	--
6	22.5	S	2	2	16
7	22.5	D	2	8	4
8	22.5	S	4	1	16
9	22.5	D	4	4	8
10	22.5	S	4	C	--
11	30	S	1/2	1	16
12	30	D	1/2	4	4
13	30	S	1/2	C	--
14	30	D	1	2	8
15	30	S	1	8	8
16	30	D	2	1	16
17	30	S	2	4	16
18	30	D	2	C	--
19	30	S	4	2	16
20	30	D	4	8	4

2.4.1.2 The Controller design parameters are as follows:

Arm Power	ON/OFF Function
Dispense Pulse	START/STOP Function
Dispense Pulse Width	.125 ± .010 sec.
Dispense Pulse Rate	.5, 1, 2, 4, Pulses/Sec. ± 10%
Dispense Pulse Count	1, 2, 4, 8 Pulses/Sequence or Continuous Pulsing
Dispense Mode	Single or Dual
Telemetry Signal	4.7VDC ± 5% No Dispense
	2.35VDC ± 5% Single Dispense
	1.57VDC ± 5% Dual Dispense
Reset Pulse Width	0.050 ± 0.15 Sec.
Reset Pulse Rate	8 ± 2 Pulses/Sec.

2.4.1.3 The test shall be performed at room ambient conditions.

2.4.2 <u>Test Setup</u>

a) Connect Controller and test equipment as shown in Figure 2.

b) Verify that all Controller switches are in the most counterclockwise position.

c) Verify that all Simulator switches are in the OFF or OUT position as is applicable.

d) Adjust recorder and/or oscilloscope to appropriate input setting as is applicable for each test signal to be monitored.

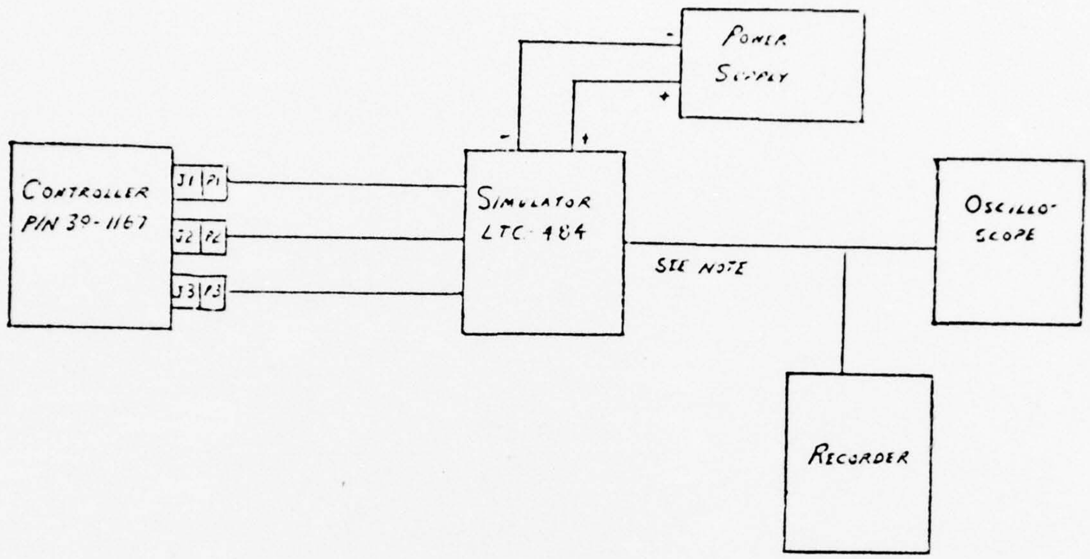


Figure 2

NOTE 4

Monitoring equipment will be connected to Simulator Test Points TP3, TP4 and TP5.

2.4.3 Arming and Reset Verification

a) Turn power supply on, adjust for 22.5VDC and verify application of power to Simulator as indicated by illumination of Simulator Buss Power Lamp L1.

b) Depress Simulator Reset Command and hold on during steps c) through e). Simulator Reset Command Lamp L5 will illuminate.

c) Verify arming relay operation by first placing the Simulator Arm Power Switch in the ON position and then return it to the OFF position.

NOTE 5

In the ON position Simulator Arm Power Lamp L2, left Pod Power Lamp L8, and Right Pod Power Lamp L10 will illuminate and Reset Command Lamp L5 will flash indicating arming relay has energized and applied power to the Controller circuits.

NOTE 6

In the OFF position, the four lamps will be out indicating the arming relay has de-energized removing power from the Controller circuits.

d) Return Arm Power Switch to the ON position and verify reset pulse rate as indicated by the flashing rate of L5.

e) Verify reset pulse width and telemetry voltage for no dispense mode from Simulator Test Point TP5.

f) Release Simulator Reset Command Switch.

g) Adjust power supply for 30.0VDC and repeat steps c) through f) of this paragraph.

2.4.4 Rate, Sequence, Mode Function Verification

2.4.4.1 Controller operation will be verified through an 80 cycle test whereby the applied voltage, mode, bursts per second, bursts per sequence and number of sequences per cycle will be as set forth in Table 2.

2.4.4.2 For each cycle the following functions will be performed and verified:

a) Depress and release Simulator Dispense Start Switch S2 to activate Controller.

b) Using Simulator Test Point TP5 verify dispense pulse width, dispense pulse rate, bursts per sequence, and telemetry voltage before, during and after pulsing.

c) Verify proper dispensing sequence as indicated by Simulator Left and Right Dispense Indicator Lamps L7 and L9.

NOTE 7

In the Single Mode of operation, Lamps L7 and L9 will illuminate alternately at a rate equal to one-half that set on the Controller until the set bursts per sequence have been completed.

NOTE 8

In the Dual Mode, Lamps L7 and L9 will illuminate simultaneously at a rate equal to that set on the Controller until the set bursts per sequence have been completed.

d) Repeat Steps a) through c) the number of times set forth in Table I under the heading Seq./Test.

e) When Table 2 sets forth Bursts/Seq. operation as continuous (C), perform the following additional tests.

f) After initiating the dispense start pulse and after a minimum of sixteen dispense pulses, momentarily depress Simulator Dispense Stop Switch S3.

g) Verify through telemetry voltage from Simulator Test Point TP5 and by no further illumination of Lamps L7 and L9 that dispense pulses stop.

h) Upon completion of the eighty (80) cycles, place all Controller Switches in the most counterclockwise position, place the Simulator Arm Power Switch in the OFF position, and turn off test system power.

TABLE 2

VOLTAGE AND SETTING FOR CONTROLLER FUNCTIONAL TEST

CYCLE #	VDC	MODE	BURSTS/ SEC.	BURSTS/ SEQ.	SEQ/ TEST	CYCLE #	VDC	MODE	BURSTS/ SEC.	BURSTS/ SEQ.	SEQ/ TEST
1	23.0	S	1/2	1	4	21	23.0	S	2	1	4
2	23.0	S	1/2	2	4	22	23.0	S	2	2	4
3	23.0	S	1/2	4	4	23	23.0	S	2	4	4
4	23.0	D	1/2	1	2	24	23.0	D	2	1	2
5	23.0	S	1/2	8	2	25	23.0	S	2	8	2
6	23.0	D	1/2	2	4	26	23.0	D	2	2	4
7	23.0	D	1/2	4	2	27	23.0	D	2	4	2
8	23.0	S	1/2	C	-	28	23.0	S	2	C	-
9	23.0	D	1/2	8	2	29	23.0	D	2	8	2
10	23.0	D	1/2	C	-	30	23.0	D	2	C	-
11	23.0	S	1	1	4	31	23.0	S	4	1	4
12	23.0	S	1	2	4	32	23.0	S	4	2	4
13	23.0	S	1	4	4	33	23.0	S	4	4	4
14	23.0	D	1	1	2	34	23.0	D	4	1	2
15	23.0	S	1	8	2	35	23.0	S	4	8	2
16	23.0	D	1	2	4	36	23.0	D	4	2	4
17	23.0	D	1	4	2	37	23.0	D	4	4	2
18	23.0	S	1	C	-	38	23.0	S	4	C	-
19	23.0	D	1	8	2	39	23.0	D	4	8	2
20	23.0	D	1	C	-	40	23.0	D	4	C	-

Cycle 41 through 80: Repeat Cycles 1 through 40 using 30.0 VDC.

2.5 Module Function Test

The module breech plate, Drawing 39-1169, is to be tested for its ability to contain chaff units and prevent squib gas leaks detrimental to the dispensing of chaff units or the integrity of the module assembly.

Chaff units should be held and contained during firing without tendency for the chaff sleeves to eject. Squib gas leaks should not materially degrade squib connectors or the squib wiring harness. Discoloration of components is acceptable.

The breech plate of a single module serves as a cap for 16 chaff units and squibs and is held in place by four bolts through the holes "B" of Drawing 39-1178.

Structurally the breech plate behaves as a clamped beam with free ends. The free ends are structurally weakest and most susceptible to an upward bending deflection during squib firing, thereby potentially allowing a leak. Therefore, module testing with chaff units and squibs will be performed in the end hole of a module.

Twelve RR-129 chaff units with squibs will be fired during this test. The breech plate will be removed after each unit has been fired and the module visually inspected for burn marks and straightness.

2.5.1 Pre-Test Examination

a) Inspect the Breech Plate for straightness starting from one end identified as "A" to the opposite end identified as "B". Record actual results.

b) Visually examine base of Breech Plate for any discolorations and damage. Record observations.

2.5.2 Preparation for Test

a) Load one RR-129 Chaff Unit into the lower right hand chamber of module.

NOTE 9

This same chamber will be utilized for all test firings for the Module Function Test.

b) Mate a clean paper filter disc with the rubber gasket and assemble with the paper filter disc adjacent to the chaff unit.

c) Complete the module assembly including squib and cable.

d) Connect cable to 28VDC power supply.

2.5.3 Function Test

a) Turn power on. Squib should fire and disperse chaff load.

b) Dis-assemble module to the extent that the expended chaff unit can be removed.

c) Visually examine the paper filter disc for damage and extent of discoloration. Record observations.

d) Visually examine the Breech Plate for evidence of damage and discoloration, compare with observations noted in Para. 2.3.1, step b) and record results.

e) Repeat the procedure from Para. 2.5.2, Step a) through Para. 2.5.3, Step e) eleven (11) times.

f) After the last test has been completed, inspect the Breech Plate for straightness as in Para. 2.3.1, Step a). Record results and compare with initial results.

2.6 <u>Environmental/EMI Tests for Sequencer and Controller</u>

Environmental/EMI tests to be performed on a sequencer and controller are described in Appendix A of this procedure.

2.7 <u>System Acceptance Bench Test</u>

2.7.1 <u>Requirements</u>

2.7.1.1 The purpose of this test is to verify operational compatibility and compliance to design requirements of all BQM-34 components as a system as well as to develop and establish various system operating parameters.

2.7.1.2 The test shall be performed at room ambient conditions.

2.7.1.3 All testing will be performed at 28VDC.

2.7.2 <u>Test Setup</u>

a) Connect the Controller, two Sequencers, four Modules, and required test equipment as shown in Figure 3.

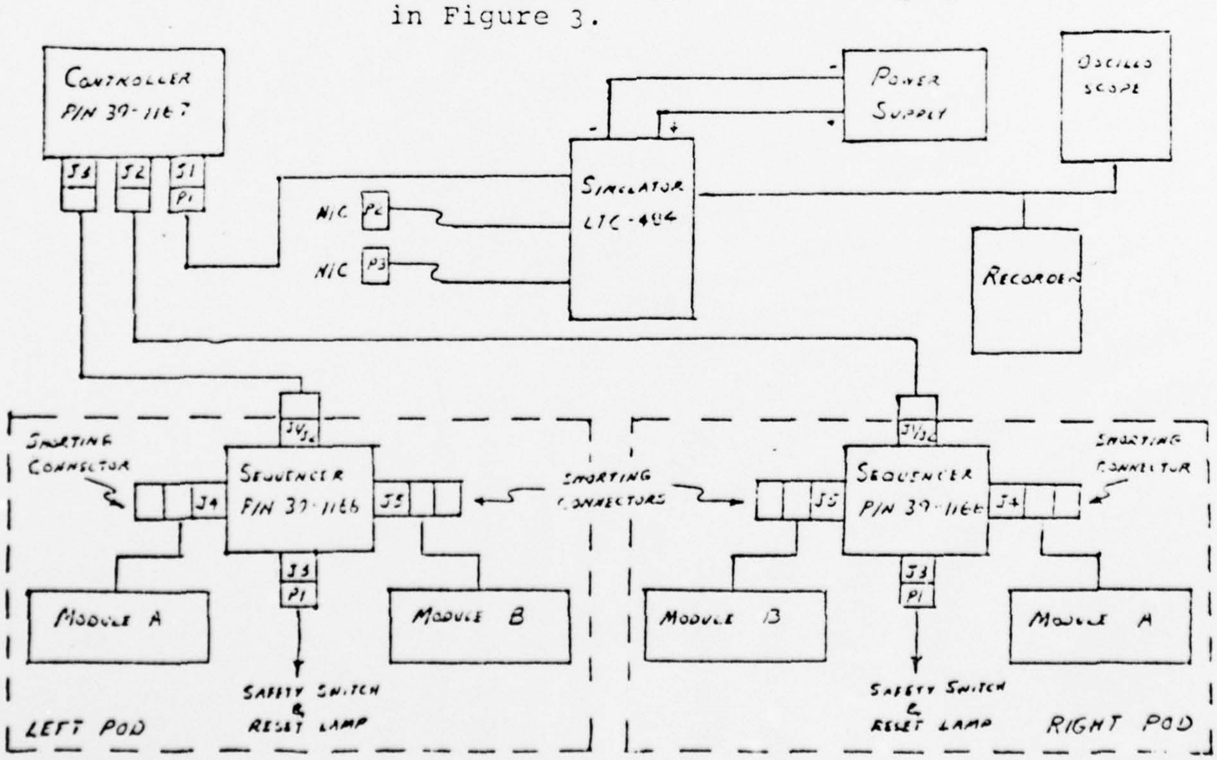


FIGURE 3

NOTE 10

Monitoring equipment will be connected to all five Simulator Test Points, TP1, TP2, TP3, TP4 and TP5.

NOTE 11

The test set-up will be arranged in an area where discharge of live chaff rounds can be performed safely.

b) Verify that all Controller Switches are in the most counterclockwise position.

c) Verify that all Simulator Switches are in the OFF or OUT position as is applicable.

d) Verify that power supply is OFF.

e) Verify that shorting connectors are in place on all module connectors and that Safety Pins are inserted in both Pods.

f) Remove Module A from Right Hand Pod, load with 16 squibs and RR-129 chaff rounds, and re-insert in Pod.

g) Adjust recorder and/or oscilloscope to the appropriate input settings as is applicable for each test signal to be monitored.

2.7.3 Arming, Reset, Safety Verification

a) Turn power supply on and adjust for 28.0VDC and verify illumination of Simulator Buss Lamp L1.

b) Place Simulator Arm Power Switch S1 in the ARM position and verify illumination of Arm Power Lamp L2.

c) Depress and hold Simulator Reset Command Switch S4 and verify illumination of Reset Command Lamp L5.

d) Verify that both Sequencers reset or are already reset as indicated by flashing of each Pod Reset Lamp at the reset pulse rate.

e) Set Controller Burst/Seq. Selector on 8, Bursts/Sec. Selector on 1 and Mode Selector on Single.

f) Place Simulator Arm Power Switch S1 in OFF position, Simulator Dropping Resistor Switch S5 in the IN position and remove shorting connector from Module A in the Right Hand Pod.

g) Return Simulator Arm Power Switch S5 to the ON position, momentarily depress Simulator Dispense Start Switch S2, and verify the following:

    1) Dispense command pulse as indicated from Simulator Test Point TP3 was a minimum of 10 milliseconds duration.

    2) Dispense pulses were generated as indicated from Simulator Test Point TP5.

    3) System did not fire as indicated by no discharge of units from Module A in the right hand pod, and about .3 VDC (3 amps) across Simulator Test Points TP1 and TP2.

h) Turn off Simulator Arm Power Switch S1 and remove Safety Pins from both pods.

i) Turn on Simulator Arm Power Switch S1 and depress Simulator Reset Command Switch S4 for a minimum of 5 seconds.

j) Verify that Sequencers do not reset as indicated by the fact that both Pod Reset Lamps do not begin flashing.

k) Turn off Simulator Arm Power Switch S1 and re-insert Safety Pins in both Pods.

l) Reset Sequencers and verify per steps 2.5.3.2 through 2.5.3.4.

m) Turn off Simulator Arm Power Switch S1, remove both pod safety pins, and momentarily depress Simulator Dispense Start Switch.

n) Verify that system does not operate as reflected by no dispense pulses from Simulator Test Point TP5 and no discharge of live rounds from the Module A in the Right Hand Pod.

o) Return all Controller Switches to the most counterclockwise position.

2.7.4 <u>System Functional Test</u>

2.7.4.1 System functional testing will consist of a forty cycle test using Controller Mode, Bursts/Sec., and Bursts/Seq. settings for each cycle as set forth in Table 5.

2.7.4.2 Each cycle will be repeated the number of times set forth in Table 5 under the heading Seq./Test.

2.7.4.3 Cycles 1 through 8 will involve the discharge of live chaff rounds from Module A of the right hand pod after which the shorting connector must be re-inserted in the Module A connector in order to complete Cycles 9 through 40.

2.7.4.4 Perform the following functions and verifications for each cycle set forth in Table 2.

a) Verify that 28VDC is applied to Simulator Buss.

b) Place Controller Switches in the positions prescribed for the cycle.

c) Verify that Simulator Arm Power Switch S1 is on, that Simulator Dropping Resistor is switched on and that Sequencers are reset.

d) Remove Safety Pins from both Sequencers.

e) Momentarily depress Simulator Dispense Start Switch S2 and verify the following parameters and functions.

1) Dispense start pulse width and amplitude as measured from TP3.

2) Dispense Pulse rate, pulse width, and number per sequence as measured across TP1 and TP2.

3) Dispense mode as indicated by telemetry voltage from TP5.

4) Proper sequencing as indicated by 1VDC (10 amps) pulses in the Single Mode and 2VDC (20 amps) pulses in the Dual Mode across TP1 and TP2 throughout each dispense sequence.

NOTE 12

When firing live chaff rounds proper sequencing will be further indicated by round discharge rate in the Single Mode equal to 1/4 that set on the Controller and in the Dual Mode equal to 1/2 that set on the Controller.

f) Repeat Step 2.5.4.4.5 the number times set forth in Table 5 under the heading Seq./ Test.

g) When Table 5 calls for Sequencer reset, insert Safety Pin into both pods, reset both Sequencers in the manner set forth in Steps 2.5.3.3 and 2.5.3.4, and then remove both pod safety pins.

h) When Table 5 calls for Continuous (C) bursts per sequence operation perform the following additional tests.

i) After initiating the dispense start pulse and a minimum of sixteen dispense pulses have occurred, momentarily depress the Simulator Dispense Stop Switch S3.

j) Verify through telemetry voltage from TP5 and reading across TP1 and TP2 that dispense pulsing has stopped.

k) Momentarily depress Simulator Dispense Start and complete dispense test cycle.

l) Upon completion of all test cycles, place all Controller Switches in the most counterclockwise positions, all Simulator Switches in the applicable OFF or OUT position and turn system power off.

TABLE 5

CONTROLLER SETTINGS FOR SYSTEM FUNCTIONAL TEST

CYCLE #	MODE	BURSTS/ SEC.	BURSTS/ SEQ.	SEQ/ TEST	RESET
1	S	4	8	1	
2	S	4	4	2	
3	S	4	2	4	
4	S	4	1	4	
5	D	4	8	1	
6	D	4	4	1	
7	D	4	2	2	
8	D	4	1	2	X
9	S	4	C	-	X
10	D	4	C	-	X
11	S	2	8	2	
12	S	2	4	4	
13	S	2	2	8	
14	S	2	1	16	X
15	S	2	C	--	X
16	D	2	8	1	
17	D	2	4	2	
18	D	2	2	4	
19	D	2	1	4	X
20	D	2	C	--	X
21	S	1	8	2	
22	S	1	4	4	
23	S	1	2	8	
24	S	1	1	16	X
25	S	1	C	--	X
26	D	1	8	1	
27	D	1	4	2	
28	D	1	2	4	
29	D	1	1	8	X
30	D	1	C	--	X
31	S	1/2	8	2	
32	S	1/2	4	4	
33	S	1/2	2	8	
34	S	1/2	1	16	X
35	S	1/2	C	--	X
36	D	1/2	8	1	
37	D	1/2	4	2	
38	D	1/2	2	4	
39	D	1/2	1	8	X
40	D	1/2	C	--	X

APPENDIX A

ENVIRONMENTAL/EMI TESTS FOR

SEQUENCER AND CONTROLLER

ENVIRONMENTAL/EMI

QUALIFICATION TEST PROCEDURE

FOR

LUNDY ELECTRONICS AND SYSTEMS, INC.

APPLICABLE ITEMS

1. Control Unit - Drawing Number 39-1155
2. Sequencer Unit - Drawing Number 39-1138

HARRIS
COMMUNICATIONS AND INFORMATION HANDLING

HARRIS CORPORATION Electronic Systems Division*
P O Box 37, Melbourne, Florida 32901 305/727-4000
*(formerly RADIATION)

ENVIRONMENTAL/EMI

QUALIFICATION TEST PROCEDURE

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SECTION I

ENVIRONMENTAL QUALIFICATION TEST
PROCEDURE
FOR
LUNDY ELECTRONICS AND SYSTEMS, INC.
CONTROL AND SEQUENCER UNITS

1.0 SCOPE

1.1 Application

This document delinates the test procedure and methods to be utilized to perform the Environmental Qualification Tests on one (1) each Control Unit (CU), Drawing Number 39-1155, and one (1) each Sequencer Unit (SU), Drawing Number 39-1138, manufactured by Lundy Electronics and Systems, Incorporated.

1.2 Purpose

The purpose of these tests is to verify the operational integrity of the CU and SU while being subjected to the dynamic and climatic environments specified in this procedure.

2.0 APPLICABLE DOCUMENT

MILITARY SPECIFICATION	TITLE
MIL-T-5422	Testing, Environmental, Airborne Electronics Equipment Revision E, dated 13 April 1959

3.0 TEST FACILITIES

3.1 Location

Qualification Testing shall be conducted at Harris Corporation, Electronic Systems Division, Environmental Engineering Laboratory.

3.2 Standard Conditions

Unless otherwise specified, tests are to be conducted under standard laboratory conditions. Standard laboratory conditions are defined as follows:

Temperature - Room Ambient 23°C ± 10°C (73°F ± 18°F)

Relative Humidity - 50 ± 40%

Atmosphere Pressure - 725 +50/-115mm of mercury (28.5 +2/-4.5 inches of mercury)

3.3 Test Tolerances

The maximum allowable tolerances on test conditions shall be as follows:

(a) Temperature (degrees centigrade): ±2 degrees
(b) Altitude (feet): ±5%
(c) Humidity (relative): ±5% -0%
(d) Vibration Amplitude: ±10%
(e) Vibration Frequency: ±2%
(f) Additional Tolerances: Additional tolerances shall be as specified

3.4 Measurements

All measurements shall be made with instruments whose accuracy has been verified. The accuracy of instruments and test equipment shall be verified periodically to the satisfaction of the procurring agency. All instruments and test equipment used shall:

a. Conform to laboratory standards whose calibration is traceable to the prime standards at the U.S. Bureau of Standards.

b. Have an accuracy of at least one-third the tolerance for the variable to be measured. In the event of conflict between this accuracy and a requirement for accuracy in any one of the test procedures of this document, the latter shall govern.

c. Be appropriate for measuring the test parameters.

3.5 Definition of Terms

1. Temperature Stabilization, Equipment Non-Operating: Unless otherwise specified, temperature stabilization has been achieved when the temperature of the unit(s) having the longest thermal lag does not differ more than 2oC (3.6oF) from the ambient temperature.

2. Resonant Modes - A resonant mode shall be considered to be any frequency dependent mechanical disturbance which can be detected visually, orally, or by means of other sensing devices. A resonant mode exists at any frequency at which the ratio of specimen response level to input level (a ratio of at least 2 to 1 shall be considered as a resonant point for the test program prescribed in this procedure) is at a peak such that both an increase and a decrease in the excitation frequency will produce a decrease in the specimen response level. The disturbance may also exhibit itself as an erratic sharp waveform, and in the specimen as erratic operation, deviation from required performance or complete malfunction.

3.6 Test Equipment

The below listed, or equivalent equipment shall be utilized for these tests:

ITEM	MANFACTURER	MODEL NO.	SERIAL NO.	CALIBRATIO INTERVAL
Temperature/Altitude Chamber	Tenny Engineering	36ST-100350	7598	N/A

ITEM	MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATION INTERVAL
Temperature Controller Chamber	Honeywell	Y15214316-01-03-2	U0339203001	90 days
Manometer	Merian	11AA10WM		N/A
Temperature Recorder	Honeywell	16303856	F7108905001	90 days
Vibration Shaker	Ling	A249-1	69	N/A
Vibration Power Amplifier	Ling	PP-175/240B	35	N/A
Vibration Console	Ling	SRC-503L	14	N/A
Sweep Oscillator Servo	Spectral Dynamics	SD114	94	N/A
Clipper-Mixer Amplifier	Ling	CMA-10	166	N/A
Shaker Cutoff	Radiation	T-4040A	2	At time test
Line Amplifier	Ling	LA-100	58	N/A
Oscilloscope	Tektronix	RM564	Various	120 days
Time Base	Tektronix	2B67	Various	120 days
Amplifier	Tektronix	3A72	Various	120 days
True RMS Voltmeter	Ballantine	320	Various	120 days
X-Y Recorder	Hewlett Packard	135	Various	180 days
Log Converter	Hewlett Packard	7560A	Various	180 days
Counter	Hewlett Packard	5512A	Various	120 days
Amplifier Power Supply	Unholtz Dickie	608PS-1	Various	N/A
Amplifier Power Supply	Unholtz Dickie	608R	Various	N/A
Charge Amplifier	Unholtz Dickie	8PCV	Various	180 days
Charge Amplifier	Unholtz Dickie	8PMVCA	Various	180 days

ITEM.	MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATIO INTERVAL
\ccelerometer	Endevco	2224C	Various	90 days
A—celerometer	Endevco	2222B	Various	90 days
'ape Recorder	CEC	VR3300	Various	at time of test
imer	Dimco Gray	171	Various	180 days
S ock Pulse Generator	Radiation	612554	2	at time of test
S ope Camera	Polaroid	C-12	Various	N/A

4.0 GENERAL

4.1 Data

All environmental test data, with the exception of recorder charts and magnetic tape, taken during these tests shall be entered in a bound notebook. A complete log of all environmental test information shall be maintained, including test dates, sketches of all test setups, instrumentation used, test events, deviations from this procedure and explanation for deviations, test data and results. All recorder charts and magnetic tapes shall be properly identified, packaged, and retained as support to the test reports written by Harris ESD. These recorder charts and magnetic tapes shall be delivered to the customer at the completion of the program.

4.2 Test Deviations

Deviations from this test procedure caused by malfunction and/or failure of the environmental or auxiliary equipment shall not be caused for rejection of the entire test.

In the case of test equipment malfunction, the test shall be stopped. After the malfunction has been corrected, the test shall be restarted at the test conditions prevailing at the time of the malfunction or at a prior point in the test as designated by the cognizant Test Engineer with the concurrance of the Lundy Electronics and Systems Project Engineer or his representa ve.

4.3 Visual Inspection

Prior to and immediately after each test, the units under test shall be given a complete visual inspection. Any mechanical discrepancies shall be noted, entered in the project log, and brought to the attention of the Test Engineer and the Lundy Electronics and Systems Project Engineer, or his representative.

5.0 TEMPERATURE/ALTITUDE TEST

5.1 General

Thermocouples shall be installed in and on the CU and SU units to allow measurement of the following temperatures (locations to be determined at time of test).

a. Thermocouples shall be located internally in each unit to allow measurement as nearly as possible of the average internal ambient temperature of the units.

b. Contact temperature on the largest transformer or inductor (except RF inductors) or other large mass in each unit.

c. Contact temperature on the component or components where the highest operating temperature is expected, except vacuum tubes surfaces.

d. Contact temperature on the component or components whose temperature rise is likely to limit equipment performance

e. External surface points having the largest thermal lag.

5.2 Procedure

The CU and SU shall be placed in the test chamber on thermally inert spacers in a manner similar to that in which it shall be used in service. The required electrical connectors shall be accomplished and a functional test performed to ensure proper operation of the units prior to sealing the test chamber. After verification of proper operation has been completed, the test chamber door shall be sealed and the units subjected to the Temperature/Altitude Test specified in Steps 1 through 12 below.

Step 1 - With the units non-operating, adjust the internal test chamber temperature to -62°C ±2°C. The temperature of the units shall be stabilized at -62°C and maintained for at least two (2) hours. Where it is possible without changing the temperature condition, a visual inspection of the units shall be made to determine whether or not deterioration which would impair future operation of the units has occurred.

Step 2 - With the units non-operational, adjust the internal test chamber temperature to -54°C ± 2°C. After stabilization of the units at -54°C, the units shall be energized at the lowest specified input voltage. The units shall operate satisfactorily within the specified warm-up time. The units shall be turned on and off several times and checked for satisfactory operation. (See notes a and b). The internal chamber ambient temperature shall be maintained at -54°C. Operation of the units shall be continued, and during this period it shall be checked to determine satisfactory operation.

Note (a): Satisfactory operation within the specified warm-up time shall be determined by checking to see if the visual or oral presentation or other performance characteristics appear normal.

Note (b): All characteristics which are likely to be effected by low temperatures shall be checked first. Should the time required to check the units exceed 15 minutes beyond the warm-up time, the units shall again be stabilized at -54°C and the operational check continued.

Step 3 - With the units non-operational, permit the units to restabilize at -54°C. After stabilization at -54°C, the units shall be energized and the internal chamber pressure adjusted to 70,000 feet. Upon reaching 70,000 feet, an operational and performance check shall be made at the highest specified input voltage and the results recorded.

Step 4 - With the units non-operational, adjust the internal chamber conditions to -10°C ± 2°C and atmospheric pressure. After stabilization of the units at -10°C, the test chamber door shall be opened and frost permitted to form on the units. The door shall remain open long enough for the frost to melt, but not long enough to allow the moisture to evaporate. (See note c.) The chamber door shall be closed and the units energized at the highest specified input voltage to see if the units operate satisfactory within the specified warm-up time. The units shall be turned on and off at least three (3) times. (See note a.)

Note (c): When the chamber door is opened, it is intended that frost will form; however, should the relative humidity of the air be such that frost will not form, an artificial means shall be used to provide the relative humidity necessary to have frost form.

Note (d): After completion of the cold test (Steps 1, 2, 3, and 4), and prior to starting the high temperature tests, a reference run shall be made at room ambient conditions. The reference run shall be made at the highest specified input voltages and the data obtained compared with that of the reference run made prior to Step 1.

Step 5 - With the units non-operational, adjust the internal chamber temperature to 95°C ± 2°C. The internal temperature shall be stabilized at 95°C and maintained for a minimum period of 16 hours. At the conclusion of this 16 hour period the units shall, when feasible, be visually inspected to determine the extent of any deterioration.

Step 6 - With the units non-operational, adjust the internal chamber temperature to 71°C ± 2°C. After stabilization of the units at 71°C, the units shall be energized and operated continuously at the highest specified input voltage for a period of four (4) hours. Thermocouple readings shall be recorded every 30 minutes. At the completion of the four (4) hour operating, and while maintaining the specified temperature, continue to operate the units until the units have been checked for satisfactory operation and the results recorded.

Step 7 - With the units non-operational, adjust the internal chamber temperature to 95°C ± 2°C. After stabilization of the units at 95°C, the units shall be energized at the highest specified input voltage for four (4) cycles, each cycle consisting of a 30 minute pperational period followed by a 15 minute non-operational period. The units shall be checked for satisfactory operation during each period of operation and the results recorded. Thermocouple readings shall be recorded every 10 minutes.

Step 8 - With the units non-operational, adjust the internal chamber temperature to 36°C ± 2°C. After stabilization of the units at 36°C, the units shall be energized, and the internal chamber pressure adjusted to 50,000 feet. After stabilization of the units and the internal chamber conditions, the units shall be operated at the highest specified input voltage for a period of four (4) hours. Thermocouple readings shall be recorded every 30 minutes. At the completion of the four (4) hour operating period, and while maintaining the specified internal chamber conditions, continue to operate the units until the units have been checked for satisfactory operation and the results recorded.

Step 9 - With the units non-operational, adjust the internal chamber temperature to 60°C ± 2°C. (Note: Chamber altitude shall remain at 50,000 feet throughout this step.) After stabilization of the units at 60°C, the units shall be energized at the highest specified input voltage for four (4) cycles, each cycle consisting of a 30 minute operational period followed by a 15 minute non-operational period. The units shall be checked for satisfactory operation during each period of operation and the results recorded. Thermocouple readings shall be recorded every 10 minutes of operation.

Step 10 - With the units non-operational, adjust the internal chamber temperature to 10° ± 2°C. After the internal chamber temperature has been adjusted, the units shall be energized, and the internal chamber pressure adjusted to 70,000 feet. After stabilization of the internal chamber conditions, the units shall be operated for four (4) hours at the highest input voltage specified. Thermocouple readings shall be recorded every 30 minutes. At the completion of the four (4) hour operating period, continue to operate the units at the specified conditions until an operational and performance check is made and the results recorded.

Step 11 - With the units non-operational, adjust the internal chamber temperature to 35°C ± 2°C. (Note: Chamber altitude shall remain at 70,000 feet throughout this step.) After stabilization of the units at 35°C, the units shall be energized at the highest specified input voltage for four (4) cycles, each cycle consisting of a 30 minute operational period followed by a 15 minute non-operational period. The units shall be checked for satisfactory operation during each period of operation and the results shall be recorded every 10 minutes of operation.

Step 12 - With the units non-operational, adjust the internal chamber conditions to normal laboratory conditions. When the internal chamber conditions have stabilized, an operational and performance check shall be made on the units and the results recorded.

Note (e): In order to expedite the stabilization of unit temperature, chamber temperatures other than those stated may be used.

Note (f): The steps listed herein include certain essential operational test points. These steps define the required temperature-altitude operational envelopes for the units. In addition to the essential test points stated, any combination of conditions, in any sequence, within the design limitation envelopes as defined by the class of equipment or as modified by the equipment specification, may be chosen as additional operational test points.

6.0 VIBRATION TEST

6.1 Test Setup

Prior to the attachment of the CU or SU to the vibration test fixture, a bare fixture run shall be conducted to ensure the operational integrity of the vibration system.

6.2 Procedure

The CU or SU shall be attached to the vibration test fixture and subjected to the tests described in subparagraphs 6.2.1 (Resonance Survey), 6.2.2 (Resonance Dwell), and 6.2.3 (Cycling). Both units shall be subjected to these tests in each of the three (3) orthogonal axes.

6.2.1 Resonance Survey

After attachment of the unit to the vibration test fixture and all electrical connections made, monitor accelerometers shall be attached to the unit to allow measurement of the structural responses during the resonant survey described in Table I below. (Locations to be determined at the time of test.) During the resonant survey, the normalized outputs of the control and monitor accelerometers shall be recorded on magnetic tape. This recorded data shall be played back and plotted as acceleration versus frequency. This data shall be reviewed and all structural resonant points noted in the Project Log Book.

TABLE I
INPUT RESONANCE SURVEY

FREQUENCY	AMPLITUDE
5 to 10 Hz	0.08 inches DA
10 to 15 Hz	0.41 Go-pk
15 to 53 Hz	0.036 inches DA
53 to 500 Hz	5.0 Go-pk

Sweep Rate: 0.875 octaves per minute
Sweep Duration: 7 1/2 minutes

NOTE: The unit under test shall be operational during the entire resonance survey.

6.2.2 Resonance Dwell

The unit under test shall be subjected to a 30 minute exposure at each resonant point noted during the resonant survey. If more than four (4) resonant points are noted, the four (4) most severe shall be used. The input amplitude shall be in accordance with Table I for each frequency selected. A performance check of the unit under test shall be made during each dwell. During each dwell the normalized outputs of the control and monitor accelerometers and the applicable frequency shall be recorded in the Project Log Book at five (5) minute intervals.

6.2.3 Cycling

The unit under test, while operational, shall be subjected to a sinusoidal sweep from 5 to 500 to 5 Hz at a sweep rate of 0.875 octaves per minute. The amplitudes shall be as specified in Table I. Each sweep shall be 15 minutes in duration with the number of sweeps required being determined by Table II.

TABLE II
VIBRATION TEST SCHEDULE

Number of Resonances	0	1	2	3	4
Total Time At Resonance	-	30 min.	1 Hr.	1½ Hrs.	2 Hrs.
Cycling Time	3 Hrs.	2½ Hrs.	2 Hrs.	1½ Hrs.	1 Hr

7.0 SHOCK TEST

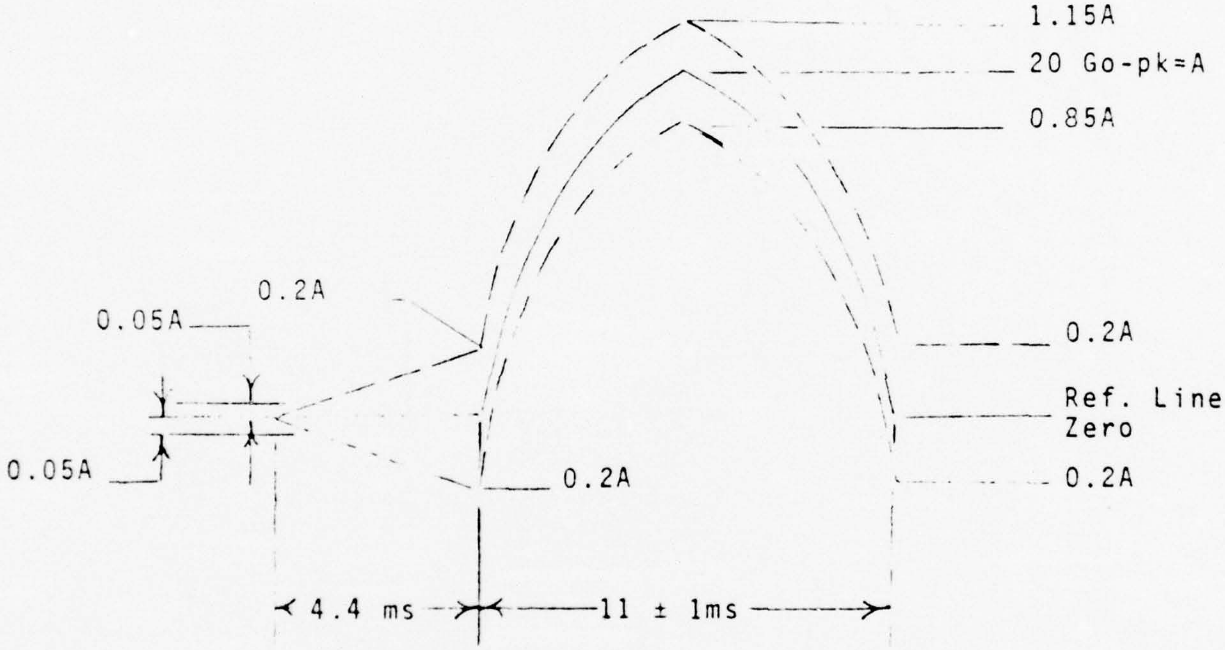
7.1 Test Setup

Prior to the attachment of the unit under test to the shock test fixture, the Shock Pulse Generator shall be adjusted to apply a shapped half-sine pulse having an amplitude of 20 Go-pk ± 3.0 Go-pk and a duration of 11 ± 1 milliseconds. Reference Figure 1.

7.2 Procedure

At the completion of the test setup, the unit under test shall be attached to the shock test fixture and subjected to the three (3) applied shock pulses of 20 Go-pk ± 3.0 Go-pk and a duration of 11 ± 1 milliseconds (reference Figure 1), in each direction of each of the three (3) orthogonal axes. The unit under test shall be operational before, during, and immediately after each applied shock pulse.

A polaroid picture shall be taken of each applied shock pulse and shall be included in the test data. Each picture shall have noted on its back the data, Go-pk per centimeter, time per centimeter, pulse number, and unit under test nomenclature.



HALF SINE SHOCK PULSE CONFIGURATION
AND ITS TOLERANCE LIMITS

FIGURE 1

8.0 HUMIDITY TEST

8.1 Preconditioning

Prior to subjecting the CU and SU to the humidity exposure, the units shall be preconditioned by stabilizing and maintaining the units at the extreme temperature conditions in accordance with Steps 1 and 5 of Paragraph 5.2 of this procedure. If the units have been subjected to the temperature-altitude specified in Paragraph 5.0 of this procedure, then the preconditioning requirement has been satisfied.

8.2 Procedure

The CU and SU shall be placed in the humidity chamber in a manner similar to that in which it will be used in service. If operation of the units is required, all necessary electrical connections shall be made. The relative humidity shall be maintained in excess of 95 per cent unless otherwise stated throughout the entire test. Moisture shall be provided by steam or by evaporation of tapwater having a pH value between 6.5 and 7.5 measured at 25°C. The velocity of air throughout the exposure area shall not exceed 150 feet per minute. The test chamber shall be vented to the atmosphere to prevent the buildup of pressure. Provisions shall be made to prevent dripping of water onto the equipment from above.

Step 1 - The internal chamber temperature shall be raised to 50°C during a two (2) hour period, with the relative humidity maintained in excess of 95 per cent.

Step 2 - The internal chamber conditions shall be maintained at 50°C and 95 per cent or greater relative humidity during the next six (6) hours.

Step 3 - During the next 16 hour period, the internal test chamber temperature shall be decreased gradually to a temperature of 38°C or lower. During this period, the relative humidity shall be maintained as high as possible and shall not be allowed to drop below 85 per cent.

Step 4 - Steps 1, 2, and 3 shall constitute a complete cycle. Repeat these steps (1, 2, and 3) for total of ten (10) continuous cycles (not less than 240 hours). At the completion of the tenth cycle, the units shall be operated as soon as possible, but no later than one (1) hour after completion of the ten (10) cycles, and checked for satisfactory operation. Satisfactory operation shall be determined by no part failures and within a specified warm-up time, readings shall indicate unit(s) operation within the specified limits of satisfactory operation. The warm-up shall not exceed the time specified in the applicable detailed specification.

NOTE: Following the above operation, check for satisfactory operation. The units shall be examined for any evidence of entrapped moisture. Presense of entrapped condensation may be cause for rejection, provided its presense could adversely effect the units.

SECTION II

EMI QUALIFICATION TEST
PROCEDURE
FOR
LUNDY ELECTRONICS AND SYSTEMS, INC
CONTROL AND SEQUENCER UNITS

1.0 PURPOSE

The purpose of this informal test plan is to provide the necessary factual data and basic test procedures to perform MIL-STD-461A tests CE01, CE02, CE03, CE04, CS01, RE02 and RS01 on one Control Unit and one Sequencer unit as provided by Lundy Electronics Systems Inc.

2.0 SPECIFICATIONS, INVOKED

The following specifications or drawings form a part of this document to the extent herein:

MIL-STD-461A	Electromagnetic Interference Characteristics, Requirements for Equipment
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
Drawing No 39-1165	Lundy Interconnection Diagram

3.0 UNIT UNDER TEST

The system to be tested consists of one (1) Control Unit (P/N39-1155) and one (1) Sequencer (P/N39-1138) interconnected by shielded cables.

Lundy representatives shall be present to aid in the UUT setup and to operate and monitor the system during all EMI testing.

4.0 TESTS TO BE PERFORMED

Table 4.0-1 is a list of the tests to be performed along with applicable data for each test.

5.0 TEST EQUIPMENT

All emanation measurements will be made using a Fairchild automatic test set which covers the freqeuncy ranoe of 20 Hz to 1 GHz. All test equipment and calibration intervals are shown in Table 5.0-1.

6.0 UUT OPERATION

Lundy Personnel shall determine the modes of operation and shall maintain proper functioning of equipment during EMC testing.

The Equipment should be operated, during emission testing, in a mode in which all circuitry is active. During suscentibility testing, the equipment shall be operated in its most susceptible state.

Test to be performed	Frequency Range of test	UUT Mode of operation	Lines to be tested	No. Times test to be performed	Ref Figure	Test Equipment to be used	Pick up injection device
Power line conducted CE01	30 Hz-20 kHz		J1 Pins J&C ±28 VDC	1 scan each line	19 and 22	Fairchild automatic test set	PCL-10 current probe
CE03	20 kHz-50 MHz		J1 Pins J&C ±28 VDC	1 scan each line			Stoddart
Signal Line conducted CE02	30 Hz-20 kHz		J1, Pins A,D,F,E,G	1 scan each line	19 and 22	Fairchild automatic test set	PCL-10 current probe
CE04	20 kHz-50 MHz		J1, Pins A,D,F,E,G				
Conducted Susceptibility Power leads CS01	30 Hz-50 kHz		J1, Pins J&C	1 scan each line	CS01-1	651B osc. K.H. W.B.AMP TEK515 6220-1A ISO transformer	
Radiated Emissions RE02	14 kHz-1 GHz		N/A	1 scan 1 antenna position	RE02-1	Fairchild automatic test set	Singer 95010-1 EMCO 3104 CLP 1A
Radiated Susceptibility RS01	30 Hz-30 kHz		N/A		RS01-1	ELS-10 EMC-10 651B osc.	RS01 loop

Table 4.0-1 TESTS TO BE PERFORMED

TYPE	MANUFACTURER	MODEL	FREQUENCY RANGE	SERIAL NUMBER	CAL DUE DATE
Receiver	Fairchild	EMC-10	20 Hz - 50 kHz		
Receiver	Fairchild	EMC-25	14 kHz - GHz		
Plotter	Houston Inst.	EXY-125	---		
Programmer	Fairchild	ESC-125	---		
Spectrum Display	Farichild	SPD-125	14 kHz - 1 GHz		
Signal Generator	Hewlett Packard	651B	10 Hz - 10 MHz		
Amplifier	Krohn-Hite	DCA50R	20 Hz - 500 kHz		
Scope	Tektronix	515 or 545A	0 - 15 MHz		
Probe	Fairchild	PCL-10	120 Hz - 50 kHz		
Probe	Stoddart	91550-1	14 kHz - 50 MHz		
Antenna	Singer	95010-1	10 kHz - 40 MHz		
Antenna	EMCO	3104	20 MHz - 200 MHz		
Antenna	EMCO	CLP1A	200 MHz - 1 GHz		
Antenna	EMCO	CLP1B	1 GHz - 10 GHz		
Antenna	HESD	RS-01	30 Hz - 30 kHz		
Antenna	Fairchild	ELS-10	20 Hz - 50 kHz		
Transformer	Solar	6220-1A	---		
Transformer	HESD	---	---		
10 μf caps.	Solar	6512-106	---		
Insulators	HESD	---	---		
Coaxial Cable, 30 ft	HESD	---	---		

Table 5.0-1 TEST EQUIPMENT LIST

7.0 PROCEDURE

The EMI test to be performed on the Sequencer and Control Box shall be tested in accordance with the following MIL-STD-462 procedures.

The configurations will be modified slightly to accomodate the Fairchild test equipment and the specific test sample.

METHOD CE01

CONDUCTED EMISSION, 30 Hz to 20 kHz, POWER LEADS

1. Purpose - This test method is used for measuring conducted emissions on all power leads.

2. Applicability - This test method is applicable for measuring conducted emissions in the frequency range of 30 Hz to 20 kHz on a.c. and d.c. power input and output leads, including neutrals which are grounded externally to the equipment. Bonding straps do not have to be measured.

3. Apparatus - The test apparatus shall include the following:

(a) Current Probes.
(b) Matching Transformer - An impedance matching transformer may be needed between certain current probes and the interference meter so that the measuring system will meet the sensitivity requirements needed to perform the test.
(c) Electromagnetic Interference Meter.
(d) Band-Reject Filter - A band-reject filter shall be used in the measuring circuit to remove the power frequency and its 2nd, 3rd, and 4th harmonics when testing ac power lines for broadband interference.
(e) Ten Microfarad Feed-Through Capacitor

4. Test Procedure - The test setup shall be as shown on Figure CE01-1.

4.1 Narrowband Measurements - The following equipment shall be used:

(a) Current Probe.
(b) Matching transformer
(c) Instrument with selectivity (that is interference meter).

4.2 Broadband Measurements - The following equipment shall be used for broadband measurements:

(a) Interference meter (used in 20 kHz bandwidth position)
(b) Current Probe
(c) Matching transformer
(d) Band-reject filter

5. Notes

(a) When matching transformers or band-reject filters are used, their characteristics must be described in the control plan and test plan.
(b) Conducted emissions shall be measured separately on each power lead.

1. 5 cm Standoffs
2. Low Impedance Bond to Ground Plane
3. Current Probe
4. Test Sample Chassis Ground
5. High Side
6. Return
7. DC bond impedance between the ground plane and enclosure shall not exceed 2.5 milliohms.

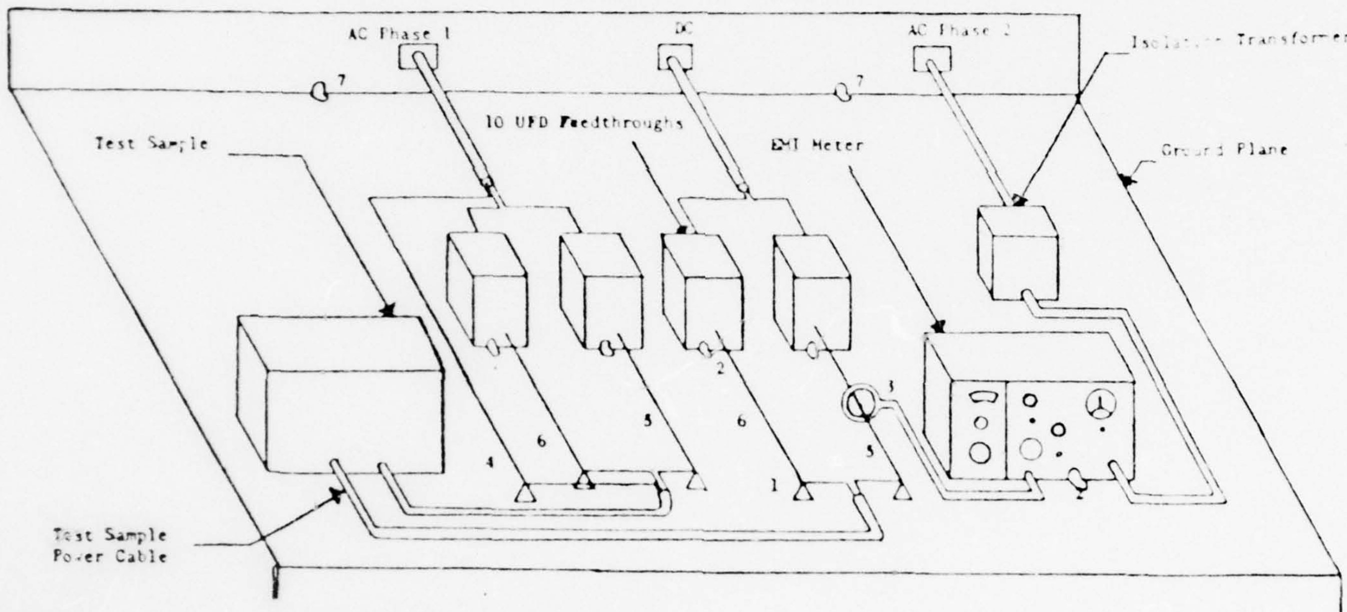


Figure CE01-1 - Typical current probe test setup for conducted emission measurements on power leads (cont'd).

METHOD CE01

NOTES:

1. The minimum separation between cables, leads, and ground plan shall be 5 cm.
2. The length of power lead from the test sample to the feedthrough capacitor shall not exceed 1 meter.
3. The length of each power lead between the point of separation and connection to the feedthrough capacitor shall be 30 $\pm$ 2 cm. The current probe shall be positioned along this length to produce a maximum reading on the EMI meter.
4. The test sample and EMI instrumentation shall derive their power requirements from two separate phases of the AC power source. The purpose of this requirement is to provide isolation between the test sample and measurement instrumentation through the shielded enclosure's power line filters.
5. The EMI measuring instrumentation shall be connected to the a.c. power source through an isolation transformer. It is imperative that the chassis power ground be broken at this point to prevent the circulation of r.f. ground currents in the test equipment.

CAUTION: Be sure all test instrumentation is properly bonded to the ground plane before applying power to prevent a potential shock hazard to personnel.

Figure CE01-1 Typical current probe test setup for conducted emission measurements on power leads.

METHOD CE02

CONDUCTED EMISSION, 30 Hz to 20 kHz, CONTROL AND SIGNAL LEADS

1. Purpose - This method is used for measuring conducted emissions on control and signal leads.

2. Applicability - This test method is applicable for measuring conducted emissions in the frequency range of 30 Hz to 20 kHz on all interconnecting signal and control wires.

3. Apparatus - The test apparatus shall include the following:

(a) Current Probes
(b) Matching Transformer - An impedance matching transformer may be needed between certain current probes and the interference meter so that the measuring system will meet the sensitivity requirements needed to perform the test.
(c) Electromagnetic Interference Meter
(d) Ten-Microfarad Feed-Through Capacitor
(e) Band-Reject Filter - A band-reject filter shall be used in the measuring circuit to reject, from the EMI meter, the emissions contained in the necessary information bandwidth.

4. Test Setup and Test Procedure - The test setup shall be as shown in Figure CE02-1.

4.1 Narrowband Measurements - The following equipment shall be used for narrowband measurements:

(a) Current Probe
(b) Matching Transformer
(c) Instrument with selectivity (interference meter)

4.2 Broadband measurements - The following equipment shall be used for broadband measurements:

(a) Interference meter (used in 20 kHz bandwidth position).
(b) Current probe
(c) Matching transformer
(d) Band-reject filter

5. Notes -

(a) The equipment shall be located as specified under the test sample requirements.
(b) Any control lead carrying ac power shall be tested in accordance with CE01.
(c) Signal and control leads within the same cable may be group tested under the following conditions:

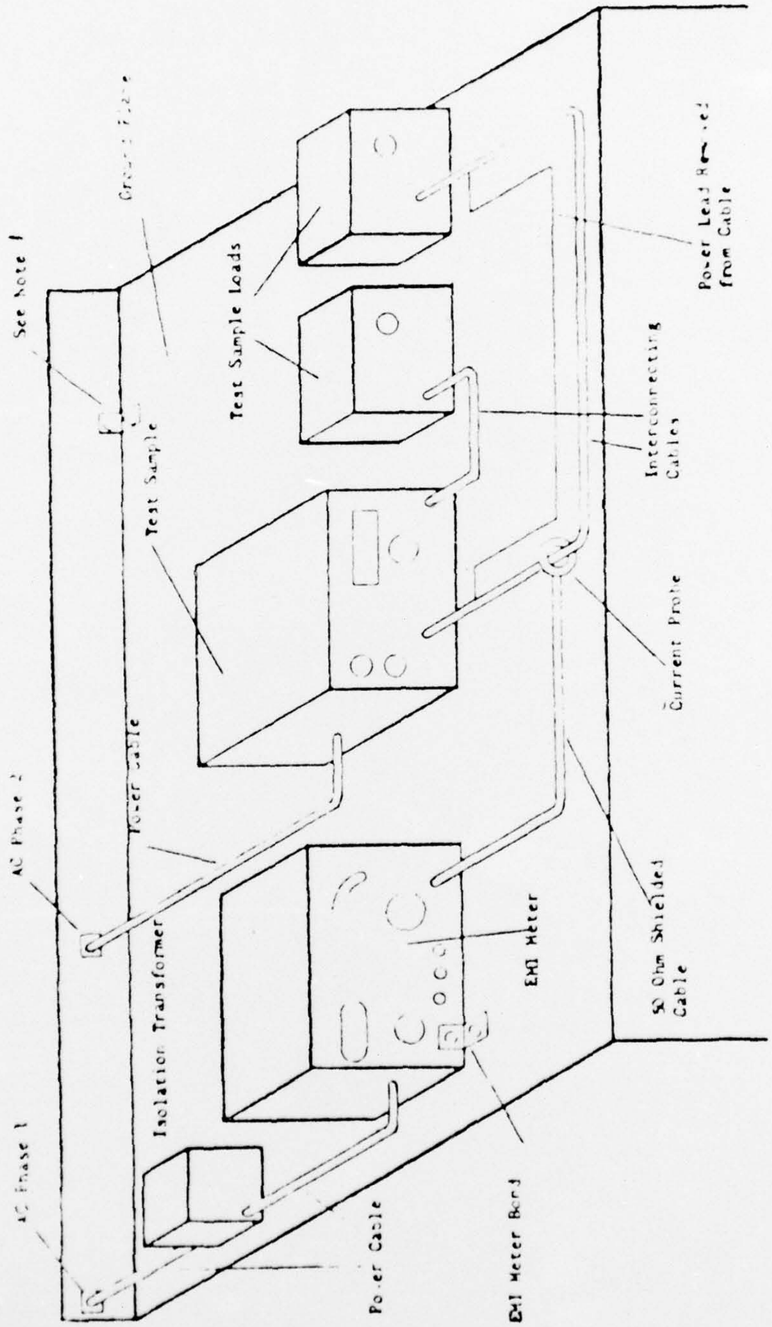


Figure CI02-1 Typical probe test setup for conducted measurement of interconnecting cables

METHOD CE02

(1) When testing cables whose dimensions exceed the current probe's diameter, the cable should be divided into groups so that the probe can enclose the conductors being tested. Each group which results from the division should contain approximately the same number of conductors.

(2) In no case shall a group of leads be probed with both the high and return leads in the test group, except for twisted pairs.

(3) If a group of leads exceeds the limits of this standard the offending leads shall be identified and measured separately.

NOTES:

1. The d.c. bond impedance between the ground plane and enclosure shall not exceed 2.5 milliohms.
2. The minimum separation between cables, leads, and ground plane shall be 5.cm.
3. The test sample and EMI measuring instrumentation shall derive their power from two separate phases of the a.c. power source. The purpose of this requirement is to provide additional isolation between the test sample and measuring instrumentation through the enclosure's power line filters.
4. The current probe shall be positioned along the length of interconnecting cable to produce a maximum reading on the EMI meter.
5. The EMI measuring instrumentation shall be connected to the a.c. power source through an isolation transformer. It is imperative that the chassis power ground be broken at this point to prevent the circulation of RF ground currents in the test equipment.

CAUTION: Be sure the instumentaion is properly bonded to the ground plane before applying ac power to prevent potential shock hazard to personnel.

Figure CE02-1 Typical probe test setup for conducted measurement of interconnecting cables

METHOD CE03

CONDUCTED EMISSION, 20 kHz to 50 MHz, POWER LEADS

1. Purpose - This method is used for measuring conducted emissions on all power leads.

2. Applicability - This test method is applicable for measuring conducted emissions in the frequency range of 20 kHz to 50 MHz on a.c. and d.c. power input and output leads, including neutrals which are grounded externally to the equipment. Bonding straps need not be measured.

3. Apparatus - The test apparatus shall include the following:

(a) Current Probes
(b) Electromagnetic Interference Meter
(c) Ten Microfarad Feed-through Capacitor

4. Test Procedure - The test setup shall be as shown in Figure CE01-1. Conducted emissions shall be measured separately on each power lead.

METHOD CE04

CONDUCTED EMISSION, 20 kHz to 50 MHz, CONTROL AND SIGNAL LEADS

1. Purpose - This method is for measuring conducted emissions on control and signal leads.

2. Applicability - This test method is applicable for measuring conducted emissions in the frequency range of 20 kHz to 50 kHz on all interconnecting signal and control wires.

3. Apparatus - The test apparatus shall include the following:

(a) Current Probes
(b) Electromagnetic Interference Meter
(c) Ten Microfarad Feed-Through Capacitor

4. Test Procedure - The test setup shall be as shown in Figure CE02-1.

5. Notes -

(a) The equipment shall be loaded as specified under the test sample requirements in this standard.
(b) Any control lead carrying ac power shall be tested in accordance with CE03.
(c) Signal and control leads within the same cable may be group tested under the following conditions:

(1) When testing cables whose dimensions exceed the current probe's diameter, the cable should be divided into groups so that the probe can enclose the conductors being tested. Each group which results from the division should contain approximately the same number of conductors.
(2) In no case shall a group leads be proved with both the high and return leads in the test group, except for twisted pairs.
(3) If a group of leads exceeds the limits of this standard, the offending leads shall be identified and measured separately.

METHOD CS01

CONDUCTED SUSCEPTIBILITY, 30 Hz to 50 kHz, POWER LEAD

1. Purpose - This method is used to determine whether communication electronic equipment is susceptible to electromagnetic energy injected on its power leads.

2. Applicability - This test method is applicable for all Class I equipment (see MIL-STD-461).

3. Apparatus - Test apparatus shall be as follows:

(a) The measuring apparatus is shown in Figure CS01-1.
(b) Figure CS01-2 shows the construction data for an acceptable isolation transformer. The transformer shall carry all currents without saturation, shall have low leakage reactance, less than one microhenry, and shall have a secondary current capability of 35 amperes (power line current) a.c. or d.c. with 10-percent drop. (Ref. MIL-STD-462 for figure).
(c) A 100-microfarad capacitor across d.c. power source might be required if difficulty is encountered in obtaining the required test voltage.

4. Test Setup and Procedure - The test setup is shown in Figure CS01-1. The procedure is as specified in 4.1 through 4.5.

4.1 If the output impedance of the signal source looking into the secondary terminals of the isolation transformer is unknown, measurement shall be as follows:

(a) Apply a signal to the primary of the transformer and measure the open circuit secondary voltage (Voc).
(b) Connect a know load, R_L, across the secondary and measure the closed circuit secondary voltage(Vcc).
(c) The impedance shall be calculated as follows:

$$Z = \frac{R_L\,(Voc-Vcc)}{Vcc}$$

(d) Repeat the above at one frequency per decade from 30 Hz to 50 kHz (including 30 Hz and 50 kHz).
(e) The measured impedance shall be less than or equal to 0.5 ohms. If it is not, adjust the turns ratio until the desired impedance is attained.

4.2 The test sample shall be connected as shown in figure CS01-1.

4.3 The oscillator shall be tuned through the required frequency range, the output to the specified level adjusted and verification made that: (a) malfunction is present (b) there is degradation of performance, or (c) deviation from indication occur beyond tolerances indicated in the equipment specification or approved test plan. The frequency range within 10 percent of the rated power frequency can be omitted, unless otherwise specified by the procuring activity.

4.4 If the test sample is susceptible to the specified limit level, the output shall be decreased to determine the susceptibility threshold level. This value shall be recorded.

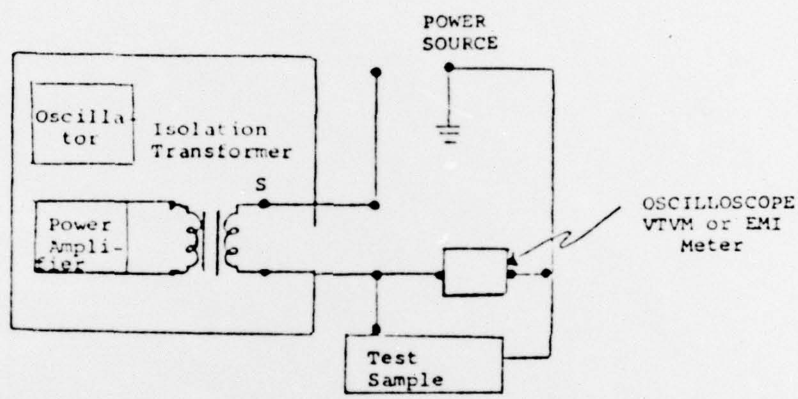


Figure CS01-1 Conducted susceptibility, 30 Hz to 50 kHz typical test setup

4.5 The power voltage applied to the test sample shall be measured over the frequency range of the test and recorded. In some cases, the supply voltage will have to be raised to compensate for losses in the isolation transformer.

5. Notes

5.1 On a.c. lines, a network to eliminate the power frequency at the oscilloscope, VTVM, or EMI meter will simplify measurement.

5.2 The unused primary windings on the transformer shown on figure CS01-3 can be used either to buck flux out from the power current or all can be used in parallel with each other to increase current capacity.

5.3 A 50-ampere transformer can be constructed by using a double stack of 19EI laminations and 0.707 as many turns as that shown on figure CS01-3. The iron weight would then be 20 pounds and the copper weight 7 pounds. Copper loss will be about 50 percent higher but leakage inductance should not increase. Flux density shall be less than 0.68 tests.

METHOD RE02

RADIATED EMISSION, 14 kHz to 10 GHz, ELECTRIC FIELD

1. Purpose - This method is used for measuring radiated electromagnetic emissions from electronic, electrical and electromechanical equipment.

2. Applicability - Any equipment or device to which this method is applicable shall be measured for radiated emissions from all units, cables (including control, pulse, IF, video antenna transmission lines, and power cables), and interconnecting wiring. This method applies to the transmitter fundamental, spurious radiation, oscillator radiation, and broadband emissions, but does not include radiation emanating from an antenna.

2.1 Applicable Frequency Range for Test

2.1.1 Electronic Equipment

(a) Narrowband emissions shall be measured from 14 kHz to 10 times the highest used or intentionally generated frequency, or 1 GHz, whichever is greater; however, the measure frequency shall not exceed 10 GHz.
(b) Broadband emissions shall be measured from 14 kHz to 1 GHz.

2.1.2 Electrical Equipment (Classes IIB and IIC)

(a) Class IIB items shall be tested from 150 kHz to 400 MHz, except electrical hand tools, which shall be tested from 150 kHz to 30 MHz.
(b) Class IIC items shall be tested from 150 kHz to 1 GHz.

3. Apparatus - Test apparatus shall consist of the following:

(a) Test antennas
(b) EMI Meters
(c) 10-Microfarad Feed-Through Capacitor

4. Test Set-up and Procedure

4.1 Test Setup - The basic test set-ups shall be as shown in Figure RE02-1.

4.1.1 Nonportable Equipment - Equipment which is permanently connected either physically or electrically, to a vehicle, system, or installation shall be tested in accordance with the setup shown in Figure RE02-1.

4.1.3 Equipment falling into both of the categories indicated in 4.1.1 shall be tested both ways, unless otherwise specified by the procuring activity or as approved in the test plan.

4.2 Procedure - The test procedures shall be as follows:

(a) Probe the test sample as indicated in Section 4 of this standard to locate the points of maximum radiation from the test sample.
(b) Select and position the test antennas as indicated in Section 4 of this standard. In the frequency range of 25 to 200 MHz, position the test antenna so as to make both vertical and horizontal measurements.
(c) For each test antenna, scan the applicable frequency range of this test with the EMI meter and take measurements as required.

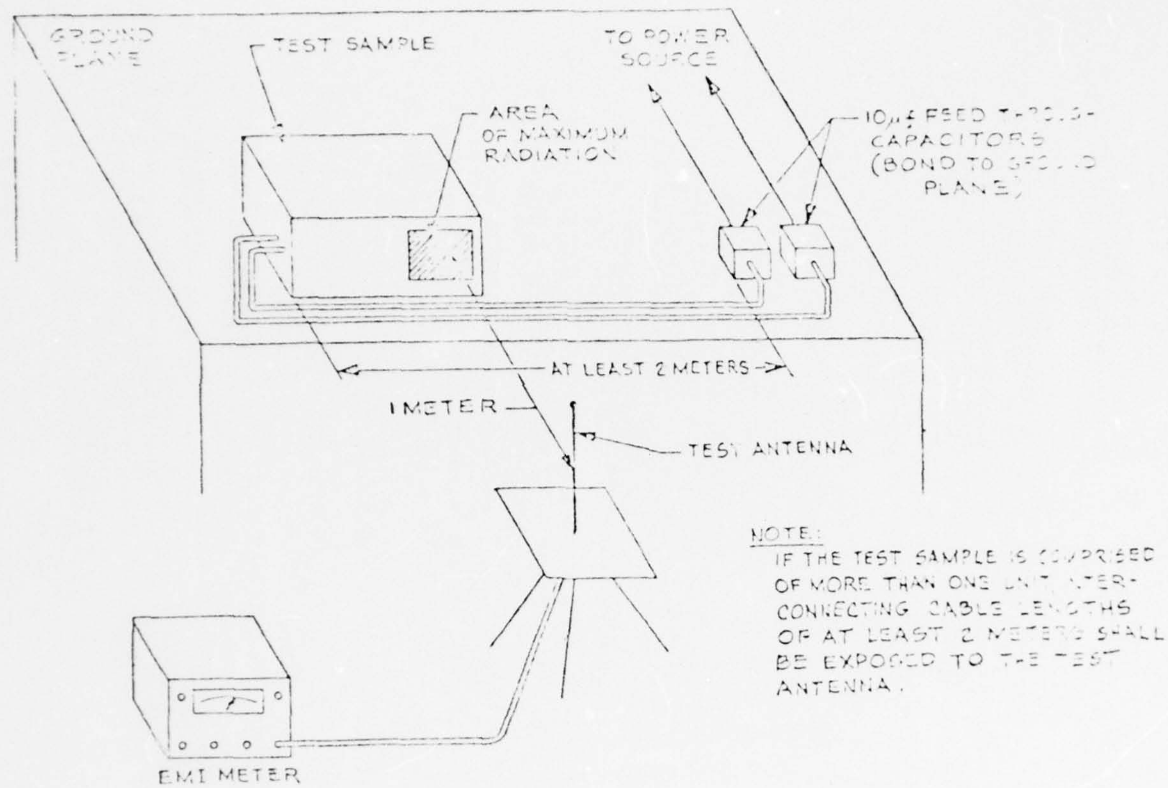


Figure RE02-1 - Typical test setup for radiated measurements

METHOD RS01

RADIATED SUSCEPTIBILITY, 30 Hz to 30 kHz, MAGNETIC FIELD

1. Purpose - The purpose of this test method is to determine whether Class I equipment (see MIL-STD-461) is susceptible to magnetic field radiation.

2. Applicability - This method is applicable in the frequency range of 30 Hz to 30 kHz to Class I equipment, its cables, and connectors. Equipment operating at frequencies greater than 30 MHz are exempt from this test.

3. Apparatus - Test apparatus shall consist of the following:

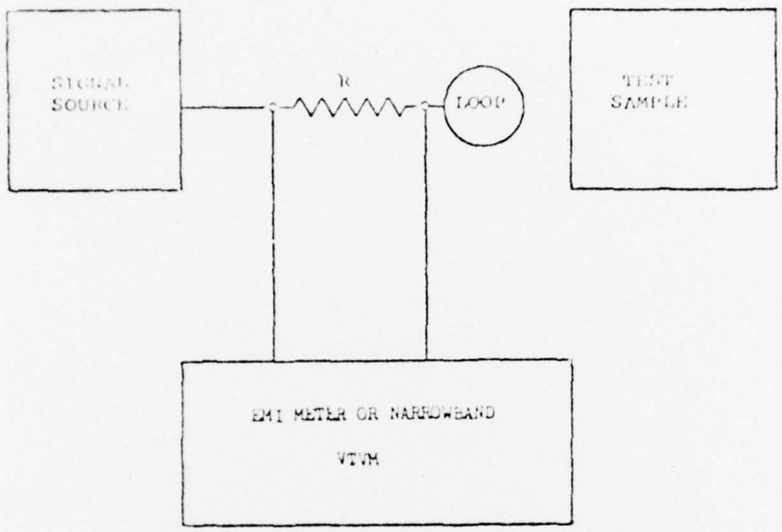
(a) Radiating Loop - The radiating loop shall be as shown in MIL-STD-461. The loop is capable of producing a magnetic flux density of 5 X 10^{-5} Tesla/Ampere at a point approximately 5 cm from the face of the loop. It shall be supported on a wooden form or similar non-conducting material.
(b) Signal Source - The signal source shall be as specified in MIL-STD-461. The loop shall supplied with sufficient current capable of producing magnetic flux densitites 20 to 30 dB greater than the applicable limit at the test frequency.
(c) EMI Meter or Narrowband VTVM - The EMI Meter or Narrowband VTVM shall be capable of reading levels as low as 30 μv in the 30-Hz to 30-kHz frequency range. The equipment shall have a 10-Hz or narrower bandwidth at the 3-dB points.

4. Test Setup and Procedures - Test setups and procedures shall be as follows:

(a) Position the field radiating loop 5 cm from the surface of the test sample. The plane of the loop shall be parallel to the plane of the test sample's surface. (See Figure RS01-1.)
(b) Supply the loop with sufficient current to produce magnetic flux densitites approximately 20 to 30 dB greater than the applicable limit at the test frequencies.
(c) Move the loop over the entire surface and signal input and output cables and connectors to determine the point at which the applied field produces the maximum effect on the test sample.
(d) With the loop at the point of maximum susceptibility, adjust the loop current until the performance of the test sample is not affected by the applied field.

   (1) For test samples with an aural output, adjust the loop current until the test sample gives a reading 20 dB greater than its internal noise. If a 20-dB value cannot be obtained, 6-dB interference signal-to-noise ratio will be used.
   (2) For test samples with outputs other than aural, the degree of degradation shall be defined in the test plan.
   (3) For test samples with aural and nonaural outputs, the test shall be performed to meet both steps (d) (1) and (d) (2).

(e) Record the magnitude of the magnetic field density produced by the source and the maximum value of magnetic flux density required by step (d) above.



R = Resistor of 1 ohm (A 1-volt output to the voltmeter yeilds a 1 amp input to the loop)

Figure RS01-1 - Radiated Susceptibility, 30 kHz to 30 kHz, magnetic field

(f) Repeat steps (a) through (e) at the test frequencies approved in the test plan.

5. Notes

5.1 The magnitude of the magnetic flux density produced by the magnetic field source will be converted to a value representing the equivalent interfering magnetic flux density for a 6-dB signal-to-noise ratio in a system bandwidth of 1 Hz. To make this conversion, the calculations specified hereinafter are necessary:

5.1.1 If a 20-dB interfering signal-to-noise ratio was used the magnetic flux density recorded in step 4 (e) shall be reduced by 14 dB.

(a) If the bandwidth of the tunable voltmeter of EMI meter is greater than that of the test sample or if the overall bandwidth of the test sample plus measuring instrument is greater than 1 Hz, the value will be further reduced by a factor of 10 log Δf_v where Δf_v is the 3-dB bandwidth of the EMI meter or tunable voltmeter. This final value shall be recorded at that frequency.

(b) If the overall bandwidth of the test sample, plus measuring instruments is less than 1 Hz, or if the tunable voltmeter or EMI meter is less than that of the test sample, the magnetic flux density recorded shall be increased by a factor 10 log $\frac{1}{\Delta f_s}$, where Δf_s of the overall 3 dB bandwidth of the test sample. This final value shall be recorded and compared with the limit.

5.1.2 If a 6-dB signal-to-noise ratio was used, the magnetic flux density recorded in step 4(e) shall be approximately adjusted as specified in 5.1.1(a) and 5.1.1(b).