APPENDIX A
RT VALIDATION TEST PLAN

FOREWORD

This section of the handbook provides a sample test plan for MIL-STD-1553B that may serve several different purposes. This section is intended to be noncontractual when the entire MIL-HDBK-1553 is referenced in an equipment specification or SOW. In this case the test plan, as well as the rest of the handbook, provides guidance to both the DOD procuring engineer and the contractor design engineer. This section is intended to be contractual when specifically called out in a specification, SOW, or when required by a DID. If the contractor is required to submit a test plan for his RT to the government, he may remove this section from the handbook and submit it as a portion of his test plan. A better approach would be to simply reference this section. In either case, any and all contractor changes, alterations, or testing deviations to this section shall be separately listed for easy review by government personnel.

MILITARY HANDBOOK

MULTIPLEX APPLICATION

HANDBOOK

TO ALL HOLDERS OF MIL-HDBK-1553:

1. THE FOLLOWING PAGES OF MIL-HDBK-1553 ARE PUBLISHED AND SHOULD BE INSERTED IN THE DOCUMENT:

NEW PAGE	DATE	
Appendix A (ii thru vi) (1 thru 67)	24 September 1986	INITIAL PUBLICATION

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

3. Holders of MIL-HDBK-1553 will verify that additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or canceled.

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1.0 SCOPE

1.1 **General.** This validation test plan defines the test requirements for verifying that the design of remote terminals meet the requirements of MIL-STD-1553B, "Digital Time Division Command/Response Multiplex Data Bus." A remote terminal is considered to have failed to meet the above requirements if that remote terminal fails any test or a portion of any test performed according to this test plan. Passing this test plan does not automatically mean that the remote terminal is acceptable for use by the government. The remote terminal must also meet all the requirements of MIL-STD-1553B over all the environmental, EMI, vibration, and application requirements in the subsystem specification.

1.2 **Application.** This general test plan is intended for design verification of remote terminals designed to meet the requirements of MIL-STD-1553B, Notice 2. Appendix A and B provide cross references between this test plan and MIL-STD-1553B. For those remote terminals not required to meet Notice 2, Appendix C and D list the changes in this test plan for MIL-STD-1553B only and MIL-STD-1553B, Notice 1. These requirements shall apply to the terminal under test, when invoked in a specification or statement of work.

2.0 APPLICABLE DOCUMENTS

2.1 **Standards**

MILITARY

MIL-STD-1553	Digital Time Division Command/Response Multiplex Data Bus

3.0 DEFINITIONS

3.1 **Responses.** The following are definitions of the responses of the RT as used in this test plan. In each case the status word must have the correct terminal address and unused status bits set to zero.

3.1.1 **Broadcast command received (BCR).** The broadcast command received bit (bit time fifteen) is set in status word (and no data words in response to a transmit status mode command or a single data word in response to a transmit last command mode command).

3.1.2 **Busy bit (BUSY).** CS with the busy bit (bit time sixteen) set in the status word, and no data words.

3.1.3 **Clear status (CS).** The status word may have the busy bit and/or service request bit set. All other status code bits in the status word must be zero and the associated message must have the proper word count.

3.1.4 **Dynamic bus acceptance bit (DBA).** CS with the dynamic bus control acceptance bit (bit time eighteen) set in the status word.

3.1.5 Service request bit (SRB). CS with the service request bit (bit time eleven) set in the status word.

3.1.6 Message error bit (ME). The message error bit (bit time nine) is set in the status word and no data words (except in response to a transmit last command mode command which requires one data word).

3.1.7 No response (NR). The addressed terminal does not produce any response to the command.

3.1.8 Respond in form. A terminal is said to "respond in form" if its response to an illegal command as defined in the paragraph titled "Illegal command" of MIL-STD-1553 consists of a response formatted as though it were a legal command.

3.1.9 Subsystem flag bit (SF). CS with the subsystem flag bit (bit time seventeen) set in the status word.

3.1.10 Terminal flag bit (TF). CS with the terminal flag bit (bit time nineteen) set in the status word.

4.0 GENERAL REQUIREMENTS

4.1 General test requirements. The following paragraphs define the configurations, pass/fail criteria, and general procedures for testing remote terminals (RT). Specifically, this document contains the test configurations and procedures for the Electrical Tests (5.1), the Protocol Tests (5.2), and the Noise Rejection Test (5.3) for MIL-STD-1553 remote terminals. The remote terminal under test is referred to as the unit under test (UUT). Proper terminal responses are defined in each test paragraph. If the hardware/software design of the UUT does not permit a test to be performed, then adequate analysis shall be provided in place of the test results to demonstrate that the design meets the requirements of MIL-STD-1553 as stated in the test.

Any condition which causes the UUT to respond other than as called out in MIL-STD-1553, to lock up, or require a power cycle in order to recover for any reason shall automatically cause that UUT to fail the test. All occurrences of responses with the busy bit set in the status word shall be recorded. If the UUT response does not match the pass criteria for a particular test, then the UUT has failed that test.

4.2 Tests for optional requirements. All tests for optional requirements defined in 5.2.2 shall be executed if that MIL-STD-1553 option is required by the subsystem specification or interface control document (ICD). Any optional capabilities implemented in the RT should also be tested, if possible. Within the constraints imposed by the hardware/software design, optional capabilities must be tested prior to use by system integrators.

4.3 General monitoring requirement. In addition to the specific tests that follow, certain RT parameters must be continuously monitored throughout all tests. These parameters are:

a. response time
b. contiguous data
c. proper Manchester encoding
d. proper bit count
e. odd parity
f. proper word count
g. proper terminal address in the status word
h. reserved status and instrumentation bits in the status word are set to zero
i. proper sync

The UUT shall have failed the test if at any time during the test any of these parameters fail to meet the requirements of MIL-STD-1553. Record the parameters for all failures.

5.0 DETAILED REQUIREMENTS

5.1 Electrical tests. Each test paragraph contains the requirements for both transformer and direct coupled stubs. A UUT which provides both transformer and direct coupled stubs must be tested on both stubs. Electrical tests shall be performed on all buses for UUTs with redundant bus configurations.

5.1.1 Output characteristics. The following tests are designed to verify that all UUT output characteristics comply with MIL-STD-1553. These tests shall be performed after establishing communications between the test equipment and the UUT. All output electrical tests shall use figure 1A, General Resistor Pad Configuration, with all measurements taken at point "A", unless otherwise noted.

5.1.1.1 Amplitude. A valid, legal transmit command shall be sent to the UUT, requesting the maximum number of words that it is capable of sending. The amplitude of the waveform transmitted by the UUT shall be measured, peak-to-peak, as shown on figure 2.

The pass criteria for Vpp for transformer coupled stubs shall be 18.0 V minimum, and 27.0 V maximum. The pass criteria for Vpp for direct coupled stubs shall be 6.0 V minimum and 9.0 V maximum. The maximum and minimum measured parameters, Vpp, shall be recorded.

5.1.1.2 Risetime/falltime. A valid, legal transmit command shall be sent to the UUT, requesting at least one data word. The rise and fall time of the UUT waveform shall be measured between the 10% and 90% points of the waveform as shown on figure 2. The measurements shall be taken at both the rising and falling edges of a sync waveform and a data bit waveform. The risetime (Tr) and the falltime (Tf) shall be recorded.

The pass criteria shall be 100 ns $\leq$ Tr $\leq$ 300 ns and 100 ns $\leq$ Tf $\leq$ 300 ns. The measured parameters, Tr and Tf, shall be recorded.

Note: The risetime of the sync waveform shall be measured at the mid-crossing of a data word sync, and the fall time of the sync waveform shall be measured at the mid-crossing of the status word sync.

5.1.1.3 **Zero crossing stability.** A valid legal transmit command shall be sent to the UUT, requesting the UUT to transmit words having zero crossing time intervals of 500 ns, 1000 ns, 1500 ns and 2000 ns. The zero crossing time shall be measured for both the positive (Tzcp) and the negative (Tzcn) waveforms as shown on figure 3.

The pass criteria for each case shall be that Tzcp and Tzcn = 500 $\pm$25 ns, 1000 $\pm$25 ns, 1500 $\pm$25 ns and 2000 $\pm$25 ns. The measured parameters, Tzcp and Tzcn shall be recorded for each case.

5.1.1.4 **Distortion, overshoot and ringing.** A valid legal transmit command shall be sent to the UUT, requesting the UUT to transmit at least one data word. The distortion of the waveform, distortion voltage (VD) shall be measured as indicated on figure 2.

Pass criteria shall be VD $\leq$ $\pm$900 mV peak, line-to-line, for transformer coupled stubs or VD $\leq$ $\pm$300 mV peak, line-to-line, for direct coupled stubs. The worst measured parameter, VD, shall be recorded.

5.1.1.5 **Output symmetry.** A valid legal transmit command shall be sent to the UUT requesting the maximum number of data words that the UUT is capable of transmitting. The output symmetry is determined by measuring the waveform tail-off at the end of each message. The maximum residual voltage (Vr) shall be measured as shown on figure 2. This test shall be run six times with each data word in the message having the same bit pattern. The six data word bit patterns that shall be used are:

8000(HEX), 7FFF(HEX), 0000(HEX), FFFF(HEX),
5555(HEX), and AAAA(HEX)

The pass criteria shall be Vr $\leq$ $\pm$250 mV peak, line-to-line, for transformer coupled stubs and Vr $\leq$ $\pm$90 mV peak, line-to-line, for direct coupled stubs after time Tt (the time beginning 2.5 us after the mid-bit zero crossing of the last parity bit). The measured parameter, Vr, shall be recorded for each bit pattern.

5.1.1.6 **Output noise.** The test configuration shown on figure 4 shall be used to test the UUT inactive bus output noise levels. The test shall be conducted while the UUT is in the power-on receive state and the power-off state. The output noise (Vrms) shall be measured at point "A" as shown on figure 4 for both states. Measurements shall be made with an instrument that has a minimum frequency bandwidth of DC to 10 MHz.

The pass criteria shall be Vrms $\leq$ 14.0 mV for transformer coupled stubs and Vrms $\leq$ 5.0 mV for direct coupled stubs. The measured parameter, Vrms, shall be recorded for each case.

5.1.1.7 Output isolation. This test shall be performed only if the UUT is configured with redundant buses. A valid legal transmit command shall be sent to the UUT requesting the maximum number of data words that it is capable of sending. The voltage of the output waveform transmitted by the UUT shall be measured on the active and redundant bus (or buses). Each data bus shall be alternately activated and measurements taken.

The pass criteria shall be that the ratio in dB between the output peak-to-peak voltage on the active bus and the output peak-to-peak voltage on all inactive buses shall be greater than or equal to 45 dB (figure 5). The measured parameter, output isolation, expressed as a ratio in dB, shall be recorded for each bus combination.

5.1.1.8 Power on/off

5.1.1.8.1 Power on/off noise. A UUT shall limit any spurious differential output during a power-up or power-down sequence. Power shall be applied to the UUT and any outputs from the UUT shall be measured. Power shall be removed from the UUT and any output from the UUT shall be measured. Repeat the test ten times.

The pass criteria shall be:

a. For transformer coupled stubs any spurious noise pulses produced shall be less than or equal to $\pm$250 mV peak, line-to-line.

b. For direct coupled stubs any spurious noise pulses produced shall be less than or equal to $\pm$90 mV peak, line-to-line.

All measured parameters, output noise amplitudes and pulse widths, shall be recorded.

Note: This test shall be performed using the normal on/off power sequence of the UUT.

5.1.1.8.2 Power on response. The purpose of this test is to verify that the UUT responds correctly to commands after power is applied to the UUT. Using the normal power on sequence for the UUT, repeat the following test sequence a minimum of ten times.

Step 1. Power the UUT off.

Step 2. Send valid, legal, non-broadcast, non-mode commands to the UUT with a maximum intermessage gap of 1 ms.

Step 3. Power on the UUT and observe all the responses for a minimum of 2 s from the first transmission of the UUT after power on.

The pass criteria shall be: step 3 - NR until the first UUT transmission, and CS for the first transmission and all responses thereafter.

5.1.1.9 Terminal response time. The purpose of this test is to verify that the UUT responds to messages within the proper response time. The test sequence shown below shall be performed.

Step 1. A valid legal transmit command shall be sent to the UUT and the response time measured.

Step 2. A valid legal receive command shall be sent to the UUT and the response time measured.

Step 3. A valid legal RT-to-RT command, with the UUT as the receiving terminal, shall be sent to the UUT and the response time measured.

Step 4. A valid legal mode command shall be sent to the UUT and the response time measured.

The pass criteria for step 1, step 2, step 3, and step 4 shall be a response time between 4.0 and 12.0 us at point A of figure 1A and measured as shown on figure 7. The command words used and the response times shall be recorded.

5.1.1.10 Frequency stability. The purpose of this test is to verify that the transmitter clock in the UUT has the proper accuracy and long term stability and proper short term stability. The transmitter clock measured shall be either the main oscillator output or an appropriate derivative of that clock (e.g., either the 16 MHz oscillator or the 1-2 MHz transmitter shift clock). The test sequence shown below shall be performed on the clock output whose ideal frequency is Fi.

Step 1. The short term transmitter clock frequency shall be measured for a single period of the waveform.

Step 2. Repeat step 1 for at least 10,000 samples and record the minimum (Fsmin) and the maximum (Fsmax) frequency from the samples taken.

Step 3. The transmitter clock frequency shall be measured with a gate time of 0.1 s and the mean frequency for at least 1,000 samples (Fav) shall be recorded.

The pass criteria shall be:

Step 1 and step 2 - $Ss1 = 100(Fsmax - Fav)/Fav \leq 0.01$ and
$Ss2 = 100(Fav-Fsmin)/Fav \leq 0.01$;

Step 3 - the magnitude of $S1 = 100(Fav-Fi)/Fi \leq 0.1$. Record Ss1, Ss2 and S1.

5.1.2 Input characteristics. The input tests are designed to verify that multiplex devices can properly decode bi-phase data. All input electrical tests shall use figure 1A or figure 1B with all measurements taken at point "A," unless otherwise noted. For Air Force applications, all input electrical tests shall use figure 1B, with all measurements taken at point "A" unless otherwise noted.

5.1.2.1 Input waveform compatibility

5.1.2.1.1 Zero crossing distortion. A legal valid receive message shall be sent to the UUT and the proper response verified. Positive and negative zero crossing distortions equal to N ns, with respect to the previous zero crossing shall be introduced individually to each zero crossing of each word transmitted to the UUT. The transmitted signal amplitude at point "A" shall be 2.1 Vpp for transformer coupled stubs and 3.0 Vpp for direct coupled stubs. The rise and fall time of the transmitted message (measured at a data bit zero crossing with the prior zero crossing and the next zero crossing at 500 ns intervals from the measured zero crossing) measured at point "A" shall be 200 ns ±20 nS. Each zero crossing distortion shall be transmitted to the UUT a minimum of 1000 times.

The pass criteria is the transmission of a CS by the UUT for each zero crossing distortion sent with $N \geq 150$ ns. Positive and negative zero crossing distortions shall then be applied in turn to a single zero crossing and adjusted to determine the values at which the first NR of the UUT occurs; these values shall be recorded.

The fail criteria is the transmission of a NR by the UUT for any zero crossing distortion sent with $N \leq 150$ ns.

5.1.2.1.2 Amplitude variations. A legal valid receive message shall be sent to the UUT. The transmitter's voltage, as measured at point "A" of figure 1A or figure 1B, shall be decremented from 6.0 Vpp to 0.1 Vpp for transformer coupled stubs and from 9.0 Vpp to 0.1 Vpp for direct coupled stubs in steps no greater than 0.1 Vpp. The rise and fall time of the transmitted message (measured at a data bit zero crossing with the prior zero crossing and the next zero crossing at 500 ns intervals from the measured zero crossing) measured at point "A" shall be 200 ns ±20 ns. The response of the UUT shall be observed at each step. A minimum of 1000 messages shall be transmitted for each setting.

The pass criteria shall be:

a. A CS for $0.86 \leq Vpp \leq 6.0$ for transformer coupled stubs and $1.2 \leq Vpp \leq 9.0$ for direct coupled stubs

b. A NR for $Vpp \leq 0.20$ for transformer coupled stubs and $Vpp \leq 0.28$ for direct coupled stubs

The measured parameter, Vpp, at which NR first occurs shall be recorded.

5.1.2.1.3 Rise and fall time

5.1.2.1.3.1 Trapezoidal. A minimum of 1000 valid receive messages shall be sent to the UUT with a signal amplitude of 2.1 Vpp for the transformer coupled stub and 3.0 Vpp for the direct coupled stub. The rise and fall times of the signal shall be less than or equal to 100 ns.

The pass criteria shall be CS by the UUT for each message.

5.1.2.1.3.2 Sinusoidal. A minimum of 1000 valid receive messages shall be sent to the UUT with a signal amplitude of 2.1 Vpp for the transformer coupled stub and 3.0 Vpp for the direct coupled stub. The rise and fall times of the signal shall approximate that of a 1 MHz sinusoidal signal.

The pass criteria shall be CS by the UUT for each message.

5.1.2.2 Common mode rejection. The common mode test configuration, figure 6A or figure 6B, shall be used for this test. Legal valid receive messages with the UUT's maximum word count shall be sent to the UUT at a repetition rate which generates a bus activity duty cycle of 50% ±10% with a common mode voltage injected at point "C", and the UUT response observed. The voltage of the transmitted message measured at point "A" shall be .86 Vpp for transformer coupled stubs and 1.2 Vpp for direct coupled stubs. The rise and fall time of the transmitted message (measured at a data bit zero crossing with the prior zero crossing and the next zero crossing at 500 ns intervals from the measured zero crossing) measured at point "A" shall be 200 ns ±20 ns. The following common mode voltage levels shall be applied in turn: +10.0 V.D.C. line-to-ground, -10.0 V.D.C. line-to-ground and ±10 Vp line-to-ground sinusoidal signal that is swept through the range of 1 Hz to 2 MHz. Each test condition shall be present for a minimum time period of 90 seconds.

The pass criteria shall be a CS by the UUT for all messages at each setting. If a failure occurs, the measured parameter, common mode signal injected shall be recorded.

5.1.2.3 Input impedance. The input impedance of the UUT in a stand alone configuration (i.e., disconnected from figure 1A or 1B) shall be measured with the UUT power on and with the UUT power off. The input impedance, Zin, shall be measured with a sinusoidal waveform having an amplitude 1.0 VRMS to 2.0 VRMS, at the following frequencies: 75.0 kHz, 100.0 kHz, 250.0 kHz, 500.0 kHz and 1.0 MHz.

The pass criteria shall be Zin $\geq$ 1000 ohms for transformer coupled stubs and Zin $\geq$ 2000 ohms for direct coupled stubs. The measured parameter, Zin, shall be recorded at each frequency.

5.2 Protocol tests. All tests in this section shall use the test configuration as shown on figure 1A or figure 1B. The test signal amplitude shall be 3.0 Vpp ±0.1 Vpp for direct coupled stubs and 2.1 Vpp ±0.1 Vpp for transformer coupled stubs measured at point A. For UUTs having both direct and transformer coupled stubs, the protocol tests need only be performed on one stub type per bus. The protocol tests shall be performed on all buses for UUTs with redundant bus configurations.

5.2.1 Required remote terminal operation. The following tests verify required operations of a remote terminal.

5.2.1.1 Response to command words. The purpose of this test is to verify that the UUT responds properly to all commands.

5.2.1.1.1 RT response to command words. All possible command words (65,536 combinations) meeting the criteria of the paragraph on "Word validation" of MIL-STD-1553 shall be sent to the UUT. Mode commands tested in 5.2.1.5, 5.2.2.1 or 5.2.2.4 may be omitted from this test since they are tested separately. Each command word shall be followed by the proper number of contiguous valid data words as defined in the paragraph on "Message formats" of MIL-STD-1553. Refer to table I for undefined mode commands. The associated data may be either random or controlled, depending on the UUT requirements. The following sequence shall be executed for all combinations of command words where the varying command word is sent as step 2.

Step 1. Send a valid legal non-broadcast non-mode command to the UUT

Step 2. Send the variable command word to the UUT.

Step 3. Send a transmit last command mode command to the UUT. (If this mode command is not implemented, then a transmit status mode command shall be used and the data word associated with transmit last command mode command shall be deleted from the pass criteria.)

The pass criteria given below is contingent on the type of command sent. All commands which cause the UUT to fail shall be recorded.

Non-Broadcast Commands (including mode commands):

a. Valid legal commands: step 1- CS; step 2- CS; step 3- CS and the data word contains the command word bit pattern from step 2 (except for transmit last command mode command where the data word contains the command word bit pattern from step 1).

b. Valid illegal commands:

(1) If illegal command detection option is implemented: step 1- CS; step 2- ME with no data words; step 3- ME and the data word contains the command word bit pattern from step 2.

(2) If the illegal command detection option is not implemented: step 1- CS; step 2- CS; step 3- CS and the data word contains the command word bit pattern from step 2.

c. Invalid command (wrong RT address): step 1- CS; step 2- NR; step 3- CS and the data word contains the command word bit pattern from step 1.

d. Undefined mode commands (see table I) (any single set (1), (2), (3), (4), is acceptable):

(1) step 1- CS; step 2- CS; step 3- CS and the data word contains the command word bit pattern addressed to the UUT from step 2.

(2) step 1- CS; step 2- ME; step 3- ME and the data word contains the word bit pattern addressed to the UUT from step 2.

(3) step 1- CS; step 2- NR; step 3- CS and the data word contains the command word bit pattern addressed to the UUT from step 1.

(4) step 1- CS; step 2- NR; step 3- ME and the data word contains the command word bit pattern addressed to the UUT from step 2.

TABLE I. MIL-STD-1553B undefined mode codes.

T/R	MODE CODE	ASSOCIATED DATA WORD
0	00000	NO
↓	↓	↓
0	01111	NO
0	10000	YES
0	10010	YES
0	10011	YES
1	10001	YES
1	10100	YES
1	10101	YES

Broadcast Commands (including mode commands):

e. If there are any broadcast commands that are considered as valid commands:

(1) Legal commands: step 1- CS; step 2- NR; step 3- BCR and the data word contains the command word bit pattern from step 2.

(2) Illegal commands (if illegal command detection is implemented): step 1- CS; step 2- NR; step 3- BCR and ME and the data word contains the command word bit pattern from step 2.

(3) Illegal commands (if illegal command detection is not implemented): step 1- CS; step 2- NR; step 3- BCR and the data word contains the command word bit pattern from step 2.

f. If there are no broadcast commands that are considered as valid commands: step 1- CS; step 2- NR; step 3- CS and the data word contains the command word bit pattern from step 1.

g. Undefined broadcast mode commands (see table I) (any single set (1), (2), (3) is acceptable):

(1) step 1- CS; step 2- NR; step 3- BCR and the data word contains the command word bit pattern from step 2.

(2) step 1- CS; step 2- NR; step 3- ME and BCR and the data word contains the command word bit pattern from step 2.

(3) step 1- CS; step 2- NR; step 3- CS and the data word contains the command word bit pattern from step 1.

5.2.1.1.2 **RT-RT response to command words.** All possible command words (65,536 combinations) meeting the criteria of the paragraph on "Word validation" of MIL-STD-1553 shall be sent to the UUT embedded in an RT-RT message format. The test equipment shall supply the required responses for the other RT in order to properly complete the message formats as defined in paragraph on "Message format" of MIL-STD-1553. Refer to table I for undefined mode commands. The associated data may be either random or controlled, depending on the UUT requirements. The intent of this test is for the UUT to be the receiving RT for half of the command combinations (i.e., T/R bit=0) and the transmitting RT for the rest of the command combinations (i.e., T/R bit=1). The following sequence shall be executed for all combinations of command words where the varying command word is sent as step 2.

Step 1. Send a valid legal non-broadcast non-mode command to the UUT.

Step 2. Send the variable command word to the UUT embedded in the RT-RT message format.

Step 3. Send a transmit last command mode command to the UUT. (If this mode command is not implemented, then a transmit status mode command shall be used and the data word associated with transmit last command mode command shall be deleted from the pass criteria.)

The pass criteria shall be as listed in 5.2.1.1.1, except the pass criteria for any RT-RT mode command is as specified in 5.2.1.1.1.d and the pass criteria for any broadcast RT-RT mode command shall be as specified in 5.2.1.1.1.g.

5.2.1.2 **Intermessage gap**

5.2.1.2.1 **Minimum time.** The purpose of this test is to verify that the UUT responds properly to messages with a minimum intermessage gap. The message pairs listed in table II shall be sent to the UUT with the minimum intermessage gaps as defined in the paragraph on "Intermessage gap" of MIL-STD-1553. Each message pair shall be sent to the UUT a minimum of 1,000 times. Message pairs which include commands not implemented by the UUT shall be deleted from the test. Each message pair shall have an intermessage gap time (T) of 4.0 us as shown on figure 7.

The pass criteria for this test is CS for each message. All message pairs used shall be recorded and message pairs which cause the UUT to fail the test shall be indicated.

5.2.1.2.2 **Transmission rate.** The purpose of this test is to verify that the UUT responds properly to messages sent for a sustained period with a minimum intermessage gap. The messages listed in each step shall be sent with an intermessage gap of 7 us $\pm$3 us, i.e. a burst of messages with an intermessage gap of 7 us $\pm$3 us between each message as shown on figure 7. Each step shall be performed for a minimum of 30 s.

Step 1. A valid legal transmit message followed by a valid legal transmit message.

Step 2. A valid legal receive message followed by a valid legal receive message.

TABLE II. Intermessage gap messages.

COMMAND TYPES

A) BC to UUT Transfer (maximum word count)
B) UUT to BC Transfer (maximum word count)
C) UUT/RT (maximum word count)
D) RT/UUT (maximum word count)
E) Mode Command Without Data Word
F) Mode Command With Data Word (Transmit)
G) Mode Command With Data Word (Receive)
H) BC to UUT Transfer (Broadcast)(maximum word count)
I) UUT/RT (Broadcast)(maximum word count)
J) RT/UUT (Broadcast)(maximum word count)
K) Mode Command Without Data Word (Broadcast)
L) Mode Command With Data Word (Broadcast)

MESSAGE PAIRS

1) A (GAP) A
2) B (GAP) A
3) C (GAP) A
4) D (GAP) A
5) E (GAP) A
6) F (GAP) A
7) G (GAP) A
8) H (GAP) A
9) I (GAP) A
10) J (GAP) A
11) K (GAP) A
12) L (GAP) A

Note: This table defines the types and combinations of messages to be used in test 5.2.1.2, e.g., pair number 2 specifies a transmit command with the maximum word count to be followed (after the minimum intermessage gap time specified in the paragraph on "Intermessage gap" of MIL-STD-1553) by a receive command with the maximum word count.

UUT/RT: denotes RT to RT transfer with UUT receiving
RT/UUT: denotes RT to RT transfer with UUT transmitting

Step 3. A valid legal transmit message followed by a valid legal receive message.

The pass criteria for this test is a CS for each message. All messages which cause the UUT to fail the test shall be recorded.

Note: If the busy bit gets set, then increase the intermessage gap until the busy bit is reset. At this time record the intermessage gap and repeat steps 1 thru 3 until the test is completed without the busy bit getting set.

5.2.1.3 **Error injection.** The purpose of these tests is to examine the UUT's response to specific errors in the message stream. Unless otherwise noted, the following test sequence shall be used for all error injection tests. The error to be encoded in step 2 for a given message is specified in each test paragraph.

Test sequence:

Step 1. A valid legal message shall be sent to the UUT. A mode command shall not be used.

Step 2. A legal message containing the specified error shall be sent to the UUT.

Step 3. A transmit status mode command shall be sent to the UUT.

The pass criteria is defined in each test paragraph. All commands and responses shall be recorded.

5.2.1.3.1 **Parity.** The purpose of these tests is to verify the UUT's capability of detecting parity errors embedded in different words within a message.

5.2.1.3.1.1 **Transmit command word.** This test verifies the ability of the UUT to detect a parity error occurring in a transmit command word. The test sequence as defined in 5.2.1.3 shall be performed with a parity error encoded into a transmit command word for test step 2.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS.

5.2.1.3.1.2 **Receive command word.** This test verifies the ability of the UUT to recognize a parity error occurring in a receive command word. The test sequence as defined in 5.2.1.3 shall be performed with a parity error encoded in a receive command word for test step 2.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS.

5.2.1.3.1.3 **Receive data words.** This test verifies the ability of the UUT to recognize a parity error occurring in a data word. The test sequence as defined in 5.2.1.3 shall be performed with a parity error encoded in a data word for test step 2. The message shall be a receive command with the maximum number of data words that the UUT is designed to receive. The test sequence must be sent N times, where N equals the number of data words sent.

Individually each data word must have the parity bit inverted. Only one parity error is allowed per message.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.2 Word length. This test verifies the ability of the UUT to recognize an error in word length occurring within a message. The test plan excludes testing of high bit errors on a transmit command and on the last data word of a receive message.

5.2.1.3.2.1 Transmit command word. This test verifies the ability of the UUT to recognize transmit command word length errors. The test sequence as defined in 5.2.1.3 shall be performed with the command word shortened as defined below for test step 2.

a. Transmit command shortened by one bit

b. Transmit command shortened by two bits

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS.

5.2.1.3.2.2 Receive command word. This test verifies the ability of the UUT to recognize receive command word length errors. The test sequence as defined in 5.2.1.3 shall be performed with the command word as defined below for test step 2.

a. Shorten the receive command word by one bit

b. Shorten the receive command word by two bits

c. Lengthen the receive command word by two bits

d. Lengthen the receive command word by three bits

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS, or alternately for c and d only, the pass criteria may be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.2.3 Receive data words. This test verifies the ability of the UUT to recognize data word length errors. The test sequence as defined in 5.2.1.3 shall be performed as defined below for test step 2. The message shall be a receive command with the maximum number of data words that the UUT is designed to receive.

a. Shorten the data word by one bit

b. Shorten the data word by two bits

c. Lengthen the data word by two bits

d. Lengthen the data word by three bits

The test sequence of 5.2.1.3 shall be performed N times for a and b and N-1 times for c and d, where N equals the number of data words sent. High bit errors shall not be tested in the last data word of a receive message. Only one data word shall be altered at a time. Steps a through d shall be performed for each data word in the message.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.3 Bi-phase encoding. This test verifies the ability of the UUT to recognize bi-phase errors. A bi-phase encoding error is defined to be the lack of a zero crossing in the center of a bit time. A bi-phase error occurs as either a logic high or low for the duration of a bit time. Each bit location, except the sync period, of each word shall have a single bi-phase error encoded into it. Only a single bi-phase error shall be injected for each message.

5.2.1.3.3.1 Transmit command word. This test verifies the ability of the UUT to recognize bi-phase encoding errors in transmit command words. The test sequence as defined in 5.2.1.3 shall be performed with a bi-phase encoding error encoded into a transmit command word for test step 2. Each bit location shall have each of the bi-phase errors injected into it. Only one bi-phase error is allowed per command word. A test set involves performing the test sequence 17 times, once for each bit location. A complete test requires two test sets to be performed, one for injecting high bi-phase errors and another for injecting low bi-phase errors.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS.

5.2.1.3.3.2 Receive command word. This test verifies the ability of the UUT to recognize bi-phase encoding errors in receive command words. The test sequence as defined in 5.2.1.3 shall be performed with a bi-phase error encoded into a receive command word for test step 2. Each bit location must have each of the bi-phase errors injected into it. Only one bi-phase error is allowed per command word. A test set involves performing the test sequence 17 times, once for each bit location. A complete test requires two test sets to be performed one for injecting high bi-phase errors and another for injecting low bi-phase errors.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS.

5.2.1.3.3.3 Receive data words. This test verifies the ability of the UUT to recognize bi-phase encoding errors in data words. The test sequence as defined in 5.2.1.3 shall be performed with a bi-phase error encoded into each data word in the message for test step 2. The message shall be a receive command and the maximum number of data words that the UUT is designed to receive. Individually each bit location of each data word shall have a bi-phase error encoded into it. Only one bi-phase error is allowed for each message. A test set involves performing the sequence 17 times. The test set shall be repeated N times, where N equals the number of data words sent. A complete test requires 2*N test sets to be performed, once for high bi-phase errors and once for low bi-phase errors.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.4 Sync encoding. This test verifies the ability of the UUT to recognize sync errors. The sync pattern, as defined for this test, is a waveform with six 0.5 us divisions. The divisions are represented as a 1 or 0 to indicate the polarity of each division on the data bus. A proper command sync is represented as 111000 and a proper data sync is represented as 000111.

5.2.1.3.4.1 Transmit command word. This test shall verify that the UUT rejects transmit commands with invalid sync waveforms. The test sequence as defined in 5.2.1.3 shall be performed with a sync error encoded in a transmit command word for test step 2. The test sequence shall be performed for each of the following invalid sync patterns:

111100, 110000, 111001, 011000, 000111

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS.

5.2.1.3.4.2 Receive command word. This test shall verify that the UUT rejects receive commands with invalid sync waveforms. The test sequence as defined in 5.2.1.3 shall be performed with a sync error encoded in a receive command word for test step 2. The test sequence shall be performed for each of the following invalid sync patterns:

111100, 110000, 111001, 011000, 000111

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- CS.

5.2.1.3.4.3 Data word. This test shall verify that the UUT rejects invalid data sync waveforms. Perform the test sequence as defined in 5.2.1.3 with a sync error encoded into each data word for test step 2. The message is a valid receive command word and the maximum number of data words that the UUT is designed to receive. Only one data word per message shall have an invalid sync encoded into it. The test sequence shall be performed N times for each of the following invalid sync patterns: where N equals the maximum number of data words in the message.

000011, 001111, 000110, 100111, 111000

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- ME.

Note: Data words shall not be encoded such that bit times 4 thru 8 match the terminal address of the UUT or be 11111 when the invalid data sync pattern 111000 is being used.

5.2.1.3.5 Message length. These tests shall verify that the UUT properly detects an error when an incorrect number of data words are received.

5.2.1.3.5.1 Transmit command. This test verifies the ability of the UUT to respond properly if a data word is contiguous to a transmit command word. Perform the test sequence as defined in 5.2.1.3 with a data word contiguously following a transmit command word for test step 2.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.5.2 **Receive command.** This test shall verify that the UUT recognizes an error in the number of data words that are received. Perform the test sequence as defined in 5.2.1.3 with a data word count error in a receive message for test step 2. This message is a valid legal receive command word with the word count field equal to the maximum number of data words that the UUT is designed to receive but with a different number of data words than specified in the command word. The test sequence shall be performed N+1 times, where N equals the maximum number of data words. The first sequence shall have N+1 data words. The second sequence shall have N-1 data words and each of the remaining sequences shall remove one additional data word until the number of data words equals zero.

The pass criteria shall be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.5.3 **Mode command word count error.** This test verifies the ability of the UUT to respond properly when an incorrect number of words are sent with a mode command. Perform the test sequence defined in 5.2.1.3 using a valid receive mode command in step 2 which would normally have an associated data word transmitted with it, but send the number of data words equal to the mode code value used. Repeat the test sequence with the same mode command but with no data word in step 2. Repeat the test sequence using a valid transmit mode command except send a data word contiguously following the command word.

In all three cases the pass criteria shall be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.5.4 **RT to RT word count error.** This test verifies the ability of the UUT to respond properly when an incorrect number of words are sent to it as a receiving RT during an RT to RT transfer. Perform the following test sequence.

Step 1 - Send a valid legal RT to RT command pair followed in 4 to 12 us by a valid status word and N data words to the UUT, where N is the number of data words requested in the transmit command.

Step 2 - Send the same RT to RT command pair followed in 4 to 12 us by a valid status word and N-1 data words.

Step 3 - A transmit status mode command shall be sent to the receiving RT.

Step 4 - Repeat steps 1 through 3 using a word count of N+1 in step 2.

The pass criteria in both cases shall be that the receiving RT's status is: step 1 - CS; step 2- NR; step 3- ME.

5.2.1.3.6 Contiguous data. This test verifies that the UUT recognizes discontiguous data in a message. Perform the test sequence as defined in 5.2.1.3 with a 4.0 us data word gap error in a receive message for test step 2. The gap is measured as on figure 7. The receive message shall be a receive command with the maximum number of data words that the UUT is designed to receive with a gap between the command word and the first data word or between a data word pair. The test sequence shall be performed N times, where N equals the maximum number of data words. Only one gap time insertion is allowed per message.

The pass criteria for this test shall be: step 1- CS; step 2- NR; step 3- ME.

5.2.1.3.7 Terminal fail-safe. The purpose of this test is to verify that the terminal fail-safe timer is properly implemented in the UUT. The UUT is required to contain a hardware implemented timer that will cause the transmitter to shutdown if the UUT transmits a message longer than 800 us. A fail-safe time-out occurring on one bus shall not affect the transmitter on any other bus. The reception of a valid command on the bus on which the time-out has occurred shall enable the transmitter. The test sequence below shall be performed for each bus:

Step 1. Initiate a condition in the UUT which causes the fail-safe timer to timeout. Measure the duration of the transmission.

Step 2. Remove the condition initiated in step 1.

Step 3. Send the UUT a valid legal message over the bus on which the time-out has occurred.

The pass criteria shall be that the timeout in step 1 occurs and the transmitter is shut down allowing the total transmission time to be between 660 us and 800 us. The response of the UUT in step 3 shall be CS. Record the measured parameter at which the fail-safe time-out occurs. For test failures, record the test parameters at which the failure occurred.

5.2.1.4 Superseding commands. This test verifies that the UUT will not malfunction and responds properly to possible occurrences of superseding commands. The following test sequence shall be used for this test:

Step 1. A valid legal receive message shall be sent to the UUT with the maximum number of words that the UUT is designed to receive encoded in the word count field.

Step 2. Before step 1 is completed, a superseding message shall be sent to the UUT.

Step 3. A transmit status mode command shall be sent to the UUT.

Record the UUT's response to each step when the test is performed with the following superseding command formats (step 2):

a. After at least one data word is transmitted in step 1, but before the last data word is transmitted, follow the selected data word with a gap of 4 us (reference figure 7), then a valid legal transmit command requesting the maximum number of data words that the UUT is designed to transmit.

b. Proceed as in "a" above, except transmit a valid legal transmit status mode command as the superseding command.

c. After at least one data word is transmitted in step 1, but before the last data word is transmitted, follow the selected data word contiguously with a valid legal transmit command requesting the maximum number of data words that the UUT is designed to transmit.

d. After the last data word is transmitted in step 1 follow it contiguously with a valid legal transmit command requesting the maximum number of data words that the UUT is designed to transmit.

The pass criteria shall be:

for a, step 1 - NR, step 2 - CS, step 3 - CS
for b, step 1 - NR, step 2 - ME, step 3 - ME
for c, step 1 - NR, step 2 - NR, step 3 - ME
or, step 1 - NR, step 2 - CS, step 3 - CS
for d, step 1 - NR, step 2 - CS, step 3 - CS
or, step 1 - NR, step 2 - NR, step 3 - ME

For test failures, record the test parameters for which the failure occurred.

5.2.1.5 **Required mode commands.** The purpose of these tests is to verify that the UUT responds properly to the required mode commands. The tests are not intended to verify the mission aspects stated in the equipment specification. The UUT shall be tested for each required mode code with a subaddress field mode code indicator of all zeros and repeated with a subaddress field of all ones.

The pass criteria is defined in each test paragraph. If any test fails, record the UUT response to that test.

5.2.1.5.1 **Transmit status.** The purpose of this test is to verify that the UUT has the ability to recognize the transmit status mode command and to transmit its last status word. The following sequence shall be performed:

Step 1. A valid legal message shall be sent to the UUT on the primary bus.

Step 2. A transmit status mode command shall be sent to the UUT on the primary bus.

Step 3. A valid legal message shall be sent to the UUT on the alternate bus.

Step 4. A transmit status mode command shall be sent to the UUT on the alternate bus.

Step 5. A valid legal receive command with a parity error in a data word shall be sent on the primary bus.

Step 6. A transmit status mode command shall be sent to the UUT on the alternate bus.

Step 7. Repeat step 6.

Step 8. Repeat step 4.

Step 9. Repeat step 1.

Step 10. Repeat step 2.

Step 11. Repeat step 4.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- CS; step 3- CS; step 4- CS; step 5- NR; step 6- ME; step 7- ME; step 8- ME; step 9- CS; step 10- CS; step 11- CS.

5.2.1.5.2 Transmitter shutdown and override. This test shall verify that the UUT recognizes the dual redundant mode code commands to shutdown the alternate bus transmitter and to override the shutdown. In a dual redundant system each bus must be tested as the alternate bus and as the primary bus. A valid legal transmitter shutdown mode command shall be sent to the UUT to cause an alternate bus transmitter shutdown. A valid legal override transmitter shutdown mode command shall be sent to the UUT to cause an override of the transmitter shut-down. The following test sequence shall be used for each case including verification of the UUT response indicated.

Step 1. A valid legal command shall be sent on the primary bus to the UUT.

Step 2. A valid legal command shall be sent on the alternate bus to the UUT.

Step 3. A valid legal transmitter shutdown mode command shall be sent to the UUT on the primary bus.

Step 4. A valid legal command shall be sent on the alternate bus to the UUT.

Step 5. A valid legal command shall be sent on the primary bus to the UUT.

Step 6. A valid legal override transmitter shutdown mode command shall be sent to the UUT on the alternate bus.

Step 7. A valid legal command shall be sent to the UUT on the alternate bus.

Step 8. A valid legal override transmitter shutdown mode command shall be sent to the UUT on the primary bus.

Step 9. A valid legal command shall be sent on the alternate bus to the UUT.

Step 10. A valid legal command shall be sent on the primary bus to the UUT.

The pass criteria for each of the above steps shall be as follows: step 1-CS; step 2- CS; step 3- CS; step 4- NR; step 5- CS; step 6- NR; step 7- NR; step 8- CS; step 9- CS; step 10- CS.

5.2.1.5.3 **Reset remote terminal.** The purpose of this test is to verify that the UUT has the ability to recognize the reset remote terminal mode command. The following sequence shall be performed:

Step 1. A reset remote terminal mode command shall be sent to the UUT on one bus.

Step 2. After time T from step 1, as measured per figure 7, a valid legal command shall be sent to the UUT on the same bus.

The time T shall be obtained by repeating step 1 and step 2 while varying the intermessage gap from 100 ms down to 4 us in the following steps: from 100 ms to 6 ms in no greater than 1 ms steps, and from 6 ms to 4 us in no greater than 10 us steps. When the time T is between 5 ms and 100 ms, then in addition to each command sent in step 2, a minimum of one valid legal command shall be sent to the UUT positioned within 4 ms after step 1.

Step 3. A valid legal transmitter shutdown mode command shall be sent to the UUT on the same bus.

Step 4. A valid legal command shall be sent to the UUT on the alternate bus.

Step 5. A reset remote terminal mode command shall be sent to the UUT on the first bus.

Step 6. After 5 ms repeat step 5.

The minimum time between step 1 and step 2 as measured per figure 7 in which the UUT's response to step 2 is CS (with BUSY bit reset), shall be recorded.

The pass criteria for each of the above steps shall be as follows: step 1-CS; step 2- CS (with BUSY bit reset) for all time $T \geq 5$ ms, and CS or NR for $T < 5$ ms; step 3- CS; step 4- NR; step 5- CS; step 6- CS.

5.2.1.6 Data wrap-around. The purpose of this test is to verify that the UUT properly implements the data wrap-around capability. The following sequence shall be performed 10,000 times, with random data patterns for each data word in each sequence. The messages used shall contain the maximum number of data words that the RT is capable of transmitting or receiving, i.e., the maximum word count from the set of all messages defined for that RT. Record the number of correct responses and the number of incorrect responses.

Step 1. Send a receive message to the UUT at subaddress 30 (11110) or the appropriate receive wrap-around subaddress defined for the UUT.

Step 2. Send a transmit command to the UUT with the appropriate transmit wrap-around subaddress and with the same word count as step 1.

The pass criteria shall be: step 1- CS; step 2- CS with each data word having the same bit pattern as the corresponding data word in step 1.

5.2.1.7 RT to RT timeout. The purpose of this test is to verify that the UUT functions properly when operating as the receiving RT in a RT to RT transfer. The UUT must not respond after receiving a RT to RT command pair if the data is not received within 54 us to 60 us as shown on figure 8. This time is measured from the zero crossing of the parity bit of the receive command to the mid sync zero crossing of the first data word. The following test sequence shall be performed:

Step 1. A valid legal RT to RT command pair followed in 4 us to 12 us by a valid status word with the RT address of the transmit command and the proper number of data words shall be sent to the UUT.

Step 2. The transmitting RT's status word shall be delayed until the UUT (receiving RT) stops responding and the time "T" as specified in figure 8 shall be measured.

Step 3. A transmit status mode command shall be sent to the UUT when the time "T" is greater than 60 us.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- "T" shall be between 54 us and 60 us; step 3- ME. All commands, UUT responses and time "T" shall be recorded.

5.2.1.8 Bus switching. This test shall be performed only if the UUT is configured with dual redundant buses. This test verifies that the dual redundant remote terminal properly performs the bus switching requirements of MIL-STD-1553 (para on "Data bus activity"). The requirements are as follows:

a. If the UUT is receiving or operating on a message on one bus, and another valid, legal command to the UUT occurs on the opposite bus later in time, then the UUT is required to reset and respond appropriately to the later command on the opposite bus.

b. An invalid command on the alternate bus shall not affect the response of the UUT to commands on the original bus.

Unless otherwise specified, legal messages are used in this test. The interrupting message on the alternate bus shall be swept through the command word, the response time gap, the UUT's status word, and the UUT's data transmission on the first bus. For all tests, record the command words used. The following test sequences shall be performed twice for each interrupting command, once for each redundant bus.

RT transmitting:

Step 1. Send a valid transmit command to the UUT requesting the maximum number of data words that the UUT is designed to transmit.

Step 2. Send the interrupting command on the alternate bus beginning 4.0 us after the beginning of the first command.

Step 3. Send a valid transmit status mode command after the messages on both buses have been completed.

Step 4. Repeat step 1 through step 3 increasing the time between step 1 and step 2 in no greater than 0.25 us increments until the messages no longer overlap.

Perform the test with the following interrupting messages for step 2.

a. A valid legal message.

b. A message with a parity error in the command word.

c. A valid message with a terminal address different than that of the UUT.

The pass criteria shall be: for a, step 1- truncated message or CS, step 2- CS and step 3- CS; and for b and c, step 1- CS, step 2- NR and step 3- CS. For test failures, record the test parameters at which the failure occurred.

RT receiving:

Step 1. Send a valid RT to RT message command to the UUT and a second RT with the UUT the receiving terminal with the maximum number of data words that the UUT is designed to receive.

Step 2. Send the interrupting command on the alternate bus beginning 4.0 us after the beginning of the first command.

Step 3. Send a valid transmit status mode command after the messages on both buses have been completed.

Step 4. Repeat step 1 through step 3 varying the time between step 1 and step 2 in no greater than 0.25 us increments until the messages no longer overlap.

Perform the test with the following interrupting messages for step 2.

a. A valid legal message.

b. A message with a parity error in the command word.

c. A valid message with a terminal address different than that of the UUT.

The pass criteria shall be: for a, step 1- NR or CS, step 2 CS and step 3- CS; and for b and c, step 1- CS, step 2- NR and step 3- CS. For test failures, record the test parameters at which the failure occurred.

5.2.1.9 Unique address. The purpose of this test is to verify that the UUT can be assigned any unique address from an external connector on the UUT. The following sequence shall be performed for the UUT:

Step 1. Send a valid, legal command to the UUT.

Step 2. Repeat step 1 thirty-one times with the same command word except use all other possible bit combinations in the RT address field of the command word.

Step 3. Repeat step 1 and step 2 after externally changing the RT address for all possible combinations from 00000 thru 11110.

Step 4. After externally changing the RT address to simulate a single point address validation failure (e.g., parity error on the address lines), repeat step 1 and step 2.

The pass criteria shall be: step 1- CS; step 2- NR for each combination; step 3- same as step 1 and step 2; step 4- NR for each combination.

Note: Power cycling may be required after externally changing the RT address.

5.2.2 Optional operation. This section provides for testing the optional requirements of MIL-STD-1553. If a remote terminal implements any of the options, it shall be tested in accordance with the test herein identified for the option. If the transmit last command mode command is not implemented in the UUT, then the transmit status mode command shall be used.

5.2.2.1 Optional mode commands. The purpose of these tests is to verify that the UUT responds properly to implemented mode commands. The tests are not intended to verify the mission aspects stated in the equipment specification. The UUT shall be tested for each mode code implemented with a subaddress field mode code indicator of all zeros and repeated with a subaddress field of all ones.

The pass criteria is defined in each test paragraph. If any test fails, record the UUT response to that test.

5.2.2.1.1 Dynamic bus control. The purpose of this test is to verify that the UUT has the ability to recognize the dynamic bus control mode command and to take control of the data bus. A valid legal dynamic bus control mode command shall be sent to the UUT. The UUT shall take control of the data bus when its response is DBA as required in the UUT's design specification.

The pass criteria shall be that the UUT respond with a DBA upon acceptance of bus control or a CS upon rejection of bus control.

5.2.2.1.2 Synchronize. The following paragraphs provide the test criteria for the synchronize mode commands.

5.2.2.1.2.1 Synchronize (without data word). The purpose of this test is to verify that the UUT has the ability to recognize a synchronization mode command without using a data word. A valid legal synchronize (without data word) mode command shall be sent to the UUT.

The pass criteria shall be that the UUT respond with CS.

5.2.2.1.2.2 Synchronize (with data word). The purpose of this test is to verify that the UUT has the ability to recognize a synchronization mode command which uses a data word. A valid legal synchronize (with data word) mode command shall be sent to the UUT.

The pass criteria shall be that the UUT respond with CS.

5.2.2.1 3 Initiate self-test. The purpose of this test is to verify that the UUT has the ability to recognize the initiate self-test mode command. The following sequence shall be performed:

Step 1. An initiate self-test mode command shall be sent to the UUT on one bus.

Step 2. After time T from step 1, as measured per figure 7, a valid legal command shall be sent to the UUT on the same bus.

Step 3. The time T shall be obtained by repeating step 1 and step 2 while varying the intermessage gap from 200 ms down to 4 us in no greater than 1 ms steps. When the time T is between 200 ms and 100 ms then in addition to each command sent in step 2, a minimum of one valid legal command shall be sent to the UUT positioned within 50 ms after step 1.

The minimum time between step 1 and step 2 as measured per figure 7 in which the UUT's response to step 2 is CS (with BUSY bit reset) shall be recorded.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- CS (with BUSY bit reset) for all time $T \geq 100$ ms, and CS or NR for $T < 100$ ms.

5.2.2.1.4 Transmit BIT word. The purpose of this test is to verify that the UUT has the ability to recognize this mode command. A valid legal transmit BIT mode command shall be sent to the UUT.

The pass criteria shall be that the UUT respond with CS.

5.2.2.1.5 Selective transmitter shutdown and override. This test shall verify that the UUT recognizes the multi-redundant mode code commands to shut down a selected bus transmitter and to override the shutdown. In a multi-redundant system, each bus must be tested as the primary bus with the remaining busses as alternate busses. A valid legal selected transmitter shutdown mode command shall be sent to the UUT accompanied by the appropriate data word to cause a selective bus transmitter shutdown. A valid legal override selected transmitter shutdown mode command shall be sent to the UUT accompanied by the appropriate data word to cause an override of the selected bus transmitter shutdown. The following test sequence shall be performed using each bus as the primary bus and each of the remaining busses in turn as the alternate bus, including verification of the UUT response indicated.

Step 1. A valid legal command shall be sent on the first bus to the UUT.

Step 2. A valid legal command shall be sent on the alternate bus to the UUT.

Step 3. A valid legal selected transmitter shutdown mode command shall be sent to the UUT on the first bus with the data word encoded to shutdown the alternate bus.

Step 4. A valid legal command shall be sent on the alternate bus to the UUT.

Step 5. A valid legal command shall be sent on the first bus to the UUT.

Step 6. A valid legal override selected transmitter shutdown mode command shall be sent to the UUT on the alternate bus with the same data word as sent in step 3.

Step 7. A valid legal command shall be sent to the UUT on the alternate bus.

Step 8. A valid legal override selected transmitter shutdown mode command shall be sent to the UUT on the first bus with the same data word as sent in step 3.

Step 9. A valid legal command shall be sent on the alternate bus to the UUT.

Step 10. A valid legal command shall be sent on the first bus to the UUT.

Step 11. Repeat step 3 except that the data word shall be encoded with a bit pattern that would normally shutdown the first bus if it was sent on the alternate bus.

Step 12. Repeat step 4.

Step 13. Repeat step 5.

The data words associated with step 3 and step 11 for each bus shall be recorded.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- CS; step 3- CS; step 4- NR; step 5- CS; step 6- NR; step 7- NR; step 8- CS; step 9- CS; step 10- CS; step 11- CS; step 12- CS; step 13- CS.

5.2.2.1.6 Terminal flag bit inhibit and override. This test verifies that the UUT recognizes and responds properly to the mode code commands of inhibit terminal flag bit and override inhibit terminal flag bit. Beginning in step 2 of the test sequence below, the UUT shall be caused to set the terminal flag bit.

Step 1. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 2. Procedures as defined for the UUT, shall be performed that will set the terminal flag in the UUT status response. Send a valid legal receive command with at least one data word to the UUT.

Step 3. A valid legal inhibit terminal flag mode code command shall be sent to the UUT.

Step 4. Repeat step 1.

Step 5. A valid legal override inhibit terminal flag mode code command shall be sent to the UUT.

Step 6. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 7. Procedures, as defined for the UUT, shall be performed which resets the TF bit.

Step 8. Repeat step 1.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- TF; step 3- CS or TF; step 4- CS; step 5- CS or TF; step 6- TF; step 8- CS.

5.2.2.1.7 **Transmit vector word.** This test verifies the capability of the UUT to recognize and respond properly to a transmit vector word mode code command. A valid legal transmit vector word mode code command shall be sent to the UUT.

The pass criteria shall be that the UUT respond with CS.

5.2.2.1.8 **Transmit last command.** This test verifies that the UUT recognizes and responds properly to a transmit last command mode code. The following test sequence shall be used:

Step 1. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 2. A valid legal receive command different from that used in step 1 above with at least one data word shall be sent to the UUT and a parity error shall be encoded into the first data word.

Step 3. A valid transmit last command mode command shall be sent to the UUT.

Step 4. A valid transmit status mode command shall be sent to the UUT.

Step 5. A valid legal transmit last command mode command shall be sent to the UUT.

Step 6. A valid legal transmit last command mode command shall be sent to the UUT.

Step 7. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 8. A valid legal transmit last command mode command shall be sent to the UUT.

Step 9. A valid legal transmit command shall be sent to the UUT.

Step 10. A valid legal transmit last command mode command shall be sent to the UUT.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- NR; step 3- ME, followed by a data word containing the command word from step 2; step 4- ME; step 5- ME, followed by a data word containing the command word from step 4; step 6- ME, followed by a data word containing the

command word from step 4; step 7- CS; step 8- CS, followed by a data word containing the command word from step 7; step 9- CS; step 10- CS, followed by a data word containing the command word from step 9.

5.2.2.2 Status word bits. The following tests verify that all implemented status code bits are properly used and cleared. Implementation of all status code bits in the status word except the ME bit is optional. In addition to the separate tests, for each of the following status bits: service request, busy, subsystem flag, and terminal flag, provide the analysis as listed below.

a. What conditions set the status bit in the status word transmitted on the data bus.

b. What conditions reset the status bit in the status word transmitted on the data bus.

c. If the condition specified in item a. occurred and disappeared without intervening commands to the UUT, list the cases where the status bit is set and reset in response to a valid, non-mode command to the UUT.

d. Given that the status bit was set, and the condition which set the bit has gone away, list the cases where the status bit is still set in response to the second valid, non-mode command to the UUT.

The UUT has failed a test sequence if it does not respond as indicated in each of the separate tests below.

5.2.2.2.1 Service request. This test verifies that the UUT sets the service request bit as necessary and clears it when appropriate. The UUT shall set bit time eleven of the status word when a condition in the UUT warrants the RT to be serviced. A reset of the bit shall occur as defined by each RT. The following steps shall be performed and the appropriate responses verified:

Step 1. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 2. A condition which causes the service request bit to be set shall be introduced into the UUT. A valid legal command that does not service the request shall be sent to the UUT.

Step 3. A valid legal command that does not service the request shall be sent to the UUT.

Step 4. Procedures, as defined for the UUT, shall be performed which resets the service request bit.

Step 5. A valid legal receive command with at least one data word shall be sent to the UUT.

The pass criteria for each of the above steps shall be as follows: step 1- CS, with the service request bit reset; step 2- SRB; step 3- SRB; step 5- CS, with the service request bit reset. All commands and UUT responses shall be recorded.

5.2.2.2.2 **Broadcast command received.** This test verifies that the UUT sets the broadcast command received bit of the status word after receiving a broadcast command. The UUT shall set status bit fifteen to a logic one after receiving the broadcast command. The following test sequence shall be performed using either the transmit last command or transmit status mode code command to verify the bit condition.

Step 1. A valid legal broadcast receive message shall be sent to the UUT.

Step 2. A valid legal transmit last command shall be sent to the UUT.

Step 3. A valid, legal, non-broadcast command shall be sent to the UUT.

Step 4. Repeat step 1.

Step 5. Repeat step 3.

Step 6. A broadcast receive message with a parity error in one of the data words shall be sent to the UUT.

Step 7. A valid legal transmit last command shall be sent to the UUT.

The pass criteria for each of the above steps shall be as follows: step 1- NR; step 2- BCR, and the data word contains the bit pattern of the command word in step 1; step 3- CS; step 4- NR; step 5- CS; step 6- NR; step 7- ME and BCR, and the data word contains the bit pattern of the command word in step 6. All commands and UUT responses shall be recorded.

5.2.2.2.3 **Busy.** This test verifies the capability of the UUT to set the busy bit of the status word. Bit time sixteen of the status word shall be set when the UUT is busy. Prior to performing the test sequence below, a condition which sets the busy bit must be activated.

Step 1. A valid legal transmit command shall be sent to the UUT.

Step 2. Procedures, as defined for the UUT, shall be performed which resets the busy bit.

Step 3. A valid legal transmit command shall be sent to the UUT.

The pass criteria for each of the above steps shall be as follows: step 1- BUSY; step 3- CS. All commands and UUT responses shall be recorded.

5.2.2.2.4 **Subsystem flag.** This test verifies the capability of the UUT to set the subsystem flag of the status word. Bit time seventeen of the status word shall be set to a logic one when a subsystem fault has been determined. Prior to performing the test sequence below, a condition which sets the subsystem flag bit must be activated.

Step 1. A valid legal transmit command shall be sent to the UUT.

Step 2. Remove the condition which sets the subsystem flag bit. Cycling power to the UUT shall not be part of these procedures to reset the SF bit.

Step 3. A valid legal transmit command shall be sent to the UUT.

Step 4. Repeat step 3.

The pass criteria for each of the above steps shall be as follows: step 1- SF; step 3- SF or CS; step 4- CS. All commands and UUT responses shall be recorded.

5.2.2.2.5 Terminal flag. This test verifies that the UUT sets the terminal flag bit as necessary and clears it when appropriate. The UUT shall set bit time nineteen of the status word when an occurrence in the UUT causes a terminal fault condition. Prior to performing the test sequence below, a condition which sets the terminal flag bit must be activated.

Step 1. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 2. Remove the condition which sets the terminal flag bit. Cycling power to the UUT shall not be part of this procedure.

Step 3. A valid legal transmit command shall be sent to the UUT.

Step 4. Repeat step 3.

The pass criteria for each of the above steps shall be as follows: step 1 - TF; step 3 - CS or TF; step 4 - CS. All commands and UUT responses shall be recorded.

5.2.2.3 Illegal command. This test verifies that the UUT recognizes and responds properly to illegal commands when the illegal command detection option is implemented. The following sequence shall be performed:

Step 1. Send an illegal receive command to the UUT.

Step 2. Send a valid legal transmit command to the UUT.

Step 3. Send an illegal receive command to the UUT with a parity error in one of the data words.

Step 4. Send a transmit status mode command to the UUT.

Step 5. Repeat step 2.

Step 6. Send an illegal command to the UUT with a parity error in the command word.

Step 7. Send a transmit last command mode command to the UUT.

Step 8. Repeat step 1 thru step 7, except step 1 shall be an illegal transmit command.

The pass criteria shall be: step 1- status word only with ME bit set; step 2- CS; step 3- NR; step 4- ME; step 5- CS; step 6- NR; step 7- CS and the data word shall represent the command word associated with step 5; step 8 - same as step 1 thru step 7.

5.2.2.4 **Broadcast mode commands.** The purpose of this test is to verify that the UUT responds properly to implemented broadcast mode commands. This test is not intended to verify the mission aspects stated in the equipment specification. The UUT shall be tested for each mode code implemented with a subaddress field mode code indicator of all zeros and repeated with a subaddress field of all ones. Use the following test sequence unless otherwise noted.

Step 1. A valid receive message shall be sent to the UUT.

Step 2. A valid legal broadcast message shall be sent to the UUT.

Step 3. A transmit last command mode command shall be sent to the UUT.

The pass criteria is defined in each test paragraph. If any test fails, record the UUT response to that test.

5.2.2.4.1 **Broadcast synchronize (without data word).** The purpose of this test is to verify that the UUT has the ability to recognize a broadcast synchronize (without data word) mode command. The test sequence defined in 5.2.2.4 shall be used with a broadcast synchronize (without data word) mode command in step 2.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- NR; step 3- BCR and the data word contains the broadcast command sent in step 2.

5.2.2.4.2 **Broadcast synchronize (with data word).** The purpose of this test is to verify that the UUT has the ability to recognize a broadcast synchronize (with data word) mode command. The test sequence defined in 5.2.2.4 shall be used with a broadcast synchronize (with data word) mode command in step 2.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- NR; step 3- BCR and the data word contains the broadcast command sent in step 2.

5.2.2.4.3 **Broadcast initiate self-test.** The purpose of this test is to verify that the UUT has the ability to recognize the broadcast initiate self-test mode command. The following sequence shall be performed:

Step 1. A broadcast initiate self-test mode command shall be sent to the UUT on one bus.

Step 2. After time "T" from step 1, as measured per figure 7, a valid, legal, non-broadcast, non-mode command shall be sent to the UUT on the same bus.

Step 3. The time T shall be obtained by repeating step 1 and step 2 while varying the intermessage gap from 200 ms down to 4 us in no greater than 1 ms steps. When the time, T, is between 200 ms and 100 ms then in addition to each command sent in step 2, a minimum of one valid legal command shall be sent to the UUT positioned within 50 ms after step 1.

The minimum time between step 1 and step 2 as measured per figure 7 in which the UUT's response to step 2 is CS (with BUSY bit reset), shall be recorded.

The pass criteria for each of the above steps shall be as follows: step 1- NR; step 2- CS (with BUSY bit reset) for all time T $\geq$ 100 ms, and CS or NR for T $<$ 100 ms.

5.2.2.4.4 **Broadcast transmitter shutdown and override.** The purpose of this test is to verify that the UUT has the ability to recognize and properly execute these broadcast mode commands. The pass criteria for each individual test is contained in the paragraph below. The following sequence shall be performed for each test:

Step 1. A valid legal command shall be sent on the first bus to the UUT.

Step 2. A valid legal command shall be sent on the alternate bus to the UUT.

Step 3. A valid legal broadcast transmitter shutdown mode command shall be sent to the UUT on the first bus.

Step 4. A transmit last command mode command shall be sent on the first bus to the UUT.

Step 5. A valid legal command shall be sent on the alternate bus to the UUT.

Step 6. A valid legal command shall be sent on the first bus to the UUT.

Step 7. A valid legal broadcast override transmitter shutdown mode command shall be sent to the UUT on the alternate bus.

Step 8. A valid legal command shall be sent to the UUT on the alternate bus.

Step 9. A valid legal broadcast override transmitter shutdown mode command shall be sent to the UUT on the first bus.

Step 10. A transmit last command mode command shall be sent on the first bus to the UUT.

Step 11. A valid legal command shall be sent on the alternate bus to the UUT.

Step 12. A valid legal command shall be sent on the first bus to the UUT.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- CS; step 3- NR; step 4- BCR (and the data word contains the command word of step 3); step 5- NR; step 6- CS; step 7- NR; step 8- NR; step 9- NR; step 10- BCR (and the data word contains the command word of step 9); step 11- CS; step 12- CS.

5.2.2.4.5 **Broadcast selective transmitter shutdown and override.** This test shall verify that the UUT recognizes the multi-redundant broadcast mode code commands to shutdown a selected bus transmitter and to override the shutdown. In a multi-redundant system each bus must be tested as the primary bus with the remaining busses as alternate busses. A valid legal broadcast selected transmitter shutdown mode command shall be sent accompanied by the appropriate data word to cause a selective bus transmitter shutdown. A valid legal broadcast override selected transmitter shutdown mode command shall be sent accompanied by the appropriate data word to cause an override of the selected bus transmitter shutdown. The following test sequence shall be performed using each bus as the primary bus and each of the remaining busses in turn as the alternate bus, including verification of the UUT response indicated.

Step 1. A valid legal command shall be sent on the first bus to the UUT.

Step 2. A valid legal command shall be sent on the alternate bus to the UUT.

Step 3. A valid legal broadcast selected transmitter shutdown mode command shall be sent to the UUT on the first bus with the data word encoded to shutdown the alternate bus.

Step 4. A transmit last command mode shall be sent on the first bus to the UUT.

Step 5. A valid legal command shall be sent on the alternate bus to the UUT.

Step 6. A valid legal command shall be sent on the first bus to the UUT.

Step 7. A valid legal broadcast override selected transmitter shutdown mode command shall be sent to the UUT on the alternate bus with same data word as sent in step 3.

Step 8. A valid legal command shall be sent to the UUT on the alternate bus.

Step 9. A valid legal broadcast override selected transmitter shutdown mode command shall be sent to the UUT on the first bus with the same data word as sent in step 3.

Step 10. Repeat step 4.

Step 11. A valid legal command shall be sent on the alternate bus to the UUT.

Step 12. A valid legal command shall be sent on the first bus to the UUT.

Step 13. Repeat step 3 except that the data word shall be encoded with a bit pattern that would normally shutdown the first bus if it was sent on the alternate bus.

Step 14. Repeat step 4.

Step 15. Repeat step 5.

Step 16. Repeat step 6.

The data words associated with step 3 and step 13 for each bus shall be recorded.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- CS; step 3- NR; step 4- BCR (and the data word contains the command word of step 3); step 5- NR; step 6- CS; step 7- NR; step 8- NR; step 9-NR; step 10- BCR (and the data word contains the command word of step 9); step 11- CS; step 12- CS; step 13- NR; step 14- BCR (and the data word contains the command word of step 13); step 15- CS; step 16- CS.

5.2.2.4.6 **Broadcast terminal flag bit inhibit and override.** This test verifies that the UUT recognizes and responds properly to the broadcast mode code commands of inhibit terminal flag bit and override inhibit terminal flag bit. Beginning in step 2 of the test sequence below, the UUT shall be caused to set the terminal flag bit.

Step 1. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 2. Procedures, as defined for the UUT, shall be performed that will set the terminal flag in the UUT status response. Send a valid legal receive command with at least one data word to the UUT.

Step 3. A valid legal inhibit terminal flag broadcast mode code command shall be sent to the UUT.

Step 4. A transmit last command mode command shall be sent to the UUT.

Step 5. Repeat step 1.

Step 6. A valid legal override inhibit terminal flag broadcast mode code command shall be sent to the UUT.

Step 7. A transmit last command mode command shall be sent to the UUT.

Step 8. A valid legal receive command with at least one data word shall be sent to the UUT.

Step 9. Procedures, as defined for the UUT, shall be performed which resets the TF bit.

Step 10. Repeat step 1.

The pass criteria for each of the above steps shall be as follows: step 1- CS; step 2- TF; step 3- NR; step 4- BCR or (BCR and TF) and in either case the data word contains the command word of step 3; step 5- CS; step 6- NR; step 7- BCR or (BCR and TF) and in either case the data word contains the command word of step 6; step 8- TF; step 10- CS.

5.2.2.4.7 **Broadcast reset remote terminal.** The purpose of this test is to verify that the UUT has the ability to recognize the broadcast mode code command to reset itself to a power up initialized state. The following sequence shall be performed:

Step 1. A broadcast reset remote terminal mode command shall be sent to the UUT on one bus.

Step 2. After time T from step 1, as measured per figure 7, a valid legal transmit command shall be sent to the UUT on the same bus.

Step 3. The time T shall be obtained by repeating step 1 and step 2 while varying the intermessage gap from 100 ms down to 4 us in the following steps: from 100 ms to 6 ms in no greater than 1 ms steps, and from 6 ms to 4 us in no greater than 10 us steps. When the time T is between 5 ms and 100 ms then in addition to each command sent in step 2, a minimum of one valid legal command shall be sent to the UUT positioned within 4 ms after step 1.

Step 4. A valid legal transmitter shutdown mode command shall be sent to the UUT on the same bus.

Step 5. A valid legal command shall be sent to the UUT on the alternate bus.

Step 6. A broadcast reset remote terminal mode command shall be sent to the UUT on the first bus.

Step 7. After 5 ms repeat step 5.

The minimum time between step 1 and step 2 as measured per figure 7 in which the UUT's response to step 2 is CS (with BUSY bit reset), shall be recorded.

The pass criteria for each of the above steps shall be as follows: step 1- NR; step 2- CS (with BUSY bit reset) for all time T $\geq$ 5 ms and CS or NR for T $<$ 5 ms; step 4- CS; step 5- NR; step 6- NR; step 7- CS.

5.2.2.4.8 **Broadcast dynamic bus control.** The purpose of this test is to insure that the UUT does not take over bus control function in response to a broadcast mode command. The following sequence shall be performed:

Step 1. A broadcast dynamic bus control mode command shall be sent to the UUT.

Step 2. A transmit status mode command shall be sent to the UUT.

The pass criteria shall be: step 1- NR; step 2- CS (the BCR bit shall be set, ME bit may be set, but the DBA bit shall not be set).

5.2.2.5 **Error injection - broadcast messages.** The purpose of this test is to verify the UUT's response to data specific errors in broadcast messages. Unless otherwise noted, the following test sequence shall be used for all error injection tests. The error to be encoded in step 4 for a given message is specified in each test paragraph. The pass criteria is defined in each test paragraph. All responses shall be recorded.

Test sequence:

Step 1. A valid legal broadcast message shall be sent to the UUT.

Step 2. A transmit last command mode command shall be sent to the UUT.

Step 3. A valid legal receive message shall be sent to the UUT.

Step 4. A broadcast message containing the specified error shall be sent to the UUT.

Step 5. A transmit last command mode command shall be sent to the UUT.

Step 6. Repeat Step 3.

5.2.2.5.1 **Parity: bus controller (BC)-RT broadcast.** The purpose of this test is to verify the UUT's capability to detect parity errors embedded in different words within a message.

5.2.2.5.1.1 **Command word error.** This test verifies the ability of the UUT to recognize a parity error in the broadcast command. The test sequence as defined in 5.2.2.5 shall be performed with a parity error encoded in a broadcast command for test step 4.

The pass criteria for this test shall be: step 1- NR; step 2- BCR and the data word contains the command word of step 1; step 3- CS; step 4- NR; step 5- CS and the data word contains the command word of step 3; step 6- CS.

5.2.2.5.1.2 **Data word error.** This test verifies the ability of the UUT to recognize a parity error occurring in a data word. The test sequence as defined in 5.2.2.5 shall be performed with a parity error encoded in a data word for step 4. The message shall be a BC-RT (broadcast) command with the maximum number of data words that the UUT is designed to receive. The test sequence must be executed N times, where N equals the number of data words in the message. Each data word in the message will be transmitted with a parity error. Only one parity error is allowed per message.

The pass criteria for this test shall be: step 1- NR; step 2- BCR and the data word contains the command word of step 1; step 3- CS; step 4- NR; step 5- ME (BCR may be set) and the data word contains the command word of step 4; step 6- CS.

5.2.2.5.2 **Message length, BC to RT broadcast.** This test shall verify that the UUT recognizes an error in the number of data words that are received. Perform the test sequence as defined in 5.2.2.5 with the data word count error in a BC - RT (broadcast) message for test step 4. The message is a valid legal broadcast command word with the word count field equal to the maximum number of data words that the UUT is designed to receive and a different number of data words than specified in the command word. The test sequence shall be performed N+1 times, where N equals the maximum number of data words. The first sequence shall have N+1 data words. The second sequence shall have N-1 data words. Other sequences shall remove one additional data word until the number of data words equals zero.

The pass criteria for this test shall be: step 1- NR; step 2- BCR and the data word contains the command word of step 1; step 3- CS; step 4- NR; step 5- ME (BCR may be set) and the data word contains the command word of step 4; step 6- CS.

5.3 **Noise rejection test.** This test verifies the RT's ability to operate in the presence of noise. The maximum word error rate for a RT is one part in 10^7. While performing this test, all words received by the UUT shall be in the presence of an additive white Gaussian noise distributed over a bandwidth of 1.0 kHz to 4.0 MHz at an RMS amplitude of 140 mV for transformer coupled stubs or 200 mV for direct coupled stubs measured at point A of figure 9A or figure 10A. This test shall be conducted with a signal level of 2.1 V peak-to-peak, line-to-line, for transformer coupled stubs or 3.0 V peak-to-peak, line-to-line, for direct coupled stubs measured at point A of figure 9A or figure 10A. The rise and fall time of the transmitted message (measured at a data bit zero crossing with the prior zero crossing and the next zero crossing at 500 ns intervals from the measured zero crossing) measured at point "A" shall be 200 ns $\pm$20 ns. Figure 9A and figure 10A depict the configurations for conducting the noise rejection test. Air Force applications shall only use the configuration in figure 10A. Figure 9B and figure 10B depict suggested configurations for the noise rejection test. The noise test shall run continuously with intermessage gaps of $\geq$ 100 us until the total number of all words received by the UUT exceeds the required number for acceptance of the UUT or is less than the required number for rejection of the terminal, as specified in table III. All data words used in the tests shall contain random bit patterns. These bit patterns shall be unique for each data word in a message and shall change randomly from message to message.

TABLE III. Criteria for acceptance or rejection of a terminal for the noise rejection tests.

Total number of words received by the terminal (in multiples of 10^7)		
NO. OF ERRORS	REJECT (EQUAL OR LESS)	ACCEPT (EQUAL OR MORE)
0	N/A	4.40
1	N/A	5.21
2	N/A	6.02
3	N/A	6.83
4	N/A	7.64
5	N/A	8.45
6	.45	9.27
7	1.26	10.08
8	2.07	10.89
9	2.88	11.70
10	3.69	12.51
11	4.50	13.32
12	5.31	14.13
13	6.12	14.94
14	6.93	15.75
15	7.74	16.56
16	8.55	17.37
17	9.37	18.19
18	10.18	19.00
19	10.99	19.81
20	11.80	20.62
21	12.61	21.43
22	13.42	22.24
23	14.23	23.05
24	15.04	23.86
25	15.85	24.67
26	16.66	25.48
27	17.47	26.29
28	18.29	27.11
29	19.10	27.92
30	19.90	28.73
31	20.72	29.54
32	21.53	30.35
33	22.34	31.16
34	23.15	31.97
35	23.96	32.78
36	24.77	33.00
37	25.58	33.00
38	26.39	33.00
39	27.21	33.00
40	28.02	33.00
41	33.00	N/A

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APPENDIX A

TEST PLAN TO MIL-STD-1553B

CROSS REFERENCE

P = Primary Reference
R = Related Reference

Test Plan			MIL-STD-1553B
5.0	Detailed requirements		
5.1	Electrical tests		
5.1.1	Output characteristics		
5.1.1.1	Amplitude	(Transformer coupled)	4.5.2.1.1.1-P
		(Direct coupled)	4.5.2.2.1.1-P
5.1.1.2	Rise time/fall time	(Transformer coupled)	4.5.2.1.1.2-P
		(Direct coupled)	4.5.2.2.1.2-P
5.1.1.3	Zero crossing stability		
		(Transformer coupled)	4.5.2.1.1.2-P
		(Direct coupled)	4.5.2.2.1.2-P
5.1.1.4	Distortion, overshoot & ringing		
		(Transformer coupled)	4.5.2.1.1.2-P
		(Direct coupled)	4.5.2.2.1.2-P
5.1.1.5	Output symmetry	(Transformer coupled)	4.5.2.1.1.4-P
		(Direct coupled)	4.5.2.2.1.4-P
5.1.1.6	Output noise	(Transformer coupled)	4.5.2.1.1.3-P
		(Direct coupled)	4.5.2.2.1.3-P
5.1.1.7	Output isolation		4.6.1-P 30.10.6-P
5.1.1.8	Power on/off		
5.1.1.8.1	Power on/off noise	(Transformer coupled)	30.10.6-P
		(Direct coupled)	30.10.6-P
5.1.1.8.2	Power on response		30.5.1-P 3.16-R
5.1.1.9	Terminal response time		4.3.3.8-P
5.1.1.10	Frequency stability		4.3.3.3-P
5.1.2	Input characteristics		
		(Transformer coupled)	4.5.2.1.2-P
		(Direct coupled)	4.5.2.2.2-P
5.1.2.1	Input waveform compatibility		
		(Transformer coupled)	4.5.2.1.2.1-P
		(Direct coupled)	4.5.2.2.2.1-P
5.1.2.1.1	Zero crossing distortion		
		(Transformer coupled)	4.5.2.1.2.1-P
		(Direct coupled)	4.5.2.2.2.1-P
5.1.2.1.2	Amplitude variations		
		(Transformer coupled)	4.5.2.1.2.1-P
		(Direct coupled)	4.5.2.2.2.1-P
5.1.2.1.3	Rise and fall time		4.5.2.1.2.1-P
5.1.2.1.3.1	Trapezoidal		4.5.2.1.2.1-P
5.1.2.1.3.2	Sinusoidal		4.5.2.1.2.1-P

P = Primary Reference
R = Related Reference

Test Plan		MIL-STD-1553B
5.1.2.2	Common mode rejection (Transformer coupled)	4.5.2.1.2.2-P
	(Direct coupled)	4.5.2.2.2.2-P
5.1.2.3	Input impedance (Transformer coupled)	4.5.2.1.2.3-P
	(Direct coupled)	4.5.2.2.2.3-P
5.2	Protocol tests	4.4.1.3-P 4.2.3-R
5.2.1	Required remote terminal operation	4.4.3-P
5.2.1.1	Response to command words	
5.2.1.1.1	RT response to command words	4.3.3.6-P 4.4.3-P
5.2.1.1.2	RT-RT response to command words	4.3.3.6-P 4.4.3-P
5.2.1.2	Intermessage gap	
5.2.1.2.1	Minimum time	4.3.3.7-P
5.2.1.2.2	Transmission rate	4.3.3.7-P 4.3.3.8-R
5.2.1.3	Error injection	4.3.3.5.1.6-R 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.1-R 4.4.3.3-R 4.4.3.5-R 4.4.3.6-R
5.2.1.3.1	Parity	4.3.3.5.1.6-R 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.1-R 4.4.3.3-P
5.2.1.3.1.1	Transmit command word	4.3.3.5.1.6-R 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.3-P 4.4.3.5-R 4.4.3.6-R
5.2.1.3.1.2	Receive command word	4.3.3.5.1.6-R 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.3-P 4.4.3.5-R 4.4.3.6-R
5.2.1.3.1.3	Receive data word	4.3.3.5.1.6-R 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.1-R 4.4.3.3-P 4.4.3.5-R 4.4.3.6-R

P = Primary Reference
R = Related Reference

Test Plan		MIL-STD-1553B
5.2.1.3.2	Word length	4.3.3.4-R 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.1-R 4.4.3.3-P
5.2.1.3.2.1	Transmit command word	4.3.3.4-P 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.3-P 4.4.3.5-R
5.2.1.3.2.2	Receive command word	4.3.3.4-P 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.3-P 4.4.3.6-R
5.2.1.3.2.3	Receive data words	4.3.3.4-P 4.3.3.5.3.3-P 4.4.1.1-R 4.4.3.6-R
5.2.1.3.3	Bi-phase encoding	4.3.3.2-P 4.3.3.5.3.3-R 4.4.1.1-R 4.4.3.5-R 4.4.3.6-R
5.2.1.3.3.1	Transmit command word	4.3.3.2-P 4.3.3.5.3.3-R 4.4.1.1-R 4.4.3.3-R
5.2.1.3.3.2	Receive command word	4.3.3.2-P 4.3.3.5.3.3-R 4.4.1.1-R 4.4.3.3-R
5.2.1.3.3.3	Receive data word	4.3.3.2-P 4.3.3.5.3.3-R 4.4.1.1-R 4.4.3.5-R 4.4.3.6-R
5.2.1.3.4	Sync encoding	4.3.3.5.1.1-P 4.3.3.5.2.1-P 4.3.3.5.3.1-P 4.4.1.1-R 4.4.3.3-R 4.4.3.5-R 4.4.3.6-R

P = Primary Reference
R = Related Reference

Test Plan		MIL-STD-1553B
5.2.1.3.4.1	Transmit command word	4.3.3.5.1.1-P 4.4.1.1-R 4.4.3.3-R
5.2.1.3.4.2	Receive command word	4.3.3.5.1.1-P 4.4.1.1-R 4.4.3.3-R
5.2.1.3.4.3	Data word	4.3.3.5.2.1-P 4.4.1.1-R 4.4.3.6-R
5.2.1.3.5	Message length	4.3.3.5.1.5-P
5.2.1.3.5.1	Transmit command	4.3.3.5.1.5-P 4.3.3.6-R 4.3.3.6.2-R
5.2.1.3.5.2	Receive command	4.3.3.5.1.5-P 4.3.3.6-R 4.3.3.6.1-R
5.2.1.3.5.3	Mode command word count error	4.3.3.6-R
5.2.1.3.5.4	RT to RT word count error	4.3.3.5.1.5-P 4.3.3.6-R
5.2.1.3.6	Contiguous data	4.3.3.6.1-P 4.4.1.2-R 4.4.3.5-R
5.2.1.3.7	Terminal fail-safe	4.4.1.3-P
5.2.1.4	Superseding commands	4.4.3.2-P
5.2.1.5	Required mode commands	30.4.2.1-P 4.3.3.5.1.7-P
5.2.1.5.1	Transmit status	4.3.3.5.1.7.3-P
5.2.1.5.2	Transmitter shutdown & override	4.3.3.5.1.7.5-P 4.3.3.5.1.7.6-P
5.2.1.5.3	Reset remote terminal	4.3.3.5.1.7.9-P 30.4.3-P
5.2.1.6	Data wrap-around	30.7-P
5.2.1.7	RT to RT timeout	30.9-P 4.3.3.9-P
5.2.1.8	Bus switching	4.6.3-P 30.2-R
5.2.1.9	Unique address	30.3-P 4.3.3.5.1.2-R
5.2.2	Optional operation	
5.2.2.1	Optional mode commands	4.3.3.5.1.7-P
5.2.2.1.1	Dynamic bus control	4.3.3.5.1.7.1-P 4.3.3.5.3.10-R
5.2.2.1.2	Synchronize	
5.2.2.1.2.1	Synchronize without data word	4.3.3.5.1.7.2-P
5.2.2.1.2.2	Synchronize with data word	4.3.3.5.1.7.12-P
5.2.2.1.3	Initiate self-test	4.3.3.5.1.7.4-P 30.4.4-P

P = Primary Reference
R = Related Reference

Test Plan		MIL-STD-1553B
5.2.2.1.4	Transmit bit word	4.3.3.5.1.7.14-P
5.2.2.1.5	Selective transmitter shutdown & override	4.3.3.5.1.7.15-P 4.3.3.5.1.7.16-P
5.2.2.1.6	Terminal flag bit inhibit and override	4.3.3.5.1.7.7-P 4.3.3.5.1.7.8-P
5.2.2.1.7	Transmit vector word	4.3.3.5.1.7.11-P
5.2.2.1.8	Transmit last command	4.3.3.5.1.7.13-P
5.2.2.2	Status word bits	4.3.3.5.3-P 30.5.2-P
5.2.2.2.1	Service request	4.3.3.5.3.5-P
5.2.2.2.2	Broadcast command received	4.3.3.5.3.7-P
5.2.2.2.3	Busy	4.3.3.5.3.8-P 30.5.3-P
5.2.2.2.4	Subsystem flag	4.3.3.5.3.9-P
5.2.2.2.5	Terminal flag	4.3.3.5.3.11-P
5.2.2.3	Illegal command	4.4.3.4-P
5.2.2.4	Broadcast mode commands	4.3.3.6.7.3-P 4.3.3.6.7.4-P
5.2.2.4.1	Broadcast synchronize (without data word)	4.3.3.5.1.7.2-P 4.3.3.6.7.3-P
5.2.2.4.2	Broadcast synchronize (with data word)	4.3.3.5.1.7.12-P 4.3.3.6.7.4-P
5.2.2.4.3	Broadcast initiate self-test	4.3.3.5.1.7.4-P 4.3.3.6.7.3-P
5.2.2.4.4	Broadcast transmitter shutdown and override	4.3.3.5.1.7.5-P 4.3.3.5.1.7.6-P 4.3.3.6.7.3-P
5.2.2.4.5	Broadcast selective transmitter shutdown and override	4.3.3.5.1.7.15-P 4.3.3.5.1.7.16-P 4.3.3.6.7.4-P
5.2.2.4.6	Broadcast terminal flag bit inhibit and override	4.3.3.5.1.7.7-P 4.3.3.5.1.7.8-P 4.3.3.6.7.3-P
5.2.2.4.7	Broadcast reset remote terminal	4.3.3.5.1.7.9-P 4.3.3.6.7.3-P
5.2.2.4.8	Broadcast dynamic bus control	4.3.3.5.1.7.1-P

P = Primary Reference
R = Related Reference

Test Plan		MIL-STD-1553B
5.2.2.5	Error injection - broadcast messages	4.3.3.5.3.3-P 4.3.3.5.3.7-R 4.4.1.1-R 4.4.3.1-R 4.4.3.3-R 4.4.3.5-R 4.4.3.6-R
5.2.2.5.1	Parity: BC-RT broadcast	4.3.3.5.1.6-P 4.3.3.6.7.1-R
5.2.2.5.2	Command word error	4.3.3.5.1.6-P 4.3.3.5.1-R
5.2.2.5.3	Data word error	4.3.3.5.1.6-P 4.3.3.5.2-R
5.2.2.5.4	Message length, BC to RT broadcast	4.3.3.6.7.1-P 4.4.3.6-P 4.3.3.5.3.7-R
5.3	Noise rejection (Transformer coupled)	4.5.2.1.2.4-P
	(Direct coupled)	4.5.2.2.2.4-P

APPENDIX B

MIL-STD-1553B TO TEST PLAN

CROSS REFERENCE

MIL-STD-1553B		Test Plan
4.	General requirements	
4.1	Test & operating requirements	none
4.2	Data bus operation	5.2
4.3	Characteristics	
4.3.1	Data form	none
4.3.2	Bit priority	none
4.3.3	Transmission method	
4.3.3.1	Modulation	none
4.3.3.2	Data code	5.2.1.3.3
4.3.3.3	Transmission bit rate	5.1.1.10
4.3.3.4	Word size	5.2.1.3.2
4.3.3.5	Word formats - command	5.2.1.1
	- data	none
	- status	5.2.2.2
4.3.3.5.1	Command word	5.2.1.1
4.3.3.5.1.1	Sync	5.2.1.3.4.1
4.3.3.5.1.2	Remote terminal address (not 11111)	5.2.1.1
	(11111)	5.2.1.1
4.3.3.5.1.3	Transmit/receive	5.2
4.3.3.5.1.4	Subaddress/mode - subaddress	5.2.1.1
	- mode	5.2.2.1
4.3.3.5.1.5	Data word count/mode code - word count	5.2.1.3.5
	- mode code	5.2.2.1
4.3.3.5.1.6	Parity	5.2.1.3.1
4.3.3.5.1.7	Optional mode control	5.2.2.1
4.3.3.5.1.7.1	Dynamic bus control	5.2.2.1.1
4.3.3.5.1.7.2	Synchronize (without data word)	5.2.2.1.2.1
4.3.3.5.1.7.3	Transmit status word	5.2.1.5.1
4.3.3.5.1.7.4	Initiate self test	5.2.2.1.3
4.3.3.5.1.7.5	Transmitter shutdown	5.2.1.5.2
4.3.3.5.1.7.6	Override transmitter shutdown	5.2.1.5.2
4.3.3.5.1.7.7	Inhibit T/F bit	5.2.2.1.6
4.3.3.5.1.7.8	Override inhibit T/F flag	5.2.2.1.6
4.3.3.5.1.7.9	Reset remote terminal	5.2.1.5.3
4.3.3.5.1.7.10	Reserved mode codes (01001-01111)	5.2.1.1
4.3.3.5.1.7.11	Transmit vector word	5.2.2.1.7
4.3.3.5.1.7.12	Synchronize (with data word)	5.2.2.1.2.2
4.3.3.5.1.7.13	Transmit last command word	5.2.2.1.8
4.3.3.5.1.7.14	Transmit built-in-test (BIT) word	5.2.2.1.4
4.3.3.5.1.7.15	Selected transmitter shutdown	5.2.2.1.5
4.3.3.5.1.7.16	Override selected transmitter shutdown	5.2.2.1.5
4.3.3.5.1.7.17	Reserved mode codes (10110 to 11111)	5.2.1.1

MIL-STD-1553B		Test Plan
4.3.3.5.2	Data word	
4.3.3.5.2.1	Sync	5.2.1.3.4.2
4.3.3.5.2.2	Data	none
4.3.3.5.2.3	Parity	4.1
4.3.3.5.3	Status word	5.2.2.2
4.3.3.5.3.1	Sync	4.2
4.3.3.5.3.2	RT address	4.2
4.3.3.5.3.3	Message error bit	5.2.1.3
4.3.3.5.3.4	Instrumentation bit	4.2
4.3.3.5.3.5	Service request bit	5.2.2.2.1
4.3.3.5.3.6	Reserved status bits	4.2
4.3.3.5.3.7	Broadcast command received bit	5.2.2.2.2
4.3.3.5.3.8	Busy bit	5.2.2.2.3
4.3.3.5.3.9	Subsystem flag bit	5.2.2.2.4
4.3.3.5.3.10	Dynamic bus control acceptance bit	5.2.2.1.1
4.3.3.5.3.11	Terminal flag bit	5.2.2.2.5
4.3.3.5.3.12	Parity bit	4.2
4.3.3.5.4	Status word reset	5.2.2.2
4.3.3.6	Message formats	n/a
4.3.3.6.1	BC to RT transfers	5.2.1.1.1
4.3.3.6.2	RT to BC transfers	5.2.1.1.1
4.3.3.6.3	RT to RT transfers	5.2.1.1.2
4.3.3.6.4	Mode command w/o data word	5.2.2.1
4.3.3.6.5	Mode command with data word (transmit)	5.2.2.1
4.3.3.6.6	Mode command data word (receive)	5.2.2.1
4.3.3.6.7	Optional broadcast command	5.2.1.1
4.3.3.6.7.1	BC to RT transfer (broadcast)	5.2.1.1
4.3.3.6.7.2	RT to RT transfer (broadcast)	5.2.1.1
4.3.3.6.7.3	Mode commands w/o data word (broadcast)	5.2.2.4
4.3.3.6.7.4	Mode commands with data word (broadcast)	5.2.2.4
4.3.3.7	Intermessage gap	5.2.1.2
4.3.3.8	Response time	4.2 5.1.1.9
4.3.3.9	Minimum no-response time-out	5.2.1.7
4.4	Terminal operation	
4.4.1	Common operation	
4.4.1.1	Word validation	5.2.1.3
4.4.1.2	Transmission continuity	5.2.1.3.6
4.4.1.3	Terminal fail-safe	5.2.1.3.7
4.4.2	Bus controller operation	n/a
4.4.3	Remote terminal	5.2
4.4.3.1	Operation	5.2.1.1
4.4.3.2	Superseding valid commands	5.2.1.4
4.4.3.3	Invalid commands	5.2.1.3
4.4.3.4	Illegal commands	5.2.2.3
4.4.3.5	Valid data reception	5.2.1.3
4.4.3.6	Invalid data reception	5.2.1.3
4.4.4	Bus monitor operation	n/a

MIL-STD-1553B		Test Plan
4.5	Hardware characteristics	
4.5.1	Data bus characteristics	
4.5.1.1	Cable	n/a
4.5.1.2	Characteristics impedance	n/a
4.5.1.3	Cable attenuation	n/a
4.5.1.4	Cable termination	n/a
4.5.1.5	Cable stub requirements	n/a
4.5.1.5.1	Transformer coupled stubs	n/a
4.5.1.5.1.1	Coupling transformer	n/a
4.5.1.5.1.1.1	Transformer input impedance	n/a
4.5.1.5.1.1.2	Transformer waveform integrity	n/a
4.5.1.5.1.1.3	Transformer common mode rejection	n/a
4.5.1.5.1.2	Fault isolation	n/a
4.5.1.5.1.3	Cable coupling	n/a
4.5.1.5.1.4	Stub voltage requirements	n/a
4.5.1.5.2	Direct coupled stubs	n/a
4.5.1.5.2.1	Fault isolation	n/a
4.5.1.5.2.2	Cable coupling	n/a
4.5.1.5.2.3	Stub voltage requirements	n/a
4.5.1.5.3	Wiring & cabling for EMC	n/a
4.5.2	Terminal characteristics	5.1
4.5.2.1	Terminals with transformer coupled stubs	5.1
4.5.2.1.1	Terminal output characteristics	5.1.1
4.5.2.1.1.1	Output levels	5.1.1.1
4.5.2.1.1.2	Output waveform	5.1.1.2 5.1.1.3 5.1.1.4
4.5.2.1.1.3	Output noise	5.1.1.6 5.1.1.8
4.5.2.1.1.4	Output symmetry	5.1.1.5
4.5.2.1.2	Terminal input characteristics	5.1.2
4.5.2.1.2.1	Input waveform compatibility	5.1.2.1
4.5.2.1.2.2	Common mode rejection	5.1.2.2
4.5.2.1.2.3	Input impedance	5.1.2.3
4.5.2.1.2.4	Noise rejection	5.3
4.5.2.2	Terminals with direct coupled stubs	5.1
4.5.2.2.1	Terminal output characteristics	5.1.1
4.5.2.2.1.1	Output levels	5.1.1.1
4.5.2.2.1.2	Output waveform	5.1.1.2 5.1.1.3 5.1.1.4
4.5.2.2.1.3	Output noise	5.1.1.6 5.1.1.8
4.5.2.2.1.4	Output symmetry	5.1.1.5
4.5.2.2.2	Terminal input characteristics	5.1.2
4.5.2.2.2.1	Input waveform compatibility	5.1.2.1
4.5.2.2.2.2	Common mode rejection	5.1.2.2
4.5.2.2.2.3	Input impedance	5.1.2.3
4.5.2.2.2.4	Noise rejection	5.3

MIL-STD-1553B		Test Plan
4.6	Redundant data bus requirements	5.2.1.8
4.6.1	Electrical isolation	5.1.1.7
4.6.2	Single event failures	n/a
4.6.3	Dual standby redundant data bus	5.2.1.8
4.6.3.1	Data bus activity	5.2.1.8
4.6.3.2	Superseding valid commands	5.2.1.8
30.	GENERAL REQUIREMENTS	n/a
30.1	Option selection	n/a
30.2	Application	n/a
30.3	Unique address	5.2.1.9
30.4	Mode codes	n/a
30.4.1	Subaddress/mode	5.2.1.5
30.4.2	Required mode codes	n/a
30.4.2.1	Remote terminal required mode codes	5.2.1.5
30.4.2.2	Bus controller required mode codes	n/a
30.4.3	Reset remote terminal	5.2.1.5.3
30.4.4	Initiate RT self-test	5.2.2.1.3
30.5	Status word bits	n/a
30.5.1	Information content	5.1.1.8.2
30.5.2	Status bit requirements	5.2.2.2
30.5.3	Busy bit	5.2.2.2.3
30.6	Broadcast	5.2.1.1
30.7	Data wrap-around	5.2.1.6
30.8	Message formats	n/a
30.9	RT to RT validation	5.2.1.7
30.10	Electrical characteristics	n/a
30.10.1	Cable shielding	n/a
30.10.2	Shielding	n/a
30.10.3	Connector polarity	n/a
30.10.4	Characteristic impedance	n/a
30.10.5	Stub coupling	n/a
30.10.6	Power on/off noise	5.1.1.8

APPENDIX C

TEST PLAN CHANGES FOR MIL-STD-1553B ONLY RTs

For remote terminals designed to only comply with MIL-STD-1553B, the following changes shall be made for the pass criteria in this document.

1. The following paragraphs are optional and are subject to the same requirements as 5.2.2.

5.2.1.5	Required mode commands
5.2.1.5.1	Transmit status
5.2.1.5.2	Transmitter shutdown and override
5.2.1.5.3	Reset remote terminal
5.2.1.6	Data wrap-around
5.2.1.7	RT to RT timeout
5.2.1.8	Bus switching
5.2.1.9	Unique address

2. For the following paragraphs, the pass criteria for step 2 shall be changed to delete the words "(with BUSY bit reset)."

5.2.2.1.3	Initiate self-test
5.2.1.5.3	Reset remote terminal
5.2.2.4.3	Broadcast initiate self-test
5.2.2.4.7	Broadcast reset remote terminal

3. For 5.1.1.8.1 Power on/off noise, the pass criteria shall not be defined in this document.

4. For the following paragraphs, the requirement to implement both mode code indicators of all zeros and all ones is optional and subject to the same requirements as 5.2.2. The RT must meet the pass criteria for either all zeros or all ones, but is not required to meet both.

5.2.1.5	Required mode commands
5.2.2.1	Optional mode commands
5.2.2.4	Broadcast mode commands

5. The following note shall be added to the end of 5.2.1.3.

Note: If transmit status mode command is not implemented, then transmit last command mode command shall be used. If neither mode command is implemented, then step 3 shall be deleted.

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APPENDIX D

TEST PLAN CHANGES FOR MIL-STD-1553B, NOTICE 1 RTs

For remote terminals designed to comply with MIL-STD-1553B, Notice 1, the following changes shall be made for the pass criteria in this document.

1. The following paragraphs are optional, and are subject to the same requirements as 5.2.2.

5.2.1.5	Required mode commands
5.2.1.5.1	Transmit status
5.2.1.5.2	Transmitter shutdown and override
5.2.1.5.3	Reset remote terminal
5.2.1.6	Data wrap-around
5.2.1.7	RT to RT timeout
5.2.1.9	Unique address

2. For the following paragraphs, the pass criteria for step 2 shall be changed to delete the words "(with BUSY bit reset)."

5.2.2.1.3	Initiate self-test
5.2.1.5.3	Reset remote terminal
5.2.2.4.3	Broadcast initiate self-test
5.2.2.4.7	Broadcast reset remote terminal

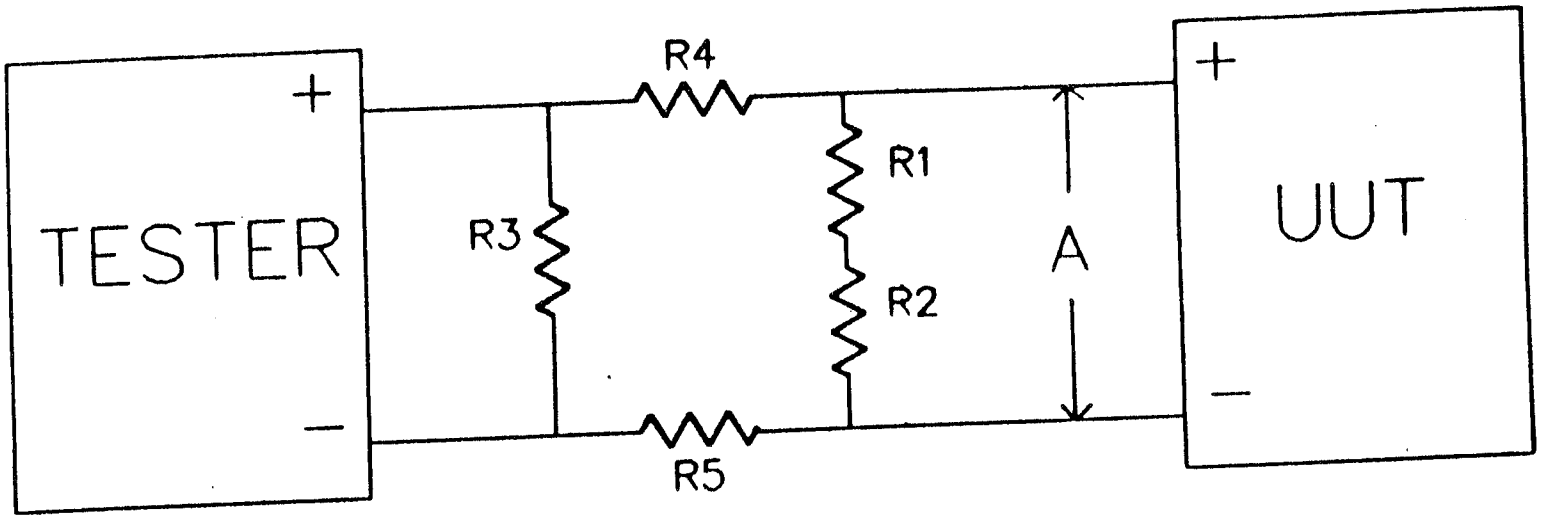
3. For 5.1.1.8, the pass criteria shall not be defined in this document.

4. For the following paragraphs the requirement to implement mode code indicator of all ones is optional and subject to the same requirements as 5.2.2.

5.2.1.5	Required mode commands
5.2.2.1	Optional mode commands
5.2.2.4	Broadcast mode commands

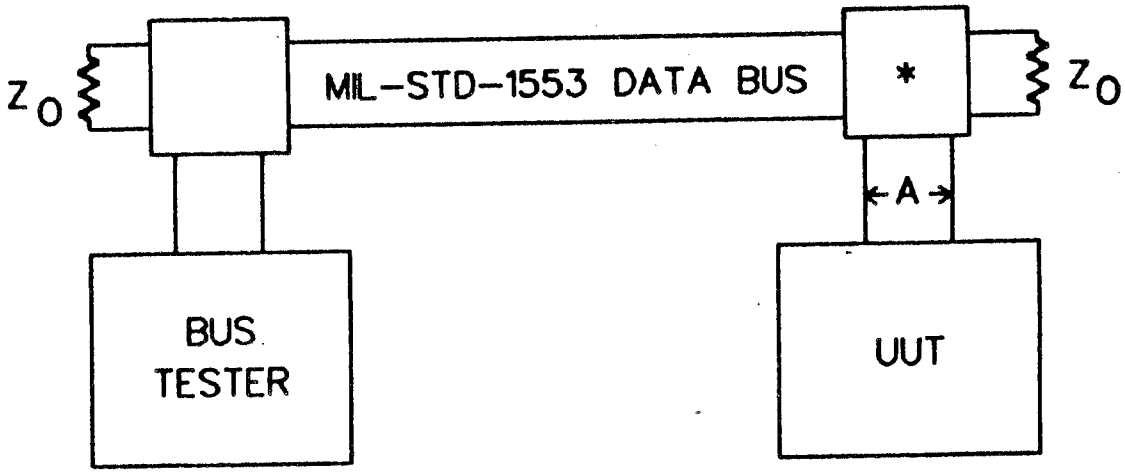
5. The following note shall be added to the end of 5.2.1.3.

Note: If transmit status mode command is not implemented, then transmit last command mode command shall be used. If neither mode command is implemented, then step 3 shall be deleted.



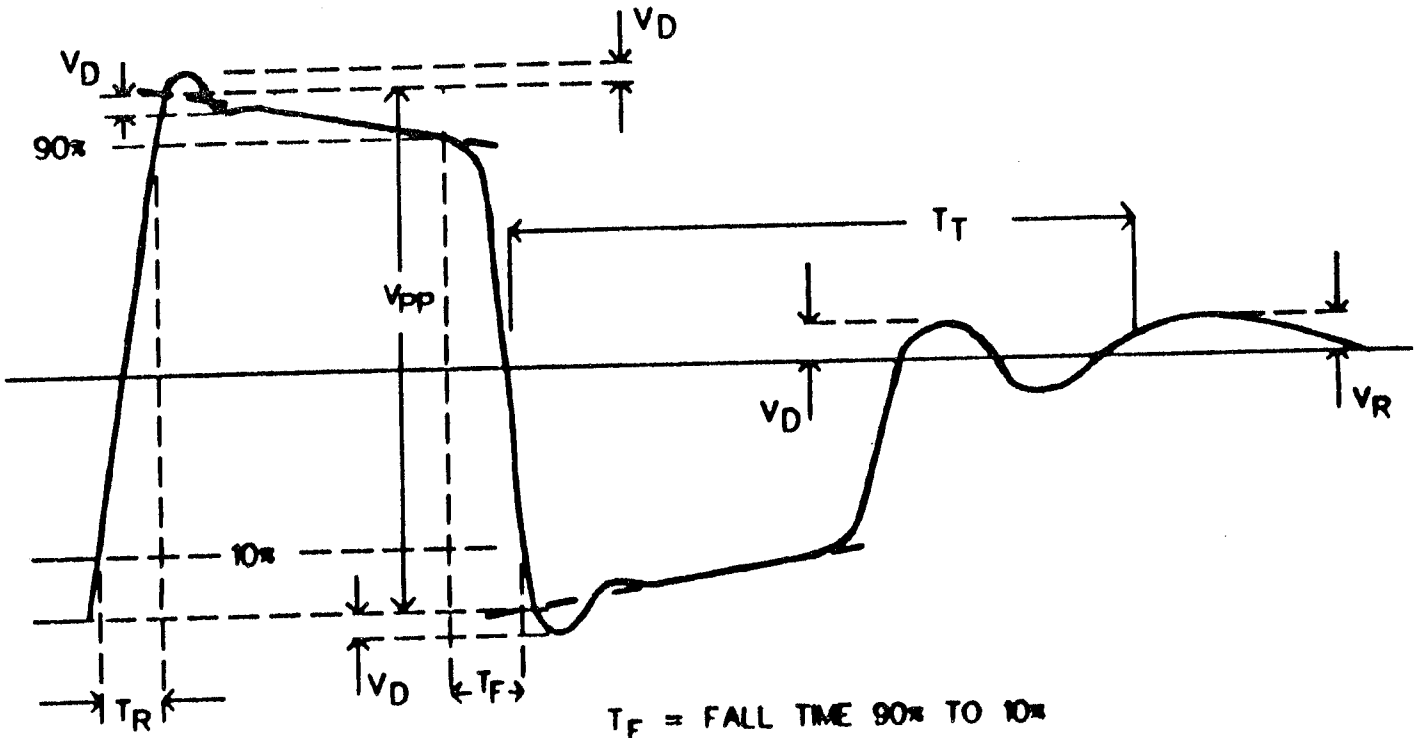
	DIRECT COUPLED	TRANSFORMER COUPLED
	35 ohms ±2%	70 ohms ±2%
R1, R2	20	46.5
R3, R4, R5	100	93.1

GENERAL RESISTOR PAD CONFIGURATION
Figure 1A.



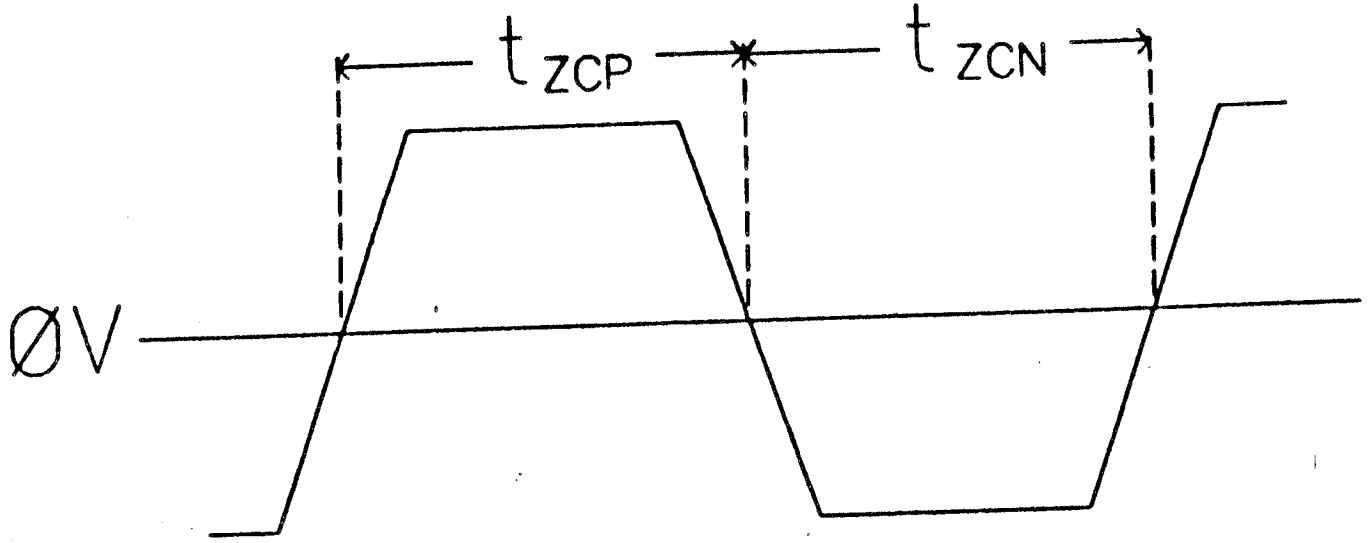
* NOTE: REFERENCE FIGURES 9A AND 10A OF MIL-STD-1553 FOR DATA BUS INTERFACE COUPLING.
REFERENCE FIGURE 10B OF THIS TEST PLAN FOR SUGGESTED CABLE TYPE, BUS AND STUB LENGTHS, ETC.

GENERAL BUS CONFIGURATION
Figure 1B.

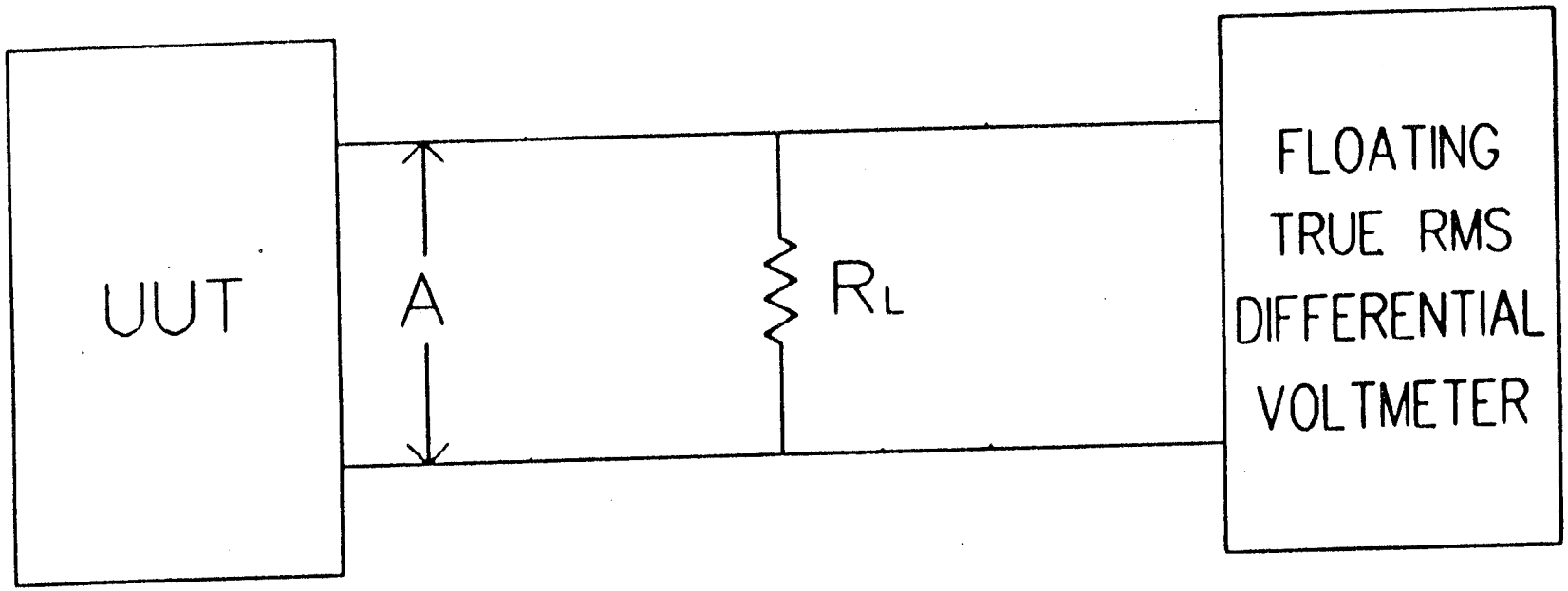


T_F = FALL TIME 90% TO 10%
T_R = RISE TIME 10% TO 90%
T_T = WAVEFORM TAILOFF TIME = 2.5 µSEC
V_R = RESIDUAL VOLTAGE
V_D = DISTORTION VOLTAGE
V_{PP} = PEAK-TO-PEAK VOLTAGE

WAVEFORM MEASUREMENTS
Figure 2.

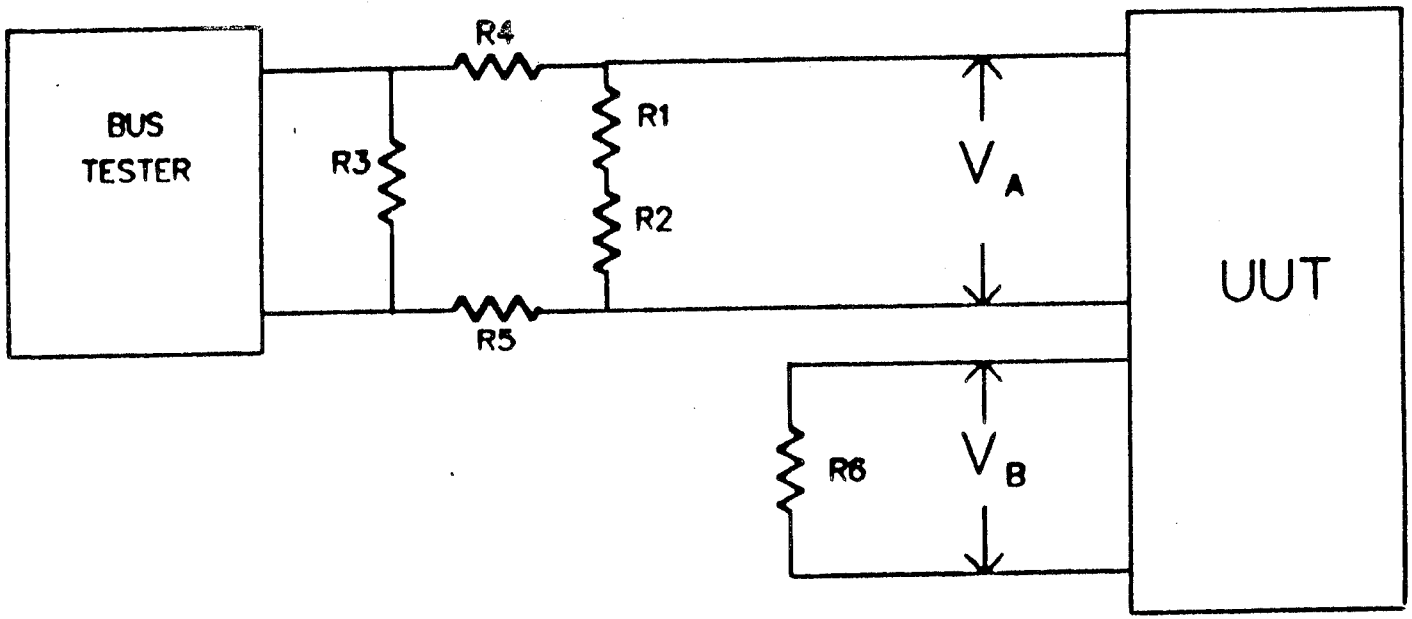


ZERO CROSSING INTERVAL MEASUREMENTS
Figure 3.



TRANSFORMER COUPLED R_L = 70.0 ohms ±2%
DIRECT COUPLED R_L = 35.0 ohms ±2%

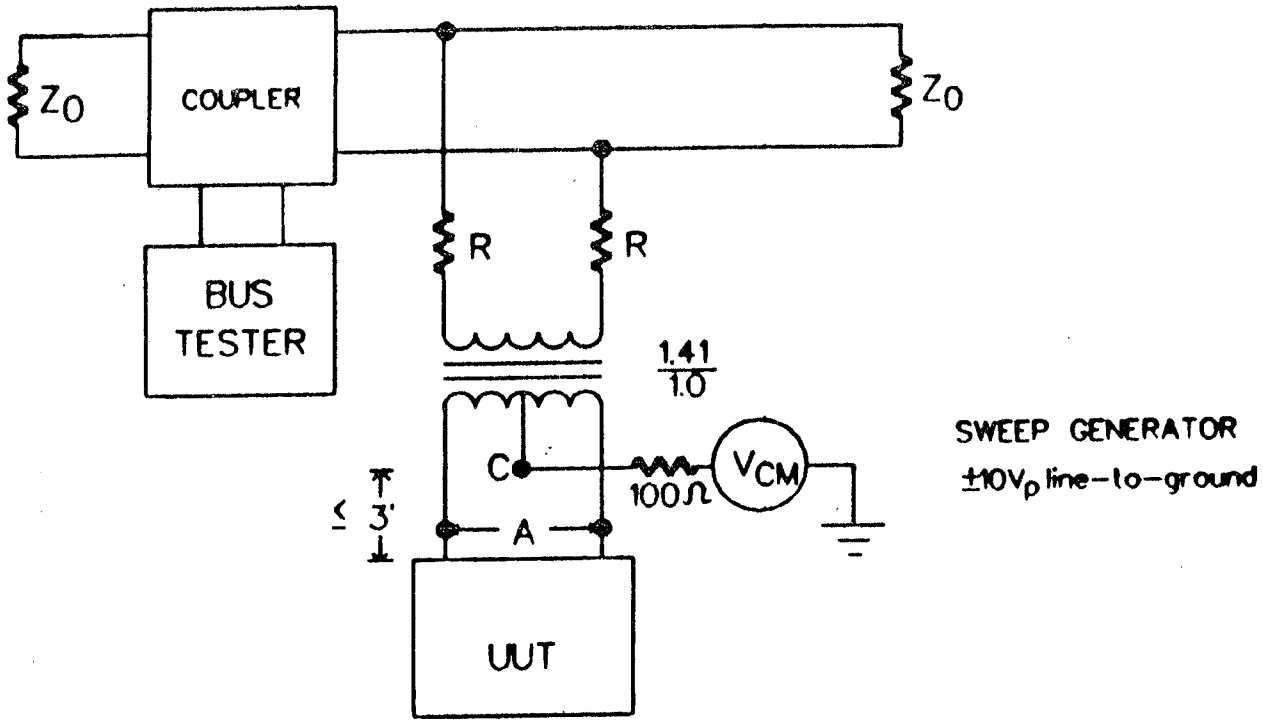
OUTPUT NOISE CONFIGURATION
Figure 4.



	DIRECT COUPLED	TRANSFORMER COUPLED
	35 ohms ±2%	70 ohms ±2%
R1, R2	20	46.5
R3, R4, R5	100	93.1
R6	35	70

$$dB = 20 \log \frac{V_A}{V_B}$$

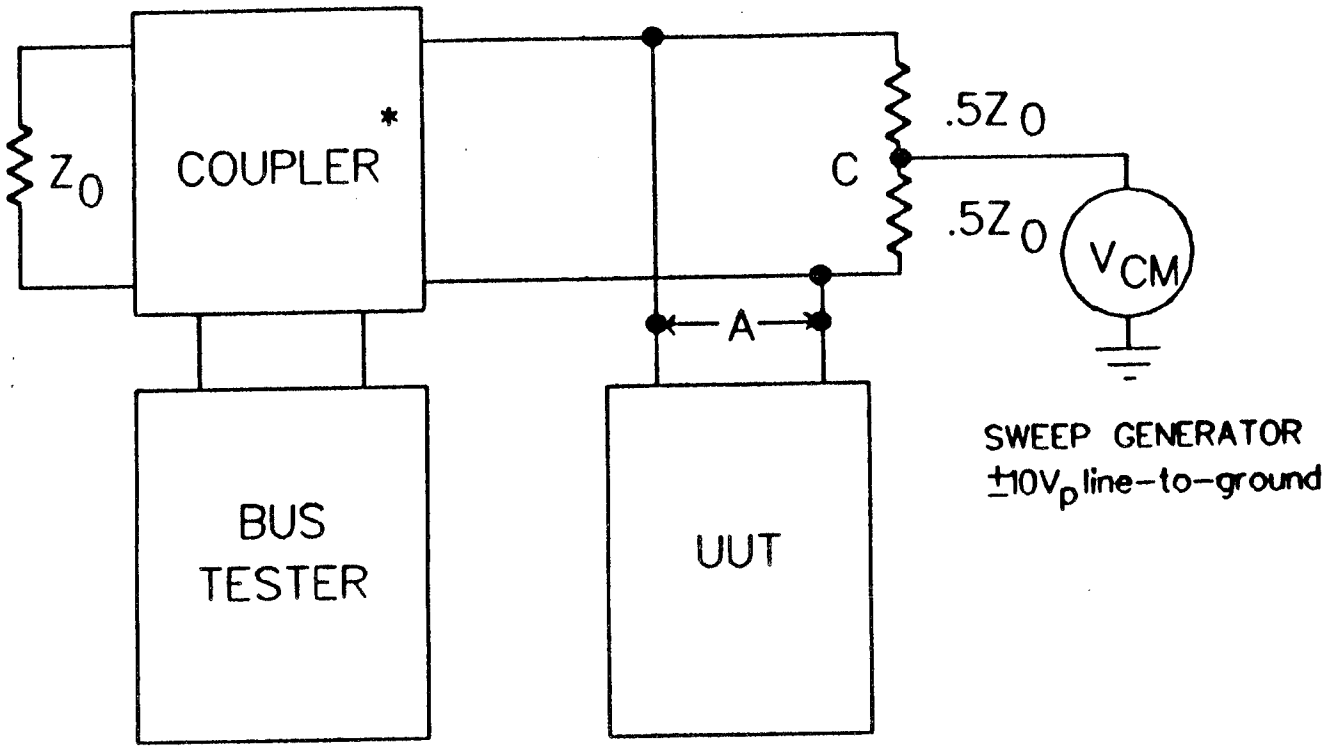
OUTPUT ISOLATION
Figure 5.



$R = 0.75\ Z_0 \pm 2\%$

Z_0 – Selected Cable Nominal Characteristic Impedance

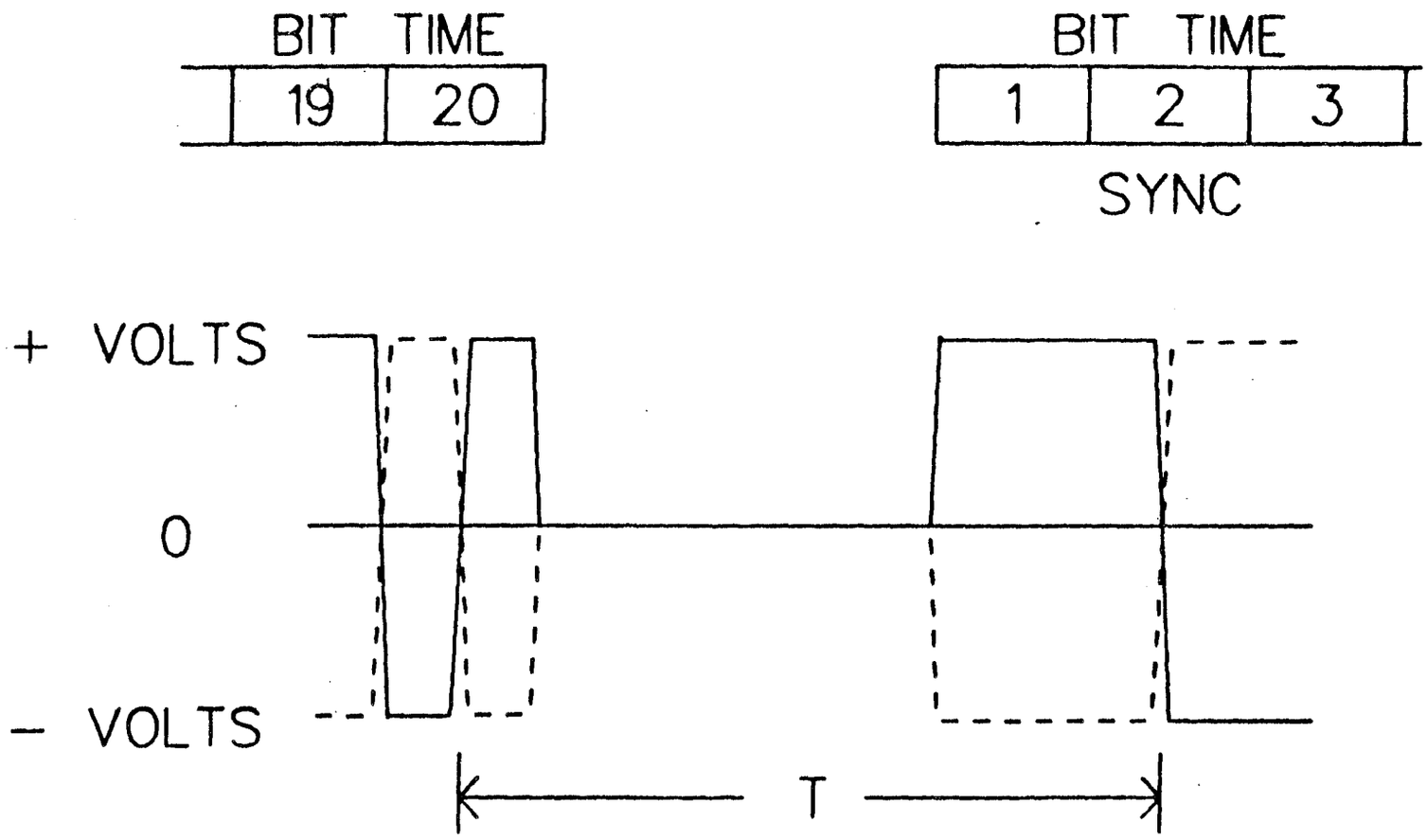
TRANSFORMER COUPLED
COMMON MODE CONFIGURATION
Figure 6A.



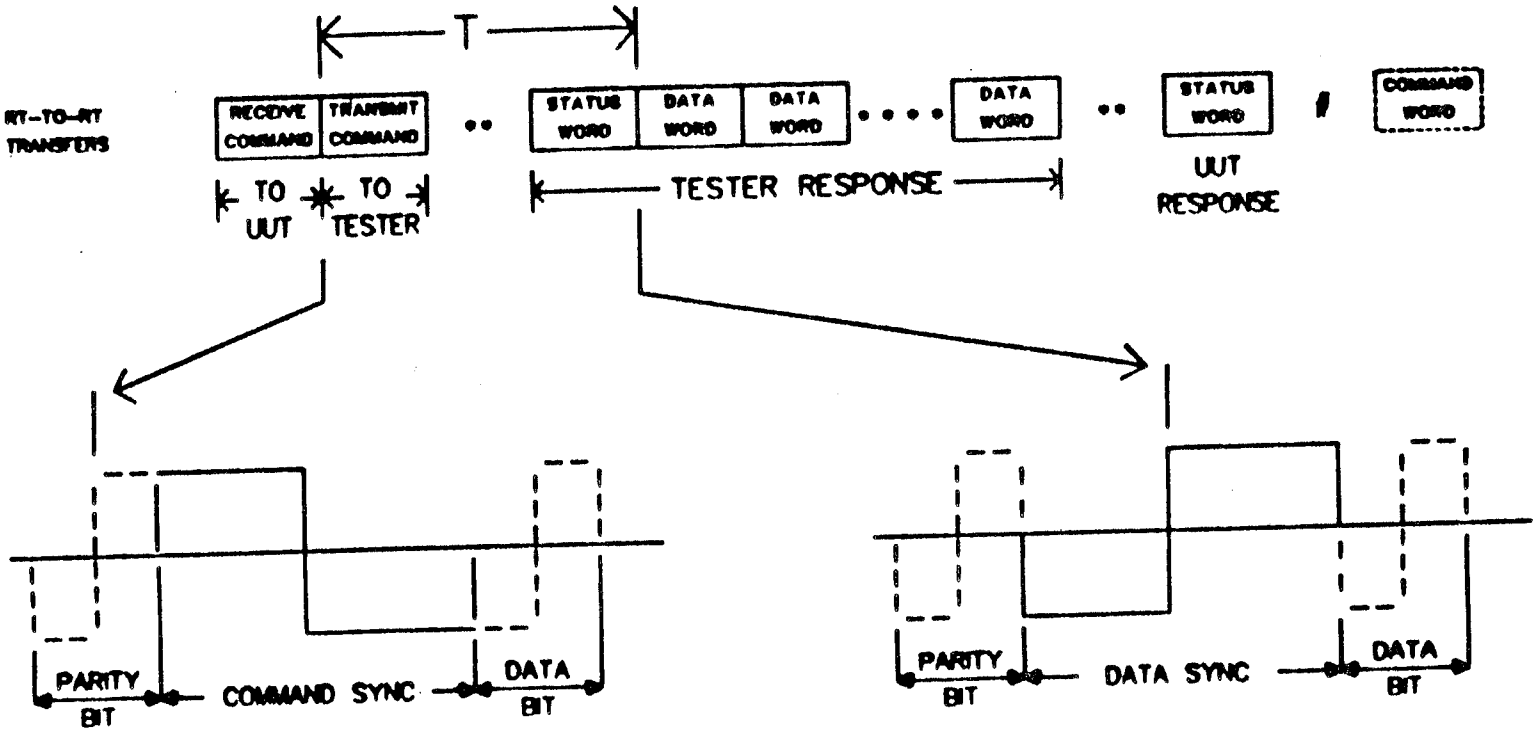
* – Transformer Coupled Stub Must Be Used

Z_0 – Selected Cable Nominal Characteristic Impedance

DIRECT COUPLED
COMMON MODE CONFIGURATION
Figure 6B.



GAP TIME MEASUREMENT
Figure 7.

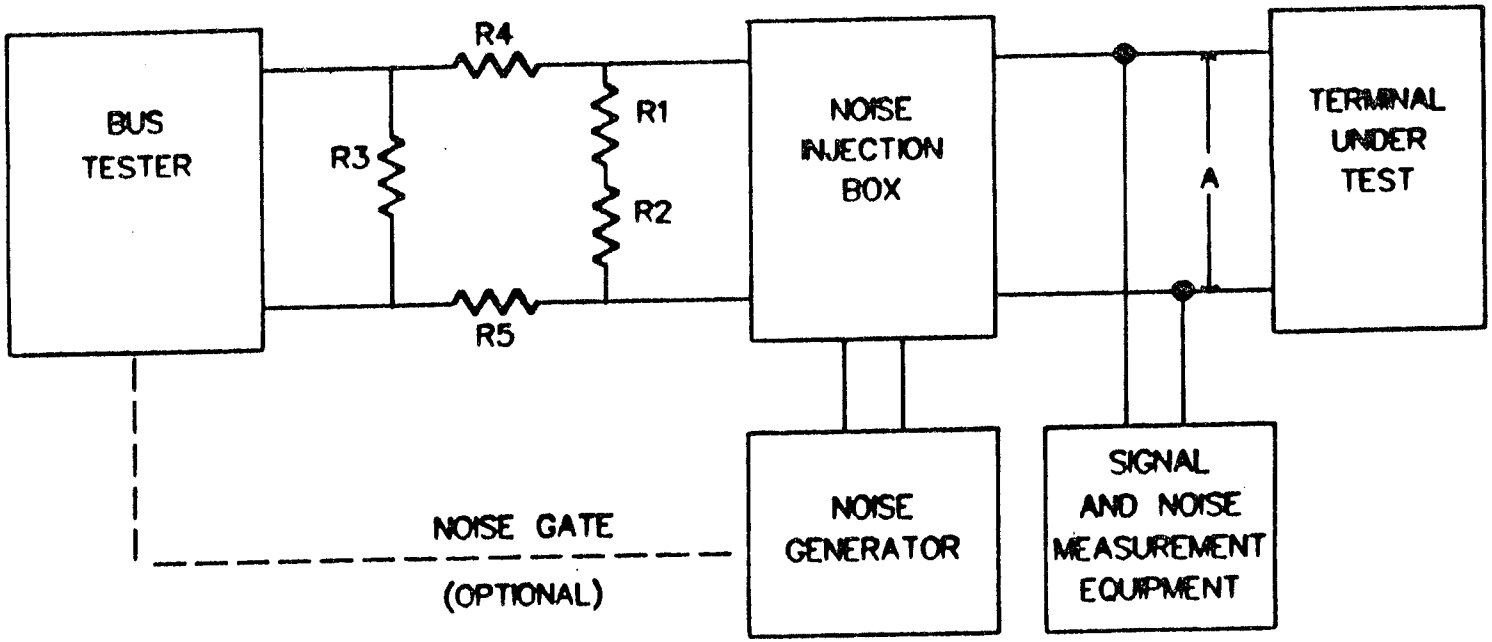


T = 54 to 60 μsec measured as shown

Delay tester response until UUT response goes away

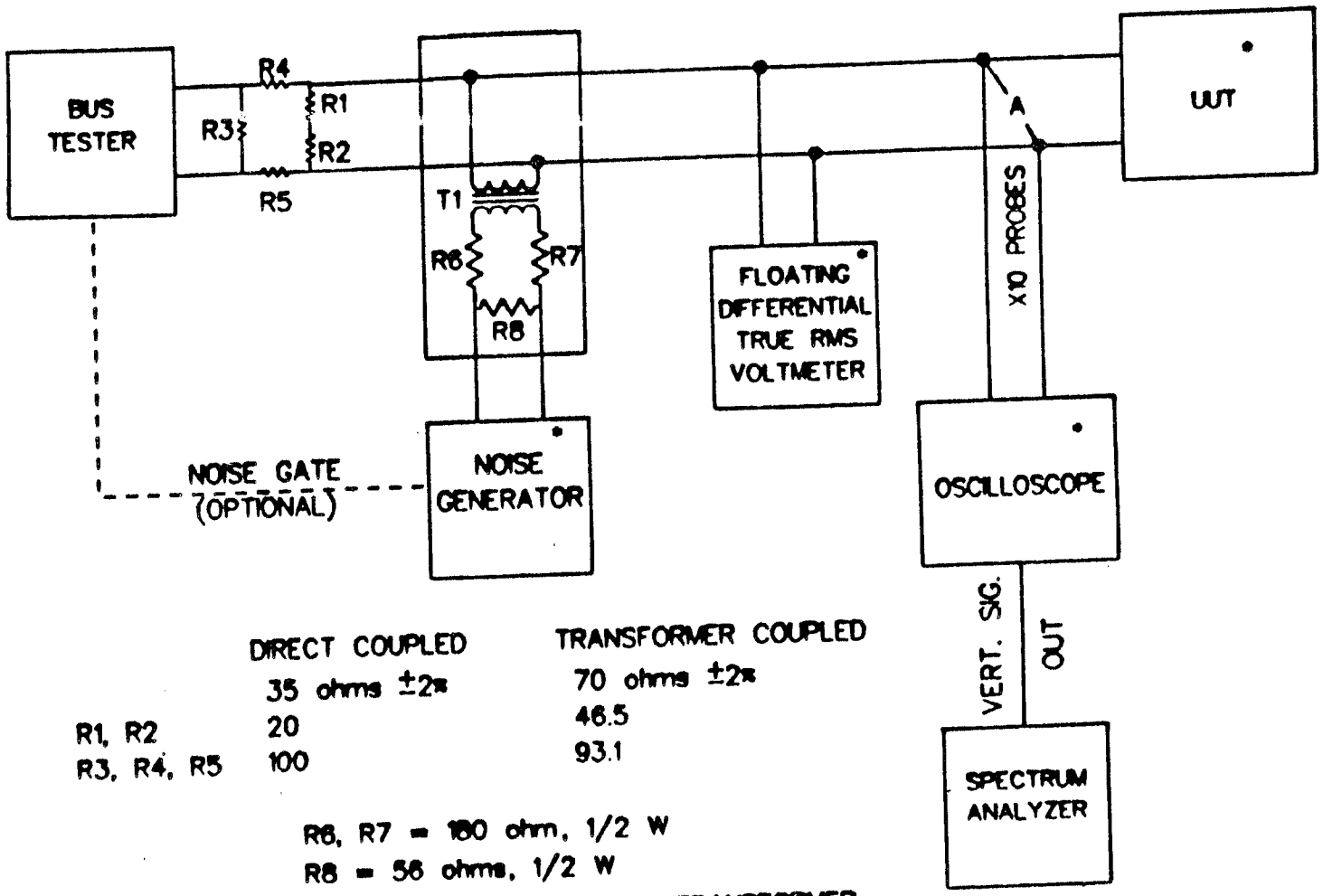
RT - RT TIMEOUT MEASUREMENT

Figure 8.

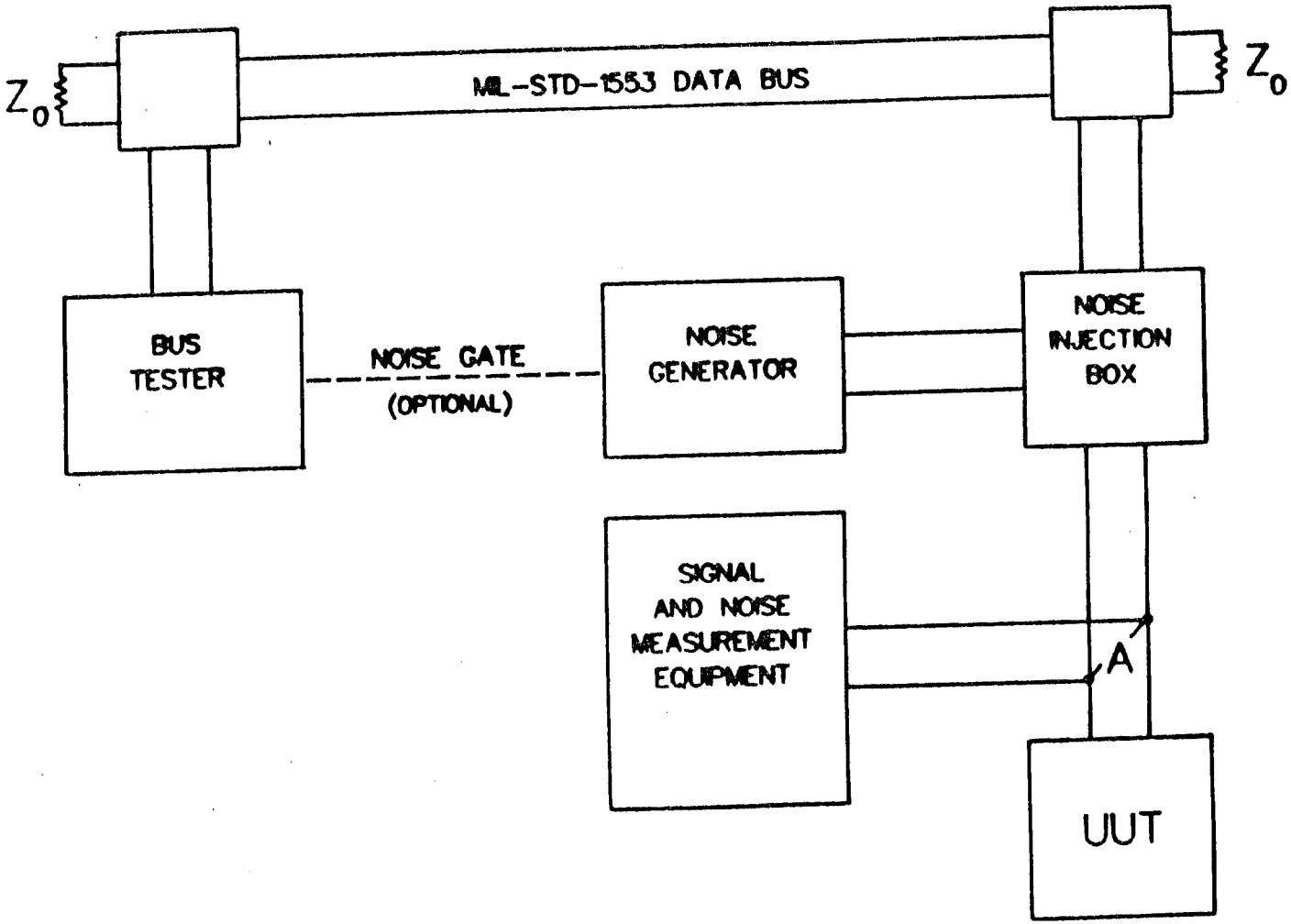


	DIRECT COUPLED	TRANSFORMER COUPLED
	35 ohms ±2%	70 ohms ±2%
R1, R2	20	46.5
R3, R4, R5	100	93.1

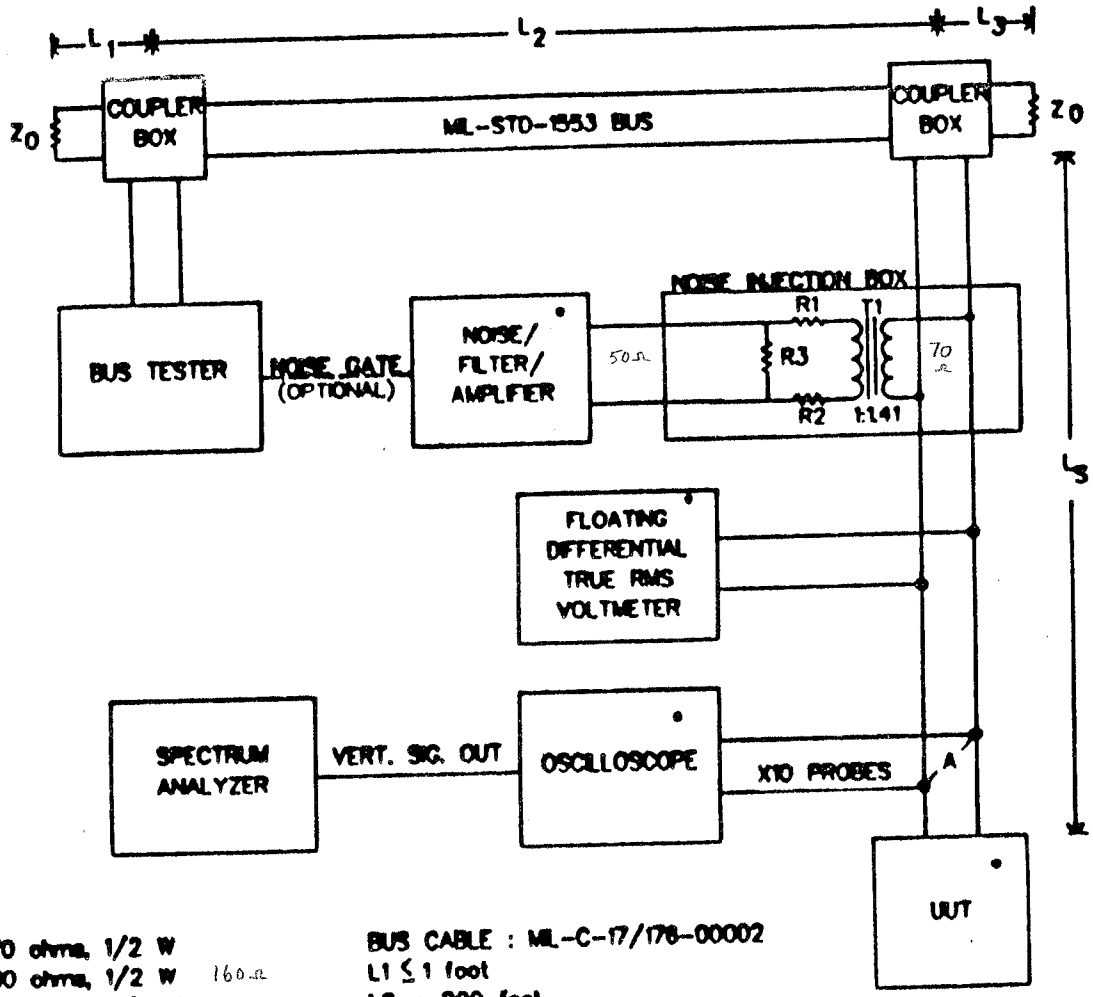
CONFIGURATION FOR NOISE REJECTION TEST
Figure 9A.



SUGGESTED CONFIGURATION FOR NOISE REJECTION TEST
Figure 9B.



CONFIGURATION FOR NOISE REJECTION TEST
Figure 10A.



Z0 = 70 ohms, 1/2 W
R1 = 180 ohms, 1/2 W
R2 = 180 ohms, 1/2 W
R3 = 56 ohms, 1/2 W

BUS CABLE : MIL-C-17/176-00002
L1 ≤ 1 foot
L2 = 200 feet
L3 ≤ 1 foot
LS ≤ 3 feet

• SEPARATE AC POWER ISOLATION & FILTERS

SUGGESTED CONFIGURATION FOR NOISE REJECTION TEST
Figure 10B.