**TEST SYSTEMS, INC.**

# MIL-STD-1553B

**RT VALIDATION TEST PROCEDURE**

# RT VALIDATION TEST PROCEDURE

APPLICABLE DOCUMENTS:

MIL-STD-1553B, 21 September 1978, "Aircraft Internal Time Division Command/Response Multiplex Data Bus" with Notice 2, 8 September 1986.

MIL-HDBK-1553, Notice 1, 24 September 1986, "RT Validation Test Plan".

MIL-HDBK-1553A, Section 100, 1 November 1988.


## I.  INTRODUCTION

This test procedure is used with the Test Systems, Inc., (TSI) VALIDATE.EXE program for RT Validation Testing.  The test procedure explains how to initialize, set up and run the Electrical, Protocol and Noise Rejection Tests in a semi-automated manner.  Testing complies with the RT Validation Test Plan, MIL-HDBK-1553 Appendix A (Notice 1), except for the following deviations:

1.  The following tests are not run:
    5.1.1.10  Frequency stability
    5.2.1.3.7  Terminal fail-safe

2.   Step 6 of 5.2.1.5.3, Reset remote terminal, is changed to repeat step 4 rather than step 5.

3.  Not all commands which cause the busy bit to be set are recorded for every test. This can be impractical in tests where, for example, 10,000 iterations are performed.

## A. CUSTOMER INFORMATION

Create a Wordstar customer information textfile that includes the following information: customer, UUT identification, test personnel and equipment used.  This textfile will be incorporated into the Test Results File prior to the generation of the test report.

RT VALIDATION TEST PROCEDURE

1. CUSTOMER
    Name:
    Street Address:
    City, State, Zip Code:

2. UNIT UNDER TEST IDENTIFICATION
    Part Number:
    Serial Number:
    Microcode/Software Revision:
    Terminal Address Used:
    RT Design Criteria:

3. TEST PERSONNEL

    Name                          Company


4. EQUIPMENT LIST

| EQUIPMENT TYPE | MANUFACTURER MODEL NO./SERIAL NO. | CALIBRATION Date Of / Date Due |
|---|---|---|
| 1553 BUS Tester | TSI 122 / 8804111 | N/A |
| Oscilloscope | TEK 2445* / TBD | TBD |
| True RMS Voltmeter | HP 3400A* / TBD | TBD |
| Impedance Analyzer | HP 4192A* / TBD | TBD |
| Function Generator | HP 3312A* / TBD | N/A |
| Host Processor ** | MIT SYS / TSC 11442 | N/A |
| Monochrome Monitor | TBD / TBD | N/A |
| Connection Panel *** | TSI 0100 / 900101 | N/A |

TBD - To Be Determined at the time of testing.

* Suggested equipment or equivalent.

** The host processor uses three TSI cards: the PC/AT PARALLEL I/O CARD is a parallel interface used by a PC compatible for high-speed control of the 1553 BUS TESTER; the MANCHESTER CARD is used to transmit a single Manchester encoded word with a controlled delay; the 1553 NOISE GENERATOR CARD provides band-limited additive, random white Gaussian noise required for noise rejection testing.

*** The CONNECTION PANEL provides the equivalent functions of the bus couplers, networks, terminators and cables required for the test configurations. The bus networks are tuned to provide rise and fall times of approximately 100 ns for the short bus and 200 +/- 20 ns for the long bus.

The 1553 BUS TESTER is a multiplex test instrument used for the design, development and final testing of MIL-STD-1553A/B terminals and systems.

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**B**.  TEST INFORMATION

Pass/fail criteria for the Electrical, Protocol and Noise Rejection tests are found in the RT Validation Test Plan, MIL-HDBK-1553 Appendix A (Notice 1).

Data is analyzed in the software by comparing test results to the pass/fail criteria.

All test results are saved in a Test Results File.  At the completion of the Validation tests, this data file will be used to generate the test report.

For tests with multiple iterations, the test data saved for inclusion in the test report is (1) the data for the first failure detected (with a count of the total number of failures and the total number of busy responses), or (2) the data for the first busy response if there are no failures (with a count of the total number of busy responses) or (3) the first iteration of the test if there are no failures or busy responses.

If at any time during testing a peculiarity in the waveform is present, a picture may be taken and attached to the test report.

## II. INITIALIZATION PROCEDURE

**A.** Power up all of the equipment that will be used for testing.

    1. Connect the PC/AT PARALLEL I/O CARD CABLE (I/O Cable) from the COMPUTER to the 1553 BUS TESTER.

    2. Connect the Trigger output on the back of the 1553 BUS TESTER to the oscilloscope (SCOPE) external trigger input and the trigger input on the MANCHESTER CARD (bottom connector).

    3. Connect Bus A and Bus B (top and center connectors, respectively) of the MANCHESTER CARD to the Bus A and Bus B connectors on the back of the CONNECTION PANEL.

**B.** Load the Validation Program. Type **VALIDATE** and press **RETURN** twice."Enter data file path name to use (i.e. VAL_TEST.DAT):" appears.

**C.** Enter the filename for the Test Results File and **RETURN**. Now "Select Validation or Control or Exit (V,C,E):" will appear.

**D.** Press **C** to enter the main menu of CONTROL PROGRAM.

**E.** Place the cursor at "Restore Tester Parameters".

**F.** Enter **STDVAL1** and press **RETURN**.

**G.** Place the cursor in the line "Controller 1 [BC]" on the word "LOAD" and press **RETURN**.

**H.** Press **ALT-F10** to enter the VALIDATION program.

**I.** To specify legal/illegal commands for the UUT, do the following:

    1. Press **F2** and then **F7** to configure the program for non-broadcast commands for subaddresses 0 to 15. Each of the 32 mode code or word count decimal number positions on a line must be made legal or illegal for the Transmit and Receive tables.

        a. To make all of the mode codes or word counts legal for the line marked by the cursor, press the **A** key. To make all of the mode codes or word counts illegal, press the **N** key. To make a specific mode code or data word count legal for a command, place the cursor on the decimal number representation of the mode code or word count, press the **+** key and the number will appear. To make the mode code or word count illegal, press the **-** key and the "-" symbol will appear in that position.

        b. Press **TAB** to move between the Receive Command and Transmit Command tables. Use the arrow keys to move around in a table.

    2. Press **F8** to configure the program for non-broadcast commands for subaddresses 16 to 31. Each of the 32 mode code or word count decimal number positions on each line must be made legal or illegal.

3. Press **F9** to configure the program for broadcast commands for subaddresses 0 to 15. Each of the 32 mode code or word count decimal number positions on each line must be made legal or illegal.

4. Press **F10** to configure the program for broadcast commands for subaddresses 16 to 31. Each of the 32 mode code or word count decimal number positions on each line must be made legal or illegal. Press **RETURN** to exit to the F2 menu.

**J.** To specify UUT test parameters on the F2 menu, do the following:

1. Move the cursor to "Bus Selected". Press the **SPACE BAR** to select the bus to be tested.

2. Move the cursor to "UUT Address" and enter the address.

3. Move the cursor to "Bus Coupling" and press the **SPACE BAR** to select the form of coupling (Transformer/Direct).

   **NOTE**: The entire Test Plan is run for one form of bus coupling. If the UUT has a second form of coupling, run the Test Plan for the Electrical Tests (required) and Noise Rejection (optional) using a separate data file to generate a second report.

4. Move the cursor to "Operation Mode" and press the **SPACE BAR** to select the mode of operation (Continuous/Halt on Error).

**K.** Press **F5** to specify implementation of UUT functions.

1. Move the cursor to each UUT status bit option and press the **SPACE BAR** to toggle between "Yes" and "No".

2. Move the cursor to "Broadcast Implemented", "Illegal Command Detection Implemented" and "Data Wrap Around Implemented" and press the **SPACE BAR** to toggle between "Yes" and "No" for each.

3. Move cursor to "Wrap Around RECEIVE Subaddress" and "Wrap Around TRANSMIT Subaddress" and enter the Receive and Transmit Command Subaddresses.

   **NOTE**: If the remote terminal doesn't support the Data Wrap Around test (5.2.1.6), suppress the Data Wrap Around test and modify the Output Symmetry test (5.1.1.5) (it uses Data Wrap Around).

4. Press **RETURN** to exit to the F2 menu.

**L.** Press **F6** to specify UUT implementation of mode commands. Move the cursor to each mode command and press the **SPACE BAR** to select between "Non & Brdcst", "Not Implemented", "NonBrdcst Only" and "Broadcast Only". Press **RETURN** and then **F2** to exit to the main menu.

## NOTES ON TESTING

When a test has been run, press **F5** to see the test results.  To find errors reported in the test results, press **ALT-F10** to enter the CONTROL PROGRAM and search the appropriate menus. Press **ALT-F10** to return.

To discard test results, use the Clear Function (**ALT-F5**).

The Pass Criteria Mask Menu is provided to mask selected pass criteria.  A conditional pass will be granted for tests that would have failed due to a set status bit or late response but pass with modified pass criteria.  To mask pass criteria, press **F2** and then **F1**.  Move the cursor to the late response or status bit to be masked and press the **SPACE BAR** to toggle between "Yes" and "No".

**RETURN** applies to the key marked **ENTER** on some keyboards.

To see the text of a specific test in the RT VALIDATION TEST PLAN, place the cursor on the test paragraph number on the main menu and press **F3**.  Press **RETURN** to exit the text and return to the main menu.

To exit the Validation Program at any time, press **CTRL-F2** and then press **E**.  To re-enter the Validation Program, repeat steps A through H.

Suppress a test by moving the cursor to the test paragraph number and pressing **ALT-S**.  An "S" or "s" to the left of a test paragraph number indicates a suppressed test.  An "S" means that the test or all subtests for a set of tests are suppressed.  An "s" means that one or more (but not all) of the subtests of a set of tests have been suppressed.

**CTRL-B** enables/disables a beeper.  The beeper indicates that a test is completed or operator assistance is required.

The following Help Menu is available by pressing **F1**:

| | |
|---|---|
| arrows | Move to field in direction of arrow |
| TAB | Moves to submenu |
| RETURN | Moves to higher level of menu |
| 0..9,.,-, | Valid characters for numeric fields |
| F1,? | Displays Help Menu (This display) |
| F2 | Selects General Configuration Parameters Menu |
| F3 | Displays RT Validation Test Plan text |
| F4 | Displays Testing Status in Serial Format |
| F5;ALT-F5 | Displays Test Results; Clears Test Results |
| F7;ALT-F7 | Enables Test Logging; Disables Test Logging |
| F8 | Selects MANCHESTER CARD Control/Status Menu |
| F9 | STARTS the selected test(s) |
| F10 | Displays Function Key Map |
| ESC | ABORTS testing |
| ALT-F10 | Invokes CONTROL Program |
| CTRL-F2 | Allows selection of Validation or Control or Exit |
| SPACE BAR | Steps some fields (See ALT-S) thru its valid values |

## III.  5.1  OFF-LINE ELECTRICAL TESTS

**A.**  5.1.1.6  OUTPUT NOISE TEST PROCEDURE

1.  Use the test configuration in Figure 1 for transformer or direct coupled connections.  Connect a cable from the UUT to the appropriate Pad or Load on the CONNECTION PANEL.  Use the TC PAD or 70 OHM load for transformer coupling or the DC PAD or 35 OHM load  for direct coupling.  See Figure 4 of the RT Validation Test Plan for the Pad schematic.



Figure 1. Output Noise Test Configuration

2.  Install an isolation plug on the power cable of the RMS voltmeter and connect the voltmeter to one of the UUT's bus inputs.

3.  Measure the output voltage of the UUT for power on and power off for both buses.

|  | - - - - Transformer Coupled - - - - | | - - - - - - Direct Coupled - - - - - - | |
|---|---|---|---|---|
|  | - - BUS A - - | - - BUS B - - | - - BUS A - - | - - BUS B - - |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |

4.  Enter the measured values into the computer for test 5.1.1.6 under Section IV.G.

**B.**  5.1.1.8.1  POWER ON/OFF NOISE PROCEDURE

1.  Use the test configuration in Figure 2 for transformer or direct coupled connections.  Connect a cable from the UUT to the appropriate Pad or Load on the CONNECTION PANEL.  Use the TC PAD or 70 OHM load for transformer coupling or the DC PAD or 35 OHM load  for direct coupling.   See Figure 1A of the RT Validation Test Plan for the Pad schematic.
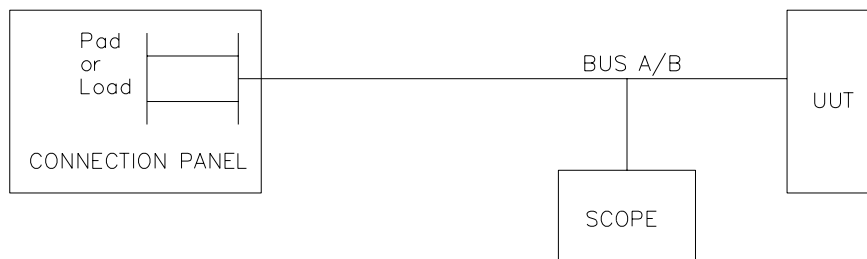


Figure 2. Power On/Off Noise Test Configuration

2. Connect the oscilloscope (SCOPE) to one bus input of the UUT.

3. Measure the UUT output after turning power on and after turning power off.  Repeat the measurements nine more times.

|  | - - - - Transformer Coupled - - - - | | - - - - - - Direct Coupled - - - - - - | |
|  | - - BUS A - - | - - BUS B - - | - - BUS A - - | - - BUS B - - |
|---|---|---|---|---|
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |
| POWER ON | ___ | ___ | ___ | ___ |
| POWER OFF | ___ | ___ | ___ | ___ |

4. Repeat Step 3 for the alternate bus.

5. Enter the **maximum** values measured for Power On and Power  Off into the computer for test 5.1.1.8.1 under Section IV.I.

**C.** 5.1.2.3  INPUT IMPEDANCE TEST PROCEDURE

1. Using the test configuration in Figure 3, connect a cable from one of the transformer coupled or direct coupled bus inputs of the UUT to the input of the impedance analyzer.



Figure 3. Input Impedance Test Configuration

2.  Measure the impedance magnitude for frequencies of 75 kHz, 100 kHz, 250 kHz, 500 kHz and 1 MHz at 1.1 Vrms.  Do this with power on and with power off for both buses for transformer and/or direct coupled inputs (where applicable).

- - - - - - - - - - - - - - - - - Transformer Coupled - - - - - - - - - - - - - - -

| | - - - - - - - - Bus A - - - - - - - - | | - - - - - - - - Bus B - - - - - - - - | |
| --- | --- | --- | --- | --- |
| f(Hz) | Power On | Power Off | Power On | Power Off |
| 75k | ___ | ___ | ___ | ___ |
| 100k | ___ | ___ | ___ | ___ |
| 250k | ___ | ___ | ___ | ___ |
| 500k | ___ | ___ | ___ | ___ |
| 1.0M | ___ | ___ | ___ | ___ |

- - - - - - - - - - - - - - - - Direct Coupled - - - - - - - - - - - - - - - - - - -

| | - - - - - - - - Bus A - - - - - - - - | | - - - - - - - - Bus B - - - - - - - - | |
| --- | --- | --- | --- | --- |
| f(Hz) | Power On | Power Off | Power On | Power Off |
| 75k | ___ | ___ | ___ | ___ |
| 100k | ___ | ___ | ___ | ___ |
| 250k | ___ | ___ | ___ | ___ |
| 500k | ___ | ___ | ___ | ___ |
| 1.0M | ___ | ___ | ___ | ___ |

3.  Enter the magnitude measurements into the computer for test 5.1.2.3 under Section IV.Q.

**IV.    5.1  ON-LINE ELECTRICAL TESTS**

A.  ELECTRICAL OUTPUT TEST SETUP

    1.  Connect equipment as shown in Figure 4 for the selected bus to be tested (A or B).  Note: Use the TC PAD for transformer coupling or the DC PAD for direct coupling.  See Figure 1A of the RT Validation Test Plan for the Pad schematic.

        a.  Connect the oscilloscope differentially to the UUT bus input.
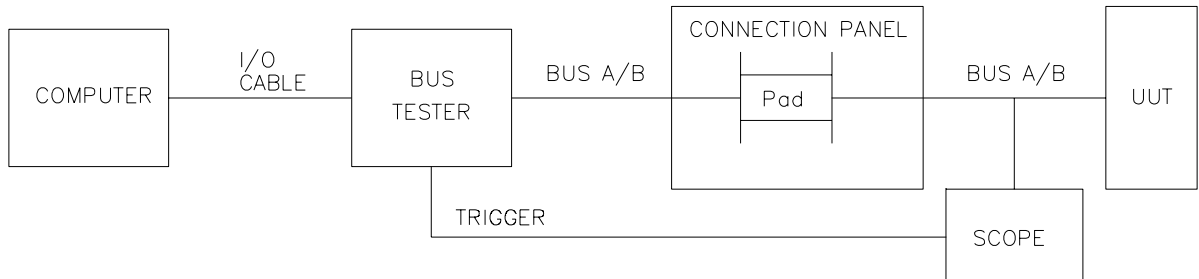        b.  Connect the 1553 BUS TESTER and the UUT to the appropriate Pad on the CONNECTION PANEL for the selected bus.



Figure 4. General Electrical Output Test Configuration

    2.  Press **F2**. With the cursor on "Bus Selected", press the **SPACE BAR** to select the desired bus (A/B).

    3.  Adjust the 1553 BUS TESTER amplitude for the Pad.

        a.  Press **F3** to enter the BC Amplitude Calibration menu.
        b.  Move the cursor to "Protocol BC Transmit Amplitude 2.1 Vpp" for the data bus being tested.
        c.  Press the **+** or **-** keys to increase or decrease the measured amplitude to 2.1 Vpp.  The amplitude is measured differentially at the bus input of the UUT with the oscilloscope.
        d.  Press **RETURN** to exit this menu.
        e.  Press **F2** to return to the main menu.

**B.**  5.1.1.1  OUTPUT AMPLITUDE

    1.  Move the cursor to "5.1 Electrical Tests".  Press **TAB** to select the Electrical Tests submenu.

    2.  Press **TAB** to select"5.1.1 Output Characteristics" submenu.

    3.  With the cursor on "5.1.1.1 Output Amplitude", press **F9** to start sending a valid, legal, transmit command to the UUT.

    4.  Measure the maximum and minimum UUT response peak-to-peak amplitude in mV.

        Maximum Output Amplitude (mVpp)  ___   Minimum Output Amplitude (mVpp)  ___

    5.  Press the **SPACE BAR** to stop sending commands to the UUT and press **RETURN**.  Enter the maximum and minimum amplitude values.

**C.** 5.1.1.2  RISETIME/FALLTIME

1.  Move the cursor to "5.1.1.2 Risetime/falltime" and press **TAB**.

2.  Press **F9** and measure the appropriate risetime or falltime of the UUT waveform.

    Rise Sync Edge (ns)   ___          Fall Sync Edge (ns)   ___
    Rise Data Edge (ns)   ___          Fall Data Edge (ns)   ___

3.  Press **SPACE BAR** and **RETURN** and enter the value.

4.  Move the cursor to each prompt and repeat Steps 2 and 3.

5.  Press **RETURN** to exit to the second submenu.

**D.** 5.1.1.3  ZERO CROSSING STABILITY

1.  Move the cursor to "5.1.1.3 Zero Crossing Stability".  Press **TAB**.

2.  Press **F9**.  Measure the selected pulse width of the UUT waveform.

    Tzcp  (500ns) (ns)    ___          Tzcn  (500ns) (ns)    ___
    Tzcp (1000ns) (ns)    ___          Tzcn (1000ns) (ns)    ___
    Tzcp (1500ns) (ns)    ___          Tzcn (1500ns) (ns)    ___
    Tzcp (2000ns) (ns)    ___          Tzcn (2000ns) (ns)    ___

3.  Press **SPACE BAR** and **RETURN** and enter the value.

4.  Move the cursor to each prompt and repeat Steps 2 and 3.

5.  Press **RETURN** to exit to the second submenu.

**E.** 5.1.1.4  DISTORTION, OVERSHOOT AND RINGING

1.  Move the cursor to "5.1.1.4  Distortion, overshoot and ringing" and press **F9**.

2.  Measure the distortion voltage of the UUT waveform.

    Distortion Voltage (mV)   ___

3.  Press **SPACE BAR** and **RETURN** and enter the value.

**F.** 5.1.1.5  OUTPUT SYMMETRY

1.  Move the cursor to "5.1.1.5 Output Symmetry" and press **TAB**.

2.  Press **F9**.  Measure the maximum residual voltage (Vr) 2.5 microseconds following the mid-bit transition of the parity bit of the last word in the message.

    Symmetry Volt. (0000) (mV)  ___         Symmetry Volt. (8000) (mV)   ___
    Symmetry Volt. (5555) (mV)  ___         Symmetry Volt. (AAAA) (mV)  ___
    Symmetry Volt. (7FFF) (mV)  ___         Symmetry Volt. (FFFF) (mV)   ___

3. Press **SPACE BAR** and **RETURN** and enter the value.

4. Move the cursor to each prompt and repeat Steps 2 and 3.

5. Press **RETURN** to exit to the second submenu.

**G.** 5.1.1.6  OUTPUT NOISE

1. Move the cursor to "5.1.1.6 Output Noise" and press **TAB**.

2. Move the cursor to each prompt and enter the output noise measurements previously obtained from Section III.A.

3. Press **RETURN** to exit to the second submenu.  Press **F9** to store the values in memory and press **RETURN**.

**H.** 5.1.1.7  OUTPUT ISOLATION

1. Connect the UUT's inactive bus to the appropriate Load on the CONNECTION PANEL.  Use the 70 OHM load for transformer coupling or the 35 OHM load  for direct coupling.

2. Move the cursor to "5.1.1.7 Output Isolation" and press **TAB**.

3. With the cursor on "Active Bus", press **F9**.

4. Measure the peak-to-peak amplitude on the active bus.

   Active Bus (mV) ___          Inactive Bus (mV) ___

5. Press **SPACE BAR** and **RETURN** and enter the value.

6. Connect the oscilloscope to the inactive bus.

7. Move the cursor to "Inactive Bus", press **F9** and measure the peak-to-peak amplitude on the inactive bus.

8. Press **SPACE BAR** and **RETURN** and enter the value.

9. Connect the oscilloscope back to the active bus (see Figure 4).

10.  Press **RETURN** to exit to the second submenu.

**I.** 5.1.1.8  POWER ON/OFF

1. Move the cursor to "5.1.1.8 Power On/Off" and press **TAB**.

2. With the cursor on "5.1.1.8.1 Power On/Off Noise", press **TAB**.

3. Move the cursor to each prompt and enter the **maximum** measurements for power on noise and power off noise previously obtained from Section III.B.

4. Press **RETURN** to exit to the third submenu.  Press **F9** to store the values in memory and press **RETURN**.

    5.  Move the cursor to "5.1.1.8.2 Power On Response" and press **F9**.

    6.  As directed on the screen, power off the UUT, press **RETURN** and then power on the UUT. (This test is run 10 times or until a failure occurs.)

    7.  Press **RETURN** to exit to the second submenu.

**J.**  5.1.1.9  TERMINAL RESPONSE TIME

    1.  Move the cursor to"5.1.1.9 Terminal Response Time".  Press **TAB**.

    2.  Press **F9**.  Measure the maximum response time.

       Transmit Response Time (ns) ___        RT-UUT Response Time (ns)    ___
       Receive Response Time (ns) ___         Mode Command Response (ns)  ___

    3.  Press **SPACE BAR** and **RETURN** and enter the value.

    4.  Move the cursor to each prompt and repeat Steps 2 and 3.

    5.  Press **RETURN** twice to exit to the first submenu.

**K.**  5.1.1.10  FREQUENCY STABILITY

This test is not run, but the requirements can be satisfied by analysis.  See Section 4.1 of the RT Validation Test Plan.

**L.**  5.1.2.1.3  RISE AND FALL TIME

    1.  Connect the equipment as shown in Figure 5 or Figure 6 for the bus to be tested.  Connect the 1553 BUS TESTER and the UUT to the appropriate short bus connectors on the CONNECTION PANEL for transformer coupling or direct coupling.  See Figure 1B of the RT Validation Test Plan for the General Bus Configuration.
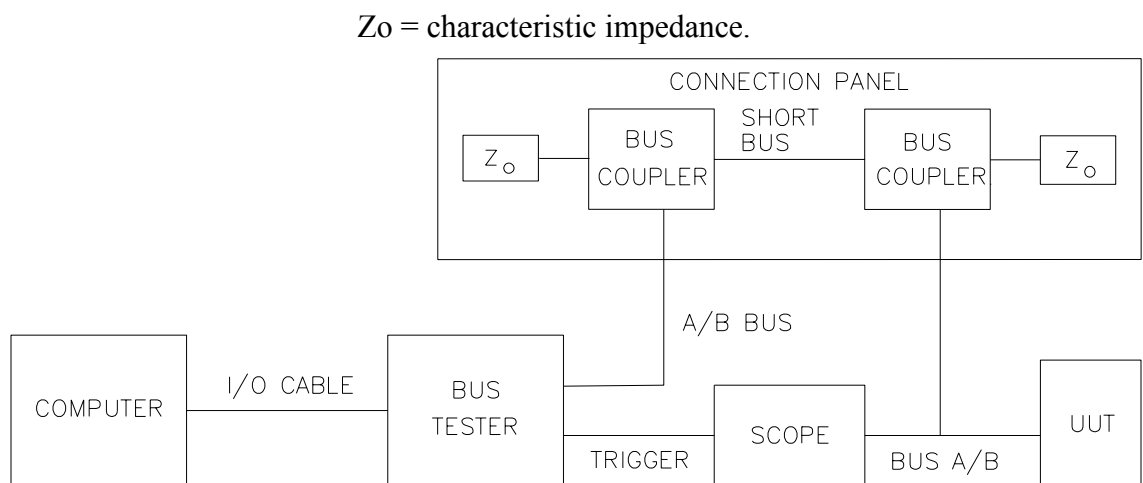
$Zo$ = characteristic impedance.



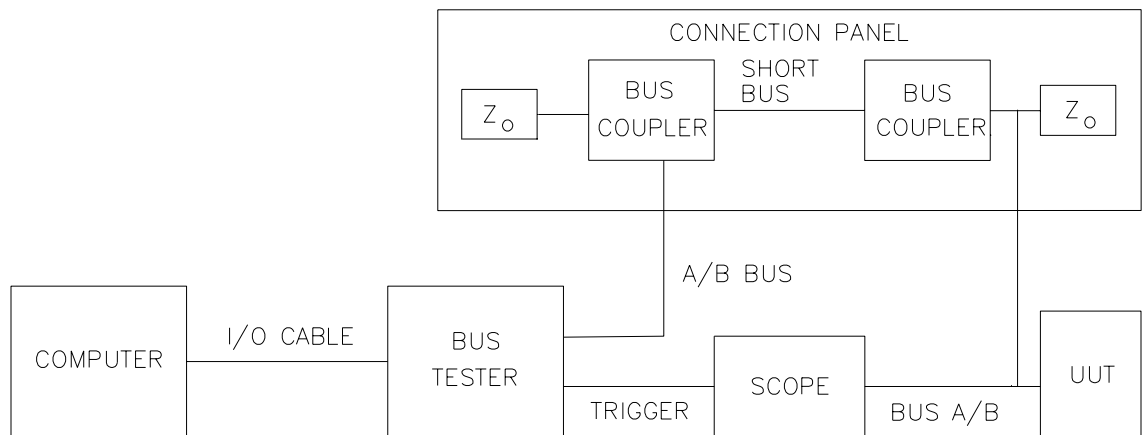Figure 5. Rise/Fall Time Transformer Coupled Configuration

Figure 6. Rise/Fall Time Direct Coupled Configuration

2. Press **F2**. With the cursor on "Bus Selected", press the **SPACE BAR** to select the desired bus (A/B).

3. Adjust the 1553 BUS TESTER amplitude to the test configuration.

    a. Press **F3** to enter the BC Amplitude Calibration menu.
    b. Move the cursor to "Protocol BC Transmit Amplitude 2.1 Vpp" for the data bus being tested.
    c. Press the **+** or **-** keys to increase or decrease the measured amplitude to 2.1 Vpp. The amplitude is measured differentially at the bus input of the UUT with the oscilloscope.
    d. Press **RETURN** to exit this menu.
    e. Press **F2** to return to the Electrical Tests submenu.

4. Move the cursor to the "5.1.2 Input Characteristics" and press **TAB** twice to select the third submenu.

5. Move the cursor to "5.1.2.1.3 Rise and Fall Time". Press **F9** to perform Sinusoidal (5.1.2.1.3.1) and Trapezoidal (5.1.2.1.3.2) waveform tests.

6. Press **RETURN** four times to exit to the highest level of the main menu.

**NOTE**

Repeat the above tests (**IV. A.** through **L.**) for the alternate bus. If both buses have been tested, proceed to COMMON MODE REJECTION.

**M.** 5.1.2.2 COMMON MODE REJECTION

1.  Connect the equipment as shown in Figure 7 or Figure 8 (Figure 6A or Figure 6B in the RT Validation Test Plan, respectively) for transformer coupling or direct coupling for the bus to be tested.  This test uses special center-tapped (*CT) bus couplers (transformer coupling) or special center-tapped (*CT) terminating resistors (direct coupling).  If the test fails, connect a small capacitor (approximately 47 pf) at the UUT  stub connection from the high side to the shield to compensate for the higher capacitance in the connectors  from the low side to the shield. This capacitance differential creates a differential signal from the applied common mode signal.

    a.  Connect the 1553 BUS TESTER and the UUT to the appropriately coupled long bus connectors on the CONNECTION PANEL for one bus.
    b.  Connect the Function Generator to the appropriate common mode input on the CONNECTION PANEL (BNC connector) for the bus being tested.

    **NOTE**:  It is only necessary to test one form of coupling per bus.

M = MANCHESTER CARD Bus A/B output.        Zo = characteristic impedance.
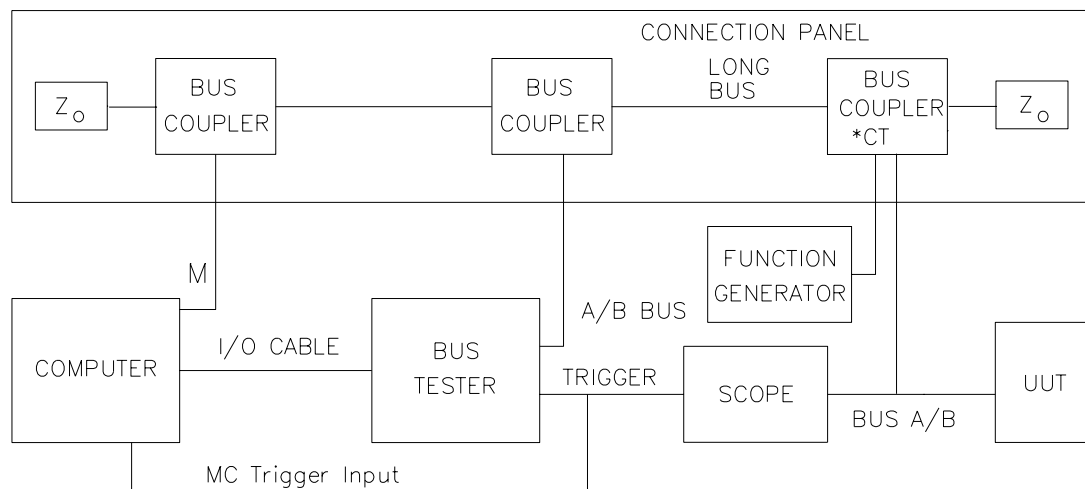


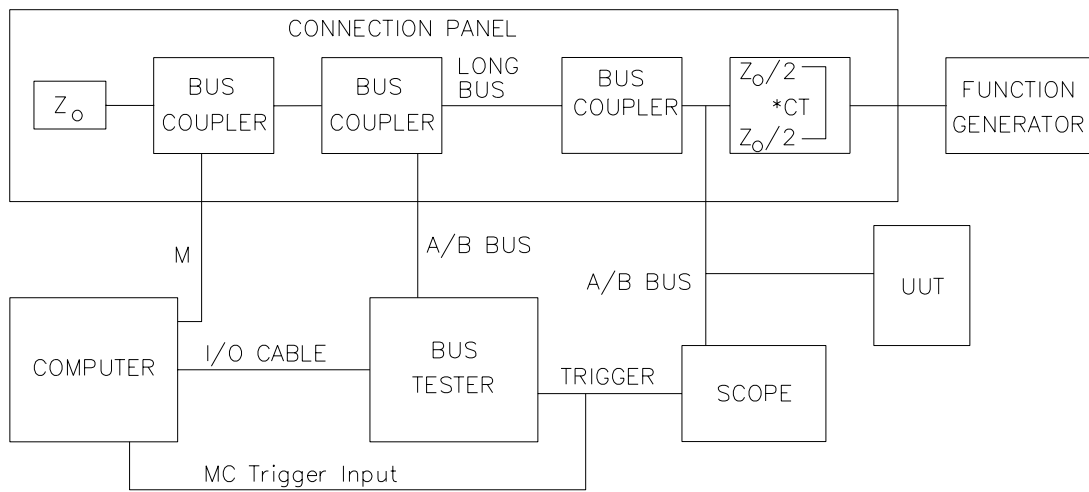Figure 7. Common Mode Rejection Transformer Coupled Configuration

Figure 8. Common Mode Rejection Direct Coupled Configuration

2. Press **F2**. With the cursor on "Bus Selected", press the **SPACE BAR** to select the desired bus (A/B).

3. Adjust the 1553 BUS TESTER amplitude to the test configuration.

   a. Press **F3** to enter the BC Amplitude Calibration menu.
   b. Move the cursor to "CS Amplitude Limit 0.86 Vpp" for the data bus being tested.
   c. Press the **+** or **-** keys to increase or decrease the measured amplitude to 0.86 Vpp.  The amplitude is measured differentially at the bus input of the UUT with the oscilloscope.
   d. Press **RETURN** to exit this menu.
   e. Press **F2** to return to the main menu.

4. With the cursor on "5.1 Electrical Tests", press **TAB**, move the cursor to "5.1.2 Input Characteristics" and press **TAB** again.

5. Move the cursor to "5.1.2.2 Common Mode Rejection" and press **F9**.

6. With the cursor on "Common Mode Rejection (+10V)", adjust the function generator to +10V DC as measured on the oscilloscope line to shield.  Note: This is not a differential measurement.

7. Press **RETURN** to start this test.  It will stop after 90 sec.

8. With the cursor on "Common Mode Rejection (-10V)", adjust the function generator to -10V DC as measured on the oscilloscope line to shield.

9. Press **RETURN**. The test will stop after 90 sec.

10. With the cursor on "Common Mode Rejection (+/- 10V)", adjust the function generator to +/-10V AC (20 Vpp) as measured on the oscilloscope line to shield.

11. Press **RETURN** to start this test and manually sweep the frequency of the signal generator from 1hz to 2Mhz during the 90 sec for the test.

12. Press **RETURN** three times to exit to the highest level of the main menu.

**NOTE**

Repeat the above tests (IV.M.) for the alternate bus. If both buses have been tested, disconnect the Function Generator and proceed to ELECTRICAL INPUT TEST SETUP.


**N.** ELECTRICAL INPUT TEST SETUP

1. Connect the equipment as shown in Figure 9 or Figure 10 for the transformer coupled or direct coupled bus to be tested.  See Figure 1B of the RT Validation Test Plan for the General Bus Configuration.

M = MANCHESTER CARD Bus A/B output.     Zo = characteristic impedance.
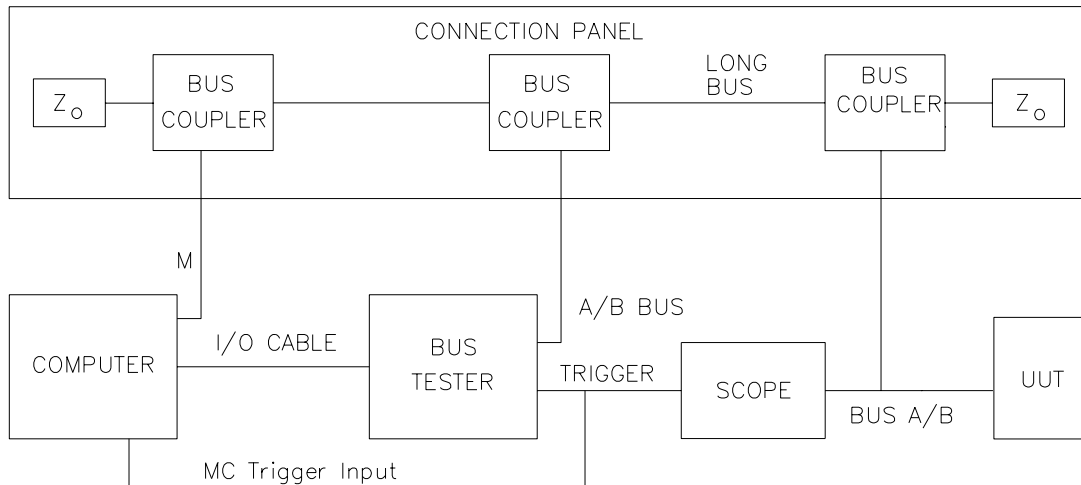


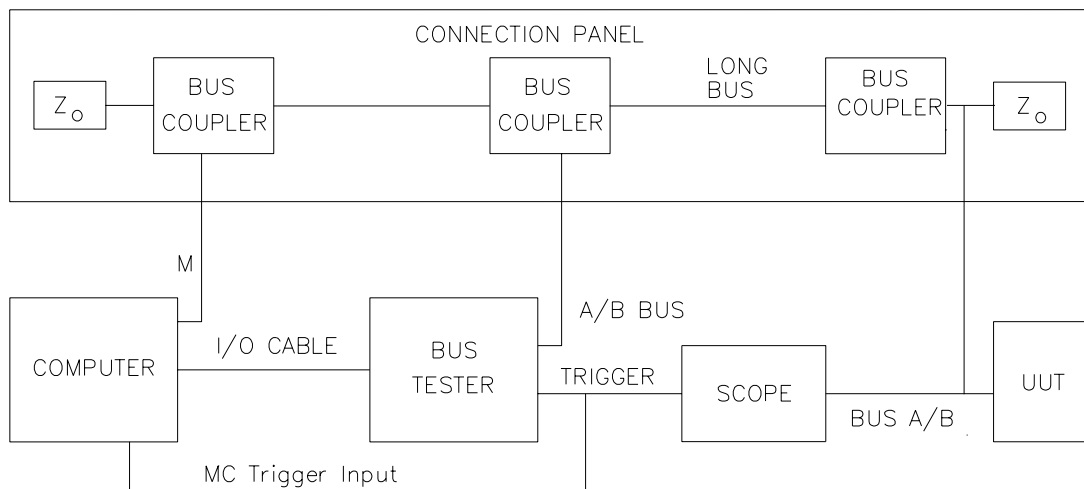Figure 9. Electrical Input Transformer Coupled Configuration

Figure 10. Electrical Input Direct Coupled Configuration

2. Press **F2**. With the cursor on "Bus Selected", press the **SPACE BAR** to select the desired bus (A/B).

3. Adjust the 1553 BUS TESTER amplitude to the test configuration.

    a. Press **F3** to enter the BC Amplitude Calibration menu.
    b. Move cursor to "NR Amplitude Limit 0.20 Vpp" for the data bus being tested.
    c. Press the **+** or **-** keys to increase or decrease the measured amplitude to 0.20 Vpp. The amplitude is measured differentially at the bus input of the UUT with the oscilloscope.
    d. Move the cursor to the other voltages and adjust them.
    e. Press **RETURN** to exit this menu.

4. Adjust the 1553 BUS TESTER Zero Crossing Distortion (ZCD) to the test configuration.

    a. Press **F4** to enter the ZCD Calibration menu.
    b. Move the cursor to the "+ 180 nsecs" for the bus being tested.
    c. Press the **+** or **-** keys to increase or decrease the first zero crossing deviation (ZCD) to + 180 ns. The ZCD is measured with the oscilloscope differentially at the input to the UUT.
    d. Move the cursor to the other voltages and adjust them.
    e. Press **RETURN** to exit this menu.
    f. Press **F2** to return to the main menu.

**O.** 5.1.2.1.1  ZERO CROSSING DISTORTION

1. With the cursor on "5.1 Electrical Tests", press **TAB**, move the cursor to "Input Characteristics" and press **TAB** three times to select the Zero Crossing submenu.

2. With the cursor on "Min ZCD", press **F9**.

3. As directed on the screen, measure the value, press the **SPACE BAR**, enter the value and press **RETURN** twice.

   Min ZCD (ns) _____     Max ZCD (ns) _____

4. Move the cursor to "Max ZCD", press **F9** and repeat step 3.

5. Move the cursor to "Plus 150 ns ZCD" and press **F9**.

6. As directed on the screen, enter the number of data words and press **RETURN**.  When the test is finished, press **RETURN**.

7. Move cursor to "Minus 150 ns ZCD", press **F9** and repeat step 6.

8. Press **RETURN** to exit to the third submenu.

**P.** 5.1.2.1.2  AMPLITUDE VARIATIONS

1. Move the cursor to "5.1.2.1.2 Amplitude Variations" and press **TAB** to select the fourth submenu.

2. With the cursor on "First Clear Status", press **F9**.

3. As directed by the screen messages, measure the peak-to-peak amplitude, press the **SPACE BAR**, enter the measured value and press **RETURN** twice.

   First Clear Status (mV) _____          First No Response (mV) _____

4. Move the cursor to "First No Response," press **F9** and repeat step 3.

5. Press **RETURN** twice to exit to the second submenu.

**Q.** 5.1.2.3  INPUT IMPEDANCE

1. Move the cursor to the "5.1.2.3 Input Impedance" and press **TAB** twice to enter "Power ON" measurements.

2. Move the cursor to each prompt and enter the magnitude and phase angle measurements obtained from Section III.C.

3. Press **RETURN** and then press **F9** to store the values in memory.

4. Press **RETURN**, move the cursor to "Power OFF" and press **TAB**.

5. Repeat steps 2 and 3 to enter "Power OFF" measurements.

6. Press the **RETURN** four times to exit to the main menu.

**NOTE**

Repeat the above tests (**IV. N.** through **Q.**) for the alternate bus.  If both buses have been tested, proceed to REQUIRED PROTOCOL TESTS.

## V. 5.2.1 REQUIRED PROTOCOL TESTS

**A**. Connect the equipment as shown in Figure 11 or Figure 12 for the transformer coupled or direct coupled buses to be tested. See Figure 1B of the RT Validation Test Plan for the General Bus Configuration. The oscilloscope is not required for running Protocol tests but may be connected to the monitor outputs (MON) on the back of the 1553 BUS TESTER to observe bus traffic.

**NOTE**: It is only necessary to test one form of coupling per bus.

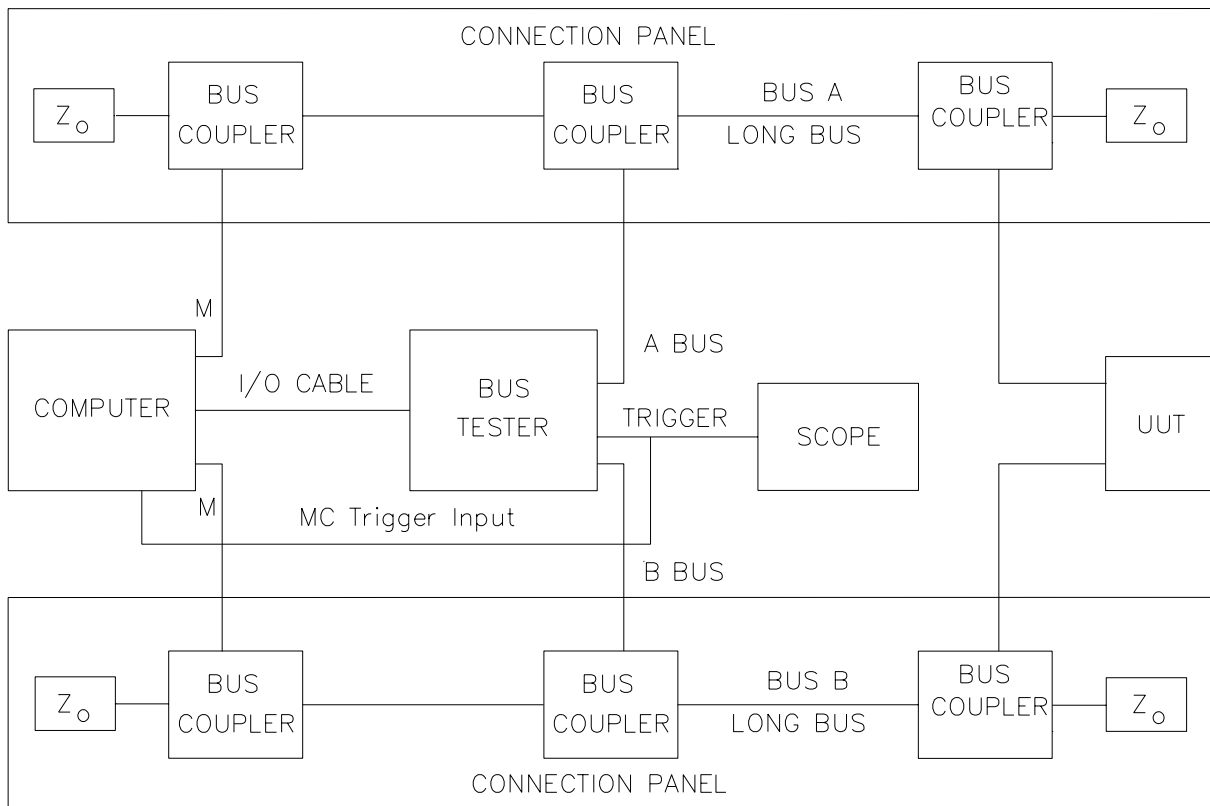M = MANCHESTER CARD Bus A/B output.        Zo = characteristic impedance.



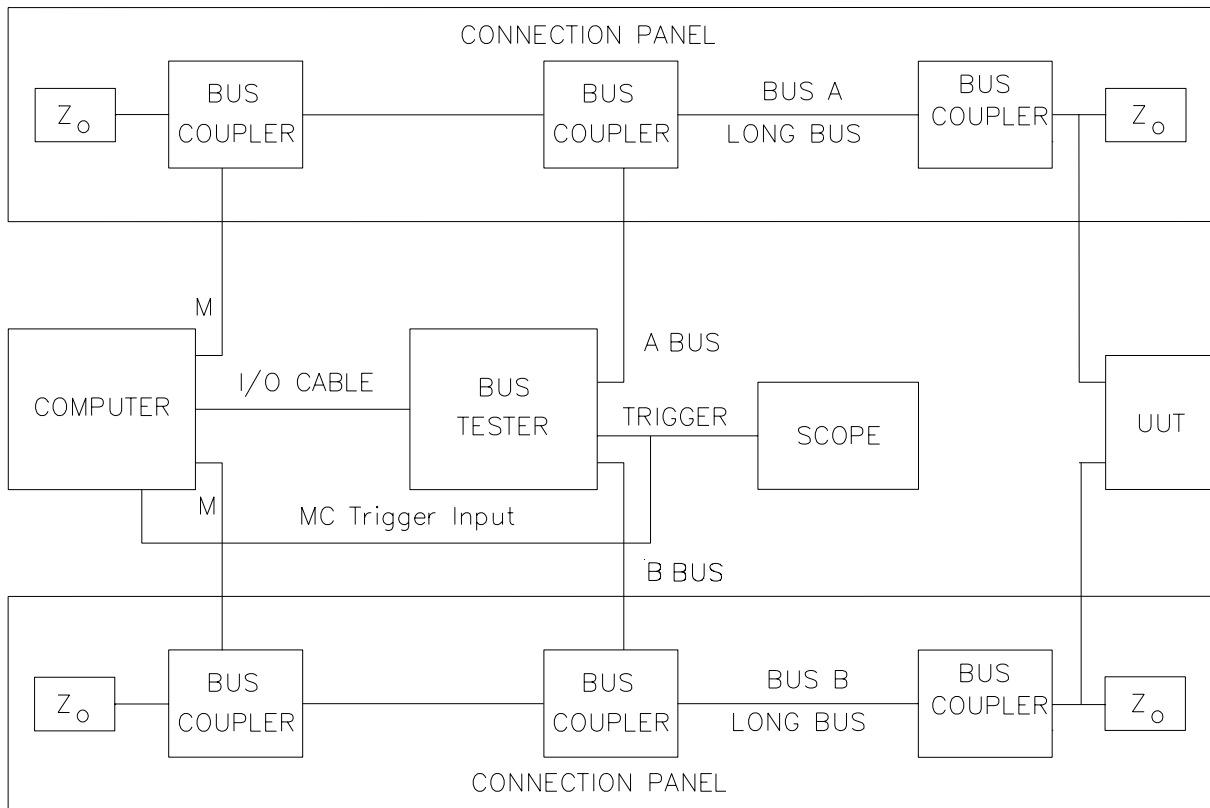Figure 11. Protocol Tests Transformer Coupled Configuration

Figure 12. Protocol Tests Direct Coupled Configuration

**B.** Press **F2**.  With the cursor on "Bus Selected", press the **SPACE BAR** to select the desired bus (A/B).

**C.** Adjust the 1553 BUS TESTER amplitude to the test configuration.

    1.  Press **F3** to enter the BC Amplitude Calibration menu.
    2.  Move the cursor to "Protocol BC Transmit Amplitude 2.1 Vpp" for Bus A.
    3.  Press the **+** or **-** keys to increase or decrease the measured amplitude to 2.1 Vpp.  The amplitude
        is measured  differentially at the bus input of the UUT with the oscilloscope.
    4.  Move the cursor to "Protocol BC Transmit Amplitude 2.1 Vpp" for Bus B and repeat step 3.
    5.  Press **RETURN** to exit this menu.
    6.  Press **F2** to return to the main menu.

**D.** Move the cursor to "5.2 Protocol Tests" and press **TAB**.

**E.** With the cursor on "5.2.1 Required Protocol Tests", press **F9** to run all unsuppressed tests.

    **NOTE**: When running the tests, follow the directions of the messages  at the bottom of the screen.

RT VALIDATION TEST PROCEDURE

The following Required Protocol tests are run:

| | |
|---|---|
| 5.2 | Protocol tests |
| 5.2.1 | Required remote terminal operation |
| 5.2.1.1 | Response to command words |
| 5.2.1.1.1 | RT response to command words |
| 5.2.1.1.2 | RT-RT response to command words |
| 5.2.1.2 | Intermessage gap |
| 5.2.1.2.1 | Minimum time |
| 5.2.1.2.2 | Transmission rate |
| 5.2.1.3 | Error injection |
| 5.2.1.3.1 | Parity |
| 5.2.1.3.1.1 | Transmit command word |
| 5.2.1.3.1.2 | Receive command word |
| 5.2.1.3.1.3 | Receive data words |
| 5.2.1.3.2 | Word length |
| 5.2.1.3.2.1 | Transmit command word |
| 5.2.1.3.2.2 | Receive command word |
| 5.2.1.3.2.3 | Receive data words |
| 5.2.1.3.3 | Bi-phase encoding |
| 5.2.1.3.3.1 | Transmit command word |
| 5.2.1.3.3.2 | Receive command word |
| 5.2.1.3.3.3 | Receive data words |
| 5.2.1.3.4 | Sync encoding |
| 5.2.1.3.4.1 | Transmit command word |
| 5.2.1.3.4.2 | Receive command word |
| 5.2.1.3.4.3 | Data word |
| 5.2.1.3.5 | Message length |
| 5.2.1.3.5.1 | Transmit command |
| 5.2.1.3.5.2 | Receive command |
| 5.2.1.3.5.3 | Mode command word count error |
| 5.2.1.3.5.4 | RT to RT word count error |
| 5.2.1.3.6 | Contiguous data |
| 5.2.1.4 | Superseding commands |
| 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 |

All Protocol tests are automated and run in order.  NOTE: The Terminal fail-safe test (5.2.1.3.7) is not run but the requirements can be satisfied by analysis.  See Section 4.1 of the RT Validation Test Plan.

**F.** When the tests are completed, press **RETURN** until the cursor returns to the main menu.

**NOTE**

Repeat steps B through F for the alternate bus. If both buses have been tested, proceed to OPTIONAL PROTOCOL TESTS.

**VI.**     **5.2.2 OPTIONAL PROTOCOL TESTS**

**A.** Connect the equipment as shown in Figure 11 or Figure 12 for the transformer coupled or direct coupled buses to be tested. See Figure 1B of the RT Validation Test Plan for the General Bus Configuration. The oscilloscope is not required for running Protocol tests but may be connected to the monitor outputs (MON) on the back of the 1553 BUS TESTER to observe bus traffic.

    **NOTE**: It is only necessary to test one form of coupling per bus.

**B.** Press **F2**. With the cursor on "Bus Selected", press the **SPACE BAR** to select the desired bus (A/B).

**C.** Adjust the 1553 BUS TESTER amplitude to the test configuration.

    1.  Press **F3** to enter the BC Amplitude Calibration menu.
    2.  Move the cursor to "Protocol BC Transmit Amplitude 2.1 Vpp" for Bus A.
    3.  Press the **+** or **-** keys to increase or decrease the measured amplitude to 2.1 Vpp. The amplitude is measured differentially at the bus input of the UUT with the oscilloscope.
    4.  Move the cursor to "Protocol BC Transmit Amplitude 2.1 Vpp" for Bus B and repeat step 3.
    5.  Press **RETURN** to exit this menu.
    6.  Press **F2** to return to the main menu.

**D.** With the cursor on "5.2 Protocol Tests", press **TAB** and move the cursor to "5.2.2 Optional Operation".

**E.** With the cursor on "5.2.2 Optional Operation", press **F9** to run all unsuppressed tests.

    **NOTE:** When running the tests, follow the directions of the messages at the bottom of the screen.

RT VALIDATION TEST PROCEDURE

The following Optional Protocol tests are run:

| | |
|---|---|
| 5.2.2.1 | Optional mode commands |
| 5.2.2.1.1 | Dynamic bus control |
| 5.2.2.1 2 | Synchronize |
| 5.2.2.1.2.1 | Synchronize (without data word) |
| 5.2.2.1.2.2 | Synchronize (with data word) |
| 5.2.2.1.3 | Initiate self-test |
| 5.2.2.1.4 | Transmit BIT word |
| 5.2.2.1.5 | Selective transmitter shutdown and override |
| 5.2.2.1.6 | Terminal flag bit inhibit and override |
| 5.2.2.1.7 | Transmit vector word |
| 5.2.2.1.8 | Transmit last command |
| 5.2.2.2 | Status word bits |
| 5.2.2.2.1 | Service request |
| 5.2.2.2.2 | Broadcast command received |
| 5.2.2.2.3 | Busy |
| 5.2.2.2.4 | Subsystem flag |
| 5.2.2.2.5 | Terminal flag |
| 5.2.2.3 | Illegal command |
| 5.2.2.4 | Broadcast mode commands |
| 5.2.2.4.1 | Broadcast synchronize (without data word) |
| 5.2.2.4.2 | Broadcast synchronize (with data word) |
| 5.2.2.4.3 | Broadcast initiate self-test |
| 5.2.2.4.4 | Broadcast transmitter shutdown and override |
| 5.2.2.4.5 | Broadcast selective transmitter shutdown and override |
| 5.2.2.4.6 | Broadcast terminal flag bit inhibit and override |
| 5.2.2.4.7 | Broadcast reset remote terminal |
| 5.2.2.4.8 | Broadcast dynamic bus control |
| 5.2.2.5 | Error injection-broadcast messages |
| 5.2.2.5.1 | Parity:  bus controller (BC)-RT broadcast |
| 5.2.2.5.1.1 | Command word error |
| 5.2.2.5.1.2 | Data word error |
| 5.2.2.5.2 | Message length, BC to RT broadcast |

All unsuppressed Optional Protocol Tests are run in order.

**F.** When the optional tests are finished, press **RETURN** until the cursor returns to the main menu.


**NOTE**

Repeat steps B through F for the alternate bus.  If both buses have been tested, proceed to NOISE REJECTION TEST.

## VII.   5.3 NOISE REJECTION TEST

**A.** Connect the equipment as shown in Figure 13 or Figure 14 for the transformer coupled or direct coupled bus to be tested.  See Figure 10A of the RT Validation Test Plan for the Noise Rejection Test Configuration.  Note: The True RMS Voltmeter should be warmed up for one hour prior to testing.

1.   Connect the bus connector on the 1553 NOISE GENERATOR CARD in the computer to the appropriately coupled long bus connector on the CONNECTION PANEL and the UUT input.

2.   Connect the SCOPE and the True RMS Voltmeter to the UUT input.  Use an isolation plug on the True RMS Voltmeter.
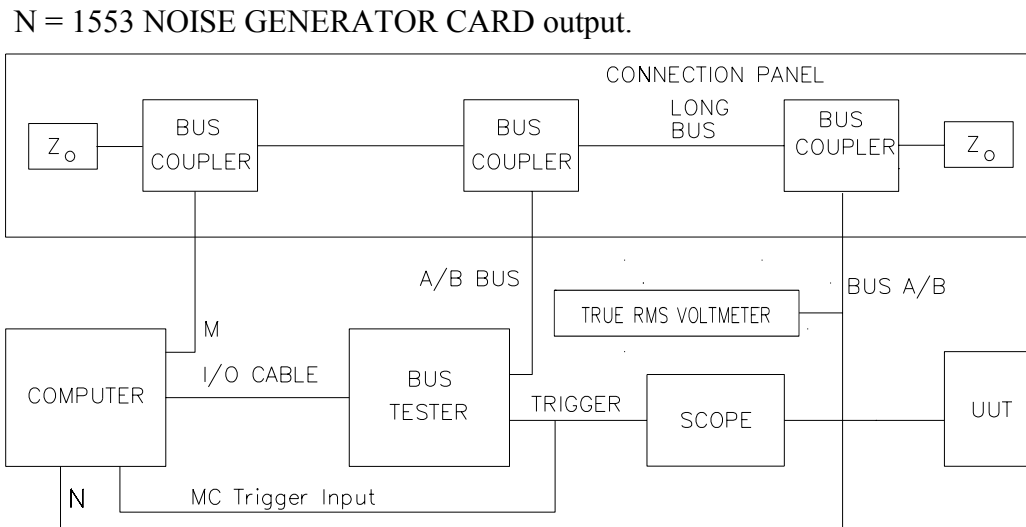
N = 1553 NOISE GENERATOR CARD output.
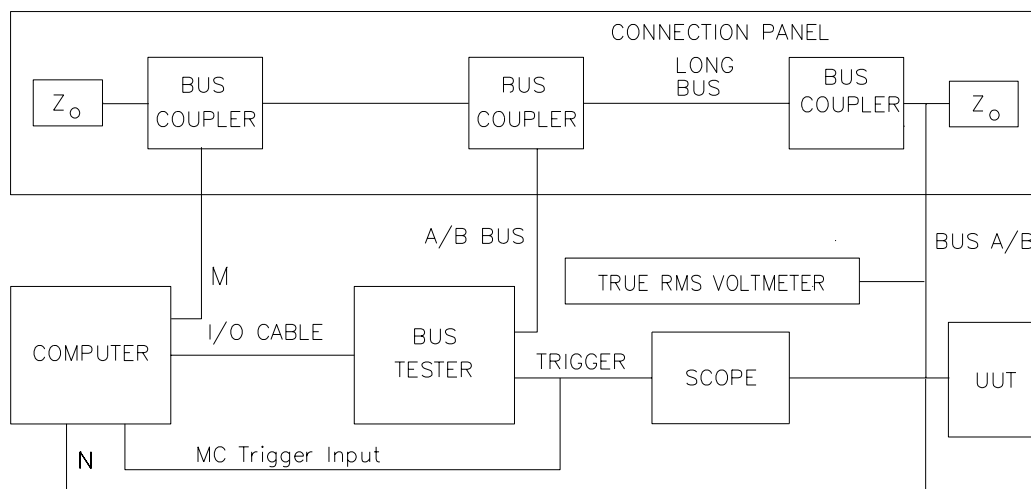


Figure 13. Noise Rejection Transformer Coupled Configuration



Figure 14. Noise Rejection Direct Coupled Configuration

**B.** Press **F2**.  With the cursor on "Bus Selected", press the **SPACE BAR** to select the desired bus (A/B).

**C.** With the Noise off on the 1553 NOISE GENERATOR CARD, adjust the 1553 BUS TESTER amplitude to the test configuration.

    1.  Press **F3** to enter the BC Amplitude Calibration menu.
    2.  Move the cursor to "Protocol BC Transmit Amplitude 2.1 Vpp" for the data bus being tested.
    3.  Press the **+** or **-** keys to increase or decrease the measured amplitude to 2.1 Vpp.  The amplitude is measured  differentially at the bus input of the UUT with the oscilloscope.
    4.  Press **RETURN** to exit this menu.
    5.  Press **F2** to return to the main menu.

**D.** Set the noise level on the 1553 NOISE GENERATOR CARD.

    1.  Press **ALT-F10** to enter the Control Program.  Press **ALT-F9** to enter DOS.  Enter **NOISE** (or **NOISE/M** for a monochrom monitor) and press **RETURN** to enter the 1553 NOISE GENERATOR CARD CONTROL PROGRAM.

    2.  Set the noise level to 140 mVrms for transformer coupling or 200 mVrms for direct coupling using the True RMS Voltmeter.  Note the value of the noise level reading on the screen.  Remove the True RMS Voltmeter.  The noise level reading on the screen will have changed so adjust the noise level to the value noted.

    3.  Exit the 1553 NOISE GENERATOR CARD CONTROL PROGRAM.  Press **ALT-F10** to return to the Validation Program.

**E.** Move the cursor to "5.3 Noise Rejection Tests".

**F.** Press **TAB** to select the first submenu.  The prompts "Total Words Sent" and "Total Errors" appear.

**G.** With the cursor on "Total Words Sent", press **F9** to start the Noise Rejection Test.  This test takes approximately 25 minutes if there are no errors.

**H.** When the Noise Rejection Test is finished, press **RETURN** until the cursor returns to the main menu.

**I.** Turn the noise off on the 1553 NOISE GENERATOR CARD.

<div align="center">

**NOTE**

</div>

Repeat steps A through H for the alternate bus. If both buses have been tested, disconnect the 1553 NOISE GENERATOR CARD and proceed to TEST TERMINATION.

## VIII. TEST TERMINATION

**A.** Add any pertinent comments concerning the testing to the Wordstar customer information textfile.

**B.** Incorporate the Wordstar customer information textfile into the Test Results File.

1. In the Validation Program, press **F2** and type the customer information data file filename at the prompt "Cust. Info File:".  Press **RETURN**.

2. Press **F2** to return to the main menu.

**C.** Press **CTRL-F2** and type **E** to exit the Validation Program.

**D.** Generate the Validation Report using the VALREPT program.

1. Type **VALREPT** at the prompt and press **RETURN** twice.

2. Enter the Test Results File filename on the first line and press **RETURN**.

3. Suppress a page or set of pages (containing a test or group of tests) that are not to be printed in the report by placing the cursor on the appropriate line and pressing the **SPACE BAR**.  Page numbers appear in parentheses next to the test section or subsection.  An "S" indicates that all pages for a test or set of tests have been suppressed.  An "s" indicates that one or more (but not all) pages for a test or set of tests have been suppressed.

4. Print the report to a disk file by pressing **F1** and specifying the test report filename (i.e. Customer.RPT) at the prompt.

5. Press **CTRL-F2** to exit.

**E.** Before printing the Validation Report on a printer, the report can be checked on the monitor using the **VIEWREPT** program.

1. On the MS DOS command line, specify the report filename when calling the VIEWREPT program.  Type **VIEWREPT filename.ext**.

2. Type **CTRL-F2** to exit the VIEWREPT program.

3. If changes need to be made in the report, modify the customer information textfile in Wordstar and repeat steps B through E.

**F.** Print the hard copy of the test report.