

SECTION B

TEST SET VERIFICATION AND ACCEPTANCE CHECKS

4.3 General

These procedures will be performed on an Unopened Test Set, except where noted, by measuring inputs/outputs. If the Test Set results are not within tolerances, the Test Set will require a full Calibration and Alignment as outlined in *Section C*. The tests are broken down into individual sections to allow the operator to verify proper operation of individual functions when a discrepancy may arise or repair was accomplished.

4.3.1 Test Equipment Required

The following support equipment (or their equivalent) is necessary to perform the Test Set Verification and Acceptance Checks:

Name	Designation/Description
Oscilloscope	Infinium 54835A
Signal Generator	Hewlett Packard 8648B
Spectrum Analyzer	HP 8558B
Digital Voltmeter	Fluke 8000A
Oscilloscope	Hewlett Packard 54615B
Pulse Generator	Agilent 81101A
Crystal Detectors W/Load Resistor	Hewlett Packard P423B
Copy of Data Sheet (Appendix A) ¹	
Assorted Connectors and Adapters	
Assorted Cables with calibrated loss	

Support Equipment

Table 4-1

¹ To ensure accuracy and for simplicity, the Data Sheet is written and organized to reference each step by paragraph and step number. Make a photocopy, review and become familiar with the datasheet before beginning the tests.

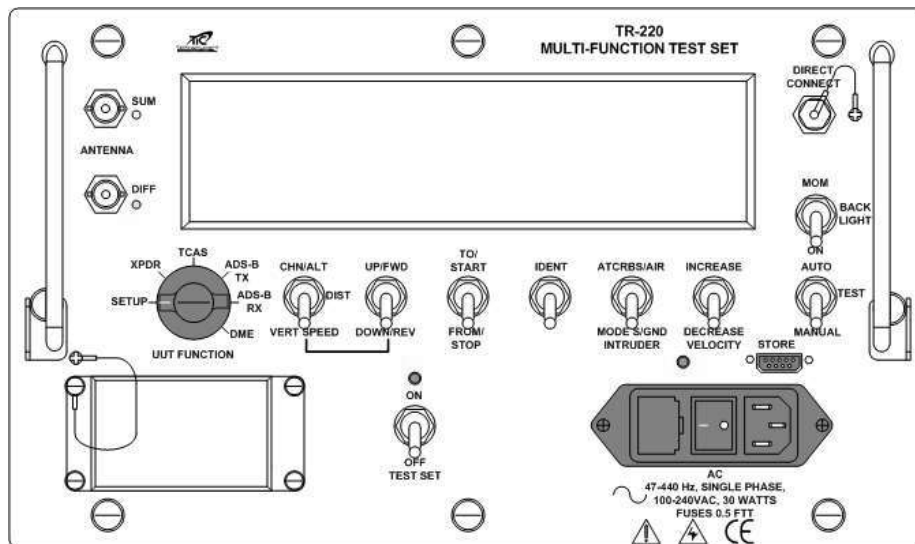
4.3.2 Test Set Initial Settings

Set the TR-220 front panel switches to the following positions before each test, unless otherwise instructed:

Function/Rotary Switch	Position
UUT FUNCTION	XPDR
CHNALT/DIST/VERT SPEED CODE/ALT – ATTN	Centered
UP – DOWN/FWD – REV	Centered
TO/FROM – START/STOP	Centered
IDENT	Default
ATCRBS/AIR – MODE S GND	ATCRBS/AIR
INCREASE – DECREASE	Default
AUTO/TEST/MANUAL	Default
BACK LIGHT	Default
ON/OFF	OFF
Power Charge Rocker Switch	OFF
DIRECT CONNECT PORT	Termination Cap On
SUM – DIFF Connectors	Capped

Initial Settings

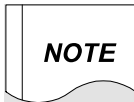
Table 4-2



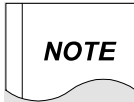
Initial Settings

Figure 4-1

4.4 Display Operation, Self Test and Initial Start Verification



Due to different Software revisions, displays and procedures may vary slightly.



Pictured Test results in this procedure are for reference only. Due to numerous types of equivalent test equipment, your actual results may vary.

1. Connect the Test Set to an appropriate power source.
2. Turn the AC Rocker switch to the **ON** position and ensure that the green LED illuminates.
3. Turn the Test Set **ON/OFF** switch to the **ON** position and verify the green LED illuminates.
4. The TR-220 Self Test will initiate will be displayed **briefly**, verify the following:

Tel-Instrument	TR-220
REV X.XX	00001 hrs

The Rev Level will display the current software installed. Hours will indicate the total hours the Test Set has been in operation.

Self Test Testing . . .

Self Test PASS

ANTENNA Connections Missing or reversed
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The Test Set will Stop at this display.

5. The Test Set will indicate the current software version and total hours the Test Set has been "ON". Log this and the Self Test results on the Data Sheet.
6. Toggle the **BACKLIGHT** switch *down* and verify the backlighting remains illuminated.
7. Toggle the **BACKLIGHT** switch *Up* to the **MOM** position, hold momentarily, and release. Verify the backlighting illuminates briefly, and then extinguishes.
8. Turn the Test Set "OFF" by toggling the **ON/OFF** switch *down*. The Test Set will turn "OFF".

9. Disconnect the AC Power Cord and turn the Test Set back “ON” and ensure the Test Set turns “OFF” after approximately 15 minutes of inactivity (AC power not connected).
10. Remove the **DIRECT CONNECT** Termination Cap, Connect the Directional Antenna to the **SUM/DIFF** ports and turn the Test Set back “ON”. Verify the following Display:

Direct Connection
REMOVE ANTENNA

11. Remove the Directional Antenna and ensure that the Test set progresses to the following display:

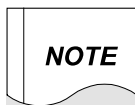
TRANSPONDER test
Press AUTO/MANUAL

12. Turn the Test Set “OFF”.

4.4.1 Transponder, Transmitter/Frequency Verification Tests

These Tests will verify the Test Set RF output to ensure the Test Set is properly transmitting with the appropriate power at the correct frequency.

1. Set all Test Set Initial settings IAW Table 4-2.
2. Connect the Spectrum Analyzer to the Test Set **SUM** connector, ensure the **DIRECT CONNECT** termination Cap is installed.



Any time that tests are conducted utilizing the **SUM and DIFF** ports and the Test Set is turned on, a message indicating “ANTENNA Connections Missing or reversed” may be displayed. To bypass this, simply short the center pin of the **DIFF** connector to advance.

3. Turn the Test Set “ON” with the **UUT FUNCTION** switch in the **SETUP** position. Locate the **ANT GAIN** menu by toggling the **AUTO/MANUAL** switch. Observe the Antenna gain menu and set the Antenna gain to **0 dB** for the 1030 and 1090 MHz positions. At the **CABLE LOSS** menu, set the cable loss also to **0 dB**.

At the **T/S Distance Menu** page, set the distance for **25 ft** and select **AUTO**.

T/S Distance:	25 ft
Chg:Up/Dn Cont:	AUTO

Return the **UUT FUNCTION** switch to the **XPDR** position and turn the Test Set “OFF”.

4. With the **FUNCTION SWITCH** in the **XPDR** position and turn the Test Set “ON” while holding “Down” the **TO/START – FROM/STOP** switches. This will disable the LED power and the display will briefly indicate this.

Antenna LED is OFF

5. Toggle the **AUTO/MANUAL** switch to **AUTO**. At the Transponder Test page, select the **MANUAL** Tests by toggling **AUTO/MANUAL** switch “Down” and continue to toggle down until reaching the *M A Menu* page.

TRANSPONDER test Press AUTO/MANUAL

M A No reply

Set the Spectrum Analyzer to the following positions:

Function	Setting
Frequency	1030 MHz
Span	0 MHz
Amplitude	0 dBm
Res BW	3 MHz
Video BW	3 MHz
Sweep	500 ms

Connect the **SUM** port to the Spectrum Analyzer. Measure the output power of the Test Set ensuring to add the cable loss from the **SUM** to the Spectrum Analyzer to the total. The output power shall be **7dBm / ± 2 dB**. *Note the actual reading on the Data sheet.*

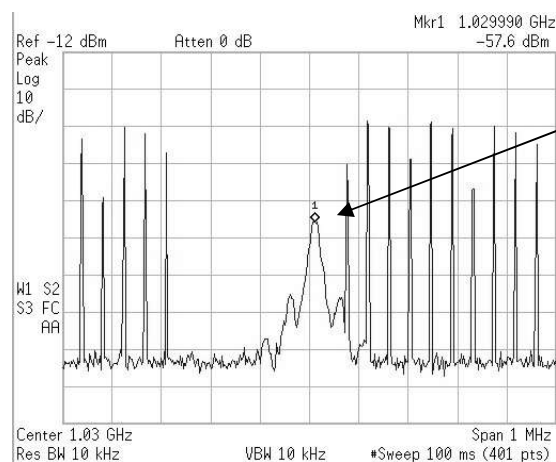
6. Without turning Off the Test Set, disconnect the Spectrum Analyzer connector at the **SUM** port and connect it to the **DIFF** port.

Verify that the output power has reduced at least minimum of **20 dB** from that in step #5, remembering to take into account cable loss.

7. Select **SETUP** on the **UUT FUNCTION** switch and select the **T/S Distance Menu**: Set the distance to **35 feet**. Return the **UUT FUNCTION** switch to **XPDR** and return to the **M A Test** and ensure that the power is **9 db LOWER / ± 2 db** than what was measured at the **SUM** port Step 5.
8. Repeat the same procedure in Step 8, but set the *Distance Menu* to **75 feet**. Verify that the peak power off the **DIFF** port is **5 db LOWER / ± 2 db** than the **SUM** port measurement in Step 5.
9. Remove the Spectrum Analyzer from the **DIFF** port and reattach it to the **SUM** port.
10. Turn the Test Set “OFF” and then back “ON” and return to the *MODE 3A Menu Display*.
11. Set the Spectrum Analyzer for the Following:

Function	Setting
Frequency	1030 MHz
Span	1 MHz
Amplitude	0 dBm
Res BW	10 kHz
Video BW	10 kHz
Sweep	100 ms

12. Measure the center frequency of the Spectrum Analyzer Display (Figure 4-2). Verify that the Center Frequency is **1030 MHz / ± 0.2 MHz**.



Center Frequency of Oscillator

Transponder Output Frequency

Figure 4-2

13. Turn the Test Set “OFF” and disconnect test equipment.

4.4.2 TCAS Verification

These Tests will verify the Test Set TCAS modes are properly transmitting with the appropriate power at the correct frequency.

1. Set all Test Set Initial settings IAW Table 4-2.
2. Connect the Signal Generator output, to the Pulse "IN" connector on the rear of the Signal Generator. Set the Pulse Generator to the following:

Adjust the Pulse Generator for 2 *Continuous Double Pulses* and the following (simulates a M3A Interrogation):

Function	Setting
Frequency	100 Hz
DbI Delay	8.0 μ s
Pulse Width	800 ns
Leading Edge Rise	5 ns
Amplitude	+4 V HI / + 0 V Low
Input Impedance	50 Ω Out / 1 K In

Adjust the Signal Generator to the following:

Function	Setting
Frequency	1030 MHz
Amplitude	0.00 dBm
Modulation	Pulse Modulated
Rear In	ON

3. Connect the output of the Pulse Generator directly to the **SUM** port of the Test Set. Place the Test Set **FUNCTION** switch in the **SETUP** position and turn the Test Set "ON".
4. At the Set Distance Menu, set the distance for 25 feet by toggling the **TO/FROM** switch. Toggle the **AUTO** switch UP when finished.

Set Distance: 25 ft.
Chg:Up/Dn Cont: AUTO

5. Place the **FUNCTION** switch in **TCAS** and toggle the **AUTO/MANUAL** switch to **AUTO**.

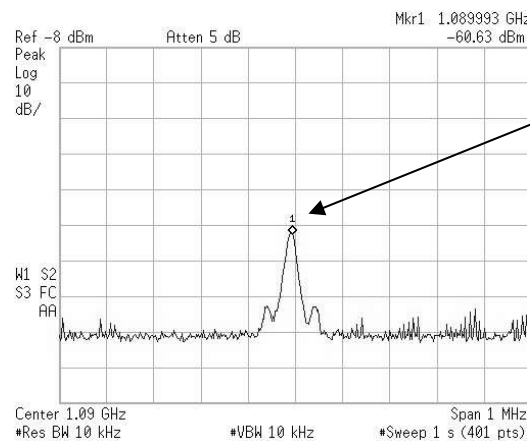
Power	Frequency /
Listening . . .	

Power 50 dBm	Frequency / 1030.0 MHz	} Results Shown are typical, your display may slightly vary. Output Power displayed is "don't care". A "FAIL" display or incorrect frequency measurement is considered a fail.
Power FAIL	Frequency /	

6. Vary the Frequency output of the Signal Generator in 0.1 MHz steps (1033.0 to 1027.0 MHz). Ensure that the displayed frequency follows ± 200 kHz at each step.
7. Set a Spectrum Analyzer for the Following:

Function	Setting
Frequency	1090 MHz
Span	1 MHz
Amplitude	-10 dBm (approx)
Res BW	10 kHz
Video BW	10 kHz
Sweep	1 sec

8. Disconnect the Signal generator from the **SUM** port. Connect a "T" connector to the **SUM** port and reconnect the Signal Generator, Connect the other output to the Spectrum Analyzer.
9. Measure the output frequency of the Test Set and ensure output is **1090 MHz ± 200 kHz** (See Figure 4-3). Turn the Test Set "OFF".



Center Frequency of Oscillator

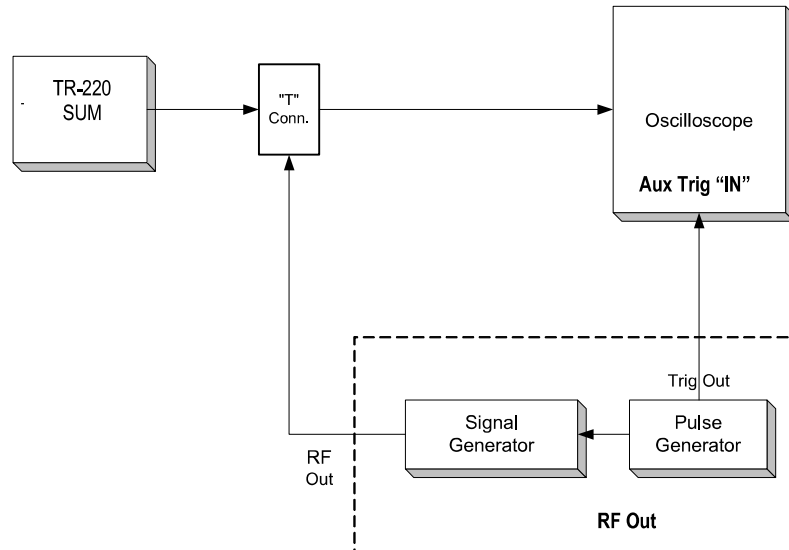
TCAS Output Frequency

Figure 4-3

4.4.3 DME Verification

1. Set all Test Set Initial settings IAW Table 4-2 and connect the UUT to the Test Equipment IAW the following diagram.

NOTE A crystal detector must be utilized at the input of the O'Scope to eliminate noise. If utilized, ensure that the LED function of the UUT is disabled before connecting the detector.



DME Test Se- up

Figure 4-4

Adjust the Pulse Generator for 2 *Continuous Double Pulses* and the following:

Function	Setting
Frequency	100 Hz
Delay	12 μ s
Pulse Width	3.5 μ s
Leading Edge Rise	5 ns
Amplitude	+4 V HI / + 0 V Low
Input Impedance	50 Ω Out / 1 K In

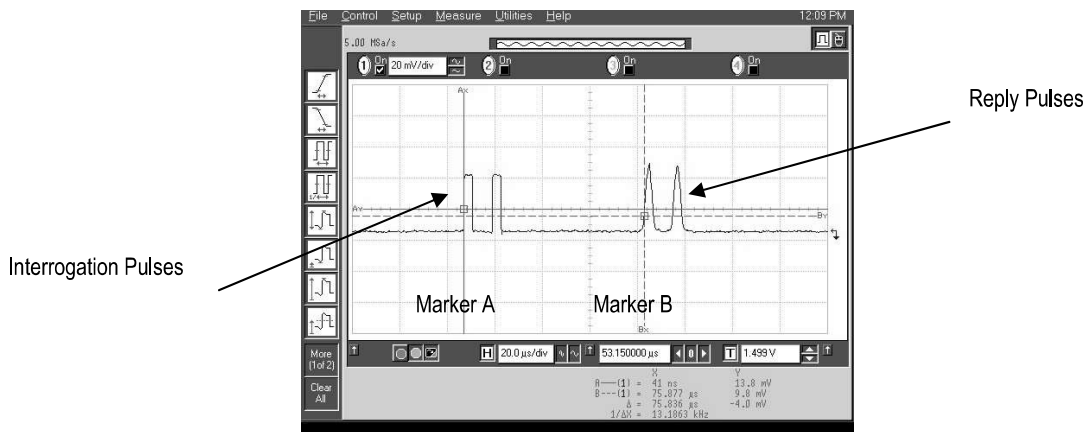
2. Connect the output of the Pulse Generator to the "*Pulse IN*" port of the Signal Generator. On the UUT, Select **DME** on the UUT using the **FUNCTION SWITCH** and turn the Test Set "*ON*" by holding the **TO/FROM** and **UP/DOWN** switches at the same time; this removes the LED power through the **SUM** port.

Select the Test Set Channel to 108.00 MHz (17X) with a 2 nmi range. Set the Signal Gen. to 1041 MHz at 0 dB.

Adjust the O' Scope for the following:

Function	Setting
Horizontal	20 μ s
Vertical	50mV/Div
Trigger	Aux
Utilize the Auto Function for best results	

Observe on the scope the Interrogation Pulses and Reply Pulses (utilize the Averaging Mode if necessary).



DME Interrogation and Reply Pulses

Figure 4-5

Verify the following:

- Each Interrogation Pulse is 3.5 μ s / $\pm$.5 μ s spaced 12.0 μ s $\pm$.5 μ s
- Verify that the Test Set Reply Pulses spacing are 12 μ s / $\pm$.25 μ s.
- Change the Test Set to **108.05** (17Y) and verify the spacing at 30 μ s / $\pm$.25 μ s.

Return the UUT to 108.00. Record the results on the data sheet.

- DME Range Verification, utilizing the Infinium O' scope and markers. Place Marker "A" on the 50% rise of the first Interrogation Pulse. Place the Second Marker on the 50% rise of the first Reply pulse (See Figure 4-5). Measure the distance IAW with Table 4-3 changing the Test Set distance and frequency when needed:

	Range	DME 108.00		DME 108.05	Tolerance
		50 μs delay		56 μs delay	
a.	2	74.72 μ sec	d.	80.72 μ sec	$\pm 6.18 \mu$ sec
b.	130	1656.66 μ sec	e.	1662.66 μ sec	$\pm 6.18 \mu$ sec
c.	250	3140.00 μ sec	f.	3146.00 μ sec	$\pm 6.18 \mu$ sec

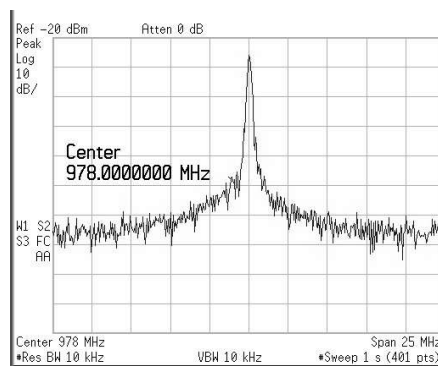
DME Range Verification

Table 4-3

4. DME Frequency verification is conducted by connecting the UUT **SUM** port to a Spectrum Analyzer. Turn on the UUT holding the **TO/FROM – START/STOP** and **UP/DOWN** Switches at the same time to disable the LED. Ensure Channel 108.00 MHz is selected. Set the Spectrum Analyzer to the following:

FUNCTION	SETTING
Frequency	978 MHz
Span	10 MHz
Amplitude	0 dBm
Res BW	10 kHz
Video	AUTO
Averaging	OFF
Sweep	1 sec

Verify a Center frequency of **978 MHz / ± 0.5 MHz** (Figure 4-6) and continue to test the frequency IAW Table 4-4.



DME Frequency

Figure 4-6

X Channels		Y Channels	
a.	108.00 MHz – 978 MHz	d.	108.05 MHz – 1104 MHz
b.	112.60 MHz – 1160 MHz	e.	112.65 MHz – 1034 MHz
c.	117.50 MHz – 1209 MHz	f.	117.55 MHz – 1083 MHz

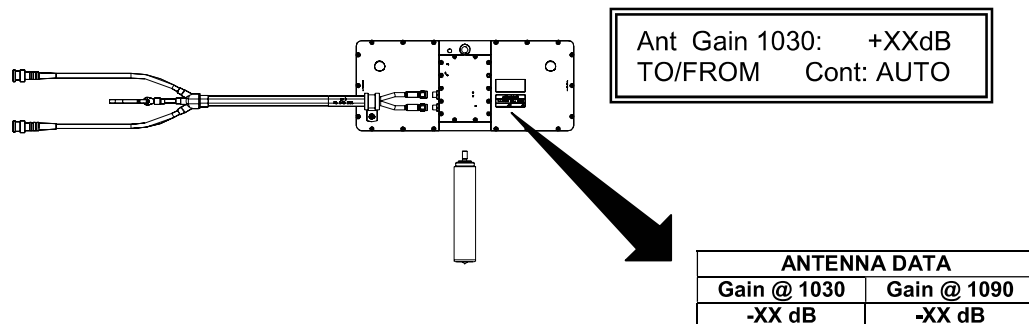
DME Frequency Verification

Table 4-4

Log on the Data Sheet DME Frequency Test results.

4.4.4 Final Checks

1. Place the Test Set Function Switch in the **SETUP** position.
2. Turn the Test Set “ON”. Locate the *ANT GAIN* menu by toggling the **AUTO/MANUAL** switch.
3. Locate the Hand-Held Antenna located in the Test Set cover. Find the Antenna Gains Label located on the back of the Antenna (Figure 4-7).



Directional Antenna Gain

Figure 4-7

4. Enter the correct gains for the appropriate frequencies as listed on the back of the antenna.
5. Turn the Test Set “OFF”.