Tower 5



# 5 EMI/EMC TEST PROCEDURE

## 5.1 *Preliminary Set-Up*

The initial test set up of the TKR and the Tracker Test Setup shall be as illustrated in Figure 3-1 of this procedure. The power cable from the TKR/TEM/TPS shall be connected to the line conditioner within 2.5 meters for all EMI tests.

- Date/time tests started 6-3-05 4:2

Name of primary tester Tom Hirl

Name of Quality Assurance Engineer none - ctd by Doug Dunlavey

GASU-TEM cable used (circle one): 4 meter (LAT-DS-05541) (1 meter ( LAT-DS-02106)

Record Spectrum Analyzer Model Number Agilant 4935A , Serial Number MY41100915 .

Calibration due date 11/4/05 .

Record Oscilloscope Model Number Tektronix TDS 2024 , Serial Number C030822

Calibration due date 6/21/05 .

Record Current probe Model Number Electrometrics EM 6981 , Serial Number 1782 .

Calibration due date 4/26/06 .

## 5.2 *CE102 Conducted Emissions, Power Leads, 10 kHz to 10 MHz*

The CE102 test is performed to verify that electromagnetic emissions from the TKR do not exceed the specified requirements for input power leads (including returns). The test is to be performed over the frequency range of 10 kHz to 10 MHz as specified in the following paragraphs. This test is performed per MIL-STD-462 method CE03, and does not conform to MIL-STD-461E.

### 5.2.1 Initial Test Set-Up and calibration check

Configure the test set per Figure 4-2 and conduct a pre-test calibration of the EMI test measurement system as follows:

- Initial to show that setup is done and checked. Tester TMH QA_____.

a. Turn On power to the measurement system and allow sufficient time for equipment stabilization.

b. Recall Analyzer setup CE102CAL.

c. Apply a signal with the signal generator. The signal level should be 6 dB lower than the maximum allowable limits illustrated in Figure 4-1 at 10 kHz, 2 MHz and 10 MHz. Determine the signal level with the oscilloscope which is across the resistor.

The table below shows the values to set the Analyzer source amplitude to (dBm out), and the expected readings on the scope and the Analyzer. The spreadsheet from which it is derived is in appendix A.

Fill in the two columns in the table below. These are the measurements for steps c and d.

| Freq (MHz) | dBm out | Expected pk-pk voltage (V) | Measured pk-pk voltage (V) | Expected dBm on Analyzer | Actual dBm on Analyzer |
|---|---|---|---|---|---|
| 10 | 1 | 0.71 | .728 | -19.4 | -17.9 |
| 2 | 15 | 3.55 | 3.62 | -6.9 | -4.7 |
| .01 | -13 | 0.141 | .140 | -70.3 | -67.8 |

d. Scan the Spectrum Analyzer and verify that the measured signals are within +/- 3 dB of the injected test signal levels. Correction factors shall be applied for any attenuator used. If the measured levels deviate by more than +/- 3 dB, determine the source of the error and correct the problem before proceeding. The results of the pre-test calibration shall be recorded in the EMI test log.

### 5.2.2 TKR CE102 Emissions Test Procedure

a. Set up the TKR and measurement equipment per **Figure 4-3**. Turn On power to the TKR and configure the unit to operate in the EMI Test mode as specified in paragraph 3.4.1.

Initial to show that setup is done and checked. Tester TMH QA_____.

b. Connect the spectrum analyzer's current probe to the +28Vdc line. Monitor output of the current probe.

c. Set the EMI measurement equipment to scan the frequency range of 10 kHz to 10 MHz, using the bandwidths and minimum measurement times specified in Table 3-2. The details on how to do this are given in the bullets of the next step of this procedure.

d. Review the spectrum plot of the measurement equipment's scan results and verify that the resultant plot is within the limits specified in Figure 4-1. Record the results in the table below and place a copy of the spectrum plot with the EMI test data package. If any out-of-specification emissions are observed, record the frequency and level of the out-of-specification data and initiate a Failure Report.

The test is done in 3 frequency ranges. Recall the setups in the table below, allow time for a scan to occur, record pass/fail and save the analyzer data to the floppy disk with the file names given (or write in the filenames you used). The test limits are contained in the setups and are shown on the analyzer as the top green line. The test passes if the measured spectrum is all below the green line. The spreadsheet which calculates the green line is in Appendix B.

| Frequency Range (MHz) | Current Probe on | Setup to Recall | Pass/fail | Saved data filename |
|---|---|---|---|---|
| 0.15 - 2 | +28 V | CE102A | P | A |
| 2-6 | +28 V | CE102B | P | B |
| 6-10 | +28 V | CE102C | P | C |
| 0.15 - 2 | +28 V return | CE102A | P | A2 |
| 2-6 | +28 V return | CE102B | P | B2 |
| 6-10 | +28 V return | CE102C | P | C2 |

e. If the test is successful, reconnect the spectrum analyzer to the +28 Vdc return line. Monitor output of the current probe.

f. Repeat steps (c) and (d). If the test is successful, proceed to the next test in the EMI test sequence.

g. If the test results show any out-of-specification emissions, initiate a Failure Report.

## *5.3 CS102 Conducted Susceptibility, Power Leads, 10 kHz to 10 MHz*

This test is conducted to verify the ability of the TKR to withstand signals coupled onto the unit's +28 VDC input line. The TKR will be exercised as specified in paragraph 3.4.1during the test. If any of the unit's operating parameters identified in paragraph 3.5 are out-of-tolerance, the test will be stopped and an evaluation of the interference frequency and signal level will be conducted. This test is performed over the frequency range of 10 kHz to 10 MHz. It is done in two parts. The signal is inductively coupled in the low frequency range and capacitively coupled in the high frequency range.

### 5.3.1 <u>CS102, 10 kHz to 150 kHz</u>

This test is performed per MIL-STD-461E method CS01 over the frequency range of 10 kHz to 150 kHz.

#### 5.3.1.1 CS102 Initial Test Set Up

Set up the measurement equipment per Figure 4-5 and conduct a pre-test calibration of the test set up as follows:

Initial to show that setup is done and checked. Tester TMH QA_____

a. Turn on the EMI measurement equipment and allow sufficient warm-up time for equipment stabilization.

b. Recall analyzer setup CS102A. This setup includes a green line that shows the desired signal levels. See appendix C for the spreadsheet where these values were calculated. It also includes signal generator strengths that should result in a signal that matches or is slightly above the green line.

Scan the entire test frequency range of 10 kHz to 150 kHz and make sure the yellow measurement line is near or somewhat above the green limit line. Note that the setup has the trigger set to SINGLE so measurements are not continuously made as this would wear out the relay that changes the source amplitude. To make a measurement, go to the TRIGGER menu and select MEASURE RESTART.

d. If the whole yellow line is shifted, correct it by adjusting the amplifier gain (which is not a calibrated device).

If you need to make frequency dependent changes to the source strength, edit the sweep list on the analyzer by going to the SWEEP menu, selecting SWEEP TYPE MENU and then EDIT LIST. If the rest of what needs to be done is not obvious from the menus, see page 9-3 of the manual for details. Note the changes you made below, or initial the no changes needed line.

List source strength changes made, or initial that: No source strength changes made TMH

When happy with the setup, save the analyzer data to floppy with filename AA ✓

### 5.3.1.2 TKR CS102 Conducted Susceptibility Test Procedure

a. Set up the EMI test equipment and the TKR per Figure 4-6.

Initial to show that setup is done and checked. Tester TMH QA_____

b. Turn On input power to the TKR and allow sufficient time for unit temperature stabilization.

c. Continue to use setup CS102A which was loaded in the previous step.

d. Do a single quick measurement or two to make sure things are working. The yellow measurement line will not be exactly where it was during the setup as the impedance of the TPS is different from the simple resistor used in the setup. However, it will look similar. If it is flat at low magnitude, something isn't setup right.

e. Set the sweep time to 246 seconds (3 seconds per point as specified in Table 3-3)

Initial to show the sweep time was set. Tester TMH QA_____

f. Set up the Tracker test system to exercise the TKR as specified in paragraph 3.4. Verify that all data received from the TKR is within limits.

g. Hit MEASURE RESTART on the TRIGGER menu to do the scan.

h. During the test scan, monitor the data received by the Tracker test system for any out-of-specification readings. (Occupancy above 1E-4 or error messages on the screen) If any are noted, stop the test and determine the level and frequency at which the susceptibility occurs and record the results in the test log. If no susceptibility is noted, or the required test signal level cannot be achieved, the test is considered to be successful.

Tracker run number 399001998

Save analyzer data to floppy with filename A3 ✓.

Test pass/fail? Pass

### 5.3.2 CS102, 150 kHz to 10 MHz

This test is performed per MIL-STD-462 method CS02 over the frequency range of 150 kHz to 10 MHz.

#### 5.3.2.1 CS102 Initial Test Set Up

Set up the measurement equipment per Figure 4-7 and conduct a pre-test calibration of the test set up as follows:

Initial to show that setup is done and checked. Tester TMH QA_____.

Turn on the EMI measurement equipment and allow sufficient warm-up time for equipment stabilization.

b. Recall analyzer setup CS102B. This setup includes a green line that shows the desired signal levels. See appendix C for the spreadsheet where these values were calculated. It also includes signal generator strengths that should result in a signal that matches or is slightly above the green line.

c. Scan the entire test frequency range of 150 kHz to 10 MHz and make sure the yellow measurement line is near or somewhat above the green limit line. Note that the setup has the trigger set to SINGLE so measurements are not continuously made as this would wear out the relay that changes the source amplitude. To make a measurement, go to the TRIGGER menu and select MEASURE RESTART.

d. If you need to make changes to the source strength, edit the sweep list on the analyzer by going to the SWEEP menu, selecting SWEEP TYPE MENU and then EDIT LIST. If the rest of what needs to be done is not obvious from the menus, see page 9-3 of the manual for details. Note the changes you made below, or initial the no changes needed line.

List source strength changes made, or initial that: No source strength changes made TMH

When happy with the setup, save the analyzer data to floppy with filename B3 V

#### 5.3.2.2 TKR CS102 Conducted Susceptibility Test Procedure

a. Set up the EMI test equipment and the TKR per **Figure 4-8**.

Initial to show that setup is done and checked. Tester TMH QA _____

b. Turn on input power to the TKR and allow sufficient time for unit temperature stabilization.

c. Continue to use setup CS102B which was loaded in the previous step.

d. Do a single quick measurement or two to make sure things are working. The yellow measurement line will not be exactly where it was during the setup as the impedance of the TPS is different from the simple resistor used in the setup. However, it will look similar. If it is flat at low magnitude, something isn't setup right.

e. Set the sweep time to 357 seconds (3 seconds per point as specified in Table 3-3)

Initial to show the sweep time was set. Tester TMH QA_____

f. Set up the Tracker test system to exercise the TKR as specified in paragraph 3.4.1. Verify that all data received from the TKR is within limits.

g. Hit MEASURE RESTART on the TRIGGER menu to do the scan.

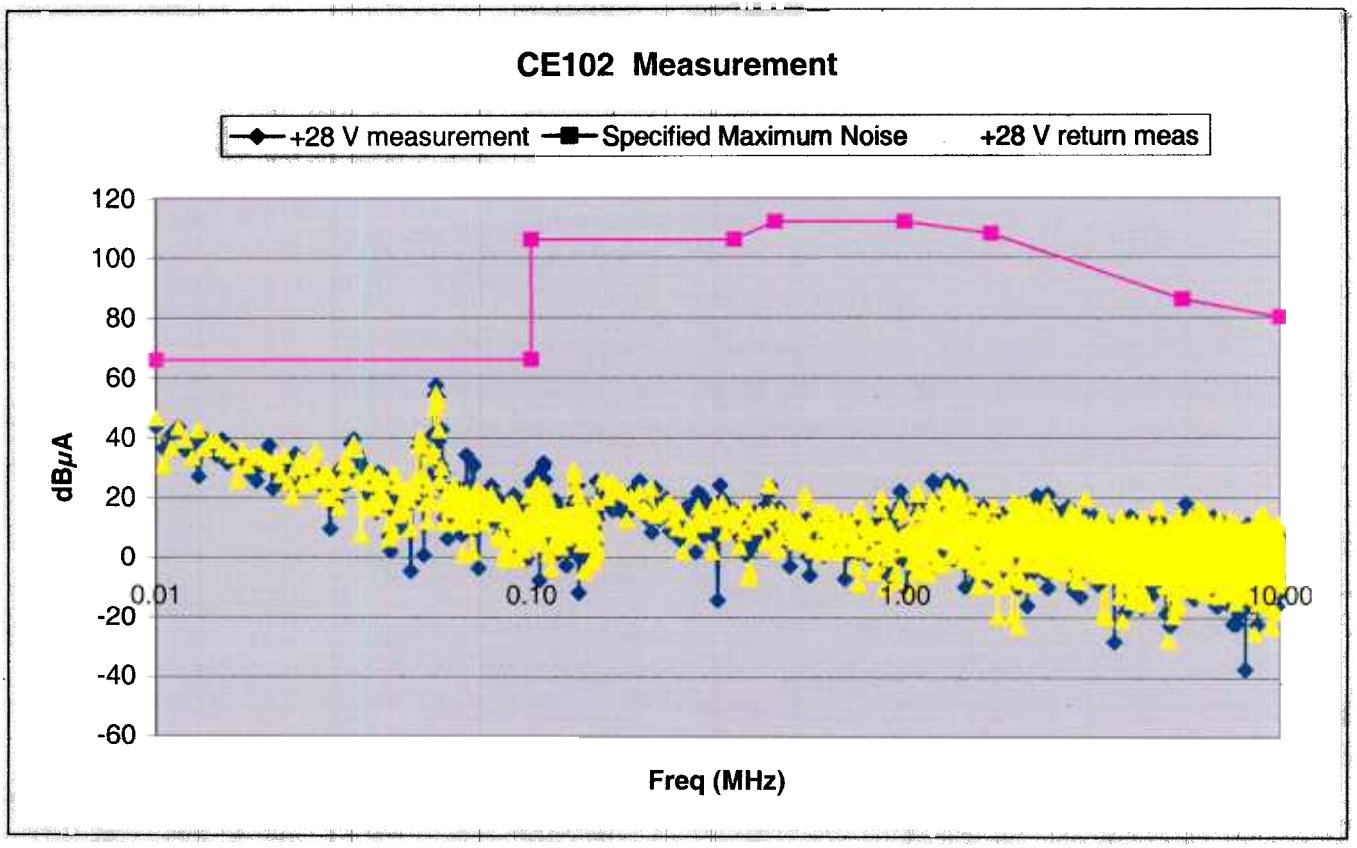
h. During the test scan, monitor the data received by the Tracker test system for any out-of-specification readings. (Occupancy above 1E-4 or error messages on the screen) If any are noted, stop the test and determine the level and frequency at which the susceptibility occurs and record the results in the test log. If no susceptibility is noted, or the required test signal level cannot be achieved, the test is considered to be successful.

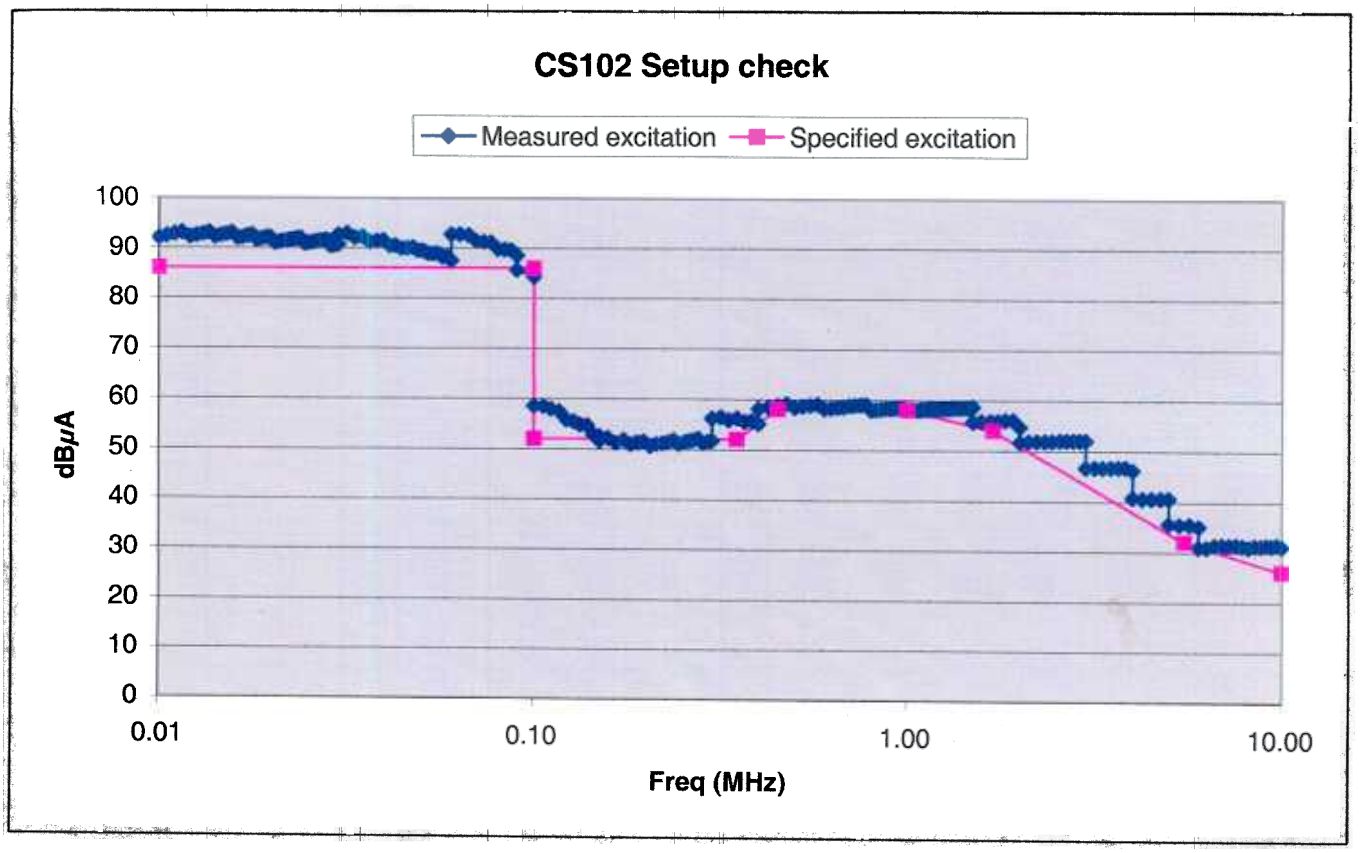
- Tracker run number 39001999
- Save analyzer data to floppy with filename B4 ✓.

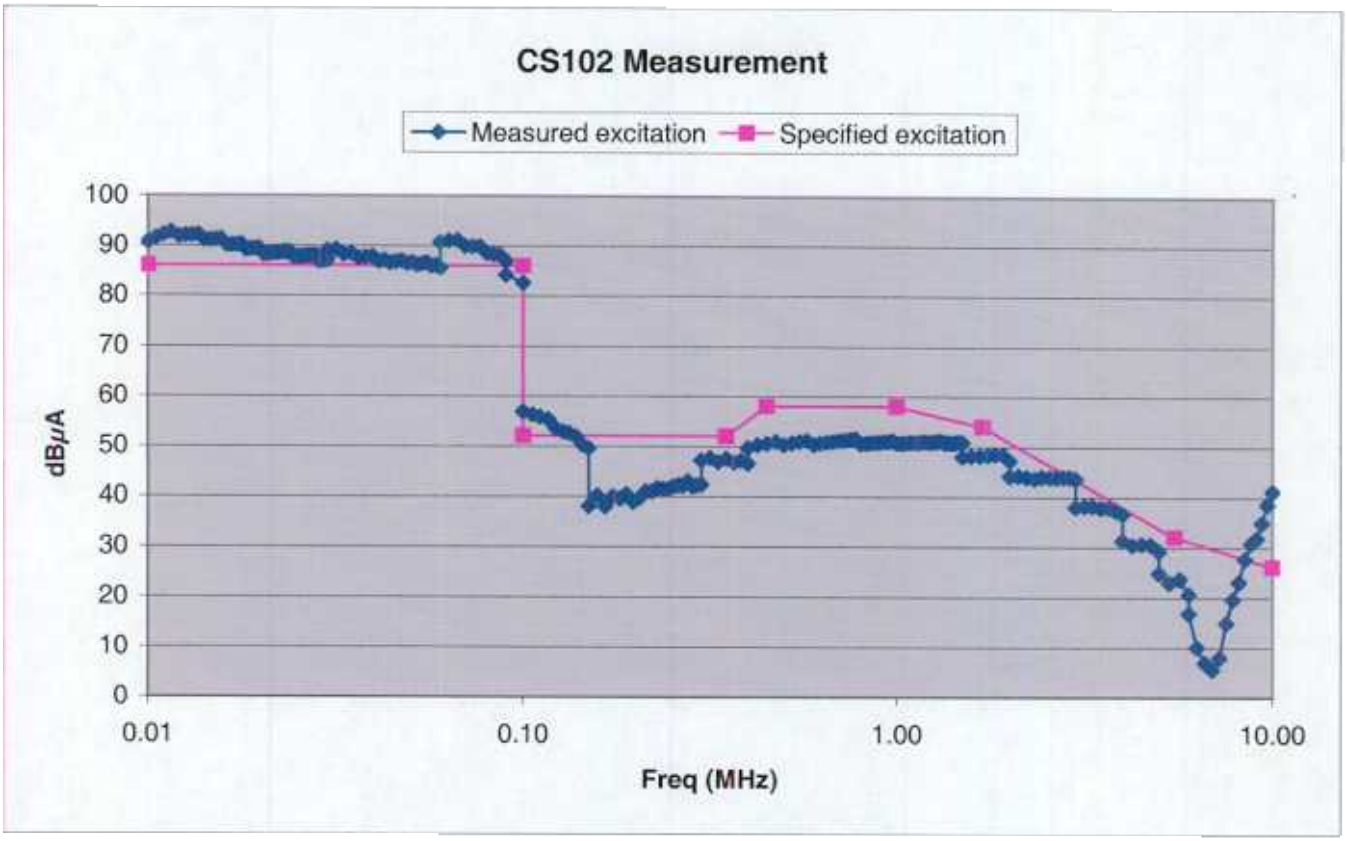
Test pass/fail? Pass

Overall EMI test pass/fail? Pass

Tower 5 test results




CS102 Measurement
Measured excitation
Specified excitation
100
90
80
70
60
50
40
30
20
10
0
dBμA
0.01
0.10
1.00
10.00
Freq (MHz)