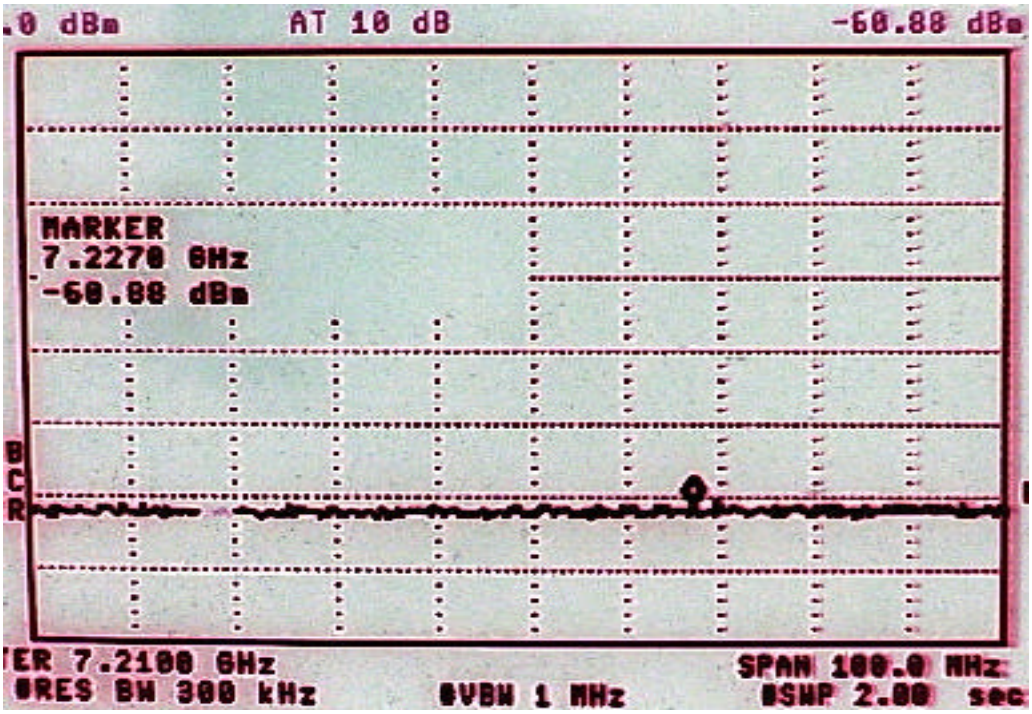

Figure 44: 7th Harmonic

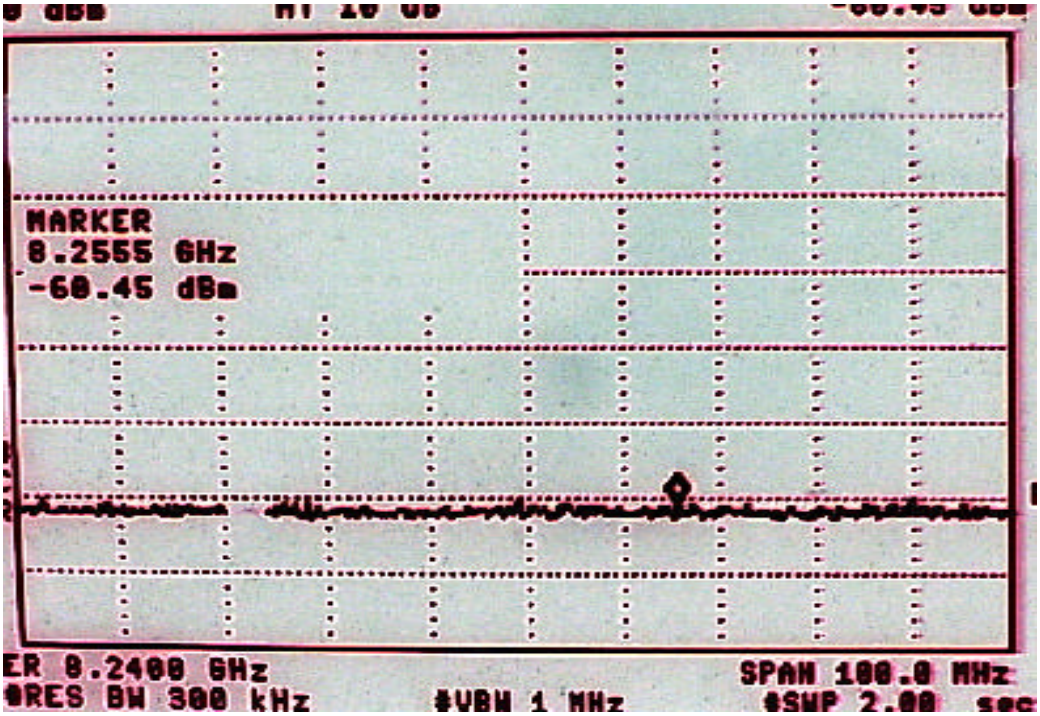

Figure 45: 8th Harmonic

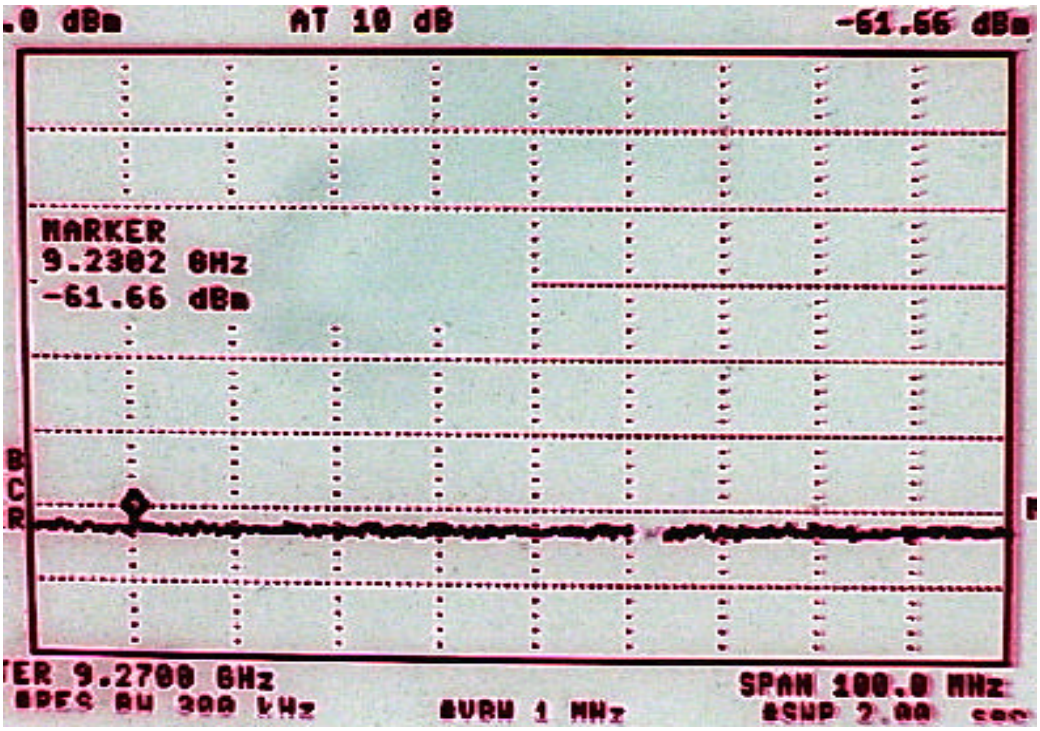

Figure 46: 9th Harmonic

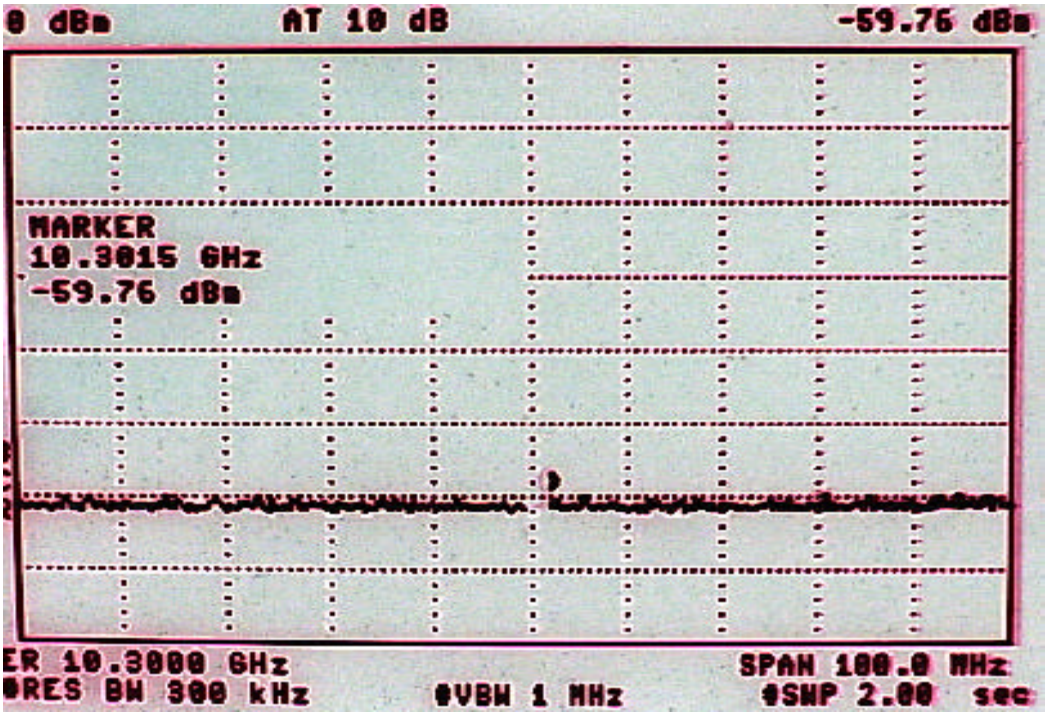

Figure 47: 10th Harmonic

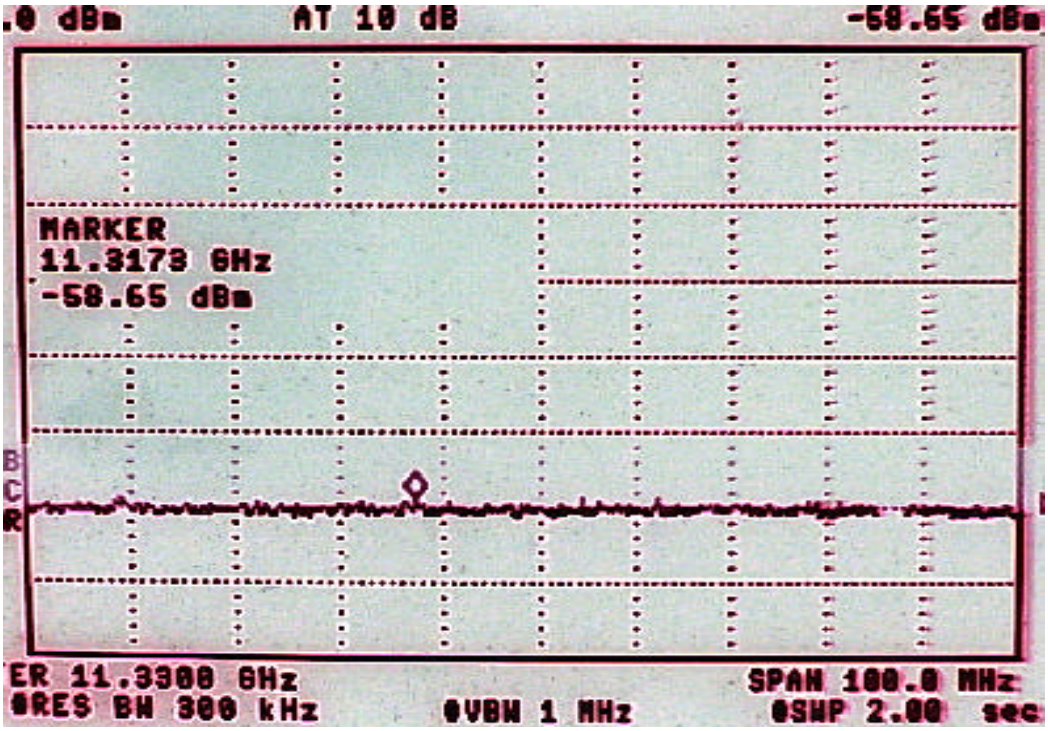

Figure 48: 11th Harmonic

8.4.3 Spurious Emissions at Antenna Terminals Local Oscillator Leakage (1030 MHz)

8.4.3.1 Spurious Emissions at Antenna Terminals L.O. Leakage (1030 MHz) Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model	Asset #	Cal Date
A	T2CAS Computer	ACSS	RT-952	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	23/7/03

Table 13: Spurious Emissions at Antenna Terminals L.O. Leakage (1030 MHz) Test Equipment Required

8.4.3.2 Spurious Emissions at Antenna L.O. Leakage (1030 MHz) Test Setup

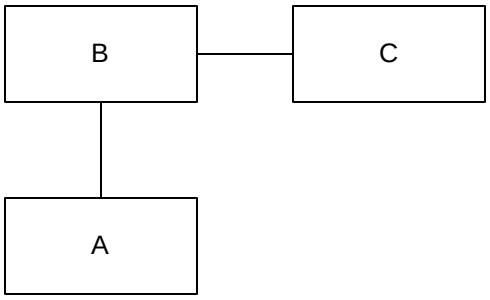

Figure 49: Spurious Emissions at Antenna Local Oscillator Leakage (1030 MHz) Test Setup

8.4.3.3 Spurious Emissions at Antenna L.O. Leakage (1030 MHz) Test Procedure

1 Connect the equipment as shown in Figure 49 above.
2 Configure the TCAS 2000 System Panel to invoke the No-Interrogation Test Mode (transmitter in standby, no interrogations, Test Mode Program switches on System Panel to DUUD).
3 Measure and record the L.O. leakage out of the top and bottom ports.

8.4.3.4 Spurious Emissions at Antenna L.O. Leakage (1030 MHz) Test Data

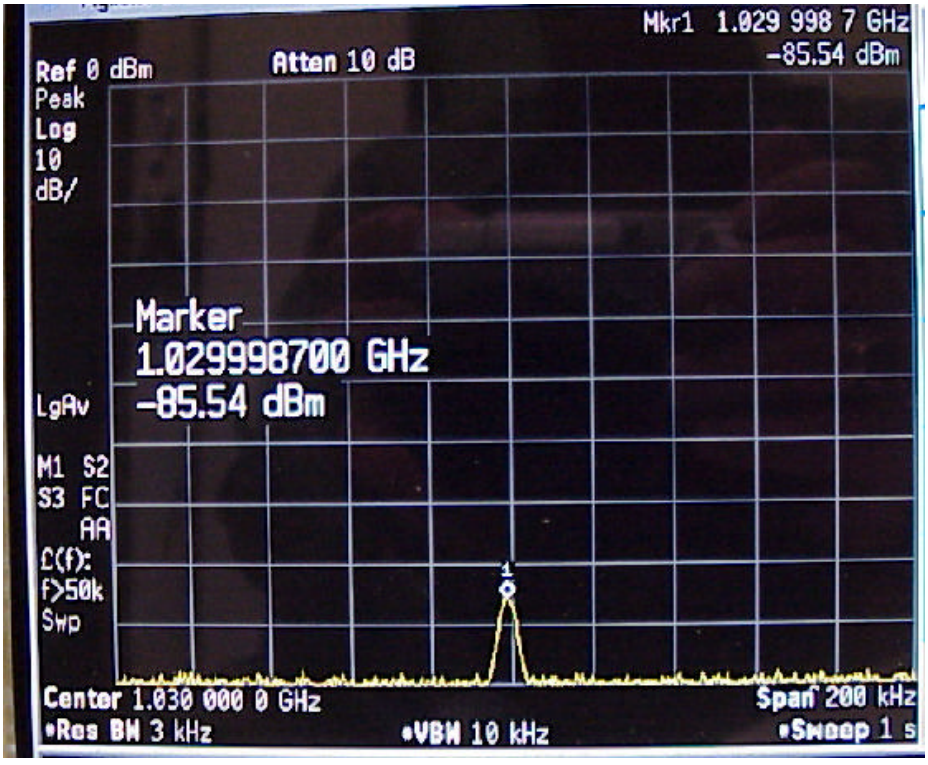

Figure 50: Top Antenna L.O. Leakage

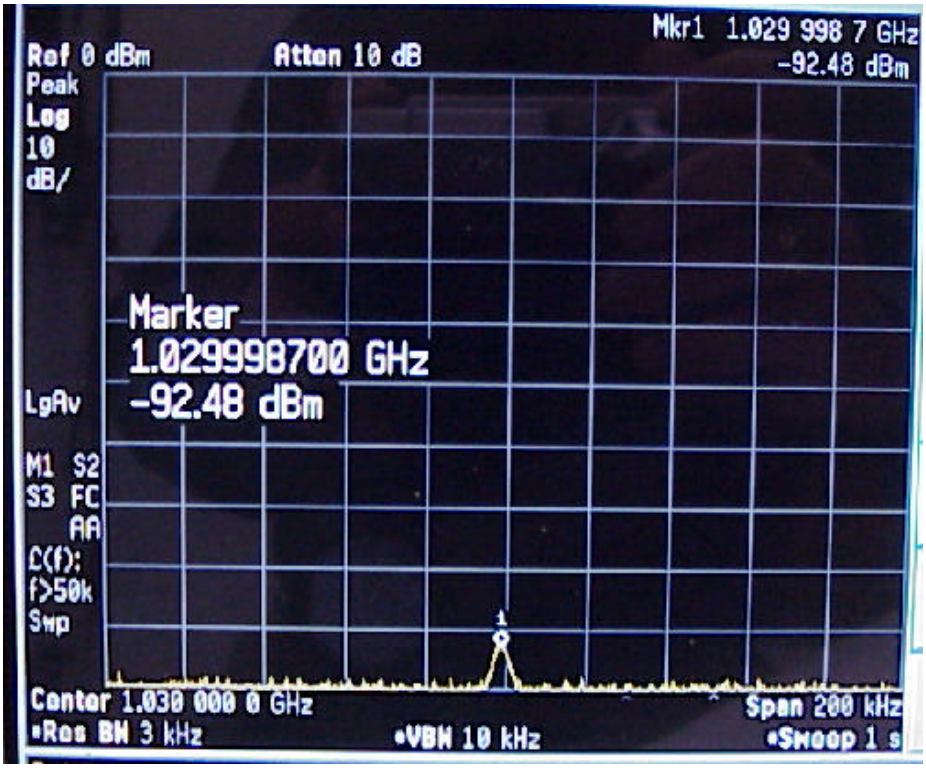

Figure 51: Bottom Antenna L.O. Leakage

8.5 Field Strength of Spurious Radiation

47CFR References:
2.1053, Field Strength of Spurious Radiation
15.109, Radiated Emission Limits
15.31, Measurement Standards
15.33, Frequency Range of Radiated Measurements
87.139, Emissions Limitations

Per 47CFR15.109, the following limits on radiated emissions apply to T²CAS because it contains digital devices:

Frequency (MHz)	Field Strength (microvolts/meter)	** Measurement Distance (meters)
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

** Measurements will be taken at 3m.

Table 14: Allowable radiated emissions levels for units containing digital devices per 47CFR15.109

47CFR15.31 para (i) states that the emission tests shall be performed with the device and accessories configured in a manner that tends to produce maximized emissions within the range of variations that can be expected under normal operating conditions. In order to accomplish this, the T2CAS will be operated in Test Mode 2 (Mode S, long P6, DPSK modulation, Test Mode Program switches on System Panel to UUDU) during the emissions tests.

Per 47CFR15.33 para (a) (1), because T2CAS operates below 10 Ghz, the 10th harmonic of the highest frequency or to 40 Ghz, whichever is lower, shall be used for the upper frequency of the measurement range.

47CFR15.33 para (b) (3) states that receivers employing superheterodyne techniques controlled by digital devices shall be investigated up to the higher of the 2nd harmonic of the highest local oscillator frequency generated in the device or the upper frequency of the measurement range of the digital device. Thus, a check for emissions at the first two harmonics of the fundamental frequency (1030 Mhz) will be done with the TCAS portion of the T2CAS unit in an idle (non-transmitting) state.

8.5.1 Field Strength of Spurious Radiation

The T2CAS model TT-952 unit will be subjected to the full suite of FCC compliance tests.

8.5.1.1 Field Strength of Spurious Radiation Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model
A	T2CAS Computer	ACSS	RT-950
B	TCAS 2000 System Panel	ACSS	9000121-001
C	Termination	ATTA	N4425-10
D	Antenna, Biconical	Emco	3109
E	Antenna, Log Per.	Aprel	AL-2001
F	Antenna, Horn	Aprel	AH-118
G	Spectrum Analyzer	Hewlett-Packard	HP8566B
H	Preselector	Hewlett-Packard	85685A
I	Quasi-Peak	Hewlett-Packard	85650A

Table 15: Field Strength of Spurious Radiation Test Equipment Required

8.5.1.2 Field Strength of Spurious Radiation Test Setup

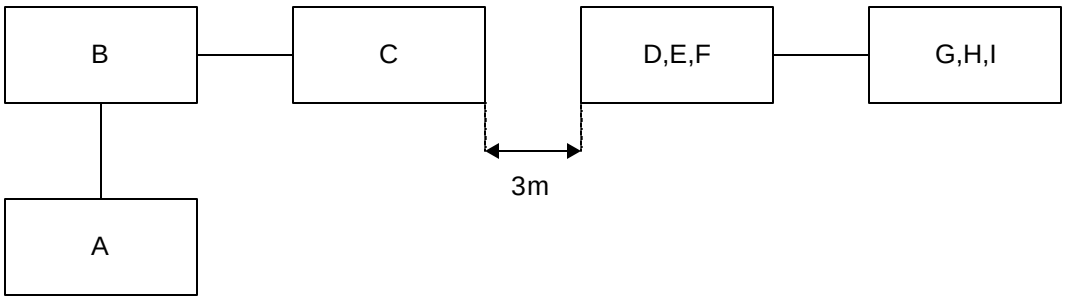

Figure 52: Field Strength of Spurious Radiation Test Setup

8.5.2 Field Strength of Spurious Radiation Test Procedure

1. Connect the equipment as shown in Figure 52 above.
2. Configure the TCAS System Panel to invoke Test Mode 2 (Mode S, long P6, DPSK modulation, Test Mode Program switches on System Panel to DDUD).
3. Measure and record all spurious emissions using the appropriate antenna in the frequency ranges indicated in Table 14 at a distance of 3 meters.
4. Calculate the field strength at 3m using the recorded power measurement, antenna factor and cable loss for each frequency.

8.5.3 Field Strength of Spurious Radiation Test Data

8.5.3.1 TT-952 (6MCU) Radiated Test Data

Refer to Appendix A for the test data and plots for the TT-952.

8.5.3.2 TT-952 (6MCU) Conducted Test Data

Refer to Appendix B for the test data and plots for the TT-952.

8.6 Frequency Stability

8.6.1 Frequency Stability (Temperature Variation)

47CFR Reference:
2.1055, Frequency Stability
15.31, Measurement Standards
87.133, Frequency Stability

8.6.1.1 Frequency Stability (Temperature Variation) Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model	Asset#	Cal Date
A	T2CAS Computer	ACSS	RT-952	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	

D	Attenuator	Narda	765-20	NA	
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	23/7/03
F	Spectrum Analyzer	Hewlett-Packard	HP8592L	1025	6/11/03

Table 16: Frequency Stability (Temperature Variation) Test Equipment Required

8.6.1.2 Frequency Stability (Temperature Variation) Test Setup

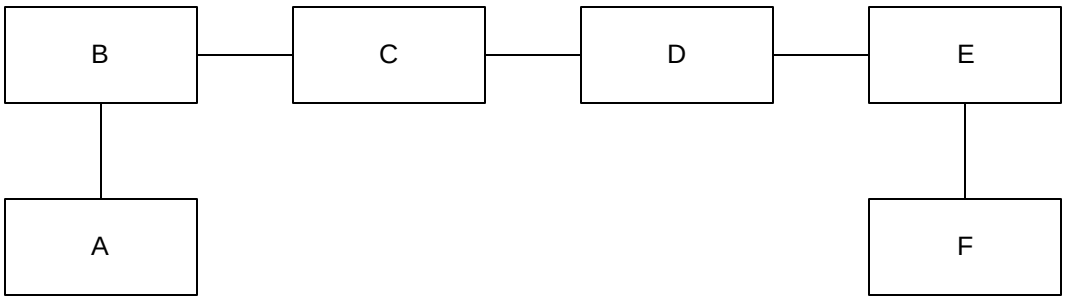

Figure 53: Frequency Stability (Temperature Variation) Test Setup

8.6.1.3 Frequency Stability (Temperature Variation) Test Procedure

1 Connect the equipment as shown in Figure 53 above.
2 Configure the TCAS 2000 System Panel to invoke Test Mode 3 (Mode S, Long P6, No DPSK Modulation, Test Mode Program switches on System Panel to DDUU).
3 Set the temperature chamber to - 50°C and allow the transmitter (non-operating) temperature to stabilize.
4 Apply power to the unit and record the transmission frequency for both the top and bottom antennas.
5 Repeat steps 3 and 4 at –40°C, -30°C, -20°C, -10°C, 0°C, +10°C, +20°C, +30°C, +40°C,+50°C, +60°C, +70°C, and +80°C. Perform the test for both +28VDC and +115VAC power.
6 Record results in tables similar to Table 17 and Table 18 below.

Table 17: Frequency Stability (Temperature Variation, 115 VAC Power Supply) Test Results Example Table

	115VAC POWER SUPPLY					
TEMP C	TOP 0 DEGREE ANTENNA		BOT 0 DEGREE ANTENNA		FREQ LIMIT	POWER LIMIT
	POWER OUT	FREQUENCY	POWER OUT	FREQUENCY		
-50	55.214	1.0300013	55.245	1.0299978	<.01MHz	>54dBm
-40	55.243	1.0300007	55.268	1.0299979	<.01MHz	>54dBm
-30	55.248	1.0300017	55.272	1.0299981	<.01MHz	>54dBm
-20	55.241	1.0300012	55.275	1.0299987	<.01MHz	>54dBm
-10	55.248	1.0300008	55.251	1.0299988	<.01MHz	>54dBm
0	55.237	1.0300011	55.248	1.0299989	<.01MHz	>54dBm
10	55.223	1.0300008	55.234	1.0299992	<.01MHz	>54dBm
20	55.231	1.0300005	55.228	1.0299998	<.01MHz	>54dBm
30	55.235	1.0300022	55.238	1.0299997	<.01MHz	>54dBm

40	55.209	1.0300016	55.204	1.0299992	<.01MHz	>54dBm
50	55.184	1.0300011	55.198	1.0299997	<.01MHz	>54dBm
60	55.145	1.0300016	55.156	1.0299990	<.01MHz	>54dBm
70	55.114	1.0300012	55.108	1.0299992	<.01MHz	>54dBm
80	55.118	1.0300016	55.098	1.0299997	<.01MHz	>54dBm

	28VDC POWER SUPPLY					
TEMP C	**TOP 0 DEGREE ANTENNA**		**BOT 0 DEGREE ANTENNA**		**FREQ LIMIT**	**POWER LIMIT**
	POWER OUT	**FREQUENCY**	**POWER OUT**	**FREQUENCY**		
-50	55.204	1.0300013	55.235	1.0299976	<.01MHz	>54dBm
-40	55.267	1.0300000	55.298	1.0299978	<.01MHz	>54dBm
-30	55.268	1.0300016	55.282	1.0299995	<.01MHz	>54dBm
-20	55.251	1.0300005	55.283	1.0299984	<.01MHz	>54dBm
-10	55.204	1.0300016	55.220	1.0299995	<.01MHz	>54dBm
0	55.218	1.0300005	55.204	1.0299995	<.01MHz	>54dBm
10	55.142	1.0300022	55.111	1.0299995	<.01MHz	>54dBm
20	55.157	1.0300022	55.126	1.0299995	<.01MHz	>54dBm
30	55.157	1.0300016	55.095	1.0299995	<.01MHz	>54dBm
40	55.111	1.0300011	55.079	1.0299992	<.01MHz	>54dBm
50	55.064	1.0300011	55.017	1.0299989	<.01MHz	>54dBm
60	55.111	1.0300027	54.986	1.0300022	<.01MHz	>54dBm
70	55.097	1.0300016	54.928	1.0300012	<.01MHz	>54dBm
80	55.064	1.0300022	54.889	1.0300011	<.01MHz	>54dBm

Table 18: Frequency Stability (Temperature Variation, +28 VDC Power Supply) Test Results Example Table

8.6.2 Frequency Stability (Primary Power Variation)

47CFR Reference:
2.1055, Frequency Stability
15.31, Measurement Standards
87.133, Frequency Stability

47CFR15.31 (e) states that measurements of the radiated signal level of the fundamental frequency component of the emission shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

For the 28 vdc power, 85%/115% = 23.8 vdc/32.2 vdc,. and 23 vdc & 33 vdc will be used.

For the 115 vac power, 85%/115% = 97.75 vac/132.25 vac and 97vac & 133vac will be used

8.6.2.1 Frequency Stability (Primary Power Variation) Test Equipment Required

Block Diagram Reference	**Type**	**Manufacturer**	**Model**	**Asset#**	**Cal Date**
A	T2CAS Computer	ACSS	RT-952	NA	

B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	
D	Attenuator	Narda	765-20	NA	
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	23/7/03
F	Spectrum Analyzer	Hewlett-Packard	HP8592L	1025	6/11/03

Table 19: Frequency Stability (Primary Power Variation) Test Equipment Required

8.6.2.2 Frequency Stability (Primary Power Variation) Test Setup

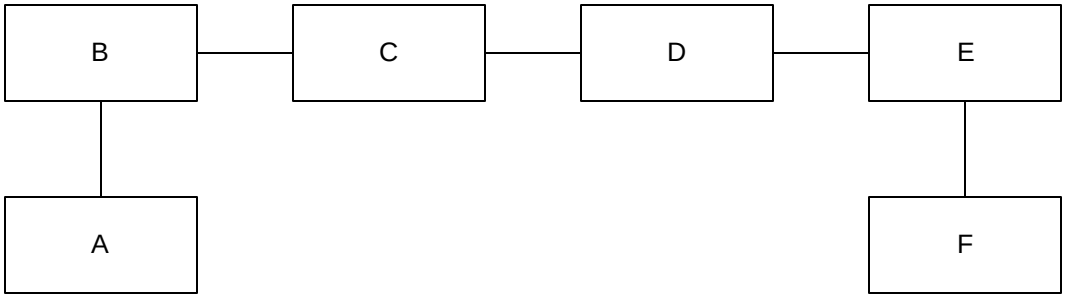

Figure 54: Frequency Stability (Primary Power Variation) Test Setup

8.6.2.3 Frequency Stability (Primary Power Variation) Test Procedure

1 Connect the equipment as shown in the block diagram above.
2 Configure the TCAS 2000 System Panel to invoke Test Mode 3 (Mode S, Long P6, No DPSK Modulation, Test Mode Program switches on System Panel to DDUU).
3 Apply +28VDC power to the unit and vary the primary power by +/-15% to the values shown in Table 20. Record the transmission frequency and power out for both the top and bottom antennas in a table similar to Table 20 shown below.
4 Repeat step 3 for +115VAC power.

Frequency Stability (Primary Power Variation) 115 VAC					
Power Supply Voltage (VRMS)	**Measured Frequency Top 0 Degree Ant Port**	**Measured Power Top 0 Degree Ant Port**	**Measured Frequency Bot 0 Degree Ant Port**	**Measured Power Bot 0 Degree Ant Port**	**Limits Frequency**
97	1.0299980	55.251	1.0299989	54.943	1.03 +/- .01 GHZ
115	1.0300008	55.126	1.0299979	54.986	1.03 +/- .01 GHZ
133	1.0299983	55.189	1.0299988	54.939	1.03 +/- .01 GHZ
Frequency Stability (Primary Power Variation) +28 VDC					

Power Supply Voltage (VDC)	Measured Frequency Top 0 Degree Ant Port	Measured Power Top 0 Degree Ant Port	Measured Frequency Bot 0 Degree Ant Port	Measured Power Bot 0 Degree Ant Port	Limits Frequency
23	1.0299986	55.189	1.0299991	54.939	1.03 +/- .01 GHZ
28	1.0299989	55.230	1.0299986	54.988	1.03 +/- .01 GHZ
33	1.0300003	55.251	1.0299986	55.001	1.03 +/- .01 GHZ

Table 20: Frequency Stability (Primary Power Variation) Test Results Example Table

9 APPENDIX A: TT-952 (6MCU) RADIATED EMISSIONS

9.1 Class B Spurious Emissions (Radiated)

9.1.1 Class B Spurious Emissions (Radiated) Mode 2 (Transmitting)

All data was taken in mode #2, transmitting into a dummy load. The tables below reflect the measured data and the limit. The pass/fail results for the measured data were calculated on the following methods:

- 10KHz - 150 KHz: Averaged Measurement
- 150KHz – 1GHz: Quasi-Peak Measurement
- 1- 10GHz: Average Measurement

000 Deg Horizontal

Emissions Level (MHz)	Level @ 3 Meters dBuV/m	Calculated Level @ 3 Meters dBuV/m	Limit dBuV/m	Peak Or Average
1030.00	74.7	67.5		Peak
1030.00	61.3	52.9	54	Average
2060.00	61.1	54.6		Peak
2060.00	52.4	48.2	54	Average
3090.00	65.2	58.3		Peak
3090.00	48.2	42.9	54	Average

000 Deg Vertical

Emissions Level (MHz)	Level @ 3 Meters dBuV/m	Calculated Level @ 3 Meters dBuV/m	Limit dBuV/m	Peak Or Average
1030.00	92.5	79.6		Peak
1030.00	59.4	51.8	54	Average
2060.00	74.6	63.2		Peak
2060.00	52.1	45.7	54	Average
3090.00	57.7	54.2		Peak
3090.00	47.6	39.5	54	Average
4120.00	61.3	57.4		Peak
4120.00	44.8	36.8	54	Average

180 Deg Horizontal

Emissions Level (MHz)	Level @ 3 Meters dBuV/m	Calculated Level @ 3 Meters dBuV/m	Limit dBuV/m	Peak Or Average
1030.00	84.1	74.9		Peak

1030.00	59.4	51.3	54	Average
2060.00	70.5	61.4		Peak
2060.00	51.8	47.1	54	Average
3090.00	71.4	61.8		Peak
3090.00	46.7	41.3	54	Average

180 Deg Vertical

Emissions Level (MHz)	Level @ 3 Meters dBuV/m	Calculated Level @ 3 Meters dBuV/m	Limit dBuV/m	Peak Or Average
1030.00	84.0	74.6		Peak
1030.00	59.1	51.0	54	Average
2060.00	69.0	58.9		Peak
2060.00	49.4	42.3	54	Average
3090.00	53.8	45.4		Peak
3090.00	44.6	40.9	54	Average

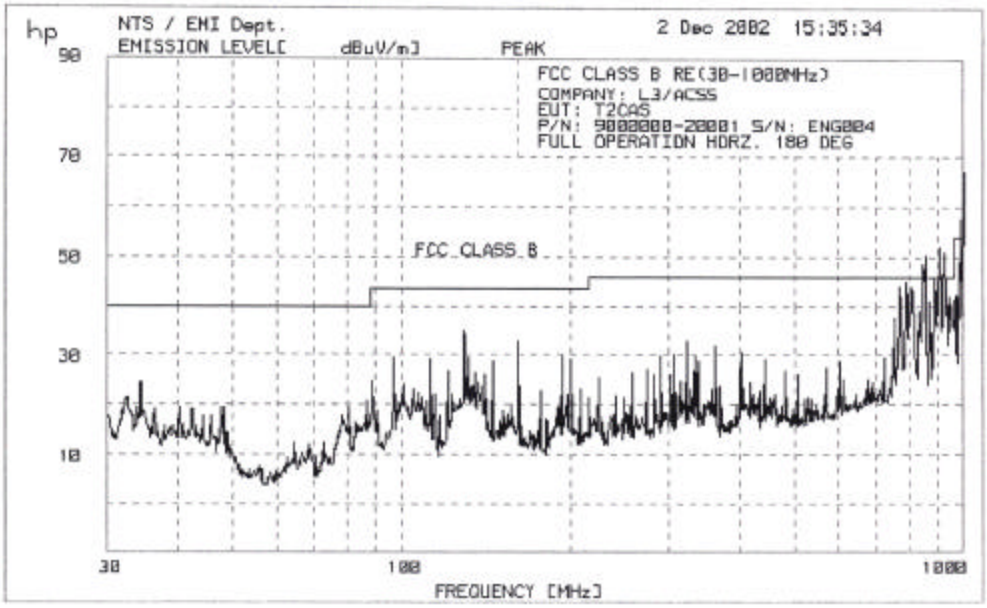

Figure 55: 6MCU, Radiated, Mode 2, 30MHz-1GHz, 180Degree, Horizontal

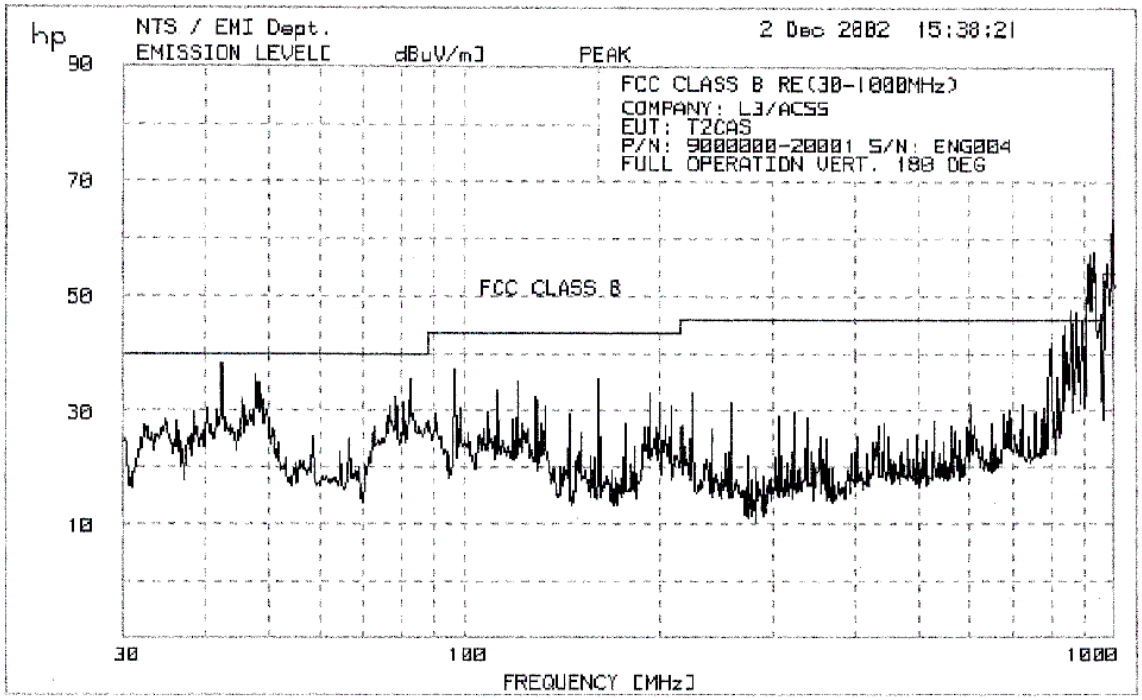

Figure 56: 6MCU, Radiated, 30MHz-1GHz, 180 Degree, Vertical

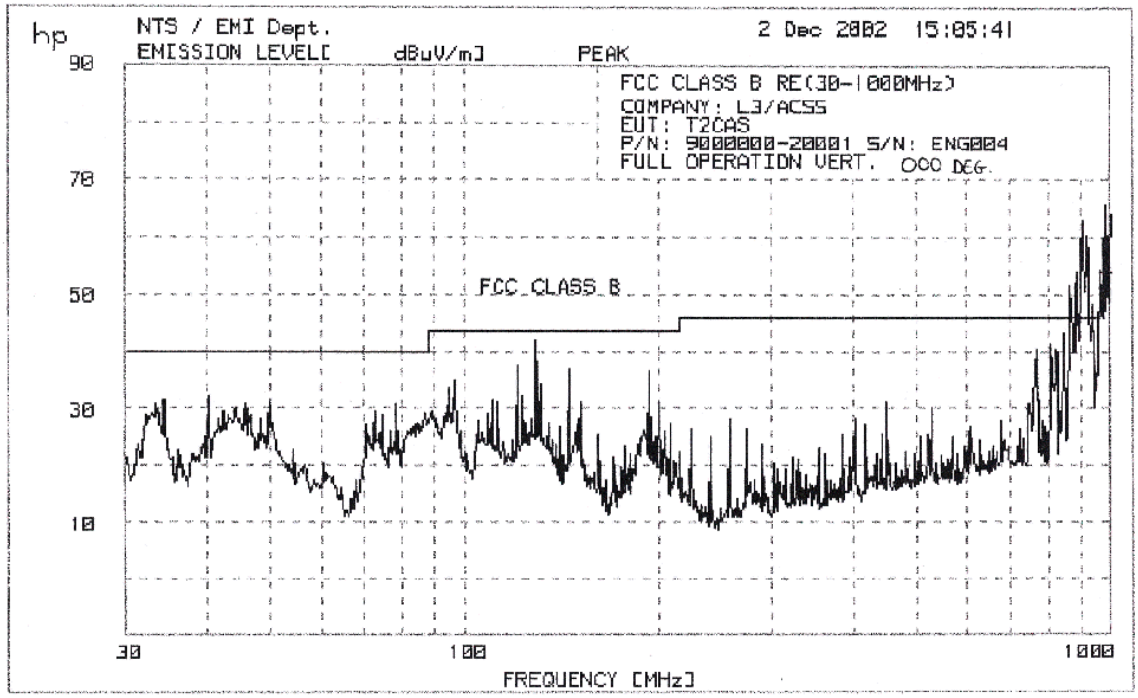

Figure 57: 6MCU, Radiated, 30MHz-1GHz, 000 Degree, Vertical

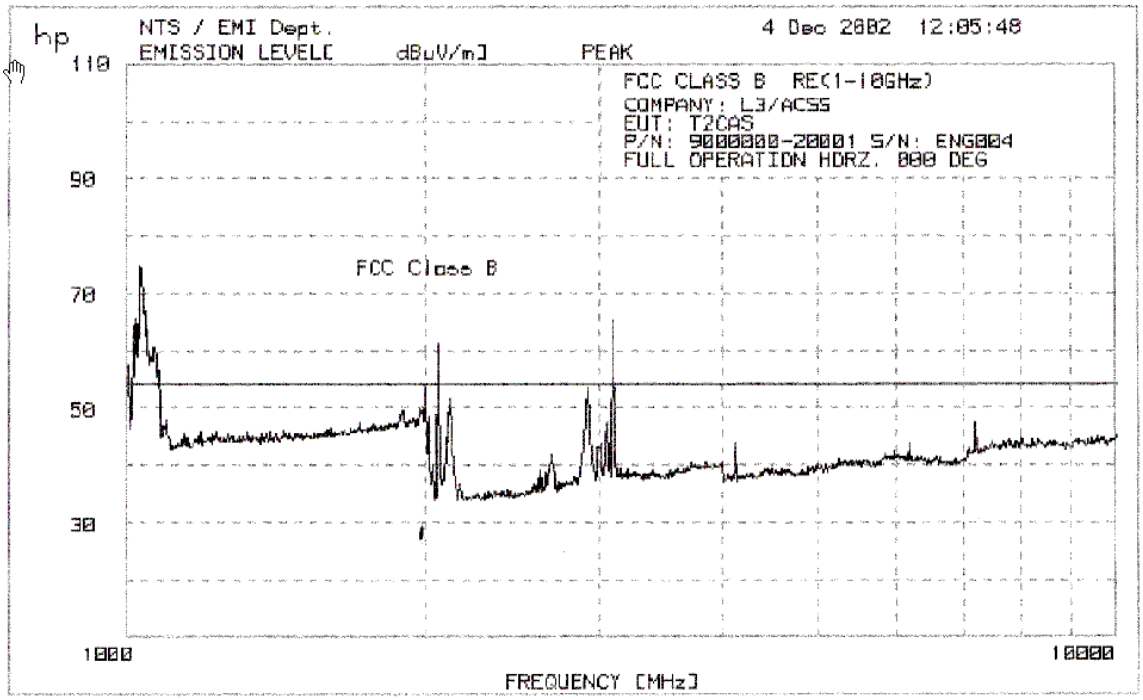

Figure 58: 6MCU, Radiated, 1-10GHz, 000 Degree, Horizontal

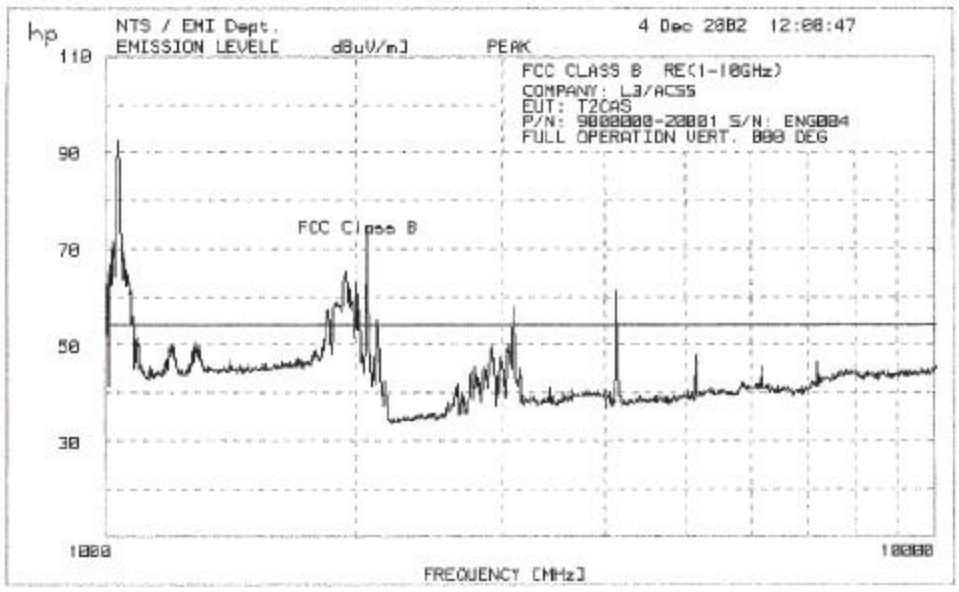

Figure 59: 6MCU, Radiated, 1-10GHz, 000 Degree, Vertical

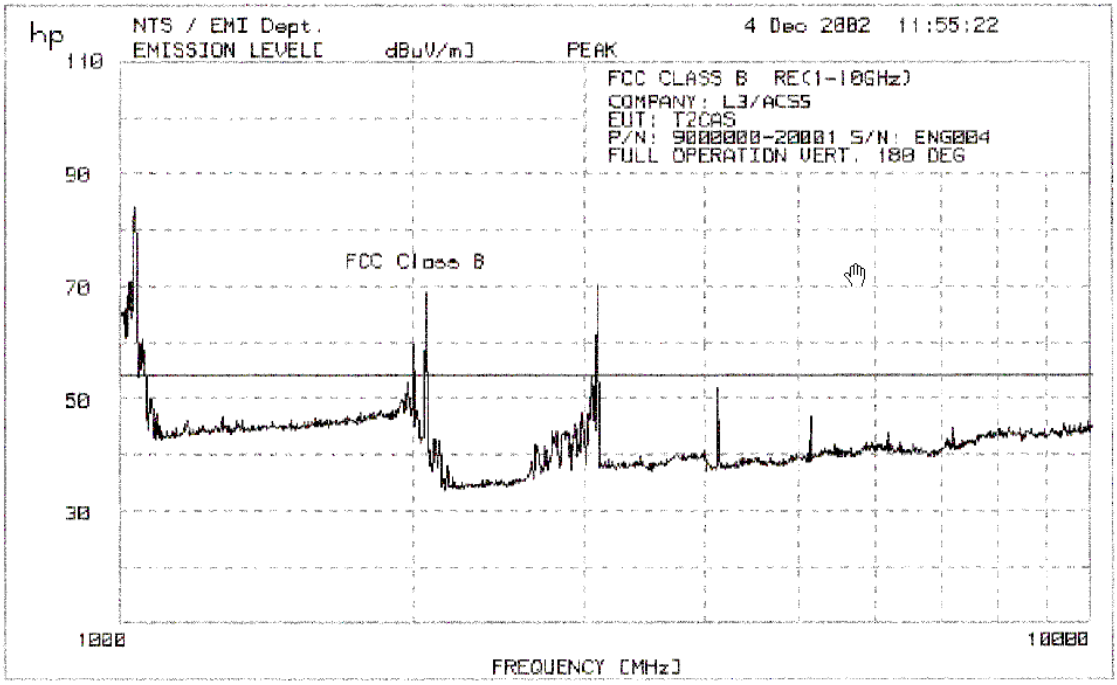

Figure 60: 6MCU, Radiated, 1-10GHz, 180 Degree, Vertical

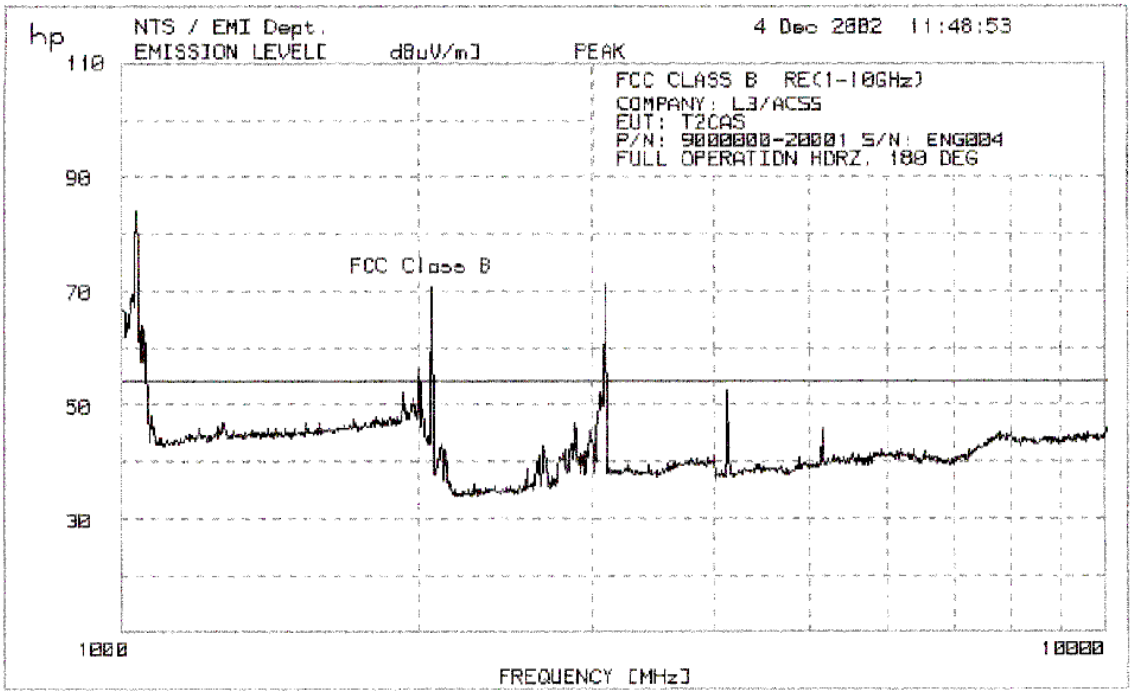

Figure 61: 6MCU, Radiated, 1-10GHz, 180 Degree, Horizontal

9.1.2 Class B Spurious Emissions (Radiated) Standby Mode (Non-Transmitting)

Transmitting in standby mode for the first two harmonics to measure local oscillator leakage. All other data taken while transmitting into a dummy load.

(2)

NTS

Radiated Emission Test Data Sheet

CUSTOMER: L3/ACSS	MJO No: 271-1729
TEST ITEM: T2CAS	P/N: 9000000-2000/
MODEL:	S/N: ENG-001
TESTED BY: MARK TRAN	DATE: 1/13/03
ENGINEER:	NTS QA
SPECIFICATION: FCC [redacted] Class: B	

Frequency (MHz)	Vert/ Horiz	Receiver Reading (dBµV)	Ant. Factor (dB/m)	Pre-Amp. Gain (dB)	Actual Reading (dBµV/m)	Limit (dBµV/m)	EUT Position (Degree)	Antenna Height (m)	Delta (dB)	Pass/ Fail
4129.6	V	59.6	32.6	41.7	50.5	54	0	1.0	-3.5	P
2003.1	V	53.2	27.7	31.8	49.1	54	0	1.0	-4.9	P
4124.6	V	62.7	32.6	41.7	53.6	54	180	1.0	-.4	P
7213.4	V	54.93	36.87	39.6	52.2	54	180	1.0	-1.8	P
1993.9	V	64.2	27.7	42.5	49.4	54	180	1.0	-4.6	P
8000.1	V	52.35	37.15	40.8	48.7	54	180	1.0	-5.3	P
1953	H	64.2	27.7	42.5	49.4	54	0	1.0	-4.6	P
4124.6	H	57.3	32.6	41.7	48.2	54	0	1.0	-5.8	P
5155.7	H	53.2	33.5	40.7	46	54	0	1.0	-8.0	P
4129.6	H	70	32.6	41.7	60.9	54	180	1.0	6.9	
2003.1	H	54	27.7	31.8	49.9	54	180	1.0	-4.1	P
5155.7	H	54.6	33.5	40.7	47.4	54	180	1.0	-6.6	P

Notes:

1. 10kHz - 150kHz: ***Average*** Measurement
2. 150kHz - 1GHz: ***Quasi-Peak*** Measurement
3. 1 - 10GHz: ***Average*** Measurement *(GR-1089 only)*

Figure 62: 6MCU Radiated Test Results

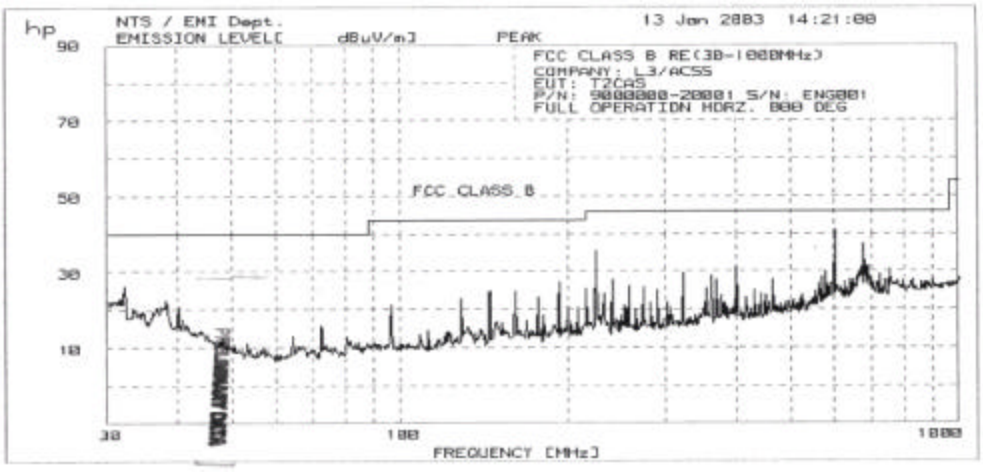

Figure 63: 6MCU, Radiated, 30MHz-1GHz, 000 Deg, Horizontal

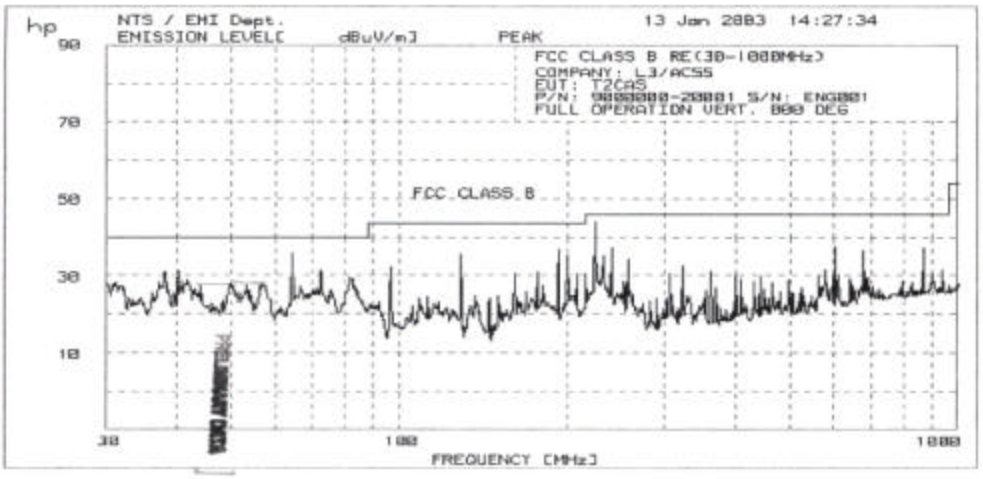

Figure 64: 6MCU, Radiated, 30MHz-1GHz, 000 Deg, Vertical

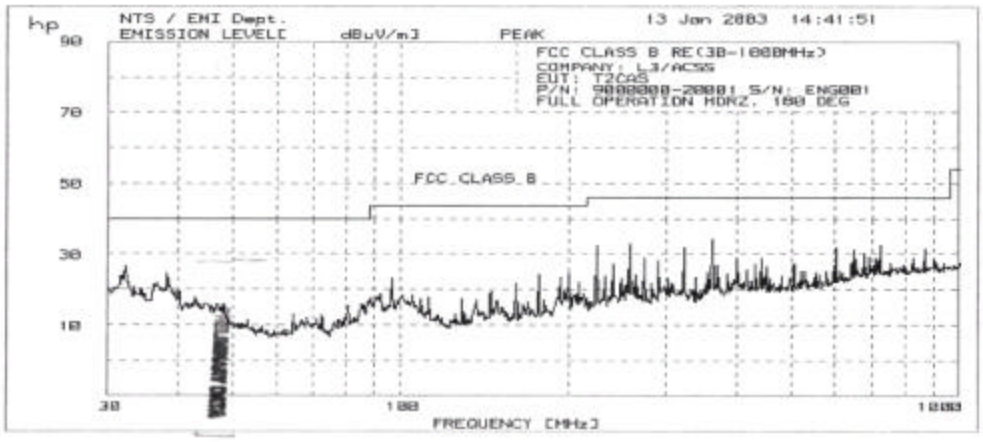

Figure 65: 6MCU, Radiated, 30MHz-1GHz, 180 Deg, Horizontal

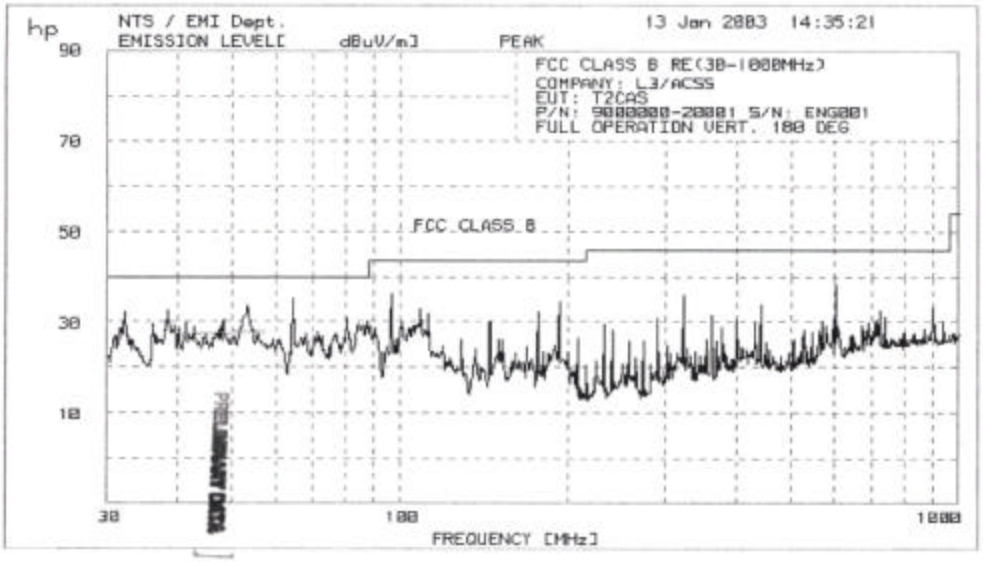

Figure 66: 6MCU, Radiated, 30MHz-1GHz, 180 Deg, Vertical

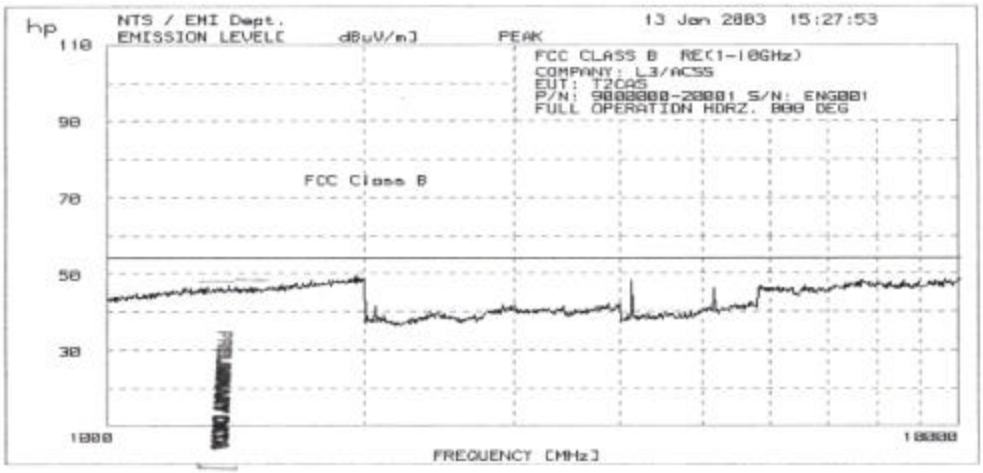

Figure 67: 6MCU, Radiated, 1-10GHz, 000 Deg, Horizontal

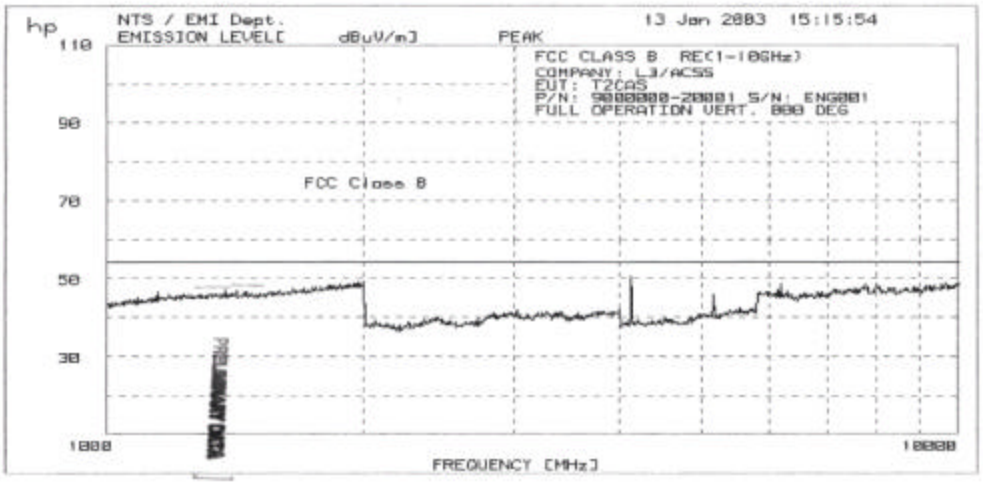

Figure 68: 6MCU, Radiated, 1-10GHz, 000 Deg, Vertical

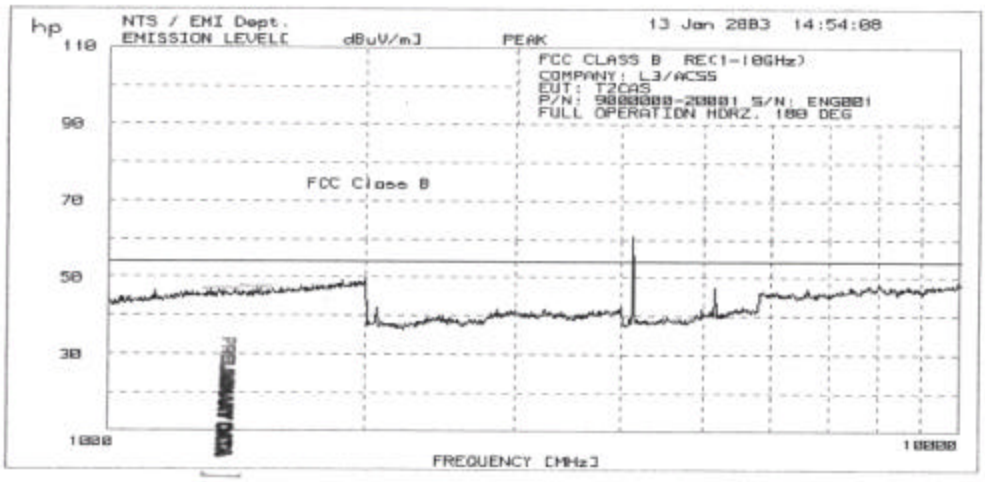

Figure 69: 6MCU, Radiated, 1-10GHz, 180 Deg, Horizontal

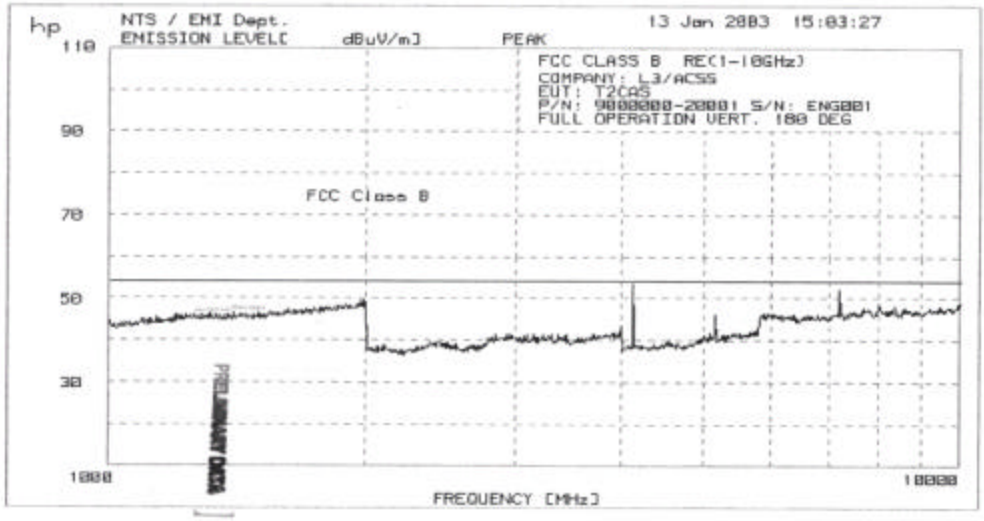

Figure 70: 6MCU, Radiated, 1-10GHz, 180 Deg, Vertical

10 APPENDIX B: TT-952 (6MCU) CONDUCTED EMISSIONS

NTS (3)

CONDUCTED EMISSION TEST DATA SHEET

CUSTOMER: L3 COMMUNICATIONS	MJO NO.: 271-1729
TEST ITEM: TTCAS	P/N: 9000000-20001
MODEL:	S/N: ENG0001
TEST BY: MARK TRAIN	DATE: 12/4/02 PAGE OF
ENGINEER:	NTS QA / GOVT
SPECIFICATION: FCC Class B	

CONDUCTED EMISSION (450 kHz - 30 MHz)
AC Power Leads - Voltage

Tested Line: HIGH

Frequency (MHz)	Actual Reading (dBµV)	Limits (dBµV)	Delta (dB)	Results (Pass/Fail)	Remarks
1.701	35.1	47.96	-12.86	PASS	
.5019	37.6	47.96	-10.36	PASS	
.9875	36.6	47.96	-11.36	PASS	
3.516	27.6	47.96	-20.36	PASS	
16.12	37.4	47.96	-10.56	PASS	
10.08	31.6	47.96	-16.36	PASS	

Tested Line: RETURN

Frequency (MHz)	Actual Reading (dBµV)	Limits (dBµV)	Delta (dB)	Results (Pass/Fail)	Remarks
1.23	35.1	47.96	-12.86	PASS	
.4998	41.7	47.96	-6.26	PASS	
16.06	42.1	47.96	-5.9	PASS	
10.09	40.9	47.96	-7.1	PASS	
3.606	40.8	47.96	-7.2	PASS	
9.716	38.8	47.96	-9.2	PASS	

Note: A *Quasi-Peak* detector **should** be used

Figure 71: 6MCU, Conducted Test Results

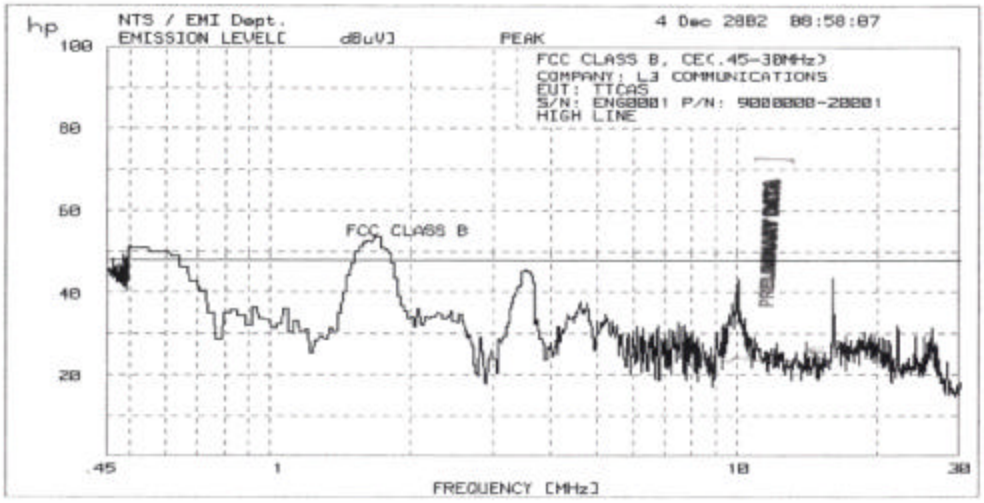

Figure 72: 6MCU, Conducted, High Line

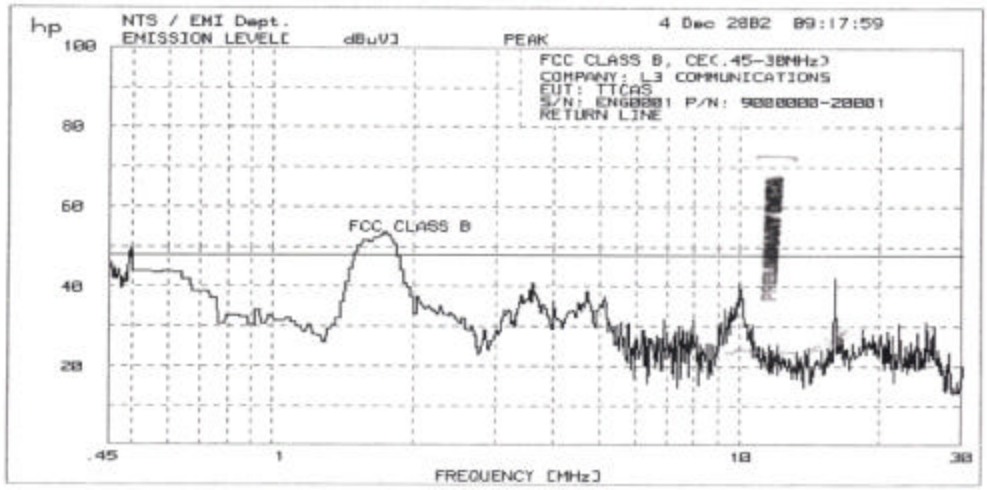

Figure 73: 6MCU, Conducted, Return Line