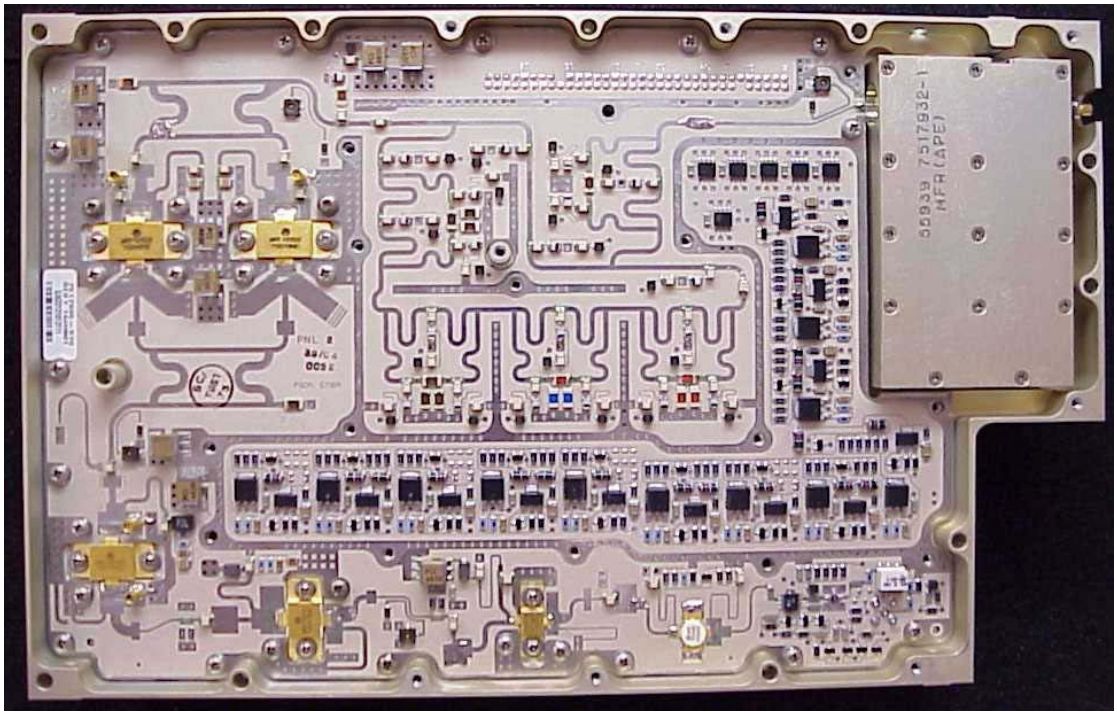

Figure 29: View of A3 Transmitter Assembly, Cover Removed, Side A

6 FCC COMPLIANCE TEST PLAN

6.1 FCC Compliance Overview

The Code of Federal Regulations, Title 47, Volume 1, Part 2, Subpart J (47CFR2.xxxx) provides procedures for radio frequency equipment to be authorized by the FCC. Certification is an equipment authorization issued by the commission, based on representations and test data submitted by the applicant. Certification attaches to all units subsequently marketed by the grantee which are identical (see section 6.1.2) to the sample tested except for permissive changes or other variations authorized by the commission.

6.1.1 FCC Identifier

47CFR2.924 states that equipment, which has been authorized by the FCC, bears an FCC Identifier. Equipment, which has been authorized, may be marketed under different model/type numbers or trade names without additional authorization from the commission, provided that such devices are electrically identical and the equipment bears an FCC Identifier validated by a grant of equipment authorization.

6.1.2 Changes in Certified Equipment

47CFR2.907, 8 defines Identical as either being units whose variances fall within those expected to arise as a result of quantity production techniques, or those that have been changed where the change meets the criteria of a *permissive change*.

47CFR2.1043 states that changes to the basic frequency determining and stabilizing circuitry (including clock or data rates), frequency multiplication stages, basic modulator circuit or maximum power or field strength ratings shall not be performed without application for and authorization of a new grant of certification.

Variations in electrical or mechanical construction, other than the above indicated items, are permitted provided the variations either do not affect the characteristics required to be reported to the commission or are made in compliance with other provisions in 47CFR2.1043

Two classes of permissive changes may be made in certified equipment without requiring a new application for and grant of certification. Neither class of change shall result in a change of identification.

- A Class I permissive change includes those modifications in the equipment that do not degrade the characteristics reported by the manufacturer and accepted by the commission when certification is granted (i.e., power, frequency, etc.). *No filing with the commission is required for a Class I permissive change.*

- A Class II permissive change includes those modifications that degrade the performance characteristics as reported to the commission at the time of initial certification.

6.2 TCAS 3000 Units Similarity to Predecessor TCAS 2000 Unit

The TCAS 3000 units evolved from the predecessor TCAS 2000 unit. The TCAS 3000 units utilize the same TCAS circuit boards that the predecessor TCAS 2000 units utilize. These TCAS circuit boards have been previously certified with the FCC in the predecessor TCAS 2000 unit. Two TCAS 3000 units may be powered by either AC or DC power, and the third TCAS 3000 unit is powered exclusively from a DC power source.

6.3 TCAS 3000 Units to be Subjected to FCC Compliance Testing

The TCAS 3000 6MCU unit will be subjected to the full suite of FCC compliance tests with the resulting data submitted to the FCC for certification. Due to mechanical differences, the TCAS 3000 4MCU unit will be subjected for the field strength of spurious radiation testing only.

6.4 All Three TCAS 3000 Units Considered Identical

For the majority of FCC compliance testing and certification, all three TCAS 3000 units will be considered identical. Photographs of the TCAS 3000 units illustrating the assembly drawings, including markings, are shown in Figures 3 – 29. All original photographs are available for inspection. Differences exist between the three TCAS 3000 units, however these differences fall within the definition of a Class I permissive change because the items which provide the transmit and receive functions (the TCAS circuit boards and their software) are the same in all three TCAS 3000 units.

6.4.1 Conclusion

The full suite of FCC compliance tests were performed on a TCAS 3000 6MCU unit (9003000-10001). Due to mechanical differences, the TCAS 3000 4MCU unit (9003000-65001) was subjected to field strength of spurious radiation testing only. The 9003000-55001 and 9003000-65001 units are considered identical per the FCC definition. Test data for TCAS 3000 units compliance testing will be submitted to the FCC to apply for a new certification and FCC identifier for the TCAS 3000 family of units.

7 TEST DATA AND FACILITIES

LOCATION OF TEST FACILITIES

All FCC testing were performed at the following facility:

National Technical Systems (NTS)
1536 E. Valencia Drive
Fullerton, California 92831-4797

8 FCC COMPLIANCE TESTS

47CFR2.1041 states that for equipment operating under parts 15 & 18, the measurement procedures are specified in the rules governing the particular device for which certification is requested. For equipment operating in the authorized radio services, measurements are required as specified in sections 2.1046 (RF Power Output), 2.1047 (Modulation Characteristics), 2.1049 (Occupied Bandwidth), 2.1051 (Spurious Emissions at Antenna Terminals), 2.1053 (Field Strength of Spurious Radiation), 2.1055 (Frequency Stability), 2.1057 (Frequency Spectrum to be Investigated).

8.1 RF Power Output

47CFR Reference:
2.1046, RF Power Output
87.135, Power and Emissions

8.1.1 RF Power Output Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model/P/N	Asset#	Cal Date
A	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	7/21/06
D	Attenuator	Narda	765-20	NA	7/21/06
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06
F	Spectrum Analyzer	Hewlett-Packard	HP8592L	1025	9/15/06

Table 7: RF Power Output Test Equipment Required

8.1.2 RF Power Output Test Setup

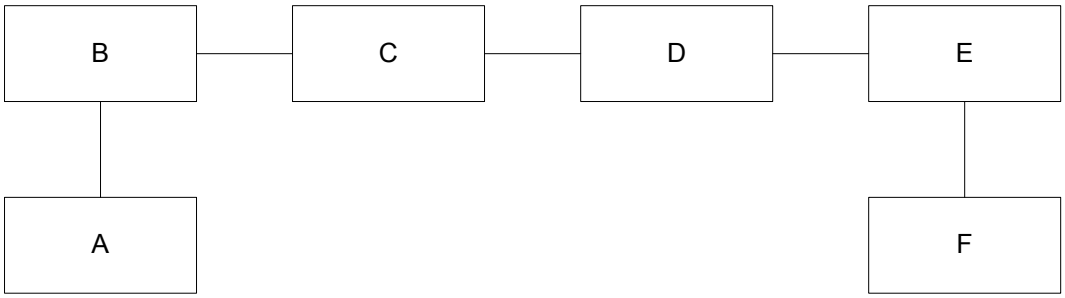

Figure 30: RF Power Output Test Setup

8.1.3 RF Power Output Test Procedure

1. Connect the equipment as shown in Figure 30 above.
2. Configure the TCAS 2000 System Panel to invoke Test Mode 2 (Mode S, Long P6, DPSK Modulation, Test Mode Program switches on System Panel to DDUD) and then

Test Mode 4 (Mode C only all-call interrogation, Test Mode Program switches on System Panel to UDUU).

3. Record the measured output power and frequency as measured on the Peak Power Analyzer and Spectrum Analyzer.

8.1.4 RF Power Output Test Data

Peak power output & frequency measured at top 0 degree antenna port		
Modulation Characteristic	**Measured Power Output (dBm)**	**Measured Frequency (GGz)**
Mode S DPSK Modulation	54.60	1.030,000,950
Mode C Only All Call	54.57	1.030,000,880

Peak power output & frequency measured at bottom 0 degree antenna port		
Modulation Characteristic	**Measured Power Output (dBm)**	**Measured Frequency (GHz)**
Mode S DPSK Modulation	54.46	1.030,000,880
Mode C Only All Call	54.53	1.030,000,005

Table 8: Peak power output and frequency measured at bottom antenna 0 degree port

8.2 Modulation Characteristics

47CFR Reference:
2.1047, Modulation Characteristics
87.141c, Modulation Requirements

8.2.1 Modulation Characteristics Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model/P/N	Asset#	Cal Date
A	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	7/21/06
D	Attenuator	Narda	765-20	NA	7/21/06
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06

Table 9: Modulation Characteristics Test Equipment Required

8.2.2 Modulation Characteristics Test Setup

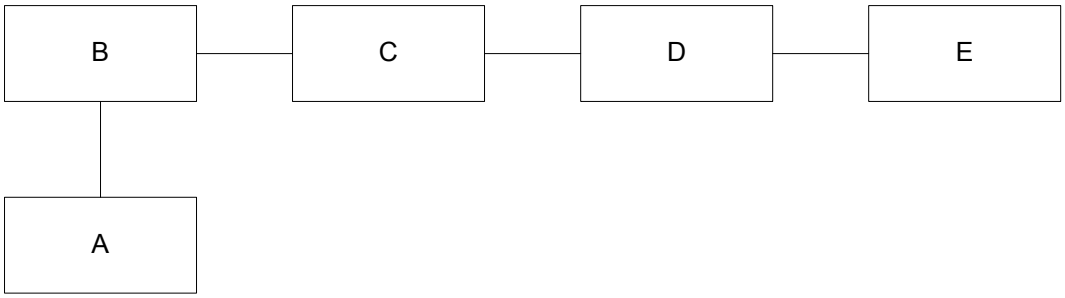

Figure 31: Modulation Characteristics Test Setup

8.2.3 Modulation Characteristics Test Procedure

1. Connect the equipment as shown in Figure 31above.
2. Configure the TCAS 2000 System Panel to invoke Test Mode 2 (Mode S, Long P6, DPSK Modulation, Test Mode Program switches on System Panel to DDUD).
3. Record the modulation characteristics on the Peak Power Analyzer. Capture pictures of the following data to be shown in the test report:
    - Typical ATCRBS or Mode S interrogation pulse showing rise and fall times.
    - Mode S interrogation with DPSK modulation
    - Close up of Mode S interrogation preamble and sync phase reversal
    - ATCRBS Mode C interrogation

8.2.4 Modulation Test Data

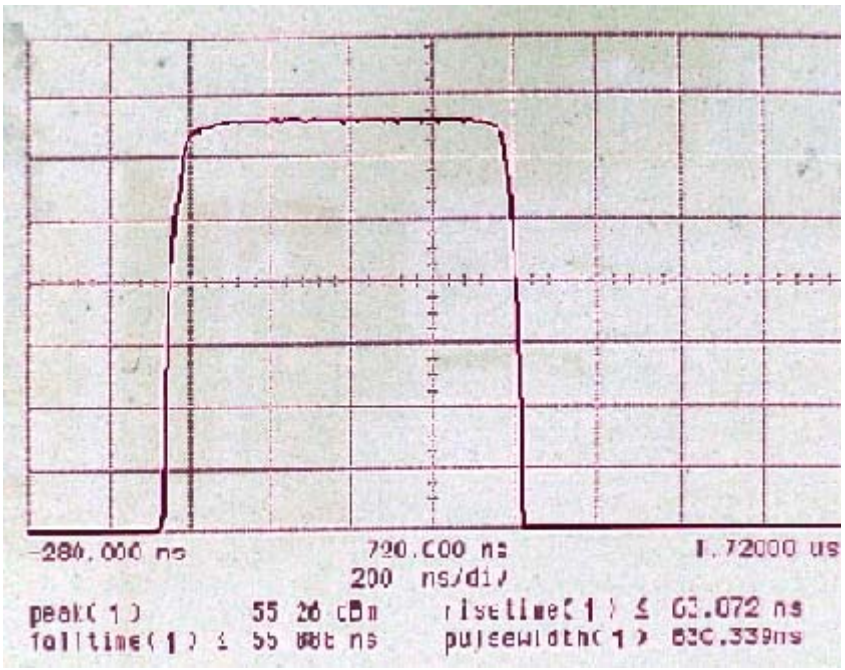

Figure 32: Typical ATCRBS or Mode S Interrogation Pulse Showing Rise and Fall Times

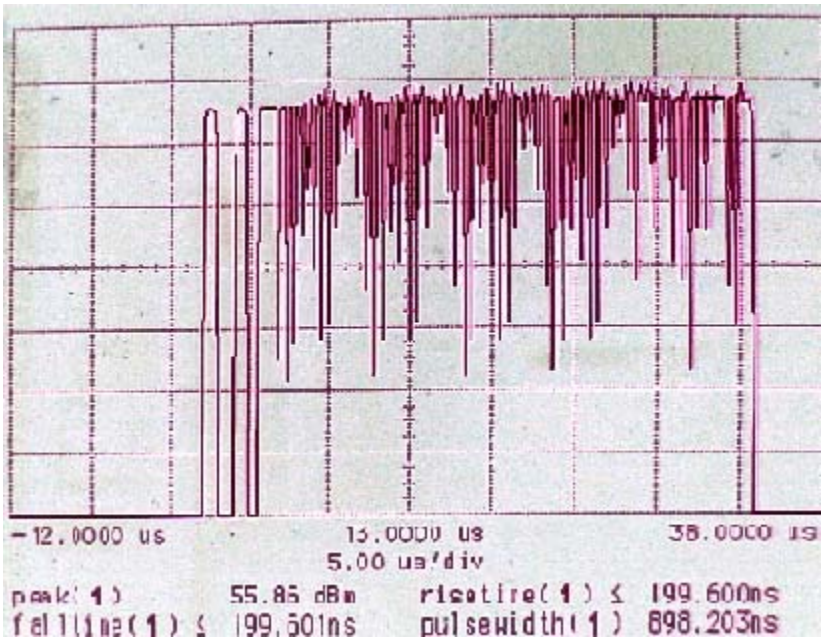

Figure 33: Mode S Interrogation With DPSK Modulation

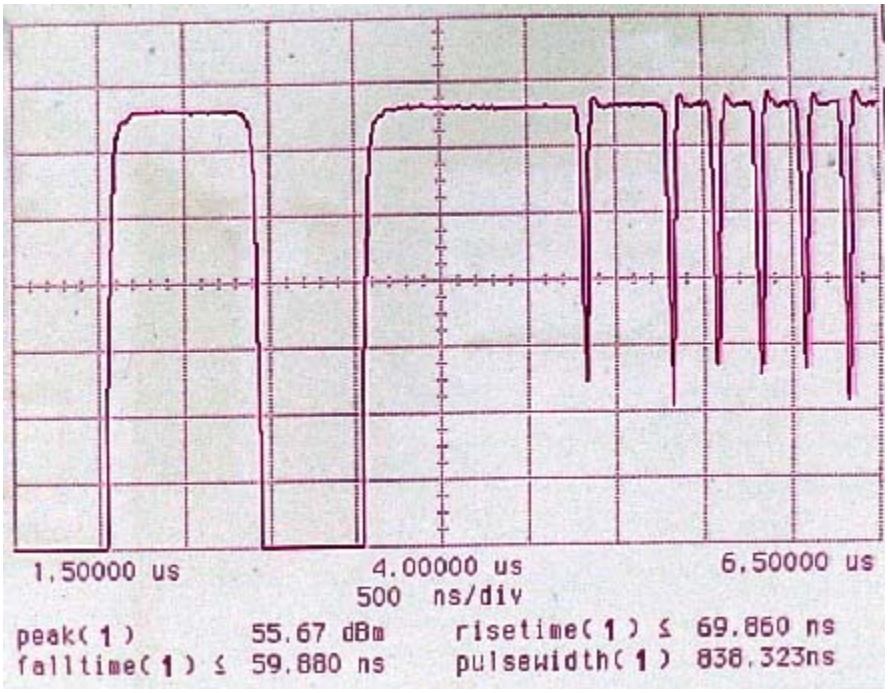

Figure 34: Close Up of Mode S Interrogation Preamble and Sync Phase Reversal

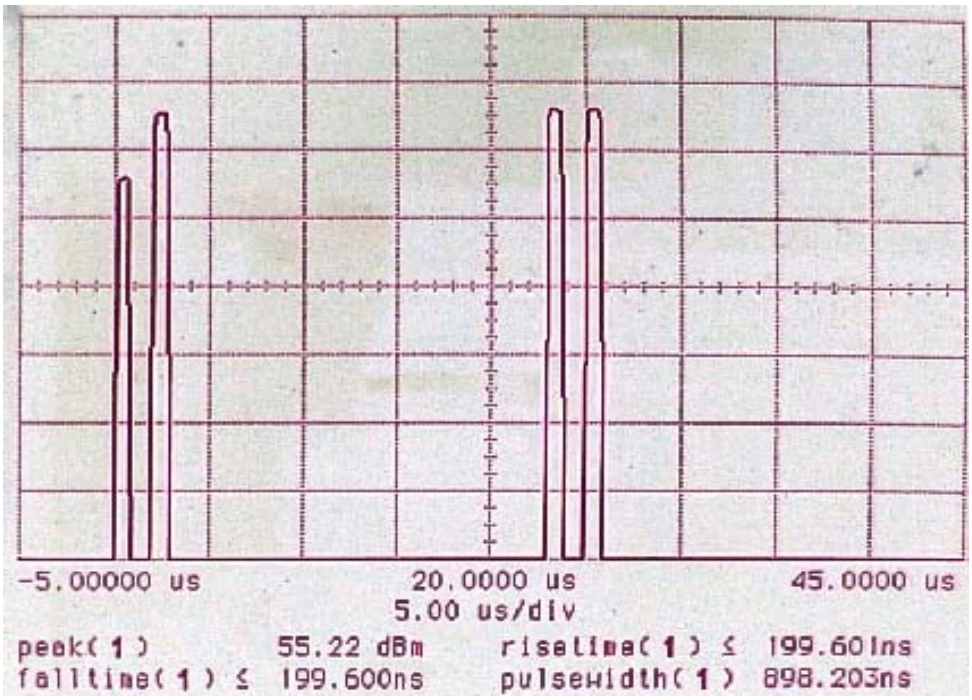

Figure 35: ATCRBS Mode C Interrogation

8.3 Occupied Bandwidth and In Close Spurious

47CFR Reference:
2.1049, Occupied Bandwidth
87.135, Bandwidth of Emission

8.3.1 Occupied Bandwidth Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model/P/N	Asset #	Cal Date
A	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	7/21/06
D	Attenuator	Narda	765-20	NA	7/21/06
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06

Table 10: Occupied Bandwidth Test Equipment Required

8.3.2 Occupied Bandwidth and In Close Test Setup

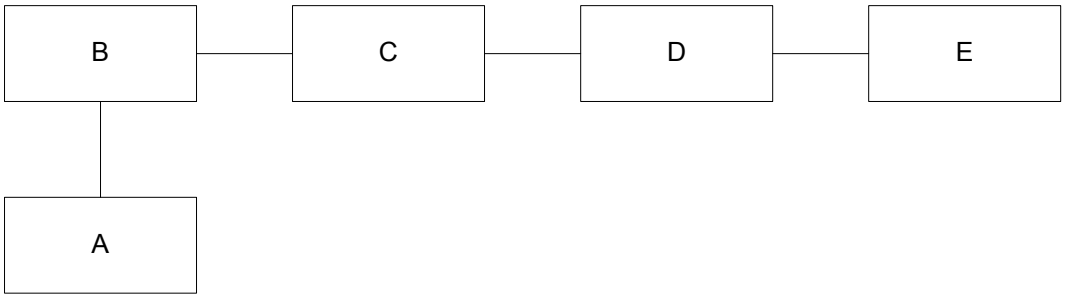

Figure 36: Occupied Bandwidth Test Setup

8.3.3 Occupied Bandwidth and In Close Test Procedure

1 Connect the equipment as shown in Figure 36 above.
2 Configure the program pins on the TCAS 2000 System Panel to invoke Test Mode 2 (Mode S, Long P6, DPSK Modulation, Test Mode Program switches on System Panel to DDUD).
3 Use a 300 kHz IF bandwidth on the Spectrum Analyzer and record the peak power levels at 1 MHz intervals from 1005 MHz to 1055 MHz.
4 Enter the data into the ACSS utility program “OCCBW.EXE” and calculate the Occupied Bandwidth.
5 Record the occupied bandwidth that has been calculated by the OCCBW.EXE program in the T^2CAS FCC Test Report.

8.3.4 Occupied Bandwidth and In Close Spurious Test Data

FREQ OFFSET (MHZ)	LEVEL (DBC)	FREQ OFFSET (MHZ)	LEVEL (DBC)
-1.0	-8.7	+1.0	-8.7
-2.0	-8.9	+2.0	-9.0
-3.0	-9.8	+3.0	-10.9
-4.0	-19.1	+4.0	-20.6
-5.0	-20.8	+5.0	-20.6
-6.0	-25.8	+6.0	-25.6
-7.0	-30.5	+7.0	-37.2
-8.0	-37.1	+8.0	-30.6
-9.0	-39.2	+9.0	-39.3
-10.0	-49.1	+10.0	-50.0
-11.0	-45.9	+11.0	-45.9
-12.0	-47.4	+12.0	-47.7
-13.0	-46.1	+13.0	-45.9
-14.0	-40.7	+14.0	-40.9
-15.0	-48.7	+15.0	-49.0
-16.0	-32.9	+16.0	-33.7
-17.0	-44.1	+17.0	-43.9
-18.0	-40.2	+18.0	-40.6
-19.0	-19.2	+19.0	-19.1
-20.0	-25.6	+20.0	-25.7
-21.0	-52.2	+21.0	-52.4
-22.0	-53.1	+22.0	-53.2
-23.0	-58.1	+23.0	-57.8
-24.0	-56.1	+24.0	-55.5
-25.0	-9.8	+25.0	-11.1

PERCENT TOTAL ENERGY	OCCUPIED BANDWIDTH (MHZ)
+50.7	+1.0
+64.4	+3.0
+77.4	+5.0
+86.8	+7.0
+87.9	+9.0
+88.7	+11.0
+89.0	+13.0
+89.1	+15.0
+89.1	+17.0
+89.1	+19.0
+89.1	+21.0
+89.1	+23.0
+89.1	+25.0
+89.1	+27.0
+89.1	+29.0
+89.1	+31.0
+89.2	+33.0
+89.2	+35.0
+89.2	+37.0
+90.4	+39.0
+90.7	+41.0
+90.7	+43.0
+90.7	+45.0
+90.7	+47.0
+90.7	+49.0
+100.0	+51.0

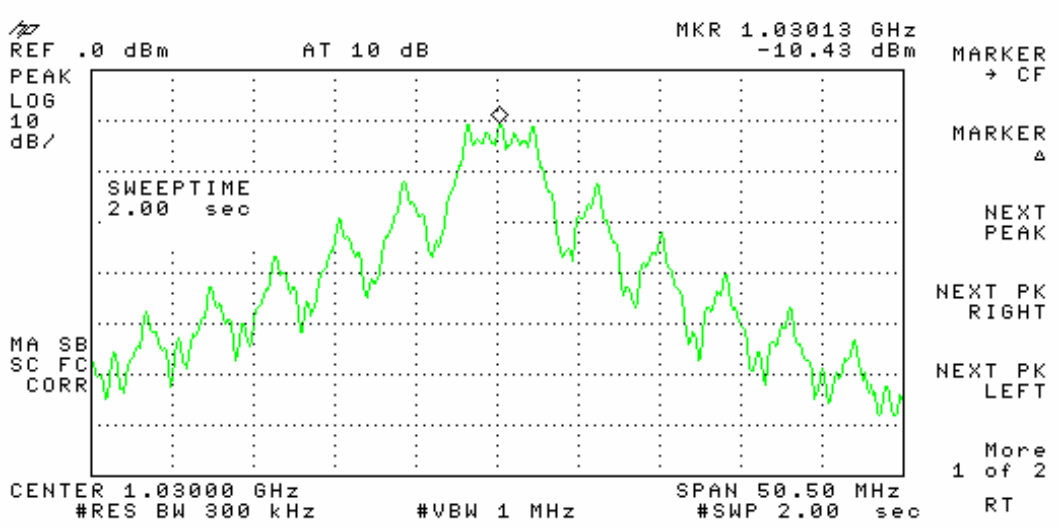

Figure 37: In Close Spurious: 5 MHz/Div

8.4 Spurious Emissions at Antenna Terminals

47CFR Reference:
2.1051, Spurious Emissions at Antenna Terminals
87.139, Emissions Limitations

47CFR2.1051 states that the radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.

47CFR2.1051 says that curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec 2.1049 (Occupied Bandwidth) as appropriate. In the Occupied Bandwidth test, the TCAS portion of the T^2CAS unit was operated in Test Mode 2, and that same test mode will be used here for the Spurious Emissions at Antenna Terminals Test.

8.4.1 Spurious Emissions at Antenna Terminals (0 – 2000 MHz)

8.4.1.1 Spurious Emissions at Antenna Terminals (0 – 2000 MHz) Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model/P/N	Asset #	Cal Date
A	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	7/21/06
D	Attenuator	Narda	765-20	NA	7/21/06
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06

Table 11: Spurious Emissions at Antenna Terminals (0 – 2000 MHz) Test Equipment Required

8.4.1.2 Spurious Emissions at Antenna Terminals (0 – 2000 MHz) Test Setup

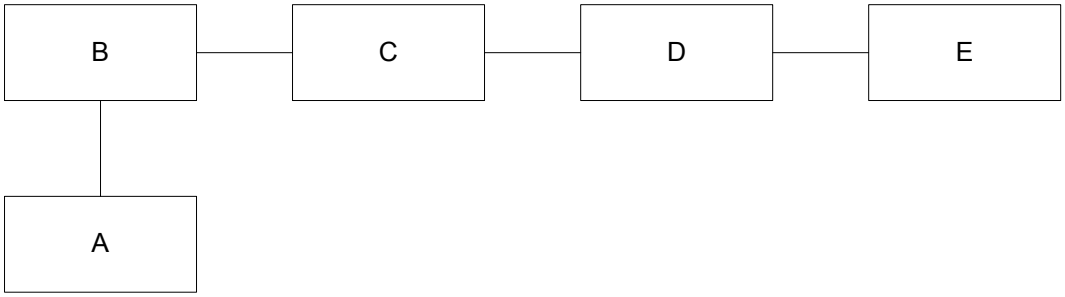

Figure 38: Spurious Emissions at Antenna Terminals (0 – 2000 MHz) Test Setup

8.4.1.3 Spurious Emissions at Antenna Terminals (0 – 2000 MHz) Test Procedure

1. Connect the equipment as shown in Figure 38 above.
2. Configure the TCAS 2000 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 plot all spurious below 2000 MHz. Use a 300 kHz IF bandwidth on the Spectrum Analyzer.

8.4.1.4 Spurious Emissions at Antenna Terminals (0-2000 MHz) Test Data

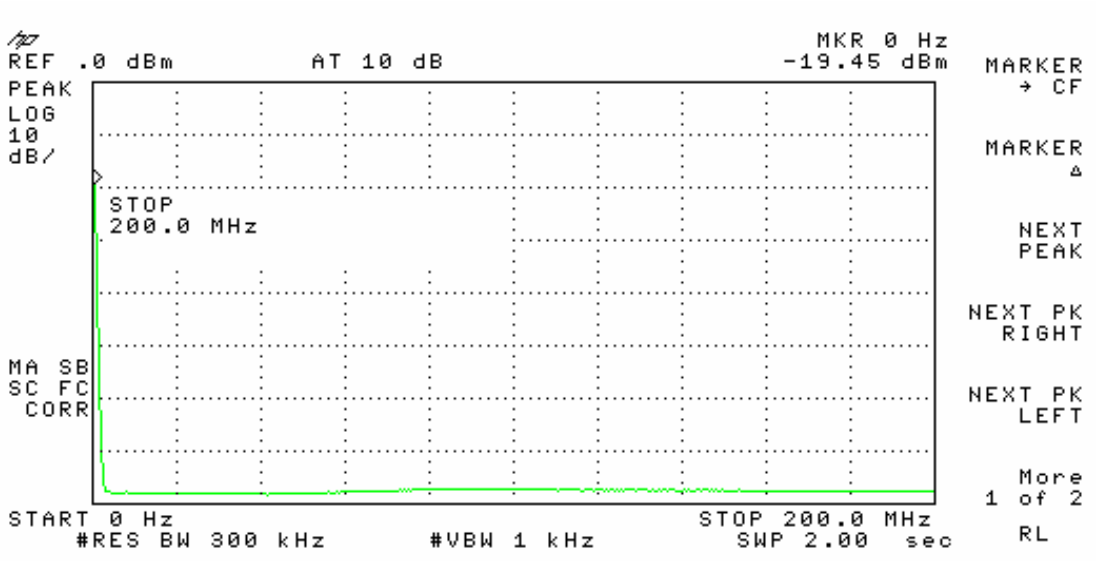

Figure 39: 0 – 200 MHz Frequency Span

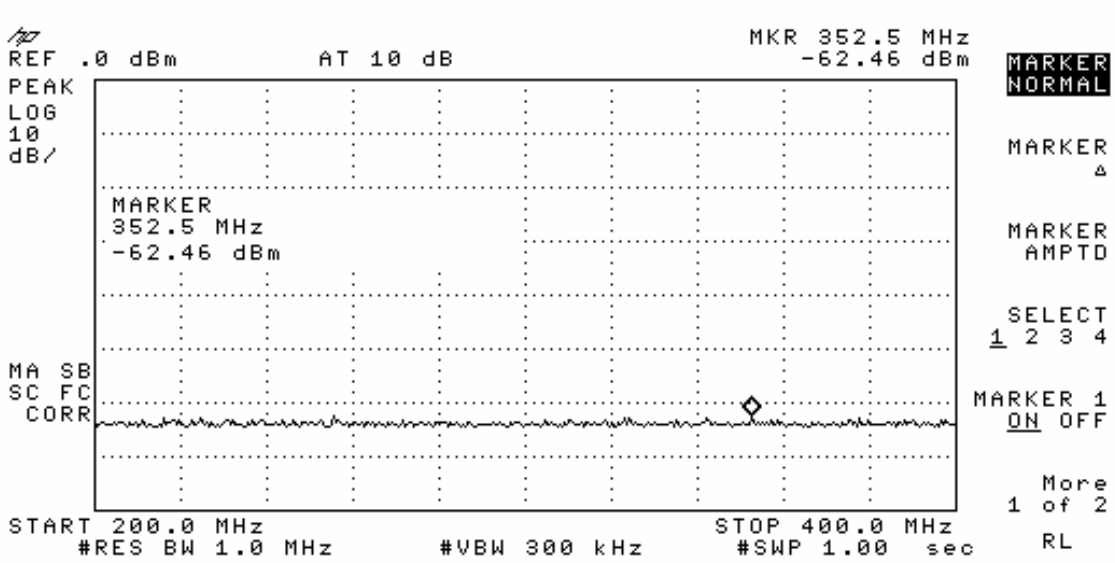

Figure 40: 200 – 400 MHz Frequency Span

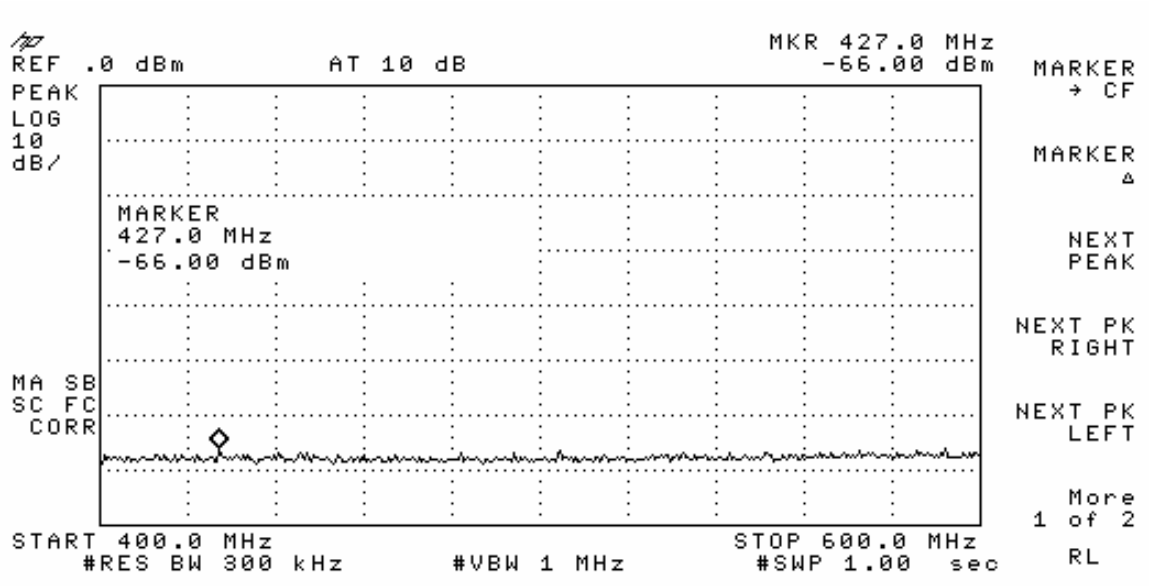

Figure 41: 400 – 600 MHz Frequency Span

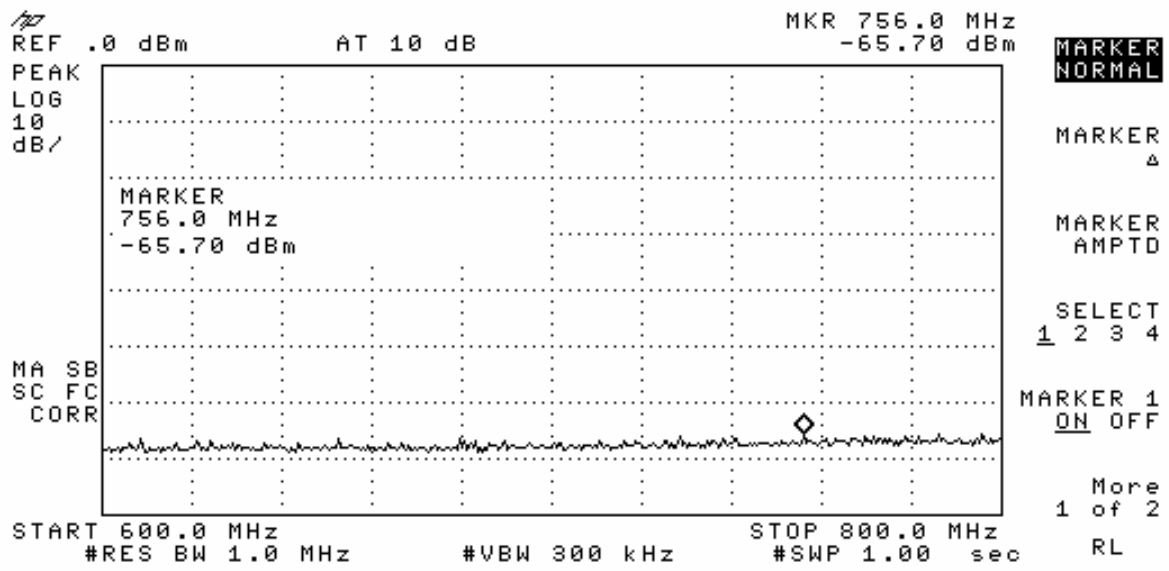

Figure 42: 600 – 800 MHz Frequency Span

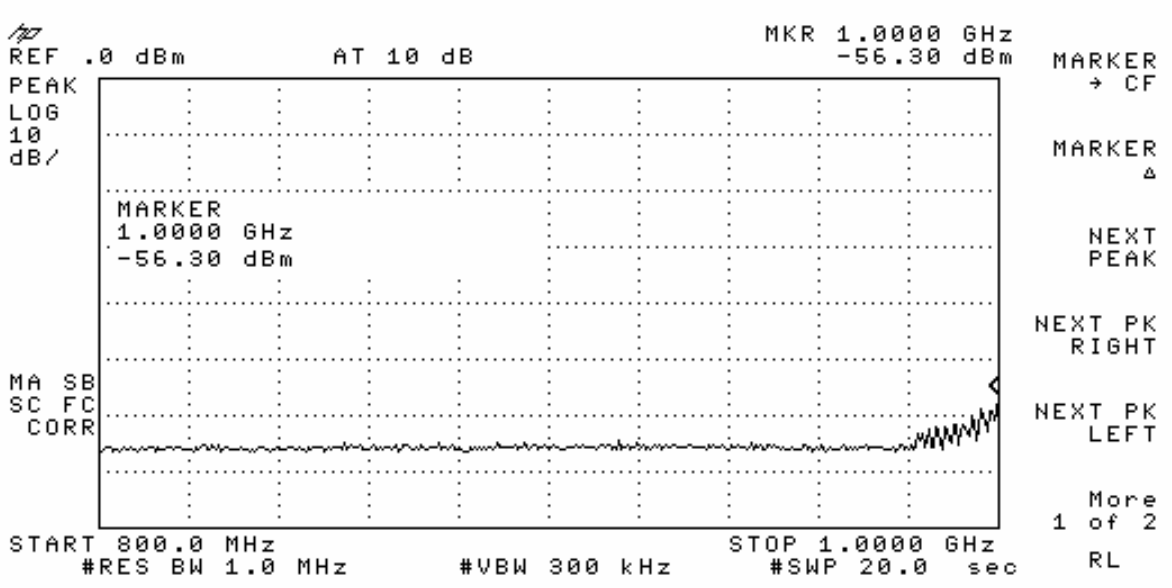

Figure 43: 800 – 1000 MHz Frequency Span

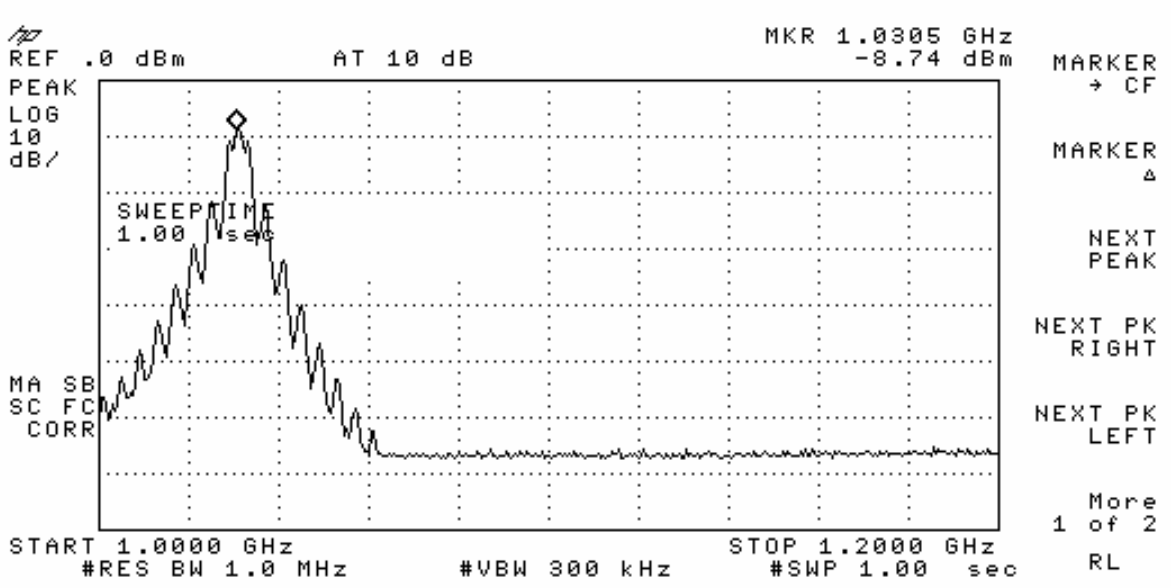

Figure 44: 1000 – 1200 MHz Frequency Span

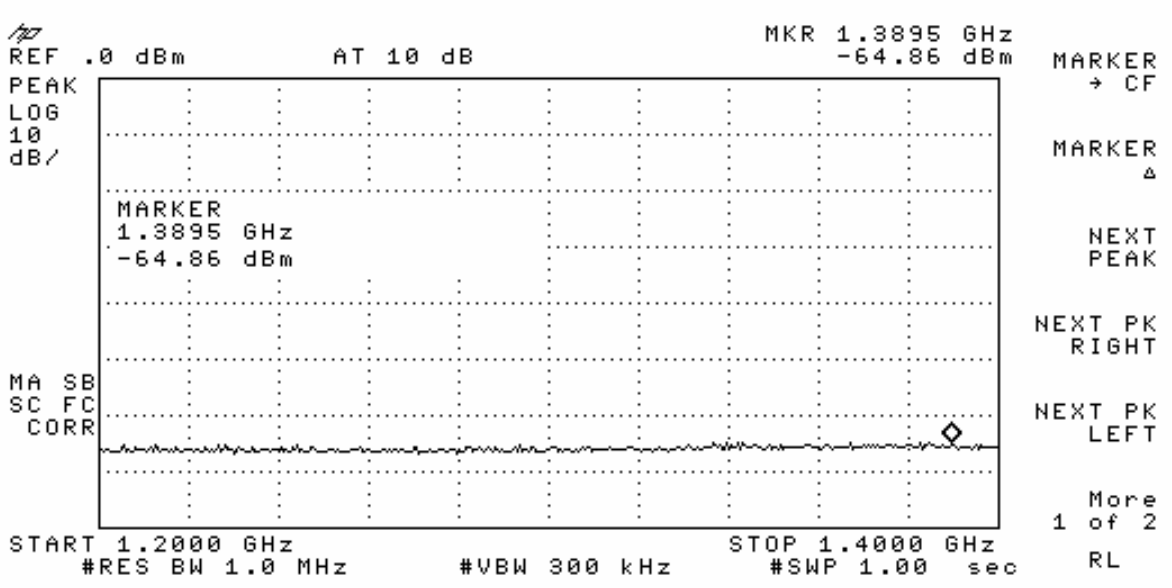

Figure 45: 1200 – 1400 MHz Frequency Span

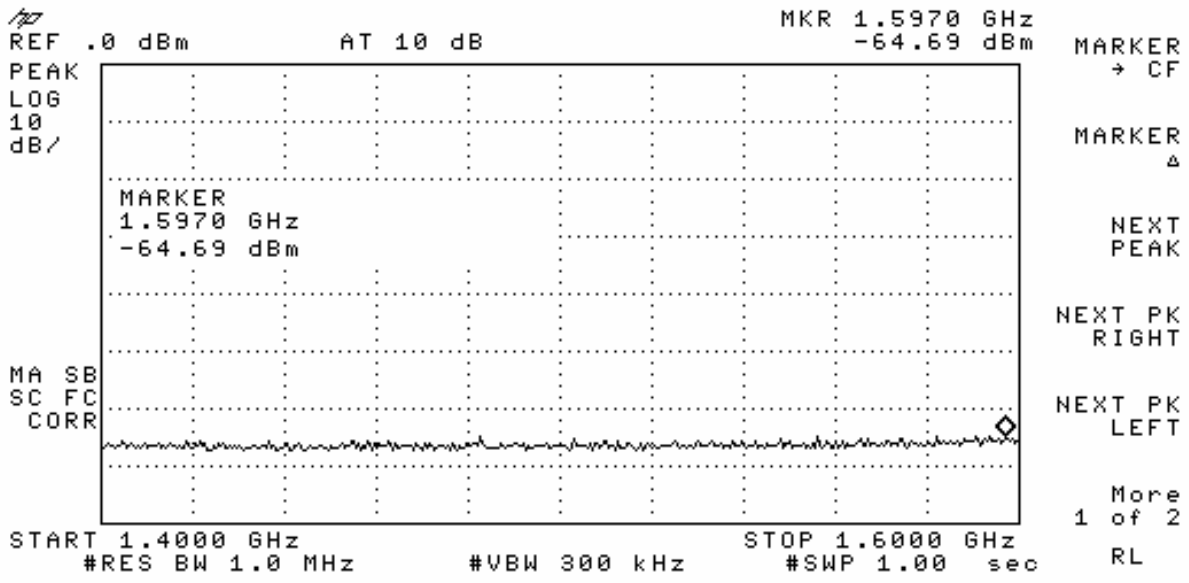

Figure 46: 1400 – 1600 MHz Frequency Span

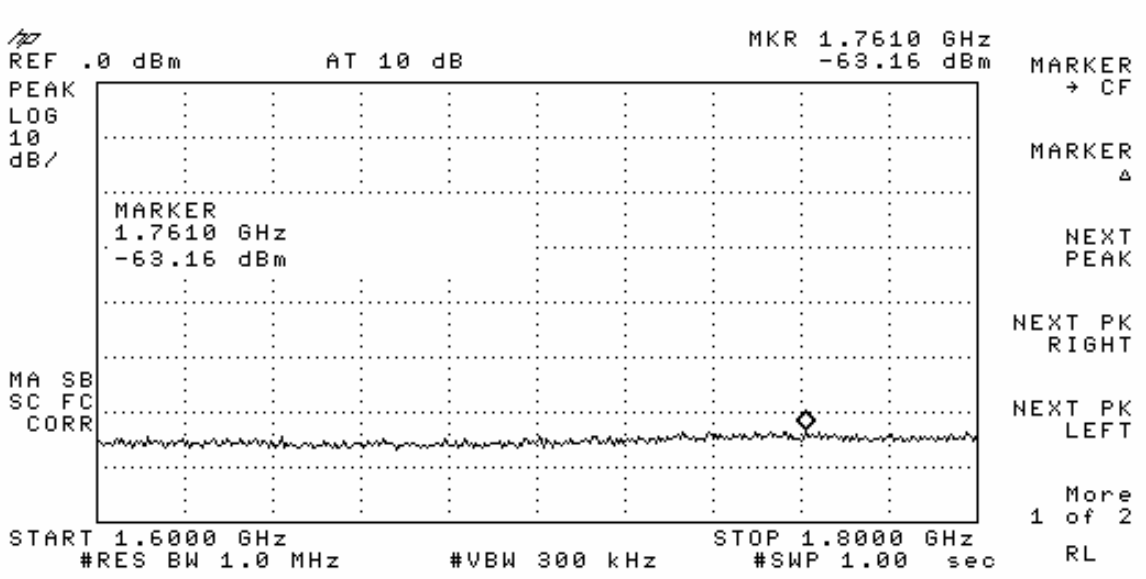

Figure 47: 1600 – 1800 MHz Frequency Span

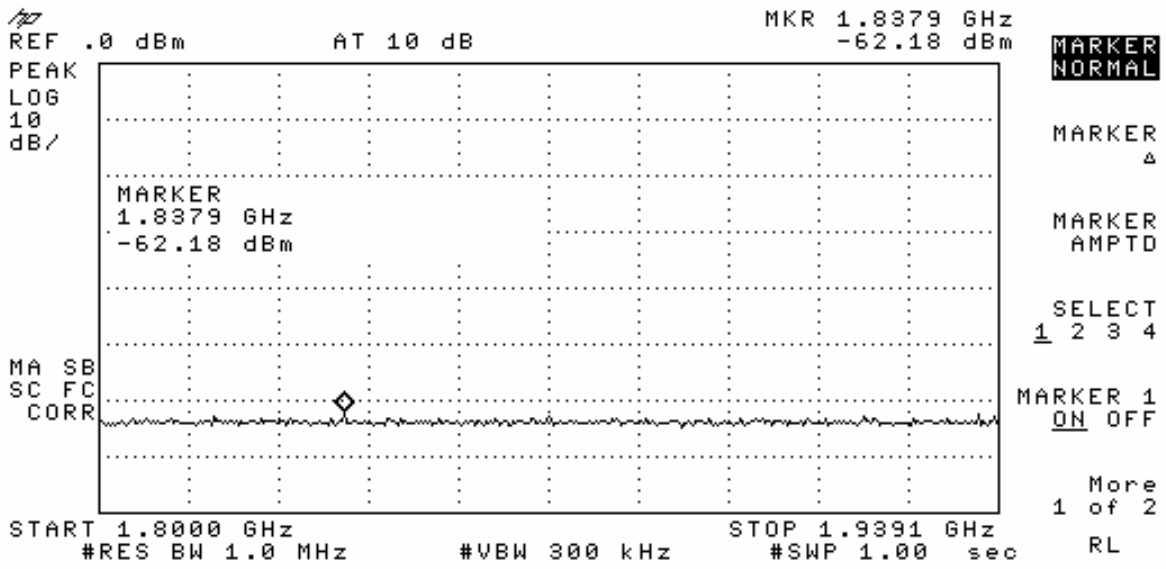

Figure 48: 1800 – 2000 MHz Frequency Span

8.4.2 Spurious Emissions at Antenna Terminals (2000 - 11330 MHz) Test Equipment Required

Block Diagram Reference	Type	Manufacturer	Model	Asset #	Cal Date
A	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	7/21/06
D	Hi-Pass Filter	Microlab/FXR	HD-20N	NA	
E	Hi-Pass Filter	Microlab/FXR	HD-40N	NA	
F	Hi-Pass Filter	Microlab/FXR	HD-60N	NA	
G	Attenuator	Narda	765-6	NA	7/21/06
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06

Table 12: Spurious Emissions at Antenna Terminals (2000 – 11330 MHz) Test Equipment Required

8.4.2.1 Spurious Emissions at Antenna Terminals (2000 - 11330 MHz) Test Setup

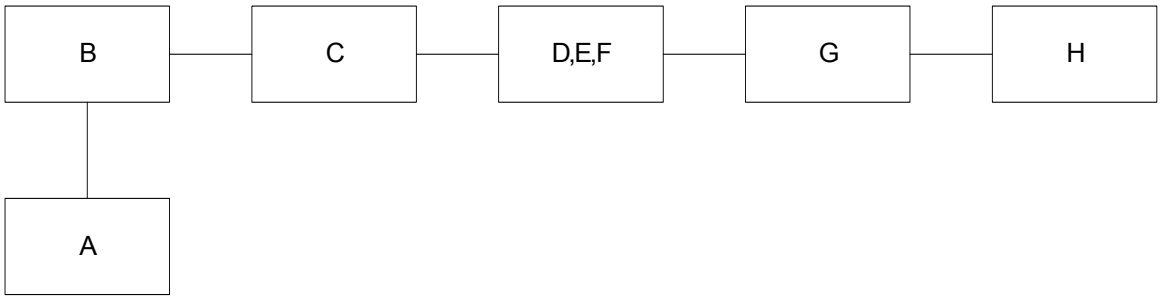

Figure 49: Spurious Emissions at Antenna Terminals (2000 - 11330 MHz) Test Setup

8.4.2.2 Spurious Emissions at Antenna Terminals (2000 - 11330 MHz) Test Procedure

1. Connect the equipment as shown in Figure 49 above.
2. Configure the TCAS 2000 System Panel to invoke Test Mode 2 (Mode S, Long P6, DPSK Modulation, Test Mode Program switches on System Panel to DDUD).
3. Adjust the Spectrum Analyzer so that no signal exceeds the dynamic range of the analyzer. Set the resolution bandwidth to 3 MHz.
4. Measure and record all spurious emissions between 2 Ghz and 4 Ghz using the 2 Ghz high pass filter.
5. Measure and record all spurious emissions between 4 Ghz and 8 Ghz using the 4 Ghz high pass filter.
6. Measure and record all spurious emissions between 8 Ghz and 12 Ghz using the 6 Ghz high pass filter.
7. Measure and record Attenuator/filter/cable calibration factor for each harmonic.

8.4.2.3 Spurious Emissions at Antenna Terminals (2000 - 11330 MHz) Test Data

FREQUENCY (MHz)	CALIBRATION FACTOR (dB)	TOP ANTENNA SPURIOUS LEVEL (dB)	BOTTOM ANTENNA SPURIOUS LEVEL (dB)	TOP ANTENNA SPURIOUS LEVEL CORRECTED (dB)	BOTTOM ANTENNA SPURIOUS LEVEL CORRECTED (dB)	SPURIOUS OUTPUT LIMIT
2060	17.86	-37.78	-39.19	-19.92	-21.33	12.5 dBm
3090	18.32	-47.18	-46.64	-28.86	-28.32	12.5 dBm
4120	18.52	-47.70	-48.66	-29.18	-30.14	12.5 dBm
5150	19.20	-64.93	-65.16	-45.73	-45.96	12.5 dBm
6180	20.87	-65.82	-65.20	-44.95	-44.33	12.5 dBm
7210	20.68	-60.88	-60.56	-40.20	-39.88	12.5 dBm
8240	22.06	-60.45	-60.65	-38.39	-38.59	12.5 dBm
9270	22.29	-61.66	-61.28	-39.37	-38.99	12.5 dBm
10300	23.18	-59.76	-59.89	-36.58	-36.71	12.5 dBm
11330	28.42	-58.65	-58.49	-30.23	-30.07	12.5 dBm

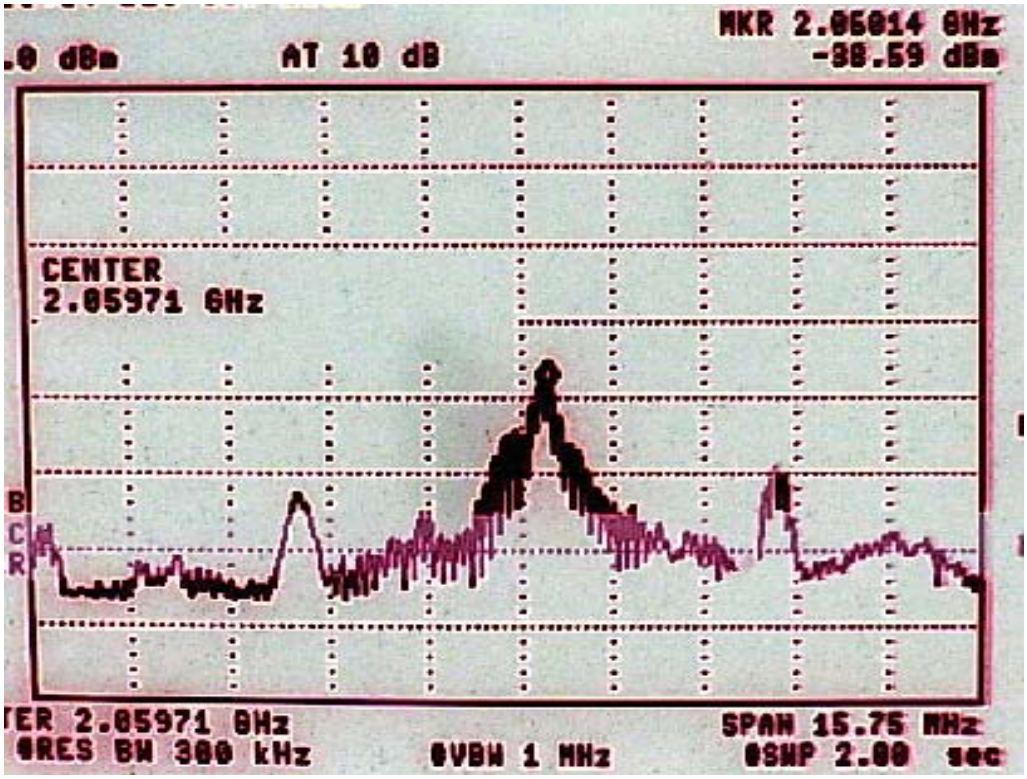

Figure 50: 2nd Harmonic

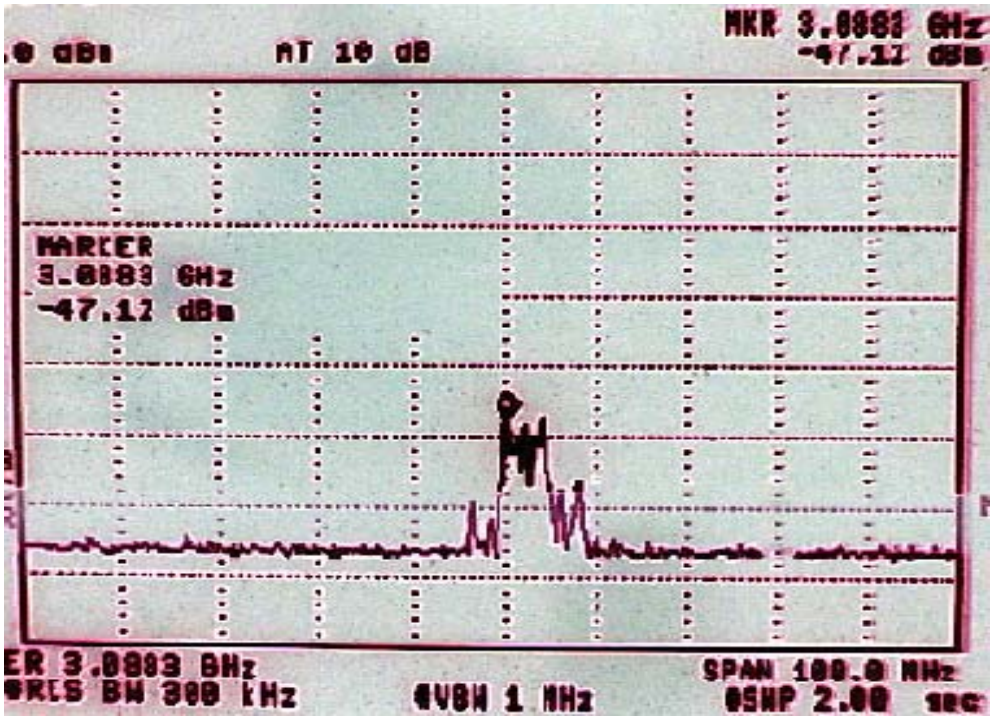

Figure 51: 3rd Harmonic

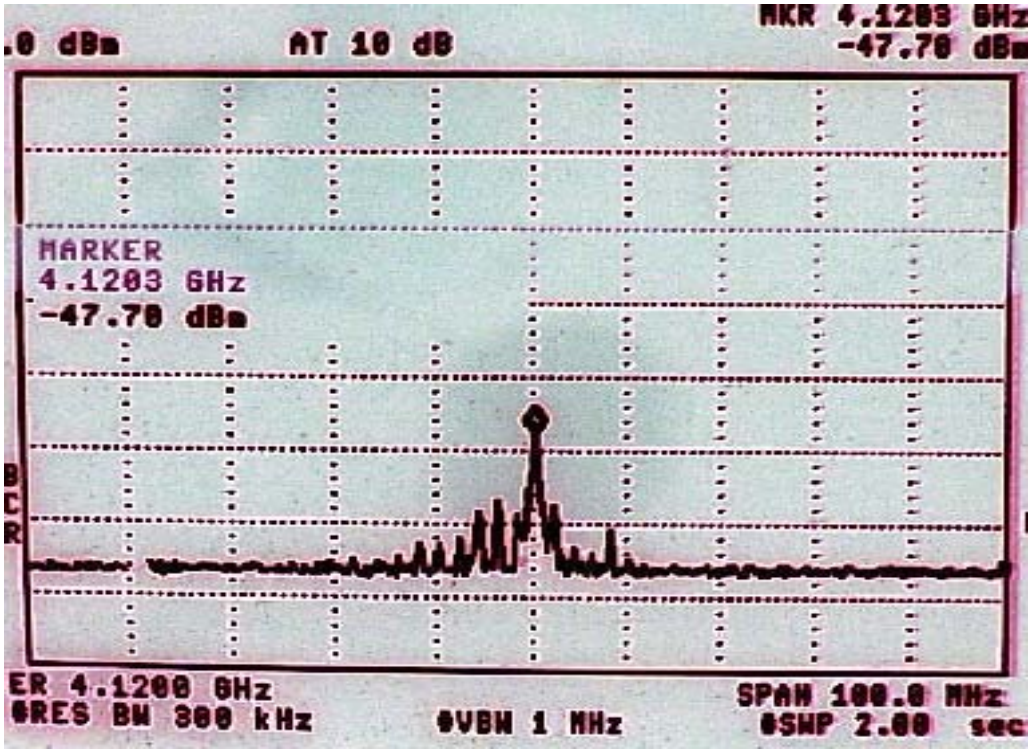

Figure 52: 4th Harmonic

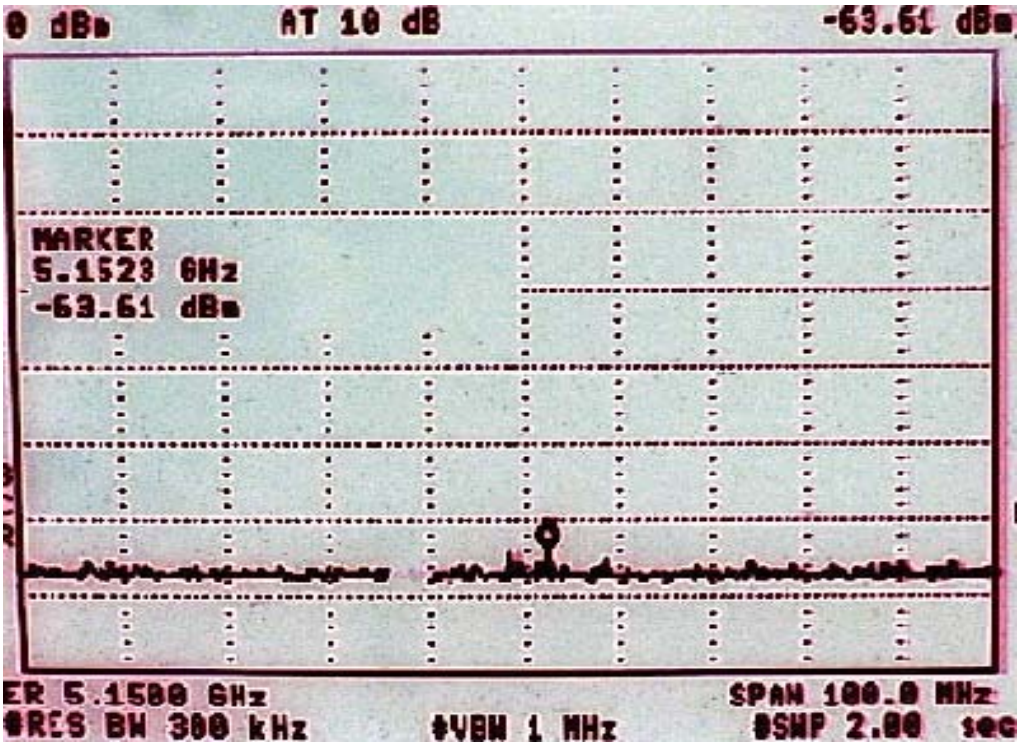

Figure 53: 5th Harmonic

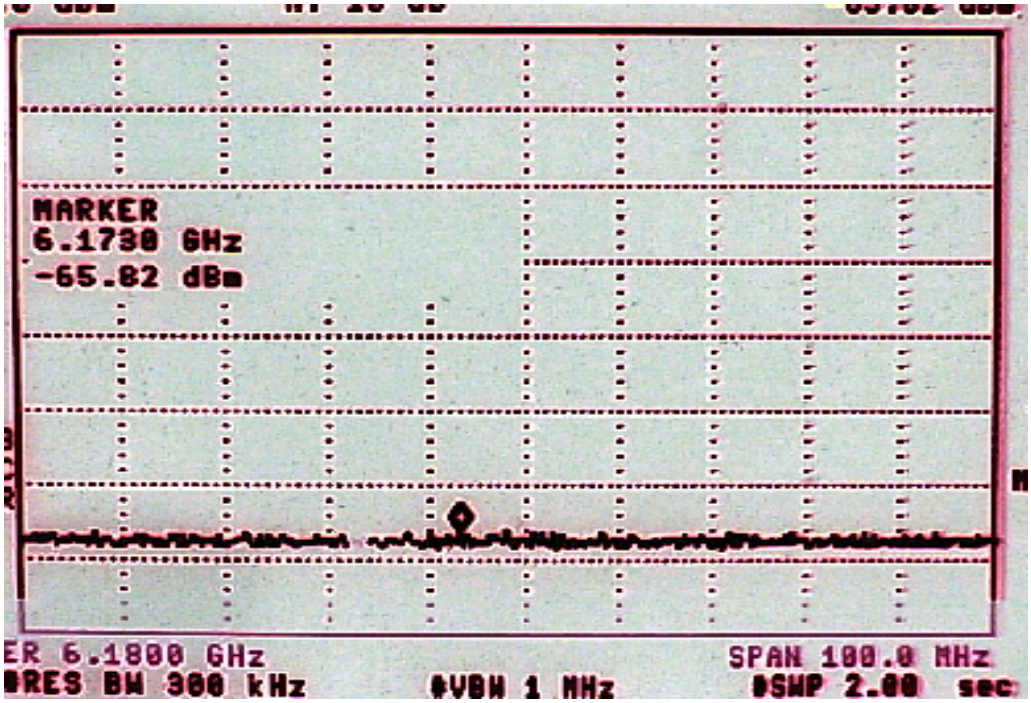

Figure 54: 6th Harmonic

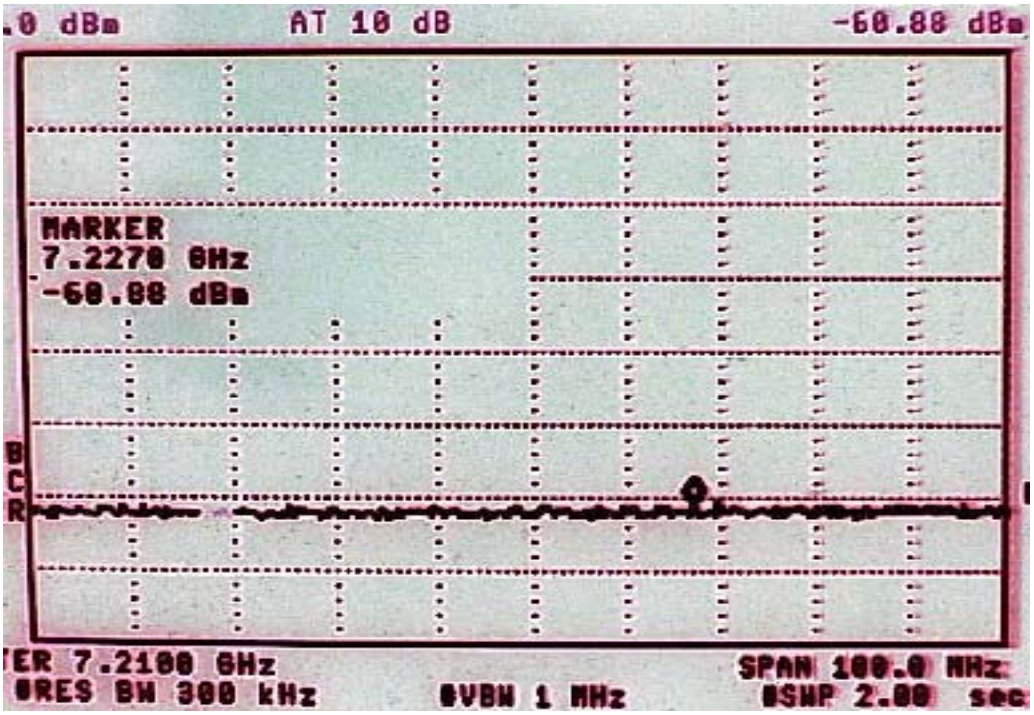

Figure 55: 7th Harmonic

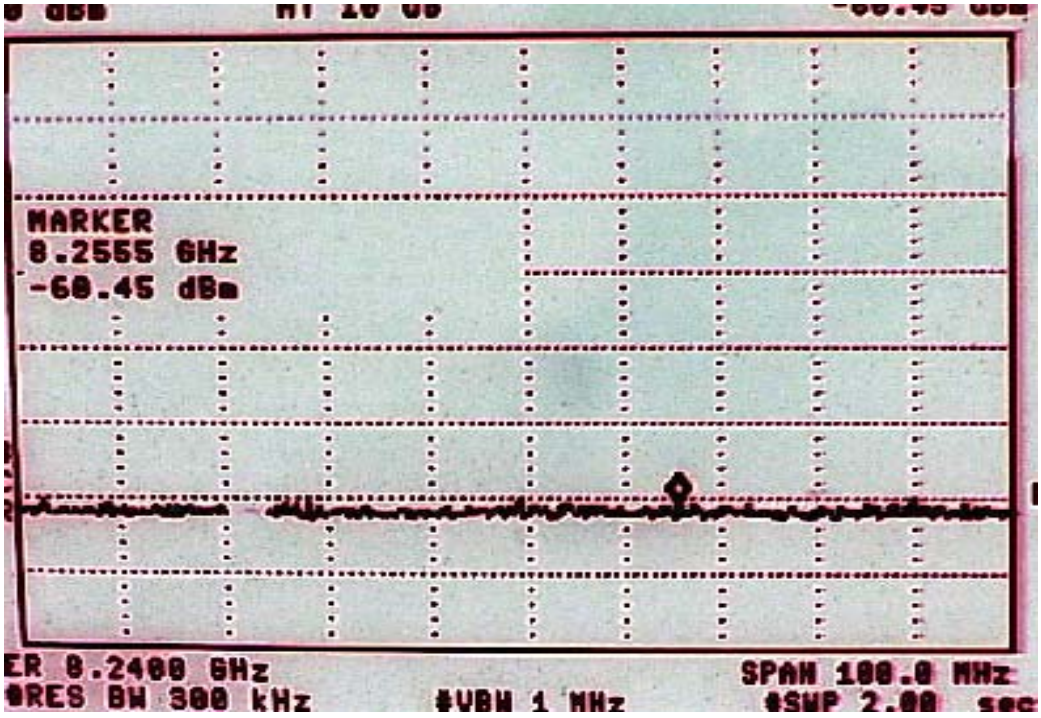

Figure 56: 8th Harmonic

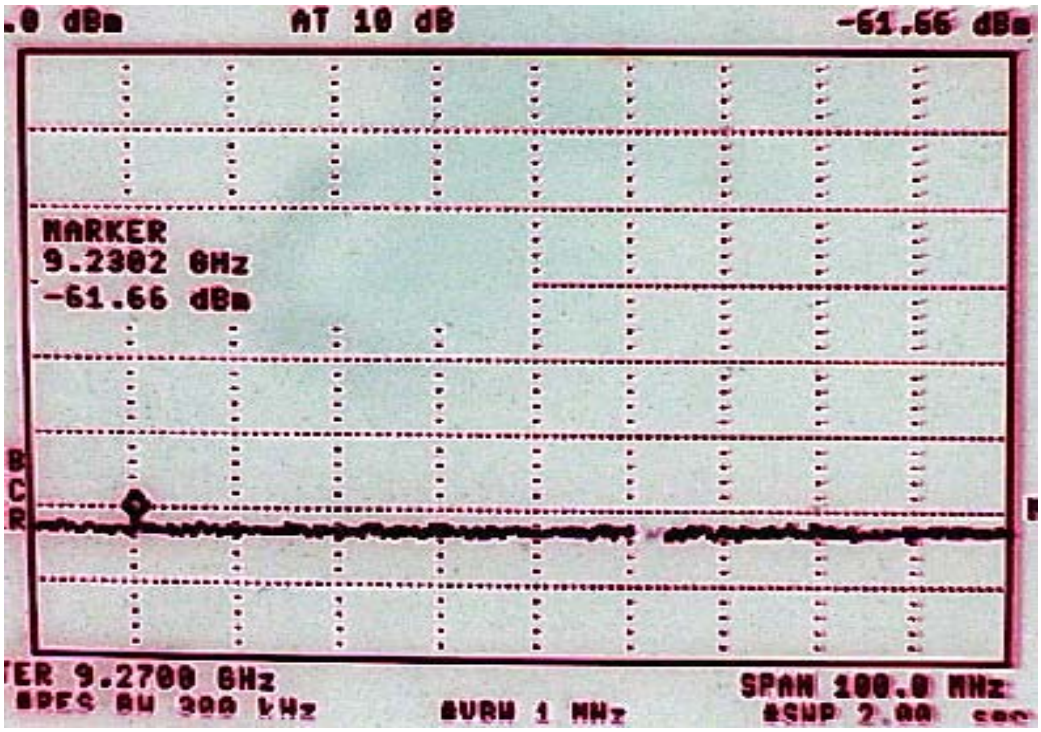

Figure 57: 9th Harmonic

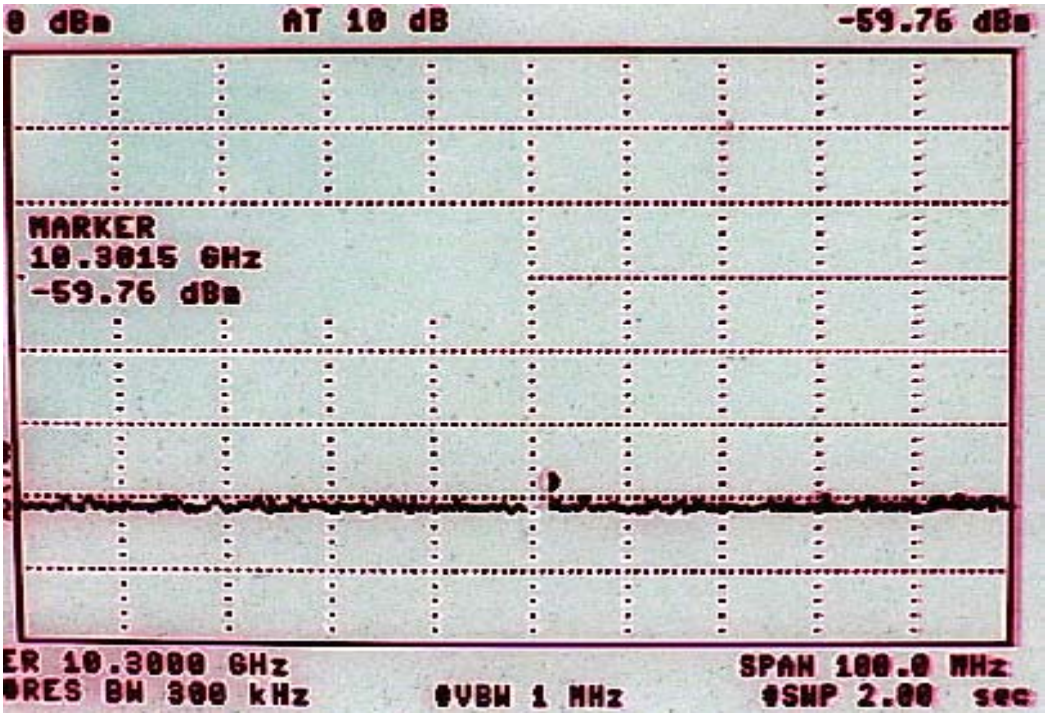

Figure 58: 10th Harmonic

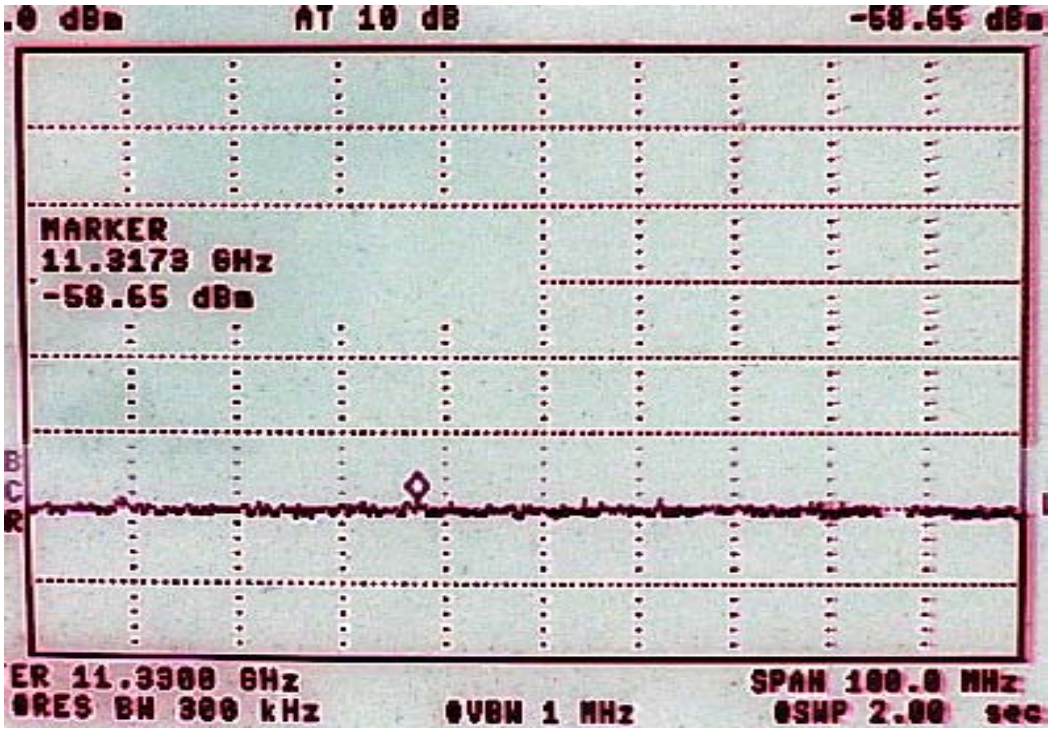

Figure 59: 11th Harmonic

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	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06

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

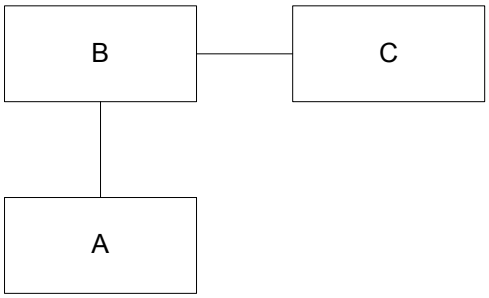

Figure 60: Spurious Emissions at Antenna Local Oscillator Leakage (1030 MHz) Test Setup

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

1 Connect the equipment as shown in Figure 60 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

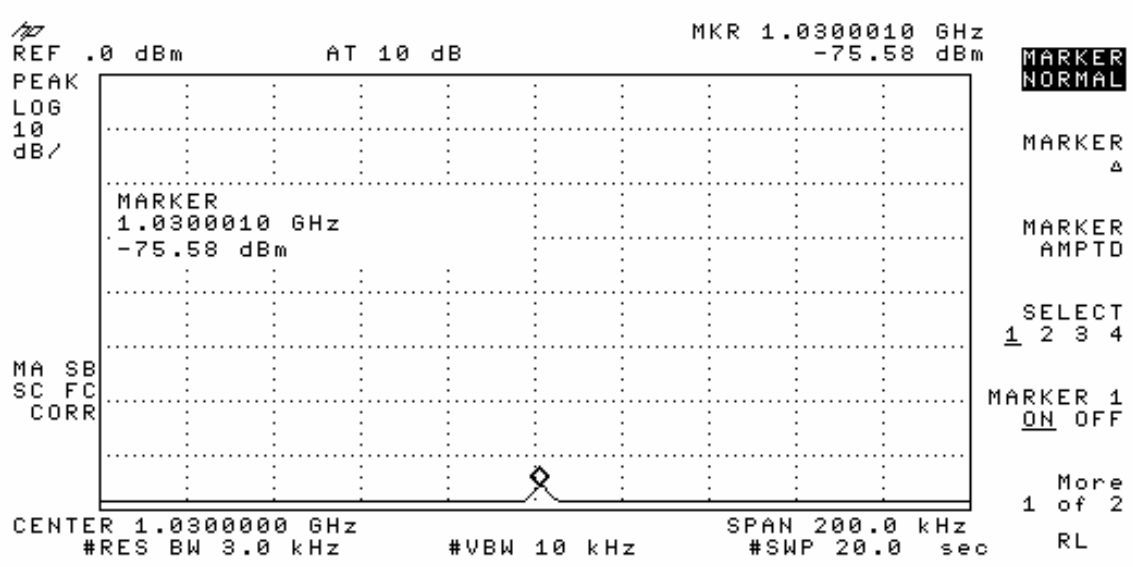

Figure 61: Top Antenna L.O. Leakage

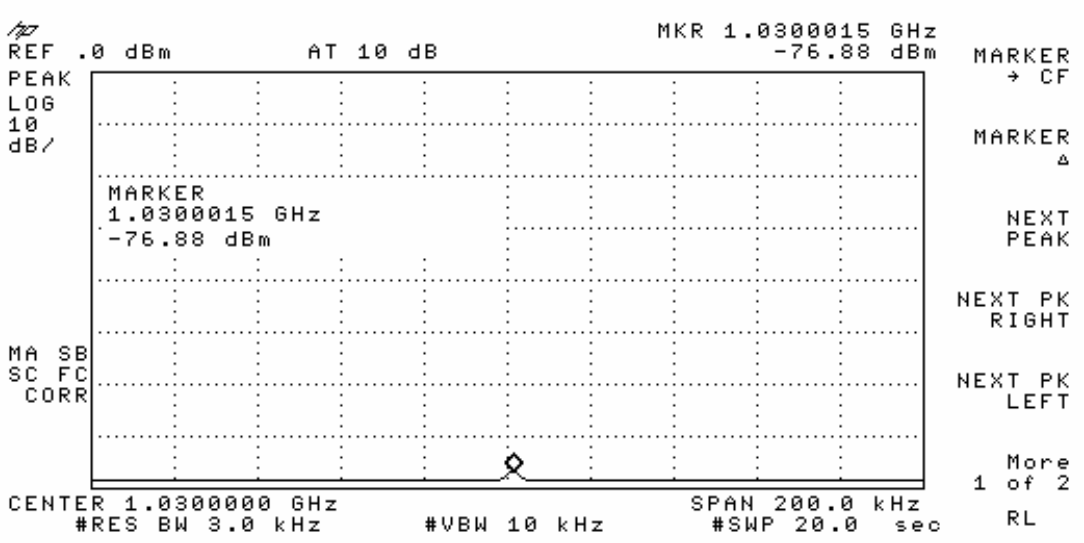

Figure 62: Bottom Antenna L.O. Leakage

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 TCAS 3000 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 TCAS 3000 units 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 TCAS 3000 units 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.

The TCAS 3000 units operate at the fundamental frequency of 1030 MHz. TCAS 3000 has a deviation in the frequency range of 100-150 MHz and 1215-6000 MHz. An exclusion band of 1030 MHz ± 20% will be utilized for testing.

8.5.1 Field Strength of Spurious Radiation

The TCAS 3000 units 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	TCAS 3000 Unit	ACSS	9003000-10001
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

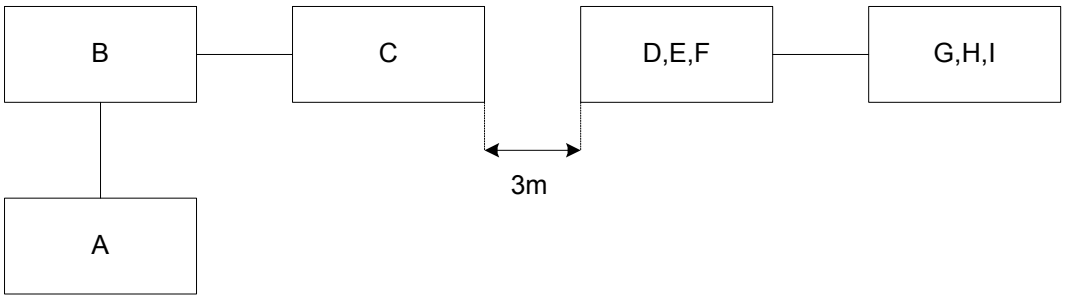

Figure 63: Field Strength of Spurious Radiation Test Setup

8.5.2 Field Strength of Spurious Radiation Test Procedure

1. Connect the equipment as shown in Figure 63 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 (6MCU) Radiated and Radiated Test Data

Refer to NTS Electromagnetic Compatibility (EMC) Test Report, dated November 15, 2005, document 8005748-001, for the test data and plots.

8.5.3.2 (4MCU) Radiated and Radiated Test Data

Refer to NTS Electromagnetic Compatibility (EMC) Test Report, dated November 15, 2005, document 8005748-001, for the test data and plots.

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/P/N	Asset #	Cal Date
A	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	7/21/06
D	Attenuator	Narda	765-20	NA	7/21/06
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06

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

8.6.1.2 Frequency Stability (Temperature Variation) Test Setup

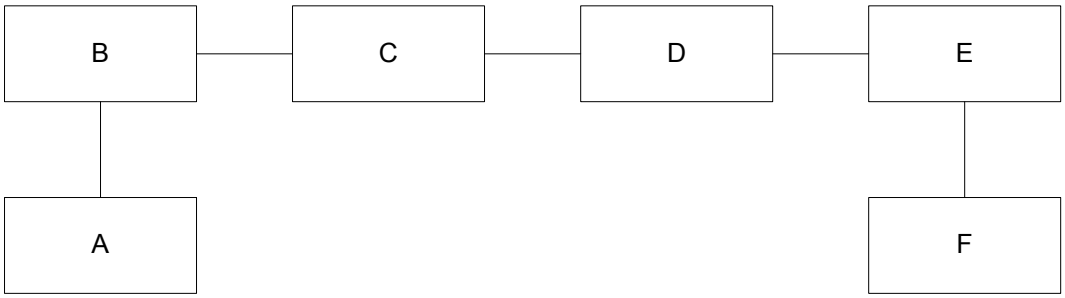

Figure 64: Frequency Stability (Temperature Variation) Test Setup

8.6.1.3 Frequency Stability (Temperature Variation) Test Procedure

1 Connect the equipment as shown in Figure 64 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/P/N	Asset #	Cal Date
A	TCAS 3000 Unit	ACSS	9003000-10001	NA	
B	TCAS 2000 System Panel	ACSS	9000121-001	NA	
C	Attenuator	Narda	765-20	NA	7/21/06
D	Attenuator	Narda	765-20	NA	7/21/06
E	Peak Power Analyzer	Hewlett-Packard	HP8990A	418	10/04/06

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

8.6.2.2 Frequency Stability (Primary Power Variation) Test Setup

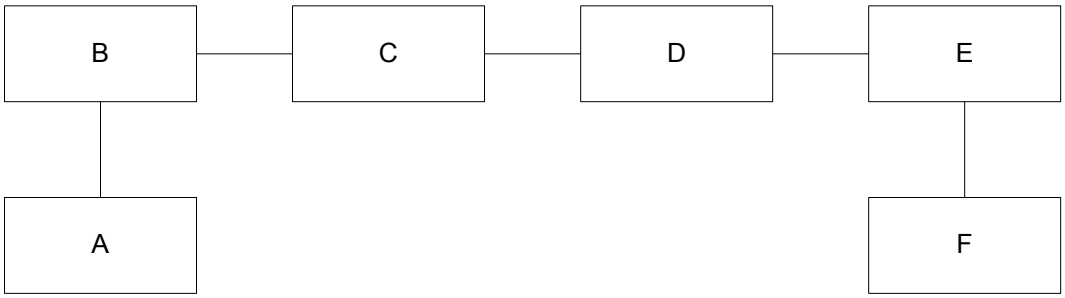

Figure 65: Frequency Stability (Primary Power Variation) Test Setup

8.6.2.3 Frequency Stability (Primary Power Variation) Test Procedure

1 Connect the equipment as shown in Figure 65 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

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