Attachment to FCC Form 731

FCC ID: AQZ-VSR-4141-001

Exhibit 6

TX Test Report

- **FCC Form 731 Submittal Matrix**
- **Final Stages DC Voltages/Currents [Paragraph 2.1033(c)8]**
- **TX Test Report [Paragraph 2.1033(c)14]**

The full contents of Exhibit 6 are contained in 6 files as follows:

1. File 1: this header sheet, including:
    - a submittal matrix for the Form 731 attachments (exhibits) vs. the FCC Part 2 requirements for the SCAT VHF Transmitter, Harris model number VSR-4141-001;
    - DC voltages and currents for the final amplifying stages;
    - the main portion of the transmitter test report.
2. File 2: Power Output procedure and data
3. File 3: Occupied Bandwidth procedure and data
4. File 4: Frequency Stability procedure and data
5. File 5: Spurious emissions at antenna terminals
6. File 6: Field strength of spurious radiation

The SCAT VHF Transmitter, model number VSR-4141-001, referenced in this application for certification, has exactly the same hardware as the LAAS VHF Transmitter, model number VLR-4141-001. The installed software differs slightly between the two units, solely due to the slight modulation waveform differences between the two, the control of the output power level, and the somewhat narrower frequency range of the SCAT Transmitter, VSR-4141-001. Any test data in this report that references the LAAS Transmitter is applicable to both model numbers, unless otherwise so noted.

SUBMITTAL MATRIX

Part 2 Requirement (Paragraph)	Description	Filing Submittal
2.1033(c)1	Name/mailing address	Form 731
2.1033(c)2	FCC Identifier	Form 731
2.1033(c)3	Operating Instructions	Exhibit 8
2.1033(c)4	Emission Type	Form 731
2.1033(c)5	Frequency Range	Form 731
2.1033(c)6	Operating Power Levels	Part of Exhibit 12
2.1033(c)7	Maximum Power Rating	Form 731
2.1033(c)8	Final Stage DC Voltages/Currents	Part of Exhibit 6
2.1033(c)9	Tune-Up Procedure	Exhibit 10
2.1033(c)10	Circuit Details	Exhibits 4 (block diagrams), 5 (schematics), and part of 12 (description)
2.1033(c)11	ID Label	Exhibit 1
2.1033(c)12	Photographs	Exhibits 3 (external) and 9 (internal)
2.1033(c)13	Modulation Description	Part of Exhibit 12
2.1033(c)14	Test Report	Part of Exhibit 6
2.1033(c)15	Part 97 Power Amplifier	Not applicable
2.1033(c)16	AM Broadcast Stereo Exciter-Generator	Not applicable
2.1033(c)17	Single Application	Not applicable
	Attestation Statement	Exhibit 2
	Test Setup Photos	Exhibit 7
	Cover Letter	Exhibit 13

2.1033(c)8 DC voltages and currents into the final amplifier stages

Refer to Exhibit 4, Block Diagrams, and Exhibit 5, Schematic Diagrams, for further details about the Exciter and Power Amplifier PWB assemblies. A summary of the DC power input to the transmit amplifier devices (at 20 watt RF output level) is as follows:

DC Voltages and Currents
(20 Watt RF power level)

	Predriver	Driver	Output Amplifier
Device	1 x MRF-1508	3 x MRF-183	6 x MRF-275
Supply Voltage (V) DC	28	28	28
Current (A) DC	0.235	1.2	1.1
Power input (W) DC	6.58	101	185

It should be noted that all devices are operated as Class A amplifiers.

2.1033(c)14 Test Report

Per FCC Ruling 99-40, the specific rules pertaining to differential GPS ground station transmitters are set forth in 47 C.F.R. §§ 87.131, 87.133(a)(5), 87.137(a), and 87.139(a) and (j). These requirements correlate to the following tests outlined in Part 2:

Differential GPS Transmitter Req't	Part 2 Test
87.131 Power and Emissions	2.1046 RF Power Output
87.133(a)(5) Frequency Stability	2.1055 Frequency Stability
87.137(a) Types of Emission	2.1047 Modulation Characteristics
87.139(a) Emission Limitations	2.1051 Spurious emissions at antenna terminals
87.139(a) Emission Limitations	2.1053 Field strength of spurious radiation
87.139(j) Emission Limitations	2.1049 Occupied bandwidth

2.1046 - RF power output

Test Procedure

For the G7D emission mode, the RF power output measurement was made with the unit operating under conditions simulating a typical customer installation.

The transmitter received serial control commands and transmit data commands from the Host Simulator computer. The control commands set the transmit frequency, the RF power output level (20 Watts), and the TDMA time slot assignments. The format of the transmit data sent to the unit resulted in RF transmissions in every other TDMA slot (slots: a, c, e, and g), which provided a 50% transmit duty cycle. The messages were of the maximum length allowed (222 bytes). The data used resulted in different data messages being transmitted each time.

Power output was measured for the +43 dBm (20 Watt) power output level (nominal maximum), at the center frequency of the band (115 MHz), at the nominal supply voltage of 115 VAC, and again for a nominal DC supply of 28 VDC, and the results were recorded. Power output was also measured with the transmitter operating at AC line voltages of +/- 15 percent from nominal, at the two ends of the frequency band, i.e., at center frequencies of 112 and 117.950 MHz, and the results were recorded. This set of data was repeated at the DC input voltage limits of 26 and 30 VDC. The results are summarized below. Refer to the **Power Output** file included with this exhibit for further information on the test setup and data.

RF Power Summary Test Data

The RF power output test data is as follows:

RF Power Output, AC Supply

Input voltage, AC	Power output at 112.000 MHz (dBm)	Power output at 115.000 MHz (dBm)	Power output at 117.950 MHz (dBm)
98	+42.64	---	+42.67
115	---	+42.61	---
133	+42.55	---	+42.70

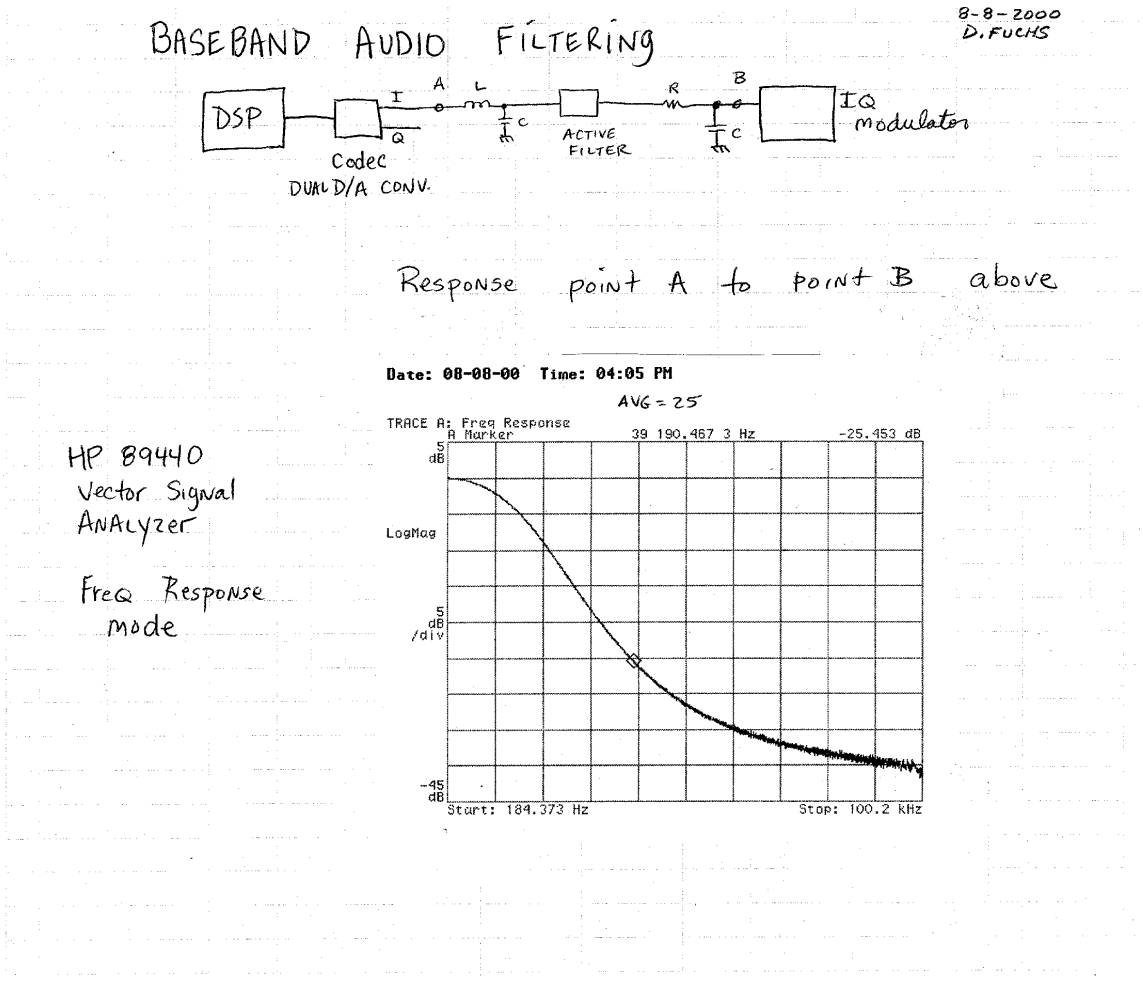
RF Power Output, DC Supply

Input voltage, DC	Power output at 112.000 MHz (dBm)	Power output at 115.000 MHz (dBm)	Power output at 117.950 MHz (dBm)
26	+42.60	---	+42.67
28	---	+42.64	---
30	+42.61	---	+42.66

2.1047 - Modulation characteristics

In order to understand the modulation characteristics of this transmitter please refer to Exhibit 12, Operational Description, for technical discussion of information for 2.1033(c)10 (modulation limiting) and 2.1033(c)13 (description of digital modulation system).

The 4 section baseband filter referred to in the discussion under 2.1033(c)13 is the last filter before the modulated stage. Its function is to prevent unwanted modulation of the carrier by spurious sources ("digital noise") outside of the authorized bandwidth. The frequency response characteristics of this filter are shown in the following plot, which shows a –3 dB point of approximately 12 kHz.



2.1049 - Occupied bandwidth

Emission Limits

For differential GPS transmitters, the limits specified in 87.139 are as follows (power measured over a 25 kHz bandwidth):

1st adjacent channel, 25 KHz from center frequency: not specified

2nd adjacent channel, 50 KHz from center frequency: -25 dBm

4th adjacent channel, 100 KHz from center frequency: -30 dBm

8th adjacent channel, 200 KHz from center frequency: -35 dBm

16th adjacent channel, 400 KHz from center frequency: -40 dBm

32nd adjacent channel, 800 KHz from center frequency: -45 dBm

64th adjacent channel, 1.6 MHz from center frequency: -50 dBm

128th adjacent channel and beyond, 3.2 MHz from center frequency: -52 dBm

Test Procedure

Similar to the RF power output measurements discussed earlier, measurements of the adjacent channel power levels were made with the unit operating under conditions simulating a typical customer installation. The transmitter received serial control commands and transmit data commands from the Host Simulator computer. The control commands set the transmit frequency, the RF power output level (20 Watts), and the TDMA time slot assignments. The format of the transmit data sent to the unit resulted in RF transmissions in every other TDMA slot (slots: a, c, e, and g), which provided a 50% transmit duty cycle, the maximum permitted. The messages were of the maximum length allowed (222 bytes). Transmit frequencies were selected at the low and high ends of the band (112.000 and 117.950 MHz, respectively), and in the middle (114.975 MHz).

Adjacent channel power levels were made for the second adjacent channel and at each octave up to the 128th channel, for frequency offsets on both sides of the transmit frequency. In order to effectively measure the relatively low levels of power in the adjacent channels (-95 dBc and lower), notch filters with known attenuation characteristics were used to selectively reduce the transmit power level. Adjacent channel levels were measured via a vector signal analyzer, set for a bandwidth of 25 kHz. To obtain the average power levels for each adjacent channel, a 3 dB factor was incorporated into the calculations to account for the 50% transmit duty cycle. More typically, this duty cycle would be lower, which would reduce the adjacent power levels even further than noted in the test data. Further details of the test setup and data may be found in the **Occupied Bandwidth** file included with this exhibit. A summary of the test data follows.

Test Data Summary

2nd through 128th Channel Power

Adjacent Channel No.	Offset (kHz)	Limit (dBm)	Transmit Frequency = 112.000 MHz	Transmit Frequency = 114.975 MHz	Transmit Frequency = 117.950 MHz

Adjacent Channel No.	Offset (kHz)	Limit (dBm)	Transmit Frequency = 112.000 MHz		Transmit Frequency = 114.975 MHz		Transmit Frequency = 117.950 MHz	
			Channel Freq. (MHz)	ACP (dBm)	Channel Freq. (MHz)	ACP (dBm)	Channel Freq. (MHz)	ACP (dBm)
2nd	+50	-25	112.050	-40.1	115.025	-39.4	118.000	-39.7
4th	+100	-30	112.100	-45.2	115.075	-45.1	118.050	-45.3
8th	+200	-35	112.200	-52.1	115.175	-52.0	118.150	-52.6
16th	+400	-40	112.400	-53.8	115.375	-53.6	118.350	-54.4
32nd	+800	-45	112.800	-54.3	115.775	-54.2	118.750	-55.2
64th	+1600	-50	113.600	-54.4	116.575	-54.4	119.550	-55.8
128th	+3200	-52	115.200	-55.2	118.175	-55.9	121.150	-57.7
2nd	-50	-25	111.950	-40.6	114.925	-40.3	117.900	-40.0
4th	-100	-30	111.900	-44.9	114.875	-45.1	117.850	-44.6
8th	-200	-35	111.800	-51.8	114.775	-51.5	117.750	-51.7
16th	-400	-40	111.600	-53.3	114.575	-52.9	117.550	-53.1
32nd	-800	-45	111.200	-53.7	114.175	-53.1	117.150	-53.2
64th	-1600	-50	110.400	-53.5	113.375	-52.7	116.350	-52.4
128th	-3200	-52	108.800	-53.9	111.775	-52.9	114.750	-52.3

2.1051-Spurious emissions at antenna terminals

Please refer to file 5 included with this exhibit, for more details on the test procedure and for the recorded data.

Note that the wideband data was taken on the LAAS transmitter at a power level of 150 watts output, yet still easily met the requirements of 87.139(a). Data is submitted for frequencies from the lowest RF frequency generated, 14.745 MHz, to 10 times the highest fundamental frequency generated, which is 1179.500 MHz. Note that all emissions, except the fundamental frequency of 113.000 MHz, were at least 28 dB below the limit, so are not individually reported per 2.1057(c). Note that the limit of 101 dB microvolt is drawn on each plot, but did not in all cases survive the data compression that occurred when converting from the scanned .tif files to the requested .pdf files.

Also, because a notch filter was used to achieve full, sensitivity for the wideband data, additional data was taken in our lab on a SCAT transmitter (at 20 watts output) to show the close in spectrum. Two plots were taken at each of three frequencies to provide the best detail.

2.1053-Field strength of spurious radiation

Please refer to file 6, included with this exhibit, for more details on the test procedure and for the recorded data.

Data taken on the LAAS transmitter at an output level of 150 watts for the MIL-STD-461C RE-02 test is used to show compliance with this requirement. The transmitter meets this requirement by more than 30 dB, even at this higher output power level.

The allowable limit was determined as follows:

The field strength produced by 20 watts 1 meter from a dipole antenna is:

E(V/M)=sqrt(49.2*P)/D = 31.4 V/M = 29.9 dB V/M = 149.9 dB microvolt/M

Radiated emissions are required to be 43+10Log P = 43 + 10 Log (20 watts) = 56 dB below the mean transmitted power. Therefore, the allowable field strength for a spurious emission, 1 meter from the transmitter, is:

149.9 dB microvolt/M – 56 dB = 93.9 dB microvolt/M

This limit applies for frequencies removed from the carrier frequency 62.5 KHz or more.

Spurious emissions at frequencies removed from the assigned frequency by 25 to 62.5 KHz must be at a level of:

149.9 dB microvolt/M – 35 dB = 114.9 dB microvolt/M

Spurious emissions at frequencies removed from the assigned frequency by 12.5 to 25 KHz must be at a level of:

149.9 dB microvolt/M – 25 dB = 124.9 dB microvolt/M

All measured emissions were 30-50 dB better than the required limit and so are not individually reported per 2.1057(c).

2.1055 - Frequency Stability

Please refer to file **Frequency Stability** included with this exhibit, for a complete test procedure, with recorded data.