

FCC CERTIFICATION INFORMATION

The P07-1111-2 customer premises transceiver made by TSI is a single integrated unit design using a single antenna for both transmit and receive. The transceiver is designed to interface with cable modems (not supplied by TSI). The transceiver receives RF input from the modem , up converts, amplifies, and transmits the signal to the base station.

The transceiver operates in the 710-716 MHz band, under Part 27 of FCC Rules. The following information is in accordance with FCC Rules, 47CFR Part 2.

- 2.1033(c)1** Applicant: TRANSYSTEM INC.
 NO. 1-2, LI-HSIN RD.I,
 SCIENCE-BASED INDUSTRIAL PARK
 HASINCHU, TAIWAN
- 2.1033(c)2** FCC ID: OUPP07-1111-2
- 2.1033(c)3** Installation instructions are found in attached document.
- 2.1033(c)4** Emission type is dependent on IF input to EUT. Refer to Table 1 below.
- 2.1033(c)5** Frequency range: 710-716 MHz, FCC Rule Part 27 para. 27.5c(1)
- 27.5(c)** *698-746 MHz band.* The following frequencies are available for licensing pursuant to this part in the 698-746 MHz band:
(1) Three paired channel blocks of 12 megahertz each are available for assignment as follows:
 Block C: 710-716 MHz and 740-746 MHz.
- 2.1033(c)6 Range of Operating Power**
 0 - 24 dBm (dependent on input from indoor cable modem unit)
- 2.1033(c)7 Maximum Power Rating**
 24.4 dBm
- 2.1033(c)8 Applied voltages and currents into the final transistor elements**
 Refer to schematics accompanying this application
- 2.1033(c)10 Circuit and Functional Block Diagram, Description of Circuitry**
 Refer to separate attachment
- 2.1033(c)11 FCC ID Label**
 Refer to separate attachment
- 2.1033(c)12 Product Photographs**
 Refer to separate attachment
- 2.1033(c)13 Description of Modulation System**
 320, 640, and 1280 ksym/sec QPSK
 320, 640, and 1280 ksym/sec 16QAM

2.1055 RF Output Power Measurements**Limit per: Part 27 para. 27.5c****Measurement equipment used:**

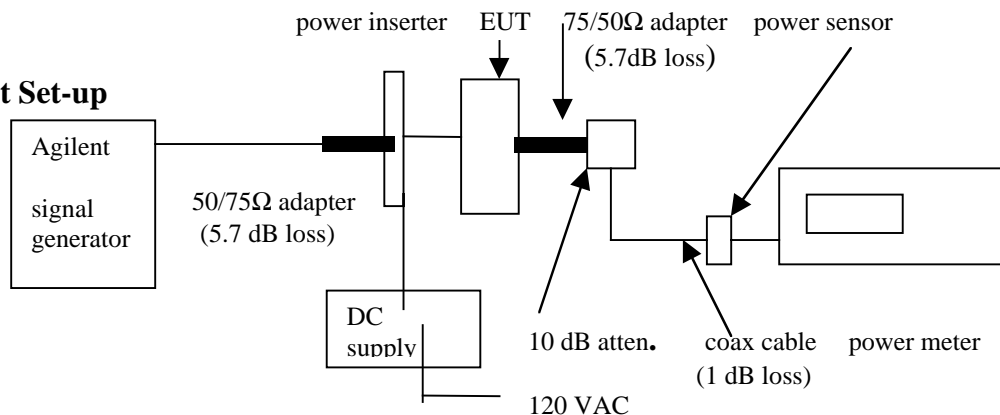
HP 436A RF power meter

HP 8482A power sensor

10 dB attenuator (50 ohm)

2- 50/75 ohm adapters (5.7 dB loss each)

Agilent A4433B ESG-D Signal Generator

Test Set-up**Limits:**

27.50(c) The following power and antenna height requirements apply to stations transmitting in the 698-746 MHz band:

(1) Fixed and base stations are limited to a maximum effective radiated power (ERP) of 50 kW, with the limitation on antenna heights as follows:

(i) Fixed and base stations with an ERP of 1000 watts or less must not exceed an antenna height of 305 m height above average terrain (HAAT) except when the power is reduced in accordance with Table 1 of this section;

(ii) The antenna height for fixed and base stations with an ERP greater than 1000 watts but not exceeding 50 kW is limited only to the extent required to satisfy the requirements of §27.55(b).

Test Procedures

Signal generator was set to IF frequency for maximum RF output at desired frequency.

RF output frequency = (665.6 + IF) MHz

Test Results

$P_{out} = \text{meter reading} + 5.7\text{dB} + 1\text{ dB} + 10\text{ dB} = \text{meter reading} + 16.7\text{ dB}$

IF Frequency	IF Input	RF output	Pout, QPSK	Pout, 16QAM
45.3 MHz	-1.7 dBm	710.9 MHz	24.4 dBm	24.1 dBm
47.4 MHz	-1.7 dBm	713 MHz	24.1 dBm	23.7 dBm
49.9 MHz	-1.7 dBm	715.5 MHz	23.7 dBm	23.4 dBm

Output power tested at each data rate: 320, 640, and 1280 ksym/sec

Output power for each modulation is independent of symbol rate.

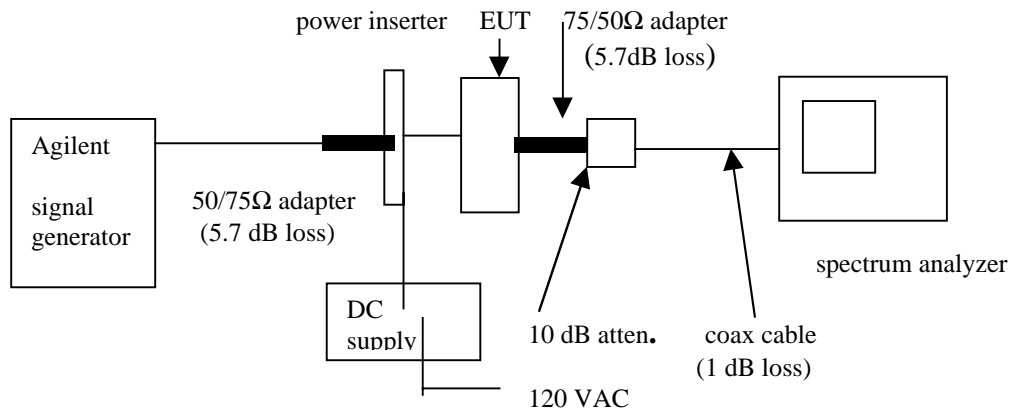
Section 2.1047 Modulation Characteristics**Section 2.1051 Spurious and Harmonic Emissions at Antenna Terminals****Limit Per: FCC Part 27 para. 27.53(f)****Measurement Equipment Used:**

HP 8593EM Spectrum analyzer, 9kHz – 26.5 GHz

10 dB attenuator (50 ohm)

2- 50/75 ohm adapters (5.7 dB loss each)

Agilent A4433B ESG-D Signal Generator

Test Set-up:**Limits:**

27.53(f) For operations in the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

Test Procedures:

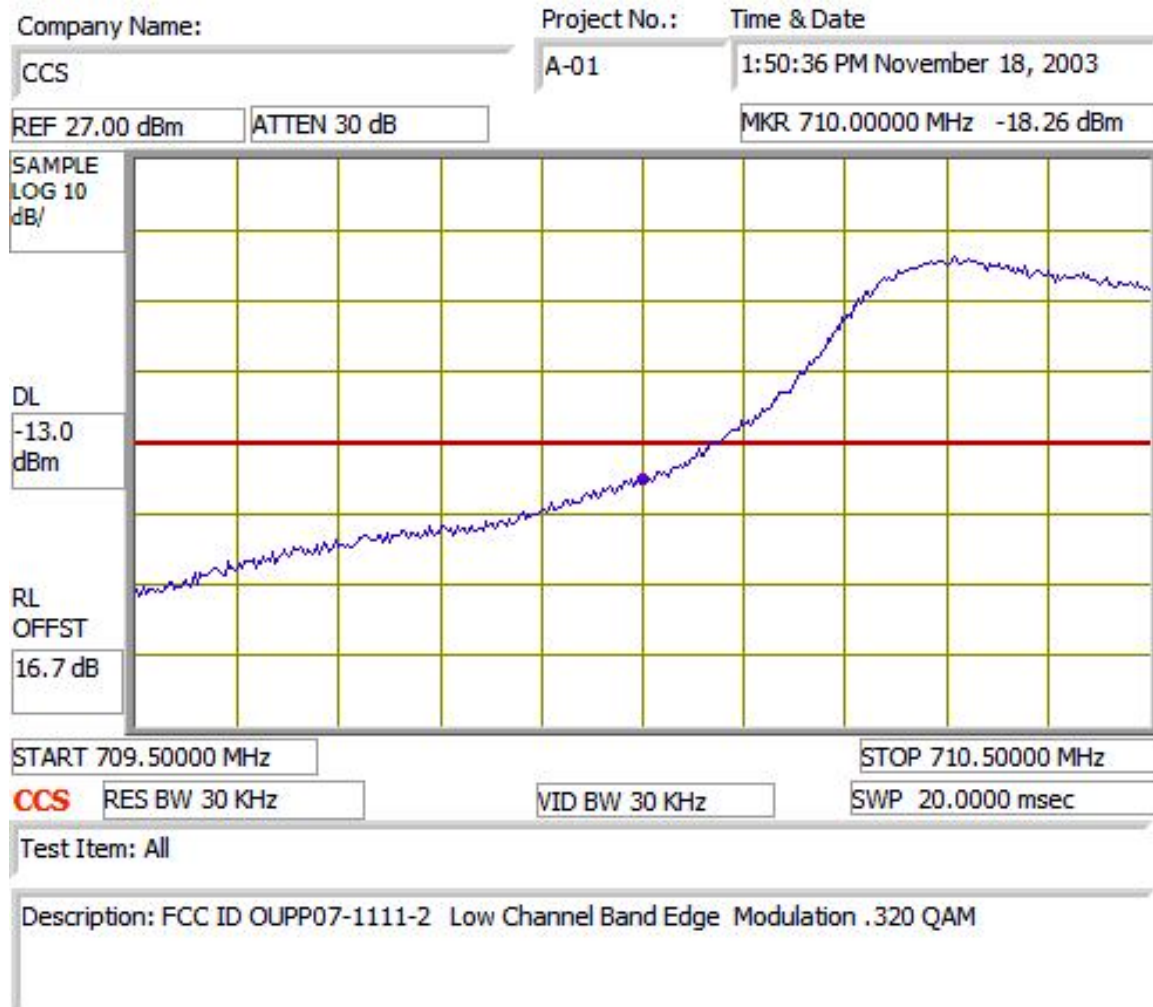
For the various modulations IF power and frequency were set to produce maximum output power without exceeding the out-of-band limits in section 27.53.

Test Results

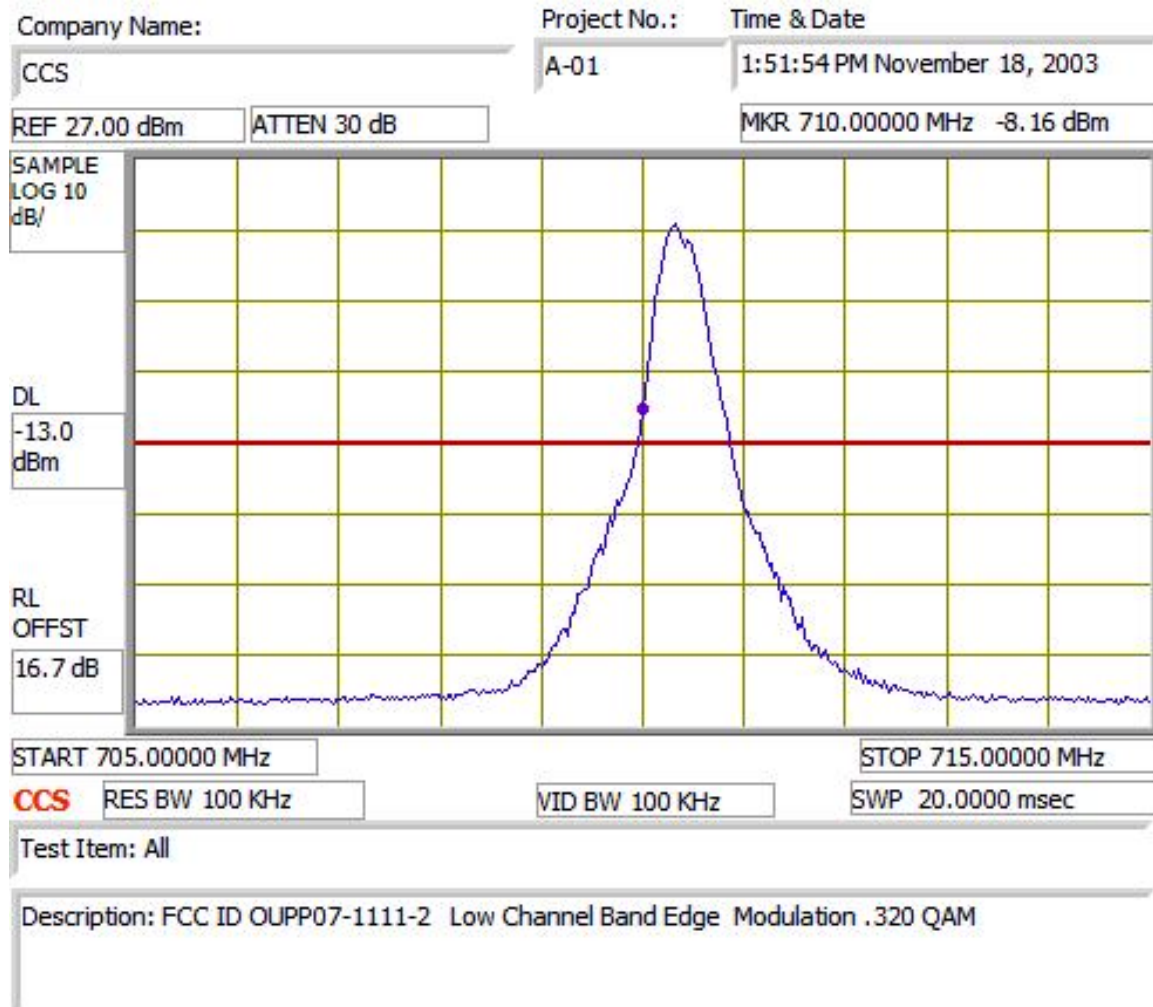
Refer to QPSK masks and 16QAM plots below. Emissions beyond ± 5 MHz of fundamental were virtually identical for all data rates at each modulation, therefore only one plot is shown for 30-2092 MHz and 2090-7130 MHz ranges for QPSK and 16QAM.

Data rate kSym/sec	Lowest fc QAM	Hi ghest fc, QAM	Low est fc, QPSK	Hi ghest fc., QPSK
320	710.4 MHz	715.6MHz	710.3 MHz	715.6 MHz
640	710.7 MHz	715.4 MHz	711 MHz	715.5 MHz
1280	711.7 MHz	715.1 MHz	712 MHz	715.1 MHz

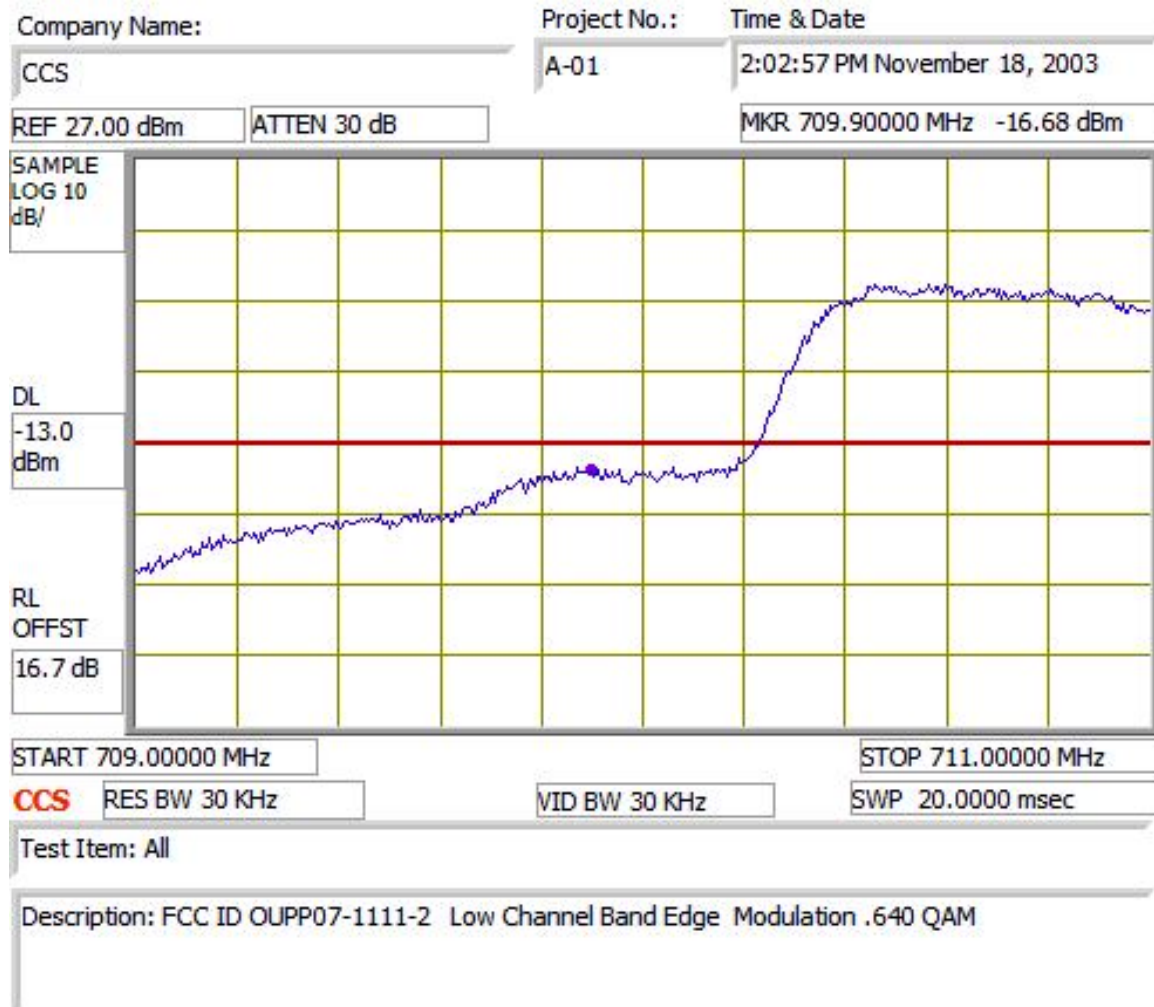
Low Channel, 16QAM 320 ksym/sec, $f_c = 710.4$ MHz



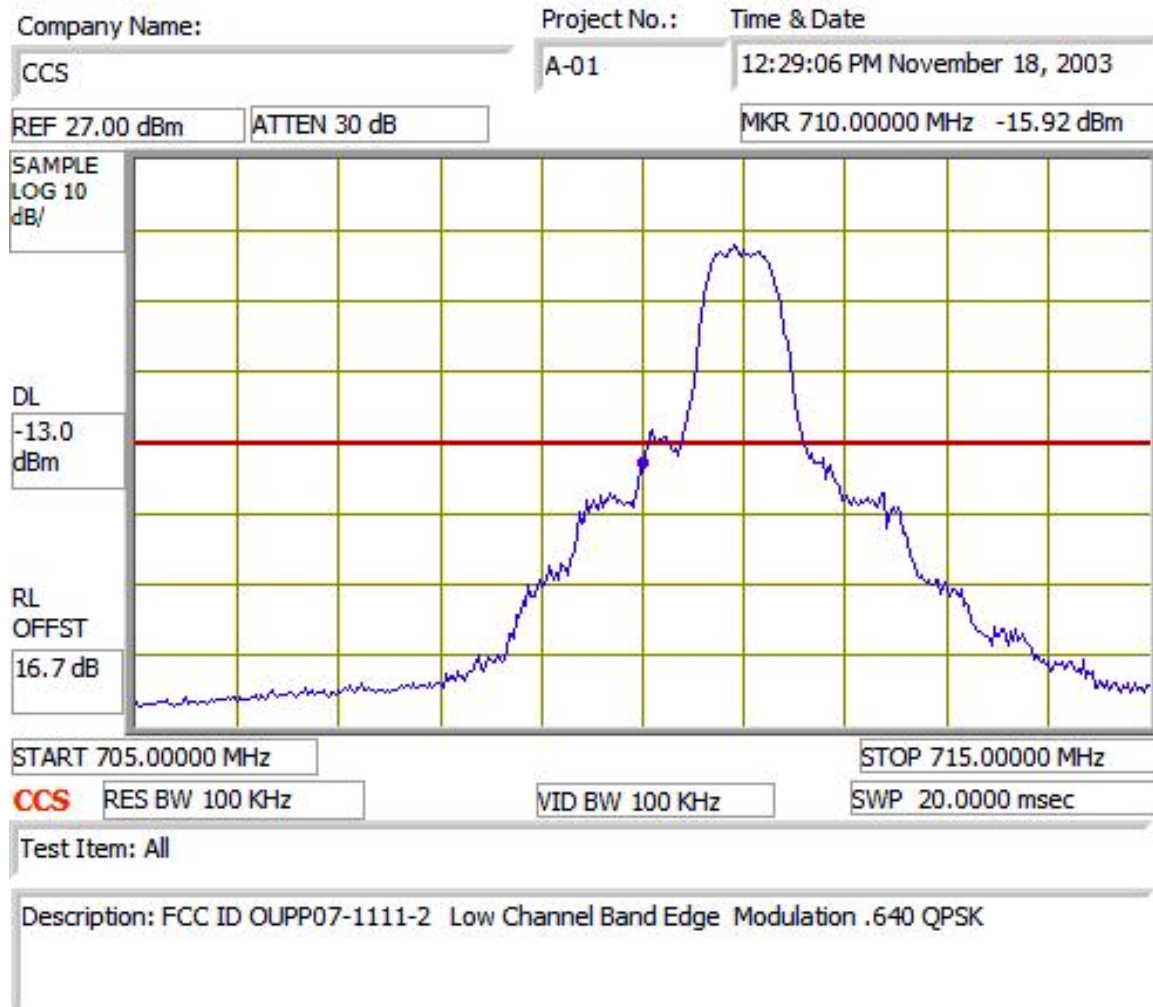
Low Channel, 16QAM 320 ksym/sec, $f_c = 710.4$ MHz



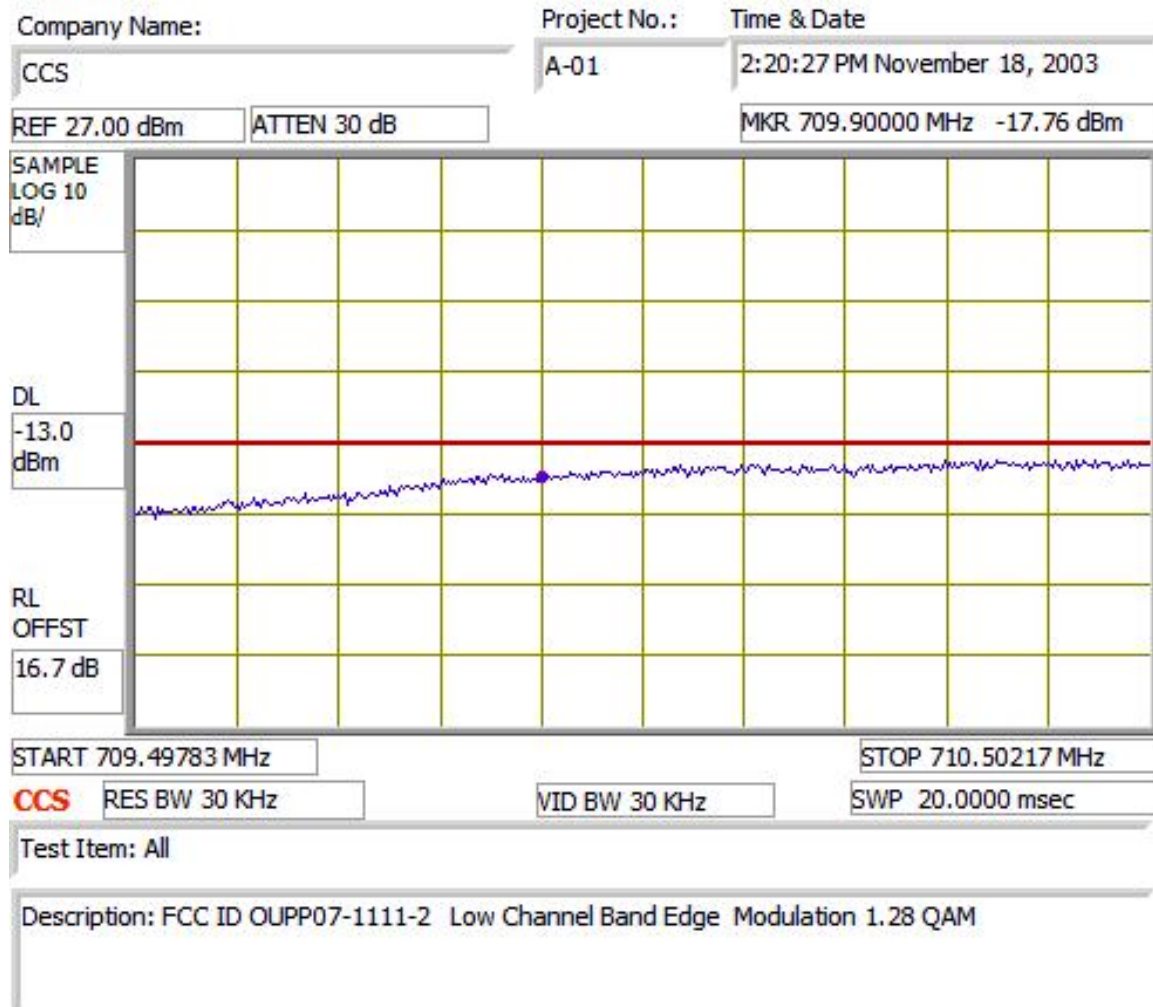
Low Channel, 16QAM 640 ksym/sec, $f_c = 710.7$ MHz



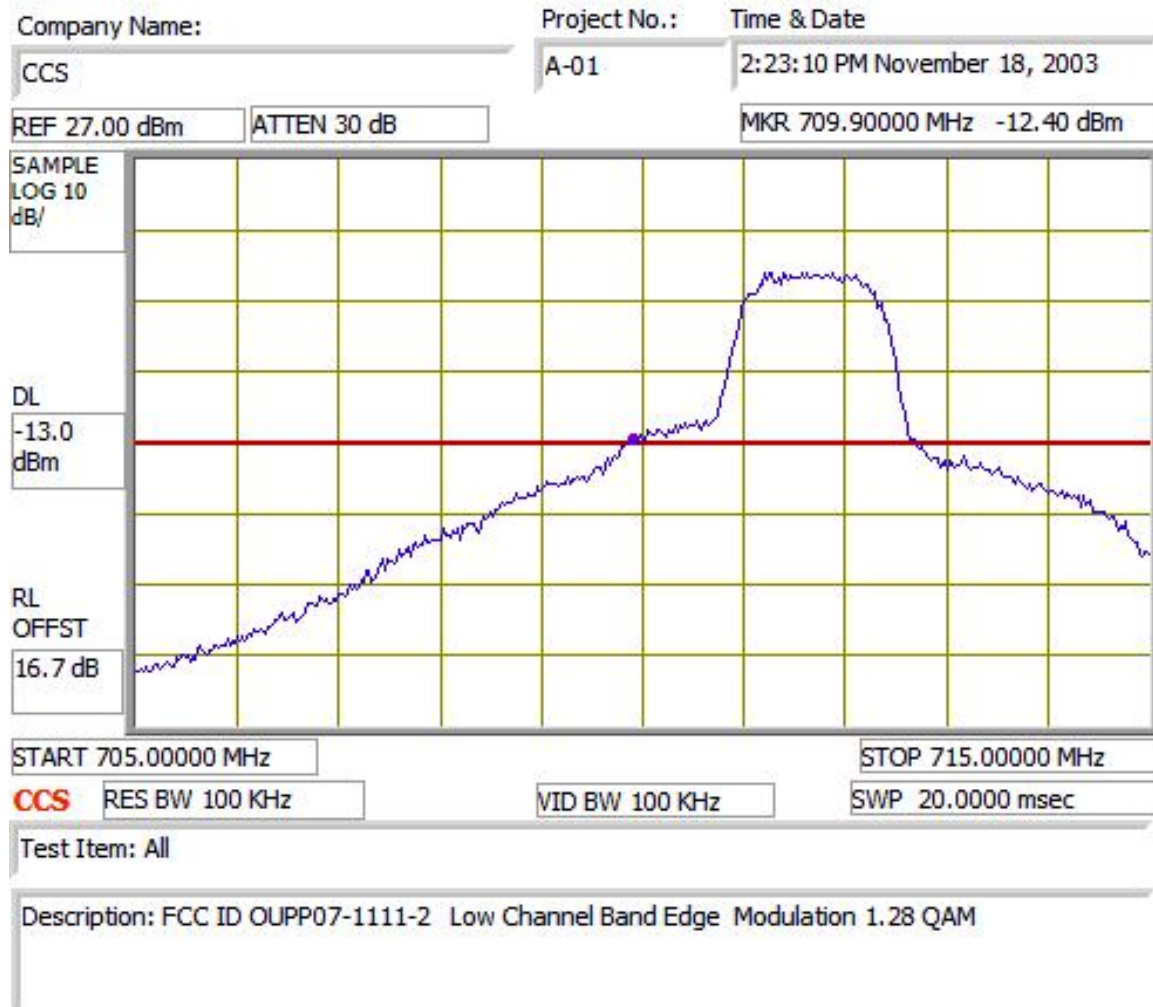
Low Channel, 16QAM 640 ksym/sec, $f_c = 710.7$ MHz



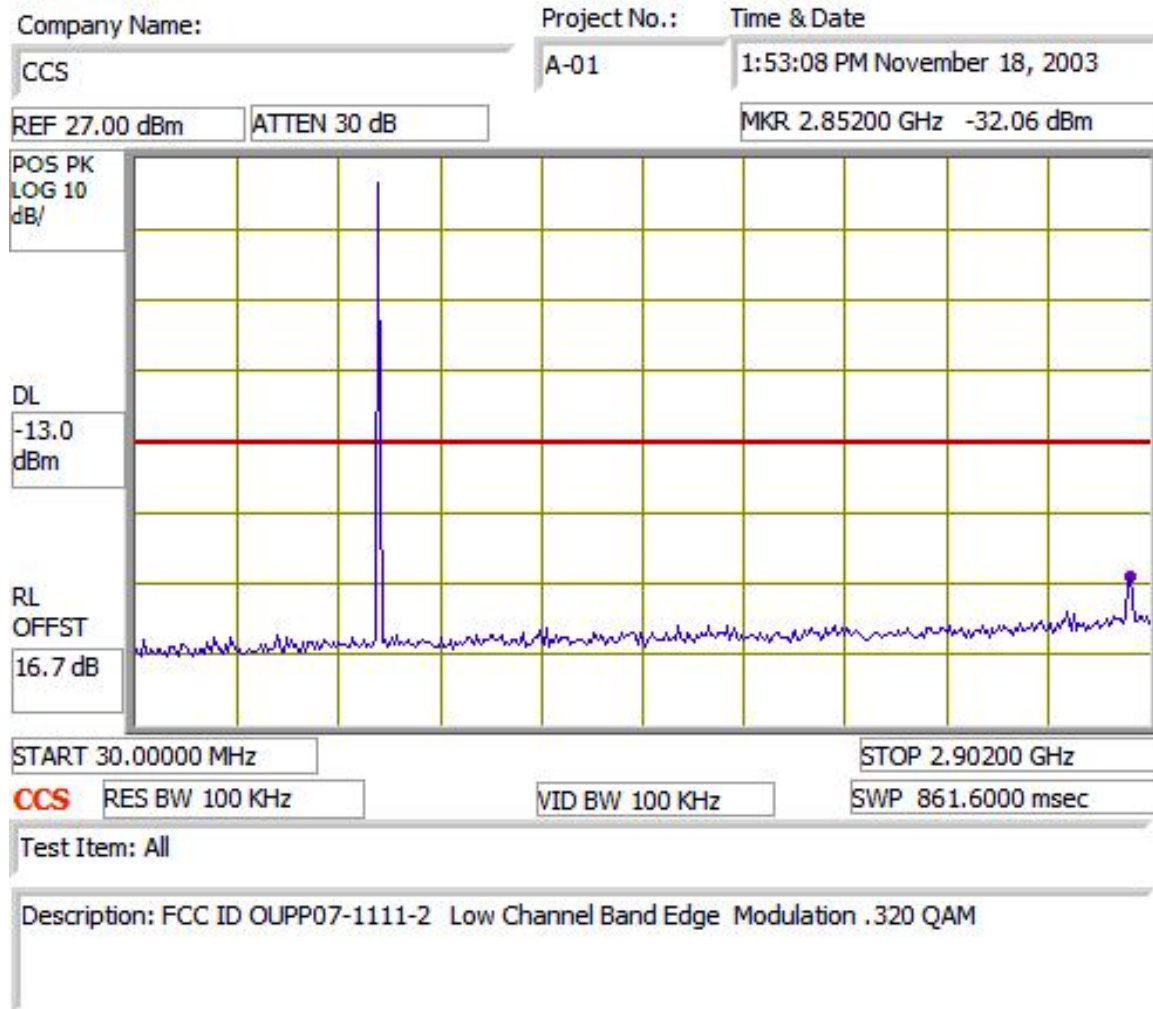
Low Channel, 16QAM 1280 ksym/sec, $f_c = 711.7$ MHz



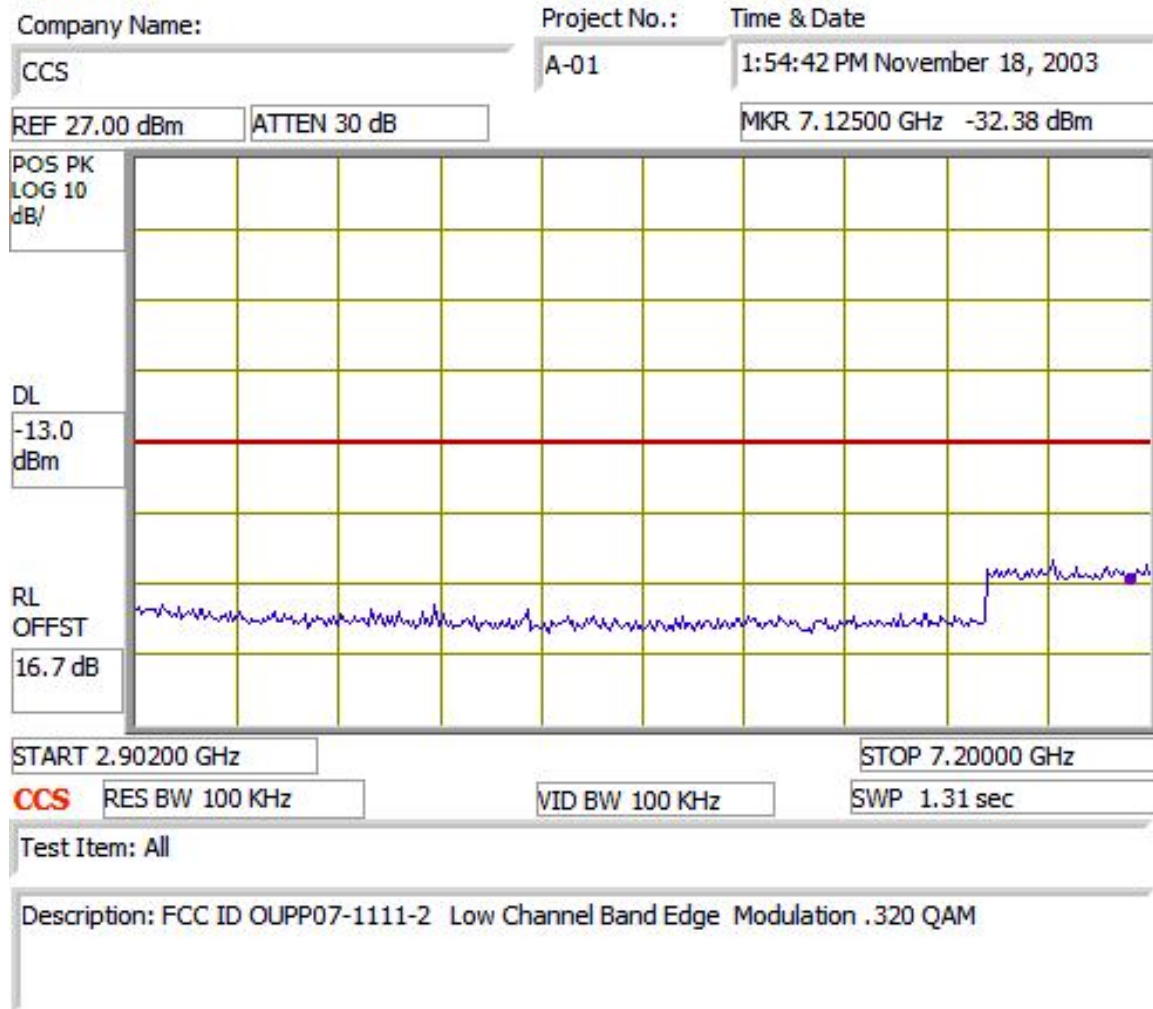
Low Channel, 16QAM 1280 ksym/sec, $f_c = 711.7$ MHz



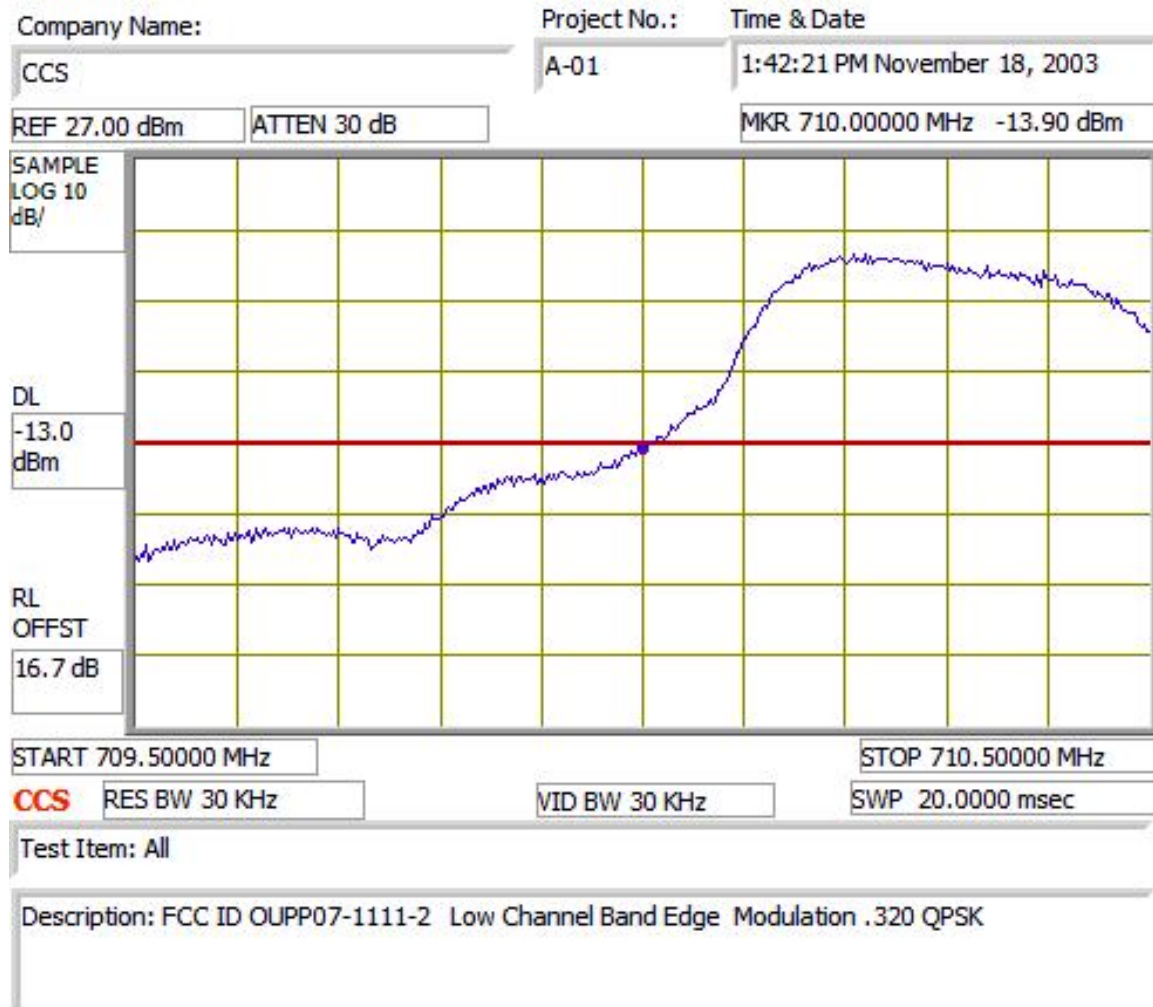
Low Channel, 16QAM (all data rates)



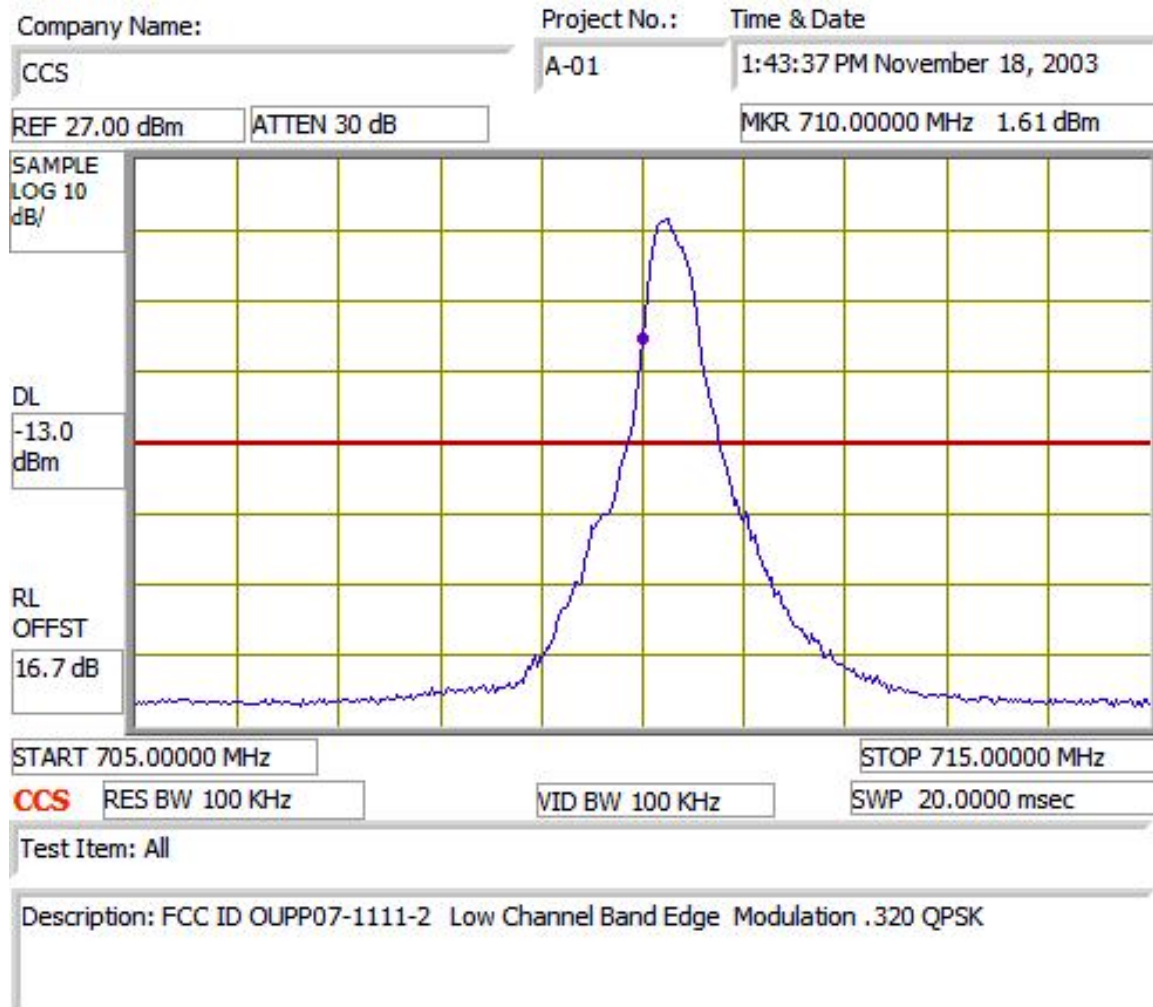
Low Channel, 16QAM (all data rates)



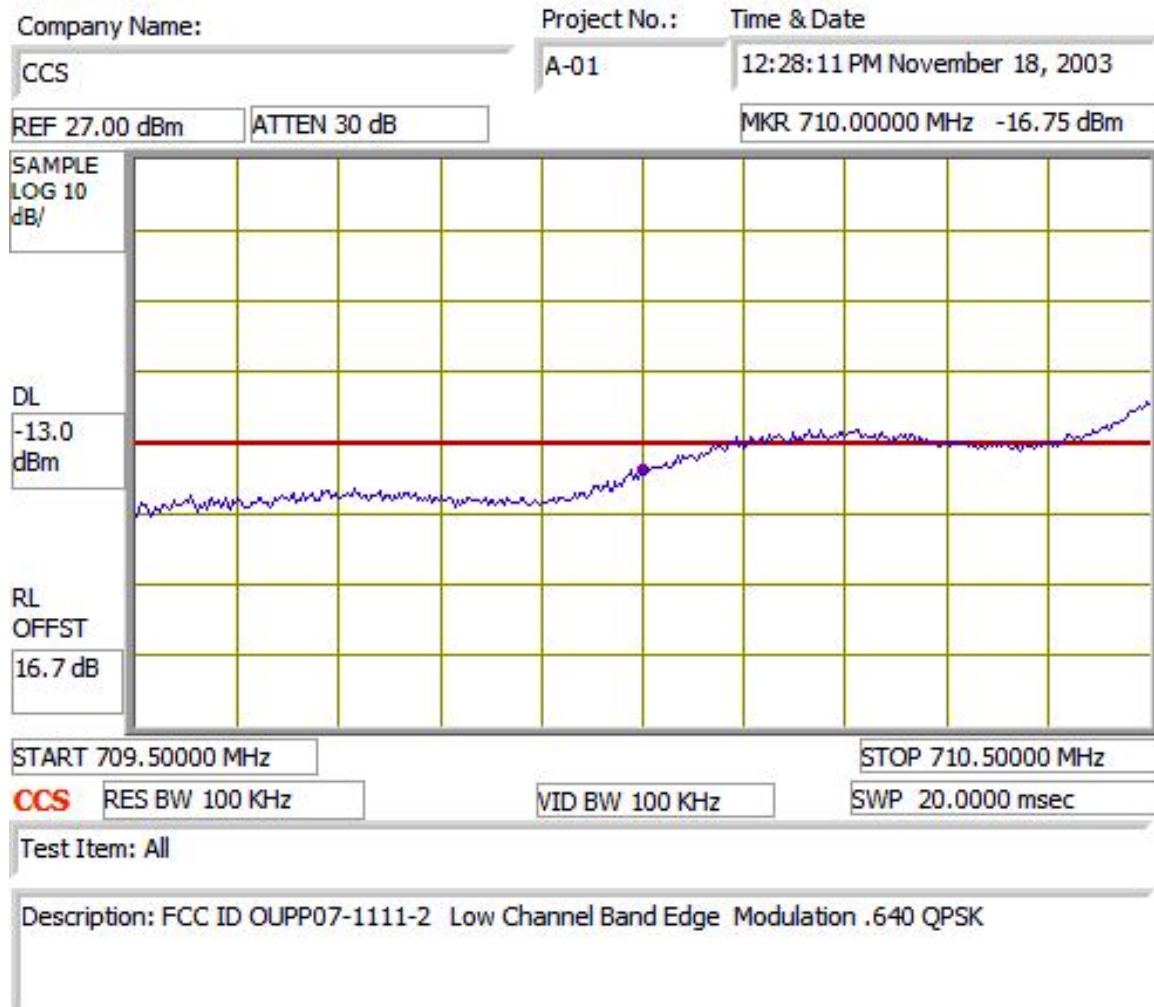
Low Channel, QPSK 320 ksym/sec, $f_c = 710.3$ MHz

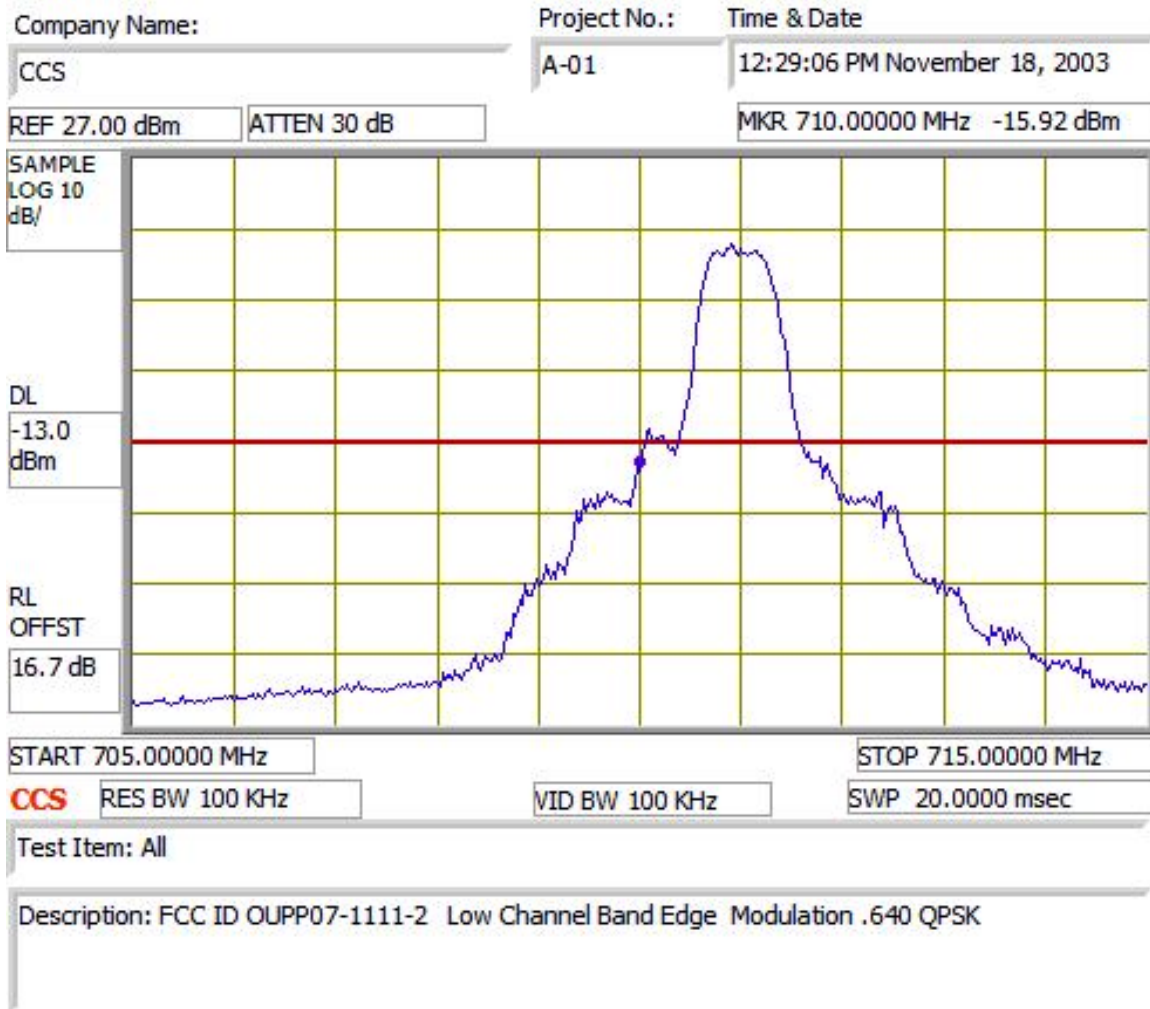


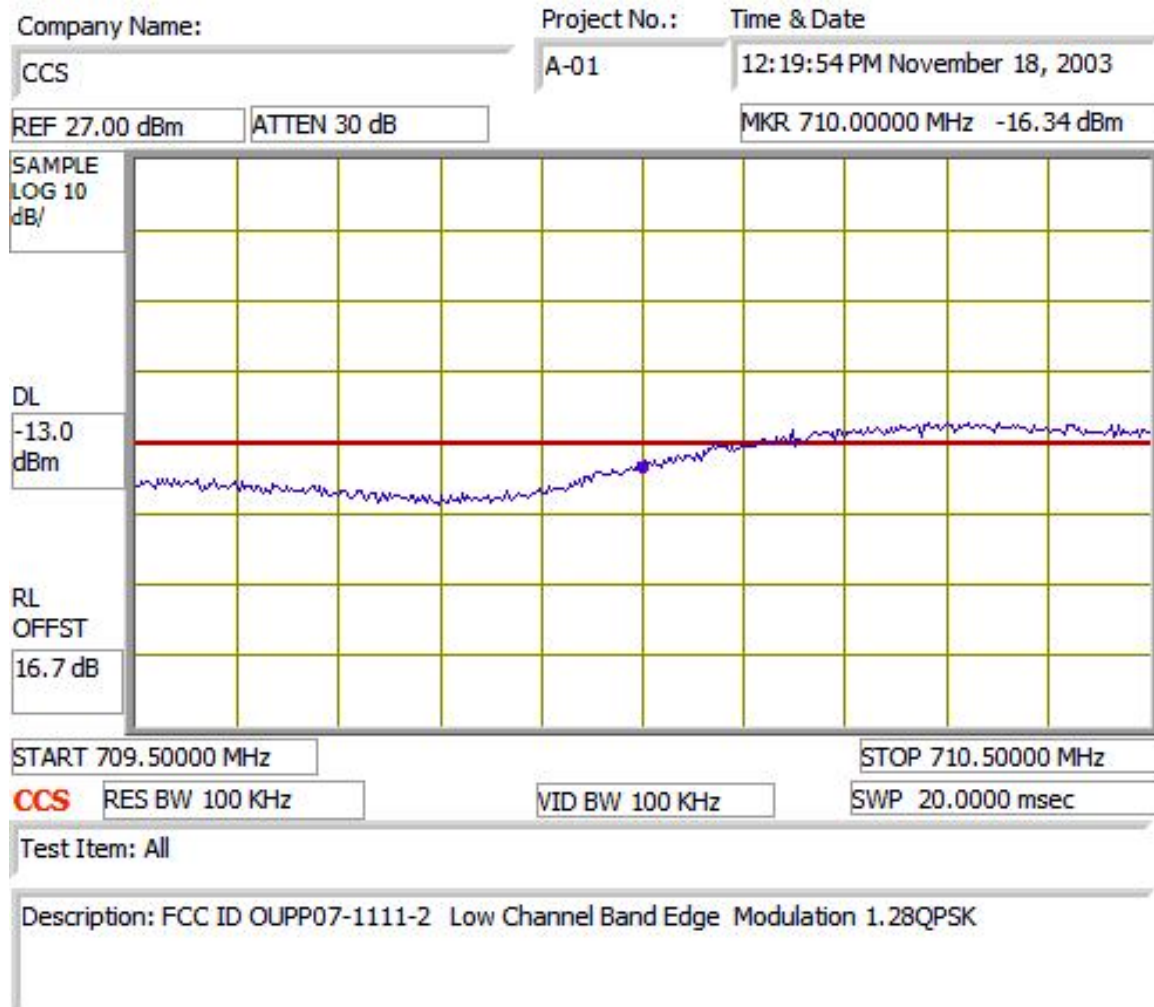
Low Channel, QPSK 320 ksym/sec, $f_c = 710.3$ MHz

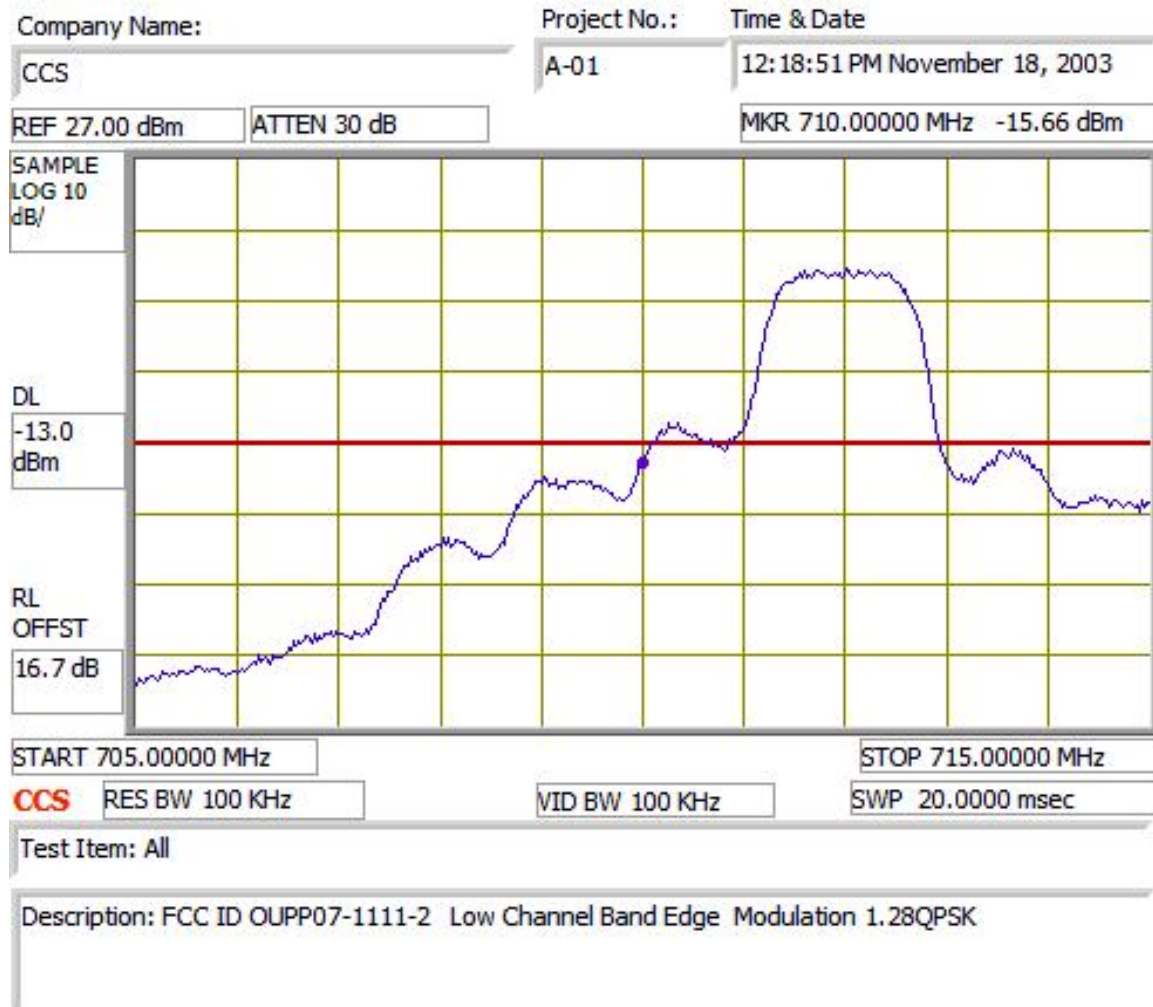


Low Channel, QPSK 640 ksym/sec, $f_c = 711$ MHz

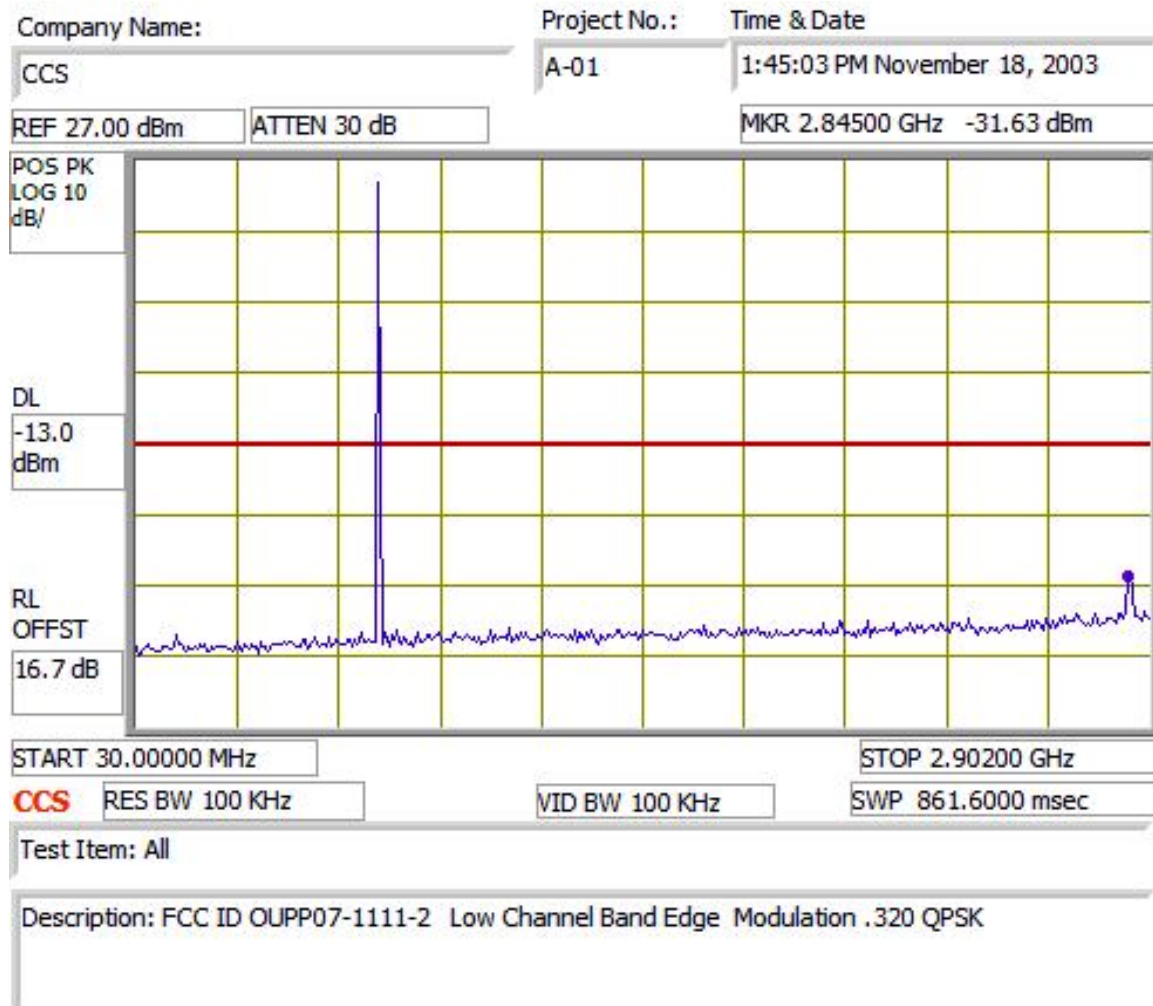


Low Channel, QPSK 640 ksym/sec, $f_c = 711$ MHz

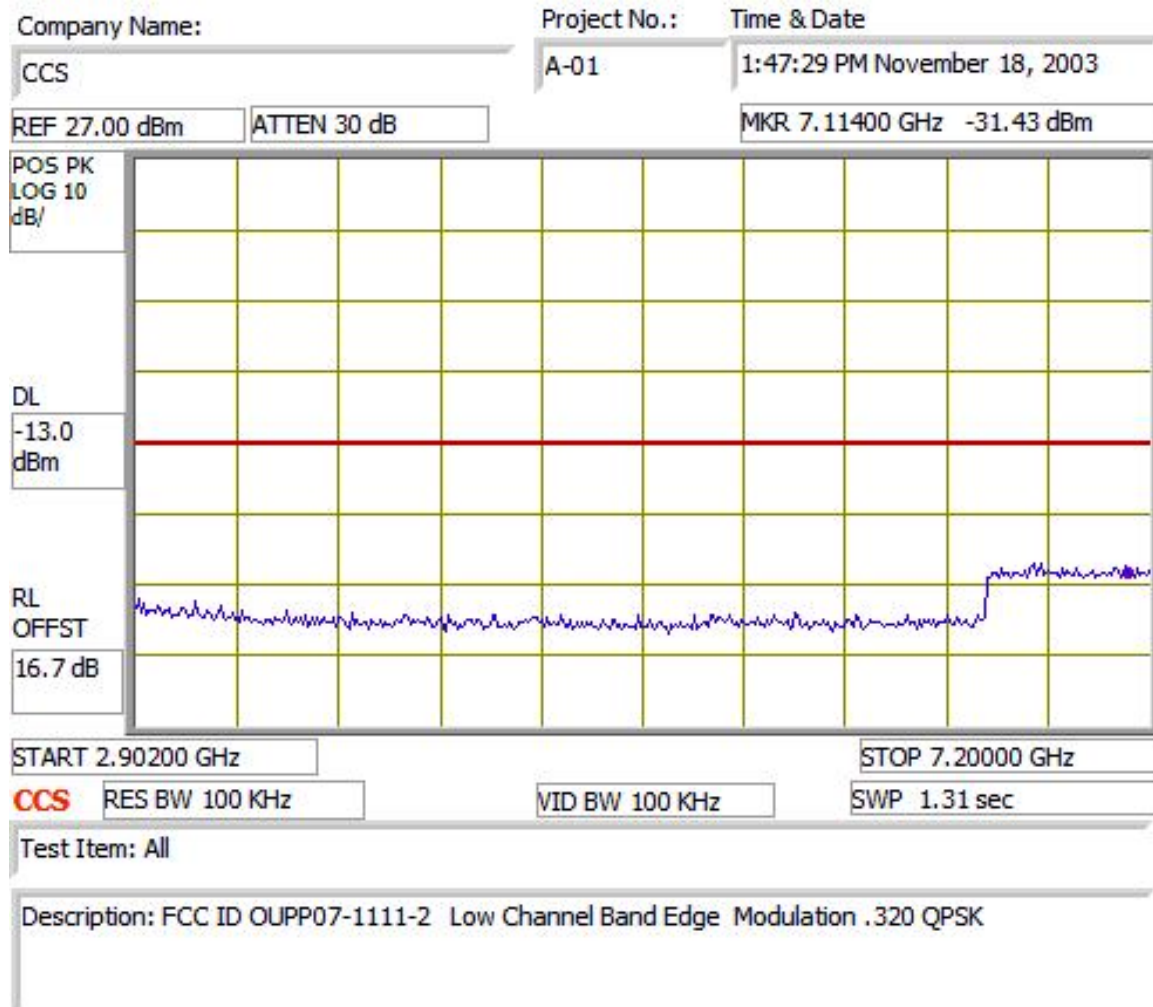
Low Channel, QPSK 1280ksym/sec, $f_c = 712$ MHz

Low Channel, QPSK 1280ksym/sec, $f_c = 712$ MHz

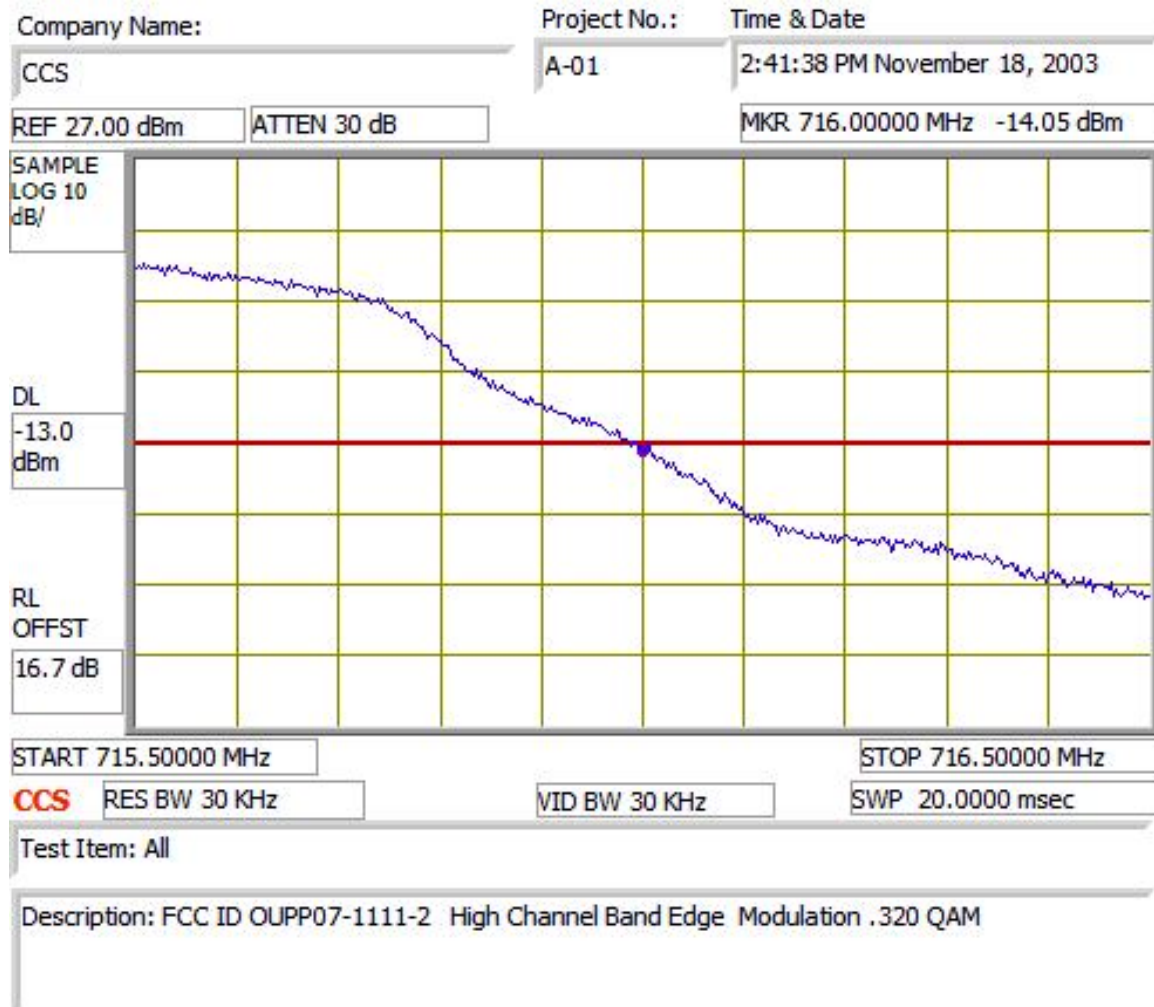
Low Channel, QPSK (all data rates)



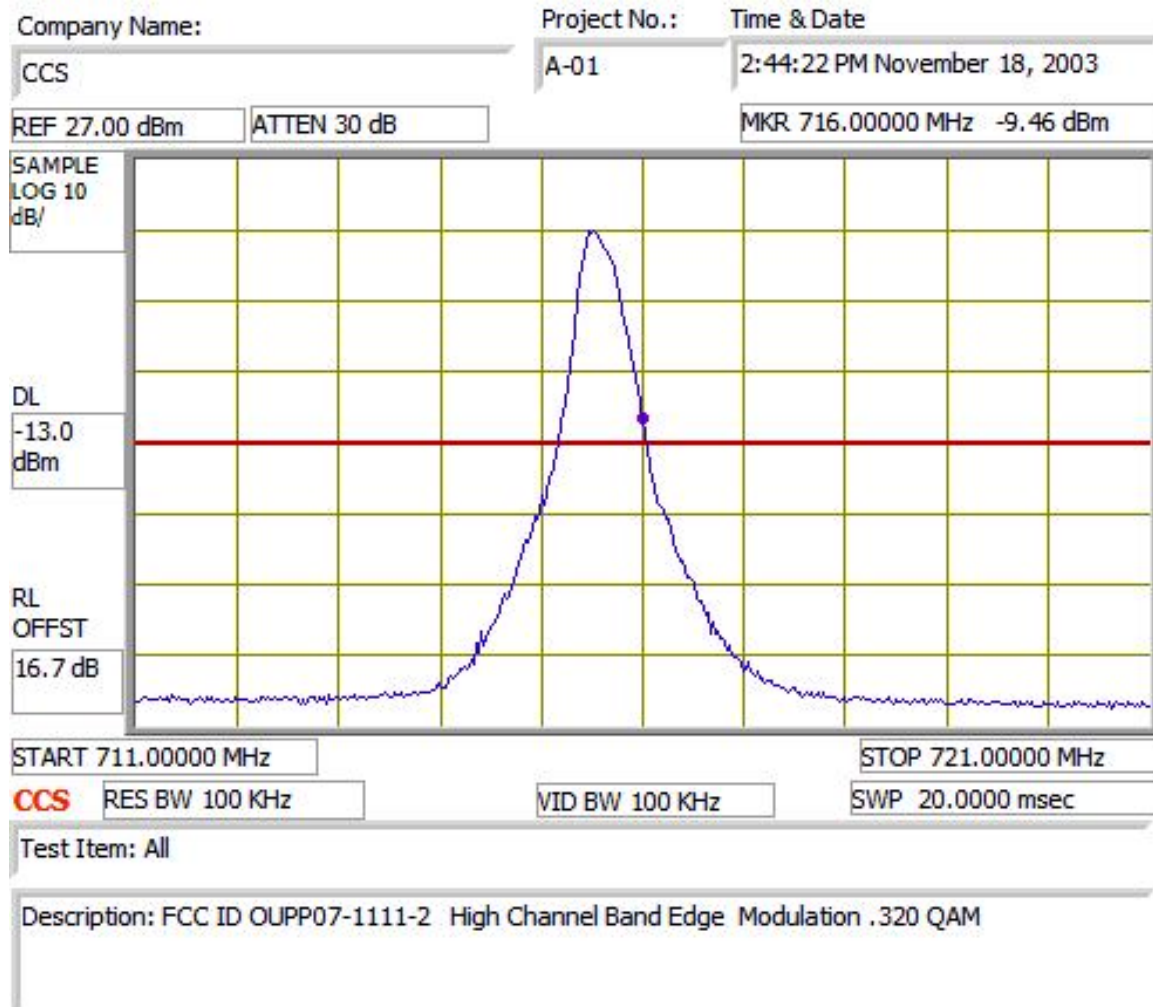
Low Channel, QPSK (all data rates)



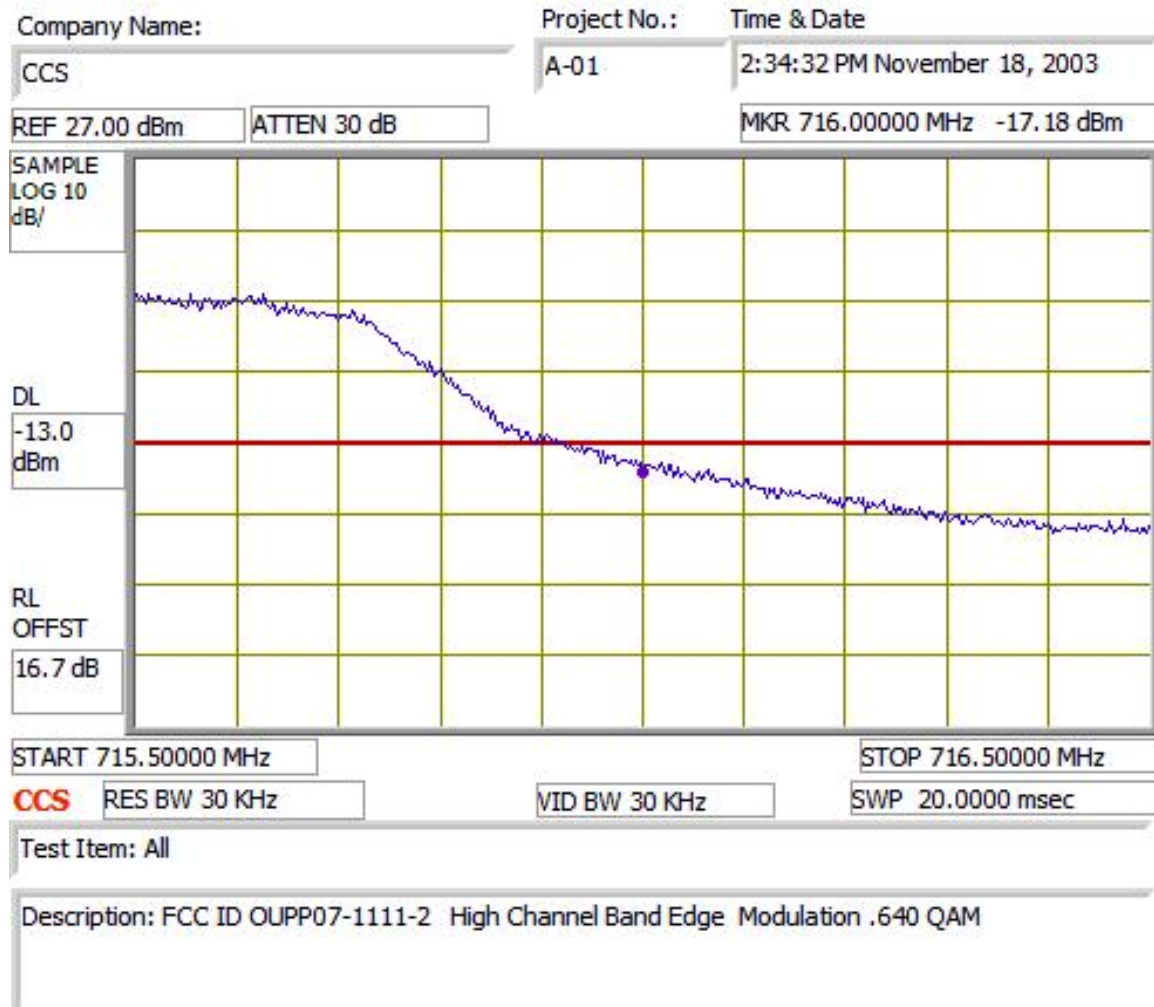
High Channel, 16QAM 320 ksym/sec, $f_c = 715.6$ MHz



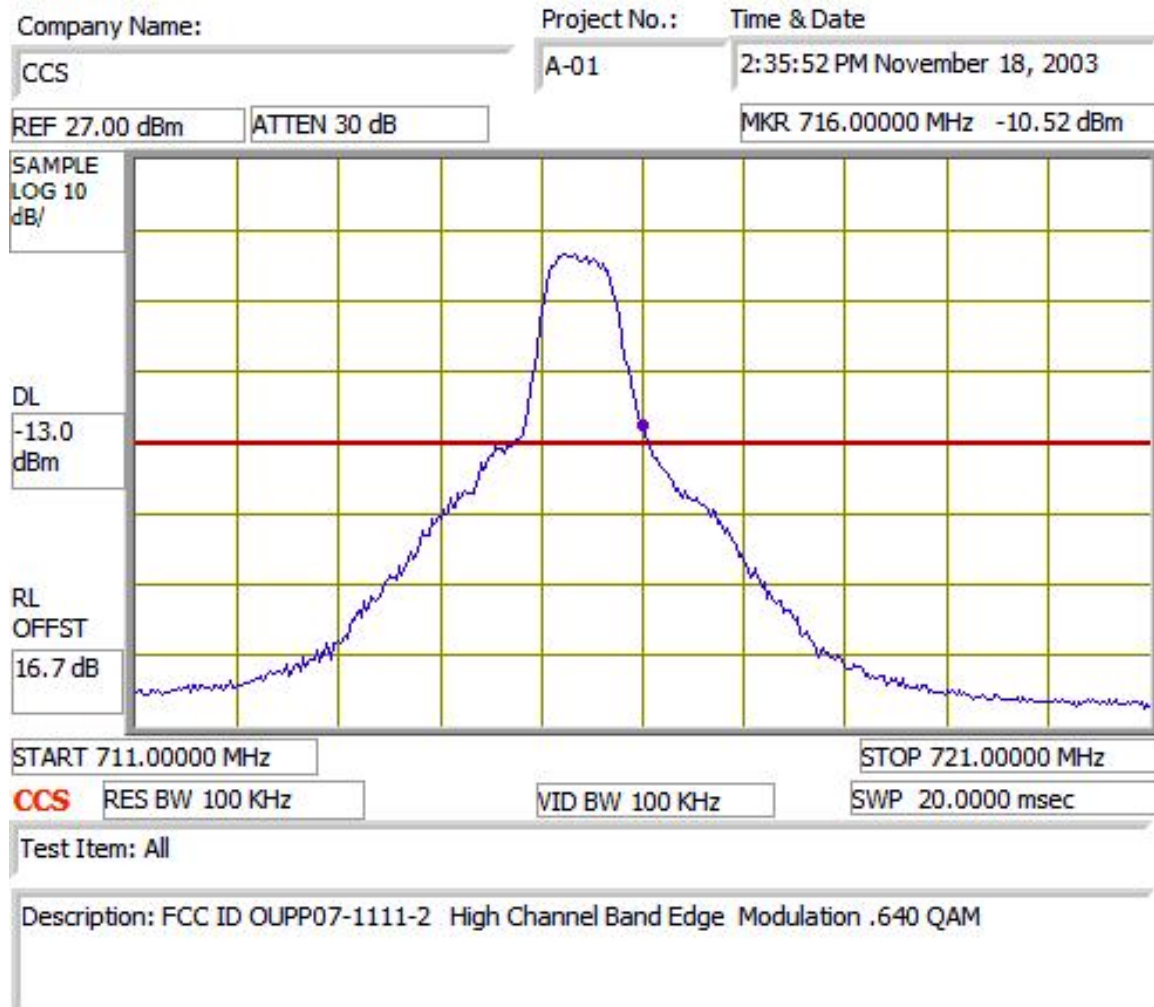
High Channel, 16QAM 320 ksym/sec, $f_c = 715.6$ MHz



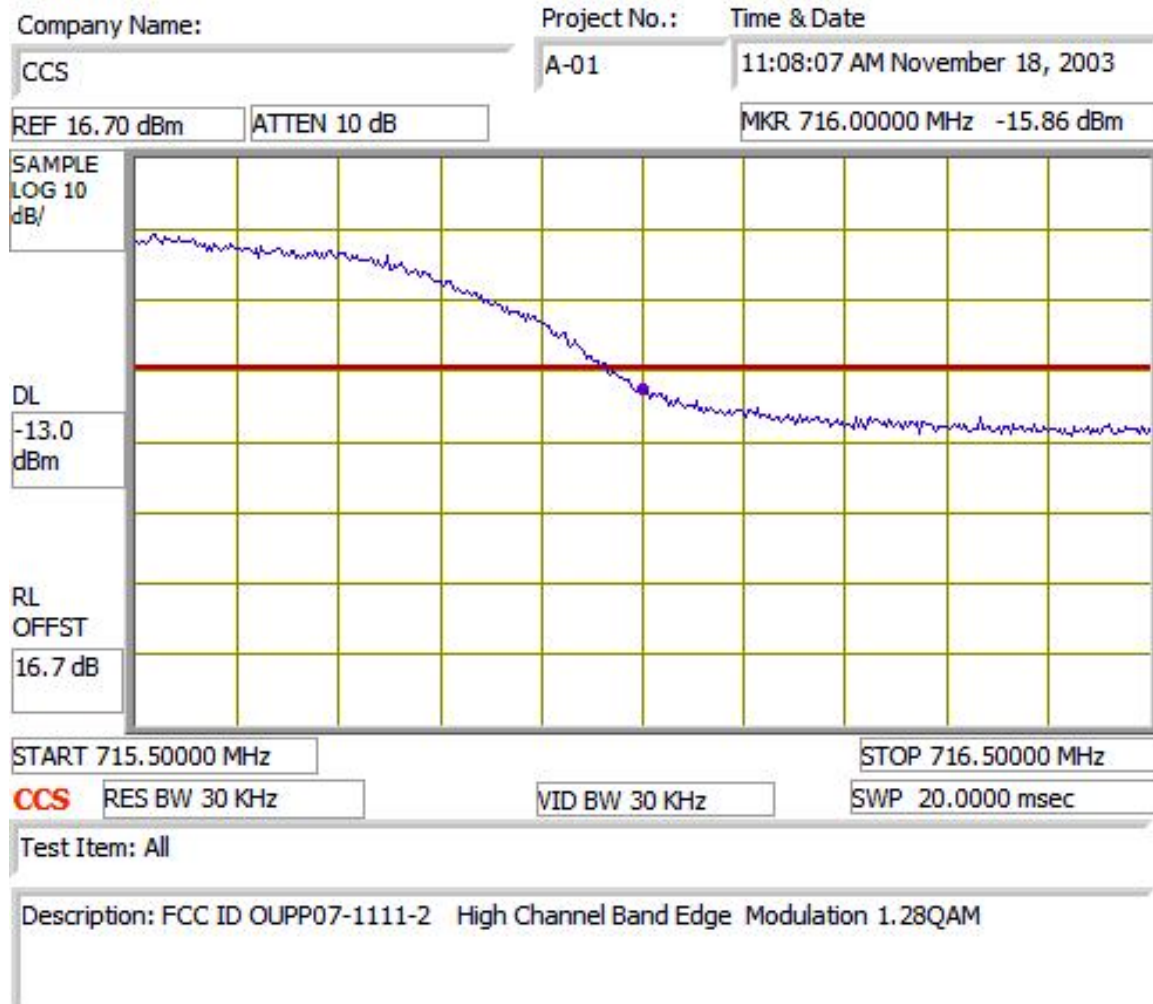
High Channel, 16QAM 640 ksym/sec, $f_c = 715.4$ MHz



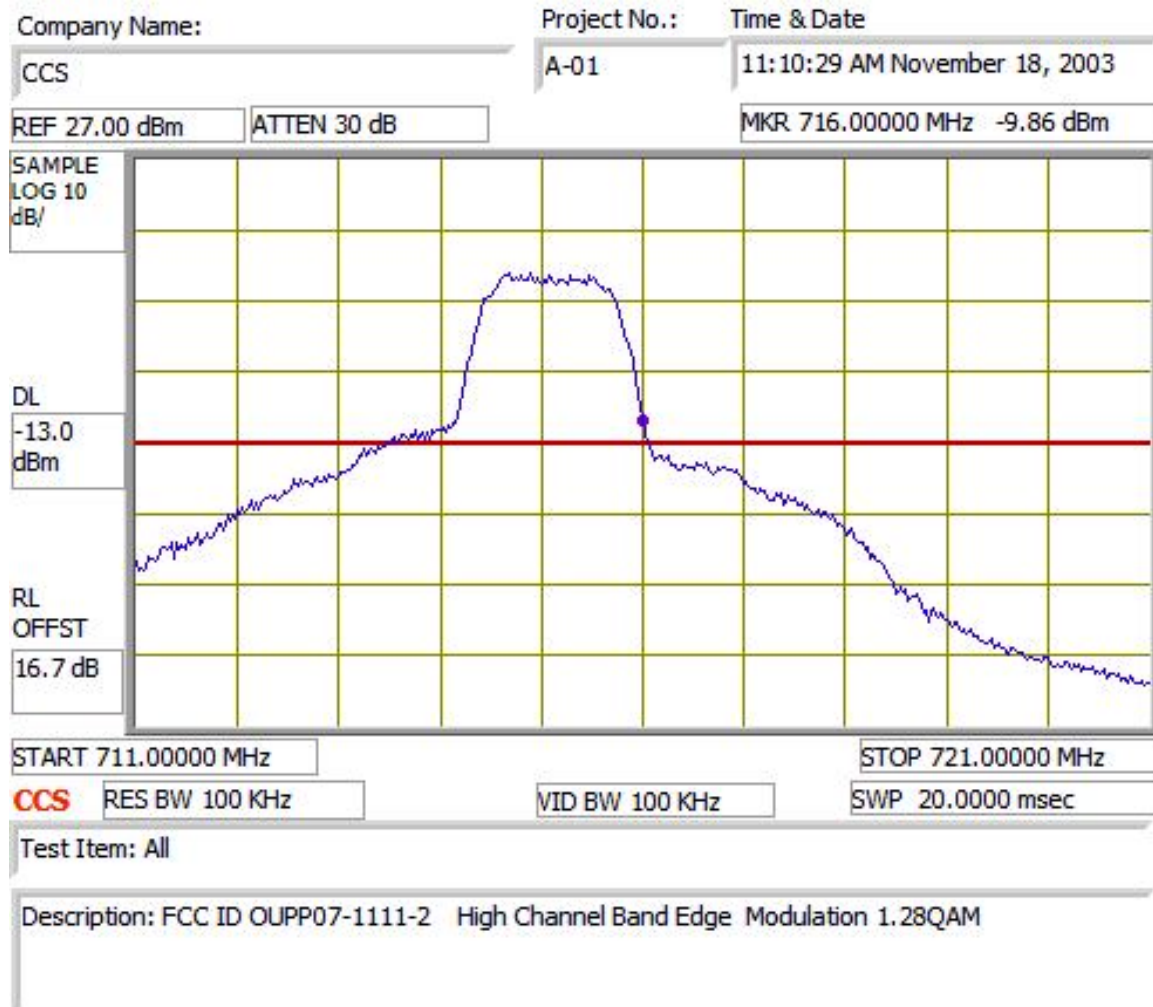
High Channel, 16QAM 640 ksym/sec, $f_c = 715.4$ MHz



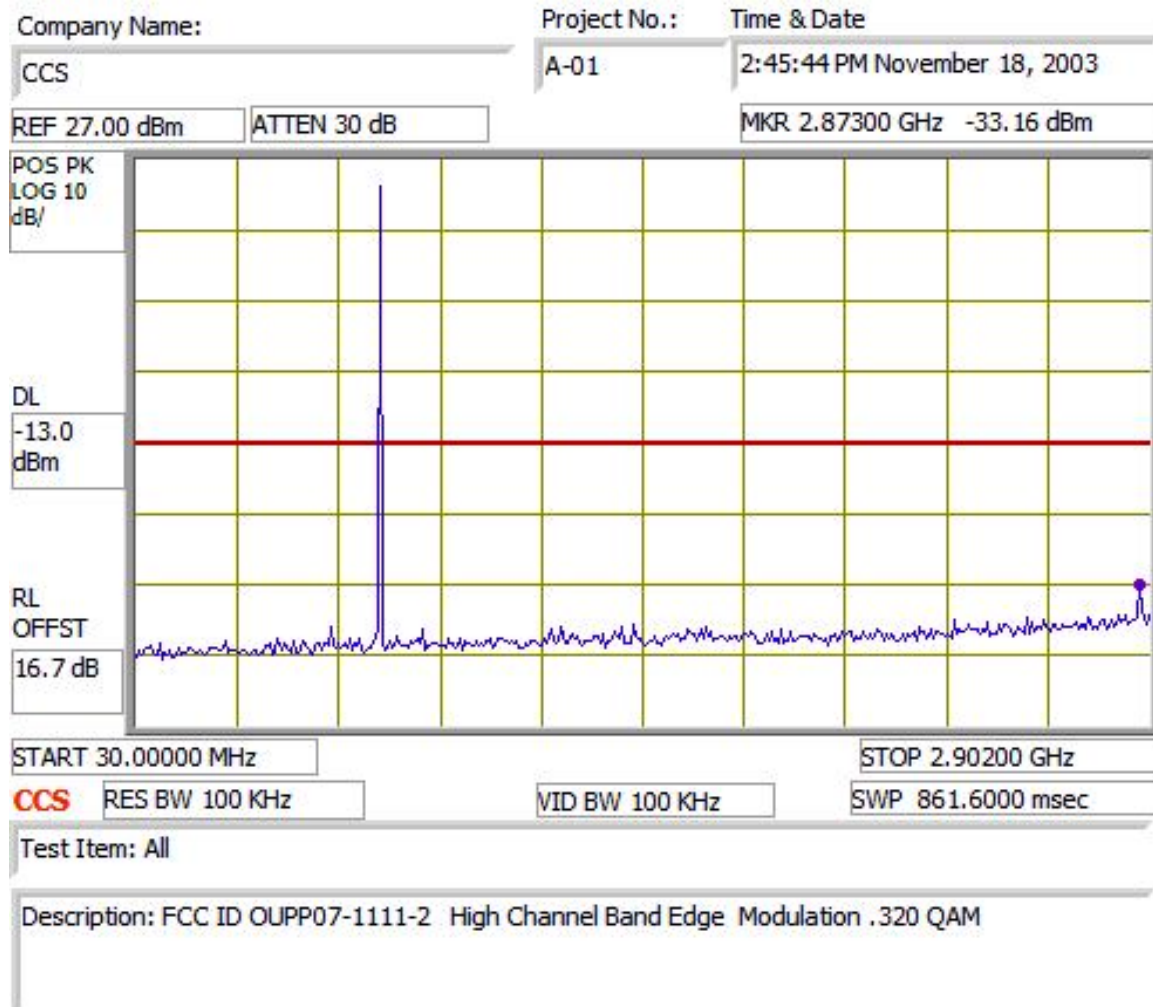
High Channel, 16QAM 1280 ksym/sec, $f_c = 715.1$ MHz



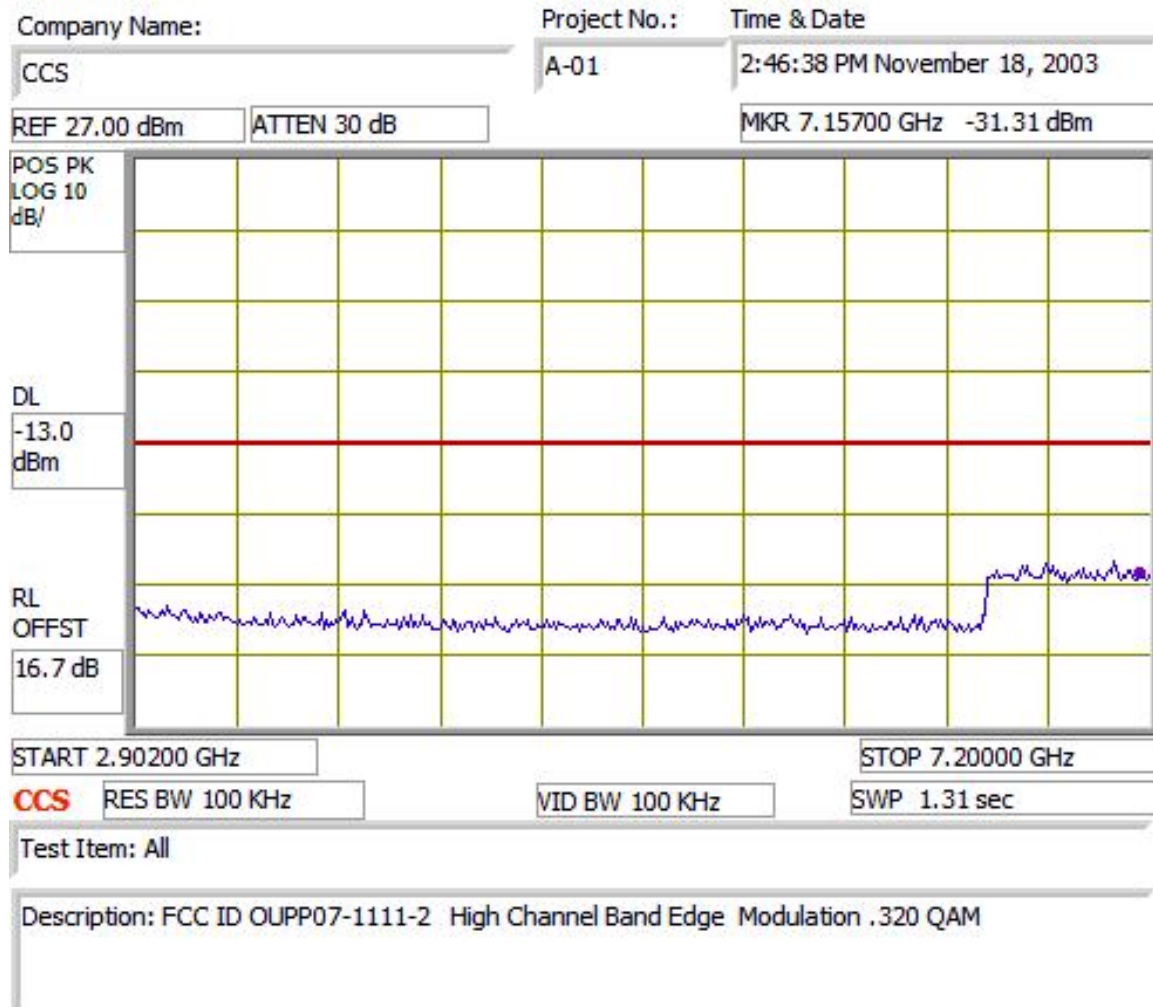
High Channel, 16QAM 1280 ksym/sec, $f_c = 715.1$ MHz



High Channel, 16QAM , all data rates



High Channel, 16QAM , all data rates



Section 2.1049 Occupied Bandwidth**Limit Per: FCC Part 27 para. 27.53(f)****Measurement Equipment Used:**

Agilent E4440A spectrum analyzer, 3Hz – 26.5 GHz
 10dB coaxial attenuator
 2- 75/50 ohm adapters

Test Procedures

1. Set RF generator to produce desired modulation at MID channel.
2. Activate the analyzer OCCUPIED BANDWIDTH function
3. Record 99% bandwidth

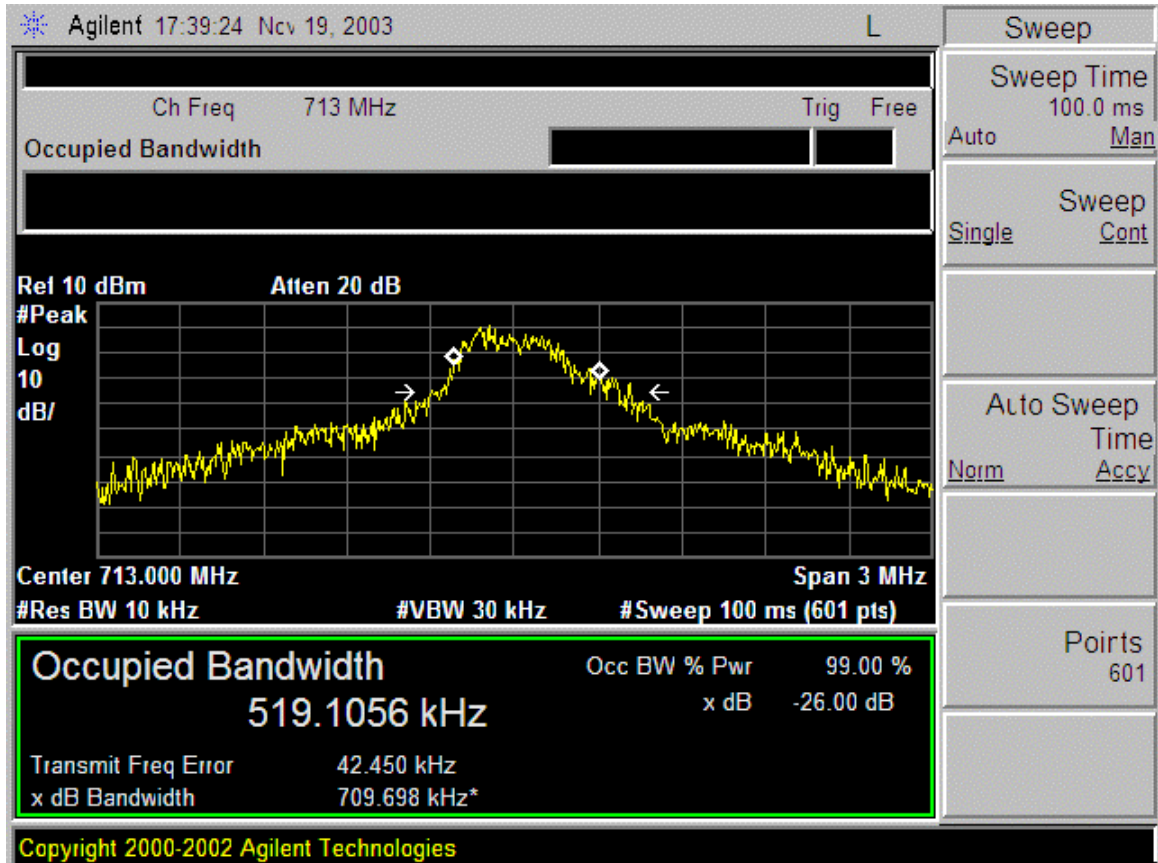
Test Results

Refer to occupied bandwidth plots below. Occupied bandwidth and emission designators are summarized in the following table:

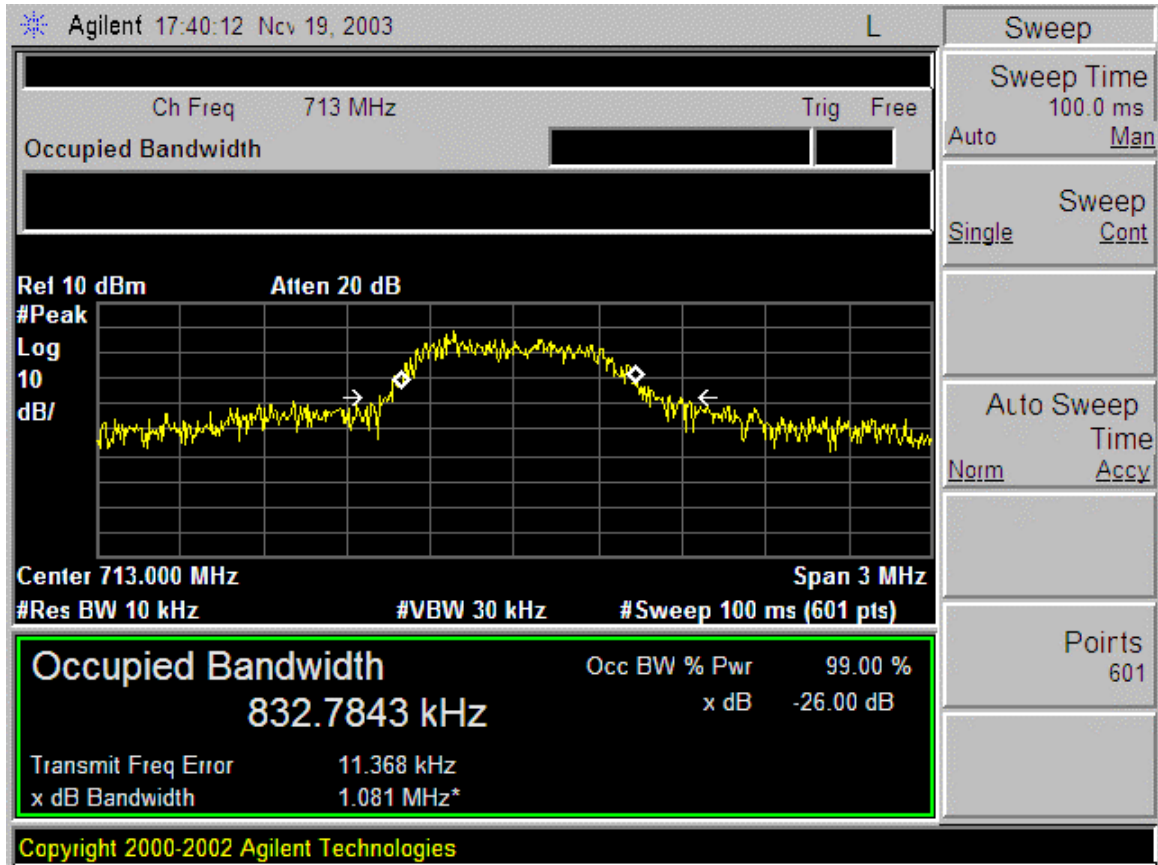
Occupied bandwidth, Spectrum Analyzer Plots

fo, MHz	Modulation	Symbol rate	BW, kHz	Emission Designator
713	16QAM	320 kbps	519.1 kHz	520KD7W
713	16QAM	640 kbps	832.8 kHz	833KD7W
713	16QAM	1280 kbps	1872.2 kHz	1M87D7W
713	QPSK	320 kbps	393.9 kHz	394KG7W
713	QPSK	640 kbps	775.8 kHz	776KG7W
713	QPSK	1280 kbps	1621 kHz	1M62G7W

Occupied Bandwidth, 320 ksym/sec, 16QAM



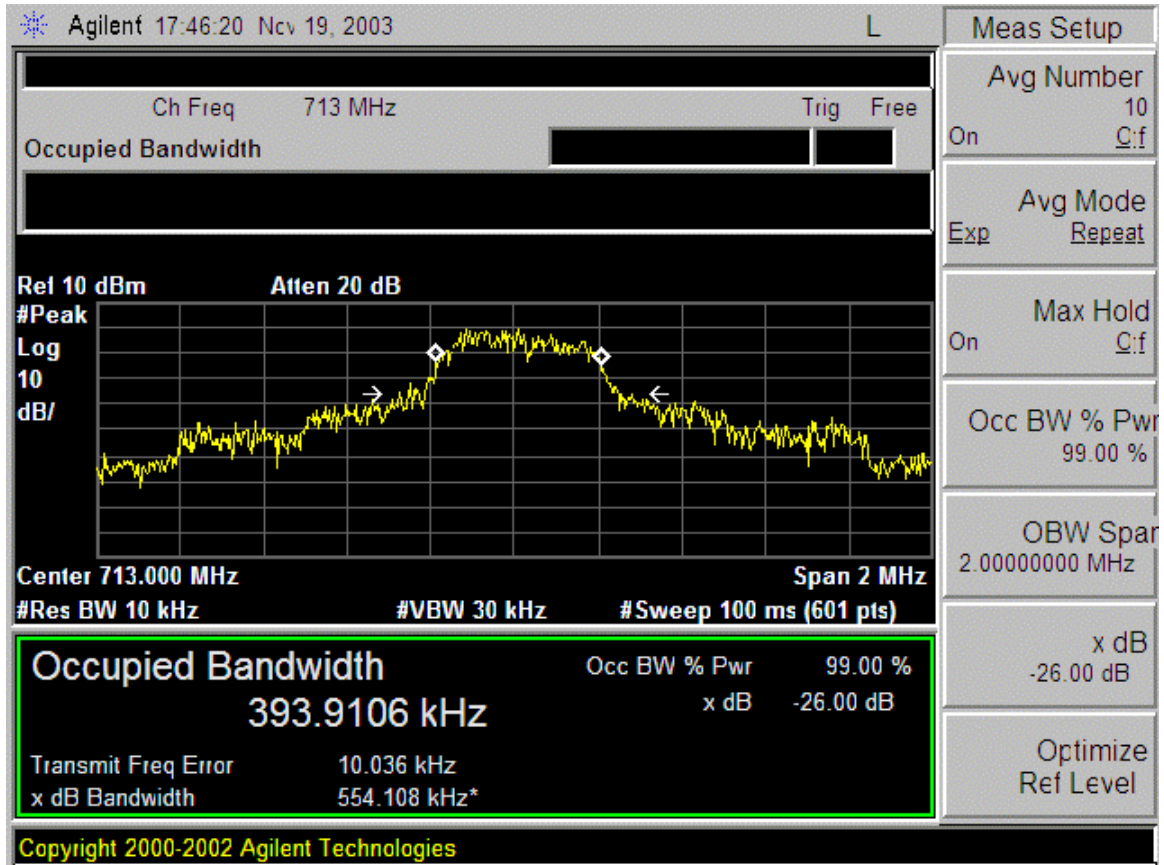
Occupied Bandwidth, 640 ksym/sec, 16QAM



Occupied Bandwidth, 1280 ksym/sec, 16QAM



Occupied Bandwidth, 320 ksym/sec, QPSK



Occupied Bandwidth, 640 ksym/sec, QPSK



Occupied Bandwidth, 1280 ksym/sec, QPSK



Section 2.1053 Field Strength of Spurious and Harmonic Radiation

Limit Per: FCC Part 27 para. 27.53(f)

Measurement Equipment Used:

HP 8595EM Spectrum Analyzer

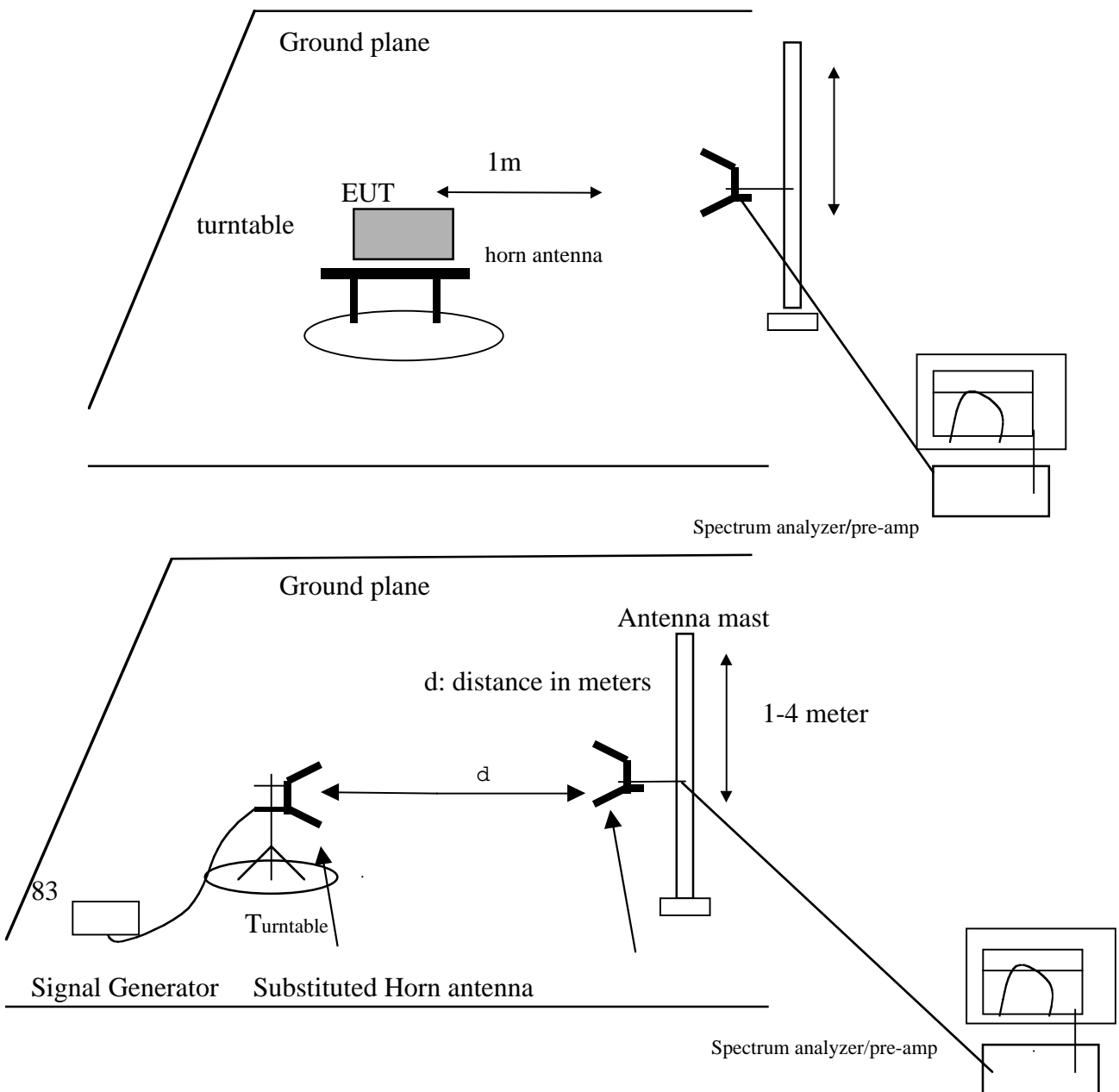
2- EMCO 3115 Horn antennas, 1- 18 GHz

Antenna Research Associates MWH 1826/B, 18 - 26.5 GHz

Miteq NSP2600-SP pre-amplifier, 1-26.5 GHz

HP 8372B Signal Generator, 10 MHz – 20 GHz

Test Set-Up



Limit Per: FCC Part 27 para. 27.53(f)

The magnitude of each spurious and harmonic emission detected as being radiated from the EUT case and cables must be below -13 dBm EIRP.

Test Procedures

The antenna output port of the EUT was terminated with a 75 ohm load. With the transmitter operating at full power, the EUT was rotated 360° and the search antenna was raised and lowered in both polarities, all in an attempt to maximize the levels of the received emission for each harmonic and spurious emission up to 10 fo.

The EUT was then replaced with a horn antenna connected to a signal generator. The signal generator was set to the same frequency as the detected emission, the search antenna was raised and lowered to maximize the signal, and then the signal generator output level was adjusted to match the previously measured radiated emission level.

The signal generator output level was recorded, corrections for cable loss and G,dBi were applied, and the result was compared against the -13 dBm limit.

Test Results

Pass. Refer to attached spread sheet. Worst-case margin is -9.4 dB.

11/24/03 **High Frequency Substitution Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Blair Wright
Project #: 710-716 MHz transceiver
Company: TSI
EUT Desc: Part 27 transceiver
FCC ID: OUPP07-1111-2
Test Target: -13 dBm eirp
Mode Op: normal TX, CW mode

Test Equipment:

EMCO Horn 1-18GHz	Pre-amplifier 1-26GHz	Spectrum Analyzer	Horn > 18GHz	Limit
T59; S/N: 3245 @3m ▼	▼	▼	▼	FCC 24 ▼

Hi Frequency Cables

<input checked="" type="checkbox"/> (2 ft)	<input type="checkbox"/> (2 ~ 3 ft)	<input type="checkbox"/> (4 ~ 6 ft)	<input type="checkbox"/> (12 ft)
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Peak Measurements:
Fundamental:
 RBW>99% or 26dB Emissions BW
 VBW=RBW

Bandedge:
 RBW=>1% Emissions BW
 VBW=> 3*RBW

Spurious
 RBW=1MHz
 VBW=1MHz

f GHz	SA reading (dBuV)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Notes
2.852	97.0	-30.9	0.3	8.8	6.7	-22.4	-13.0	-9.4	
1.426	47.0	-73.8	0.2	7.0	4.8	-67.0	-13.0	-54.0	
2.139	60.0	-54.0	0.2	8.0	5.9	-46.2	-13.0	-33.2	
3.565	50.9	-57.0	0.4	9.4	7.2	-48.0	-13.0	-35.0	
4.278	51.7	-68.0	0.4	10.0	7.9	-58.4	-13.0	-45.4	
4.991	45.2	-80.0	0.5	11.0	8.9	-69.5	-13.0	-56.5	
5.704	53.4	-58.0	0.5	11.4	9.2	-47.1	-13.0	-34.1	
6.417	56.3	-56.0	0.5	11.5	9.4	-45.0	-13.0	-32.0	
7.130	44.0	-80.0	0.6	11.6	9.4	-69.0	-13.0	-56.0	

2.1055 Frequency Stability**Limit:** FCC Part 27, para. 25.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Measurement Equipment Used:

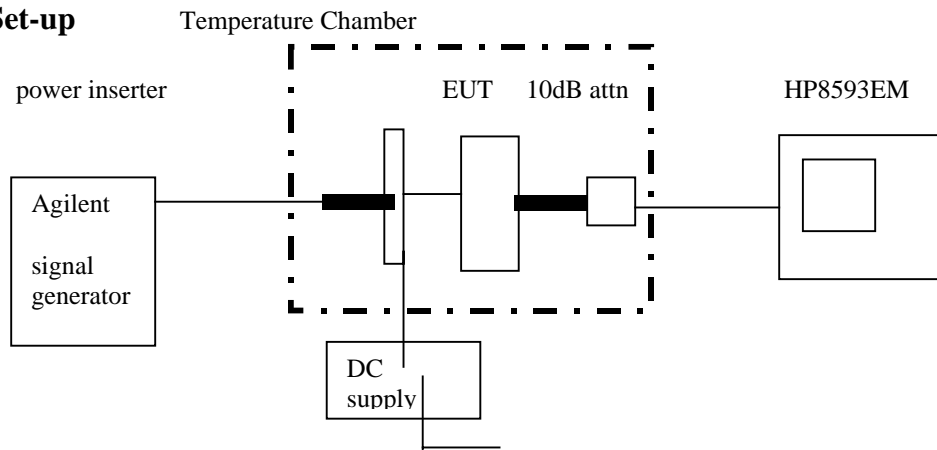
HP 8593EM Spectrum analyzer, 9kHz – 26.5 GHz

10 dB attenuator (50 ohm)

2- 50/75 ohm adapters (5.7 dB loss each)

Agilent A4433B ESG-D Signal Generator

Thermotron SE 600-10-10 Temperature Chamber

Test Set-up**Limit:** FCC Part 27, para. 25.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Test Procedures

The EUT was set to mid-channel, 713 MHz. Emission was set for CW for ease of detection. Operating frequency was measured at 23C (ambient) and at normal operating voltage (120 VAC, 60 Hz).

Output frequency was measured at ambient temperature at 85% and 115% operating voltage.

Output frequency was measured at –30C and at +50C at normal voltage.

This range in temperature and voltage is considered reasonable for determining that fundamental emissions stay within authorized bands of operation, as these are the default ranges in section 2.1055 of the Rules.

Test Results

Operating Voltage, VAC	Temp., °C	Frequency	Difference from Set Point, Hz	Difference from Set Point, ppm
120	23	712.998813	-1187	-1.66
	-30	712.999475	- 525	-.73
	+50	712.994576	-5424	-7.6
102(85%)	+23	712.997788	-1025	-1.4
138(115%)	+23	712.997726	-1087	-1.5

PASS. Based on band edge test results, frequency shifts measured above will not results in any EUT modulation products being generated outside the authorized operating band.