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     From: Bill Moyer x8-3542 <wmoyer@qualcomm.com>
  Subject: Final Globalstar Module Spurious Radiated Emissions Test Plan
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X-Attachments:
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Dave Marshall:

The following is the test plan for measuring the field strength of the spurious radiated emissions of the Globalstar Satellite Packet Data Modem Module (GS Module) at TUV, following pre-scans and ODU antenna gain measurements performed at Qualcomm.

Globalstar Module Part 25 Spurious Radiated Emissions Test Plan
Emissions Limits: FCC Part 25, Section 25.202 (f)

Test Setup:

Horizontal Digital/RF Unit, resting face up, connected via 2 coaxial cables to Passive-Tx outdoor antenna unit (ODU). Horizontal ODU is pointed towards horizon and boresighted on test antenna at zero degrees azimuth (ODU is normally pointing to zenith with ODU resting on its base), on nonconductive support on wooden table on test site turntable, 1.0 m above ground plane. (Maximum UT antenna gain is in line with antenna axis.) Receive antenna will also be at 1.0 m height, except where E-Field maximization yields higher emissions levels at higher elevations, due to in-phase addition of ground-plane reflected power.

EUT Operation:

The car kit will be tested with the Module in a special-test stand-alone mode, with pre-loaded test code which permits fine adjustment of output power levels and channel frequencies, and with the ODU transmitting a full-power OQPSK CDMA pilot signal. Tests will be performed on 3 TX channels: low (1), middle (6), and high (9). Prior to the start of each test, the UT will be set to transmit using a laptop computer, RS-232 data monitor test port cable, calibrated (0.4 dB loss at 1610 MHz) RF Tx test port coaxial cable and adaptor, Power Meter, and the Hyperterminal program, as follows:

Data port cable connected to laptop and Digital/RF Unit.
Power Meter connected via calibrated coax cable adaptor and 30 dB pad to Unit's Tx output port (Rx port at top/outside of unit, Tx port located below/inside Rx port). Set Power Meter offset to 30.2 dB, to account for 0.2 dB RF Tx test coaxial cable loss at 1610 MHz and the 30 dB pad attenuation.

Hyperterminal link settings, Com 1 port:
- 38400 bps
- 8 bits data,
- No parity
- 1 stop bit
- No flow control

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h       Hardware Menu
gi      GUM Init
tx 2    Transmit Pilot signal
agc 17  AGC Init
agc 1 [power level]    (000 - 1FF)    Power Adjust Hex Code

        (hex numbering sequence:  0 1 2 3 4 5 6 7 8 9  A  B  C  D  E  F
                                  0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15)
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agc 1 0  (minimum Tx power)
rf [rx channel index] [tx channel index]

     TX Channel 1 > TX Channel Index 4     1610.73 MHz
     TX Channel 6 > TX Channel Index 209   1616.88 MHz
     TX Channel 9 > TX Channel Index 332   1620.57 MHz

     RX Channel 1 > RX Channel Index 3

agc 1 55      (approx. 0 dBm)
     (iob 6046 39   Set Input/Output Buffer for Car Kit Transmit Mode)

agc 1 0d9     Approx. Max power hex value for Channel 1
agc 1 0e5     Approx. Max power hex value for Channel 6
agc 1 0eb     Approx. Max power hex value for channel 9

agc 1 0       Set Tx power to minimum prior to switching frequencies
              (repeating sequence after agc 17 for each channel)
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Power adjust hex values shall be adjusted up/down as required to bring conducted Tx power level to 27.5+ dBm (corrected for attenuator pad and adaptor cable loss), the maximum rated conducted RF power output of the PA. This sets the Module to provide the maximum radiated transmit power (and intermod products) that the pre-production ODU is capable of producing.

The expected production ODU maximum achievable antenna gain (including optimized feed mismatch, internal cable losses, and tolerance error) is 7.0 dBic, yielding a maximum rated transmit power of 34.5 dBm circularly polarized. The pre-production test unit's previously measured maximum antenna gain is 5.7 dBic. Thus the test emissions limit, relative to a rated maximum radiated transmission power level of 34.5 dBm (4.5 dBW, 2.8 W) circularly polarized, must be adjusted downwards by the difference in the antenna gains and radiated power levels: 1.3 dB plus the loss (0.6 dB) of the 1.0 m long I/O cable used with the test unit, yielding a total test limit correction factor of 1.9 dB.

After the conducted power level has been established, the power meter shall be disconnected from the ODU Tx power test port, the ODU coaxial Tx I/O cable shall be reconnected, and the laptop RS-232 data cable shall be disconnected from the unit and removed from the vicinity of the radiating EUT.

Empirical Determination of Emissions Limit:

Part 25 Emissions Limit, at frequencies greater than twice the authorized bandwidth away from the band edge: Power in a 4 kHz bandwidth, shall be attenuated by 43 dB + 10*log(EIRP in Watts) below intentional signal power.

Measure Max Inband E-Field in 30 kHz BW (E.o dBuV/m) to establish baseline free-space 1.0 W EIRP equivalent value. (Best accuracy, in measuring Globalstar and IS-95 CDMA waveform inband E-field strengths with a spectrum analyzer, is obtained when measuring with a 30 kHz resolution BW, 30 kHz video bandwidth, and 30 sample averaging. Applying a quasi-empirical correction factor of 17 dB, the E-field level so measured will closely correspond to the total power measured using a power meter and (again with a 17 dB correction factor) the power measured with a spectrum analyzer with a CDMA measurement personality PCMCIA card.) Optimize antenna height for each frequency and polarization, starting at height of 1.0 m above ground.

$$E^2 = 30\, P.o / (r^2)$$

$$E.o\ dBuV/m = 120 + 10*\log(30 / r^2) + P.o\ dBW$$

Measure spurious harmonics E-field strengths in a 1 MHz bandwidth, and compare that level to the spurious limit, corrected for difference between measurement and limit bandwidths:

3.55 W EIRP Spurious Emissions Limit (for 1 MHz Res. BW measurement):

Pwr Limit = P.o dBW - 43 dB - 4.5 dBW + 10*log(1000/4) - 1.9 dB
= P.o - 25.4 dB

E-Field Limit = E.o dBuV/m - 43 dB - 4.5 dBW + 10*log(1000/4) - 1.9 dB
= E.o dBuV/m - 25.4 dB

Test Procedure:

Use 1 MHz resolution BW for spurious emissions measurements. (If peak measurements are close to limit value, re-measure using average measurements, with 1 MHz Res. BW, 10 Hz Video BW, 30 samples.) Install test lab-provided previously-characterized high-pass filter in-line, between test instrumentation external pre-amp and antenna, as necessary to prevent pre-amp front-end overload and generation of harmonically-related intermod product test artifacts. (Typically seen when measuring pseudo-noise signals.) If high-pass filter is employed, include plot of filter insertion loss curve with pre-amp gain curve in test report.
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1. Channel 1 Emissions Measurements

   a. Setup Module on table on OATS turntable per Setup description.

   b. Set frequency, load power adjust hex code, and measure Conducted Power out of ODU Tx test port, adjusting hex code input as required to get maximum rated conducted power level, 28.5 dBm. Record hex code value and conducted power level. Disconnect power meter and laptop.

   c. Measure vertically-polarized inband radiated E-Field strength. Optimize antenna height. Calculate and record radiated limit value. Measure E-Field strengths for transmitter harmonic frequencies in table following and record values.

   d. Repeat Step c for Horizontal polarization.

2. Channel 6 Emissions Measurements

   Repeat Steps a-d.

3. Channel 9 Emissions Measurements

   Repeat Steps a-d.

TX Frequency Harmonics to Measure

Harmonic	Frequency (MHz)		
	Ch. 1	Ch. 6	Ch. 9
Fundamental	1610.73	1616.88	1620.57
2	3221.46	3233.76	3241.14
3	4832.19	4850.64	4861.71
4	6442.92	6467.52	6482.28
5	8053.65	8084.40	8102.85
6	9664.38	9701.28	9723.42

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  7           11275.11   11318.16   11343.99
  8           12885.84   12935.04   12964.56
  9           14496.57   14551.92   14585.13
 10           16107.30   16168.80   16205.70
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-WEM