



Mobile Devices business
iDEN Mobile Devices Operations

RF Test Report

FCC Rule Parts: 90S and 24D

Industry Canada: RSS-Gen, RSS-119, RSS-134

Product Name: i412/i420

FCC ID: IHDT56MR1

IC ID: 1090-T56MR1

Date: March 3, 2011

Table of Contents

Test Report Details	6a.0-1
Transmitter Output Power	6a.1-1
Modulation Characteristics	6a.2-1
Radiated Spurious Emissions	ACS Report
Power Line Conducted Spurious Voltage	ACS Report
Frequency Stability	6a.5-1
Effective Radiated Power (ERP)	6a.6-1

Test Report Details

Tests Performed by:

Advanced Compliance Solutions
Laboratory details in report

FCC Registration Number: **581606**

Industry Canada Number: **4175C**

Product Type:

Cellular Phone

Signaling Capabilities:

iDEN 800 MHz, iDEN 900 MHz

FCC ID:

IHDT56MR1

IC ID:

109O-T56MR1

Applicable Standards

All tests and measurements indicated in this document were performed in accordance with the United States Code of Federal Regulations, Title 47 Part 2, Sub-part J, as well as the following parts:

- | | |
|--------------|--|
| <u> X </u> | Part 90 Subpart S – Private Land Mobile Radio Service. |
| <u> X </u> | Part 24 Subpart D – Personal Communications Services. |
| <u> X </u> | RSS-119 – Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41-960 MHz. |
| <u> X </u> | RSS-134 – 900 MHz Narrowband Personal Communications Services. |

Applicable Standards: TIA/EIA-603-A, TIA/EIA-603-B, TIA/EIA-603-C, and ANSI C63.4-2009.

Exhibit 6a.1. Part 90/Part 24 Measured Data -- Pursuant 47 CFR. 2.1046; RSS-Gen Section 3, RSS-119 Section 5.4, RSS-134 Section 6.2.

6a.1.1 Land Mobile Transmitter Power

The transmitter is a variable power type used in a SMR trunking system. Output power (as defined in 47 CFR 90.7 and/or §24.132) is dynamically controlled as described in Exhibit 12.

6a.1.2 Maximum Output Power Rating -- Pursuant 47 CFR 2.1033(c)(7), §90.635(d), and §24.132(a)

Maximum output power rating: 640 milliwatts (28.06 dBm), pulse average power. Output power will vary from 0.22 to 640 milliwatts (pulse average power).

Note 1: Nominal output power rating: 600 milliwatts (27.78 dBm) (Pulse average power).

Note 2: These ratings are compliant with the FCC maximum of 100 watts (50 dBm) for Mobile stations operating under Part 90.

Note 3: These ratings are compliant with the FCC maximum of 7 watts ERP for Mobile stations operating under Part 24.

Note 4: The term pulse average power is used to specify the power that would be measured during the intervals of recurrent TDM transmission pulses by an average responding RF power meter. Power expressed in this manner is independent of the TDM duty cycle, and facilitates RF system coverage analysis.

6a.1.3 Operating output power range -- Pursuant 47 CFR 2.1033(c)(6)

Maximum tuned output power will vary over a range of 500 to 640 milliwatts (maximum pulse average power) to a minimum power of 34 dB below maximum tuned output power.

6a.1.4 DC power used by final amplifier device -- Pursuant 47 CFR 2.1033(c)(8)

In order to prevent the malfunctions that can occur due to directly measuring the DC characteristics of the final RF amplifying stage, data was obtained by measuring the entire radio DC current and is reported herein for the entire radio.

The DC current and the RF output power was measured with a special RF/DC test fixture set to supply the radio with the nominal battery voltage of 4V. The characteristics were measured during a transmission pulse and are listed in the Table below.

Characteristics	800 MHz		900 MHz		901.5 MHz	
Power Setting	minimum	maximum	minimum	maximum	minimum	maximum
DC Voltage (Volts)	4.0	4.0	4.0	4.0	4.0	4.0
DC Current (A)	0.58	1.76	0.59	1.86	0.59	1.871
Output Power (mW)	0.26	640	0.26	640	0.26	640

Table 6a.1-1 Characteristics for 800 and 900 MHz SMR bands, and NBPCS Band

6a.2. Modulation Characteristics and Necessary Bandwidth -- Pursuant 47 CFR §2.1047(d), §2.1049, §2.202, §90.210(g), §90.669(a), and §90.691; RSS-Gen Section 3, RSS-119 Section 4.2.

6a.2.0 Emission Mask Application

- i. Emission Mask G is applied between 809 and 824 MHz, per the Applicable Emission Masks Table in §90.210.
- ii. Emission Mask G is applied also in the range between 806 and 809 MHz. The above referenced table calls for Emission Mask H, but the band plan for this spectrum was established for 12.5 kHz channels (§90.209(b)(5)). Mask H is intended for that application. The subject transmitter's emission is suited to 25 kHz channels (aggregated), and thus the G-Mask is applicable.
- iii. Similarly, the table calls for the use of Emission Mask J in the spectrum between 896 and 901 MHz, which was established for 12.5 kHz channels. The subject transmitter operates on (aggregated) 25 kHz channels in this band as well, and thus the G-Mask is most appropriate.
- iv. For these plots, the Authorized Bandwidth is taken to be 20 kHz (per §90.205(b)(5)) for all the above bands.
- v. According to the above reference table, the EA Mask (§90.691) is also applicable, and thus compliance to this requirement is also demonstrated in this exhibit.

6a.2.1 Emission Designator 18K3D7W - iDEN 800 MHz Band Measured data

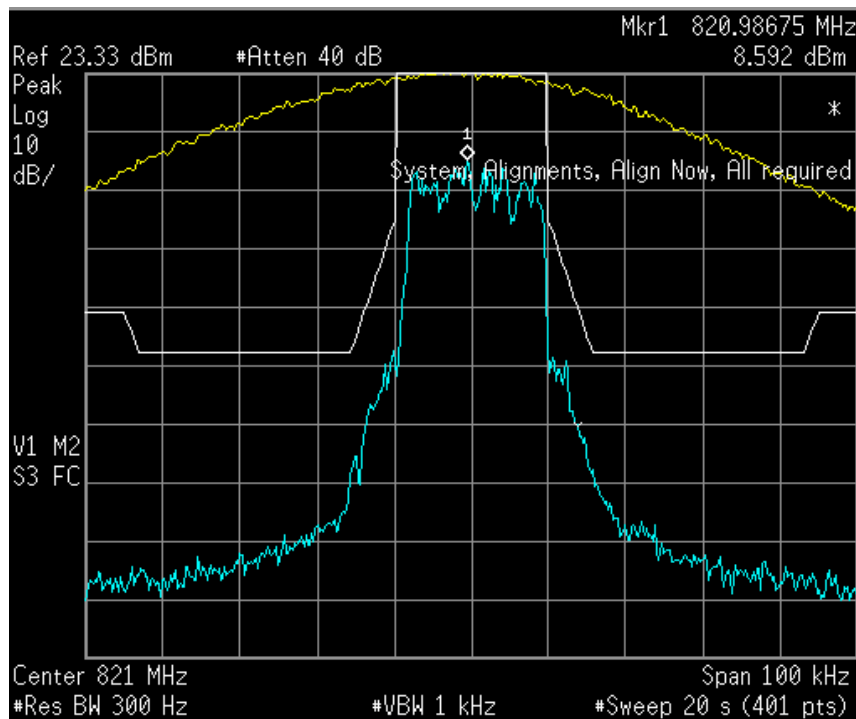


Figure 6a.2.1-1. iDEN 800 MHz Band, Quad-QPSK, Max. Power, Emission Mask G

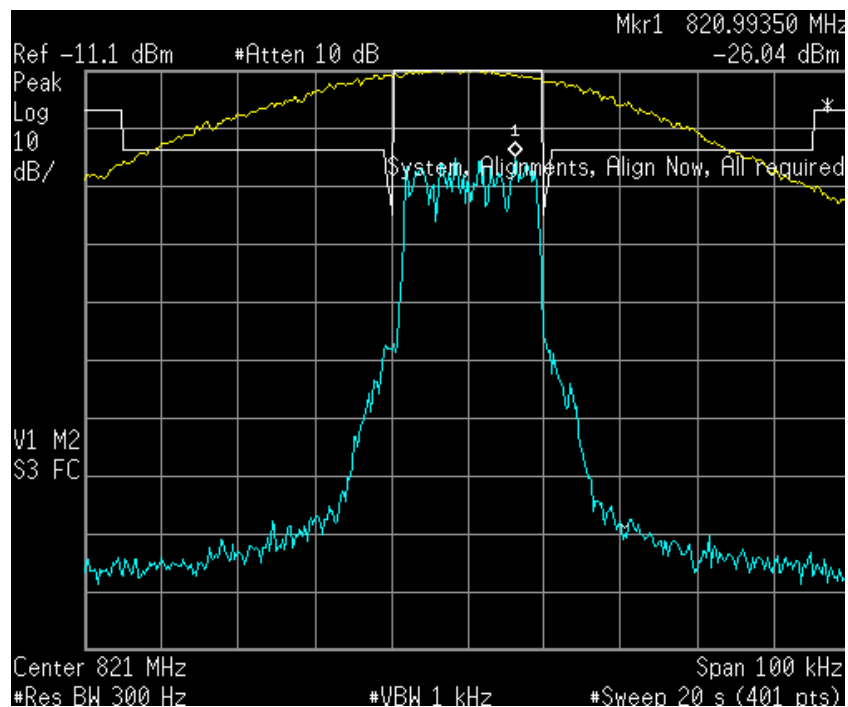


Figure 6a.2.1-2. iDEN 800 MHz Band, Quad-QPSK, Min. Power, Emission Mask G

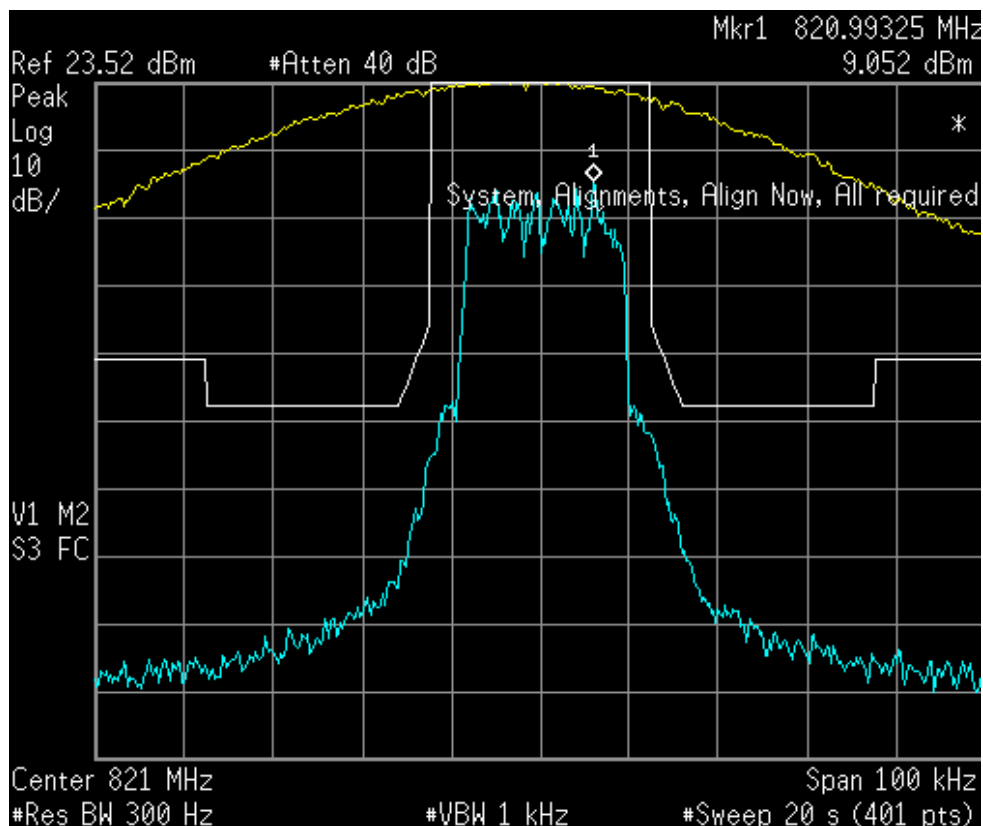


Figure 6a.2.1-3. iDEN 800 MHz Band, Quad-QPSK, Max. Power, EA Emission Mask

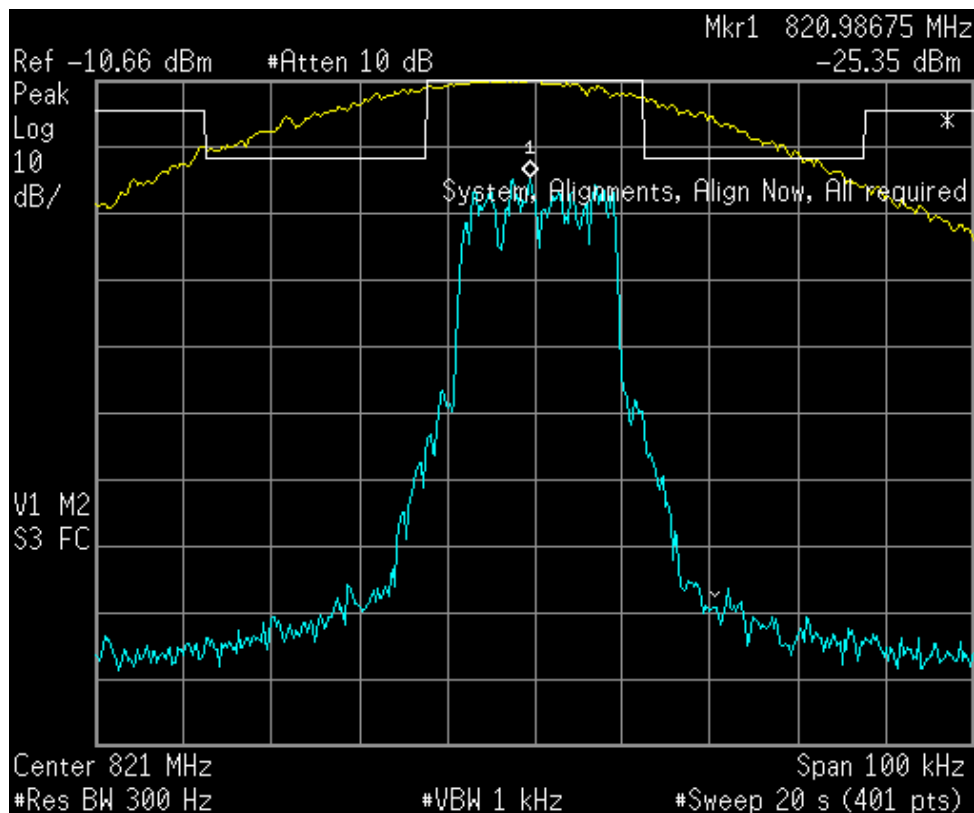


Figure 6a.2.1-4. iDEN 800 MHz Band, Quad-QPSK, Min.m Power, EA Emission Mask

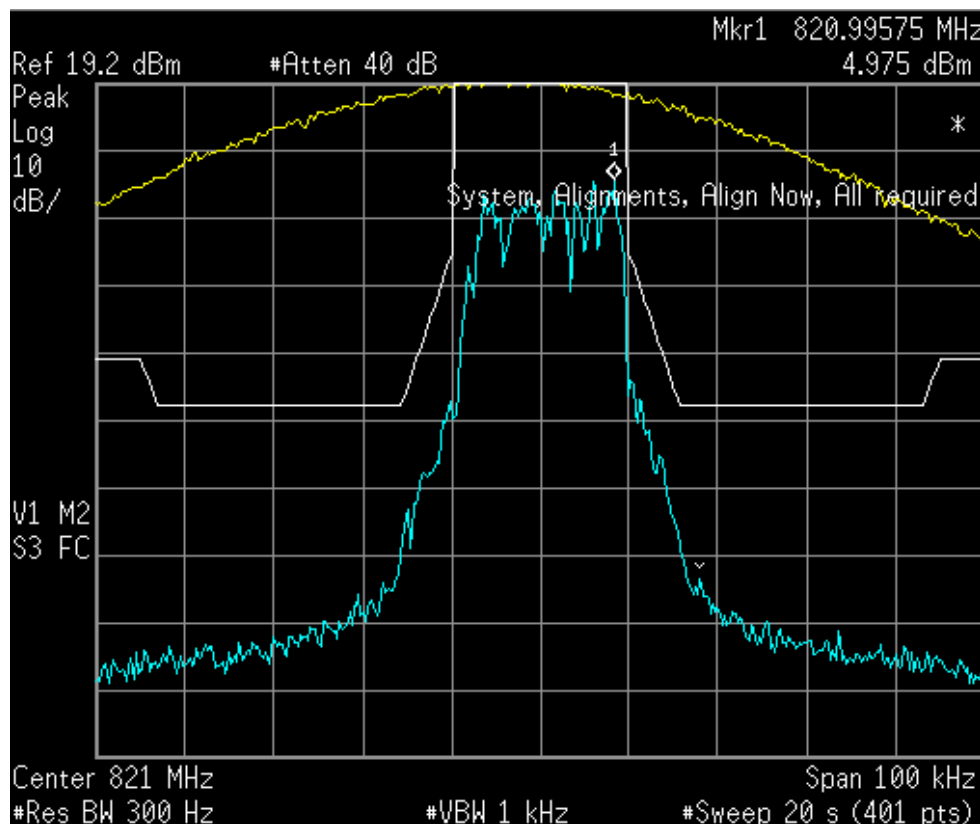


Figure 6a.2.1-5. iDEN 800 MHz Band, Quad-16QAM, Max. Power, Emission Mask G

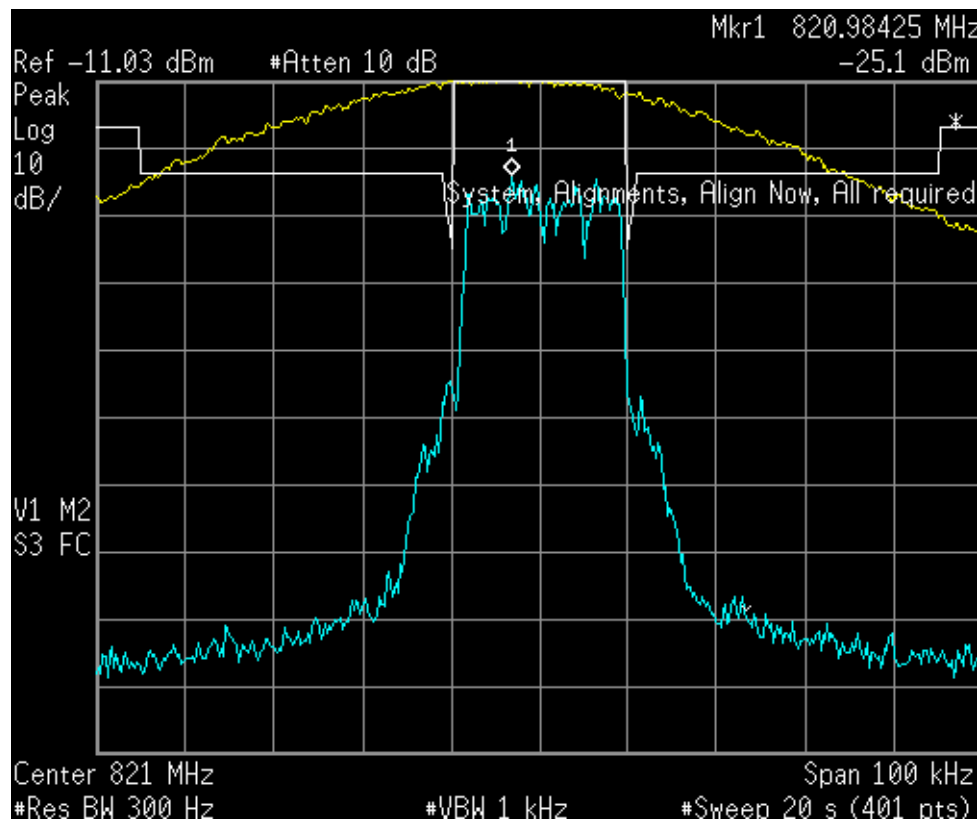


Figure 6a.2.1-6. iDEN 800 MHz Band, Quad-16QAM, Min. Power, Emission Mask G

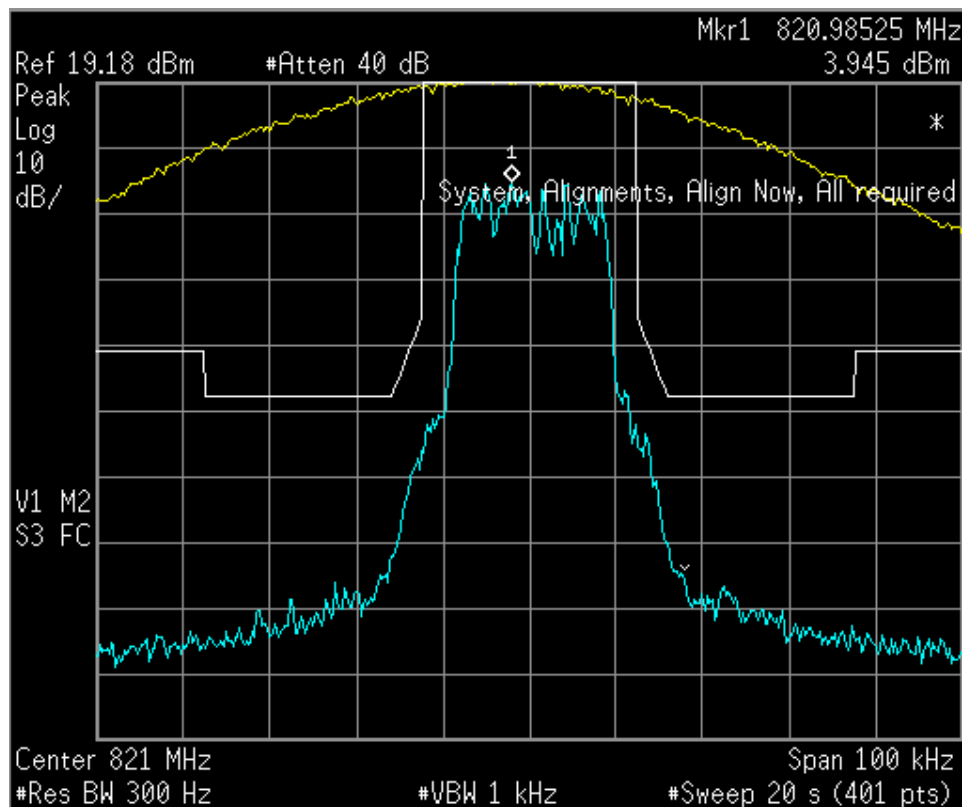


Figure 6a.2.1-7. iDEN 800 MHz Band, Quad-16QAM, Max. Power, EA Emission Mask

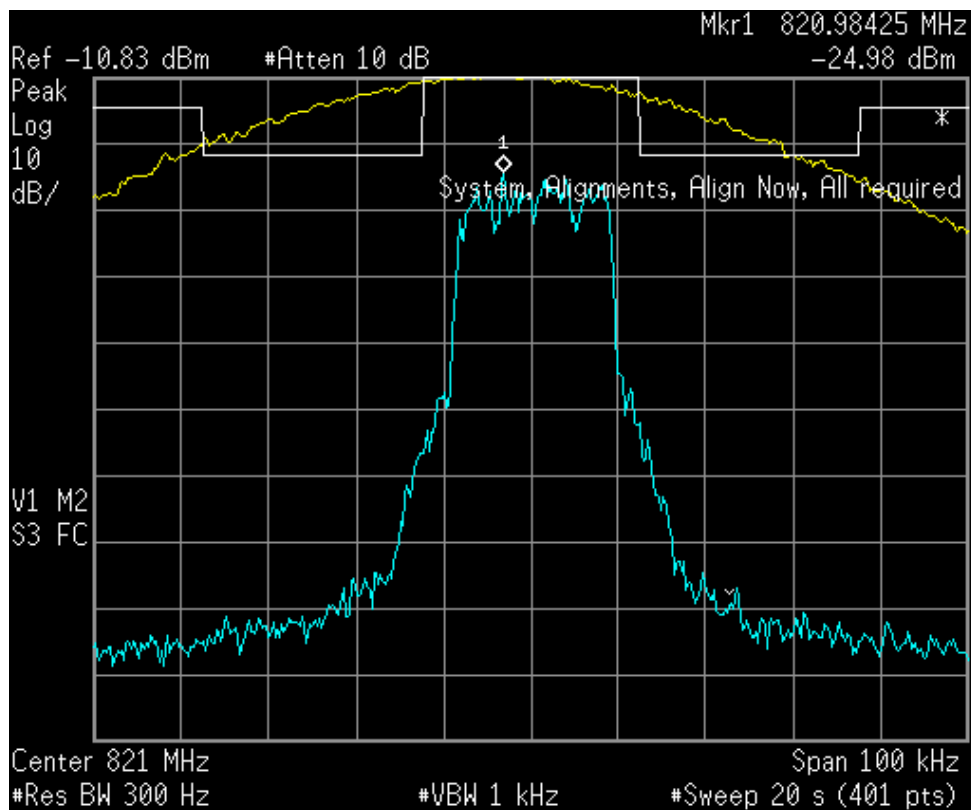


Figure 6a.2.1-8. iDEN 800 MHz Band, Quad-16QAM, Min. Power, EA Emission Mask

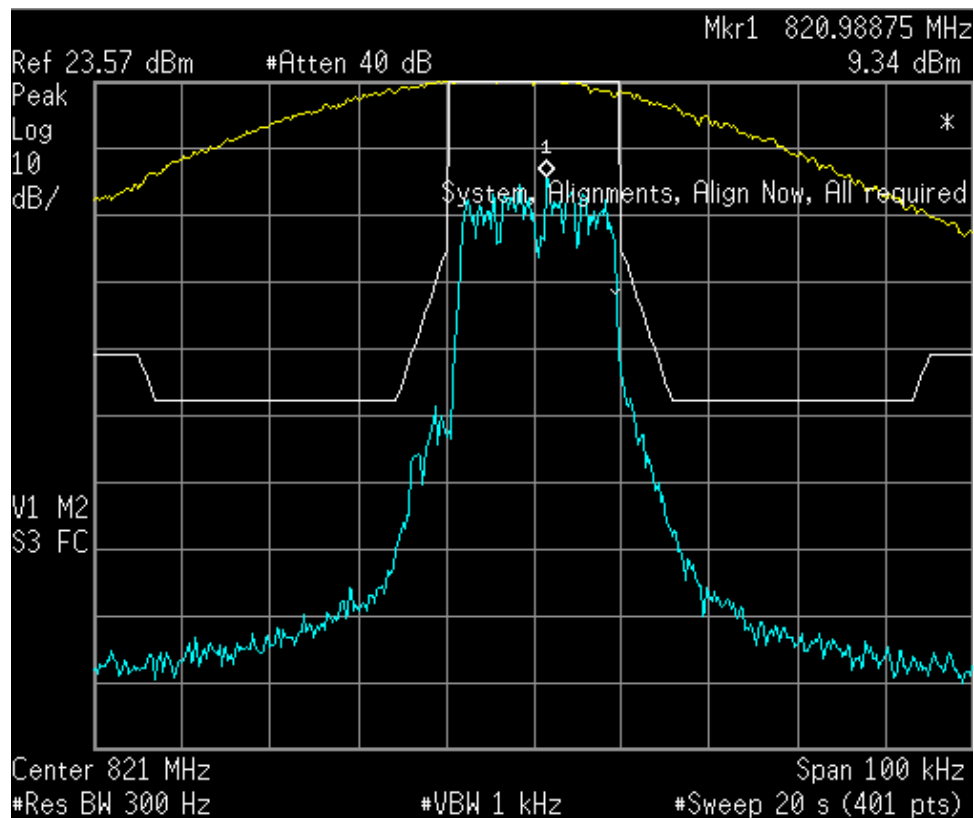


Figure 6a.2.1-9. iDEN 800 MHz Band, Quad-64QAM, Max. Power, Emission Mask G

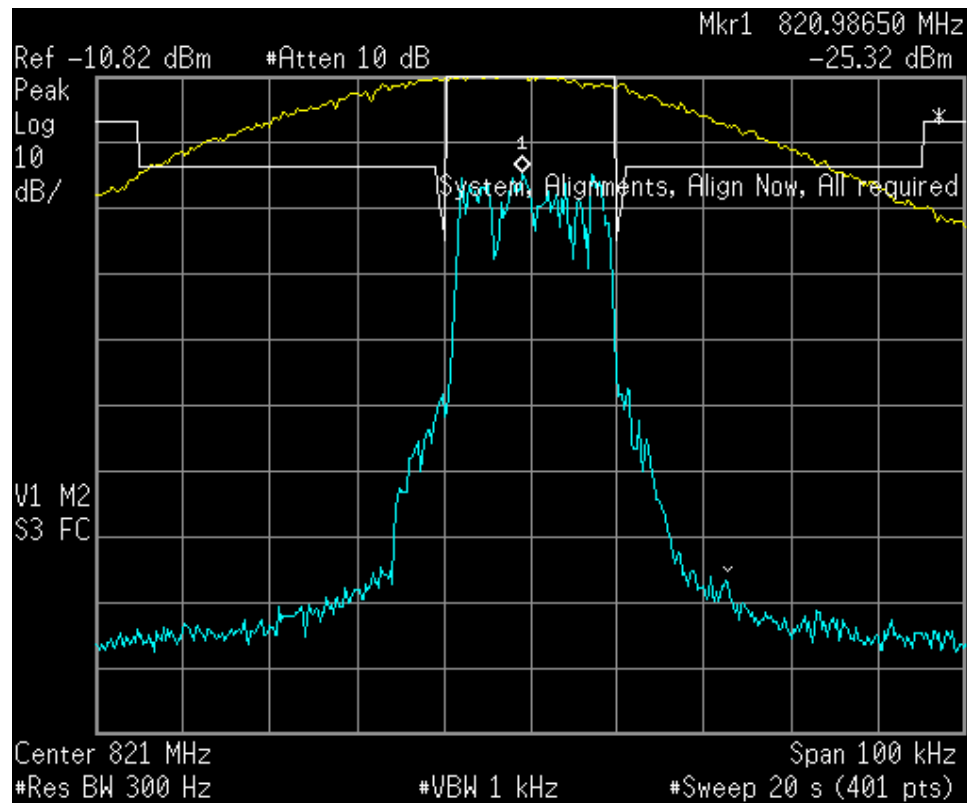


Figure 6a.2.1-10. iDEN 800 MHz Band, Quad-64QAM, Min. Power, Emission Mask G

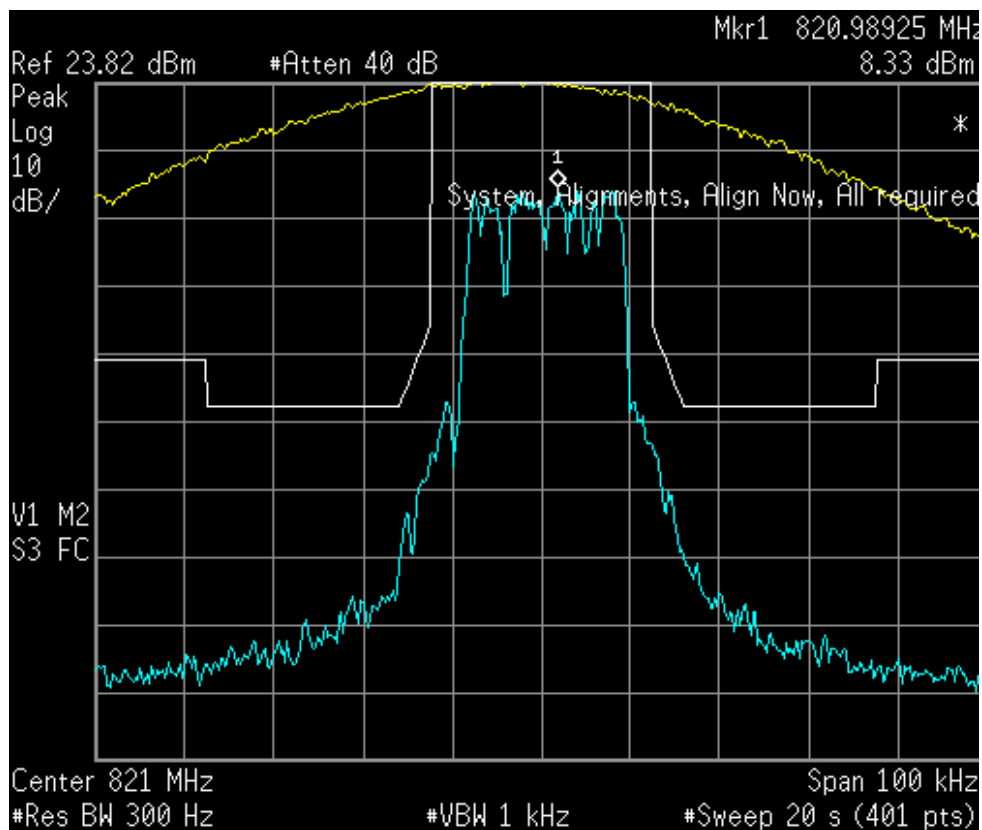


Figure 6a.2.1-11. iDEN 800 MHz Band, Quad-64QAM, Max. Power, EA Emission Mask

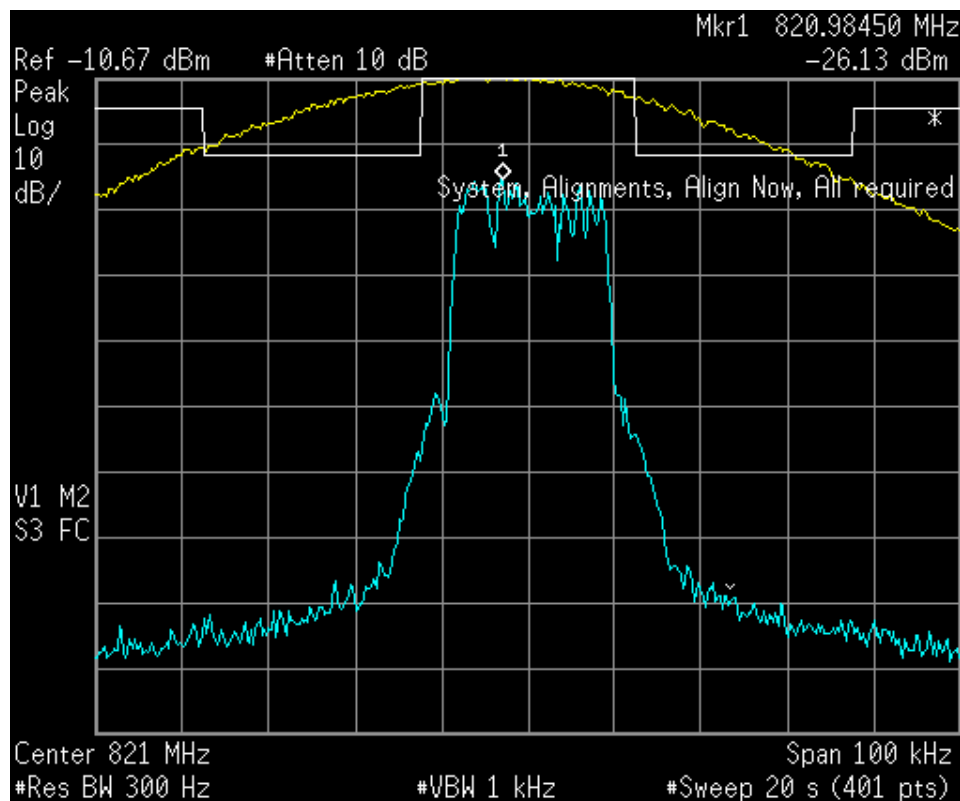


Figure 6a.2.1-12. iDEN 800 MHz Band, Quad-64QAM, Min. Power, EA Emission Mask

6a.2.2. Emission Designator 18K3D7W - iDEN 900 MHz Band Measured Data

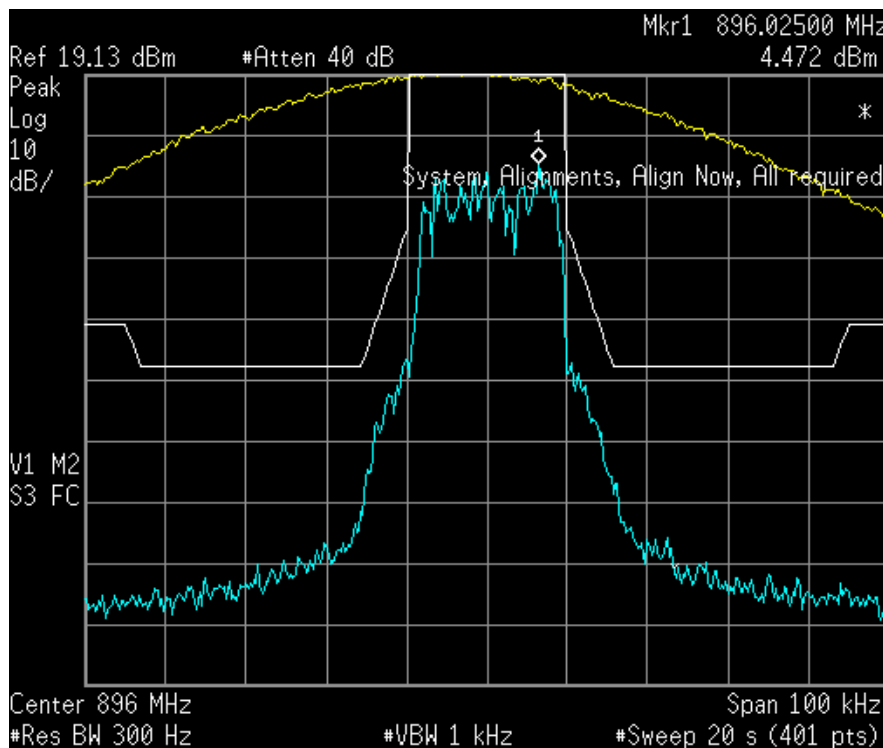


Figure 6a.2.2-1. iDEN 900 MHz Band, Quad-QPSK, Max. Power, Emission Mask G

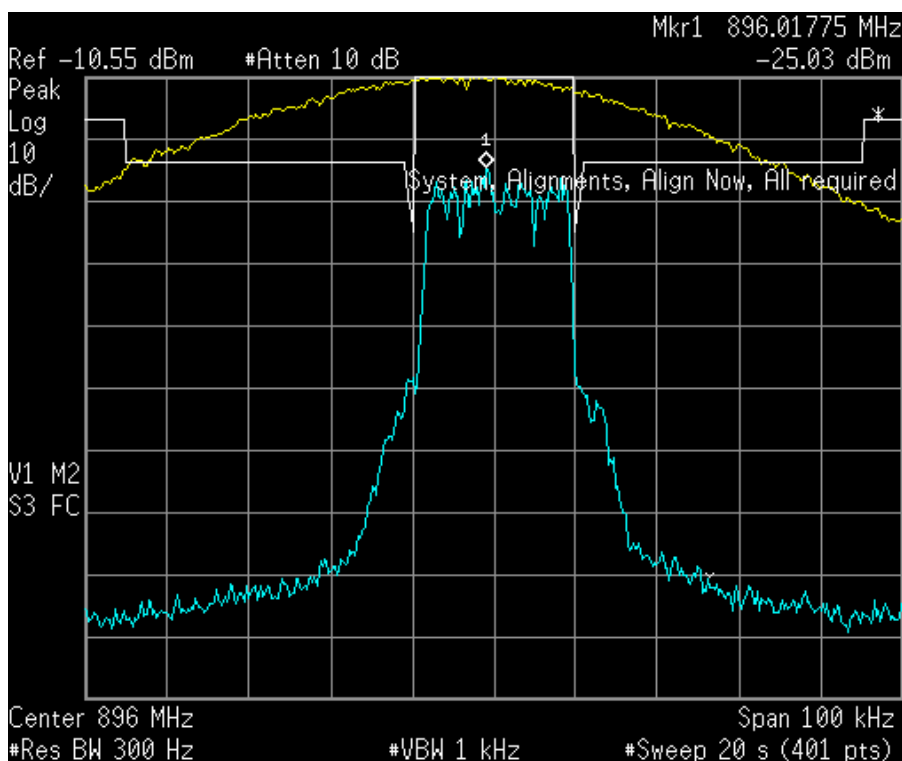


Figure 6a.2.2-2. iDEN 900 MHz Band, Quad-QPSK, Min. Power, Emission Mask G

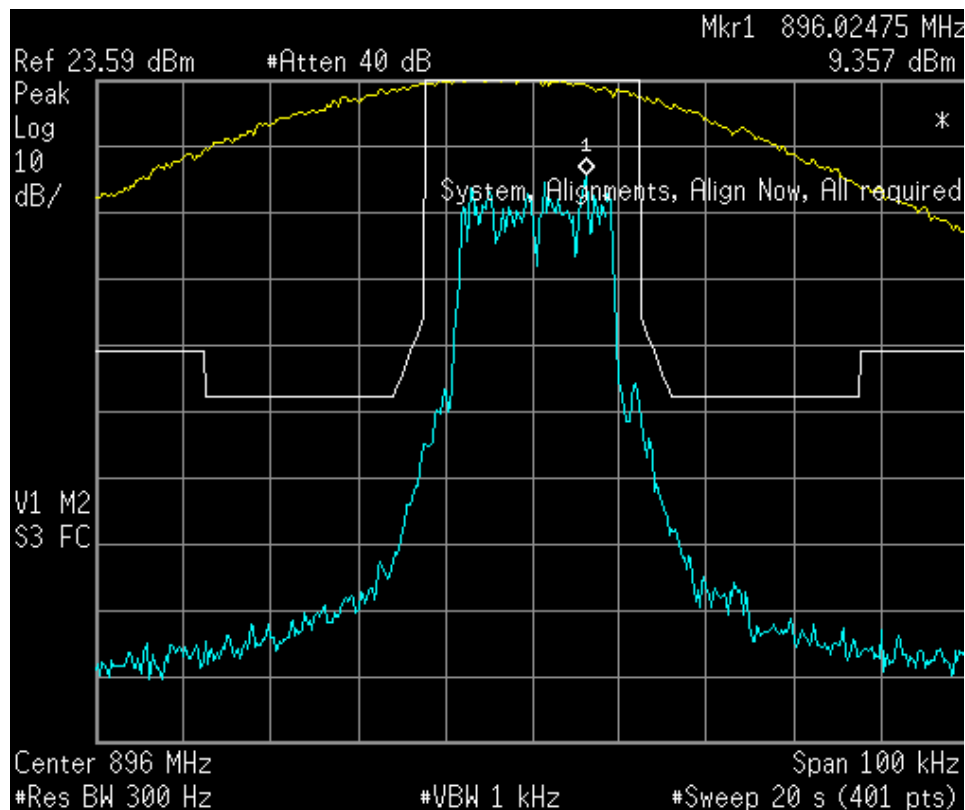


Figure 6a.2.2-3. iDEN 900 MHz Band, Quad-QPSK, Max. Power, EA Emission Mask

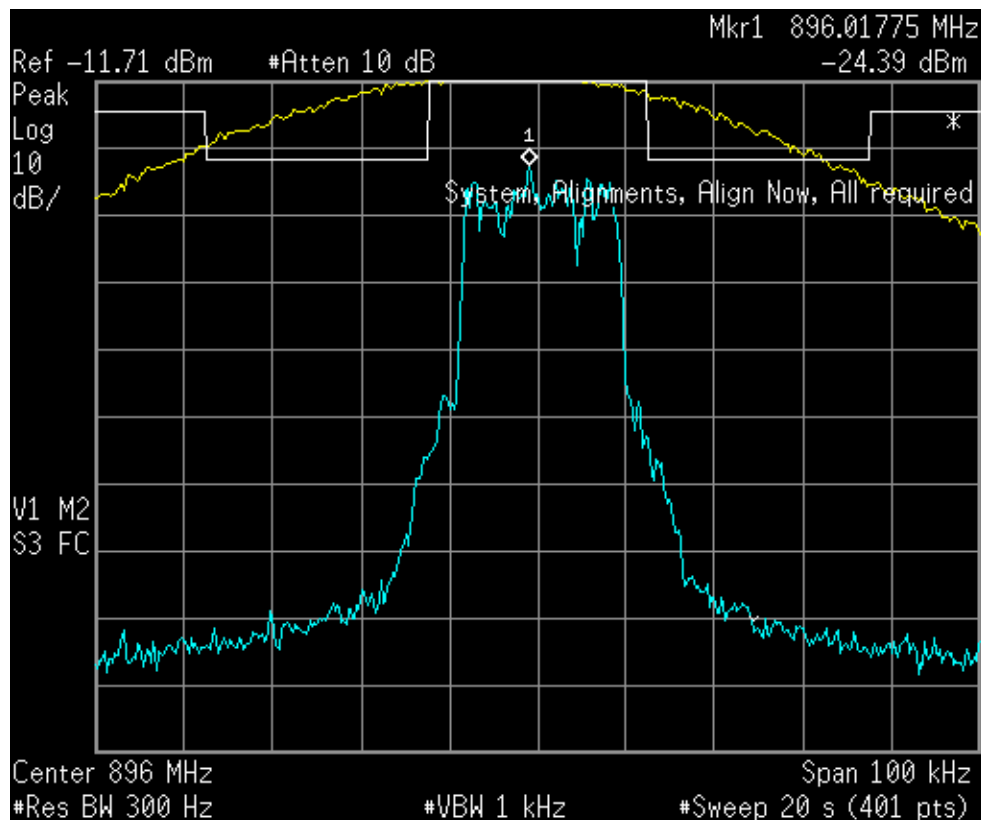


Figure 6a.2.2-4. iDEN 900 MHz Band, Quad-QPSK, Min. Power, EA Emission Mask

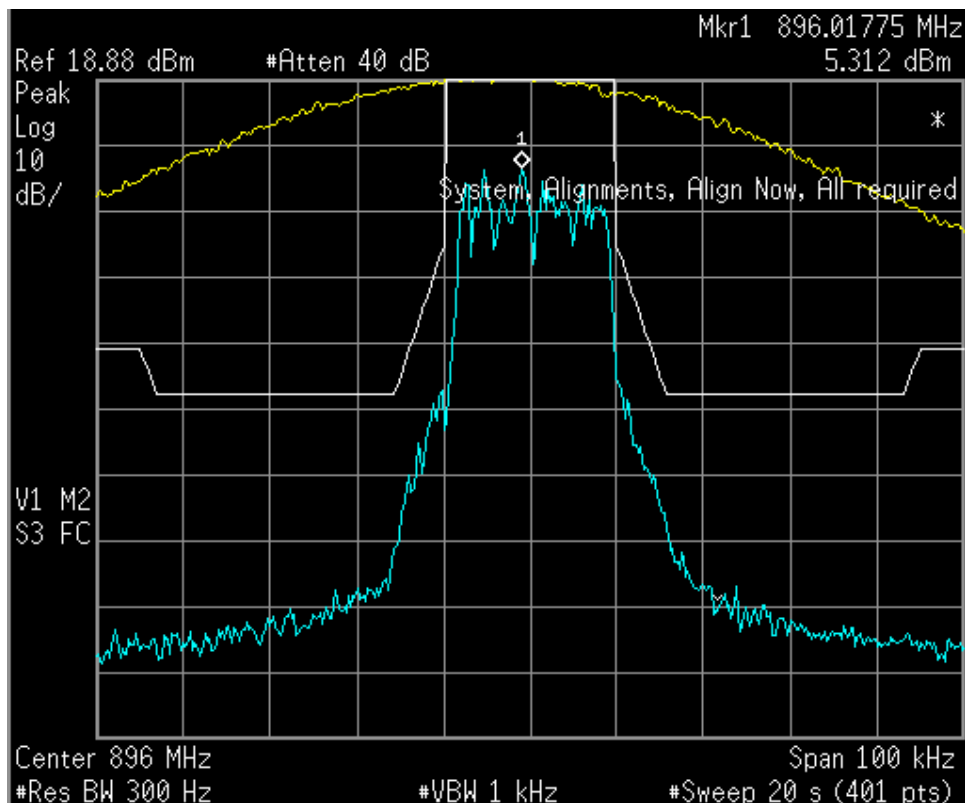


Figure 6a.2.2-5. iDEN 900 MHz Band, Quad-16QAM, Max. Power, Emission Mask G

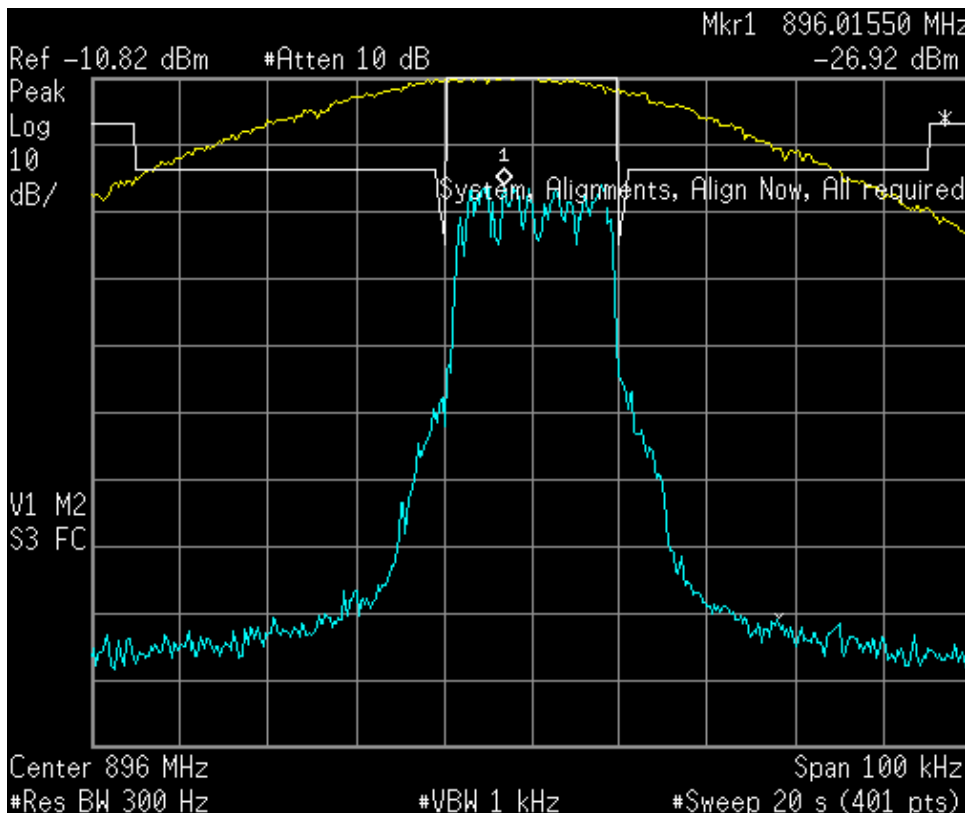


Figure 6a.2.2-6. iDEN 900 MHz Band, Quad-16QAM, Min. Power, Emission Mask G

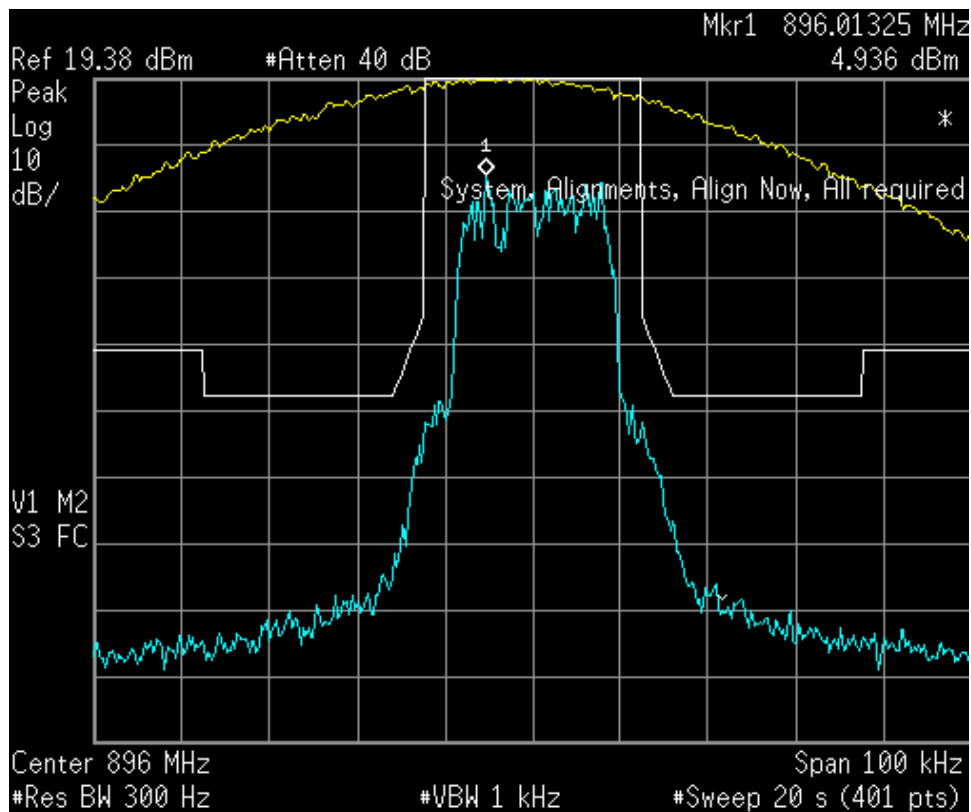


Figure 6a.2.2-7. iDEN 900 MHz Band, Quad-16QAM, Max. Power, EA Emission Mask

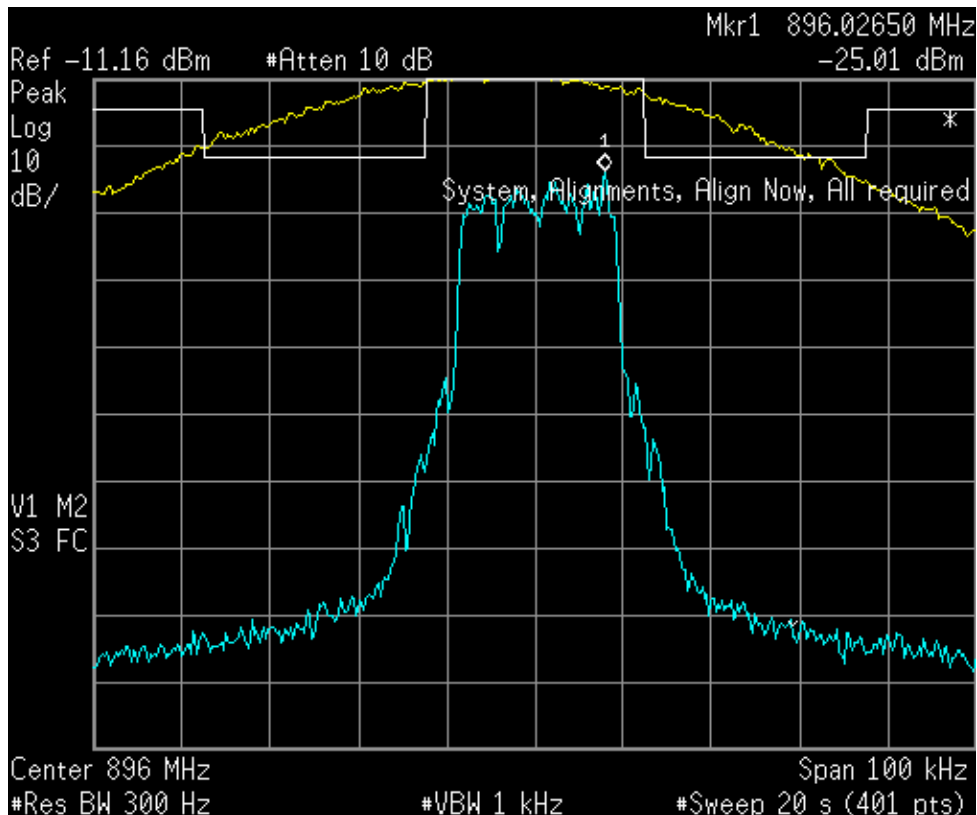


Figure 6a.2.2-8. iDEN 900 MHz Band, Quad-16QAM, Min. Power, EA Emission Mask

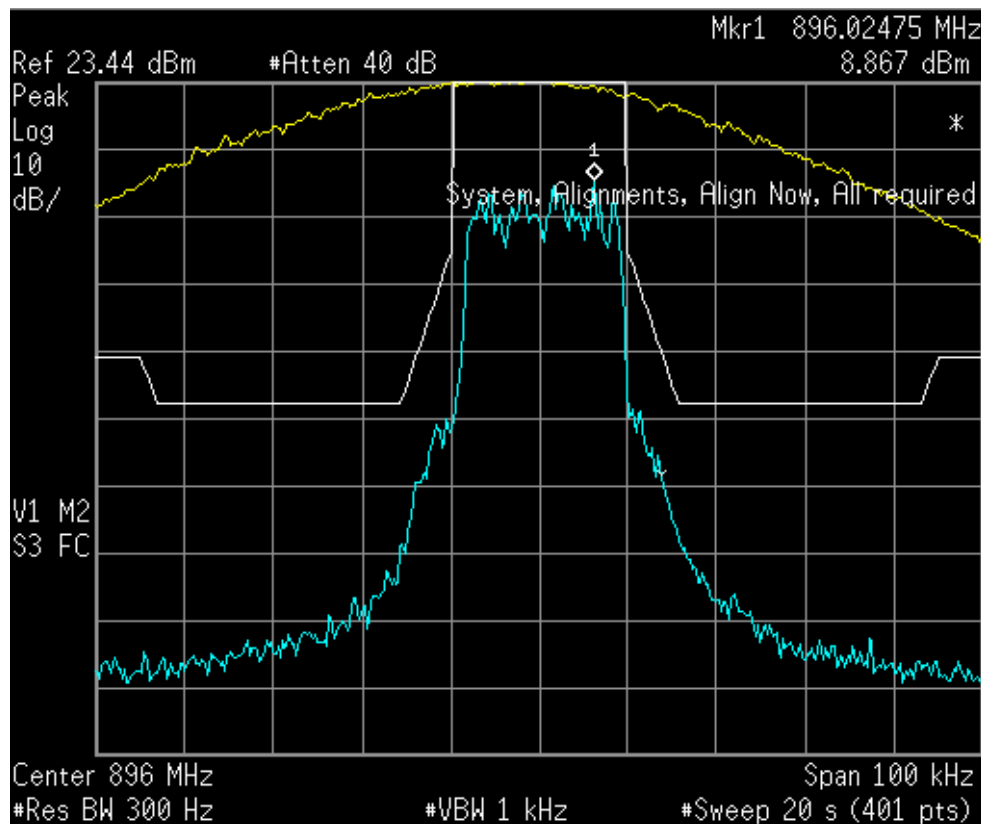


Figure 6a.2.2-9. iDEN 900 MHz Band, Quad-64QAM, Max. Power, Emission Mask G

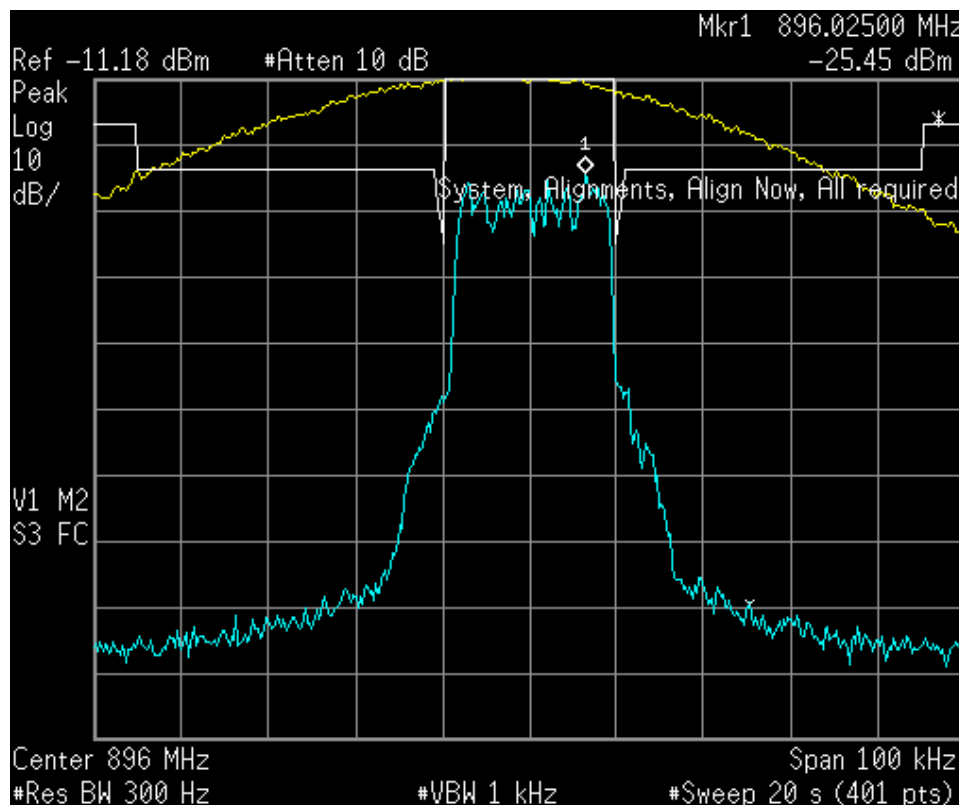


Figure 6a.2.2-10. iDEN 900 MHz Band, Quad-64QAM, Min. Power, Emission Mask G

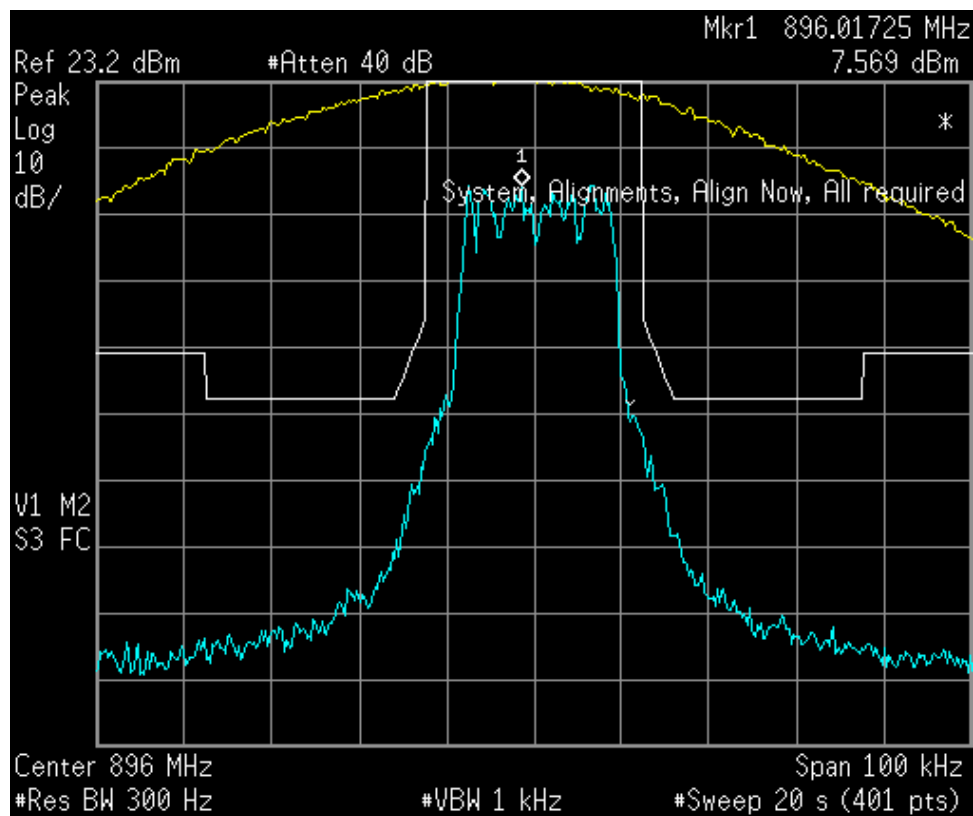


Figure 6a.2.2-11. iDEN 900 MHz Band, Quad-64QAM, Max. Power, EA Emission Mask

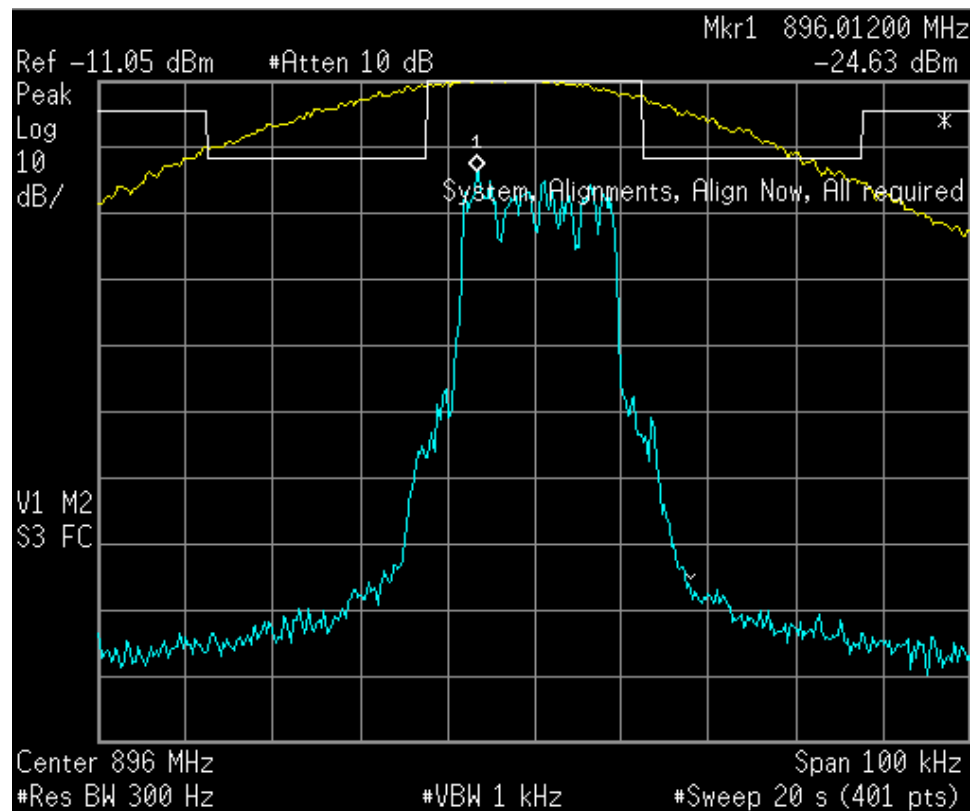
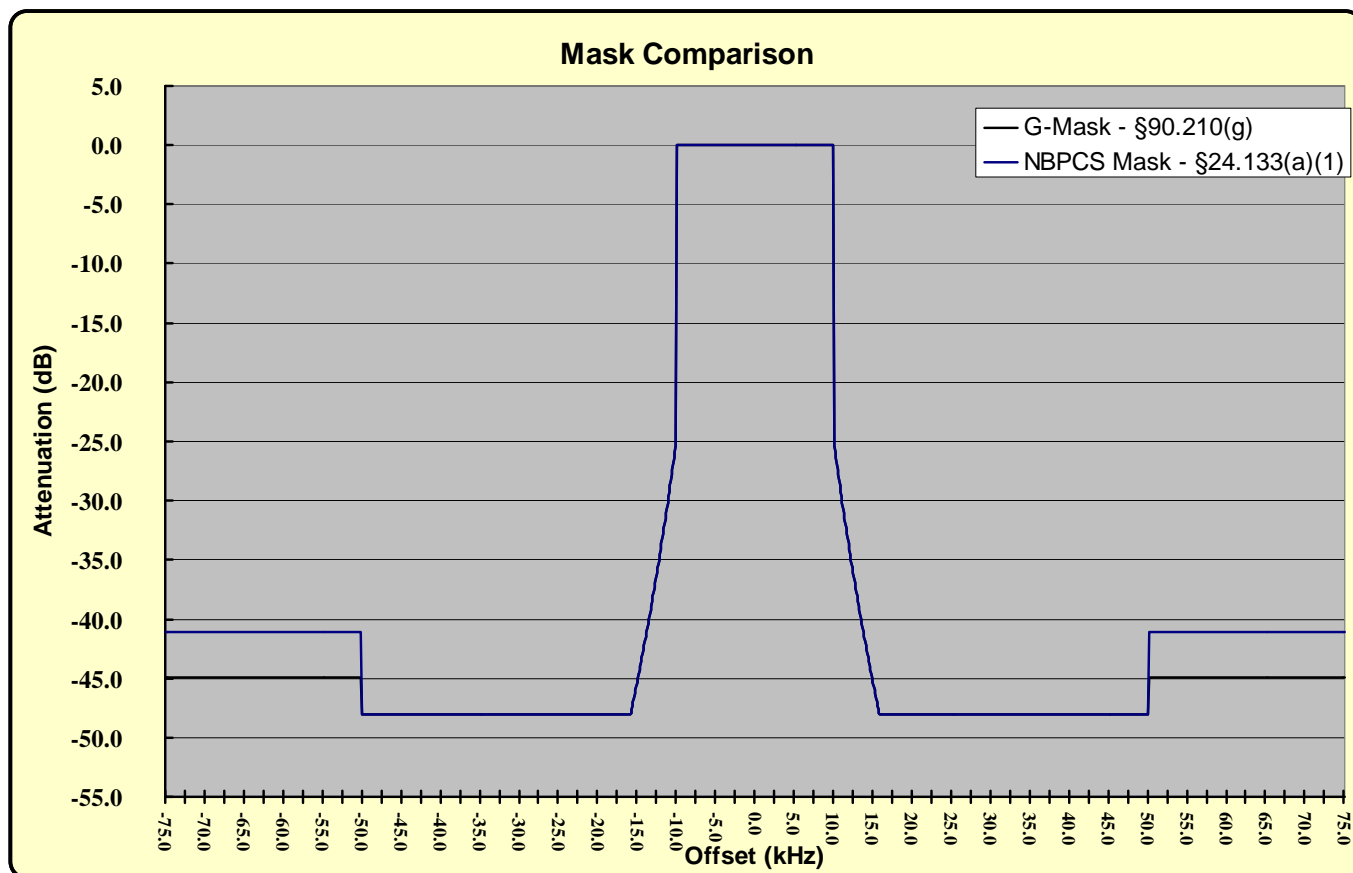


Figure 6a.2.2-12. iDEN 900 MHz Band, Quad-64QAM, Min. Power, EA Emission Mask

6b.2. Modulation Characteristics and Necessary Bandwidth -- Pursuant 47 CFR 2.1033(c)(13), §2.1047(d), §2.1049, §2.202, §24.131, and §24.133(a)(1); RSS-Gen Section 3, RSS-134 Section 6.3.

6b.2.0 Emission Mask Application

- For Narrowband PCS operation, the emission mask requirements are defined in §24.133.
- The Authorized Bandwidth is taken to be 20 kHz, per §24.131, given aggregation of 12.5 kHz channels.
- Given these considerations, the G-Mask is identical to the NBPCS mask out to 50 kHz, whereupon it becomes slightly more severe (3.9 dB).



6b.2.1 Emission Designator 18K3D7W - NBPCS iDEN Measured data

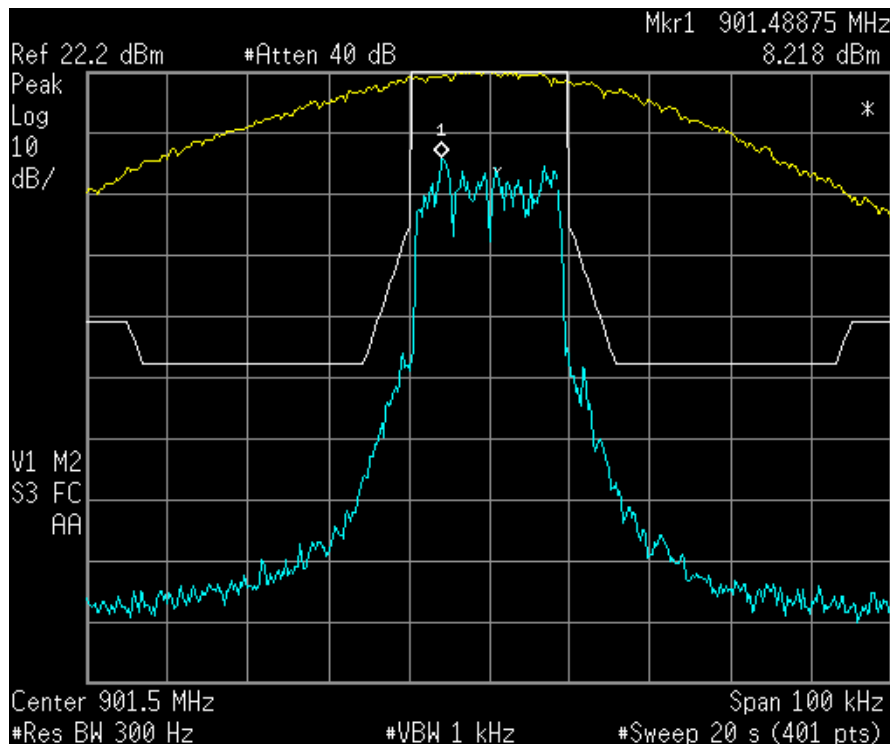


Figure 6b.2.1-1 iDEN NBPCS Band, Occupied Bandwidth, Quad-QPSK, Max. Power.

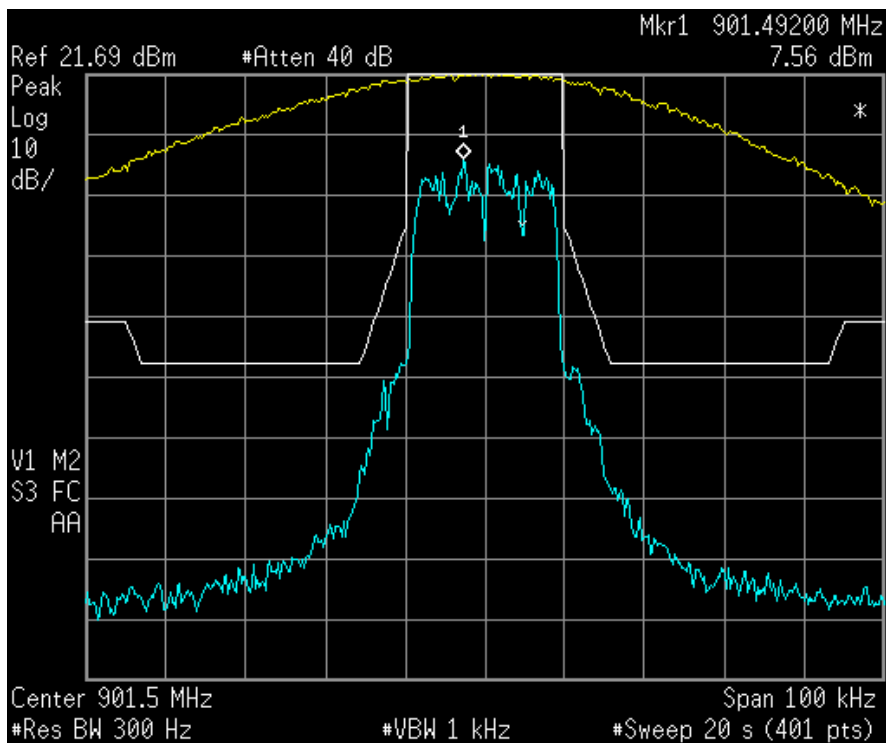


Figure 6b.2.1-2 iDEN NBPCS Band, Occupied Bandwidth, Quad-16QAM, Max. Power.

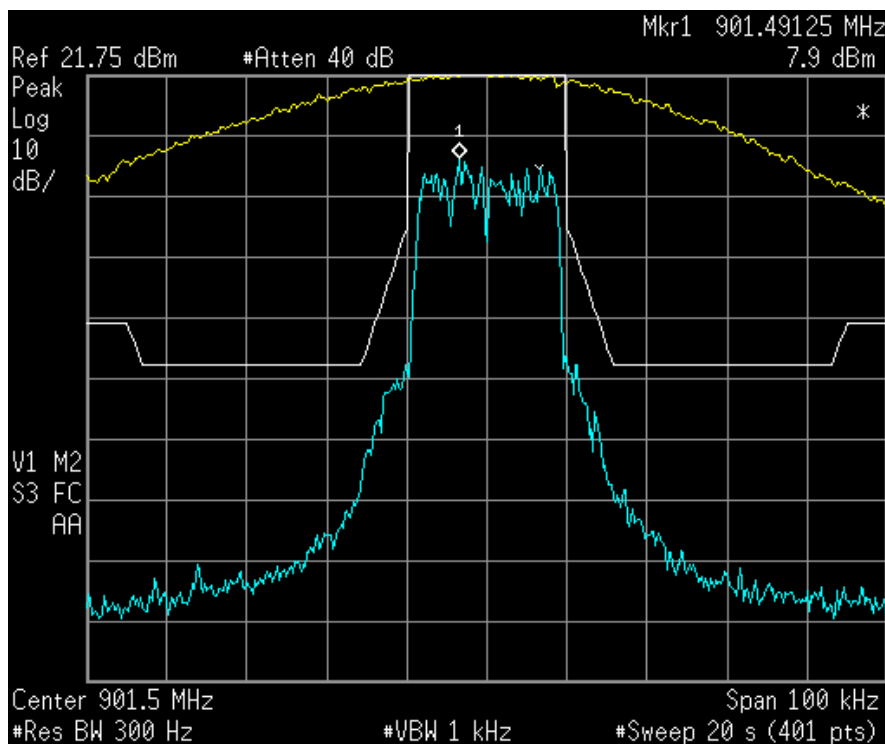


Figure 6b.2.1-3. iDEN NBPCS Band, Occupied Bandwidth, Quad-64QAM, Max. Power.

6a.5 Land Mobile Frequency Stability -- Pursuant to 47 CFR 2.1055(a)(1), §2.1055(d)(2), and §24.135; RSS-Gen Section 3.2, RSS-119 Section 5.3, RSS-134 Section 7.

Frequency stability measurements were made as described in paragraph 7.4. Because of the transmitter's dependence on the stability of the base station oscillator, it is not possible to provide stability data for this transmitter as is commonly supplied for certification per 47 CFR 2.1055 for a radio with a locally stabilized oscillator. The following data was collected in a setup comprising of a base station simulator and it represents the absolute frequency error of the transceiver under test versus the base station frequency reference.

Frequency Stability (in ppm) at 813.5125 MHz, Voltage = 4V _{DC}		
TEMP (°C)	Frequency Error (Hz)	Error (ppm)
-30	7.32	0.009
-20	8.14	0.010
-10	20.34	0.025
0	10.58	0.013
10	26.85	0.033
20	10.58	0.013
30	30.91	0.038
40	20.34	0.025
50	25.22	0.031
60	13.83	0.017
70	14.64	0.018

Table 6a.5-1. Transmitter Frequency Stability vs. Temperature in 800 MHz SMR Band.

Frequency Stability in PPM at 899.98125 MHz, Voltage = 4V_{DC}		
TEMP (°C)	Frequency Error (Hz)	Error (ppm)
-30	14.40	0.016
-20	8.10	0.009
-10	7.20	0.008
0	11.70	0.013
10	10.80	0.012
20	7.20	0.008
30	18.00	0.02
40	19.80	0.022
50	16.20	0.018
60	18.00	0.02
70	18.90	0.021

Table 6a.5-2. Transmitter Frequency Stability vs. Temperature in 900 MHz SMR Band.

Frequency Stability in PPM at 901.88125 MHz, Voltage = 4V_{DC}		
TEMP (°C)	Frequency Error (Hz)	Error (ppm)
-30	11.71	0.013
-20	11.71	0.013
-10	13.51	0.015
0	15.32	0.017
10	14.42	0.016
20	16.22	0.018
30	12.61	0.014
40	13.51	0.015
50	15.32	0.017
60	10.81	0.012
70	15.32	0.017

Table 6a.5-3. Transmitter Frequency Stability vs. Temperature in 900 MHz NBPCS Band.

Frequency Stability in PPM at 813.5125 MHz, Temperature = 25°C		
Power Supply Output Voltage	Frequency Error in Hz	PPM
3.6	27.66	0.034
3.7	17.08	0.021
3.8	18.71	0.023
3.9	15.46	0.019
4	9.76	0.012
4.1	13.02	0.016
4.2	11.39	0.014
4.3	13.83	0.017

Table 6a.5-4. Transmitter Frequency Stability vs. Voltage in 800 MHz SMR Band.

Frequency Stability in PPM at 900.98125 MHz, Temperature = 25°C		
Power Supply Output Voltage	Frequency Error in Hz	PPM
3.6	9.01	0.010
3.7	9.91	0.011
3.8	12.61	0.014
3.9	10.81	0.012
4	10.81	0.012
4.1	11.71	0.013
4.2	10.81	0.012
4.3	14.42	0.016

Table 6a.5-5. Transmitter Frequency Stability vs. Voltage in 900 MHz SMR Band.

Frequency Stability in PPM at 901.88125 MHz, Temperature = 25°C		
Power Supply Output Voltage	Frequency Error in Hz	PPM
3.6	13.51	0.015
3.7	16.22	0.018
3.8	16.22	0.018
3.9	15.32	0.017
4	14.42	0.016
4.1	14.42	0.016
4.2	18.92	0.021
4.3	18.92	0.021

Table 6a.5-6. Transmitter Frequency Stability vs. Voltage in 900 MHz NBPCS Band.

6a.6 Effective Radiated Power (ERP) -- Pursuant 47 CFR 2.1046 and §24.132(b); RSS-Gen Section 3.2, RSS-119 Section 5.4, RSS-134 Section 6.2.

The ERP characteristic was measured while a radio was set to transmit a test mode signal at the maximum rated output power (+/- 5%) and was vertically mounted on a non-conducting platform/turntable in a spherical RF Anechoic Chamber. The power at the receive antenna was recorded on a power meter with the unit rotating about the z-axis. The azimuth of receiving antenna is rotated 180 degrees while the UUT is rotating producing a spiral antenna measurement. For this ERP test, the phi cuts were taken in 15 degree increments or slices and the theta spins used about 200 measurements per rotation. ERP data is extracted from the phi= 90 degree cut. The power recorded from the meter is then corrected to compensate for path loss, cable losses, and amplifier and antenna gains at the given frequencies resulting in absolute radiated power.

The following calculations show how the reported scaled max ERP was determined.

For 800 MHz SMR band operation,

$$\begin{aligned} \text{Measured MaxERP, dBm} &= 10 * \log(\text{measured output power, mW}) + \text{measured antenna gain, dBd} \\ &= 27.78 \text{ dBm} \end{aligned}$$

The resulting max ERP was converted to mW:

$$\begin{aligned} \text{MeasuredMaxERP, mW} &= 10^{\left(\frac{\text{Measured MaxERP, dBm}}{10}\right)} \\ &= 599.79 \text{ mW} \end{aligned}$$

Since the measured max ERP was determined at the production maximum output power, no scaling was necessary:

$$\begin{aligned} \text{Scaled MaxERP, mW} &= \text{Measured MaxERP, mW} * \left(\frac{640 \text{ mW}}{\text{measured output power, mW}}\right) \\ &= 599.8 \text{ mW} \end{aligned}$$

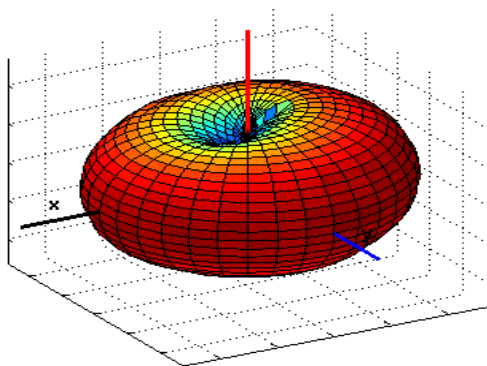


Figure 6a.6-1 Antenna pattern in the 800 MHz band (Flip Open).

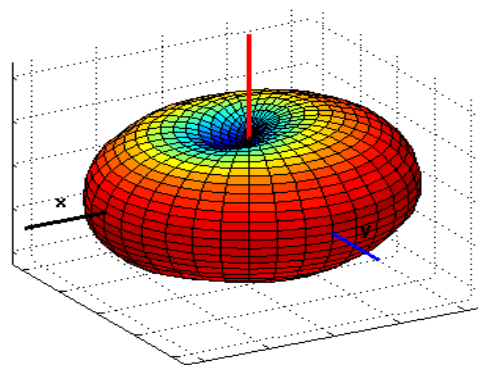


Figure 6a.6-2 Antenna pattern in the 800 MHz band (Flip Closed).

For 900 MHz SMR band operation,

$$\begin{aligned} \text{Measured MaxERP, dBm} &= 10 * \log(\text{measured output power, mW}) + \text{measured antenna gain, dBd} \\ &= 27.95 \text{ dBm} \end{aligned}$$

The resulting max ERP was converted to mW:

$$\begin{aligned} \text{MeasuredMaxERP, mW} &= 10^{\left(\frac{\text{Measured MaxERP, dBm}}{10}\right)} \\ &= 623.74 \text{ mW} \end{aligned}$$

Since the measured max ERP was determined at the production maximum output power, no scaling was necessary:

$$\begin{aligned} \text{Scaled MaxERP, mW} &= \text{Measured MaxERP, mW} * \left(\frac{640 \text{ mW}}{\text{measured output power, mW}} \right) \\ &= 623.7 \text{ mW} \end{aligned}$$

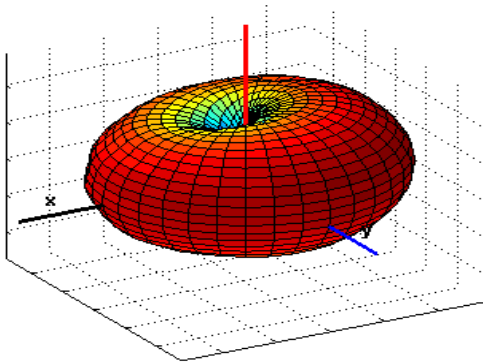


Figure 6a.6-3 Antenna pattern in the 900 MHz band (Flip Open).

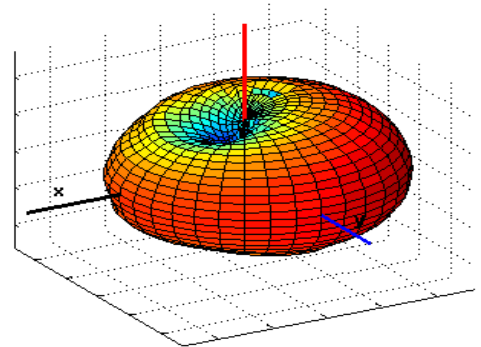


Figure 6a.6-4 Antenna pattern in the 900 MHz band (Flip Closed).

For 900 MHz NBPCS band operation,

$$\begin{aligned} \text{Measured MaxERP, dBm} &= 10 * \log(\text{measured output power, mW}) + \text{measured antenna gain, dBd} \\ &= 27.99 \text{ dBm} \end{aligned}$$

The resulting max ERP was converted to mW:

$$\begin{aligned} \text{MeasuredMaxERP, mW} &= 10^{\left(\frac{\text{Measured MaxERP, dBm}}{10}\right)} \\ &= 629.77 \text{ mW} \end{aligned}$$

Since the measured ERP was not determined at the production maximum output power, a simple scaling is performed to 640 mW:

$$\begin{aligned} \text{Scaled MaxERP, mW} &= \text{Measured MaxERP, mW} * \left(\frac{640 \text{ mW}}{\text{measured output power, mW}} \right) \\ &= 629.8 \text{ mW} \end{aligned}$$

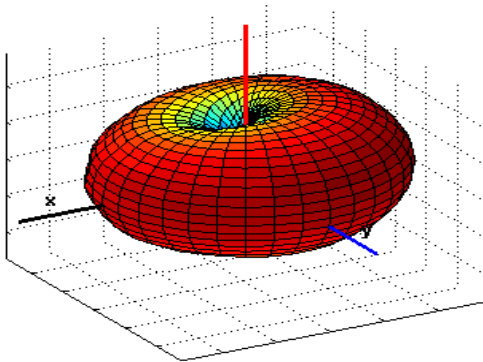


Figure 6a.6-5 Antenna pattern in the 900 MHz NBPCS band (Flip Open).

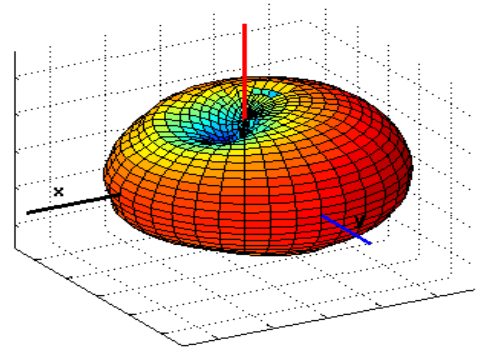


Figure 6a.6-6 Antenna pattern in the 900 MHz NBPCS band (Flip Closed).