



**FCC CFR47 PART 22 SUBPART G  
CERTIFICATION TEST REPORT**

**FOR**

**AIR-TO-GROUND TRANSCEIVER**

**MODEL NUMBER: ATG4000**

**FCC ID: WPX-AHSI**

**REPORT NUMBER: 09U12769-1, REVISION B**

**ISSUE DATE: OCTOBER 07, 2009**

*Prepared for*  
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**303 S. TECHNOLOGY CT, BUILDING A**  
**BROOMFIELD, CO 80021, U.S.A.**

*Prepared by*  
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**NVLAP LAB CODE 200065-0**

Revision History

Rev.	Issue Date	Revisions	Revised By
---	09/18/09	Initial Issue	T. Chan
A	10/05/09	Added MPE Section	T. Chan
B	10/07/09	Changed plot and added EUT serial number	A. Zaffar

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** AIRCELL LLC  
303 S. TECHNOLOGY CT, BUILDING A  
BROOMFIELD, CO 80021, U.S.A.

**EUT DESCRIPTION:** AIR-TO-GROUND TRANSCEIVER

**SERIAL NUMBER:** 1398910004

**MODEL:** ATG4000

**DATE TESTED:** AUGUST 25-27, 2009

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 22 Subpart G	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:

Tested By:



THU CHAN  
EMC MANAGER  
COMPLIANCE CERTIFICATION SERVICES

CHIN PANG  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA-603-C, FCC CFR 47 Part 2, and FCC CFR 47 Part 22.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is an Air to ground transceiver.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
894.75	8PSK	40.03	10069.32
894.75	BPSK	39.18	8279.42
894.75	QPSK	38.74	7481.70

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a CI 5500 antenna, with a maximum gain of 5.8dBi.

### 5.4. SOFTWARE AND FIRMWARE

Anritsu 8820B Radio Communication Analyzer is used to establish link between the EUT and radio communication analyzer.

### 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-position was the EUT with highest emissions. To determine the worst-case, the EUT was investigated at X and Y-Positions, with antenna J1 and J2. The worst case is at J2 vertical position.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
DC Power Supply	XANTREX	XHR 60-18	C0164	DoC
Directional Coupler, 100 W, 40 dB, 0.01 ~ 1000 MHz	Werlatone	C2630	NA	NA (Cal Before Test)
Directional Coupler, 400 W, 40 dB, 0.8 ~ 4.2 GHz	Amplifier Research	DC7144A	C00983	NA (Cal Before Test)
Radio Communications	Anritsu	MT8820B	6200772673	NA
Antenna	Comant Industries Inc.	CI5500	277312	NA
Antenna	Comant Industries Inc.	CI5500	258388	NA

### I/O CABLES (CONDUCTED TEST SETUP)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	DC	1	DC	Twisted Shielded Pair	2m	
2	AFTH	1	N-Type	Shielded	1m	
3	N-Type	1	Call Box	Shielded	2m	
4	RF In/Out	1	Spectrum Analyzer	Shielded	1m	

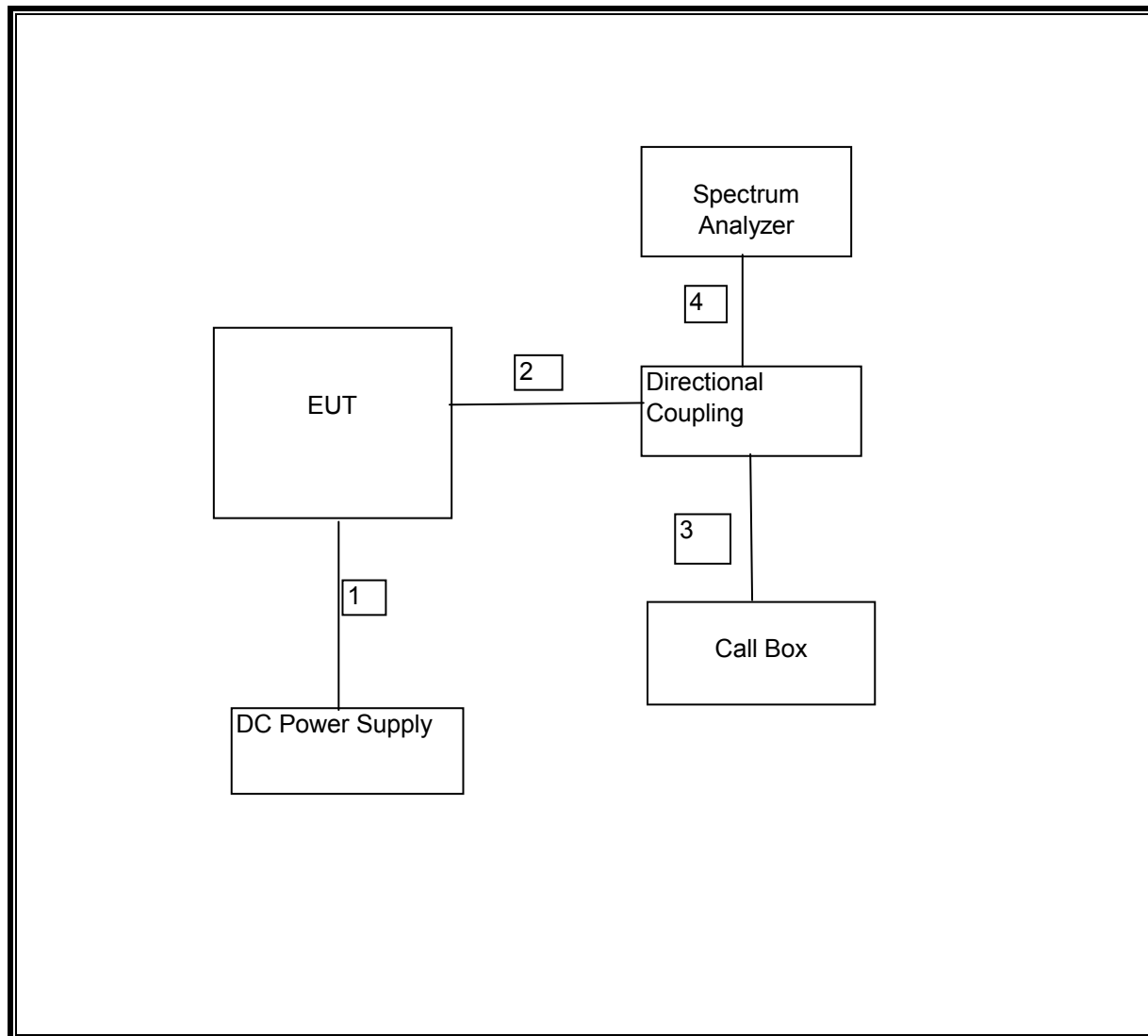
### I/O CABLES (RADIATED TEST SETUP)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	2m	
2	DC	1	DC	Twisted Shielded	2m	
3	N-Type	1	Antenna	Shielded	0.1m	

### TEST SETUP

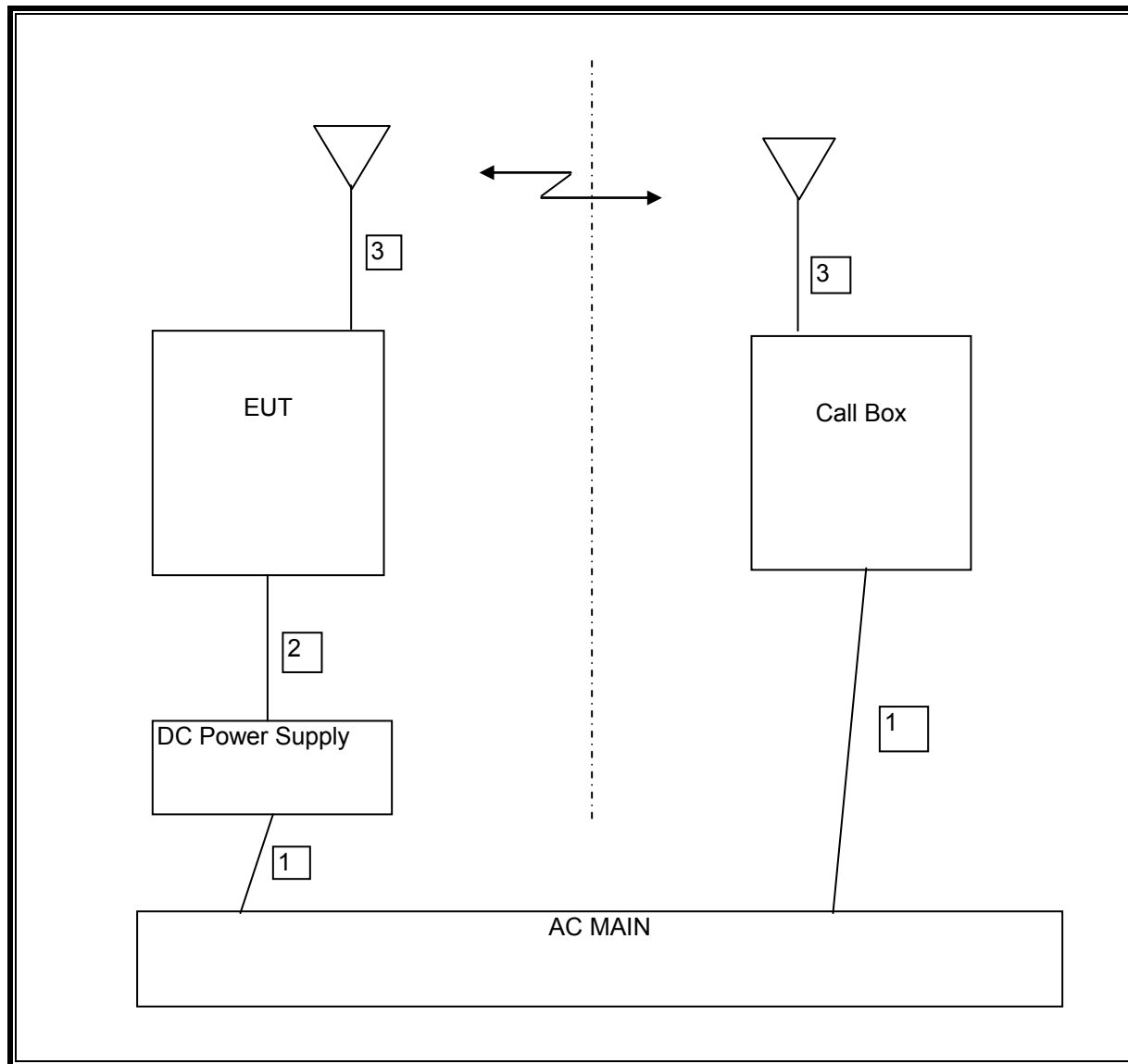
The EUT is a stand alone device. The Radio Communication test set is linked to the EUT.

**CONDUCTED TEST SETUP DIAGRAM**





**RADIATED TEST SETUP DIAGRAM**



## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	MY45300064	01/05/10
Antenna, Horn, 18 GHz	EMCO	3115	9001-3245	01/29/10
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	A121003	01/14/10
Preamplifier, 26.5 GHz	Agilent / HP	8449B	3008A00931	02/04/10
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	12/16/09
Radio Communication Analyzer	Anritsu	MT8820B	6200772673	12/16/09
Temperature Chamber	Tenney	T10RC	NA	03/31/10
Signal Generator 1024 MHz	R & S	SMY01	DE 12311	05/28/10
Dipole	EMCO	3121C-DB2	22435	06/17/10
1.5GHz HPF	MicroTronic	HPM13195	1	CNR

### 6.1.1. OCCUPIED BANDWIDTH

#### LIMITS

None; for reporting purposes only.

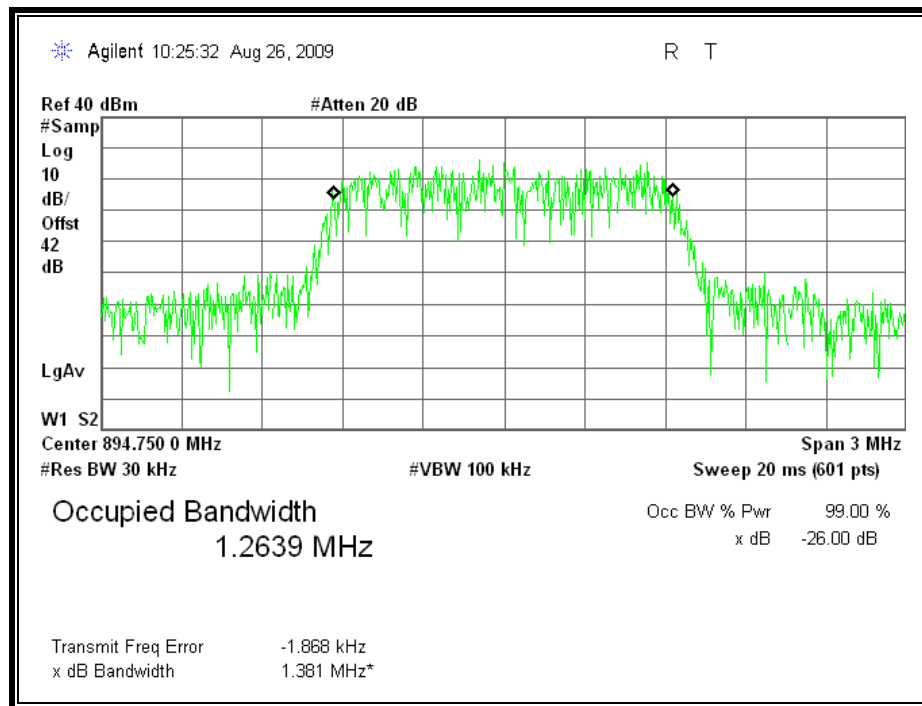
#### TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the -26 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal -26 dB bandwidth function is utilized.

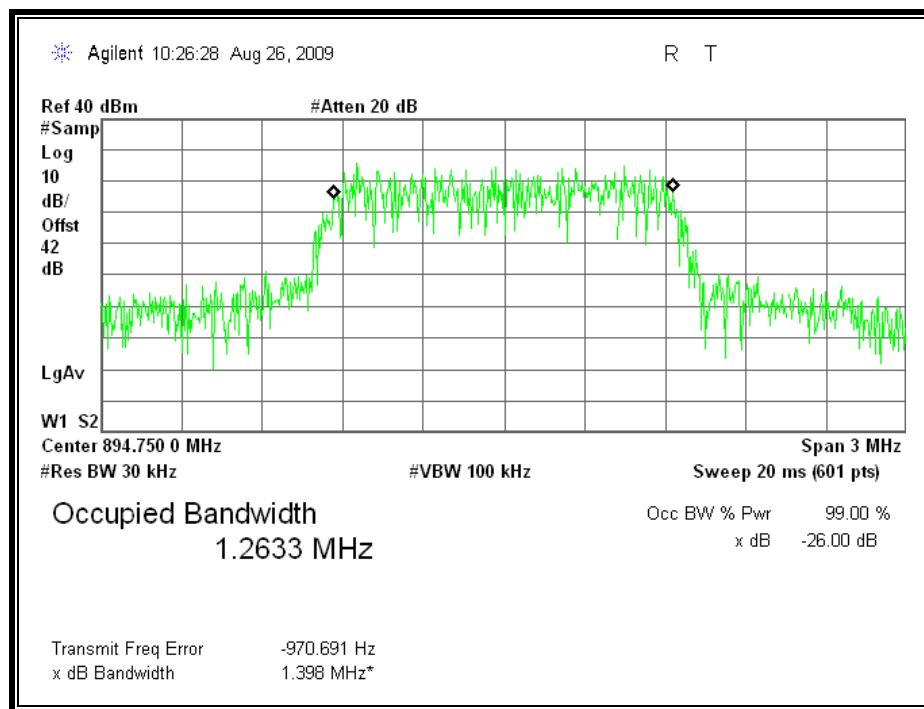
#### RESULTS

Mode	Frequency (MHz)	99% BW (MHz)	-26dB BW (MHz)
8PSK	894.75	1.264	1.381
BPSK	894.75	1.263	1.398
QPSK	894.75	1.262	1.407

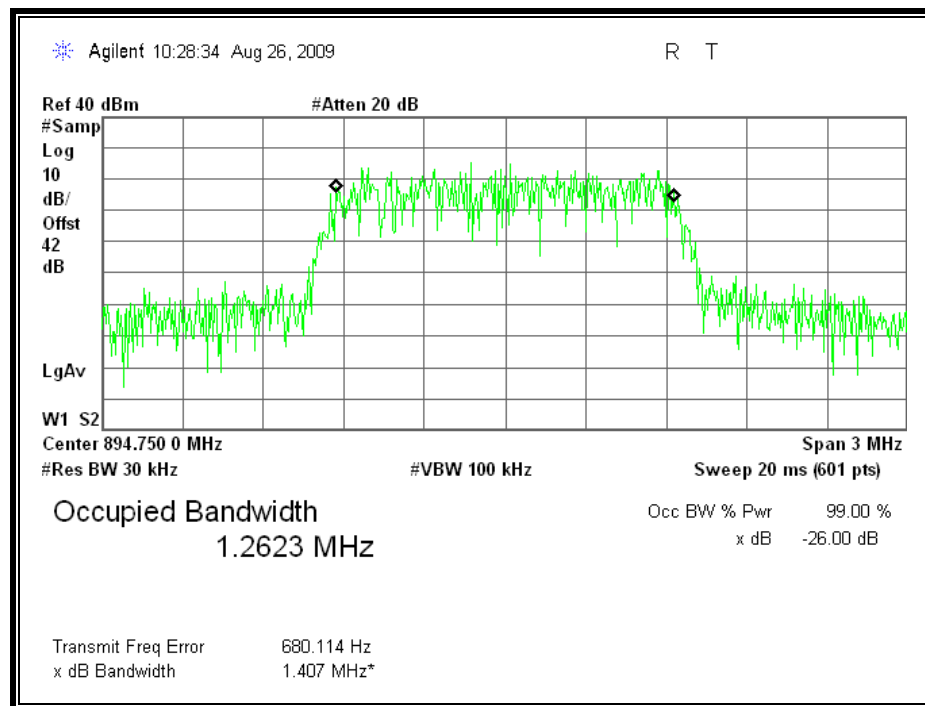
## 8PSK MODULATION BANDWIDTH



## BPSK MODULATION BANDWIDTH



### QPSK MODULATION BANDWIDTH



## 6.1.2. RF POWER OUTPUT

### LIMIT

§ 22.867 Effective radiated power limits. The effective radiated power (ERP) of ground and airborne stations operating on the frequency ranges listed in §22.857 must not exceed the limits in this section.

- (a) The peak ERP of airborne mobile station transmitters must not exceed 12 Watts.
- (b) The peak ERP of ground station transmitters must not exceed 500 Watts.

### TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 2.2.17

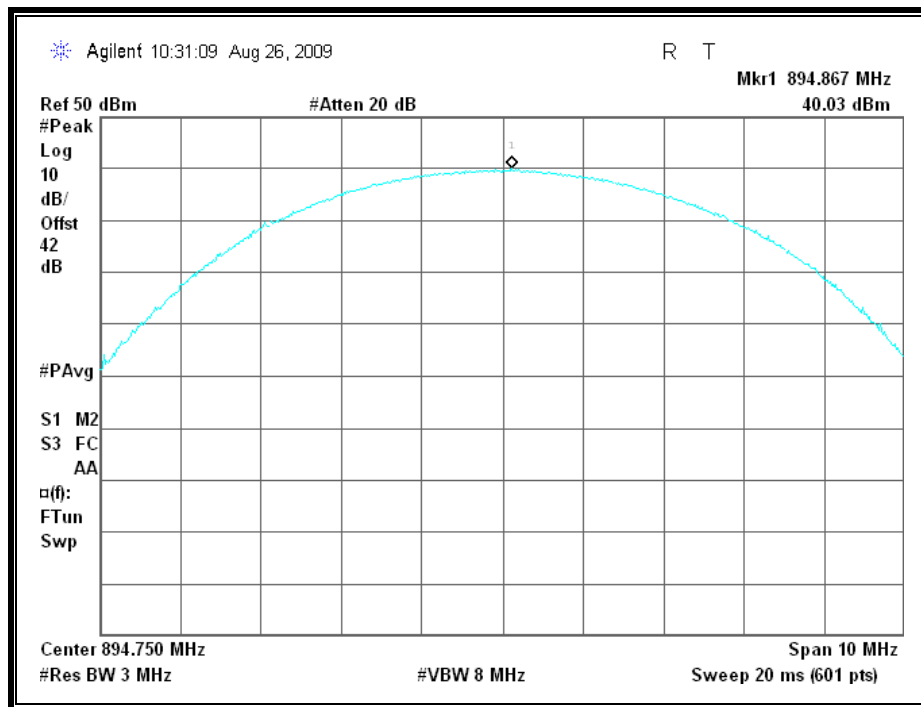
### RESULTS

Output Power

Mode	Frequency (MHz)	Output Power (dBm)	Output Power (W)
8PSK	894.75	40.03	10.07
BPSK	894.75	39.18	8.28
QPSK	894.75	38.74	7.48

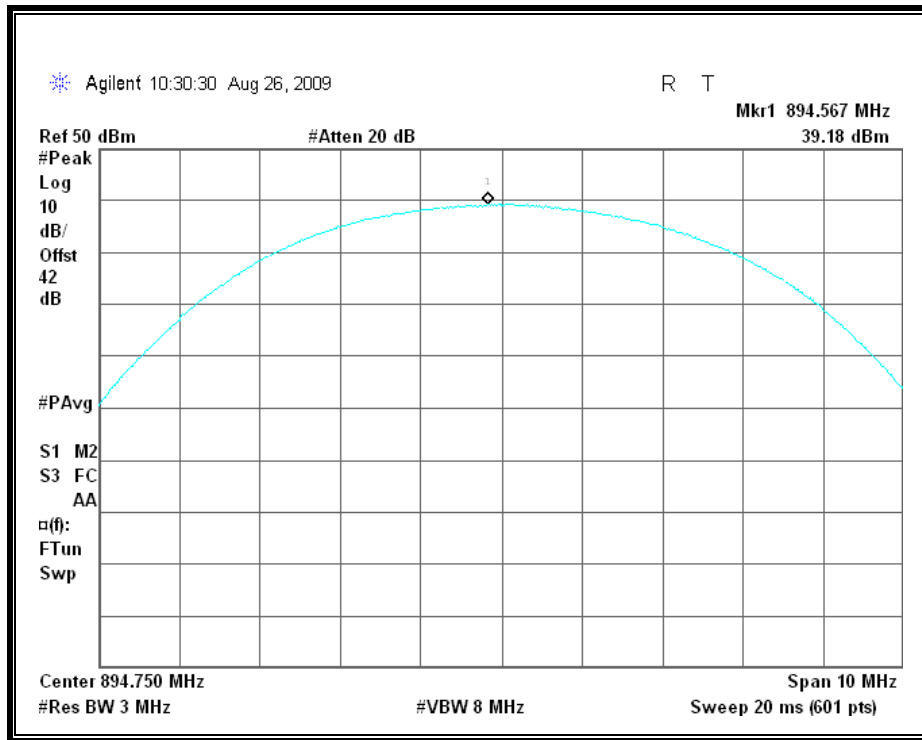
## Conducted Output Power

### 8PSK

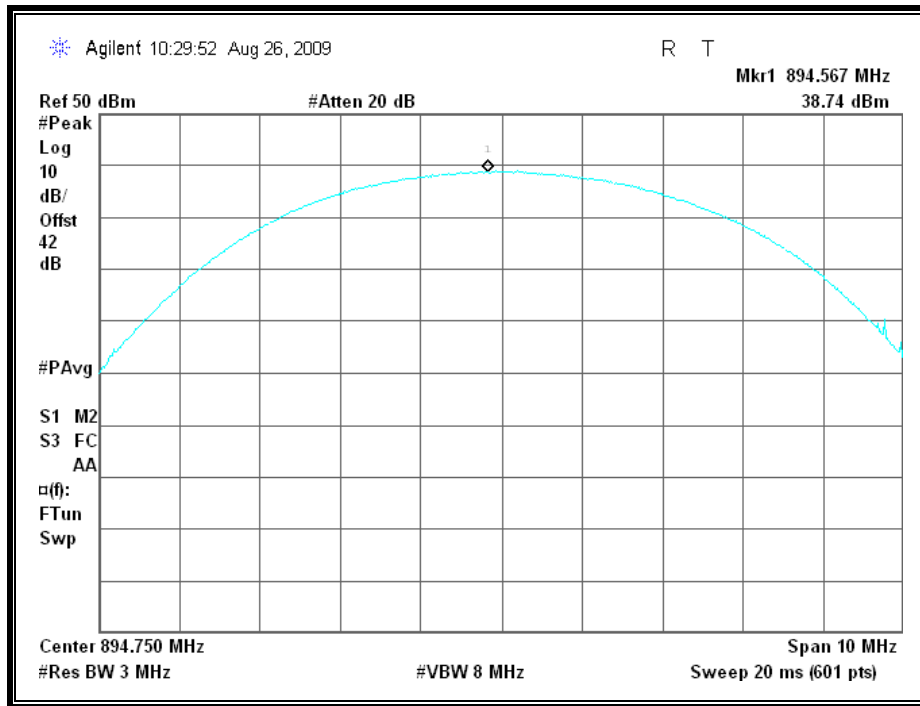




BPSK



QPSK



### **6.1.3. SPURIOUS EMISSION AT ANTENNA TERMINAL**

#### **LIMIT**

§ 22.861 Emission limitations. The rules in this section govern the spectral characteristics of emissions for commercial aviation systems in the Air-Ground Radiotelephone Service. Commercial aviation air-ground systems may use any type of emission or technology that complies with the technical rules in this subpart.

- (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

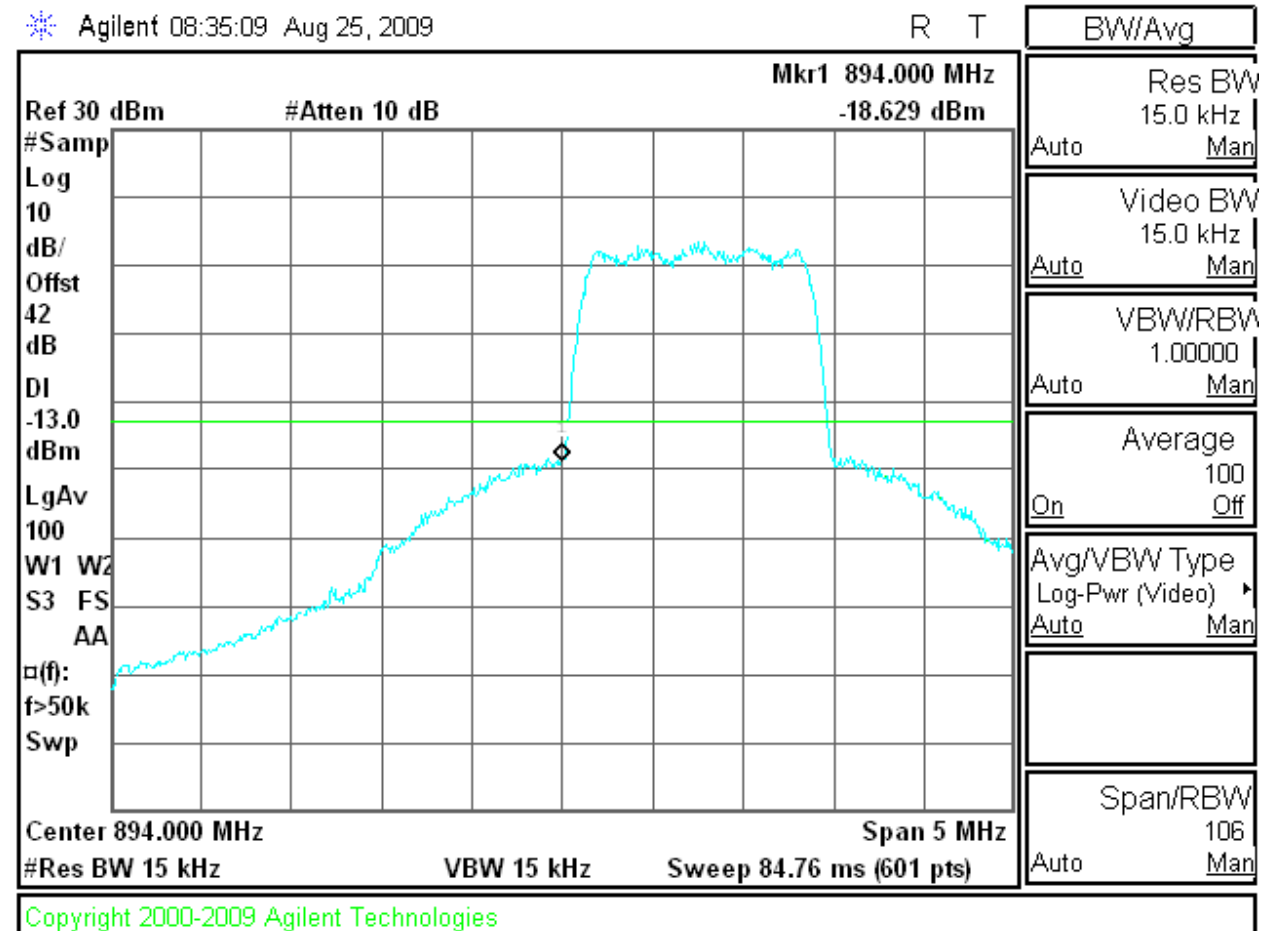
#### **TEST PROCEDURE**

ANSI / TIA / EIA 603 Clause 3.2.13 & 22.861 (b)

#### **RESULTS**

# 8PSK MODULATION:

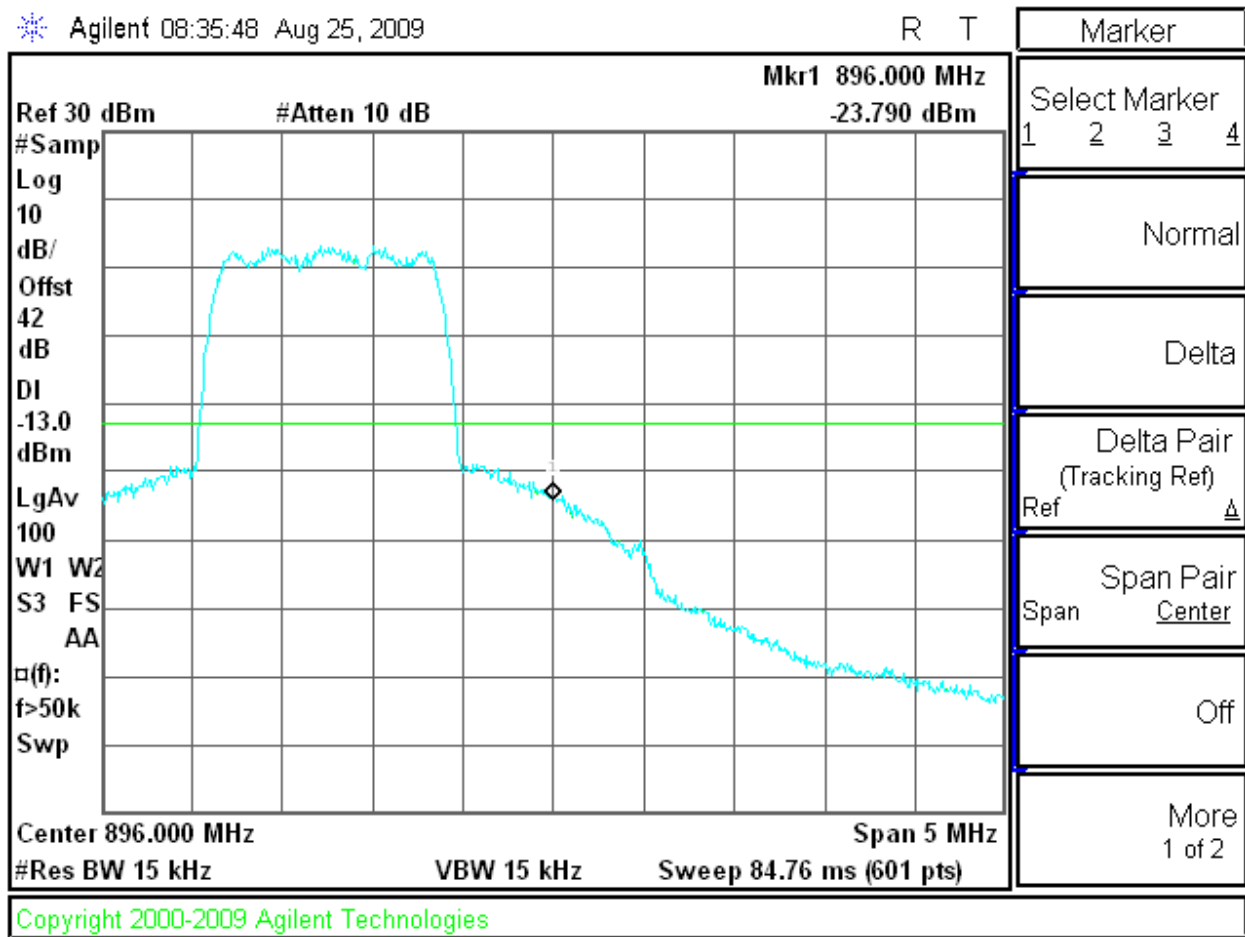
## LOW BANDEGE



# HIGH BANDEGE

\* Agilent 08:35:48 Aug 25, 2009

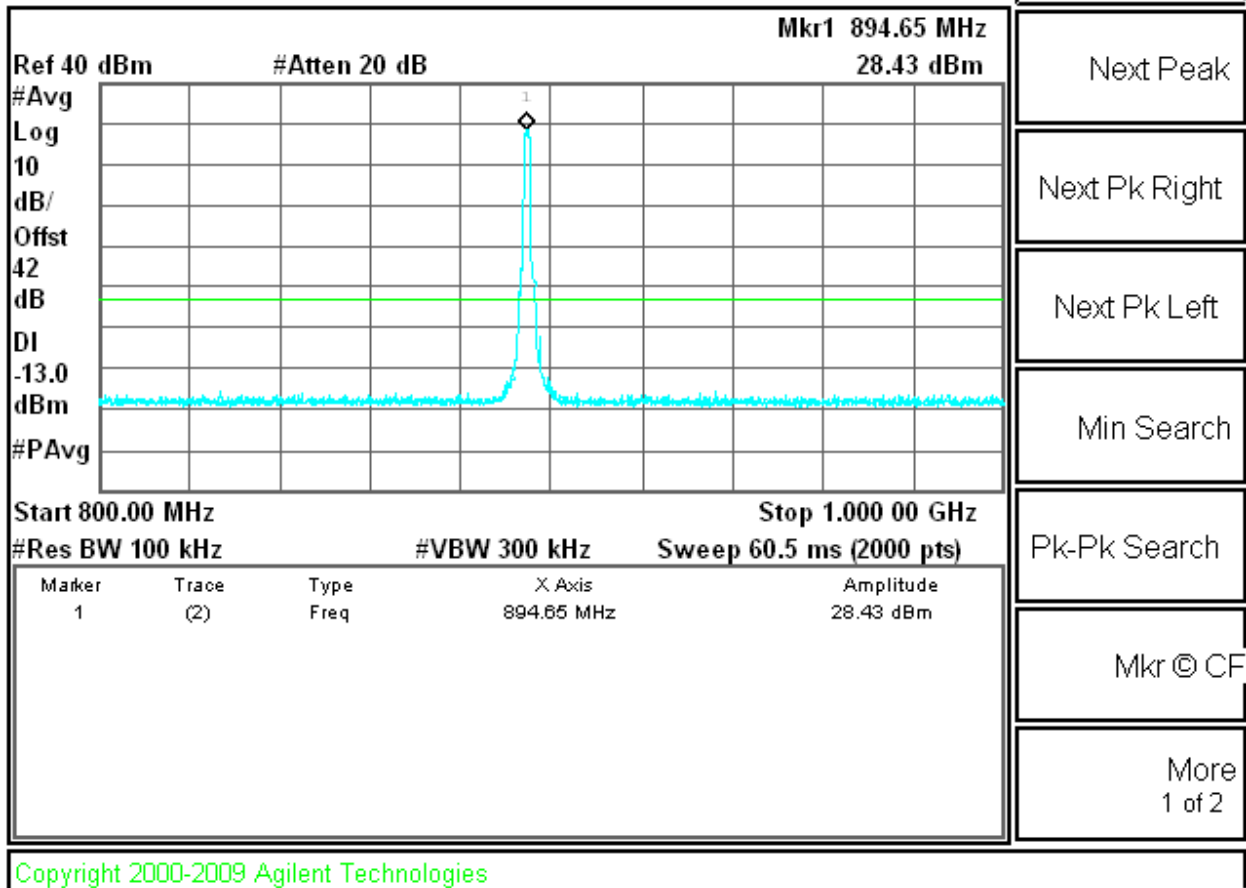
R T



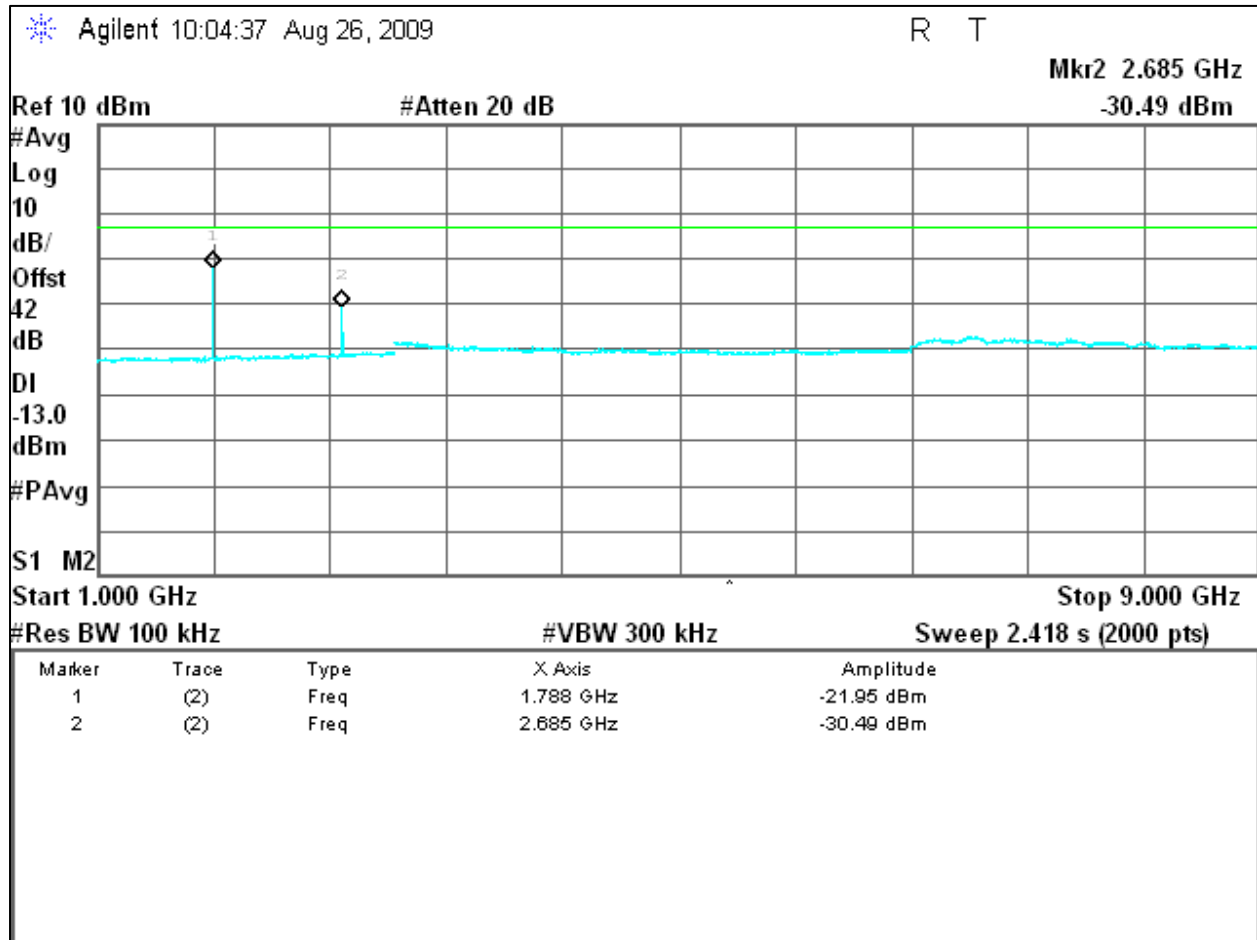
# Out-Of-Band Emissions

Agilent 10:05:55 Aug 26, 2009

R T

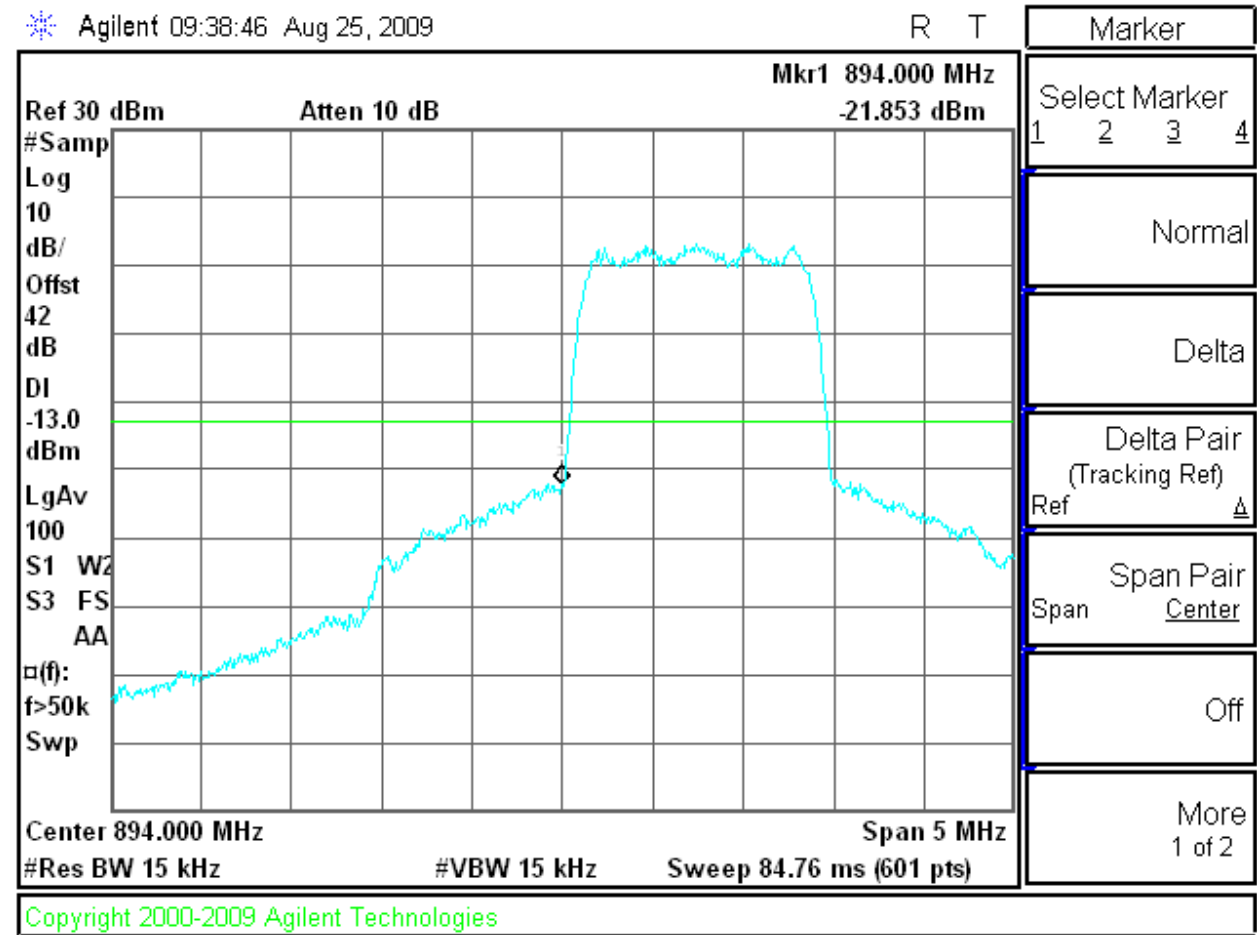


# **Out-Of-Band Emissions**



**BPSK MODULATION:**

**LOW BANDEGE**

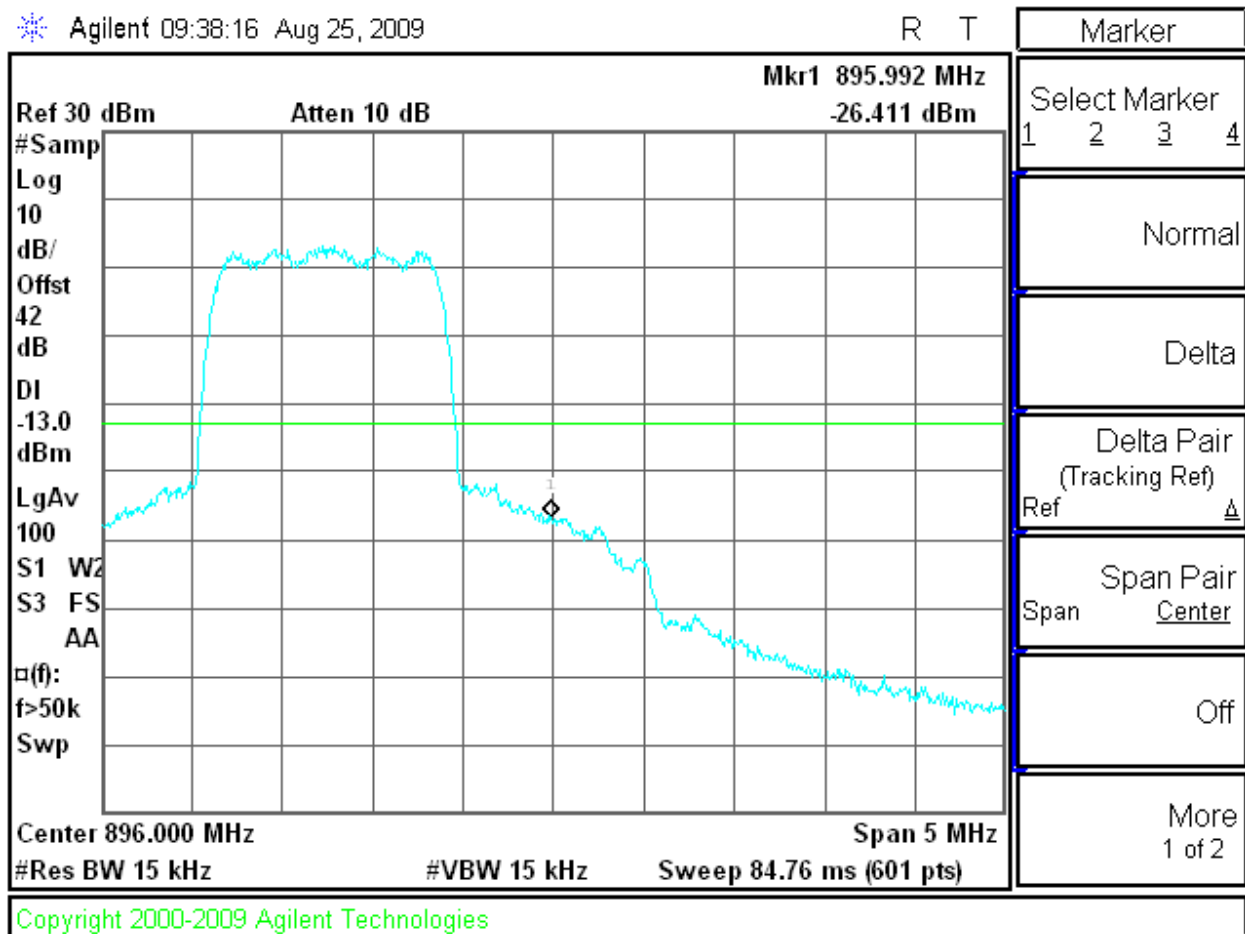




# HIGH BANDEGE

\* Agilent 09:38:16 Aug 25, 2009

R T

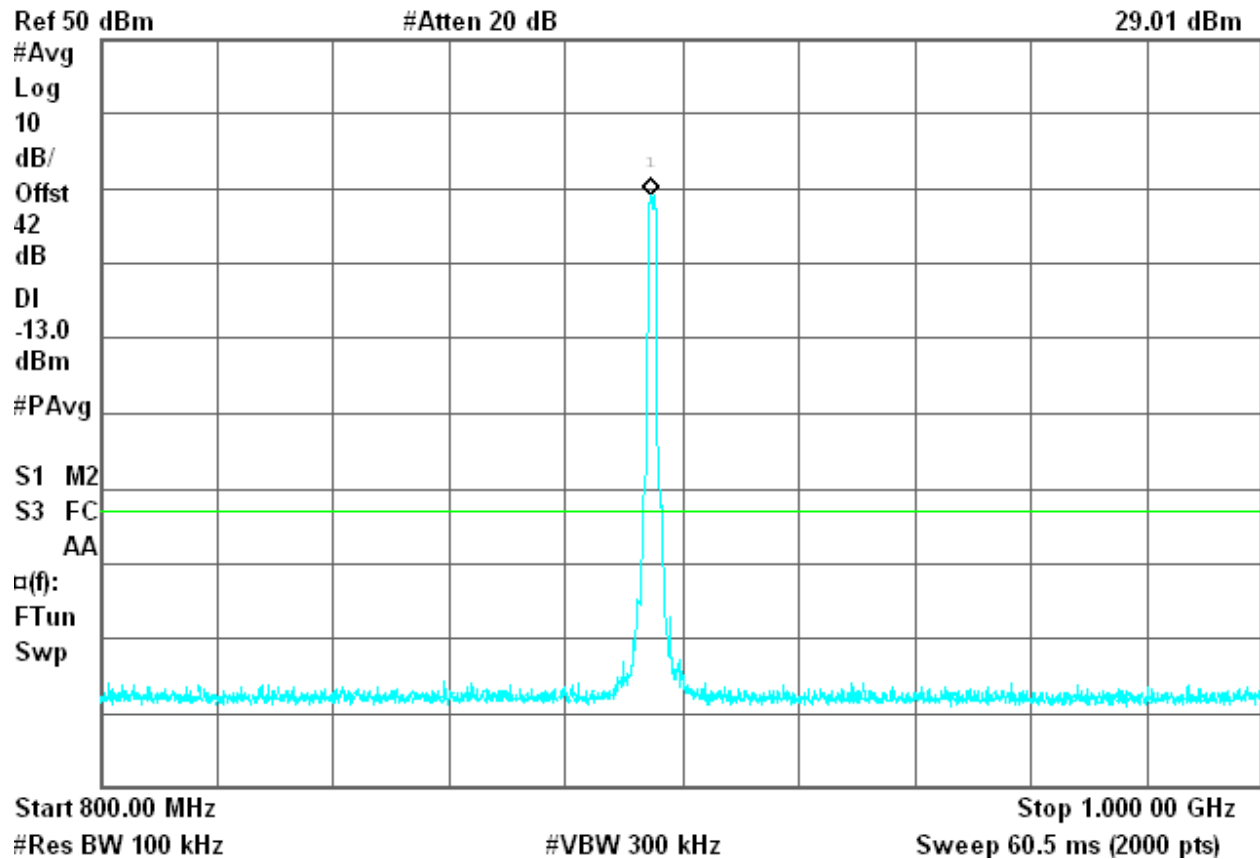


### Out-Of-Band Emissions

✱ Agilent 10:12:35 Aug 26, 2009

R T

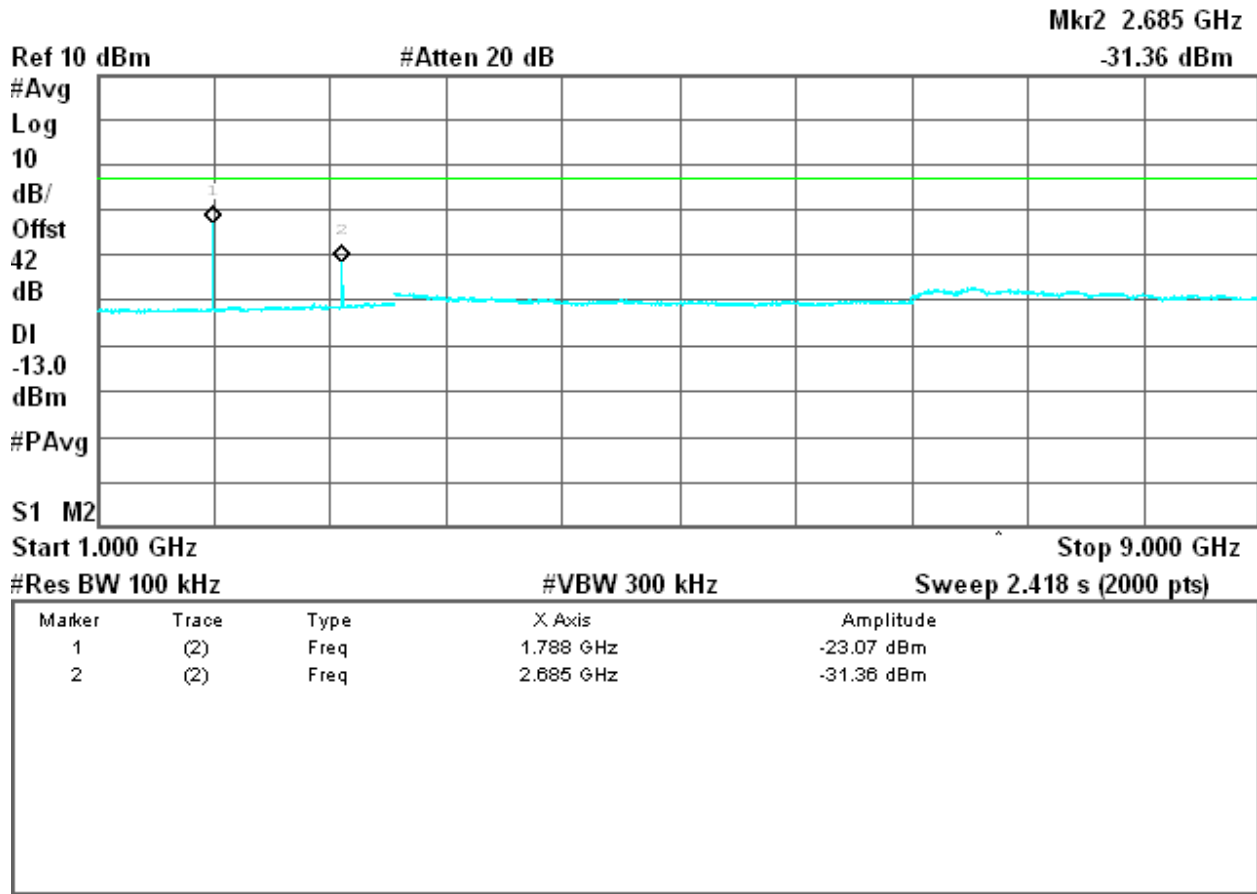
Mkr1 894.45 MHz  
29.01 dBm



# Out-Of-Band Emissions

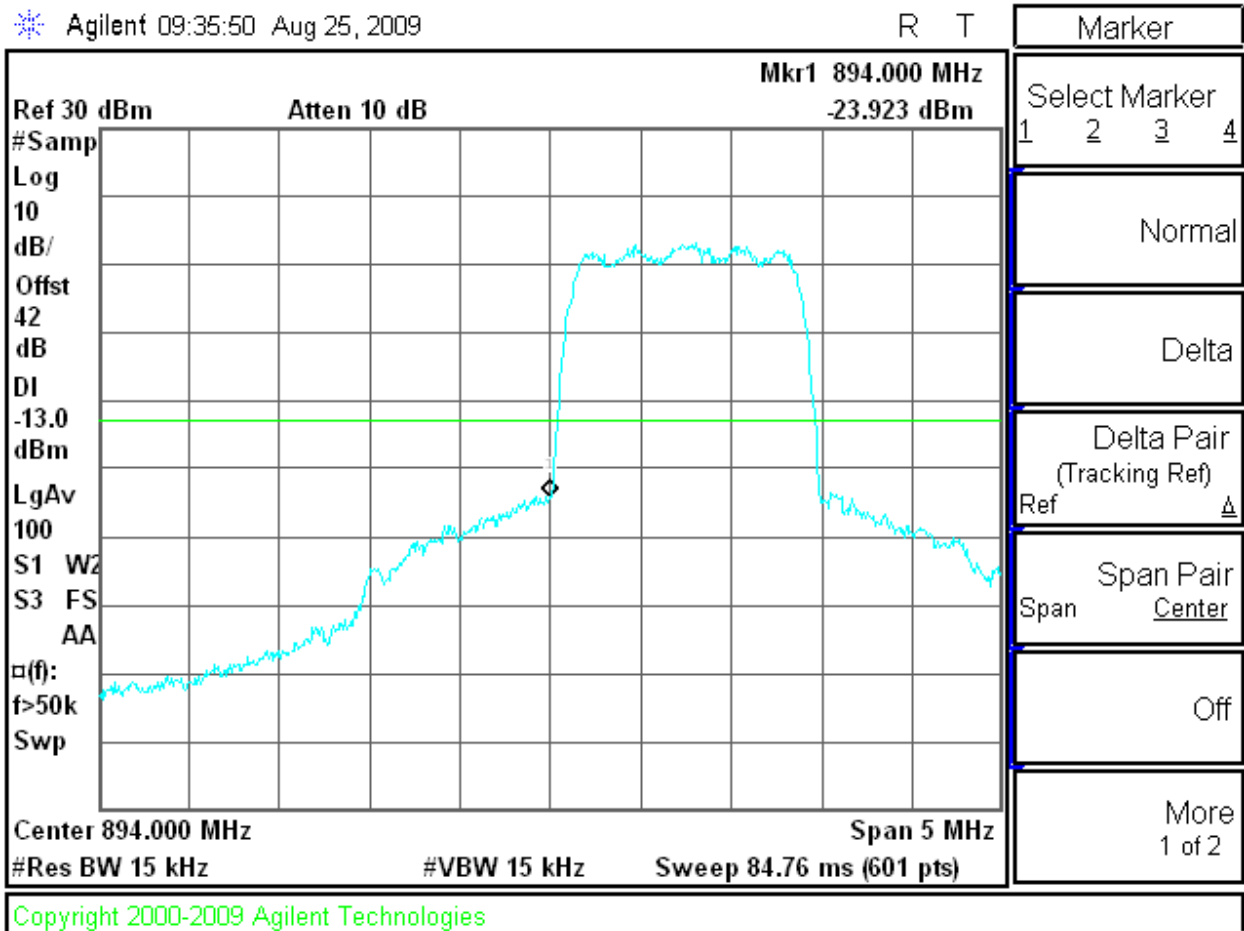
Agilent 10:13:37 Aug 26, 2009

R T



**QPSK MODULATION:**

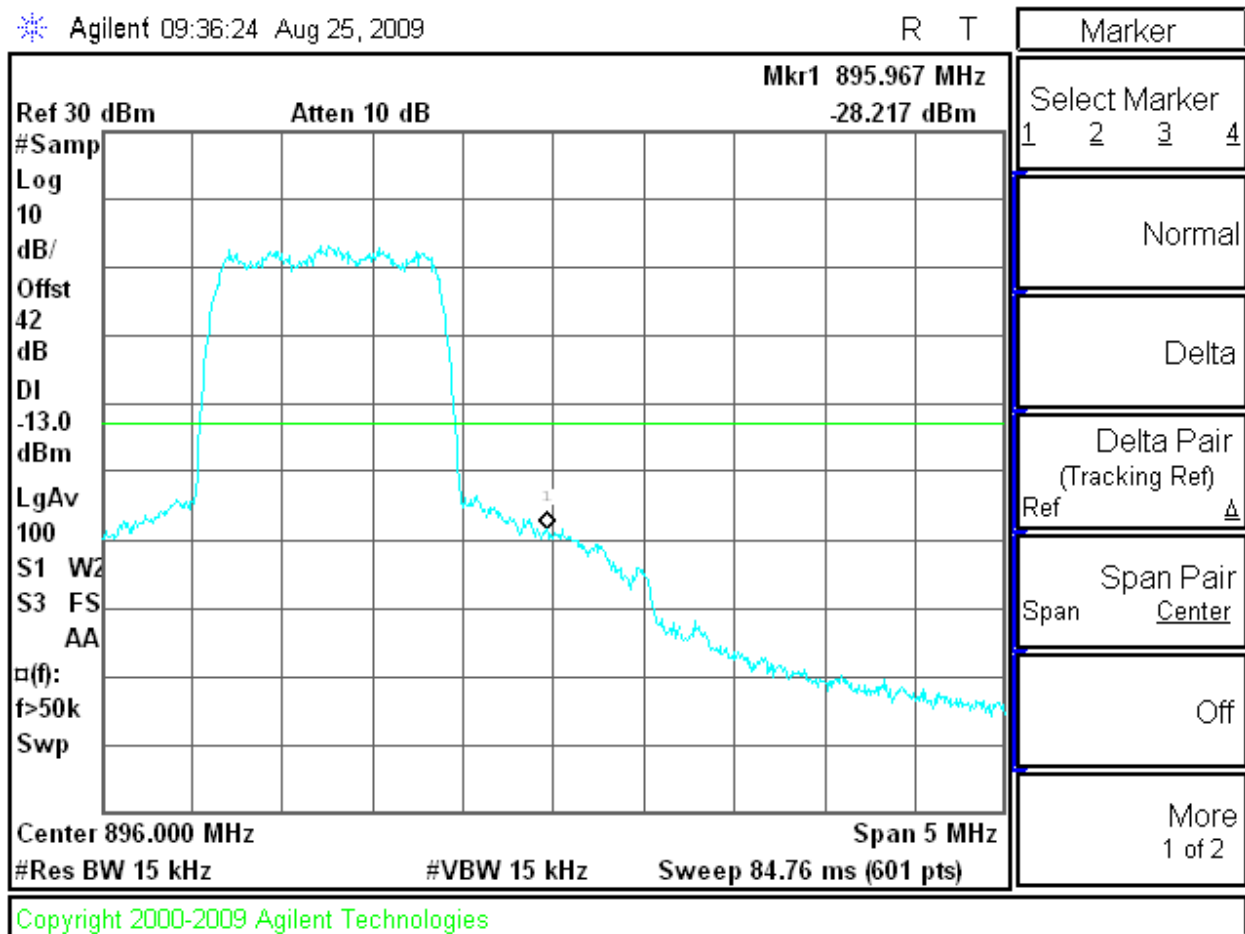
**LOW BANDEGE**



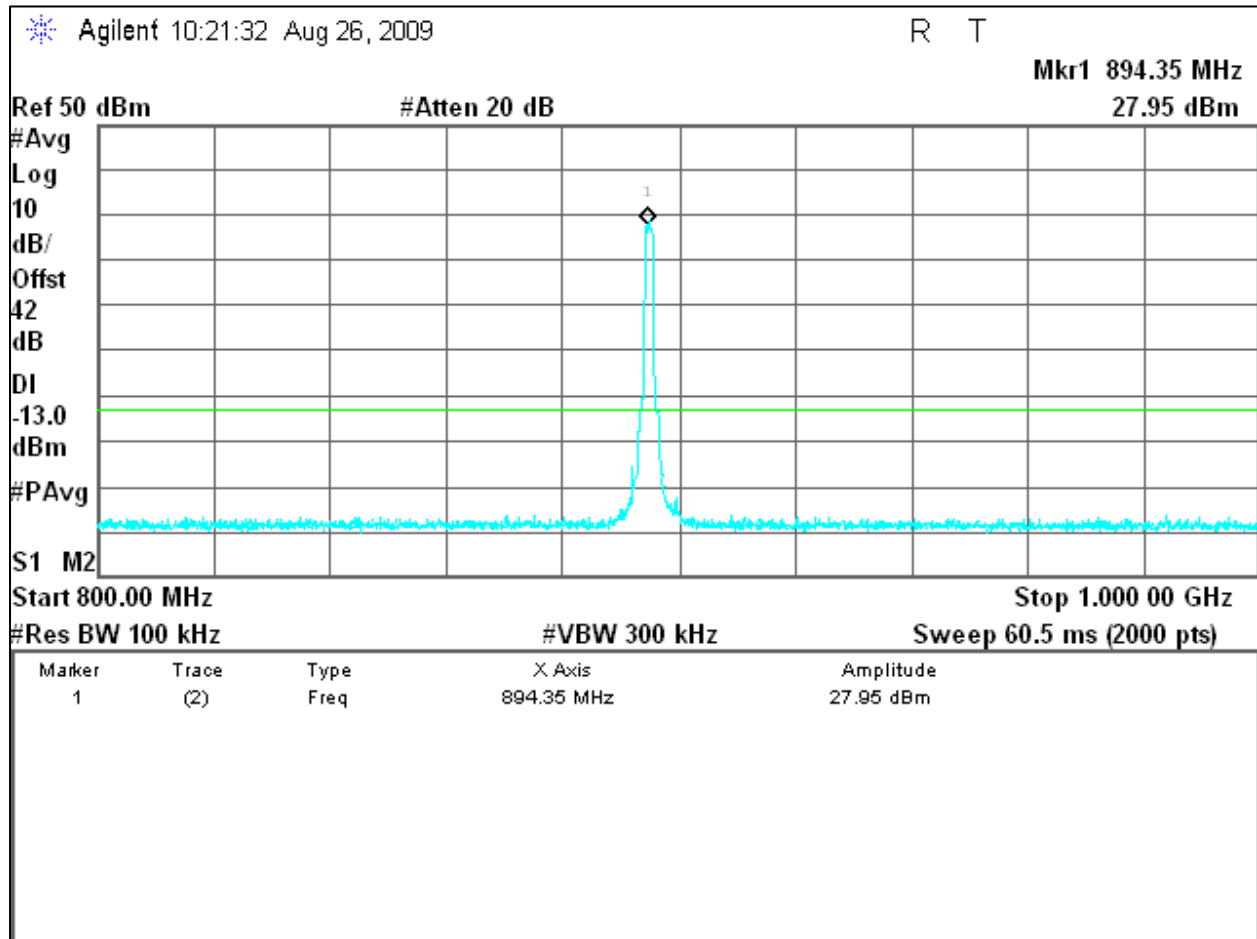
# HIGH BANDEGE

\* Agilent 09:36:24 Aug 25, 2009

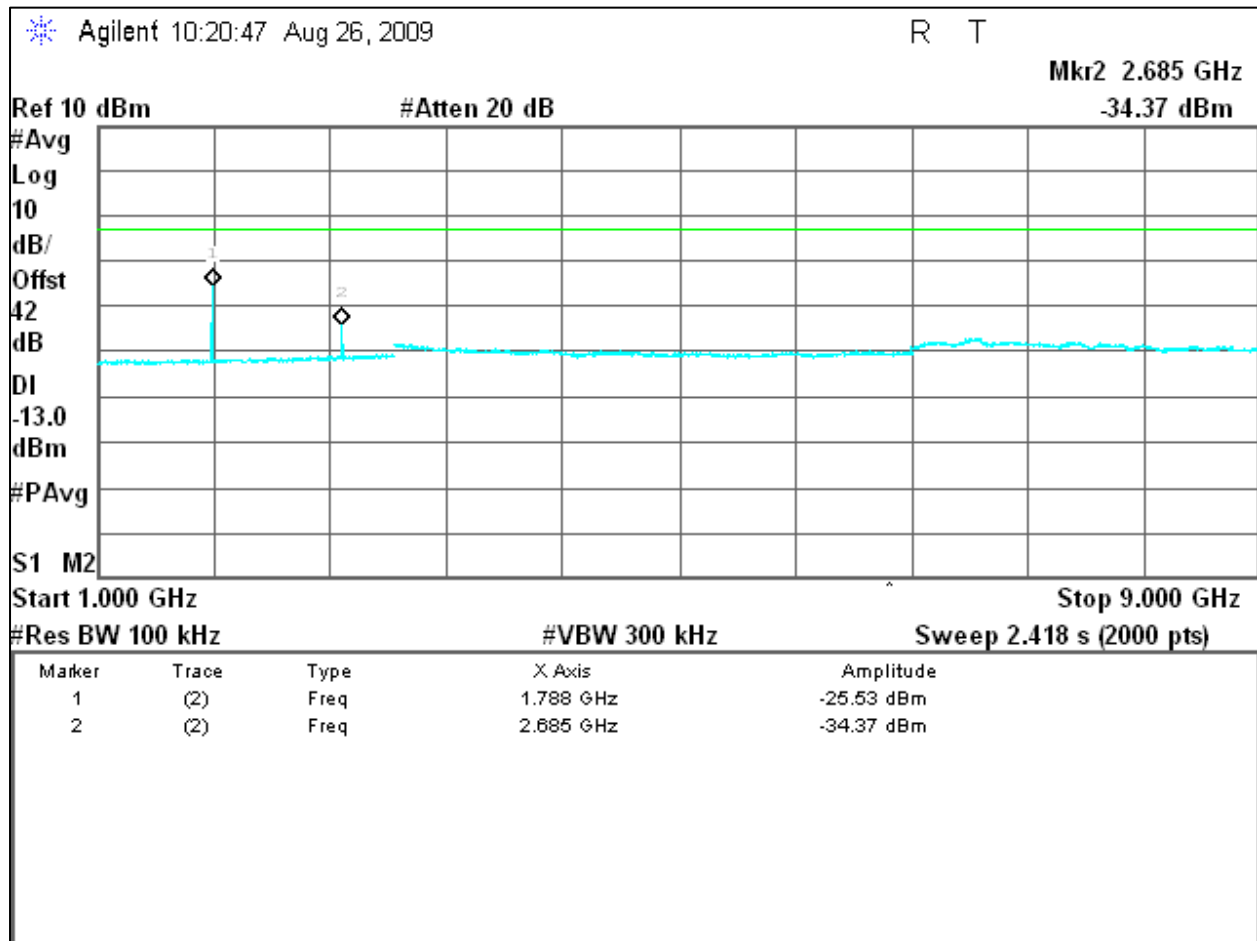
R T



### Out-Of-Band Emissions



# **Out-Of-Band Emissions**



## 6.1.4. FREQUENCY STABILITY

### LIMIT

§22.863 Frequency stability. The frequency stability of equipment used under this subpart shall be sufficient to ensure that, after accounting for Doppler frequency shifts, the occupied bandwidth of the fundamental emissions remains within the authorized frequency bands of operation.

### TEST PROCEDURE

ANSI / TIA / EIA 603C Clause 2.3.1 and 2.3.2

### RESULTS

Reference Frequency: Cellular Mid Channel 894.75000MHz @ 20°C				
Within the authorized frequency bands of operation.				
DC Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	(Hz)	Result
28.00	50	894.750005	-4.60	Within the authorized frequency band
28.00	40	894.750004	-4.30	
28.00	30	894.750008	-8.00	
<b>28.00</b>	<b>20</b>	<b>894.750000</b>	<b>0</b>	
28.00	10	894.750005	-5.00	
28.00	0	894.750006	-5.80	
28.00	-10	894.750009	-9.10	
28.00	-20	894.749992	8.20	
28.00	-30	894.749992	8.10	
Reference Frequency: Cellular Mid Channel 894.750000MHz @ 20°C				
Within the authorized frequency bands of operation.				
DC Power Supply (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	(Hz)	Result
<b>100%</b>	<b>20</b>	<b>894.750000</b>	<b>0</b>	Within the authorized frequency band
85%	20	894.750005	-4.80	
115%	20	894.749996	4.00	



## 7. LIMITS AND RESULTS

### 7.1. RADIATED OUTPUT POWER

#### LIMIT

§ 22.867 Effective radiated power limits. The effective radiated power (ERP) of ground and airborne stations operating on the frequency ranges listed in §22.857 must not exceed the limits in this section.

- (a) The peak ERP of airborne mobile station transmitters must not exceed 12 Watts.
- (b) The peak ERP of ground station transmitters must not exceed 500 Watts.

#### TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 2.2.17

#### RESULTS

894.75MHz

Mode	Frequency (MHz)	ERP Peak Power (dBm)	ERP Peak Power (mW)
8PSK	894.75	38.80	7585.78
BPSK	894.75	38.10	6456.54
QPSK	894.75	38.10	6456.54

**8PSK OUTPUT POWER (ERP)**

High Frequency Substitution Measurement Compliance Certification Services Chamber A							
<b>Company:</b> Aircell <b>Project #:</b> 09U12769 <b>Date:</b> 8/25/2009 <b>Test Engineer:</b> Chin Pang <b>Configuration:</b> EUT with antenna J2 <b>Mode:</b> 8PSK ( Worst Case)							
<b>Test Equipment:</b> Receiving: Sunol T122, and 3m Chamber N-type Cable (Setup this one for testing EUT) Substitution: Dipole S/N: 00022117, 6ft SMA Cable (SN # 208947003) Warehouse.							
f MHz	SA reading (dBm)	Ant. Pol. (H/V)	Path Loss (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
<b>J2 Antenna at Horiz</b>							
894.75	3.9	V	32.1	36.0	40.8	-4.8	
894.75	2.3	H	31.2	33.5	40.8	-7.3	
<b>J2 Antenna at Vert</b>							
894.75	-5.4	V	32.1	26.7	40.8	-14.1	
894.75	7.6	H	31.2	38.8	40.8	-2.0	
Rev. 1.24.7							

**BPSK OUTPUT POWER (ERP)**

High Frequency Substitution Measurement Compliance Certification Services Chamber A							
Company: Aircell							
Project #: 09U12769							
Date: 8/26/2009							
Test Engineer: Chin Pang							
Configuration: EUT with antenna J2 ( worst Case)							
Mode: BPSK							
<b><u>Test Equipment:</u></b>							
Receiving: Sunol T122, and 3m Chamber N-type Cable (Setup this one for testing EUT)							
Substitution: Dipole S/N: 00022117, 6ft SMA Cable (SN # 208947003) Warehouse.							
f MHz	SA reading (dBm)	Ant. Pol. (H/V)	Path Loss (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
<b>J2 Antenna at Horiz</b>							
894.75	5.9	V	32.1	38.1	40.8	-2.7	
894.75	-0.5	H	31.2	30.7	40.8	-10.1	
<b>J2 Antenna at Vert</b>							
894.75	4.5	V	32.1	27.6	40.8	-13.2	
894.75	4.6	H	31.2	35.8	40.8	-5.0	
Rev. 1.24.7							

**QPSK OUTPUT POWER (ERP)**

<b>High Frequency Substitution Measurement  Compliance Certification Services Chamber A</b>							
<b>Company:</b> Aircell <b>Project #:</b> 09U12769 <b>Date:</b> 8/26/2009 <b>Test Engineer:</b> Chin Pang <b>Configuration:</b> EUT with antenna J2 ( Worst Case 0 <b>Mode:</b> QPSK							
<b>Test Equipment:</b> Receiving: Sunol T122, and 3m Chamber N-type Cable (Setup this one for testing EUT) Substitution: Dipole S/N: 00022117, 6ft SMA Cable (SN # 208947003) Warehouse.							
f MHz	SA reading (dBm)	Ant. Pol. (H/V)	Path Loss (dBm)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
J2 Antenna at Horiz							
894.75	6.0	V	32.1	38.1	40.8	-2.7	
894.75	0.6	H	31.2	30.6	40.8	-10.1	
J2 Antenna at Vert							
894.75	-6.7	V	32.1	25.4	40.8	-15.4	
894.75	6.9	H	31.2	38.1	40.8	-2.7	
Rev. 1.24.7							

## **7.2. FIELD STRENGTH OF SPURIOUS EMISSION**

### **LIMIT**

§ 22.861 Emission limitations. The rules in this section govern the spectral characteristics of emissions for commercial aviation systems in the Air-Ground Radiotelephone Service. Commercial aviation air-ground systems may use any type of emission or technology that complies with the technical rules in this subpart.

- (b) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

### **TEST PROCEDURE**

ANSI / TIA / EIA 603 Clause 3.2.13 & 22.861 (b)

### **RESULTS**

Note: No emissions were found within 30-1000MHz & after the third harmonic of 20dB below the system noise.

**Compliance Certification Services**  
Above 1GHz High Frequency Substitution Measurement

---

Company:Aircell  
Project #:09U12769  
Date:8/25/2009  
Test Engineer:Chin Pang  
Configuration:EUT/Antenna  
Mode:TX, 8PSK

Chamber	Pre-amplifier	Filter	Limit
5m Chamber A ▼	T144 8449B ▼	Filter 1 ▼	TX Part 22G ▼

f GHz	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
1.79	-17.0	H	3.0	37.9	38.0	1.0	-16.0	-13.0	-3.0	
2.60	-33.5	H	3.0	40.7	37.4	1.0	-29.2	-13.0	-16.2	
3.58	-66.0	H	3.0	44.7	36.9	1.0	-57.3	-13.0	-44.3	
1.79	-21.1	V	3.0	38.4	38.0	1.0	-19.6	-13.0	-6.6	
2.60	-35.7	V	3.0	42.1	37.4	1.0	-30.0	-13.0	-17.0	
3.58	-66.3	V	3.0	44.6	36.9	1.0	-57.6	-13.0	-44.6	

Rev. 03.03.09  
Note: No other emissions were detected above the system noise floor.

**BPSK, SPURIOUS & HARMONIC (ERP)**

Compliance Certification Services Above 1GHz High Frequency Substitution Measurement										
Company: Aircell Project #: 09U12769 Date: 8/26/2009 Test Engineer: Chin Pang Configuration: EUT and Antenna Mode: BPSK at Antenna J2 ( Worst Case )										
<b>Chamber</b>		<b>Pre-amplifier</b>		<b>Filter</b>		<b>Limit</b>				
5m Chamber A		T144 8449B		Filter 1		TX Part 22G				
f GHz	SA reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Path Loss (dB)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
1.79	-27.8	H	3.0	37.9	38.0	1.0	-26.8	-13.0	-13.8	
2.60	-39.5	H	3.0	40.7	37.4	1.0	-35.3	-13.0	-22.3	
3.58	-58.0	H	3.0	44.7	36.9	1.0	-49.3	-13.0	-36.3	
1.79	-29.0	V	3.0	38.4	38.0	1.0	-27.6	-13.0	-14.6	
2.60	-37.5	V	3.0	42.1	37.4	1.0	-31.8	-13.0	-18.8	
3.58	-65.0	V	3.0	44.6	36.9	1.0	-56.3	-13.0	-43.3	

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Note: No other emissions were detected above the system noise floor.

[illegible]



## 8. MAXIMUM PERMISSIBLE EXPOSURE

### FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
30–300 .....	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## **EQUATIONS**

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * D^2)$$

where

S = Power density in W/m<sup>2</sup>

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m<sup>2</sup> is converted to units of mW/cm<sup>2</sup> by dividing by 10.

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

## **LIMITS**

For radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency, as 894.75 MHz / 300 = 2.9825 mW/cm<sup>2</sup> (FCC).

## **RESULTS**

Band	Mode	FCC Limit (mW/cm <sup>2</sup> )	Output Power (dBm)	Antenna Gain (dBi)	Duty Cycle (%)	Separation Distance (m)
894.75 MHz	8PSK	2.983	40.03	5.80	100	0.32

## 9. SETUP PHOTOS

### RADIATED RF MEASUREMENT SETUP

CONDUCTED MEASUREMENT SETUP



RADIATED FRONT



RADIATED BACK



**END OF REPORT**