

Nemko Korea Co., Ltd.

300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-City, Gyeonggi-Do, KOREA

TEL:+82 31 322 2333

FAX:+82 31 322 2332

FCC EVALUATION REPORT FOR CERTIFICATION

Applicant :**C-motech Co., Ltd.****8,9F Yongsan Bldg. Yoido-dong, Youngdungpo-Gu
Seoul, Korea, (Post code : 150-871)****Dates of Issue : April, 17, 2009****Test Report No. : NK09R045****Test Site : Nemko Korea Co., Ltd.****FCC ID****TARCDU-685****Brand Name****C-motech****C-motech Co., Ltd.****CONTACT PERSON****8,9F Yongsan Bldg, Yoido-dong,
Youngdungpo-gu, Seoul Korea (150-871)
Mr. brian Song
Telephone No. : +82 2 368-9881**

Applied Standard:

FCC 47 CFR Part 2

FCC 47 CFR Part 22H & Part 24E

Classification:

FCC Class B Device

Equipment Class:

Public Mobile Services

EUT Type:

CDMA 1x EVDO USB MODEM

The device bearing the brand name and FCC ID specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2003.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



Tested By : S. Lee
Engineer
Reviewed By : H.H. Kim
Manager & Chief Engineer**C-motech Co., Ltd.****FCC ID :TARCDU-685****Page 1 of 61**

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1. Scope

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC Part 2 & Part 22 & 24.

Responsible Party :	C-motech Co., Ltd.
Contact Person :	Mr. Brian Song Tel No. : +82 2 368 9881
Manufacturer :	C-motech Co., Ltd. 8,9F Yongsan Bldg., Yoido-dog, Youngdungpo-gu, Seoul Korea (150-871)

- FCC ID: TARCDU-685
- Model: CDU-685
- Brand Name: C-motech
- EUT Type: CDMA 1x EVDO USB MODEM
- Electric Rating: +5 Vdc from USB port
- Equipment Class: Public Mobile Service
- Applied Standard: FCC 47 CFR Part & 2
FCC 47 CFR Part 22H &24E
- Test Procedure(s): ANSI C63.4 (2003)
- Dates of Test: April 02, 2009 to April 16, 2009
- Place of Tests: Nemko Korea Co., Ltd.

2. Introduction (Site Description)

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2003) was used in determining radiated and conducted emissions emanating from **C-motech Co., Ltd.**

FCC ID : **TARCDU-685**

These measurement tests were conducted at **Nemko Korea Co., Ltd.**

The site address is 300-2, Osan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, KOREA

The area of Nemko Korea Corporation Ltd. Test site is located in a mountain area at 80 kilometers (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 kilometers (18miles) south-southeast from central Seoul.

It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.

The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 2003.



Nemko Korea Co., Ltd.
300-2, Osan-Ri, Mohyeon-Myeon,
Cheoin-Gu, Yongin-Si, Gyeonggi-Do,
KOREA 449-852
Tel) +82-31-322-2333
Fax) +82-31-322-2332

Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. and Incheon Airport.

3. Test Conditions & EUT Information

Operating During Test

The EUT was tested at the lowest channel, middle channel and the highest channel with maximum RF power and all data were recorded in the report.

Environmental Conditions

Temperature	20℃ ~ 25℃
Relative Humidity	35% ~ 55%

Description of EUT

Frequency Band	Tx	824.70 ~ 848.31MHz 1851.25 ~ 1908.75MHz
	Rx	869.70 ~ 893.31MHz 1931.25 ~ 1988.75MHz
Output Power	Cellular : ERP 0.197 W(22.95dBm) US PCS : EIRP 0.277 W(24.43 dBm)	
Interface	USB port	
Type of Oscillation	PLL Synthesizer & VCTCXO (19.2MHz)	
Modulation Method	Tx : OQPSK / Rx : QPSK	
Emission Designator	1M28F9W	
Number of channels	20CH for CDMA / 48CH for US PCS	
Antenna Type	PIFA Antenna (Internal)	
Dimensions	32.1 mm x 72.1mm x 11.9 mm	
Weight	Approx. 23.2 g	
Operating Conditions	-20℃ ~ +55℃ , 85% at 50℃	
Antenna Length (LXWXH)	25 mm x 19 mm x 5 mm	

4. Measuring Instrument Calibration

All measurements were made with instruments calibrated according to the recommendation by manufacturer. Measurement of radiated emissions and conducted emissions were made with instruments conforming to American National Standards Institute, ANSI C63.4-2003.

The calibration of measuring instrument, including any accessories that may affect test results, were performed according to the recommendation by manufacturer.

- End of page -

5. Summary of Test Results

The EUT has been tested according to the following specification:

Description of Test	FCC Rule	Result
ERP / EIRP Measurement	§2.1046 §22.913(a) §24.232(c)	Complies
Conducted Output Power	§2.1046(a) §22.913(a) §24.232(c)	Complies
Occupied Bandwidth / 26dB Emission Bandwidth	§2.1049(h) (i)	Complies
Spurious Emission at antenna Terminals	§2.1051 §22.917(a) §24.238(a)	Complies
Field Strength of spurious Radiations	§2.1053 §22.917(a) §24.238(a)	Complies
Frequency Stability / Temperature Variation	§2.1055 §22.355 §24.235	Complies
Band Edge	§22.905 §24.229	Complies

6. Recommendation / Conclusion

The data collected shows that the **C-motech Co., Ltd.**

FCC ID : **TARCDU-685, CDMA 1x EVDO USB Modem.**

The highest emission observed was at 2544.93 MHz for radiated emissions with a margin of **8.48 dB**.

7. Sample Calculation

7.1 Radiation for Part 15

$$\text{dB } \mu V = 20 \log_{10} (\mu V/m)$$

$$\mu V = 10^{(\text{dB } \mu V/20)}$$

EX. 1.

@165.0 MHz

Class B limit = 30.0 dB $\mu V/m$

Reading = 38.2 dB μV (calibrated level)

Antenna factor + Cable Loss + Amplifier Gain = -12.9 dB

Total = 25.30 dB $\mu V/m$

Margin = 30.0 – 25.30 = 4.70

4.70 dB below the limit

7.2 Radiation for Part 22 / 24

The formula below was used to calculate the ERP/EIRP of the EUT.

$P_{\text{subst_TX[dBm]}}$, $P_{\text{subst_RX[dBm]}}$, $L_{\text{Cable[dB]}}$ and $G_{\text{substitute_antenna[dBd/dBi]}}$ factors are combined in one correction factor.

$$P_{\text{ERP[W]}} = \frac{10^{(P_{\text{sust_Tx[dBm]}} + P_{\text{EUT[dBm]}} - P_{\text{subst_Rx[dBm]}} + G_{\text{subst_antenna[dBd/dBi]}} - L_{\text{cable[dB]}})/10}}{1000}$$

Where the variables are as follows:

$P_{\text{EUT [dBm]}}$	Measured power level from the EUT
$P_{\text{Subst_TX [dBm]}}$	Power fed to the substituting antenna
$P_{\text{Subst_RX [dBm]}}$	Power received with the spectrum analyzer
$G_{\text{Substitute_antenna [dBd/dBi]}}$	Gain of the substitutive antenna over dipole
$L_{\text{Cable [dB]}}$	Loss of the cable between signal generator and the substituting antenna

8. Test Equipment List

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	Test Receiver	R & S	ESCS 30	833364/020	Mar.28.2009	1year
2	Test Receiver	R & S	ESCS 30	100302	Dec. 04.2008	1year
3	Amplifier	HP	8447F	2805A03427	Jul. 21 2008	1year
4	Amplifier	HP	8447F	2805A03351	Oct. 23 2008	1year
5	Amplifier	HP	8449B	3008A00107	Feb. 12 2009	1year
6	Spectrum Analyzer	Advantest	R3265A	45060401	Nov.12 2008	1year
7	Spectrum Analyzer	Agilent	E4440A	MY44303257	Sep. 03 2008	1year
8	Biconical Log Antenna	ARA	LBP-2520/A	1209	Dec. 08 2008	1year
9	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-474	Jun. 13 2008	1year
10	Biconical Log Anten	ARA	LPB-2520/A	1180	Apr. 21 2008	1year
11	Radio Communication tester	R & S	CMU200	106332	Jan. 22 2009	1year
12	LISN	R & S	ESH3-Z5	833874/006	Nov. 11 2008	1year
13	Position Controller	DAEIL EMC	N/A	N/A	N/A	N/A
14	Turn Table	DAEIL EMC	N/A	N/A	N/A	N/A
15	Antenna Mast	DAEIL EMC	N/A	N/A	N/A	N/A
16	Anechoic Chamber	EM Eng.	N/A	N/A	N/A	N/A
17	Shielded Room	EM Eng.	N/A	N/A	N/A	N/A
18	Position Controller	Inn-co	CO2000	N/A	N/A	N/A
19	Turn Table	Inn-co	DS1200S	N/A	N/A	N/A
20	Antenna Mast	Inn-co	AS2000P	N/A	N/A	N/A
21	Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
22	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-508	Dec. 18 2008	1year
22	Communications Test Set	Agilent	E5515C	GB43193659	May. 20 2008	1year
23	Spectrum Analyzer	Agilent	E4440A	MY44022567	Sep. 09 2008	1year
24	Signal Generator	Agilent	E4438C	MY45092564	Feb. 12 2009	1year
25	Signal Generator	R & S	SMP02	833286/003	Jul. 21 2008	1year

9. Description of Tests

9.1 Effective Radiated Power / Equivalent Isotropic Radiated Power

Test Set-up

Effective Radiated Power Output and Equivalent Isotropic Radiated Power output Measurements by Substitution Method according to ANSI/TIA/EIA-603-A-2003.

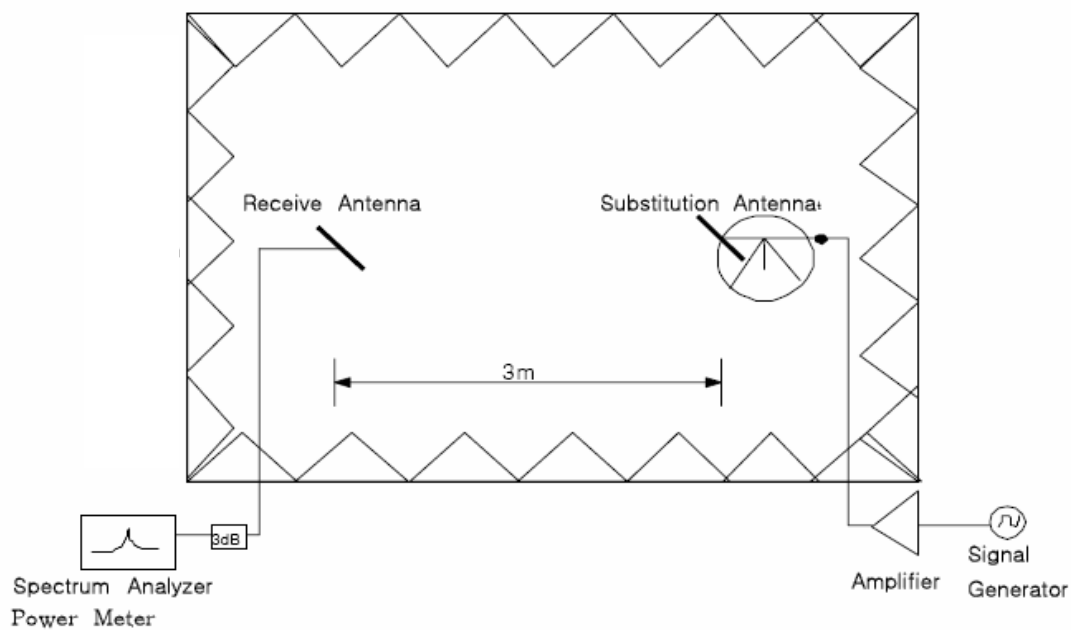


Diagram of ERP/EIRP test Set-up

The EUT was set on a non-conductive turntable in a semi anechoic chamber. In the corner of the chamber there was a communication antenna, which was connected to the BS simulator located outside the chamber. The radiated power from the EUT was measured with an antenna fixed to a antenna tower. The tower and turn table were remotely controlled to turn the EUT and change the antenna polarization. The measured signal was routed from the measuring antenna to the spectrum analyzer. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.

Test Method

- The maximum power level was searched by moving the turn table and measuring antenna and manipulating the EUT. This level (P_{EUT}) was recorded.
- Spectrum analyzer were set to RBW 3 MHz, VBW 3 MHz for measurement.
- The peak detection was used.
- The EUT was replaced with a substituting antenna.
- The substituting antenna was fed with the power (P_{Subst_TX}) giving a convenient reading on the spectrum analyzer. That reading (P_{Subst_RX}) on spectrum analyzer was recorded.

9.2 Radiated Spurious & Harmonic Emission

Test Set-up

Effective Radiated Power Output and Equivalent Isotropic Radiated Power output Measurements by Substitution Method according to ANSI/TIA/EIA-603-A-2003.

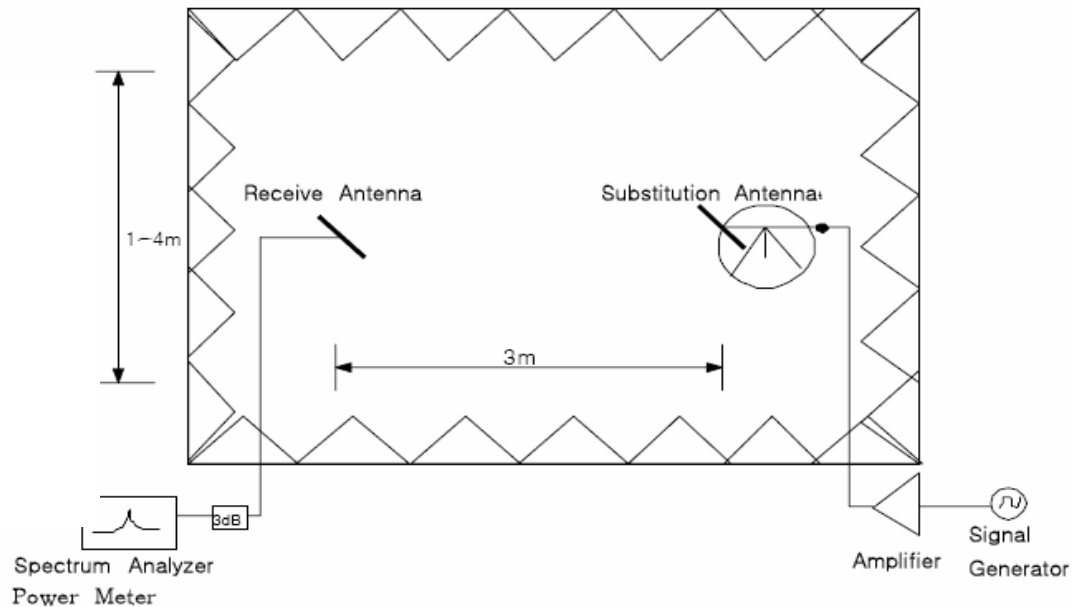


Diagram of Radiated Spurious & Harmonic test Set-up

The EUT was set on a non-conductive turntable in a semi anechoic chamber.

In the corner of the chamber there was a communication antenna, which was connected to the BS simulator located outside the chamber. The radiated power from the EUT was measured with an antenna fixed to a antenna tower.

The tower and turn table were remotely controlled to turn the EUT and change the antenna polarization. The measured signal was routed from the measuring antenna to the spectrum analyzer. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.

The radiated spurious and harmonic emission were measured up to 10th harmonic of the fundamental frequency of operation. 30 MHz~10 GHz for cell and 30 MHz~ 20 GHz for PCS were searched.

Test Method

- The maximum power level was searched by moving the turn table and measuring antenna and manipulating the EUT. This level (P_{EUT}) was recorded.
- For measurements the resolution bandwidth and video bandwidth were set to 100 kHz for emissions below 1GHz and 1 MHz for emissions over 1GHz.
- The peak detection was used.
- The EUT was replaced with a substituting antenna.
- The substituting antenna was fed with the power (P_{Subst_TX}) giving a convenient reading on the spectrum analyzer. That reading (P_{Subst_RX}) on spectrum analyzer was recorded.

9.3 Occupied Bandwidth / 26dB Emission Bandwidth

Occupied Bandwidth

The EUT was setup to maximum output power at its lowest channel. The occupied bandwidth was measured using a spectrum analyzer. The measurements are repeated for the highest and a middle channel.

The EUT's occupied bandwidth is measured as the width of the signal between two points, one below the carrier center frequency and one above the carrier frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Plots of the EUT's occupied bandwidth are shown herein.

26dB Emission Bandwidth

The transmitter output is connected to the spectrum analyzer.

The RBW of spectrum analyzer is set to approximately 1% of the emission bandwidth. And peak detection is used. The emission bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 26 dB.

9.4 Spurious and Harmonic Emissions at Antenna Terminal

9.4.1 Occupied Bandwidth Emission Limits

- a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB.
- b) Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater.
However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 1 % of the emission bandwidth of the fundamental emission of the transmitter may be employed.
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.
- c) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.
- d) The measurement of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

9.4.2 Frequency Bands

BLOCK	Frequency Range (MHz) Transmitter (Tx)	Frequency Range (MHz) Receiver (Rx)
A* Low +A	824 ~ 835	869 ~ 880
B	835 ~ 845	880 ~ 890
A* High	845 ~ 846.5	890 ~ 891.5
B*	846.5 ~ 849	891.5 ~ 894

Table 1. Cellular Service Frequency Blocks

BLOCK	Frequency Range (MHz) Transmitter (Tx)	Frequency Range (MHz) Receiver (Rx)
A	1850 ~ 1865	1930 ~ 1745
B	1870 ~ 1885	1950 ~ 1965
C	1895 ~ 1910	1975 ~ 1990
D	1865 ~ 1870	1945 ~ 1950
E	1885 ~ 1890	1965 ~ 1970
F	1890 ~ 1895	1970 ~ 1975

Table 2. Broadband PCS Service Frequency Blocks

9.4.3 Conducted Spurious Emission

Minimum standard:

On any frequency outside a license frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least $43+10\log(P)$ dB. Limit equivalent to -13 dBm, calculation shown below.

$$43 + 10\log(0.277 \text{ W}) = 37.43 \text{ dB}$$

$$24.43 \text{ dBm} - 37.43 \text{ dB} = -13 \text{ dBm}$$

Compliance with the out-of-band emissions requirement is based on test being performed with an analyzer resolution bandwidth of 1 MHz. However in the 1 MHz band immediately outside and adjacent to the frequency block a resolution bandwidth of at least 1 % of the fundamental emissions bandwidth may be employed.

Test Procedure:

The EUT was setup to maximum output power at its lowest channel.

The Resolution BW of the analyzer is set to 1 % of the emission bandwidth to show compliance with the -13 dBm limit, in the 1 MHz bands immediately outside and adjacent to the edge of the frequency block.

The measurements are repeated for the EUT's highest channel. For the Out-of-Band measurements a 1 MHz RBW was used to scan from 10 MHz to 20 GHz.

A display line was placed at -13 dBm to show compliance. The high, lowest and middle channels were tested for out of band measurements.

Plots are shown.

9.5 Frequency Stability / Temperature Variation

The frequency stability of the transmitter is measured by:

- a) Temperature: The temperature is carried from -30 °C to + 60 °C using an environmental chamber.
- b) Primary Supply Voltage: The primary supply voltage is varied from 85 % to 115 % of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ± 0.00025 % (± 2.5 ppm) of the center frequency.

Time Period and Procedure:

- a) The carrier frequency of the transmitter and the individual oscillators is measured at room temperature (20 °C to 25 °C to provide a reference).
- b) The equipment is subjected to an overnight “soak” at -30 °C without any power applied.
- c) After the overnight “soak” at -30 °C (Usually 14 ~ 16 hours), the equipment is turned on in a “standby” condition for one minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter and the individual oscillators is made within a three minute interval after applying power to the transmitter.
- d) Frequency measurements are made at 10 °C interval up to room temperature. At least a period of one and one half-hour is provided to allow stabilization of the equipment at each temperature level.
- e) Again the transmitter carrier frequency and the individual oscillators is measured at room temperature to begin measurement of the upper temperature levels.
- f) Frequency measurements are at 10 intervals starting at – 30 °C up to + 60 °C allowing at least two hours at each temperature for stabilization. In all measurements the frequency is measured within three minutes after re-applying power to the transmitter.
- g) The artificial load is mounted external to the temperature chamber.

9.6 Output Power Variation

Test Condition to measure the Output Power

This device was tested under all RCs and SOs and worst case is reported with RC3, SO55 with “All Up” power control bits. (MS protocol rev. number 6)

- If the mobile station supports Reverse TCH RC1 and Forward TCH RC 1, set-up a call using Fundamental Channel Test Mode 1 (RC 1/1) with 9600bps data rate only.
- Under RC1 C.S0011, Table 3 parameters were applied.
- If the mobile station supports the RC3 Reverse FCH, RC3 Reverse SCH0 and demodulation of RC3, RC4, RC5, set-up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600bps fundamental channel and 9600bps SCH0 data rate.
- Under RC3 C.S0011, Table 4 was applied.

Parameter	Units	Value
\hat{I}_{or}	dBm/1.23 MHz	-104
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 3 Test Parameters for Maximum RF Output Power for RC 1

Parameter	Units	Value
\hat{I}_{or}	dBm/1.23 MHz	-86
$\frac{\text{Pilot } E_c}{I_{or}}$	dB	-7
$\frac{\text{Traffic } E_c}{I_{or}}$	dB	-7.4

Table 4 Test Parameters for Maximum RF Output Power for RC 3

10. Test Data

10.1 Conducted Output Power

1x RTT Power Measurement

Band	Channel	SO2 (dBm)	SO2 (dBm)	SO2 (dBm)	SO55 (dBm)	SO55 (dBm)	SO9 (dBm)	SO9 (dBm)	SO55 (dBm)	TDSO SO32 FCH Only (dBm)	TDSO SO32 FCH +SCH (dBm)
	F-RC	RC1	RC3	RC4	RC1	RC3	RC2	RC5	RC2	RC3	RC3
	Vocoder Rate	Full	Full	Full	Full	Full	Full	Full	Full	Full	Full
Cellular	1013	23.53	23.50	23.52	23.55	23.50	23.50	23.52	23.51	23.51	23.48
	384	23.50	23.45	23.53	23.58	23.47	23.59	23.51	23.55	23.46	23.51
	777	23.67	23.72	23.58	23.64	23.73	23.57	23.34	23.52	23.78	23.52
PCS	25	23.42	23.32	23.35	23.42	23.35	23.44	23.39	23.43	23.40	23.35
	600	23.35	23.32	23.33	23.47	23.32	23.42	23.47	23.42	23.42	23.42
	1175	23.21	23.20	23.20	23.25	23.24	23.24	23.20	23.25	23.24	23.24

EvDO Rev. 0 Power Measurement

EvDO Rev.0 (dBm) – FTAP Rate = 2Slot Version 307.2 kbps						
Band	RTAP Rate	9.6 kbps	19.2 kbps	38.4 kbps	76.8 kbps	153.6 kbps
	Channel					
Cellular	1013	23.43	23.43	23.45	23.44	23.49
	384	23.43	23.53	23.50	23.50	23.54
	777	23.72	23.66	23.64	23.61	23.64
PCS	25	23.38	23.41	23.35	23.36	23.40
	600	23.28	23.30	23.38	23.36	23.45
	1175	23.29	23.26	23.19	23.20	23.23

EvDO Rev. A Power Measurement

EvDO Rev.A (dBm) – FETAP Rate = 2Slot Version 307.2 kbps													
Band	RETAP Payload	128	256	512	768	1024	1536	2048	3072	4096	6144	8192	12288
	Channel	bits	bits	bits	bits	bits	bits	bits	bits	bits	bits	bits	bits
Cellular	1013	23.62	23.60	23.59	23.50	23.54	23.62	23.58	23.61	23.61	23.54	23.61	23.60
	384	23.55	23.52	23.48	23.47	23.56	23.46	23.51	23.51	23.55	23.53	23.53	23.51
	777	23.62	23.59	23.62	23.60	23.53	23.53	23.52	23.58	23.57	23.51	23.54	23.52
PCS	25	23.60	23.58	23.55	23.55	23.49	23.52	23.38	23.55	23.47	23.41	23.53	23.44
	600	23.46	23.40	23.43	23.38	23.34	23.43	23.46	23.47	23.45	23.48	23.48	23.47
	1175	23.25	23.21	23.25	23.15	23.16	23.25	23.26	23.25	23.17	23.17	23.21	23.12

Note:

For conducted power measurement, connected the EUT to Cell site E5515C directly.
Set the EUT transmit the maximum power at the wanted channel by controlled E5515C.
Using the average power measure function with E5515C, measure the average power

10.2 Effective Radiated Power (ERP)

Measurement Results : Cellular

Mode : 1x RTT

Frequency (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)
824.70	H	H	-18.55	0.00	-39.60	1.00	1.83	20.22	38.45
		V	-20.85	0.00	-39.28	1.00	1.83	17.60	
	E1	H	-17.07	0.00	-39.60	1.00	1.83	21.70	
		V	-16.80	0.00	-39.28	1.00	1.83	21.65	
	E2	H	-15.82	0.00	-39.60	1.00	1.83	22.95	
		V	-19.57	0.00	-39.28	1.00	1.83	18.88	
836.52	H	H	-17.09	0.00	-37.62	1.31	1.72	20.12	38.45
		V	-19.53	0.00	-37.59	1.31	1.72	17.65	
	E1	H	-17.11	0.00	-37.62	1.31	1.72	20.10	
		V	-14.87	0.00	-37.59	1.31	1.72	22.31	
	E2	H	-17.75	0.00	-37.62	1.31	1.72	19.46	
		V	-20.24	0.00	-37.59	1.31	1.72	16.94	
848.31	H	H	-17.99	0.00	-37.99	1.61	1.64	19.97	38.45
		V	-20.24	0.00	-37.91	1.61	1.64	17.64	
	E1	H	-17.26	0.00	-37.99	1.61	1.64	20.70	
		V	-16.07	0.00	-37.91	1.61	1.64	21.81	
	E2	H	-17.71	0.00	-37.99	1.61	1.64	20.25	
		V	-22.88	0.00	-37.91	1.61	1.64	15.00	

Radiated Measurements at 3meters

Mode : EV-DO

Frequency (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)
824.70	H	H	-17.64	0.00	-39.60	1.00	1.83	21.13	38.45
		V	-19.91	0.00	-39.28	1.00	1.83	18.54	
	E1	H	-17.92	0.00	-39.60	1.00	1.83	20.85	
		V	-15.68	0.00	-39.28	1.00	1.83	22.77	
	E2	H	-17.41	0.00	-39.60	1.00	1.83	21.36	
		V	-21.58	0.00	-39.28	1.00	1.83	16.87	
836.52	H	H	-17.16	0.00	-37.62	1.31	1.72	20.05	38.45
		V	-18.91	0.00	-37.59	1.31	1.72	18.27	
	E1	H	-16.96	0.00	-37.62	1.31	1.72	20.25	
		V	-15.07	0.00	-37.59	1.31	1.72	22.11	
	E2	H	-16.38	0.00	-37.62	1.31	1.72	20.83	
		V	-18.48	0.00	-37.59	1.31	1.72	18.70	
848.31	H	H	-18.16	0.00	-37.99	1.61	1.64	19.80	38.45
		V	-20.15	0.00	-37.91	1.61	1.64	17.73	
	E1	H	-18.44	0.00	-37.99	1.61	1.64	19.52	
		V	-16.25	0.00	-37.91	1.61	1.64	21.63	
	E2	H	-17.52	0.00	-37.99	1.61	1.64	20.44	
		V	-18.74	0.00	-37.91	1.61	1.64	19.14	

Radiated Measurements at 3meters

10.3 Equivalent Isotropic Radiated Power (EIRP)

Measurement Results: PCS

Mode : 1x RTT

Frequency (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBi)	L _{Cable} (dB)	EIRP (dBm)	Limit (dBm)
1851.25	H	H	-18.16	0.00	-33.64	10.40	2.69	23.19	33
		V	-19.18	0.00	-33.43	10.40	2.69	21.96	
	E1	H	-24.56	0.00	-33.64	10.40	2.69	16.79	
		V	-19.23	0.00	-33.43	10.40	2.69	21.91	
	E2	H	-17.99	0.00	-33.64	10.40	2.69	23.36	
		V	-20.10	0.00	-33.43	10.40	2.69	21.04	
1880.00	H	H	-16.91	0.00	-33.55	10.43	2.64	24.43	33
		V	-19.86	0.00	-33.55	10.43	2.64	21.48	
	E1	H	-23.43	0.00	-33.55	10.43	2.64	17.91	
		V	-18.26	0.00	-33.55	10.43	2.64	23.08	
	E2	H	-18.44	0.00	-33.55	10.43	2.64	22.90	
		V	-20.47	0.00	-33.55	10.43	2.64	20.87	
1908.75	H	H	-18.20	0.00	-33.42	10.44	2.59	23.07	33
		V	-21.89	0.00	-33.51	10.44	2.59	19.47	
	E1	H	-27.46	0.00	-33.42	10.44	2.59	13.81	
		V	-20.50	0.00	-33.51	10.44	2.59	20.86	
	E2	H	-20.61	0.00	-33.42	10.44	2.59	20.66	
		V	-22.02	0.00	-33.51	10.44	2.59	19.34	

Radiated Measurements at 3meters

Mode : EV-DO

Frequency (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBi)	L _{Cable} (dB)	EIRP (dBm)	Limit (dBm)
1851.25	H	H	-17.82	0.00	-33.64	10.40	2.69	23.53	33
		V	-19.57	0.00	-33.43	10.40	2.69	21.57	
	E1	H	-23.23	0.00	-33.64	10.40	2.69	18.12	
		V	-18.56	0.00	-33.43	10.40	2.69	22.58	
	E2	H	-17.42	0.00	-33.64	10.40	2.69	23.93	
		V	-20.94	0.00	-33.43	10.40	2.69	20.20	
1880.00	H	H	-17.30	0.00	-33.55	10.43	2.64	24.04	33
		V	-20.70	0.00	-33.55	10.43	2.64	20.64	
	E1	H	-22.90	0.00	-33.55	10.43	2.64	18.44	
		V	-18.01	0.00	-33.55	10.43	2.64	23.33	
	E2	H	-17.12	0.00	-33.55	10.43	2.64	24.22	
		V	-19.63	0.00	-33.55	10.43	2.64	21.71	
1908.75	H	H	-18.29	0.00	-33.42	10.44	2.59	22.98	33
		V	-22.42	0.00	-33.51	10.44	2.59	18.94	
	E1	H	-26.58	0.00	-33.42	10.44	2.59	14.69	
		V	-20.00	0.00	-33.51	10.44	2.59	21.36	
	E2	H	-18.92	0.00	-33.42	10.44	2.59	22.35	
		V	-23.87	0.00	-33.51	10.44	2.59	17.49	

Radiated Measurements at 3meters

10.4 Occupied Bandwidth / 26dB Emission Bandwidth

Measurement Results : Cellular

Channel	Frequency (MHz)	Occupied BW (MHz)	26dB Emission BW (MHz)
1013	824.70	1.2721	1.425
384	836.52	1.2787	1.439
777	848.31	1.2762	1.435

Measurement Results : PCS

Channel	Frequency (MHz)	Occupied BW (MHz)	26dB Emission BW (MHz)
25	1851.25	1.2751	1.440
600	1880.00	1.2815	1.441
1175	1908.75	1.2782	1.432

10.5 Radiated Spurious & Harmonic Emission (Cellular)

Measurement Results:

CH1013 (824.70MHz)

Freq. (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1649.40	H	H	-32.77	0.00	-1.12	7.51	2.39	-26.53	-13	13.53
2474.10	H	H	-33.57	0.00	-2.89	8.34	2.80	-25.14	-13	12.14
3298.80	E2	V	-42.44	0.00	-4.14	10.38	3.57	-31.49	-13	18.49
4123.50	E1	V	-63.68	0.00	-8.36	10.51	4.02	-48.83	-13	35.83
4948.20	H	H	-64.37	0.00	-9.98	10.48	4.49	-47.93	-13	34.93
5772.90	E2	V	-65.62	0.00	-10.54	10.95	5.00	-49.13	-13	36.13
8247.00	E1	V	-62.67	0.00	-17.35	9.72	5.81	-41.41	-13	28.41

CH384 (836.52MHz)

Freq. (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1673.04	H	H	-29.24	0.00	-1.08	7.62	2.42	-22.96	-13	9.96
2509.56	H	H	-30.86	0.00	-3.12	8.42	2.81	-22.13	-13	9.13
3346.08	E2	V	-42.01	0.00	-3.97	10.58	3.56	-31.02	-13	18.02
4182.60	E1	V	-62.24	0.00	-8.32	10.54	4.12	-47.50	-13	34.50
5019.12	E1	V	-62.52	0.00	-9.31	10.52	4.46	-47.15	-13	34.15

CH777 (848.31MHz)

Freq. (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
1696.62	E2	H	-30.55	0.00	-1.04	7.73	2.44	-24.22	-13	11.22
2544.93	H	V	-30.16	0.00	-3.01	8.50	2.83	-21.48	-13	8.48
3393.24	E1	V	-44.78	0.00	-3.80	10.78	3.55	-33.75	-13	20.75
4241.55	E2	V	-56.12	0.00	-8.24	10.55	4.15	-41.48	-13	28.48
5089.86	E2	V	-62.83	0.00	-9.19	10.59	4.43	-47.48	-13	34.48
5938.17	E1	H	-65.30	0.00	-11.10	10.88	5.07	-48.39	-13	35.39
6786.48	E1	V	-65.27	0.00	-13.07	10.17	5.25	-47.28	-13	34.28
7634.79	E1	V	-62.31	0.00	-17.53	9.31	5.61	-41.08	-13	28.08
8483.10	E1	V	-62.67	0.00	-17.02	9.74	5.89	-41.80	-13	28.80

Note: All modes of operation were investigated and the worst-case emissions are reported.

10.6 Radiated Spurious & Harmonic Emission (PCS)

Measurement Results :

CH25 (1851.25MHz)

Freq. (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
3702.50	E1	V	-51.65	0.00	-11.35	12.66	3.79	-31.43	-13	18.43
5553.75	E1	H	-56.68	0.00	-9.55	13.15	4.67	-38.65	-13	25.65
7405.00	E1	V	-60.65	0.00	-17.33	11.02	5.43	-37.73	-13	24.73
9256.25	E1	V	-61.19	0.00	-19.21	11.70	6.11	-36.39	-13	23.39
11107.50	E1	V	-63.29	0.00	-24.01	11.67	6.67	-34.28	-13	21.28

CH600 (1880.00MHz)

Freq. (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
3760.00	E1	V	-55.72	0.00	-10.63	12.71	3.84	-36.22	-13	23.22
5640.00	E1	H	-59.77	0.00	-9.87	13.14	4.72	-41.48	-13	28.48
7520.00	E1	V	-55.56	0.00	-17.45	11.28	5.54	-32.37	-13	19.37
9400.00	E1	V	-54.42	0.00	-19.32	11.59	5.77	-29.28	-13	16.28
11280.00	E1	V	-57.48	0.00	-23.61	11.92	6.68	-28.63	-13	15.63

CH1175 (1908.75MHz)

Freq. (MHz)	EUT Pol.	Ant. Pol.	P _{EUT} (dBm)	P _{TX} (dBm)	P _{RX} (dBm)	G _{antenna} (dBd)	L _{Cable} (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)
3817.50	E1	V	-61.29	0.00	-9.51	12.74	3.87	-42.91	-13	29.91
5726.25	E1	V	-56.58	0.00	-10.17	13.11	4.91	-38.21	-13	25.21
7635.00	E1	V	-52.25	0.00	-17.53	11.46	5.61	-28.87	-13	15.87
9543.75	E1	V	-48.94	0.00	-19.50	11.84	5.84	-23.44	-13	10.44
11452.50	E1	V	-58.38	0.00	-23.49	12.18	6.66	-29.37	-13	16.37
15270.00	E2	H	-66.06	0.00	-26.50	12.99	7.36	-33.93	-13	20.93

Note: All modes of operation were investigated and the worst-case emissions are reported.

10.7 Frequency Stability / Temperature Variation (Cellular)

Test channel : Middle channel (836.52 MHz)

Standard test voltage : 5 Vdc

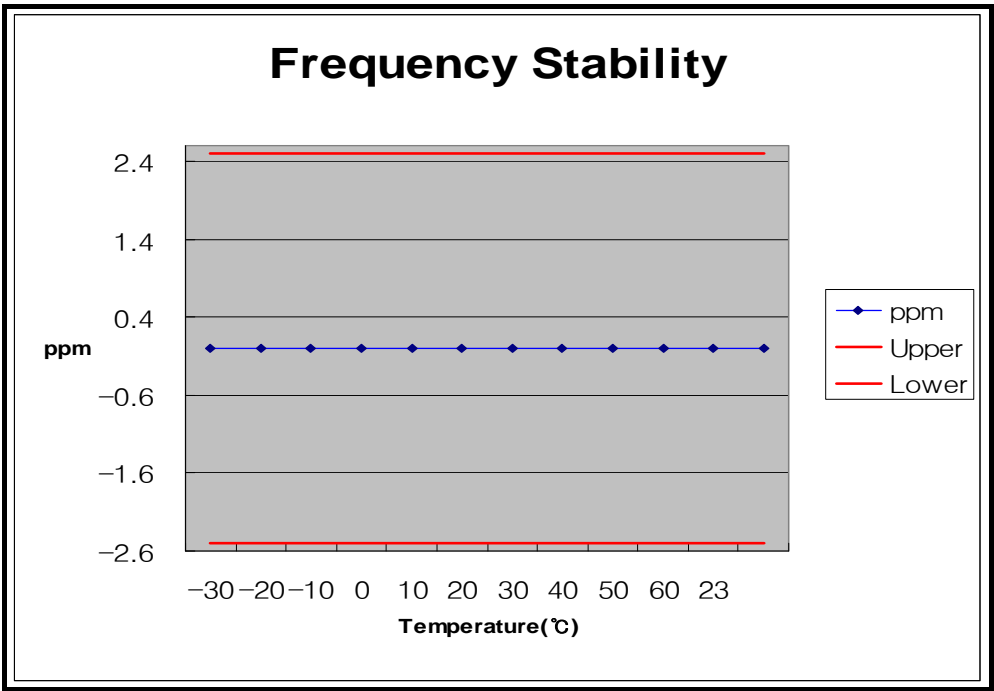
Deviation Limit : ± 2.5 ppm

Measurement Result :

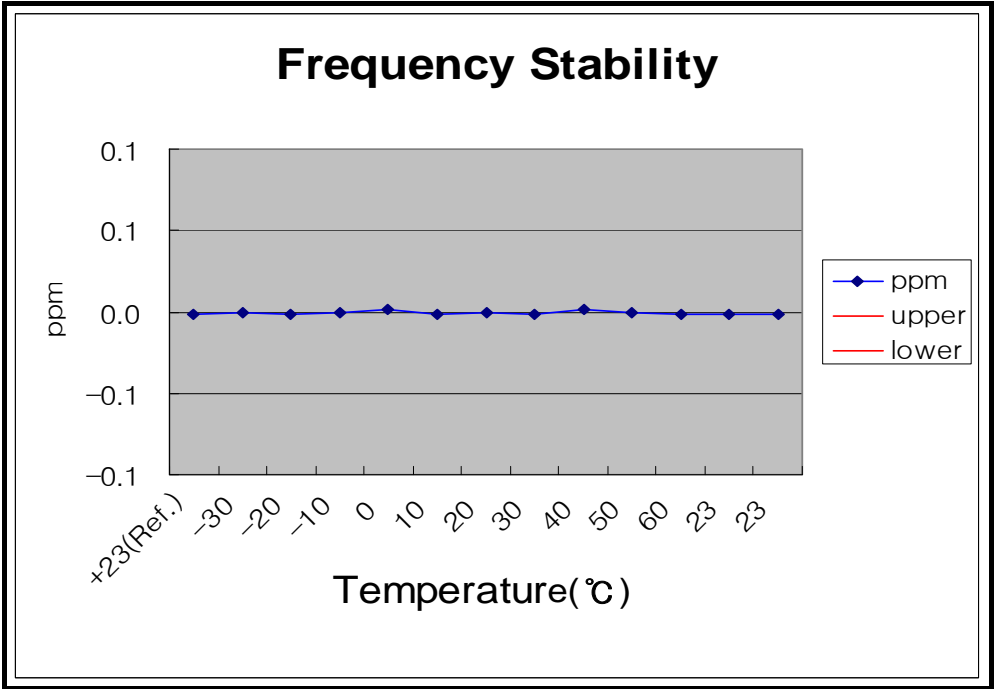
Voltage (%)	Power (Vdc)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	ppm
100%	5.00	+23(Ref.)	836,519,999	-1	-0.0012
100%		-30	836,520,000	0	0.0000
100%		-20	836,519,999	-1	-0.0012
100%		-10	836,520,000	0	0.0000
100%		0	836,520,001	1	0.0012
100%		10	836,519,999	-1	-0.0012
100%		20	836,520,000	0	0.0000
100%		30	836,519,999	-1	-0.0012
100%		40	836,520,001	1	0.0012
100%		50	836,520,000	0	0.0000
100%		60	836,519,999	-1	-0.0012
85%	4.25	23	836,519,999	-1	-0.0012
115%	5.75	23	836,519,999	-1	-0.0012

*The temperature is varied from -30°C to +60°C using an environmental chamber.

Frequency Stability Graph (Cellular)



Zoom In



10.8 Frequency Stability / Temperature Variation (PCS)

Test channel : Middle channel (1880.00 MHz)

Standard test voltage : 5 Vdc

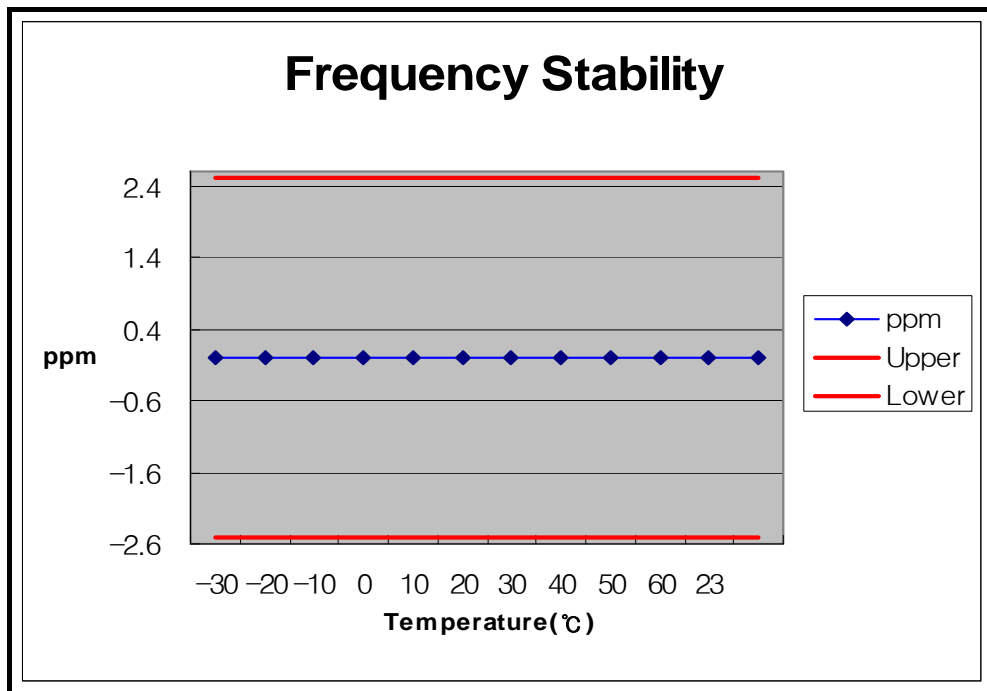
Deviation Limit : $\pm 2.5\text{ppm}$

Measurement Result :

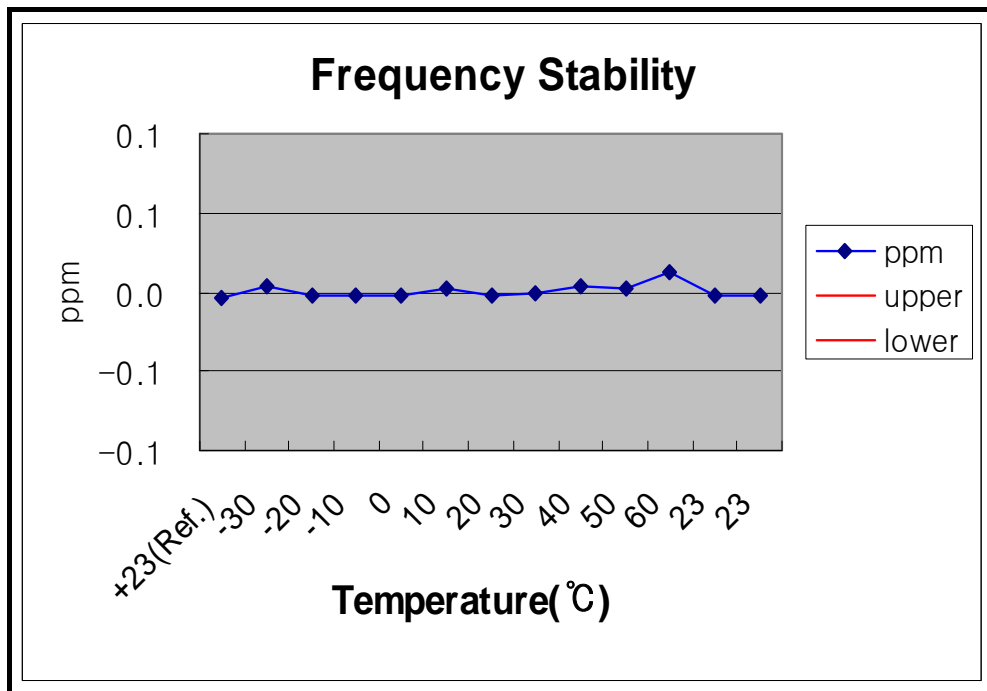
Voltage (%)	Power (Vdc)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	ppm
100%	5.00	+23(Ref.)	1,879,999,993	-7	-0.0037
100%		-30	1,880,000,008	8	0.0043
100%		-20	1,879,999,996	-4	-0.0021
100%		-10	1,879,999,995	-5	-0.0027
100%		0	1,879,999,996	-4	-0.0021
100%		10	1,880,000,003	3	0.0016
100%		20	1,879,999,997	-3	-0.0016
100%		30	1,880,000,000	0	0.0000
100%		40	1,880,000,006	6	0.0032
100%		50	1,880,000,004	4	0.0021
100%		60	1,880,000,025	25	0.0133
85%	4.25	23	1,879,999,997	-3	-0.0016
115%	5.75	23	1,879,999,995	-5	-0.0027

*The temperature is varied from -30°C to +60°C using an environmental chamber.

Frequency Stability Graph (PCS)



Zoom In



11. ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 with the confidence level of 95%

1. Radiation Uncertainty Calculation

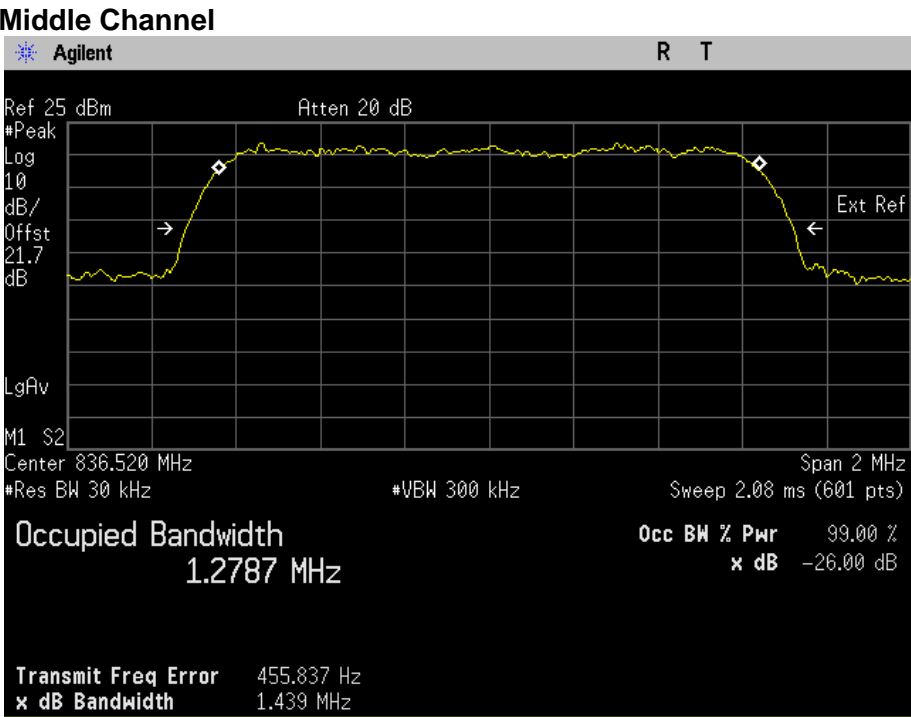
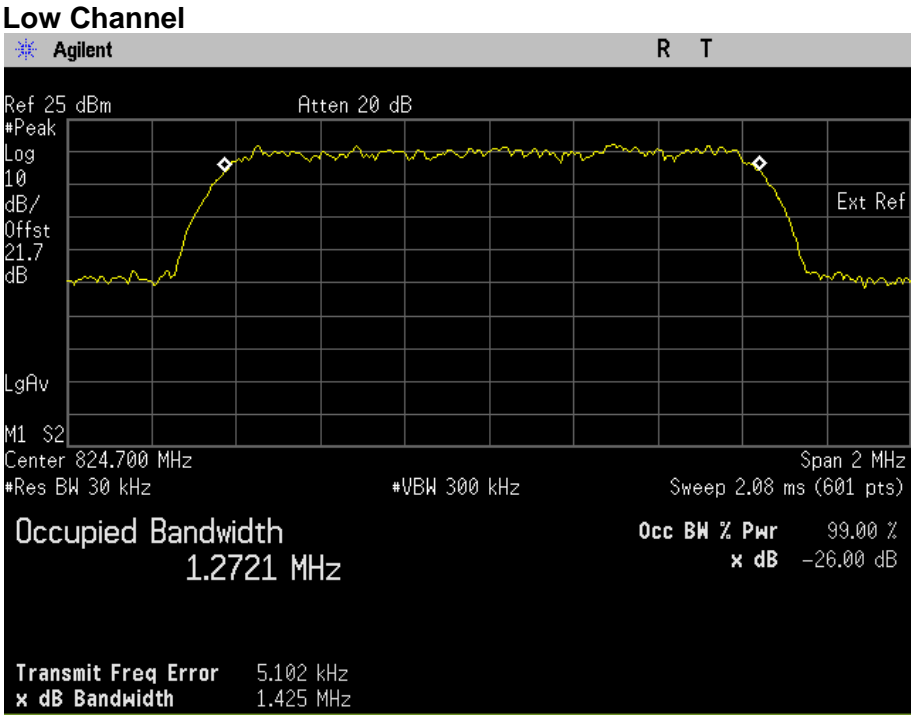
<i>Contribution</i>	<i>Probability Distribution</i>	<i>Uncertainty(+/-dB)</i>
Antenna Factor	Normal (k=2)	± 0.5
Cable Loss	Normal (k=2)	± 0.04
Receiver Specification	Rectangular	± 2.0
Antenna directivity	Rectangular	± 1.0
Antenna Factor variation with Height		
Antenna Phase Center Variation		
Antenna Factor Frequency Interpolation		
Measurement Distance Variation		
Site Imperfections	Rectangular	± 2.0
Mismatch:Receiver VRC $r_i=0.3$ Antenna VRC $r_R=0.1(B_i)0.4(L_p)$ Uncertainty Limits $20\text{Log}(1+/-r_i r_R)$	U-Shaped	$+ 0.25 / - 0.26$
System Repeatibility	Std.deviation	± 0.05
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	± 1.77
Expended Uncertainty U	Normal (k=2)	± 3.5

2. Conducted Uncertainty Calculation

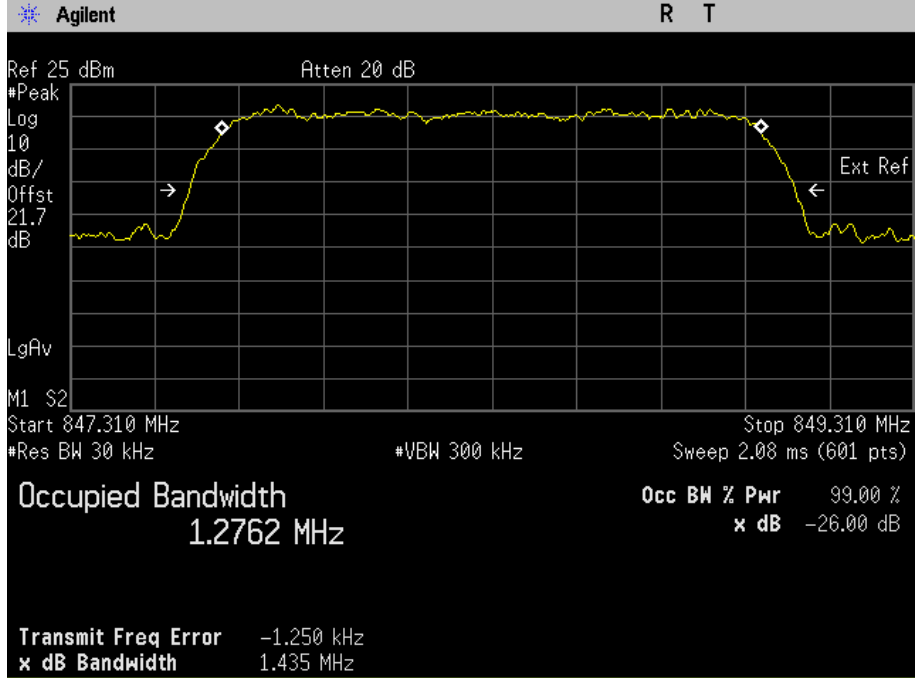
<i>Contribution</i>	<i>Probability Distribution</i>	<i>Uncertainty(+/-dB)</i>
Receiver Specification	Normal (k=2)	± 2.0
LISN coupling spec.	Normal (k=2)	± 0.4
Cable and input attenuator cal.	Rectangular	± 0.4
Mismatch:Receiver VRC $r_i=0.3$ LISN vrc $r_g=0.1$ Uncertainty Limits $20\text{Log}(1+/-r_i r_R)$	U-Shaped	± 0.26
System Repeatibility	Std.deviation	± 0.68
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	± 1.18
Expended Uncertainty U	Normal (k=2)	± 2.4

12. Test Plots (Cellular)

● Occupied Bandwidth / 26dB Bandwidth

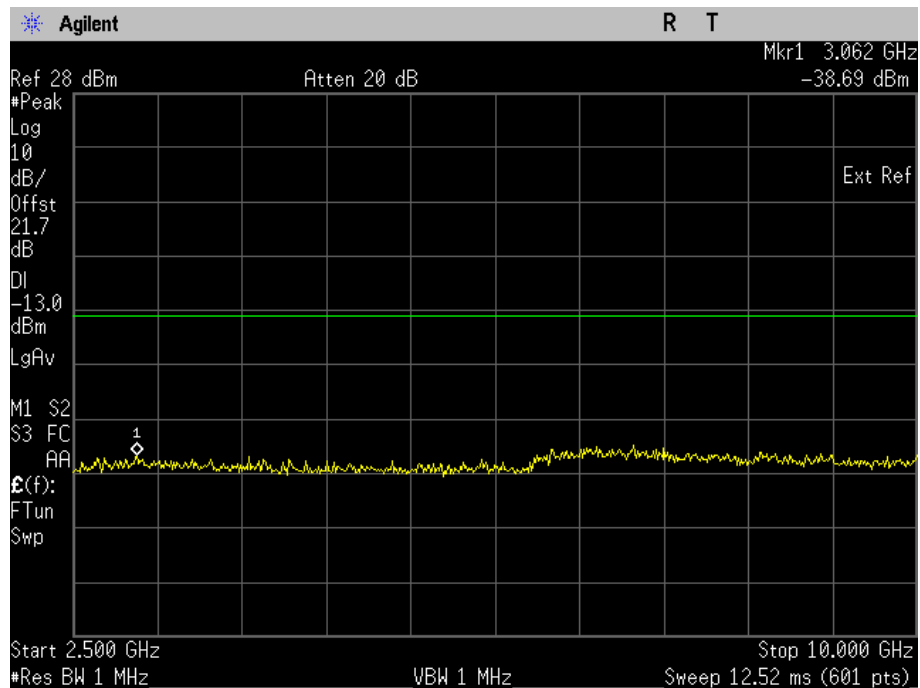
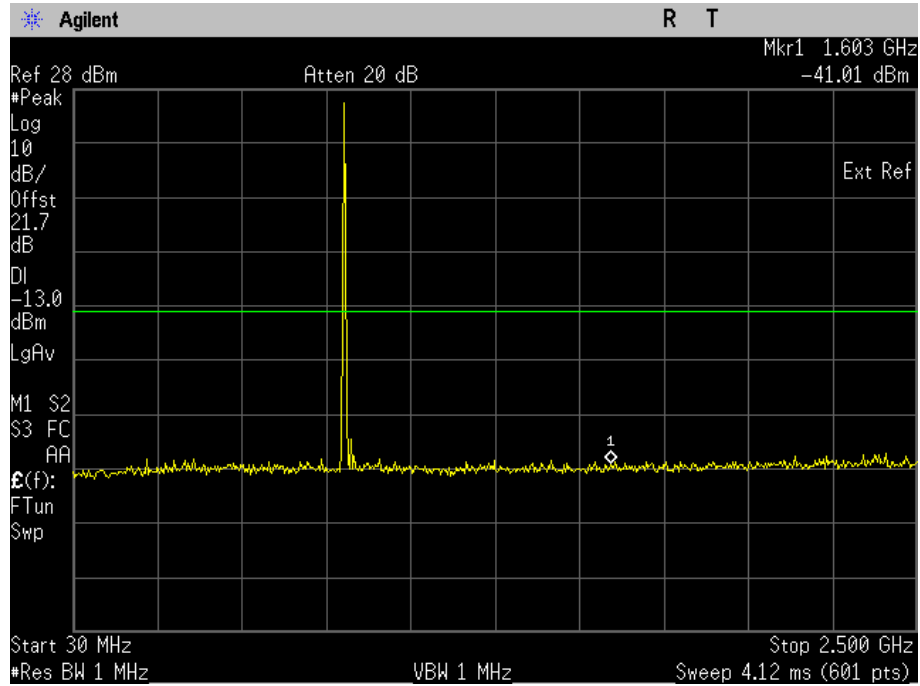


High Channel

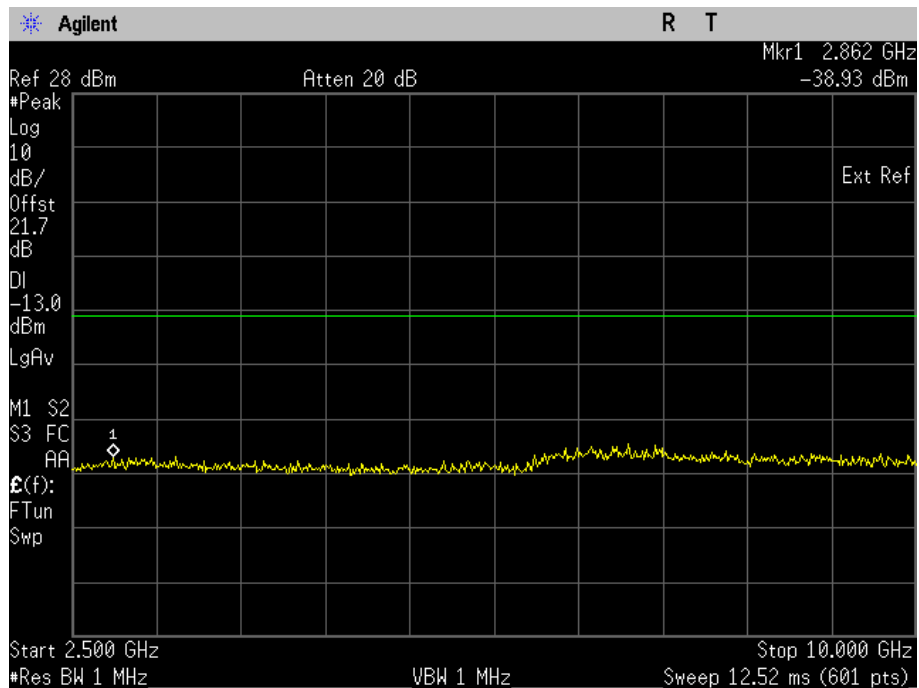
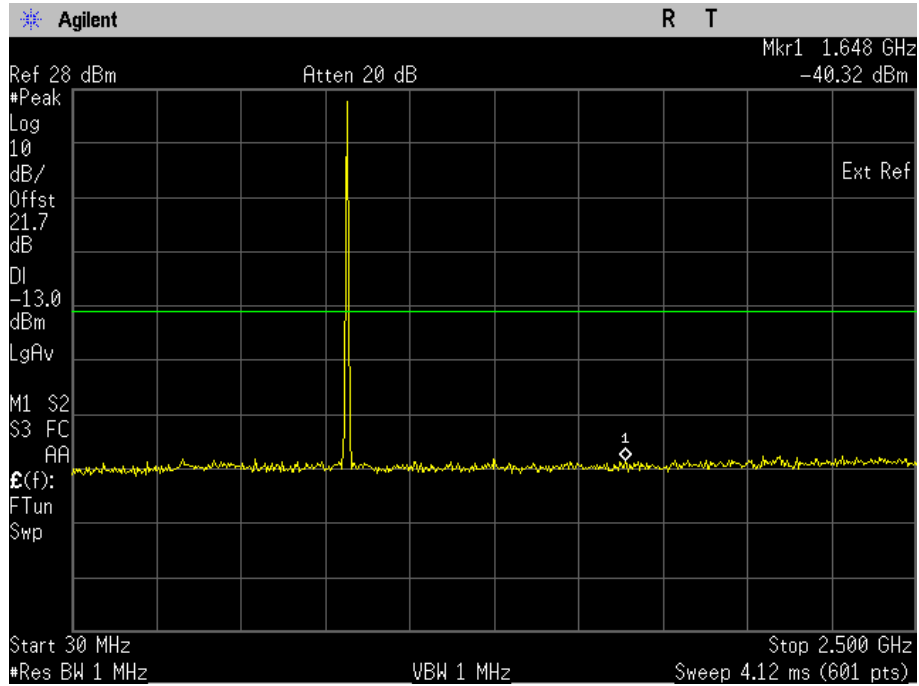


● Spurious Emission at antenna Terminals

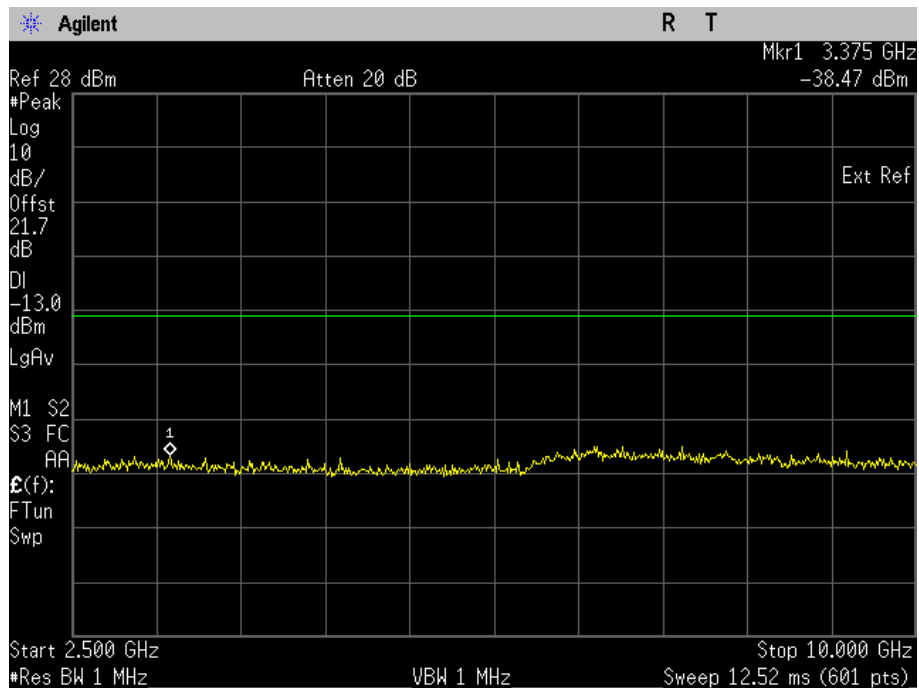
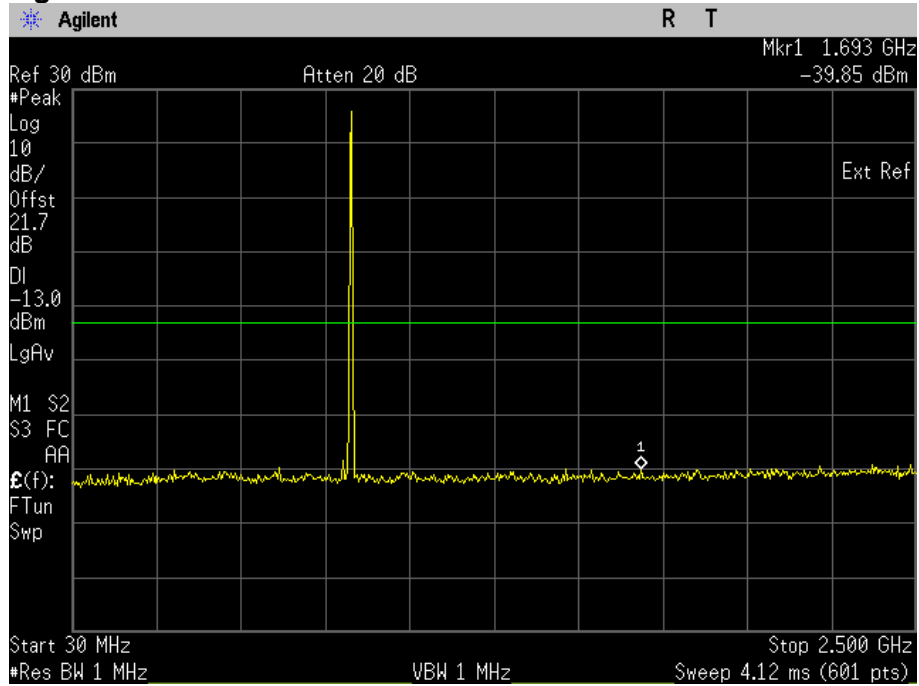
Low Channel



Middle Channel

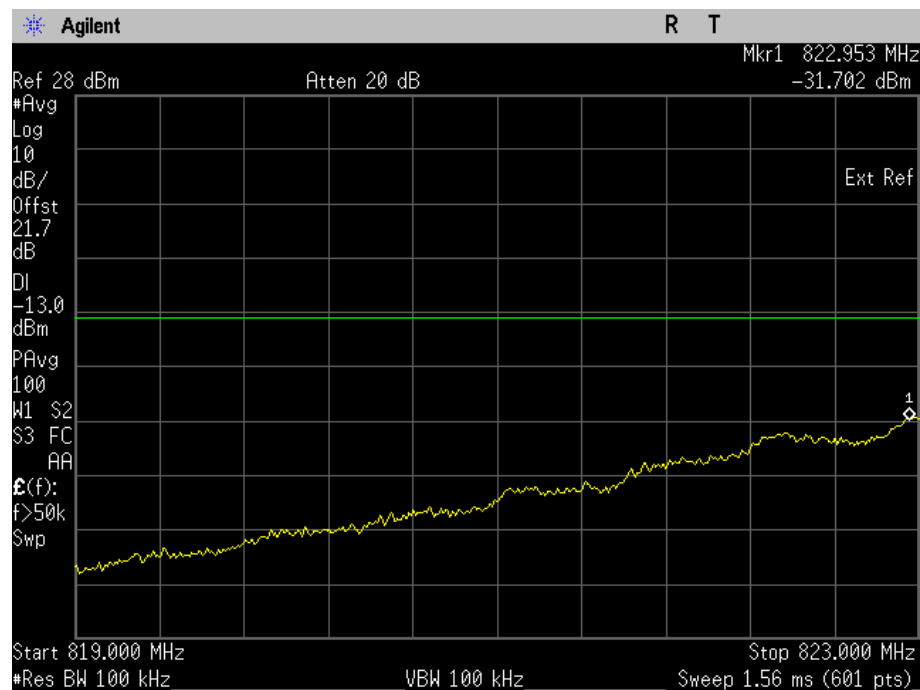
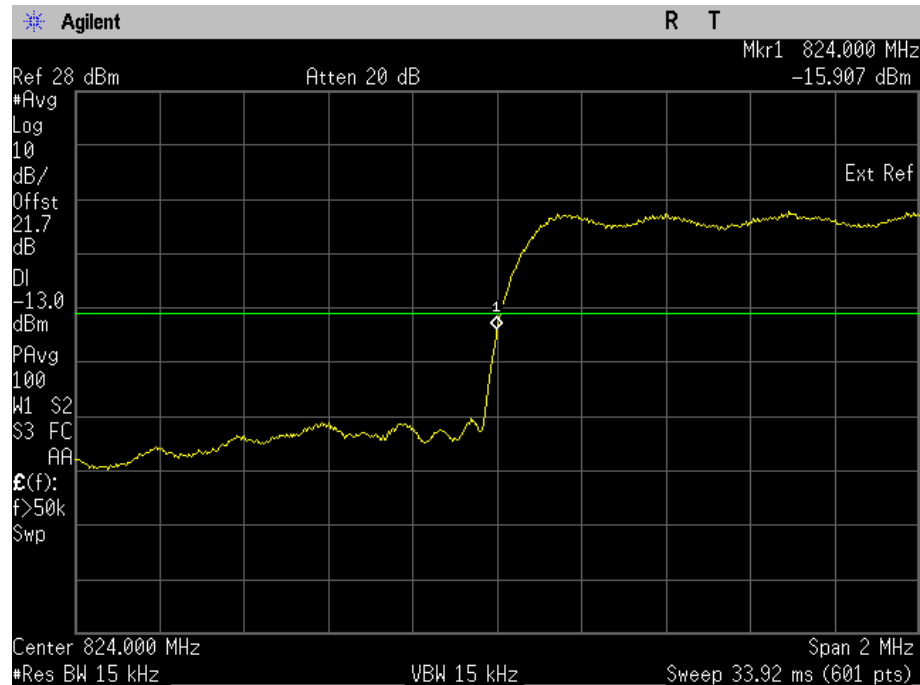


High Channel

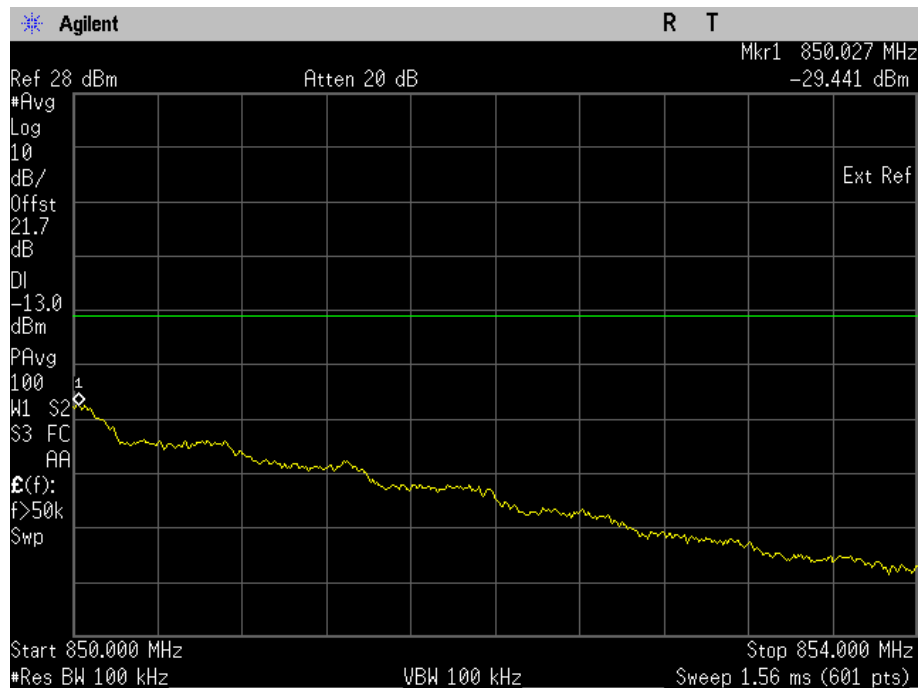
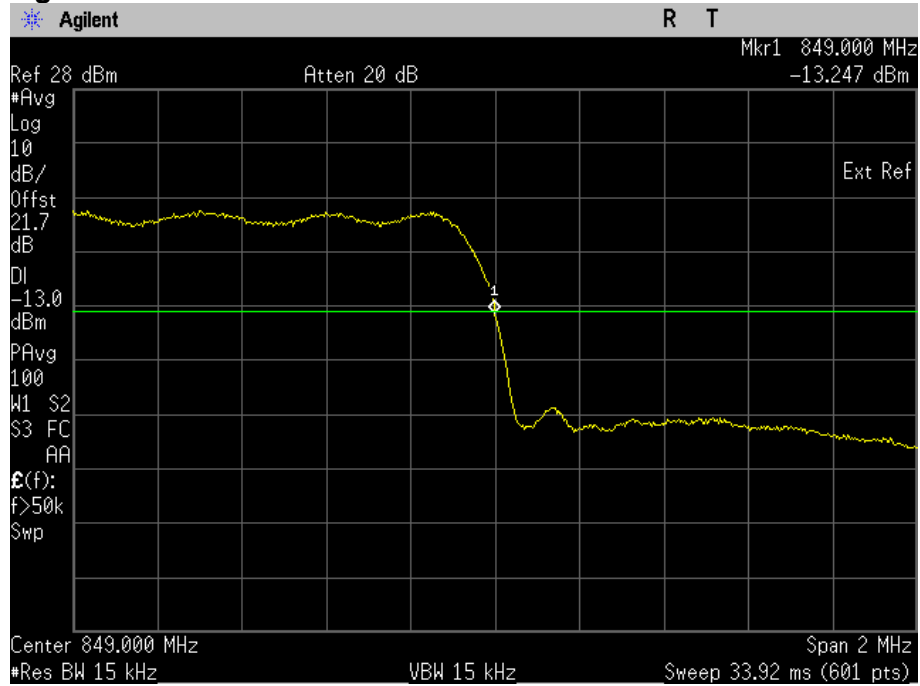


- **Band Edge**

Low Channel



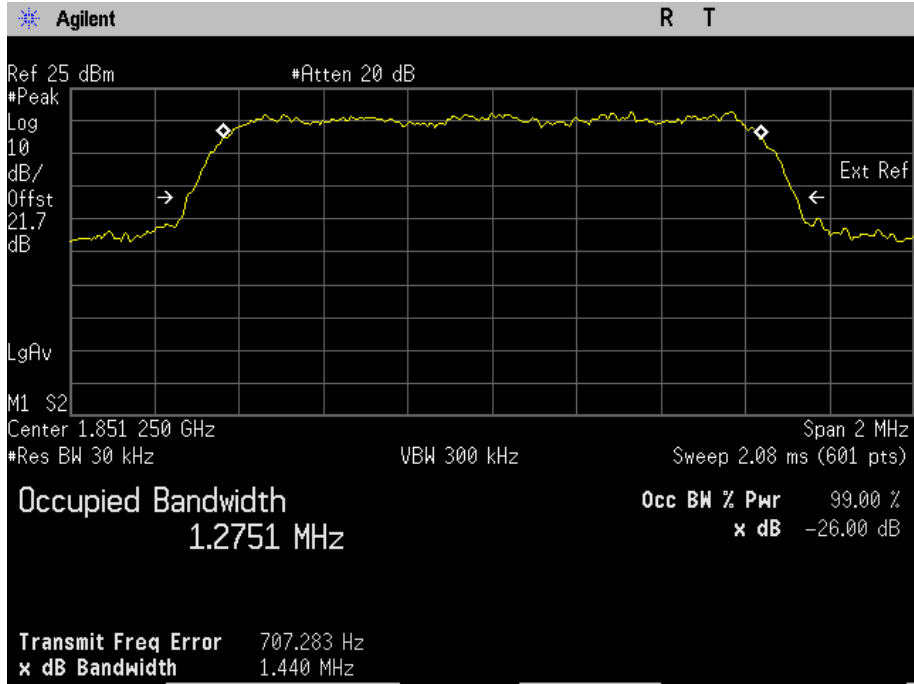
High Channel



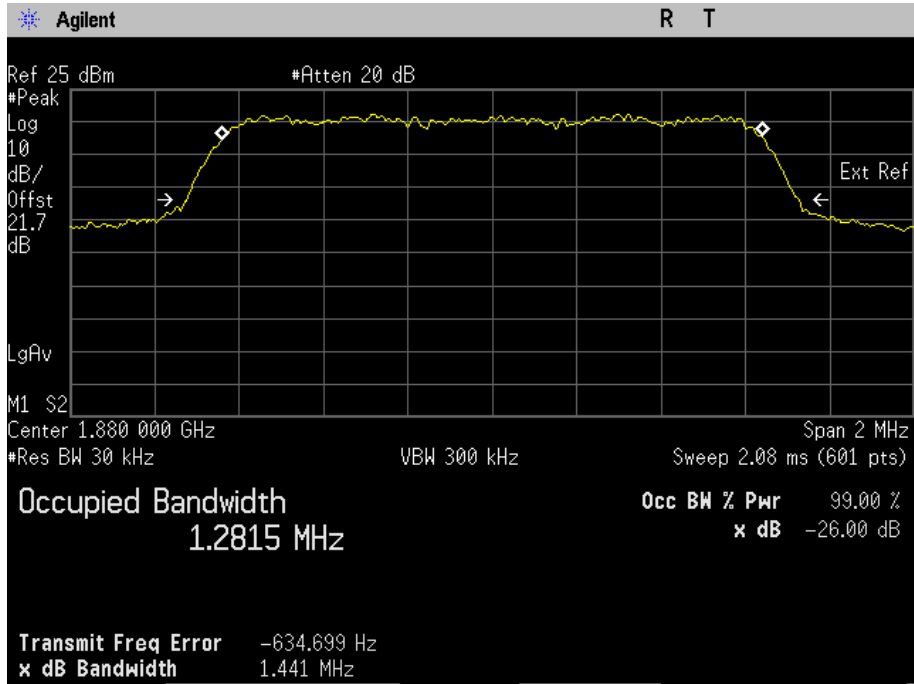
13. Test Plots (US PCS)

● Occupied Bandwidth / 26dB Bandwidth

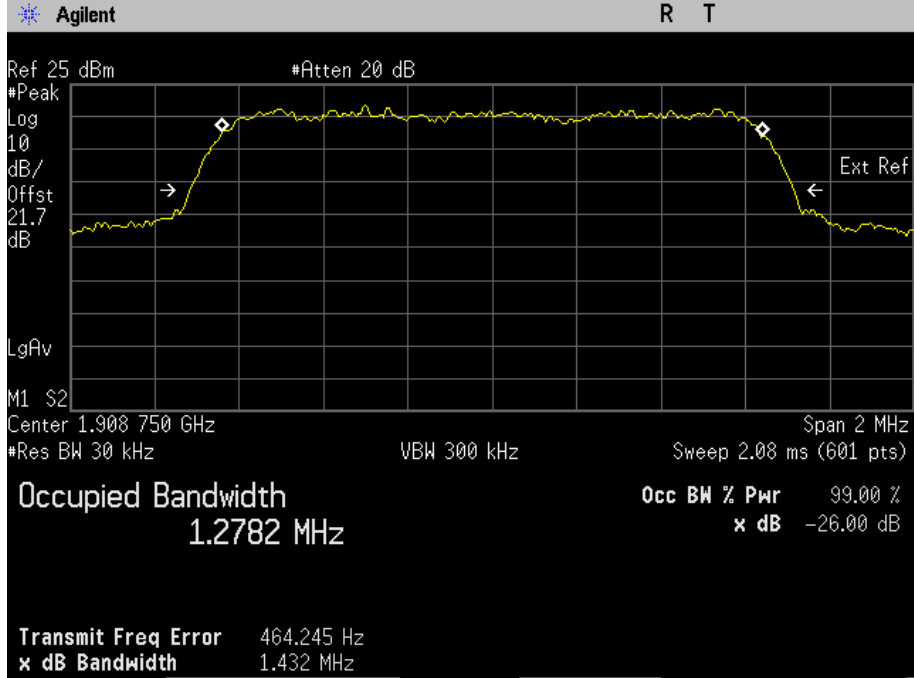
Low Channel



Middle Channel

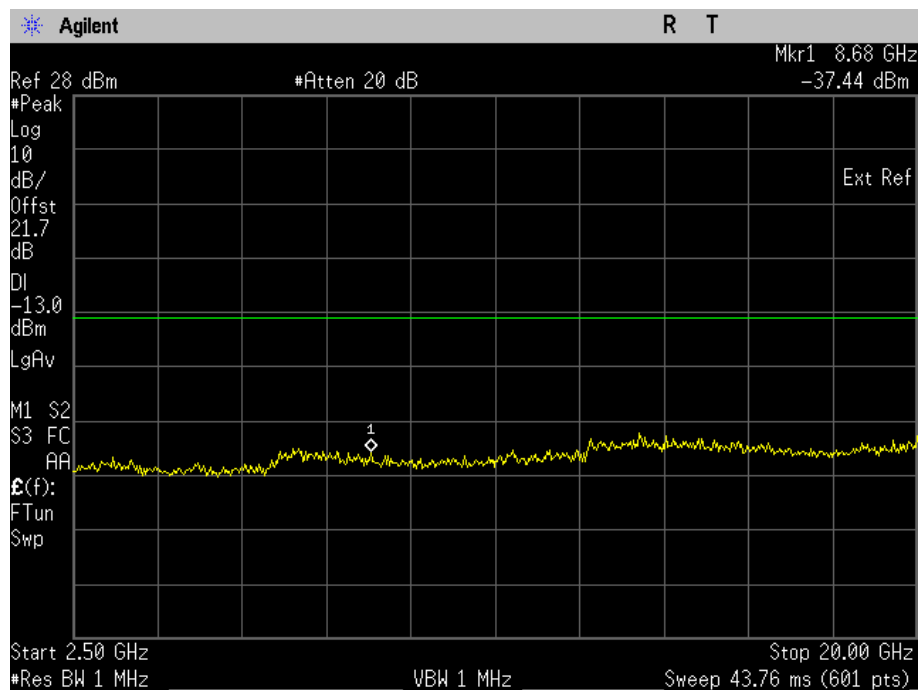
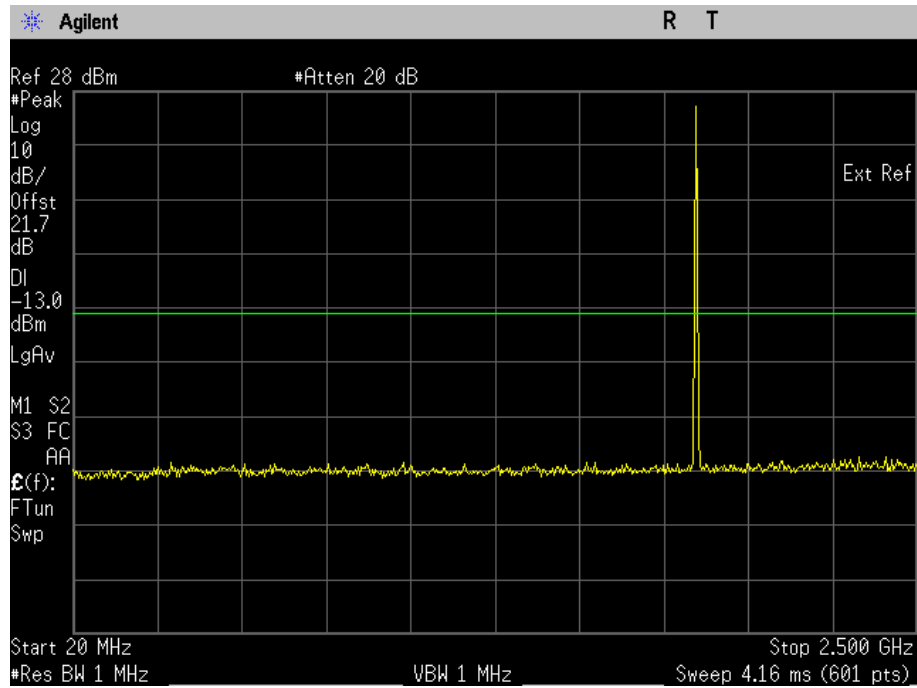


High Channel

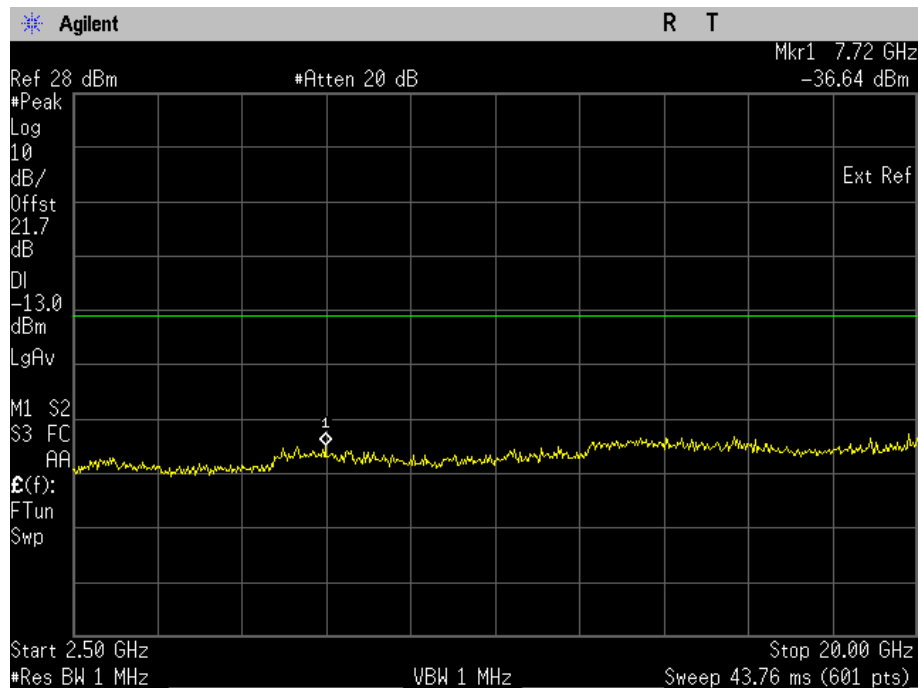
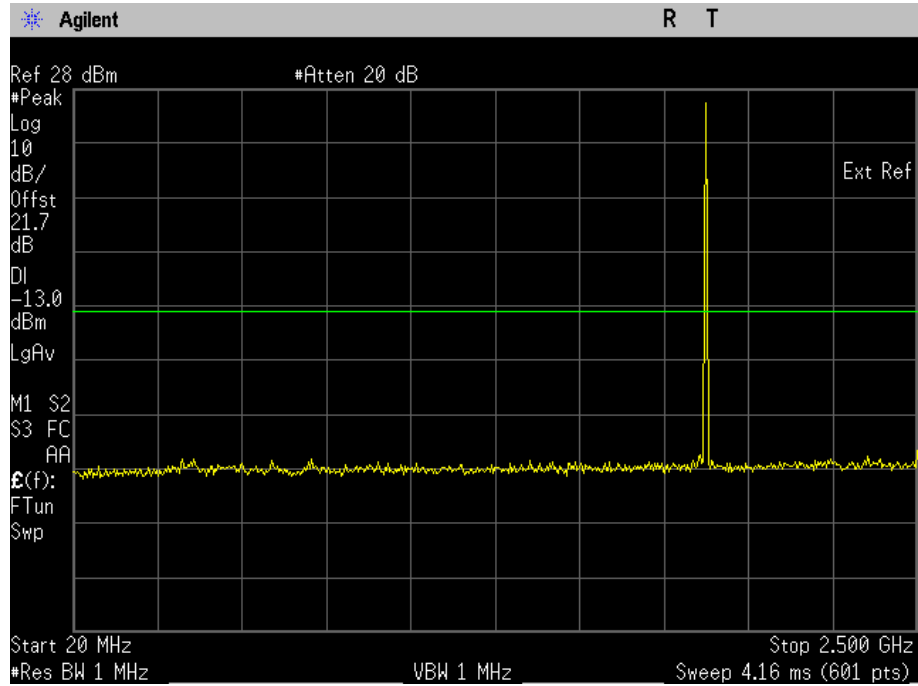


● Spurious Emission at antenna Terminals

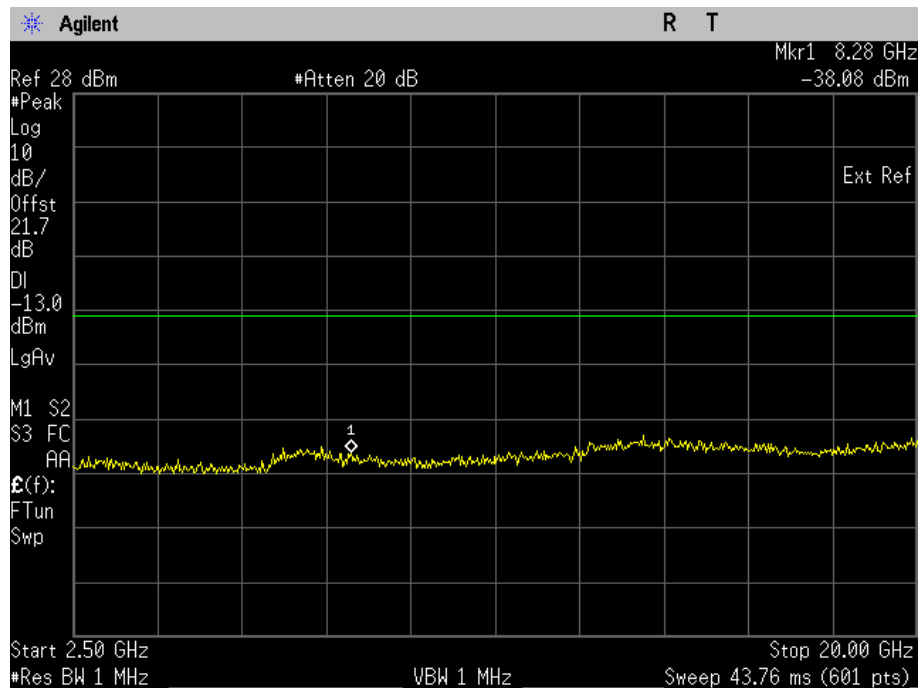
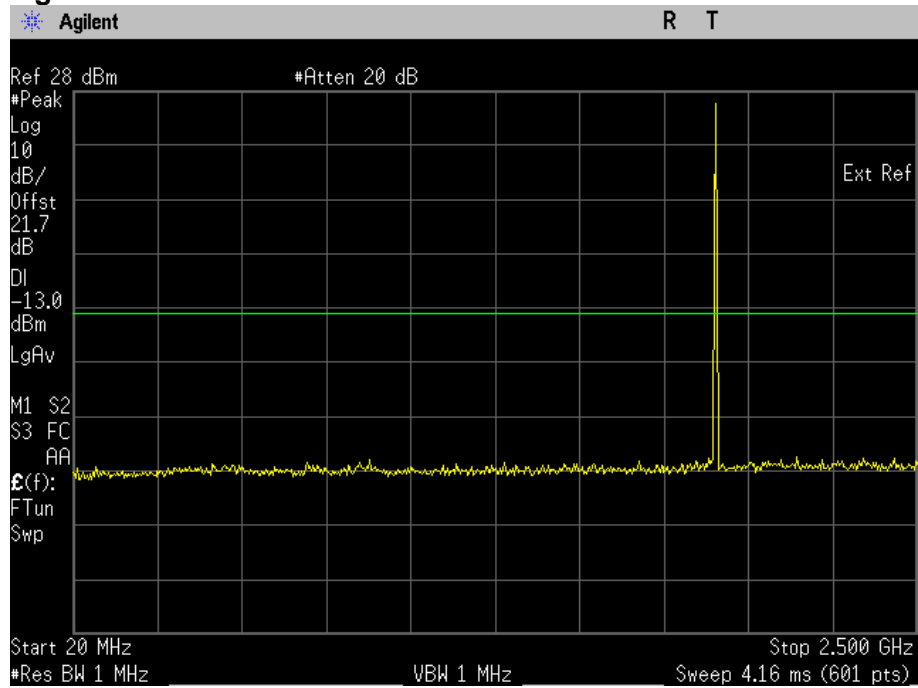
Low Channel



Middle Channel

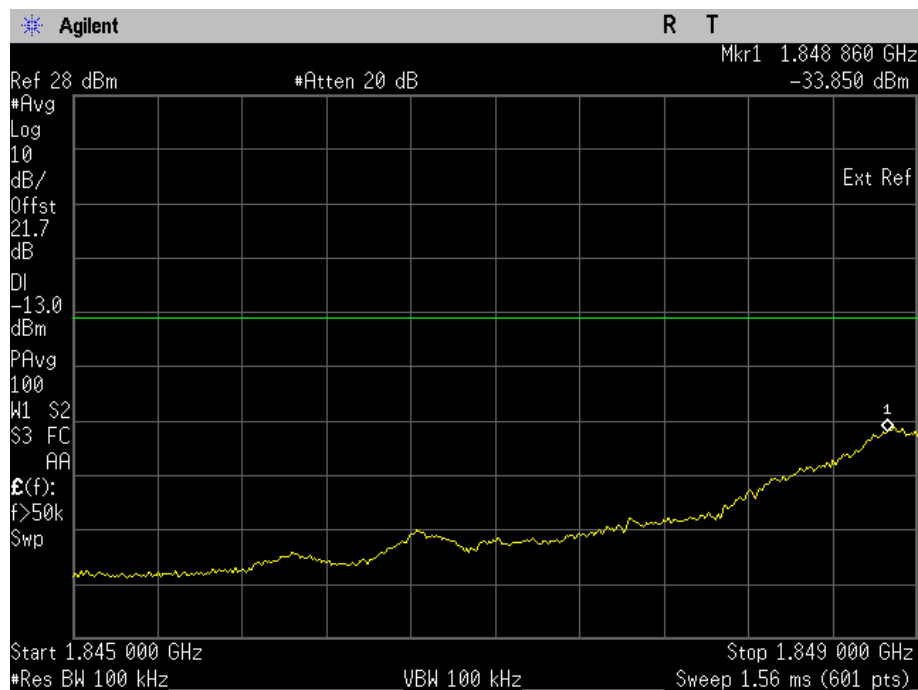
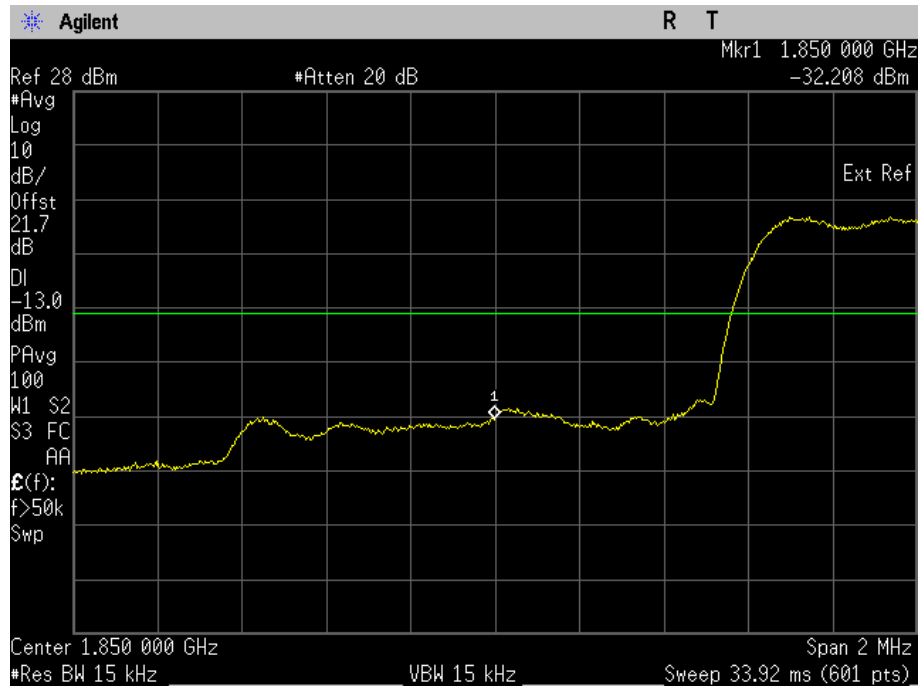


High Channel



● Band Edge

Low Channel



High Channel

