HCT CO., LTD.

CERTIFICATE OF COMPLIANCE
FCC Certification

Applicant Name:
Franklin Technology Inc.

Address:
906 JEI Platz, 459-11 Gasan-dong, Gumcheon-gu, Seoul, Korea

Date of Issue:
October 18, 2013

Test Site/Location:
HCT CO., LTD., 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Kyunggi-Do, Korea

Report No.: HCTR1310FR06

HCT FRN: 0005866421

FCC ID:	**XHG-R700**
APPLICANT:	**Franklin Technology Inc.**

FCC Model(s):	MHS700L	
EUT Type:	Mobile Router	
FCC Classification:	Licensed Non-Broadcast Transmitter (TNB)	
FCC Rule Part(s):	§2 , §27	
Tx Frequency:	782 MHz (LTE–Band 13)	
Max. RF Output Power:	Band 13 (10MHz) :	0.357 W (QPSK) (25.53 dBm) 0.372 W (16-QAM) (25.70 dBm)
Emission Designator(s):	Band 13 (10MHz) :	9M00G7D (QPSK) / 8M95W7D (16-QAM)

The measurements shown in this report were made in accordance with the procedures specified in §2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Report prepared by	**Approved by**
: Jae Chul Shin	**: Chang Seok Choi**
Test engineer of RF Team	**Manager of RF Team**

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCTR1310FR06	October 18, 2013	First Approval Report

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MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	Franklin Technology Inc.
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Date(s) of Tests:	September 12, 2013 ~ September 30, 2013
Antenna Specification	Manufacturer: KWANG HYUN AIRTECH CO., LTD Antenna type: PIFA type Peak Gain: -3.8 dBi

2. INTRODUCTION

2.1. EUT DESCRIPTION

The Franklin Technology Inc. MHS700L Mobile Router consists of LTE 13.

2.2. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.3. TEST FACILITY

The Fully-anechoic and conducted measurement facility used to collect the radiated data are located at the 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Kyunggi-Do, 467-811, Korea.

3. DESCRIPTION OF TESTS

3.1 ERP/EIRP RADIATED POWER AND RADIATED SPURIOUS EMISSIONS

ERP/EIRP

Note: ERP(Effective Radiated Power), EIRP(Effective Isotropic Radiated Power)

Test Procedure

Radiated emission measurements are performed in the Fully-anechoic chamber. The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna in accordance with ANSI/TIA-603-C-2004 Clasue 2.2.17. The turntable is rotated through 360 degrees, and the receiving antenna scans in order to determine the level of the maximized emission. The level and postion of the maximized emission is recorded with the spectrum analyzer using a positive peak detector.

A half wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.

The power is caculated by the following formula;

$$P_{d(dBm)} = Pg_{(dBm)} - \text{cable loss}_{(dB)} + \text{antenna gain}_{(dB)}$$

Where: P_d is the dipole equivalent power and P_g is the generator output power into the substitution antenna.

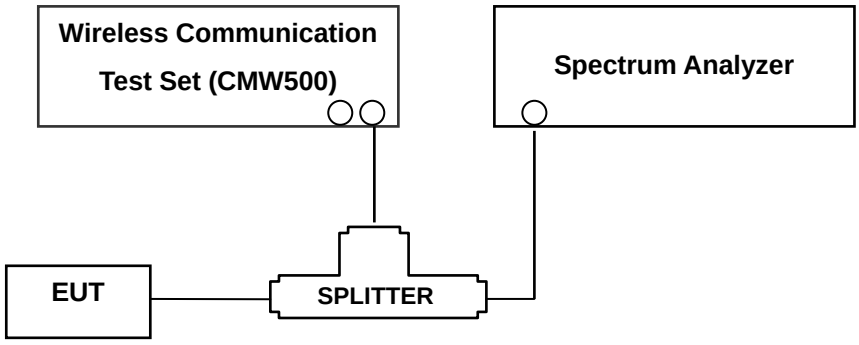
The maximum EIRP is calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps are repeated with the receiving antenna in both vertical and horizontal polarization. the difference between the gain of the horn and an isotropic antenna are taken into consideration

Radiated spurious emissions

1. Frequency Range : 30 MHz ~ 10th Harmonics of highest channel fundamental frequency.
2. Measured distance : 30 MHz ~ 10th Harmonics at 3m

3.2 OCCUPIED BANDWIDTH.

Test set-up



(Configuration of conducted Emission measurement)

Test Procedure

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.

3.3 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL.

Test Procedure

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer.

The spectrum is scanned from the lowest frequency generated
in the equipment up to a frequency including its 10th harmonic. 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. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30kHz bandwidth 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

Additionally, for operations in the 776-788MHz band, the power of any emission outside the licensee's frequency band of operation shall be attenuated below the transmitted power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 776-788MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43+10log(P)dB.

(2) On all frequencies between 763-775 and 793-805MHz, by a factor not less than 65+10log(P)dB in a 6.25kHz band segment.

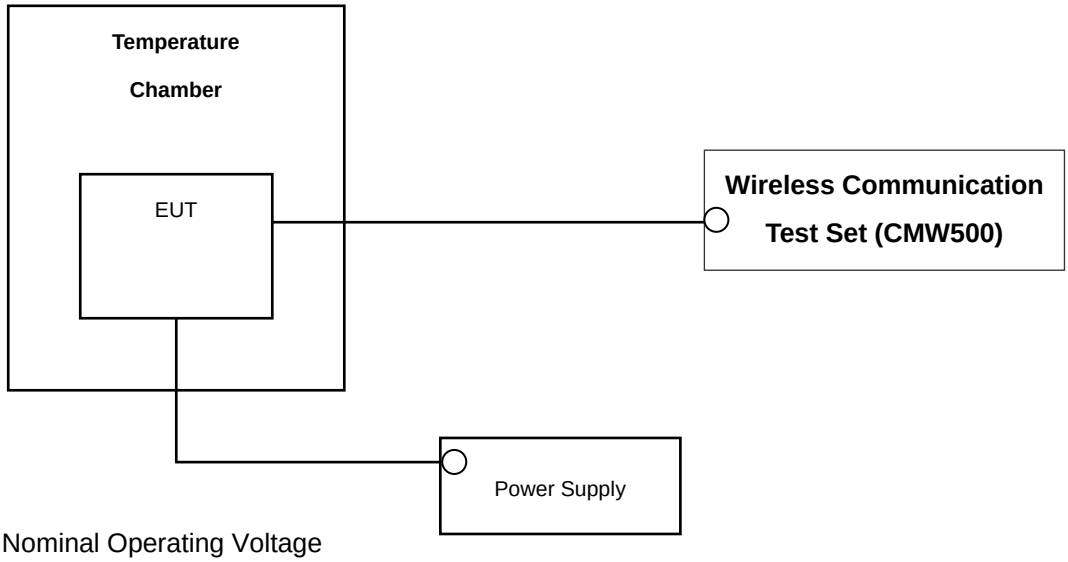
For operations in the 788–793 MHz band, the power of any emission outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769–775 MHz and 799–805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(2) On any frequency between 775–788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB

3.4 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

Test Set-up



* Nominal Operating Voltage

Test Procedure

The frequency stability of the transmitter is measured by:
a.) **Temperature:** The temperature is varied from - 30 °C to + 50 °C using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from battery end point 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 ± 0.000 25 %(± 2.5 ppm) of the center frequency.

Time Period and Procedure:

The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
1. 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 is made within one minute after applying power to the transmitter.

2. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

4. LIST OF TEST EQUIPMENT

Manufacture	Model/ Equipment	Serial Number	Calibration Interval	Calibration Due
Agilent	E9327A/ Power Sensor	MY4442009	Annual	04/16/2014
MITEQ	AMF-6D-001180-35-20P/AMP	1081666	Annual	09/12/2014
Wainwright	WHK1.2/15G-10EF/H.P.F	4	Annual	06/24/2014
Wainwright	WHK3.3/18G-10EF/H.P.F	2	Annual	06/24/2014
Hewlett Packard	11667B / Power Splitter	10126	Annual	11/07/2013
Digital	EP-3010/ Power Supply	3110117	Annual	11/07/2013
Schwarzbeck	UHAP/ Dipole Antenna	557	Biennial	03/05/2015
Schwarzbeck	UHAP/ Dipole Antenna	558	Biennial	05/03/2015
Korea Engineering	KR-1005L / Chamber	KRAB05063-3CH	Annual	11/07/2013
Schwarzbeck	BBHA 9120D/ Horn Antenna	147	Biennial	05/15/2014
Schwarzbeck	BBHA 9120D/ Horn Antenna	1151	Biennial	10/05/2015
Agilent	E9020A/Spectrum Analyzer	MY51110063	Annual	05/14/2014
WEINSCHEL	ATTENUATOR	BR0592	Annual	11/07/2013
REOHDE&SCHWARZ	FSV40/Spectrum Analyzer	1307.9002K40-100931-NK	Annual	06/10/2014
Agilent	8960 (E5515C)/ Base Station	GB44400269	Annual	02/14/2014

5. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result
2.1049, 27.53	Occupied Bandwidth	N/A	CONDUCTED	PASS
2.1051, 27.53(c)	Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	< 43 +10 $\log_{10}$ (P[Watts]) at Band Edge and for all-of-band emissions <65 + 10 log (P[Watts]) in a 6.25kHz bandwidth for emissions in the 776–788 MHz bands		PASS
*2.1046	Conducted Output Power	N/A		PASS
2.1055, 27.54	Frequency stability / variation of ambient temperature	< 2.5 ppm		PASS
27.50(b)(10)	Effective Radiated Power (Band 13)	< 3 Watts max. ERP	RADIATED	PASS
2.1053, 27.53(c)	Undesirable Emissions	< 43 +10 $\log_{10}$ (P[Watts]) for all out-of-band emissions		PASS
2.1053,27.53(f)	Undesirable Emissions in the 1559 – 1610 MHz band	< -40dBm/MHz EIRP (wideband) < -50dBm EIRP (narrowband)		PASS

*: See SAR Report

Note regarding all Emission Mask test plots:

The FCC limit is 65 + 10$\log_{10}$($P_{[Watts]}$) = -35dBm in a 6.25kHz bandwidth. Since it was not possible to set the resolution bandwidth to 6.25kHz with the available equipment, a bandwidth of 10kHz was used instead to show compliance. By using a 10kHz bandwidth, the limit was adjusted by 10$\log_{10}$(10kHz/6.25kHz) = 2.04dB. Thus, the limit shown in all emission mask plots for all available modulation types was -35dBm + 2.04dB = -32.96dBm.

6. SAMPLE CALCULATION

A. ERP Sample Calculation

Mode	Ch./ Freq.		Measured Level(dBm)	Substitude LEVEL(dBm)	Ant. Gain (dBd)	C.L	Pol.	ERP	
	channel	Freq.(MHz)						W	dBm
LTE	23230	782	-23.12	36.72	-10.62	0.83	H	0.337	25.27

ERP = SubstitudeLEVEL(dBm) + Ant. Gain – CL(Cable Loss)

1) The EUT mounted on a non-conductive tuntable is 0.8 meter above test site ground level.
2) During the test , the turn table is rotated until the maximum signal is found.
3) Record the field strength meter's level.
4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
6) The signal generator output level with Ant. Gain and cable loss are the rating of effective radiated power (**ERP**).

B. Emission Designator

QPSK Modulation

Emission Designator = 8M95G7D

LTE BW = 8.95 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Amplitude/Angle Modulated

16QAM Modulation

Emission Designator = 8M94W7D

LTE BW = 8.94 MHz

D = Amplitude/Angle Modulated

7 = Quantized/Digital Info

W = Combination (Audio/Data)

7. TEST DATA

7.1 OCCUPIED BANDWIDTH

Band	Band Width (MHz)	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Data (MHz)
Band 13	10	782	QPSK	50	0	8.9972
			16-QAM	50	0	8.9517

- Plots of the EUT's Occupied Bandwidth are shown Page 18.

7.2 CONDUCTED SPURIOUS EMISSIONS

Band	Band Width (MHz)	Frequency (MHz)	Modulation	Resource Block Size	Resource Block Offset	Frequency of Maximum Harmonic (GHz)	Maximum Data [dBm]
Band 13	10	782	QPSK	1	0	3.1992	-28.484

- Plots of the EUT's Conducted Spurious Emissions are shown Page 24.

7.2.1 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 20 ~ 23.

7.3 EFFECTIVE RADIATED POWER OUTPUT

Freq (MHz)	Bandwidth	Modulation	Measured Level (dBm)	Substitude Level (dBm)	Ant. Gain(dBd)	C.L	Pol	ERP	
								W	dBm
782.0	10 MHz	QPSK	-22.86	36.98	-10.62	0.83	V	0.357	25.53
		16-QAM	-22.69	37.15	-10.62	0.83	V	0.372	25.70

Effective Radiated Power Data (Band 13 – 10 MHz)

Note: Worst case is 1 resource block.

NOTES:

Effective Radiated Power Output Measurements by Substitution Method

according to ANSI/TIA/EIA-603-C-2004, Aug. 17, 2004:

The EUT was placed on a non-conductive styrofoam resin table 3-meters from the receive antenna. The receive antenna height and turntable rotation was adjusted for the highest reading on the receive spectrum analyzer. For 1 MHz BW signals, a peak detector is used, with RBW = VBW = 1 MHz. For 10 MHz BW signals, a peak detector is used, with RBW = VBW = 10 MHz. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminals of the dipole is measured. The ERP is recorded.

Also, we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. The worst case of the EUT is y plane in LTE mode. Also worst case of detecting Antenna is vertical polarization in LTE mode.

7.4 RADIATED SPURIOUS EMISSIONS

7.4.1 RADIATED SPURIOUS EMISSIONS (Band 13)

▣ OPERATING FREQUENCY : 782.00 MHz

▣ MEASURED OUTPUT POWER: 25.70 dBm = 0.372 W

▣ MODULATION SIGNAL: 10 MHz 16-QAM

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 lo_{g10} (W) = 38.70 dBc

Ch	Freq (MHz)	Measured Level (dBm)	Ant. Gain (dBd)	Substitude Level (dBm)	C.L	Pol	Spurious Emission Level (dBm)	dBc
23230 (782.00)	2346.00	-53.24	7.75	-56.44	1.68	H	-50.37	76.07
	3128.00	-51.51	9.26	-53.86	1.93	V	-46.53	72.23
	3910.00	-48.64	10.31	-50.97	2.15	V	-42.81	68.51

NOTES: 1. Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA/EIA-603-C-2004, Aug. 17, 2004:

2. We are performed all frequency to 10th harmonics from 30 MHz. Measurements above show only up to 3 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

3. we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

4. Worst case is 1 resource block.

7.4.2 RADIATED SPURIOUS EMISSIONS (1559 ~ 1610 MHz Band)

▣ OPERATING FREQUENCY : 782.00 MHz

▣ MODULATION SIGNAL: 10 MHz QPSK

▣ DISTANCE: 3 meters

▣ WIDEBAND EMISSION LIMIT: - 40 dBm/MHz

FREQUENCY (MHz)	EMISSION TYPE	Measured Level (dBm)	Ant. Gain (dBd)	Substitude Level (dBm)	C.L	Pol	Spurious Emission Level (dBm)	MARGIN (dB)
1567.8	WIDEBAND	-55.47	6.81	-61.90	1.11	H	-56.20	16.20

7.5 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

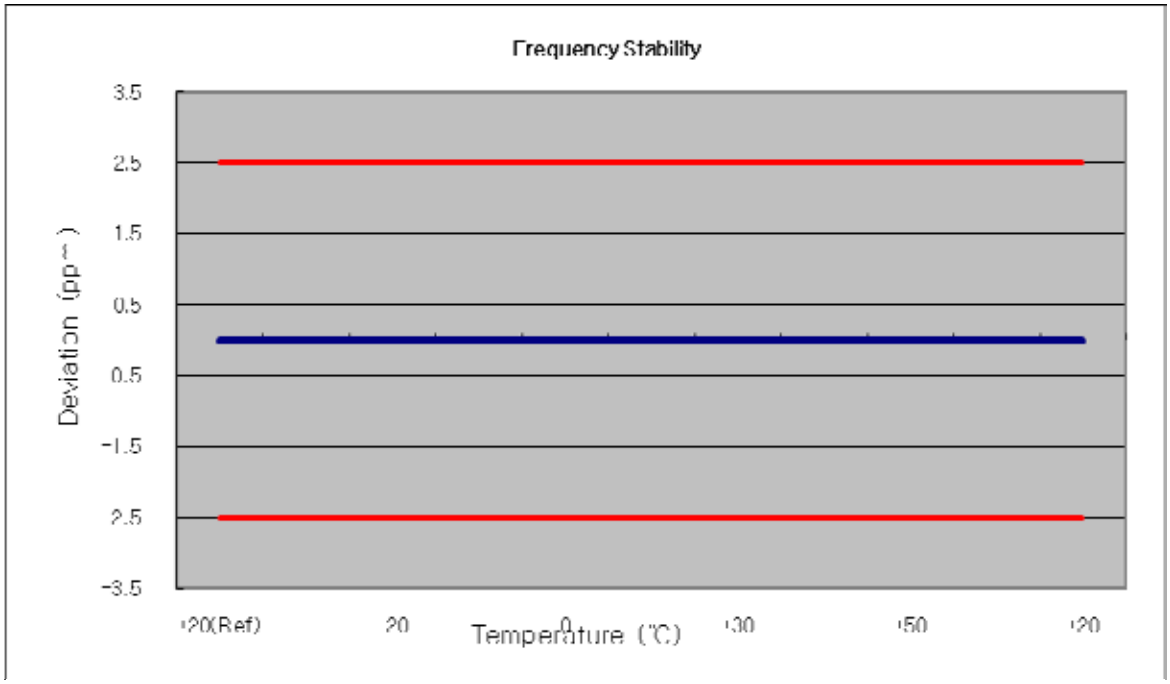
▣ OPERATING FREQUENCY: 782,000,000 Hz

▣ CHANNEL: 23230 (10 MHz)

▣ REFERENCE VOLTAGE: 3.8 VDC

▣ DEVIATION LIM IT: ± 0.000 25 % or 2.5 ppm

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	3.80	+20(Ref)	782 000 003	0	0.000 000	0.000
100%		-30	781 999 995	-7.90	-0.000 001	-0.010
100%		-20	781 999 993	-9.90	-0.000 001	-0.013
100%		-10	781 999 995	-8.20	-0.000 001	-0.010
100%		0	782 000 000	-3.50	0.000 000	-0.004
100%		+10	781 999 999	-4.50	-0.000 001	-0.006
100%		+30	781 999 992	-11.00	-0.000 001	-0.014
100%		+40	782 000 000	-3.60	0.000 000	-0.005
100%		+50	781 999 999	-4.60	-0.000 001	-0.006
115%	4.37	+20	782 000 004	0.40	0.000 000	0.001
85%	3.23	+20	782 000 000	-2.90	0.000 000	-0.004

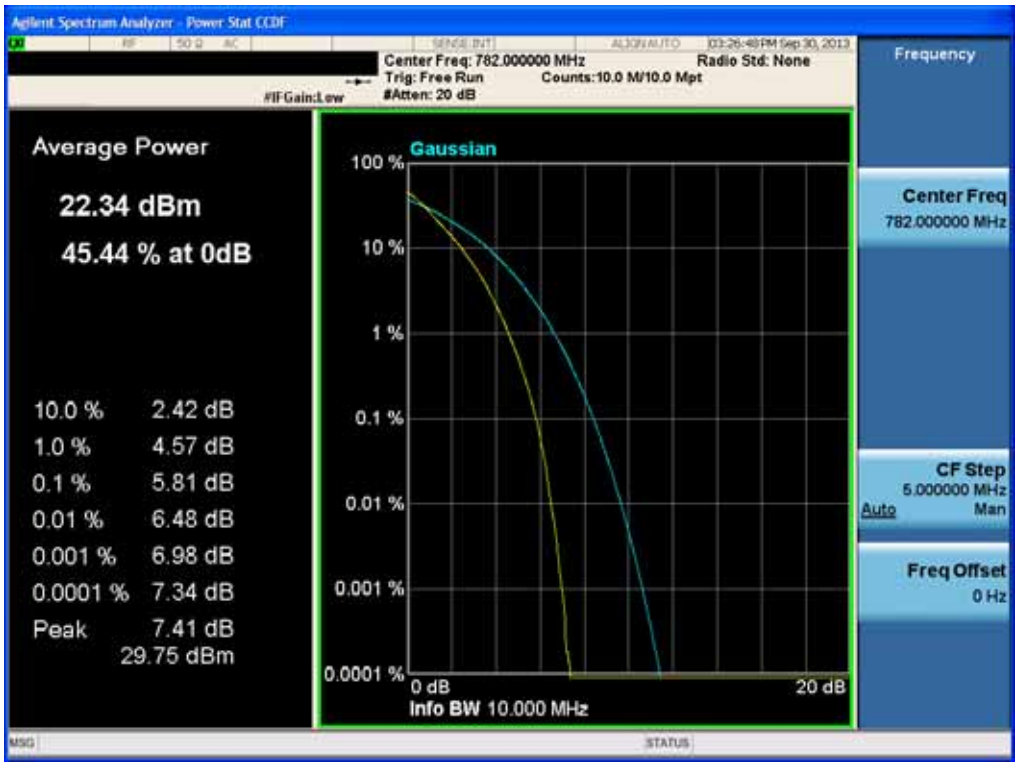


8. TEST PLOTS

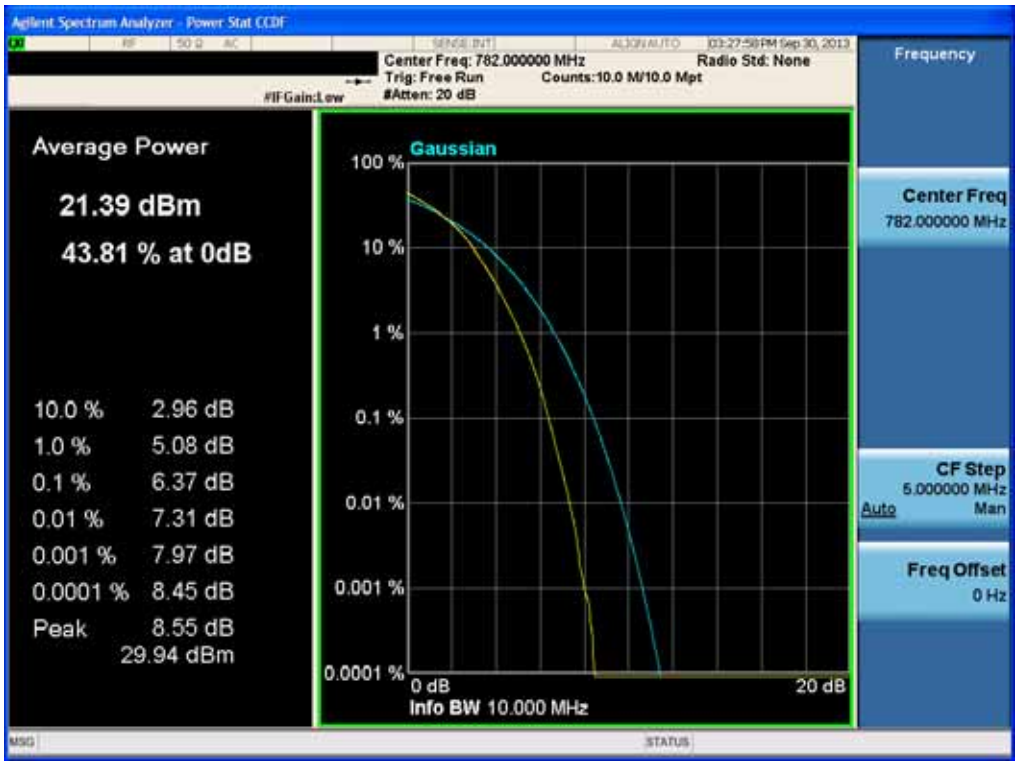
BAND 13. Occupied Bandwidth Plot (23230ch_10MHz_QPSK_RB 50)

BAND 13. Occupied Bandwidth Plot (23230ch_10MHz_16-QAM_RB 50)

BAND 13. PAR Plot (23230ch_10MHz_QPSK_RB 50)



BAND 13. PAR Plot (23230ch_10MHz_16-QAM_RB 50)

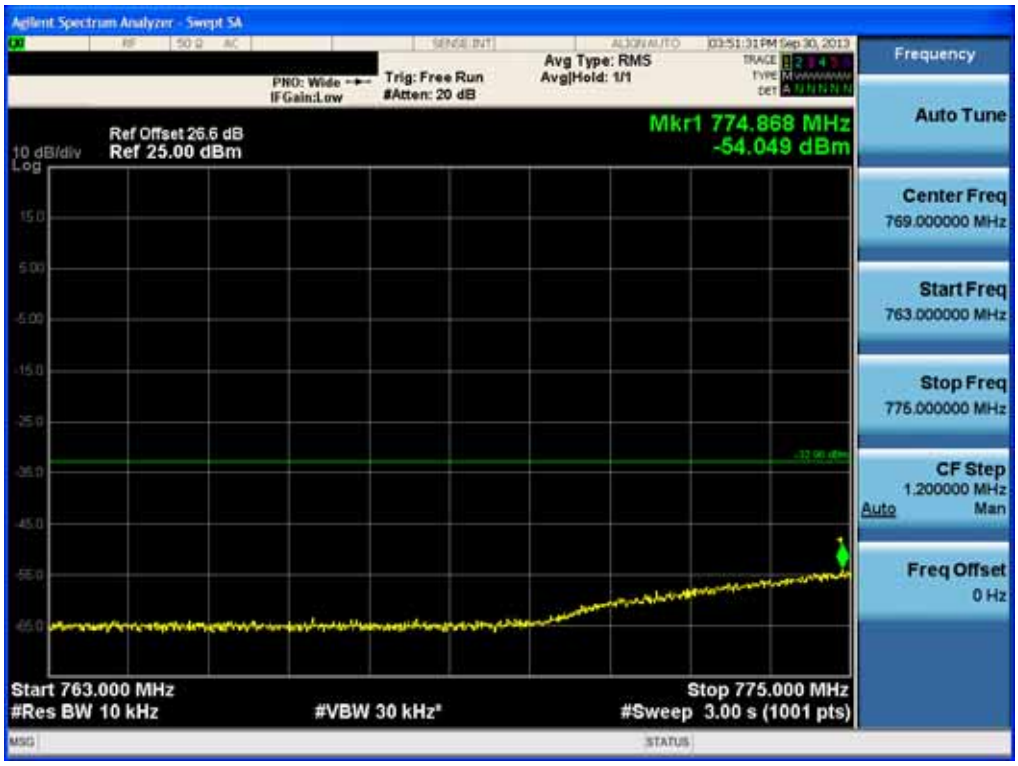


BAND 13. Low Band Edge Plot (23230ch_10MHz_ QPSK _RB 50)

BAND 13. Low Band Edge Plot (23230ch_10MHz_16-QAM _RB 50)

BAND 13. Low Emission Mask Plot (23230ch_10MHz_ QPSK _RB 50)

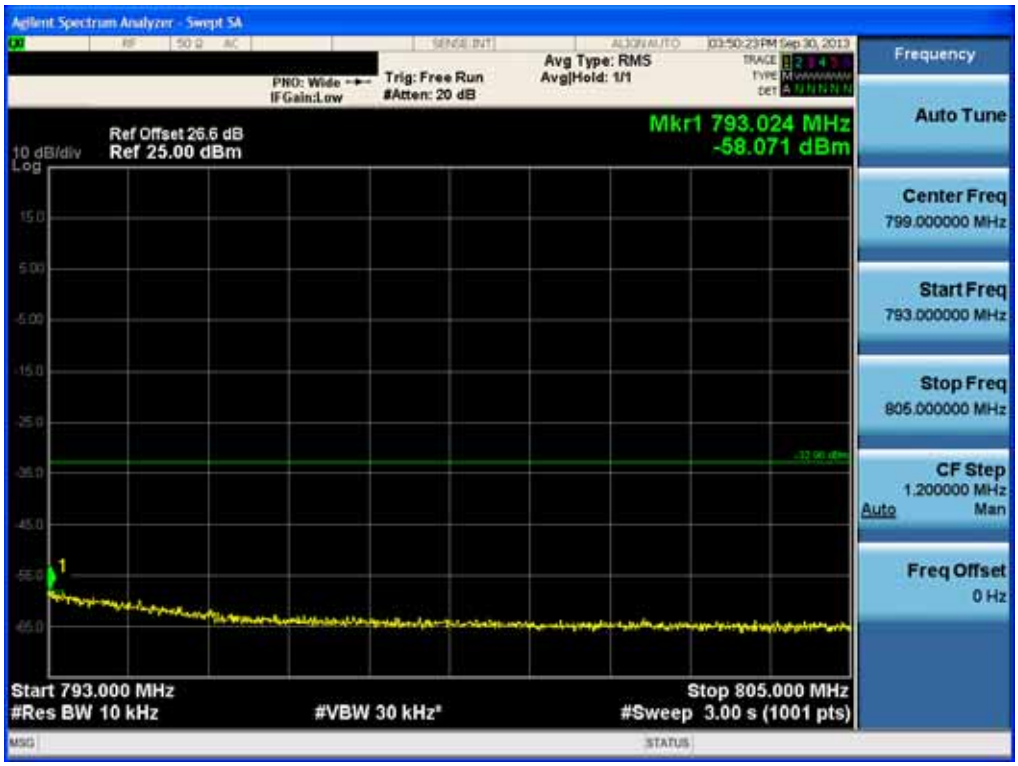
BAND 13. Low Emission Mask Plot (23230ch_10MHz_16-QAM _RB 50)



BAND 13. Upper Band Edge Plot (23230ch_10MHz_ QPSK _RB 50)

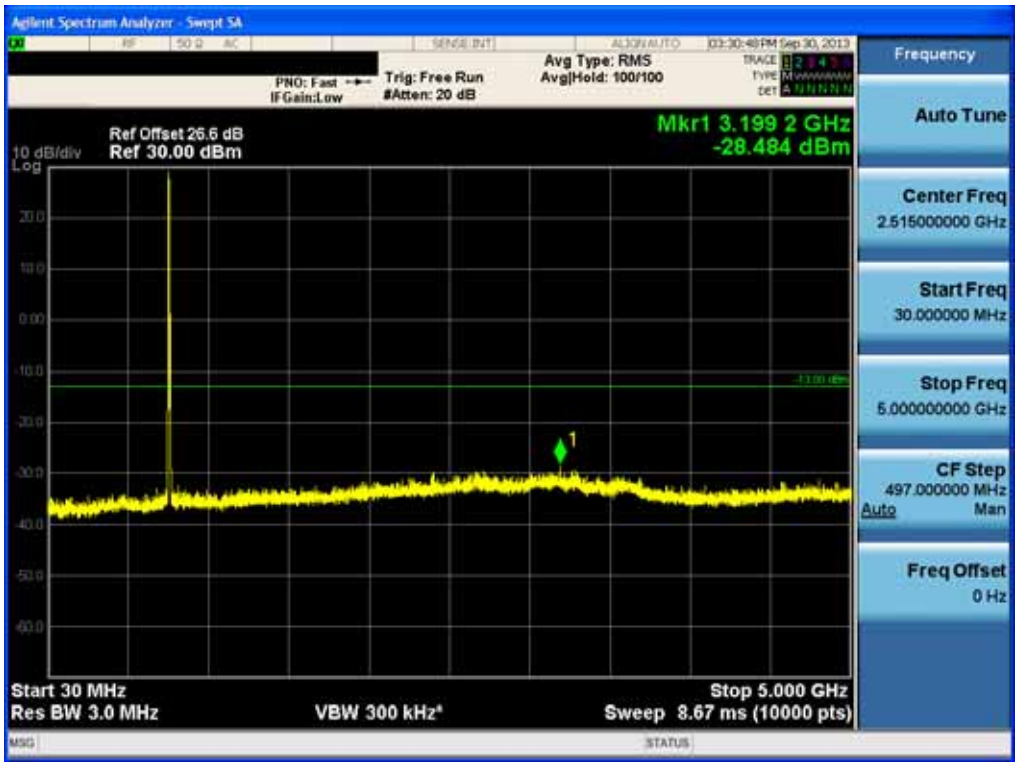
BAND 13. Upper Band Edge Plot (23230ch_10MHz_16-QAM _RB 50)

BAND 13. Upper Emission Mask Plot (23230ch_10MHz_ QPSK _RB 50)



BAND 13. Upper Emission Mask Plot (23230ch_10MHz_16-QAM _RB 50)

BAND 13. Conducted Spurious Plot_1 (23230ch_10MHz_QPSK_RB 1_0)



BAND 13. Conducted Spurious Plot_2 (23230ch_10MHz_QPSK_RB 1_0)