FCC PART 90

TEST REPORT

For

Hytera Communications Corporation Limited

Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, People's Republic of China

FCC ID: YAMMT680PF4

Report Type:	Product Type:
Original Report	TETRA Mobile Terminal

Test Engineer:	Gavin Xu
Report Number:	RDG160427006-00A
Report Date:	2016-06-01
Reviewed By:	Dean Liu RF Engineer
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

TABLE OF CONTENTS

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Hytera Communications Corporation Limited's* product, model number:*MT680 PLUS F4 (FCC ID: YAMMT680PF4)* or the "EUT" in this report was a *TETRA Mobile Terminal,* which was measured approximately:186 mm (L)×184 mm (W)×70 mm (H) ,rated input voltage: DC 13.2V.

**All measurement and test data in this report was gathered from production sample serial number: 160427006 (Assigned by BACL Dongguan). The EUT was received on 2016-04-27.*

Objective

This test report is prepared on behalf of *Hytera Communications Corporation Limited* in accordance with Part 2, and Part 90 of the Federal Communication Commission rules.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS submissions with FCC ID: YAMMT680PF4.
FCC Part 15.247 DTS submissions with FCC ID: YAMMT680PF4.

Test Methodology

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

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D and ANSI 63.4-2014.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

Equipment Modifications

No modification was made to the EUT tested.

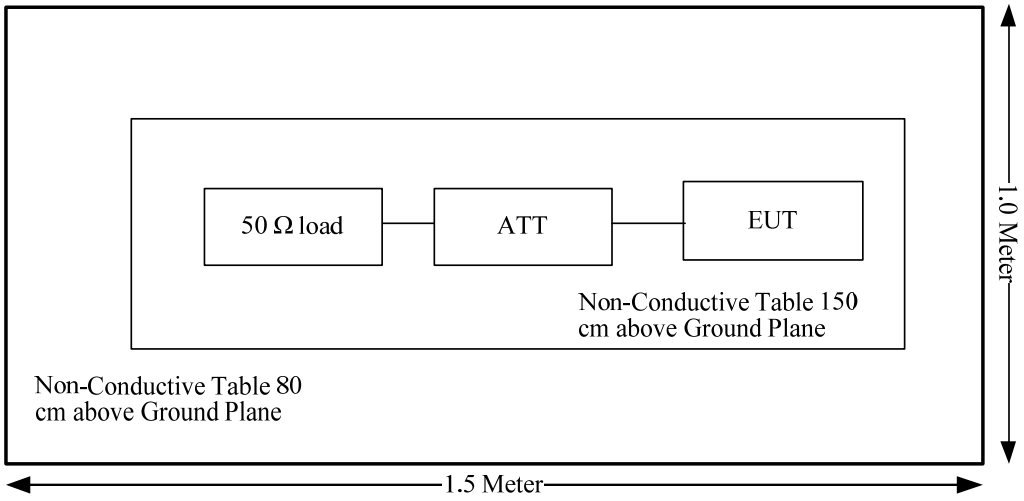
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	50 Load Teminal	2W	/
AA-MCS	Attenuator	CAT-50-40-200-Nm-Nf	0602-010

External I/O Cable

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
/	/	/	/	/	/

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§1.1307 (b)(1), §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§2.1046; §90.205	RF Output Power	Compliance
§90.210; §90.221	Adjacent Channel Power	Compliance
§2.1047;§90.207	Modulation Characteristic	Not Applicable*
§2.1049; §90.209; §90.210; §90.691	Occupied Bandwidth	Compliance
§2.1051; §90.210	Spurious Emission at Antenna Terminal	Compliance
§2.1053; §90.210	Spurious Radiated Emissions	Compliance
§2.1055; §90.213	Frequency Stability	Compliance
§90.214	Transient Frequency Behavior	Not Applicable*

Not applicable*: Modulation Characteristic test item is not required for digital device

FCC§1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for Maximum Permissible Exposure (MPE)

Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/cm^2)**	**Averaging Time |E|, |H| or S (minutes)**
0.3- 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

f = frequency in MHz;
* = Plane-wave equivalent power density;

MPE Calculation

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

MPE Results

Tune-Up Power Including Tolerance:

For Tetra, the highest Power is 10+/-1W, for bluetooth, the highest Power is 6.8 dBm.

Frequency Bands	Antenna Gain		Tune-Up Power		Output Power* 50% duty cycle (PTT)	Evaluation Distance	Power Density	S_{limit}	S_i/S_{limit}
	(dBi)	(numeric)	dBm	(mW)	(mW)	cm	(mW/cm^2)	(mW/cm^2)	
450-470MHz	5.5	3.55	\	11000	5500	35	1.26770	1.5	0.84513
2402-2480MHz	1	1.26	6.8	4.79	\	35	0.00039	5	0.00008

The Tetra module can transmit simultaneously with BT, the Ratio for Tetra, and:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$=S_{Tetra}/S_{limit\_Tetra}+ S_{BT}/S_{limit\ BT}$

=0.84513+0.00008

=0.84521

< 1.0

Result: Compliance, The device meets MPE requirement for Occupational/Controlled use at 35 cm distance

FCC §2.1046 & §90.205- RF OUTPUT POWER

Applicable Standard

FCC §2.1046 and §90.205

Test Procedure

Conducted RF Output Power:

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer Setting:

RBW	VBW
100 kHz	300 kHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	831259/019	2015-07-28	2016-07-27
AA-MCS	Attenuator	CAT-50-40-200-Nm-Nf	0602-010	2016-04-10	2017-04-10
/	RF Coaxial cable (0.5 dB)	0.1m	/	2015-05-09	2016-05-09

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	28.8℃
Relative Humidity:	55 %
ATM Pressure:	100.4 kPa

The testing was performed by Gavin Xu on 2016-04-28.

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table.

DMO:

ModulationMode	f_c (MHz)	Conducted power (dBm)	Conducted power (W)	Limit (W)
π/4-DQPSK	450.0125	40.39	10.94	8-12
	460	40.36	10.86	8-12
	469.9875	40.31	10.74	8-12

TMO:

ModulationMode	f_c (MHz)	Conducted power (dBm)	Conducted power (W)	Limit (W)
π/4-DQPSK	450.0125	40.28	10.67	8-12
	460	40.34	10.81	8-12
	469.9875	40.28	10.67	8-12

Note: The rated power is 10W.

FCC §90.210& §90.221- ADJACENT CHANNEL POWER

Applicable Standard

FCC §2.1046, §90.210& §90.221

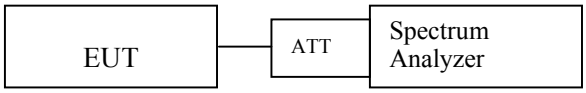
According to FCC§90.221 (b) (1), Maximum adjacent power levels for frequencies in the 450-470 MHz band:

Frequency offset	Maximum ACP (dBc) for devices 1 watt and less	Maximum ACP (dBc) for devices above 1 watt
25 kHz	−55 dBc	−60 dBc
50 kHz	−70 dBc	−70 dBc
75 kHz	−70 dBc	−70 dBc

(2) In any case, no requirement in excess of −36 dBm shall apply

Test Procedure

The EUT was connected to the Spectrum Analyzer with a suitable attenuator.



Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
IFR	Tetra Signal Analyzer	2310	231001/73	2016-03-11	2017-03-11
AA-MCS	Attenuator	CAT-50-40-200-Nm-Nf	0602-010	2016-04-10	2017-04-10
/	RF Coaxial cable	0.1m	/	2015-05-09	2016-05-09

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	28.8℃
Relative Humidity:	55 %
ATM Pressure:	100.4 kPa

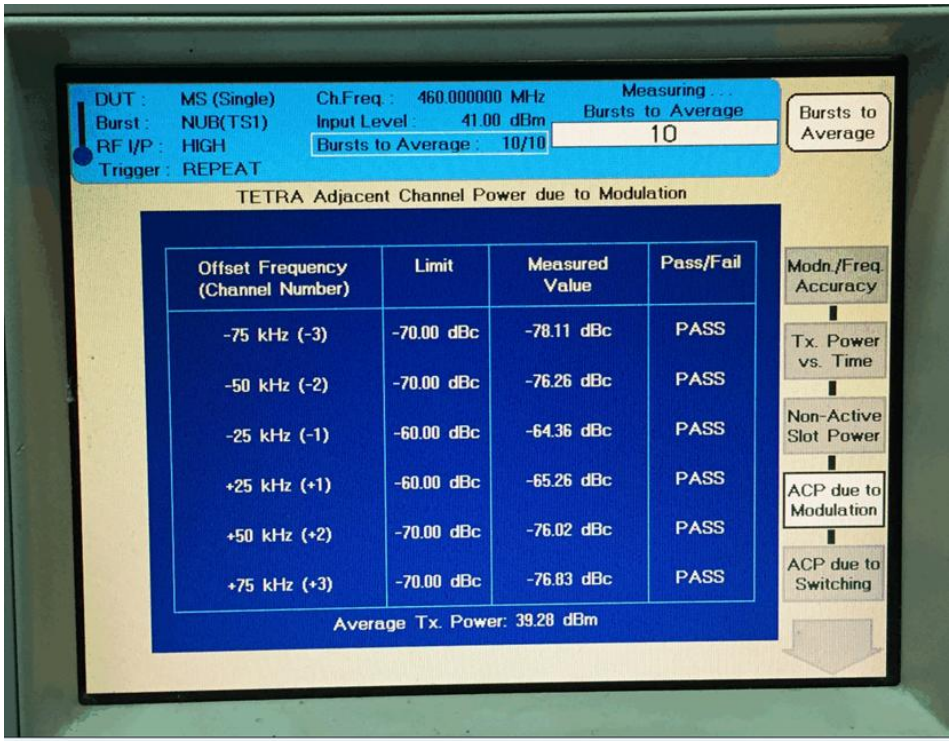
The testing was performed by Gavin Xu on 2016-04-28.

Test Mode: DMO Transmitting

Test Result: Compliance. Please refer to following table and plots.

Modulation Mode	f_c (MHz)	Frequency offset (kHz)	Adjacent Channel Power Ratio (dB)	Limit (dB)
π/4-DQPSK	460	±25	64.36	60
		±50	76.02	70
		±75	76.83	70

π/4-DQPSK for Frequency 460.0000 MHz



FCC §2.1049 & §90.209,§90.691 – OCCUPIED BANDWIDTH

Applicable Standard

FCC §2.1049, §90.209, §90.210 and §90.691

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Emission Mask I. For transmitters that are equipped with an audio low pass filter, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency of more than 6.8 kHz, but no more than 9.0 kHz: At least 25 dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency of more than 9.0 kHz, but no more than 15 kHz: At least 35 dB;

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency of more than 15 kHz: At least 43 + 10 log (P) dB, or 70 dB, whichever is the lesser attenuation.

Emission mask requirements for EA-based systems.

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 $Log_{10}(f/6.1)$ decibels or 50 + 10 $Log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + $10Log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 300 Hz.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	831259/019	2015-07-28	2016-07-27
AA-MCS	Attenuator	CAT-50-40-200-Nm-Nf	0602-010	2016-04-10	2017-04-10
/	RF Coaxial cable	0.1m	/	2015-05-09	2016-05-09

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	28.8℃
Relative Humidity:	55 %
ATM Pressure:	100.4 kPa

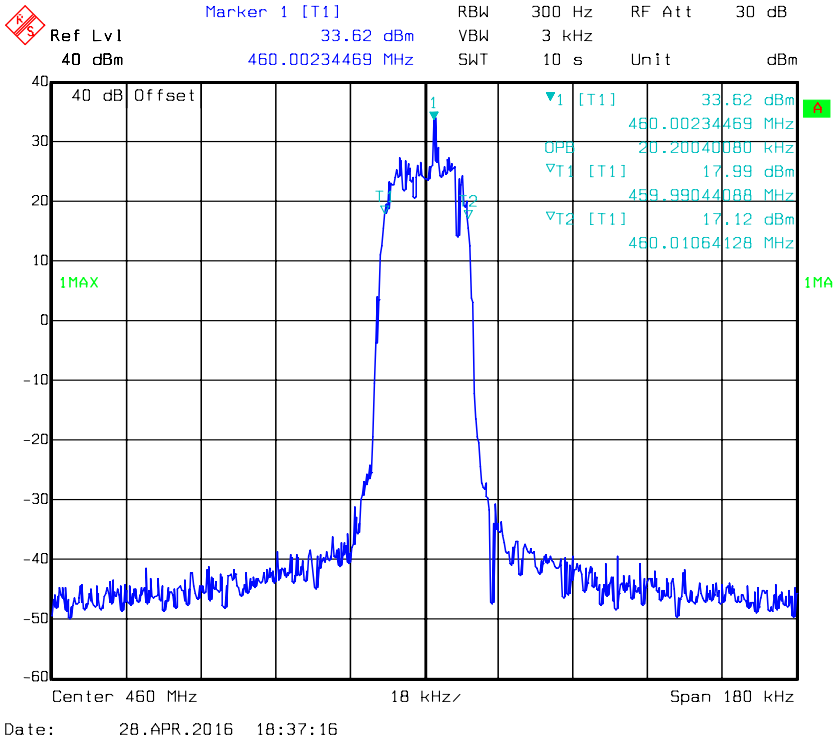
The testing was performed by Gavin Xu on 2016-04-28.

Modulation Mode	f_c	99% Occupied Bandwidth	Limit
	MHz	kHz	kHz
π/4-DQPSK	460	20.2	22

Note: Equipment meets the Adjacent Channel Power limits of §90.221, so emission mask is not tested.

DMO:

Occupied Bandwidth –π/4-DQPSK, 460.0000 MHz



FCC §2.1051 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100kHz for below 1GHz, and 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	831259/019	2015-07-28	2016-07-27
AA-MCS	Attenuator	CAT-50-40-200-Nm-Nf	0602-010	2016-04-10	2017-04-10
/	RF Coaxial cable	0.1m	/	2015-05-09	2016-05-09
Mini-circuits	High Pass Filter	UHF-3100+	31251	2015-05-06	2016-05-06

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

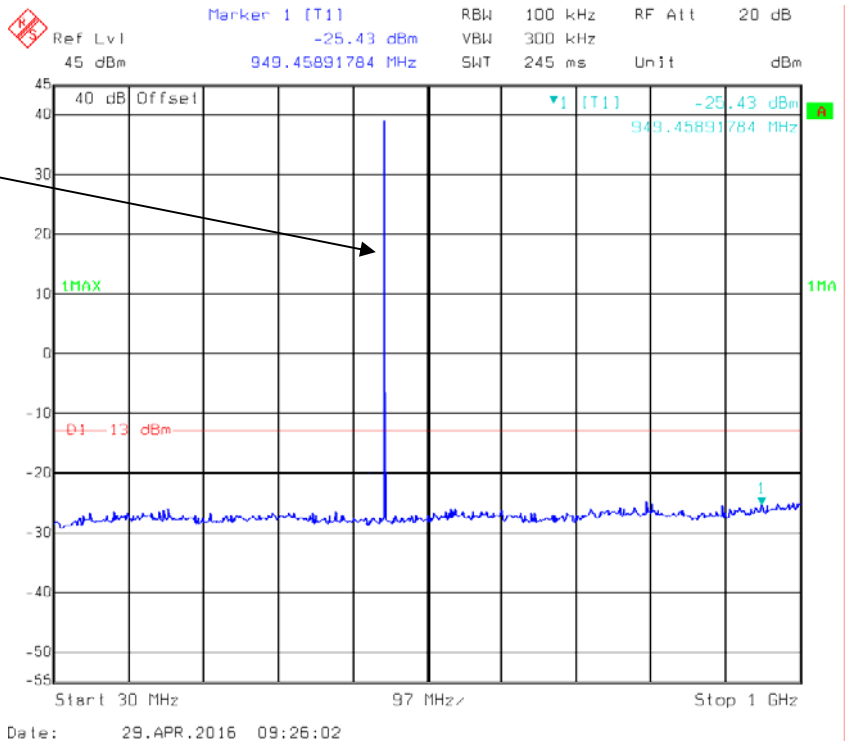
Temperature:	28.8℃
Relative Humidity:	55 %
ATM Pressure:	100.4 kPa

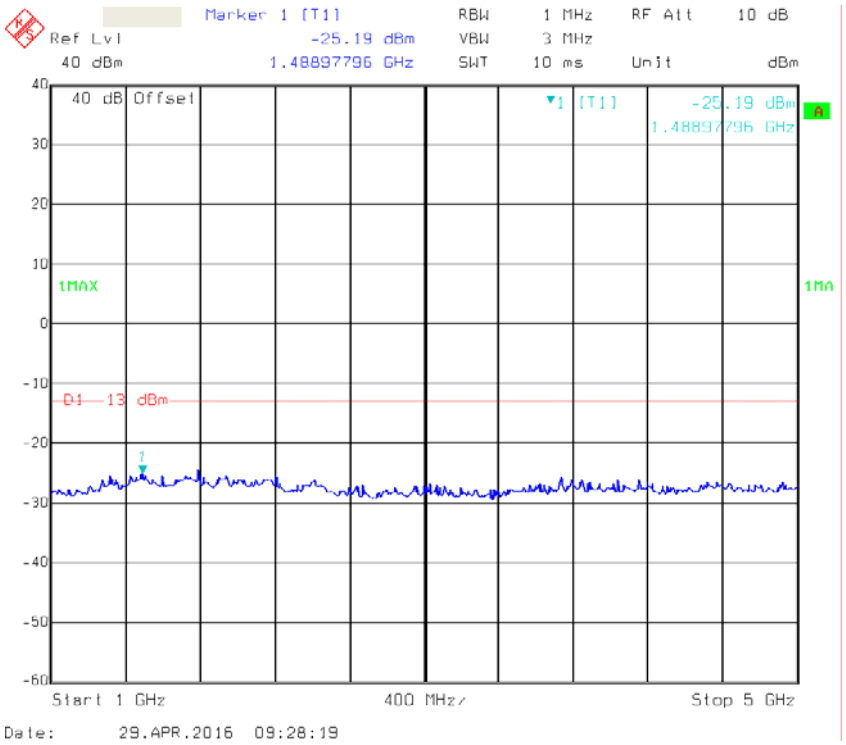
The testing was performed by Gavin Xu on 2016-04-29.

Test Mode: DMO Transmitting

π/4-DQPSK, 460.0000 MHz

Fundamental





FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053, §90.210

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT .The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to teeth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB =10 1g (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB =43+10 Log_{10} (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
HP	Signal Generator	1026	320408	2015-11-23	2016-11-22
Sunol Sciences	Antenna	JB3	A060611-3	2014-07-28	2017-07-27
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
/	RF Coxial cable	10m	/	2015-05-09	2016-05-09
/	RF Coxial cable	14m	/	2015-05-09	2016-05-09
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
R&S	EMI Test Receiver	ESCI	100224	2015-08-03	2016-08-02
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2016-02-19	2017-02-19
TDK RF	Horn Antenna	HRN-0118	130 084	2015-09-06	2018-09-06
ETS-Lindgren	Horn Antenna	3115	9808-5557	2015-09-06	2018-09-06
Agilent	Spectrum Analyzer	E4440A	SG43360054	2015-11-23	2016-11-22
AA-MCS	Attenuator	CAT-50-40-200-Nm-Nf	0602-010	2016-04-10	2017-04-10
/	50 Load Teminal	2W	/	2016-04-10	2017-04-10

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	28.8℃
Relative Humidity:	55 %
ATM Pressure:	100.4 kPa

The testing was performed by Gavin Xu on 2016-04-28.

Test Mode: DMO Transmitting

30MHz - 10GHz:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)			
π/4-DQPSK,Frequency:460.0000 MHz								
920.000	H	28.59	-45.3	0.0	1.0	-46.3	-13.0	33.3
920.000	V	25.99	-44.6	0.0	1.0	-45.6	-13.0	32.6
1380.000	H	32.99	-67.5	8.8	1.4	-60.1	-13.0	47.1
1380.000	V	32.68	-67.7	8.8	1.4	-60.3	-13.0	47.3
1840.000	H	31.97	-67.8	11.4	1.3	-57.7	-13.0	44.7
1840.000	V	32.25	-67.6	11.4	1.3	-57.5	-13.0	44.5
2300.000	H	30.86	-65.4	11.2	2.3	-56.5	-13.0	43.5
2300.000	V	32.02	-63.8	11.2	2.3	-54.9	-13.0	41.9

Note:
Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

FCC §2.1055 & §90.213- FREQUENCY STABILITY

Applicable Standard

FCC §2.1055, §90.213

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	831259/019	2015-07-28	2016-07-27
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-4	2015-09-10	2016-09-09
UNI-T	Multimeter	UT39A	M130199938	2016-04-10	2017-04-10
AA-MCS	Attenuator	CAT-50-40-200-Nm-Nf	0602-010	2016-04-10	2017-04-10
/	RF Coaxial cable	0.1m	/	2015-05-09	2016-05-09

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	28.8 ℃
Relative Humidity:	55 %
ATM Pressure:	100.4 kPa

The testing was performed by Gavin Xu on 2016-04-28.

Test Mode: DMO Transmitting

fc =460 MHz				
Temerature	**Voltage**	**Reading**	**Frequency Error**	**Limit**
℃	**Vdc**	**MHz**	**ppm**	**ppm**
-30	13.2	460.000250	0.54	5
-20	13.2	460.000437	0.95	
-10	13.2	460.000442	0.96	
0	13.2	460.000388	0.84	
10	13.2	460.000364	0.79	
20	13.2	460.000365	0.79	
30	13.2	460.000333	0.72	
40	13.2	460.000334	0.73	
50	13.2	460.000337	0.73	
60	13.2	460.000367	0.80	
25	11.2	460.000384	0.83	
25	15.2	460.000312	0.68	

******* END OF REPORT *******