

FCC PART 15.231

TEST REPORT

For

GUARDIAN SHANGHAI CORP.

368, Min Shen Rd, SongJiang, Shanghai , China

FCC ID: YJFWKTX01-CC

Report Type: Original Report	Product Type: WIRELESS KEYPAD CC
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Report Number: RKS170527001-00A	
Report Date: 2017-06-20	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	GUARDIAN SHANGHAI CORP.
Tested Model	WKCC
Product Type	WIRELESS KEYPAD CC
Dimension	135 mm(L) × 65 mm(W) × 30 mm(H)
Power Supply	DC 3V from batteries (AAA 1.5V*2)

**All measurement and test data in this report was gathered from production sample serial number: 20170526001 (Assigned by the BACL. The EUT supplied by the applicant was received on 2017-05-26)*

Objective

This test report is prepared on behalf of GUARDIAN SHANGHAI CORP. All the test measurements were performed according to the measurement procedure described in ANSI C63.10 - 2013.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.209, 15.35(c) and 15.231 rules.

Related Submittal(s)/Grant(s)

No related submittal(s)/grant(s)

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10 - 2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz ~18GHz	5.23dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
Humidity		6%

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) 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 December 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. 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

Justification

The system was configured in testing mode which was provided by manufacturer, 2 channels are provided for testing:

Channel 1: 303MHz, Channel 2: 390MHz

Only “Enter” buttons can transmit the RF signal.

EUT Exercise Software

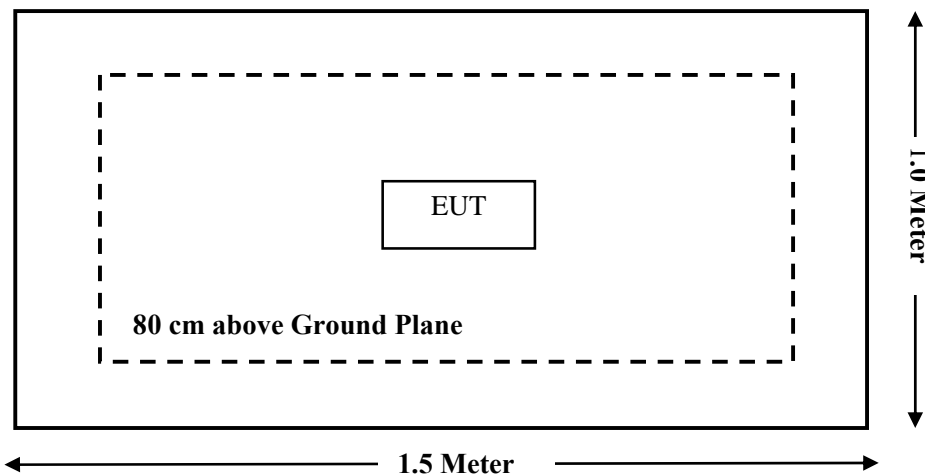
No exercise software.

Equipment Modifications

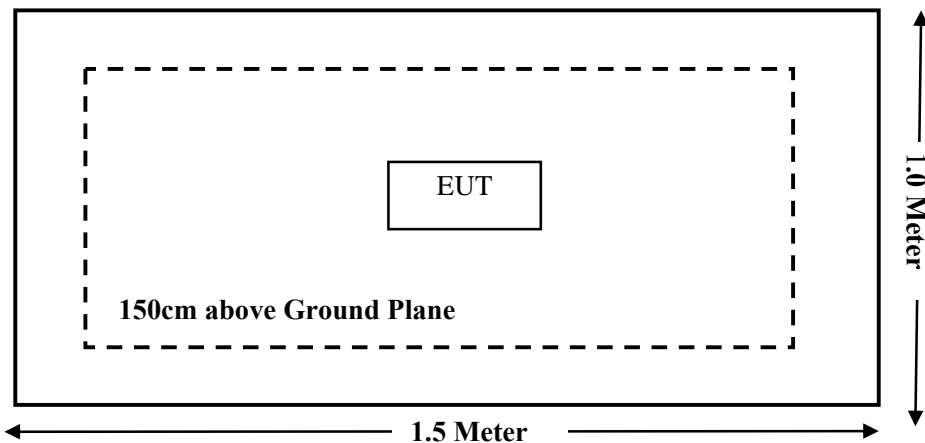
No modification was made to the EUT.

Block Diagram of Test Setup

For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conducted Emissions	Not Applicable (See Note1)
§15.205, §15.209, §15.231(b)	Radiated Emissions	Compliance
§15.231 (a)(1)	Deactivation	Compliance
§15.215 (c)	20dB Emission Bandwidth	Compliance

Note1: The EUT is powered by battery only.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2016-11-25	2017-11-24
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
Sonoma Instrunent	Pre-amplifier	330	171377	2016-12-12	2017-12-11
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-12-12	2017-12-11
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
Haojintech	Coaxial Cable	Cable-1	001	2016-12-12	2017-12-11
Haojintech	Coaxial Cable	Cable-2	002	2016-12-12	2017-12-11
Haojintech	Coaxial Cable	Cable-3	003	2016-12-12	2017-12-11
MICRO-COAX	Coaxial Cable	Cable-4	004	2016-12-12	2017-12-11
MICRO-COAX	Coaxial Cable	Cable-5	005	2016-12-12	2017-12-11
ETS-LINDGREN	PASSIVE LOOP	6512	108100	2016-01-09	2019-01-08
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2016-09-21	2017-09-20
GUARDIAN	RF Cable	N/A	N/A	2017-06-06	2018-06-05

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

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Antenna Connected Construction

The EUT has a PCB antenna arrangement which was permanently attached and the antenna gain is 0 dBi; fulfill the requirement of this section. Please refer to EUT photos.

Result: Compliant.

FCC §15.205, §15.209, §15.231 (b) - RADIATED EMISSIONS**Applicable Standard**

FCC §15.205, §15.209, §15.231 (b)

According to FCC §15.231(b), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750 **	125 to 375 **
174-260	3750	375
260-470	3750 to 12500 **	375 to 1250**
Above 470	12500	1250

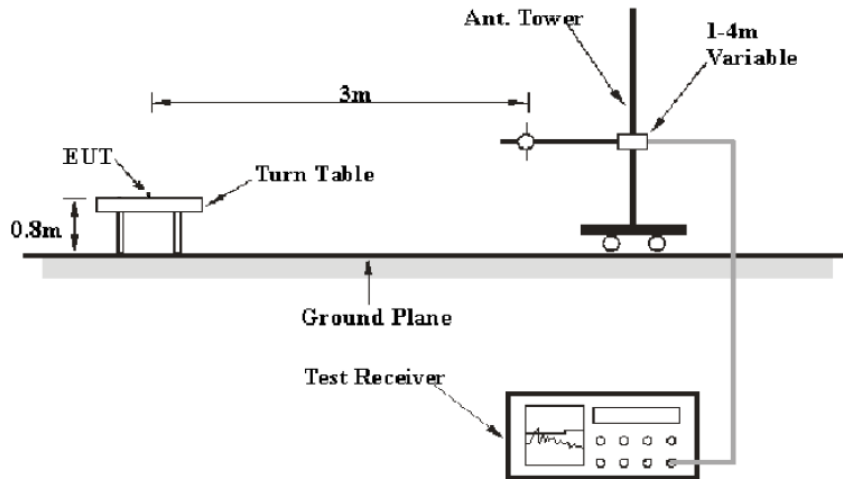
(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

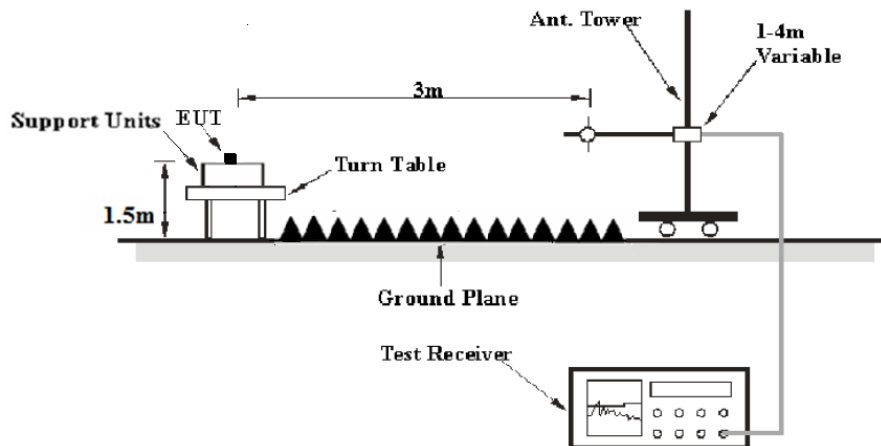
(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

EUT Setup

Below 1GHz:



Above 1 GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10 - 2013. The specification used was the FCC 15 § 15.209, 15.205 and 15.231.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 5 GHz.

During the radiated emission test, the EMI test Receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
1000MHz – 5000MHz	1MHz	3MHz	/	PK

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Loss and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Loss} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.205, §15.209, §15.231 (b).

Test Data

Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Ada Yu on 2017-06-06 to 2017-06-07.

Test mode: Transmitting (Scan with X-Axis, Y-Axis and Z-Axis position, the worst case was recorded)

Channel 1:

30MHz-5GHz (ASK modulation)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.231(b)/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
303.00	70.39	PK	301	191	H	-4.73	65.66	94.87	29.21
303.00	69.15	PK	118	178	V	-4.73	64.42	94.87	30.45
606.00	46.17	PK	91	125	H	0.65	46.82	74.87	28.05
606.00	45.01	PK	11	198	V	0.65	45.66	74.87	29.21
909.00	52.69	PK	85	100	H	5.17	57.86	74.87	17.01
909.00	51.26	PK	293	160	V	5.17	56.43	74.87	18.44
1212.00	48.23	PK	203	210	H	-11.18	37.05	74.00	36.95
1212.00	47.56	PK	335	220	V	-11.18	36.38	74.00	37.62
1515.00	51.03	PK	284	107	H	-9.39	41.64	74.00	32.36
1515.00	49.97	PK	293	212	V	-9.39	40.58	74.00	33.42
1818.00	45.23	PK	298	108	H	-7.95	37.28	74.87	37.59
1818.00	44.13	PK	92	242	V	-7.95	36.18	74.87	38.69
3030.00	42.06	PK	324	160	H	-3.16	38.90	74.87	35.97
3030.00	41.23	PK	165	150	V	-3.16	38.07	74.87	36.80

Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBμV/m)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.231(b)/205/209	
					Limit (dBμV/m)	Margin (dB)
303.00	65.66	H	-6.66	59.00	74.87	15.87
303.00	64.42	V	-6.66	57.76	74.87	17.11
606.00	46.82	H	-6.66	40.16	54.87	14.71
606.00	45.66	V	-6.66	39.00	54.87	15.87
909.00	57.86	H	-6.66	51.20	54.87	3.67
909.00	56.43	V	-6.66	49.77	54.87	5.10
1212.00	37.05	H	-6.66	30.39	54.00	23.61
1212.00	36.38	V	-6.66	29.72	54.00	24.28
1515.00	41.64	H	-6.66	34.98	54.00	19.02
1515.00	40.58	V	-6.66	33.92	54.00	20.08
1818.00	37.28	H	-6.66	30.62	54.87	24.25
1818.00	36.18	V	-6.66	29.52	54.87	25.35
3030.00	38.90	H	-6.66	32.24	54.87	22.63
3030.00	38.07	V	-6.66	31.41	54.87	23.46

Note 1:

Corrected Amplitude = Corrected Factor + Reading

Corrected Factor = Antenna factor (Rx) + cable loss – amplifier factor

Margin = Limit - Corr. Amplitude

Note 2:

Calculate Average value based on Duty Cycle correction factor:

$T_p=54.066\text{ms}$

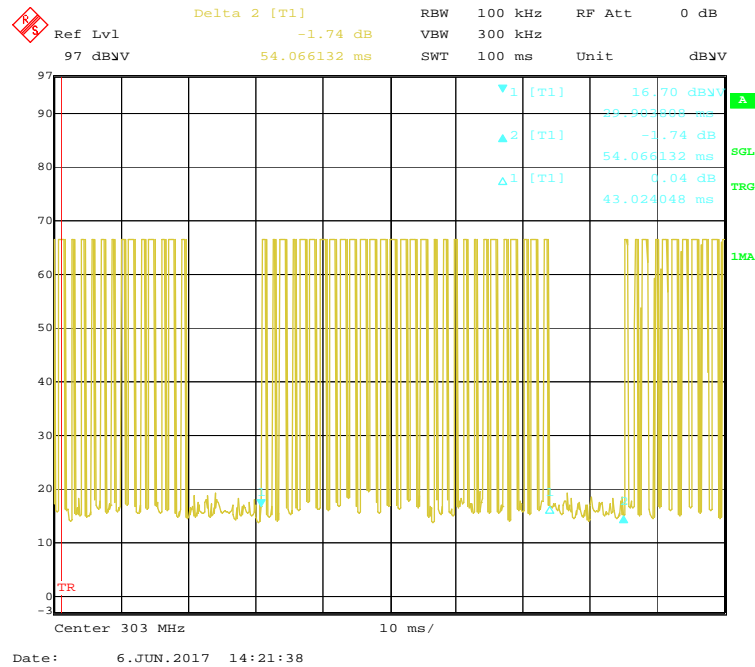
$T_{on}=T_{on1}N_1 + T_{on2}N_2 + \dots + T_{onn}N_n=0.561\text{ms} * 12 + 1.082\text{ms} * 17=25.126\text{ms}$

Duty Cycle Corrected Factor $=20*\log(T_{on}/T_p)=20*\log(25.126\text{ms}/54.066\text{ms})=-6.66\text{dB}$

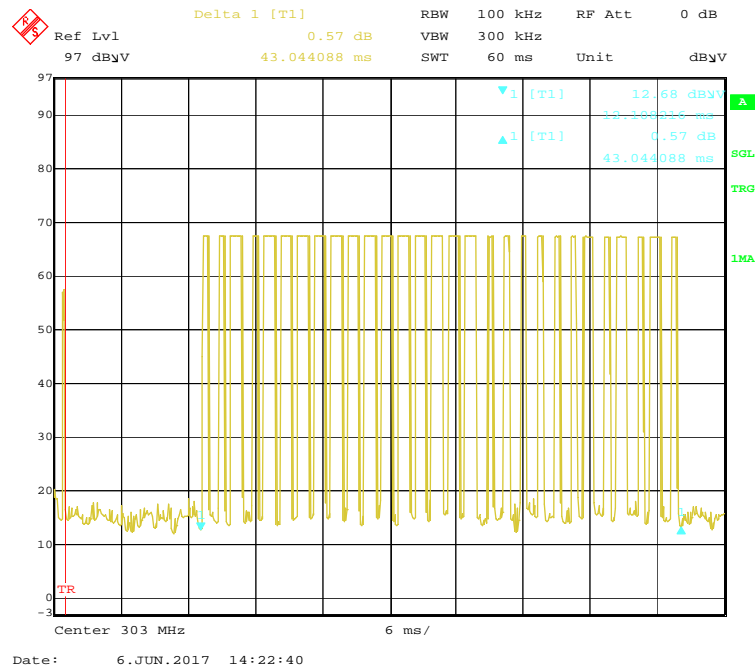
Average = Peak + Duty Cycle Corrected Factor

This duty cycle is the worst case for the EUT

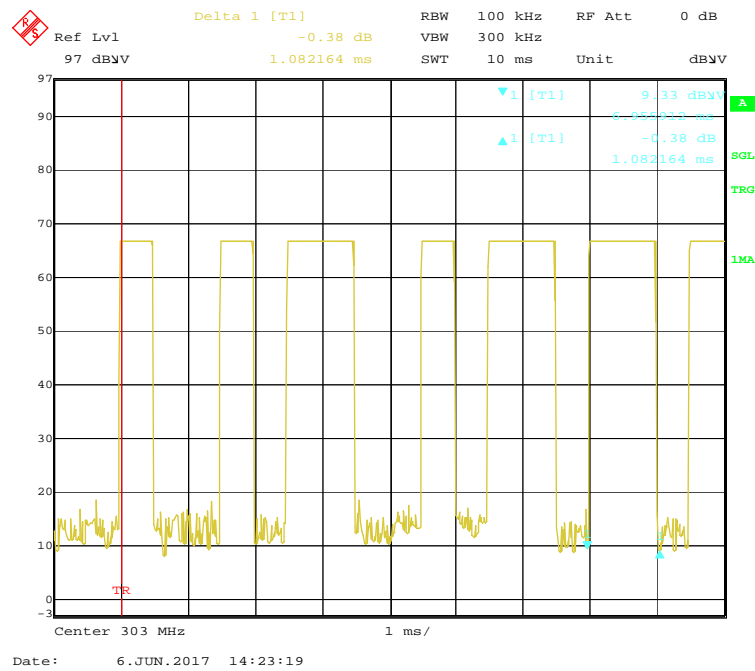
Duty Cycle 1



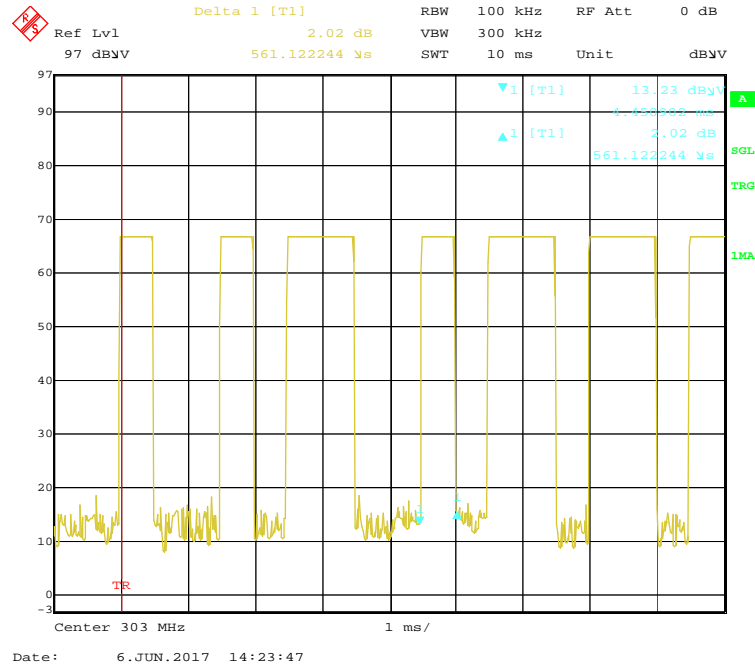
Duty Cycle 2



Duty Cycle 3



Duty Cycle 4



Channel 2:

30MHz-5GHz (ASK modulation)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.231(b)/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
390.00	68.41	PK	125	160	H	-2.88	65.53	99.24	33.71
390.00	66.89	PK	250	233	V	-2.88	64.01	99.24	35.23
780.00	54.28	PK	152	120	H	4.11	58.39	79.24	20.85
780.00	53.22	PK	310	127	V	4.11	57.33	79.24	21.91
1170.00	56.34	PK	16	127	H	-11.43	44.91	74.00	29.09
1170.00	54.29	PK	125	175	V	-11.43	42.86	74.00	31.14
1560.00	55.57	PK	163	236	H	-9.18	46.39	74.00	27.61
1560.00	54.13	PK	10	199	V	-9.18	44.95	74.00	29.05
1950.00	50.01	PK	316	150	H	-7.33	42.68	79.24	36.56
1950.00	49.25	PK	311	227	V	-7.33	41.92	79.24	37.32
2340.00	46.31	PK	42	214	H	-6.33	39.98	74.00	34.02
2340.00	45.02	PK	149	162	V	-6.33	38.69	74.00	35.31
3900.00	41.03	PK	123	163	H	-0.63	40.40	74.00	33.60
3900.00	40.28	PK	3	124	V	-0.63	39.65	74.00	34.35

Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBμV/m)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.231(b)/205/209	
					Limit (dBμV/m)	Margin (dB)
390.00	65.53	H	-6.48	59.05	79.24	20.19
390.00	64.01	V	-6.48	57.53	79.24	21.71
780.00	58.39	H	-6.48	51.91	59.24	7.33
780.00	57.33	V	-6.48	50.85	59.24	8.39
1170.00	44.91	H	-6.48	38.43	54.00	15.57
1170.00	42.86	V	-6.48	36.38	54.00	17.62
1560.00	46.39	H	-6.48	39.91	54.00	14.09
1560.00	44.95	V	-6.48	38.47	54.00	15.53
1950.00	42.68	H	-6.48	36.20	59.24	23.04
1950.00	41.92	V	-6.48	35.44	59.24	23.80
2340.00	39.98	H	-6.48	33.50	54.00	20.50
2340.00	38.69	V	-6.48	32.21	54.00	21.79
3900.00	40.40	H	-6.48	33.92	54.00	20.08
3900.00	39.65	V	-6.48	33.17	54.00	20.83

Note 1:

Corrected Amplitude = Corrected Factor + Reading

Corrected Factor = Antenna factor (Rx) + cable loss – amplifier factor

Margin = Limit - Corr. Amplitude

Note 2:

Calculate Average value based on Duty Cycle correction factor:

$T_p = 54.110\text{ms}$

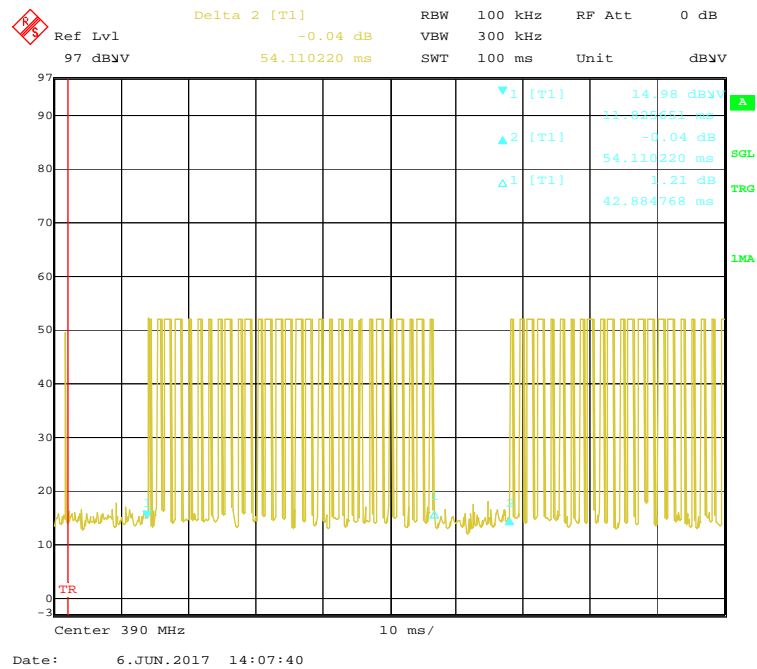
$T_{on} = T_{on1}N_1 + T_{on2}N_2 + \dots + T_{onn}N_n = 0.539\text{ms} * 9 + 1.040\text{ms} * 20 = 25.651\text{ms}$

Duty Cycle Corrected Factor $= 20 * \log(T_{on}/T_p) = 20 * \log(25.651\text{ms}/54.110\text{ms}) = -6.48\text{dB}$

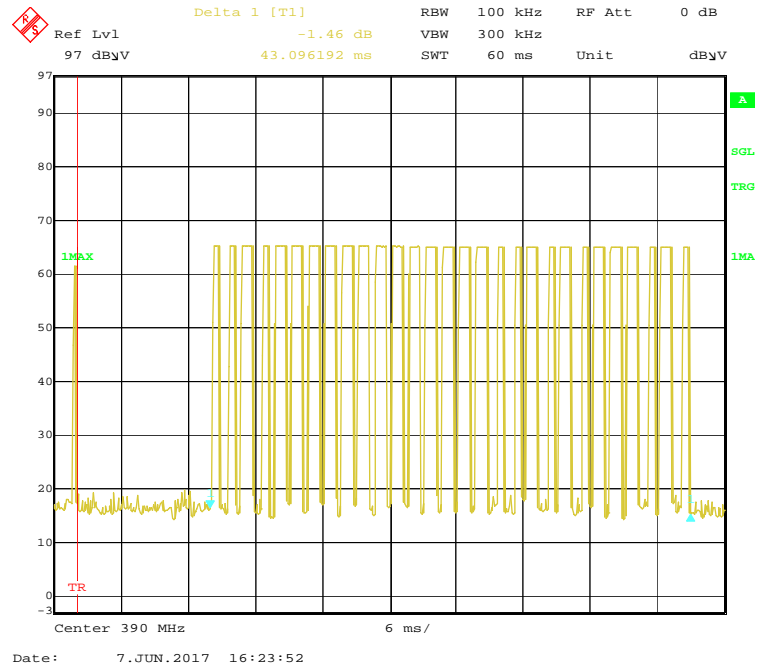
Average = Peak + Duty Cycle Corrected Factor

This duty cycle is the worst case for the EUT

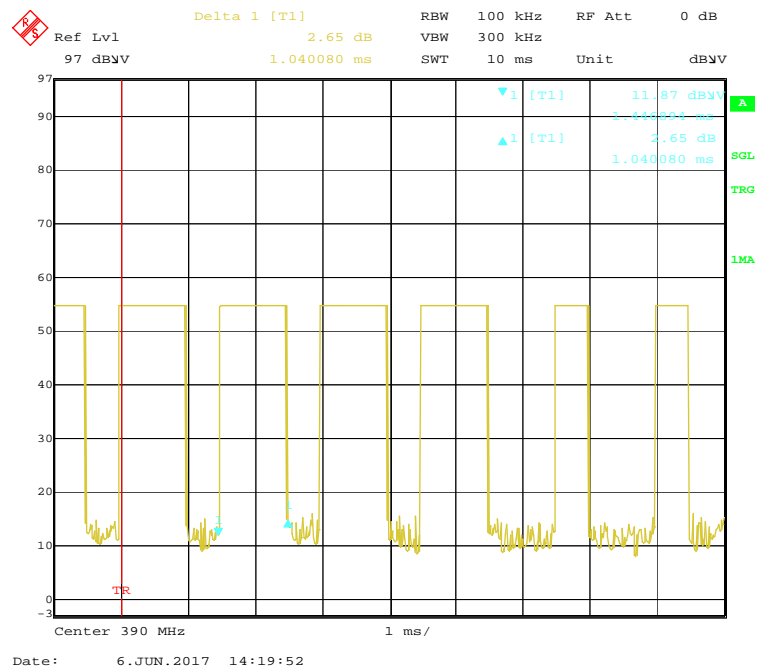
Duty Cycle 1



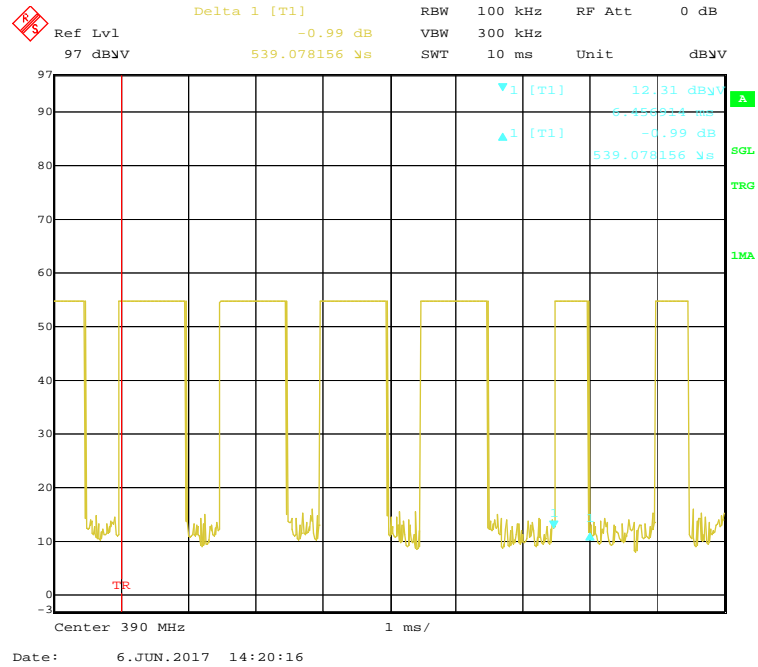
Duty Cycle 2



Duty Cycle 3



Duty Cycle 4



FCC §15.231(a) (1) - DEACTIVATION TESTING**Applicable Standard**

Per FCC §15.231(a) (1), A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set center frequency of spectrum analyzer=operating frequency.
3. Set the spectrum analyzer as RBW=100k VBW=300k Span=0Hz.
4. Repeat above procedures until all frequency measured was complete.

Test Data**Environmental Conditions**

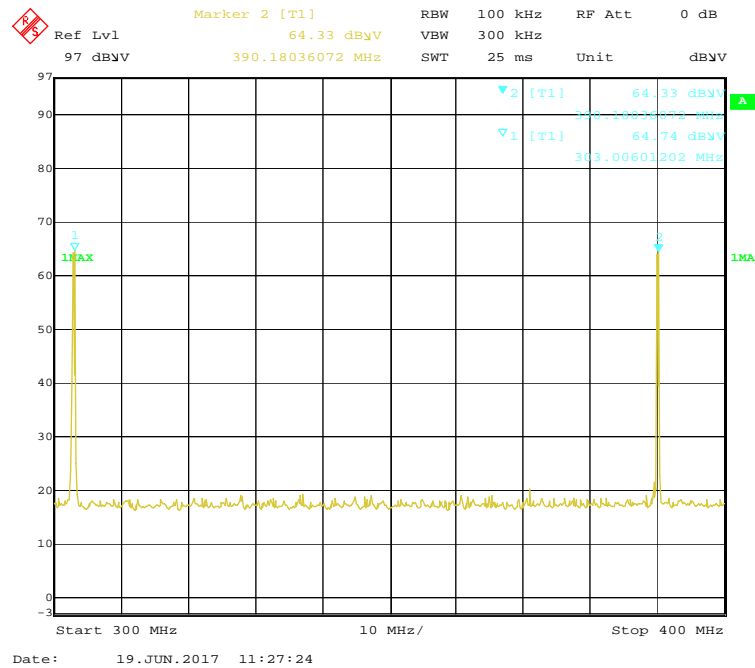
Temperature:	24.1 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Ada Yu on 2017-06-06 to 2017-06-19.

Test mode: Transmitting

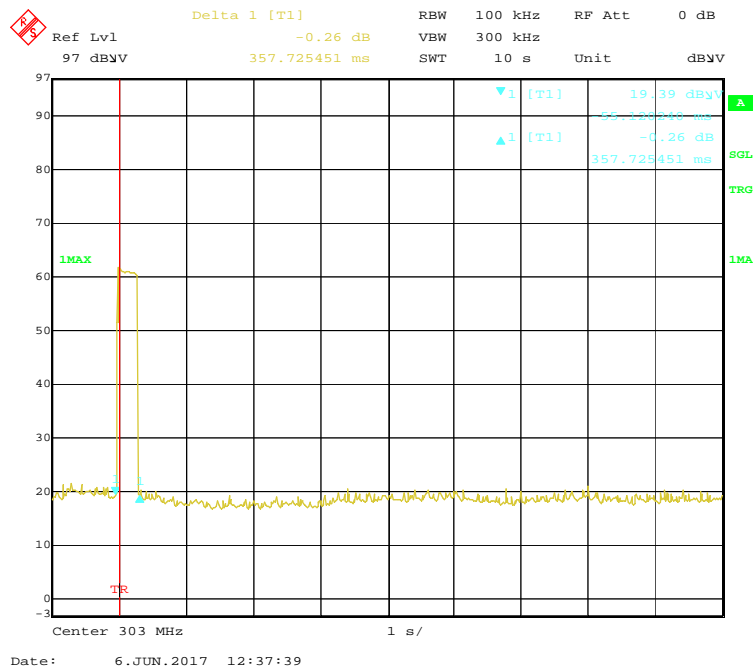
Channel Frequency (MHz)	Transmission Time (s)	Limit (s)	Result
303.00	0.36	<5	Pass
390.00	0.37	<5	Pass

Press the key, The EUT will transmit in 303MHz for 360ms and then shift immediately to 390MHz for 370ms, then stop transmitting.

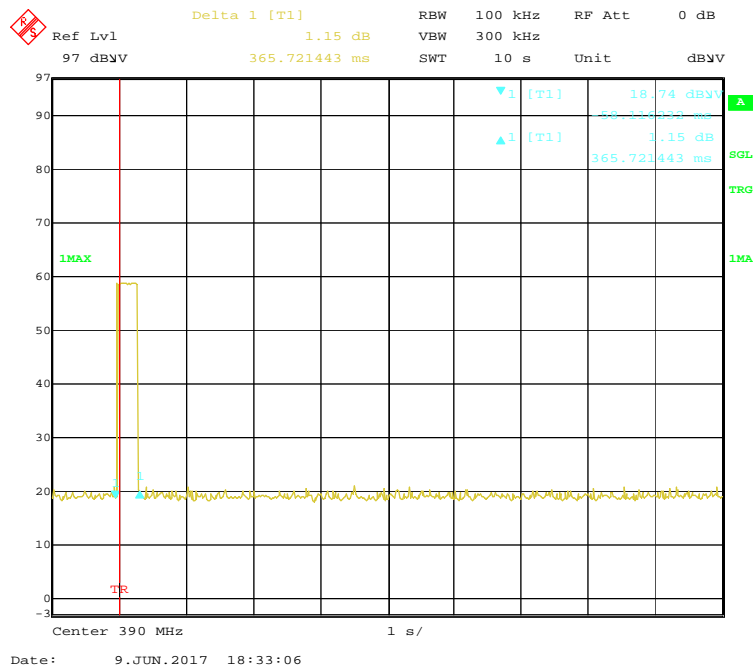


ASK Modulation

Channel 1 :5s



Channel 2:5s



FCC §15.231(c) - 20dB EMISSION BANDWIDTH TESTING**Applicable Standard**

Per 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Procedure

With the EUT's antenna attached, the waveform was received by the test antenna which was connected to the spectrum analyzer, plot the 20 dB bandwidth.

Test Data**Environmental Conditions**

Temperature:	24.1 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Ada Yu on 2017-06-06.

Test Mode: Transmitting

Please refer to following table and plot.

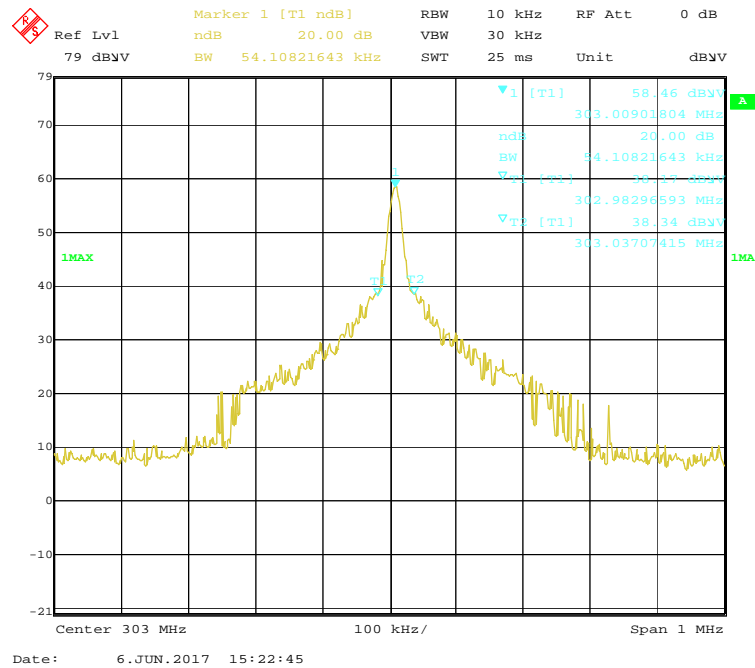
ASK modulation:

Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Result
303.00	54.11	757.5	Pass
390.00	56.11	975.0	Pass

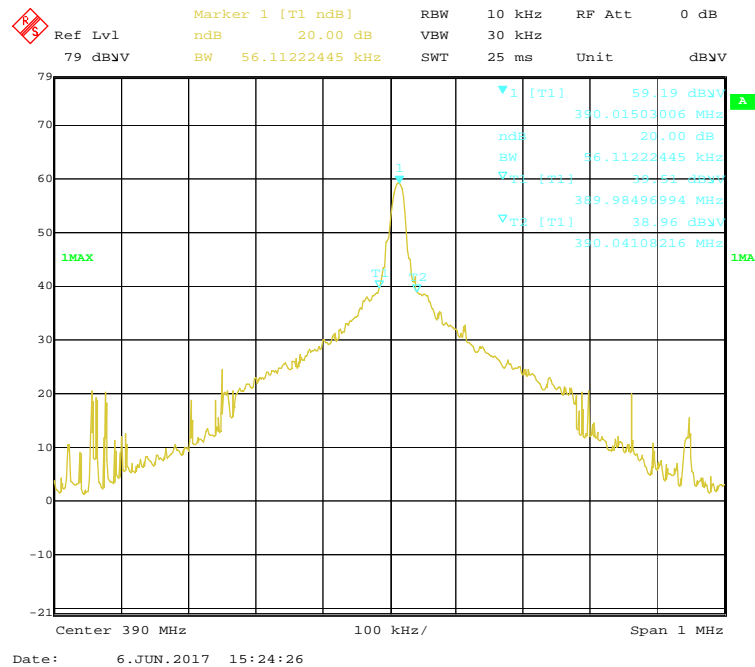
Note: Channel 1 Limit = 0.25% * Center Frequency = 0.25% * 303.00 MHz = 757.5 kHz

Channel 2 Limit = 0.25% * Center Frequency = 0.25% * 390.00 MHz = 975.0 kHz

Channel 1: 20 dB Emission Bandwidth



Channel 2: 20 dB Emission Bandwidth



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