



Test Report

Date : 2019-07-05
No. : HM19050032

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Applicant: Gatekeeper Systems (HK) Ltd.
36/F, Tower 2, Times Square, 1 Matheson Street, Causeway Bay,
Hong Kong

Manufacturer: Gatekeeper Systems (HK) Ltd.
36/F, Tower 2, Times Square, 1 Matheson Street, Causeway Bay,
Hong Kong

Description of Sample(s): Product: Retrieval Key
Brand Name: Gatekeeper Systems
Model Number: K-9300
FCC ID: W3Z-K9300

Date Sample(s) Received: 2019-05-27

Date Tested: 2019-06-08 to 2019-06-11

Investigation Requested: Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 and ANSI C63.10:2013 for FCC Certification.

Conclusion(s): The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

Remark(s): ---




CHEUNG Chi, Kenneth
Authorized Signatory

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1.0 General Details

1.1 Equipment Under Test [EUT] Description of Sample(s)

Product: Carttronics CRFII
Manufacturer: Gatekeeper Systems (HK) Ltd.
36/F, Tower 2, Times Square, 1 Matheson Street, Causeway Bay, Hong Kong
Brand Name: Gatekeeper Systems
Model Number: CRFII
Rating: 100-240V a.c, 0.5A

1.2 Description of EUT Operation

The Equipment Under Test (EUT) is transmitter of Gatekeeper Systems (HK) Ltd., which is 2.4GHz transceiver.
The CRFII Operational mode transmissions are modulated at O-QPSK &FSK. The EUT was tested under test mode which was set in maximum output power and transmit continuously.

1.3 Date of Order

2018-12-20

1.4 Submitted Sample(s):

2 Samples

1.5 Test Duration

2019-01-05 to 2019-01-20

1.6 Country of Origin

China

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2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations and ANSI C63.10:2013 for FCC Certification.

2.2 Test Standards and Results Summary Tables

EMISSION Results Summary					
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result	
				Pass	Fail
Field Strength of Fundamental & Harmonics Emissions	FCC 47CFR 15.249	ANSI C63.10:2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AC power-line conducted emissions	FCC 47CFR 15.207	ANSI C63.10:2013	N/A	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Radiated Emissions	FCC 47CFR 15.209	ANSI C63.10:2013	N/A	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Note: N/A - Not Applicable

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3.0 Test Results

3.1 Emission

3.1.1 Field Strength of Fundamental & Harmonics Emissions

Test Requirement:	FCC 47CFR 15.249
Test Method:	ANSI C63.10:2013
Test Date:	2019-06-11
Mode of Operation:	Tx Mode

Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. In the frequency range of 9kHz to 30MHz, The center of the loop antenna shall be 1 meter above the ground and rotated loop axis for maximum reading. The emissions worst-case are shown in Test Results of the following pages.

Remark: 3 orthogonal axis apply to hand-held device only.

*: Semi-anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd.
FCC Test Firm Registration Number 723883
Designation Number HK0001

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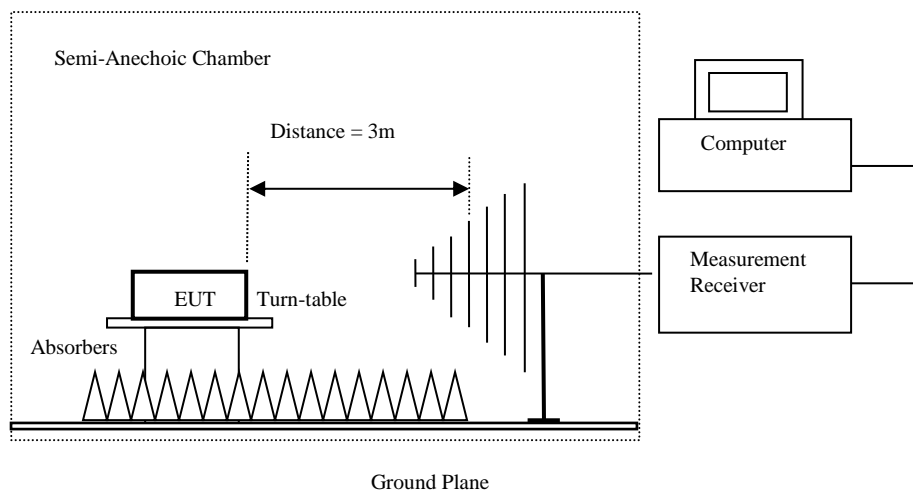
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Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)	RBW: 10kHz VBW: 30kHz Sweep: Auto Span: Fully capture the emissions being measured Trace: Max. hold
30MHz – 1GHz (QP)	RBW: 120kHz VBW: 120kHz Sweep: Auto Span: Fully capture the emissions being measured Trace: Max. hold
Above 1GHz (Pk & Av)	RBW: 3MHz VBW: 3MHz Sweep: Auto Span: Fully capture the emissions being measured Trace: Max. hold

Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used, 9kHz to 30MHz loop antennas are used.
- For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground

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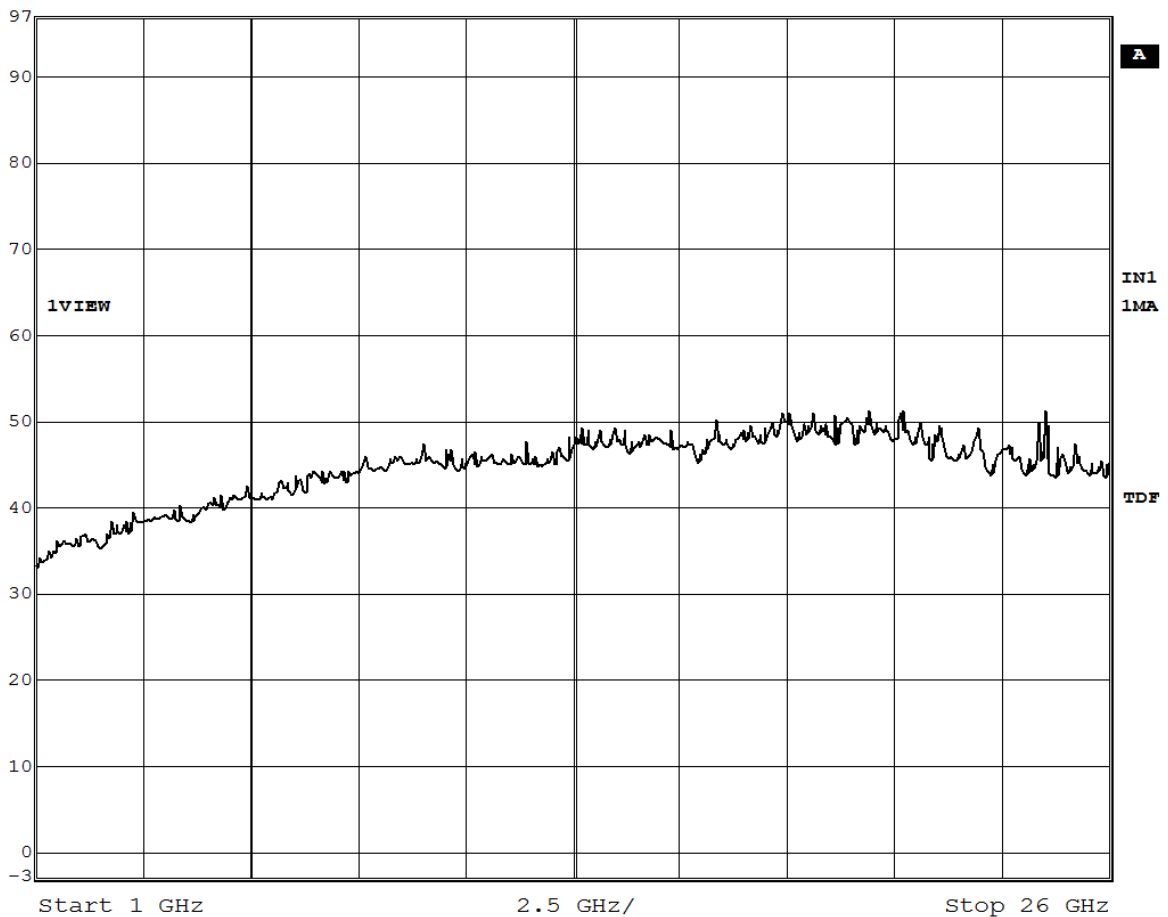
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Limits for Field Strength of Fundamental & Harmonics Emissions [FCC 47CFR 15.249]:

Fundamental frequency [MHz]	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

Result of TX mode (Lowest Channel), (Above 1GHz): Pass

 UNCAL RBW 1 MHz RF Att 0 dB
Ref Lvl VBW 1 MHz
97 dB* SWT 250 ms Unit dB μ V/m



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Result of TX mode (Lowest Channel), (Above 1GHz): Pass

Field Strength of Fundamental and Harmonics Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dB μ V/m	Correction Factor dB μ V/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit @3m μ V/m	E-Field Polarity
2402.0	64.4	27.9	92.3	41,209.8	500,000	Vertical
* 4804.0	4.1	32.1	36.2	64.6	5,000	Vertical
7206.0	1.1	38.6	39.7	96.6	5,000	Vertical
9608.0	Emissions detected are more than 20 dB below the FCC Limits				5,000	Vertical
* 12010.0					5,000	Vertical
14412.0					5,000	Vertical
16814.0					5,000	Vertical
* 19216.0					5,000	Vertical
21618.0					5,000	Vertical
24020.0					5,000	Vertical

Field Strength of Fundamental and Harmonics Emissions						
Average Value						
Frequency MHz	Measured Level @3m dB μ V/m	Correction Factor dB μ V/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit @3m μ V/m	E-Field Polarity
2402.0	53.9	27.9	81.8	12,302.7	50,000	Vertical
* 4804.0	0.8	32.1	32.9	44.2	500	Vertical
7206.0	-1.3	38.6	37.3	73.3	500	Vertical
9608.0	Emissions detected are more than 20 dB below the FCC Limits				500	Vertical
* 12010.0					500	Vertical
14412.0					500	Vertical
16814.0					500	Vertical
* 19216.0					500	Vertical
21618.0					500	Vertical
24020.0					500	Vertical

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.



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Result of TX mode (Middle Channel), (Above 1GHz): Pass

Field Strength of Fundamental and Harmonics Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dB μ V/m	Correction Factor dB μ V/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit @3m μ V/m	E-Field Polarity
2440.0	63.7	27.9	91.6	38,018.9	500,000	Vertical
* 4880.0	3.8	32.1	35.9	62.4	5,000	Vertical
* 7320.0	1.9	38.6	40.5	105.9	5,000	Vertical
9760.0	Emissions detected are more than 20 dB below the FCC Limits				5,000	Vertical
* 12200.0					5,000	Vertical
14640.0					5,000	Vertical
17080.0					5,000	Vertical
* 19520.0					5,000	Vertical
21960.0					5,000	Vertical
24400.0					5,000	Vertical

Field Strength of Fundamental and Harmonics Emissions						
Average Value						
Frequency MHz	Measured Level @3m dB μ V/m	Correction Factor dB μ V/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit @3m μ V/m	E-Field Polarity
2440.0	54.7	27.9	82.6	13,489.6	50,000	Vertical
* 4880.0	0.9	32.1	33.0	44.7	500	Vertical
* 7320.0	-1.5	38.6	37.1	71.6	500	Vertical
9760.0	Emissions detected are more than 20 dB below the FCC Limits				500	Vertical
* 12200.0					500	Vertical
14640.0					500	Vertical
17080.0					500	Vertical
* 19520.0					500	Vertical
21960.0					500	Vertical
24400.0					500	Vertical

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.



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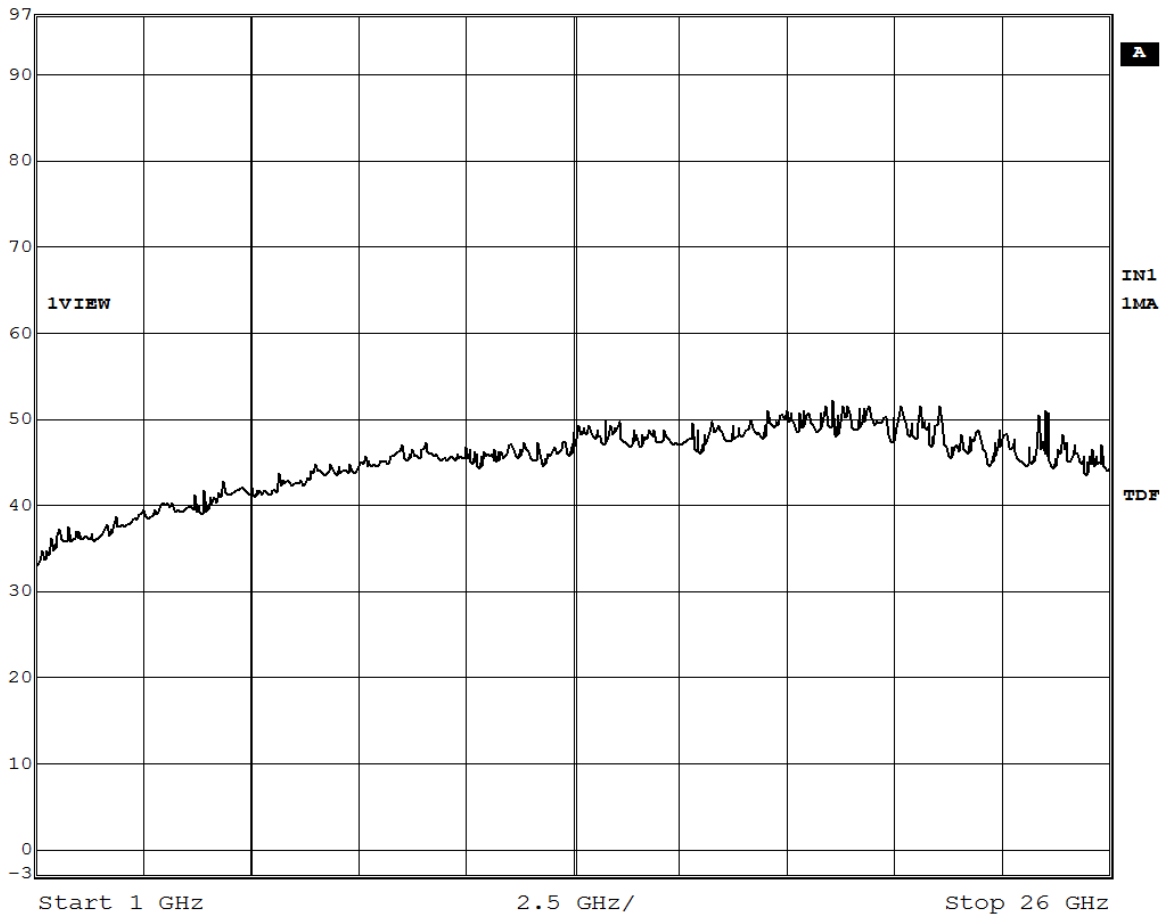
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Result of TX mode (Highest Channel), (Above 1GHz): Pass



UNCAL	RBW	1 MHz	RF Att	0 dB
Ref Lvl	VBW	1 MHz		
97 dB*	SWT	250 ms	Unit	dB μ V/m



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Result of TX mode (Highest Channel), (Above 1GHz): Pass

Field Strength of Fundamental and Harmonics Emissions						
Peak Value						
Frequency MHz	Measured Level @3m dB μ V/m	Correction Factor dB μ V/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit @3m μ V/m	E-Field Polarity
2480.0	70.5	27.9	98.4	83,176.4	500,000	Vertical
* 4960.0	5.7	32.1	37.8	77.6	5,000	Vertical
* 7440.0	1.9	38.6	40.5	105.9	5,000	Vertical
9920.0	Emissions detected are more than 20 dB below the FCC Limits				5,000	Vertical
* 12400.0					5,000	Vertical
14880.0					5,000	Vertical
17360.0					5,000	Vertical
* 19840.0					5,000	Vertical
22320.0					5,000	Vertical
24800.0					5,000	Vertical

Field Strength of Fundamental and Harmonics Emissions						
Average Value						
Frequency MHz	Measured Level @3m dB μ V/m	Correction Factor dB μ V/m	Field Strength dB μ V/m	Field Strength μ V/m	Limit @3m μ V/m	E-Field Polarity
2480.0	59.7	27.9	87.6	23,988.3	50,000	Vertical
* 4960.0	1.3	32.1	33.4	46.8	500	Vertical
* 7440.0	-1.5	38.6	37.1	71.6	500	Vertical
9920.0	Emissions detected are more than 20 dB below the FCC Limits				500	Vertical
* 12400.0					500	Vertical
14880.0					500	Vertical
17360.0					500	Vertical
* 19840.0					500	Vertical
22320.0					500	Vertical
24800.0					500	Vertical

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver, please refer the band-edge plot for the level of fundamental frequency.

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

*: Denotes restricted band of operation.

Measurements were made using a peak detector. Any emission less than 1000 MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Calculated measurement uncertainty : 9kHz to 30MHz: 2.4dB
 30MHz to 18GHz: 5.0dB
 18GHz – 26.5Hz: 5.24dB

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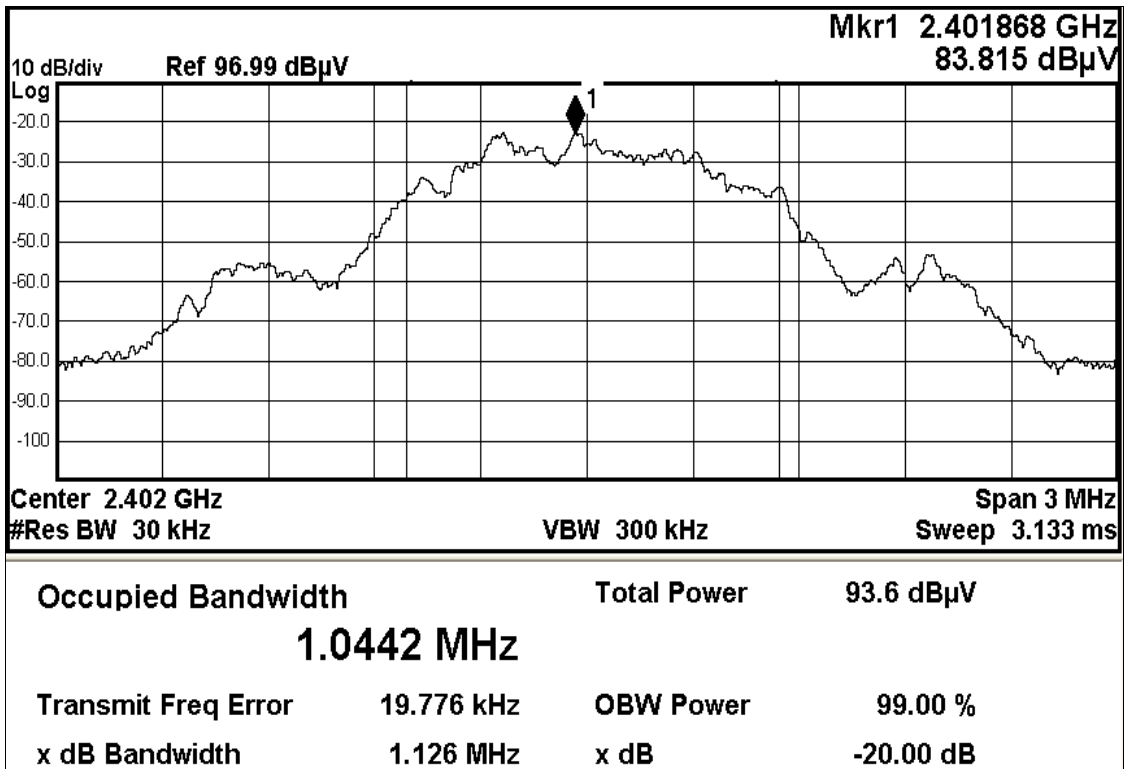
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Limits for 20dB Bandwidth of Fundamental Emission:

Frequency Range [MHz]	20dB Bandwidth [MHz]
2402.0	1.126

TX mode (Lowest Channel)

20dB Bandwidth of Fundamental Emission



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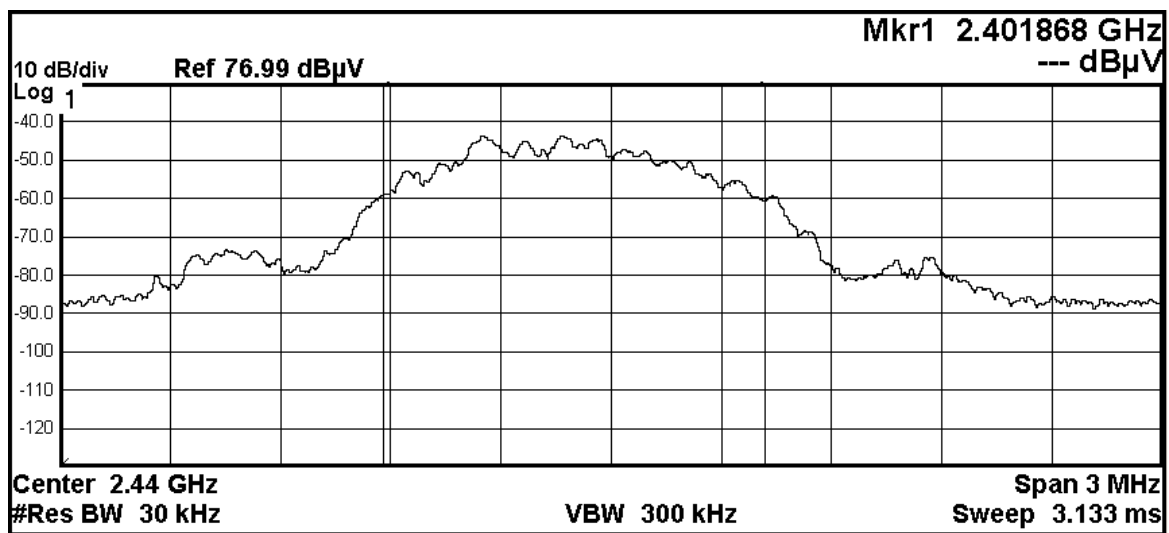
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Frequency Range [MHz]	20dB Bandwidth [MHz]
2440.0	1.148

TX mode (Middle Channel)

20dB Bandwidth of Fundamental Emission



Occupied Bandwidth	Total Power	73.5 dBµV
1.0372 MHz		
Transmit Freq Error	-99.117 kHz	OBW Power
x dB Bandwidth	1.148 MHz	99.00 %
	x dB	-20.00 dB



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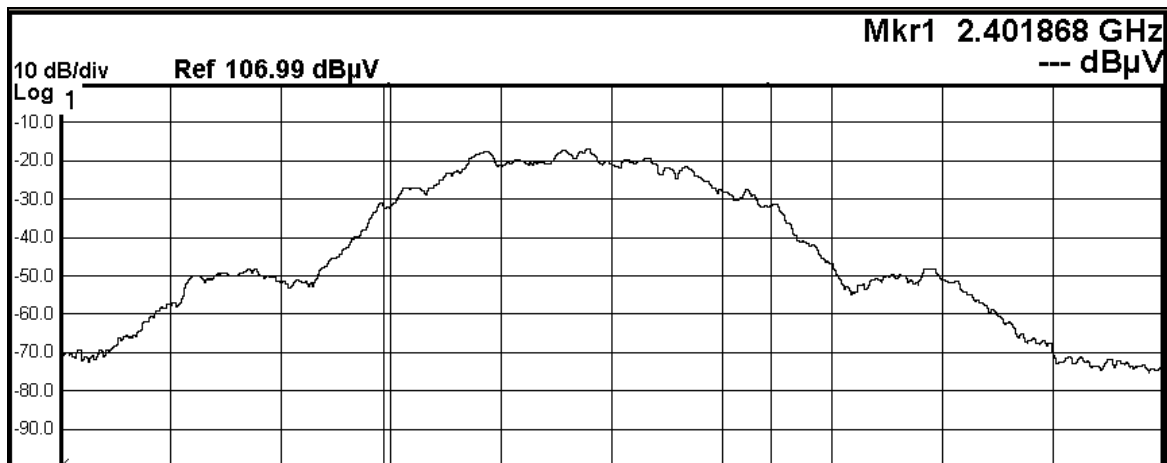
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Frequency Range [MHz]	20dB Bandwidth [MHz]
2480.0	1.148

TX mode : CC2430 Highest Channel

20dB Bandwidth of Fundamental Emission



Center 2.48 GHz Span 3 MHz
 #Res BW 30 kHz VBW 300 kHz Sweep 3.133 ms

Occupied Bandwidth	Total Power	101 dBμV
1.0468 MHz		
Transmit Freq Error	-90.555 kHz	OBW Power
x dB Bandwidth	1.148 MHz	x dB
		99.00 %
		-20.00 dB



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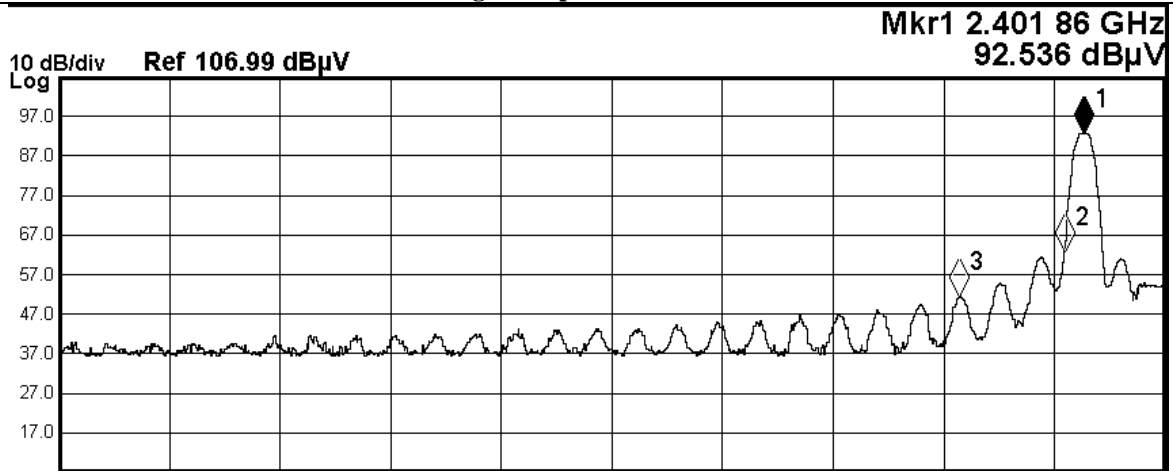
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Band Edge Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
2400MHz – Lowest Fundamental	30.6

Band Edge Compliance Measurement



Start 2.3000 GHz Res BW 1.0 MHz VBW 50 MHz Stop 2.4100 GHz Sweep 1.000 ms (1001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.401 86 GHz	92.536 dBμV			
2	N	1	f	2.400 00 GHz	62.766 dBμV			
3	N	1	f	2.389 54 GHz	51.226 dBμV			
4								



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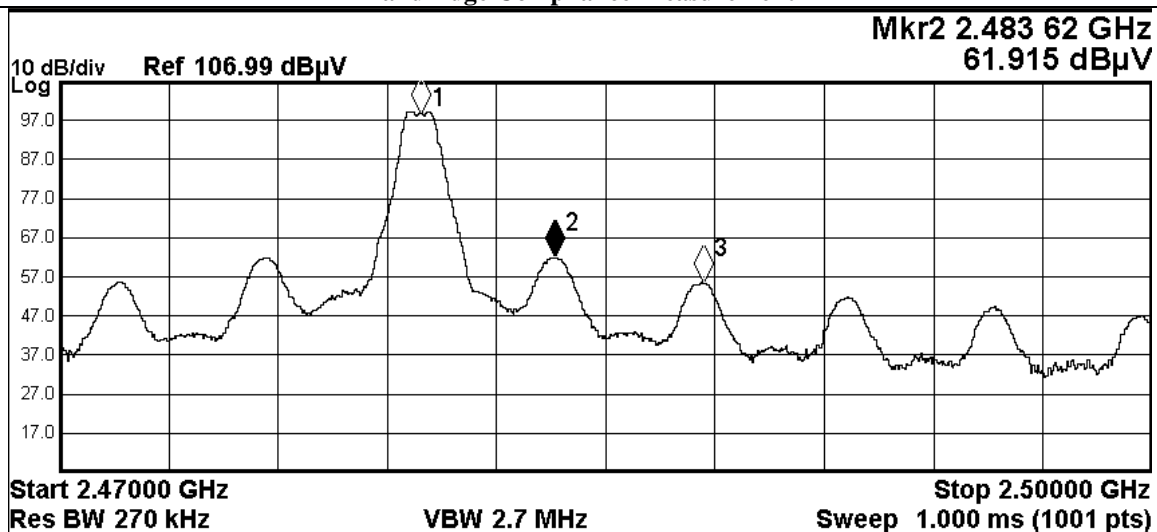
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Band Edge Measurement:

Frequency Range [MHz]	Radiated Emission Attenuated below the Fundamental [dB]
Highest Fundamental – 2483.5MHz	36.0

Band Edge Compliance Measurement



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.479 93 GHz	98.762 dBμV			
2	N	1	f	2.483 62 GHz	61.915 dBμV			
3	N	1	f	2.487 67 GHz	55.396 dBμV			
4								

Result of TX mode: CC2430, Band-edge measurement: PASS

Field Strength of Fundamental and Harmonics Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2389.5	23.3	27.9	51.2	363.1	5,000	Vertical
2487.7	27.5	27.9	55.4	588.8	5,000	Vertical

Field Strength of Fundamental and Harmonics Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2389.5	12.8	27.9	40.7	108.4	500	Vertical
2487.7	16.4	27.9	44.3	164.1	500	Vertical



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Limits for Radiated Emissions [FCC 47 CFR 15.209]:

Frequency Range [MHz]	Quasi-Peak Limits [μ V/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Remarks: Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate in the table below is the worst case rate with respect to the specific test item.
Investigation has been done on all the possible configurations for searching the worst cases.

Result of TX mode, (9kHz – 30MHz): PASS

Emissions detected are more than 20 dB below the FCC Limits

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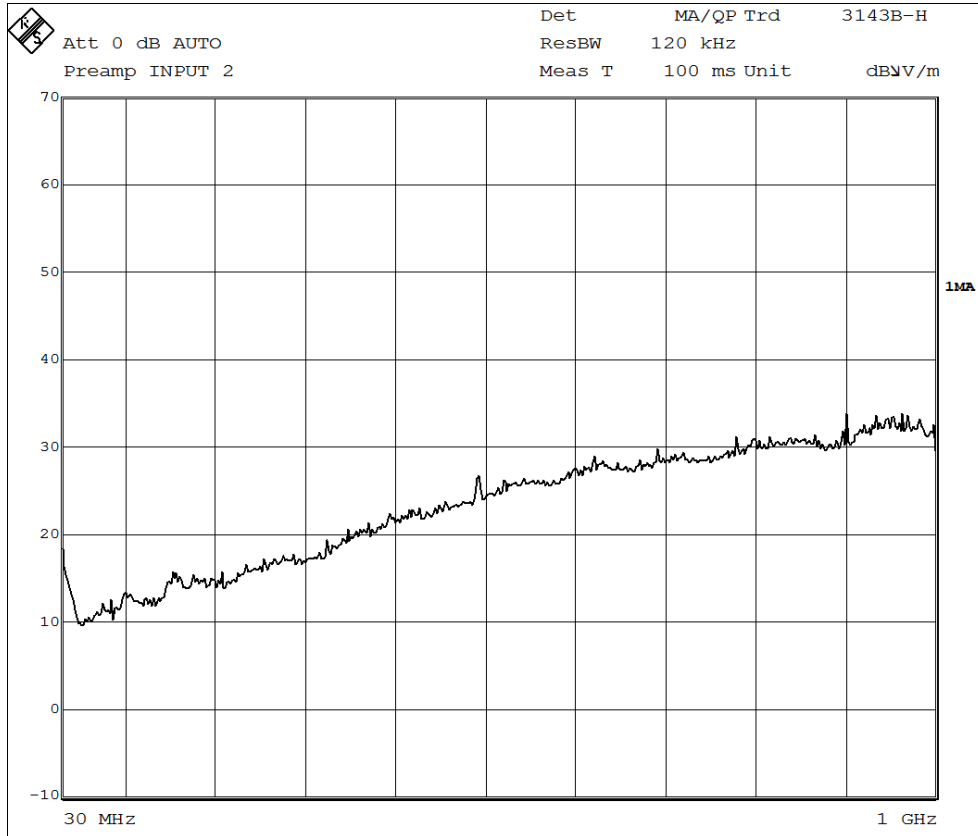


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Result of TX mode (30MHz – 1GHz): PASS



Field Strength of Fundamental and Harmonics Emissions						
Quasi-Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
38.4	9.8	7.5	17.3	7.3	100	Horizontal
111.4	5.4	8.4	13.8	4.9	150	Horizontal
224.5	4.8	10.5	15.3	5.8	150	Horizontal
387.4	6.8	18.2	25.0	17.8	200	Horizontal
512.8	3.4	21.2	24.6	17.0	200	Horizontal
598.4	2.3	21.1	23.4	14.8	200	Horizontal



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Result of Receiver mode, (9kHz – 30MHz): N/A

Result of Receiver mode, (30MHz – 1GHz): N/A

Result of Receiver mode, (1GHz – 18GHz): N/A

Remarks:

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz
Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty	:	(9kHz – 30MHz):	2.4dB
		(30MHz – 18GHz):	5.0dB
		(18GHz - 26GHz):	5.24dB

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Appendix A

LIST OF MEASUREMENT EQUIPMENT

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2019/04/24	2020/04/24
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM355	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00201783	2019/03/11	2021/03/11
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2019/06/11	2020/06/11
EM299	DOUBLE-RIDGED WAVEGUIDE HORN ANTENNA	ETS-LINDGREN	3115	00114120	2018/04/27	2020/04/27
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2018/05/13	2020/05/13
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2018/03/16	2020/03/16

Remarks:

CM Corrective Maintenance
N/A Not Applicable or Not Available
TBD To Be Determined

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Appendix B

Photographs of EUT

Front View of the product



Rear View of the product



Rear View of the product



Rear View of the product



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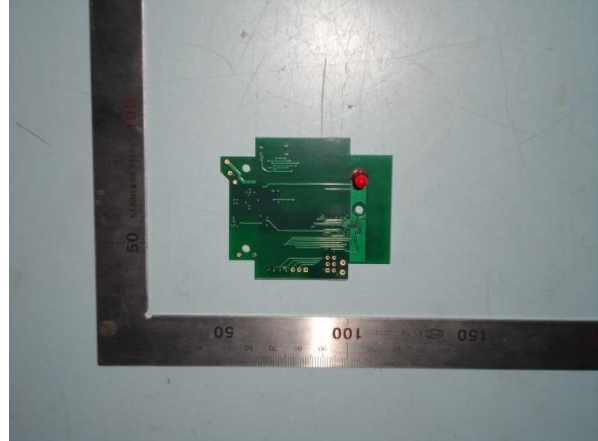
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Photographs of EUT

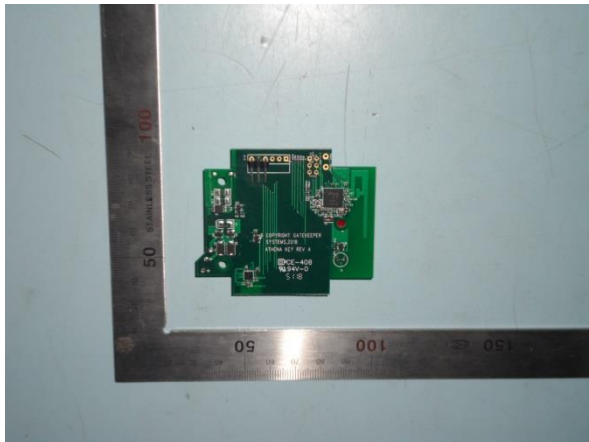
Inner View of the Product



PCB Front View of the Product



PCB Bottom View of the Product



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Photographs of EUT

Measurement of Radiated Emission Test Set Up (9kHz to 30MHz)



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Photographs of EUT

Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)



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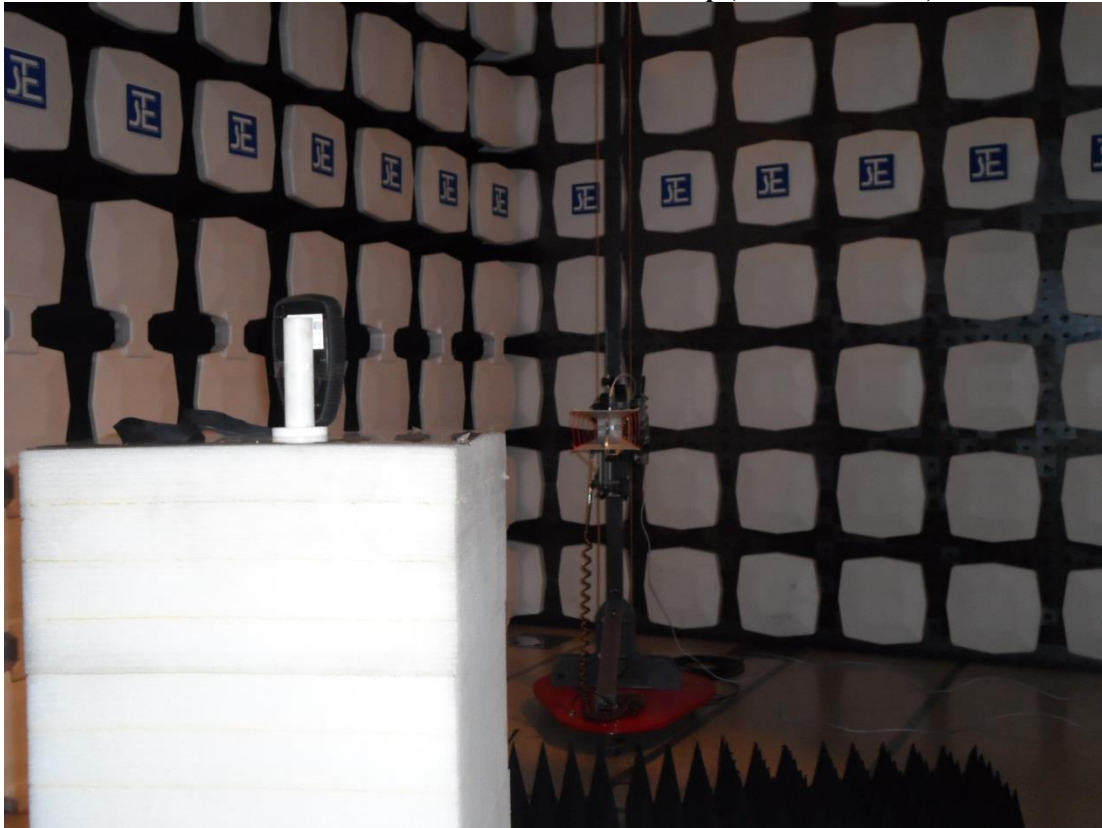
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Photographs of EUT

Measurement of Radiated Emission Test Set Up (Above 1000MHz)



******* End of Test Report *******

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