

FCC / IC Test Report

FOR:

Telular Corporation

Model Name: SCR GXT5002C

Product Description:

The GXT5002C is a solar powered GPS asset management solution that provides enhanced asset utilization and cargo visibility

FCC ID: MTFGXT5002C IC ID: 2175D-GXT5002C

Applied Rules and Standards:

47 CFR Part 15.247 (DTS) RSS-247 Issue 2 (DTS) & RSS-Gen Issue 5

REPORT #: EMC_TELUL-076-19001_15.247_ISM_DTS

DATE: 2019-08-29



A2LA Accredited

IC recognized # 3462B-2

CETECOM Inc.

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Date of Report 2019-08-29

FCC ID: MTFGXT5002C IC ID: 2175D-GXT5002C

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1 <u>Assessment</u>

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company	Description	Model #
Telular Corporation	The GXT5002C is a solar powered GPS asset management solution that provides enhanced asset utilization and cargo visibility	GXT5002C

Responsible for Testing Laboratory:

O. I		
Cindy	1	
Ciriay	_	-

2019-08-29	Compliance	(EMC Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

Chin Ming Lui

2019-08-29	Compliance	(Associate EMC Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.



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Administrative Data 2

Identification of the Testing Laboratory Issuing the EMC Test Report 2.1

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Cathy Palacios

Identification of the Client 2.2

Applicant's Name:	Telular Corporation
Street Address:	3225 Cumberland Blvd, Suite 300
City/Zip Code	Atlanta, GA 30339
Country	USA

2.3 **Identification of the Manufacturer**

Manufacturer's Name:	
Manufacturers Address:	Same as Client
City/Zip Code	Same as Client
Country	



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3 **Equipment Under Test (EUT)**

3.1 **EUT Specifications**

Model No:	GXT5002C		
HW Version :	REV C		
SW Version :	CM.00.01.1025		
FCC-ID:	MTFGXT5002C		
IC-ID:	2175D-GXT5002C		
HVIN:	REV C		
PMN:	Falcon GXT5002C		
Product Description:	The GXT5002C is a solar powered GPS asset management solution that provides enhanced asset utilization and cargo visibility		
Frequency Range / number of channels:	Nominal band: 905 MHz – 924 MHz; Center to center: 905 MHz (ch 0) – 924 MHz (ch 19), 20 channels		
Type(s) of Modulation:	2GFSK		
Modes of Operation:	ISM radio in both advertising and connected mode of operation		
Antenna Information as declared:	Max Gain: 0.8 dBi		
Max. Peak Output Power:	Conducted Power: 20.36 dBm		
Power Supply/ Rated Operating Voltage Range:	Battery / Vmin: 6.2 VDC/ Vnom: 12 VDC / Vmax: 17 VDC		
Operating Temperature Range:	-30 °C to 70 °C		
Other Radios included in the device:	 LTE Module name: Sierra Wireless Model number: HL7688 FCC ID: N7NHL7688 IC ID: 2417C-HL7688 Frequency Band of Operation: FDD LTE 2 FDD LTE 4 FDD LTE 5 		



FDD LTE 17 Main Antenna Type: Ethertronics P822601 Location: Internal ■ Gain: 2 dBi ❖ WCDMA (UMTS) Module name: Sierra Wireless Model number: HL7688 FCC ID: N7NHL7688 IC ID: 2417C-HL7688 Frequency Band of Operation: **UMTS II** UMTS V Main Antenna Type: Ethertronics P822601 Location: Internal Gain: 2 dBi ❖ GPS Module: Quectel L80 Antenna location: Internal **Sample Revision:** □Prototype Unit; ■ Production Unit; ☐ Pre-Production



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3.2 **EUT Sample details**

EUT#	Serial Number	HW Version	SW Version	Notes/Comments
1	GXL7ESPD180464594	REV C	CM.00.01.1025	Radiated Measurement
2	GXL7ESPD180464717	REV C	CM.00.01.1025	Radiated Measurement
3	GXL7ESPD180464645	REV C	CM.00.01.1025	Conducted Measurement

Support Equipment 3.3

SE#	Туре	Model	Manufacturer	Serial Number
1	DC Power Supply	1672	BK PRECISION	1672002260611085
2	Debug Board and Cable	Interposer Rev XA	Telular Corporation	IMAG 94V-0 BD02 3616

3.4 **Test Sample Configuration**

EUT Set-up #	Combination of AE used for test set up	Comments
1 EUT#1 or EUT#2		Radiated RF measurements were performed by configuring the ISM radio of the unit to low, mid, and high channels via customer provided special commands through command window that will not be available to the end user
2	EUT#3	Conducted RF measurements were performed by configuring the ISM radio of the unit to low, mid, and high channels via customer provided special commands through command window that will not be available to the end user.



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3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels at maximum output power. Based on client declaration, the EUT was configured to the highest duty cycle. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r01 – "GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES" – February 11, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.



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5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(a)(1) RSS-247 5.2(1)	Emission Bandwidth	Nominal	2GFSK	•			Complies
§15.247(e) RSS-247 5.2(2)	Power Spectral Density	Nominal	2GFSK	•			Complies
§15.247(b)(1) RSS-247 5.4(4)	Maximum Conducted Output Power and EIRP	Nominal	2GFSK				Complies
§15.247(d) RSS-247 5.5	Band edge compliance Unrestricted Band Edges	Nominal	2GFSK	•			Complies
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	2GFSK	•			Complies
§15.247(d); §15.209 RSS-Gen 6.13	TX Spurious emissions- Radiated	Nominal	2GFSK	•			Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	2GFSK				N/A ²

Note1: NA= Not Applicable; NP= Not Performed. **Note2**: EUT is powered by 12VDC battery

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30 MHz ±2.5 dB (Magnetic Loop Antenna) 30 MHz to 1000 MHz ±2.0 dB (Biconilog Antenna) 1 GHz to 40 GHz ±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz ± 0.7 dB (LISN)

RF conducted measurement ±0.5 dB



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According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: http://physics.nist.gov/cuu/Uncertainty/typeb.html. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

6.1 **Environmental Conditions During Testing:**

The following environmental conditions were maintained during the course of testing:

• Ambient Temperature: 20-25° C

• Relative humidity: 40-60%

6.2 **Dates of Testing:**

07/30/2019 - 08/22/2019



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7 Measurement Procedures

7.1 Radiated Measurement

The radiated measurement is performed according to ANSI C63.10 (2013)

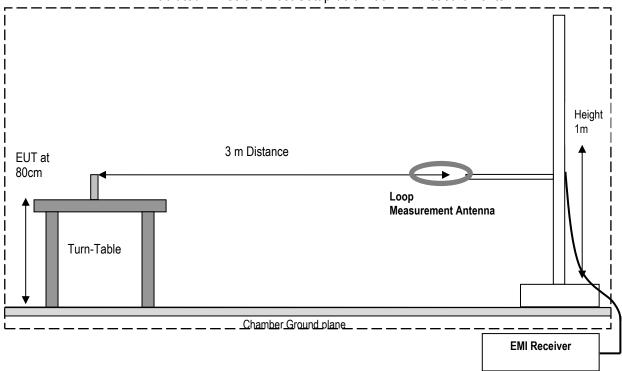
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop
 is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn
 antennas are used to cover frequencies up to 40 GHz.



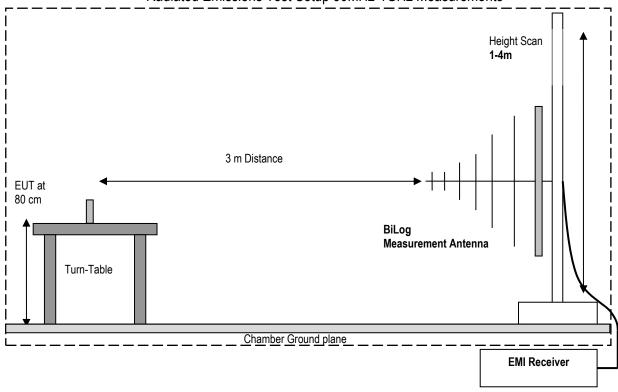
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Radiated Emissions Test Setup below 30MHz Measurements



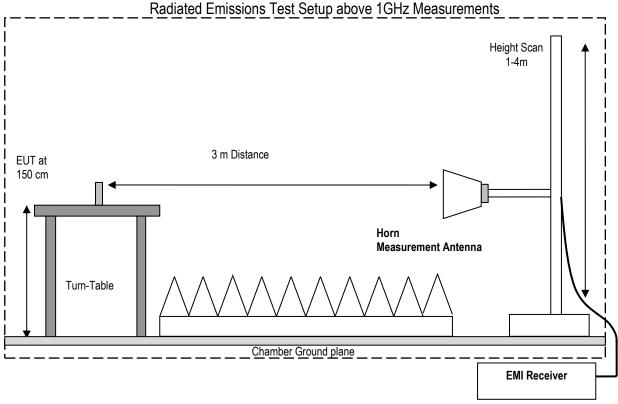
Radiated Emissions Test Setup 30MHz-1GHz Measurements





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Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

- 1. Measured reading in dBµV
- 2. Cable Loss between the receiving antenna and SA in dB and
- 3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS ($dB\mu V/m$) = Measured Value on SA ($dB\mu V$)- Cable Loss (dB)+ Antenna Factor (dB/m)

Example:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0



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7.2 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r01 – "GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES" - February 11, 2019, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode
 of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.
- Calculate the conducted power by taking into account attenuation of the cable and the attenuator



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8 **Test Result Data**

8.1 Maximum Peak Conducted Output Power

8.1.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r01

Spectrum Analyzer settings:

- RBW ≥ DTS bandwidth
- VBW \geq 3 x RBW
- Span $\geq 3 \times RBW$
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use peak marker function to determine the peak amplitude level

8.1.2 Limits:

Maximum Peak Output Power:

• FCC §15.247 (b)(1): 1 W

• IC RSS-247: 1 W

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up#	EUT operating mode	Power Input	Antenna Gain
24.3° C	2	2GFSK continuous fixed channel	12 VDC	0.8 dBi

8.1.4 Measurement result:

Attenuation of cable and attenuator (already taken into account): 21.6 dB

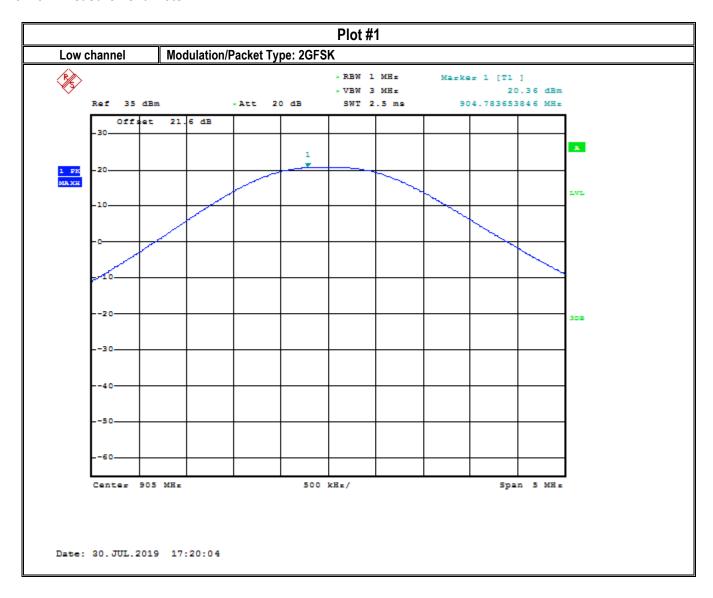
Plot #	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
1	905	20.36	21.16	30 (Pk) / 36 (EIRP)	Pass
2	915	20.32	21.12	30 (Pk) / 36 (EIRP)	Pass
3	924	20.31	21.11	30 (Pk) / 36 (EIRP)	Pass



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Measurement Plots: 8.1.5





Plot #2 Mid channel Modulation/Packet Type: 2GFSK - RBW 1 MHz Marker 1 [T1] · VBW 3 MHz 20.32 dBm Ref 35 dBm -Att 20 dB SWT 2.5 mg 914.807692308 MH± Offset 21.6 dB A 1 PK LVL Span 5 MHz Center 915 MHz 500 kHz/ Date: 15.AUG.2019 17:33:49



Plot #3 High channel Modulation/Packet Type: 2GFSK · RBW 1 MHz Marker 1 [T1] · VBW 3 MHz 20.31 dBm Ref 35 dBm -Att 20 dB SWT 2.5 mg 923.791666667 MHz Offset 21.6 dB A 1 PK MAXH LVL Center 924 MHz Span 5 MHz 500 kHz/ Date: 30.JUL.2019 17:42:25



8.2 Power Spectral Density

8.2.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r01

Spectrum Analyzer settings for Peak PSD method:

- Set analyzer center frequency to DTS channel center frequency
- Set the span to 1.5 x DTS bandwidth
- Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz
- Set the VBW ≥ 3 x RBW
- Detector = Peak
- Sweep time = Auto couple
- Trace mode = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level within the RBW
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat

8.2.2 Limits:

FCC§15.247(e) & RSS-247 5.2(2)

• For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
24.3° C	2	2GFSK continuous fixed channel	12 VDC	0.8 dBi

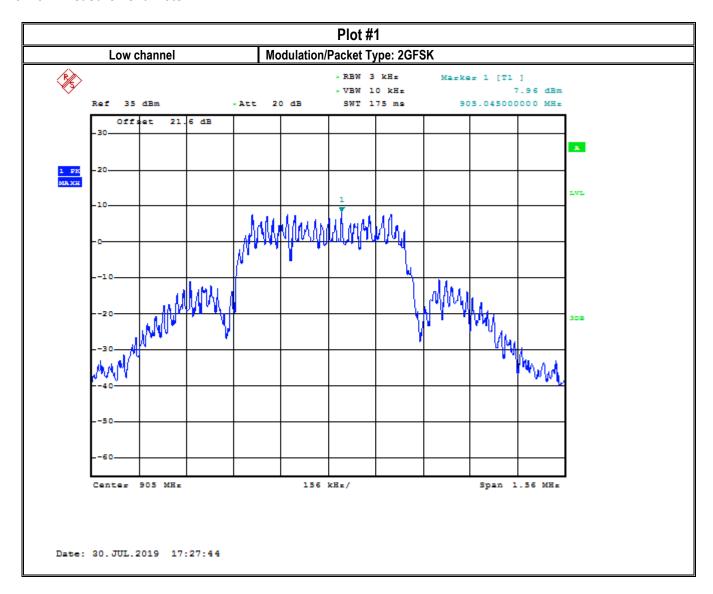
8.2.4 Measurement result:

Attenuation of cable and attenuator (already taken into account): 21.6 dB

Plot #	Frequency (MHz)	Maximum Power Spectral Density (dBm/3 kHz)	Limit (dBm / 3 kHz)	Result
1	905	7.96	8	Pass
2	915	7.90	8	Pass
3	924	7.94	8	Pass



8.2.5 Measurement Plots:





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		Plot #2				
Mid channel	Modulation/Pack	et Type: 2GFSK				
Ref 35 dBm	-Att 20 dB	* RBW 3 kHr * VBW 10 kHr SWT 175 ms		= 1 [T1] 7. 5.0450000	90 dBm	
Offset 21.6 dB						
-30						A
-20-						
-20-						LVL
-10		1 T				
	AA ANDAHAAAA.	dali maddalla i				
0	Was all the sa	h i mi'a ii a kalii				
-10	J°	<u> </u>				
-20				lu.		
30	Ψ		W '	MM.	2	ios
<u> </u>				• 7/4	m/w/	
50-						
60						
Center 915 MHz	156	kHr/		Span 1.	56 MHz	
: 15.AUG.2019 17:42:4	,					



Plot #3 High channel Modulation/Packet Type: 2GFSK - RBW 3 kHz · VBW 10 kHz 7.94 dBm Ref 35 dBm SWT 175 mg 924.045000000 MH± *Att 20 dB 21.6 dB Offset A 1 PK MAXH LVL Center 924 MHz 156 kHz/ Span 1.56 MHz Date: 30.JUL.2019 18:06:40



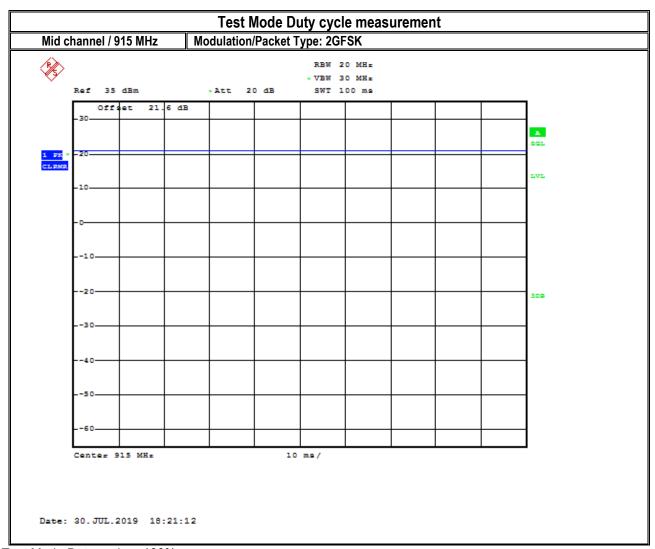
8.3 Duty cycle

8.3.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r01

Spectrum Analyzer settings:

- Set the center frequency and of the instrument to the center frequency of the transmission
- Zero span
- Set RBW >= OBW if possible; otherwise, set RBW to the largest available value
- Detector = Peak or average

8.3.2 Measurement result



Test Mode Duty cycle = 100%

Duty cycle correction factor =10*log (1/1) = 0 dB



8.4 Band Edge Compliance

8.4.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r01

Spectrum Analyzer settings for band edge:

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 100 kHz
- VBW ≥ 3 x RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge

8.4.2 Limits non restricted band:

FCC§15.247 (d)

• In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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• In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB.

Spectrum Analyzer settings for restricted band:

Peak measurements are made using a peak detector and RBW=1 MHz



8.4.3 Limits restricted band §15.247/15.209/15.205 and RSS-Gen 8.9/8.10

• *PEAK LIMIT= 74 dB μ V/m @3m =-21.23 dBm

- *AVG LIMIT= 54 dBµV/m @3m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205 & RSS-Gen 8.10
- Measurements with a peak detector were used to show compliance to average limits, thus showing compliance to both peak and average limits.
- (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

(b)

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

8.4.4 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
24.3° C	2	2GFSK continuous fixed channel	12 VDC	0.8 dBi

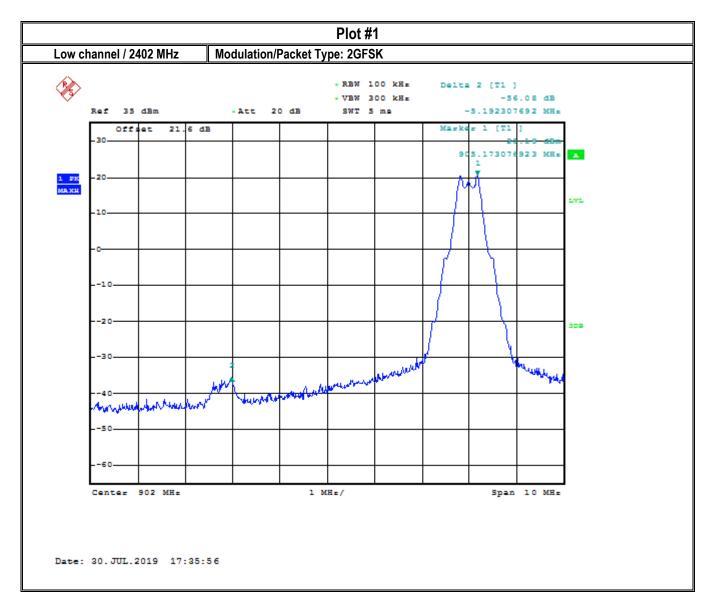
8.4.5 Measurement result:

Plot #	EUT operating mode	Band Edge	Band Edge Delta (dBc)	Limit (dBc)	Result
1	2GFSK continuous fixed channel	Lower, Non-restricted	56.08	> 20	Pass
2	2GFSK continuous fixed channel	Upper, Non-restricted	54.51	> 20	Pass

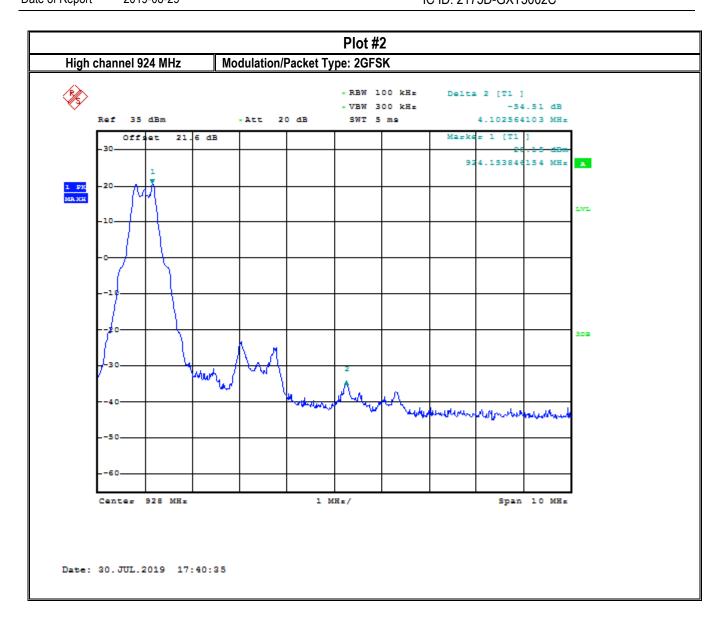


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8.4.6 Measurement Plots:









8.5 Emission Bandwidth 6 dB and 99% Occupied Bandwidth

8.5.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r01

Spectrum Analyzer settings:

- Set RBW = 100 kHz
- Set the video bandwidth (VBW) ≥ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two
 outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the
 maximum level measured in the fundamental emission.

8.5.2 Limits:

FCC §15.247(a)(1) and RSS-247 5.2(1)

• Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.5.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
24.3° C	2	2GFSK continuous fixed channel	12 VDC

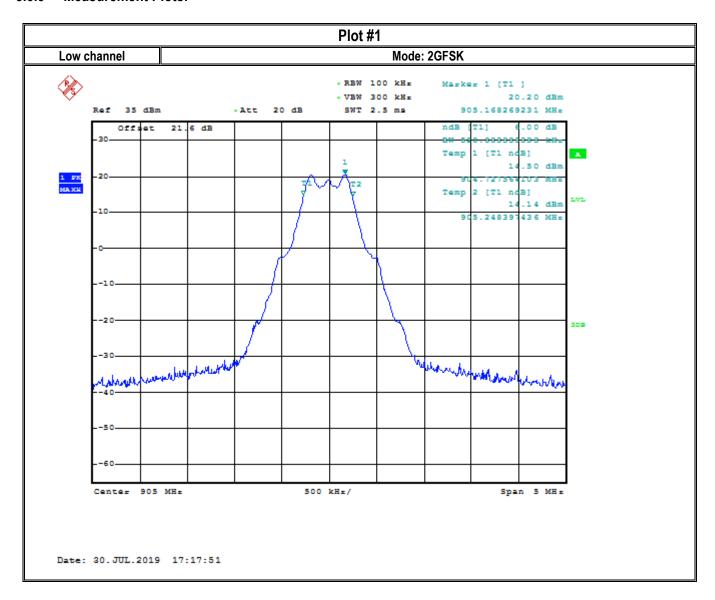
8.5.4 Measurement result:

Plot #	Frequency (MHz)	6 dB Emissions Bandwidth (MHz)	Limit (MHz)	Result
1	905	0.5208	> 0.5	Pass
2	915	0.5208	> 0.5	Pass
3	924	0.5208	> 0.5	Pass

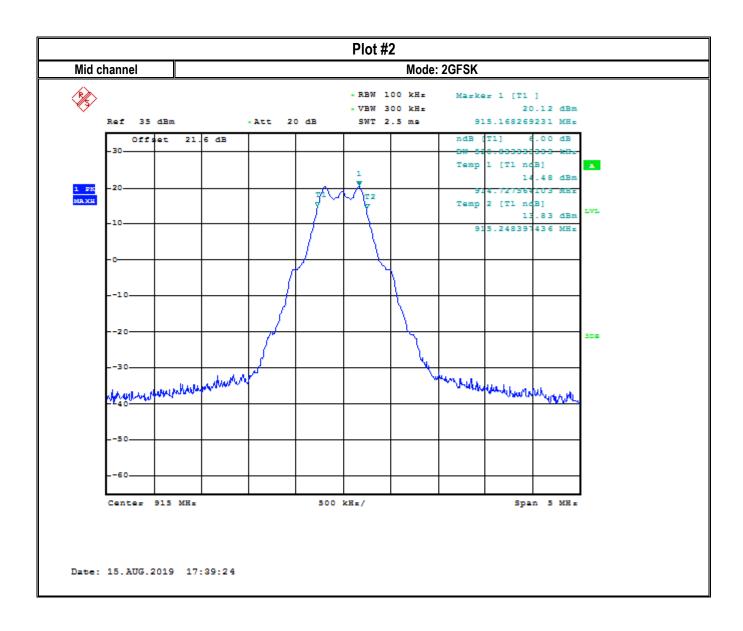
Plot #	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
4	905	0.7051	> 0.5	Pass
5	915	0.7051	> 0.5	Pass
6	924	0.6571	> 0.5	Pass



8.5.5 Measurement Plots:







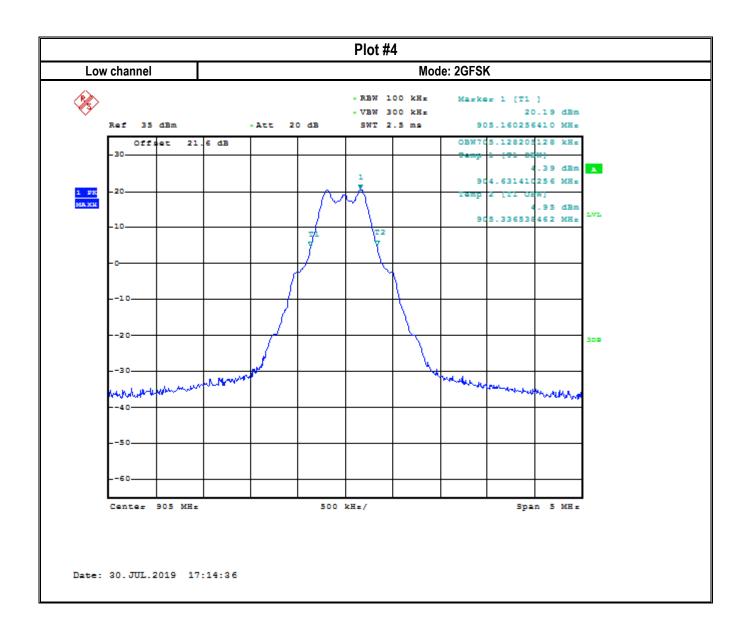


Plot #3 High channel Mode: 2GFSK * RBW 100 kHz Marker 1 [T1] 20.17 dBm . VBW 300 kH± Ref 35 dBm -Att 20 dB SWT 2.5 mg 924.160256410 MHz Offset 21.6 dB 1 [T1 ndB] Temp 14.44 dBm 1 PK 2 [T1 ndB] Temp 13.85 dBm 924.248397436 MH± Way which which was hought Center 924 MHz Span 5 MHz 500 kHz/ Date: 30.JUL.2019 17:45:10



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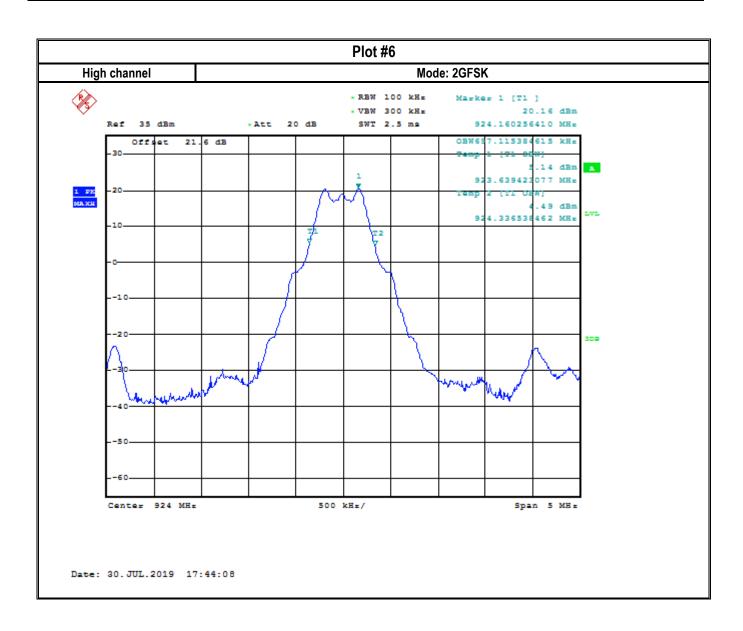


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Plot #5 Mode: 2GFSK Mid channel * RBW 100 kHz Marker 1 [T1] . VBW 300 kHz 20.15 dBm Ref 35 dBm *Att 20 dB SWT 2.5 mg 914.807692308 MH± 21.6 dB Offset .20 dBm 256 MH: 1 PK MAXH .63 dBm 915.336538462 MH± 500 kHz/ Span 5 MHz Center 915 MHz Date: 15.AUG.2019 17:36:41







8.6 Radiated Transmitter Spurious Emissions and Restricted Bands

8.6.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz 30 MHz
- RBW = 9 KHz
- Detector: Peak
- Frequency = 30 MHz 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)
- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz
- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

8.6.2 Limits:

FCC §15.247

• In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).



FCC §15.209 & RSS-Gen 8.9

• Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (μV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009-0.490	2400/F(kHz) /	300	-
0.490–1.705	24000/F(kHz) /	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBμV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBμV/m
Above 960	500	3	54 dBµV/m

FCC §15.205 & RSS-Gen 8.10

• Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41		·	

• Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

*PEAK LIMIT= 74 dBµV/m

*AVG. LIMIT= 54 dBµV/m



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8.6.3 Test conditions and setup:

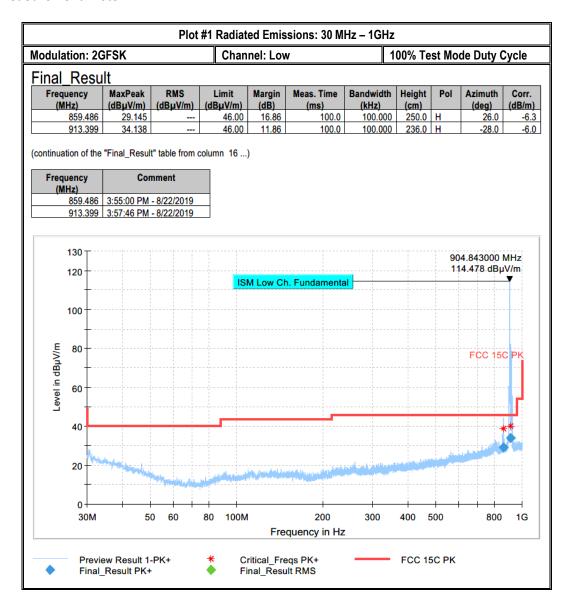
Ambient Temperature	EUT Set-Up#	EUT operating mode	Power Input
24.3° C	1	2GFSK continuous fixed channel	12 VDC

8.6.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-3	Low	30 MHz – 10 GHz	See section 8.5.2	Pass
4-7	Mid	9 kHz – 10 GHz	See section 8.5.2	Pass
8-10	High	30 MHz – 10 GHz	See section 8.5.2	Pass



8.6.5 Measurement Plots:





Plot #2 Radiated Emissions: 1-3 GHz **Modulation: 2GFSK** Channel: Low 100% Test Mode Duty Cycle Final_Result Frequency (MHz) MaxPeak RMS Margin Meas. Time Bandwidth Height Azimuth Corr. Sig Path Limit Pol (dBµV/m) (dBµV/m) (dB) (dB/m) (dBµV/m) (ms) (kHz) (cm) (deg) (dB) 1809.612 61.716 53.98 -7.74300.0 1000.000 208.0 H 54.0 4.9 -21.8 1809.612 65.126 208.0 H 74.00 8.87 300.0 1000.000 54.0 4.9 -21.8 2714.432 44.253 53.98 9.73 300.0 1000.000 137.0 H 108.0 7.8 -20.9 2714.432 52.160 73.99 21.83 300.0 1000.000 137.0 H 108.0 7.8 -20.9 (continuation of the "Final_Result" table from column 17 ...) Raw Rec Frequency Preamp Trd Corr. Comment (dB) (MHz) (dB/m) (dBµV) 1809.612 56.8 11:31:38 AM - 8/16/2019 0.0 26.8 1809.612 0.0 26.8 60.2 11:31:38 AM - 8/16/2019 36.4 11:34:39 AM - 8/16/2019 2714.432 0.0 28.8 2714.432 0.0 28.8 44.3 11:34:39 AM - 8/16/2019 120 110 100 90 80 Level in dBµV/m 70 60 50 40 30 20 10 1G 2G 3G Frequency in Hz Preview Result 1-PK+ Critical_Freqs PK+ FCC 15C PK FCC 15C AVG Final_Result RMS Final_Result PK+

Note: Based on customer declaration, highest duty cycle seen in normal operating mode (when the SCR exchanges information with the wireless sensor) is 6%. The duty cycle correction factor calculated is 12.22 dB and applied to the margin. Worst case margin is at frequency 1809.612 MHz for RMS measurement. After applying the duty cycle correction factor, the corrected margin is 4.48 dB, thus passing FCC average limit of 54 dBµV/m.



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dulati	on: 20	FSK		Chan	nel: Low	ı	1	00% Te	st Mo	de Duty (Cycle
nal	Resu	lt		.,,						-	-
Freque (MH		MaxPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr (dB/n
36	19.230	58.296	`	73.99	15.70	200.0	1000.000	139.0	٧	272.0	-7
	319.230		53.530	53.98	0.45	200.0	1000.000	139.0		272.0	-7
_	31.028	48.719		73.99	25.27	200.0	1000.000	256.0		229.0	-3
	131.028		39.402	53.98	14.58	200.0	1000.000	256.0	V	229.0	-3
		"Final_Resul		column 16)						
Freque (MH	_	Cor	nment								
	319.230	3:49:23 PM	- 8/16/2019								
		3:49:23 PM									
		3:46:04 PM									
54	31.028	3:46:04 PM	- 8/16/2019								
m//	70									FCC 15C	PK AVG
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dula	tion: 2	2GFSK			Chanı	nel: Mid		1	00% Te	st Mo	de Duty	Cycle
nal	Res	ult										
	uency Hz)	QuasiPe (dBµV/r		RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Cori (dB/r
	0.10		$\overline{}$		107.48	44.83	500.0	0.100	100.0		18.0	18
ntinua	20.90			table from o	70.00 column 16)	38.00	500.0	9.000	100.0	V	219.0	16
Frequ	uency			ment								
<u>(M</u>	Hz) 0.10	1 11:00:51	A N.4	8/22/2019								
		5 11:09:36			_							
Level in dBµV/m	100 - 80 - 60 -	Markana			N. I.	Muna	- Annother with	J - F	CC 15 9	kHz co	inverted to	3m
	40 +									No.		
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	0 9k	20	30	50	100k 20	00 300 Freq	500 1M uency in Hz	2M 3	M 5M	10	DM 20	30M
_	FCC	view Result C 15 9kHz o al Result R	onv		* m •		tical_Freqs Pk al_Result QPI					



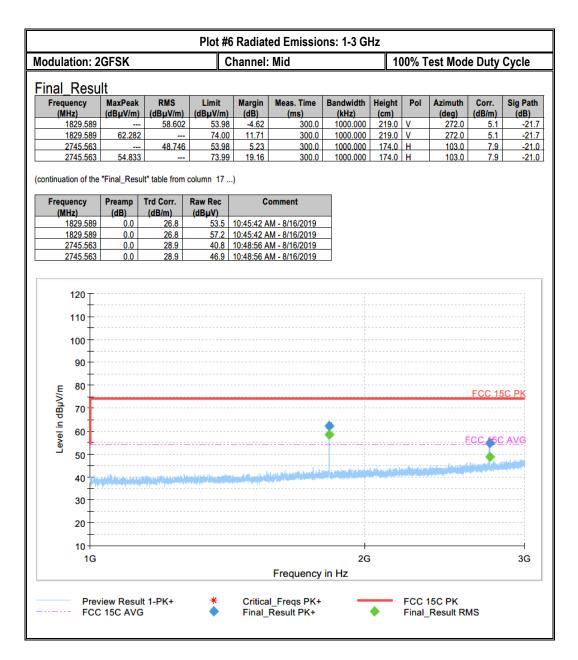
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0.471	MaxPeak	RMS								
9.471		RMS								
			Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr.
	37.747	`	46.00	8.25	100.0	100.000	190.0	Н	17.0	3.
0.124	38.878		46.00 column 16	7.12	100.0	100.000	217.0	H	17.0	3.
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Note: Based on customer declaration, highest duty cycle seen in normal operating mode (when the SCR exchanges information with the wireless sensor) is 6%. The duty cycle correction factor calculated is 12.22 dB and applied to the margin. Worst case margin is at frequency 1829.589 MHz for RMS measurement. After applying the duty cycle correction factor, the corrected margin is 7.60 dB, thus passing FCC average limit of 54 dBµV/m.

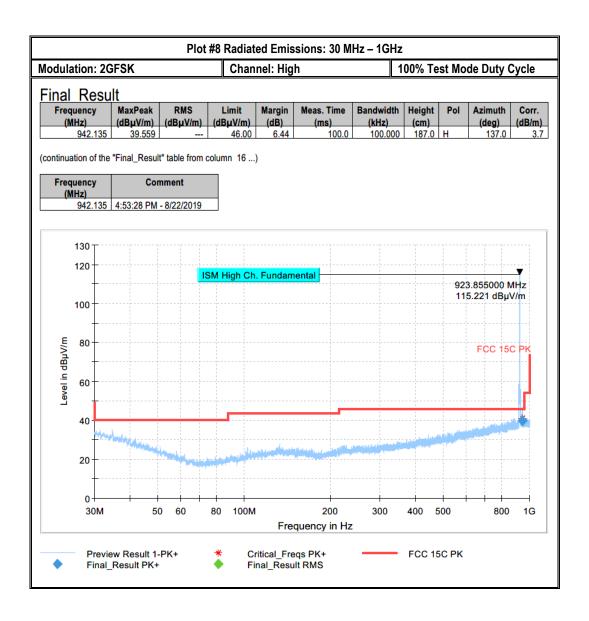


Plot #7 Radiated Emissions: 3-10 GHz **Modulation: 2GFSK** Channel: Mid 100% Test Mode Duty Cycle Final Result Frequency (MHz) MaxPeak **RMS** Limit Margin Meas. Time Bandwidth **Azimuth** Height (dBµV/m) (dBµV/m) (dB) (kHz) (dB/m) (dBµV/m) (ms) (cm) (deg) 3659.217 59.058 14.93 200.0 1000.000 73.99 145.0 V 272.0 -7.7 3659.217 54.530 53.98 -0.55 200.0 1000.000 145.0 V 272.0 -7.7 213.0 V 4574.121 37.673 53.98 16.31 200.0 1000.000 204.0 -6.0 4574.121 46.966 73.99 27.02 200.0 1000.000 213.0 V 204.0 -6.0 5488.645 52.488 73.99 21.50 200.0 1000.000 330.0 V 61.0 -3.6 45.251 200.0 1000.000 330.0 V 61.0 5488.645 53.98 8.73 -3.6 (continuation of the "Final_Result" table from column 16 ...) Comment Frequency (MHz) 3659.217 4:18:21 PM - 8/16/2019 3659.217 4:18:21 PM - 8/16/2019 4574.121 4:15:02 PM - 8/16/2019 4574.121 4:15:02 PM - 8/16/2019 5488.645 4:11:33 PM - 8/16/2019 5488.645 4:11:33 PM - 8/16/2019 100 90 80 70 Level in dBµV/m 60 50 40 30 20 10-3G 5G 10G Frequency in Hz Preview Result 1-PK+ FCC 15C PK FCC 15C AVG Final Result PK+ Final Result RMS

Note: Based on customer declaration, highest duty cycle seen in normal operating mode (when the SCR exchanges information with the wireless sensor) is 6%. The duty cycle correction factor calculated is 12.22 dB and applied to the margin. Worst case margin is at frequency 3659.217 MHz for RMS measurement. After applying the duty cycle correction factor, the corrected margin is 11.67 dB, thus passing FCC average limit of 54 dBµV/m.



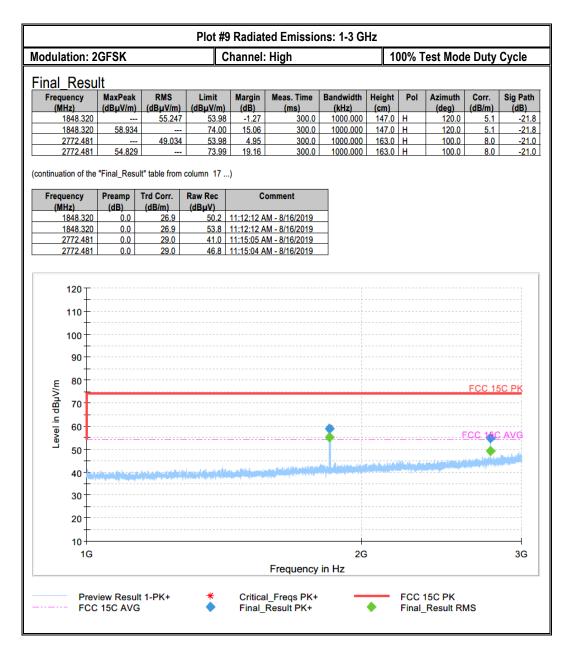
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Note: Based on customer declaration, highest duty cycle seen in normal operating mode (when the SCR exchanges information with the wireless sensor) is 6%. The duty cycle correction factor calculated is 12.22 dB and applied to the margin. Worst case margin is at frequency 1848.320 MHz for RMS measurement. After applying the duty cycle correction factor, the corrected margin is 10.95 dB, thus passing FCC average limit of 54 dBµV/m.



Plot #10 Radiated Emissions: 3-10 GHz **Modulation: 2GFSK** Channel: High 100% Test Mode Duty Cycle Final Result MaxPeak Meas. Time Bandwidth Azimuth Frequency **RMS** Margin Height (MHz) (dBµV/m) (dBµV/m) (dBµV/m) (dB) (kHz) (dB/m) (ms) (cm) (deg) 1000.000 3696.480 58.729 73.99 15.26 200.0 114.0 V 270.0 -7.7 3696.480 54.549 53.98 -0.57 200.0 1000.000 114.0 V 270.0 -7.7 26.99 4619.134 47.001 73.99 200.0 1000.000 327.0 V 317.0 -5.7 4619.134 37.283 53.98 16.70 200.0 1000.000 327.0 V 317.0 -5.7 5542.772 42.977 53.98 11.00 200.0 1000.000 133.0 V 234.0 -4.0 50.663 23.32 200.0 133.0 V 234.0 5542.772 73.99 1000.000 -4.0 (continuation of the "Final_Result" table from column 16 ...) Frequency Comment (MHz) 3696.480 | 4:41:32 PM - 8/16/2019 3696.480 4:41:32 PM - 8/16/2019 4619.134 4:44:36 PM - 8/16/2019 4619.134 4:44:36 PM - 8/16/2019 5542.772 4:38:17 PM - 8/16/2019 5542.772 4:38:16 PM - 8/16/2019 100 90 80 70 Level in dBµV/m 60 50 40 30 20 10 3G 10G Frequency in Hz Preview Result 1-PK+ FCC 15C PK FCC 15C AVG Final Result PK+ Final Result RMS

Note: Based on customer declaration, highest duty cycle seen in normal operating mode (when the SCR exchanges information with the wireless sensor) is 6%. The duty cycle correction factor calculated is 12.22 dB and applied to the margin. Worst case margin is at frequency 3696.480 MHz for RMS measurement. After applying the duty cycle correction factor, the corrected margin is 11.65 dB, thus passing FCC average limit of 54 dBµV/m.



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9 **Test setup photos**

Setup photos are included in supporting file name: "EMC_TELUL-076-19001_15.247_Setup_Photos.pdf"

Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Active Loop Antenna	ETS LINDGREN	6507	00161344	3 years	10/26/2017
Biconlog Antenna	TESEO	CBL 6141B	41106	3 years	11/01/2017
Horn Antenna	EMCO	3115	00035111	3 years	04/17/2019
Horn Antenna	ETS LINDGREN	3117	00167061	3 years	08/08/2017
Signal Analyzer	R&S	FSU26	200302	3 years	07/16/2019
Signal Analyzer	R&S	FSV 40	101022	3 years	07/15/2019
Thermometer Humidity Monitor	CONTROL COMPANY	36934-164	191871994	2 years	01/10/2019
DC Power Supply	BK PRECISION	1672	1672002260611085	N/A	N/A

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.



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11 Revision History

Date	Report Name	Changes to report	Report prepared by	
2019-08-29	EMC_TELUL-076-19001_15.247_ISM_DTS	Initial version	Chin Ming Lui	