EMC
TEST REPORT

Report No. : TS12040057-EME
Model No. : F21-6S-TX
Issued Date : May 11, 2012

Applicant: **Intercontinental Technologies, Ltd.**
558-2 Plate Drive, East Dundee IL 60118 USA

Test Method/ Standard: **47 CFR FCC Part 15.231 & ANSI C63.4 2003**

Test By: **Intertek Testing Services Taiwan Ltd.**
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,
Shiang-Shan District, Hsinchu City, Taiwan

The test report was prepared by: Sign on File
Julie Wang / Senior Assistant

These measurements were taken by: Sign on File
Hugo Yeh / Engineer

The test report was reviewed by: Jimmy Yang

Name Jimmy Yang
Title Engineer

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Summary of Tests

Test Item	Reference	Results
Timing requirement of manually operated transmitter	15.231(a)(1)	Pass
Radiated Emission test	15.231(b), 15.209	Pass
Measured bandwidth	15.231(c)	Pass
Conducted Emission test	15.231(b), 15.207	N/A

1. General information

1.1 Identification of the EUT

Product:	Industrial Radio Remote Control Transmitter
Model No.:	F21-6S-TX
FCC ID.:	JI9-F21-6S-007
Frequency Range:	311.6375 MHz
Channel Number:	Single channel
Frequency of Each Channel:	311.6375 MHz
Access scheme:	AFSK
Power Supply:	DC 3 V from battery
Power Cord:	N/A
Sample Received:	Apr. 03, 2012
Test Date(s):	Apr. 16, 2012 ~ May 04, 2012
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Additional information about the EUT

The EUT is Industrial Radio Remote Control Transmitter, and was defined as information technology equipment.

For more detail features, please refer to User's manual as file name “Installation guide.pdf”

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain : ≦1.5 dBi
Antenna Type : Helical antenna
Connector Type : N/A

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 2.1053 and the requirement in FCC Part 15 Subpart C Section 15.231.

2.2 Operation mode

The EUT was transmitted continuously during the test.

2.3 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2011/12/6	2012/12/4
Spectrum Analyzer	Rohde&schwarz	FSP30	100137	2011/6/29	2012/6/28
Spectrum Analyzer	Rohde&schwarz	FSEK30	100186	2012/2/6	2013/2/5
Horn Antenna (1-18G)	Schwarzbeck	BBHA 9120 D	9120D-456	2010/8/31	2012/8/30
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2010/9/3	2012/9/2
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2011/7/26	2013/7/25
Pre-Amplifier	MITEQ	AFS44-00102650 --42-10P-44	1495287	2011/10/27	2013/10/26
Pre-Amplifier	MITEQ	JS4-26004000--2 7-8A	828825	2010/9/8	2012/9/7
Power Meter	Anritsu	ML2495A	0844001	2011/10/13	2012/10/12
Power Senor	Anritsu	MA2411B	0738452	2011/10/13	2012/10/12
Temperature&Humidity Test Chamber	TERCHY	MHU-225LRU(SA)	950838	2011/6/17	2012/6/16
Two-Line V-Network	Rohde&schwarz	ESH3-Z5	838979/014	2011/10/19	2012/10/18

Note: The above equipments are within the valid calibration period.

3. Radiated emission test FCC 15.231 (b)

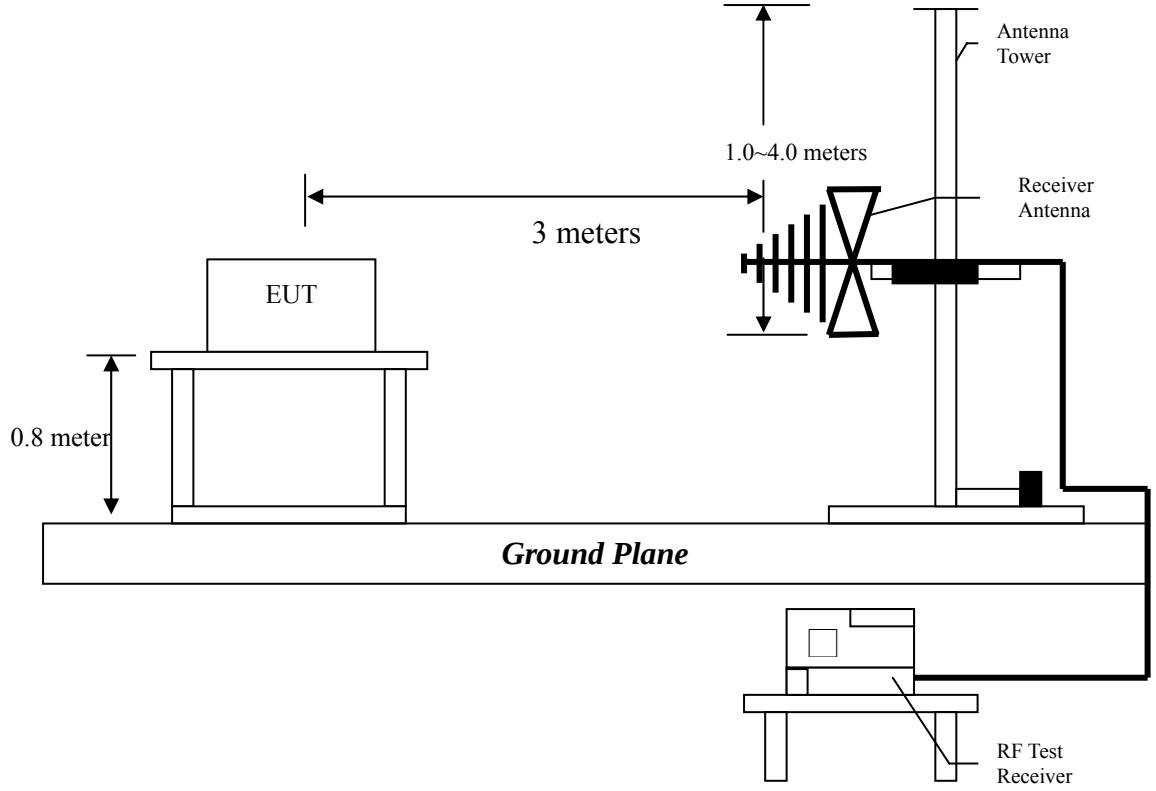
3.1 Operating environment

Temperature:	24	℃
Relative Humidity:	55	%
Atmospheric Pressure	1008	hPa

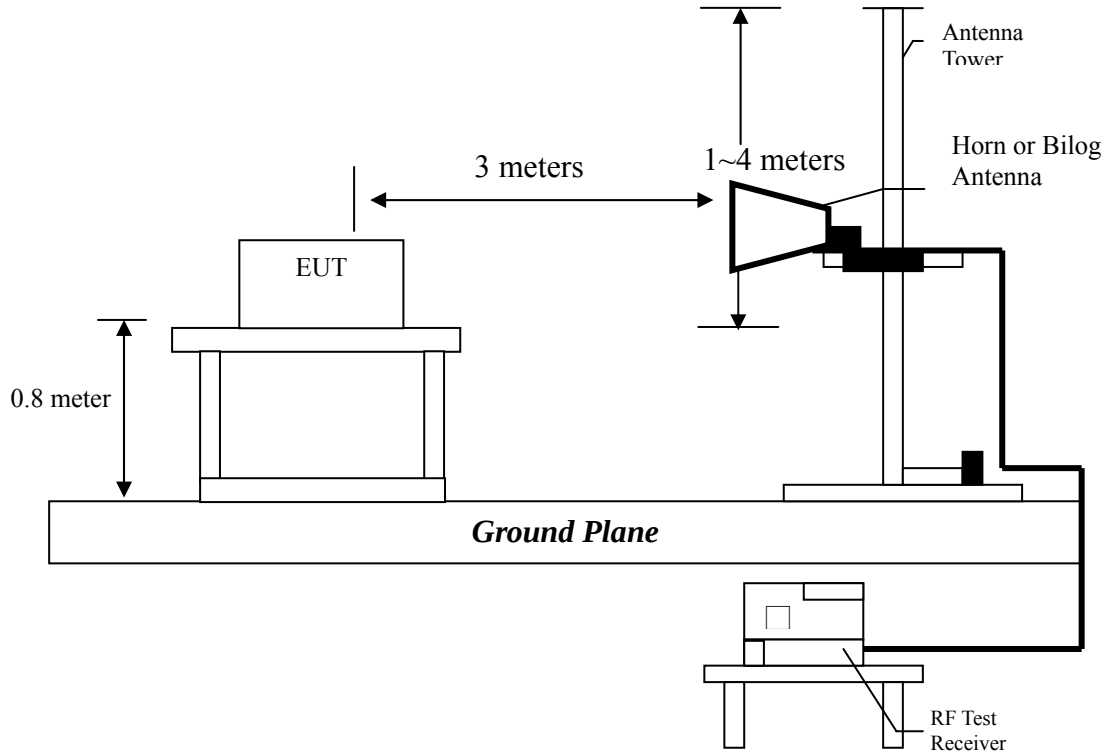
3.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.

The frequency spectrum from 30MHz to 1000MHz was investigated.



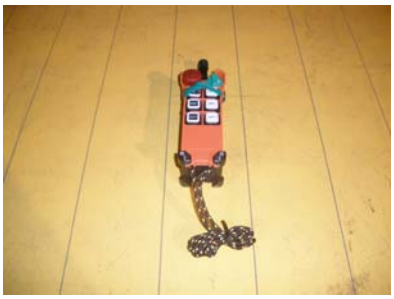
The frequency spectrum from over 1GHz was investigated.



The signal is maximized through rotation and placement in the three orthogonal axes.
Radiated emission measurements were performed from 30 MHz to 25 GHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1 GHz, 1MHz – for frequencies above 1 GHz.
The EUT for testing is arranged on a fiberglass turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

The signal is maximized through rotation and placement in the three orthogonal axes.



X axis

Y axis

Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at Z axis. The final test data was executed under this configuration.

The EUT configuration please refer to the "Spurious set-up photo.pdf".

3.3 Radiated emission limit

3.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(uV/m@3 m)	(dBuV/m@3 m)	(uV/m@3 m)	(dBuV/m@3 m)
311.6375	59020.11	95.42	5902.01	75.42

3.3.2 General radiated emission limit

The spurious Emission shall test through the 10th harmonic. 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).

Frequency MHz	15.209 Limits (dBμV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Measurement uncertainty was calculated in accordance with TR 100 028-1.

Parameter	Uncertainty
Radiated Emission	±5.056 dB
Conducted Emission	±2.786 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of *k*=2.

3.4 Calculation of Average Factor

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured in 100 ms or the repetition cycle, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer in zero span mode at 100 resolution bandwidth.

Model: F21-6S-TX

Averaging factor in dB = 20log (duty cycle)

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 203.4ms. It is greater than 100ms. Use the 100ms for duration of one cycle.

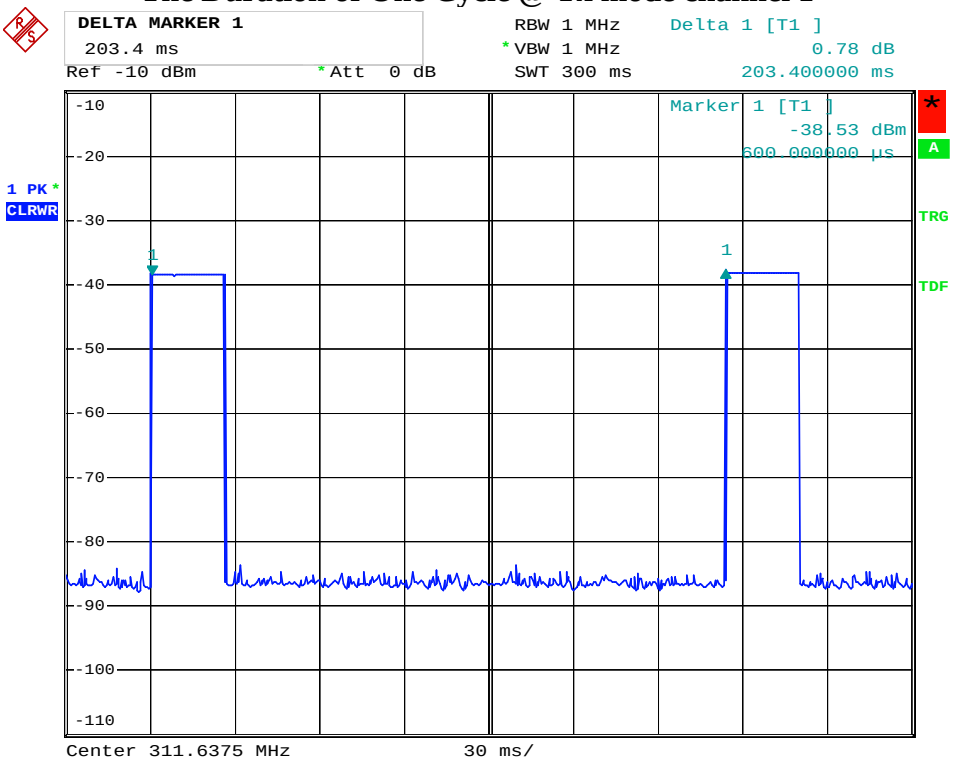
The pulses in each period = 26.2ms

Duty Cycle = 26.2 ms / 100 ms = 0.262

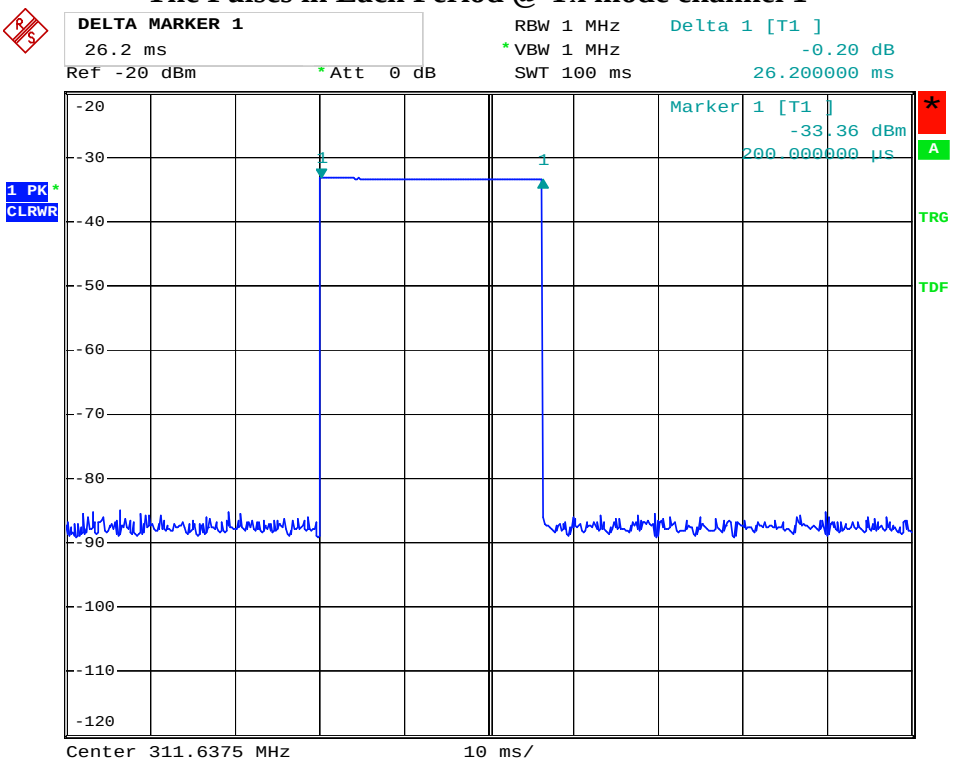
Therefore, the duty cycle correction factor will be $20 \log_{10} 0.262 = -11.63$ dB

Please see the plot below.

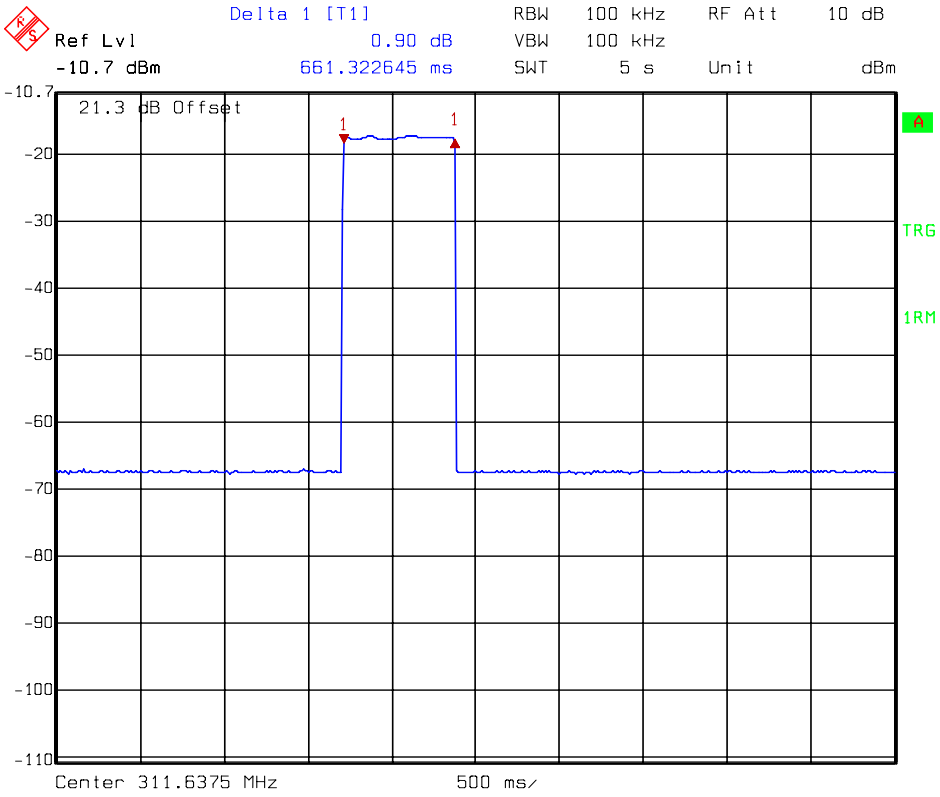
The Duration of One Cycle @ Tx mode channel 1



The Pulses in Each Period @ Tx mode channel 1



Release Time @ Tx mode channel 1



3.5 Radiated emission test data FCC 15.231

3.5.1 Measurement results: Fundamental emission

EUT : F21-6S-TX
Worst Case : Tx at 311.6375 MHz at Z axis

Polarization (circle)	Frequency (MHz)	Detector	Corr. Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Calculated (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Vertical	311.6375	PK	14.10	64.36	-	78.46	95.42	-16.96
Vertical	311.6375	AV	14.10	64.36	-11.63	66.83	75.42	-8.59
Horizontal	311.6375	PK	14.32	55.17	-	69.48	95.42	-25.94
Horizontal	311.6375	AV	14.32	55.17	-11.63	57.85	75.42	-17.57

Remark:
1. Calculated = Reading + Corr. Factor
2. Correction Factor = Antenna Factor + Cable Loss
3. Margin= Calculated – Limit

3.5.2 Measurement results: frequencies equal to or less than 1 GHz

EUT : F21-6S-TX
Worst Case : Tx at 311.6375 MHz at Z axis

Polarization (circle)	Frequency (MHz)	Detector	Corr. Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Calculated (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Vertical	282.20000	PK	13.70	30.06	-	43.75	46.00	-2.25
Vertical	296.75000	PK	13.95	41.15	-	55.10	75.42	-20.32
Vertical	296.75000	AV	13.95	41.15	-11.63	43.47	55.42	-11.95
Vertical	620.73000	PK	20.88	31.77	-	52.64	75.42	-22.78
Vertical	620.73000	AV	20.88	31.77	-11.63	41.01	55.42	-14.41
Horizontal	297.72000	PK	14.17	27.26	-	41.42	75.42	-34.00
Horizontal	297.72000	AV	14.17	27.26	-11.63	29.79	55.42	-25.63
Horizontal	620.73000	PK	20.88	16.76	-	37.63	75.42	-37.79
Horizontal	620.73000	AV	20.88	16.76	-11.63	26.00	55.42	-29.42

Remark:
1. Calculated = Reading + Corr. Factor – Average Factor
2. Correction Factor = Antenna Factor + Cable Loss
3. Margin= Calculated – Limit

3.5.3 Measurement results: frequency above 1GHz

The emissions were very low against the limit in the frequency range above 1 GHz.

4. Measured bandwidth FCC 15.231(C)

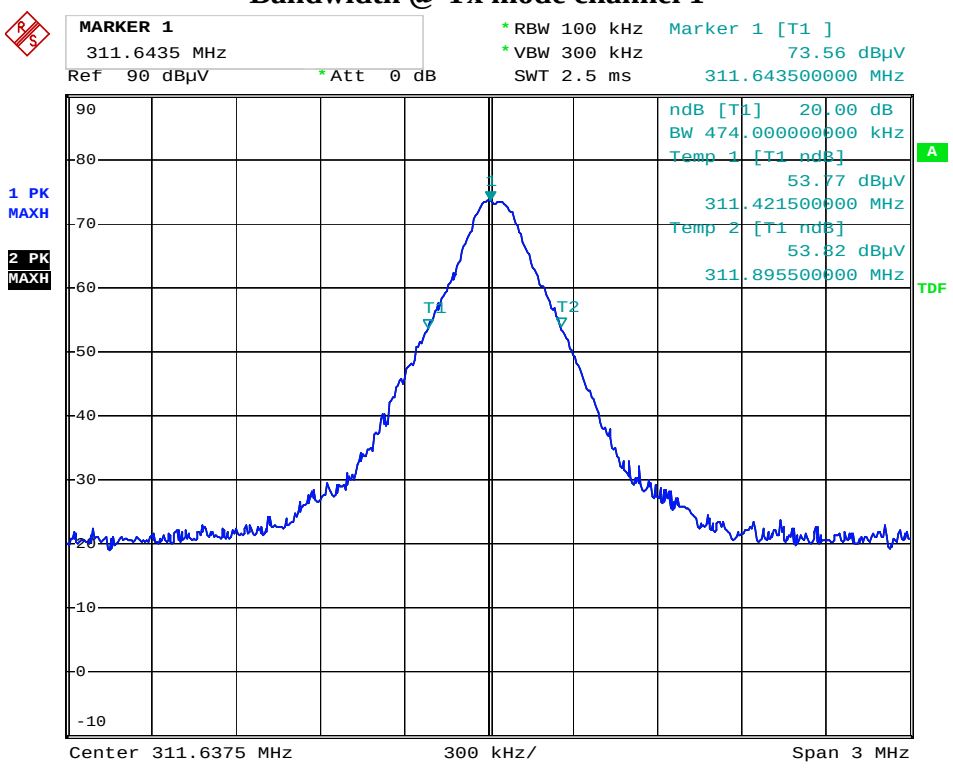
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. Bandwidth is determined at the points 20dB down from the modulated carrier.

B.W(20dBc) Limit = 0.25% × f(MHz) = 0.25% × 311.6375 MHz = 0.7791MHz

From the plot, the bandwidth is observed to be 474.00 kHz, at 20dBc where the bandwidth limit is 0.7791 MHz.

Please see the plot below.

Bandwidth @ Tx mode channel 1



5. Conducted emission FCC 15.207

According to FCC 15.207, the EUT only employs battery power for operation and does not operate from the AC power lines. Therefore, the test can be exempted.