

# EMC TEST REPORT

**Report No. : TS12060158-EME****Model No. : F21-2S-TX****Issued Date : Jul. 23, 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**

It may be duplicated completely for legal use with the allowance of the applicant. It shall not be reproduced except in full, without the written approval of Intertek Laboratory. The test result(s) in this report only applies to the tested sample(s).

**The test report was prepared by:**Sign on File  
Jill Chen / Assistant**These measurements were taken by:**Sign on File  
Terry Hsu / Engineer**The test report was reviewed by:****Name** Jimmy Yang  
**Title** Engineer

## Table of Contents

|                                                                         |    |
|-------------------------------------------------------------------------|----|
| Summary of Tests .....                                                  | 3  |
| 1. General information .....                                            | 4  |
| 1.1 Identification of the EUT .....                                     | 4  |
| 1.2 Additional information about the EUT.....                           | 4  |
| 1.3 Antenna description.....                                            | 5  |
| 2. Test specifications .....                                            | 6  |
| 2.1 Test standard.....                                                  | 6  |
| 2.2 Operation mode .....                                                | 6  |
| 2.3 Test equipment .....                                                | 6  |
| 3. Radiated emission test FCC 15.231 (b).....                           | 7  |
| 3.1 Operating environment.....                                          | 7  |
| 3.2 Test setup & procedure.....                                         | 7  |
| 3.3 Radiated emission limit.....                                        | 9  |
| 3.3.1 Fundamental and harmonics emission limits .....                   | 9  |
| 3.3.2 General radiated emission limit.....                              | 9  |
| 3.4 Radiated emission test data FCC 15.231 .....                        | 11 |
| 3.4.1 Measurement results: Fundamental emission .....                   | 11 |
| 3.4.2 Measurement results: frequencies equal to or less than 1 GHz..... | 11 |
| 3.4.3 Measurement results: frequency above 1GHz .....                   | 12 |
| 4. Measured bandwidth FCC 15.231(C) .....                               | 13 |
| 5. Timing requirement of manually operated transmitter.....             | 14 |
| 6. Conducted emission FCC 15.207 .....                                  | 15 |



## Summary of Tests

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

## 1. General information

### 1.1 Identification of the EUT

Product: Industrial Radio Remote Controller  
Model No.: F21-2S-TX  
FCC ID.: JI9-F21-2S-031  
Frequency Range: 318.0575 MHz  
Channel Number: Single channel  
Frequency of Each Channel: 318.0575 MHz  
Access scheme: AFSK  
Power Supply: DC 3 V from battery  
Power Cord: N/A  
Sample Received: Jun. 22, 2012  
Test Date(s): Jun. 26, 2012 ~ Jul. 18, 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 Controller, 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 antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain :  $\leq 1.5$  dBi

Antenna Type : Dipole antenna

Connector Type : 2-Pin connect

## 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 supplied with DC 3 V from battery and transmitted RF signal continuously by pressing UP button 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     | 2012/6/25        | 2013/6/25             |
| 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             |
| Broadband Antenna    | SCHWARZBECK     | VULB 9168                     | 9168-172   | 2011/7/26        | 2013/7/25             |
| Pre-Amplifier        | MITEQ           | AFS44-00102650<br>--42-10P-44 | 1495287    | 2011/10/27       | 2013/10/26            |
| Pre-Amplifier        | MITEQ           | JS4-26004000--2<br>7-8A       | 828825     | 2010/9/8         | 2012/9/7              |

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

### 3. Radiated emission test FCC 15.231 (b)

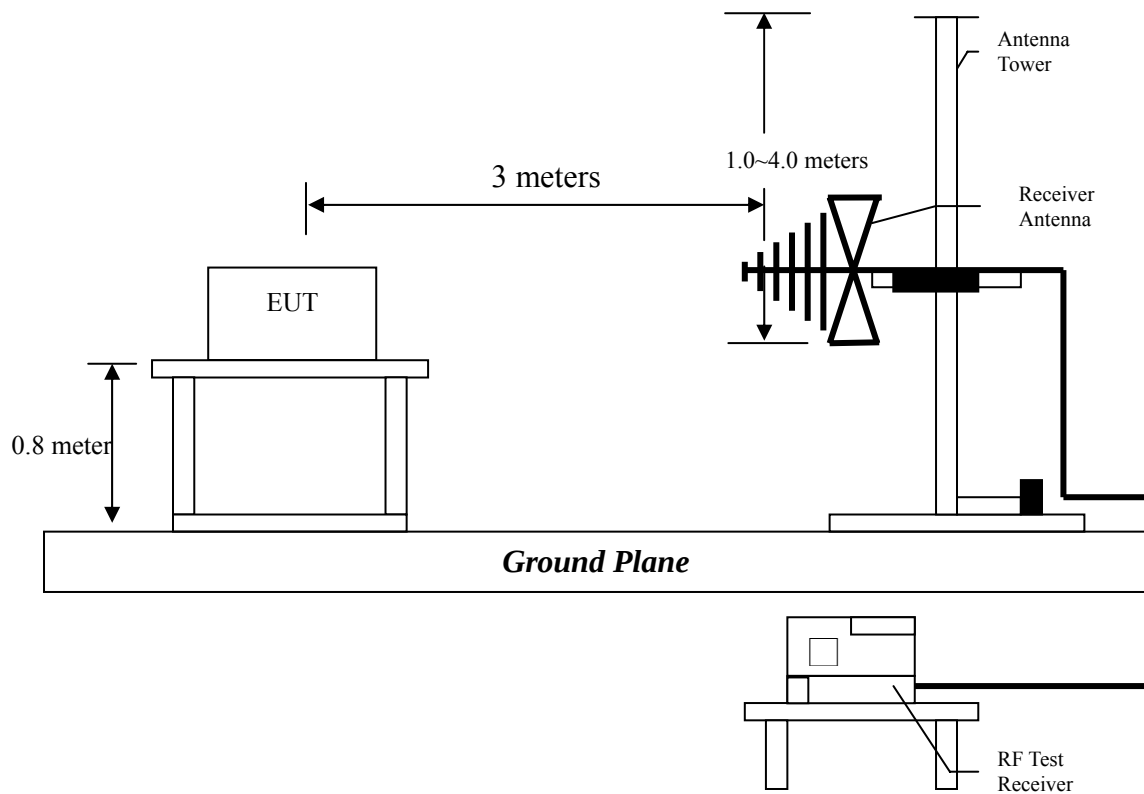
#### 3.1 Operating environment

Temperature: 24 °C  
Relative Humidity: 55 %  
Atmospheric Pressure 1008 hPa

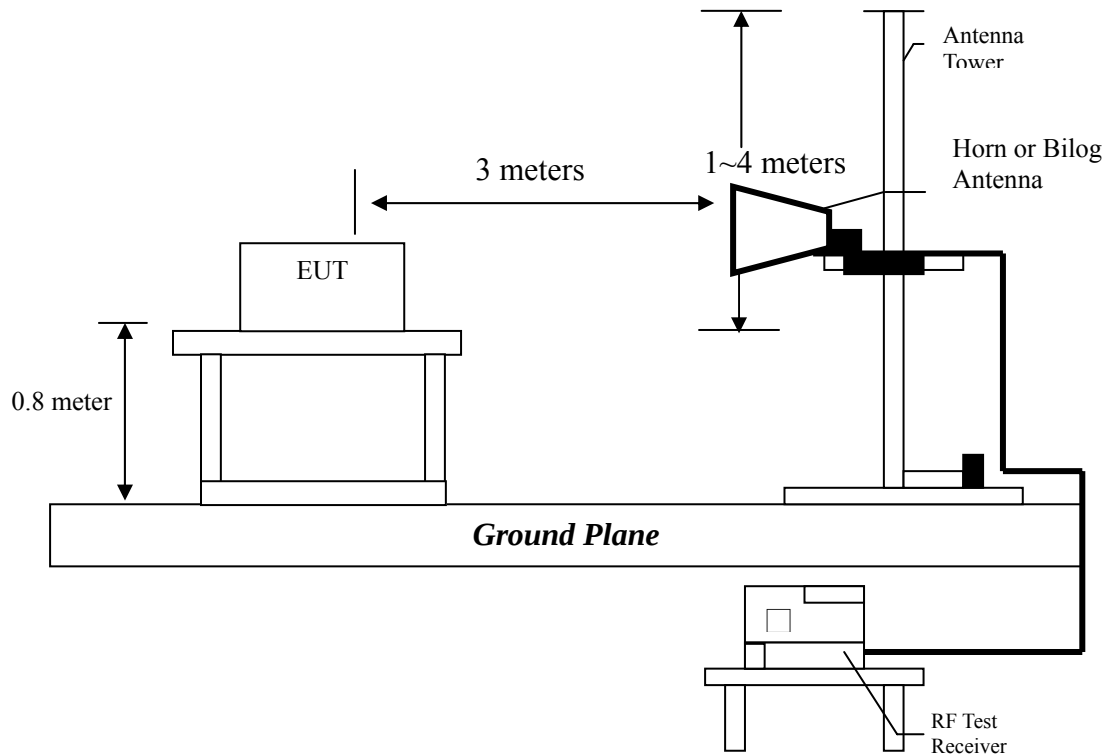
#### 3.2 Test setup & procedure

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.

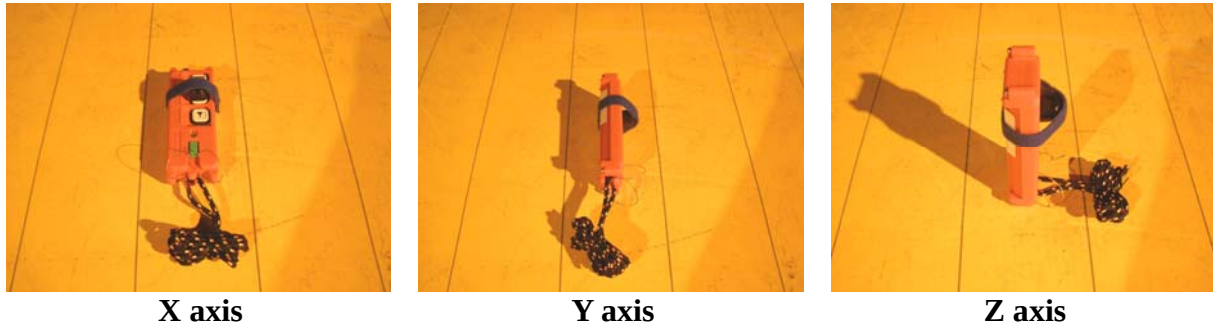
The frequency range of radiated measurements is starting at the lowest RF signal generated in the device (without < 9 kHz) and up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower, for transmitter operates below 10 GHz. Spectrum Analyzer Resolution Bandwidth 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.



After verifying three axes, we found the maximum electromagnetic field was occurred at X 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) |
| 318.0575        | 6165.95                       | 75.80        | 616.60                      | 55.80        |

#### 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<br>MHz | 15.209 Limits<br>(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  | $\pm 5.056$ dB |
| Conducted Emission | $\pm 2.786$ dB |

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

### 3.4 Radiated emission test data FCC 15.231

#### 3.4.1 Measurement results: Fundamental emission

EUT : F21-2S-TX  
 Worst Case : Tx at 318.0575 MHz at X axis

| Polarization<br>(circle) | Frequency<br>(MHz) | Detector | Corr.<br>Factor<br>(dB/m) | Reading<br>(dBuV) | Calculated<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) |
|--------------------------|--------------------|----------|---------------------------|-------------------|------------------------|-------------------|----------------|
| Vertical                 | 318.0575           | PK       | 14.10                     | 40.96             | 55.06                  | 75.80             | -20.74         |
| Horizontal               | 318.0575           | PK       | 14.32                     | 53.97             | 68.28                  | 75.80             | -7.52          |

Remark:

1. Calculated = Reading + Corr. Factor
2. Margin= Calculated – Limit

#### 3.4.2 Measurement results: frequencies equal to or less than 1 GHz

EUT : F21-2S-TX  
 Worst Case : Tx at 318.0575 MHz at X axis

| Polarization<br>(circle) | Frequency<br>(MHz) | Detector | Corr.<br>Factor<br>(dB/m) | Reading<br>(dBuV) | Calculated<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) |
|--------------------------|--------------------|----------|---------------------------|-------------------|------------------------|-------------------|----------------|
| Vertical                 | 636.1150           | PK       | 21.53                     | 23.82             | 45.35                  | 55.80             | -10.45         |
| Vertical                 | 954.1725           | PK       | 25.54                     | 16.48             | 42.02                  | 55.80             | -13.78         |
| Horizontal               | 636.1150           | PK       | 21.55                     | 25.61             | 47.15                  | 55.80             | -8.65          |
| Horizontal               | 954.1725           | PK       | 25.54                     | 23.43             | 48.97                  | 55.80             | -6.83          |

Remark:

1. Calculated = Reading + Corr. Factor
2. Margin= Calculated – Limit

### 3.4.3 Measurement results: frequency above 1GHz

EUT : F21-2S-TX  
Worst Case : Tx at 318.0575 MHz at X axis

| Frequency (MHz) | Spectrum Analyzer Detector | Antenna Polariz. (H/V) | Preamp. Gain (dB) | Correction Factor (dB/m) | Reading (dBuV) | Corrected Level (dBuV/m) | Limit @ 3 m (dBuV/m) | Margin (dB) |
|-----------------|----------------------------|------------------------|-------------------|--------------------------|----------------|--------------------------|----------------------|-------------|
| 1272.23         | PK                         | V                      | 34.9              | 27.98                    | 41.75          | 34.83                    | 55.80                | -20.97      |
| 1590.29         | PK                         | V                      | 34.9              | 29.16                    | 39.36          | 33.62                    | 54.00                | -20.38      |
| 1908.35         | PK                         | V                      | 34.9              | 29.16                    | 42.35          | 36.61                    | 55.80                | -19.19      |
| 2226.40         | PK                         | V                      | 34.4              | 30.35                    | 40.86          | 36.81                    | 54.00                | -17.19      |
| 2544.46         | PK                         | V                      | 34.1              | 32.51                    | 43.61          | 42.02                    | 55.80                | -13.78      |
| 2862.52         | PK                         | V                      | 34.1              | 32.51                    | 39.29          | 37.70                    | 54.00                | -16.30      |
| 3180.58         | PK                         | V                      | 33.8              | 36.24                    | 43.79          | 46.23                    | 55.80                | -9.57       |
| 1272.23         | PK                         | H                      | 34.9              | 27.98                    | 38.90          | 31.98                    | 55.80                | -23.82      |
| 1590.29         | PK                         | H                      | 34.9              | 29.16                    | 39.37          | 33.63                    | 54.00                | -20.37      |
| 1908.35         | PK                         | H                      | 34.9              | 29.16                    | 41.31          | 35.57                    | 55.80                | -20.23      |
| 2226.40         | PK                         | H                      | 34.4              | 30.35                    | 44.00          | 39.95                    | 54.00                | -14.05      |
| 2544.46         | PK                         | H                      | 34.1              | 32.51                    | 45.40          | 43.81                    | 55.80                | -11.99      |
| 2862.52         | PK                         | H                      | 34.1              | 32.51                    | 38.58          | 36.99                    | 54.00                | -17.01      |
| 3180.58         | PK                         | H                      | 33.8              | 36.24                    | 41.30          | 43.74                    | 55.80                | -12.06      |

Remark:

1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The data values listed above which are higher than the system noise floor.

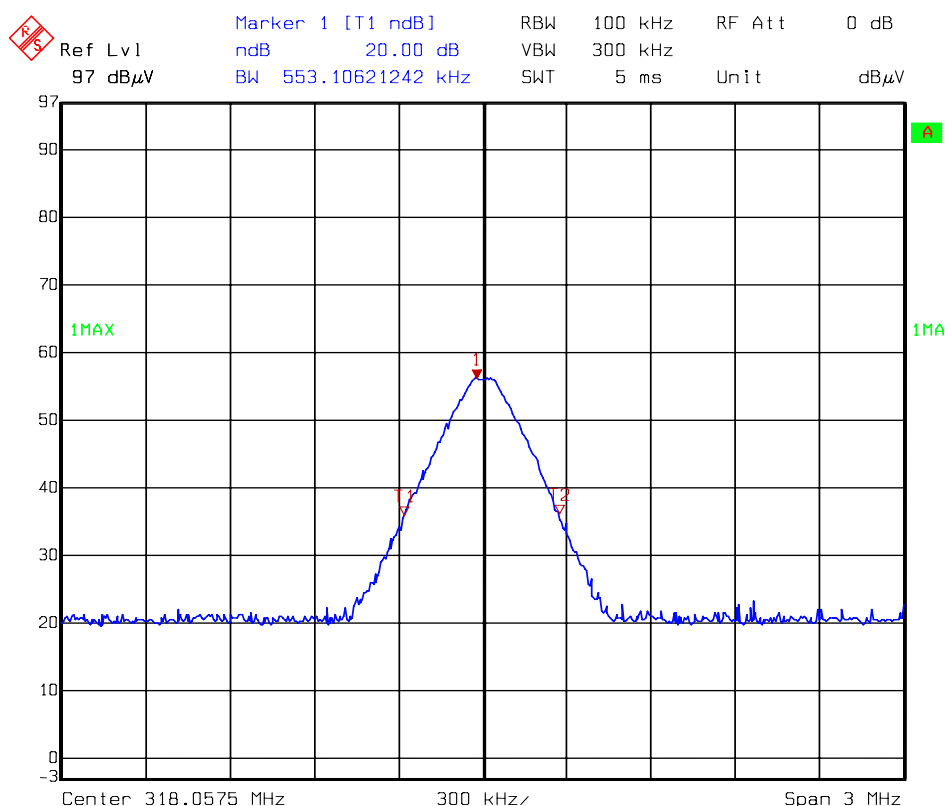
#### 4. Measured bandwidth FCC 15.231(C)

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.

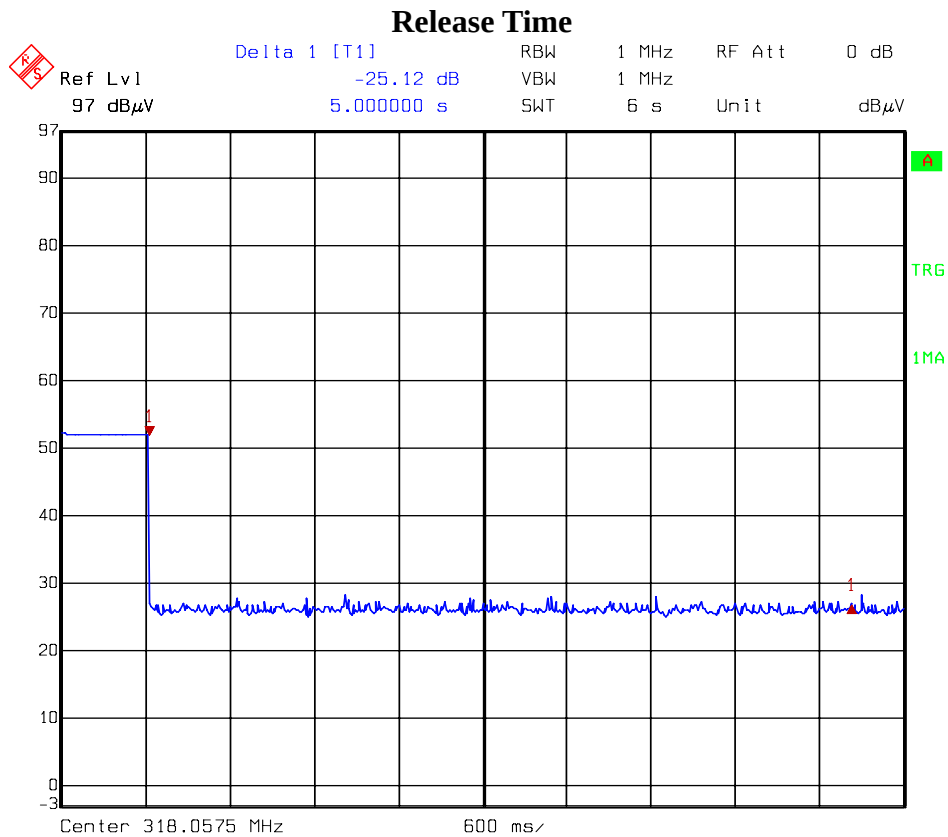
$$B.W(20dBc) \text{ Limit} = 0.25\% \times f(\text{MHz}) = 0.25\% \times 318.0575 \text{ MHz} = 0.7951 \text{ MHz}$$

From the plot, the bandwidth is observed to be 553 kHz at 20dBc, where the bandwidth limit is 0.7951 MHz.

Please see the plot below.



## 5. Timing requirement of manually operated transmitter



## **6. 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.