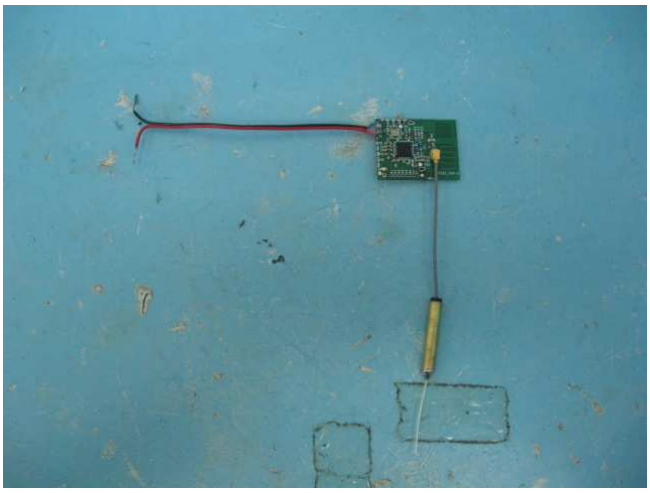
**TEST REPORT No: (5215)356-1008**

# TEST REPORT

| | | | |
|---|---|---|---|
| To: | **EXCEL ENGINEERING (HK) CO. LTD.** | To: | - |
| Attn: | Trudy Cheung | Attn: | - |
| Address: | Rm 905, Podium Plaza, 5 Honoi Road, Tsim Sha Tsui, Kowloon | Address: | - |
| Fax: | 23144424 | Fax: | - |
| E-mail: | -- | E-mail: | - |
| Folder No.: | ECL-15DE158ETHS-B | | |
| | | | |
| Factory name: | **--** | | |
| Location: | -- | | |
| Product: | RF Module<br>Model No.: X020 | | |



| | |
|---|---|
| Sample No: | HK151221/001<br>HK151221/002 |
| Date of Receipt: | December 21, 2015 |
| Test date: | December 24, 2015 |
| Test Requested: | FCC Part 15 - 2012 |
| Test Method: | ANSI C63.4 - 2009 |
| FCC ID: | OWGX020 |

**The results given in this report are related to the tested specimen of the described electrical apparatus.**

**CONCLUSION: The submitted sample was found to <u>COMPLY</u> with requirement of FCC Part 15 Subpart C.**

Authorized Signature:

| | |
|---|---|
| Reviewed by: Keith Yeung | Approved by: Law Man Kit |
| Date: January 07, 2015 | Date: January 07, 2015 |

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## TEST REPORT No: (5215)356-1008
# Test Result Summary

| EMISSION TEST | | | |
|---|---|---|---|
| **Test requirement: FCC Part 15 - 2012** | | | |
| Test Condition | Test Method | Test Result | |
| | | Pass | Failed |
| Radiated Emission Test,<br>9kHz to 25GHz | ANSI C63.4 | ☒ | ☐ |
| Frequency range of Fundamental Emission | ANSI C63.4 | ☒ | ☐ |
| 26dB Bandwidth of Fundamental Emission | ANSI C63.4 | ☒ | ☐ |
| Duty Cycle Correction During 100msec | ANSI C63.4 | ☒ | ☐ |

## Report Revision & Sample Re-submit History:
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## Location of the test laboratory

Radiated and Conducted emissions measurements are investigated and taken pursuant to the procedures of ANSI C63.4 – 2009. An Open Area Test Site and Full Anechoic Chamber (FCC Listed Site, Registration No. 642151) are set up for investigation and located at :

**BUREAU VERITAS HONG KONG LIMITED, EMC CENTRE**

No. 2106-2107, 21/F., Westin Centre,
26 Hung To Road,
Kwun Tong, Kowloon,
Hong Kong

## List of measuring equipment

**Radiated Emission**

| EQUIPMENT | MANUFACTURER | MODEL NO. | SERIAL NO. | LAST CALIBRATION | CALIBRATION DUE |
|---|---|---|---|---|---|
| EMI TEST RECEIVER | R&S | ESCI | 100379 | 21-JAN-2015 | 20-JAN-2016 |
| SPECTRUM ANALYZER | R&S | R3127 | 111000909 | 26-MAR-2015 | 25-MAR-2016 |
| LOOP ANTENNA | ETS LINDGREN | 6502 | 00102266 | 06-NOV-2015 | 05-NOV-2016 |
| BILOG ANTENNA | SCHAFFNER | CBL6112D | 25229 | 02-JAN-2015 | 02-JAN-2016 |
| HORN ANTENNA | SCHWARZBECK | BBHA9120D | 9120D-692 | 27-DEC-2014 | 26-DEC-2016 |
| PREAMPLIFIER | SCHWARZBECK | BBV9718 | 9718-152 | 13-OCT-2015 | 12-OCT-2016 |
| OPEN AREA TEST SITE | BVCPS | N/A | N/A | 06-JUL-2015 | 05-JUL-2016 |
| ANECHOIC CHAMBER | ALBATROSS | M-CDC | 80374004499B | 05-FEB-2014 | 03-FEB-2016 |
| COAXIAL CABLE | HUBER + SUHNER | RG223 | N/A | 22-DEC-2015 | 21-DEC-2016 |
| COAXIAL CABLE | HUBER + SUHNER | RG214 | N/A | 22-DEC-2015 | 21-DEC-2016 |
| Signal Analyzer 40GHz | Rohde & Schwarz | FSV 40 | 100977 | 13-MAY-2015 | 12-MAY-2016 |
| Wideband Horn Antenna 18 to 40GHz | STEATITE | QWH-SL-18-40-K-SG | 12688 | 03-SEP-2015 | 02-SEP-2016 |
| High frequency RF cable | Rohde & Schwarz | N/A | N/A | 04-NOV-2015 | 03-NOV-2016 |

## Measurement Uncertainty

| MEASUREMENT | FREQUENCY | UNCERTAINTY |
|---|---|---|
| Radiated emissions | 9kHz to 30MHz | 4.2dB |
| | 30MHz to 1GHz | 5.0dB |
| | 1GHz to 18GHz | 4.9dB |
| | 18GHz to 40GHz | 4.8dB |

**Remarks:-**
N/A : Not Applicable or Not Available

The measurement instrumentation uncertainty would be taking into consideration on each of the test result

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## TEST REPORT No: (5215)356-1008

### Equipment Under Test [EUT]

### Description of Sample:

| | |
|---|---|
| Model Name: | RF Module |
| Model Number: | X020 |
| Rating: | 3.3Vd.c. (“DC power supply”) |

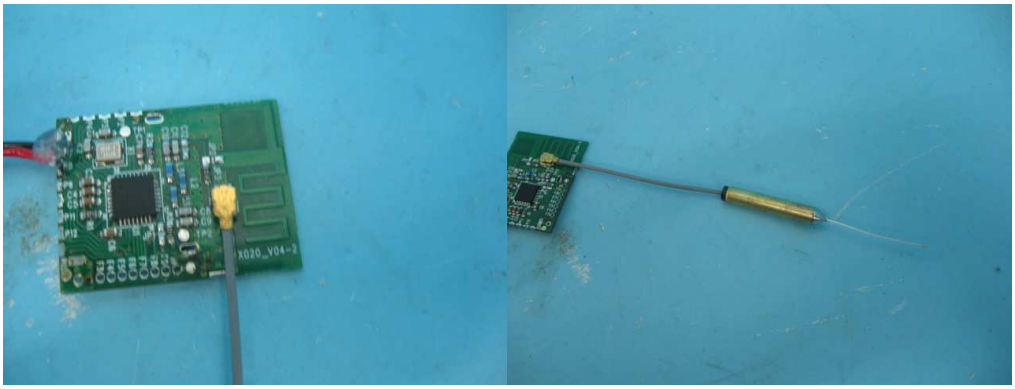
### Description of EUT Operation:

The Equipment Under Test (EUT) is a **EXCEL ENGINEERING (HK) CO. LTD.** of RF Module. It is a transmitter and operating at 2458MHz. The worst results are shown in the report. The EUT transmit while it is triggered by the control circuit, Modulation by IC, and type is GFSK.
The transmitter has the control:
When a signal is received, the encoded signal will then be transmitted.

### Antenna Requirement (Section 15.203)

The EUT is use of a permanently antenna. It is soldered on the PCB. The antenna consists of 10.3 cm long wire and PCB trace. The antenna is not replaceable or user serviceable. The requirements of S15.203 are met. There are no deviations or exceptions to the specifications.

**Photo of Antenna**



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# Test Results

## Radiated Emissions (Fundamental)

| | |
|---|---|
| Test Requirement: | FCC Part 15 Section 15.249 |
| Test Method: | ANSI C63.4 |
| Test Date(s): | 2015-12-24 |
| Temperature: | 21.0 °C |
| Humidity: | 65.0 % |
| Atmospheric Pressure: | 100.3 kPa |
| Mode of Operation: | Transmission mode |
| Tested Voltage: | 3.3Vd.c. (“DC power supply”) |

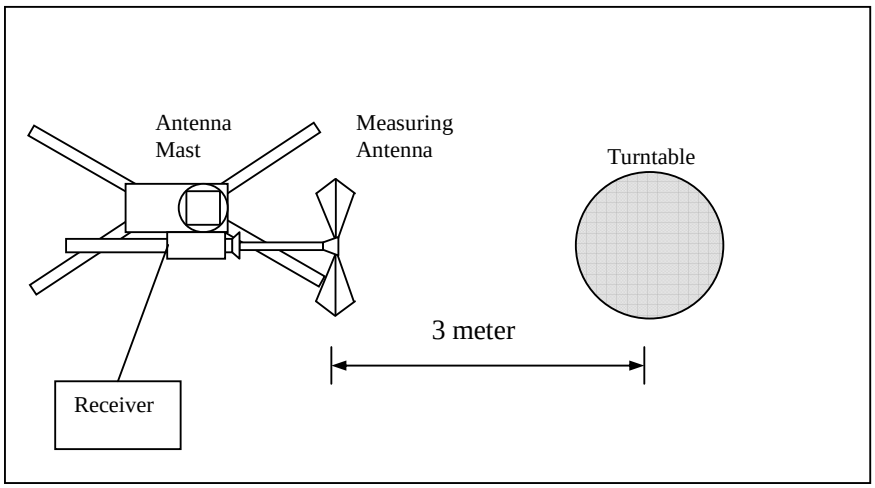
## Test Procedure:

Radiated emissions measurements are investigated and taken pursuant to the procedures of ANSI C63.4 – 2009.

The equipment under test (EUT) was placed on a non-conductive turntable with dimensions of 1.5m x 1m and 0.8m high above the ground. 3m from the EUT, a broadband antenna mounting on the mast received the signal strength. 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, For battery operated equipment, the equipment tests shall be perform using new battery. The turntable was rotated to maximize the emission level. The antenna was then moving along the mast from 1m up to 4m until no more higher value was found. Both horizontal and vertical polarization of the antenna were placed and investigated.

Location: The Roof, Westin Centre, 26 Hung To Road, Kwun Tong, Kowloon, Hong Kong

## Test Setup: Open Area Test Site

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## TEST REPORT No: (5215)356-1008

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

| Frequency Range of Fundamental [MHz] | Field Strength of Fundamental Emission (Average) [mV/m] | Field Strength of Harmonics Emission (Average) [µV/m] |
|---|---|---|
| 2400-2483.5 | 50 | 500 |

## Measurement Data

## Test Result of (Transmission mode): PASS

| Frequency (MHz) | Polarity (H/V) | Antenna Factor & Cable Loss (dB/m) | Duty-cycle correction (dB) | Field Strength at 3m – Peak (dBµV/m) | Limit at 3m – Peak (dBµV/m) | Margin - Peak (dB) | Field Strength at 3m – Average (dBµV/m) | Limit at 3m – Average (dBµV/m) | Margin - Average (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 2458.00 | H | *0.0 | -29.8 | 85.6 | 114.0 | -28.4 | **55.8 | 94.0 | -38.2 |
| 2458.00 | V | *0.0 | -29.8 | 92.1 | 114.0 | -21.9 | **62.3 | 94.0 | -31.7 |

# For pulse modulated devices and using measuring equipment employing a peak detection mode, properly adjusted for such factor as pulse desensitisation.
* Correction factor: Antenna factor + Cable loss - Gain of pre-amplifier
**Duty Cycle Correction = 20Log(0.032) = -29.8dB.

Note: Field Strength includes Antenna Factor and Cable Loss.
Receiver setting: RBW = 1MHz
VBW = 1MHz

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## TEST REPORT No: (5215)356-1008

## Radiated Emissions (Spurious Emission)

| | |
|---|---|
| Test Requirement: | FCC Part 15 Section 15.249 |
| Test Method: | ANSI C63.4 |
| Test Date(s): | 2015-12-24 |
| Temperature: | 21.0 °C |
| Humidity: | 65.0 % |
| Atmospheric Pressure: | 100.3 kPa |
| Mode of Operation: | Transmission mode |
| Tested Voltage: | 3.3Vd.c. (“DC power supply”) |

## Measurement Data

## Test Result of (Transmission mode): PASS

| Frequency (MHz) | Polarity (H/V) | Antenna Factor & Cable Loss (dB/m) | Duty-cycle correction (dB) | Field Strength at 3m – Peak (dBμV/m) | Limit at 3m – Peak (dBμV/m) | Margin - Peak (dB) | Field Strength at 3m – Average (dBμV/m) | Limit at 3m – Average (dBμV/m) | Margin - Average (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4916.00 | H | 5.9 | -29.8 | 63.5 | 74.0 | -10.5 | **33.7 | 54.0 | -20.3 |
| 7374.00 | H | 12.7 | -29.8 | 53.2 | 74.0 | -20.8 | **23.4 | 54.0 | -30.6 |
| 9832.00 | H | 16.4 | -29.8 | 52.6 | 74.0 | -21.4 | **22.8 | 54.0 | -31.2 |
| 12290.00 | H | 18.4 | -29.8 | 56.0 | 74.0 | -18.0 | **26.2 | 54.0 | -27.8 |
| 14748.00 | H | 25.0 | -29.8 | 62.3 | 74.0 | -11.7 | **32.5 | 54.0 | -21.5 |
| 17206.00 | H | 27.2 | -29.8 | 63.9 | 74.0 | -10.1 | **34.1 | 54.0 | -19.9 |
| 19664.00 | H | 46.6 | -29.8 | 64.2 | 74.0 | -9.8 | **34.4 | 54.0 | -19.6 |
| 22122.00 | H | 47.3 | -29.8 | 61.6 | 74.0 | -12.4 | **31.8 | 54.0 | -22.2 |
| 24580.00 | H | 48.1 | -29.8 | 62.0 | 74.0 | -12.0 | **32.2 | 54.0 | -21.8 |
| 27038.00 | H | 48.8 | -29.8 | 62.6 | 74.0 | -11.4 | **32.8 | 54.0 | -21.2 |

# For pulse modulated devices and using measuring equipment employing a peak detection mode, properly adjusted for such factor as pulse desensitisation.
**Duty Cycle Correction = 20Log(0.032) = -29.8dB.

Note: Field Strength includes Antenna Factor and Cable Loss.
Receiver setting: RBW = 1MHz
VBW = 1MHz

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## TEST REPORT No: (5215)356-1008

## Measurement Data

## Test Result of (Transmission mode): PASS

| Frequency (MHz) | Polarity (H/V) | Antenna Factor & Cable Loss (dB/m) | Duty-cycle correction (dB) | Field Strength at 3m – Peak (dBµV/m) | Limit at 3m – Peak (dBµV/m) | Margin - Peak (dB) | Field Strength at 3m – Average (dBµV/m) | Limit at 3m – Average (dBµV/m) | Margin - Average (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 4916.00 | V | 5.9 | -29.8 | 64.5 | 74.0 | -9.5 | **34.7 | 54.0 | -19.3 |
| 7374.00 | V | 12.7 | -29.8 | 51.2 | 74.0 | -22.8 | **21.4 | 54.0 | -32.6 |
| 9832.00 | V | 16.4 | -29.8 | 53.8 | 74.0 | -20.2 | **24.0 | 54.0 | -30.0 |
| 12290.00 | V | 18.4 | -29.8 | 56.1 | 74.0 | -17.9 | **26.3 | 54.0 | -27.7 |
| 14748.00 | V | 25.0 | -29.8 | 63.0 | 74.0 | -11.0 | **33.2 | 54.0 | -20.8 |
| 17206.00 | V | 27.2 | -29.8 | 65.1 | 74.0 | -8.9 | **35.3 | 54.0 | -18.7 |
| 19664.00 | V | 46.6 | -29.8 | 63.9 | 74.0 | -10.1 | **34.1 | 54.0 | -19.9 |
| 22122.00 | V | 47.3 | -29.8 | 62.2 | 74.0 | -11.8 | **32.4 | 54.0 | -21.6 |
| 24580.00 | V | 48.1 | -29.8 | 63.9 | 74.0 | -10.1 | **34.1 | 54.0 | -19.9 |
| 27038.00 | V | 48.8 | -29.8 | 63.0 | 74.0 | -11.0 | **33.2 | 54.0 | -20.8 |

# For pulse modulated devices and using measuring equipment employing a peak detection mode, properly adjusted for such factor as pulse desensitisation.
**Duty Cycle Correction = 20Log(0.032) = -29.8dB.

Note: Field Strength includes Antenna Factor and Cable Loss.
Receiver setting: RBW = 1MHz
VBW = 1MHz

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## TEST REPORT No: (5215)356-1008

## Radiated Emissions (9kHz – 40GHz)

| | |
|---|---|
| Test Requirement: | FCC Part 15 Section 15.209 |
| Test Method: | ANSI C63.4 |
| Test Date(s): | 2015-12-24 |
| Temperature: | 21.0 °C |
| Humidity: | 65.0 % |
| Atmospheric Pressure: | 100.3 kPa |
| Mode of Operation: | On mode |
| Tested Voltage: | 3.3Vd.c. (“DC power supply”) |

## Limits for Radiated Emissions [FCC 47 CFR 15.209]:

| Frequency Range [MHz] | Quasi-Peak Limits [μV/m] | Measurement Distance m |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above960 | 500 | 3 |

## Measurement Data

## Test Result of (On mode): PASS

## Detection mode: Peak

| Frequency | Polarity (H/V) | Field Strength | Limit | Margin (dB) |
|---|---|---|---|---|
| | | | | |
| Emissions detected are more than 20 dB below the limit line(s) in 9kHz to 30MHz | | | | |
| | | | | |

Note: Field Strength includes Antenna Factor and Cable Loss.

Receiver setting: RBW = 200Hz
VBW = 200Hz

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## TEST REPORT No: (5215)356-1008

## Measurement Data

## Test Result of (On mode): PASS

## Detection mode: Quasi-Peak

| Frequency (MHz) | Polarity (H/V) | Field Strength at 3m (dBµV/m) | Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|
| 60.56 | H | 21.2 | 40.0 | -18.8 |
| 115.32 | H | 23.5 | 43.5 | -20.0 |
| 233.36 | H | 23.7 | 46.0 | -22.3 |
| 352.80 | H | 24.3 | 46.0 | -21.7 |
| 412.16 | H | 27.2 | 46.0 | -18.8 |
| 586.08 | H | 30.8 | 46.0 | -15.2 |

| Frequency (MHz) | Polarity (H/V) | Field Strength at 3m (dBµV/m) | Limit at 3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|
| 60.56 | V | 21.4 | 40.0 | -18.6 |
| 115.32 | V | 23.7 | 43.5 | -19.8 |
| 233.36 | V | 23.6 | 46.0 | -22.4 |
| 352.80 | V | 24.6 | 46.0 | -21.4 |
| 412.16 | V | 27.0 | 46.0 | -19.0 |
| 586.08 | V | 31.2 | 46.0 | -14.8 |

Note: Field Strength includes Antenna Factor and Cable Loss.

Receiver setting: RBW = 120KHz
VBW = 120KHz

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## TEST REPORT No: (5215)356-1008

## Frequency range of Fundamental Emission

| | |
|---|---|
| Test Requirement: | FCC 47 CFR 15.249 |
| Test Method: | ANSI C63.4:2009 (Section 13.1.7) |
| Test Date(s): | 2015-12-24 |
| Temperature: | 21.0 °C |
| Humidity: | 65.0 % |
| Atmospheric Pressure: | 100.3 kPa |
| Mode of Operation: | Transmission mode |
| Tested Voltage: | 3.3Vd.c. (“DC Power supply”) |

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

**Limits for Frequency range of Fundamental Emission:**

| Frequency [MHz] | FCC Limits [MHz] |
|---|---|
| 2456.640 – 2459.300 | 2400.00 – 2483.50 |

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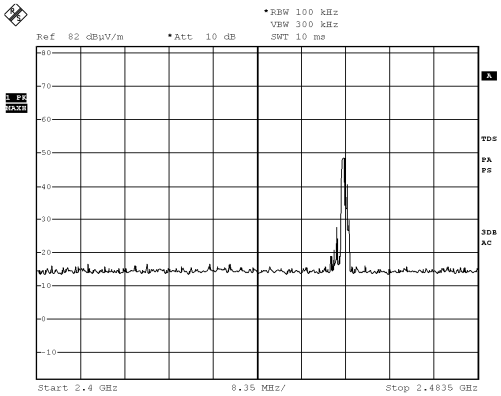
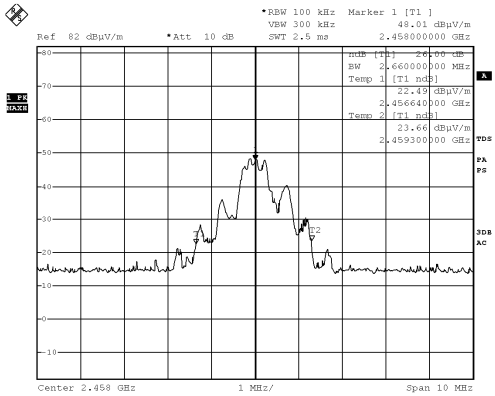
## TEST REPORT No: (5215)356-1008

## Measurement Data :

### Test Result of Frequency Range of Fundamental Emission: PASS




### Test Result of 26dB Bandwidth of Fundamental Emission: PASS

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## TEST REPORT No: (5215)356-1008

### Duty Cycle Correction During 100msec:

Each function key sends a different series of characters, but each packet period (100msec) never exceeds a series of 4 pulses (0.8 msec). Assuming any combination of short and long pulses maybe obtained due to encoding the worst case transmit duty cycle would be considered 4*0.8 per 100msec = 3.2% duty cycle.

Remarks:

Duty Cycle Correction = 20Log(0.032) = -29.8dB

The following figures [Figure A] show the characteristics of the pulse train for one of these functions.

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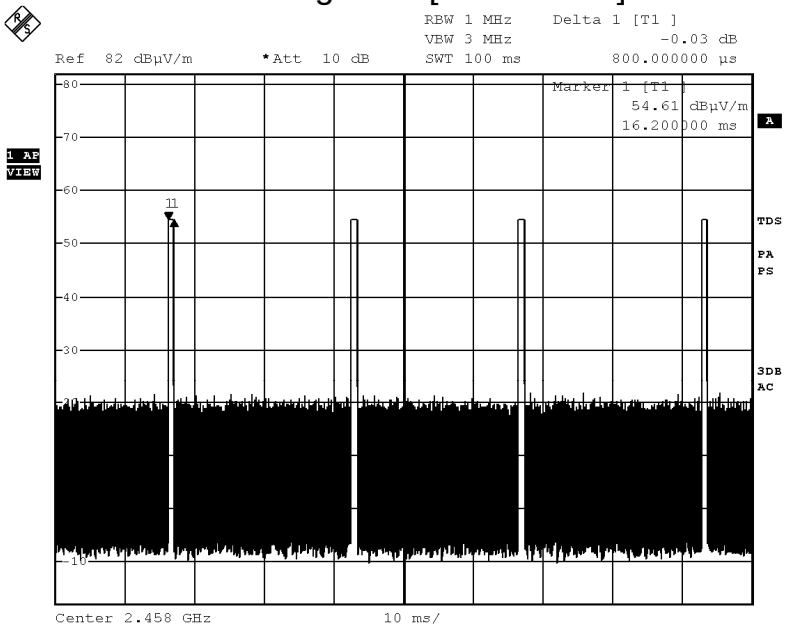
## TEST REPORT No: (5215)356-1008

## Measurement Data :

Figure A [Pulse Train]

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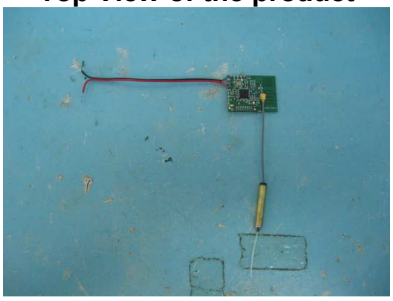
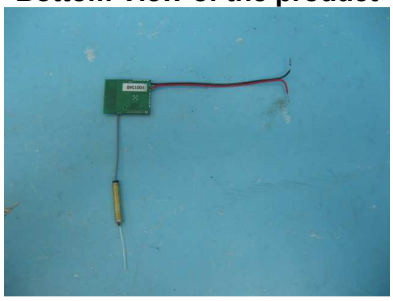
## Photographs of EUT

**Top View of the product**

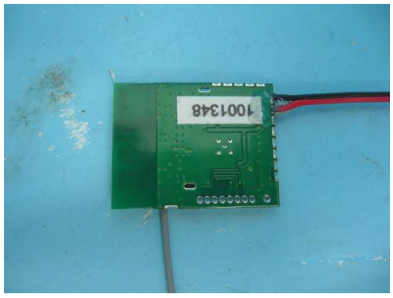


**Bottom View of the product**



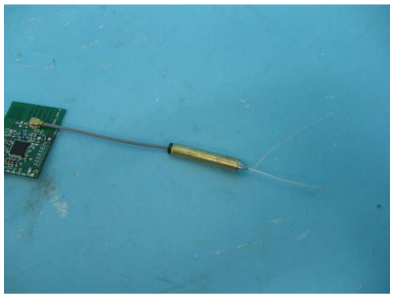
**Circuit Top View**

**Circuit Bottom View**



**Antenna**

**Antenna**



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## Measurement of Radiated Emission Test Set Up

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

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