



Electromagnetic Emission

FCC MEASUREMENT REPORT

CERTIFICATION OF COMPLIANCE FCC PART15 CERTIFICATION

PRODUCT : X-Band Microwave Sensor Module
MODEL/TYPE NO : DNS-010
FCC ID : RJVDNS-010
TRADE NAME : Dnet

APPLICANT : DongNam En-Tech Co., Ltd.
#79B12L, Paho-dong, Dalseo-gu, Daegu, Korea
Attn. : Jong Bae, Ju / Director of Research Dept.

FCC CLASSIFICATION : FDS Part 15 Field Disturbance Sensor
FCC RULE PART(S) : FCC Part 15 Subpart C Section 15.245
FCC PROCEDURE : Certification
DATES OF TEST : September 24, 2003
DATES OF ISSUE : September 28, 2003
TEST REPORT No. : BWS-03-RF-0015
TEST LAB. : BWS Tech., Inc. (Registration No. : 553281)

This Microwave Sensor Module DNS-010 has been tested in accordance with the measurement procedures specified in ANSI C63.4-2000 at the BWS TECH/EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart C Section15.245.

I attest to the accuracy of data. All measurement herein was performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. The results of testing in this report apply to the product/system, which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

K. Young Kim
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BWS TECH Inc.

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FCC TEST REPORT

Scope – Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)

1. General Information

Applicant

Company Name : DongNam En-Tech Co., Ltd.
Company Address : #79B12L, Paho-dong, Dalseo-gu, Daegu, 704-230, Korea
Phone/Fax : Phone : +82-53-584-3545 Fax : +82-53-584-6423

Manufacturer

Company Name : DongNam En-Tech Co., Ltd.
Company Address : #79B12L, Paho-dong, Dalseo-gu, Daegu, 704-230, Korea
Phone/Fax : Phone : +82-53-584-3545 Fax : +82-53-584-6423

- **EUT Type** : Microwave Sensor Module
- **Model Number** : DNS-010
- **FCC Identifier** : RJVDNS-010
- **S/N** : Prototype
- **Freq. Range** : 10.525GHz
- **Channel** : 1ch
- **RF Power Output** : 13dBm
- **FCC Classification** : FDS: Part 15 Field Disturbance Sensor
- **FCC Rule Part(s)** : Part 15 Subpart C Section 15.245
- **Test Procedure** : ANSI C63.4-2000
- **Dates of Tests** : September 24, 2003
- **Place of Tests** : BWS TECH Inc.
EMC Testing Lab (FCC Registration Number : 553281)
294-9, Jungdae-Dong, Kwangju-Si,
Kyunggi-Do, 464-080, Korea
TEL: +82 31 762 0124 FAX: +82 31 762 0126
- **Test Report No.** : BWS-03-RF-0003

2. Description of Test Facility

The measurement test for radiated and conducted emission test were conducted at the open area test site of BWS TECH Inc. facility located at 294-9, Jungdae-Dong, Kwangju-Si, Kyunggi-Do, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-2000 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission with the FCC for 3 and 10-meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-1992 and registered to the Federal Communications Commission (Registration Number : 553281).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2000) was used in determining radiated and conducted emissions from the DongNam En-Tech Co., Ltd. Microwave Motion Sensor Module Model : DNS-010.

3. Product Information

3.1 Equipment Description

The Equipment Under Test (EUT) is the DongNam En-Tech Co., Ltd. Microwave Motion Sensor Module Model : DNS-010. The transmitter use Doppler radar principle to sense motion. The role of sensor module is transmitting a low power microwave and receiving the microwave energy reflected by objects. This Field Disturbance Sensor Module is used for collecting and delivering the traffic statistics.

The power is supplied from the external DC power supply (5VDC).

3.2 General Specification

- TX Carrier Freq.	10.525 GHz
- Freq. accuracy	3 MHz
- Antenna	Patch Type 8dBi
- RF Output Power	13 dBm
- Supply Voltage	5 VDC, 50mA Max.
- Receiver Sensitivity	-85dBm
- Size	40(W) x 46.5(D) x 7.2(H)
- Operating Temperature	-20 ~ +55

4. Description of Tests

4.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2000. The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50 /50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 10KHz or for "quasi-peak" within a bandwidth of 9KHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1m x 1.5m x 0.8m wooden table, which is placed 40cm away from the vertical wall, and 1.5m away from the sidewall of the chamber room. Two LISNs are bonded to the shielded room. The EUT is powered from the PMM LISN and the support equipment is powered from the another Koritsu LISN. Power to the LISNs is filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the EMCO LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling (serpentine fashion) to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the R3261A Spectrum Analyzer to determine the frequency producing the max. Emission from the EUT. The frequency producing the max. Level was reexamined using the detector function set to the CISPR Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.45 to 30MHz. The bandwidth of the Spectrum Analyzer was set to 9KHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by switching power lines, varying the mode of operation or resolution, clock or data exchange speed, if applicable, whichever determined the worst-case emission. Each emission reported was calibrated using self-calibrating mode.

Photographs of the worst-case emission can be seen in photographs of conducted emission test setup.

4.2 Radiated Emission Measurement

Preliminary measurements were made at indoors 3-meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the emission frequencies producing the maximum EME.

Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configurations, mode of operation, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using biconilog antenna and above 1000MHz, linearly polarized double ridge horn antennas were used. Above 1GHz, linearly polarized double ridge horn antennas were used. The measurements were performed with three frequencies, which were selected as bottom, middle, and top frequency in the operating band. Emission level from the EUT with various configurations was examined on the spectrum analyzer connected with the RF amplifier and plotted graphically.

Final measurements were made outdoors open site at 3-meter test range using biconical and log periodic, Horn antenna. The output from the antenna was connected, via a preselector or a preamplifier, to the input of the EMI Measuring Receiver and Spectrum analyzer (for above 25GHz). The detector function was set to the quasi-peak or peak mode as appropriate. The measurement bandwidth on the Field strength receiver was set to at least 120kHz (1MHz for measurement above 1GHz), with all post-detector filtering no less than 10 times the measurement bandwidth. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during preliminary measurement was examined and investigated as the same set up and configuration which produced the maximum emission. The EUT, support equipment and interconnecting cables were configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1m x 1.5 meter table. The turntable containing the system was rotated and the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20dB/decade) as per section 15.31(f).

Photographs of the worst-case emission test setup can be seen in Appendix A.

5. Test Condition

5.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the EUT and the supported equipments were installed to meet FCC requirement and operated in a manner, which tends to maximize its emission level in a typical application.

Radiated Emission Test

Preliminary radiated emission tests were conducted using the procedure in ANSI C63.4/2000 Clause 8.3.1.1 to determine the worst operating condition. Final radiated emission tests were conducted at 3-meter open field test site. To complete the test configuration required by the FCC, the EUT was tested in all three orthogonal planes. All testing was performed with internal battery.

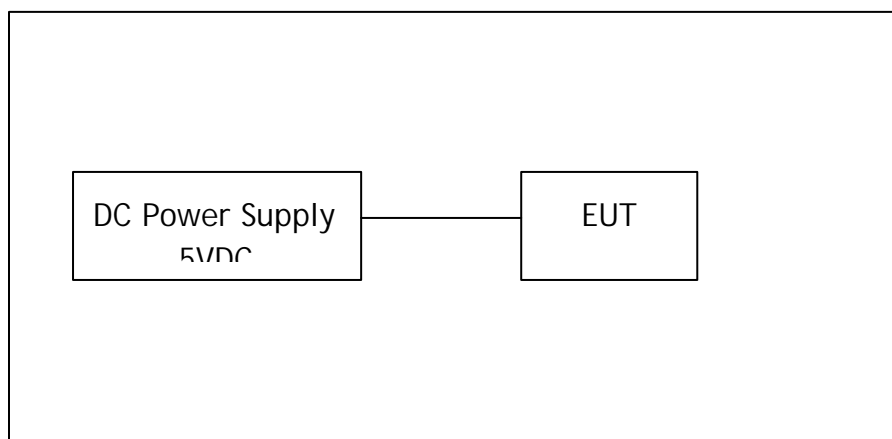
Test Setup Information

Following peripheral devices and interface cables were connected during the measurement:

Type of Peripheral Equipment Used:

Description	Model Name	Serial No.	Manufacturer	FCC ID
EUT	DWRF-30	N/A	Dowon Electronics	QY3DWRF-30
DC Power Supply				

Test Setup Diagram



5.2 EUT operation

The EUT was set to the normal transmitting mode during all the testing in a manner similar to a typical use. The EUT was operated by 5VDC

6. TEST RESULTS

6.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

FCC Rule Parts	Measurement Required	Result
15.207	Conducted Emission	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input checked="" type="checkbox"/> n/a
15.245(b)	Radiated Emissions of Carrier Frequency	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> n/a
15.245(b)(1)	Radiated Emissions of Carrier Harmonics	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> n/a
15.245(b)(3)/15.209	Out-of-Band Radiated Emissions	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> n/a

The data collected shows that the Enter Tech Co., Ltd. X-band Microwave Motion Sensor Module **DNS-010** complies with technical requirements of the Part 15.209 and 15.245 of the FCC Rules.

Note : Modification to EUT

The device tested is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

EUT :
Limit apply to : FCC Part15 Subpart C Section 15.207
Test Date :
Operating Condition :
Environment Condition : Humidity Level : %RH, Temperature :
Result : ☐ Pass ☐ Fail ☒ n/a

Tabulated Conducted Emission Test Data

[illegible]

BWS TECH Inc.
294-9 Jungdae-Dong,
Kwanggu-Si, Kyunggi-Do,
464-800, Korea

6.3 Radiated Emissions of RF Carrier frequency

EUT : Microwave Sensor Module DNS-010
Limit apply to : FCC Part15 Subpart C Section 15.245(b)
Test Date : September 24, 2003
Operating Condition : Continuous Tx operating mode
Test Engineer : Choi, Chang Young
Result : ☒ Pass (by -14.93 dB) ☐ Fail ☐ n/a

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.

Measurement Distance : 3 meters

Detector mode : Peak mode

Freq. [GHz]	Reading [dBμV]	ANT.Pol. [H/V]	Ant. Factor [dB]	Cable Loss [dB]	Pre-amp. [dB]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin
10.525	97.67	H	39.14	5.83	30	112.64	148	34.93

Detector mode : Average mode

Freq. [GHz]	Reading [dBμV]	ANT.Pol. [H/V]	Ant. Factor [dB]	Cable Loss [dB]	Pre-amp. [dB]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin
10.525	98.10	H	39.14	5.83	30	113.07	128	14.93

NOTES :

1. H : Horizontal polarization , V : Vertical polarization
2. Emission Level = Reading + Antenna factor + Cable loss-preamplifier gain
3. Measurement was performed at 3 operating channels.
4. The EUT was positioned with three(3) orthogonal plane and the Horizontal plane was the worst case emission.
5. Spectrum Setting : RBW 1MHz , VBW 1MHz

Tested by Choi, Chang Young

6.4 Radiated Emissions of RF Carrier Harmonics

EUT : Microwave Sensor Module DNS-010
Limit apply to : FCC Part15 Subpart C Section 15.245(b)
Test Date : September 24, 2003
Operating Condition : Continuous Tx operating mode
Test Engineer : Choi, Chang Young
Result : ☒ Pass (by -11.02 dB) ☐ Fail ☐ n/a

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.

Measurement Distance : 3 meters

Detector mode : Peak mode

Freq. [GHz]	Reading [dBμV]	ANT.Pol. [H/V]	Ant. Factor [dB]	Cable Loss [dB]	Pre-amp. [dB]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin
21.050	64.33	H	36.95	18.33	30	89.61	108	26.01

Detector mode : Average mode

Freq. [GHz]	Reading [dBμV]	ANT.Pol. [H/V]	Ant. Factor [dB]	Cable Loss [dB]	Pre-amp. [dB]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin
21.050	51.7	H	36.95	18.33	30	76.98	88.0	11.02

NOTES :

1. H : Horizontal polarization , V : Vertical polarization
2. Emission Level = Reading + Antenna factor + Cable loss-preamplifier gain
3. Measurement was performed at 3 operating channel.
4. The EUT was positioned with three(3) orthogonal plane and the Horizontal plane was the worst case emission.
5. The spectrum from 1GHz to 50GHz was investigated .For measurement above 26GHz, the maximum distance from the EUT that yields a minimum system noise floor at least 6dB BELOW THE 15.209 limit is calculated for each harmonics. The antenna is scanned around the entire surface of the EUT, in both horizontal and vertical polarization.

Tested by Choi, Chang Young

6.5 Out-of-band Radiated Emissions

EUT : Microwave Sensor Module DNS-010
Limit apply to : FCC Part15 Subpart C Section 15.245(b)(3) / 15.209
Test Date : September 20, 2003
Operating Condition : Continuous Tx operating mode
Environment Condition : Choi, Chang Young
Result : ☒ Pass (by -15.32 dB) ☐ Fail ☐ n/a

Radiated Emission Test Data

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.

Detector mode : CISPR Quasi-Peak mode (6dB Bandwidth : 120 kHz)

Measurement Distance : 3 meters

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Pre-amp. [dB]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
30							40.0	
-								
-								
88							43.5	
-								
-								
216							46.0	
-								
240	25.45	V	18.34	2.16	22	23.95	46.0	22.05
504	27.86	V	17.53	5.28	22	28.67	46.0	17.33
-								
960							54.0	

NOTES :

- * H : Horizontal polarization , ** V : Vertical polarization
- Emission Level = Reading + Antenna factor + Cable loss
- Margin value = Limit - Emission Level
- All other emissions not reported were more than 25dB below the permitted limit.

Tested by Choi, Chang Young

7. ANTENNA REQUIREMENT

7.1 Antenna Requirement

According to the section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to be complied.

7.2 Antenna Construction

The antenna used for the EUT is so designed that antenna is designed as permanently incorporated to the main PCB and can not be separated. There is no external antenna port so that the user could not use or attach the antenna with this device.

8. Sample Calculation and Other Information

8.1 Sample Calculations

$$\text{dB}\mu\text{V} = 20 \log_{10} (\mu\text{V}/\text{m})$$

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)}$$

EX. 1.

@ 2,470 MHz Radiated Emissions limit(Average)= 50 mV/m = 94 dB μ V/m

Reading = 48.17 dB μ V (calibrated level)

Antenna factor + Cable Loss = 38.93 dB

Total = 87.10 dB μ V/m

$10^{(37.62/20)} = \mu\text{V}$

Margin = 87.10 – 94 = -6.90

6.90 dB ; below limit

EX. 2.

@ 123.96 MHz Radiated Emissions limit (Quasi-peak) =150 μ V/m = 43.5 dB μ V

Reading = 26.40 dB μ V(calibrated level)

Antenna factor + Cable Loss = 15.44 dB

Total = 41.84 dB μ V/m

$10^{(40.29/20)} = \mu\text{V}/\text{m}$

Margin = 41.84 – 43.5 = -1.66 dB

1.66 dB ; below limit

8.2. Measurement Uncertainty

Measurement uncertainty of RFI Voltage Measurement test was estimated at ± 3.51 dB(k=2)

Measurement uncertainty of RFI Field Strength Measurement test was estimated at ± 4.34 dB (k=2)

9. TEST EQUIPMENTS LIST

The listing below denotes the test equipments utilized for the test(s).

<u>Test Equipment</u>	<u>Manufacture</u>	<u>Model Number</u>	<u>Serial Number</u>	<u>Cal.Due date</u>
Signal Analyzer	PMM	PMM9000	3100570602	08/16/03
EMC Analyzer	HP	E7403A	US39150108	02/27/04
Spectrum Analyzer	ADVANTEST	E7403A	61720002	08/22/03
Spectrum Analyzer	HP	8563E	3611A05046	05/14/04
Spectrum Analyzer	HP	8565E	3510A04410	07/10/04
Preamplifier	HP	8447E	2945A02712	08/19/03
Preamplifier	HP	8449B	3008A00809	11/12/03
Harmonic Mixer	HP	11970A	3003A03357	03/30/04
Biconical Antenna	SWALZBECK	BBA9106	N/A	09/12/03
Log Periodic Antenna	CHAFFNER	UPA6109	N/A	09/12/03
Horn Antenna	SCHAFFNER	BBHA 9120 D	N/A	06/20/04
Horn Antenna	SCHAFFNER	BBHA 9170	N/A	06/20/04
Plotter	HP	7475A	007475A	N/A
Shield Room	SEMITECH	000815	N/A	
7m x 4m x 4m				
Turn Table	JAEMC	JAC-2	N/A	N/A
Antenna Mast	Dae-il EMC	JAC-1	N/A	N/A
Artificial Mains	PMM	L3-25	1110K70403	10/02/03
Network				
Artificial Mains	KYORITSU	KNW-242C	8-920-20	08/31/03
Network				
Antenna Turntable	JAEMC	JAC-2	N/A	N/A
Controller				