



<b>Prüfbericht - Nr.:</b> 02422012 001		<b>Seite 1 von 25</b>	
<i>Test Report No.:</i>		<i>Page 1 of 25</i>	
<b>Auftraggeber:</b> <i>Client:</i>		Honeywell International Inc. ACS, Environmental & Combustion Controls 1985, Douglas Drive Golden Valley, Minnesota United States Zip Code - 55422	
<b>Gegenstand der Prüfung:</b> <i>Test item:</i>		Spread Spectrum Transmitter - Wireless Receiver	
<b>Bezeichnung:</b> <i>Identification:</i>	WRECVR WRECVRU	<b>Serien-Nr.:</b> <i>Serial No.</i>	WRECVR : 619701500000584 WRECVRU: 619701500000584
<b>Wareneingangs-Nr.:</b> <i>Receipt No.:</i>	1403007022	<b>Eingangsdatum:</b> <i>Date of receipt:</i>	18.05.2009
<b>Prüfort:</b> <i>Testing location:</i>	TÜV Rheinland India Pvt. Ltd. #7, Whitefield Main Road, Alpha Tower, Sigma Soft Tech park, Varthur Kodi, Bangalore, India.		
<b>Prüfgrundlage:</b> <i>Test specification:</i>	FCC Part 15, Subpart C RSS-210 Issue 7 RSS-Gen Issue 2		
<b>Prüfergebnis:</b> <i>Test Result:</i>	Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n). The test item passed the test specification(s).		
<b>Prüflaboratorium:</b> <i>Testing Laboratory:</i>	TÜV Rheinland India Pvt. Ltd #7, Whitefield Main Road, Alpha Tower, Sigma Soft Tech park, Varthur Kodi, Bangalore, India.		
<b>geprüft / tested by:</b>		<b>kontrolliert / reviewed by:</b>	
 30.06.2009 L.Narasimha Charyulu Manager		02.07.2009 Thomas Berns Manager 	
<b>Datum</b> <i>Date</i>	<b>Name/Stellung</b> <i>Name/Position</i>	<b>Unterschrift</b> <i>Signature</i>	<b>Datum</b> <i>Date</i>
<b>Sonstiges / Other Aspects:</b>		FCC ID : HS9WLKFRV IC : 573R-WLKF	
<b>Abkürzungen:</b>	P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet	<b>Abbreviations:</b>	P(ass) = passed F(ail) = failed N/A = not applicable N/T = not tested
<b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b> <i>This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.</i>			

**Test Result Summary**

<b>Clause(s)</b>	<b>Test Item</b>	<b>Result</b>
FCC 15.247(b) (3) RSS-210 Issue 7, A8.4 (4)	Conducted Peak Output Power	Pass
FCC 15.247(a) (2) RSS-210 Issue 7, A8.2 (a)	6dB Bandwidth	Pass
FCC 15.247(e) RSS-210 Issue 7, A8.2 (b)	Transmitter Output Power Spectral Density	Pass
FCC 15.247(d) RSS-210 Issue 7, A8.5	Band-edge compliance	Pass
FCC 15.207 RSS-Gen Issue 2, 7.2.2	Conducted Emission Test on a.c. Power Line	Pass
FCC 15.205 / 15.209 RSS-210 Issue 7, A8.5	Spurious Radiated Emissions – Transmission mode	Pass
-- RSS-Gen Issue 2, 7.2.3	Spurious Radiated Emissions – Receiving mode	Pass

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## List of Test and Measurement Instruments

### TUV Rheinland India Pvt. Ltd, Bangalore

#### List of Test and Measurements

Equipment	Manufacturer	Type	S/N	Calibration Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100661	23.10.2009
LISN	Rohde & Schwarz	ENV216	100022	16.10.2009
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100811	03.04.2010

### Wipro Technologies, Bangalore

#### List of Test and Measurements

Equipment	Manufacturer	Type	S/N	Calibration Due Date
EMI Test Receiver	Rohde & Schwarz	ESIB40	100306	21.07.2009
Hybrid Log Periodic Antenna	TDK	HLP3003C	130334	16.02.2010
Broadband Horn Antenna	Schwarzbeck Mess-Electronik	BBHA9170	9170-344,2007	14.02.2010
Double Ridged Horn Antenna	Schwarzbeck Mess-Electronik	BBHA9120D	2008	29.07.2009
Per-Amplifier	TDK-RFSolution	PA-02	100008	14.02.2010

### SAMEER-Center for Electromagnetics, Chennai

#### List of Test and Measurements

Equipment	Manufacturer	Type	S/N	Calibration Due Date
EMI Receiver	Rohde & Schwarz	ESIB7	100319	06.03.2010
Loop Antenna	ETS Lingdren	6507	1484	12.10.2009

#### Testing Facilities

- 1) TUV Rheinland India Pvt Ltd  
73-74, Ground Floor,  
South Phase, Ambattur Estate,  
Ambattur, Chennai – 600058  
India
- 2) Wipro Technologies  
Survey No. 70,77,78 / 8A, Dodda Kannelli,  
Sarjapur Road, Bangalore – 560 035  
India
- 3) SAMEER-Center for Electromagnetics  
C.I.T.Campus, Taramani,  
2nd Main Road, Chennai – 600113  
India

## General Product Information

### Product Function and Intended Use

The wireless sensor (TR21-Wx, TR23-Wx models) and wireless receiver (WRECVRx models), provide a point-to-point communication between a zone sensor and associated controller (one-to-one association only). This application requires two-way communication with the sensor and the receiver both containing an RF transceiver.

The receiver emulates the resistance on its I/O lines so that controller connected to it identifies the zone space temperature, set point value, override status and low battery status at sensor device. Detail specifications of the EUT refer to appendix 6.

The EUT of this test report is the wireless receiver of model WRECVR.

The EUT consists of two variation of model number: WRECVR and WRECVRU in which they are totally identical except the model number only.

### Ratings and System Details

Operating Frequency	2405 – 2475 MHz
No. of channel	15 channels
Channel Spacing	5 MHz
RF port	MMCX
Transmitted Power	16 dBm ( Typical )
Occupied Bandwidth	2.5 MHz ( Typical )
Receiver Sensitivity	-101 dBm
Modulation	1. Direct Sequence Spread Spectrum ( DSSS ) 2. Offset Quadrature phase shift keying ( OQPSK )
Data Rate	250 Kbps
Chip rate	2 Mbps
Antenna Type	2.4 GHz Internal PCB mounted
Number of antenna	2
Antenna Gain	<b>Antenna – 1</b> 2405 MHz : -2.50 dBi 2440 MHz : -2.65 dBi 2475 MHz : -2.80 dBi <b>Antenna – 2</b> 2405 MHz : -2.50 dBi 2440 MHz : -2.65 dBi 2475 MHz : -2.80 dBi
RF Transmission Type	Duty cycled burst transmission . RF transmit occupancy time of 1.0 msec every 30 sec.
Voltage	20 – 30 VAC / DC, 50 / 60 Hz, 24 VAC typical

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Dimensions	140mm x 81mm x 56mm (LxWxT)
Environmental	Operating Temperature: -40° to 150°F (-40° to 65.5°C) Storage Temperature : -40° to 150°F (-40° to 65.5°C) Operating Humidity : 5% to 95% RH (non-condensing)
Housing	UL94-5VA
Radio Frequency Range	2.4 GHz (IEEE Std 802.15.4-2003 compliant) <ul style="list-style-type: none"><li>• Open Range: 3000 feet</li><li>• Typical Range: 100 feet</li></ul>
Power Consumption	<1.5 VA at 24 VAC

## Operation Descriptions

The TR21-Wx, TR23-Wx models provide Temperature, Override, Setpoint adjustment controls; and the WRECVRx models reproduces the same as analog information to the controller it connects.

The RF implementation utilizes a 2.4 GHz 802.15.4 Radio from Atmel i.e. AT86RF230. RF signal transmission frequency is at 30 second intervals excluding interrupt driven demands (which will have < 1 sec. latency) and is based on the need to update the space temperature and recognize a change in the set point temperature or occupancy override selection.

## **Test Set-up and Operation Mode**

### **Principle of Configuration Selection**

**Emission:** The test was performed under test mode to obtain the maximum emissions.

### **Test Operation and Test Software**

Testing software was used to enable the continuous transmission and frequency on the EUT for the tests in this report.

### **Special Accessories and Auxiliary Equipment**

The EUT was tested together with the following additional accessory:

- Deep switch was used to controlling different transmit channels and power levels.
- Antenna
- A transformer was provided by client for the ac mains line conducted emission test:

### **Countermeasures to achieve EMC Compliance**

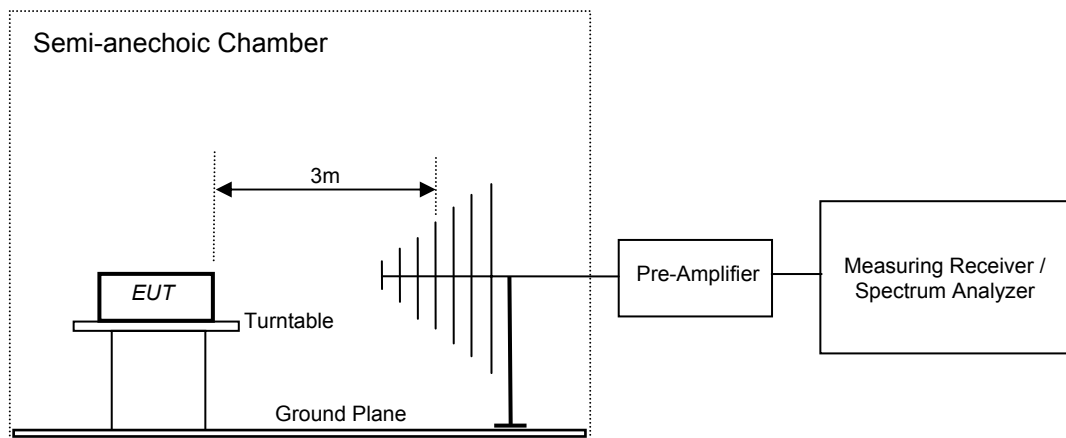
- none



## Test Methodology

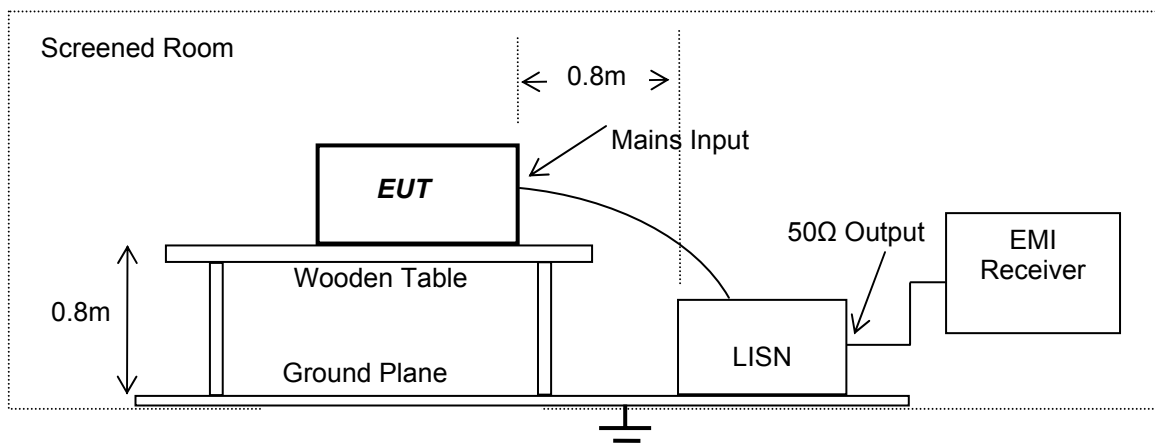
### Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.4-2003. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable, and the EUT is 3 meters far from the measuring antenna. The turntable was rotated 360° for obtaining the maximum emission. The height of the measuring antennas was scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurement above 1000MHz was performed by horn antenna. The measurement below 30MHz was performed by loop antenna.



### Conducted Emission Test on a.c. mains line

The equipment under test (EUT) was placed on a wooden table 80cm above the ground plane, the LISN was placed 80cm away from the EUT. The test was performed in accordance with ANSI C63.4: 2003, with the following: an initial measurement was performed in peak and average detection mode on the live and neutral lines. The pre-scan was performed by peak detection on both live and neutral conductors. Any emissions recorded within 20dB of the relevant limit line were re-measured using quasi-peak and average detections, the worst cases were recorded in the table of results.



## Test Results

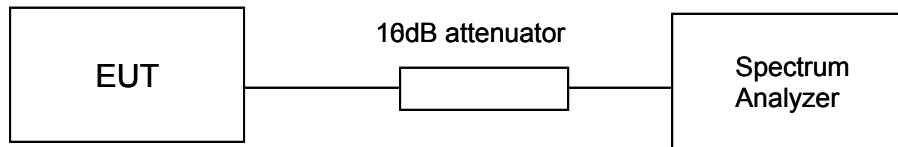
### Conducted Peak Output Power

### Section 15.247(b)(3)

**RESULT:****Pass**

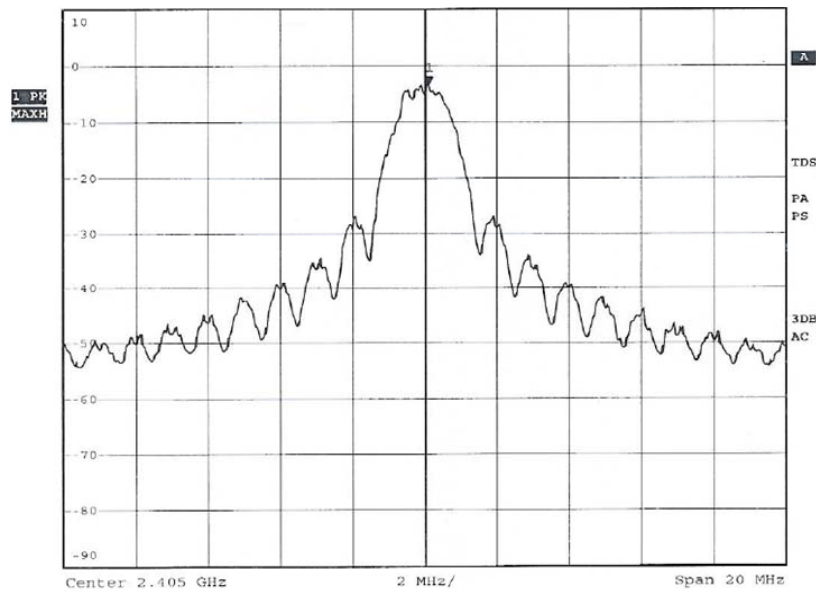
Test Specification : FCC Part 15 Section 15.31  
Test Method : ANSI C63.4-2003  
Measurement Bandwidth (RBW) : 1MHz / 3MHz  
Detector : Peak  
Supply voltage : 24 Volt AC  
Requirement : Shall not exceed 1.0 watt (30dBm) for systems using digital modulation.

Test Method:

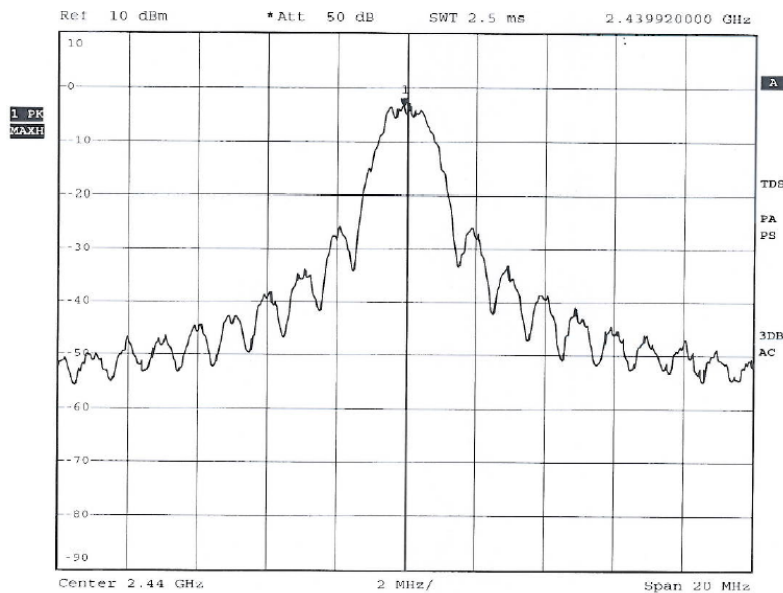


Test Result:

Channel	Frequency (MHz)	Measured Power (dBm)	Attenuation (dB)	Conducted Power (dBm)
Low	2405	-3.43	-16.36	12.93
Middle	2440	-3.50	-16.34	12.84
High	2475	-3.55	-16.26	12.71

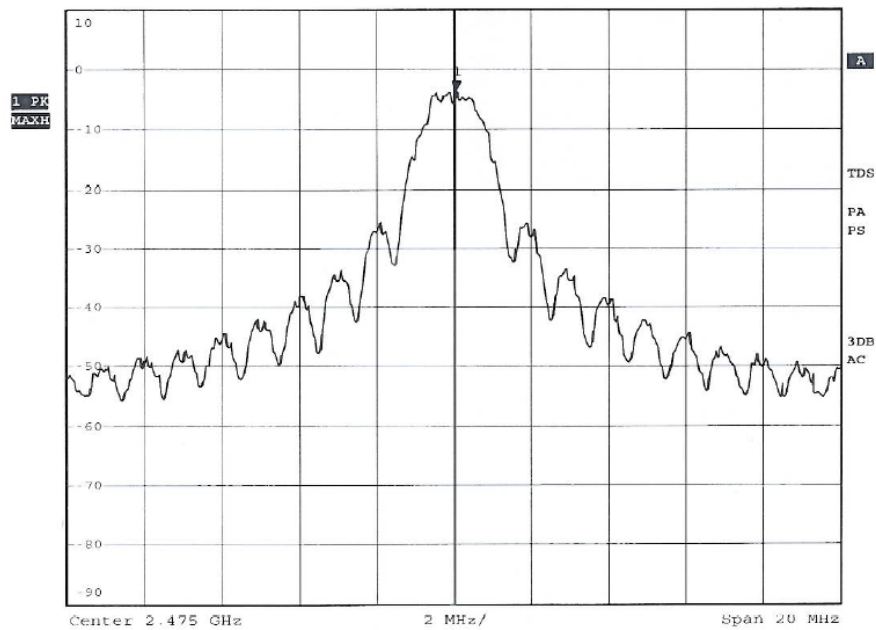


**Channel – Low**



**Channel - Middle**

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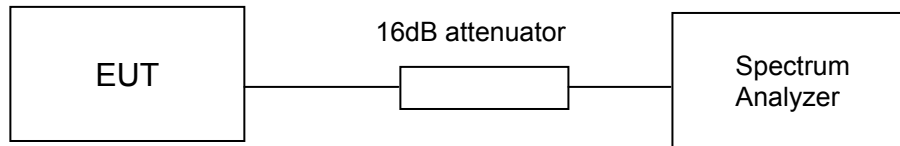


**Channel – High**

**6 dB Bandwidth****Section 15.247(a)(2)****RESULT:****Pass**

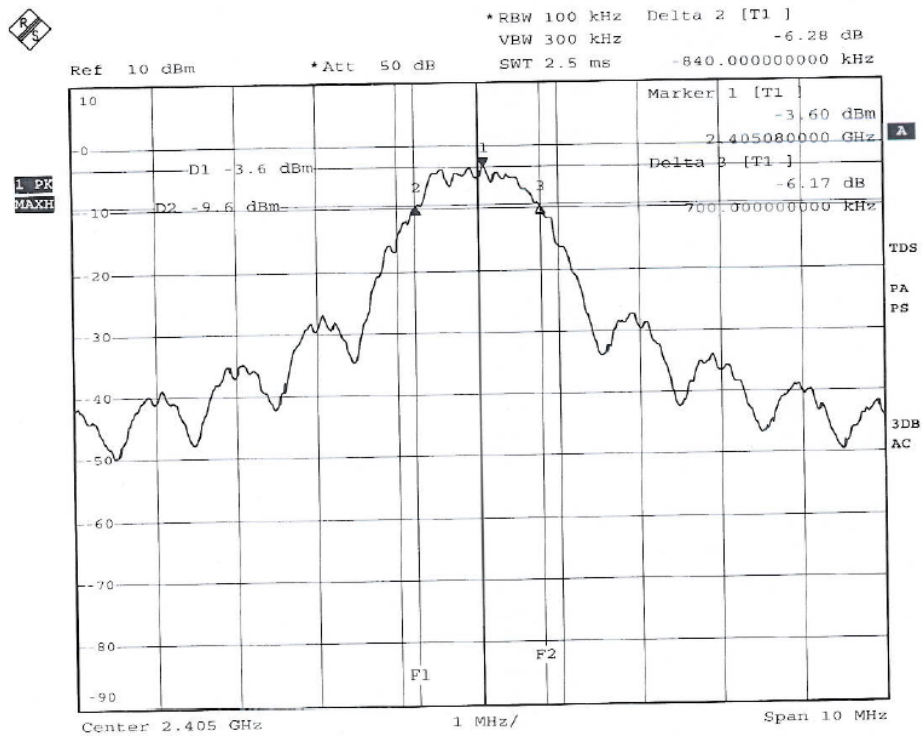
Test Specification : FCC Part 15 Section 15.247 (a) (2)  
Detector Function : Peak  
Supply Voltage : 24 V AC  
Port of testing : Antenna port  
Requirement : The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Method:

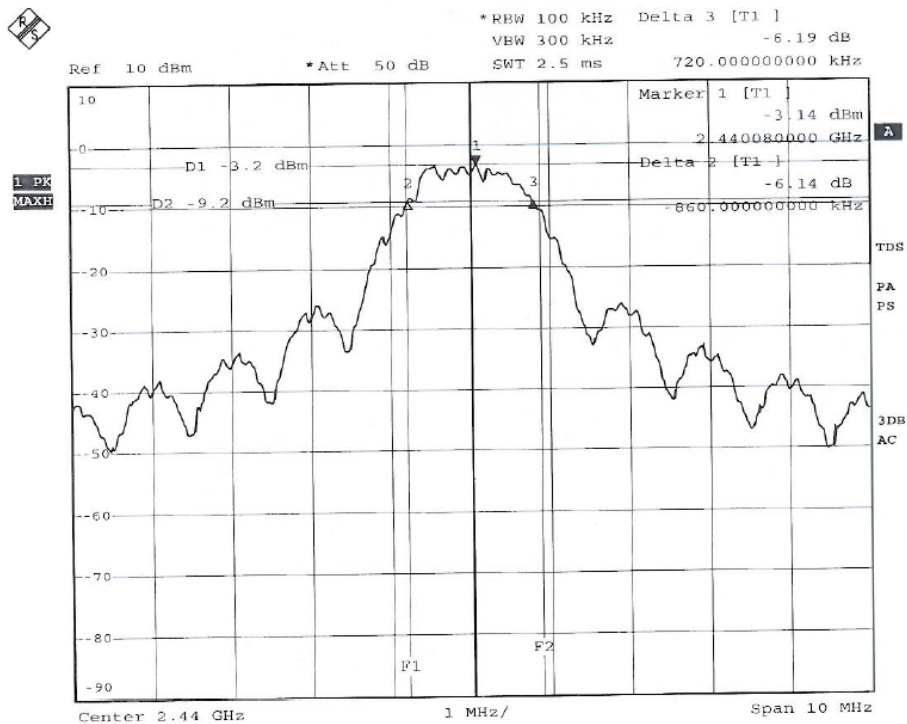


Test Result:

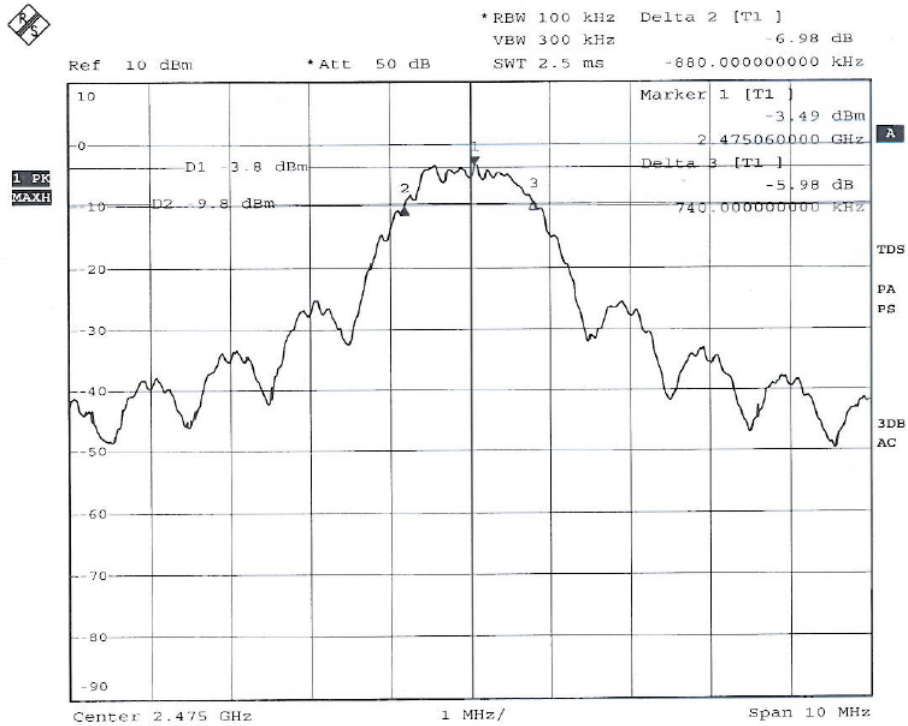
Center Frequency ( MHz )	Lower Frequency (MHz)	Upper Frequency (MHz)	6 dB Bandwidth (MHz)
2405	0.840	0.700	1.540
2440	0.860	0.720	1.580
2475	0.880	0.740	1.620



**Channel – Low**



**Channel – Middle**

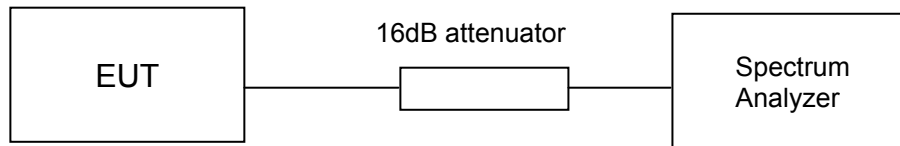


**Channel – High**

**Transmitter Output Spectral Power Density****Section 15.247(e)****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.247 (e)  
Detector Function : Peak  
Supply Voltage : 24 Volt AC  
Requirement : For digitally modulated systems, the 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.

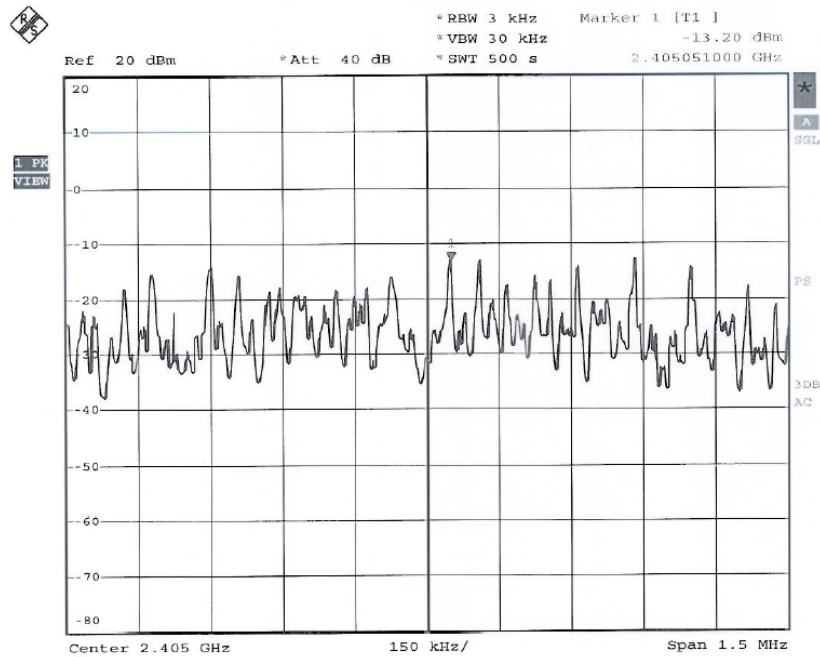
Test Method:



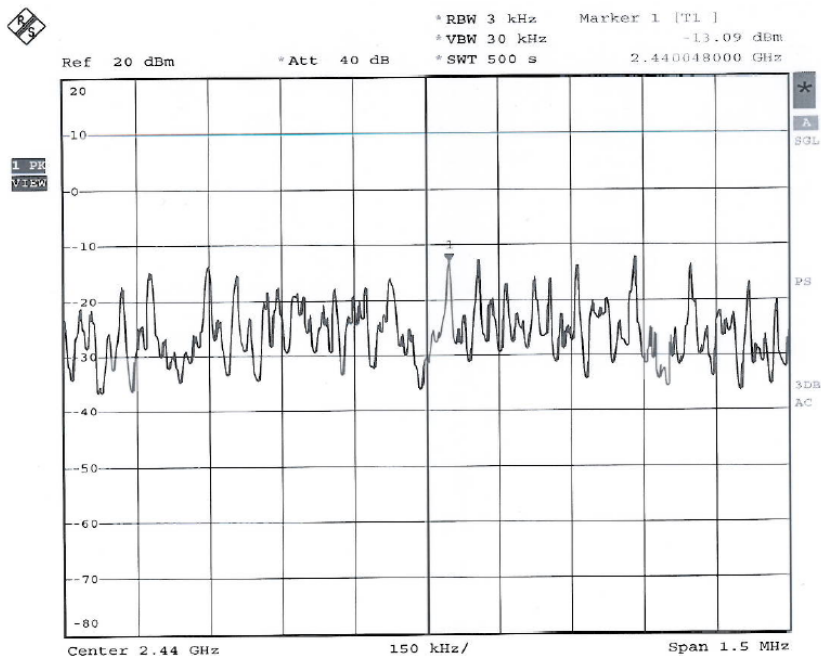
Test Result:

Channel	Frequency (MHz)	Measured Power (dBm)	Attenuation (dB)	Conducted Power (dBm)
Low	2405	-13.20	-16.36	3.16
Middle	2440	-13.09	-16.34	3.25
High	2475	-13.39	-16.26	2.87



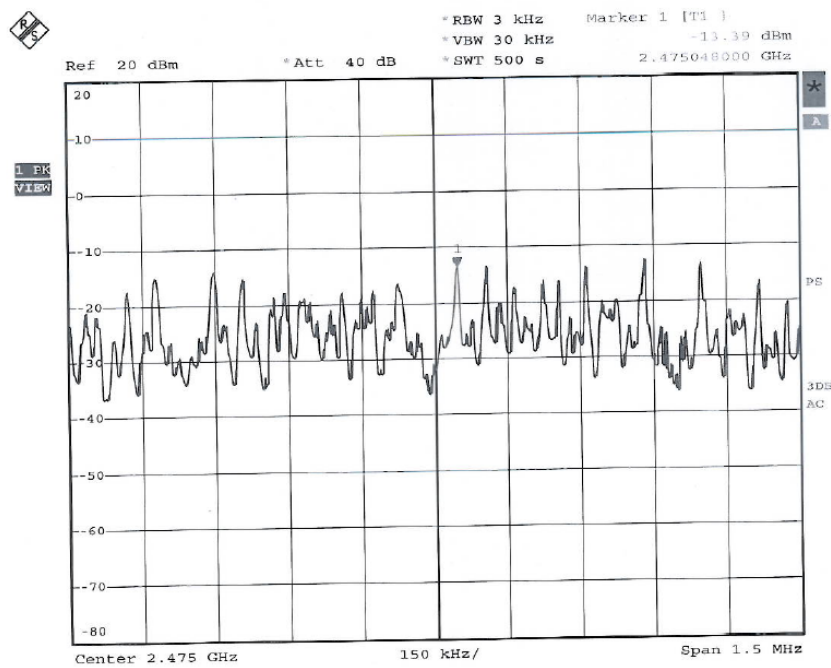


**Channel: Low**



**Channel: Middle**

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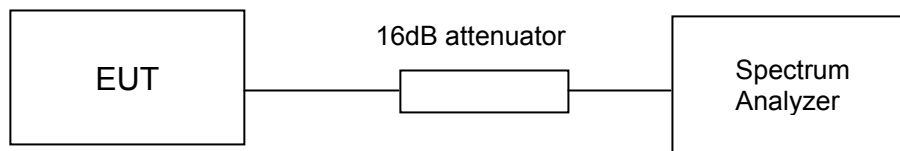


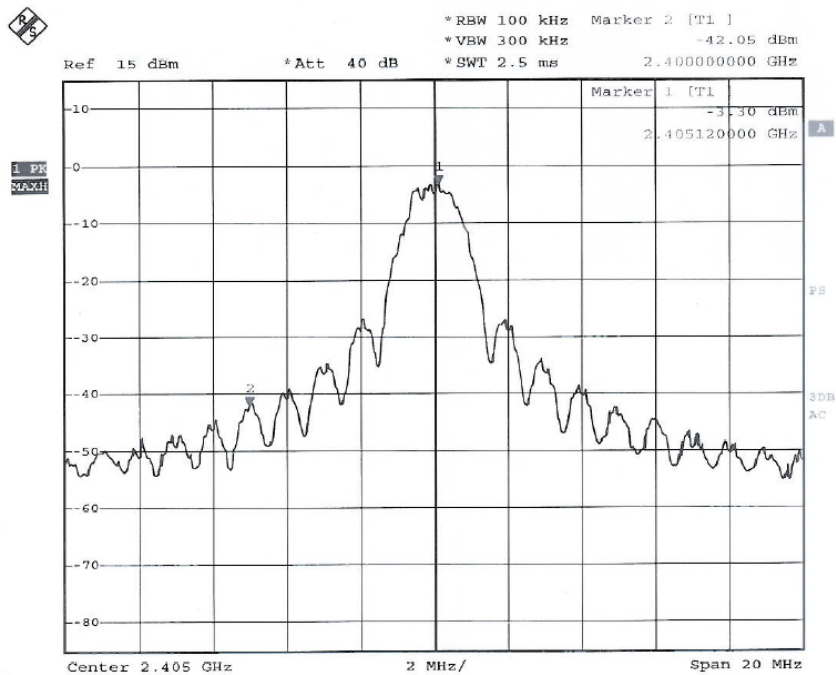
**Channel: High**

**Band-edge Compliance****Section 15.247(d)****RESULT:****Pass**

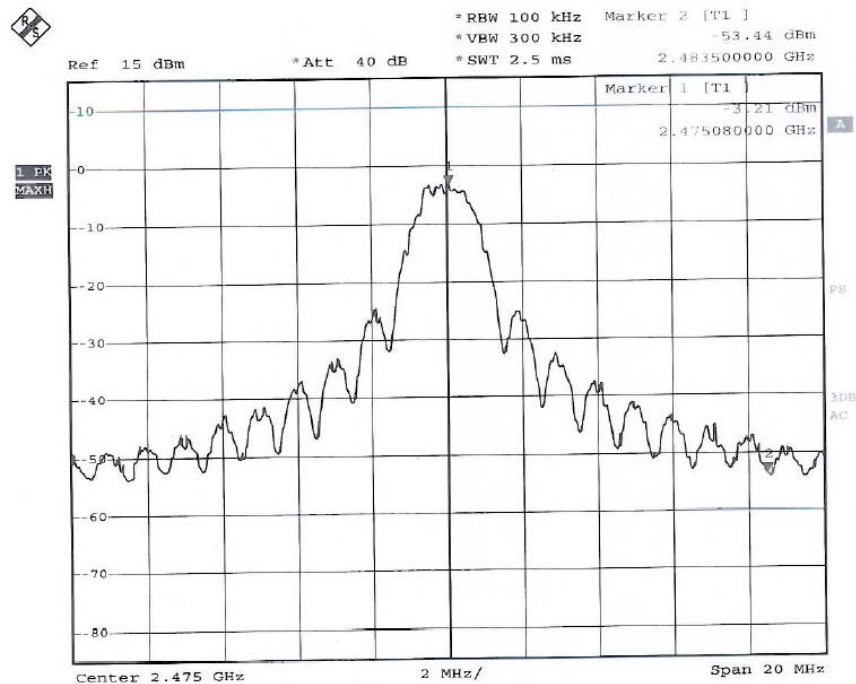
Test Specification : FCC Part 15 Section 15.247(d)  
Detector Function : Peak  
Supply Voltage : 24 Volt AC  
Requirement : In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz 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.

## Test Method:





**Channel: Low**



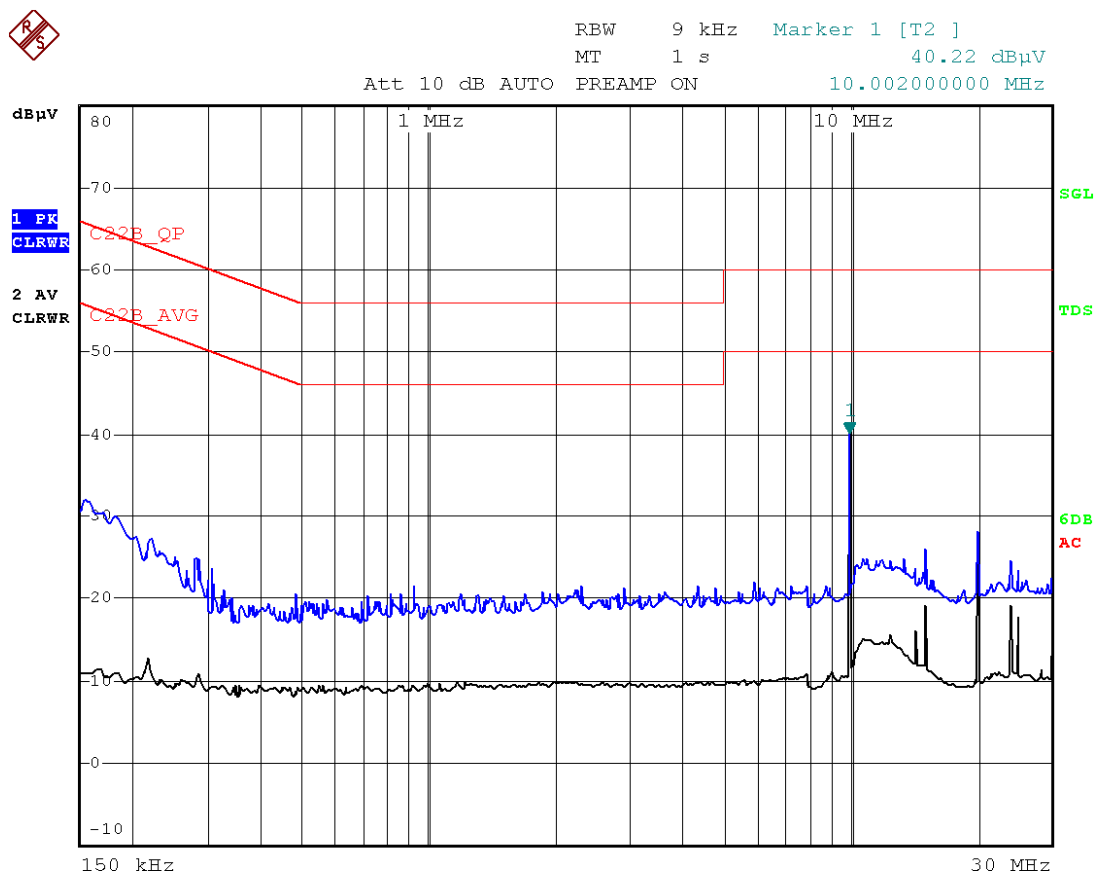
**Channel: High**

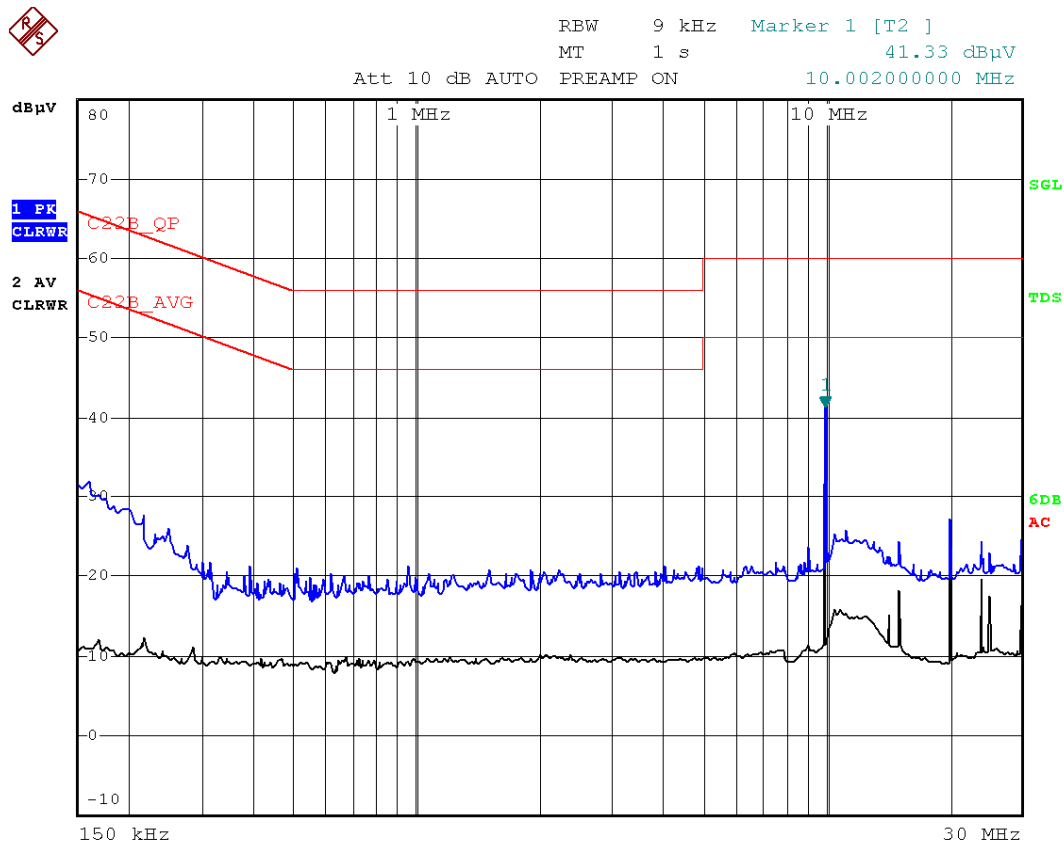
**Conducted Emission Test on a.c. Power Line**
**Section 15.207**
**RESULT:**
**Pass**

Test Specification : FCC Part 15 Section 15.207  
 Test Method : ANSI C63.4-2003  
 Testing Location : Screened room  
 Measurement Bandwidth : 9kHz  
 Frequency Range : 150kHz – 30MHz  
 Supply Voltage : 110 Volt AC

**Test Result:**

Conductor	Frequency of Emission ( MHz )	Emission Level (QP)	Emission Level (AV)	Result
Line	10.002	40.43	40.23	Pass
Neutral	10.002	40.90	40.74	Pass


**PLOT : LINE**



**PLOT : NEUTRAL**

**Limit of section 15.207:**

Frequency of emission (MHz)	QP Limit (dBμV)	AV Limit (dBμV/m)
0.15 – 0.5	66 – 56*	56 – 46*
0.5 – 5	56	46
5 – 30	60	50

\* Decreases with the logarithm of the frequency.

**Spurious Radiated Emissions****Section 15.209****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.205, 15.209 & 15.247(d)  
Test Method : ANSI C63.4-2003  
Measurement Location : Semi Anechoic Chamber  
Supply Voltage : 24 Volt AC  
Measuring Frequency Range : 9.0kHz (Lowest internal oscillator frequency of 1.0MHz) – 25GHz(Up to 10<sup>th</sup> harmonic of the highest fundamental frequency)  
Antenna connected with EUT : -2.5 dBi gain patch antenna provided by client.  
Measuring Distance : 3m  
Detection : QP for frequency below 1GHz, Average for frequency above 1GHz  
Requirement : 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. Attenuation below the general limits specified in Sections 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

Test result: **Transmitting Mode**

Channel	Fundamental Frequency (MHz)	Antenna Polrization	Spurious Emission (MHz)	Field Strength ( dB $\mu$ V/m )	Limit ( dB $\mu$ V/m )	Margin ( dB )
Low	2405	V	30.10	15.79	40.00	-24.21
			34.90	18.93	40.00	-21.07
			39.70	21.25	40.00	-18.75
			48.30	16.91	40.00	-23.09
			624.05	25.88	46.00	-20.12
			656.00	24.85	46.00	-21.15
			2405.00	91.32	-	*
			# 4811.00	41.38	54.00	-12.62
			7216.00	32.88	54.00	-21.12
		H	# 281.55	20.57	46.00	-25.43
			288.05	25.41	46.00	-20.59
			320.05	23.29	46.00	-22.71
			448.05	21.71	46.00	-24.29
			512.05	20.13	46.00	-25.87
			2405.00	91.32	-	*
			# 4811.00	40.67	54.00	-13.33
			7216.00	48.04	54.00	-5.96
Middle	2440	V	903.75	20.6	46.00	-25.4
			916.10	21.6	46.00	-24.4
			2440.00	91.22	-	*
			# 4880.00	41.89	54.00	-12.11
			# 7320.00	32.48	54.00	-21.52
			14179.00	42.54	54.00	-11.46
		H	890.85	21.84	46.00	-24.16
			939.80	21.6	46.00	-24.40
			2440.00	91.22	-	*
			# 4879.00	39.39	54.00	-14.61
			# 7321.00	40.67	54.00	-13.33
			14179.00	42.64	54.00	-11.36
High	2475	V	34.70	17.84	40.00	-22.16
			40.00	21.29	40.00	-18.71
			48.15	18.34	40.00	-21.66
			2475.00	90.71	-	*
			# 7426.50	35.14	54.00	-18.86
		H	864.05	26.64	46.00	-19.36
			926.45	20.87	46.00	-25.13
			953.10	22.43	46.00	-23.57
			2475.00	91.23	-	*
			# 7426.50	44.27	54.00	-9.73



Test result: **Receiving Mode**

Antenna Polrization	Spurious Emission (MHz)	Field Strength ( dB $\mu$ V/m )	Limit ( dB $\mu$ V/m )	Margin ( dB )
<b>V</b>	80.15	14.49	40	25.51
	112.05	13.60	40	26.40
	183.00	11.77	40	28.23
	191.00	15.61	40	24.39
	193.05	13.42	40	26.58
	201.00	13.90	40	26.10
	229.00	14.62	46	31.38
	257.00	16.42	46	29.58
<b>H</b>	561.00	21.35	46	24.65
	119.65	17.78	40	22.22
	185.00	18.77	40	21.23
	187.05	18.95	40	21.05
	257.00	24.63	46	21.37
	265.05	24.72	46	21.28
	269.00	24.61	46	21.39
	516.75	14.63	46	31.37
	561.00	16.62	46	29.38

\* Operation Band

# Spurious emissions that falls into the restricted band of Section 15.205.

**Limit for Radiated Emission of Section 15.209:**

Frequency (MHz)	Field strength (dB $\mu$ V) at 3m range	Field strength (dB $\mu$ V/m) at 3m range
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80 (300m range)*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00 (30m range)*
1.705-30	30 (30m range)*	29.5(30m range)*
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

Remark: \* the limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz are at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 88,50 – 53.80, 53.80 – 43.00 and 49.5dB $\mu$ V/m at 3m range by extrapolation calculation and the measurement of loop antenna.

The emission limits shows in the table are based on measurements employing a CISPR quasi-peak detector and above 1000 MHz are based on the measurements employing an average detector.