

Prüfbericht - Nr.:		19660322 001		Seite 1 von 15	
<i>Test Report No.:</i>		<i>Page 1 of 15</i>			
Auftraggeber: <i>Client:</i>		Nidec Motor Corporation 8050 W Florissant Avenue St. Louis, MO 63136 United States of America			
Gegenstand der Prüfung: <i>Test item:</i>		Vibration and Temperature Sensor			
Bezeichnung: <i>Identification:</i>		FY01	Serien-Nr.: <i>Serial No.</i>		FY01WLS1
Wareneingangs-Nr.: <i>Receipt No.:</i>		1803237030	Eingangsdatum: <i>Date of receipt:</i>		21.06.2017
Prüfort: <i>Testing location:</i>		Refer Page 3 of 15 for test facilities			
Prüfgrundlage: <i>Test specification:</i>		FCC Part 15 Subpart C - 15.249, RSS-210 Issue 9, ANSI C63.10-2013			
Prüfergebnis: <i>Test Result:</i>		Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n). <i>The test items passed the test specification(s).</i> FCC Test Firm Registration No.: 176555 & IC OATS Reg. Number.: 3466E			
Prüflaboratorium: <i>Testing Laboratory:</i>		TÜV Rheinland (India) Pvt. Ltd. 82/A, 3rd Main, West Wing, Electronic City Phase 1 Hosur Road, Bangalore – 560 100, India			
geprüft / tested by:			kontrolliert / reviewed by:		
18.06.2017	Santhosh SK Engineer		10.07.2017	Saibaba Siddapur Assistant Manager	
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>
Sonstiges / Other Aspects: FCC ID: 2AMLK- FY01 & IC: 22825-FY01					
Abkürzungen: P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet			Abbreviations: P(ass) = passed F(ail) = failed N/A = not applicable N/T = not tested		
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. <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.</i> <i>This test report does not entitle to carry any safety mark on this or similar products.</i>					

Contents

1	Test Result Summary	3
2	List of Test and Measurement Instruments	3
3	General Product Information	4
3.1	Product Function and Intended Use	4
3.2	Ratings and System Details	4
3.3	Measurement Uncertainty:	5
4	Operational Description	5
5	Test Set-up and Operation Mode	5
6	Test Methodology	7
7	Test Results	9
7.1	Restricted Spurious Emissions & Restricted Bands of Operation	9
8	List of Tables	15
9	List of Figures	15

Appendix 1: Test Setup Photos

Appendix 2: EUT External Photos

Appendix 3: EUT Internal Photos

Appendix 4: FCC & IC Label and Location

Appendix 5: Block Diagram

Appendix 6: Specification of EUT

Appendix 7: Schematic Diagrams

Appendix 8: Bill of Materials

Appendix 9: User Manual

Appendix 10: Maximum Permissible Exposure Information

1 Test Result Summary

Table 1: Test result summary

Test Item	Test Clause	Results
Radiated Spurious Emissions and Restricted bands of operation	FCC 15.249(a)(d)(e) & RSS210-B10(a)(b)	Pass
Conducted Emission on A.C Mains Lines	15.207 & RSS-Gen Issue 4 section 8.8	NA*

The module is certified by **acs** with report reference **11-0216.W06.1A**, FCC ID : **U90-SM200** & IC: **7084A-SM200** for **FCC 15.249 & RSS-210**.

Note: EUT exclusive works on Battery only.

2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Instruments

Equipment	Manufacturer	Model Name	Serial Number	Calibration Due Date	Periodicity	Used for Test Items
EMI Test Receiver	Rohde & Schwarz	ESU 40	100288	29-10-2017	Yearly	Spurious Radiated Emissions
Active loop antenna	Frankonia	LAX-10	LAX-10-800	22-12-2017	Yearly	
Broadband Antenna	Frankonia	ALX-4000	ALX-4000-814	09-01-2018	Yearly	
Broadband Horn Antenna	Frankonia	HAX-18	HAX18-802	16-03-2018	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	

Testing Facilities

TUV Rheinland (India) Private Limited
108 , Beside ISBR Business School,
Electronic city Phase I
Bangalore - 560 100.

3 General Product Information

3.1 Product Function and Intended Use

The FY01 model VIBRATION AND TEMPERATURE SENSOR is a Sensor with IEEE 802.15.4 compliant 2.4 GHz Wireless Connectivity, used for monitoring motors and other equipment.

Features :

- ✓ Accurately monitors vibration and temperature in a wide variety of applications.
- ✓ Provides continuous wireless communication of monitored data and alerts for quick analysis and efficient equipment maintenance.
- ✓ Robust industrial-grade design allows vibration and temperature sensor to be reliably used in harsh industrial environments.
- ✓ Very easy installation – locate, place and use
- ✓ Long Battery life

Applications:

- ✓ Food & Beverage Production Facilities
- ✓ Paper & Metal Manufacturing
- ✓ Cooling Towers
- ✓ Pumping Stations
- ✓ HVAC System Equipment
- ✓ Power Plants

3.2 Ratings and System Details

Table 3: Ratings and System Details

Operating Frequency Range	2405 MHz – 2480 MHz
Radio Protocol	SNAP (Sub network Access Protocol)
No. of channels	16
Channel Spacing	5 MHz
Modulation	O-QPSK
Number of antennas	Refer Table 5: List of antennas options
Antenna Gain & Type	Refer Table 5: List of antennas options
Supply Voltage to Product	3 VDC, Li-Ion Battery
Dimensions	Dia 54 mm x 90 mm (without Antenna) Dia 54 mm x 218 mm (with Antenna)
Environmental conditions	-25 °C to +70 °C

Test Conditions:

Supply Voltage: 3 VDC, Li-Ion Battery

Environmental conditions:

Temperature: +24.7 °C RH: 57.2 %

3.3 Measurement Uncertainty:

Table 4: Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3 dB
Unwanted Emissions, conducted	±3 dB
All emissions, radiated	±6 dB
Temperature	±3 °C
Supply Voltages	±3 %
Time	±5 %

4 Operational Description

The FY01 VIBRATION AND TEMPERATURE SENSOR is installed on motors and other equipment to sense the Vibration and Temperature the unit and send the data to a nearby paired gateway over IEEE 802.15.4 compliant 2.4 GHz Wireless Connectivity. From gateway the data are sent to cloud over WiFi or Cellular network. In the cloud, the data are analysed and stored for future reference. If there are any abnormalities, the cloud sends the alerts to the user over E-Mail and SMS. The analysed data can be viewed in the Forecyte Portal through a PC. Apart from viewing the data, we can also update the firmware and configure the settings of the unit and gateway over the air using the Forecyte portal.



5 Test Set-up and Operation Mode

Principle of Configuration Selection

Transmission was enabled on highest possible duty cycled transmission on low, mid and high channel.

Test Operation and Test Software

SBU Firmware (SBU_FCC_19042017) & RF module Script (Fast PacketsTest) was used to enable the highest possible duty cycle transmission, changing channels (low/mid/high) and select data rates (250 kbps) on the EUT for the tests in this report & RF module Script (FCC_Receiving) was used to enable receive mode on EUT.

Special Accessories and Auxiliary Equipment

- Thermocouple (Make: Omega & Model: 5SRTC-KK-T-30-72) is used along with EUT during operation.

Countermeasures to achieve EMC Compliance

- None

Table 5: List of antennas options

Manufacturer	Antenna Type	Antenna Part No.	Operating Frequency (GHz)	Antenna Gain(dBi)
Pulse Electronics	Dipole	W1027	2.4-2.5	3.2
Taoglas	Dipole	GW.11.A153	2.4-2.483	2.3
Pulse Electronics	Dipole	W1030	2.4-2.5	2

Table 6: List of Centre Frequencies

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2405 – 2480	0	2405
	1	2410
	2	2415
	3	2420
	4	2425
	5	2430
	6	2435
	7	2440
	8	2445
	9	2450
	10	2455
	11	2460
	12	2465
	13	2470
	14	2475
	15	2480

6 Test Methodology

Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.10-2013. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable for below 1 GHz & 1.5 m height for above 1 GHz measurement, 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 1 m and 4 m, 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 1000 MHz was performed by horn antenna, The measurement below 30 MHz was performed by loop antenna.

The EUT was rotated around the X-, Y-, and Z-Axis and the results from worst case axis are recorded.

Test Setup Configuration

Figure 1: Frequency Range 9 KHz -30 MHz

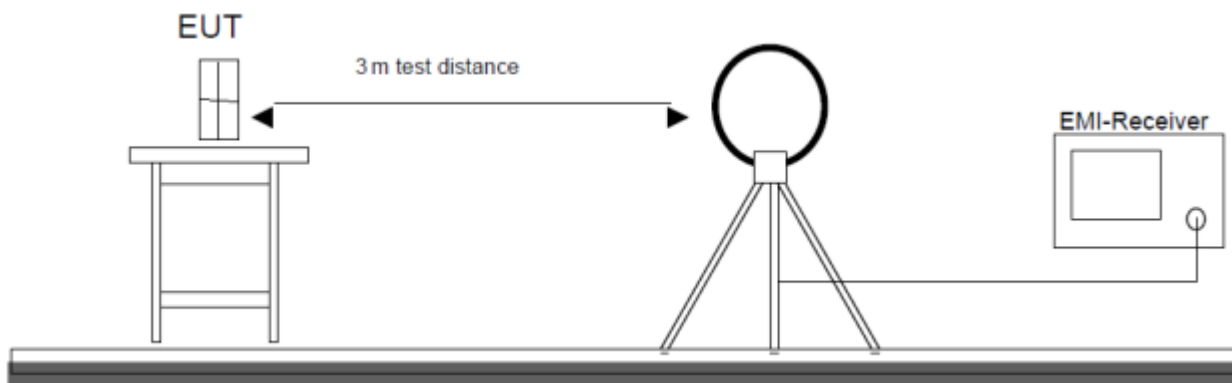


Figure 2: Frequency Range 30 MHz - 1 GHz

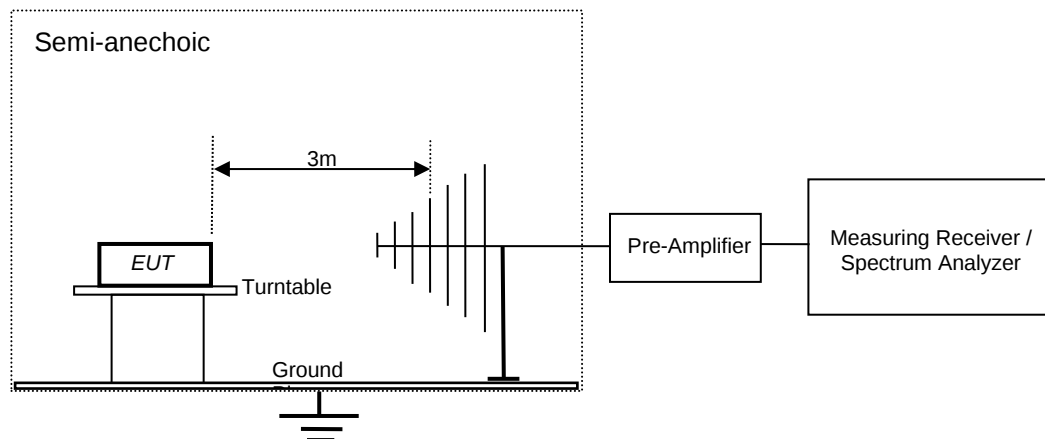
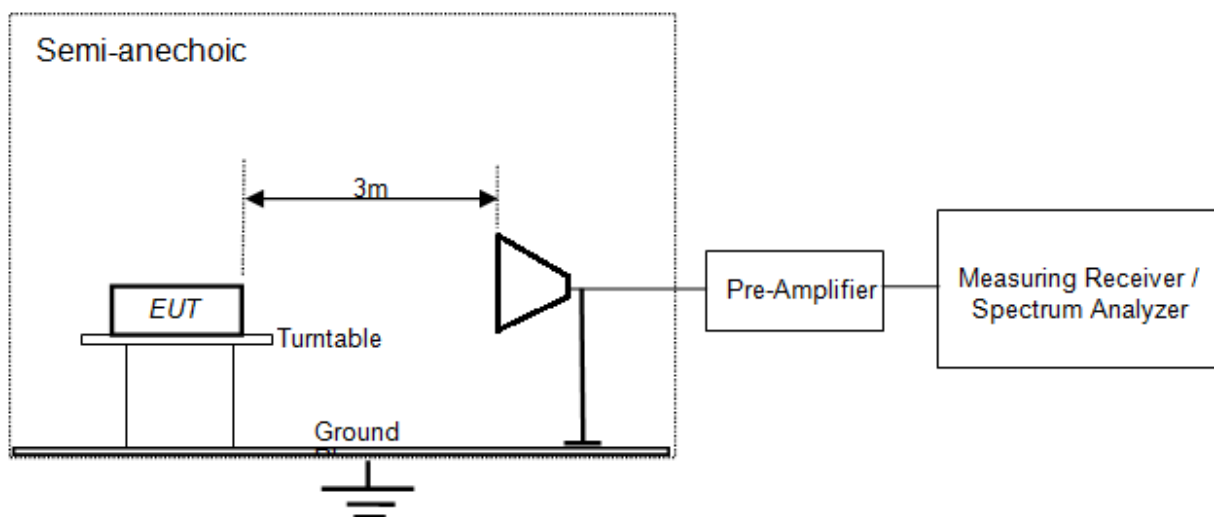


Figure 3: Frequency above 1 GHz



7 Test Results

7.1 Restricted Spurious Emissions & Restricted Bands of Operation

Result

Pass

Test Specification	FCC 15.249(a)(d)(e) & RSS-210 B10(a)(b)
Test Method	ANSI C63.10-2013
Measurement Location	Semi Anechoic Chamber
Measuring Frequency Range	9 KHz to 40 GHz (Up to 10 th harmonic of the highest fundamental frequency)
Measuring Distance	3 m
Detection	QP for frequency below 1 GHz, Peak, Average for frequency above 1 GHz
Requirement	As per the limits mentioned in the below table

Transmitter limits for operation

Table 7: Limit for field strength measurement within band 15.249(a) & RSS-210 B10(a)

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902 - 928 MHz	50	500
2400 - 2483.5 MHz	50	500
5725 - 5875 MHz	50	500
24.0 - 24.25 GHz	250	2500

Table 8: Limit for radiated emission measurement 15.209 & RSS- Gen 8.9

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Distance of Measurement (m)
0.009 – 0.490	2400/F (KHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F (KHz)	33.80 – 23.00	30*
1.705 - 30	30	29.54	30*
30 - 88	100	40.0	3
88 - 216	150	43.5	3
216 - 960	200	46.0	3
Above 960	500	54.0	3

Remark: * The limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30 MHz is at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 88.50 – 53.80, 53.80 – 43.00 and 49.5 dBμV/m at 3 m range by extrapolation calculation and the measurement of loop antenna.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 KHz, 110–490 KHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

No emission found for the frequency range 9 KHz to 30 MHz

Test results for the frequency range 30 MHz to 1GHz are reported below.

Table 9: Test results for frequency range 30 MHz to 1 GHz for W1027 Antenna

Polarization	Measured Frequency (MHz)	Radiated Spurious Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Vertical	32.13	17.40	40	-22.60
	450.1	20.14	46	-25.86
	672.53	25.61	46	-20.39
	876.03	33.77	46	-12.23
	939.08	31.73	46	-14.27
Horizontal	31.06	18.93	40	-21.07
	218.37	13.81	43.5	-29.69
	599.39	18.64	46	-27.36
	875.65	24.26	46	-21.74
	939.08	28.01	46	-17.99

Table 10: Test results for frequency range 30 MHz to 1 GHz for GW.11.A153 Antenna

Polarization	Measured Frequency (MHz)	Radiated Spurious Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Vertical	30.97	17.64	40	-22.36
	406.166	19.89	46	-26.11
	568.35	24.04	46	-21.96
	668.163	24.74	46	-21.26
	969.736	22.87	46	-23.13
Horizontal	30.776	17.68	40	-22.32
	405.972	17.32	46	-28.68
	617.141	19.24	46	-26.76
	857.216	21.27	46	-24.73
	922.4	22.25	46	-23.75

Table 11: Test results for frequency range 30 MHz to 1 GHz for W1030 Antenna

Polarization	Frequency (MHz)	Unwanted Spurious Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	31.455	17.09	40	-22.91
	400.443	19.80	46	-26.20
	590.466	24.72	46	-21.28
	675.729	23.97	46	-22.03
	912.991	23.18	46	-22.82
Horizontal	30.776	17.64	40	-22.36
	401.316	16.16	46	-29.84
	602.494	18.52	46	-27.48
	746.539	21.26	46	-24.74
	847.516	22.14	46	-23.86

Table 12: Test results for frequency range 1 GHz to 26.5 GHz for W1027 Antenna

Data rate	Channel	Polarization	Measured Frequency (MHz)	Radiated Spurious Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
250 kbps	2405	Vertical	2390 (Pk)	53.91	74	-20.09
			2390 (Av)	27.59	54	-26.41
			2405 (Pk)	94.08	114	-19.92
			2405 (Av)	82.12	94	-11.88
			4810 (Pk)	50.27	74	-23.73
			4810 (Av)	36.85	54	-17.15
			7215 (Pk)	56.34	74	-17.66
			7215 (Av)	43.21	54	-10.79
		Horizontal	2390 (Pk)	42.97	74	-31.03
			2390 (Av)	25.93	54	-28.07
			2405 (Pk)	80.89	114	-33.11
			2405 (Av)	69.78	94	-24.22
			4810 (Pk)	49.43	74	-24.57
			4810 (Av)	36.82	54	-17.18
			7215 (Pk)	55.21	74	-18.79
			7215 (Av)	43.17	54	-10.83
	2440	Vertical	2440 (Pk)	94.21	114	-19.79
			2440 (Av)	82.51	94	-11.49
			4880 (Pk)	49.60	74	-24.40
			4880 (Av)	37.45	54	-16.55
			7320 (Pk)	56.28	74	-17.72
			7320 (Av)	43.75	54	-10.25
		Horizontal	2440 (Pk)	81.49	114	-32.51
			2440 (Av)	70.35	94	-23.65
			4880 (Pk)	50.45	74	-23.55
			4880 (Av)	37.27	54	-16.73
	2480	Vertical	7320 (Pk)	56.77	74	-17.23
			7320 (Av)	43.67	54	-10.33
			2483.5 (Pk)	48.09	74	-25.91
			2483.5 (Av)	32.6	54	-21.40
			2480 (Pk)	77.9	114	-36.10
			2480 (Av)	66.25	94	-27.75
			4960 (Pk)	49.37	74	-24.63
			4960 (Av)	37.45	54	-16.55
		Horizontal	7440 (Pk)	56.7	74	-17.30
			7440 (Av)	44.50	54	-09.50
			2483.5 (Pk)	43.43	74	-30.57
			2483.5 (Av)	31.64	54	-22.36
			2480 (Pk)	76.23	114	-37.77
			2480 (Av)	65.75	94	-28.25
			4960 (Pk)	49.76	74	-24.24
			4960 (Av)	37.43	54	-16.57
			7440 (Pk)	57.34	74	-16.66
			7440 (Av)	44.48	54	-09.52

Pk- Peak detector
Av- Average detector

Table 13: Test results for frequency range 1 GHz to 26.5 GHz for GW.11.A153 Antenna

Data rate	Channel	Polarization	Measured Frequency (MHz)	Radiated Spurious Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
250 kbps	Low	Vertical	2390 (Pk)	55.07	74	-18.93
			2390 (Av)	28.15	54	-25.85
			2405 (Pk)	95.92	114	-18.08
			2405 (Av)	83.49	94	-10.51
			4810 (Pk)	50.79	74	-23.21
			4810 (Av)	37.42	54	-16.58
		Horizontal	2390 (Pk)	44.38	74	-29.62
			2390 (Av)	25.91	54	-28.09
			2405 (Pk)	83.48	114	-30.52
			2405 (Av)	71.64	94	-22.36
			4810 (Pk)	50.41	74	-23.59
			4810 (Av)	37.71	54	-16.29
	Mid	Vertical	2440 (Pk)	95.11	114	-18.89
			2440 (Av)	82.92	94	-11.08
			4880 (Pk)	51.6	74	-22.40
			4880 (Av)	38.49	54	-15.51
		Horizontal	2440 (Pk)	83.58	114	-30.42
			2440 (Av)	70.36	94	-23.64
			4880 (Pk)	50.65	74	-23.35
			4880 (Av)	37.85	54	-16.15
	High	Vertical	2483.5 (Pk)	49.87	74	-24.13
			2483.5 (Av)	34.04	54	-19.96
			2480 (Pk)	80.39	114	-33.61
			2480 (Av)	67.66	94	-26.34
			4960 (Pk)	51.17	74	-22.83
			4960 (Av)	37.51	54	-16.49
		Horizontal	2483.5 (Pk)	40.74	74	-33.26
			2483.5 (Av)	27.43	54	-26.57
			2480 (Pk)	67.66	114	-46.34
			2480 (Av)	54.89	94	-39.11
			4960 (Pk)	50.75	74	-23.25
			4960 (Av)	38.25	54	-15.75

Pk- Peak detector
Av- Average detector

Table 14: Test results for frequency range 1 GHz to 26.5 GHz for W1030 Antenna

Data rate	Channel	Polarization	Measured Frequency (MHz)	Radiated Spurious Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
250 kbps	Low	Vertical	2390 (Pk)	39.68	74	-34.32
			2390 (Av)	25.92	54	-28.08
			2405 (Pk)	66.73	114	-47.27
			2405 (Av)	54.49	94	-10.51
			4810 (Pk)	50.33	74	-23.67
			4810 (Av)	36.94	54	-17.06
		Horizontal	2390 (Pk)	39.03	74	-34.97
			2390 (Av)	26.16	54	-27.84
			2405 (Pk)	58.8	114	-55.20
			2405 (Av)	47.82	94	-46.18
			4810 (Pk)	48.94	74	-25.06
			4810 (Av)	36.8	54	-17.20
	Mid	Vertical	2440 (Pk)	67.75	114	-46.25
			2440 (Av)	55.43	94	-38.57
			4880 (Pk)	51.16	74	-22.84
			4880 (Av)	37.58	54	-16.42
		Horizontal	2440 (Pk)	60.09	114	-53.91
			2440 (Av)	49.03	94	-44.97
			4880 (Pk)	50.4	74	-23.60
			4880 (Av)	37.49	54	-16.51
	High	Vertical	2483.5 (Pk)	39.37	74	-34.63
			2483.5 (Av)	26.33	54	-27.67
			2480 (Pk)	57.82	114	-56.18
			2480 (Av)	44.39	94	-49.61
			4960 (Pk)	50.29	74	-23.71
			4960 (Av)	37.52	54	-16.48
		Horizontal	2483.5 (Pk)	39.37	74	-34.63
			2483.5 (Av)	26.26	54	-27.74
			2480 (Pk)	49.31	114	-64.69
			2480 (Av)	37.41	94	-56.59
			4960 (Pk)	50.74	74	-23.26
			4960 (Av)	37.44	54	-16.56

Pk- Peak detector
 Av- Average detector

8 List of Tables

Table 1: Test result summary	3
Table 2: List of Test and Measurement Instruments	3
Table 3: Ratings and System Details.....	4
Table 4: Measurement Uncertainty	5
Table 5: List of antennas options	6
Table 6: List of Centre Frequencies	6
Table 7: Limit for field strength measurement within band 15.249(a) & RSS-210 B10(a).....	9
Table 8: Limit for radiated emission measurement 15.209 & RSS- Gen 8.9.....	9
Table 9: Test results for frequency range 30 MHz to 1 GHz for W1027 Antenna	10
Table 10: Test results for frequency range 30 MHz to 1 GHz for GW.11.A153 Antenna.....	10
Table 11: Test results for frequency range 30 MHz to 1 GHz for W1030 Antenna	11
Table 12: Test results for frequency range 1 GHz to 26.5 GHz for W1027 Antenna	12
Table 13: Test results for frequency range 1 GHz to 26.5 GHz for GW.11.A153 Antenna	13
Table 14: Test results for frequency range 1 GHz to 26.5 GHz for W1030 Antenna	14

9 List of Figures

Figure 1: Frequency Range 9 KHz -30 MHz.....	7
Figure 2: Frequency Range 30 MHz - 1 GHz	8
Figure 3: Frequency above 1 GHz	8

END OF TEST REPORT