

**SK TECH CO., LTD.**

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Certificate of Compliance

Test Report No.:	SKTTRT-050729-016		
NVLAP CODE:	200220-0		
Applicant:	DAEWOO PRECISION INDUSTRIES LTD.		
Applicant Address:	609-600 P.O.BOX 25, KumJeong, Busan, Korea		
Manufacturer:	DAEWOO PRECISION INDUSTRIES LTD.		
Manufacturer Address:	609-600 P.O.BOX 25, KumJeong, Busan, Korea		
Device Under Test:	Remote Keyless Entry System (Transmitter), Model RK950NAT		
FCC ID: IC:	IT7-RK950NAT 1176A-RK950NAT	Trade Name:	GMDAT, DPI
Receipt No.:	SKTEU05-0422	Date of receipt:	June 22, 2005
Date of Issue:	July 29, 2005		
Location of Testing:	SK TECH CO., LTD. 820-2, Wolmoon-Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea		
Test Specification:	FCC Part 15 Rules, RSS-210 Issue 5		
FCC Equipment Class: IC Equipment Category:	DSC - Part 15 Security/Remote Control Transmitter Category I Equipment		
Test Result:	The above-mentioned device has been tested and passed.		
Tested & Reported by: Jong-Soo, Yoon		Approved by: Jae-Kyung, Bae	
 2005. 07. 29		 2005. 07. 29	
Signature		Signature	
Date		Date	
Other Aspects:			
Abbreviations:	· OK, Pass = passed · Fail = failed · N/A = not applicable		

- This test report is not permitted to copy partly without our permission.
- This test result is dependent on only equipment to be used.
- This test result is based on a single evaluation of one sample of the above mentioned.
- This test report must not be used to claim product endorsement by NVLAP or any agency of the U.S Government.
- We certify that this test report has been based on the measurement standards that is traceable to the national or International standards.



NVLAP Lab. Code: 200220-0



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1. GENERAL

These tests were performed using the test procedure outlined in ANSI C63.4, 2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.231 for periodic transmitter. The EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards.

We attest to the accuracy of data. All measurements reported herein were performed by SK Tech Co., Ltd. and were made under Chief Engineer's supervision.

We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. TEST SITE

SK TECH Co., Ltd.

2.1 Location

820-2, Wolmoon Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

This laboratory is accredited by NVLAP for NVLAP Lab. Code: 200220-0 and DATech for DAR-Registration No.: TTI-P-G155/97-10



2.2 List of Test and Measurement Instruments

Description	Manufacturer	Model #	Serial #	
Spectrum Analyzer	Agilent	E4405B	US40520856	
EMC Spectrum Analyzer	Agilent	E7405A	US40240203	☒
EMI Test Receiver	Rohde&Schwarz	ESVS10	825120/013	☒
EMI Test Receiver	Rohde&Schwarz	ESVS10	834468/008	☒
EMI Test Receiver	Rohde&Schwarz	ESHS10	825120/013	
EMI Test Receiver	Rohde&Schwarz	ESHS10	834468/008	
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	836679/018	
Pre-amplifier	HP	8447F	3113A05153	☒
Pre-amplifier	HP	8349B	2644A03250	☒
Power Meter	Agilent	E4418B	3318A13916	
Power Sensor	HP	8485A	3318A13916	
VHF Precision Dipole Antenna (TX & RX)	Schwarzbeck	VHAP	1014 & 1015	
UHF Precision Dipole Antenna (TX & RX)	Schwarzbeck	UHAP	989 & 990	
Loop Antenna	Schwarzbeck	HFH2-Z2	863048/019	
TRILOG Broadband Antenna	Schwarzbeck	VULB9160	3141	☒
Biconical Antenna	Schwarzbeck	VHA9103	2265	☒
Log-Periodic Antenna	Schwarzbeck	UHALP9107	1819	☒
Horn Antenna	AH Systems	SAS-200/571	304	☒
Horn Antenna	ETS-LINDGREN	3115	00040723	
Horn Antenna	ETS-LINDGREN	3115	00056768	
Vector Signal Generator	Agilent	E4438C	MY42080359	
Signal Generator	HP	8349B	2644A03250	
DC Power Supply	HP	6634A	2926A-01078	
DC Power Supply	HP	6268B	2542A-07856	
Digital Multimeter	HP	HP3458A	2328A14389	☒
PCS Interface	HP	83236B	3711J00881	
CDMA Mobile Test Set	HP	8924C	US35360253	
Hygro/Thermo Graph	SATO	PC-5000TRH-II	-	☒
Temperature/Humidity Chamber	All Three	ATH-50M	20030425	

2.3 Test Date

Date of Application : June 22, 2005

Date of Test : July 29, 2005 ~ July 29, 2005

2.4 Test Environment

See each test item's description.



3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

The EUT is a small remote controller that has two buttons intended to transmit control signals to the receiver in vehicles. The EUT is manually operated and deactivated automatically within one second after transmitting the appropriate control code.

3.1 Rating and Physical Characteristics

	Remote Keyless Entry System	
	Transmitter (EUT)	Receiver ^{*1}
Model Name	RK950NAT	RK950NAR
Power source	DC 3V, Lithium battery	DC 12V supplied from a vehicle
Consumption current	Max 14mA	Max 5mA
Local Oscillator	9.84375 MHz	4MHz, 50.7167 MHz
Operating frequency	315MHz	
Type of Modulation	FSK	-
Output power	1mW under	-
Antenna	PCB pattern antenna	pole antenna
Sensitivity	-	-100dBm(Min)

^{*1}: The test report for the receiver should be separately issued.

3.2 Equipment Modifications

None

3.3 Submitted Documents

Block diagram

Schematic diagram

Part List

Instruction manual



4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The EUT was tested in a typical fashion. During preliminary emission tests, all transmitter codes were investigated to find worst-case emission mode. Pressing the "UNLOCK" button was found to be the worst-case emission mode. Therefore, final qualification testing was completed with EUT activated with the "UNLOCK" button.

4.2 List of Peripherals

Equipment Type	Manufacture	Model	Serial Number
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The EUT was tested as stand-alone device.

4.3 Type of Used Cables

Description	Length	Type of shield	Manufacturer
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None

4.4 Uncertainty

Measurement Item	Combined Standard Uncertainty U_c	Expanded Uncertainty $U = KU_c (K = 2)$
Conducted RF power	± 1.49 dB	± 2.98 dB
Radiated disturbance	± 2.37 dB	± 4.74 dB
Conducted disturbance	± 1.47 dB	± 2.94 dB



5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	FCC, 47CFR15	RSS-210, Issue 5	Report Section	Test Result
Antenna Requirement	15.203	5.5, 5.11	5.1	PASS
Periodic Operation Characteristics	15.231(a)	6.1.1(a)	5.2	PASS
Radiated Emission – Field Strength	15.231(b) 15.209(a)	6.1.1(b) Table 1 6.3 Table 3	5.3	PASS
Occupied bandwidth	15.231(c)	6.1.1(c)	5.4	PASS
Frequency Stability (devices operating at 40.66 – 40.70 MHz)	15.231(d)	6.1.1(d)	N/A	N/A
Reduced Field Strength Operation	15.231(e)	6.1.1(e)	N/A *	N/A *
Conducted Emissions	15.207	6.6	N/A *	N/A*

*** Not required, the EUT is only battery powered.**



5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

FCC 47CFR15 – 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 comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

RSS-210, Issue 5 – 5.5, 5.11

The transmitter antenna shall be integral with the device, or the antenna coupling be so designed that no antenna other than that furnished by the party responsible for compliance shall be used.

Example: Special antenna connectors not readily available in retail shops in Canada may be acceptable.

The antenna design may be such as to allow a broken antenna to be replaced by the user, but the use of a standard jack or electrical connector is prohibited. The special antenna connector requirement does not apply to 6.2.2 (a), 6.2.2 (b), and 8.1 to 8.5. Further, this requirement does not apply to transmitters that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to transmitters which require unwanted emission measurements after installation (section 5.15). In the installation/ user manual, the user shall be notified that a proper type of antenna must be employed and of the RF field limits to be met. When the standard limits the antenna gain to N dB, this limit applies only to the transmitting antenna system net gain, i.e. antenna gain minus its cabling loss.

When a measurement at the antenna connector (section 10) is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in this Standard for devices of RF output powers 10 milliwatts or less. In the case of devices of output powers more than 10 milliwatts, the total antenna gain shall be added, except for the case of 6.2.2 (o) on spread spectrum systems.

User Manual (for transmitter with detachable antenna): The user manual of transmitter devices equipped with a detachable antenna shall contain the following information in a conspicuous location:

"This device has been designed to operate with an antenna having a maximum gain of [x] dB. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is [y] ohms."
Equipment manufacturer shall provide proper values of x and y to comply with the standard.

If the antenna is detachable (selectable by the user), see the user manual requirement in section 5.5. The following instructions in the user manual is also required:

"To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication".

5.1.2 Result:

PASS

The transmitter has an integral pattern antenna and meets the requirements of this section.



5.2 PERIODIC OPERATION CHARACTERISTICS

5.2.1 Regulation

FCC 47CFR15 – 15.231(a)

(a) The provisions of this Section are restricted to periodic operation within the band 40.66 -40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal.

The following conditions shall be met to comply with the provisions for this periodic operation:

- (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
- (2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.
- (3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.
- (4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.
- (5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmission are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

RSS-210, Issue 5 – 6.1.1(a)

The frequency bands and field strength limits in Tables 1 and 4 are only for the transmission of a control signal such as that used with alarm systems, door openers, remote switches, etc. Radio control of toys or model aircraft, and continuous transmissions, such as voice or video, and data transmissions are not permitted except as provided in 6.1.1(e). The prohibition against data transmissions does not preclude the use of recognition codes. Those codes are used to identify the sensor that is activated or to identify the particular component as being part of the system.

The following conditions shall be met to comply with the provisions for momentary operation:

- (1) A manually operated transmitter shall employ a push-to-operate switch and be under manual control at all transmission times. When released, the transmitter shall cease transmission (holdover time of up to 5 seconds is permitted).
- (2) A transmitter activated automatically shall cease transmission within 5 seconds after activation, i.e. maximum 5 seconds of operation.
- (3) Periodic transmissions at regular predetermined intervals are not permitted, except as provided in 6.1.1(e). However, polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.
- (4) Intentional radiators employed for radio control purposes during emergencies involving fire, security of goods (e.g. burglar alarm), and safety-of-life, when activated to signal an alarm, may operate during the interval of the alarm condition.

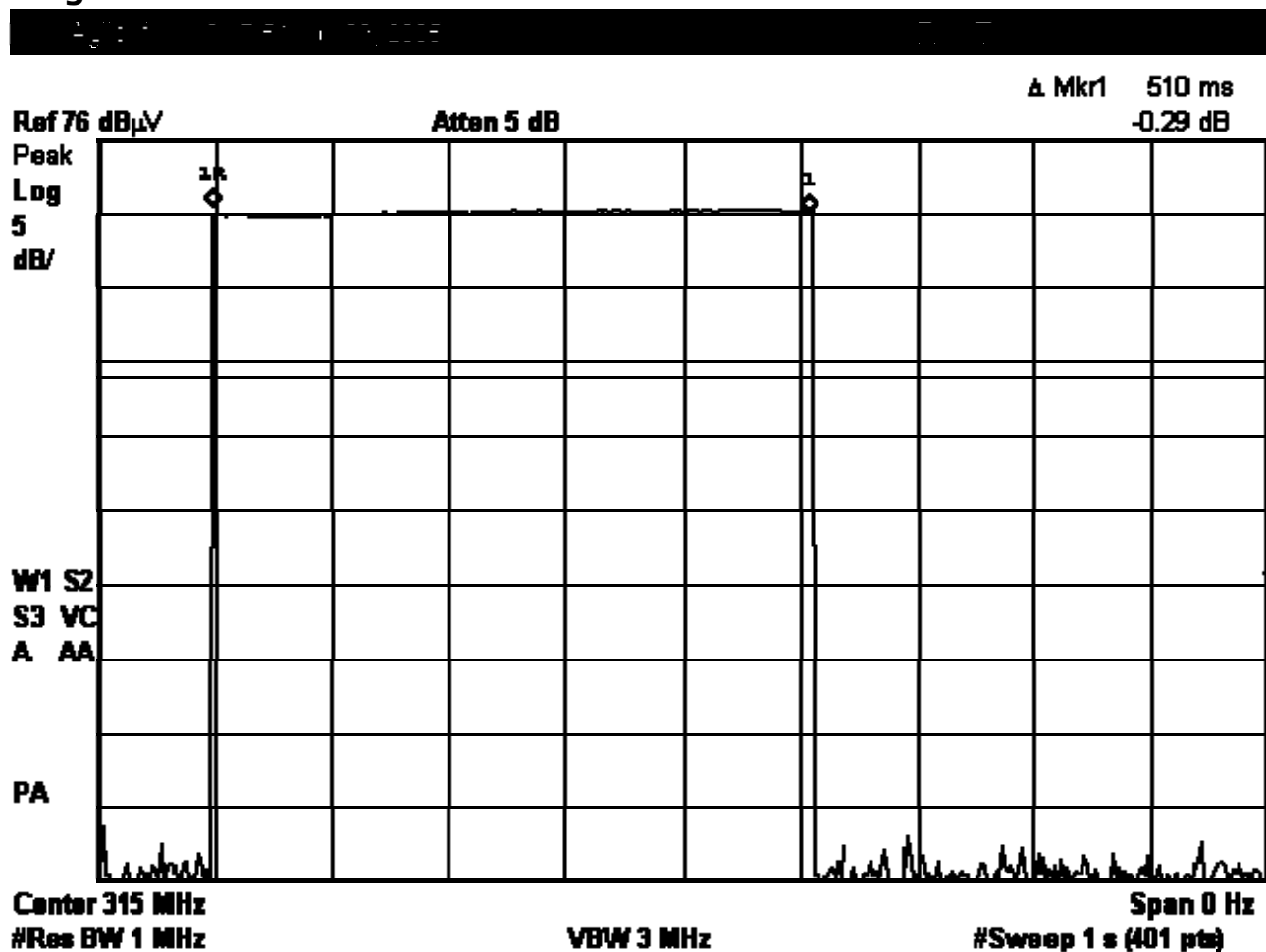
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5.2.2 Result**PASS**

The EUT is intended to transmit activation code, LOCK/UNLOCK the door, to the receiver in the vehicles. The EUT is manually operated and deactivated automatically after transmitting the pre-programmed activation code.

The result of the transmission duration is shown in Figure 1. The worst-case transmission duration is **510 msec** when "UNLOCK" button is pressed.

Figure 1: Measured value of the transmission duration



5.3 RADIATED EMISSIONS

5.3.1 Regulation

FCC 47CFR15 – 15.231(b)

In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental ($\mu\text{V/m @ 3m}$)	Field strength of spurious emissions ($\mu\text{V/m @ 3m}$)
40.66 – 40.70	2,250	225
70 – 130	1,250	125
130 – 174	1,250 to 3,750 **	125 to 375 **
174 – 260	3,750	375
260 – 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** linear interpolations

- (1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
- (2) Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in Section 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of Section 15.205 shall be demonstrated using the measurement instrumentation specified in that section.
- (3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits a higher field strength.

Any emissions that fall within the restricted bands specified in FCC Section 15.205 shall not exceed the following limits according to §15.209:

Frequency (MHz)	Field strength ($\mu\text{V/m @ 3m}$)	Field strength ($\text{dB}\mu\text{V/m @ 3m}$)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

** linear interpolations

RSS-210, Issue 5 – 6.1.1(b)

The field strength of emissions from intentional radiators momentarily operated shall not exceed the limits in Table 1 (The same as FCC requirements).



5.3.2 Measurement Procedure

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1000 MHz to 18000 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.

5.3.3 Calculation of the field strength limits by linear interpolation (F=315MHz)

Field strength limit of the fundamental frequency:

$$\text{Limit} = (F-260) \cdot (12500-3750) / (470-260) + 3750 = 6041.7 \text{ uV/m} = \underline{75.6 \text{ dBuV/m}}$$

Field strength limit of spurious emissions:

$$\text{Limit} = (F-260) \cdot (1250-375) / (470-260) + 375 = 604.2 \text{ uV/m} = \underline{55.6 \text{ dBuV/m}}$$

5.3.4 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100 msec time period and using the formula:

$$\text{Corrections Factor} = 20 \log (\text{worst case on time} / 100 \text{ msec}).$$

The maximum correction factor to be applied is 20 dB per section 15.35 of the FCC rules.

All following emission measurements were performed using the test receiver's average and peak detectors and "Max Hold" mode; the average and peak values were measured directly without the necessity of additional average correction factor.

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5.3.5 Test Results:**PASS****Table 1: Measured values of the Field strength**

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. (V/H)	Antenna Height [m]	Table Angle [°]	Reading [dB(μV)]	Amp Gain [dB]	AF / CL [dB(1/m)]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Emissions AVERAGE DATA 15.231(b) Bands										
315.02	120	H	1.0	230	81.1	27.0	16.5/3.1	73.7	75.6	1.9
630.96	120	V	2.1	330	29.9	28.5	21.5/4.6	27.5	55.6	28.1
945.06	120	V	1.3	350	21.7	27.8	24.8/5.6	24.3	55.6	31.3
Emissions PEAK DATA 15.231(b) Bands										
315.02	120	H	1.0	230	82.7	27.0	16.5/3.1	75.3	95.6	20.3
630.96	120	V	2.1	330	35.0	28.5	21.5/4.6	32.6	75.6	43.0
945.06	120	V	1.3	350	32.2	27.8	24.8/5.6	34.8	75.6	40.8
Emissions Quasi-peak DATA 15.209; general radiated emissions										
	120									
No Spurious Radiated Emissions Found										

Margin (dB) = Limit – Actual**[Actual = Reading – Amp Gain + AF + CL]**

1. H = Horizontal, V = Vertical Polarization

2. AF/CL = Antenna Factor and Cable Loss

NOTE: The spectrum was scanned from 30 MHz to 4 GHz. All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



5.4 OCCUPIED BANDWIDTH

5.4.1 Regulation

FCC 47CFR15 – 15.231(c)

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

RSS-210, Issue 5 – 6.1.1(b)

For the purpose of sections 6.1.1 (a) to (f) the 20 dB bandwidth (see 5.9 for definition) shall be no wider than 0.25% of the centre frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the centre frequency.

5.4.2 Calculation of 20 dB Bandwidth Limit (F=315MHz)

The 20 dB bandwidth limit = $F \times 0.0025 = 315 \text{ MHz} \times 0.0025 = 787.5 \text{ kHz}$

5.4.3 Test Procedure

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 either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. Once the reference level is established, the equipment is conditioned with typical modulating signals to produce worst-case (i.e., the widest) bandwidth. The measurement was performed at the operating frequency, 315MHz. The spectrum trace data around fundamental frequency of the EUT was obtained with the spectrum analyzer in "Max Hold" mode. The bandwidth value was determined between the two points of 20dB down from the modulated carrier.

5.4.4. Test Results:

PASS

Operating frequency (MHz)	RBW (kHz)	20dB BW (kHz)	Limit (kHz)
315	1	47.0	787.5



Figure 2: Measured value of the Occupied bandwidth

