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TEST REPORT

Report Number: 100087801LEX-002
Project Number: G100087801

Report Issue Date: 7/12/2010

Product Name: RC20
FCCID: TXT-F034K69P01
ICIC: 909G-F03469P01
Standards: Title 47 CFR Part 15 Subpart C and RSS-210 Issue 7; June 2007

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

Client:
Robert Bosch Tool Corporation
255 West Flemming
Watseka, IL 60970

Report prepared by
Bryan C. Taylor, Team Leader

Report reviewed by
Jason Centers, Senior Project Engineer

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1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Section	Test full name	Industry Canada Reference	Test date	Result
4	Radiated Emissions Per FCC Part 15.249 (a, d) (Fundamental, Harmonics, and Spurious Emissions)	RSS-210 (2.2)	5/11/2010 – 5/21/2010	Pass
10	Radiated Emissions per FCC Part 15.109 (Receive Mode)	RSS-210 (2.3); RSS-Gen	5/23/2010	Pass
14	Antenna Requirement per FCC Part 15.203	---	5/23/2010	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Robert Bosch Tool Corporation
Model Number	RC20
Serial Number	Test Sample 1
Receive Date	4/15/2010
Device Received Condition	Good
Frequency Band	2.4GHz ISM Band (2.4095MHz)
Mode(s) of Operation	802.15 (Zigbee)
Modulation Type	QPSK
Duty Cycle	8.4% (Averaged over 100mS)
Transmission Control	Test Commands
Maximum Output Power	16.24dBm (EIRP)
Test Channels	2.4095MHz
Antenna Type	Internal PCB
Operating Voltage	12VDC

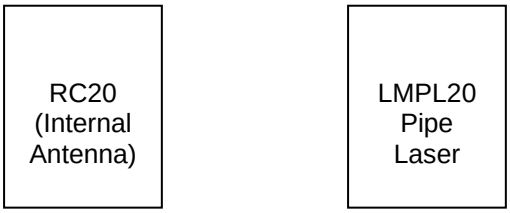
Description of Equipment Under Test
The RC20 is a hand held remote control for the electronic self-leveling pipe laser product (LMPL20). It is used to remotely control the functions of the laser.

Operating modes of the EUT:

No.	**Descriptions of EUT Exercising**
1	The transmission was controlled by attaching a plastic clamp to one of the buttons on the RC20 in order to force continuous transmission. According to Robert Bosch Tool Corporation, the RC20 only operates on one frequency (2.4095MHz).
2	Receive mode scans were performed by removing the plastic clamp so that the transmission was disabled.

3.1 System setup including cable interconnection details, support equipment and simplified block diagram

3.2 EUT Block Diagram:



3.3 Cables:

No cables were used during this evaluation as the test sample was a battery operated wireless transmitter

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Self Leveling Pipe Laser	Robert Bosch Tool Corporation	LMPL20 Pipe Laser	LMPL20

4 Radiated Emissions Per FCC Part 15.249 (a, d) (Fundamental, Harmonics, and Spurious Emissions)

4.1 Test Limits

The radiated emission test limits are outlined below:

§ 15.249 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHZ, and 24.0–24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

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

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

4.2 Test Procedure

- The EUT was placed on a wooden table 80 cm above the ground reference plane. Measurements were made with the device oriented in three orthogonal axes and the highest level measured is reported.

- Measurements are made over the frequency range of 30 MHz to ten times the highest frequency operating within the device or 40GHz (whichever is lower).

- The antenna to EUT distance was 3m unless otherwise noted.

- Pre-scans were performed prior to final measurements using peak detection. From 30 to 1000 MHz, a quasi-peak detector was used for final measurement. Above 1000 MHz, average and peak measurements were performed.

- During the scans the antenna is adjusted between 1m and 4m in height above the ground plane, the antenna-to-EUT azimuth, and the antenna polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.

- The readings obtained from the measurement receiver were corrected for antenna factor, cable loss, and pre-amp gain. An example calculation is shown below.

4.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculation are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

4.4 Test Location

This test was performed at the Intertek offices located at the following address:

Intertek
731 Enterprise Drive
Lexington, KY 40510

4.5 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/14/2009	9/14/2010
Preamplifier	987410	Miteq	AFS44-00102000-30-10P-44	6/17/2009	6/17/2010
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	2/12/2010	2/12/2011
Biconnilog Antenna	00051864	ETS	3142C	12/21/2009	12/21/2010
Horn Antenna	6556	ETS	3115	8/4/2009	8/4/2010
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	2/10/2010	2/10/2011

4.6 Results:

The sample tested was found to Comply. The fundamental emission and harmonics were all below the field strength limits from FCC Part 15.249(a). All spurious emissions were attenuated by at least 50dB below the level of the fundamental as required by FCC Part 15.249(d).

4.7 Test Data:

Position	Frequency	Pol.	Corr. Peak Reading. (dBuV/m)	Corr. Avg Reading. (dBuV/m)	Peak Limit (dBuV/m)	Avg. Limit (dBuV/m)	Results	Comments
Side Position	2.4095GHz	H	107.63	86.13	114	94	**Compliant**	Fundamental Emission
	2.4095GHz	V	105.19	83.69	114	94	**Compliant**	
Back Position	2.4095GHz	H	108.59	87.09	114	94	**Compliant**	
	2.4095GHz	V	110.96	89.46	114	94	**Compliant**	
Vertical Axis	2.4095GHz	H	113.23	91.73	114	94	**Compliant**	
	2.4095GHz	V	108.7	87.2	114	94	**Compliant**	
Side Position	4.819GHz	H	63.35	41.85	74	54	**Compliant**	2nd Harmonic
	4.819GHz	V	67.16	45.66	74	54	**Compliant**	
Back Position	4.819GHz	H	67.54	46.04	74	54	**Compliant**	
	4.819GHz	V	69.81	48.31	74	54	**Compliant**	
Vertical Axis	4.819GHz	H	72.84	51.34	74	54	**Compliant**	
	4.819GHz	V	70.71	49.21	74	54	**Compliant**	
Side Position	7.2286GHz	H	46.35	24.85	74	54	**Compliant**	3rd Harmonic
	7.2286GHz	V	43.67	22.17	74	54	**Compliant**	
Back Position	7.2286GHz	H	49.3	27.8	74	54	**Compliant**	
	7.2286GHz	V	47.39	25.89	74	54	**Compliant**	
Vertical Axis	7.2286GHz	H	45.63	24.13	74	54	**Compliant**	
	7.2286GHz	V	50.48	28.98	74	54	**Compliant**	

Note(1): The average measurement was computed from the peak measurement using the duty cycle correction factor (20log [duty cycle]). In this case the duty cycle was measured at the time of testing to be 8.4%. Therefore the duty cycle correction factor is 20log(0.084) = -21.5dB.

Note(2): The duty cycle was measured at the time of testing and was averaged over 100mS per ANSIC63.10-2009

5 Radiated Emissions per FCC Part 15.109 (Receive Mode)

5.1 Test Limits

The radiated emission test limits are outlined below:

§ 15.109 Radiated emission limits.

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)
30–88	100
88–216	150
216–960	200
Above 960	500

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

Frequency of emission (MHz)	Field strength (microvolts/meter)
30–88	90
88–216	150
216–960	210
Above 960	300

5.2 Test Procedure

- Radiated emission field strength measurements were performed in accordance with ANSI C63.4:2003.

- A preliminary scan was first performed using peak detection with the EUT placed on a wooden table 80 cm above the ground reference plane. Measurements were made with the device oriented in three orthogonal axes and the highest level measured is reported.

- During the scans the antenna was adjusted between 1m and 4m in height above the ground plane. The antenna-to-EUT azimuth, and the antenna polarization (horizontal and vertical) was varied during the measurements to find the maximum field-strength readings.

- The antenna to EUT distance was 3m unless otherwise noted.

- For final measurements a quasi-peak detector was used for frequencies below 1000 MHz. Above 1000 MHz, average and peak measurements were performed. Emissions more than 10dB below the limit were not measured with quasi-peak or average detectors.

- The readings obtained from the measurement receiver were corrected for antenna factor, cable loss, and pre-amp gain. An example calculation is shown below.

5.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculation are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
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Example Calculation:

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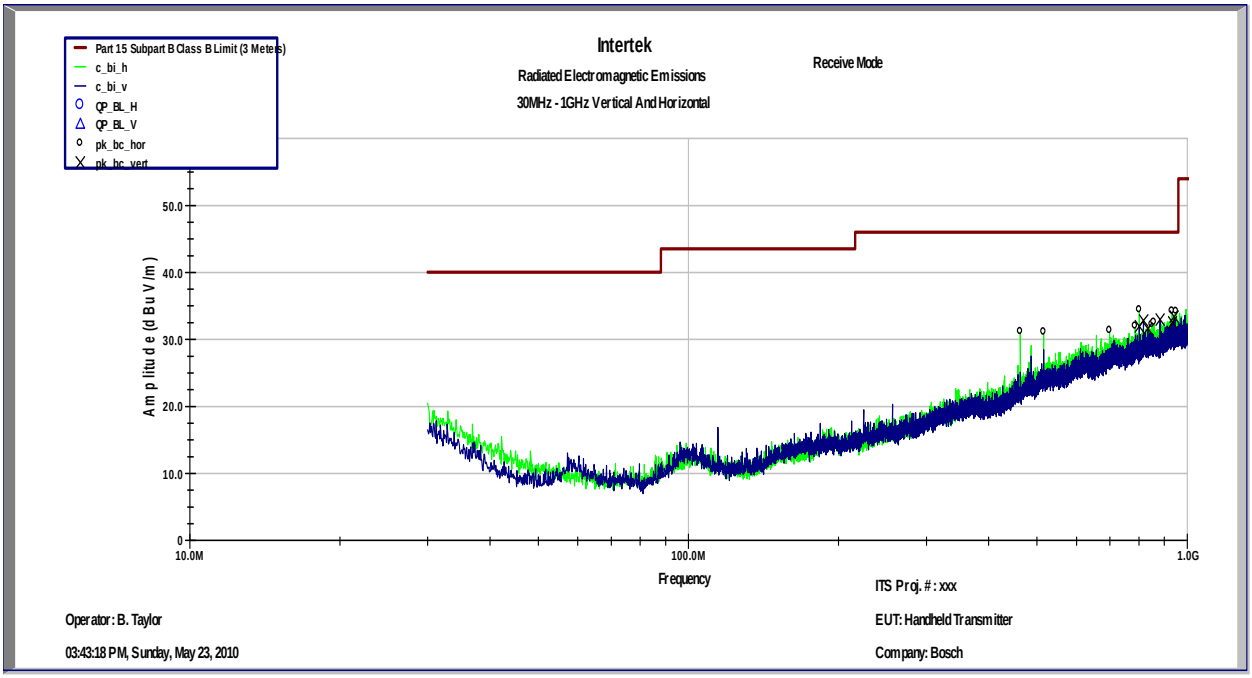
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use

5.6 Results:

The sample tested was found to Comply. All emissions were at least 10dB below the limit as shown in the plot below.

5.7 Plots:



5.8 Test Data:

The emissions listed below were all measured with peak detection and were all corrected for cable loss, antenna factor, and preamp factor as shown above.

Frequency (MHz)	Horz. BiLog (dBuV/m)	Vert. BiLog (dBuV/m)	Class B Limit (dBuV/m)
462.9 MHz	31.161	---	46.020
515.5 MHz	31.115	---	46.020
699.2 MHz	31.303	---	46.020
786.9 MHz	31.979	---	46.020
801.8 MHz	34.447	31.963	46.020
817.6 MHz	---	32.816	46.020
833.7 MHz	---	31.602	46.020
850.2 MHz	32.182	---	46.020
857.8 MHz	32.518	---	46.020
882.7 MHz	---	32.948	46.020
932.9 MHz	34.215	---	46.020
934.6 MHz	---	32.529	46.020
941.6 MHz	---	33.384	46.020
949.6 MHz	34.197	---	46.020

Deviations, Additions, or Exclusions: None

6 Antenna Requirement per FCC Part 15.203

6.1 Test Limits

The antenna requirement for FCC Part 15C is shown below:

§ 15.203 Antenna requirement.

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 §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 §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.

6.2 Results:

The sample tested was found to Comply. The antenna used was permanently attached and integral to the PCB.

7 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

8 Revision History

Revision Level	Date	Report Number	Notes
0	7/12/2010	100087801LEX-002	Original Issue