SK TECH CO., LTD.

Certificate of Compliance

Test Report No.:	**SKTTRT-030602-001**		
NVLAP CODE:	**200220-0**		
Applicant:	**BONTEC Co., Ltd.**		
Applicant Address:	#27-31, Hanchun-Ri, Duck-San-Myun, Jinchun-Gun, Chungbuk, Korea		
Device Under Test:	**Remote Keyless Entry**		
FCC ID:	**PLNBONTEC-T016**	**Model No.:**	**BONTEC-T016**
Receipt No.:	SKTEU03-0318	**Date of receipt:**	May 26, 2003
Date of Issue:	June 02, 2003		
Location of Testing:	**SK TECH CO., LTD.** 820-2, Wolmoon-Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea		
Test Procedure:	**ANSI C63.4 / 1992**		
Test Specification:	**FCC Title 47, Part 15 Subpart C**		
Equipment Class:	**Part 15 Security/Remote Control Transmitter**		
Test Result:	The above-mentioned device has been tested and passed.		

Tested & Reported by: *Jong-Soo, Yoon*

2003. 06. 02

Signature *Date*

Approved by: *Jae-Kyung, Bae*

2003. 06. 02

Signature *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.**

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1. GENERAL

These tests were performed using the test procedure outlined in ANSI C64.4, 1992 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

Equipment Type	Manufacturer	Model No.	Serial No.	Cal. Due Date
EMI Test Receiver	Rohde&Schwarz	ESVS 10	825120/013	10, 2003
EMI Test Receiver	Rohde&Schwarz	ESVS 10	834468/008	10, 2003
Spectrum Analyzer	Advantest	R3361A	11730187	10, 2003
EMC Spectrum Analyzer	Agilent	E7405A	US40240203	12. 2003
Amplifier	H.P	8447F	3113A05153	10, 2003
Log Periodic Antenna	Schwarzbeck	UHALP9107	1819	10, 2003
Biconical Antenna	Schwarzbeck	BBA9106	91031626	10, 2003
Horn Antenna	Schwarzbeck	SAS-200/571	304	03, 2004
Antenna Mast	TOKIN	5907	N/A	N/A
Antenna & Turntable controller	TOKIN	5906	N/A	N/A
50Ω Switcher	Anritsu	MP59B	6100214538	N/A

2.3 Test Date

Date of Application : May 26, 2003
Date of Test : May 29, 2003 ~ May 31, 2003

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 four buttons, two lock/unlock the car door, one opens the rear glass, and the other is intended to transmit a panic signal to the receiver in the vehicle as ETACS.
The EUT is manually operated and deactivated automatically within one second after pressing any button on it to transmit the appropriate control code.

3.1 Rating and Physical Characteristics

	Transmitter (EUT)	Receiver (ETACS) *1
Type (Model No.)	BONTEC-T016	BONTEC-E016
Power source	DC 3V, Lithium battery	DC 12V supplied from a vehicle
Consumption current	Max 20mA	Max 5.5mA
Local Oscillator	9.8437 MHz	10.17813 MHz
Operating frequency	315MHz	
Type of Modulation	AM	-
Output power	10mW under	-
Sensitivity	-	-105dBm(typical)

*1: The receiver (BONTEC-E016) was verified on Test report No. SKTFCE-030602-070
The ETACS stands for Electronic Time & Alarm Control System. It receives the activation code transmitted by the EUT, and decodes that code and then controls the appropriate door relay.

3.2 Equipment Modifications

The EUT was programmed to send its activation code repeatedly by using modified firmware that was programmed into the EUT's processor, during the field strength measurements of the fundamental and spurious/harmonic emissions in FCC section 15.231(b), to permit radiated emission measurements to be readily performed. This unit was then returned to normal operation for testing of the transmission duration and occupied bandwidth.

3.3 Submitted Documents

Description of Transmitter and ETACS
Block diagram for Transmitter and ETACS
Circuit diagram for Transmitter and ETACS

4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The EUT was tested in a typical fashion. During preliminary emission tests all 4-transmitter codes were investigated to find worst-case emission mode. Pressing the "Lock" button was found to be the worst-case emission mode. Therefore, final qualification testing was completed with EUT activated with the "Lock" button.

4.2 List of Peripherals

Equipment Type	Manufacture	Model	Serial Number

The EUT was tested as stand-alone device.

4.3 Type of Used Cables

Description	Length	Type of shield	Manufacturer

None

4.4 Uncertainty

Radiated disturbance

Uc (Combined standard Uncertainty) = ± 1.9 dB

Expanded uncertainty U = KUc

K = 2

∴ U = ±3.8dB

5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	CFR Section	Report Section	Test Result
Antenna Requirement	15.203	5.1	PASS
Radiated Spurious Emissions	15.231(b), 15.205, 15.209	5.2	PASS
Field Strength (Fundamental)	15.231(b)	5.2	PASS
Periodic Operation Characteristics	15.231(a)	5.3	PASS
Occupied bandwidth	15.231(c)	5.4	PASS
Conducted Emissions	15.207	*	*

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

5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

FCC 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 comply with the provisions of Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, 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.

5.1.2 Result: PASS

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

5.2 RADIATED EMISSIONS

5.2.1 Regulation

According to §15.231(b), the field strength of emissions from intentional radiators operated under this frequency band shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (uV/m @ 3m)	Field strength of spurious emissions (uV/m @ 3m)
260–470	3,750 to 12,500	375 to 1,250

<Use quasi-peak or average detector function>

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 (uV/m @ 3m)	Field strength (dBuV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

5.2.2 Measurement Procedure

Preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters. The EUT was placed on the top of the 0.8 meter high, 1 x 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°. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 300 MHz using the biconical antenna and from 300 to 1000 MHz using the log-periodic antenna. Above 1GHz, linearly polarized double ridge horn antenna was used.

To obtain the final test data, the EUT was arranged on a turntable situated on a 4x4 meter at the Open Area Test Site. The EUT was tested at a 3-meter test distance. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average and peak detector function with specified bandwidth. 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.

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

Field strength limit of the fundamental frequency:

Limit = (F-260)(12500-3750)/(470-260) + 3750 = 6041.7uV/m = 75.6 dBuV/m*

Field strength limit of spurious emissions:

Limit = (F-260) (1250-375)/(470-260) + 375 = 604.2uV/m = 55.6 dBuV/m*

5.2.4 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:

Corrections Factor = 20log (worst case on time/100 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.

5.2.5 Test Results: PASS

The results of the field strength of the fundamental and spurious/harmonic emissions are shown in Table 1. The worst-case emission level is 63.1 dBuV/m @ 3m at 314.993 MHz, This is 12.5 dB below the specified limit.

Table 1: Measured values of the Field strength								
Frequency (MHz)	Pol. (V/H)	Antenna Height(m)	Table Angle(°)	Reading (dBuV)	AF / CL (dB/m)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Emissions AVERAGE DATA 15.231 Bands								
314.993	H	1.08	35	43.39	16.5 / 3.2	63.1	75.6	12.5
305.155	H	1.06	196	17.04	16.4 / 3.1	36.5	55.6	19.1
629.993	H	1.57	332	7.48	21.5 / 5.2	34.2	55.6	21.4
944.980	H	1.12	50	4.64	24.8 / 6.9	36.3	55.6	19.3
Emissions PEAK DATA 15.231 Bands								
314.993	H	1.08	35	50.88	16.5 / 3.2	70.6	95.6	25.0
305.155	H	1.06	196	23.99	16.4 / 3.1	43.5	75.6	32.1
629.993	H	1.57	332	15.18	21.5 / 5.2	41.9	75.6	33.7
944.980	H	1.12	50	12.71	24.8 / 6.9	44.4	75.6	31.2
Emissions DATA 15.205 Restricted Bands								
324.848	H	1.00	176	10.86 Av	16.7 / 3.2	30.8	46.0	15.2
324.848	H	1.00	176	18.40 Pk	16.7 / 3.2	38.3	66.0	27.7

1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss
3. Av = Average detector function, Pk = Peak detector function
4. The frequency range was scanned from 30MHz to 4GHz. All emissions not reported were more than 20dB below the specified limit.

Margin (dB) = Limit – Actual

[Actual = Reading + AF + CL]

5.3 PERIODIC OPERATION CHARACTERISTICS

5.3.1 Periodic Operation

FCC 15.231 (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. Radio control of toys is not permitted. Continuous transmissions, such as voice or video, and data transmissions are not permitted. 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.

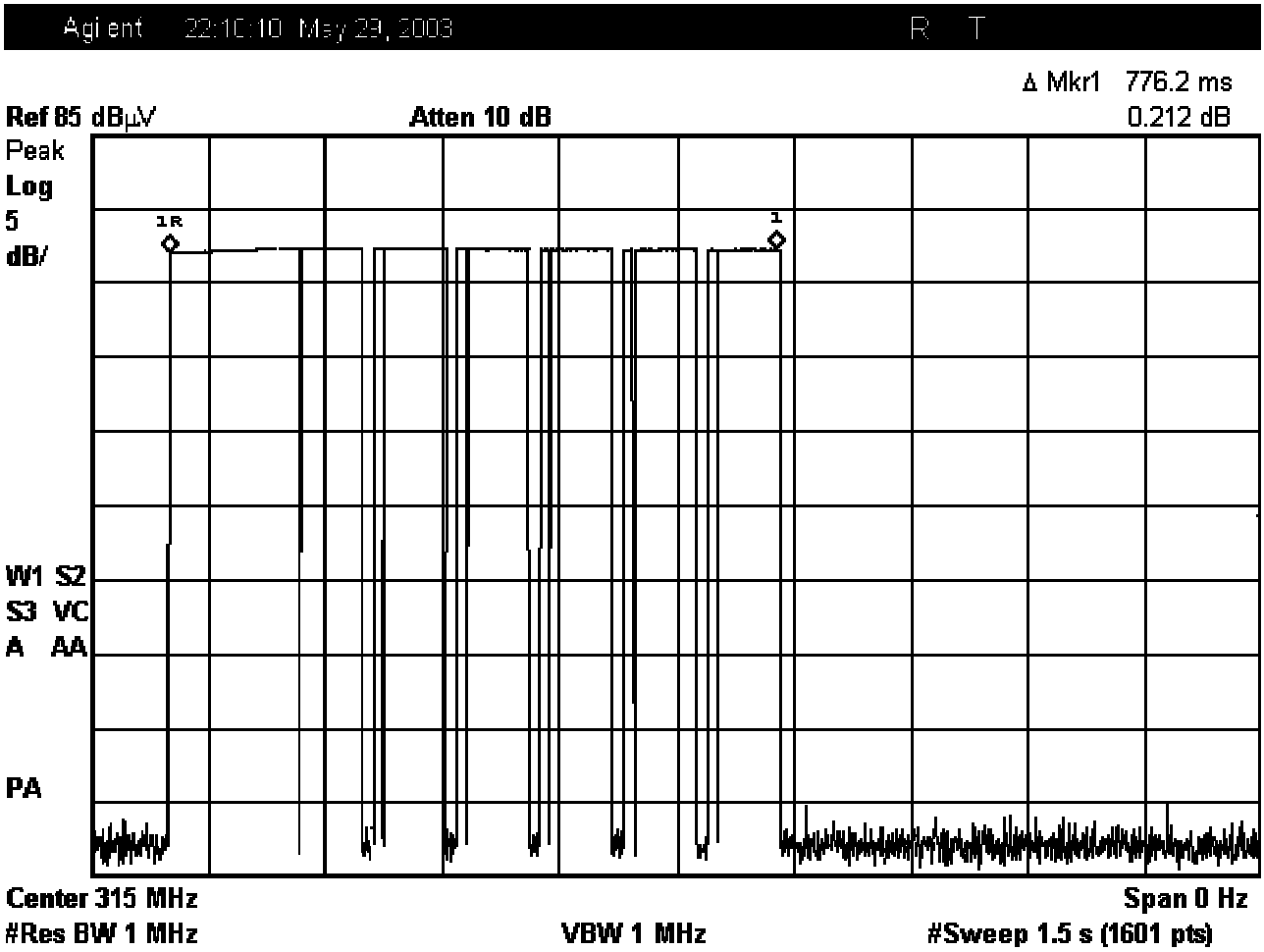
5.3.2 Manually Operated Transmitter Deactivation

FCC 15.231 (a1), A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

5.3.3 Result PASS

The EUT is intended to transmit activation code to the receiver in the vehicle as ETACS.
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 776.2msec when "Lock" button is pressed.

Figure 1: Measured value of the transmission duration



5.4 OCCUPIED BANDWIDTH

5.4.1 Regulation

FCC 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.

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

The 20 dB bandwidth limit = F X 0.0025 = 315 MHz X 0.0025 = 787.5 kHz

5.4.3 Test Procedure

ANSI C63.4-1992 Section 13.1.7, Occupied Bandwidth Measurements. 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

The measured spectrum of the signal is shown in Figure 2. From the plot, we can see that in the worst case, the occupied bandwidth is 49.97 KHz.

Figure 2: Measured value of the Occupied bandwidth