SK TECH CO., LTD.

TEST REPORT

Test Report No.:	**SKTRFC-110331-008**		
Applicant:	**KYUNGWOO SYSTECH INC.**		
Applicant Address:	#401, Daeryung Post Tower 5, Gasan-dong, Geumcheon-gu, Seoul, 153-702, Korea		
Manufacturer:	**KYUNGWOO SYSTECH INC.**		
Manufacturer Address:	#401, Daeryung Post Tower 5, Gasan-dong, Geumcheon-gu, Seoul, 153-702, Korea		
Device Under Test:	**SMART KEY READER**		
FCC ID:	**ZE8-A230**	**Model Name:**	**A230**
Brand/Trade Name:	**KYUNGWOO**		
Receipt No.:	SKTEU11-0288	**Date of receipt:**	March 17, 2011
Date of Issue:	March 31, 2011		
Location of Testing:	**SK TECH CO., LTD.** #820-2, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, 472-905 South Korea		
Test Procedure:	**ANSI C63.4-2003**		
Test Specification:	**47CFR, FCC Part 15 Rules**		
FCC Equipment Class:	**DCD - Part 15 Low Power Transmitter Below 1705kHz**		
Test Result:	The above-mentioned device has been tested and passed.		

Tested & Reported by: *Jungtae Kim*

March 31, 2011

Signature *Date*

Approved by: *Jongsoo Yoon*

March 31, 2011

Signature *Date*

Other Aspects:	-
Abbreviations:	**· OK, Pass = passed · Fail = failed · N/A = not applicable**

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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 15.209 and 15.207. 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, 472-905 South Korea
(FCC Registered Test Site Number: 938639)
(OPEN AREA TEST SITE INDUSTRY CANADA NUMBER: IC 5429A)

This laboratory is recognized as a Conformity Assessment Body (CAB) for CAB's Designation Number: KR0007 by FCC, is accredited by NVLAP for NVLAP Lab. Code: 200220-0.

2.2 List of Test and Measurement Instruments

No.	Description	Manufacturer	Model No.	Serial No.	Calibrated until	Used
1	Spectrum Analyzer	Agilent	E4405B	US40520856	2012.03	
2	Spectrum Analyzer	Agilent	E4440A	MY46186322	2011.05	☒
3	EMC Spectrum Analyzer	Agilent	E7405A	US40240203	2012.03	☒
4	EMI Test Receiver	Rohde&Schwarz	ESPI7	101206	2011.07	☒
5	EMI Test Receiver	Rohde&Schwarz	ESIB40	100277	2012.03	
6	EMI Test Receiver	Rohde&Schwarz	ESHS10	862970/019	2011.07	
7	Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	836679/018	2011.07	
8	Pre-amplifier	HP	8447F	3113A05153	2011.07	☒
9	Pre-amplifier	MITEQ	AFS44	1116321	2011.12	
10	Pre-amplifier	MITEQ	AFS44	1116322	2011.07	
11	Power Meter	Agilent	E4417A	MY45100426	2011.07	
12	Power Meter	Agilent	E4418B	US39402176	2011.07	
13	Power Sensor	Agilent	E9327A	MY44420696	2011.07	
14	Power Sensor	Agilent	8482A	MY41094094	2011.07	
15	Attenuator (10dB)	HP	8491B	38067	2011.07	
16	Attenuator (20dB)	Weinschel	44	AH6967	2011.07	
17	High Pass Filter	Wainwright	WHKX3.0/18G	8	2011.07	
18	VHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	VHAP	1014 / 1015	2011.05	
19	UHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	UHAP	989 / 990	2011.05	
20	Loop Antenna	Schwarzbeck	HFH2-Z2	863048/019	2011.11	☒
21	TRILOG Broadband Antenna	Schwarzbeck	VULB9168	230	2011.07	☒
22	TRILOG Broadband Antenna	Schwarzbeck	VULB9168	189	2011.05	
23	Horn Antenna	AH Systems	SAS-200/571	304	N/A	
24	Horn Antenna	EMCO	3115	00040723	2011.04	
25	Horn Antenna	EMCO	3115	00056768	2010.09	
26	Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170318	2013.09	
27	Vector Signal Generator	Agilent	E4438C	MY42080359	2011.08	
28	PSG analog signal generator	Agilent	E8257D-520	MY45141255	2011.07	
29	DC Power Supply	HP	6622A	3448A032223	2011.08	☒
30	DC Power Supply	HP	6268B	2542A-07856	2011.07	
31	Temperature/Humidity Chamber	All Three	ATM-50M	20030425	2012.03	
32	Hygro/Thermo Graph	SATO	PC-5000TRH-II	-	2011.07	☒

2.3 Test Date

Date of Test: March 4, 2011 ~ March 10, 2011

2.4 Test Environment

See each test item's description.

3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

The product specification described herein was obtained from the product data sheet or user's manual.

3.1 Rating and Physical Characteristics

Power source	DC 12 V or 24 V (from the battery in a vehicle)	
Local Oscillator or X-Tal	8 MHz, 16 MHz, and 32 MHz	
Transmit Frequency	2405 MHz to 2480 MHz (16 CH)*	125 kHz RFID
Antenna Type	Integral chip antenna	Integral loop coil antenna
Type of Modulation	OQPSK	ASK
RF Output power	3.05 dBm (measured conducted RF power)	92.37 dBμV/m(PEAK) (measured @ 3m)
External Ports**	- DC INPUT for the lead-acid battery input terminal - CAN for the communication with Cluster, MCU, or ECU in a vehicle.	

** The test report for the 2.4 GHz ZigBee was issued with other test report number.*

*** The test report for the compliance with FCC Part 15B as a digital device was issued with other test report number.*

3.2 Equipment Modifications

None

3.3 Submitted Documents

Block diagram

Schematic diagram

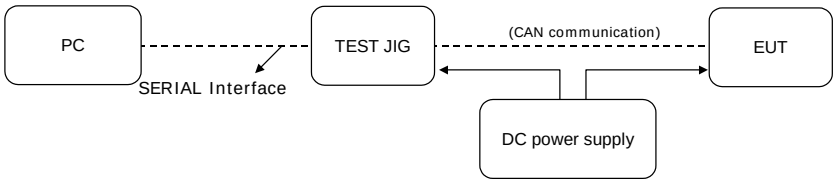
Part List

User manual

4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The measurements were taken in continuous transmitting mode provided by the applicant.



[System Block Diagram of Test Configuration]

4.2 List of Peripherals

Equipment Type	Manufacturer	Model	S/N
Notebook PC **	DELL	INSPIRION	14791079949
Adaptor (for Notebook PC)	DELL	LA65NS0-00	CN-0DF263-71615-6BT-81A8
TEST JIG	KYUNGWOO SYSTECH INC	-	-

** *For the control of the RF module with TEST JIG. For the radiated spurious emission measurements, the measurements were performed without PC after setting the radio module to TEST MODE.*

4.3 Type of Used Cables

#	START		END		CABLE	
	NAME	I/O PORT	NAME	I/O PORT	LENGTH(m)	SHIELDED
1	EUT	CONNECTOR	TESE JIG	CONNECTOR	-	-
2	TEST JIG	UART	Notebook PC	USB	0.4	-
2	Notebook PC	DC Input	Adaptor	DC Output	1.5	NO
3	Adaptor	AC Input	AC mains	-	0.8	NO

4.4 Uncertainty

Measurement Item	Combined Standard Uncertainty *Uc*	Expanded Uncertainty $U = k \times Uc$ ($k = 1.96$)
Radiated disturbance	± 2.30 dB	± 4.51 dB
Conducted disturbance	± 1.96 dB	± 3.84 dB

5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	FCC, 47CFR15	Report Section	Test Result
Antenna Requirement	15.203	5.1	PASS
Radiated Spurious Emissions	15.209	5.2	PASS
AC Power Line Conducted Emissions	15.207	-	N/A**

** The product is powered from a DC 12 V or 24 V lead-acid battery in a vehicle

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 EUT has an integral loop coil antenna, and meets the requirements of this section.

5.2 RADIATED EMISSIONS

5.2.1 Regulation

FCC 47CFR15 – 15.209

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength limit (μV/m)	Field strength limit (dBμV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F (kHz) = 266.7 – 4.9	48.5 – 13.8	300
0.490 – 1.705	24000/F (kHz) = 49.0 – 14.1	33.8 – 23.0	30
1.705 – 30.0	30	29.5	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

* The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector. For the frequency bands 9 – 90 kHz, 110 – 490 kHz and above 1000 MHz, the radiated emission limits are based on measurements employing an average detector.

* The lower limit shall apply at the transition frequencies.

5.2.2 Measurement Procedure

Radiated Emissions Test, 9 kHz to 30 MHz (Magnetic Field Test)

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 1 meter or 3 meters according to Section 15.31(f)(2).
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, 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.

Radiated Emissions Test, above 30 MHz

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.
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 EUT is situated in three orthogonal planes (if appropriate)
7. 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 below 30 MHz

1. No special calculation for obtaining the field strength in dBμV/m is necessary, because the EMI receiver and the active loop antenna operate as a system, where the reading gives directly the field strength result (dBμV/m). The antenna factors and cable losses are already taken into consideration.
2. For test distance other than what is specified, but fulfilling the requirements of section 15.31 (f) (2) the field strength is calculated by adding additionally an extrapolation factor of 40dB/decade (inverse linear distance for field strength measurements).
3. All following emission measurements were performed using the test receiver's average, peak, and quasi-peak detector function with specified bandwidth.
4. The basic equation is as follows;

FS= RA + DF

Where

FS = Field strength in dBμV/m

RA = Receiver Amplitude in dBμV/m

DF = Distance Extrapolation Factor in dB

Where $DF = 40\log(D_{TEST} / D_{SPEC})$ where D_{TEST} = Test Distance and D_{SPEC} = Specified Distance

DF = 40log(3m/300m) = -80dB, for frequency band: 0.009 to 0.490MHz

DF = 40log(3m/30m) = -40dB, for frequency band: 0.490 to 30MHz

5.2.4 Test Results: PASS

Table 1: Field strength below 30 MHz

Frequency [kHz]	RBW [kHz]	Reading [dB(μV/m)]	Cable Loss [dB]	Actual [dB(μV/m)]	Limit (at 3m) [dB(μV/m)]	Margin [dB]
Emissions (Average Detector)						
125.00	0.2	77.07	0.3	77.37	105.6	28.23
122.50	0.2	72.01	0.3	72.31	105.8	33.49
127.42	0.2	70.55	0.3	70.85	105.5	34.65
134.75	0.2	50.94	0.3	51.24	105.0	53.76
Emissions (Peak Detector)						
125.00	0.2	92.07	0.3	92.37	125.6	33.23
122.50	0.2	79.40	0.3	79.70	125.8	46.10
127.42	0.2	77.68	0.3	77.98	125.5	47.52
134.75	0.2	57.96	0.3	58.26	125.0	66.74
Emissions (Quasi-peak Detector); Frequency within 90 kHz ~ 110 kHz and above 490 kHz						
	No Spurious Radiated Emissions Found					

Actual (dBμV/m) = Reading + Cable Loss
Margin (dB) = Limit – Actual
NOTE: These test results were measured at the 3 m distance.

Table 2: Measured values of the Field strength (above 30 MHz)

Frequency [MHz]	RBW [kHz]	POL [V/H]	ANT [m]	Reading [dBμV]	AMP [dB]	AF [dB/m]	CL [dB]	Actual [dBμV/m]	Limit [dBμV/m]	Margin [dB]
151.30	120	H	1.56	45.23	28.03	12.95	1.21	31.36	43.50	12.14
151.30	120	V	1.00	42.63	28.03	12.95	1.21	28.76	43.50	14.74
416.00	120	H	1.36	42.22	28.34	14.20	2.00	30.08	46.00	15.92
416.00	120	V	1.00	46.21	28.34	14.20	2.00	34.07	46.00	11.93
431.98	120	H	1.18	49.29	28.44	14.51	2.04	37.40	46.00	8.60
431.98	120	V	1.11	48.80	28.44	14.51	2.04	36.91	46.00	9.09

Margin (dB) = Limit – Actual
[Actual = Reading + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss

NOTE: 1. All emissions not reported were more than 20 dB below the specified limit or in the noise floor.
2. These test results measured at the 3 m distance.