FCC RF TEST REPORT

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Test Report Number: SKTRFC-130619-010

Date of issue: June 19, 2013

Applicant:	**G.I.T Co., Ltd.** GIT BLDG., 38-5 Garakbon-Dong, Songpa-Gu, Seoul, 138-801 Korea
Manufacturer:	**G.I.T Co., Ltd.** GIT BLDG., 38-5 Garakbon-Dong, Songpa-Gu, Seoul, 138-801 Korea
Product:	Scan Tool
Model:	**G-scan 2** (please see P5 for all the model numbers)
FCC ID:	TMGG1FDDMN015
File number:	SKTEU13-0749
EUT received:	May 24, 2013
Applied standards:	ANSI C63.10-2009 and ANSI C63.4-2009
Rule parts:	FCC Part 15 Subpart C - Intentional radiators
Equipment Class:	DCD – Part 15 Low Power Transmitter Below 1705 kHz
Remarks to the standards:	None

The above equipment has been tested by SK Tech Co., Ltd., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product or system, which was tested.

Jungtae Kim / **Testing Engineer**

Jongsoo Yoon / **Technical Manager**

Revision History of Report

Rev.	Revisions	Effect page	Reviewed by	Date
-	Initial issue	All	Jongsoo Yoon	June 19, 2013

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1 Summary of test results

Requirement	CFR 47 Section	Result
Antenna Requirement	15.203	Meets the requirements
Radiated Spurious Emissions	15.205(a), 15.209(a)	Meets the requirements
AC power line Conducted emissions	15.207(a)	Meets the requirements

2 Description of equipment under test (EUT)

Product:	Scan Tool
Model:	G-scan 2
Serial number:	None (prototype)

Model differences:

Model name	Difference	Tested (checked)
G-scan 2	Original	☒
G-scan, G-scan +,G-scan Plus, G-scan α, G-scan Alpha, G-scan Pro, G-scan Ace, G-scan Gold, G-scan Premium, G-scan II, G-scan W, G-scan M	For marketing purpose	

Note: *All the differences were compared with the test sample*

Technical data:

Power source	Intentional Li-ion battery DC 7.4 V, and/or External AC power adapter or 12 V/ 24 V lead-acid battery installed in vehicles
Local Oscillator or X-Tal	32.768 kHz, 4 MHz, 10 MHz, 10.178125 MHz, 13.225625 MHz, 12 MHz, 24 MHz, 32 MHz
Transmit Frequency (NOTE)	(a) WLAN IEEE 802.11b: 2412 MHz ~ 2462 MHz (11 channels) IEEE 802.11g: 2412 MHz ~ 2462 MHz (11 channels) (b) Bluetooth: 2402 MHz ~ 2462 MHz (79 channels) (c) TPMS(125 kHz transmitter), 315 MHz / 433.92 MHz receiver
Antenna Type	(a) Bluetooth and WLAN (integral PCB antenna, peak gain: -3.55 dBi) (b) TMPS Loop coil antenna (125 kHz transmitter) Integral PCB antenna & wire antenna (315 MHz / 433.92 MHz receiver)
Type of Modulation	(a) WLAN IEEE 802.11b: DSSS (DBPSK, DQPSK, CCK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) (b) Bluetooth: GFSK, 4QDPSK, 8DPSK (c) TPMS(ASK, FSK)
RF Output power	(a) WLAN: 18.58 dBm PEAK (measured) (b) Bluetooth: -4.97 dBm (measured) (c) 125 kHz transmitter: 64.88 dBμV/m @ 3 m (measured)

NOTE *1) The test report for the WLAN/Bluetooth should be issued with the separate test report number.*
2) The test report for the receivers should be issued with the separate test report number.

I/O port	Type	Q'ty	Remark
DC power input	Jack	1	
USB	USB interface	2	
SD card slot	SD	1	

Equipment Modifications

none

Submitted Documents

Block diagram , Schematic diagram, Antenna Specification, Part List, User manual

3 Test and measurement conditions

3.1. Test configuration (arrangement of EUT)

The EUT (Scan Tool) consisted of two units; Main unit and TPMS pack / VMI pack / Battery pack. The Main unit incorporated the radio modules of WLAN and Bluetooth, and those radio functions of the Main unit were evaluated while the TPMS pack was fitted.

The measurements were taken in TEST MODE provided by the applicant for controlling the EUT.
■ Test software installed in the EUT: (for WLAN and Bluetooth) rftest_com0 and (for TPMS) TpmsTest.
■ Software version (driver version): none
■ Software manufacturer: FUJISU COMPONENT LIMITED
■ Power setting
- IEEE 802.11b(target power: 15 dBm)
- IEEE 802.11g(target power: 12 dBm)
- Bluetooth and 125 kHz transmitter: Power setting could not be adjusted

3.2. Description of support units (accessory equipment)

The following support units or accessories were used to form a representative test configuration during the tests.

#	Equipment	Manufacturer	Model No.	Serial No.
1	USB memory	-	-	-
2	SD card	-	-	-

3.3. Interconnection and I/O cables

The following support units or accessories were used to form a representative test configuration during the tests.

#	Start		End		Cable	
	Name	I/O port	Name	I/O port	length (m)	shielded (Y/N)
1	EUT	DC IN	DC power supply	DC OUT	0.5	N
2	DC power supply	AC IN	AC mains	AC mains	1.8	N

Note: *1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3.4. Measurement Uncertainty (*U*)

Measurement Item	Combined Standard Uncertainty *Uc*	Expanded Uncertainty $U = k \times Uc$ ($k = 2$)
Conducted RF power	±1.49 dB	±2.98 dB
Radiated disturbance	±2.30 dB	±4.60 dB
Conducted disturbance	±1.96 dB	±3.92 dB

3.5. Test date

Date Tested	May 27, 2013 – June 13, 2013

4 Facilities and accreditations

4.1. Facilities

All of the measurements described in this report were performed at SK Tech Co., Ltd
Site I: 820-2, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea
Site II: 688-8, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-4. The sites comply with the Normalized Site Attenuation requirements given in ANSI C63.4, and site VSWR requirements specified in CISPR 16-1-4. The measuring apparatus and ancillary equipment conform to CISPR 16-1 series.

4.2. Accreditations

The laboratory has been also notified to FCC by RRA as a Conformity Assessment Body, and designated to perform compliance testing on equipment subject to Declaration of Conformity (DOC) and Certification under Parts 15 and 18 of the FCC Rules.

Designation No. KR0007

4.3. List of test and measurement instruments

No	Description	Manufacturer	Model	Serial No.	Cal. due	Use
1	Spectrum Analyzer	Agilent	E4405B	US40520856	2014.03.07	
2	Spectrum Analyzer	Agilent	E4440A	MY46186322	2014.03.18	☒
3	EMC Spectrum Analyzer	Agilent	E7405A	US40240203	2013.07.09	
4	EMI Test Receiver	Rohde&Schwarz	ESPI7	101206	2014.07.10	☒
5	EMI Test Receiver	Rohde&Schwarz	ESHS10	835871/002	2013.09.18	☒
6	Artificial Mains Network	Rohde&Schwarz	ESH2-Z5	834549/011	2013.07.09	☒
7	Pre-amplifier	HP	8447F	3113A05153	2013.07.10	☒
8	Pre-amplifier	MITEQ	AFS44	1116321	2013.12.15	
9	Pre-amplifier	MITEQ	AFS44	1116322	2014.03.08	☒
10	Power Meter	Agilent	E4417A	MY45100426	2013.07.10	
11	Power Meter	Agilent	E4418B	US39402176	2013.07.10	
12	Power Sensor	Agilent	E9327A	MY44420696	2013.07.10	
13	Power Sensor	Agilent	8485A	3318A13916	2013.07.10	
14	Attenuator (10dB)	HP	8491B	38072	2013.07.09	☒
15	High Pass Filter	Wainwright	WHKX3.0/18G	8	2013.07.09	☒
16	VHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	VHAP	1014 / 1015	2013.10.04	
17	UHF Precision Dipole Antenna (TX/RX)	Schwarzbeck	UHAP	989 / 990	2013.10.04	
18	Loop Antenna	Schwarzbeck	HFH2-Z2	863048/019	2013.12.22	☒
19	TRILOG Broadband Antenna	Schwarzbeck	VULB9168	230	2014.03.29	☒
20	Horn Antenna	AH Systems	SAS-200/571	304	N/A	
21	Horn Antenna	EMCO	3115	00040723	2014.03.26	☒
22	Horn Antenna	EMCO	3115	00056768	2013.08.13	
23	Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170318	2013.09.28	☒
24	Vector Signal Generator	Agilent	E4438C	MY42080359	2013.07.10	
25	PSG analog signal generator	Agilent	E8257D-520	MY45141255	2013.07.10	
26	DC Power Supply	HP	6622A	3348A03223	2013.07.10	☒
27	DC Power Supply	KYUNGEUN ELECTRONICS	KE-5A	-	N/A	☒
28	Hygro/Thermo Graph	SATO	PC-5000TRH-II	-	2013.07.18	☒
29	Temperature/Humidity Chamber	All Three	ATM-50M	20030425	2014.03.08	

5 Test and measurements (125 kHz transmitter)

5.1. Antenna requirement

5.1.1 Regulation

According to §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.

5.1.2 Result: PASS

The transmitter has the integral loop antenna (125 kHz transmitter) and meets the requirements

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)						
0.125	0.2	64.11	0.3	64.41	105.7	41.29
0.375	9	41.21	0.3	41.51	96.1	54.59
Emissions (Peak Detector)						
0.125	0.2	64.58	0.3	64.88	125.7	60.82
0.375	9	44.50	0.3	44.80	116.1	71.3
Emissions (Quasi-peak Detector); Frequency within 90 kHz ~ 110 kHz and above 490 kHz						
		No Radiated Spurious Emissions Found				

Margin (dB) = Limit – Reading

Table 2 : Measured values of the Field strength (above 30 MHz)												
Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Turn Table [degree]	Reading [dB(μV)]	Amp Gain [dB]	ATT [dB]	AF dB(1/m)	CL [dB]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
523.34	100	H	1.37	217	39.80	28.39	-	18.07	2.68	32.16	46.00	13.84
523.34	100	V	1.00	290	43.35	28.39	-	18.07	2.68	35.71	46.00	10.29
528.01	100	H	1.48	266	45.58	28.38	-	18.16	2.69	38.05	46.00	7.95
528.01	100	V	1.00	92	46.36	28.38	-	18.16	2.69	38.83	46.00	7.17
549.50	100	H	1.43	190	41.00	28.37	-	18.58	2.73	33.94	46.00	12.06
549.50	100	V	1.00	269	44.84	28.37	-	18.58	2.73	37.78	46.00	8.22
628.01	100	H	1.33	128	33.84	28.21	-	19.90	2.91	28.44	46.00	17.56
628.01	100	V	1.44	219	38.07	28.21	-	19.90	2.91	32.67	46.00	13.33
942.01	100	H	1.21	228	37.84	27.67	-	23.54	3.57	37.28	46.00	8.72
942.01	100	V	1.17	229	38.02	27.67	-	23.54	3.57	37.46	46.00	8.54

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. The tests were performed at the 3 m distance.

5.3. AC power line conducted emissions

5.3.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.3.2 Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5 m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω/50 μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

5.3.3 Test Results: PASS

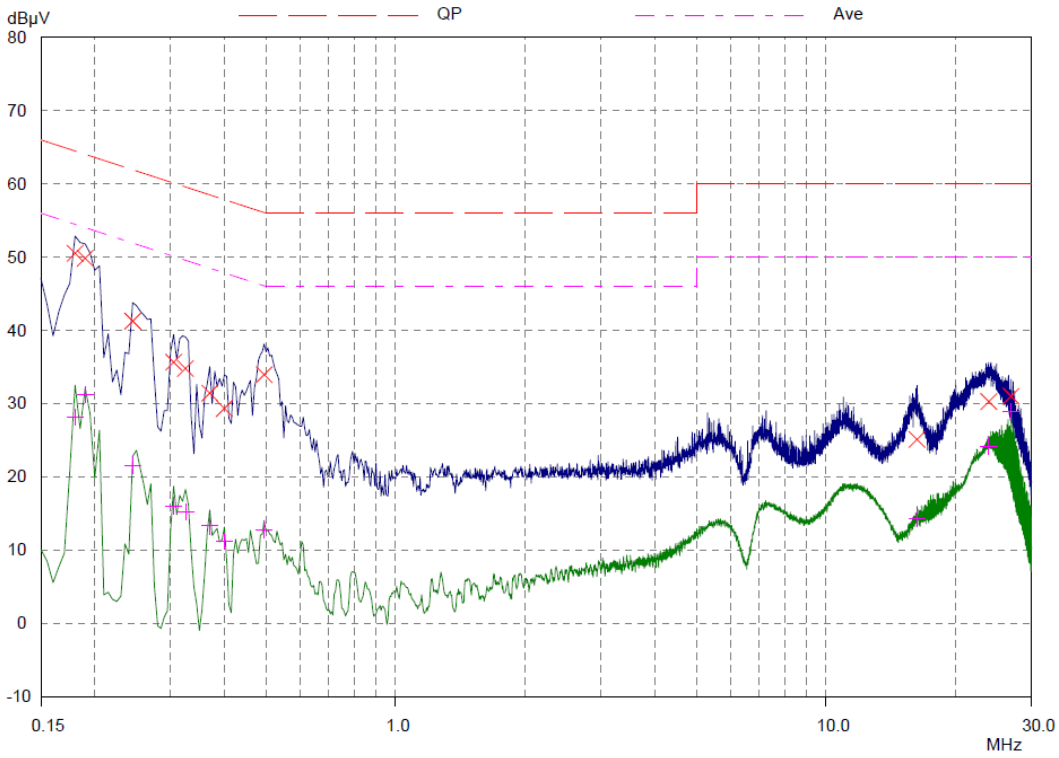
Table 3: Measured values of the AC Power Line Conducted Emissions							
Frequency [MHz]	Reading [dBμV]	L / N	CF [dB]	CL [dB]	Actual [dBμV]	Limit [dBμV]	Margin [dB]
QUASI-PEAK DATA							
0.180	50.98	N	0.10	0.01	51.09	64.49	13.40
0.190	50.35	N	0.10	0.01	50.46	64.04	13.58
0.245	41.25	L	0.10	0.01	41.36	61.92	20.56
0.305	36.27	N	0.12	0.01	36.40	60.11	23.71
0.330	34.72	N	0.12	0.01	34.85	59.45	24.60
0.370	31.43	L	0.12	0.01	31.56	58.50	26.94
0.400	29.33	L	0.12	0.01	29.46	57.85	28.39
0.495	33.96	L	0.12	0.01	34.09	56.08	21.99
23.790	30.38	N	0.64	0.28	31.30	60.00	28.70
23.860	30.28	L	0.85	0.28	31.41	60.00	28.59
26.900	31.00	L	1.02	0.30	32.32	60.00	27.68
AVERAGE DATA							
0.180	28.36	N	0.10	0.01	28.47	54.49	26.02
0.190	31.55	N	0.10	0.01	31.66	54.04	22.38
0.245	21.57	L	0.10	0.01	21.68	51.92	30.24
0.305	16.21	N	0.12	0.01	16.34	50.11	33.77
0.330	15.36	N	0.12	0.01	15.49	49.45	33.96
0.370	13.30	L	0.12	0.01	13.43	48.50	35.07
0.400	11.18	L	0.12	0.01	11.31	47.85	36.54
0.495	12.72	L	0.12	0.01	12.85	46.08	33.23
23.790	24.62	N	0.64	0.28	25.54	50.00	24.46
23.860	24.20	L	0.85	0.28	25.33	50.00	24.67
26.900	28.94	L	1.02	0.30	30.26	50.00	19.74

Margin (dB) = Limit – Actual
[Actual = Reading + CF + CL]
L/N = LINE / NEUTRAL
CF/CL = Correction Factor and Cable Loss

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.

Figure 1. Plot of the AC Power Line Conducted Emissions

Line – PE (Peak and Average detector used)



Neutral – PE (Peak and Average detector used)