

TEST REPORT

FCC Standards : FCC Part 24 Subpart D and Part 90

Test Report No. : CTK-2016-00411
Date of Issue : 2016-03-31
FCC ID : R2ST52
Model/Type No. : T52
Kind of Product : Two Way Pager
Applicant : Hoseo Telnet Co., Ltd.
Applicant Address : Hoseo Plaza B/D 7F, 416, Gangseo-ro, Gangseo-gu, Seoul, Korea
Manufacturer : Hoseo Telnet Co., Ltd.
Manufacturer Address : Hoseo Plaza B/D 7F, 416, Gangseo-ro, Gangseo-gu, Seoul, Korea
Contact Person : Mr. Chang-Soo, Kim / Principal Engineer
Telephone : +82-2-2659-7345
Received Date : 2016-03-09
Test period : Start : 2016-03-15 End : 2016-03-25
Test Results : ☒ In Compliance ☐ Not in Compliance

The test results presented in this report relate only to the object tested.

Tested by



Won-Jae, Hwang
Test Engineer
Date: 2016-03-31

Reviewed by



Young-Joon, Park
Technical Manager
Date: 2016-03-31



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REPORT REVISION HISTORY

Date	Revision	Page No
2016-03-31	Issued (CTK-2016-00411)	All

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1.0 General Product Description

Equipment model name	: T52
Serial number	: Prototype
EUT condition	: Pre-production, not damaged
Antenna type	: Fixed Helical Antenna Gain 0 dBi
Frequency Range	: 896 MHz – 902 MHz (Transmit) : 929 MHz – 932 MHz, 935 MHz – 942 MHz (Receiving)
Applicable Frequency	: 896 MHz – 901 MHz (Part 90) : 901 MHz – 902 MHz (Part 24)
Rated RF Output power	: < 2 W
Type of Modulation	: GFSK
Data Transfer Rate	: Max. 9600 bps
Channel spacing	: 6.25 kHz (Transmit) : 10 kHz and 12.5 kHz (Receiving)
Power Source	: DC 1.5 V AA Size Alkaline Battery
Hardware Rev	: Ver 1.00
Software Rev	: Ver 1.00
Firmware Rev	: Ver.m.1.00

2017.02 Test mode

Test Item	Modulation	Data Rate
Maximum Output Power Occupied Bandwidth Bandwidth Limitation Emission Masks Spurious emission Radiated Emissions Frequency Stability	GFSK	9600 bps

1.2 EUT Operation Test Setup

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

1.3 Tested Frequency

	LOW	-	HIGH
Frequency (MHz)	896	-	902

1.4 EUT Exercise of Software

Not applicable

1.5 Device Modifications

The following modifications were necessary for compliance:

Not applicable

1.6 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
-	-	-	-

1.7 Maximum measurement uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-5}$
Total PF power (Conducted)	± 1.5 dB
RF power density (Conducted)	± 3 dB
Spurious emission (Conducted)	± 3 dB
All emission (Radiated)	± 6 dB
Temperature	± 1 °C
Humidity	± 5 %
DC and low frequency voltage	± 3 %

2017.02 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

2017.02 Test Facility

The measurement facility is located at 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.10 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.0 Summary of tests

FCC Part Section(s)	Parameter	Status (note 1)
2.1046 24.132(b) 90.205	RF Power Output at Antenna Terminals	C
2.1046 24.131 90.209(b)	Occupied Bandwidth, Bandwidth Limitation, Emission Masks	C
2.1051 24.133 90.210(j)	Spurious Emissions at Antenna Terminals	C
2.1053 24.133 90.210(j)	Field strength of Spurious Radiation	C
15.109(b)	Field strength of Spurious Radiation (Receiving Mode)	C
2.1055(a)(1) 24.135 90.213	Frequency Stability with Temperature variation	C
2.1055(d) 24.135 90.213	Frequency Stability with primary voltage variation	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

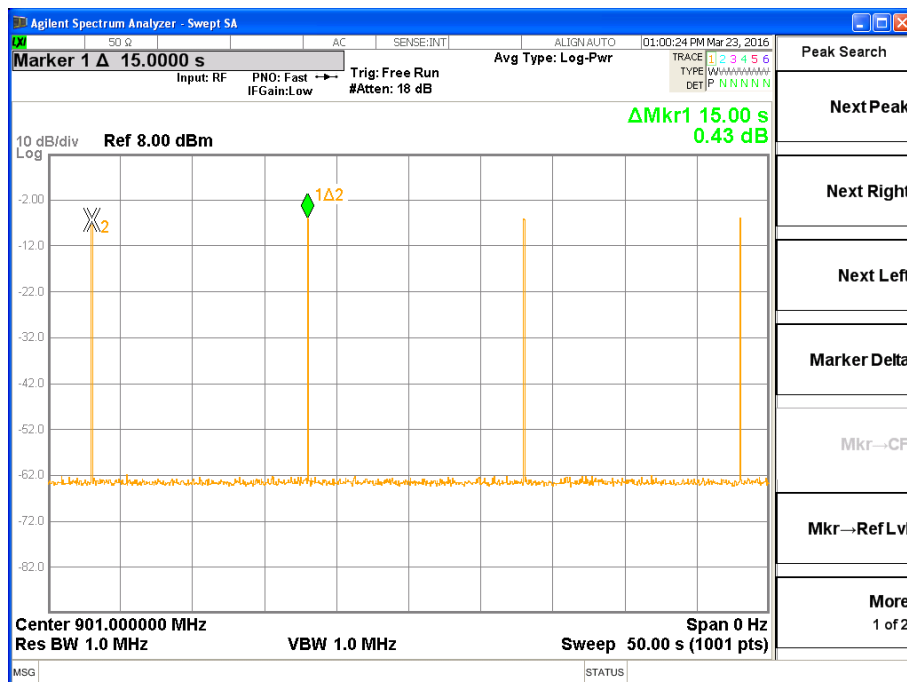
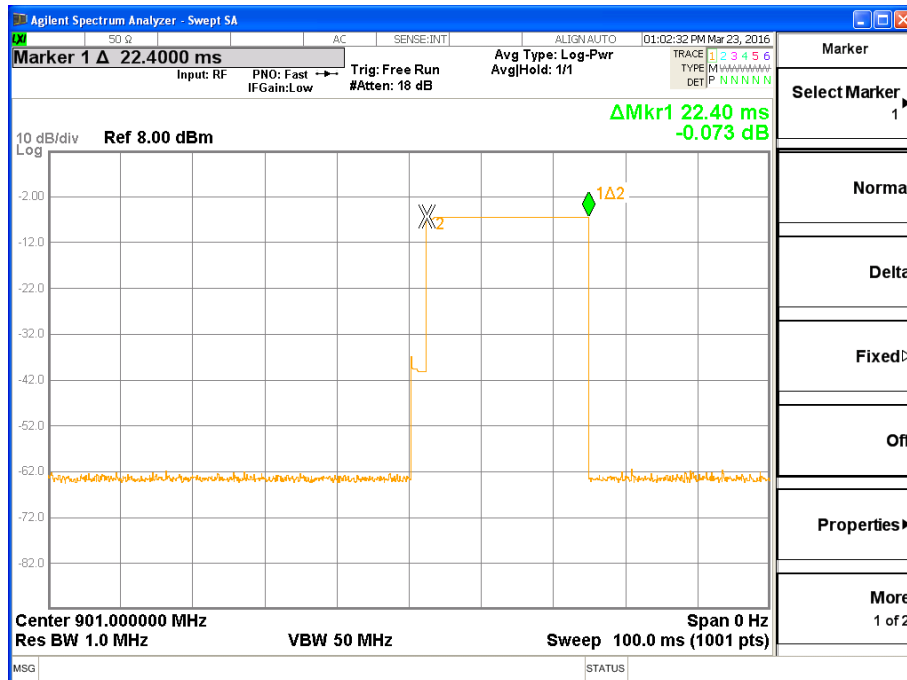
Note 2: The data in this test report are traceable to the national or international standards.

The sample was tested according to the following specification:
 - FCC Title 47 Part 2, Sub-part J as well as the following individual parts: Part 24D - PCS Part 90 – Private Land Mobile Radio Service Applicable Standards: TIA EIA 137-A, TIA EIA 98-C, TIA/EIA-603, ANSI C63.10-2013

2017.02 Technical Characteristic Test

2.1.1.0 Duty Cycle

Duty Cycle	0.149 %
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RF Power Output at Antenna Terminals

Procedure:

The RF output port of the EUT was connected to the input of the spectrum analyzer through sufficient attenuation. The resolution bandwidth was set to 2 MHz and video bandwidth of the spectrum analyzer was set at 3 MHz and the spectrum as recorded in the frequency band ± 5 MHz from the carrier frequency.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 2 MHz

VBW = 3 MHz

Trace = Max hold

Sweep = auto

Detector function = peak

Measurement Data:

Channel	Frequency (MHz)	Detector Mode	RF Power Output (dBm)	RF Power Output (W)
Low	896	Peak	31.70	1.479
High	902	Peak	31.52	1.419
Low	896	Average	31.69	1.476
High	902	Average	31.51	1.416

Minimum Standard:

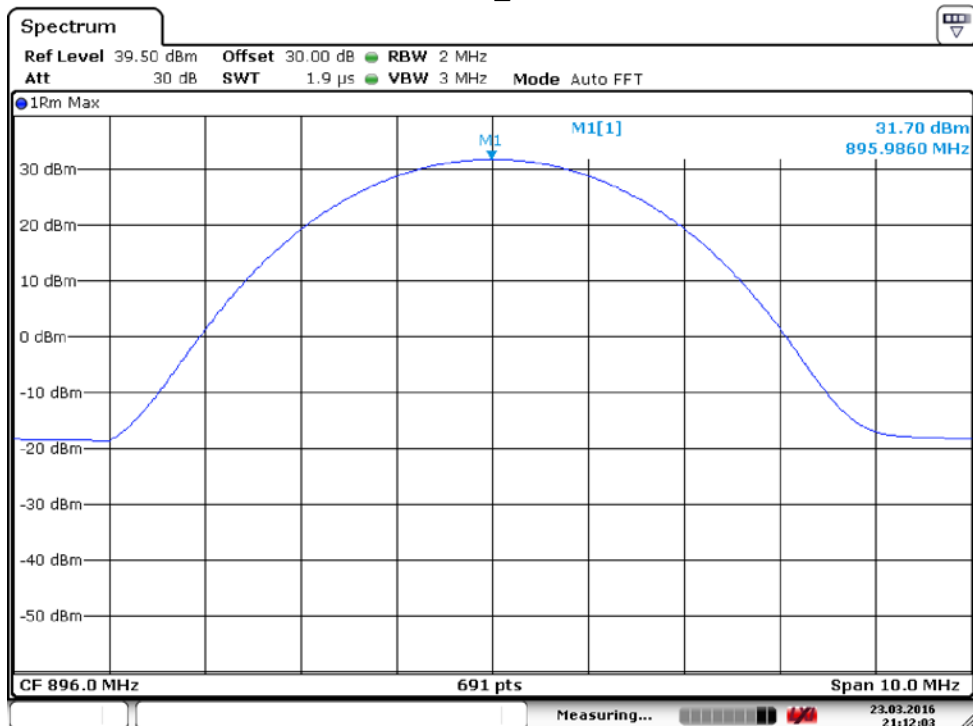
2.1046

24.132(a) : < 7 Watts E.R.P

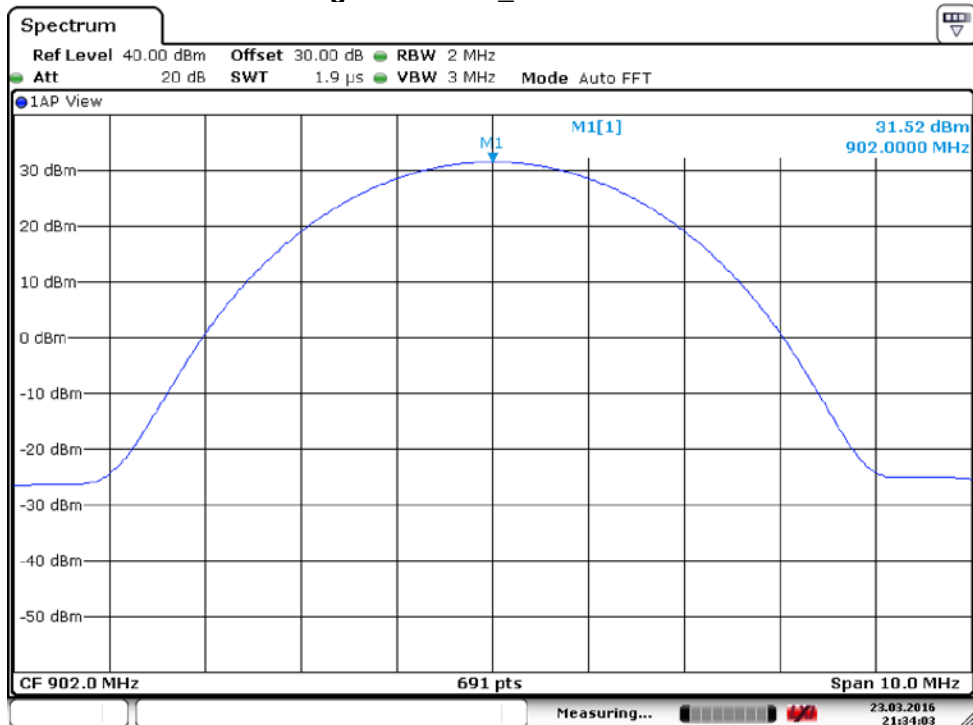
90.635 : Power dependent upon station's antenna HAAT and required service area and may be from 1 to 500 watts.

See next pages for actual measured spectrum plots.

Low Channel_Peak Value



High Channel_Peak Value



2.1.2 Occupied Bandwidth, Bandwidth Limitation, Emission Masks

Test Location

RF Test Room

Test Set-up

The RF output port of the EUT was connected to the input of the spectrum analyzer through sufficient attenuation. The resolution bandwidth and video bandwidth of the spectrum analyzer was set at 300 Hz for emission mask, 1 kHz for 99 % occupied bandwidth and the spectrum was recorded in the frequency band ± 25 kHz from the carrier frequency.

Limit

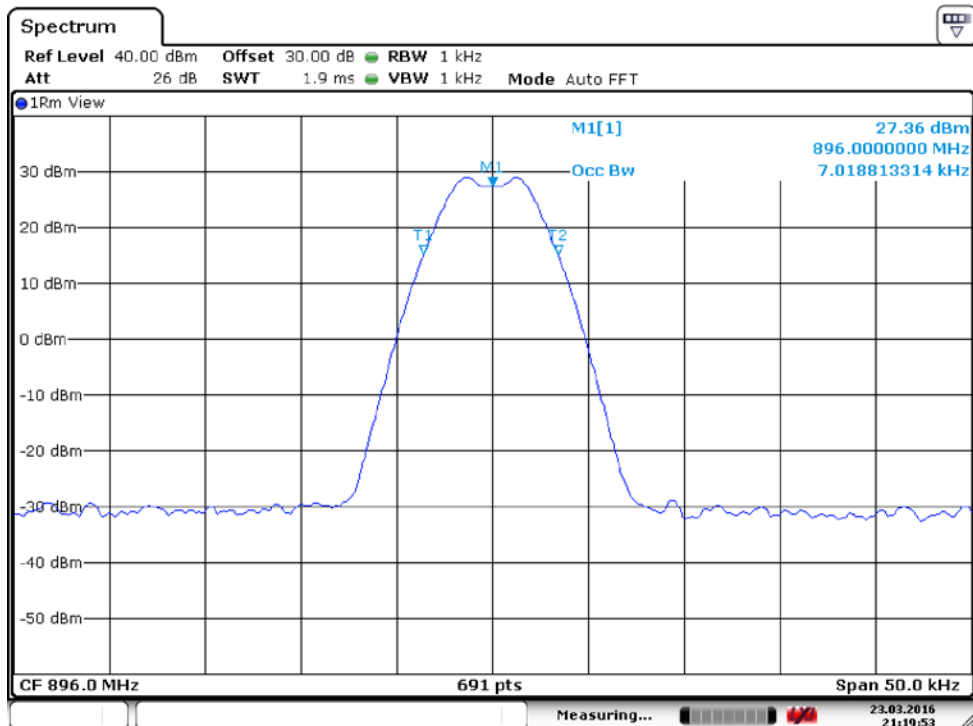
10.0 kHz for Part 24
13.6 kHz for Part 90

Test Results

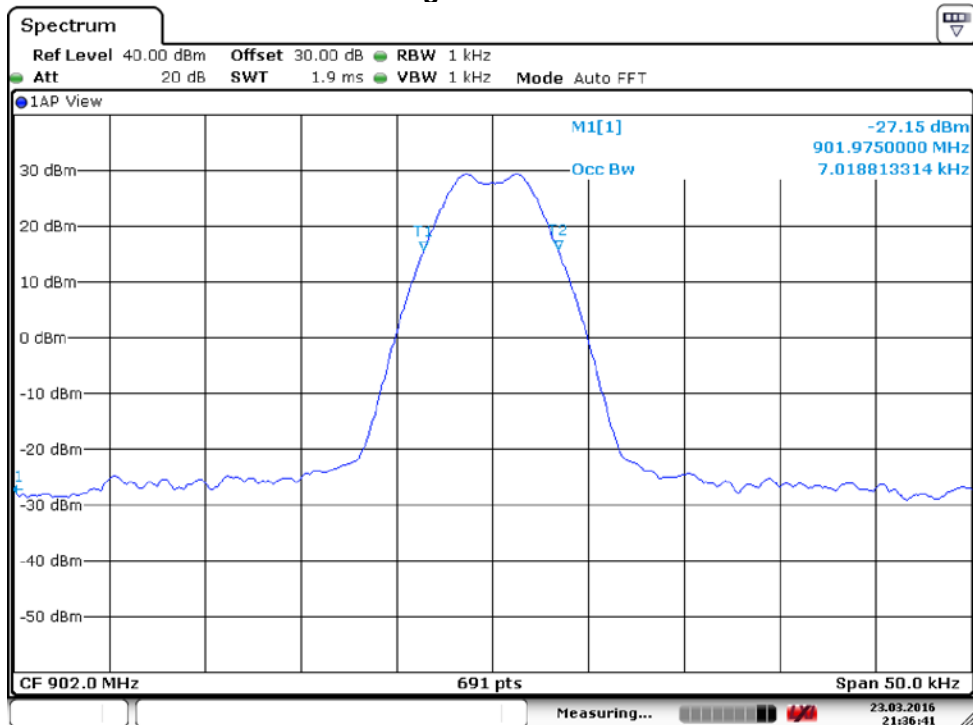
Channel	Frequency (MHz)	Measured Value (kHz)	Result
Low	896	7.018	Complies
High	902	7.018	Complies

See next pages for actual measured spectrum plots.

Low Channel



High Channel





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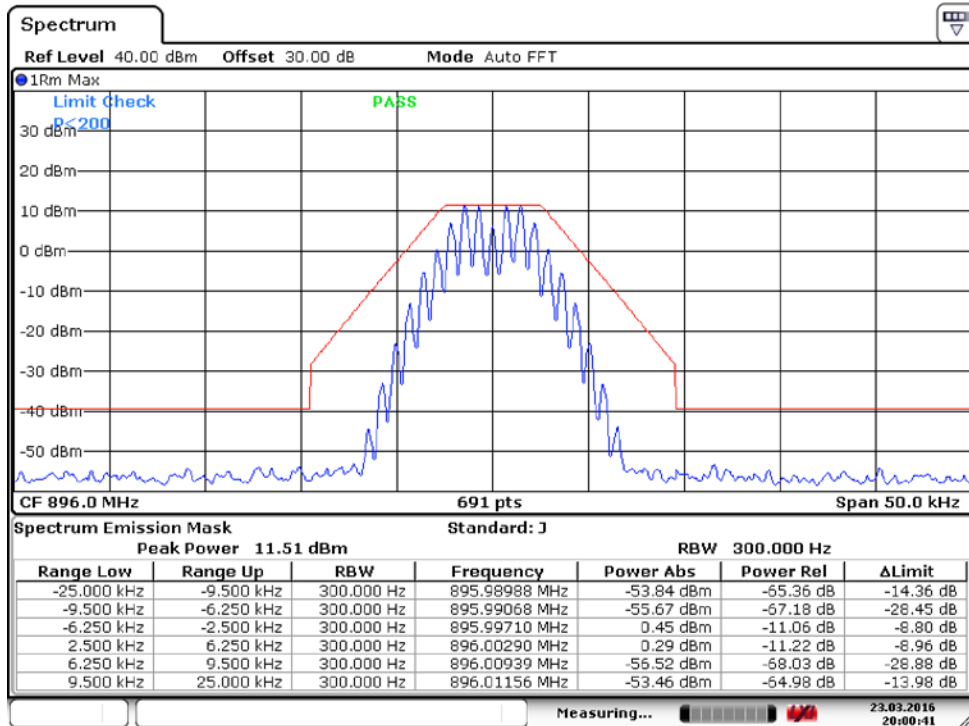
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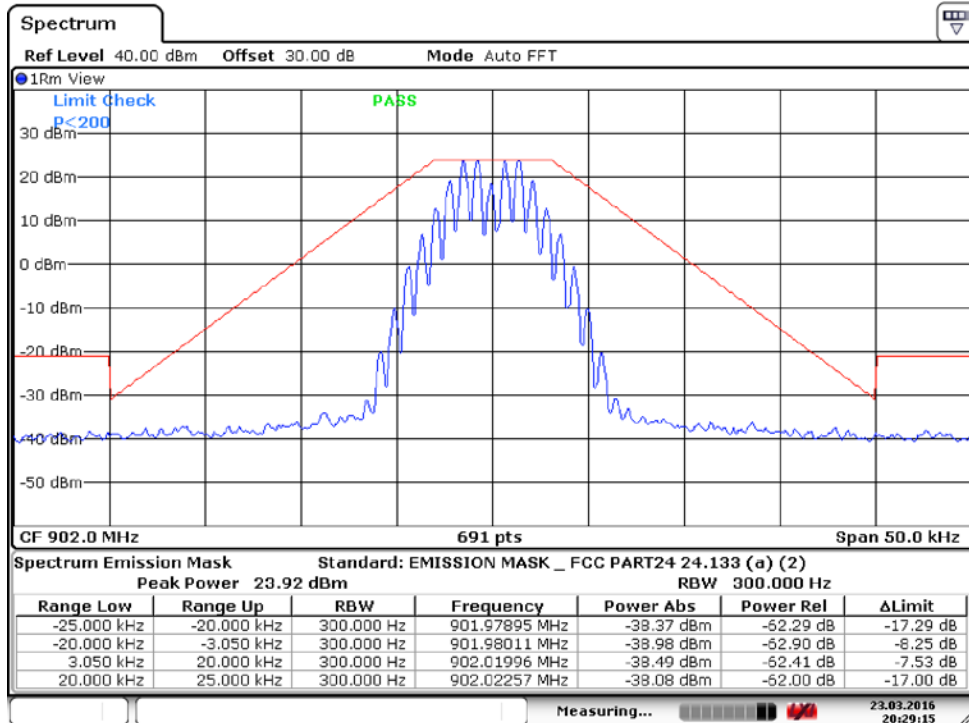
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Low Channel



High Channel





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2.1.3 Spurious Emissions at Antenna Terminals

Procedure:

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW = 100 kHz

Span = -

Detector function = peak

Trace = Max hold

Sweep = auto

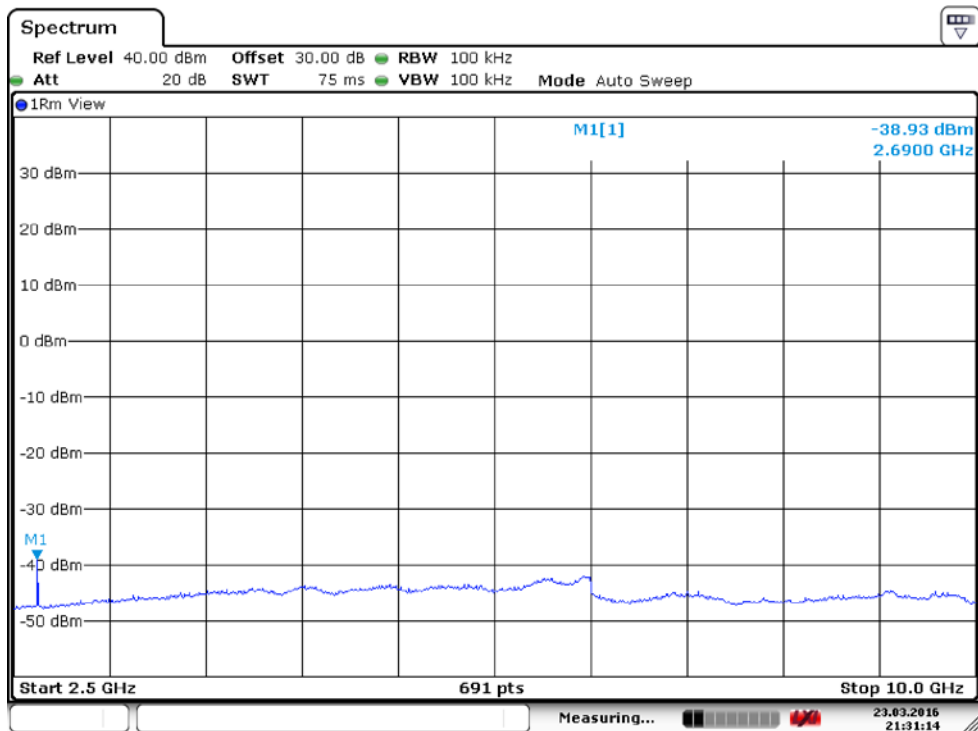
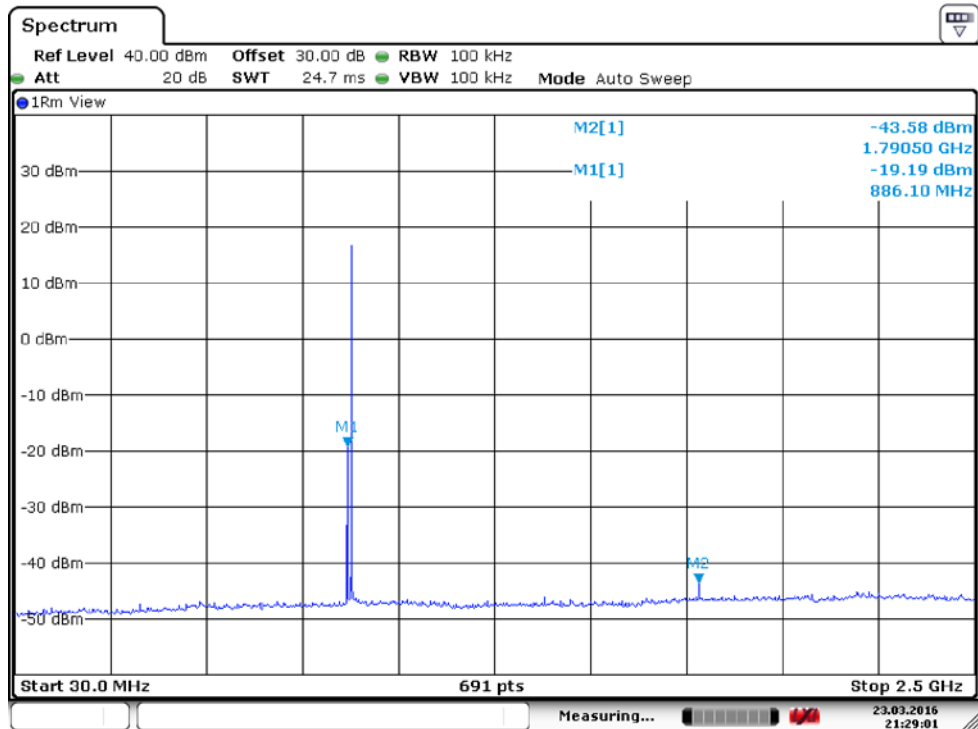
Measurement Data: Complies

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least -13dBm lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

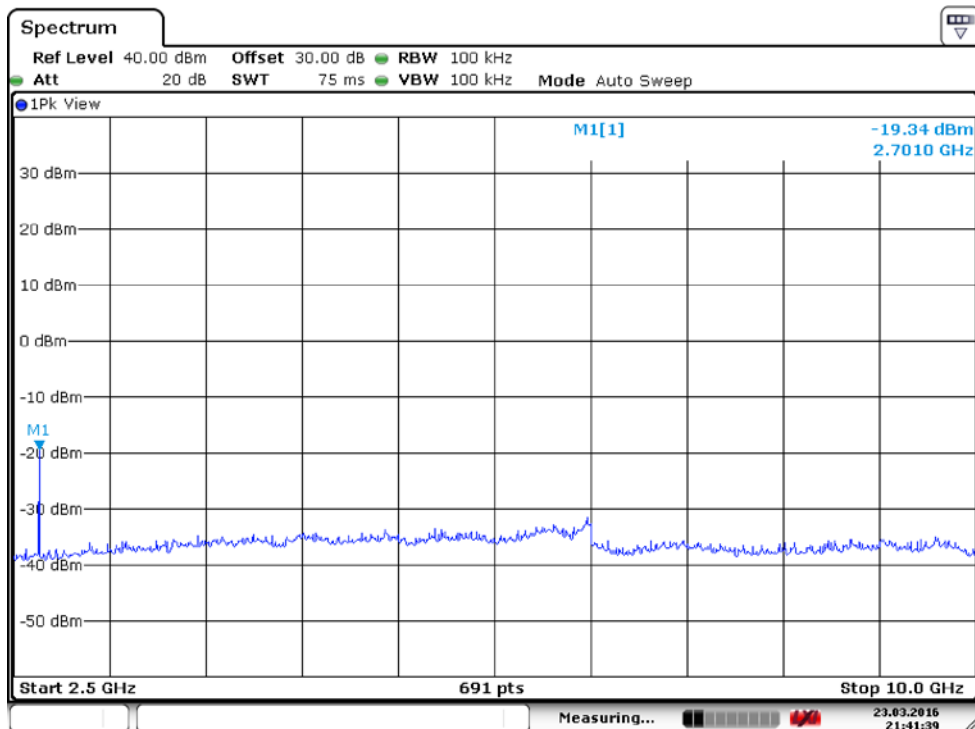
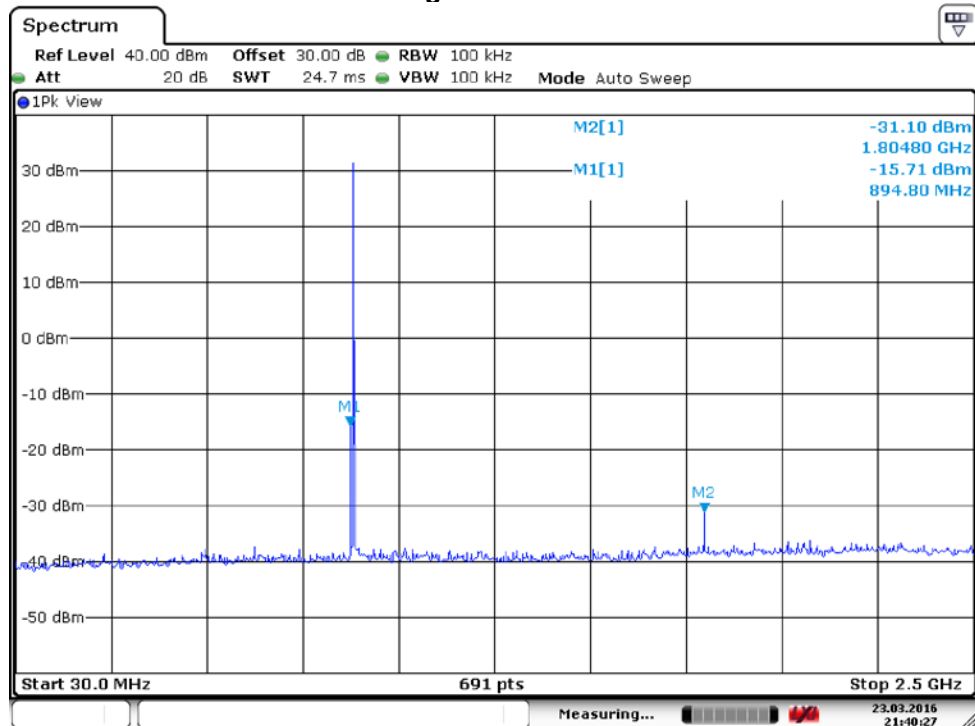
Minimum Standard:	< -13 dBm
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See next pages for actual measured spectrum plots.

Low Channel



High Channel



2.1.4 Field Strength of Emissions

Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

The spectrum analyzer is set to:

Frequency Range = 9 kHz ~ 10 GHz (10th harmonic)

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz

VBW $\geq$ RBW

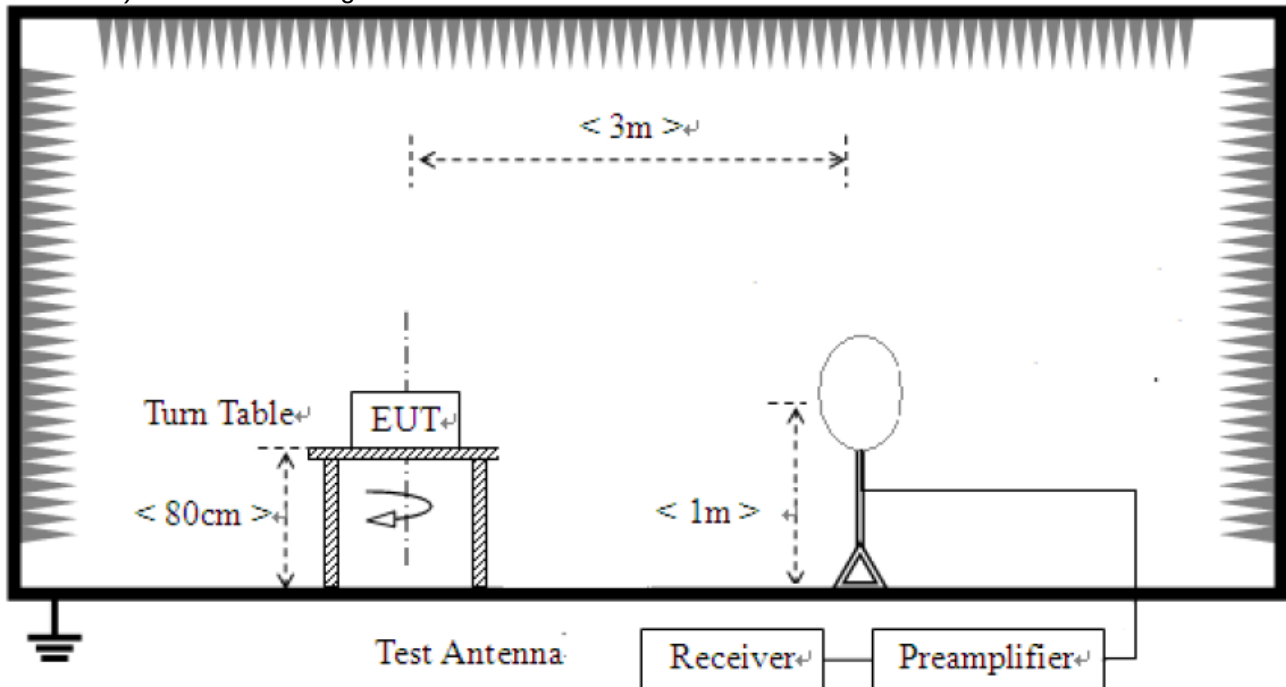
Sweep = auto

Limit

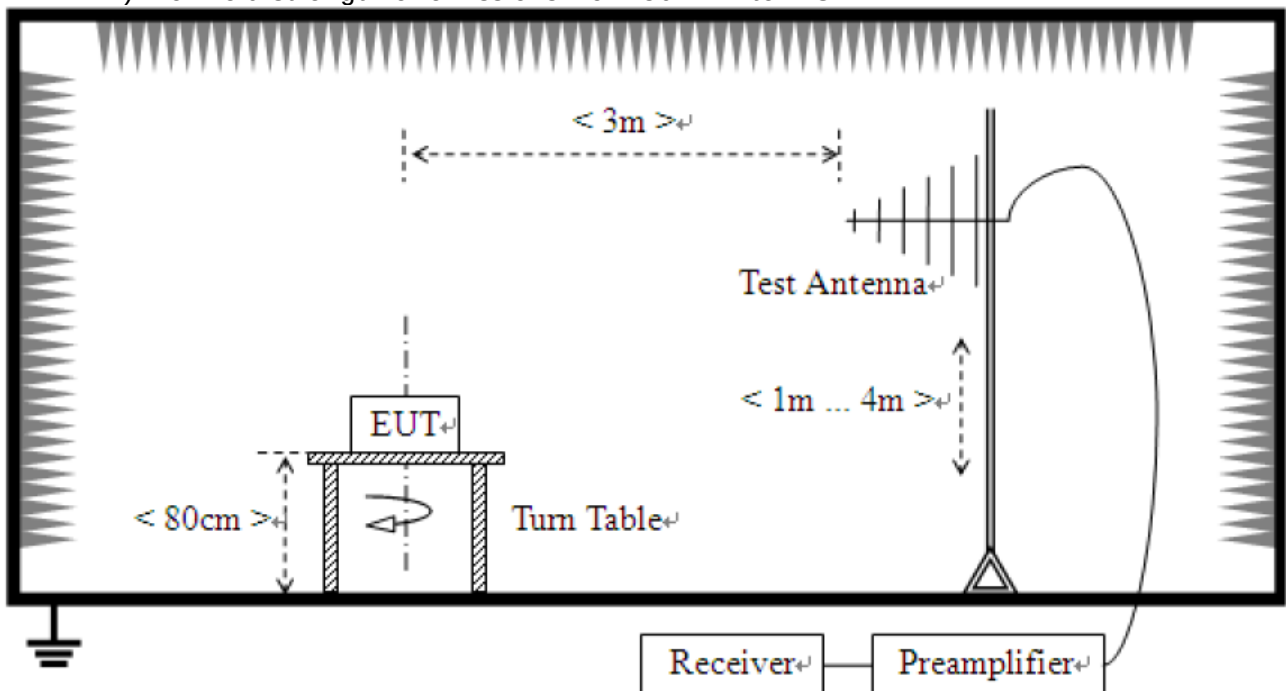
-13 dBm

Test Setup:

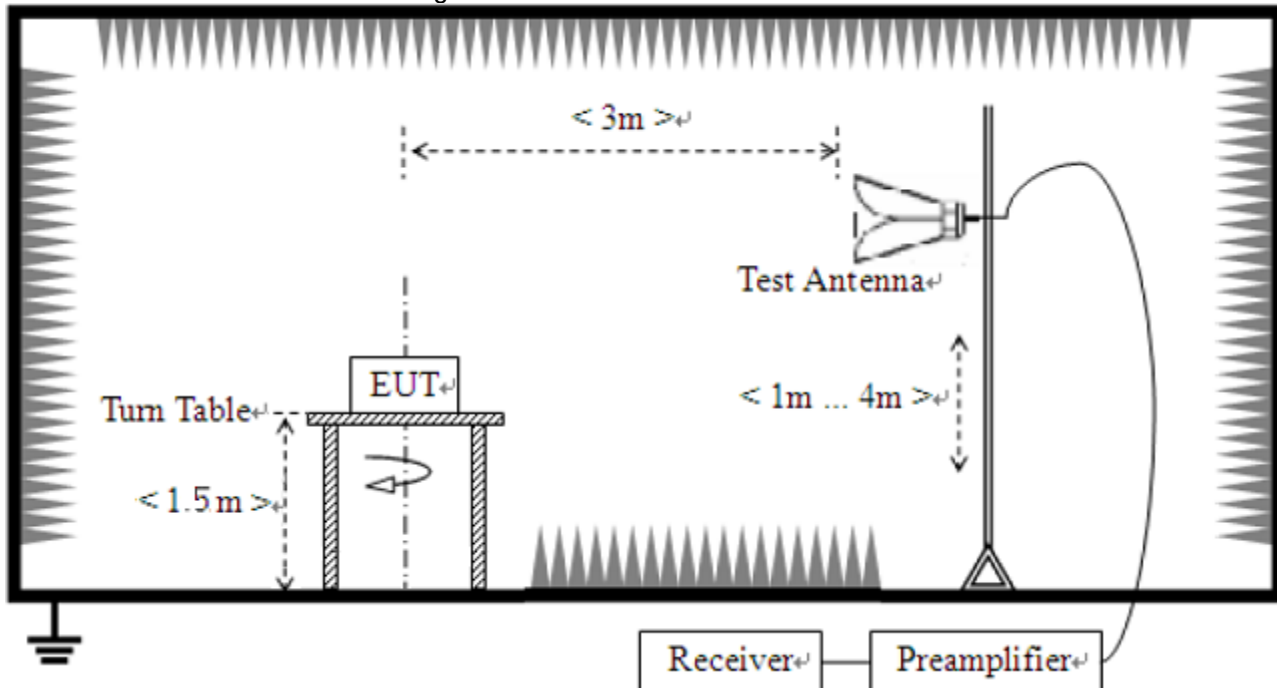
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



2017.□ For field strength of emissions above 1 GHz



Test Results

2017.□ **9 kHz to 30 MHz**

Test mode : Continuous modulated carrier

EUT	Two Way Pager	Measurement Detail	
Model	T52	Frequency Range	9 kHz – 30 MHz
Test mode	Continuous modulated carrier	Detector function	Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBm)	Margin (dB)	Remark
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

2017.□ **30 MHz to 1 GHz**

Test mode : Continuous modulated carrier

EUT	Two Way Pager	Measurement Detail	
Model	T52	Frequency Range	Below 1000MHz
Mode	Continuous modulated carrier	Detector function	Peak

The requirements are:

☒ Complies

Low Channel : 896 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
886.1	-41.6	-13.0	28.6

High Channel : 902 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
894.8	-42.1	-13.0	29.1

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

3) above 1 GHz

Test mode : Continuous modulated carrier

EUT	Two Way Pager	Measurement Detail	
Model	T52	Frequency Range	1-10 GHz
Mode	Continuous modulated carrier	Detector function	Peak

The requirements are:

☒ Complies

Low Channel : 896 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
1790.5	-35.5	-13.0	22.5
2690.0	-31.5	-13.0	18.5

High Channel : 902 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
1804.8	-36.4	-13.0	23.4
2701.0	-32.6	-13.0	19.6

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

Test Results

2017.□ **9 kHz to 30 MHz**

Test mode : Receiving

EUT	Two Way Pager	Measurement Detail	
Model	T52	Frequency Range	9 kHz – 30 MHz
Test mode	Receiving	Detector function	Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBm)	Margin (dB)	Remark
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

2017.□ **30 MHz to 1 GHz**

Test mode : Receiving

EUT	Two Way Pager	Measurement Detail	
Model	T52	Frequency Range	Below 1000MHz
Mode	Receiving	Detector function	Peak

The requirements are:

☒ Complies

Low Channel : 896 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
-	-	-	See note

High Channel : 902 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

2017.□ **above 1 GHz**

Test mode : Receiving

EUT	Two Way Pager	Measurement Detail	
Model	T52	Frequency Range	1-10 GHz
Mode	Receiving	Detector function	Peak

The requirements are:

☒ Complies

Low Channel : 896 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
-	-	-	See note

High Channel : 902 MHz

Frequency (MHz)	Measured Data (dBm)	Limit (dBm)	Margin (dB)
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

2.1.5 Frequency Stability with Temperature variation

Test Location

RF Test Room

Test Set-up

The EUT was connected to an external DC power supply and the RF output port of the EUT was connected to a frequency counter via feed-through attenuators. The EUT was placed inside of the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

Turn EUT off and set chamber temperature to -30 °C and then allow sufficient time (approximately 20 to 30 minutes after chamber reach the assigned temperature) for EUT to stabilize. Turn ON EUT and measure the EUT operating frequency and then turn off the EUT after the measurement.

Repeat above method emission measurements at +50 °C and then record all measured frequencies on each temperature step.

Limit

± 1 ppm

Test Results

Temperature (°C)	Carrier Frequency (Hz)	Measured Frequency (Hz)	Result (ppm)	Limit
-30	896 000 000	896 000 162	0.180 803 6	±1 ppm
-20		896 000 105	0.117 187 5	
-10		896 000 135	0.150 669 6	
0		896 000 286	0.319 196 4	
10		896 000 438	0.488 839 3	
20		896 000 506	0.564 732 1	
30		896 000 444	0.495 535 7	
40		896 000 302	0.337 053 6	
50		896 000 293	0.327 008 9	
-30	902 000 000	902 000 131	0.146 205 4	±1 ppm
-20		902 000 106	0.118 303 6	
-10		902 000 086	0.095 982 1	
0		902 000 162	0.180 803 6	
10		902 000 198	0.220 982 1	
20		902 000 256	0.285 714 3	
30		902 000 245	0.273 437 5	
40		902 000 206	0.229 910 7	
50		902 000 301	0.335 937 5	

2.1.6 Frequency Stability with Voltage variation

Test Location

RF Test Room

Test Set-up

An external variable DC power supply was connected to the battery terminals of the EUT. The voltage of EUT set to 115 % of the nominal value and was then decreased until the EUT light no longer illuminated; i.e., the battery end point. The output frequency was recorded for each battery voltage.

Limit

± 1 ppm

Test Results

Voltage (vdc)	Carrier Frequency (Hz)	Measured Frequency (Hz)	Result (ppm)	Limit
4.255	896 000 000	896 000 236	0.263 392 9	± 1 ppm
3.600		896 000 243	0.271 205 4	
4.255	902 000 000	902 000 118	0.131 696 4	± 1 ppm
3.600		902 000 128	0.142 857 1	

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Agilent	N9020A	MY48011598	2015-11-02	2016-11-02
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2016-01-20	2017-01-20
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100816	2015-11-02	2016-11-02
4	LISN	ENV216	Rohde & Schwarz	101760	2016-02-05	2017-02-05
5	EMI Test Receiver	Rohde & Schwarz	ENV216	100814	2015-11-02	2016-11-02
6	Trilog Broadband Antenna	SCHWARZBECK	VULB 9161 SE	9161-4133	2015-06-18	2017-06-18
7	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2014-05-19	2016-05-19
8	6dB Attenuator	R&S	DNF	272.4110.50-2	2015-11-03	2016-11-03
9	AMPLIFIER	SONOMA	310	291721	2016-02-02	2017-02-02
10	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2015-05-15	2016-05-15
11	PREAMPLIFIER	Agilent	8449B	3008A02307	2015-10-01	2016-10-01
12	Horn Antenna	ETS-Lindgren	3115	00078894	2015-09-02	2017-09-02
13	Horn Antenna	ETS-Lindgren	3116	00062504	2015-09-04	2017-09-04
14	Horn Antenna	ETS-Lindgren	3116	00062916	2015-04-30	2017-04-30
15	Horn Antenna	ETS-Lindgren	3117	00154525	2015-09-02	2017-09-02
16	Temp&Humi Chamber	ESPEC CORP.	SH-242	93008423	2015-10-01	2016-10-01
17	DC Power Supply	Agilent	E3632A	KR94907541	2015-11-02	2016-11-02
18	DC Power Supply	Agilent	E3632A	MY40011638	2015-11-02	2016-11-02
19	DC Power Supply	Topward	6303D	666421	2016-02-03	2017-02-03
20	Signal Analyzer	Rohde & Schwarz	FSV30	100925	2016-03-09	2017-03-09