TEST REPORT

Application No.:	HKEM2304000316PF
Applicant:	Kingtronics Industrial Co Ltd
Address of Applicant:	Penthouse, Century Centre, 44-46 Hung To Road, Kwun Tong, Kowloon, Hong Kong
Equipment Under Test (EUT):	
EUT Name:	Bluetooth and RFID Smart Lock
Model No.:	CL4510 BS, CL4XYY ZZ, CL5XYY ZZ
Additional Model:	Please refer to section 2 of this report which indicates which item was actually tested and which were electrically identical.
FCC ID:	FA5CL5500CL4500
Standard(s) :	47 CFR Part 15, Subpart C 15.225
Date of Receipt:	2023-05-23
Date of Test:	2023-05-23 to 2023-05-30
Date of Issue:	2023-06-19
Test Result:	The submitted sample was found to comply with the test requirement

Law Man Kit
EMC Manager

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

Revision Record			
Revision No.	**Date**	**Report superseded**	**Remark**

Authorized for issue by:				
		Chan Chun Lok /Project Engineer		Date: 2023-06-14
		Law Man Kit /Reviewer		Date: 2023-06-19

2 Test Summary

Radio Spectrum Technical Requirement				
Item	**Standard**	**Method**	**Requirement**	**Result**
Antenna Requirement	47 CFR Part 15, Subpart C	N/A	47 CFR Part 15, Subpart C 15.203	Pass

Radio Spectrum Matter Part				
Item	**Standard**	**Method**	**Requirement**	**Result**
Emission Mask	47 CFR Part 15, Subpart C	ANSI C63.10 (2013) Section 11.9.1	47 CFR Part 15, Subpart C 15.225 (a)(b)(c)	Pass
20dB Bandwidth	47 CFR Part 15, Subpart C	ANSI C63.10 (2013) Section 6.9	47 CFR Part 15, Subpart C 15.215	Pass
Frequency Tolerance	47 CFR Part 15, Subpart C	ANSI C63.10 (2013) Section 6.8	47 CFR Part 15, Subpart C 15.225(e)	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass

Declaration of EUT Family Grouping:

Item no.: CL4510 BS, CL4XYY ZZ, CL5XYY ZZ

According to the confirmation from the applicant, the above models are identical in all electrical aspects in relating to the circuitry design, PCB layout, electrical components used, internal wiring and functions. The differences are only product outlook and colour.

Digit	Combination	Meaning
X	0-9	N/A
YY	00-99	N/A
ZZ	BS	Brushed Steel
	SS	Stainless Steel
	MG	Marine Grade
	BK	Black
	PB	Polished Brass

Therefore, only the model CL4510 BS was tested in this report.

Abbreviation:

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radiated Frequency.

CH: In this whole report CH means channel.

Volt: In this whole report Volt means Voltage.

Temp: In this whole report Temp means Temperature.

Humid: In this whole report Humid means humidity.

Press: In this whole report Press means Pressure.

N/A: In this whole report not application.

3 Contents

Page

1 COVER PAGE 1

2 TEST SUMMARY 3

3 CONTENTS 5

4 GENERAL INFORMATION 6

4.1 DETAILS OF E.U.T. 6
4.2 DESCRIPTION OF SUPPORT UNITS 6
4.3 MEASUREMENT UNCERTAINTY 7
4.4 TEST LOCATION 8
4.5 TEST FACILITY 8
4.6 DEVIATION FROM STANDARDS 8
4.7 ABNORMALITIES FROM STANDARD CONDITIONS 8

5 EQUIPMENT LIST 9

6 RADIO SPECTRUM TECHNICAL REQUIREMENT 10

6.1 ANTENNA REQUIREMENT 10
6.1.1 Test Requirement: 10
6.1.2 Conclusion 10

7 RADIO SPECTRUM MATTER TEST RESULTS 11

7.1 EMISSION MASK 11
7.1.1 E.U.T. Operation 11
7.1.2 Test Setup Diagram 11
7.1.3 Measurement Procedure and Data 11
7.2 20DB BANDWIDTH 12
7.2.1 E.U.T. Operation 12
7.2.2 Test Setup Diagram 12
7.2.3 Measurement Procedure and Data 12
7.3 FREQUENCY TOLERANCE 13
7.3.1 E.U.T. Operation 13
7.3.2 Test Setup Diagram 13
7.3.3 Measurement Procedure and Data 13
7.4 RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS 14
7.4.1 E.U.T. Operation 14
7.4.2 Test Setup Diagram 14
7.4.3 Measurement Procedure and Data 15
7.5 RADIATED SPURIOUS EMISSIONS 16
7.5.1 E.U.T. Operation 16
7.5.2 Test Setup Diagram 17
7.5.3 Measurement Procedure and Data 18

8 PHOTOGRAPHS 23

8.1 EUT CONSTRUCTIONAL DETAILS (EUT PHOTOS) 23

9 APPENDIX 15.225 24

9.1 EMISSION MASK 24
9.2 20DB BANDWIDTH 25
9.3 FREQUENCY TOLERANCE 25

4 General Information

4.1 Details of E.U.T.

Power supply:	DC 6 V (‘AA’ size battery x 4)
Test voltage:	DC 6 V
Cable:	N/A
Antenna Type:	PCB loop antenna
Modulation Type:	ASK
Operation Frequency:	13.56MHz

Frequency List:

Channel	Frequency (MHz)
1	**13.56**

The frequencies under test are bolded.

4.2 Description of Support Units

The EUT has been tested as an independent unit.

4.3 Measurement Uncertainty

RF

No.	Item	Measurement Uncertainty
1	Radio Frequency	± 7.25 x 10^{-8}
2	Duty cycle	± 0.37%
3	Occupied Bandwidth	± 3%
4	RF conducted power (30MHz-40GHz)	1.5dB
5	RF power density	1.5dB
6	Conducted Spurious emissions	1.5dB
7	RF Radiated power & Radiated Spurious emission test	4.7dB (30MHz-1GHz)
		4.7dB (1GHz-6GHz)
		4.7dB (6GHz-18GHz)
		5.7dB (18GHz-40GHz)
8	Temperature test	± 1℃
9	Humidity test	± 3%
10	Supply voltages	± 1.5%
11	Time	± 3%

Remark:

The U_{lab} (lab Uncertainty) is less than U_{cispr} (CISPR Uncertainty), so the test results

– compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;

– non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

According to decision rule based on Clause 4.2 of CISPR 16-4-2, the EUT complied with the standards specified above.

4.4 Test Location

All tests were performed at:

SGS Hong Kong Limited

Unit 2 and 3, G/F, Block A, Po Lung Centre,

11 Wang Chiu Road, Kowloon Bay, Kowloon, Hong Kong

Tel: +852 2305 2570 Fax: +852 2756 4480

No tests were sub-contracted.

4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **IAS Accreditation (Lab Code: TL-817)**

SGS Hong Kong Limited has met the requirements of AC89, IAS Accreditation Criteria for Testing Laboratories, and has demonstrated compliance with ISO/IEC Standard 17025:2017, General requirements for the competence of testing and calibration laboratories. This organization is accredited to provide the services specified in the scope of accreditation maintained on the IAS website (www.iasonline.org).

The report must not be used by the client to claim product certification, approval, or endorsement by IAS, NIST, or any agency of the Federal Government.

- **FCC Recognized Accredited Test Firm(CAB Registration No.: 514599)**

SGS Hong Kong Limited has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: HK0015, Test Firm Registration Number: 514599.

- **Industry Canada (Site Registration No.: 26103; CAB Identifier No.: HK0015)**

SGS Hong Kong Limited has been recognized by Department of Innovation, Science and Economic Development (ISED) Canada as a wireless testing laboratory. The acceptance letter from the ISED is maintained in our files. CAB Identifier No: HK0015, Site Registration Number: 26103.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

5 Equipment List

Emission Mask, 20dB Bandwidth, Frequency Tolerance, Radiated Emissions which fall in the restricted bands, Radiated Spurious Emissions					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
3m Semi-Anechoic Chamber	ChamPro	N/A	E229	2022/08/09	2023/08/08
Coaxial Cable	SGS	N/A	E167	2022/07/15	2023/07/14
EMI Test Receiver 9kHz to 7GHz	Rohde & Schwarz	ESR7 / 102298	E314	2022/06/29	2023/06/28
Active Loop Antenna 9k-30MHz	Schwarzbeck	FMZB 1513	E327	2022/11/23	2024/11/22
TRILOG Super Broadb. Test Antenna, (25) 30-1000 MHz	Schwarzbeck	VULB 9168	E264	2021/10/18	2023/10/17
EMC32 Test software	Rohde & Schwarz	Version 10	N/A	N/A	N/A
Boresight Mast Controller	ChamPro	AM-BS-4500-E	E237	N/A	N/A
Turntable with Controller	ChamPro	EM1000	E238	N/A	N/A

General used equipment					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
Digital temperature & humidity data logger	SATO	SK-L200TH II	E232	2022/08/16	2023/08/15
Electronic Digital Thermometer with Hygrometer	nil	2074/2075	E159	2022/08/16	2023/08/15
Barometer with digital thermometer	SATO	7612-00	E218	2023/03/29	2024/03/28
Conditional Chamber	Zhong Zhi Testing Instruments	CZ-E-608D	E216	2022/08/17	2023/08/16

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

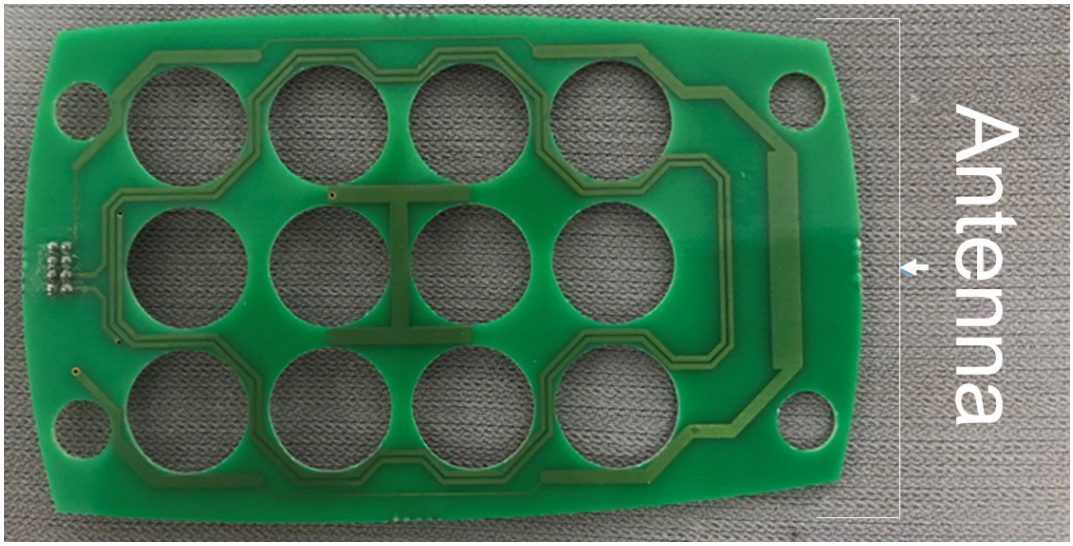
6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203

6.1.2 Conclusion

Standard 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, 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.



EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement.

Antenna location: Refer to internal photo.

7 Radio Spectrum Matter Test Results

7.1 Emission Mask

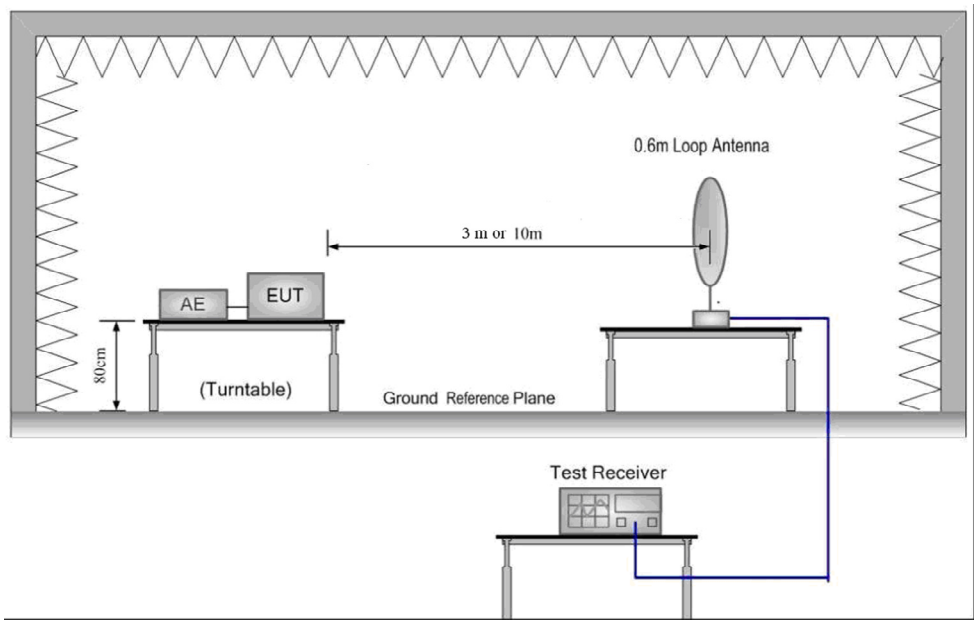
Test Requirement 47 CFR Part 15, Subpart C 15.225 (a)(b)(c)
Test Method: ANSI C63.10 (2013) Section 6.4
Limit:

Frequency range(MHz)	Output power of the intentional radiator(dBµV/m) at 3 m
13.553-13.567	124.0
13.410-13.553	90.5
13.567-13.710	
13.110-13.410	80.5
13.710-14.010	

7.1.1 E.U.T. Operation

Operating Environment:
Temperature: 26.7 °C Humidity: 53.7 % RH
Test mode a: TX mode_Keep the EUT in continuously transmitting mode with ASK modulation

7.1.2 Test Setup Diagram



7.1.3 Measurement Procedure and Data

The detailed test method see: ANSI C63.10 (2013) Section 6.4
The detailed test data see: Appendix 15.225

7.2 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.215
Test Method: ANSI C63.10 (2013) Section 6.9

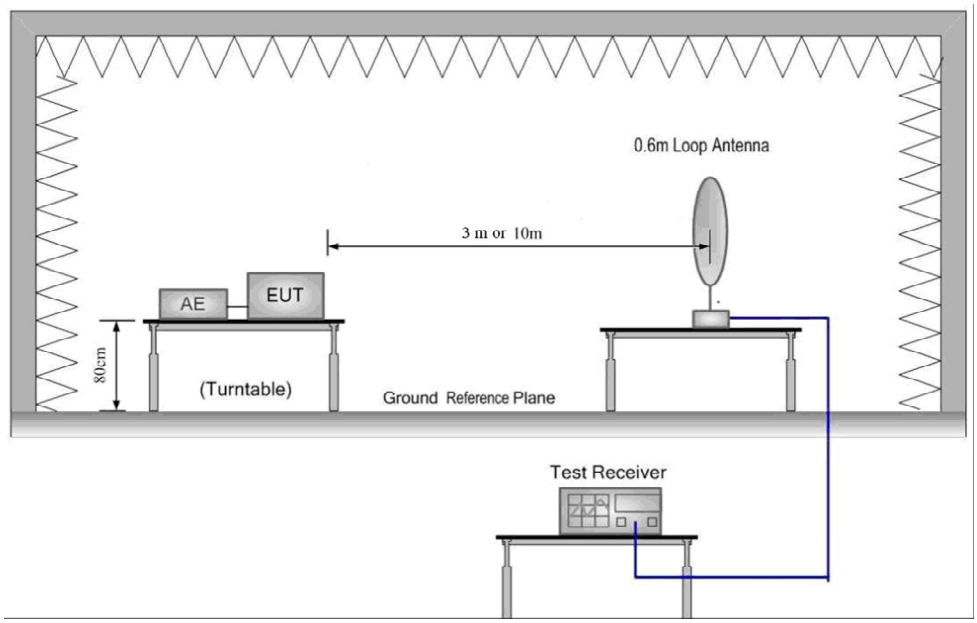
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 26.7 °C Humidity: 53.7 % RH

Test mode a: TX mode_Keep the EUT in continuously transmitting mode with ASK modulation

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

The detailed test method see: ANSI C63.10 (2013) Section 6.9
The detailed test data see: Appendix 15.225

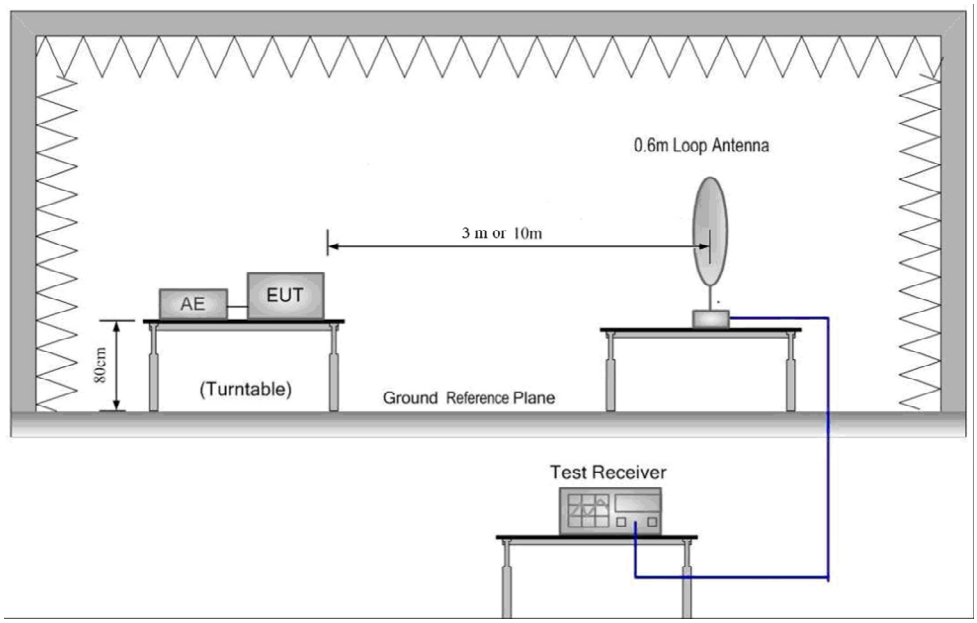
7.3 Frequency Tolerance

Test Requirement 47 CFR Part 15, Subpart C 15.225 (e)
Test Method: ANSI C63.10 (2013) Section 6.8
Limit: ± 0.01 % of operating frequency

7.3.1 E.U.T. Operation

Operating Environment:
Temperature: 26.7 °C Humidity: 53.7 % RH
Test mode a: TX mode_Keep the EUT in continuously transmitting mode with ASK modulation

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

The detailed test method see: ANSI C63.10 (2013) Section 6.8
The detailed test data see: Appendix 15.225

7.4 Radiated Emissions which fall in the restricted bands

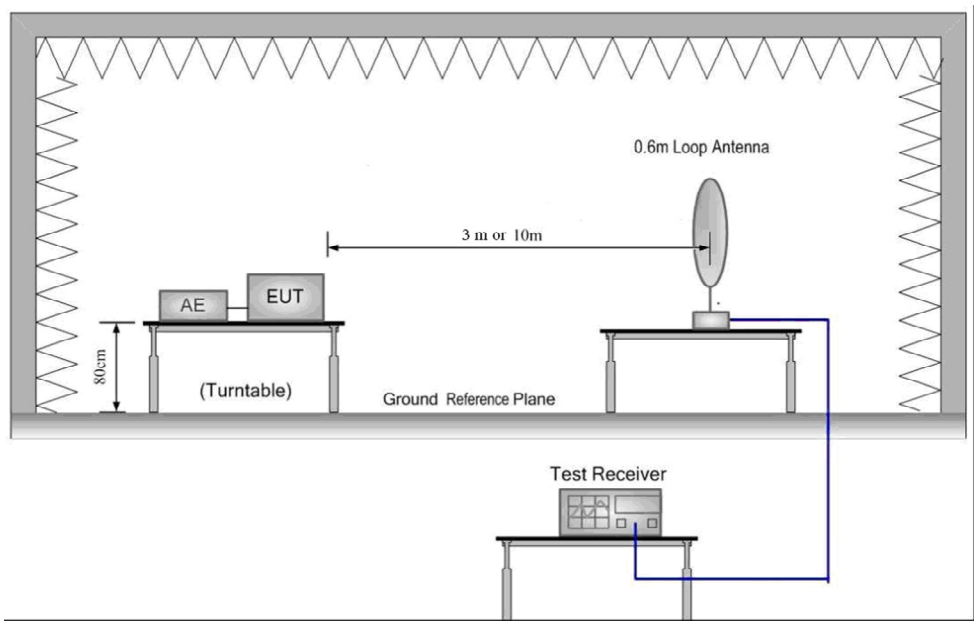
Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209
Test Method: ANSI C63.10 (2013) Section 6.10.5
Measurement Distance: 3m
Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, 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.		

7.4.1 E.U.T. Operation

Operating Environment:
Temperature: 26.7 °C Humidity: 53.8 % RH
Test mode a: TX mode_Keep the EUT in continuously transmitting mode with ASK modulation

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits 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. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Frequency (MHz)	Emission Level (dBµV/m)		Limit (dBµV/m)		Result
	Peak	Average	Peak	Average	
13.410000	37.9	35.7	74.0	54.0	Pass
16.420000	37.1	36.3	74.0	54.0	Pass

7.5 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209
Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6
Measurement Distance: 3m
Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, 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.		

7.5.1 E.U.T. Operation

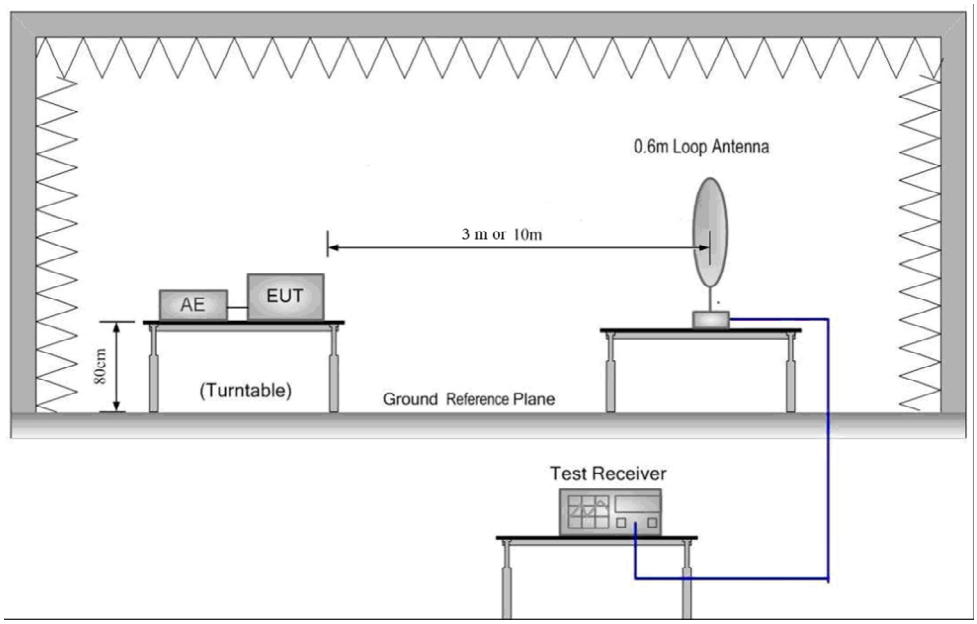
Operating Environment:

Temperature: 26.6 °C Humidity: 52.8 % RH

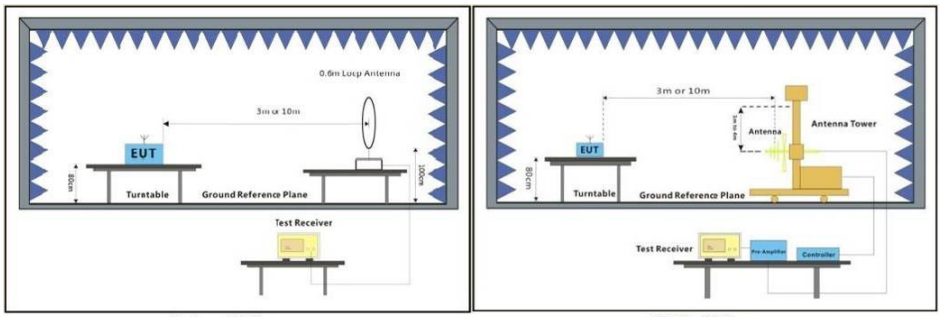
Test a: TX mode_Keep the EUT in continuously transmitting mode with ASK modulation

7.5.2 Test Setup Diagram

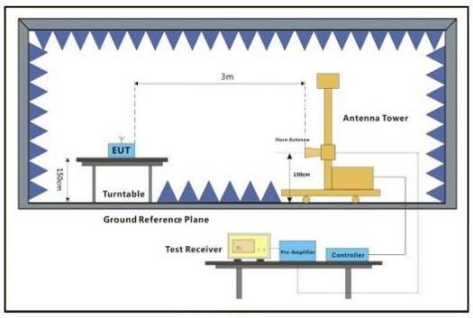
9 kHz – 30 MHz:



30 MHz – 1 GHz:



Below 30MHz 30MHz-1GHz



Above 1GHz

7.5.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark:

1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.

2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

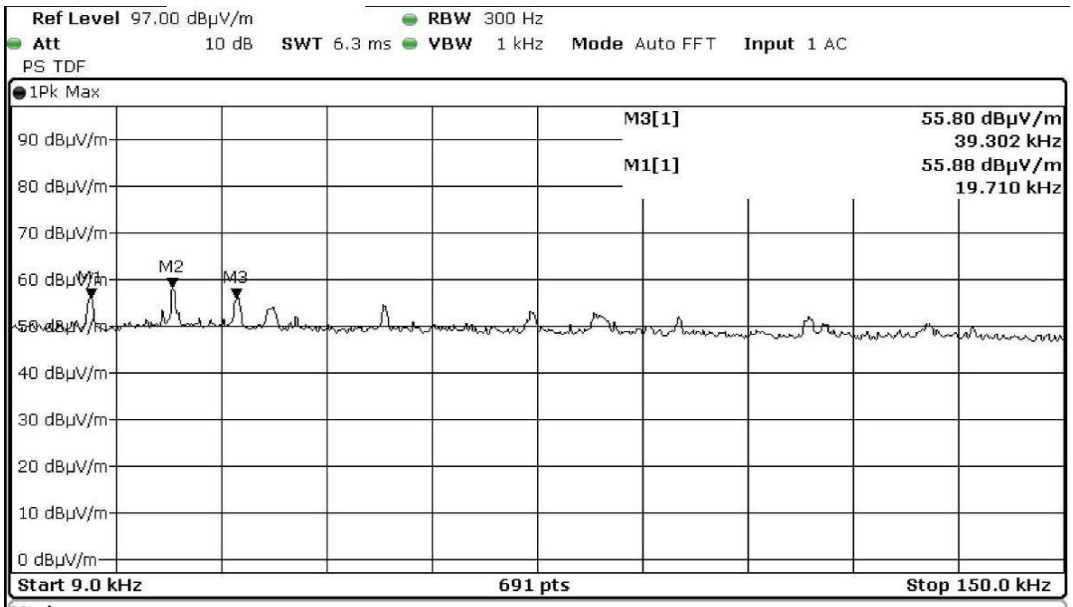
Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

4) For frequencies above 1GHz, the field strength limits 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. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

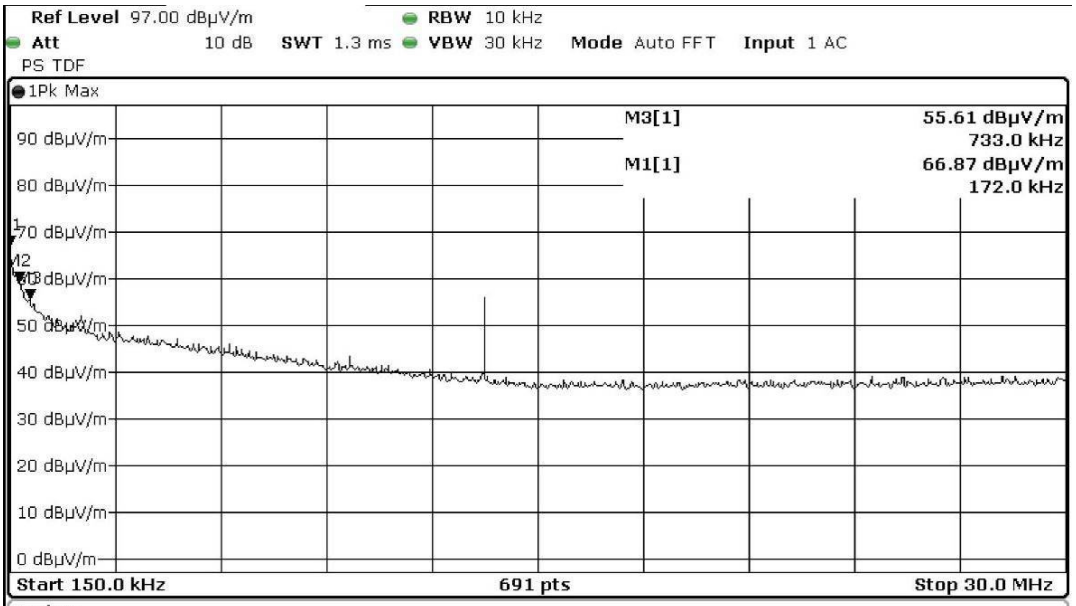
Radiated emission below 30MHz

Mode:a; Modulation:ASK;



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	19.71 kHz	55.88 dBµV/m		
M2		1	30.732 kHz	58.21 dBµV/m		
M3		1	39.302 kHz	55.80 dBµV/m		



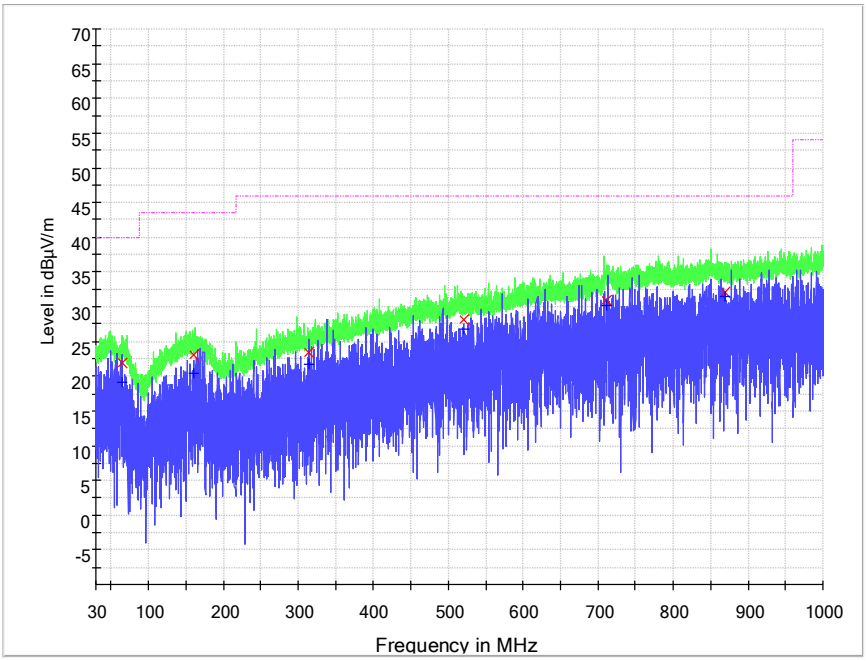
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	172.0 kHz	66.87 dBµV/m		
M2		1	431.0 kHz	59.18 dBµV/m		
M3		1	733.0 kHz	55.61 dBµV/m		

Frequency (MHz)	QuasiPeak (dBµV/m)	Corr. (dBµV/m)	Margin (dB)	Limit (dBµV/m)	Result
0.019710	55.9	19.5	65.8	121.7	Pass
0.030732	58.2	21.6	59.6	117.9	Pass
0.039302	55.8	20.6	59.9	115.7	Pass
0.172000	66.9	19.5	36.0	102.9	Pass
0.431000	59.2	19.9	35.7	94.9	Pass
0.733000	55.6	20.4	14.7	70.3	Pass

Radiated emission above 30MHz

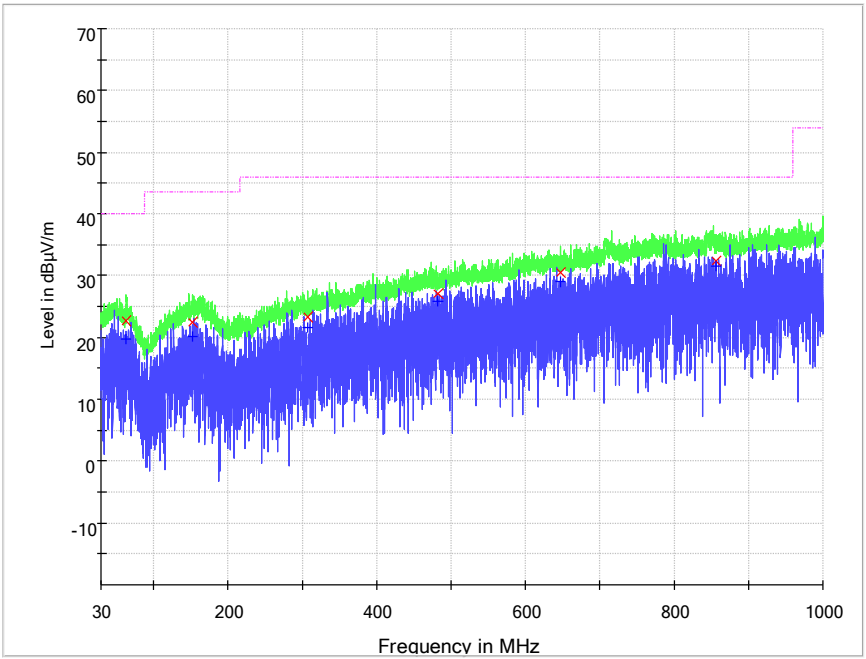
Mode:a; Polarization:Horizontal; Modulation:ASK;



Frequency (MHz)	QuasiPeak (dBµV/m)	Pol.	Corr. (dB/m)	Margin (dB)	Limit (dBµV/m)	Result
65.183929	21.9	H	13.0	18.1	40.0	Pass
160.942857	23.1	H	14.6	20.4	43.5	Pass
314.087500	23.4	H	15.1	22.6	46.0	Pass
521.275000	28.2	H	20.2	17.8	46.0	Pass
711.330357	30.9	H	23.6	15.1	46.0	Pass
869.698214	32.1	H	25.2	13.9	46.0	Pass

Remark: Only the worst case is shown.

Mode:a; Polarization:Vertical; Modulation:ASK;



Frequency (MHz)	QuasiPeak (dBµV/m)	Pol.	Corr. (dB/m)	Margin (dB)	Limit (dBµV/m)	Result
64.000000	22.7	V	13.2	17.3	40.0	Pass
153.142857	22.5	V	14.4	21.0	43.5	Pass
307.401786	23.2	V	14.9	22.8	46.0	Pass
482.275000	27.2	V	19.2	18.8	46.0	Pass
647.189286	30.4	V	22.4	15.6	46.0	Pass
855.908929	32.4	V	25.2	13.6	46.0	Pass

Remark: Only the worst case is shown.

8 Photographs

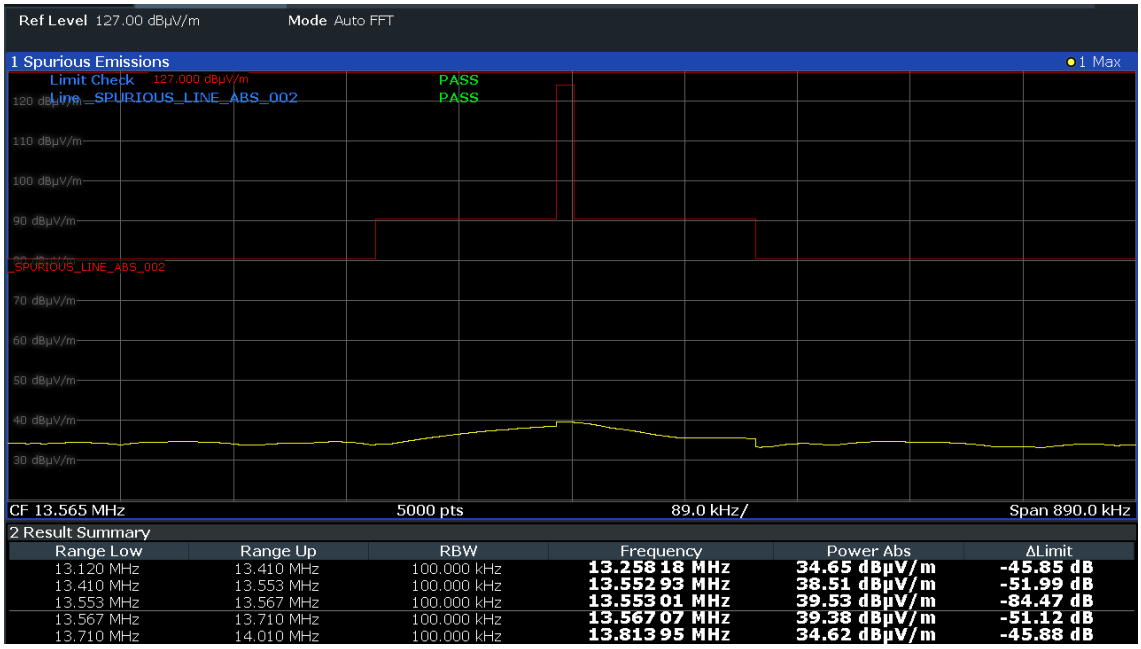
8.1 EUT Constructional Details (EUT Photos)

Refer to the appendices external, internal and setup photos.

9 Appendix 15.225

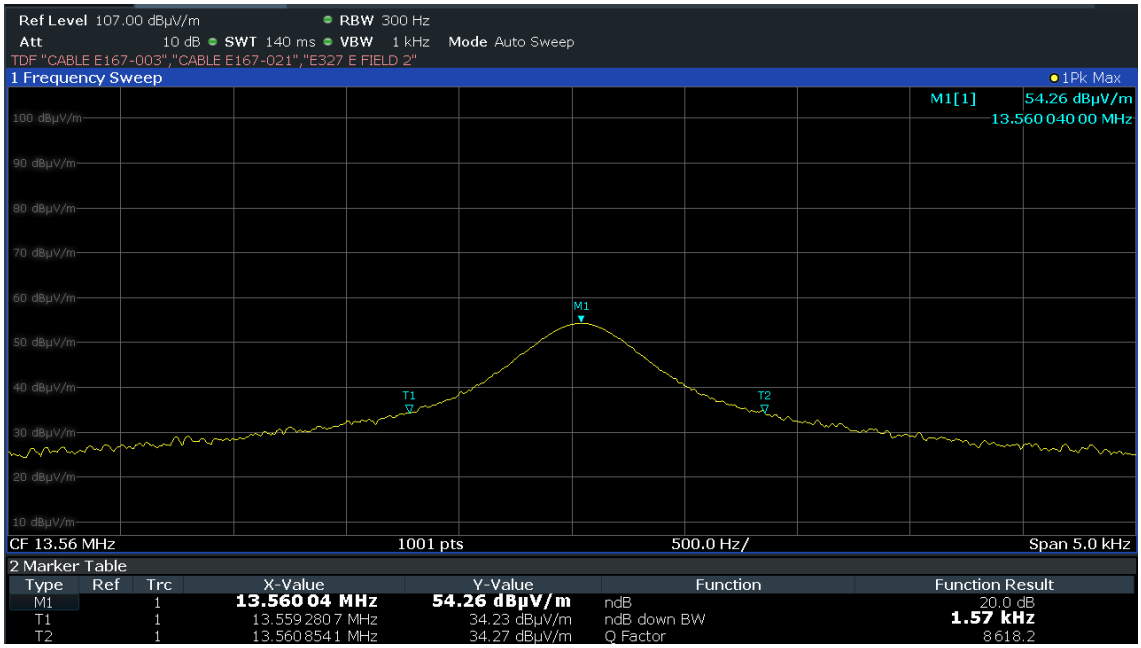
9.1 Emission Mask

Frequency (MHz)	Peak Power (dBµV/m)	Limit (dBµV/m)	Result
13.560000	39.5	124.0	PASS



9.2 20dB Bandwidth

Frequency (MHz)	Bandwidth (MHz)	Limit (MHz)	Result
13.560000	0.001570	---	PASS



Remark: Operation within the band 13.110 –14.010 MHz

9.3 Frequency Tolerance

Temperature (˚C)	Voltage (V DC)	Frequency (MHz)	Frequency Tolerance (%)	Limit (%)	Result
50	6	13.561017	0.008	± 0.01	PASS
40		13.560610	0.005	± 0.01	PASS
30		13.561003	0.007	± 0.01	PASS
20		13.561112	0.008	± 0.01	PASS
10		13.559783	-0.002	± 0.01	PASS
0		13.561058	0.008	± 0.01	PASS
-10		13.560298	0.002	± 0.01	PASS
-20		13.561017	0.008	± 0.01	PASS
20	6.9	13.559173	-0.006	± 0.01	PASS
	5.1	13.559688	-0.002	± 0.01	PASS

- End of the Report -