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TEST REPORT

Eurofins KCTL Co.,Ltd.
65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Korea
TEL: 82-31-285-0894 FAX: 82-505-299-8311
www.kctl.co.kr

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1. Client

- Name : TYMICT
- Address : 222-12, Sangseo-ri, Useong-myon, Gongju-si, Chungcheongnam-do, Republic of Korea
- Date of Receipt : 2022-12-05

2. Use of Report : Certification

3. Name of Product / Model : TBOX / TBX2

4. Manufacturer / Country of Origin : TYMICT / Korea

5. FCC ID : 2A9Q6-TBX2

6. IC Certificate No. : 29802-TBX2

7. Date of Test : 2022-12-26 to 2022-12-28

8. Location of Test : ■ Permanent Testing Lab ☐ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

9. Test method used : FCC Part 2 / RSS-Gen Issue 5
FCC Part 90 subpart R / RSS-140 Issue 1

10.Test Result : Refer to the test result in the test report

Affirmation	Tested by Name : Hosung Lee (Signature)	Technical Manager Name : Heesu Ahn (Signature)

2023-02-14

Eurofins KCTL Co.,Ltd.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by Eurofins KCTL Co.,Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2023-01-26	Originally issued	-
2023-02-14	Updated	1, 4, 6, 9, 13

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Note. The report No. KR23-SRF0052 is superseded by the report No. KR23-SRF0052-A.

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

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1. General information

Client	:	TYMICT
Address	:	222-12, Sangseo-ri, Useong-myon, Gongju-si, Chungcheongnam-do, Republic of Korea
Manufacturer	:	TYMICT
Address	:	222-12, Sangseo-ri, Useong-myon, Gongju-si, Chungcheongnam-do, Republic of Korea
Laboratory	:	Eurofins KCTL Co.,Ltd.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132
		VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
		CAB Identifier: KR0040
		ISED Number: 8035A
		KOLAS No.: KT231

2. Device information

Equipment under test	:	TBOX
Model	:	TBX2
Modulation technique	:	LTE_QPSK, 16QAM
Power source	:	DC 12.00 V
Antenna specification	:	LTE_Chip Antenna
Frequency range	:	LTE Band 2_1 850.7 ㎒ ~ 1 909.3 ㎒
		LTE Band 4_1 710.7 ㎒ ~ 1 754.3 ㎒
		LTE Band 5_824.7 ㎒ ~ 848.3 ㎒
		LTE Band 12_699.7 ㎒ ~ 715.3 ㎒
		LTE Band 13_779.5 ㎒ ~ 784.5 ㎒
		LTE Band 14_790.5 ㎒ ~ 800.5 ㎒
		LTE Band 66_1 710.7 ㎒ ~ 1 779.3 ㎒
		LTE Band 71_665.5 ㎒ ~ 695.5 ㎒
Software version	:	V109
Hardware version	:	V106
Operation temperature	:	-10 ℃ ~ 50 ℃
Test device serial No.	:	T101224800020002

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source	FCC ID & IC
-	-	-	-	-	-

2.2. Frequency/channel operations

This device contains the following capabilities:
LTE Band (2, 4, 5, 12, 13, 14, 66, 71)

LTE Band 14

Ch.	Frequency (MHz)
23305	790.5
23330	793.0
23355	795.5

Table 2.1.2. 5 M BW

Ch.	Frequency (MHz)
23330	793.0

Table 2.1.4. 10M BW

3. Maximum ERP/EIRP power

LTE Band 14

Mode	Tx frequency (MHz)	Emission designator	ERP	
			Max. power (dBm)	Max. power (W)
LTE Band 14	790.5 ~ 795.5	4M53G7D	24.59	0.288
		4M54W7D	23.58	0.228
	793.0	9M02G7D	**25.04**	**0.319**
		9M03W7D	23.59	0.229

4. Summary of tests

FCC Part section(s)	RSS Section(s)	Parameter	Test Limit	Test Condition	Test results
2.1046 90.635	RSS-140(4.3)	Conducted Output Power	N/A	Conducted	N/T[1)]
2.1049	RSS-Gen(6.7)	Occupied Bandwidth & 26 dB Bandwidth	N/A		N/T[1)]
2.1051 90.543(e)	RSS-140(4.4)	Band Edge Emissions at Antenna Terminal	<43 + 10Log$_{10}$(P) dB for all out of band emissions, <65 + 10Log$_{10}$(P) dB		N/T[1)]
		Spurious Emissions at Antenna Terminal			N/T[1)]
2.1055 90.539	RSS-140(4.3)	Peak to Average Power Ratio	< 13 dB		N/T[1)]
22.542(a)(7)	RSS-140(4.2)	Frequency stability	< 2.5 ppm		N/T[1)]
2.1053 90.543(e)	RSS-140(4.3)	Effective Radiated Power	< 3 Watts max. ERP	Radiated	Pass
2.1046 90.635	RSS-140(4.4)	Radiated Spurious Emissions	<43 + 10Log$_{10}$(P) dB		Pass

Notes:

1. These test items were performed by the certified module. (FCC ID: XMR201808EC25AF, Test Report No. R1806A0301-R4V1 issued on July 31, 2018 by TA Technology (Shanghai) Co., Ltd.)
2. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.26-2015
   - ANSI/TIA-603-E-2016
   - KDB 971168 D01 v03r01

4.1. Worst case orientation

1. All modes of operation were investigated and the worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations in the test data.
2. All final radiated testing was performed with the EUT in worst case orientation.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **Y** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **Y** orientation.

Test condition	LTE Band	Modulation	Bandwidth (MHz)	RB size	RB offset
Radiated	B14	QPSK	10	1	0, 25, 49

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014.

All measurement uncertainty values are shown with a coverage factor of *k*=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

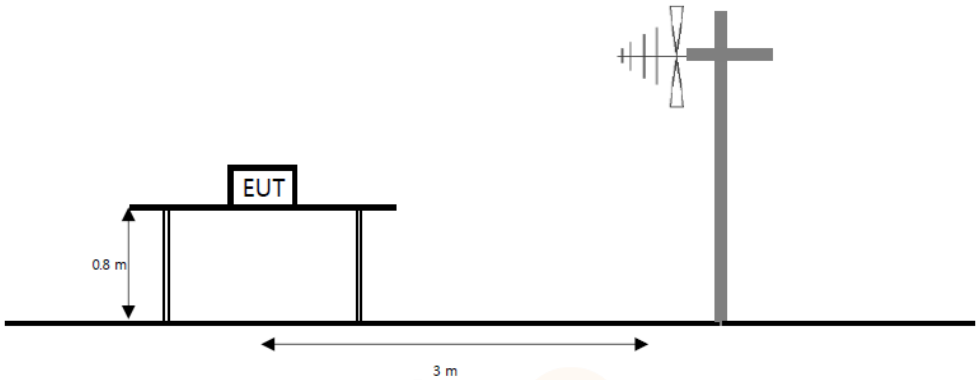
Parameter	Expanded uncertainty (±)	
Conducted RF power	0.9 dB	
Conducted spurious emissions	1.1 dB	
Radiated spurious emissions	Below 1 000 MHz	4.3 dB
	1 000 MHz ~ 18 000 MHz	3.8 dB
	Above 1 8000 MHz	5.9 dB

6. Test results

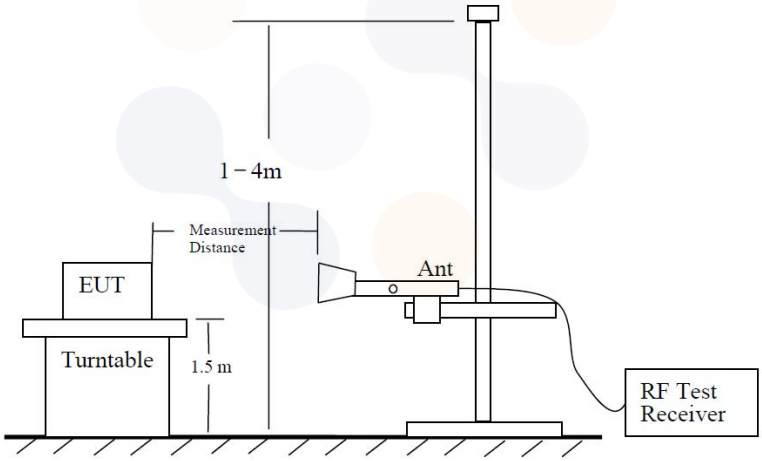
6.1. Radiated Power (ERP/EIRP)

Test setup

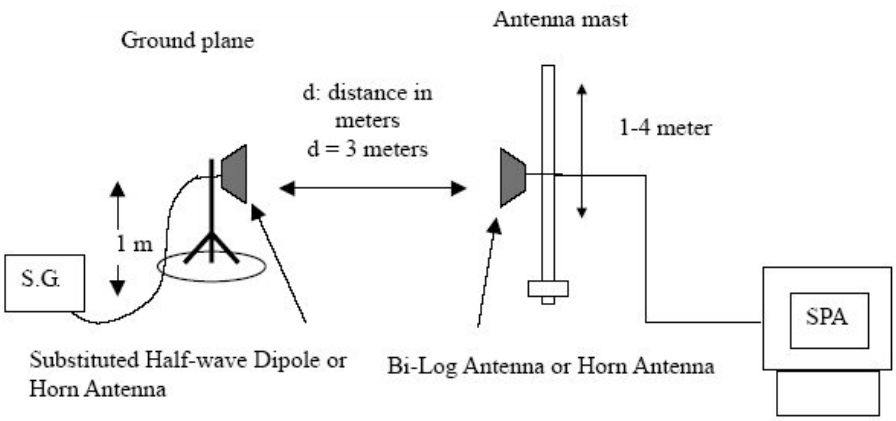
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



Limit

According to §90.542(7) and RSS-140(4.3), Portable stations (hand-held devices) transmitting in the 758-768 ㎒ band and the 788-798 ㎒ band are limited to 3 watts ERP.

Test procedure

971168 D01 v03r01 - Section 5.2 and 5.8
ANSI 63.26-2015 – Section 5.2
ANSI/TIA-603-E-2016 - Section 2.2.17

Test settings

1) RBW = 1 % to 5 % of the OBW.
2) VBW ≥ 3 × RBW.
3) SPAN = 2 × to 3 × the OBW.
4) Number of measurement points in sweep ≥ 2 × span / RBW.
5) Sweep time :
   1) Auto couple, or
   2) ≥ [10 × (number of points in sweep) × (transmission period)] for single sweep (automation-compatible) measurement. Transmission period is the on and off time of the transmitter.
6) Detector = RMS
7) If the EUT can be configured to transmit continuously, then set the trigger to free run.
8) If the EUT cannot be configured to transmit continuously, then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Verify that the sweep time is less than or equal to the transmission burst duration. Time gating can also be used under similar constraints (i.e., configured such that measurement data is collected only during active full -power transmissions).
9) Trace mode = trace averaging (RMS) over 100 sweeps.
10) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
11) Allow trace to fully stabilize.

Notes:

1. On a test site, the EUT shall be placed at 80 cm or 1.5 m height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to Correspond to the fundamental frequency of the transmitter.
3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the Level of the maximized emission.
4. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
5. The maximum signal level detected by the measuring receiver shall be noted.
6. The EUT was replaced by half-wave dipole (1 ㎓ below) or horn antenna (1 ㎓ above) connected to a signal generator.
   The power is calculated by the following formula;
   Pd(㏈m) = Pg(㏈m) – Cable loss (㏈) + Antenna gain (㏈)
   Note. Pd is the dipole equivalent power and Pg is the generator output power into the substitution antenna.
7. The test antenna shall be raised and lowered through the specified range of height to ensure that The maximum signal is received.
8. The input signal to the substitution antenna shall be adjusted to the level that produces a level Detected by the measuring corrected for the change of input attenuator setting of the measuring Receiver.
9. The input level to the substitution antenna shall be recorded as power level in ㏈m, corrected for Any change of input attenuator setting of the measuring receiver.
10. The measurement shall be repeated with the test antenna and the substitution antenna Orientated for horizontal polarization.

Test results

Test mode: LTE Band 14

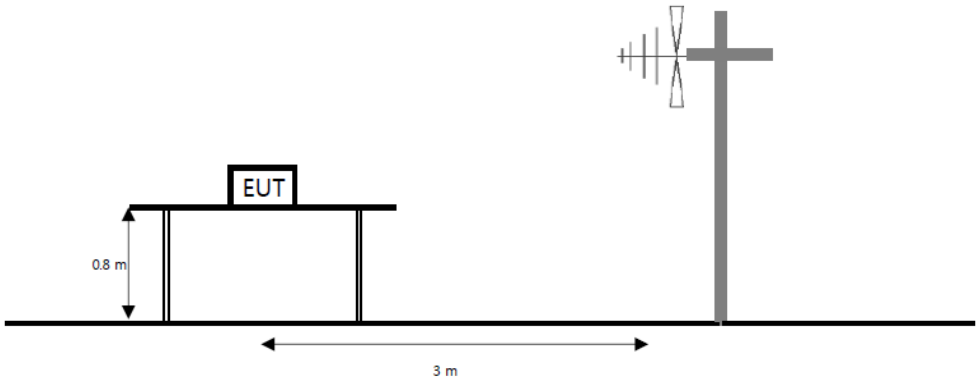
Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	ERP	
		[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[W]
5 M	QPSK	790.5	V	0.42	4.73	28.78	24.47	0.280
		793.0	V	0.52	4.75	28.63	24.40	0.275
		795.5	V	0.62	4.75	28.72	24.59	0.288
	16QAM	790.5	V	0.42	4.73	27.77	23.46	0.222
		793.0	V	0.52	4.75	27.42	23.19	0.208
		795.5	V	0.62	4.75	27.71	23.58	0.228
10 M	QPSK	793.0	V	0.52	4.75	29.27	25.04	0.319
	16QAM	793.0	V	0.52	4.75	27.82	23.59	0.229

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈i&㏈d) - C.L(Cable loss) (㏈)

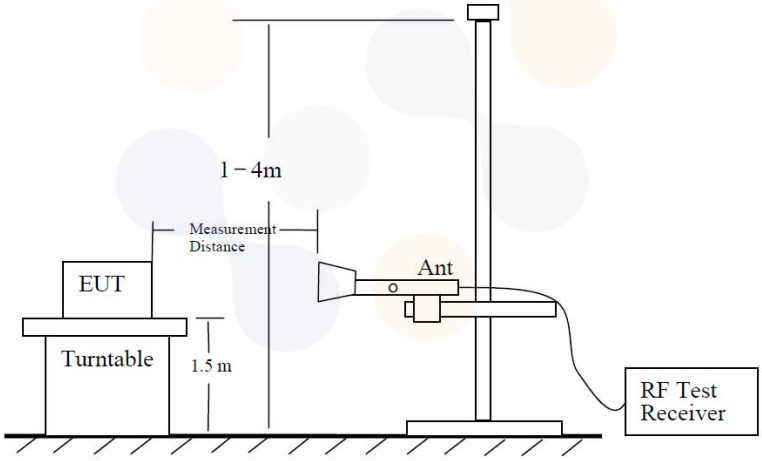
6.2. Radiated Spurious Emissions

Test setup

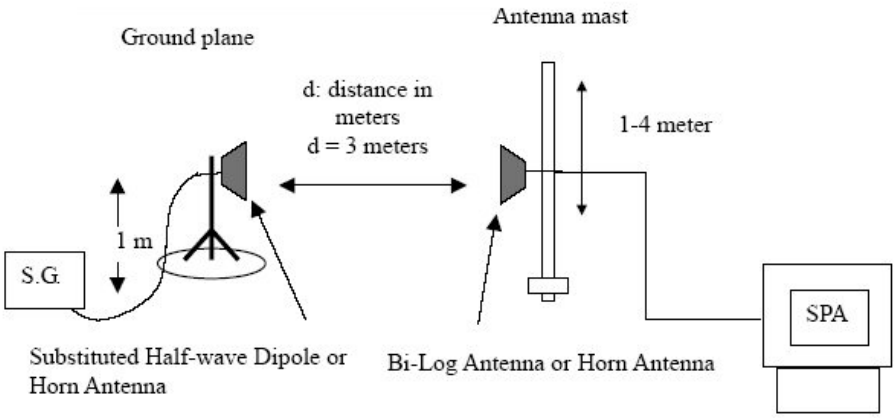
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



Limit

According to §90.543(e) and RSS-140(4.4), For operations in the 758-768 ㎒ and the 788-798 ㎒ bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 ㎒ and 799-805 ㎒, by a factor not less than 76 + 10 log (P) ㏈ in a 6.25 ㎑ band segment, for base and fixed stations.
(2) On all frequencies between 769-775 ㎒ and 799-805 ㎒, by a factor not less than 65 + 10 log (P) ㏈ in a 6.25 ㎑ band segment, for mobile and portable stations.
(3) On any frequency between 775-788 ㎒, above 805 ㎒, and below 758 ㎒, by at least 43 + 10 log (P) ㏈.
(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 ㎑ segment.
(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 ㎑ or greater. However, in the 100 ㎑ bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 ㎑ may be employed.

According to §90.543(f) and RSS-140(4.4), For operations in the 758-775 ㎒ and 788-805 ㎒ bands, all emissions including harmonics in the band 1559-1610 ㎒ shall be limited to −70 ㏈W/㎒ equivalent isotropically radiated power (EIRP) for wideband signals, and −80 ㏈W EIRP for discrete emissions of less than 700 ㎐ bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Test procedure

971168 D01 v03r01 - Section 6.2
ANSI 63.26-2015 – Section 5.5
ANSI/TIA-603-E-2016 - Section 2.2.12

Test settings

1) RBW = 1 ㎑ for below 1 ㎓ and 1 ㎒ for above 1 ㎓.
2) VBW ≥ 3 × RBW.
3) Detector = RMS
4) Trace mode = Max hold
5) Sweep time = Auto couple
6) Number of sweep points ≥ 2 × span / RBW
7) Allow trace to fully stabilize.

Notes:

1. On a test site, the EUT shall be placed at 80 cm or 1.5 m height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to correspond to the fundamental frequency of the transmitter.
3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the level of the maximized emission.
4. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
5. The maximum signal level detected by the measuring receiver shall be noted.
6. The EUT was replaced by half-wave dipole (1 GHz below) or horn antenna (1 GHz above) connected to a signal generator.
7. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
8. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring corrected for the change of input attenuator setting of the measuring receiver.
9. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
10. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

Test results (Above 1 000 ㎒)

Test mode : LTE Band 14
Frequency(㎒) : 793
Channel : 23330
Bandwidth(㎒) : 10

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 577.20	V	5.78	6.52	-56.06	-56.80	-40.00	16.80
	2 365.60	V	5.70	8.10	-47.20	-49.60	-13.00	36.60
	3 154.80	V	7.41	9.80	-55.81	-58.20	-13.00	45.20
	3 942.80	V	8.81	11.33	-56.28	-58.80	-13.00	45.80

Test mode : LTE Band 14
Frequency(㎒) : 793(1 559 – 1 610 ㎒)
Channel : 23330
Bandwidth(㎒) : 10

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 577.09	V	5.78	6.52	-51.96	-52.70	-40.00	12.70

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈i&㏈d) - C.L(Cable loss) (㏈)

7. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Bilog Antenna	Teseq GmbH	CBL 6143A	35039	23.05.12
Bilog Antenna	ETS.LINDGREN	'3143B	00228420	23.09.28
Horn Antenna	ETS.LINDGREN	3117	161225	23.05.04
Horn Antenna	ETS.LINDGREN	3117	00227509	23.09.20
Horn Antenna	ETS.lindgren	3116	00086632	23.01.25
Horn Antenna	Steatite Antennas	QMS-00225	17790	23.07.14
Horn Antenna	Steatite Antennas	QMS-00238	17791	23.07.14
High Pass Filter	Wainwright Instruments GmbH	WHKX10-900-1000-15000-40SS	11	23.08.10
High Pass Filter	Wainwright Instruments GmbH	WHKX12-2805-3000-18000-40SS	32	23.08.10
Broadband Amplifier	SONOMA INSTRUMENT	315	300314	23.01.19
Low Noise Amplifier	TESTEK	TK-PA18H	220123-L	23.12.02
DC Power Supply	AGILENT	E3632A	MY40006352	23.05.02
Signal Generator	R&S	SMB100A	176206	23.01.19
Spectrum Analyzer	AGILENT	N9040B	MY57010132	23.10.14
Widebnad Radio Communication Tester	R & S	CMW500	141780	23.03.28
Antenna Stand	innco systems GmbH	AS1500-EP-10kg	N/A	-
Antenna Stand	innco systems GmbH	AS1500-EP-10kg	N/A	-
Compact Table	innco systems GmbH	CT1000	N/A	-
Cable Assembly	Radiall	R286303620	1649.241	-
Cable Assembly	Radiall	TESTPRO 3	-	-

End of test report