

TEST REPORT

Euro 65, Sir Suwon-si, TEL: 82-70-500	f ins KC won-ro, Y Gyeonggi- 08-1021 F www.kctl	FL Co.,Ltd. ′eongtong-gu, ·do, 16677, Korea FAX: 82-505-299-8311 I.co.kr	Rep KR24- Page (ort No.: SRF0130 1) of (16)	CTL	
1. Client			1			
∘ Name		: TYMICT				
 Addres 	• Address : 222-12, Sangseo-ri, Useong-myon, Gongju-si, Chungcheongnam-do,					
		Republic of Korea	a			
∘ Date of	Receip	ot : 2024-08-23				
2. Use of Re	port	: Certification				
3. Name of P	roduct	/ Model : TB	OX / TBX4			
4. Manufactu	urer / Co	ountry of Origin : TY	MICT / Ko	rea		
5. FCC ID		: 2A9Q6-TBX4				
6 IC Certific	ate No	· 29802-TBX4				
7. Date of Te	est	: 2024-09-09 to 2	024-09-13			
8. Location of	of Test	: ■ Permanent Testi	ng Lab	On Site T	esting	
		(Address:65, Sinwo	n-ro, Yeong	tong-gu, Suwor	n-si, Gyeonggi-do, 16677, Korea)	
9. Test meth 10. Test Res	od use ult	d : FCC Part 2 / RS FCC Part 90 sub : Refer to the test	S-Gen Iss opart R / F resul <mark>t in t</mark>	ue 5 SS-140 Issu he test repor	e 1 t	
	Testec	l by		Technical Ma	anager	
Affirmation					OFE	
	Name	: Hosung Lee	gnature)	Name : Hees	su Ahn 🦂 (Signature)	
		0			2024-09-30	
					20210000	
Eurotins KCIL Co.,Ltd.						
As a test result of the sample which was submitted from the client, this report does not guara ntee the whole product quality. This test report should not be used and copied without a written agreement by Eurofins KCTL Co.,Ltd.						

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr Report No.: KR24-SRF0130 Page (2) of (16)



KCTL

REPORT REVISION HISTORY

Date	Revision	Page No
2024-09-30	Originally issued	-

This report shall not be reproduced except in full, without the written approval of Eurofins KCTL Co.,Ltd. This document may be altered or revised by Eurofins KCTL Co.,Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by Eurofins KCTL Co.,Ltd. will constitute fraud and shall nullify the document. This test report is a general report that does not use the KOLAS accreditation mark and is not related to KS Q ISO/IEC 17025 and KOLAS accreditation.

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

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr

Report No.: KR24-SRF0130 Page (3) of (16)



KCTL

CONTENTS

1.	General information	4
2.	Device information	4
2.1	. Accessory information	5
2.2	P. Frequency/channel operations	5
2.3	8. RF power setting in TEST SW	5
3.	Maximum ERP/EIRP power	5
4.	Summary of tests	6
4.1	. Worst case orientation	6
5.	Measurement uncertainty	7
6.	Test results	8
6.1	. Radiated Power (ERP/EIRP)	8
6.2	2. Radiated Sp <mark>urious Emi</mark> ssions	12
7.	Measurement equipment	16

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr Report No.: KR24-SRF0130 Page (4) of (16)



KCTL

1. General information

Client	:	ТҮМІСТ				
Address	:	222-12, Sangseo-ri, Useong-myon, Gongju-si, Chungcheongnam-do, Republic of Korea				
Manufacturer	:	ТҮМІСТ				
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	: TBX4
Modulation technique	: LTE_QPSK, 16QAM
Power source	: DC 12 V
Antenna specification	: LTE_Chip Antenna
Frequency range	: LTE Band 2_1 850.7 Mtz ~ 1 909.3 Mtz
	LTE Band 4_1 710.7 Mb ~ 1 754.3 Mb
	LTE Band 5_824.7 Mz ~ 848.3 Mz
	LTE Band 12_699.7 啦 ~ 715.3 🕸
	LTE Band 13_779.5 <u>№</u> ~ 784.5 №
	LTE Band 14_790.5 <mark>№ ~ 800.5</mark> №
	LTE Band 66_1 710.7 № ~1 779.3 №
	LTE Band 71_665.5 Mz ~ 695.5 Mz
Software version	: V201
Hardware version	: V303
Operation temperature	: -30 °C ~85 °C
Test device serial No.	: T202243500040004

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr

Report No.: KR24-SRF0130 Page (5) of (16)



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)

		Sar
Ch.	Frequency (畑)	
23305	790.50	
23330	793.00	
23355	795.50	

Table 2.2.1. 5M BW

LTE Band 14

Ch.

-

23330

Table 2.2.2. 10M BW

Frequency

(MHz)

_

793.0

2.3. RF power setting in TEST SW

Mada	Frequency	DE Dewer eetting value	Test Coffware				
wode	[MHz]	RF Power setting value	Test Software				
	790.50						
Band 14	793.00	Default	-				
	795.50						

3. Maximum ERP/EIRP power

LTE Band 14

Mada	Tx frequency (MHz)	Emission	ERP		
wode		design <mark>ator</mark>	Max. power (dBm)	Max. power (W)	
LTE Band 14	790.5 ~ 795.5	4M50G7D	24.57	0.287	
		4M54W7D	23.76	0.238	
	702.0	9M03G7D	24.71	0.296	
	793.0	9M03W7D	23.62	0.230	

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr Report No.: KR24-SRF0130 Page (6) of (16)



KCTL

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		N/T ¹⁾
2.1049	RSS-Gen(6.7)	Occupied Bandwidth & 26 dB Bandwidth	N/A	Conducted	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		N/T ¹⁾
		Spurious Emissions at Antenna Terminal	missions at emissions, Terminal <65 + 10Log ₁₀ (P) dB		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	Padiated	Pass
2.1046 90.635	RSS-140(4.4)	Radiated Spurious Emissions	<43 + 10Log10(P) dB	Naulateu	Pass

Notes:

1. These test items were performed by the certified module. (FCC ID: XMR201808EC25AF, IC: 10224A-2018EC25AF)

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 (∰)	RB size	RB offset
Radiated	B14	QPSK	10	1	0, 25, 49

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 <u>www.kctl.co.kr</u> Report No.: KR24-SRF0130 Page (7) of (16)





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	1.9 dB			
	Below 1 000 Mz	2.5 dB		
Radiated spurious emissions	1 000 MHz ~ 18 000 MHz	2.5 dB		
	Above 1 8000 Mz	2.6 dB		



Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr

Report No.: KR24-SRF0130 Page (8) of (16)



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 Mz to 1 Gz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 $\mathbb{G}_{\mathbb{Z}}$ to the tenth harmonic of the highest fundamental frequency or to 40 $\mathbb{G}_{\mathbb{Z}}$ emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 <u>www.kctl.co.kr</u>



<u>Limit</u>

According to §90.542(7) and RSS-140(4.3), Portable stations (hand-held devices) transmitting in the 758-768 Mz band and the 788-798 Mz 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 \geq 3 × RBW.
- 3) SPAN = $2 \times \text{to } 3 \times \text{the OBW}$.
- 4) Number of measurement points in sweep $\geq 2 \times \text{span} / \text{RBW}$.
- 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.

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu,

Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 <u>www.kctl.co.kr</u>

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.

The power is calculated by the following formula;

Pd(dBm) = Pg(dBm) – Cable loss (dB) + Antenna gain (dB)

- 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 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.

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr Report No.: KR24-SRF0130 Page (11) of (16)



KCTL

Test results

Test mode: LTE Band 14

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	ERP	
		[MHz]	[V/H]	[dBd]	[dB]	[dB m]	[dB m]	[W]
5 M	QPSK	790.50	Н	3.15	5.90	27.32	24.57	0.287
		793.00	Н	3.15	5.92	27.09	24.32	0.271
		795.50	Н	3.15	5.91	26.97	24.21	0.263
	16QAM	790.50	Н	3.15	5.90	26.51	23.76	0.238
		793.00	Н	3.15	5.92	26.08	23.31	0.214
		795.50	Н	3.15	5.91	26.11	23.35	0.216
10 M	QPSK	793.00	Н	3.15	5.92	27.48	24.71	0.296
	16QAM	793.00	H	3.15	5.92	26.39	23.62	0.230

Note.

1. E.R.P & E.I.R.P(dBm) = Substitute Level(dB) + Antenna gain(dBi&dBd) - C.L(Cable loss) (dB)

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr



6.2. Radiated Spurious Emissions <u>Test setup</u>

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



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 $\mathbb{G}_{\mathbb{Z}}$ to the tenth harmonic of the highest fundamental frequency or to 40 $\mathbb{G}_{\mathbb{Z}}$ emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



🔅 eurofins

<u>Limit</u>

According to \$90.543(e) and RSS-140(4.4), For operations in the 758-768 Mb and the 788-798 Mb 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 Mz and 799-805 Mz, by a factor not less than 76 + 10 log (P) dB in a 6.25 Mz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 Mb and 799-805 Mb, by a factor not less than 65 + 10 log (P) dB in a 6.25 kb band segment, for mobile and portable stations.

(3) On any frequency between 775-788 Mz, above 805 Mz, and below 758 Mz, by at least 43 + 10 log (P) dB.

(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 km 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 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

According to §90.543(f) and RSS-140(4.4), For operations in the 758-775 ML and 788-805 ML bands, all emissions including harmonics in the band 1559-1610 ML shall be limited to -70 dBW/ML equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz 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

<u>Test settings</u>

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

Eurofins KCTL Co.,Ltd. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea

TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr

KCTL

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.

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr



KCTL

Test results (Above 1 000 Mb)

<u>Test mode</u>	: LTE Band 14	1
Frequency(Mb)	: <u>793.0</u>	
<u>Channel</u>	: <u>23330</u>	
Bandwidth(Mb)	: <u>10</u>	

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 594.49	V	5.92	8.47	-51.45	-54.00	-40.00	14.00
	2 392.48	Н	5.72	10.51	-40.41	-45.20	-13.00	32.20
	3 190.88	Н	7.68	12.24	-38.24	-42.80	-13.00	29.80
	3 990.92	Н	9.18	13.97	-34.91	-39.70	-13.00	26.70

: LTE Band 14

Frequency(Mb) : <u>793.0 (1 559 – 1 610 Mtz)</u>

<u>Channel</u> : 23330

Bandwidth(Mtz) : 10

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[MHz]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 594.78	Н	5.92	8.47	-53.35	-55.90	-40.00	15.90

Note.

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

65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-70-5008-1021 FAX: 82-505-299-8311 www.kctl.co.kr Report No.: KR24-SRF0130 Page (16) of (16)



KCTL

7. Measurement equipment									
Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date					
Spectrum Analyzer	Agilent	N9040B	US55230151	25.07.01					
Wideband Radio Communication Tester	R&S	S CMW500		25.01.18					
Bilog Antenna	Teseq GmbH	q GmbH CBL 6112D		24.11.17					
Bilog Antenna	ETS-LINDGREN	3143B	00228420	25.07.20					
Horn Antenna	ETS-LINDGREN	3117	00251528	25.01.26					
Horn Antenna	ETS-LINDGREN	3117	00227509	25.06.28					
Horn Antenna	ETS-LINDGREN	3116C	00251516	25.02.01					
Horn Antenna	ETS-LINDGREN	3116	00086635	25.01.25					
Amplifier	SONOMA INSTRUMENT	310N	421822	24.10.12					
Amplifier	B&Z Technologies	BZRT-00504000- 481055-382525	26299-27735	25.06.24					
Amplifier	B&Z Technologies	BZR-0050400- 551028-252525	27736	25.06.24					
High pass Filter	Wainwright Instruments GmbH	WHKX3.0/18G-12SS	44	25.01.18					
Signal Generator	R&S	SMB100A	176206	25.01.18					
High pass Filter	Wainwright Instruments GmbH	WHKX1.0/15G-10SS	14	25.01.18					

End of test report