TEST REPORT

DT&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2009-0297(1)

2. Customer

- Name : DASAN Networks, Inc.
- Address : DASAN Tower, 49, Daewangpangyo-ro644Beon-gil, Bundang-gu, Seongnam-si, South Korea 13493

3. Use of Report : FCC Certification

4. Product Name / Model Name : Vehicle Control Terminal / TMS3.0 (300611-01930)
FCC ID : 2AXDMTMS30DUALTYPEB

5. FCC Regulation(s): Part 2, 22(H), 90
Test Method Used : KDB971168 D01v03r01, ANSI C63.26-2015, ANSI/TIA-603-E-2016

6. Date of Test : 2020.07.16 ~ 2020.09.21

7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing

8. Testing Environment : Refer to appended test report.

9. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by Name : JaeHyeok Bang (Signature)	Reviewed by Name : JaeJin Lee (Signature)

2020 . 10. 22.

DT&C Co., Ltd.

Unconnected with KS Q ISO / IEC 17025 and KOLAS accreditation.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2009-0297	Sep. 23, 2020	Initial issue	JaeHyeok Bang	JaeJin Lee
DRTFCC2009-0297(1)	Oct. 22, 2020	Update the FCC ID	JaeHyeok Bang	JaeJin Lee

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1. GENERAL INFORMATION

Applicant Name : DASAN Networks, Inc.

Address : DASAN Tower, 49, Daewangpangyo-ro644Beon-gil, Bundang-gu, Seongnam South Korea 13493

FCC ID : 2AXDMTMS30DUALTYPEB

FCC Classification : PCS Licensed Transmitter (PCB)

Product Name : Vehicle Control Terminal

Model Name : TMS3.0 (300611-01930)

Add Model Name : NA

Hardware Version : A1

Software Version : V3.01.002

Serial Number : NA

Supplying power : DC 12 V, 24 V

Antenna Information : PCB Antenna

Note: The emission designator was reported based on the original report of certified module.

Mode	TX Frequency (MHz)	Emission Designator	Modulation	ERP	
				Max power (dBm)	Max power (W)
LTE Band 26	819.0	8M91G7D	QPSK	23.63	0.231
LTE Band 26	819.0	8M91W7D	16QAM	21.64	0.146
LTE Band 26	816.5 ~ 821.5	4M48G7D	QPSK	23.50	0.224
LTE Band 26	816.5 ~ 821.5	4M50W7D	16QAM	21.78	0.151
LTE Band 26	815.5 ~ 822.5	2M70G7D	QPSK	23.42	0.220
LTE Band 26	815.5 ~ 822.5	2M69W7D	16QAM	22.04	0.160
LTE Band 26	814.7 ~ 823.3	1M09G7D	QPSK	23.62	0.230
LTE Band 26	814.7 ~ 823.3	1M09W7D	16QAM	22.10	0.162

2. INTRODUCTION

2.1 EUT DESCRIPTION

This EUT contains the following capabilities:
850/1900 GPRS/EDGE, 850/1700/1900 WCDMA/HSUPA, Multi-band LTE and IRIDIUM Satellite communication.

2.2 TESTING ENVIRONMENT

Ambient Condition	
▪ Temperature	+22 ℃ ~ +25 ℃
▪ Relative Humidity	41 % ~ 45 %

2.3 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.4 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C 63.4-2014. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

Parameter	Measurement uncertainty
Radiated Disturbance (Below 1 GHz)	4.9 dB (The confidence level is about 95 %, k = 2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated Disturbance (Above 18 GHz)	5.3 dB (The confidence level is about 95 %, k = 2)

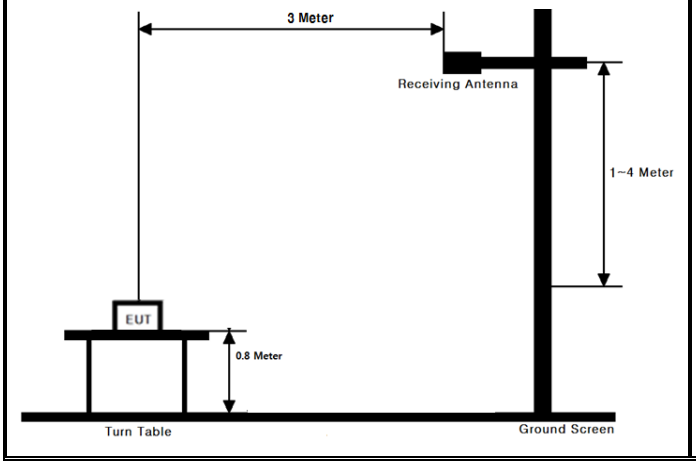
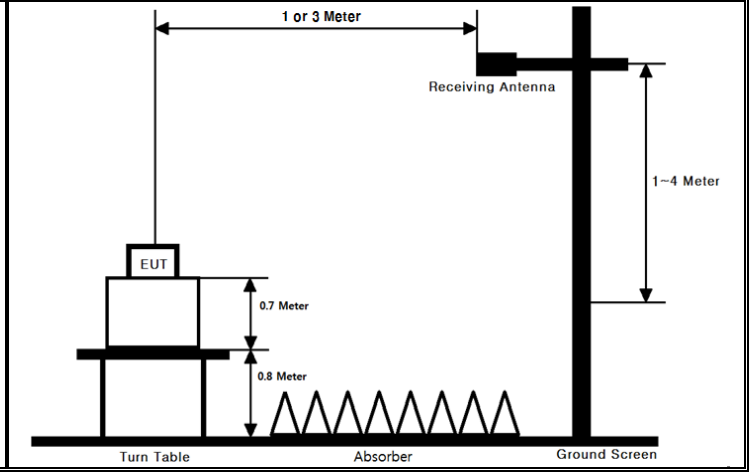
2.5 TEST FACILITY

DT&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site comply with the requirements of § 2.948 according to ANSI 63.4-2014. **- FCC & IC MRA Designation No. : KR0034** **- ISED #: 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

3. DESCRIPTION OF TESTS

3.1 ERP & EIRP (Effective Radiated Power & Equivalent Isotropic Radiated Power)

Test Set-up

Below 1 GHz	Above 1 GHz
	

These measurements were performed at 3 m test site. The equipment under test is placed on a non-conductive table 0.8 m or 1.5 m above a turntable which is flush with the ground plane and 3 meters from the receive antenna. For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.

Test Procedure

- **ANSI/TIA-603-E-2016 - Section 2.2.17**
- **KDB971168 D01v03 - Section 5.2.2**
- **ANSI C63.26-2015 – Section 5.2.4.4.1**

Test setting

1. Set span to 2 x to 3 x the OBW.
2. Set RBW = 1 % to 5 % of the OBW.
3. Set VBW ≥ 3 x RBW.
4. Set number of points in sweep ≥ 2 × span / RBW.
5. Sweep time:
   1) Set = auto-couple, or
   2) Set ≥ [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 = power averaging (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 average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over multiple symbols, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.

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.

The receiver antenna height and turntable rotations were adjusted for the highest reading on the receive spectrum analyzer.

A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminal of the substitute antenna is measured.

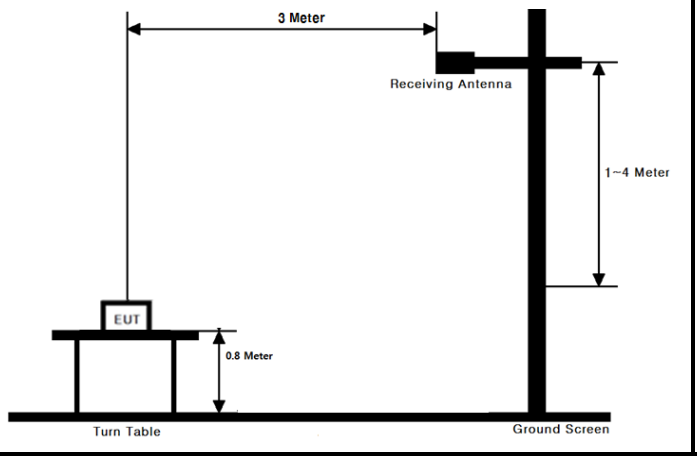
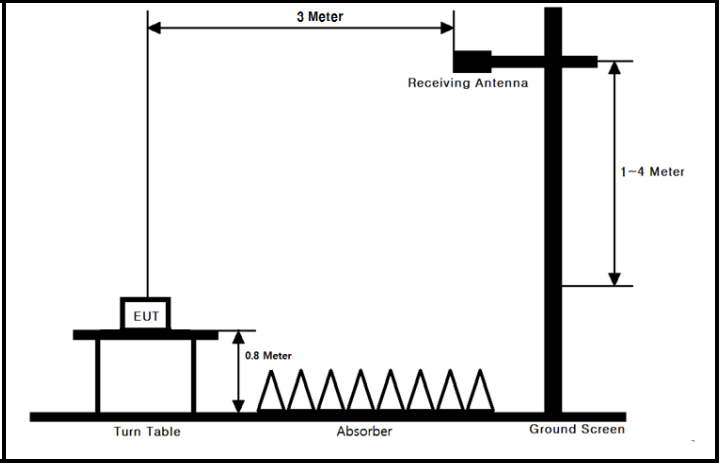
The ERP/EIRP is calculated using the following formula:

ERP/EIRP = The conducted power at the substitute antenna`s terminal [dBm] + Substitute Antenna gain [dBd for ERP , dBi for EIRP]

For readings above 1 GHz, the above procedure is repeated using horn antennas and the difference
Between the gain of the horn antenna and an isotropic antenna are taken into consideration.

3.2 UNDESIRABLE EMISSIONS

Test Set-up

Below 1 GHz	Above 1 GHz
	

These measurements were performed at 3 test site. The equipment under test is placed on a non-conductive table 0.8 m or 1.5 m above a turntable which is flush with the ground plane and 3 meters from the receive antenna. For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.

Test Procedure

- **ANSI/TIA-603-E-2016 - Section 2.2.12**
- **KDB971168 D01v03 - Section 5.8**
- **ANSI C63.26-2015 – Section 5.5**

Test setting

1. RBW = 100 kHz for below 1 GHz and 1 MHz for above 1 GHz / VBW ≥ 3 X RBW
2. Detector = RMS & Trace mode = Max hold
3. Sweep time = Auto couple
4. Number of sweep point ≥ 2 X span / RBW
5. The trace was allowed to stabilize

The receive antenna height and turntable rotations were adjusted for the highest reading on the receive spectrum analyzer.

For radiated power measurements below 1 GHz, a half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same spectrum analyzer reading.

For radiated power measurements above 1 GHz, a Horn antenna was substituted in place of the EUT. This Horn antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same spectrum analyzer reading. The difference between the gain of the horn and an isotropic antenna are taken into consideration.

4. LIST OF TEST EQUIPMENT

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal. Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	20/06/24	21/06/24	US47360812
DC power supply	SM techno	SDP30-5D	20/06/24	21/06/24	305DNF079
Multimeter	FLUKE	17B+	19/12/16	20/12/16	36390701WS
Radio Communication Analyzer	Anritsu	MT8820C	19/12/16	20/12/16	6201274516
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-2
Signal Generator	Rohde Schwarz	SMBV100A	19/12/16	20/12/16	255571
Signal Generator	ANRITSU	MG3695C	19/12/16	20/12/16	173501
Loop Antenna	ETS-Lindgren	6502	19/09/18	21/09/18	00226186
Bilog Antenna	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
Dipole Antenna	A.H.Systems Inc.	FCC-4	19/03/26	21/03/26	710A
Dipole Antenna	Schwarzbeck	UHA9105	20/04/10	22/04/10	2262
HORN ANT	ETS	3117	20/04/24	21/04/24	00140394
HORN ANT	ETS	3117	20/03/26	21/03/26	00152145
Amplifier	EMPOWER	BBS3Q7ELU	20/06/24	21/06/24	1020
PreAmplifier	H.P	8447D	19/12/16	20/12/16	2944A07774
PreAmplifier	Agilent	8449B	20/06/24	21/06/24	3008A02108
High-pass filter	Wainwright	WHKX12-935-1000-15000-40SS	20/06/24	21/06/24	7
Cable	DTNC	Cable	20/01/13	21/01/13	M-01
Cable	DTNC	Cable	20/01/13	21/01/13	M-04
Cable	Junkosha	MWX315	20/01/13	21/01/13	M-05
Cable	Junkosha	MWX221	20/01/13	21/01/13	M-06

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.
Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

5. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Status Note 1
2.1046 90.635	Conducted Output Power	< 100 Watts	Conducted	**NA** Note 2
2.1049	Occupied Bandwidth	N/A		**NA** Note 2
2.1051 90.691	Band Edge / Conducted Spurious Emissions	> 43 + 10log$_{10}$ (P) dB for all out-of-band emissions except > 50 + 10log$_{10}$ (P) dB at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge		**NA** Note 2
90.210(n)	Emission Mask	Emission Mask B: (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB. (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB. (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.		**NA** Note 2
2.1055 90.213	Frequency Stability	< 2.5 ppm		**NA** Note 2
22.913(a.5)	Radiated Output Power	< 7 Watts max. ERP	Radiated	**C** Note2
2.1053 90.691	Undesirable Emissions	> 43 + 10log$_{10}$ (P) dB for all out-of-band emissions except > 50 + 10log$_{10}$ (P) dB at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge		**C** Note2

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: These test items were not performed because this device uses the granted module.
(FCC ID : XMR201903EG25G, IC: 10224A-201903EG25G)
Please refer to the test report of the granted module

Note 3: The radiated test items were tested at DC 12 V and DC 24 V. And the worst case data are reported.

6. EMISSION DESIGNATOR AND SAMPLE CALCULATION

A. For substitution method

1) The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and 1.5 meter height for frequency above 1 GHz respectively above ground.
2) The EUT was set 3 meters from the receiving antenna mounted on the antenna tower.
3) During the test, the turn table is rotated until the maximum signal is found.
4) Record the field strength meter's level. (ex. Spectrum reading level is -8.5 dBm)
5) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
6) Increase the signal generator output till the field strength meter's level is equal to the item (4). (ex. Signal generator level is -18.04 dBm)
7) The gain of the cable and amplifier between the signal generator and terminals of substituted antenna is 46.92 dB at test frequency.
8) Record the level at substituted antenna terminal. (ex. 28.88dBm)
9) The result is calculated as below;

EIRP(dBm) = LEVLE@ANTENNA TERMINAL + TX Antenna Gain (dBi)
ERP(dBm) = LEVLE@ANTENNA TERMINAL + TX Antenna Gain (dBd)
Where, TX Antenna Gain (dBd) = TX Antenna Gain (dBi) - 2.15 dB

7. TEST DATA

7.1 CONDUCTED OUTPUT POWER

- Not Applicable

7.2 OCCUPIED BANDWIDTH

- Not Applicable

7.3 BAND EDEG EMISSIONS (Conducted)

- Not Applicable

7.4 SPURIOUS AND HARMONICS EMISSIONS (Conducted)

- Not Applicable

7.5 EMISSION MASK (Conducted)

- Not Applicable

7.6 ERP

- Test Notes

This device was tested under all bandwidths, modulations and RB configurations and the worst case data are reported in the table above.

- Measurement data:

<DC 12 V>

Channel Bandwidth (MHz)	Test Frequency (MHz)	Test Mode	RB Size/ Offset	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain (dBd)	ERP (dBm)	ERP (W)
10	819	QPSK	1/49	H	24.21	-0.58	23.63	0.231
		16QAM	1/49	H	22.22	-0.58	21.64	0.146
5	816.5	QPSK	1/24	H	23.63	-0.55	23.08	0.203
		16QAM	1/24	H	22.33	-0.55	21.78	0.151
	821.5	QPSK	1/12	H	24.10	-0.60	23.50	0.224
		16QAM	1/12	H	22.38	-0.60	21.78	0.151
3	815.5	QPSK	1/14	H	22.89	-0.54	22.35	0.172
		16QAM	1/14	H	22.58	-0.54	22.04	0.160
	819	QPSK	1/14	H	24.00	-0.58	23.42	0.220
		16QAM	1/14	H	21.92	-0.58	21.34	0.136
	822.5	QPSK	1/7	H	24.03	-0.61	23.42	0.220
		16QAM	1/7	H	22.59	-0.61	21.98	0.158
1.4	814.7	QPSK	1/2	H	24.16	-0.54	23.62	0.230
		16QAM	1/2	H	22.14	-0.54	21.60	0.145
	819	QPSK	1/5	H	23.85	-0.58	23.27	0.212
		16QAM	1/5	H	22.10	-0.58	21.52	0.142
	823.3	QPSK	1/0	H	23.91	-0.62	23.29	0.213
		16QAM	1/0	H	22.72	-0.62	22.10	0.162

<DC 24 V>

Channel Bandwidth (MHz)	Test Frequency (MHz)	Test Mode	RB Size/ Offset	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain (dBd)	ERP (dBm)	ERP (W)
10	819	QPSK	1/49	H	23.92	-0.58	23.34	0.216
		16QAM	1/49	H	21.92	-0.58	21.34	0.136

7.7 UNDESIRABLE EMISSIONS (Radiated)

- Test Notes

1. This device was tested under all bandwidths, modulations and RB configurations and the worst case data are reported.
2. Limit Calculation = 43 + 10log$_{10}$ (P[Watts])
3. This device was tested under all bandwidths, modulations and RB configurations and the worst case data are reported in the table above.
4. The frequency spectrum is examined from 9 kHz to the 10th harmonic of the fundamental frequency of the transmitter. No other spurious and harmonic emissions were reported greater than listed emissions above table.

- Measurement data:

<DC 12 V>

B.W (MHz)	Test Freq. (MHz)	RB Size/ Offset	Test Mode	Freq.(MHz)	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain(dBd)	Result		Limit (dBc)
								(dBm)	(dBc)	
10	819	1/49	QPSK	1646.88	V	-59.15	4.17	-54.98	78.61	36.63
				2470.33	V	-60.25	3.57	-56.68	80.31	
				3293.72	V	-57.76	5.24	-52.52	76.15	
				4116.92	V	-59.16	6.78	-52.38	76.01	
				4940.61	H	-56.96	7.85	-49.11	72.74	
				5763.30	H	-63.43	8.42	-55.01	78.64	
			16QAM	1646.84	V	-60.25	4.18	-56.07	77.71	34.64
				2469.98	V	-60.89	3.57	-57.32	78.96	
				3293.57	V	-58.49	5.24	-53.25	74.89	
				4117.03	V	-59.95	6.78	-53.17	74.81	
				4940.37	H	-57.86	7.85	-50.01	71.65	
				5763.68	H	-63.44	8.42	-55.02	76.66	

<DC 24 V>

B.W (MHz)	Test Freq. (MHz)	RB Size/ Offset	Test Mode	Freq.(MHz)	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain(dBd)	Result		Limit (dBc)
								(dBm)	(dBc)	
10	819	1/49	QPSK	1646.78	V	-57.89	4.18	-53.71	77.05	36.34
				2470.24	V	-58.47	3.57	-54.90	78.24	
				3293.70	V	-58.84	5.24	-53.60	76.94	
				4117.21	V	-60.29	6.78	-53.51	76.85	
				4940.26	H	-56.98	7.85	-49.13	72.47	
				5763.02	H	-63.66	8.42	-55.24	55.24	