

FCC&IC Class II Permissive Change TEST REPORT
for DTS Device (2.4G Band)
No. 160600920SHA-002

Applicant : TELE RADIO AB
Datavägen 21, SE-436 32 Askim, Sweden

Manufacturer : TELE RADIO AB
Datavägen 21, SE-436 32 Askim, Sweden

Product Name : Transceiver radio modular

Type/Model : CL-TR600-1, D00005-15, D5-15

TEST RESULT : PASS

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2015): Radio Frequency Devices

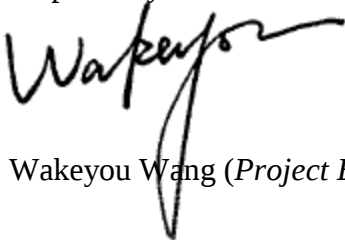
RSS-247 (Issue 1, 2015): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 4 (November 2014): General Requirements and Information for the Certification of Radiocommunication Equipment

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

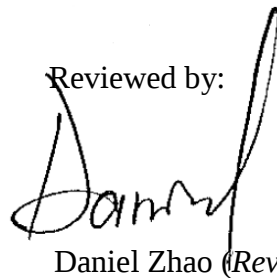
Date of issue: Sep 26, 2016

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1. General Information

1.1 Applicant Information

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Manufacturer: TELE RADIO AB
Datavägen 21, SE-436 32 Askim, Sweden

Sample received date : Sep 5, 2016

Sample Identification No : /

Date of test : Sep 5, 2016 ~ Sep 15, 2016

1.2 Identification of the EUT

Equipment: Transceiver radio modular

Type/model for FCC: CL-TR600-1, D00005-15, D5-15

FCC ID: ONFC1602A

IC: 4807A-C1602A

Host product name: Transceiver

Host model: TR501

Model Difference for host: /

1.3 Technical specification

Frequency Range:	2405 - 2480 MHz
Modulation:	O-QPSK
Gain of Antenna:	Antenna 1 & 3: Chip antenna, 4.0dBi max; Antenna 2: External omni antenna, 3.0dBi max
Rating:	DC 12-24V
Description of EUT:	There is one model only.
Channel Description:	

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

1.4 Mode of operation during the test / Test peripherals used

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied. The EUT was tested together with the host device (**Product name: transceiver; Model: TR501**)

The L, M and H channels were tested as representatives (2405MHz, 2440MHz and 2480MHz).

The EUT contains 3 antennas. Antenna 1 and 2 share the same Antenna port. Therefore, for RF conducted test, antenna 1 and 3 are tested as representative. For radiated emission test, Each antenna is assessed individually.

The EUT doesn't support simultaneously transmission. No combination emission is assessed.

Test peripheral: DC power supply manufactured by Chroma, model 62024P-100-50;
Laptop X201i manufactured by Lenovo

The EUT is powered by the host.

2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2015-10-21	2016-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2015-10-20	2016-10-19
A.M.N.	ESH2-Z5	R&S	EC 3119	2016-1-9	2017-1-8
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2016-4-28	2017-4-27
Horn antenna	HF 906	R&S	EC 3049	2016-4-28	2017-4-27
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2016-4-28	2017-4-27
Semi-anechoic chamber	-	Albatross project	EC 3048	2016-4-28	2017-4-27
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2016-1-8	2017-1-7
Power sensor / Power meter	N1911A/N1921A	Agilent	EC4318	2016-04-12	2017-04-11
Temperature Camber	SETH-E	tayasaf	EC4315	2016-4-9	2017-4-8
Spectrum analyzer	E7402A	Agilent	EC2254	2016-08-16	2017-08-15

2.2 Test Standard

47CFR Part 15 (2015)
 RSS-247 (Issue 1, 2015)
 RSS-Gen Issue 4 (November 2014)
 ANSI C63.10 (2013)
 KDB 558074 (V03R03)

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERENCE	IC REFERENCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	RSS-Gen Issue 3 Clause 4.6.1 RSS-210 Issue 8 Annex 8	NP
Maximum peak output power	15.247(b)	RSS-210 Issue 8 Annex 8	NP
Power spectrum density	15.247(e)	RSS-210 Issue 8 Annex 8	NP
Radiated emission	15.205 & 15.209	RSS-210 Issue 8 Clause 2	Pass
Emission outside the frequency band	15.247(d)	RSS-210 Issue 8 Annex 8	NP
Power line conducted emission	15.207	RSS-Gen Clause 8.8	Pass
Occupied bandwidth	-	RSS-Gen Clause 6.6	NP

Note: 1. NP means 'not performed'. Among this C2PC report, these test items are not influenced and no repeated test is necessary.

2. NA means 'not applied'. For the host device is powered by battery, no Power line conducted emission is required.

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3. Radiated emission

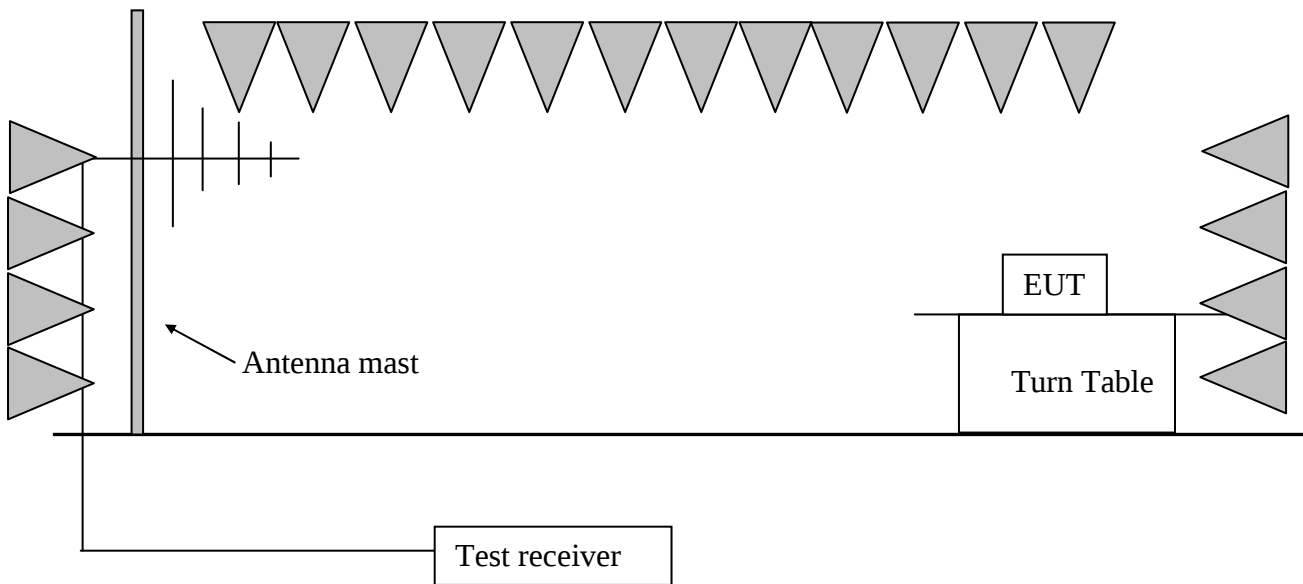
Test result: **PASS**

3.1 Test limit

The radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) showed as below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

3.2 Test Configuration



3.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The EUT was tested according to DTS test procedure of KDB558074 D01 DTS “Meas Guidance v03r03” for compliance to FCC 47CFR 15.247 requirements.

3.4 Test protocol

Antenna 1

CH	Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	2405.03	34.30	110.80	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	V	2390.00	34.30	62.10	74.00	11.90	PK
	V	2390.00	34.30	50.60	54.00	3.40	AV
	V	4809.61	-3.50	62.40	74.00	11.60	PK
	V	4809.61	-3.50	35.20	54.00	18.80	AV
	V	7208.42	2.00	62.10	74.00	11.90	PK
	V	7208.42	2.00	32.20	54.00	21.80	AV
	V	9621.24	4.90	52.00	54.00	2.00	PK
M	V	2440.16	34.50	111.60	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	H	4885.73	-3.30	63.40	74.00	10.60	PK
	H	4885.73	-3.30	36.00	54.00	18.00	AV
	H	7322.65	2.60	62.50	74.00	11.50	PK
	H	7322.65	2.60	32.80	54.00	21.20	AV
	V	9805.17	4.80	52.50	54.00	1.50	PK
H	V	2479.68	34.60	108.50	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK

	H	383.78	16.80	31.50	46.00	14.50	PK
	V	2483.50	34.60	73.20	74.00	0.80	PK
	V	2483.50	34.60	49.90	54.00	4.10	AV
	V	4949.90	-3.20	57.90	74.00	16.10	PK
	V	4949.90	-3.20	32.10	54.00	21.90	AV
	V	7446.89	2.70	65.10	74.00	8.90	PK
	V	7446.89	2.70	38.50	54.00	15.50	AV
	H	9929.85	5.00	48.60	54.00	5.40	PK

Antenna 2

CH	Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	2405.03	34.30	112.40	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	V	2390.00	34.30	61.90	74.00	12.10	PK
	V	2390.00	34.30	50.50	54.00	3.50	AV
	V	4809.61	-3.50	62.70	74.00	11.30	PK
	V	4809.61	-3.50	35.50	54.00	18.50	AV
	V	7208.42	2.00	62.30	74.00	11.70	PK
	V	7208.42	2.00	32.40	54.00	21.60	AV
	V	9621.24	4.90	52.10	54.00	1.90	PK
M	V	2440.16	34.50	113.20	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	H	4885.73	-3.30	63.20	74.00	10.80	PK

	H	4885.73	-3.30	35.90	54.00	18.10	AV
	H	7322.65	2.60	62.60	74.00	11.40	PK
	H	7322.65	2.60	33.00	54.00	21.00	AV
	V	9805.17	4.80	52.70	54.00	1.30	PK
H	V	2479.68	34.60	110.60	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	V	2483.50	34.60	73.60	74.00	0.40	PK
	V	2483.50	34.60	50.30	54.00	3.70	AV
	V	4949.90	-3.20	57.90	74.00	16.10	PK
	V	4949.90	-3.20	32.10	54.00	21.90	AV
	V	7446.89	2.70	65.30	74.00	8.70	PK
	V	7446.89	2.70	38.70	54.00	15.30	AV
	H	9929.85	5.00	49.00	54.00	5.00	PK

Antenna 3

CH	Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	2405.03	34.30	95.00	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	V	2390.00	34.30	61.70	74.00	12.30	PK
	V	2390.00	34.30	50.30	54.00	3.70	AV
	V	4809.61	-3.50	50.10	54.00	3.90	PK
	V	9621.24	4.90	46.30	54.00	7.70	PK

M	V	2440.16	34.50	95.20	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	H	4885.73	-3.30	50.50	54.00	3.50	PK
	V	9805.17	4.80	46.80	54.00	7.20	PK
H	V	2480.46	34.60	95.60	Fundamental	/	PK
	V	90.26	12.10	41.10	43.50	2.40	PK
	H	146.63	13.20	32.30	43.50	11.20	PK
	H	212.72	12.50	30.10	43.50	13.40	PK
	H	383.78	16.80	31.50	46.00	14.50	PK
	V	2483.50	34.60	66.40	74.00	7.60	PK
	V	2483.50	34.60	37.80	54.00	16.20	AV
	V	4949.90	-3.20	50.60	54.00	3.40	PK
	H	9929.85	5.00	46.60	54.00	7.40	PK

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)

2. Corrected Reading = Original Receiver Reading + Correct Factor

3. Margin = limit – Corrected Reading

4. If the PK reading is lower than AV limit, the AV test can be elided.

5. For all the frequencies assessed with QP detector, it is found they have pulse-repetition frequency higher than 20 Hz.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,

Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.

Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m

Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then Margin = 54 - 10.20 = 43.80dBuV/m

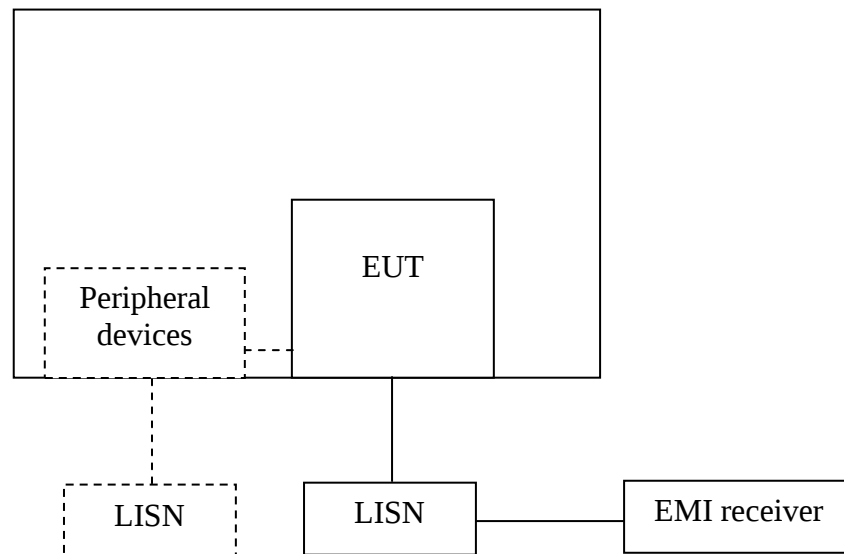
4. Power line conducted emission

Test result: Pass

4.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

4.2 Test configuration



☒ For table top equipment, wooden support is 0.8m height table

☐ For floor standing equipment, wooden support is 0.1m height rack.

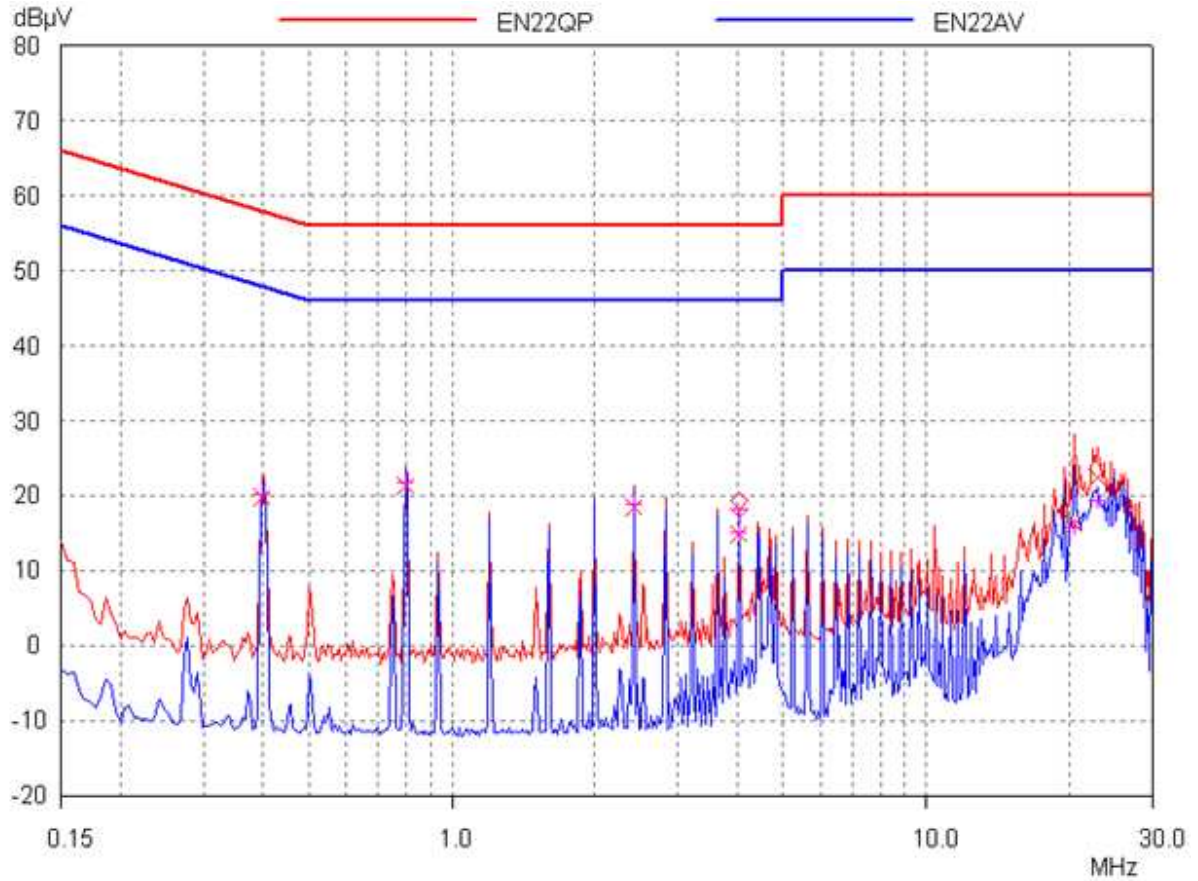
4.3 Test procedure and test set up

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a $50\Omega/50\mu\text{H}$ coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a $50\Omega/50\mu\text{H}$ coupling impedance with 50Ω termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement. The bandwidth of the test receiver is set at 9 kHz.

4.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %



Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.40 (L)	3.00	19.67	20.13	57.91	47.91	38.24	27.78
0.80 (L)	3.00	21.27	21.76	56.00	46.00	34.73	24.24
2.40 (N)	3.00	18.46	18.86	56.00	46.00	37.54	27.14
4.00 (L)	3.00	14.84	15.01	56.00	46.00	41.16	30.99
20.41 (N)	3.00	16.27	15.65	60.00	50.00	43.73	34.35
22.81 (L)	3.00	22.41	19.28	60.00	50.00	37.59	30.72
Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB). 2. Margin (dB) = Limit - Corrected Reading.							