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16 July 2014

Prüfbericht / *Test Report* Nr. / *No.* 69582-43757-1 (Edition 1)

Auftraggeber *Applicant*	Futaba Corporation
Geräteart *Type of equipment*	Transmitter for Radio control system 72 MHz
Typenbezeichnung *Type designation*	FRT-Tx
Auftragsnummer / *Order No.*	--
Prüfgrundlage *Test standards*	FCC Code of Federal Regulations, CFR 47, Part 95, Subpart C&E FCC Code of Federal Regulations, CFR 47, Part 2, Subpart J

Table of Contents

1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	FRT-Tx
Parts[2]:	Lithium-ion Battery pack (2UR18650F)c
Serial number(s):	121100039
Manufacturer:	Futaba Corporation
Type of equipment:	Transmitter for Radio control system 72 MHz
Version:	As received
FCC ID:	AZP-L35-N4581
Additional parts/accessories:	

Technical data of EUT		
Application frequency range:	72.01 MHz - 72.99 MHz	
Frequency range:	72.69 MHz – 72.95 MHz	
Operating frequency:	72.950 MHz	
Type of modulation:	FSK	
Pulse train:	Not Applicable	
Pulse width:	Not Applicable	
Number of RF-channels:	10	
Channel spacing:	8 kHz	
Designation of emissions[3]:	10K0F1D	
Type of antenna:	Telescope antenna	
Size/length of antenna:	110 cm	
Connection of antenna:	☐ detachable	☒ not detachable
Type of power supply:	Battery supply (Lithium-ion Battery)	
Specifications for power supply:	nominal voltage: minimum voltage: maximum voltage: nominal frequency:	7.40 V 6.29 V 8.51 V DC Hz

[1] Type designation of the system if EUT consists of more than one part.
[2] Type designations of the parts of the system, if applicable.
[3] Also known as "Class of Emission".

2 Administrative Data

Application details	
Applicant (full address):	Futaba Corporation 1080, Yabutsuka Chosei-mura, Chosei-gun, Chiba-ken 299-4395 Japan
Contact person:	Mr. Masaki Wakatsuki
Contract identification:	--
Receipt of EUT:	2014-06-10
Date(s) of test:	2014-06-10 - 2014-06-15
Note(s):	--

Report details	
Report number:	69582-43757-1
Edition:	1
Issue date:	July 16, 2014

3 Identification of the Test Laboratory

Details of the Test Laboratory	
Company name:	TÜV Süd Product Service GmbH
Address:	Aeussere Fruehlingstrasse 45 D-94315 Straubing Germany
Laboratory accreditation:	DAkkS Registration No. D-PL-11321-11-01
FCC test site registration number	90926
Industry Canada test site registration:	3050A-2
Contact person:	Mr. Johann Roidt Phone: (+49) (0)9421 5522-0 Fax: (+49) (0)9421 5522-99

4 Summary

Summary of test results
The tested sample complies with the requirements set forth in the **Code of Federal Regulations CFR 47, Part 95, Subpart C & E** and the **Code of Federal Regulations CFR 47 Part 2, Subpart J** of the Federal Communication Commission (FCC).

Personnel involved in this report	
Laboratory Manager:	 Mr. Johann Roidt
Responsible for testing:	 Mr. Thomas Eberl
	 Mr. Markus Biberger
Responsible for test report:	Mr. Markus Biberger

5 Operation Mode and Configuration of EUT

Operation Mode(s)
Operation mode 1: Transmitting continuously CH 0 at 72.690 MHz. Operation mode 2: Transmitting continuously CH 5 at 72.810 MHz. Operation mode 1: Transmitting continuously CH 9 at 72.950 MHz. Modulation as indicated in appropriate test record. The antenna extended to maximum.

Configuration(s) of EUT
The EUT was configured as stand alone device.

List of ports and cables				
Port	*Description*	*Classification*[4]	*Cable type*	*Cable length*
	Not applicable			

List of devices connected to EUT				
Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
	Not applicable			

List of support devices				
Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
	Not applicable			

[4] Ports shall be classified as ac power, dc power or signal/control port

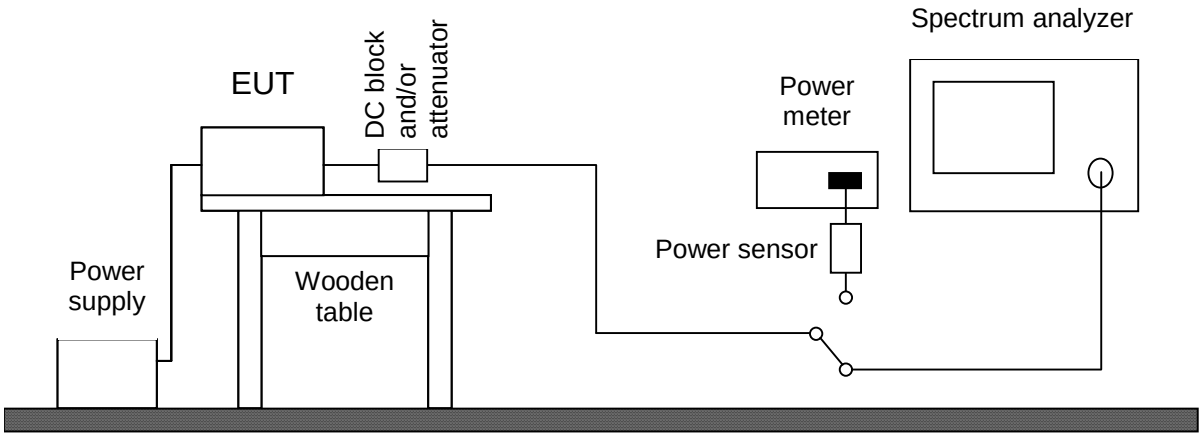
6 Measurement Procedures

6.1 Maximum Transmitter Power

The maximum transmitter power was measured conducted and radiated.

6.1.1 Conducted Maximum Transmitter Power

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 95, section 95.639
Guide:	CFR 47 Part 2, section 2.1046
Conducted output power is measured at the RF output terminals (e.g. antenna connector if antenna is detachable) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer and/or a power meter with appropriate sensor. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable. If a spectrum analyzer is used and no other settings are specified resolution bandwidth shall be selected according to the carrier frequency f_c and set to 100 kHz. The video bandwidth shall be at least three times greater than the resolution bandwidth. The settings used have to be indicated within the appropriate test record(s).	



Test instruments used:

Used	Type	Model	Serial No. or ID	Manufacturer
☐	Spectrum Analyzer	FSP 30	100063	Rohde & Schwarz
☒	EMI test receiver	ESPI7	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	839379/013 839587/006	Rohde & Schwarz
☐	Radio Communication Service Monitor	CMS 54	838384/030	Rohde & Schwarz
☐	Power meter	NRVS	836856/015	Rohde & Schwarz
☐	Peak power sensor	NRV-Z31	8579604.03	Rohde & Schwarz
☐	Power sensor	NRV-Z52	837901/030	Rohde & Schwarz
☐	Power sensor	NRV-Z4	863828/015	Rohde & Schwarz
☒	DC-block	7006	A2798	Weinschel
☐	Attenuator	4776-10	9412	Narda
☐	Attenuator	4776-20	9503	Narda
☐	Dummy Load	LD 01	001	Futaba

6.1.2 Radiated Maximum Transmitter Power

Measurement Procedure:
For measurement setup and procedure see section *Unwanted Emission 30 MHz - 1 GHz* (6.4)

6.2 Frequency tolerance

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 95, section 95.623
Guide:	ANSI C63.4

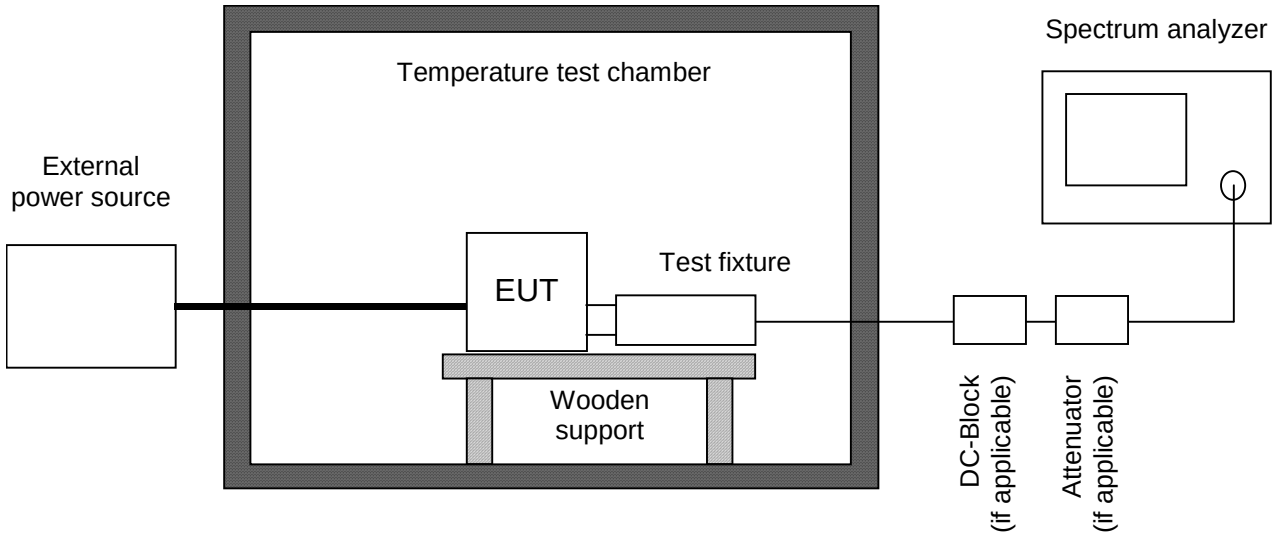
The frequency tolerance of the carrier signal is measured over a temperature variation of -30 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of +20 °C.

If the EUT provides an antenna connector the spectrum analyzer is connected to this port. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). In cases where the EUT does not provide an antenna connector a test fixture is used.

For battery operated equipment, the test is performed using a new battery. Alternatively, an external supply voltage can be used and is at least set to:

- the maximum battery voltage as delivered by a new battery or 115% of the battery nominal voltage
- the battery nominal voltage
- 85% of the battery nominal voltage
- the battery operating end point voltage which shall be specified by the equipment manufacturer

The EUT is operating providing an unmodulated carrier. The peak detector of the spectrum analyzer is selected and resolution as well as video bandwidth are set to values appropriate to the shape of the spectrum of the EUT. The frequency counter mode of the spectrum analyzer is used to maximize the accuracy of the measured frequency tolerance.
If an unmodulated carrier is not available a significant and stable point on the spectrum is selected and the span is reduced to a value that delivers an accuracy which shall be better than 1% of the maximum frequency tolerance allowed for the carrier signal. This method may be performed as long as the margin to the frequency tolerance allowed is larger than the uncertainty of the measured frequency tolerance.

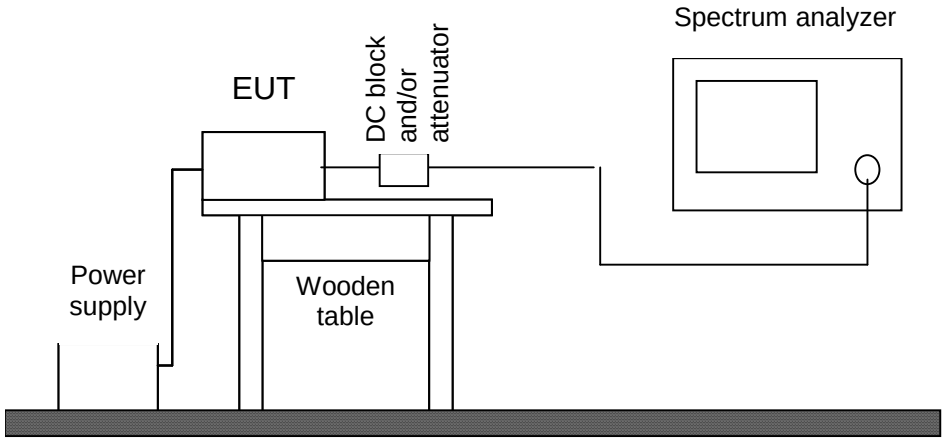


Test instruments used:

Used	Type	Model	Serial No. or ID	Manufacturer
☐	Spectrum Analyzer	FSP 30	100063	Rohde & Schwarz
☒	EMI test receiver	ESPI7	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	839379/013 839587/006	Rohde & Schwarz
☐	Radio Communication Service Monitor	CMS 54	838384/030	Rohde & Schwarz
☐	DC-block	7006	A2798	Weinschel
☐	Attenuator	4776-10	9412	Narda
☐	Attenuator	4776-20	9503	Narda
☐	Test probe	TP01	001	Senton
☒	DC power supply	NGSM 32/10	203	Rohde & Schwarz
☐	Isolating transformer	RT 5A	10387	Grundig
☐	Isolating transformer	RT 5A	10416	Grundig
☒	Temperature test chamber	HT4010	07065550	Heraeus
☐	Dummy Load	LD 01	001	Futaba

6.3 Emission Bandwidth

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 2, section 2.1046(a)
Guide:	TIA/EI-603
Emission bandwidth is measured at the RF output terminals (e.g. antenna connector if antenna is detachable) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable. The occupied bandwidth measurement was performed referring to 99% of total power with RBW as close to, but not less than 1% of the 99% power bandwidth.	



Test instruments used:

Used	Type	Model	Serial No. or ID	Manufacturer
☒	Spectrum Analyzer	FSP 30	100063	Rohde & Schwarz
☐	EMI test receiver	ESPI7	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	839379/013 839587/006	Rohde & Schwarz
☐	Power meter	NRVS	836856/015	Rohde & Schwarz
☐	Peak power sensor	NRV-Z31	8579604.03	Rohde & Schwarz
☐	Power sensor	NRV-Z52	837901/030	Rohde & Schwarz
☐	Power sensor	NRV-Z4	863828/015	Rohde & Schwarz
☒	DC-block	7006	A2798	Weinschel
☐	Attenuator	4776-10	9412	Narda
☐	Attenuator	4776-20	9503	Narda
☒	Dummy Load	LD 01	001	Futaba

6.4 Unwanted Emission 30 MHz - 1 GHz

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 95, section 95.635
Guide:	ANSI C63.4 TIA/EIA-603, section 2.2.12

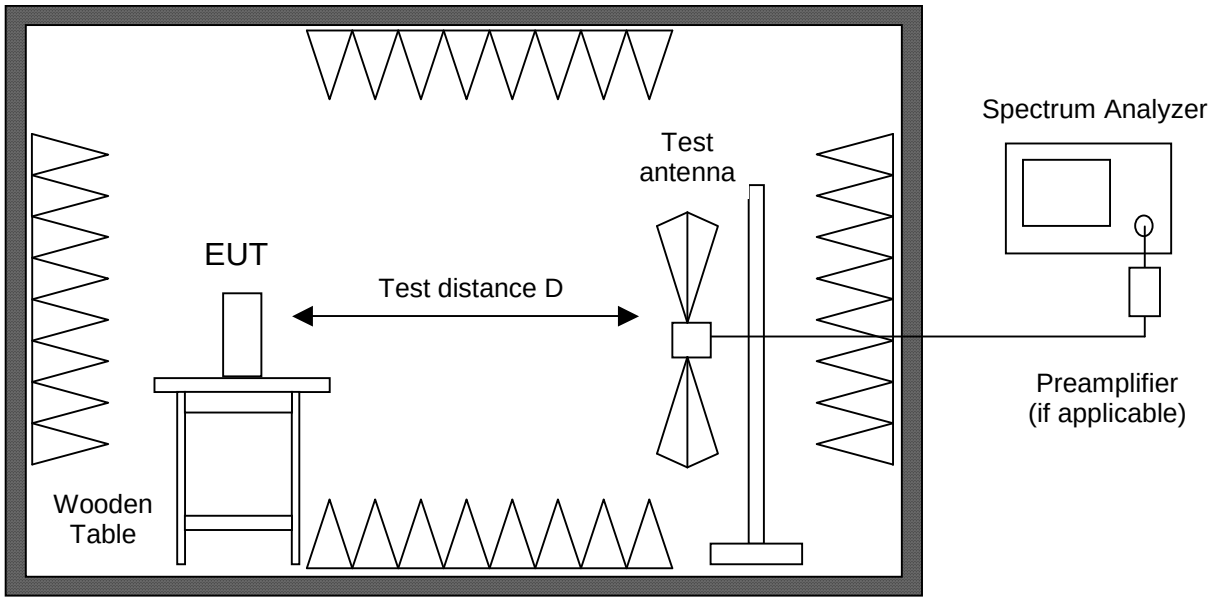
Pre-measurements are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution bandwidth set to 30 kHz, video bandwidth set to 100 kHz.

Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas are used.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

During testing the EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

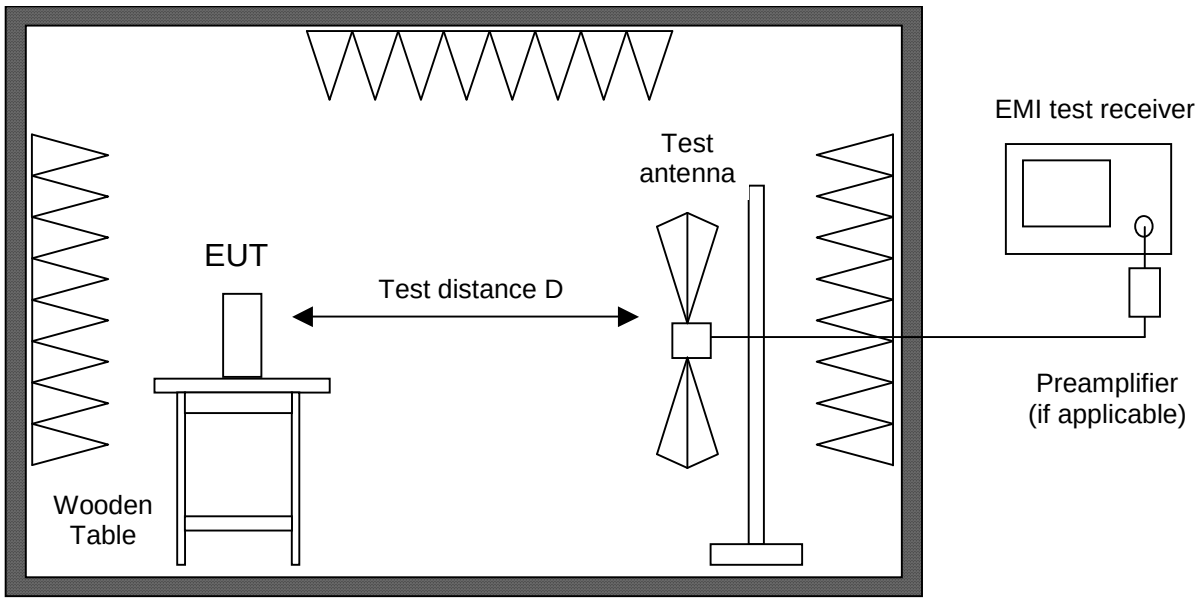
Final testing was performed in the anechoic room referring to substitution method as described in TIA/EIA-603, section 2.2.12 ("Radiated Spurious Emissions") and NSA requirements of ANSI C63.4.



Fully or semi anechoic room

Test instruments used:

Used	Type	Model	Serial No. or ID	Manufacturer
☒	Spectrum Analyzer	FSP 30	100063	Rohde & Schwarz
☐	Spectrum analyzer	R 3271	05050023	Advantest
☐	EMI test receiver	ESMI	839379/013 839587/006	Rohde & Schwarz
☒	Preamplifier	CPA9231A	3393	Schaffner
☐	Preamplifier	R14601		Advantest
☐	Preamplifier 1-8 GHz	AFS3-00100800-32-LN	847743	Miteq
☐	Preamplifier 0.5-8 GHz	AMF-4D-005080-25-13P	860149	Miteq
☐	Preamplifier 8-18 GHz	ACO/180-3530	32641	CTT
☐	External Mixer	WM782A	845881/005	Tektronix
☐	Harmonic Mixer Accessories	FS-Z30	843389/007	Rohde & Schwarz
☒	Trilog broadband antenna	VULB 9162	9162-048	Schwarzbeck
☐	Horn antenna	3115	9508-4553	EMCO
☐	Horn antenna	3160-03	9112-1003	EMCO
☐	Horn antenna	3160-04	9112-1001	EMCO
☐	Horn antenna	3160-05	9112-1001	EMCO
☐	Horn antenna	3160-06	9112-1001	EMCO
☐	Horn antenna	3160-07	9112-1008	EMCO
☐	Horn antenna	3160-08	9112-1002	EMCO
☐	Horn antenna	3160-09	9403-1025	EMCO
☐	Horn antenna	3160-10	399185	EMCO
☒	Fully anechoic room	No. 2	1452	Albatross Projects
☐	Semi-anechoic room	No. 3	1453	Siemens



Alternate test site (semi anechoic room)

Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☒	Trilog antenna	Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
☒	Semi anechoic room		No. 8	2057	---	Albatross

7 Photographs Taken During Testing

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94315 Straubing
Germany

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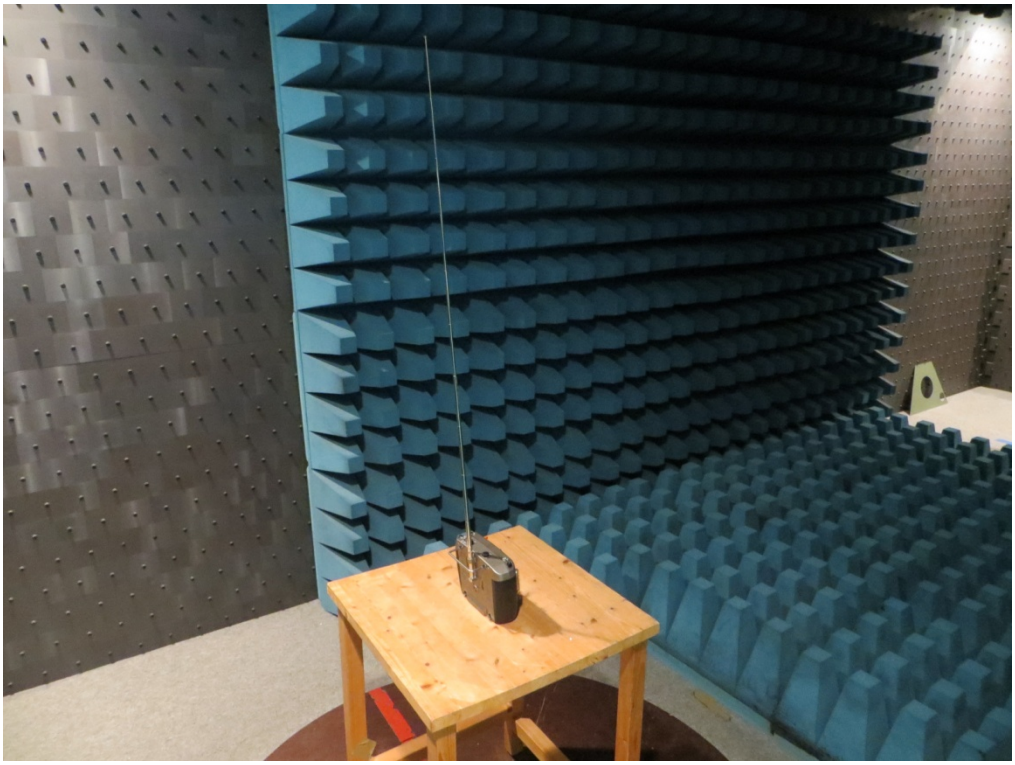
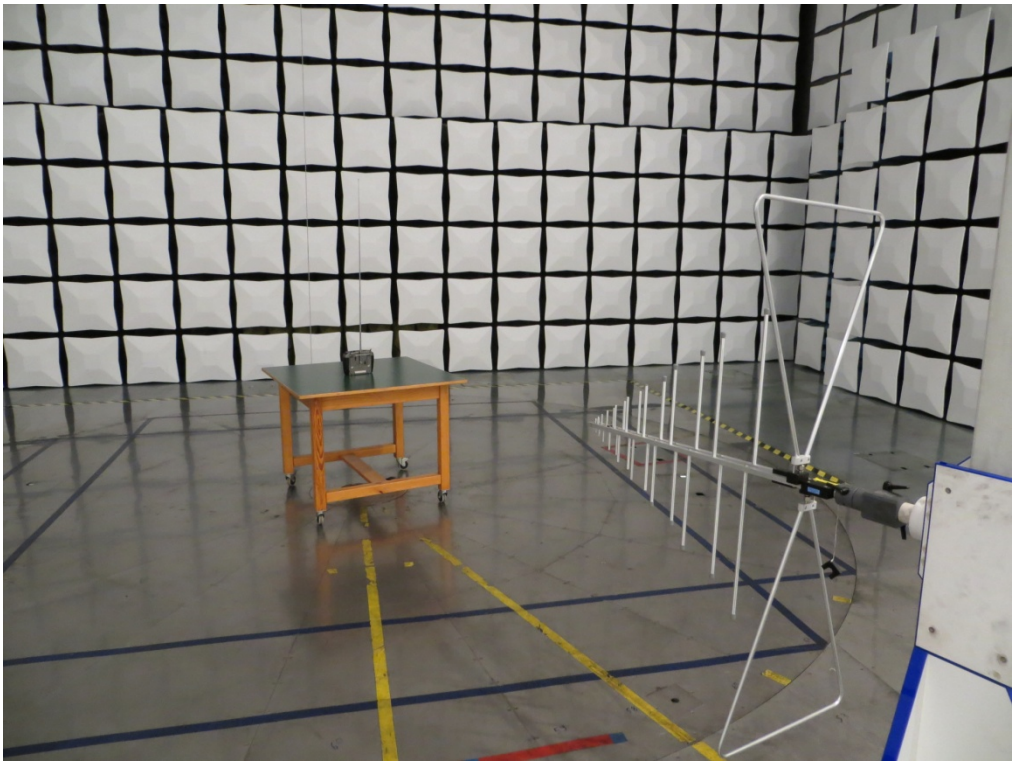
Web: www.tuev-sued.de

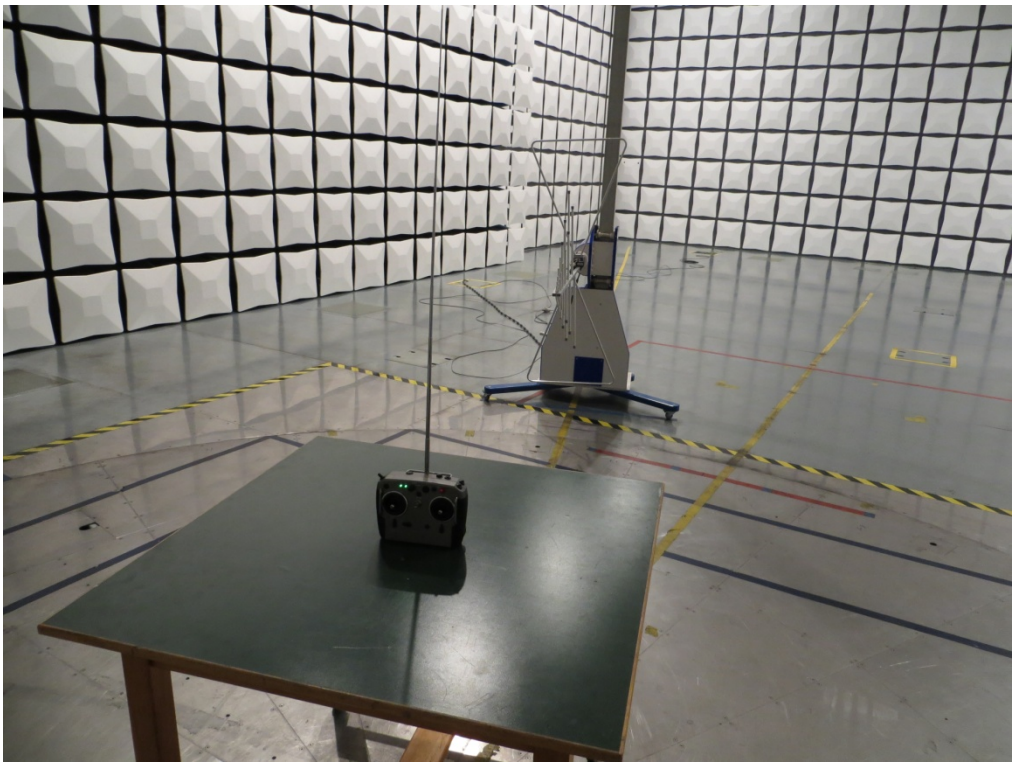
Product Service

Test setup for radiated emission measurement (alternative test site)

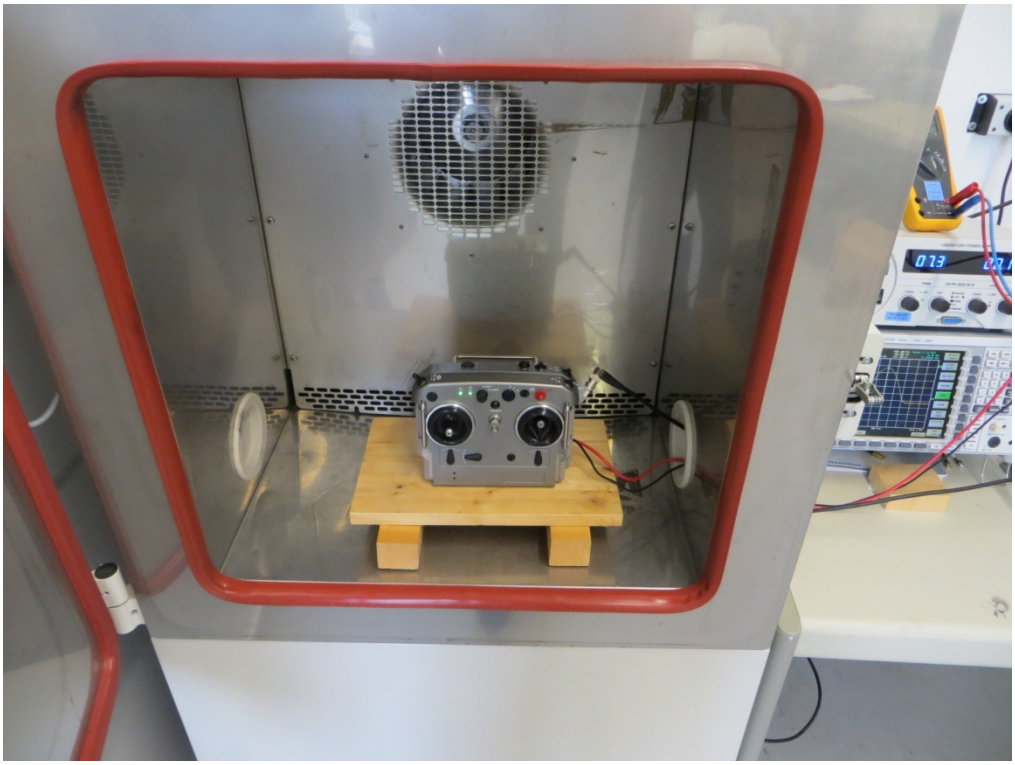


Test setup for radiated emission measurement (fully anechoic room) - continued -





Test setup for carrier frequency stability measurement



8 Test Results

CFR 47 Part 95 Subpart C / E CFR 47 Part 2 Subpart J			
Section(s)	*Test*	*Page*	*Result*
95.639	Maximum transmitter power	22	Test passed
95.623	Frequency tolerance	28	Test passed
95.633	Emission bandwidth	35	Test passed
95.635 (b) (1) (3) (7) (10) (11) (12)	Unwanted radiation 30 MHz - 1 GHz	39	Test passed

8.1 Maximum transmitter power

8.1.1 Maximum transmitter power - Conducted

Rules and specifications:	CFR 47 Part 95, section 95.639(b)(3)
Guide:	CFR 47 Part 2, section 2.1046
Limit:	0.75 W in the 72 – 76 MHz frequency band
Measurement procedure:	Conducted Maximum Transmitter Power (6.1.1)

Comment:	--	
Date of test:	2014-07-14	
Test site:	Fully anechoic room, cabin no. 2	
Test conditions:	Temperature	+ 20 °C
	Nominal supply voltage:	7.40 V
Specifications:	Voltage range:	±15 % of nominal supply voltage

Operating frequency 72.690 MHz:

Supply voltage (V)	Modulation	Transmitter power (dBm)	Transmitter power (W)	Limit (W)
6,29	off	25,36	0,344	0,750
7,40	off	25,91	0,390	0,750
8,51	off	25,84	0,384	0,750
6,29	on	25,38	0,345	0,750
7,40	on	25,84	0,384	0,750
8,51	on	25,91	0,390	0,750

Operating frequency 72.810 MHz:

Supply voltage (V)	Modulation	Transmitter power (dBm)	Transmitter power (W)	Limit (W)
6,29	off	25,54	0,358	0,750
7,40	off	25,91	0,390	0,750
8,51	off	25,95	0,394	0,750
6,29	on	25,45	0,351	0,750
7,40	on	25,91	0,390	0,750
8,51	on	25,94	0,393	0,750

Operating frequency 72.950 MHz:

Supply voltage (V)	Modulation	Transmitter power (dBm)	Transmitter power (W)	Limit (W)
6,29	off	25,87	0,386	0,750
7,40	off	26,29	0,426	0,750
8,51	off	26,31	0,428	0,750
6,29	on	25,85	0,385	0,750
7,40	on	26,27	0,424	0,750
8,51	on	26,32	0,429	0,750

Test Result:	Test passed

8.1.2 Maximum transmitter power - Radiated

Rules and specifications:	CFR 47 Part 95, section 95.635
Guide:	ANSI C63.4 TIA/EIA-603, section 2.2.12
Limit:	0.75 W (28.8 dBm) in the 72 – 76 MHz frequency band
Measurement procedure:	Radiated Maximum Transmitter Power (6.1.2)

Comment:	--
Date of test:	2014-07-16
Test site:	Alternative test site, cabin no. 8
Test conditions:	Temperature + 20 °C
	Nominal supply voltage: 7.40 V
Note:	For calculation of correction factors see table “Test Site Calibration Data Sheets” (supplied as additional information summarized next pages).

Operating frequency 72.690 MHz:

Position of EUT	Antenna polarization	Frequency (MHz)	Reading value (dBm)	Correction factor (dB)	E(I)RP (dBm)	Limit (dBm)	Margin to limit (dB)
EUT in vertical position, Antenna to the top	Horizontal	72,692	-20,1	29,0	8,9	28,8	+19,9
EUT in vertical position, Antenna to the top	Vertical	72,692	-7,5	30,8	23,3	28,8	+5,5
EUT in horizontal position, Rear side on table	Vertical	72,692	-16,6	30,8	14,5	28,8	+14,3
EUT in horizontal position, Rear side on table	Horizontal	72,692	-7,5	29,0	21,5	28,8	+7,3
EUT in horizontal position, Left side on table	Vertical	72,692	-13,8	30,8	17,0	28,8	+11,8
EUT in horizontal position, Left side on table	Horizontal	72,692	-7,7	29,0	21,3	28,8	+7,5

Operating frequency 72.810 MHz:

Position of EUT	Antenna polarization	Frequency (MHz)	Reading value (dBm)	Correction factor (dB)	E(I)RP (dBm)	Limit (dBm)	Margin to limit (dB)
EUT in vertical position, Antenna to the top	vertical	72,812	-7,2	30,7	23,5	28,8	+5,3
EUT in vertical position, Antenna to the top	horizontal	72,812	-19,4	28,9	9,5	28,8	+19,3
EUT in horizontal position, Rear side on table	Vertical	72,812	-16,5	30,7	14,2	28,8	+14,6
EUT in horizontal position, Rear side on table	Horizontal	72,812	-7,7	28,9	21,2	28,8	+7,6
EUT in horizontal position, Left side on table	Vertical	72,812	-13,7	30,7	17,0	28,8	+11,8
EUT in horizontal position, Left side on table	Horizontal	72,812	-7,9	28,9	21,0	28,8	+7,8

Operating frequency 72.950 MHz:

Position of EUT	Antenna polarization	Frequency (MHz)	Reading value (dBm)	Correction factor (dB)	E(I)RP (dBm)	Limit (dBm)	Margin to limit (dB)
EUT in vertical position, Antenna to the top	Horizontal	72,952	-20,7	28,8	8,1	28,8	+20,7
EUT in vertical position, Antenna to the top	Vertical	72,952	-7,5	30,6	23,1	28,8	+5,7
EUT in horizontal position, Rear side on table	horizontal	72,952	-6,9	28,8	21,9	28,8	+6,9
EUT in horizontal position, Rear side on table	vertical	72,952	17,5	30,6	13,1	28,8	+15,7
EUT in horizontal position, Left side on table	horizontal	72,952	-6,7	28,8	22,1	28,8	+6,7
EUT in horizontal position, Left side on table	vertical	72,952	-13,3	30,6	17,3	28,8	+11,5

Test Result:	Test passed

8.2 Carrier Frequency Stability

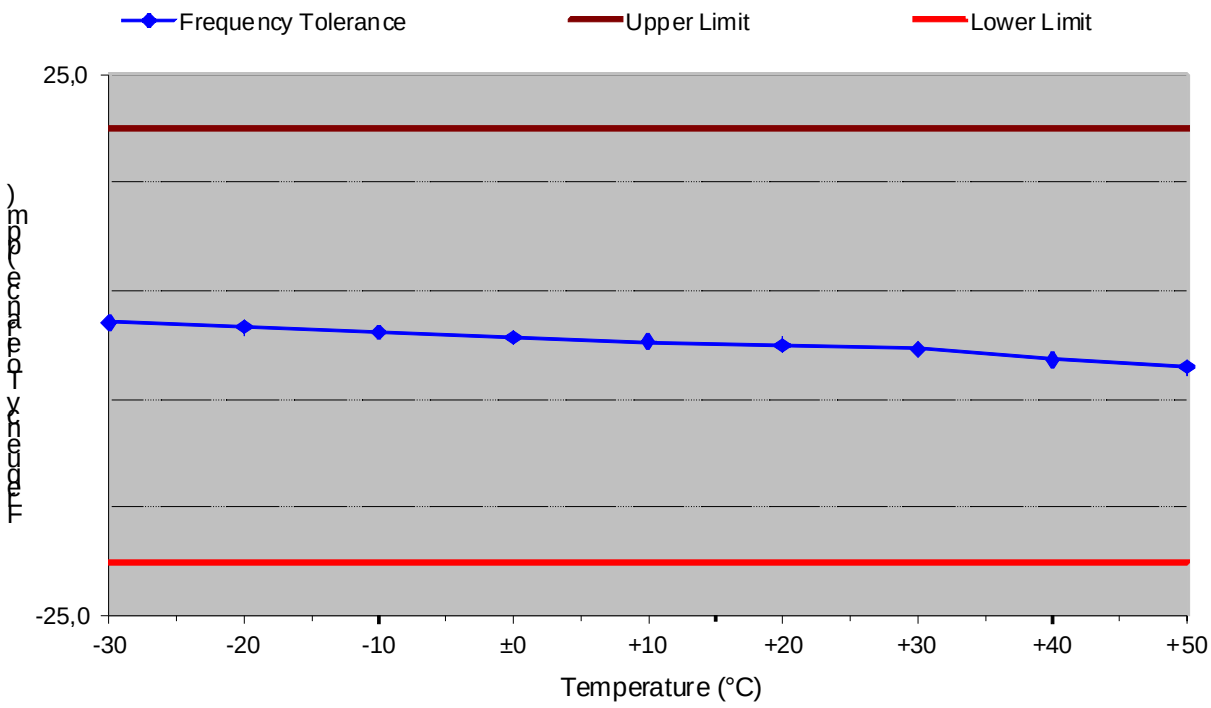
Rules and specifications:	CFR 47 Part 95, section 95.623(c)
Guide:	ANSI C63.4
Limit:	The frequency tolerance of the carrier signal shall be maintained within ±0.002 % (±20 ppm) of the carrier frequency under nominal conditions.
Temperature range: Voltage range:	-30°C to +50°C (at normal supply voltage) 85% to 115% of the rated supply voltage (at a temperature of +20 °C)
Measurement procedure:	Frequency tolerance (6.2)

Comment:	--
Mode:	See tests
Date of test:	2014-07-01

Test Result:	Test passed

8.2.1 Frequency Stability vs. Temperature

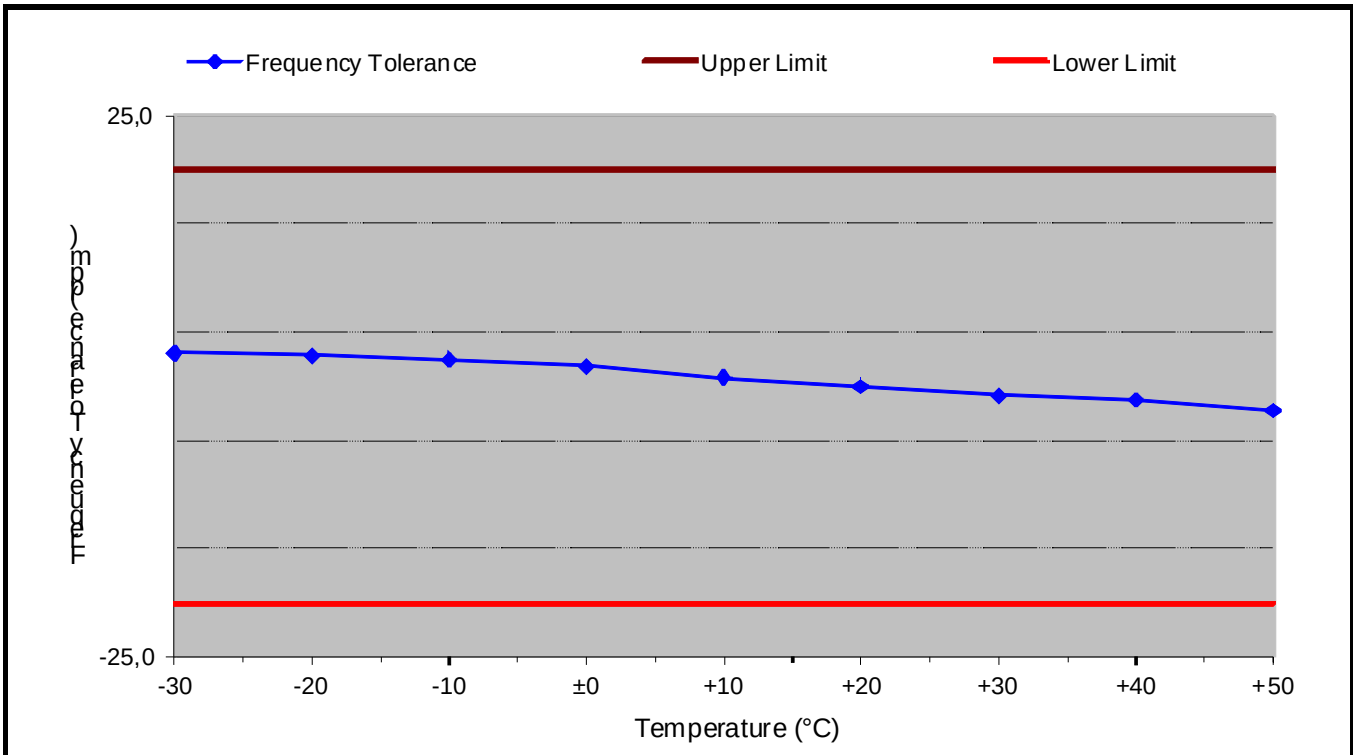
Operating frequency 72.690 MHz:



Supply voltage: 7,4 V Nominal frequency: 72,690052 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-30	72,690205	153	2,1	+20,0	-20,0	**17,9**
-20	72,690171	119	1,6	+20,0	-20,0	18,4
-10	72,690138	86	1,2	+20,0	-20,0	18,8
±0	72,690101	49	0,7	+20,0	-20,0	19,3
+10	72,690075	23	0,3	+20,0	-20,0	19,7
+20	72,690052	0	0,0	+20,0	-20,0	20,0
+30	72,690023	-29	-0,4	+20,0	-20,0	19,6
+40	72,689955	-97	-1,3	+20,0	-20,0	18,7
+50	72,689903	-149	-2,0	+20,0	-20,0	18,0

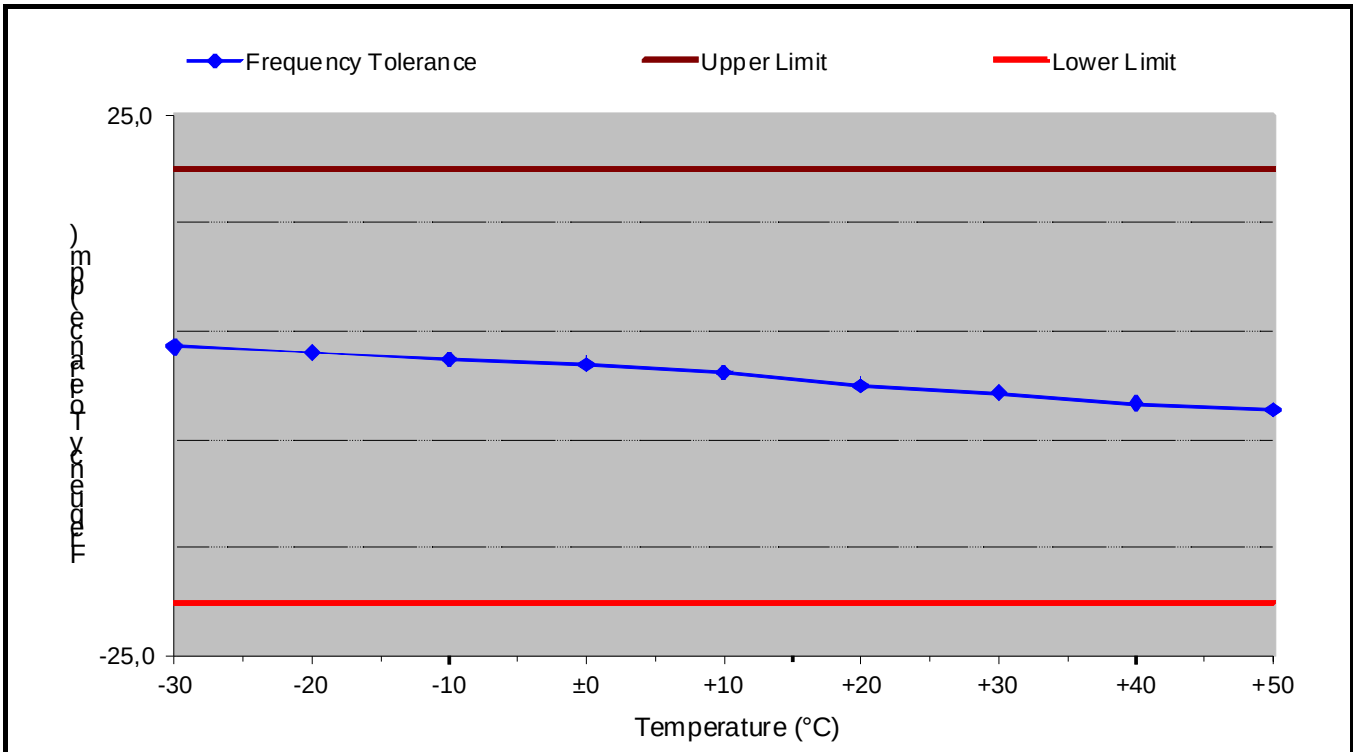
Operating frequency 72.810 MHz:



Supply voltage: 7,4 V Nominal frequency: 72,810065 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-30	72,810288	223	3,1	+20,0	-20,0	**16,9**
-20	72,810269	204	2,8	+20,0	-20,0	17,2
-10	72,810245	180	2,5	+20,0	-20,0	17,5
±0	72,810198	133	1,8	+20,0	-20,0	18,2
+10	72,810123	58	0,8	+20,0	-20,0	19,2
+20	72,810065	0	0,0	+20,0	-20,0	20,0
+30	72,810002	-63	-0,9	+20,0	-20,0	19,1
+40	72,809974	-91	-1,2	+20,0	-20,0	18,8
+50	72,809901	-164	-2,3	+20,0	-20,0	17,7

Operating frequency 72.950 MHz:



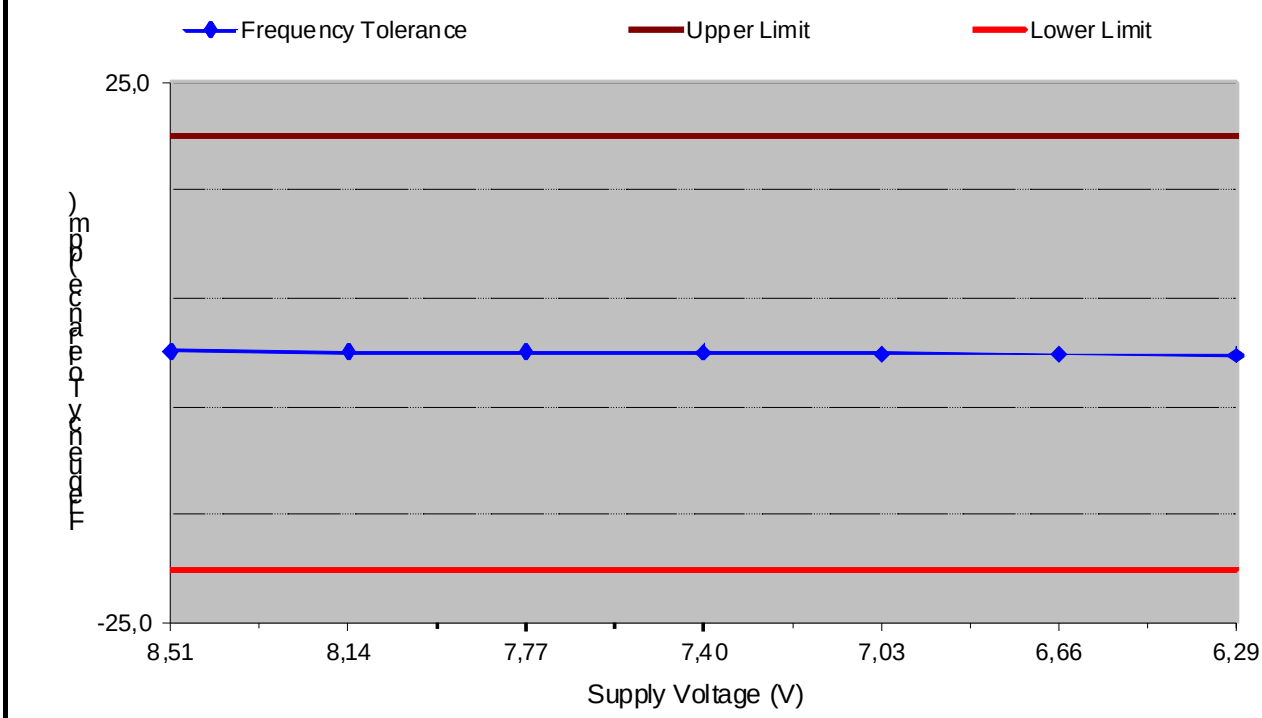
Supply voltage: 9,6 V Nominal frequency: 72,949935 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-30	72,950197	262	3,6	+20,0	-20,0	**16,4**
-20	72,950156	221	3,0	+20,0	-20,0	17,0
-10	72,950112	177	2,4	+20,0	-20,0	17,6
±0	72,950078	143	2,0	+20,0	-20,0	18,0
+10	72,950023	88	1,2	+20,0	-20,0	18,8
+20	72,949935	0	0,0	+20,0	-20,0	20,0
+30	72,949887	-48	-0,7	+20,0	-20,0	19,3
+40	72,949813	-122	-1,7	+20,0	-20,0	18,3
+50	72,949769	-166	-2,3	+20,0	-20,0	17,7

Test Result:	Test passed

8.2.2 Frequency Stability vs. Supply Voltage

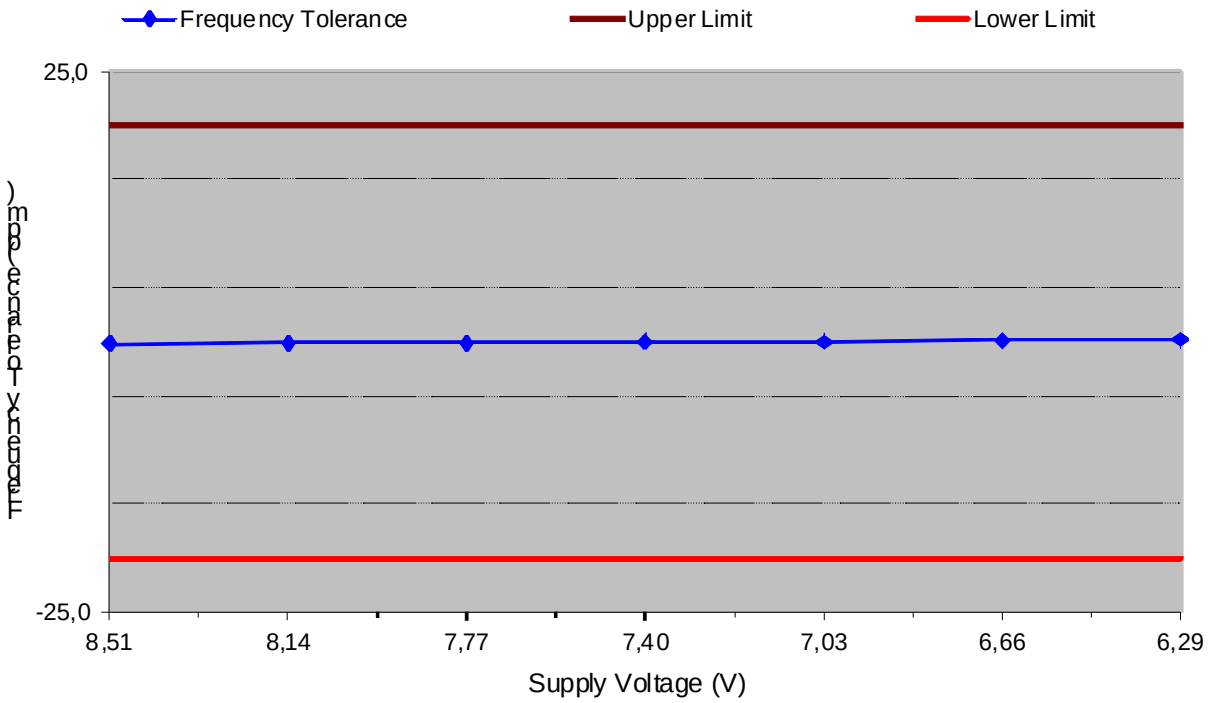
Operating frequency 72.690 MHz:



Temperature: +20 °C
Nominal frequency: 72,690059 MHz

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
8,51	72,690066	7	0,1	+20,0	-20,0	19,9
8,14	72,690064	5	0,1	+20,0	-20,0	19,9
7,77	72,690061	2	0,0	+20,0	-20,0	20,0
7,40	72,690059	0	0,0	+20,0	-20,0	20,0
7,03	72,690050	-9	-0,1	+20,0	-20,0	19,9
6,66	72,690047	-12	-0,2	+20,0	-20,0	19,8
6,29	72,690042	-17	-0,2	+20,0	-20,0	**19,8**

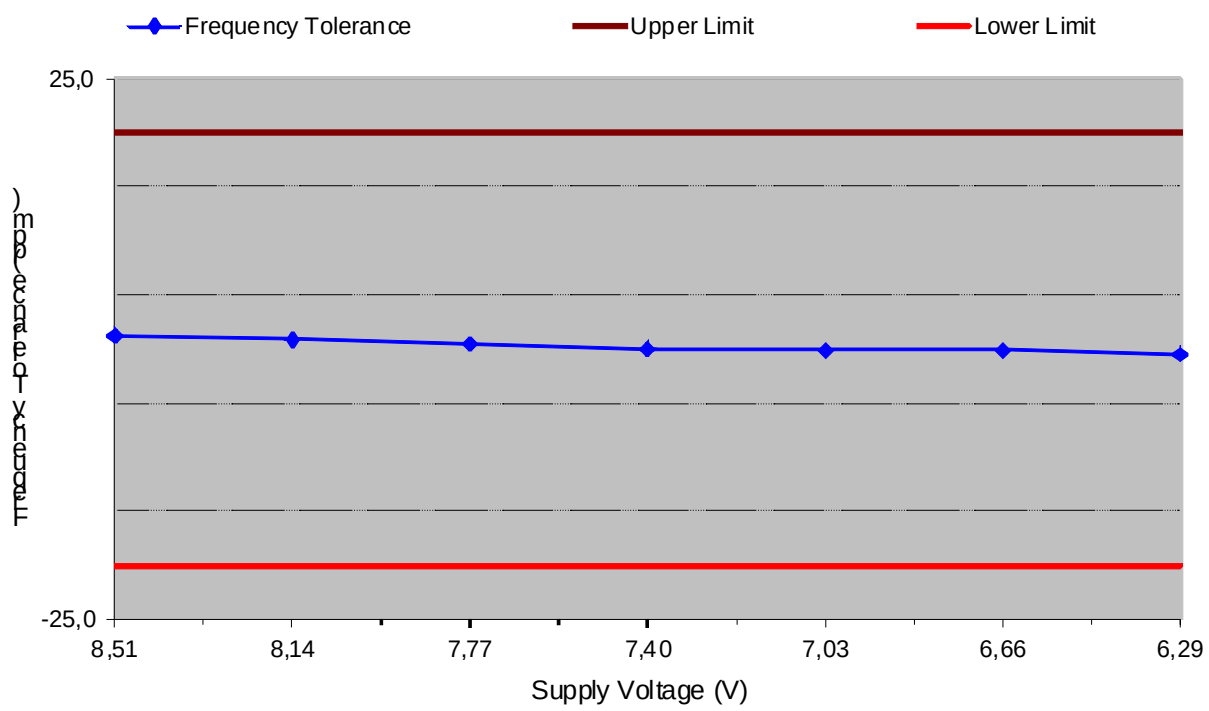
Operating frequency 72.810 MHz:



Temperature: +20 °C
Nominal frequency: 72,810065 MHz

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
8,51	72,810050	-15	-0,2	+20,0	-20,0	**19,8**
8,14	72,810057	-8	-0,1	+20,0	-20,0	19,9
7,77	72,810056	-9	-0,1	+20,0	-20,0	19,9
7,40	72,810065	0	0,0	+20,0	-20,0	20,0
7,03	72,810066	1	0,0	+20,0	-20,0	20,0
6,66	72,810075	10	0,1	+20,0	-20,0	19,9
6,29	72,810078	13	0,2	+20,0	-20,0	19,8

Operating frequency 72.950 MHz:



Temperature: +20 °C
Nominal frequency: 72,949935 MHz

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
8,51	72,950025	90	1,2	+20,0	-20,0	**18,8**
8,14	72,949997	62	0,8	+20,0	-20,0	19,2
7,77	72,949968	33	0,5	+20,0	-20,0	19,5
7,40	72,949935	0	0,0	+20,0	-20,0	20,0
7,03	72,949925	-10	-0,1	+20,0	-20,0	19,9
6,66	72,949925	-10	-0,1	+20,0	-20,0	19,9
6,29	72,949900	-35	-0,5	+20,0	-20,0	19,5

Test Result:	Test passed

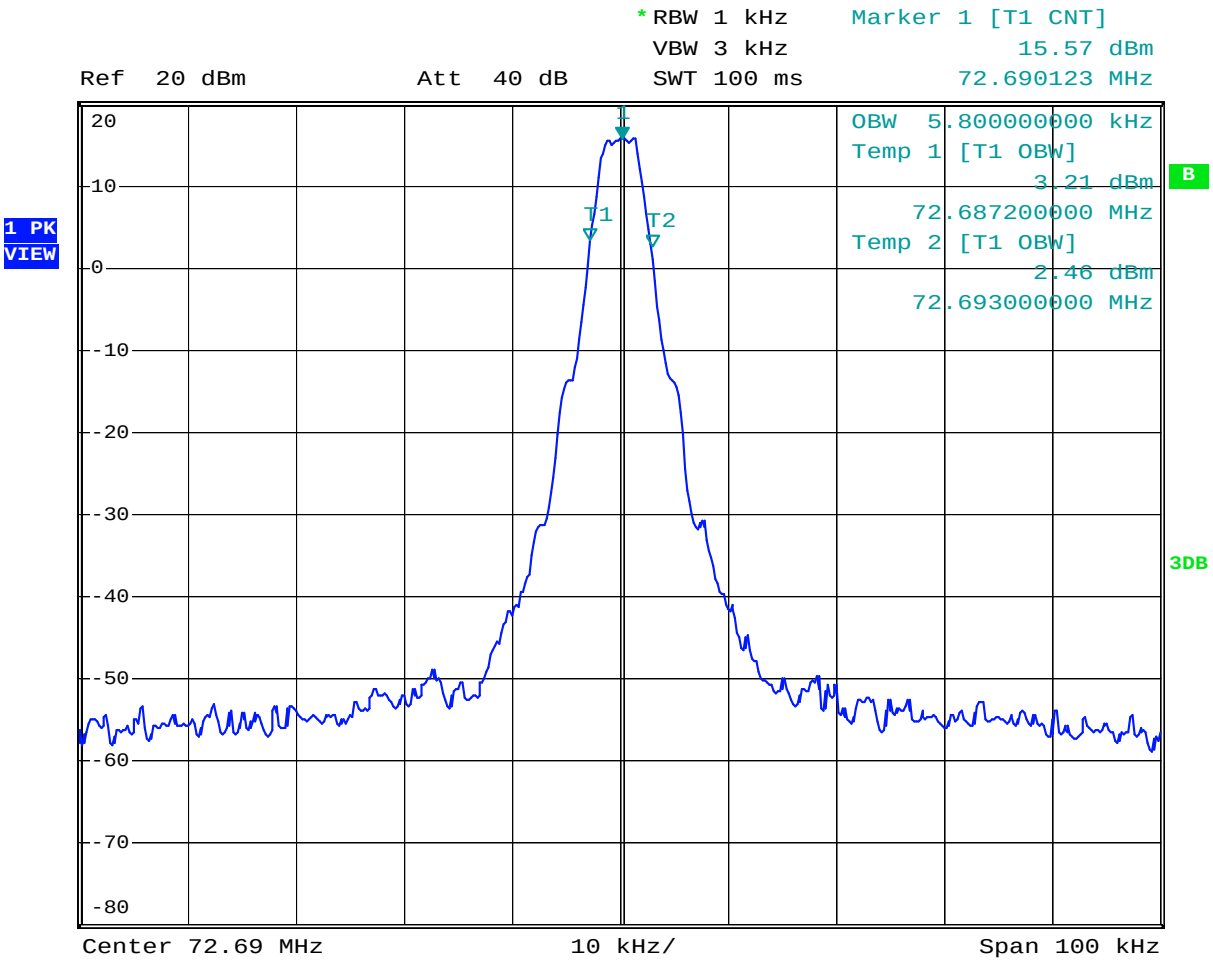
8.3 Emission Bandwidth

Rules and specifications:	CFR 47 Part 2, section 2.1046(a)
Guide:	TIA/EI-603
Limit:	Authorized bandwidth: 8 kHz
Measurement procedure:	Emission Bandwidth (6.3)

Calculation	$B_n = 2 \cdot B \cdot K$
B = modulation rage	B = 5 kHz
K = Overall numerical factor	K = 1
	$B_n = 2 \cdot 5\ kHz \cdot 1 = 10\ kHz$
Type of Emission	**10K0F1D**

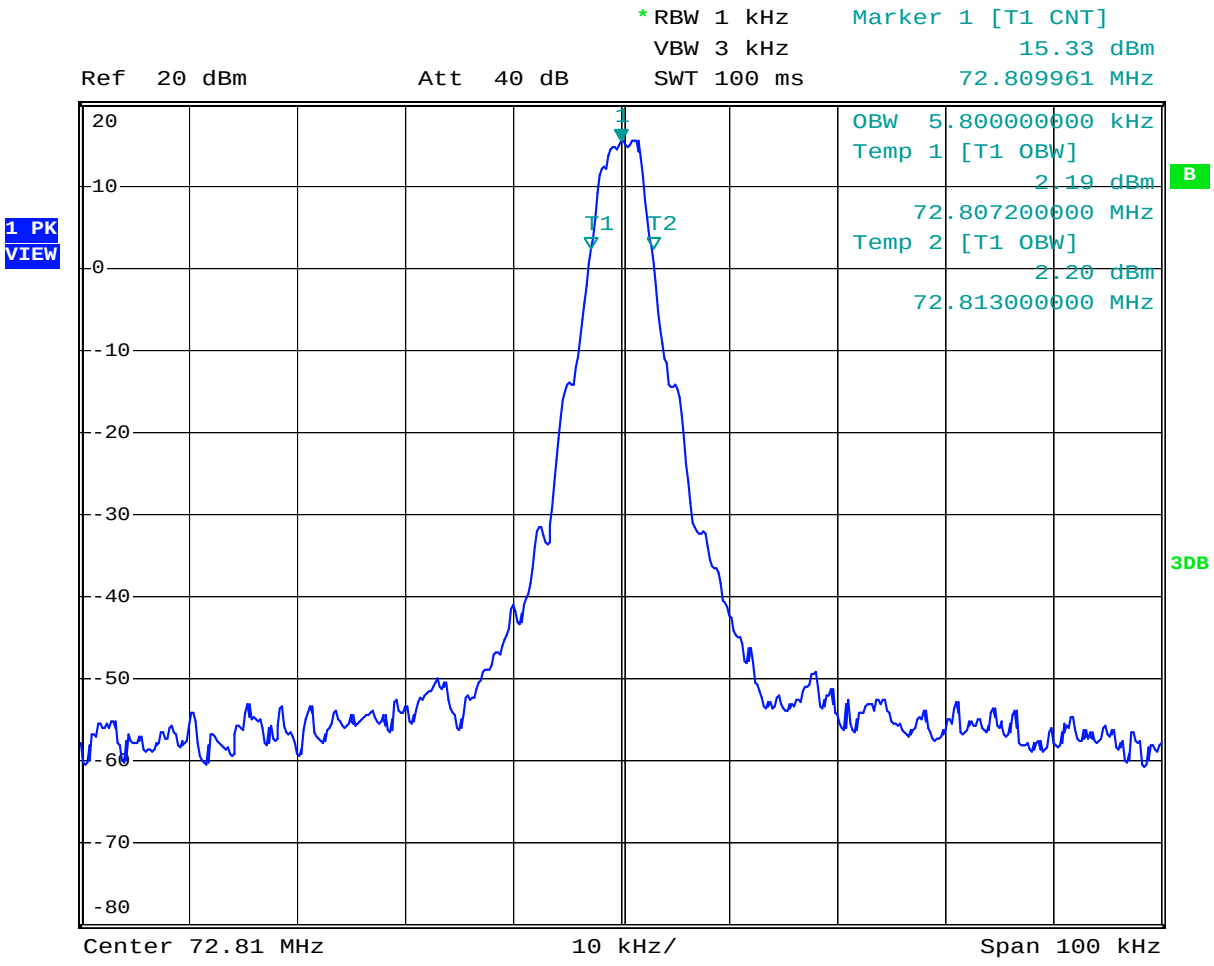
Test Result:	Test passed

Comment:	Operating frequency 72.690 MHz
Date of test:	2014-07-15



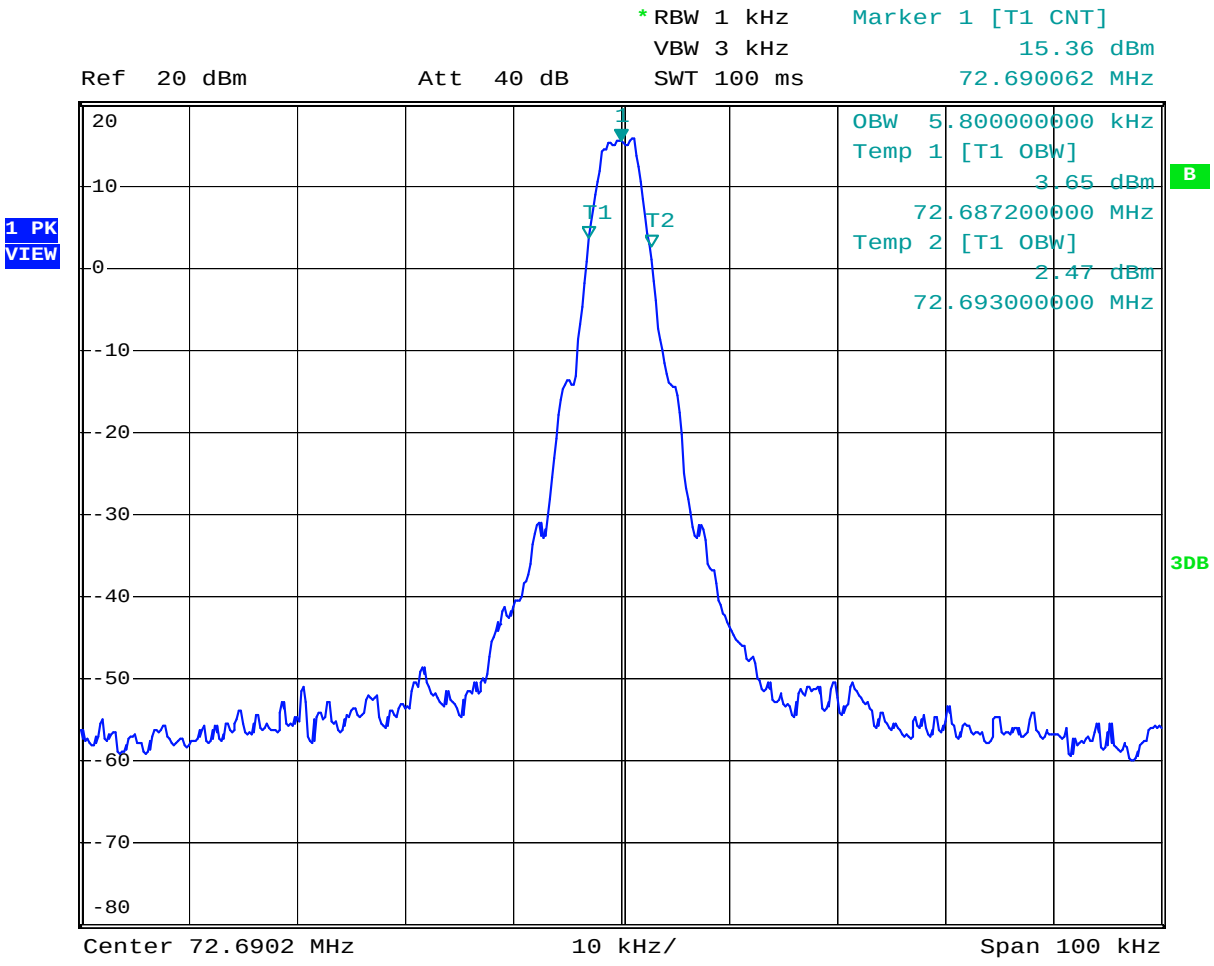
Occupied Bandwidth (99 %):	**5.80 kHz**

Comment:	Operating frequency 72.810 MHz
Date of test:	2014-07-15



Occupied Bandwidth (99 %):	**5.80 kHz**

Comment:	Operating frequency 72.950 MHz
Date of test:	2014-07-15



Occupied Bandwidth (99 %):	**5.80 kHz**

Test Result:	Test passed

8.4 Unwanted Radiation 30 MHz - 1 GHz

Rules and specifications:	CFR 47 Part 95, section 95.635
Guide:	ANSI C63.4 TIA/EIA-603, section 2.2.12
Limit:	10 log($P_{carrier}$) - 56 dB according to §95.635(b)(12) with $P_{carrier}$ as the maximum transmitter power limit in W for the unmodulated carrier according to §95.639(b)(3); that is -27.25 dBm.
Note	For calculation of correction factors see tables "Test Site Calibration Data Sheets" (supplied as additional information summarized next pages) Notch filter was tuned to operating frequencies. Final measurement was carried out on alternative test site. Pre- scans was carried out in fully anechoic room.
Measurement procedure:	Unwanted Emission 30 MHz - 1 GHz (6.4)

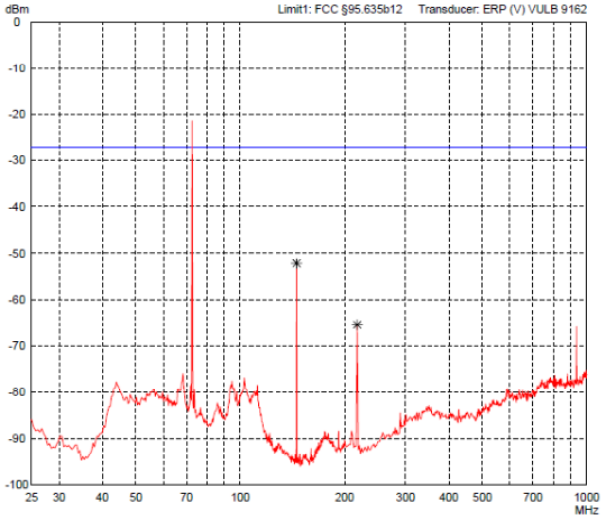
Test Result:	Test passed

Position:	EUT in vertical position
Mode:	Operating frequency 72.690 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

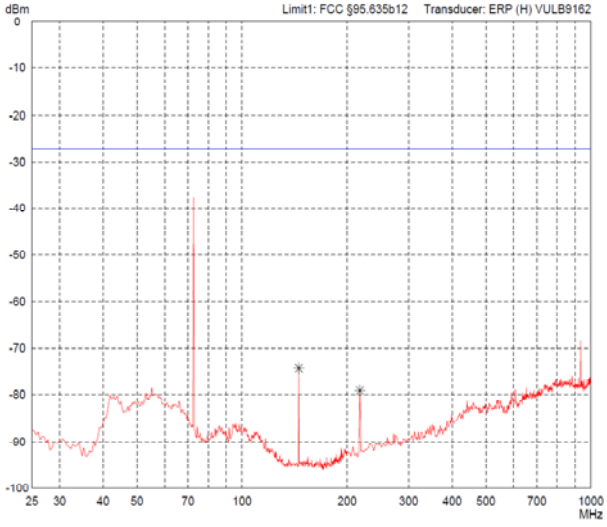
Maximum transmitter power (conducted):	25.8 dBm	0.380 W
Maximum transmitter power (radiated):	23.3 dBm	0.214 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
145,400	vertical	Peak	-71,7	19,4	-52,3	-27,3	**25,1**
217,600	vertical	Peak	-87,0	21,6	-65,5	-27,3	38,3

Antenna polarization horizontal



Antenna polarization vertical



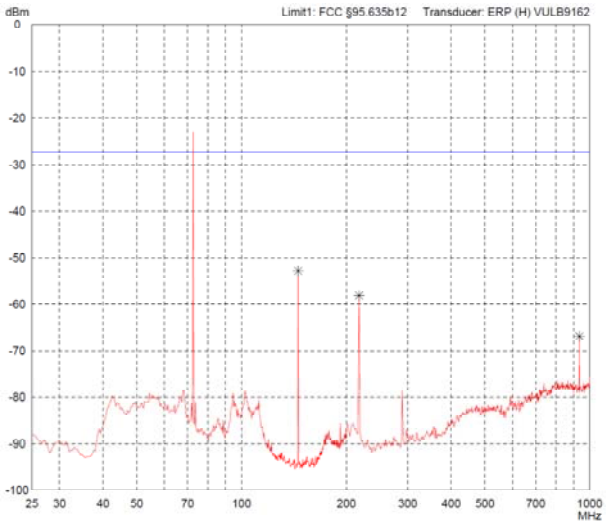
Test Result:	Test passed

Position:	EUT in horizontal position (Right side on table)
Mode:	Operating frequency 72.690 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

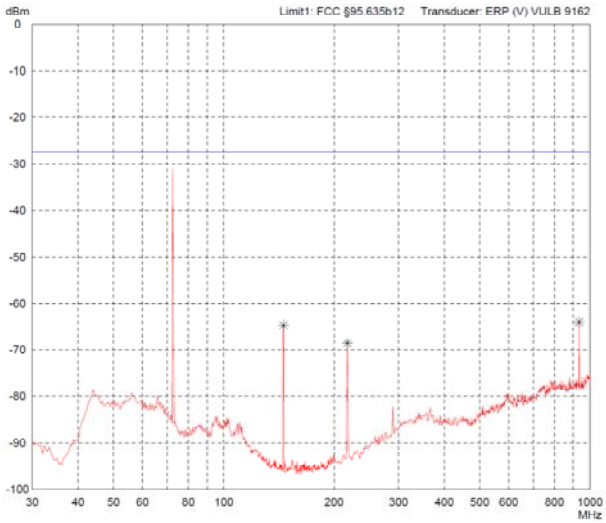
Maximum transmitter power (conducted):	25.9 dBm	0.380 W
Maximum transmitter power (radiated):	21.5 dBm	0.141 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
145,400	horizontal	Peak	-72,8	20,0	-52,8	-27,3	**25,6**
217,600	horizontal	Peak	-80,9	22,8	-58,0	-27,3	30,8

Antenna polarization horizontal



Antenna polarization vertical



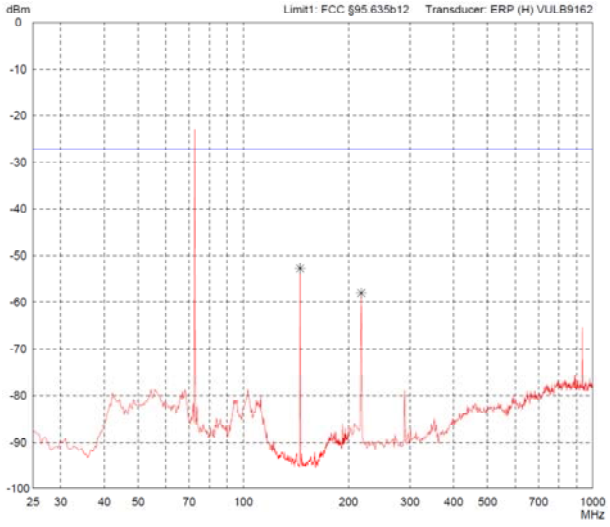
Test Result:	Test passed

Position:	EUT in horizontal position (Rear side on table)
Mode:	Operating frequency 72.690 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

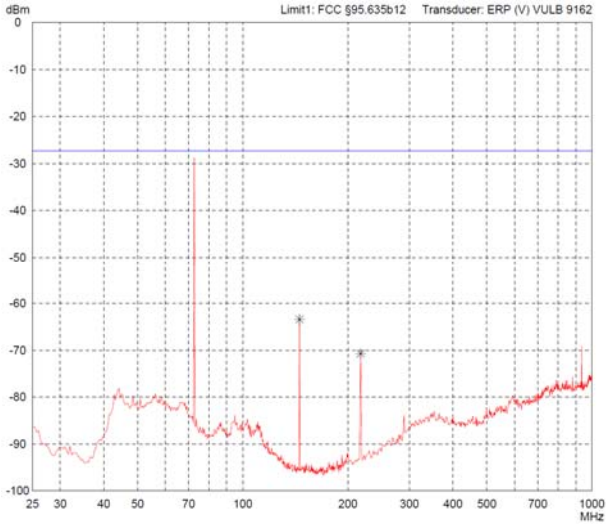
Maximum transmitter power (conducted):	25.9 dBm	0.380 W
Maximum transmitter power (radiated):	21.3 dBm	0.135 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
145,400	horizontal	Peak	-72,7	20,0	-52,7	-27,3	**25,5**
217,600	horizontal	Peak	-80,8	22,8	-58,0	-27,3	30,8

Antenna polarization horizontal



Antenna polarization vertical



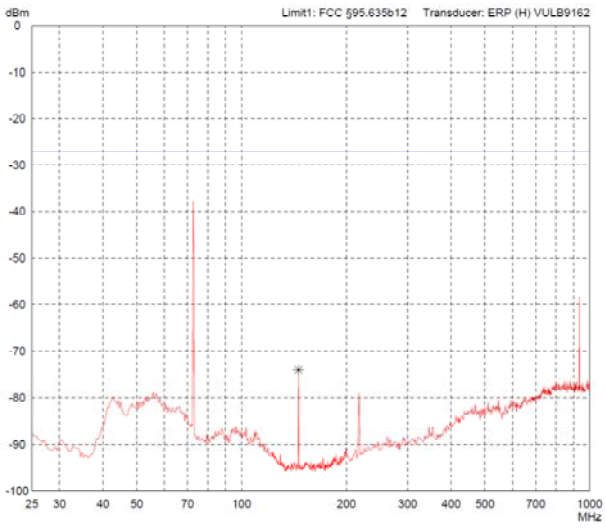
Test Result:	Test passed

Position:	EUT in vertical position
Mode:	Operating frequency 72.810 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

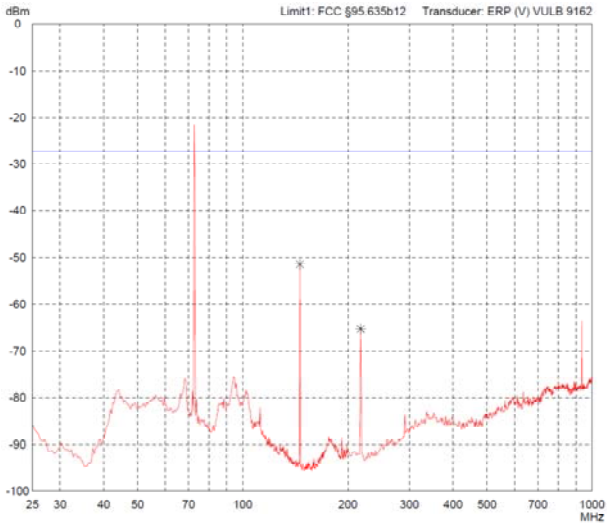
Maximum transmitter power (conducted):	25.9 dBm	0.390 W
Maximum transmitter power (radiated):	23.5 dBm	0.224 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
145,750	vertical	Peak	-70,8	19,4	-51,5	-27,3	**24,2**
217,600	vertical	Peak	-86,6	21,6	-65,2	-27,3	38,0

Antenna polarization horizontal



Antenna polarization vertical



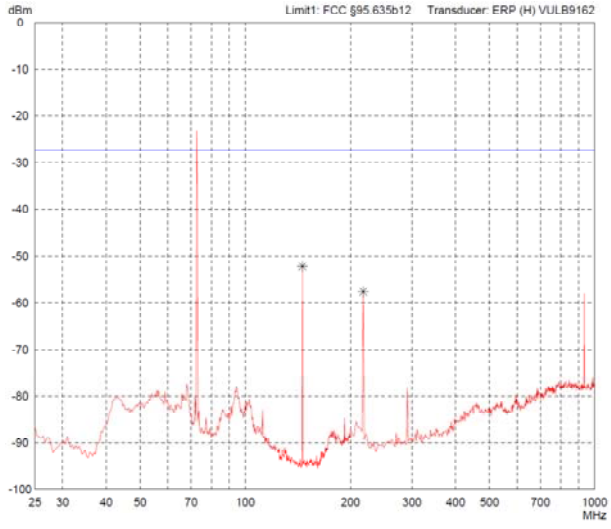
Test Result:	Test passed

Position:	EUT in horizontal position (Right side on table)
Mode:	Operating frequency 72.810 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

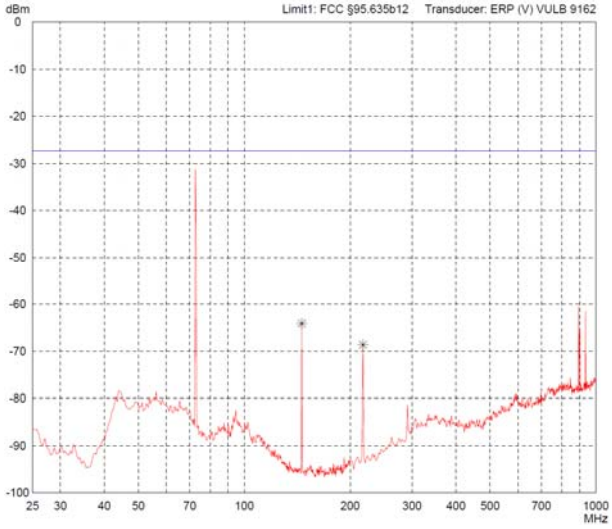
Maximum transmitter power (conducted):	25.9 dBm	0.390 W
Maximum transmitter power (radiated):	21.2 dBm	0.132 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
145,750	horizontal	Peak	-72,2	20,0	-52,2	-27,3	**25,0**
217,600	horizontal	Peak	-80,4	22,8	-57,6	-27,3	30,4

Antenna polarization horizontal



Antenna polarization vertical



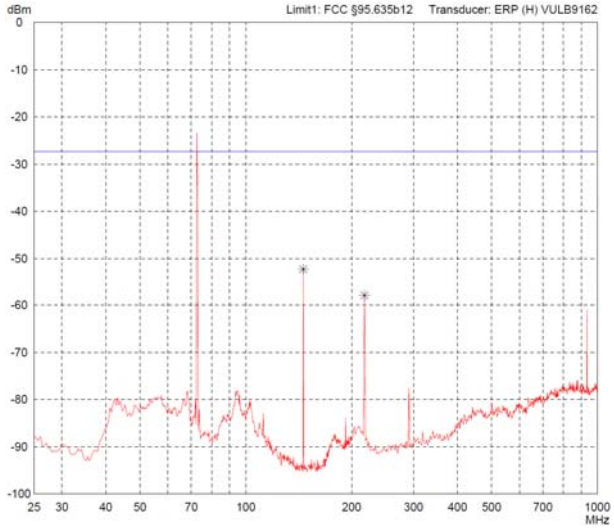
Test Result:	Test passed

Position:	EUT in horizontal position (Rear side on table)
Mode:	Operating frequency 72.810 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

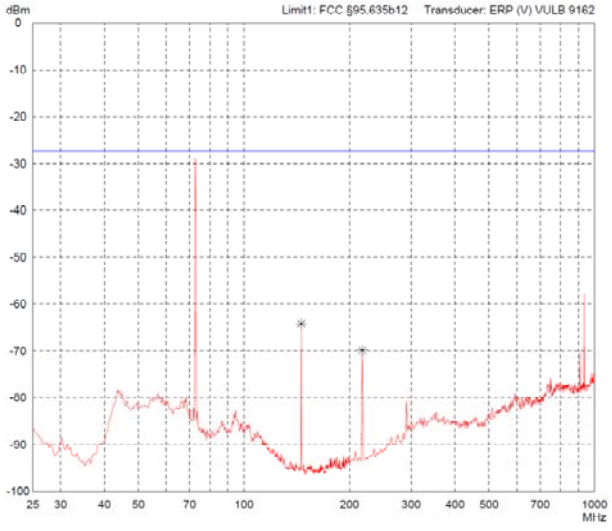
Maximum transmitter power (conducted):	25.9 dBm	0.390 W
Maximum transmitter power (radiated):	21.0 dBm	0.126 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
145,750	horizontal	Peak	-72,4	20,0	-52,4	-27,3	**25,2**
217,600	horizontal	Peak	-80,7	22,8	-57,9	-27,3	30,7

Antenna polarization horizontal



Antenna polarization vertical



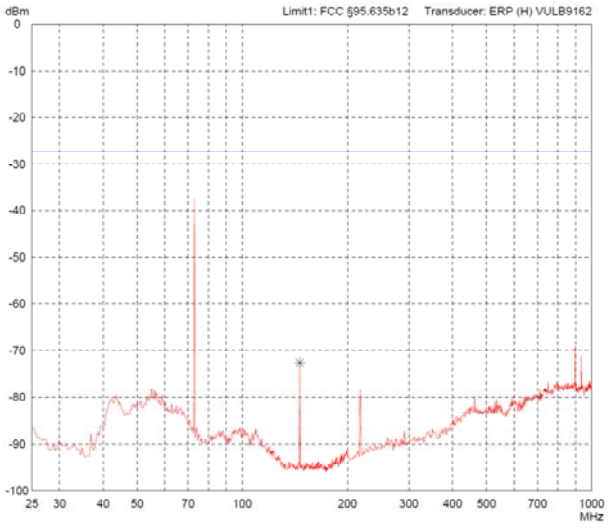
Test Result:	Test passed

Position:	EUT in vertical position
Mode:	Operating frequency 72.950 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

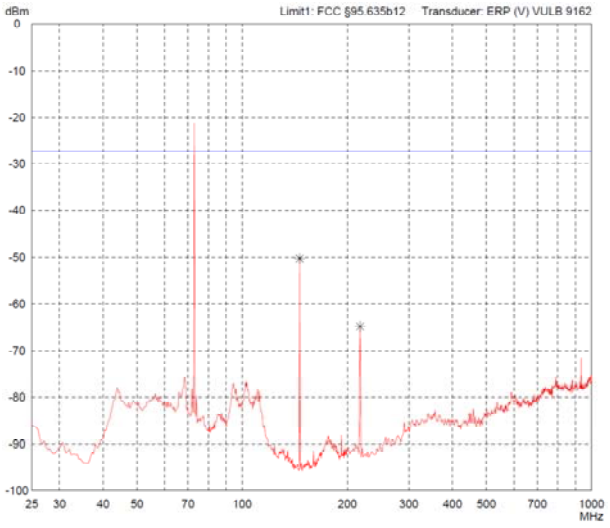
Maximum transmitter power (conducted):	26.3 dBm	0.427 W
Maximum transmitter power (radiated):	23.1 dBm	0.204 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
146,100	vertical	Peak	-69,6	19,4	-50,3	-27,3	**23,1**
217,600	vertical	Peak	-86,3	21,6	-64,8	-27,3	37,6

Antenna polarization horizontal



Antenna polarization vertical



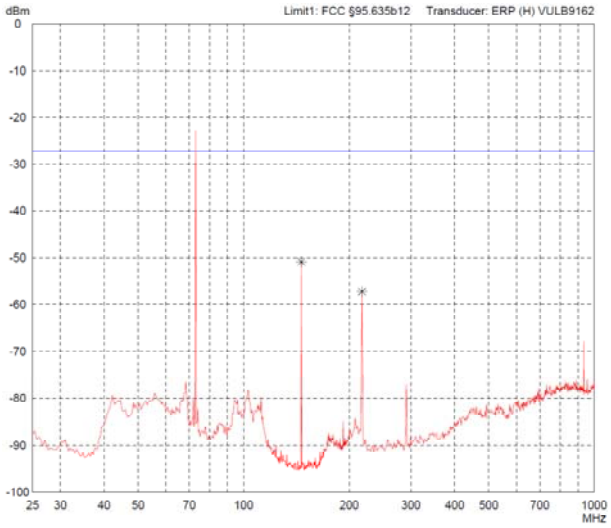
Test Result:	Test passed

Position:	EUT in vertical position
Mode:	Operating frequency 72.950 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

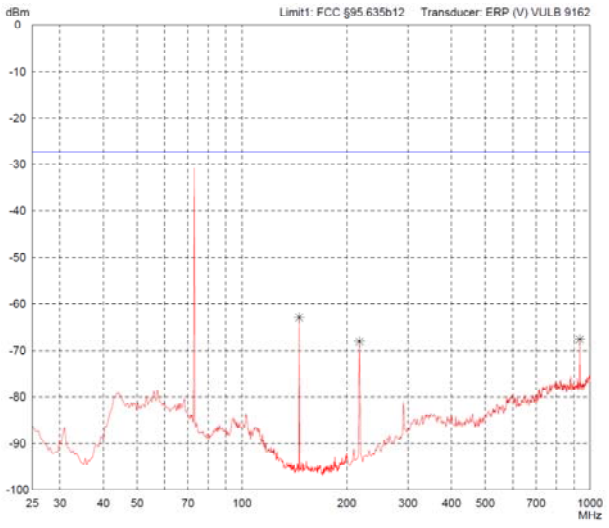
Maximum transmitter power (conducted):	26.3 dBm	0.427 W
Maximum transmitter power (radiated):	21.9 dBm	0.155 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
146,100	horizontal	Peak	-70,8	20,0	-50,8	-27,3	**23,6**
217,600	horizontal	Peak	-80,0	22,8	-57,2	-27,3	30,0

Antenna polarization horizontal



Antenna polarization vertical



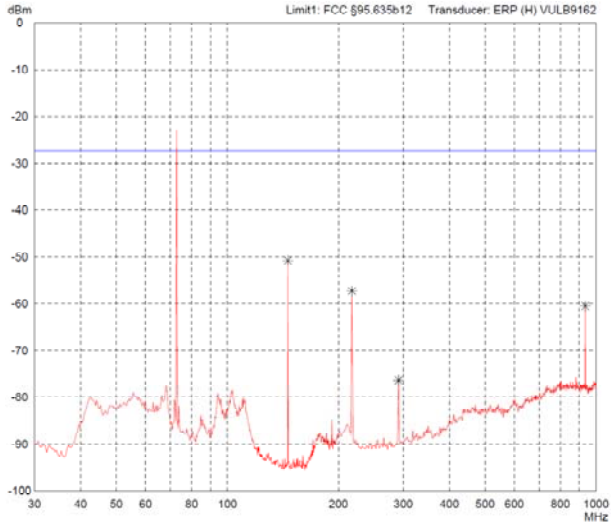
Test Result:	Test passed

Position:	EUT in vertical position
Mode:	Operating frequency 72.950 MHz
Date of test:	2014-07-15
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters

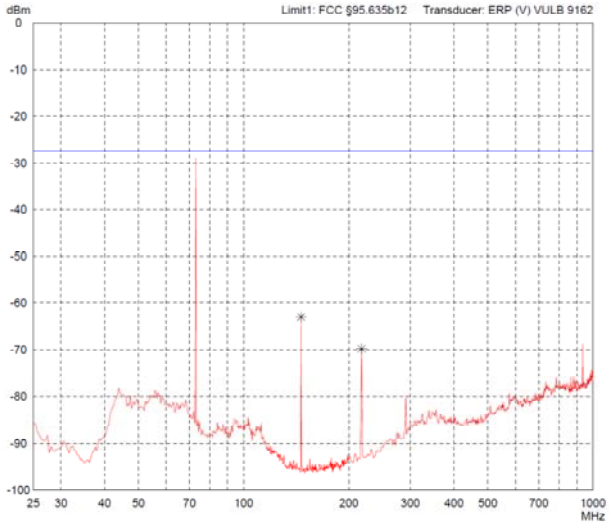
Maximum transmitter power (conducted):	26.3 dBm	0.427 W
Maximum transmitter power (radiated):	22.1 dBm	0.162 W
Calculated limit (referring to TP):	-27.25 dBm	

Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dBm)	Correction Factor (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
145,940	horizontal	Peak	-70,7	20,0	-50,8	-27,3	**23,5**
217,600	horizontal	Peak	-80,1	22,8	-57,3	-27,3	30,0
291,200	horizontal	Peak	-101,9	25,5	-76,4	-27,3	49,1

Antenna polarization horizontal



Antenna polarization vertical



Test Result:	Test passed

9 Referenced Regulations

All tests were performed with reference to the following regulations and standards:

☒	CFR 47 Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)	October 1, 2013
☒	CFR 47 Part 95 Subpart C/E	Code of Federal Regulations Part 95 (Personal Radio Services), Subpart C/E (Radio Control(R/C) Radio Service) of the Federal Communication Commission (FCC)	October 1, 2013
☒	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	December 11, 2003 (published on January 30, 2004)
☐	RSS-210	Radio Standards Specification RSS-210 Issue 7 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada	June 2007
☐	RSS-102	Radio Standards Specification RSS-102 Issue 2: Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)	November 2005
☐	ICES-003	Interference-Causing Equipment Standard ICES-003 Issue 4 for Digital Apparatus, published by Industry Canada	February 2004
☐	CISPR 22	Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, “Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement”	1997
☐	CAN/CSA-CEI/IEC CISPR 22	Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment	2002
☒	TIA/EIA-603 Revision C	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	August 17, 2004
☐	TRC-43	Notes Regarding Designation of Emission (Including Necessary Bandwidth and Classification), Class of Station and Nature of Service, published by Industry Canada	October 9, 1982

10 Test Equipment List with Calibration Data

Type	*Inv.-No.*	*Type Designation*	*Serial Number*	*Manufacturer*	*Calibration Organization*	*Last Calibration*	*Next Calibration*
EMI test receiver	1711	ESPI7	836914/0002	Rohde & Schwarz	Rohde & Schwarz	05/2014	12/2015
EMI test receiver	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	01/2014	06/2015
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	05/2014	12/2015
Preamplifier	1484	ACO/180-3530	32641	CTT	TÜV SÜD PS-EMC-STR	06/2013	06/2015
Preamplifier	1651	CPA9231A	3393	Schaffner Electrotest	TÜV SÜD PS-EMC-STR	09/2012	09/2014
Preamplifier	1684	AFS3-00100800-32-LN	847743	MITEQ	TÜV SÜD PS-EMC-STR	10/2013	04/2015
Preamplifier	1685	AMF-4D-005080-25-13P	860149	MITEQ	TÜV SÜD PS-EMC-STR	08/2013	11/2015
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	06/2014	12/2015
TRILOG Broadband Antenna	2256	VULB 9162	9162-048	Schwarzbeck	Schwarzbeck	09/2013	03/2015
Multimeter	1654	21 III	76381229	Fluke	ZMK	11/2012	11/2014
Temperature test chamber	1271	HT 4010	07065550	Heraeus	TÜV SÜD PS-EMC-STR	06/2013	06/2015
DC power supply	1267	NGSM 32/10	203	Rohde & Schwarz		see note 4	

Note 1: No calibration required.
Note 2: Not calibrated separately but with the whole test system when recording calibration data.
Note 3: No calibration required. Devices are checked before use.
Note 4: No calibration required. Devices are checked by calibrated equipment during test.

11 Revision History

Revision History			
Edition	*Date*	*Issued by*	*Modifications*
1	2014-07-17	M. Biberger	First Edition