

Produkte *Products*

Prüfbericht - Nr.:		12607283 004		Seite 1 von 49
Test Report No.:				Page 1 of 49
Auftraggeber: Client:		Sysmex Corporation* 1-5-1, Wakinohama-Kaigandori, Chuo-ku, Kobe 651-0073 Japan		
Gegenstand der Prüfung: Test item:		RFID Module		
Bezeichnung: Identification:		TR3-C202-A0-8	Serien-Nr.: Serial No.:	10000055(F)
Wareneingangs-Nr.: Receipt No.:		PT0214006750-1/-2	Eingangsdatum: Date of receipt:	2010-12-10
Prüfstandort: Testing location:		TÜV Rheinland Japan Ltd. - Global Technology Assessment Center 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan		
Prüfgrundlage: Test specification:		FCC 47 CFR Part 15, Subpart C, Section 15.225 (October 1, 2010) ANSI C63.4-2003		
RSS-210 (Issue 8): 2010 RSS-Gen (Issue 3): 2010				
Prüfergebnis: Test Result:		Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n). <i>The test item passed the test specification(s).</i>		
Prüflaboratorium: Testing Laboratory:		TÜV Rheinland Japan Ltd. - Global Technology Assessment Center 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan		
geprüft/ tested by:		kontrolliert/ reviewed by:		
2011-03-24 T. Sauter / Inspector		2011-03-24 T. Cheung / Reviewer		
Datum Date	Name/Stellung Name/Position	Unterschrift Signature	Datum Date	Name/Stellung Name/Position
Sonstiges / Other Aspects:				
This test report deals with the Permissive Change II on the existing Single Modular Approval of Intentional radiator RFID (13.56MHz). For the details, refer to Section 1: General remarks				
*License holder of FCC is TAKAYA Corporation. (661-1, Ibara-cho, Ibara-City, Okayama, 715-8503 Japan)				
Abkürzungen:	P(pass) = entspricht Prüfgrundlage F(all) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet		Abbreviations:	P(pass) = passed F(all) = failed N/A = not applicable N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.				
<i>This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.</i>				

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TEST SUMMARY

3.2.1 VOLTAGE REQUIREMENTS, FCC 15.31(E)

RESULT: PASS

3.2.2 ANTENNA REQUIREMENTS, FCC 15.203, FCC 15.204 AND RSS-GEN 7.1.2

RESULT: PASS

5.1.1 20dB BANDWIDTH, FCC 15.215(c)

RESULT: PASS

5.1.2 99% BANDWIDTH, RSS-GEN 4.6.1

5.1.3 FREQUENCY STABILITY, FCC 15.225(E), RSS-210 A2.6, RSS-GEN 4.7 AND RSS-GEN 7.2.6

RESULT: PASS*

6.1.1 MAINS TERMINAL CONTINUOUS DISTURBANCE VOLTAGE OF TRANSMITTER, FCC 15.207 AND RSS-GEN 7.2.4

RESULT: PASS

7.1.1 FUNDAMENTAL AND IN-BAND RADIATED EMISSION, FCC 15.225(A)(B)(C), RSS-210 A2.6(A)(B)(C)

RESULT: PASS

7.1.2 OUT-OF-BAND RADIATED SPURIOUS EMISSION OF TRANSMITTER BELOW 30MHz, FCC 15.225(D), FCC 15.209, RSS-210 A2.6(D), 2.1, 2.2, 2.5 AND RSS-GEN 7.2.2, 7.2.5

RESULT: PASS

7.1.3 RADIATED EMISSION, 30MHz – 1000MHz, FCC 15.225(D), FCC 15.209, RSS-210 A2.6(D), 2.1, 2.2, 2.5 AND RSS-GEN 7.2.2, 7.2.5

RESULT: PASS

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1. General Remarks

It is a permissive change project which is classified as **Permissive Change II** of the existing FCC Grant (FCC ID: MK4TR3-C202-A0-8) and IC certificate (IC: 9070A-TR3-C202-A0-8) by following modification.

1. Previously, the rated voltage DC $5V \pm 10\%$ of the RFID was tested in configuration 1. But rated voltage DC $3.3V \pm 10\%$ of the module was tested in configuration 2. Therefore, the rated voltage DC $3.3V \pm 10\%$ of the RFID will be tested in configuration 1. (Configuration 2 is not related to certification)

For the test data of receiver, refer to test report 12607283 005.

1.1 Complementary Materials

No document is attached to this test report.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. - Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 299054.

The Industry Canada has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance. The description of the test facility is listed under OATS filing number 3466B.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2005. TÜV Rheinland Japan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number JP0017 and Test Firm Registration Number 386498.

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2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equipment ID	Calibrated until
For Extreme Condition Measurement					
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	2011-02
Loop Antenna with power supply, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	2011-02
Temperature Chamber	Voetsch	VT 4018	585660250 90010	BT-8012	2011-08
DC Power Supply	Agilent	E3646A	MY400046 42	BT-8153	N/A
For Power Line Conducted Emission					
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	2011-12
LISN	Rohde & Schwarz	ENV216	100276	RF-0016	2011-06
LISN	Schwarzbeck Mess-Electronik	NSLK 8128 (4X32/50A)	8128-239	RF-0017	2011-05
For Radiated Emission					
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	2011-02
RF Selector (10m)	Toyo Corporation	NS4900	0703-182	RF-0029	2011-05
Loop Antenna with power supply, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	2011-02
Trilog Antenna, 30-1000MHz	Schwarzbeck	VULB9168	0245	RF-0019	2011-05
3dB Attenuator 50Ohm	Tamagawa Electronics Co., Ltd.	CFA-01	-	RF-0265	2011-05
Low Noise Pre-Amplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	2011-05
Constant Voltage Constant Frequency Stabilizers					
CVCF (Shielded Room)	NF Corporation	ESU2000S	9075612	RF-0210	N/A
CVCF Booster (Shielded Room)	NF Corporation	ESU2000B	9074403	RF-0211	N/A
CVCF (10m chamber)	NF Corporation	ESU2000S	9067307	RF-0212	N/A
CVCF Booster (10m chamber)	NF Corporation	ESU2000B	9074408	RF-0213	N/A

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2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Conducted Emission	150kHz - 30MHz	±3.0dB
Radiated Emission	9kHz – 30MHz	±3.99dB
	30MHz - 1GHz	±4.7dB

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3. General Product Information

3.1 Product Function and Intended Use

The **EUT** (Equipment Under Test) is a RFID module with 3 different kinds of antennas and 2 different kinds of antenna cables. Specification details are shown in section 3.2.

3.2 System Details

Specified output power:	Maximum 73.2 dBuV/m at 3m (QP)
Antenna gain:	-60dBi (TR3-A202) -65dBi (TR3-A302) -68dBi (TR3-A401)
Antenna cable:	0.5m and 3.0m
Antenna type:	Loop coil
Frequency range:	13.56MHz
Number of channels:	1
Modulation type:	AM in double-sideband ASK (Transmitter) and FSK (Receiver)
Temperature range:	0°C – +55°C
Environment:	Heavy industry environment or hospital
FCC Classification :	DXX – Part 15 Low Power Communication Device Transmitter
IC Type of Device:	RFID device
Emission designator:	A1D (Transmitter) and F1D (Receiver)
Rated voltage:	AC (100 - 240)V, (50/60)Hz (Via Switching mode power supply, accessory) DC 3.3V and DC 5.0V (for RFID module)
Rated current:	100VA max
Protection class:	III
Duty cycle for practical:	<10%

Table 3: Interfaces present on the EUT and Accessories

No.	Interface	Cable Length for Testing, Shielding	Interface Classification
1.	AC Mains input [Switching mode power supply <-> AC mains]	1.85m, non-shielded	AC Power Port
2.	DC Mains input [Switching mode power supply <-> Interface board]	0.85m, non-shielded	DC Power Port
3.	Antenna cable [Antenna <-> module]	0.5m, shielded	DC Power and Signal Port
4.	Antenna cable [Antenna <-> module]	3.0m, shielded	DC Power and Signal Port
5.	DC control cable [Module <-> Interface board]	0.15m, non-shielded	DC Power and Signal Port
6.	RS232C cable [Laptop PC <-> Interface board]	1.6m, non-shielded	Signal Port

3.2.1 Voltage Requirements, FCC 15.31(e)

RESULT:

PASS

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the power supply requirements.

3.2.2 Antenna Requirements, FCC 15.203, FCC 15.204 and RSS-Gen 7.1.2

RESULT:

PASS

The antennas are to be installed inside the host and not to be user accessible. Hence they comply with the requirement.

3.3 Clock Frequencies

The highest clock frequency generated by the EUT is 13.56 MHz for the module.

3.4 Independent Operation Modes

The system was configured for testing with the test jig (interface board), Laptop PC and Switching mode power supply.

Testing was performed at the operating frequency (13.56MHz) in the following operation modes:

- A. Continuously transmitting (Tx) mode, 13.56MHz (RFID) in ASK 10% modulation according to ISO 15693 (1/4)
- B. Continuously transmitting (Tx) mode, 13.56MHz (RFID) in ASK 100% modulation according to ISO 15693 (1/4)
- C. Continuously transmitting (Tx) mode, 13.56MHz (RFID) in un-modulated signal.
- D. Continuously communication with Tag. Transmitting signal in ASK then receiving in FSK.
- E. Normal Operation (The EUT is repeating the analyzing with the sample solution. Each tube is analyzed around 70 sec. The data of the Tag will be checked in 10-20ms. There are 9 times tag readings per (around) 60sec. During the measurement, the stored test data is sent to the PC through the USB hub and USB cable.)
- F. Normal Operation (The EUT is repeating the analyzing with the sample solution. Each tube is analyzed around 70 sec continuously reading the Tag in 10-20ms. The time interval between each reading is 0.8-0.9sec. During the measurement, the stored test data is sent to the PC through the USB hub and USB cable.)
- G. Stand-By (The EUT is powered, and waiting for a start command.)

Test configurations:

1: Module tested in stand-alone basis

2: Module installed inside host (not tested for this time. For the details, refer to 12607283 002 report.)

Note: Only mode A, B and C are considered in this test report. Modes D to G are not tested.

3.5 Noise Suppressing Parts

Details refer to the schematic.

4. Test Set-up and Operation Modes

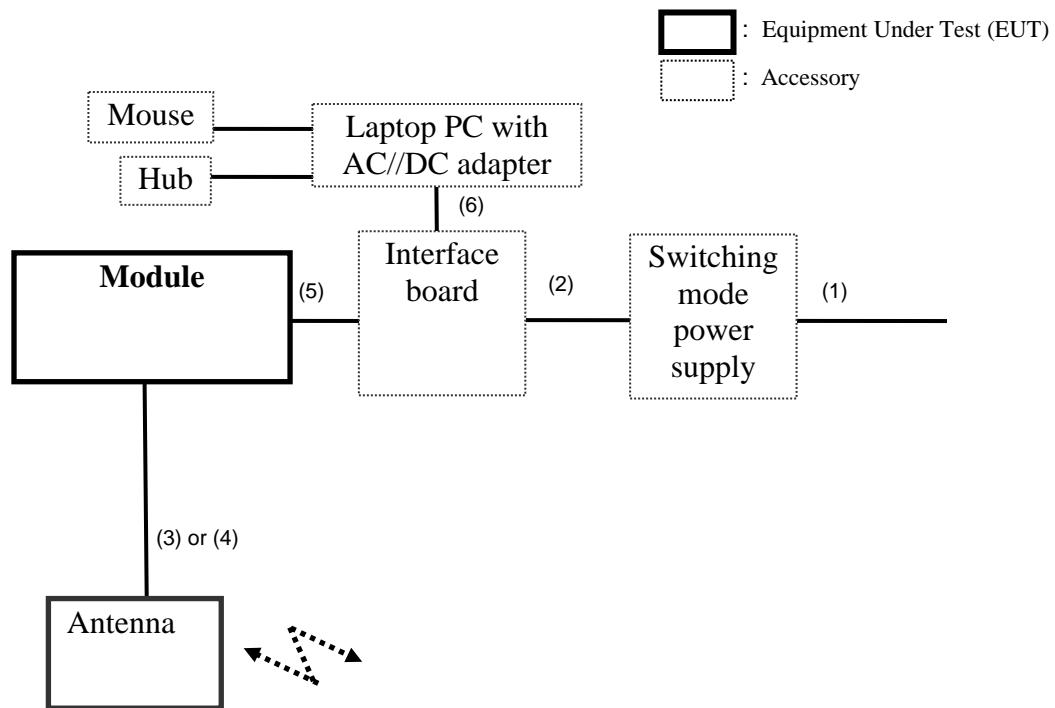
4.1 Test Methodology

The test methodology and test methods, which have been used, are based on ANSI C63.4-2003, RSS-210 (Issue 8):2010 and RSS-Gen (Issue 3):2010.

For details, see under each test item.

4.2 Physical Configuration for Testing

Figure 1: Test configuration 1



Remark: The module has 8 antennas, but only one was connected for testing since two or more antennas cannot operate simultaneously.

For more details, refer to section: Photographs of the Test Set-Up.

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4.3 Test Operation and Test Software

Software TR3RWManagerV100 is used for module in PC.

4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Test jig
Manufacturer: Sysmex Corporation.
Model: PCBNO.90013
Rated Voltage: DC 5V via USB cable
2. Product: Laptop PC
Manufacturer: DELL
Model: PP17L (Latitude D510)
Rated Voltage: 19.5VDC
Input Current: 4.62A (max.)
Serial Number: CN-0N8829-48643-58Q-1575
3. Product: AC/DC adaptor of PC
Manufacturer: DELL
Model: DA65NS0-00
Rated Voltage: 100-240VAC
Input Current: 1.5A
Frequency: 50-60Hz
Serial Number: CN-0CF745-48661-94Q-02HZ-A05
4. Product: Switching mode power supply
Manufacturer: TRACO POWER
Model: TXL060-0512D1
Rated Voltage: 100-240VAC
Input Current: 1.8A max.
Frequency: 47-63Hz
Serial Number: 09104055 706-021R
5. Product: Ethernet Hub
Manufacturer: Buffalo
Model: Giga Switching Hub, LSW3-GT-5NS(D1)
Rated Voltage: AC 100V
Input Power: 5W
Frequency: 50/60Hz
Protection Class: II
Serial Number: 16485784211186

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6. Product: Mouse
Manufacturer: Elecom
Model: M-GRUP2RWH
Rated Voltage: DC 5V
Protection Class: III
Serial Number: 5091402399A

7. Product: Mouse
Rated Voltage: DC 5V
Protection Class: III
Serial Number: 047003646

4.5 Countermeasures to achieve EMC Compliance

No Countermeasures used to achieve compliance.

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5. Test Results RADIO Requirements

5.1 Transmitter Parameters

5.1.1 20dB Bandwidth, FCC 15.215(c)

RESULT: Pass

Date of testing: 2011-01-18

Ambient temperature: 23°C

Relative humidity: 24%

Atmospheric pressure: 1012hPa

Operation mode: A and B

Requirements:

The 20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

In the present case, the frequency band is from 13.110MHz to 14.010MHz, therefore the 20dB bandwidth should be maintained within this frequency band.

Test procedure:

ANSI C63.4-2003

Measurement was done in a radiated way with a loop antenna connected to a spectrum analyzer. Measurement was performed with a suitable span to encompass the peak of the fundamental and using the following settings: RBW = 1kHz, VBW = 3kHz.

Remark:

There is no difference in the result between 0.5m and 3m antenna cables. Therefore, 0.5m cable was tested.

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Table 4: 20dB Bandwidth Edge Frequencies

Type of Antenna	Operation Mode	Operation Frequency [MHz]	Edge Frequency [MHz]		Limit [MHz]		Margin [MHz]	
			Low	High	Low	High	Low	High
TR3-A202	A	13.56	13.558	13.562	13.110	14.010	0.448	0.448
TR3-A202	B	13.56	13.558	13.562			0.448	0.448
TR3-A302	A	13.56	13.558	13.562			0.448	0.448
TR3-A302	B	13.56	13.558	13.562			0.448	0.448
TR3-A401	A	13.56	13.558	13.562			0.448	0.448
TR3-A401	B	13.56	13.558	13.562			0.448	0.448

Table 5: 20dB Bandwidth

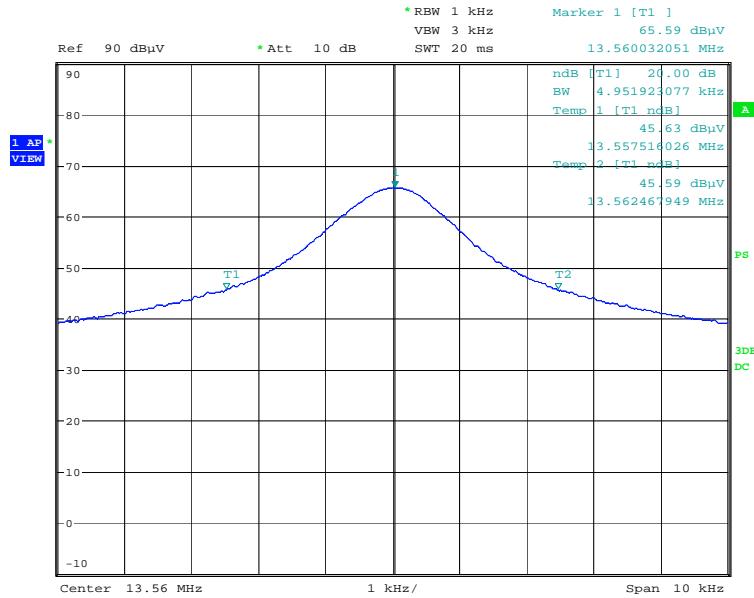
Type of antenna	Operation mode	Operating Frequency [MHz]	20dB Bandwidth [kHz]
TR3-A202	A	13.56	4.952
TR3-A202	B	13.56	4.968
TR3-A302	A	13.56	4.487
TR3-A302	B	13.56	4.455
TR3-A401	A	13.56	4.647
TR3-A401	B	13.56	4.679

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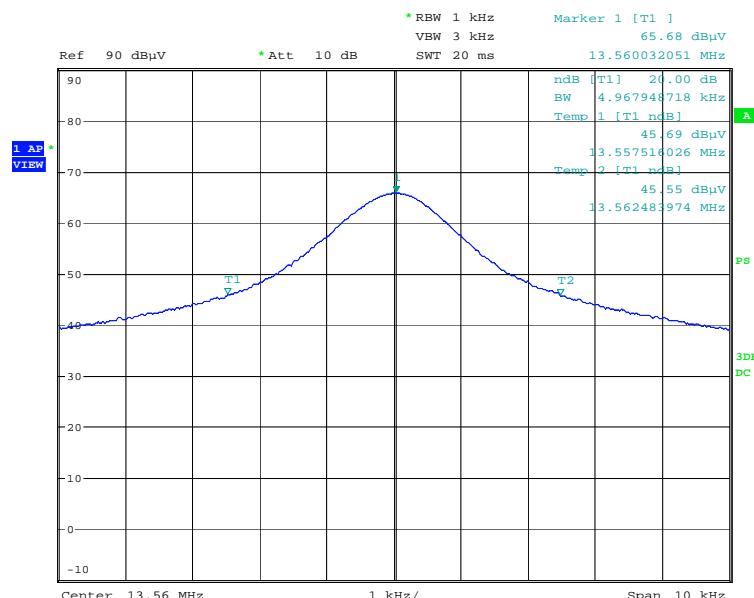
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Figure 2: 20dB Bandwidth, Mode A, TR3-A202



20dB Bandwidth, Mode A, Antenna TR3-A-202
Date: 18.JAN.2011 15:38:03

Figure 3: 20dB Bandwidth, Mode B, TR3-A202



20dB Bandwidth, Mode B, Antenna TR3-A-202
Date: 18.JAN.2011 15:39:44

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Figure 4: 20dB Bandwidth, Mode A, TR3-A302

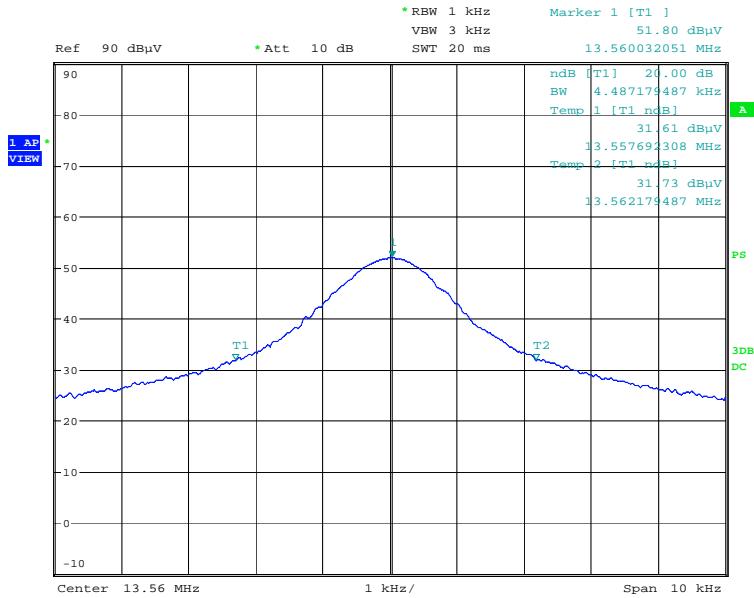
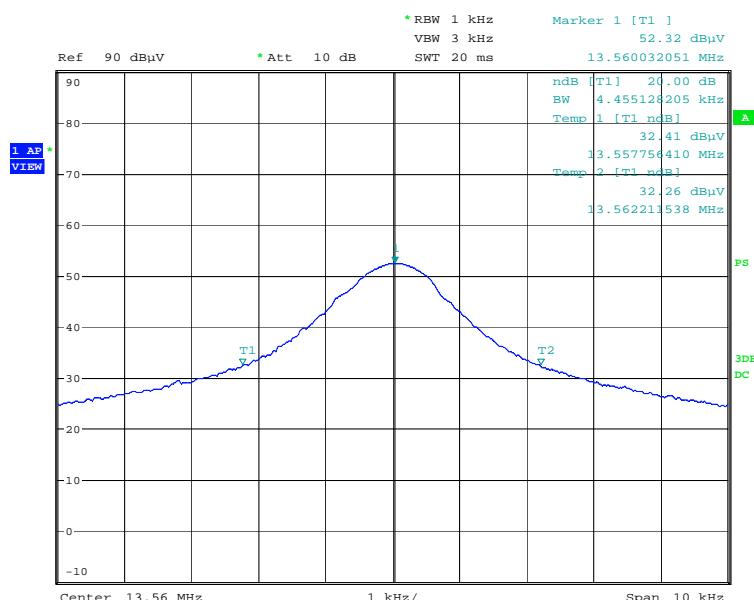


Figure 5: 20dB Bandwidth, Mode B, TR3-A302



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Figure 6: 20dB Bandwidth, Mode A, TR3-A401

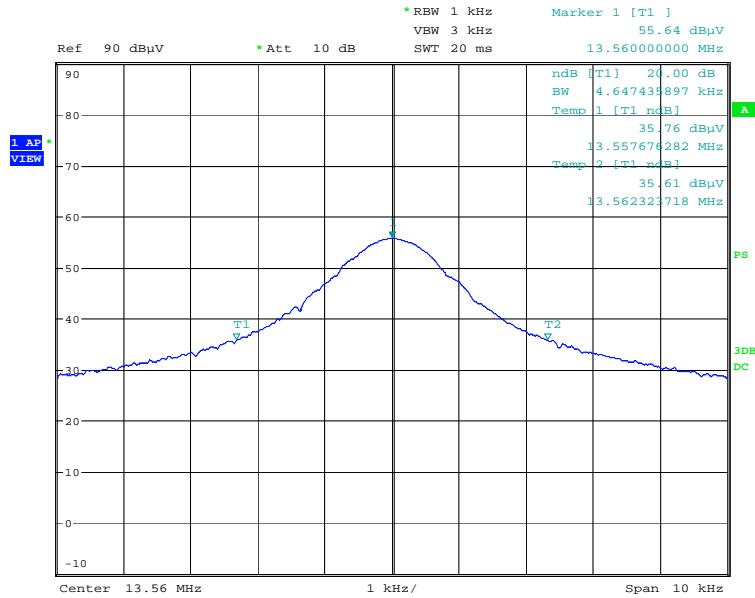
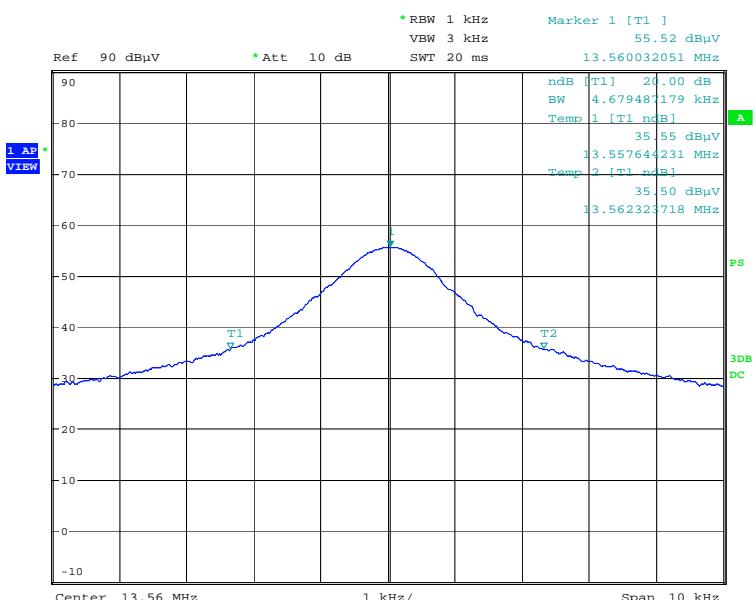


Figure 7: 20dB Bandwidth, Mode B, TR3-A401



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5.1.2 99% Bandwidth, RSS-Gen 4.6.1

Date of testing: 2011-01-18

Ambient temperature: 23°C

Relative humidity: 24%

Atmospheric pressure: 1012hPa

Operation mode: A and B

Requirements:

The 99% bandwidth shall be reported according to RSS-Gen 4.6.1.

Test procedure:

RSS-Gen 4.6.1

Measurement was done in a radiated way with a loop antenna connected to a spectrum analyzer. The spectrum analyzer resolution bandwidth (100Hz) corresponded to 1% of the span (10kHz). The 99% bandwidth was measured by using the OBW function of the analyzer with a 99% coverage setting.

Remark:

There is no difference in the result between 0.5m and 3m antenna cables. Therefore, 0.5m cable was tested.

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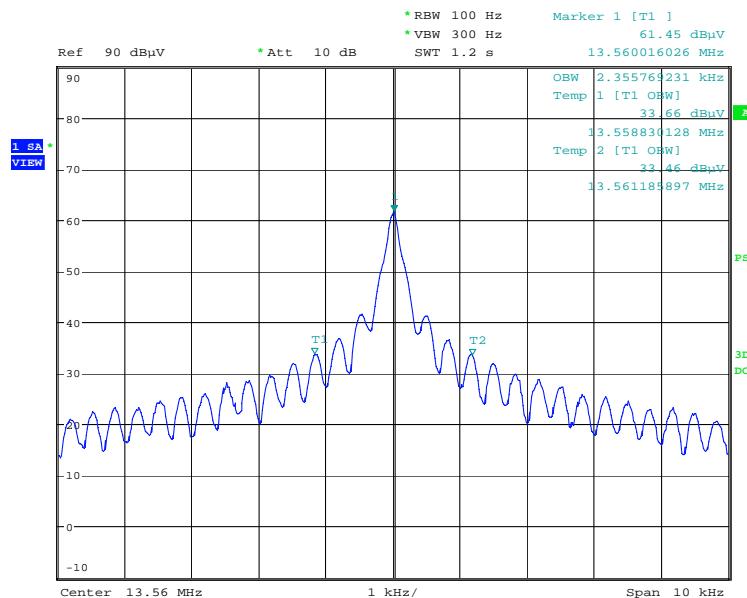
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Table 6: 99% Bandwidth

Type of antenna	Operation mode	Operating Frequency [MHz]	99% Bandwidth [kHz]
TR3-A202	A	13.56	2.356
TR3-A202	B	13.56	2.388
TR3-A302	A	13.56	2.372
TR3-A302	B	13.56	2.372
TR3-A401	A	13.56	2.292
TR3-A401	B	13.56	2.340

Figure 8: 99% Bandwidth, Mode A, TR3-A202



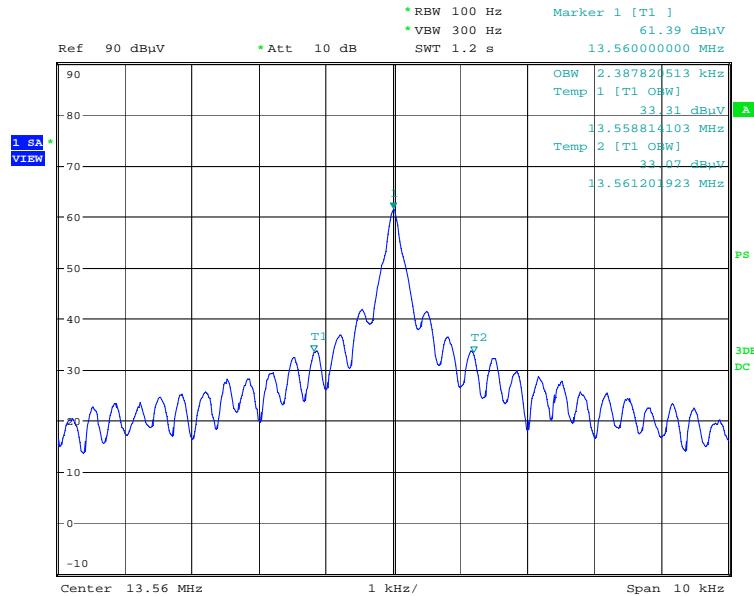
99% Bandwidth, Mode A, Antenna TR3-A202
Date: 18.JAN.2011 15:10:24

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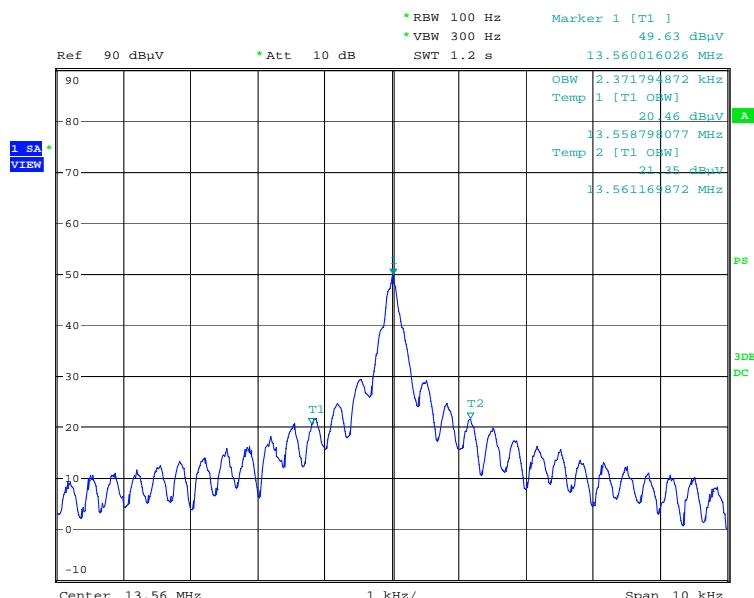
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Figure 9: 99% Bandwidth, Mode B, TR3-A202



99% Bandwidth, Mode B, Antenna TR3-A202
Date: 18.JAN.2011 15:12:00

Figure 10: 99% Bandwidth, Mode A, TR3-A302



99% Bandwidth, Mode A, Antenna TR3-A302
Date: 18.JAN.2011 15:15:09

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Figure 11: 99% Bandwidth, Mode B, TR3-A302

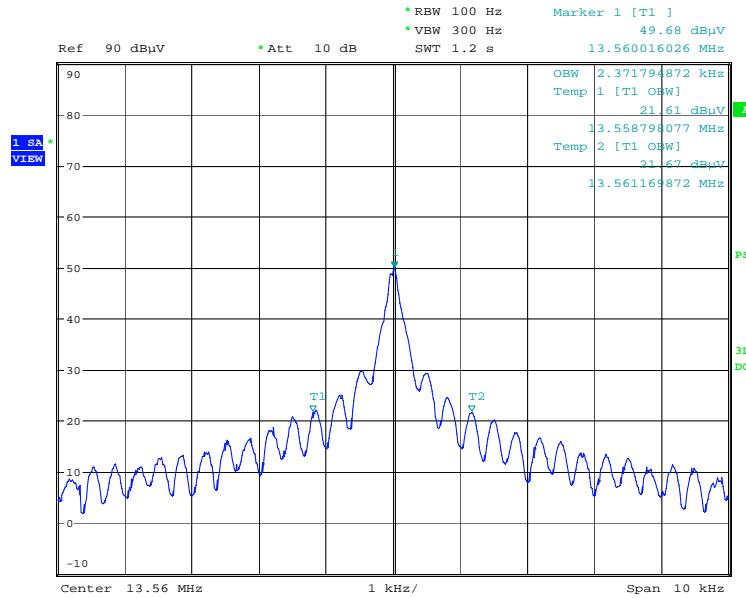
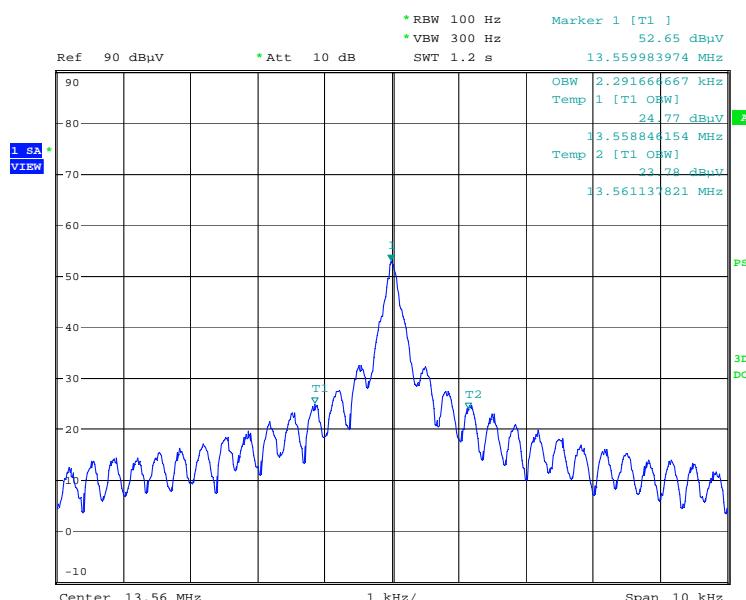


Figure 12: 99% Bandwidth, Mode A, TR3-A401

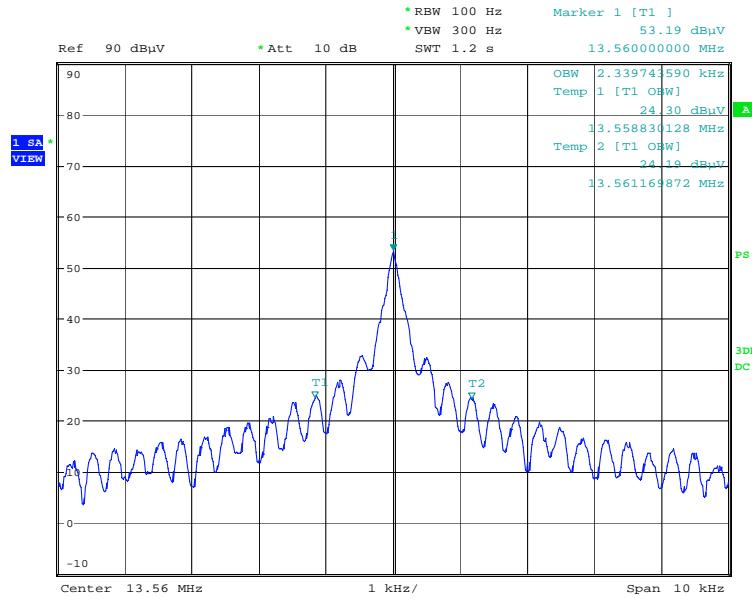


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Figure 13: 99% Bandwidth, Mode B, TR3-A401



99% Bandwidth, Mode B, Antenna TR3-A401
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5.1.3 Frequency Stability, FCC 15.225(e), RSS-210 A2.6, RSS-Gen 4.7 and RSS-Gen 7.2.6

RESULT:

PASS*

Date of testing: 2011-01-18

Ambient temperature: 23°C

Relative humidity: 24%

Atmospheric pressure: 1012hPa

Low test voltage: DC 2.97V

Normal test voltage: DC 3.3V

High test voltage: DC 3.63V

Lowest test temperature: 0°C*

Normal test temperature: 20°C

Highest test temperature: 55°C

Operation mode: C

Requirements:

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over customer defined temperature variation of 0°C to +55°C at normal supply voltage, and for a variation in the customer defined supply voltage from 90% to 110% of the rated supply voltage at a temperature of 20°C. ***It is passed with condition. Manufacturer shall state these operating conditions (rated voltage and temperature range) in the User Manual as it is different to specification in FCC 15.225(e) and RSS-Gen 4.7 and 7.2.6.**

Test procedure:

ANSI C63.4-2003 and RSS-Gen 4.7

The EUT was placed inside a temperature chamber and the frequency of the carrier signal was measured with a loop antenna placed near the EUT outside the temperature chamber.

Measurements were performed for 0°C, 20°C and 55°. Measurements started after the temperature was sufficiently stabilized and were performed at start-up of the EUT, and then after 2, 5 and 10 minutes.

This test was then repeated at a temperature of 20°C for a variation of $\pm 10\%$ of the input voltage. Voltage variations were done by a tunable power supply connected at the DC power port of the EUT.

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Remark:

There is no result difference between 0.5m and 3m antenna cables.

Table 7: Frequency Stability at 55°C and DC 3.3V, TR3-A202

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.55994	0.00044	0.01	Pass
2	13.56	13.55994	0.00044	0.01	Pass
5	13.56	13.55994	0.00044	0.01	Pass
10	13.56	13.55994	0.00044	0.01	Pass

Table 8: Frequency Stability at 20°C and DC 2.97V, TR3-A202

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56002	0.00015	0.01	Pass
2	13.56	13.56002	0.00015	0.01	Pass
5	13.56	13.56002	0.00015	0.01	Pass
10	13.56	13.56002	0.00015	0.01	Pass

Table 9: Frequency Stability at 20°C and DC 3.3V, TR3-A202

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56002	0.00015	0.01	Pass
2	13.56	13.56002	0.00015	0.01	Pass
5	13.56	13.56002	0.00015	0.01	Pass
10	13.56	13.56002	0.00015	0.01	Pass

Table 10: Frequency Stability at 20°C and DC 3.63V, TR3-A202

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56003	0.00022	0.01	Pass
2	13.56	13.56003	0.00022	0.01	Pass
5	13.56	13.56003	0.00022	0.01	Pass
10	13.56	13.56002	0.00015	0.01	Pass

Table 11: Frequency Stability at 0°C and DC 3.3V, TR3-A202

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56005	0.00037	0.01	Pass
2	13.56	13.56006	0.00044	0.01	Pass
5	13.56	13.56005	0.00037	0.01	Pass
10	13.56	13.56006	0.00044	0.01	Pass

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Table 12: Frequency Stability at 55°C and DC 3.3V, TR3-A302

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.55994	0.00044	0.01	Pass
2	13.56	13.55994	0.00044	0.01	Pass
5	13.56	13.55994	0.00044	0.01	Pass
10	13.56	13.55994	0.00044	0.01	Pass

Table 13: Frequency Stability at 20°C and DC 2.97V, TR3-A302

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56002	0.00015	0.01	Pass
2	13.56	13.56000	0	0.01	Pass
5	13.56	13.56000	0	0.01	Pass
10	13.56	13.56000	0	0.01	Pass

Table 14: Frequency Stability at 20°C and DC 3.3V, TR3-A302

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56002	0.00015	0.01	Pass
2	13.56	13.56002	0.00015	0.01	Pass
5	13.56	13.56002	0.00015	0.01	Pass
10	13.56	13.56002	0.00015	0.01	Pass

Table 15: Frequency Stability at 20°C and DC 3.63V, TR3-A302

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56002	0.00015	0.01	Pass
2	13.56	13.56002	0.00015	0.01	Pass
5	13.56	13.56002	0.00015	0.01	Pass
10	13.56	13.56002	0.00015	0.01	Pass

Table 16: Frequency Stability at 0°C and DC 3.3V, TR3-A302

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56005	0.00037	0.01	Pass
2	13.56	13.56005	0.00037	0.01	Pass
5	13.56	13.56006	0.00044	0.01	Pass
10	13.56	13.56005	0.00037	0.01	Pass

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Table 17: Frequency Stability at 55°C and DC 3.3V, TR3-A401

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.55994	0.00044	0.01	Pass
2	13.56	13.55994	0.00044	0.01	Pass
5	13.56	13.55994	0.00044	0.01	Pass
10	13.56	13.55995	0.00037	0.01	Pass

Table 18: Frequency Stability at 20°C and DC 2.97V, TR3-A401

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56000	0	0.01	Pass
2	13.56	13.56002	0.00015	0.01	Pass
5	13.56	13.56002	0.00015	0.01	Pass
10	13.56	13.56002	0.00015	0.01	Pass

Table 19: Frequency Stability at 20°C and DC 3.3V, TR3-A401

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56002	0.00015	0.01	Pass
2	13.56	13.56002	0.00015	0.01	Pass
5	13.56	13.56002	0.00015	0.01	Pass
10	13.56	13.56002	0.00015	0.01	Pass

Table 20: Frequency Stability at 20°C and DC 3.63V, TR3-A401

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56003	0.00022	0.01	Pass
2	13.56	13.56003	0.00022	0.01	Pass
5	13.56	13.56002	0.00015	0.01	Pass
10	13.56	13.56003	0.00022	0.01	Pass

Table 21: Frequency Stability at 0°C and DC 3.3V, TR3-A401

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.56005	0.00037	0.01	Pass
2	13.56	13.56005	0.00037	0.01	Pass
5	13.56	13.56005	0.00037	0.01	Pass
10	13.56	13.56006	0.00044	0.01	Pass

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6. Test Results Conducted Emission

6.1 Conducted Emission of Transmitter

6.1.1 Mains Terminal Continuous Disturbance Voltage of Transmitter, FCC 15.207 and RSS-Gen 7.2.4

RESULT: PASS

Date of testing: 2011-01-11

Ambient temperature: 23°C

Relative humidity: 27%

Atmospheric pressure: 1007hPa

Frequency range: 0.15 – 30MHz

Kind of test site: Shielded Room

Operation mode: A and B*

Requirements:

The AC power line on any frequency within the band 150 kHz to 30MHz shall not exceed the limits specified in RSS-Gen 7.2.4.

Test procedure:

ANSI C63.4-2003 and RSS-Gen 7.2

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT.

The DC power cable of the EUT was connected to a Line Impedance Stabilization Network (LISN) / Artificial Mains Network (AMN).

The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed using a CISPR quasi-peak detector and average detector.

* Final measurement was taken in mode B with 0.5m antenna cable as worst level was found in mode B with 0.5m antenna cable after preliminary test. Disturbances other than those mentioned are small or not detectable.

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Table 22: Conducted Emission, 150kHz – 30MHz, Quasi Peak and Average Data, Positive Polarity (+) and Negative Polarity (-), Mode B, Antenna TR3-A202 with 0.5m Antenna Cable

Freq. [MHz]	Phase	Reading QP [dB(µV)]	Reading AV [dB(µV)]	Factor [dB]	Level QP [dB(µV)]	Level AV [dB(µV)]	Limit QP [dB(µV)]	Limit AV [dB(µV)]	Margin QP [dB]	Margin AV [dB]
0.32886	-	25.6	23.5	9.7	35.3	33.2	59.5	49.5	24.2	16.3
1.21113	-	29.4	24.5	9.7	39.1	34.2	56.0	46.0	16.9	11.8
1.34531	-	29.7	24.9	9.7	39.4	34.6	56.0	46.0	16.6	11.4
4.87144	-	23.0	19.2	9.8	32.8	29.0	56.0	46.0	23.2	17.0
27.12017	-	26.8	23.8	10.5	37.3	34.3	60.0	50.0	22.7	15.7
0.33014	+	25.4	23.3	9.7	35.1	33.0	59.4	49.4	24.3	16.4
1.27869	+	29.4	26.2	9.7	39.1	35.9	56.0	46.0	16.9	10.1
4.87040	+	22.8	19.1	9.8	32.6	28.9	56.0	46.0	23.4	17.1
27.12047	+	28.8	25.8	10.3	39.1	36.1	60.0	50.0	20.9	13.9

Notes: Level QP = Reading QP + Factor

Level AV = Reading AV + Factor

Table 23: Conducted Emission, 150kHz – 30MHz, Quasi Peak and Average Data, Positive Polarity (+) and Negative Polarity (-), Mode B, Antenna TR3-A302 with 0.5m Antenna Cable

Freq. [MHz]	Phase	Reading QP [dB(µV)]	Reading AV [dB(µV)]	Factor [dB]	Level QP [dB(µV)]	Level AV [dB(µV)]	Limit QP [dB(µV)]	Limit AV [dB(µV)]	Margin QP [dB]	Margin AV [dB]
0.32939	-	25.5	23.4	9.7	35.2	33.1	59.5	49.5	24.3	16.4
1.29045	-	25.0	14.4	9.7	34.7	24.1	56.0	46.0	21.3	21.9
4.80248	-	22.5	18.2	9.8	32.3	28.0	56.0	46.0	23.7	18.0
18.24514	-	17.3	15.0	10.3	27.6	25.3	60.0	50.0	32.4	24.7
0.32459	+	25.4	21.1	9.7	35.1	30.8	59.6	49.6	24.5	18.8
1.35149	+	23.6	16.0	9.7	33.3	25.7	56.0	46.0	22.7	20.3
4.60428	+	19.4	13.3	9.8	29.2	23.1	56.0	46.0	26.8	22.9
16.22918	+	21.1	18.7	10.2	31.3	28.9	60.0	50.0	28.7	21.1

Notes: Level QP = Reading QP + Factor

Level AV = Reading AV + Factor

Table 24: Conducted Emission, 150kHz – 30MHz, Quasi Peak and Average Data, Positive Polarity (+) and Negative Polarity (-), Mode B, Antenna TR3-A401 with 0.5m Antenna Cable

Freq. [MHz]	Phase	Reading QP [dB(µV)]	Reading AV [dB(µV)]	Factor [dB]	Level QP [dB(µV)]	Level AV [dB(µV)]	Limit QP [dB(µV)]	Limit AV [dB(µV)]	Margin QP [dB]	Margin AV [dB]
0.32545	-	25.5	21.4	9.7	35.2	31.1	59.6	49.6	24.4	18.5
1.34505	-	29.8	24.8	9.7	39.5	34.5	56.0	46.0	16.5	11.5
4.87396	-	22.1	17.5	9.8	31.9	27.3	56.0	46.0	24.1	18.7
16.22828	-	22.0	20.2	10.2	32.2	30.4	60.0	50.0	27.8	19.6
0.33053	+	25.2	23.1	9.7	34.9	32.8	59.4	49.4	24.5	16.6
1.27360	+	26.0	21.6	9.7	35.7	31.3	56.0	46.0	20.3	14.7
4.80162	+	22.0	17.4	9.8	31.8	27.2	56.0	46.0	24.2	18.8
16.22728	+	23.3	21.8	10.2	33.5	32.0	60.0	50.0	26.5	18.0

Notes: Level QP = Reading QP + Factor

Level AV = Reading AV + Factor

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7. Test Results Radiated Emission

7.1 Radiated Emission of Transmitter

7.1.1 Fundamental and In-band Radiated Emission, FCC 15.225(a)(b)(c), RSS-210 A2.6(a)(b)(c)

RESULT: PASS

Date of testing: 2011-01-06 2011-01-07

Ambient temperature: 24°C 24°C

Relative humidity: 32% 32%

Atmospheric pressure: 1003hPa 1008hPa

Frequency range: 13.110MHz – 14.010MHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Operation mode: B

Requirements:

The emissions from the intentional radiator shall not exceed the field strength specified in FCC 15.225(a)(b)(c) and RSS-210 A2.6(a)(b)(c).

Test procedure:

ANSI C63.4-2003 and RSS-Gen 4.9

The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. Final radiated emissions measurements were made at 3m with a loop antenna placed 1m above the ground plane. The values were recalculated for a 30m distance using a factor of 40dB/decade according to FCC 15.31(f)(2) and RSS-Gen 7.2.7(b). The spectrum was examined from 9 kHz to 30MHz.

Before final measurements of radiated emissions were made in Semi Anechoic Chamber, the EUT was scanned to determine its emissions spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained. The antenna rotation angle was varied, too, in small increments, in order to determine the maximum emission orientation.

At each frequency, the EUT was rotated 360° in order to determine the emission's maximum level. For frequencies between 150kHz and 30MHz, the spectrum analyzer's

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6 dB bandwidth was set to 9kHz, and the analyzer was operated in the CISPR quasi-peak detection mode.

Final measurement was taken in mode B with 0.5m antenna cable as worst level was found in mode B with 0.5m antenna cable after preliminary test. Disturbances other than those mentioned are small or not detectable.

The highest emission amplitudes relative to the appropriate limit were in this report. Emissions other than those mentioned are small or not detectable.

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Table 25: Fundamental Emission, Quasi Peak Data, mode B, TR3-A202 with 0.5m antenna cable

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dB(uV/m)]	Level QP at 30m [dB(uV/m)]	Limit at 30m [dB(uV/m)]	Margin QP [dB]
13.560	48.5	20.3	68.8	28.8	84.0	55.2

Notes: Level QP at 3m = Reading QP at 3m + Factor

Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade

Distance extrapolation factor = 40dB/decade (FCC 15.31(f)(2) and RSS-Gen 7.2.7(b))

dB(uV/m) = 20 x log(uV/m)

Final measurement was performed for the EUT orientation Z (worst case).

Table 26: In-band Radiated Emission, Quasi Peak Data, mode B, TR3-A202 with 0.5m antenna cable

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dB(uV/m)]	Level QP at 30m [dB(uV/m)]	Limit at 30m [dB(uV/m)]	Margin QP [dB]
13.553	34.5	20.3	54.8	14.8	50.5	35.7
13.567	34.3	20.3	54.6	14.6	50.5	35.9

Notes: Level QP at 3m = Reading QP at 3m + Factor

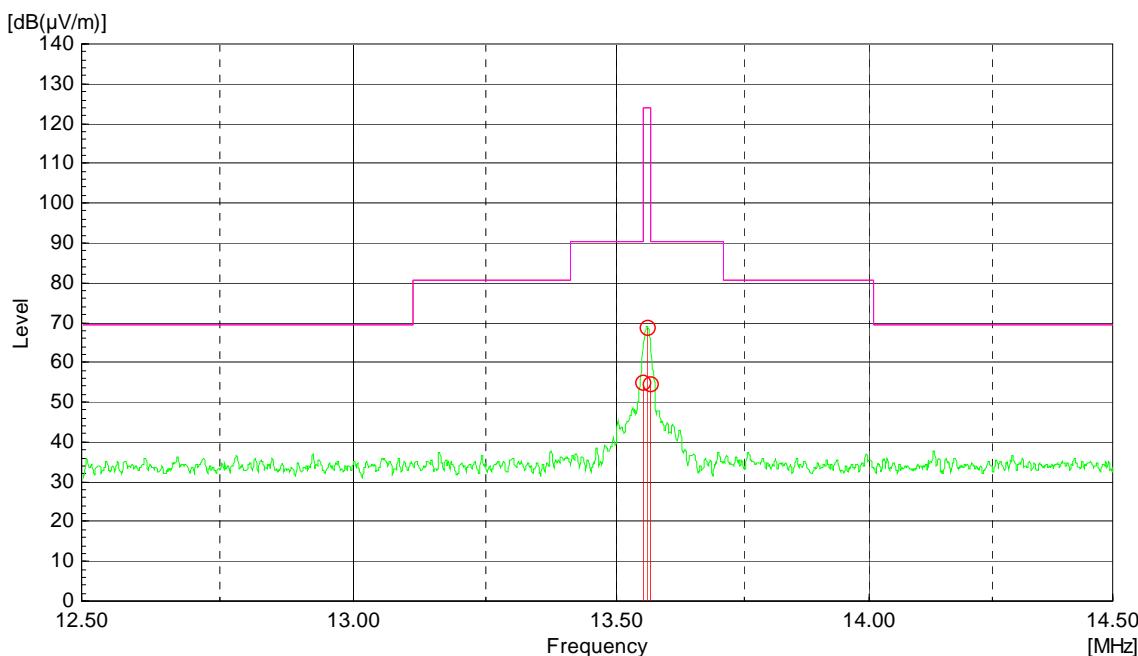
Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade

Distance extrapolation factor = 40dB/decade (FCC 15.31(f)(2) and RSS-Gen 7.2.7(b))

dB(uV/m) = 20 x log(uV/m)

Final measurement was performed for the EUT orientation Z (worst case).

Figure 14: Emission mask in the Frequency Range 12.50 – 14.50MHz, mode B, TR3-A202 with 0.5m antenna cable



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Table 27: Fundamental Emission, Quasi Peak Data, mode B, TR3-A302 with 0.5m antenna cable

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dB(uV/m)]	Level QP at 30m [dB(uV/m)]	Limit at 30m [dB(uV/m)]	Margin QP [dB]
13.560	43.5	20.3	63.8	23.8	84.0	60.2

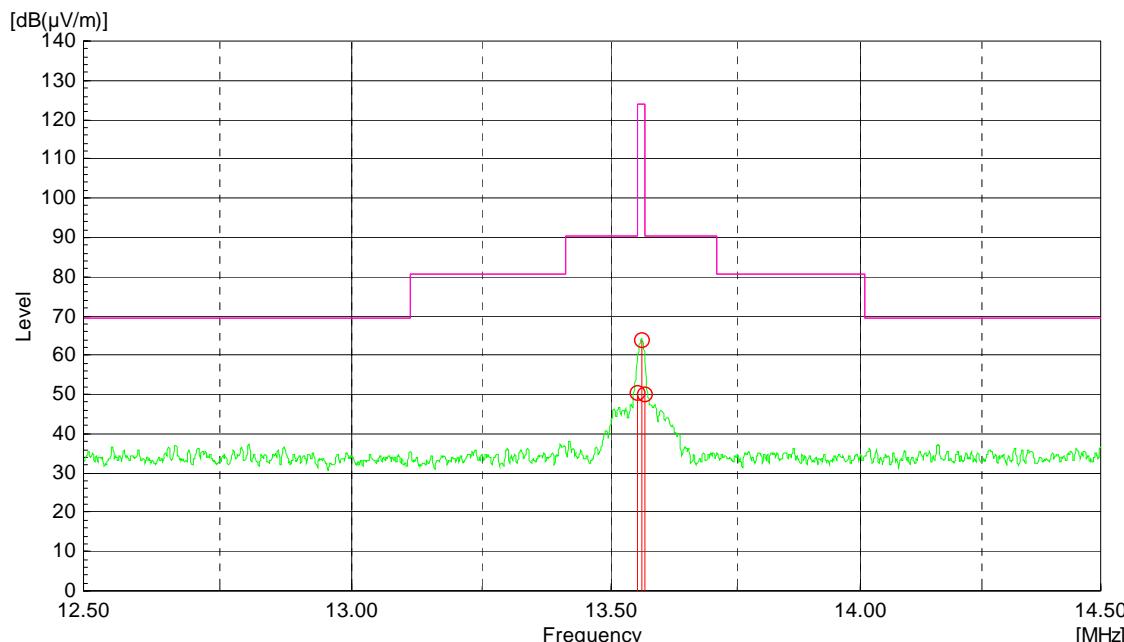
Notes: Level QP at 3m = Reading QP at 3m + Factor
Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade
Distance extrapolation factor = 40dB/decade (FCC 15.31(f)(2) and RSS-Gen 7.2.7(b))
dB(uV/m) = 20 x log(uV/m)
Final measurement was performed for the EUT orientation Z (worst case).

Table 28: In-band Radiated Emission, Quasi Peak Data, mode B, TR3-A302 with 0.5m antenna cable

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dB(uV/m)]	Level QP at 30m [dB(uV/m)]	Limit at 30m [dB(uV/m)]	Margin QP [dB]
13.553	30.2	20.3	50.5	10.5	50.5	40.0
13.567	29.9	20.3	50.2	10.2	50.5	40.3

Notes: Level QP at 3m = Reading QP at 3m + Factor
Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade
Distance extrapolation factor = 40dB/decade (FCC 15.31(f)(2) and RSS-Gen 7.2.7(b))
dB(uV/m) = 20 x log(uV/m)
Final measurement was performed for the EUT orientation Z (worst case).

Figure 15: Emission mask in the Frequency Range 12.50 – 14.50MHz, mode B, TR3-A302 with 0.5m antenna cable



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Table 29: Fundamental Emission, Quasi Peak Data, mode B, TR3-A401 with 0.5m antenna cable

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dB(uV/m)]	Level QP at 30m [dB(uV/m)]	Limit at 30m [dB(uV/m)]	Margin QP [dB]
13.560	33.1	20.3	53.4	13.4	84.0	70.6

Notes: Level QP at 3m = Reading QP at 3m + Factor

Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade

Distance extrapolation factor = 40dB/decade (FCC 15.31(f)(2) and RSS-Gen 7.2.7(b))

dB(uV/m) = 20 x log(uV/m)

Final measurement was performed for the EUT orientation Y (worst case).

Table 30: In-band Radiated Emission, Quasi Peak Data, mode B, TR3-A401 with 0.5m antenna cable

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dB(uV/m)]	Level QP at 30m [dB(uV/m)]	Limit at 30m [dB(uV/m)]	Margin QP [dB]
13.553	27.9	20.3	48.2	8.2	50.5	42.3
13.567	27.6	20.3	47.9	7.9	50.5	42.6

Notes: Level QP at 3m = Reading QP at 3m + Factor

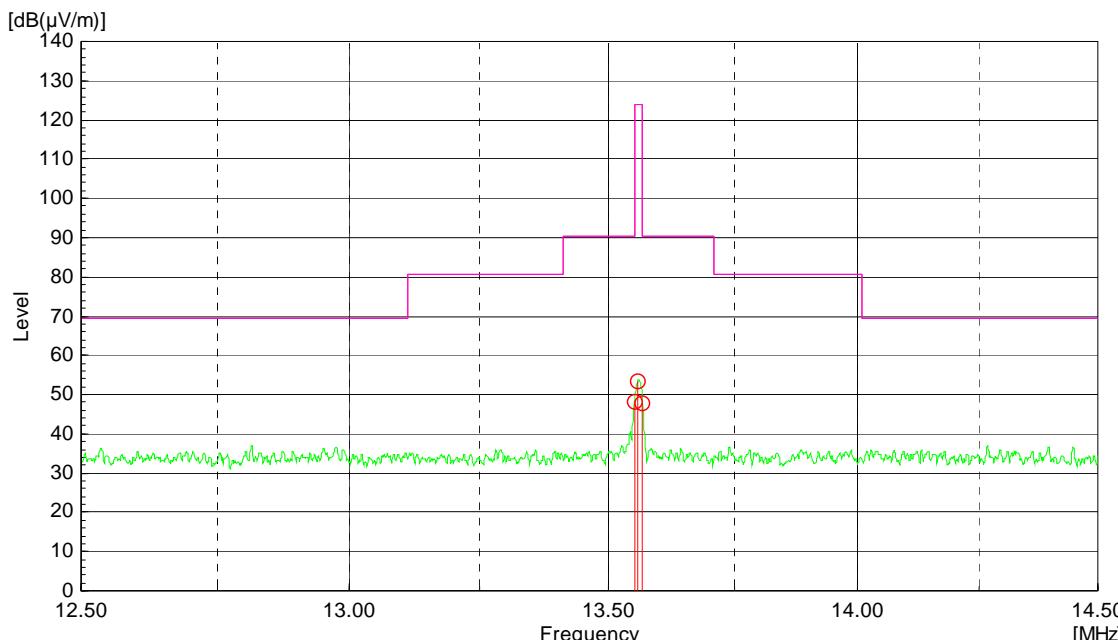
Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade

Distance extrapolation factor = 40dB/decade (FCC 15.31(f)(2) and RSS-Gen 7.2.7(b))

dB(uV/m) = 20 x log(uV/m)

Final measurement was performed for the EUT orientation Y (worst case).

Figure 16: Emission mask in the Frequency Range 12.50 – 14.50MHz, mode B, TR3- A401 with 0.5m antenna cable



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7.1.2 Out-of-Band Radiated Spurious Emission of Transmitter below 30MHz, FCC 15.225(d), FCC 15.209, RSS-210 A2.6(d), 2.1, 2.2, 2.5 and RSS-Gen 7.2.2, 7.2.5

RESULT:

PASS

Date of testing: 2011-01-06 2011-01-07

Ambient temperature: 24°C 24°C

Relative humidity: 32% 32%

Atmospheric pressure: 1003hPa 1008hPa

Frequency range: 9kHz – 30MHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Operation mode: B

Requirements:

The emissions from the intentional radiator shall not exceed the field strength specified in FCC 15.209(a), RSS-210 A2.6(d) and RSS-Gen 7.2.5

Test procedure:

ANSI C63.4-2003 and RSS-Gen 4.9

The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane.

Before final measurements of radiated emissions were made in Semi Anechoic Chamber, the EUT was scanned to determine its emissions spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained. The antenna rotation angle was varied, too, in small increments, in order to determine the maximum emission orientation.

No significant out-of band spurious emission was found in the frequency 9kHz – 30MHz.

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7.1.3 Radiated Emission, 30MHz – 1000MHz, FCC 15.225(d), FCC 15.209, RSS-210 A2.6(d), 2.1, 2.2, 2.5 and RSS-Gen 7.2.2, 7.2.5

RESULT:

PASS

Date of testing: 2011-01-07

Ambient temperature: 24°C

Relative humidity: 32%

Atmospheric pressure: 1008hPa

Frequency range: 30MHz – 1GHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Operation mode: A and B*

Requirements:

The emission from the intentional radiator shall not exceed the field strength specified in FCC 15.209(a), RSS-210 A2.6(d) and RSS-Gen 7.2.5

Test procedure:

ANSI C63.4-2003 and RSS-Gen 4.9.

The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. Final radiated emissions measurements were made at 3m.

Before final measurements of radiated emissions were made in Semi Anechoic Chamber, the EUT was scanned to determine its emissions spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode.

*Final measurement was taken in mode B with 0.5m antenna cable as worst level was found in mode B with 0.5m antenna cable after preliminary test. Disturbances other than those mentioned are small or not detectable.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

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Table 31: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, mode B, TR3-A202 with 0.5m antenna cable

Freq. [MHz]	Antenna polarity	Reading QP [dB(µV)]	Factor [dB(1/m)]	Level QP [dB(µV/m)]	Limit [dB(µV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
84.691	H	63.7	-27.1	36.6	40.0	3.4*	375	215
96.816	H	64.6	-26.3	38.3	43.5	5.2	280	192
250.002	H	65.3	-23.0	42.3	46.0	3.7*	139	173
798.607	H	56.6	-11.1	45.5	46.0	0.5*	113	249
48.417	V	61.3	-23.2	38.1	40.0	1.9*	100	210
60.546	V	61.1	-23.9	37.2	40.0	2.8*	103	13
66.606	V	59.0	-24.3	34.7	40.0	5.3	113	91
67.757	V	61.8	-24.3	37.5	40.0	2.5*	100	199
797.637	V	54.1	-11.0	43.1	46.0	2.9*	100	7

Notes: Level QP = Reading QP + Factor

dB(µV/m) = 20 x log(µV/m)

Final measurement was performed for the EUT orientation Z (worst case).

Uncertainty

(*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is not therefore possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a higher probability that the product tested complies with the specification limit.

Table 32: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, mode B, TR3-A302 with 0.5m antenna cable

Freq. [MHz]	Antenna polarity	Reading QP [dB(µV)]	Factor [dB(1/m)]	Level QP [dB(µV/m)]	Limit [dB(µV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
96.802	H	65.4	-26.3	39.1	43.5	4.4*	209	204
249.987	H	63.4	-23.0	40.4	46.0	5.6	145	174
797.632	H	55.9	-11.2	44.7	46.0	1.3*	115	249
48.414	V	61.8	-23.2	38.6	40.0	1.4*	101	226
60.510	V	62.6	-23.9	38.7	40.0	1.3*	104	325
62.578	V	57.6	-24.1	33.5	40.0	6.5	105	8
66.558	V	62.3	-24.3	38.0	40.0	2.0*	101	107
797.796	V	53.5	-11.0	42.5	46.0	3.5*	101	7

Notes: Level QP = Reading QP + Factor

dB(µV/m) = 20 x log(µV/m)

Final measurement was performed for the EUT orientation Z (worst case).

Uncertainty

(*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is not therefore possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a higher probability that the product tested complies with the specification limit.

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Table 33: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, mode B, TR3-A401 with 0.5m antenna cable

Freq. [MHz]	Antenna polarity	Reading QP [dB(µV)]	Factor [dB(1/m)]	Level QP [dB(µV/m)]	Limit [dB(µV/m)]	Margin QP [dB]	Height [cm]	Angle [°]
84.701	H	63.4	-27.1	36.3	40.0	3.7*	373	217
96.814	H	65.3	-26.3	39.0	43.5	4.5*	210	206
798.638	H	56.6	-11.1	45.5	46.0	0.5*	114	247
48.408	V	61.1	-23.2	37.9	40.0	2.1*	100	236
60.521	V	62.1	-23.9	38.2	40.0	1.8*	100	325
62.145	V	54.0	-24.0	30.0	40.0	10.0	100	359
67.759	V	63.0	-24.3	38.7	40.0	1.3*	105	273
798.232	V	53.4	-11.0	42.4	46.0	3.6*	100	9

Notes: Level QP = Reading QP + Factor

dB(µV/m) = 20 x log(µV/m)

Final measurement was performed for the EUT orientation Y (worst case).

Uncertainty

(*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is not therefore possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a higher probability that the product tested complies with the specification limit.

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