

Produkte *Products*

Prüfbericht - Nr.: Test Report No.:		50003239 005		Seite 1 von 29 Page 1 of 29	
Auftraggeber: Client:		TECHTOM Ltd. Shiba Bldg. 5F, 5-3-11 Chuo, Nakano-ku, Tokyo 164-0011, Japan			
Gegenstand der Prüfung: Test Item:		Vehicle Management Device 20			
Bezeichnung: Identification:		CS20-**F-**-* (Refer to section 3.2.)		Serien-Nr.: Serial No.: 1401ES01	
Wareneingangs-Nr.: Receipt No.:		A000039744-1		Eingangsdatum: Date of Receipt: 2014-01-20	
Zustand des Prüfgegenstandes bei Anlieferung: Condition of Test Item at Delivery:		Good			
Prüfport: 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, 2013) ANSI C63.10-2009			
Prüfresultat: 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:			
2014-05-26 T. Sauter / Inspector		2014-05-26 R. Meiranke / Reviewer			
Datum Date	Name/Stellung Name/Position	Unterschrift Signature	Datum Date	Name/Stellung Name/Position	Unterschrift Signature
Sonstiges / Other Aspects: The Equipment Under Test (EUT) is a Car Sharing and Status Management Module. It contains a cellular/PCS module, an RFID unit and a GPS unit. The cellular/PCS module was already tested and certified according to FCC rules (modular approval, FCC ID: N7NSL9090). This test report covers only FCC 15C requirements for the RFID function.					
Abkürzungen: P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet		Abbreviations: P(ass) = passed F(ail) = 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>					

Produkte
Products

Prüfbericht - Nr.:

50003239 005

Seite 2 von 29

Test Report No.:

Page 2 of 29

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENTS

RESULT: PASS

5.1.2 RESTRICTED BANDS OF OPERATION

RESULT: PASS

5.2.1 20dB BANDWIDTH

RESULT: PASS

5.2.2 FREQUENCY STABILITY

RESULT: PASS

5.2.3 FIELD STRENGTH OF FUNDAMENTAL

RESULT: Pass

5.2.4 RADIATED SPURIOUS EMISSIONS OF TRANSMITTER

RESULT: PASS

5.3.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER

RESULT: N/A

Prüfbericht - Nr.:**50003239 005****Seite 3 von 29***Test Report No.:**Page 3 of 29*

Contents

1.	GENERAL REMARKS	5
1.1	COMPLEMENTARY MATERIALS	5
2.	TEST SITES	5
2.1	TEST FACILITIES	5
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS	6
2.3	MEASUREMENT UNCERTAINTY	6
3.	GENERAL PRODUCT INFORMATION	7
3.1	PRODUCT FUNCTION AND INTENDED USE	7
3.2	SYSTEM DETAILS	7
3.3	CLOCK FREQUENCIES	8
3.4	NOISE SUPPRESSING PARTS	8
4.	TEST SET-UP AND OPERATION MODES	9
4.1	TEST METHODOLOGY	9
4.2	OPERATION MODES	9
4.3	PHYSICAL CONFIGURATION FOR TESTING	10
4.4	TEST SOFTWARE	11
4.5	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	12
4.6	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE	12
5.	TEST RESULTS RADIO	13
5.1	TECHNICAL REQUIREMENTS	13
5.1.1	<i>Antenna Requirements</i>	<i>13</i>
5.1.2	<i>Restricted Bands of Operation</i>	<i>13</i>
5.2	RADIATED MEASUREMENTS	14
5.2.1	<i>20dB Bandwidth</i>	<i>14</i>
5.2.2	<i>Frequency Stability</i>	<i>16</i>
5.2.3	<i>Field Strength of Fundamental</i>	<i>19</i>
5.2.4	<i>Radiated Spurious Emissions of Transmitter</i>	<i>21</i>
5.3	AC POWER LINE CONDUCTED MEASUREMENTS	23
5.3.1	<i>AC Power Line Conducted Emission of Transmitter</i>	<i>23</i>
6.	PHOTOGRAPHS OF THE TEST SETUP	24
7.	LIST OF TABLES	29
8.	LIST OF FIGURES	29

Produkte
Products

Prüfbericht - Nr.:	50003239 005	Seite 4 von 29
<i>Test Report No.:</i>		<i>Page 4 of 29</i>
9.	LIST OF PHOTOGRAPHS	29

Prüfbericht - Nr.: 50003239 005
*Test Report No.:***Seite 5 von 29**
Page 5 of 29

1. General Remarks

This test report supersedes test report 50003239 001 by TÜV Rheinland Japan Ltd.

1.1 Complementary Materials

There is no attachment 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 facilities and has found these test sites 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 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.

Prüfbericht - Nr.: 50003239 005
Test Report No.:
Seite 6 von 29
Page 6 of 29

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 Radiated Measurements					
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	2014-02
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	2014-11
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	2014-02
Biconical Antenna, 30-300MHz	EMCO	3110B	9603-2379	RF-0207	2014-08
10dB Attenuator	Hewlett Packard	8491A 10dB	58354	RF-0314	2014-11
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	2014-11
Low Pass Filter, DC-1GHz	R&K	LP1000CH3	12104001	RF-0515	2014-11
For Frequency Stability					
Temperature Chamber	Voetsch	VT 4018	585660250 90010	BT-8012	2014-08
DC Power Supply	Agilent	E3646A	MY400046 42	BT-8153	N/A
Constant Voltage Constant Frequency Stabilizers and Power Accessories					
CVCF (10m Chamber)	NF Corporation	ES2000U	9067307	RF-0212	N/A
CVCF Booster (10m Chamber)	NF Corporation	ES2000B	9074408	RF-0213	N/A
True RMS Multimeter	Fluke	87V	97680450	RF-0282	2015-01

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Radiated Emission	9kHz - 30MHz	±4.7dB
	30MHz - 1GHz	±4.7dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is a M2M apparatus used in vehicular environment as car sharing and status management module. It has cellular/PCS, GPS and RFID interfaces.

The cellular/PCS function is used to send GPS position and other status information to a remote server. The RFID function is used to lock or unlock the vehicle.

3.2 System Details

Table 3: Radio Specifications

Radio Standard:	Cellular/PCS: CDMA2000 1x/EVDO Rev. A (Band 0: 800MHz, Band 1: 1900MHz) GSM/GPRS/EDGE (850/1900) WCDMA/HSPA (850/1900) GPS (L1) RFID (ISO 14443)		
Frequency Range:	CDMA2000: GSM/GPRS/EDGE: WCDMA: GPS: RFID:	Band 0: 850: 1900: 850: 1900: 1575.42MHz (RX) 13.56MHz (TX/RX)	UL: 824-849MHz, DL: 869-894MHz UL: 1850-1910MHz, DL: 1930-1990MHz UL: 824-849MHz, DL: 869-894MHz UL: 1850-1910MHz, DL: 1930-1990MHz UL: 824-849MHz, DL: 869-894MHz UL: 1850-1910MHz, DL: 1930-1990MHz
Output Power:	CDMA2000: GSM/GPRS: EDGE: WCDMA/HSPA: GPS: RFID:	Band 0: 0.265W, 850: 1.754W, 850: 0.459W, 850: 0.201W, - 60.3dBuV/m at 3m	Band 1: 0.272W 1900: 0.863W 1900: 0.337W 1900: 0.183W
Emission Designator:	CDMA2000: GSM/GPRS: EDGE: WCDMA/HSPA: GPS: RFID:	Band 0: 1M28F9W, 850: 244KGXW, 850: 248KG7W, 850: 4M13F9W, - 119HA1D	Band 1: 1M29F9W 1900: 248KGXW 1900: 242KG7W 1900: 4M14F9W
Antenna Gain:	Cellular/PCS: GPS: RFID:	2.5dBi Unspecified Unspecified	
Antenna Type:	Cellular/PCS: GPS: RFID:	Patch antenna Patch antenna Loop antenna	

Produkte
 Products
Prüfbericht - Nr.:**50003239 005****Seite 8 von 29**

Test Report No.:

Page 8 of 29

FCC classification: DXX for RFID function
PCB for cellular/PCS function

Rated voltage: DC 12V & DC24V

Rated current: Max. 8A or lower (during door lock), 300mA (during transmission), 20mA or lower during sleep condition (DC 12V)

Protection class: III

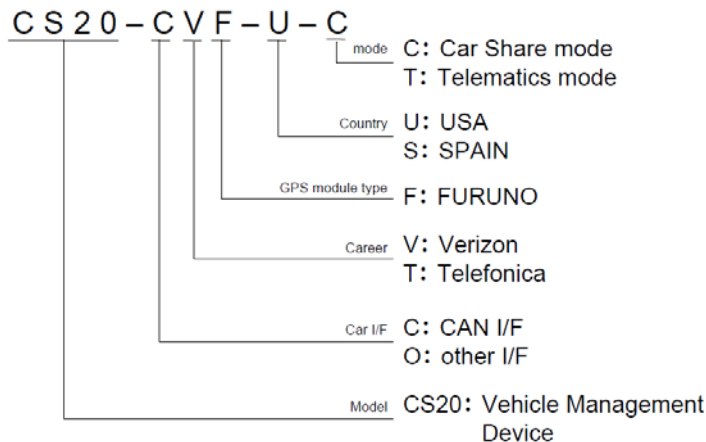
Test voltage: DC 12V unless otherwise specified

The model number (product identification) of the EUT is described here below:

Model Name: Vehicle Management Device 20

Model Number: CS20-**F-**-* (ex. CS20-CVF-U-C)

How to Read the Product Type



All model numbers have the same hardware. Only internal software is different. The model used for testing had a special modified internal software for the operation of the product in appropriate test modes.

3.3 Clock Frequencies

The highest frequency generated or used by the EUT is 27.12MHz for the RFID transmitter and 192MHz for the digital interface.

3.4 Noise Suppressing Parts

Refer to schematics.

4. Test Set-up and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.209 and 15.225.

The test methods, which have been used, are based on ANSI C63.10-2009.

For details, see under each test item.

4.2 Operation Modes

The basic operation mode used for testing is:

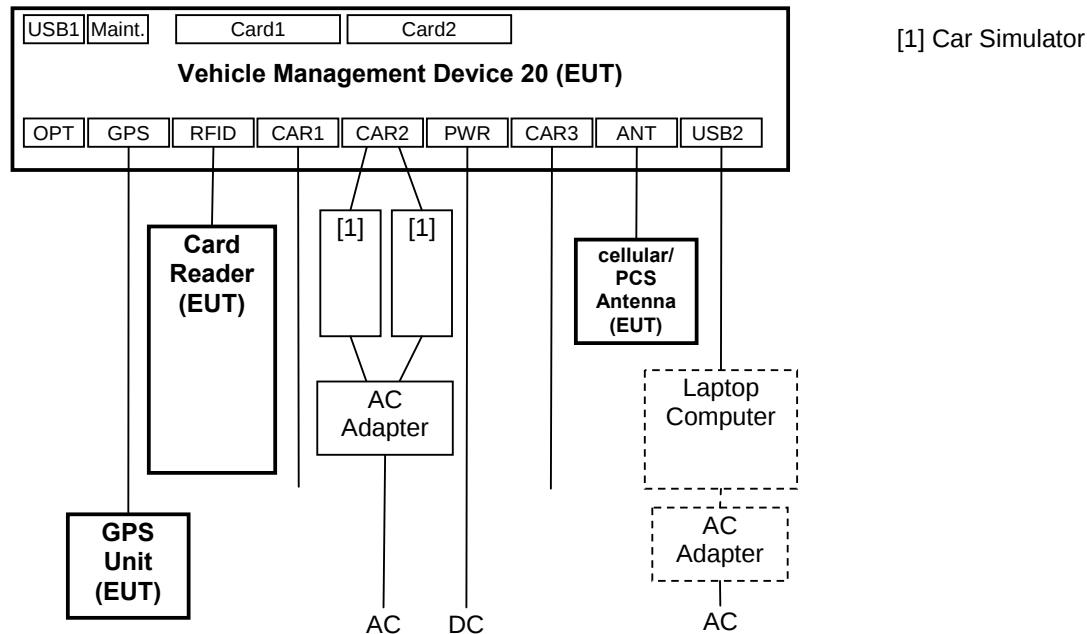
R. RFID continuous read/write operation

4.3 Physical Configuration for Testing

The test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10-2009.

Figure 1: Block Diagram



Notes:

Cables of CAR1 and CAR3 were left open to simulate high impedance loads.

The Laptop Computer is used to set the operation mode only and was disconnected during the test.

No cards were used for testing in slots Card1 and Card2 because their function is only to sense if a card is present or not using optic sensors, which is not EMC/radio relevant.

Table 4: Units of EUT

Unit	Model Name	Serial Number
Main Unit	CS2x-MAIN1	1401ES01
Card Reader	CS2x-CR1	
GPS Unit	CS2x-GPS4	
Cellular/PCS Antenna	PH-04ASS	

Table 5: Interfaces present on the EUT

No.	Interface	Cable Length for Testing, Shielding	Interface Classification
1.	PWR	2.5m, Un-Shielded	DC Power Port
2.	GPS (for GPS Unit)	2.5m, Shielded	Signal Port
3.	RFID (for Card Reader)	1.5m, Shielded	Signal Port
4.	CAR1	2.5m, Un-Shielded	Signal Port
5.	CAR2	2.8m, Un-Shielded	Signal Port
6.	CAR3	2.5m, Un-Shielded	Signal Port
7.	ANT (for Cellular/ PCS Antenna)	2.9m, Un-Shielded	Signal Port
8.	OPT (not used)	N/A	Signal Port
9.	USB1 (for maintenance only)	N/A	Signal Port
10.	USB2 (for maintenance only)	N/A	Signal Port
11.	Maintenance (for maintenance only)	N/A	Signal Port
12.	Card1	N/A	Card Slot
13.	Card2	N/A	Card Slot

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

4.4 Test Software

Software used for testing: Tera Term Professional version 4.58 by TeraTerm Project.

This software was running on the laptop computer connected to the EUT. It was used to enable the test operation mode listed in section 4.2 as appropriate.

4.5 Special Accessories and Auxiliary Equipment

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

1. Product: Car Simulator (2x)
Manufacturer: Techtom
Model: EMCS20-01
Rated Voltage: DC 15V
Protection Class: III
Serial Number: -
2. Product: AC Adapter for Car Simulator
Manufacturer: Go Forward Enterprise Corp.
Model: GF12-US1508
Rated Voltage: AC 100-240V
Input Current: 0.3A
Frequency: 50/60Hz
Protection Class: II
Serial Number: 1105-04
3. Product: Laptop Computer
Manufacturer: IBM
Model: X41 (2525)
Rated Voltage: DC 16V
Input Current: 3.5A
Protection Class: III
Serial Number: LV-H2424 06/02
4. Product: AC Adapter for Laptop Computer
Manufacturer: IBM
Model: 02K6810
Rated Voltage: AC 100-240V
Input Current: 5A
Frequency: 50-60Hz
Protection Class: II
Serial Number: 11S02K6810Z1Z3BJ59G08B

4.6 Countermeasures to achieve EMC Compliance

No additional measures were employed to achieve compliance.

5. Test Results RADIO

5.1 Technical Requirements

5.1.1 Antenna Requirements

RESULT:**PASS**

Requirements:

FCC 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The EUT has an internal RFID antenna which is not user accessible. Hence it complies with the antenna requirements.

5.1.2 Restricted Bands of Operation

RESULT:**PASS**

Requirements:

FCC 15.205

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT nominal operation frequency of RFID function is 13.56MHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

Prüfbericht - Nr.: 50003239 005
*Test Report No.:***Seite 14 von 29**
Page 14 of 29

5.2 Radiated Measurements

5.2.1 20dB Bandwidth

RESULT:**PASS**

Date of testing: 2014-01-21

Ambient temperature: 24°C

Relative humidity: 40%

Atmospheric pressure: 1006hPa

Requirements:

FCC 15.215(c) and FCC15.225

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

Test procedure:

ANSI C63.10-2009

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations for 3 EUT orientations (X, Y and Z). The results corresponding to the worst case antenna polarization and EUT orientation are recorded in this report.

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings: RBW = 50Hz, VBW = 200Hz.

Produkte
Products

Prüfbericht - Nr.: 50003239 005
Test Report No.:

Seite 15 von 29
Page 15 of 29

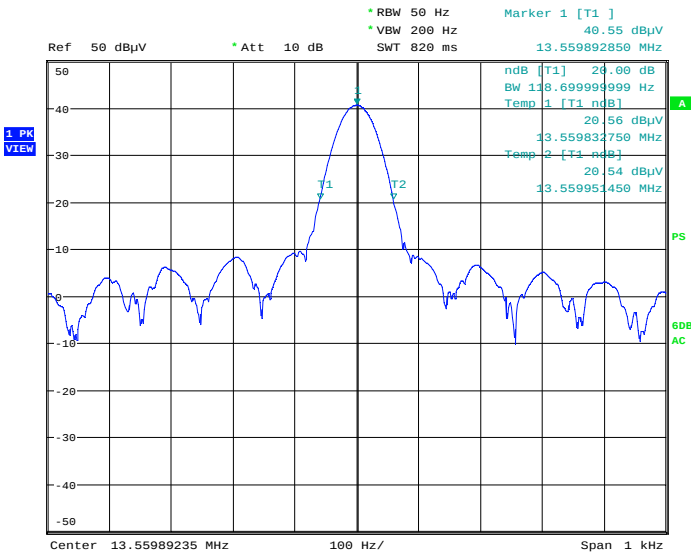
Table 6: 20dB Bandwidth Edge Frequencies

20dB Bandwidth Edge Side	Operating Frequency [MHz]	EUT Orient.	Edge Frequency [MHz]	Limit [MHz]	Margin [MHz]
Low	13.56	Z	13.55983	13.010	0.54983
High	13.56	Z	13.55995	14.010	0.45005

Table 7: 20dB Bandwidth

Operating Frequency [MHz]	EUT Orient.	20dB Bandwidth [Hz]
13.56	Z	118.7

Figure 2: 20dB Bandwidth



20dB bandwidth
Date: 21.JAN.2014 15:21:24

Prüfbericht - Nr.: 50003239 005

Test Report No.:

Seite 16 von 29

Page 16 of 29

5.2.2 Frequency Stability**RESULT:****PASS**

Date of testing: 2014-01-22

Ambient temperature: 24°C

Relative humidity: 31%

Atmospheric pressure: 1016hPa

Low test voltage: DC 10.2V

Normal test voltage: DC 12V

High test voltage: DC 27.6V

Lowest test temperature: -20°C

Normal test temperature: 20°C

Highest test temperature: 50°C

Requirements:

FCC 15.225(e)

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20°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.

Test procedure:

ANSI C63.10-2009

The Card Reader Unit of the EUT was placed inside a temperature chamber. The frequency of the carrier signal was measured with a spectrum analyzer.

Measurements were performed for every 10°C inside the specified temperature interval. 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 $\pm 15\%$ of the input voltage.

Prüfbericht - Nr.: 50003239 005
Test Report No.:
Seite 17 von 29
Page 17 of 29
Table 8: Frequency Stability at 50°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560200	0.0015	0.01	Pass
2	13.56	13.560200	0.0015	0.01	Pass
5	13.56	13.560200	0.0015	0.01	Pass
10	13.56	13.560200	0.0015	0.01	Pass

Table 9: Frequency Stability at 40°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560224	0.0017	0.01	Pass
2	13.56	13.560208	0.0015	0.01	Pass
5	13.56	13.560208	0.0015	0.01	Pass
10	13.56	13.560208	0.0015	0.01	Pass

Table 10: Frequency Stability at 30°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560240	0.0018	0.01	Pass
2	13.56	13.560232	0.0017	0.01	Pass
5	13.56	13.560232	0.0017	0.01	Pass
10	13.56	13.560232	0.0017	0.01	Pass

Table 11: Frequency Stability at 20°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560280	0.0021	0.01	Pass
2	13.56	13.560272	0.0020	0.01	Pass
5	13.56	13.560264	0.0020	0.01	Pass
10	13.56	13.560264	0.0020	0.01	Pass

Table 12: Frequency Stability at 10°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560321	0.0024	0.01	Pass
2	13.56	13.560304	0.0022	0.01	Pass
5	13.56	13.560296	0.0022	0.01	Pass
10	13.56	13.560296	0.0022	0.01	Pass

Prüfbericht - Nr.: 50003239 005
Test Report No.:
Seite 18 von 29
Page 18 of 29
Table 13: Frequency Stability at 0°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560329	0.0024	0.01	Pass
2	13.56	13.560321	0.0024	0.01	Pass
5	13.56	13.560321	0.0024	0.01	Pass
10	13.56	13.560321	0.0024	0.01	Pass

Table 14: Frequency Stability at -10°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560321	0.0024	0.01	Pass
2	13.56	13.560329	0.0024	0.01	Pass
5	13.56	13.560329	0.0024	0.01	Pass
10	13.56	13.560329	0.0024	0.01	Pass

Table 15: Frequency Stability at -20°C, DC 12V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560280	0.0021	0.01	Pass
2	13.56	13.560313	0.0023	0.01	Pass
5	13.56	13.560321	0.0024	0.01	Pass
10	13.56	13.560321	0.0024	0.01	Pass

Table 16: Frequency Stability at 20°C, DC 10.2V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560264	0.0020	0.01	Pass
2	13.56	13.560264	0.0020	0.01	Pass
5	13.56	13.560264	0.0020	0.01	Pass
10	13.56	13.560264	0.0020	0.01	Pass

Table 17: Frequency Stability at 20°C, DC 27.6V

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560288	0.0021	0.01	Pass
2	13.56	13.560272	0.0020	0.01	Pass
5	13.56	13.560264	0.0020	0.01	Pass
10	13.56	13.560264	0.0020	0.01	Pass

Prüfbericht - Nr.: 50003239 005

Test Report No.:

Seite 19 von 29

Page 19 of 29

5.2.3 Field Strength of Fundamental

RESULT:**Pass**

Date of testing: 2014-01-21

Ambient temperature: 24°C

Relative humidity: 40%

Atmospheric pressure: 1006hPa

Frequency range: 13.110 - 14.010MHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Requirements:

FCC 15.225(a)(b)(c)

The emissions from the intentional radiator shall not exceed the field strength specified in FCC 15.225(a)(b)(c).

Test procedure:

ANSI C63.10-2009

The EUT was placed on a nonconductive turntable 0.8m above the ground plane in a semi-anechoic chamber. Measurements were made at 3m distance with a loop antenna. 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, to maximize the level of the measured signals.

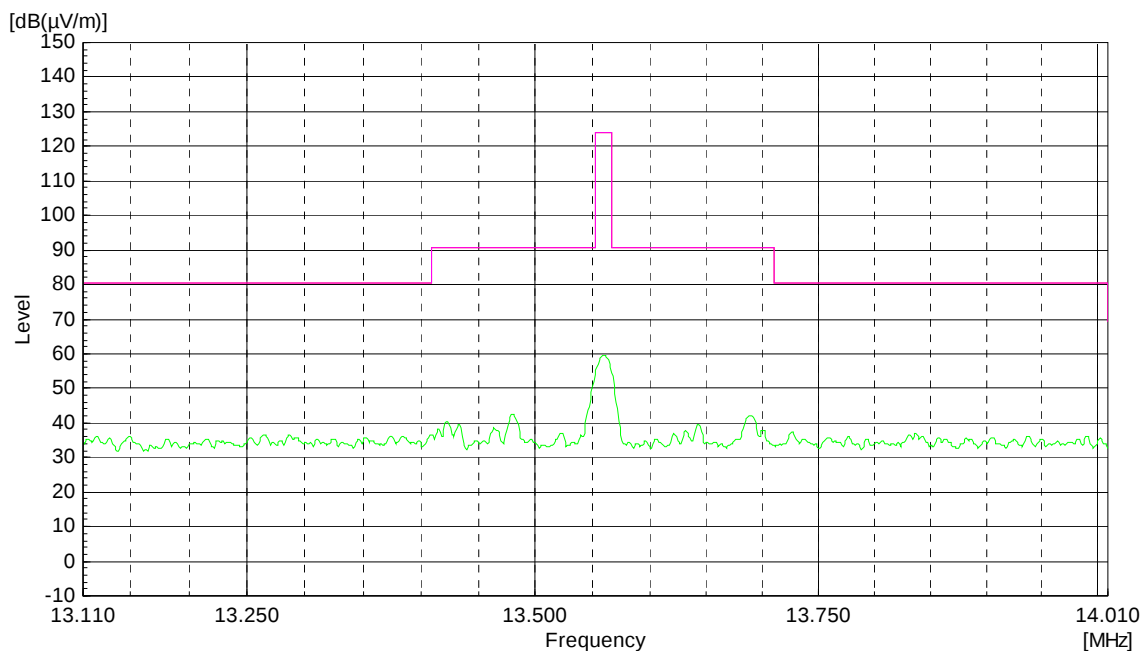
Final measurements were performed using a test receiver in CISPR quasi-peak detection mode. The test receiver's 6dB bandwidth was set to 9kHz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. The values were recalculated for a 30m distance using a factor of 40dB/decade according to FCC 15.31(f).

Table 18: Field Strength of Fundamental

Frequency [MHz]	Reading QP at 3m [dBuV]	Factor [dB(1/m)]	Level QP at 3m [dBuV/m]	Level QP at 30m [dBuV/m]	Limit at 30m [dBuV/m]	Margin QP [dB]	Angle [°]
13.11000	4.5	20.2	24.7	-15.3	29.5	44.8	359
13.41000	7.5	20.2	27.7	-12.3	40.5	52.8	359
13.55300	24.9	20.2	45.1	5.1	50.5	45.4	359
13.56033	40.1	20.2	60.3	20.3	84.0	63.7	359
13.56700	26.3	20.2	46.5	6.5	50.5	44.0	359
13.71000	8.5	20.2	28.7	-11.3	40.5	51.8	359
14.01000	5.2	20.2	25.4	-14.6	29.5	44.1	359

Notes: Level QP at 3m = Reading QP at 3m + Factor
 Level QP at 30m = Level QP at 3m – 40dB
 EUT orientation: Z

Figure 3: Field Strength of Fundamental, Spectral Diagram


Notes: This spectral diagram is given for reference purpose only.
 Measurement distance: 3m (limit is adjusted from 30m to 3m with 40dB correction factor)
 Detector: Peak, RBW: 100kHz
 EUT orientation: Z

5.2.4 Radiated Spurious Emissions of Transmitter**RESULT:****PASS**

Date of testing: 2014-01-20

Ambient temperature: 21°C

Relative humidity: 37%

Atmospheric pressure: 1018hPa

Frequency range: 9kHz - 300MHz (except 13.110-14.010MHz)

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Requirements:

FCC 15.209, FCC 15.225(d)

Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a).

Test procedure:

ANSI C63.10-2009

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission 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 spectrum was examined from 9kHz to 300MHz. Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For emissions between 30MHz and 1GHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode. The receiver's 6dB bandwidth was set to 120kHz.

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

No spurious emission was found in the range 9kHz - 30MHz.

Produkte
Products

Prüfbericht - Nr.: 50003239 005

Test Report No.:

Seite 22 von 29

Page 22 of 29

Table 19: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP [dBμV/m]	Limit [dBμV/m]	Margin QP [dB]	Height [cm]	Angle [°]
32.053	Z / V	45.1	-16.2	28.9	40.0	11.1	102	208
40.679	Z / V	52.1	-18.2	33.9	40.0	6.1	100	183
42.923	Z / V	54.1	-18.7	35.4	40.0	4.6 (*)	104	210
54.241	Z / V	46.0	-20.2	25.8	40.0	14.2	101	223
67.727	Z / V	39.7	-20.4	19.3	40.0	20.7	110	93
83.412	Z / V	46.6	-19.6	27.0	40.0	13.0	101	203
189.843	Z / H	52.9	-13.7	39.2	43.5	4.3 (*)	179	240
216.963	Z / H	51.0	-11.9	39.1	46.0	6.9	160	93
230.524	Z / H	46.6	-11.5	35.1	46.0	10.9	150	109

Note: Level QP = Reading QP + Factor

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

Prüfbericht - Nr.: 50003239 005
*Test Report No.:***Seite 23 von 29**
Page 23 of 29

5.3 AC Power Line Conducted Measurements

5.3.1 AC Power Line Conducted Emission of Transmitter

RESULT:**N/A**

Requirements:

FCC 15.207

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC 15.207.

Note:

The EUT is for vehicular use only and is not intended to be connected to the AC power line network. Therefore this test is not applicable.

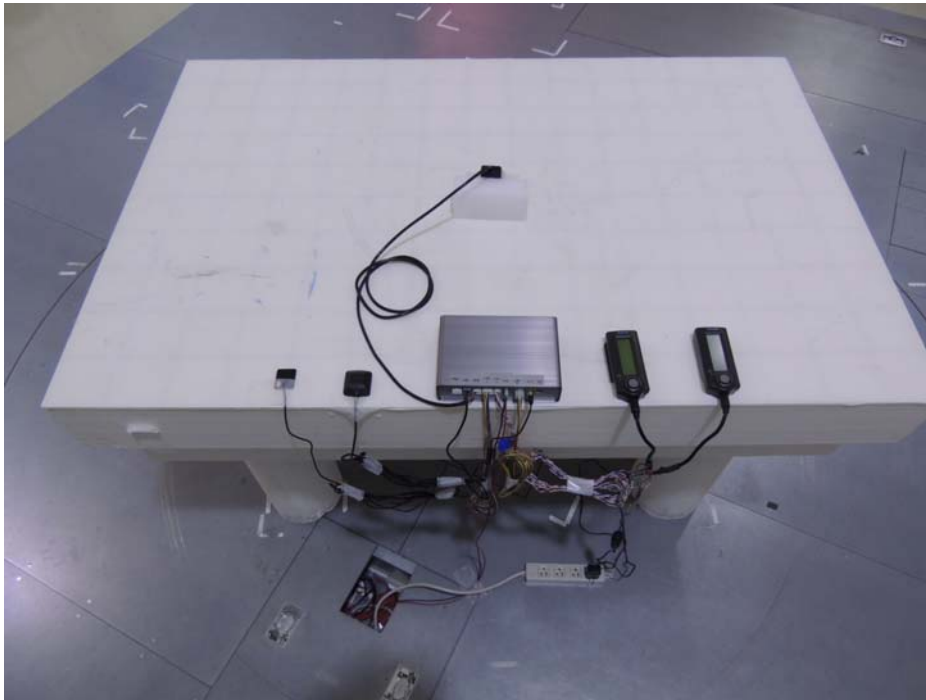
Prüfbericht - Nr.: 50003239 005
Test Report No.:

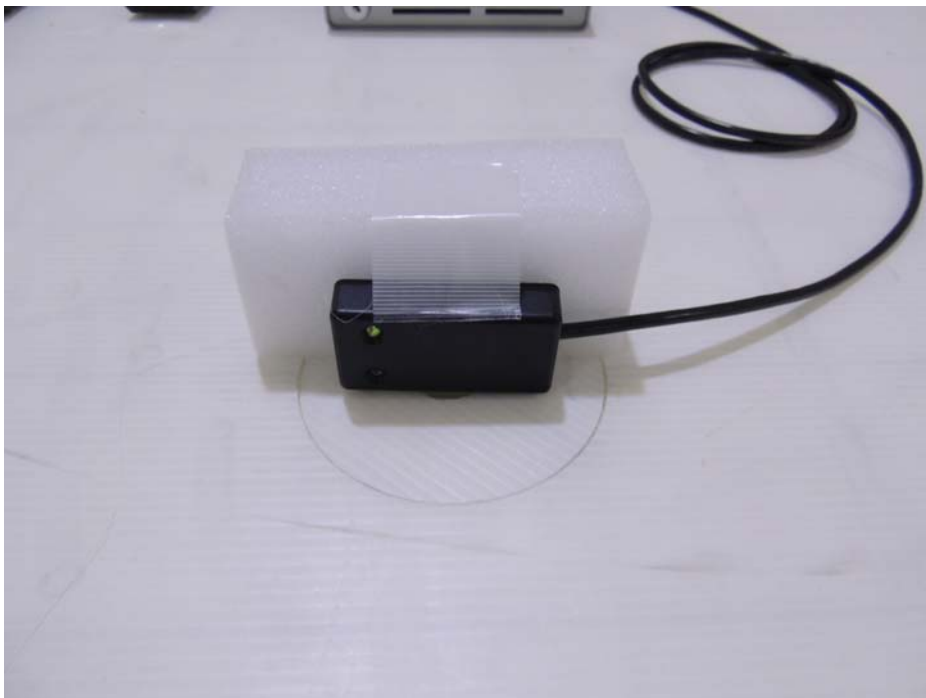
Seite 24 von 29
Page 24 of 29

6. Photographs of the Test Setup

Photograph 1: Set-up for Radiated Emission of Transmitter, Front View



Prüfbericht - Nr.: 50003239 005
Test Report No.:Seite 25 von 29
Page 25 of 29**Photograph 2: Set-up for Radiated Emission of Transmitter, Rear View****Photograph 3: Set-up for Radiated Emission of Transmitter, below 30MHz**

Prüfbericht - Nr.: 50003239 005
*Test Report No.:***Seite 26 von 29**
*Page 26 of 29***Photograph 4: Set-up for Radiated Emission, EUT Configuration X-Axis****Photograph 5: Set-up for Radiated Emission, EUT Configuration Y-Axis**

Prüfbericht - Nr.: 50003239 005
Test Report No.:Seite 27 von 29
Page 27 of 29**Photograph 6: Set-up for Radiated Emission, EUT Configuration Z-Axis****Photograph 7: Set-up for Frequency Stability, General View**

Prüfbericht - Nr.: 50003239 005
Test Report No.:

Seite 28 von 29
Page 28 of 29

Photograph 8: Set-up for Frequency Stability, Inside Temperature Chamber



7. List of Tables

Table 1: List of Test and Measurement Equipment.....	6
Table 2: Emission Measurement Uncertainty.....	6
Table 3: Radio Specifications	7
Table 4: Units of EUT	10
Table 5: Interfaces present on the EUT	11
Table 6: 20dB Bandwidth Edge Frequencies.....	15
Table 7: 20dB Bandwidth.....	15
Table 8: Frequency Stability at 50°C, DC 12V	17
Table 9: Frequency Stability at 40°C, DC 12V	17
Table 10: Frequency Stability at 30°C, DC 12V	17
Table 11: Frequency Stability at 20°C, DC 12V	17
Table 12: Frequency Stability at 10°C, DC 12V	17
Table 13: Frequency Stability at 0°C, DC 12V	18
Table 14: Frequency Stability at -10°C, DC 12V	18
Table 15: Frequency Stability at -20°C, DC 12V	18
Table 16: Frequency Stability at 20°C, DC 10.2V	18
Table 17: Frequency Stability at 20°C, DC 27.6V	18
Table 18: Field Strength of Fundamental	20
Table 19: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations	22

8. List of Figures

Figure 1: Block Diagram	10
Figure 2: 20dB Bandwidth.....	15
Figure 3: Field Strength of Fundamental, Spectral Diagram	20

9. List of Photographs

Photograph 1: Set-up for Radiated Emission of Transmitter, Front View	24
Photograph 2: Set-up for Radiated Emission of Transmitter, Rear View.....	25
Photograph 3: Set-up for Radiated Emission of Transmitter, below 30MHz.....	25
Photograph 4: Set-up for Radiated Emission, EUT Configuration X-Axis.....	26
Photograph 5: Set-up for Radiated Emission, EUT Configuration Y-Axis.....	26
Photograph 6: Set-up for Radiated Emission, EUT Configuration Z-Axis.....	27
Photograph 7: Set-up for Frequency Stability, General View	27
Photograph 8: Set-up for Frequency Stability, Inside Temperature Chamber	28