
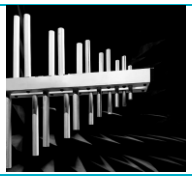
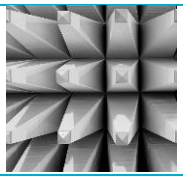

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TEST REPORT

Test report no.: 1-2635/16-01-02

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing Laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
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Fax: + 49 681 5 98 - 9075
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Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

Applicant

Becker Avionics GmbH
Baden Airpark Gebäude B108
77836 Rheinmünster/GERMANY
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Fax:
Contact: Detlev Töpler
e-mail: toepler@becker-avionics.com
Phone: +49 7229 305-192

Manufacturer

Becker Avionics GmbH
Baden Airpark Gebäude B108
77836 Rheinmünster/GERMANY

Test Standard/s

47 CFR Part 87	Title 47 of the Code of Federal Regulations; Chapter I; Part 87 - Aviation Services

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**Diversity Mode S Transponder with ADS-B**
Model name:	**BXT6513-(000)**
FCC ID:	**B54BXT6513**
Frequency:	Tx: 1090 MHz Rx: 1030 MHz
Antenna:	two external antennas
Power supply:	18.0 – 32.2 V DC (typ. 28.0 V DC)
Temperature range:	-45°C to +70°C

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

M. Walla
cn=Walla Meheza, o=ctcadvanced GmbH, ou=WAL-161220, email=meheza.walla@ctcadvanced.com, c=DE
2017.01.17 15:52:56 +01'00'

Meheza Walla
Lab Manager
Radio Communications & EMC

Test performed:

Geraldy Karsten
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Datum: 2017.01.17 15:50:38 +01'00'

Karsten Geraldy
Lab Manager
Radio Communications & EMC

1 Table of contents

2 General Information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

2.2 Application details

Date of receipt of order:	2016-09-16
Date of receipt of test item:	2016-11-14
Start of test:	2016-11-14
End of test:	2016-12-07
Person(s) present during the test:	Mr. Detlev Toepler

2.3 Test Laboratories sub-contracted

None

3 Test standard/s

Test Standard	Date	Description
47 CFR Part 87	2016	Title 47 of the Code of Federal Regulations; Chapter I; Part 87 - Aviation Services

Guidance	Version	Description
ANSI C63.4-2014	-/-	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

4 Test Environment

Temperature:	T_{nom}	+22 °C during room temperature tests
	T_{max}	+50 °C during high temperature tests
	T_{min}	-20 °C during low temperature tests
Relative humidity:		45 %
Air pressure:		not relevant for this kind of testing
Power supply:	V_{nom}	28.0 V DC
	V_{max}	32.2 V
	V_{min}	18.0 V

5 Test item

5.1 General description

Kind of test item	:	Diversity Mode S Transponder with ADS-B
Type identification	:	BXT6513-(000)
S/N serial number	:	00114
HW hardware status	:	DoM: NOV/16
SW software status	:	software package version 2
Frequency band	:	Tx: 1090 MHz Rx: 1030 MHz
Type of modulation	:	pulse position modulation (PPM)
Number of channels	:	1
Antenna	:	two external antennas
Power supply	:	18.0 – 32.2 V DC (typ. 28.0 V DC) by aircraft battery
Temperature range	:	-45°C to +70°C

5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in documents: 1-2635/16-01-01_AnnexA
1-2635/16-01-01_AnnexB
1-2635/16-01-01_AnnexD

6 Description of the test setup

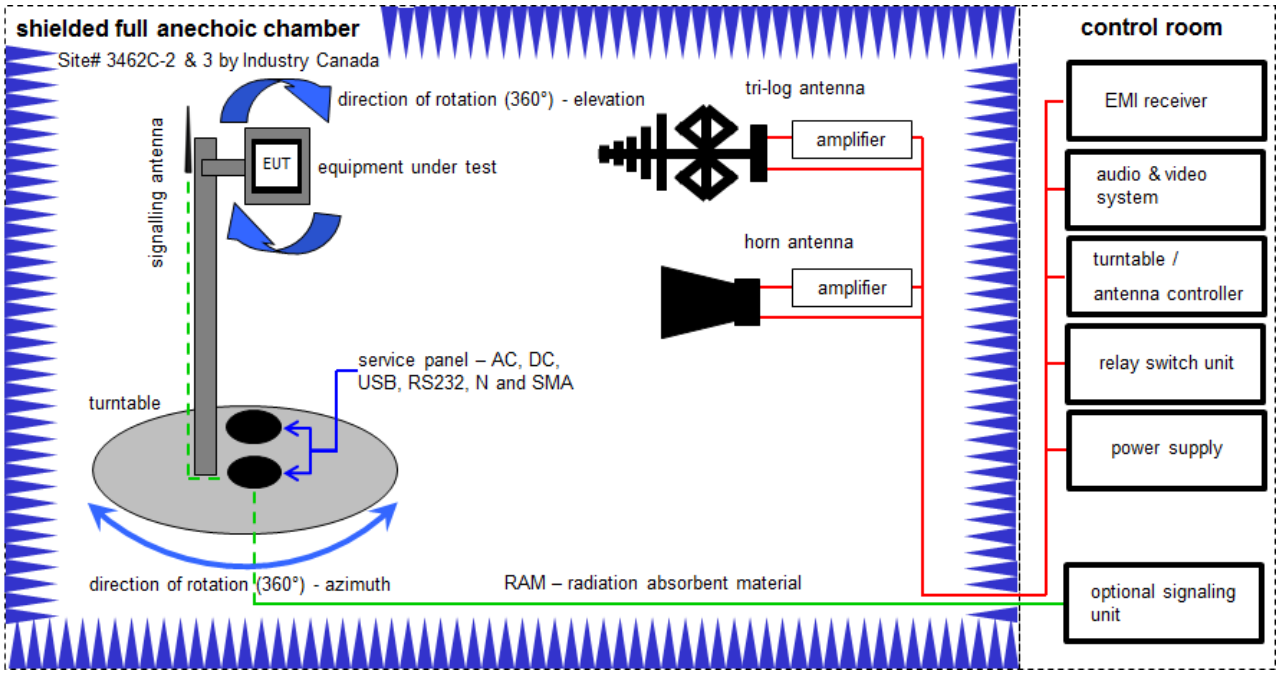
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

6.1 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter

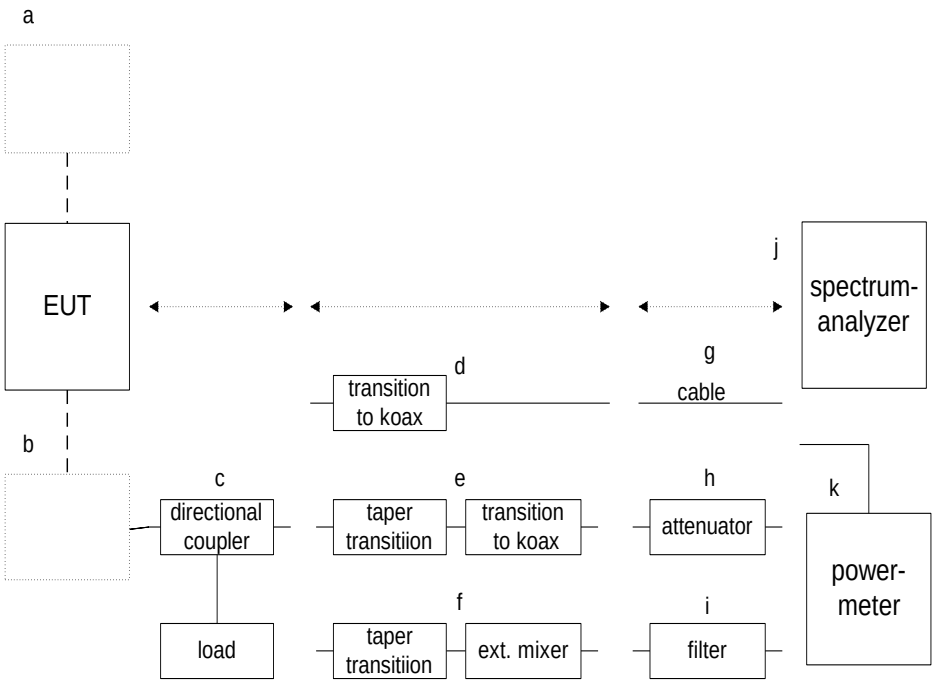
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	Ve	20.01.2015	20.01.2018
2	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKI!	20.05.2015	20.05.2017
3	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
5	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-
6	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017
7	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne	-/-	-/-
8	Band Reject filter	WRCG1855/1910-1835/1925-40/8SS	Wainwright	7	300003350	ev	-/-	-/-
9	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev	-/-	-/-
10	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
11	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vIKI!	29.10.2014	29.10.2017
12	Spectrumanalyzer	FSV30	R&S	100763	300003950	k	03.02.2016	03.02.2017
13	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
14	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
15	EMI Test Receiver 9kHz-26,5GHz	ESR26	R&S	101376	300005063	vIKI!	13.09.2016	13.03.2018

6.2 Conducted measurements with peak power meter & spectrum analyzer



Equipment table:

No.	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	Fixed Coaxial Attenuator, 20dB 100W DC-18GHz	WA91-20-43	Weinschel Ass	A514	300004824	ev	14.11.2016	-/-
2	RF Peak Power Analyzer+ PPA Sensor	4500B + 58318	Boonton Electronics	12331 + 6276	300003871	k	28.01.2016	28.01.2017
3	PXA Spectrum Analyzer 3Hz to 50GHz	N9030A PXA Signal Analyzer	Agilent Technologies	US51350267	300004338	k	09.02.2016	09.02.2017
4	10 dB fixed attenuation	401001	Inmet	-/-	-/-	ev	14.11.2016	-/-
5	Power Splitter	11667B	HP	00616	-/-	ev	14.11.2016	-/-
6	High Pass Filter	VHF-1500+	Mini-Circuits	31022	-/-	ev	14.11.2016	-/-
7	Coaxial Cable	ST18 - 72	H&S	-/-	-/-	ev	-/-	-/-
8	Temperature Test Chamber	T-40/50	CTS GmbH	064023	300003540	ev	03.09.2015	03.09.2017
9	DC Power Supply, 60V, 10A	6038A	HP	2933A08295	300001519	Ve	21.01.2015	21.01.2018

6.3 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

6.4 Sequence of testing radiated spurious 1 GHz to 12.75 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

7 Summary of measurement results

☒	**No deviations from the technical specifications were ascertained**
☐	There were deviations from the technical specifications ascertained

TC identifier	Description	verdict	date	Remark
RF-Testing	47 CFR 87	see table	2017-01-17	-/-

Test specification clause	Test Case	temperature / voltages	Mode	pass	Fail	NA	NP	Results (max.)
§2.1046 §87.131	Measurements required: RF power output / Power and emissions	Nominal	TX	☒	☐	☐	☐	PK: 55.9 dBm AV: 30.5 dBm
§2.1049 §87.135	Measurements required: Occupied bandwidth / Bandwidth of emissions	Nominal	TX	☒	☐	☐	☐	8.4 MHz
§2.1051 §87.139	Measurements required: Spurious emissions at antenna terminals / Spectrum mask / Conducted spurious emissions	Nominal	TX	☒	☐	☐	☐	
§2.1053 §87.139	Measurements required: Field strength of spurious radiation/ Radiated spurious emissions	Nominal	TX	☒	☐	☐	☐	
§2.1055 §87.133	Measurements required: Frequency stability / Frequency stability	Nominal Extreme	TX	☒	☐	☐	☐	-3.7 ppm

Note:
NA = Not applicable; NP = Not performed

8 Measurement results

8.1 Power and emissions

§2.1046 Measurements required: RF power output.
(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

§87.131 Power and emissions.
Power must be determined by direct measurement.
The power is measured at the transmitter output terminals and the type of power is determined according to the emission designator as follows:
(i) Mean power (pY) for amplitude modulated emissions and transmitting both sidebands using unmodulated full carrier.
(ii) Peak envelope power (pX) for all emission designators other than those referred to in paragraph (i) of this note.

Measurement results:

Test Conditions		conducted output power (dBm)	
		S-Mode	A/C-Mode
Pos-Peak	T_{nom} / V_{nom}	55.9 dBm	55.9 dBm
AVG	T_{nom} / V_{nom}	27.5 dBm	30.5 dBm
Measurement uncertainty		± 1.5 dB	

Note:
see Annex A

Limits:

Note 7: maximum output power will be determined during the certification process

Verdict: **Test passed**

8.2 Occupied bandwidth

§2.1049 Measurements required: Occupied bandwidth.
The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

§87.135 Bandwidth of emission.
(a) Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 percent of the total mean power of a given emission.
(b) The authorized bandwidth is the maximum occupied bandwidth authorized to be used by a station.
(c) The necessary bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Measurement parameters:

Measurement parameters	
Detector:	Pos-Peak
Sweep time:	20 s
Resolution bandwidth:	200 kHz
Video bandwidth:	500 kHz
Span:	20 MHz
Trace-Mode:	Max-Hold

Measurement results:

Test Conditions		Occupied bandwidth (MHz)	
		S-Mode	A/C-Mode
Pos-Peak Max-Hold	T_{nom} / V_{nom}	8.0 MHz	8.4 MHz

Note:
see Annex B, plot 1 – 2

Limits:

no limits defined

Verdict: **Test passed**

8.3 Spectrum mask and conducted spurious emissions

§2.1051 Measurements required: Spurious emissions at antenna terminals.
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§87.139 Emission limitations.
(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:
(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;
(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.
(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10}$ pY dB.

Measurement parameters:

Measurement parameters	
Detector:	AVG
Resolution bandwidth:	1 MHz
Video bandwidth:	≥ ResBW
Span:	see plots
Trace-Mode:	Max-Hold

Measurement results:

Spurious emissions (Carrier-on state)								
F	BW	p	F	BW	p	F	BW	p
Measurement uncertainty			± 3dB					

Where F = Frequency of spurious (MHz)
BW = Measurement receiver bandwidth (MHz)
p = Level of spurious (dBm)

Note:
see Annex B, plot 3 – 12

Verdict: **Test passed**

8.4 Radiated spurious emissions

§2.1053 Measurements required: Field strength of spurious radiation.
(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz.
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission.

§87.139 Emission limitations.
(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the 1435-1525 MHz, 2345-2395 MHz, or 5091-5150 MHz band or digital modulation (G7D) for differential GPS, the mean power of any emissions must be attenuated below the mean power of the transmitter (pY) as follows:
(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;
(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.
(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10}$ pY dB.

Measurement parameters:

Measurement parameters	
Detector:	AVG
Sweep time:	1 s
Resolution bandwidth:	1 MHz
Video bandwidth:	≥ ResBW
Span:	see plots
Trace-Mode:	Max-Hold

Measurement results:

Spurious emissions (Carrier-on state)								
						-/-		
F	BW	p	F	BW	p	F	BW	p
2180 MHz	1 MHz	-36.8 dBm						
3270 MHz	1 MHz	-45.5 dBm						
Measurement uncertainty			± 3dB					

Where F = Frequency of spurious (MHz)
BW = Measurement receiver bandwidth (MHz)
p = Level of spurious (dBm)

Note:
See Annex B, plot 13

Limits:

frequency range	max. spurious level
30 MHz – 11 GHz	-13 dBm / 1 MHz

Verdict: **Test passed**

8.5 Frequency tolerance

§2.1055 Measurements required: Frequency stability.
(a) The frequency stability shall be measured with variation of ambient temperature as follows:
(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
(2) From −20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.
(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.
(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and + 30° centigrade with no primary power applied.
(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10° centigrade above the respective beginning ambient temperature level.
(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.
(4) When it is impracticable to subject the complete transmitter to this test because of its physical dimensions or power rating, only its frequency determining and stabilizing portions need be tested.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c), and (d) of this section. (For example measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

§87.133 Frequency stability.
(a) Except as provided in paragraphs (c), (d), (f), and (g) of this section, the carrier frequency of each station must be maintained within these tolerances:
7) Band-470 to 2450 MHz: Aircraft stations Tolerance of 20 ppm

Measurement result:

Temperature [°C]	Voltage [V DC]	Reference Frequency [MHz]	Measured Frequency [MHz]	Deviation [kHz]	Deviation [ppm]
-20	28	1090	1089.997	-3.0	-2.8
-10	28	1090	1089.996	-4.0	-3.7
0	28	1090	1089.996	-4.0	-3.7
10	28	1090	1089.997	-3.0	-2.8
20	18	1090	1089.997	-3.0	-2.8
20	28	1090	1089.997	-3.0	-2.8
20	32	1090	1089.997	-3.0	-2.8
30	28	1090	1089.997	-3.0	-2.8
40	28	1090	1090.000	0.0	0.0
50	28	1090	1090.002	2.0	1.8

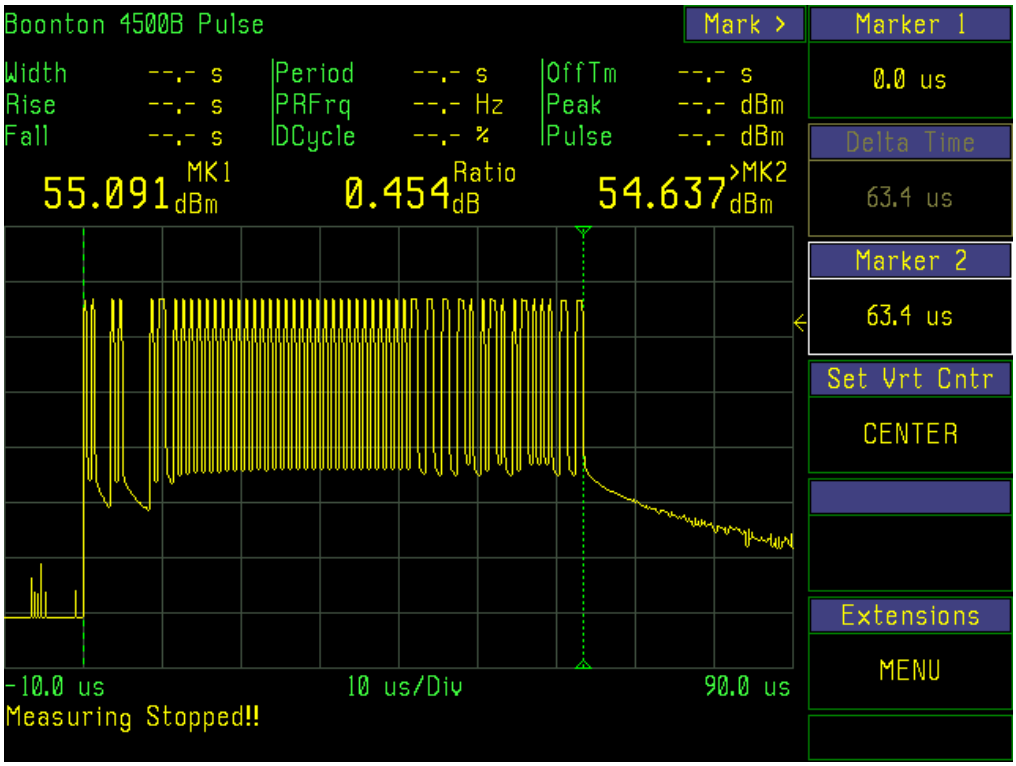
Limits:

Frequency tolerance	20 ppm

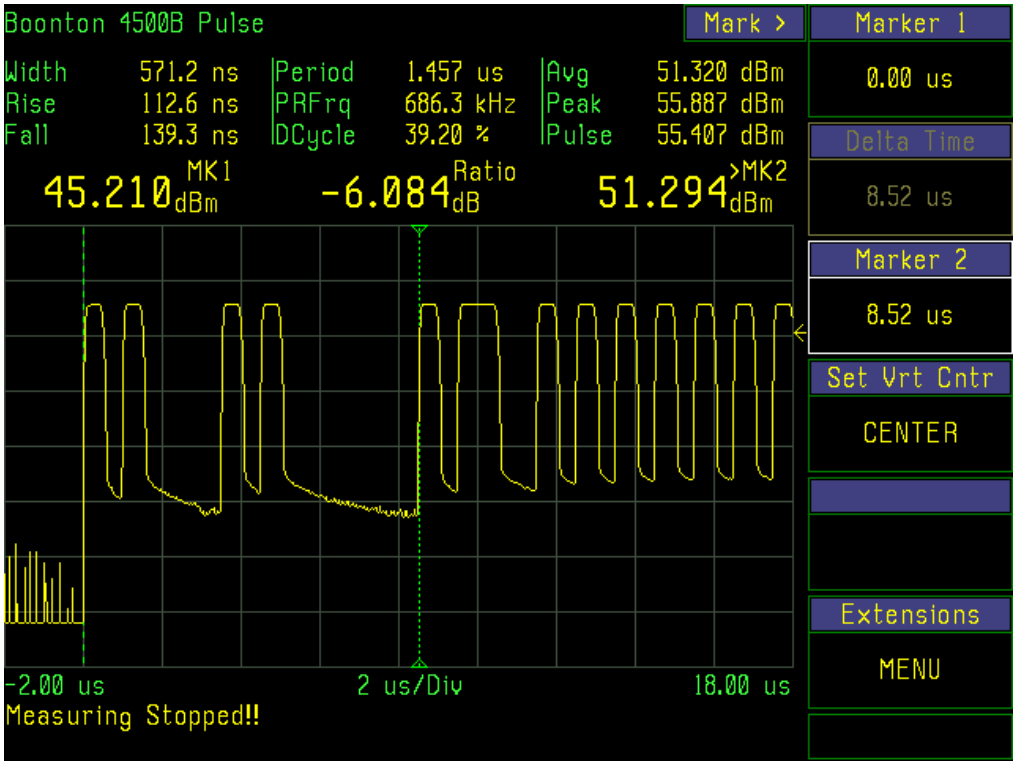
Verdict: **Test passed**

Annex A Measurement results (Peak Power Measurements)

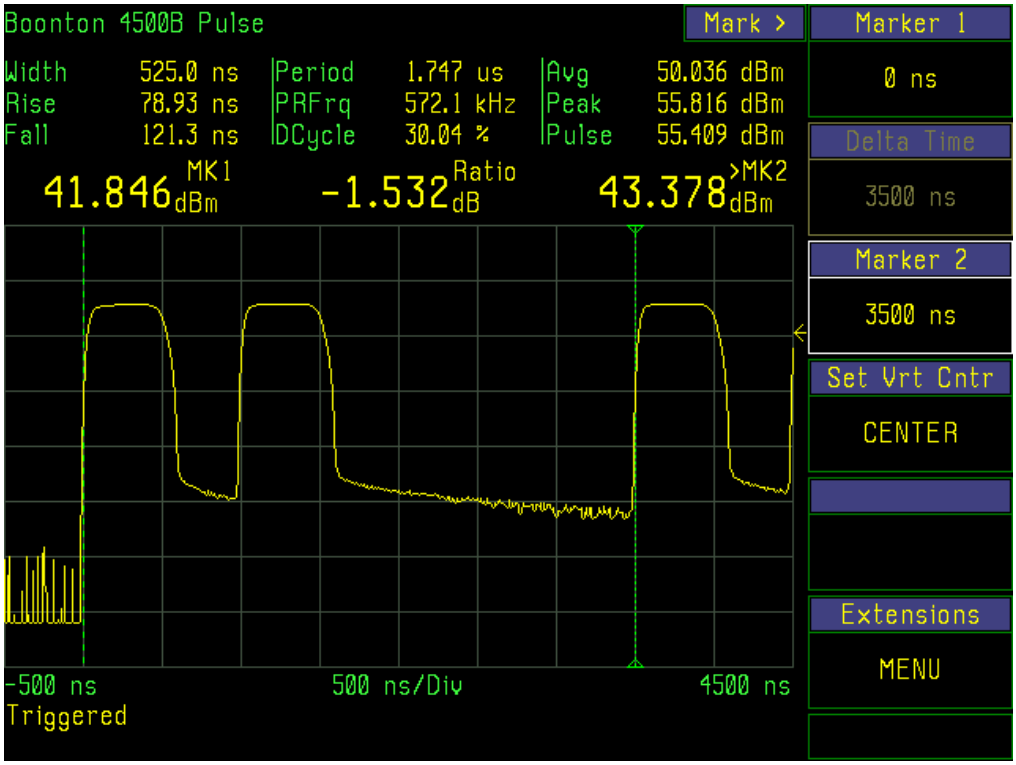
Plot No. 1: S-Mode



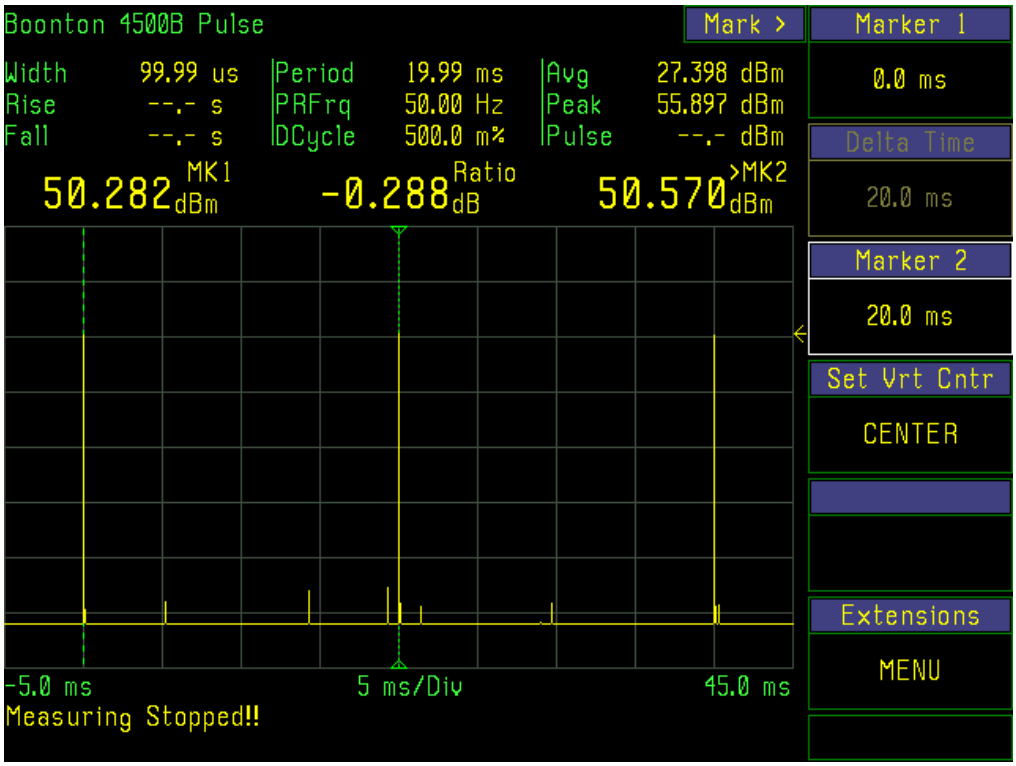
Plot No. 2: S-Mode



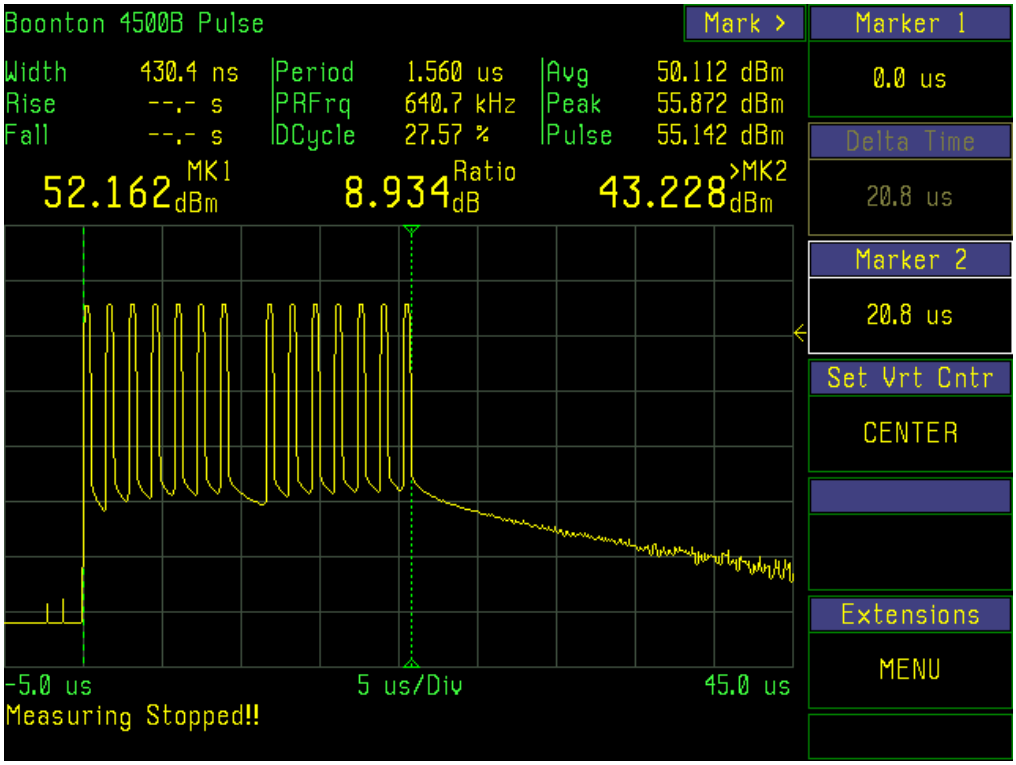
Plot No. 3: S-Mode



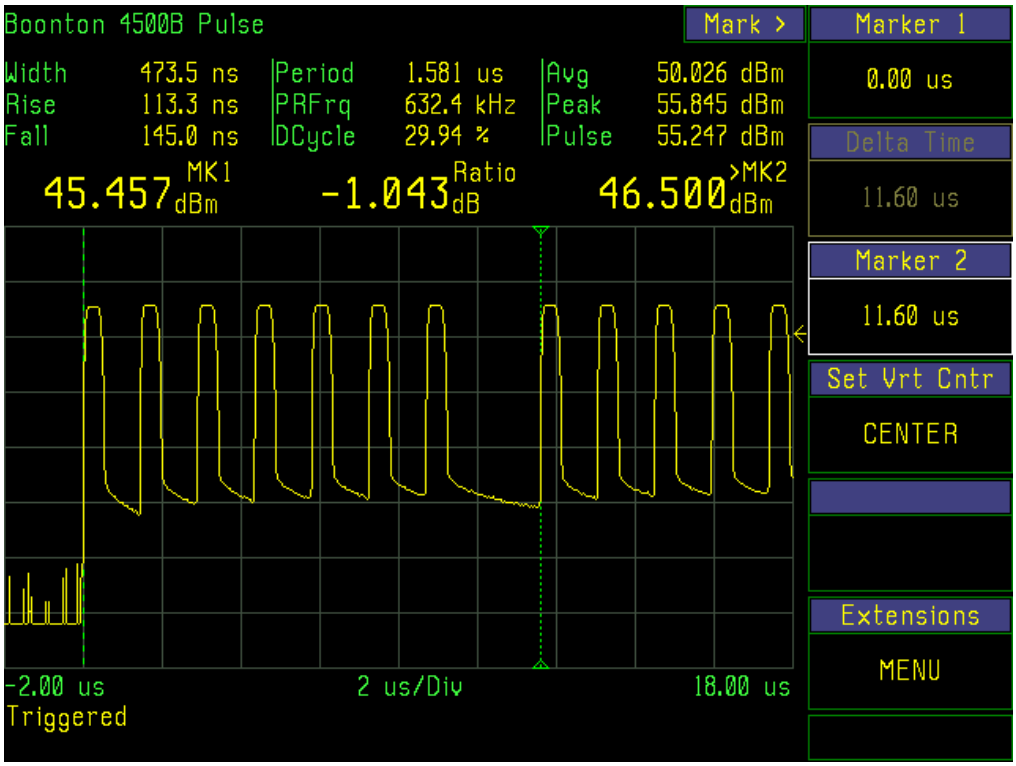
Plot No. 4: S-Mode



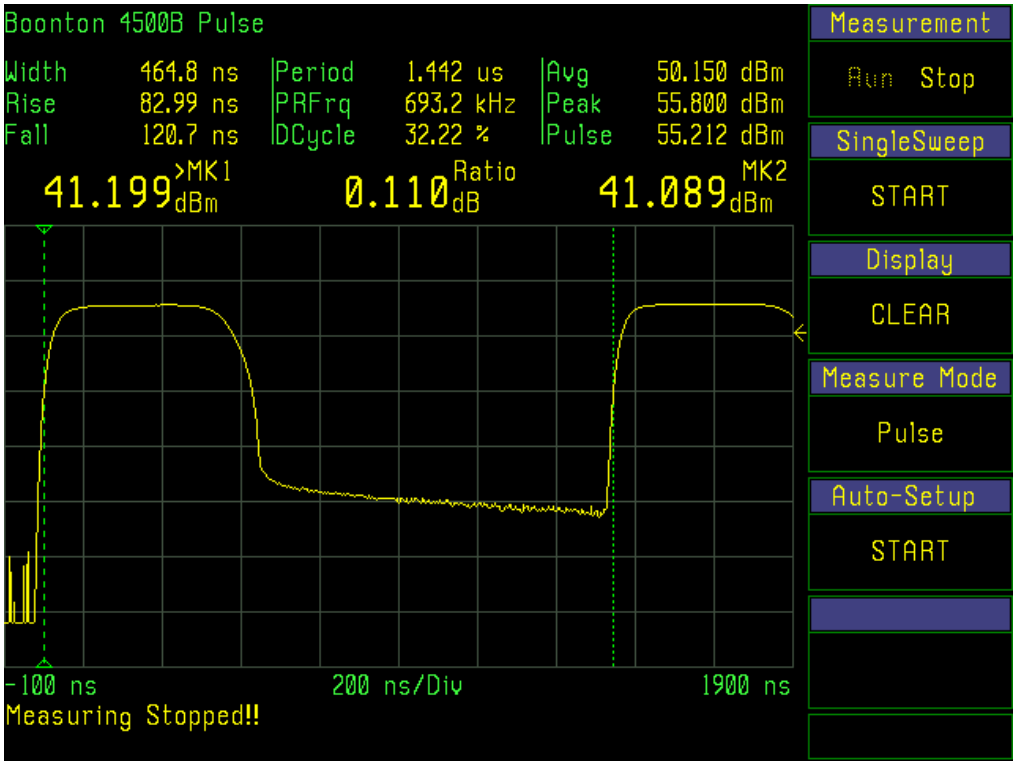
Plot No. 5: A/C-Mode



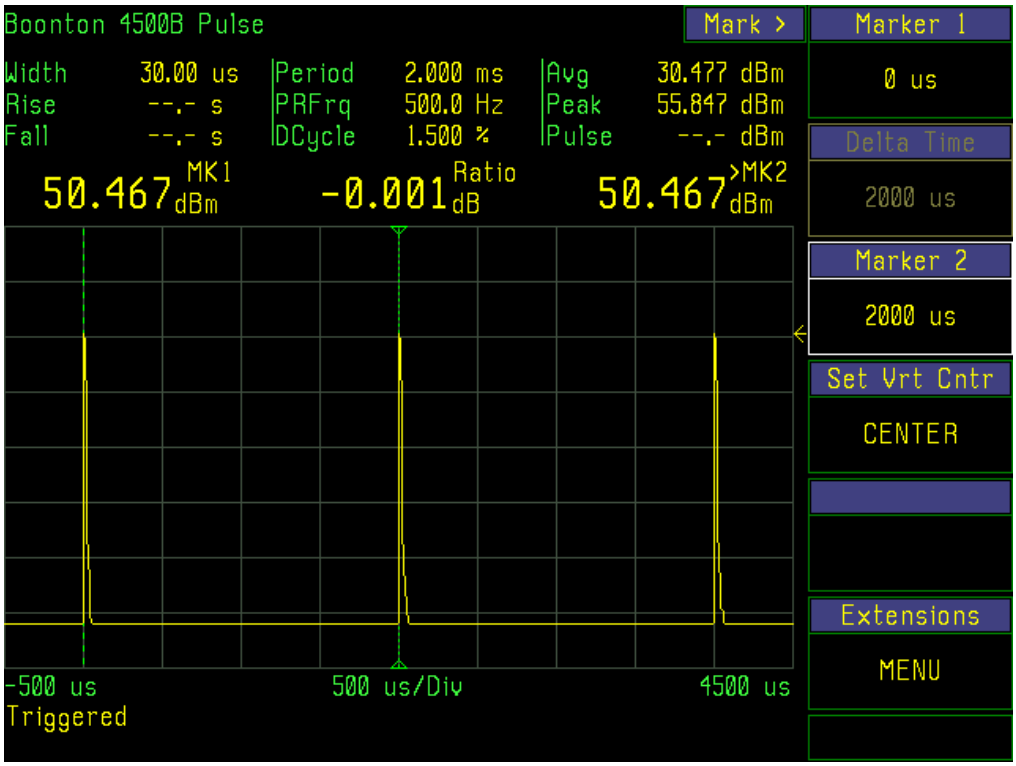
Plot No. 6: A/C-Mode



Plot No. 7: A/C-Mode



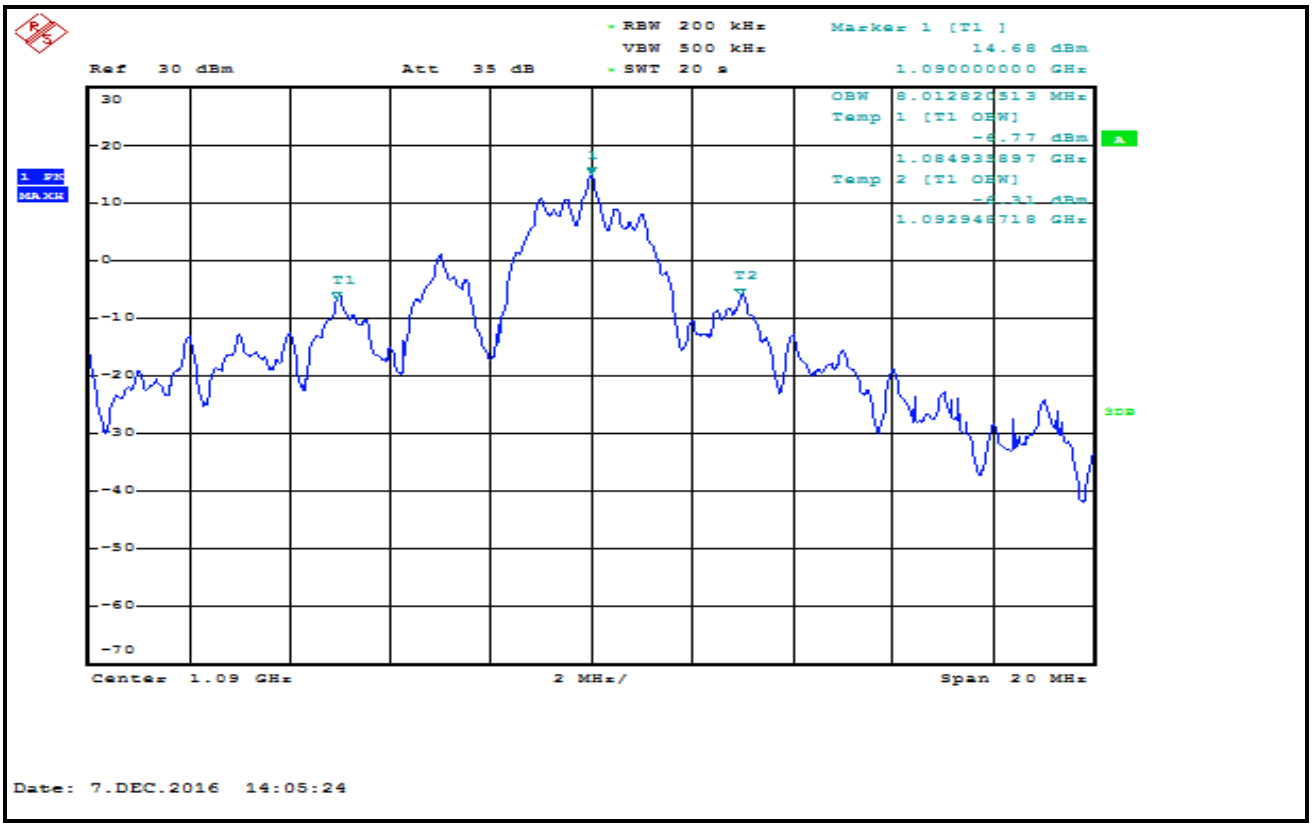
Plot No. 8: A/C-Mode



Annex B Measurement results (Spectrum Measurements)

This annex consists of 14 pages including this page.

Plot No. 1 (13)



Subclause: -/- Function test
RF-carrier at 1090 MHz
Determination of the occupied bandwidth

Limit:
no limits defined

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, S-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Determination of the occupied bandwidth**

Environment condition:

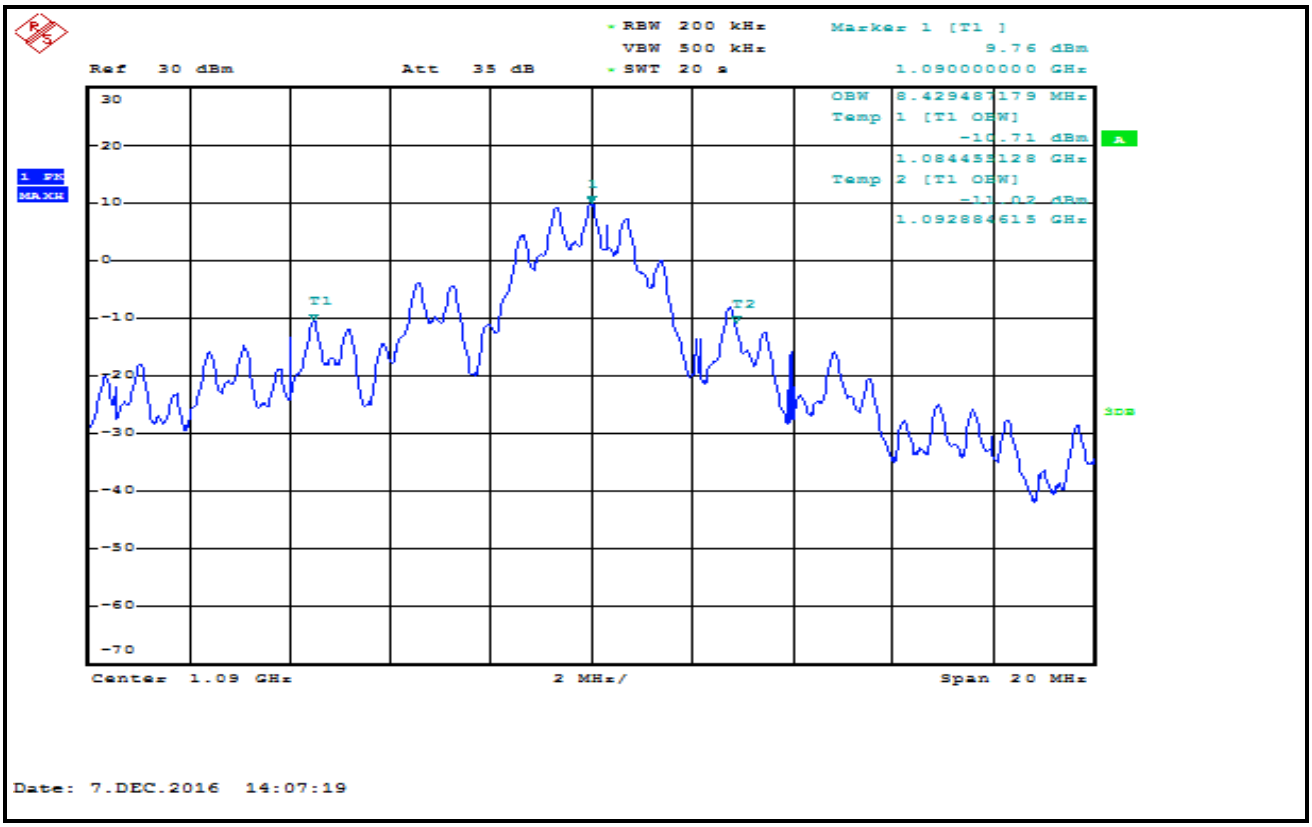
Date & Time:	Wed 07/Dec/2016 14:05:24	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	1.08	GHz
Stop frequency:	1.10	GHz
Center frequency:	1.09	GHz
Frequency span:	20	MHz
Resolution-BW:	200	kHz
Video-BW:	500	kHz
Input attenuation:	35	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	Pos Peak	

Remarks:
Determination of the occupied bandwidth
The measured value is about 7.75 MHz (delta marker)
(acc. to the definitions: 99% of the total mean power)
Max-Hold measurement.

Plot No. 2 (13)



Subclause: -/- Function test
RF-carrier at 1090 MHz
Determination of the occupied bandwidth

Limit:
no limits defined

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 2, A/C-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Determination of the occupied bandwidth**

Environment condition:

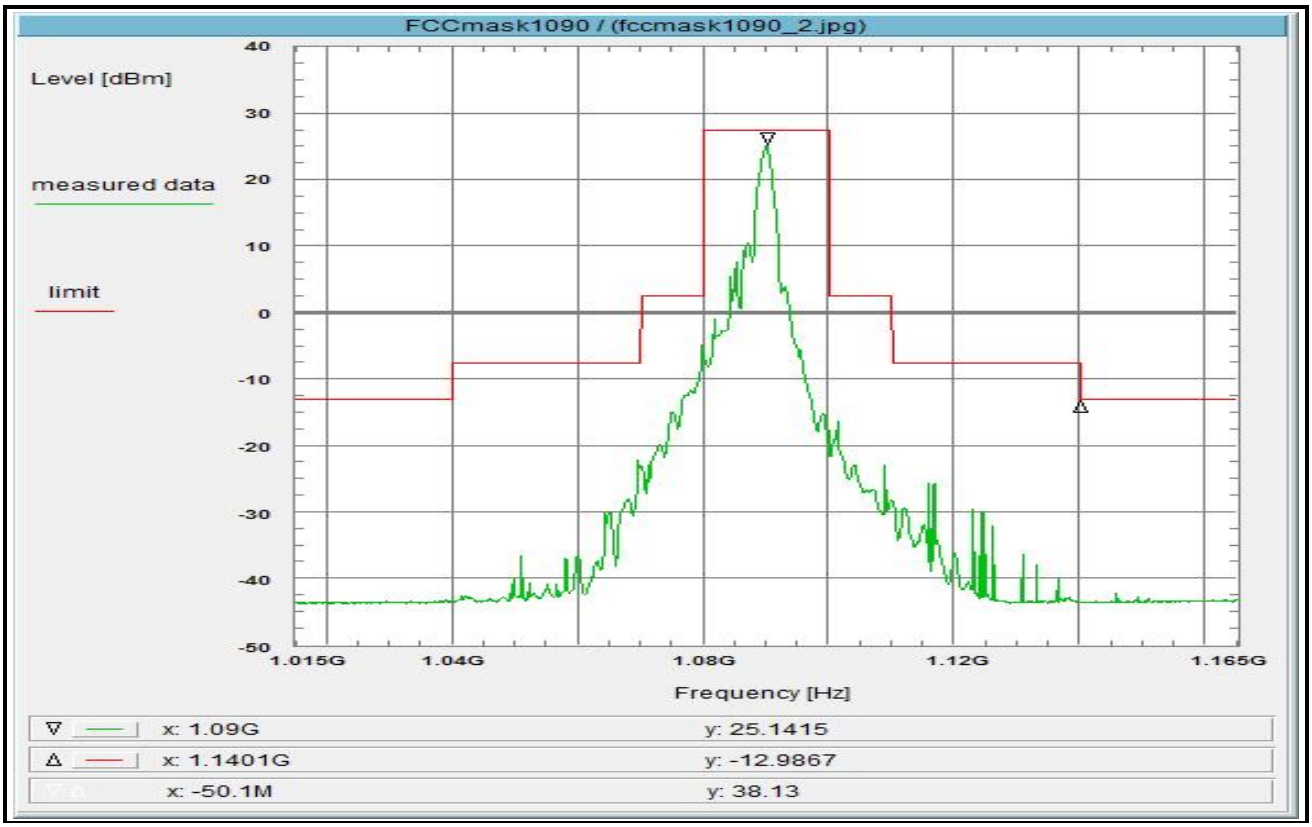
Date & Time:	Wed 07/Dec/2016 14:07:19	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	1.08	GHz
Stop frequency:	1.10	GHz
Center frequency:	1.09	GHz
Frequency span:	20	MHz
Resolution-BW:	200	kHz
Video-BW:	500	kHz
Input attenuation:	35	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	Pos Peak	

Remarks:
Determination of the occupied bandwidth
The measured value is about 9.0 MHz (delta marker)
(acc. to the definitions: 99% of the total mean power)
Max-Hold measurement.

Plot No. 3 (13)



Subclause: -/- Spectrum mask
RF-carrier at 1090 MHz
Spectrum mask

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, S-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 13:31:34	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

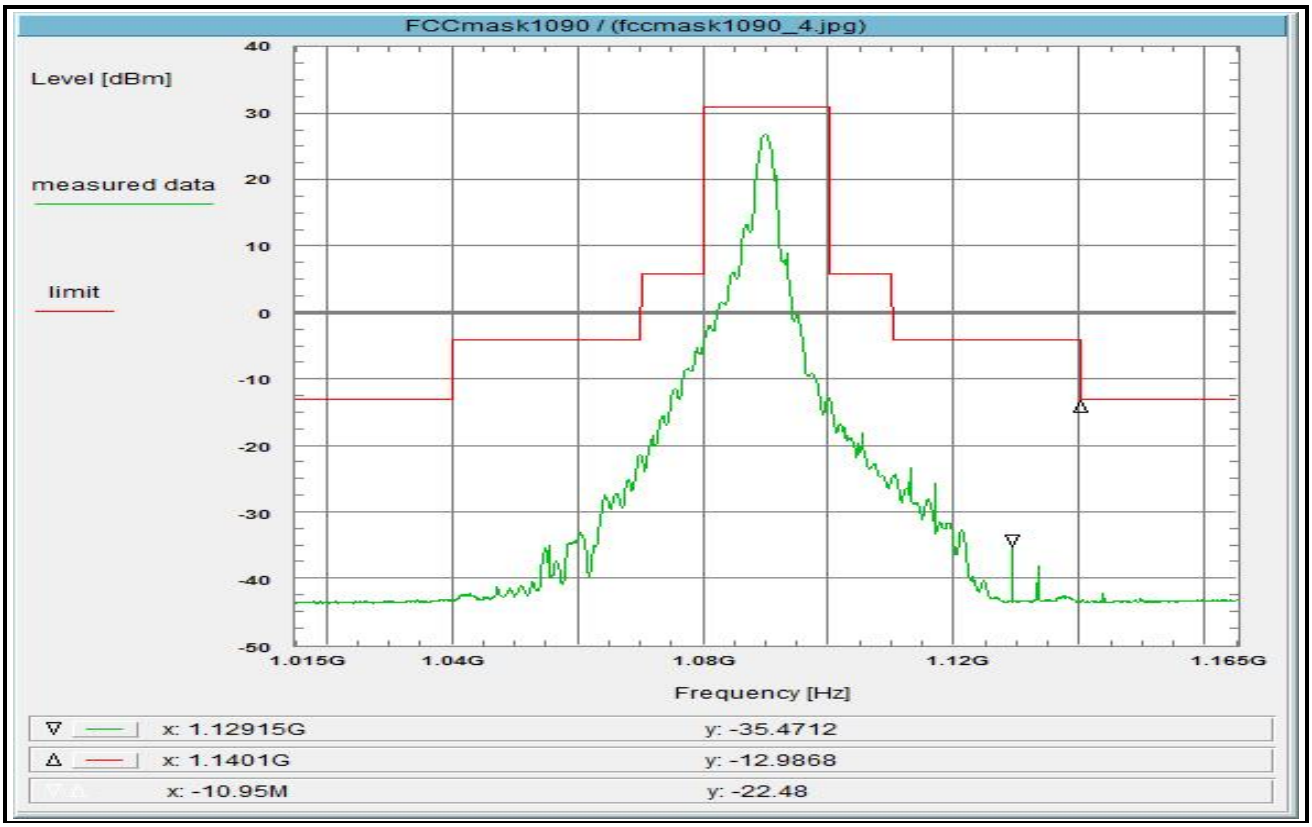
Start frequency:	1.015	GHz
Stop frequency:	1.165	GHz
Center frequency:	1.09	GHz
Frequency span:	150	MHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	30	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	0.7	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (UBEC)	+	35.8	dB
TOTAL CORRECTION:	+	36.5	dB

Remarks:
Spectrum mask based on 20 MHz bandwidth.
Max-Hold measurement.

Plot No. 4 (13)



Subclause: -/- Spectrum mask
RF-carrier at 1090 MHz
Spectrum mask

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 2, A/C-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 15:09:48	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

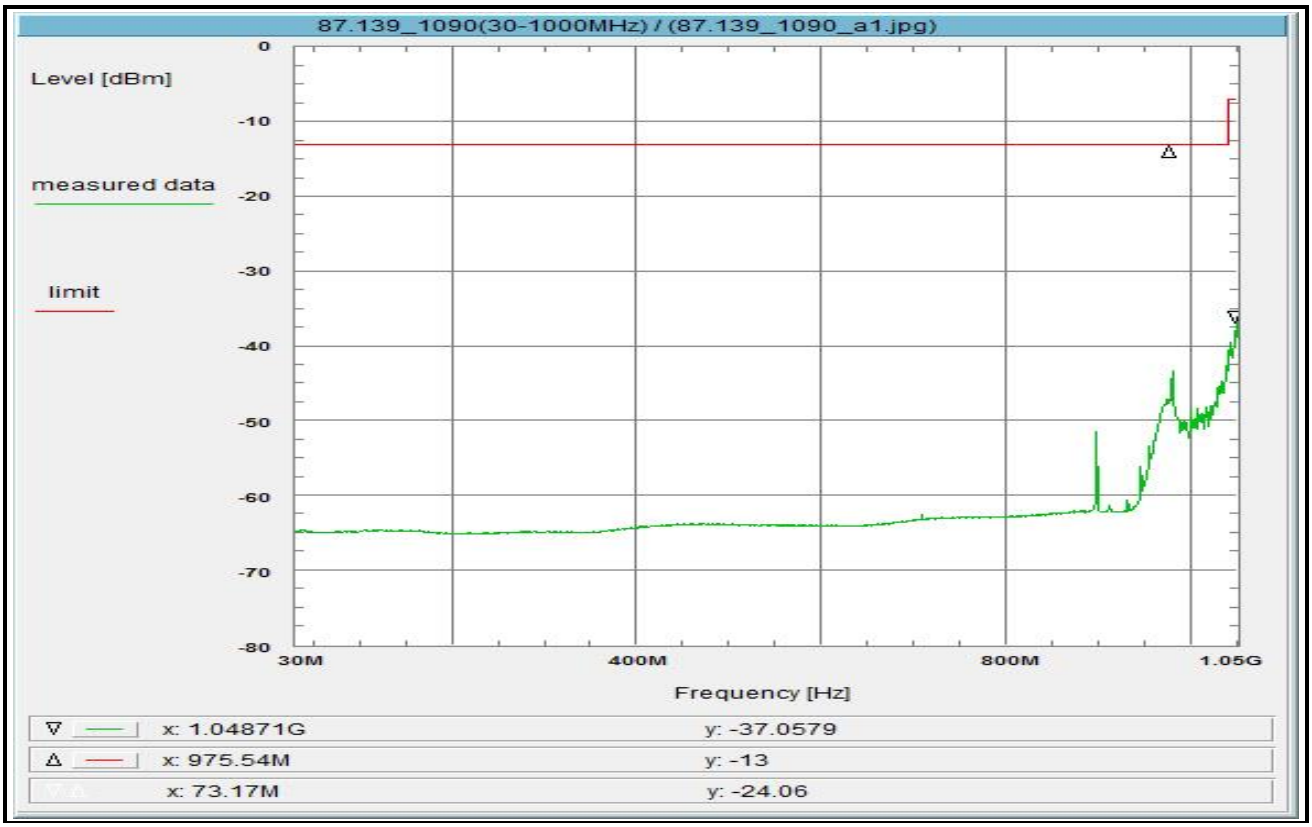
Start frequency:	1.015	GHz
Stop frequency:	1.165	GHz
Center frequency:	1.09	GHz
Frequency span:	150	MHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	30	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	0.7	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (UBEC)	+	35.8	dB
TOTAL CORRECTION:	+	36.5	dB

Remarks:
Spectrum mask based on 20 MHz bandwidth.
Max-Hold measurement.

Plot No. 5 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 30 MHz - 1000 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, S-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 15:42:33	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

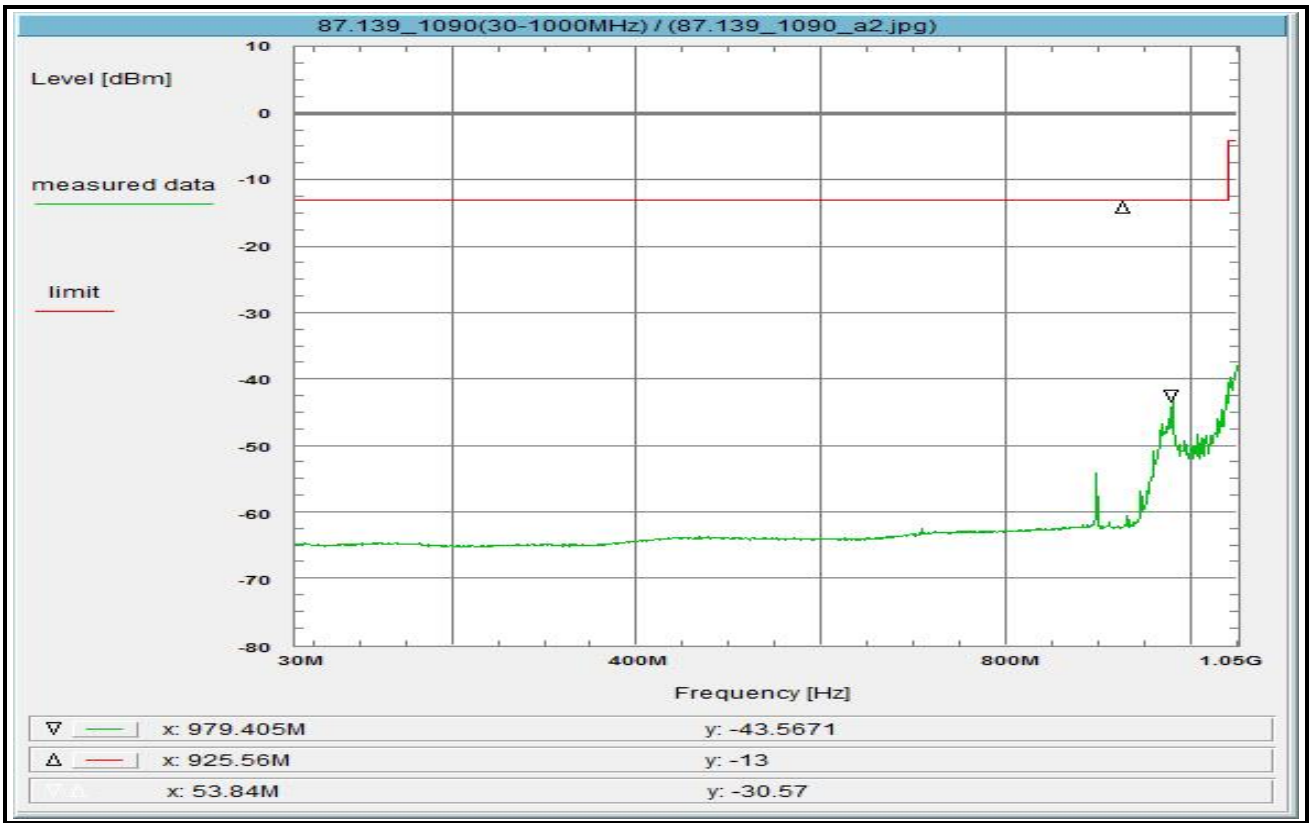
Start frequency:	30	MHz
Stop frequency:	1.05	GHz
Center frequency:	540	MHz
Frequency span:	1.02	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	10	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	0.5	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (UBEC)	+	35.7	dB
TOTAL CORRECTION:	+	36.2	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot No. 6 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 30 MHz - 1000 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 2, A/C-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 15:16:27	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

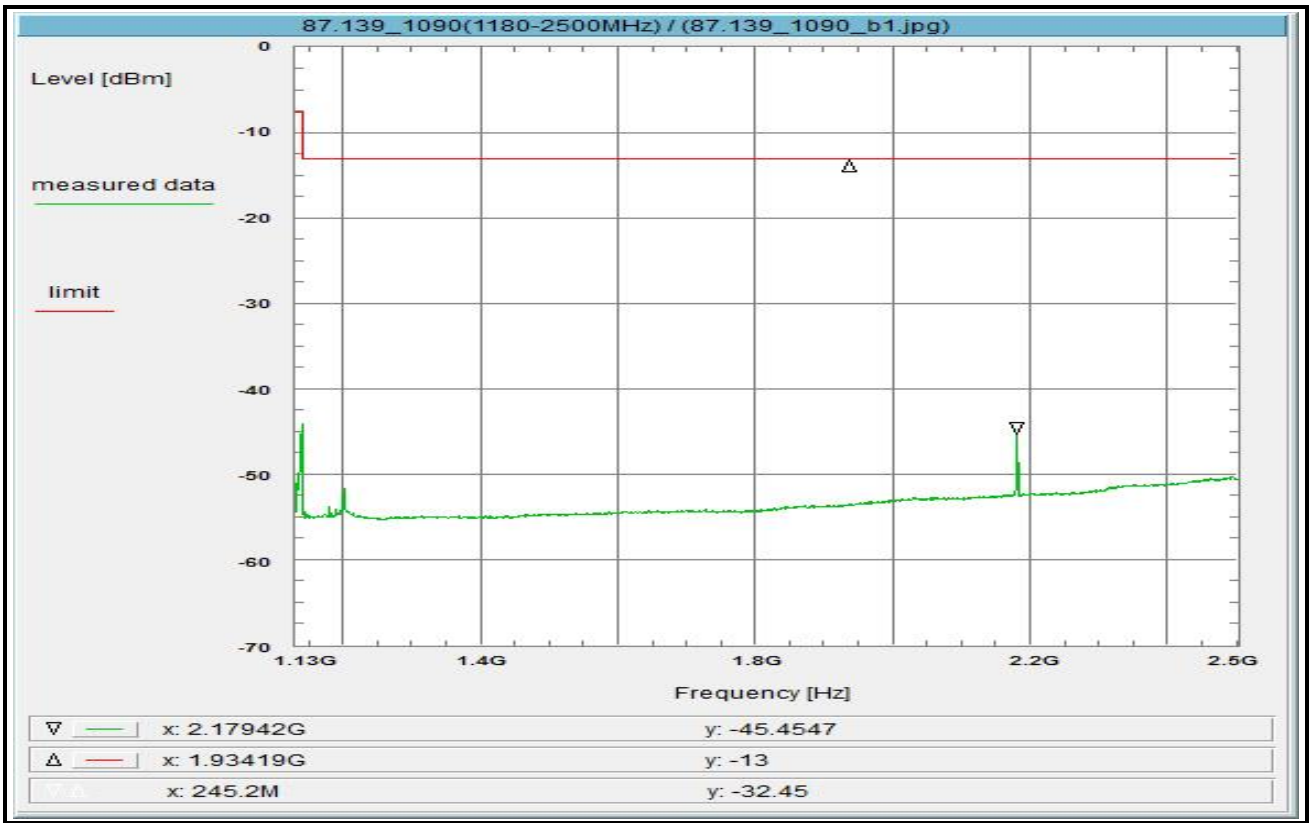
Start frequency:	30	MHz
Stop frequency:	1.05	GHz
Center frequency:	540	MHz
Frequency span:	1.02	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	10	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	0.5	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (UBEC)	+	35.7	dB
Splitter		0.0	dB
HPF		0.0	dB
TOTAL CORRECTION:	+	36.2	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot No. 7 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 1180 MHz - 2500 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, S-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 13:43:01	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	1.13	GHz
Stop frequency:	2.5	GHz
Center frequency:	1.815	GHz
Frequency span:	1.37	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	18	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

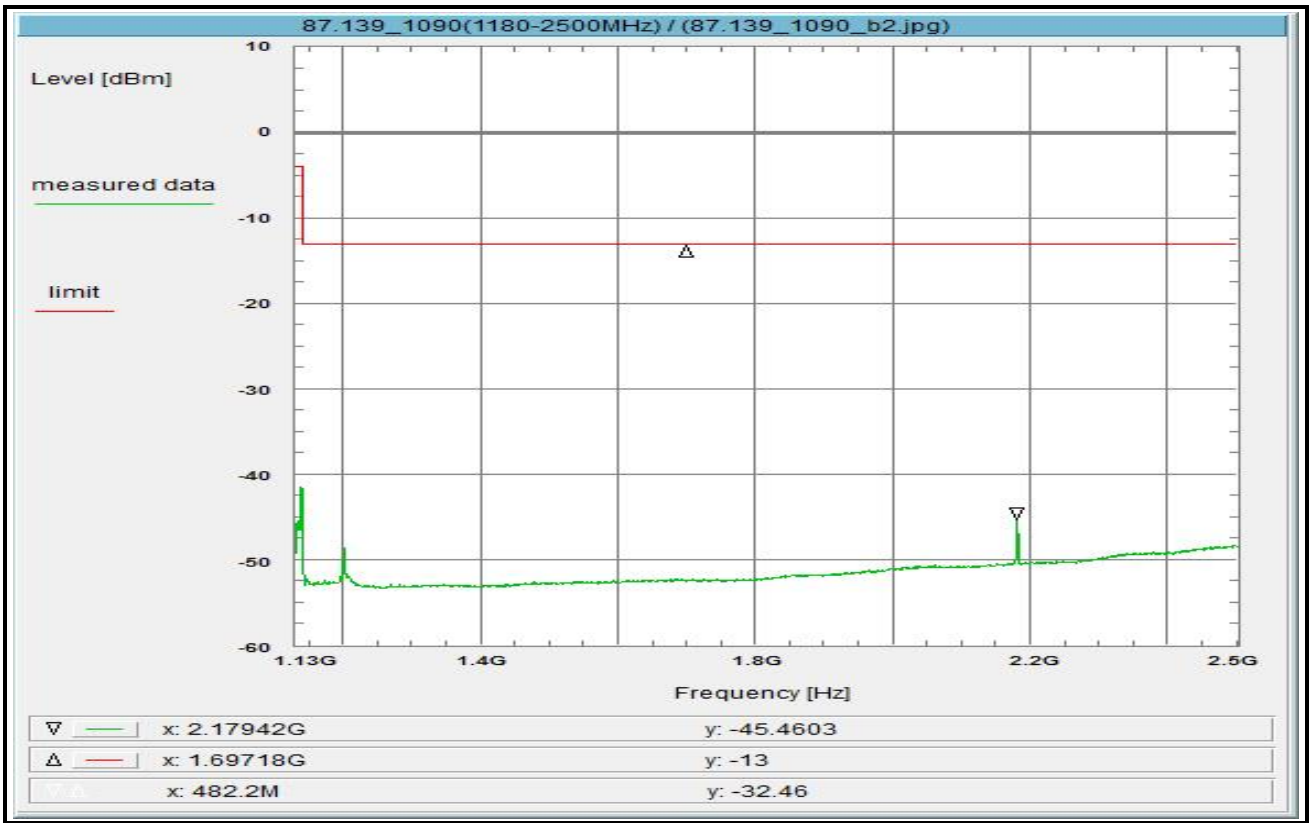
Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	0.9	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (UBEC)	+	35.7	dB
TOTAL CORRECTION:	+	36.6	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot shows 2nd harmonic.

Plot No. 8 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 1180 MHz - 2500 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 2, A/C-Mode

Test setup:
see section 6.2: 1.2hgj

Test equipment:
see annex 2: C218, R001, UBEC

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 15:32:56	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	1.13	GHz
Stop frequency:	2.5	GHz
Center frequency:	1.815	GHz
Frequency span:	1.37	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	20	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

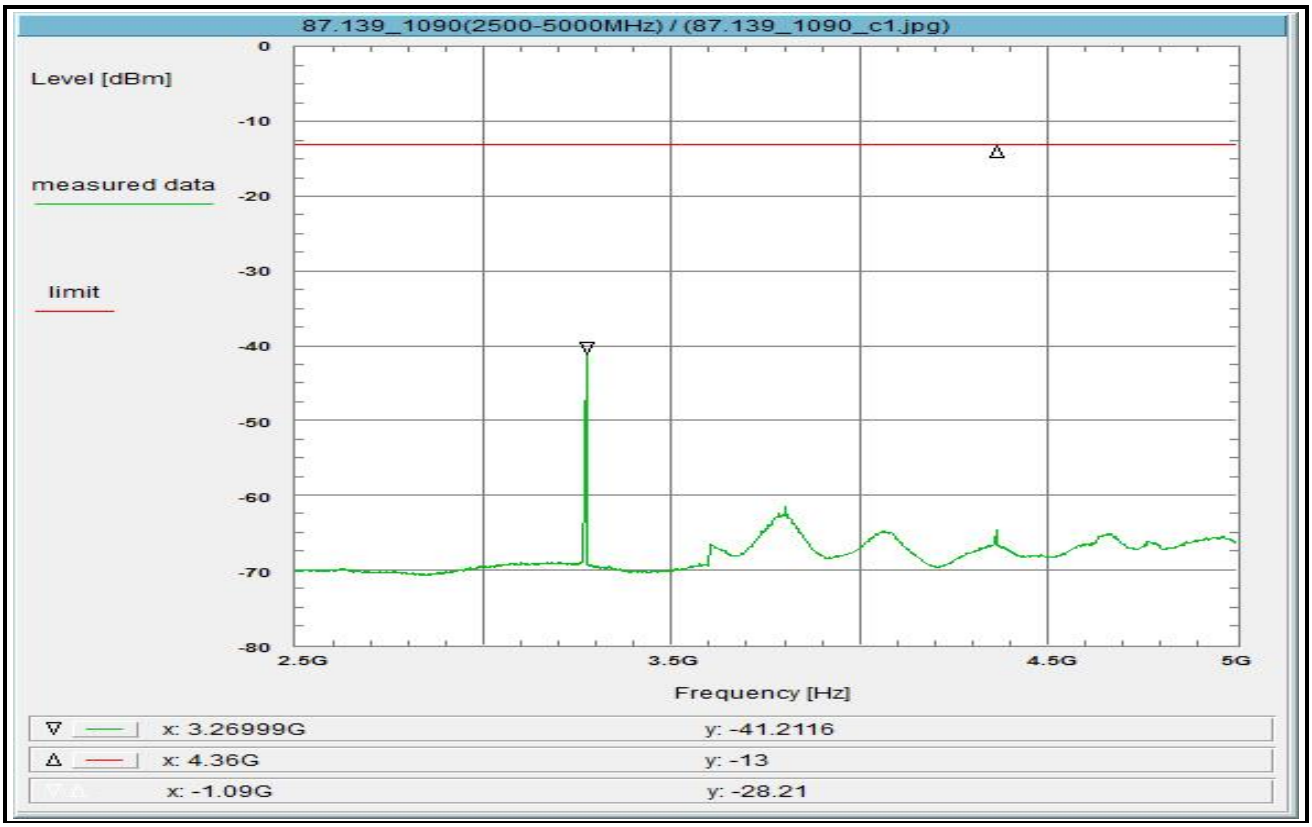
Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	0.9	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (UBEC)	+	35.7	dB
Splitter	+	0.0	dB
HPF	+	0.0	dB
TOTAL CORRECTION:	+	36.6	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot shows 2nd harmonic.

Plot No. 9 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 2500 MHz - 5000 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, S-Mode

Test setup:
see section 6.2: 1.2higj

Test equipment:
see annex 2: C218, F150, R001, U312

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 13:50:55	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	2.5	GHz
Stop frequency:	5	GHz
Center frequency:	3.75	GHz
Frequency span:	2.5	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	10	dB
Trace-Mode:	Clear Write	
Detector-Mode:	AVG	

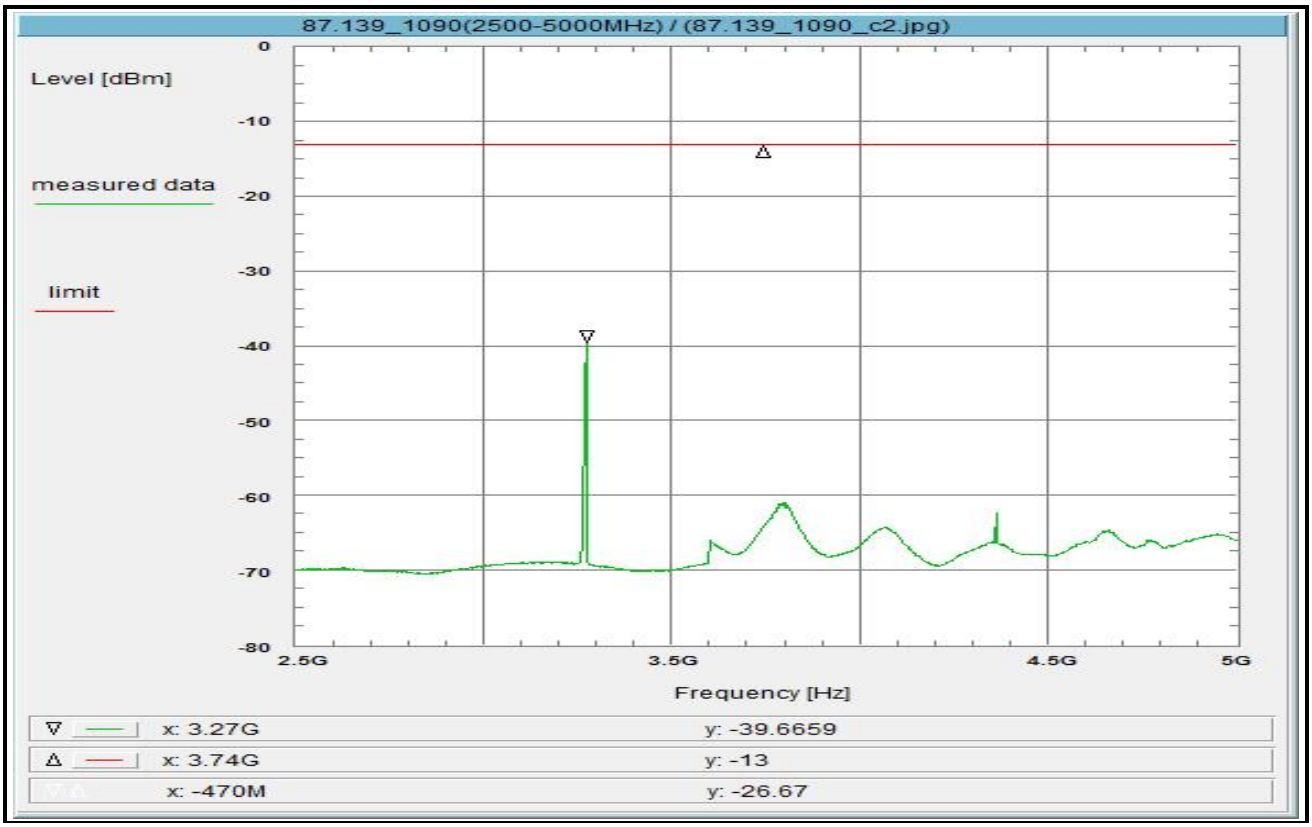
Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	1.2	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (U312)	+	19.7	dB
Splitter	+	6.0	dB
HPF (F150)	+	0.4	dB
TOTAL CORRECTION:	+	27.3	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot shows 3rd and 4th harmonic.

Plot No. 10 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 2500 MHz - 5000 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 2, A/C-Mode

Test setup:
see section 6.2: 1.2higj

Test equipment:
see annex 2: C218, F150, R001, U312, UBEC

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 15:23:46	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	2.5	GHz
Stop frequency:	5	GHz
Center frequency:	3.75	GHz
Frequency span:	2.5	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	10	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

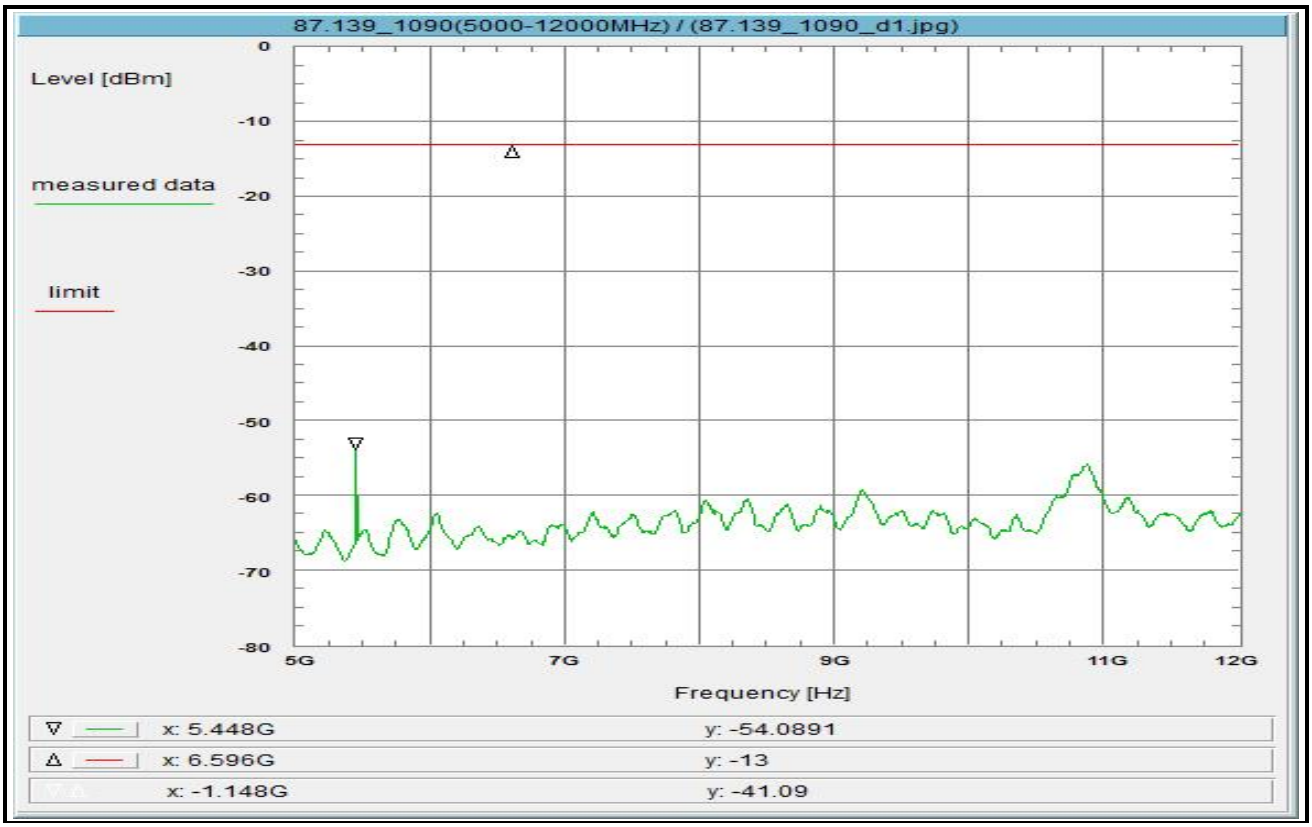
Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	1.2	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (U312)	+	19.7	dB
Splitter	+	6.0	dB
HPF (F150)	+	0.4	dB
TOTAL CORRECTION:	+	27.3	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot shows 3rd and 4th harmonic.

Plot No. 11 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 5000 MHz - 12000 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 1, S-Mode

Test setup:
see section 6.2: 1.2higj

Test equipment:
see annex 2: C218, F150, R001, U312

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 14:08:40	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	5	GHz
Stop frequency:	12	GHz
Center frequency:	8.5	GHz
Frequency span:	7	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	10	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

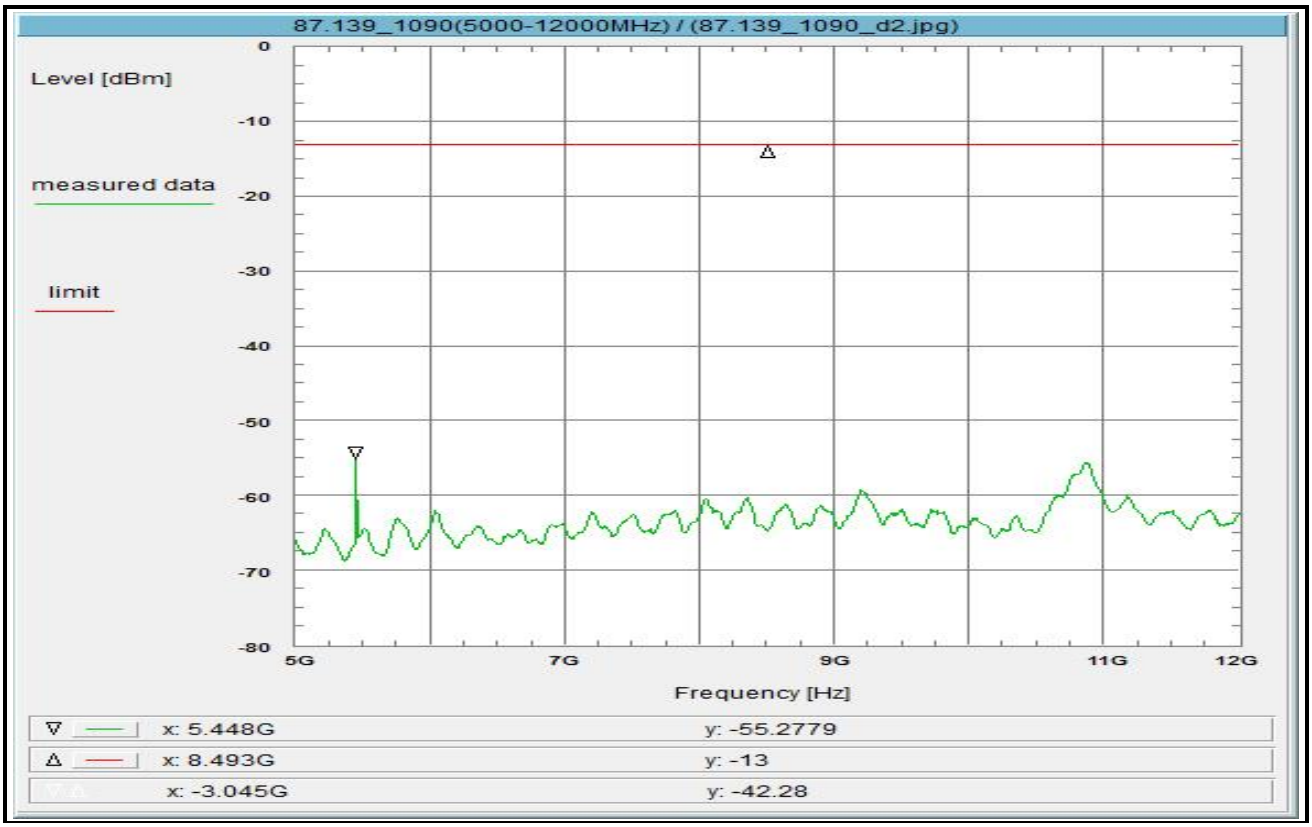
Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	1.8	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (U312)	+	19.8	dB
Splitter	+	6.0	dB
HPF (F150)	+	3.1	dB
TOTAL CORRECTION:	+	30.7	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot shows 5th harmonic.

Plot No. 12 (13)



Subclause: -/- Spurious emissions
RF-carrier at 1090 MHz
Examination of the frequency range 5000 MHz - 12000 MHz

Limit:
Limit acc. to FCC Part 87.139

Test results:
see plot (an explicit table was not generated)

Operating condition of DUT:
operating condition 2, A/C-Mode

Test setup:
see section 6.2: 1.2higj

Test equipment:
see annex 2: C218, F150, R001, U312

Remark:

Test result: **Test passed**

Environment condition:

Date & Time:	Mon 14/Nov/2016 15:26:57	
Location:	CTC advanced GmbH, Laboratory RCE-Sat	
Temperature:	22	°C
Humidity:	40	%
Voltage:	233	Vac

Setup of measurement equipment:

Start frequency:	5	GHz
Stop frequency:	12	GHz
Center frequency:	8.5	GHz
Frequency span:	7	GHz
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Input attenuation:	10	dB
Trace-Mode:	Max-Hold	
Detector-Mode:	AVG	

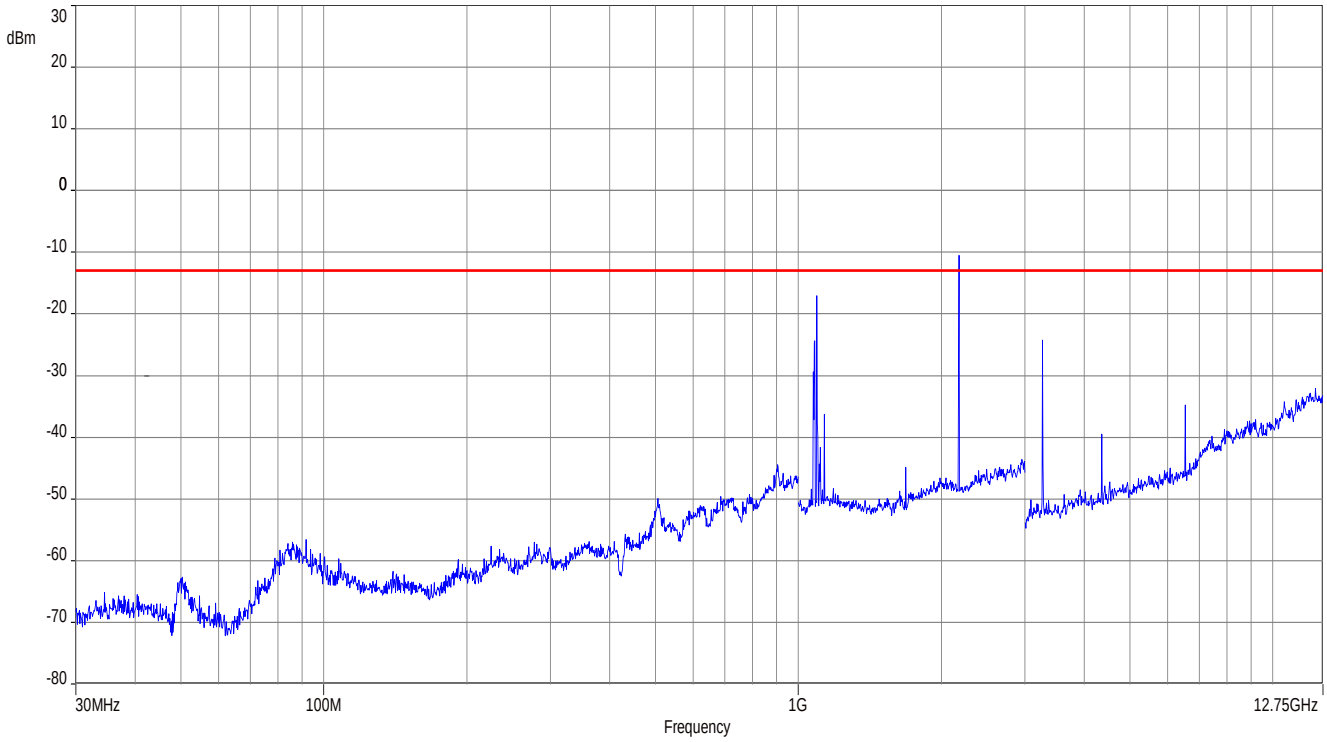
Correction:

Directional coupler	+	0.0	dB
Coaxial cable (C218)	+	1.8	dB
DUT-Antenna	+	0.0	dBi
Test antenna	+	0.0	dB
BW correction factor	+	0.0	dB
Atten. between HPA and feedhorn	-	0.0	dB
Attenuation (U312)	+	19.8	dB
Splitter	+	6.0	dB
HPF (F150)	+	3.1	dB
TOTAL CORRECTION:	+	30.7	dB

Remarks:
Spurious emissions under normal test conditions
Max-Hold measurement.

Plot shows 5th harmonic.

Plot No. 13 (13)



Re-measurement:

frequency	level	limit	detector	polarization	turntable
1090 MHz	wanted signal	wanted signal	wanted signal	wanted signal	wanted signal
2180 MHz	-36.8 dBm	-13 dBm	RMS	horizontal	225°
3270 MHz	-45.5 dBm	-13 dBm	RMS	horizontal	295°

Note:
Plot shows measurement results with pos-peak detector and max-hold for all single pre-scans.

Annex C Document history

Version	Applied changes	Date of release
	Initial release – DRAFT	2017-01-13
	published without changes	2017-01-17

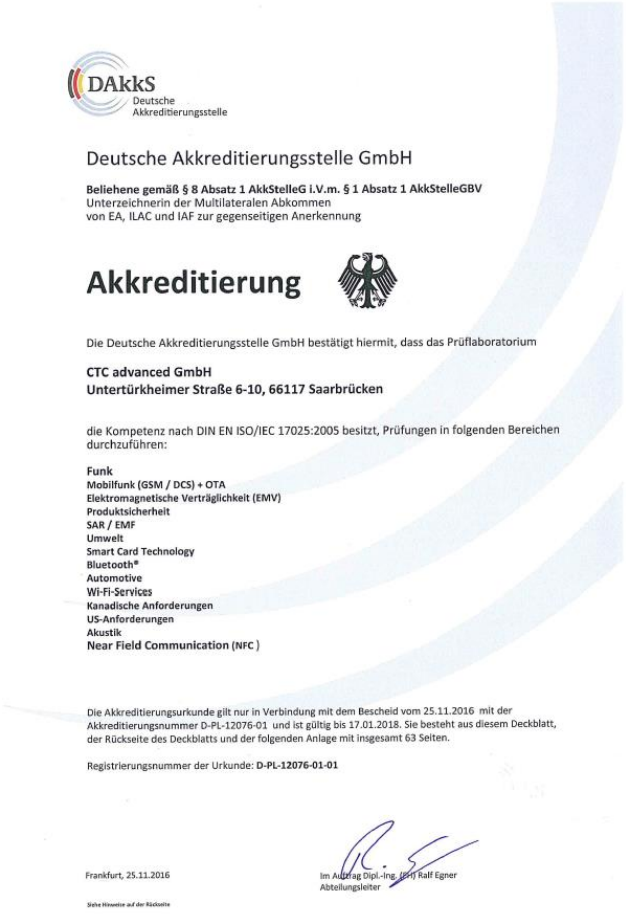
Annex D Further information

Glossary

AVG	-	Average
DUT	-	Device under test
EMC	-	Electromagnetic Compatibility
EN	-	European Standard
EUT	-	Equipment under test
ETSI	-	European Telecommunications Standard Institute
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	Not applicable
PP	-	Positive peak
QP	-	Quasi peak
S/N	-	Serial number
SW	-	Software
PMN	-	Product marketing name
HMN	-	Host marketing name
HVIN	-	Hardware version identification number
FVIN	-	Firmware version identification number
OBW		Occupied Bandwidth
OC		Operating Channel
OCW		Operating Channel Bandwidth
OOB		Out Of Band

Annex E Accreditation Certificate

Front side of certificate



DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

CTC advanced GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Funk
Mobilfunk (GSM / DCS) + OTA
Elektromagnetische Verträglichkeit (EMV)
Produktsicherheit
SAR / EMF
Umwelt
Smart Card Technology
Bluetooth®
Automotive
Wi-Fi-Services
Kanadische Anforderungen
US-Anforderungen
Akustik
Near Field Communication (NFC)

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 25.11.2016 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 63 Seiten.

Registrierungsnummer der Urkunde: **D-PL-12076-01-01**

Frankfurt, 25.11.2016

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Back side of certificate

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