**CETECOM™****CETECOM ICT Services**
consulting - testing - certification >>>

TEST REPORT

Test report no.: 1-4679/12-03-02-A

Deutsche
Akkreditierungsstelle
D-PL-12076-01-00

Testing laboratory

CETECOM ICT Services GmbH

Untertuerkheimer Strasse 6 – 10

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Internet: <http://www.cetecom.com>e-mail: ict@cetecom.com**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-12076-01-00

Applicant

Marquardt GmbH

Schloss-Str. 16

78604 Rietheim-Weilheim / GERMANY

Phone: +49 7424 99-0

Fax: +49 742 499-2541

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e-mail: bernd.baer@marquardt.de

Phone: +49 742 499-1867

Manufacturer

Marquardt GmbH

Schloss-Str. 16

78604 Rietheim-Weilheim / GERMANY

Test standard/s

47 CFR Part 15

Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

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

Test Item

Kind of test item:	Keyless entry
Model name:	MS1
FCC-ID	FCC ID: IYZ-MS1A
Frequency:	433 - 434.5 MHz
Technology tested:	Proprietary data transmission
Antenna:	Integrated antenna
Power supply:	3.0 V DC by Battery
Temperature range:	-20°C to +55°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 authorised:

p.o.

Marco Bertolino
Lab Manager
Radio Communications & EMC**Test performed:**Tobias Wittenmeier
Testing Manager
Radio Communications & EMC

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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. CETECOM ICT Services 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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2.2 Application details

Date of receipt of order:	2015-06-10
Date of receipt of test item:	2015-06-22
Start of test:	2015-06-19
End of test:	2015-06-22
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 15		Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

7 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 signalling equipment as well as measuring receivers and analysers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

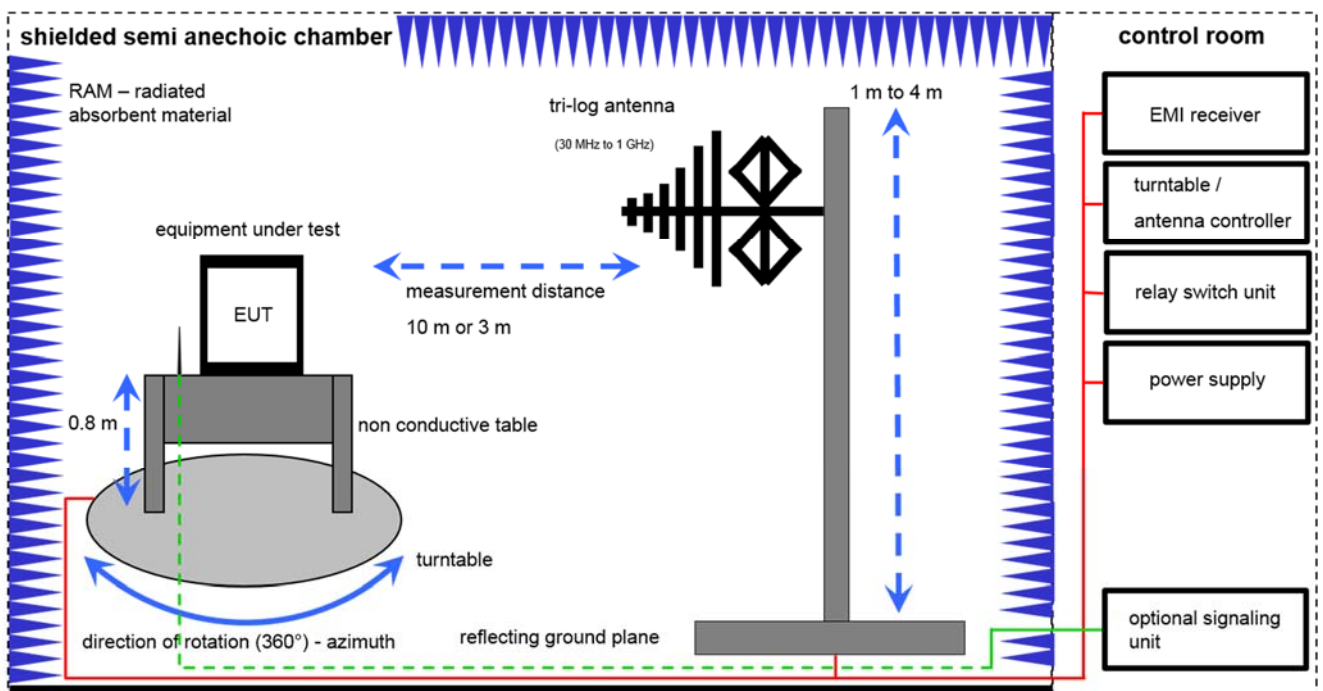
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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
vkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

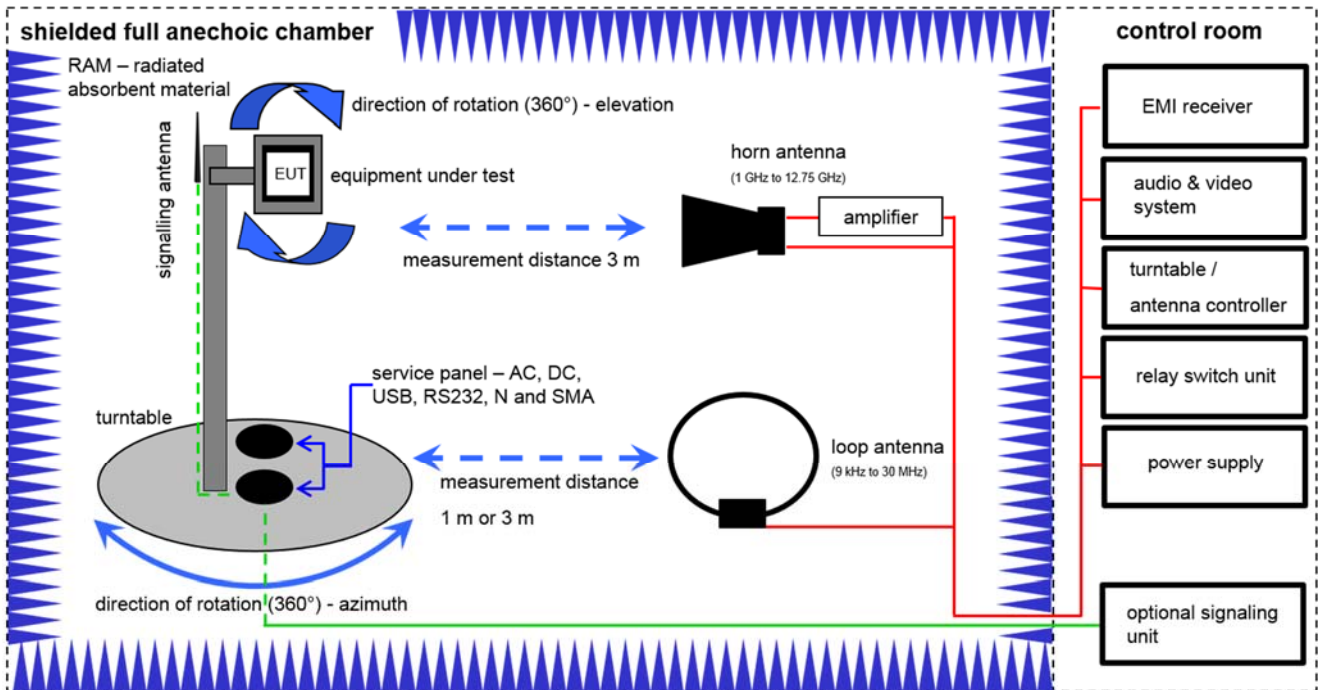
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	45	Switch-Unit	3488A	HP	2719A14505	300000368	ev		
2	45	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	26.01.2015	26.01.2016
3	45	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	11.02.2014	11.02.2016
4	45	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw		
5	45	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw		
6	45	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw		
7	45	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	22.04.2014	22.04.2016
8	45	Spectrum-Analyzer	FSU26	R&S	200809	300003874	k	26.01.2015	26.01.2016
9	45	Breitband Doppelsteg-Hornantenne	BBHA9120 B	Schwarzbeck	188	300003896	k	20.05.2015	20.05.2017

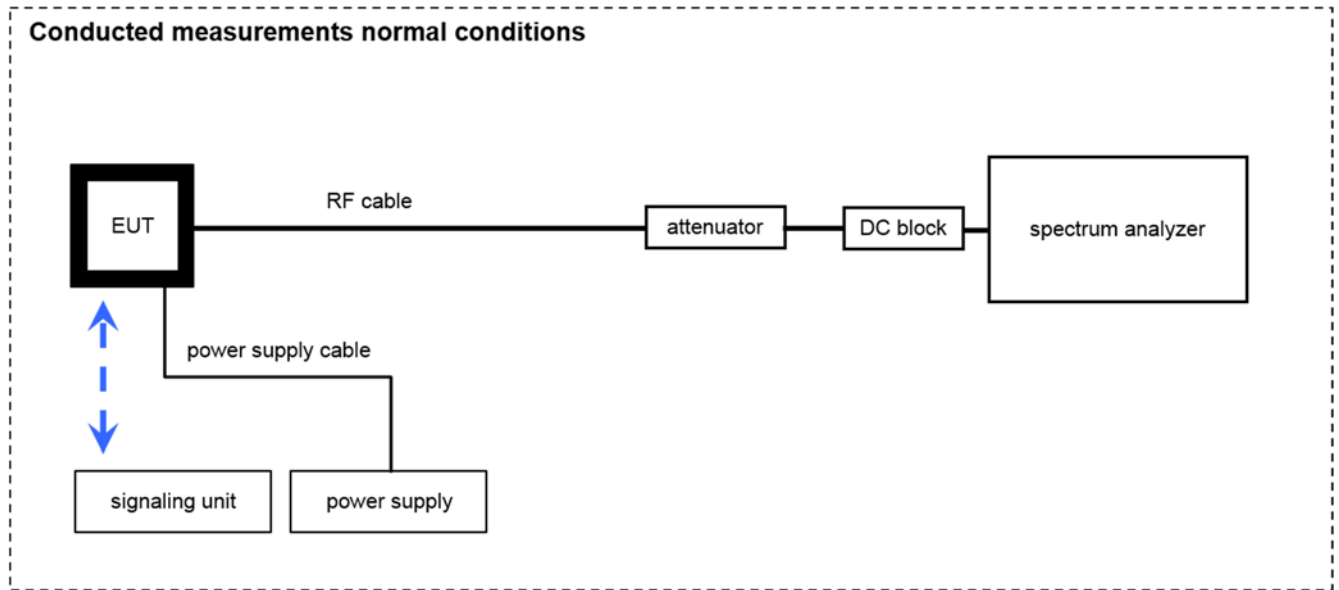
7.2 Shielded fully anechoic chamber



Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKI!	20.05.2015	20.05.2017
2	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev		
3	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne		
4	90	Active Loop Antenna 10 kHz to 30 MHz	6502	Kontron Psychotech	8905-2342	300000256	k	13.06.2015	13.06.2017
5	90	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
6	90	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne		
7	90	MXE EMI Receiver 20 Hz to 26.5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	06.03.2015	06.03.2016
8	90	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne		

7.3 Conducted measurements



Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Spectrum Analyzer 9kHz to 30GHz - 140..+30dBm	FSP30	R&S	100886	300003575	k	26.08.2014	26.08.2016

8 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input type="checkbox"/>	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15	See table!	2015-09-07	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	C	NC	NA	NP	Remark
§ 15.35 (c)	Timing of the transmitter (Duty cycle correction factor)	Nominal	Nominal					
§ 15.231 (a) (1)	Switch off time	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§ 15.231 (b) (3) (c)	Emission bandwidth	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§ 15.231 (b)	Fieldstrength of Fundamental	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§ 15.209	Fieldstrength of harmonics and spurious	Nominal	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§ 15.209	Receiver spurious emissions (radiated)	Nominal	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-

Note: C = compliant; NC = not compliant; NA = not applicable; NP = not performed

8.1 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

9 Measurement results

9.1 Timing of the transmitter

Measurement:

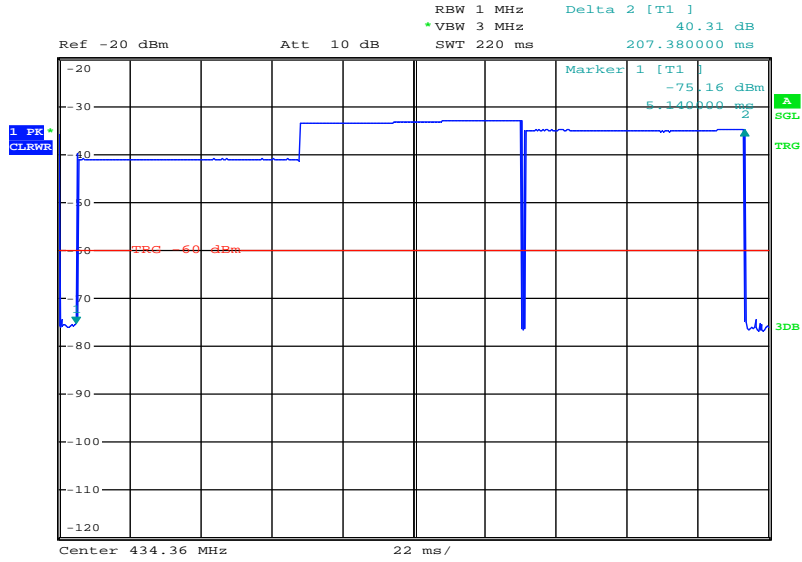
Measurement parameter	
Detector:	Peak
Sweep time:	100 ms
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	Zero
Trace-Mode:	Single sweep

Limits:

FCC
(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Result:

Plot 1: Transmit burst



Date: 22.JUN.2015 11:11:57

The peak-to-average correction factor is calculated with $20\text{Log} [\text{Tx on}/(\text{Tx on} + \text{Tx off})]$. Hereby the peak-to-average correction factor is 0 dB.

9.2 Switch off time

Measurement:

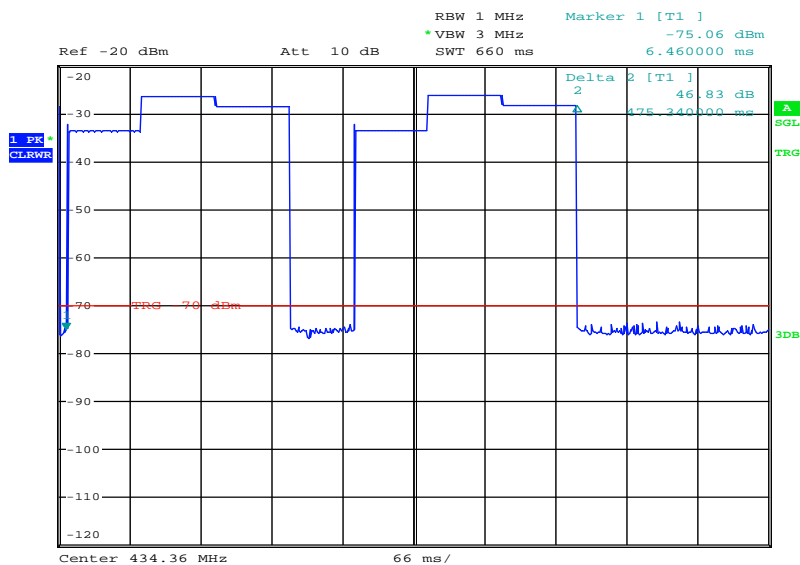
Measurement parameter	
Detector:	Peak
Sweep time:	Depends on the pulse train
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	Zero
Trace-Mode:	Single sweep

Limits:

FCC
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Results:

Plot 1: TX on time



Date: 22.JUN.2015 11:09:30

The EUT automatically ceases transmission within 475.34 ms after releasing the switch.

9.3 Emission bandwidth

Measurement:

Measurement of the 99 % bandwidth of the modulated signal

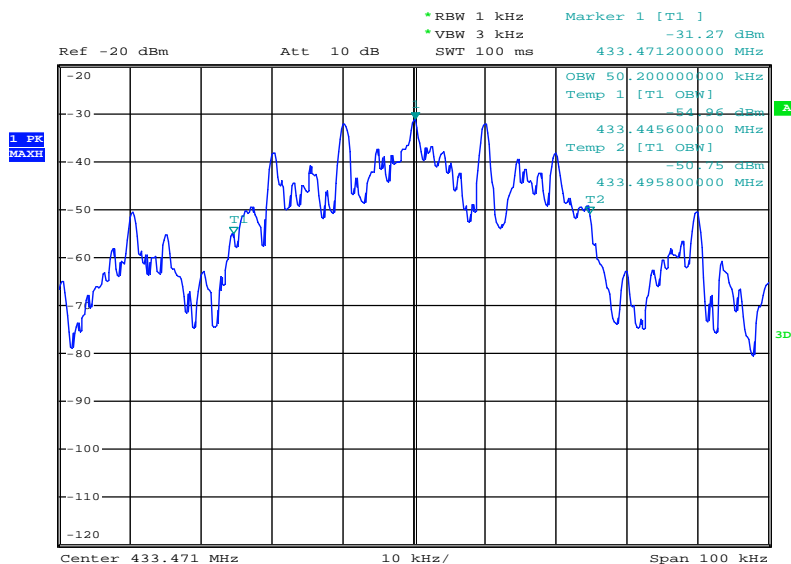
Measurement parameter	
Detector:	Peak
Sweep time:	100 ms
Resolution bandwidth:	1 % of the span
Video bandwidth:	3 x RBW
Span:	100 kHz
Trace-Mode:	Max. hold

Limits:

FCC
The OBW shall not be wider than 0.25% of the centre frequency, here maximum 1082,5 kHz.

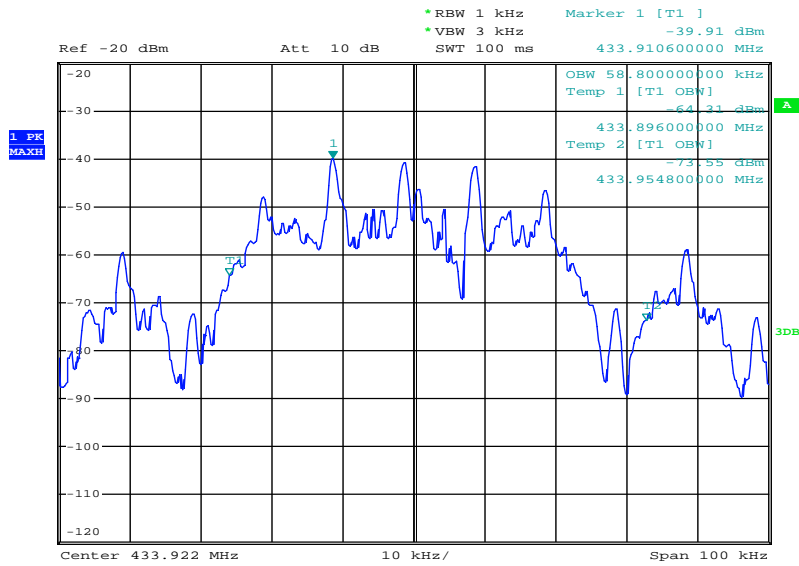
Result:

Plot 1: Emissions bandwidth ch low



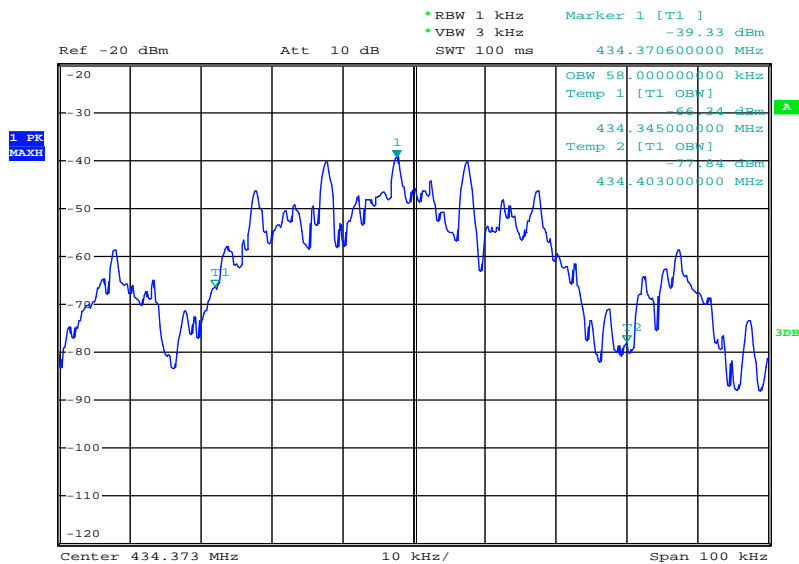
Date: 22.JUN.2015 11:40:54

Plot 2: Emissions bandwidth ch mid



Date: 22.JUN.2015 11:42:30

Plot 3: Emissions bandwidth ch high



Date: 22.JUN.2015 11:38:41

99 % emission bandwidth: 58.8 kHz

9.4 Field strength of the fundamental

Measurement:

Measurement parameter	
Detector:	Peak / pulse averaging / quasi peak
Sweep time:	Auto
Resolution bandwidth:	120 kHz
Video bandwidth:	3 x RBW
Trace-Mode:	Max. hold

Limits:

FCC		
Field strength of the fundamental.		
In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:		
Fundamental Frequency (MHz)	Field strength of Fundamental ($\mu\text{V/m}$)	Measurement distance (m)
40.66 – 40.70	2,250	3
70-130	1,250	3
130-174	1,250 to 3,750	3
174-260	3,750	3
260-470	3,750 to 12,500	3
Above 470	12,500	3

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:

- for the band 130-174 MHz, $\mu\text{V/m}$ at 3 meters = $56.81818(F) - 6136.3636$;
- for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$.

In this case (calculated for 433 MHz): 80.8 dB $\mu\text{V/m}$

Result:

Ch low

TEST CONDITIONS		MAXIMUM POWER (dB μ V/m at 3 m distance)	
Frequency		MHz	MHz
Mode		Quasi-Peak	Average
T _{nom}	V _{nom}	77.17*	77.17**
Measurement uncertainty		±3dB	

Ch mid

TEST CONDITIONS		MAXIMUM POWER (dB μ V/m at 3 m distance)	
Frequency		MHz	MHz
Mode		Quasi-Peak	Average
T _{nom}	V _{nom}	79.96*	79.96**
Measurement uncertainty		±3dB	

Ch high

TEST CONDITIONS		MAXIMUM POWER (dB μ V/m at 3 m distance)	
Frequency		MHz	MHz
Mode		Quasi-Peak	Average
T _{nom}	V _{nom}	78.49*	78.49**
Measurement uncertainty		±3dB	

*Value recalculated from 10 m to 3 m with a correction factor of 20 dB/decade

**Value recalculated from Peak-to-Average correction factor described in 6.1

9.5 Field strength of the harmonics and spurious

Measurement:

Measurement parameter	
Detector:	Peak / average / quasi peak
Sweep time:	Auto
Resolution bandwidth:	200 Hz / 9 kHz / 120 kHz
Video bandwidth:	3 x RBW
Span:	See plots
Trace-Mode:	Max. hold

Limits:

FCC		
Field strength of the fundamental.		
In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:		
Fundamental Frequency (MHz)	Field strength of spurious (µV/m)	Measurement distance (m)
40.66 – 40.70	225	3
70-130	125	3
130-174	125 to 375	3
174-260	375	3
260-470	375 to 1,250	3
Above 470	1,250	3

The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits a higher field strength.

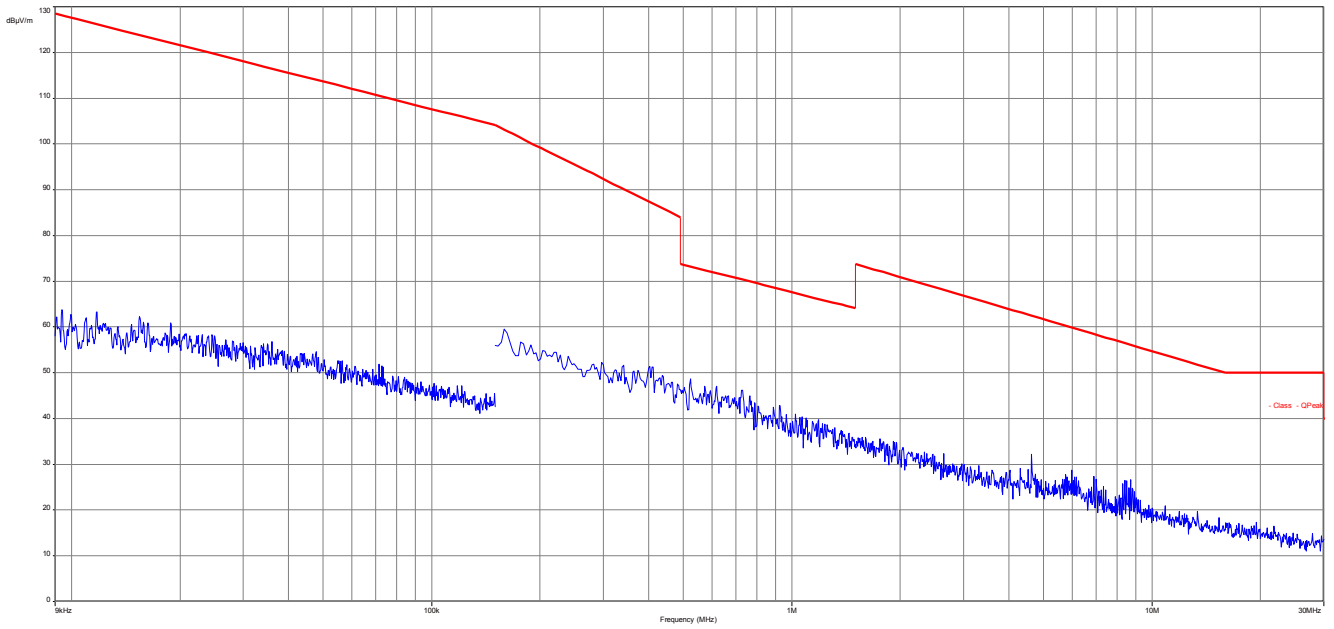
FCC		IC
Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
above 960	500	3

Results:

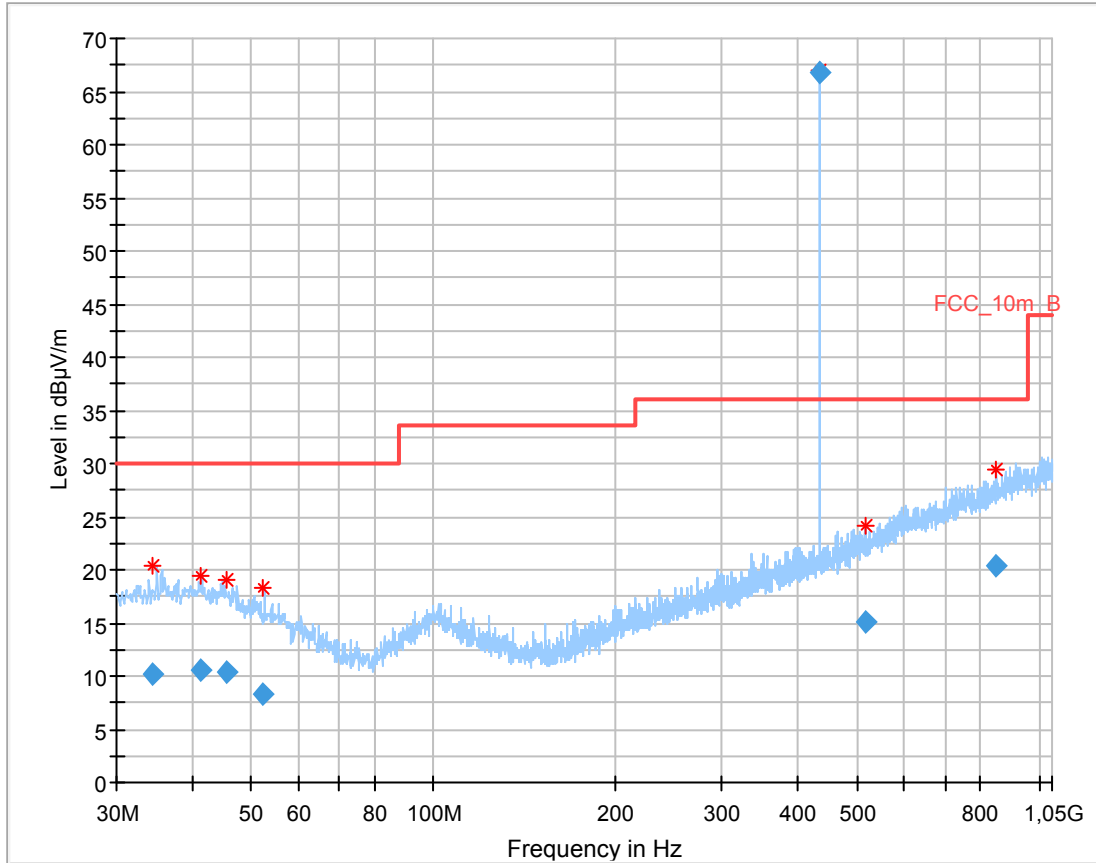
f [MHz]	Detector	Limit max. allowed [dB μ V/m]	Amplitude of emission [dB μ V/m]	Results
All emissions were more than 6 dB below the limit.				

Plots ch low:

Plot 1: 9 kHz to 30 MHz



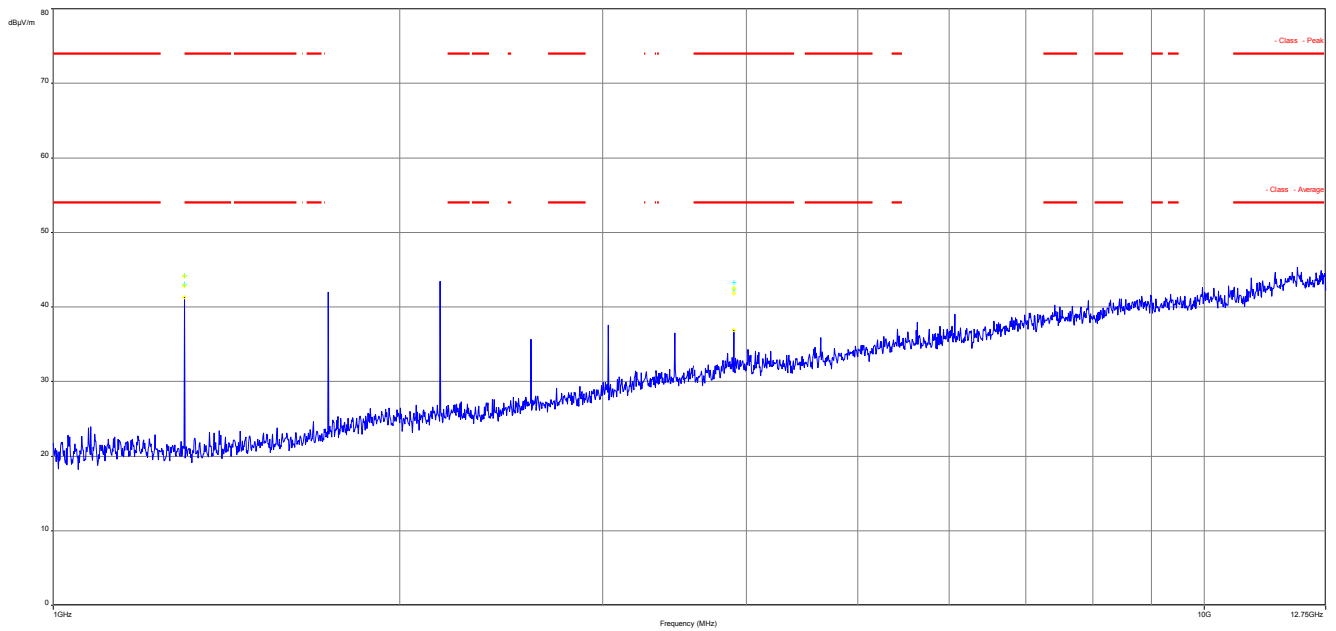
Plot 2: 30 MHz to 1000 MHz, vertical & horizontal polarisation



Final Result

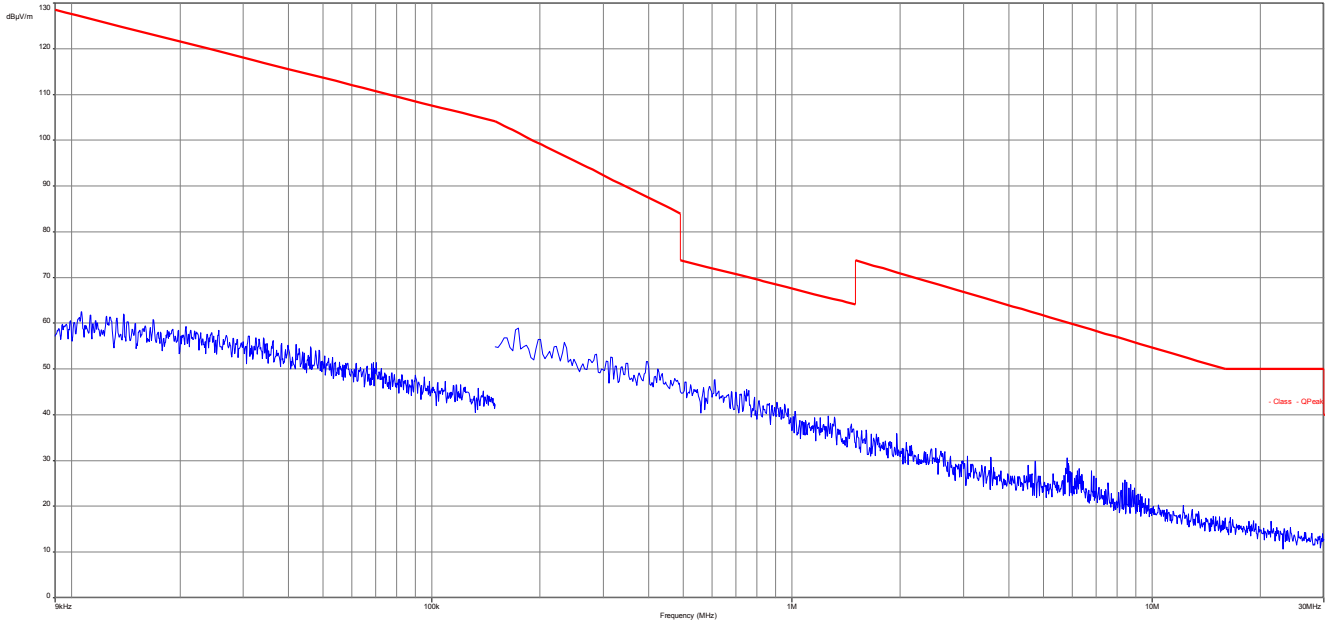
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
34.373400	10.19	30.00	19.81	1000.0	120.000	200.0	V	141	13.7
41.176950	10.51	30.00	19.49	1000.0	120.000	103.0	V	297	14.0
45.612600	10.32	30.00	19.68	1000.0	120.000	272.0	V	251	13.7
52.208100	8.21	30.00	21.79	1000.0	120.000	358.0	H	275	12.3
433.459950	66.71	36.00	-----	1000.0	120.000	100.0	V	99	17.4
517.328850	15.18	36.00	20.82	1000.0	120.000	200.0	V	95	18.9
851.332800	20.29	36.00	15.71	1000.0	120.000	174.0	H	253	23.5

Plot 3: 1 GHz to 12.75 GHz, vertical & horizontal polarisation

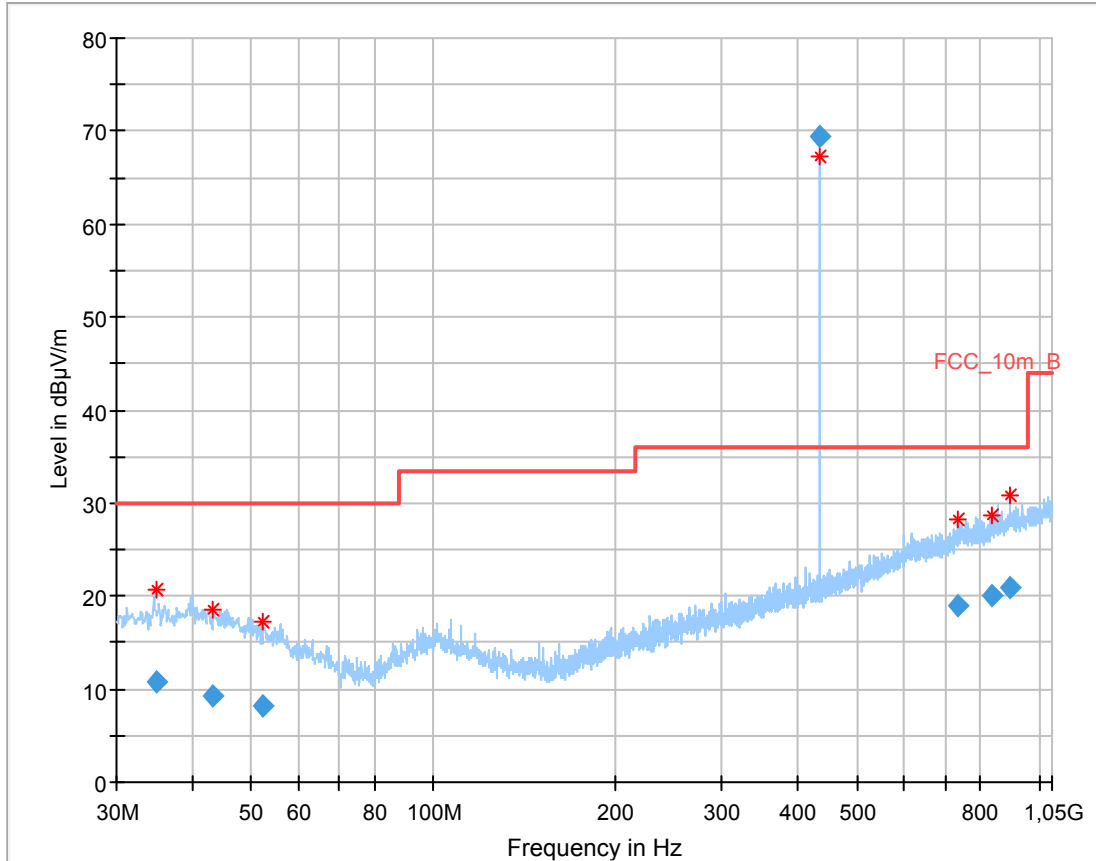


Plots ch mid:

Plot 1: 9 kHz to 30 MHz



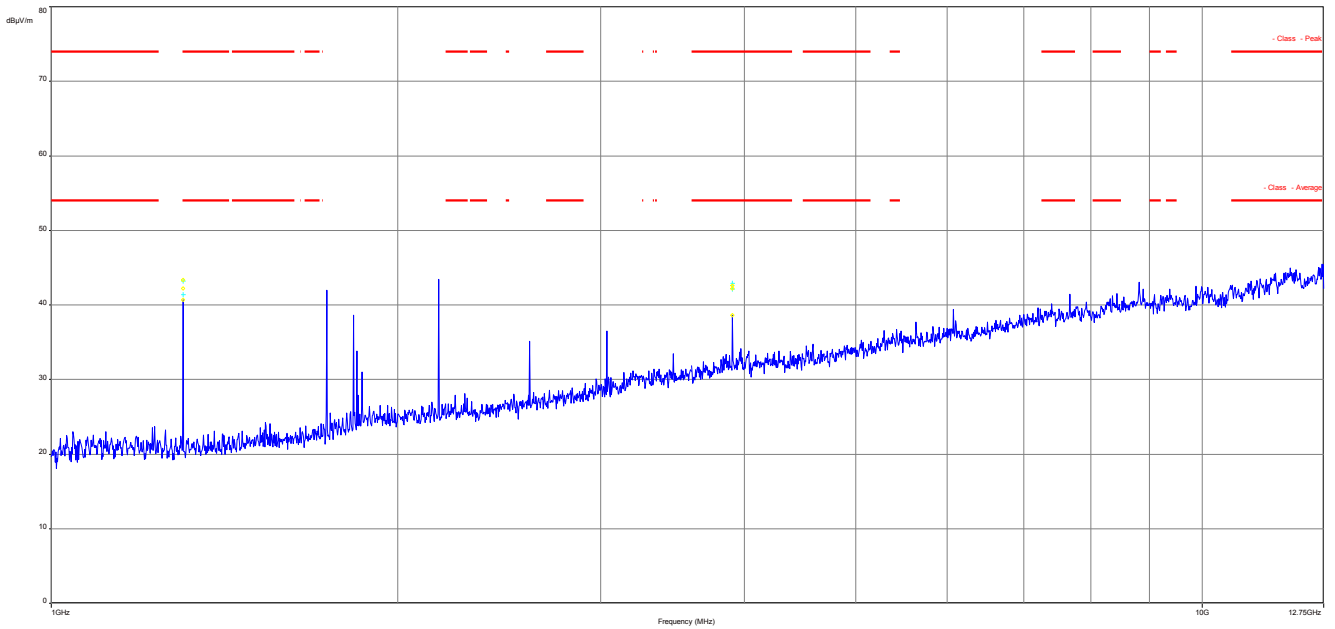
Plot 2: 30 MHz to 1000 MHz, vertical & horizontal polarisation



Final_Result

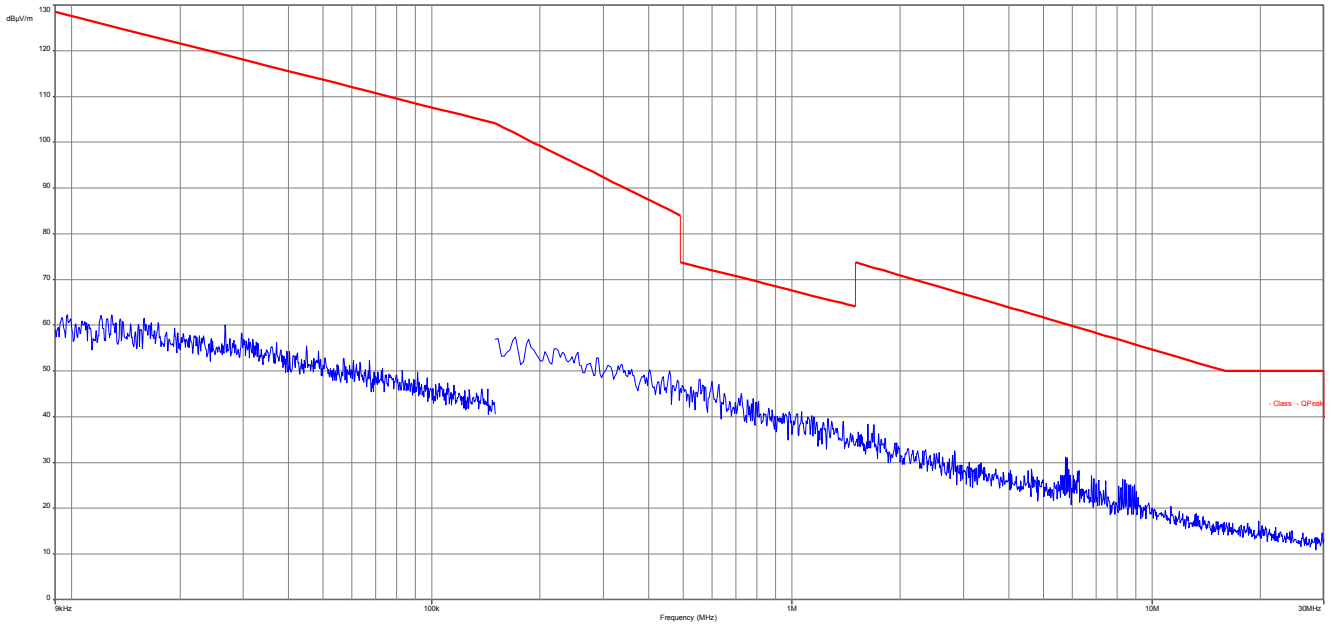
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
34.968300	10.87	30.00	19.13	1000.0	120.000	103.0	H	130	13.8
43.238550	9.21	30.00	20.79	1000.0	120.000	348.0	V	117	13.9
52.270950	8.15	30.00	21.85	1000.0	120.000	103.0	H	297	12.3
433.932150	69.50	36.00	-----	1000.0	120.000	350.0	V	99	17.4
733.416450	19.03	36.00	16.97	1000.0	120.000	200.0	H	117	22.3
835.480650	19.98	36.00	16.02	1000.0	120.000	400.0	V	85	23.2
896.138850	20.83	36.00	15.17	1000.0	120.000	400.0	H	207	24.1

Plot 3: 1 GHz to 12.75 GHz, vertical & horizontal polarisation

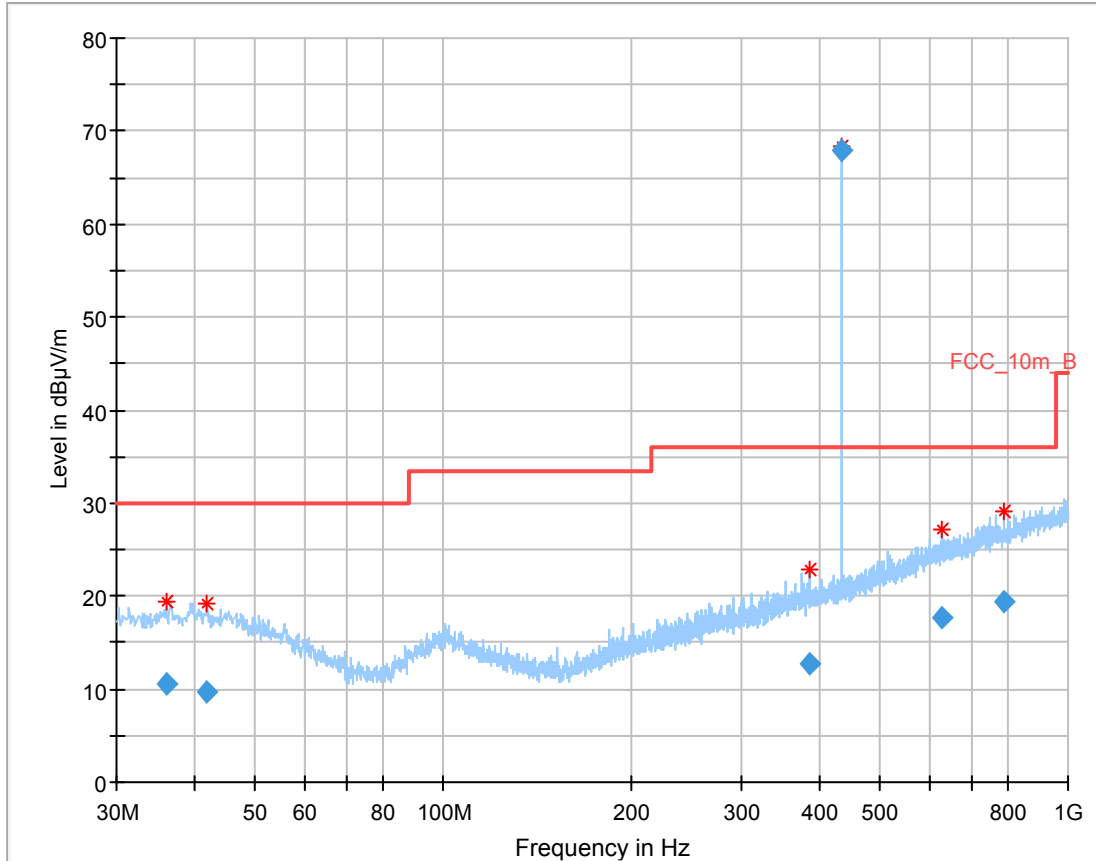


Plots ch high:

Plot 1: 9 kHz to 30 MHz



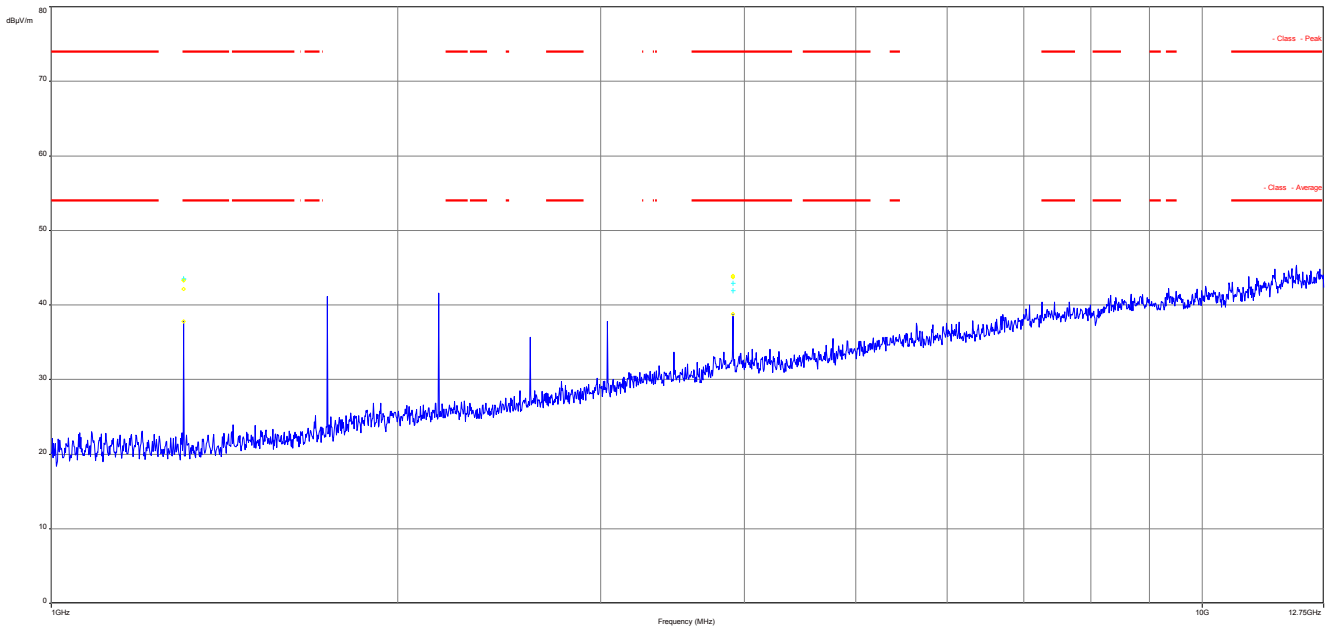
Plot 2: 30 MHz to 1000 MHz, vertical & horizontal polarisation



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
36.171300	10.57	30.00	19.43	1000.0	120.000	275.0	V	320	13.9
41.845950	9.80	30.00	20.20	1000.0	120.000	273.0	H	232	14.0
384.473100	12.70	36.00	23.30	1000.0	120.000	400.0	H	8	16.6
434.360400	68.03	36.00	---	1000.0	120.000	274.0	V	97	17.4
629.623650	17.63	36.00	18.37	1000.0	120.000	200.0	V	162	21.0
788.722350	19.36	36.00	16.64	1000.0	120.000	275.0	V	266	22.7

Plot 3: 1 GHz to 12.75 GHz, vertical & horizontal polarisation



10 Observations

No observations except those reported with the single test cases have been made.

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2015-09-03
-A	Correction of the fundamental field strength table	2015-09-07

Annex B 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

Annex C Accreditation Certificate

Front side of certificate

Back side of certificate



Deutsche Akkreditierungsstelle GmbH

Bellehene 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

CETECOM ICT Services GmbH
 Untertürkheimer Straße 6-10, 66117 Saarbrücken

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

- Drahtgebundene Kommunikation einschließlich xDSL
- VoIP und DECT
- Akustik
- Funk einschließlich WLAN
- Short Range Devices (SRD)
- RFID
- WiFiMax und Richtfunk
- Mobilfunk (GSM / GPRS, Over the Air (OTA) Performance)
- Elektromagnetische Verträglichkeit (EMV) einschließlich Automotive
- Produktsicherheit
- SAR und Hearing Aid Compatibility (HAC)
- Umweltsimulation
- Smart Card Terminals
- Bluetooth
- Wi-Fi Services

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 07.03.2014 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 77 Seiten.

Registrierungsnummer der Urkunde: D-PL-12076-01-00

Frankfurt am Main, 07.03.2014

Stelle des Leiters der Stelle

Im Auftrag (PL-12076-01) soll signed
 Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
 Spittelmarkt 10
 10117 Berlin

Standort Frankfurt am Main
 Gartenstraße 6
 60594 Frankfurt am Main

Standort Braunschweig
 Bundesallee 100
 38115 Braunschweig

Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkkS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Kartografische Dienstleistungsstelle in unveränderter Form.

Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkkS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abt. L 238 vom 9. Juli 2008, S. 30). Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der Kompetenzkompetenz für Akkreditierung (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
 EA: www.european-accreditation.org
 IAF: www.iaf.or.jp
 IAC: www.ilac.org

Note:

The current certificate including annex is published on our website (see link below) or may be received from CETECOM ICT Services on request.

<http://www.cetecom.com/eu/de/cetecom-group/europa/deutschland-saarbruecken/akkreditierungen.html>