InterLab®

FCC Measurement/Technical Report on

Radio Identification Device
PL7

Report Reference: MDE_HUF_1301_FCCa

Test Laboratory:
Borsigstr. 11
Germany
7Layers AG
40880 Ratingen

DAkkS Deutsche Akkreditierungsstelle D-PL-12140-01-01

7 layers AG
Borsigstrasse 11
40880 Ratingen, Germany
Phone: +49 (0) 2102 749 0
Fax: +49 (0) 2102 749 350
www.7Layers.com

Aufsichtsratsvorsitzender•
Chairman of the Supervisory Board:
Peter Mertel
Vorstand• Board:
Dr. H.-J. Meckelburg

Registergericht• registered in:
Düsseldorf, HRB 44096
USt-IdNr • VAT No.:
DE 203159652
TAX No. 147/5869/0385

Table of Contents

0 Summary

0.1 Technical Report Summary

Type of Authorization
Certification for an Intentional Radiator (Periodic operation in the band above 70 MHz)

Applicable FCC Rules

Edition of FCC Rules: 10-1-12

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15. The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.231 Periodic operation in the band 40.66-40.70 MHz, above 70 MHz

Note: The newer version of ANSI C63.4–2009 is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

0.2 Measurement Summary

FCC Part 15, Subpart C	**§ 15.231**	
Duty cycle measurement (based on dwell time measurement)		
The measurement was performed according to FCC § 15.31		10-1-12 Edition
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1	Setup_b01	Enclosure	passed

FCC Part 15, Subpart C	**§ 15.231**	
Spurious Radiated Emissions		
The measurement was performed according to ANSI C63.4		2009
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 2	Setup_a01	Enclosure	passed

FCC Part 15, Subpart C	**§ 15.231**	
Peak power output		
The measurement was performed according to ANSI C63.4		2009
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 2	Setup_a01	Enclosure	passed

FCC Part 15, Subpart C	**§ 15.231**	
Occupied Bandwidth		
The measurement was performed according to FCC § 15.31		10-1-12 Edition
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 2	Setup_a01	Enclosure	passed

Responsible for Accreditation Scope:

Digitally signed by Andreas Petz
DN: cn=Andreas Petz, sn=Petz, givenName=Andreas, o=7Layers AG, serialNumber=00100000000120291 80001, email=andreas.petz@7layers.de
Reason: I am approving this document
Date: 2013.10.07 11:16:03 +02'00'

Responsible for Test Report:

Digitally signed by Marco Kullik
DN: cn=Marco Kullik, sn=Kullik, givenName=Marco, o=7 Layers AG, serialNumber=00100000000120290 50002, email=Marco.Kullik@7Layers.de
Reason: I am the author of this document
Date: 2013.10.07 10:13:07 +02'00'

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7Layers AG
Address	Borsigstr. 11 40880 Ratingen Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716.

The test facility is also accredited by the following accreditation organisation:

Laboratory accreditation no.:	DAkkS D-PL-12140-01-01
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Andreas Petz Dipl.-Ing. Marco Kullik
Report Template Version:	2012-10-01

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Marco Kullik
Date of Test(s):	2013-07-09 to 2013-08-16
Date of Report:	2013-09-24

1.3 Applicant Data

Company Name:	Huf Hülsbeck & Fürst GmbH & Co. KG
Address:	Steeger Straße 17 42 551, Velbert Germany
Contact Person:	Mr. Thomas Herzog

1.4 Manufacturer Data

Company Name:	please see the applicant data
Address:	
Contact Person:	

2 Test object Data

2.1 General EUT Description

Equipment under Test	Vehicle remote keyless entry transceiver
Type Designation:	PL7
Kind of Device:	SRD transceiver operating at 433 MHz ISM band
Voltage Type:	DC / Li, non rechargeable battery
Voltage level:	3.0 V
Repeated Operation:	Manually
The EUT is part of a security or safety system:	No

General product description:

The EUT is a wireless handheld remote control unit consisting of transmitter and receiver (non-periodic operation in the band above 70 MHz).
The operating frequencies are: Ch. 1 = 433.2 MHz and Ch. 2 = 434.64 MHz.

Specific product description for the EUT:

The EUT is a vehicle remote keyless entry transceiver which uses Manchester coded FSK modulation. The transmitter is activated manually by pressing a command button and is deactivated automatically within 5 seconds after the button release.

The EUT provides the following ports:

Ports
Enclosure

The main components of the EUT are listed and described in Chapter 2.2.

2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: UG060b01)	Vehicle remote keyless entry transceiver with modified SW for CW or CM RF carrier, 4 buttons, no chrome ring	PL7 HUF5767	1985	3.0	20.00	-
EUT B (Code: UG060e01)	Vehicle remote keyless entry transceiver with normal SW 3 buttons, with chrome ring	PL7 HUF5767	2046	3.0	20.00	-
Remark: EUT A, EUT B and are equipped with an integral antenna (gain= -23.8 dBi).						

The short description is used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
-	-	-	-	-	-	-

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
-	-	-	-	-	-	-

2.5 EUT Setups

This chapter describes the combination of EUTs and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
Setup_a01	EUT A	setup for radiated measurements (continuous operation)
Setup_b01	EUT B	setup for Duty Cycle measurements (normal operation)

2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	normal operation	Transmitter sending shortly a Manchester coded FSK modulated signal. Normal operating mode.
op-mode 2	continuous operation	Transmitter is sending continuously Manchester coded FSK modulated signal. Special operating mode for test purpose only.
op-mode 3	continuous operation	Transmitter is sending continuously CW signal. Special operating mode for test purpose only.

2.7 Product labelling

2.7.1 FCC ID label

Please refer to the documentation of the applicant.

2.7.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Duty cycle measurement (based on dwell time measurement)

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.35, §15.231

3.1.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the dwell time measurements. For analyzer settings please see measurement plots in annex.

3.1.2 Test Limits

Depending on the function of the EUT different paragraphs of FCC §15.231 apply:

Either
(a)(1): A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Or
(a)(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

And
(a)(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

Otherwise
(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation [...]. In addition, [...] the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

This test is also performed to determine the pulse train of the transmitter and calculate the correction factor for pulse modulated transmitters according to FCC §15.35. This factor is used as a correction factor for the field strength measurements, both for Spurious radiated emissions and Peak power output.

3.1.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1014 hPa
Humidity: 39 %

Op. Mode	Setup	Port
op-mode 1	Setup_b01	Enclosure

a) Determine the total duration of a transmission within 100 ms:

Duty cycle = ((L1*N1) + (L2*N2) + ... + (Ln*Nn)) / 100 ms or T, whichever is less
Correction factor = 20 * LOG (Duty cycle) [dB]

Step 1	Holdover time	Less than 5s
Step 2	Cycle to determine the on/off ratio within a cycle (period T)	100 ms
Step 3	Sweep of a data word to determine the on time within a data word (L1-LN).	L1 = 43 ms
Step 4	Determine the number of pulses (N1-NN). First range (trigger delay = - 2 ms; sweep time = 100 ms).	N1 = 1

Calculation of Duty Cycle / Correction Factor:
If T > 100 ms => T:= 100 ms; L1 = 43.4 ms; N1 = 1;
Duty cycle = 1*43.4/ 100 = 0.434
Correction factor = 20*LOG(0.43) = –7.3 dB

Please see annex for the measurement plots.

3.1.4 Test result: Duty cycle / correction factor

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

3.2 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31, ANSI C 63.4

3.2.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4
The radiated emissions measurements were made in a typical installation configuration.
The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

1. Measurement up to 30 MHz
The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.
The Loop antenna HFH2-Z2 is used.
Step 1: pre measurement
- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF–Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 10 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.
Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 200 Hz - 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz
Step 1: Preliminary scan
Preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 µs
- Turntable angle range: –180 to 180°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the

relevant emissions for the final measurement are identified.
Step 2: second measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –180 to 180°
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):
- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:
- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by +/- 22.5° around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by +/- 25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: –22.5° to + 22.5° around the determined value
- Height variation range: –0.25 m to +0.25 m around the determined value

Step 4: final measurement with QP detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18-25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.

Important EMI receiver settings:

- Detector: Peak, Average
- RBW = 1 MHz, VBW = 3 MHz
- Sweeptime = 100 ms / per 100 MHz sweep

3.2.2 Test Requirements / Limits

1) A radiated emission test is relating to the fundamental frequency.

a) Either for "non-periodic" operation of the EUT as defined in §15.231(a) the limits for the average field strength apply according to FCC Part 15, Subpart C, §15.231(b):

For fundamental frequency (MHz)	Limit Fundamental (dBµV/m)	Limit Spurious (dBµV/m)
40.66 – 40.70	67.0	47.0
70 – 130	67.0	47.0
130 – 174	67.0 – 71.5	47.0 – 51.5 *)
174 – 260	71.5	51.5
260 – 470	71.5 – 81.9	51.5 – 61.9 *)
above 470	81.9	61.9

b) Or for "periodic" operation of the EUT the limits for the average field strength apply according to FCC Part 15, Subpart C, §15.231(e):

For fundamental frequency (MHz)	Limit Fundamental (dBµV/m)	Limit Spurious (dBµV/m)
40.66 – 40.70	60.0	40.0
70 – 130	54.0	34.0
130 – 174	54.0 – 63.5	34.0 – 43.5 *)
174 – 260	63.5	43.5
260 – 470	63.5 – 74.0	43.5 – 54.0 *)
above 470	74.0	54.0

*) linear interpolation

2) A radiated emission test applies to harmonic/spurs that fall in the restricted bands as listed in § 15.205(a). The maximum permitted QP (< 1 GHz) and Average (> 1GHz) field strength is listed in § 15.209(a):
Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Calculate Limit(dBµV/m @10m)	Limit (dBµV/m) @10m
0.009 – 0.49	2400/F (kHz)	300	(48.5 – 13.8) + 30 dB	78.5 – 46.8
0.49 – 1.705	24000/F (kHz)	30	(48.9 – 23.0) + 10 dB	58.9 – 33.0
1.705 – 30	30	30	29.5 + 10 dB	39.5

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit ... .

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

§15.35(c):
[...] 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 [...].

§15.231(b)(3)
The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator.
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 §15.209, whichever limit permits a higher field strength.

Interpretation of the test laboratory:
The lats subordinate clause of §15.231(b)(3) is overruled by §15.205/209, therefore within the restricted bands the limits defined at §15.205/209 and outside the restricted bands the limits defined at §15.231(b) resp. §15.231(e) are applied.

3.2.3 Test Protocol

3.2.3.1 Measurement up to 30 MHz

Temperature: 28 °C
Air Pressure: 1016 hPa
Humidity: 43 %

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

Polari-sation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Margin to limit dB	Margin to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
CH 1									
–	–	–	–	–	–	–	–	–	–
CH 2									
–	–	–	–	–	–	–	–	–	–

Remarks: 1. No spurious emissions in the range 20 dB below the limit found. Therefore step 2 was not performed.

3.2.3.2 Measurement 30 MHz – 1 GHz

Temperature: 28 °C
Air Pressure: 1016 hPa
Humidity: 42 %

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Margin to limit dB	Margin to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
CH 1									
vertical	30.120	24.1	-	-	40.0	-	-	15.9	-
vertical	924.500	24.1	-	-	46.0	-	-	21.9	-
CH 2									
vertical	30.600	24.2	-	-	40.0	-	-	15.8	-
vertical	928.500	25.8	-	-	46.0	-	-	20.2	-

Remark: No further spurious emissions in the range 20 dB below the limit found. The test was performed in the frequency range from 30 MHz to 1 GHz.
The values listed above include the correction factor of the test system.

3.2.3.3 *Measurement above 1 GHz*

Temperature: 24 °C
Air Pressure: 1009 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Margin to limit dB	Margin to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
CH 1									
–	–	–	–	–	–	–	–	–	–
CH 2									
–	–	–	–	–	–	–	–	–	–

Remark: No spurious emissions in the range 20 dB below the limit found. The test was performed in The frequency range from 1 GHz to 6 GHz.

3.2.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 2	passed

3.3 Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31, §15.231, ANSI C 63.4, 2009

3.3.1 Test Description

Please refer to sub-clause 3.2.1.

3.3.2 Test Limits

Please refer to sub-clause 3.2.2.

3.3.3 Test Protocol

Temperature: 24 °C
Air Pressure: 1016 hPa
Humidity: 42 %

Op. Mode	Setup	Port
op-mode 3	Setup_a01	Enclosure

Channel	Output power dBµV/m	Corrected Output power dBµV/m	Limit dBµV/m	Margin to limit dB	Remarks
CH. 1	83.5	76.2	80.8	4.6	4 command buttons, no chrome ring
CH. 2	83.7	76.4	80.8	4.4	4 command buttons, no chrome ring

Remarks: Maximum radiated field strength at fundamental frequency.
Measured with Peak detector and CW signal.
The values are corrected using the Duty Cycle Correction Factor = -7.3 dB, calculated in 3.1.3.

3.3.4 Test result: Peak power output

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 3	passed

3.4 Occupied bandwidth

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.231

3.4.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.
For analyzer settings please see measurement plots in annex.

3.4.2 Test Limits

FCC Part 15, Subpart C, §15.231(c)
The maximum 20 dB bandwidth of a transmitter operating at a frequency range:
70 to 900 MHz is 0.25% of the centre frequency
above 900 MHz is 0.5% of the centre frequency

3.4.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1014 hPa
Humidity: 38 %

Op. Mode	Setup	Port
op-mode 2	Setup_a01	Enclosure

20 dB bandwidth kHz	Limit kHz	Remarks
for Ch.1 = 400	1083.0	The limit is calculated as 433.20 MHz * 0.25% = 1083.0 kHz.
for Ch.2 = 400	1086.6	The limit is calculated as 433.64 MHz * 0.25% = 1086.6 kHz.

Remark: Please see annex for the measurement plots.
For information: The 99% Bandwidths are respectively: 336.7 kHz for Ch. 1 and 336.7 kHz for Ch. 2.

3.4.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 2	passed

4 Test Equipment

Test Equipment Details

List of Used Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID:	**Lab 1**
Manufacturer:	Frankonia
Description:	Anechoic Chamber for radiated testing
Type:	10.58x6.38x6.00 m³

Calibration Details	*Last Execution*	*Next Exec.*
NSA (FCC, IC)	2011/01/10	2014/01/10

Single Devices for Anechoic Chamber

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Air compressor	none	-	Atlas Copco	
Anechoic Chamber	10.58 x 6.38 x 6.00 m³	none	Frankonia	
	Calibration Details		*Last Execution*	*Next Exec.*
	FCC listing 96716 3m Part15/18		2011/01/11	2014/01/10
	IC listing 3699A-1 3m		2011/02/07	2014/02/06
Controller Maturo	MCU	961208	Maturo GmbH	
EMC camera	CE-CAM/1	-	CE-SYS	
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi	
Filter ISDN	B84312-C110-E1		Siemens&Matsushita	
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita	

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID:	**Lab 1**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Antenna mast	AM 4.0	AM4.0/180/11920513	Maturo GmbH	
Antenna mast	AS 620 P	620/37	HD GmbH	
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2009/06/04	2014/06/03
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2008/10/27	2013/10/26
	Standard Calibration		2012/01/18	2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq	
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq	
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq	
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01-2	Kabel Kusch	
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax	
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/05/18	2015/05/17
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/06/26	2015/06/25
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic	
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright	
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170			
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2012/12/18	2015/12/17
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG	
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/10/27	2014/10/26

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH

Test Equipment Auxiliary Test Equipment

Lab ID:	**Lab 1, Lab 2**
Manufacturer:	see single devices
Description:	Single Devices for various Test Equipment
Type:	various
Serial Number:	none

Single Devices for Auxiliary Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.	
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates	
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates	
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2011/10/19	2013/10/18
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis	
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis	
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorenwerke GmbH	
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright	
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard		2012/06/13	2015/06/12
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG	

Test Equipment Digital Signalling Devices

Lab ID: **Lab 1, Lab 2**
Description: Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2011/11/24 2014/11/23
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Initial factory calibration		2012/01/26 2014/01/25
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2011/11/28 2014/11/27
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG
	HW/SW Status		*Date of Start* *Date of End*
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2011/12/07 2014/12/06
	HW/SW Status		*Date of Start* *Date of End*
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02
	SW: K62, K69		2008/11/03
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG

Test Equipment Emission measurement devices

Lab ID:	**Lab 1**
Description:	Equipment for emission measurements
Serial Number:	see single devices

Single Devices for Emission measurement devices

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Personal Computer	Dell	30304832059	Dell
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2013/05/03 2014/05/02
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard calibration		2013/04/30 2014/04/29
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	standard calibration		2011/05/12 2014/05/11
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution* *Next Exec.*
	Standard Calibration		2011/12/05 2013/12/04
	HW/SW Status		*Date of Start* *Date of End*
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03

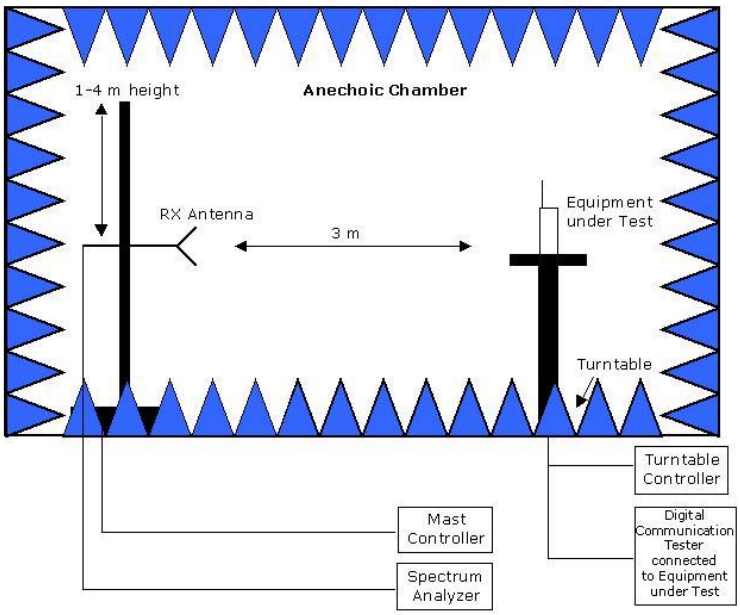
Test Equipment Radio Lab Test Equipment

Lab ID: **Lab 2**
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*	
Broadband Power Divider SMA	WA1515	A856	Weinschel Associates	
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates	
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates	
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates	
Coax Cable Huber&Suhner	Sucotest 2,0m		Huber&Suhner	
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/05/03	2014/05/02
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG	
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2012/06/21	2013/06/23
	Standard calibration		2013/06/24	2014/06/23
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/04/30	2014/04/29
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2011/11/25	2014/11/24
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard calibration		2013/05/06	2016/05/05
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG	
	Calibration Details		*Last Execution*	*Next Exec.*
	Standard Calibration		2013/02/12	2015/02/11
Temperature Chamber Vötsch 03	VT 4002	58566002150010	Vötsch	
	Calibration Details		*Last Execution*	*Next Exec.*
	Customized calibration		2012/03/12	2014/03/11

5 Setup Drawings



Drawing 1: Setup in the anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.

6 Annex measurement plots

6.1 Duty cycle measurement (based on dwell time measurement)

Op. Mode
op-mode 1

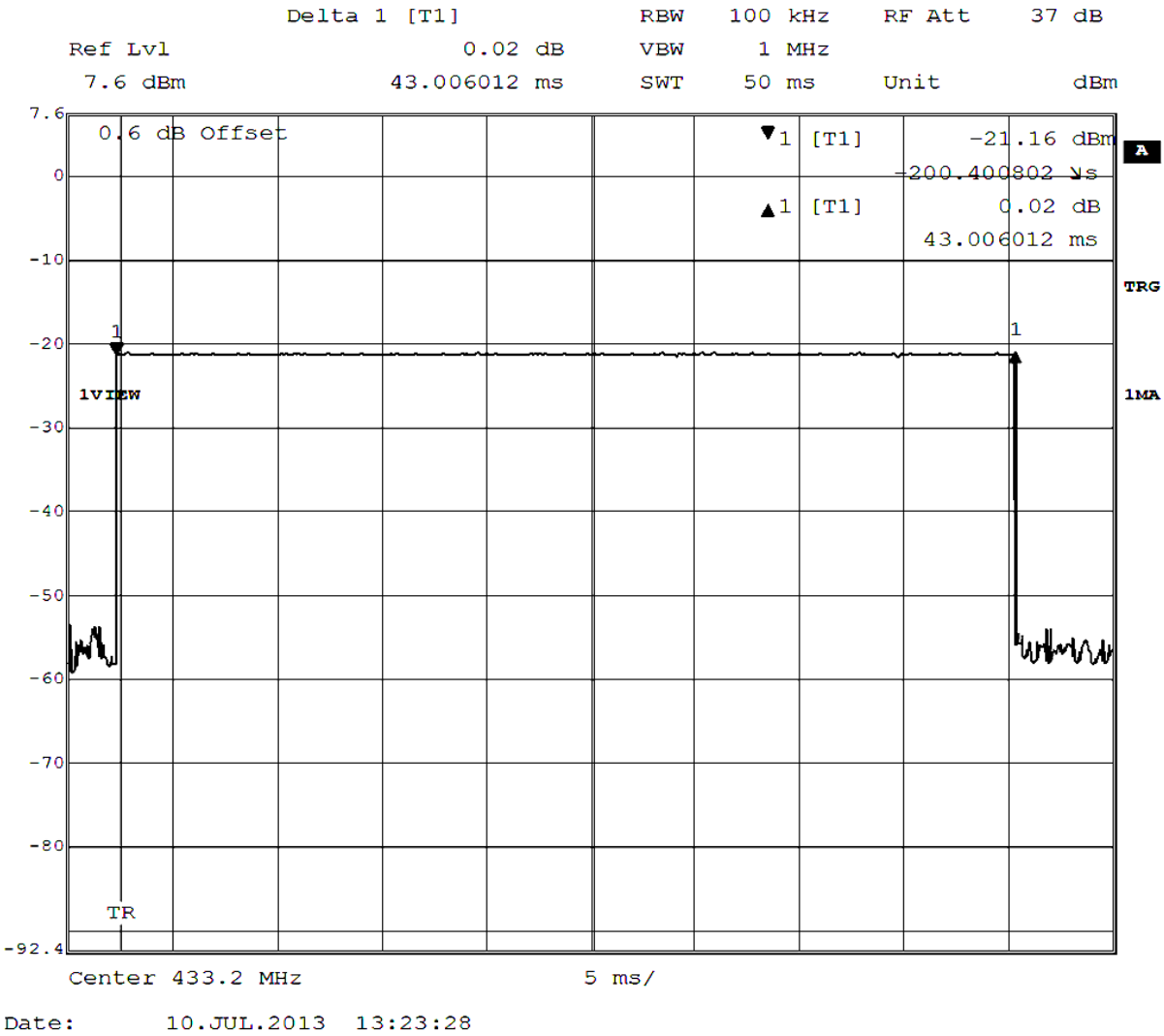


Fig. 1: "On" time in 100 ms

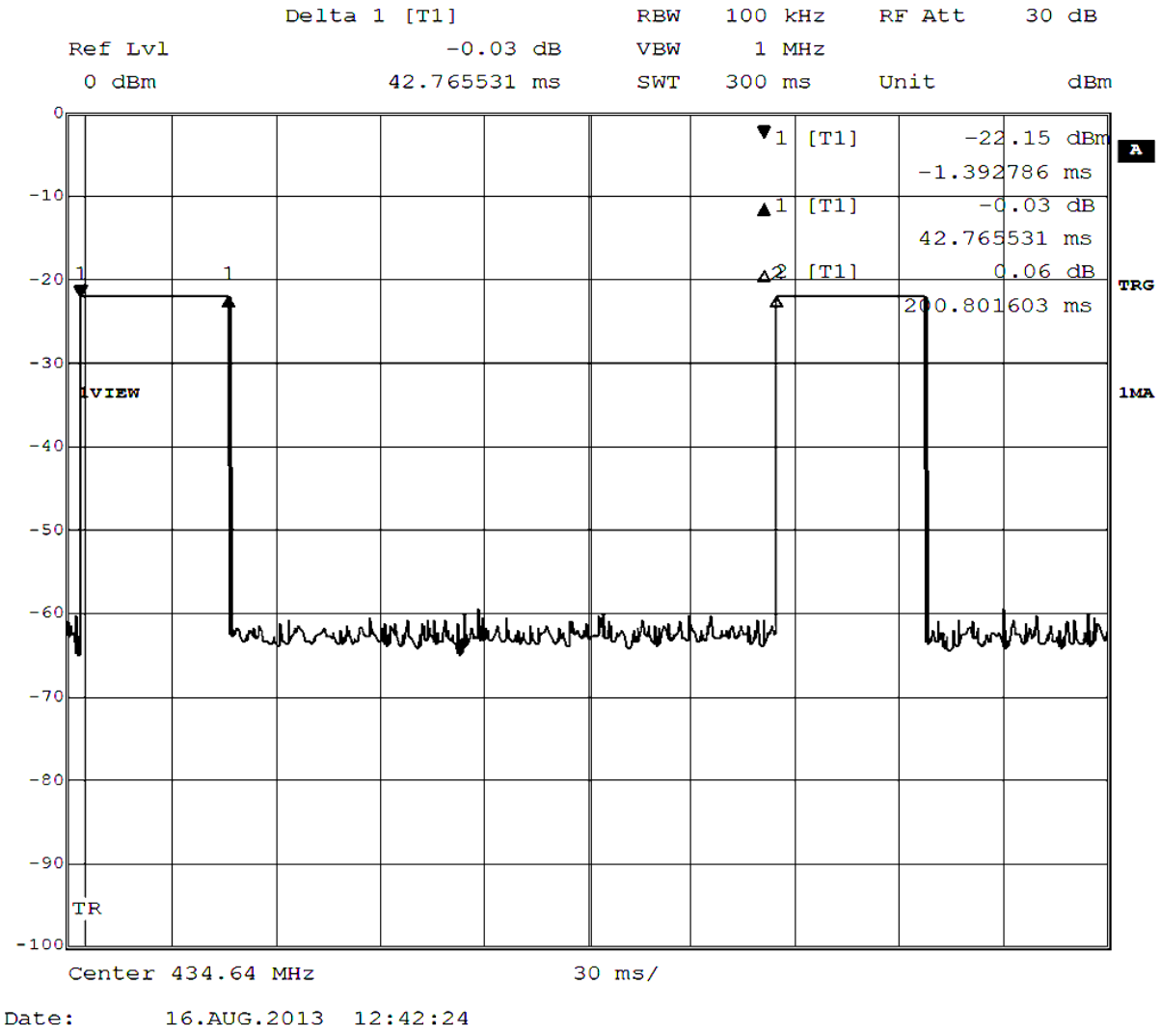
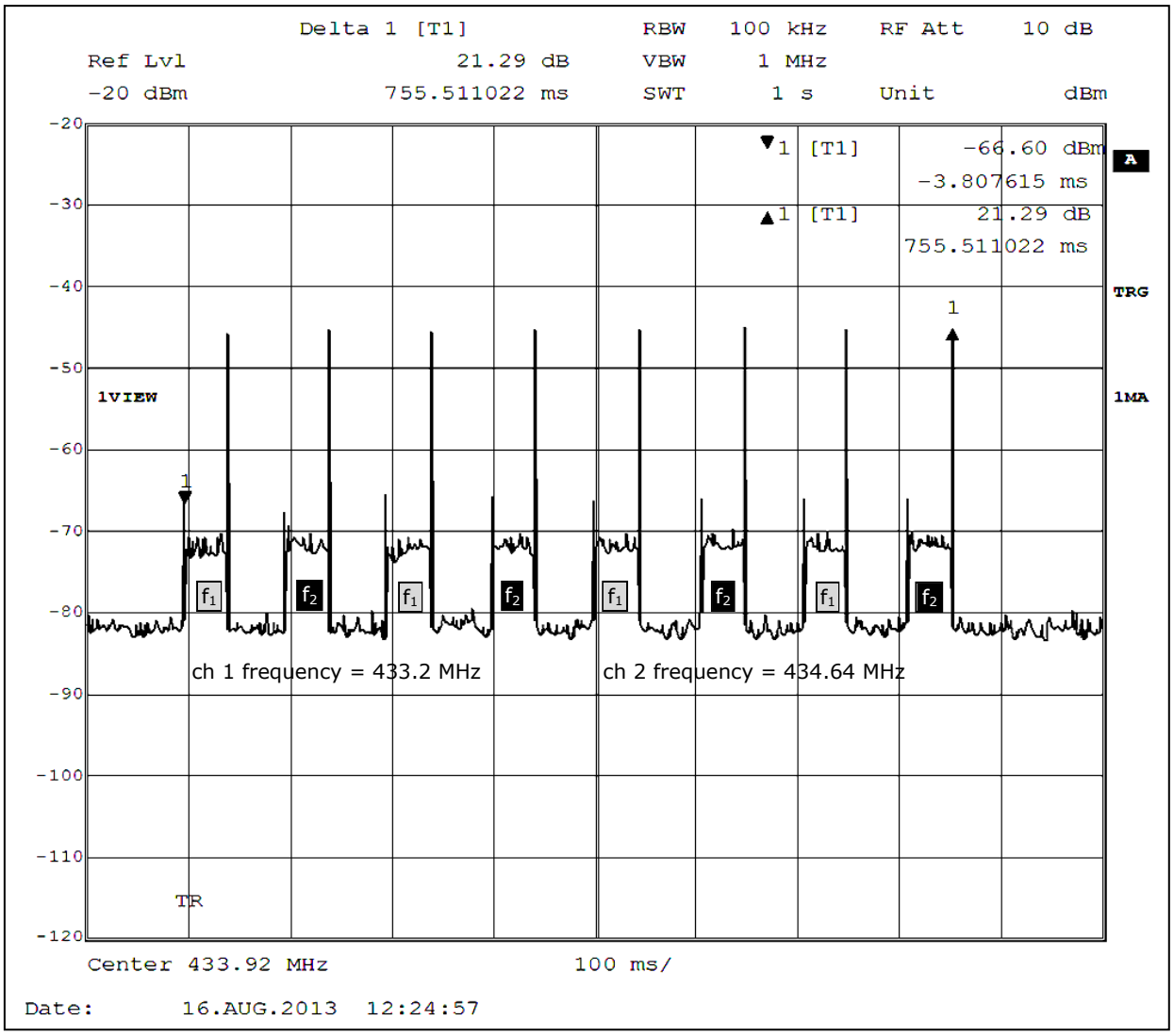


Fig. 2: Period per channel = 200.9 ms



Remarks: 1. The EUT transmitts telegram sequences on two channels. The first pulse (of 43.2 ms lengt) is sent on channel 1 carrier frequency = 433.2 MHz and if there is no acknowledge message received after 100 ms (the "worst case scenario"), the EUT sends a same length pulse on the second channel frequency = 434.64 MHz. The maximal number of pulses per channel (if no acknowledge message received) is 4. The maximal length of the pulse sequense emited on the both channels is 755.5 ms (shown between ▼1 and ▲1).

2. The level of the measured signal is low because the middle frequency of the both channels (433.2 + 434.64)/2 = 433.92 MHz was set as a centre frequency of the spectrum analyzer, for both channel-transmissions to be observed in the time domain simultaneously.

Fig. 3 Total "On" time for both channels = 755.5 ms

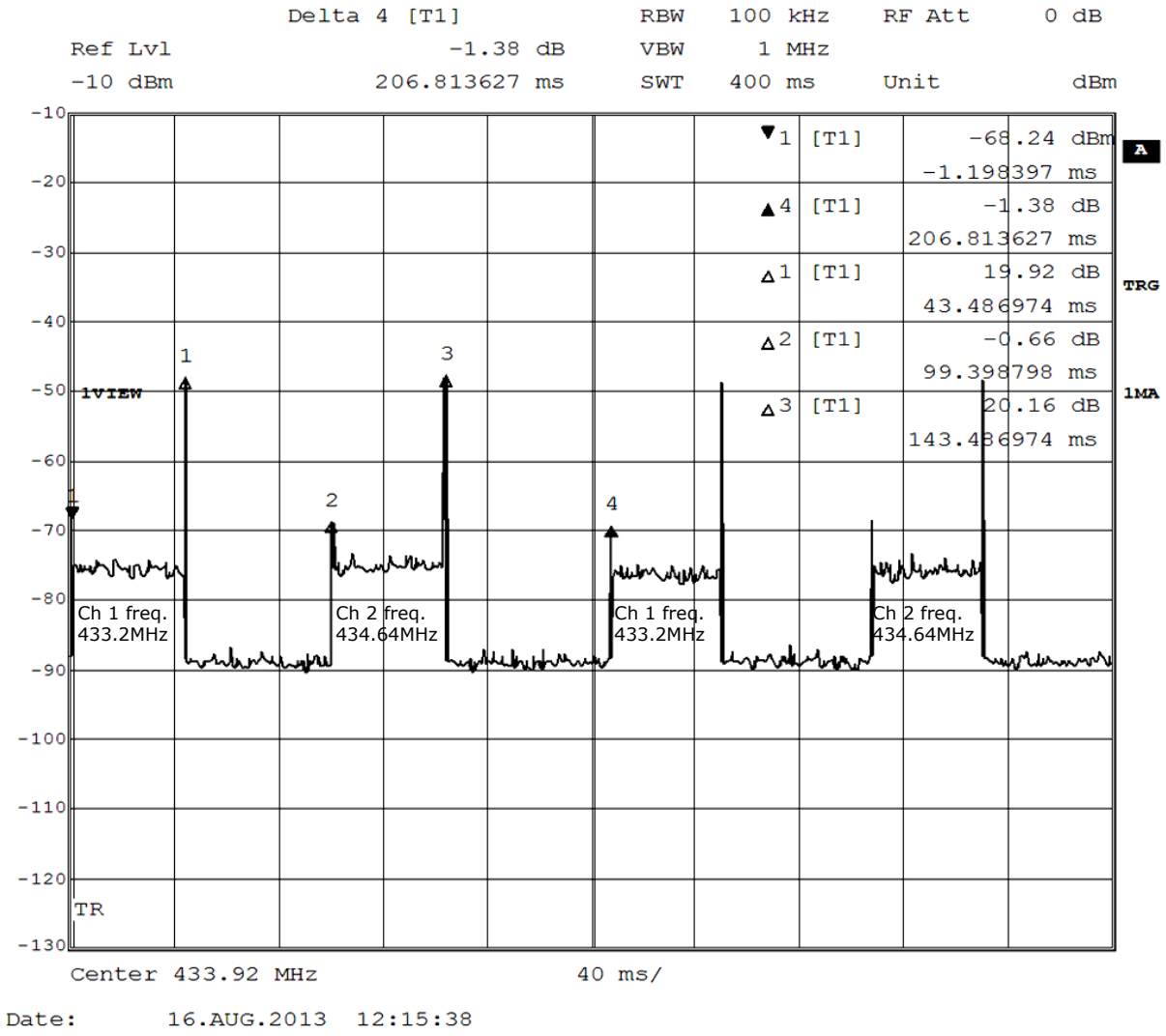


Fig. 4: Determining the pulse length and period per channel.

- L1 between ▼1 and Δ1 = time "on" on channel 1 in period of 100 ms.
  L1 = 43.5 ms.
- T_{off} between Δ1 and Δ2 = time between second channel transmission beginning:
  T_{off} = 55.9 ms.
- L2 = Δ3 – Δ2 = L2 = time "on" on channel 2 in period of 100 ms. L2 = 43.5 ms.
- T_{ch} = between ▼1 and Δ4 = period per channel = 206.9 ms.

Remark: The level of the measured signal is low because the middle frequency of the both channels (433.2 + 434.64)/2 = 433.92 MHz was set as a centre frequency of the spectrum analyzer, for both channel-transmissions to be observed in the time domain simultaneously.

6.2 Occupied bandwidth

Op. Mode 20 dB bandwidth Channel 1 = 433.2 MHz

op-mode 2

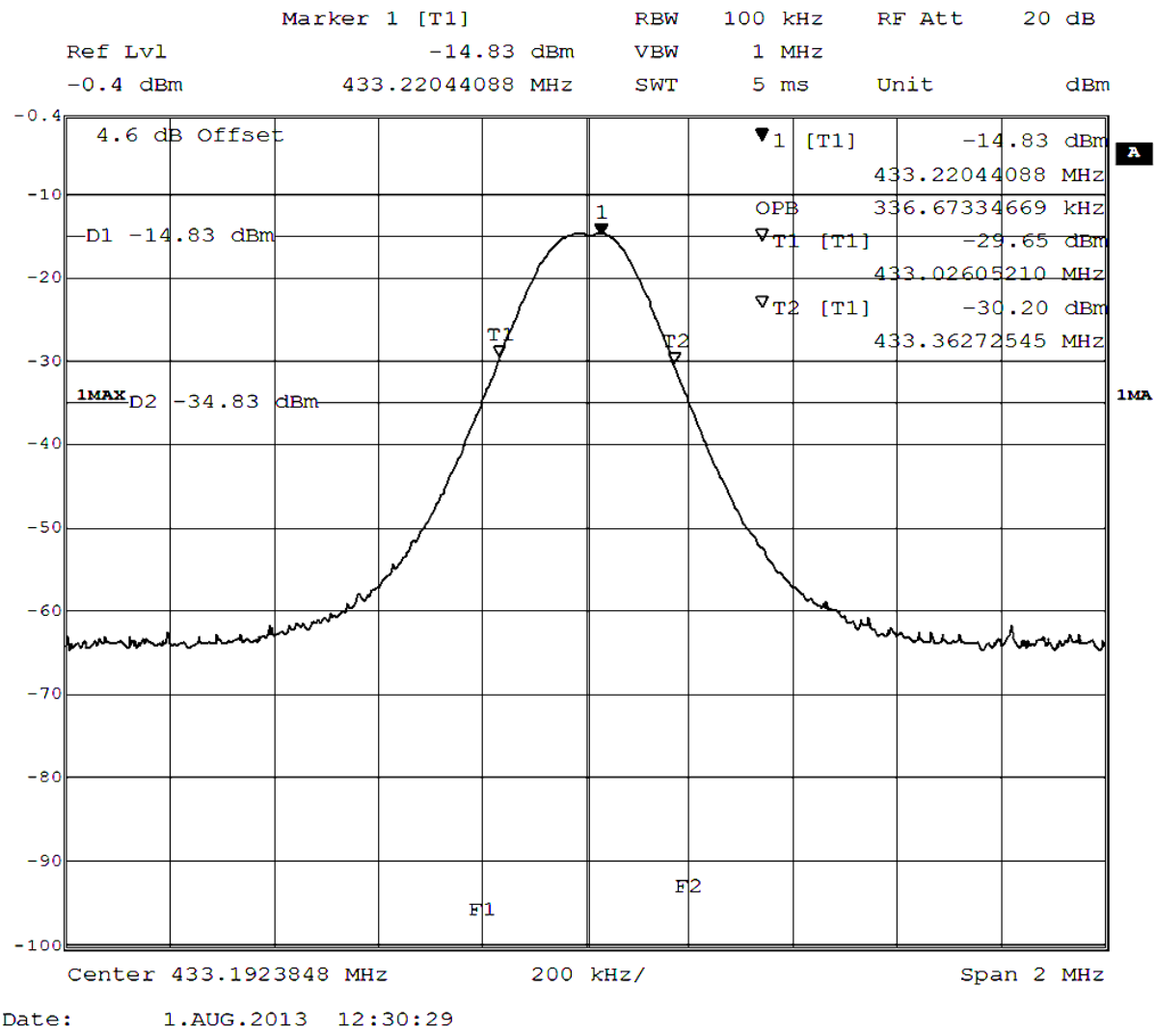


Fig. 1: Occupied bandwidths: 20 dB and 99% - Channel 1.

Op. Mode 20 dB bandwidth Channel 2 = 434.64 MHz

op-mode 2

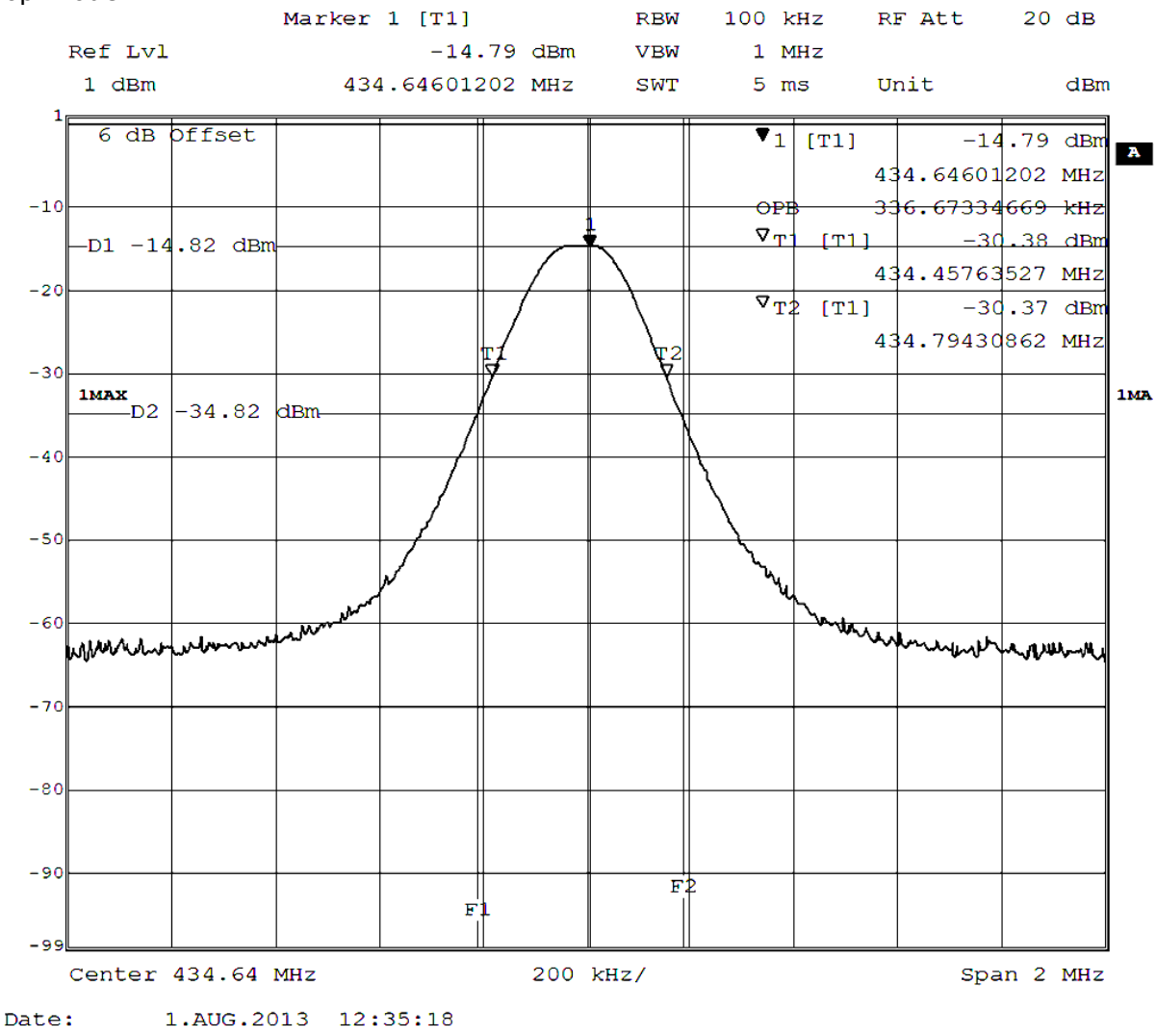


Fig. 2: Occupied bandwidths: 20 dB and 99% - channel 2.