electronic GmbH

a member of the STC

Test report

according to ISO/IEC 17025:2005

FCC
(Federal Communications Commission)
Test Firm Registration Number: 768032
Designation Number DE0022

Electromagnetic compatibility

e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C

Intentional Radiators

DAkkS Deutsche Akkreditierungsstelle D-PL-17379-01-00

Bundesnetzagentur

BNetzA-CAB-18/21-19

TESTED IN GERMANY

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Test report no.: **18/09-0026B**

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Location of test facility:

PKM electronic GmbH

Ohmstrasse 1

84160 Frontenhausen, Germany

1. CLIENT INFORMATION:

Name:	Bosch Security Systems, Inc.
Address:	130 Perinton Parkway, FAIRPORT, NY 14450, USA
Name of contact:	Mr. Peter Namisnak
Telephone:	585 678 3462
Fax:	585 223 9180
E-mail:	peter.namisnak@us.bosch.com

Authorized Representative Germany

Name	Bosch Communications Systems EVI Audio GmbH
Address	Sachsenring 60, 94315 Straubing, Germany
Name of contact:	Mr. Patrick Engl
Telephone:	+ 49 (0) 9421 706 415
Fax:	+ 49 (0) 9421 706 265
E-mail:	Patrick.Engl@de.bosch.com

2. EQUIPMENT UNDER TEST (EUT):

2.1 Identification of the EUT

Equipment:	Active Speaker
Model:	ZLX Brand: ELECTRO VOICE
Brand name:	ELECTRO VOICE
Serial no.:	Version ZLX-12BT Sample 01: 095414385334570006 / Sample 02: 095414385334570009 Version ZLX-15BT Sample 01: 095414485334640005 / Sample 02: 095414485334640007
Manufacturer:	Bosch Security Systems, Inc. 130 Perinton Parkway, FAIRPORT, NY 14450, USA
Country of origin:	China
Power rating:	100 – 240 V ~, 50 – 60 Hz, 0.8 – 0.5 A

Highest frequency generated or used in the device or on which the device operates or tunes: 2480 MHz (Bluetooth)

2.2 Additional information about the EUT:

The ZLX is an active speaker with Bluetooth interface (Bluetooth Module BTM-630) operating as A2DP audio sink for music streaming with Basic Rate (GFSK with 1 MBit/s), EDR (PI/4-DQPSK with 2 MBit/s), EDR (8-DPSK with 3 MBit/s).
The model ZLX was tested in the versions ZLX-12BT and ZLX-15BT which differs in design.
The requested operation modes had been adjusted with CSR USB_SPI_TOOLS interface and CSR BLUE TEST3 software.
FCC ID: ESVZLX

Tests are performed from June 11 2018 – March 11 2019

3. Performed measurements and results

List of measurements
The list of measurements required in e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, Intentional Radiators for the EUT is given below

Subclause:		**test requirements applicable**		**fulfilled:**	
		yes	**no**	**yes**	**no**
§15.203	Antenna requirement	☒	☐	☒	☐
§15.205	Restricted bands of operation	☒	☐	☒	☐
§15.207	Conducted limits	☒	☐	☒	☐
§15.209	Radiated emission limits; general requirements	☒	☐	☒	☐
§15.215	Additional provisions to the general radiated emission limitations	☒	☐	☒	☐
§15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz	☒	☐	☒	☐

All required / applicable tests according to the following standard(s) were performed.

e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, Intentional Radiators

4. Antenna requirement §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The used antenna is a PCB antenna which is inside the EUT's (Version ZLX-12BT, Version ZLX-15BT) and is not serviceable and can not be replaced by the user, so that the above mentioned requirements are fulfilled.

5. Restricted bands of operation §15.205

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	above 38.6
13.36-13.41			

The EUT's (Version ZLX-12BT, Version ZLX-15BT) are operating on frequencies between 2.402 GHz and 2.480 GHz and therefor not in a restricted band.

6. Conducted limits (AC power line conducted emission measurements) §15.207

Test site
Measurements of conducted emission from EUT was made in the shielded chamber (DC - 10GHz) located in the test facility.

Detector function selection and bandwidth
In conducted emissions measurement CISPR quasi-peak- and average-detector were used.
The bandwidth of the detector of instrument is 9 kHz over the frequency range of 150 kHz to 30 MHz.

Frequency range to be scanned
For conducted emission measurements, the spectrum in the range of 150 kHz to 30 MHz was investigated.

Test conditions and configuration of EUT
The EUT was configured and operated with a pink noise input signal and an output power of 12.5 % of max. output power on internal speaker, so as to find the maximum conducted emission generated from EUT. Additional the Bluetooth transmitter was set to continuous transmission (hopping), receiving and link mode (connected to Smartphone with data transfer) using Basic Rate (GFSK with 1 MBit/s), EDR (PI/4-DQPSK with 2 MBit/s), EDR (8-DPSK with 3 MBit/s). These operation modes represents the normal operation. The procedure according to ANSI C63.10:2013 clause 6.2 is used with these modes of operation of the EUT, with typical cable positions and with a typical system equipment configuration and arrangement are investigated. For each AC power current-carrying conductor, cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below. The corresponding configuration is shown in the “Photo(s) of test setup”.
During test the EUT was operated with rated Power (120 V~, 60 Hz), as specified by client/in the user manual of the EUT. The EUT was placed on a 80 cm high non metallic table. Measurements on neutral (N)- and live (L1)-wire had been performed.
As worst case the mode EDR (8-DPSK with 3 MBit/s) continuous transmission (hopping) was documented.

Applied standards
e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart B, § 15.207 (a) Conducted limits,
ANSI C63.10:2013

Tested versions:
Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)
Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

Requirements

Frequency MHz	Limits dBµV	
	Quasi-peak	Average
0.15–0.5	66–56 *	56–46 *
0.5–5.0	56	46
5.0–30.0	60	50

* Decreases with the logarithm of the frequency.

Measurements

The measurements for Version ZLX-12BT and ZLX-15BT had been performed on June 13, 2018.

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005).

The measurement data please find annex 1 pages 1 to 3. It was found that there is no difference of the AC power line conducted emission values between Bluetooth transmitting, receiving and Bluetooth off. As worst case the mode EDR (8-DPSK with 3 MBit/s) continuous transmission (hopping) was documented.

The six highest emissions for each port (L/N)/detector are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Detector (3)	Port (4)	loss of cable between LISN and test receiver (dB) (5)	LISN correction [dB] (6)	AC power line conducted emission [dBµV] (7)	Limit [dBµV] (8)	Result (9)
0.15	45.9	QP	N	0.1	0.1	46.1	66.0	PASS
0.20	44.4	QP	N	0.1	0.1	44.6	63.6	PASS
0.25	42.2	QP	N	0.1	0.1	42.4	61.7	PASS
0.30	40.1	QP	N	0.1	0.1	40.3	60.2	PASS
0.35	38.7	QP	N	0.1	0.1	38.9	58.9	PASS
0.65	36.0	QP	N	0.1	0.1	36.2	56.0	PASS
0.15	40.8	AV	N	0.1	0.1	41.0	56.0	PASS
0.20	37.3	AV	N	0.1	0.1	37.5	53.6	PASS
0.50	27.2	AV	N	0.1	0.1	27.4	46.0	PASS
0.55	27.3	AV	N	0.1	0.1	27.5	46.0	PASS
0.65	27.2	AV	N	0.1	0.1	27.4	46.0	PASS
all other values								
<0.5	<36.0	AV	N	0.1	0.1	<36.2	56.0 – 46.0	PASS
>0.5 - 30	<30.0	AV	N	0.3	0.4	<30.7	46.0, 50.0	PASS
all values								
<0.5	<36.0	QP	L1	0.1	0.1	<36.2	66.0 – 56.0	PASS
>0.5 - 30	<30.0	QP	L1	0.3	0.4	<30.7	56.0, 60.0	PASS
all values								
<0.5	<36.0	AV	L1	0.1	0.1	<36.2	56.0 – 46.0	PASS
>0.5 - 30	<30.0	AV	L1	0.3	0.4	<30.7	46.0, 50.0	PASS

AC power line conducted emission [dBµV] (7) = Reading of test receiver [dBµV] (2) + loss of cable between Line impedance stabilisation network (LISN) and test receiver (dB) (5) + LISN correction [dB] (6)

(1) = test frequency
(4) = tested port Phase (live, L1) or Neutral (N)
(8) = limit according to § 15.107 (a) Class B Conducted limits
(9) = comparison between Limit [dBµV] (8) and AC power line conducted emission [dBµV] (7)

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the conducted emission measurements.

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

The measurement data please find annex 1 pages 4 to 7

The six highest emissions for each port (L/N)/detector are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Detector (3)	Port (4)	loss of cable between LISN and test receiver (dB) (5)	LISN correction [dB] (6)	AC power line conducted emission [dBµV] (7)	Limit [dBµV] (8)	Result (9)
0.15	46.1	QP	N	0.1	0.1	46.3	66.0	PASS
0.20	44.5	QP	N	0.1	0.1	44.7	63.6	PASS
0.25	41.7	QP	N	0.1	0.1	41.9	61.7	PASS
0.30	39.4	QP	N	0.1	0.1	39.6	60.2	PASS
0.35	38.5	QP	N	0.1	0.1	38.7	58.9	PASS
0.65	35.9	QP	N	0.1	0.1	36.1	56.0	PASS
0.15	42.3	AV	N	0.1	0.1	42.5	56.0	PASS
0.20	38.2	AV	N	0.1	0.1	38.4	53.6	PASS
0.25	33.1	AV	N	0.1	0.1	33.3	51.7	PASS
all other values								
<0.5	<36.0	AV	N	0.1	0.1	<36.2	56.0 – 46.0	PASS
>0.5 - 30	<30.0	AV	N	0.3	0.4	<30.7	46.0, 50.0	PASS
0.15	45.9	QP	L1	0.1	0.1	46.1	66.0	PASS
0.21	52.8	QP	L1	0.1	0.1	53.0	63.2	PASS
0.46	36.5	QP	L1	0.1	0.1	36.7	56,7	PASS
0.51	35.7	QP	L1	0.1	0.1	35.9	56.0	PASS
0.56	35.8	QP	L1	0.1	0.1	36.0	56.0	PASS
21.26	39.5	QP	L1	0.3	0.4	40.2	60.0	PASS
0.15	39.2	AV	L1	0.1	0.1	39.4	55.8	PASS
0.21	34.9	AV	L1	0.1	0.1	35.1	53.5	PASS
0.46	27.4	AV	L1	0.1	0.1	27.6	46.8	PASS
0.51	27.5	AV	L1	0.1	0.1	27.7	46.0	PASS
0.56	26.7	AV	L1	0.1	0.1	26.9	46.0	PASS
0.62	28.4	AV	L1	0.1	0.1	28.6	46.0	PASS

AC power line conducted emission [dBµV] (7) = Reading of test receiver [dBµV] (2) + loss of cable between Line impedance stabilisation network (LISN) and test receiver (dB) (5) + LISN correction [dB] (6)

(1) = test frequency
(4) = tested port Phase (live, L1) or Neutral (N)
(8) = limit according to § 15.207 Conducted limits
(9) = comparison between Limit [dBµV] (8) and AC power line conducted emission [dBµV] (7)

Results

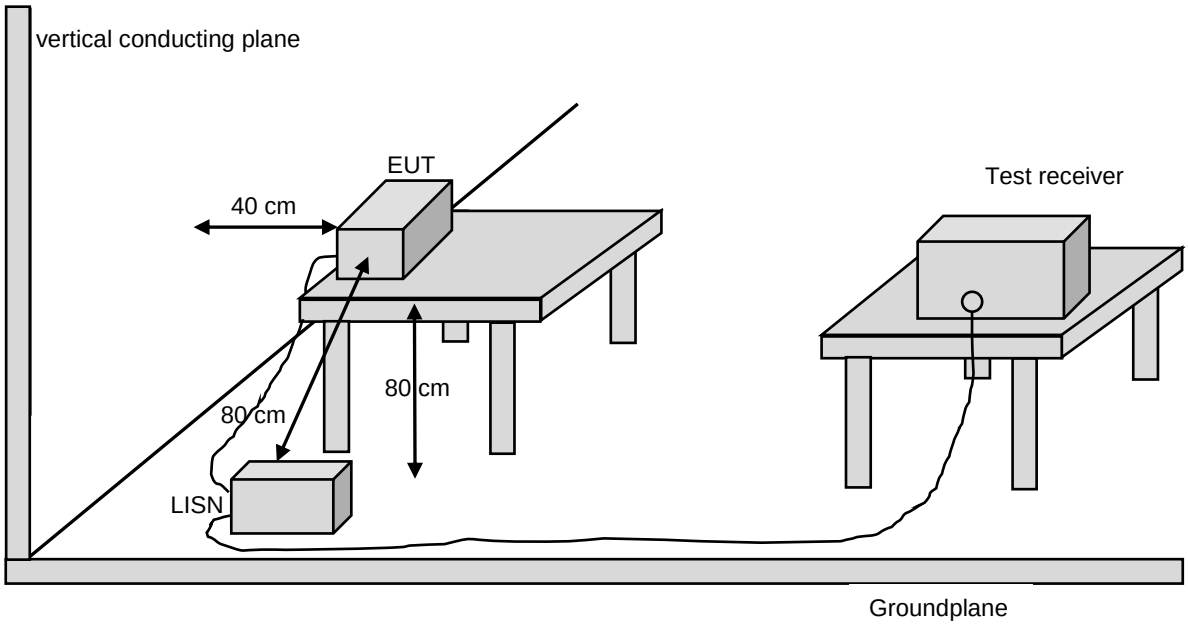
From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the conducted emission measurements.

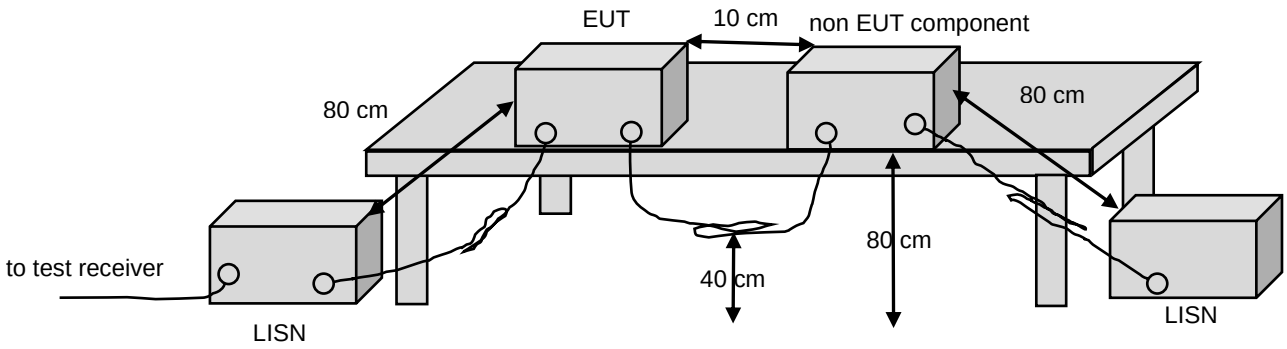
Test equipment used:

Kind of equipment	**Manufacturer**	**Type**	**PKM-ident no.**	**Serial no.**	**Calibrated on**	**Calibration interval**
EMI-Test-Receiver	Rohde & Schwarz	ESR7 Instrument FW 3.36	11676	101694	2018-03-26	3 years
Software	PKM	PKM U5/6	-/-	V1.01.03	-/-	-/-
Line impedance stabilisation network (LISN)	Rohde & Schwarz	ESH2-Z5	10139	879675/028	2017-10-10	1 year
Shielded room	Siemens	(6,2 x 4,7 x 3,3) m (l x w x h) DC – 10 GHz	10113	1	-/-	-/-

All measurements were made with measuring instruments, including any accessories that may affect test results, calibrated according to the requests of ISO/IEC 17025 according to which the test site is accredited from DAkkS. Measurement of conducted emissions was made with instruments conforming to American National Standard Specification, ANSI C63.10-2013.

Block diagram Conducted emissions





Measurement uncertainty according to CISPR 16-4-2 Edition 2.0 2011-06

Measurement	**calculated uncertainty U_{lab}**	**Specified CISPR uncertainty according CISPR 16-4-2 Edition 2.0 2011-06, table 1 U_{CISPR}**
Conducted disturbance at mains port using AMN 150 kHz – 30 MHz	3,2 dB	3,4 dB

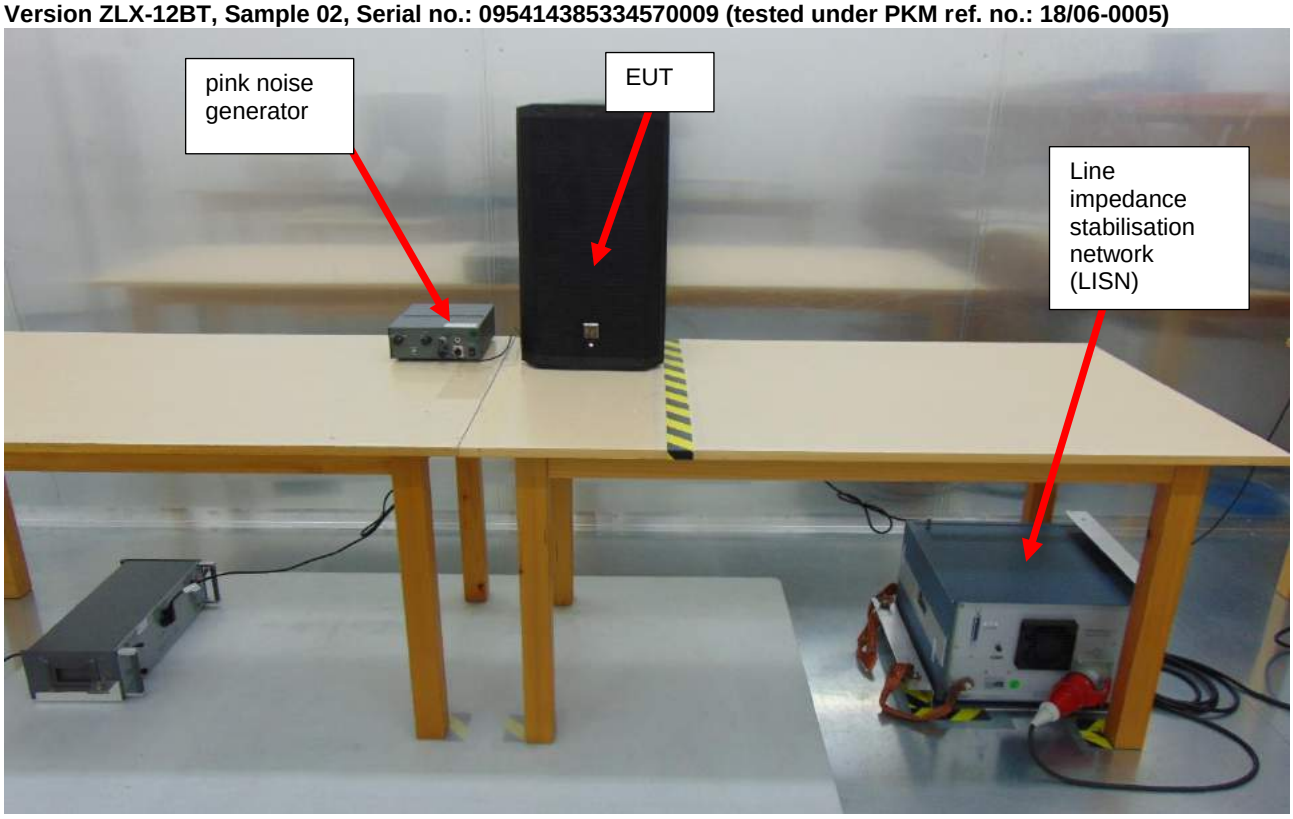
The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT in the above mentioned way.

The measurements uncertainty was calculated in accordance with CISPR 16-4-2 Edition 2.0 2011-06.

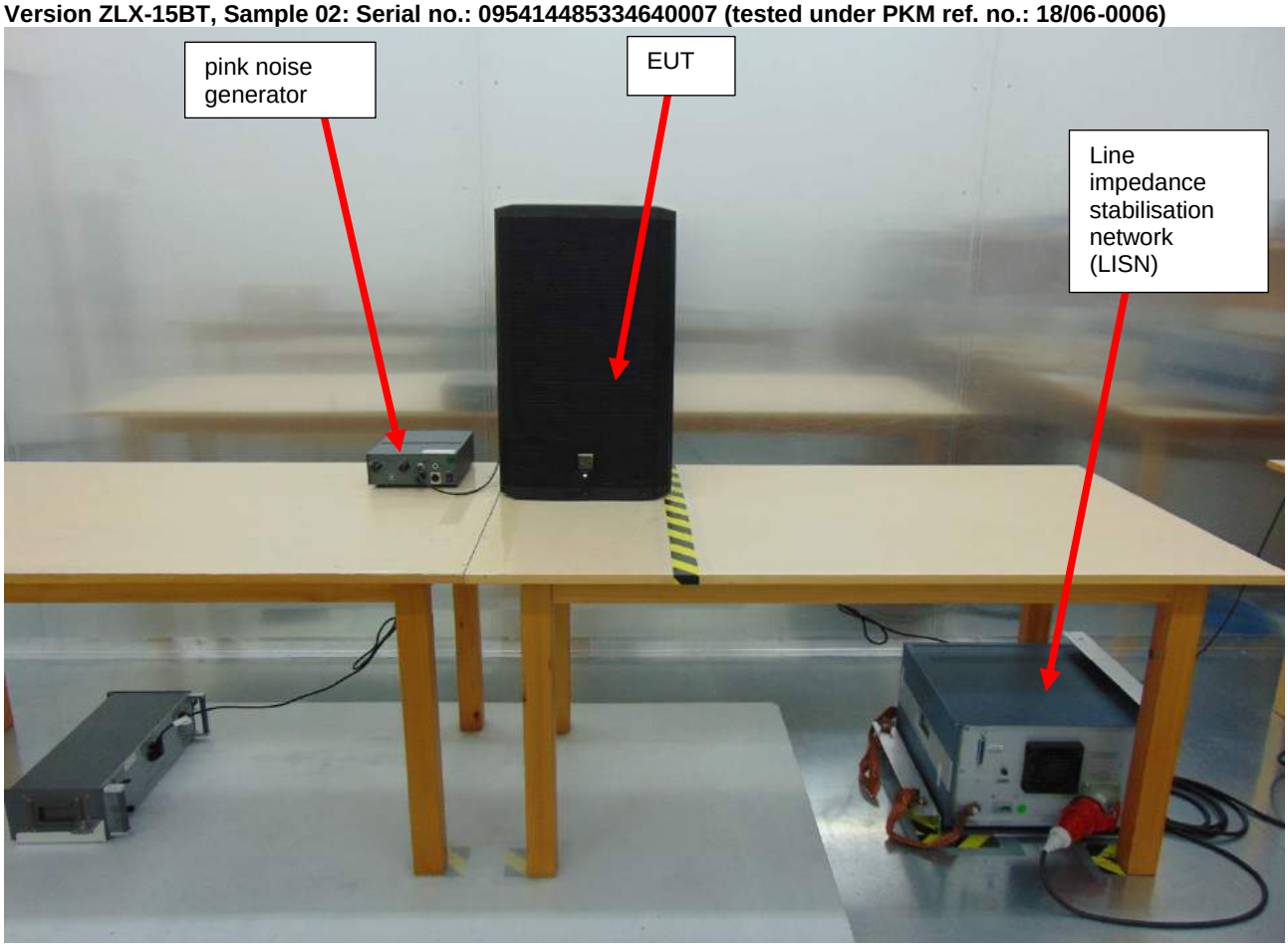
The measurement uncertainty was given with a confidence of 95 % (k = 2).

Photo(s) of test setup

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)



Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)



7. Radiated emission limits; general requirements §15.209

Test site
Measurement of radiated emissions from EUT was made in the semi-anechoic chamber SAC3 from DC to 26.5 GHz located in the test facility.

Detector function selection and bandwidth
For the radiated emissions measurement in the frequency range of 9 kHz to 1000 MHz, an EMI test receiver that have CISPR quasi-peak detector was used. The bandwidth of the detector of the EMI test receiver is 200 Hz over the frequency range of 9 kHz to 150 kHz, 9 kHz over the frequency range of 150 kHz to 30 MHz and 120 kHz over the frequency range of 30 to 1000 MHz. Emissions to be measured are detected in CISPR quasi peak mode, except for the frequency bands 9-90 kHz, 110-490 kHz. Radiated emission limits in these two bands are based on measurements with an average detector.

In the frequency range above 1 GHz the used bandwidth was 1000 kHz and emissions to be measured are detected in average and peak mode.

Antennas
Measurements were made using a calibrated loop antenna in the range of 9 kHz to 30 MHz, a calibrated bilog antenna in the range of 30 to 1000 MHz to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization.
The horizontal distance between the receiving antenna and the EUT was 3 meters.
In the range above 1 GHz measurements were made using a calibrated horn antenna to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization.
The horizontal distance between the receiving antenna and the EUT was 3 meters.

Frequency range to be scanned
For radiated emissions measurements, the spectrum in the range of 9 kHz to 24.800 GHz (10^{th} harmonic of highest frequency) was investigated as the highest frequency generated is 2480 MHz.

Test conditions and configuration of EUT

The EUT was configured and operated with a pink noise input signal and an output power of 12.5 % of max. output power on internal speaker, so as to find the maximum radiated emission generated from EUT. Additional the Bluetooth transmitter was set to continuous transmission (hopping), transmitting on fixed frequencies (low, middle, high), receiving and link mode (connected to Smartphone with data transfer) using Basic Rate (GFSK with 1 MBit/s), EDR (PI/4-DQPSK with 2 MBit/s), EDR (8-DPSK with 3 MBit/s). These operation modes represents the normal operation. The procedure according to ANSI C63.10:2013 clause 6.3, 6.4, 6.5 and 6.6 is used and this modes were investigated by operating the EUT with typical cable positions and with a typical system equipment configuration and arrangement. Cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below. The corresponding configuration is shown in the “Photo(s) of test setup”.
During test the EUT was operated with rated Power (120 V~, 60 Hz), as specified in the user manual of the EUT. For frequencies up to 1000 MHz the EUT was placed on a 80 cm high non metallic table placed on the turntable. The EUT was rotated and the antenna height was varied between 1 m to 4 m to find the maximum RF energy generated from EUT.

For frequencies above 1000 MHz the EUT was placed on a 150 cm high non metallic table placed on the turntable. The EUT was rotated and the antenna height was varied between 1 m to 4 m to find the maximum RF energy generated from EUT.

As worst case the mode EDR (8-DPSK with 3 MBit/s) continuous transmission (hopping) was found and documented.

Applied standards
e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart B, § 15.209 Radiated emission limits

Requirements

Frequency MHz	Limits µV/m Quasi-peak	Limits dBµV/m Quasi-peak	Limits µV/m Average	Limits dBµV/m Average	Test distance m
0.009 – 0.090	-/-	-/-	2400/F (kHz)	48.5 – 28.5	300
0.090 - 0.110	2400/F (kHz)	28.5 – 26.8	-/-	-/-	300
0.110 – 0.490	-/-	-/-	2400/F (kHz)	26.8 – 13.8	300
0.490 - 1.705	24000/F (kHz)	33.8 – 23.0	-/-	-/-	30
1.705 - 30.0	30	29.5	-/-	-/-	30
30 - 88	100	40	-/-	-/-	3
88 - 216	150	43.5	-/-	-/-	3
216 - 960	200	46	-/-	-/-	3
960 - 1000	500	54	-/-	-/-	3
Above 1000	/-	-/-	500	54	3

Measurements

The measurements for Version ZLX-12BT and ZLX-15BT in the frequency range 9 kHz – 30 MHz had been performed on June 12, 2018.
The measurements for Version ZLX-12BT and ZLX-15BT in the frequency range 30 MHz – 24.800 GHz had been performed on June 11, 2018.

In the frequency range 9 kHz – 30 MHz the EUT'S had been scanned in a distance of 3 m and the relevant limit was adjused to this distance using a factor with 20 dB/decade. The values are detected in peak. Since all peak values are at least 10 dB below the relevant limit for both models, no further measurements had been performed.

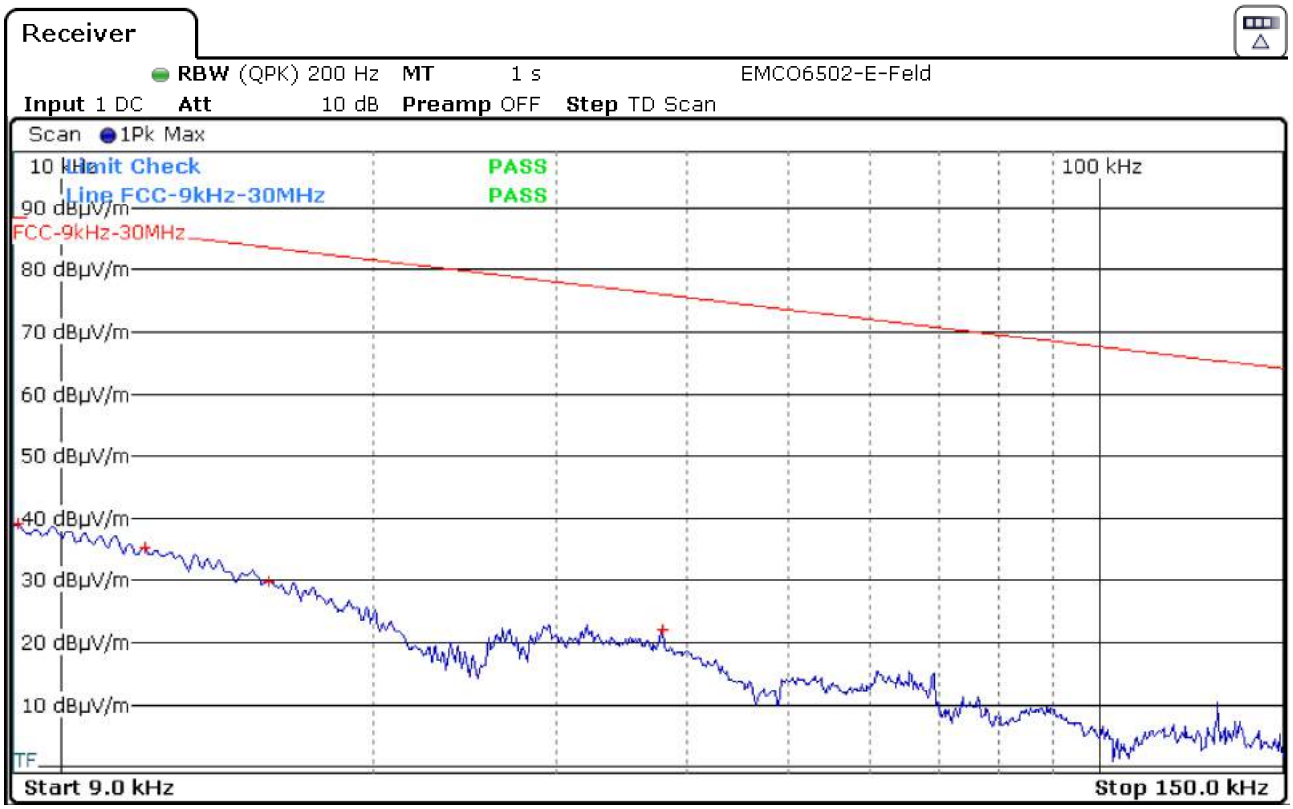
Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

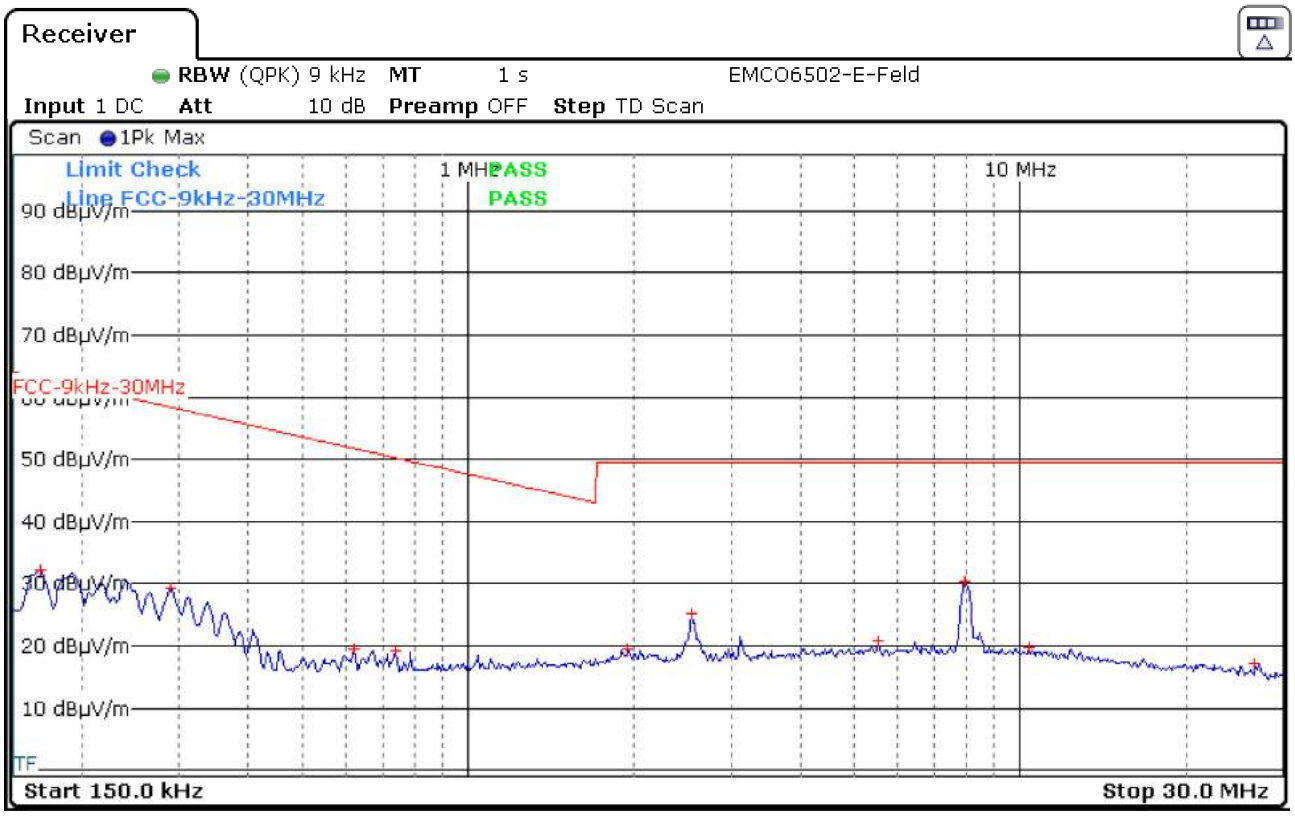
The highest peak emissions in the frequency range 9 kHz – 30 MHz in 3 m distance are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Antenna polarization (3)	Correction factor [dB/m] (4)	Radiated emission [dBµV/m] (5)	Limit [dBµV/m] (6)	Result (7)
0.009100	21.3	vertical	17.7	39.0	88.4	PASS
0.012050	19.0	vertical	16.3	35.3	86.0	PASS
0.015850	15.3	vertical	14.6	29.9	83.6	PASS
7.939500	19.8	vertical	10.6	30.4	49.5	PASS
2.535000	14.3	vertical	10.9	25.2	49.5	PASS
5.536500	10.1	vertical	10.7	20.8	49.5	PASS
-/-	-/-	horizontal	-/-	-/-	-/-	PASS
All other emissions in the frequency range 9 kHz – 30 MHz are at least 20 dB below the relevant limit.						

Radiated emission [dBµV/m] (5) = Reading of test receiver [dBµV] (2) + Correction factor [dB] (4) (= loss of cable between antenna and test receiver + antenna factor)

(1) = test frequency
(3) = polarization of the test antenna (Horizontal/Vertical)
(6) = relevant limit according to §15.209 Radiated emission limits; general requirements corrected to 3 m test distance using a correction factor with 20 dB/decade (300 m to 3 m : +40 dB, 30 m to 3 m : +20 dB)
(7) = comparison between Limit [dBµV/m] (7) and Radiated emission [dBµV/m] (6)


Receiver
RBW (QPK) 200 Hz MT 1 s EMCO6502-E-Feld
Input 1 DC Att 10 dB Preamp OFF Step TD Scan
Scan 1Pk Max
Limit Check PASS
Line FCC-9kHz-30MHz PASS
10 kHz
100 kHz
90 dBµV/m
FCC-9kHz-30MHz
80 dBµV/m
70 dBµV/m
60 dBµV/m
50 dBµV/m
40 dBµV/m
30 dBµV/m
20 dBµV/m
10 dBµV/m
TF
Start 9.0 kHz
Stop 150.0 kHz


Receiver
RBW (QPK) 9 kHz MT 1 s EMCO6502-E-Feld
Input 1 DC Att 10 dB Preamp OFF Step TD Scan
Scan 1Pk Max
Limit Check PASS
Line FCC-9kHz-30MHz PASS
1 MHz
10 MHz
90 dBµV/m
80 dBµV/m
70 dBµV/m
FCC-9kHz-30MHz
50 dBµV/m
40 dBµV/m
30 dBµV/m
20 dBµV/m
10 dBµV/m
TF
Start 150.0 kHz
Stop 30.0 MHz

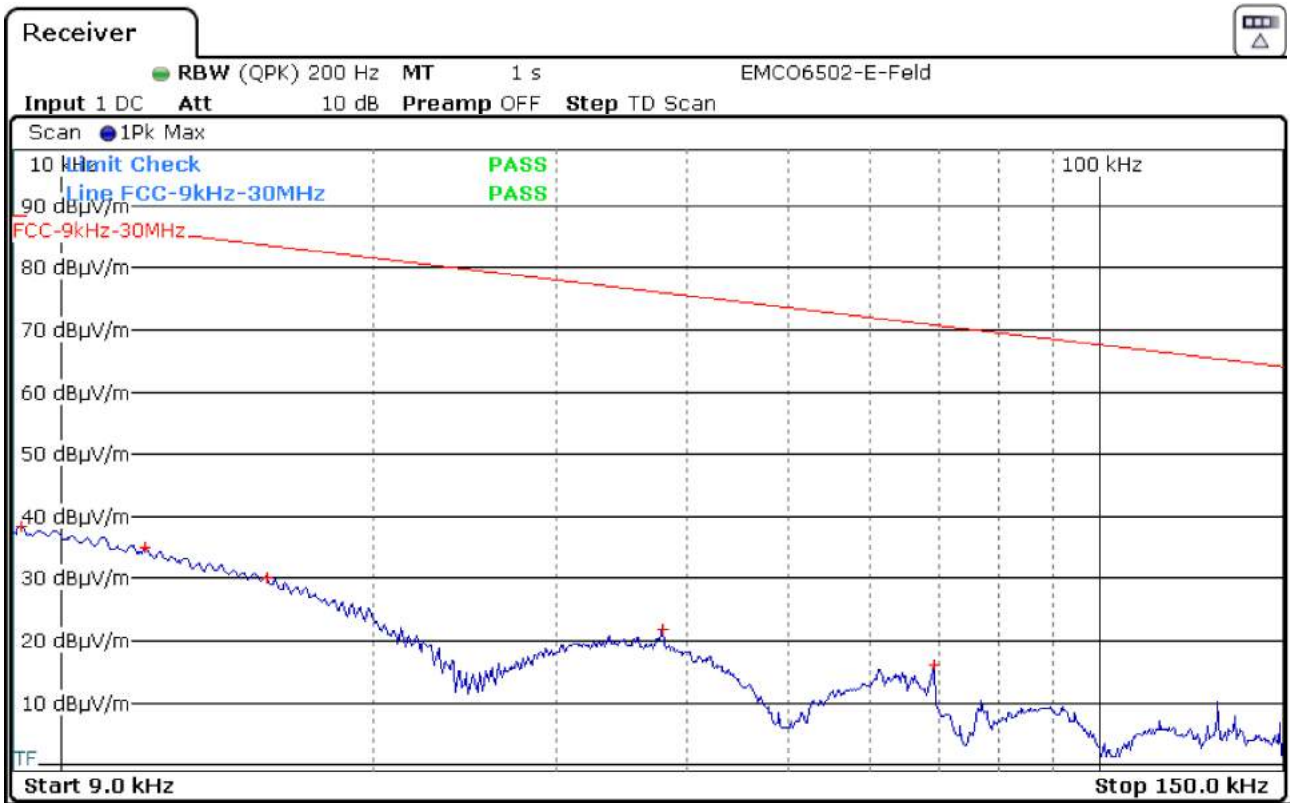
Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

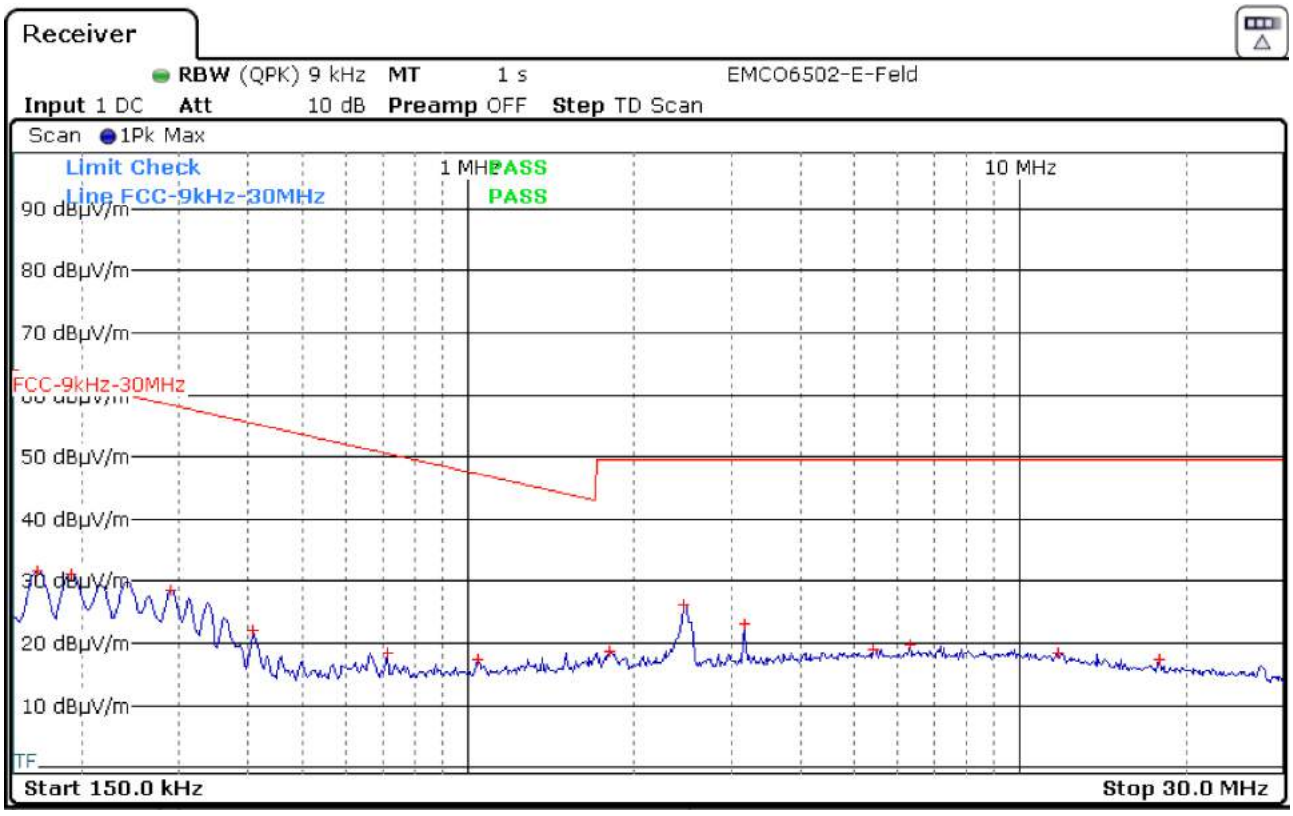
The highest peak emissions in the frequency range 9 kHz – 30 MHz in 3 m distance are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Antenna polarization (3)	Correction factor [dB/m] (4)	Radiated emission [dBµV/m] (5)	Limit [dBµV/m] (6)	Result (7)
0.009150	20.8	vertical	17.6	38.4	88.3	PASS
0.012050	18.7	vertical	16.3	35.0	85.9	PASS
0.015800	15.4	vertical	14.6	30.0	83.6	PASS
2.465250	15.3	vertical	10.9	26.2	49.5	PASS
3.169500	12.2	vertical	10.8	23.0	49.5	PASS
0.1041000	6.6	vertical	10.9	17.5	47.3	PASS
-/-	-/-	horizontal	-/-	-/-	-/-	PASS
All other emissions in the frequency range 9 kHz – 30 MHz are at least 20 dB below the relevant limit.						

Radiated emission [dBµV/m] (5) = Reading of test receiver [dBµV] (2) + Correction factor [dB] (4) (= loss of cable between antenna and test receiver + antenna factor)

(1) = test frequency
(3) = polarization of the test antenna (Horizontal/Vertical)
(6) = relevant limit according to §15.209 Radiated emission limits; general requirements corrected to 3 m test distance using a correction factor with 20 dB/decade (300 m to 3 m : +40 dB, 30 m to 3 m : +20 dB)
(7) = comparison between Limit [dBµV/m] (7) and Radiated emission [dBµV/m] (6)





Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

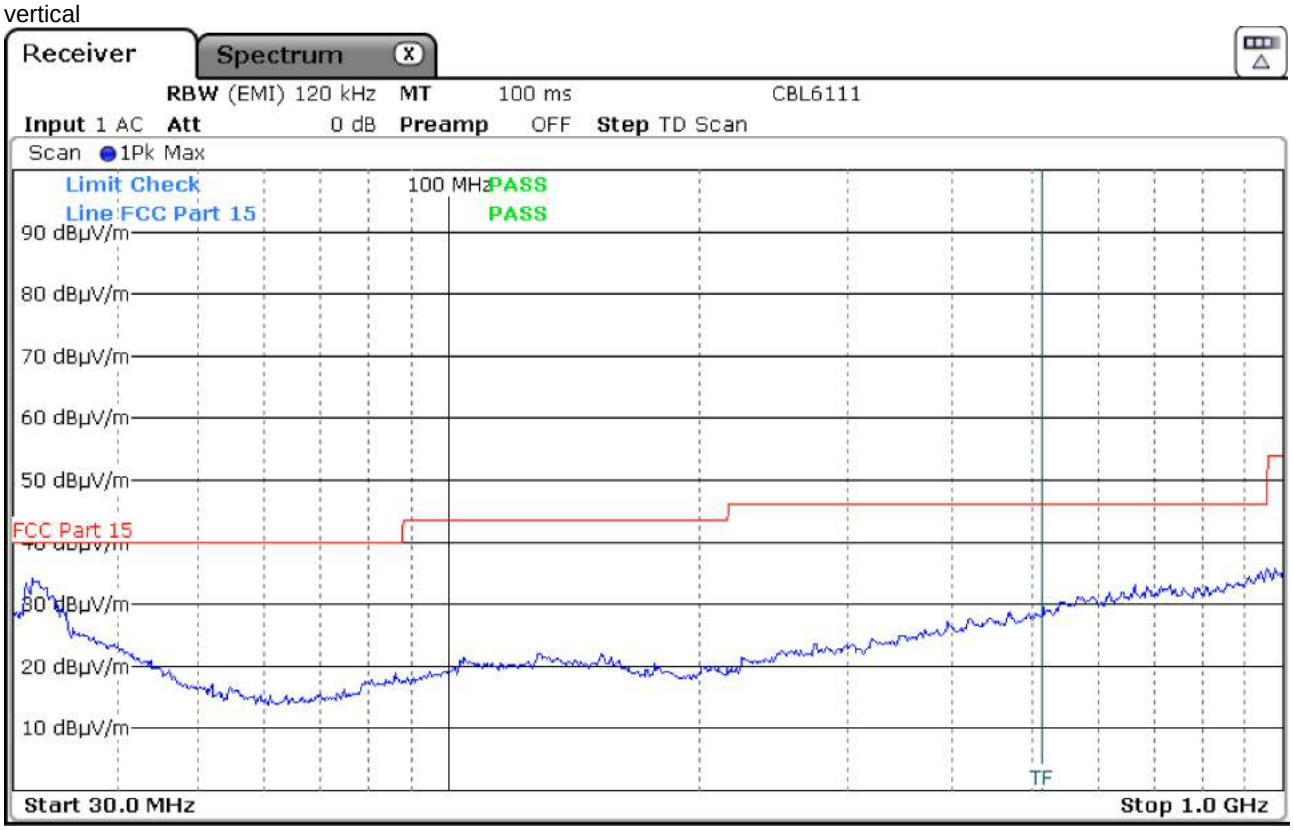
Since all peak values are at least 6 dB below the relevant limit for both models, no further measurements had been performed. The six highest emissions for each polarization (H/V) in the frequency range 30 MHz – 1000 MHz are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Antenna polarization (3)	loss of cable between antenna and test receiver (dB) (4)	Antenna factor [dB/m] (5)	Radiated emission [dBµV/m] (6)	Limit [dBµV/m] (7)	Result (8)
31.86	10.6	vertical	4.4	17.9	32.9	40.0	PASS
31.14	8.5	vertical	4.5	17.8	30.8	40.0	PASS
33.48	7.9	vertical	4.5	17.3	29.7	40.0	PASS
34.36	8.3	vertical	4.5	16.8	29.6	40.0	PASS
34.91	7.3	vertical	4.6	16.4	28.3	40.0	PASS
35.01	5.2	vertical	4.6	16.3	26.1	40.0	PASS
-/-	-/-	horizontal	-/-	-/-	-/-	-/-	PASS
All other emissions in the frequency range 30 MHz – 1000 MHz are at least 20 dB below the relevant limit.							

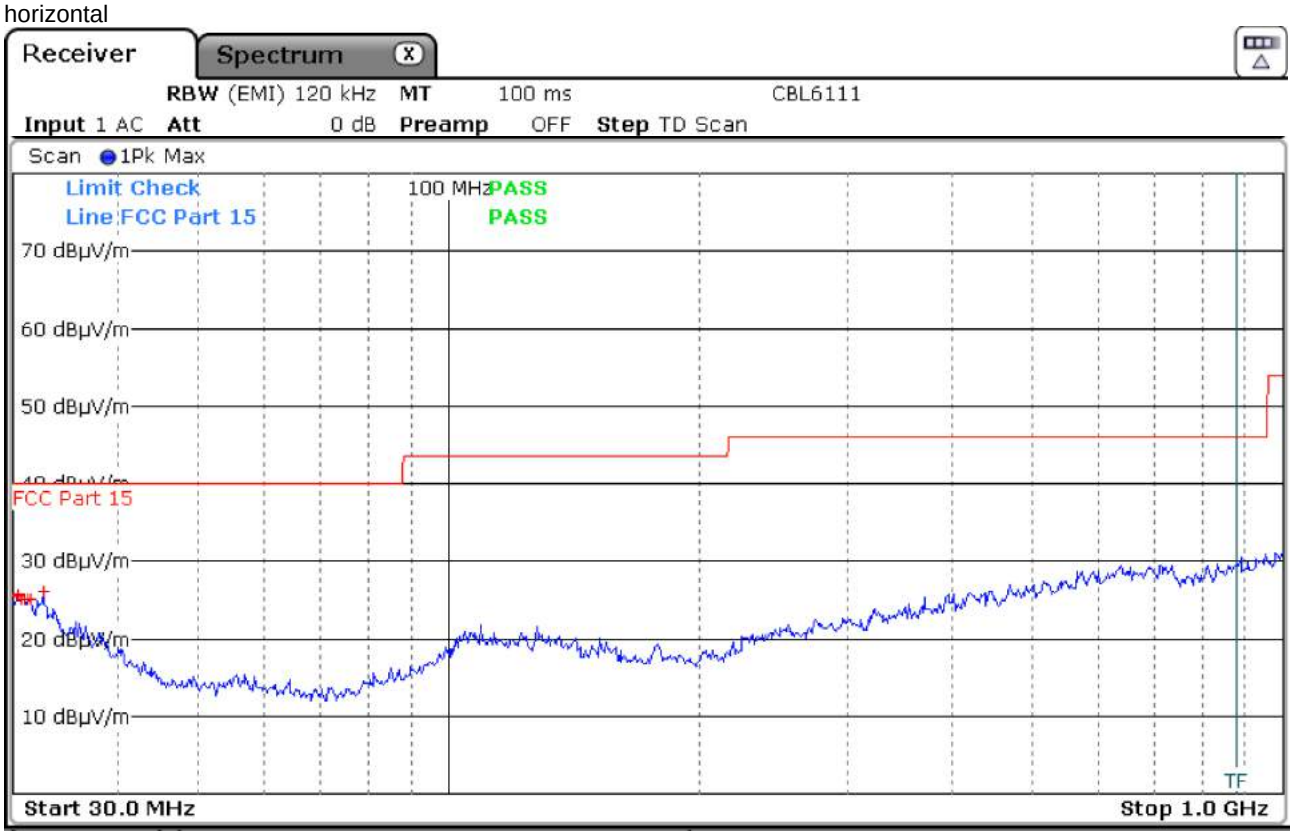
Radiated emission [dBµV/m] (6) = Reading of test receiver [dBµV] (2) + loss of cable between antenna and test receiver (dB) (4) + antenna factor [dB] (5)

(1) = test frequency
(3) = polarization of the test antenna (Horizontal/Vertical)
(7) = relevant limit according to §15.209 Radiated emission limits; general requirements
(8) = comparison between Limit [dBµV/m] (7) and Radiated emission [dBµV/m] (6)

vertical



horizontal



Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

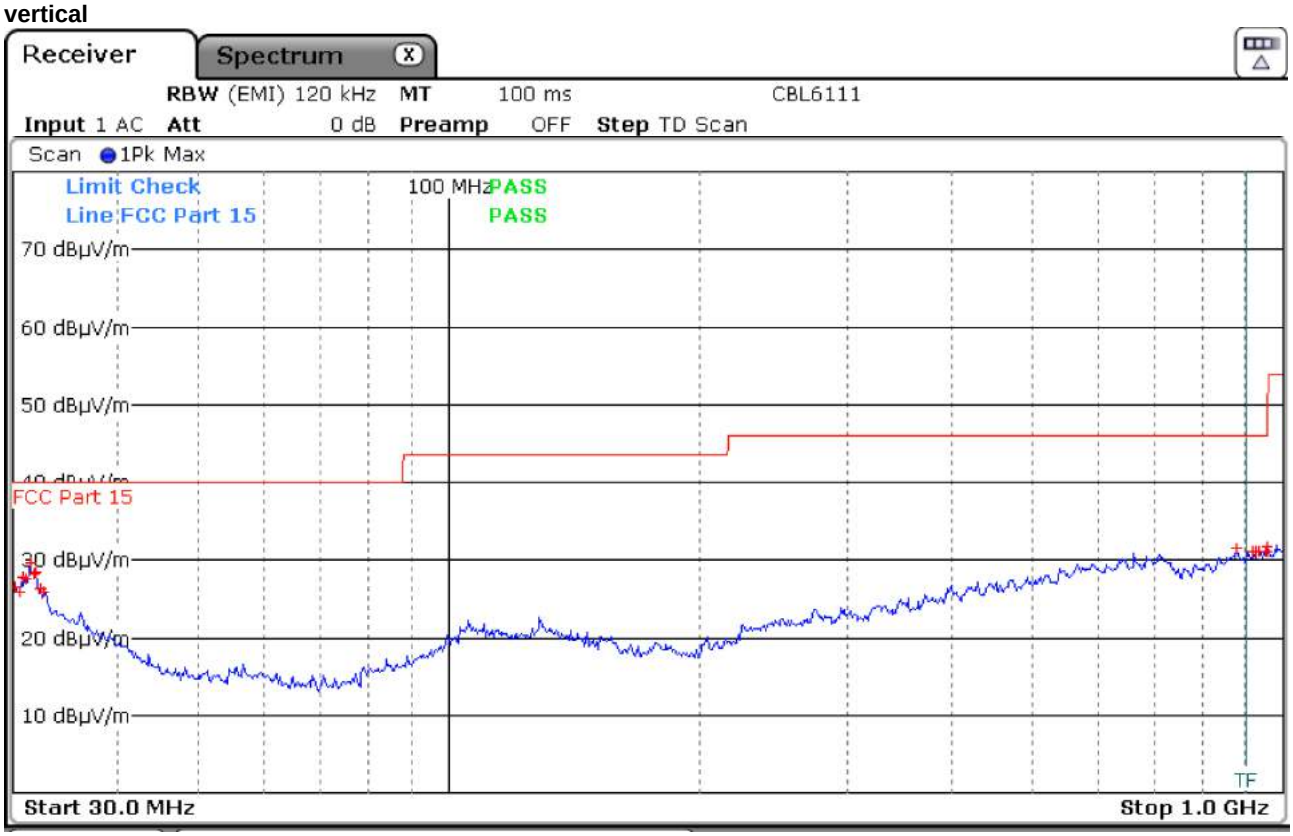
Since all peak values are at least 10 dB below the relevant limit for both models, no further measurements had been performed. The six highest emissions for each polarization (H/V) in frequency range 30 MHz – 1000 MHz are as following:

Frequency [MHz] (1)	Reading of test receiver [dBµV] (2)	Antenna polarization (3)	loss of cable between antenna and test receiver (dB) (4)	Antenna factor [dB/m] (5)	Radiated emission [dBµV/m] (6)	Limit [dBµV/m] (7)	Result (8)
30.09	4.2	vertical	4.4	17.9	26.5	40.0	PASS
30.84	5.5	vertical	4.5	17.8	27.8	40.0	PASS
31.11	5.8	vertical	4.5	17.3	27.6	40.0	PASS
31.44	8.2	vertical	4.5	16.9	29.6	40.0	PASS
31.83	7.2	vertical	4.6	16.5	28.3	40.0	PASS
31.98	7.4	vertical	4.6	16.4	28.4	40.0	PASS
-/-	-/-	horizontal	-/-	-/-	-/-	-/-	PASS
All other emissions in the frequency range 30 MHz – 1000 MHz are at least 10 dB below the relevant limit.							

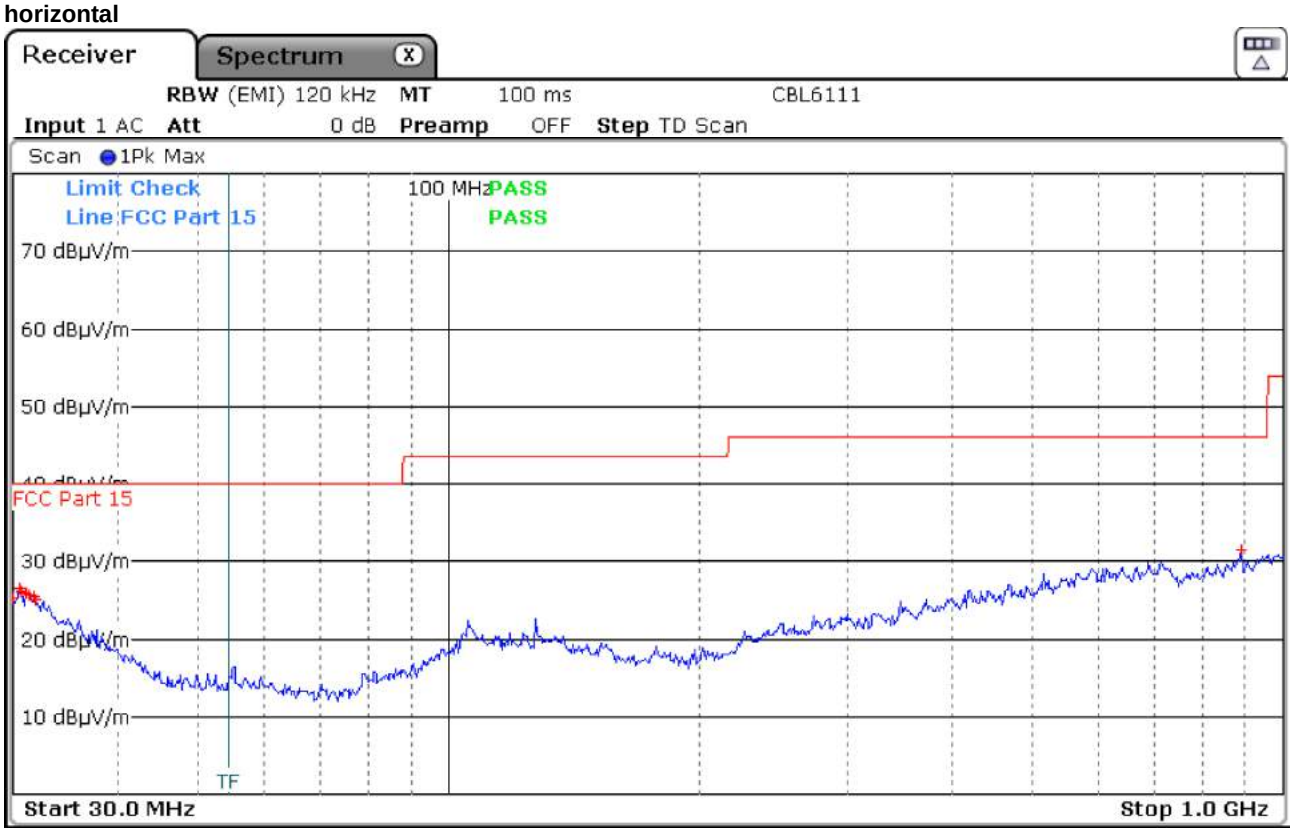
Radiated emission [dBµV/m] (6) = Reading of test receiver [dBµV] (2) + loss of cable between antenna and test receiver (dB) (4) + antenna factor [dB] (5)

(1) = test frequency
(3) = polarization of the test antenna (Horizontal/Vertical)
(7) = relevant limit according to §15.209 Radiated emission limits; general requirements
(8) = comparison between Limit [dBµV/m] (7) and Radiated emission [dBµV/m] (6)

vertical



horizontal



The highest emissions for each polarization (H/V) in frequency range 1 GHz – 24.800 GHz are as following:

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)
Lower Channel 2402MHz

Test Frequency [MHz] (1)	Antenna Polarisation (H/V) (2)	Reading [dBµV] (3)	Corr. [dB/m] (4)	Meas. value [dBµV/m] (5)	Limit [dBµV/m] (6)	Meas. value [µV/m] (7)	Limit [µV/m] (8)	Result (9)
4804	V	41.0	0.5	41.5	54.0	118.9	500	PASS
7206	V	39.9	3.1	43.0	54.0	141.3	500	PASS
9608	V	<38.1	4.7	<42.8	54.0	<138.0	500	PASS
12010	V	<37.2	5.8	<43.0	54.0	<141.3	500	PASS
14412	V	<36.2	6.5	<42.7	54.0	<136.5	500	PASS
16814	V	<36.9	7.1	<44.0	54.0	<158.5	500	PASS
19216	V	<38.1	6.4	<44.5	54.0	<167.9	500	PASS
21618	V	<38.6	7.2	<45.8	54.0	<195.0	500	PASS
24020	V	<38.9	7.6	<46.5	54.0	<211.3	500	PASS
4804	H	48.0	0.5	48.5	54.0	266.1	500	PASS
7206	H	42.8	3.1	45.9	54.0	197.2	500	PASS
9608	H	<38.1	4.7	<42.8	54.0	<138.0	500	PASS
12010	H	<37.2	5.8	<43.0	54.0	<141.3	500	PASS
14412	H	<36.2	6.5	<42.7	54.0	<136.5	500	PASS
16814	H	<36.9	7.1	<44.0	54.0	<158.5	500	PASS
19216	H	<38.1	6.4	<44.5	54.0	<167.9	500	PASS
21618	H	<38.6	7.2	<45.8	54.0	<195.0	500	PASS
24020	H	<38.9	7.6	<46.5	54.0	<211.3	500	PASS

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)
Middle Channel 2440MHz

Test Frequency [MHz] (1)	Antenna Polarisation (H/V) (2)	Reading [dBµV] (3)	Corr. [dB/m] (4)	Meas. value [dBµV/m] (5)	Limit [dBµV/m] (6)	Meas. value [µV/m] (7)	Limit [µV/m] (8)	Result (9)
4880	V	45.9	0.8	46.7	54.0	216.3	500	PASS
7320	V	<39.3	3.2	<42.5	54.0	<133.4	500	PASS
9760	V	<37.8	5.0	<42.8	54.0	<138.0	500	PASS
12200	V	<38.9	5.8	<44.7	54.0	<171.8	500	PASS
14640	V	<36.6	6.4	<43.0	54.0	<141.3	500	PASS
17080	V	<36.9	7.2	<44.1	54.0	<160.3	500	PASS
19520	V	<38.5	6.8	<45.3	54.0	<184.1	500	PASS
21960	V	<38.9	7.4	<46.3	54.0	<206.5	500	PASS
24400	V	<39.5	7.7	<47.2	54.0	<229.1	500	PASS
4880	H	45.2	0.8	46.0	54.0	199.5	500	PASS
7320	H	<39.8	3.2	<43.0	54.0	<141.3	500	PASS
9760	H	<37.5	5.0	<42.5	54.0	<133.4	500	PASS
12200	H	<39.1	5.8	<44.9	54.0	<175.8	500	PASS
14640	H	<36.3	6.4	<42.7	54.0	<136.5	500	PASS
17080	H	<37.6	7.2	<44.8	54.0	<173.8	500	PASS
19520	H	<38.6	6.8	<45.4	54.0	<186.2	500	PASS
21960	H	<39.3	7.4	<46.7	54.0	<216.3	500	PASS
24400	H	<39.8	7.7	<47.5	54.0	<237.1	500	PASS

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)
Upper Channel 2480MHz

Test Frequency [MHz] (1)	Antenna Polarisation (H/V) (2)	Reading [dBµV] (3)	Corr. [dB/m] (4)	Meas. value [dBµV/m] (5)	Limit [dBµV/m] (6)	Meas. value [µV/m] (7)	Limit [µV/m] (8)	Result (9)
4960	V	43.7	1.0	44.7	54.0	171.8	500	PASS
7440	V	<38.1	3.2	<41.3	54.0	<116.1	500	PASS
9920	V	<39.8	5.2	<45.0	54.0	<177.8	500	PASS
12400	V	<39.2	5.7	<44.9	54.0	<175.8	500	PASS
14880	V	<36.3	6.3	<42.6	54.0	<134.9	500	PASS
17360	V	<36.8	7.2	<44.0	54.0	<158.5	500	PASS
19840	V	<38.7	6.9	<45.6	54.0	<190.5	500	PASS
22320	V	<39.0	7.5	<46.5	54.0	<211.3	500	PASS
24800	V	<39.4	7.8	<47.2	54.0	<229.1	500	PASS
4960	H	48.3	1.0	49.3	54.0	291.7	500	PASS
7440	H	<39.3	3.2	<42.5	54.0	<133.4	500	PASS
9920	H	<38.7	5.2	<43.9	54.0	<156.7	500	PASS
12400	H	<39.3	5.7	<45.0	54.0	<177.8	500	PASS
14880	H	<36.7	6.3	<43.0	54.0	<141.3	500	PASS
17360	H	<37.1	7.2	<44.3	54.0	<164.1	500	PASS
19840	H	<38.6	6.9	<45.5	54.0	<188.4	500	PASS
22320	H	<39.1	7.5	<46.6	54.0	<213.8	500	PASS
24800	H	<39.4	7.8	<47.2	54.0	<229.1	500	PASS

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)
Lower Channel 2402MHz

Test Frequency [MHz] (1)	Antenna Polarisation (H/V) (2)	Reading [dBµV] (3)	Corr. [dB/m] (4)	Meas. value [dBµV/m] (5)	Limit [dBµV/m] (6)	Meas. value [µV/m] (7)	Limit [µV/m] (8)	Result (9)
4804	V	43.7	0.5	44.2	54.0	162.2	500	PASS
7206	V	<38.9	3.1	<42.0	54.0	<125.9	500	PASS
9608	V	<38.0	4.7	<42.7	54.0	<136.5	500	PASS
12010	V	<37.4	5.8	<43.2	54.0	<144.5	500	PASS
14412	V	<36.2	6.5	<42.7	54.0	<136.5	500	PASS
16814	V	<36.9	7.1	<44.0	54.0	<158.5	500	PASS
19216	V	<38.1	6.4	<44.5	54.0	<167.9	500	PASS
21618	V	<38.6	7.2	<45.8	54.0	<195.0	500	PASS
24020	V	<38.9	7.6	<46.5	54.0	<211.3	500	PASS
4804	H	44.8	0.5	45.3	54.0	184.1	500	PASS
7206	H	<39.5	3.1	<42.6	54.0	<134.9	500	PASS
9608	H	<41.1	4.7	<45.8	54.0	<195.0	500	PASS
12010	H	<37.2	5.8	<43.0	54.0	<141.3	500	PASS
14412	H	<36.2	6.5	<42.7	54.0	<136.5	500	PASS
16814	H	<36.9	7.1	<44.0	54.0	<158.5	500	PASS
19216	H	<38.1	6.4	<44.5	54.0	<167.9	500	PASS
21618	H	<38.6	7.2	<45.8	54.0	<195.0	500	PASS
24020	H	<38.9	7.6	<46.5	54.0	<211.3	500	PASS

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)
Middle Channel 2440MHz

Test Frequency [MHz] (1)	Antenna Polarisation (H/V) (2)	Reading [dBµV] (3)	Corr. [dB/m] (4)	Meas. value [dBµV/m] (5)	Limit [dBµV/m] (6)	Meas. value [µV/m] (7)	Limit [µV/m] (8)	Result (9)
4880	V	46.1	0.8	46.9	54.0	221.3	500	PASS
7320	V	44.0	3.2	47.2	54.0	229.1	500	PASS
9760	V	39.7	5.0	44.7	54.0	171.8	500	PASS
12200	V	<40.0	5.8	<45.8	54.0	<195.0	500	PASS
14640	V	<36.6	6.4	<43.0	54.0	<141.3	500	PASS
17080	V	<36.9	7.2	<44.1	54.0	<160.3	500	PASS
19520	V	<38.5	6.8	<45.3	54.0	<184.1	500	PASS
21960	V	<38.9	7.4	<46.3	54.0	<206.5	500	PASS
24400	V	<39.5	7.7	<47.2	54.0	<229.1	500	PASS
4880	H	43.5	0.8	44.3	54.0	164.1	500	PASS
7320	H	46.0	3.2	49.2	54.0	288.4	500	PASS
9760	H	43.5	5.0	48.5	54.0	266.1	500	PASS
12200	H	<40.8	5.8	<46.6	54.0	<213.8	500	PASS
14640	H	<36.3	6.4	<42.7	54.0	<136.5	500	PASS
17080	H	<37.6	7.2	<44.8	54.0	<173.8	500	PASS
19520	H	<38.6	6.8	<45.4	54.0	<186.2	500	PASS
21960	H	<39.3	7.4	<46.7	54.0	<216.3	500	PASS
24400	H	<39.8	7.7	<47.5	54.0	<237.1	500	PASS

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)
Upper Channel 2480MHz

Test Frequency [MHz] (1)	Antenna Polarisation (H/V) (2)	Reading [dBµV] (3)	Corr. [dB/m] (4)	Meas. value [dBµV/m] (5)	Limit [dBµV/m] (6)	Meas. value [µV/m] (7)	Limit [µV/m] (8)	Result (9)
4960	V	46.7	1.0	47.7	54.0	242.7	500	PASS
7440	V	48.7	3.2	51.9	54.0	393.6	500	PASS
9920	V	40.5	5.2	45.7	54.0	192.8	500	PASS
12400	V	<38.8	5.7	<44.5	54.0	<167.9	500	PASS
14880	V	<36.3	6.3	<42.6	54.0	<134.9	500	PASS
17360	V	<36.8	7.2	<44.0	54.0	<158.5	500	PASS
19840	V	<38.7	6.9	<45.6	54.0	<190.5	500	PASS
22320	V	<39.0	7.5	<46.5	54.0	<211.3	500	PASS
24800	V	<39.4	7.8	<47.2	54.0	<229.1	500	PASS
4960	H	49.8	1.0	50.8	54.0	346.7	500	PASS
7440	H	44.9	3.2	48.1	54.0	254.1	500	PASS
9920	H	39.8	5.2	45.0	54.0	177.8	500	PASS
12400	H	<39.4	5.7	<45.1	54.0	<179.9	500	PASS
14880	H	<36.7	6.3	<43.0	54.0	<141.3	500	PASS
17360	H	<37.1	7.2	<44.3	54.0	<164.1	500	PASS
19840	H	<38.6	6.9	<45.5	54.0	<188.4	500	PASS
22320	H	<39.1	7.5	<46.6	54.0	<213.8	500	PASS
24800	H	<39.4	7.8	<47.2	54.0	<229.1	500	PASS

Measured value [dBµV/m] (5) = Reading of test receiver [dBµV] (3) + correction factor (dB) (4) (loss of cable between antenna and test receiver + antenna factor)

(1) = test frequency
(2) = polarization of the test antenna (Horizontal/Vertical)
(6) = relevant limit [dBµV/m]
(7) = Measured value [µV/m] =10^[(Measured value [dBµV/m] (5) /20)]
(8) = relevant limit [µV/m]
(9) = comparison between Limit [µV/m] (7) and Radiated emission [µV/m] (7)

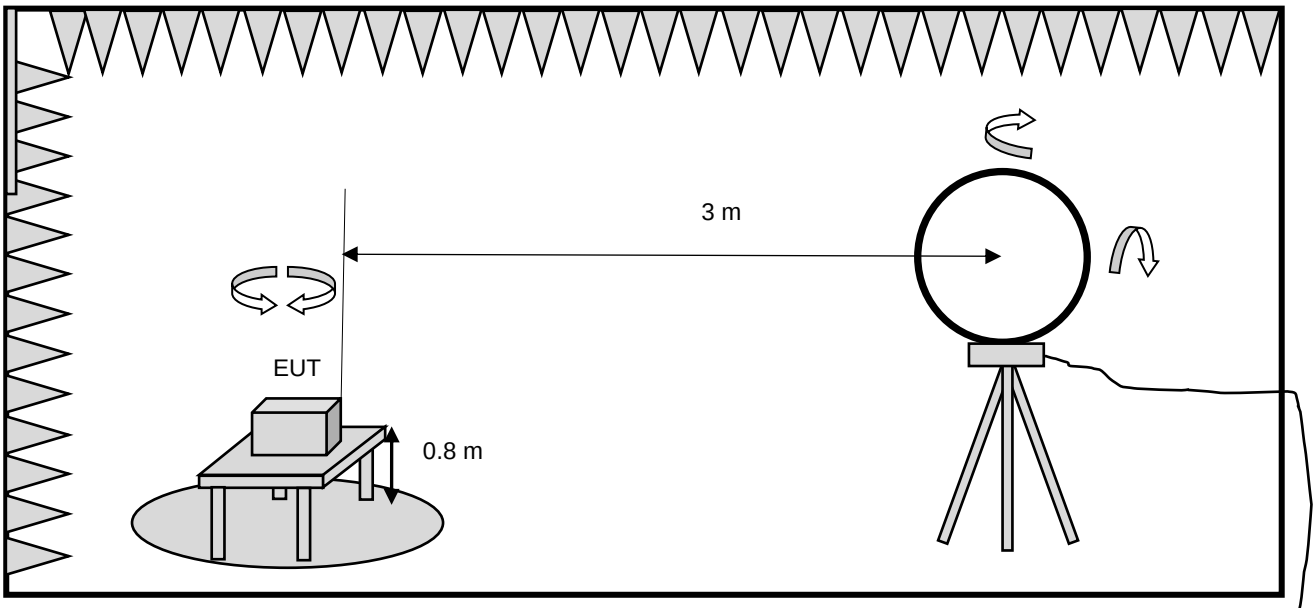
Results
From the measurement data obtained, the tested samples were considered to have **COMPLIED** with the requirements for the radiated emission measurements.

Test equipment used:

Kind of equipment	Manufacturer	Type	PKM-ident no.	Serial no.	Calibrated on (y-m-d)	Calibration interval
Signal Spectrum Analyzer 2Hz - 26,5 GHz	Rohde & Schwarz	FSW 26 Instrument FW 2.60	11571	102047	2017-12-13 2019-01-17	1 year
EMI-Test-Receiver	Rohde & Schwarz	ESR7 Instrument FW 3.36	11676	101694	2018-03-26	3 years
Software	PKM	PKM IT 5/6	-/-	V1.03.04	-/-	-/-
Antenna 9 kHz – 30 MHz	EMCO	6502	10546	2018	2017-11-03	3 years
Antenna	Chase	CBL6111C	10022	1064	2017-01-30	3 years
Antenna 1GHz – 18 GHz	Electro Metric	RGA50/60	10273	2753	2017-11-06	3 years
Broadband-Hornantenne 15 - 26,5 (40) GHz	Schwarzbeck	BBHA 9170	11580	BBHA9170621	2017-01-27	3 years
Broadband-Preamplifier 1-18 GHz	Schwarzbeck	BBV9718	11231	9718-002	2017-10-09	3 year
Preamplifier 18 - 40 GHz	CERNEX	CBM18403523	11679	29711	2018-05-07	1 year
Cable	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2017-12-07	3 years
Shielded room/Chamber	Frankonia	SAC3 "SEMI-ANECHOIC-CHAMBER"	11609	004/16	2016-03-23	3 years

All measurements were made with measuring instruments, including any accessories that may affect test results, calibrated according to the requests of ISO/IEC 17025 according to which the test site is accredited from DAkkS. Measurement of radiated emissions was made with instruments conforming to American National Standard Specification, ANSI C63.10-2013.

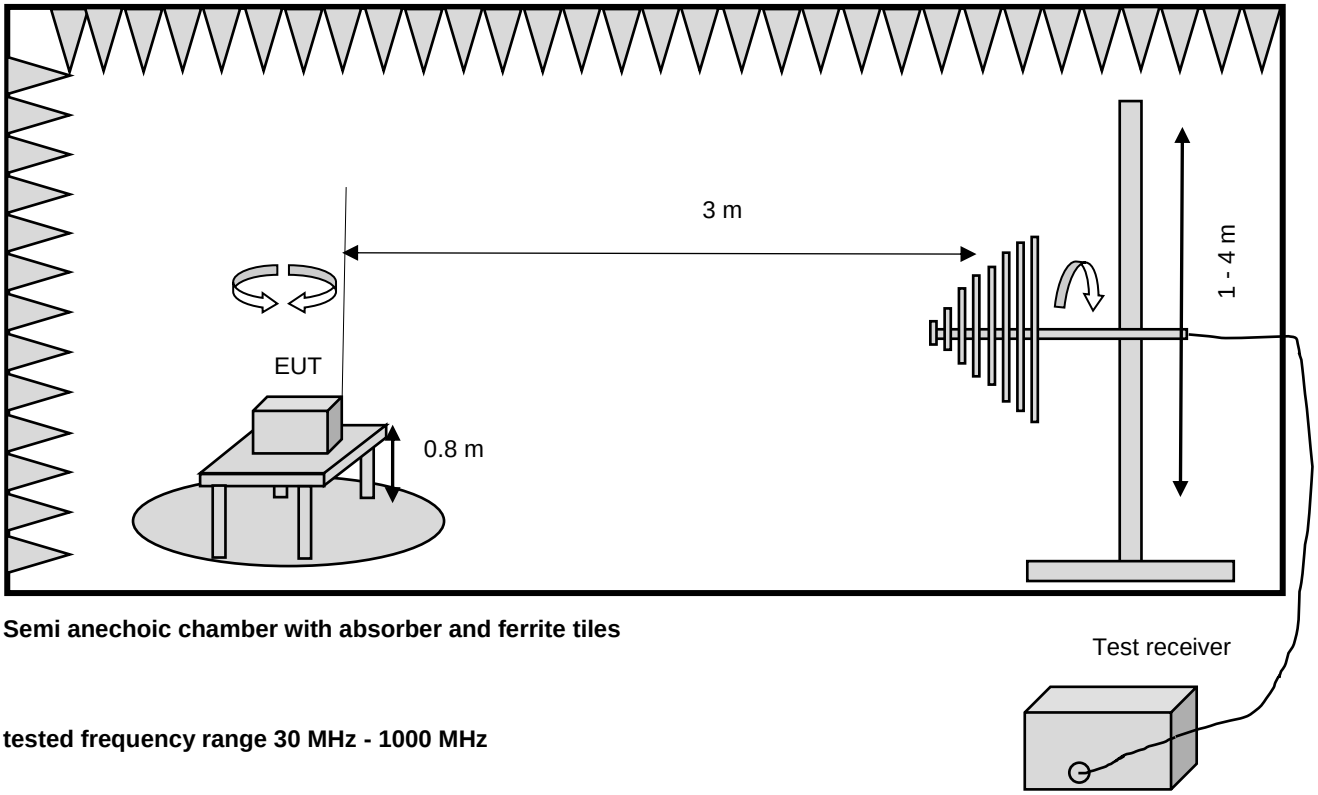
Block diagram Radiated emissions



Semi anechoic chamber with absorber and ferrite tiles

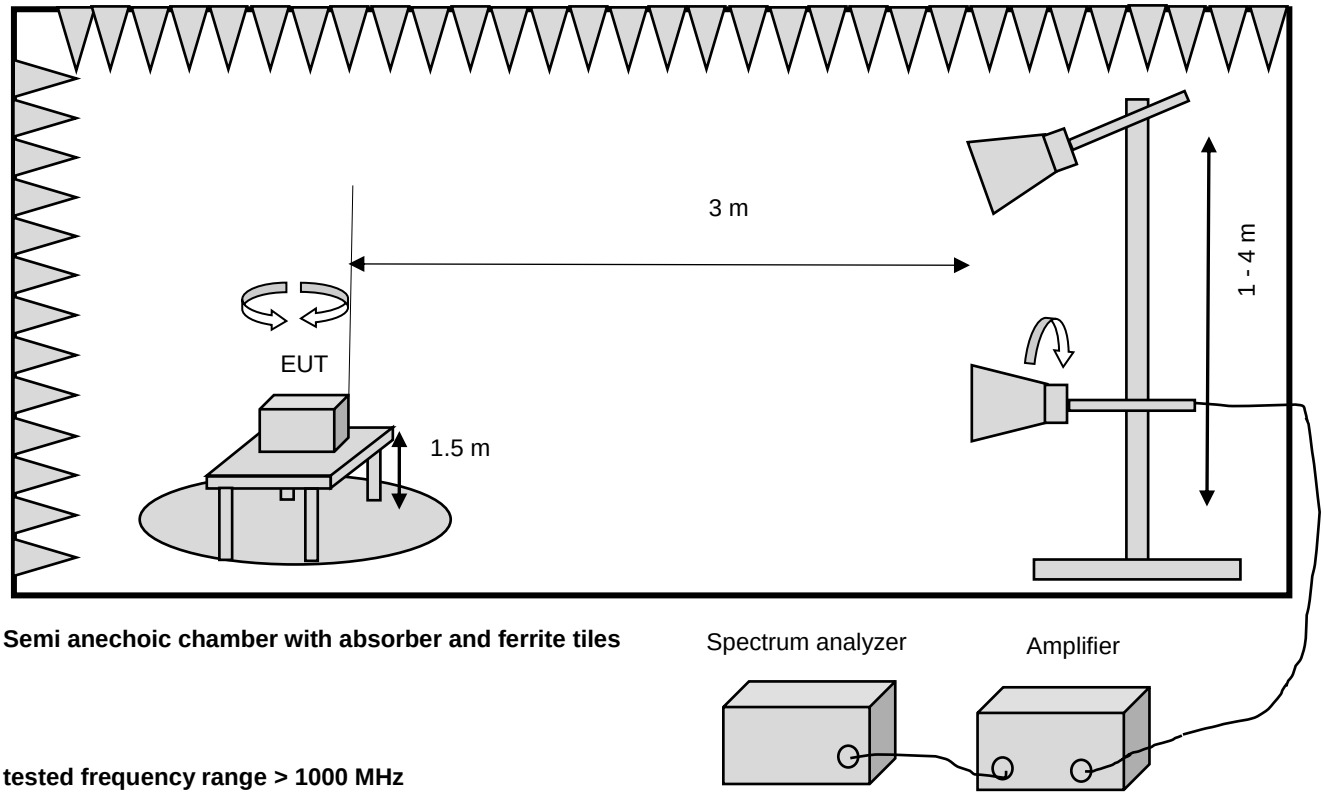
Test receiver

tested frequency range 9 kHz - 30 MHz



Semi anechoic chamber with absorber and ferrite tiles

tested frequency range 30 MHz - 1000 MHz



Semi anechoic chamber with absorber and ferrite tiles

tested frequency range > 1000 MHz

Measurement uncertainty

according to *CISPR 16-4-2 Edition 2.0 2011-06*

Measurement	**calculated uncertainty U_{lab}**	**Specified CISPR uncertainty according CISPR 16-4-2 Edition 2.0 2011-06, table 1 U_{CISPR}**
Radiated disturbance (electric field strength in the SAC) 30 MHz to 1 000 MHz	4,7 dB	6,3 dB
Radiated disturbance (electric field strength in the SAC) 1 GHz to 26.5 GHz	4.1 dB	-/-

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT in the above mentioned way.

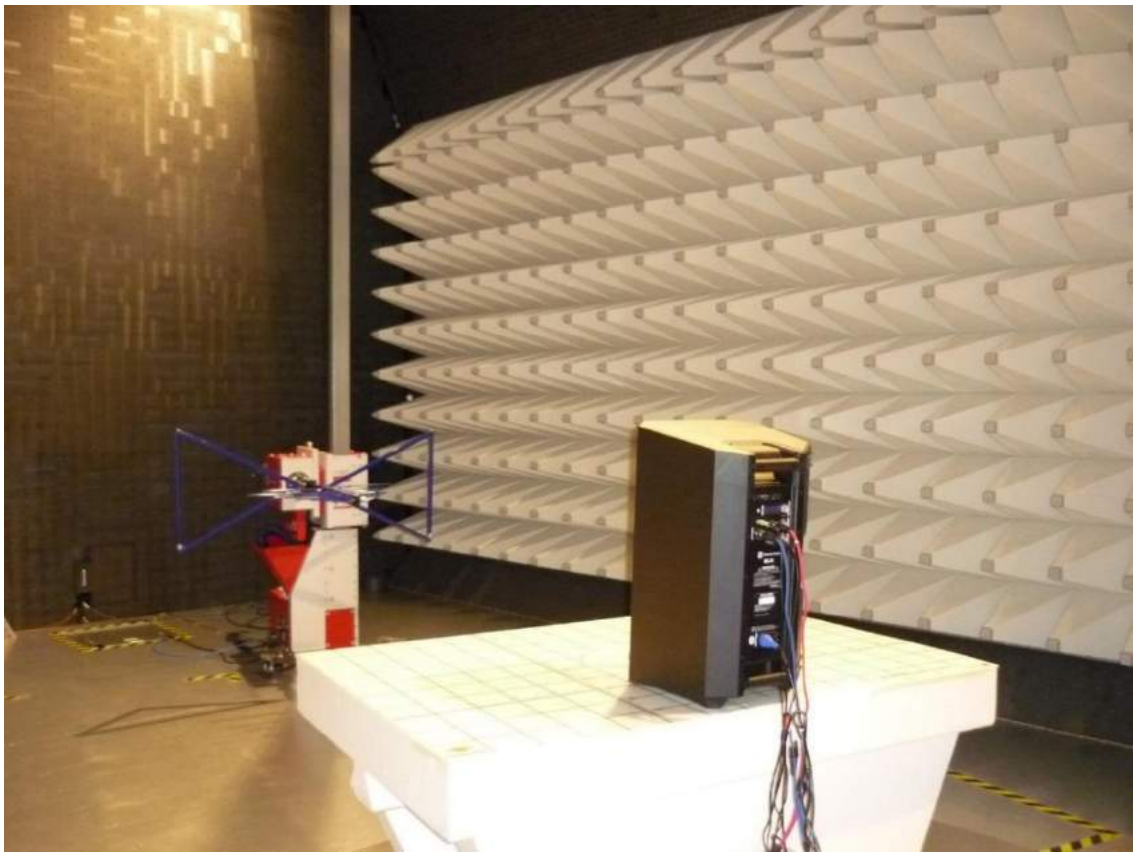
The measurements uncertainty was calculated in accordance with CISPR 16-4-2 Edition 2.0 2011-06.

The measurement uncertainty was given with a confidence of 95 % (k = 2).

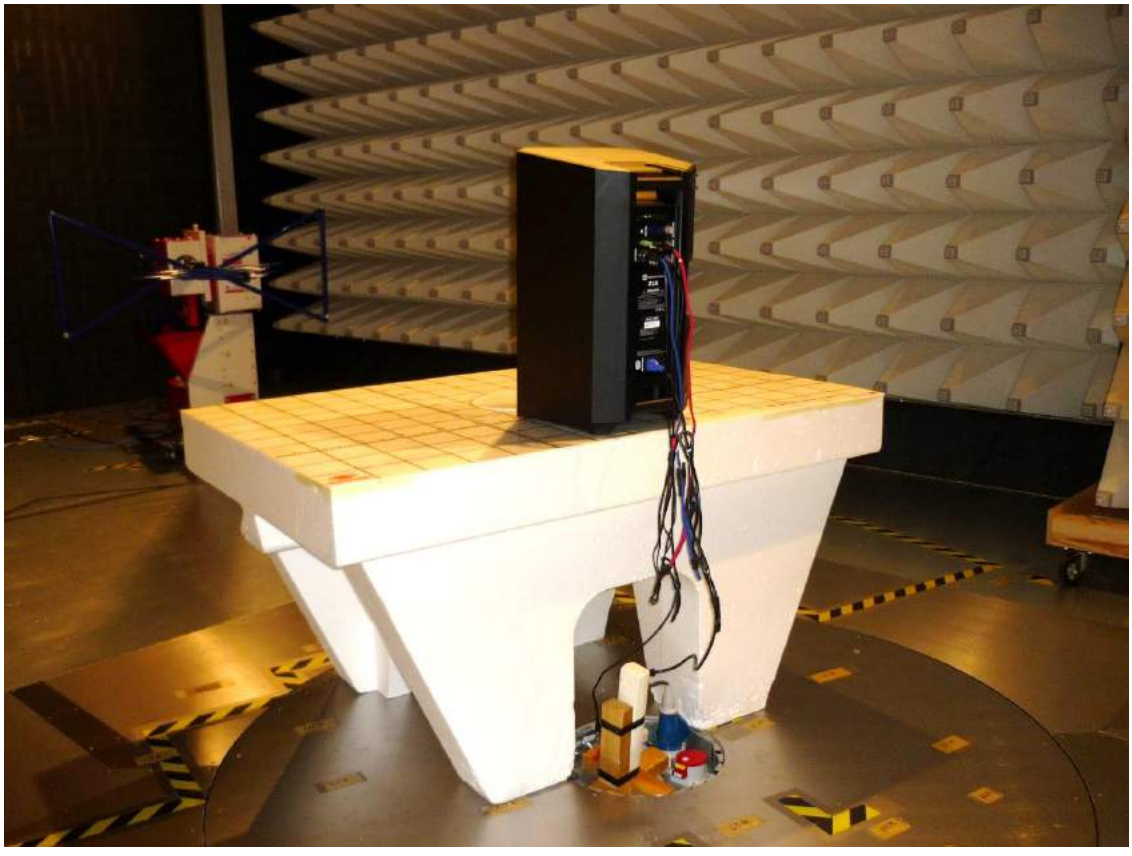
Photo(s) of test setup

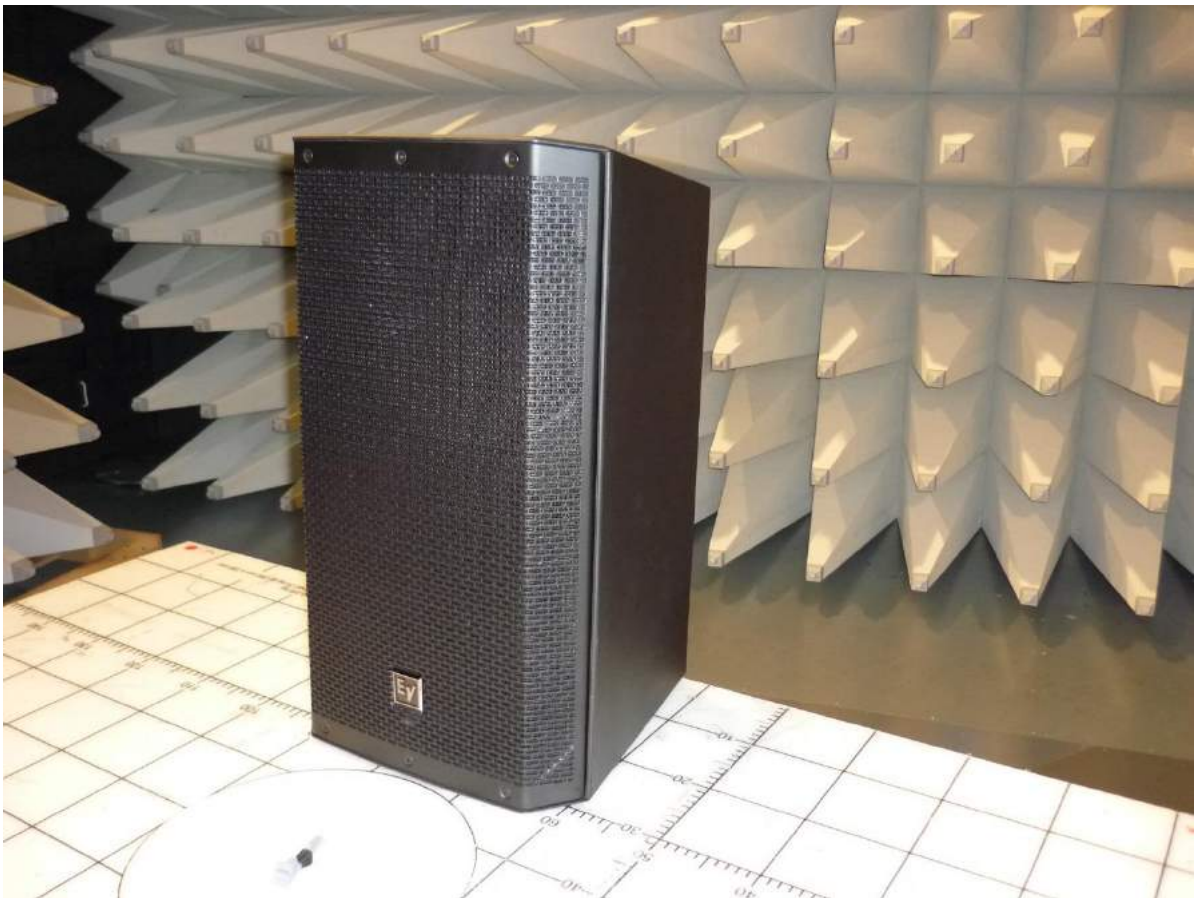
Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

tested frequency range 9 kHz - 30 MHz

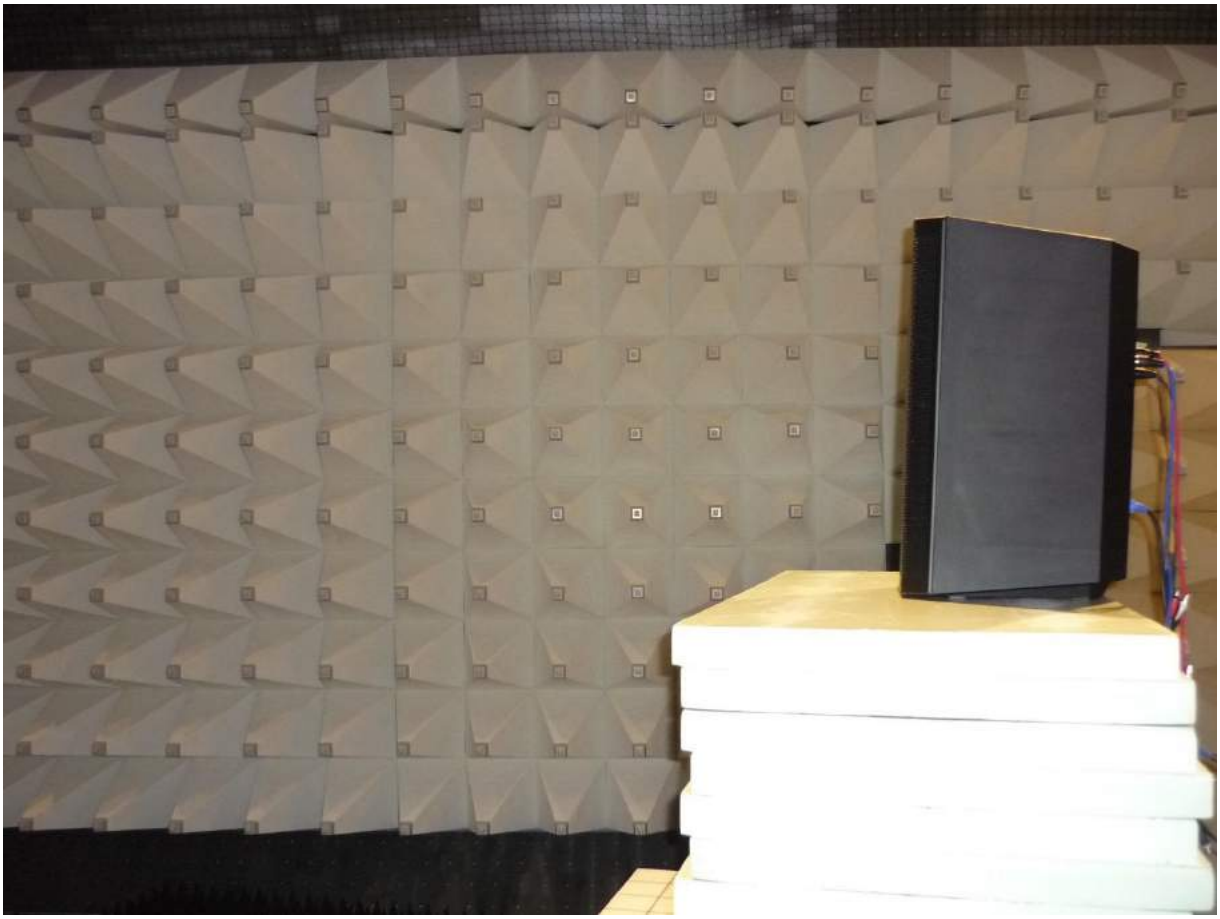


tested frequency range 30 MHz – 1000 MHz



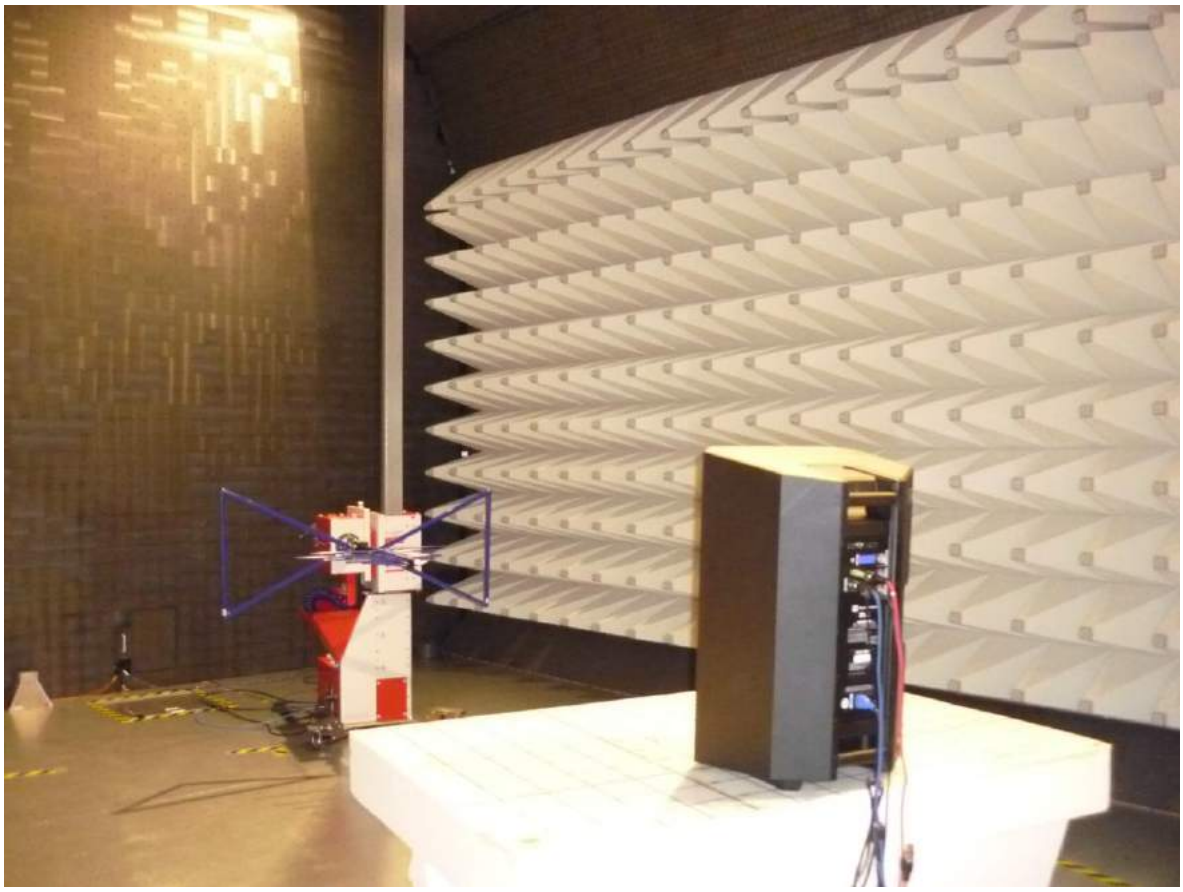


tested frequency range >1000 MHz

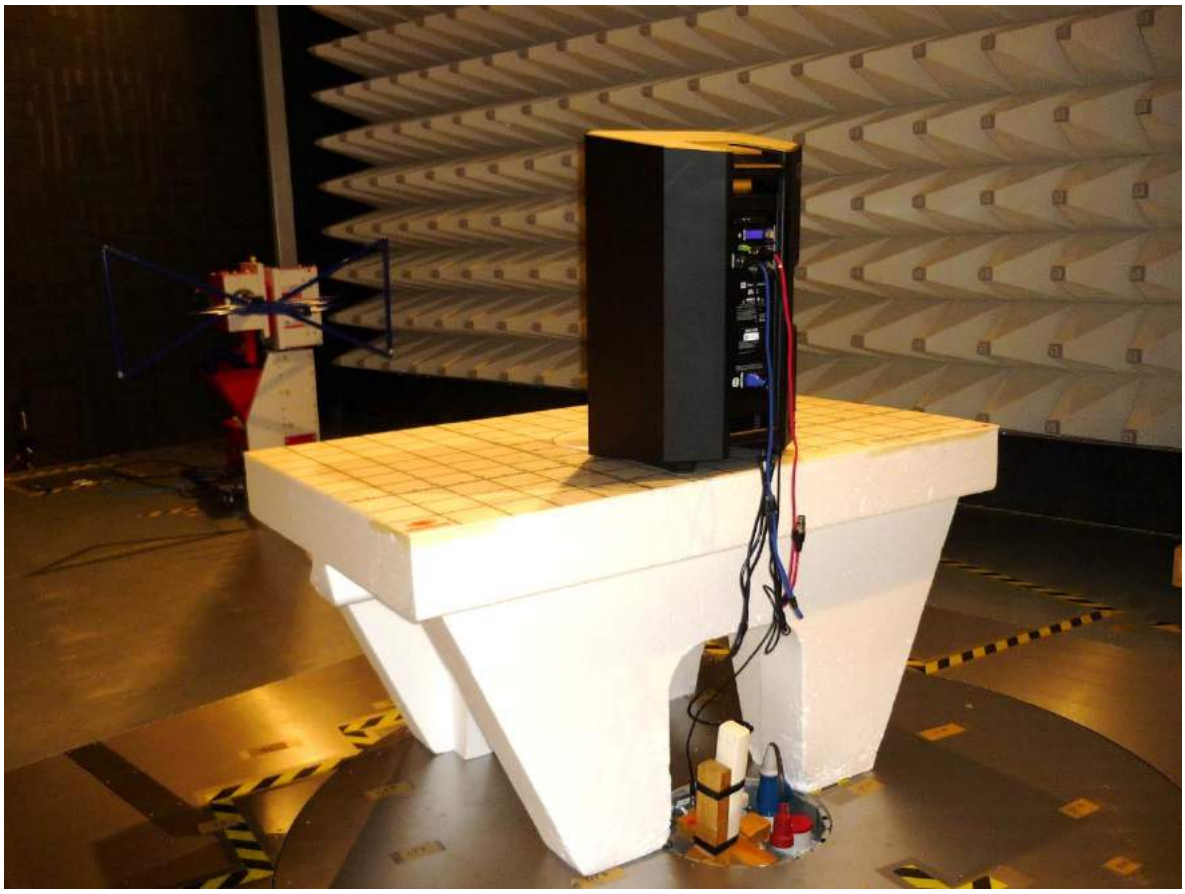


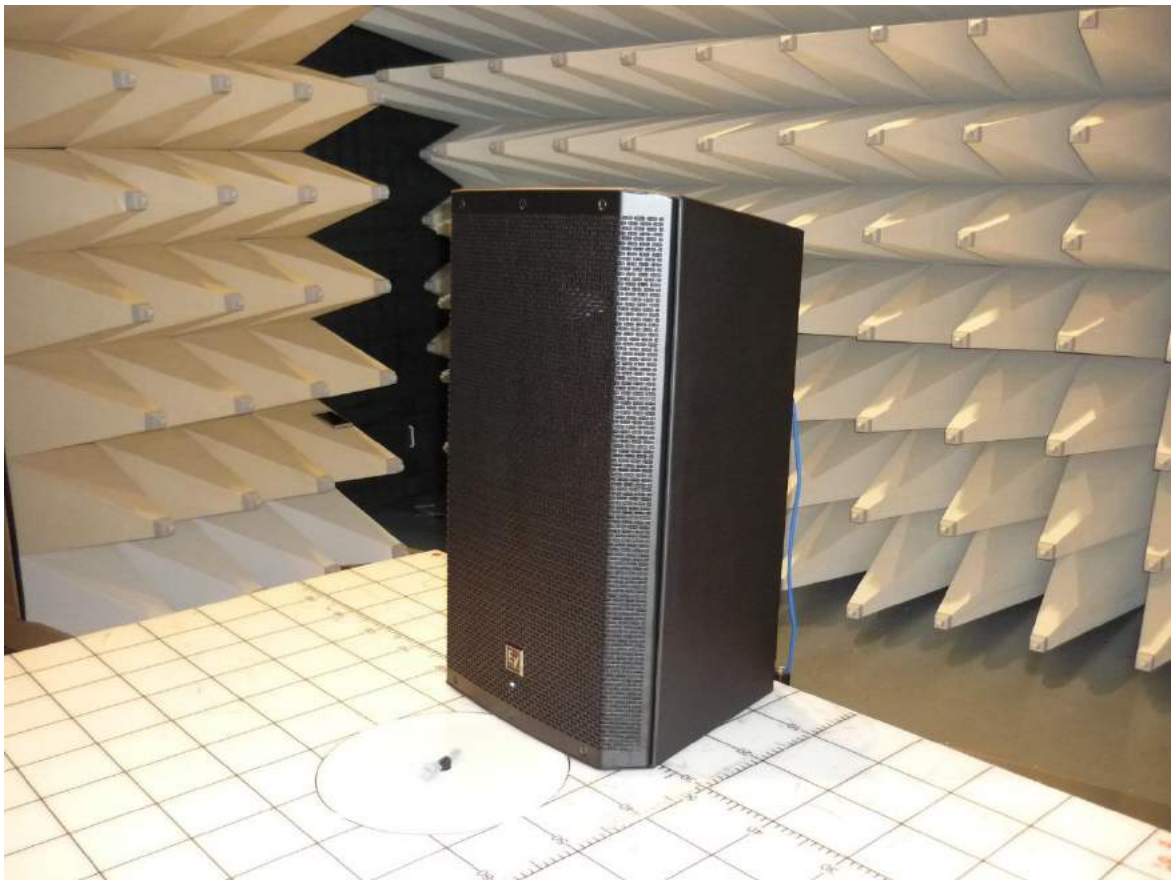
Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

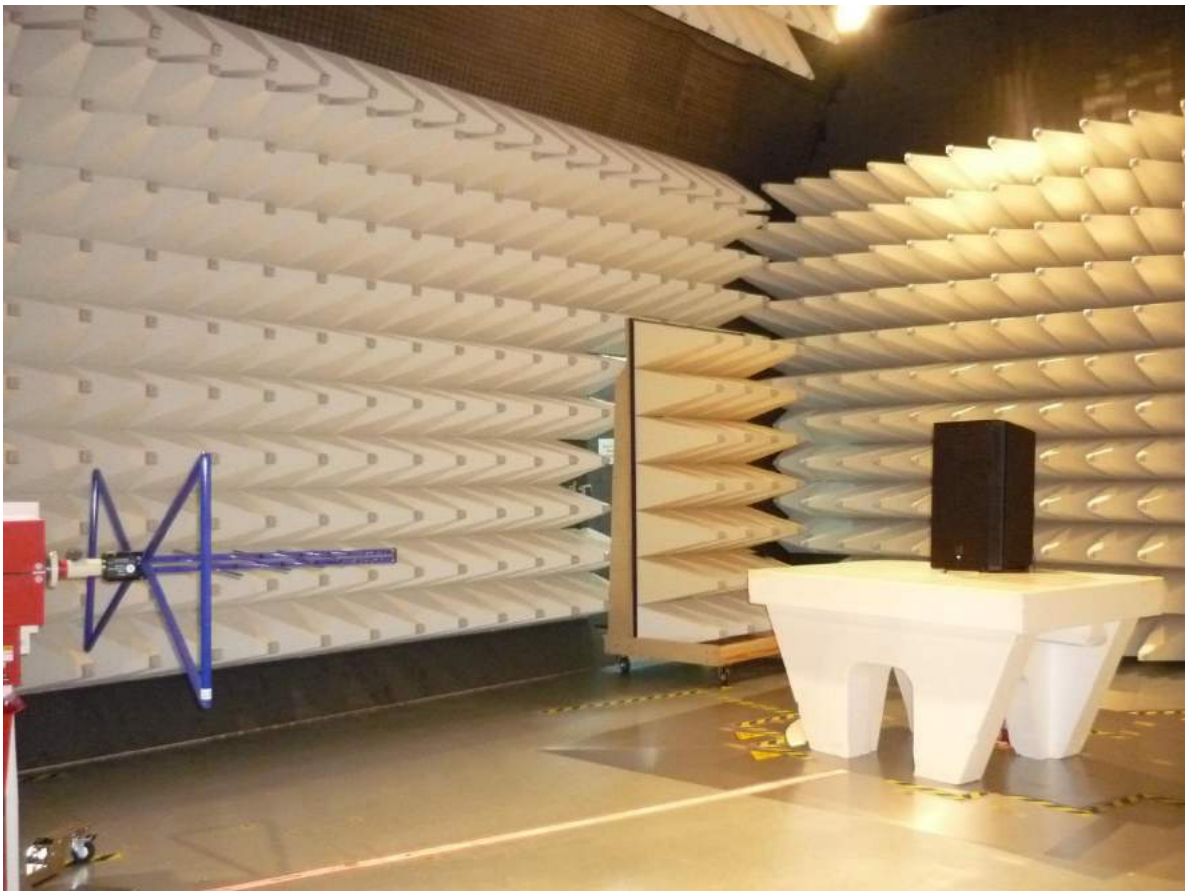
tested frequency range 9 kHz - 30 MHz

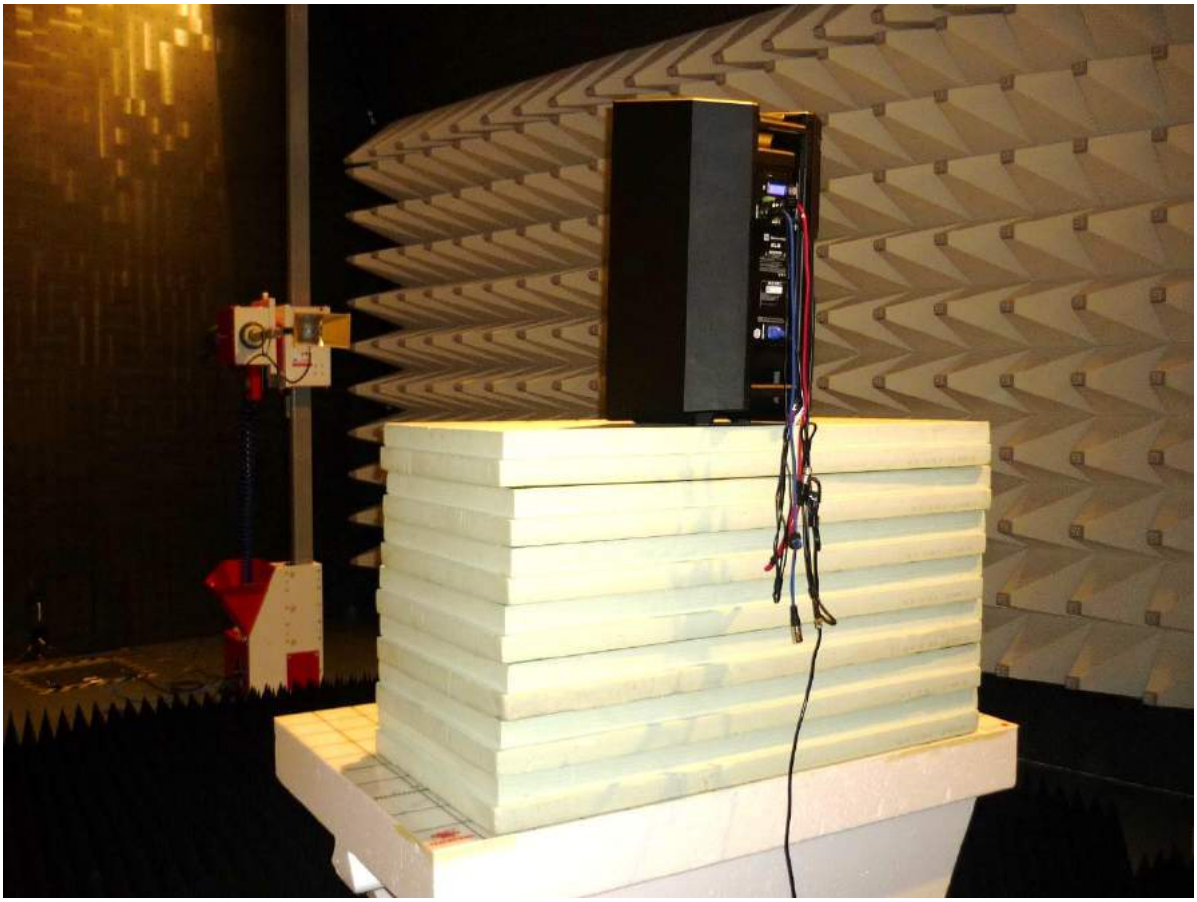


tested frequency range 30 MHz – 1000 MHz









tested frequency range >1000 MHz

8. Additional provisions to the general radiated emission limitations §15.215

The additional provisions to the general radiated emission limitations are fulfilled.

9. Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz §15.247.

The measurements for Version ZLX-12BT and ZLX-15BT had been performed on:
20 dB/99 % Bandwidth: Mar 14, 2019.
hopping channel carrier frequencies separation: Mar 18, 2019, Apr 02, 2019
hopping channel frequencies: June 11, 2018
Time of Occupancy (Dwell Time): Mar 15,2019
Maximum peak conducted output power: Mar 19, 2019
Conducted RF band edge emissions: Oct 25, 2018
Spurious emission: Mar 19,2019

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

The separation is 1 MHz, which is within the two-thirds of the 20 dB bandwidth (0.677 MHz) of the hopping channel and the 20 dB bandwidth (1.016 MHz) of the hopping channel.

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

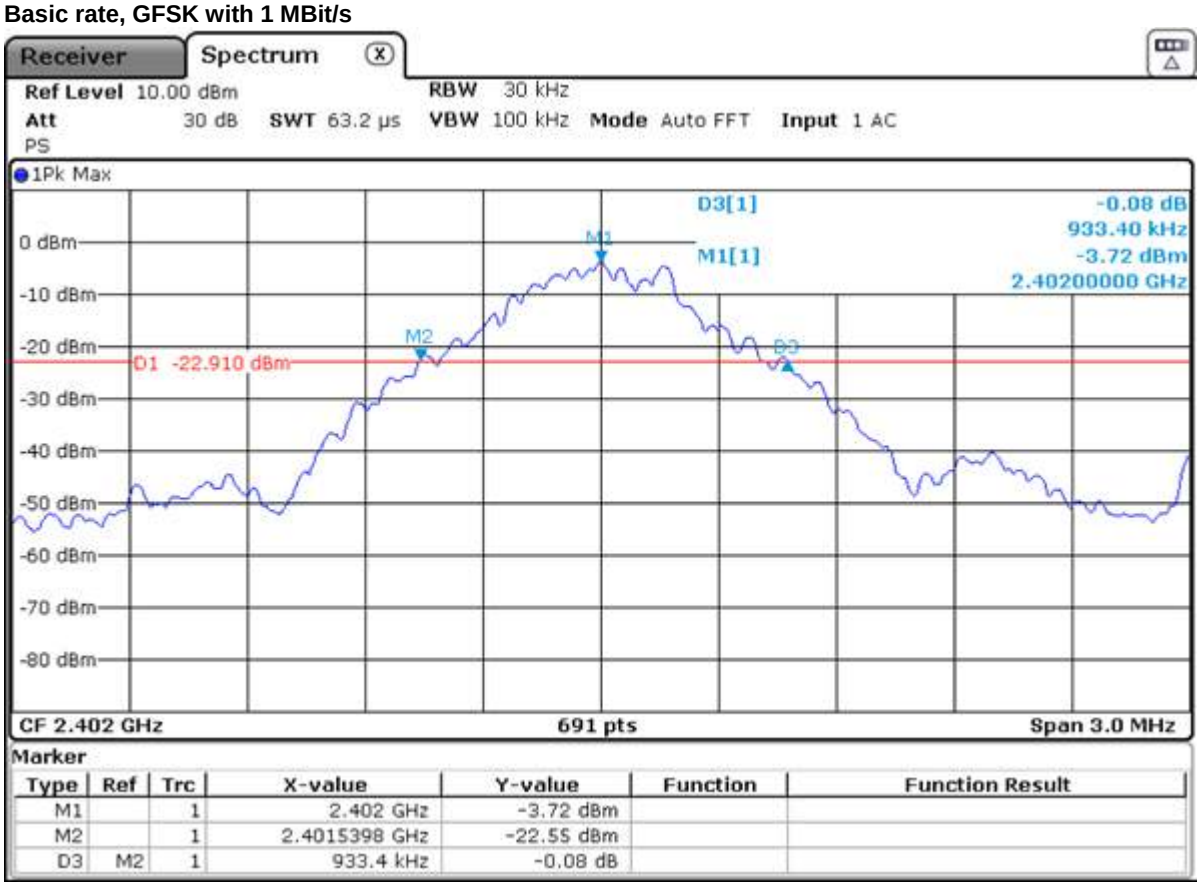
Operating frequency [MHz]	Modulation /Data rate	20 dB bandwidth [MHz]	99 % bandwidth [MHz]	channel separation [MHz]	Channel separation limit (two-thirds of the 20 dB bandwidth)/ 20 dB bandwidth [MHz]	Result
2402	Basic rate, GFSK with 1 MBit/s	0.9334	0.8683	1000	>0.9334 (20 dB bandwidth)	PASS
2441	Basic rate, GFSK with 1 MBit/s	0.9421	0.8596	1000	>0.9421 (20 dB bandwidth)	PASS
2480	Basic rate, GFSK with 1 MBit/s	0.9465	0.8640	1000	>0.9465 (20 dB bandwidth)	PASS
2402	EDR, π/4-DQPSK with 2 MBit/s	1.2373	1.1852	1000	>0.8249 (two-thirds of the 20 dB bandwidth)	PASS
2441	EDR, π/4-DQPSK with 2 MBit/s	1.2547	1.1852	1000	>0.8365 (two-thirds of the 20 dB bandwidth)	PASS
2480	EDR, π/4-DQPSK with 2 MBit/s	1.2504	1.1896	1000	>0.8336 (two-thirds of the 20 dB bandwidth)	PASS
2402	EDR, 8-DPSK with 3 MBit/s	1.2547	1.1679	1000	>0.8365 (two-thirds of the 20 dB bandwidth)	PASS
2441	EDR, 8-DPSK with 3 MBit/s	1.2634	1.1809	1000	>0.8423 (two-thirds of the 20 dB bandwidth)	PASS
2480	EDR, 8-DPSK with 3 MBit/s	1.2547	1.1852	1000	>0.8365 (two-thirds of the 20 dB bandwidth)	PASS

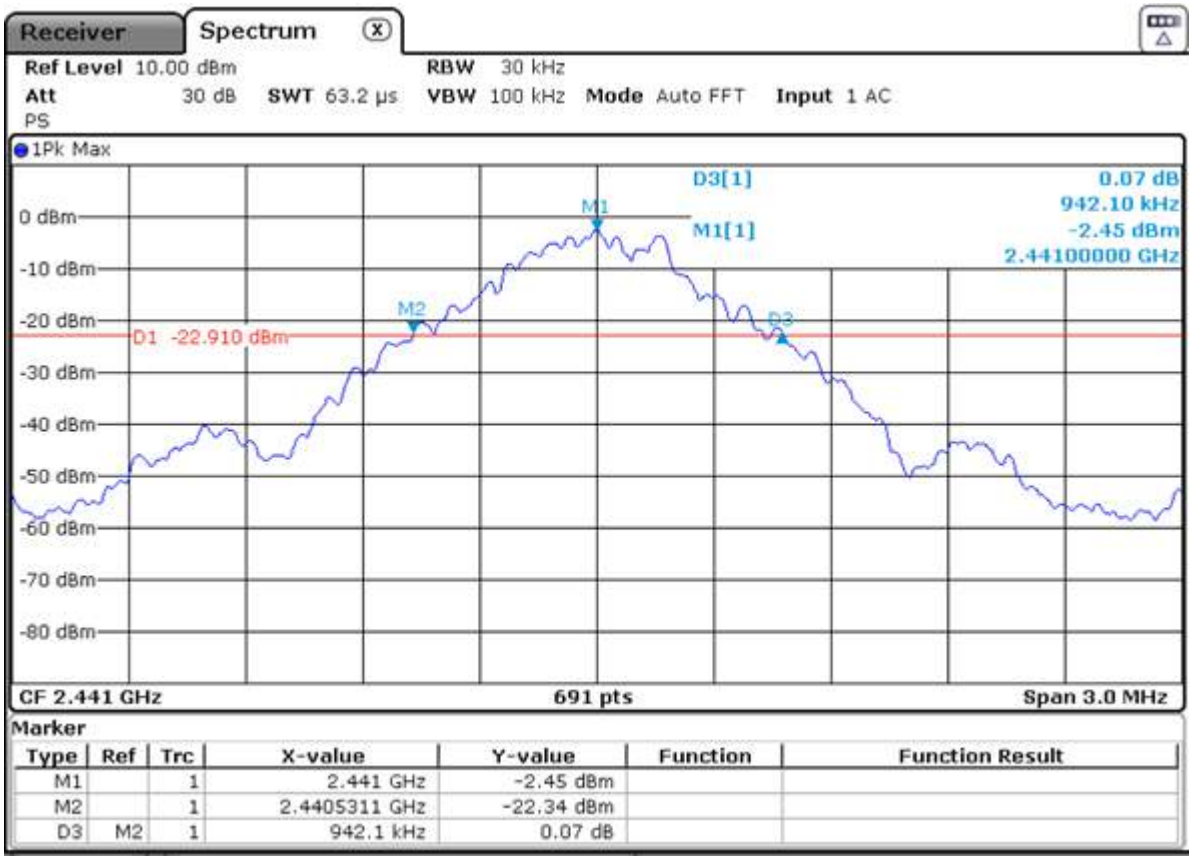
Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

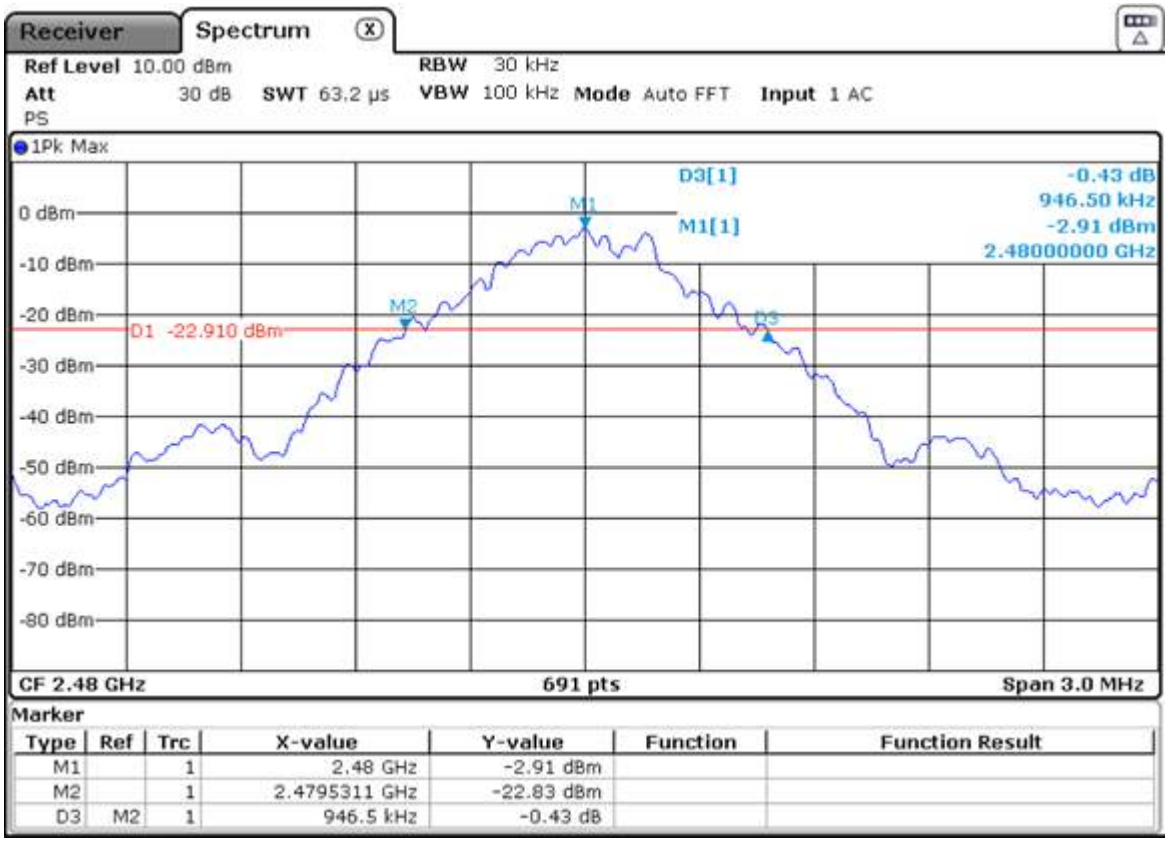
Operating frequency [MHz]	Modulation /Data rate	20 dB bandwidth [MHz]	99 % bandwidth [MHz]	channel separation [MHz]	Channel separation limit (two-thirds of the 20 dB bandwidth) [MHz]	Result
2402	Basic rate, GFSK with 1 MBit/s	0.9030	0.8683	1000	>0.9030 (20 dB bandwidth)	PASS
2441	Basic rate, GFSK with 1 MBit/s	0.9204	0.8640	1000	>0.9204 (20 dB bandwidth)	PASS
2480	Basic rate, GFSK with 1 MBit/s	0.9161	0.8596	1000	>0.9161 (20 dB bandwidth)	PASS
2402	EDR, π/4-DQPSK with 2 MBit/s	1.2677	1.1809	1000	>0.8451 (two-thirds of the 20 dB bandwidth)	PASS
2441	EDR, π/4-DQPSK with 2 MBit/s	1.2417	1.1896	1000	>0.8278 (two-thirds of the 20 dB bandwidth)	PASS
2480	EDR, π/4-DQPSK with 2 MBit/s	1.2460	1.2113	1000	>0.8307 (two-thirds of the 20 dB bandwidth)	PASS
2402	EDR, 8-DPSK with 3 MBit/s	1.2547	1.1679	1000	>0.8365 (two-thirds of the 20 dB bandwidth)	PASS
2441	EDR, 8-DPSK with 3 MBit/s	1.2590	1.1896	1000	>0.8393 (two-thirds of the 20 dB bandwidth)	PASS
2480	EDR, 8-DPSK with 3 MBit/s	1.2634	1.2026	1000	>0.8423 (two-thirds of the 20 dB bandwidth)	PASS

a) 20 dB bandwidth:
Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

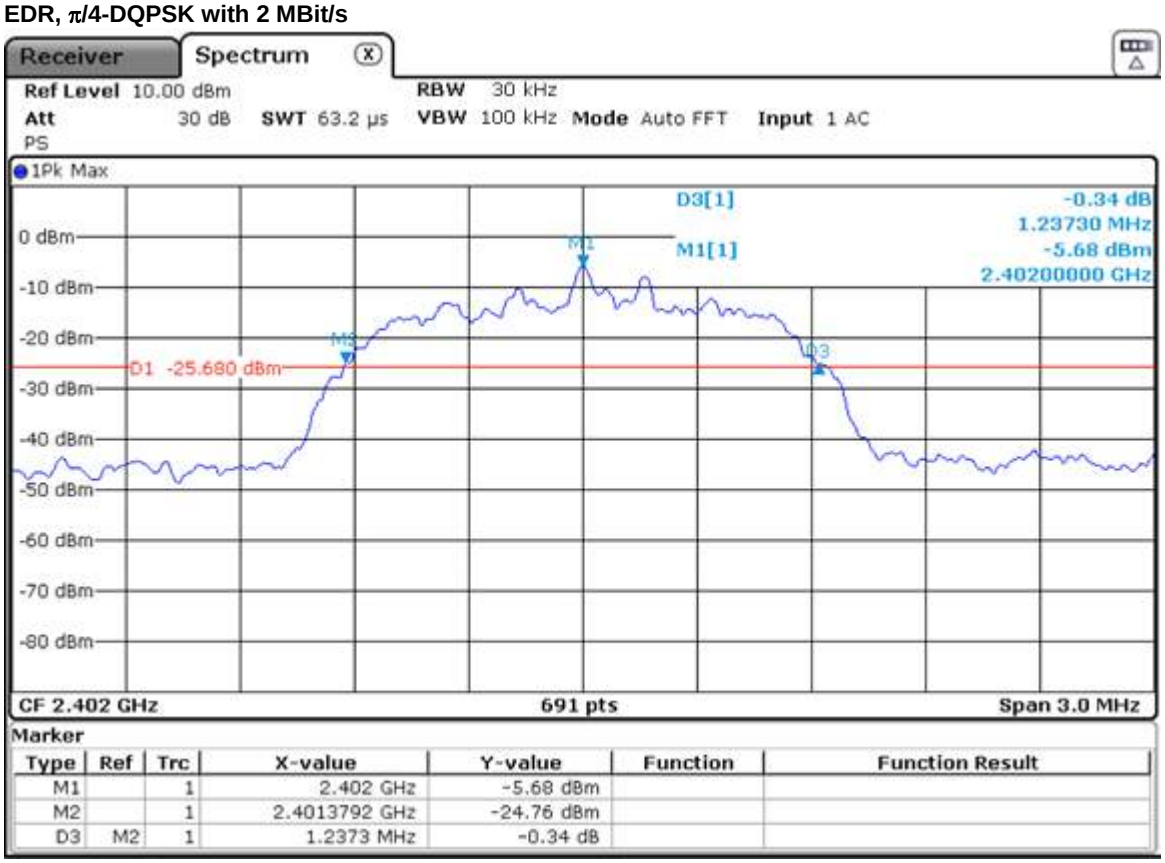
Basic rate, GFSK with 1 MBit/s

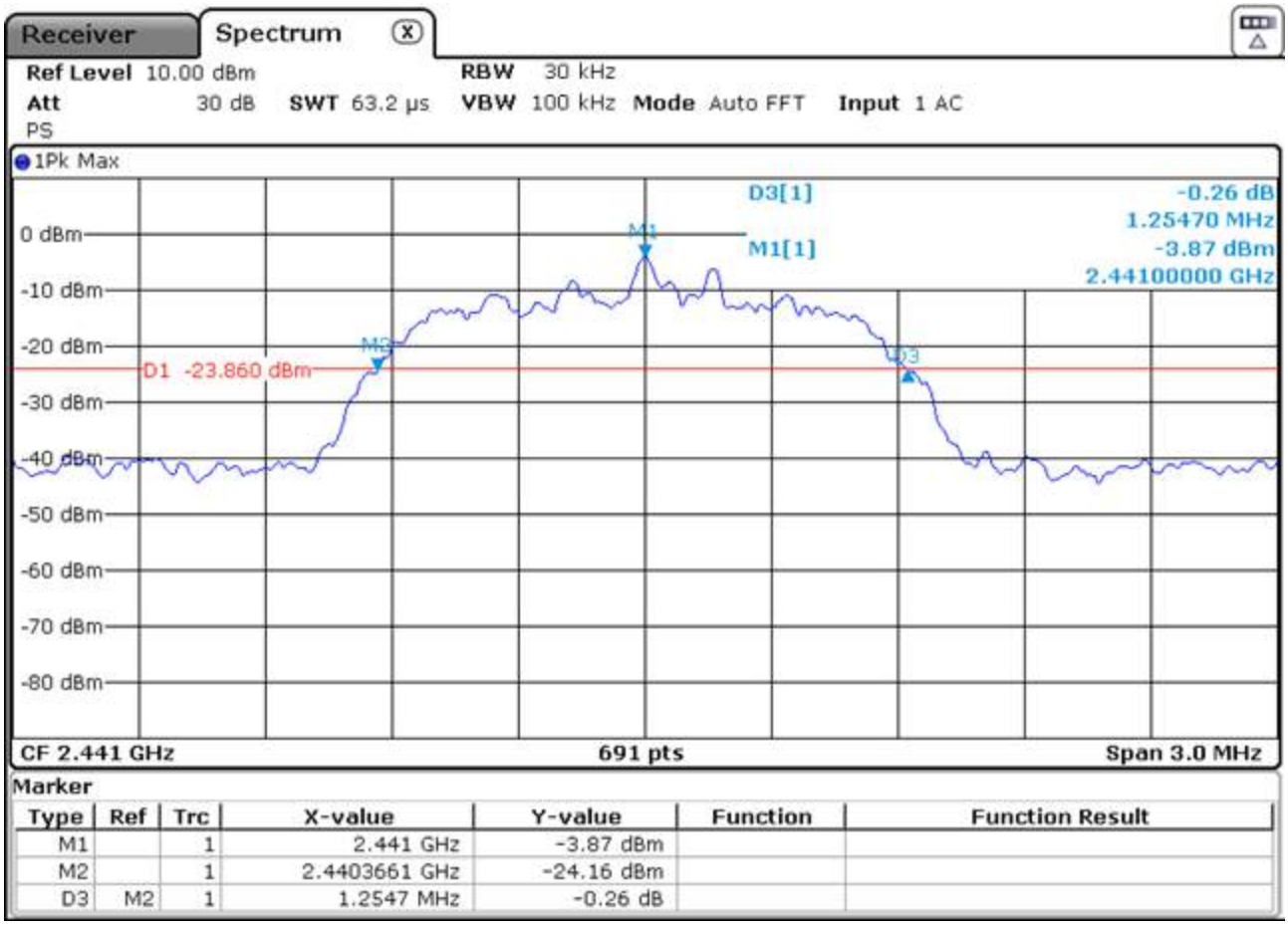






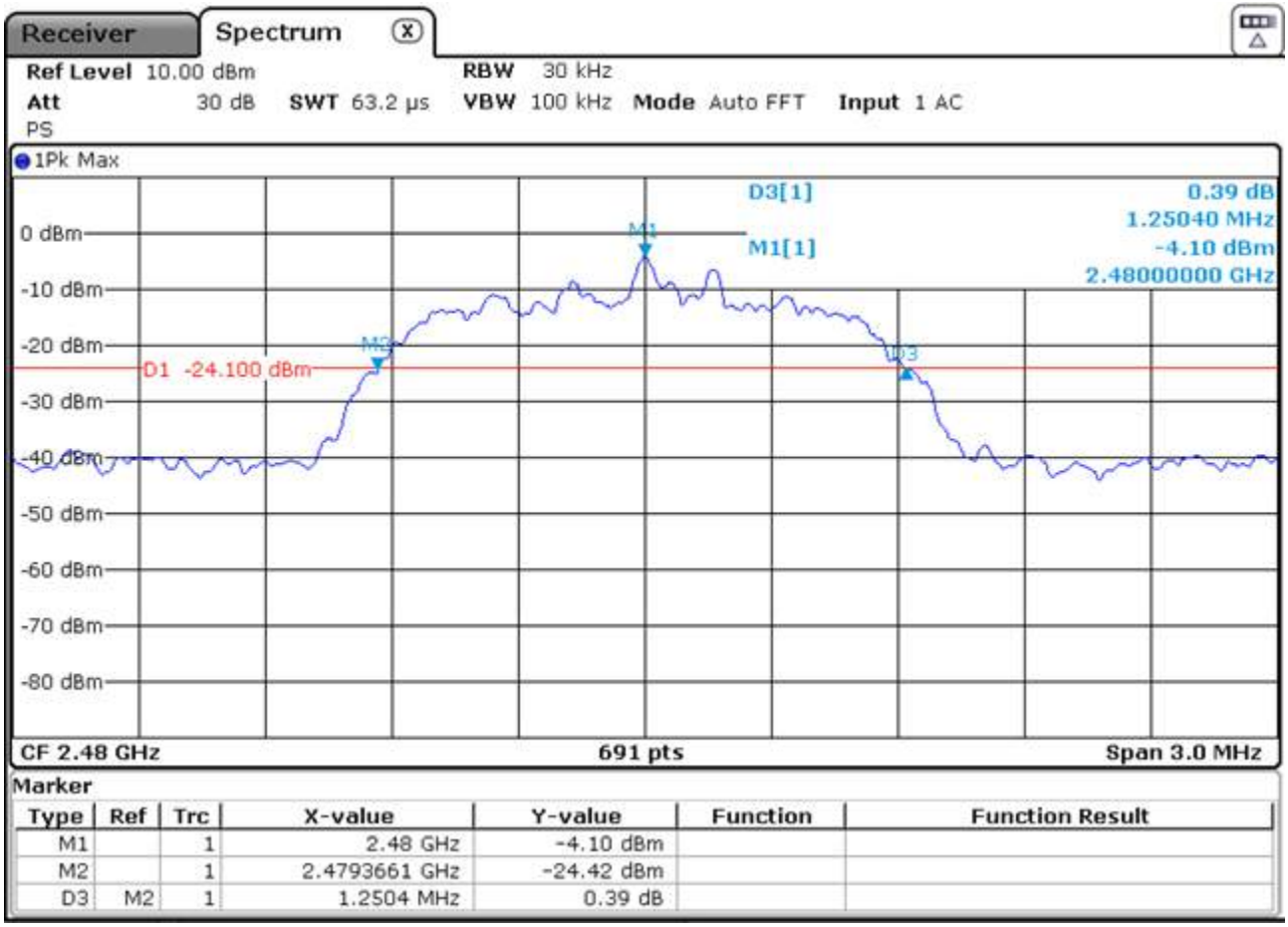
EDR, π/4-DQPSK with 2 MBit/s





Marker

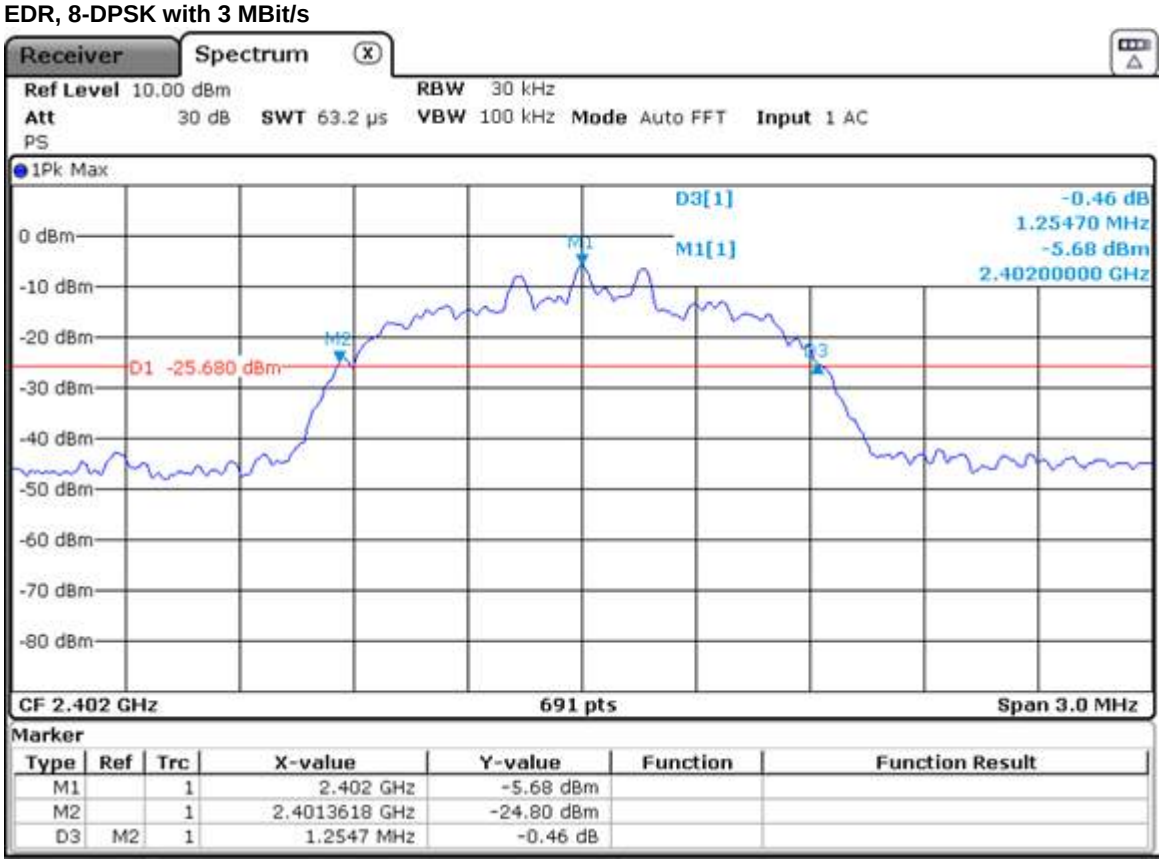
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.441 GHz	-3.87 dBm		
M2		1	2.4403661 GHz	-24.16 dBm		
D3	M2	1	1.2547 MHz	-0.26 dB		

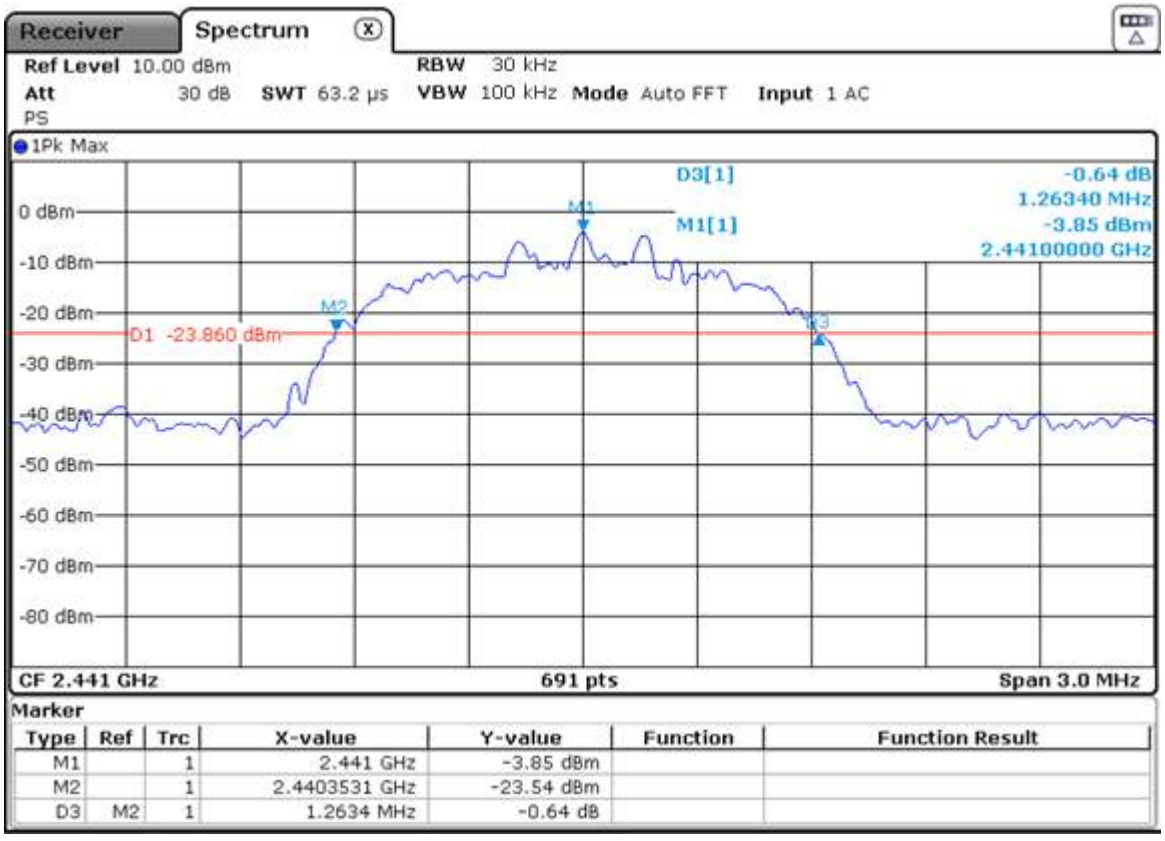


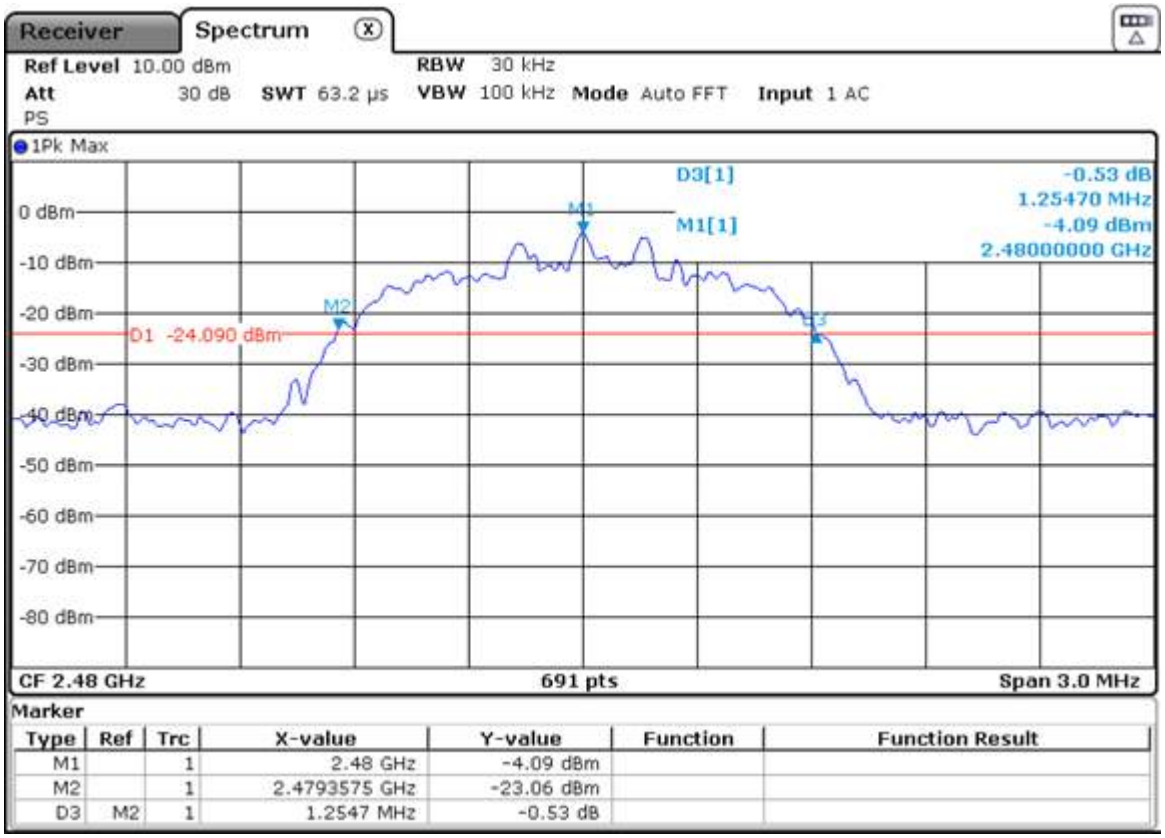
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48 GHz	-4.10 dBm		
M2		1	2.4793661 GHz	-24.42 dBm		
D3	M2	1	1.2504 MHz	0.39 dB		

EDR, 8-DPSK with 3 MBit/s

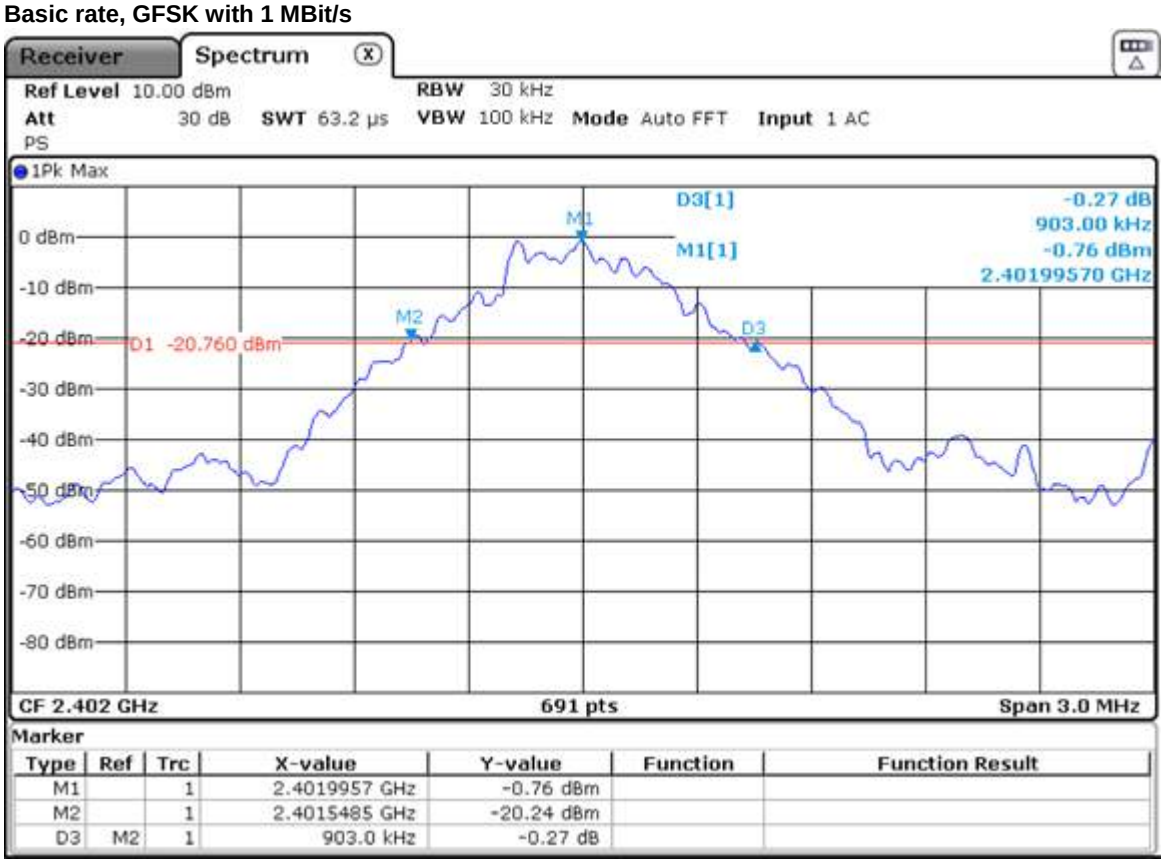


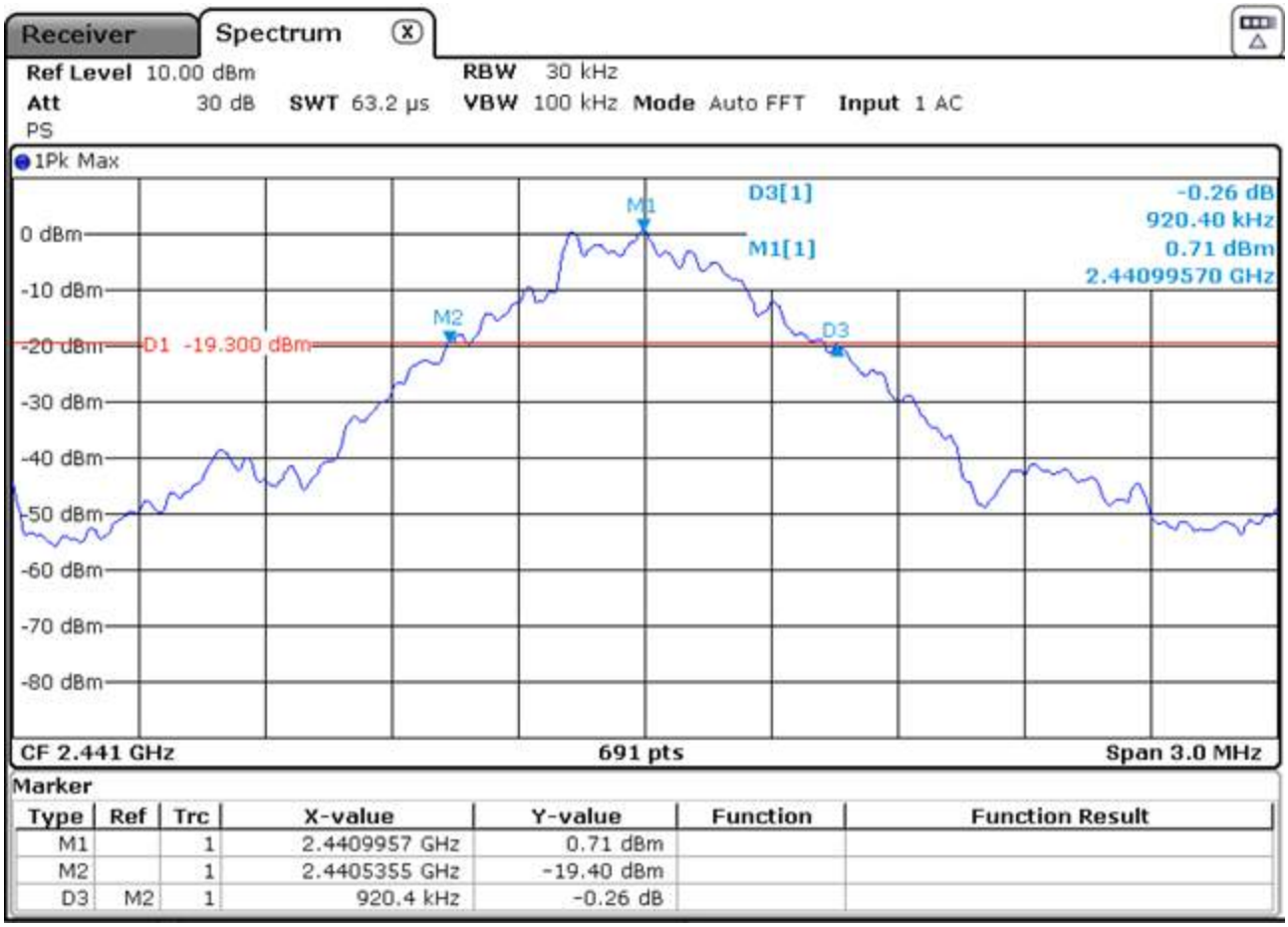




20 dB bandwidth:
Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

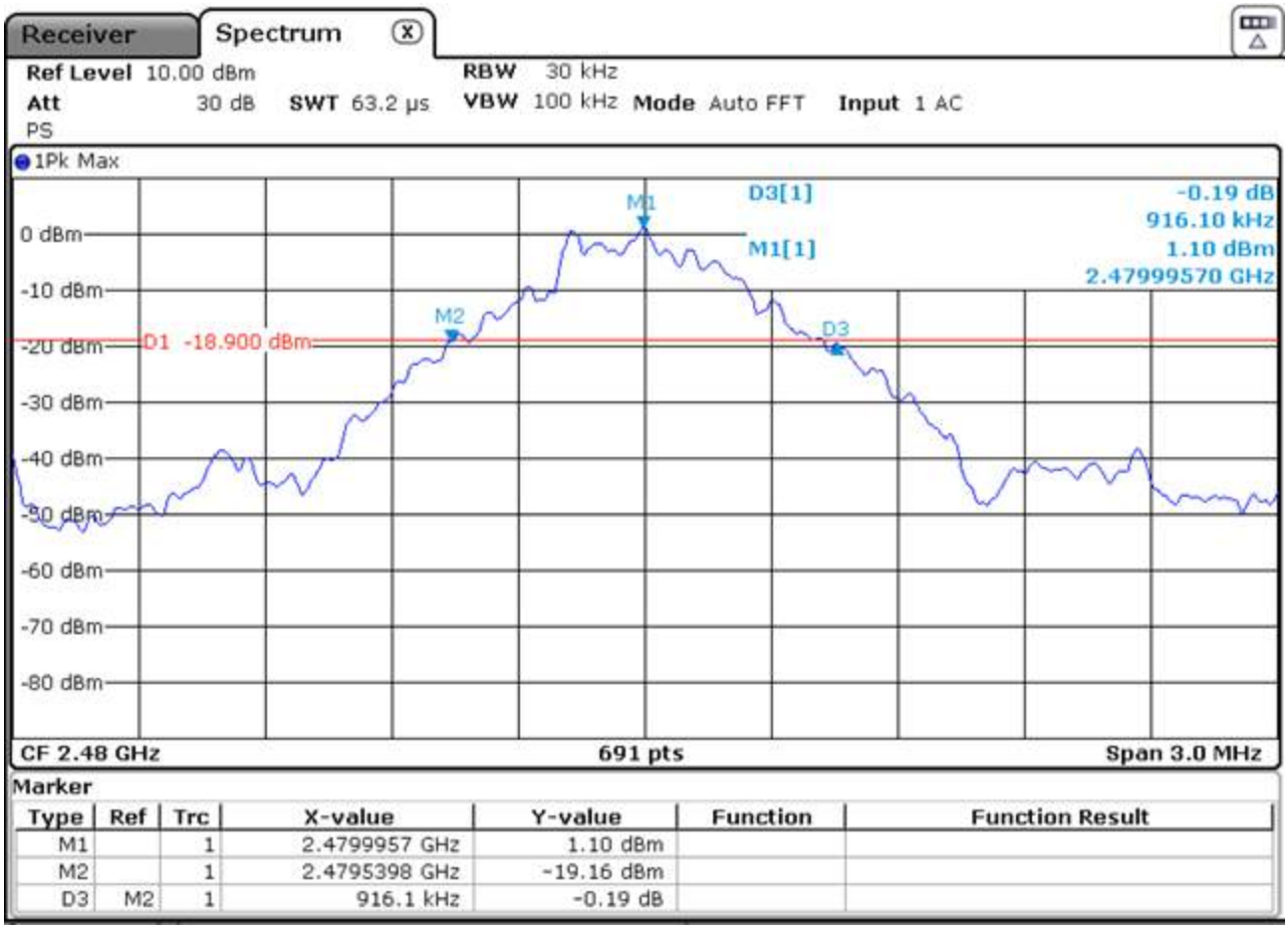
Basic rate, GFSK with 1 MBit/s





Marker

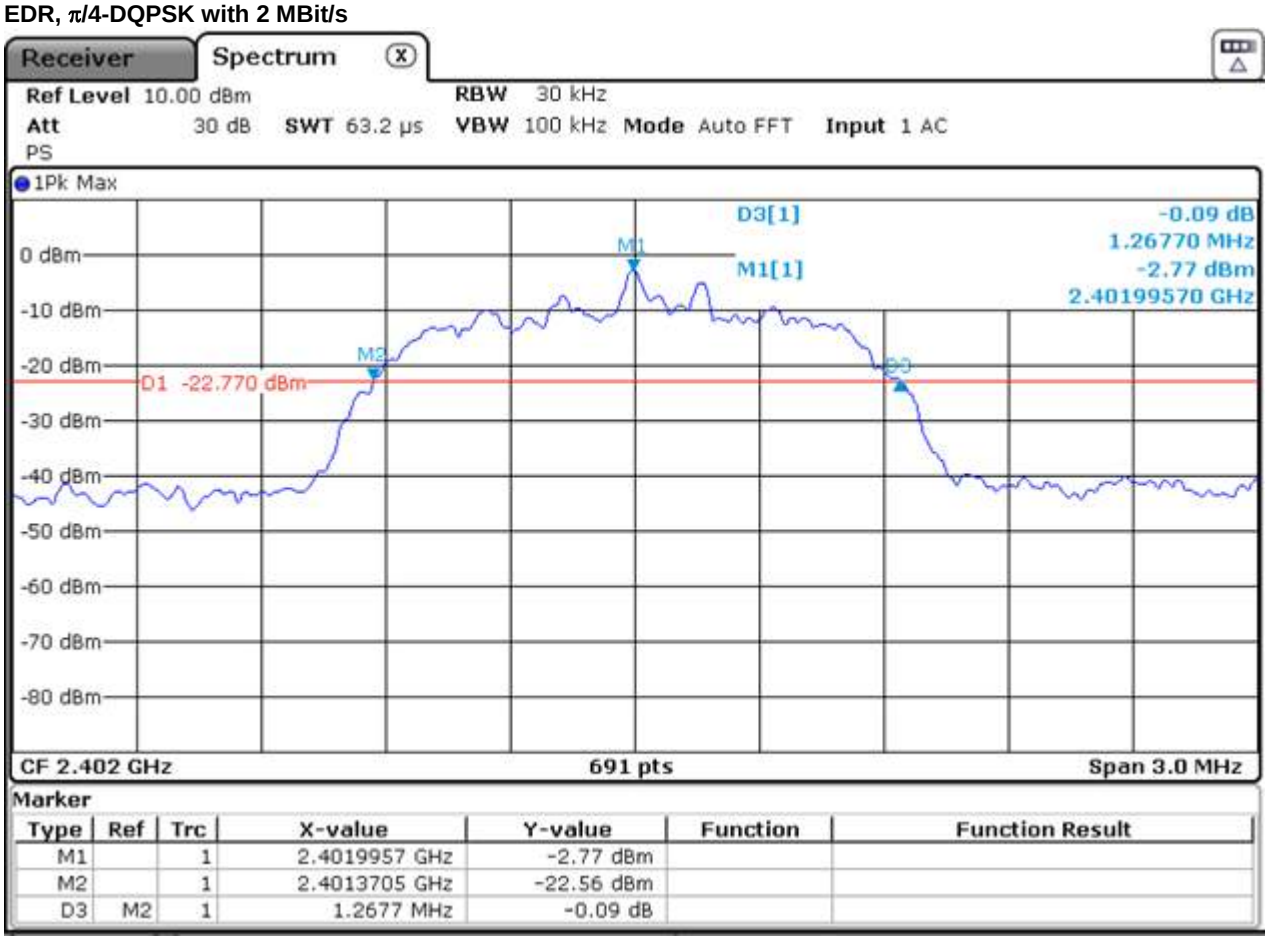
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4409957 GHz	0.71 dBm		
M2		1	2.4405355 GHz	-19.40 dBm		
D3	M2	1	920.4 kHz	-0.26 dB		

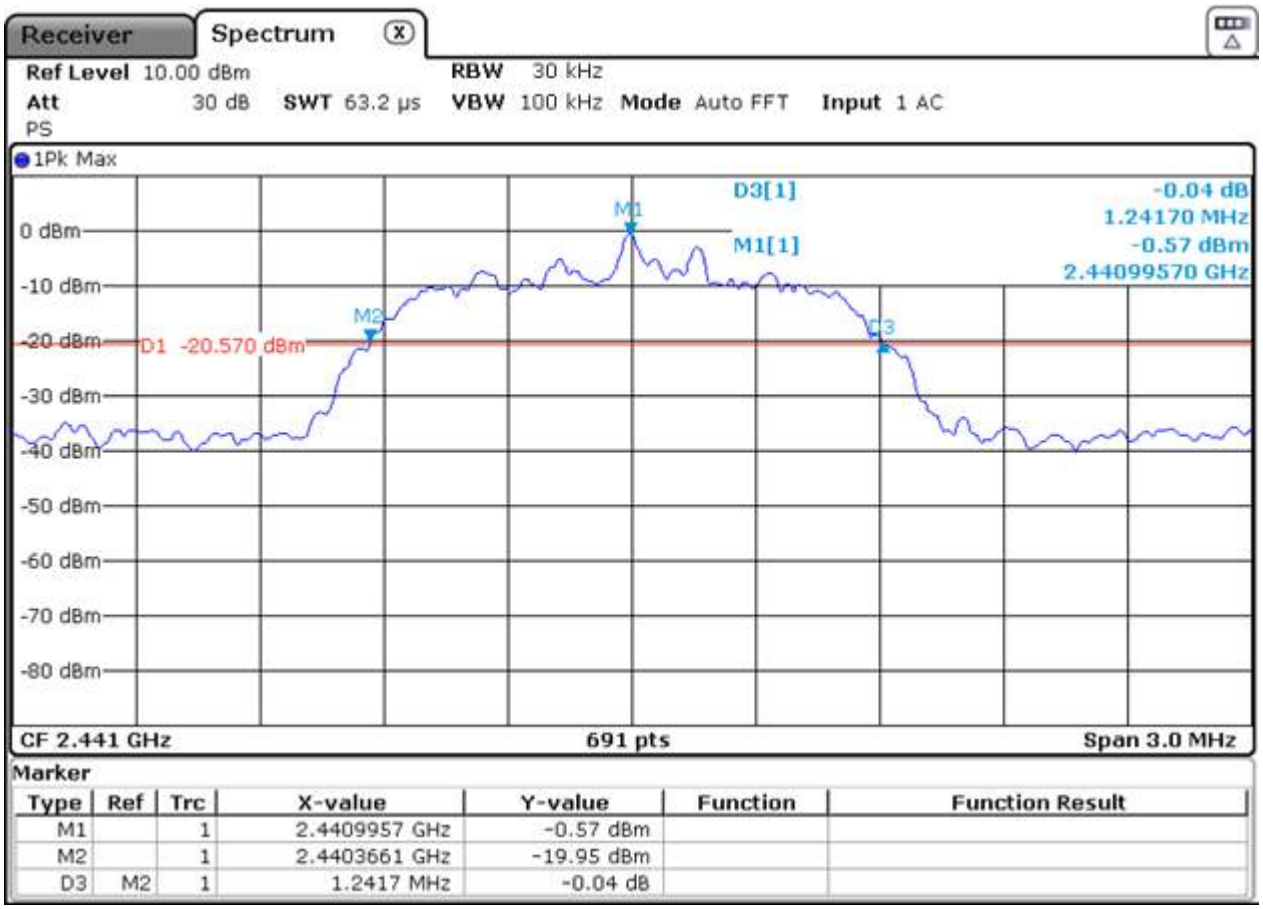


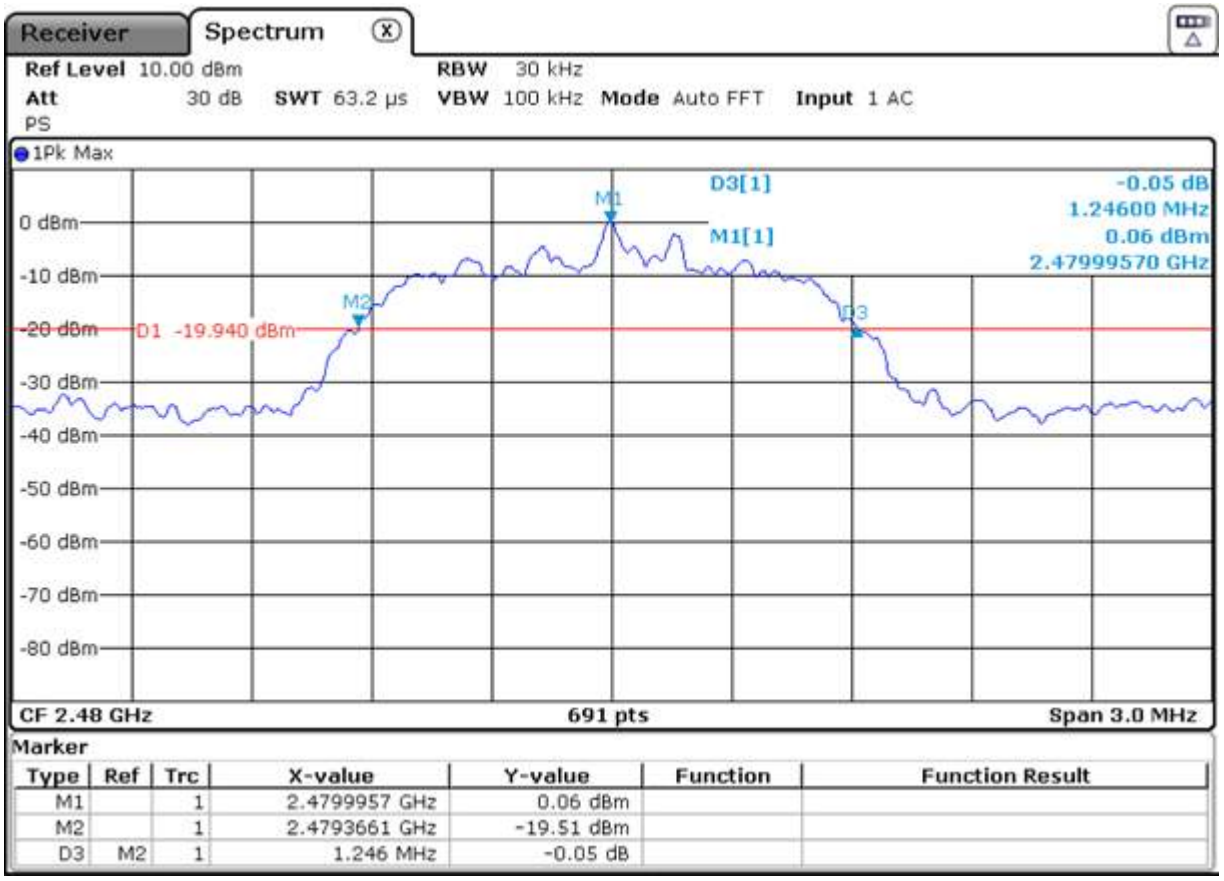
Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4799957 GHz	1.10 dBm		
M2		1	2.4795398 GHz	-19.16 dBm		
D3	M2	1	916.1 kHz	-0.19 dB		

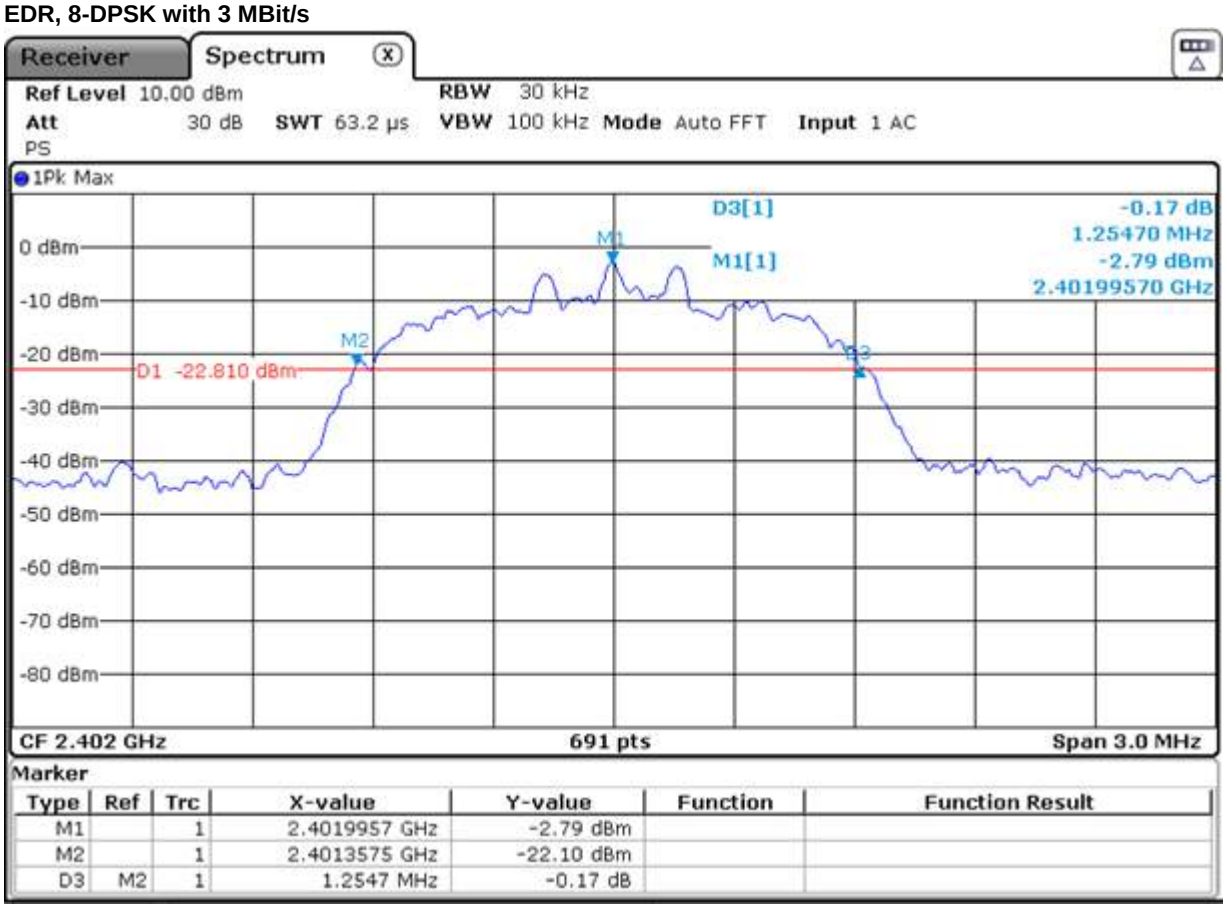
EDR, π/4-DQPSK with 2 MBit/s

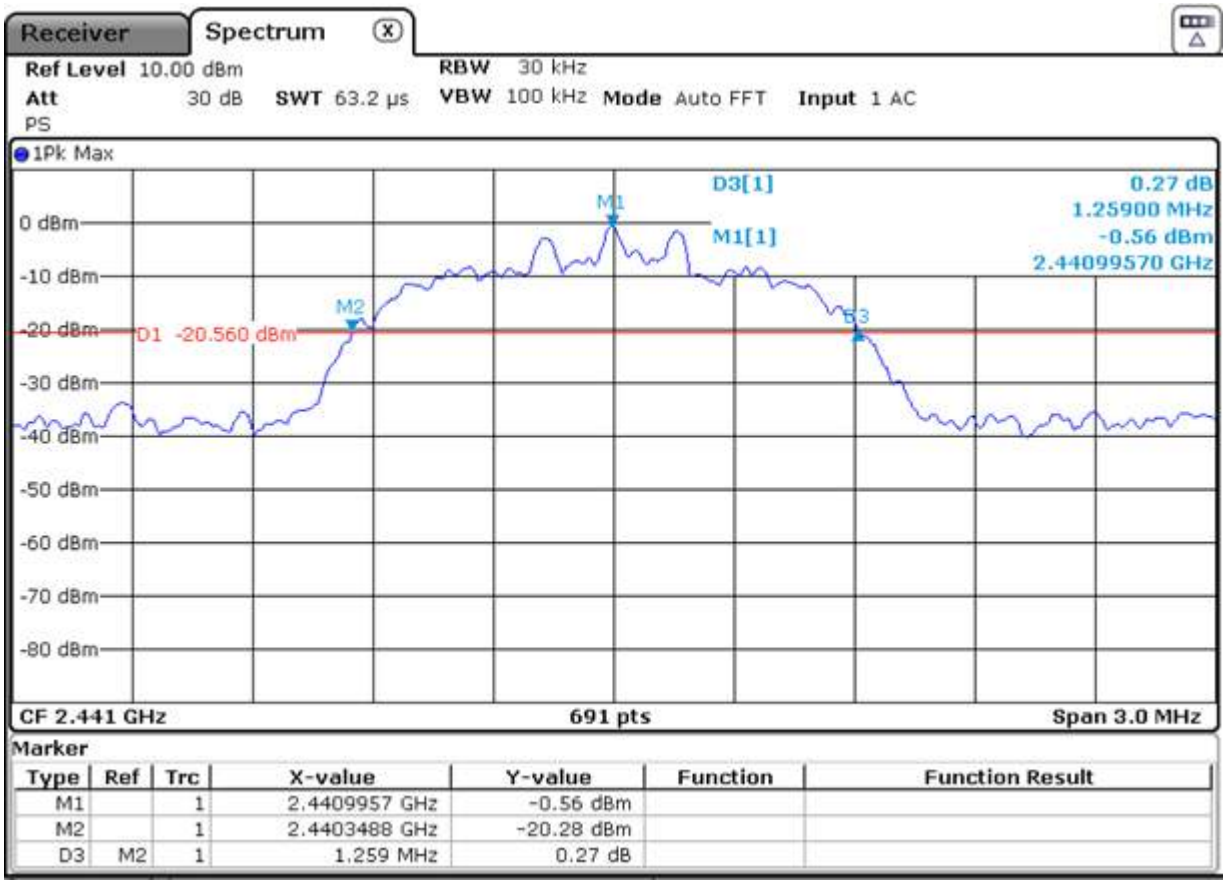


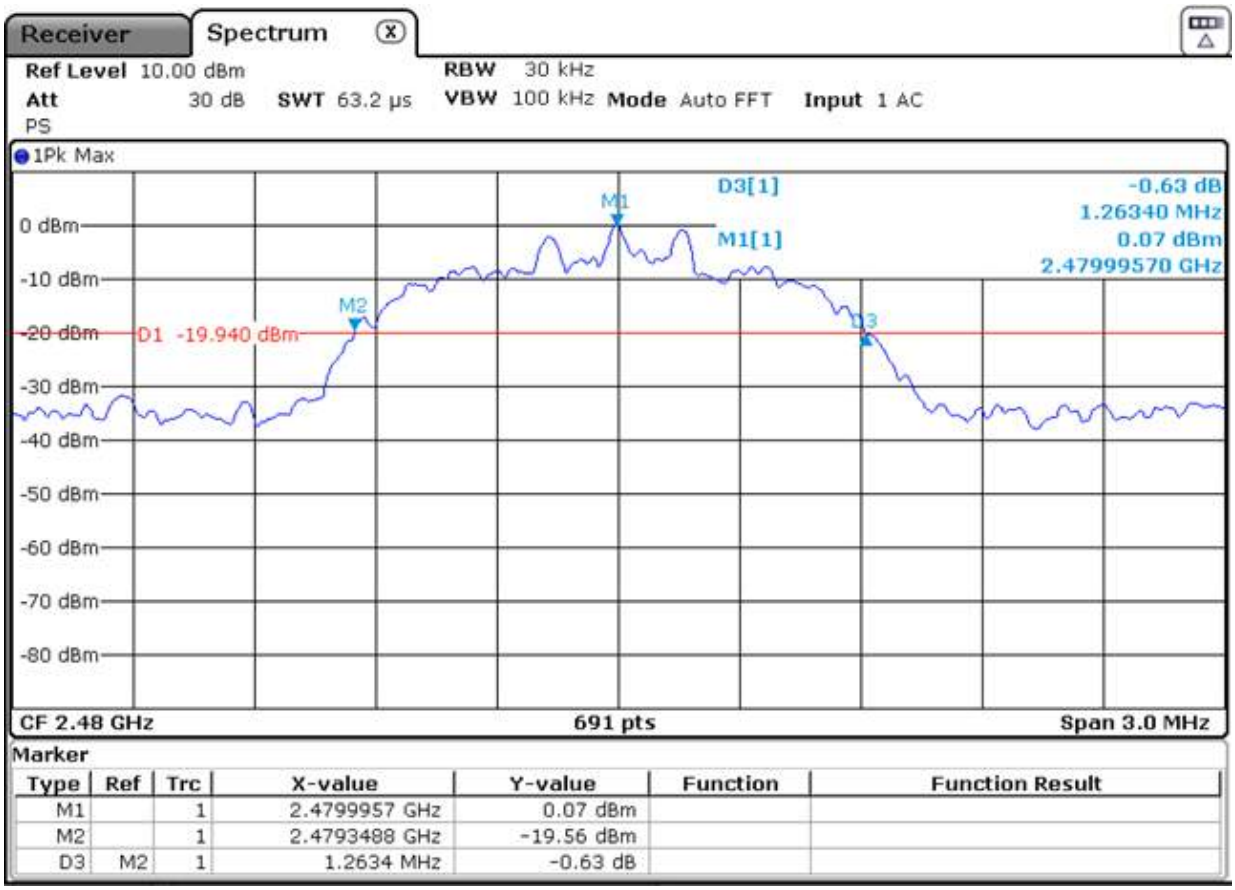




EDR, 8-DPSK with 3 MBit/s



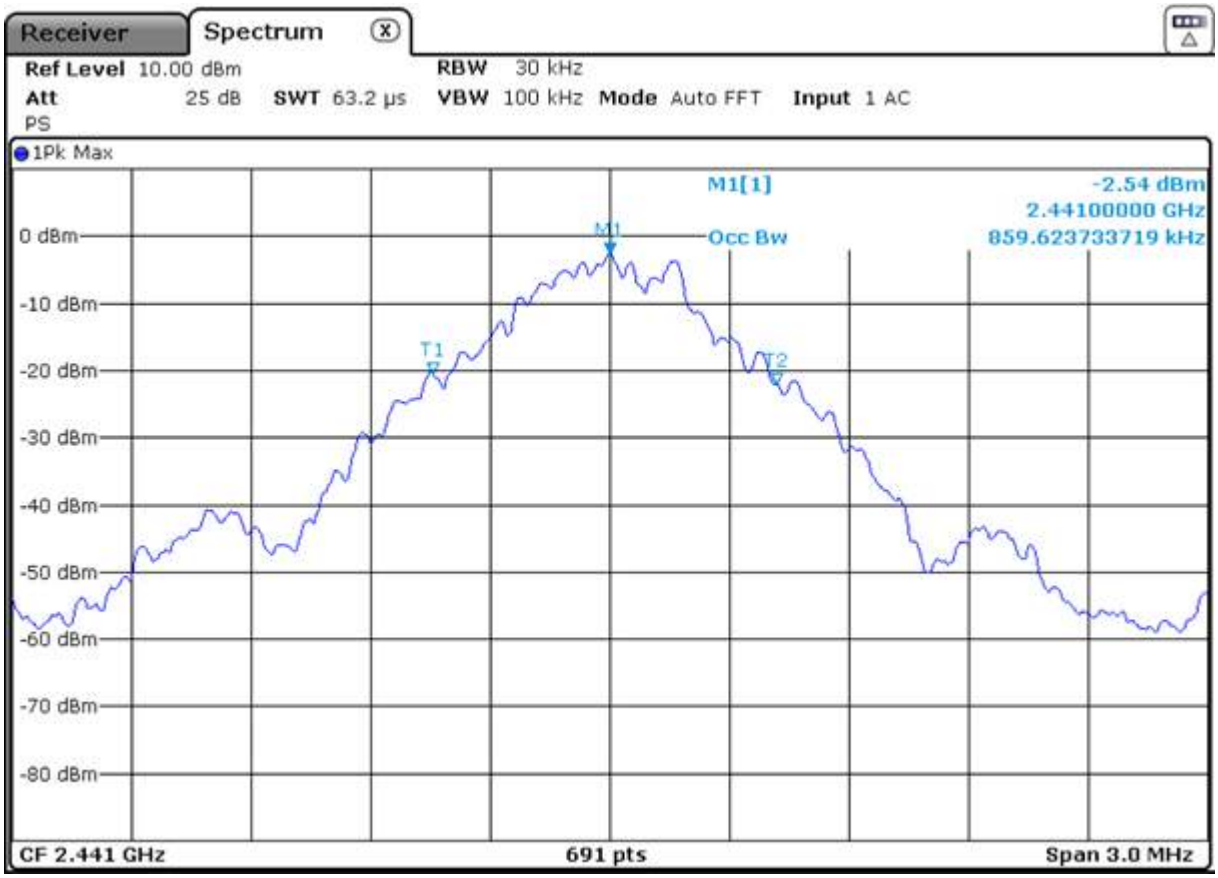

Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 30 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
D3[1] 0.27 dB
1.25900 MHz
M1[1] -0.56 dBm
2.44099570 GHz
M1
M2
D3
D1 -20.560 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4409957 GHz -0.56 dBm
M2 1 2.4403488 GHz -20.28 dBm
D3 M2 1 1.259 MHz 0.27 dB

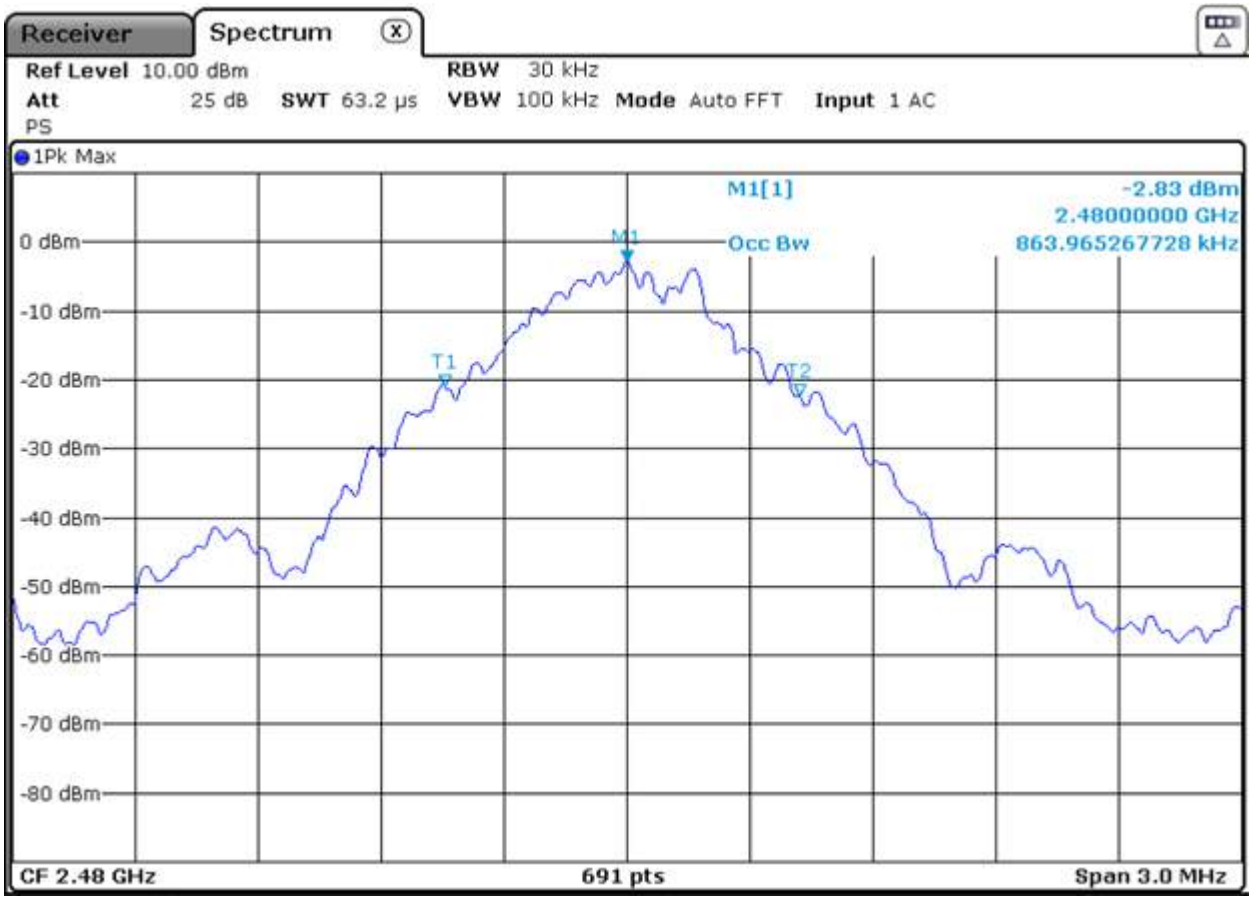

Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 30 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
D3[1] -0.63 dB
1.26340 MHz
M1[1] 0.07 dBm
2.47999570 GHz
M1
M2
D3
D1 -19.940 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4799957 GHz 0.07 dBm
M2 1 2.4793488 GHz -19.56 dBm
D3 M2 1 1.2634 MHz -0.63 dB

b) 99% bandwidth:

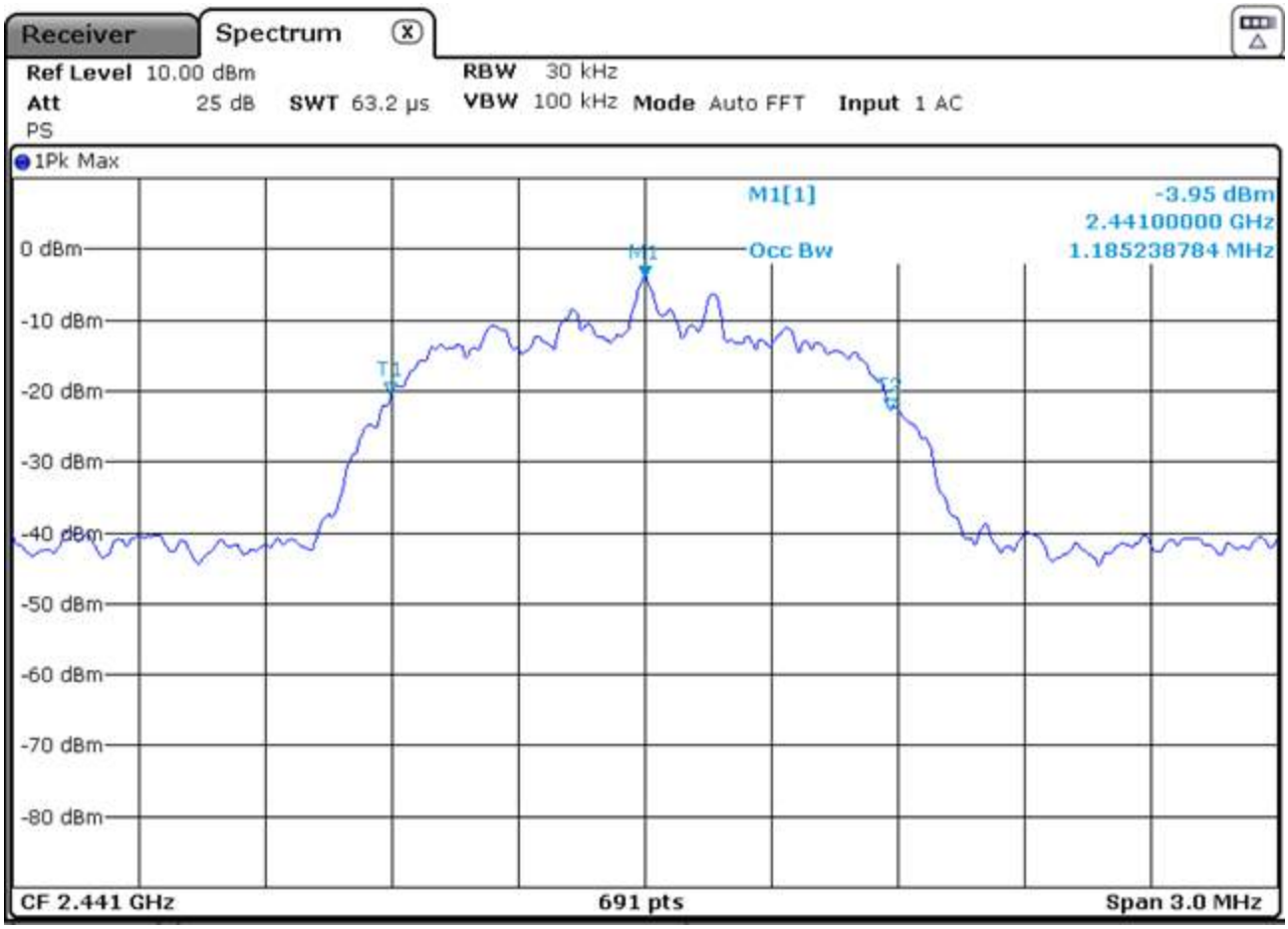
Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

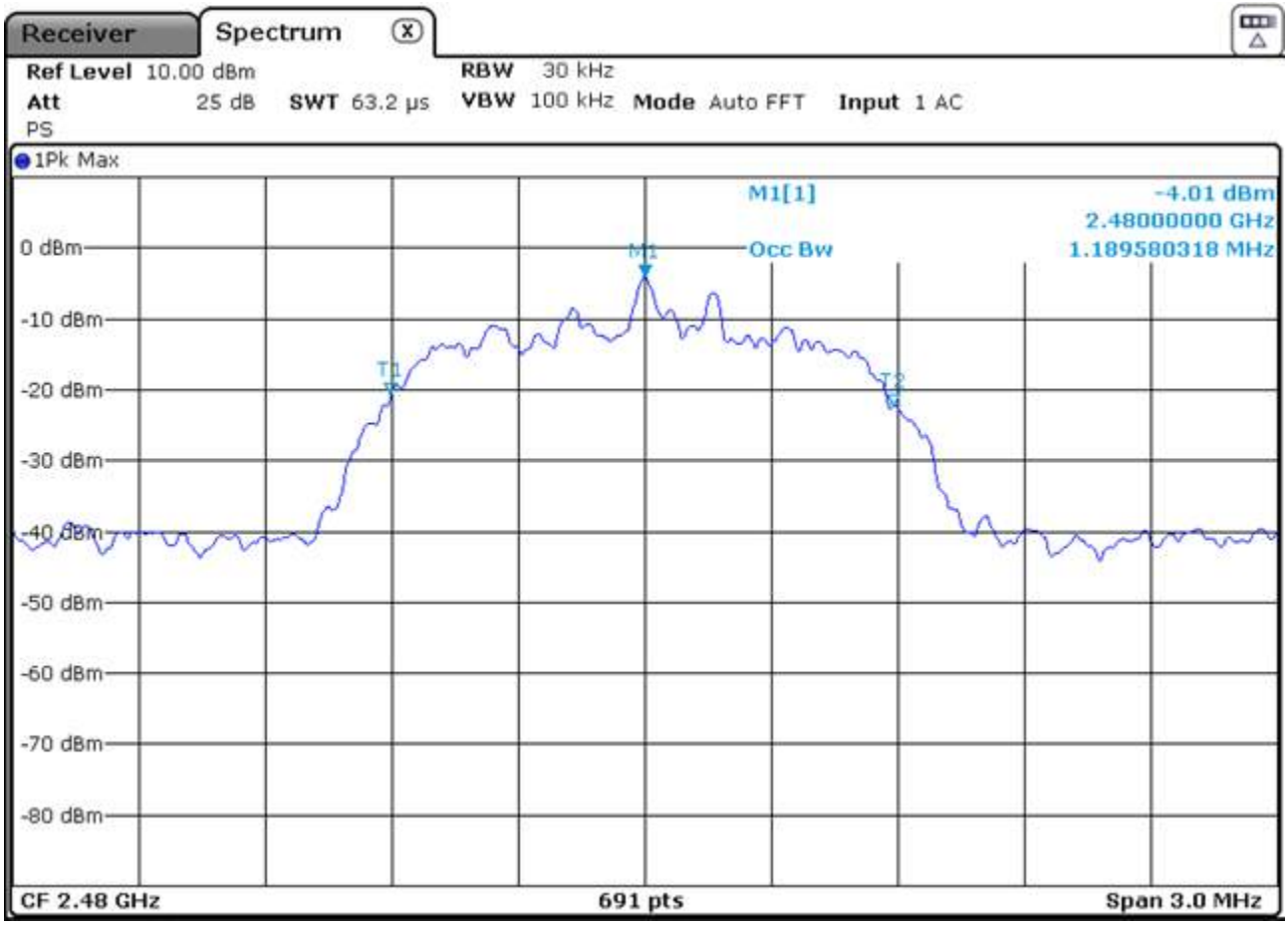
Basic rate, GFSK with 1 MBit/s



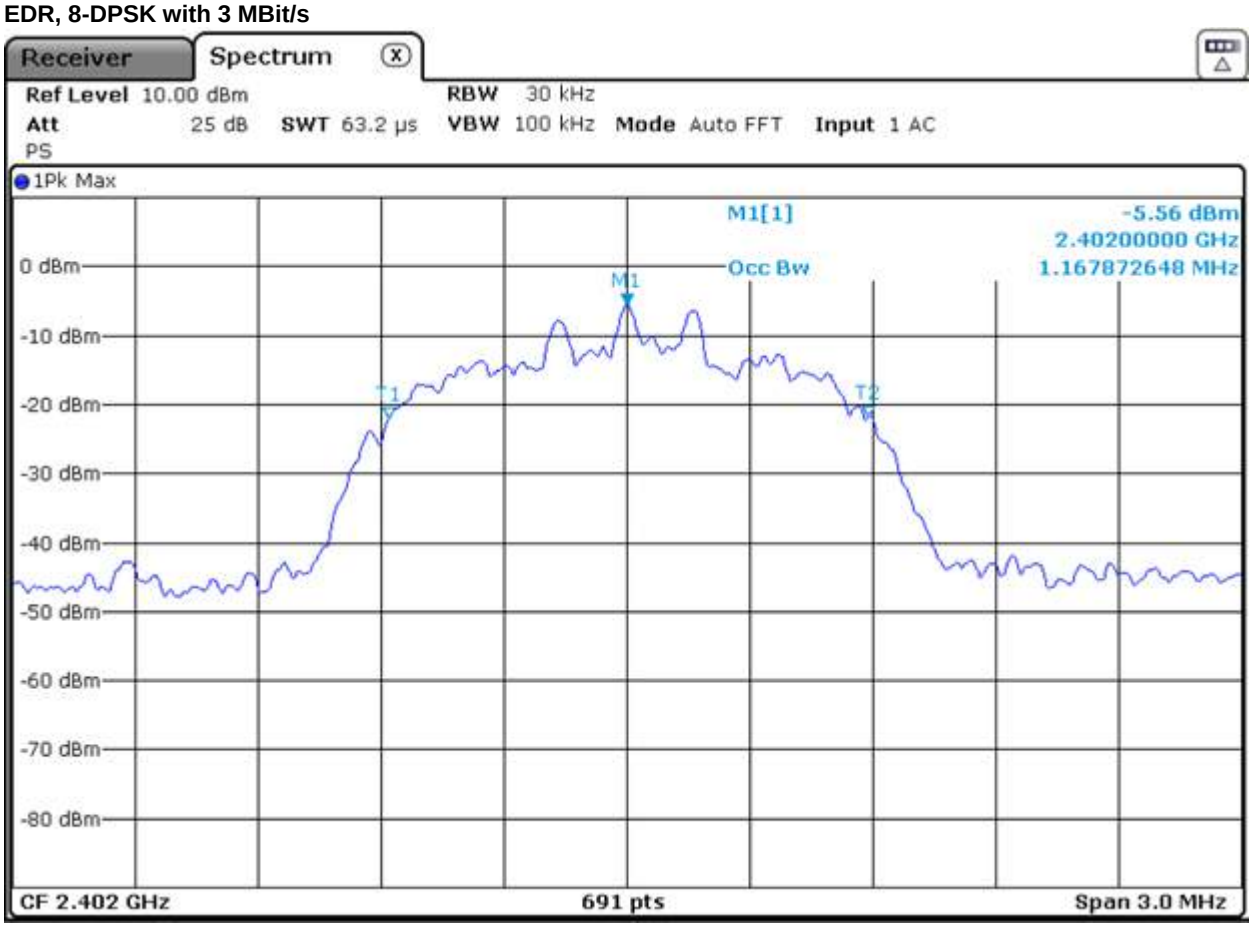


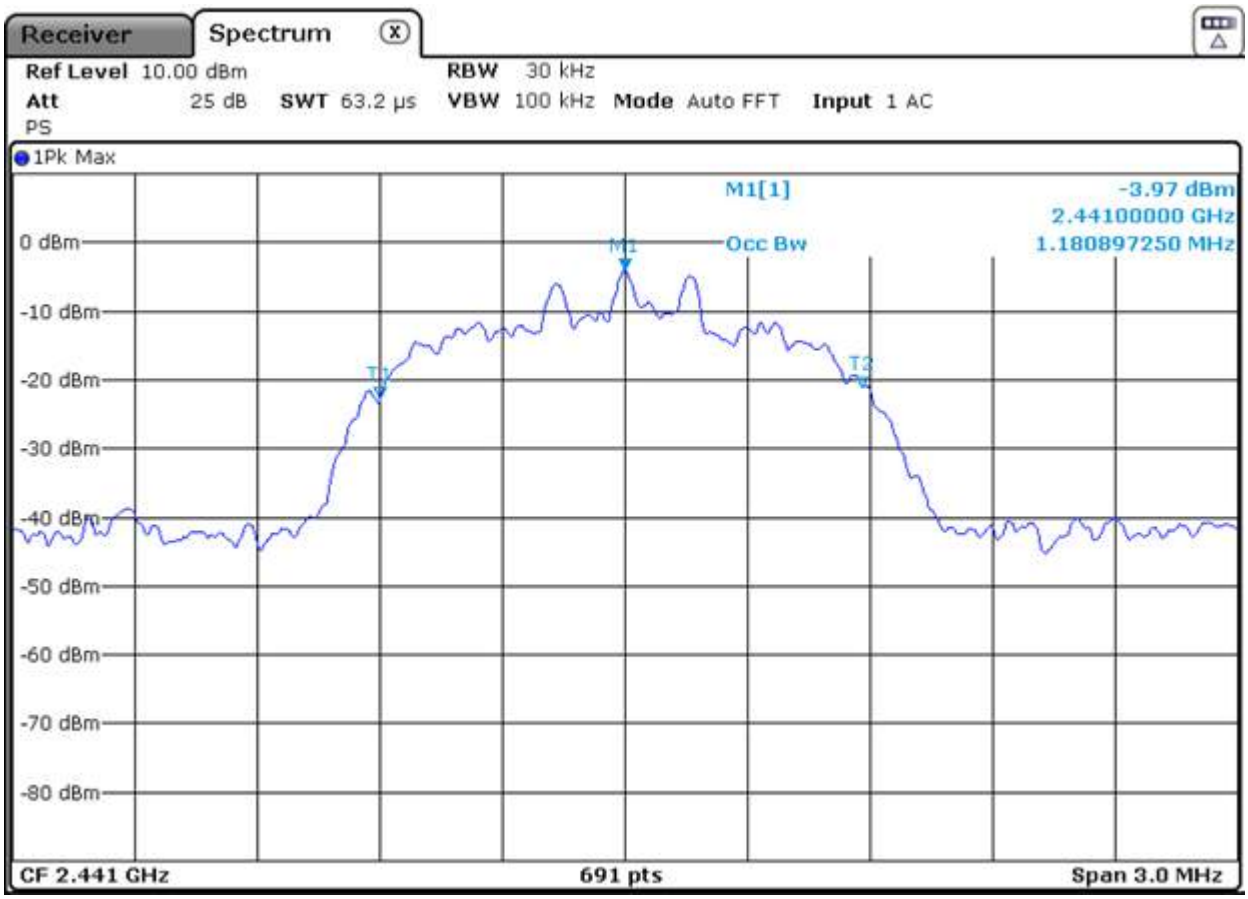
EDR, π/4-DQPSK with 2 MBit/s

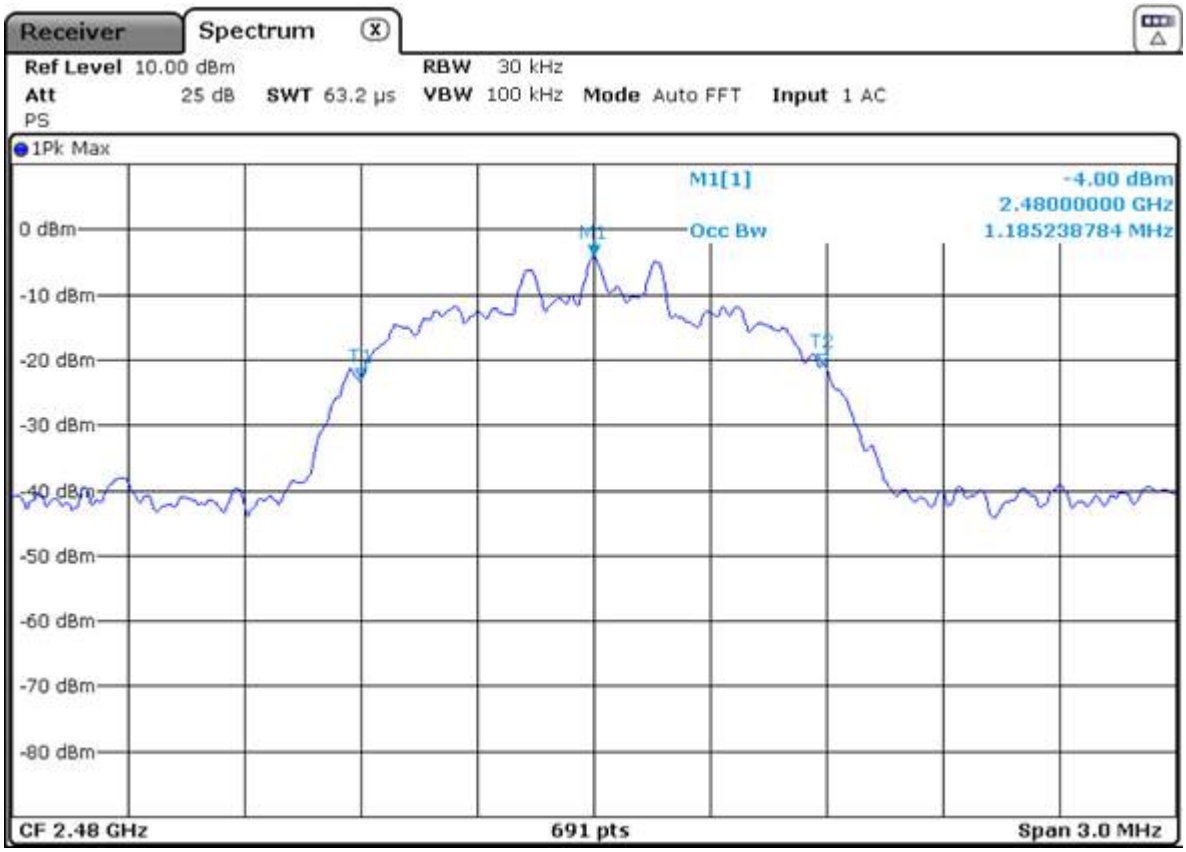

Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 25 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
M1[1]
-3.95 dBm
2.44100000 GHz
Occ Bw
1.185238784 MHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
691 pts
Span 3.0 MHz


Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 25 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
M1[1]
-4.01 dBm
2.48000000 GHz
Occ Bw
1.189580318 MHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
691 pts
Span 3.0 MHz

EDR, 8-DPSK with 3 MBit/s

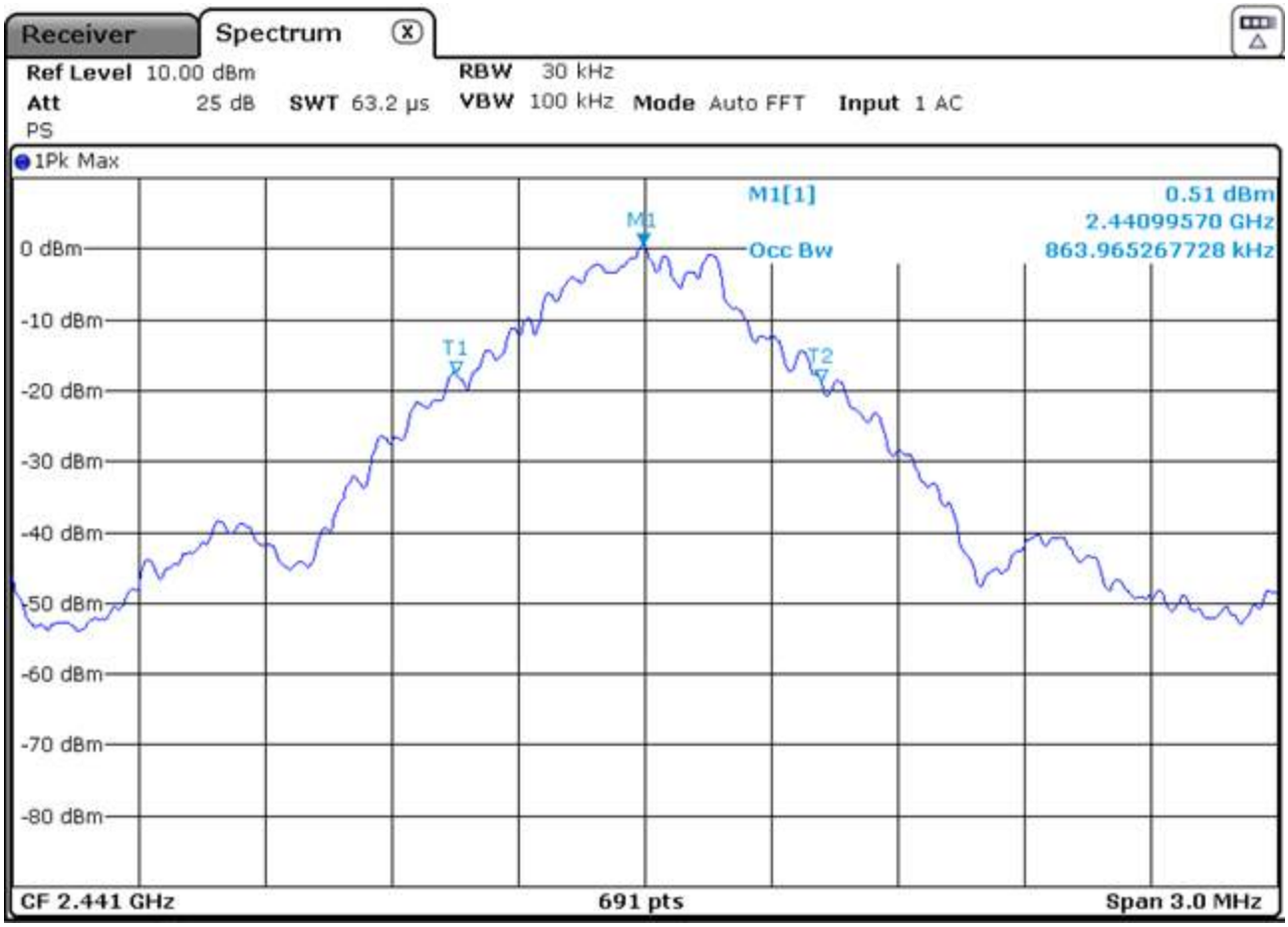


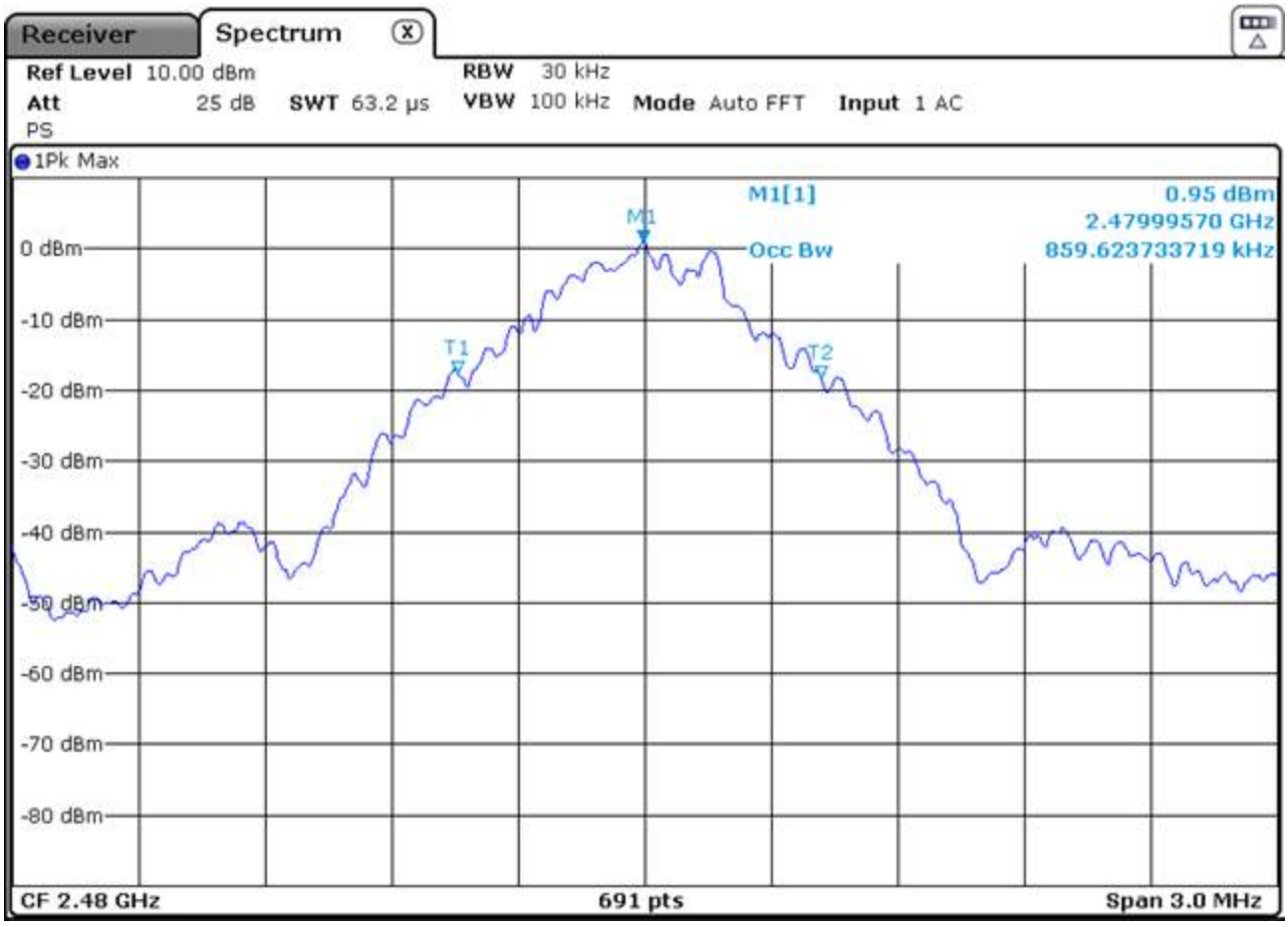




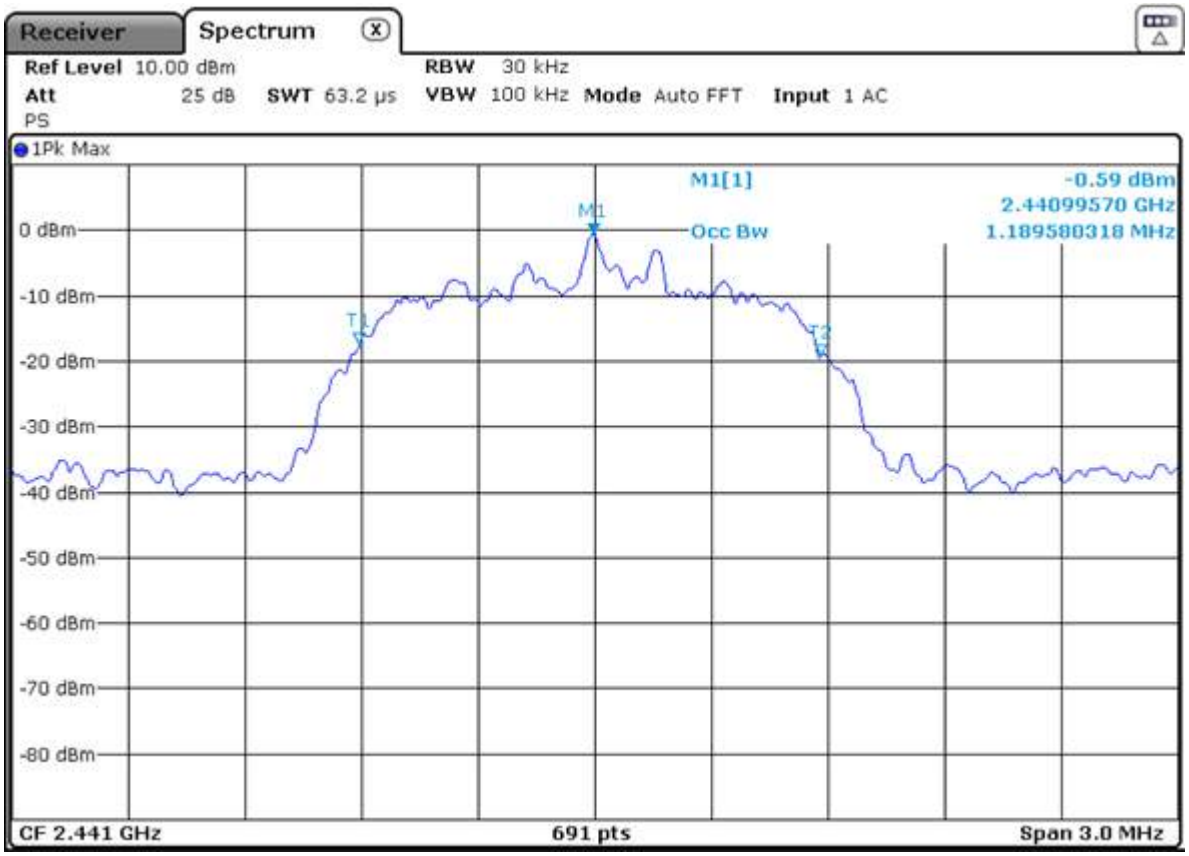
99% bandwidth:
Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

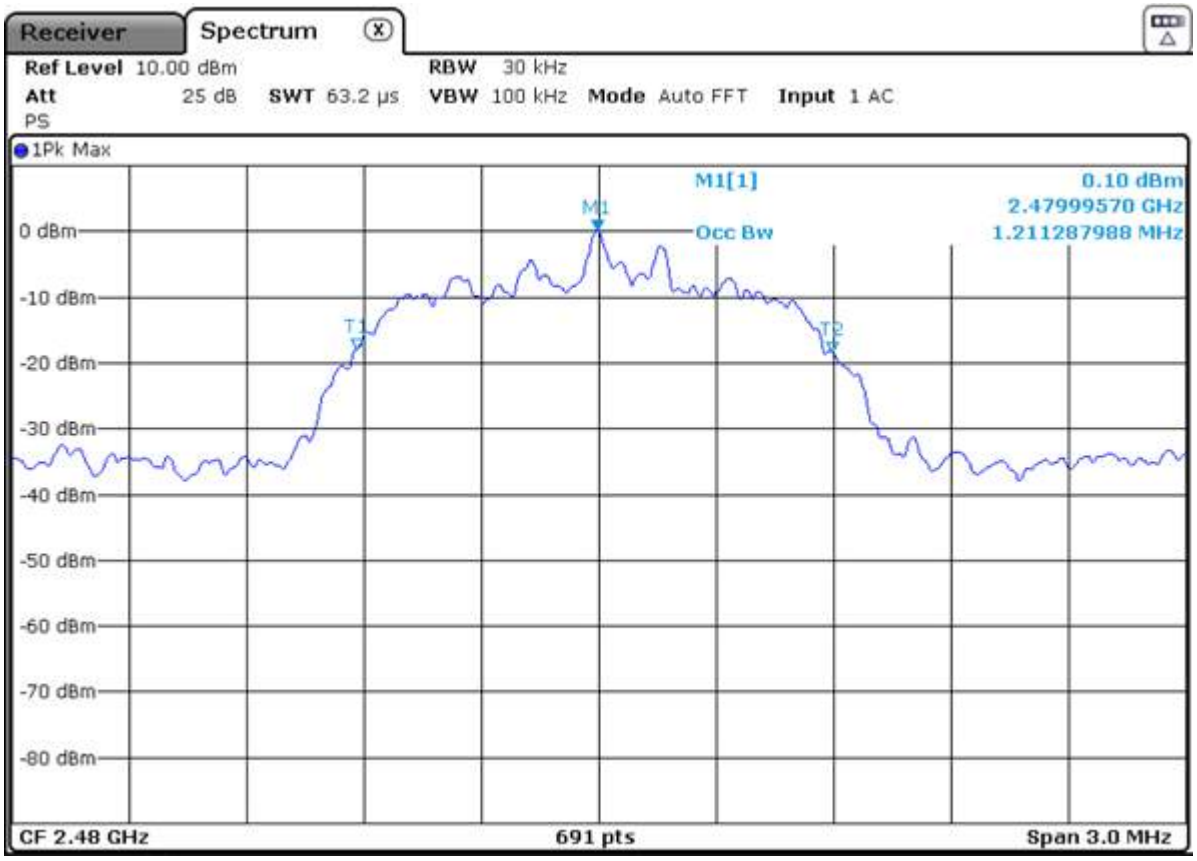
Basic rate, GFSK with 1 MBit/s


Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 25 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
M1[1]
0.51 dBm
2.44099570 GHz
Occ Bw
863.965267728 kHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
T1
T2
CF 2.441 GHz
691 pts
Span 3.0 MHz


Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 25 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
M1[1]
0.95 dBm
2.47999570 GHz
Occ Bw
859.623733719 kHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
T1
T2
CF 2.48 GHz
691 pts
Span 3.0 MHz

EDR, π/4-DQPSK with 2 MBit/s





EDR, 8-DPSK with 3 MBit/s

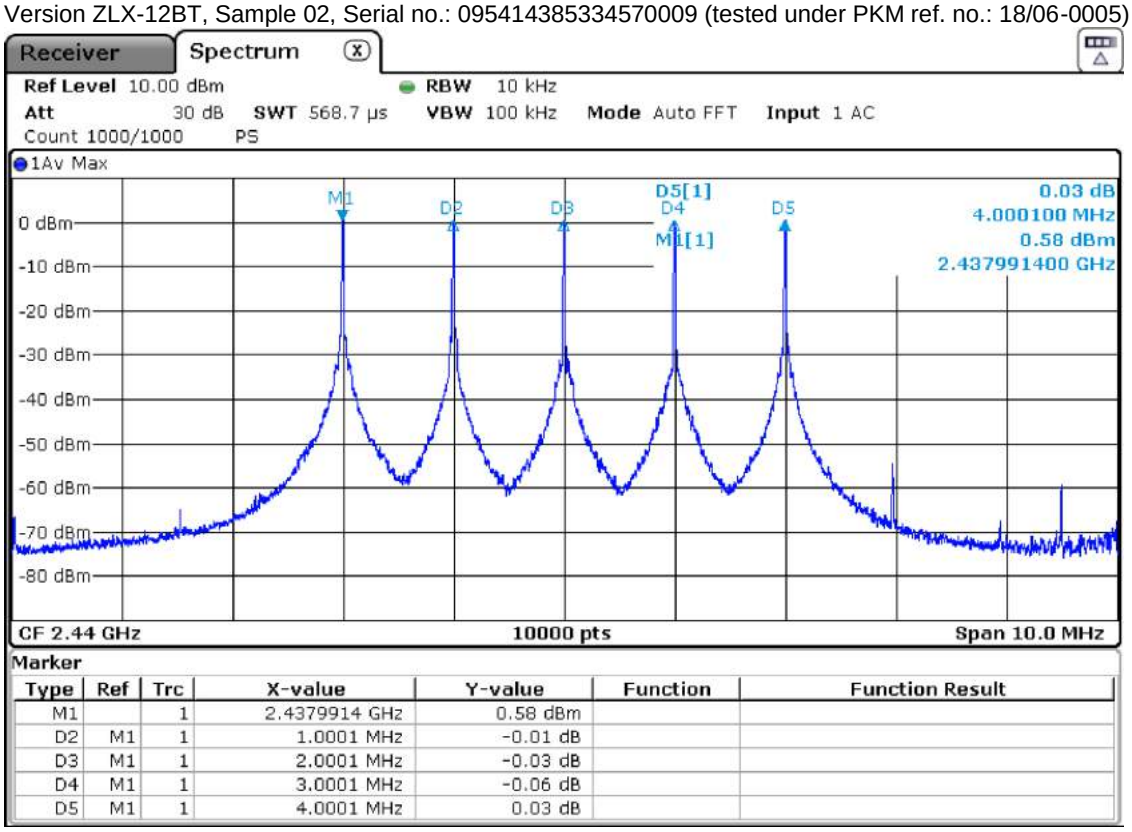

Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 25 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
M1[1]
-0.58 dBm
2.44099570 GHz
1.189580318 MHz
Occ Bw
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
691 pts
Span 3.0 MHz


Receiver
Spectrum
Ref Level 10.00 dBm
RBW 30 kHz
Att 25 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT Input 1 AC
PS
1Pk Max
M1[1]
0.10 dBm
2.47999570 GHz
1.202604920 MHz
Occ Bw
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
691 pts
Span 3.0 MHz

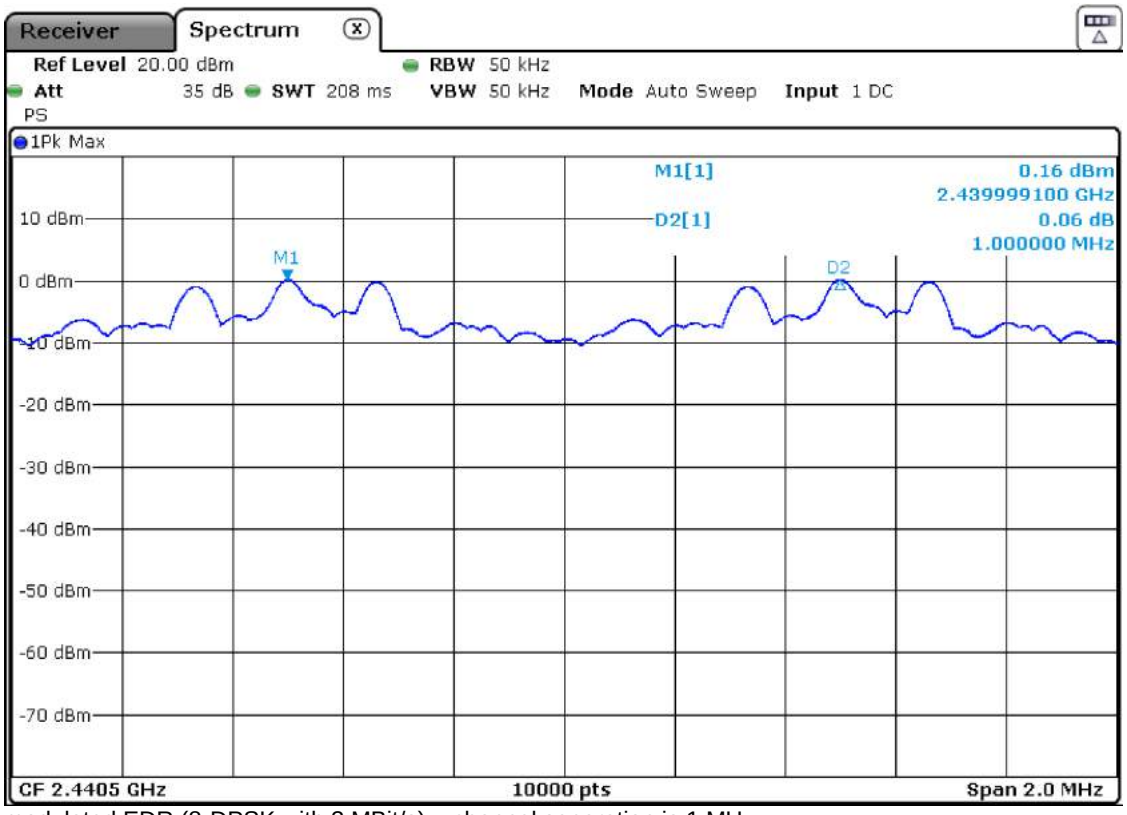
c) hopping channel carrier frequencies separation

The hopping channel carrier frequencies separation is for all modulations and bit rates same.

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)



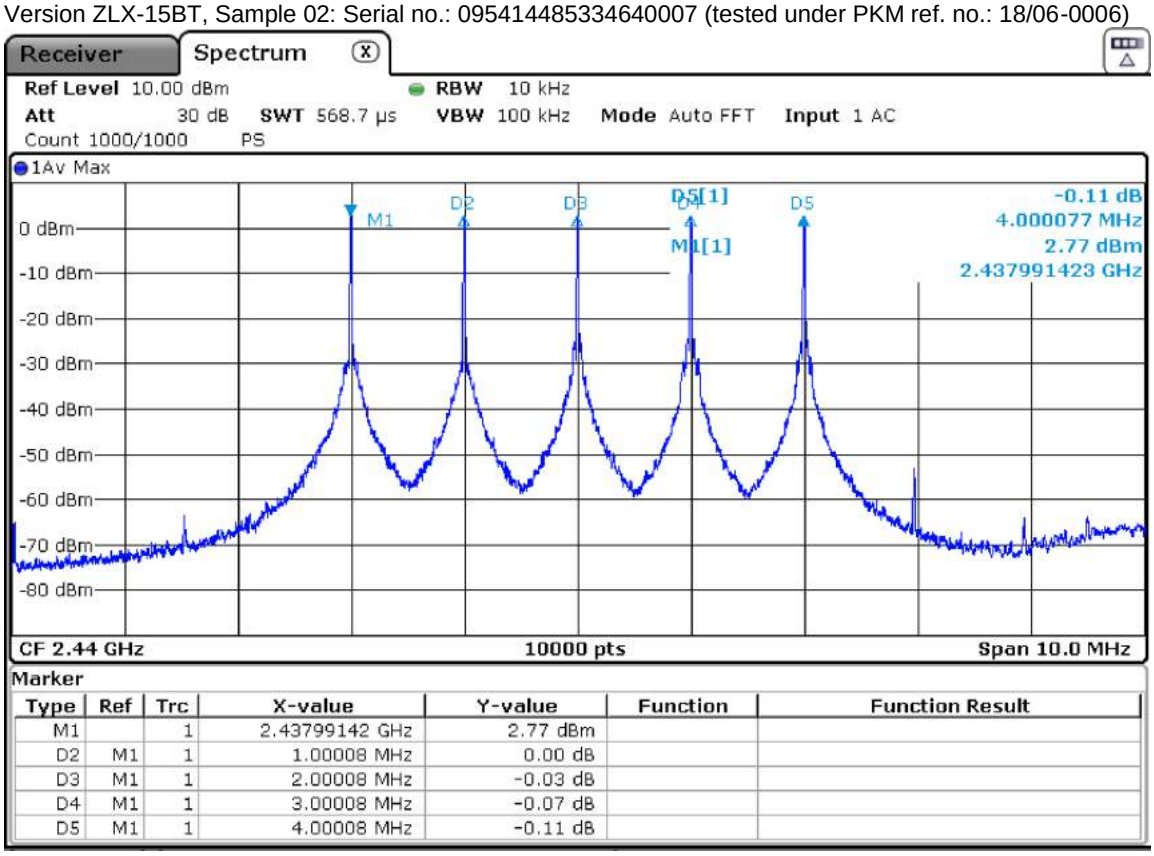
only unmodulated carrier



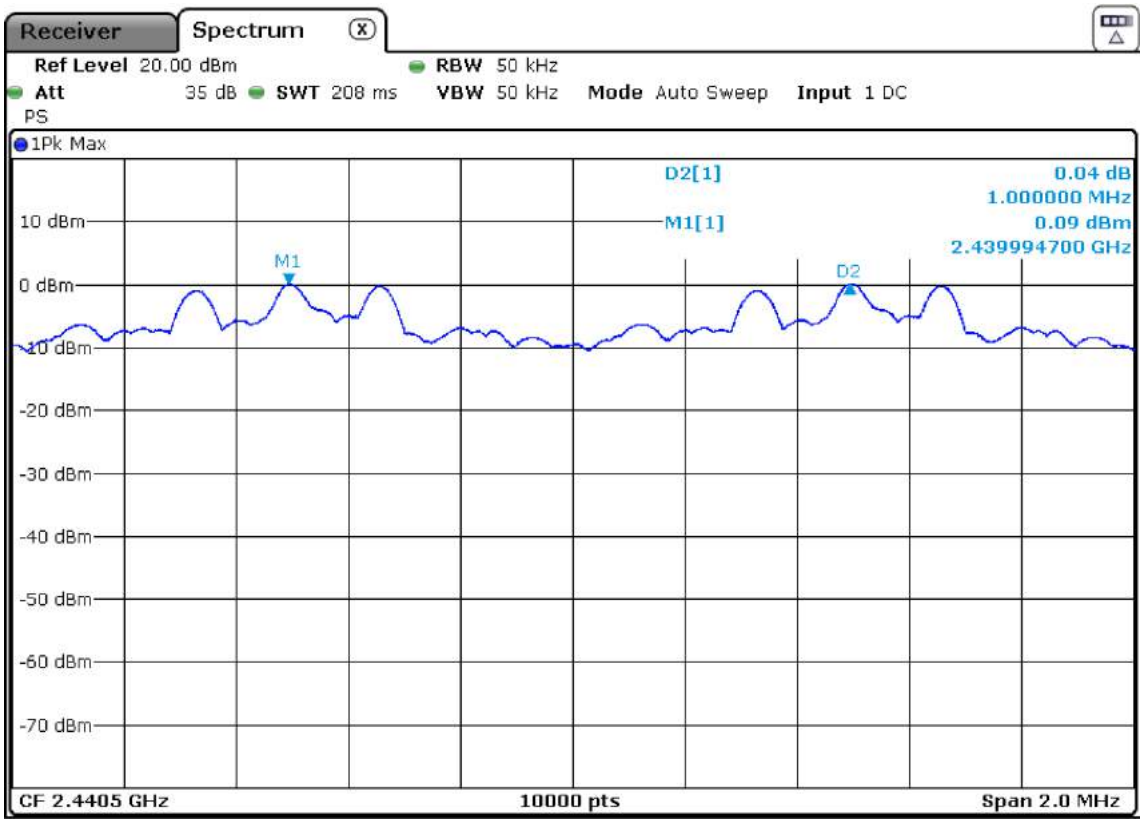
modulated EDR (8-DPSK with 3 MBit/s) – channel separation is 1 MHz

hopping channel carrier frequencies separation

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)



only unmodulated carrier



modulated EDR (8-DPSK with 3 MBit/s) – channel separation is 1 MHz

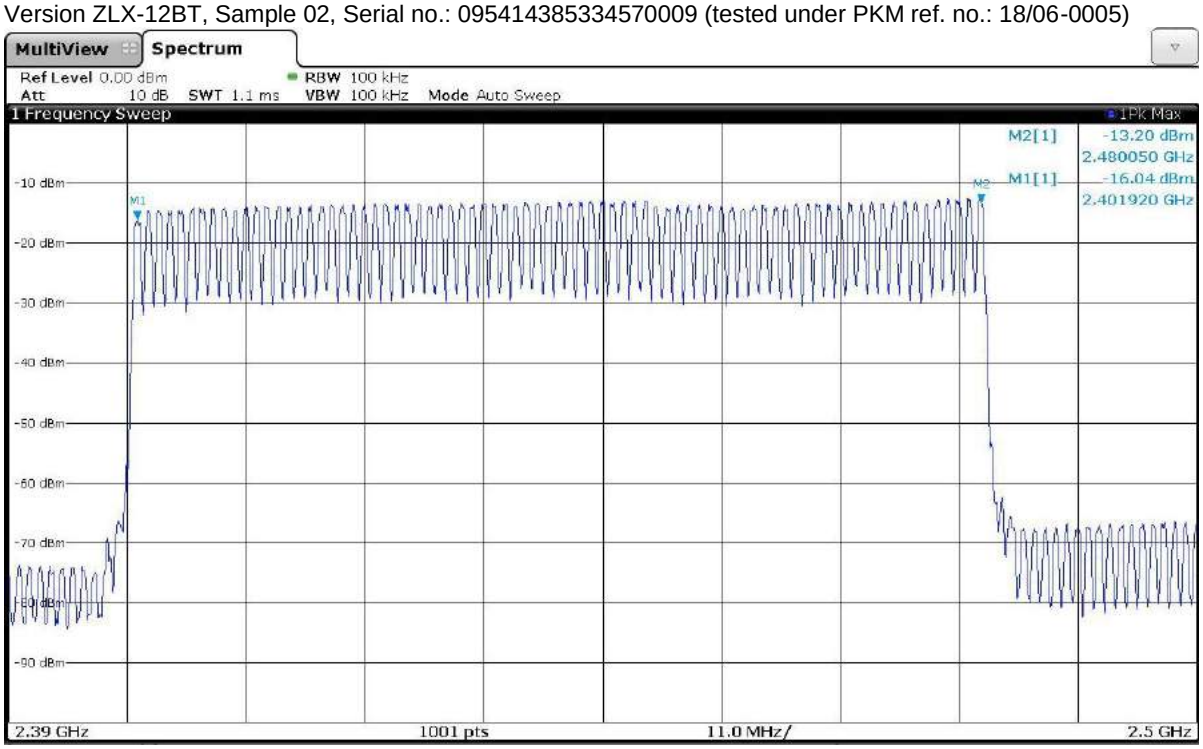
(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

d) hopping channel frequencies:

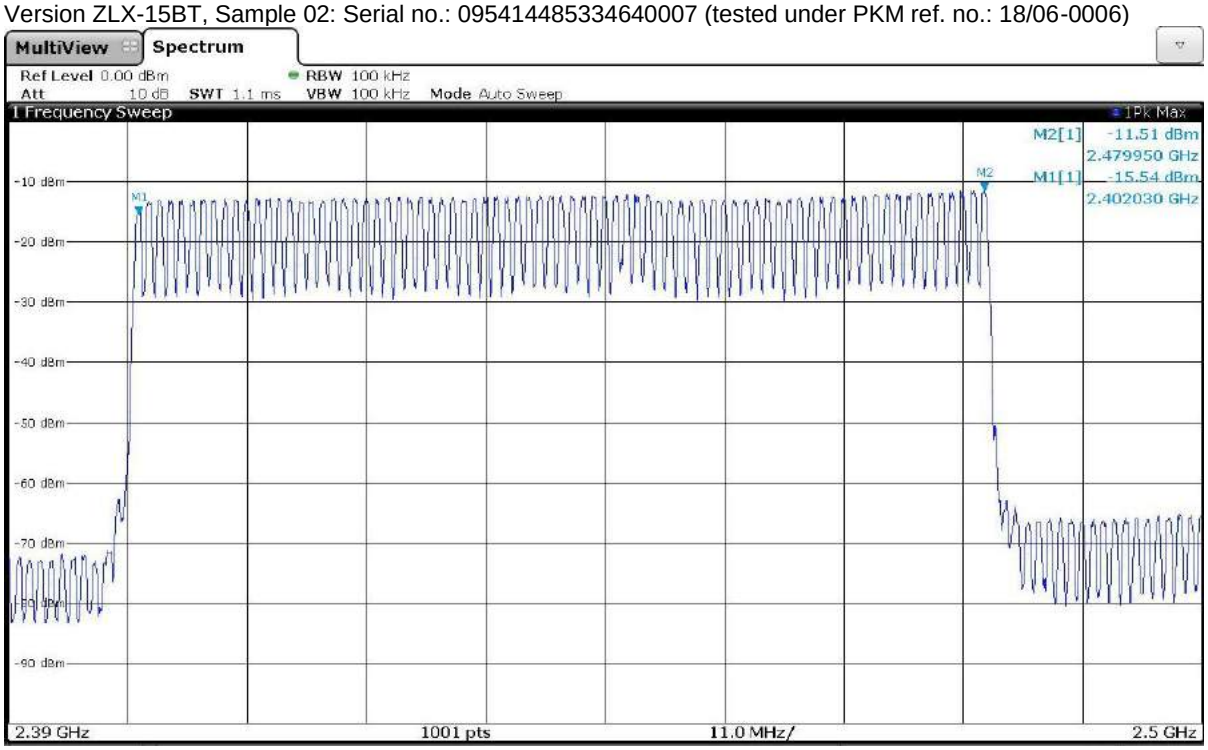
The number of hopping channel frequencies is 79 for all modes. The documented mode is BR (GFSK with 1MBit/s).

Frequency Band (MHz)	Number of Hopping Frequencies	Limit	Result
2402 - 2480.0	79	>15	Pass

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)



Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)



e) Time of Occupancy (Dwell Time)

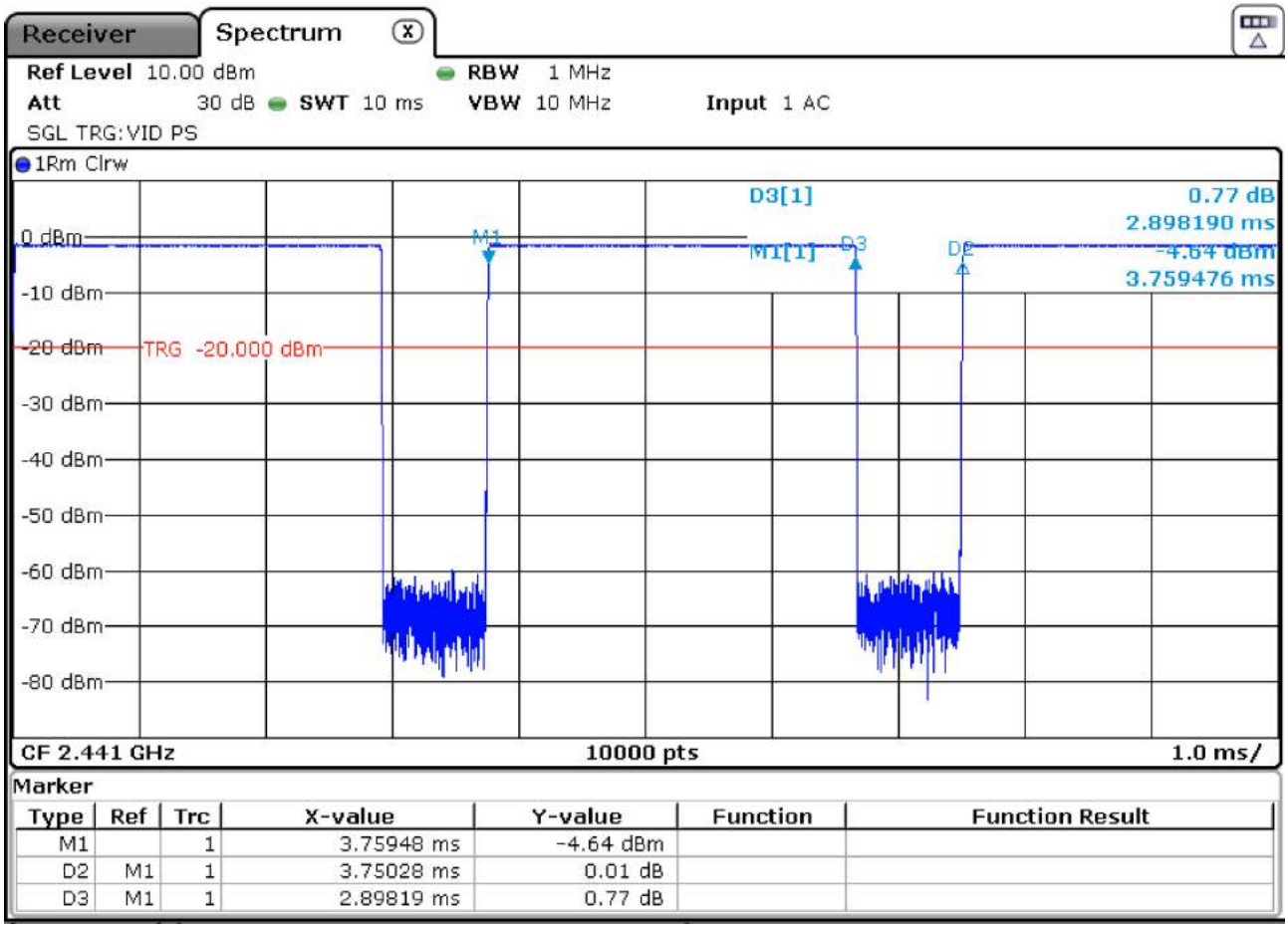
The average time of occupancy on any channel shall not be greater then 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

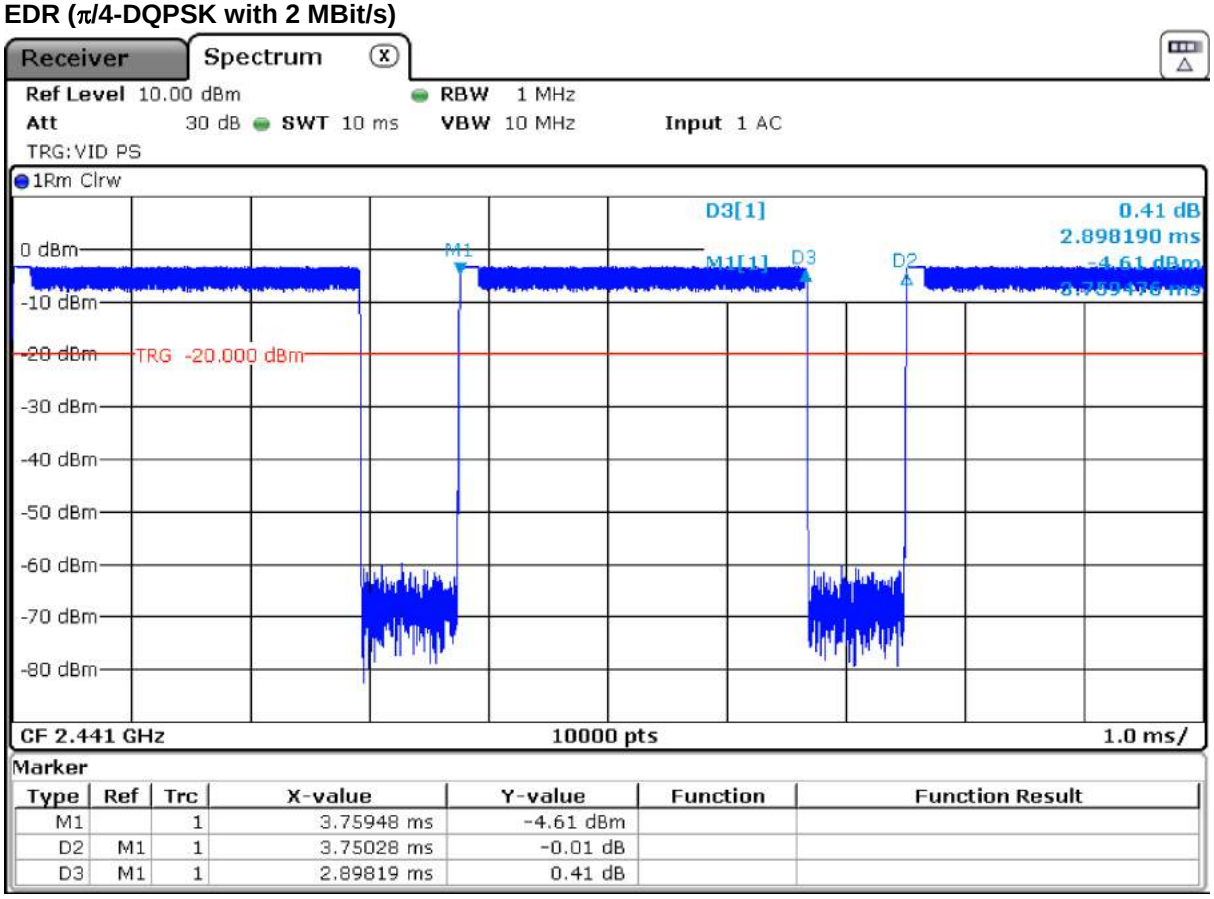
Channel No.	Frequency (MHz)	Modulation	Time of Occupancy (ms)	Limit (ms)	Result
39	2441	GFSK with 1 MBit/s	309.4	< 400	Pass
39	2441	EDR (π/4-DQPSK with 2 MBit/s)	309.4	< 400	Pass
39	2441	EDR (8-DPSK with 3 MBit/s)	309.4	< 400	Pass

Test time period: 0.4 x 79 = 31.6 s
Hopping time of one hop: 3.75 ms
Hopping times within 1 s: 1000 ms/3.75 ms = 266.7 hops/sec.
Occupancy time per hop: 2.90 ms
The maximum occupancy time within 31.6sec: [(2.90 ms x 266.7)/79] x 31.6 = 309.4 msec

GFSK with 1 MBit/s



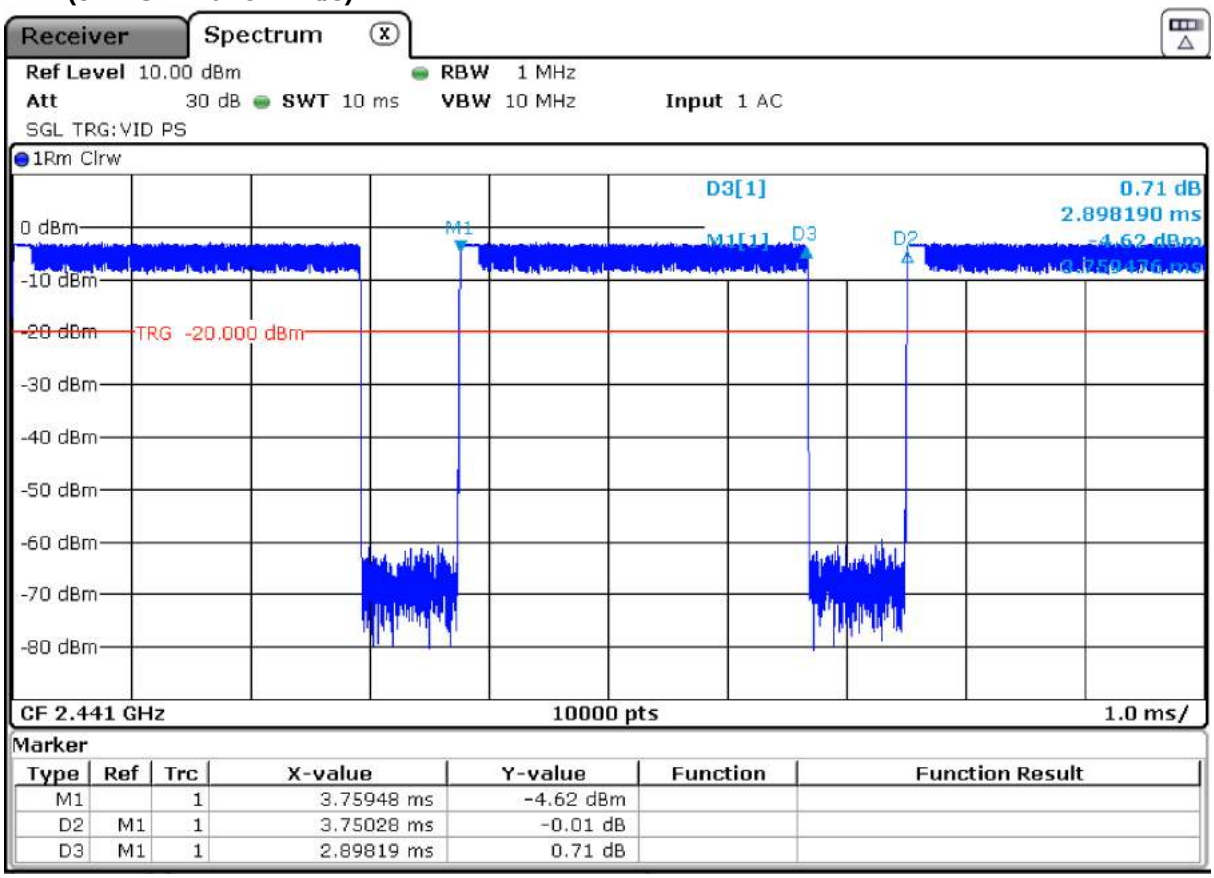
EDR (π/4-DQPSK with 2 MBit/s)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	3.75948 ms	-4.61 dBm		
D2	M1	1	3.75028 ms	-0.01 dB		
D3	M1	1	2.89819 ms	0.41 dB		

EDR (8-DPSK with 3 MBit/s)



Marker

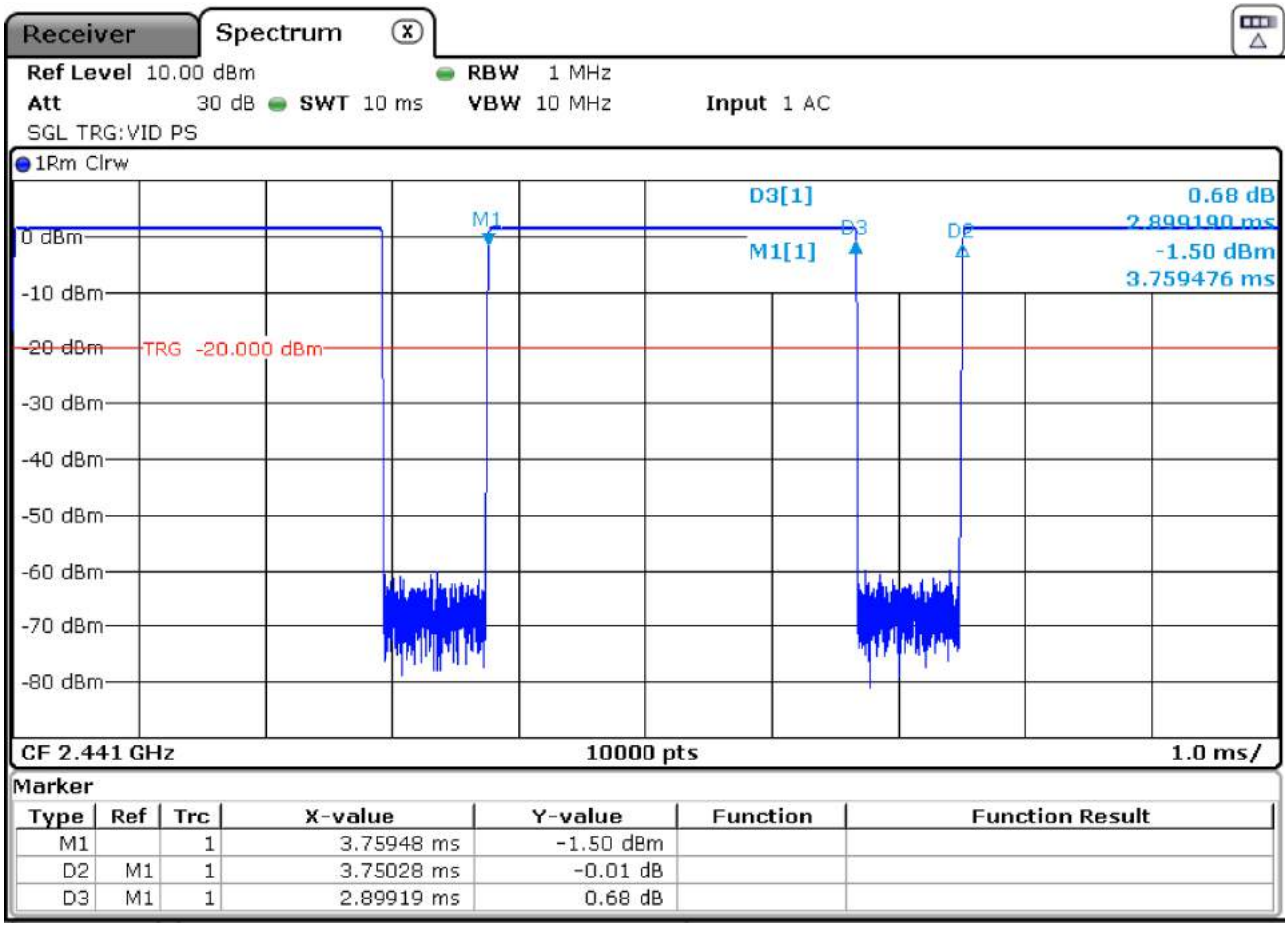
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	3.75948 ms	-4.62 dBm		
D2	M1	1	3.75028 ms	-0.01 dB		
D3	M1	1	2.89819 ms	0.71 dB		

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

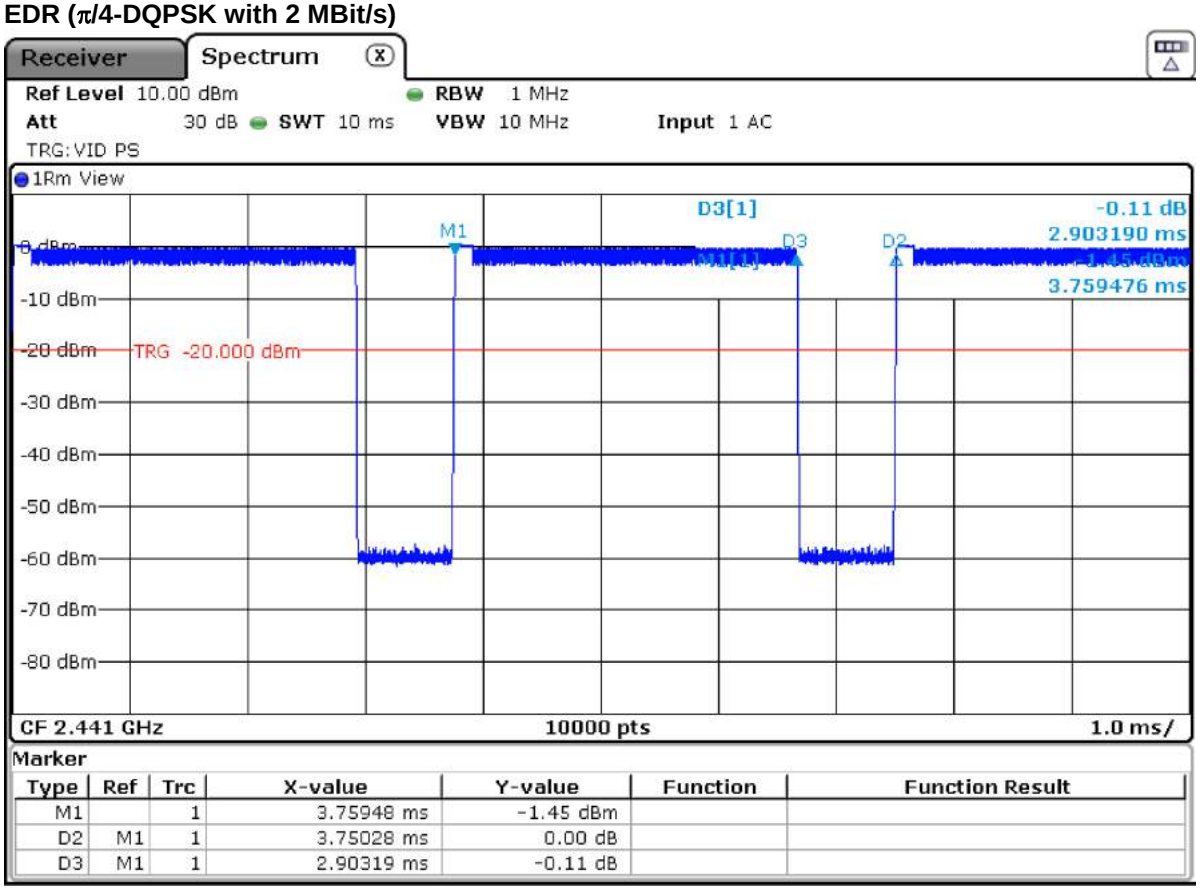
Channel No.	Frequency (MHz)	Modulation	Time of Occupancy (ms)	Limit (ms)	Result
39	2441	GFSK with 1 MBit/s	309.4	< 400	Pass
39	2441	EDR (π/4-DQPSK with 2 MBit/s)	309.4	< 400	Pass
39	2441	EDR (8-DPSK with 3 MBit/s)	309.4	< 400	Pass

Test time period: 0.4 x 79 = 31.6 s
Hopping time of one hop: 3.75 ms
Hopping times within 1 s: 1000 ms/3.75 ms = 266.7 hops/sec.
Occupancy time per hop: 2.90 ms
The maximum occupancy time within 31.6sec: [(2.90 ms x 266.7)/79] x 31.6 = 309.4 msec

GFSK with 1 MBit/s



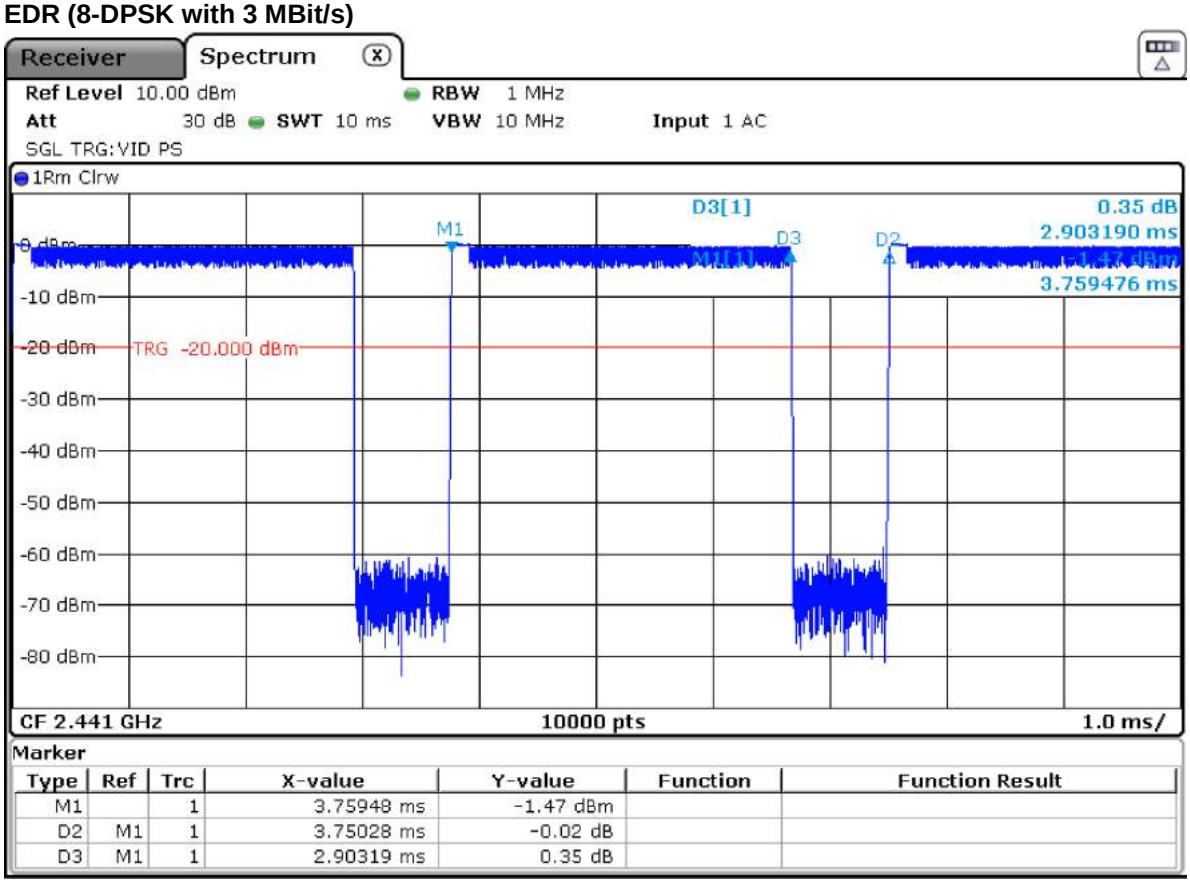
EDR (π/4-DQPSK with 2 MBit/s)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	3.75948 ms	-1.45 dBm		
D2	M1	1	3.75028 ms	0.00 dB		
D3	M1	1	2.90319 ms	-0.11 dB		

EDR (8-DPSK with 3 MBit/s)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	3.75948 ms	-1.47 dBm		
D2	M1	1	3.75028 ms	-0.02 dB		
D3	M1	1	2.90319 ms	0.35 dB		

f) Maximum peak conducted output power

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
As the EUT's have a channel separation less than the 20 dB bandwidth, 0.125 W is the applicable limit.

All maximum peak conducted output power measurements had been performed with maximum output power setting of the EUT.

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

GFSK with 1 MBit/s

Channel No. (1)	Frequency (MHz) (2)	Measured Output Power (dBm) (3)	Cable correction (dB) (4)	Corrected Output Power (dBm) (5)	Output Power (mW) (6)	Limit (mW) (7)	Result (8)
0	2402	0.83	0.3	1.13	1.3	125	Pass
39	2441	2.36	0.3	2.66	1.8	125	Pass
78	2480	2.72	0.3	3.02	2.0	125	Pass

EDR (π/4-DQPSK with 2 MBit/s)

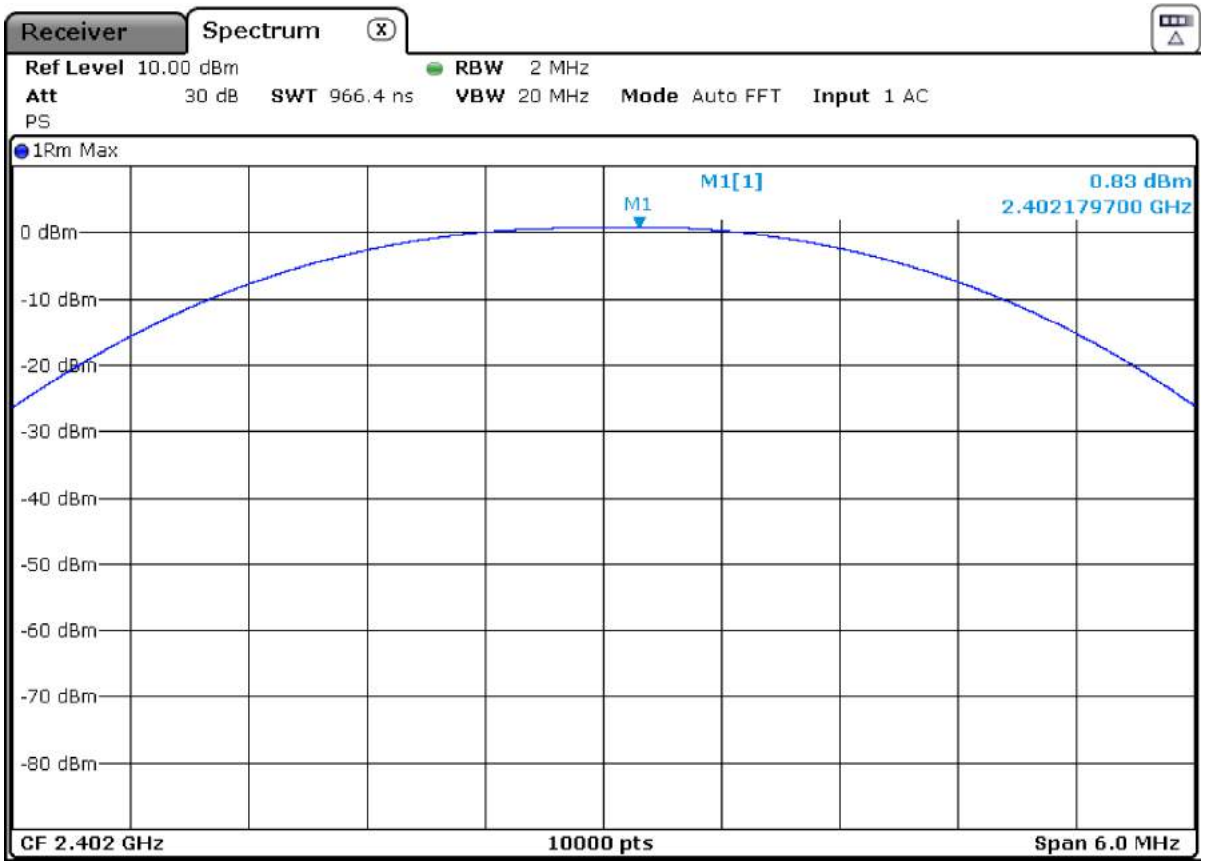
Channel No. (1)	Frequency (MHz) (2)	Measured Output Power (dBm) (3)	Cable correction (dB) (4)	Corrected Output Power (dBm) (5)	Output Power (mW) (6)	Limit (mW) (7)	Result (8)
0	2402	-0.08	0.3	0.22	1.1	125	Pass
39	2441	2.02	0.3	2.32	1.7	125	Pass
78	2480	2.53	0.3	2.83	1.9	125	Pass

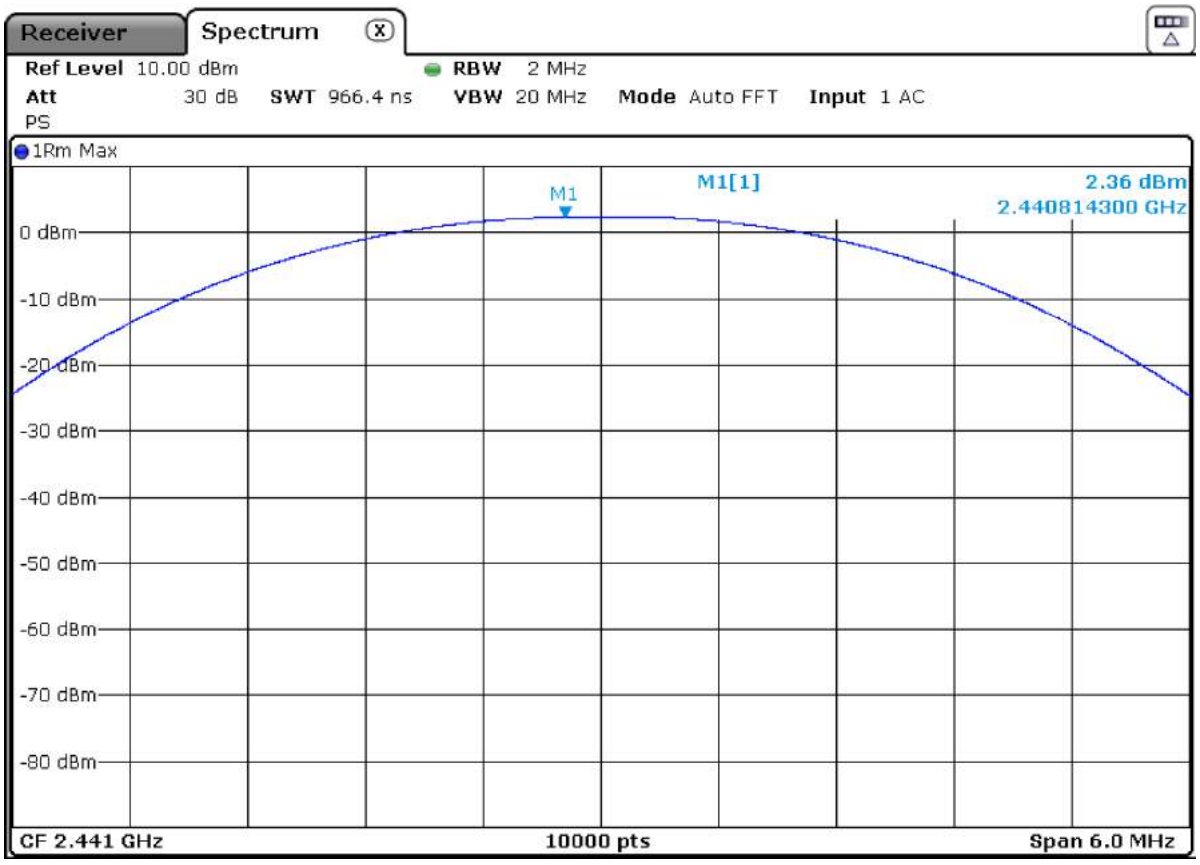
EDR (8-DPSK with 3 MBit/s)

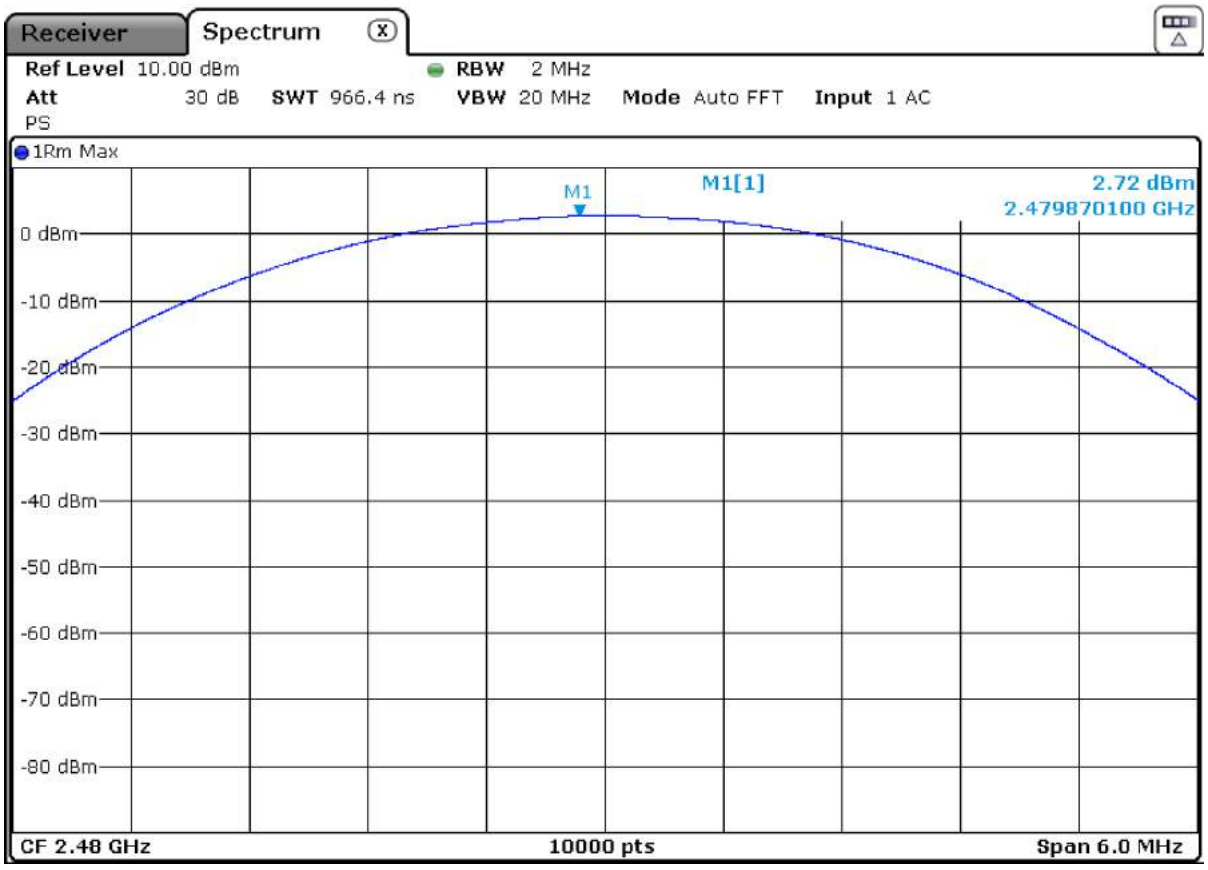
Channel No. (1)	Frequency (MHz) (2)	Measured Output Power (dBm) (3)	Cable correction (dB) (4)	Corrected Output Power (dBm) (5)	Output Power (mW) (6)	Limit (mW) (7)	Result (8)
0	2402	0.45	0.3	0.75	1.2	125	Pass
39	2441	2.68	0.3	2.98	2.0	125	Pass
78	2480	2.81	0.3	3.11	2.0	125	Pass

(1) = Bluetooth channel number
(2) = Corresponding Bluetooth channel frequency
(3) = Measured output power on spectrum analyzer
(4) = Cable loss between EUT and analyzer
(5) = (3) + (4)
(6) = Linear power ($10^{(5)/10}$)
(7) = Limit
(8) = Comparison between (6) and (7)

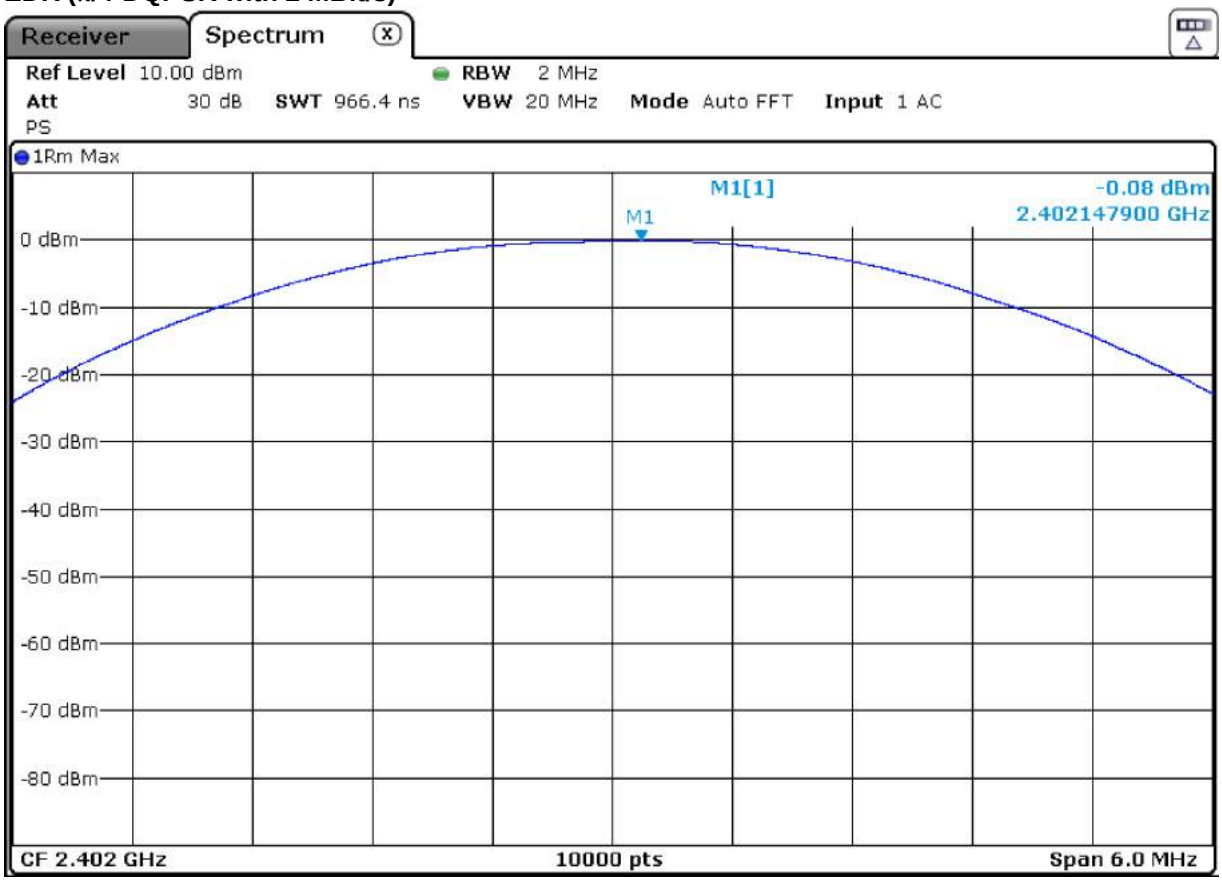
GFSK with 1 MBit/s

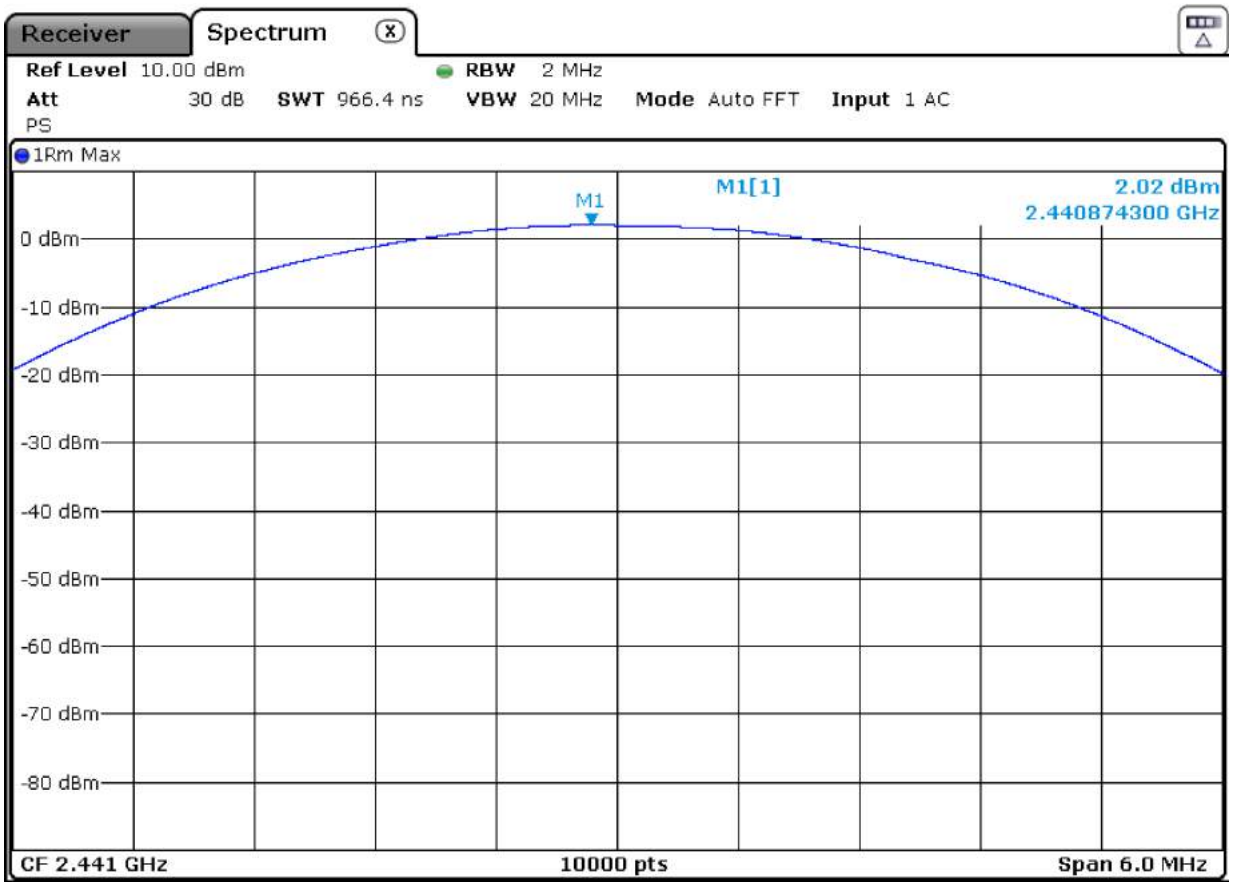


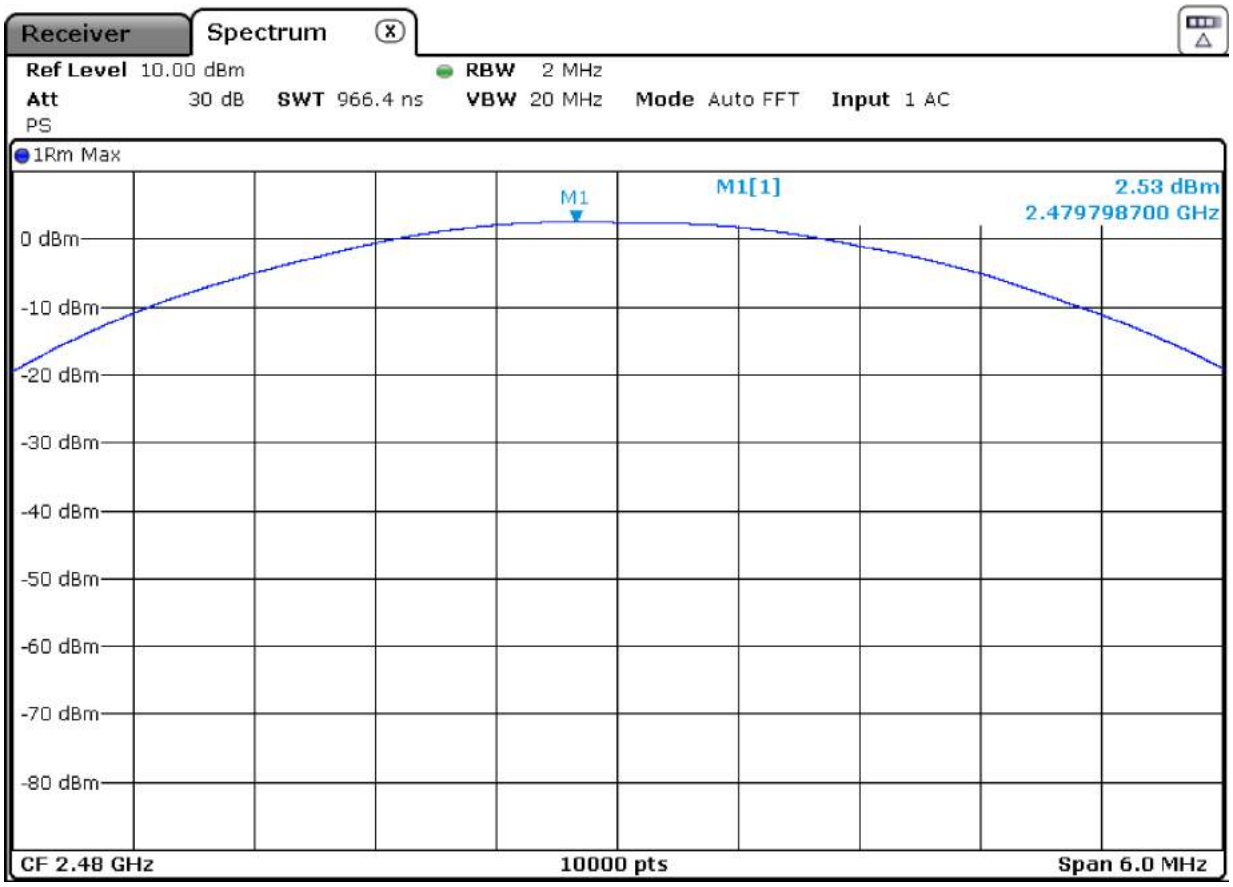




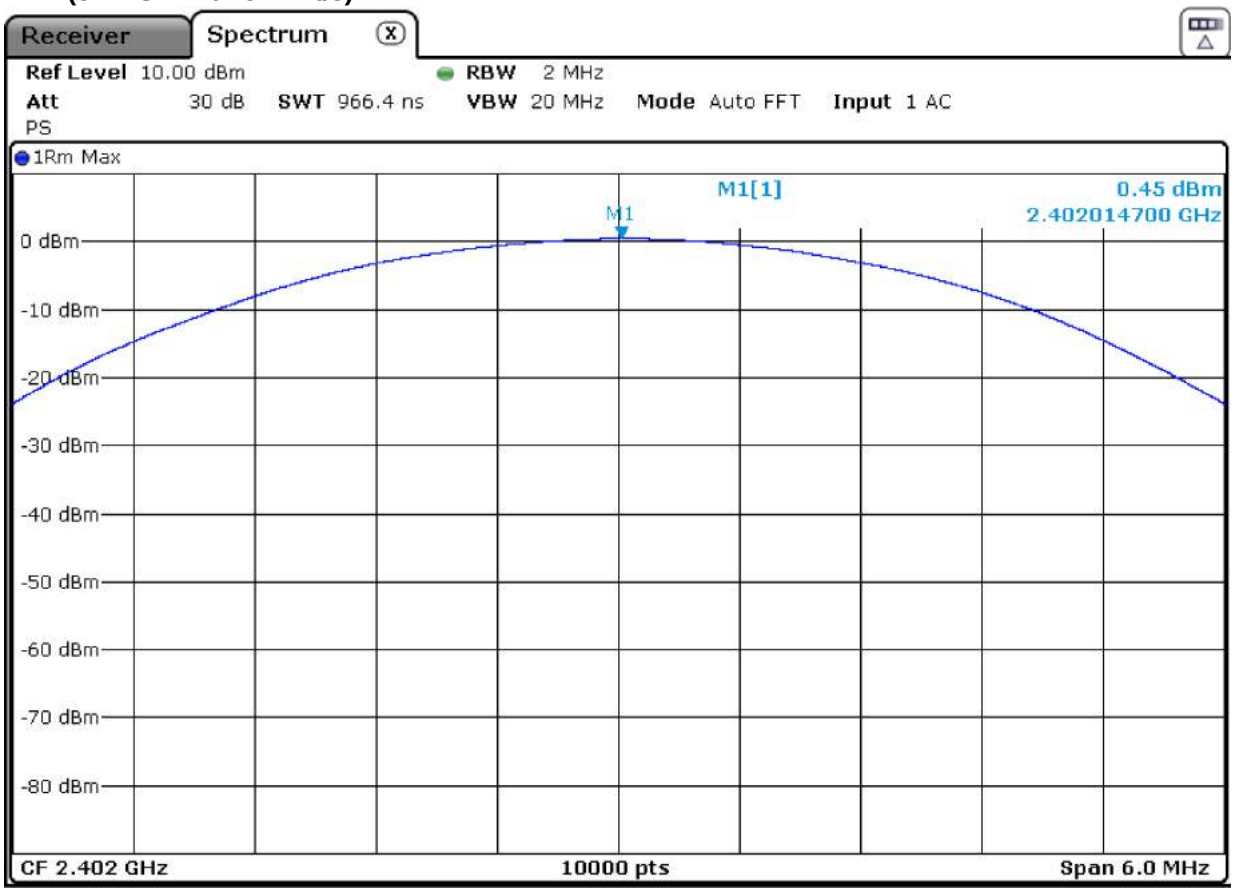
EDR (π/4-DQPSK with 2 MBit/s)

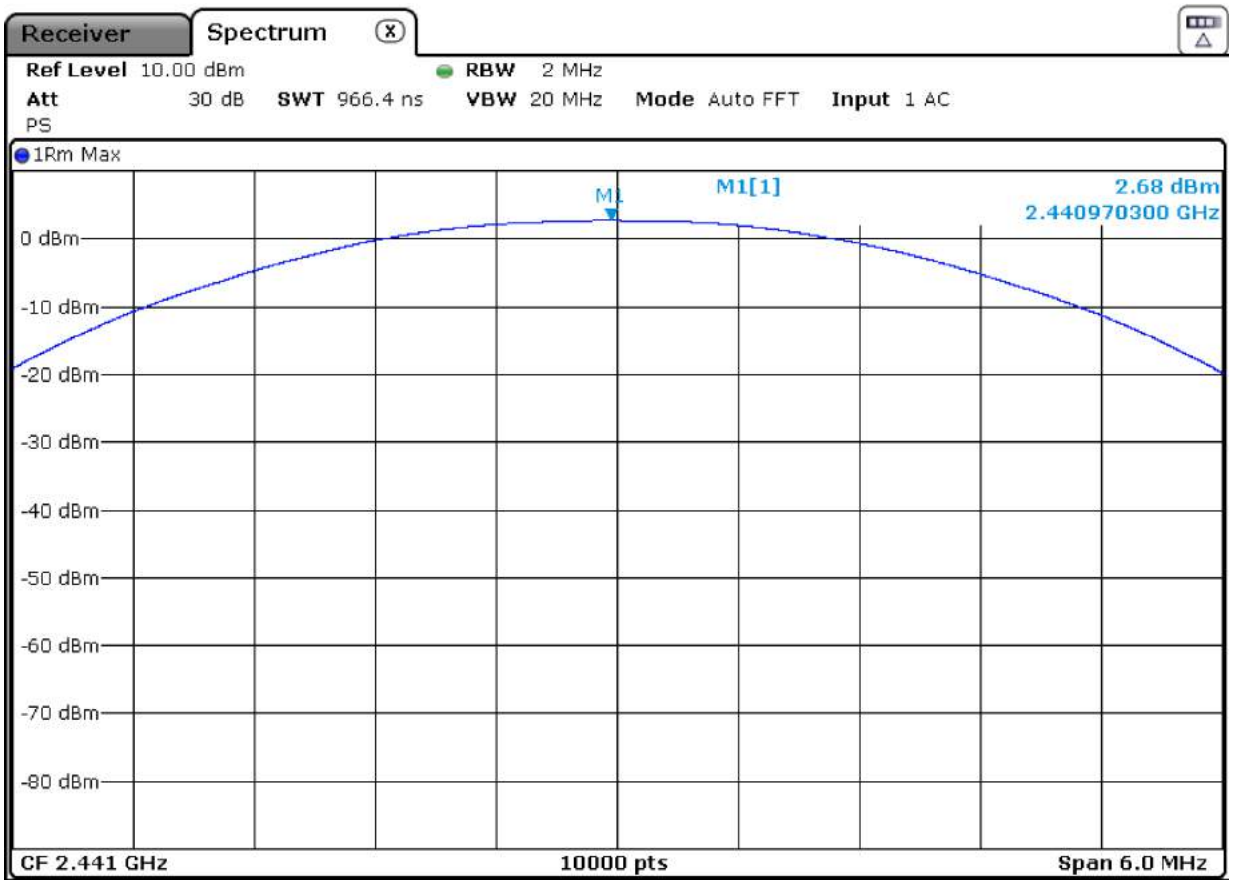


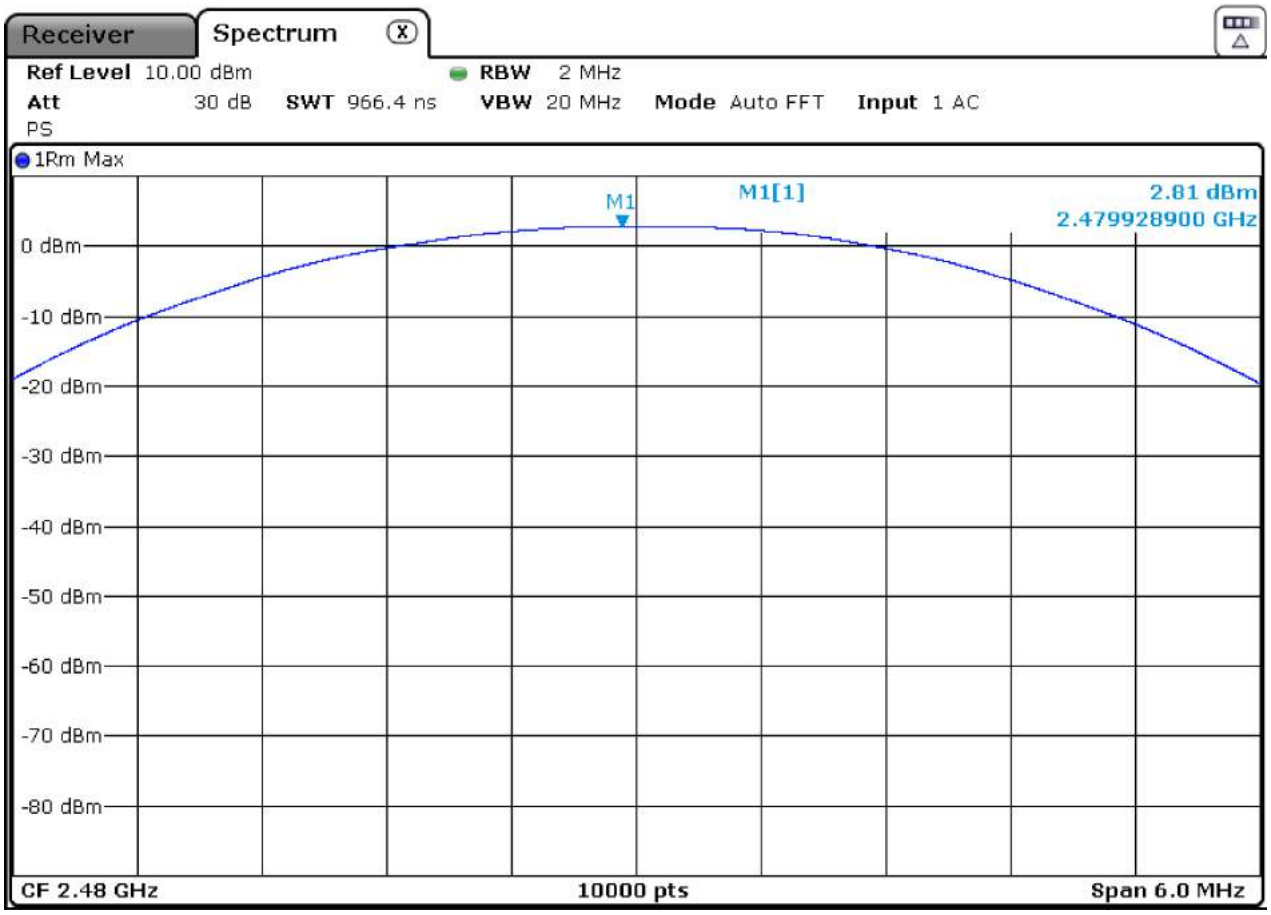

Receiver
Spectrum
Ref Level 10.00 dBm
RBW 2 MHz
Att 30 dB SWT 966.4 ns VBW 20 MHz Mode Auto FFT Input 1 AC
PS
1Rm Max
M1
M1[1]
2.02 dBm
2.440874300 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
10000 pts
Span 6.0 MHz


Receiver
Spectrum
Ref Level 10.00 dBm
RBW 2 MHz
Att 30 dB SWT 966.4 ns VBW 20 MHz Mode Auto FFT Input 1 AC
PS
1Rm Max
M1
M1[1]
2.53 dBm
2.479798700 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
10000 pts
Span 6.0 MHz

EDR (8-DPSK with 3 MBit/s)






Receiver
Spectrum
Ref Level 10.00 dBm
RBW 2 MHz
Att 30 dB
SWT 966.4 ns
VBW 20 MHz
Mode Auto FFT
Input 1 AC
PS
1Rm Max
M1
M1[1]
2.81 dBm
2.479928900 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
10000 pts
Span 6.0 MHz

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

GFSK with 1 MBit/s

Channel No. (1)	Frequency (MHz) (2)	Measured Output Power (dBm) (3)	Cable correction (dB) (4)	Corrected Output Power (dBm) (5)	Output Power (mW) (6)	Limit (mW) (7)	Result (8)
0	2402	1.24	0.3	1.54	1.4	125	Pass
39	2441	2.83	0.3	3.13	2.1	125	Pass
78	2480	3.25	0.3	3.55	2.3	125	Pass

EDR (π/4-DQPSK with 2 MBit/s)

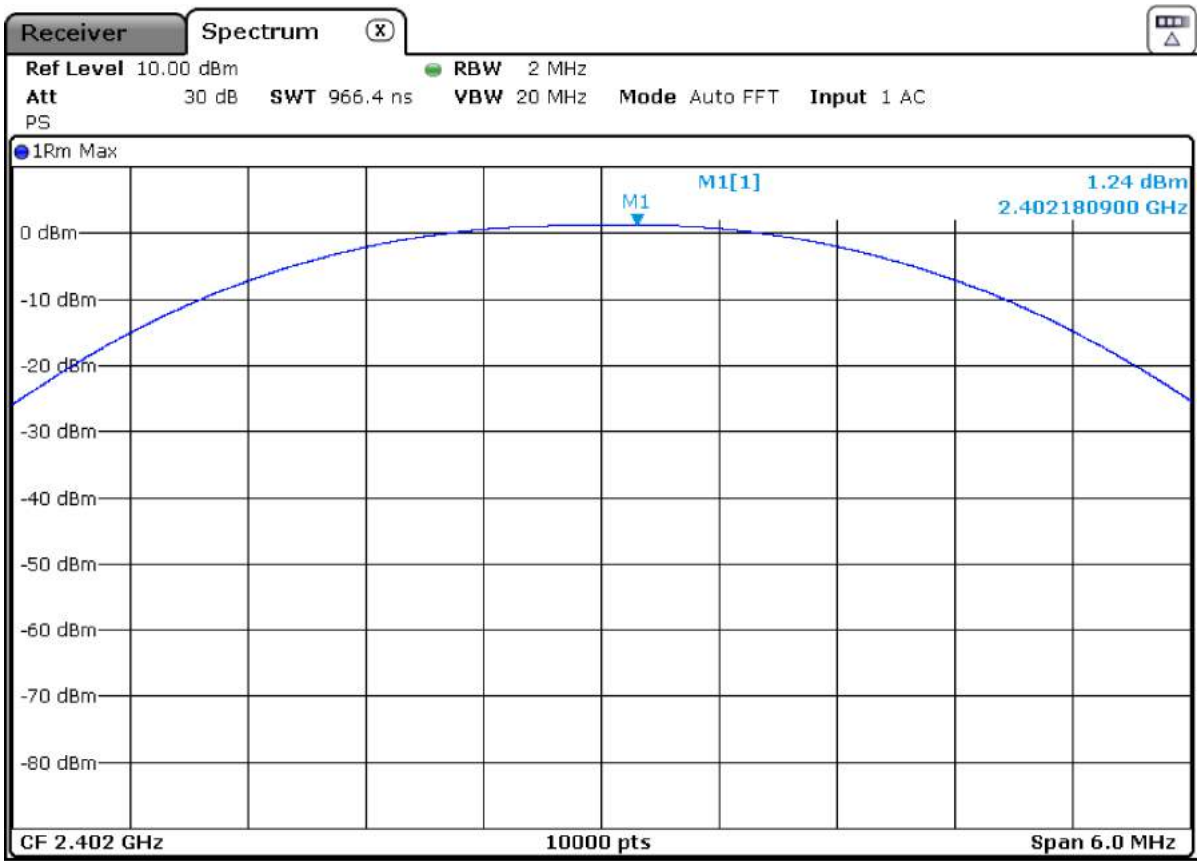
Channel No. (1)	Frequency (MHz) (2)	Measured Output Power (dBm) (3)	Cable correction (dB) (4)	Corrected Output Power (dBm) (5)	Output Power (mW) (6)	Limit (mW) (7)	Result (8)
0	2402	0.22	0.3	0.52	1.1	125	Pass
39	2441	2.52	0.3	2.82	1.9	125	Pass
78	2480	2.84	0.3	3.14	2.1	125	Pass

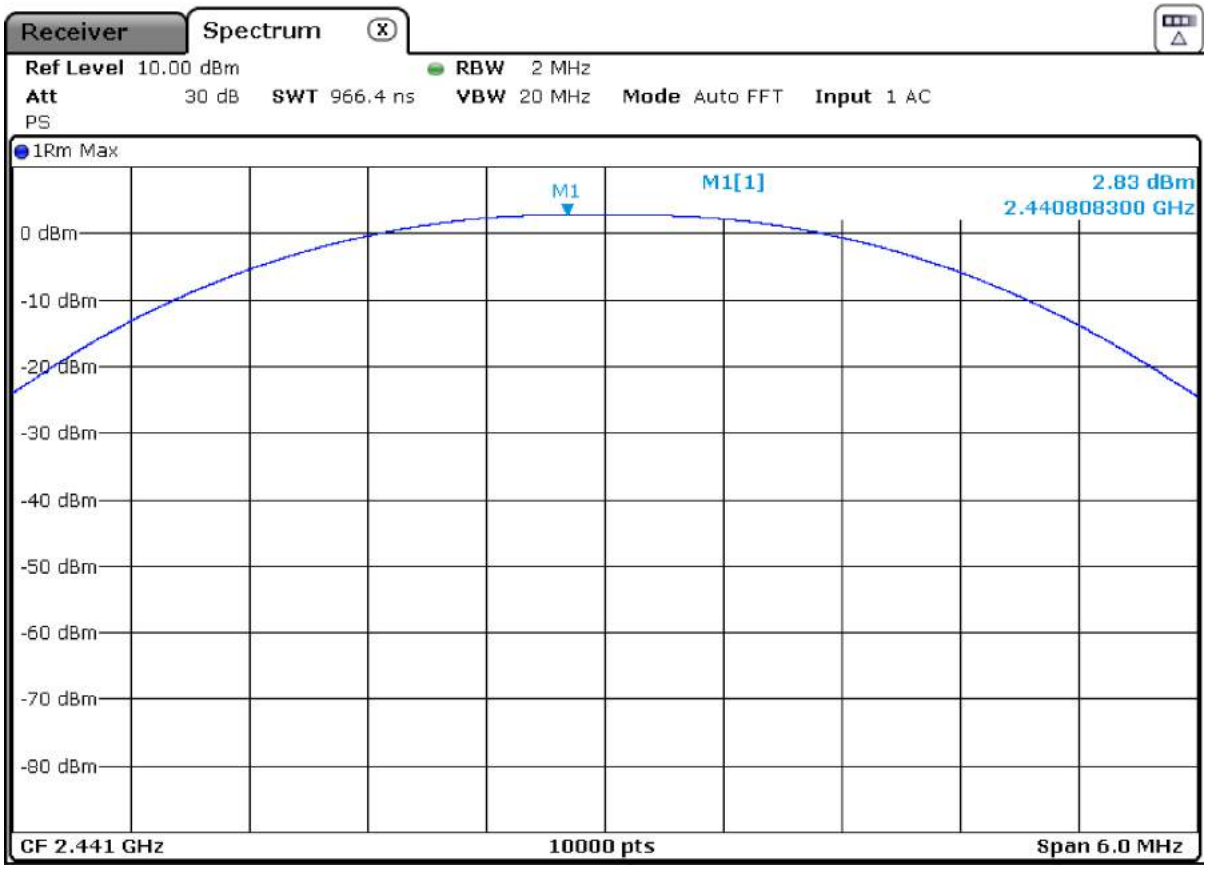
EDR (8-DPSK with 3 MBit/s)

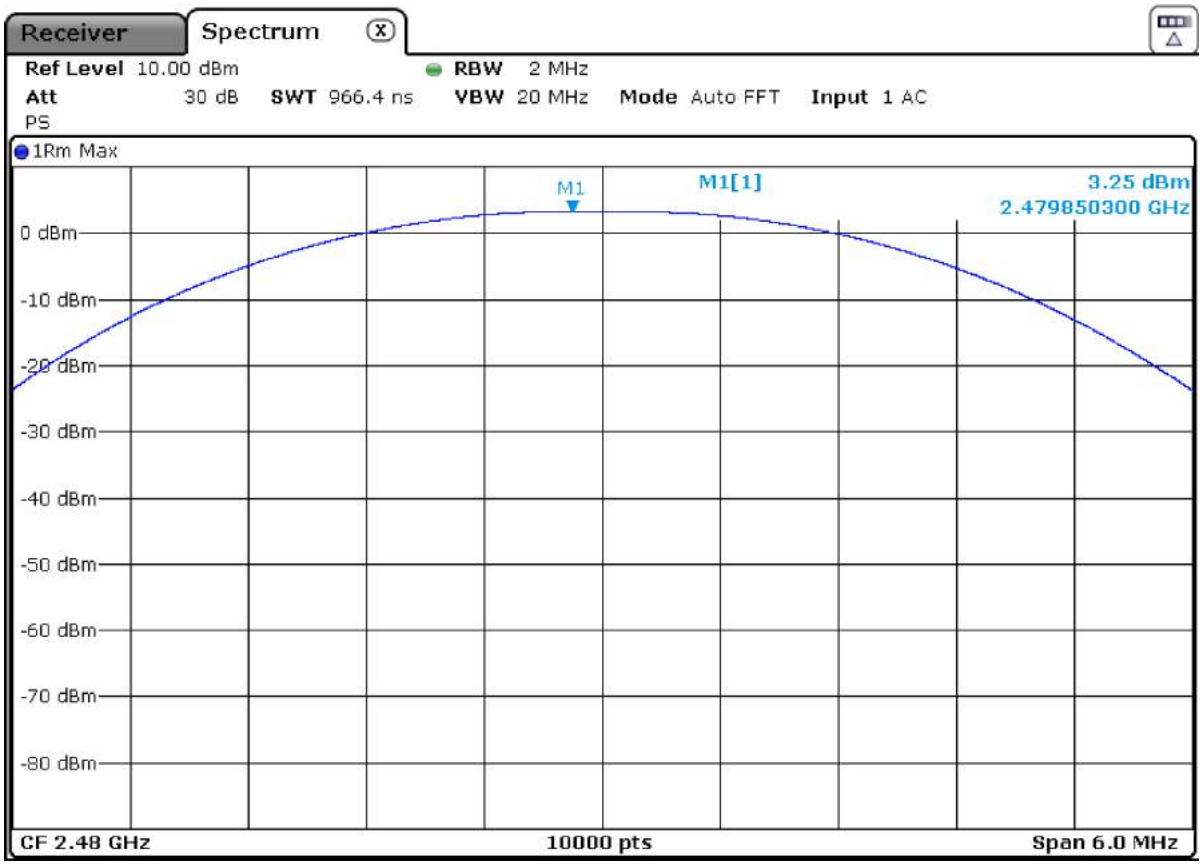
Channel No. (1)	Frequency (MHz) (2)	Measured Output Power (dBm) (3)	Cable correction (dB) (4)	Corrected Output Power (dBm) (5)	Output Power (mW) (6)	Limit (mW) (7)	Result (8)
0	2402	0.28	0.3	0.58	1.1	125	Pass
39	2441	2.63	0.3	2.93	2.0	125	Pass
78	2480	2.99	0.3	3.29	2.1	125	Pass

(1) = Bluetooth channel number
(2) = Corresponding Bluetooth channel frequency
(3) = Measured output power on spectrum analyzer
(4) = Cable loss between EUT and analyzer
(5) = (3) + (4)
(6) = Linear power ($10^{(5)/10}$)
(7) = Limit
(8) = Comparison between (6) and (7)

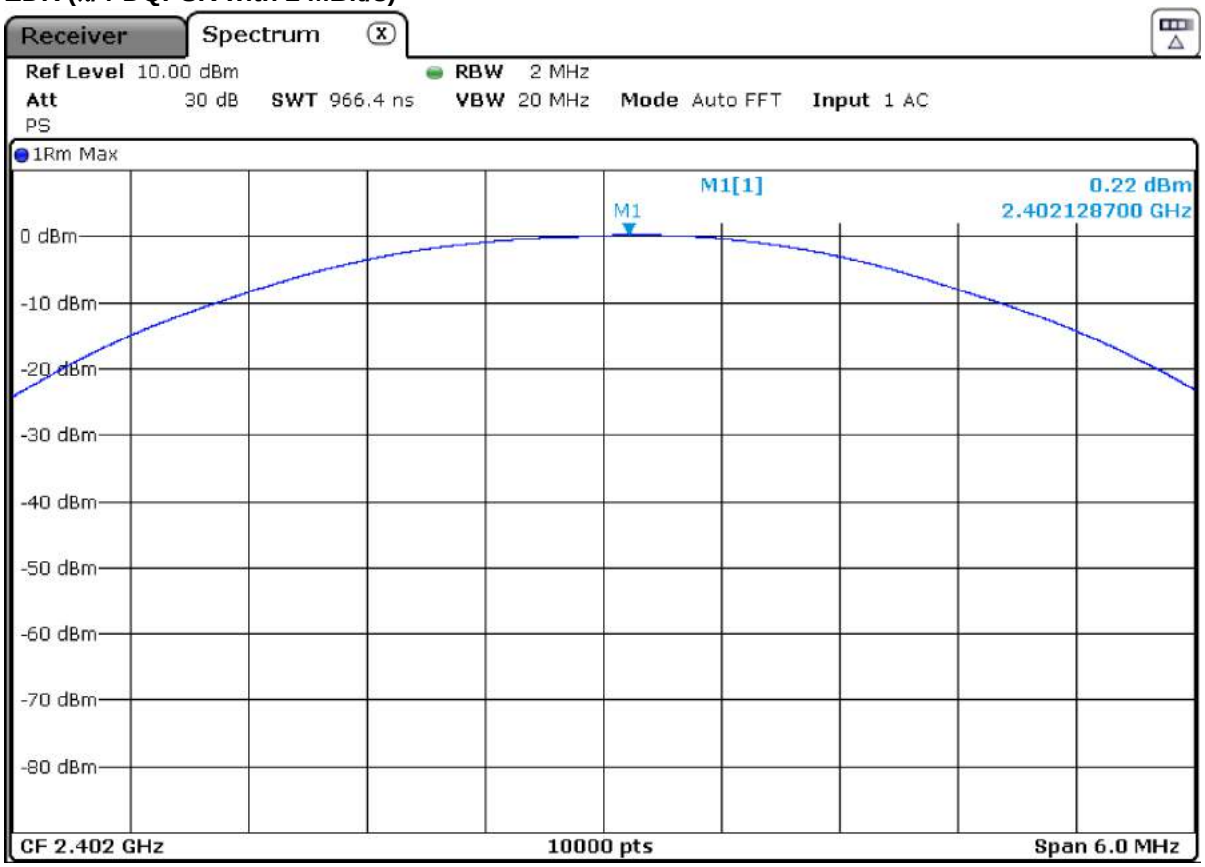
GFSK with 1 MBit/s

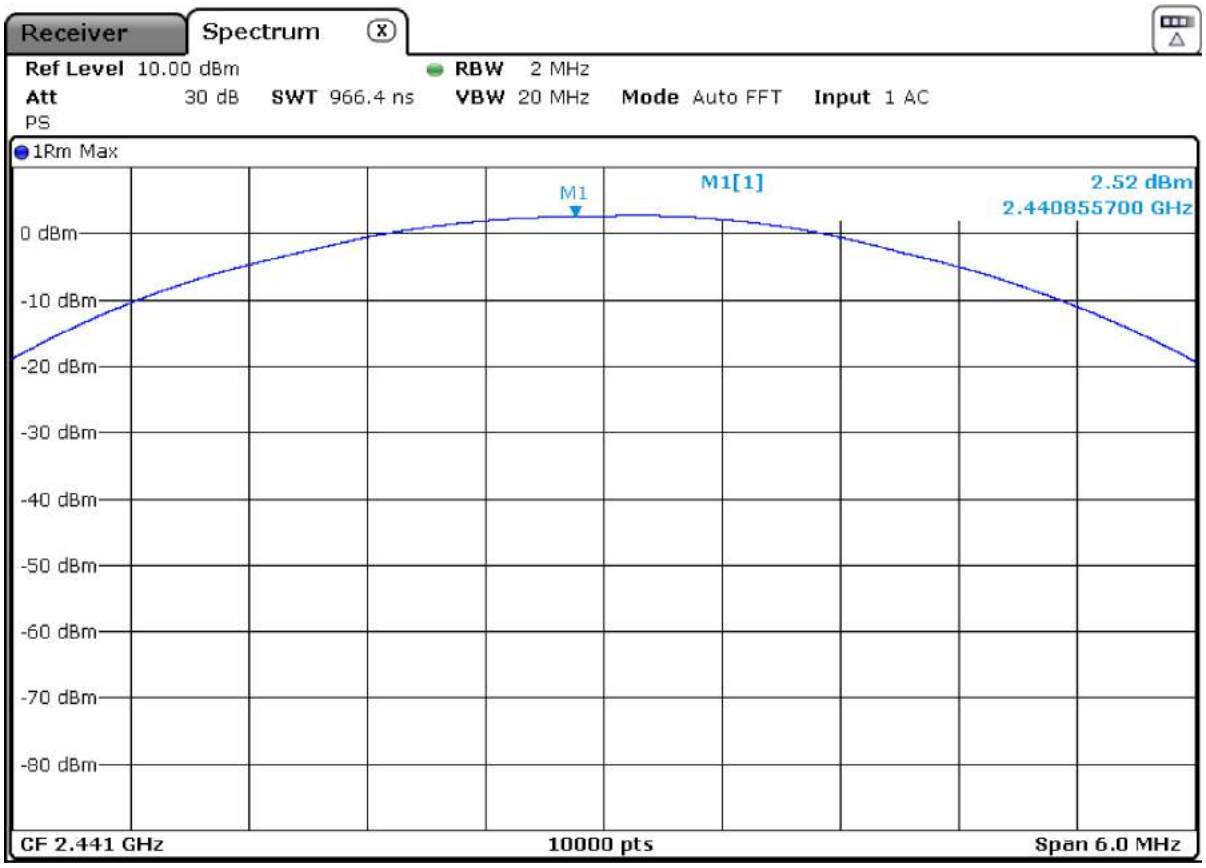


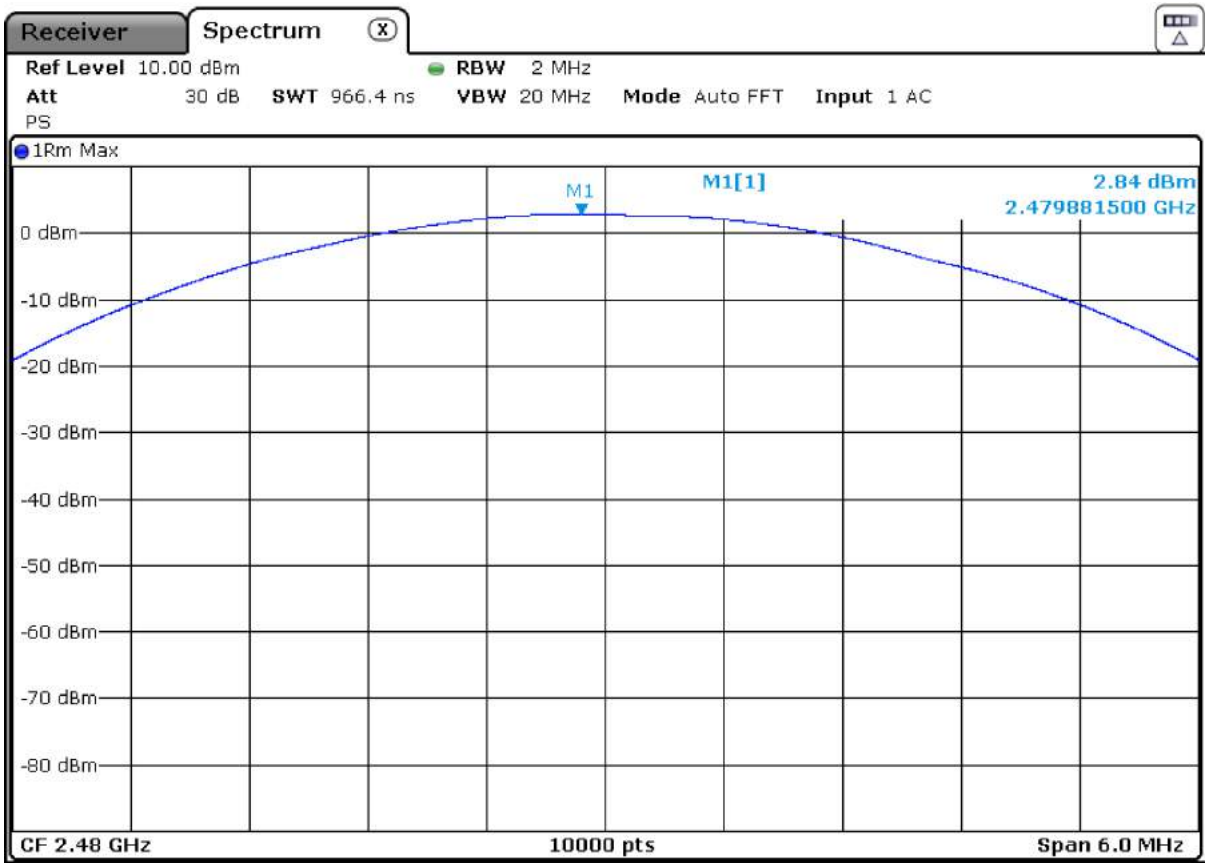




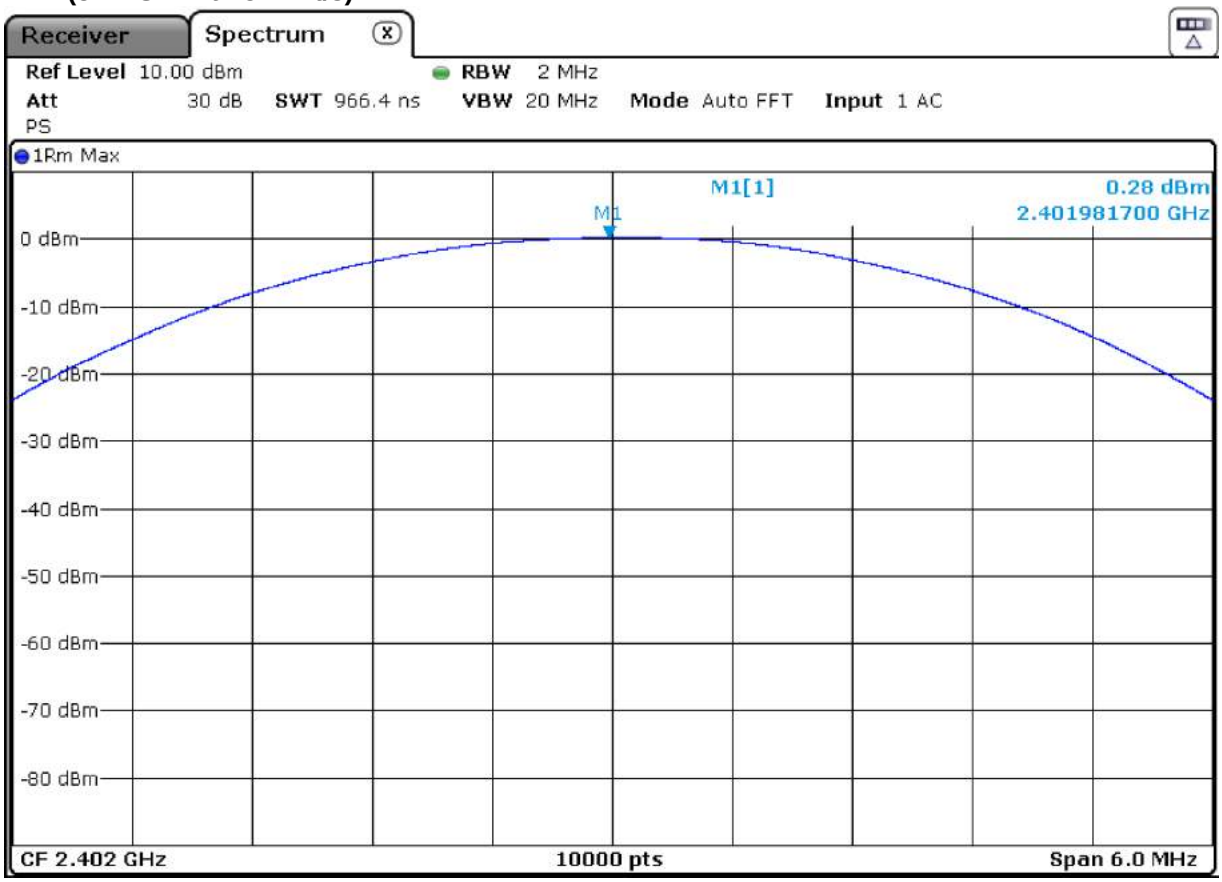
EDR (π/4-DQPSK with 2 MBit/s)

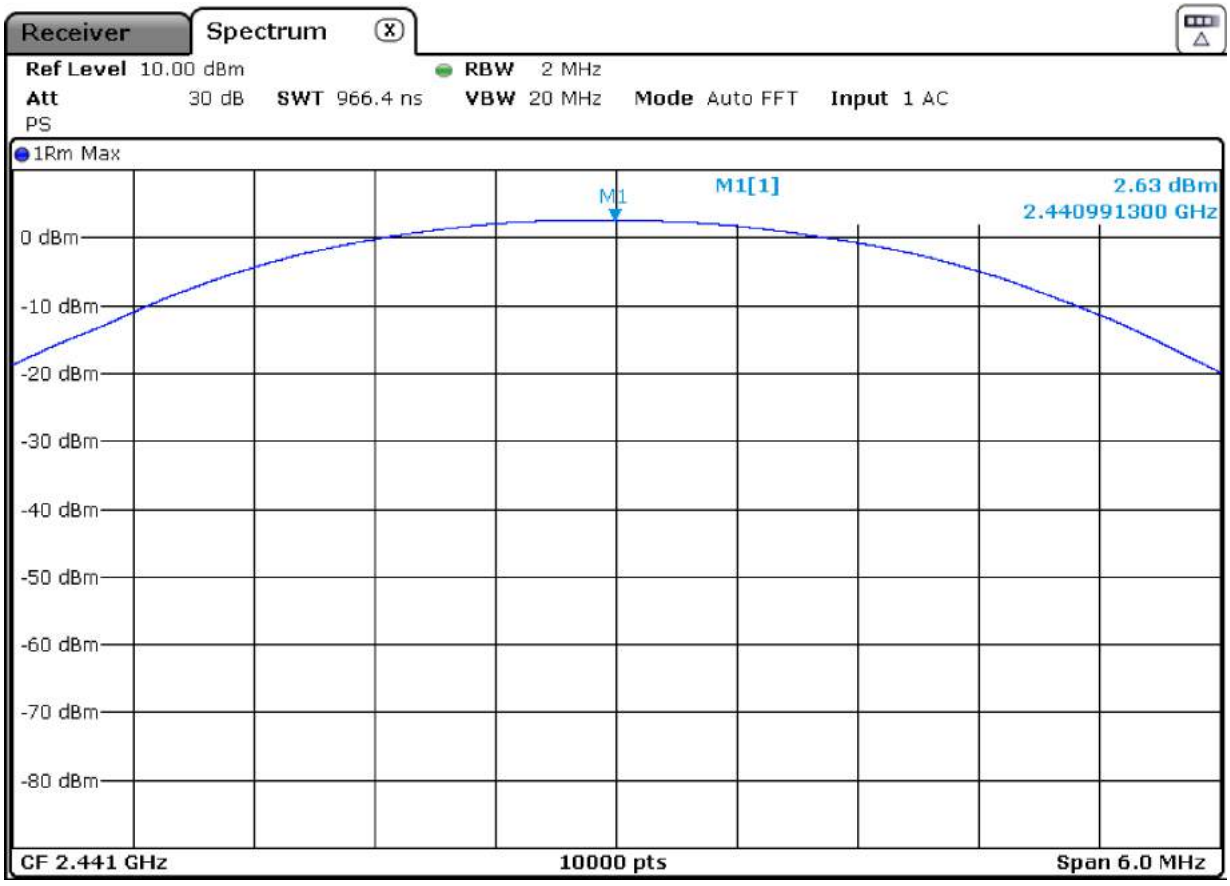


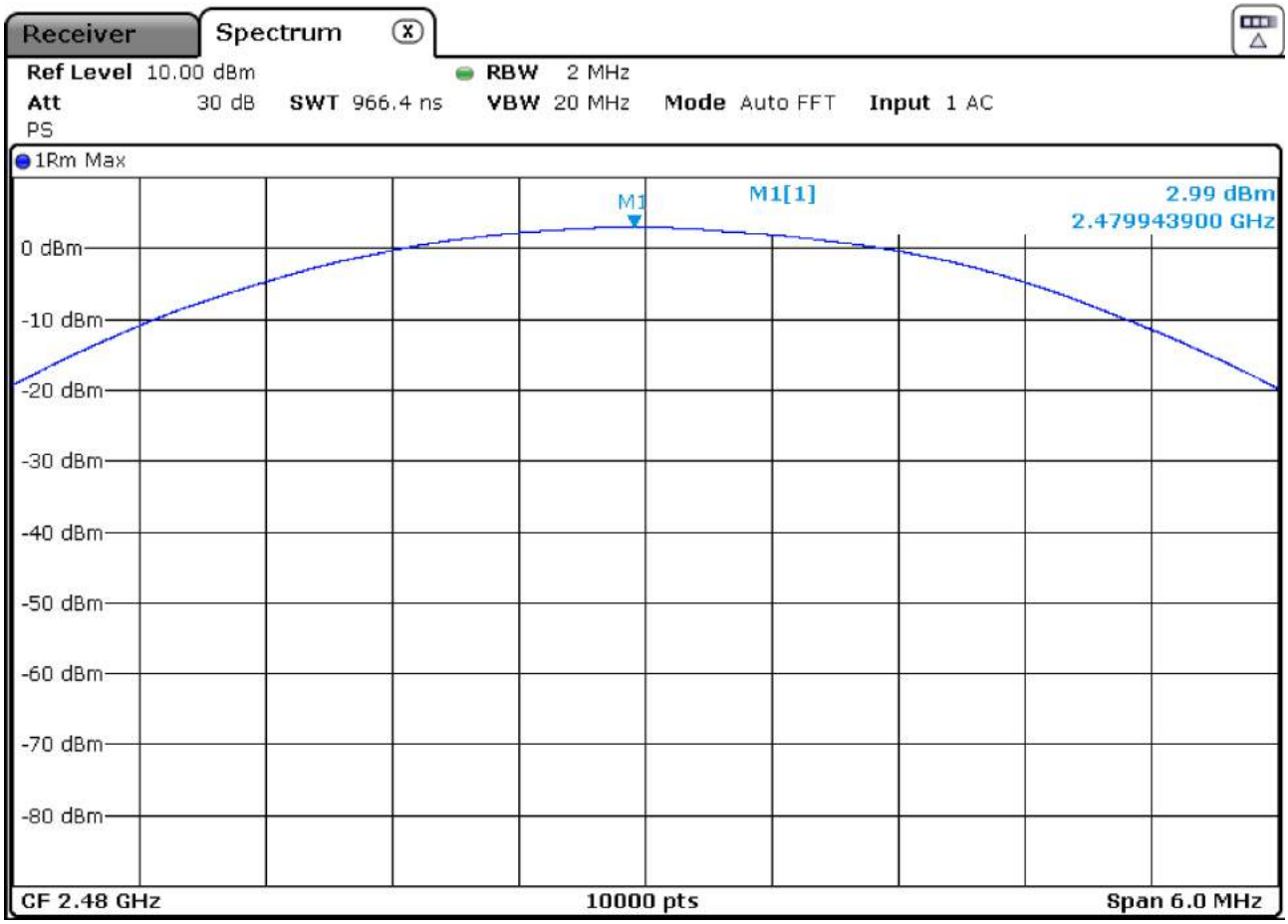

Receiver
Spectrum
Ref Level 10.00 dBm
RBW 2 MHz
Att 30 dB SWT 966.4 ns VBW 20 MHz Mode Auto FFT Input 1 AC
PS
1Rm Max
M1
M1[1]
2.52 dBm
2.440855700 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.441 GHz
10000 pts
Span 6.0 MHz


Receiver
Spectrum
Ref Level 10.00 dBm
RBW 2 MHz
Att 30 dB SWT 966.4 ns VBW 20 MHz Mode Auto FFT Input 1 AC
PS
1Rm Max
M1
M1[1]
2.84 dBm
2.479881500 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
10000 pts
Span 6.0 MHz

EDR (8-DPSK with 3 MBit/s)





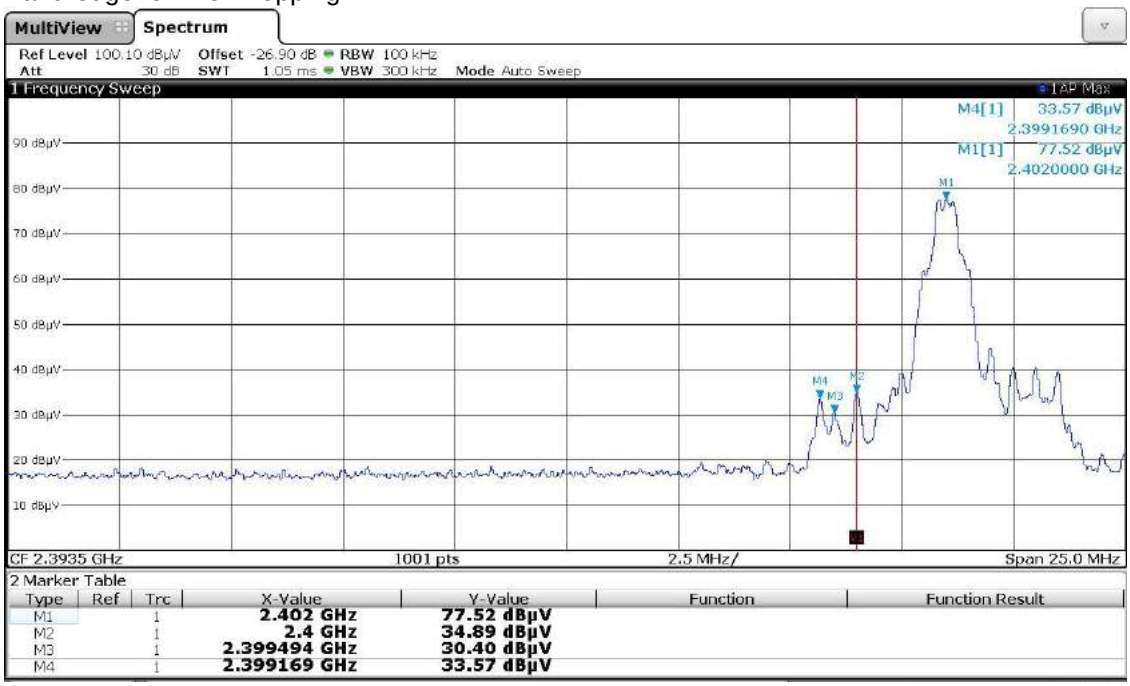

Receiver
Spectrum
Ref Level 10.00 dBm
RBW 2 MHz
Att 30 dB
SWT 966.4 ns
VBW 20 MHz
Mode Auto FFT
Input 1 AC
PS
1Rm Max
M1
M1[1]
2.99 dBm
2.479943900 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 2.48 GHz
10000 pts
Span 6.0 MHz

g) Conducted RF band edge emissions

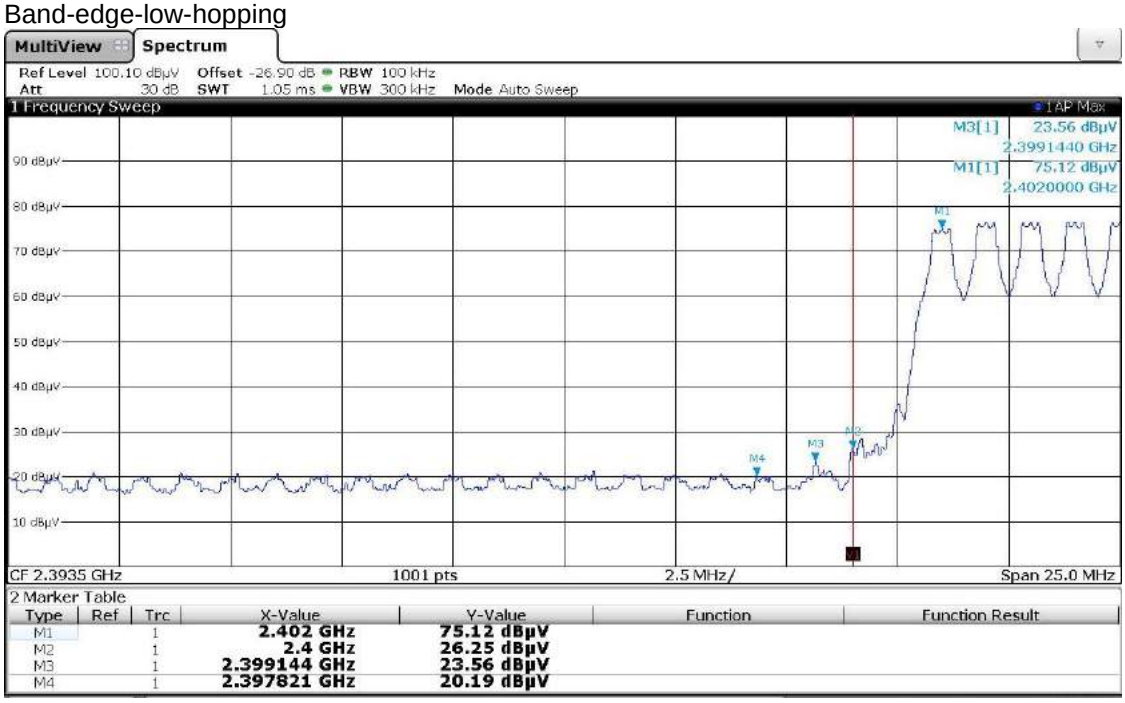
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required.

All conducted measured radio frequency power that is produced by the intentional radiator is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Measurement had been performed with GFSK with 1 MBit/s as worst case.

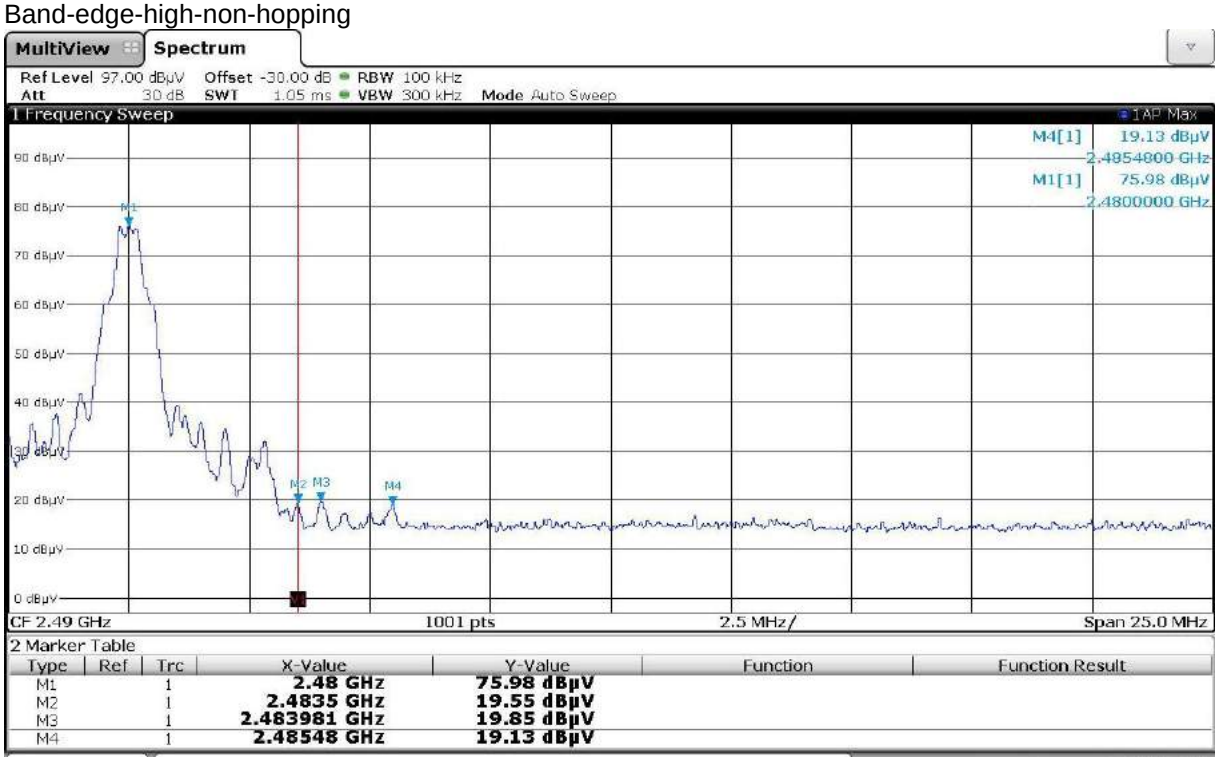
Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)
Band-edge-low-non-hopping



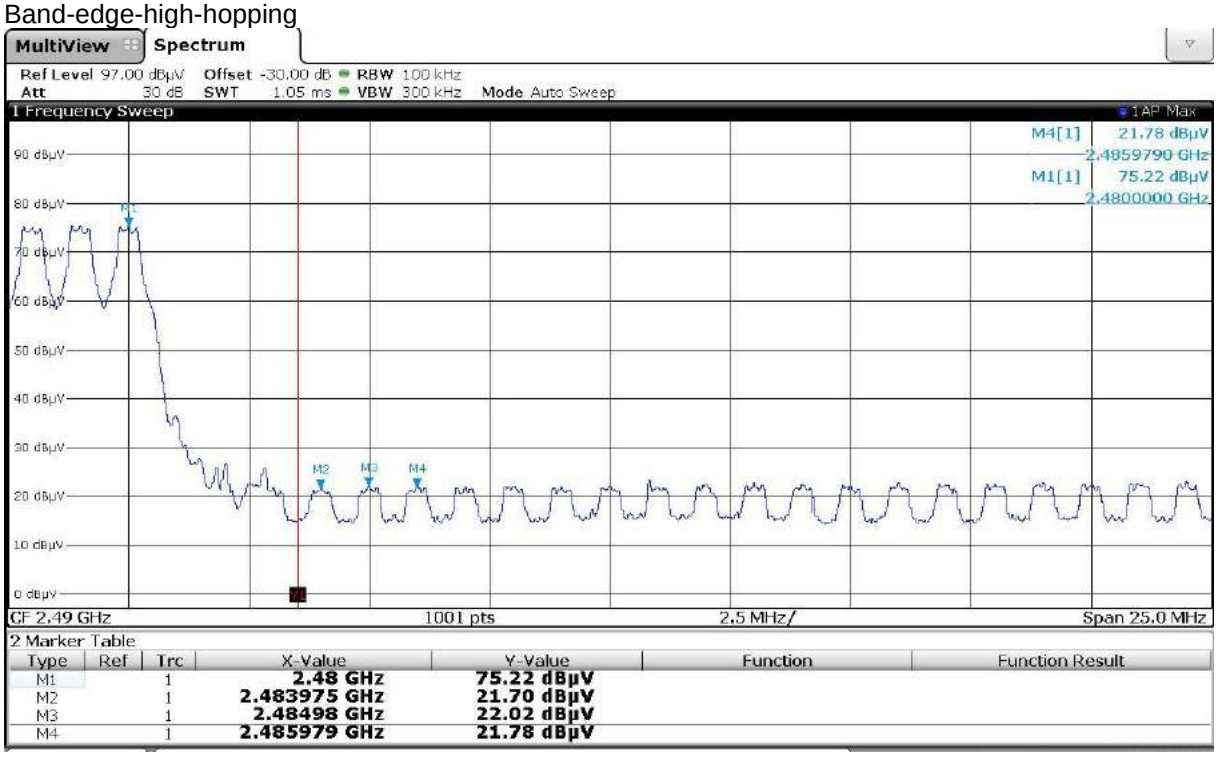
Band-edge-low-hopping



Band-edge-high-non-hopping



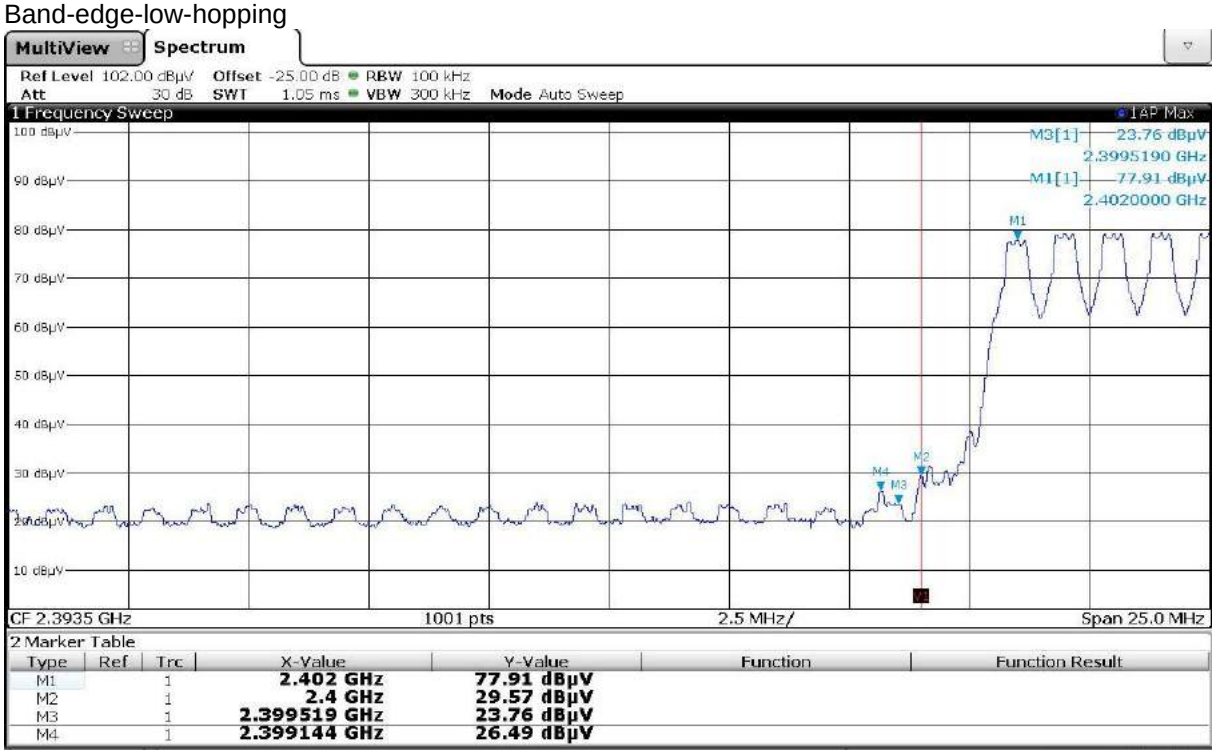
Band-edge-high-hopping



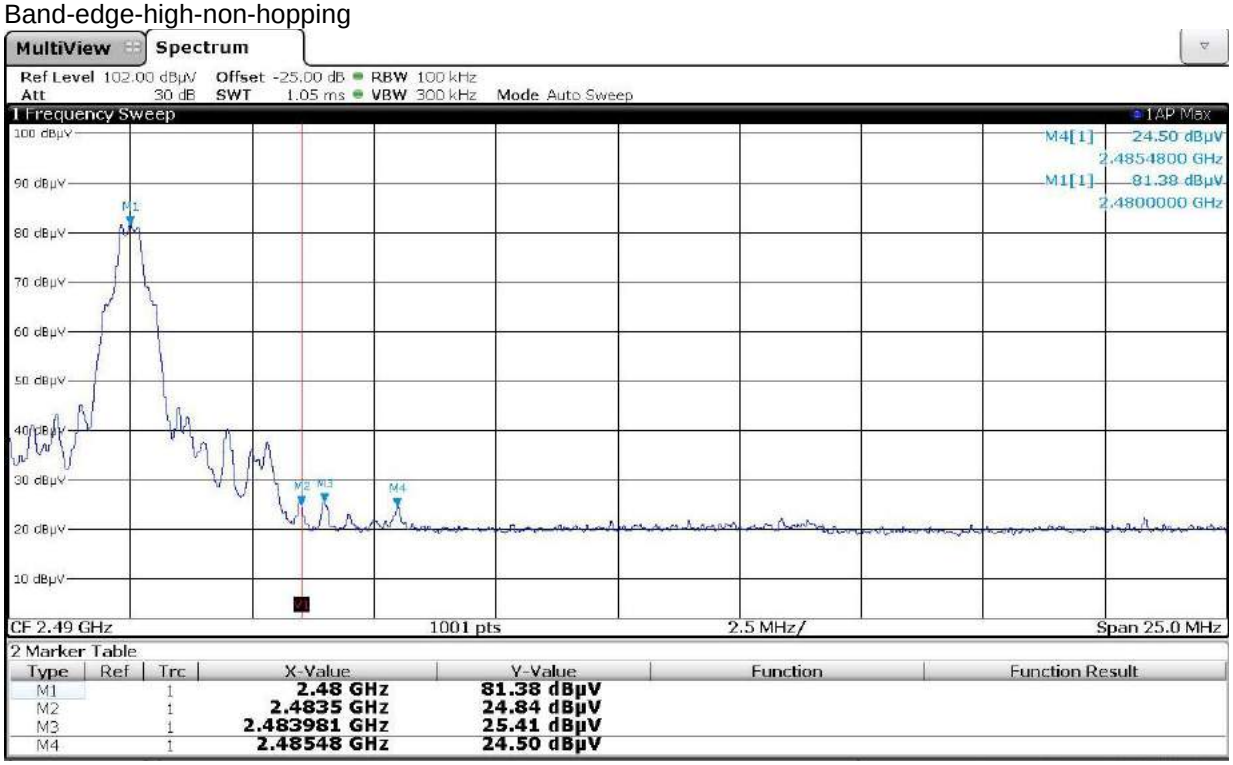
Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)

Band-edge-low-non-hopping

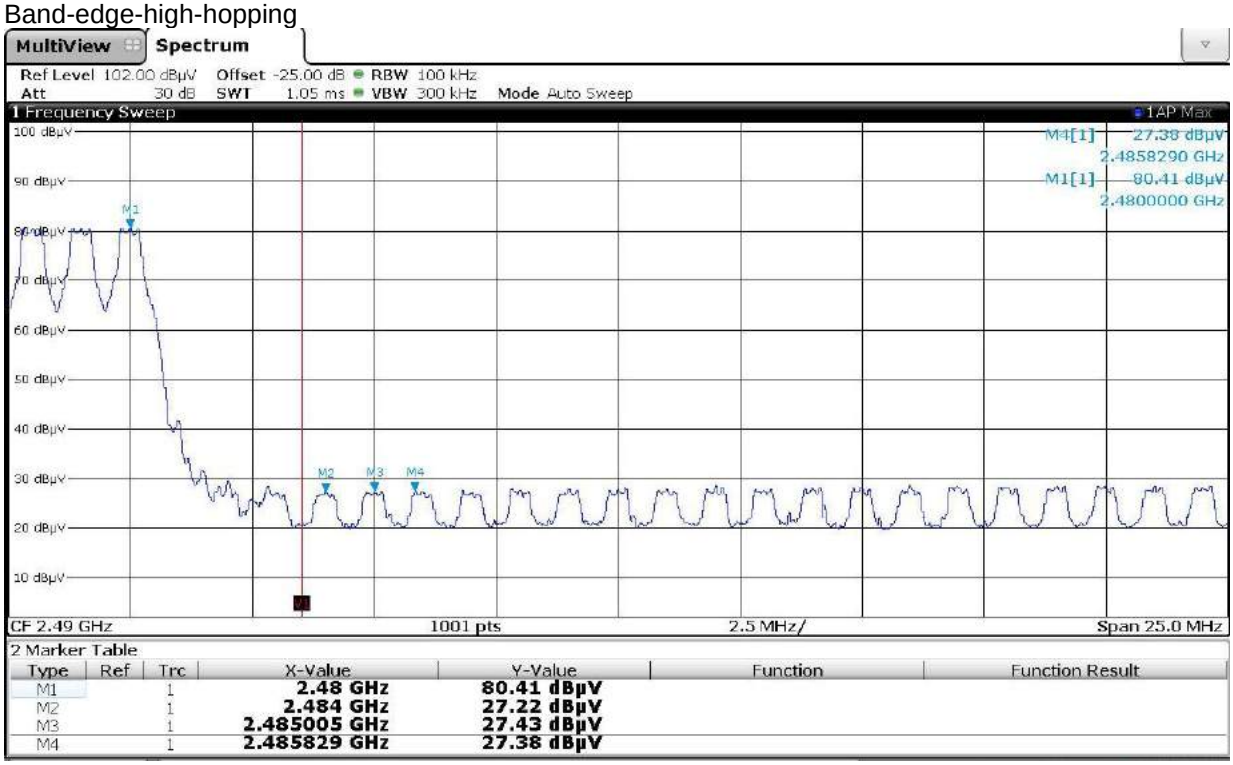
Band-edge-low-hopping



Band-edge-high-non-hopping



Band-edge-high-hopping

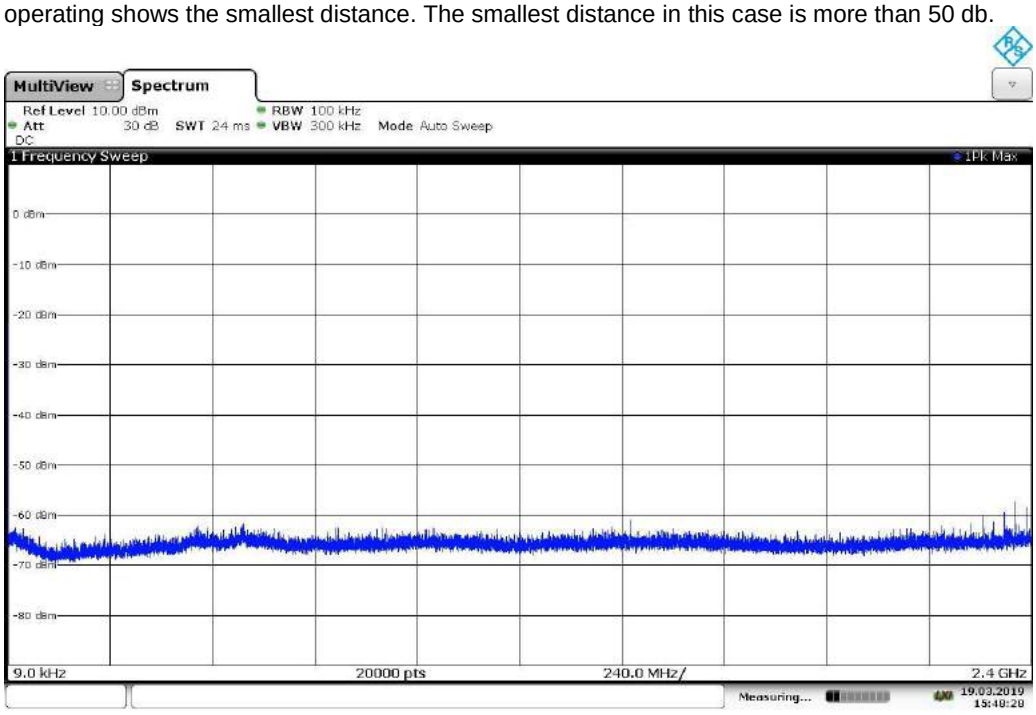


h) Spurious emission

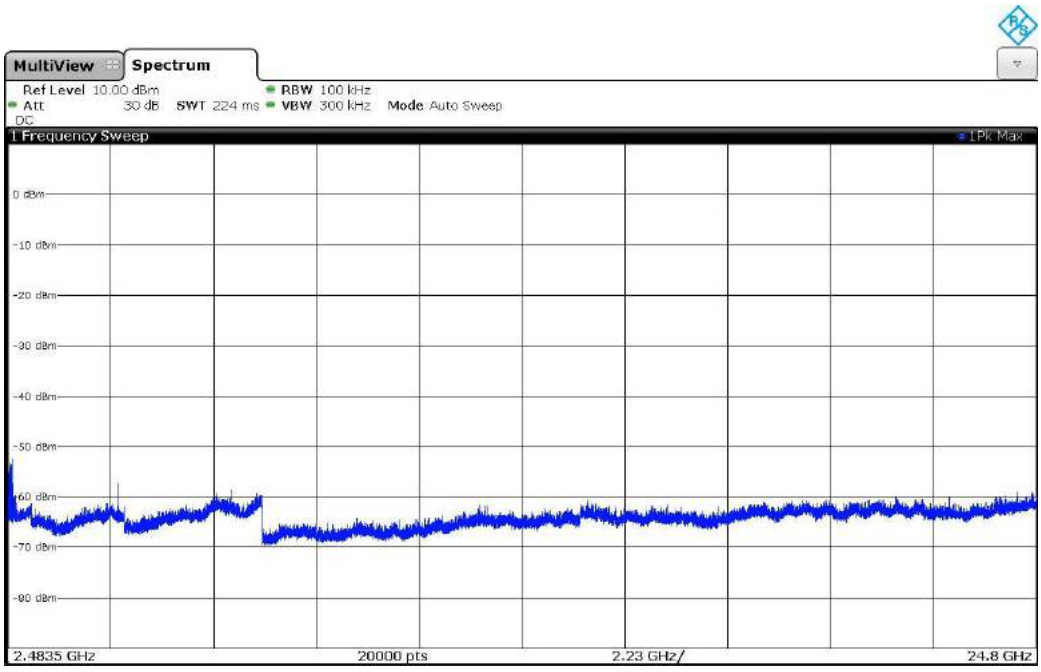
All radio frequency power that is produced in any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power (0.1 dBm, smallest wanted power value, worst case), based on the RF conducted/radiated measurements and comply with the limits.

All radiated emissions including emissions which fall in the restricted bands comply with the radiated emission limits specified in §15.209 (see clause 7 in this thest report).

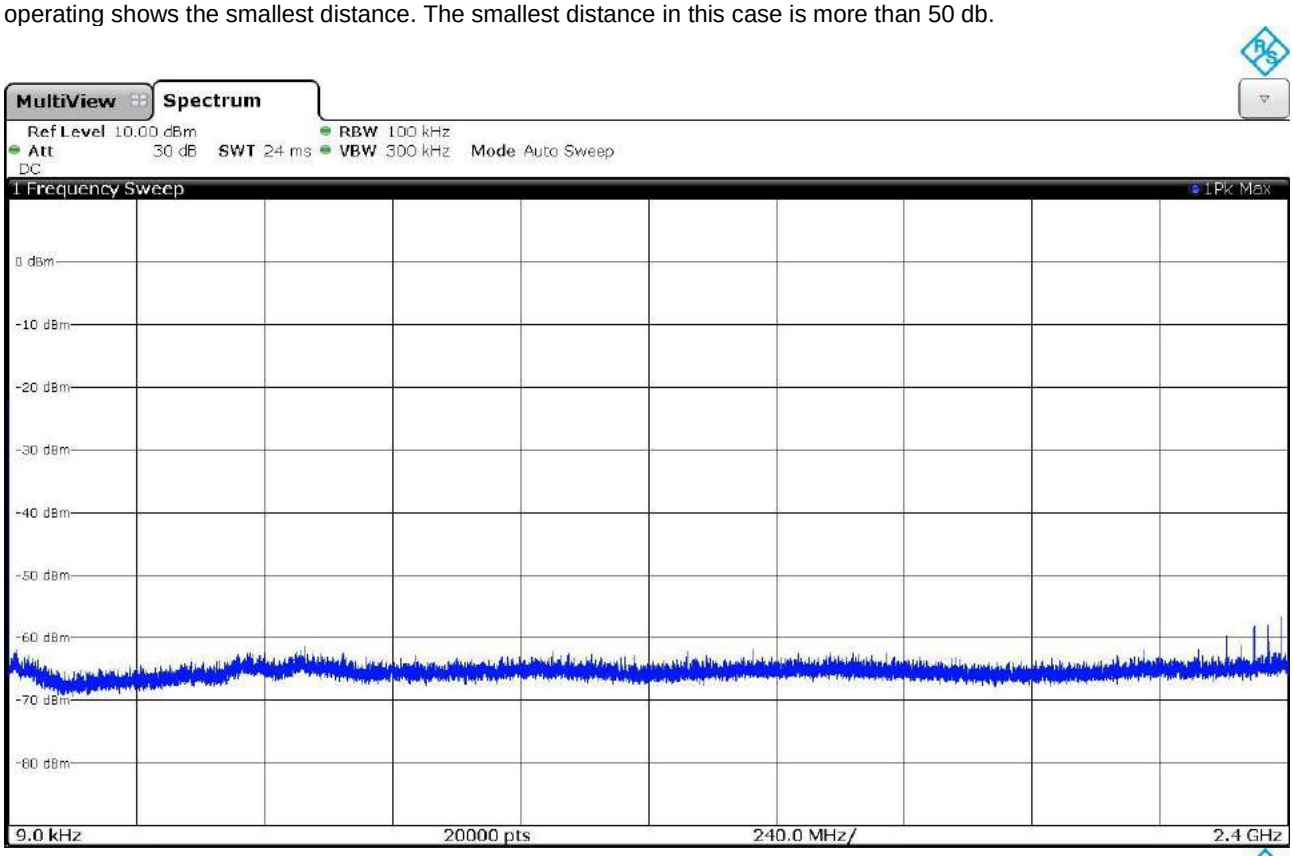
Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)
Hopping with GFSK with 1 MBit/s, which is the worst case as the distance between desired power and the power that is produced in any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating shows the smallest distance. The smallest distance in this case is more than 50 db.

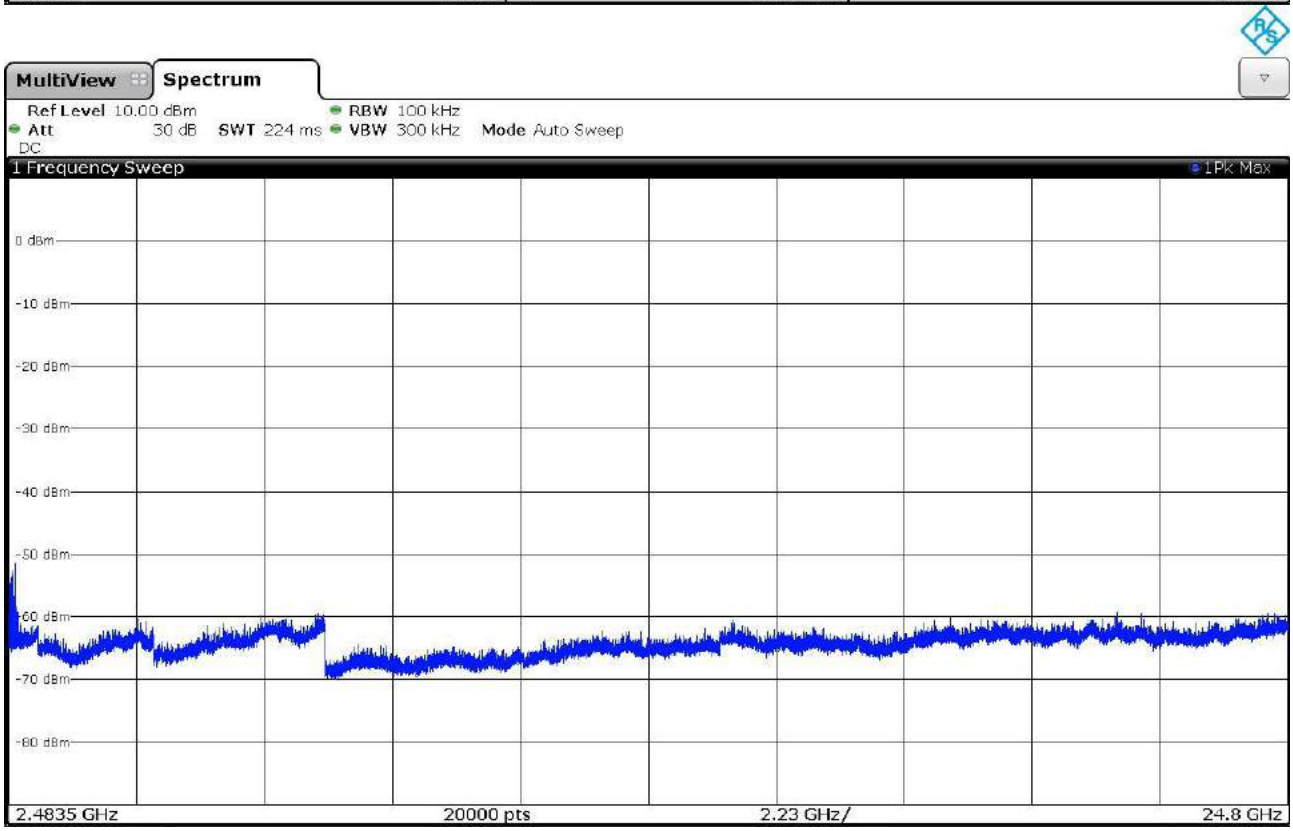


15:48:28 19.03.2019



Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)
Hopping with GFSK with 1 MBit/s, which is the worst case as the distance between desired power and the power that is produced in any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating shows the smallest distance. The smallest distance in this case is more than 50 db.





The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

The hopping algorithm of the EUT is dictated by the Bluetooth specification according to which the EUT is certified, so that the above mentioned requirements are fulfilled.

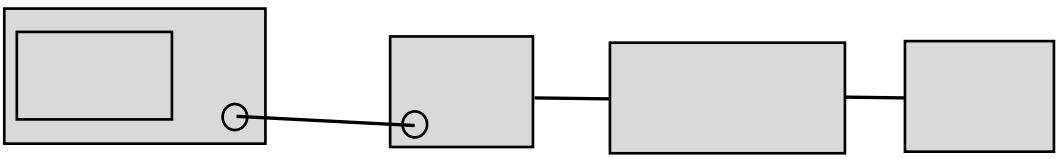
Results
From the measurement data obtained, the tested samples were considered to have COMPLIED with the requirements for the operation within the band 2400-2483.5 MHz according to §15.247.

Test equipment used:

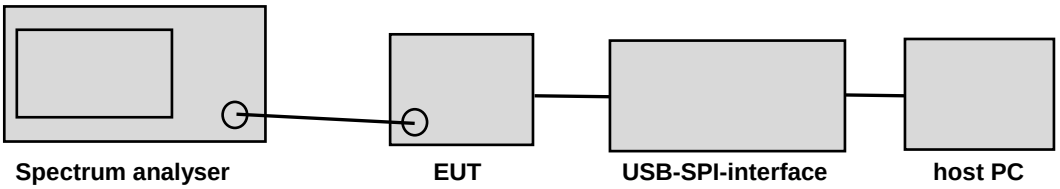
Kind of equipment	Manufacturer	Type	PKM-ident no.	Serial no.	Calibrated on (y-m-d)	Calibration interval
Signal Spectrum Analyzer 2Hz - 26,5 GHz	Rohde & Schwarz	FSW 26 Instrument FW 2.60	11571	102047	2017-12-13 2019-01-17	1 year
ESR7 EMI Testreceiver 7GHz	Rohde & Schwarz	ERS7	11676	101694	2018-03-26	3 years
Antenna 9 kHz – 30 MHz	EMCO	6502	10546	2018	2017-11-03	3 years
Antenna	Chase	CBL6111C	10022	1064	2017-01-30	3 years
Antenna 1GHz – 18 GHz	Electro Metric	RGA50/60	10273	2753	2017-11-06	3 years
Broadband-Hornantenne 15 - 26,5 (40) GHz	Schwarzbeck	BBHA 9170	11580	BBHA9170621	2017-01-27	3 years
Broadband-Preamplifier 1-18 GHz	Schwarzbeck	BBV9718	11231	9718-002	2017-10-09	3 year
Preamplifier 18 - 40 GHz	CERNEX	CBM18403523	11679	29711	2018-05-07	1 year
Cable	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2017-12-07	3 years
Shielded room/Chamber	Frankonia	SAC3 "SEMI-ANECHOIC-CHAMBER"	11609	004/16	2016-03-23	3 years

All measurements were made with measuring instruments, including any accessories that may affect test results, calibrated according to the requests of ISO/IEC 17025 according to which the test site is accredited from DAkkS. Measurement of radiated emissions was made with instruments conforming to American National Standard Specification, ANSI C63.10-2013.

Block diagram for conducted measurements (20 dB bandwidth, 99 % bandwidth, hopping channel separation, hopping channel frequencies, time of occupancy, Maximum peak conducted output power, Conducted RF band edge emissions).



Block diagram for spurious emission conducted (radiated emissions see clause 7 in this thest report)



Measurement uncertainty

according to *CISPR 16-4-2 Edition 2.0 2011-06*

Measurement	**calculated uncertainty U_{lab}**	**Specified CISPR uncertainty according CISPR 16-4-2 Edition 2.0 2011-06, table 1 U_{CISPR}**
Conducted disturbance at mains port using AMN 150 kHz – 30 MHz	3,2 dB	3,4 dB
Radiated disturbance (electric field strength in the SAC) 30 MHz to 1 000 MHz	4,7 dB	6,3 dB
Radiated disturbance (electric field strength in the SAC) 1 GHz to 26.5 GHz	4.1 dB	-/-
		Maximum measurement uncertainty according to EN300328:V2.1.1, table 17
Channel Bandwidth	1.17 %	±5 %
RF output power, conducted	±1,36 dB	±1,5 dB
Power Spectral Density, conducted	±1.99 dB	±3 dB
Unwanted Emissions, conducted	±1.71 dB	±3 dB
All emissions, radiated	±4.8 dB	±6 dB
Temperature	±0.72 °C	±3 °C
Supply voltages	±0.76 % (DC up to 40V) ±1.74 % (AC 50Hz up to 400V)	±3 %
Time	±0.012 %	±5 %

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT in the above mentioned way.

The measurements uncertainty was calculated in accordance with CISPR 16-4-2 Edition 2.0 2011-06.

The measurement uncertainty was given with a confidence of 95 % (k = 2).

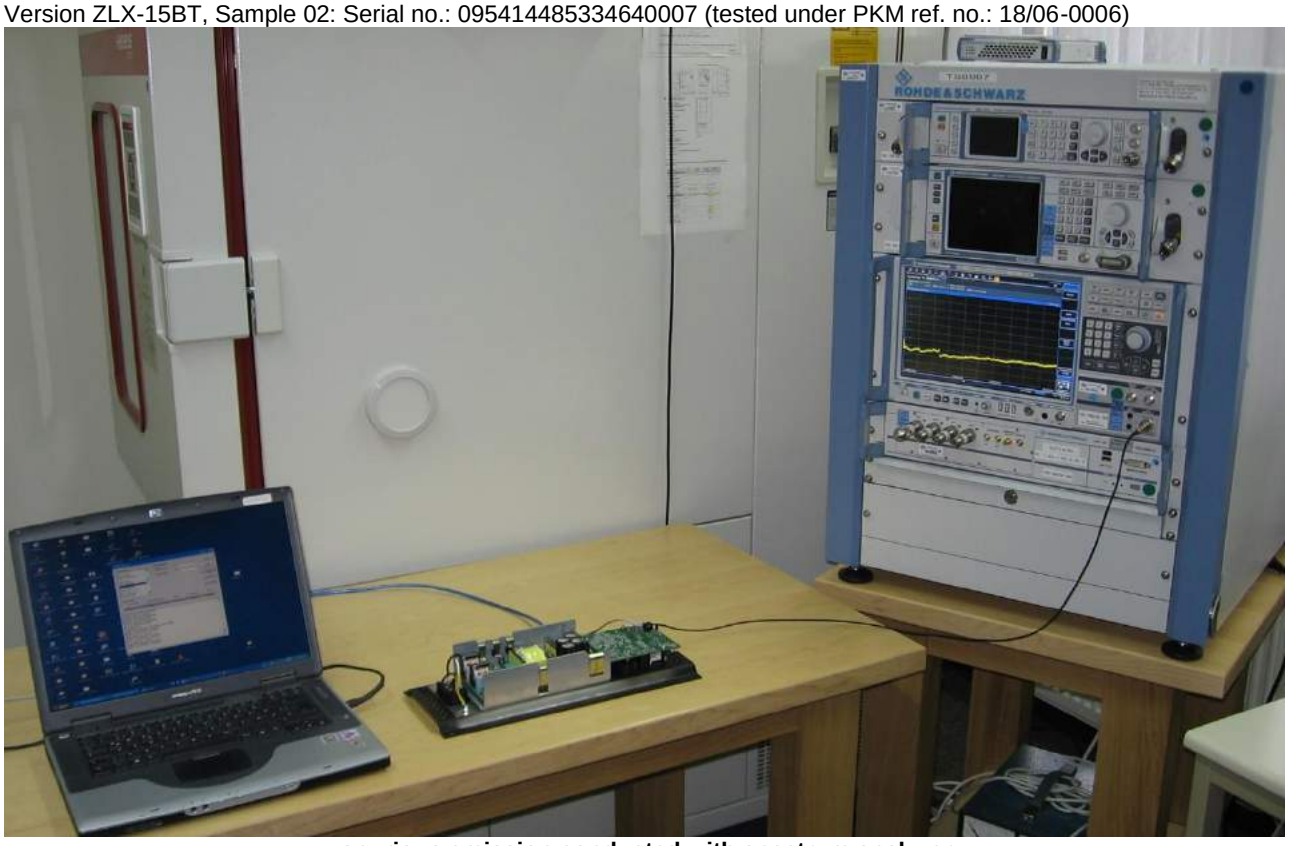
Photo(s) of test setup

Version ZLX-12BT, Sample 02, Serial no.: 095414385334570009 (tested under PKM ref. no.: 18/06-0005)

spurious emission conducted with spectrum analyzer

20 dB bandwidth, 99 % bandwidth, hopping channel separation, hopping channel frequencies, time of occupancy, Maximum peak conducted output power, Conducted RF band edge emissions with ESR7 EMI Testreceiver

Version ZLX-15BT, Sample 02: Serial no.: 095414485334640007 (tested under PKM ref. no.: 18/06-0006)



spurious emission conducted with spectrum analyzer

20 dB bandwidth, 99 % bandwidth, hopping channel separation, hopping channel frequencies, time of occupancy, Maximum peak conducted output power, Conducted RF band edge emissions with ESR7 EMI Testreceiver

10. CONCLUSIONS

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the following clauses of Federal Communications Commission Rules for intentional radiators e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C and Part 2.

§15.203 Antenna requirement
§15.205 Restricted bands of operation
§15.207 Conducted limits
§15.209 Radiated emission limits; general requirements
§15.215 Additional provisions to the general radiated emission limitations
§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

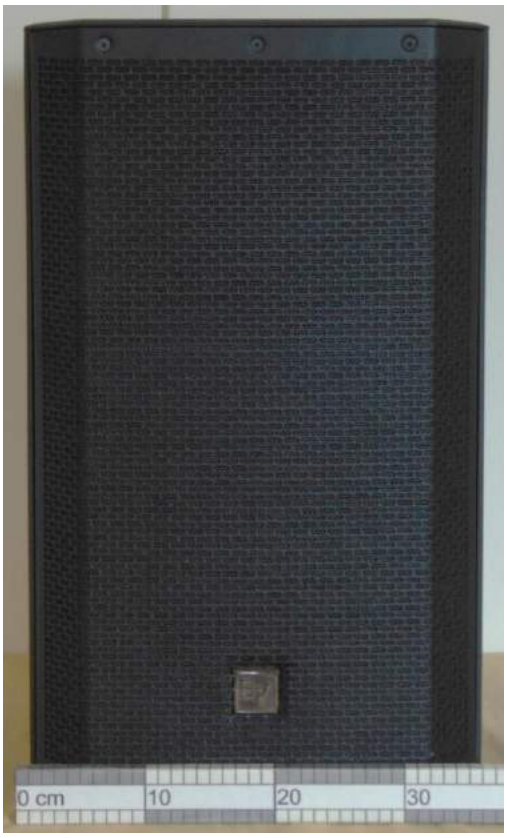
Following specific modifications and/or special attributes are necessary to pass the above mentioned requirements: none

pkm electronic GmbH
a member of the STC

05.04.2019	G. Raithel Dipl.-Ing. (FH), Head of Laboratory	
prepared on	*(name / position)*	*(signature)*
05.04.2019	K. Simon, Deputy Head of Laboratory	
released *on*	*(name / position)0*	*(signature)*

11. Photos of tested sample(s)

Version ZLX-12BT




Electro-Voice
ZLX


DSP
MASTER VOL
PUSH FOR DSP
AUX IN
LINE
MIC
MAX
INPUT 1
INPUT 2
OUTPUT
Electro-Voice
ZLX
CAUTION! AVIS!


POWER
ZLX-12BT
OUTPUT
Electro-Voice
ZLX


Electro-Voice
ZLX
CAUTION! AVIS!
SHOCK HAZARD - DO NOT OPEN
RISQUE DE CHOC ÉLECTRIQUE
NE PAS OUVRIR
WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.
AVIS: RISQUÉ DE CHOC ELECTRIQUE - NE PAS OUVRIR
THIS CLASS B DIGITAL APPARATUS COMPLIES WITH CANADIAN ICES-003. CET APPAREIL NUMÉRIQUE DE LA CLASSE B EST CONFORME À LA NORME NMB-003 DU CANADA.
THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: 1. THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND 2. THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.
ZLX-12BT
SINGLE 12" TWO-WAY POWERED LOUDSPEAKER
BLUETOOTH® AUDIO STREAMING


SHOCK HAZARD - DO NOT OPEN
RISQUE DE CHOC ÉLECTRIQUE
NE PAS OUVRIR
WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.
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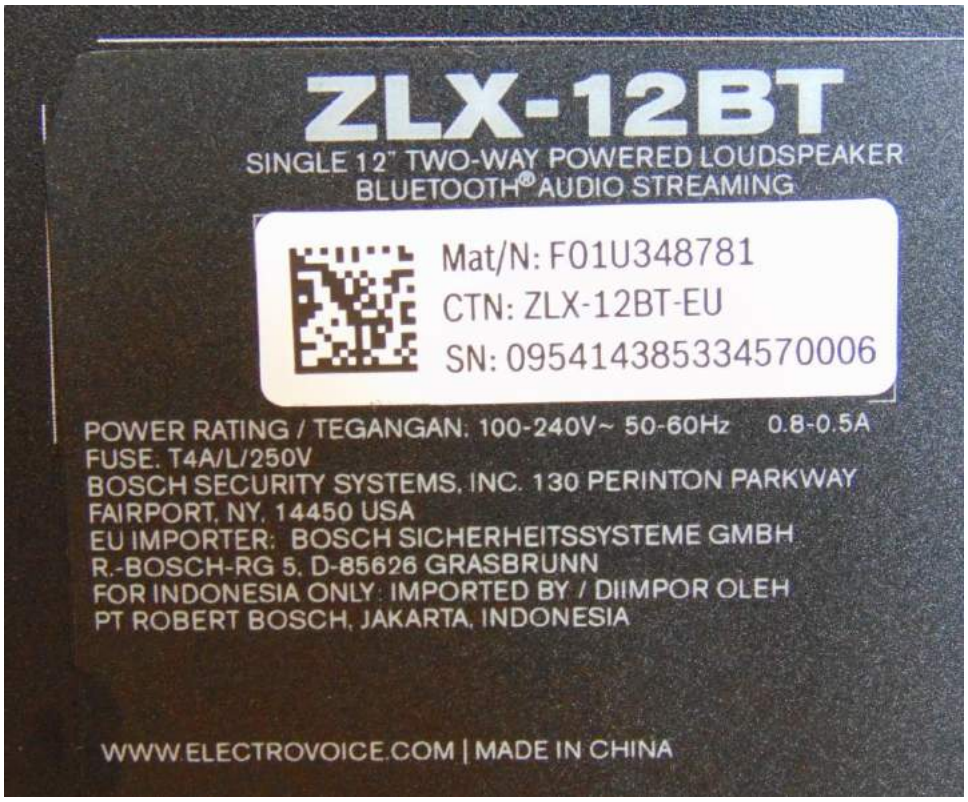
ZLX-12BT
CAUTION: TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, GROUNDING OF THE CENTRE PIN OF THIS PLUG MUST BE MAINTAINED.
ATTENTION: POUR RÉDUIRE LE RISQUE DE CHOC ÉLECTRIQUE, CONSERVER LA MISE À LA TERRE ASSURÉE PAR LA TIGE CENTRALE DE CETTE FICHE.
POWER
ON
OFF


ZLX-12BT
SINGLE 12" TWO-WAY POWERED LOUDSPEAKER
BLUETOOTH® AUDIO STREAMING
Mat/N: F01U348781
CTN: ZLX-12BT-EU
SN: 095414385334570006
POWER RATING / TEGANGAN: 100-240V~ 50-60Hz 0.8-0.5A
FUSE: T4A/L/250V
BOSCH SECURITY SYSTEMS, INC. 130 PERINTON PARKWAY
FAIRPORT, NY, 14450 USA
EU IMPORTER: BOSCH SICHERHEITSSYSTEME GMBH
R.-BOSCH-RG 5, D-85626 GRASBRUNN
FOR INDONESIA ONLY: IMPORTED BY / DIIMPOR OLEH
PT ROBERT BOSCH, JAKARTA, INDONESIA
WWW.ELECTROVOICE.COM | MADE IN CHINA


ZLX-12BT
SINGLE 12" TWO-WAY POWERED LOUDSPEAKER
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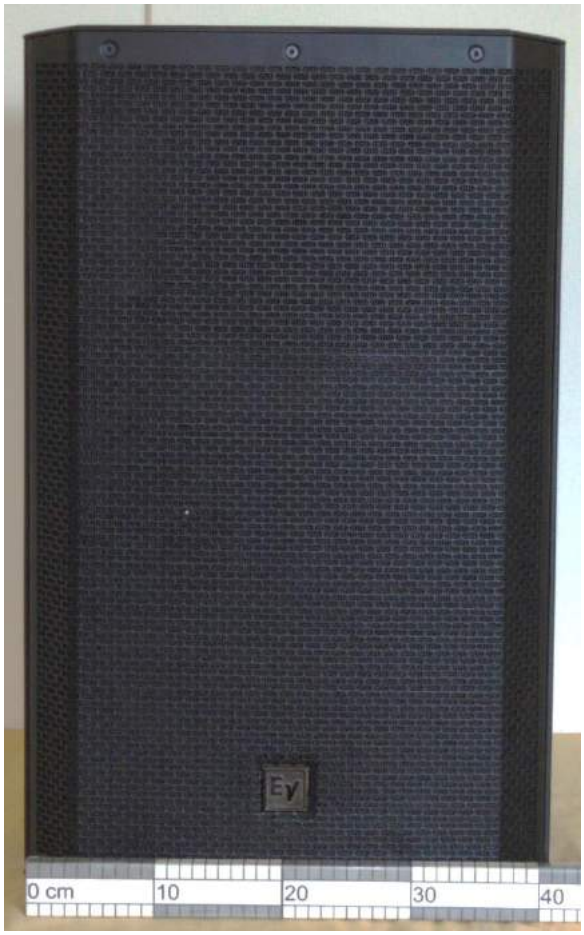
Version ZLX-15BT




Electro-Voice
ZLX


Electro-Voice
ZLX


Electro-Voice
ZLX
CAUTION! AVIS!
SHOCK HAZARD - DO NOT OPEN
RISQUE DE CHOC ELECTRIQUE
NE PAS OUVRIR
WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.
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SINGLE 15" TWO-WAY POWERED LOUDSPEAKER
BLUETOOTH® AUDIO STREAMING
Mat/N: F01U348782
CTN: ZLX-15BT-EU
SN: 095414485334640005
POWER RATING / TEGANGAN: 100-240V~ 50-60Hz (0.8-0.5A)
FUSE: T4A/L/250V
BOSCH SECURITY SYSTEMS, INC. 130 PERINTON PARKWAY
FAIRPORT, NY. 14450 USA
EU IMPORTER: BOSCH SICHERHEITSSYSTEME GMBH
R-BOSCH-RG 5, D-85626 GRASBRUNN
FOR INDONESIA ONLY: IMPORTED BY / DIIMPOR OLEH
PT ROBERT BOSCH, JAKARTA, INDONESIA


INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.
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PT ROBERT BOSCH, JAKARTA, INDONESIA


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ATTENTION: POUR RÉDUIRE LE RISQUE DE CHOC ÉLECTRIQUE, CONSERVER
LA MISE À LA TERRE ASSURÉE PAR LA TIGE CENTRALE DE CETTE FICHE.
EMV
POWER
ON
OFF

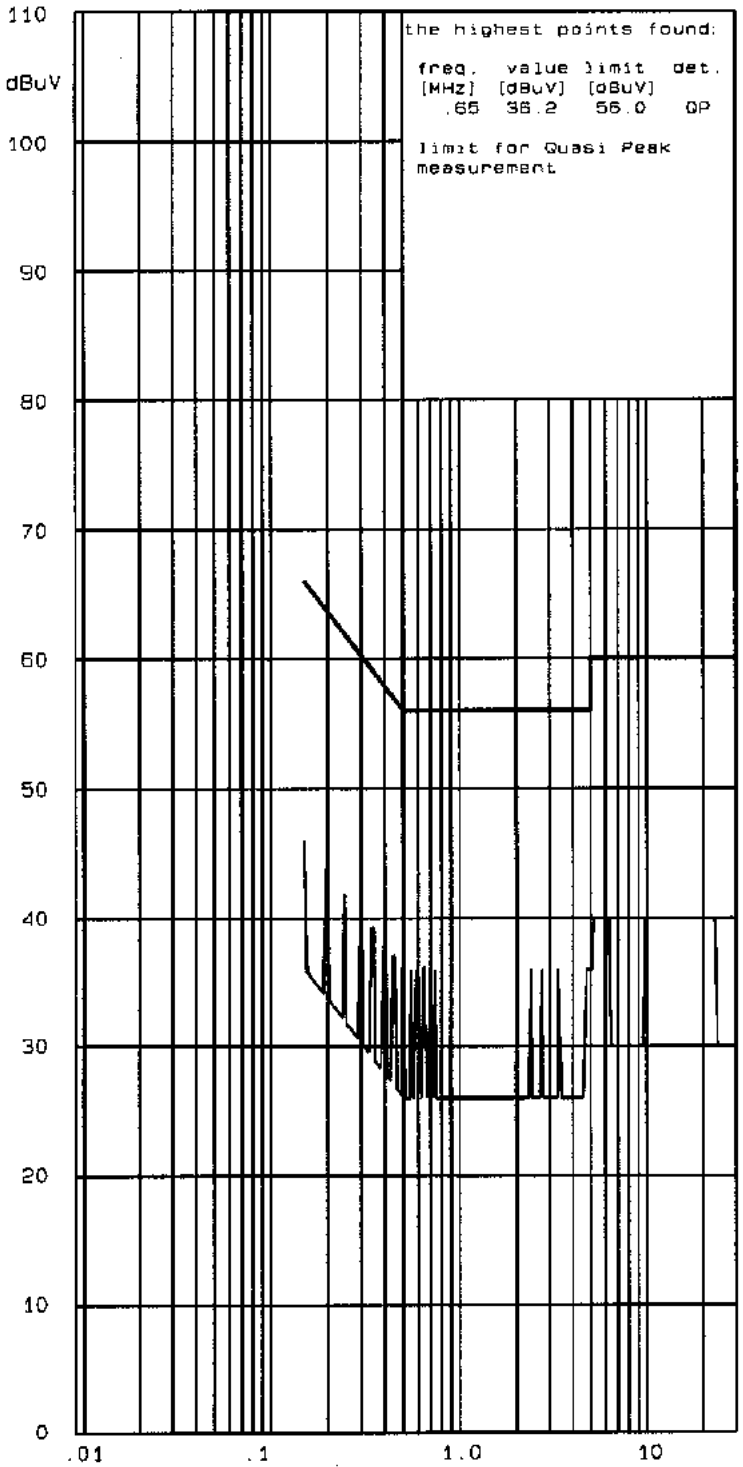
End of test report

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



Ref.-No.: 18/06-0005

Product: Active Speaker

Sample: 02

Date: 13 Jun 2018

Operator: Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
Noise Generator

Operating mode:

Speaker active
Signal input pink noise
Speaker output 12.5 %
Tested on N

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass [X] fail [ ]

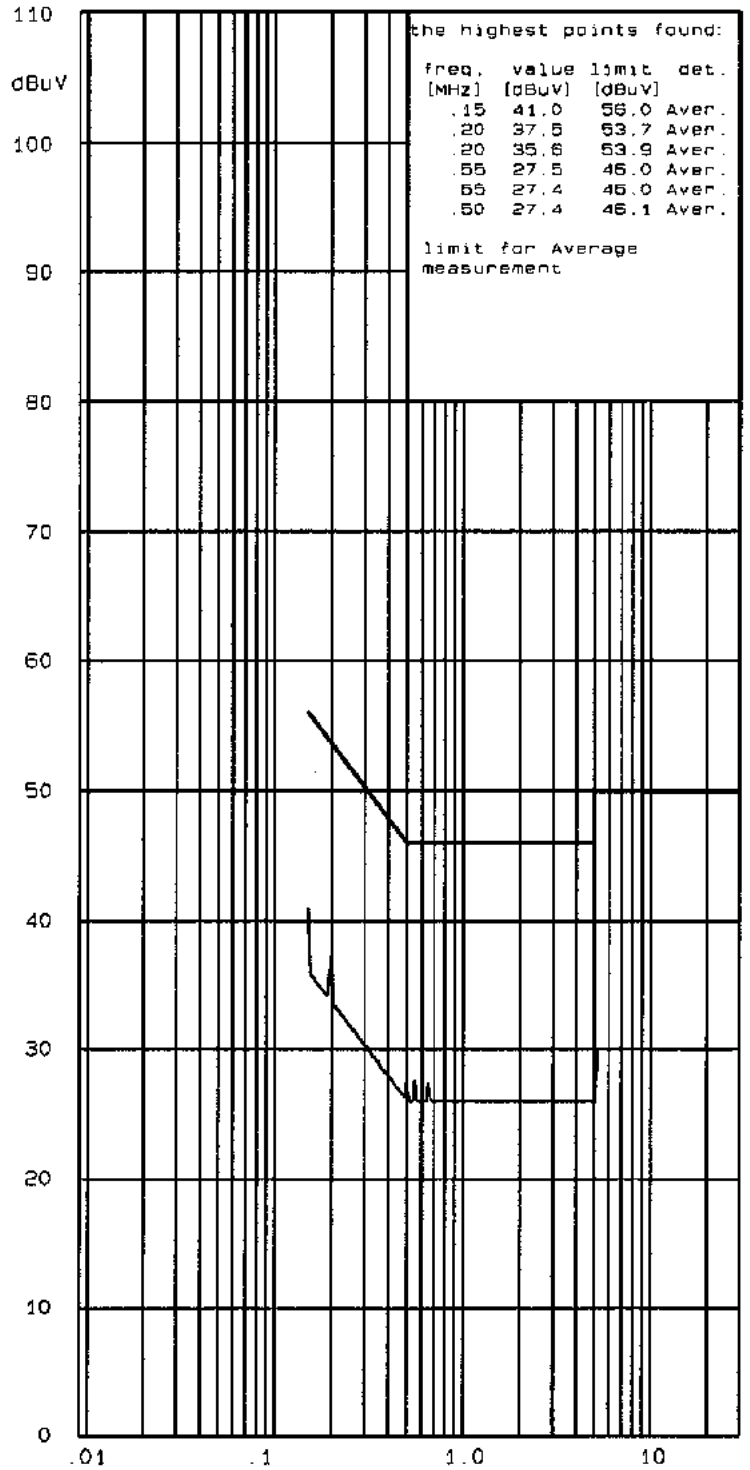
PKM electronic GmbH
Frontenhausen

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



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Speaker output 12.5 %
Tested on N

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* two dB safety margin for type approval recommended

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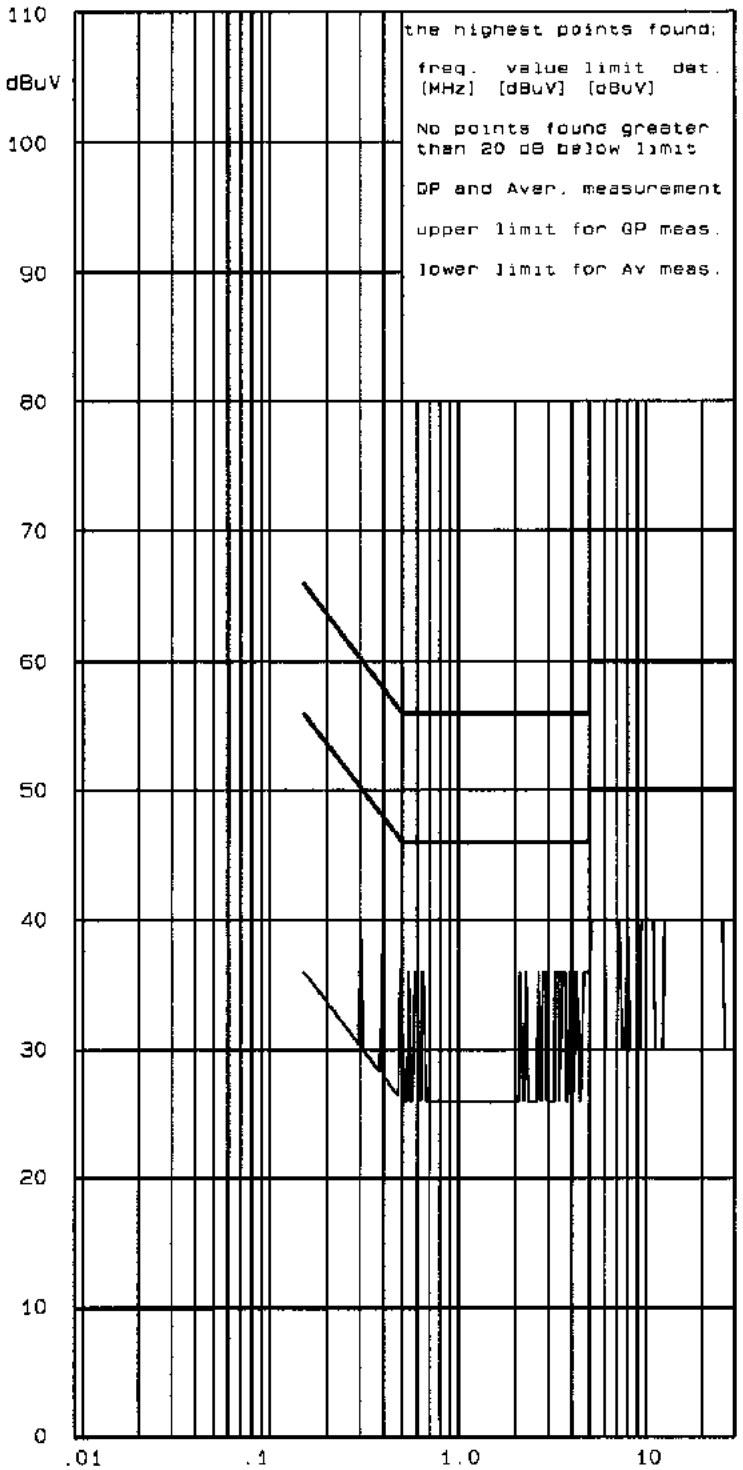
PKM electronic GmbH
Frontenhausen

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



Ref.-No.: 18/06-0005

Product: Active Speaker

Sample: 02

Date: 13 Jun 2018

Operator: Gi

Test equipment:

Rohde & Schwarz ESHS 30

Rohde & Schwarz ESH 2-Z5

Connected sets:

Input Voltage 120 V / 60 Hz
Noise Generator

Operating mode:

Speaker active
Signal input pink noise
Speaker output 12.5 %
Tested on L1

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass [X] fail [ ]

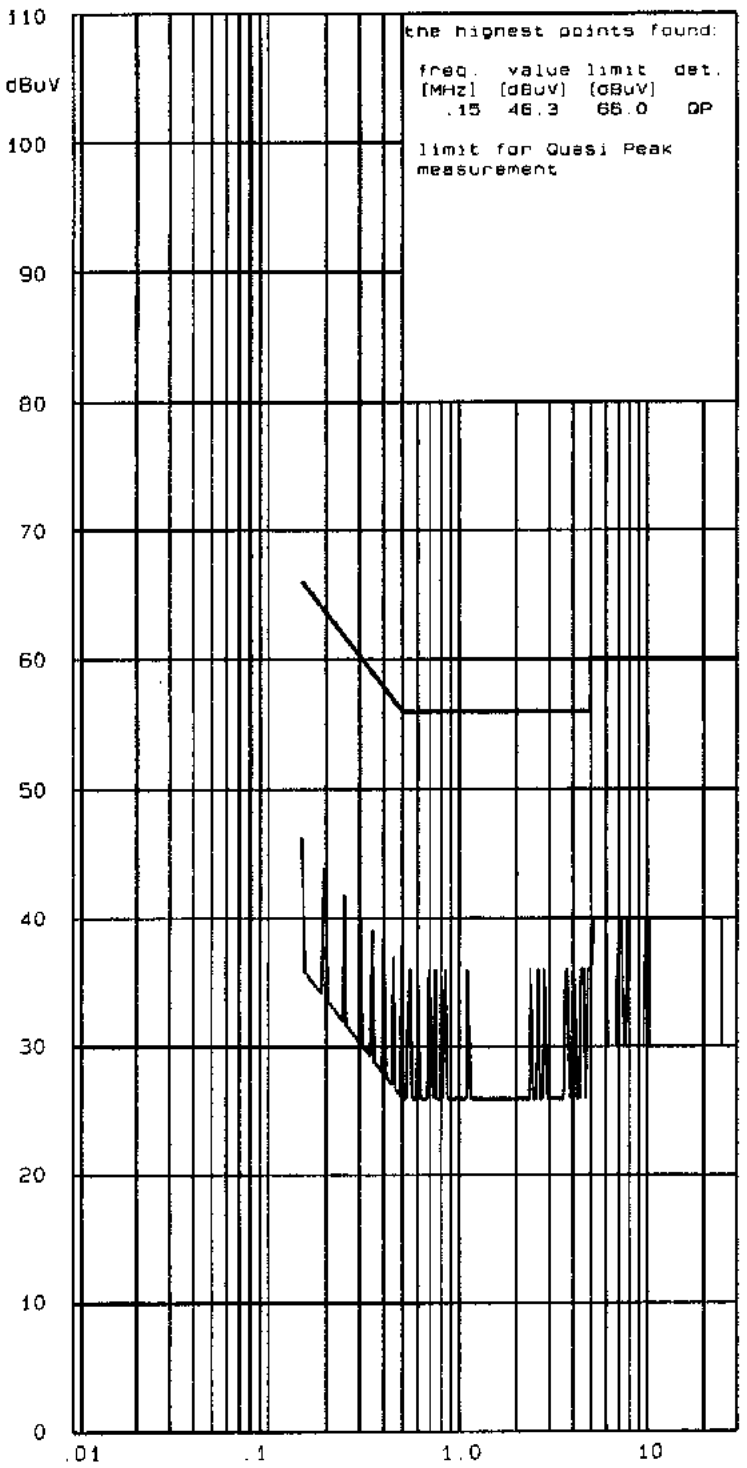
PKM electronic GmbH
Frontenhausen

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



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Product: Active Speaker

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Connected sets:

Input Voltage 120 V / 60 Hz
Noise Generator

Operating mode:

Speaker active
Signal input pink noise
Speaker output 12.5 %
Tested on N

RFI suppression parts:

* two dB safety margin for type approval recommended

Result: pass [X] fail [ ]

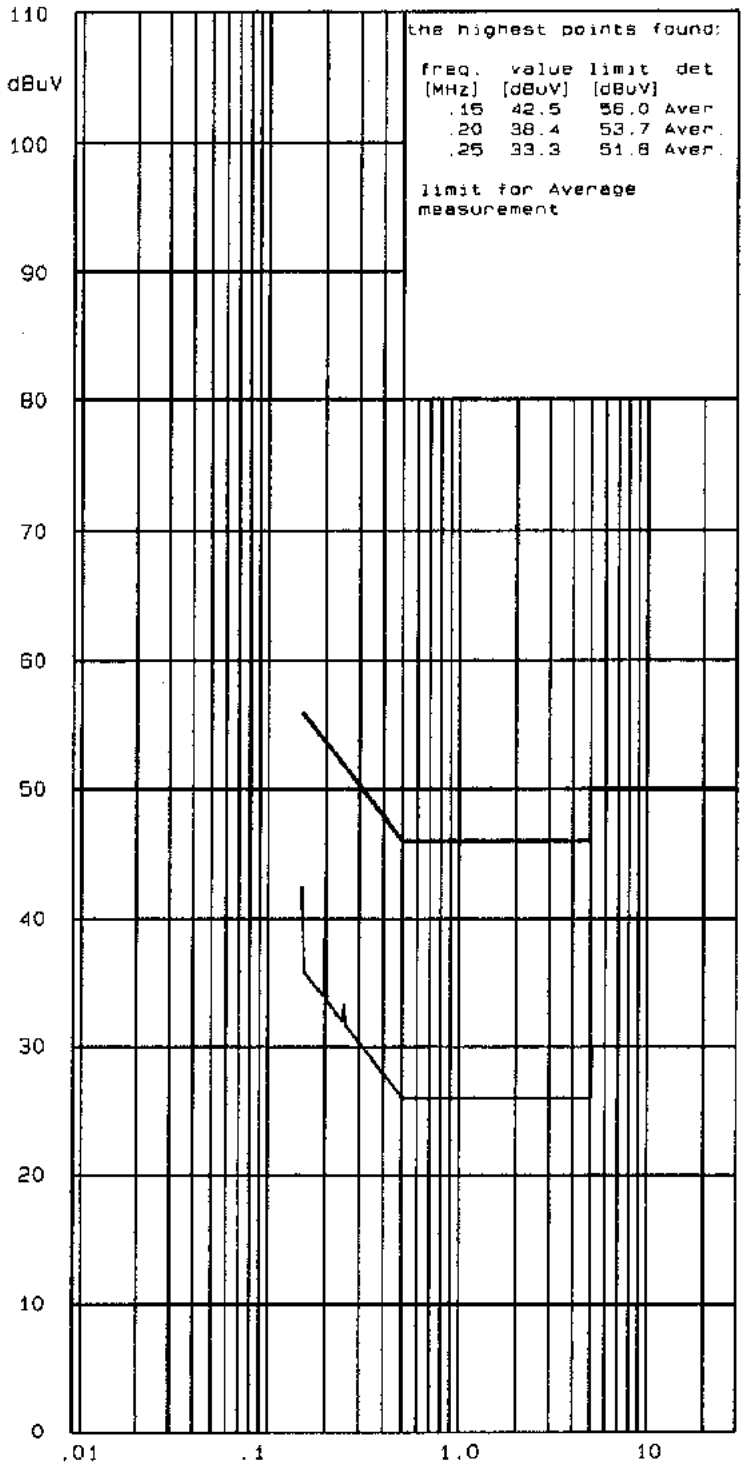
PKM electronic GmbH
Frontenhausen

I T 1 / 2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



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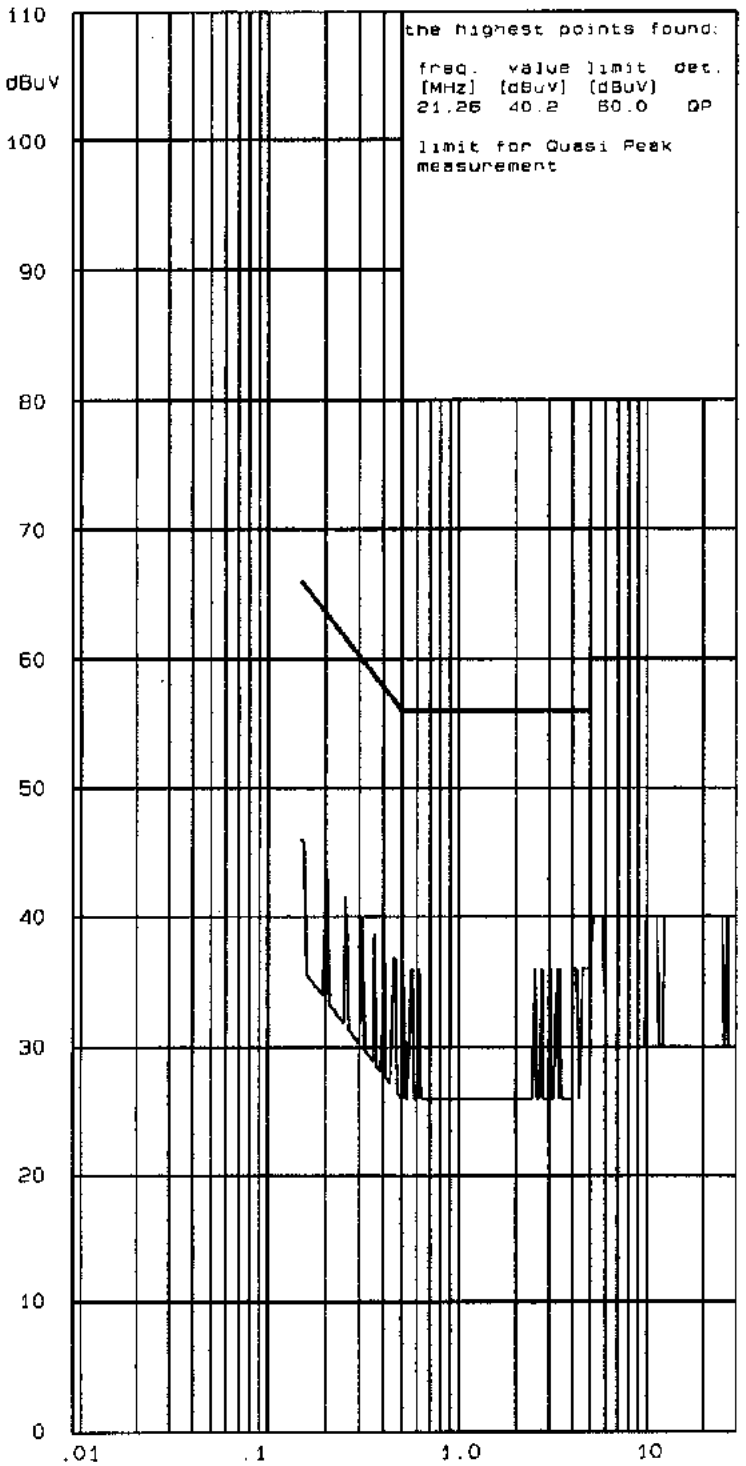

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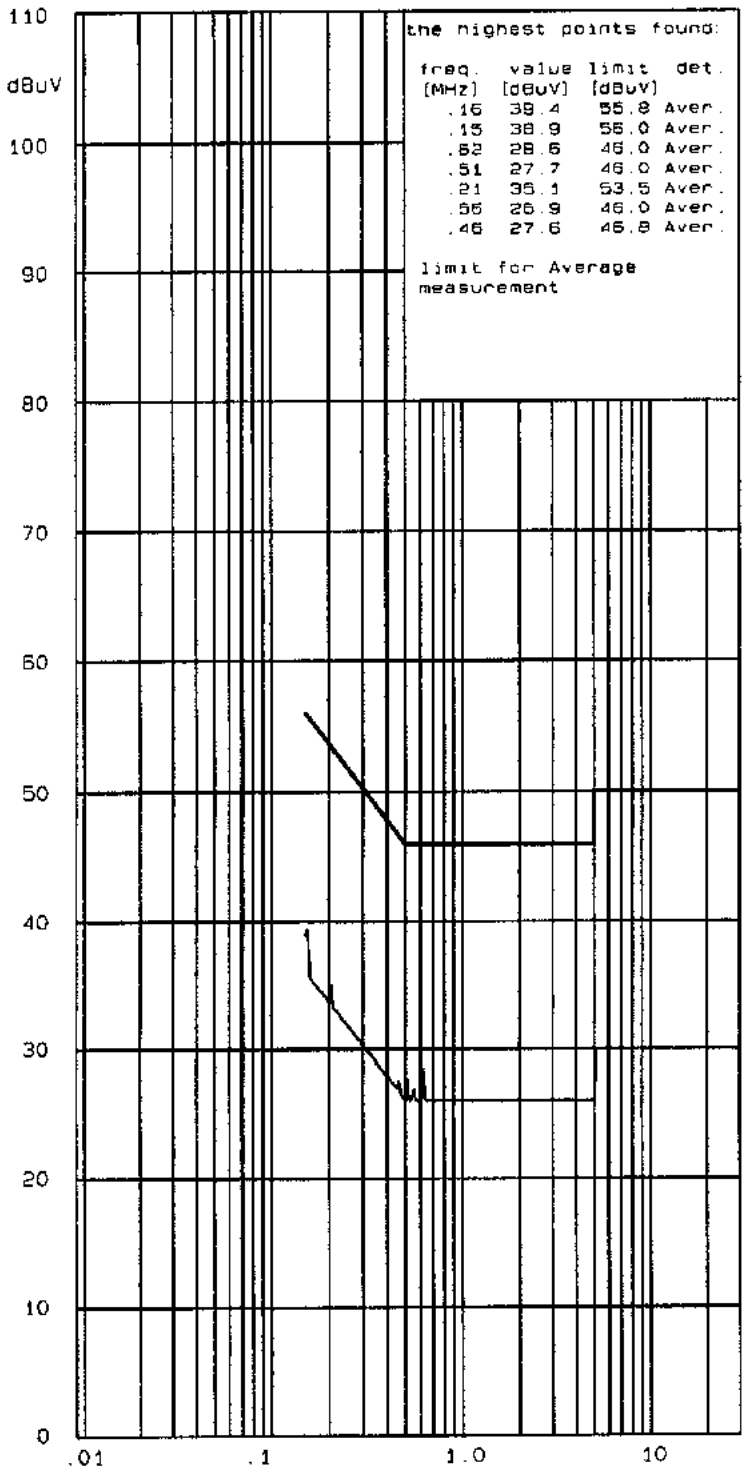
Frontenhausen

IT 1/2

Interference Voltage 150 KHz - 30 MHz

acc. FCC PART 15.107(a) Class B

ICES-003



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