

EMI - TEST REPORT

- FCC 15.231, RSS210 -

Type / Model Name : MonoTec-915

Product Description : Radio transceiver

Applicant : elero GmbH

Address : Linsenhofer Str. 65

72660 Beuren

GERMANY

Manufacturer : elero GmbH

Address : Linsenhofer Str. 65

72660 Beuren

GERMANY

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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Test Report No. : T41252-00-03JP	20. November 2017 <small>Date of issue</small>
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Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

Contents

1	<u>TEST STANDARDS</u>	3
2	<u>EQUIPMENT UNDER TEST</u>	4
2.1	Photo documentation of the EUT	4
2.2	Equipment type	4
2.3	Short description of the equipment under test (EUT)	4
2.4	Variants of the EUT	4
2.5	Operation frequency	4
2.6	Antenna	4
2.7	Transmit operating modes	4
2.8	Power supply system utilised	4
2.9	Peripheral devices and interface cables	4
3	<u>Test result summary</u>	5
3.1	FINAL ASSESSMENT:	5
4	<u>TEST ENVIRONMENT</u>	6
4.1	Address of the test laboratory	6
4.2	Environmental conditions	6
4.3	Statement of the measurement uncertainty	6
4.4	Measurement Protocol for FCC an ISED	7
5	<u>TEST RESULTS</u>	8
5.1	Field strength of the fundamental wave	8
5.2	Spurious emissions radiated	10
5.3	Duty cycle correction	12
5.4	Emission bandwidth	15
5.5	Signal deactivation	18
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	20

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (August 2017)

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (August´ 2017)

- Part 15, Subpart C, Section 15.209 Radiated emission limits, general requirements
- Part 15, Subpart C, Section 15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz

RSS-210 Issue 9, August 2016

Spectrum Management and Telecommunications Radio Standards
Specifications - Licence-exempt Radio Apparatus: Category I
Equipment

RSS-Gen Issue 4, November 2014

Spectrum Management and Telecommunications Radio Standards
Specifications - General Requirements and Information for the
Certification of Radio Apparatus

ANSI C63.10: 2013

Testing Unlicensed Wireless Devices

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT

External pictures of EuT:

Refer to document T41252-00-03JP Attachment B

Internal pictures of EuT:

Refer to document T41252-00-03JP Attachment C

2.2 Equipment type

Radio transceiver

2.3 Short description of the equipment under test (EUT)

The MonoTec flush-mounted radio transceiver is used together with transceivers connected to tubular or venetian blind motors. The basic transmitter is manually operated by the user and allows the control over the tubular or venetian blind motors. The EuT supports GFSK1 and GFSK05 modulation.

Number of tested samples: 1

Serial number: none

2.4 Variants of the EUT

none

2.5 Operation frequency

918.3 MHz

2.6 Antenna

Integral antenna

2.7 Transmit operating modes

The equipment under test was operated during the measurement under the following conditions:

- TX mode 918.3 MHz

- RX mode 918.3 MHz

2.8 Power supply system utilised

Power supply voltage, V_{nom} : 3V DC (Battery supplied)

2.9 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- none _____ Model : _____

3 Test result summary

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	not applicable ¹
15.231(b)	RSS 210, A1.2	Field strength of the fundamental wave	passed
15.209 15.231(b)	RSS Gen, 8.9 RSS 210, A1.2	Spurious emissions radiated	passed
15.35(c)	RSS Gen, 6.10	Duty cycle correction	--
15.231(c)	RSS210, A1.3	20dB and 99% bandwidth	passed
15.231(a)	RSS210, A1.1	Signal deactivation	passed

¹device is battery supplied

3.1 FINAL ASSESSMENT:

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 07 February 2017

Testing concluded on : 12 July 2017

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Jürgen Pessinger

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement Protocol for FCC an ISED

4.4.1 General information

4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out in ANSI C63.10 as shown under section 1 of this report.

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-3

The anechoic chamber site is a listed chamber under the Canadian Test-Sites File-No:

IC 3009A-2

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.3 Details of test procedures

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices"

Example of value calculation:

Frequency (MHz)	Reading (dB μ V)	+	Correction (dB)	=	Level (dB μ V/m)	-	Limit (dB μ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

5 TEST RESULTS

5.1 Field strength of the fundamental wave

For test instruments and accessories used see section 6 Part **CPR 2**.

5.1.1 Description of the test location

Test location: OATS 3

Test distance: 3 m

5.1.2 Photo documentation of the test set-up

Refer to document T41252-00-03JP Attachment A

5.1.1 Applicable standard

According to FCC Part 15.231(b) and RSS 210, A1.2

EMI test receiver settings:

30 MHz – 1000 MHz: RBW: 120 kHz

5.1.2 Test result

PK Values

Frequency (MHz)	Reading PK Vert. (dB μ V)	Reading PK Hor. (dB μ V)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level PK Vert. (dB μ V/m)	Level PK Hor. (dB μ V/m)	Limit PK (dB μ V/m)	Dlimit (dB)
918,30	68,8	70,4	27,0	27,0	95,8	97,4	101,9	-4,5

Corrected AV values

Frequency (MHz)	Level PK Vert. (dB μ V/m)	Level PK Hor. (dB μ V/m)	DC Correct.* (dB)	DC Correct.* (dB)	Level AV Vert. (dB μ V/m)	Level AV Hor. (dB μ V/m)	Limit PK (dB μ V/m)	Dlimit (dB)
918,30	95,8	97,4	-22,0	-22,0	73,8	75,4	81,9	-6,5

*refer to clause 5.3 of this report

AV Limit according to FCC Part 15.231(b) and RSS 210, A1.2:

Frequency (MHz)	Field strength of fundamental @ 3m	
	($\mu\text{V}/\text{m}$)	$\text{dB}(\mu\text{V}/\text{m})$
40.66 – 40.70	2250	67
70 - 130	1250	62
130 - 174	1250 to 3750*	62 to 71.4*
174 - 260	3750	71.4
260 - 470	3750 to 12500*	71.4 to 81.9*
Above 470	12500	81.9

*Linear interpolation

The requirements are **FULFILLED**.

Remarks: Measurement was performed with unmodulated signal.

5.2 Spurious emissions radiated

For test instruments and accessories used see section 6 Part **SER 1, SER 2, SER 3.**

5.2.1 Description of the test location

Test location: OATS 3
 Test location: Anechoic chamber 1
 Test distance: 3 m

5.2.2 Photo documentation of the test set-up

Refer to document T41252-00-03JP Attachment A

5.2.3 Applicable standard

According to FCC Part 15.209 and RSS Gen, 8.9

Instrument settings:

9 kHz – 150 kHz: RBW: 200 Hz
 150 kHz – 30 MHz: RBW: 9 kHz
 30 MHz – 1000 MHz: RBW: 120 kHz
 1000 MHz – 10000 MHz: RBW: 1 MHz

5.2.4 Test result $f < 30$ MHz

TX and RX mode 918.3MHz

Frequency (MHz)	Level QP (dB μ V)	Correct. factor (dB)	Corrected level QP dB(μ V/m)	AV limit* dB(μ V/m)	Delta (dB)
0,536	24,1	20,1	44,2	73,0	-28,8
1,073	23,4	20,3	43,7	67,0	-23,3
1,342	21,6	20,4	42,0	65,0	-23,0

*limit corrected to 3m distance

Remark: No unwanted emissions from the EuT could be detected, noted levels are ambient noise

5.2.5 Test result 30 MHz $< f < 1$ GHz

TX and RX mode 918.3MHz

Frequency (MHz)	Reading Vert. (dB μ V)	Reading Hor. (dB μ V)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dB μ V/m)	Level Hor. (dB μ V/m)	Limit (dB μ V/m)	Dlimit (dB)
50,00	4,1	4,1	15,3	15,3	19,4	19,4	61,9	-42,5
250,00	4,9	4,9	15,2	15,2	20,1	20,1	46,0	-25,9
500,00	6,1	6,6	21,3	21,3	27,4	27,9	61,9	-34,0

Remark: No unwanted emissions from the EuT could be detected, noted levels are ambient noise

5.2.6 Test result 1GHz < f < 10 GHz

TX mode 918.3MHz

Frequency (MHz)	Reading PK Vert. (dBµV)	Reading PK Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level PK Vert. (dBµV/m)	Level PK Hor. (dBµV/m)	AV Limit (dBµV/m)	Dlimit (dB)
1660,00	--	57,0	--	-20,2	--	36,8	54,0	-17,2
1836,60	56,3	--	-17,1	--	39,2	--	54,0	-14,8
1990,00	60,1	--	-15,7	--	44,4	--	54,0	-9,6
2754,90	56,3	--	-13,1	--	43,2	--	54,0	-10,8
5509,80	43,1	40,4	4,3	4,3	47,5	44,7	54,0	-6,5
7346,40	39,7	37,2	7,0	7,0	46,7	44,2	54,0	-7,3

RX mode 918.3MHz

Frequency (MHz)	Reading PK Vert. (dBµV)	Reading PK Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level PK Vert. (dBµV/m)	Level PK Hor. (dBµV/m)	AV Limit (dBµV/m)	Dlimit (dB)
1330,00	--	57,0	--	-19,6	--	37,4	54,0	-16,6
2044,00	57,7	--	-15,6	--	42,2	--	54,0	-11,8
2254,00	--	54,8	--	-15,9	--	38,8	54,0	-15,2
4144,00	40,9	41,9	0,1	0,1	41,0	42,0	54,0	-12,0

Limit according to FCC Section 15.209 and RSS Gen, 8.9:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	(µV/m)	dB(µV/m)	
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

Frequency (MHz)	15.209 Limits (µV/m)	15.209 Limits dB(µV/m)
30 - 88	100	40
88 - 216	150	43,5
216 - 960	200	46
Above 960	500	54

The requirements are **FULFILLED**.

Remarks: The measurement is performed up to the 10th harmonic.

Measurement was performed with unmodulated signal.

5.3 Duty cycle correction

For test instruments and accessories used see section 6 Part DC.

5.3.1 Description of the test location

Test location: Shielded Room S4

5.3.2 Photo documentation of the test set-up

Refer to document T41252-00-03JP Attachment A

5.3.3 Applicable standard

According to FCC Part 15.35(c) and RSS Gen, 6.10:

5.3.4 Description of Measurement

The Duty cycle factor (dB) is calculated applying the following formula:

$$KE = 20 \log (t_B/T_w)$$

KE : pulse operation correction factor (dB)
 t_B : on time (ms)
 T_w : a period of the pulse track or 100ms whichever is shorter (ms)

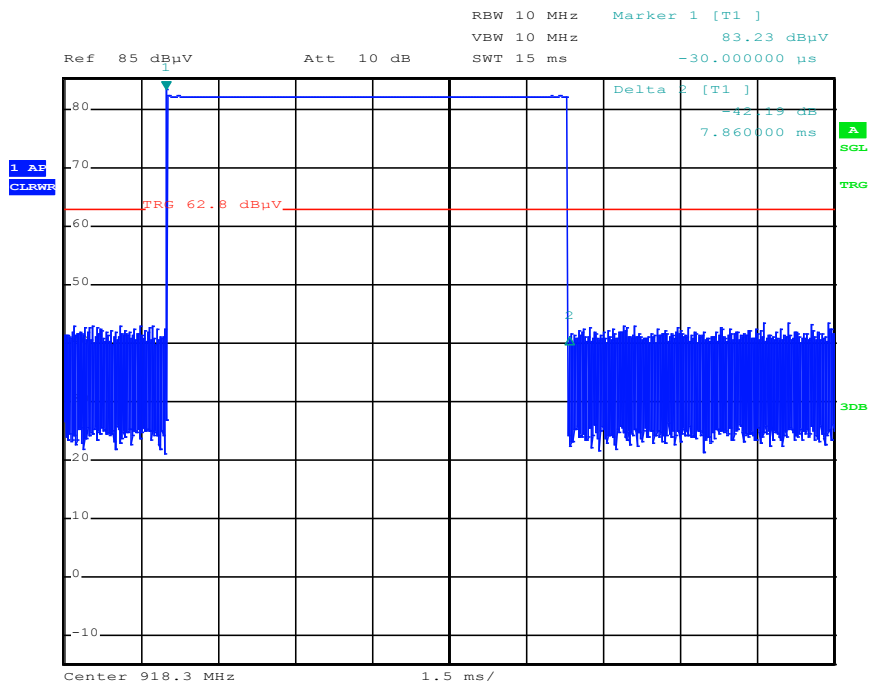
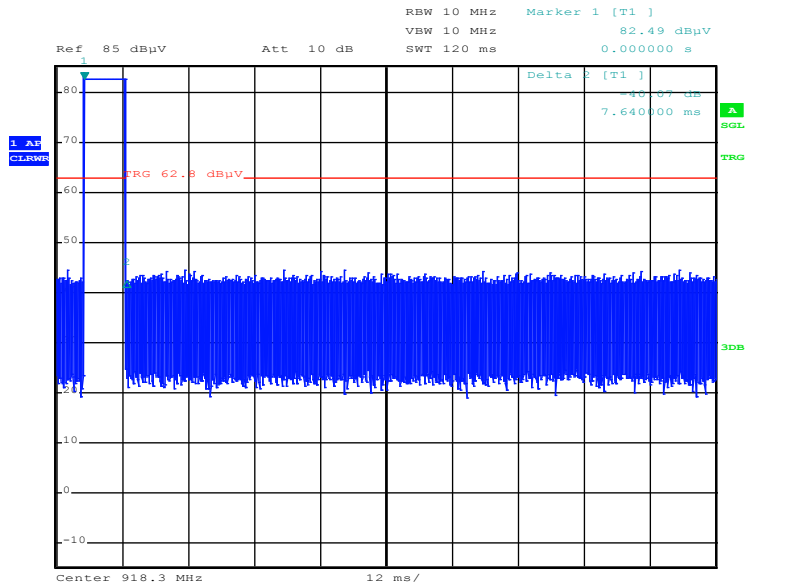
5.3.5 Test result

Modulation	T_w (ms)	t_B (ms)	KE (dB)
GFSK1	100	7,86	-22,0
GFSK05	100	7,89	-22,0

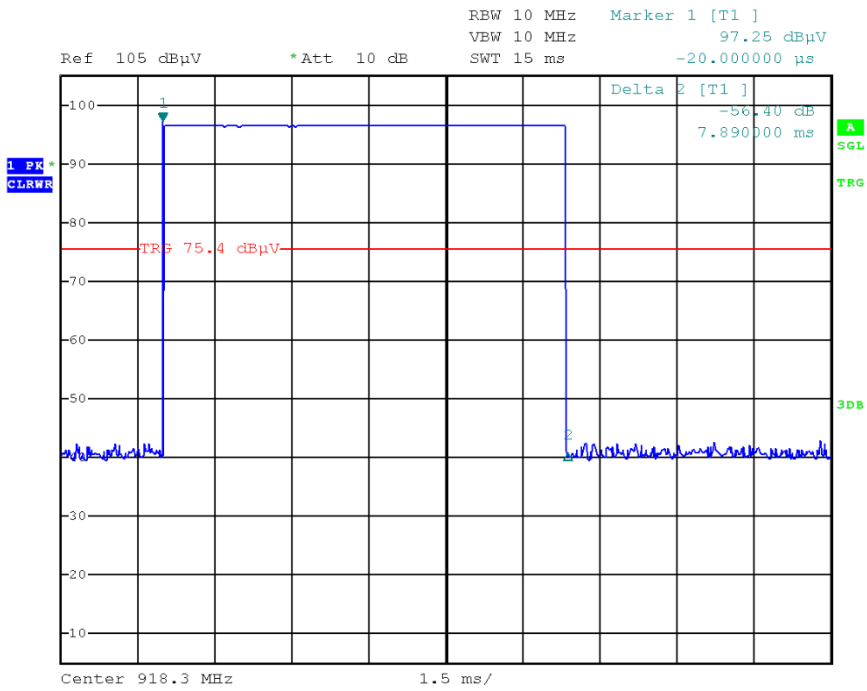
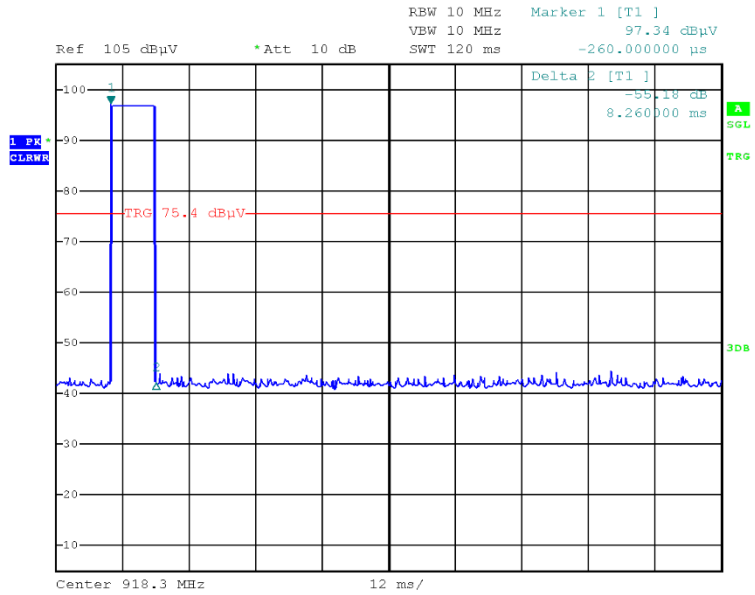
Remarks: The pulse train (T_w) exceeds 100 ms, therefore the duty cycle has been calculated by using 100ms. Used values indicates the worst case.
 For detailed test results please see the following test protocols.

5.3.6 Test protocol

GFSK1 modulation



GFSK05 modulation



5.4 Emission bandwidth

For test instruments and accessories used see section 6 Part **MB**.

5.4.1 Description of the test location

Test location: AREA4

5.4.2 Photo documentation of the test set-up

Refer to document T41252-00-03JP Attachment A

5.4.3 Applicable standard

According to FCC Part 15.231(c) and RSS 210, A1.3

Analyser settings:

Span: 500 kHz, RBW: 3 kHz VBW: 10 kHz Detector: peak;

5.4.4 Test result

Fundamental [MHz]	Modulation	20dB Bandwidth [MHz]	99% Bandwidth [MHz]	Limit [MHz]	Result
918.3	GFSK1	0.158	0.153	4.59	PASS
918.3	GFSK05	0.133	0.127	4.59	PASS

Limit according to FCC Part 15C Section 15.231(c):

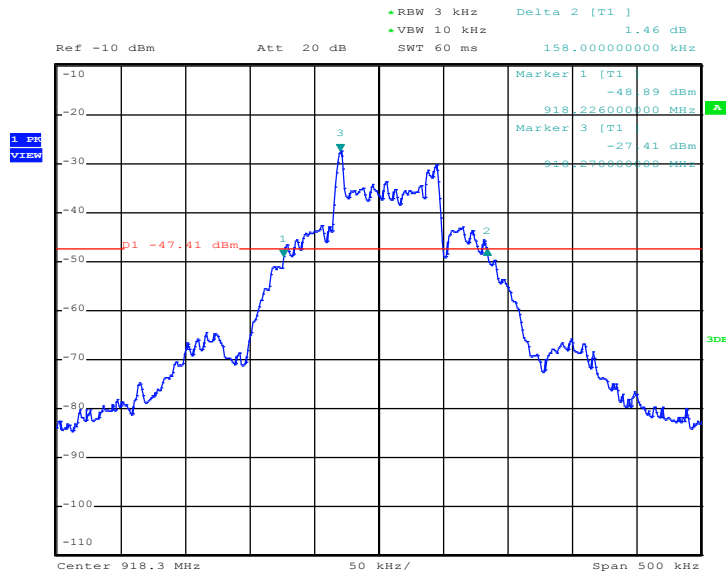
Frequency (MHz)	20 dB BW limit dependent of the carrier (%)
70 – 900	0.25
above 900	0.50

The requirements are **FULFILLED**.

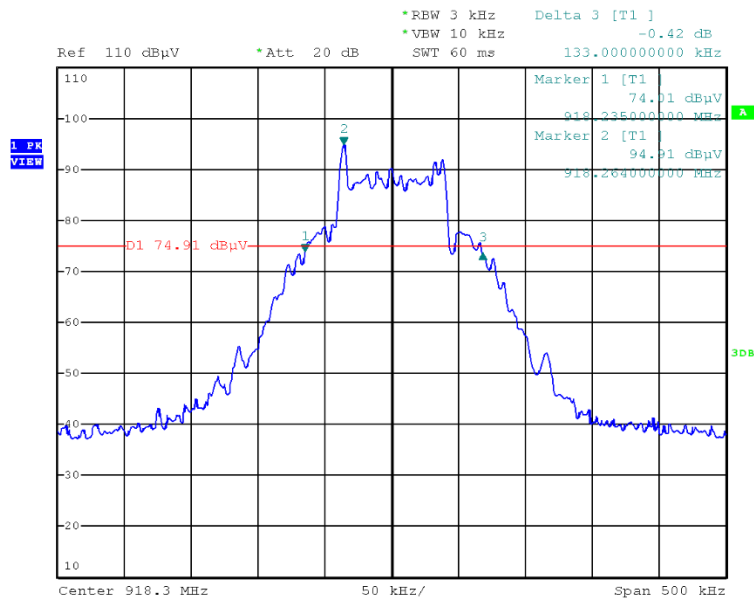
Remarks: For detailed test results please see the following test protocols.

5.4.5 Test protocol

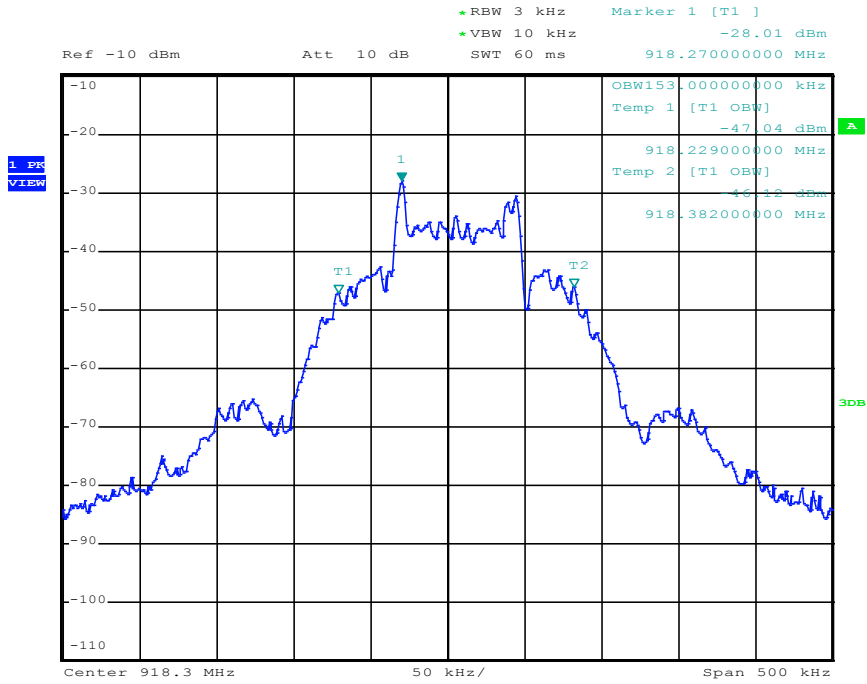
20dB Bandwidth, GFSK1 modulation



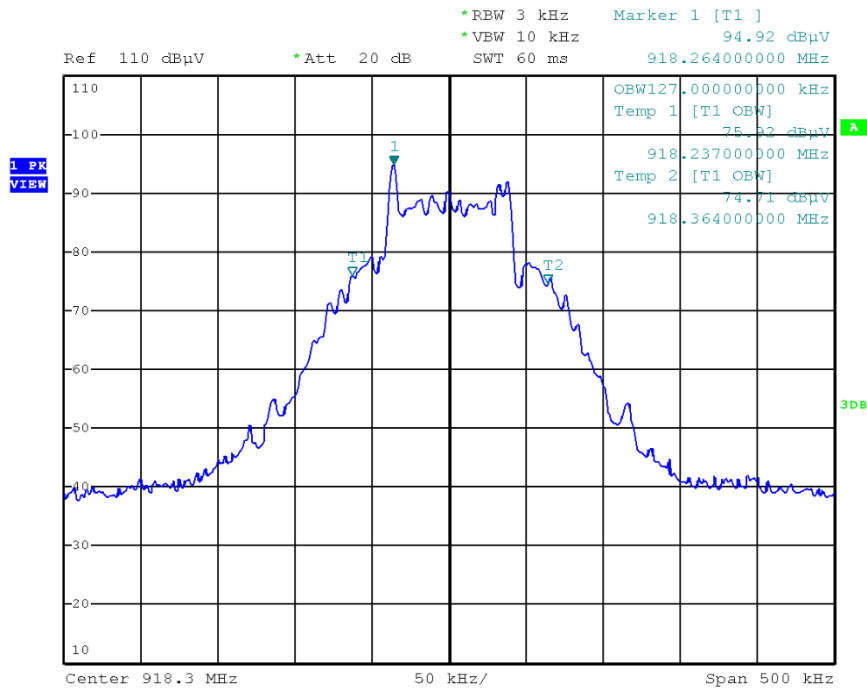
20dB Bandwidth, GFSK05 modulation



99 Bandwidth, GFSK1 modulation



99 Bandwidth, GFSK05 modulation



5.5 Signal deactivation

For test instruments and accessories used see section 6 Part DC.

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up

Refer to document T41252-00-03JP Attachment A

5.5.3 Applicable standard

According to FCC Part 15.231(a) and RSS 210, A1.1

5.5.4 Test result

Duration of transmission (ms)	Duration after releasing the button (ms)
7.86	Due to the short transmission duration no emission after releasing the button could be detected.

Limit according to FCC Part 15C, Section 15.231(a) and RSS 210, A1.1:

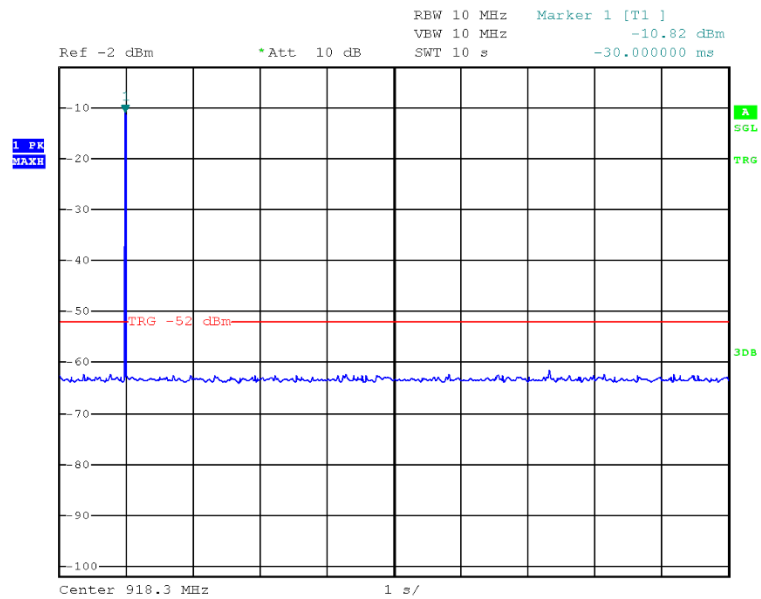
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released and a transmitter activated automatically shall cease transmission within 5 seconds after activation.

The requirements are **FULFILLED**.

Remarks: For detailed test results please see the following test protocols.

5.5.5 Test protocol

918.3 MHz



Marker 1 indicates the release of the TX button

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 2	ESPI 3	01-02/03-03-004	02/10/2018	02/10/2017		
	VULB 9163	01-02/24-01-006	19/10/2018	19/10/2017		
	N-40000-N	01-02/50-05-043				
	N-30000-N	01-02/50-05-044				
DC	FSP 40	02-02/11-11-001	09/10/2018	09/10/2017		
MB	FSP 40	02-02/11-11-001	09/10/2018	09/10/2017		
SER 1	ESPI 3	01-02/03-03-004	02/10/2018	02/10/2017		
	FMZB 1516	01-02/24-01-018			27/03/2018	27/03/2017
	N-40000-N	01-02/50-05-043				
	N-30000-N	01-02/50-05-044				
SER 2	ESPI 3	01-02/03-03-004	02/10/2018	02/10/2017		
	VULB 9163	01-02/24-01-006	19/10/2018	19/10/2017		
	N-40000-N	01-02/50-05-043				
	N-30000-N	01-02/50-05-044				
SER 3	FSP 40	02-02/11-11-001	09/10/2018	09/10/2017		
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P 3117	02-02/17-13-003				
		02-02/24-05-009	10/05/2018	10/05/2017		
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				