

EMI -- TEST REPORT

Test Report No. : E-0115-1706-01 KJ	21. June 2005
	Date of issue

Type / Model Name : S122228002

Product Description : Tire Pressure unit

Applicant : Siemens VDO Automotive AG

Address : Siemensstrasse 12
93055 Regensburg, Germany

Manufacturer : Siemens VDO Automotive AG

Address : Siemensstrasse 12
93055 Regensburg, Germany

Licence holder : Siemens VDO Automotive AG

Address : Siemensstrasse 12
93055 Regensburg, Germany

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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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.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart C - Intentional Radiators (October 01, 2003)

Part 15, Subpart C, Section 15.231	Periodic operation in the band 40.66-40.70 MHz and above 70 MHz §15.231(a) Signal deactivation §15.231(c) Emission Bandwidth §15.231(e) Reduced Field Strength Limits
Part 15, Subpart C, Section 15.35(c)	Correction for Pulse Operation (Duty Cycle)
Part 15, Subpart C, Section 15.209(a)	Radiated emissions, general requirements



2 SUMMARY

GENERAL REMARKS:

The tests according to §15.207 (conducted emissions) are not applicable, because the EuT is battery powered.

FINAL ASSESSMENT:

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

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

Testing commenced on : 14. June 2005

Testing concluded on : 15. June 2005

Checked by:

Tested by:

Dieter Fröhlich
Dipl. Ing.(FH)

Josef Knab

3 EQUIPMENT UNDER TEST

3.1 Power supply system utilised

Power supply voltage : 3 V / DC lithium battery

3.2 Short description of the Equipment under Test (EuT)

The EuT is a tire guard transmitter type S122228002 wich includes an integrated pressure, temperature and acceleration sensor and a RF transmitter (434 MHz).

The tire guard system monitors a vehicle´s tire pressure whilst driving or stationary. An electronic unit (wheel unit) inside each tire, mounted to the valve stem, periodically measures the actual tire pressure. By means of RF communication, the pressure information is transmitted to the RF receiver/decoder.

Number of tested samples: 1
Serial number: Prototype

EuT operation mode:

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

- continuous transmission at 434 MHz

-

-

EuT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

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

- _____	Model : _____
- _____	Model : _____
- _____	Model : _____
- _____	Model : _____
- _____	Model : _____
- _____	Model : _____

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

emitel AG
Landshuter Strasse 211a
94315 Straubing
Deutschland

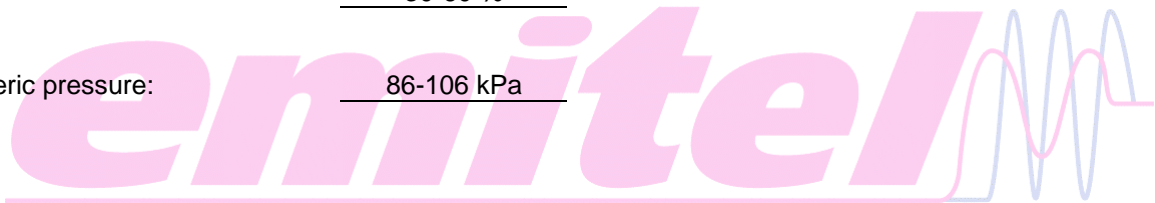
4.2 Environmental conditions

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. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. 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 emitel AG quality system acc. to DIN EN ISO/IEC 17025. 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, VCCI and AUSTEL

4.4.1 GENERAL INFORMATION

4.4.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22 (1997), European Standard EN 55022 and Australian Standard AS 3548 (which are based on CISPR 22).

The Japanese standard, "Voluntary Control Council for Interference (VCCI) by Data Processing Equipment and Electronic Office Machines, Technical Requirements" is technically equivalent to CISPR 22 (1997). For official compliance, a conformance report must be sent to and accepted by the VCCI.

In compliance with FCC Docket 92-152, "Harmonization of Rules for Digital Devices Incorporate International Standards", testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using the CISPR 22 Limits.

4.4.1.2 Measurement Error

The data and results referenced in this document are true and accurate. The reader is cautioned that there is some measurement variability due to the tolerances of the test equipment that can contribute to a nominal product measurement uncertainty. The measurement uncertainty was calculated for all measurements listed in this test report according to NIS 81/5.1994 "The treatment of uncertainty in EMC measurements" and is documented in the emitel AG quality system according to DIN EN ISO/IEC 17025. Furthermore, component differences and manufacturing process variability of production units similar to that tested may result in additional product uncertainty. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the device.

4.4.1.3 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 into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

4.4.2.1 General Standard Information

The test methods used comply with CISPR Publication 22 (1997), EN 55022 (2001) and AS 3548 (1992) - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" and with ANSI C63.4-2003 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

4.4.2.2 Conducted disturbance

Conducted disturbance on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi peak detection, and a Line Impedance Stabilization Network (LISN), with 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi peak and average detection and recorded on the data sheets.

4.4.2.3 Radiated disturbance

Radiated disturbance from the EUT are measured in the frequency range of 30 to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and average detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees.

5 TEST CONDITIONS AND RESULTS

5.1 Radiated power 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: OATS1
Test distance: 3 metres

5.1.2 Photo documentation of the test set-up



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5.1.3 Test result

Frequency [MHz]	L: PK [dBµV]	Corr. Duty Cycle [dB]	L: AV [dBµV]	Band width [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
433.88	55.9	-19.3	-	120	20.5	57.1	-	72.9	-15.8

Limit according to FCC Subpart 15.231(e)

Frequency (MHz)	Fieldstrength of fundamental		Fieldstrength of spurious emissions	
	µV/m	dB (µV/m)	µV/m	dB (µV/m)
40,66 – 40,70	1000	60	100	40
70 - 130	500	54	50	34
130 - 174	500 to 1500*	54 to 63.5*	50 to 150*	34 to 43.5*
174 - 260	1500	63.5	150	43.5
260 - 470	1500 to 5000*	63.5 to 74*	150 to 500*	43.5 to 54*
Above 470	5000	74	500	54

*Linear interpolations

The requirements are **FULFILLED**.

Remarks:

5.2 Radiated emissions (electric field) 30 MHz – 18 GHz

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

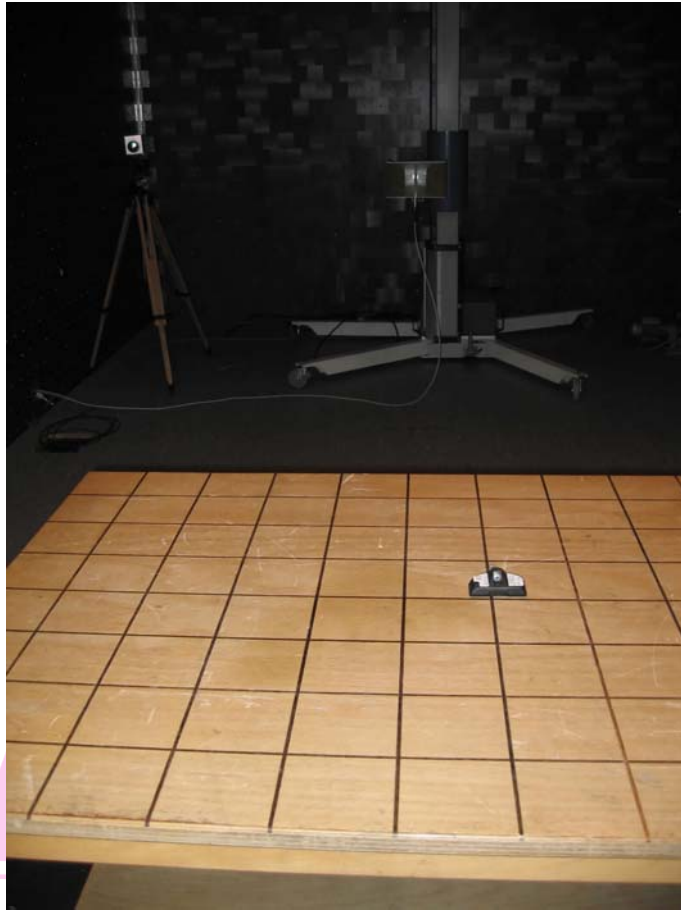
5.2.1 Description of the test location

Test location: OATS1
Test location: Anechoic Chamber A1

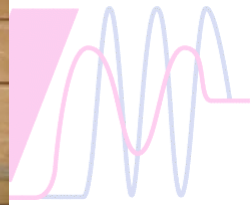
5.2.2 Photo documentation of the test set-up



FCC ID: KR5S122228002



e



5.2.3 Test result

Testresult in detail:(<1GHz)

Frequency [MHz]	L: PK [dBµV]	Corr. Duty Cycle [dB]	L: AV [dBµV]	Band width [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
867.76	13.0	-19.3	-	120	27.7	21.4	-	52.9	-31.5

Testresult in detail:(>1GHz)

Frequency [MHz]	L: PK [dBµV]	Corr. Duty Cycle [dB]	L: AV [dBµV]	Band width [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
1301.64	63.8	-19.3	-	1000	-9.4	35.1	-	52.9	-17.8
1735.52	53.1	-19.3	-	1000	-6.6	27.2	-	52.9	-25.7
2169.40	53.6	-19.3	-	1000	-4.6	29.7	-	52.9	-23.2
2603.28	44.9	-19.3	-	1000	-3.8	21.8	-	52.9	-31.1
3471.04	46.6	-19.3	-	1000	0.5	27.8	-	52.9	-25.1
3904.92	58.1	-19.3	-	1000	3.3	42.1	-	52.9	-10.8
4338.80	61.4	-19.3	-	1000	3.7	45.8	-	52.9	-7.1

Limit according to FCC Subpart 15.231(e) Subpart 15.209(a) / Subpart 15.205(a)

Frequency (MHz)	Fieldstrength of fundamental		Fieldstrength of spurious emissions	
	(µV/m)	dB (µV/m)	(µV/m)	dB (µV/m)
40,66 – 40,70	1000	60	100	40
70 - 130	500	54	50	34
130 - 174	500 to 1500*	54 to 63.5*	50 to 150*	34 to 43.5*
174 - 260	1500	63.5	150	43.5
260 - 470	1500 to 5000*	63.5 to 74*	150 to 500*	43.5 to 54*
Above 470	5000	74	500	54

*Linear interpolations

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in the table above or to the general limits shown in the table below according to § 15.209, whichever limit permits a higher field strength.

Frequency [MHz]	15.209 Limits [µV/m]	15.209 Limits [dBµV/m]
30-88	100	40
88-216	150	43,5
216-960	200	46
Above 960	500	54

Besides is a limit according to §15.35(b) on the radio frequency emissions, as measured with a peak detector, corresponding to 20 dB above the maximum permitted average limits.

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209

MHz	MHz	GHz
25.5 – 25.67	960 – 1240	4.5 – 5.15
37.5 – 38.25	1300 – 1427	5.35 – 5.46
73 – 74.6	1435 – 1626.5	7.25 – 7.75
74.8 – 75.2	1645.5 – 1646.5	8.025 – 8.5
108 – 121.94	1660 – 1710	9.0 – 9.2
123 – 138	1718.8 – 1722.2	9.3 – 9.5
149.9 – 150.05	2200 – 2300	10.6 – 12.7
156.52475 – 156.52525	2310 – 2390	13.25 – 13.4
156.7 – 156.9	2483.5 – 2500	14.47 – 14.5
162.0125 – 167.17	2655 – 2900	15.35 – 16.2
167.72 – 173.2	3260 – 3267	17.7 – 21.4
240 – 285	3332 – 3339	22.01 – 23.12
322 – 335.4	3345.8 – 3358	23.6 – 24.0
399.9 – 410	3600 – 4400	31.2 – 31.8
608 – 614		36.43 – 36.5

The requirements are **FULFILLED**.

Remarks: During the test, the Eut was set into continuous transmitting mode.

The measurement was performed up to the 10th harmonic (4340MHz).

5.3 Correction for Pulse Operation (Duty Cycle)

5.3.1 Description of Measurement

The Duty cycle factor, expressed in dB, is arrived by taking the following formula:

$$KE = 20 \log [(t_{iB} * p) / T_w]$$

KE: pulse operation correction factor [dB]
t_{iw} pulse duration for one complete pulse track [msec]
t_{iB} pulse duration for one pulse [µsec]
T_w a period of the pulse track [msec]
p number of pulses in one train

Remarks: The pulse train [T_w] exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulsewidths over the 100 ms width with the highest average value.

For detailed results, please see the test protocol below.

5.3.2 Test protocol

Correction for Pulse Operation (Duty Cycle) FCC Part 15 Subpart 15.35(c)

$$\text{Averaging factor (Worst case)} = 20 \times \log \left(\frac{T_{on}}{T_{period}} \right) = 20 \times \log \left(\frac{10.72ms}{98.72ms} \right) = -19.3dB$$

with:

- T_{on} (+5% Baud rate tolerance) = 10.21 + 0.51 = 10.72ms
- T_{period} = 88 + 10.72 = 98.72ms

because Shortest inter frame timing (considering its -20% tolerances) = 110 – 22 = 88ms.

GENERAL PROTOCOL REQUIREMENTS

Table 1 Transmission Format	
3.1 Transmission rate	9.6 kbps +/- 480bps
3.2 Signal type	FM modulated

Table 2 Byte Format	
2.1 Coding strategy	Standard Manchester upper transmitter frequency lower transmitter frequency
2.2 Bit timing	104us rising edge to rising edge

Message Structure

Block Definition

A "block" of data contains 3 identical data frames. A successful block consists of one correctly received and decoded frame. A complete block is sent within a one-second interval. A block of data will be sent at regular intervals during normal rolling operation, driving mode. Additional data blocks will be sent at delta pressure events in both driving and parking mode.

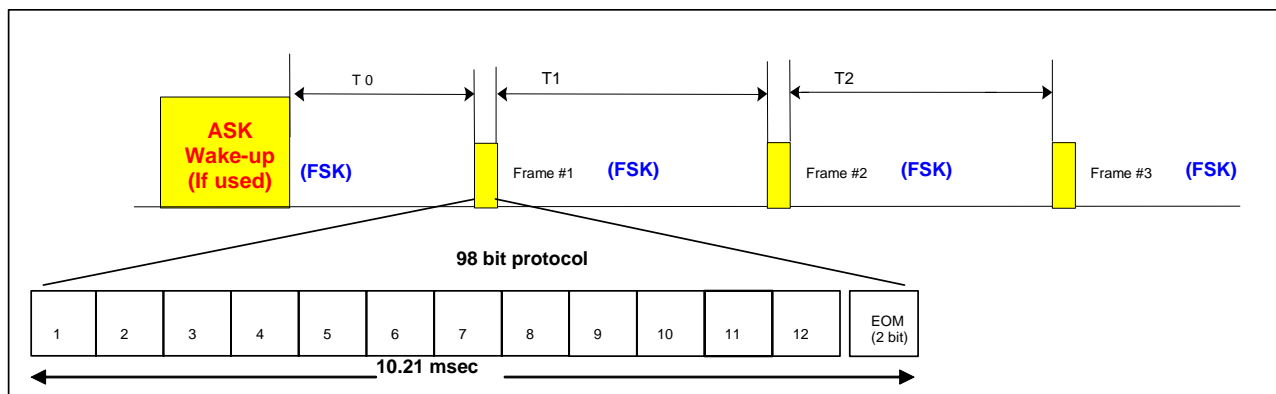
Frame Spacing

Packets shall be spaced apart (from start to start of packets):

The time between RF frames in a block is defined by:

- T0 = 110ms +/- 20%
- T1 = 120 ms +/- 20%
- T2 = 160 ms +/- 20%

Frame Structure



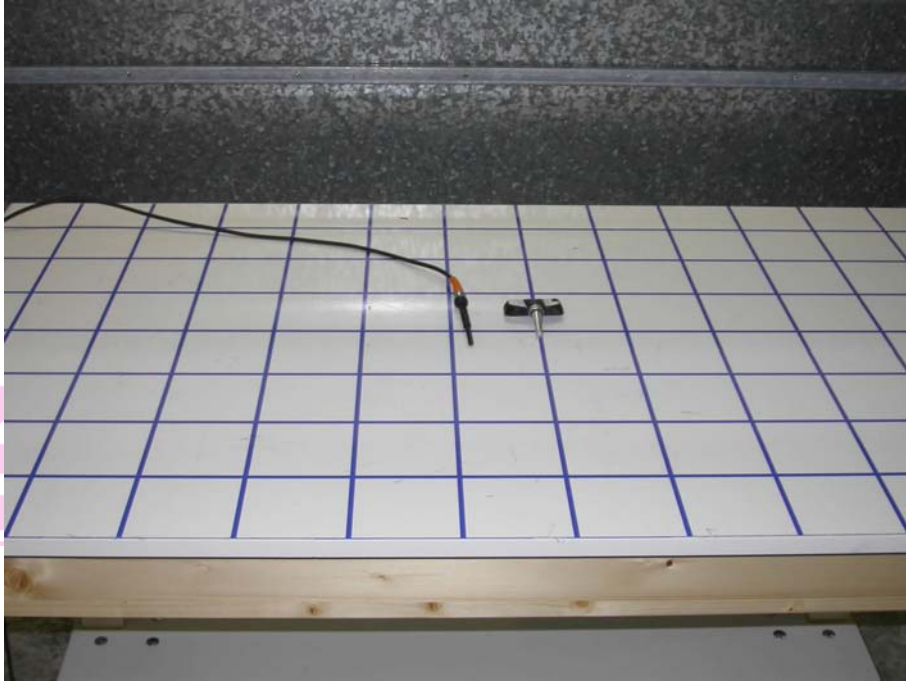
5.4 Emission Bandwidth

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

5.4.1 Description of the test location

Test location: Shielded Room S4

5.4.2 Photo documentation of the test set-up



5.4.3 Test result

Fundamental [MHz]	Duty Cycle	20dB Bandwidth F1	20dB Bandwidth F2	Measured Bandwidth	LIMIT Fundamental f*0,0025
433.880	100%	433.866	433.892	0.026	1.085

Limit according to FCC Part 15 Subpart 15.231(c):

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

The requirements are **FULFILLED**.

Remarks: For detailed results, please see the test protocol below.

5.4.4 Test protocol

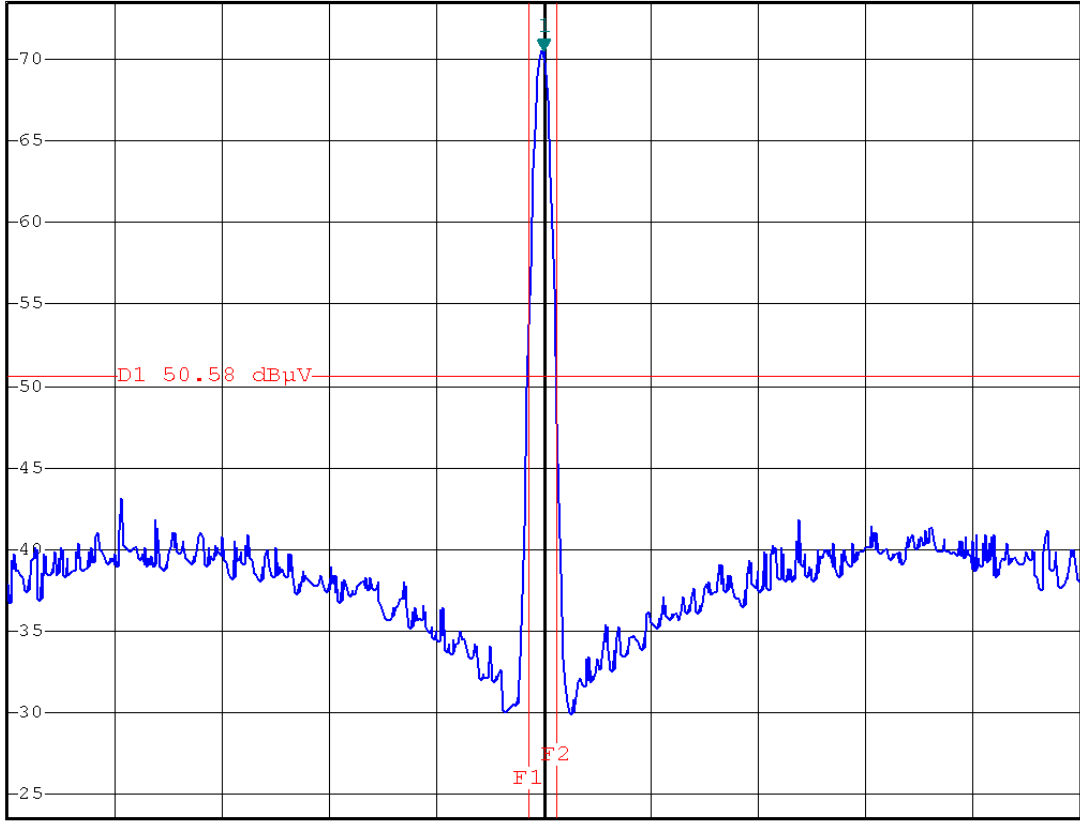
Emission Bandwidth
FCC Part 15 Subpart 15.231(c)



*RBW 10 kHz Marker 1 [T1]
*VBW 10 kHz 70.58 dBμV
SWT 20 ms 433.880000000 MHz

Ref 73.5 dBμV *Att 10 dB

1 PK
VIEW



Center 433.88 MHz 100 kHz/ Span 1 MHz

5.5 Signal deactivation

Limit according to FCC Part 15 Subpart 15.231(e):

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

The requirements are **FULFILLED**.

Remarks: The limits are met.

For detailed information see Correction for Pulse Operation (Duty Cycle) Point 5.4



6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

Test ID	Model / Type	Kind of Equipment	Manufacturer	Equipment No.
CPR2	ESVP	Receiver	Rohde & Schwarz	01-01/01-01-035
	VULB 9163	Antenna	Schwarzbeck	01-01/01-01-059
	RG 217	RF-Cable	Suhner	01-05/02-01-048
	RG 214	RF-Cable	Emitel	01-05/02-01-050
SER2	ESVP	Receiver	Rohde & Schwarz	01-01/01-01-035
	VULB 9163	Antenna	Schwarzbeck	01-01/01-01-059
	RG 217	RF-Cable	Suhner	01-05/02-01-048
	RG 214	RF-Cable	Emitel	01-05/02-01-050
SER3	FSP 30	Analyzer	Rohde & Schwarz	01-01/01-01-063
	3115	Horn Antenna	EMCO	01-01/01-01-062
	FA210A0050M0000	RF-Cable	Anritsu	01-05/02-01-034
	AMF-40-005-180-24-10P	Preamplifier	MITEQ Inc.	01-02/01-02-005
BW	FSP 30	Analyzer	Rohde & Schwarz	01-01/01-01-063
	RG 214	RF-Cable	Emitel	01-05/02-01-109
	7405	Field Probes	ETS EMC Systems LP	01-05/02-01-022