TEST REPORT # EMCC-910036IEAB, 2011-06-16

EQUIPMENT UNDER TEST:

Trade Name:	RFID Reader Module M21
Type Designation(s):	MP02001 / Rev. 17 (M21) with antenna: MK07491
Serial Number:	02171789 (RFID Reader M21); ASBE-0027 (Antenna)
Equipment Class:	Low Power Transceiver
Manufacturer:	Dräger Medical GmbH
Address:	Moislinger Allee 53-55 23558 Lübeck Germany
Phone:	+49 451 882-0
Fax:	+49 451 882-2080

RELEVANT STANDARD(S): 47 CFR 15.225, RSS-210 Issue 8, limited tests performed, only

MEASUREMENT PROCEDURE:

☒ RSS-Gen Issue 3 ☒ ANSI C63.4-2003 ☐ Other

TEST REPORT PREPARED BY:

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TEST PERSONNEL: **HEAD OF LABORATORY:**

Wolfgang Döring Manuel Zenk Reinhard Sauerschell

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance to the FCC regulations for unlicensed devices operating under section 15.225 of the Code of Federal Regulations title 47.
Further the report addresses compliance with the Industry Canada RSS-210 requirements for the certification of licence-exempt (i.e. unlicensed) low-power radiocommunication devices (LPDs) defined as Category I equipment.

1.2 Limits and Reservations

The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.
This test report substitutes Test Report # 910036IEA, 2011-05-26.

1.3 Test Location

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
Accreditation No.:	D-PL-12067-01
Address of Labs I, II, III and Head Office:	EMCCons DR. RAŠEK GmbH & Co. KG Moggast, Boelwiese 8 91320 Ebermannstadt GERMANY
Address of Labs IV and V:	EMCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter GERMANY
Laboratory:	Test Laboratory IV, The 3 m & 10 m semi-anechoic chamber site has been fully described in a report submitted to the FCC, and accepted under Registration Number 878769. This 3 m/10 m alternative test site is approved by Industry Canada under file number 3464C.
Phone:	+49 9194 9016
Fax:	+49 9194 8125
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Manufacturer

Company Name:	Dräger Medical GmbH
Street:	Moislinger Allee 53-55
City:	23558 Lübeck
Country:	Germany
Name for contact purposes:	Mr Markus Steeger
Phone:	+49 451 882 1259
Fax:	+49 451 882 71259
E-Mail:	markus.steeger@draeger.com

1.5 Dates and Test Location

Date of receipt of EUT: 2011-04-21
Test date: CW 17/2011 and CW 18/2011
Test Location: Test Laboratory IV

1.6 Ordering Information

Purchase Order and Date: M61NB45485941, 2011-04-15
Vendor Number: 118562

1.7 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2011-04-29	25	37	969	IV	no
2011-05-02	26	31	967	IV	no
2011-05-03	22	33	965	IV	no
2011-05-04	25	29	974	IV	no
2011-05-06	25	28	978	IV	no

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade Name:	RFID Reader Module M21
Type Designation(s):	MP02001 / Rev. 17 (RFID Reader M21); MK07491
Serial Number(s):	02171789 (RFID Reader M21); ASBE-0027 (Antenna)
FCC ID:	UVFEASTM21
Industry Canada Certification Number:	IC: 5895C-M21
Application:	Low Power Transceiver
Transmit Frequency:	13.56 MHz
Modulation:	ASK
Emission designator:	10K0A1D
Antenna:	detachable, see above
Power supply:	24 VDC **
Ports, RFID Reader M21:	Signal and supply - 5 pin connector Antenna ports A1 … A8 – 8 U.FL series miniaturized SMD coaxial connectors (sockets, male); during test antenna port A1 used, only
Ports, Antennas:	U.FL series miniaturized SMD coaxial connector (socket, male), fitted with U.FL series miniaturized coaxial connector cable (f-f)
Variants:	none
Remarks:	none

** nominal voltage; tests performed with the DRÄGER power supply model M7.3 with a DC voltage of 26.0 V.

2.2 Intended Use

The RFID Reader Module M21 is intended for the Dräger Infinity® ID System. The system enables the wireless communication between therapy device and dedicated RFID accessories.
By utilizing wireless RFID communication to integrate the control functions during operation of anaesthesia and ventilation devices, the Infinity ID system can enhance the information flow in the hospital and supports the caregiver in operating the device. With the Infinity ID accessories this level of control is extended down to the modern anaesthesia and ventilation devices of the Infinity Acute Care System. In practical terms this means that the Infinity ID accessories provide compatibility and can avoid mismatch of components; they can adjust the configuration, can check that accessories are locked in correctly and can tell when to exchange them – all automatically [Information taken from Dräger Website, file: “infinity_RFID_accessories_br_9051996_en.pdf”].

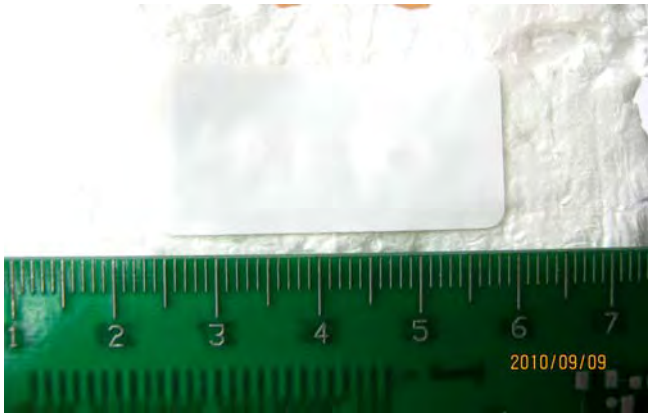
2.3 EUT Peripherals/Simulators

The EUT was tested connected with

- Laptop personal computer (Fujitsu Siemens) as RS-232 controller for the M21 reader,
- TTL Converter,
- Transponder (Infineon),
- power supply M7.3 (Dräger).

Photograph 2.2-1: Peripheral/Simulator: Laptop PC, labelling

Photograph 2.2-2: Peripheral/Simulator: TTL Converter



Photograph 2.2-3: Transponder (Tag), fixed on Styrofoam

Photograph 2.2-4: Power supply M7.3

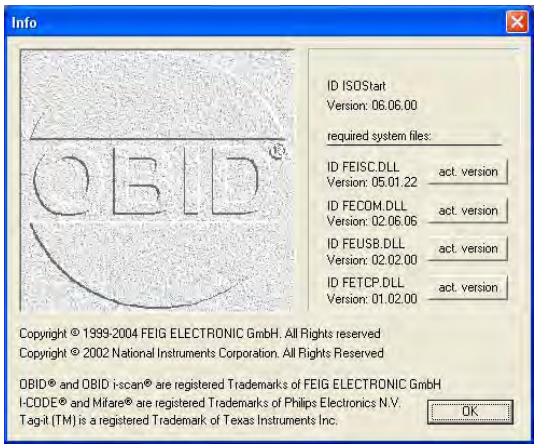
2.4 Mode of operation during testing and test set-up

The equipment under test (EUT) was operated during the tests under the following conditions:

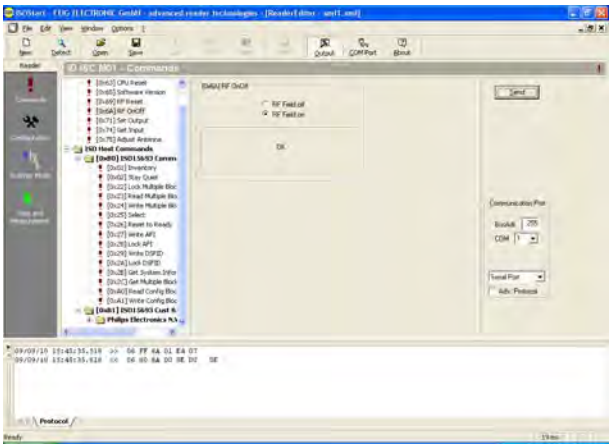
a) normal operating mode (INVENTORY mode w/ and w/o tag),
b) CW mode,
c) Standby mode.

All modes were set via RS-232 from the PC using test software "M21_Tester_3" with batch file start02.bat for mode a) and "OBID ISOstart V06.06.00" for modi b) and c) supplied by the applicant.
During tests one single antenna (worst-case antenna for FCC testing: type MK07491) was connected to antenna port A1.
Carrier frequency stability test performed with external antenna model FEIG 100 mm * 100 mm, SN 1020307.

Under normal test conditions the EUT was powered with 26 VDC by AC / DC supply M7.3 delivered by the customer. All peripherals/simulators were operated outside of the test environment, with the exception of the transponder.



Screenshot: Software OBID ISOstart V06.06.00



Screenshot: CW mode setting

```
M21Tester a1 n0 c1
Pause
```

Listing: start02.bat

2.5 Modifications required for compliance

None.

3 TEST RESULTS SUMMARY

Summary of Test Results for the following EUT:

Manufacturer: Dräger Medical GmbH
Device: RFID Reader Module M21
Type(s): MP02001 / Rev. 17 (RFID Reader M21); MK07491 (Antenna)
Serial No(s): 02171789 (RFID Reader M21); ASBE-0027 (Antenna)

Requirement	RSS, Section	47 CFR Section	Report Section	Result
Antenna Requirement	RSS-Gen, 7.1.2	15.203	4	Pass
Occupied Bandwidth (99%)	RSS-Gen, 4.6.1	2.202(a)	-	N.T.
Bandwidth of Emission (20 dB)	-	15.215(c)	-	N.T.
Class of Emission / Designation of Emissions	RSS-Gen, 4.3(a)(iv)	2.201, 2.202	-	N.T.
Conducted AC Powerline Emissions 150 kHz – 30 MHz	RSS-Gen, 7.2.4	15.207	-	N.T.
Spectrum Mask	RSS-210, A2.6	15.225(a)-(d)	-	N.T.
Radiated Emissions 9 kHz – 30 MHz	RSS-210, A2.6 RSS-Gen, 7.2.2(b)(c), 7.2.5	15.205, 15.209, 15.225(d)	5	Pass
Radiated Emissions 30 MHz – 1 GHz	RSS-210, A2.6 RSS-Gen, 7.2.2(b)(c), 7.2.5	15.205, 15.209, 15.225(d)	6	Pass
Carrier Frequency Stability	RSS-210, A2.6 RSS-Gen, 4.7, 7.2.6	15.225(e)	7	Pass
Radio frequency exposure	RSS-102 Issue 3		-	N.T.

N.A. – not applicable; N.T. – Not tested acc. to applicant's order.

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein. Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.
The measurements contained in this report were made in accordance with the procedures described in RSS-Gen Issue 3 and ANSI C63.4-2003.
All requirements were found to be within the limits outlined in this report.
The test results in this report apply only to the particular Equipment Under Test (EUT) as declared in this report.

Test Personnel: Wolfgang Döring, Manuel Zenk
Issuance Date: 2011-06-16

4 ANTENNA REQUIREMENT

Test Requirement: 47 CFR 15.203, RSS-Gen

4.1 Regulation

FCC 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 Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221.
Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

RSS-Gen: 7.1.2 Transmitter Antenna
A transmitter can only be sold or operated with antennas with which it was approved. Transmitter may be approved with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest gain antenna of each combination of transmitter and antenna type for which approval is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type having equal or lesser gain as an antenna that had been successfully tested with the transmitter, will also be considered approved with the transmitter, and may be used and marketed with the transmitter. For Category I transmitters, the manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter. […]
User Manual for Transmitters with Detachable Antennas
The user manual of transmitter devices equipped with detachable antennas shall contain the following information in a conspicuous location:

> *This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.*

Immediately following the above statement, the manufacturer shall provide a list of all antennas acceptable for use with the transmitter Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi) and required impedance for each.

No antenna requirement specified in **RSS-210**.

4.2 Result

Device:	RFID Reader Module M21
Type:	MP02001 / Rev. 17 with MK07491
Serial number:	02171789 (RFID Reader M21); ASBE-0027 (Antenna)

Antenna connectors are commercial available U.FL series miniaturized SMD coaxial connectors.
The equipment however requires professional installation.

The EUT meets the requirements of this section.

5 RADIATED EMISSIONS 9 kHz – 30 MHz

Test Requirement: FCC 47 CFR, §15.205, 15.209, 15.225(d);
IC RSS-Gen Issue 3, 7.2.2(b)(c), 7.2.5, RSS-210 A2.6
Test Procedure: ANSI C63.4-2003, RSS-Gen

5.1 Regulation

Section 15.33 Frequency range of radiated measurements:
(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz […]

Section 15.35 Measurement detector functions and bandwidths.
The conducted and radiated emission limits shown in this Part are based on the following, unless otherwise specified elsewhere in this Part:
(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified.
(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Section 15.205(d)(7) Devices operated pursuant to § 15.225 are exempt from complying with this section for the 13.36–13.41 MHz band only.

Section 15.225 Operation within the band 13.110–14.010 MHz.
(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

Section 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
0.009–0.490	2400/F[kHz]	67.6 – 20 logF[kHz]	300
0.490–1.705	24000/F[kHz]	87.6 – 20 logF[kHz]	30
1.705–30.0	30	29.5	30

(b) In the emission table above, the tighter limit applies at the band edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

IC RSS-Gen 7.2.2 Emissions Falling Within Restricted Frequency Bands
(b) unwanted emissions falling into restricted bands of Table 1 shall comply with the limits specified in RSS-Gen;
(c) unwanted emissions not falling within restricted frequency bands shall either comply with the limits specified in the applicable RSS, or with those specified in RSS-Gen.

Table 6: General Field Strength Limits for Transmitters at Frequencies Below 30 MHz (Transmit)

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector.

IC RSS-210 A2.6 Band 13.110-14.010 MHz
The field strength of any emission shall not exceed the following limits:
(d) 30 microvolts/m (29.5 dBµV/m) at 30 m, outside the band 13.110-14.010 MHz.

→ The IC limits are equal to the FCC limits.

5.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Antenna (9 kHz – 30 MHz)	Rohde & Schwarz HFH-Z2	374	2011-04	2014-04
Receiver (9 kHz - 1 GHz)	Rohde & Schwarz ESS	303	2011-03	2012-09

5.3 Test Procedures

Measurement was performed in a semi-anechoic room at a test distance of 3 m. A calibrated loop antenna as specified in ANSI C63.4 clause 4.1.5.1 was positioned with its plane vertical at the test distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. For certain applications, the loop antenna may also need to be positioned horizontally at the specified distance from the EUT. Instead of changing the loop antenna polarization to horizontal the EUT antenna was rotated by 90 degrees. I.e. tests performed for 2 EUT antenna polarizations. The center of the loop antenna was 1 m above the ground.

Portable, small, lightweight, or modular devices that may be hand-held, worn on the body, or placed on a table during operation are positioned on a nonconducting platform, the top of which is 80 cm above the reference groundplane. The EUT was tested on a 0.8 meter high tabletop.
The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter.
In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling from the remotely located device to the EUT or accessories to be placed directly on the reference groundplane or, if normally installed beneath the reference groundplane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that it does not contribute to the measured level. This procedure evaluates the interference potential of the EUT, its accessories, and interconnecting cables or wires standing apart from the remotely located device, which in turn shall be evaluated separately, if required.
[Remark: The control Laptop PC was located outside of the test environment.].

Worst case emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz - 30 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	200 Hz (9 kHz - 150 kHz)
	10 kHz (150 kHz - 30 MHz)
Receive antenna height	1 m
Receive antenna polarization	Vertical

* According to Section 15.31 (f)(2): At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The 40 dB/decade factor was used.

5.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the band 1.705–30.0 MHz:

µV/m at 30 meters = 30

30 µV/m corresponds with 29.5 dBµV/m.

5.5 Field Strength Calculation

All emission measurements performed using the test receiver's transducer factor setting capability, i.e. the field strength value measured directly without the necessity of additional correction factors.
For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(2) the field strength is calculated by adding additionally an extrapolation factor of 40 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

FS = FST + DF
where
FS = Field Strength in dBµV/m
FST = Field Strength at test distance in dBµV/m
DF = Distance Extrapolation Factor in dB,
where DF = 40 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 3 m instead of the Specified Distance of 30 m giving a Distance Extrapolation Factor of DF = 40 log(3 m/30 m) = -40 dB.
Assuming a measured field strength level of 58.8 dBµV/m is obtained. The Distance Factor of -40 dB is added, giving a field strength of 18.8 dBµV/m. The 18.8 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 58.8 - 40 = 18.8 [dBµV/m]
Level in µV/m = Common Antilogarithm (18.8/20) = 8.7

5.6 Test Results

Frequency [MHz]	Detector	3m_Result [dB(µV/m)]	Distance Correction [dB]	30m_Result [dB(µV/m)]	30m_Limit [µV/m]	30m_Limit [dB(µV/m)]	Margin [dB]
0.550	QP	63.5	-40	23.5	43.6	32.8	9.3
0.555		63.3		23.3	43.2	32.7	9.4
0.695		56.9		16.9	34.5	30.8	13.9
0.815		51.8		11.8	29.4	29.4	17.6
0.930		53.8		13.8	25.8	28.2	14.4
1.105		51.4		11.4	21.7	26.7	15.3

The table above contains worst-case emissions, only. For further details refer to the test plots.

Device: RFID Reader Module M21
Type: MP02001 / Rev. 17 with MK07491
Serial number: 02171789 (RFID Reader M21); ASBE-0027 (Antenna)

All emissions in the range 9 kHz to 30 MHz are below the specified limits.

The EUT meets the requirements of this section.

5.7 Measurement Plots

refer to the following pages.

EMCCons DR. RASEK

29. Apr 11 14:43

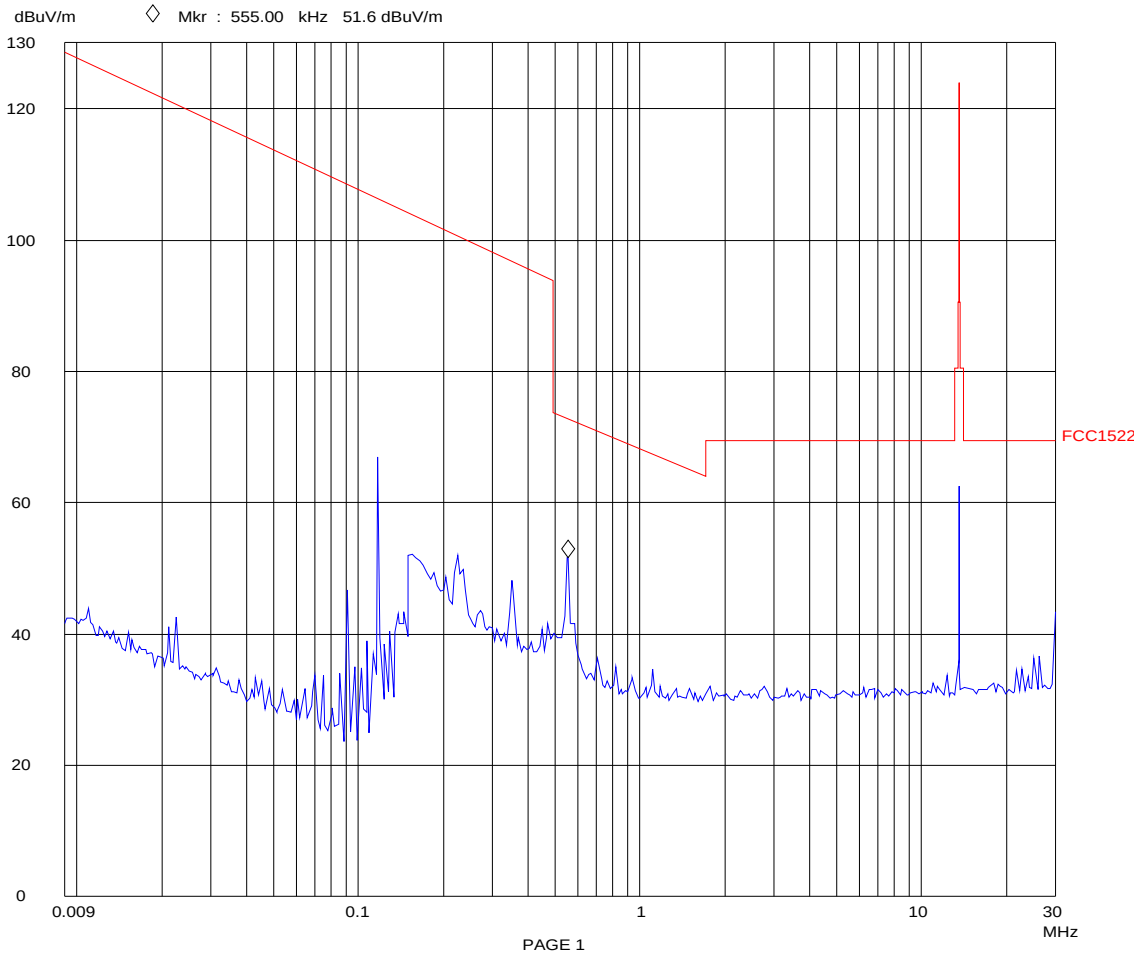
Radiated Emissions H Field in SAR, d=3m

EUT:	M21 MP02001 / Rev17 w/ MK07491
Manuf:	Draeger
Op Cond:	CW mode
Operator:	Doering
Test Spec:	FCC 15, RSS-210
Comment:	4 sides, ant: I, _
	EUT hor

Scan Settings (2 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
9k	150k	100Hz	200Hz	PK	10ms AUTO	LN OFF		60dB
150k	30M	5k	10k	PK	5ms AUTO	LD OFF		30dB

Final Measurement: x Hor-Max / + Vert-Max
Meas Time: 1 s
Subranges: 25
Acc Margin: 30dB



EMCCons DR. RASEK

29. Apr 11 15:40

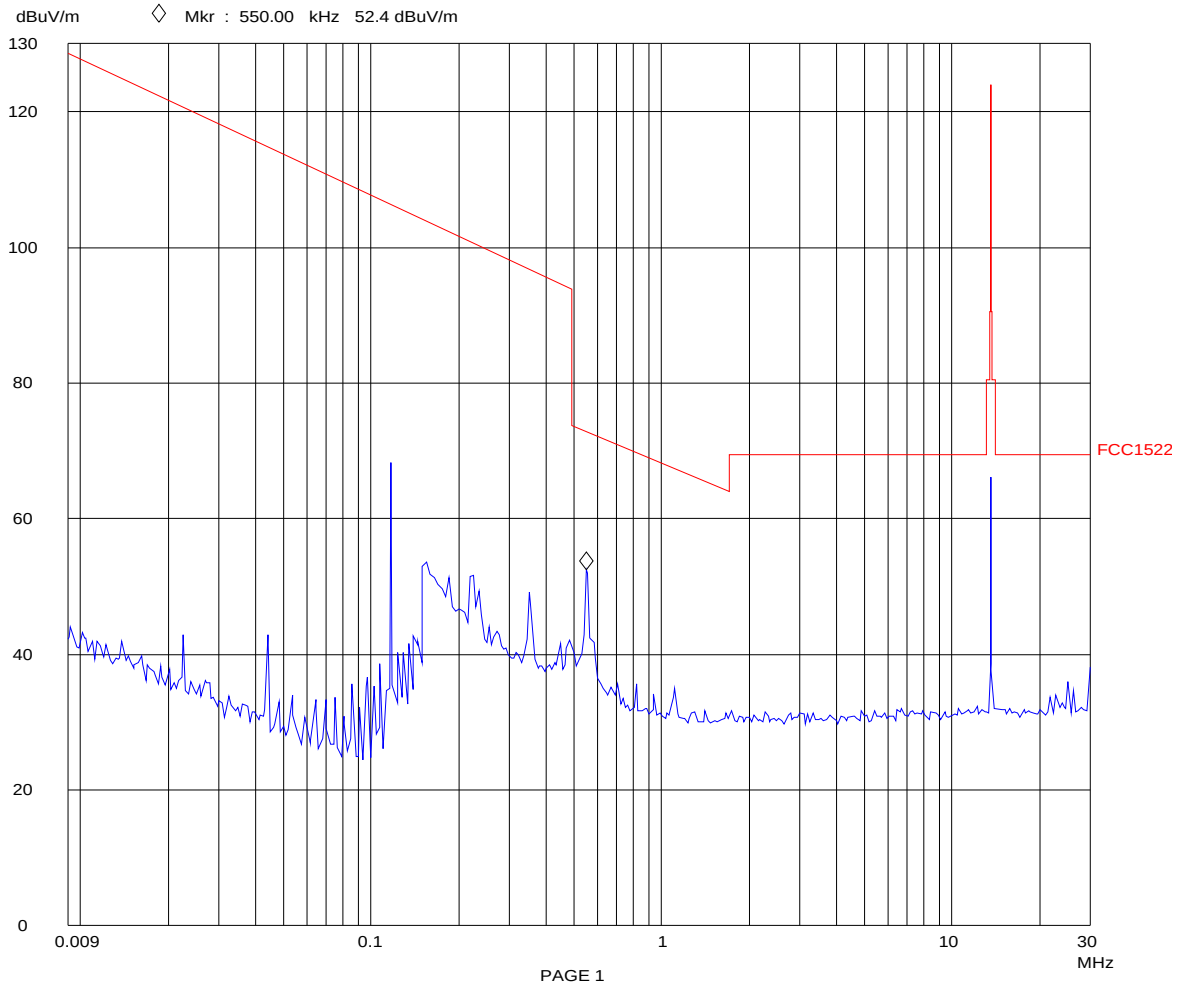
Radiated Emissions H Field in SAR, d=3m

EUT: M21 MP02001 / Rev17 w/ MK07491
Manuf: Draeger
Op Cond: CW mode
Operator: Doering
Test Spec: FCC 15, RSS-210
Comment: 4 sides, ant: I, _
EUT vert

Scan Settings (2 Ranges)

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
9k	150k	100Hz	200Hz	PK	10ms	AUTO	LN OFF	60dB
150k	30M	5k	10k	PK	5ms	AUTO	LD OFF	30dB

Final Measurement: x Hor-Max / + Vert-Max
Meas Time: 1 s
Subranges: 25
Acc Margin: 30dB



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EMCCons DR. RASEK

29. Apr 11 13:46

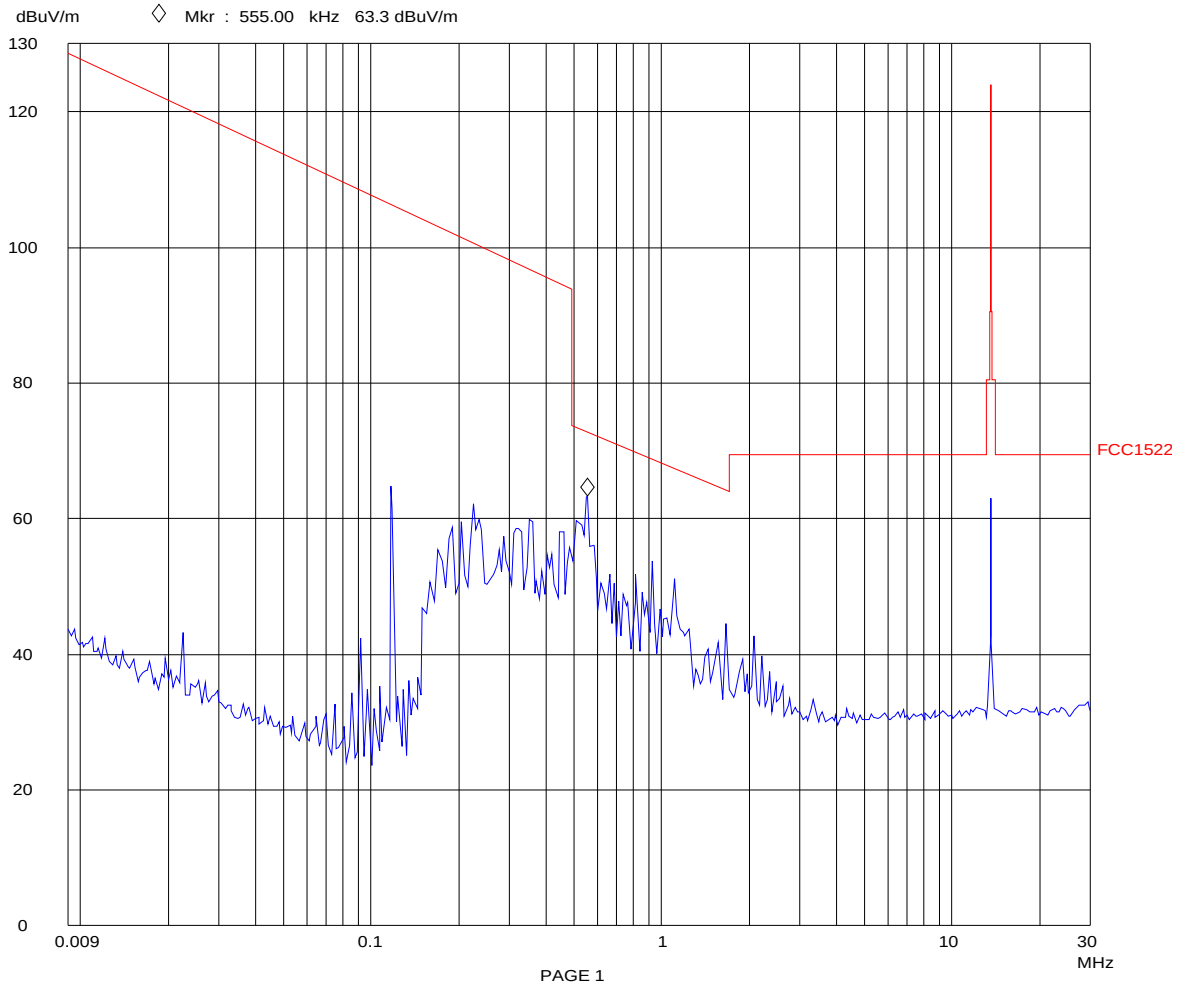
Radiated Emissions H Field in SAR, d=3m

EUT: M21 MP02001 / Rev17 w/ MK07491
Manuf: Draeger
Op Cond: w/ tag, inventory
Operator: Doering
Test Spec: FCC 15, RSS-210
Comment: 4 sides, ant: I, _
EUT hor

Scan Settings (2 Ranges)

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
9k	150k	100Hz	200Hz	PK	10ms	AUTO	LN OFF	60dB
150k	30M	5k	10k	PK	5ms	AUTO	LD OFF	30dB

Final Measurement: x Hor-Max / + Vert-Max
Meas Time: 1 s
Subranges: 25
Acc Margin: 30dB



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EMCCons DR. RASEK

29. Apr 11 11:38

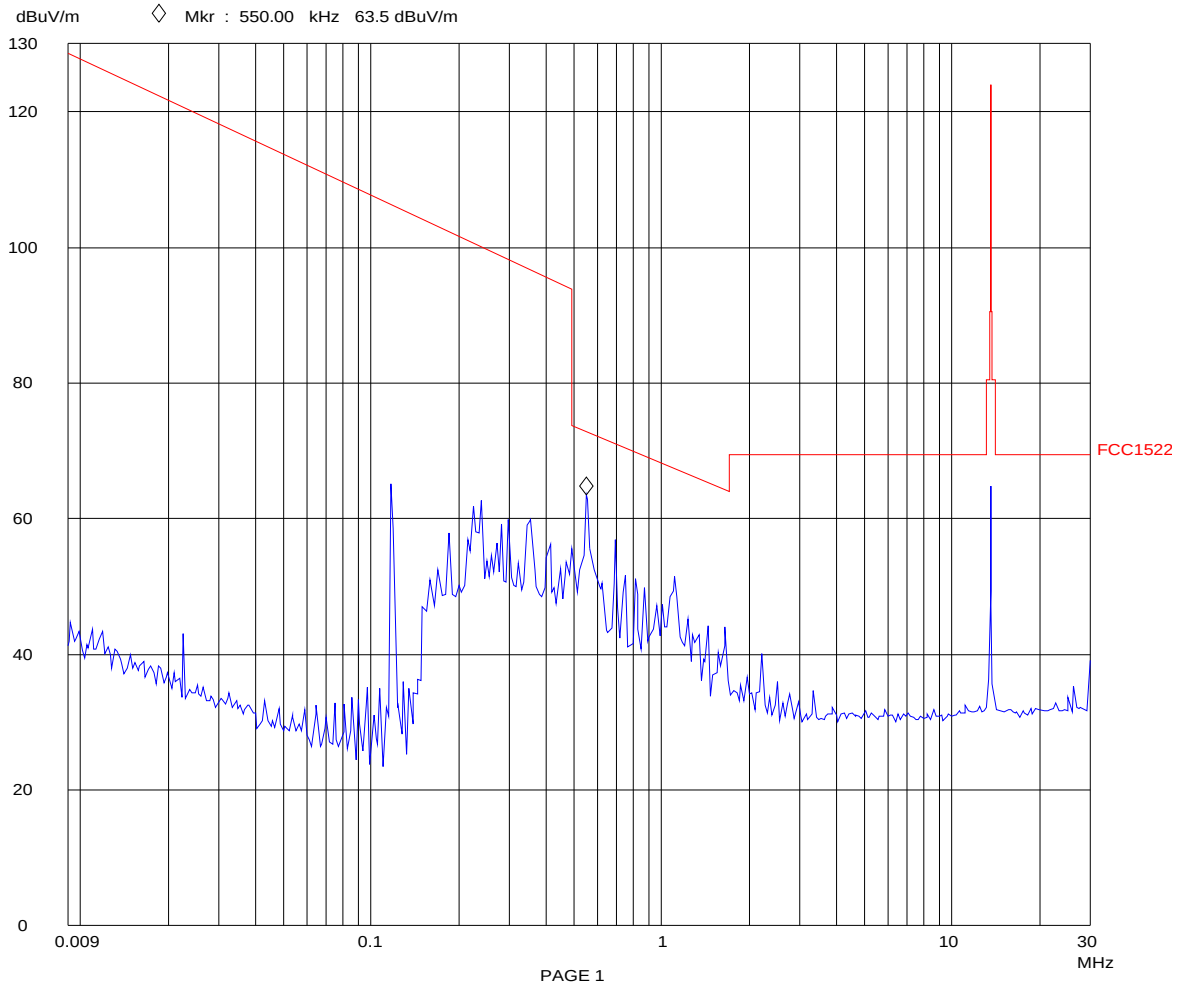
Radiated Emissions H Field in SAR, d=3m

EUT: M21 MP02001 / Rev17 w/ MK07491
Manuf: Draeger
Op Cond: w/ tag, inventory
Operator: Doering
Test Spec: FCC 15, RSS-210
Comment: 4 sides, ant: I, _
EUT vert

Scan Settings (2 Ranges)

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
9k	150k	100Hz	200Hz	PK	10ms	AUTO	LN OFF	60dB
150k	30M	5k	10k	PK	5ms	AUTO	LD OFF	30dB

Final Measurement: x Hor-Max / + Vert-Max
Meas Time: 1 s
Subranges: 25
Acc Margin: 30dB



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6 RADIATED EMISSIONS 30 MHz – 1000 MHz

Test Requirement: FCC 47 CFR, §15.205, 15.209, 15.225(d);
IC RSS-Gen Issue 3, 7.2.2(b)(c), 7.2.5, RSS-210 A2.6
Test Procedure: ANSI C63.4-2003, RSS-Gen

6.1 Regulation

Section 15.33 Frequency range of radiated measurements:
(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:
(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1)-(a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this Section, whichever is the higher frequency range of investigation.

Section 15.35 Measurement detector functions and bandwidths.
The conducted and radiated emission limits shown in this Part are based on the following, unless otherwise specified elsewhere in this Part:
(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission. As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, as long as the same bandwidths as indicated for CISPR quasi-peak measurements are employed.
Note: For pulse modulated devices with a pulse-repetition frequency of 20 Hz or less and for which CISPR quasi-peak measurements are specified, compliance with the regulations shall be demonstrated using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements.

Section 15.225 Operation within the band 13.110–14.010 MHz.
(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.
Section 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency	Field Strength		Measurement distance
[MHz]	[µV/m]	[dB(µV/m)]	[m]
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
Above 960	500	54.0	3

(b) In the emission table above, the tighter limit applies at the band edges.
(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

IC RSS-Gen 7.2.2 Emissions Falling Within Restricted Frequency Bands
(b) unwanted emissions falling into restricted bands of Table 1 shall comply with the limits specified in RSS-Gen;
(c) unwanted emissions not falling within restricted frequency bands shall either comply with the limits specified in the applicable RSS, or with those specified in RSS-Gen.

Table 5: General Field Strength Limits for Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

Note: Transmitting devices are not permitted in Table 1 bands or, unless stated otherwise, in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz).

IC RSS-210 A2.6 Band 13.110-14.010 MHz
The field strength of any emission shall not exceed the following limits:
(d) 30 microvolts/m (29.5 dBµV/m) at 30 m, outside the band 13.110-14.010 MHz.

→ The IC limits for radiated spurious emissions within the range above 960 MHz are equal to the FCC limits. In the range 30 – 960 MHz less stringent limits apply.

6.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Antenna (30 MHz - 1 GHz)	EMCO Model 3143	898	2008-11	2011-05
Receiver (9 kHz - 1 GHz)	Rohde & Schwarz ESS	303	2011-03	2012-09

6.3 Test Procedures

Portable, small, lightweight, or modular devices that may be hand-held, worn on the body, or placed on a table during operation are positioned on a nonconducting platform, the top of which is 80 cm above the reference groundplane. The EUT was tested on a 0.8 meter high tabletop.
In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling from the remotely located device to the EUT or accessories to be placed directly

on the reference groundplane or, if normally installed beneath the reference groundplane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that it does not contribute to the measured level. This procedure evaluates the interference potential of the EUT, its accessories, and interconnecting cables or wires standing apart from the remotely located device, which in turn shall be evaluated separately, if required.
[Remark: The control Laptop PC was located outside of the test environment.].
With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions *[Remark: Not applicable]*. All tests performed with the EUT placed in both vertical and horizontal polarizations on the nonconductive table.

Measurement initially performed as a pre-scan in a fully anechoic room in the full frequency range in order to find worst case emissions. Final measurement performed at worst-case emission frequencies in a FCC and IC listed semi-anechoic room at the specified 3 m test distance. Due to signal timing issues maxima searched in CW mode, final measurement performed in modulated mode.

Worst case emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz - 1,000 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz (30 MHz - 1,000 MHz)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

* According to Section 15.31 (f)(1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. (...) When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

6.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the restricted band 108-121.94 MHz:

µV/m at 3 meters = 150

150 µV/m corresponds with 43.5 dBµV/m.

6.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB(1/m)
CF = Cable Attenuation Factor in dB

Assume a receiver reading of 23.5 dBµV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dBµV/m. The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 23.5 + 7.4 + 1.1 = 32 [dBµV/m]

Level in µV/m = Common Antilogarithm (32/20) = 39.8

6.6 Test Results

Frequency [MHz]	Polarization	Reading QP	Antenna factor	Result [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]
67.8	v	22.7	8.6	31.3	40.0	8.7
94.9	v	22.3	9.4	31.7	43.5	11.8
122.0	v	24.5	9.4	33.9	43.5	9.6
149.2	h	21.1	12.3	33.4	43.5	10.1
379.7	h	15.3	18.8	34.1	46.0	11.9
528.9	h	14.1	23.5	37.6	46.0	8.4
406.8	h	13.2	19.7	32.9	46.0	13.1

All tests performed at 3 m distance. The table above contains worst-case emissions for the normal modulated mode (INVENTORY mode), only. For further details refer to the pre-scan test plots.

Device: RFID Reader Module M21
Type: MP02001 / Rev. 17 with MK07491
Serial number: 02171789 (RFID Reader M21); ASBE-0027 (Antenna)

All emissions in the range 30 MHz to 1000 MHz are below the specified limits.

The EUT meets the requirements of this section.

6.7 Pre-scan Plots

Refer to the following page.

EMCCons DR. RASEK

03. May 11 08:31

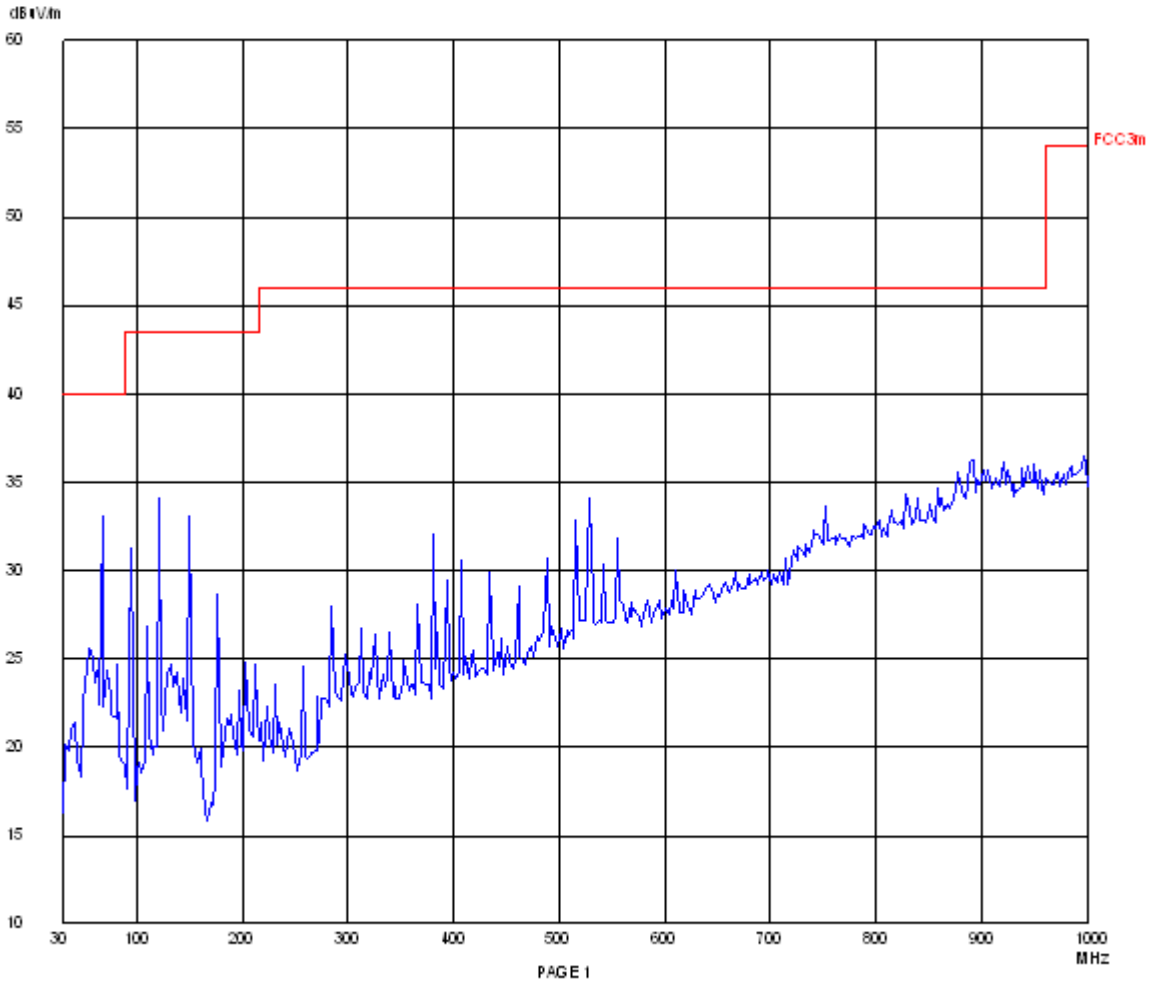
Radiated Emissions Prescan d=3m

EUT:	M21 MP02001 / Rev17 w/ antenna MH07491
Manuf:	Draeger
Op Cond:	w/tag, Inventory
Operator:	Doering
TestSpec:	FCC 15 RSS210
Comment:	EUT vert, 4 sides, antenna h1/1.5/2/2.5m, v1/1.5/2m

FastScan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	1000M	40k	120k	PK	0.10ms	0dB	LN ON	60dB

Transducer No.	Start	Stop	Name
22	30M	1000M	89625K33



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7 CARRIER FREQUENCY STABILITY

Test Requirement: FCC 47 CFR, §15.225(e); IC RSS-210 A2.6
Test Procedure: ANSI C63.4-2003, RSS-Gen

7.1 Regulation

Section 15.225 Operation within the band 13.110–14.010 MHz.
(e) The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

IC RSS-210 A2.6 Band 13.110-14.010 MHz
Carrier frequency stability shall be maintained to ±0.01% (±100 ppm).

7.2 Test Procedures

According to ANSI C63.4 section 13.1.6 and appropriate RSS-Gen sections.

IC RSS-Gen 4. Measurement Methods
4.7 Transmitter Frequency Stability
Frequency stability is a measure of frequency drift due to temperature and supply voltage variations with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage.
Unless specified otherwise in the RSS that is applicable to the device, the reference temperature for transmitters is +20°C.
A hand-held device that is only capable of operating using internal batteries shall be tested using a new battery without any further requirement to vary the supply voltage. Alternatively, an external supply voltage can be used and set at the battery nominal voltage, and again at the battery operating end point voltage which must be specified by the equipment manufacturer.
The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency-determining circuit element shall be made subsequent to this initial set-up.
With the transmitter installed in an environment test chamber, the unmodulated carrier frequency shall be measured under the conditions specified below. A sufficient stabilization period at each temperature shall be used prior to each frequency measurement. The following temperatures and supply voltage ranges apply, unless specified otherwise in the applicable RSS.

(a) at temperatures of -30°C, +20°C and +50°C, and at the manufacturer's rated supply voltage; and
(b) at a temperature of +20°C and at ±15 percent of the manufacturer's rated supply voltage.

If the frequency stability limits are only met at a different temperature range than specified in (a), the frequency stability requirement will be deemed met if the transmitter is automatically inhibited from operating outside this different temperature range and the published equipment operating characteristics are revised to reflect this different temperature range.

IC RSS-Gen 7. Licence-exempt Radio Apparatus
7.2.6 Transmitter Frequency Stability
Transmitter frequency stability for licence-exempt radio apparatus shall be measured in accordance with Section 4.7. Also, for licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C, +20°C and +50°C instead of at the temperatures specified in Section 4.7(a).

7.3 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
ESIB40	R&S	516	2010-02	2012-02
Antenna 7405-903	EMCO	1729	not applicable	not applicable
Climatic chamber 3216/16	Feutron	3025	not applicable	not applicable
Power supply NGPE40	R&S	529	not applicable	not applicable
Multimeter 3478A	Hewlett-Packard	2483	not applicable	not applicable

7.4 Test Results

7.4.1 Carrier Frequency Stability vs Temperature

Test conditions: Supply voltage = 24 VDC
f_{nom} = 13.56 MHz

Temperature	Frequency	Deviation from nominal frequency f_{nom}		Limit
[°C]	[MHz]	[kHz]	[%]	[%]
-30	13.56002	+0.02	+0.0001	±0.01
-20	13.56012	+0.12	+0.0009	
-10	13.56017	+0.17	+0.0013	
0	13.56019	+0.19	+0.0014	
+10	13.56020	+0.20	+0.0015	
+20	13.56018	+0.18	+0.0013	
+30	13.56017	+0.17	+0.0013	
+40	13.56017	+0.17	+0.0013	
+50	13.56016	+0.16	+0.0012	

Test performed at nominal supply voltage and within the temperature range of -30°C up to +50°C starting at nominal ambient temperature and continuing with the highest specified temperature and proceeding with temperature lowered in 10 degree steps down to the lowest specified temperature (refer to ANSI C63.10 section 6.8.1).

7.4.2 Carrier Frequency Stability vs Supply Voltage

Test conditions: Temperature = 20 °C
f_{nom} = 13.56 MHz

Supply voltage	Frequency	Deviation from nominal frequency f_{nom}		Limit
[V]	[MHz]	[kHz]	[%]	[%]
18	13.56018	+0.18	+0.0013	±0.01
19	13.56018	+0.18	+0.0013	
20	13.56018	+0.18	+0.0013	
21	13.56019	+0.19	+0.0014	
22	13.56019	+0.19	+0.0014	
23	13.56019	+0.19	+0.0014	
24	13.56019	+0.19	+0.0014	
25	13.56018	+0.18	+0.0013	
26	13.56018	+0.18	+0.0013	
27	13.56018	+0.18	+0.0013	
28	13.56018	+0.18	+0.0013	
29	13.56018	+0.18	+0.0013	
30	13.56018	+0.18	+0.0013	

Test performed at normal ambient temperature and within the manufacture's specified supply voltage range.

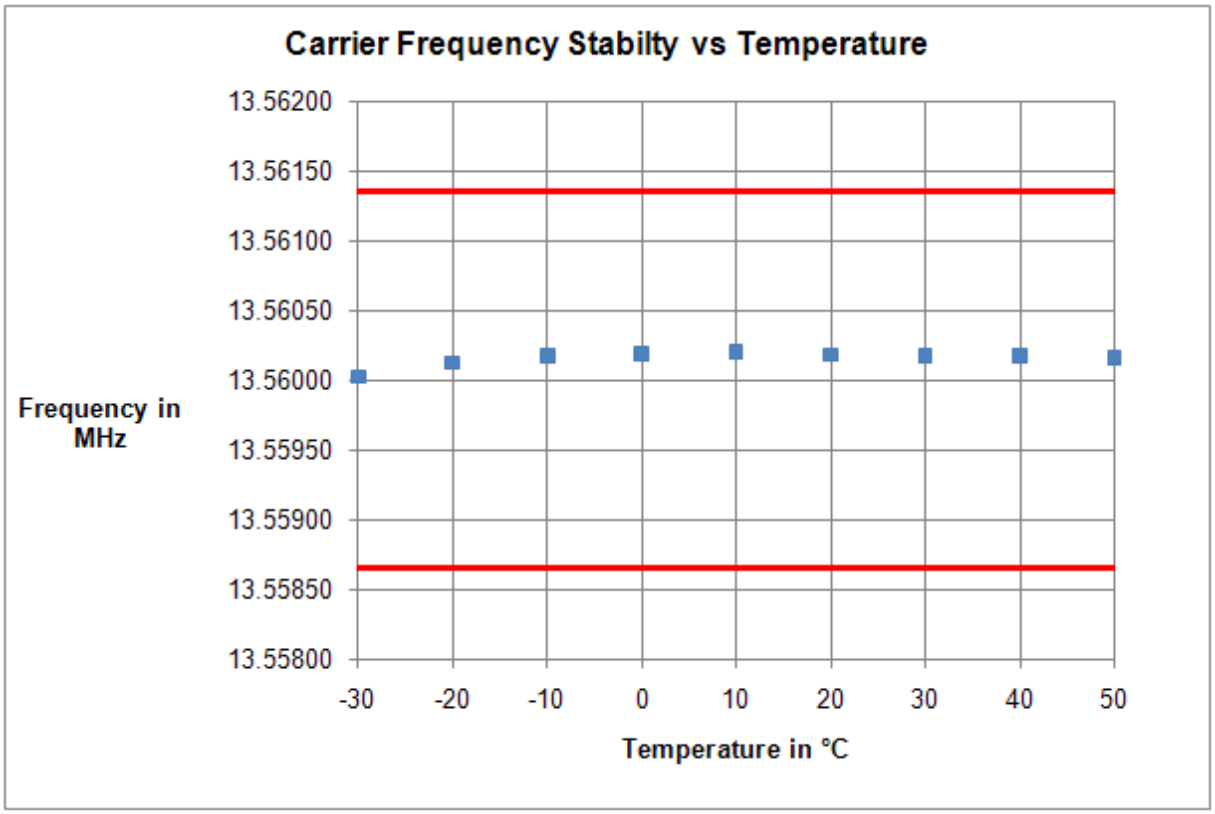
Device: RFID Reader Module M21
Type: MP02001 / Rev. 17 with MK07491
Serial number: 02171789 (RFID Reader M21); FEIG antenna 100 mm * 100 mm SN 1020307

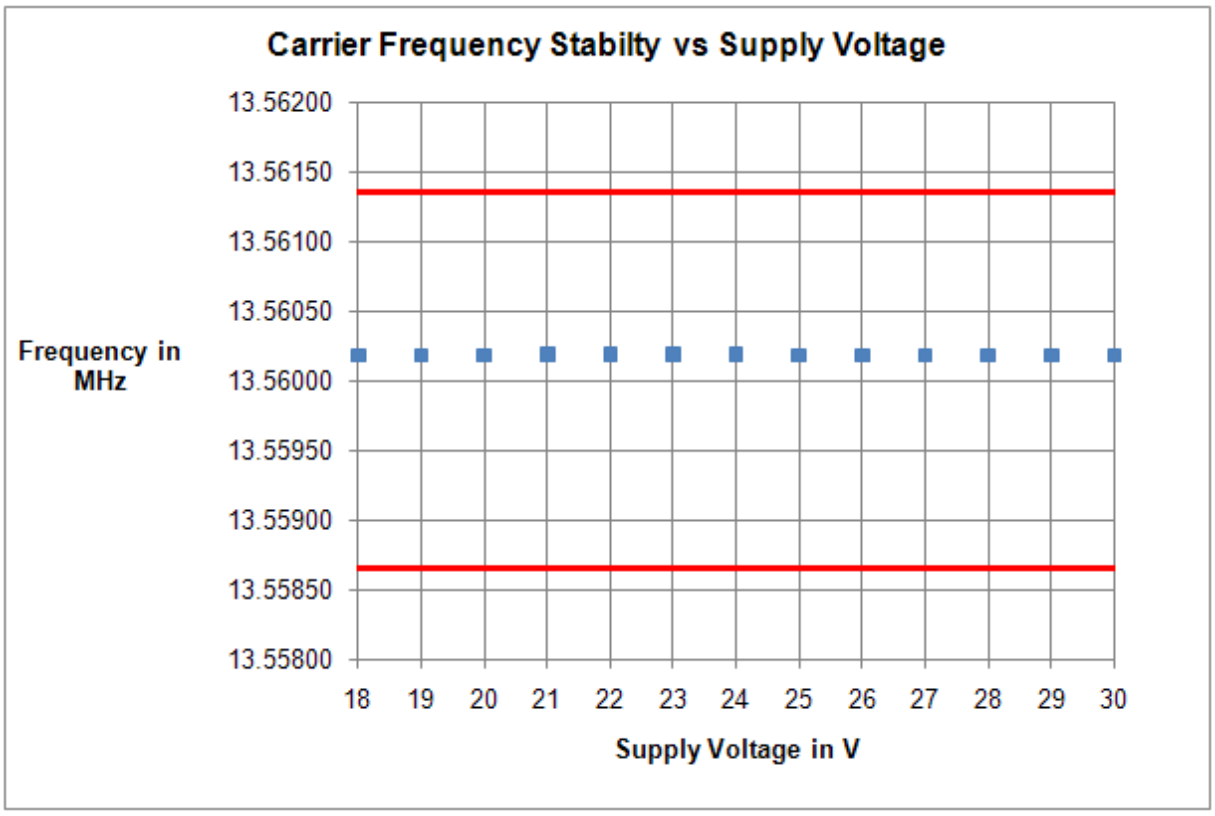
Carrier frequency stability is within the specified limits.

The EUT meets the requirements of this section.

7.5 Measurement Plots

refer to the following page.





8 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	3
Annex 2: Photographs of equipment under test (EUT)	2