TEST REPORT # EMCC-110010DB, 2013-05-17

EQUIPMENT UNDER TEST:

Trade Name:	Transmitter Module
Model:	PTM 330 U
Serial No:	018074B3 (sample 1)
Equipment Category:	Transmitter
Manufacturer:	EnOcean GmbH
Address:	Kolpingring 18 a 82041 Oberhaching Germany
Phone:	+49 89 6734 689-627
Fax:	+49 89 6734 689-56
E-mail:	darius.draksas@enocean.com

RELEVANT STANDARD(S): 47 CFR Part 15C

RSS-210 Issue 8 (2010-12)

MEASUREMENT PROCEDURE USED:

☒ ANSI C63.4-2009 ☐ FCC/OET MP-4 (1987) ☐ Other

TEST REPORT PREPARED BY:

Mr Karlheinz Kraft
EMCCons DR. RAŠEK GmbH & Co. KG
Moggast, Boelwiese 8
91320 Ebermannstadt
Germany
Phone: +49 9194 9016
Fax: +49 9194 8125
E-mail: k.kraft@emcc.de

TEST PERSONNEL: **HEAD OF GROUP :**

Manuel Zenk Karlheinz Kraft Wolfgang Döring

Test of EnOcean GmbH Transmitter Module Model PTM 330 U to 47 CFR Part 15C and RSS-210 Issue 8 (2010-12)

CONTENTS

Page

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 15.231 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 radio communication 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.

1.3 Test Laboratory

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
Accreditation No.:	D-PL-12067-01-01
Address of Head Office and Labs I, II, III:	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
Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG, Test Laboratory IV located at Stoernhofer Berg 15, 91364 Unterleinleiter, Germany the 3 m & 10 m semi-anechoic chamber site has been fully described in a report submitted to the FCC, and accepted in the letter dated December 22, 2010, Registration Number 878769.
Name for contact purposes:	Mr Karlheinz Kraft
Phone:	+49 9194 9016
Fax:	+49 9194 8125
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Manufacturer

Company Name:	EnOcean GmbH
Street:	Kolpingring 18 a
City:	82041 Oberhaching
Country:	Germany
Name for contact purposes:	Mr Darius Draksas
Phone:	+49 89 67 34 689-627
Fax:	+49 89 67 34 689-56
E-mail:	darius.draksas@enocean.com

1.5 Dates and Test Location

Date of receipt of EUT:	CW 17/2013
Test date:	CW 17/2013
Test Location:	Test Laboratory IV

1.6 Ordering Information

Purchase Order and Date:	2013-10357, 2013-04-02
Vendor Number:	K701624

1.7 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Customer attended tests
2013-04-24	24	34	983	Yes
2013-04-25	23	37	982	No
2013-04-26	24	36	969	No
2013-05-03	22	40	972	No

The tests were attended by Mr Meineke on 2013-04-24.

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade Name:	Transmitter Module
Model:	PTM 330 U
Serial Number:	018074B3 (sample 1)
Application:	wireless switch
Power:	electro dynamic power supply device
Transmit Frequency:	902.88 MHz, one RF channel
Modulation:	FSK
Emission designator:	F1D
Lowest frequency in EUT:	> 100 kHz (DC/DC converter)
Antenna:	whip antenna, soldered on PCB
Interface ports:	none
Variants:	none
Test samples:	sample 1 was used for the tests (serial number: 018074B3) sample 2 for backup purposes only (no serial number provided by the customer)
Remarks:	none

2.2 Test Samples and Mode of Operation During Testing

There were two different modes for test purposes submitted as well as the normal operating mode:

CW:
Software modified unit without modulation. Power supply is a Lithium battery, 1/2 AA, 3.6 V. Used for testing the max. radiated field strength of the fundamental.

Continuous modulated transmission:
Software modified unit, where the original data pattern is repeated each some 100 ms. Power supply is a Lithium battery, 1/2 AA, 3.6 V. Used for testing carrier, harmonics, spurious emissions, bandwidth and duty cycle.

Normal operating mode:
The EUT was programmed to its normal operating algorithm. Power supply is an electro dynamic power device. Used for testing the periodic operation characteristic.

2.3 EUT Peripherals

None.

2.4 Modifications Required for Compliance

None.

3 TEST RESULTS SUMMARY

Requirement	47 CFR Section	RSS, Section	Report Section	Test Result
Antenna Requirement	15.203	RSS-Gen Issue 3 (2010-12), 7.1.2	4	Pass
AC Line Conducted Emissions	15.207	RSS-Gen Issue 3 (2010-12), 7.2.4	5	N.A.[1]
Radiated Spurious Emissions	15.231, 15.209, 15.205(b)	RSS-210 Issue 8 (2010-12), A1.1.2(3)	6	Pass
Periodic Operation Characteristics	15.231(a)	RSS-210 Issue 7 (2007-06), A1.1.1	7	Pass
Field Strength Limits (Fundamental)	15.231(b)	RSS-210 Issue 8 (2010-12), A1.1.2(2)	6	Pass
20 dB Bandwidth (Occupied Bandwidth)	15.231(c)		8	Pass
99 % Power Bandwidth (Occupied Bandwidth)		RSS-210 Issue 8 (2010-12), A1.1.3	8	Pass

N.A.[1] – Not applicable. The EUT is powered by electro dynamic device, only.

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 procedure ANSI C63.4 - 2009 and all applicable Public Notices received prior to the date of testing. All emissions from the device 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: Manuel Zenk, Karlheinz Kraft
Issuance Date: 2013-05-17

4 ANTENNA REQUIREMENT

Test Requirement: FCC 47 CFR, Part 15C, Industry Canada RSS-Gen Section 7.1.2

4.1 Regulation

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.

According to DA 00-2225 "OET Extends Effective Date of Antenna Connector Requirement Indefinitely", dated September 28, 2000, the OET extends the effective date of Public Notice, DA 00-1087, indefinitely.

4.2 Result

Equipment under test (EUT): PTM 330 U, sample 1

The antenna is a permanently attached antenna (whip antenna, soldered on PCB).

The EUT meets the requirements of this section.

5 CONDUCTED EMISSIONS TEST

Test Requirement: FCC 47 CFR, Part 15C, Industry Canada RSS-Gen Section 7.2.1
Test Procedure: ANSI C63.4-2009, Industry Canada RSS-Gen

5.1 Regulation

Section 15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak (QP)	Average (AV)
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

Section 15.207 (c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

5.2 Test Equipment

Not applicable.

5.3 Test Procedures

Not applicable.

5.4 Test Results

Equipment under test (EUT): none

The EUT is powered by electro dynamic power device only. Therefore - according to Section 15.207 (c) - conducted emissions measurements to demonstrate compliance with the conducted limits are not required.

6 RADIATED EMISSIONS TESTS

Test Requirement: FCC 47 CFR, Part 15C, Industry Canada RSS-210 Annex 1
Test Procedure: ANSI C63.4-2009, Industry Canada 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.
(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§ 15.250, 15.252, 15.255, and 15.509–15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.
(c) Unless otherwise specified, e.g. § 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 15.209 (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)	(microvolts/meter)	(meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	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.
(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.
(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

Section 15.231(b) In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750 *	125 to 375 *
174 - 260	3,750	375
260 - 470	3,750 to 12,500 *	375 to 1,250 *
Above 470	12,500	1,250

* Linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, μV/m at 3 meters = 56.81818(F) - 6136.3636; for the band 260-470 MHz, μV/m at 3 meters = 41.6667(F) - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in Section 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of Section 15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits a higher field strength.

6.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Calibration Interval
Loop Antenna (9 kHz - 30 MHz)	Rohde & Schwarz HFH2-Z2	374	2011-04	36 months
Antenna (30 MHz - 1 GHz)	EMCO Model 3143	898	2011-05	36 months
Receiver (9 kHz - 1 GHz)	Rohde & Schwarz ESS	303	2013-02	24 months
Antenna (1 GHz – 3.2 GHz)	Schwarzbeck BBHA 9120 D	3236	2013-02	36 months
EMI Receiver / Analyser (20 Hz – 8 GHz)	Rohde & Schwarz ESU8	3846	2012-05	12 months
Spectrum Analyser (20 Hz – 50 GHz	Rohde & Schwarz FSU	3831	2012-05	12 months

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 shall be positioned on a no conducting platform, the top of which is 80 cm above the reference ground plane. Ceiling and wall-mounted devices shall also be positioned on a tabletop for testing purposes.

The EUT was tested on a 0.8 meter high platform.

For test at frequencies > 1GHz the EUT was placed at 1.5 meter height for better alignment with the test antenna.

Preview tests are performed to determine the "worst case" mode of operation. 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 3 axis on the nonconductive platform. Worst case emissions are listed under chapter: test results.

New batteries were installed at the beginning of the tests.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz – 10 GHz
Test distance	1 / 3 m*
Test instrumentation resolution bandwidth	200 Hz (9 kHz - 150 kHz)
	10 kHz (150 kHz - 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1,000 MHz - 3,200 MHz)
Receive antenna scan height	1 m - 4 m (E-field antenna only)
Receive antenna polarization	Horizontal (H-field, f < 30 MHz)
	Vertical/Horizontal (E-field, f > 30 MHz)

* 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).
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).

H-field measurement up to 30 MHz 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 at the test distance from the EUT and rotated about its vertical axis for maximum response at each azimuth of the EUT. In a second test run the EUT position was turned by 90 degrees. I.e. tests performed for 2 EUT orientations. The centre of the loop antenna was 1 m above the ground.

E-field measurements above 30 MHz were performed in two steps:

- pre-scan at a distance of 3 m,
- final test up to 1 GHz in semi-anechoic room at a test distance of 3 m and above 1 GHz at a closer distance of 1 m (due to very low responses during pre-scan).
-

6.4 Calculation of Field Strength Limits

Fundamental field strength limits for frequencies above 470 MHz (fundamental frequency F = 902.88 MHz):
µV/m at 3 meters = 12500 µV/m corresponds with 82 dBµV/m (average value).

The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level, i.e. 62 dBµV/m (average value).

For the peak limiting value the provisions in § 15.35 apply, i.e. by adding 20 dB.
Carrier peak limit is 102 dBµV/m and unwanted emission peak limit is 82 dBµV/m.

6.5 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100 mSec time period and using the formula:

Corrections Factor (dB) = 20*log (worst case on time/100 mSec)

6.6 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

Note: the Correction Factor in following tables consists of Antenna Factor and Cable Attenuation.

For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(1) the field strength is calculated by adding additionally an extrapolation factor of 20 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 = 20 log (Dtest/Dspec) where Dtest = Test Distance and Dspec = Specified Distance

Assume the tests performed at a reduced Test Distance of 1 m instead of the Specified Distance of 3 m giving a Distance Extrapolation Factor of DF = 20 log (1m/3m) = -9.5 dB.

Assuming a measured field strength level of 39.5 dBµV/m is obtained. The Distance Factor of -9.5 dB is added, giving a field strength of 30 dBµV/m. The 30 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
FS = 39.5 - 9.5 = 30 [dBµV/m]
Level in µV/m = Common Antilogarithm (30/20) = 31.6

6.7 Test Results

Equipment under test (EUT): PTM 330 U, sample 1

The EUT meets the requirements of this section.

Test Personal: Manuel Zenk, Karlheinz Kraft

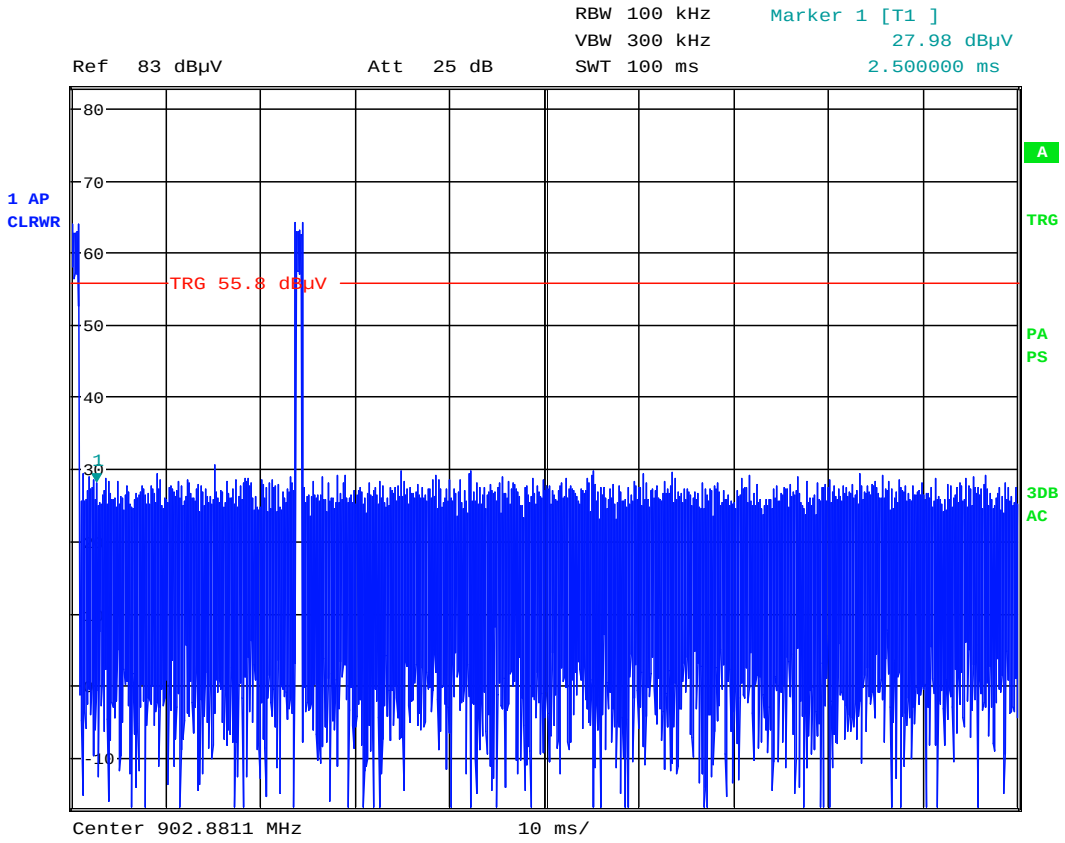
Test Date: 2013-04-24 to 26

Detailed test data please refer to the following pages.

6.7.1 Duty Cycle

Duty cycle was tested with a pick up antenna close to the EUT to get sufficient signal. The spectrum analyser was set to zero span and to max. resolution bandwidth.

Equipment under test (EUT): PTM 330 U, sample 1

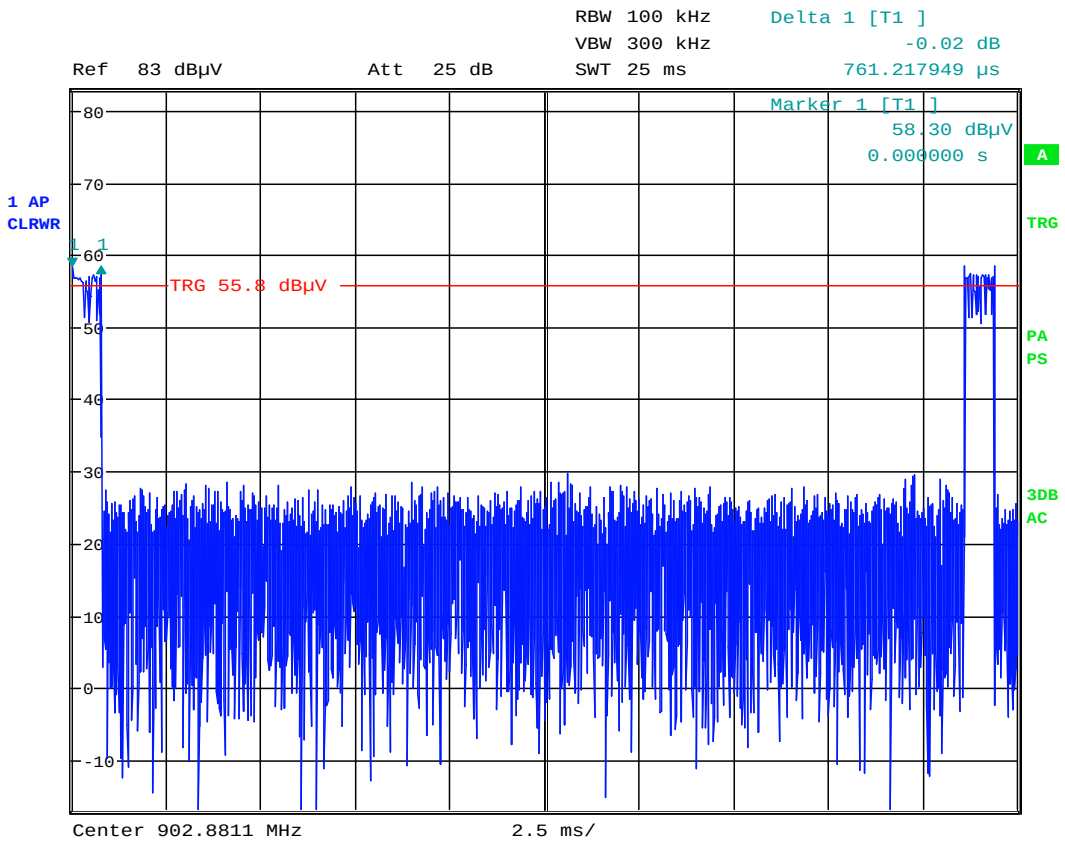


DUT: PTM330U

Date: 24.APR.2013 09:44:32

Plot 6.7.1-1: EUT sample 1, Complete transmission pattern after starting at line TR (= video trigger)

**Test of EnOcean GmbH Transmitter Module Model PTM 330 U
to 47 CFR Part 15C and RSS-210 Issue 8 (2010-12)**

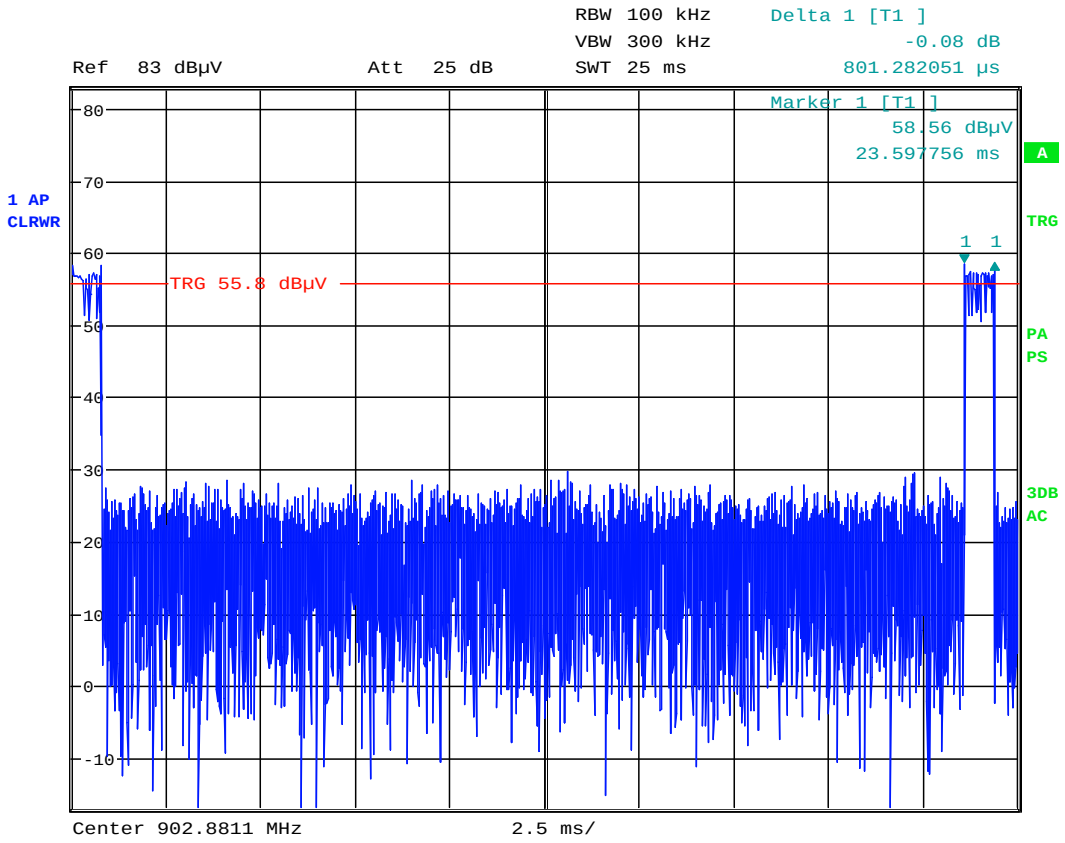


DUT: PTM330U-firstpacket

Date: 24.APR.2013 09:51:10

Plot 6.7.1-2: EUT sample 1, duration of one block, t_{on1} = 761.22 µs

**Test of EnOcean GmbH Transmitter Module Model PTM 330 U
to 47 CFR Part 15C and RSS-210 Issue 8 (2010-12)**



DUT: PTM330U-pos

Date: 24.APR.2013 09:46:58

Plot 6.7.1-3: EUT sample 1, duration of one block, t_{on2}= 801.28 µs

The duty cycle is computed by analysing the "worst case" on time in any 100 mSec time period and using the formula:

duty cycle = worst case on time/100 mSec = t_{on} / 100 ms

$t_{on} = \sum t_{on\,1} + t_{on\,2} + \ldots\ldots t_{on\,x}$

$t_{on} = t_{on1} + t_{on2}$ = 1.563 ms

duty cycle = 1.563 ms / 100 ms → = 0.0156

duty cycle factor (dB) = 20*log duty cycle = 20*log(0.0156) = -36.14 dB.

Result: The measured worst case duty cycle factor (AV factor) is -36.14 dB.

6.7.2 Magnetic Field (f = 9 kHz to 30 MHz)

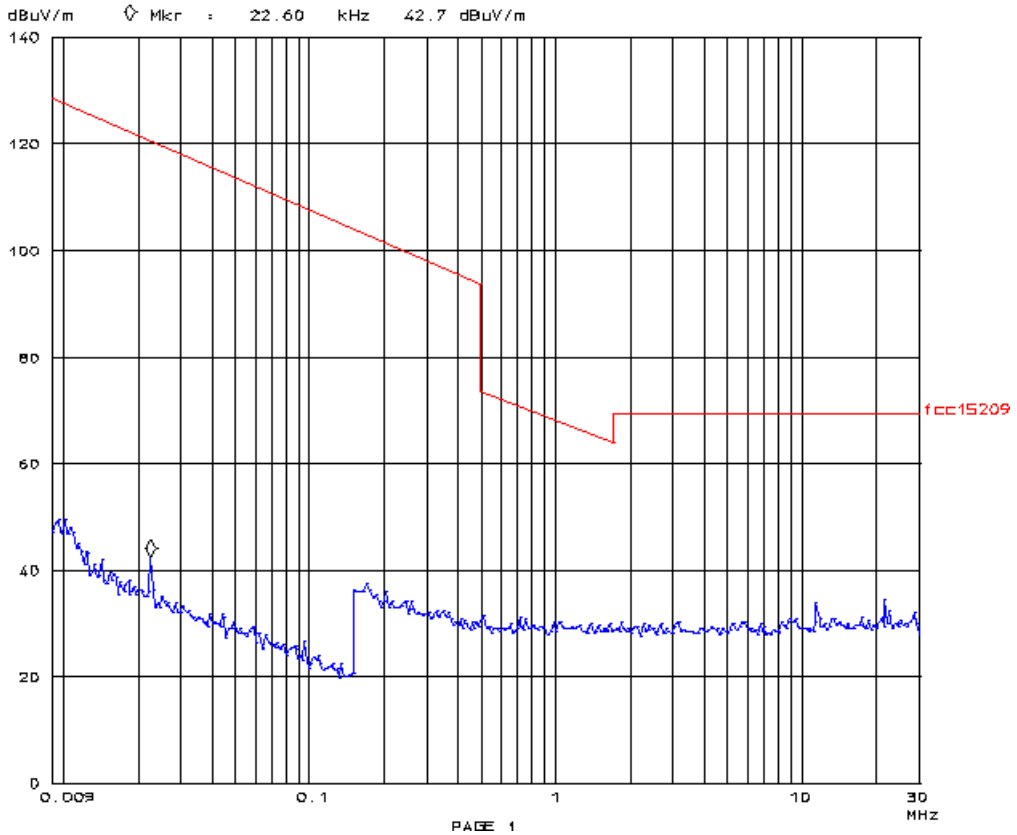
The magnetic field test was performed in a distance of 3 m. Therefore distance correction factors of 80 dB (= correction from 300 m to 3 m) or 40 dB (= correction from 30 m to 3 m) are applicable.
The plot below shows the worst case emissions of the EUT with corrected limit line.
The distance to the noise is more than 30 dB.

```
EMCCons DR. RASEK                                    25. Apr 13  08:26
Radiated Emissions H Field in SAR, d=3m

EUT:            PTM330U
Manuf:          ENocean
Op Cond:        continues tx, modulated
Operator:       M.Zenk, K.Kraft
Test Spec:      FCC 15, RSS-210
Comment:        antenna in 2 orientations
                EUT 4 positions

Scan Settings (2 Ranges)
|--------- Frequencies -----------||----------- Receiver Settings ------------|
  Start       Stop          Step       IF BW  Detector  M-Time Atten Preamp OpRge
   9k         150k         100Hz        200Hz     PK       1ms AUTO LD OFF   30dB
 150k          30M           5k          10k      PK       1ms AUTO LD OFF   30dB

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



Plot 6.7.2: EUT sample 1, Magnetic Field emissions at 3 m distance

6.7.3 Electric Field (f = 30 MHz to 1 GHz)

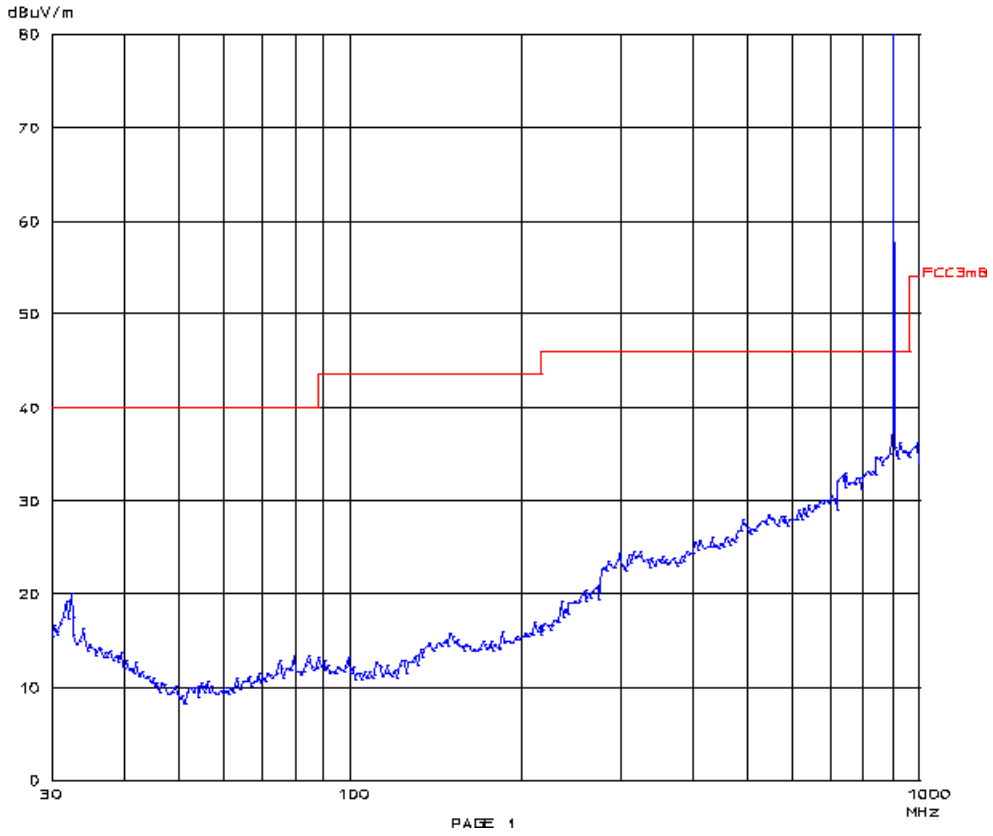
EMCC DR. RASEK 24. Apr 13 13:32
Radiated Emissions Prescan in SAR, d=3m

EUT: PTM 330U
Manuf: enocean GmbH
Op Cond: continous modulated transmission
Operator: K.Kraft
Test Spec: FCC 15.209
Comment: 4 sides, hor. and vert. pol. 3/4 heights
EUT position 1

Fast Scan Settings (1 Range)

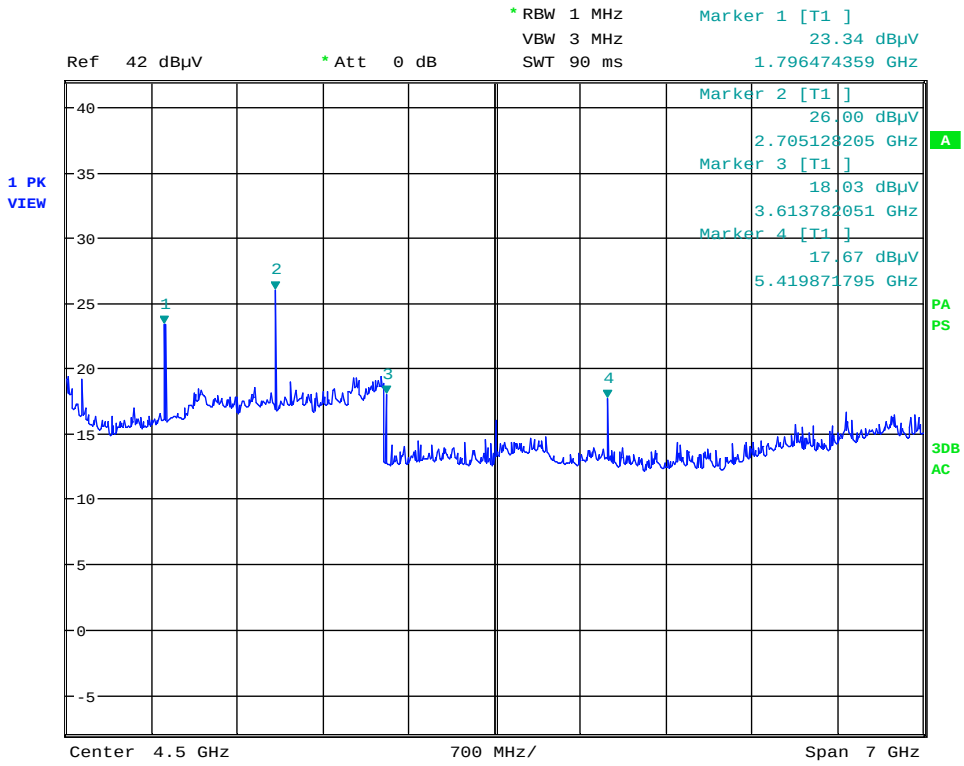
Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	1000M	40k	120k	PK	0.10ms	0dBLN	ON	60dB

Transducer	No.	Start	Stop	Name
	Z1	30M	1000M	895Z6K33



Plot 6.7.3-1: EUT sample 1, pre-scan plot d = 3 m (30 MHz to 1 GHz)

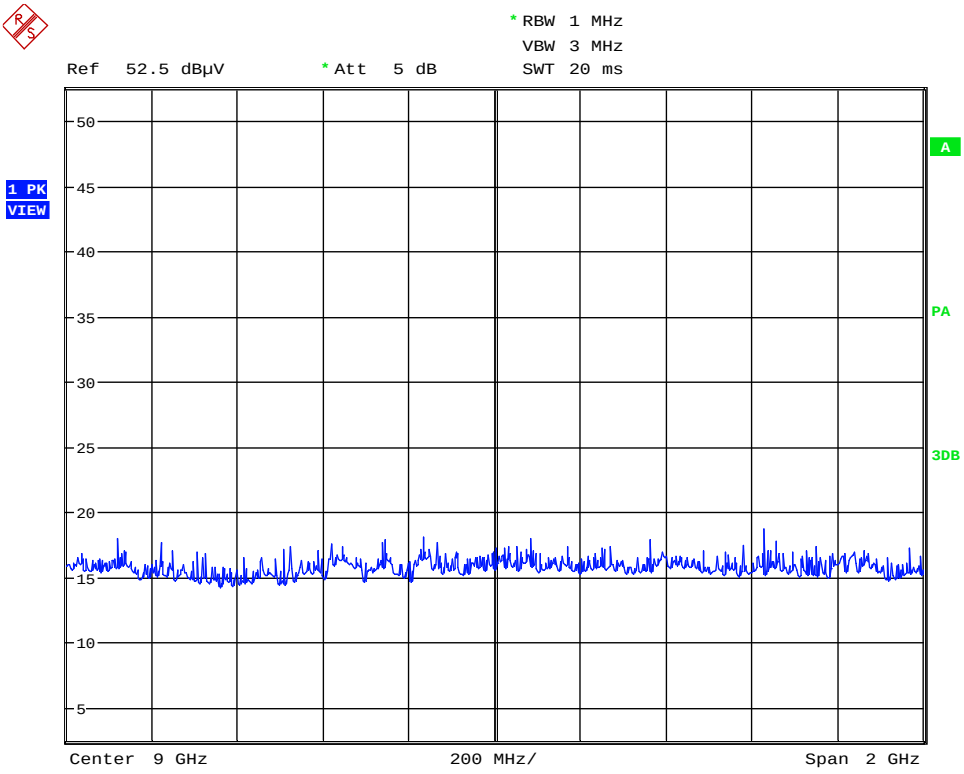
6.7.4 Electric Field (f = 1 GHz to 10 GHz)



PTM330U, continues Tx, modulated
Date: 26.APR.2013 11:22:42

Plot 6.7.4-1: EUT sample 1, pre-scan plot d = 1 m (1 MHz to 8 GHz)

**Test of EnOcean GmbH Transmitter Module Model PTM 330 U
to 47 CFR Part 15C and RSS-210 Issue 8 (2010-12)**



PTM330U, continues Tx, modulated
Date: 26.APR.2013 11:44:37

Plot 6.7.4-2: EUT sample 1, pre-scan plot d = 1 m (8 GHz to 10 GHz)

Equipment under test (EUT): PTM 330 U, sample 1

FINAL RESULTS: PRODUCT EMISSIONS **PEAK** DATA											
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	Test Distance [m]	Receiver Reading RA [dB(µV)]	Correction Factor AF+CF [dB(1/m)]	DF [dB]	Result = Corrected Reading FS [dB(µV/m)]	Spec Limit PK [dB(µV/m)]	Polarization Antenna	Polarization EUT	Margin [dB]
1	902.66	120, Pk	3	66.4	29.6	0	96	102			6
2	1805.79	1000, PK	1	23.0	26.3	-9.5	39.8	82	h	v	42.2
3	2708.56	1000, PK	1	26.6	29.5	-9.5	46.6	74	v	v	27.4
4	3611.53	1000, PK	1	19.6	30.8	-9.5	40.9	74	v	v	33.1
5	5416.92	1000, PK	1	19.0	34	-9.5	43.5	74	h	v	30.5

The following results are calculated from the PEAK data by adding the duty cycle factor of - 31.2 dB

FINAL RESULTS: PRODUCT EMISSIONS **AVERAGE** DATA									
No	Emission Frequency [MHz]	Receiver Mode and Bandwidth [kHz]	PEAK data result FS [dB(µV/m)]	Duty cycle Factor [dB]	Result AV FS [dB(µV/m)]	Spec Limit AV [dB(µV/m)]	Margin [dB]	Notes	
1	902.66	120, Pk	96	-36.14	59.86	82	22.14	carrier	
2	1805.79	1000, PK	39.8	-36.14	3.66	62	58.34	2nd harmonic	
3	2708.56	1000, PK	46.6	-36.14	10.46	54	43.54	3rd harmonic	
4	3611.53	1000, PK	40.9	-36.14	4.76	54	49.24	4th harmonic	
5	5416.92	1000, PK	43.5	-36.14	7.36	54	46.64	5th harmonic	

7 PERIODIC OPERATION CHARACTERISTICS

Test Requirement: FCC CFR47 Part 15C, Industry Canada RSS-210 Annex 1

7.1 Periodic Operation

7.1.1 Regulation

15.231 (a) The provisions of this section are restricted to periodic operation within the band 40.66–40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal.

7.1.2 Result

The EUT has no periodic operation feature.

The EUT meets the requirements of this section.

7.2 Manually Operated Transmitter Deactivation

7.2.1 Regulation

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

7.2.2 Result

Equipment under test (EUT): PTM 330 U, sample 1
The EUT was programmed to its normal operation mode.

Transmitter ceases transmission within less than 25 milliseconds after starting the transmission.

See also chapter 6.7.1, Plot 6.7.1-1

Transmitting of any further signal after 25 milliseconds within a time range of 5 seconds was not observed.

The EUT meets the requirements of this section.

Test Personal: Manuel Zenk, Karlheinz Kraft

Test Date: 2013-04-24

7.3 Automatically Operated Transmitter Deactivation

7.3.1 Regulation

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

7.3.2 Result

The EUT does not have automatic transmission.

7.4 Prohibition of Periodic Transmission

7.4.1 Regulation

15.231(a)(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

7.4.2 Result

The EUT does not employ periodic transmission.

7.5 Continuous Transmission During an Alarm Condition

7.5.1 Regulation

15.231(a4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

7.5.2 Result

This section is not applicable to the EUT.

7.6 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Calibration Interval
Antenna (30 MHz - 1 GHz)	EMCO Model 3143	898	2011-05	36 months
EMI Receiver / Analyser (20 Hz – 8 GHz)	Rohde & Schwarz ESU8	3846	2012-05	12 months

8 BANDWIDTH

Test Requirement: FCC 47 CFR, Part 15C, Industry Canada RSS-210 Annex 1
Test Procedure: ANSI C63.4-2009, Industry Canada RSS-Gen

8.1 Regulation

FCC 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. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

IC RSS-210 A1.1.3
For the purpose of Section A1.1, the 99 % bandwidth shall be no wider than 0.25 % of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the centre frequency.

8.2 Calculation of Bandwidth Limit

Bandwidth limit = 0.005 * 902.175 MHz = 4.5109 MHz

8.3 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Calibration Interval
Antenna (30 MHz - 1 GHz)	EMCO Model 3143	898	2011-05	36 months
EMI Receiver / Analyser (20 Hz – 8 GHz)	Rohde & Schwarz ESU8	3846	2012-05	12 months

8.4 Test Procedure

ANSI C63.4-2003 Section 13.1.7 Occupied Bandwidth Measurements.
(...) The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. Once the reference level is established, the equipment is conditioned with typical modulating signals to produce worst-case (i.e., the widest) bandwidth. (...) In order to measure the modulated signal properly, a resolution bandwidth that is small compared to the bandwidth required by the procuring or regulatory agency shall be used on the measuring instrument. However, the 6 dB resolution bandwidth of the measuring instrument shall be set to a value greater than 5 % of the bandwidth requirements. When no bandwidth requirements are specified, the minimum resolution bandwidth of the measuring instrument is given in the following table:

Fundamental frequency	**Minimum resolution bandwidth**
9 kHz to 30 MHz	1 kHz
30 to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

IC RSSGEN Chapter 4.6.1 Occupied Bandwidth
When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 % emission bandwidth, as calculated or measured.
The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyser shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 % of the selected span as is possible without being below 1 %. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.
The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

8.5 Test Result

Equipment under test (EUT): PTM 330 U, sample 1

The measured 20 dB bandwidth is: ..... 285.256 kHz
The measured 99 % bandwidth (according to RSSGen) is: ..... 299.679 kHz

For detailed bandwidth plots refer to the following page.

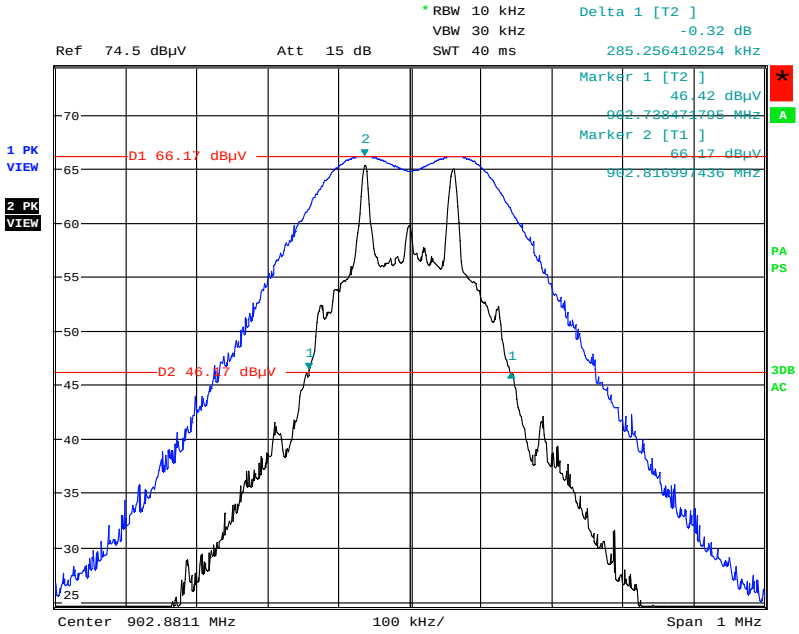
The EUT meets the requirements of this section.

Test Personnel: Manuel Zenk

Test Date: 2013-04-25

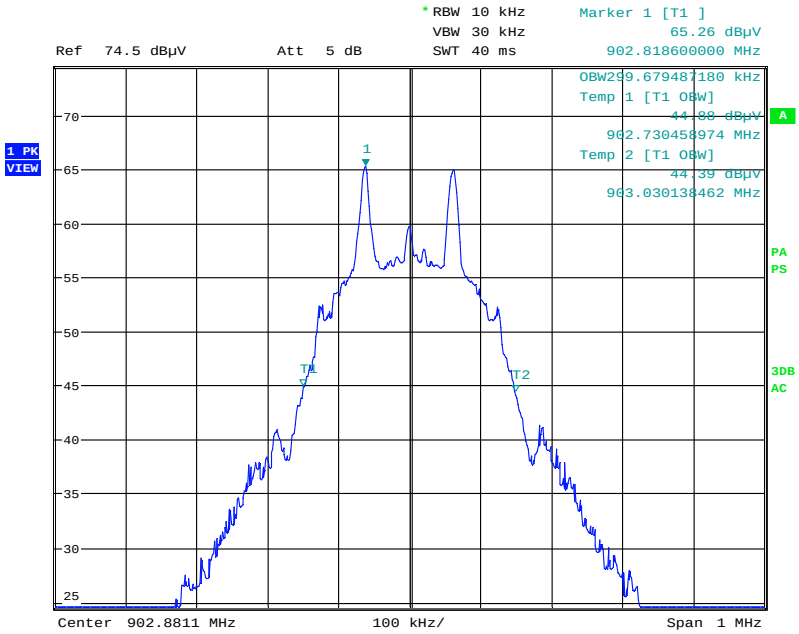
Detailed test data plots refer to the following pages.

**Test of EnOcean GmbH Transmitter Module Model PTM 330 U
to 47 CFR Part 15C and RSS-210 Issue 8 (2010-12)**



DUT: PTM330U, Mode: continues Tx, modulated
Date: 25.APR.2013 10:59:31

Plot 8.5-1: EUT sample 1, bandwidth plot – 20 dB bandwidth



DUT: PTM330U, Mode: continues Tx, modulated
Date: 25.APR.2013 10:53:15

Plot 8.5-2: EUT sample 1, bandwidth plot – 99 % bandwidth

9 MISCELLANEOUS COMMENTS AND NOTES

None.

10 LIST OF ANNEXES

The following annexes are separated parts to this test report. These annexes may be file attachments for electronic filing.

Annex	Description	Pages
Annex 1	Photographs of test setups	4
Annex 2	Photographs of equipment under test (EUT)	7