eurofins | Product Service

FCC TEST REPORT

FCC 47 CFR Part 24E
ISED RSS-133, Issue 5
2GHz Personal Communication Services

Report Reference No. ..... :	G0M-1809-7680-TFC224UL-V02
Testing Laboratory ..... :	Eurofins Product Service GmbH
Address ..... :	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation ..... :	FCC Test Firm Designation Number: DE0008 IC Testing Laboratory site: 3470A-2
Applicant's name ..... :	BIOTRONIK SE & Co. KG
Address ..... :	Woermannkehre 1 12359 Berlin GERMANY
Test specification:	
Standard..... :	47 CFR Part 24E RSS-133, Issue 6: 2013-01
Test scope…….. ..... :	partial Radio compliance test
Equipment under test (EUT):	
Product description	CardioMessenger Smart
Model No.	CardioMessenger Smart 4G
Additional Model(s)	None
Brand Name(s)	BIOTRONIK
Hardware version	CardioMessenger Smart 4G mit LP, best.LP1/Telex Smart 4G Rev. B
Firmware / Software version	Modem-FW: 30.00.102
	FCC-ID: QRI-CMSMART4GNA IC: N/A
Test result	**Passed**

Possible test case verdicts:

- neither assessed nor tested ..... : N/N
- required by standard but not appl. to test object ..... : N/A
- required by standard but not tested ..... : N/T
- not required by standard for the test object ..... : N/R
- test object does meet the requirement..... : P (Pass)
- test object does not meet the requirement ..... : F (Fail)

Testing:

Test Lab Temperature ..... :	20 – 23 °C	
Test Lab Humidity ..... :	32 – 38 %	
Date of receipt of test item ..... :	2018-09-24	
Date (s) of performance of tests ..... :	2018-09-24 - 2019-02-26	
Compiled by ..... :	Burkhard Pudell	
Tested by (+ signature)..... : (Responsible for Test)	Burkhard Pudell	B. Pudell .....
Approved by (+ signature) ..... : (Head of Lab)	Christian Weber	C. Weber .....
Date of issue ..... :	2019-03-21	
Total number of pages ..... :	29	

General remarks:

The test results presented in this report relate only to the object tested.
The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

Additional comments:

Test case reduction on radiated measurements only is based on the requirements for host integration for full modular approved transmitter modules (KDB 996369 D02) used by the EUT. The EUT uses a module with full modular approval according to FCC and IC rules. For details about the radio module see EUT description in section 1.

Version History

Version	Issue Date	Remarks	Revised by
01	2018-10-19	Initial Release	
02	2019-03-21	Insert add. Result for Modulation 16-QAM	B. Pudell

REPORT INDEX

1 EQUIPMENT (TEST ITEM) DESCRIPTION 5

1.1 Photos – Equipment External 7
1.2 Photos – Equipment internal 9
1.3 Photos – Test setup 12
1.4 Supporting Equipment Used During Testing 13
1.5 Test Modes 13
1.6 Test Equipment Used During Testing 14
1.7 Sample emission level calculation 15

2 RESULT SUMMARY 16

3 TEST CONDITIONS AND RESULTS 17

3.1 Test Conditions and Results – Occupied Bandwidth 17
3.2 Test Conditions and Results – Effective radiated power / Equivalent isotropic radiated power 24
3.3 Test Conditions and Results – Transmitter radiated emissions 26
3.4 Test Conditions and Results – Receiver radiated emissions 28

1 Equipment (Test item) Description

Description	CardioMessenger Smart		
Model	CardioMessenger Smart 4G		
Additional Model(s)	None		
Brand Name(s)	BIOTRONIK		
Serial number	None		
Hardware version	CardioMessenger Smart 4G mit LP, best.LP1/Telex Smart 4G Rev. B		
Software / Firmware version	Modem-FW: 30.00.102		
PMN	n/a		
HVIN	n/a		
FVIN	n/a		
HMN	n/a		
FCC-ID	QRI-CMSMART4GNA		
IC	n/a		
Equipment type	End product		
Equipment classification	Portable Device (Human Body distance < 20 cm)		
Radio type	Transceiver		
Radio technology	LTE Cat-M1		
Operating frequency range	LTE FDD 2 : TX = 1850 - 1910 MHz, RX = 1930 - 1990 MHz		
Assigned frequency band	Broadband PCS : 1850 - 1910 MHz & 1930 - 1990 MHz		
Main test frequencies LTE FDD 2	F_{LOW}	CH : 18615 UL: 1851.5 MHz	CH : 615 DL: 1931.5 MHz
	F_{MID}	CH : 18900 UL: 1880.0 MHz	CH : 900 DL: 1960.0 MHz
	F_{HIGH}	CH : 19185 UL: 1908.5 MHz	CH : 1185 DL: 1988.5 MHz
Supported transmission modes	Packet switched		
Modulations	LTE : QPSK, 16-QAM		
Number of antennas	1x TX/RX		
Radio module	Type	4G module	
	Model	ME910C1-NA	
	Manufacturer	TELIT COMMUNICATIONS	
	HW Version	0.0	
	SW Version	30.00.102	
	FCC-ID	RI7ME910C1NA	
	IC	5131A-ME910C1NA	
Antenna	Type	integrated	
	Model	PCB antenna	
	Manufacturer	BIOTRONIK SE & Co.KG	
	Gain	3.8 dBi	

Manufacturer	BIOTRONIK SE & Co. KG Woermannkehre 1 12359 Berlin GERMANY	
Power supply	V_{NOM}	3.7 VDC (Lithium Battery)
	V_{MIN}	N/A
	V_{MIN}	N/A
AC/DC-Adaptor	Model	FW7520/05
	Vendor	FRIWO Gerätebau GmbH
	Input	110 - 240 V AC
	Output	5V DC

1.4 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments
SIM	Network	R&S	CMW500	LTE -Tester

***Note:** Use the following abbreviations:

AE : Auxiliary/Associated Equipment, or

SIM : Simulator (Not Subjected to Test)

CABL : Connecting cables

1.5 Test Modes

Mode #	Description	
LTE FDD Cat-M1 QPSK	General conditions:	EUT powered by battery with connected AC/DC-adapter. Active call to communication tester.
	Radio conditions:	Mode = TX mode (eMTC) Connection = RMC Half Duplex Modulation = QPSK Configuration = Cell BW = 3 MHz, RB6, NB low Power level = Maximum
LTE FDD Cat-M1 16-QAM	General conditions:	EUT powered by battery with connected AC/DC-adapter. Active call to communication tester.
	Radio conditions:	Mode = TX mode (eMTC) Connection = RMC Half Duplex Modulation = 16-QAM Configuration = Cell BW = 3 MHz, RB3, NB low Power level = Maximum
LTE - RX	General conditions:	EUT powered by battery with connected AC/DC-adapter. Active call to communication tester.
	Radio conditions:	Mode = TX mode (eMTC) Connection = RMC Half Duplex Modulation = QPSK Configuration = Cell BW = 3 MHz, RB 0 UL / 0 DL

1.6 Test Equipment Used During Testing

Measurement Software			
Description	Manufacturer	Name	Version
EMC Test Software	Dare Instruments	Radimation	15.2.4

Radiated power					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Fully-anechoic chamber	Frankonia	AC 3	EF00199	-	-
Spectrum Analyzer	R&S	FSIQ 26	EF00151	2018-07	2019-07
LPD Antenna	R&S	HL 223	EF00187	2016-05	2019-05
Horn Antenna	R&S	BBHA 9120D	EF01153	2018-09	2019-09

Radiated spurious emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Semi-anechoic chamber	Frankonia	AC 1	EF00062	-	-
Spectrum Analyzer	R&S	FSIQ 26	EF00242	2018-07	2019-07
Biconical Antenna	R&S	HK 116	EF00186	2018-03	2020-03
LPD Antenna	R&S	HL 223	EF00202	2018-03	2020-03
Horn Antenna	R&S	BBHA 9120D	EF01153	2018-09	2019-09

1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dBµV. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

Reading on Analyzer (dBµV) + A.F. (dB) = Net field strength (dBµV/m)

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

Limit (dBµV/m) = 20*log (µV/m)

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading	+	AF	=	Net Reading	:	Net reading - FCC limit = Margin
21.5 dBµV	+	26 dB	=	47.5 dBµV/m	:	47.5 dBµV/m - 57.0 dBµV/m = -9.5 dB

2 Result Summary

FCC 47 CFR Part 24E, ISED RSS-133				
Product Specific Standard Section	**Requirement – Test**	**Reference Method**	**Result**	**Remarks**
RSS-Gen 6.6	Occupied Bandwidth	RSS-Gen 6.6 KDB 971168		Informational only
FCC § 24.235 ISED RSS-133 § 6.3	Frequency stability	FCC § 24.235 ISED RSS-133 § 6.3 KDB 971168	N/R	
FCC § 24.232(c) ISED RSS-133 § 6.4	Equivalent isotropic radiated power	ANSI/TIA-603-D KDB 971168	PASS	
FCC § 24.232(d) ISED RSS-133 § 6.4	Peak to average ratio	KDB 971168	N/R	
FCC § 24.238(b) ISED RSS-133 § 6.5	Band-edge compliance	KDB 971168	N/R	
FCC § 24.238(a) ISED RSS-133 § 6.5	Conducted out-of-band emissions	KDB 971168	N/R	
FCC § 24.238(a) ISED RSS-133 § 6.5	Radiated out-of-band emissions	ANSI/TIA-603-D KDB 971168	PASS	
ISED RSS-133 § 6.6 ISED RSS-Gen 7.1	Receiver radiated spurious emissions	ISED RSS-Gen 7.1	PASS	
Remarks:				

3 Test Conditions and Results

3.1 Test Conditions and Results – Occupied Bandwidth

Occupied Bandwidth acc. to ISED RSS-Gen	
Test according to measurement reference	Reference Method
	RSS-Gen 6.6
Test frequency range	Tested frequencies
	F_{LOW} / F_{MID} / F_{HIGH}
Limits	
None (Informational only)	
Test setup	
Spectrum Analyzer — EUT	
Test procedure	
1. EUT set to test mode (Communication tester is used if needed) 2. Span set to at least twice the emission spectrum 3. Resolution bandwidth set to 1 % of span 4. Occupied Bandwidth (99 %) measurement with spectrum analyzer built in measurement function	

Test results – LTE FDD 2 Cat-M1

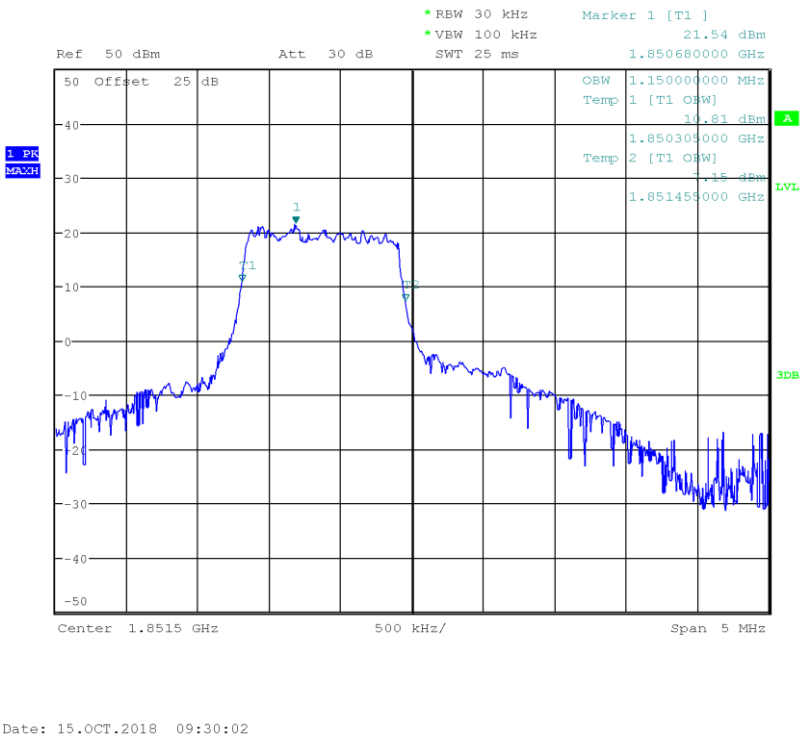
Channel	Frequency [MHz]	Mode	Occupied Bandwidth [kHz]
F_{LOW}	1851.5	QPSK	1.150
F_{MID}	1880.0	QPSK	1.155
F_{HIGH}	1908.5	QPSK	1.125
F_{LOW}	1851.5	16-QAM	561.0
F_{MID}	1880.0	16-QAM	564.0
F_{HIGH}	1908.5	16-QAM	573.0

Comments:

Occupied Bandwidth - LTE FDD 2 F_{Low} - QPSK

Occupied Bandwidth

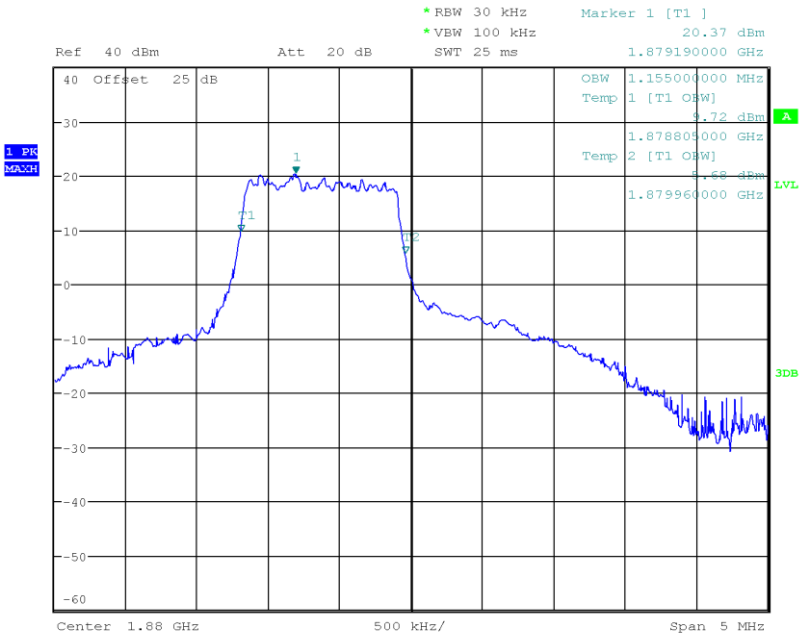
Project Number:	G0M-1809-7680
Applicant:	BIOTRONIK SE & Co. KG
Model Description:	CardioMessenger Smart
Model:	CardioMessenger Smart 4G
Test Sample ID:	20497
Reference Standards:	RSS-Gen
Reference Method:	ANSI C63.26:2015, Section 5.4.4
Operating Frequency:	1851.5 MHz
Operating Conditions:	Tnom/Vnom
Operator:	B. Pudell
Test Site:	Eurofins Product Service GmbH
Test Date:	2018-10-15
Note:	LTE FDD2 Cat-M1; QPSK; RB6
Occupied Bandwidth [kHz]:	1150.0



Occupied Bandwidth – LTE FDD 2 F_{MID} - QPSK

Occupied Bandwidth

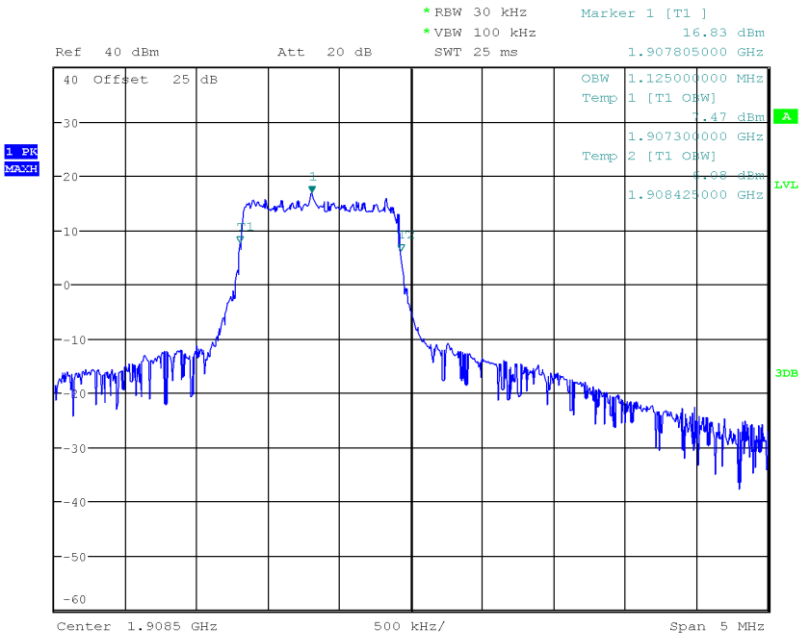
Project Number:	G0M-1809-7680
Applicant:	BIOTRONIK SE & Co. KG
Model Description:	CardioMessenger Smart
Model:	CardioMessenger Smart 4G
Test Sample ID:	20497
Reference Standards:	RSS-Gen
Reference Method:	ANSI C63.26:2015, Section 5.4.4
Operating Frequency:	1880 MHz
Operating Conditions:	Tnom/Vnom
Operator:	B. Pudell
Test Site:	Eurofins Product Service GmbH
Test Date:	2018-10-15
Note:	LTE FDD2 Cat-M1; QPSK; RB6
Occupied Bandwidth [kHz]:	1155.0



Occupied Bandwidth – LTE FDD 2 F_{HIGH} - QPSK

Occupied Bandwidth

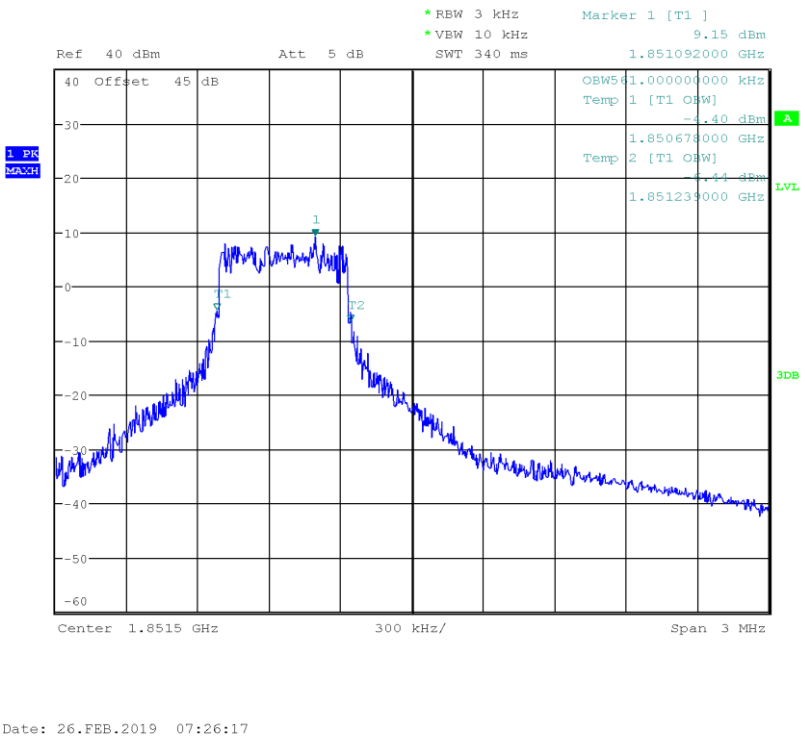
Project Number:	G0M-1809-7680
Applicant:	BIOTRONIK SE & Co. KG
Model Description:	CardioMessenger Smart
Model:	CardioMessenger Smart 4G
Test Sample ID:	20497
Reference Standards:	RSS-Gen
Reference Method:	ANSI C63.26:2015, Section 5.4.4
Operating Frequency:	1908.5 MHz
Operating Conditions:	Tnom/Vnom
Operator:	B. Pudell
Test Site:	Eurofins Product Service GmbH
Test Date:	2018-10-15
Note:	LTE FDD 2_CH: 18900 ; QPSK; RB6
Occupied Bandwidth [kHz]:	1125.0



Occupied Bandwidth – LTE FDD 2 F_{LOW} - 16-QAM

Occupied Bandwidth

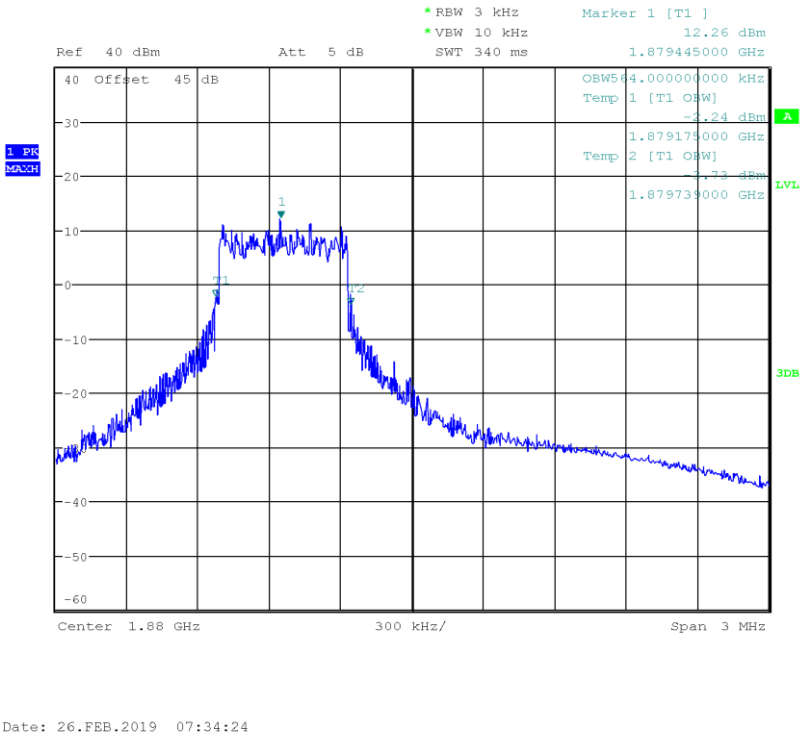
Project Number:	G0M-1809-7680
Applicant:	Biotronik SE & Co. KG
Model Description:	CardioMessenger Smart
Model:	CardioMessenger Smart 4G
Test Sample ID:	20465
Reference Standards:	RSS-Gen
Reference Method:	ANSI C63.26:2015, Section 5.4.4
Operating Frequency:	1851.5 MHz
Operating Conditions:	Tnom/Vnom
Operator:	Burkhard Pudell
Test Site:	Eurofins Product Service GmbH
Test Date:	2019-02-26
Note:	LTE FDD 2_CH: 18615 ; 16-QAM; RB3
Occupied Bandwidth [kHz]:	561.0



Occupied Bandwidth – LTE FDD 2 F_{MID} - 16-QAM

Occupied Bandwidth

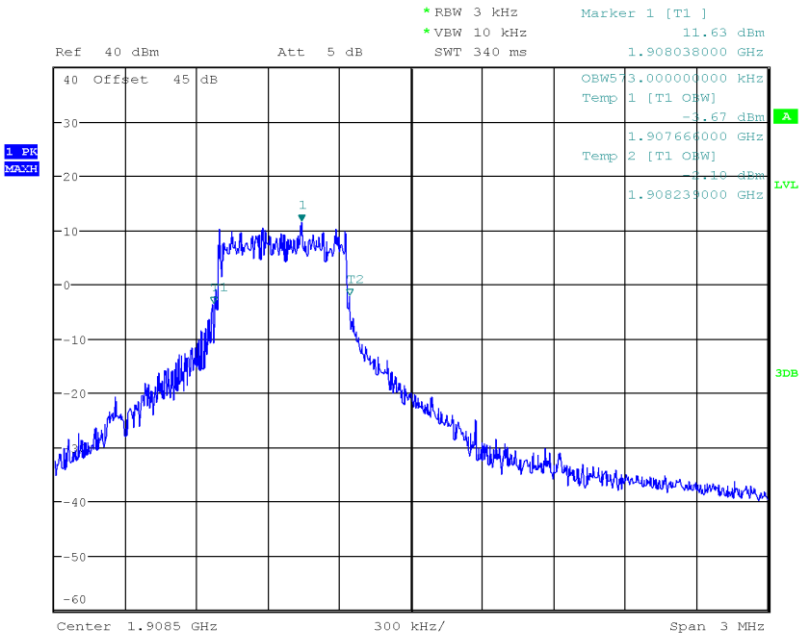
Project Number:	G0M-1809-7680
Applicant:	Biotronik SE & Co. KG
Model Description:	CardioMessenger Smart
Model:	CardioMessenger Smart 4G
Test Sample ID:	20465
Reference Standards:	RSS-Gen
Reference Method:	ANSI C63.26:2015, Section 5.4.4
Operating Frequency:	1880.0 MHz
Operating Conditions:	Tnom/Vnom
Operator:	Burkhard Pudell
Test Site:	Eurofins Product Service GmbH
Test Date:	2019-02-26
Note:	LTE FDD 2_CH: 18900 ; 16-QAM; RB3
Occupied Bandwidth [kHz]:	564.0



Occupied Bandwidth – LTE FDD 2 F_{HIGH} - 16-QAM

Occupied Bandwidth

Project Number:	G0M-1809-7680
Applicant:	Biotronik SE & Co. KG
Model Description:	CardioMessenger Smart
Model:	CardioMessenger Smart 4G
Test Sample ID:	20465
Reference Standards:	RSS-Gen
Reference Method:	ANSI C63.26:2015, Section 5.4.4
Operating Frequency:	1908.5 MHz
Operating Conditions:	Tnom/Vnom
Operator:	Burkhard Pudell
Test Site:	Eurofins Product Service GmbH
Test Date:	2019-02-26
Note:	LTE FDD 2_CH: 19185 ; 16-QAM; RB3
Occupied Bandwidth [kHz]:	573.0

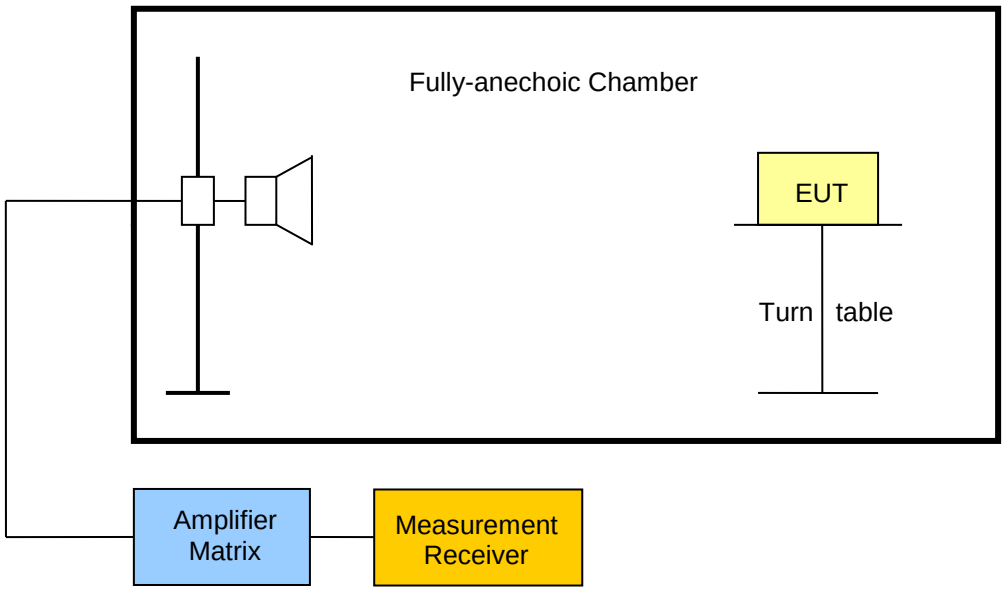


Date: 26.FEB.2019 07:31:16

3.2 Test Conditions and Results – Effective radiated power / Equivalent isotropic radiated power

Radiated power acc. to FCC 24E / ISED RSS-133		**Verdict: PASS**
EUT requirement rule parts and clause	Reference	
	FCC § 24.232(c) ISED RSS-133 § 6.4	
Test according to measurement reference	Reference Method	
	FCC § 24.232(c) / ANSI/TIA-603-D ISED RSS-133 § 6.4	
Test frequency range	Tested frequencies	
	F_{LOW} / F_{MID} / F_{HIGH}	
Limits		
Carrier Frequency range	Equipment type	Power limit
1850-1910 MHz	Mobile transmitter	FCC : 2 Watts (33 dBm) e.i.r.p. ISED : 2 Watts (33 dBm) e.i.r.p.

Test setup



Test procedure

1. EUT set to test mode
2. The radiated power is measured with a measurement antenna in vertical polarization
3. To obtain maximum level the EUT is rotated
4. The EUT is replaced with a half-wave dipole and the power to the dipole is adjusted to obtain same radiated power measurement value

Test results – LTE FDD 2 Cat-M1 E.I.R.P.							
Channel	Frequency [MHz]	Mode	Pol.	Power [dBm e.i.r.p]	Limit [dBm e.i.r.p]	Margin [dB]	Result
F_{LOW}	1851.5	QPSK	ver	24.8	33	-8.2	PASS
F_{MID}	1880.0	QPSK	ver	27.4	33	-5.6	PASS
F_{HIGH}	1908.5	QPSK	ver	27.1	33	-5.9	PASS
F_{LOW}	1851.5	16-QAM	ver	25.3	33	-7.7	PASS
F_{MID}	1880.0	16-QAM	ver	27.8	33	-5.2	PASS
F_{HIGH}	1908.5	16-QAM	ver	27.8	33	-5.2	PASS
Comments:							

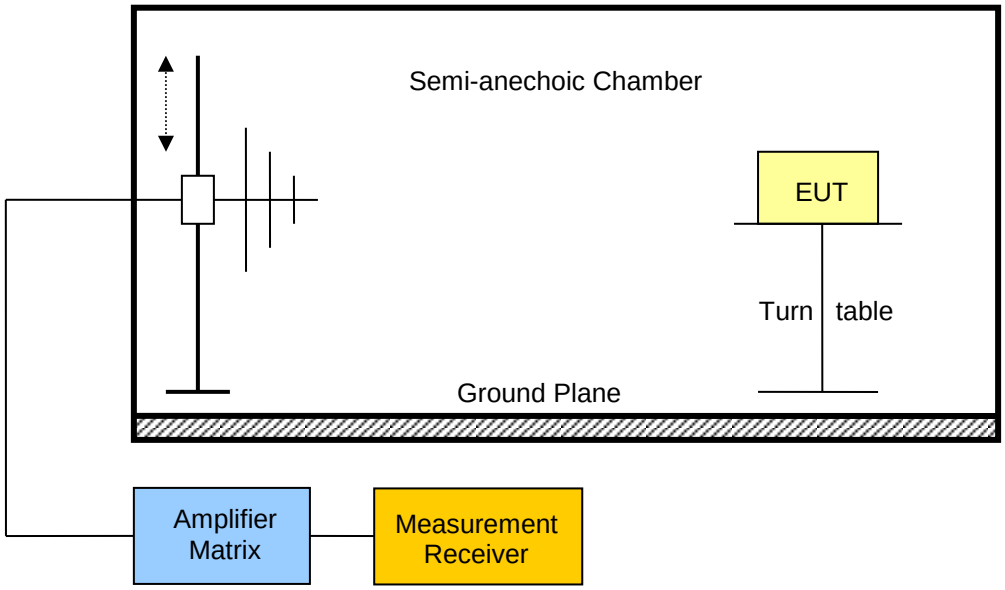
3.3 Test Conditions and Results – Transmitter radiated emissions

Transmitter radiated power acc. to FCC 24E / ISED RSS-133	**Verdict: PASS**
Test according referenced standards	Reference Method
	FCC § 24.238(a) ISED RSS-133 § 6.5
Test according to measurement reference	Reference Method
	ANSI/TIA-603-D
Test frequency range	Tested frequencies
	30 MHz – 10th Harmonic

Limits

Carrier Frequency range	Limit
1850-1910 MHz	Attenuation below transmitter power ≥ 43 + 10 · $\log_{10}$(P) [dB] = -13 dBm

Test setup



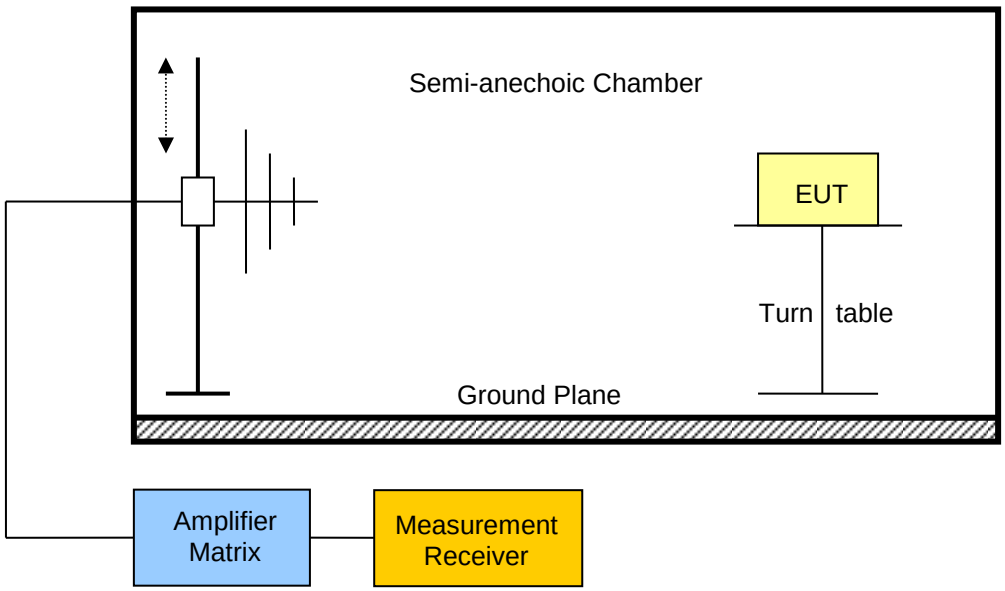
Test procedure

1. EUT set to test mode
2. Maximum emission level is measured by rotating the EUT and adjusting the antenna height for vertical polarization
3. The EUT is replaced by a substitution antenna and generator
4. The power level is set to obtain the same power reading
5. Measurement is repeated for horizontal polarization

Test results – LTE FDD 2 Cat-M1							
Channel	Frequency [MHz]	Mode	Emission [MHz]	Level [dbm]	Pol.	Limit [dBm]	Margin [dB]
F_{LOW}	1851.5	QPSK	1843	-15.6	ver	-13	-02.6
F_{LOW}	1851.5	QPSK	1850	-14.9	ver	-13	-01.9
F_{HIGH}	1908.5	QPSK	1910	-16.5	ver	-13	-03.5
F_{HIGH}	1908.5	QPSK	1910	-19.2	ver	-13	-06.2
F_{LOW}	1851.5	16-QAM	1833	-17.6	ver	-13	-04.6
Comments:							

3.4 Test Conditions and Results – Receiver radiated emissions

Receiver radiated emissions acc. to ISED RSS-133				**Verdict: PASS**
Test according referenced standards	Reference Method			
	ISED RSS-133 6.6			
Test according to measurement reference	Reference Method			
	ANSI C63.4			
Test frequency range	Tested frequencies			
	30 MHz – 5th Harmonic			
EUT test mode	Receive			
Limits				
Frequency range [MHz]	Detector	Limit [µV/m]	Limit [dBµV/m]	Limit Distance* [m]
30 – 88	Quasi-Peak	100	40	3
88 – 216	Quasi-Peak	150	43.5	3
216 – 960	Quasi-Peak	200	46	3
960 – 1000	Quasi-Peak	500	54	3
> 1000	Average	500	54	3
Test setup				



Test procedure
1. EUT set to receive mode (Communication tester is used if needed) 2. Span it set according to measurement range 3. Resolution bandwidth below 1GHz is set according to CISPR 16 with peak/quasi-peak detector and RBW of 1MHz with peak/average detector is used above 1GHz 4. Markers are set to peak emission levels

Test results

Channel	Frequency [MHz]	Emission [MHz]	Emission Level [dbµV/m]	Emission Level [µV/m]	Det.	Limit [µV/m]	Margin [µV/m]
F_{MID}	1960.0	10840	45.67	190	pk	500	-310

Comments:
* Physical distance between EUT and measurement antenna.
** Emission level corresponds to ambient noise floor