

ANTENNA PATTERN REPORT	
Report Reference No	G0M-2403-2480-AUT-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Applicant	BIOTRONIK SE & Co. KG
Address	Woermannkehre 1 12359 Berlin GERMANY
Equipment under Test (EUT):	
Product Description	CardioMessenger Smart / Telemonitorig System
Model(s)	CardioMessenger Smart 4G
Additional Model(s)	None
Brand Name(s)	BIOTRONIK
Hardware Version(s)	CardioMessenger Smart 4G mit LP1 Rev Cx
Software Version(s)	ULP_HIGH_1_37_0, ULP_LOW_1_17_0, M0C.400005, SMARTAPP 1.x
Test Result	PASSED

Possible test case verdicts:		
Required by standard but not tested	N/T	
Not required by standard	N/R	
Not applicable to EUT	N/A	
Test object does meet the requirement	P(PASS) – equivalent to GOOD	
Test object does not meet the requirement	F(FAIL) – equivalent to NG	
Testing:		
Test Lab Temperature	20 - 25 °C	
Test Lab Humidity	45 – 65 %	
Date of receipt of test item	2024-08-01	
Report:		
Compiled by	Azamat Ibraimov	
Tested by (+ signature) (Responsible for Test)	Azamat Ibraimov	
Approved by (+ signature) (Senior Expert)	Radwan Jaafar	
Date of Issue	2025-01-27	
Total number of pages	36	
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:		
None		

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2025-01-27	Initial Release	

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
EUT	Equipment Under Test
OCTRCC	Ordinance concerning technical regulations conformity certification
ORRE	Japanese Ordinance regulating radio equipment
PPM	Part per million
RBW	Resolution bandwidth
RMS	Root mean square
VBW	Video bandwidth
V _{NOM}	Nominal supply voltage
V _{MIN}	Minimum supply voltage
V _{MAX}	Maximum supply voltage

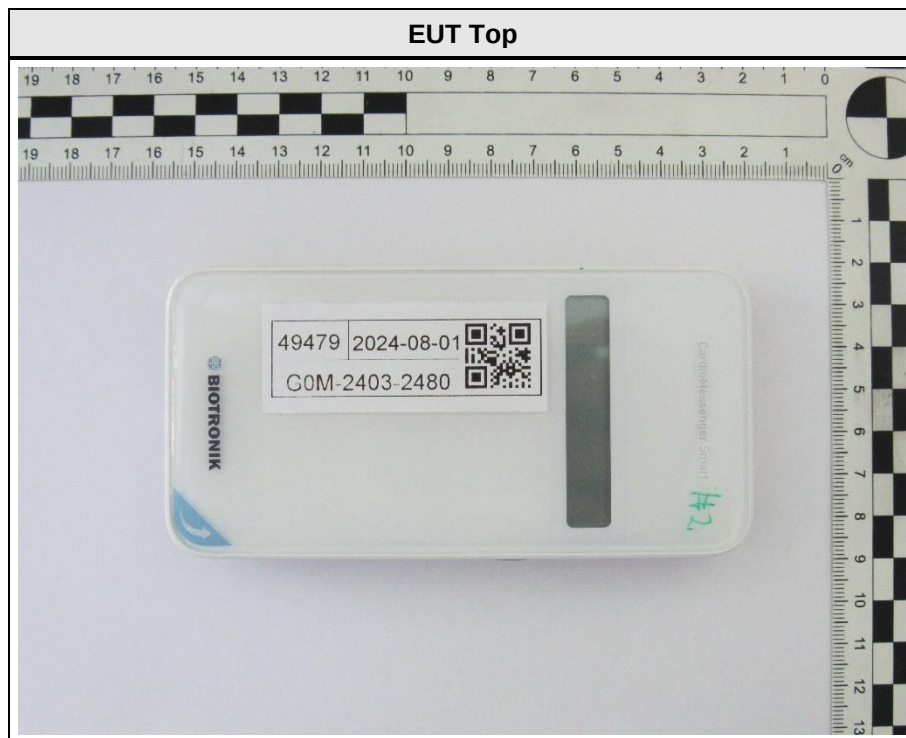
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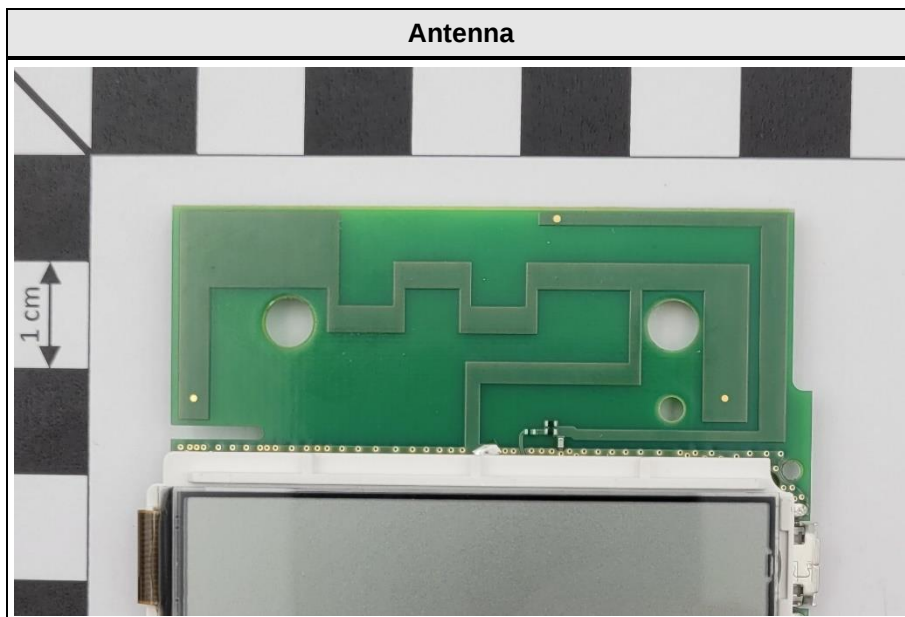
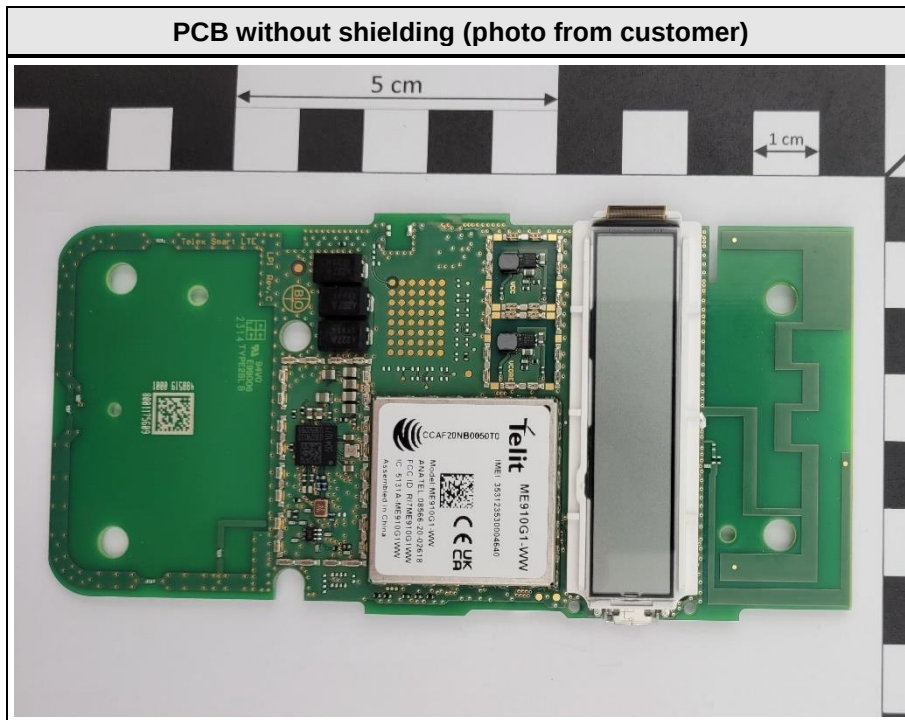
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1 Equipment (Test Item) Under Test

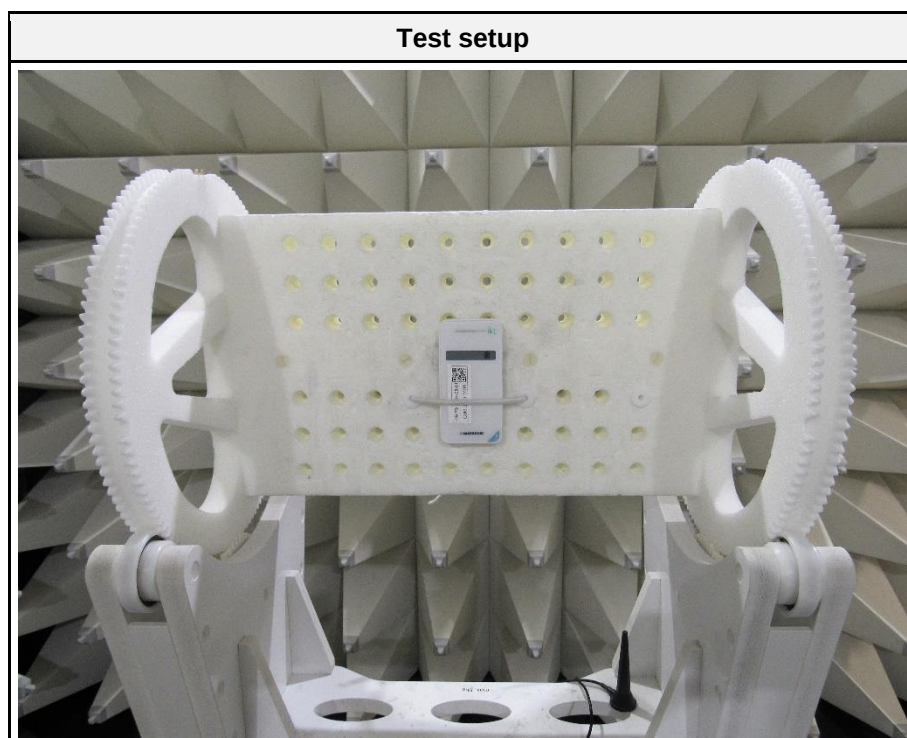
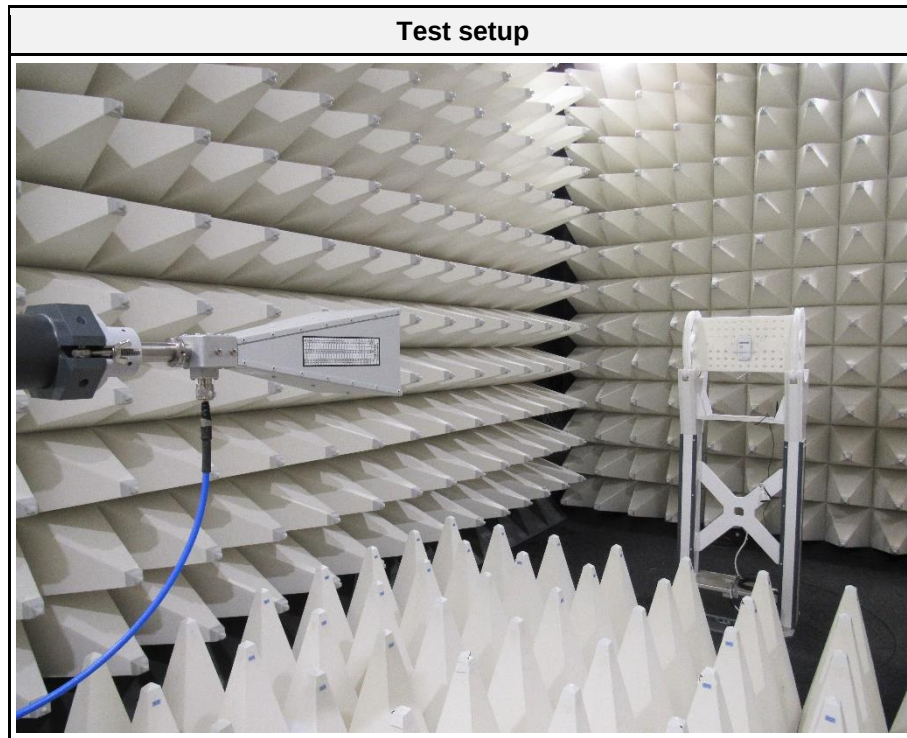
Description	CardioMessenger Smart / Telemonitorig System	
Model	CardioMessenger Smart 4G	
Additional Model(s)	None	
Brand Name(s)	BIOTRONIK	
Sample identification	49479	
Hardware Version(s)	CardioMessenger Smart 4G mit LP1 Rev Cx	
Software Version(s)	ULP_HIGH_1_37_0, ULP_LOW_1_17_0, M0C.400005, SMARTAPP 1.x	
Equipment type	End Product	
Assigned frequency bands	FDD B1 : UL = 2110 - 2170 MHz, DL = 1920 - 1980 MHz FDD B3 : UL = 1805 - 1880 MHz, DL = 1710 - 1785 MHz FDD B8 : UL = 925 - 960 MHz, DL = 880 - 915 MHz FDD B18 : UL = 860 - 875 MHz, DL = 815 - 830 MHz FDD B19 : UL = 875 - 890 MHz, DL = 830 - 845 MHz FDD B26 : UL = 859 - 894 MHz, DL = 814 - 849 MHz FDD B28 : UL = 758 - 803 MHz, DL = 703 - 748 MHz	
Radio technology	LTE Cat M1	
Modulation	QPSK 16-QAM, 64-QAM	
Number of antenna ports	1	
Antenna	Type	Integrated PCB-antenna
	Model	Unspecified
	Manufacturer	BIOTRONIK SE & Co. KG
Radio Module	Type	LTE Cat M1/NB2 module
	Model	ME910G1-WW
	Manufacturer	Telit Cinterion
	HW Version	HW1.0
	SW Version	M0C.400005
Supply Voltage	V _{NOM}	3.7 V DC via internal battery
Operating Temperature	T _{NOM}	24°C
Manufacturer	BIOTRONIK SE & Co. KG Woermannkehre 1 12359 Berlin GERMANY	

1.1 Equipment Photos

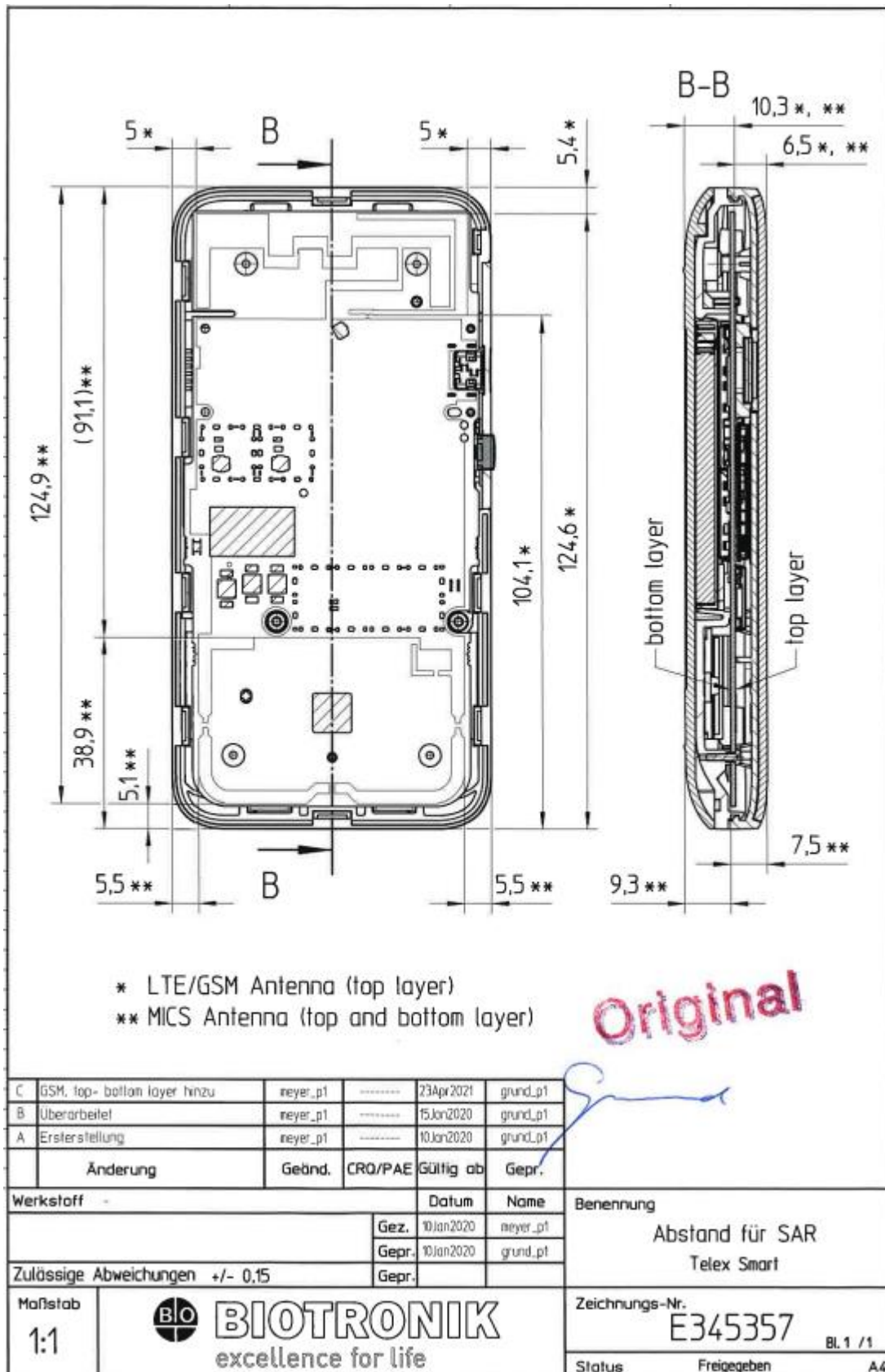




1.2 Setup Photos



1.3 Antenna Mechanical Properties



1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
SIM	Communication Tester	R&S	CMW500	Base Station Simulator
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
SFT	Software			
Comment: --				

1.5 Test Modes

Mode	Description
Transmit	Mode = RMC TPC = Max. power Modulation = QPSK Bandwidth = 5 MHz Number of resource blocks = 1 Resource block offset = 0 NB Position = 0 Duty cycle = 30 %
Comment: --	

1.6 Test Frequencies

Designator	Mode	LTE Cat-M1 bands	Frequency [MHz]
F1	Transmit	FDD B1	1950.0
F2	Transmit	FDD B3	1747.5
F3	Transmit	FDD B8	897.5
F4	Transmit	FDD B18	822.5
F5	Transmit	FDD B19	837.5
F6	Transmit	FDD B26	831.5
F7	Transmit	FDD B28	725.5

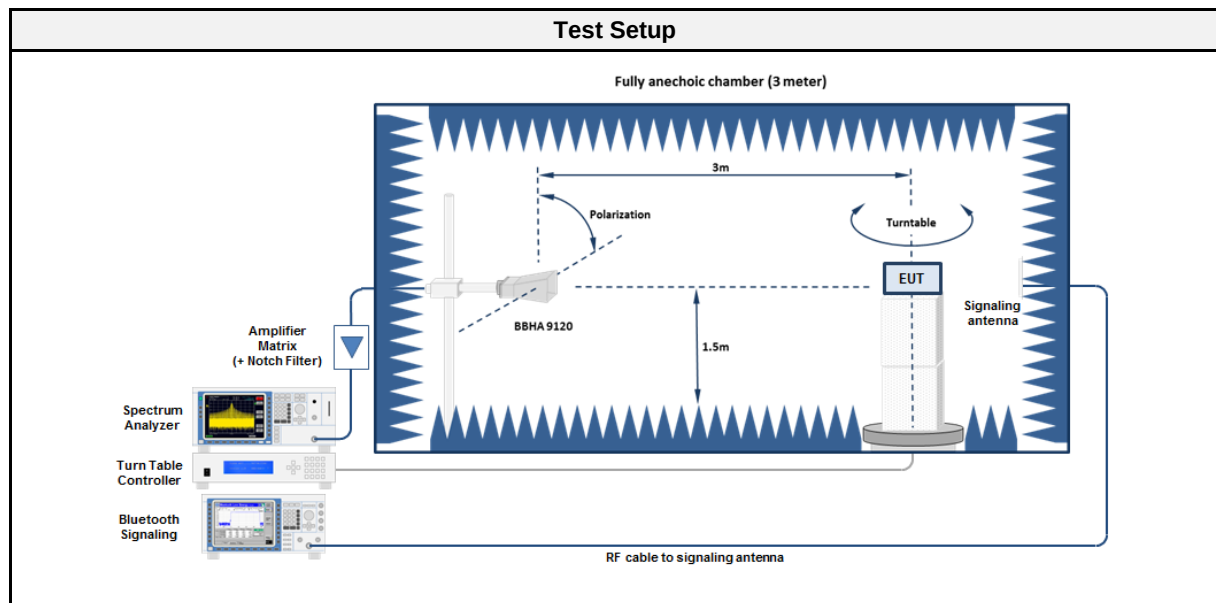
2 Test Conditions and Results

2.1 Test Conditions and Results - Antenna pattern

2.1.1 Information

Test Information	
Operator	Azamat Ibraimov
Measurement uncertainty	$\pm 2.86 \%$
Date	2024-08-22

2.1.2 Setup



2.1.3 Equipment

Test Software			
Description	Manufacturer	Name	Version
Antenna pattern software	Eurofins Product Service GmbH	Radiation Pattern Measurement	1

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber	Frankonia	AC 2	EF01616	2023-12	2024-12
Spectrum analyzer	R&S	FSW43	EF00896	2023-08	2024-08
LPD antenna	R&S	HL223	EF00187	2022-06	2025-06
Antenna	Schwarzbeck	BBHA 9120B	EF01678	2024-05	2027-05

2.1.4 Procedure

Test Procedure	
1.	EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground
2.	The EUT is activated in test mode on the test channel
3.	The measurement antenna is set to vertical polarization
4.	The spectrum analyser is set to the EUT channel in zero span with RBW = 1 MHz and peak detection
5.	The EUT is rotated through 0° to 360° in horizontal plane and 0° to 180° in vertical plane.
6.	The measurement procedure is repeated for all possible EUT positions.
7.	The measurement antenna polarization is changed to horizontal and the measurement is repeated

2.1.5 Results

Test result			
Band	Conducted Power [dBm]	Max. rad. Power [dBm e.i.r.p]	Max. antenna gain [dBi]
FDD 1	21.15	24.69	3.54
FDD 3	21.25	25.09	3.84
FDD 8	21.70	23.19	1.49
FDD 18	21.9	23.76	1.86
FDD 19	21.6	23.28	1.68
FDD 26	22.4	23.41	1.01
FDD 28	21.4	23.13	1.73

ANNEX A Antenna Pattern

Antenna Pattern FDD1

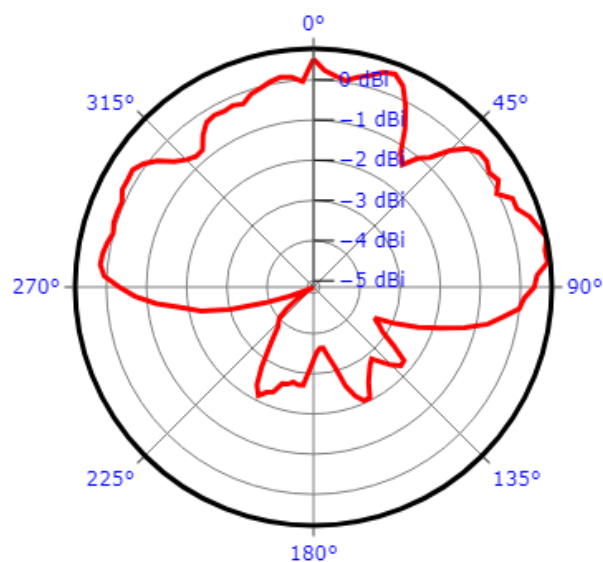
Project Number: G0M-2403-2480
 Product: CardioMessenger Smart / Telemonitoring System
 Model: CardioMessenger Smart 4G
 EUT Antenna: Integrated PCB-antenna
 Operating Conditions: Tnom / Vnom
 Operating Frequency: 1747.84 MHz (FDD B1)
 Detector: RMS
 RBW: 1 MHz
 VBW: 3 MHz
 Sweep Time: 20 ms
 Conducted Power: 21.15 dBm
 Operator: A. Ibraimov
 Date: 2024-08-21

Result Summary

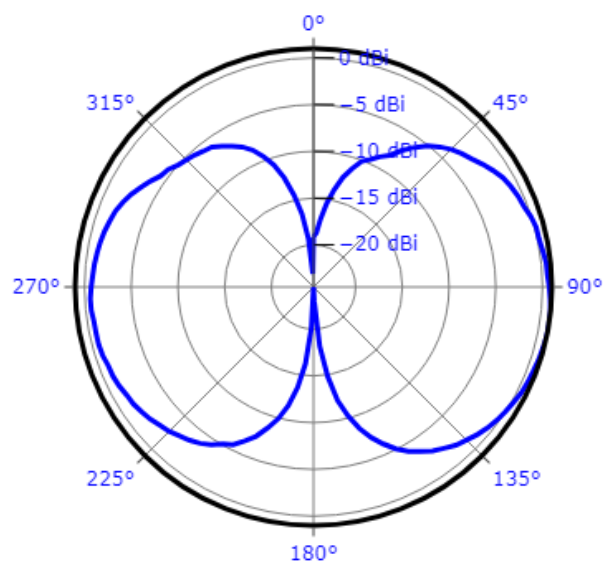
Antenna Polarization	Half power beamwidth ϕ [°]	Half power beamwidth θ [°]	Max. antenna gain [dBi]
Vertical	207	81	1.08
Horizontal	57	72	3.54

Antenna Pattern vertical polarization

Polar radiation pattern at $\theta = 104^\circ$

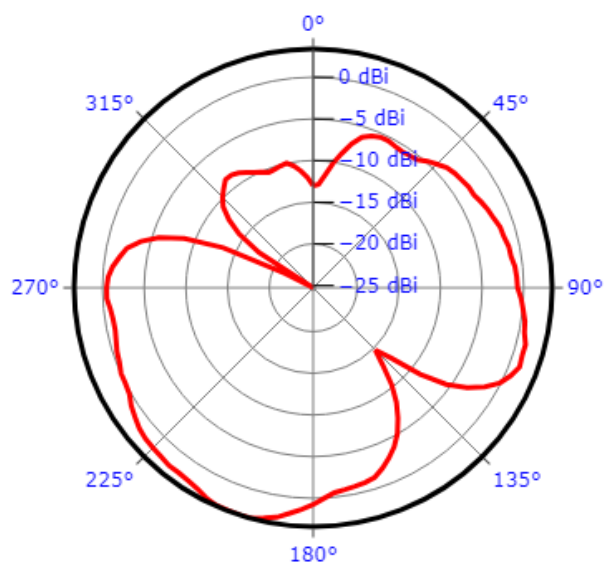


Polar radiation pattern at $\phi = 80^\circ$

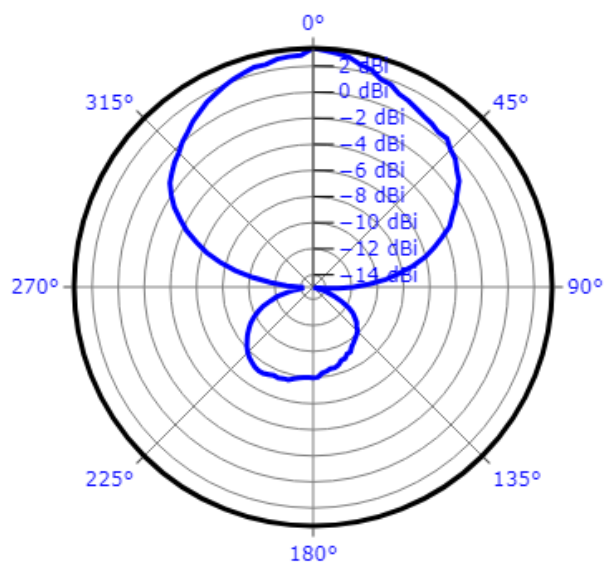


Antenna Pattern horizontal polarization

Polar radiation pattern at $\theta = -5^\circ$



Polar radiation pattern at $\phi = 200^\circ$



Antenna Pattern FDD3

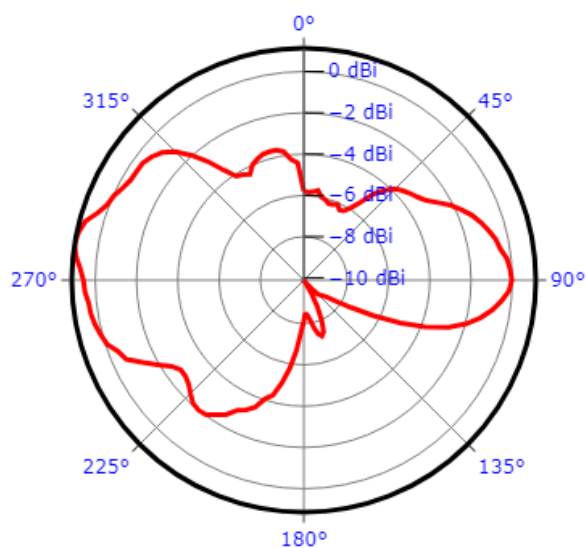
Project Number: G0M-2403-2480
 Product: CardioMessenger Smart / Telemonitoring System
 Model: CardioMessenger Smart 4G
 EUT Antenna: Integrated PCB-antenna
 Operating Conditions: Tnom / Vnom
 Operating Frequency: 1745.34 MHz (FDD B3)
 Detector: RMS
 RBW: 1 MHz
 VBW: 3 MHz
 Sweep Time: 20 ms
 Conducted Power: 21.25 dBm
 Operator: A. Ibraimov
 Date: 2024-08-21

Result Summary

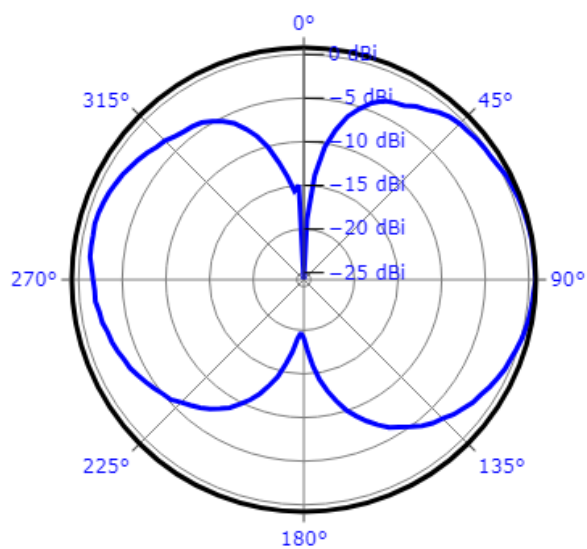
Antenna Polarization	Half power beamwidth ϕ [°]	Half power beamwidth θ [°]	Max. antenna gain [dBi]
Vertical	72	93	0.69
Horizontal	54	24	3.84

Antenna Pattern vertical polarization

Polar radiation pattern at $\theta = 84^\circ$

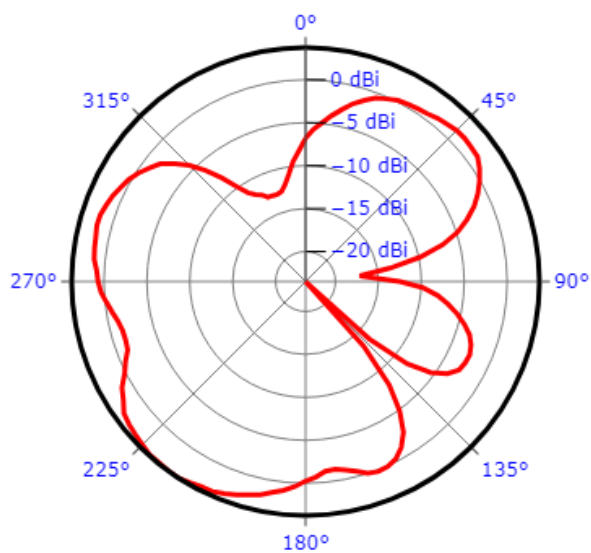


Polar radiation pattern at $\phi = 280^\circ$

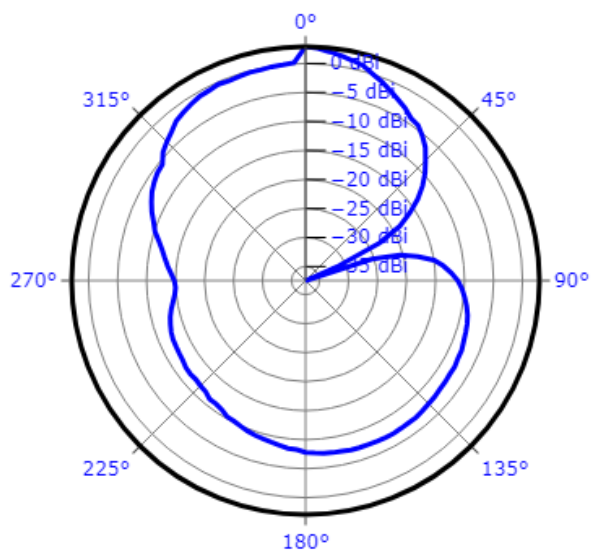


Antenna Pattern horizontal polarization

Polar radiation pattern at $\theta = -15^\circ$



Polar radiation pattern at $\phi = 210^\circ$



Antenna Pattern FDD8

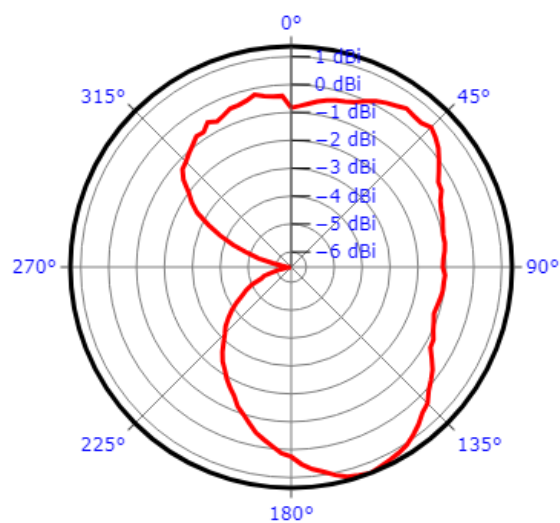
Project Number: G0M-2403-2480
 Product: CardioMessenger Smart / Telemonitoring System
 Model: CardioMessenger Smart 4G
 EUT Antenna: Integrated PCB-antenna
 Operating Conditions: Tnom / Vnom
 Operating Frequency: 895.35 MHz (FDD B8)
 Detector: RMS
 RBW: 1 MHz
 VBW: 3 MHz
 Sweep Time: 20 ms
 Conducted Power: 21.70 dBm
 Operator: A. Ibraimov
 Date: 2024-08-21

Result Summary

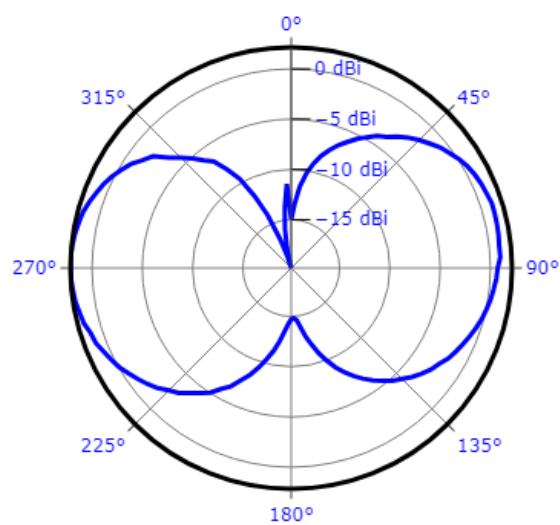
Antenna Polarization	Half power beamwidth ϕ [°]	Half power beamwidth θ [°]	Max. antenna gain [dBi]
Vertical	255	66	1.49
Horizontal	57	33	0.16

Antenna Pattern vertical polarization

Polar radiation pattern at $\theta = 76^\circ$

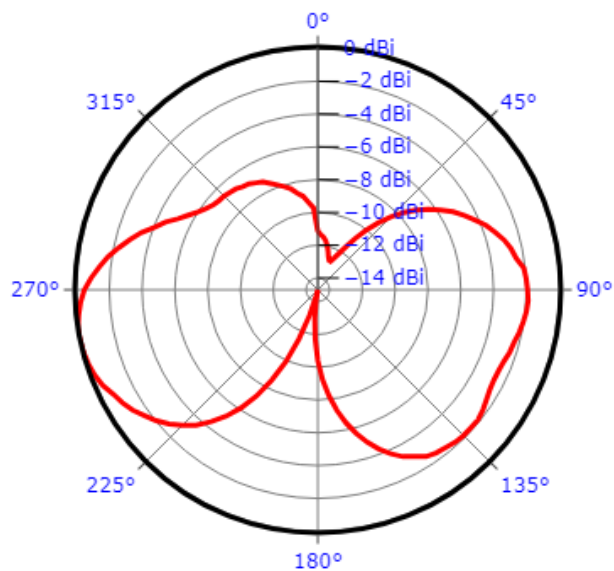


Polar radiation pattern at $\phi = 160^\circ$

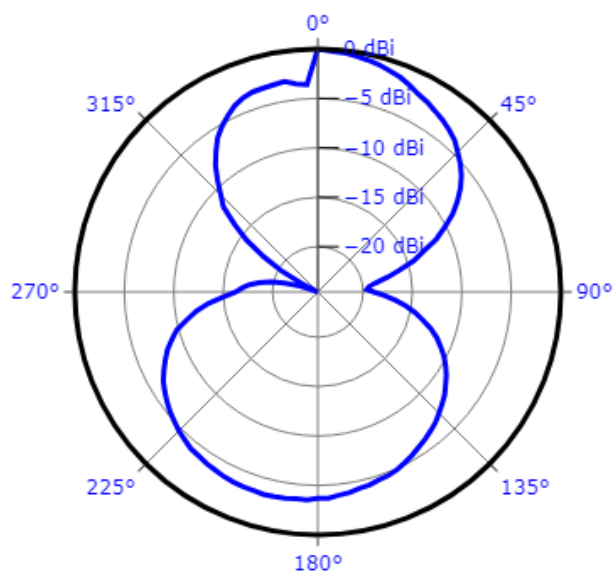


Antenna Pattern horizontal polarization

Polar radiation pattern at $\theta = -7^\circ$



Polar radiation pattern at $\phi = 256^\circ$



Antenna Pattern FDD18

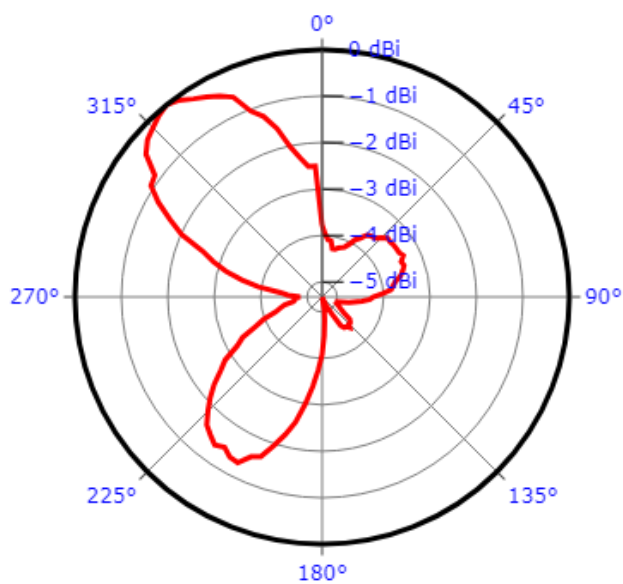
Project Number: G0M-2403-2480
 Product: CardioMessenger Smart / Telemonitoring System
 Model: CardioMessenger Smart 4G
 EUT Antenna: Integrated PCB-antenna
 Operating Conditions: Tnom / Vnom
 Operating Frequency: 820.35 MHz (FDD B18)
 Detector: RMS
 RBW: 1 MHz
 VBW: 3 MHz
 Sweep Time: 20 ms
 Conducted Power: 21.9 dBm
 Operator: A. Ibraimov
 Date: 2024-08-21

Result Summary

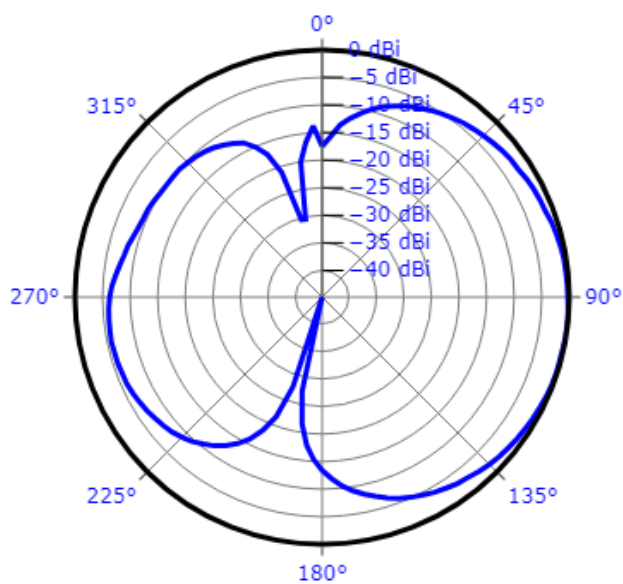
Antenna Polarization	Half power beamwidth ϕ [°]	Half power beamwidth θ [°]	Max. antenna gain [dBi]
Vertical	69	93	0.23
Horizontal	93	96	1.86

Antenna Pattern vertical polarization

Polar radiation pattern at $\theta = 102^\circ$

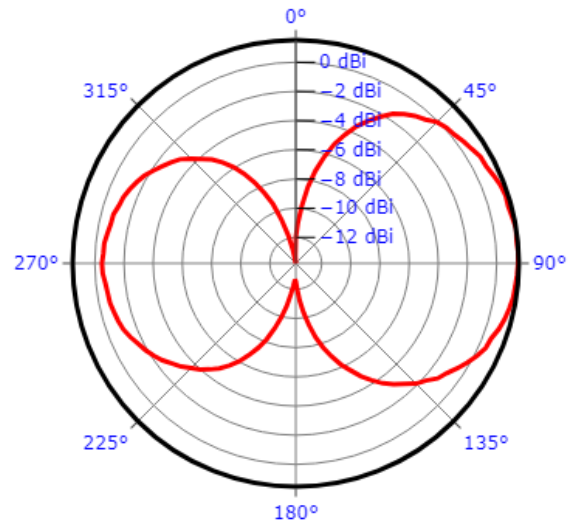


Polar radiation pattern at $\phi = 320^\circ$

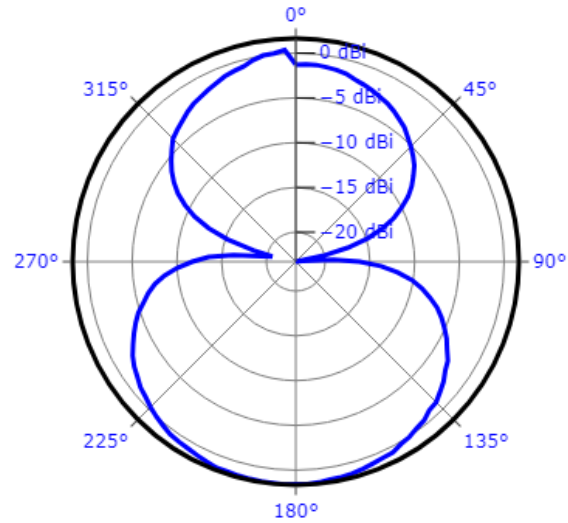


Antenna Pattern horizontal polarization

Polar radiation pattern at $\theta = 182^\circ$



Polar radiation pattern at $\phi = 88^\circ$



Antenna Pattern FDD19

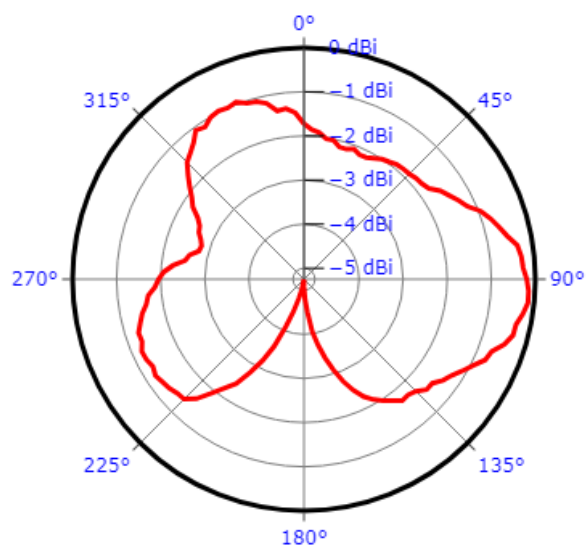
Project Number: G0M-2403-2480
 Product: CardioMessenger Smart / Telemonitoring System
 Model: CardioMessenger Smart 4G
 EUT Antenna: Integrated PCB-antenna
 Operating Conditions: Tnom / Vnom
 Operating Frequency: 835.35 MHz (FDD B19)
 Detector: RMS
 RBW: 1 MHz
 VBW: 3 MHz
 Sweep Time: 20 ms
 Conducted Power: 21.6 dBm
 Operator: A. Ibraimov
 Date: 2024-08-21

Result Summary

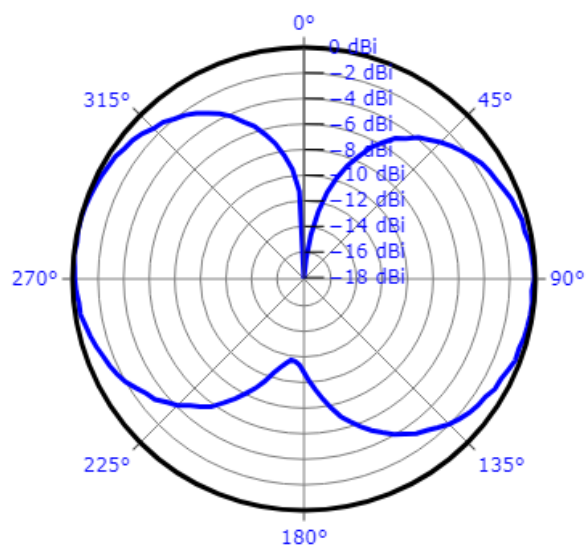
Antenna Polarization	Half power beamwidth ϕ [°]	Half power beamwidth θ [°]	Max. antenna gain [dBi]
Vertical	312	93	0.03
Horizontal	87	30	1.68

Antenna Pattern vertical polarization

Polar radiation pattern at $\theta = 92^\circ$

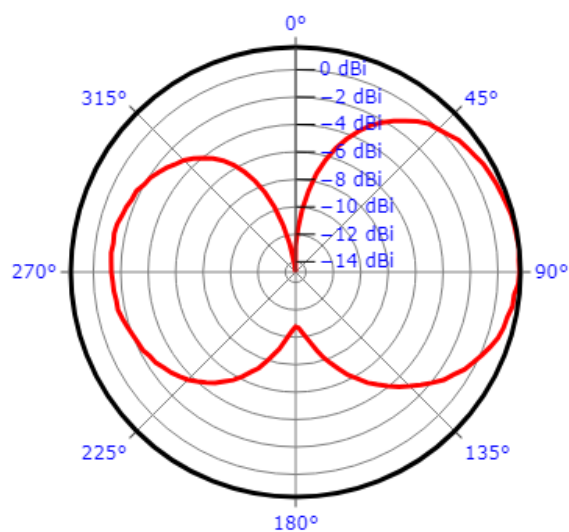


Polar radiation pattern at $\phi = 86^\circ$

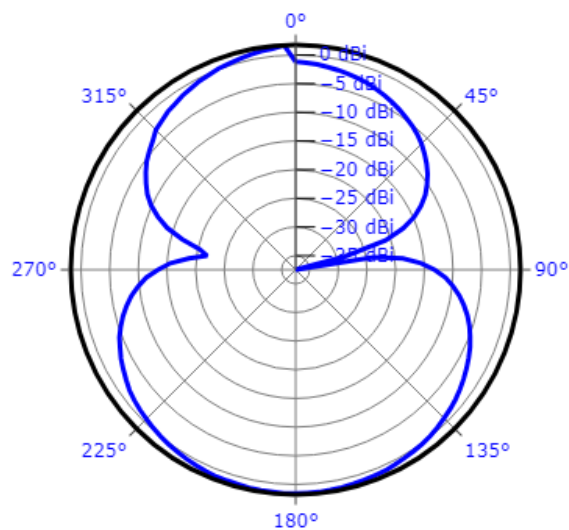


Antenna Pattern horizontal polarization

Polar radiation pattern at $\theta = 176^\circ$



Polar radiation pattern at $\phi = 82^\circ$



Antenna Pattern FDD26

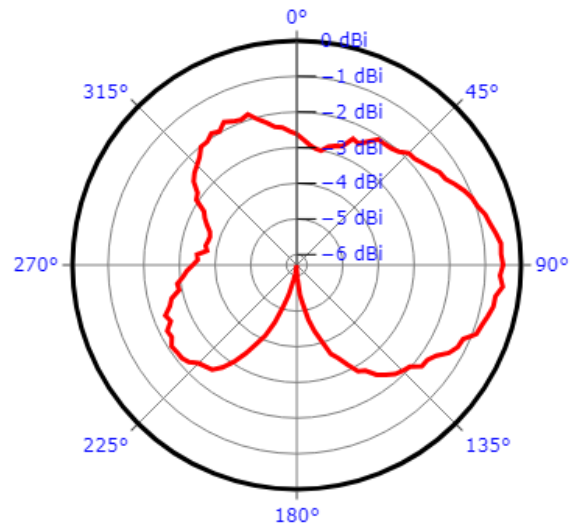
Project Number: G0M-2403-2480
 Product: CardioMessenger Smart / Telemonitoring System
 Model: CardioMessenger Smart 4G
 EUT Antenna: Integrated PCB-antenna
 Operating Conditions: Tnom / Vnom
 Operating Frequency: 829.35 MHz (FDD B26)
 Detector: RMS
 RBW: 1 MHz
 VBW: 3 MHz
 Sweep Time: 20 ms
 Conducted Power: 22.4 dBm
 Operator: A. Ibraimov
 Date: 2024-08-21

Result Summary

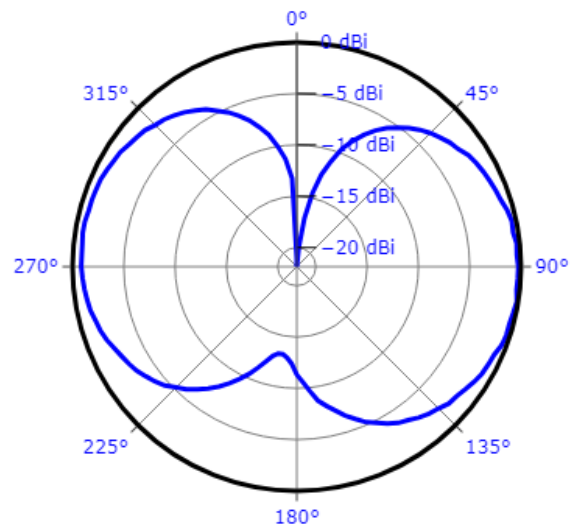
Antenna Polarization	Half power beamwidth ϕ [°]	Half power beamwidth θ [°]	Max. antenna gain [dBi]
Vertical	219	93	-0.38
Horizontal	90	99	1.01

Antenna Pattern vertical polarization

Polar radiation pattern at $\theta = 102^\circ$

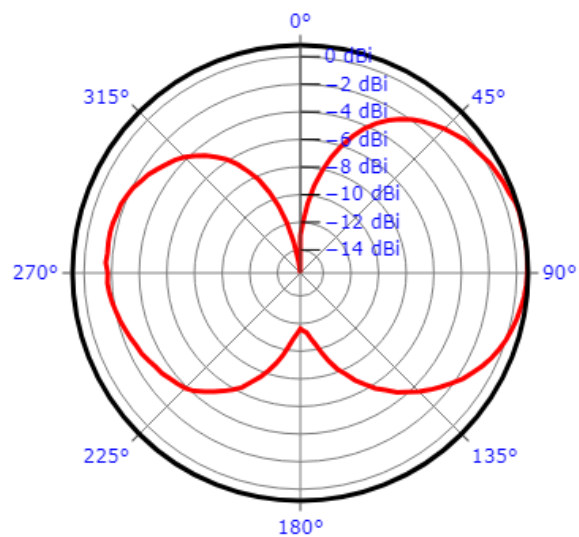


Polar radiation pattern at $\phi = 90^\circ$

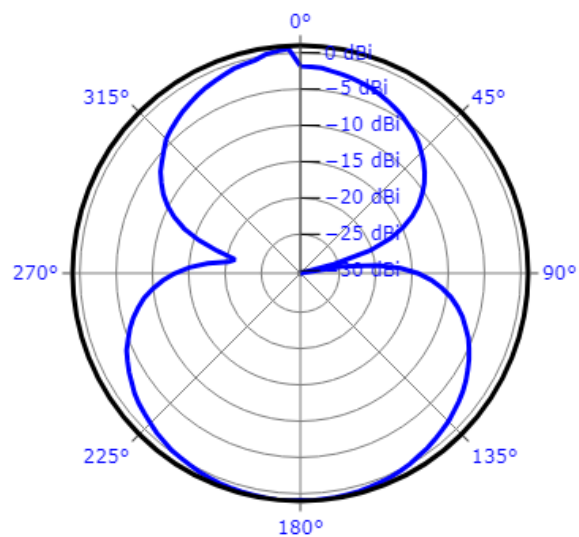


Antenna Pattern horizontal polarization

Polar radiation pattern at $\theta = 186^\circ$



Polar radiation pattern at $\phi = 82^\circ$



Antenna Pattern FDD28

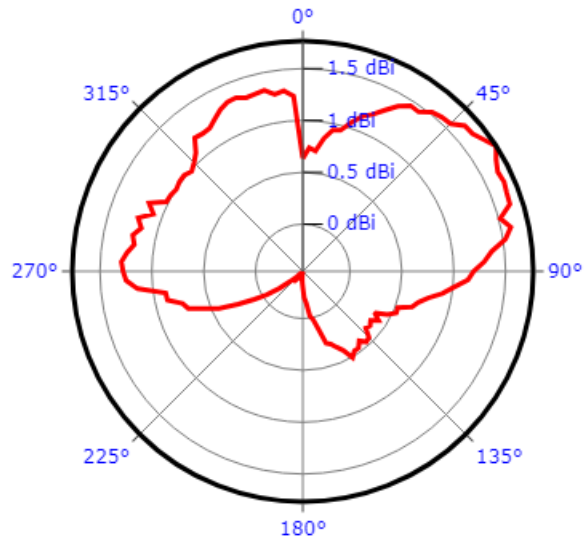
Project Number: G0M-2403-2480
 Product: CardioMessenger Smart / Telemonitoring System
 Model: CardioMessenger Smart 4G
 EUT Antenna: Integrated PCB-antenna
 Operating Conditions: Tnom / Vnom
 Operating Frequency: 723.35 MHz (FDD B28)
 Detector: RMS
 RBW: 1 MHz
 VBW: 3 MHz
 Sweep Time: 20 ms
 Conducted Power: 21.4 dBm
 Operator: A. Ibraimov
 Date: 2024-08-21

Result Summary

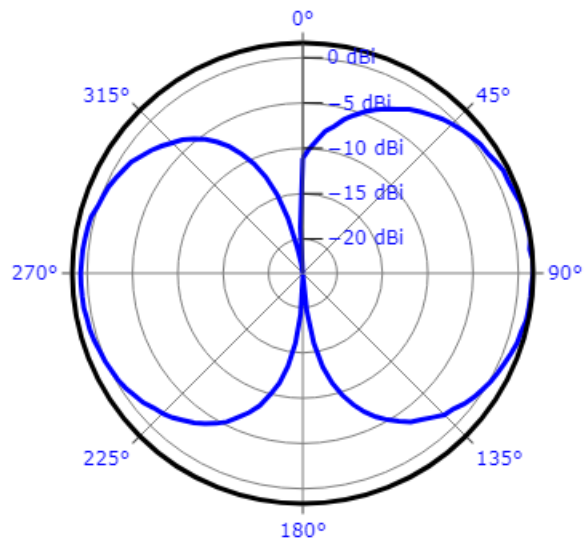
Antenna Polarization	Half power beamwidth ϕ [°]	Half power beamwidth θ [°]	Max. antenna gain [dBi]
Vertical	354	90	1.73
Horizontal	90	93	-0.33

Antenna Pattern vertical polarization

Polar radiation pattern at $\theta = 86^\circ$

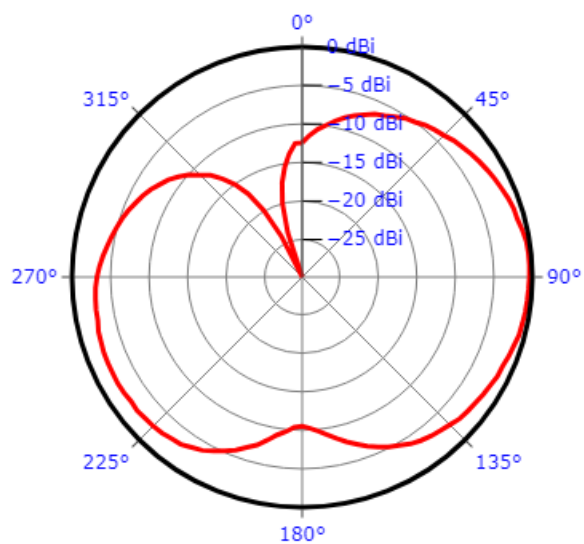


Polar radiation pattern at $\phi = 60^\circ$

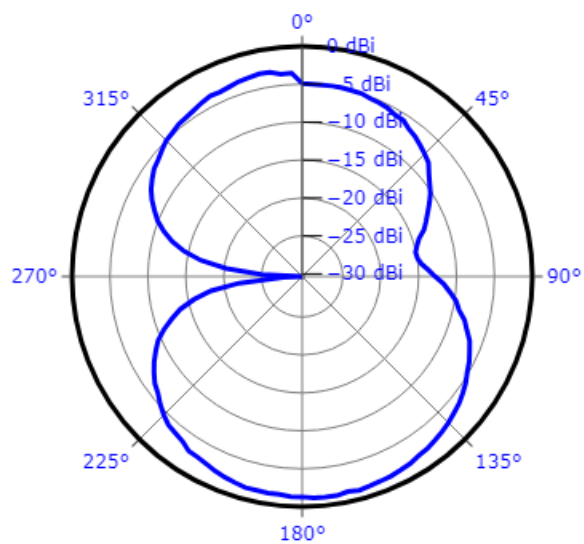


Antenna Pattern horizontal polarization

Polar radiation pattern at $\theta = 164^\circ$



Polar radiation pattern at $\phi = 92^\circ$



=== END OF TEST REPORT ===