eurofins | Product Service

FCC TEST REPORT

FCC 47 CFR Part 15C
Industry Canada RSS-310

License exempt radio equipment

Report Reference No.....:	G0M-1402-3601-TFC209LP-V01
Testing Laboratory.....:	Eurofins Product Service GmbH
Address.....:	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation.....:	A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Filed Test Laboratory, Reg.-No.: 96970 IC OATS Filing assigned code: 3470A
Applicant's name.....:	Biotronik SE & Co. KG
Address.....:	Woermannkehre 1 12359 Berlin GERMANY
Test specification:	
Standard.....:	47 CFR Part 15C RSS-310, Issue 3, 2010-12 RSS-Gen, Issue 3, 2010-12 ANSI C63.4:2009
Equipment under test (EUT):	
Product description	ICD / Implantable Cardioverter Defibrillator
Model No.	Inventra 7 HF-T QP / SN: 60508645 (additional models according to family letter)
Additional Model(s)	None
Brand Name(s)	Iperia; Itrevia; Inventra
Hardware version	Rev.: 0A
Firmware / Software version	ROM: 2.3 / RAM: 3.0
	FCC-ID: QRITACH70 IC: 4708A-TACH70
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 .....: 2014-02-10

Date (s) of performance of tests .....: 2014-02-10 - 2014-02-14

Compiled by ..... : Wilfried Treffke

Tested by (+ signature)..... : Wilfried Treffke W. Treffke
(Responsible for Test)

Approved by (+ signature) ..... : Christian Weber C. Weber

Date of issue ..... : 2014-03-27

Total number of pages ..... : 34

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.

Additional comments:

The report applies to all model stated in the “TACH_70 Family Listing” issued by the Manufacturer 2014-02-10.

	Product Name	Type	no. of chambers	Connector	max.stored energy	SN
1	Inventra 7 HF-T	CRT	3	DF-1	45J	
2	Inventra 7 HF-T	CRT	3	DF-4	45J	
3	Inventra 7 HF-T QP	CRT	3	DF-4 + IS-4	45J	60508645 (Master)
4	Inventra 7 DR-T	DR	2	DF-1	45J	
5	Inventra 7 DR-T	DR	2	DF-4	45J	
6	Inventra 7 VR-T DX	DX	1	DF-1	45J	
7	Inventra 7 VR-T	VR	1	DF-1	45J	
8	Inventra 7 VR-T	VR	1	DF-1	45J	
9	Iperia 7 HF-T	CRT	3	DF-1	40J	60732362
10	Iperia 7 HF-T	CRT	3	DF-4	40J	60732030
11	Iperia 7 HF-T QP	CRT	3	DF-4 + IS-4	40J	
12	Iperia 7 DR-T	DR	2	DF-1	40J	60736887
13	Iperia 7 DR-T	DR	2	DF-4	40J	60732055
14	Iperia 7 VR-T DX	DX	1	DF-1	40J	
15	Iperia 7 VR-T	VR	1	DF-1	40J	60737145
16	Iperia 7 VR-T	VR	1	DF-4	40J	60732364
17	Itrevia 7 HF-T	CRT	3	DF-1	40J	
18	Itrevia 7 HF-T	CRT	3	DF-4	40J	
19	Itrevia 7 HF-T QP	CRT	3	DF-4 + IS-4	40J	
20	Itrevia 7 DR-T	DR	2	DF-1	40J	
21	Itrevia 7 DR-T	DR	2	DF-4	40J	
22	Itrevia 7 VR-T DX	DX	1	DF-1	40J	
23	Itrevia 7 VR-T	VR	1	DF-1	40J	
24	Itrevia 7 VR-T	VR	1	DF-4	40J	
25	Iperia 5 HF-T	CRT	3	DF-1	40J	
26	Iperia 5 HF-T	CRT	3	DF-4	40J	
27	Iperia 5 HF-T QP	CRT	3	DF-4 + IS-4	40J	
28	Iperia 5 DR-T	DR	2	DF-1	40J	
29	Iperia 5 DR-T	DR	2	DF-4	40J	
30	Iperia 5 VR-T DX	DX	1	DF-1	40J	
31	Iperia 5 VR-T	VR	1	DF-1	40J	
32	Iperia 5 VR-T	VR	1	DF-4	40J	
33	Itrevia 5 HF-T	CRT	3	DF-1	40J	
34	Itrevia 5 HF-T	CRT	3	DF-4	40J	
35	Itrevia 5 HF-T QP	CRT	3	DF-4 + IS-4	40J	
36	Itrevia 5 DR-T	DR	2	DF-1	40J	
37	Itrevia 5 DR-T	DR	2	DF-4	40J	
38	Itrevia 5 VR-T DX	DX	1	DF-1	40J	
39	Itrevia 5 VR-T	VR	1	DF-1	40J	
40	Itrevia 5 VR-T	VR	1	DF-4	40J	

The ulp-ami antenna is built into the headers (DF-1 / DF-4 or IS-4). The antenna of header model DF-1 / DF-4 is slightly different from the antenna built into header DF-4. Evaluation measurements were performed for worst case antenna selection and header DF-4 + IS-4 was selected. Besides the DF-4 + IS-4 header, model Inventra 7 HF-T QP, as the most complex model, was selected for the measurements. Hence, the measurements were performed with the following model: “Inventra 7 HF-T QP with connector DF-4 + IS-4”.

2. TACH 70 Family Explanation

All devices feature the two RF-Telemetry functions Home Monitoring and wireless Wand.
RF-Telemetry functions are using the MICS-Band (402MHz – 405MHz).
A „-T“ inside the name of the device represents a device containing RF-Telemetry.
HF-T are triple-chamber devices.
DR-T are dual-chamber devices.
VR-T DX are single chamber devices with additional atrial detection.
VR-T are single chamber devices without additional atrial detection.
All variants are available either with DF-1 or with DF-4 connector except for the VR-T DX models that are only available with DF-1 connector. All VR-T DX devices do have the same header.
Iperia and Itrevia are the high energy devices with 40 J max. stored energy.
Inventra represents the ultra high energy device with 45 J max. stored energy.
All of these differences are only relevant in terms of medical aspects. They do not interfere the RF performance.
The different max. stored energies needed for the medical therapy are solely a medical feature that does not affect the RF performance of the devices.

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TACH_70 Header Configuration:

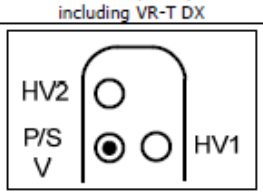
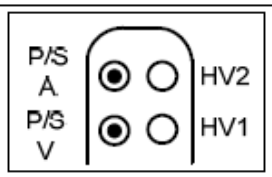
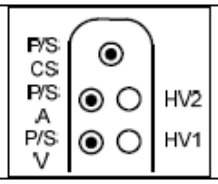
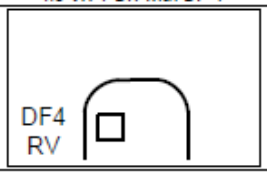
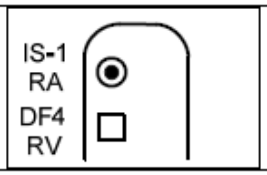
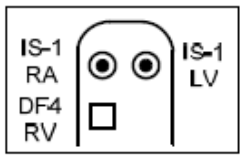
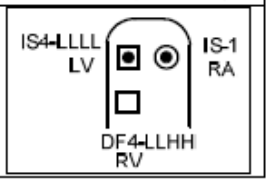
Abbreviations:
ICD Implantable Cardioverter Defibrillator

1. Header configuration

The ICD header configuration depends on how many chambers of the heart should be part of the therapy. The main configurations are:

- VR single chamber (ventricle) device
- DR dual chamber (atria, ventricle) device
- HF three chamber (atria, ventricle, coronary artery) device

All these cambers are related to the pacemaker part of the ICD. Therefore the used voltages are low (below10V). The ICD related connectors are the same for all three device configurations. The case, HV1 and HV2 are delivering the high voltage (800V) to the leads to deliver a shock to the patient.
The "-T" declares a device with RF Telemetry. This means the BIOTRONIK Home Monitoring function.
DX is a special VR-T device with a higher sensitivity for the ventricular sense signals.

	single chamber header	dual chamber header	three chamber header
	VR-T (DF1) including VR-T DX	DR-T (DF1)	HF-T (DF1)
DF1			
	VR-T (DF4) no VR-T DX with DF-4	DR-T (DF4)	HF-T (DF4)
DF4			
			HF-T QP (IS4/DF4)
QP			

The IS4 and DF-4 symbol shows are rectangular signs. In the reality the hole is round.

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2. Connector system overview

Connector explanation:

Connector	Explanation
IS-1 	- pacemaker lead connector standard Each lead will be connected via one hole with two electrical contacts. The connected electrical signals are low voltage signals, pace and sense. The standard was used within the last 30 years.
IS-4 	- new pacemaker lead connector standard All lead's will be connected via one hole with several electrical contacts. The connected electrical signals are low voltage signals, pace and sense.
DF-1 	- ICD lead connector standard Each lead will be connected via one hole with two electrical contacts. The connected electrical signals are high voltage signals (800V), HV1 and HV2. The standard was used within the last 30 years.
DF-4 	- new ICD HV lead connector standard All lead's will be connected via one hole with several electrical contacts. The connected electrical signals are high voltage signals (800V), HV1 and HV2.

Advantage of IS-4 /DF-4 versus IS-1/DF-1 is that the connection is smaller (one hole instead of 2), reduced number of screw's, a smaller header design, a improved handling and improved reliability of the leads.

DF-4 connector system (VR-T)	
DF-1 versus DF-4 leads	

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Version History

Version	Issue Date	Remarks	Revised by
01	2013-03-27	Initial Release	

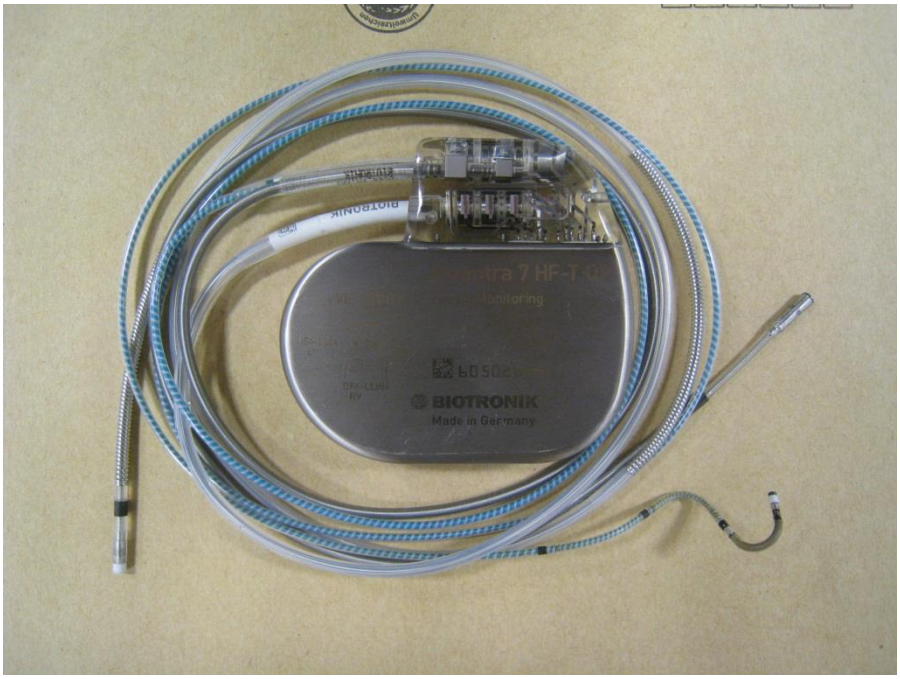
REPORT INDEX

1 Equipment (Test item) Description

Description	ICD / Implantable Cardioverter Defibrillator	
Model	Inventra 7 HF-T QP / SN: 60508645 (additional models according to family letter)	
Additional Model(s)	additional models according to family letter	
Brand Name(s)	Iperia; Itrevia; Inventra	
Serial number	None	
Hardware version	Rev.: 0A	
Software / Firmware version	ROM: 2.3 / RAM: 3.0	
FCC-ID	QRITACH70	
IC	4708A-TACH70	
Equipment type	End product	
Radio type	Transceiver / Inductive Loop Coil Transmitter	
Radio technology	ULP-AMI	
Operating frequency range	64 kHz	
Frequency range	F_{MID}	64 kHz
Modulations	OOK	
Number of channels	1	
Channel spacing	None	
Number of antennas	1	
Antenna	Type	integrated
	Model	loop antenna
	Manufacturer	Biotronik SE & Co. KG
	Gain	unspecified
Manufacturer	Biotronik SE & Co. KG Woermannkehre 1 12359 Berlin GERMANY	
Power supply	V_{NOM}	3.0 VDC (Lithium-Battery)
	V_{MIN}	N/A
	V_{MIN}	N/A
AC/DC-Adaptor	Model	N/A
	Vendor	N/A
	Input	N/A
	Output	N/A

1.1 Photos – Equipment External

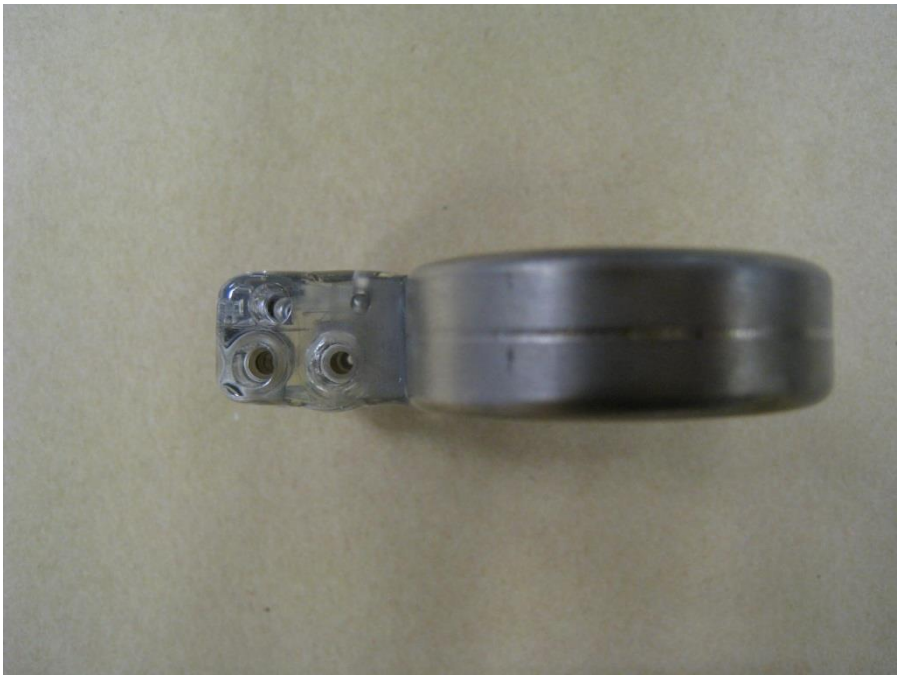
MASTER EUT OVERVIEW



MASTER EUT TOP

MASTER EUT BOTTOM


MASTER EUT HEADER


MASTER EUT CONNECTOR


Iperia 7 HF-T DF4 TOP

Iperia 7 HF-T DF4 BOTTOM

Iperia 7 HF-T DF4 HEADER

Iperia 7 HF-T DF4 CONNECTOR

Iperia 7 VR-T DF4 TOP

Iperia 7 VR-T DF4 BOTTOM

Iperia 7 VR-T DF4 HEADER

Iperia 7 VR-T DF4 CONNECTOR

Iperia 7 DR-T DF4 TOP

Iperia 7 DR-T DF4 BOTTOM

Iperia 7 DR-T DF4 HEADER

Iperia 7 DR-T DF4 CONNECTOR

Iperia 7 VR-T DF1 TOP

Iperia 7 VR-T DF1 BOTTOM

Iperia 7 VR-T DF1 HEADER

Iperia 7 VR-T DF1 CONNECTOR

Iperia 7 HF-T DF1 TOP

Iperia 7 HF-T DF1 BOTTOM

Iperia 7 HF-T DF1 HEADER

Iperia 7 HF-T DF1 CONNECTOR

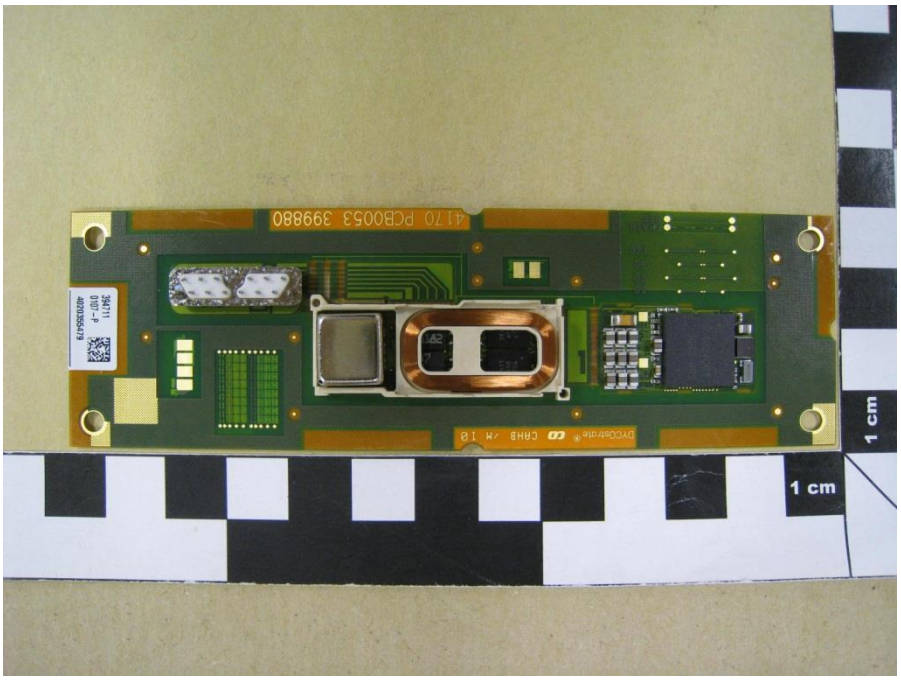
Iperia 7 DR-T DF1 TOP

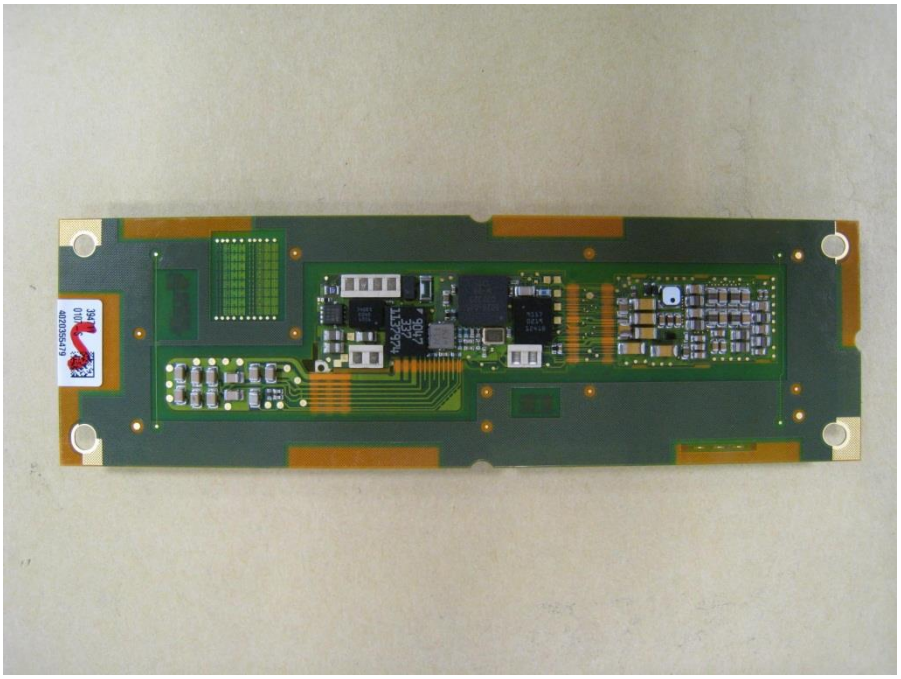
Iperia 7 DR-T DF1 BOTTOM

Iperia 7 DR-T DF1 HEADER

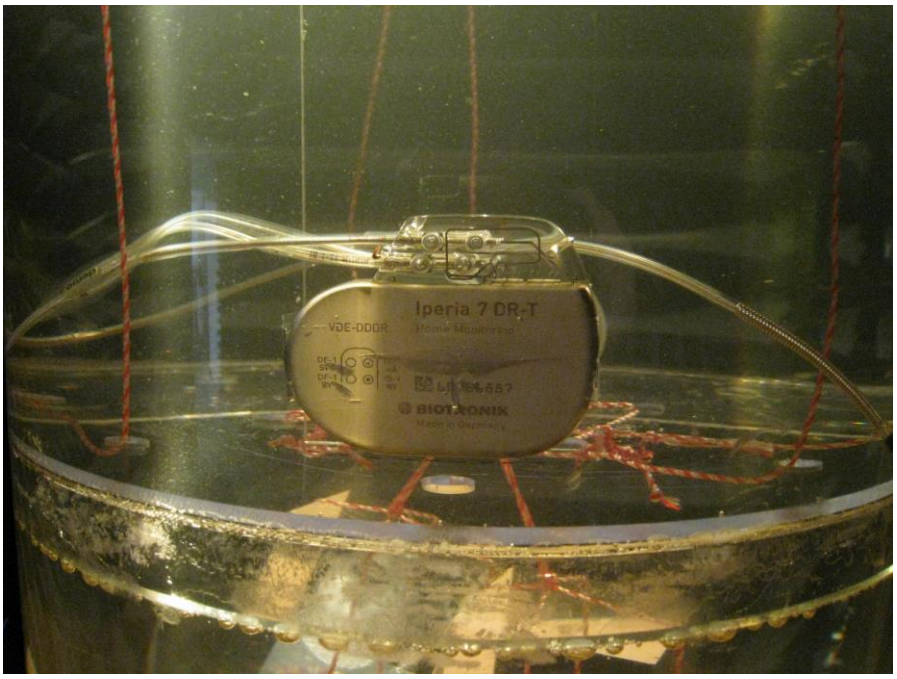
Iperia 7 DR-T DF1 CONNECTOR

1.2 Photos – Equipment internal

PCB TOP


PCB BOTTOM


1.3 Photos – Test setup

Test setup – Radiated emissions EUT


Test setup – Radiated emissions chamber


1.4 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments
AE	Enginnering communication box	BIOTRONIK	TelBoxII	for test mode
AE	Cardio Messenger	BIOTRONIK	TelexIII	Companion device

***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	
Single	General conditions:	EUT powered by fully charged battery
	Radio conditions:	Mode = standalone transmit Modulation = OOK Power level = Maximum
Receive	General conditions:	EUT powered by fully charged battery
	Radio conditions:	Mode = standalone receive Modulation = OOK

1.6 Test Equipment Used During Testing

Measurement Software			
Description	Manufacturer	Name	Version
EMC Test Software	Dare Instruments	Radimation	5.8.37

Occupied Bandwidth					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyzer	R&S	FSP 30	EF00312	2014-02	2015-02

Field strength emissions					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Semi-anechoic chamber	Frankonia	AC 5	EF00395	-	-
Spectrum Analyzer	R&S	FSIQ26	EF00242	2013-06	2014-06
Biconical Antenna	R&S	HK 116	EF00012	2013-02	2016-02
LPD antenna	R&S	HL 223	EF00212	2013-02	2016-02
LPD Antenna	R&S	HL 025	EF00327	2013-02	2016-02

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

1.8 Simulated human body

For radiated tests the implant was placed in a simulated human body.

Liquid components	
Component	percentage per weight
Deionized water	52.4
Bactericide	0.08
Hydroxy ethyl cellulose (HCE)	1.0
Sodium chloride	1.4
Sucrose	45.0

Measured tissue parameters:

Tissue parameters – 403.5MHz			
Component	Target	Measured	Tolerance [%]
Dielectric constant ε	62.5	63.01	0.82
Conductivity σ [ms/cm]	9.0	8.9	-1.11

2 Result Summary

FCC 47 CFR Part 15C, IC RSS-310				
Product Specific Standard Section	**Requirement – Test**	**Reference Method**	**Result**	**Remarks**
RSS-Gen 4.6.1	Occupied Bandwidth	RSS-Gen 4.6.1	N/R	Informational only
FCC 15.201(a), FCC 15.209 IC RSS-310 3.7	Field strength emissions	ANSI C63.4	PASS	
IC RSS-310 2.3 IC RSS-Gen 4.10 6.1	Receiver radiated spurious emissions	ANSI C63.4	PASS	
Remarks:				

3 Test Conditions and Results

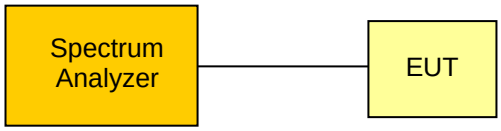
3.1 Test Conditions and Results – Occupied Bandwidth

Occupied Bandwidth acc. IC RSS-Gen	**Verdict: PASS**
Test according to measurement reference	Reference Method
	RSS-Gen 4.6.1
Test frequency range	Tested frequencies
	F_{MID}
EUT test mode	Single

Limits

None (Informational only)

Test setup



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

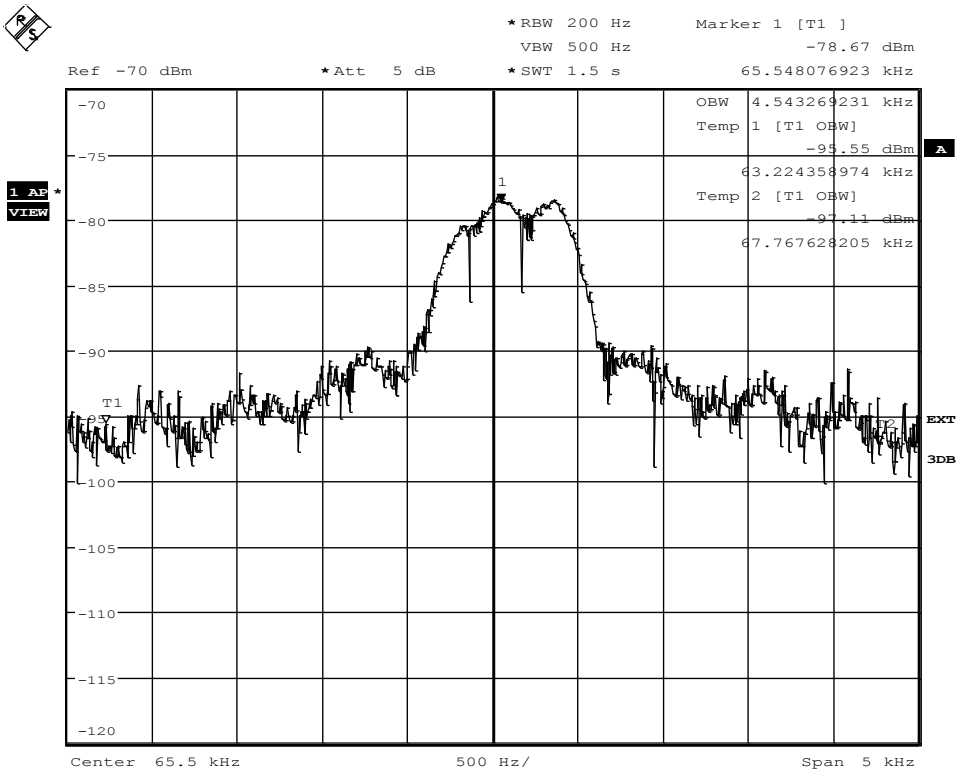
Channel	Frequency [kHz]	Occupied Bandwidth [kHz]
F_{MID}	64	4.54

Comments: Measurement is applicable to all variants

Occupied Bandwidth - F_{MID}

RSS-Gen
Occupied frequency bandwidth

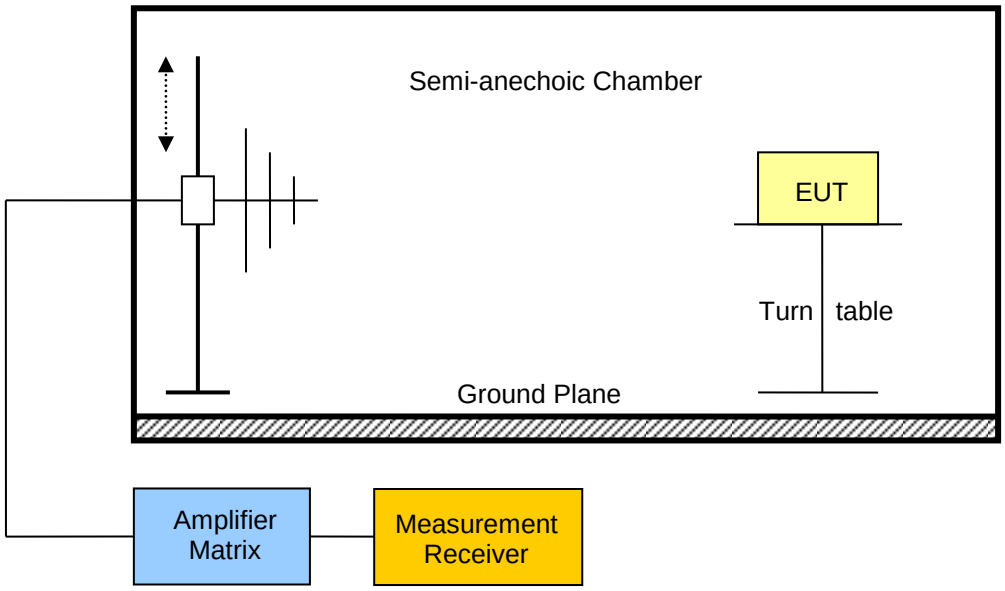
EUT	IPG / Implantable Cardioverter Defibrillator
Model	Tach_70 / G0M-1402-3601
Approval Holder	Biotronik SE & Co. KG
Temperature / Voltage	37°C / Vnom
Test Site / Operator	Eurofins Product Service GmbH / Mr Treffke
Test Specification	Occupied frequency bandwidth
Comment 1	A spectrum analyzer with an integrated 99% power bandwidth function is used
Comment 2	Near-field measurement, test fixture
Comment 3	64kHz System



3.2 Test Conditions and Results – Fundamental field strength emissions

Field strength emissions acc. FCC 47 CFR 15.201 / IC RSS-310				**Verdict: PASS**
Test according referenced standards		Reference Method		
		FCC 15.201(a) + 15.209 / IC RSS-310 3.7		
Test according to measurement reference		Reference Method		
		ANSI C63.4		
Test frequency range		Tested frequencies		
		9 kHz – 10th Harmonic		
EUT test mode		Single		
Limits				
Frequency range [MHz]	Detector	Limit [µV/m]	Limit [dBµV/m]	Limit Distance [m]
0.009 – 0.490	Quasi-Peak	2400/F[kHz]	48.5 – 13.8	300
0.490 – 1.705	Quasi-Peak	2400/F[kHz]	13.8 – 1.4	30
1.705 – 30	Quasi-Peak	30	29.5	30
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
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.				

Test setup



Test procedure

1. EUT set to test mode
2. Span it set according to measurement range
3. Resolution bandwidth below 1 GHz is set according to CISPR 16 with peak/quasi-peak detector and RBW of 1 MHz with peak/average detector is used above 1 GHz
4. Markers are set to maximum emission levels

Test results

Channel	Frequency [kHz]	Emission [kHz]	Level [dbµV/m]	Detector	Pol.	Limit [dbµV/m]	Limit distance [m]*	Margin [dB]
F_{MID}	64	19.2	-50.3	pk	ver	41.9	300	92.2

Comments: * Physical distance between EUT and measurement antenna.

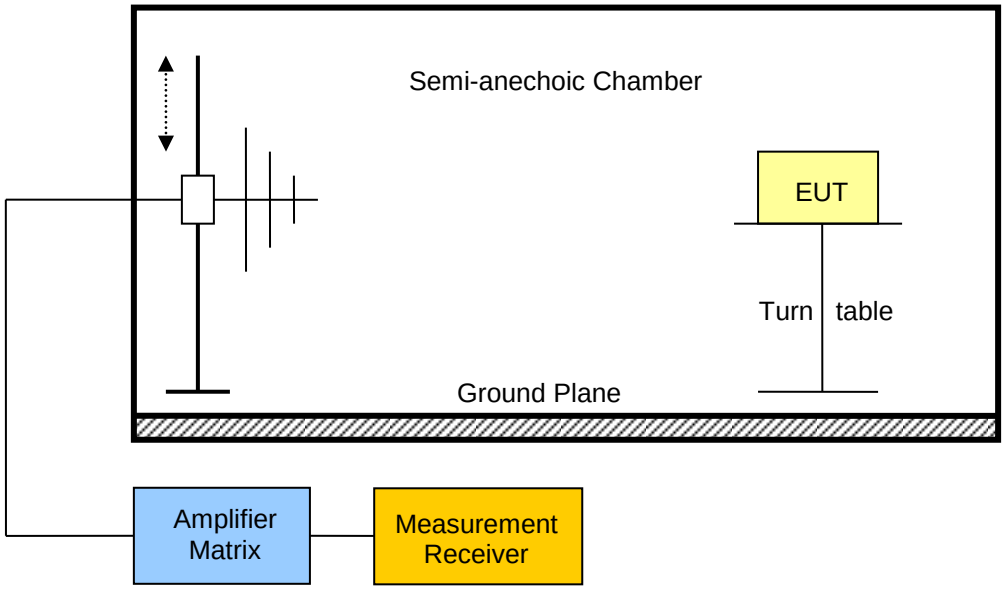
3.4 Test Conditions and Results – Receiver radiated emissions

Receiver radiated emissions acc. IC RSS-310	**Verdict: PASS**
Test according referenced standards	Reference Method
	IC RSS-310 3.7
Test according to measurement reference	Reference Method
	ANSI C63.4
Test frequency range	Tested frequencies
	9 kHz – 10th Harmonic
EUT test mode	Receive

Limits

Frequency range [MHz]	Detector	Limit [µV/m]	Limit [dBµV/m]	Limit Distance [m]
0.009 – 0.490	Quasi-Peak	2400/F[kHz]	48.5 – 13.8	300
0.490 – 1.705	Quasi-Peak	2400/F[kHz]	13.8 – 1.4	30
1.705 – 30	Quasi-Peak	30	29.5	30
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 1 GHz is set according to CISPR 16 with peak/quasi-peak detector and RBW of 1 MHz with peak/average detector is used above 1 GHz 4. Markers are set to peak emission levels

Test results

Channel	Frequency [kHz]	Emission [kHz]	Emission Level [dbµV/m]	Emission Level [µV/m]	Det.	Limit [dµV/m]	Margin [µV/m]
F_{MID}	64	19.2	-49.9	0.0032	pk	41.9	91.9

Comments:

ANNEX A Transmitter radiated spurious emissions

Spurious emissions according to FCC 15.209

Project number: G0M-1402-3601

Manufacturer:	Biotronik SE & Co.KG
EUT Name:	ICD / Implantable Cardioverter Defibrillator
Model:	TACH_70
Test Site:	Eurofins Product Service GmbH
Operator:	Treffke
Test Conditions:	Tnom: 25°C, Vnom: 3.0 V DC lithium battery
Antenna:	Rohde & Schwarz HFH 2-Z2
Measurement distance:	3 m converted to 300 m
Mode:	TX; 64 kHz
Test Date:	2014-02-10
Note:	

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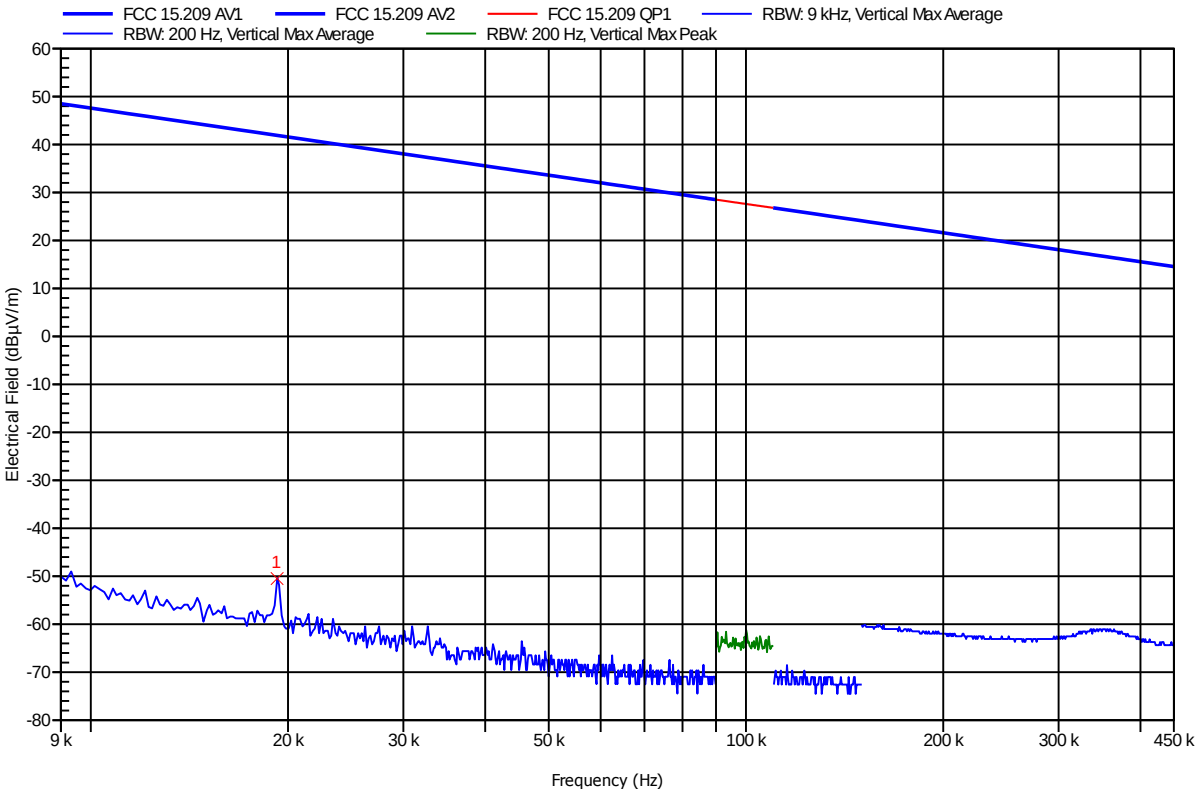

Frequency	Average	Average Limit	Average Difference	Average Status
19.206 kHz	-50.3 dBµV/m	41.9 dBµV/m	-92.25 dB	Pass

Spurious emissions according to FCC 15.209

Project number: G0M-1402-3601

Manufacturer:	Biotronik SE & Co.KG
EUT Name:	ICD / Implantable Cardioverter Defibrillator
Model:	TACH_70
Test Site:	Eurofins Product Service GmbH
Operator:	Treffke
Test Conditions:	Tnom: 25°C, Vnom: 3.0 V DC lithium battery
Antenna:	Rohde & Schwarz HFH 2-Z2
Measurement distance:	3 m converted to 30 m
Mode:	TX; 32 kHz
Test Date:	2014-02-10
Note:	

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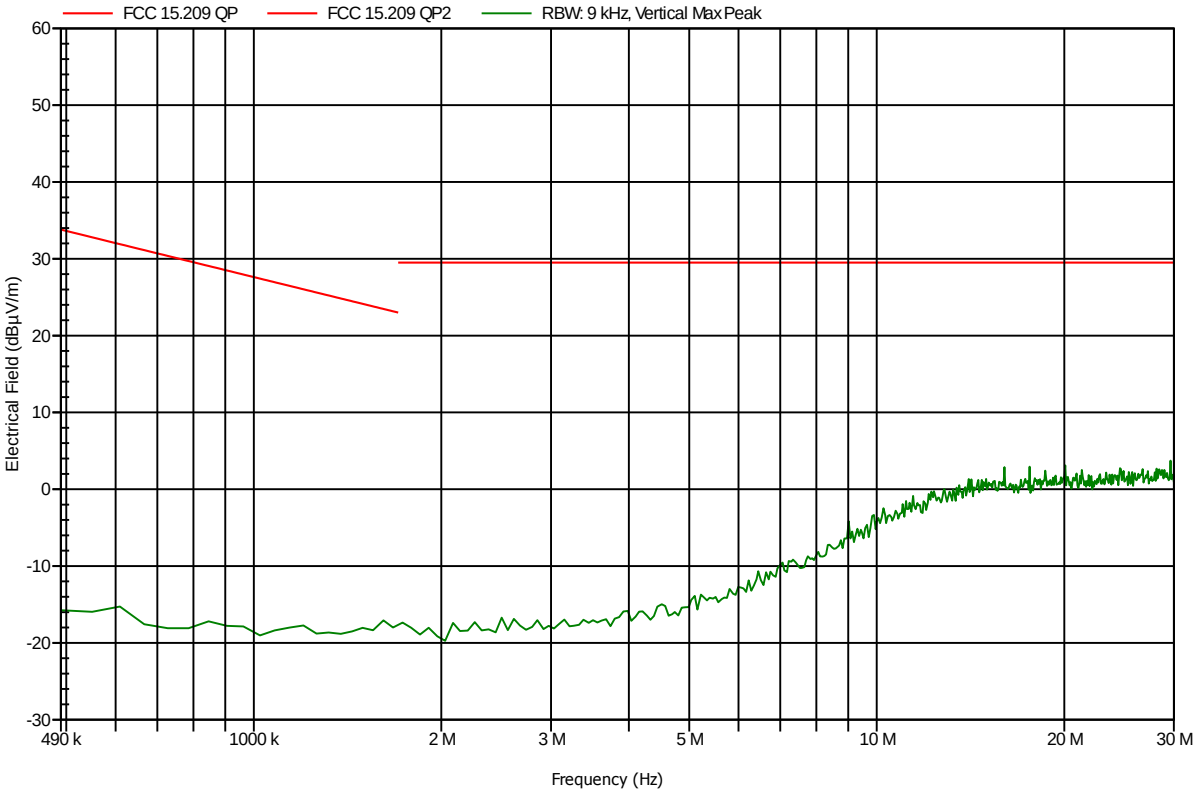

ANNEX B Receiver radiated spurious emissions

Spurious emissions according to RSS-Gen

Project number: G0M-1402-3601

Manufacturer:	Biotronik SE & Co.KG
EUT Name:	ICD / Implantable Cardioverter Defibrillator
Model:	TACH_70
Test Site:	Eurofins Product Service GmbH
Operator:	Treffke
Test Conditions:	Tnom: 25°C, Vnom: 3.0 V DC lithium battery
Antenna:	Rohde & Schwarz HFH 2-Z2
Measurement distance:	3 m converted to 300 m
Mode:	RX; 64 kHz
Test Date:	2014-02-10
Note:	

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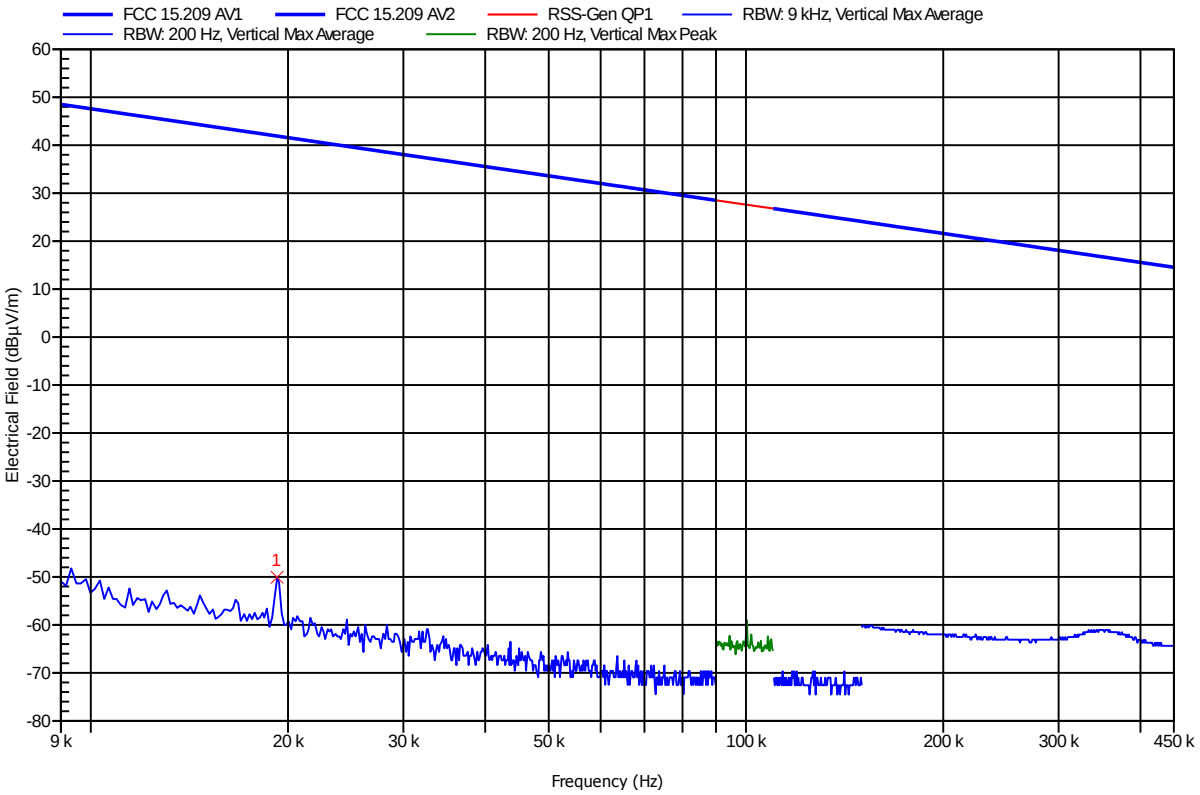

Frequency	Average	Average Limit	Average Difference	Average Status
19.206 kHz	-49.9 dBµV/m	41.9 dBµV/m	-91.85 dB	Pass

Spurious emissions according to RSS-Gen

Project number: G0M-1402-3601

Manufacturer:	Biotronik SE & Co.KG
EUT Name:	ICD / Implantable Cardioverter Defibrillator
Model:	TACH_70
Test Site:	Eurofins Product Service GmbH
Operator:	Treffke
Test Conditions:	Tnom: 25°C, Vnom: 3.0 V DC lithium battery
Antenna:	Rohde & Schwarz HFH 2-Z2
Measurement distance:	3 m converted to 30 m
Mode:	RX; 32 kHz
Test Date:	2014-02-10
Note:	

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