TEST REPORT CONCERNING THE COMPLIANCE OF A WAVERIDER HF TRANSMITTER, BRAND DATAWELL, MODEL WAVERIDER HF TRANSMITTER HXV AND WAVERIDER HF TRANSMITTER HVA WITH THE STANDARDS EN 300-220-1 V2.4.1 AND EN 300-220-2 V2.4.1.

FCC listed	: 90828
Industry Canada	: 2932G-2
R&TTE, LVD, EMC Notified Body	: 1856

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Description of test item

Test item	:	Waverider HF transmitter
Manufacturer	:	Datawell BV
Brand mark	:	Datawell
Model	:	Waverider HF transmitter HXV Waverider HF transmitter HVA
Serial number(s)	:	--

Applicant information

Applicant's representative	:	Mr. J.J. de Vries
Company	:	Datawell BV
Address	:	Zomerluststraat 4
City	:	2012 LM Haarlem
Country	:	The Netherlands
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e-mail	:	info@datawell.nl
Internet	:	http://www.datawell.nl/

Test(s) performed

Location	:	Leek
Test(s) started	:	September 17, 2013
Test(s) completed	:	September 18, 2013
Purpose of test(s)	:	Compliance with standard
Test specification(s)	:	EN 300 220-1 V.2.4.1 EN 300 220-2 V 2.4.1
Project leader	:	O. H. Hoekstra
Test engineer(s)	:	O. H. Hoekstra
Report written by	:	O. H. Hoekstra
Report approved by	:	M.C. Edwards van Muyen
Report date	:	September 26, 2013

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1 General

1.1 Applied standards

The Waverider HF transmitter, brand Datawell, model Waverider, transmits on a frequency between 25 MHz and 45 MHz and is therefore classified as a short range device, of which the parameters to comply with are described in ERC/REC 70-03 (9 October 2012).
The relevant ETSI standard, applicable to this type of equipment, as indicated in Annex 1 of ERC/REC 70-03 (9 October 2012), is:

EN 300 220-2 V2.4.1
Electromagnetic compatibility and radio spectrum matters (ERM); Short range devices (SRD); Radio equipment to be used in the 25 MHz to 1000 MHz. frequency range with power levels ranging up to 500 mW;
Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive

EN 300 220-1 V2.4.1
Electromagnetic compatibility and radio spectrum matters (ERM); Short range devices (SRD); Radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW;
Part 1: Technical characteristics and test methods

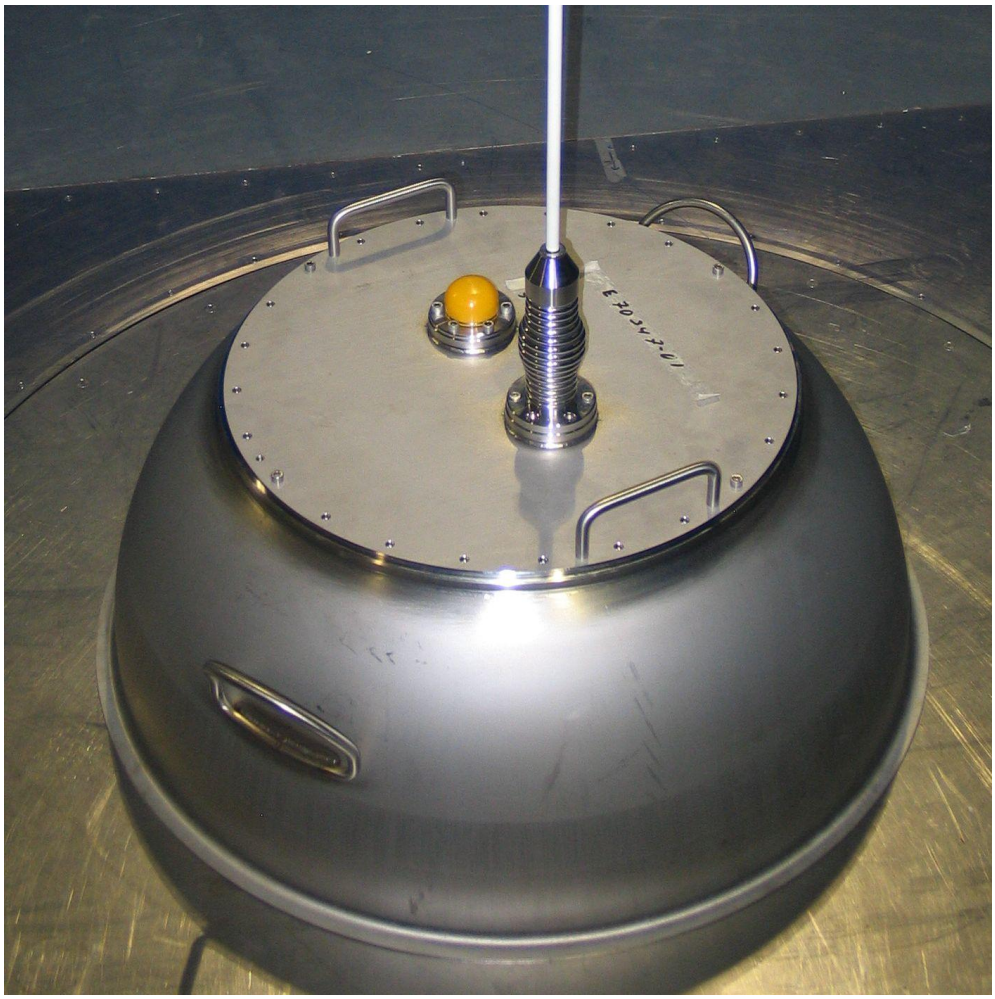
1.2 Remarks

The Waverider HF transmitter, brand Datawell, model Waverider, will be referred to as EUT for the purpose of this test report.

For the test methods, according to the EN 300 220-1 V2.4.1 document, the uncertainty figures have been calculated according to the methods described in the ETR 100-028-1 and ETR 100-028-2.
The expansion factor used is 1,96 (which provides a confidence level of 95% (Gaussian).

2 Description of test configuration

Test item	:	Waverider HF transmitter
Manufacturer	:	Datawell BV
Brand mark	:	Datawell
Model	:	Waverider HF transmitter HXV Waverider HF transmitter HVA
Voltage input rating	:	12.0 – 30.0 VDC (battery powered)
Current input rating	:	-
Antenna	:	Fixed whip antenna
Remarks	:	A GPS module is also included in the test sample.



Buoy with Waverider HF transmitter and GPS module

2.1 RF and antenna characteristics

This section refers to the standard EN 300 220-1 V2.4.1 and ERC/REC 70-03 (9 October 2012).

2.1.1 Regulatory parameters related to Annex 7

Frequency Band (ERC/REC 70-3)	Power / Magnetic field (ERC/REC 70-3)	Duty Cycle (ERC/REC 70-3E)	Applicable
6765 - 6795 kHz	42 dBµA/m at 10m	No Restriction	
13.553 – 13.567 MHz	42 dBµA/m at 10 meter	No Restriction	
26.957 – 27.283 MHz	42 dBµA/m at 10 meter 10 mW e.r.p..	No Restriction	
40.660 – 40.700 MHz	10 mW e.r.p.	No Restriction	
433.050 – 434.790 MHz	10 mW e.r.p.	< 10 %	
433.040 – 434.790 MHz	1 mW e.r.p. -13 dBm/10kHz	up to 100 %	
434.040 – 434.790 MHz	10 mW e.r.p.	up to 100 %	
868.000 – 868.600 MHz	25 mW e.r.p.	< 1.0 %	
868.700 – 869.200 MHz	25 mW e.r.p.	< 0.1 %	
869.300 – 869.400 MHz	10 mW e.r.p.	No Restriction	
869.400 – 869.650 MHz	500 mW e.r.p.	< 10 %	
869.700 – 870.000 MHz	5 mW e.r.p.	up to 100%	
2400 – 2483.5 MHz	10 mW e.i.r.p.	No Restriction	
5725 – 5875 MHz	25 mW e.i.r.p.	No Restriction	
24.00 – 24.25 GHz	100 mW e.i.r.p.	No Restriction	
61.0 – 61.5 GHz	100 mW e.i.r.p.	No Restriction	
122 – 123 GHz	100 mW e.i.r.p.	No Restriction	
244 – 246 GHz	100 mW e.i.r.p.	No Restriction	
138.2 – 138.45 MHz	10 mW e.r.p.	< 1.0 %	

Not applicable.

3 Test conditions

The tests have been carried out under the following standard- and extreme test conditions.

3.1 Normal test conditions

Temperature (*) : +15 °C to +35 °C
Relative humidity (*) : 20 % to 75 %
Air pressure : 1015 hPa

Supply voltage : 24.0 Vdc (internal batteries)

(*) When it was impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests is stated separately.

3.2 Extreme test conditions

Temperature : -10 °C to +60 °C
Supply voltage : +12.0 VDC (min) to +30.0 VDC (max)

4 Test suites (overview)

An overview of radio test suites as laid out in EN 300 220-2 V2.4.1 and a summary of test results is given below.

4.1 Transmitter test suites and overview of results

	Essential Radio test suite	Applicable	Report clause	Compliance results
1	Frequency error and frequency drift	Yes	5.1.1	Pass
2	Average power (conducted)	No	5.1.2	N/A
3	Effective radiated power	Yes	5.1.3	Pass
4	Transient power	No	5.1.4	N/A
5	Adjacent channel power	Yes	5.1.5	Pass
6	Modulation bandwidth	No	5.1.6	N/A
7	Spurious emissions	Yes	5.1.7	Pass
8	Frequency stability under low-voltage conditions	Yes	5.1.8	Pass
9	Duty cycle	No	5.1.9	N/A
10	Minimum transmitter off-time	No	5.1.10	N/A
11	Maximum listening time	No	5.1.11	N/A
12	Maximum dead time	No	5.1.12	N/A
13	Maximum transmitter on-time	No	5.1.13	N/A
14	Time-out-timer	No	5.1.14	N/A

4.2 Receiver test suites and overview of results

	Essential Radio test suite	Applicable	Report clause	Compliance results
15	Receiver sensitivity	No	5.2.1	N/A
16	Receiver LBT threshold	No	5.2.2	N/A
17	Adjacent channel selectivity	No	5.2.3	N/A
18	Blocking	No	5.2.4	N/A
19	Spurious response rejection	No	5.2.5	N/A
20	Receiver spurious radiation	Yes	5.2.6	Pass

5 Test results

5.1 Transmitter parameters

5.1.1 Transmitter frequency error/ drift

Ambient temperature : 21 °C Relative humidity: 50 %
Transmitter : Operating / ~~Standby~~

Test conditions		Measured frequency (kHz)		
		25.50 MHz version	35.25 MHz version	45.00 MHz version
T_{nom} +21 °C	V_{nom} +24.0 VDC	25499.945	35249.970	44999.960
T_{min} 0 °C	V_{min} +12.0 VDC	25499.990	35249.990	44999.850
	V_{max} +30.0 VDC	25499.990	35249.990	44999.850
T_{min} -10 °C	V_{min} +12.0 VDC	25500.060	35250.010	44999.610
	V_{max} +30.0 VDC	25500.060	35250.010	44999.610
T_{max} +30 °C	V_{min} +12.0 VDC	25499.870	35249.850	44999.860
	V_{max} +30.0 VDC	25499.870	35249.850	44999.860
T_{max} +60 °C	V_{min} +12.0 VDC	25499.880	35249.820	44999.790
	V_{max} +30.0 VDC	25499.880	35249.820	44999.790
Measured frequency (lowest)		25499.870	35249.820	44999.610
Measured frequency (highest)		25500.060	35250.010	44999.960
Maximum frequency error (kHz)		-0.130	-0.180	-0.390
Measurement uncertainty		Better than 2e-7		

5.1.1.1 Limits

Frequency separation (kHz)	**Frequency error limit (kHz)**				
	< 47 MHz	47 to 137 MHz	>137 to 300 MHz	>300 to 500 MHz	>500 to 1 000 MHz
Less than or equal to 25 kHz:	**+/-10.0 (applicable)**	+/-10	+/-10	+/-12	+/-12.5
Others	+/-100 ppm				

5.1.1.2 Test equipment used (for reference see test equipment listing)

12553	12640	99045	99318			

5.1.2 Average power (conducted)

Not applicable, the equipment is supplied with a dedicated antenna.

5.1.2.1 Limits

Not applicable.

5.1.3 Effective radiated power

Ambient temperature: +21 °C Relative humidity: 50 %

Transmitter : Operating/~~standby~~
Modulated with 2-FSK/~~unmodulated~~

Effective radiated power (dBm)		
Transmit frequency (MHz)	Bandwidth** (kHz)	Level (dBm)
25.50	120	18.0 (63 mW)
35.25	120	19.7 (93 mW)
45.00	120	18.4 (69 mW)
Measurement uncertainty	-2.4 dB / +1.6 dB	

** Bandwidth = the measuring receiver bandwidth

5.1.3.1 Limits

Not applicable

5.1.3.2 Test equipment used (for reference see test equipment listing)

15667	99847	99877				

5.1.4 Transient power

Not applicable, the EUT is a continuously transmitting transmitter and is not switched on and off during normal operation.

5.1.5 Adjacent channel power

Ambient temperature: +21 °C Relative humidity: 50 %

Transmitter : operating/~~standby~~
modulated/~~unmodulated~~

Note:
Measured under normal conditions only, as the frequency error has been measured under extreme conditions.

5.1.5.1 10 / 12.5 kHz channel separation

Transmit frequency	Measurement displacement	Adjacent channel power (dBc)	
		2 FSK mode	4 FSK mode
25.50 MHz	-8.25 kHz	-72.5 (0.0035 µW)	-70.4 (0.0058 µW)
	+8.25 kHz	-74.1 (0.0025 µW)	-72.8 (0.0033 µW)
35.25 MHz	-8.25 kHz	-77.3 (0.0017 µW)	-74.3 (0.0035 µW)
	+8.25 kHz	-79.6 (0.0010 µW)	-76.3 (0.0022 µW)
45.00 MHz	-8.25 kHz	-74.0 (0.0028 µW)	-75.5 (0.0019 µW)
	+8.25 kHz	-76.0 (0.0017 µW)	-77.9 (0.0011 µW)
Measurement uncertainty		-2.58 dB / +2.31 dB	

5.1.5.2 20 kHz channel separation

Transmit frequency	Measurement displacement	Adjacent channel power (dBc)	
		2 FSK mode	4 FSK mode
25.50 MHz	-13 kHz	-76.8 (0.0013 µW)	-74.9 (0.0020 µW)
	+13 kHz	-79.3 (0.0007 µW)	-76.6 (0.0014 µW)
35.25 MHz	-13 kHz	-79.2 (0.0011 µW)	-75.1 (0.0029 µW)
	+13 kHz	-83.3 (0.0004 µW)	-77.8 (0.0015 µW)
45.00 MHz	-13 kHz	-76.9 (0.0014 µW)	-77.2 (0.0013 µW)
	+13 kHz	-79.9 (0.0007 µW)	-80.3 (0.0006 µW)
Measurement uncertainty		-2.58 dB / +2.31 dB	

5.1.5.3 25 kHz channel separation

Transmit frequency	Measurement displacement	Adjacent channel power (dBc)	
		2 FSK mode	4 FSK mode
25.50 MHz	-17 kHz	-79.1 (0.0008 µW)	-75.7 (0.0017 µW)
	+17 kHz	-80.8 (0.0005 µW)	-77.0 (0.0012 µW)
35.25 MHz	-17 kHz	-81.7 (0.0006 µW)	-73.3 (0.0044 µW)
	+17 kHz	-83.4 (0.0004 µW)	-78.1 (0.0014 µW)
45.00 MHz	-17 kHz	-79.1 (0.0007 µW)	-78.0 (0.0011 µW)
	+17 kHz	-79.7 (0.0009 µW)	-80.7 (0.0006 µW)
Measurement uncertainty		-2.58 dB / +2.31 dB	

5.1.5.4 Limits

	Channel separation < 20 kHz	Channel separation >=20 kHz
Normal test condition	10 µW	200 nW
Extreme test conditions (not applicable)	32 µW	640 nW

5.1.5.5 Test equipment used (for reference see test equipment listing)

12553						

5.1.6 Range of modulation bandwidth

Not applicable, the EUT is a channelized transmitter.

5.1.7 Transmitter spurious emissions radiated

Ambient temperature: +21 °C Relative humidity: 50 %

Transmitter : Operating/~~standby~~
Modulated with 2-FSK/~~unmodulated~~

5.1.7.1 25.5 MHz version

Spurious emissions level (dBm)		
Frequency (MHz)	Bandwidth** (kHz)	Level (dBm)
51.0	100	-73.1
76.5	100	-77.3
76.5 – 4000	100	< -67.0
Measurement uncertainty	-2.4 dB / +1.6 dB	

** Bandwidth = the measuring receiver bandwidth

5.1.7.2 35.25 MHz version

Spurious emissions level (dBm)		
Frequency (MHz)	Bandwidth** (kHz)	Level (dBm)
70.5	100	-77.6
105.7	100	-74.9
141.0	100	-86.3
141.0 – 4000	100	< -67.0
Measurement uncertainty	-2.4 dB / +1.6 dB	

** Bandwidth = the measuring receiver bandwidth

5.1.7.3 45.00 MHz version

Spurious emissions level (dBm)		
Frequency (MHz)	Bandwidth** (kHz)	Level (dBm)
90.0	100	-54.8
90.0 – 4000	100	< -67.0
Measurement uncertainty	-2.4 dB / +1.6 dB	

** Bandwidth = the measuring receiver bandwidth

5.1.7.1 DWR-G4, 35.25 MHz version

Spurious emissions level (dBm)		
Frequency (MHz)	Bandwidth** (kHz)	Level (dBm)
70.5	100	-54.2
70.5 – 4000	100	< -67.0
Measurement uncertainty	-2.4 dB / +1.6 dB	

** Bandwidth = the measuring receiver bandwidth

5.1.7.1 DWR-G unit, 35.25 MHz version

Spurious emissions level (dBm)		
Frequency (MHz)	Bandwidth** (kHz)	Level (dBm)
37.5	100	-62.4
50.1	100	-66.1
81.5	100	-63.9
81.5 – 4000	100	< -67.0
Measurement uncertainty	-2.4 dB / +1.6 dB	

** Bandwidth = the measuring receiver bandwidth

5.1.7.2 Limits

47 MHz to 74 MHz 87.5 to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies below 1000 MHz	Frequencies > 1000 MHz
4.0 nW (-54 dBm)	250 nW (-36 dBm)	1.00 µW (-30 dBm)

5.1.7.3 Test equipment used (for reference see test equipment listing)

15667	99847	99877				

5.1.8 Transmitter spurious emissions conducted (DWR-G unit)

Ambient temperature: +21 °C Relative humidity: 50 %

Transmitter : Operating/~~standby~~
Modulated with 2-FSK/~~unmodulated~~

Note:
DWR-G unit only. The other units have a dedicated antenna.

5.1.8.1 DWR-G unit, 35.25 MHz version

Spurious emissions level (dBm)		
Frequency (MHz)	Bandwidth** (kHz)	Level (dBm)
70.5	100	-54.9
105.7	100	-65.7
141.0	100	-72.2
141.0 – 4000	100	< -67.0
Measurement uncertainty	-2.4 dB / +1.6 dB	

** Bandwidth = the measuring receiver bandwidth

5.1.8.2 Limits

47 MHz to 74 MHz 87.5 to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies below 1000 MHz	Frequencies > 1000 MHz
4.0 nW (-54 dBm)	250 nW (-36 dBm)	1.00 µW (-30 dBm)

5.1.8.3 Test equipment used (for reference see test equipment listing)

15667	99538					

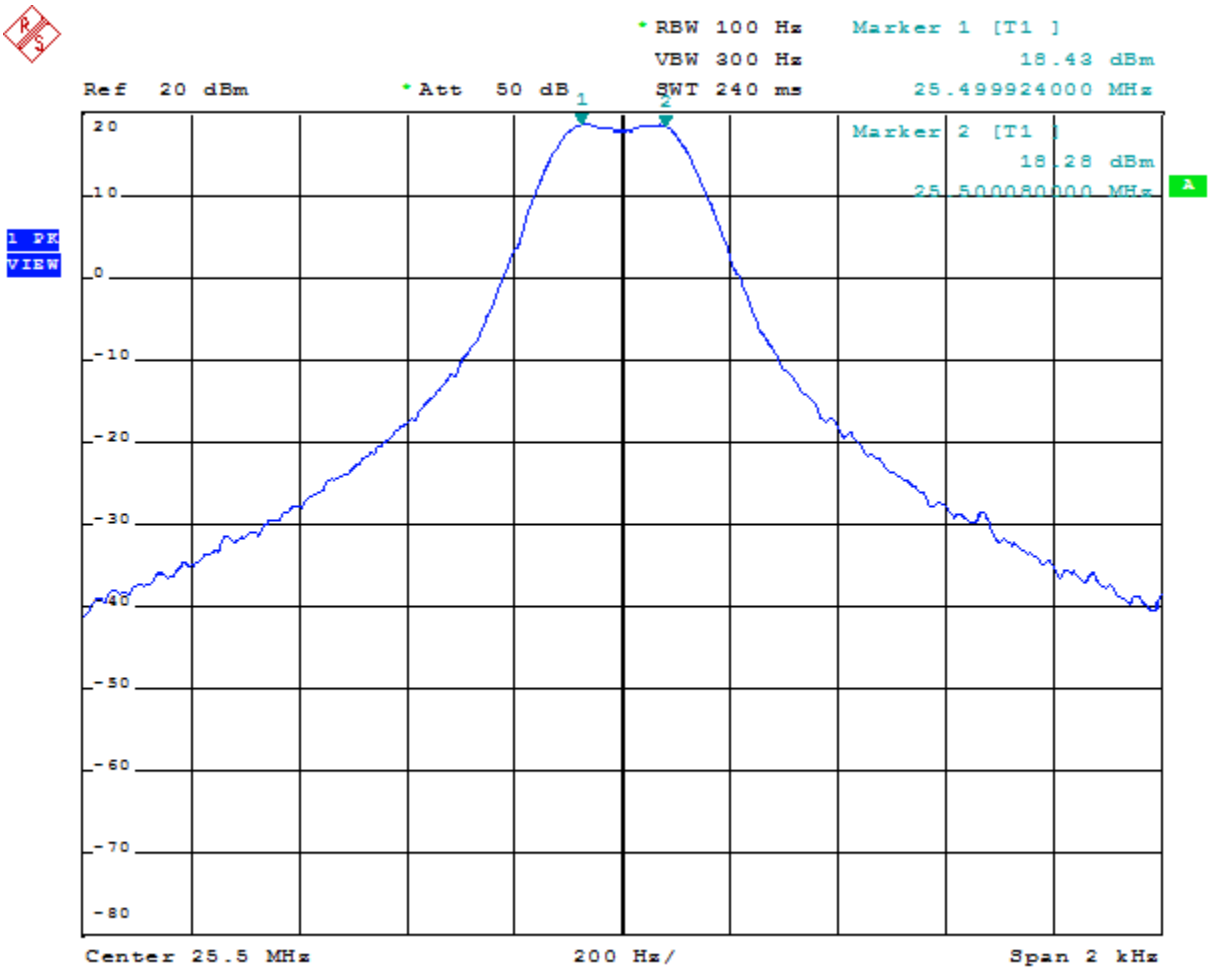
5.1.9 Frequency stability under low voltage conditions

Ambient temperature: +21 °C Relative humidity: 50 %

Transmitter : Operating/~~standby~~
Modulated/~~unmodulated~~

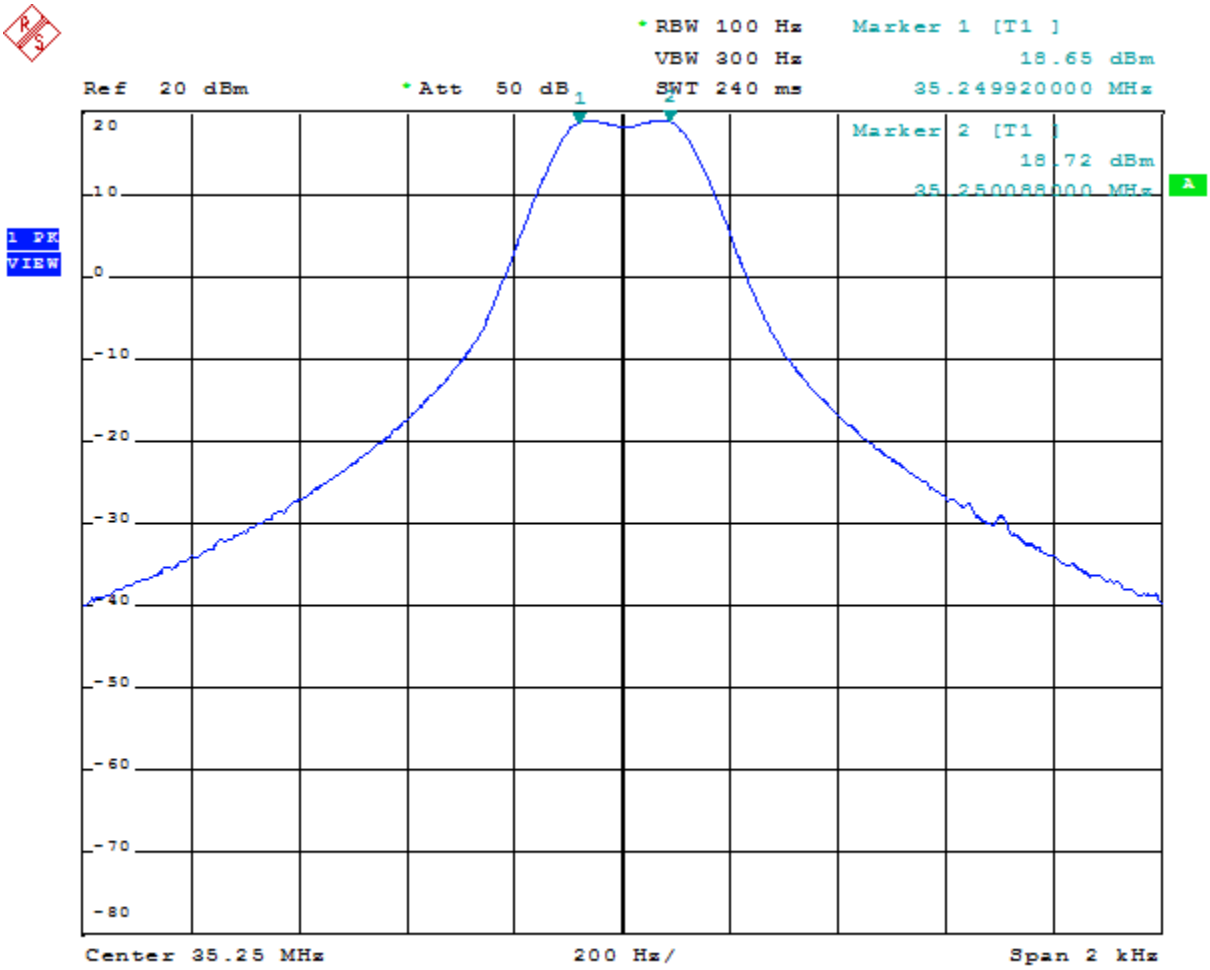
This test is for battery-operated equipment only. Declared EUT operating voltage range:
Vmax = +30.0 VDC
Vmin = +12.0 VDC

5.1.9.1 25.5 MHz version



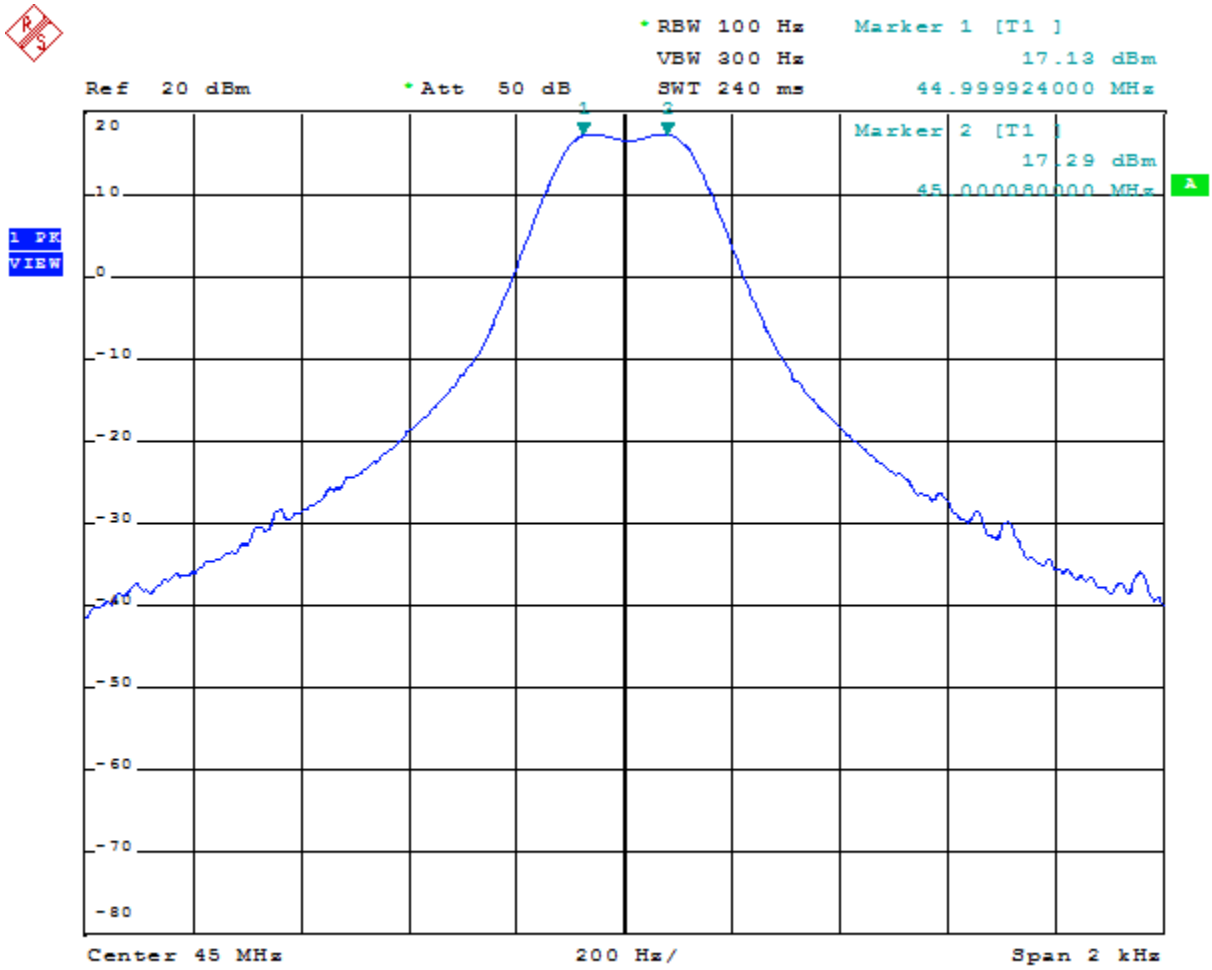
25.5 MHz version

5.1.9.2 35.25 MHz version



35.25 MHz version

5.1.9.3 45.00 MHz version



45.00 MHz version

5.1.9.4 Limits

The equipment shall either:

a) Remain on the operating frequency, within the limits stated in sub clause 8.1.4 whilst the radiated or conducted power is greater than the spurious emissions limits; or
b) The equipment ceases to function below the applicants declared operating voltage.

5.1.9.5 Test equipment used (for reference see test equipment listing)

99538						

5.1.10 Duty cycle

Not applicable, EUT is a continuously transmitting transmitter.

5.1.11 Minimum transmitter off time

Not applicable, EUT is a continuously transmitting transmitter.

5.1.12 Minimum listening time

Not applicable, EUT is a continuously transmitting transmitter.

5.1.13 Maximum transmitter on-time

Not applicable, EUT is a continuously transmitting transmitter.

5.1.14 Frequency hopping spread spectrum devices

Not applicable, EUT is not a hopping device.

5.1.15 Direct sequence or other spread spectrum than FHSS

Not applicable, EUT is not a direct sequence or spread spectrum device.

5.2 Receiver parameters

Not applicable, the EUT is not a receiver.

5.2.1.1 Limits

The power of any spurious emission, radiated or conducted, shall not exceed the values given below:

The limits are applicable to all receiver classes.

- 2 nW (-57 dBm) below 1000 MHz;
- 20 nW (-47 dBm) above 1000 MHz

5.2.1.2 Test equipment used (for reference see test equipment listing)

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6 Conclusion

The Waverider HF transmitter, brand Datawell, model Waverider HF transmitter HXV and Waverider HF transmitter HVA, complies with the requirements of the standard ETSI EN 300 220-2 V2.4.1 in the configuration and operation mode(s) as stated in this test report.

7 Additional information supplementary to the test report

Photographs of the equipment.

8 Test equipment and ancillaries used for tests

To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

Inventory number	Description	Brand	Model
12484	Guidehorn	EMCO	3115
12533	Signalgenerator	Marconi	2032
12553	Communication Analyzer	R&S	CMTA 84
12605	Calibrated dipole 28MHz-1GHz	Emco	3121c
12640	Temperature chamber	Heraeus	VEM03/500
13664	Spectrum analyzer	HP	HP8593E
14340	Biconilog antenna	Emco	3143
15453	Magnetic loop antenna	Chase	HLA6120
15667	Measuring receiver	R&S	ESCS 30
99045	DC Power Supply 3A/30V	Delta	E030/3
99077	Regulating trafo	RFT	LTS006
99318	Digital multi meter	HP	34401A
99538	Spectrum analyzer	Rohde & Schwarz	FSP40
99606	Bandfilter / preamplifier system	EMCS	RFS06S
99733	Spectrum analyzer	Rohde & Schwarz	FSV30
99846	Full Anechoic room	Siepel	HERA 3F
99847	Semi Anechoic room	Siepel	HERMES 3
99877	Biconilog antenna	Tesec	CBL6111D