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DATE: 28 March 2016

I.T.L. (PRODUCT TESTING) LTD.

Test Report According to EN 300 328 V1.9.1: (2015)

for

Pointer Telocation

Equipment under test:

Multi-Sensing Device

MultiSense TH P/N 715-50200; MultiSense P/N 715-50100*

*See customer's Declaration on page 5

Tested by: _____

M. Zohar

Approved by: _____

D. Shidlowsky

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1. General Information

1.1 Administrative Information

Manufacturer:	Pointer Telocation
Manufacturer's Address:	14 Hamelacha St., Rosh Ha'ayin,48091 Israel Tel: +972-3-572-3111 Fax: +972-3-572-3100
Manufacturer's Representative:	Itamar Gohary
Equipment Under Test (E.U.T):	Multi-Sensing Device
Equipment Model No.:	MultiSense TH P/N 715-50200; MultiSense P/N 715-50100*
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	20.12.2015
Start of Test:	23.12.2015
End of Test:	30.12.2015
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	EN 300 328 V1.9.1: 2015

*See customer's Declaration on following page.

POINTER

DECLARATION

Date: 14/2/2016

I HEREBY DECLARE THE FOLLOWING REGARDING THE BELOW MODELS:

#	Product name	P/N
1	MultiSense	715-50100
2	MultiSense-TH	715-50200

These models use an identical PCB. The difference between the models is that MultiSense (P/N 715-50100) has a temperature sensor chip while the MultiSense-TH (P/N 715-50200) has a single combined chip of temperature and humidity with a filter and a corresponding hole in the Lexan to permit humidity measuring.

Please relate to them (from an EMC/RADIO point of view) as the same product.

Signature
Igor Rogov
VP R&D
Pointer Telocation Inc.

IGOR ROGOV
16-02-2016
VP R&D

1.2 Abbreviations and Symbols

The following abbreviations and symbols are applicable to this test report:

A/m	ampere per meter
AC	alternating current
AM	amplitude modulation
ARA	Antenna Research Associates
Aux	auxiliary
Avg	average
CDN	coupling-decoupling network
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dbµV	decibel referred to one microvolt
dbµV/m	decibel referred to one microvolt per meter
DC	direct current
EFT/B	electrical fast transient/burst
EMC	electromagnetic compatibility
ESD	electrostatic discharge
E.U.T.	equipment under test
GHz	gigahertz
HP	Hewlett Packard
Hz	Hertz
kHz	kilohertz
kV	kilovolt
LED	light emitting diode
LISN	line impedance stabilization network
m	meter
mHn	millihenry
MHz	megahertz
msec	millisecond
N/A	not applicable
per	period
QP	quasi-peak
PC	personal computer
RF	radio frequency
RE	radiated emission
sec	second
V	volt
V/m	volt per meter
VRMS	volts root mean square

1.3 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation Number IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site Nos. IC 4025A-1, 4025A-2.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

2. Applicable Documents

2.1	**R&TTE Directive: 1999**	*DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity*
2.2	**EN 300 328 V1.9.1 (2015-02)**	*Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive*

3. Test Site Description

3.1 Location:

The Electromagnetic Compatibility Test Facility of I.T.L. (Product testing) Ltd. Is located at
Telrad Industrial Park, Lod, 7120101 Israel.

Telephone: +972-8-9153100

Fax: +972-8-9153101

3.2 Shielded Room:

A Modular Shielded Room, Type 20 SpaceSaver, manufactured by ETS, consisting of a Main Room and a Control Room.

The dimensions of the Main Room are: length: 7.0 m, width: 3.0 m, height: 3.0 m.

The shielding performance is:

magnetic field: 60 dB at 10 kHz rising linearly to 100 dB at 100 kHz,

electric field: better than 110 dB between 50 MHz and 1 GHz,

plane wave: 110 dB between 50 MHz and 1 GHz.

All the power lines entering the shielded room are filtered.

3.3 Open Site:

The OATS is located on a one floor-building roof. The OATS consists of 3 meter and 10 meter ranges, using a 21.5m X 8.5m solid metal ground plane, a remote controlled turntable and an antenna mast.

3.4 Ground Plane:

The ground plane is made from steel plates, which are welded continuously together. The Ground plane is lies and welded on welded steel construction with vias to allow for water drainage. All the power, control, and signal lines to the turntable and the 3 m and 10m antenna mast outlets are routed in shielded conduits under the plane to the control building.

3.5 Antenna Mast:

ETS model 2070-2. The antenna position and polarization are remote controlled via Fiber Optical Link using ETS/EMCO Dual Controller Type 2090. The antenna position is adjustable between 1-4 meters. Pressurized air is used to power changing the polarity of the antenna.

3.6 Turntable:

ETS model 2087 series. The position of the turntable is remote-controlled via Fiber Optic Link, using ETS/EMCO Dual Controller Type 2090. The turntable is mounted in a pit and its surface is flush with the Open Site Ground Plane. Brushes near the periphery of the turntable ensure good conductive connection to the ground plane. The Turntable maximum load is 1250 Kg.

3.7 EMI Receiver:

Type ESCI7, manufactured by Rohde & Schwarz, being in full compliance with CISPR 16 requirements.

3.8 E.U.T. Support:

Table mounted E.U.T.s are supported during testing on 150 cm high all plastic table.

3.9 Test Equipment:

See details in Section 6.

4. Summary of Test Results

Test	Results
RF Output Power EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.2, 5.3.2	The E.U.T met the performance requirements of the specification.
Power Spectral Density EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.3, 5.3.3	The E.U.T met the performance requirements of the specification.
Duty Cycle, Tx-Sequence, Tx-Gap EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.4, 5.3.2	N/A according to Section 4.3.2.4
Medium Utilization Factor EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.5, 5.3.2	N/A according to Section 4.3.2.5
Adaptivity EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.6, 5.3.7.2.1.2 or 5.3.7.2.1.3	N/A according to Section 4.3.2.6
Occupied Channel Bandwidth EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.7, 5.3.8	The E.U.T met the performance requirements of the specification.
Transmitter Unwanted Emission in the Out-of-Band Domain EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.8, 5.3.9	The E.U.T met the performance requirements of the specification.

Summary of Test Results (cont'd.)

Test	Results
Transmitter Unwanted Emissions in the Spurious Domain EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.9, 5.3.10	The E.U.T met the performance requirements of the specification.
Receiver Spurious Emission EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.10, 5.3.11	The E.U.T met the performance requirements of the specification.
Receiver Blocking EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.11, 5.3.7.2.1.2 or 5.3.7.2.1.3	N/A according to Section 4.3.2.11

5. Equipment Under Test (E.U.T.) Description

All in one multi-sensing device including humidity sensor for cargo and cold chain monitoring, supporting short range RF communication.
MultiSense does not contain humidity sensor.

Model name	MultiSense TH
Mode of operation	Transceiver BLE
Working voltage	3.0VDC lithium battery
Modulations	GFSK
Frequency Range	2402.0MHz-2480.0MHz
Transmit power	~8.0dBm
Antenna Gain	0.5dBi
Channel BW	>500kHZ
Voltage range for extreme conditions	2.1VDC-3.3VDC
Temperature Range for extreme conditions	+70.0ºC, -30.0ºC
Ambient Temperature (°C)/ Humidity (%RH)	21.4ºC /33.0%
*See additional information according to Annex E in section 16.	

6. List of Test Equipment

6.1 Radio Tests

The equipment indicated below by an "X" was used for testing according to EN 300 328 V1.9.1 (2015), Sections 5.3.2; 5.3.3; 5.3.7; 5.3.8, 5.3.9, 5.3.10, 5.3.11.

Test equipment calibration is in accordance with ITL Q.A. Procedure PM 110 "Calibration Control Procedure", which complies with ISO 9002 and ISO/IEC Guide 17025.

Instrument	Manufacturer	Model	Serial No.	Used in Test		
				5.3.2/3	5.3.8/9	5.3.10/11
Spectrum Analyzer	HP	8592L	3826A01204			X
Horn Antenna	ETS	3115	6142	X		X
Biconical Antenna	EMCO	3104	2606			X
Log Periodic Antenna	EMCO	3146	9505-4081			X
Radi Power USB RF Power Sensor	DARE	RPR3006W	14I00048SNO085	X		
Environmental Chamber	Russells	RBB-2-03-03	9921222	X	X	
Signal Generator	Wiltron	6747B	278007	X		X
Power Supply	Nemic Lambda	GEN8-180	-	X		
Spectrum Analyzer	R&S	FSL6	MY50000243		X	
20dB Attenuator	Bird	8304-N20DB	-	X	X	
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	X	X	X
Spectrum Analyzer	HP	8592L	3826A01204			X
EMI Receiver	HP	8542E	3906A00276			X
RF Filter Section	HP	85420E	3705A00248			X
Low Noise Amplifier	Narda	DBS-0411N313	13			X
Low Noise Amplifier	Sophia Wireless	LNA28-B	232			X
Spectrum Analyzer	HP	8593EM	3536A00120ADI			X

7. E.U.T. Mode of Operation

Conducted emission tests were performed with the E.U.T. antenna terminal connected by a RF cable to the Spectrum Analyzer through a 20dB external attenuator.

For radiated emission tests, exploratory emission testing was performed in 3 orthogonal polarities to determine the worst case. The fundamental results are shown in the below table:

Frequency (MHz)	**Y axis** (dBuV/m)	**X axis** (dBuV/m)	**Z axis** (dBuV/m)
2402.0	94.4	90.1	87.3
2440.0	94.2	91.1	93.4
2480.0	97.4	94.9	95.1

Figure 1. Screening Results

According to above results the worst case was the Y axis.

The unit was evaluated while transmitting at the low channel (2402MHz), the mid channel (2440MHz) and the high channel (2480MHz) in BLE technology.

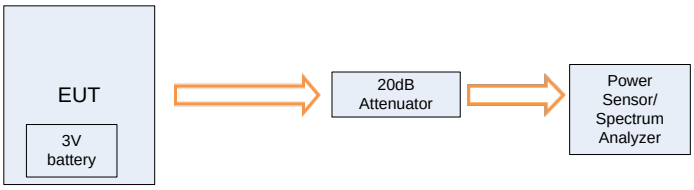

Figure 2. Conducted Tests

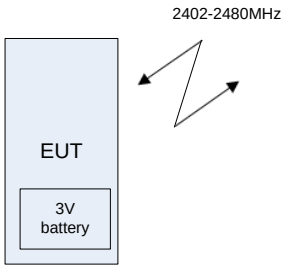

Figure 3. Radiated Tests

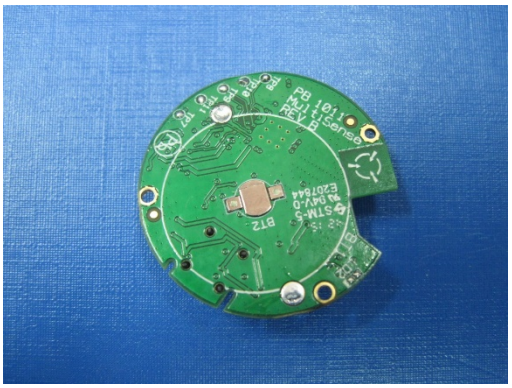

Figure 4. Tested Unit

8. RF Output Power

8.1 Test Specification

EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.2; 5.3.2

8.2 Test Procedure

The E.U.T operation mode and test setup are as described in Section 5.3.2 of EN 300 328.

The E.U.T. was connected to an external power supply and thermal chamber temperature and power supply voltage at suitable values were set.

The results were reached by conducted measurements through a 20dB attenuator to a high speed sensor 1Mb/S.

The E.U.T was evaluated in 3 channels: Low, Mid and High.

The results were recorded.

The configuration tested is shown in the photograph, *Figure 12. RF Output Power Test.*

8.3 Test Results

The E.U.T met the requirements of the EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.2; 5.3.2.

Additional information of the results is given in *Figure 5*.

RF Output Power

E.U.T Description	Multi-Sensing Device
Type	MultiSense TH P/N 715-50200
Serial Number:	Not designated

Specification: EN 300 328 V1.9.1 (2015), Sections 4.3.2.2, 5.3.2

Operational Frequency	Temperature	Voltage	Reading	Antenna Gain	EIRP	Limit	Margin
	(°C)	(VDC)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
Low	+25ºC	3.0V	7.7	0.5	8.2	20.0	-11.8
	+70ºC	3.3V	4.7	0.5	5.2	20.0	-14.8
		2.1V	4.7	0.5	5.2	20.0	-14.8
	-30ºC	3.3V	7.4	0.5	7.9	20.0	-12.1
		2.1V	7.4	0.5	7.9	20.0	-12.1
Mid	+25ºC	3.0V	7.9	0.5	8.4	20.0	-11.6
	+70ºC	3.3V	4.9	0.5	5.4	20.0	-14.6
		2.1V	4.9	0.5	5.4	20.0	-14.6
	-30ºC	3.3V	7.8	0.5	8.3	20.0	-11.7
		2.1V	7.7	0.5	8.2	20.0	-11.8
High	+25ºC	3.0V	7.9	0.5	8.4	20.0	-11.6
	+70ºC	3.3V	5.3	0.5	5.8	20.0	-14.2
		2.1V	5.3	0.5	5.8	20.0	-14.2
	-30ºC	3.3V	8.1	0.5	8.6	20.0	-11.4
		2.1V	8.1	0.5	8.6	20.0	-11.4

Figure 5. RF Output Power

9. Power Spectral Density

9.1 Test Specification

EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.3; 5.3.3

9.2 Test Procedure

The E.U.T operation mode and test set-up are as described in section 5.3.3 of EN 300 328.

The configuration tested is shown in Figure 2.
The measurement was performed at normal test conditions and in the lowest, middle and highest operational frequency range.
The RBW was set to 10 kHz and VBW was set to 30 kHz.
Step 1 - Starting from the first 1MHz segment for the lowest frequency, the power of the following samples representing a 1 MHz segment was added up and the results for power and position were recorded. This is the power spectral density (e.i.r.p.) for the first 1 MHz segment which was recorded.
Step 2 - The start point of the samples added up in Step 1 was shifted by 1 sample and the procedure in Step 1 was repeated.

Step 3 –Step 2 was repeated until the end of the data set and the radiated Power Spectral Density values for each of the 1 MHz segments was recorded.

From all the recorded results, the highest value is the maximum Power Spectral Density for the E.U.T.

9.3 Test Results

The E.U.T met the requirements of the EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.3; 5.3.3 specifications.

Additional information of the results is given in *Figure 6.*

Power Spectral Density

E.U.T Description	Multi-Sensing Device
Type	MultiSense TH P/N 715-50200
Serial Number:	Not designated

Specification: EN 300 328 V.1.9.1 (2015-06), Sections 4.3.2.3; 5.3.3

Frequency (MHz)	PSD (dBm/MHz)	Antenna Gain (dBi)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
Low	4.7	0.5	5.2	10.0	-4.8
Mid	4.2	0.5	4.7	10.0	-5.3
High	4.6	0.5	5.1	10.0	-4.9

Figure 6. Power Spectral Density

10. Occupied Channel Bandwidth

10.1 Test Specification

EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.7; 5.3.8

10.2 Test Procedure

The E.U.T operation mode and test setup are as described in Section 5.3.8 of EN 300 328.

The lowest operating frequency of the E.U.T. was selected and the highest operating frequency of the E.U.T. was selected.

The RBW was set to ~ 1% from the span. Sweep time was set to 1sec.

The automatic channel bandwidth test was activated at the SA (99% BW).

RMS detector was used for this evaluation

These measurements were performed at normal test conditions.

The configuration tested is shown in the photograph, *Figure 13 Occupied Channel Bandwidth*.

Limit:

Non adaptive with EIRP<10dBm	All bandwidth within 2.4-2.4835GHz

10.3 Test Results

The E.U.T met the requirements of the EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.7; 5.3.8 specifications.

Additional information of the results is given in *Figure 7* to *Figure 8.*

Occupied Channel Bandwidth

E.U.T Description	Multi-Sensing Device
Type	MultiSense TH P/N 715-50200
Serial Number:	Not designated

Specification: EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.7; 5.3.8

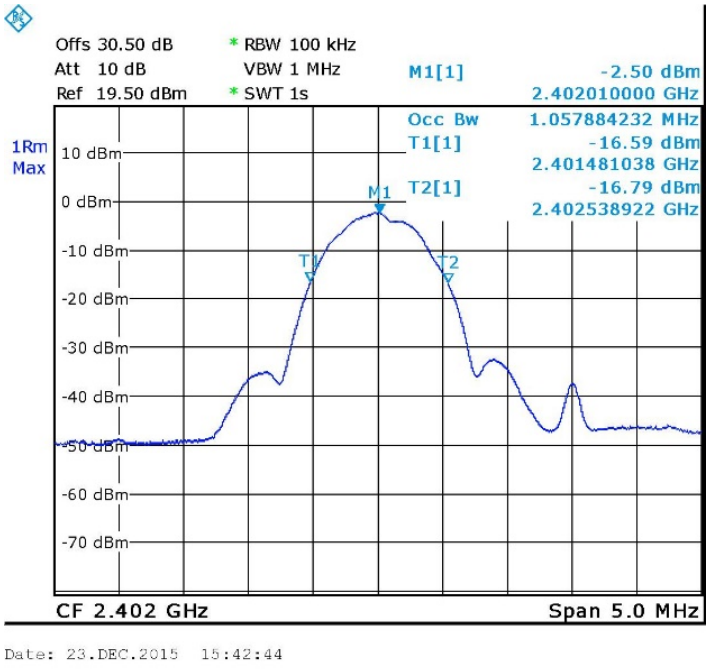

Figure 7. Low Channel

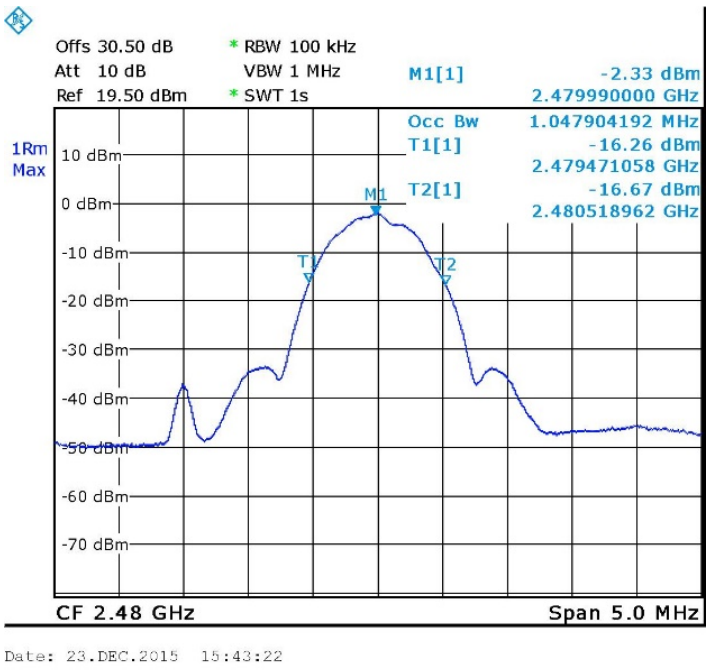

Figure 8. High Channel

11. Transmitter Unwanted Emission in the OOB Domain

11.1 Test Specification

EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.8; 5.3.9

11.2 Test Procedure

The E.U.T operation mode and test setup are as described in Section 5.3.9 of EN 300 328.

The lowest operating frequency of the E.U.T. was selected and the highest operating frequency of the E.U.T. was selected.
The limits for OOB were tested according to the limits below.

These measurements were performed at normal conditions.

RMS detector used, number of sweep points was set to 5000.

The configuration tested is shown in the photograph, *Figure 14 Transmitter Unwanted Emission in the OOB Domain.*

Limit:

Low band [MHz]	Limit	High band [MHz]
2400 to (2400-OBW)	-10dBm/MHz e.i.r.p	2483.5 to (2483.5 +OBW)
(2400-OBW) to (2400-2OBW)	-20dBm/MHz e.i.r.p	(2483.5 +OBW) to (2483.5 +2OBW)
(2400-2OBW) and below	-30dBm/MHz e.i.r.p	(2483.5 +2OBW) and above

11.3 Test Results

The E.U.T met the requirements of the EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.8; 5.3.9 specifications.

Additional information of the results is given in *Figure 9* to *Figure 10.*

Transmitter Unwanted Emission in the OOB Domain

E.U.T Description	Multi-Sensing Device
Type	MultiSense TH P/N 715-50200
Serial Number:	Not designated

Specification: EN 300 328 V1.9.1 (2015-02), Sections 4.3.2.8; 5.3.9

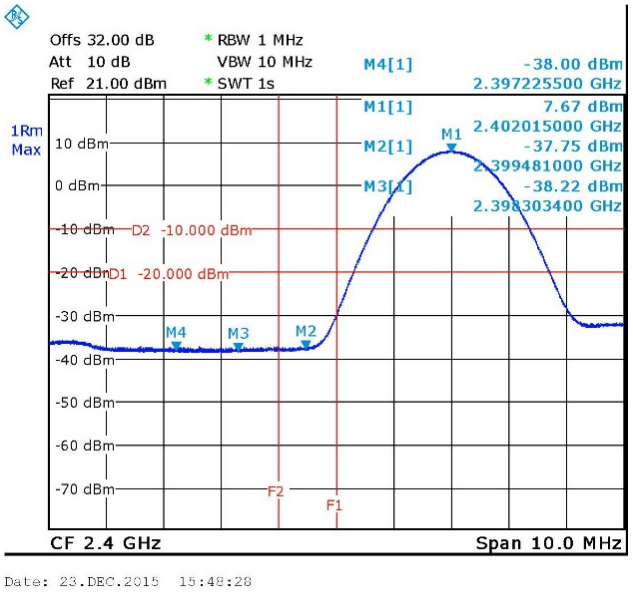

Figure 9. Low Channel, 25ºC°, Nominal voltage

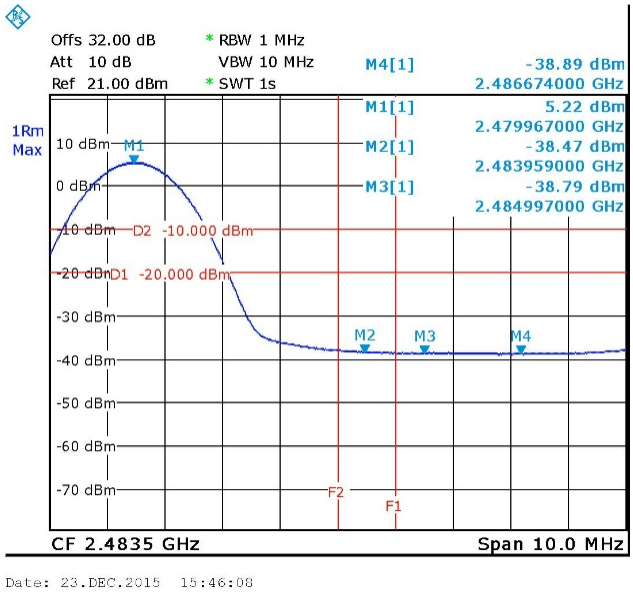

Figure 10. High channel, 25ºC°, Nominal voltage

12. Transmitter Unwanted Emissions in the Spurious Domain

12.1 Test Specification

EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.9, 5.3.10

12.2 Test Procedure

The test was performed in the frequency band 30MHz –12.75GHz.

For 30MHz-1000MHz range:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in *Figure 3.*

The frequency range 30 MHz-1000 MHz was scanned.

RBW was set to 100 kHz.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

1000MHz-12,750MHz range:

The E.U.T was placed in the chamber and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in *Figure 3.*
The frequency range 1000 MHz-12750 MHz was scanned.

RBW was set to 1000 kHz.

The readings were maximized by adjusting the turntable azimuth between 0-360° and the antenna polarization.

For all the tests a RMS detector was used.

The E.U.T. was replaced by a substitution antenna. The substitution antenna was driven by a signal generator operating in C.W. Mode. The height of the test antenna was adjusted for maximum level.

The input signal of the substitution antenna was adjusted to the level that produced a receiver reading equal to the level noted while the spurious emissions of the E.U.T. were measured.

The above tests were performed in both horizontal and vertical polarizations.

The transmitter was set to the lowest operating frequency and to the highest operating frequency.

The spurious emission was calculated as follows:
Signal Generator Level (dBm) – Cable Loss (dB) + Substitution Antenna Gain (dB).

The E.U.T was evaluated in Tx mode.

12.3 Tests Results

The E.U.T met the specification EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.8, 5.3.10 requirements

Additional information of the results is given in *Figure 11*.

Antenna Distance: 3 meters Operating Frequency: Low, High

Freq operation (MHz)	**Freq.** (MHz)	**E** (dBµV /m)	**Ant.pol.** (V /H)	**Power Output Generator** (dBm)	**Cable Loss** (dB)	**Gain Antenna** (dB)	**ERP** (dBm)	**Spec.** (dBm)	**Margin** (dB)
2402.0	7206.6	61.0	H	-43.1	1.0	10.0	-34.1	-30.0	-4.1
	7206.1	66.0	V	-40.4	1.0	10.0	-31.4	-30.0	-1.4
2480.0	7440.0	57.4	H	-46.7	1.0	10.0	-37.7	-30.0	-7.7
	7440.0	56.4	V	-46.9	10	10.0	-37.9	-30.0	-7.9

Figure 11. Transmitter Spurious Emissions

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

13. Receiver Spurious Emissions

13.1 Test Specification

EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.10, 5.3.11

13.2 Test Procedure

The test was performed in the frequency band 30MHz –12.75GHz.

For 30MHz-1000MHz range:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in *Figure 3.*
The frequency range 30 MHz-1000 MHz was scanned.

RBW was set to 100 kHz.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

For 1000MHz-12,750MHz range:

The E.U.T was placed in the chamber and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in *Figure 3.*
The frequency range 1000 MHz-12750 MHz was scanned.

RBW was set to 1000 kHz.

The readings were maximized by adjusting the turntable azimuth between 0-360° and the antenna polarization.

For all the tests a RMS detector was used.

The E.U.T. was replaced by a substitution antenna.

The substitution antenna was driven by a signal generator operating in C.W. Mode. The height of the test antenna was adjusted for maximum level.

The input signal of the substitution antenna was adjusted to the level that produced a receiver reading equal to the level noted while the spurious emissions of the E.U.T. were measured.

The above tests were performed in both horizontal and vertical polarizations.

The transmitter was set to the lowest operating frequency and to the highest operating frequency.

The spurious emission was calculated as follows:

Signal Generator Level (dBm) – Cable Loss (dB) + Substitution Antenna

Gain (dB).

The E.U.T was evaluated in Rx mode.

13.3 Test Results

The E.U.T met the requirements of EN 300 328 V1.9.1 (2015-02) Sections 4.3.2.9, 5.3.11 specification.

All signals were below the EMI receiver noise level which is at least 6dB below the specification limit.

14. Information as Required by Clause 5.3.1 According to Annex E

Information as required by EN 300 328 V1.9.1, Clause 5.3.1

In accordance with EN 300 328, clause 5.3.1, the following information is provided by the supplier.

a) The type of modulation used by the equipment:

☐ FHSS

☒ other forms of modulation

b) In case of FHSS modulation:

In case of non-Adaptive Frequency Hopping equipment:

The number of Hopping Frequencies: N/A

In case of Adaptive Frequency Hopping Equipment:

The maximum number of Hopping Frequencies: N/A

The minimum number of Hopping Frequencies: N/A

The Dwell Time: N/A

The Minimum Channel Occupation Time: N/A

c) Adaptive / non-adaptive equipment:

☐ non-adaptive Equipment

☒ adaptive Equipment without the possibility to switch to a non-adaptive mode

☐ adaptive Equipment which can also operate in a non-adaptive mode

d) In case of adaptive equipment:

The Channel Occupancy Time implemented by the equipment: 40 ms

☐ The equipment has implemented an LBT based DAA mechanism

In case of equipment using modulation different from FHSS:

☐ The equipment is Frame Based equipment

☐ The equipment is Load Based equipment

☐ The equipment can switch dynamically between Frame Based and Load Based equipment

The CCA time implemented by the equipment: ..... µs

The value q as referred to in clause 4.3.2.5.2.2.2 .....

☒ The equipment has implemented an non-LBT based DAA mechanism

☐ The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): …N/A (system is adaptive)…dBm

The maximum (corresponding) Duty Cycle: N/A (system is adaptive)… …%

Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared): N/A (system is adaptive)

f) The worst case operational mode for each of the following tests:

• RF Output Power

All modes limited to +10dBm per Spec (need discussion on whether customer implements different power profiles for advertising and connected states for example) spec

• Power Spectral Density

Should be identical in all modes (advertising and/or connected)

• Duty cycle, Tx-Sequence, Tx-gap

N/A: Only applicable to non-adaptive equipment

• Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment)

N/A: Only applicable for FHSS systems

• Hopping Frequency Separation (only for FHSS equipment)

N/A: Only applicable for FHSS systems

• Medium Utilisation

N/A: Only applicable to non-adaptive equipment

• Adaptivity & Receiver Blocking

N/A: Only applicable to systems transmitting > +10dBm

• Occupied Channel Bandwidth

Should be identical in all modes (advertising and/or connected)

• Transmitter unwanted emissions in the OOB domain

Should be identical in all modes (advertising and/or connected)

• Transmitter unwanted emissions in the spurious domain

Should be identical in all modes (advertising and/or connected)

• Receiver spurious emissions

Should be identical in all modes (advertising and/or connected)

g) The different transmit operating modes (tick all that apply):

☐ Operating mode 1: Single Antenna Equipment

- ☒ Equipment with only 1 antenna
- ☐ Equipment with 2 diversity antennas but only 1 antenna active at any moment in time
- ☐ Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)

☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming

- ☐ Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)
- ☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
- ☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming

☐ Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

h) In case of Smart Antenna Systems:

The number of Receive chains: .....

The number of Transmit chains: .....

☐ symmetrical power distribution

☐ asymmetrical power distribution

In case of beam forming, the maximum beam forming gain: .....

NOTE: Beam forming gain does not include the basic gain of a single antenna.

i) Operating Frequency Range(s) of the equipment:

Operating Frequency Range 1: 2402 MHz to 2480 MHz

Operating Frequency Range 2: ..... MHz to ..... MHz

NOTE: Add more lines if more Frequency Ranges are supported.

j) Occupied Channel Bandwidth(s):

Occupied Channel Bandwidth 1: 1.2 MHz

Occupied Channel Bandwidth 2: ..... MHz

NOTE: Add more lines if more channel bandwidths are supported.

k) Type of Equipment (stand-alone, combined, plug-in radio device, etc.):

☒ Stand-alone

☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)

☐ Plug-in radio device (Equipment intended for a variety of host systems)

☐ Other .....

l) The extreme operating conditions that apply to the equipment:

Operating temperature range: -30°C to +85°C

Operating voltage range: 2.2V to 3.6V ~~AC~~ DC

Details provided are for the: ☒stand-alone equipment

☐combined (or host) equipment

☐test jig

m) The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:

Antenna Type:

☒ Integral Antenna

Antenna Gain: 0.5 dBi

If applicable, additional beamforming gain (excluding basic antenna gain): ..... dB

☐ Temporary RF connector provided

☐ No temporary RF connector provided

☐ Dedicated Antennas (equipment with antenna connector)

☐ Single power level with corresponding antenna(s)

☐ Multiple power settings and corresponding antenna(s)
Number of different Power Levels: .....
Power Level 1: ..... dBm
Power Level 2: ..... dBm
Power Level 3: ..... dBm

NOTE 1: Add more lines in case the equipment has more power levels.

NOTE 2: These power levels are conducted power levels (at antenna connector).
For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable

Power Level 1: ..... dBm
Number of antenna assemblies provided for this power level: .....

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	P/N or Model Name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 2: ..... dBm
Number of antenna assemblies provided for this power level: .....

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	P/N or Model Name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 3: ..... dBm
Number of antenna assemblies provided for this power level: .....

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	P/N or Model Name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

n) The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:

Details provided are for the: ☒stand-alone equipment
☐combined (or host) equipment
☐test jig

Supply Voltage ☐AC mains State AC voltage V
☒DC State DC voltage 3.0 V

In case of DC, indicate the type of power source

☐ Internal Power Supply
☐ External Power Supply or AC/DC adapter
☒ Battery
☐ Other: .....

o) Describe the test modes available which can facilitate testing:

Direct Test Mode is available, but shouldn't be required for this (especially given regulatory certification test is performed at the product level whereas DTM is component (chip) level functionality)

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):

Bluetooth low energy.

15. Set Up Photographs

Figure 12. RF Output Power Test

Figure 13 Occupied Channel Bandwidth

Figure 14 Transmitter Unwanted Emission in the OOB Domain

Figure 15 Spurious Emission (Tx/Rx) Test

16. Signatures of the E.U.T's Test Engineers

Test	Test Engineer Name	Signature
RF Output Power	M. Zohar	
Power Spectral Density	M. Zohar	
Occupied Channel Bandwidth	M. Zohar	
Transmitter Unwanted Emission in the Out-of-Band Domain	M. Zohar	
Transmitter Unwanted Emission in Spurious Domain	M. Zohar	
Receiver Spurious Emission	M. Zohar	

17. APPENDIX A - CORRECTION FACTORS

17.1 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

Frequency (MHz)	**Cable Loss** (dB)	**Frequency** (MHz)	**Cable Loss** (dB)
0.010	0.4	50.00	1.2
0.015	0.2	100.00	0.7
0.020	0.2	150.00	2.1
0.030	0.3	200.00	2.3
0.050	0.3	300.00	2.9
0.075	0.3	500.00	3.8
0.100	0.2	750.00	4.8
0.150	0.2	1000.00	5.4
0.200	0.3	1500.00	6.7
0.500	0.4	2000.00	9.0
1.00	0.4	2500.00	9.4
1.50	0.5	3000.00	9.9
2.00	0.5	3500.00	10.2
5.00	0.6	4000.00	11.2
10.00	0.8	4500.00	12.1
15.00	0.9	5000.00	13.1
20.00	0.8	5500.00	13.5
		6000.00	14.5

NOTES:

1. The cable type is SPUMA400 RF-11N(X2) and 39m long

2. The cable is manufactured by Huber + Suhner

17.2 Correction factors for Biconical ANTENNA

Model: 3104
Antenna serial number: 2606
3 meter range

CALIBRATION DATA

Frequency, MHz	Near free space antenna factor, dB/m	Geometry specific correction factor, dB	Free space antenna factor, dB/m [1)]
30	12.97	0.13	12.84
35	12.34	0.09	12.25
40	12.03	0.06	11.97
45	11.42	0.02	11.40
50	11.91	0.03	11.88
60	11.92	0.37	11.55
70	9.60	0.25	9.35
80	6.99	-0.45	7.44
90	10.87	-0.34	11.21
100	11.51	-0.06	11.57
120	13.30	0.20	13.10
140	12.56	-0.01	12.57
160	14.49	-0.12	14.61
180	16.53	0.05	16.48
200	15.30	0.15	15.15

[1)] The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

17.3 Correction factors for Horn ANTENNA

Model: 3115
Antenna serial number: 6142
3 meter range

FREQUENCY (MHz)	Antenna Factor (dB/m)	FREQUENCY (MHz)	Antenna Factor (dB/m)
1000	23.9	10500	38.4
1500	25.4	11000	38.5
2000	27.3	11500	39.4
2500	28.5	12000	39.2
3000	30.4	12500	39.4
3500	31.6	13000	40.7
4000	33	14000	42.1
4500	32.7	15000	40.1
5000	34.1	16000	38.2
5500	34.5	17000	41.7
6000	34.9	17500	45.7
6500	35.1	18000	47.7
7000	35.9		
7500	37.5		
8000	37.6		
8500	38.3		
9000	38.5		
9500	38.1		
10000	38.6		

17.4 Correction factors for Log Periodic ANTENNA

Model: 3146
Antenna serial number: 9606-4081
3 meter range

CALIBRATION DATA

Frequency, MHz	Antenna factor, dB/m [1]
200	11.55
250	11.60
300	14.43
400	15.38
500	17.98
600	18.78
700	21.17
800	21.16
900	22.67
1000	24.09

[1] The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

18. APPENDIX B - MEASUREMENT UNCERTAINTY

Occupied Channel Bandwidth	**$7.7*10.^{-8}$ up to 2.9 GHz and 1.2*10.-7 from 2.9GHz to 12.75GHz.**
RF output power, conducted	**± 25.53% or ±0.99dB, Up to 2.9GHz and ± 26.91% or ±1.03dB from 2.9GHz to 12.75GH**
Power Spectral Density, conducted	**± 25.53% or ±0.99dB, Up to 2.9GHz and ± 26.91% or ±1.03dB from 2.9GHz to 12.75GH**
Unwanted Emissions, conducted	**± 25.53% or ±0.99dB, Up to 2.9GHz and ± 26.91% or ±1.03dB from 2.9GHz to 12.75GH**
All emissions, radiated	**±4.58dB Up to 2.9GHz, and ±2.92dB from 2.9GHz to 12.75GHz**
Duty Cycle	**± 25.53% or ±0.99dB, Up to 2.9GHz and ± 26.91% or ±1.03dB from 2.9GHz to 12.75GH**