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DATE: 27 February 2013

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

FCC Radio Test Report

for

3M Electronic Monitoring Ltd.

Equipment under test:

Tracking Bracelet

TRX-900F-2

Written by: _____
D. Shidlowsky, Documentation

Approved by: _____
I. Siboni, Test Engineer

Approved by: For/_____
I. Raz, EMC Laboratory Manager

Measurement/Technical Report for
3M Electronic Monitoring Ltd.

Tracking Bracelet

TRX-900F-2

FCC ID: LSQTRX900F2

This report concerns: Original Grant:
Class I change:
Class II change: X

Equipment type: Part 15 Security/Remote Control Transceiver

47CFR15 Section 15231 (a-d)

Measurement procedure used is ANSI C63.4-2003.

Application for Certification
prepared by:
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Applicant for this device:
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1. General Information

1.1 Administrative Information

Manufacturer:	3M Electronic Monitoring Ltd.
Manufacturer's Address:	P.O.B. 13236 2 Habarzel St., Tel-Aviv, 61132 Israel Tel: +972-3-767-1700 Fax: +972-3-767-1701
Manufacturer's Representative:	Shai Avigdori
Equipment Under Test (E.U.T):	Tracking Bracelet
Equipment Model No.:	TRX-900F-2
Equipment Serial No.:	Not Designated
Date of Receipt of E.U.T:	19.12.2012
Start of Test:	19.12.2012
End of Test:	24.12.2012
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 71100
Test Specifications:	FCC Part 15 Subpart C

1.2 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.), Registration No. 861911.
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 No. IC 4025A-1.
6. TUV Product Services, England, ASLLAS No. 97201.

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.

1.3 Product Description

The TRX-900F-2 is a small ankle worn device designed for offender monitoring applications.

The device comprises a printed circuit board (PCB) that includes a RF transceiver module with an integral antenna and a microcontroller that controls its operation.

The TRX-900F-2 has one 433 MHz RF channel over which it communicates with its allocated home unit and/or GPS tracking device.

The unit is powered by an internal 3.6V Lithium Thionyl Chloride battery.

The TRX-900F-2 is attached to the ankle of the offender by means of a fiber optic strap. When attached to the offender, the strap is connected in such a way that the optical fiber is facing an IR transmitter on one side and an IR receiver on the other. The IR transmitter sends light signals periodically via the fiber. The reception of these signals by the IR receiver proves the integrity of the strap.

When activated, the TRX-900F-2 transmits signals separated by an interval of 19 seconds. After each transmission, the TRX-900F-2 listens for an acknowledge signal in order to ascertain whether its home unit/tracking device is within range. If a defined timeout has expired without receiving an acknowledge signal, the TRX-900-2 activates an internal vibrator so as to warn the offender that they are out of range before a violation event is generated.

1.4 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

The radiated emissions tests were performed at I.T.L.'s testing facility at 1 Batsheva St., Lod, Israel. This site is a FCC listed test laboratory (FCC Registration No. 861911, date of listing June 30, 2010).
I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

1.6 Measurement Uncertainty

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.98 dB

2. System Test Configuration

2.1 Justification

Due reduction in the size of some components, and change of battery, A C2PC is being applied.

Radiated emission screening was performed in 3 orthogonal orientations. The worst case orientation was the vertical position.

2.2 Special Accessories

No special accessories were needed.

2.3 Equipment Modifications

No modifications were needed in order to achieve compliance

2.4 Configuration of Tested System

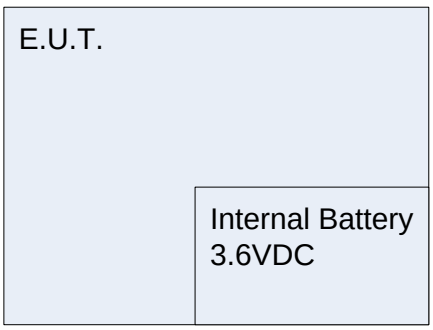

Figure 1. Configuration of Tested System

3. Radiated Measurement Test Set-up Photos

Figure 2. Radiated Emission Test 9 kHz – 30 MHz

Figure 3. Radiated Emission Test 30-1000 MHz

Figure 4. Radiated Emission Test Above 1 GHz

4. Average Factor Calculation

1. Burst duration =3.0msec
2. Time between bursts =19sec
3. $$\text{Average Factor} = 20\log\left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within } 100\text{msec}\right]$$

$$\text{Average Factor} = 20\log\left[1 \times \frac{3}{100}\right] = -30.5dB$$

Note: Pulse duration and pulse period was considered 1 since unit is FSK modulated

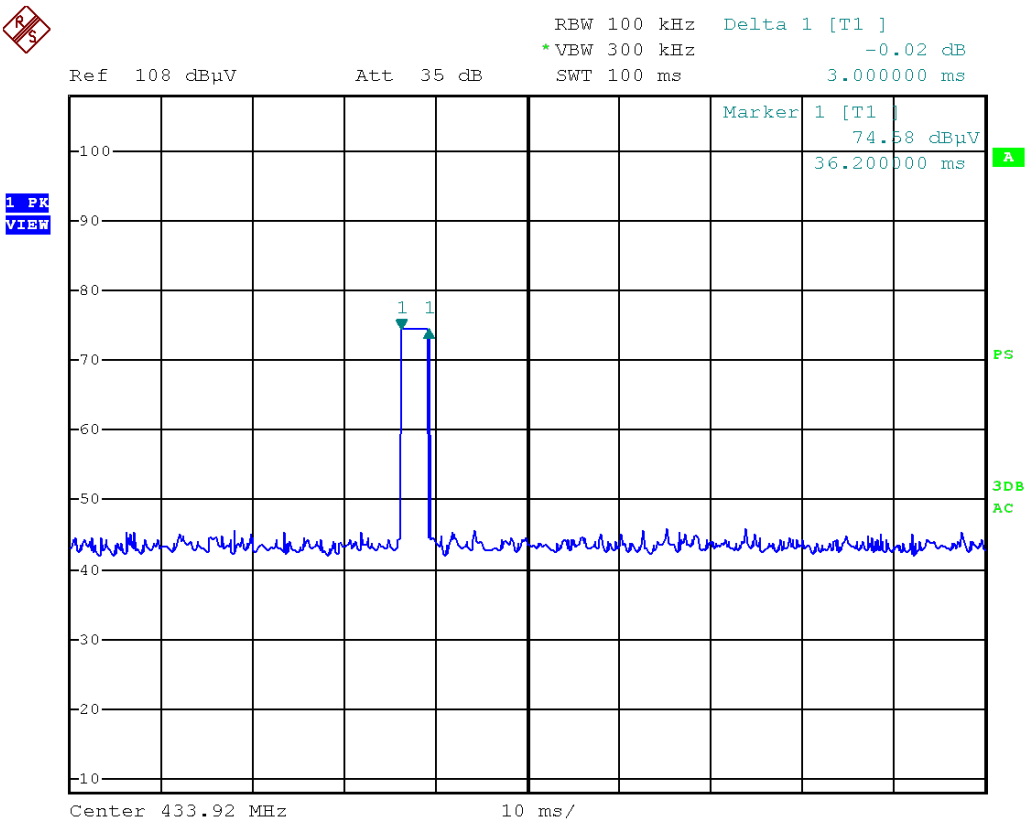

Figure 5. . Burst Duration = 3 msec

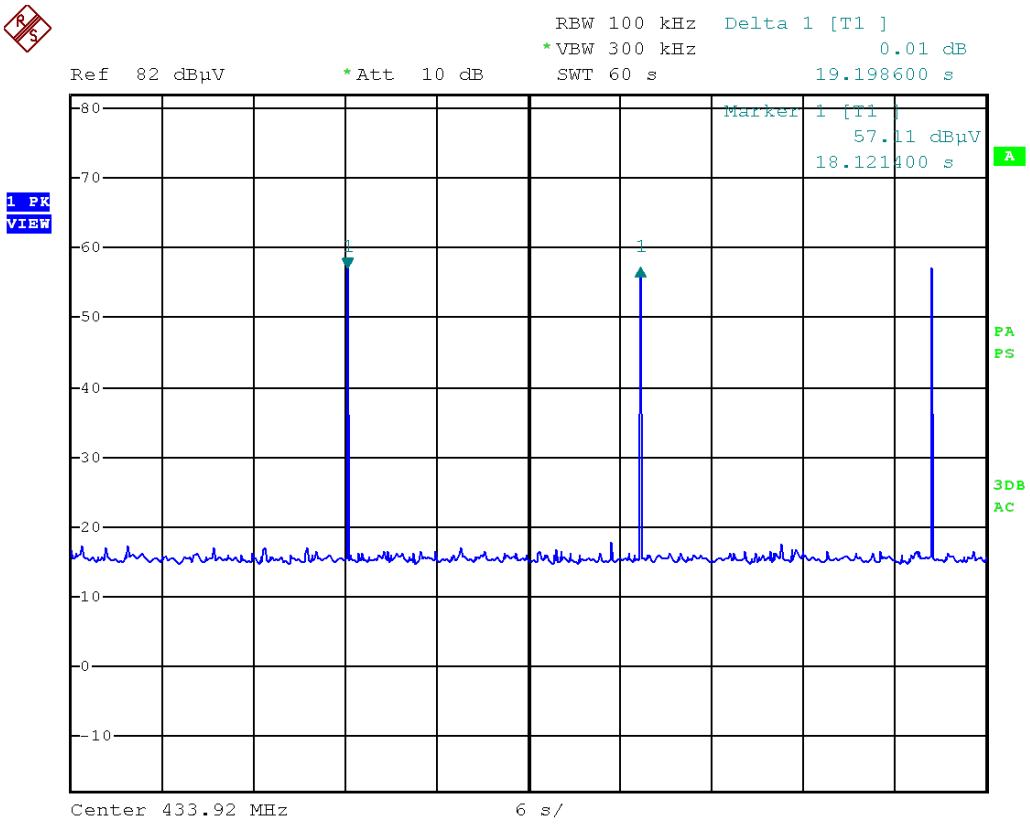

Figure 6. Number of Transmissions Within 60 Seconds

4.1 Test Instrumentation Used

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	RHODE & SCHWARZ	ESC17	100724	October 30, 2012	1 Year
Antenna Bioconical	Emco	3412	1078	August 30, 2012	1 Year
Antenna Mast	ETS	2070-2	9607-1993	N/A	N/A
Turntable	ETS	2065	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

5. Periodic Operation

5.1 Specification

F.C.C., Part 15, Subpart C, Section 15.231(a)

5.2 Requirements

Requirement	Rationale	Verdict
Continuous transmissions are not permitted.	N/A	Complies
A manually operated transmitter shall be deactivated within not more than 5 seconds after releasing the switch.	N/A	Complies
An automatically operated transmitter shall cease operation within 5 seconds after activation.	N/A	Complies
Periodic transmissions at regular predetermined intervals are not permitted.	N/A	Complies
Polling or supervised transmissions to determine system integrity of transmitter used in security or safety applications shall not exceed more than 2 seconds per hour.	See plots in Figure 7 to Figure 8.	Complies

5.3 Results

JUDGEMENT: Passed

The EUT met the FCC Part 15, Subpart C, Section 15.231(a) specification requirements.

TEST PERSONNEL:

Tester Signature: _____ Date: 03.01.13

Typed/Printed Name: I. Siboni

Periodic Operation

E.U.T Description	Tracking Bracelet
Type	TRX-900F-2
Serial Number:	Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(a)

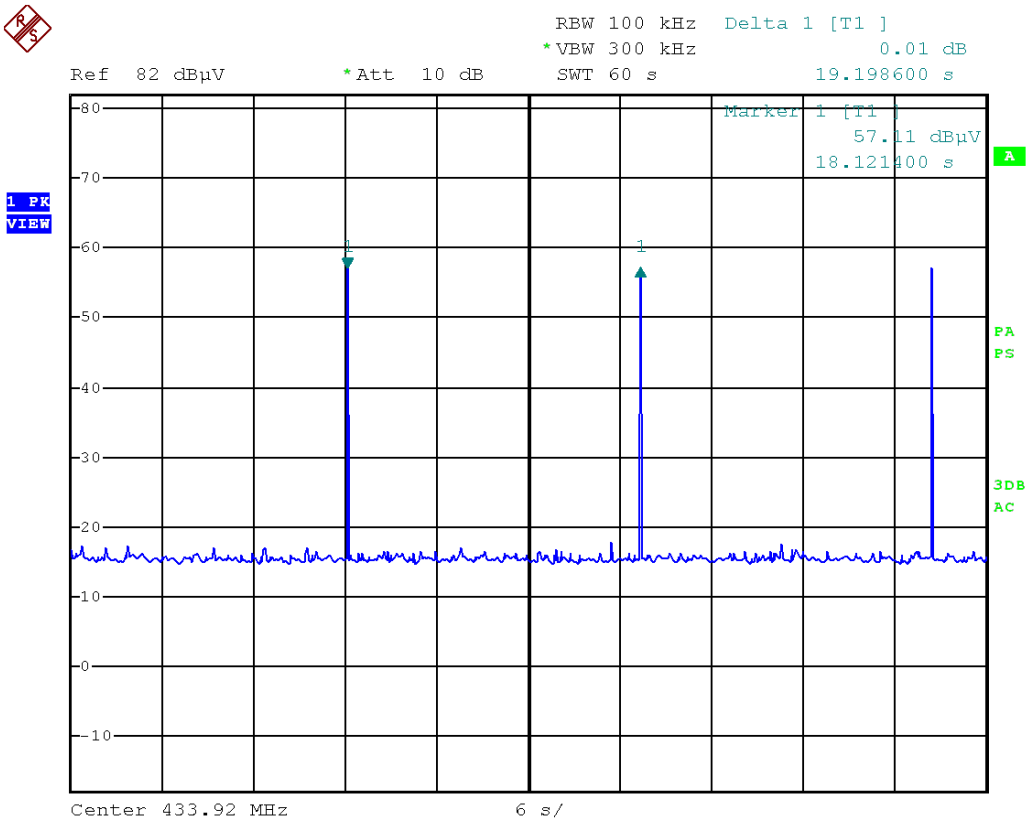

Figure 7. Supervision Signal Once Every 19sec for 3msec

Periodic Operation

E.U.T Description	Tracking Bracelet
Type	TRX-900F-2
Serial Number:	Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(a)

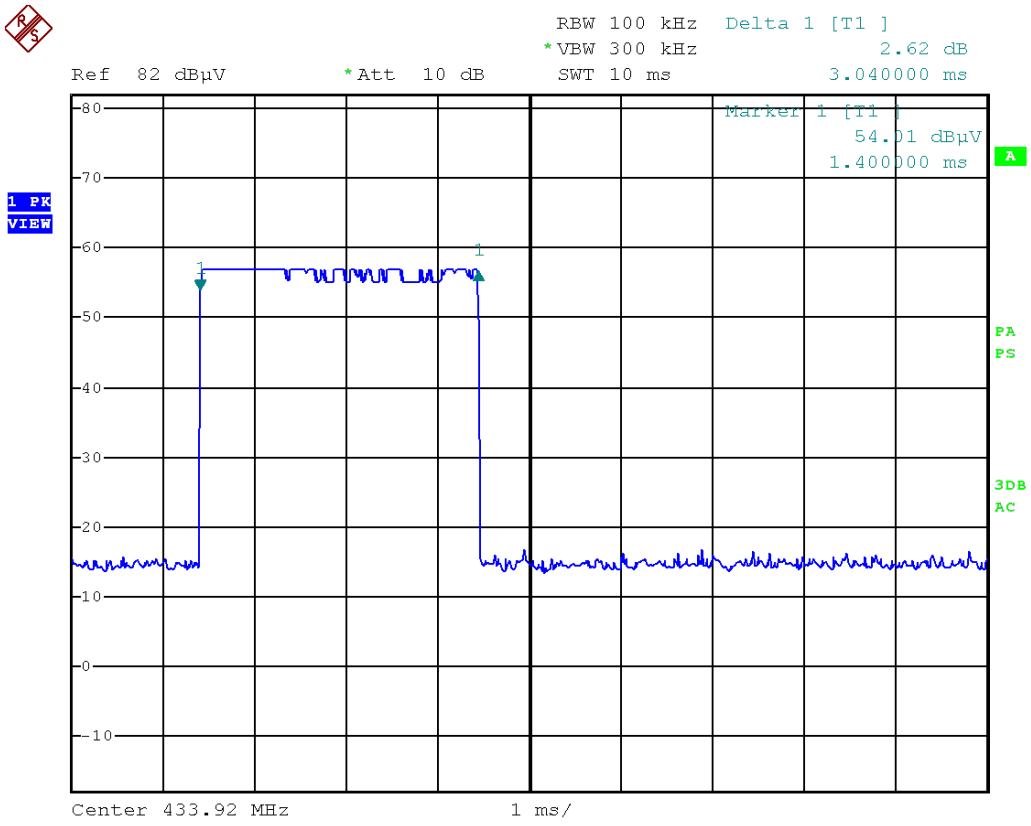

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Figure 8. Supervision Signal Once Every 19sec

[(3600/19)X3msec=568.4msec]<2sec

5.1 Test Instrumentation Used, Periodic Operation

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	RHODE & SCHWARZ	ESC17	100724	October 30, 2012	1 Year
Antenna Bioconical	Emco	3412	1078	August 30, 2012	1 Year
Antenna Mast	ETS	2070-2	9607-1993	N/A	N/A
Turntable	ETS	2065	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

6. Field Strength of Fundamental

6.1 Test Specification

F.C.C., Part 15, Subpart C, Section 15.231(b)

6.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

The E.U.T. was placed on a non-conductive table, 0.8 meters above the O.A.T.S. ground plane.
The EMI receiver was set to the E.U.T. Fundamental Frequency (433.92 MHz) and Peak Detection.
The turntable and antenna mast were adjusted for maximum level reading on the EMI receiver.
The measurement was performed for vertical and horizontal polarizations of the test antenna.

The average result is:

Peak Level(dBµV/m) + E.U.T. Duty Cycle Factor, in 100msec time window (dB)

6.3 Measured Data

JUDGEMENT: Passed by 18.5 dB

The EUT met the FCC Part 15, Subpart C, Section 15.231(b) specification requirements.

The details of the highest emissions are given in Figure 9 to Figure 11.

TEST PERSONNEL:

Tester Signature: _____ Date: 03.01.13

Typed/Printed Name: I. Siboni

Field Strength of Fundamental

E.U.T Description	Tracking Bracelet
Type	TRX-900F-2
Serial Number:	Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(b)

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters Detector: Peak

Freq.	Pol.	Peak Reading	Average Factor	AVG Result	AVG Specification	Margin
(MHz)	V/H	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
433.92	H	90.64	-30.5	60.14	80.8	-20.66
433.92	V	92.84	-30.5	62.34	80.8	-18.46

Figure 9. Field Strength of Fundamental. Antenna Polarization: HORIZONTAL/VERTICAL.

Notes:

1. 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.
2. “Peak Reading.” (dBµV/m) included the “Correction Factors”.
3. “Correction Factors” (dB) = Test Antenna Correction Factor(dB) + Cable Loss.
4. “Average Result” (dBµV/m)= Peak Reading (dBµV/m) + Average Factor (dB)

Field Strength of Fundamental

E.U.T Description	Tracking Bracelet
Type	TRX-900F-2
Serial Number:	Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(b)

Antenna Polarization: Horizontal

Test Distance: 3 meters Detector: Peak

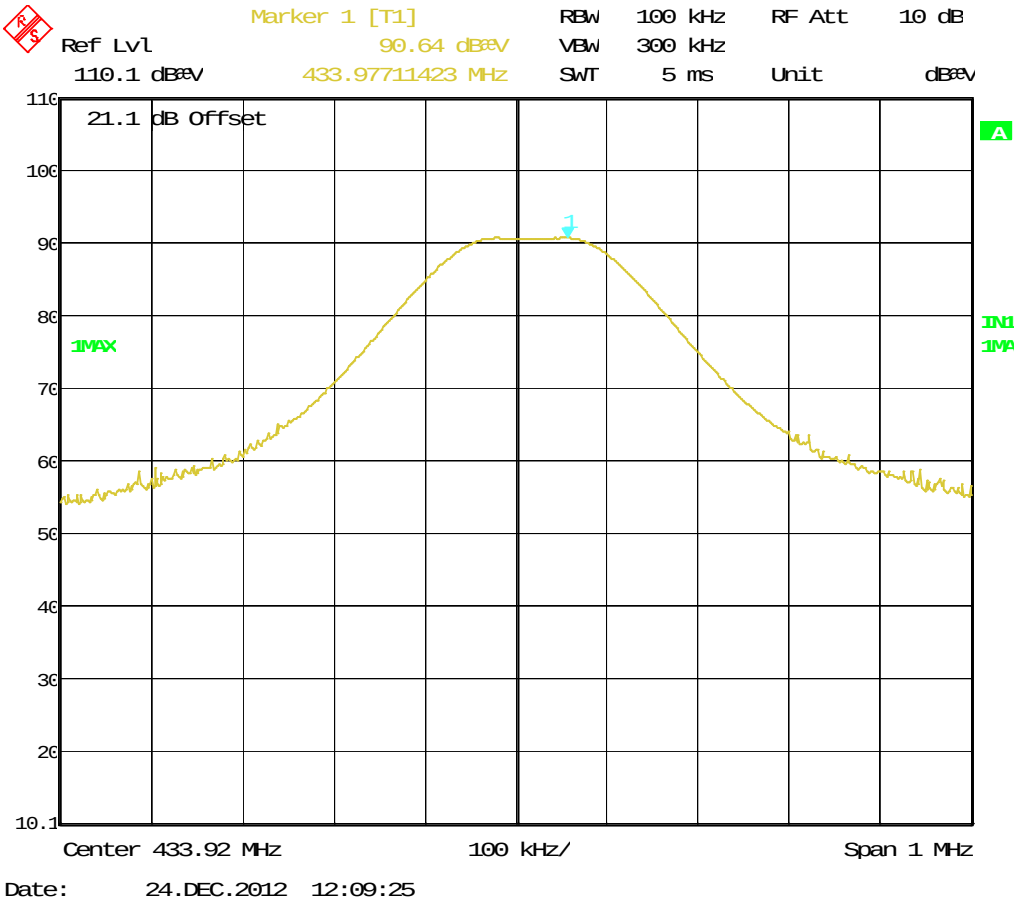

Figure 10. Field Strength of Fundamental

Antenna Polarization: HORIZONTAL

Field Strength of Fundamental

E.U.T Description	Tracking Bracelet
Type	TRX-900F-2
Serial Number:	Not Designated

Specification: F.C.C., Part 15, Subpart C, 15.231(b)

Antenna Polarization: Vertical

Test Distance: 3 meters Detector: Peak

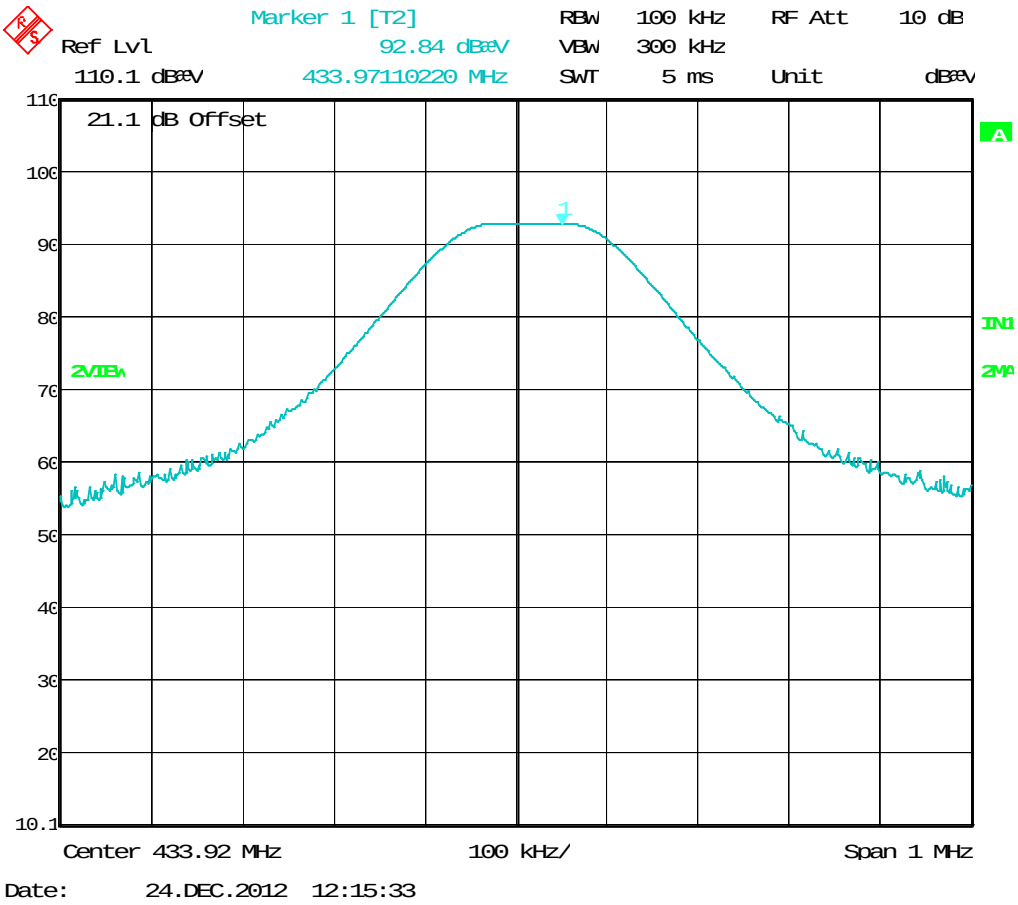

Figure 11. Field Strength of Fundamental

Antenna Polarization: VERTICAL.

6.4 Test Instrumentation Used, Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	Rohde & Schwarz	1066.301	100120	November 1, 2012	1 year
Antenna Bioconical	Emco	3142	1250	August 30, 2012	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

7. Radiated Emission, 9 kHz – 30 MHz

7.1 Test Specification

9 kHz-30 MHz, FCC, Part 15, Subpart C, Section 209

7.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

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, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The E.U.T. highest frequency source or used frequency is 433.92 MHz.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

The E.U.T. was operated at the frequency of 433 MHz. This frequency was measured using a peak detector.

7.3 Measured Data

JUDGEMENT: Passed

The EUT was tested and it met the requirements of the FCC Part 15, Subpart C, specification.

No signals were detected in the frequency range of 9 kHz – 30 MHz.

TEST PERSONNEL:

Tester Signature: _____ Date: 01.03.13

Typed/Printed Name: I. Siboni

7.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	Rohde & Schwarz	1066.301	100120	November 1, 2012	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 21, 2012	1 year
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

7.5 Field Strength Calculation

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

FS = RA + AF + CF

FS: Field Strength [dBμv/m]
RA: Receiver Amplitude [dBμv]
AF: Receiving Antenna Correction Factor [dB/m]
CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers are used.

8. Spurious Radiated Emission, 30 MHz – 4.5 GHz

8.1 Test Specification

30 - 4500 MHz, F.C.C., Part 15, Subpart C

8.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.
See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.
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, 0.8 meters above the ground. The configuration tested is shown in Figure 1.
The signals from the list of the highest emissions were verified and the list was updated accordingly.
The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The E.U.T. highest frequency source or used frequency is 433.92 MHz.

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

The emissions were measured at a distance of 3 meters.

8.3 Test Data

JUDGEMENT: Passed by 30.4 dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.

TEST PERSONNEL:

Tester Signature: _____ Date: 03.01.13

Typed/Printed Name: I. Siboni

Spurious Radiated Emission

E.U.T Description Tracking Bracelet
Type TRX-900F-2
Serial Number: Not Designated

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 30 MHz to 4500 MHz
Antenna: 3 meters distance Detector: Peak

Frequency (MHz)	Antenna Polarity (H/V)	Peak Reading (dBµV/m)	Average Factor (dBM)	Average Result (dBµV/m)	Average Specification (dBµV/m)	Margin (dB)
867.00	H	50.3	-30.5	19.8	60.8	-41.0
867.00	V	59.5	-30.5	29.0	60.8	-31.8
1301.00	H	54.1	-30.5	23.6	54.0	-30.4
1301.00	V	51.6	-30.5	21.1	54.0	-32.9

Figure 12. Radiated Emission.

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.

8.4 Test Instrumentation Used, Spurious Radiated Emission, 30 MHz – 4.5 GHz

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	Rohde & Schwarz	1066.301	100120	November 1, 2012	1 year
Antenna Bioconical	Emco	3142	1250	August 30, 2012	1 year
Horn Antenna	ETS	3115	6142	March 14, 2012	2 Years
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

9. Bandwidth

9.1 Test Specification

F.C.C. Part 15, Subpart C: (15.231(c))

9.2 Test procedure

The transmitter unit operated with normal modulation. The EMI receiver was set to 100 kHz resolution BW and center frequency of the transmitter fundamental. The spectrum bandwidth of the transmitter unit was measured and recorded. The BW was measured at 20 dBc points.

The EUT was set up as shown in Figure 1, and its proper operation was checked. The transmitter occupied bandwidth was measured with the EMI receiver as frequency delta between reference points on the modulation envelope.

9.3 Test Results

Bandwidth Reading (kHz)	Specification (1) (kHz)	Margin (kHz)
426.85	1084.8	-657.95

Figure 13 Bandwidth

See additional details in Figure 14.

JUDGEMENT: Passed by 657.95 kHz

TEST PERSONNEL:

Tester Signature: _____ Date: 03.01.13

Typed/Printed Name: I. Siboni

(1) 0.25% of the E.U.T. fundamental frequency, Section 15.231(c).

Bandwidth

E.U.T Description	Tracking Bracelet
Type	TRX-900F-2
Serial Number:	Not Designated

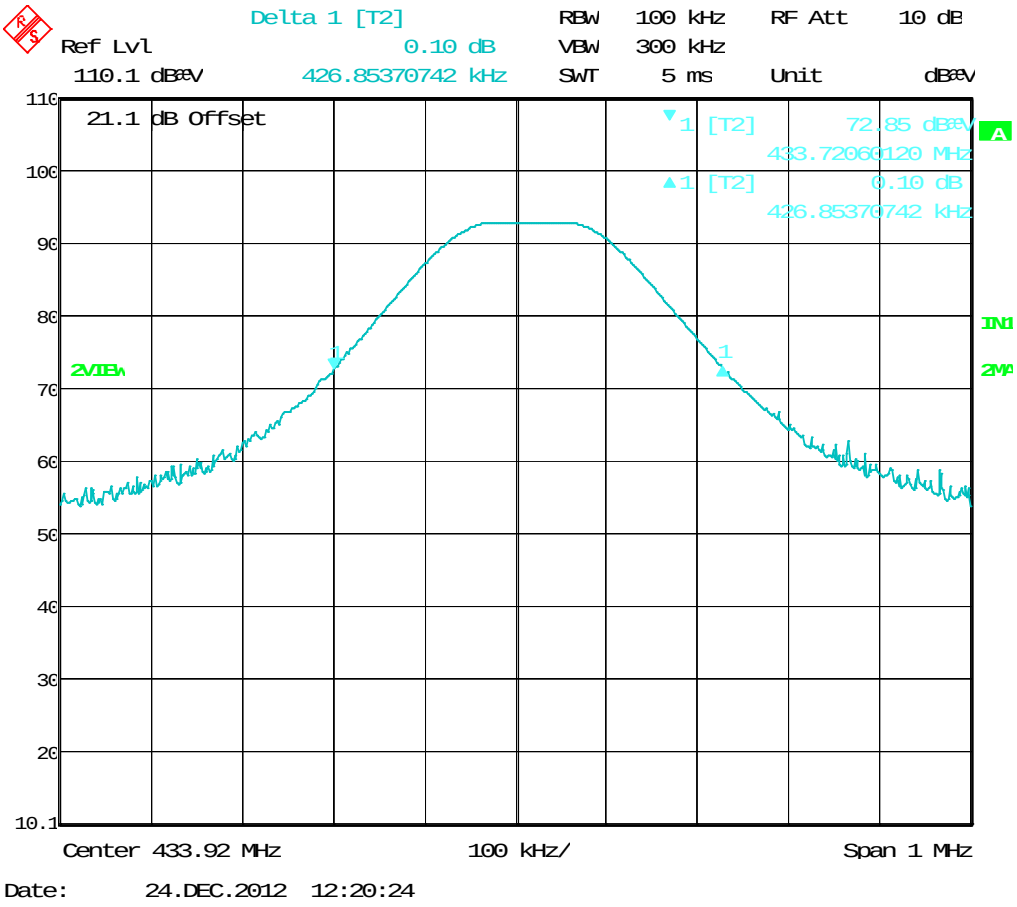

Figure 14 Bandwidth

9.4 Test Equipment Used, Bandwidth

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	Rohde & Schwarz	1066.301	100120	November 1, 2012	1 Year
Antenna Bioconical	Emco	3142	1250	August 30, 2012	1 Year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

Figure 15 Test Equipment Used

10. APPENDIX A - CORRECTION FACTORS

10.1 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

FRQ	S.G.	REF	A AMP	
10K	-30	-29.8	-30.2	0.4
15K	-30	-29.5	-29.7	0.2
20K	-30	-29.7	-29.9	0.2
30K	-30	-29.6	-29.9	0.3
50K	-30	-29.7	-30.0	0.3
75K	-30	-29.7	-30.0	0.3
100K	-30	-29.8	-30.0	0.2
150K	-30	-29.8	-30.0	0.2
200K	-30	-29.9	-30.2	0.3
500K	-30	-29.9	-30.3	0.4
1M	-30	-30.1	-30.5	0.4
1.5M	-30	-30.1	-30.6	0.5
2M	-30	-30.2	-30.7	0.5
5M	-30	-30.3	-30.9	0.6
10M	-30	-30.2	-31.0	0.8
15M	-30	-30.2	-31.1	0.9
20M	-30	-30.5	-31.3	0.8

FRQ	S.G.	REF	A	
			AMP	
50M	-30	-30.5	-31.7	1.2
100M	-30	-30.5	-32.2	0.7
150M	-30	-30.4	-32.5	2.1
200M	-30	-30.5	-32.8	2.3
300M	-30	-30.4	-33.3	2.9
500M	-30	-30.5	-34.3	3.8
750M	-30	-30.7	-35.3	4.8
1G	-30	-30.9	-36.3	5.4
1.5G	-15	-15.7	-22.4	6.7
2G	-15	-15.9	-24.9	9.0
2.5G	-15	-16.3	-25.7	9.4
3G	-15	-16.5	-26.4	9.9
3.5G	-15	-16.7	-26.9	10.2
4G	-15	-16.3	-27.5	11.2
4.5G	-15	-16.6	-28.7	12.1
5G	-15	-16.8	-29.9	13.1
5.5G	-15	-17.6	-31.1	13.5
6G	-15	-17.2	-31.7	14.5

NOTEs:

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

2. The cable is manufactured by Huber + Suhner

10.2 Correction factors for Bilog ANTENNA

Model: 3142
Antenna serial number: 1250
3 meter range

FREQUENCY (MHz)	AFE (dB/m)	FREQUENCY (MHz)	AFE (dB/m)
30	18.4	1100	25
40	13.7	1200	24.9
50	9.9	1300	26
60	8.1	1400	26.1
70	7.4	1500	27.1
80	7.2	1600	27.2
90	7.5	1700	28.3
100	8.5	1800	28.1
120	7.8	1900	28.5
140	8.5	2000	28.9
160	10.8		
180	10.4		
200	10.5		
250	12.7		
300	14.3		
400	17		
500	18.6		
600	19.6		
700	21.1		
800	21.4		
900	23.5		
1000	24.3		

10.3 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		

10.4 Correction factors for ACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2