ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO FCC PART 15, SUBPART C, §15.231

FOR

Tadiran Telematics Ltd.

EQUIPMENT UNDER TEST

Remote control unit transmitter
model Tx-5003

FCC ID:NTATX5003

Hermon Laboratories Ltd.
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ACCREDITED
839.01
Electrical

Description of equipment under test

Test items	Remote control unit transmitter
Manufacturer	Tadiran Telematics Ltd.
Type (Model)	Tx-5003

Applicant information

Applicant's responsible person	Mr. Roman Shternberg, general manager
Company	Tadiran Telematics Ltd.
Address	26 Hashoftim street
P.O.Box	267
Postal code	58102
City	Holon
Country	Israel
Telephone number	+972 3557 5722
Telefax number	+972 3556 4476

Test performance

Project Number	14175
Location of the test	Hermon Laboratories, Binyamina, Israel
Test performed	July 25, 2000
Purpose of test	The EUT certfiication in accordance with CFR 47, part 2, §2.1033
Test specification(s)	FCC part 15, subpart C, §15.231, subpart B, §15.109

Table of Contents

1 Summary and signatures

The EUT, remote control unit transmitter Tx-5003 was tested according to FCC part 15 subpart C, §.15.231, part 15 subpart B §15.109 and found to comply with the standard requirements.

Test performed by:

Mrs. E. Pitt, test engineer _____

Test report prepared by:

Mrs. M. Cherniavsky, certification engineer _____

Test report approved by:

Mr. M. Nikishin, EMC group leader _____

Dr. E. Usoskin, C.E.O. _____

The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation by A2LA.
Through this report period is used as decimal separator while thousands are separated by comma.
This report is in conformity with EN 45001 and ISO GUIDE 25.
The test results relate only to the items tested.

2 General information

2.1 Abbreviations and acronyms

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

AC	alternating current
ASK	amplitude - shift keyed
BW	bandwidth
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
DC	direct current
EUT	equipment under test
GHz	gigahertz
H	height
HL	Hermon Laboratories
Hz	hertz
IF	intermediate frequency
kHz	kilohertz
L	length
m	meter
mm	millimeter
MHz	megahertz
msec	millisecond
NA	not applicable
NARTE	National Association of Radio and Telecommunications Engineers, Inc.
Ω	ohm
QP	quasi-peak (detector)
RBW	resolution bandwidth
RF	radio frequency
RE	radiated emission
RMS	root-mean-square
sec	second
V	volt

2.2 Specification references

CFR 47 part 15: October 1999	Radio Frequency Devices.
ANSI C63.2:06/1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:1992	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

2.3 EUT description

The EUT, Tx – 5003, is a remote control unit transmitter, operating at 433.92 MHz frequency with ASK type of modulation. It is used for short range wireless application - to transfer the operator (driver) commands to the alarm unit installed in the car. The EUT is supplied with printed loop antenna and is powered by 3 V internal lithium battery.

3 Test facility description

3.1 General

Tests were performed at Hermon Laboratories, which is a fully independent, private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47) and by Industry Canada for radiated measurements (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-809 for anechoic chamber, C-845 for conducted emissions site), assessed by NMi Certin B.V. (Netherlands) for a number of EMC, Telecommunications, Safety standards, and assessed by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO GUIDE 25/EN 45001 for EMC, Telecommunications and Product Safety Information Technology Equipment (Certificate No. 839.01).

Address: PO Box 23, Binyamina 30550, Israel
Telephone: +972 6628 8001
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Person for contact: Mr. Alex Usoskin, testing and QA manager.

3.2 Equipment calibration

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error. The standards and instruments used in the calibration system conform to the present requirements of MIL-STD-45662A.
The laboratory standards are calibrated by the third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

3.2.1 Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Radiated emissions in the anechoic chamber at 3 m measuring distance	Biconilog antenna: ±3.2 dB Double ridged guide antenna: ±2.36 dB

3.3 Statement of qualification

The test measurement data supplied in this test measurement report having been received by me, is hereby duly certified. The following is a statement of my qualifications:
I am an engineer, graduated from university in 1974 with an MScEE degree and certified by NARTE as an EMC accredited test laboratory engineer, the certificate no. is ATL–0006–E.
I have obtained 27 years experience in EMC measurements and have been with Hermon Laboratories since 1991.

Name: Mrs. Eleonora Pitt Signature: _____
Position: test engineer Date: October 15, 2000

I hereby certify that this test measurement report was prepared by me and is hereby duly certified. The following is a statement of my qualifications.
I am an engineer, graduated from university in 1971, with an MScEE degree, have obtained 27 years experience in electronic products design and development, have been with Hermon Laboratories since 1991. Also, I am a telecommunication class II engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA.), the certificate no. is E2-03410.

Name: Mrs. Marina Cherniavsky Signature: _____
Position: certif. engineer Date: October 15, 2000

4 Emission measurements

4.1 Field strength of emissions according to § 15.231 (b)

4.1.1 General

Specified limits at 3 m distance are given in Table 4.1.1 below

Table 4.1.1 The field strength limits

Fundamental frequency, MHz	Field strength of fundamental, dB (μV/m)		Field strength of spurious emissions, dB (μV/m)	
	Average	Peak	Average	Peak
433.92	80.8	100.8	60.8	80.8

4.1.2 Test procedure

The test was performed in the anechoic chamber at 3 meters test distance, i.e. the distance between measuring antenna and EUT boundary. The EUT was placed on the wooden table, as shown in Figure 4.1.1, Photographs 4.1.1 to 4.1.3, operated in continuous transmitting mode and measured in three orthogonal axes during the testing. All the transmitter modes of operation were tested.

Frequency range from 30 MHz up to 10^{th} harmonic (5 GHz) was investigated with biconilog and double ridged guide antennas. To find maximum radiation the turntable was rotated 360^{o}, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

The peak detector with RBW = 120 kHz at frequencies below 1 GHz and RBW = 1 MHz above 1 GHz was used in course of measurements.
The test results are recorded in Table 4.1.2. The pulse train duration measurements for average factor calculation are shown in Plots 4.1.1 to 4.1.4.

Average factor –8.09 dB was calculated according to the formula

$$\text{Average factor} = 20 \log (T_{ON} / 100),$$

where the pulse train duration within 0.1 sec is 78.8 msec and whole transmission time T_{ON} is 39.4 msec, refer to the 0.5 duty cycle

$$20 \log (39.4 \text{ ms}/100 \text{ ms}) = -8.09 \text{ dB}$$

The EUT has met the average emission requirements and peak emission limitations of §15.35. The EUT was found to comply with the standard requirements and successfully passed the test.

Reference numbers of test equipment used

HL 0041	HL 0413	HL 0465	HL 0483	HL 0521	HL 0589	HL 0593	HL 0594
HL 0604	HL 0815	HL 0816	HL 1175	HL 1176			

Full description is given in Appendix A.

Table 4.1.2 Radiated emission measurements - test results
(Field strength of fundamental frequency and spurious)

TEST SPECIFICATION: FCC part 15 subpart C § 15.231
DATE: July 25, 2000
RELATIVE HUMIDITY: 57%
AMBIENT TEMPERATURE: 23°C

a) peak limit

Frequency, MHz	Antenna type	Radiated emission, peak, dB (μV/m)	Peak limit @ 3 m, dB(μV/m)	Margin, dB	Pass/ Fail
433.935	BL	77.15	100.8	23.65	Pass
867.889	BL	62.25	80.8	18.55	Pass
1301.81*	DRG	56.89	74	17.11	Pass
1735.74	DRG	55.38	80.8	25.42	Pass

* Falls into the restricted band (refer to 15.205, 15.209)
Test results listed in the table were obtained through the measurements with the peak detector and antennas in horizontal polarization
Antenna type = BL – biconilog, DRG – double ridged guide
Peak limit = average limit dB(μV/m) +20 dB.
Margin = dB below (negative if above) limit.

b) average limit

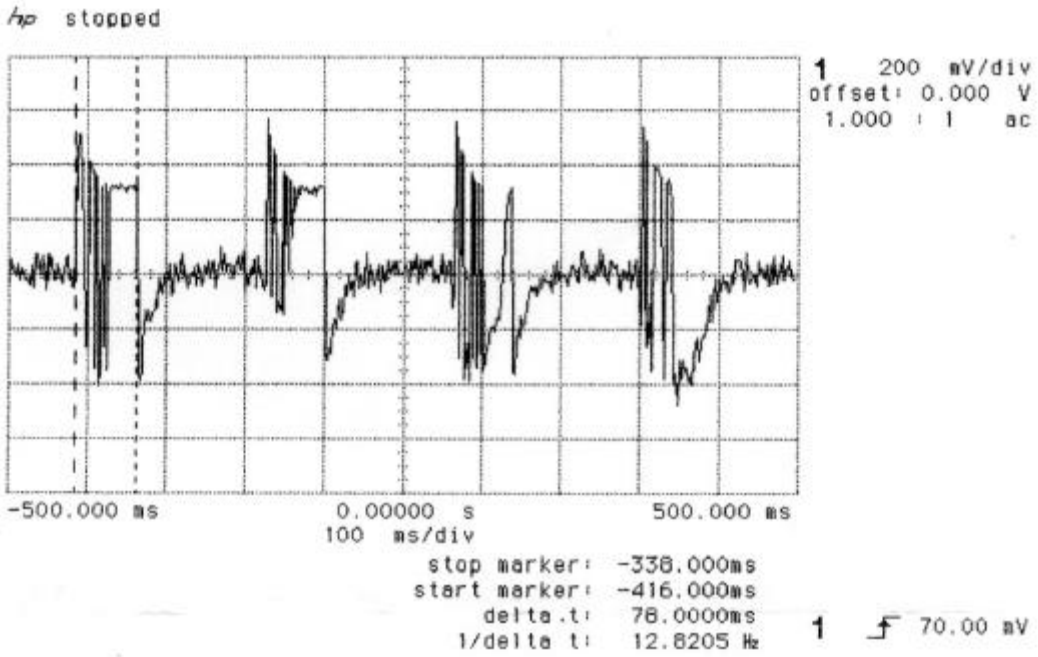
Frequency, MHz	Antenna type	Radiated emission, average, dB (μV/m)	Average limit @ 3 m, dB(μV/m)	Margin, dB	Pass/ Fail
433.935	BL	69.06	80.8	11.74	Pass
867.889	BL	54.16	60.8	6.64	Pass
1301.81*	DRG	48.80	54	5.20	Pass
1735.74	DRG	47.29	60.8	13.51	Pass

* Falls into the restricted band (refer to 15.205, 15.209)

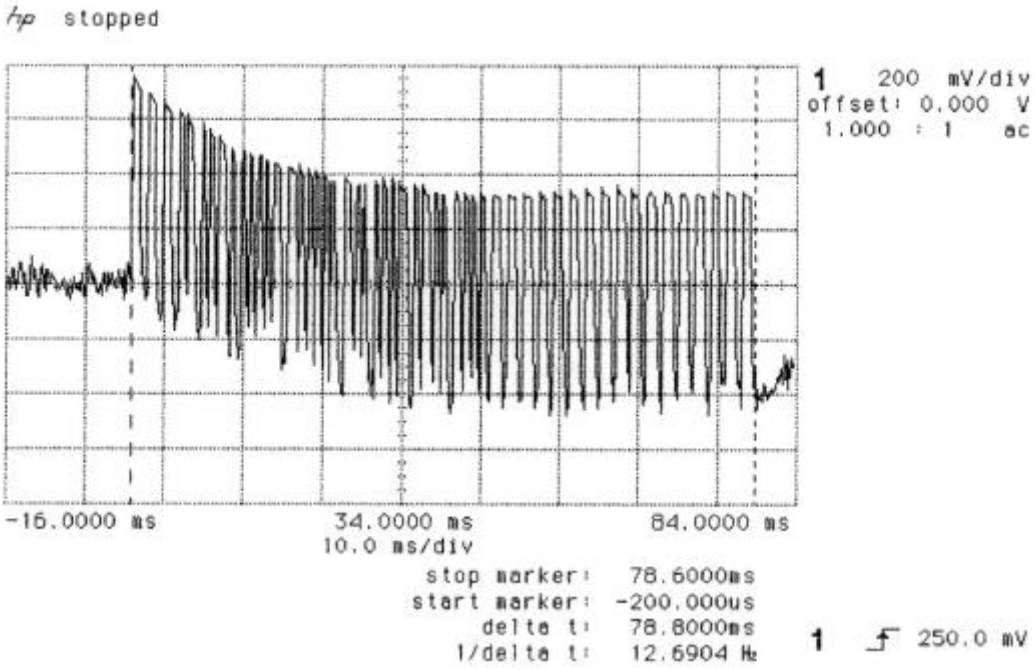
Test results listed in the table were obtained through the measurements with the peak detector and antennas in horizontal polarization
Radiated emission, average, dB(μV/m) = radiated emissions, peak, {dB(μV/m)}+ average factor (dB).
Average factor = -8.9 dB.
Average limit is in accordance with § 15.231(b) and §15.209

Margin = dB below (negative if above) limit.
Antenna type = BL – biconilog, DRG – double ridged guide.

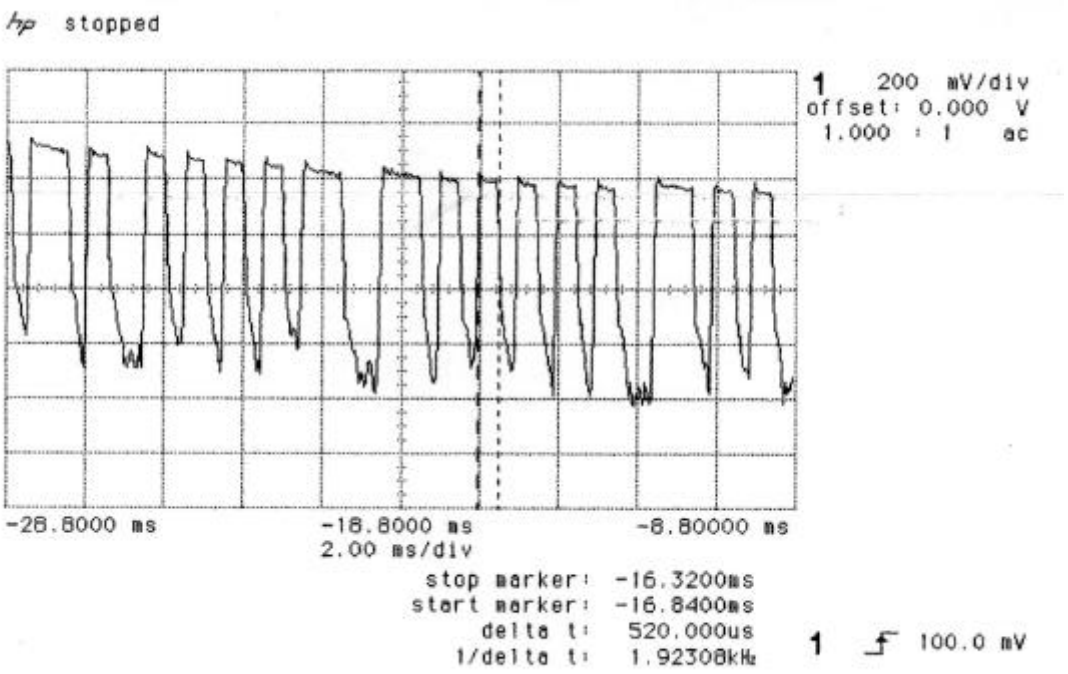
Plot 4.1.1
Average factor measurement
Pulse train within 0.1 sec



Plot 4.1.2
Average factor measurement
Pulse duration = 78.8 msec



Plot 4.1.3
Average factor measurement
Transmitting time measurement



Plot 4.1.4
Average factor measurement
Transmitting time measurement

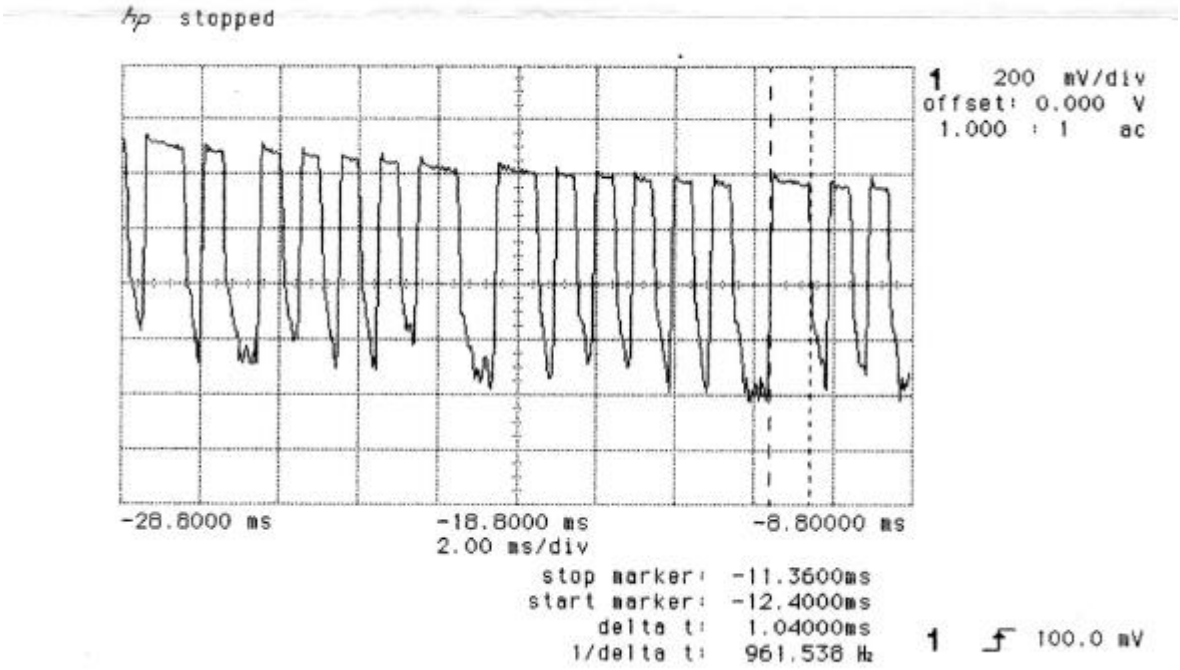
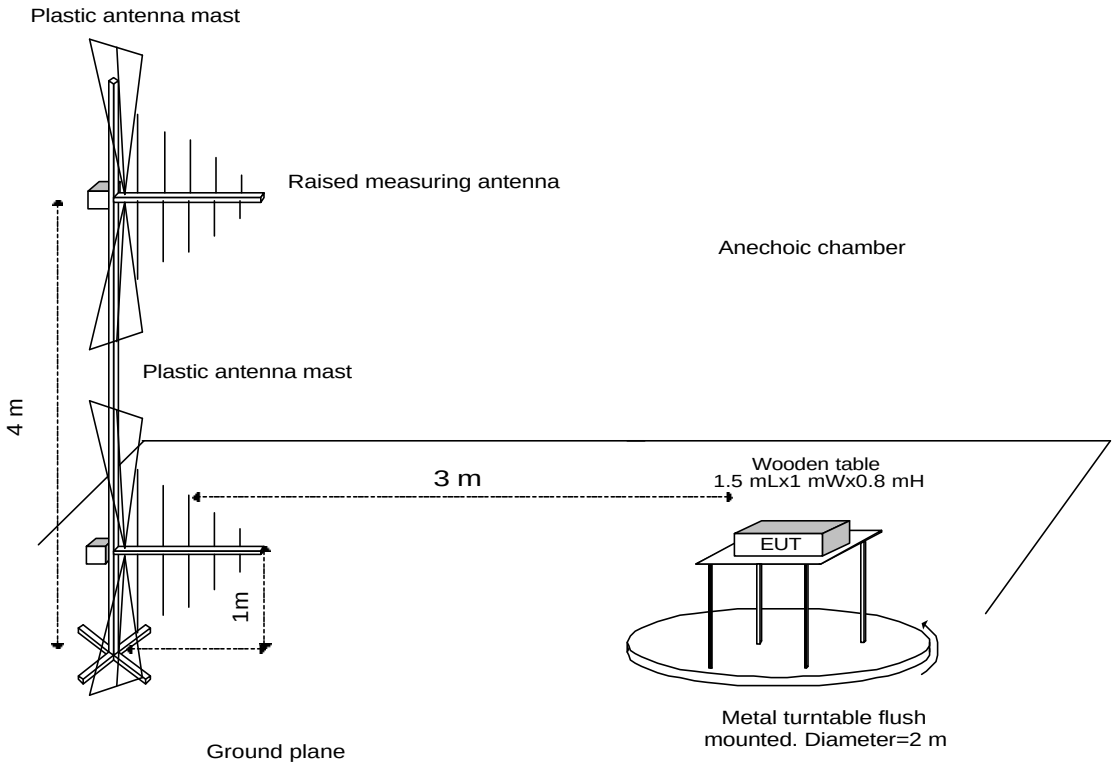
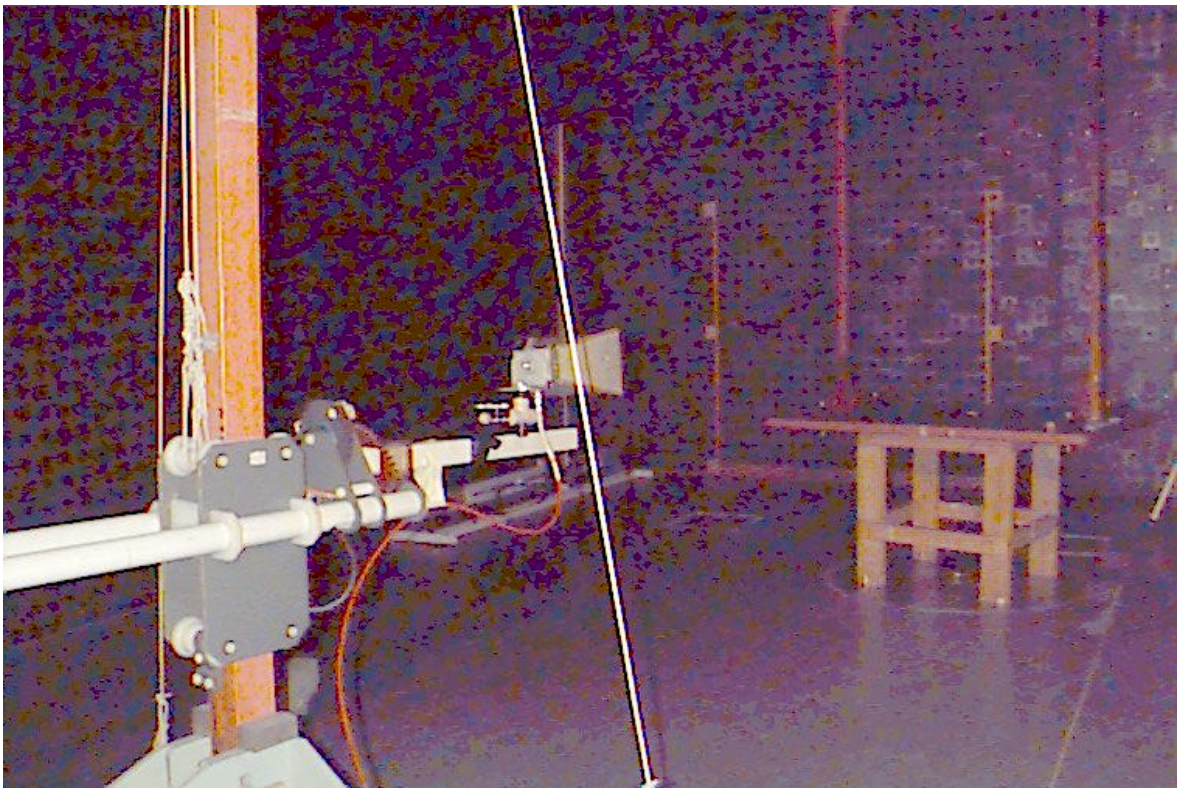


Figure 4.1.1
Radiated emission test setup

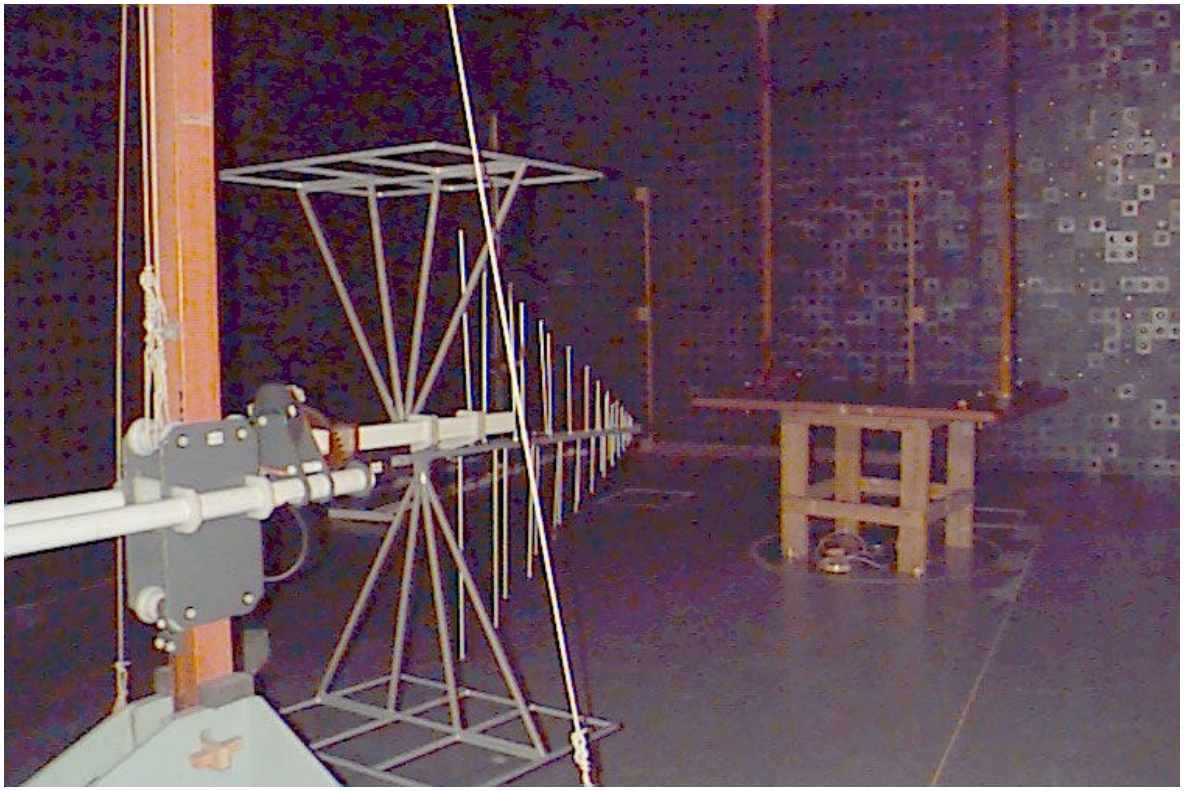


Photograph 4.1.1
Radiated emission measurements setup

Photograph 4.1.2
Radiated emission measurements setup



Photograph 4.1.3
Radiated emission measurements setup



4.2 Bandwidth of emission according to § 15.231 (c)

4.2.1 Specified limits

The bandwidth of the emissions shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.

4.2.2 Test procedure and results

The maximum allowed occupied bandwidth was calculated as 0.0025 of the center frequency:

0.0025 x 433.92 MHz = 1080 kHz

The spectrum trace data around transmitter fundamental frequency was obtained with the spectrum analyzer in "Max Hold" mode. The bandwidth value was determined between two points 20 dB down from the modulated carrier. The occupied bandwidth of 210 kHz was measured which is narrower than admitted 1080 kHz.

The test results are shown in Plot 4.2.1.

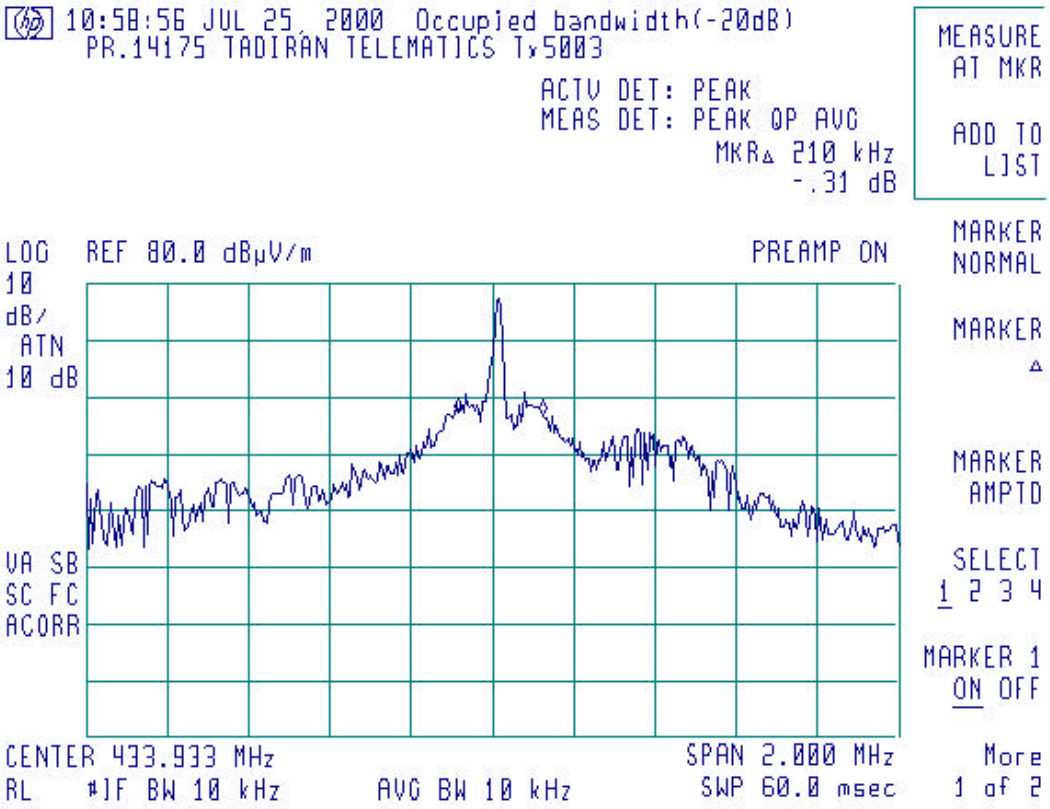
Reference numbers of test equipment used

HL 0465	HL 0521	HL 0604

Full description is given in Appendix A.

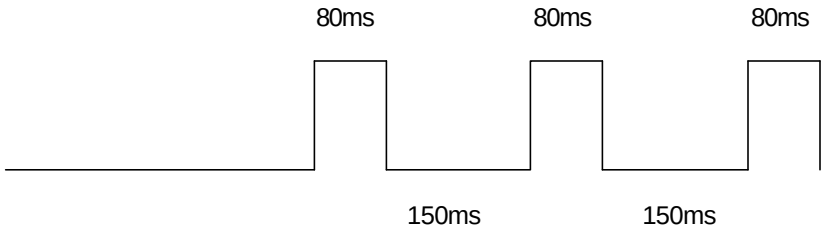
Plot 4.2.1

Emission bandwidth measurements result



4.3 Periodic operation requirement §15.231 (a) (1)

It is a manually operated transmitter, pressing each one of the keys will be followed by this transmit pattern



It means that there are 3 transmissions each of 80 ms.
Transmissions will cease automatically after half a second (540 ms).

4.4 Unintentional radiated emissions test according to §15.109

4.4.1 General

This test was performed to measure radiated emissions from the incorporated digital device of the EUT and also to verify the EUT full compliance with §15.109.

Radiated emission measurements specification limits are given in Table 4.4.1 below:

Table 4.4.1
Limits for electric field strength, quasi-peak detector

Frequency, MHz	Class B equipment @ 3 meter distance, dB(μV/m)
30 - 88	40
88 - 216	43.5
216 - 960	46
960 - 5000	54

4.4.2 Test procedure

The radiated emissions measurements of the EUT incorporated digital device were performed in the anechoic chamber at 3 meter measuring distance in the frequency range from 30 MHz to 2 GHz with the biconilog antenna.
The EUT was placed on the wooden table as shown in Figure 4.1.1 and Photographs 4.1.1, 4.1.3. To find maximum radiation the turntable was rotated 360^{o}, the measuring antenna height changed from 1 to 4 m, and the antenna polarization was changed from vertical to horizontal.
The measurements were performed with the EMI receiver settings:
from 30 MHz to 1 GHz RBW=120 kHz, peak detector;
from 1 GHz up to 2 GHz RBW = VBW = 1 MHz, peak detector.
The results of measurements are shown in Plots 4.4.1, 4.4.2. All the found emissions were at least 15 dB below specified limit.

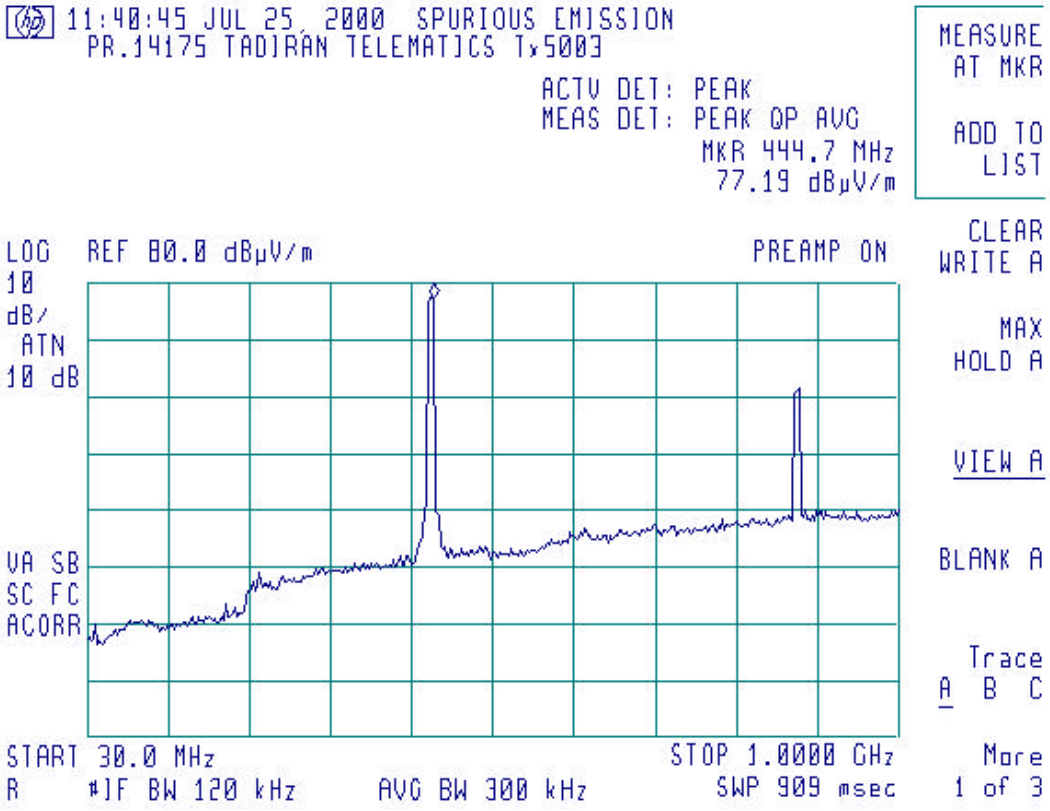
Reference numbers of test equipment used

HL 0465	HL 0521	HL 0593	HL 0594	HL 0604	HL 0815	HL 0816

Full description is given in Appendix A

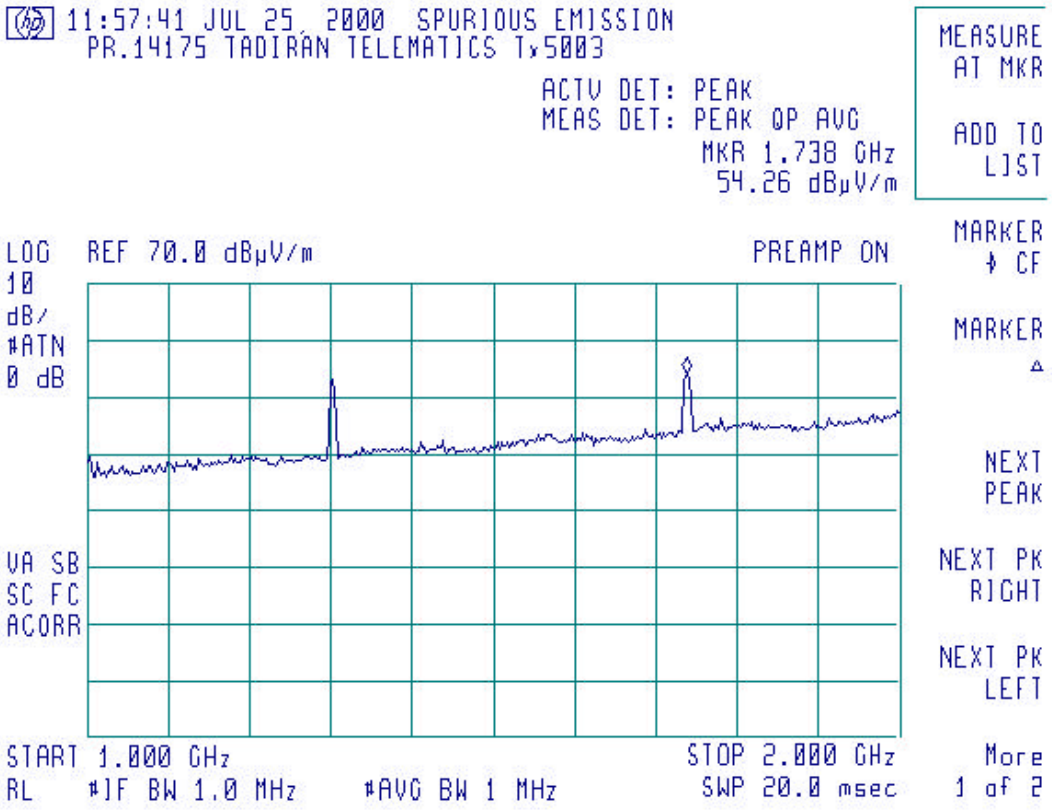
Plot 4.4.1

Test Specification: §15.109
Radiated emissions of digital incorporated device



Plot 4.4.2

Test Specification: §15.109
Radiated emissions of digital incorporated device



APPENDIX A – Test equipment and ancillaries used for tests

HL Serial No.	Serial No.	Description	Manufacturer	Model No.	Due Calibr.
0041	2811	Double ridged guide antenna, 1-18 GHz	Electro-Metrics	RGA 50/60	8/01
0413	413	Cable coax, microwave, DC- 18 GHz, TNC-TNC, 4 m	Gore	R3C01C0116 2.6	2/01
0465	023	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	3/01
0483	1325	Oscilloscope, Digitizing, 100 MHz	Hewlett Packard	HP 54501A	11/00
0521	0319	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	7/01
0589	589	Cable Coaxial, GORE A2POL118.2, 3m	Hermon Labs	GORE-3	11/00
0593	101	Antenna Mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	AM-F1	4/01
0594	102	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	11/00
0604	9611-1011	Antenna biconilog log-periodic/T bow-tie, 26 - 2000 MHz	EMCO	3141	7/01
0815	151	Cable, coax, RG-214, 7.3 m, N-type connectors, inside anechoic chamber	Hermon Labs	C214-7	8/01
0816	152	Cable, coax, RG-214, 8 m, N-type connectors, outside anechoic chamber	Hermon Labs	C214-8	8/01
1175	NA	Microwave 5 m cable	Gore	01C02245.2	2/01
1176	NA	Microwave 1 m cable	Suhner	SMA/SMA	2/01

APPENDIX B-Test equipment correction factors

Antenna factor
Double ridged guide antenna
Model RGA-50/60
S/N 2811

Frequency, MHz	Antenna Factor, dB
1000	24.3
1500	25.4
2000	28.4
2500	29.2
3000	30.5
3500	31.6
4000	33.7
4500	32.2
5000	34.5
5500	34.5
6000	34.6
6500	35.3
7000	35.5
7500	35.9
8000	36.6
8500	37.3
9000	37.7
9500	37.7
10000	38.2
10500	38.5
11000	39.0
11500	40.1
12000	40.2
12500	39.3
13000	39.9
13500	40.6
14000	41.1
14500	40.5
15000	39.9
15500	37.8
16000	39.1
16500	41.1
17000	41.7
17500	45.1
18000	44.3

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field intensity in dB(μV)/meter

Antenna factor at 3m calibration
Biconilog antenna, EMCO, model 3141, Ser.No.1011

Frequency, MHz	Antenna Factor, dB(1/m)	Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8	940	24.0
28	7.8	960	24.1
30	7.8	980	24.5
40	7.2	1000	24.9
60	7.1	1020	25.0
70	8.5	1040	25.2
80	9.4	1060	25.4
90	9.8	1080	25.6
100	9.7	1100	25.7
110	9.3	1120	26.0
120	8.8	1140	26.4
130	8.7	1160	27.0
140	9.2	1180	27.0
150	9.8	1200	26.7
160	10.2	1220	26.5
170	10.4	1240	26.5
180	10.4	1260	26.5
190	10.3	1280	26.6
200	10.6	1300	27.0
220	11.6	1320	27.8
240	12.4	1340	28.3
260	12.8	1360	28.2
280	13.7	1380	27.9
300	14.7	1400	27.9
320	15.2	1420	27.9
340	15.4	1440	27.8
360	16.1	1460	27.8
380	16.4	1480	28.0
400	16.6	1500	28.5
420	16.7	1520	28.9
440	17.0	1540	29.6
460	17.7	1560	29.8
480	18.1	1580	29.6
500	18.5	1600	29.5
520	19.1	1620	29.3
540	19.5	1640	29.2
560	19.8	1660	29.4
580	20.6	1680	29.6
600	21.3	1700	29.8
620	21.5	1720	30.3
640	21.2	1740	30.8
660	21.4	1760	31.1
680	21.9	1780	31.0
700	22.2	1800	30.9
720	22.2	1820	30.7
740	22.1	1840	30.6
760	22.3	1860	30.6
780	22.6	1880	30.6
800	22.7	1900	30.6
820	22.9	1920	30.7
840	23.1	1940	30.9
860	23.4	1960	31.2
880	23.8	1980	31.6
900	24.1	2000	32.0
920	24.1		

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field intensity in dB(μV/meter).