ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO FCC PART 15, SUBPART C, §15.231

FOR

ELMOTECH Ltd.

EQUIPMENT UNDER TEST

PANIC MANUAL RESET DEVICE

model MRDFF-600

Hermon Laboratories Ltd.
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ACCREDITED
839.01
Electrical

Description of equipment under test

Test items	Panic manual reset device, FCC ID:LSQ-MRDRF-600
Manufacturer	Elmotech Ltd.
Type (Model)	**MRDRF-600**
Serial number	65500

Applicant information

Applicant's representative & responsible person	Mr. Natan Halpein, project manager
Company	Elmotech Ltd.
Address	2 Habarzel St.
Postal code	69710
City	Tel Aviv
Country	Israel
Telephone number	+972 3647 8871
Telefax number	+972 3647 9139

Test performance

Project Number	13740
Location of the test	Hermon Laboratories, Binyamina, Israel
Test started	October 24, 1999
Test completed	October 29, 1999
Purpose of test	The EUT certification in accordance with CFR 47, part 2, §2.1033
Test specification(s)	FCC part 15, subpart C, §15.231, §15.209, subpart B, §15.109

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1. Summary and signatures

The EUT, manual reset device MRDRF-600 was tested according to FCC part 15 subpart C, §.15.231 and part 15 subpart B §.15.109 and found to comply with the standard requirements.

Test performed by:

Mr. M. Nikishin, test engineer _____

Test report prepared by:

Mrs. V. Mednikov, certification engineer _____

Test report approved by:

Mr. A. Usoskin, QA manager _____

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
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 1998	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, panic manual reset device, is a small microprocessor based and battery operated device which is housed in a small plastic case. The panic MRD is used by probation officers in the home arrest environment. It is used for turning the offenders' transmitters on and off as well as transmitting three types of signal messages.

The panic MRD is composed of one PCB and a replaceable 12 V battery. The PCB includes the controlling CPU and the transmitter circuit.

The antenna is a rectangular loop antenna at the PCB's edges.

The external interface of the unit includes:
1 LED,
5 touch pushbuttons,
2 touch points for resetting an offender's transmitter.

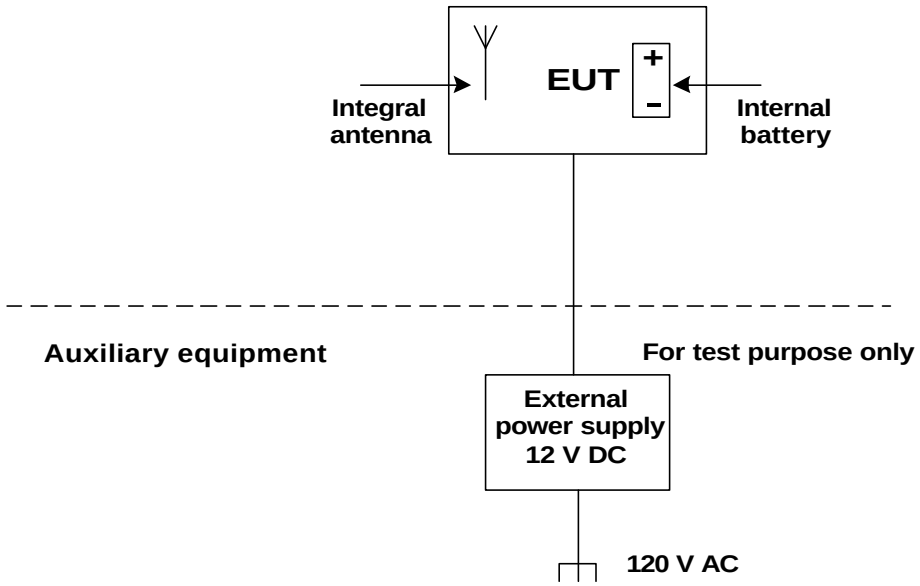
The panic MRD transmits at 318.000 MHz.

Oscillators in the MRD:

Y1 – 2 MHz Ceramic resonator,
Y2 – 318 MHz SAW filter.

The EUT configuration is given in Figure 2.3.1.

Figure 2.3.1
EUT test configuration



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
Fax: +9726 628 8277

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 open field test site at 3 m measuring distance	Log periodic antenna: ±3 dB Double ridged guide antenna: ±2.36 dB
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 Laboratory personnel

The three people of Hermon Laboratories that have participated in measurements and documentation preparation are: Dr. Edward Usoskin - C.E.O., Mr. Michael Nikishin, EMC group leader and Mrs. Valeria Mednikov - certification engineer.

3.4 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 1996 with an M. Sc. EE degree and certified by NARTE as an EMC Accredited Test Laboratory engineer, the certificate No. is ATL–0005–E.
I have obtained 2 years experience in EMC measurements and have been with Hermon Laboratories since 1998.

Name: Mr. Michael Nikishin Signature: _____
Position: EMC group leader Date: January 11, 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 have a university degree and more than 10 years experience in document processing.
I have been with Hermon Laboratories since May 1999.

Name: Mrs. Valeria Mednikov Signature: _____
Position: certification engineer Date: January 11, 2000

I hereby certify that this test measurement report was prepared under my direction and that to the best of my knowledge and belief, the facts set in the report and accompanying technical data are true and correct.
The following is a statement of my qualifications.
I have a Ph.D. degree in electronics, have obtained more than 42 years of experience in EMC measurements, electronic product design and have been with Hermon Laboratories since 1986.
.Also, I am an EMC engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA). The certificate no. is EMC-000623-NE, Senior Member.

Name: Dr. Edward Usoskin Signature: _____
Position: C.E.O. Date: January 11, 2000

4 Radiated emission measurements

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

4.1.1 General

Specified limit at 3 m distance is given in Table 4.1.1 below

Table 4.1.1 The field strength limits

Frequency,	Average detector		Peak detector	
	Field strength of fundamental,	Field strength of spurious emissions,	Field strength of fundamental,	Field strength of spurious emissions,
MHz	dB(μV/m)	dB(μV/m)	dB(μV/m)	dB(μV/m)
318	75.8	55.8	95.8	75.8

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, 4.1.2 and operated in continuous transmitting mode. The EUT was tested in 3 axes. The frequency range from 30 MHz up to 10^{th} harmonic was investigated. All harmonics were then separately investigated at the open field test site except the frequency 954.11 MHz at which an ambient noise was encountered, hence the measurements at this frequency were repeated in the anechoic chamber.

Log periodic and double ridged guide antennas were used at the open field test site and biconilog and double ridged guide antennas in the anechoic chamber. 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 EUT has met the average emission requirements. The peak emission limitations of §15.35 were also met.

The test results are recorded into Tables 4.1.2, 4.1.3. Average factor -26 dB was calculated according to the formula

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

where

T_{ON} , transmission duration within 100 msec , is 5 ms, see Plot 4.1.1,

$$20 \log (5 \text{ ms}/100 \text{ ms}) = -26 \text{ dB}.$$

Reference numbers of test equipment used

HL 0025	HL 0026	HL 0034	HL 0038	HL 0091	HL 0275	HL 0287	HL 0465
HL 0483	HL 0521	HL 0554	HL 0604	HL 0812	HL 0813	HL 1116	

Full description is given in Appendix A.

Table 4.1.2

Radiated emission measurements, peak limit

TEST SPECIFICATION: FCC part 15 subpart C § 15.209
DATE: October 29, 1999
RELATIVE HUMIDITY: 47%
AMBIENT TEMPERATURE: 23°C

Frequency MHz	Measured result, dB (μV)	Ant. type	Ant. pol.	RBW, MHz	VBW, MHz	Antenna factor, dB(1/m)	Cable loss and ampl. gain, dB	Radiated emission, Peak dB (μV/m)	Peak limit @ 3 m dB(μV/m)	Margin, dB	Pass/ Fail
318.02	67.99	LP	H	0.1	OFF	19.2		87.19	95.8	8.61	Pass
636.04	30.43	LP	H	0.1	OFF	26.1		56.53	75.8	19.27	Pass
954.11	-	BL	V	0.1	0.3	-		44.64	75.8	31.16	Pass
1272.24	50.8	DR	H	1	3	25.2	23.3	52.7	75.8	23.1	Pass
1590.14	36.6	DR	V	1	3	27.0	5.3	58.3	74	15.7	Pass
1908.12	45.8	DR	H	1	3	29.1	14.8	60.1	75.8	15.7	Pass
2225.66	52.0	DR	H	1	3	29.9	17.7	64.2	74	9.8	Pass
2544.30	58.5	DR	H	1	3	31.1	17.0	72.5	75.8	3.3	Pass
2861.74	52.5	DR	H	1	3	31.4	16.4	67.5	74	6.5	Pass
3180.30	53.5	DR	H	1	3	31.9	17.9	67.5	75.8	8.3	Pass

Notes to table:

Peak detector was used.

Radiated emission dB(μV/m) = peak measured result (dB(μV)) + ant. factor (dB(1/m)) + cable loss (dB) – amplifier gain (dB).
Ant. type = antenna type (LP – log periodic, BL – biconilog, DR – double ridged guide antenna).
Ant.pol. = antenna polarization (H – horizontal, V – vertical).
Average factor = -26 dB.
Peak limit = average limit dB(μV/m) +20 dB.
Margin = dB below (negative if above) limit.

Table 4.1.3

Radiated emission measurements, average limit

TEST SPECIFICATION: FCC part 15 subpart C § 15.209
DATE: October 29, 1999
RELATIVE HUMIDITY: 47%
AMBIENT TEMPERATURE: 23°C

Frequency, MHz	Measured result, dB (μV)	Ant. type	Ant. pol.	RBW, MHz	VBW, MHz	Antenna factor, dB(1/m)	Cable loss and ampl. gain, dB	Radiated emission, average dB (μV/m)	Avg. limit @ 3 m, dB(μV/m)	Margin, dB	Pass/ Fail
318.02	67.99	LP	H	0.1	OFF	19.2		61.19	75.8	14.61	Pass
636.04	30.43	LP	H	0.1	OFF	26.1		30.53	55.8	25.27	Pass
954.11	-	BL	V	0.1	0.3	-		18.64	55.8	37.16	Pass
1272.24	50.8	DR	H	1	3	25.2	23.3	26.7	55.8	29.1	Pass
1590.14	36.6	DR	V	1	3	27.0	5.3	32.3	54	21.7	Pass
1908.12	45.8	DR	H	1	3	29.1	14.8	34.1	55.8	21.7	Pass
2225.66	52.0	DR	H	1	3	29.9	17.7	38.2	54	15.8	Pass
2544.30	58.5	DR	H	1	3	31.1	17.0	46.5	55.8	9.3	Pass
2861.74	52.5	DR	H	1	3	31.4	16.4	41.5	54	12.5	Pass
3180.30	53.5	DR	H	1	3	31.9	17.9	41.5	55.8	14.3	Pass

Notes to table:

Peak detector was used.
Radiated emission dB(μV/m) = peak measured result (dB(μV)) + ant. factor (dB(1/m)) + cable loss (dB) – amplifier gain (dB) + average factor (dB).
Ant. type = antenna type (LP – log periodic, BL – biconilog, DR – double ridged guide antenna).
Ant.pol. = antenna polarization (H – horizontal, V – vertical).
Average factor = -26 dB.
Average limit is in accordance with § 15.231(b).
Margin = dB below (negative if above) limit.

Plot 4.1.1

Transmission duration measurements

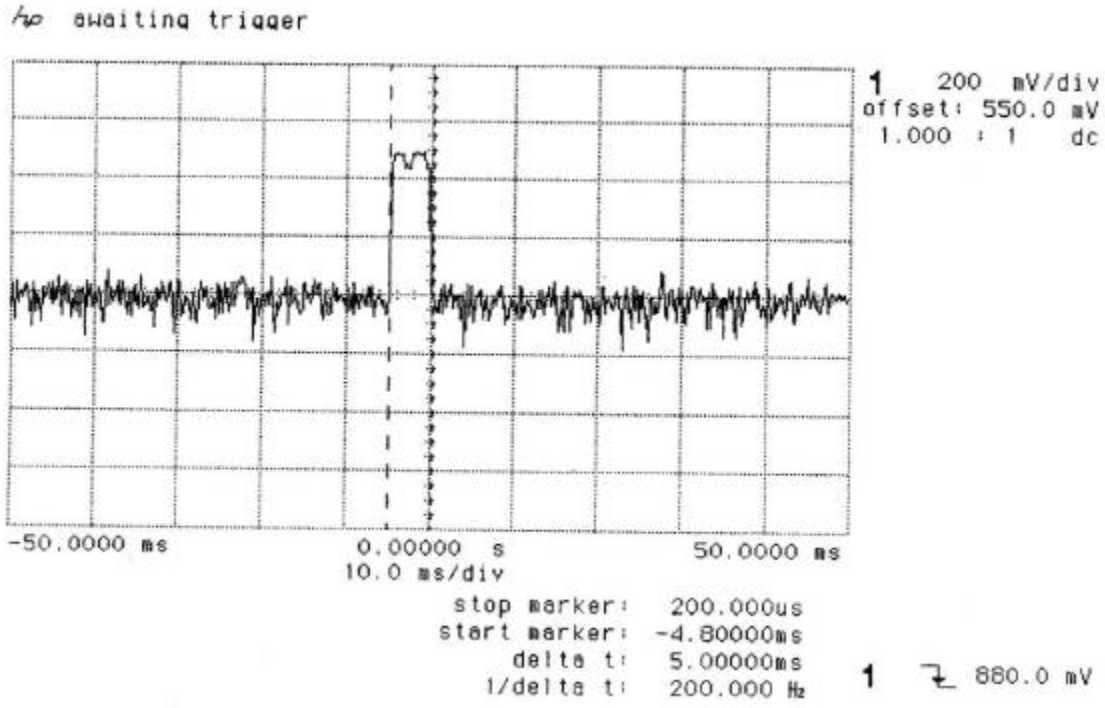
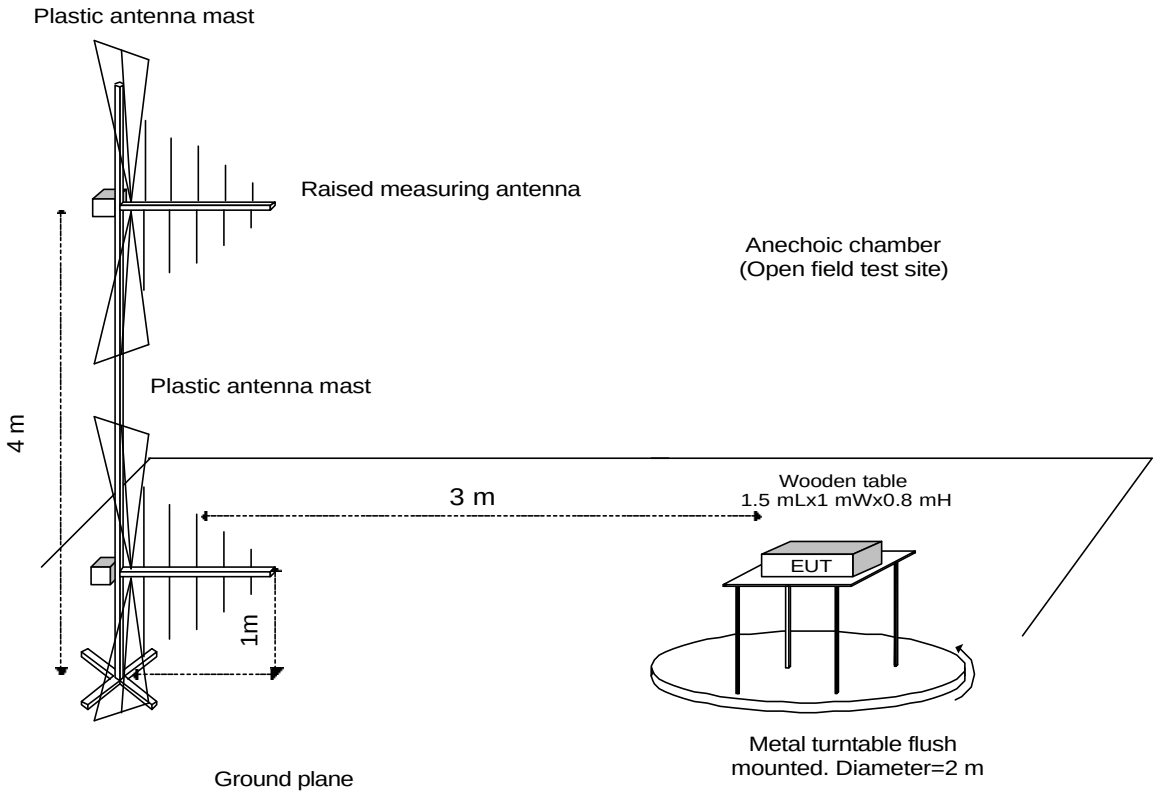
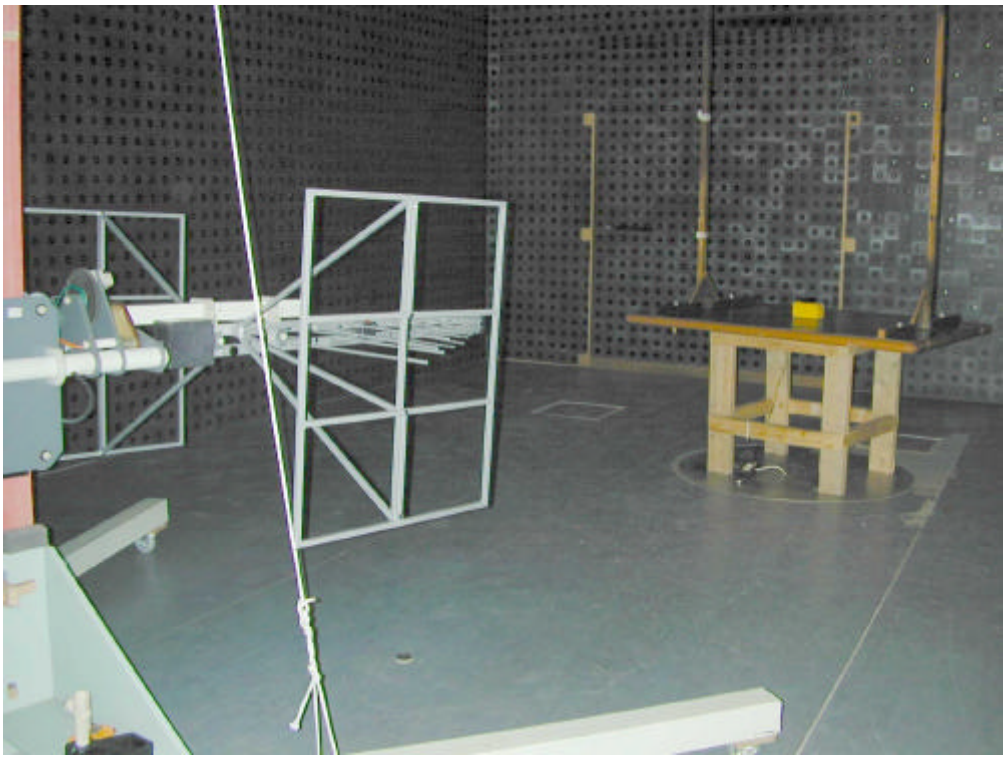


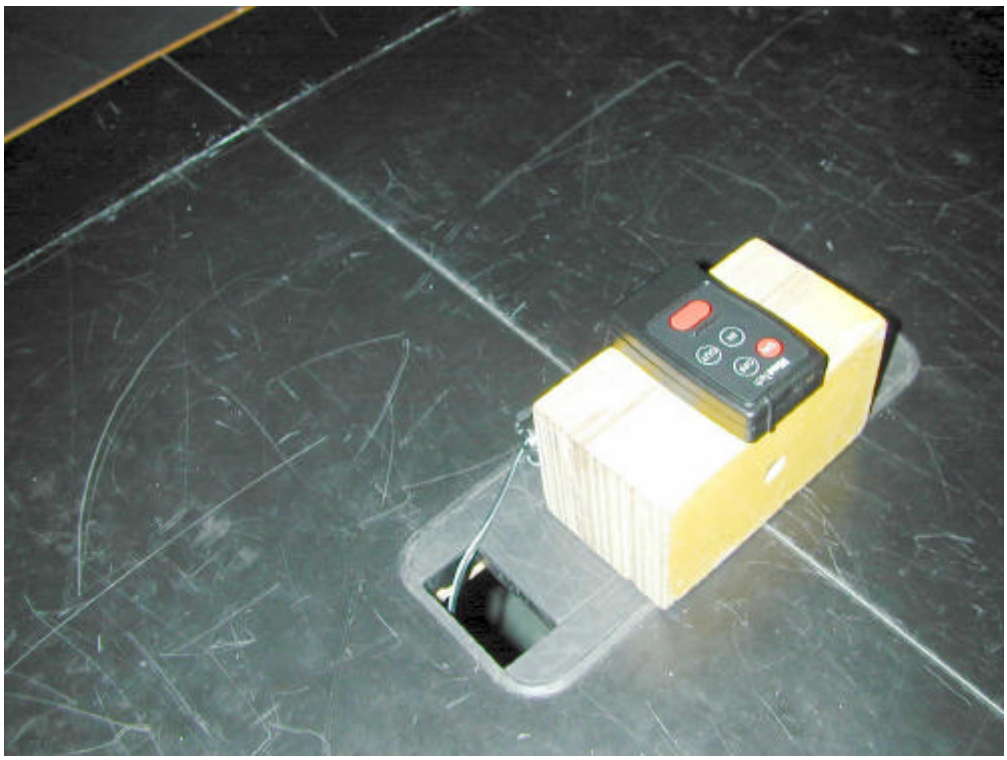
Figure 4.1.1
Radiated emission test setup



Photograph 4.1.1
Radiated emission measurements setup



Photograph 4.1.2
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 318 MHz = 795 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 460 kHz was measured which is narrower than admitted 795 kHz.

The test results are shown in Plot 4.2.1.

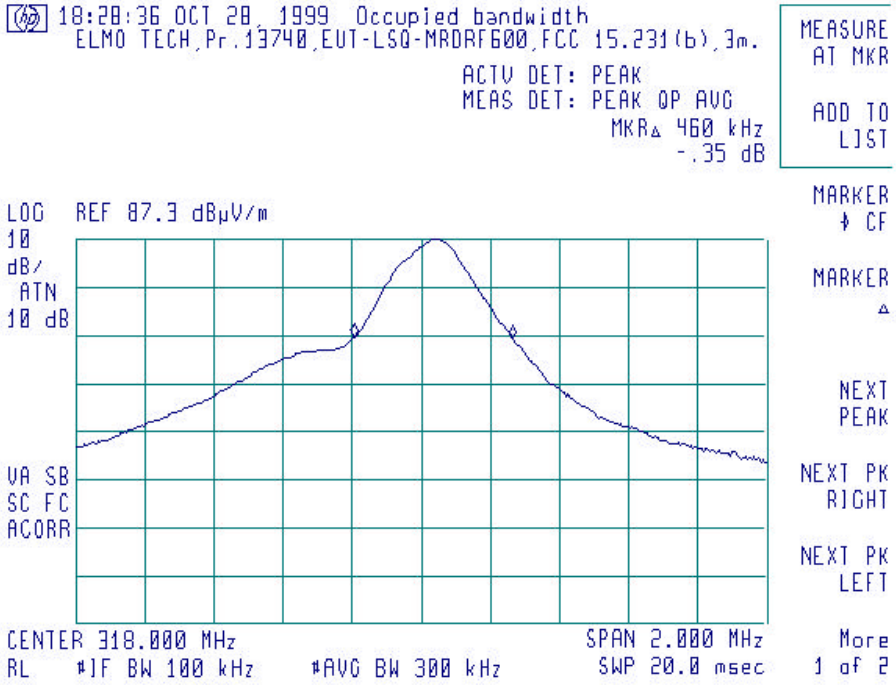
Reference numbers of test equipment used

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)

In the Panic MRD the transmission is triggered once the operator presses the panic button. The press does not activate the transmission directly, it commands a CPU that a transmission is required. The CPU then activates the transmission switch and immediately deactivates it. The transmission duration is only 5 milliseconds therefore the requirement is fully met.

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 1 GHz. The EUT was placed on the wooden table as shown in Figure 4.1.1 and Photographs 4.1.1, 4.1.2. The biconilog antenna was used. 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: RBW=120 kHz, peak and quasi peak detectors.

The EUT was tested in stand-by mode.

All emissions were found at least 15 dB below the limit.

The test measurement results are shown in Plot 4.4.1.

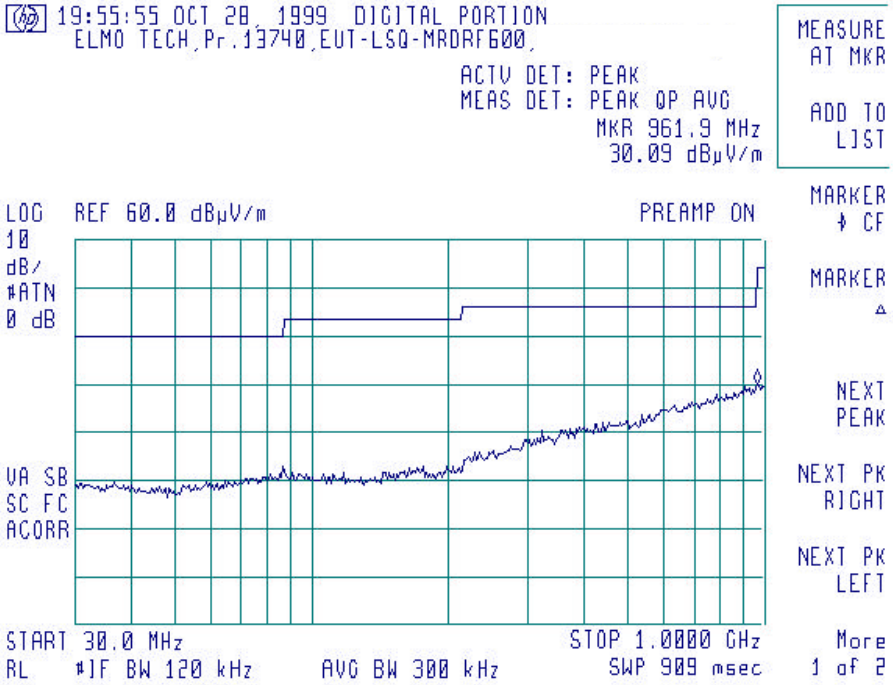
Reference numbers of test equipment used

HL 0465	HL 0521	HL 0604

Full description is given in Appendix A.

Plot 4.4.1

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.
0025	5837	Spectrum analyzer, 10 kHz-23 GHz	Anritsu	MS-710C	8/00
0026	3460	Spectrum analyzer, 100 Hz-2.2 GHz	Anritsu	MS 2601A	10/00
0034	1988	Log periodic antenna, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	3/00
0038	028	Antenna mast, 1-4 m	Hermon Labs	AM-1	2/00 Check
0091	032	Position controller for Antenna mast + turntable, OFTS	Hermon Labs	CRL-2	1/00 Check
0275	040	Table non-metallic, adjustable height, 1.5 x 1.0 x 0.8 m	Hermon Labs	TNM	3/00 Check
0287	042	Turntable, motorized diameter, 2m	Hermon Labs	TMD-2	4/00 Check
0465	023	Anechoic chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	3/00
0483	1325	Oscilloscope, digitizing, 100 MHz	Hewlett Packard	54501A	11/00
0521	0319	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	7/00
0554	4300	Amplifier, 2 – 18 GHz	Miteq	AFD-4	12/00
0604	9611-1011	Antenna biconilog log-periodic/T bow-tie, 26 - 2000 MHz	EMCO	3141	7/00
0812	148	Cable, coax, RG-214, 11.5 m, N-type connectors	Hermon Labs	C214-11	8/00
0813	149	Cable, coax, RG-214, 12 m, N-type connectors	Hermon Labs	C214-12	8/00
1116	186	Double ridged guide antenna, 1-18 GHz	Hermon Labs	A1-18	4/00

APPENDIX B-Test equipment correction factors

Log Periodic antenna LPA-25/30(s/n 035)
(3 m distance)

Frequency MHz	Antenna factor dB(1/m)
200.0	12.7
250.0	13.4
300.0	16.3
400.0	17.1
500.0	18.9
600.0	19.9
700.0	22.3
800.0	22.5
900.0	24.1
950.0	24.4
1000.0	25.4

Hermon Laboratories
Antenna factor
Double ridged guide antenna, model A1-18
S/N 186

Freq, MHz	ANTENNA FACTOR, dB(1/m)
1000.0	24.6
1500.0	26.4
2000.0	29.7
2500.0	31.1
3000.0	31.5
3500.0	32.7
4000.0	36.1
4500.0	36.1
5000.0	39.9
5500.0	40.5
6000.0	40.4
6500.0	41.0
7000.0	41.2
7500.0	41.2
8000.0	44.3
8500.0	40.7
9000.0	39.3
9500.0	41.3
10000.0	42.8
10500.0	43.8
11000.0	47.0
11500.0	46.3
12000.0	43.4
12500.0	41.8
13000.0	41.9
13500.0	44.5
14000.0	44.8
14500.0	44.9
15000.0	44.4
15500.0	43.4
16000.0	42.6
16500.0	43.6
17000.0	42.3
17500.0	45.9
18000.0	45.3

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).