Keytron Electronics & Technologies Ltd.

FCC requirements § 2.1033 (b)

TECHNICAL REPORT

FCC requirements § 2.1033 (b)(1)

The applicant and the manufacturer is the same company
Keytron Electronics & Technologies Ltd.

Address	Science Park-Kiryat Weizmann, 3
P.O.B.	2111
City	Rehovot
Zip code	76120
State	Israel
Telephone number	011-972-8940 5068
Telefax number	011-972-8940 4768
Responsible person	Mr. Yaakov Krupka, President

HERMON LABORATORIES

Test Report: KEYTX.12648
Date: March, 1998
Total 26 pages
FCC ID: NRFET9744

ELECTROMAGNETIC EMISSIONS TEST REPORT

ACCORDING TO FCC PART 15, SUBPART C, §15.249

FOR

KEYTRON ELECTRONICS & TECHNOLOGIES Ltd.

EQUIPMENT UNDER TEST

EXERCITOR ™ 21 TRANSMITTER

Prepared by: _____
Mrs. M. Cherniavsky, Certif. Engineer
Hermon Labs

Approved by: _____
Mr. A. Usoskin, QA Manager
Hermon Labs

Approved by: _____ 27 March 1998
Dr. E. Usoskin, C.E.O.
Hermon Labs

Approved by: _____
Mr. Y. Krupka, President
Keytron Electronics & Technologies Ltd.

Hermon Laboratories Ltd.
P.O.Box 23
Binyamina 30550, Israel
Tel.+972-6628-8001
Fax.+972-6628-8277
Email:hermon@Netvision.net.il

ACCREDITED
839.01

Description of equipment under test

Test items	Low Power Transmitter, FCC ID:NRFET9744
Manufacturer	Keytron Electronics & Technologies Ltd.
Brand Mark	Keytron Electronics & Technologies Ltd.
Type (Model)	Exercitor ™ 21
S/N	9746-106

Applicant information

Applicant's representative	Mr. Yaakov Krupka, President
Responsible person	Mr. Yaakov Krupka, President
Company	Keytron Electronics & Technologies Ltd.
Address	Science Park, Kiryat Weizmann
P.O. Box	2111
Postal code	76120
City	Rehovot
Country	Israel
Telephone number	011-972-8940 5068
Telefax number	011-972-8940 4768

Test performance

Project Number	12648
Test facility and its location	Hermon Laboratories, Binyamina, Israel
Test started	March 4, 1998
Test completed	March 4, 1998
Purpose of test	The EUT certification in accordance with CFR 47, part 2, §2.1033
Test specification(s)	FCC part 15, subpart C, §15.249

Table of Contents

1 General Information

1.1 Abbreviations and Acronyms

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

AVR	average
BW	bandwidth
cm	centimeter
dB	decibel
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
DC	Direct Current
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
GHz	Gigahertz
H	Height
HL	Hermon Laboratories
HP	Hewlett Packard
Hz	Hertz
IF	Intermediate frequency
kHz	kilohertz
kV	kilovolt
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
V	volt
V/m	volt per meter

1.2 Specification References

CFR 47 part 15:1997	Radio Frequency Devices
ANSI C63.2:06/1987	American National Standard for Instrumantation-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.

1.3 EUT Description

The Exercitor ™ 21 transmitter is a part of Exercitor ™ 21 computerized exercising system which turns a computer into a personal aerobic exercise trainer.
The Exercitor ™ 21 comprises the PC software on CD-ROM, an ergonomically-designed lightweight belt (to wear around the chest) with transmitter and a telemetry receiver connected directly to the PC serial port.
The belt transmitter, FCC ID:NRFET9744, is the HX2000 Hybrid transmitter operating at 916.5 MHz frequency and is powered by 3.6 V DC.

1.4 Statement of Manufacturer

I, Yaakov Krupka, President of Keytron Electronics & Technologies Ltd., declare that the Exercitor ™ 21 transmitter, FCC ID:NRFET9744 was tested on March 4, 1998 by Hermon Laboratories and which this test report applies to, is identical of the equipment that will be marketed.

The term identical means identical within the variations that can be expected to arise as a result of quantity production technique.

Yaakov Krupka, President
Keytron Electronics & Technologies Ltd.

Signature: _____

Date: 6-APR-98

2 Test Facility Description

2.1 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), recognized by VDE (Germany) for witness test, certified by VCCI (Japan), Registration No. C-266, R-263, accredited by Netherlands Metrology Institute according to EN 45001 for all European Telecommunications (Network and Wireless) standards, including Safety, recognized by TUV Sudwest (Germany) for Safety testing, and Accredited 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 of Information Technology Equipment (Certificate No. 839.01).

Address:	PO Box 23, Binyamina 30550, Israel.
Telephone:	+972-6-628-8001
Fax:	+972-6-628-8277

Person for contact: Mr. Alex Usoskin, Testing and QA Manager.

2.2 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.

2.2.1 Uncertainty in Hermon Labs Measurements

Radiated Emissions (95% Confidence)	Biconical Antenna: 3m measuring distance : + 4.06 dB Expanded uncertainty : - 3.98 dB Expanded uncertainty : + 2.032 dB Combined standard uncertainty : - 1.99 dB Combined standard uncertainty 10m measuring distance : + 3.98 dB Expanded uncertainty : - 4.08 dB Expanded uncertainty : + 1.99 dB Combined standard uncertainty : - 2.04 dB Combined standard uncertainty Log periodic Antenna: 3m measuring distance : + 4.74 dB Expanded uncertainty : - 3.26 dB Expanded uncertainty : + 2.37 dB Combined standard uncertainty : - 1.63 dB Combined standard uncertainty 10m measuring distance : + 3.06 dB Expanded uncertainty : - 3.00 dB Expanded uncertainty

2.3 Laboratory Personnel

The three people of Hermon Laboratories that have participated in measurements and documentation preparation are: Dr. Edward Usoskin - Laboratory C.E.O., Mr. Michael Feldman, test technician, and Mrs. Marina Cherniavsky - certification engineer.
Dr. E. Usoskin is an EMC Specialist and M. Cherniavsky is a Telecommunication Engineer certified by the National Association of Radio and Telecommunications Engineers (NARTE, USA.).
The Hermon Laboratories' personnel that participated in this project have more than 90 years combined experience time in EMC measurements and electronic products design.

2.4 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 a technician, have obtained 28 years experience in electronics and measurements.
I have been with Hermon Laboratories since 1995.

Name: Mr. Michael Feldman
Position: test technician
Signature:
Date: March 25, 1998

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 25 years experience in electronic products design and development and 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
Position: certif. engineer
Signature:
Date: March 25, 1998

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 41 years of experience in EMC measurements and 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
Position: C.E.O.
Signature:
Date: March 25, 1998

3 Radiated Emission Measurements

3.1 Field Strength of Emissions according to § 15.249

3.1.1 Specified Limits at 3 m distance

Fundamental Frequency (MHz)	Field Strength of Fundamental (dB μV/m)	Field Strength of Harmonics (dB μV/m)
902-928	94	114

3.1.2 Test Procedure and Results

The EUT was placed on the wooden turntable, as shown in Figure 3.1 and Photographs 3.1, 3.2. The EUT was operated in continuous transmitting mode and measured in three orthogonal axes during the testing. The frequency range from 30 MHz up to 10th harmonic was investigated. The test was performed at 3 meter test distance, i.e. the distance between measuring antenna and EUT boundary. 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 measurements from 30 MHz to 1 GHz were performed in the anechoic chamber with the biconilog antenna. The EMI receiver settings were: RBW = 120 kHz, quasi-peak detector. The results of measurements were recorded into Table 3.1.1 and are shown in Plot 3.1.1.

The measurements above 1 GHz were performed at open field test site (OFTS) with Double Ridged Guide antenna. To improve measurement sensitivity external preamplifiers were used. The spectrum analyzer settings were:

1. RBW = VBW = 1 MHz, peak detector;
2. RBW = 1 MHz, VBW = 10 Hz, peak detector (video averaging) - this mode was designated as "AVR" in Table 3.1.2.

The maximum II and IV harmonic measured results were recorded in Table 3.1.2 and are shown in Plots 3.1.3 to 3.1.5. No higher spurious signals were found.
The following calculations were made with uncorrected test results:
Maximum measured emission values in dBm were converted to dB(μV). For example, measured value @ frequency 1833 MHz is (see plot 3.1.3 and Table 3.1.2):

$$-40.5 \text{ dBm} + 107 \text{ dB} = 66.5 \text{ dB}(\mu\text{V}).$$

Preamplifiers gain, antenna factor and cable loss were added to each measured peak result to obtain radiated emission result.

Reference numbers of test equipment used

HL 0025	HL 0041	HL 0275	HL 0287	HL 0465	HL 0521	HL 0538
HL 0554	HL 0604					

Full description is given in Appendix A.

Table 3.1.1

Radiated Emission Measurements - Test Results
(Field strength of fundamental frequency)

TEST SPECIFICATION: FCC part 15 subpart C § 15.249(a)
COMPANY: Keytron Electronics & Technologies Ltd.
EUT: Exercitor ™ 21 transmitter
DATE: March 4, 1998
RELATIVE HUMIDITY: 47%
AMBIENT TEMPERATURE: 18°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Resolution Bandwidth kHz	Detector Type	Antenna Type	TT Position (°)	Antenna height m	Measured Result dB (µV)	Specification Limit dB (µV/m)	Specification Margin dB	Pass/ Fail
916.53	120	QP	BL	179	1.7	72.1	94	22.1	Pass

Notes to Table:

Antenna polarization = horizontal
Specified Limit in accordance with § 15.249(a)

Table Abbreviations:
Antenna type = BL (biconilog)
TT Position - turntable position in degrees (EUT front panel=0°)
QP- quasi-peak
Spec. Margin = Specification Margins = dB below (negative if above) specification limit.

Test Performed by:
Mr. Michael Feldman, test technician

Hermon Labs

Customer Representative person:
Mr. Ya'akov Krupka, President

Keytron Electronics & Technologies Ltd.

Table 3.1.2

Radiated Emission Measurements - Test Results
(Field strength of harmonics)

TEST SPECIFICATION: FCC part 15 subpart C § 15.249(a)
COMPANY: Keytron Electronics & Technologies Ltd.
EUT: Exercitor ™ 21 transmitter
DATE: March 4, 1998
RELATIVE HUMIDITY: 47%
AMBIENT TEMPERATURE: 18°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Detect. Type	RBW MHz	VBW	Measured Result dB (μV)	Ant. Factor dB(1/m)	Cable Loss dB	Ampl. Gain dB	Radiated Emissions dB(μV/m)	Specific Limit dB (μV/m)	Specif. Margin dB	Pass/ Fail
1833	Peak	1	1 MHz	66.5	27.2	0.6	35	59.3	114	54.7	Pass
3666	Peak	1	1 MHz	50.1	32.0	1.2	21	62.3	74	11.7	Pass
3666	AVR	1	10 Hz	28.2	32.0	1.2	21	40.4	54	13.6	Pass

Notes to Table:
Antenna type - Double Ridged Guide
Antenna polarization = horizontal
Radiated emissions [dB(μV/m)] = measured result [dB(μV)] + antenna factor [dB(1/m)] + cable loss (dB) - amplifier gain (dB). During the measurements the received emissions were amplified.

Table Abbreviations:
RBW -resolution bandwidth
VBW - video bandwidth
Ampl. Gain - amplifier gain
Specific. Limit = specification limit
Specif. Margin = margins = dB below (negative if above) specification limit.

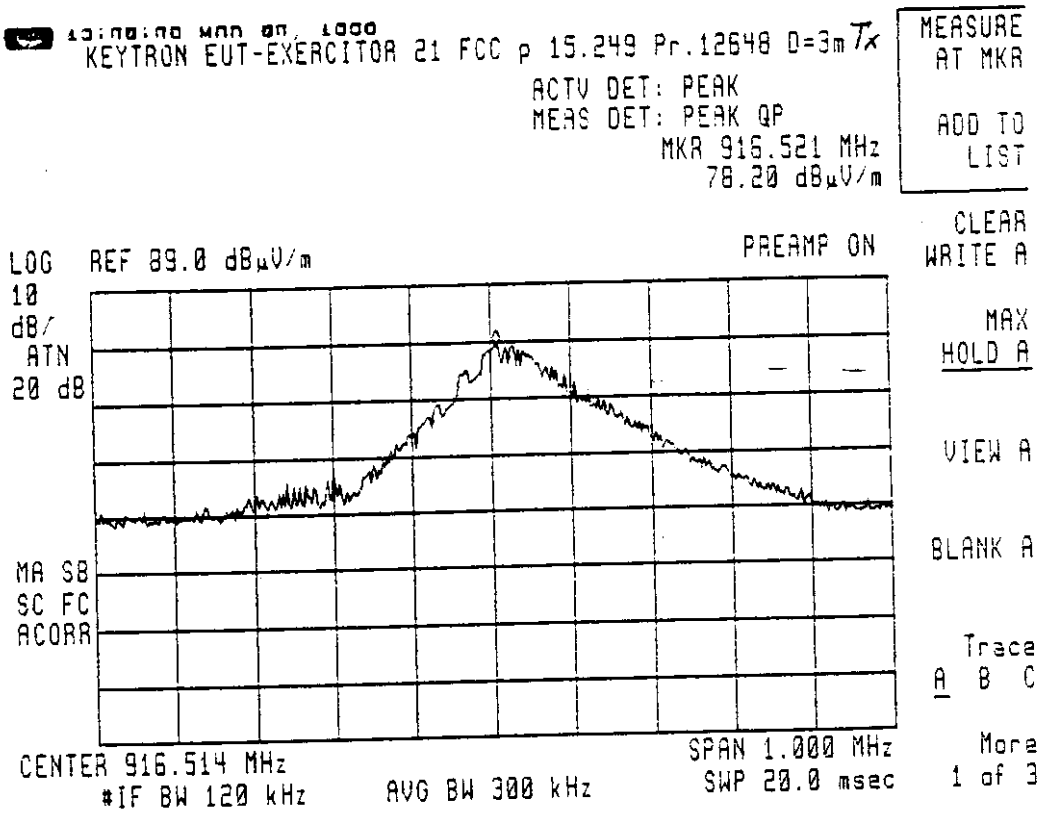
Test Performed by:
Mr. Michael Feldman, test technician

Hermon Labs

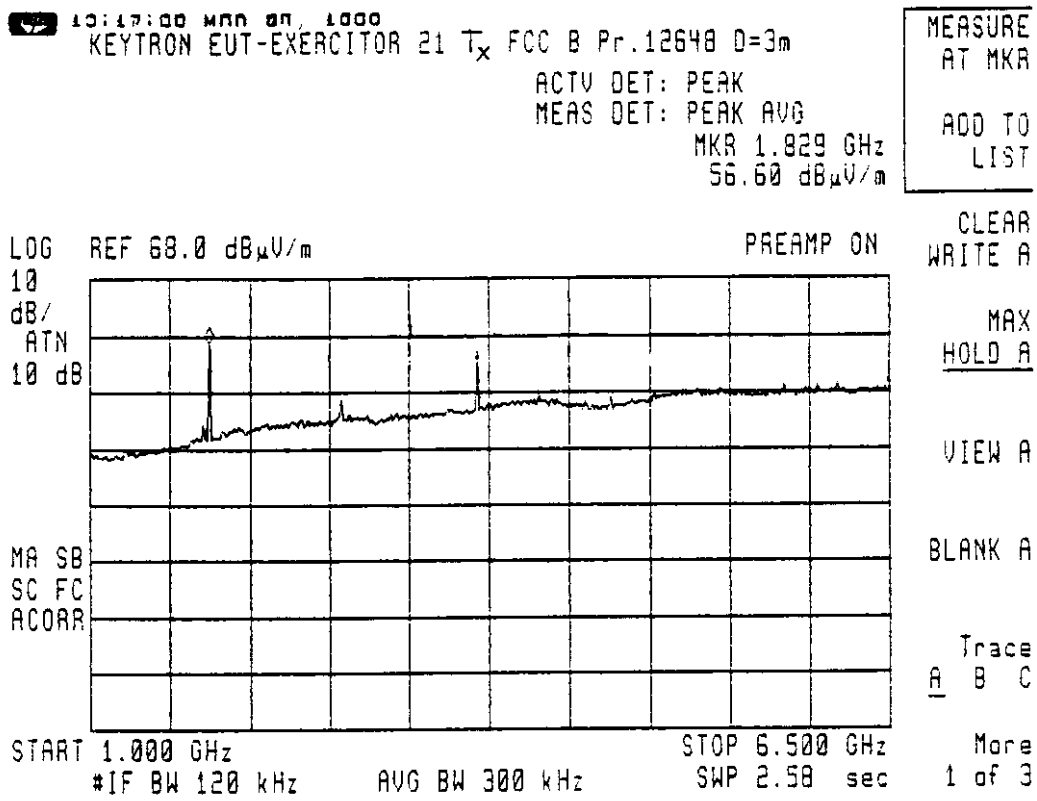
Customer Representative person:
Mr. Yaakov Krupka, President

Keytron Electronics & Technologies Ltd.

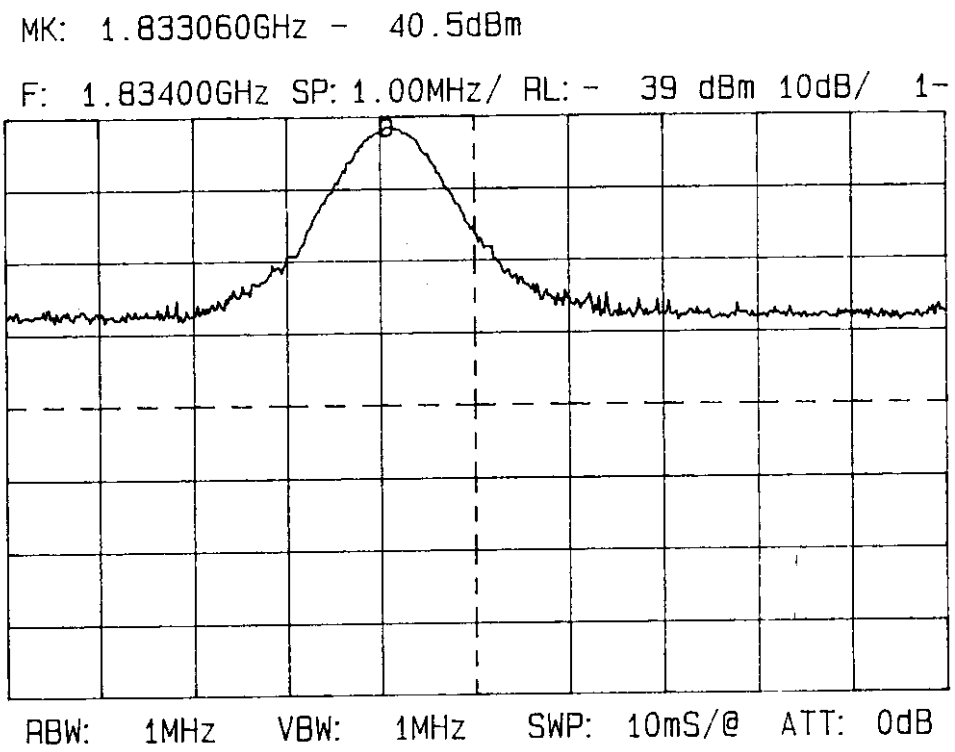
Plot 3.1.1
Radiated Emission Measurement Results
(fundamental)



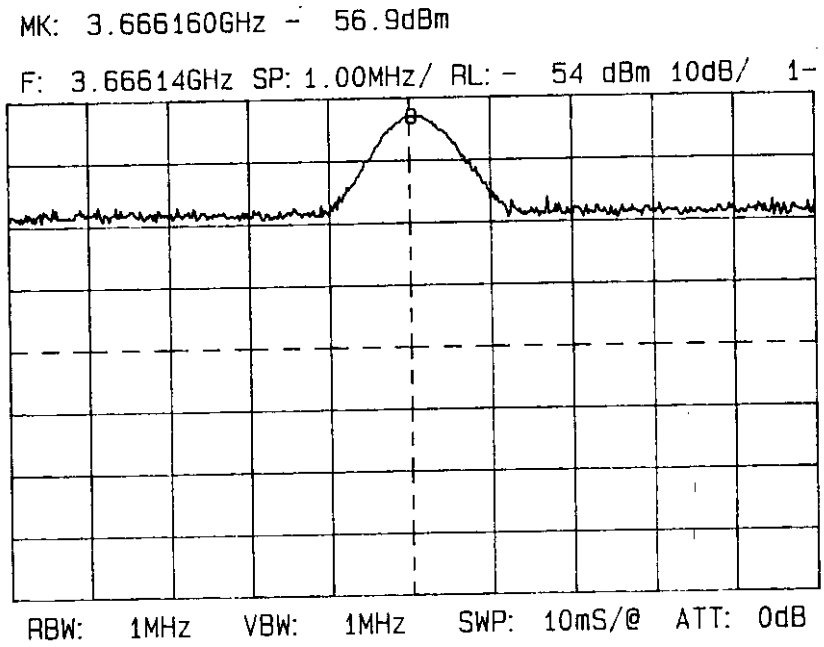
Plot 3.1.2
Radiated Emission Measurement Results
(preliminary, in anechoic chamber)



Plot 3.1.3
Radiated Emission Measurement Results (II harmonic)



Plot 3.1.4
Radiated Emission Measurement Results (IV harmonic)



Plot 3.1.5
Radiated Emission Measurement Results (IV harmonic)

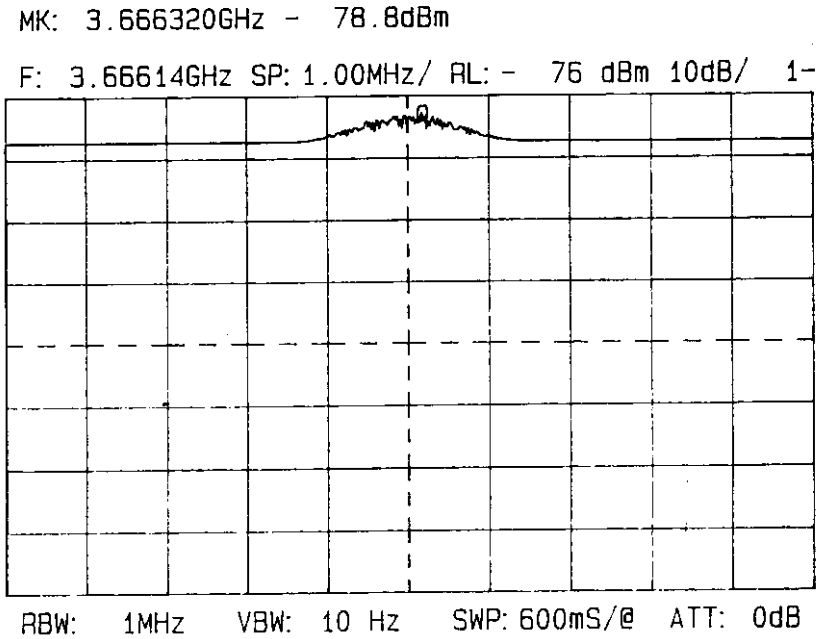
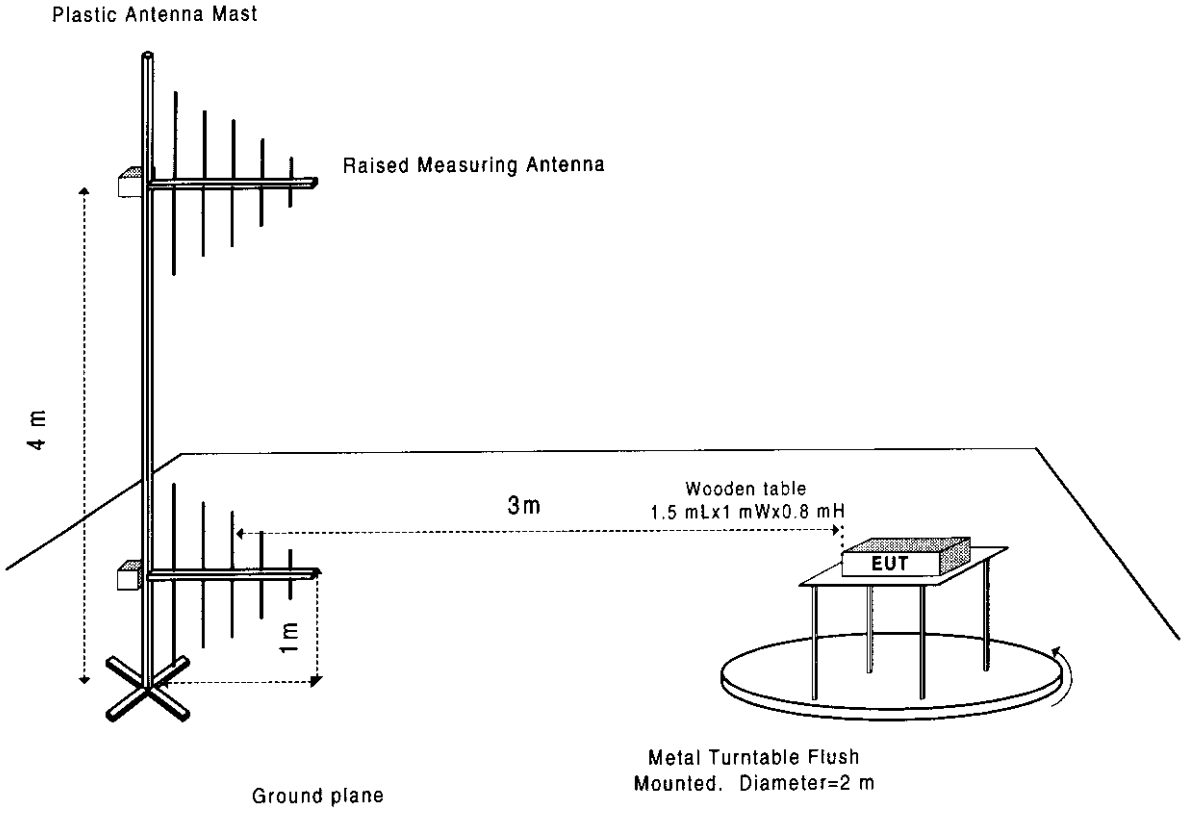
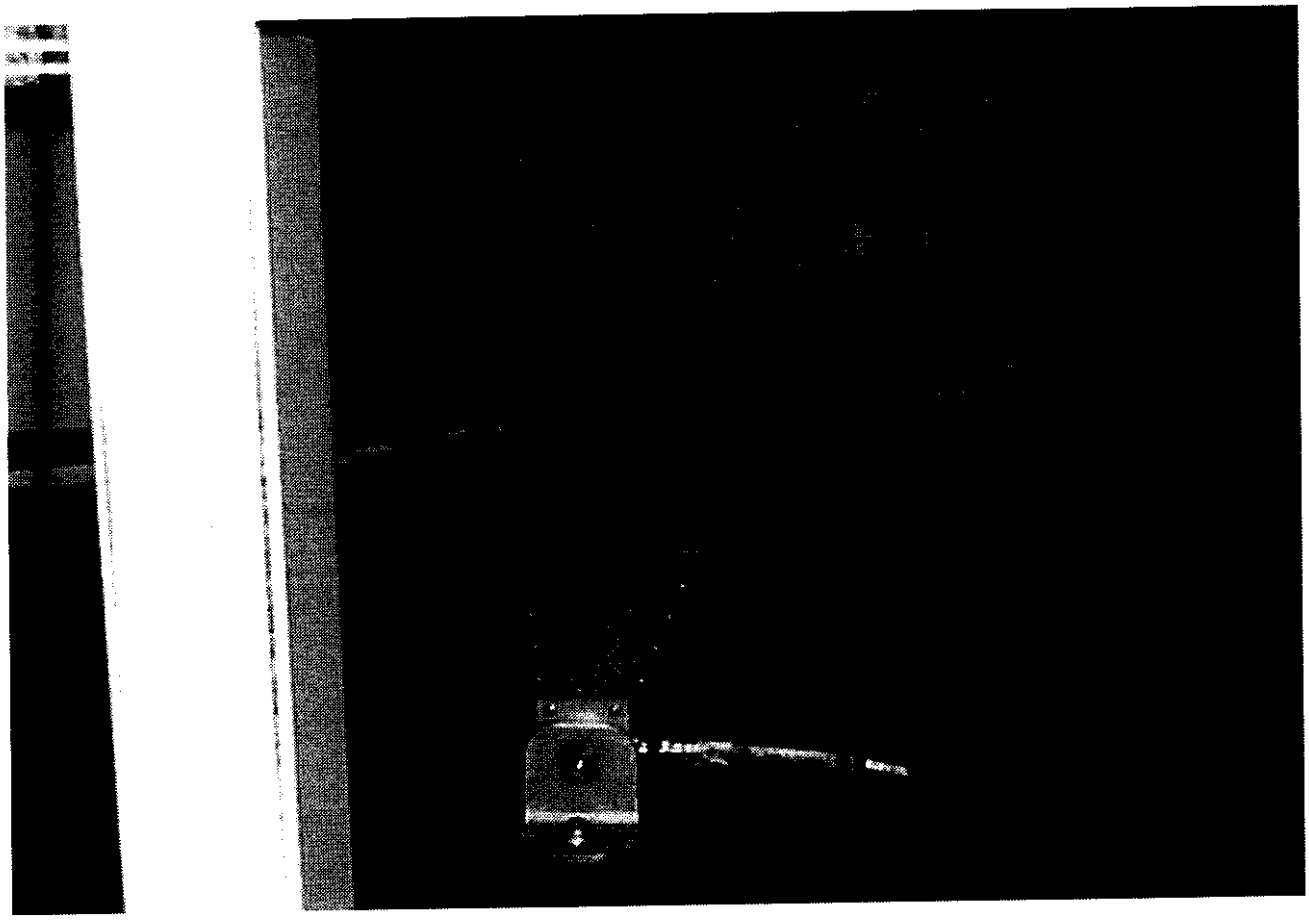


Figure 3.1
Radiated Emission Test Setup





Radiated Emission Measurements Setup
Photograph 3.1

3.2 Unintentional Radiated Emissions (class B digital device) Test according to §15.109

3.2.1 Definition of the test

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 3.2.1 below:

Table 3.2.1 Limits for electric field strength at 3 meters distance, quasi-peak detector

Frequency MHz	Class B Equipment dB (μV/m)
30 - 88	40
88 - 216	43.5
216 - 960	46
960 - 5000	54

3.2.2 Test Procedure and Results

The radiated emissions measurements of the EUT incorporating digital device in the frequency range from 30 MHz to 1 GHz were performed in the anechoic chamber at 3 meters measuring distance. The EUT was placed on the wooden table as shown in Figure 3.1 and Photograph 3.2.
The Biconilog antenna was used. To find maximum radiation the turntable was rotated 360°, the cables position was varied, the measuring antenna height changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal. The quasi-peak detector with resolution bandwidth (IF BW) of 120 kHz was used.

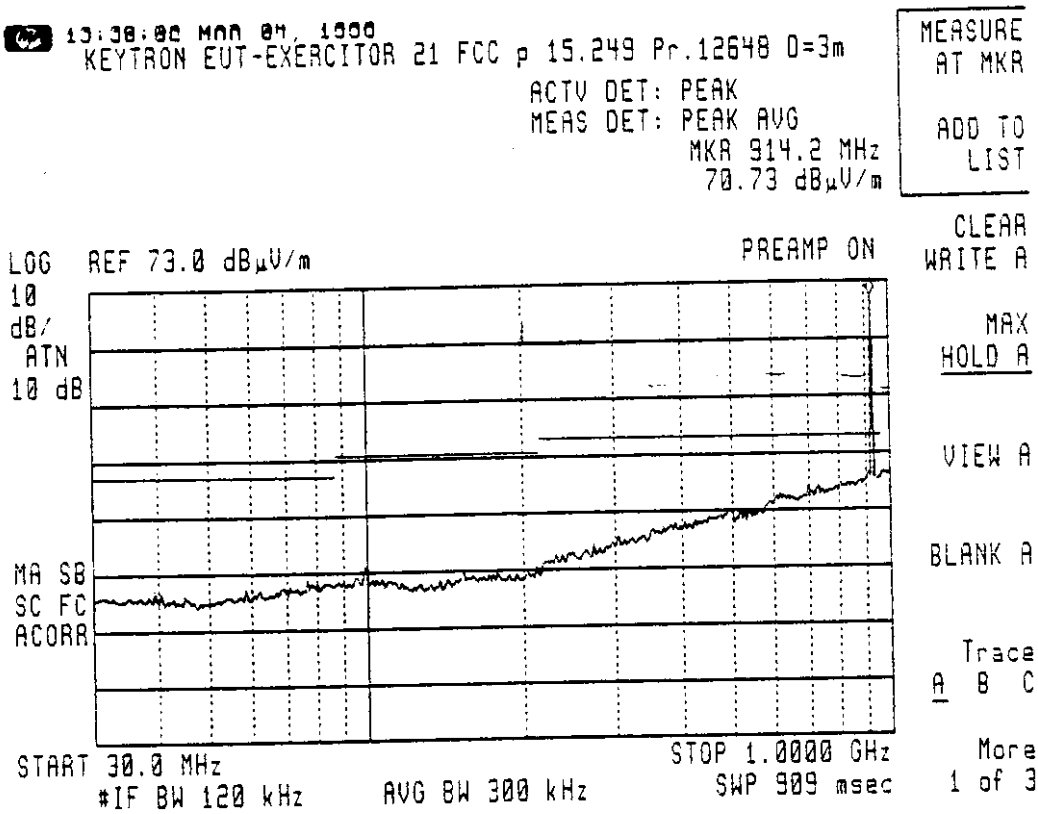
All the measured emission results were at least 20 dB below average limit (refer to Plot 3.2.1).

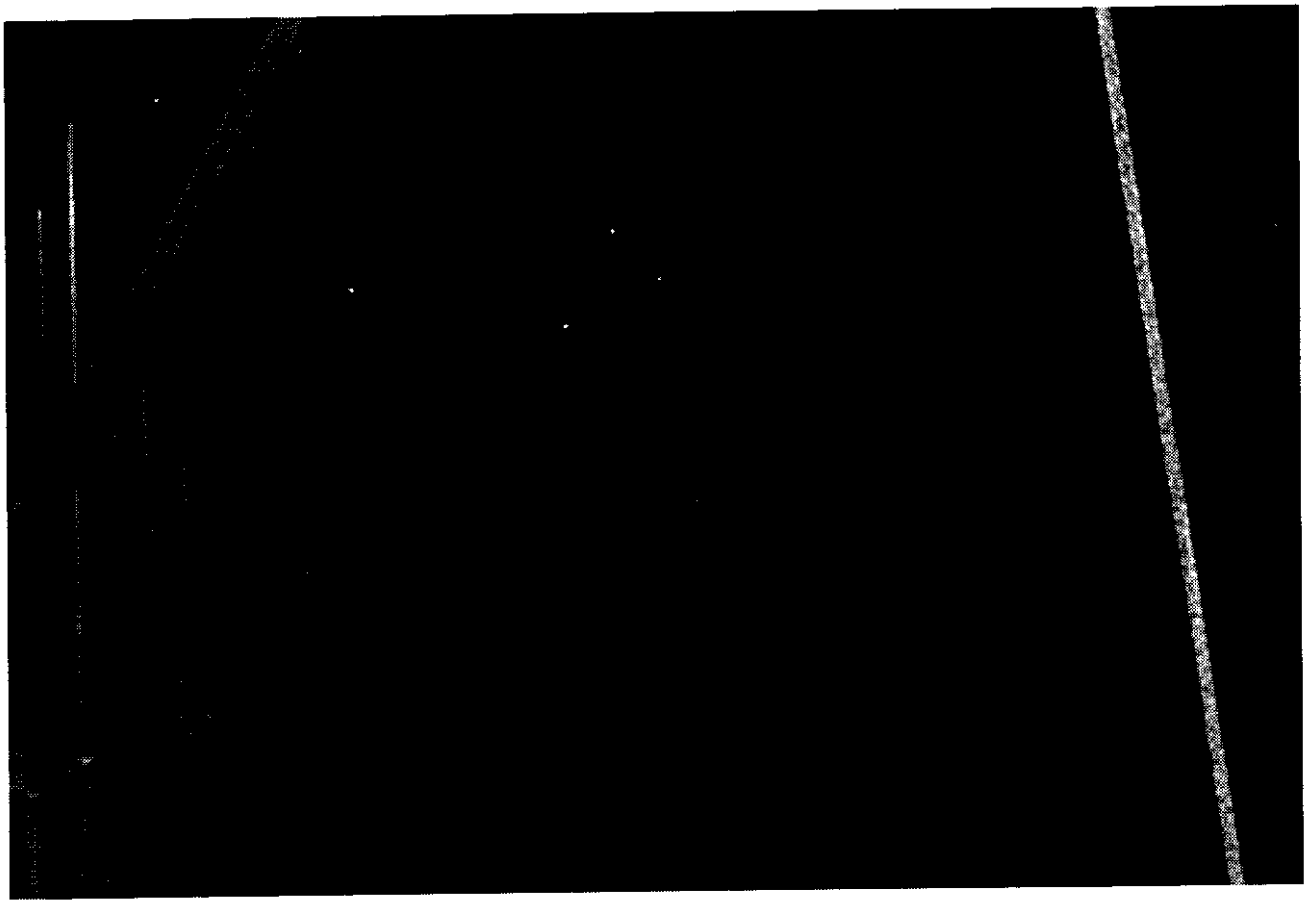
Reference numbers of test equipment used

HL 0275	HL 0465	HL 0521	HL 0593	HL 0604		

Full description is given in Appendix A.

Plot 3.2.1
Radiated Emission Measurement Results
(in 30 -1000 MHz frequency range)





Radiated Emission Measurements Setup
Photograph 3.2

4 Summary and Signatures

The Exercitor ™ 21 transmitter FCC ID:NRFET9744 was found to be in compliance with the requirements of FCC part 15, subpart C, § 15.249.

Test performed by:

Mr. Michael Feldman, test technician

Approved by:

Dr. Edward Usoskin, C.E.O.

Responsible Person from
KEYTRON ELECTRONICS & TECHNOLOGIES Ltd.

Mr. Yaakov Krupka, President

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	8/98
0041	2811	Double Ridged Guide Antenna, 1 - 18 GHz	Electro-Metrics	RGA 50/60	8/98
0275	0275	Wooden Table, 1.5 x 1.0 x 0.8	Hermon Labs	NA	NA
0287	287	Turntable Motorized, Diameter 1.2	Hermon Labs	HLTT-MDC1	NA
0465	0465	Anechoic Chamber 9 mL x 6.5 mW x 5.5 mH	Hermon Labs	NA	10/99
0521	0319	Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	7/98
0538	9285	Amplifier, GaAs FET, RF, 1-2 GHz, 2 W, 30 dB	Avantek	APG-2023M	8/98
0554	4300	Amplifier, RF, 2-18 GHz	MITEQ Inc.	AFD4	3/99
0593	593	Antenna Mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	HLAM-F1	NA
0604	1011	Antenna Log-Periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141 BICONILOG	12/98

HERMON LABORATORIES

APPENDIX B-Test Equipment Correction Factors

Antenna Factor at 3m calibration
Biconilog Antenna EMCO Model 3141
Ser.No.1011

Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8
28	7.8
30	7.8
40	7.2
60	7.1
70	8.5
80	9.4
90	9.8
100	9.7
110	9.3
120	8.8
130	8.7
140	9.2
150	9.8
160	10.2
170	10.4
180	10.4
190	10.3
200	10.6
220	11.6
240	12.4
260	12.8
280	13.7
300	14.7
320	15.2
340	15.4
360	16.1
380	16.4
400	16.6
420	16.7
440	17.0
460	17.7
480	18.1
500	18.5
520	19.1
540	19.5
560	19.8
580	20.6
600	21.3
620	21.5
640	21.2
660	21.4
680	21.9
700	22.2
720	22.2
740	22.1
760	22.3
780	22.6
800	22.7
820	22.9
840	23.1
860	23.4
880	23.8
900	24.1
920	24.1

Frequency, MHz	Antenna Factor, dB(1/m)
940	24.0
960	24.1
980	24.5
1000	24.9
1020	25.0
1040	25.2
1060	25.4
1080	25.6
1100	25.7
1120	26.0
1140	26.4
1160	27.0
1180	27.0
1200	26.7
1220	26.5
1240	26.5
1260	26.5
1280	26.6
1300	27.0
1320	27.8
1340	28.3
1360	28.2
1380	27.9
1400	27.9
1420	27.9
1440	27.8
1460	27.8
1480	28.0
1500	28.5
1520	28.9
1540	29.6
1560	29.8
1580	29.6
1600	29.5
1620	29.3
1640	29.2
1660	29.4
1680	29.6
1700	29.8
1720	30.3
1740	30.8
1760	31.1
1780	31.0
1800	30.9
1820	30.7
1840	30.6
1860	30.6
1880	30.6
1900	30.6
1920	30.7
1940	30.9
1960	31.2
1980	31.6
2000	32.0

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

Antenna Factor
Double Ridged Guide Antenna
Electro-Metrics, Model RGA-50/60
Ser.No.2811

Frequency, MHz	Antenna Factor, dB(1/m)
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
10,000	38.2
10,500	38.5
11,000	39.0
11,500	40.1
12,000	40.2
12,500	39.3
13,000	39.9
13,500	40.6
14,000	41.1
14,500	40.5
15,000	39.9
15,500	37.8
16,000	39.1
16,500	41.1
17,000	41.7
17,500	45.1
18,000	44.3

Antenna factor dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV/meter)