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Electrical

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TEST REPORT

ACCORDING TO: FCC CFR 47 PART 90 SUBPART I and PART 15 SUBPART B

FOR:

Motorola Communication Israel Ltd.

Piccolo interface unit (PIU)

Model:F4604A

FCC ID:AZ489FT4871

Table of contents

1 Applicant information

Client name:	Motorola Communication Israel Ltd.
Address:	3 Kremenetski street, P.O.B. 25016, 67899 Tel Aviv, Israel
Telephone:	+972 3565 8888
Fax:	+972 5762 8847
E-mail:	Tomer.Azov@motorola.com
Contact name:	Mr. Tomer Azov

2 Equipment under test attributes

Product name:	Piccolo interface unit of Distributed I/O System
Product type:	PIU
Model(s):	F4604A
Serial number:	870SEL430
Receipt date	7/15/2004

3 Manufacturer information

Manufacturer name:	Motorola Communication Israel Ltd.
Address:	3 Kremenetski street, P.O.B. 25016, 67899 Tel Aviv, Israel
Telephone:	+972 3565 8888
Fax:	+972 5762 8847
E-Mail:	Tomer.Azov@motorola.com
Contact name:	Mr. Tomer Azov

4 Test details

Project ID:	16002
Location:	Hermon Laboratories Ltd. P.O.Box 23, Binyamina 30500, Israel
Test started:	7/15/2004
Test completed:	8/22/2004
Test specification(s):	47CFR part 90, §§90.217(b), part 15 §15.109
Test suite:	FCC_90_BS_with_RF_connector_below_120mW (7/15/2004 12:12:42 AM, modified)

5 Tests summary

Test	Status
Transmitter characteristics	
Section 90.205, Maximum output power	Pass
Section 90.209, Occupied bandwidth	Pass
Section 90.213, Frequency stability	Pass
Section 90.214, Transient frequency behaviour	Pass
Section 90.217, Band edge emission	Pass
Section 90.217, Conducted spurious emissions	Pass
Section 90.217, Radiated spurious emissions	Pass
Section 2.1091, RF radiation exposure evaluation	Pass
Unintentional emissions	
Section 15.107, Conducted emission at AC power port	Pass
Section 15.109, Radiated emission	Pass
Section 15.111, Conducted emission at receiver antenna port	Pass

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mr. Michael Lerman, test engineer	August 22, 2004	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	September 13, 2004	
	Mr. M. Nikishin, EMC group leader	September 14, 2004	
Approved by:	Mr. A. Usoskin, C.E.O.	September 15, 2004	

6 EUT description

6.1 General information

The EUT, Piccolo Interface Unit (PIU), is a portable device which is most commonly used in the fixed installations enclosed with an indoor plastic housing. The EUT may be powered from 24 VAC or 12 VDC power source or from 9 V internal battery.

6.2 Ports and lines

Port type	Port description	Connected		Connector type	Qty.	Cable type	Cable length	Indoor / outdoor
		From	To					
EUT AC powered								
Power	24 VAC	EUT	Power adaptor	Mollex	1	Unshielded	1.0 m	Outdoor
Power	DC power/ Battery	EUT	Open circuit	Mollex	1	Unshielded	1.0 m	Outdoor
Signal	RS-232	EUT	PC	RJ45	1	Unshielded	12.0 m	Outdoor
Signal	RS-485	EUT	Adaptor	RJ10	1	Unshielded	200.0 m	Outdoor
Signal	Adaptor port	EUT	Not connectded*	RJ10	1	NA	NA	Outdoor
Signal	Antenna	EUT	Antenna	SMA	1	NA	NA	Outdoor
Control	ON	EUT	Jumper	Terminal block	1	NA	NA	Outdoor
GND	Protective earth	EUT	Protective earth		1	AWG 18	0.5 m	Outdoor
EUT DC powered								
Power	24 VAC	EUT	Open circuit	Mollex	1	Unshielded	1.0 m	Outdoor
Power	DC power/ Battery	EUT	Power adaptor	Mollex	1	Unshielded	1.0 m	Outdoor
Signal	RS-232	EUT	PC	RJ45	1	Unshielded	12.0 m	Outdoor
Signal	RS-485	EUT	Adaptor	RJ10	1	Unshielded	200.0 m	Outdoor
Signal	Adaptor port	EUT	Not connectded*	RJ10	1	NA	NA	Outdoor
Signal	Antenna	EUT	Antenna	SMA	1	NA	NA	Outdoor
Control	ON	EUT	Jumper	Terminal block	1	NA	NA	Outdoor
GND	Protective earth	EUT	Protective earth		1	AWG 18	0.5 m	Outdoor

* - Port intended for initial configuration or maintenance only.

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
PC	AST	2500C	337200005890
Monitor	CTX	1785GM	OP3-54401206
Keyboard	IBM	KB-9910	1S37L25280007146A
Mouse	Microsoft	1.3A	5099327-3

6.4 Operating frequencies

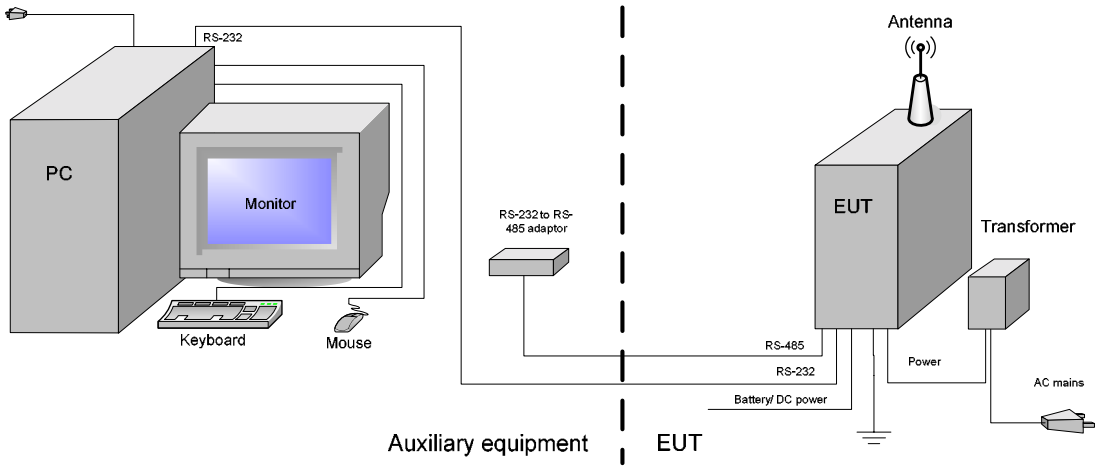
Source	Frequency, MHz	
Clock	8.0	16.8
Receiver LO	405.15 – 425.15	
Transmitter	450.0 – 470.0	

6.5 Changes made in the EUT

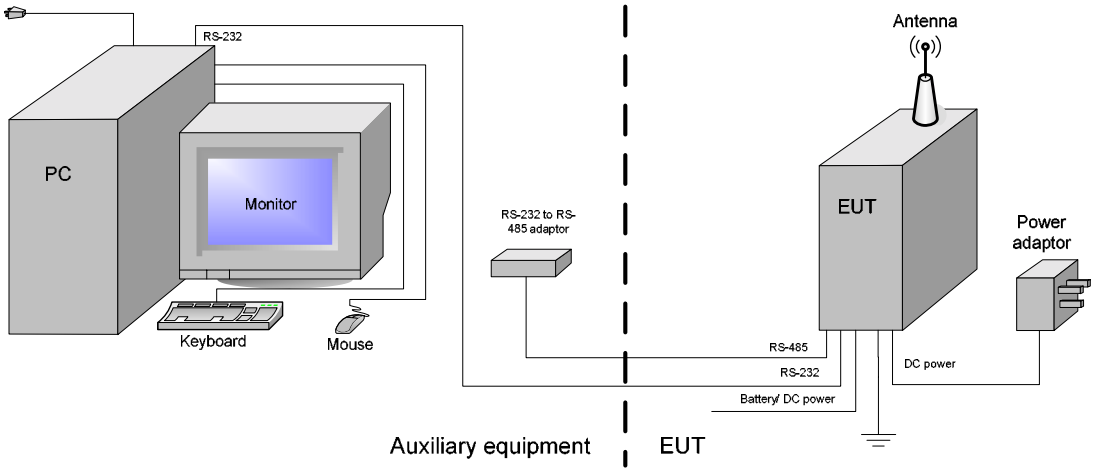
No changes were implemented.

6.6 Test configuration

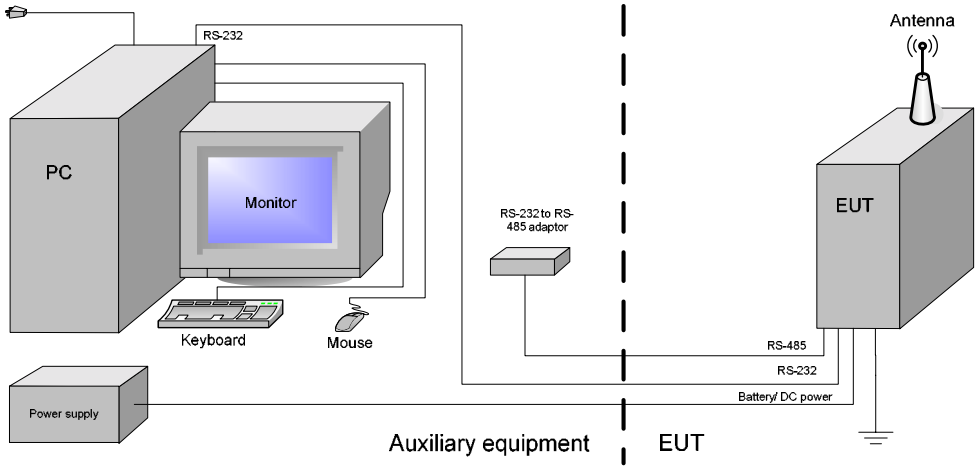
6.6.1 Configuration 1: EUT AC powered



6.6.2 Configuration 2: EUT powered through power adaptor



6.6.3 Configuration 3: EUT DC powered



6.7 Transmitter characteristics

Type of equipment	
V	Stand-alone (Equipment with or without its own control provisions)
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)
	Plug-in card (Equipment intended for a variety of host systems)

Intended use		**Condition of use**
	fixed	Always at a distance more than 2 m from all people
	mobile	Always at a distance more than 20 cm from all people
V	portable	May operate at a distance closer than 20 cm to human body

Assigned frequency range	450 -470 MHz
Operating frequency range	450 -470 MHz
RF channel spacing	12.5 kHz

Maximum rated output power	At transmitter 50 Ω RF output connector	20 dBm
	Effective radiated power (for equipment with no RF connector)	dBm

Is transmitter output power variable?		No		
	V	Yes		continuous variable
			V	stepped variable with stepsize: 10.0 dB
				minimum RF power: 10 dBm
				maximum RF power: 20 dBm

Antenna connection				
unique coupling	**V**	standard connector SMA type	integral	with temporary RF connector
				without temporary RF connector

Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
External	Centurion Wireless Technologies, Inc.	EXC450SM	Unity

Transmitter aggregate data rate/s	1200 bps					
Transmitter aggregate symbol (baud) rate/s	600 symbols per second					
Type of modulation	DPSK					
Type of multiplexing	NA					
Modulating test signal (baseband)	PRBS					
Maximum transmitter duty cycle in normal use	100%	**Tx ON time**	msec	**Period**	msec	
Transmitter duty cycle supplied for test	100%	**Tx ON time**	msec	**Period**	msec	

Transmitter power source						
V	Battery	**Nominal rated voltage**	9.0 VDC	Battery type	Alkaline	
V	DC	**Nominal rated voltage**	12.0 VDC, 6.0 – 16.0 V DC			
V	AC mains	**Nominal rated voltage**	24 VAC	Frequency	50/60 Hz	

Common power source for transmitter and receiver	**V**	yes	no

Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/23/2004 8:32:01 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

7 Transmitter tests according to 47CFR part 90 subpart I requirements

7.1 Peak output power test

7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1. The test results are provided in Table 7.1.2 and associated plots.

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power	
	mW	dBm
450.0 – 470.0	120	20.8

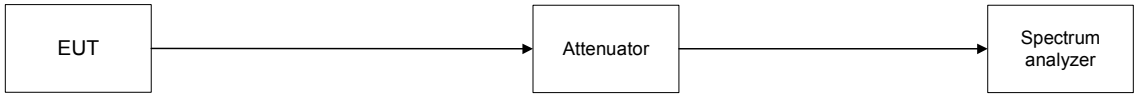
7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and associated plots.

Figure 7.1.1 Peak output power test setup



Test specification:	**Section 90.205, Maximum output power**		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/23/2004 8:32:01 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE:	450 – 470 MHz
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	100 kHz
VIDEO BANDWIDTH:	300 kHz
MODULATION:	FM
MODULATING SIGNAL:	PRBS
BIT RATE:	1200 bps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum

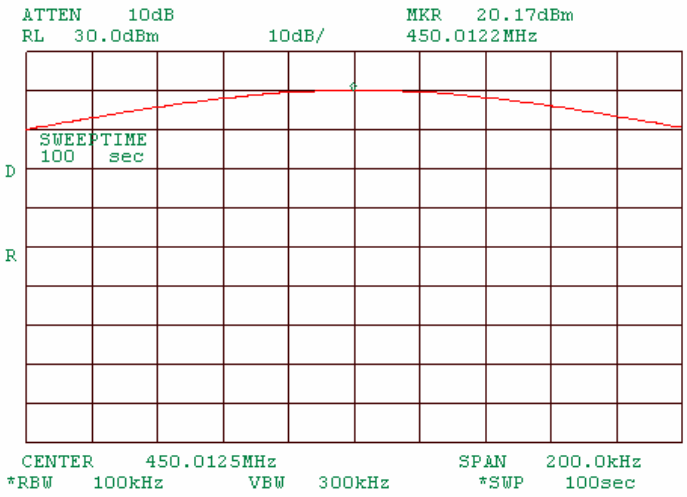
Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
450.0125	20.17	Included	Included	20.17	20.8	-0.63	Pass
460.0125	20.33	Included	Included	20.33	20.8	-0.47	Pass
469.9875	20.33	Included	Included	20.33	20.8	-0.47	Pass

Reference numbers of test equipment used

HL 1424	HL 2254	HL 2524					

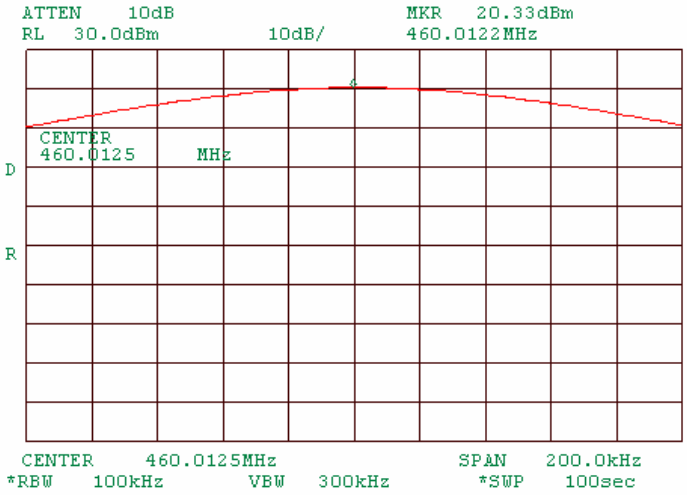
Full description is given in Appendix A.

Plot 7.1.1 Peak output power test results at low frequency

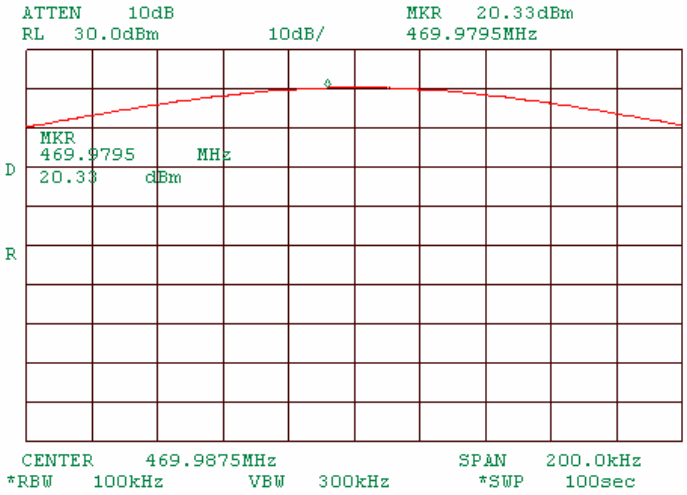


Test specification:	Section 90.205, Maximum output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/23/2004 8:32:01 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.1.2 Peak output power test results at mid frequency



Plot 7.1.3 Peak output power test results at high frequency



Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/6/2004 10:08:25 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

7.2 Occupied bandwidth test

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1. The test results are provided in Table 7.2.2 and associated plots.

Table 7.2.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450 – 470	26	11.25

* - Modulation envelope reference points provided in terms of attenuation below unmodulated carrier.

7.2.2 Test procedure

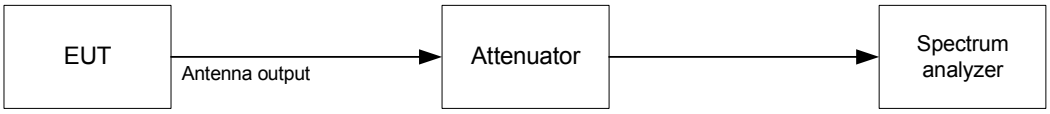
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was set to transmit unmodulated carrier and reference peak power level was measured.

7.2.2.3 The EUT was set to transmit modulated carrier.

7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.2.2 and associated plot.

Figure 7.2.1 Occupied bandwidth test setup



Test specification:	**Section 90.209, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/6/2004 10:08:25 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED:	Peak hold
RESOLUTION BANDWIDTH:	100 Hz
VIDEO BANDWIDTH:	300 Hz
MODULATION ENVELOPE REFERENCE POINTS:	26 dBc
MODULATION:	FM
MODULATING SIGNAL:	PRBS
BIT RATE:	1200 bps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450.0125	5.03	11.25	-6.22	Pass
460.0125	5.03	11.25	-6.22	Pass
469.9875	5.07	11.25	-6.18	Pass

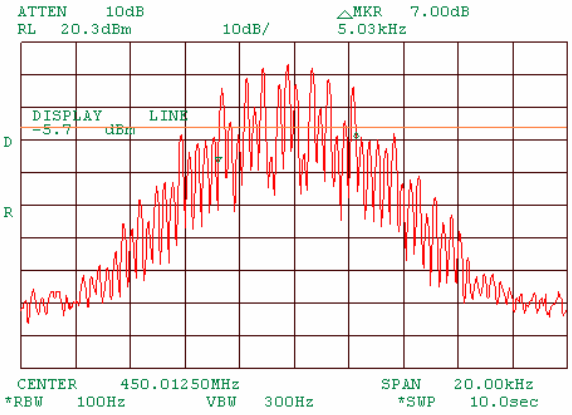
Reference numbers of test equipment used

HL 1424	HL 2254	HL 2524					

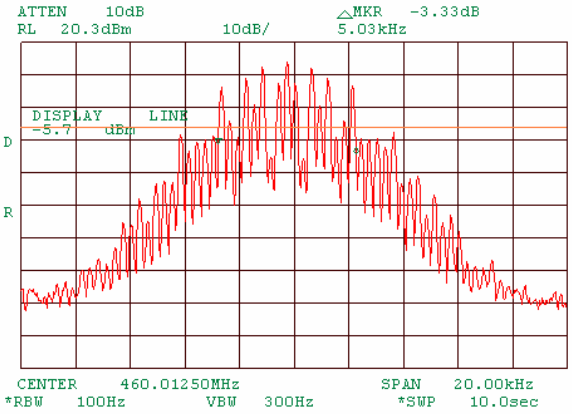
Full description is given in Appendix A.

Test specification:	Section 90.209, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/6/2004 10:08:25 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.1 Occupied bandwidth test result at low frequency

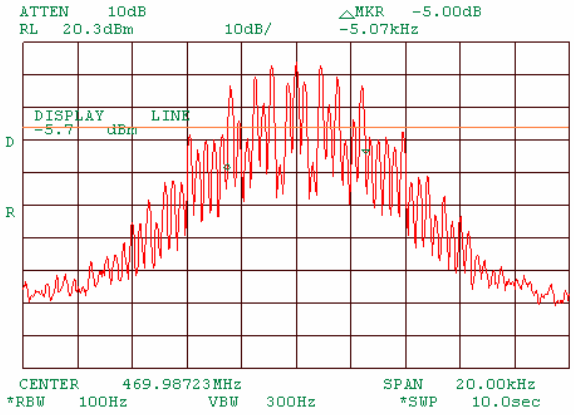


Plot 7.2.2 Occupied bandwidth test result at mid frequency



Test specification:	**Section 90.209, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/6/2004 10:08:25 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Plot 7.2.3 Occupied bandwidth test result at high frequency



Test specification:	Section 90.213, Frequency stability		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:48:07 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 230 VAC
Remarks:			

7.3 Frequency stability test

7.3.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.3.1. The test results are provided in Table 7.3.2.

Table 7.3.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450.0125	1.5	675
460.0125		690
469.9875		705

7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The EUT power was turned off. Temperature within test chamber was set to +30˚C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

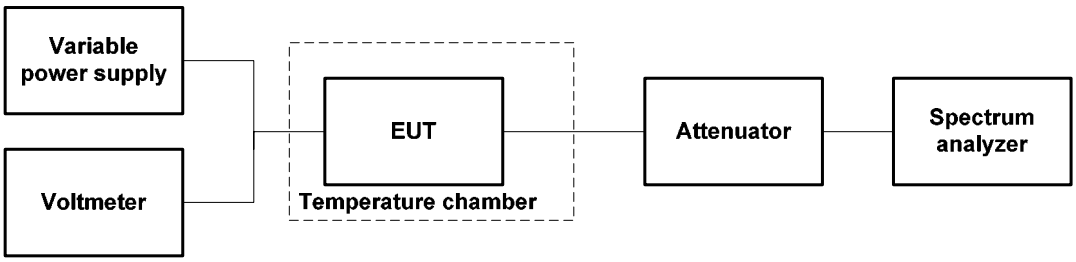
7.3.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

7.3.2.4 The above procedure was repeated at 0˚C and at the lowest test temperature.

7.3.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.

7.3.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.3.2.

Figure 7.3.1 Frequency stability test setup



Test specification:	**Section 90.213, Frequency stability**		
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/22/2004 8:48:07 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 230 VAC
Remarks:			

Table 7.3.2 Frequency stability test results

OPERATING FREQUENCY: 450 – 470 MHz
NOMINAL POWER VOLTAGE: 12 VDC
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 100 Hz
VIDEO BANDWIDTH: 300 Hz
MODULATION: Unmodulated

T, ºC	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1st min	2nd min	3rd min	4th min	5th min	10th min	Positive	Negative			
Low frequency													
-30	nominal	450.012247	450.012241	450.012230	450.012171	450.012233	450.012274	450.012409	203	-35		-472	PASS
-20	nominal	450.012325	NA	NA	NA	NA	NA	450.012330	188	-52		-487	PASS
-10	nominal	450.012365	NA	NA	NA	NA	NA	450.012101	363	-105		-312	PASS
0	nominal	450.012362	450.012365	450.012361	450.012166	450.012213	450.012232	450.012407	201	-40		-474	PASS
10	nominal	450.012349	NA	NA	NA	NA	NA	450.012083	144	-123		-531	PASS
20	+15%	450.012209	NA	NA	NA	NA	NA	450.012225	19	0	675	-656	PASS
20	nominal	450.012203	NA	NA	NA	NA	NA	450.012206	0	-47		-675	PASS
20	-15%	450.012416	NA	NA	NA	NA	NA	450.012173	210	-33		-465	PASS
30	nominal	450.012427	450.012427	450.012428	450.012428	450.012428	450.012429	450.012207	223	0		-452	PASS
40	nominal	450.012223	NA	NA	NA	NA	NA	450.012252	46	0		-629	PASS
50	nominal	450.012507	NA	NA	NA	NA	NA	450.012282	312	0		-363	PASS
Mid frequency													
-30	nominal	460.012265	460.012269	460.012564	460.012567	460.012566	460.012566	460.012269	465	0		-225	PASS
-20	nominal	460.012368	NA	NA	NA	NA	NA	460.012419	331	0		-359	PASS
-10	nominal	460.012362	NA	NA	NA	NA	NA	460.012421	319	0		-371	PASS
0	nominal	460.012345	460.012344	460.012349	460.012345	460.012347	460.012345	460.012344	247	0		-443	PASS
10	nominal	460.012354	NA	NA	NA	NA	NA	460.012354	252	0		-438	PASS
20	+15%	460.012364	NA	NA	NA	NA	NA	460.012363	265	0	690	-425	PASS
20	nominal	460.012103	NA	NA	NA	NA	NA	460.012102*	9	0		-690	PASS
20	-15%	460.012105	NA	NA	NA	NA	NA	460.012100	7	-2		-683	PASS
30	nominal	460.012368	460.012369	460.012363	460.012366	460.012362	460.012361	460.012367	267	0		-423	PASS
40	nominal	460.012368	NA	NA	NA	NA	NA	460.012369	267	0		-423	PASS
50	nominal	460.012350	NA	NA	NA	NA	NA	460.012349	252	0		-438	PASS
High frequency													
-30	nominal	469.987205	469.987225	469.987238	469.987240	469.987243	469.987246	469.987450	101	-144		-561	PASS
-20	nominal	469.987691	NA	NA	NA	NA	NA	469.987780	431	0		-274	PASS
-10	nominal	469.987550	NA	NA	NA	NA	NA	469.987544	208	0		-497	PASS
0	nominal	469.987355	469.987352	469.987351	469.987354	469.987355	469.987357	469.987353	8	0		-697	PASS
10	nominal	469.987348	NA	NA	NA	NA	NA	469.987347	1	-4		-701	PASS
20	+15%	469.987330	NA	NA	NA	NA	NA	469.987337	0	-19	705	-686	PASS
20	nominal	469.987351	NA	NA	NA	NA	NA	469.987349*	6	-1		-705	PASS
20	-15%	469.987352	NA	NA	NA	NA	NA	469.987359	10	0		-695	PASS
30	nominal	469.987331	469.987335	469.987334	469.987334	469.987330	469.987338	469.987331	0	-19		-686	PASS
40	nominal	469.987502	NA	NA	NA	NA	NA	469.987501	158	0		-547	PASS
50	nominal	469.987491	NA	NA	NA	NA	NA	469.987445	150	0		-555	PASS

* - Reference frequency

Reference numbers of test equipment used

HL 0493	HL 0808	HL 2358	HL 2524				

Full description is given in Appendix A.

Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/6/2004 10:30:09 AM		
Temperature: 24 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

7.4 Transient frequency behavior test

7.4.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 7.4.1. The test results are provided in the associated plots.

Table 7.4.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
25.0	± 25.0	5.0	t_1
	± 12.5	20.0	t_2
	± 25.0	5.0	t_3
12.5	± 12.5	5.0	t_1
	± 6.25	20.0	t_2
	± 12.5	5.0	t_3
6.25	± 6.25	5.0	t_1
	± 3.125	20.0	t_2
	± 6.25	5.0	t_3

* - t_{on} is the instant when a 1 kHz test signal is completely suppressed;
t_1 is the time period immediately following t_{on};
t_2 is the time period immediately following t_1;
t_3 is the time period from the instant when the transmitter is turned off until t_{off};
t_{off} is the instant when the 1 kHz test signal starts to rise.

7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

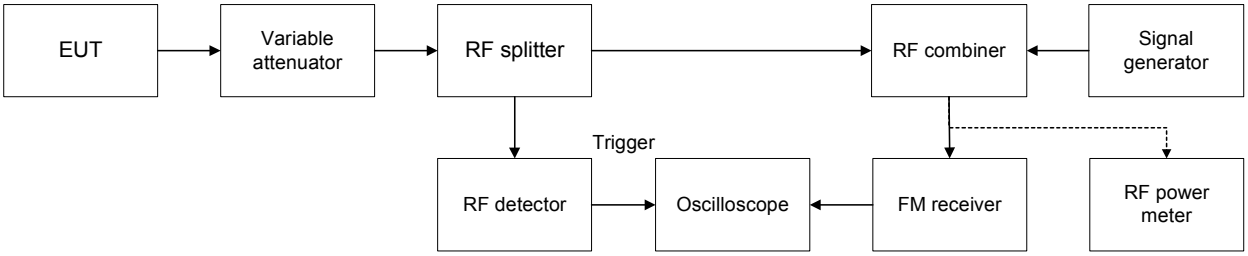
7.4.2.2 The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 12.5 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

7.4.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

7.4.2.4 The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.

Test specification:	**Section 90.214, Transient frequency behaviour**		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/6/2004 10:30:09 AM		
Temperature: 24 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Figure 7.4.1 Transient frequency test setup



Test specification:	**Section 90.214, Transient frequency behaviour**		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/6/2004 10:30:09 AM		
Temperature: 24 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.4.2 Transient frequency behavior test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 12.5 kHz						
450.0125	t_1	5.0	0.097	± 12.5	-12.4030	Pass
	t_2	20.0	0.125	± 6.25	-6.2375	
	t_3	5.0	3.903	± 12.5	-8.5970	
460.0125	t_1	5.0	0.153	± 12.5	-12.3470	Pass
	t_2	20.0	0.028	± 6.25	-6.2220	
	t_3	5.0	0.917	± 12.5	-11.5830	
469.9875	t_1	5.0	0.097	± 12.5	-12.4030	Pass
	t_2	20.0	0.028	± 6.25	-6.2220	
	t_3	5.0	1.280	± 12.5	-11.2200	

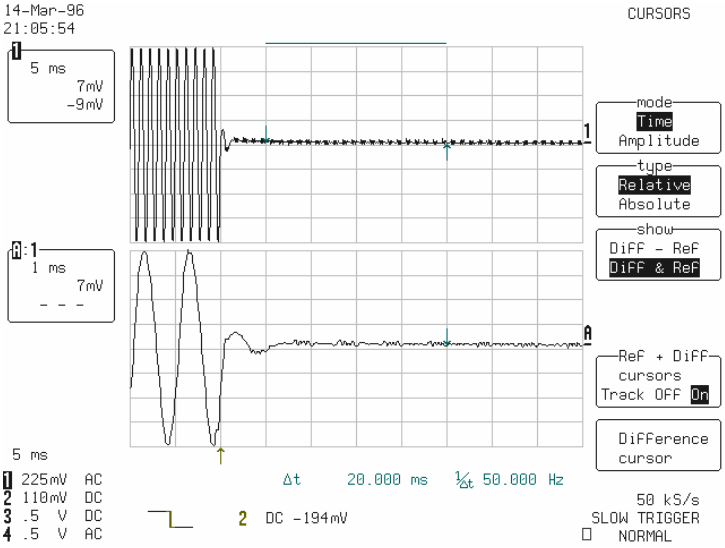
Reference numbers of test equipment used

HL 0539	HL 0670	HL 0788	HL 0808	HL 1533	HL 1556	HL 1907	HL 2227
HL 2399							

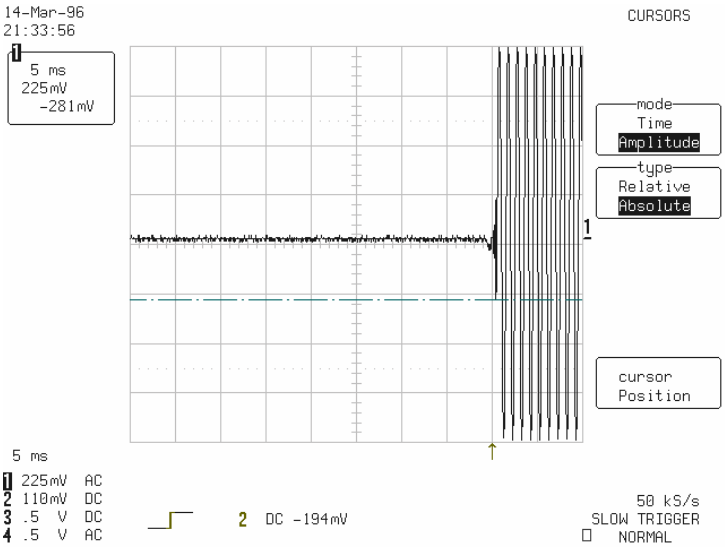
Full description is given in Appendix A.

Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/6/2004 10:30:09 AM		
Temperature: 24 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.4.1 Transient frequency during power ON test results at low carrier frequency

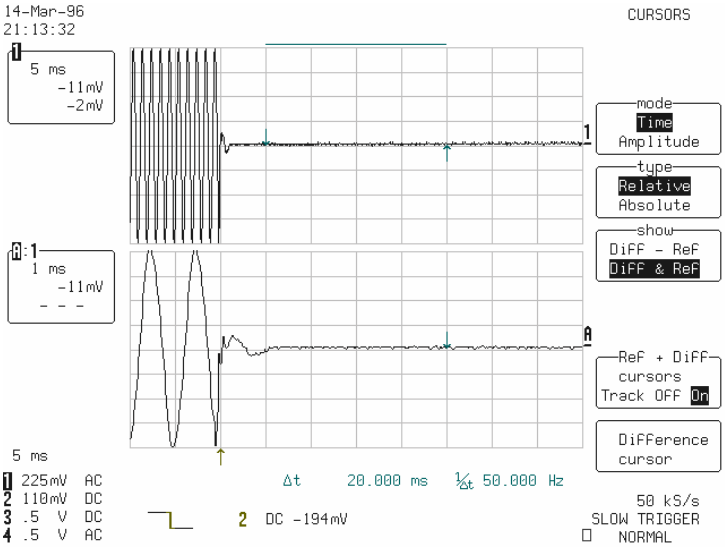


Plot 7.4.2 Transient frequency during power OFF test results at low carrier frequency

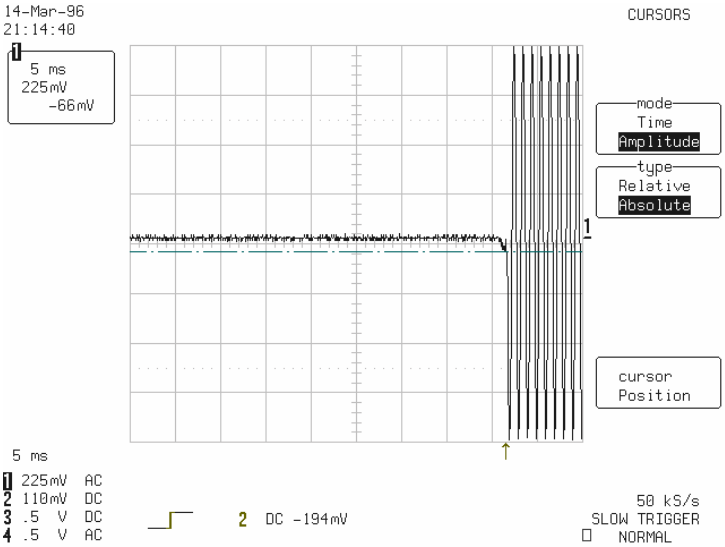


Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/6/2004 10:30:09 AM		
Temperature: 24 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.4.3 Transient frequency during power ON test results at mid carrier frequency

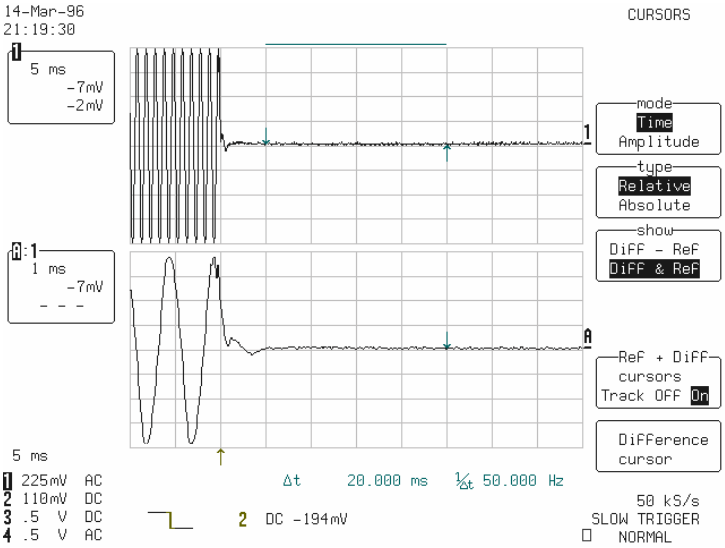


Plot 7.4.4 Transient frequency during power OFF test results at mid carrier frequency

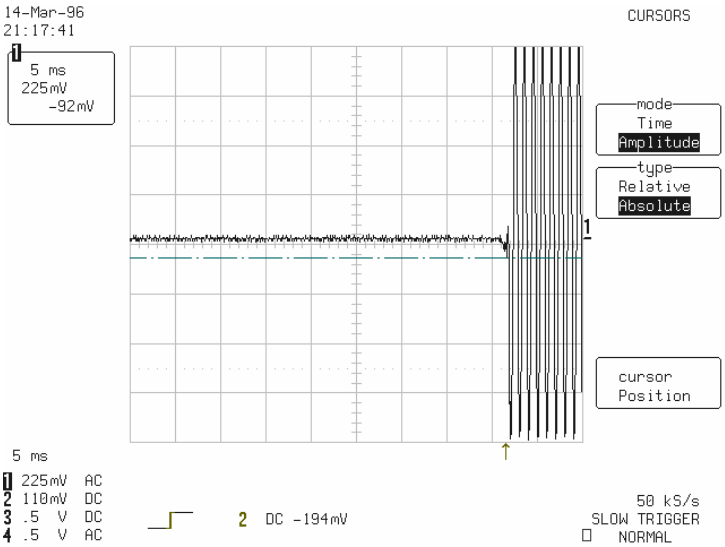


Test specification:	Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-A, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/6/2004 10:30:09 AM		
Temperature: 24 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.4.5 Transient frequency during power ON test results at high carrier frequency



Plot 7.4.6 Transient frequency during power OFF test results at high carrier frequency



Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:58:17 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 230 VAC
Remarks:			

7.5 Band edge emission

7.5.1 General

This test was performed to verify the EUT band edge emission including all associated side bands and frequency drift under extreme test conditions was attenuated at least 30 dB below the unmodulated carrier level. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Band edge emission limits

Band edge frequency shift from carrier, kHz	Channel bandwidth, kHz	Attenuation below carrier, dBc
± 40.0	25.0	30
± 25.0	12.5	30
± 12.5	6.25	30

7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

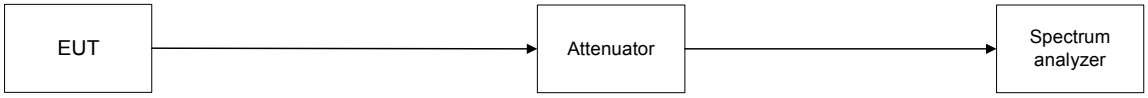
7.5.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

7.5.2.3 The frequency of modulation envelope points beyond which power level drops below the band edge emission limit was measured.

7.5.2.4 The total bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained bandwidth was verified to be within the allowed frequency range.

7.5.2.5 The test results were recorded in Table 7.5.2 and shown in the associated plots.

Figure 7.5.1 Band edge emission measurement set up



Test specification:	**Section 90.217, Band edge emission**		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/22/2004 8:58:17 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 230 VAC
Remarks:			

Table 7.5.2 Band edge emission test results

OPERATING FREQUENCY RANGE:	450 - 470MHz
DETECTOR USED:	Peak hold
SWEEP RATE:	2 kHz/s
RESOLUTION BANDWIDTH:	100 Hz
VIDEO BANDWIDTH:	300 Hz
MODULATION:	FM
MODULATING SIGNAL:	PRBS
BIT RATE:	1200 bps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum
ATTENUATION BELOW CARRIER:	30 dBc

Band edge	**Measured frequency, MHz***	**Frequency drift, Hz**		**Band edge frequency, MHz****	**Band edge limit, MHz**	**Margin, kHz*****	**Verdict**
		Negative	**Positive**				
Low carrier frequency							
Low	450.0084	363	NA	450.00878	450.0063	-0.00248	Pass
High	450.0164	NA	123	450.01654	450.0188	-0.00226	Pass
Mid carrier frequency							
Low	460.0084	465	NA	460.00889	460.0063	-0.00263	Pass
High	460.0165	NA	365	460.01687	460.0188	-0.00189	Pass
High carrier frequency							
Low	469.9834	431	NA	469.98385	469.9813	-0.00260	Pass
High	469.9915	NA	316	469.99182	469.9938	-0.00193	Pass

* - Measured frequency beyond which the emission level is attenuated at least 30 dB below the unmodulated carrier
** - Band edge frequency = Measured frequency ± Frequency drift under extreme conditions
*** - Margin = Band edge limit – Band edge frequency

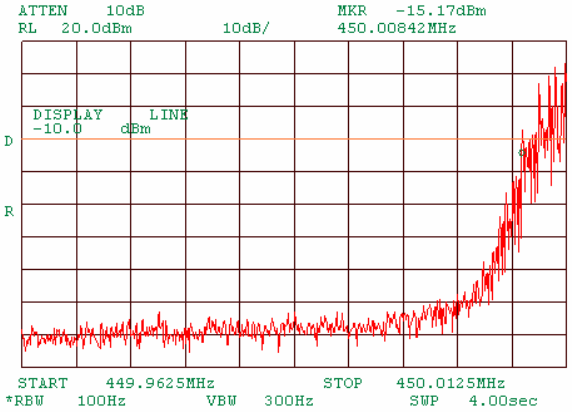
Reference numbers of test equipment used

HL 1424	HL 2254	HL 2524					

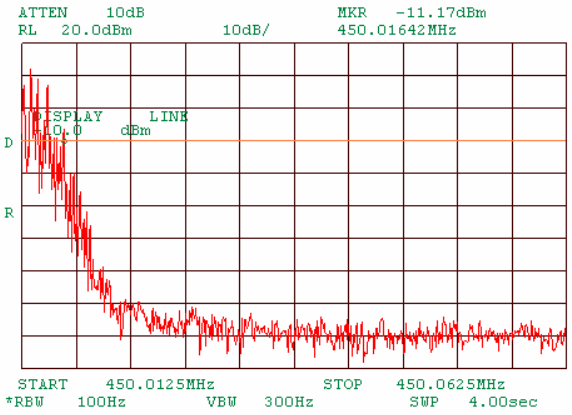
Full description is given in Appendix A.

Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:58:17 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 230 VAC
Remarks:			

Plot 7.5.1 Band edge emission test results at low carrier frequency left side

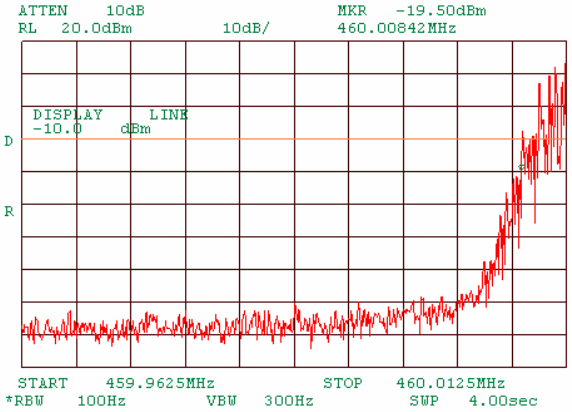


Plot 7.5.2 Band edge emission test results at low carrier frequency right side

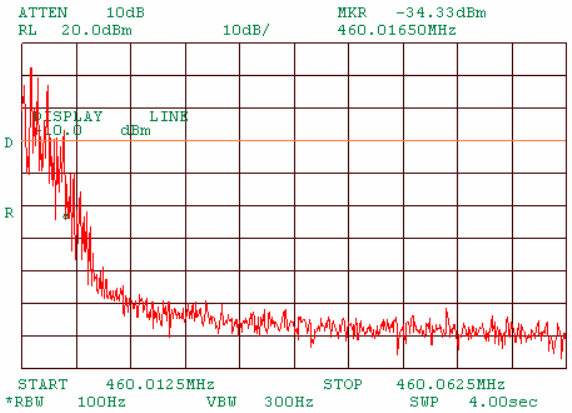


Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:58:17 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 230 VAC
Remarks:			

Plot 7.5.3 Band edge emission test results at mid carrier frequency left side

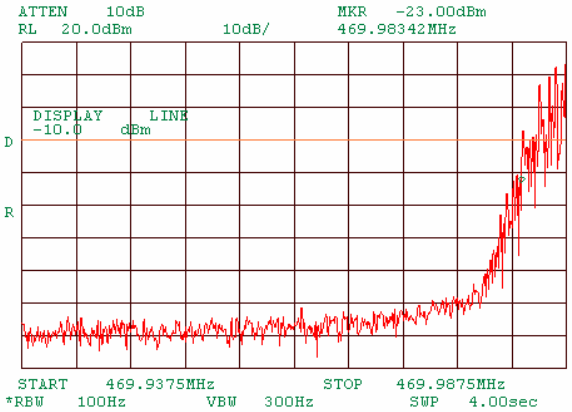


Plot 7.5.4 Band edge emission test results at mid carrier frequency right side

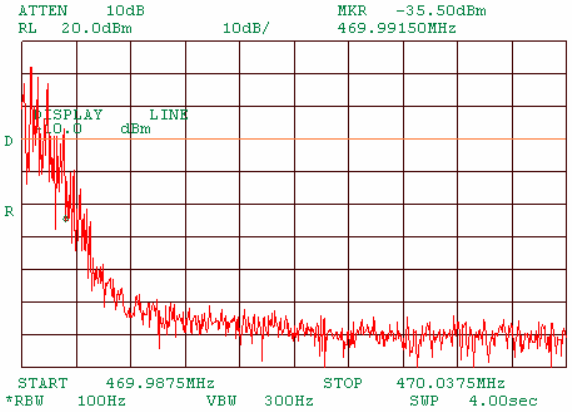


Test specification:	Section 90.217, Band edge emission		
Test procedure:	47 CFR, Sections 2.1051, 2.1047 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:58:17 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 230 VAC
Remarks:			

Plot 7.5.5 Band edge emission test results at high carrier frequency left side



Plot 7.5.6 Band edge emission test results at high carrier frequency right side



Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

7.6 Spurious emissions at RF antenna connector test

7.6.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.6.1. The test results are provided in Table 7.6.2 and associated plots.

Table 7.6.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	Spurious emission, dBm
0.009 – 10th harmonic*	30	-10

* - spurious emission limits do not apply to the in band emission within:
± 40 kHz from the carrier for equipment designed to operate with 25 kHz channel bandwidth
± 25 kHz from the carrier for equipment designed to operate with 12.5 kHz channel bandwidth
± 12.5 kHz from the carrier for equipment designed to operate with 6.25 kHz channel bandwidth

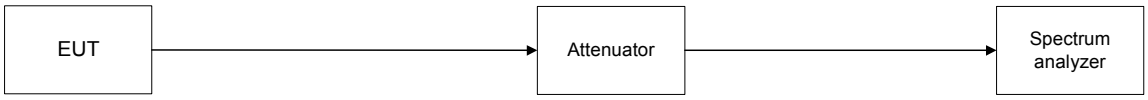
7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

7.6.2.2 The EUT was adjusted to produce maximum available for end user RF output power.

7.6.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.6.2 and associated plots.

Figure 7.6.1 Spurious emission test setup



Test specification:	**Section 90.217, Conducted spurious emissions**		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.6.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATION: FM
MODULATING SIGNAL: CW
BIT RATE: 1200 bps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
TRANSMITTER OUTPUT POWER: 20.17 dBm at low frequency
20.33 dBm at mid frequency
20.33 dBm at high frequency

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier frequency									
900.0308	-41.83	included	included	100	-41.83	62.00	30	32.00	Pass
1350.057	-42.33	included	included	1000	-42.33	62.50	30	32.50	Pass
2250	-41.50	included	included	1000	-41.50	61.67	30	31.67	Pass
Mid carrier frequency									
920.0192	-42.83	included	included	100	-42.83	63.16	30	33.16	Pass
1379.915	-41.50	included	included	1000	-41.5	61.83	30	31.83	Pass
2300.067	-43.17	included	included	1000	-43.17	63.50	30	33.50	Pass
High carrier frequency									
939.9633	-44.83	included	included	100	-44.83	65.16	30	35.16	Pass
1409.942	-42.00	included	included	1000	-42.00	62.33	30	32.33	Pass
2350.077	-43.33	included	included	1000	-43.33	63.66	30	33.66	Pass

*****- Margin = Spurious emission – specification limit.

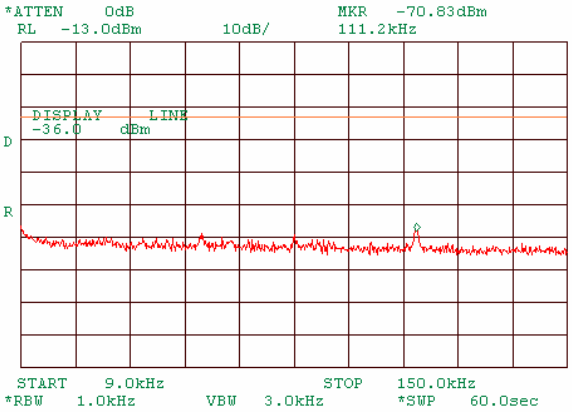
Reference numbers of test equipment used

HL 1424	HL 2254	HL 2524					

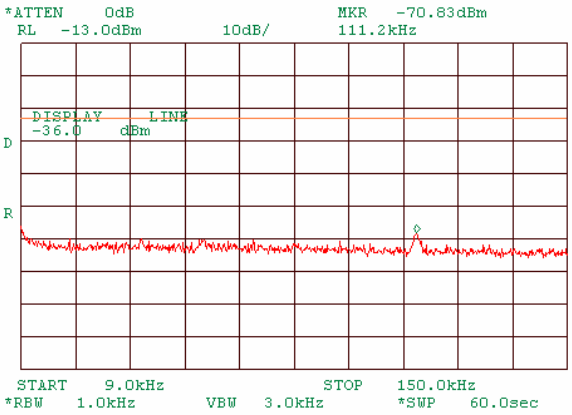
Full description is given in Appendix A.

Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

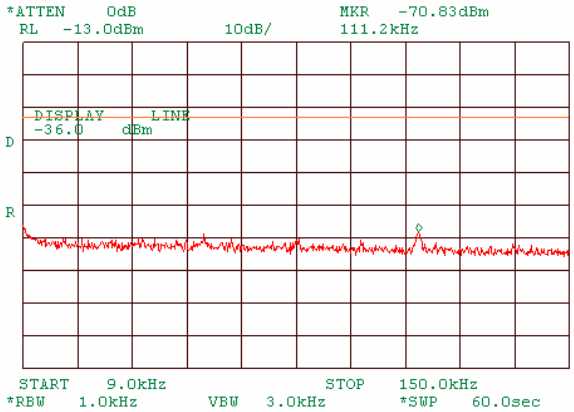


Plot 7.6.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency



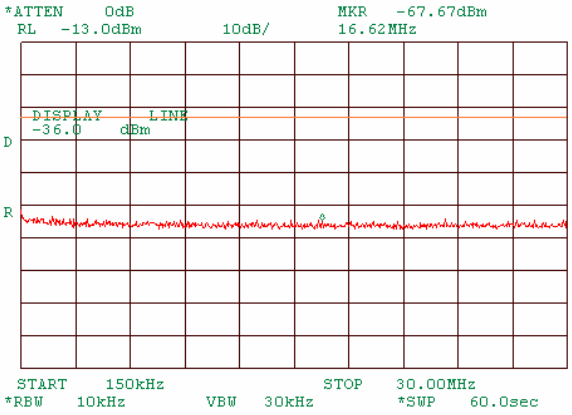
Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.3 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency

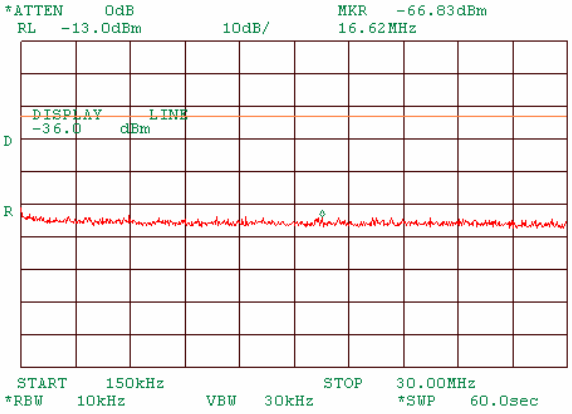


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.4 Spurious emission measurements in 0.150 - 30 MHz range at low carrier frequency

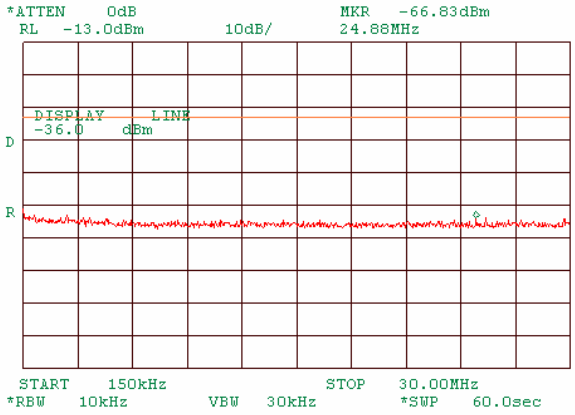


Plot 7.6.5 Spurious emission measurements in 0.150 - 30 MHz range at mid carrier frequency



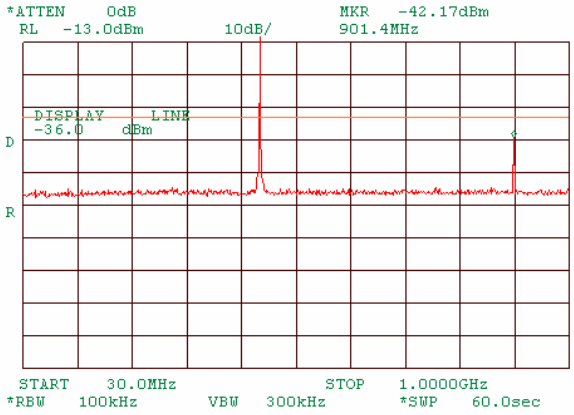
Test specification:	**Section 90.217, Conducted spurious emissions**		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Plot 7.6.6 Spurious emission measurements in 0.150 – 30 MHz range at high carrier frequency

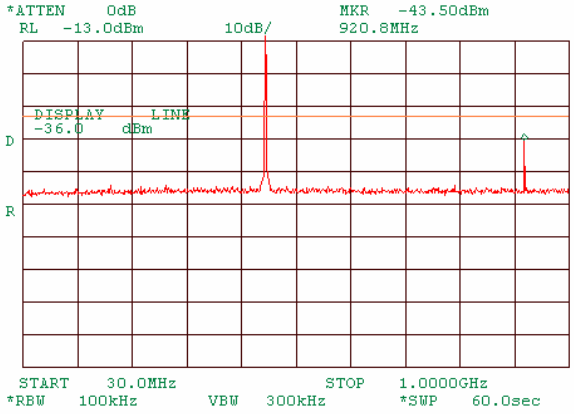


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.7 Spurious emission measurements in 30 - 1000 MHz range at low carrier frequency

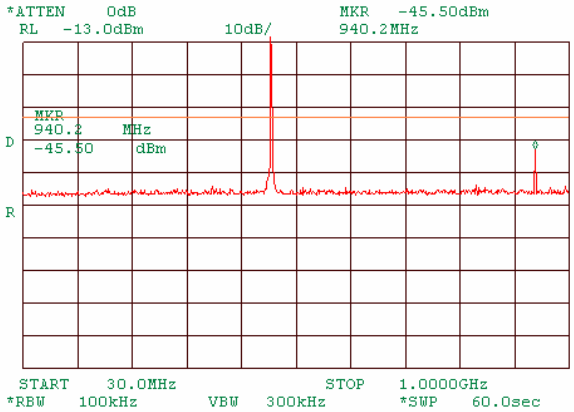


Plot 7.6.8 Spurious emission measurements in 30 - 1000 MHz range at mid carrier frequency



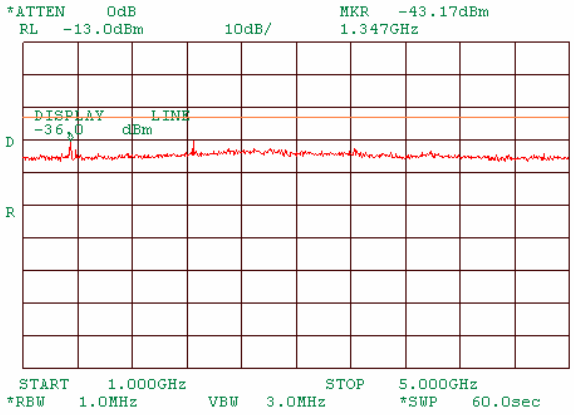
Test specification:	**Section 90.217, Conducted spurious emissions**		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Plot 7.6.9 Spurious emission measurements in 30 - 1000 MHz range at high carrier frequency

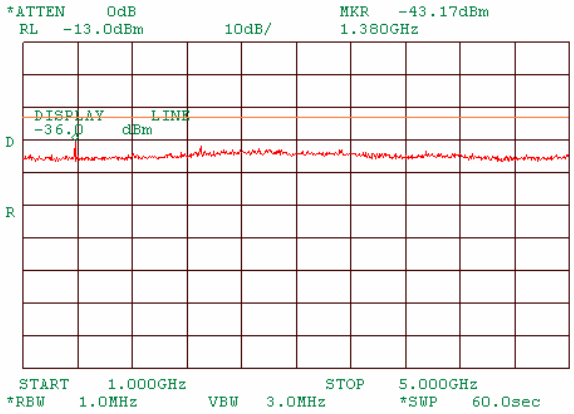


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.10 Spurious emission measurements in 1000 - 5000 MHz range at low carrier frequency

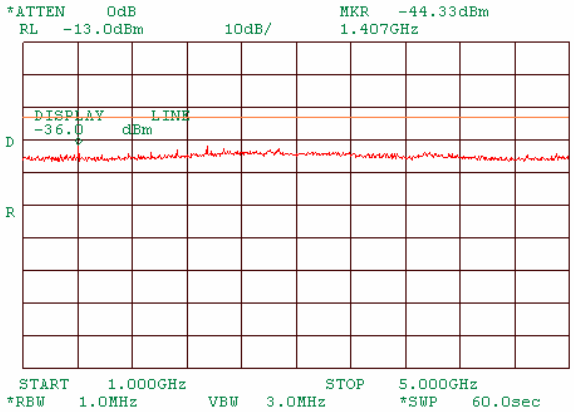


Plot 7.6.11 Spurious emission measurements in 1000 - 5000 MHz at mid carrier frequency



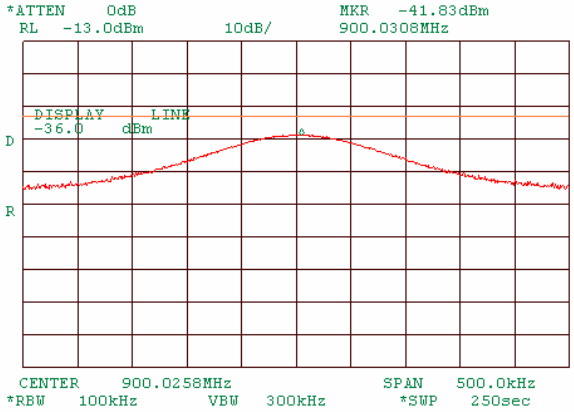
Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.12 Spurious emission measurements in 1000 - 5000 MHz at high carrier frequency

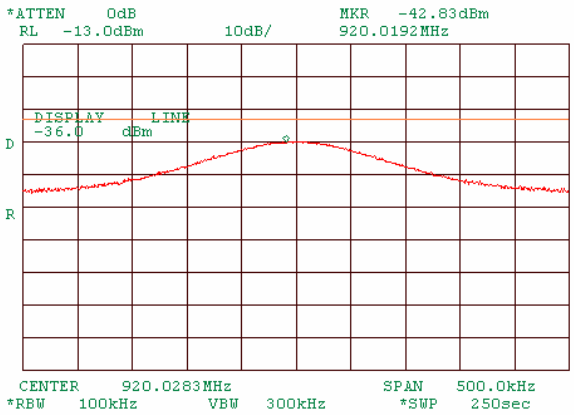


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.13 Conducted spurious emission measurements at the 2nd harmonic of low carrier frequency

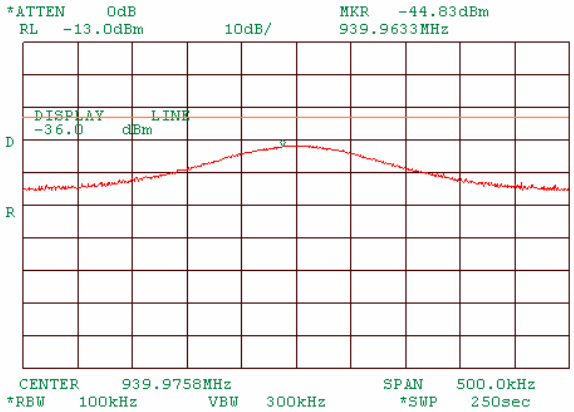


Plot 7.6.14 Conducted spurious emission measurements at the 2nd harmonic of mid carrier frequency



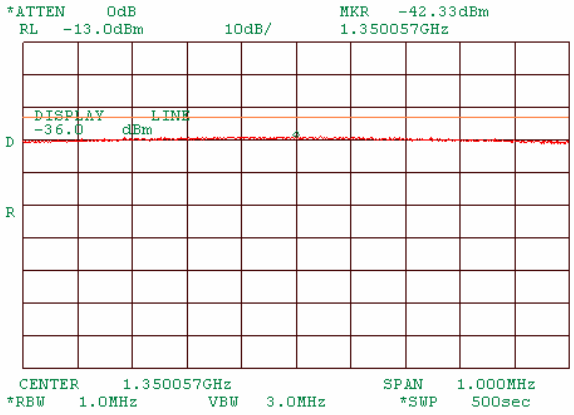
Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.15 Conducted spurious emission measurements at the 2nd harmonic of high carrier frequency

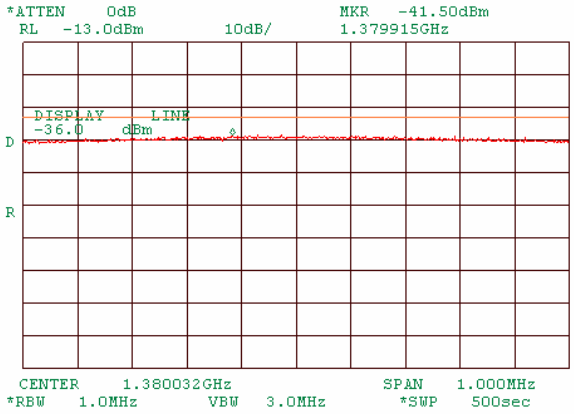


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.16 Conducted spurious emission measurements at the 3rd harmonic of low carrier frequency

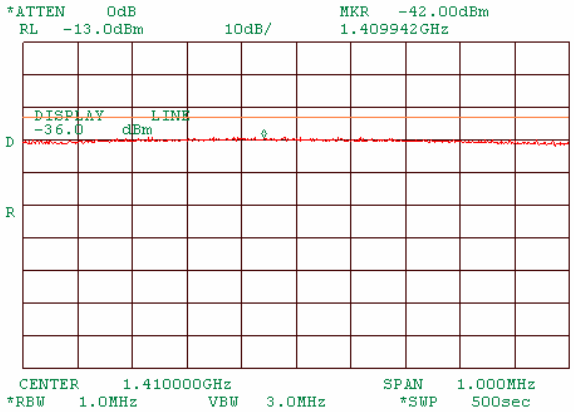


Plot 7.6.17 Conducted spurious emission measurements at the 3rd harmonic of mid carrier frequency



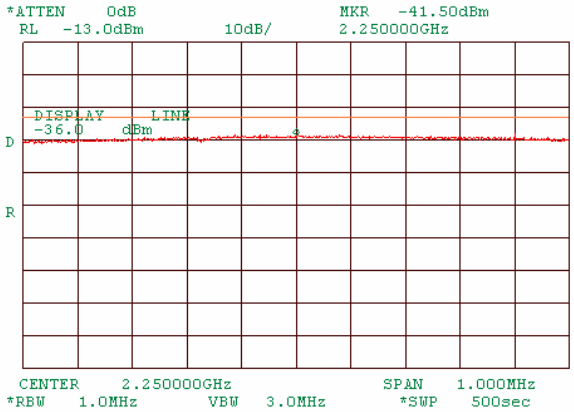
Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.18 Conducted spurious emission measurements at the 3rd harmonic of high carrier frequency

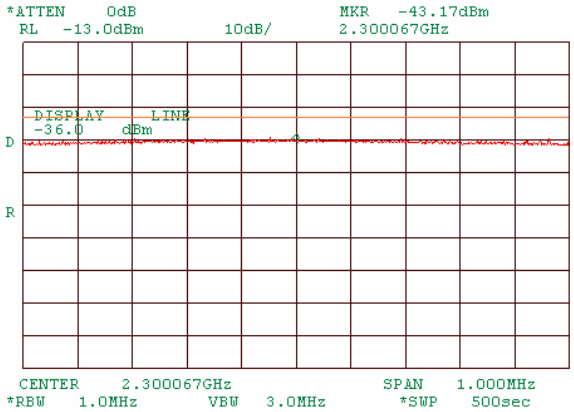


Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.19 Conducted spurious emission measurements at the 5th harmonic of low carrier frequency

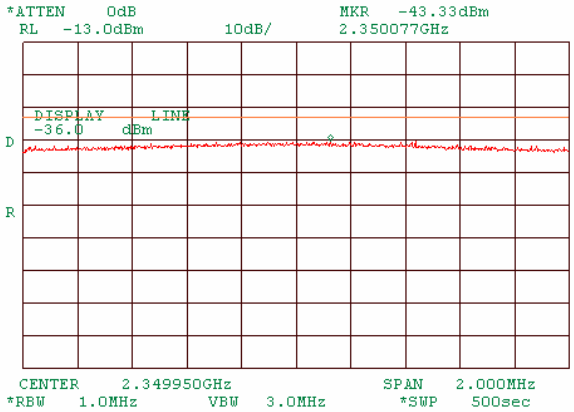


Plot 7.6.20 Conducted spurious emission measurements at the 5th harmonic of mid carrier frequency



Test specification:	Section 90.217, Conducted spurious emissions		
Test procedure:	47 CFR, Sections 2.1051 and 90.217; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/21/2004 9:34:36 AM		
Temperature: 23 ºC	Air Pressure: 1005 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 7.6.21 Conducted spurious emission measurements at the 5th harmonic of high carrier frequency



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

7.7 Radiated spurious emission measurements

7.7.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(µV/m)**
0.009 – 10th harmonic*	30	-13	82.23

* - spurious emission limits do not apply to the in band emission within:
± 40 kHz from the carrier for equipment designed to operate with 25 kHz channel bandwidth
± 25 kHz from the carrier for equipment designed to operate with 12.5 kHz channel bandwidth
± 12.5 kHz from the carrier for equipment designed to operate with 6.25 kHz channel bandwidth

** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: E=sqrt(30×P×1.64)/r, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

7.7.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and the performance check was conducted.

7.7.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna was rotated around its vertical axis.

7.7.2.3 The worst test results (the lowest margins) were recorded in Table 7.7.2 and shown in the associated plots.

7.7.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.7.3.1 The EUT was set up as shown in Figure 7.7.2, energized and the performance check was conducted.

7.7.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.7.3.3 The worst test results (the lowest margins) were recorded inTable 7.7.2 and shown in the associated plots.

Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

Figure 7.7.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

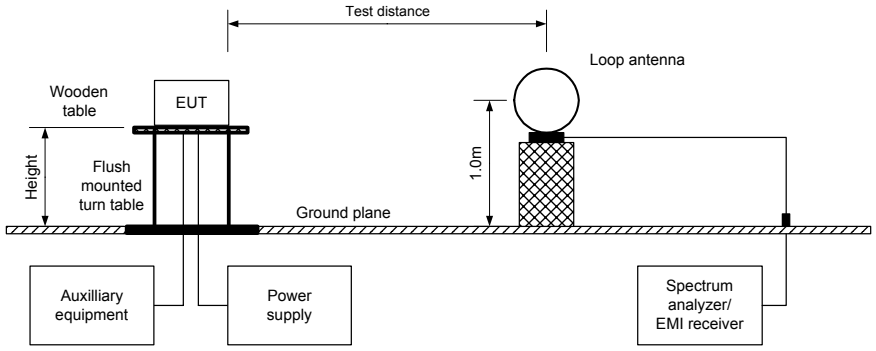
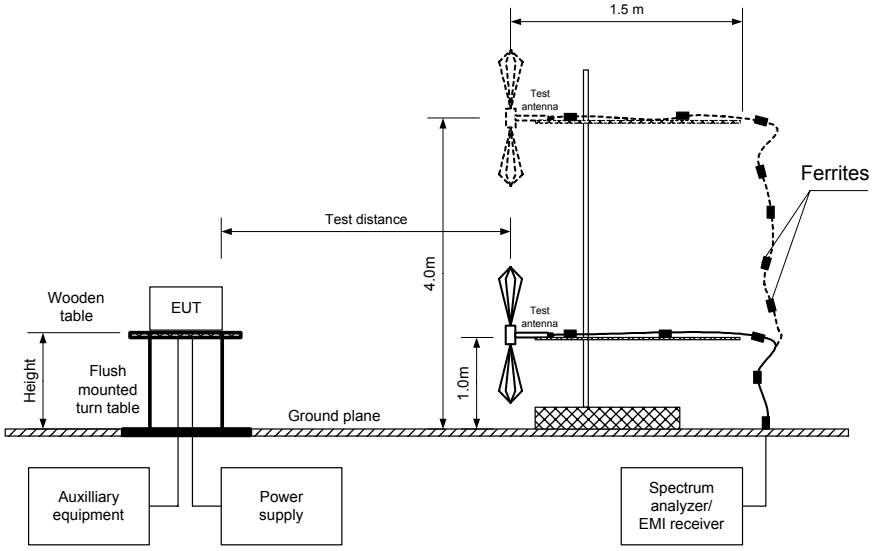


Figure 7.7.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 90.217, Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	**Air Pressure:** hPa	**Relative Humidity:** %	**Power Supply:**
Remarks:			

Table 7.7.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE:	450 - 470 MHz
TEST DISTANCE:	3 m
TEST SITE:	Semi anechoic
EUT HEIGHT:	0.8 m
INVESTIGATED FREQUENCY RANGE:	0.009 – 5000 MHz
DETECTOR USED:	Peak
VIDEO BANDWIDTH:	> Resolution bandwidth
TEST ANTENNA TYPE:	Active loop (9 kHz – 30 MHz) Biconical (30 MHz – 200 MHz) Log periodic (200 MHz – 1000 MHz) Biconilog (30 MHz – 1000 MHz) Double ridged guide (above 1000 MHz)
MODULATION:	FM
MODULATING SIGNAL:	PRBS
BIT RATE:	1200 bps
TRANSMITTER OUTPUT POWER SETTINGS:	Maximum

Frequency, MHz	Resolution bandwidth, kHz	Measured emission, dB(µV/m	Limit, dB(µV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
0.009 – 0.150	1	No emissions were found						Pass
0.150 - 30	10	All found emissions were at least 20 dB below specified limit						
30 – 1000	120	All found emissions were at least 20 dB below specified limit						
1000 - 5000	1000	No emissions were found						

*****- Margin = Field strength of spurious – calculated field strength limit.
******- EUT front panel refers to 0 degrees position of turntable.

Reference numbers of test equipment used

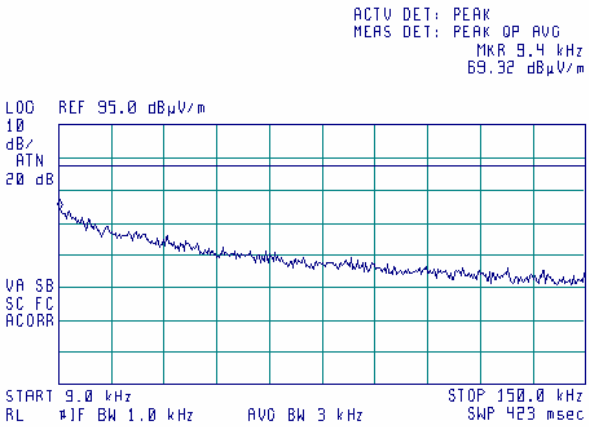
HL 0446	HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604
HL 1004	HL 1947	HL 1984	HL 2009				

Full description is given in Appendix A.

Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

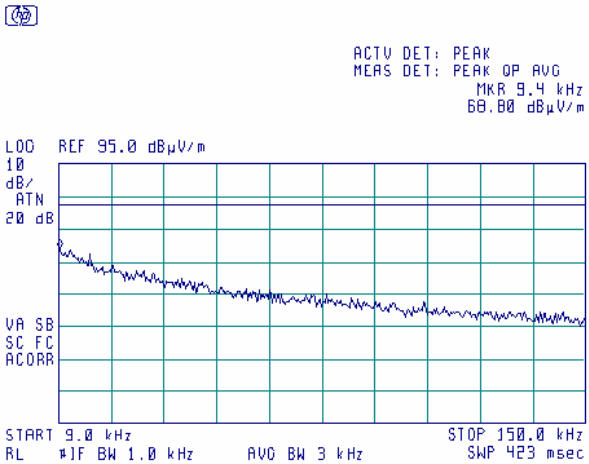
Plot 7.7.1 Radiated emission measurements in 9 - 150 kHz range

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Plot 7.7.2 Radiated emission measurements in 9 - 150 kHz range

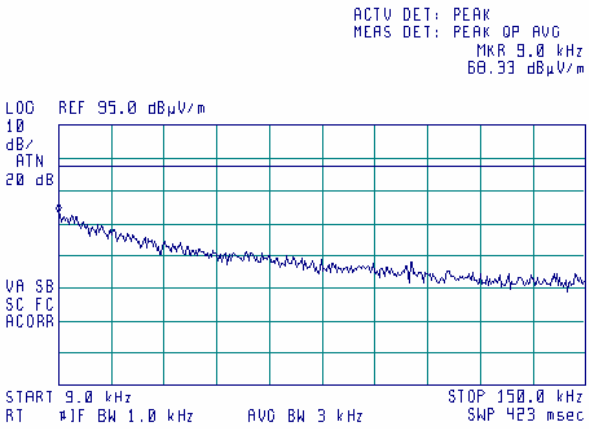
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

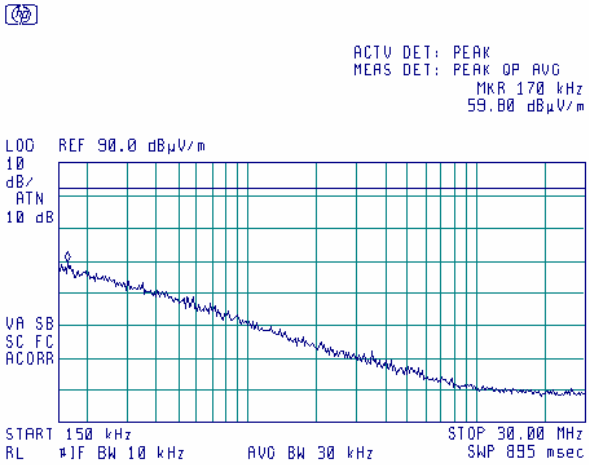
Plot 7.7.3 Radiated emission measurements in 9 - 150 kHz range

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Plot 7.7.4 Radiated emission measurements in 0.15 - 30 MHz range

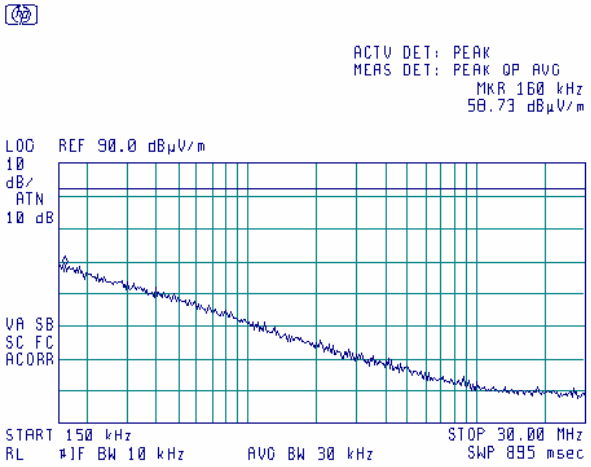
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

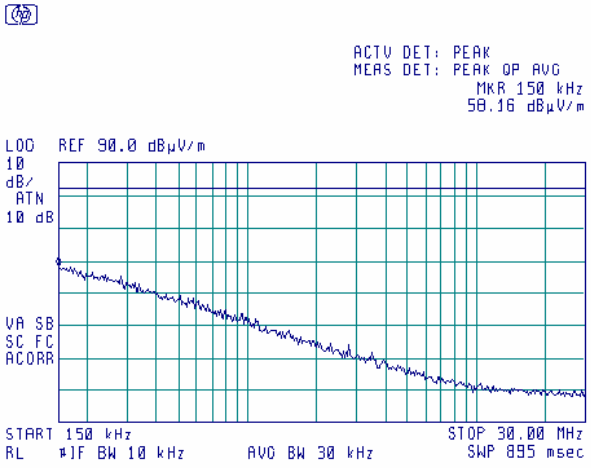
Plot 7.7.5 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Plot 7.7.6 Radiated emission measurements in 0.15 - 30 MHz range

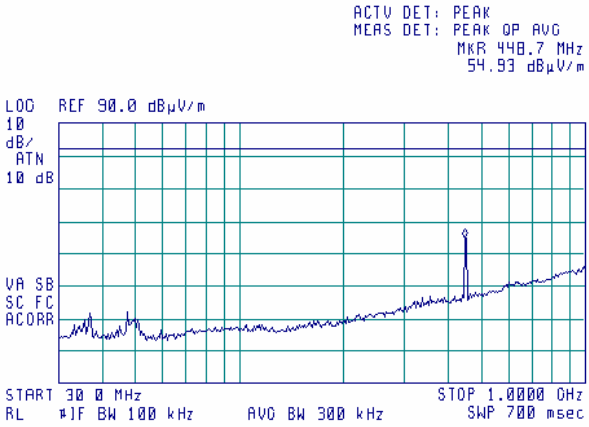
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

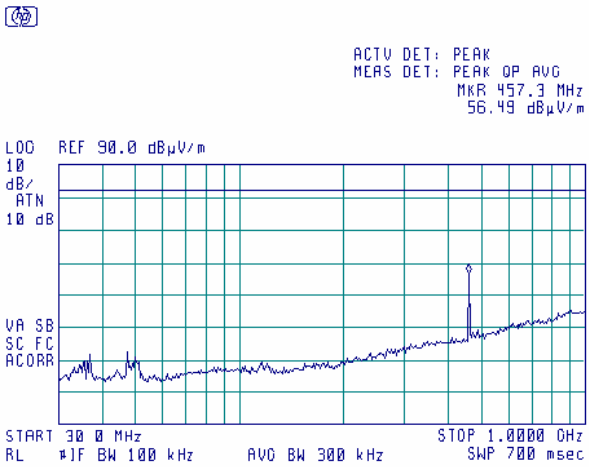
Plot 7.7.7 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Plot 7.7.8 Radiated emission measurements in 30 - 1000 MHz range

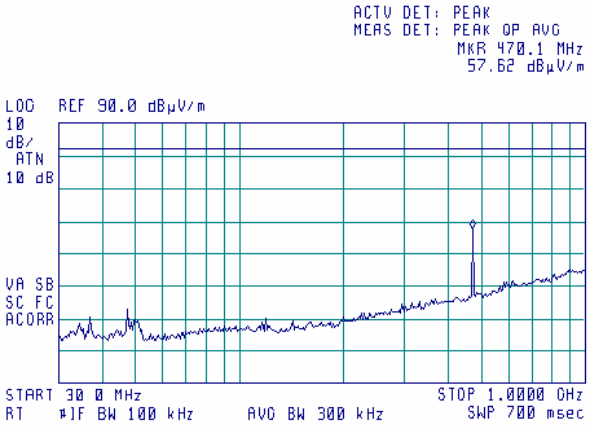
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

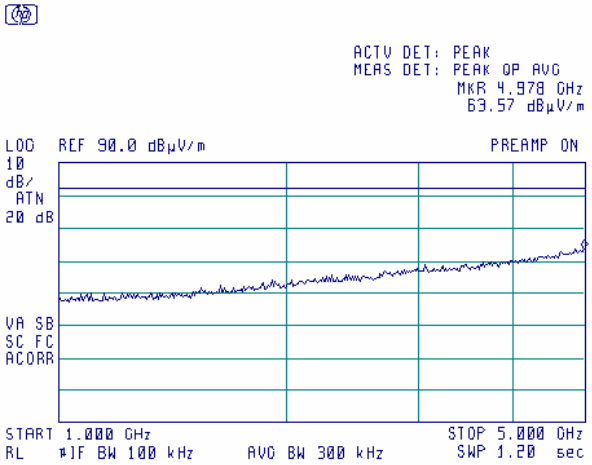
Plot 7.7.9 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Plot 7.7.10 Radiated emission measurements in 1000 – 5000 MHz range

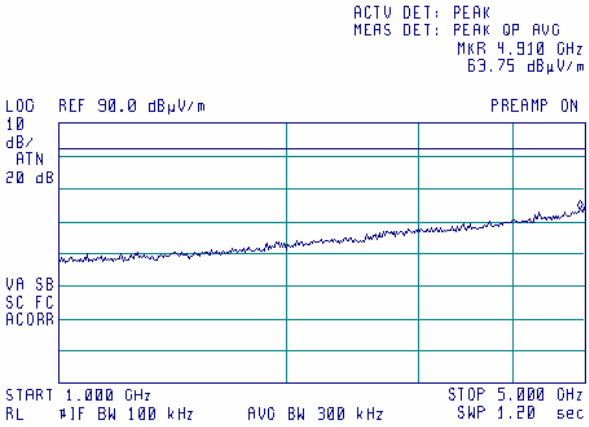
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 90.217, Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053 and 90.217; TIA/EIA-603-A, Section 2.2.12		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:46:05 PM		
Temperature: ºC	Air Pressure: hPa	Relative Humidity: %	Power Supply:
Remarks:			

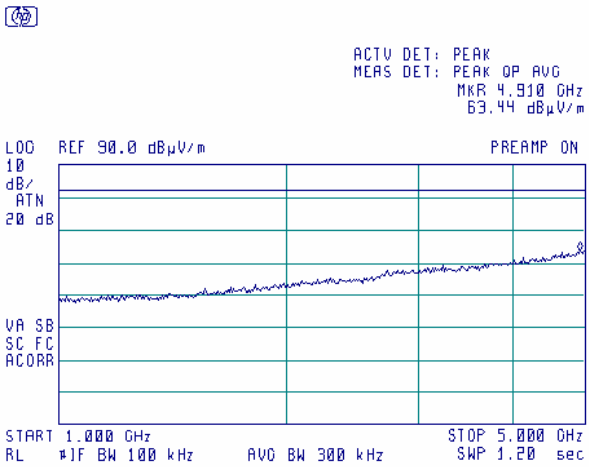
Plot 7.7.11 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Mid
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Plot 7.7.12 Radiated emission measurements in 1000 – 5000 MHz range

TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	High
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:59:31 AM		
Temperature: 25 ºC	Air Pressure: 1005 hPa	Relative Humidity: 47 %	Power Supply: 120
Remarks:			

8 Emissions tests according to 47CFR part 15 subpart B requirements

8.1 Conducted emission measurements at AC mains input / output port

8.1.1 General

This test was performed to measure common mode conducted emissions at the power port.
Specification test limits are given in Table 8.1.1. The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.

Table 8.1.1 Limits for conducted emissions at AC mains input / output port

Frequency, MHz	Class B limit, dB(µV)		Class A limit, dB(µV)	
	QP	AVRG	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*	79	66
0.5 - 5.0	56	46	73	60
5.0 - 30	60	50	73	60

* The limit decreases linearly with the logarithm of frequency.

8.1.2 Test procedure

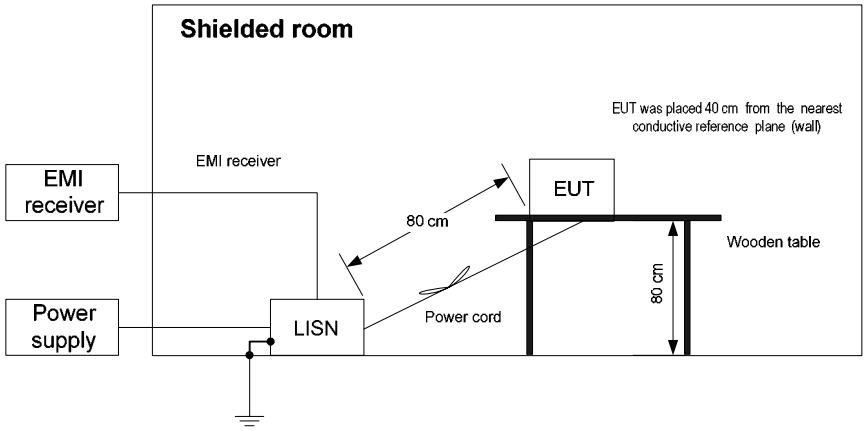
8.1.2.1 The EUT was set up as shown in Figure 8.1.1 and associated photographs, energized and the performance check was conducted.

8.1.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.1.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

8.1.2.3 The position of the device cables was varied to determine maximum emission level.

Test specification:	**Section 15.107, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/22/2004 8:59:31 AM		
Temperature: 25 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 47 %	**Power Supply:** 120
Remarks:			

Figure 8.1.1 Setup for conducted emission measurements at AC mains input / output port, table-top EUT



Test specification:	**Section 15.107, Conducted emission at AC power port**		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/22/2004 8:59:31 AM		
Temperature: 25 ºC	**Air Pressure:** 1005 hPa	**Relative Humidity:** 47 %	**Power Supply:** 120
Remarks:			

Table 8.1.2 Conducted emissions at AC mains input port test results

LINE: AC mains input
EUT SET UP: TABLE-TOP
TEST SITE: SHIELDED ROOM
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE
FREQUENCY RANGE: 150 kHz - 30 MHz
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(µV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*	Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*		
Configuration 1									
0.151430	42.76	36.14	65.93	-29.79	11.69	55.93	-44.24	L1	Pass
0.169865	44.65	37.91	65.03	-27.12	11.41	55.03	-43.62		
0.203592	43.76	37.30	63.52	-26.22	10.82	53.52	-42.70		
4.218944	37.92	36.22	56.00	-19.78	20.48	46.00	-25.52		
6.656328	27.83	25.34	60.00	-34.66	20.44	50.00	-29.56		
12.187833	34.28	32.06	60.00	-27.94	16.32	50.00	-33.68		
0.151424	44.55	37.88	65.93	-28.05	11.78	55.93	-44.15	L2	Pass
0.169861	44.30	37.84	65.03	-27.19	11.41	55.03	-43.62		
0.203591	43.52	36.73	63.52	-26.79	10.95	53.52	-42.57		
4.218944	30.21	26.97	56.00	-29.03	13.07	46.00	-32.93		
6.656328	26.45	23.94	60.00	-36.06	18.92	50.00	-31.08		
12.187833	33.78	29.20	60.00	-30.80	12.37	50.00	-37.63		
Configuration 2									
0.215169	51.82	48.41	63.07	-14.66	33.04	53.07	-20.03	L1	Pass
0.258381	51.52	48.50	61.53	-13.03	35.66	51.53	-15.87		
0.379745	44.85	41.82	58.32	-16.50	26.49	48.32	-21.83		
0.464423	41.86	39.31	56.67	-17.36	31.20	46.67	-15.47		
0.480586	42.72	38.39	56.36	-17.97	30.44	46.36	-15.92		
3.285016	36.14	32.15	56.00	-23.85	20.99	46.00	-25.01		
0.215169	53.10	50.69	63.07	-12.38	35.54	53.07	-17.53	L2	Pass
0.258383	52.84	49.91	61.53	-11.62	37.01	51.53	-14.52		
0.379751	45.55	42.70	58.32	-15.62	28.45	48.32	-19.87		
0.472560	47.88	44.87	56.51	-11.64	35.62	46.51	-10.89		
0.480580	46.22	42.80	56.36	-13.56	33.16	46.36	-13.20		
3.285015	42.43	37.81	56.00	-18.19	27.27	46.00	-18.73		

*****- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

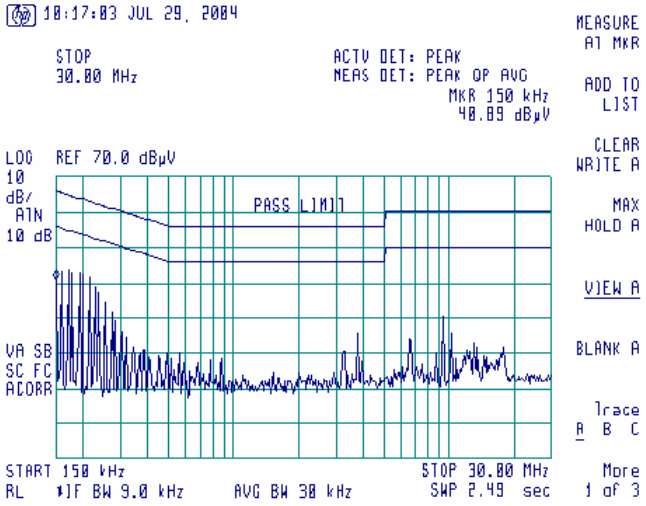
HL 0163	HL 0672	HL 0787	HL 1430	HL 1502	HL 1510		

Full description is given in Appendix A.

Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:59:31 AM		
Temperature: 25 ºC	Air Pressure: 1005 hPa	Relative Humidity: 47 %	Power Supply: 120
Remarks:			

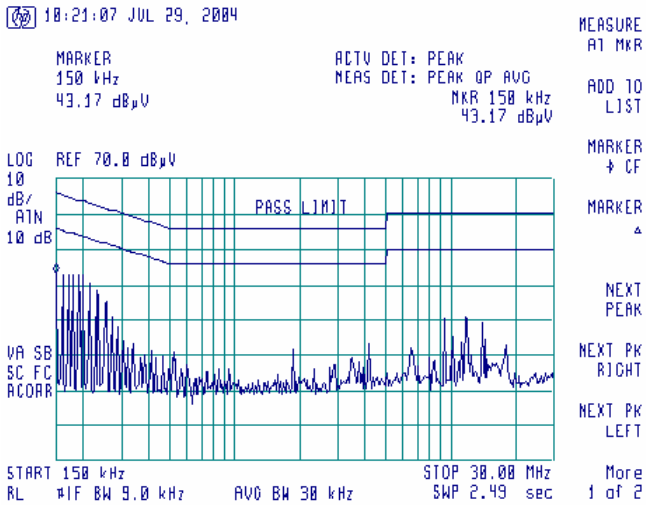
Plot 8.1.1. Conducted emissions at AC mains input port in configuration 1

LINE: L1
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.2 Conducted emissions at AC mains input / output port in configuration 1

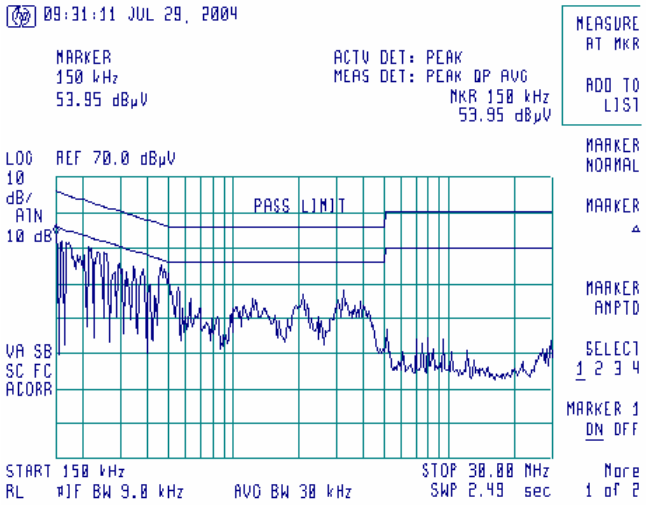
LINE: L2
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	Section 15.107, Conducted emission at AC power port		
Test procedure:	ANSI C63.4, Sections 11.5 and 12.1.3		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/22/2004 8:59:31 AM		
Temperature: 25 ºC	Air Pressure: 1005 hPa	Relative Humidity: 47 %	Power Supply: 120
Remarks:			

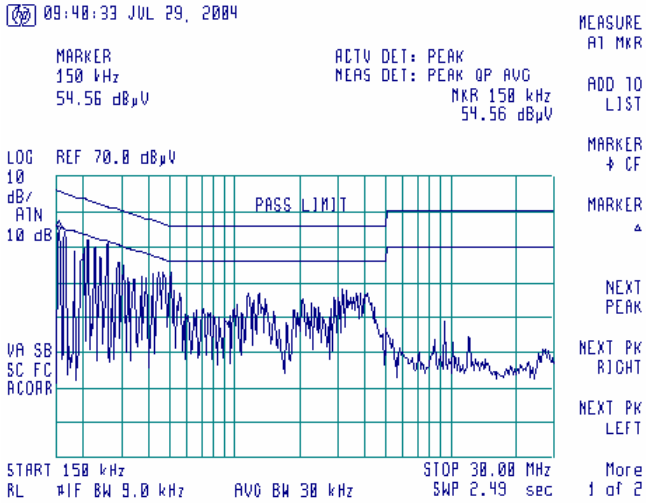
Plot 8.1.3 Conducted emissions at AC mains input port in configuration 2

LINE: L1
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Plot 8.1.4 Conducted emissions at AC mains input port in configuration 2

LINE: L2
LIMIT: QUASI-PEAK, AVERAGE
DETECTOR: PEAK



Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/2/2004 6:38:09 PM		
Temperature: 23 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 38 %	**Power Supply:** 120 VAC
Remarks:			

8.2 Radiated emission measurements

8.2.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.2.1.

Table 8.2.1 Radiated emission test limits

Frequency, MHz	Class B limit, dB(μV/m)		Class A limit, dB(μV/m)	
	10 m distance	3 m distance	10 m distance	3 m distance
30 - 88	29.5*	40.0	39.0	49.5*
88 - 216	33.0*	43.5	43.5	54.0*
216 - 960	35.5*	46.0	46.4	56.9*
Above 960	43.5*	54.0	49.5	60.0*

* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows: $Lim_{S2} = Lim_{S1} + 20 \log (S_1/S_2)$,
where S_1 and S_2 – standard defined and test distance respectively in meters.

8.2.2 Test procedure for measurements in semi-anechoic chamber

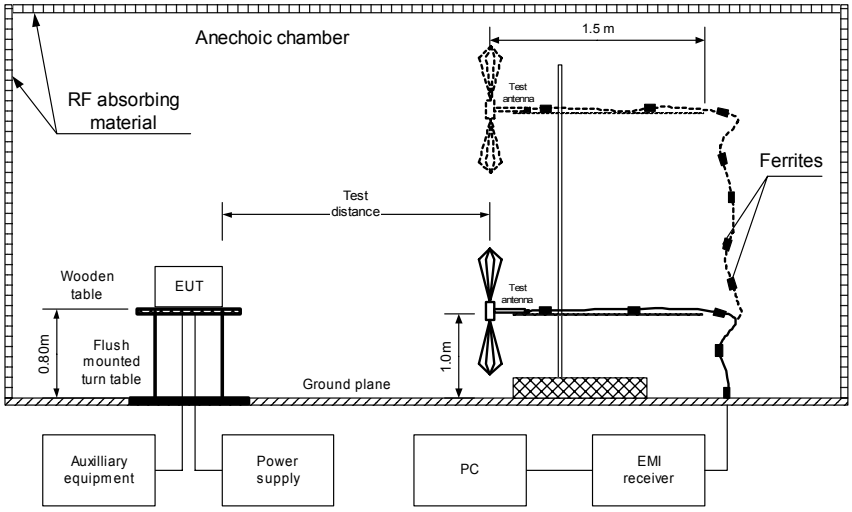
8.2.2.1 The EUT was set up as shown in Figure 8.2.1 and associated photograph/s, energized and the performance check was conducted.

8.2.2.2 The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360^0, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/2/2004 6:38:09 PM		
Temperature: 23 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 38 %	**Power Supply:** 120 VAC
Remarks:			

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment



Test specification:	**Section 15.109, Radiated emission**		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	8/2/2004 6:38:09 PM		
Temperature: 23 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 38 %	**Power Supply:** 120 VAC
Remarks:			

Table 8.2.2 Radiated emission test results

EUT SET UP: TABLE-TOP
LIMIT: Class B
EUT OPERATING MODE: Receive
TEST SITE: SEMI ANECHOIC CHAMBER
TEST DISTANCE: 3 m
DETECTORS USED: PEAK / QUASI-PEAK
FREQUENCY RANGE: 30 MHz – 1000 MHz
RESOLUTION BANDWIDTH: 120 kHz

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
With AC transformer								
67.987187	27.38	23.23	40.00	-16.77	V	1.2	224	Pass
With AC/DC adaptor								
37.430000	24.31	19.06	40.00	-20.94	V	1	10	Pass
40.546500	21.66	12.47	40.00	-27.53	V	1.1	270	Pass
48.887500	23.76	15.10	40.00	-24.90	V	1	196	Pass
74.887500	26.48	22.55	40.00	-17.45	V	1.2	31.4	Pass

*****- Margin = Measured emission - specification limit.
******- EUT front panel refer to 0 degrees position of turntable.

Reference numbers of test equipment used

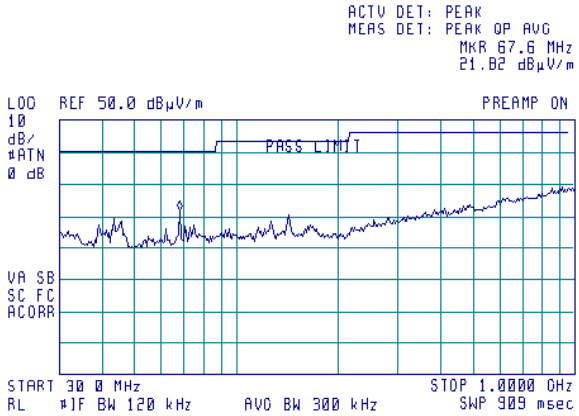
HL 0465	HL 0521	HL 0589	HL 0592	HL 0593	HL 0594	HL 0604	HL 1004
HL 1947	HL 1984	HL 2009					

Full description is given in Appendix A.

Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:38:09 PM		
Temperature: 23 ºC	Air Pressure: 1006 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

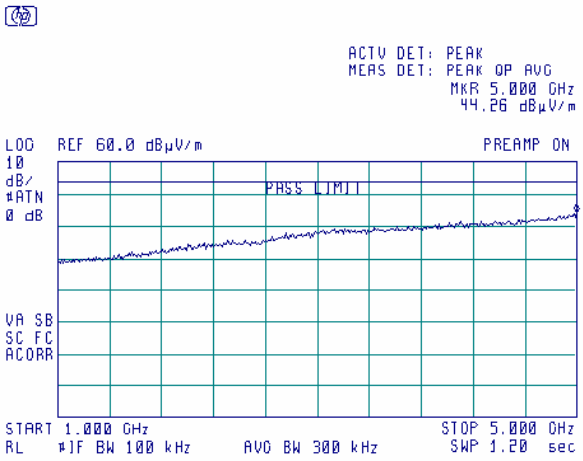
Plot 8.2.1 Radiated emission measurements in 30- 1000 MHz range, vertical antenna polarization

TEST SITE:	Semi anechoic chamber
ASSEMBLY	With AC transformer
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive



Plot 8.2.2 Radiated emission measurements 1000 – 5000 MHz, vertical and horizontal antenna polarization

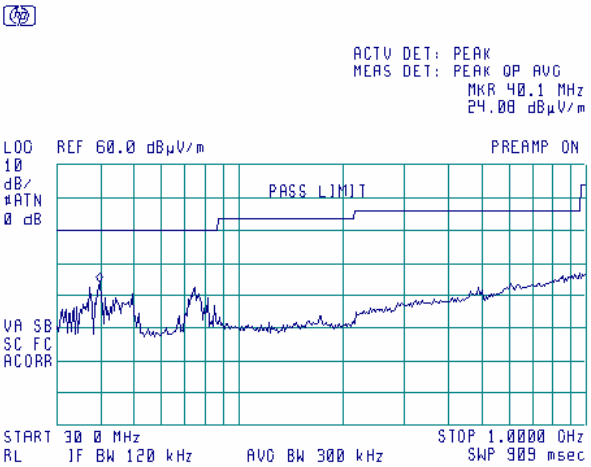
TEST SITE:	Semi anechoic chamber
ASSEMBLY	With AC transformer
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive



Test specification:	Section 15.109, Radiated emission		
Test procedure:	ANSI C63.4, Sections 11.6 and 12.1.4		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	8/2/2004 6:38:09 PM		
Temperature: 23 ºC	Air Pressure: 1006 hPa	Relative Humidity: 38 %	Power Supply: 120 VAC
Remarks:			

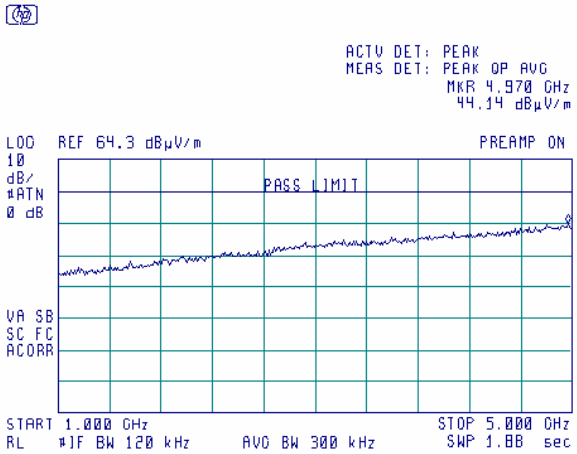
Plot 8.2.3 Radiated emission measurements in 30- 1000 MHz range, vertical antenna polarization

TEST SITE:	Semi anechoic chamber
ASSEMBLY	With AC/DC adaptor
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive



Plot 8.2.4 Radiated emission measurements 1000 – 5000 MHz, vertical and horizontal antenna polarization

TEST SITE:	Semi anechoic chamber
ASSEMBLY	With AC/DC adaptor
LIMIT:	Class B
TEST DISTANCE:	3 m
EUT OPERATING MODE:	Receive



Test specification:	Section 15.111, Conducted emission at receiver antenna port		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/22/2004 10:25:03 AM		
Temperature: 23 ºC	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

8.3 Spurious emissions at RF antenna connector

8.3.1 General

This test was performed to measure spurious emissions at RF antenna connector of receiver operated within 30 to 960 MHz band or a citizens band (CB) receiver which was tested for compliance with radiated emission limits with the antenna port connected to resistive termination. Specification test limits are given in Table 7.6.1. The test results are provided in Table 7.6.2 and associated plots.

Table 8.3.1 Spurious emission limits

Frequency, MHz	EUT type	Power of spurious	
		nW	dBm
25 MHz – 5th harmonic*	Citizens band (CB) receiver	2.0	-57.0
30 MHz – 2nd harmonic**	Superheterodyne receiver		
30 MHz – 5th harmonic*	Other receiver operates within 30 – 960 MHz		

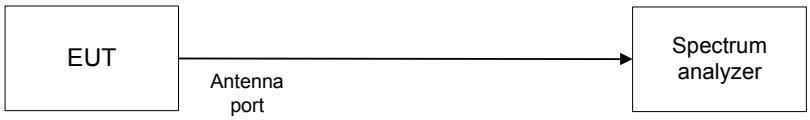
* - harmonic of the highest frequency the EUT generates, uses, operates or tunes to.
** - harmonic of the local oscillator frequency.

8.3.2 Test procedure

8.3.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

8.3.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 7.6.2 and associated plots.

Figure 8.3.1 Spurious emission test setup



Test specification:	**Section 15.111, Conducted emission at receiver antenna port**		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	**Verdict:**	PASS
Date & Time:	7/22/2004 10:25:03 AM		
Temperature: 23 ºC	**Air Pressure:** 1006 hPa	**Relative Humidity:** 37 %	**Power Supply:** 120 VAC
Remarks:			

Table 8.3.2 Spurious emission test results

INVESTIGATED FREQUENCY RANGE:	25 – 5000 MHz
RECEIVER TYPE:	CB
EUT OPERATING MODE:	Receive
DETECTOR USED:	Peak
RESOLUTION BANDWIDTH:	100, 1000 kHz
VIDEO BANDWIDTH:	> RBW

Frequency, MHz	**Spurious emission, dBm**	**Limit, dBm**	**Margin, dB**	**Verdict**
25 – 5000	No spurious emissions were found			Pass

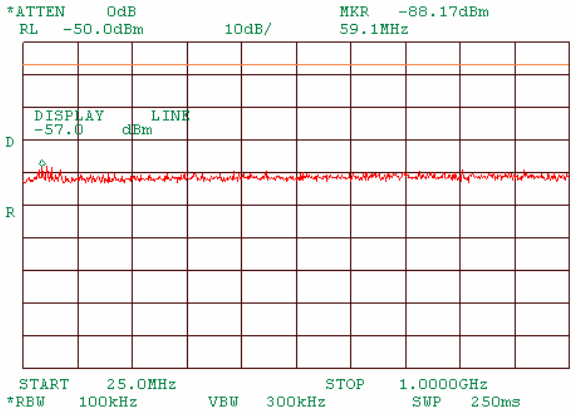
Reference numbers of test equipment used

HL 1424	HL 2254						

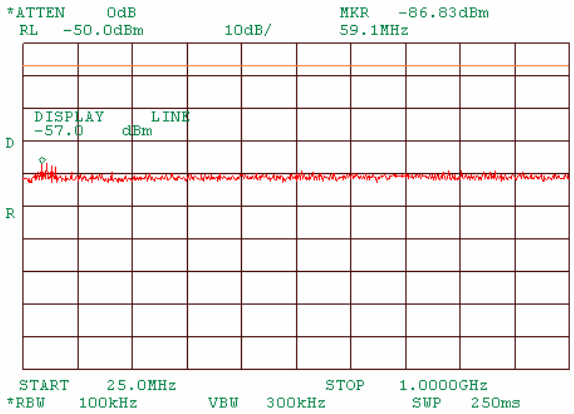
Full description is given in Appendix A.

Test specification:	Section 15.111, Conducted emission at receiver antenna port		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/22/2004 10:25:03 AM		
Temperature: 23 ºC	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 8.3.1 Spurious emission test results 25 – 1000 MHz low frequency

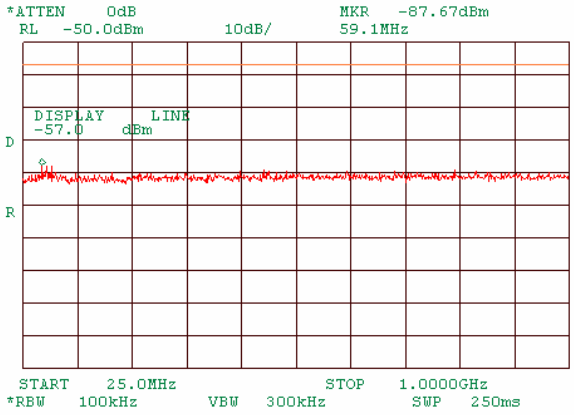


Plot 8.3.2 Spurious emission test results 25 – 1000 MHz mid frequency

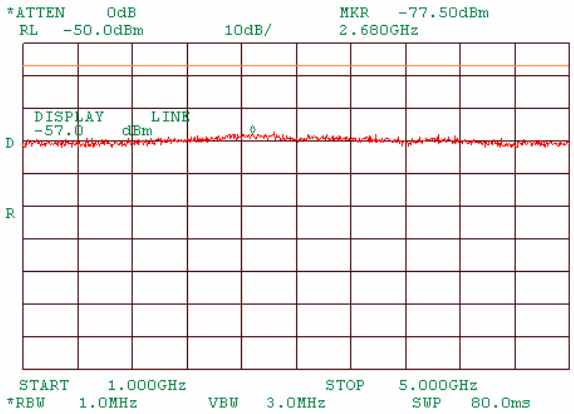


Test specification:	Section 15.111, Conducted emission at receiver antenna port		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/22/2004 10:25:03 AM		
Temperature: 23 ºC	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 8.3.3 Spurious emission test results 25 – 1000 MHz high frequency

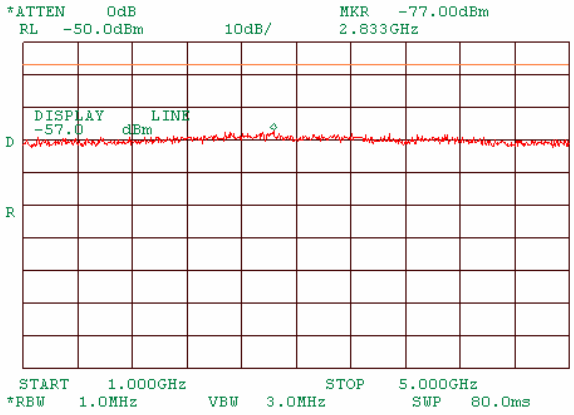


Plot 8.3.4 Spurious emission test results 1000 – 5000 MHz low frequency

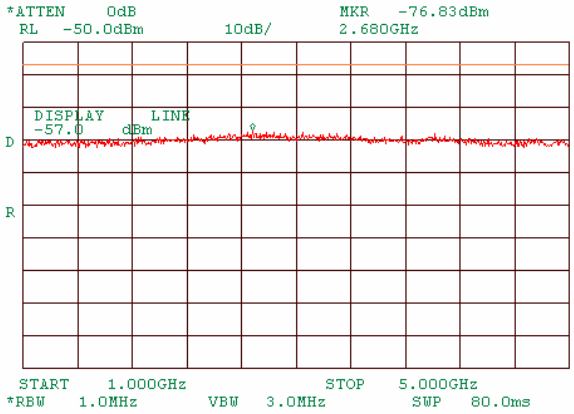


Test specification:	Section 15.111, Conducted emission at receiver antenna port		
Test procedure:	ANSI C63.4, Section 12.1.5		
Test mode:	Compliance	Verdict:	PASS
Date & Time:	7/22/2004 10:25:03 AM		
Temperature: 23 ºC	Air Pressure: 1006 hPa	Relative Humidity: 37 %	Power Supply: 120 VAC
Remarks:			

Plot 8.3.5 Spurious emission test results 1000 – 5000 MHz mid frequency



Plot 8.3.6 Spurious emission test results 1000 – 5000 MHz high frequency



9 APPENDIX A Test equipment and ancillaries used for tests

HL No.	Description	Manufacturer information			Due Calibr. Month/Year
		Name	Model No.	Serial No.	
0163	LISN FCC/VDE/MIL -STD	Electro-Metrics	ANS-25/2	1314	10/04
0446	Active loop antenna, 10 kHz-30 MHz	Electro-Mechanics	6502	2857	10/04
0465	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	023	10/05 check
0493	Oven temperature, -45°C ÷ +125°C	Thermotron	S-1.2 Mini-Max	4016	9/05
0521	Spectrum analyzer with RF filter section (EMI receiver 9 kHz - 6.5 GHz)	Hewlett Packard	8546A	0319	9/05
0539	Signal generator	Marconi Instruments	52023-001H	1041	12/04
0589	Cable coaxial, GORE A2POL118.2, 3 m	Hermon Labs	GORE-3	589	11/04
0592	Position controller	Hermon Labs	L2-SR3000	100	5/05 check
0593	Antenna mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	AM-F1	101	2/05 check
0594	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	102	1/05 check
0604	Antenna biconilog log-periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	9611-1011	1/05
0670	Oscilloscope, Digital storage 500 MHz, 2 Gs/s, 4 ch with Telecom Mask Tester	LeCroy Corporation	LC 334A	2387	8/05
0672	Shielded room 4.6(L) x 4.2(W) x 2.4(H) m	Hermon Labs	SR-3	027	11/04 check
0787	Transient limiter	Hewlett Packard	11947A-8ZE	3107A01877	11/04
0788	Power splitter/combiner	Mini-Circuits	ZFSC-2-1	923705	9/05
0808	Analyzer spectrum, 100 Hz to 2.2 GHz, AM/FM modulator	Anritsu	MS2601B	M178731	3/05
1004	Cable coaxial, ANDREW PSWJ4, 6 m	Hermon Labs	ANDREW-6	163	12/04
1424	Spectrum analyzer, 30 Hz - 40 GHz	Agilent Technologies	8564EC	3946A00219	8/05
1430	EMI receiver system, 9 kHz - 2.9 GHz	Agilent Technologies	8542E	3807A00262	9/05
1502	Cable RF, 6 m	Belden	M17/167 MIL-C-17	1502	12/04 check
1510	Cable RF, 8 m	Belden	M17/167 MIL-C-17	1510	12/04 check
1533	Cable RF, 1.0 m	Alpha wire	RG-213/U	1533	9/05
1556	Cable RF, 0.5 m	Telequis	MIL-C-17F-RG 058 CU	1556	12/04
1907	Power splitter/combiner, 5-500 MHz	Mini-Circuits	ZFSCC-2-1	NA	7/05
1947	Cable 18 GHz, 6.5 m, blue	Rhophase Microwave Ltd	NPS-1803A-6500-NPS	T4974	10/04
1984	Antenna, double ridged waveguide horn, 1-18 GHz, 300W, N-type	EMC Test Systems	3115	9911-5964	3/05

HL No.	Description	Manufacturer information			Due Calibr. Month/Year
		Name	Model No.	Serial No.	
2009	Cable RF, 8 m	Alpha Wire	RG-214	C-56	12/04
2227	Crystal Detector 0.01-18 GHz	Hewlett Packard	8472A	2227	10/04
2254	Cable 40GHz, 0.8 m, blue	Rhophase Microwave Ltd.	KPS-1503A-800-KPS	W4907	11/04
2358	Power supply, 2 X 0-36 VDC, 5A, 5 VDC / 5A	Horizon Electronics	DHR3655D	767469	4/05
2399	Cable 40 GHz, 1.5 m, blue	Rhophase Microwave Ltd.	KPS-1503A-1500-KPS	X2945	6/05
2524	Attenuator, 10 dB, DC-18 GHz	Midwest Microwave	263-10	2524	3/05

10 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	±8%
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Unintentional radiator tests	
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization Vertical polarization	 Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB

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 ISO/IEC 17025 (or alternately ANSI/NCSL Z540-1).
The laboratory calibrates its measurement standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements. The Hermon Labs EMC measurements uncertainty is given in the table above.

11 APPENDIX C Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental 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 electromagnetic emissions (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-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, telecommunications, environmental, safety standards, and by AMTAC (UK) for safety of medical devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01).

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Person for contact: Mr. Alex Usoskin, CEO.

12 APPENDIX D Specification references

47CFR part 90: 2002	Private land mobile radio services
47CFR part 1: 2003	Practice and procedure
47CFR part 2: 2002	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2001	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.
ANSI/TIA/EIA-603-A:2001	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

13 APPENDIX E Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
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
dB(μA)	decibel referred to one microampere
dBΩ	decibel referred to one Ohm
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
ITE	information technology equipment
k	kilo
kHz	kilohertz
LISN	line impedance stabilization network
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
QP	quasi-peak
PCB	printed circuit board
PM	pulse modulation
PS	power supply
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere

14 APPENDIX F Test equipment correction factors

Correction factor
Line impedance stabilization network
Model LISN 16 - 1
Hermon Laboratories

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.

Correction factor
Line impedance stabilization network
Model ANS-25/2
Electro-Metrics

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.

Biconical antenna factor

Electro-Metrics, model BIA-25/30, serial number 3577

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
20	15.1	115	16.7
25	14.6	120	14.1
30	13.7	125	13.1
35	11.8	130	13.0
40	11.4	135	12.9
45	11.7	140	12.7
50	11.4	145	12.5
55	10.5	150	14.3
60	10.3	155	14.8
65	8.9	160	14.7
70	7.6	165	15.1
75	7.3	170	15.6
80	7.3	175	16.5
85	7.8	180	16.7
90	9.4	185	17.3
95	10.6	190	17.9
100	11.8	195	17.6
105	12.5	200	17.9
110	13.7		

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

Biconical antenna factor

Electro-Metrics, model BIA-25/30, serial number 3566

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
20	14.1	115	15.2
25	14.5	120	14.9
30	13.8	125	13.5
35	11.9	130	13.5
40	11.5	135	13.0
45	11.7	140	12.7
50	11.4	145	12.9
55	10.6	150	14.7
60	10.4	155	15.0
65	9.0	160	15.0
70	7.8	165	15.5
75	7.6	170	15.9
80	7.5	175	16.6
85	7.9	180	17.1
90	9.5	185	17.5
95	10.9	190	17.9
100	11.9	195	18.0
105	12.4	200	18.1
110	13.5		

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

Log periodic antenna factor

Electro-Metrics, model LPA-25/30, serial number 1953

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
200	15.2	625	25.2
225	15.1	650	25.8
250	16.3	675	27.2
275	17.2	700	27.6
300	19.6	725	27.6
325	18.4	750	27.6
350	19.0	775	28.0
375	20.0	800	28.2
400	20.9	825	29.4
425	21.3	850	29.9
450	22.1	875	30.0
475	22.7	900	30.4
500	23.2	925	30.6
525	23.9	950	30.8
550	24.2	975	31.6
575	24.6	1000	32.1
600	24.7		

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

Log periodic antenna factor

Electro-Metrics, model LPA-25/30, serial number 1988

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
200	12.6	625	20.4
225	12.2	650	20.9
250	13.4	675	22.0
275	14.3	700	22.2
300	15.2	725	22.7
325	15.7	750	22.5
350	15.9	775	22.7
375	16.4	800	22.8
400	17.0	825	23.2
425	17.4	850	23.5
450	17.9	875	23.9
475	18.6	900	24.0
500	19.1	925	24.0
525	19.3	950	24.2
550	19.6	975	24.7
575	19.8	1000	25.1
600	20.0		

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

Antenna factor

Biconilog antenna EMCO, model 3141, serial number 1011

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

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

Biconilog antenna factor

Schaffner Chase EMC, model CBL 6140A, serial number 1120

Frequency, MHz	Antenna factor, dB(1/m)
20	12.1
22	8.8
24	5.5
26	3.0
28	2.8
30	3.9
40	8.4
50	9.3
60	9.7
70	9.3
80	7.5
90	6.8
100	7.6
110	6.6
120	6.9
140	7.6
160	11.6
170	8.3
190	9.2
200	9.9
220	10.5
240	11.2
260	12.9
280	12.1
300	12.9
320	13.2
340	13.9
360	15.2
380	15.3
400	15.7
420	16.6
440	16.8
460	17.6
480	18.3
500	18.0
520	18.0
540	18.7
560	19.2
580	19.0

Frequency, MHz	Antenna factor, dB(1/m)
600	19.1
620	19.8
640	20.6
660	20.7
680	20.9
700	21.0
720	21.4
740	21.7
760	21.6
780	21.6
800	21.9
820	22.2
840	22.6
860	22.7
880	22.7
900	22.9
920	23.2
940	23.7
960	24.3
980	24.6
1000	24.4
1.060	24.3
1.120	24.8
1.180	25.3
1.240	26.1
1.300	26.9
1.360	27.6
1.420	26.8
1.480	26.9
1.520	28.1
1.560	28.1
1.640	28.2
1.700	28.6
1.760	30.0
1.840	31.3
1.900	31.8
1.960	31.6
2.000	32.0

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

Antenna factor
Double-ridged wave guide horn antenna
EMC Test Systems, model 3115, serial no: 9911-5964

Frequency, MHz	Antenna gain, dBi	Antenna factor. dB(1/m)
1000.0	5.8	24.5
1500.0	9.0	24.8
2000.0	8.6	27.7
2500.0	9.5	28.7
3000.0	8.9	30.8
3500.0	8.2	32.9
4000.0	9.6	32.7
4500.0	11.2	32.1
5000.0	10.6	33.6
5500.0	9.8	35.3
6000.0	10.1	35.7
6500.0	10.7	35.8
7000.0	10.9	36.2
7500.0	10.5	37.2
8000.0	11.1	37.2
8500.0	10.8	38.1
9000.0	10.7	38.6
9500.0	11.5	38.3
10000.0	11.8	38.4
10500.0	12.3	38.3
11000.0	12.3	38.8
11500.0	11.5	39.9
12000.0	12.2	39.6
12500.0	12.6	39.5
13000.0	12.0	40.5
13500.0	11.7	41.1
14000.0	11.7	41.5
14500.0	12.7	40.8
15000.0	14.2	39.5
15500.0	16.0	38.1
16000.0	16.2	38.1
16500.0	14.5	40.1
17000.0	12.2	42.6
17500.0	9.7	45.4
18000.0	6.6	48.7

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

Antenna factor
Double-ridged wave guide horn antenna
EMC Test Systems, model 3115, serial no: 00027177

Frequency, MHz	Antenna gain, dBi	Antenna factor. dB(1/m)
1000.0	5.5	24.7
1500.0	8.0	25.7
2000.0	8.4	27.8
2500.0	9.3	28.9
3000.0	9.0	30.7
3500.0	9.3	31.8
4000.0	9.3	33.0
4500.0	10.4	32.8
5000.0	10.0	34.2
5500.0	10.1	34.9
6000.0	10.6	35.2
6500.0	11.0	35.4
7000.0	10.8	36.3
7500.0	10.4	37.3
8000.0	10.8	37.5
8500.0	10.8	38.0
9000.0	11.0	38.3
9500.0	11.5	38.3
10000.0	11.5	38.7
10500.0	11.9	38.7
11000.0	12.2	38.9
11500.0	11.9	39.5
12000.0	12.3	39.5
12500.0	12.7	39.4
13000.0	12.0	40.5
13500.0	12.0	40.8
14000.0	11.6	41.5
14500.0	12.2	41.3
15000.0	13.6	40.2
15500.0	15.3	38.7
16000.0	15.8	38.5
16500.0	14.8	39.8
17000.0	12.9	41.9
17500.0	9.2	45.8
18000.0	6.2	49.1

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

Antenna Factor
Active Loop Antenna
EMC Test Systems, model 6502, serial number 2857

Frequency, MHz	Magnetic Antenna Factor, dB(S/m)	Electric Antenna Factor, dB(1/m)
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.7
0.750	-41.9	9.6
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.1
4.000	-41.4	10.1
5.000	-41.5	10.0
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

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

Antenna Factor
Active Loop Antenna
EMC Test Systems, model 6507, serial number 1457

Frequency, MHz	Magnetic Antenna Factor, dB(S/m)	Electric Antenna Factor, dB(1/m)
0.009	-20.8	30.7
0.010	-21.9	29.7
0.020	-27.1	24.5
0.050	-31.0	20.5
0.075	-31.7	19.8
0.100	-31.9	19.6
0.150	-32.1	19.4
0.250	-32.3	19.2
0.500	-32.6	18.9
0.750	-32.7	18.8
1.000	-32.8	18.7
2.000	-33.2	18.3
3.000	-33.5	18.0
4.000	-33.9	17.6
5.000	-34.1	17.4
10.000	-34.8	16.7
15.000	-35.3	16.3
20.000	-35.3	16.3
25.000	-35.8	15.7
30.000	-35.9	15.7

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

Correction factor
Line impedance stabilization network
Model ANS-25/2
Electro-Metrics

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.