

Advanced Control Technologies Inc.

Application
For Certification
ZRW100/ZDW100 Repeater

FCC ID: QIE06X8-0X

August 29, 2003



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EXHIBIT 1 - CONFIGURATION PHOTOGRAPHS

1.0 JENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *Advanced Control Technologies ZRW100/ZDW100 Repeater* for Certification under FCC Part 15, Subpart C.

There are no other simultaneous applications.

The Receiver portion will be verified under Declaration of Conformity.

1.2 Product Description

ZRW100/ZDW100 Repeater is a RF remote controlled receiver-transmitter operating in 908.4MHz. The intended use of the *ZRW100/ZDW100 Repeater* is to generate and transmit a RF signal upon receiving the RF signal from other source. The *ZRW100/ZDW100 Repeater* powered at 120VAC/60Hz.

Antenna Description:

Single isolated wire 8cm length soldered to the RF Board inside the unit

Sample Submitted: August 14, 2003

Test Work Started: August 18, 2003

Test Work Completed: August 29, 2003

1.3 Test Methodology

Emission measurements were performed according to the procedures in ANSI C63.4-2000. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in Appendices D and E were followed. All field strength radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been fully described in a report dated on March 2003 submitted to FCC. Please reference the site registration number: 90706, dated April 18, 2003.

2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

Line Conducted Emissions testing for ZDW100 unit was performed with the dimmer function disabled.

2.2 EUT Exercising Software

N/A

2.3 Special Accessories

There are no special accessories necessary for compliance of these products.

2.4 Equipment Modification

No modifications were installed during the testing.

2.5 Support Equipment List and Description

N/A

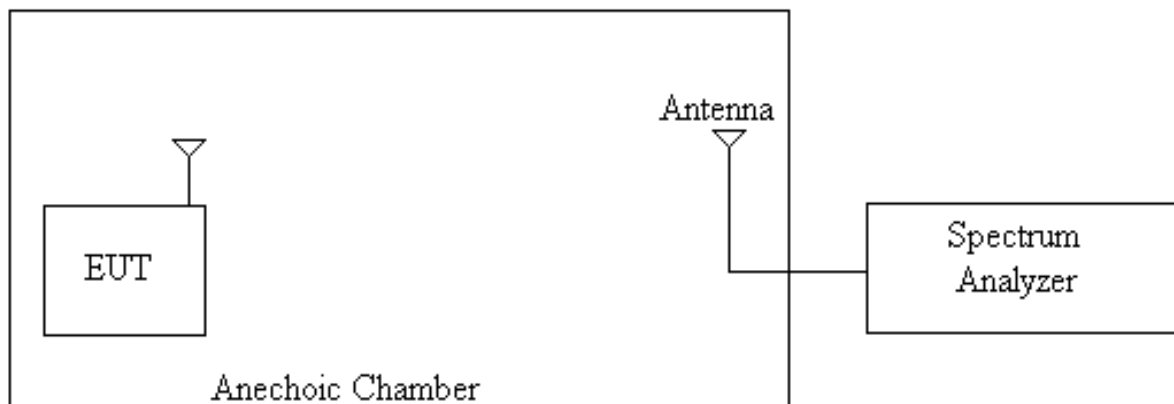
2.6 Test Configuration Block Diagrams

The EUT was setup as tabletop equipment.

The EUT was powered at 120VAC/60Hz.

For simplicity of testing, the Unit was set to transmit continuously: TP1 on the RF board was “grounded” via 4.7kOhm resistor.

Field Strength Measurements



3.0 TEST RESULTS

Data is included for the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and graphical representations of the emissions are included.

The EUT is intended for operation under the requirements of Part 15 Subpart C. Specific test requirements include the following:

47 CFR 15.249(a)(b)	Field Strength of Fundamental
47 CFR 15.249(a)(b), 15.205	Field Strength of Harmonics
47 CFR 15.249(c), 15.209	Out of Band Spurious Emissions
47 CFR 15.207	Line Conducted Emissions

3.1 Field Strength of Fundamental and Harmonics Emissions, FCC 15.249(a)(b), 15.205

Field Strength of Fundamental and Harmonics Emissions measurements were made with Fundamental frequency at 908.4MHz. The Harmonics emissions were tested up to 10th harmonic.

The EUT complies with the Standard requirements for Fundamental and Harmonics Emissions with minimum margin 3dB for Fundamental Emissions and 10.8dB for Harmonic Emissions.

The Tables 3-1-1 and 3-1-2, and Graphs 3-1-1 and 3-1-2 show the Field Strength of Fundamental Radiation and Harmonics Emissions.

No emissions above ambient was found above 5th harmonics.

Field Strength of Fundamental **Date:** 08-26-2003
Company: Advanced Control Technologies Inc.
Model: ZRW100/ZDW100 RF Module
Test Engineer: Norman Shpilsher
Special Info: Transitting mode of operation
Total Factor includes Antenna Factor and Cable Loss
Standard: FCC Part 15.249
Test Site: 3 m Anechoic Chamber
Note: Measurements were taking using a CISPR Quasi-Peak Detector
with 100kHz Resolution Bandwidth

Table # 3-1-1

Frequency MHz	Antenna		Total Factor(dB/m)	Reading dB γ V	Net at 3m. dB γ V/m	Limit dB γ V/m	Margin dB	Comments
	Polarity	Hts(m)						
908.425	V	116	25.08	59.06	84.14	93.98	-9.84	
908.425	H	109	25.08	65.89	90.97	93.98	-3.01	

Field Strength of Harmonics
Date: 08-26-2003

Company: Advanced Control Technologies Inc.

Model: ZRW100/ZDW100 RF Module

Test Engineer: Norman Shpilsher

Special Info: Transitting mode of operation

Total Factor includes Antenna Factor, Cable Loss, Pre-amp Gain, RF Filter Factor

Standard: FCC Part 15.249

Test Site: 3 m Anechoic Chamber

Note: Measurements were taking using a Peak Detector

with 1MHz Resolution Bandwidth

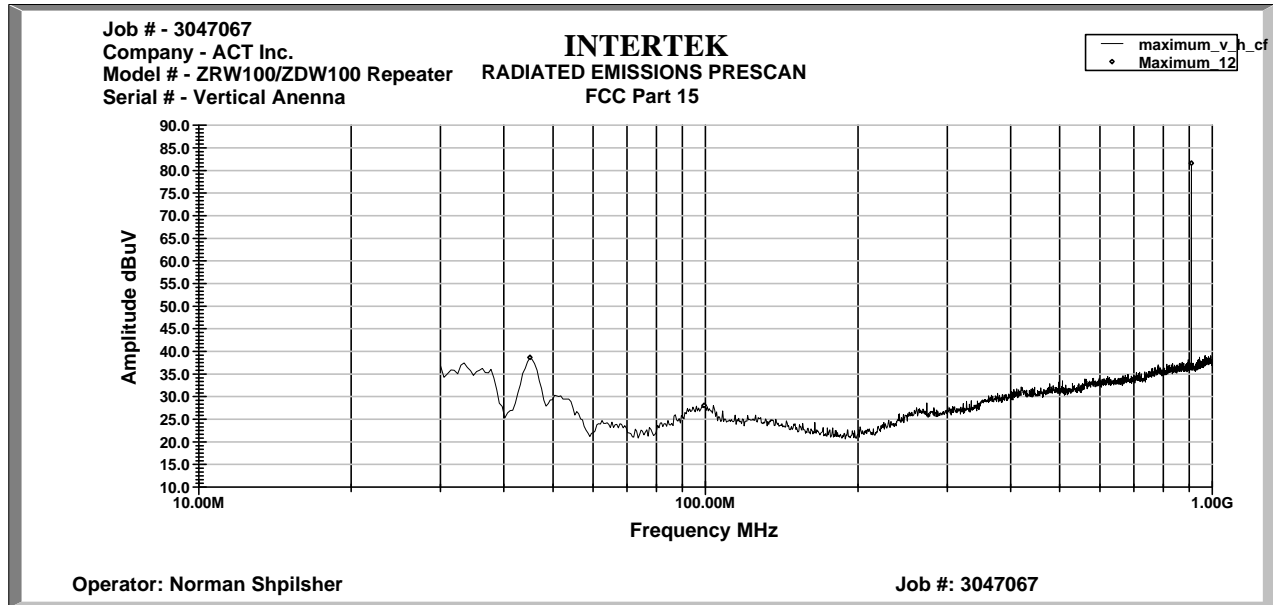
No emissions were detected above ambient above 5th harmonic.

Table # 3-1-2

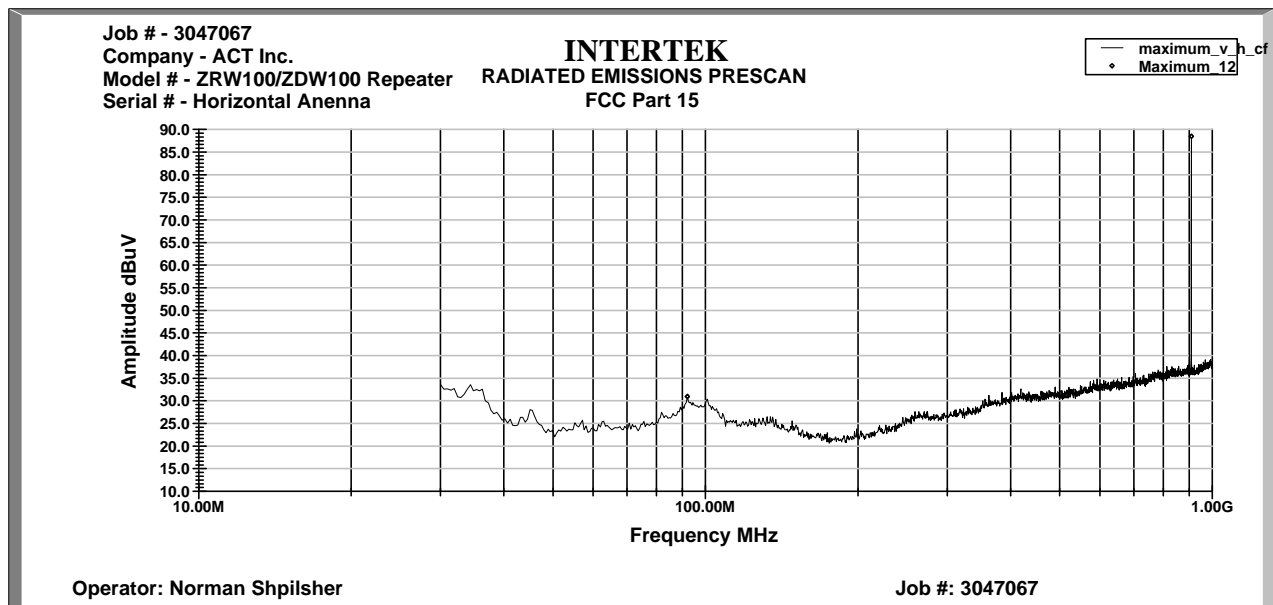
Frequency MHz	Antenna		Total Factor(dB/m)	Reading dB _μ V	Net at 3m. dB _μ V/m	Limit dB _μ V/m	Margin dB	Comments
	Polarity	Hts(m)						
1816.92	V	153	-2.40	44.60	42.20	N/A	N/A	2nd harm.
1816.92	H	189	-2.40	46.70	44.30	N/A	N/A	2nd harm.
2725.35	V	114	1.09	42.10	43.19	53.98	-10.79	3rd harm.
2725.35	H	225	1.09	40.90	41.99	53.98	-11.99	3rd harm.
3633.85	V	141	4.82	38.10	42.92	53.98	-11.06	4th harm.
3633.85	H	159	4.82	35.80	40.62	53.98	-13.36	4th harm.
4542.33	V	141	7.08	34.80	41.88	53.98	-12.10	5th harm.
4542.33	H	159	7.08	35.30	42.38	53.98	-11.60	5th harm.

Graph 3-1-1
Radiated Emissions from 30MHz to 1GHz

Vertical Antenna Polarization

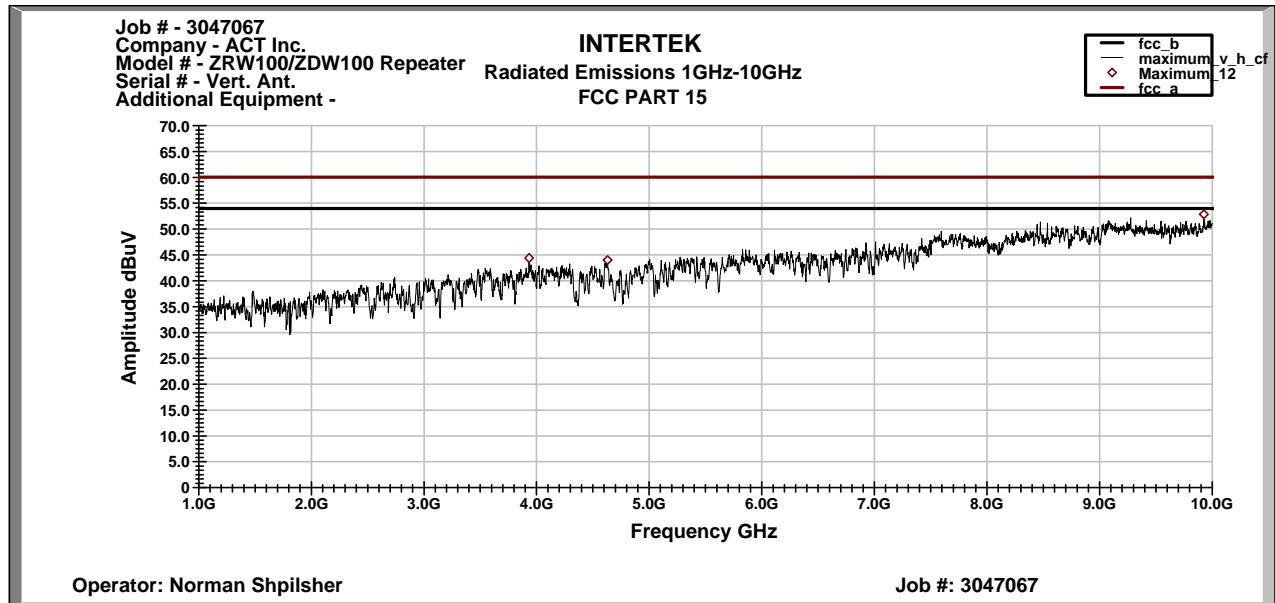


Horizontal Antenna Polarization

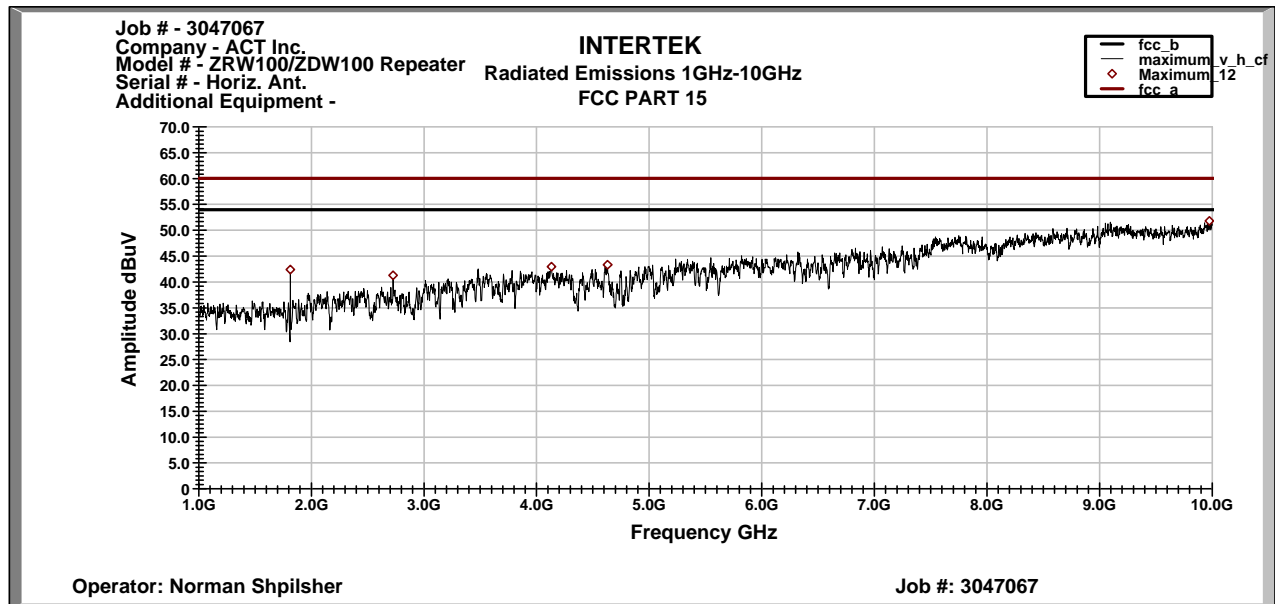


Graph 3-1-2
Radiated Emissions from 1GHz to 10GHz

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.2 Out of Band Spurious Emissions, FCC 15.249(c), 15.209

Out-of-band measurements were made for frequencies:

- 902MHz
- 928MHz.

Output frequencies of the EUT was 908.4MHz

The EUT complies with the Standard requirements Out of Band Spurious Emissions for Section 15.209 as well as for Section 15.249(c).

The Table 3-2-1 and Graph 3-2-1 show the Out of Band Spurious Emissions.

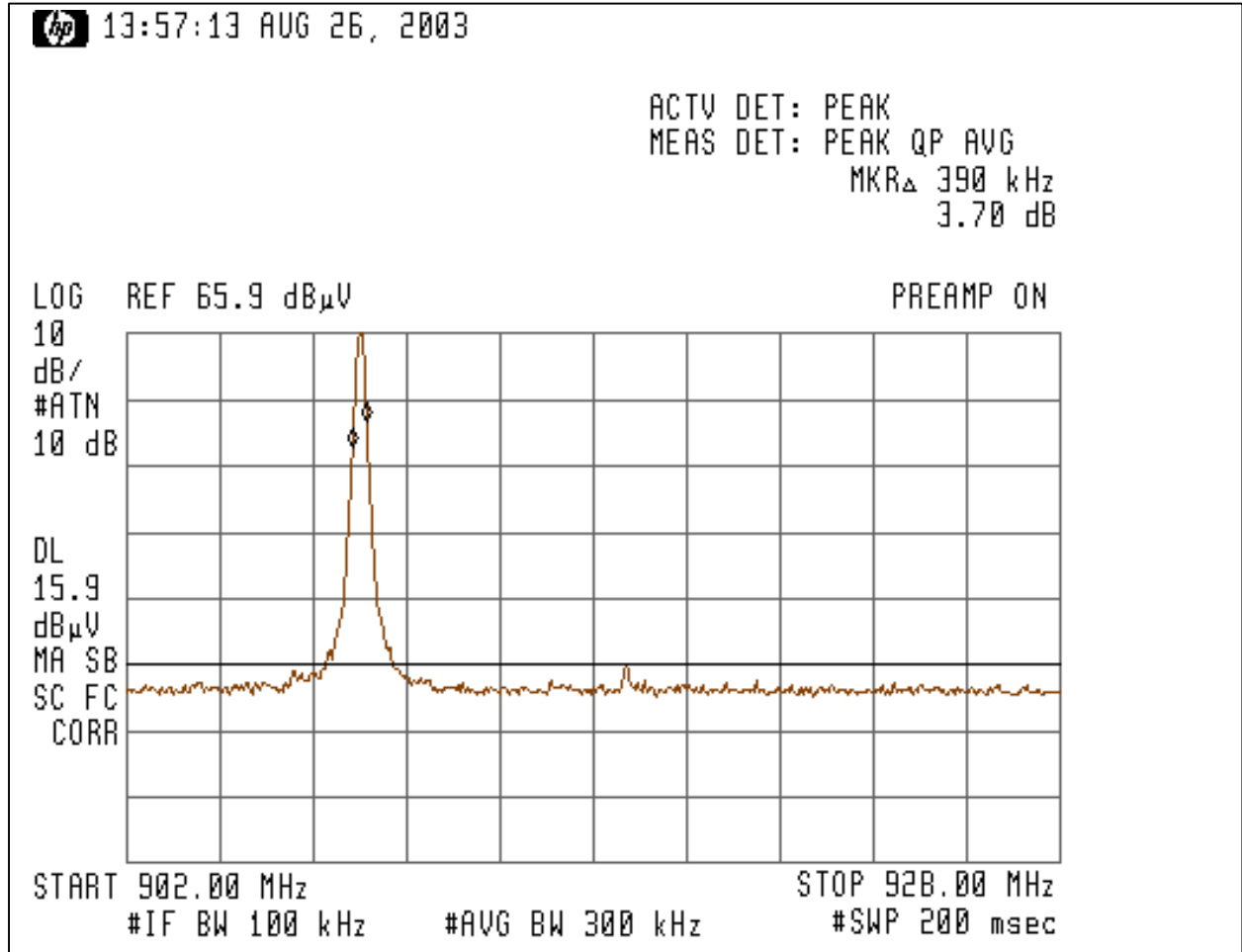
Note: Emission level shown in the Graphs does not include the Antenna, Cable and Pre-amplifier correction factors.

Band Edge Emissions **Date:** 08-26-2003
Company: Advanced Control Technologies Inc.
Model: ZRW100/ZDW100 RF Module
Test Engineer: Norman Shpilsher
Special Config. Info: Transitting mode of operation
Total Factor includes Antenna Factor and Cable Loss
Standard: FCC Part 15.209
Test Site: 3 m Anechoic Chamber
Note: Measurements were taking using a CISPR Quasi-Peak Detector
with 100kHz Resolution Bandwidth

Table # 3-2-1

Frequency MHz	Ant. Polarity	Total CF (dB/m)	Reading dB _μ V	Net at 3m. dB _μ V/m	Limit dB _μ V/m	Margin dB	Attenuation dB	Minimum Att. (dB)	Comments
902.00	H	25.02	7.0	32.0	46.0	-14.0	53.9	50.0	Pass
928.00	H	25.28	5.1	30.4	46.0	-15.6	53.6	50.0	Pass

Graph 3-2-1
Out of band Spurious Emissions



3.3 Line Conducted Emissions, FCC 15.207

Line Conducted Emissions testing was performed in frequency range from 150kHz to 30MHz. The dimmer function of the Repeater was disabled during testing (See Section 2.1)

The Table 3-3-1 and Graphs 3-3-1 and 3-3-2 show the Line Conducted Emissions.

Conducted Emissions **Date:** 08-28-2003
Company: Advanved Control Technology Inc.
Model: ZRW100
Test Engineer: Norman Shpilsher
Special Config. Info: The EUT Switch set to position OFF
Standard: FCC Part 15.207
Note: The table shows the worst case conducted emissions
 All measurements were taken using a CISPR Quasi-peak detector

Table # 3-3-1

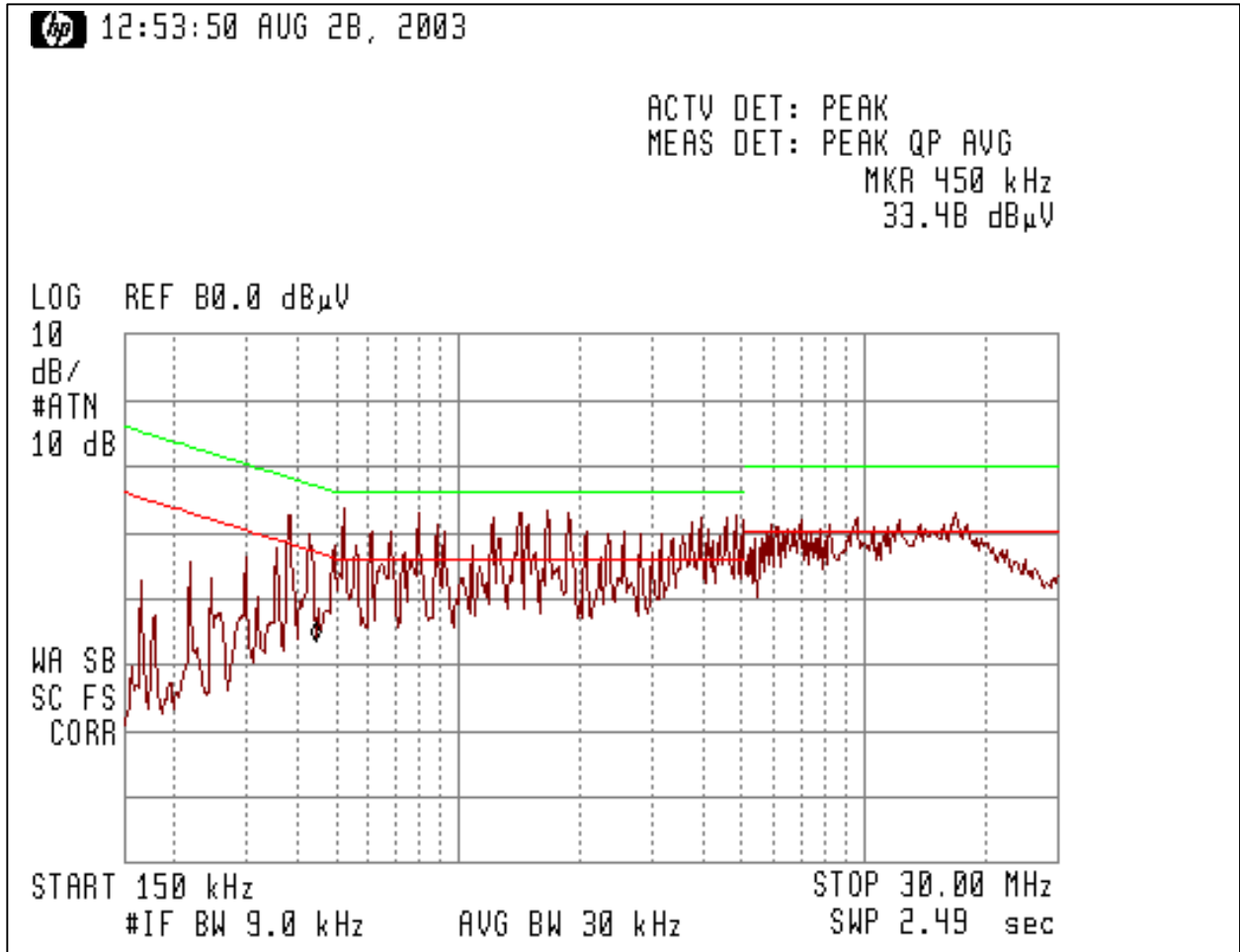
Line 1

Frequency	QP dB μ V	AVG dB μ V	QP Limit dB μ V	AVG Limit dB μ V	QP Margin dB	AVG Margin dB
0.388	50.6	38.3	58.1	48.1	-7.5	-9.8
0.512	51.8	37.9	56.0	46.0	-4.2	-8.1
0.642	51.7	37.8	56.0	46.0	-4.3	-8.2
0.784	51.1	38.2	56.0	46.0	-4.9	-7.8
0.902	49.6	36.9	56.0	46.0	-6.4	-9.1
1.039	47.8	35.9	56.0	46.0	-8.2	-10.1
1.386	49.3	37.6	56.0	46.0	-6.7	-8.4
4.879	46.6	35.3	56.0	46.0	-9.4	-10.7

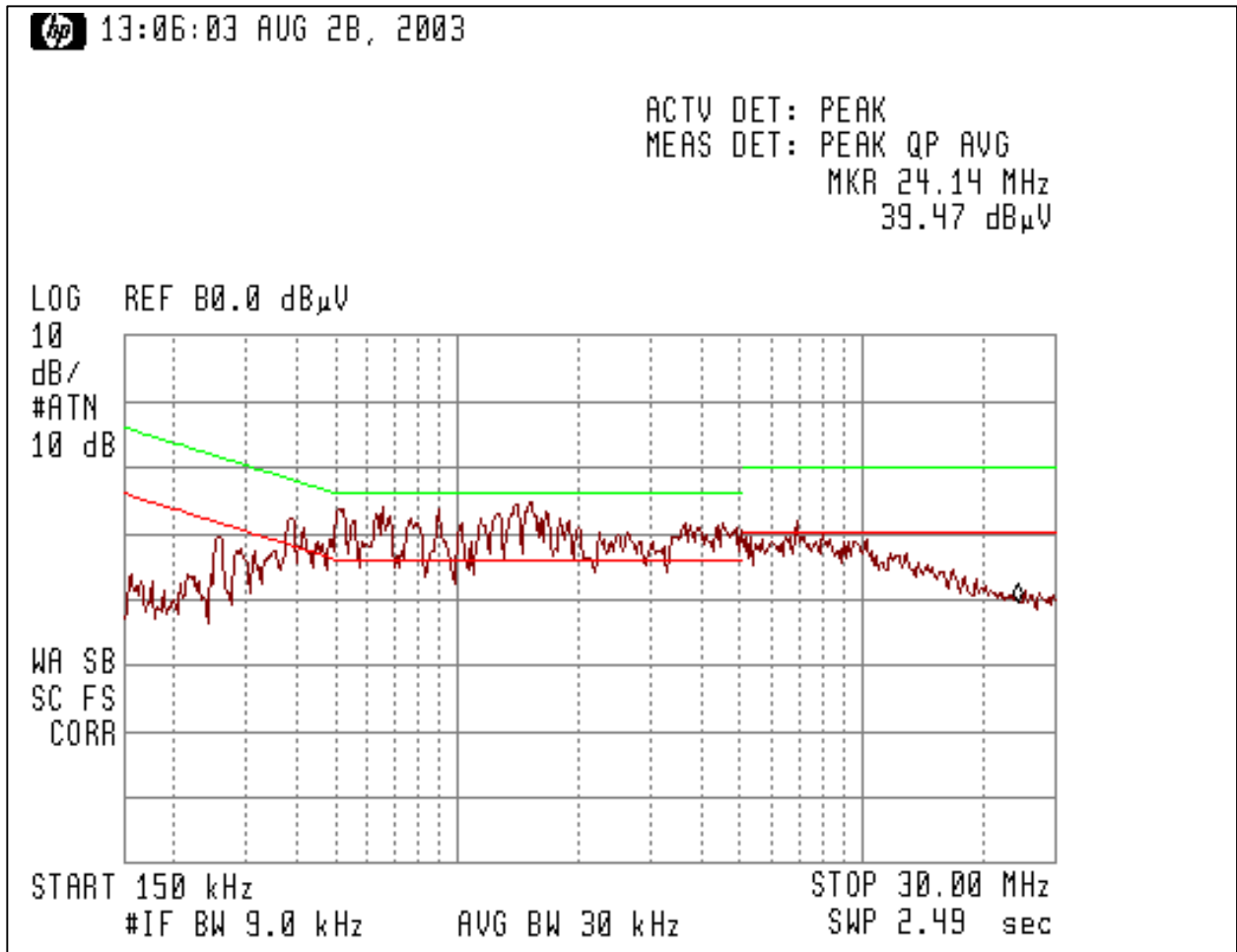
Line 2

Frequency	QP dB μ V	AVG dB μ V	QP Limit dB μ V	AVG Limit dB μ V	QP Margin dB	AVG Margin dB
0.359	46.3	40.6	58.7	48.7	-12.4	-8.1
0.519	52.7	45.3	56.0	46.0	-3.3	-0.7
0.646	52.8	45.1	56.0	46.0	-3.2	-0.9
0.772	51.7	43.8	56.0	46.0	-4.3	-2.2
0.907	50.6	42.7	56.0	46.0	-5.4	-3.3
1.269	50.4	43.9	56.0	46.0	-5.6	-2.1
1.546	51.8	44.3	56.0	46.0	-4.2	-1.7
3.920	47.8	40.9	56.0	46.0	-8.2	-5.1
4.997	47.9	40.8	56.0	46.0	-8.1	-5.2

Graph 3-3-1
Conducted Emissions, Line 1



Graph 3-3-2
Conducted Emissions, Line 2



3.4 Test Procedure

Field Strength Measurements

The EUT was placed on a non-conductive table 0.8m above the ground plane inside the Anechoic Chamber. The table was centered on a motorized turntable, which allows 360-degree rotation. The measurement antenna was positioned at 3m distance. The Bicono-Log antenna was used in frequency range from 30MHz to 1GHz, and the Horn antenna was used in frequency range above 1GHz. The radiated emissions were maximized by configuring the EUT through its placement in three orthogonal axes, by rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m. Method of the direct Field Strength Calculation is shown in Section 3.6.

Conducted Emissions

For conducted emissions testing, the equipment is moved to an insulating platform over the ground plane, and the EUT is powered from a LISN. Both sides of the AC line are measured and the results are compared to the applicable limits. Measurements are taken using CISPR quasi-peak and average detectors when the peak readings approach or exceed the average limit. Only quasi-peak readings are taken when the emissions from the EUT meet the average limit as measured with the quasi-peak detector.

3.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dB(μV/m)

RA = Receiver Amplitude in dB(μV)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB(m⁻¹)

AG = Amplifier Gain in dBi

Assume a receiver reading of 48.1 dB(μV) is obtained. The antenna factor of 7.4 dB(m⁻¹) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dBi is subtracted giving field strength of 41.1 dB(μV/m).

$$RA = 48.1 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(\text{m}^{-1})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dBi}$$

$$FS = RA + AF + CF - AG$$

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB}(\mu\text{V}/\text{m})$$

In the tables the Cable correction factors are included to the Antenna Factors.

Tested by:

Norman Shpilsher
Sr. EMC Engineer
Intertek

Signature



Date: August 29, 2003

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3325A00106	08/02	08/03	
HP85460A RF Filter Section	3330A00109	08/02	08/03	
HP85462A Receiver RF Section	3549A00306	12/02	12/03	X
HP85460A RF Filter Section	3448A00276	12/02	12/03	X
Advantest Spectrum Analyzer R3271A	55050084	06/03	06/04	X

Antennas/Pre-Amplifiers

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
Schaffner-Chase Bicono-Log Antenna	2468	12/02	12/03	X
Schaffner-Chase Bicono-Log Antenna	2630	06/03	06/04	
EMCO Horn Antenna 3115	9507-4513	11/02	11/03	X
EMCO Horn Antenna 3115	6579	12/02	12/03	
Roberts Antenna A100	00599	06/03	06/04	
HP 83017A Pre-Amplifier	3123A00475	11/02	11/03	X
HP 8447F Pre-Amplifier	3113A04974	09/02	09/03	X

Artificial Mains Networks/Absorbing Clamps

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
FCC LISN-2	316	01/03	01/04	X
FCC-LISN-50-25-2	2014	05/03	05/04	
Farnell 1EXLSN930A	136	05/03	05/04	