

Intertek

ETL SEMKO

TEST REPORT

Report Number: 3064637.011

Project Number: 3064637

October 4, 2004

Evaluation of the

ZDW120

FCC ID:

QIE067X-0X

to

FCC Part 2

FCC Part 15, Subpart C, Section 15.249

For

Advanced Control Technologies Inc.

Test Performed by:

Intertek

7250 Hudson Blvd. Suite 100

Oakdale, MN 55128

Test Authorized by:

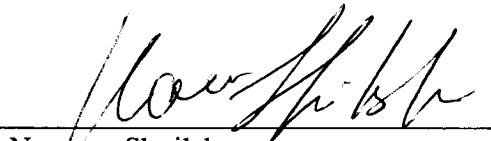
Advanced Control Technologies Inc.

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Prepared by:


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Date: October 4, 2004

Approved by:


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Date: October 4, 2004

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1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *Advanced Control Technologies ZDW120 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

The *ZDW120 Repeater* is a RF remote controlled receiver-transmitter operating in 908.4MHz. The intended use of the *ZDW120 Repeater* is to generate and transmit a RF signal upon receiving the RF signal from other source. The *ZDW120 Repeater* powered at 120VAC/60Hz.

Antenna Description:

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

Sample Submitted: September 8, 2004

Test Work Started: September 9, 2004

Test Work Completed: October 1, 2004

1.3 Test Methodology

Emission measurements were performed according to the procedures in ANSI C63.4-2001. 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

Conducted Emissions testing for *ZDW120 Repeater* was performed with the dimmer function disabled.

2.2 EUT Setup

For simplicity of testing, the transmitter was wired to transmit continuously for spurious emissions testing.

2.3 EUT Exercising Software

N/A

2.4 Special Accessories

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

2.5 Equipment Modification

No modifications were installed during the testing.

2.6 Support Equipment List and Description

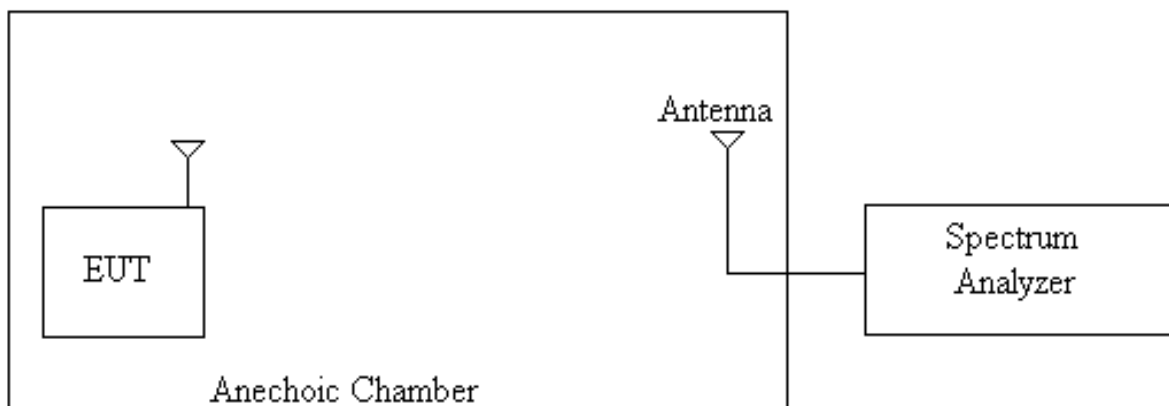
ZTH100 Remote Control used to activate normal transmission operation of the *ZDW120 Repeater*.
Rohde & Schwarz SMT 03, Signal Generator, s/n DE12157 used to activate the Receiver for FCC 15.109 Radiated Emissions testing.

2.7 Test Configuration Block Diagrams

The EUT was setup as tabletop equipment.
The EUT was powered at 120VAC/60Hz.

Field Strength Measurements

For simplicity of testing, the Unit was set to transmit continuously for spurious emissions 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
	Bandwidth of Emissions
47 CFR 15.207	Conducted Emissions
47 CFR 15.109	Unintentional Radiated 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 7.6dB for Fundamental Emissions and 2dB for Harmonic Emissions.

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

No emissions above the floor noise were found above 5th harmonics.

Field Strength of Fundamental	Date:	09-09-2004
Company:	Advanced Control Technologies Inc.	
Model:	ZDW120	
Test Engineer:	Norman Shpilsher	
Special Info:		
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 Antenna Factors include Antenna Correction Factors and Cable Loss	

Table # 3-1-1

Frequency MHz	Antenna		Antenna Factor dB(1/m)	QP Reading dBμV	Net at 3m. dBμV/m	Limit dBμV/m	Margin dB
	Polarity	Hts(m)					
908.38	V	128	25.1	67.9	93.0	94.0	-1.0
908.38	H	230	25.1	64.1	89.2	94.0	-4.8

TILE Instrument Control System EMI Measurement Software

Radiated Emissions of Spurious Emissions

Date: 09-20-2004

Company: Advanced Control Technologies Inc.

Model: ZDW120

Test Engineer: Norman Shpilsher

Special Info:

Standard: FCC Part 15.249

Test Site: 3m Anechoic Chamber, 3m measurement distance

Note: The table shows the worst case radiated emissions
All measurements were taken using a Peak detector

Total Antenna Factors include Antenna Correction Factors and Cable Loss

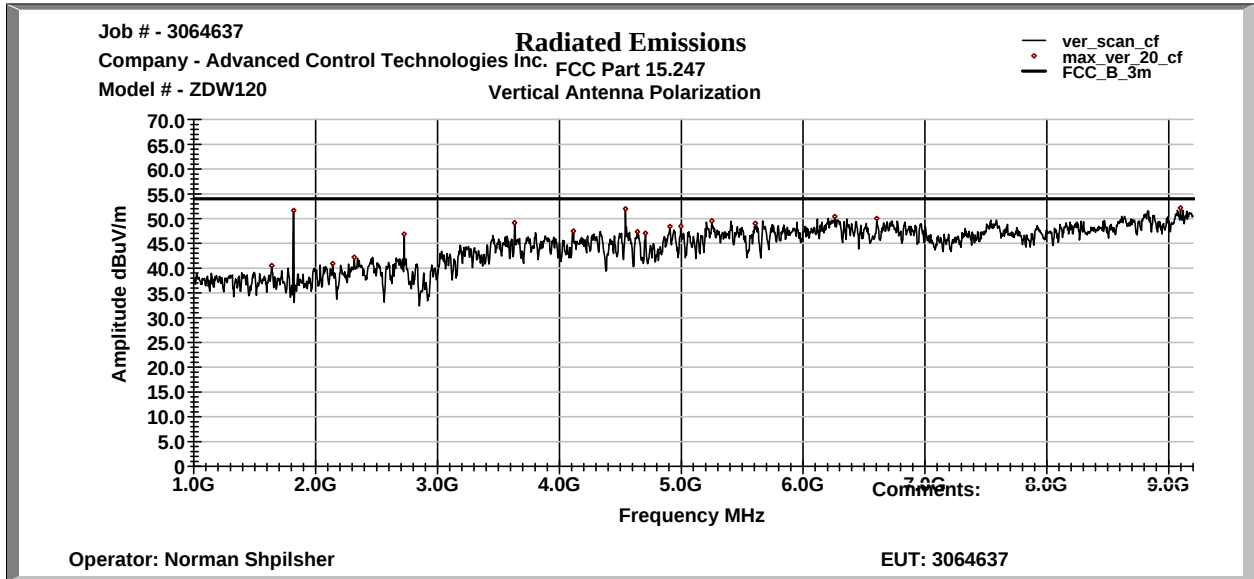
Table # 3-1-2

Frequency MHz	Antenna Polarity	Ant. Factor dB1/m	Pre-Amp Gain (dB)	Reading dB μ V	Total Emissions dB μ V/m	Limit dB μ V/m	Margin dB
1820.00	V	31.1	36.0	54.9	50.0	54.0	-4.0
2726.10	V	34.6	34.9	46.0	45.6	54.0	-8.4
3632.20	V	37.4	34.3	44.2	47.3	54.0	-6.6
4542.40	V	39.4	34.0	44.2	49.6	54.0	-4.4
1820.00	H	31.1	36.0	51.3	46.4	54.0	-7.5
2726.10	H	34.6	34.9	46.9	46.5	54.0	-7.4
4542.40	H	39.4	34.0	43.9	49.4	54.0	-4.6

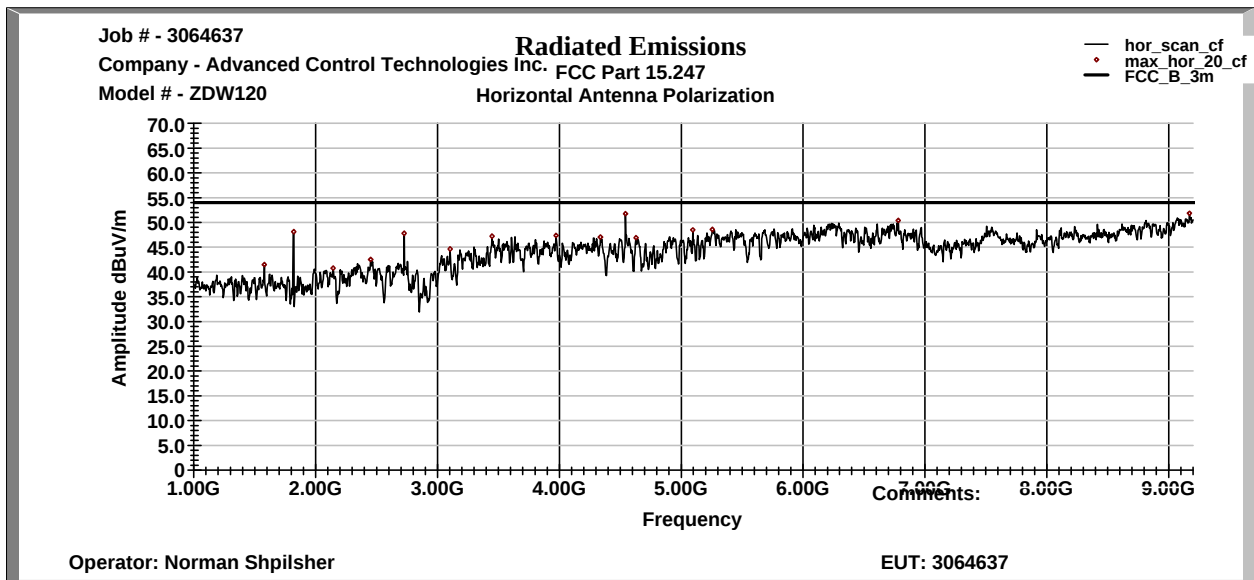
Graph # 3-1-1

Radiated Emissions from 1 to 9.2GHz

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.2 Average Correction factor Calculation, FCC 15.35

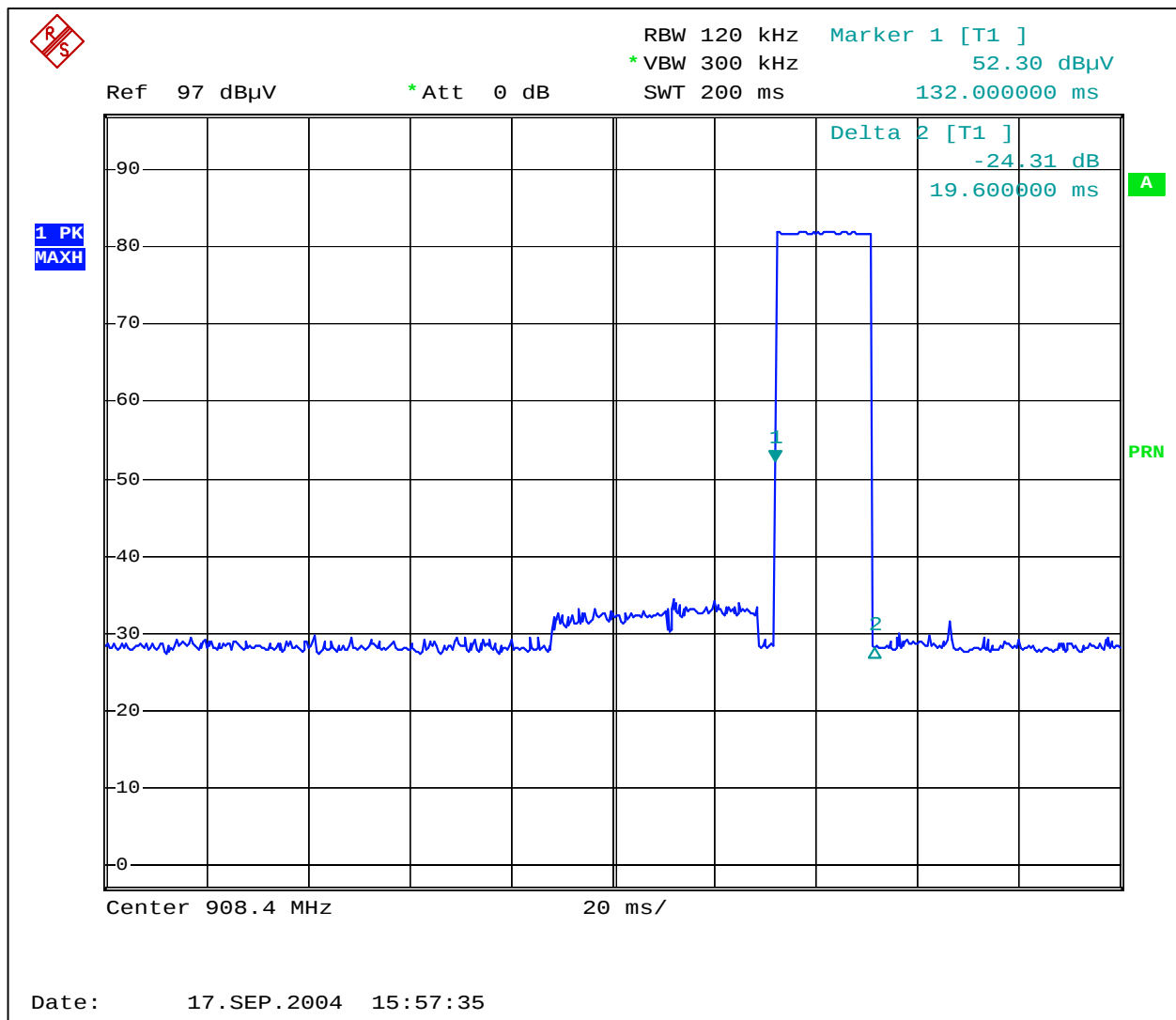
The Average Correction Factor was calculated over 0.1sec interval during which the field strength is its maximum value.

Average Correction Factor = $20\text{Log}(\text{Tms}/100\text{ms})$, or = -20dB, whichever is greater

Average Correction Factor = $20\text{Log}(19.6/100\text{ms}) = -14.1\text{dB}$

The Graph 3-2-1 shows the EUT timing.

Graph # 3-2-1



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

Out-of-band measurements were made for frequencies:

- 902MHz
- 928MHz.

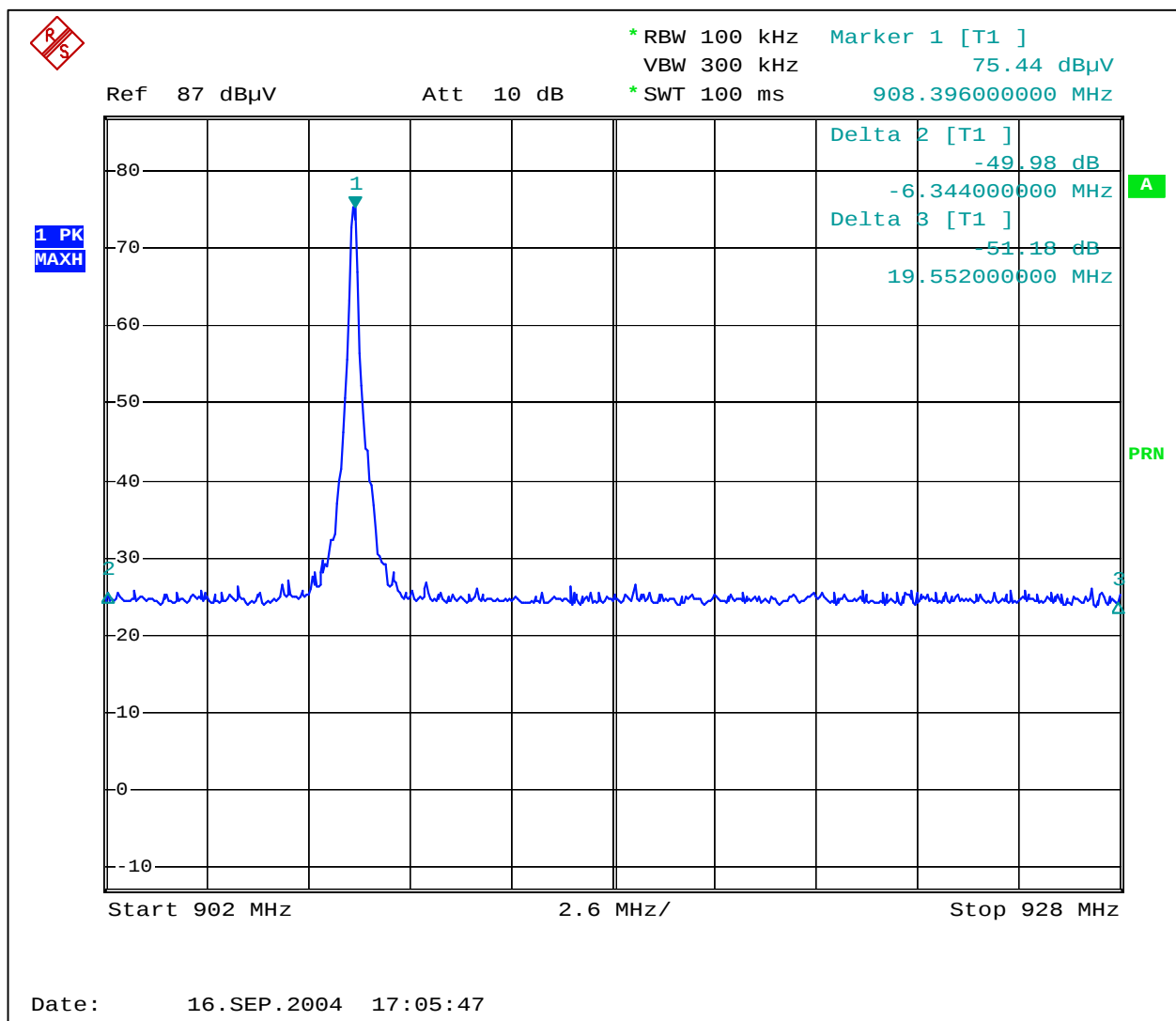
Output frequencies of the EUT was 908.4MHz

The EUT complies with the Standard requirements Out of Band Spurious Emissions for Section 15.249(c) with field strength attenuation to 50.0dB and 51.2dB.

The Graph 3-3-1 shows the Out of Band Spurious Emissions.

Note: Emission level shown in the Graph does not include the Antenna, and Cable factors.

Graph # 3-3-1



3.4 Bandwidth of Emissions

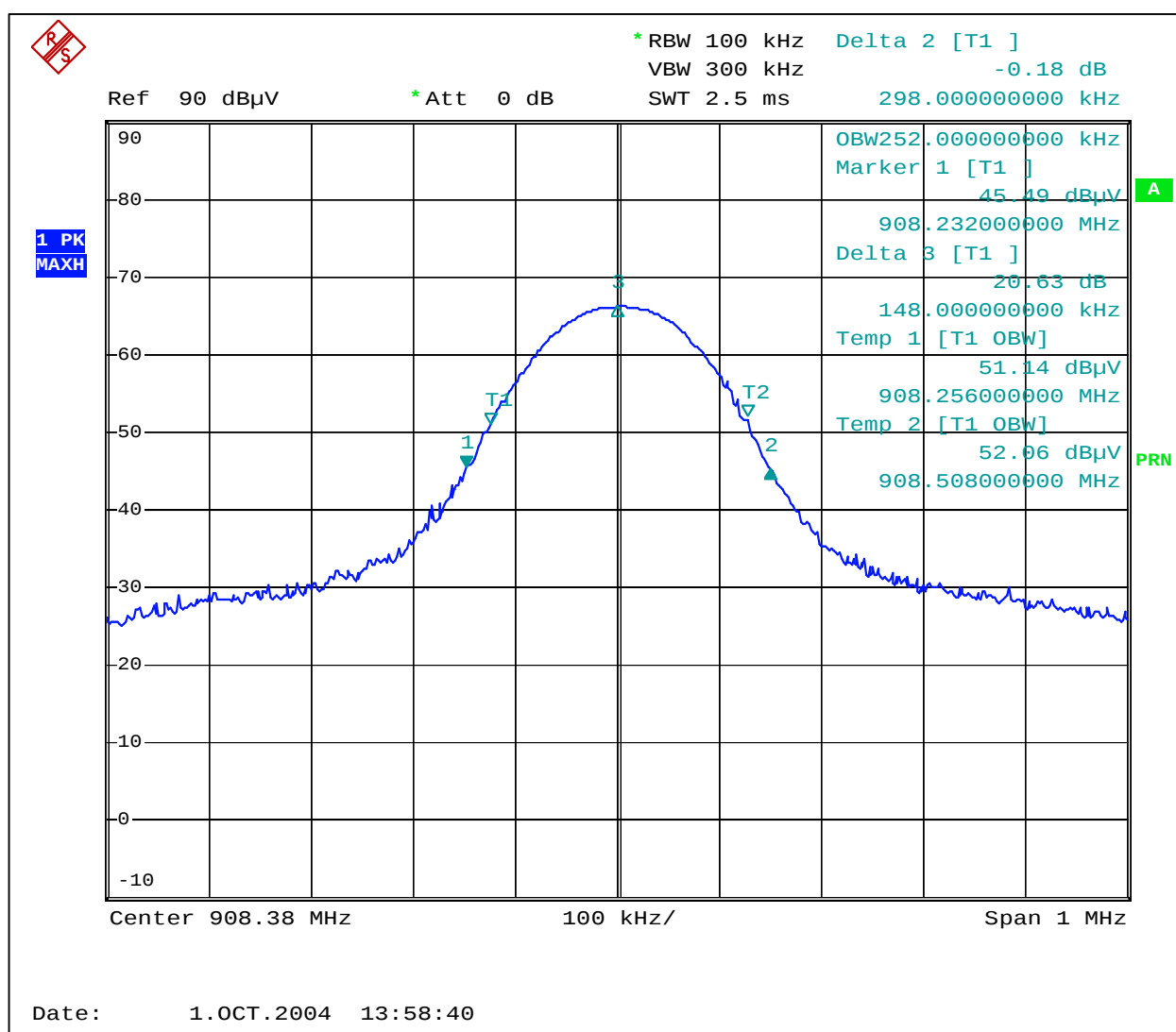
Bandwidth of Emissions measurements was made for frequency of 908.4MHz.

Bandwidth of Emissions for the EUT at 99% power was measured at 252kHz (markers T1 and T2 on the Graph).

Bandwidth of Emissions for the EUT at level -20dB was measured at 298kHz (markers 1 and 2 on the Graph).

The Graphs 3-4-1 shows the Bandwidth of Emissions.

Graph # 3-4-1



3.5 Conducted Emissions, FCC 15.207

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 3-5-1 and Graph 3-5-1 show the Conducted Emissions.

TILE Instrument Control System EMI Measurement Software

Conducted Emissions **Date:** 10-01-2004
Company: Advanced Control Technologies Inc.
Model: ZDW120
Test Engineer: Norman Shpilsher
Special Config. Info:
Standard: FCC Part 15.207
Note: The table shows the worst case conducted emissions

Table # 3-5-1

Line 1

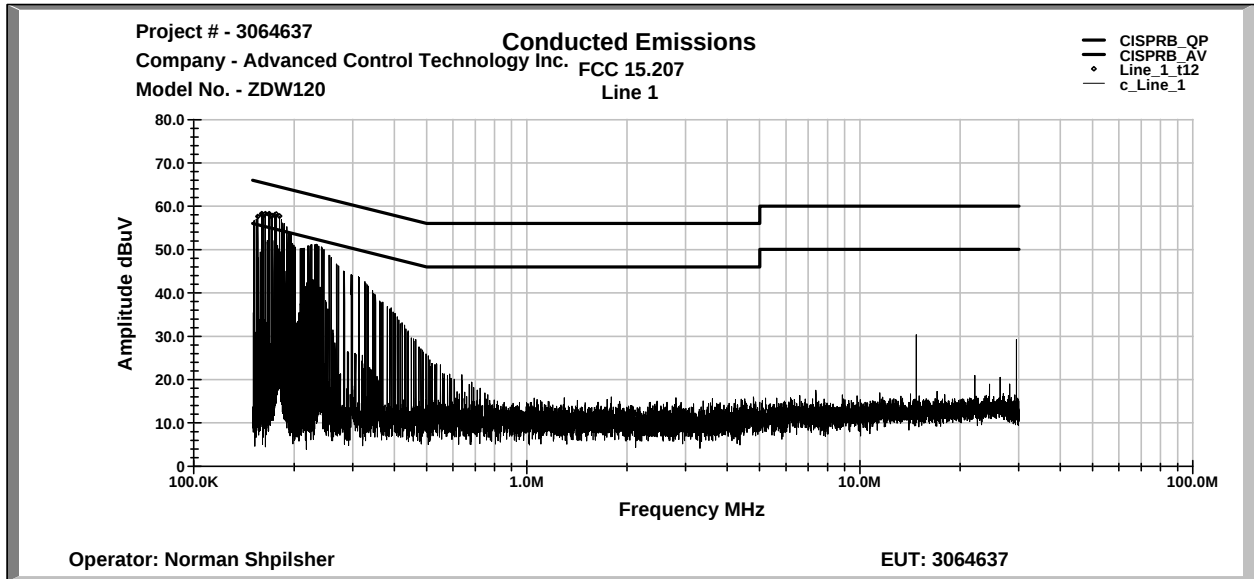
Frequency	QP dB μ V	AVG dB μ V	QP Limit dB μ V	AVG Limit dB μ V	QP Margin dB	AVG Margin dB
154.05 KHz	50.4	18.4	65.8	55.8	-15.4	-37.4
158.55 KHz	50.8	19.0	65.5	55.5	-14.7	-36.5
163.85 KHz	51.0	18.8	65.3	55.3	-14.3	-36.5
167.32 KHz	51.0	19.0	65.1	55.1	-14.1	-36.1
173.19 KHz	50.6	18.4	64.8	54.8	-14.2	-36.5
176.34 KHz	50.1	18.9	64.7	54.7	-14.6	-35.8
230.32 KHz	43.4	11.7	62.4	52.4	-19.1	-40.7
333.48 KHz	33.9	6.9	59.4	49.4	-25.5	-42.5

Line 2

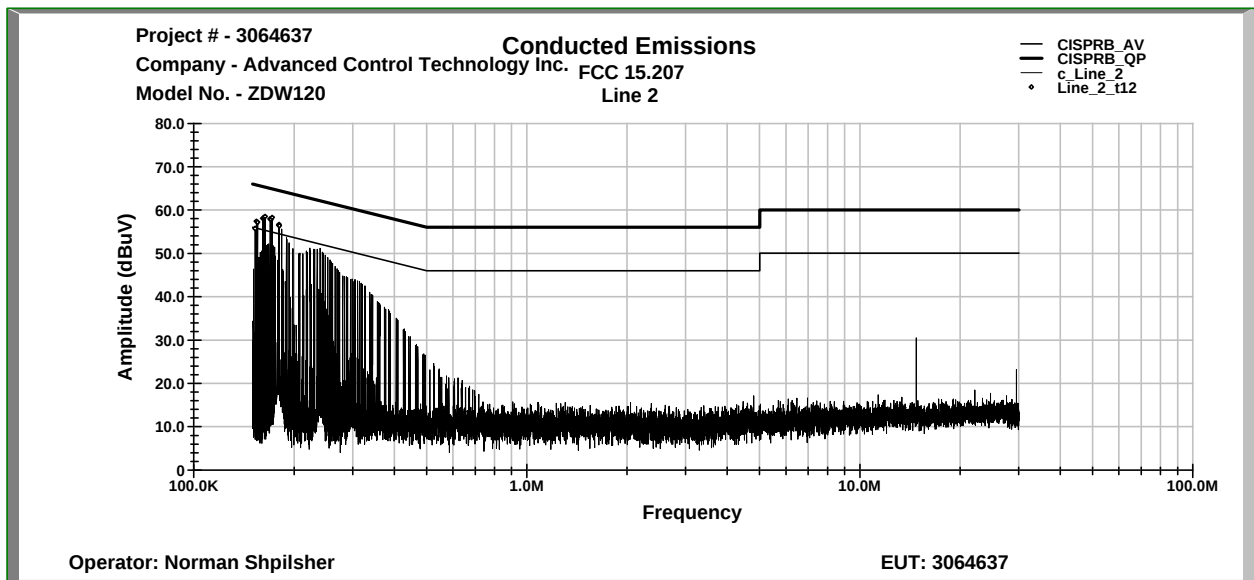
Frequency	QP dB μ V	AVG dB μ V	QP Limit dB μ V	AVG Limit dB μ V	QP Margin dB	AVG Margin dB
153.85 KHz	49.7	17.6	65.8	55.8	-16.1	-38.2
156.25 KHz	50.1	18.2	65.7	55.7	-15.5	-37.5
164.22 KHz	51.0	19.2	65.3	55.3	-14.3	-36.1
167.99 KHz	51.0	18.8	65.1	55.1	-14.1	-36.3
175.91 KHz	50.1	18.5	64.7	54.7	-14.6	-36.2
234.38 KHz	43.3	11.8	62.3	52.3	-19.0	-40.5
313.13 KHz	35.7	7.5	59.9	49.9	-24.2	-42.4

Graph # 3-5-1 Conducted Emissions

Line 1



Line 2



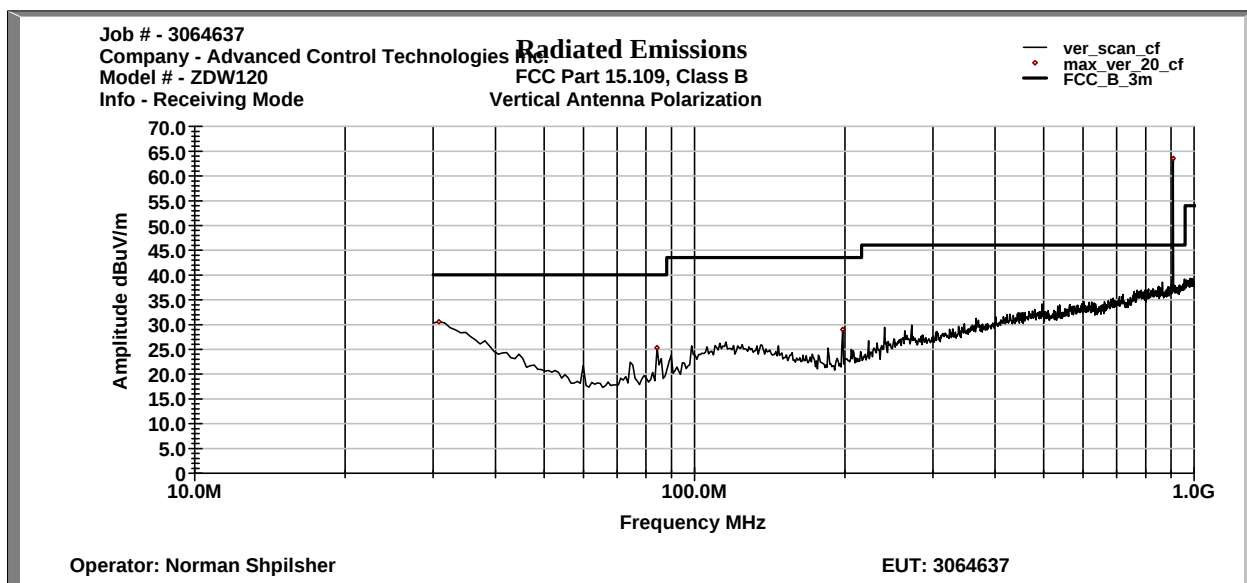
3.6 Receiver Radiated Emissions, FCC 15.109, Class B

The Receiver Radiated Emissions testing was performed in frequency range from 30MHz to 1GHz. The Signal Generator was tuned to 908.4MHz and its antenna was located in close proximity to the EUT.

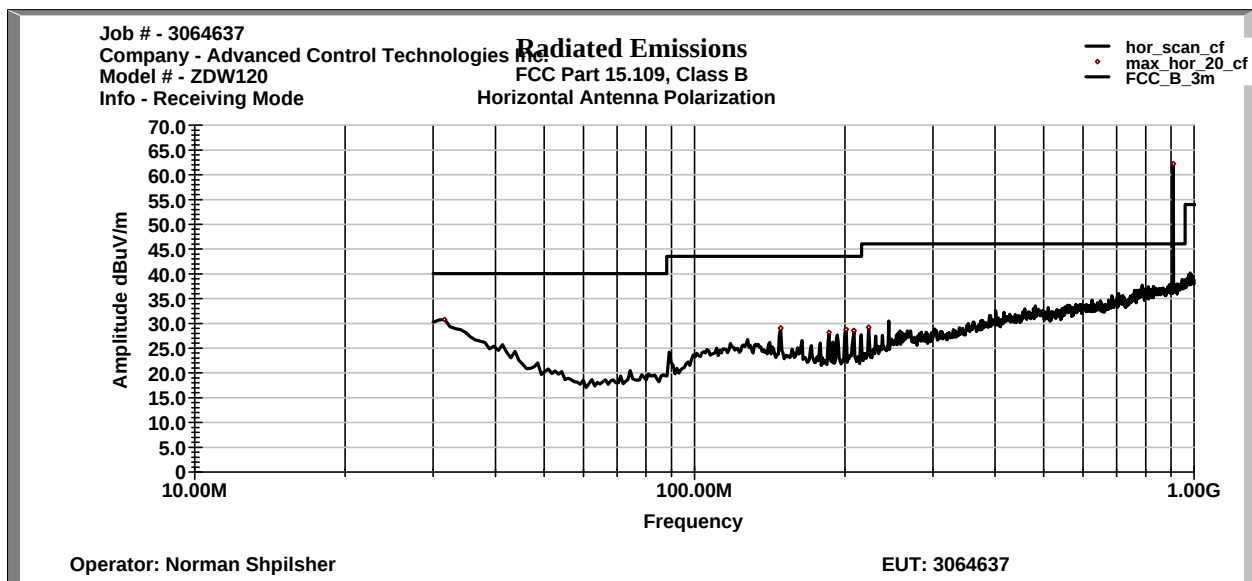
The Graph 3-6-1 shows the Radiated Emissions.

Graph # 3-6-1
Radiated Emissions from 30MHz to 1GHz

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.7 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.

3.8 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(μ V/m)

RA = Receiver Amplitude in dB(μ V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB(m^{-1})

AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(μ V) 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 dB is subtracted giving field strength of 41.1 dB(μ V/m).

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

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

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

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

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

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

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

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

Tested by:

Norman Shpilsher
Sr. EMC Engineer
Intertek ETL SEMKO

Signature



Date: October 4, 2004

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers and Test Software

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3549A00306	01/04	01/05	X
HP85460A RF Filter Section	3448A00276	01/04	01/05	X
Rohde & Schwarz FSP 40 Spectrum Analyzer	100024	03/04	03/05	X
Advantest R3271A Spectrum Analyzer	55050084	06/04	06/05	X
TILE! Instrument Control System	ver. 3.4	N/A	N/A	X

Antennas

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
Schaffner-Chase Bicono-Log Antenna	2468	01/04	01/05	X
Schaffner-Chase Bicono-Log Antenna	2630	06/03	06/04	
EMCO Horn Antenna 3115	9507-4513	12/03	12/04	
EMCO Horn Antenna 3115	6579	01/04	01/05	X

Artificial Mains Networks/Pre-Amplifiers/Filters

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
FCC LISN-2	316	04/04	04/05	X
FCC-LISN-50-25-2	2014	05/04	05/05	
HP83017A Pre-Amplifier	3123A00475	09/03	9/29/04	X
Reactel 7HS-1G-S12 Filter	0223	01/04	01/05	X