Winland Electronics Inc.

Application
For Certification
418MHz PFCS Air Bed Firmness Control System

FCC ID: LPM-3000F

February 24, 2004

ACCREDITED
CERT NO: 1427.01

Intertek ETL SEMKO
7250 Hudson Boulevard, Suite 100, Oakdale, MN 51228
Telephone 651-730-1188, Fax 651-730-1282 Home Page www.intertek.com

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1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *Winland Electronics Inc. 418MHz Air Bed Firmness Control System* for Certification under FCC Part 15, Subpart C.
There are no other simultaneous applications.
The Receiver portion of the System will be verified under Declaration of Conformity.

1.2 Product Description

The *418MHz Air Bed Firmness Control System* is a RF remote control system operating in 418MHz. The System consists of two periodic operation transceivers: *418MHz Hand Control Unit* and *418MHz Base Unit*. The intended use of the *418MHz Hand Control Unit* is to generate and transmit a RF signal to control *418MHz Base Unit* and receive data from the *418MHz Base Unit*. The intended use of the *418MHz Base Unit* is to receive command from the *418MHz Hand Control Unit*, execute this command, and send data about status of the *418MHz Base Unit* back to the *418MHz Hand Control Unit*.
Both the *418MHz Hand Control Unit* and the *418MHz Base Unit* use identical RF Modules.
The *418MHz Hand Control Unit* is powered at 9VDC from internal battery. The *418MHz Base Unit* powered at 120VAC/60Hz.

Antenna Description:

Both units have the internal integrated antenna.

Sample Submitted: February 17, 2004
Test Work Started: February 17, 2004
Test Work Completed: February 18, 2004

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

Each transceiver was tested separately in transmitting mode. For simplicity of testing, each device was wired to transmit continuously for all tests except 15.231(a)(1 and 2) testing.

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.

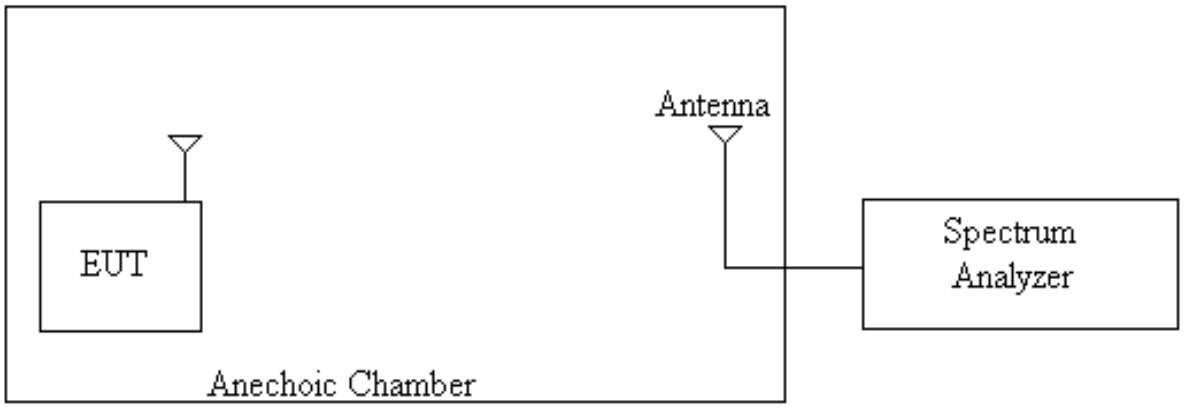
2.5 Support Equipment List and Description

N/A

2.6 Test Configuration Block Diagrams

Each EUT was setup as tabletop equipment.
The Hand Control Unit was powered at 9VDC from the fresh internal battery.
The Base Unit was powered at 120VAC/60Hz.

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 15.231(a)(1 and 2)	Transmitting Time
47 CFR 15.231(b)	Field Strength of Fundamental and Spurious Emissions
47 CFR 15.231(c)	Bandwidth of Emissions
47 CFR 15.207	Line Conducted Emissions (for Base Unit)

Note: A Conducted emissions testing was not performed for Hand Control Unit as battery powered equipment.

3.1 Transmitting Time, FCC 15.231(a)(1 and 2)

Measured total transmitting time of the Hand Control Unit after depressing the activation button of the Hand Control Unit is below 1sec. According to FCC Part 15.231(a)(1) a manually operated transmitter should stop transmitting within 5 sec after release the activation button. Therefore the maximum transmitting time after releasing the activation button is below 1sec and Hand Control Unit complies with FCC Part 15.231(a)(1) requirements.

Measured total transmitting time of the Base Unit after activation of the Hand Control Unit is below 1sec.According to FCC Part 15.231(a)(2) an automatically activated transmitter should stop transmitting within 5 sec after activation. Therefore the maximum transmitting time of the Base Unit after activation is below 1sec and Base Unit complies with FCC Part 15.231(a)(2) requirements.

3.2 Field Strength of Fundamental and Spurious Emissions, FCC 15.231(b)

Field Strength of Fundamental and Spurious Emissions measurements were made at Fundamental frequency of 418MHz; Spurious Emissions were tested up to 4.5GHz (10^{th} harmonic).

Average Correction Factor was applied when Peak readings were taken at fundamental and Harmonics Emissions.
Calculation of the Average Correction Factor is shown in Section 3.2.1.

The Tables 3-2-1 and 3-2-2 and Graphs 3-2-1, 3-2-2, and 3-2-3 show the Field Strength of Fundamental Radiation and Spurious Emissions for Hand Control Unit and for Base Unit.

Radiated Emissions Date: 02-17-2004

Company: Winland Electronics Inc.

Model: PFCS, Hand Control Unit

Test Engineer: Norman Shpilsher

Special Info:

Standard: FCC Part 15.231(a)

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

Note: The table shows the worst case radiated emissions
Peak or Average readings were taken with RBW = 100kHz below 1GHZ frequency range and RBW = 1MHz above 1GHz frequency range.
Average Factor was applied when Peak readings were taken.
Total Correction Factor includes Antenna Factor, Cable Loss and Amplifier Gain (> 1GHz).

Table # 3-2-1

Frequency MHz	Antenna Polarity	Total C.F. Factor(dB/m)	Reading dBµV	Net at 3m. dBµV/m	Average Factor (dB)	Limit dBµV/m	Margin dB	Comments
417.92	V	18.8	63.7	82.5	6.0	80.3	-3.8	Fund.
417.92	H	18.8	63.4	82.2	6.0	80.3	-4.1	Fund.
835.86	V	24.4	21.9	46.3	6.0	60.3	-20.0	
835.86	H	24.4	22.2	46.6	6.0	60.3	-19.7	
1253.83	V	-4.8	37.6	32.8	0.0	60.3	-27.4	
1253.83	H	-4.8	38.1	33.3	0.0	60.3	-26.9	
1673.50	V	-4.1	46.8	42.7	6.0	60.3	-23.6	
2507.20	H	0.0	54.8	54.8	6.0	60.3	-11.5	
3180.60	V	2.8	43.1	45.9	6.0	60.3	-20.3	
4257.20	H	7.2	39.7	46.9	6.0	60.3	-19.4	
	V							
1971.40	V	-2.3	43.9	41.6	6.0	60.3	-24.7	
2507.20	H	0.0	49.2	49.2	6.0	60.3	-17.1	
3483.50	V	4.3	41.6	45.8	6.0	60.3	-20.5	
4264.70	H	7.2	39.5	46.8	6.0	60.3	-19.5	

Radiated Emissions Date: 02-17-2004

Company: Winland Electronics Inc.

Model: PFCS, Base Unit

Test Engineer: Norman Shpilsher

Special Info:

Standard: FCC Part 15.231(a)

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

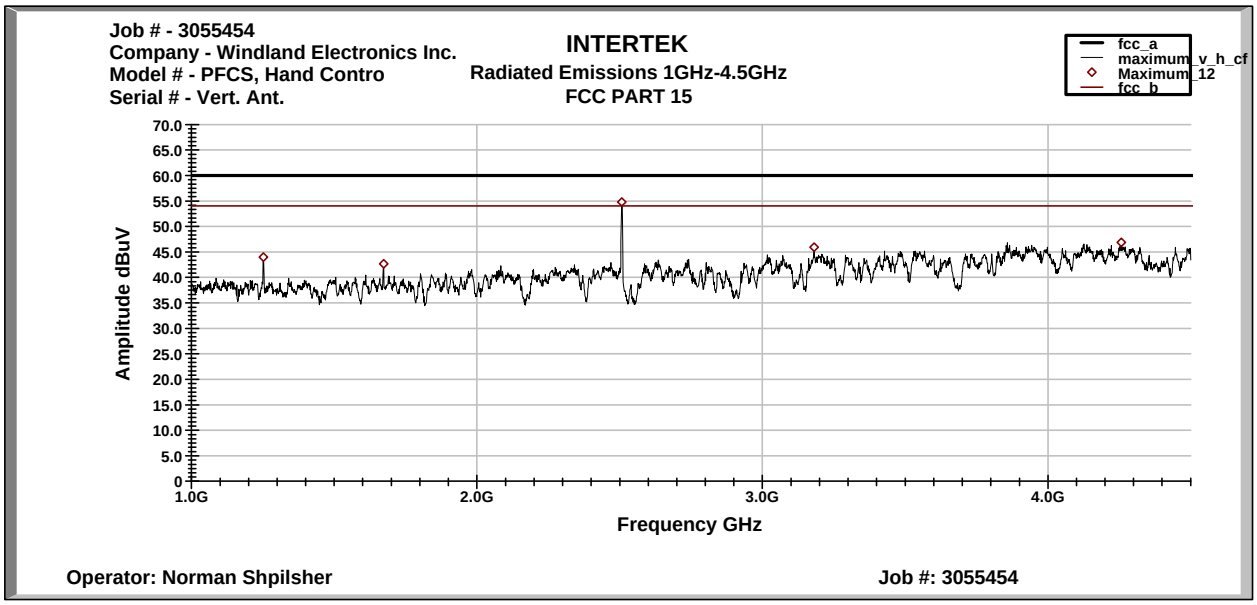
Note: The table shows the worst case radiated emissions
Peak or Average readings were taken with RBW = 100kHz below 1GHZ frequency range and RBW = 1MHz above 1GHz frequency range.
Average Factor was applied when Peak readings were taken.
Total Correction Factor includes Antenna Factor, Cable Loss and Amplifier Gain (> 1GHz).

Table # 3-2-2

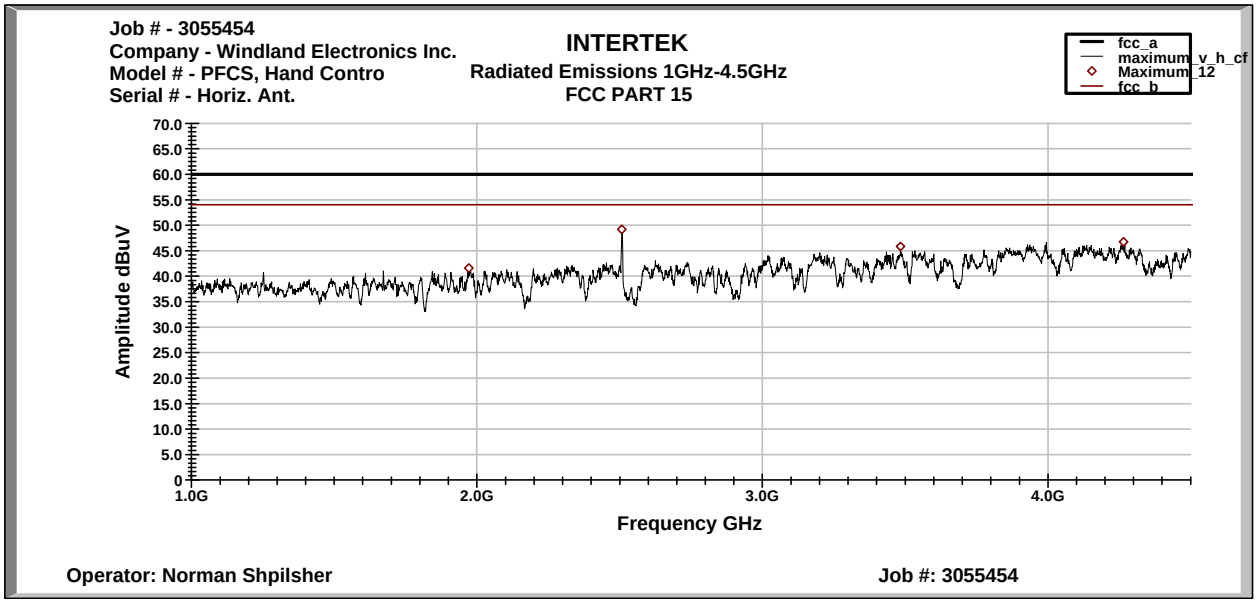
Frequency MHz	Antenna Polarity	Total C.F. Factor(dB/m)	Reading dBµV	Net at 3m. dBµV/m	Average Factor (dB)	Limit dBµV/m	Margin dB	Comments
417.97	V	18.8	62.6	81.4	6.4	80.3	-5.3	Fund.
417.97	H	18.8	67.7	86.5	6.4	80.3	-0.2	Fund.
835.85	V	24.4	25.7	50.1	6.4	60.3	-16.6	
835.85	H	24.4	35.6	60.0	6.4	60.3	-6.7	
1254.05	V	-4.8	34.5	29.7	0.0	60.3	-30.5	
1254.05	H	-4.8	36.7	31.9	0.0	60.3	-28.3	
2458.50	V	-0.2	43.2	43.0	6.4	60.3	-23.7	
2589.40	V	0.3	43.0	43.4	6.4	60.3	-23.3	
3202.40	V	3.0	42.5	45.4	6.4	60.3	-21.3	
3488.60	V	4.3	41.8	46.1	6.4	60.3	-20.6	
4136.60	V	7.0	39.3	46.3	6.4	60.3	-20.4	
2092.30	H	-1.7	45.3	43.6	6.4	60.3	-23.1	
2509.30	H	0.0	44.4	44.4	6.4	60.3	-22.3	
3532.20	H	4.5	41.4	45.9	6.4	60.3	-20.8	
4254.60	H	7.2	39.7	46.9	6.4	60.3	-19.8	

Graph #3-2-1
Radiated Emissions from 1GHz to 4.5GHz, Hand Control Unit

Vertical Antenna Polarization

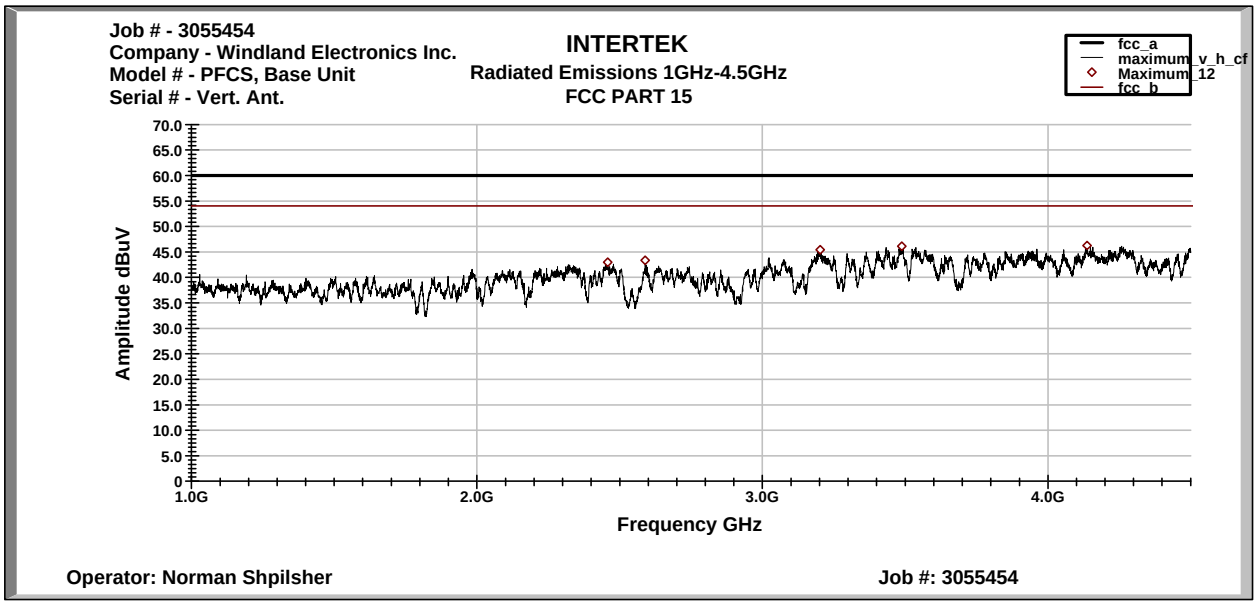


Horizontal Antenna Polarization

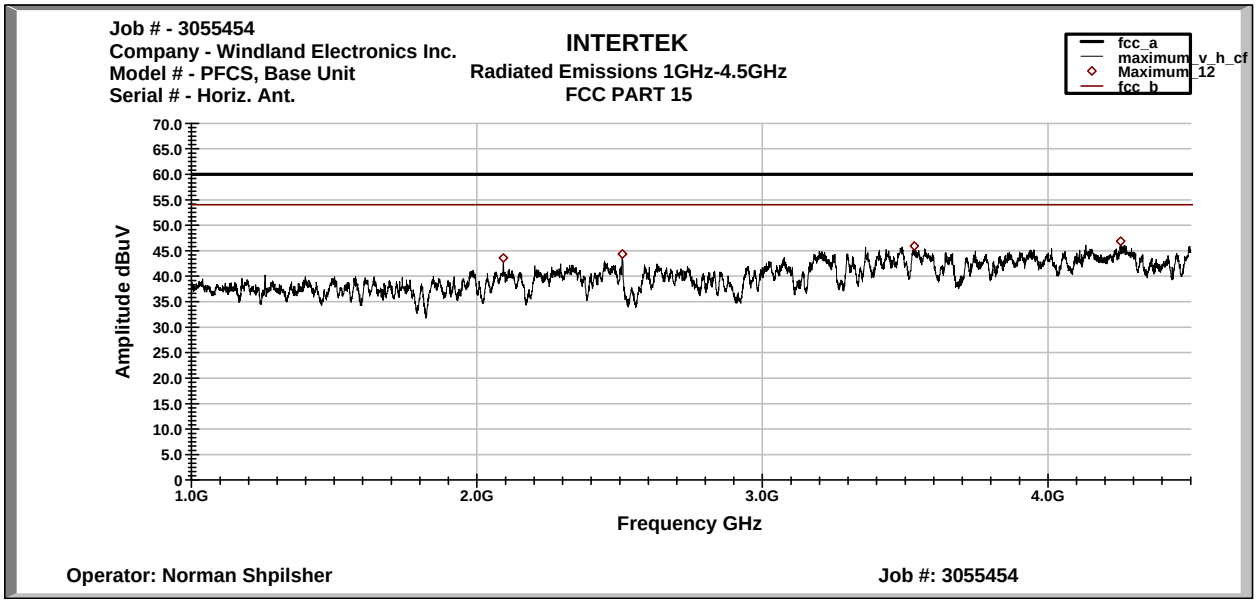


Graph #3-2-2
Radiated Emissions from 1GHz to 4.5GHz, Base Unit

Vertical Antenna Polarization

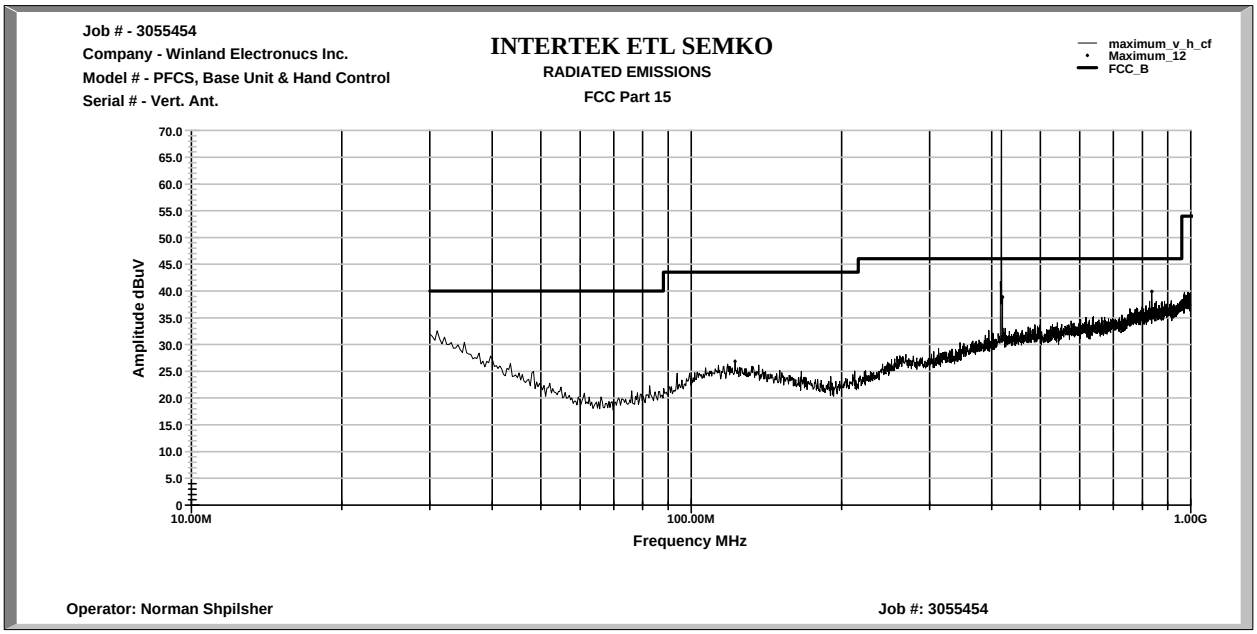


Horizontal Antenna Polarization

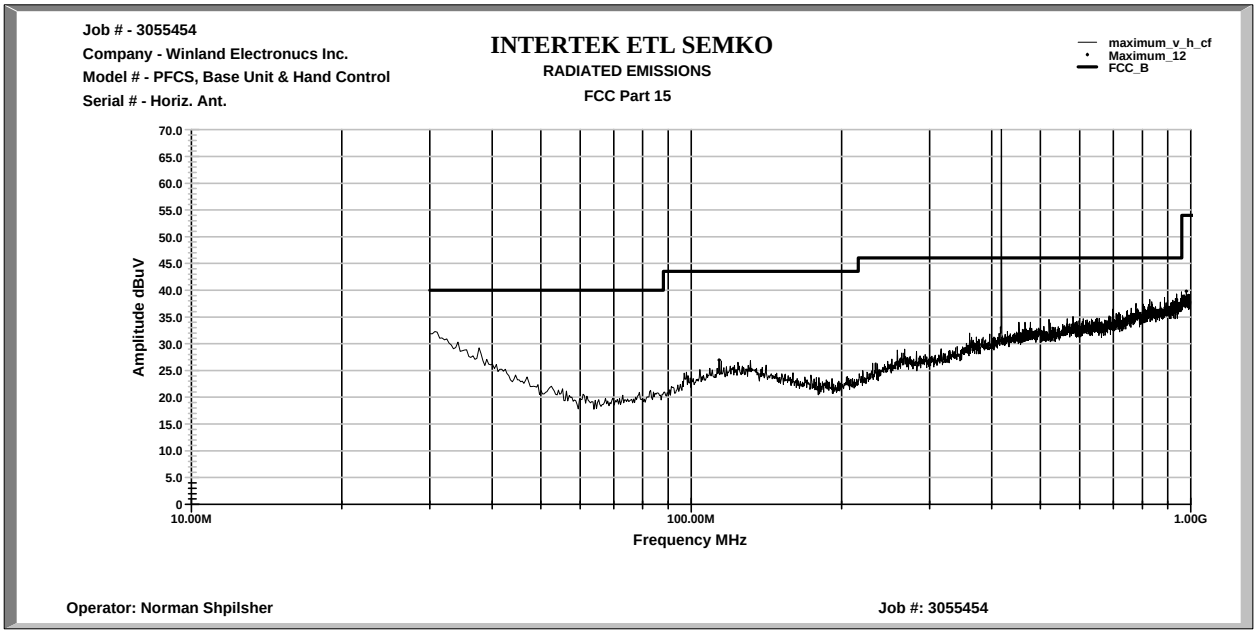


Graph #3-2-3
Radiated Emissions from 30MHz to 1GHz

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.2.1 Average Correction Factor Calculation, FCC 15.35 and 15.231(b)(2)

Average Correction Factor Calculation for Hand Control Unit

An Average Correction Factor Calculation calculated by averaging one complete pulse train.

Pulse Train = 48.5ms
Length of tree pauses by 1.275ms = 1.275ms x 3 = 3.825ms
Length of 32 pauses by 0.638ms = 0.638ms x 32 = 20.416ms
Field Strength in Maximum Value = 48.5ms – 3.825ms – 20.416ms = 24.3ms

Average Correction Factor = 20Log(24.3ms/48.5ms) = -6dB

Graphs 3-2-1-1 to 3-2-1-3 show pulse train timing for Hand Control Unit.

Average Correction Factor Calculation for Base Unit

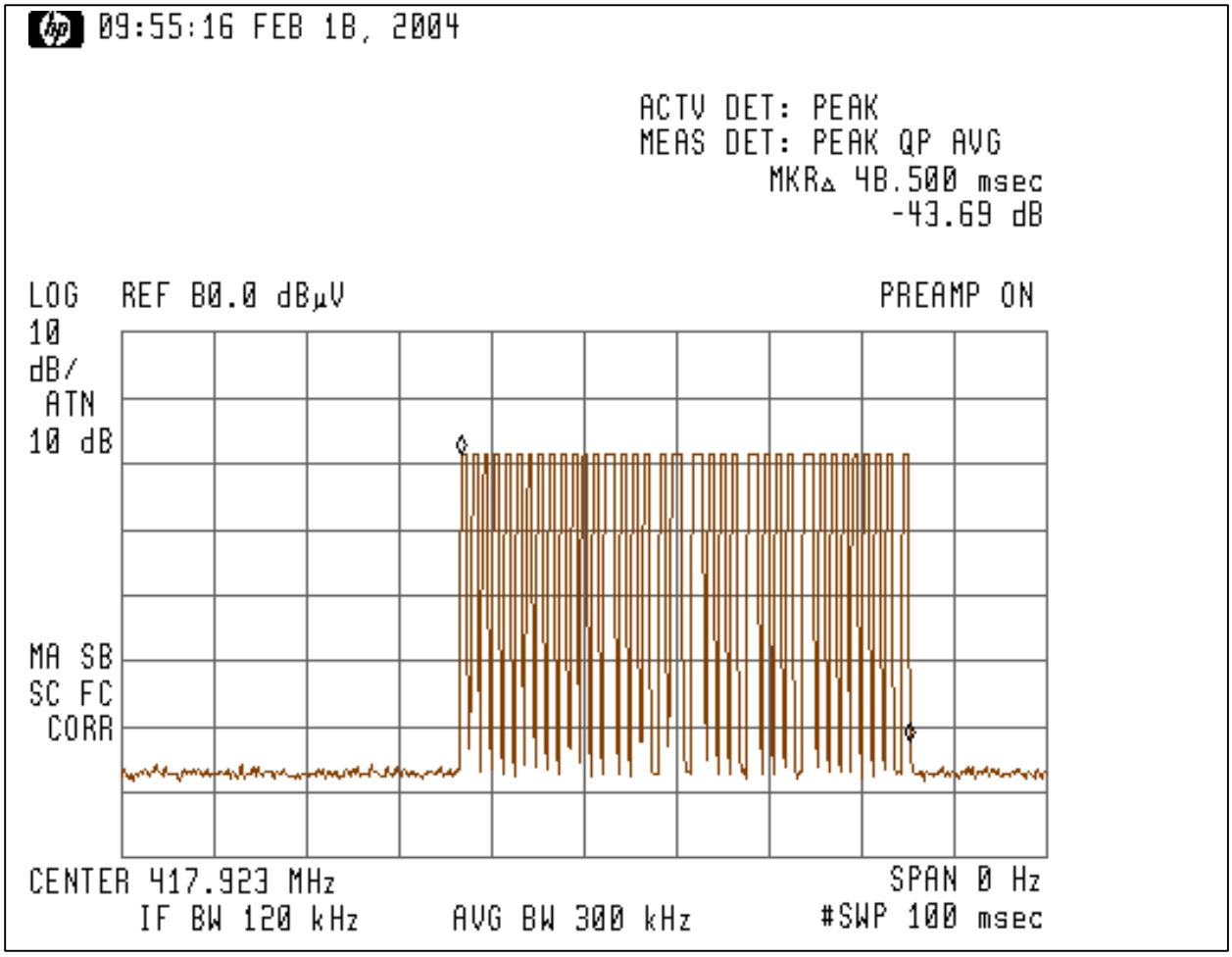
An Average Correction Factor Calculation calculated by averaging one complete pulse train.

Pulse Train = 63.525ms
Length of six pauses by 1.35ms = 1.35ms x 6 = 8.1ms
Length of 37 pauses by 0.675ms = 0.675ms x 37 = 24.9756ms
Field Strength in Maximum Value = 63.525ms – 8.1ms – 24.9756ms = 30.45ms

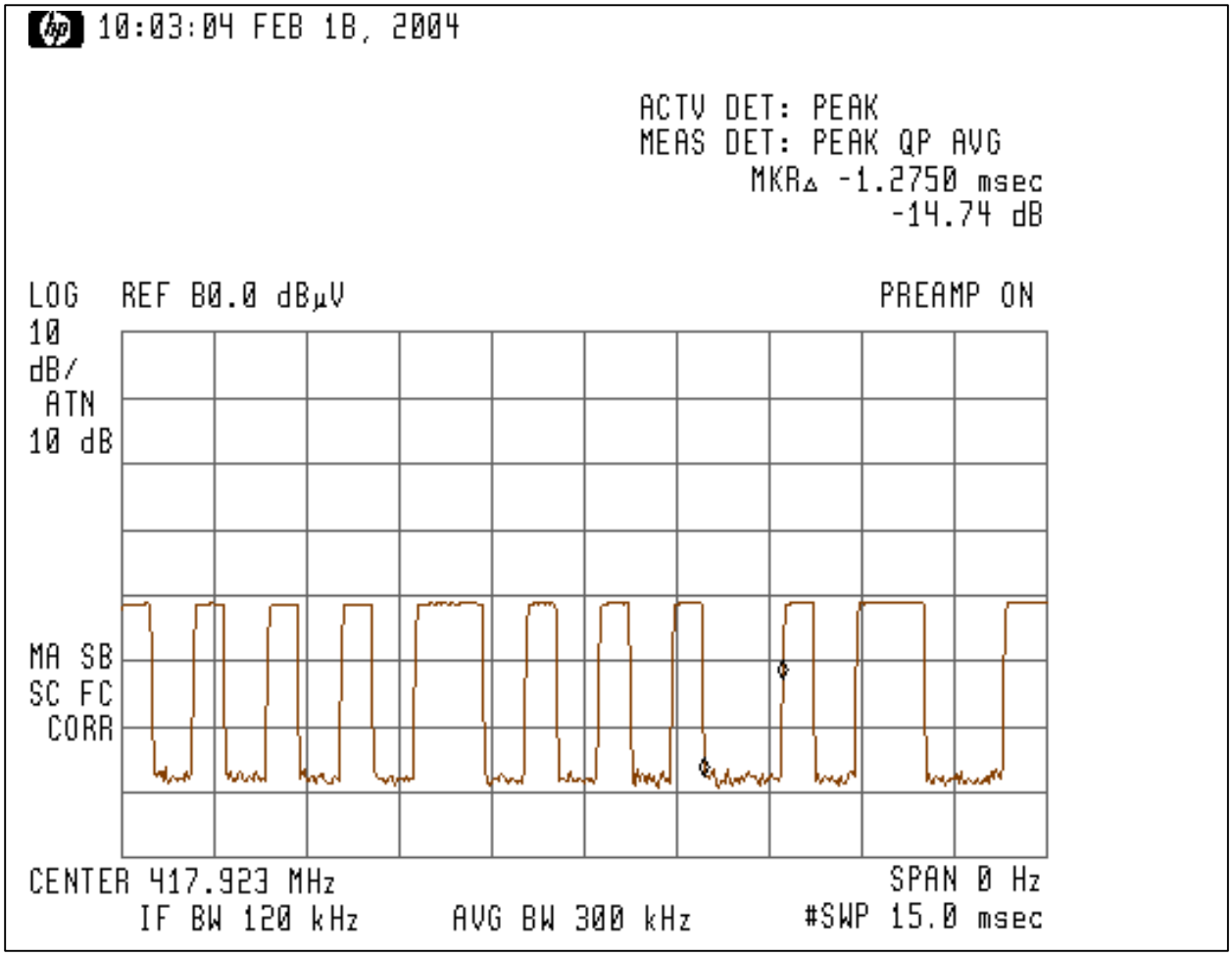
Average Correction Factor = 20Log(30.45ms/63.525ms) = -6.4dB

Graphs 3-2-1-4 to 3-2-1-6 show pulse train timing for Base Unit.

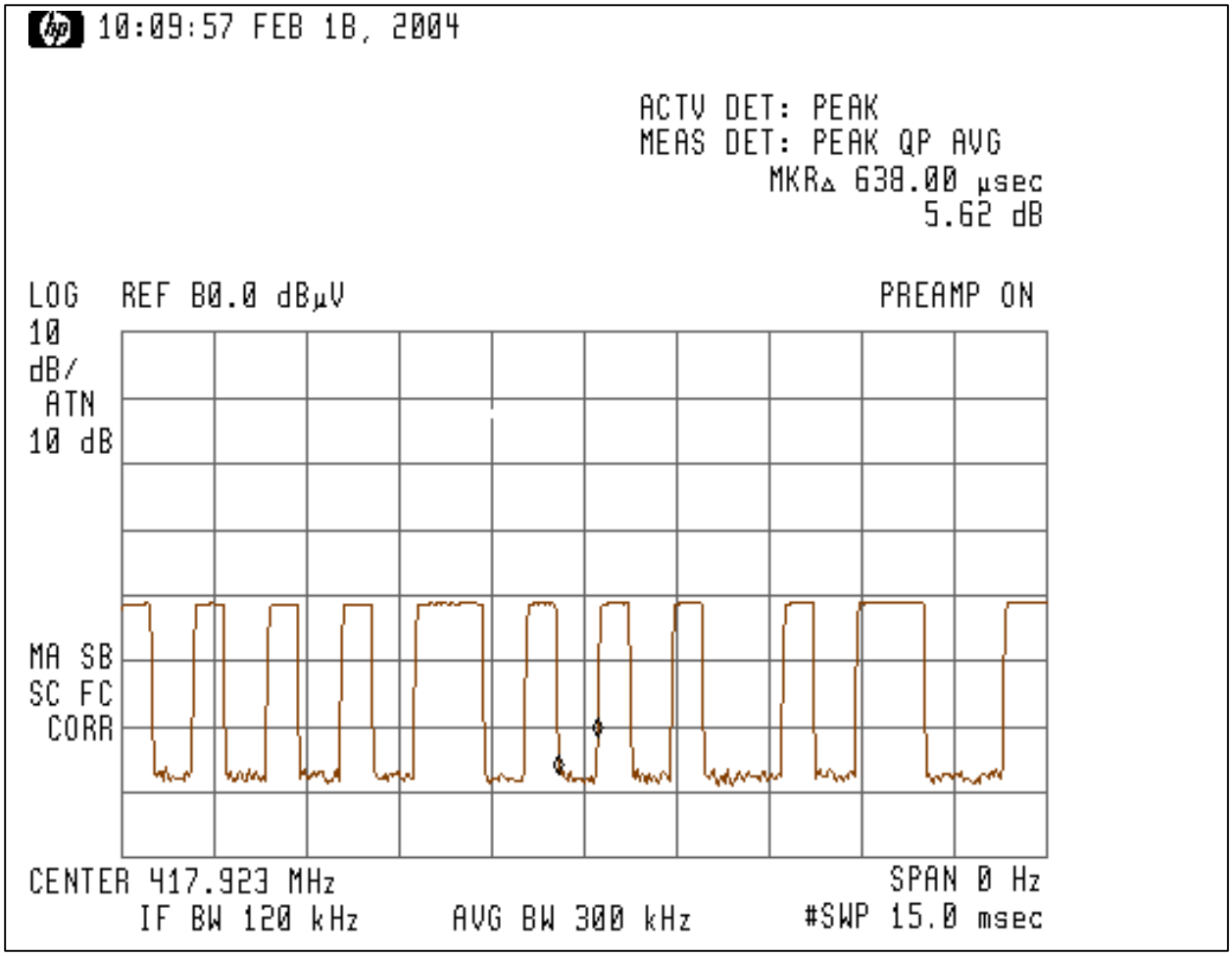
Graph #3-2-1-1
Pulse Train Timing of the Hand Control Unit



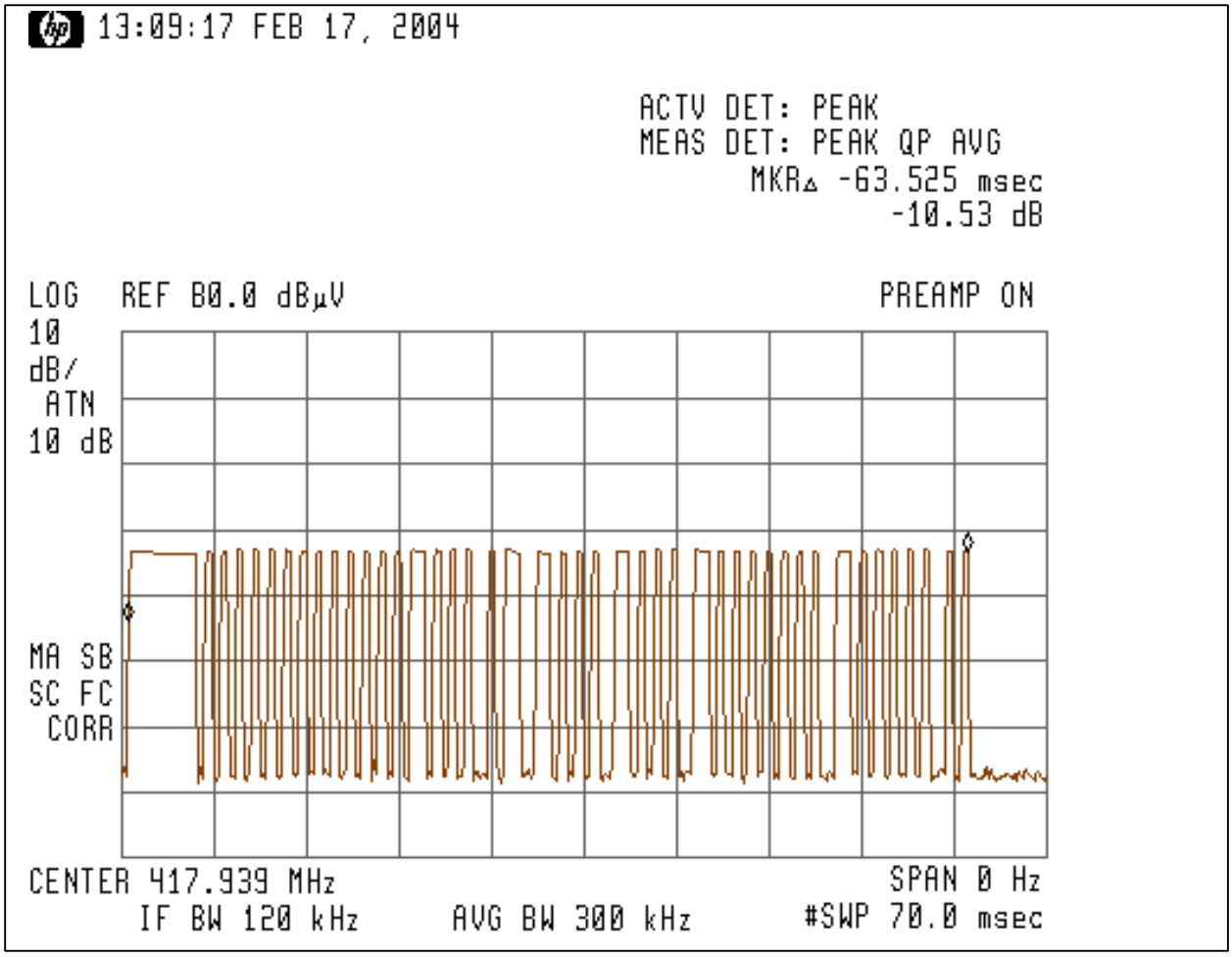
Graph #3-2-1-2
Pulse Train Timing of the Hand Control Unit



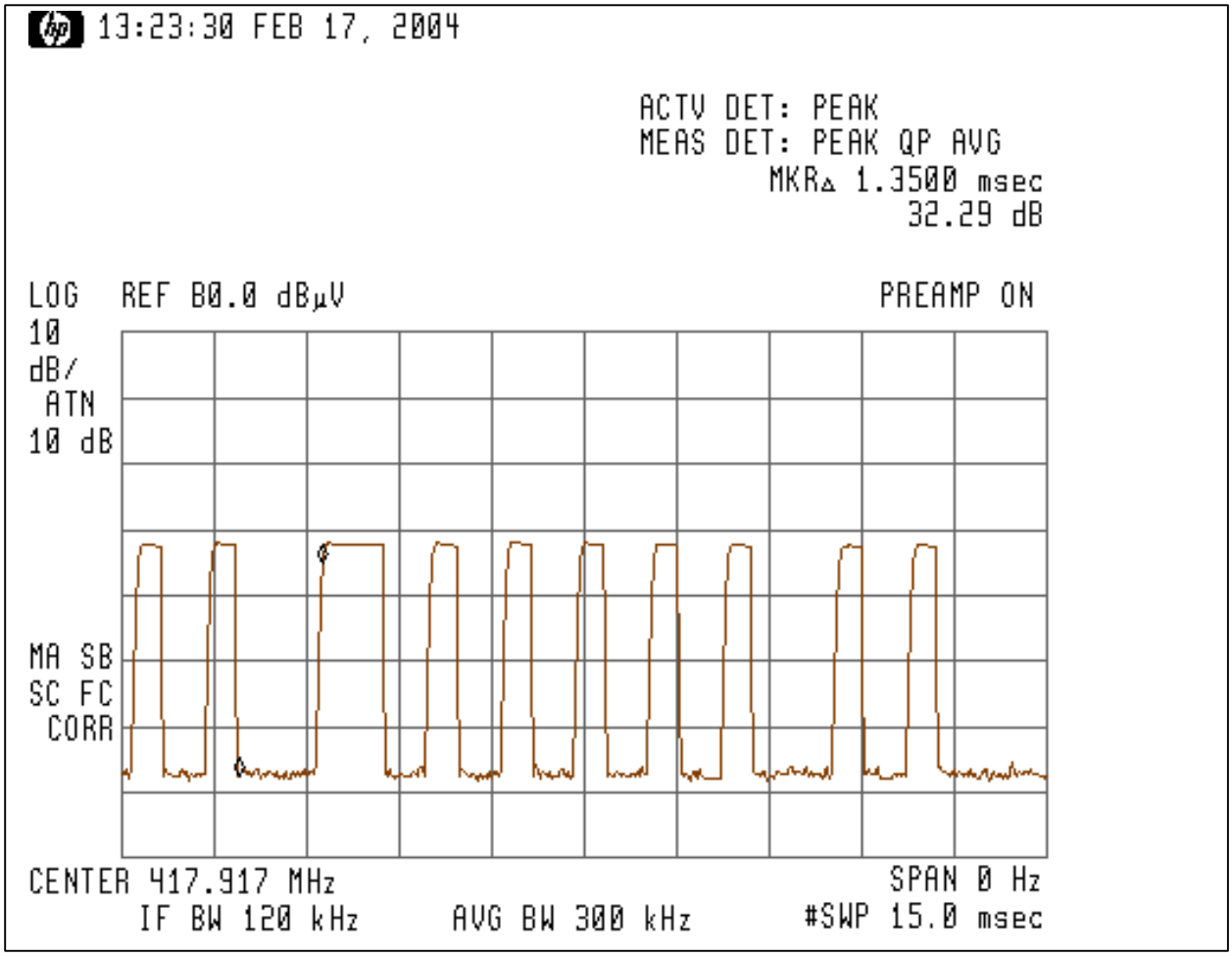
Graph #3-2-1-3
Pulse Train Timing of the Hand Control Unit



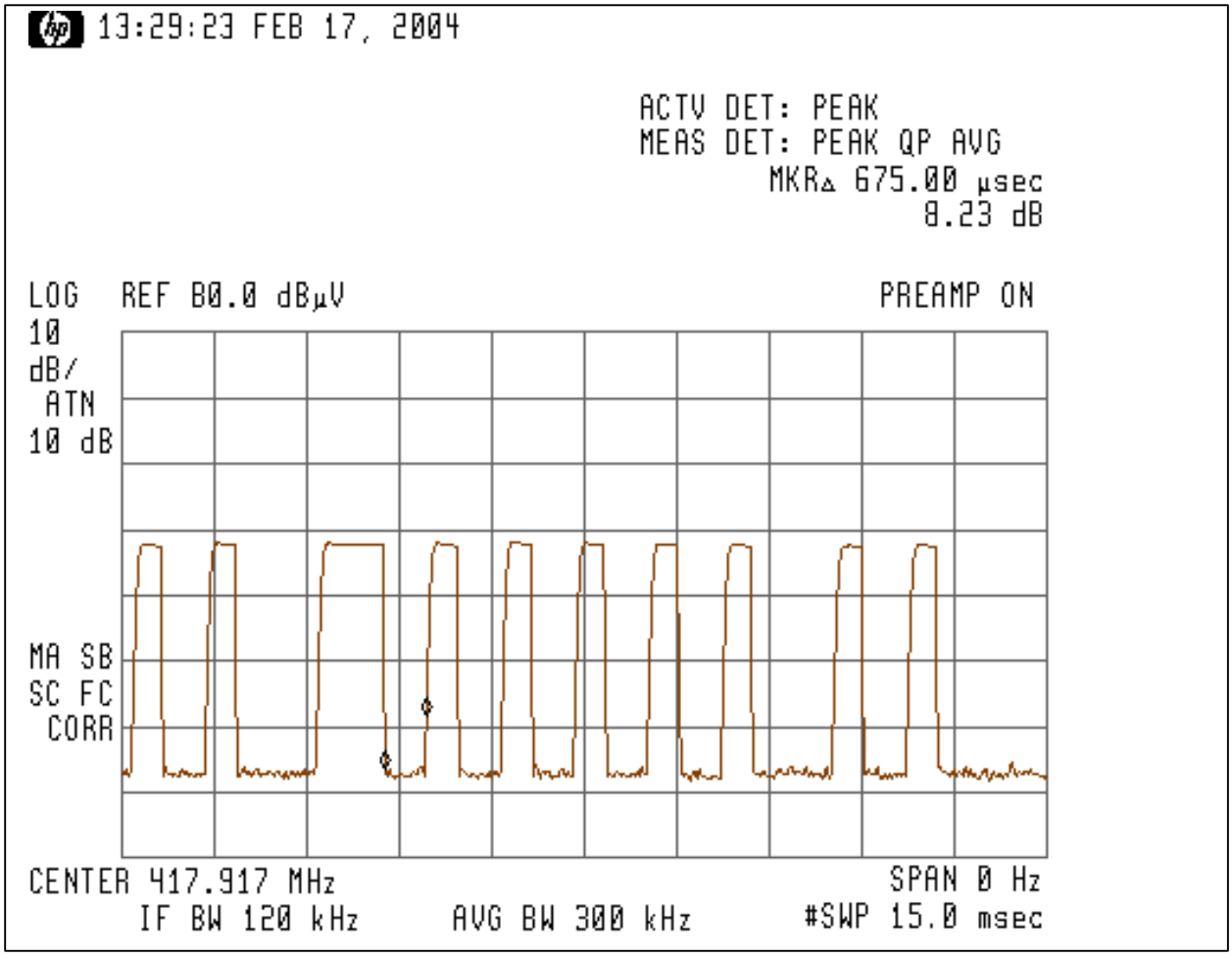
Graph #3-2-1-4
Pulse Train Timing of the Base Unit



Graph #3-2-1-5
Pulse Train Timing of the Base Unit



Graph #3-2-1-6
Pulse Train Timing of the Base Unit



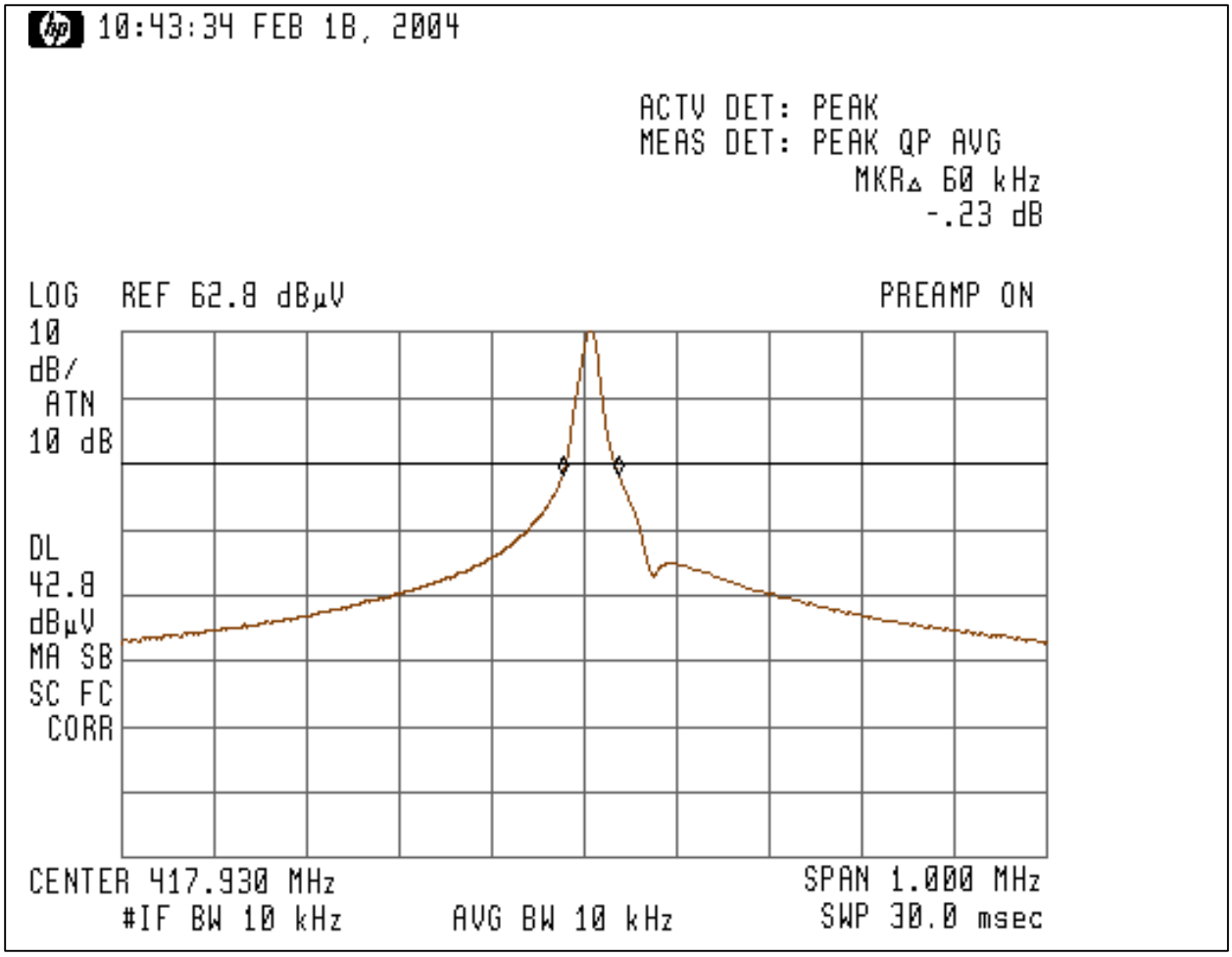
3.3 Bandwidth of Emissions, FCC 15.231(c)

Bandwidth of Emissions measurements was measured for both Hand Control unit and Base Unit at 418MHz.

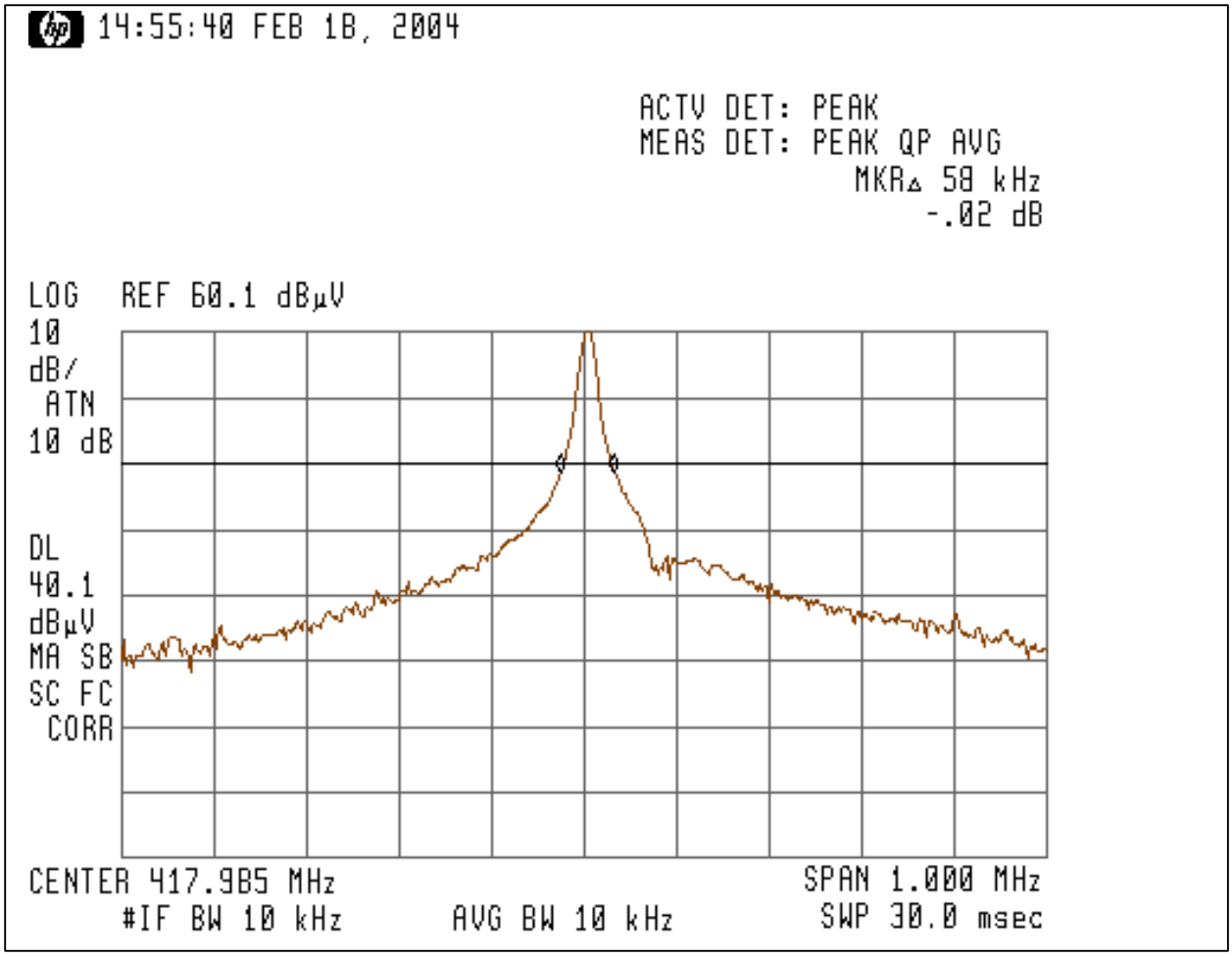
Bandwidth of Emissions for Hand Control Unit at –20dB level was measured at 60kHz.
Bandwidth of Emissions for Base Unit at –20dB level was measured at 58kHz.
The maximum allowed Bandwidth level is 418MHz x 0.25% = 1045kHz

The Graphs 3-3-1 and 3-3-2 show the Bandwidth of Emissions.

Graph #3-3-1
Bandwidth of Emissions, Hand Control Unit



Graph #3-3-2
Bandwidth of Emissions, Base Unit



3.4 Line Conducted Emissions, FCC 15.207

Line Conducted Emissions testing was performed for Base Unit in frequency range from 150kHz to 30MHz.

The Table 3-4-1 and Graph 3-4-1 show the Line Conducted Emissions.

TILE Instrument Control System EMI Measurement Software

Table # 3-4-1

Line 1

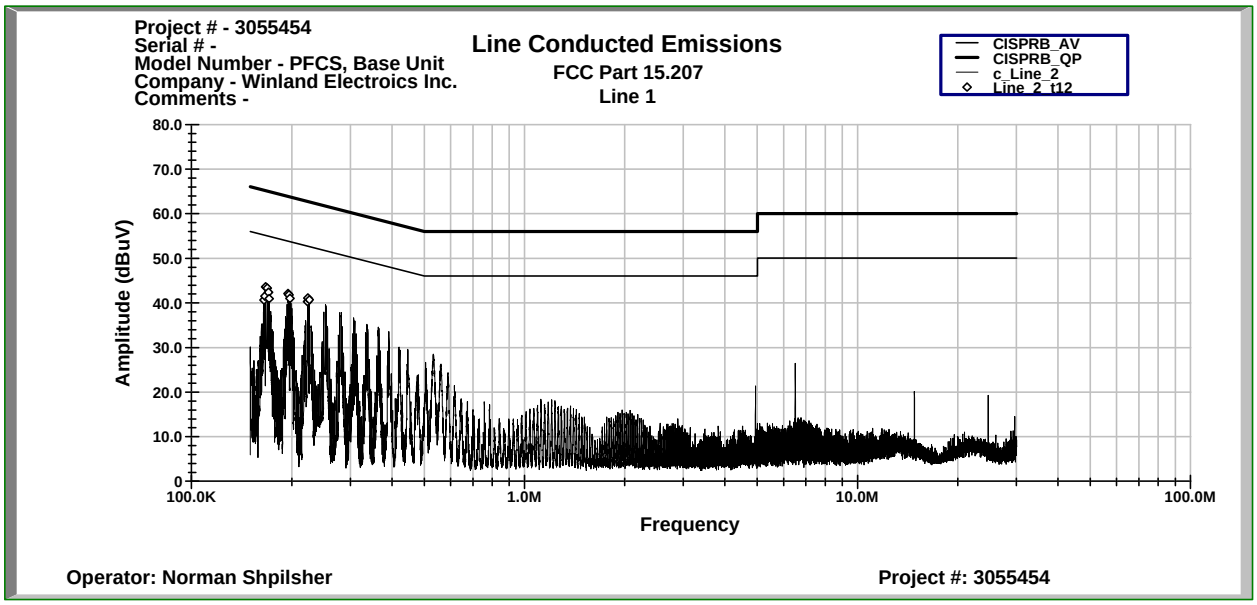
Frequency	QP dBmV	AVG dBmV	QP Limit dBmV	AVG Limit dBmV	QP Margin dB	AVG Margin dB
167.34 KHz	41.9	27.3	65.5	55.5	-23.6	-28.2
167.86 KHz	42.2	27.5	65.5	55.5	-23.3	-28.0
168.09 KHz	42.3	27.3	65.5	55.5	-23.2	-28.2
168.18 KHz	42.3	27.6	65.5	55.5	-23.2	-27.9
168.73 KHz	42.3	27.1	65.5	55.5	-23.2	-28.4
169.2 KHz	42.0	26.7	65.5	55.5	-23.5	-28.7
195.84 KHz	40.8	25.8	64.7	54.7	-23.9	-28.9
196.06 KHz	40.8	25.9	64.7	54.7	-23.9	-28.8
196.51 KHz	40.7	25.4	64.7	54.7	-24.0	-29.3
223.76 KHz	39.6	24.6	63.9	53.9	-24.3	-29.3
224.07 KHz	39.7	24.4	63.9	53.9	-24.2	-29.5
224.53 KHz	39.7	23.9	63.9	53.9	-24.2	-30.0

Line 2

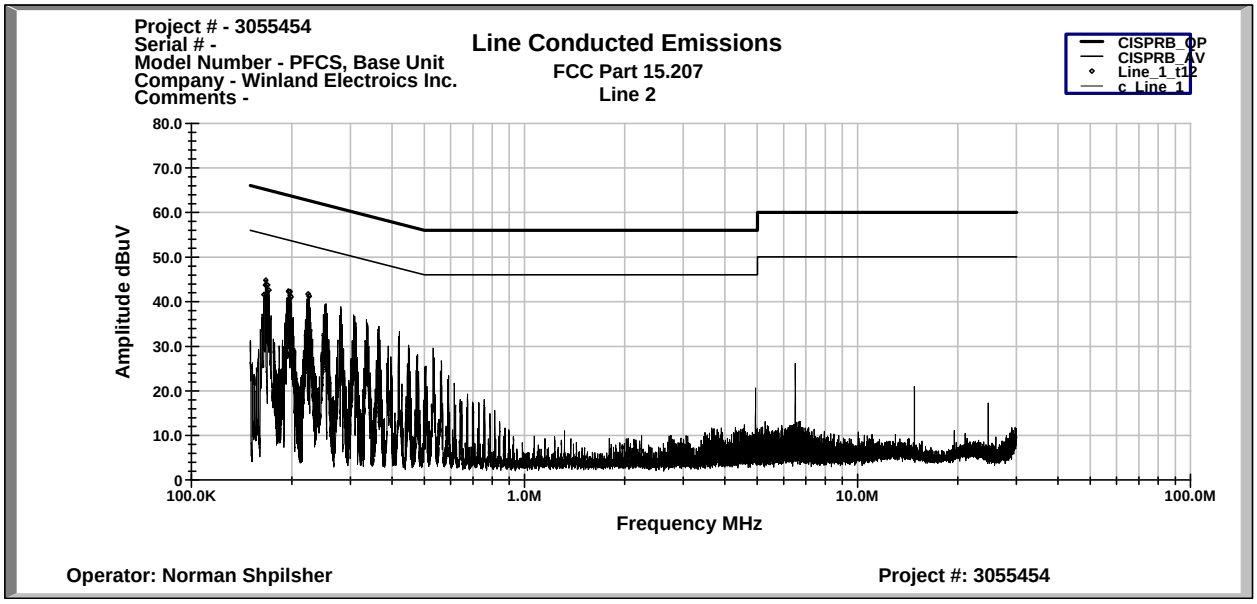
Frequency	QP dBµV	AVG dBµV	QP Limit dBµV	AVG Limit dBµV	QP Margin dB	AVG Margin dB
167.47 KHz	42.5	26.8	65.5	55.5	-23.0	-28.7
167.63 KHz	42.7	26.3	65.5	55.5	-22.8	-29.2
168.2 KHz	42.6	26.9	65.5	55.5	-22.9	-28.6
168.53 KHz	42.4	26.9	65.5	55.5	-23.1	-28.6
168.72 KHz	42.6	26.3	65.5	55.5	-22.9	-29.1
195.77 KHz	41.3	24.9	64.7	54.7	-23.4	-29.8
195.89 KHz	41.2	25.0	64.7	54.7	-23.5	-29.7
195.94 KHz	41.1	25.0	64.7	54.7	-23.6	-29.7
196.47 KHz	41.0	25.1	64.7	54.7	-23.7	-29.6
196.97 KHz	40.9	24.5	64.7	54.7	-23.8	-30.2
222.92 KHz	39.5	23.0	63.9	53.9	-24.4	-30.9
224.35 KHz	39.9	23.1	63.9	53.9	-24.0	-30.8

Graph #3-4-1
Conducted Emissions, Base Unit

Line 1



Line 2



3.5 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 rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m. Hand Control Unit was maximized also by configuring the EUT through its placement in three orthogonal axes. 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.

3.6 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(?V/m)
RA = Receiver Amplitude in dB(?V)
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(?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 dBi is subtracted giving field strength of 41.1 dB(?V/m).

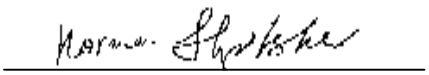
RA = 48.1 dB(?V)
AF = 7.4 dB(m^{-1})
CF = 1.6 dB
AG = 16.0 dBi
FS = RF + AF + CF - AG
FS = 48.1 + 7.4 + 1.6 – 16.0
FS = 41.1 dB(?V/m)

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: February 24, 2004

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers and Test Software

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3325A00106	08/03	08/04	X
HP85460A RF Filter Section	3330A00109	08/03	08/04	X
HP85462A Receiver RF Section	3549A00306	01/04	01/05	
HP85460A RF Filter Section	3448A00276	01/04	01/05	
Advantest Spectrum Analyzer R3271A	55050084	06/03	06/04	X
TILE! Instrument Control System	ver. 3.2 W	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/Absorbing Clamps

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
FCC LISN-2	316	01/04	01/05	
FCC-LISN-50-25-2	2014	06/03	06/04	X