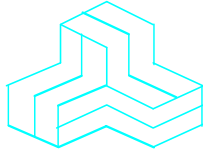


# ENGINEERING TEST REPORT



## T500 Tag Programming Station MODEL NO.: 800850-TAB

**FCC ID: JQU800850**

*Applicant:*

**Mark IV Industries Corp.**  
6020 Ambler Drive  
Mississauga, ON  
Canada L4W 2P1

*Tested in Accordance With*

**FCC Part 15, Subpart C, Section 15.249  
Low Power Transmitters  
Operating in the Frequency Band 902 - 928 MHz**

**UltraTech's File No.: MAR-016F15C249**

This Test report is Issued under the Authority of  
Tri M. Luu, Professional Engineer,  
Vice President of Engineering  
UltraTech Group of Labs



Date: June 9, 2008

Report Prepared by: Dan Huynh

Tested by: Mr. Hung Trinh, EMC/RFI Technician

Issued Date: June 9, 2008

Test Dates: May 27 & 30, 2008

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

## UltraTech

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**Korea  
MIC-RRL**

2005-82 & 83

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## EXHIBIT 1. INTRODUCTION

### 1.1. SCOPE

<b>Reference:</b>	FCC Part 15, Subpart C, Section 15.249
<b>Title:</b>	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
<b>Purpose of Test:</b>	To gain FCC Certification Authorization for Low Power Licensed-Exempt Transmitters operating in the Frequency Band 902 - 928 MHz.
<b>Test Procedures:</b>	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - 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.
<b>Environmental Classification:</b>	Commercial, industrial or business environment

### 1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

### 1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2007	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	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
CISPR 22 & EN 55022	2006 2006	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
CISPR 16-2-3	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-3: Radiated disturbance measurement

## EXHIBIT 2. PERFORMANCE ASSESSMENT

### 2.1. CLIENT INFORMATION

APPLICANT	
<b>Name:</b>	Mark IV Industries Corp.
<b>Address:</b>	6020 Ambler Drive Mississauga, ON Canada L4W 2P1
<b>Contact Person:</b>	Ms. Grace Siu Phone #: 905-624-3025 ext 1277 Fax #: 905-624-4572 Email Address: gsiu@ivhs.com

MANUFACTURER	
<b>Name:</b>	Mark IV Industries Corp.
<b>Address:</b>	6020 Ambler Drive Mississauga, ON Canada L4W 2P1
<b>Contact Person:</b>	Ms. Grace Siu Phone #: 905-624-3025 ext 1277 Fax #: 905-624-4572 Email Address: gsiu@ivhs.com

### 2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

<b>Brand Name:</b>	Mark IV Industries Corp.
<b>Product Name:</b>	T500 Tag Programming Station
<b>Model Name or Number:</b>	800850-TAB
<b>Serial Number:</b>	ENG-002
<b>Type of Equipment:</b>	Low Power Transceiver
<b>Input Power Supply Type:</b>	120 VAC 60 Hz
<b>Primary User Functions of EUT:</b>	Programming data content of the transponder products.

**2.3. EUT’S TECHNICAL SPECIFICATIONS**

<b>TRANSMITTER</b>	
<b>Equipment Type:</b>	Mobile
<b>Intended Operating Environment:</b>	[ x ] Commercial, industrial or business environment [ ] Residential environment
<b>Power Supply Requirement:</b>	120 VAC 60 Hz
<b>RF Output Power Rating:</b>	69.15 dBµV/m Peak at 3m distance
<b>Operating Frequency Range:</b>	915.75 MHz
<b>RF Output Impedance:</b>	50 Ohms
<b>20 dB Bandwidth:</b>	364.73 kHz
<b>Modulation Type:</b>	OOK
<b>Antenna Connector Type:</b>	Integral
<b>Antenna Description:</b>	Manufacturer: Mark IV Industries Corp. Type: Single Patch Shielded Model: 800890-001 Frequency Range: 860 ~ 960 MHz In/Out Impedance: 50 Ohms Gain: -7dBi

**2.4. LIST OF EUT’S PORTS**

Port Number	EUT’s Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF Control Port	2	DB-9	Shielded
2	Host Port	1	DB-9	Shielded
3	Power Port	1	IEC 320	Non-shielded

**2.5. ANCILLARY EQUIPMENT**

<b>Ancillary Equipment # 1</b>	
Description:	ThinkPad A30
Brand name:	IBM
Model Name or Number:	2652-31U
Serial Number:	KP-YMRBT
Cable Length & Type:	≤ 3 m, Non-shielded
Connected to EUT’s Port:	Host Port

### EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

#### 3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	120 VAC 60 Hz

#### 3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

<b>Operating Modes:</b>	EUT was configured to transmit continuously for emissions measurements.
<b>Special Test Software:</b>	None
<b>Special Hardware Used:</b>	None
<b>Transmitter Test Antenna:</b>	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment.

<b>Transmitter Test Signals:</b>	
<b>Frequency Band(s):</b>	915.75 MHz
<b>Test Frequency(ies):</b>	915.75 MHz
<b>Transmitter Wanted Output Test Signals:</b>	
• RF Power Output (measured maximum output power):	69.15 dBµV/m Peak at 3m distance
• Normal Test Modulation:	OOK
• Modulating signal source:	Internal

## EXHIBIT 4. SUMMARY OF TEST RESULTS

### 4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada Site No.: 2049A-3, Expiry Date: May 17, 2009).

### 4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.107(a) & 15.207	Power Line Conducted Emissions	Yes
--	20 dB Bandwidth	Yes
15.249(a), 15.209, 15.205	Transmitter Radiated Emissions, Harmonic Emissions	Yes

### 4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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## **EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS**

### **5.1. TEST PROCEDURES**

This section contains test results only. Details of test methods and procedures can be found in ANSI C63.4 and ULTR-P001-2004.

### **5.2. MEASUREMENT UNCERTAINTIES**

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document LAB 34 with a confidence level of 95%. Please refer to Exhibit 6 for Measurement Uncertainties.

### **5.3. MEASUREMENT EQUIPMENT USED**

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1-1.

### **5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER**

Programming data content of the transponder products.



## 5.5. POWER LINE CONDUCTED EMISSIONS [47 CFR15.107(a) & 15.207]

### 5.5.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Class B Limits		Measuring Bandwidth
	Quasi-Peak (dB $\mu$ V)	Average (dB $\mu$ V)	
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 1 Hz for Average

\* Decreasing linearly with logarithm of frequency.

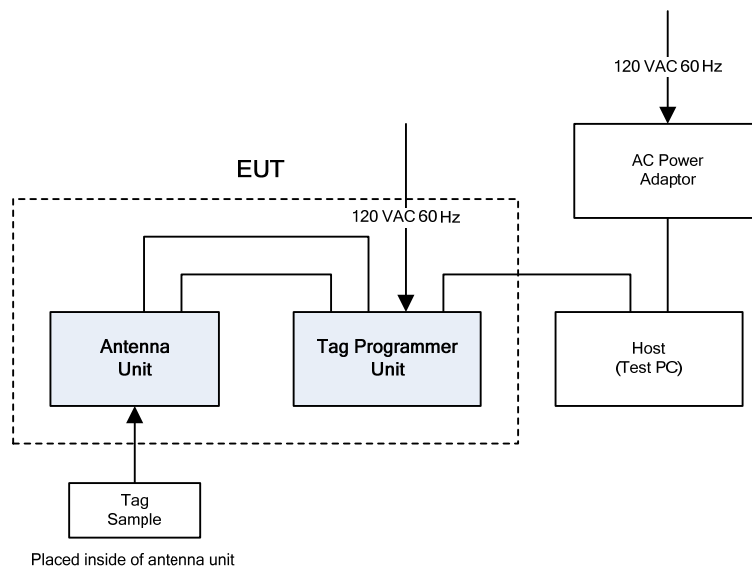
### 5.5.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

### 5.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 $\mu$ H
24'x16'x8' RF Shielded Chamber	RF Shielding	--	--	--

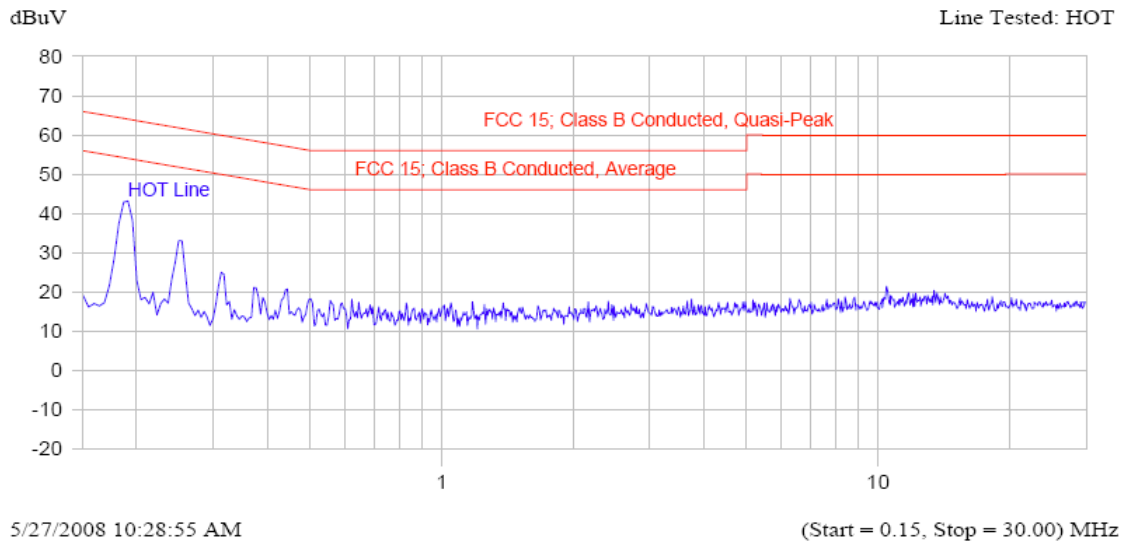
### 5.5.4. Test Arrangement



5.5.5. Test Data

**Plot 5.5.5.1** Power Line Conducted Emissions  
 Line Voltage: 120 VAC 60 Hz  
 Line Tested: Hot

Current Graph

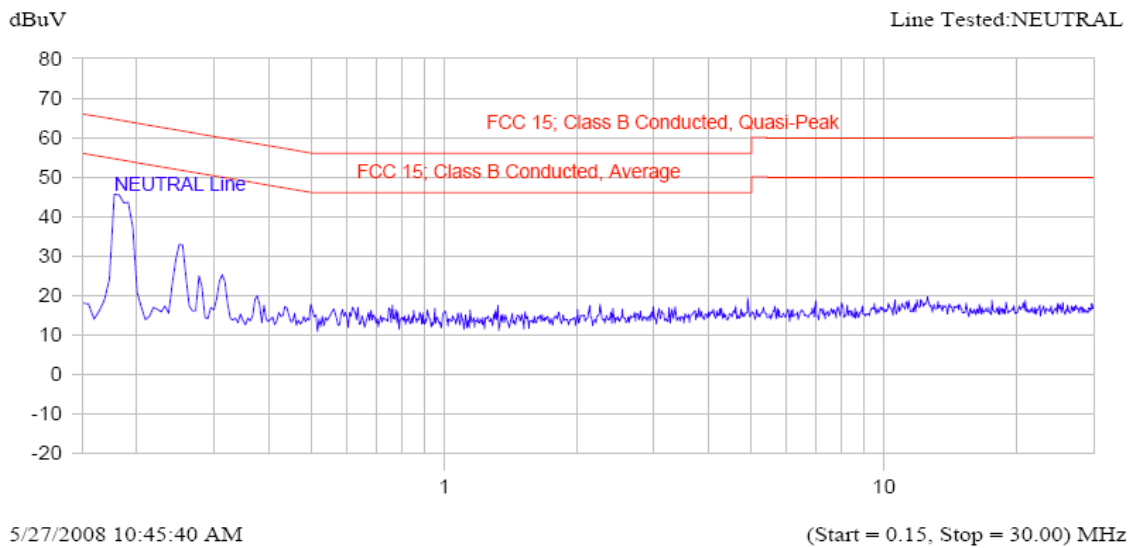


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.185	51.3	45.8	-19.2	43.0	-12.0	HOT Line
0.248	37.4	32.8	-30.4	31.3	-21.8	HOT Line
0.310	27.6	24.4	-37.0	23.2	-28.2	HOT Line

**Plot 5.5.5.2 Power Line Conducted Emissions**  
 Line Voltage: 120 VAC 60 Hz  
 Line Tested: Neutral

**Current Graph**



**Current List**

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.179	47.0	39.5	-25.7	30.1	-25.1	NEUTRAL Line
0.249	38.0	33.0	-30.2	31.6	-21.6	NEUTRAL Line
0.311	28.1	24.4	-36.9	23.1	-28.3	NEUTRAL Line

**5.6. 20 dB BANDWIDTH**

**5.6.1. Limits**

The fundamental emission must be in the authorized bandwidth.

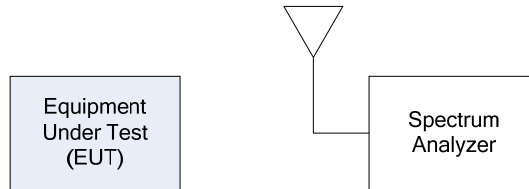
**5.6.2. Method of Measurements**

The transmitter output was loosely coupled to the spectrum analyzer through a receiving antenna and the bandwidth of the fundamental frequency was measured with the spectrum analyzer with the resolution bandwidth of the spectrum analyzer set per ANSI 63.4

**5.6.3. Test Equipment List**

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz
Biconilog antenna	EMCO	3142C	34792	26 - 3000 MHz
RF Amplifier	Hewlett Packard	8447F	2944A04098	0.1 - 1300 MHz
RF Amplifier	Hewlett Packard	8449B	3008A00769	1 – 26.5 GHz

**5.6.4. Test Arrangement**

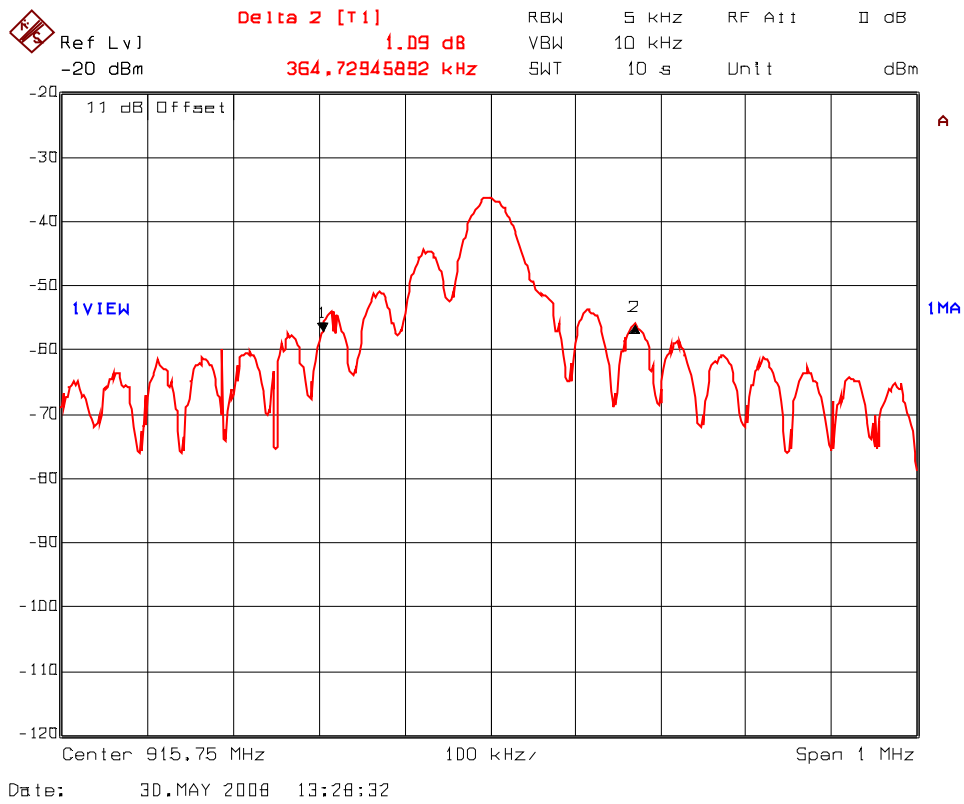


**5.6.5. Test Data**

Frequency (MHz)	20 dB Bandwidth (kHz)
915.75	364.73

See the following plot for details.

**Plot 5.6.5.1 20 dB Bandwidth**  
Test Frequency: 908.42 MHz



**5.7. FUNDAMENTAL FIELD STRENGTH AND HARMONIC EMISSIONS ( RADIATED @ 3m) [47 CFR 15.249(a), 15.209 & 15.205]**

**5.7.1. Limits**

(a) The Field Strength of emissions from intentional radiators operated within 902 - 928 MHz band shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (µV/m)
902 - 928 MHz	50	500

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

- The fundamental frequency shall not fall within any restricted frequency band specified in 15.205. All other emissions that fall in the restricted bands shall not exceed the general radiated emission limits specified in @ 15.209(a).

**FCC 47 CFR 15.205(a)  
 -- Restricted Frequency Bands --**

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 - 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 - 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 - 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 - 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 - 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 - 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 - 156.9	2200 - 2300	9000 - 9200	

**FCC 47 CFR 15.209(a)**  
**-- Field Strength Limits within Restricted Frequency Bands --**

Frequency (MHz)	Field Strength Limits ( $\mu\text{V/m}$ )	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

**5.7.2. Method of Measurements**

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

**5.7.3. Test Equipment List**

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz - 40 GHz
RF Amplifier	Hewlett Packard	8447F	2944A04098	0.1 - 1300 MHz
RF Amplifier	Hewlett Packard	8449B	3008A00769	1 - 26.5 GHz
Biconilog antenna	EMCO	3142C	34792	26 - 3000 MHz
Horn Antenna	EMCO	3155	6570	1 - 18 GHz

**5.7.4. Test Data**

The emissions were scanned from 30 MHz to 10 GHz and all significant emissions were recorded.

Frequency (MHz)	Peak E-Field @3m ( $\text{dB}\mu\text{V/m}$ )	Average E-Field @3m ( $\text{dB}\mu\text{V/m}$ )	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic ( $\text{dB}\mu\text{V/m}$ )	Field Strength Limit of § 15.209 ( $\text{dB}\mu\text{V/m}$ )	Margin (dB)
915.75	67.24	--	V	94.0	--	-26.7
915.75	69.15	--	H	94.0	--	-24.8
30 - 10000	*	*	*	54.0	54.0	*

\* All spurious emissions/harmonics are more the 20 dB below the specified limits.



## EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and LAB 34

### 6.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	$\pm 1.5$	$\pm 1.5$
LISN coupling specification	Rectangular	$\pm 1.5$	$\pm 1.5$
Cable and Input Transient Limiter calibration	Normal (k=2)	$\pm 0.3$	$\pm 0.5$
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8(9 \text{ kHz}) 0.2 (30 \text{ MHz})$ Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$	U-Shaped	$\pm 0.2$	$\pm 0.3$
System repeatability	Std. deviation	$\pm 0.2$	$\pm 0.05$
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	$\pm 1.25$	$\pm 1.30$
Expanded uncertainty U	Normal (k=2)	$\pm 2.50$	$\pm 2.60$

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

**6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY**

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY ( $\pm$ dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	$\pm 1.0$	$\pm 1.0$
Cable Loss Calibration	Normal (k=2)	$\pm 0.3$	$\pm 0.5$
EMI Receiver specification	Rectangular	$\pm 1.5$	$\pm 1.5$
Antenna Directivity	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	$\pm 2.0$	$\pm 0.5$
Antenna phase center variation	Rectangular	0.0	$\pm 0.2$
Antenna factor frequency interpolation	Rectangular	$\pm 0.25$	$\pm 0.25$
Measurement distance variation	Rectangular	$\pm 0.6$	$\pm 0.4$
Site imperfections	Rectangular	$\pm 2.0$	$\pm 2.0$
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$ (Bi) 0.3 (Lp) Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$	U-Shaped	+1.1 -1.25	$\pm 0.5$
System repeatability	Std. Deviation	$\pm 0.5$	$\pm 0.5$
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$$U = 2u_c(y) = 2x(+2.19) = +4.38 \text{ dB} \quad \text{And} \quad U = 2u_c(y) = 2x(-2.21) = -4.42 \text{ dB}$$