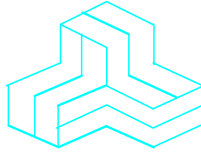


ENGINEERING TEST REPORT



T600 Tag Tester
MODEL NO.: 801235-TAB
FCC ID: JQU801235

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-015F15C249

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



Date: February 19, 2009

Report Prepared by: Dan Huynh

Tested by: Mr. Wei Wu, EMC/RFI Technician

Issued Date: February 19, 2009

Test Dates: Oct. 22, Dec. 19 & 29, 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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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.249
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Low Power Licensed-Exempt Transmitters operating in the Frequency Band 902 - 928 MHz.
Test Procedures:	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.
Environmental Classification:	Commercial, industrial or business environment

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

Publication	Year	Title
FCC 47 CFR 15	2008	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	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

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

MANUFACTURER	
Name:	Mark IV Industries Corp.
Address:	6020 Ambler Drive Mississauga, ON Canada L4W 2P1
Contact Person:	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.

Brand Name:	Mark IV Industries Corp.
Product Name:	T600 Tag Tester
Model Name or Number:	801235-TAB
Serial Number:	ENG-100
Type of Equipment:	Low Power Transceiver
Input Power Supply Type:	5 VDC, 15 VDC
Primary User Functions of EUT:	Functional and performance testing of transponder products

2.3. EUT’S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Mobile
Intended Operating Environment:	[x] Commercial, industrial or business environment [] Residential environment
Power Supply Requirement:	5 VDC, 15 VDC
RF Output Power Rating:	87.77dBµV/m at 3m distance
Operating Frequency Range:	915.75 MHz
RF Output Impedance:	50 Ohm
20 dB Bandwidth:	1.182 MHz
Modulation Type:	OOK
Antenna Connector Type:	Integral
Antenna Description:	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	HOST	1	DB-9, Male	Shielded
2	SCANNER	1	DB-9, Male	Shielded
3	Power	1	5 Pin DIN Jack	Non-shielded

2.5. ANCILLARY EQUIPMENT

Ancillary Equipment # 1	
Description:	ThinkPad
Brand name:	IBM
Model Name or Number:	2652-P3U
Serial Number:	KP-YMRBT05/03
Cable Length & Type:	≤ 3 m, Non-shielded
Connected to EUT’s Port:	Host Port

Ancillary Equipment # 2	
Description:	AC-DC Adaptor
Brand name:	Skynet
Model Name or Number:	SNP-PA54
Serial Number:	2521600
Cable Length & Type:	≤ 3 m, Non-shielded
Connected to EUT’s Port:	Power

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:	5 VDC, 15 VDC via AC-DC Adaptor

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

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

Transmitter Test Signals:	
Frequency Band(s):	915.75 MHz
Test Frequency(ies):	915.75 MHz
Transmitter Wanted Output Test Signals:	
• RF Power Output (measured maximum output power):	87.77dB μ V/m 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
15.215(c)	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

The following enhancements were made to the T600 Tag Tester:

1. Limiting the internal programmable attenuation to a minimum value of 7dB
2. Absorbing Material: Added 3 Cumming C-RAM MT-26 0.125" thick lossy carbon loaded foam to the RF Box unit walls.
3. Digital and RF PCB rotated 180deg: Internal physical change to the PCB location.
4. Shielded HOST (serial) cable: Internal cable assembly.
5. 50-ohm Dummy Load: On unused RF port 2.
6. Circulator and RF Switch Shield: Added a 2.9" x 1.4" x 0.625"(0.5" on lower end) metallic shield.

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

5.1. TEST PROCEDURES

Details of test methods and procedures can be found in Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4.

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 7 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

Functional and performance testing of transponder products

5.5. POWER LINE CONDUCTED EMISSIONS [47 CFR 15.107(a) & 15.207]

5.5.1. Limits

The equipment shall meet the limits of the following table:

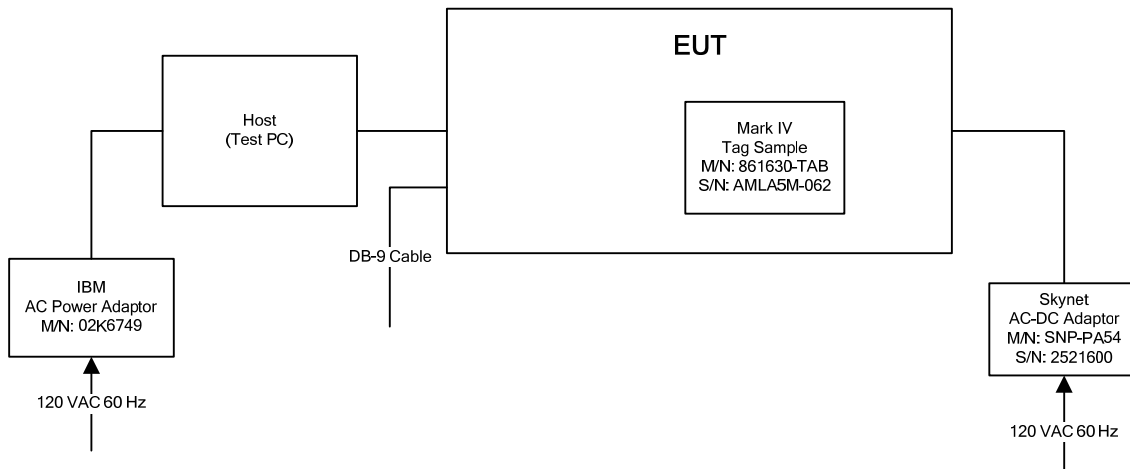
Test Frequency Range (MHz)	Class B Limits		Measuring Bandwidth
	Quasi-Peak (dBµV)	Average (dBµV)	
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW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

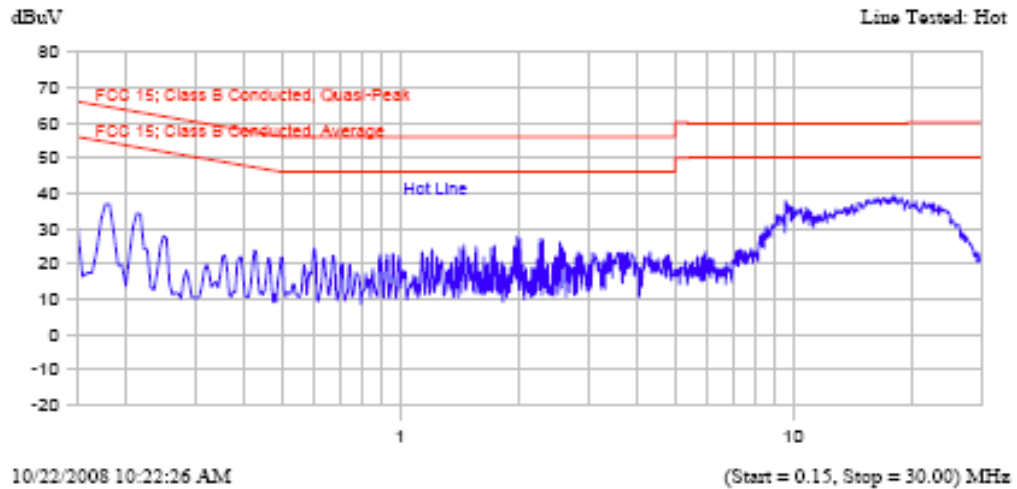
5.5.3. Test Arrangement



5.5.4. Test Data

Plot 5.5.4.1 Power Line Conducted Emissions
 Line Voltage: 120 VAC 60 Hz
 Line Tested: Hot

Current Graph

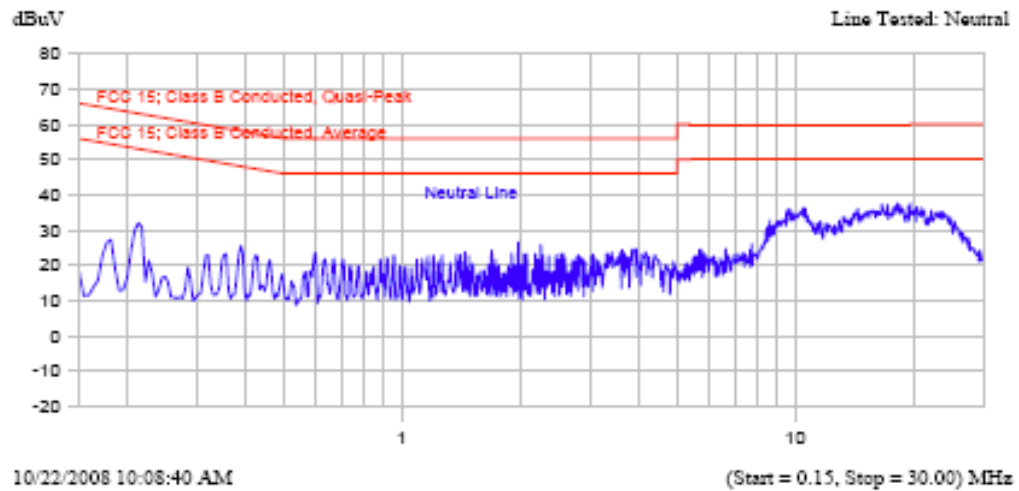


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Op-Op Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.176	39.2	37.2	-28.1	31.8	-23.4	Hot Line
0.212	35.4	33.9	-30.2	28.9	-25.3	Hot Line
0.601	21.8	20.3	-35.7	18.1	-27.9	Hot Line
1.984	27.5	26.2	-29.8	19.1	-26.9	Hot Line
9.550	28.5	28.5	-31.5	28.5	-21.5	Hot Line
18.001	40.1	37.5	-22.5	34.0	-16.0	Hot Line

Plot 5.5.4.2 Power Line Conducted Emissions
 Line Voltage: 120 VAC 60 Hz
 Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta dB	Qp-Qp Limit	Avg dBuV	Delta dB	Avg-Avg Limit	Trace Name
0.176	38.6	36.1	-29.2		26.6	-28.7		Neutral Line
0.213	33.9	29.7	-34.4		24.3	-29.9		Neutral Line
0.388	25.9	23.5	-35.7		19.6	-29.5		Neutral Line
10.577	38.4	36.0	-24.0		30.9	-19.1		Neutral Line
19.627	37.5	33.4	-26.6		27.0	-23.0		Neutral Line

5.6. 20 dB BANDWIDTH [47 CFR 15.215(c)]

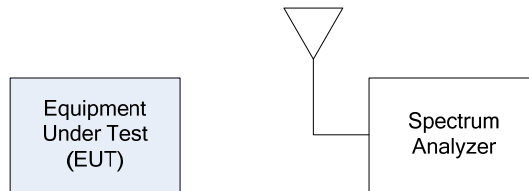
5.6.1. Limits

The 20 dB bandwidth must be contained within the frequency band designated in the rule.

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 Arrangement

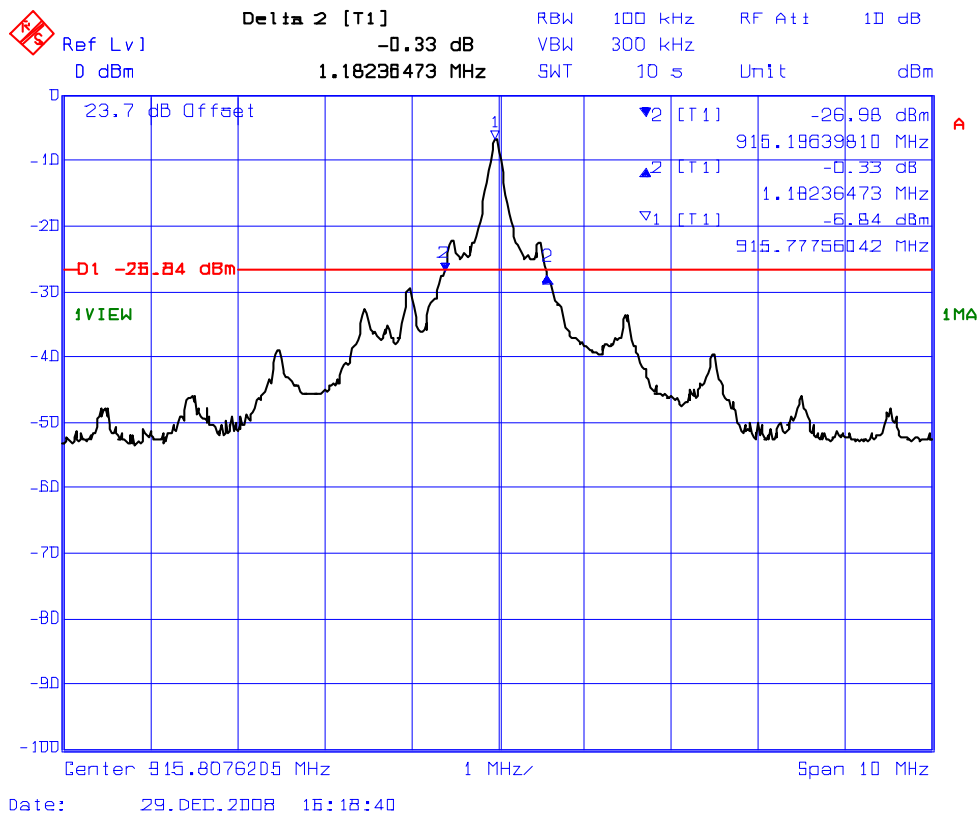


5.6.4. Test Data

Frequency (MHz)	20 dB Bandwidth (MHz)
915.75	1.182

See the following plot for details.

Plot 5.6.4.1 20 dB Bandwidth
 Test Frequency: 915.75 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 (µV/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 Data

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

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	*QP/Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Margin (dB)
915.75	103.57	87.77	V	94.0	--	-6.2
915.75	98.60	85.71	H	94.0	--	-8.3
2747.25	64.08	39.06	V	54.0	54.0	-14.9
2747.25	61.00	35.12	H	54.0	54.0	-18.9
3663.00	62.99	39.14	V	54.0	54.0	-14.8
3663.00	67.23	39.63	H	54.0	54.0	-14.3
4578.75	56.04	37.95	V	54.0	54.0	-16.0
4578.75	60.20	36.22	H	54.0	54.0	-17.8
5494.50	63.66	42.45	V	54.0	54.0	-11.5
5494.50	60.27	39.72	H	54.0	54.0	-14.3
6410.25	63.14	40.99	V	54.0	54.0	-13.0
6410.25	63.77	40.57	H	54.0	54.0	-13.4

*QP for frequencies below or equal to 1000 MHz; Average for frequencies above 1000 MHz.

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Operating 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 µH
24'x16'x8' RF Shielded Chamber	RF Shielding	--	--	--
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 KHz - 40 GHz
Log Periodic Antenna	ETS	93148	1101	200 MHz – 2000 MHz
EMI Receiver System/ Spectrum Analyzer	Hewlett Packard	HP 8546A	3520A00248	9 kHz - 5.6GHz, 50 Ohms
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz - 40 GHz with external mixer
Microwave Amplifier	Hewlett Packard	HP 83017A	311600661	1 GHz - 26.5 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz - 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz - 18 GHz

EXHIBIT 7. MEASUREMENT UNCERTAINTY

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

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	± 1.5	± 1.5
LISN coupling specification	Rectangular	± 1.5	± 1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	± 0.3	± 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	± 0.2	± 0.3
System repeatability	Std. deviation	± 0.2	± 0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	± 1.25	± 1.30
Expanded uncertainty U	Normal (k=2)	± 2.50	± 2.60

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

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

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

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (\pm dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	± 1.0	± 1.0
Cable Loss Calibration	Normal (k=2)	± 0.3	± 0.5
EMI Receiver specification	Rectangular	± 1.5	± 1.5
Antenna Directivity	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	± 2.0	± 0.5
Antenna phase center variation	Rectangular	0.0	± 0.2
Antenna factor frequency interpolation	Rectangular	± 0.25	± 0.25
Measurement distance variation	Rectangular	± 0.6	± 0.4
Site imperfections	Rectangular	± 2.0	± 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	± 0.5
System repeatability	Std. Deviation	± 0.5	± 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:

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