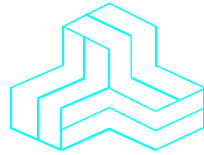


ENGINEERING TEST REPORT



Point of Sale Device
Model No.: NURIT 8000 CDPD
(WITH NOVATEL CDPD RADIO TRANSCEIVER MODULE)
FCC ID: O2SNURIT8000CI

Applicant: **Lipman USA, Inc**
50 Gordon Dr.
Syosset, NY
USA, 11791

Tested in Accordance With

Federal Communications Commission (FCC)
CFR 47, PARTS 2 and 22 (Subpart H)

UltraTech's File No.: LIP8FTX

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

Date: Oct. 12, 2001



Report Prepared by: Dan Huynh

Tested by: Hung Trinh, RFI/EMI Technicain

Issued Date: Oct. 12, 2001

Test Dates: Oct. 08, 2001

The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.

UltraTech

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex Number	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	<ul style="list-style-type: none"> • Exhibit 1: Submittal check lists • Exhibit 2: Introduction • Exhibit 3: Performance Assessment • Exhibit 4: EUT Operation and Configuration during Tests • Exhibit 5: Summary of test Results • Exhibit 6: Measurement Data • Exhibit 7: Measurement Uncertainty • Exhibit 8: Measurement Methods 	OK
1	Test Setup Photos	Radiated Emissions Test Setup	OK
2	External EUT Photos	External Photos of NURIT 8000 CDPD (with Novatel CDPD Radio Transceiver Module)	OK
3	Internal EUT Photos	Internal Photos of NURIT 8000 CDPD (with Novatel CDPD Radio Transceiver Module)	OK
4	Cover Letters	<ul style="list-style-type: none"> • Letter from Ultratech for Certification Request • Letter from the Applicant to appoint Ultratech to act as an agent • Letter from the Applicant to request for Confidentiality Filing 	OK OK OK
5	Attestation Statements	--	--
6	ID Label/Location Info	ID Label Location of ID Label	OK
7	Block Diagrams	NURIT 8000 Block Diagram	OK
8	Schematic Diagrams	<ul style="list-style-type: none"> • Main Schematics • Keyboard Schematic • Ports Schematic 	OK
9	Parts List/Tune Up Info	<ul style="list-style-type: none"> • Main Parts List • Keyboard Parts List • Connector Adaptor Parts List 	OK
10	Operational Description	Refer to Novatel Wireless Technologies Ltd. submissions	OK
11	RF Exposure Info	SAR test report	OK
12	Users Manual	NURIT 8000 User Manual	OK

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EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 22
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Parts 2 & 22
Purpose of Test:	To gain FCC Certification Authorization for Radio operating in the frequency band 824-849 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.

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

None

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Part 22	2000	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	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	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods

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EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Lipman USA, Inc
Address:	50 Gordon Dr. Syosset, NY USA, 11791
Contact Person:	John Carpino Phone #: 516-484-9898

MANUFACTURER	
Name:	Lipman Electronic Engineering, Ltd.
Address:	11 Haamal St Park Afek Rosh Haayin 48092 Israel
Contact Person:	Amit Chhabra Phone #: 1 800 454 7626 X2300 516-484-9898 X2300

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

Brand Name:	Lipman USA, Inc
Product Name:	Point of Sale Device
Model Name or Number:	NURIT 8000 CDPD (with Novatel CDPD Radio Transceiver Module)
Serial Number:	Test Sample
Type of Equipment:	Licensed Non-Broadcast Radio Communication Equipment
External Power Supply:	Lipman USA Inc., Power Supply/Charger Model No.: TRF00050
Transmitting/Receiving Antenna Type:	Integral
Primary User Functions of EUT:	Wireless hand held POS/EDC terminal for credit, debit and ERT transactions

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3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	<input checked="" type="checkbox"/> Portable <input type="checkbox"/> Mobile <input type="checkbox"/> Base station (fixed use)
Intended Operating Environment:	<input checked="" type="checkbox"/> Commercial <input checked="" type="checkbox"/> Light Industry & Heavy Industry
Power Supply Requirement:	7.2 V Li-ion Battery Pack or 8.4 VDC via Lipman Power – Supply/Charger (100 – 240V 50 – 60Hz)
RF Output Power Rating:	530 mili-Watts (at antenna terminal) 489.8 mili-Watts (ERP)
Operating Frequency Range:	824-849 MHz
RF Output Impedance:	50 Ohms
Emission Designation:	28K8FXW
Antenna Connector Type:	Integral
Antenna Description:	Manufacturer: Rangestar Wireless Type: Omnidirectional, tab-mounted embedded cellular antenna P/N: 100800 Frequency Range: 824 - 894 MHz In/Out Impedance: 50 Ohms Gain: 0 dBi Peak (dependent on ground plane size)

3.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Data I/O	1	RS 232	Shielded
2	Power	1	Miniature Power	Non-shielded

NOTES:

Ports of the EUT which in normal operation were connected to ancillary equipment through interconnecting cables via a representative interconnecting cable to simulate the input/output characteristics. RF input/output was correctly terminated to the 50 Ohms RF Load.

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3.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Laptop
Brand name:	IBM
Model Name or Number:	2625
Serial Number:	78-WWM48 96/05
Connected to EUT's Port:	Data I/O

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EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	7.2 V Li-ion Battery Pack or 8.4 VDC via Lipman Power – Supply/Charger (100 – 240V 50 – 60Hz)

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	Integral

Transmitter Test Signals	
Frequency Band(s):	Near lowest, lowest & near highest frequencies of each frequency band(s) that the transmitter covers:
<ul style="list-style-type: none"> ▪ 824-849 MHz 	<ul style="list-style-type: none"> ▪ 824, 837 and 848.97 MHz
Transmitter Wanted Output Test Signals:	
<ul style="list-style-type: none"> ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation: ▪ Modulating signal source: 	<ul style="list-style-type: none"> 530 mili-Watts (at antenna terminal) 489.8 mili-Watts (ERP) FM Data Internal

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EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. 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.

Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have 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 Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: August 08, 2001.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	APPLICABILITY (YES/NO)
22.913 & 2.1046	RF Power Output	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes. See note (2)
22.101(a) & 2.1055	Frequency Stability	Yes, See note (1)
22.915(d) & 2.1047(a)	Audio Frequency Response	N/A
22.915(a), (b) & (c) & 2.1047(b)	Modulation Limiting	Yes, See note (1)
22.917(a),(b),(c) & (d) & 2.1049	Emission Limitation & Emission Mask	Yes, See note (1)
22.917(e), (f) & (g), 2.1057 & 2.1051	Emission Limits - Spurious Emissions at Antenna Terminal	Yes, See note (1)
22.917(e), (f) & (g), 2.1057 & 2.1053	Emission Limits - Field Strength of Spurious Emissions	Yes

Note 1: Since, there is no changes in RF characteristic, circuitry and functional capabilities in the NOVATEL WIRELESS TECHNOLOGIES LTD. CDPD Licensed Non-Broadcast Radio Transceiver Module (FCC ID: NBZNRM-6832) approved by FCC as a Modular Transceiver, tests are not required to be repeated. Refer to exhibits uploaded by Novatel Wireless Technologies Ltd. Limited for further details.

Note 2: Refer to SAR test report for details.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

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EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:1992 and CISPR 16-1.

6.4. ESSENTIAL/PNOVATEL WIRELESS TECHNOLOGIES LTD.ARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

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6.5. RF POWER OUTPUT @ FCC 2.1046 & 22.913

6.5.1. Limits @ FCC 22.913

Please refer to FCC CFR 47, Part 22, Subpart I, Para. 22.913 for specification details.

The effective radiated power (EIRP) of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section:

	Maximum ERP (Watts)
Mobile Transmitters & Auxiliary Test Transmitters (824-849 MHz)	7 Watts

6.5.2. Method of Measurements

Please refer to Exhibit 8, § 8.1 (Conducted) and § 8.2 (Radiated) for test procedures and test setup.

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Spectrum Analyzer/EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
RF Pre-Amplifier	Com-Power	PA-102	1425	30 MHz to 1 GHz, 30 dB gain nominal
Microwave Amplifier	Hewlett Packard	HP 83017A	3116A00661	1 GHz to 26.5 GHz, 30 dB nominal
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 – 1000 MHz
Dipole Antenna	EMCO	3121C	8907-440	30 – 1000 MHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

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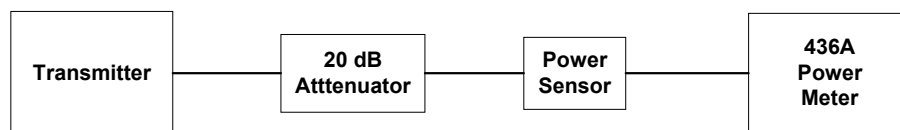
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6.5.4. Test Arrangement

- Power at RF Power Output Terminals



- For ERP test arrangement, refer to section 8.2 of this test report for details

6.5.5. Test Data

Conducted Power

Transmitter Channel Output	Fundamental Frequency (MHz)	Measured Power (dBm)	Power Rating (dBm)
Lowest	824.00	27.2	27.8
Middle	837.00	26.9	27.8
Highest	848.97	25.3	27.8

ERP Using Substitution Method

Frequency (MHz)	Peak E-Field @ 3m (dBμV/m)	Antenna Polarization (V/H)	Peak Power From Signal GEN. Ps (dBm)	Substitution Dipole Antenna Gain Gd (dBi)	Measured Peak ERP = Ps+Gd-2.15 (dBm)	FCC ERP Limit (dBm)
824.00	121.5	V	20.8	1.5	22.3	38.5
824.00	124.3	H	25.4	1.5	26.9	38.5
837.00	122.9	V	24.5	1.3	25.8	38.5
837.00	123.9	H	25.3	1.3	26.6	38.5
848.97	120.9	V	22.6	1.0	23.6	38.5
848.97	122.2	H	23.8	1.0	24.8	38.5

* The above readings are the maximum value obtained with EUT oriented in three different orthogonal positions

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6.6. RF EXPOSURE REQUIREMENTS @ 1.1310 & 2.1093

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	Compliance with FCC Rules
SAR Tests for Portable Transmitters <ul style="list-style-type: none">• Body Tissue• Brain Tissue	<ul style="list-style-type: none">• Complies with Limits for General Population/Uncontrolled Exposure. Please refer to SAR test report for details.• N/A
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Please refer to User Manual for RF Exposure information to users.

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6.7. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 22.917(A), (B), (C) & (D)

6.7.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC RULES	ATTENUATION LIMIT
FCC 22.917(e)	43+10*log(P) dBc, P is power in watts
FCC 22.917(f) for Mobile emissions	Mean power in 869-894 MHz band shall be less than -80 dBm
FCC 22.917(g)	If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

6.7.2. Method of Measurements

The spurious/harmonic ERP measurements, using substitution method specified in Exhibit 8, § 8.2 of this report and its value in dBc is calculated as follows:

If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.

If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:

Lowest ERP of the carrier = EIRP - 2.15 dB = P_c + G - 2.15 dB = xxx dBm (conducted) + 0 dBi - 2.15 dB
 Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

$$\text{ERP of spurious/harmonic (dBc)} = \text{ERP of carrier (dBm)} - \text{ERP of spurious/harmonic emission (dBm)}$$

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz - 26.5 GHz
RF Pre-Amplifier	Com-Power	PA-102	1425	30 MHz to 1 GHz, 30 dB gain nominal
Microwave Amplifier	Hewlett Packard	HP 83017A	3116A00661	1 GHz to 26.5 GHz, 30 dB nominal
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 - 1000 MHz
Dipole Antenna	EMCO	3121C	8907-440	30 - 1000 MHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz - 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz - 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 - 20 GHz

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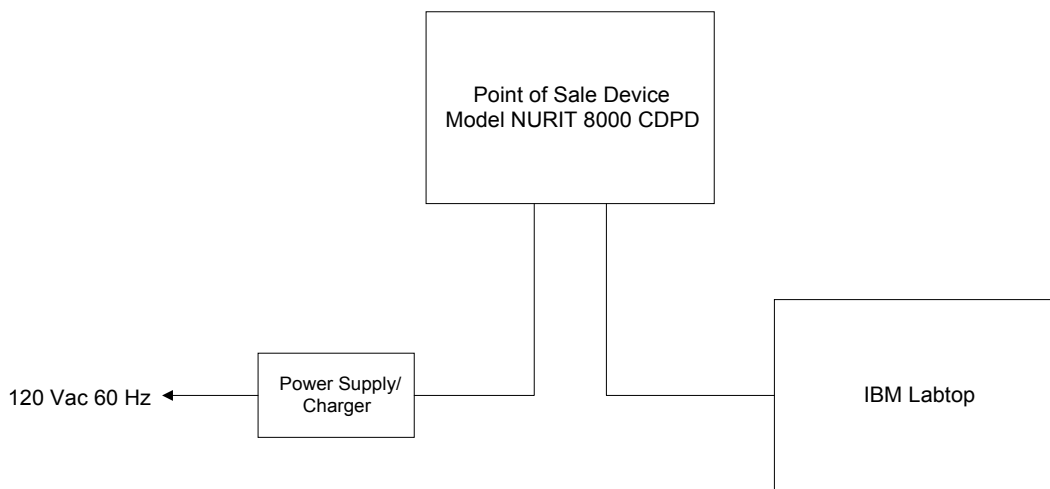
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6.7.4. Test Arrangement

The following drawings show details of the test setup for radiated emissions measurements



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6.7.5. Test Data

Carrier Frequency (MHz): 824
 ERP (dBm): 26.9
 Limit (dBc): 39.9

Frequency (MHz)	E-Field Level @3m (dBµV/m)	ERP Measured By Substitution		EMI Receiver Detector (Peak/QP)	Antenna Plane (H/V)	Minimum Limit (dBc)	Margin (dB)	Pass/Fail
		(dBm)	(dBc)					
824.09	121.5	22.3	--	Peak	V	--	--	--
824.09	124.3	26.9	--	Peak	H	--	--	--
1648.18	68.8	-35.7	62.6	Peak	V	39.9	22.7	Pass
1648.18	66.1	-39.7	66.6	Peak	H	39.9	26.7	Pass
2472.27	62.0	-40.9	67.8	Peak	V	39.9	27.9	Pass
2472.27	61.7	-40.5	67.4	Peak	H	39.9	27.5	Pass
3296.36	77.7	-25.5	52.4	Peak	V	39.9	12.5	Pass
3296.36	74.3	-23.2	50.1	Peak	H	39.9	10.2	Pass

The emissions were scanned from 10 MHz to 10 GHz and all emissions within 30 dB above the minimum FCC limit in dBc were recorded.

Carrier Frequency (MHz): 837
 ERP (dBm): 26.6
 Limit (dBc): 39.6

Frequency (MHz)	E-Field Level @3m (dBµV/m)	ERP By Measured Substitution		EMI Receiver Detector (Peak/QP)	Antenna Plane (H/V)	Minimum Limit (dBc)	Margin (dB)	Pass/Fail
		(dBm)	(dBc)					
837.00	122.9	25.8	--	Peak	V	--	--	--
837.00	123.9	26.6	--	Peak	H	--	--	--
1674.00	72.8	-30.3	56.9	Peak	V	39.6	17.3	Pass
1674.00	66.0	-39.5	66.1	Peak	H	39.6	26.5	Pass
2511.00	65.0	-38.2	64.8	Peak	V	39.6	25.2	Pass
2511.00	61.8	-39.8	66.4	Peak	H	39.6	26.8	Pass
3348.00	73.0	-29.4	56.0	Peak	V	39.6	16.4	Pass
3348.00	71.4	-30.2	56.8	Peak	H	39.6	17.2	Pass

The emissions were scanned from 10 MHz to 10 GHz and all emissions within 30 dB above the minimum FCC limit in dBc were recorded.

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Carrier Frequency (MHz): 848.97
 ERP (dBm): 24.8
 Limit (dBc): 37.8

Frequency (MHz)	E-Field Level @3m (dBμV/m)	ERP Measured By Substitution		EMI Receiver Detector (Peak/QP)	Antenna Plane (H/V)	Minimum Limit (dBc)	Margin (dB)	Pass/ Fail
		(dBm)	(dBc)					
848.97	120.9	23.6	--	Peak	V	--	--	--
848.97	122.2	24.8	--	Peak	H	--	--	--
1697.94	70.0	-32.1	56.9	Peak	V	37.8	19.1	Pass
1697.94	63.5	-41.0	65.8	Peak	H	37.8	28.0	Pass
2546.91	68.9	-33.3	58.1	Peak	V	37.8	20.3	Pass
2546.91	56.2	-45.9	70.7	Peak	H	37.8	32.9	Pass
3395.88	67.2	-35.5	60.3	Peak	V	37.8	22.5	Pass
3395.88	65.5	-37.3	62.1	Peak	H	37.8	24.3	Pass

The emissions were scanned from 10 MHz to 10 GHz and all emissions within 30 dB above the minimum FCC limit in dBc were recorded.

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EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. 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 $\Gamma_R = 0.67(\text{Bi}) 0.3 (\text{Lp})$ Uncertainty limits $20\text{Log}(1+\Gamma_1\Gamma_R)$	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:

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

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EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

The following shall be applied to the combination(s) of the radio device and its intended antenna(e).

If the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.

The following method of measurement shall apply to both conducted and radiated measurements.

The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.

The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal.

The duty cycle of the transmitter, $x = \text{Tx on} / (\text{Tx on} + \text{Tx off})$ with $0 < x < 1$, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

Step 2: Calculation of Average EIRP (See Figure 1)

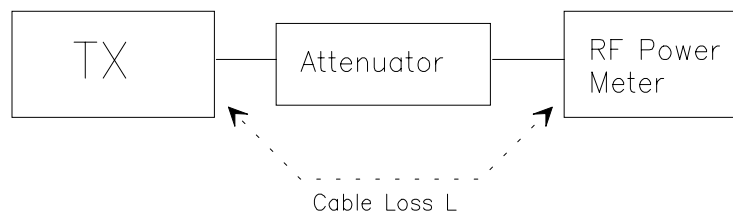
The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);

The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

$$\text{EIRP} = \text{A} + \text{G} + 10\log(1/x)$$

{X = 1 for continuous transmission => $10\log(1/x) = 0$ dB}

Figure 1.



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8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

- (a) The measurements were performed with full rf output power and modulation.
- (b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
- (c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
- (d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
- (e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level
 - ▶ Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
 - ▶ $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$
- (f) Set the EMI Receiver #1 and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

- (g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
- (h) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
- (i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
- (j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
- (k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
- (l) Repeat for all different test signal frequencies

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8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

- (a) Set the EMI Receiver #1 (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency: equal to the signal source
Resolution BW: 10 kHz
Video BW: same
Detector Mode: positive
Average: off
Span: 3 x the signal bandwidth

- (b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level
- ▶ Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
 - ▶ $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$
- (c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
- (d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- ▶ DIPOLE antenna for frequency from 30-1000 MHz or
 - ▶ HORN antenna for frequency above 1 GHz
- (e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
- (f) Use one of the following antenna as a receiving antenna:
- ▶ DIPOLE antenna for frequency from 30-1000 MHz or
 - ▶ HORN antenna for frequency above 1 GHz
- (g) If the DIPOLE antenna is used, tune its elements to the frequency as specified in the calibration manual.
- (h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
- (i) Tune the EMI Receivers to the test frequency.
- (j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
- (k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
- (l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
- (m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
- (n) Record the power level read from the Average Power Meter and calculates the ERP/EIRP as follows:

$$P = P1 - L1 = (P2 + L2) - L1 = P3 + A + L2 - L1$$
$$EIRP = P + G1 = P3 + L2 - L1 + A + G1$$
$$ERP = EIRP - 2.15 \text{ dB}$$

Total Correction factor in EMI Receiver # 2 = $L2 - L1 + G1$

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

- (o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
- (p) Repeat step (d) to (o) for different test frequency
- (q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
- (r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

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Figure 2

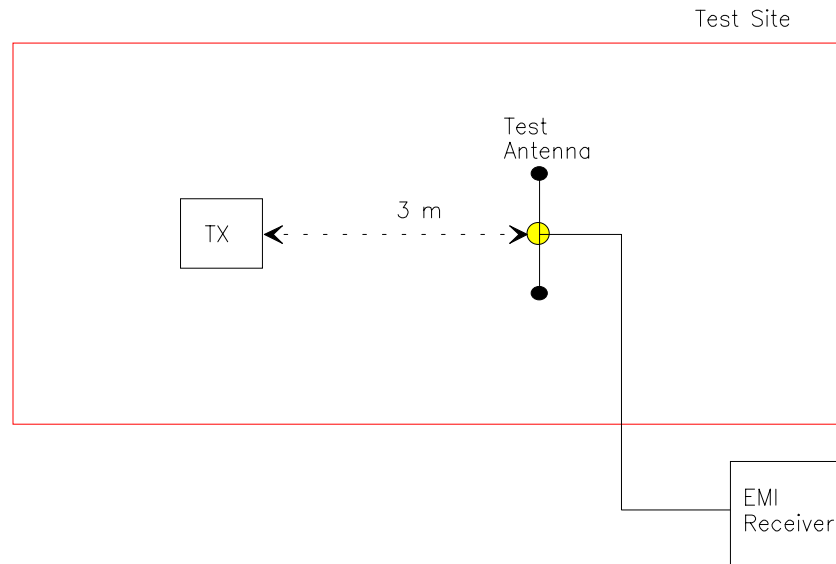
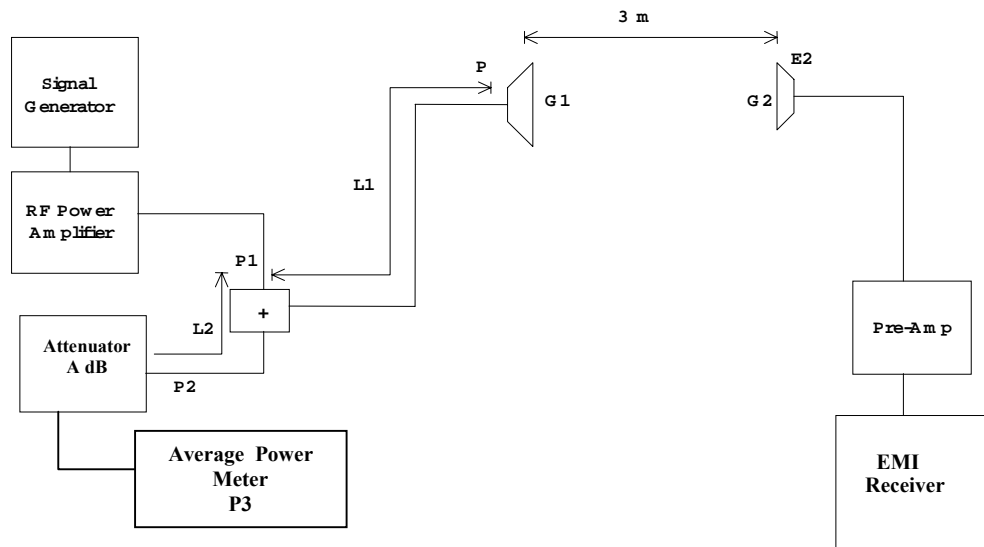


Figure 3



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