# CERTIFICATE OF COMPLIANCE FCC PART 22 MEASUREMENTS

#### **Test Lab:**

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### **Applicant Information:**

#### SIERRA WIRELESS INC.

13575 Commerce Parkway, Suite 150 Richmond, B.C. Canada V6V 2L1 Attn: Trent McKeen, Senior RF Engineer

FCC Classification: Licensed Non-Broadcast Station Transmitter (TNB)

FCC Rule Part(s): \$22.901(d), §2 FCC ID: N7NACRD2 Model(s): AirCard 300/350

Equipment Type: PCMCIA CDPD Modem Card installed in Itronix FeX21

Rugged Laptop PC with Itronix Dipole Antenna

Tx Frequency Range: 824-849 MHz
Rx Frequency Range: 869-894 MHz
Max. RF Output Power: 0.518 Watts (ERP)

Frequency Tolerance: 2.5 PPM Emission Designator: 31K5FXW

Class II Change(s): Add Itronix FeX21 Laptop PC & Itronix Dipole Antenna

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Celltech Research Inc. certifies that no party to this application has been denied FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

Shawn McMillen General Manager

Celltech Research Inc.





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# **MEASUREMENT REPORT - FCC PART 22**

### **1.1 SCOPE**

Measurement and determination of electromagnetic emissions (EME) from radio frequency devices for compliance with the technical rules and regulations of the Federal Communications Commission.

### §2.1033(a) General Information

#### **APPLICANT:**

SIERRA WIRELESS INC. 13575 Commerce Parkway, Suite 150 Richmond, B.C. Canada V6V 2LI Attn: Trent McKeen, Senior RF Engineer

FCC ID	N7NACRD2
Model(s)	AirCard 300/350
EUT Type	PCMCIA CDPD Modem Card installed in Itronix FeX21 Laptop PC with Itronix Dipole Antenna
Classification	Licensed Non-Broadcast Station Transmitter (TNB)
Rule Part(s)	§22.901(d), §2
Max. RF Output Power	0.518 Watts (ERP)
Tx Freq. Range	824-849 MHz
Rx Freq. Range	869-894 MHz
Emission Designator	31K5FXW
Signal Modulation	GMSK
Mode(s) Tested	Unmodulated Carrier
Class II Change(s)	Add Itronix FeX21 Laptop PC with Dipole Antenna

## 2.1 MEASUREMENT PROCEDURES

## 2.2 SPURIOUS EMISSIONS AT ANTENNA TERMINAL - §2.1051

The level of the carrier and the various conducted spurious and harmonic frequencies were measured by means of a calibrated spectrum analyzer. The spectrum was scanned from 10MHz to 20GHz. The antenna output terminal of the EUT was connected to the input of a  $50\Omega$  spectrum analyzer through a matched 40dB attenuator and coaxial cable. The transmitter was operating at maximum power with internal data modulation.

#### 2.3 RADIATED SPURIOUS AND HARMONIC EMISSIONS - §2.1053

Radiated and harmonic emissions above 1 GHz were measured at our 3-meter outdoor site. The EUT was placed on the turntable with the transmitter transmitting into a non-radiating load. A receiving antenna located 3 meters from the turntable received any signal radiated from the transmitter and its operating accessories. The receiving antenna was varied from 1 to 4 meters and the polarization was varied (horizontal and vertical) to determine the worst-case emission level.

#### 3.1 TEST DATA

#### 3.2 EFFECTIVE RADIATED POWER OUTPUT - §2.1046

Freq. Tuned	EUT Conducted Power	Max. Field Strength of EUT (dBm)	Dipole Gain	Dipole Forward Conducted Power	ERP o Dipole H Dipole F Conducte	e Gain - Forward
(MHz)	(dBm)	Vertical Pol.	(dBd)	(dBm)	(dBm)	(Watts)
824.04	24.45	- 10.45	- 1.44	28.58	27.14	0.518
836.49	25.10	- 10.81	- 1.34	27.57	26.23	0.420
848.97	24.46	- 13.60	- 1.24	25.21	23.97	0.249

#### Notes:

ERP Measurements by Substitution Method:

The EUT was placed on a turntable 3-meters from the receive antenna. The field of maximum intensity was found by rotating the EUT approximately 360 degrees and changing the height of the receive antenna from 1 to 4 meters. The field strength was recorded from a calibrated spectrum analyzer for each channel being tested. A half-wave dipole was substituted in place of the EUT. The dipole was fed through a directional coupler and the power at the coupler port was monitored. A signal generator and power amplifier controlled the dipole, and the input level of the dipole was adjusted to the same field strength level as the EUT. The feed point for the dipole was then connected to a calibrated power meter and the power adjusted to read the same as the coupler port previously recorded, this is to account for any mismatch in impedance, which may occur at the dipole antenna. The conducted power at the antenna feed point was recorded. The forward power for the dipole was then determined and the ERP level was determined by adding the forward dipole power and the dipole gain in dB. For readings above 1GHz the above method is repeated using standard gain horn antennas.

#### 3.3 FIELD STRENGTH OF SPURIOUS RADIATION - 2.1053

Operating Frequency (MHz): 824.04

Channel: 991 (Low)

Measured Cond. Pwr. (dBm): 24.45 Measured ERP (dBm): 27.14

Modulation: Unmodulated Carrier

Distance: 3 Meters

Limit:  $43 + 10 \log (W) = 40.31 \text{ dBc}$ 

Frequency	Field Strength of Spurious Radiation	Horn Forward Cond. Pwr.	Standard Gain Horn Antenna Gain	POL (H/V)	EIRP (dBm)	ERP (dBm)	dBc
(MHz)	(dBm)	(dBm)	(dBi)				
1648.08	-57.91	-32.73	6.6	V	-26.13	-28.27	55.41
2472.12	-73.45	-46.25	7.8	>	-38.45	-40.59	67.73
3296.16	-73.92	-38.76	7.8	>	-31.01	-33.15	60.29
4120.20	-78.80	-49.78	7.6	>	-42.18	-44.32	71.46
4944.24	-85.22	-58.86	8.5	>	-50.36	-52.50	79.64
5768.28	-85.02	-58.14	8.8	٧	-49.34	-51.48	78.62
6592.32	-79.12	-64.04	9.6	V	-54.44	-56.58	83.72
7416.36	-95.57	-70.04	9.0	V	-61.04	-63.18	90.32
8240.40	< -104						

#### Notes:

Radiated Measurements by Substitution Method:

The EUT was placed on a turntable 3-meters from the receive antenna. The field of maximum intensity was found by rotating the EUT approximately 360 degrees and changing the height of the receive antenna from 1 to 4 meters. The field strength was recorded from a calibrated spectrum analyzer for each channel being tested. A standard gain horn antenna was substituted in place of the EUT. The antenna was fed through a directional coupler and the power at the coupler port was monitored. A signal generator and power amplifier controlled the antenna, and the input level of the antenna was adjusted to the same field strength level as the EUT. The feed point for the antenna was then connected to a calibrated power meter and the power adjusted to read the same as the coupler port previously recorded, this is to account for any mismatch in impedance, which may occur at the hom antenna. The conducted power at the antenna feed point was recorded. The forward power for the antenna was then determined and the EIRP level was determined by adding the forward power and the antenna gain in dB.

#### FIELD STRENGTH OF SPURIOUS RADIATION - 2.1053

Operating Frequency (MHz): 836.49

Channel: 383 (Mid)

Measured Cond. Pwr. (dBm): 25.10

Measured ERP (dBm): 26.23

Modulation: Unmodulated Carrier

Distance: 3 Meters

Limit:  $43 + 10 \log (W) = 40.31 \text{ dBc}$ 

Frequency	Field Strength of Spurious Radiation	Horn Forward Cond. Pwr.	Standard Gain Horn Antenna Gain	POL (H/V)	EIRP (dBm)	ERP (dBm)	dBc
(MHz)	(dBm)	(dBm)	(dBi)				
1672.98	-61.26	-38.37	6.6	V	-31.77	-33.91	60.14
2509.47	-66.32	-41.26	7.8	>	-33.46	-35.60	61.83
3345.96	-77.98	-51.40	7.8	>	-43.65	-45.79	72.02
4182.45	-89.40	-61.38	7.6	<b>V</b>	-53.78	-55.92	82.15
5018.94	-84.51	-58.15	8.5	>	-49.65	-51.79	78.02
5855.43	-86.78	-65.90	8.8	>	-57.10	-59.24	85.47
6691.92	-91.27	-70.39	9.6	V	-60.79	-62.93	89.16
7528.41	< -104						
8364.90	< -104						

#### Notes:

#### Radiated Measurements by Substitution Method:

The EUT was placed on a turntable 3-meters from the receive antenna. The field of maximum intensity was found by rotating the EUT approximately 360 degrees and changing the height of the receive antenna from 1 to 4 meters. The field strength was recorded from a calibrated spectrum analyzer for each channel being tested. A standard gain horn antenna was substituted in place of the EUT. The antenna was fed through a directional coupler and the power at the coupler port was monitored. A signal generator and power amplifier controlled the antenna, and the input level of the antenna was adjusted to the same field strength level as the EUT. The feed point for the antenna was then connected to a calibrated power meter and the power adjusted to read the same as the coupler port previously recorded, this is to account for any mismatch in impedance, which may occur at the horn antenna. The conducted power at the antenna feed point was recorded. The forward power for the antenna was then determined and the EIRP level was determined by adding the forward power and the antenna gain in dB.

#### FIELD STRENGTH OF SPURIOUS RADIATION - 2.1053

Operating Frequency (MHz): 848.97

Channel: 799 (High)

Measured Cond. Pwr. (dBm): 24.46 Measured ERP (dBm): 23.97

Modulation: Unmodulated Carrier

Distance: 3 Meters

Limit:  $43 + 10 \log (W) = 40.31 \text{ dBc}$ 

Frequency	Field Strength of Spurious Radiation	Horn Forward Cond. Pwr.	Standard Gain Horn Antenna Gain	POL (H/V)	EIRP (dBm)	ERP (dBm)	dBc
(MHz)	(dBm)	(dBm)	(dBi)				
1697.94	-63.56	-37.98	6.6	V	-31.38	-33.52	57.49
2546.91	-67.03	-39.43	7.8	٧	-31.63	-33.77	57.74
3395.88	-75.17	-37.28	7.8	٧	-29.53	-31.67	55.64
4244.85	-87.36	-58.34	7.6	<b>V</b>	-50.74	-52.88	76.85
5093.82	-89.68	-63.22	8.5	>	-54.72	-56.86	80.83
5942.79	-89.94	-69.06	8.8	٧	-60.26	-62.40	86.37
6791.76	-76.31	-57.03	9.6	V	-47.43	-49.57	73.54
7640.73	-93.99	-74.71	9.0	V	-65.71	-67.85	91.82
8489.70	< -104						

#### Notes:

Radiated Measurements by Substitution Method:

The EUT was placed on a turntable 3-meters from the receive antenna. The field of maximum intensity was found by rotating the EUT approximately 360 degrees and changing the height of the receive antenna from 1 to 4 meters. The field strength was recorded from a calibrated spectrum analyzer for each channel being tested. A standard gain horn antenna was substituted in place of the EUT. The antenna was fed through a directional coupler and the power at the coupler port was monitored. A signal generator and power amplifier controlled the antenna, and the input level of the antenna was adjusted to the same field strength level as the EUT. The feed point for the antenna was then connected to a calibrated power meter and the power adjusted to read the same as the coupler port previously recorded, this is to account for any mismatch in impedance, which may occur at the horn antenna. The conducted power at the antenna feed point was recorded. The forward power for the antenna was then determined and the EIRP level was determined by adding the forward power and the antenna gain in dB.

## 4.1 TEST EQUIPMENT

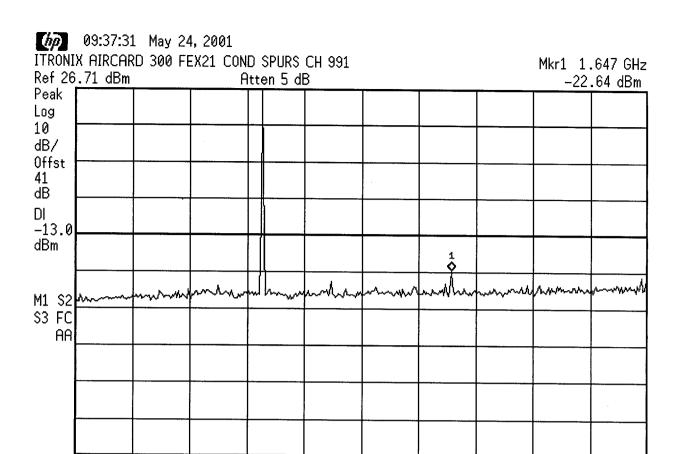
Type	<b>Model</b>	Calib. Date	Serial No.
Signal Generator	HP 8648D (9kHz-4.0GHz)	Nov 1999	3847A00611
Gigatronics Power Meter	8652A	Oct 1999	1835272
Gigatronics Power Sensor (2)	80701A (0.05-18GHz)	Oct 1999	1833535, 1833542
Amplifier Research Power Amp.	5S1G4 (5W, 800MHz-4.2GHz)	N/A	26235
Microwave System Amplifier	HP 83017A (0.5-26.5GHz)	N/A	3123A00587
Network Analyzer	HP 8753E (30kHz-3GHz)	Nov 1999	US38433013
Audio Analyzer	HP 8903B	March 1999	3729A18691
Modulation Analyzer	HP 8901A	March 1999	3749A07154
Frequency Counter	HP 53181A (3GHz)	May 1999	3736A05175
CDMA Base Station Test Set	Agilent E8285A	N/A	US40332926
DC Power Supply	HP E3611A	N/A	KR83015294
Multi-Device Controller	EMCO 2090	N/A	9912-1484
Mini Mast	EMCO 2075	N/A	0001-2277
Turntable	EMCO 2080-1.2/1.5	N/A	0002-1002
Double Ridged Horn Antenna	ETS 3115 (1-18GHz)	Oct. 2000	6267
Double Ridged Horn Antenna	ETS 3115 (1-18GHz)	Oct. 2000	6276
Horn Antenna	Chase BBHA 9120-A (0.7-4.8GHz)	Sept 1998	9120A-239
Horn Antenna	Chase BBHA 9120-A (0.7-4.8GHz)	Sept 1998	9120A-240
Roberts Dipoles	Compliance Design (2 sets) 3121C	June 2000	
Spectrum Analyzer	HP 8594E	March 2000	3543A02721
Spectrum Analyzer	HP E4408B	Nov 1999	US39240170
Shielded Screen Room	Lindgren R.F. 18W-2/2-0	N/A	16297
Environmental Chamber	ESPEC ECT-2 (Temperature/Humidity)	Feb 2000	0510154-B

Test Report S/N: 052301-114N7N Dates of Tests: May 23-24, 2001 FCC Part 22 Class II Change

#### 5.1 CONCLUSION

The data collected shows that the SIERRA WIRELESS PCMCIA CDPD Modem Card FCC ID: N7NACRD2 (installed in ITRONIX FeX21 Rugged Laptop PC with ITRONIX dipole antenna) complies with all the requirements of Parts 2 and 22.901(d) of the FCC rules.

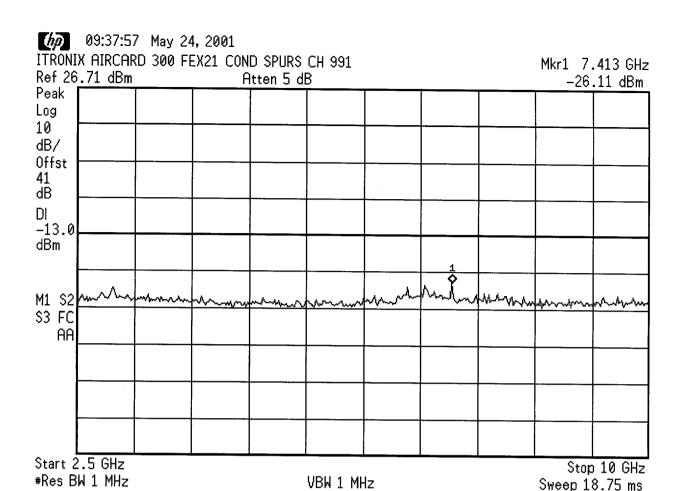
# ATTACHMENT A – TEST PLOTS



Start 10 MHz #Res BW 1 MHz

VBW 1 MHz

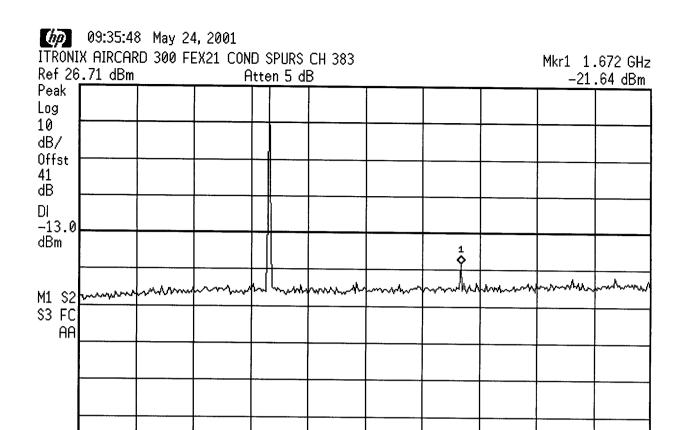
Stop 2.5 GHz Sweep 6.225 ms



Start 10 GHz \*Res BW 1 MHz

VBW 1 MHz

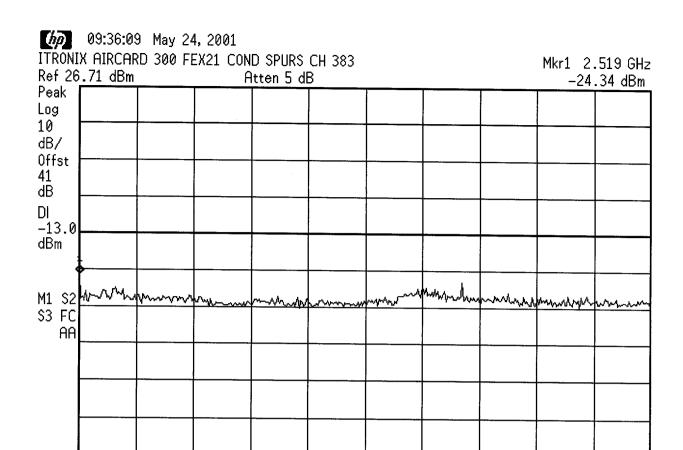
Stop 20 GHz Sweep 100 ms



Start 10 MHz #Res BW 1 MHz

VBW 1 MHz

Stop 2.5 GHz Sweep 6.225 ms



VBW 1 MHz

Stop 10 GHz

Sweep 18.75 ms

Start 2.5 GHz

\*Res BW 1 MHz

(hp) 09:36:27 May 24, 2001 ITRONIX AIRCARD 300 FEX21 COND SPURS CH 383 Mkr1 13.50 GHz Ref 26.71 dBm Atten 5 dB -25.5 dBmPeak Log 10 dB/ Offst 41 ďΒ DI -13.0 dBmM1 S2 S3 FC AA

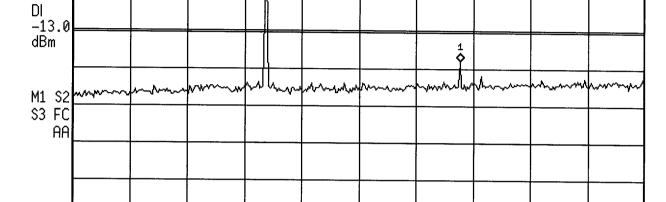
VBW 1 MHz

Stop 20 GHz

Sweep 100 ms

Start 10 GHz

#Res BW 1 MHz



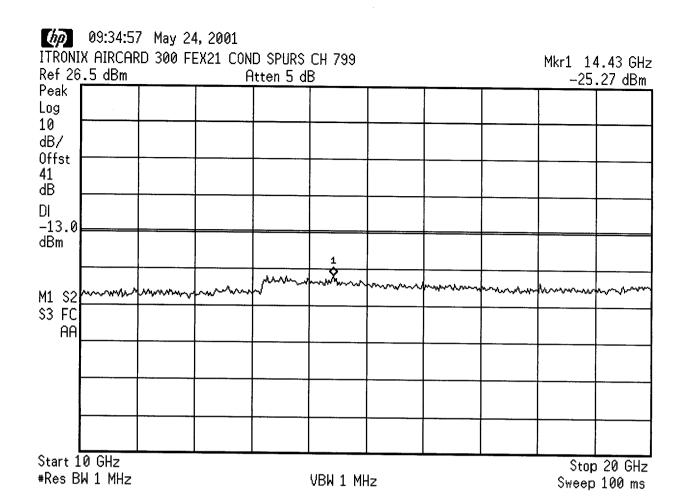
Start 10 MHz #Res BW 1 MHz

VBW 1 MHz

Stop 2.5 GHz Sweep 6.225 ms Start 2.5 GHz #Res BW 1 MHz

VBW 1 MHz

Stop 10 GHz Sweep 18.75 ms



# ATTACHMENT B – TEST SETUP PHOTOGRAPHS

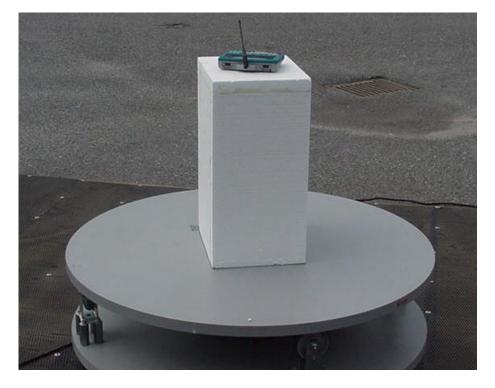
## RADIATED TEST SETUP PHOTOGRAPHS





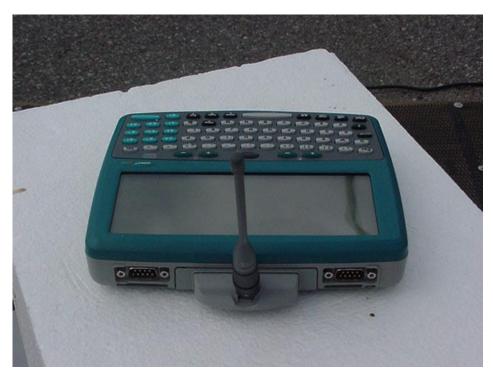
## RADIATED TEST SETUP PHOTOGRAPHS





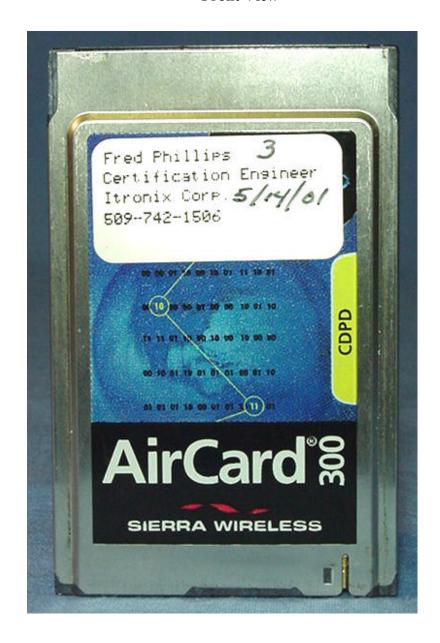
## RADIATED TEST SETUP PHOTOGRAPHS





# ATTACHMENT C – EUT PHOTOGRAPHS

## EUT PHOTOGRAPHS PCMCIA CDPD Modem Card Front View



## EUT PHOTOGRAPHS PCMCIA CDPD Modem Card Rear View



## EUT PHOTOGRAPHS Itronix FeX21 Laptop PC & Itronix Dipole Antenna





# **EUT PHOTOGRAPHS Itronix FeX21 Laptop PC**



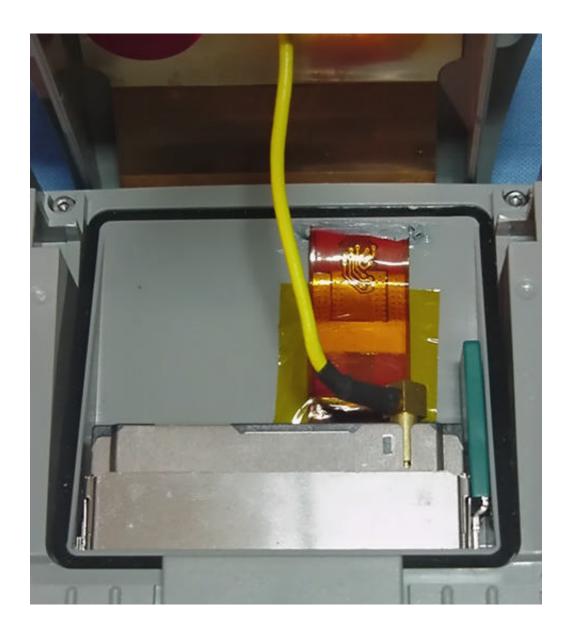




## EUT PHOTOGRAPHS Itronix FeX21 Laptop PC & Itronix Dipole Antenna



# **EUT PHOTOGRAPHS CDPD Card installed in PC**



# ATTACHMENT D – ANTENNA SPECIFICATIONS

REV	REF.	DESCRIPTION	INPT BY	APP	DATE
1		Prototype Release	SLL	SLL	5/6/98
2		Modify Antenna Gain to 0 dBd minimum (Section 4.2)	JD	SLL	6/2/98
3	1673	Add material requirement and Figure 1.	JLD	SLL	6/9/99
4	1728	Correct Section 3.5 and 3.6. Correct Figure 1	CAC	SLL	8/9/99
A	1926	Release	BAB		3/20/00

# **ITRONIX**

DOCUMENT

4PR 18 2000

# **NOTICE OF PROPRIETARY INFORMATION**

"ONTHOL

Information contained herein is proprietary and is the property of Irronix Corporation. Where furnished with a proposal, the recipient shall use it solely to evaluate the proposal. Where furnished to a customer, it shall be used solely for purposes of inspection, installation, or maintenance. Where furnished to a supplier, it shall be used solely in the performance of work contracted by this company. The information shall not be used or disclosed by the recipient for any other purpose whatsoever.

	OVALS	Unless otherwise specified dimensions are in inches. NOT TO SCALE DRAWING	ITRONIX CORPORATION S 801 STEVENS AVE P.O. BOX 0179 SPOKANE, WA 99210-0179
ORIG.	DATE		TITLE:
S. Loranger	4/23/98		
СНК.	DATE		DWG, ANTENNA,
Levelon	4-12-00	1	T5200, CDPD
ENG.	DATE 4-11-00		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
MIX	DATE		Drawing Number
Holm	4/14/00		46-0044-000
F.S.	DATE		PAGE 1 OF 5

# CHANGE RECORD

REV	SECTION	CHANGE DESCRIPTION	DATE
I	All	Prototype Release	5/6/98
2	4.2	Modify Antenna Gain to 0 dBd minimum	6/2/98
3	All	Add material requirement and Figure 1.	6/9/99
4	3.5. 3.6. Figure 1	Correct 3.5 and 3.6. Add dimensions to Figure 1	8/9/99
A	All	Release, add color coded O'Ring	3/14/00
		(Ref. P/N 32-0059-002)	3,11700
<del>-</del>			
_			

#### 1.0 **DESCRIPTION**:

CDPD Antenna, T5200.

## 2.0 APPLICABLE DOCUMENTS AND REFERENCES:

- 2.1 EIA/IEEE STANDARDS: 149-1979 for definitions of test sites and test methods.
- 2.2 ITRONIX DOCUMENTS:

Procedure, Reliability Design Guidelines....920-0806-001

- 2.3 MANUFACTURER'S SPECIFICATION:
- 2.4 O'Ring Specification: 32-0059-000

# 3.0 MECHANICAL REQUIREMENTS:

3.1 Dimensions: See Figure 1. (For Reference Only).

3.2 Material: FR-4 substrate matching network driving a length of 1/16" diameter speedometer cable.

- 3.3 Construction: End-Fed, ½ wave resonant dipole.
- 3.4 Connectors: MMCX Jack
- 3.5 Overmold Material: Polyurethane 245, 92 Durometer Shore A
- 3.6 Overmold Color: To match Lexan 70809 or RTP 300HF FRA S-87654 Dark Grey

3.7 Frequency identifier: Red (See Figure 1).

## 4.0 ELECTRICAL REQUIREMENTS:

4.1 Antenna Return Loss

	Operating Frequency	Minimum Return Loss
Transmit	824 MHz to 851 MHz	10dB (2:1VSWR)
Receive	869 MHz to 894 MHz	5dB

# 4.2 Antenna Power Gain (Directivity)

These tests are performed with the antenna connected to the T5200.

Gain Standard: The reference antenna for the gain comparison method of measurement is a thin dipole, with length adjusted to half-wavelength resonance.

Test Site: Anachoic chamber (see IEEE 149-1979 paragraph 4.5.4).

Polarization: Linear (vertical orientation).

Display Orientation: These tests are performed on the T5200. Measurements should be taken with the display enclosure in a closed position (0° from horizontal) and an open position (135° from horizontal).

Method of Measurement: The elevation of the antenna being tested is at the horizon (0° elevation from horizontal). Twelve measurements (separated by 30° rotation) are taken at each frequency.

## Performance Specification:

Test Frequency	Peak antenna gain in any direction	Average of the 12 data points
824 MHz	+4 dBd	-1.2 dBd minimum
837.5 MHz	+4 dBd	-1.2 dBd minimum
851 MHz	+4 dBd	-1.2 dBd minimum
869 MH2	+4 dBd	-2 dBd minimum
881.5 MHz	+4 dBd	-2 dBd minimum
894 MHz	+4 dBd	-2 dBd minimum

# 5.0 ENVIRONMENTAL REQUIREMENTS:

5.1 Temperature

Operating:

-30°C to +75°C

Non-Operating:

-40°C to +85C

5.2 Humidity

5% to 95% Relative Humidity, Non-Condensing

Antenna to have rugged mechanical construction to withstand the Itronix 1 meter drop test when coupled to the Itronix unit.

N/A

6.0 SAFETY REQUIREMENTS:

# 7.0 MARKING REQUIREMENTS:

The bulk shipping container must bear the Manufacturer's name and part number.

# 8.0 PACKAGING REQUIREMENTS:

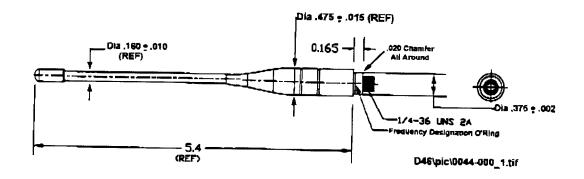
Packaging of components shall be such that no damage will occur to the component during shipment. Refer to EIA STD RS-383-A.

# 9.0 ACCEPTABILITY REQUIREMENTS:

These units must meet inspection requirements.

# 10.0 MANUFACTURER AND MANUFACTURER'S PART NUMBER:

ITRONIX P/N	MANUFACTURER	MANUFACTURER'S P/N
46-0044-001	Larsen Antenna	46-0044-001



Color Code: Black
Units are inches
TGURE 1: Antenna dimensions and Freque

FIGURE 1: Antenna dimensions and Frequency identifier location (For Reference Only)

# ATTACHMENT E – SAR MEASUREMENT REPORT