

# MEASURED DATA ON CONDUCTED AND RADIATED EMISSIONS.

a) POWER LINE CONDUCTED EMISSIONS ----- Pursuant 47 CFR 15.107.

Measured data on conducted emissions per 47CFR 15.107 on AC power lines is the subject of Technical Report No.20FOX011F, attached.

b) RADIATED EMISSIONS ----- Pursuant 47 CFR 15.109.

Measured data on radiated emissions per 47CFR 15.109 is the subject of Technical Report No.20FOX011F, attached.

# ELECTROMAGNETIC COMPATIBILITY TEST REPORT

**Company Name:** 

Foxcom Wireless Ltd.

Equipment Under Test:

Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM

Report I.D.Number:	20FOX011F.DOC
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# **EMI TEST Ltd. EMC Test Laboratory**

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#### FCC ID: OJFLITENNA009A400

# 1. General Information.

Applicant:	Foxcom Wireless Ltd.			
Applicant Address:	Ofek One Center Building B, Northern Industrial Zone Lod, Israel 71293			
Telephone:	972-8-9183818			
FAX:	972-8-9183844			
The testing was observed by the following applicant's personnel:	Mr. Shlomo Cohen			
Date of reception for testing:	December 24, 1999			
Dates of testing:	December 24, 1999; February 23, 2000			
Test Laboratory Location:	EMI TEST Ltd, Moshav Hanniel, P.O.Box 65, D.N.Lev Hasharon, Israel 42865			
Equipment Under Test:	Litenna™ Model 1900 MHz TDMA, CDMA and GSM			
Serial Numbers:	N/A			
Mode of Operation:	Down-Link Receiving and Transmitting modes			
Year of Manufacture:	1999			
Applicable EMC Specification:	Federal Communication Commission (FCC), Code of Federal Regulations 47, Ch. 1 (10-1-97 Edition) Part 15: Radio Frequency Devices, Sections 15.107 & 15.109, Class A			

## 2. Tests Summary.

EMI Test Laboratory has completed testing of Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM in accordance with the requirements of the FCC Part 15 Regulations for Class A equipment.

The EUT has been found to comply with the conducted and radiated emission requirements of the FCC Part 15 Regulations for Class A equipment:

Section 15.107:	Limits of Mains Terminal Interference Voltage (Conducted Emission) in the 0.45MHz to 30MHz frequency range.
Section 15.109:	Limits of Radiated Interference Field Strength in the 30MHz to 19,900MHz frequency range.

#### **3. Applicable Documents.**

- Federal Communication Commission (FCC), Code of Federal Regulations 47, Ch.1 (10-1-97 Edition), Part 15: Radio Frequency Devices, Sections 15.107 & 15.109.
- 3.2 FCC/OET, Laboratory Measurement Procedures MP-4, July 1987, "FCC Procedures for Measuring RF Emissions from Computing Devices".
- 3.3 FCC/Office of Science and Technology OST-55, August 1982, "Characteristics of Open Field Test Sites".
- 3.4 FCC/OET, "FCC Procedure for Measuring Electromagnetic Emissions from Digital Devices", TP-5, March 1989.
- 3.5 FCC/OET, "Understanding the FCC Regulations Concerning Computing Devices", OST-62, May 1984
- 3.6 International Special Committee On Radio Interference (CISPR) Publication 16, First Edition 1993, Part 1. "Radio disturbance and immunity measuring apparatus".
- 3.7 International Special Committee On Radio Interference (CISPR) Publication 16, First Edition 1993, Part 2. "Methods of measurement of disturbance and immunity ".
- 3.8 American National Standard, "Specifications for Electromagnetic Noise and Field Strength Instrumentation, 10KHz to 1GHz", ANSI C63.2, 1987.
- 3.9 American National Standard, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9KHz to 40GHz", ANSI C63.4, 1992.

## 4. Detailed Applicable EMC Requirements and Limits.

# 4.1 Limits of Mains Terminal Interference Voltage (Conducted Emission).

FCC Part 15 Class A Limits for mains terminal interference voltages in the frequency band 450KHz to 30MHz are:

Frequency, in MHz	Quasi-Peak (dBuV)
0.45 - 1.705	60
1.705 - 30	69.5

#### Note:

In accordance with CISPR16 Publication measurements were made across a 50 Ohm/50uH Line Impedance Stabilization Network (LISN).

## 4.2 FCC Part 15 Limits of Radiated Interference Field

The Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM operates with radio frequencies in 1930-1990MHz (Down-Link) and 1850-1910MHz (Up Link) bands. In accordance with 47 CFR.Para.15.33 (a) (1), the highest frequency of measurement range should be to the tenth harmonic of the highest fundamental frequency, or 19,900MHz.

Field strength (Radiated Emissions) for Class A equipment in the frequency range 30MHz to 8940MHz at test distance of 10 m should be less than those given in the following table:

Frequency (MHz)	Field Strength at 10 m in dBuV/m
30 - 88	39.1
88 - 216	43.5
216 - 960	46.4
Above 960	49.5

#### Notes:

1. The tighter limit shall apply at the edge between two frequency bands;

2. Distance refers to the distance in meters from measuring instrument antenna to the closest point of any part of the EUT.

### 5. Procedures for Measuring RF Emissions from EUT.

#### **5.1 DC Power line Conducted Emissions Measurements.**

Conducted emissions on the input power leads of Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM were measured in the frequency range of 450KHz to 30MHz. The measurements were performed using a spectrum analyzer, which has CISPR characteristic bandwidths and quasi-peak detector, and a Line Impedance Stabilization Network (LISN), with 50Ω/50µH (CISPR16) characteristics.

Measurements were made to determine the line-to-ground radio noise voltage which was conducted from the power-input cables that are connected to the  $\pm$ 48VDC Power Supply leads of Base Unit, and  $\pm$ 48VDC supply leads of Remote HUB Unit. EUT units were connected to the power supply through a standardized 50µH/50Ω LISN. The LISN was attached to the ground plane and bonded to it by means of low-inductance bonding strap.

Litenna<sup>TM</sup> Model 1900 MHz TDMA, CDMA and GSM was designed for table-top or rackmounted operation, and was tested as a table-top equipment. It was installed upon the 0.8m-high wooden table located in the center of a horizontal conductive ground plane with 4 x 4 meters dimensions.

Additional vertical reference ground plane with dimensions 2x2 meters was located 40cm from the EUT. This vertical ground plane was bonded to horizontal ground plane by means of low-impedance bonds with spacing of 1 meter between adjacent bonds.

The EUT was tested with unshielded power cords. The length of the power cord between the EUT and the Line Impedance Stabilization Network (LISN) was shortened to 1 meter. The excess length of the power cord was folded back and forth in a non-inductive pattern at its approximate center in a bundle 30cm to 40cm in length. The EUT and cables were positioned in a way maximizing conductive emission. No external RFI suppression devices were used during the tests.

In some cases, a pre-scan using a spectrum analyzer in Peak Detector mode was initially performed on the EUT to locate the highest emissions. If the minimum passing margin appeared to be less than 20dB, when measured in a peak detector mode, the emissions were re-measured using spectrum analyzer in quasi-peak mode. The test results of this test were recorded in the data sheets.

In case of each emission the test results were recorded and emission level was compared with the standard level.

All conducted emission tests were performed on the following supply leads:

- a) ±48VDC supply leads of Base Unit;
- b) ±48VDC supply leads of Remote HUB Unit.

#### **5.2 Radiated Emissions Measurements.**

Measurements of radiated emission were made using a spectrum analyzer with 120KHz/6dB bandwidth and peak or quasi-peak detector, and appropriate broadband linearly polarized antennas. Tests were performed in the frequency range of 30MHz to 8660MHz.

The EUT was set and operated in a manner representative of actual use. During radiated emission tests the EUT was placed on wooden table located in the center of a non-conductive rotating platform, 80cm above the horizontal metallic ground plane.

The test antenna was located 10 meters from the EUT, and precise compliance measurements were performed.

The test antenna was installed on the antenna mast in vertical polarization. When necessary, small frequency ranges (5MHz or 10MHz, typically) were spanned in order to increase resolution and make easier identification of emissions emanating from the EUT in presence of ambient noise. To locate maximum emissions from the test sample, the antenna was varied in height from 1 to 4 meters, and the EUT was rotated through 360 degrees.

For each emission the test results were recorded and emission levels were compared with the standard level. All significant emissions were recorded in tabular form.

Identical measurement procedure was repeated with antenna oriented horizontally.

During the compliance tests spectrum analyzer was set in quasi-peak detector mode.

All radiated emission tests were performed in the following operational mode:

 Transmitting Down-Link 1870MHz signal at +2dBm power level from external signal generator with Output power +11dBm;

## 6. System Test Configuration.

### 6.1 Product Description.

The Litenna<sup>™</sup> system is intended to provide the user with a network for the placement of distributed antennas to provide in-building coverage and capacity for cellular telephone services.

The Litenna<sup>™</sup> system consists of two modules:

- 1. Base Unit
- 2. Remote Hub Unit

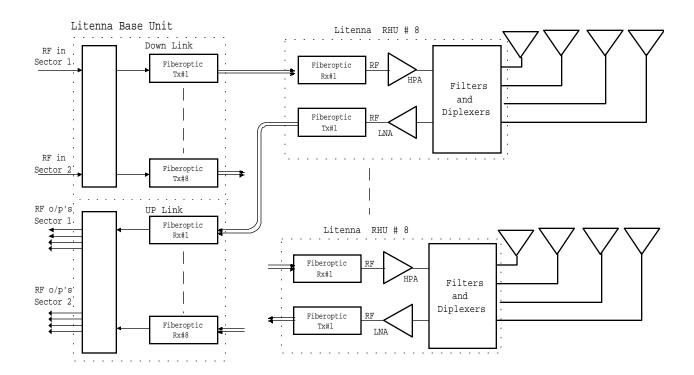
Functionally, the system behaves as a repeater, with gain/attenuation as appropriate. No signal processing/modification, or RF modulation takes place in the system. The components in the RF system are amplifiers, splitters/combines, filters, lasers and photodiodes. There are no oscillators used in the system, there are no modulators and no demodulators in the system (Base&Remote Unit).

The system is designed for the GSM services. For the downlink, the nominal total output power from the antenna ports is 11dBm (in dual band is 13dBm) per port.

On the downlink path, the Base Unit converts incoming RF signals to optical singls, transmitting these signals over fiberoptic cable to the RHU. The RHU converts the optical signal back to RF. The RHU drives four ports, powering the installed antennas.

On the uplink path, the RHU combines and converts incoming RF signals, from the four ports into optical signals, transmitting these signals back to the BU. The Base Unit converts the signals back into RF signals, and sends them to BTS.

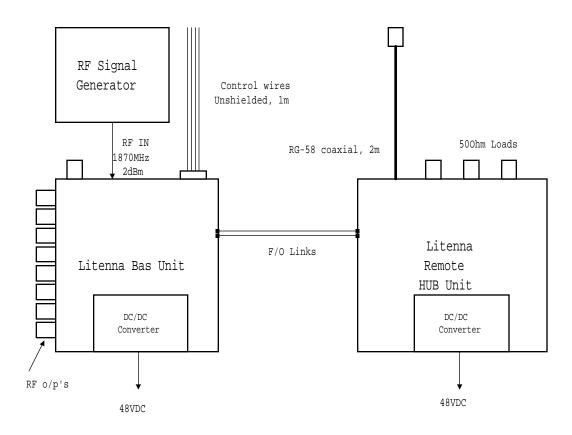
The block-diagram of the Litenna<sup>™</sup> is given in the following figure:



Litenna<sup>™</sup> Block Diagram

## 6.2 The Tested Configuration.

The Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM was tested in the configuration shown in the following figure:



## 6.3 Clock frequencies.

The Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM does not employ any digital clock oscillator.

No.	Description	Length (m)	Shielding
1	50Ohm coaxial cable from Signal Generator to the Litenna Base Unit.	1.0	85-95% braided + foil overall shield
2	50Ohm coaxial cable from the Litenna Remote Unit to 50Ohm matched load.	0.5	85-95% braided + foil overall shield
3	25 wires ribbon cable attached to D-25 connector on the Base Unit	1,0	Unshielded
4	DC Power cable to Base Unit and DC Power cable to Remote HUB Unit	3.0	Unshielded

## 6.4 Cables Used During the Tests:

## 6.5 Modifications Required for Compliance.

The Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM in its original design complied with the conducted and radiated emission requirements of FCC Part 15 for Class A equipment. Therefore no corrective actions were required.

# 7. Description of the Test Site.

Location:	Moshav Hanniel, P.O.Box 65, D.N.Lev Hasharon, 42865, Israel
Phone:	(972)-9-8987382
FAX:	(972)-9-8987383
Open Site Ranges:	3 and 10 meters
Turntable:	<ul><li>2.1 x 1.6 meter with maximum loading 1500kg, distant actuation.</li><li>The turntable and the tested equipment are environmentally protected.</li></ul>
Antenna Mast:	1 to 4 meter
Supply Voltages:	230VAC/50Hz, 3 Phases, 16A from each phase; 115VAC/50Hz, 3 Phases, 32A from each phase; up to 50VDC, 30A max

# 8. List of Test Equipment Used.

No.	Description	Description Manufacturer and Model Number			
1.	Spectrum Analyzer 9KHz to 2.2GHz	Anritsu MS2601B/K	MT81431		
2	Spectrum Analyzer	HP8563E	3821A09026		
3	<b>RF Signal Generator</b>	HP8656A	N/A		
4	Antenna, Biconical, 20MHz to 200MHz	EMCO Model 3110B	1813		
5	Antenna, Log-Periodic, 200MHz to 1GHz	og-Periodic,			
6	Antenna Double Ridged Horn	EMCO Model 3115	4272		
7	Amplifier 10MHz to 500MHz	MITEQ Model AU-1114	323214		
8	Amplifier, 500MHz to 2GHz	MITEQ Model AM-3A-0520	329110		
9	Amplifier 30dB	Microwave Technology Ltd. Model SAO-4868	14026		
10	Plotter	HP,Model 7440A-002	2929A17765		
11	LISN, 9KHz to 100MHz	EMCO Model 3825/2	2205		

EMI Test Laboratory test equipment is calibrated on regular basis according to equipment manufacturer requirements.

## 9. Conducted Emission Data.

The final level of the conducted emission in  $dB\mu V$ , is calculated by taking the reading from the spectrum analyzer and taking into account the LISN Correction Factor and the Cable Loss.

To convert the data from  $dB\mu V$  to  $\mu V$ , the following conversion is applied:

 $dB\mu V = 20log(\mu V)$  $\mu V = Inverse log(dB\mu V/20)$ 

## **10. Radiated Emission Data.**

The Final Level, expressed in dBuV/m, is calculated by taking the reading from the spectrum analyzer (Vrec, dBuV), subtracting the preamplifier gain (Gain, dB) and adding the Antenna Correction Factor (AF, dB/m) and Cable Loss Factor (CF, dB). This result then was subtracted from the FCC Part 15 Standard limit for Class A equipment to yield the Safety Margin (in dB) given in tabular form in data sheets.

#### Example:

#### Suppose that:

The test frequency F = 118MHz; Spacing between the test antenna and the EUT is 10 meters; The level detected by spectrum analyzer Vrec =  $58.9dB\mu V$ ; Preamplifier gain Gain(dB) = 35dB; The antenna factor AF(dB/m) = 10.8dB at 118 MHz; The cable loss CL(dB) = 1.6dB.

The field strength can be calculated using the following formula:

 $E(dB\mu V/m) = Vrec(dB\mu V) - Gamp(dB) + AF(dB/m) + CL(dB) =$ 

 $= 58.9 - 35 + 10.8 + 1.6 = 36.3 (dB\mu V/m).$ 

This level is 7.2dB less than the FCC Part 15 standard limit (43.5dB $\mu$ V/m) for Class A devices at frequency 118MHz.

#### **11. Results of Conducted Emissions Tests.**

#### Conducted Emission on DC Power Cord of the DC/DC Converter.

Levels of conducted emissions were measured on the following supply leads: a)  $\pm 48$ VDC of the Base Unit (see Figs. 1, Tables 1); c)  $\pm 48$ VDC of the Remote Hub Unit (see Figs. 2, Tables 2).

All measurements were performed in the 450KHz to 30MHz frequency range: The both  $\pm$ 48VDC were fed from PM-12CD111 DC/DC Converter, PWR-MATE Ltd. manufactured.

#### Summary of Conducted Emission Tests.

The conducted emissions were tested on  $\pm$ 48VDC leads from DC/DC Converter PM-12CD111 of the Litenna<sup>TM</sup> Model 1900 MHz TDMA, CDMA and GSM in the 450KHz to 30MHz frequency range.

In summary, the Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM complied with the conducted emission requirements of FCC Part 15 Standard for Class A equipment.

#### 12. Results of Radiated Emission Tests.

Radiated emission tests were conducted in the 30MHz to 1000MHz frequency range.

During emission test harmonic frequencies in the 30MHz to 1000MHz frequency range from current frequency of the Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM were not detected.

#### Summary of Radiated Emission Tests.

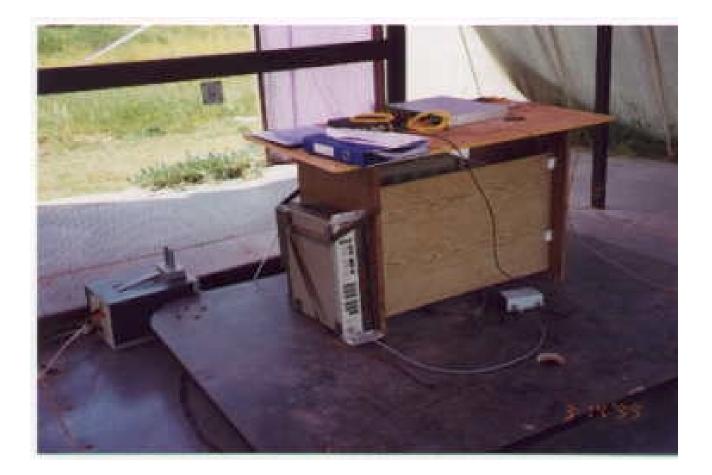
The Litenna<sup>™</sup> Model 1900 MHz TDMA, CDMA and GSM meets radiated electric field requirements of FCC Part 15 Regulations for Class A equipment.

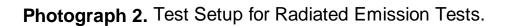
#### 13. Signatures.

Test measurements were Dr.Alexander Axelrod performed by: (EMI Test Ltd.) 20 February 2000 (Date, Signature) Test report was prepared by: Dr Alexander Axelrod (EMI Test Ltd.) 20 February Down (Date, Signature) Approved by: Dr.Alexander Axeirod (EMI Test Ltd.) Ry Tebruary 2000 (Date, Signature) The testing was observed by: Mr.Shlomo Cohen (Foxcom Wireless Ltd.) 20 February 2000 (Date, Signature)

# 14. Setup Photographs.

Photograph 1. Test Setup for Conducted Emission Tests.







# **Appendix A. Conducted Emission Data**

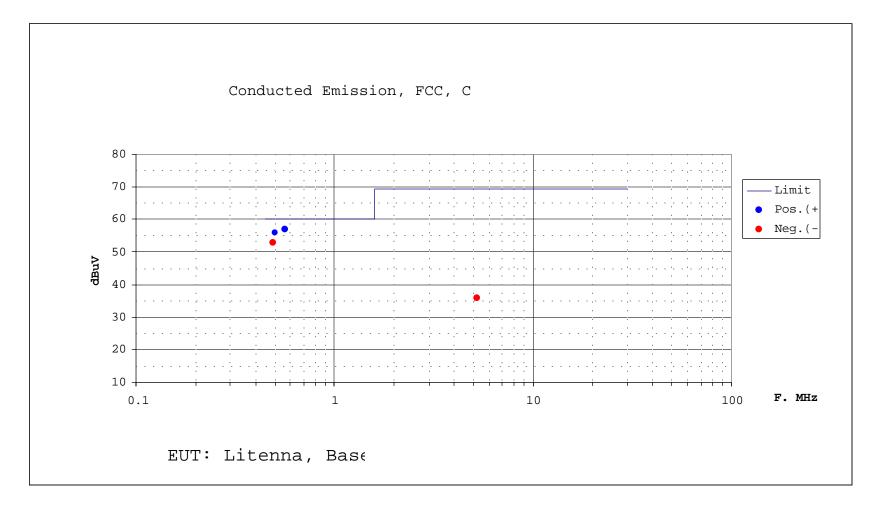


Fig. 1 Conducted Emission vrs. FCC Class A Standard Limit, ±48VDC Power Supply of the Base Unit, Q.P. Detector.

Frequency, MHz	Leads	Vmeas, dBuV	LISN CF, dB	Cable Loss, dB	Econd, dBuV	Estand, dBuV	Safety Margins, dB	Result
0.493	-	52.60	0.01	0.1	52.71	60.0	-7.3	Pass
0.500	+	55.90	0.01	0.1	56.01	60.0	-4.0	Pass
0.565	+	56.90	0.01	0.1	57.01	60.0	-3.0	Pass
5.230	-	35.74	0.01	0.1	35.85	69.5	-33.7	Pass

Table 1. Conducted Emission in 0.45MHz...30MHz Range ±48VDC Power Supply of the Base Unit, Q.P. Detector

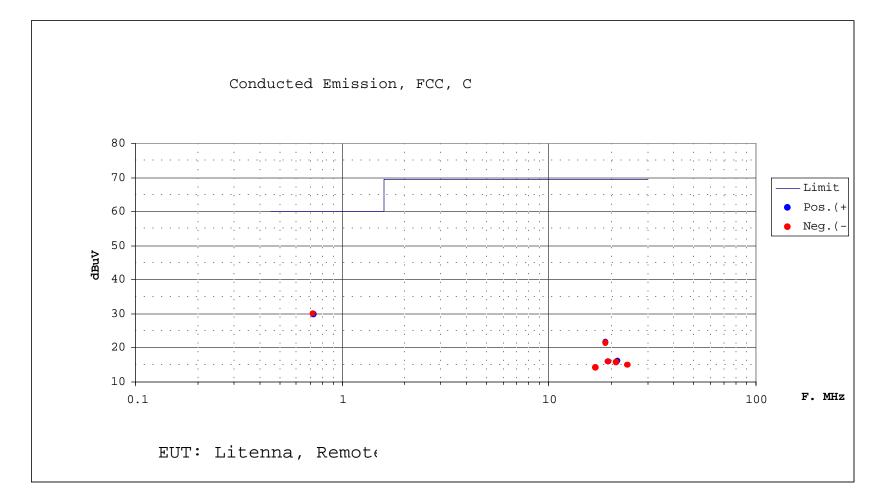


Fig. 2 Conducted Emission vrs. FCC Class A Standard Limit, ±48VDC Power Supply of the Remote Unit, Q.P. Detector.

#### FCC ID: OJFLITENNA009A400

Frequency, MHz	Leads ±48VDC	Vmeas, dBuV	LISN CF, dB	Cable Loss, dB	Econd, dBuV	Estand, dBuV	Safety Margins, dB	Result
0.72	-	29.8	0.01	0.1	29.91	60.0	-30.1	Pass
0.73	+	29.7	0.01	0.1	29.81	60.0	-30.2	Pass
16.91	-	13.8	0.01	0.1	13.91	69.5	-55.6	Pass
18.71	-	21.2	0.01	0.1	21.31	69.5	-48.2	Pass
18.72	+	21.3	0.01	0.1	21.41	69.5	-48.1	Pass
19.42	-	15.7	0.01	0.1	15.81	69.5	-53.7	Pass
19.45	+	15.8	0.01	0.1	15.91	69.5	-53.6	Pass
21.33	-	15.5	0.01	0.1	15.61	69.5	-53.9	Pass
21.39	+	15.9	0.01	0.1	16.01	69.5	-53.5	Pass
24.11	-	14.8	0.01	0.1	14.91	69.5	-54.6	Pass

Table 2. Conducted Emission in 0.45MHz...30MHz Range, ±48VDC Power Supply of the Remote Unit, Q.P. Detector