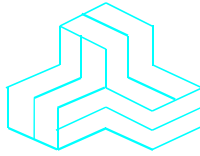


# ENGINEERING TEST REPORT



**Exciter**  
**Model No.: EX23G**

**FCC ID: PQG-EX23G**

*Applicant:*

**Lyngsoe Systems Ltd.**  
5570 Kennedy Road, Unit B  
Mississauga, Ontario  
Canada L4Z 2A9

**In Accordance With**  
**Federal Communications Commission (FCC)**  
**Part 15, Subpart C, Sections 15.209 & 15.231**  
**Low Power Transmitter & Momentarily Operation (125 kHz & 433.92 MHz)**

**UltraTech's File No.: LYI-025F15C231**

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



Date: July 20, 2006

Report Prepared by: Dan Huynh

Tested by: Hung Trinh

Issued Date: July 20, 2006

Test Dates: May 17 - June 18, 2006

- *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

|                                      |                                                                                                                                                                                                                                                                                                              |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference:</b>                    | FCC Part 15, Subpart C, Sections 15.209 and 15.231                                                                                                                                                                                                                                                           |
| <b>Title:</b>                        | Code of Federal Regulations (CFR), Title 47, Telecommunication - Part 15                                                                                                                                                                                                                                     |
| <b>Purpose of Test:</b>              | To gain FCC Equipment Authorization for a Low Power Transmitter operating at 125 kHz and Section 15.231 - Momentarily Operation at 433.92 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          | 2005                             | 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<br>+A1<br>EN 55022 | 2003-04-10<br>2004-10-14<br>2003 | 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.<br>Part 1-1: Measuring Apparatus                                                  |
| CISPR 16-2-1                | 2003                             | Specification for radio disturbance and immunity measuring apparatus and methods.<br>Part 2-1: Conducted disturbance measurement                                    |
| CISPR 16-2-3                | 2003                             | Specification for radio disturbance and immunity measuring apparatus and methods.<br>Part 2-3: Radiated disturbance measurement                                     |

## EXHIBIT 2: PERFORMANCE ASSESSMENT

### 2.1. CLIENT INFORMATION

| APPLICANT              |                                                                                                                  |
|------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Name:</b>           | Lyngsoe Systems Ltd.                                                                                             |
| <b>Address:</b>        | 5570 Kennedy Road, Unit B<br>Mississauga, Ontario<br>Canada L4Z 2A9                                              |
| <b>Contact Person:</b> | Donald Ferguson<br>Phone #: 905-501-1533 ext 221<br>Fax #: 905-501-1538<br>Email Address: dfe@lyngsoesystems.com |

| MANUFACTURER           |                                                                                                                  |
|------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Name:</b>           | Lyngsoe Systems Ltd.                                                                                             |
| <b>Address:</b>        | 5570 Kennedy Road, Unit B<br>Mississauga, Ontario<br>Canada L4Z 2A9                                              |
| <b>Contact Person:</b> | Donald Ferguson<br>Phone #: 905-501-1533 ext 221<br>Fax #: 905-501-1538<br>Email Address: dfe@lyngsoesystems.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>                    | Lyngsoe Systems Ltd.                                                                                                                   |
| <b>Product Name:</b>                  | Exciter                                                                                                                                |
| <b>Model Name or Number:</b>          | EX23G                                                                                                                                  |
| <b>Serial Number:</b>                 | Test sample                                                                                                                            |
| <b>Type of Equipment:</b>             | Low power transmitter & momentarily operated device                                                                                    |
| <b>Input Power Supply Type:</b>       | 22 Vac                                                                                                                                 |
| <b>Primary User Functions of EUT:</b> | The main function of the Exciter EX23G is to generate the LF field, which will wake up tags used in postal quality monitoring systems. |

---

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File #: LYI-025F15C231  
July 20, 2006

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## 2.3. EUT'S TECHNICAL SPECIFICATIONS

| TRANSMITTER                     |                                                                                                                                                                                                                                                                       |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment Type:                 | Base station                                                                                                                                                                                                                                                          |
| Intended Operating Environment: | Commercial, light industry & heavy industry                                                                                                                                                                                                                           |
| Power Supply Requirement:       | 22 Vac $\pm$ 10%, 0.5 A                                                                                                                                                                                                                                               |
| RF Output Power Rating:         | 111.63 dB $\mu$ V/m peak at 10m distance                                                                                                                                                                                                                              |
| Operating Frequency Range:      | 125 kHz & 433.92 MHz                                                                                                                                                                                                                                                  |
| Duty Cycle:                     | 50 %                                                                                                                                                                                                                                                                  |
| 20 dB Bandwidth:                | 42.7 kHz                                                                                                                                                                                                                                                              |
| Modulation Type:                | OOK (LF) & FSK (UHF)                                                                                                                                                                                                                                                  |
| Oscillator Frequencies:         | 20.000 MHz, 13.560 MHz                                                                                                                                                                                                                                                |
| Antenna Connector Type:         | Integral                                                                                                                                                                                                                                                              |
| Antenna Description:            | Manufacturer: Lyngsoe Systems<br>Type: Two loops 40 x 40cm, 15 turns each for 125 kHz;<br>PCB loop Antenna for 433.92 MHz<br>Model: N/A<br>Frequency Range: 125 kHz; 433.92 MHz<br>Gain: Not applicable for near field operation @ 125 kHz;<br>-17.2 dBi @ 433.92 MHz |

## 2.4. LIST OF EUT'S PORTS

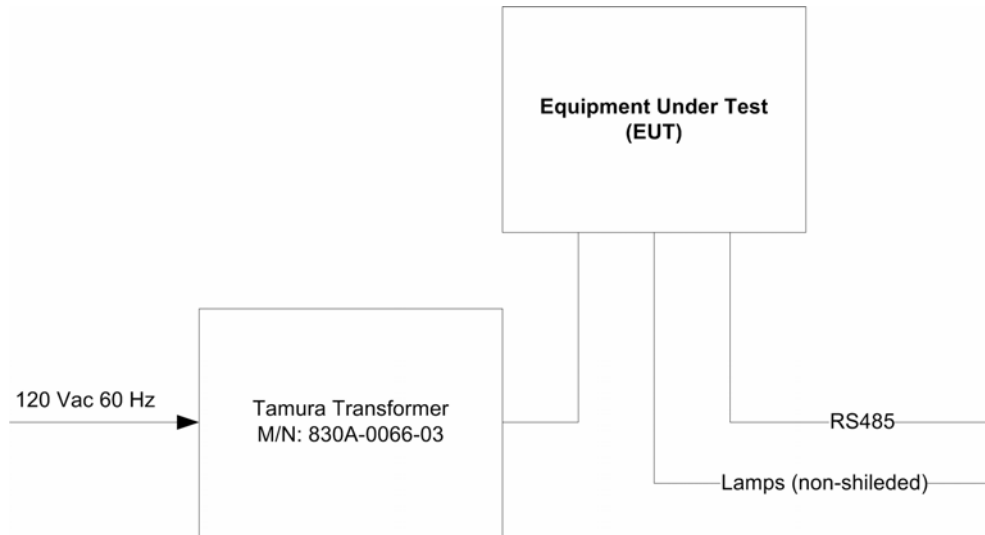
| Port Number | EUT's Port Description | Number of Identical Ports | Connector Type                               | Cable Type (Shielded/Non-shielded)                       |
|-------------|------------------------|---------------------------|----------------------------------------------|----------------------------------------------------------|
| 1           | Power Supply           | 2                         | Header,3Pins,4.2mm, RA Molex 39-30-3035      | Provo 92234-30 18/16 2/c tin Shld 105C CSA or equivalent |
| 2           | RS485 communication    | 2                         | Mod Jack,8-8,SE,LP,Shld,RJ45 - Tyco 555153-1 | Any CAT5 Ethernet cable                                  |
| 3           | Lamps                  | 1                         | Header,3Pins,3.0mm, RA Molex 43650-0304      | Non-shielded                                             |

## 2.5. ANCILLARY EQUIPMENT

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

No ancillary equipment.

## 2.6. TEST SETUP BLOCK DIAGRAM



## 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: | 22 Vac  |

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

|                                  |                                                                                                                      |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Operating Modes:</b>          | The EUT was configured for continuous transmission for the duration of testing.                                      |
| <b>Special Test Software:</b>    | N/A                                                                                                                  |
| <b>Special Hardware Used:</b>    | N/A                                                                                                                  |
| <b>Transmitter Test Antenna:</b> | The EUT was tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment. |

| Transmitter Test Signals                                                        |                                    |
|---------------------------------------------------------------------------------|------------------------------------|
| <b>Frequency Band(s):</b>                                                       | 125 kHz and 433.92 MHz             |
| <b>Test Frequency(ies):</b>                                                     | 125 kHz and 433.92 MHz             |
| <b>RF Power Output:</b><br>(measured maximum output power at antenna terminals) | 111.63 dBμV/m peak at 10m distance |
| <b>Normal Test Modulation:</b>                                                  | OOK and FSK                        |
| <b>Modulating Signal Source:</b>                                                | Internal                           |

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July 20, 2006

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

## 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 Section 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 File No.: IC2049-1). Last date of site calibration: June 20, 2005.

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

| FCC Section(s)                | Test Requirements                                                                   | Compliance (Yes/No) |
|-------------------------------|-------------------------------------------------------------------------------------|---------------------|
| 15.203                        | Antenna Requirement                                                                 | Yes                 |
| 15.207(a)                     | AC Powerline Conducted Emissions                                                    | Yes                 |
| 15.231(a)                     | Provisions for Periodic Operation                                                   | Yes                 |
| 15.231(b)<br>15.109<br>15.209 | Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious Emissions       | Yes                 |
| 15.231(c)                     | 20 dB Bandwidth                                                                     | Yes                 |
| 15.231(d)                     | Frequency Tolerance for Devices Operating within the Frequency Band 40.66-40.70 MHz | Not applicable      |

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

None.



## **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 Ultratech's test procedures 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.

### **5.4. ANTENNA REQUIREMENTS [47 CFR § 15.203]**

#### **5.4.1. Requirements**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

**Notes:** This requirement does not apply to carrier current devices operated under the provisions of @ 15.211, 15.213, 15.217, 17.219 or 15.221.

#### **5.4.2. Engineering Analysis**

The antenna is an integral part of the EUT; it is soldered onto the radio printed circuit board and located inside the enclosure.

## 5.5. AC POWERLINE CONDUCTED EMISSION [47 CFR 15.207(a)]

### 5.5.1. Limit

The equipment shall meet the limits of the following table:

| Frequency of emission<br>(MHz) | Conducted Limits (dB $\mu$ V) |           |
|--------------------------------|-------------------------------|-----------|
|                                | Quasi-peak                    | Average   |
| 0.15–0.5 .....                 | 66 to 56* .....               | 56 to 46* |
| 0.5–5 .....                    | 56 .....                      | 46        |
| 5–30 .....                     | 60 .....                      | 50        |

\*Decreases linearly with the logarithm of the frequency

### 5.5.2. Method of Measurements

Refer to ANSI C63.4.

### 5.5.3. Test Equipment List

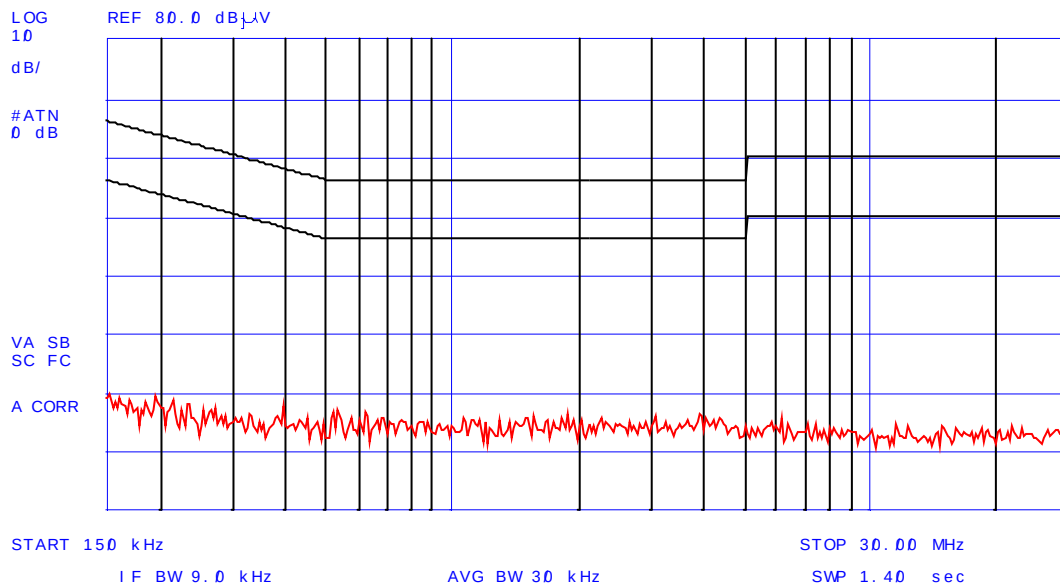
| Test Instruments                   | Manufacturer     | Model No. | Serial No. | Frequency Range                         |
|------------------------------------|------------------|-----------|------------|-----------------------------------------|
| Spectrum Analyzer/<br>EMI Receiver | Hewlett Packard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

## 5.5.4. Test Data

Plot 5.5.4.1  
AC Powerline Conducted Emission  
Line Voltage: 120VAC 60Hz  
Line Tested: L1

HP

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG



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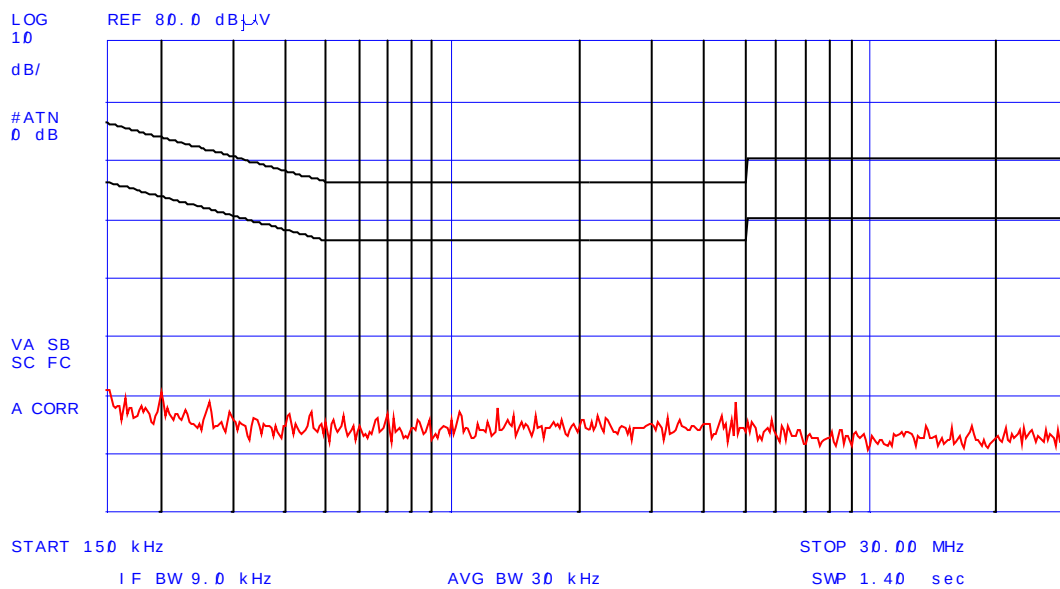
File #: LYI-025F15C231  
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Plot 5.5.4.2  
AC Powerline Conducted Emission  
Line Voltage: 120VAC 60Hz  
Line Tested: L2

HP

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG



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## 5.6. PROVISIONS FOR PERIODIC TRANSMITTERS [47 CFR 15.231(a)]

### 5.6.1. Engineering Analysis

| FCC Rules    | FCC Provisions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Analysis on Compliance                                                                  |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 15.231(a)    | The intentional radiator restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal.                                                                                                                                                                                                | The EUT transmission contains a fixed recognition code only, it does not transmit data. |
| 15.231(a)(1) | A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.                                                                                                                                                                                                                                                                                                                                        | N/A                                                                                     |
| 15.231(a)(2) | A transmitter activated automatically shall cease transmission within 5 seconds after activation.                                                                                                                                                                                                                                                                                                                                                                                                 | The transmitter is automatically deactivated within 1 second.                           |
| 15.231(a)(3) | Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour. | N/A                                                                                     |
| 15.231(a)(4) | Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.                                                                                                                                                                                                                                                                   | N/A                                                                                     |
| 15.231(a)(5) | Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.                                                                                              | N/A                                                                                     |

## 5.7. TRANSMITTER RADIATED EMISSIONS [47 CFR §§ 15.231(b), 15.209 & 15.205]

### 5.7.1. Limits

| Fundamental frequency (MHz) | Field strength of fundamental (microvolts/meter) | Field strength of spurious emissions (microvolts/meter) |
|-----------------------------|--------------------------------------------------|---------------------------------------------------------|
| 40.66-40.70.                | 2,250                                            | 225                                                     |
| 70-130                      | 1,250                                            | 125                                                     |
| 130-174                     | <sup>1</sup> 1,250 to 3,750                      | <sup>1</sup> 125 to 375                                 |
| 174-260                     | 3,750                                            | 375                                                     |
| 260-470                     | <sup>1</sup> 3,750 to 12,500                     | <sup>1</sup> 375 to 1,250                               |
| Above 470                   | 12,500                                           | 1,250                                                   |

<sup>1</sup> Linear interpolations with frequency F in MHz:

For 130-174 MHz: FS (microvolts/m) = (56.82 x F) - 6136

For 260-470 MHz: FS (microvolts/m) = (41.67 x F) - 7083.

- (1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
- (2) Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in Section 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of Section 15.205 shall be demonstrated using the measurement instrumentation specified in that section.

### 47 CFR 15.205(a) Restricted bands of operation

| MHz                      | MHz                 | MHz           | GHz              |
|--------------------------|---------------------|---------------|------------------|
| 0.090-0.110              | 16.42-16.423        | 399.9-410     | 4.5-5.15         |
| <sup>1</sup> 0.495-0.505 | 16.69475-16.69525   | 608-614       | 5.35-5.46        |
| 2.1735-2.1905            | 16.80425-16.80475   | 960-1240      | 7.25-7.75        |
| 4.125-4.128              | 25.5-25.67          | 1300-1427     | 8.025-8.5        |
| 4.17725-4.17775          | 37.5-38.25          | 1435-1626.5   | 9.0-9.2          |
| 4.20725-4.20775          | 73-74.6             | 1645.5-1646.5 | 9.3-9.5          |
| 6.215-6.218              | 74.8-75.2           | 1660-1710     | 10.6-12.7        |
| 6.26775-6.26825          | 108-121.94          | 1718.8-1722.2 | 13.25-13.4       |
| 6.31175-6.31225          | 123-138             | 2200-2300     | 14.47-14.5       |
| 8.291-8.294              | 149.9-150.05        | 2310-2390     | 15.35-16.2       |
| 8.362-8.366              | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4        |
| 8.37625-8.38675          | 156.7-156.9         | 2690-2900     | 22.01-23.12      |
| 8.41425-8.41475          | 162.0125-167.17     | 3260-3267     | 23.6-24.0        |
| 12.29-12.293             | 167.72-173.2        | 3332-3339     | 31.2-31.8        |
| 12.51975-12.52025        | 240-285             | 3345.8-3358   | 36.43-36.5       |
| 12.57675-12.57725        | 322-335.4           | 3600-4400     | ( <sup>2</sup> ) |
| 13.36-13.41.             |                     |               |                  |

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

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- (3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits a higher field strength.

**47 CFR 15.209(a) General Field Strength Limits**

| Frequency (MHz)                                                                                                                                                                                                                                                                                                                                  | Field strength (microvolts/meter) | Measurement distance (meters) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------------|
| 0.009–0.490                                                                                                                                                                                                                                                                                                                                      | 2400/F(kHz)                       | 300                           |
| 0.490–1.705                                                                                                                                                                                                                                                                                                                                      | 24000/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                             |
| ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76– 88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241. |                                   |                               |

### 5.7.2. Method of Measurements

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/<br>EMI Receiver         | Rohde & Schwarz | FSEK20/B4/B21 | 834157/005 | 9 kHz – 40 GHz<br>with external mixer |
| EMI Receiver System<br>/ Spectrum Analyzer | Hewlett Packard | HP 8546A      | 3520A00248 | 9KHz-5.6GHz,<br>50 Ohms               |
| Microwave Amplifier                        | Hewlett Packard | HP 83017A     | 311600661  | 1 GHz to 26.5 GHz                     |
| Loop Antenna                               | EMCO            | 6502          | 2611       | 10 kHz - 30 MHz                       |
| Biconilog Antenna                          | EMCO            | 3143          | 1029       | 20 MHz - 2 GHz                        |
| Horn Antenna                               | EMCO            | 3155          | 9701-5061  | 1 GHz - 18 GHz                        |

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## 5.7.4. Test Data

### 5.7.4.1. For Fundamental Frequency at 125 kHz

| Frequency (MHz)                                                                                                               | RF Peak Level @10m (dBμV/m) | <sup>(1)</sup> RF Avg Level (dBμV/m) | Antenna Plane | <sup>(2)</sup> Limit @10m 15.209 (dBμV/m) | Margin (dB) |
|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------|---------------|-------------------------------------------|-------------|
| 0.125                                                                                                                         | 109.93                      | 103.91                               | 0 degree      | 114.3                                     | -10.39      |
| 0.125                                                                                                                         | 111.63                      | 105.61                               | 90 degree     | 114.3                                     | -8.69       |
| The emissions were scanned from 10 kHz to 1 GHz and all spurious emissions were more than 20 dB below the permissible limits. |                             |                                      |               |                                           |             |

#### Remarks:

- (1) Duty Cycle = 0.50 (Tx on = Tx off)

$$\text{Peak-to-Average factor} = 20 \cdot \log(0.50) = -6.02 \text{ dB}$$

- (2) The 300m limit was converted to 10 m using cube factor (x) as it was found by measurements as follows:

- Maximum E-field at 10 meters distance: 111.63 dBμV/m (vertical)
- Maximum E-field at 20 meters distance: 93.79 dBμV/m (vertical)

Difference of measurement between 10 m & 20 m:  $\Delta E = 111.63 - 93.79 = 17.84 \text{ dB}$   
 $\Delta E = 20 \cdot \log(20/10)^x = 17.84 \text{ dB}$  or  $x = 17.84 / (20 \cdot \log(20/10)) = 2.96$

Therefore the limit for 125 kHz at 10 meters were calculated as:

$$\text{Limit}_{10\text{m}} = \text{Limit}_{300\text{m}} + 20 \cdot \log(300/10)^3 = 20 \cdot \log(2400/125) + 60 \cdot \log(300/10) = 114.3 \text{ dBμV/m}$$



#### 5.7.4.2. For Fundamental Frequency at 433.92 MHz

The emissions were scanned from 30 MHz to 5000 MHz and all significant emissions were recorded.

Note:

- For portable transmitter, EUT was placed in three different orthogonal positions for searching maximum field strength level.
- In the restricted band per FCC 15.205: § 15.209 (a) limits applied
- Outside the restricted band per FCC 15.205: § 15.231 (b) limits or § 15.209 (a) applied, whichever allows higher field strength emission.

| Frequency (MHz) | Peak E-Field @ 3m (dBµV/m) | Average E-Field @ 3m (dBµV/m) | Antenna Plane (H/V) | § 15.231 (b) Limits @ 3m (dBµV/m) | § 15.209 (a) Limits @ 3m (dBµV/m) | Margin (dB) |
|-----------------|----------------------------|-------------------------------|---------------------|-----------------------------------|-----------------------------------|-------------|
| 433.92          | 80.39                      | 60.68                         | V                   | 80.8                              | --                                | -20.1       |
| 433.92          | 81.45                      | 61.74                         | H                   | 80.8                              | --                                | -19.1       |
| 2169.60         | 61.46                      | 41.75                         | V                   | 60.8                              | 54.0                              | -19.1       |
| 2169.60         | 62.90                      | 43.19                         | H                   | 60.8                              | 54.0                              | -17.6       |
| 2603.52         | 65.65                      | 45.94                         | V                   | 60.8                              | 54.0                              | -14.9       |
| 2603.52         | 67.80                      | 48.09                         | H                   | 60.8                              | 54.0                              | -12.7       |
| 3037.44         | 60.51                      | 40.80                         | V                   | 60.8                              | 54.0                              | -20.0       |
| 3471.36         | 73.63                      | 53.92                         | V                   | 60.8                              | 54.0                              | -6.9        |
| 3471.36         | 72.83                      | 53.12                         | H                   | 60.8                              | 54.0                              | -7.7        |
| *3905.28        | 61.07                      | 41.36                         | V                   | 60.8                              | 54.0                              | -12.6       |
| *3905.28        | 57.68                      | 37.97                         | H                   | 60.8                              | 54.0                              | -16.0       |
| *4339.20        | 63.04                      | 43.33                         | V                   | 60.8                              | 54.0                              | -10.7       |
| *4339.20        | 64.60                      | 44.89                         | H                   | 60.8                              | 54.0                              | -9.1        |

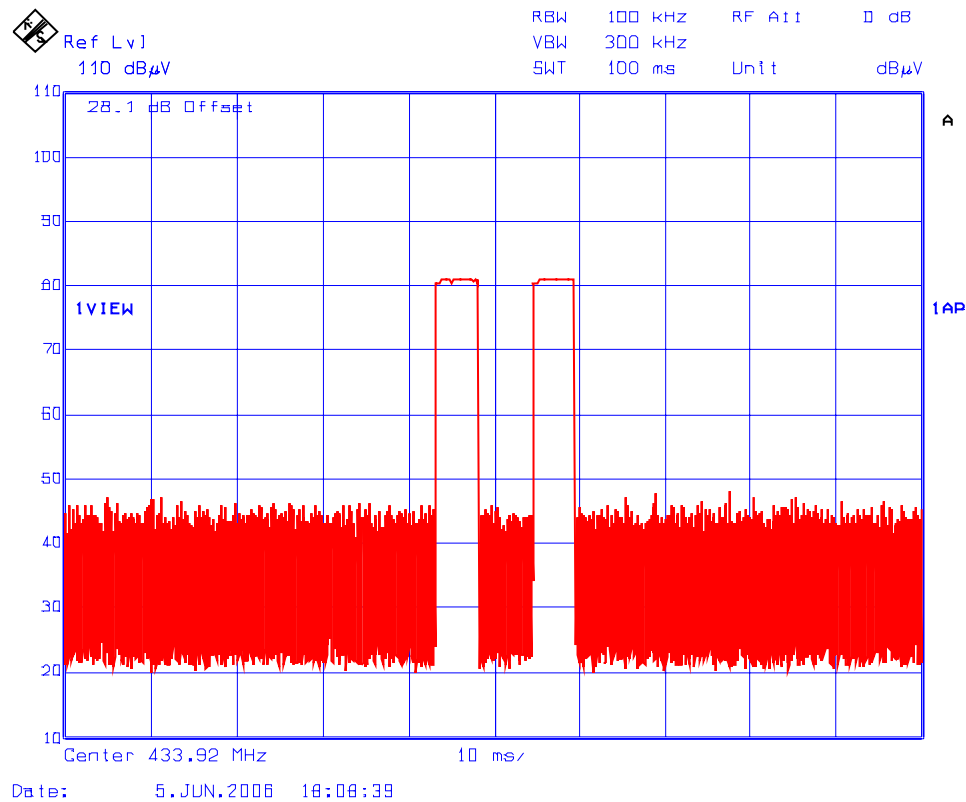
\* Emissions within the restricted bands.

Remarks:

- Field strength limit of the fundamental at 433.92 MHz =  $20 \log [(41.67 \times 433.92) - 7083] = 80.8 \text{ dB}\mu\text{V/m}$
- Spurious emissions limit is 20 dB below fundamental limit.
- Duty Cycle Measurements:  $2 * 5.170341 \text{ msec} / 100 \text{ msec} * 100 = 10.34 \%$
- Peak-Average Conversion factor =  $20 * \log(2 * 5.170341/100) = -19.71 \text{ dB}$

See the following plots for detailed duty cycle measurements.

Plot 5.7.4.2.1: Duty Cycle in 100 ms  
Tx Frequency: 433.92 MHz



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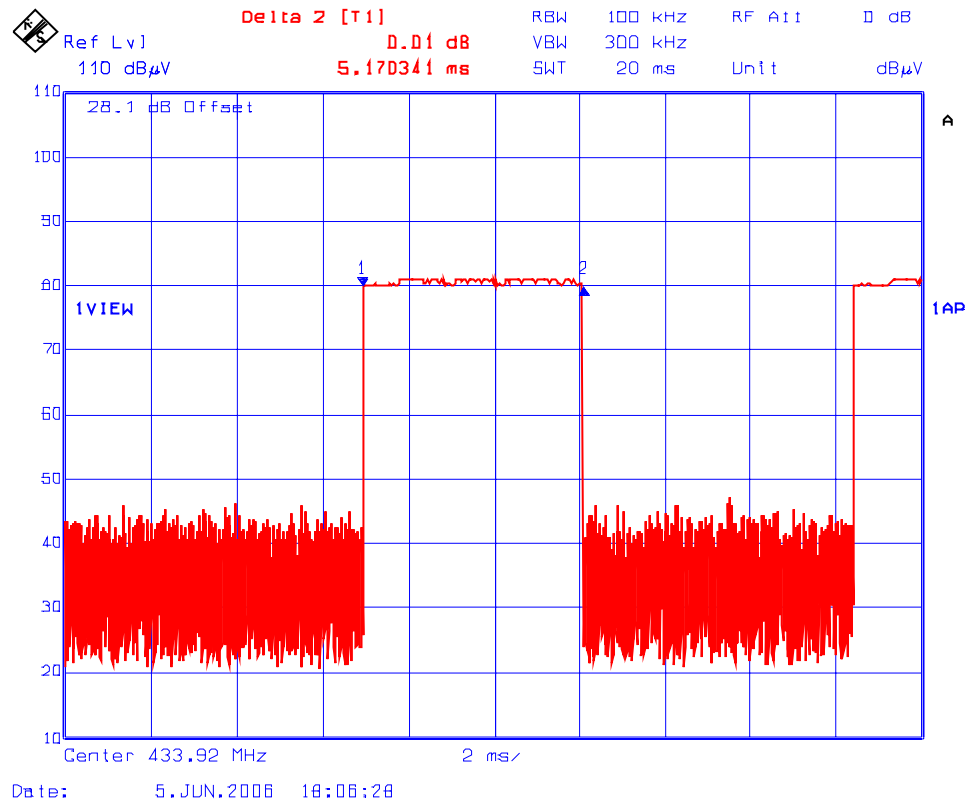
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Plot 5.7.4.2.2: Duty Cycle  
Pulse Length Measurement  
Tx Frequency: 433.92 MHz



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## 5.8. 20 dB BANDWIDTH [47 CFR 15.231(c)]

### 5.8.1. Limits

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

### 5.8.2. Method of Measurements

The measurements were performed in accordance with Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4:2003.

The transmitter output was loosely coupled to the spectrum analyzer through a receiving antenna. 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, Section 13.1.7

### 5.8.3. Test Equipment List

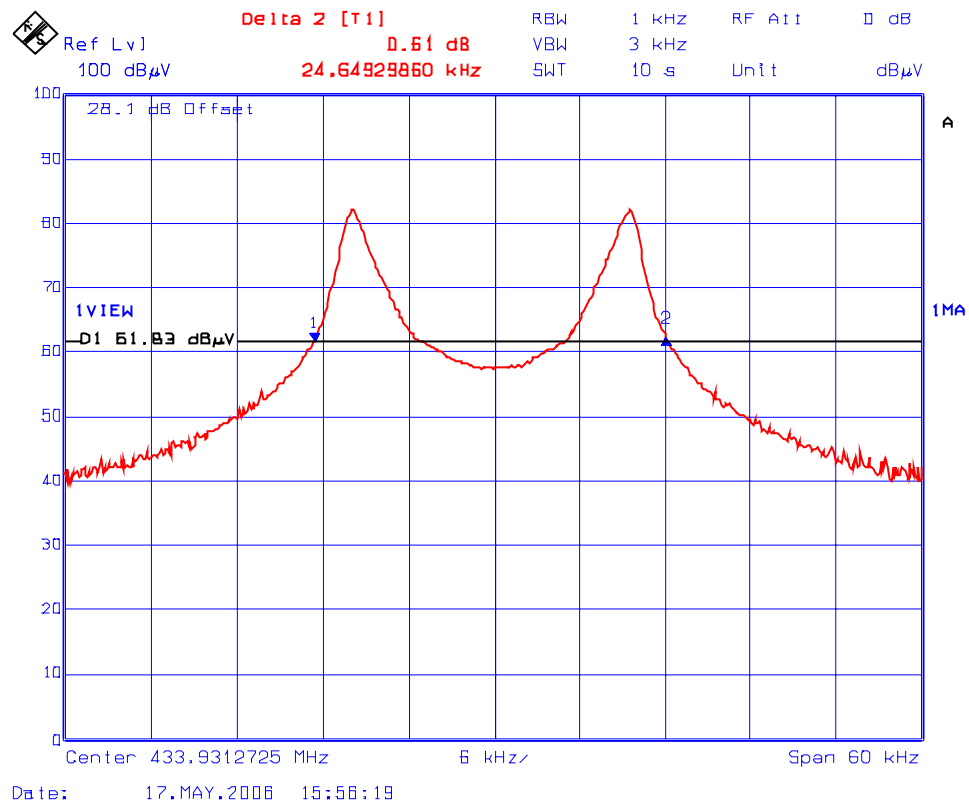
| Test Instruments                           | Manufacturer    | Model No.     | Serial No. | Frequency Range                       |
|--------------------------------------------|-----------------|---------------|------------|---------------------------------------|
| Spectrum Analyzer/<br>EMI Receiver         | Rohde & Schwarz | FSEK20/B4/B21 | 834157/005 | 9 kHz – 40 GHz<br>with external mixer |
| EMI Receiver System<br>/ Spectrum Analyzer | Hewlett Packard | HP 8546A      | 3520A00248 | 9KHz-5.6GHz,<br>50 Ohms               |
| Microwave Amplifier                        | Hewlett Packard | HP 83017A     | 311600661  | 1 GHz to 26.5 GHz                     |
| Loop Antenna                               | EMCO            | 6502          | 2611       | 10 kHz - 30 MHz                       |
| Biconilog Antenna                          | EMCO            | 3143          | 1029       | 20 MHz to 2 GHz                       |

### 5.8.4. Test Data

| Channel Frequency (MHz) | 20 dB Bandwidth (kHz) | Maximum Bandwidth Limit (kHz) |
|-------------------------|-----------------------|-------------------------------|
| 433.92                  | 42.7                  | 1084.8                        |

See the following plot for details.

Plot 5.8.4.1: 20 dB Bandwidth  
Fc: 433.92 MHz (FSK modulation with a rectangular signal at 1bps)



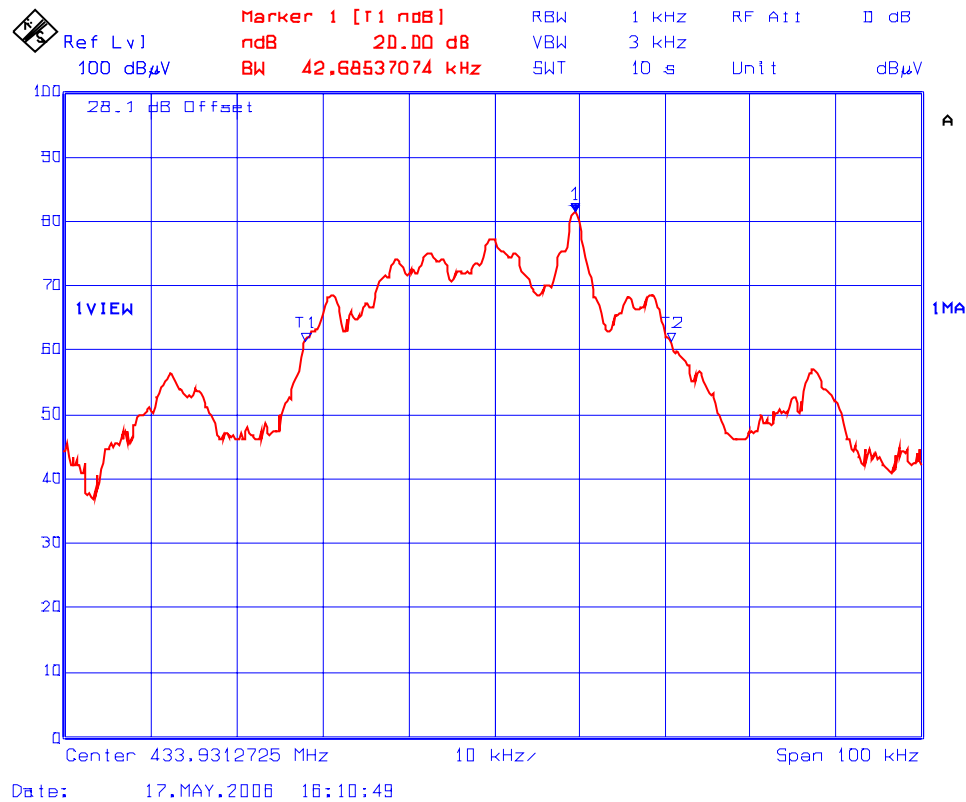
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Plot 5.8.4.2: 20 dB Bandwidth  
Fc: 433.92 MHz (FSK modulation with programmed message)



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## 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<br>(Line Conducted)                                                                                                                                   | PROBABILITY<br>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 $\Gamma_1 = 0.03$<br>LISN VRC $\Gamma_R = 0.8(9 \text{ kHz}) 0.2 (30 \text{ MHz})$<br>Uncertainty limits $20\text{Log}(1+\Gamma_1\Gamma_R)$ | 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<br>(Radiated Emissions)                                                                                                                 | PROBABILITY<br>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                 | $\pm 0.5$               | $\pm 0.5$     |
| 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 $\Gamma_1 = 0.2$<br>Antenna VRC $\Gamma_R = 0.67$ (Bi) 0.3 (Lp)<br>Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$ | U-Shaped                    | +1.1<br>-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:

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

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