# ENGINEERING TEST REPORT

**SITRANS LR250**
**Model: 7ML5431**
**FCC ID: NJA-LR250**
**IC: 267P-LR250**
*Applicant:*

**Siemens Canada Ltd. - Siemens Milltronics Process Instruments**
1954 Technology Drive
Peterborough, ON
Canada K9J 6X7

***In Accordance With***

**Federal Communications Commission (FCC)**
**Part 15, Subpart C, Section 15.256**
**And**
**RS- 211 - Level Probing Radar Equipment**

**UltraTech's File No.: SIEM-058F15C256**

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

Date: May 28, 2019

| | |
|---|---|
| Report Prepared by: Santhosh Fernandez | Tested by: Nimisha Desai |
| Issued Date: May 28, 2019 | Test Dates: April 2-5, 2019 |

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

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com


91038 1309 46390-2049 AT-1945 SL2-IN-E-1119R Korea KCC-RRA CA2049

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# EXHIBIT 1. INTRODUCTION

## 1.1. SCOPE

| | |
|---|---|
| **Reference:** | FCC Part 15, Subpart C, Sec. 15.256 - Operation of level probing radars within the bands 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz.<br>RS- 211 - Level Probing Radar Equipment |
| **Title:** | Code of Federal Regulations (CFR), Title 47 Telecommunication, Part 15, Subpart C - Intentional Radiators<br>RS- 211 - Level Probing Radar Equipment |
| **Purpose of Test:** | To gain permissive change FCC/ISED Equipment Authorization for FCC Part 15.256 and RS- 211 - Level Probing Radar Equipment |
| **Test Procedures:** | ANSI C63.4, ANSI C63.10 and KDB 890966 D01 Meas Level Probing Radars v01 |
| **Environmental Classification:** | Commercial, industrial or business environment |

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

None.

## 1.3. NORMATIVE REFERENCES

| Publication | Year | Title |
|---|---|---|
| FCC 47 CFR 15 | 2018 | Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 Radio Frequency Devices |
| ANSI C63.4 | 2014 | 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 |
| ANSI C63.10 | 2013 | American National Standard for Testing Unlicensed Wireless Devices |
| KDB 890966 D01 Meas Level Probing Radars v01 | 2014 | Measurement Procedure for Level Probing Radars |
| RSS-211 | 2015 | Level Probing Radar Equipment |

# EXHIBIT 2. PERFORMANCE ASSESSMENT

## 2.1. CLIENT INFORMATION

| Applicant | |
|---|---|
| **Name:** | Siemens Canada Ltd. - Siemens Milltronics Process Instruments |
| **Address:** | 1954 Technology Drive<br>Peterborough, ON<br>Canada K9J 6X7 |
| **Contact Person:** | Thoai Bui<br>Phone #: 705-740-7005<br>Fax #: 705-741-0466<br>Email Address: Thoai.bui@siemens,com |

| Manufacturer | |
|---|---|
| **Name:** | Siemens Canada Ltd. - Siemens Milltronics Process Instruments |
| **Address:** | 1954 Technology Drive<br>Peterborough, ON<br>Canada K9J 6X7 |
| **Contact Person:** | Thoai Bui<br>Phone #: 705-740-7005<br>Fax #: 705-741-0466<br>Email Address: Thoai.bui@siemens,com |

## 2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

| | |
|---|---|
| **Brand Name:** | Siemens |
| **Product Name:** | SITRANS LR250 |
| **Model Name or Number:** | 7ML5431 |
| **Serial Number:** | Test sample |
| **Type of Equipment:** | Level Probing Radar |
| **Input Power Supply Type:** | 24V DC |
| **Primary User Functions of EUT:** | Level probing radars operate in open-air and inside an enclosure containing the substance being measured |

## 2.3. EUT'S TECHNICAL SPECIFICATIONS

| **Transmitter** | |
|---|---|
| **Equipment Type:** | Fixed |
| **Intended Operating Environment:** | Commercial, light industry & heavy industry |
| **Power Supply Requirement:** | 24 V DC |
| **Field Strength:** | 105.27 dBµV/m Peak at 3 m |
| **Operating Frequency Range:** | 25.1 GHz |
| **RF Output Impedance:** | 50 Ω |
| **10 dB Bandwidth:** | 1340 MHz |
| **Modulation Type:** | Pulse radar |
| **Oscillator Frequencies:** | 25 GHz |
| **Antenna Connector Type:** | Integral |

## 2.4. ASSOCIATED ANTENNA DESCRIPTIONS

The EUT is equipped with the following antenna; the unit with highest gain antenna will be used for compliance testing.

| Antenna list: | # 1<br>Without process connection | #2<br>Flanged Horn |
|---|---|---|
| Manufacturer: | SIEMENS | SIEMENS |
| Type: | 3" Aluminum Horn Antenna | 3" Aluminum Horn Antenna |
| Model: | 7ML5431-5QAX0-XSXX<br>7ML5431-5QBX0-XSXX | 7ML5431-5QCX0-XSXX<br>7ML5431-5QDX0-XSXX<br>7ML5431-5QEX0-XSXX |
| Frequency Range: | 24.05 - 29.00 GHz | 24.05 - 29.00 GHz |
| Impedance: | Waveguide input | Waveguide input |
| Gain (dBi): | 22.9 dBi | 24.6 dBi |

## 2.5. LIST OF EUT'S PORTS

| Port Number | EUT's Port Description | Number of Identical Ports | Connector Type | Cable Type (Shielded/Non-shielded) |
|---|---|---|---|---|
| 1 | Loop power (Hart, Profibus PA and Foundation Fieldbus) | 1 | Terminal block | Non-shielded, >3m |

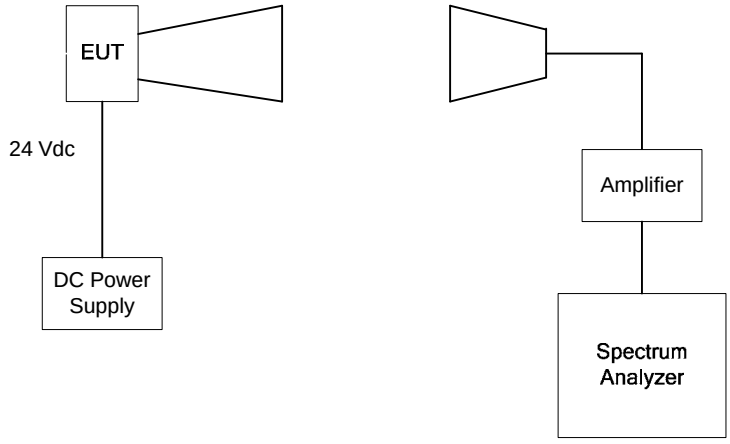
## 2.6. ANCILLARY EQUIPMENT

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

None.

## 2.7. GENERAL TEST SETUP

### 2.7.1. Fundamental Emissions, Unwanted Emissions and Emissions Bandwidth Test Setup



# 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: | 24 VDC |

## 3.2. OPEPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

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

| **Transmitter Test Signals:** | |
|---|---|
| **Frequency Band(s):** | 25.1 GHz |
| **Test Frequency(ies):** | 25.1 GHz |
| **Transmitter Wanted Output Test Signals:** | |
| ▪ RF Power Output (measured maximum output power): | 105.27 dBµV/m Peak at 3 m |
| ▪ Normal Test Modulation: | Pulse radar |
| ▪ Modulating signal source: | Internal |

# EXHIBIT 4. SUMMARY OF TEST RESULTS

## 4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

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

| FCC Regulations & RSS-Gen/211 | Test Requirements | Compliance (Yes/No) |
|---|---|---|
| 15.203, 15.204 & 15.256(b) RSS-211 §5.1 | The transmitter shall utilize a dedicated or integrated transmit antenna and installation requirement of LPR | Yes* |
| 15.209 RSS-Gen | Emissions from Digital Circuitry | Yes |
| 15.256(f) RSS-211 §5.1 (a) | Fundamental Emission Bandwidth | Yes |
| 15.215(c) & 15.256(f)(2) RSS-Gen | Frequency Stability | N/A** |
| 15.256(g) RSS-211 5.2 (b) | Fundamental Emission | Yes |
| 15.256(h) RSS-211 5.1 (b)-(d) | Unwanted Emissions | Yes |

* The EUT complies with the requirements; it employs integral antenna and is in compliance with the installation requirement.

** Not applicable for this C2PC

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

None.

# EXHIBIT 5. TEST DATA

## 5.1. RADIATED EMISSION FROM UNINTENTIONAL RADIATORS (DIGITAL CIRCUITRY) [47 CFR §15.209] [ICES-003]

### 5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

**§15.209(a) Radiated emission limits; general requirements**

| 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. | | |

### 5.1.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.
The spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency specified in §15.33(a).

### 5.1.3. Test Data

Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.

| Frequency (MHz) | RF Level (dBµV/m) | Detector Used (Peak/QP/Avg) | Antenna Plane (H/V) | Limit at 3 m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| No significant emissions were found | | | | | |

## 5.1. FUNDAMENTAL EMISSION BANDWIDTH [47 CFR §15.256(f)] [RSS-211 §5.1]

### 5.1.1. Limit(s)

§15.256(f)The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.

§15.256(f)(1) The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.

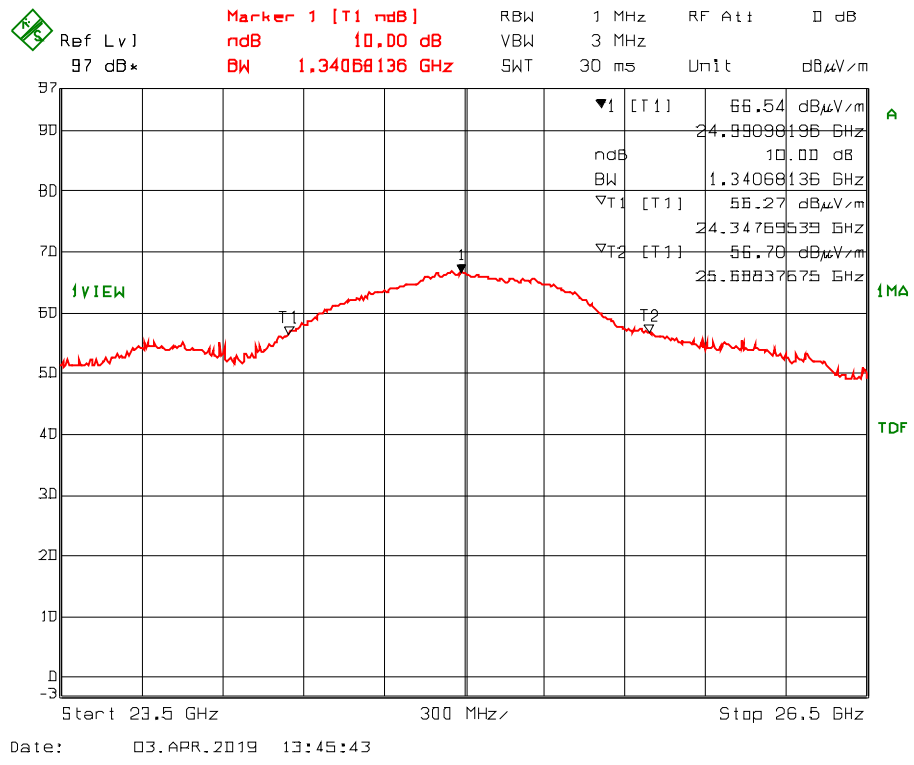
### 5.1.2. Method of Measurements

890966 D01 Meas Level Probing Radars v01, Clause D.

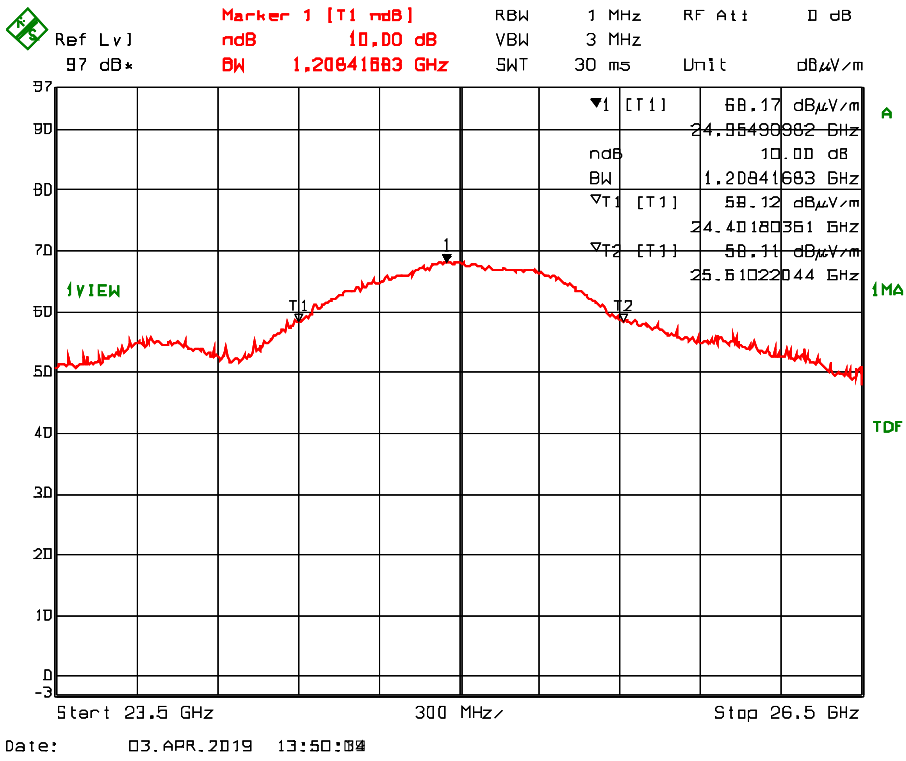
### 5.1.3. Test Data

| Test Frequency (GHz) | Antenna Polarization | 10 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---|---|---|---|
| 25.1 | V | 1340 | 50 |
| 25.1 | H | 1208 | 50 |

**Plot 5.1.3.1.** 10 dB Bandwidth, Fc: 25.1 GHz- Vertical



**Plot 5.1.3.2.** 10 dB Bandwidth, Fc: 25.1 GHz - Horizontal



## 5.2. RADIATED FUNDAMENTAL EMISSIONS [47 CFR 15.256(g)] [RSS-211§ 5.2(b)]

### 5.2.1. Limits

15.256(g)(3) The EIRP limits for LPR operations in the bands authorized by this rule section are provided in Table 1. The emission limits in Table 1 are based on boresight measurements (*i.e.,* measurements performed within the main beam of an LPR antenna).

**15.256(g)(3) - Table 1 LPR EIRP Emission Limits**

| Frequency band of operation (GHz) | Average emission limit (EIRP in dBm measured in 1 MHz) | Peak emission limit (EIRP in dBm measure in 50 MHz) |
|---|---|---|
| 5.925 - 7.250 | -33 | 7 |
| 24.05 - 29.00 | -14 | 26 |
| 75 - 85 | -3 | 34 |

### 5.2.2. Method of Measurements

FCC KDB Publication No. 890966 D01 Meas Level Probing Radars v01

### 5.2.3. Test Data

#### 5.2.3.1. Radiated Fundamental Emissions, Average EIRP in 1 MHz

| Frequency (GHz) | Antenna Plane (H/V) | Average Emissions Measured in 1 MHz (dBµV/m) | [1]EIRP Average Emissions Measured in 1 MHz (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| 25.1 | V | 61.58 | -33.68 | -14 | -19.68 |
| 25.1 | H | 59.97 | -35.29 | -14 | -21.29 |

[1]EIRP is calculated by applying the radiated emission measurements equation, EIRP (dBm) = E (dBµV/m) – 104.8 + 20 Log D, where D = 3

#### 5.2.3.2. Radiated Fundamental Emissions, Peak EIRP in 50 MHz

| Frequency (GHz) | Antenna Plane (H/V) | Peak Emissions Measured in 10 MHz (dBµV/m) | [1]Peak Emissions Calculated in 50 MHz (dBµV/m) | [2]Peak EIRP Emissions Calculated in 50 MHz (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 25.1 | V | 91.29 | 105.27 | 10.01 | 26 | -15.99 |
| 25.1 | H | 91.27 | 105.25 | 9.99 | 26 | -16.01 |

[1]Convert measurement in 10 MHz to 50 MHz by adding the correction factor 20*log(50/10) = 13.98 dB

[2]EIRP is calculated by applying the radiated emission measurements equation, EIRP (dBm) = E (dBµV/m) – 104.8 + 20 Log D, where D = 3

## 5.3. RADIATED UNWANTED EMISSIONS [47 CFR 15.256(h)] [RSS-211§ 5.1 (d)]

### 5.3.1. Limits

Unwanted emissions from LPR devices shall not exceed the general emission limit in §15.209.

**§15.209(a) Radiated emission limits; general requirements**

| 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. | | |

### 5.3.2. Method of Measurements

ANSI C63.10

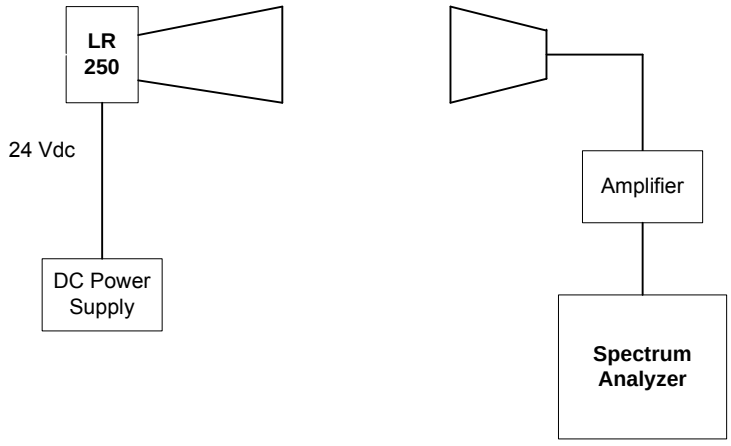
### 5.3.3. Test Data

#### 5.3.3.1. Field Strength of Emissions Outside the Permitted Band 30 MHz-40GHz at 3 m, 40 GHz-140 GHz @10 to 30 cm

| Frequency (MHz) | Measured Field Strength @ 3 m (dBµV/m) | Detector Used (Peak/QP/Avg) | Antenna Plane (H/V) | § 15.209 Field Strength Limits (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 30 - 140000 | * | Peak | V/H | * | * |
| * No unwanted emission detected that are in excess of 20 dB below the specified limit. | | | | | |

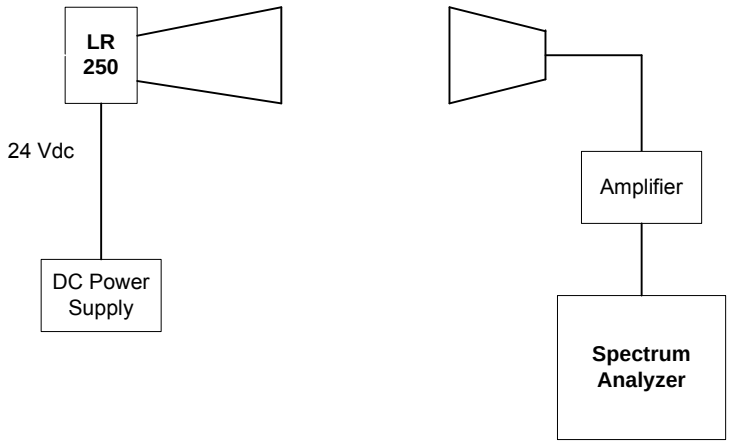
# EXHIBIT 6. TEST BLOCK DIAGRAMS AND EQUIPMENT LIST

## 6.1. Fundamental Emissions Bandwidth



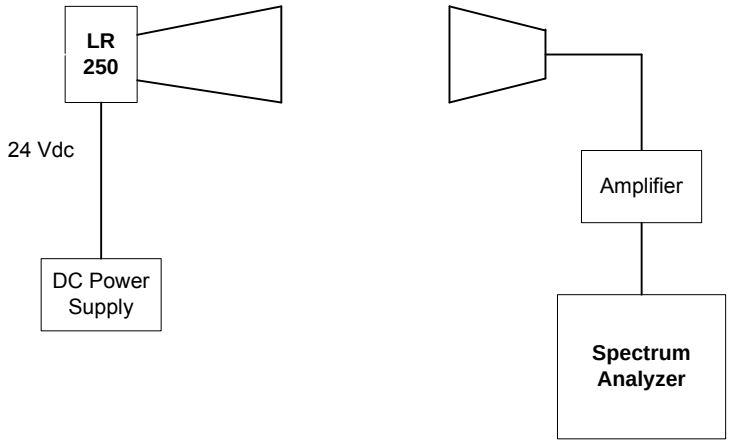

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 100077 | 20 Hz – 40 GHz | 30 Nov 2020 |
| RF Amplifier | Spacek Labs | SLKKa-30-6 | 6D26 | 18 – 40 GHz | Cal on use |
| Horn Antenna | ETS Lindgren | 3160-09 | 118385 | 18 – 26.5 GHz | 27 Oct 2020 |
| Power Supply | Tenma | 72-7295 | 490300297 | 1-40V, DC 5A | ---- |
| Multimeter | Tenma | 72-6202 | 02080027 | --- | 14 Dec 2019 |

## 6.2. Fundamental Emissions Limits




| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 100077 | 20 Hz – 40 GHz | 30 Nov 2020 |
| RF Amplifier | Spacek Labs | SLKKa-30-6 | 6D26 | 18 – 40 GHz | Cal on use |
| Horn Antenna | ETS Lindgren | 3160-09 | 118385 | 18 – 26.5 GHz | 27 Oct 2020 |
| Power Supply | Tenma | 72-7295 | 490300297 | 1-40V, DC 5A | ---- |
| Multimeter | Tenma | 72-6202 | 02080027 | --- | 14 Dec 2019 |

## 6.3. Unwanted Emissions




| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range | Calibration Due Date |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 100077 | 20 Hz – 40 GHz | 30 Nov 2020 |
| RF Amplifier | Spacek Labs | SLKKa-30-6 | 6D26 | 18 – 40 GHz | Cal on use |
| Horn Antenna | ETS Lindgren | 3160-09 | 118385 | 18 – 26.5 GHz | 27 Oct 2020 |
| Horn Antenna | ETS Lindgren | 3160-10 | 102686 | 26.5-40 GHz | 27 Oct 2020 |
| Horn Antenna | OML | M19HWD | U30625-1 | 40 – 60 GHz | Note 1 |
| Horn Antenna | OML | M12HWD | E30625-1 | 60 – 90 GHz | Note 1 |
| Horn Antenna | OML | M08HWD | F30625-1 | 90 – 140 GHz | Note 1 |
| Power Supply | Tenma | 72-7295 | 490300297 | 1-40V, DC 5A | ---- |
| Multimeter | Tenma | 72-6202 | 02080027 | --- | 14 Dec 2019 |

Note 1: Dimensions Verified on use

# EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

## 7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

| | **Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):** | **Measured** | **Limit** |
|---|---|---|---|
| **$u_c$** | **Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$ | **± 1.44** | **± 1.8** |
| **U** | **Expanded uncertainty U:** $U = 2u_c(y)$ | **± 2.89** | **± 3.6** |

## 7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

| | **Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):** | **Measured (dB)** | **Limit (dB)** |
|---|---|---|---|
| **$u_c$** | **Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$ | **± 2.39** | **± 2.6** |
| **U** | **Expanded uncertainty U:** $U = 2u_c(y)$ | **± 4.79** | **± 5.2** |

| | **Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):** | **Measured (dB)** | **Limit (dB)** |
|---|---|---|---|
| **$u_c$** | **Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$ | **± 2.39** | **± 2.6** |
| **U** | **Expanded uncertainty U:** $U = 2u_c(y)$ | **± 4.78** | **± 5.2** |

| | **Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):** | **Measured (dB)** | **Limit (dB)** |
|---|---|---|---|
| **$u_c$** | **Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$ | **± 1.87** | **Under consideration** |
| **U** | **Expanded uncertainty U:** $U = 2u_c(y)$ | **± 3.75** | **Under consideration** |