UltraTech
Group of Labs

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Oct. 07, 2003

**Siemens Milltronics Process Instruments Inc.**
1954 Technology Drive
Peterborough, Ontario
Canada, K9J 7B1

**Attn.:** **Mr. Enzo De Simone**

**Subject:** **FCC Class II Permissive Change Authorization under FCC PART 15, Subpart C, Sec. 15.209 – Low Power Transmitters operating at the frequency 6.3 GHz.**

**Product:** **Radar Level Gauge (6.3 GHz) with Plastic Enclosure**
**Model No.:** **Sitrans LR 200 or Sitrans Probe LR**
**FCC ID:** **NJA-LR200**

Dear Mr. Simone,

The product sample, as provided by you, has been tested and found to comply with **FCC PART 15, Subpart C, Sec. 15.209 - Low Power Transmitters operating in the frequency band 6.3 GHz.**

**Purpose of FCC Class II Permissive Change**: To introduce a new version of the Model Sitrans LR 200 with an alternative plastic enclosure. Differences Plastic enclosure (New Version) vs. Metal enclosure (FCC Certified Version) are as below:

- The PCB layout of the RTM has been changed. Only small changes that can not be easily noticed.
- C46 placed initially after the 3dB pi attenuator (R82, R84, R85) moved in series with the input/output port and value changed from 5.1pF to 2.0pF
- The IF output is collected now from the common terminal of the mixing diode pair. The HF stub moved close to the common terminal. A decupling capacitor (C7 – 2pF) has been placed at that point.
- Grounding stubs placed at different points.

Enclosed you will find copies of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P. Eng.,
V.P., Engineering

Encl

# ENGINEERING TEST REPORT

## Radar Level Gauge (6.3 GHz) with Plastic Enclosure
## Model No.: SITRANS LR 200 OR SITRANS PROBE LR

**FCC ID: NJA-LR200**

*Applicant:* **Siemens Milltronics Process Instruments Inc.**
*1954 Technology Drive*
*Peterborough, Ontario*
*Canada, K9J 7B1*

***In Accordance With***

**FEDERAL COMMUNICATIONS COMMISSION (FCC)**
**PART 15, SUBPART C, SEC. 15.209**
**Low Power Transmitters**
**operating in the frequency band 6.3 GHz**

**UltraTech's File No.: MIL-303FCC15C**

| | |
|---|---|
| This Test report is Issued under the Authority of<br>Tri M. Luu, Professional Engineer,<br>Vice President of Engineering<br>UltraTech Group of Labs<br><br>Date: Oct. 07, 2003 |   |
| Report Prepared by: Tri Luu, P.Eng.<br><br>Issued Date: Oct. 07, 2003 | Tested by: Hung Trinh, RFI Technician<br><br>Test Dates: Oct, 06, 2003 |

- *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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# TABLE OF CONTENTS

# EXHIBIT 1. SUBMITTAL CHECK LIST

| Annex No. | Exhibit Type | Description of Contents | Quality Check (OK) |
|---|---|---|---|
| | Test Report | Test Report | OK |
| 1 | Test Setup Photos | Photos # 1 to 2 | OK |
| 2 | External Photos of EUT | Photos # 1 to 10 | OK |
| 3 | Internal Photos of EUT | Photos of 1 to 10 | OK |
| 4 | Cover Letters | • Letter from the Applicant to appoint Ultratech to act as an agent<br>• Letter from the Applicant to request for Confidentiality Filing | OK<br>OK |
| 5 | ID Label/Location Info | • ID Label<br>• Location of ID Label | Same as original |
| 6 | Block Diagrams | • Block diagrams | Same as original |
| 7 | Schematic Diagrams | • Schematic diagrams | Same as original |
| 8 | Parts List/Tune Up Info | Parts List/Tune Up Info | Same as original |
| 9 | Operational Description | Operational Description | Same as original |
| 10 | RF Exposure Info | N/A | N/A |
| 11 | Users Manual | Users Manual | Same as original |

# EXHIBIT 1. INTRODUCTION

## 1.1. SCOPE

| | |
|---|---|
| **Reference:** | FCC Part 15, Subpart C, Section 15.209 |
| **Title** | Telecommunication - Code of Federal Regulations, CFR 47, Part 15 |
| **Purpose of Test:** | This test report is for the purpose of FCC Class II Permissive Change Authorization for Low Power Transmitters operating in the Frequency Band 6.3 GHz . |
| **Test Procedures** | Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| **Environmental Classification:** | • Light-industry, Commercial<br>• Industry |

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

None

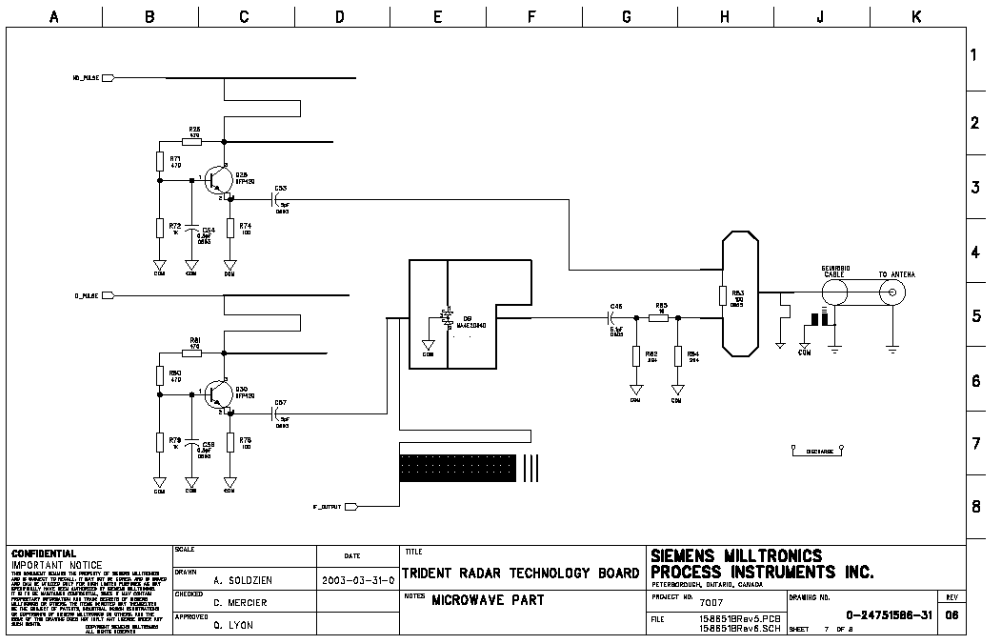
## 1.3. NORMATIVE REFERENCES

| Publication | YEAR | Title |
|---|---|---|
| FCC CFR Parts 0-19 | 2002 | Code of Federal Regulations – Telecommunication |
| ANSI C63.4 | 1992 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| CISPR 16-1 | | Specification for Radio Disturbance and Immunity measuring apparatus and methods |

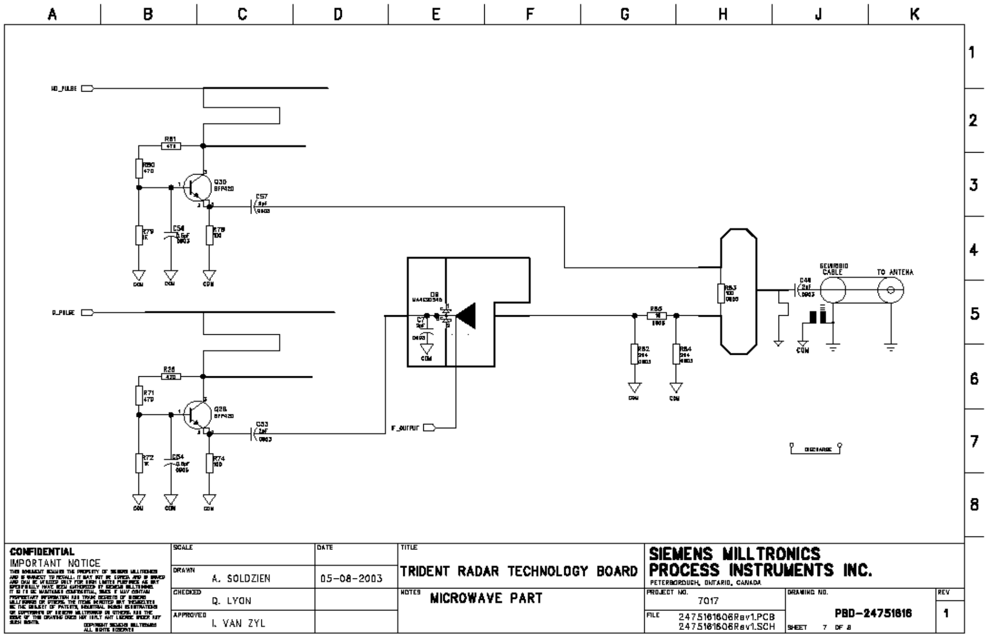
## 1.4. DESCRIPTIONS OF CLASS II PERMISSIVE CHANGES

Differences Plastic enclosure (New Version) vs. Metal enclosure (FCC Certified Version) are as below:

- The PCB layout of the RTM has been changed. Only small changes that can not be easily noticed.
- C46 placed initially after the 3dB pi attenuator (R82, R84, R85) moved in series with the input/output port and value changed from 5.1pF to 2.0pF
- The IF output is collected now from the common terminal of the mixing diode pair. The HF stub moved close to the common terminal. A decupling capacitor (C7 – 2pF) has been placed at that point.
- Grounding stubs placed at different points.




LR200 Microwave module for metal enclosure




LR200 Microwave part for plastic enclosure (new design)



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

# EXHIBIT 2. PERFORMANCE ASSESSMENT

## 2.1. CLIENT INFORMATION

| **APPLICANT**: | |
|---|---|
| **Name:** | Siemens Milltronics Process Instruments Inc. |
| **Address:** | 1954 Technology Drive<br>P.O. Box 4225<br>Peterborough, Ontario<br>Canada, K9J 7B1 |
| **Contact Person:** | Mr. Enzo De Simone<br>Phone #: 705-740-7009<br>Fax #: 705-741-0466<br>Email Address: Enzo.desimone@siemens.com |

| **MANUFACTURER:** | |
|---|---|
| **Name:** | Siemens Milltronics Process Instruments Inc. |
| **Address:** | 1954 Technology Drive<br>P.O. Box 4225<br>Peterborough, Ontario<br>Canada, K9J 7B1 |
| **Contact Person:** | Mr. Enzo De Simone<br>Phone #: 705-740-7009<br>Fax #: 705-741-0466<br>Email Address: Enzo.desimone@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 Milltronics Process Instruments Inc. |
| **Product Name** | Radar Level Gauge (6.3 GHz) with Plastic Enclosure |
| **Model Name or Number** | SITRANS LR 200 OR SITRANS PROBE LR |
| **Serial Number** | Preproduction |
| **Type of Equipment** | Low Power Transmitters |
| **Input Power Supply Type** | 24 Vdc nominal or 30 Vdc maximum |
| **Primary User Functions of EUT:** | For measuring substance level contained in a tank. Please refer to the Technical Description of the EUT for details. |

## 2.3. EUT'S TECHNICAL SPECIFICATIONS

| TRANSMITTER | |
|---|---|
| **Equipment Type:** | ▪ Base station (fixed use) with the antenna pointed downward to the ground |
| **Intended Operating Environment:** | ▪ Commercial, light industry & heavy industry |
| **Power Supply Requirement:** | 16.7 - 30 Vdc (24 Vdc nominal) |
| **RF Output Power Rating:** | 0.0 Watts EIRP |
| **Operating Frequency Range:** | 6.3 GHz |
| **RF Output Impedance:** | 50 Ohms |
| **Channel Spacing:** | N/A |
| **Duty Cycle:** | 0.075%<br>(Duty Cylce = $T_{on}/T_{on+off}$ = $1.5x10^{-9}/2x10^{-6}$ = 0.00075) |
| **Bandwidth:**<br>• **Measured 20 dB Bandwidth**<br>• **Theoretical Full Bandwidth** | <br>• 1221 MHz<br>• 2.7 GHz ($BW_n$ = 4/T = 4/1.5nS = 2.7 GHz) |
| **Modulation Type:** | Pulse modulated in Width/Duration (pulse desensitization) with pulse width 1.5 nS and repetition rate of 500kHz |
| **Emission Designation:** | 2G70L0N |
| **Oscillator Frequencies:** | 22 kHz (IF) and 6.3 GHz |
| **Antenna Connector Type:** | Integral, permanently attached |
| **Antenna Description:** | Manufacturer: Siemens Milltronics<br>Antenna Type: 100 and 250 mm Shielded Rod Antenna |

## 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 | DC IN & Loop Current Ports | 1 | Pin header | Nonshielded wirelead harness |

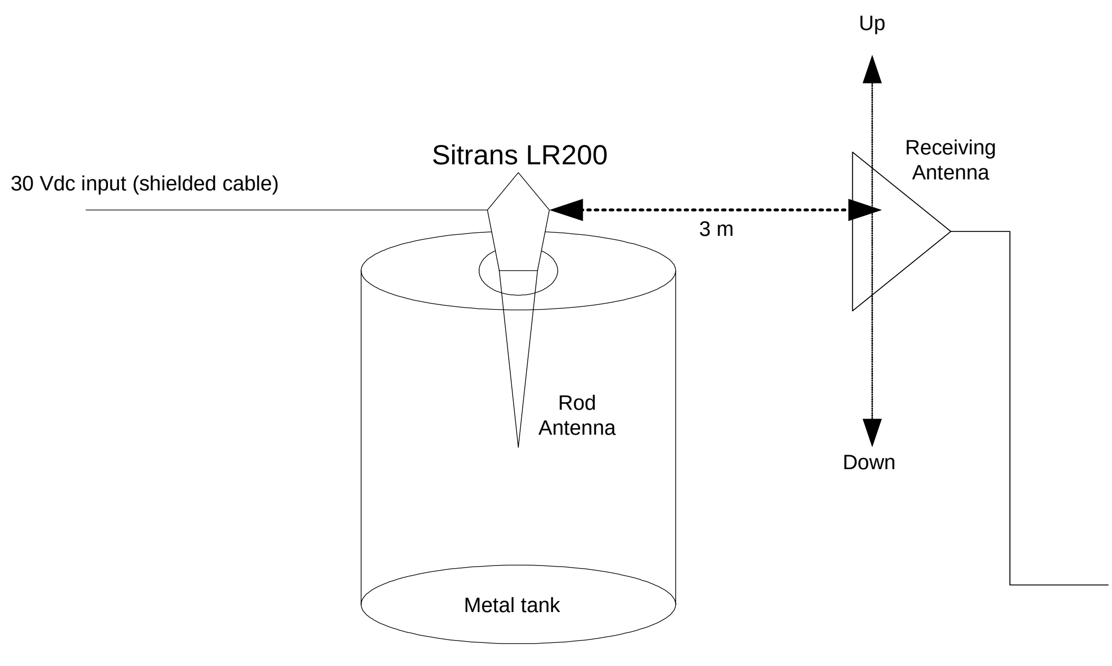
## 2.5. ANCILLARY EQUIPMENT

None

## 2.6. GENERAL TEST SETUP

The Sitrans LR 200 (plastic enclosure) was tested with a Metal Tank to compare with the original test results for LR 200 (metal enclosure). If the results is unchanged or better, tests repeated with concrete tanks and plastic tanks are not necessary for the following reasons:

(1) The type of tanks shall not have any effect caused by the change of EUT's enclosure.
(2) It is very difficult to go to different test sites with the actual concrete tanks and plastic tanks to perform tests.



# 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: | 30 Vdc max. |

## 3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

| | |
|---|---|
| **Operating Modes:** | Transmit as intended |
| **Special Test Software:** | N/A |
| **Special Hardware Used:** | N/A |
| **Transmitter Test Antenna:** | The EUT is tested with the antenna fitted in a manner typical of normal intended use as an integral antenna equipment. |

| | |
|---|---|
| **Transmitter Test Signals:** | |
| Test Frequency: | 6.3 GHz |
| **Transmitter Wanted Output Test Signals:**<br><br>▪ RF Power Output (measured maximum output power):<br>▪ Normal Test Modulation<br>▪ Modulating signal source: | <br><br>0.0 Watts<br>▪ Pulse modulated in width/duration<br>▪ 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.

- Radiated Emissions for the Siemens Sitrans LR 200 with Metal Tank were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario and Siemens Milltrornics facility located in Peterborough, Ontario, Canada

  The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: Aug. 10, 2002.

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

| FCC PARAGRAPH. | TEST REQUIREMENTS | COMPLIANCE (YES/NO) |
|---|---|---|
| 15.203 | Antenna Requirement | Yes. Permanently attached antenna. |
| 15.209 & 15.205 | Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious | Yes |
| | 20 dB Bandwidth | Not required to be repeated according to the nature of modification. |
| 15.107(a) & 15.207 | AC Power Line Conducted Emissions Measurements (Transmit & Receive) | Not required to be repeated according to the nature of modification. |
| The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class A Digital Devices, the associated Radio Receiver operating in 6.3 GHz is exempted from FCC authorization . The engineering test report can be provided upon FCC requests. | | |

## 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 Exhibit 8 of this report, ANSI C63-4:1992..

## 5.2. MEASUREMENT UNCERTAINTIES

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

## 5.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C64-3:1992, FCC 15.209 and CISPR 16-1.

## 5.4. TRANSMITTER SPURIOUS EMISSIONS (RADIATED @ 3 METERS), FCC CFR 47, PARA. 15.209 & 15.205

### 5.4.1. Limits

The fundamental frequency shall not fall within any restricted frequency band specified in 15.205
All rf other emissions shall not exceed the general radiated emission limits specified in @ 15.209(a).

**FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands**

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090 - 0.110 | 162.0125 - 167.17 | 2310 - 2390 | 9.3 - 9.5 |
| 0.49 – 0.51 | 167.72 - 173.2 | 2483.5 - 2500 | 10.6 - 12.7 |
| 2.1735 - 2.1905 | 240 - 285 | 2655 - 2900 | 13.25 - 13.4 |
| 8.362 - 8.366 | 322 - 335.4 | 3260 - 3267 | 14.47 - 14.5 |
| 13.36 - 13.41 | 399.9 - 410 | 3332 - 3339 | 14.35 - 16.2 |
| 25.5 – 25.67 | 608 - 614 | 3345.8 - 3358 | 17.7 - 21.4 |
| 37.5 – 38.25 | 960 - 1240 | 3600 - 4400 | 22.01 - 23.12 |
| 73 - 75.4 | 1300 - 1427 | 4500 - 5250 | 23.6 - 24.0 |
| 108 – 121.94 | 1435 - 1626.5 | 5350 - 5460 | 31.2 - 31.8 |
| 123 – 138 | 1660 - 1710 | 7250 - 7750 | 36.43 - 36.5 |
| 149.9 – 150.05 | 1718.8 - 1722.2 | 8025 - 8500 | Above 38.6 |
| 156.7 – 156.9 | 2200 - 2300 | 9000 - 9200 | |

**FCC CFR 47, Part 15, Subpart C, Para. 15.209(a)**
**-- Field Strength Limits within Restricted Frequency Bands --**

| FREQUENCY (MHz) | FIELD STRENGTH LIMITS (microvolts/m) | DISTANCE (Meters) |
|---|---|---|
| 0.009 - 0.490 | 2,400 / F (KHz) | 300 |
| 0.490 - 1.705 | 24,000 / 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 |

### 5.4.2. Method of Measurements

Refer to Exhibit 7, Sec. 7.2 of this test report and **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

The following measurement procedures were also applied:

- Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.
- For 9 kHz $\leq$ frequencies $\leq$ 150 kHz: RBW = 1 KHz, VBW $\geq$ 1 KHz, SWEEP=AUTO.
- For 150 MHz $\leq$ frequencies $\leq$ 30 MHz: RBW = 10 KHz, VBW $\geq$ 10 KHz, SWEEP=AUTO.
- For 30 MHz $\leq$ frequencies $\leq$ 1 GHz: RBW = 100 KHz, VBW $\geq$ 100 KHz, SWEEP=AUTO.
- For frequencies $\geq$ 1 GHz: RBW = 1 MHz, VBW = 1 MHz (Peak) & VBW = 10 Hz (Average), SWEEP=AUTO.
- If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

**Desensitization for Pulse Emissions**: Since the SITRANS LR 200 OR SITRANS PROBE LR transmits pulse RF energy with Ton = 1.5 nS, the desensitization factor ($\alpha$p) shall be included in the calculation for the final peak value.

With the measuring resolution bandwidth (RBW) of 1 MHz, the corresponding pulse desensitization factor ($\alpha$p) of 52 dB at pulse width $\tau$eff = 1.5 nS can be derived from Figure 28 of HP 150-2.

The average rf level is calculated by the peak reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

**DUTY CYCLE**: 1.5nS/2uS=0.00075 or 0.075%
**Peak-to-Average Factor = 20*log (0.00075) = -62.5 dB**

There are several conditions which must be satisfied if Eq. (10) is to be valid:

1. The IF bandwidth-pulse width product must be less than two-tenths:

$$B \cdot \tau_{eff} < 0.2 \text{ or } B < \frac{0.2}{\tau_{eff}}$$

2. The normalized scan rate (NSR) of the analyzer must be less than one:

$$\text{NSR} = \frac{\text{Scan Width } [Hz/\text{Div}]}{\text{Scan Time } [s/\text{Div}] \cdot (B[Hz])^2} < 1$$

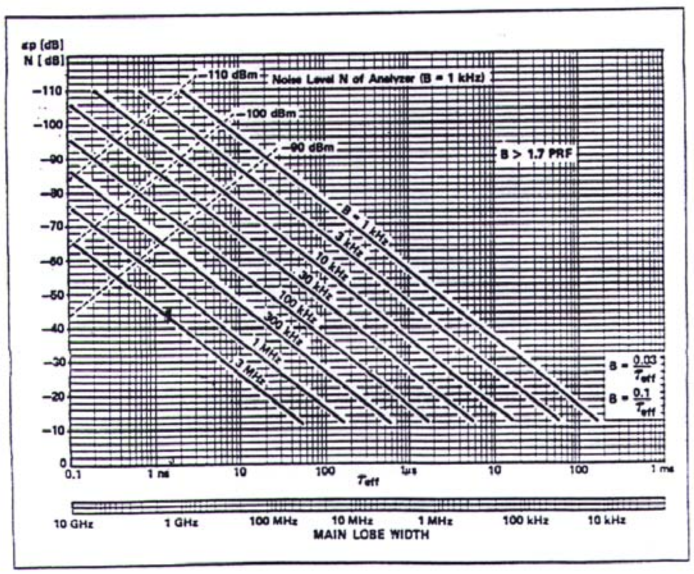
3. The IF bandwidth must be greater than the PRF: $B > \text{PRF}$

The conditions in 1 to 3 are automatically accomplished if the equations (5), (8), and (7) are satisfied.

4. The peak pulse amplitude at the broadband input mixer of the analyzer must stay below the saturation point (1 dB compression). The typical saturation point for HP spectrum analyzers is between −10 dBm and −5 dBm:

$$P_{peak} \leq -10\ dBm \qquad (11)$$

Figure 28 is a diagram showing the pulse desensitization $\alpha_p$ in relation to IF bandwidth $B$ and pulse width $\tau_{eff}$. We see that the PRF does not appear, since it is of no significance for the display amplitude as long as $B > \text{PRF}$. The shaded area between the $B = \frac{0.03}{\tau_{eff}}$ and $B = \frac{0.1}{\tau_{eff}}$ represents the optimum bandwidth range for an analysis of a pulsed signal. There are also three dotted lines which show different noise levels of an analyzer for a fast determination of the dynamic range.

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### 5.4.3. Test Equipment List

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range |
|---|---|---|---|---|
| Spectrum Analyzer/ EMI Receiver | Advantest | R3271 | 15050203 | 100 Hz to 32 GHz with external mixer for frequency above 32 GHz |
| Microwave Amplifier | Hewlett Packard | HP 83017A | | 1 GHz to 26.5 GHz |
| Active Loop antenna | EMCO | 6507 | 8906-1167 | 1 kHz – 30 MHz |
| Biconilog Antenna | EMCO | 3143 | 1029 | 20 MHz to 2 GHz |
| Horn Antenna | EMCO | 3155 | 9701-5061 | 1 GHz – 18 GHz |
| Horn Antenna | EMCO | 3160-09 | .. | 18 GHz – 26.5 GHz |
| Horn Antenna | EMCO | 3160-10 | .. | 26.5 GHz – 40 GHz |
| Mixer | Tektronix | 118-0098-00 | .. | 18 GHz – 26.5 GHz |
| Mixer | Tektronix | 119-0098-00 | .. | 26.5 GHz – 40 GHz |

### 5.4.4. Test Data

**Note**: Tests 2 different metal tanks (with and without ventilation)were performed to ensure no interference from the new enclosure and other modifications. Test with metal tank was chosen as worst case in order to observe the any reflection of the signal from the non-grounded metal tank.

#### *5.4.4.1. Test Configuration # 1: Test with Metal Tank*

| FREQUENCY (MHz) | RF PEAK LEVEL in 1 MHz @ 3m (dBuV/m) | RF ** AVG LEVEL (dBuV/m) | ANTENNA PLANE (H/V) | LIMIT 15.209 (@3 m (dBuV/m) | LIMIT MARGIN (dB) | PASS/ FAIL | Distance (m) |
|---|---|---|---|---|---|---|---|
| 6.3 | See Notes | See Notes | V | 54.0 | -- | PASS | 3 |
| 6.3 | See Notes | See Notes | H | 54.0 | -- | PASS | 3 |
| 10 kHz to 40GHz | See Notes | See Notes | V & H | -- | -- | PASS | 3 |

**Notes**:

- Tests were conducted with the EUT mounted on top of a metal tank and with the antenna enclosed in the tank and pointed downward to the bottom of the tank as its intended use. The Flanged Rod Antenna was used for testing..
- The spurious/harmonic emissions were scanned from 10 kHz to 40 GHz at the distances of 3 meters and there was no significant emissions were found.
- Plot #1 shows the spectrum analyzer's noise floor corrected with (35.5 dB Antenna Factor – 35.0 dB AMP gain + 2 dB Cable loss) showing no carrier emission at 3 m form the EUT.
- Refer to Photos # 1 and 4 in Annex 1 for test setup

**Remarks**:

1) DUTY CYCLE: 1.5nS/2uS=0.00075 or 0.075%.
Peak-to-Average Factor = 20*log (0.00075) = -62.5 dB.

(2) With the measuring resolution bandwidth (RBW) of 1 MHz, the corresponding pulse desensitization factor ($\alpha$p) of 52 dB at pulse width $\tau$eff = 1.5 nS can be derived from Figure 28 of HP 150-2.

(3) Peak measurement = peak reading from EMI receiver + desensitization factor (52 dB)

(4) Average Measurement = Peak Readings in MHz (including antenna factor & cable loss) + duty cycle factor

**Plot #1:** **Transmitter Carrier Radiated Emissions at @ 3 meters when the LR200 was mounted on top of the metal tank and the antenna was enclosed inside the tank as intended operation.**

No significant emissions found




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

#### *5.4.4.2. Test Configuration # 2: Test with Concrete Tank*

**Remarks**: Not necessary to be repeated since different types of tanks shall not have any effect caused by the change of EUT's enclosure (metal to plastic)

#### *5.4.4.3. Test Configuration # 3: Test with Plastic Tank*

**Remarks**: Not necessary to be repeated since different types of tanks shall not have any effect caused by the change of EUT's enclosure (metal to plastic)

# EXHIBIT 6. MEASUREMENT UNCERTAINTY

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

## 6.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

| CONTRIBUTION (Radiated Emissions) | PROBABILITY DISTRIBUTION | UNCERTAINTY (± dB) | |
|---|---|---|---|
| | | 3 m | 10 m |
| Antenna Factor Calibration | Normal (k=2) | ±1.0 | ±1.0 |
| Cable Loss Calibration | Normal (k=2) | ±0.3 | ±0.5 |
| EMI Receiver specification | Rectangular | ±1.5 | ±1.5 |
| Antenna Directivit | Rectangular | +0.5 | +0.5 |
| Antenna factor variation with height | Rectangular | ±2.0 | ±0.5 |
| Antenna phase center variation | Rectangular | 0.0 | ±0.2 |
| Antenna factor frequency interpolation | Rectangular | ±0.25 | ±0.25 |
| Measurement distance variation | Rectangular | ±0.6 | ±0.4 |
| Site imperfections | Rectangular | ±2.0 | ±2.0 |
| Mismatch: Receiver VRC $\Gamma_1 = 0.2$<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 | ±0.5 |
| System repeatability | Std. Deviation | ±0.5 | ±0.5 |
| Repeatability of EUT | | - | - |
| Combined standard uncertainty | Normal | +2.19 / -2.21 | +1.74 / -1.72 |
| Expanded uncertainty U | Normal (k=2) | +4.38 / -4.42 | +3.48 / -3.44 |

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

# EXHIBIT 7. MEASUREMENT METHODS

## 7.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

### 7.1.1. Normal temperature and humidity

- Normal temperature: +15$^{o}$C to +35$^{o}$C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

### 7.1.2. Normal power source

#### *7.1.2.1. Mains Voltage*

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

#### *7.1.2.2. Battery Power Source.*

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

### 7.1.3. Operating Condition of Equipment under Test

- All tests were carried out while the equipment operated at :
  - the lowest, middle and highest channel frequencies if the operating frequency band is greater than 10 MHz
  - the lowest and highest channel frequencies if the operating frequency band is from 1 to 10 MHz.
  - the middle channel frequency if the operating frequency band is less than 1 MHz.
- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers.

### 7.1.4. Method of Measurements - AC Mains Conducted Emissions

- AC Mains conducted emissions measurements were performed in accordance with the standard against appropriate limits for each detector function.
- The test was performed in the shielded room, 16'(L) by 16'(W) by 12'(H).
- The test was performed were made over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio noise voltage which was conducted from the EUT power-input terminals that were directly connected to a public power network.
- The EUT normally received power from another device that connects to the public utility ac power lines, measurements would be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.
- If the EUT operates only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines, AC Mains conducted measurements are not required.
- Table-top devices were placed on a platform of nominal size 1 m by 1.5m raised 80 cm above the conducting ground plane.
- The EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the power source. All unused 50-Ohm connectors of the LISN was terminated in 50-ohm when not connected to the measuring instruments.
- The line cord of the EUT connected to one LISN which was connected to the measuring instrument. Those power cords for the units of devices not under measurement were connected to a separate multiple ac outlet. Drawings and photographs of typically conducted emission test setups were shown in the Test Report. Each current-carrying conductor of the EUT shall be individually tested.
- The EUT was normally operated with a ground (safety) connection, the EUT was connected to the ground at the LISN through a conductor provided in the lead from the ac power mains to the LISN.
- The excess length of the power cord was folded back and forth in an 8-shape on a wooden strip with a vertical prong located on the top of the LISN case.
- The EUT was set-up in its typical configuration and operated in its various modes as described in this test report.
- A preliminary scan was made by using spectrum analyzer system with the detector function set to PEAK mode (9 KHz RBW, VBW > RBW), frequency band 450 kHz - 30 MHz.

- The maximum conducted emission for a given mode of operation was found by using the following step-by-step procedure:

| | |
|---|---|
| Step1. | Monitor the frequency range of interest at a fixed EUT azimuth. |
| Step2. | Manipulate the system cables and peripheral devices to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal. |
| Step3. | The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed. |
| Step4. | After completing step 1 through 3, record EUT and peripheral device configuration, mode of operation, cable configuration, signal levels and frequencies for final test. |

- Each highest signal level at the maximized test configuration was zoomed in a small frequency span on the spectrum analyzer's display (the manipulation of cables and peripheral devices and EUT operation modes might have to be repeated to obtain the highest signal level with the spectrum analyzer set to PEAK detector mode 10 KHz RBW and VBW > RBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (9 KHz RBW, 1 MHz VBW) and AVERAGE detector mode (9 kHz RBW, 1 Hz VBW). The final highest RF signal levels and frequencies were record.

## 7.2. SPURIOUS EMISSIONS

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10$^{th}$ harmonic of the highest frequency generated by the EUT.

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

- ➢ RBW = 100 kHz for f < 1GHz and RBW = 1 MHz for f $\geq$ 1 GHz
- ➢ VBW = RBW
- ➢ Sweep = auto
- ➢ Detector function = peak
- ➢ Trace = max hold
- ➢ Follows the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
- ➢ Allow the trace to stabilize.
- ➢ The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc…. is the peak field strength which comply with the limit specified in Section 15.35(b)

**Calculation of Field Strength**:

The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

| | | | |
|---|---|---|---|
| Where | FS | = | Field Strength |
| | RA | = | Receiver/Analyzer Reading |
| | AF | = | Antenna Factor |
| | CF | = | Cable Attenuation Factor |
| | AG | = | Amplifier Gain |

Example: If a receiver reading of 60.0 dBuV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:

Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBuV/m.
Field Level = $10^{(38/20)}$ = 79.43 uV/m.

- Submit this test data
- Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100ms, then the reading obtained may be further adjusted by a “duty cycle correction factor”, derived from 10log(dwell time/100mS) in an effort to demonstrate compliance with the 15.209.
- Submit test data

## Maximizing The Radiated Emissions:

- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

Step4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.