ENGINEERING TEST REPORT

SITRANS LR260 (HART & PROFIBUS PA)
Model No.: 7ML5427

FCC ID: NJA-LR260

Applicant: **Siemens Milltronics Process Instruments Inc.**
1954 Technology Drive, P.O. Box 4225
Peterborough, Ontario
Canada, K9J 7B1

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C, SEC. 15.209
Low Power Transmitter
Operating at frequency of 24.82 GHz

UltraTech's File No.: MIL-369FCC15C

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: Sep. 24, 2007	
Report Prepared by: Dharmajit Solanki Issued Date: Sep. 24, 2007	Tested by: Hung Trinh Test Dates: May 17-18, 2007

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

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:	To gain FCC Certification Authorization for Low Power Transmitter operating at frequency of 24.82 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:	Commercial, light industry & heavy industry

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

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2006	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 (modified) EN 55022	2005 2006	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. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
CISPR 16-2-3	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-3: Radiated disturbance measurement

EXHIBIT 1. PERFORMANCE ASSESSMENT

1.1. CLIENT INFORMATION

APPLICANT:	
Name:	Siemens Milltronics Process Instruments Inc.
Address:	1954 Technology Drive, P.O. Box 4225 Peterborough, Ontario Canada, K9J 7B1
Contact Person:	Mr. Thoai Bui Phone #: 705 740 7009 Email Address: thoai.bui@siemens.com

MANUFACTURER:	
Name:	Siemens Milltronics Process Instruments Inc.
Address:	1954 Technology Drive, P.O. Box 4225 Peterborough, Ontario Canada, K9J 7B1
Contact Person:	Mr. Thoai Bui Phone #: 705 740 7009 Email Address: thoai.bui@siemens.com

1.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

Brand Name	Siemens Milltronics Process Instruments Inc.
Product Name	SITRANS LR260 (HART & PROFIBUS PA)
Model Name or Number	7ML5427
Serial Number	N/A
Type of Equipment	Tank Level Probing Radar (TLPR) operating as Short Range Device (SRD) installed in closed metallic or reinforced concrete tanks, or similar enclosure structures made of comparable attenuating material.
Input Power Supply Type	19 – 30 Vdc / 24 Vdc Nominal
Primary User Functions of EUT:	Tank Level Probing Radar installed in closed metallic tanks or reinforced concrete tanks, or similar enclosure structures made of comparable attenuating material

1.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type: Tank level Probing Radar	fixed use in metal tanks, reinforced concrete tanks or similar enclosure structures made of comparable attenuating material
Intended Operating Environment:	Commercial, light industry & heavy industry
Power Supply Requirement:	19 – 30 Vdc / 24 Vdc Nominal
RF Output Power Rating:	No RF signal shall emanate outside of the tank
Operating Frequency:	24.82 GHz
Modulation Types (please describe all types of modulation)	Short RF pulses radar operation (1.5 nano second wide RF pulses)
Duty Cycle	0.075%
Modulation Designation:	1G33P3N
Occupied Bandwidth:	1.33 GHz
Antennas:	Options (list of all configurations): • Flange process connection: 2", 4", 6" & 8" flange • Waveguide: 100mm, 200mm, 500mm & 1000mm waveguides • Horn antennas with gains: o 2" horn antenna, gain: 18.1 dBi o 3" horn antenna, gain: 21.3 dBi o 4" horn antenna, gain: 22.7 dBi
Operating Temperature:	-40 to +80 ^{o}C

RECEIVER	
Operating Frequency Range:	24.82 GHz

1.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)	Is cable length restricted to be < 3 meters?
1	Profibus (PA) or Loop power (4 -20mA) Hart Communication Port	1	Connector terminal	Non-shielded cable	no

EXHIBIT 2. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

2.1. 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 nominal

2.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

The SIRANS LR260 operates with it's normal operation, transmitting and receiving continuously during tests.

EXHIBIT 3. SUMMARY OF TEST RESULTS

3.1. LOCATION OF TESTS

- Powerline Conducted Emissions were performed in UltraTech's shielded room, 16'(L) by 12'(W) by 12'(H).

- Test Configuration #1 – Metal tank: 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 has 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 FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049-1). Last Date of Site Calibration: May 17, 2007.

- Test Configuration #2 – Concrete tank: Radiated Emissions were performed at St. Mary's Cement plant located in Ontario, Canada

3.2. 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
15.115(c)	20 dB Bandwidth	Yes
15.107(a) & 15.207(a)	Power Line Conducted Emissions Measurements (Transmit & Receive)	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices, the associated Radio Receiver operating in 24.82 GHz is exempted from FCCs authorization. The engineering test report can be provided upon FCC requests.		

3.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

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

EXHIBIT 4. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

4.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in ANSI C63.4 and ULTR-P001-2004.

4.2. 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 5 for Measurement Uncertainties.

4.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1-1.

4.4. POWERLINE CONDUCTED EMISSIONS @ FCC PART 15, SUBPARTS B & C, PARA.15.107(A) & 15.207

4.4.1. Limits

The equipment shall meet the limits of the following table:

	CLASS B LIMITS		
Test Frequency Range (MHz)	**Quasi-Peak (dBμV)**	**Average* (dBμV)**	**Measuring Bandwidth**
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average

* Decreasing linearly with logarithm of frequency

4.4.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

4.4.3. Test Equipment List

Test Instruments	**Manufacturer**	**Model No.**	**Serial No.**	**Frequency Range**
EMI Receiver System/Spectrum Analyzer with built-in Amplifier	Hewlett Packard	HP 8546A	3520A00248	9KHz-5.6GHz, 50 Ohms
Transient Limiter	Hewlett Packard	11947A	*310701998*	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	*89071531*	9 kHz – 200 MHz 50 Ohms / 50 μH
12'x16'x12' RF Shielded Chamber	RF Shielding	N/A	N/A	N/A

4.4.4. Photographs of Test Setup

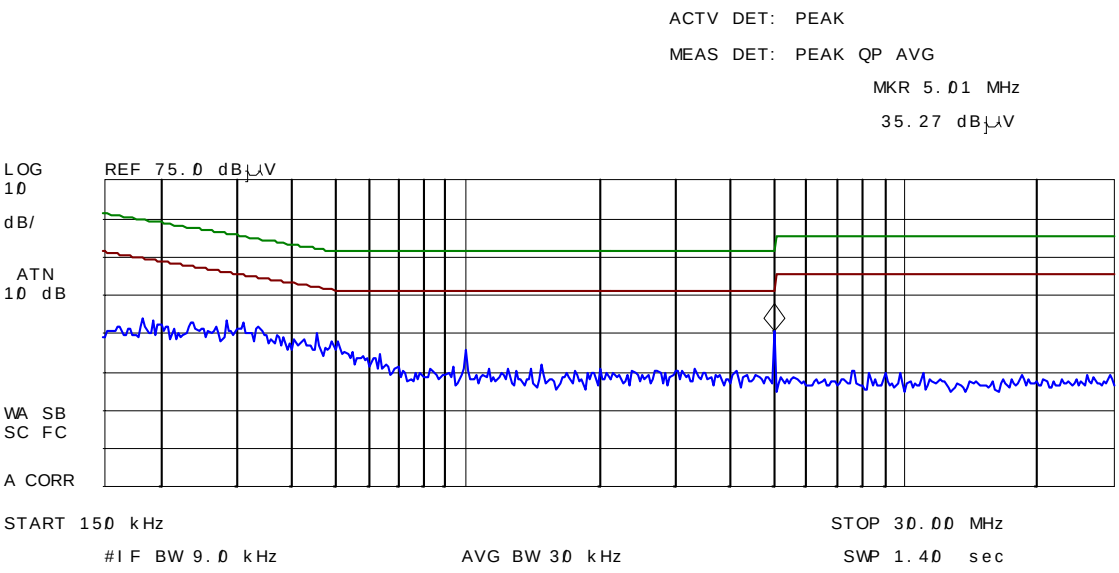
Refer to the Photographs #1 & 2 in Annex 1 for setup and arrangement of equipment under tests and its ancillary equipment.

4.4.5. Test DATA

The conducted emissions at DC Input Pots comply with FCC 15.207. Please refer to Plots # 1 and 2 below:

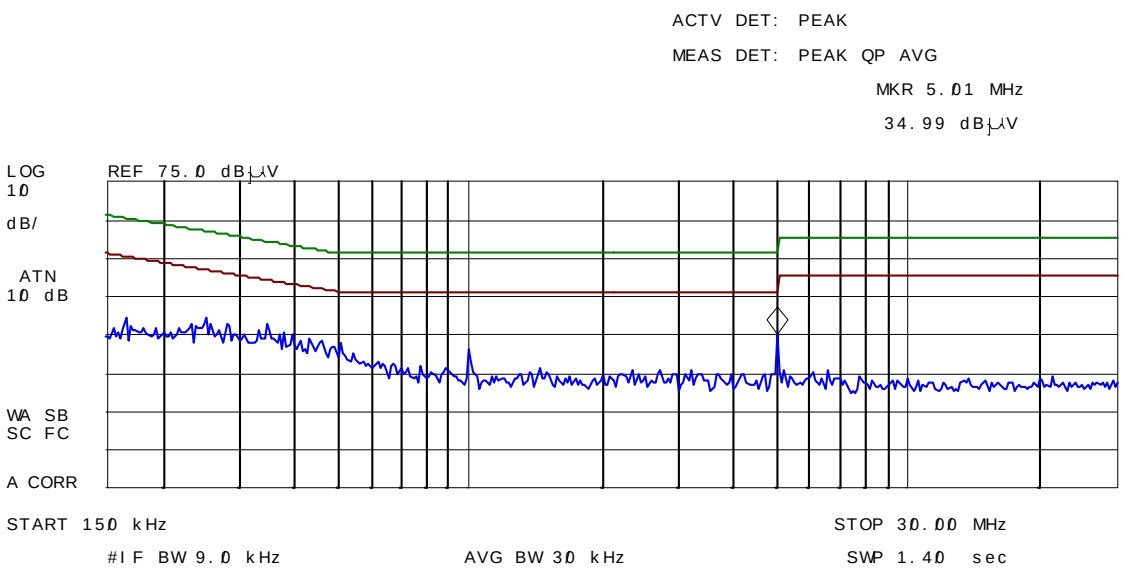
UltraTech Group of Labs		**Plot #1: DC POWER LINE CONDUCTED EMISSIONS MEASUREMENT PLOT**			
Applicant:	Siemens Milltronic Inc.	Detector:[X] PEAK [X] QUASI-PEAK [X] AVERAGE		Temp: 23 °C	Humidity: 20%
Product:	SITRANS LR260 (HART & PROFIBUS PA)	Line Tested: Positive	Line Voltage: 24 V DC	Test Tech: Wayne Wu	Test Date: 18rd May, 2007

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	AV△L2
1	0.212956	40.6	35.5	29.7	-23.5
2	1.010950	36.2	33.6	31.5	-14.5
3	4.999988	39.3	37.6	36.9	-9.1



UltraTech Group of Labs		**Plot #2: DC POWER LINE CONDUCTED EMISSIONS MEASUREMENT PLOT**			
Applicant:	Siemens Milltronic Inc.	Detector:[X] PEAK [X] QUASI-PEAK [X] AVERAGE		Temp: 23 °C	Humidity: 20%
Product:	SITRANS LR260 (HART & PROFIBUS PA)	Line Tested: Negative	Line Voltage: 24 V DC	Test Tech: Wayne Wu	Test Date: 18rd May, 2007

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	AV△L2
1	0.2500625	42.0	36.5	30.5	-21.3
2	1.0010875	35.9	33.6	31.5	-14.5
3	5.0000000	39.0	37.5	36.8	-13.2



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

4.5.1. 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

4.5.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

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).

4.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Microwave Amplifier	Hewlett Packard	HP 83051A	3332A00471	1 GHz to 50 GHz
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	1007	18 GHz – 26.5 GHz
Horn Antenna	EMCO	3160-10	1001	26.5 GHz – 40 GHz
Waveguide	CMT	RA42-K_F-5B-C	910074-004	18 GHz – 26.5 GHz
Waveguide	CMT	RA28-K_F-4B-C	920311-001	26.5 GHz – 40 GHz
Horn Antenna & Mixer	OML	WR-19	U30625-1	40 –60 GHz
Horn Antenna & Mixer	OML	E-Band	E30625-1	60 – 90 GHz
Horn Antenna & Mixer	OML	WR-08	F30625-1	90 –140 GHz

4.5.4. Photographs of Test Setup

Refer to the Photographs #3 to #7 in Annex 1 for setup and arrangement of equipment under tests and its ancillary equipment.

4.5.5. Test Data

Duty Cycle Calculation:

The duty cycle is defined as $D = t_{on} / (t_{on} + t_{off})$
Where:

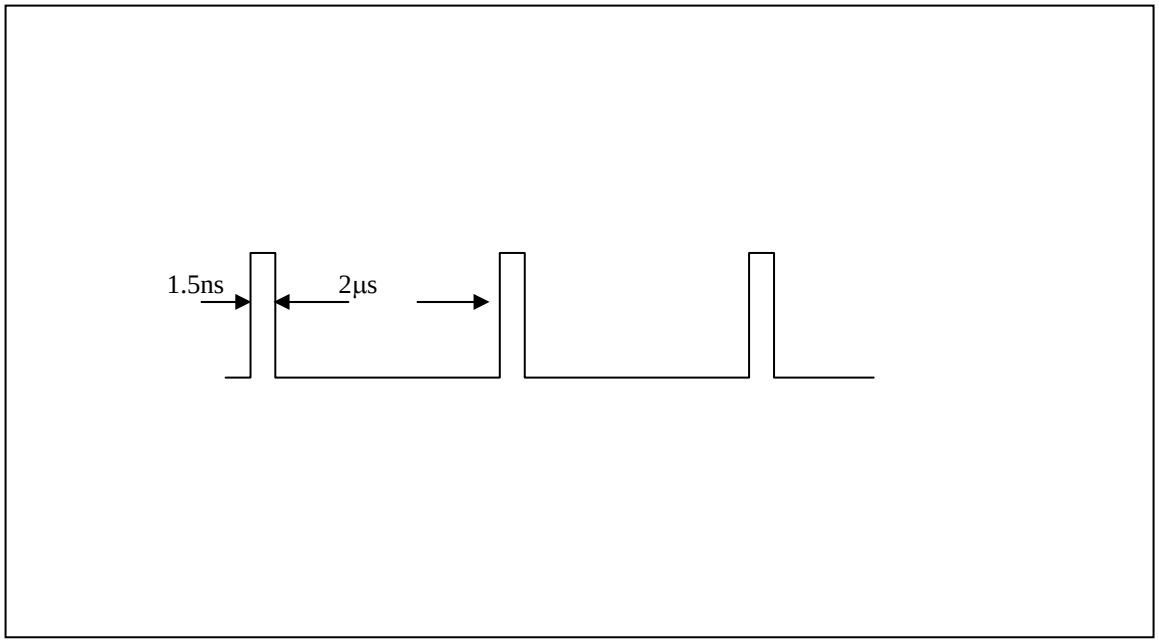
- t_{on} is the time where the transmitter is active
- t_{off} is the time where the transmitter is switched off

Duty cycle is calculated as follow:

Duty Cycle = 1.5 ns / (1.5 ns + 2000 ns) = 0.00075

- D_x = 0.00075
- Duty Cycle Class = Class 1
- Duty Cycle Ratio = 0.075 %

Transmitting diagram:



Note: SITRANS LR260 (HART & PROFIBUS PA), Model 7ML5427 with 4" horn antenna (maximum gain: 22.7 dBi)

4.5.5.1. Test Configuration #1: The LR260 was mounted on top of a Metal Tank and secured to this metal tank using metal screws and nuts as instructed by the manufacturer.

FREQUENCY	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT MARGIN (dB)	PASS/ FAIL	Distance (m)
30 – 1000 MHz	Note (1)	Note (1)	Note (1)	Note (1)	Note (1)	PASS	3
1 to 100 GHz	Note (2)	Note (2)	H and V	54.00	N/A	PASS	3, 1 & 0.5

Notes:
1. The PEAK emissions were scanned from 1 GHz to 100 GHz at 3, 1 and 0.5 meters. No rf signal was found when the E-Field was search at the separation distance of 3m, 1m and 0.5 meters from the device under test and receiving antenna.
2. Refer to Photographs #5 and #6 for test setup in Semi-Anechoic Chamber

4.5.5.2. Test Configuration #2: The LR260 was mounted on top of a Concrete Tank at St. Mary Cement Co.

Please refer to the attached Siemens Milltronics' test record conducted at St. Mary Cement CO (CF silo), 400 Waverley Road South, Bowmanville, Ontario, Canada L1C 3K3 for details of measurements.

4.6. 20 DB OCCUPIED BANDWIDTH @ FCC 15.215(C)

4.6.1. Limits

The rf spectrum shall not stay in the restricted band specified in FCC 15.205

4.6.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.4 & ANSI C63.4

The transmitter output was loosely coupled to the spectrum analyzer through a receiving antenna and the bandwidth of bandwidth of the fundamental frequency was measured with the spectrum analyzer with the resolution bandwidth of the spectrum analyzer set per ANSI 63.4, Sec. 13.1.6.2

4.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer

4.6.4. Test Data

- **Test Sample: SITRANS LR260 (HART & PROFIBUS PA), Model 7ML5427 with 4" horn antenna (maximum gain: 22.7 dBi)**

CHANNEL FREQUENCY (GHz)	20 dB BANDWIDTH (GHz)	MAXIMUM LIMIT (kHz)	PASS/FAIL
24.82	2.966	N/A	N/A

Note: The above measurement is only to full fill the FCC's requirements. The actual bandwidth for pulse desensitizing signal is calculated as below:

BW = 2/(pulse width) = 2/1.5 nS = 1.33 GHz

Plot: 20 dB Bandwidth

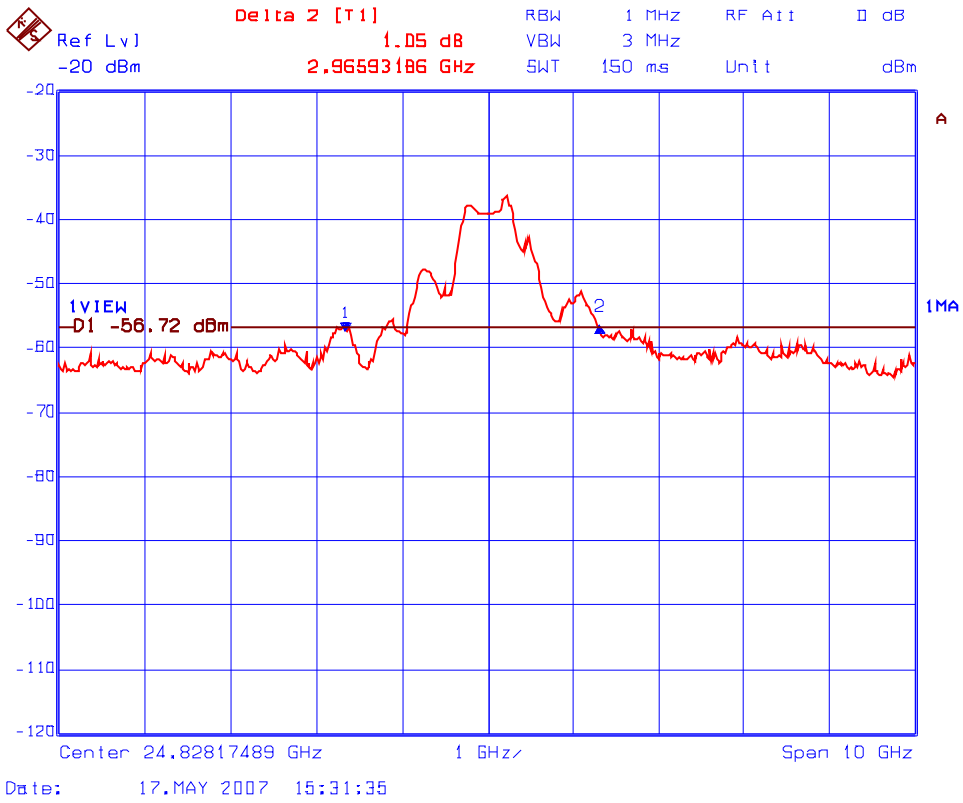


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EXHIBIT 5. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and LAB 34

5.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8$(9 kHz) 0.2 (30 MHz) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30$ dB

$U = 2u_c(y) = \pm 2.6$ dB

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5.2. 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 Directivity	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 $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	U-Shaped	+1.1 -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

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