ENGINEERING TEST REPORT

PULSE BURST RADAR LEVEL TRANSMITTER
Model No.: R82

FCC ID: LPN-R82

Applicant: **Magnetrol International Inc.**
5300 Belmont Road
Downers Grove, IL
USA 60515

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C, SEC. 15.209
Low Power Transmitter
Operating at frequency of 25.04 GHz

UltraTech's File No.: MGNT-001FCC15CRev1

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: July 14, 2009	
Report Prepared by: Dharmajit Solanki Issued Date: July 14, 2009	Tested by: Hung Trinh Test Dates: June 12 – 17 & July 14, 2009

- *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.*

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ANSI	FC	VCI	Industry Canada / Industrie Canada	NVLAP	BSMI	Korea KCC-RRL
0685	91038	1309	46390-2049	200093-0	SL2-IN-E-1119R	CA2049

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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 25.04 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	2008	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
FCC Public Notice DA: 04-3946	December 17, 2004	OET Clarifies Equipment Authorization Policy for Measurement of Broadband Emissions (Use of PDCF – Pulse Desensitization Correction Factor)
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 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT:	
Name:	Magnetrol International Inc.
Address:	5300 Belmont Road Downers Grove, IL USA 60515
Contact Person:	Mr. Paul Snider Phone # 630 969 4000 Fax # 630 969 9489 Email Address: psnider@magnetrol.com

MANUFACTURER:	
Name:	Magnetrol International Inc.
Address:	5300 Belmont Road Downers Grove, IL USA 60515
Contact Person:	Mr. Paul Snider Phone # 630 969 4000 Fax # 630 969 9489 Email Address: psnider@magnetrol.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

Brand Name	Magnetrol International Inc.
Product Name	Pulse Burst Radar Level Transmitter
Models Name or Number	R82 (Metal & Plastic Versions)
EUT Configuration Tested	Pulse Burst Radar Level Transmitter with horn antenna
Type of Equipment	Radar Level Device
Oscillators' Frequencies	1.84 MHz, 3.68 MHz & 13 GHz
Operating Temperature Range	-40 to +80 ^{O}C
Input Power Supply Type	24V DC typical <25mA through 120V AC Adaptor
Primary User Functions	Radar Level Device installed in closed plastic tanks, metallic tanks or reinforced concrete tanks.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Low Power Communication Device Transmitter Base Station (Fixed use in plastic, metal or concrete tanks)
Intended Operating Environment:	Commercial, light industry & heavy industry
RF Output Power Rating:	No RF signal shall be leaking outside the plastic, metal or concrete tank
Operating Frequency:	25.04 GHz
Modulation Types:	Short RF Pulses
Method of Frequency Generation:	Crystal
Duty Cycle:	0.167%
Emission Designation:	2G20P0N
Antenna:	Horn antenna - The antenna consists of a waveguide section (longer in one model than the other), than a horn whose design is the same (same taper and aperture) for the two models. Also the horn/waveguide is placed directly over micro-strips on the PC board as the radiating elements. There is no connector and/or launcher per se. So the horn/waveguide is simply a mechanical component with very tight tolerances. Gain will not vary significantly between units.
Operating Temperature:	-40 to +80 ^{o}C

RECEIVER	
Operating Frequency:	25.04 GHz

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 / Signal Terminal	1	Field wiring	Unshielded; 14 AWG

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:

Ancillary Equipment # 1	
Type:	AC Adaptor, I/P: 120V AC, 60 Hz. O/P: 24V DC
Brand name:	CUI Inc.
Model Name or Number:	KA12D240040045U
Part Number:	DPD240040-P6P-TK
Connected to EUT's Port:	Power/Signal Terminal via 249 Ohm Resistor Box

Ancillary Equipment # 2	
Type:	Resistor Box, 249 Ohm
Brand name:	Magnetrol International Inc.
Connected to EUT's Port:	Power/Signal Terminal via 249 Ohm Resistor Box

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:	23°C
Humidity:	54%
Pressure:	102 kPa
Power input source:	24 VDC nominal through 120V AC Adaptor

3.2. OPERATIONAL TEST CONDITIONS & CONFIGURATION FOR TESTS

The Pulse Burst Radar Level Transmitter operates as in normal operation, transmitting and receiving in burst mode during test. Also this model comes with two types of housing (1) Metal (Aluminum version) and (2) Plastic (Lexan version). We used the Plastic (Lexan version) for conducting all tests as the worst case of emission to show compliance.

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. 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 FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No: 2049A-3). Expiry date of this test site is May 1, 2011.

- Test Configuration #2 – Concrete tank: Radiated Emissions were performed at Courtice Water Pollution Control Plant, Courtice, Ontario, Canada.

- Test Configuration #3 – Plastic tank: Radiated Emissions were performed at Newcastle Water Pollution Control Plant, Newcastle, Ontario, Canada.

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
15.115(c)	20 dB Bandwidth	Yes
15.107(a) & 15.207(a)	Power Line Conducted Emissions Measurements (Transmit & Receive)	Yes
15.109(a), Class B	Radiated Emissions from Digital Devices (Unintentional)	Yes
The associated Radio Receiver operating in 25 GHz is exempted from FCC's authorization.		

4.3. 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 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 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 5 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 16-1-1.

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

5.4.1. 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

5.4.2. Method of Measurements

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

5.4.3. Test Equipment List

Test Instruments	**Manufacturer**	**Model No.**	**Serial No.**	**Frequency Range**
EMI Receiver System/Spectrum Analyzer with Sniderlt-in Amplifier	Hewlett Packard	HP 8546A	3520A00248	9 kHz – 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

5.4.4. Photographs of Test Setup

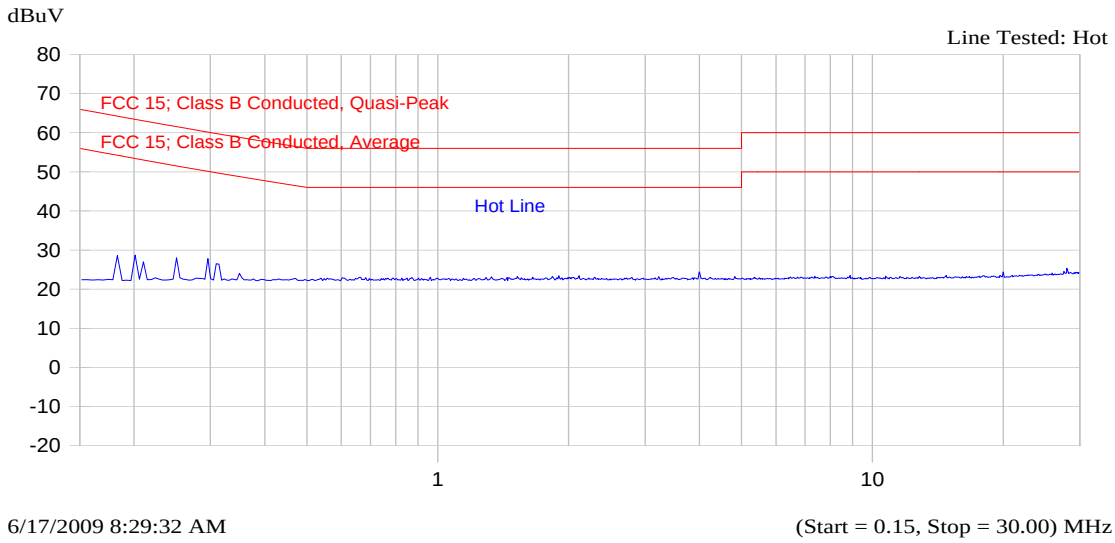
Refer to the Photographs in Annex 1 for setup and arrangement of equipment under tests and its ancillary equipment.

5.4.5. Test DATA

The conducted emissions at 120V AC Input Ports comply with FCC 15.207. Please refer to the Plots below:

Description: Power Input: 120Vac
Setup Name: FCC15B
Customer Name: Magnetrol International Inc
Project Number: MGNT-001Q
Operator Name: William Truong
EUT Name: Strobe, Model R82 Radar Level Transmitter
Date Created: 6/17/2009 8:27:01 AM
Date Modified: 6/17/2009 8:27:01 AM

Current Graph



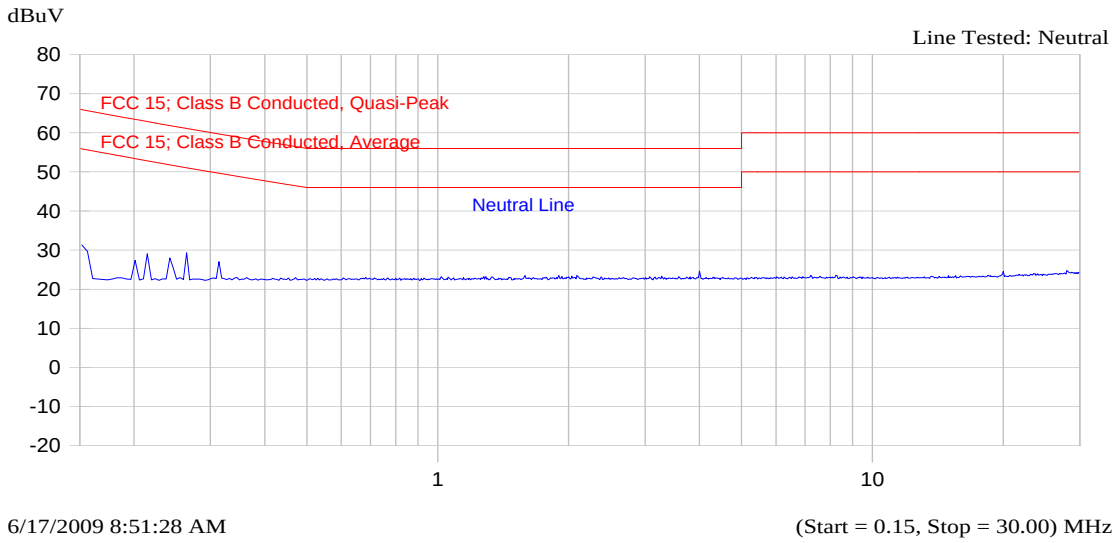
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.171	31.9	24.2	-40.7	7.6	-47.3	Hot Line
0.200	30.1	23.2	-40.4	7.7	-45.9	Hot Line
0.235	30.0	23.3	-39.0	7.7	-44.6	Hot Line
0.293	30.0	23.1	-37.3	7.7	-42.8	Hot Line

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

Description: Power Input: 120 Vac
Setup Name: FCC15B
Customer Name: Magnetrol International Inc
Project Number: MGNT-001Q
Operator Name: William Truong
EUT Name: Strobe, Model R82 Radar Level Transmitter
Date Created: 6/17/2009 8:27:01 AM
Date Modified: 6/17/2009 9:04:38 AM

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.201	31.0	23.4	-40.1	7.8	-45.7	Neutral Line
0.224	30.2	23.3	-39.4	7.8	-44.9	Neutral Line
0.263	30.7	23.5	-37.8	7.5	-43.9	Neutral Line

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

5.5.1. Limits

The fundamental frequency shall not fall within any restricted frequency band specified in 15.205
All transmitter RF 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

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

5.5.2. 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 high-pass 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 kHz $\leq$ 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), SWEEP=AUTO.
- For pulse modulated devices compliance with the regulations shall be demonstrated using measuring equipment employing a peak detector function, properly adjusted for such factors as pulse desensitization, using the same measurement bandwidths that are indicated for CISPR quasi-peak measurements. See Section 15.35(a).

5.5.3. 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
Pre-Amplifier	Com-Power	PA-103A	161243	10 – 1000 MHz
Pre-Amplifier	Hewlett Packard	8449B	3008A00769	1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3142	1005	26 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	Band U: 40 –60 GHz
Horn Antenna & Mixer	OML	E-Band	E30625-1	Band E: 60 – 90 GHz
Horn Antenna & Mixer	OML	WR-08	F30625-1	Band F: 90 –140 GHz

5.5.4. Photographs of Test Setup

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

5.5.5. Test Data

Note: Pulse Burst Radar Level Transmitter, Model R82 with horn antenna

5.5.5.1. Test Configuration #1: The R82 was mounted on top of a Metal Tank at UltraTech facility in Oakville, ON.

FREQUENCY	RF LEVEL (dBuV/m)	RF PEAK/AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT @ 3M 15.209 (dBuV/m)	MARGIN (dB)	PASS/ FAIL	ORIGINAL TEST DISTANCE (m)
30 MHz to 1 GHz	Note (1)	Note (1)	H and V	40 to 54	N/A	PASS	3.0
1 to 100 GHz	Note (2)	Note (2)	H and V	54.00	N/A	PASS	3.0 & 0.5
25.04 GHz	50.72 & 53.17*	PEAK & AVG	V	54.00	-0.83	PASS	0.5
25.04 GHz	46.44 & 48.92*	PEAK & AVG	H	54.00	-5.08	PASS	0.5

Notes:
1. The PEAK emissions were scanned 30 MHz to 1 GHz at 3 meter. No rf emissions were found from the DUT.
2. The PEAK emissions were scanned from 1 GHz to 100 GHz at 3.0 meters. No rf signal was found when the E-Field was search at the separation distance of 3m but emission at fundamental frequency was found at 0.5 meter distance as tabulated above from the device under test using receiving antenna.

* - RF level extrapolated to 3 meters. Average Measurements were obtained after adding Pulse Desensitization and Duty Cycle factors as per the formula given below.

5.5.5.2. Test Configuration #2: The R82 was mounted on top of a Concrete Tank at Courtice Water Pollution Control Plant, Courtice, ON

FREQUENCY	RF LEVEL (dBuV/m)	RF PEAK/AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT @ 3M 15.209 (dBuV/m)	MARGIN (dB)	PASS/ FAIL	ORIGINAL TEST DISTANCE (m)
30 MHz to 1 GHz	Note (1)	Note (1)	H and V	40 to 54	N/A	PASS	3.0
1 to 100 GHz	Note (2)	Note (2)	H and V	54.00	N/A	PASS	3.0 & 0.5
25.04 GHz	42.18 & 44.66*	PEAK & AVG	V	54.00	-9.34	PASS	0.5

Notes:
3. The PEAK emissions were scanned 30 MHz to 1 GHz at 3 meter. No rf emissions were found from the DUT.
4. The PEAK emissions were scanned from 1 GHz to 100 GHz at 3.0 meters. No rf signal was found when the E-Field was search at the separation distance of 3m but emission at fundamental frequency was found at 0.5 meter distance as tabulated above from the device under test using receiving antenna.

* - RF level extrapolated to 3 meters. Average Measurements were obtained after adding Pulse Desensitization and Duty Cycle factors as per the formula given below.

5.5.5.3. Test Configuration #3: The R82 was mounted on top of a Plastic Tank at Newcastle Water Pollution Control Plant, Newcastle, ON

FREQUENCY	RF LEVEL (dBuV/m)	RF PEAK/AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT @ 3M 15.209 (dBuV/m)	MARGIN (dB)	PASS/ FAIL	ORIGINAL TEST DISTANCE (m)
30 MHz to 1 GHz	Note (1)	Note (1)	H and V	40 to 54	N/A	PASS	3.0
1 to 100 GHz	Note (2)	Note (2)	H and V	54.00	N/A	PASS	3.0 & 0.5
25.04 GHz	48.54 & 51.02*	PEAK & AVG	V	54.00	-2.98	PASS	0.5

Notes:

5. The PEAK emissions were scanned 30 MHz to 1 GHz at 3 meter. No rf emissions were found from the DUT.
6. The PEAK emissions were scanned from 1 GHz to 100 GHz at 3.0 meters. No rf signal was found when the E-Field was search at the separation distance of 3m but emission at fundamental frequency was found at 0.5 meter distance as tabulated above from the device under test using receiving antenna.

* - RF level extrapolated to 3 meters. Average Measurements were obtained after adding Pulse Desensitization and Duty Cycle factors as per the formula given below.

Duty cycle

Tx. Pulse width = 0.909nS
Pulse Repetition = 542ns

The Duty Cycle for this sample is then

D = Ton/(Ton + Toff), can also be expressed as Ton/Tcycle

Ton = 0.909 nanoseconds
Toff = (1/PRF –Ton) = (543nS - .909nS) = 542.09nS

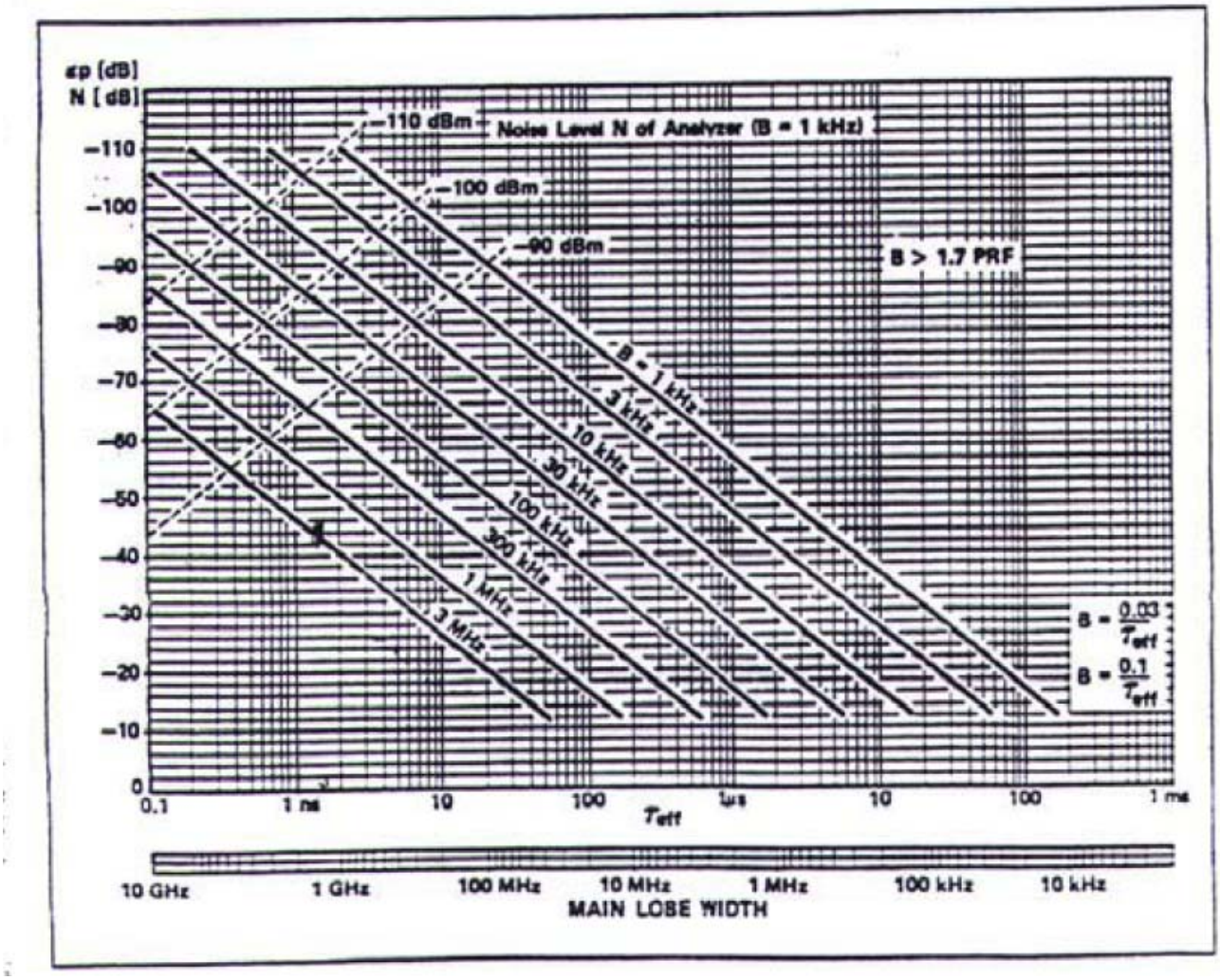
Ton + Toff (or Tcycle) is 543nS

D = 0.909/543 = .001674 or 0.1674%

Duty Cycle Factor = 20*log (0.001674) = -55.52 dB
Pulse Desensitization factor based on chart = 58 dB
The chart is shown on the next page of this report.

Average Measurement = Peak Measurement + Pulse Desensitization + Duty Cycle Factor

Pulse Desensitization Chart:



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

5.6. 20 DB OCCUPIED BANDWIDTH @ FCC 15.215(C)

5.6.1. Limits

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

5.6.2. Method of Measurements

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

The transmitter output was coupled to the spectrum analyzer and 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, Sec. 13.1.6.2

5.6.3. Test Equipment List

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

5.6.4. Test Data

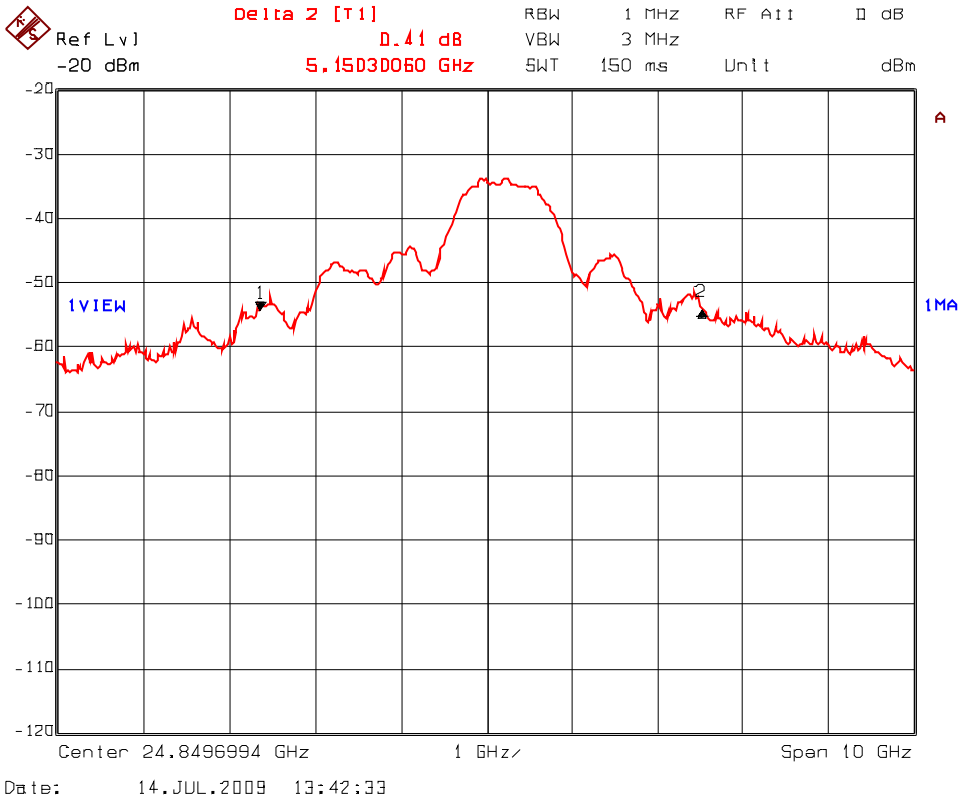
- **Test Sample: PULSE BURST RADAR LEVEL TRANSMITTER, Model R82 with horn antenna**

Channel Frequency (GHz)	20 dB Bandwidth (GHz)	Maximum Limit (GHz)	Pass/Fail
25.04	5.15	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) = 2/0.909 nS = 2.2 GHz

Plot: 20 dB Bandwidth



5.7. RADIATED EMISSIONS FROM CLASS B UNINTENTIONAL RADIATORS (DIGITAL DEVICES) @ FCC 15.109(A)

5.7.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Class B Limits @3 m (dBμV/m)	EMI Detector Used	Measuring Bandwidth (kHz)
30 – 88	40.0	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
88 – 216	43.5	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
216 – 960	46.0	Quasi-Peak	RBW = 120 kHz, VBW ≥ 120 kHz
Above 960	54.0	Average	RBW = 1 MHz, VBW = 10 Hz

5.7.2. 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 shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 -1000	5000
Above 1000	5^{th} harmonic of the highest frequency or 40 GHz, whichever is lower

5.7.3. 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
Pre-Amplifier	Com-Power	PA-103A	161243	10 – 1000 MHz
Pre-Amplifier	Hewlett Packard	8449B	3008A00769	1 GHz to 26.5 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

5.7.4. Test Data

The emissions were scanned from 30 MHz to 40 GHz at 3 Meters distance and all emissions less than 20 dB below the limits were recorded.

FREQUENCY (MHz)	RF LEVEL (dBuV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBuV/m)	MARGIN (dB)	PASS/ FAIL
No significant emissions were found and they were more than 40 dB below the limits,						

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

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 (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

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

6.2. 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