ION Digital LLP

for Andersen Corporation

0105929

Door Sensor

FCC ID: WVJ-CB00010592902

COMPLIANCE TEST REPORT

Per

FCC CFR47 Part 15 Subpart B 15.231

Revision 1.2

April 20th, 2012

	Approval	
Checked By:	Robert Stirling, P. Eng.	April 20th, 2012 Date

Protocol Data Systems Inc, EMC Lab, Abbotsford BC, Canada. SCC ISO/17025 (CAN-P-4E) Accredited Laboratory No. 612 FCC O.A.T.S. Registration Number 627740 Industry Canada O.A.T.S. Registration Number IC3384A-1

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Section I: Report of Measurement Testing Information

General Information

Applicant Company Name	Anderson Corporation
Address	100 Fourth Avenue North
	Bayport Minnesota 55003-1096
	Phone: 651 264 5150
	Fax:
	Contact Person: Mr. Sachin Gore
	Email: sgore@andersencorp.com
Product Name	Intrusion Detector Sensor Door Sensor
FCC ID#	WVJ-CB00010592902
Applicable Standards	FCC CFR Title 47 Part 15 Subpart B 15.231, ANSI C63.4:2003
Test Results	PASS
Related Report/s Approval	ION Digital RN 03330, PR11-032, PR11-040, PR11-049
Statement of Compliance	This equipment has been tested in accordance with the standards indentified in the referenced test report. To the best of our knowledge and belief, these tests were performed using the measurement procedures described in this report and demonstrate that the equipment complies with the appropriate standards. – Signature on Front Cover Page.

Equipment Under Test Specification

Manufacturer	ION Digital LLP
Product Description	DOOR Sensor
FCC ID#	WVJ-CB00010592902
Model Number	0105929
Description	Intrusion Detector Recessed Transmitter
Operating Frequency	344.94 MHz
Emission Designator	
Modulation Type	Amplitude Shift Keyed – On/Off Keyed: ASK-OOK
Bit Rate	3.7 kbit/s
Rated Transmit Power	10 dBm
EUT Power Source	3 V DC Coin Cell Battery
Test Item	EMC Test Unit
Type of Equipment	Printed Loop Antenna
Antenna Connector	Permanently Attached
Test Voltage	3 V DC Coin Cell Battery

Test Environment

Test Facility	Protocol Data Systems Inc.
	4741 Olund Rd.
	Abbotsford, BC V4X 1V6
	Office Phone: 604-504-0091
	Cell Phone: 604-218 1762
	Fax: 604-554-0091
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Test Facility ID's	SCC ISO/17025 (CAN-P-4E) Accredited Laboratory No. 612
	FCC O.A.T.S. Registration Number 627740
	Industry Canada O.A.T.S. Registration Number IC3384A
Date Tested	March 4, 6, 2012
Tested By	Rob Stirling

Test Setup

Test Supporting Equipment	None Required
Test Conditions	March 4, 6, 2012: 9°C, 50% R.H. March 6, 2012: : 6°C, 45% R.H.
Test Exercise e.g. software description, test signal, etc.	The EUT was set for continuous transmit mode of operation. It only has 1 frequency. The options were for a CW and modulated frequency. All test were conducted with the transmitter`s modulation on.
Deviation from Standard/s	No deviation from standards.
Modification to the EUT	No modifications were made.

Test Equipment List

Manufacturer	Model	Equipment Description	Serial No.	Next Cal
HP	85650A	Quasi-Peak Adapter	2811A01080	12/8/2012
HP	85662A	Spectrum Analyzer Display	2152A03569	11/8/2012
HP	8566B	Spectrum Analyzer RF Section	2241A02102	11/8/2012
HP	85685A	RF-Preselector	3107A01222	11/8/2012
EMCO	3146	Ant. Log Periodic 200-1000MHz	9611-4699	8/8/2012
EMCO	3110B	Ant. Biconical 30-200MHz	9401-1850	8/8/2012
EMCO	3115	Horn Antenna 1-18GHz	9403-4251	20/8/2012
HP	362	Controller	6452A40248	N/A
EMCO	6502	Loop Antenna	9002-2489	18/6/2012

OPERATIONAL DESCRIPTION

Rhientech	Custom	Antenna Mast	N/A	N/A
Protocol EMC	Custom	Turntable	N/A	N/A

Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	±1 x 10-5 MHz
Radiated Emissions	±3 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

Andersen Corporation Operational Description:

1. Overview

The device is a security sensor for Doors. It has a Reed Switch sensors for OPEN/CLOSE, and a levered switch for LOCKED/UNLOCKED. When the door is OPEN/CLOSED or LOCKED/UNLOCKED, the reed switch or levered switch is activated, which triggers a change of state on the sensor's microprocessor. The microprocessor then powers up the RF transmitter (Pulse Width Modulated OOK) and sends two sets of six identical packets (sextets) that flag the change of state to a receiver. The 12 packets (total) are sent with a random delay between them of 100 mS to 130 mS. The two sextets have a random delay between them of 0.580Sec to 1.430Sec.

When there is no change of state occurring, the device goes into a very low-power mode, and wakes up twice a second to check and see if there is a change of state on the reed switch. This is done using atimer internal to the microprocessor. The sensor times out every 72 minutes and transmits a Supervisory message to allow the receiver to know it is still operational. Further, a battery level indicator (ok, or low) is sent with every message packet allowing a service technician to change the battery when it gets low.

2. Battery Section

The unit uses two lithium coin cell batteries CR1632 size, and are replaceable in the package. The device operates in three modes, Idle, Monitor, and Transmit. The majority of the time the device is in the "Idle" state, and this is the major contributor to battery life, which is expected to be greater than 5 years typical.

3. Microprocessor Section

The microprocessor is a TI MSP430G2231 (U1) with onboard Flash and RAM.

Twice per second the microprocessor samples the state of the reed switch. When a change of state is detected, or a "heartbeat timeout" occurs, the microprocessor powers on the RF transmitter by raising the EN line high (U1-12), and after a brief power-up time, data is sent out on U1-11, in an amplitude shift keyed format, using On-Off keying.

4. RF Transmitter

The RF transmitter (U1) is a single frequency OOK transmitter (Melexis part TH72005). It uses a fixed Phase Locked Loop on chip to generate the transmit frequency from a crystal reference (Y1= 10.77938MHz). C4 is used with the crystal Y1 to set the fixed transmit frequency of 344.94MHz.

L1 is used to provide an RF choke to the amplifier power supply. The transmit output is matched to 50 ohms through CM1, CM2, CM3 and LM1. There is a further amplifier Q1 (NE678M04) that follows and drive a printed Loop Antenna on the pcb to complete the transmit chain.

5. Modulation Type is Amplitude Shift Keyed – On/Off keyed (ASK-OOK)

6. The carrier is modulated directly by the data coming from the microprocessor. It is a Phase Encoded (Manchester) baseband signal.

7. Peak frequency deviation is not applicable to ASK

8. The transmission rate is 3.7 Kbits/sec.

9. The rated output power into the antenna is 13dBm or 20milliwatts.

PULSED OPERATION

Duty Cycle Correction factor

On a change of state, 6 identical packets are transmitted at random intervals. The time interval between each packet is no less than 100mS and averages 125 mS. Each packet is 64 bits (16 bits preamble, 48 bit data) transmitted as PWM-ASK modulation.

Bits are Phase Encoded (Manchester) at baseband, so the duty cycle is exactly 50%. Each bit cell interval is 0.27mS, so the total on time per packet is:

On Time = 64 bits * 0.5 on/bit * 0.27mSec = 8.64 mSec

Thus, for every 100 ms, we are transmitting for 8.64 ms of that time period. Therefore our duty cycle correction factor (in the worst case 100mSec period) is:

DUTY CYCLE CORRECTION FACTOR (dB) = 20*Log(0.0864) = -21.3 dB

Transmission Time Duration from Trigger Point to End of Transmission

The processor samples the reed switch approximately once per second. After detecting a change of state, it constructs the packet (1mS), then enables the VCO on the transmitter to power up (10mS), but does not transmit during that time. Then 4 packets (29 mS each) are sent, with a random timeout between them (100mS – 800mS). Therefore the total duration time from when the device is triggered, to when transmission is completed and turned off (worst case) is 3.527 seconds.

0.000s Trigger Point

2.000s Microprocessor sample time (on close of reed switch worst case)

0.002s Microprocessor setup time for packet construction and transmitter warmup (worst case) 0.645s Sextet Packet Transmission (1st group of 6 packets)

1.305s worst case delay between sextet#1 and sextet #2

0.770s Sextet Packet Transmission (2nd group of 6 packets)

4.722s Total worst case duration from when device is triggered to transmission completed/off.

Timing plots are given below.

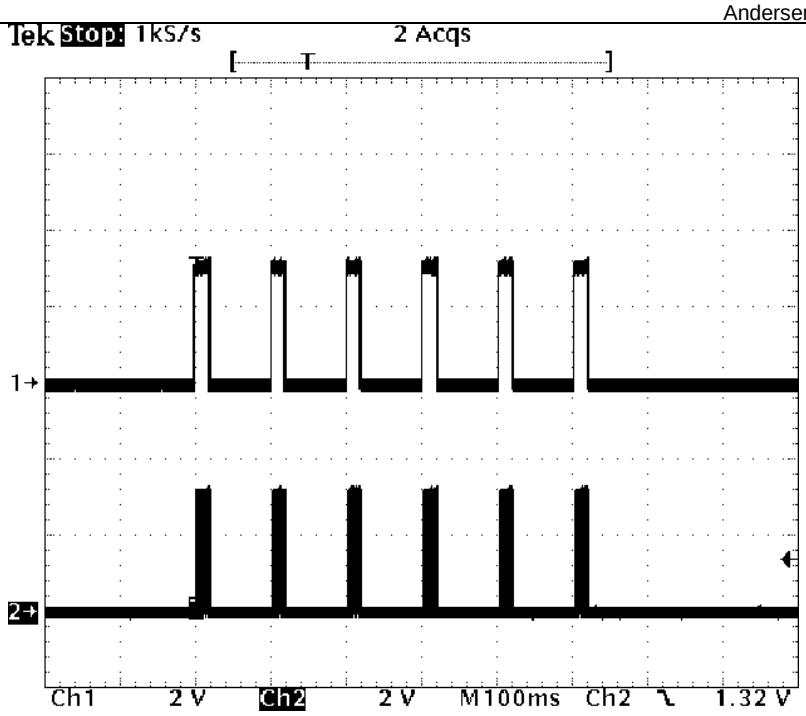


Figure 1 Transmitted (1st Sextet) Data Packets, 100ms/div

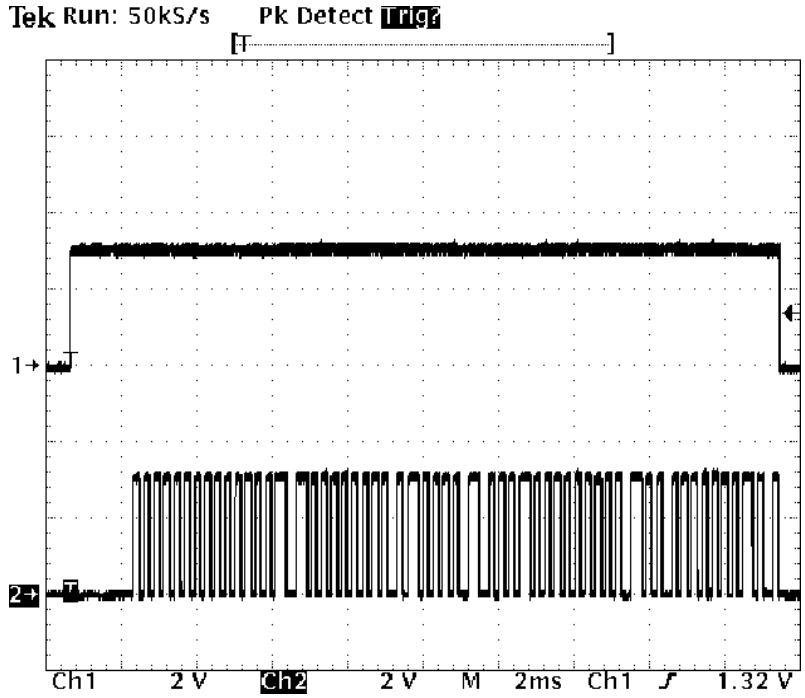


Figure 2 Transmitted Data Packet, 2.0 ms/div

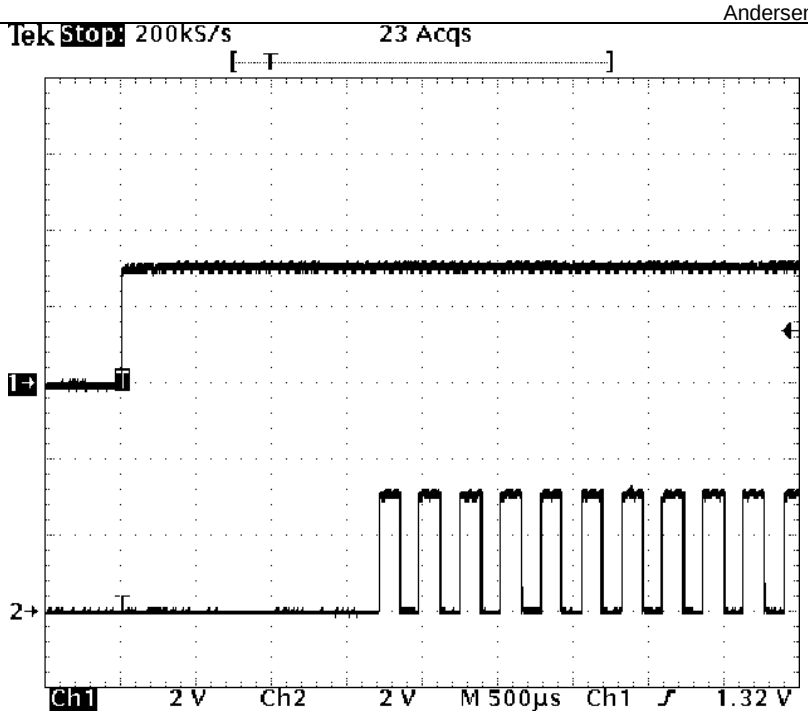


Figure 3 Transmitted Data Packet, 0.5 ms/div

Section II: Report of Measurement Test Procedures

Radiated Interference:

The measurement was made per ANSI C63.4-2003 using an Agilent model 8566B spectrum analyzer, a model 85685A Preselector, a model 85650A quasi-peak adapter, and the appropriate antenna. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was adjusted accordingly with an appropriate sweep time and the video bandwidth was adjusted accordingly up to the 10^{th} harmonic of the fundamental. When an emission was found, the table was rotated and the mast raised and lowered between 1 and 4 meters to produce the maximum signal strength. An average measurement was taken. The antenna was placed in both the horizontal and vertical planes and the stronger of the two emissions were reported. The spectrum was searched to the tenth harmonic of the transmitter.

Formula of Conversion Factors:

The field strength at 3m was established by adding the antenna factor and cable losses to the meter reading of the spectrum analyzer. The antenna correction factors are stated in terms of dB. The gain of the Preselector was accounted for in the spectrum analyzer meter reading, but any external amplifier gain and distance correction also had to be accounted for.*

Eg.:	Freq (MHz)	Meter Reading	+ ACF	+ Cable Loss	– Amp Gain	– Distance Factor	= Field Strength
	330	52.5 dBμV @ 1m	+5.0 dB	+0.5 dB	–18.5 dB	– 9.5 dB	= 50 dBμV/m @ 3m

* Where the field strength was too low to get an accurate reading at the required distance of 3 meters, the Antenna was moved closer to 1 meter. The resulting measurement was distance corrected for 3 meters by using the formula: (closer distance result) – (20Log(measured distance/required distance)) = (required distance result)

Eg.:	1M reading (dBμV/m)	– (20Log[1/3]) dB	= 3M reading (dBμV/m)
	55.42 dBμV @ 1m	- 9.54 dB	= 45.88 dBμV @ 1m

Power Line Conducted Interference:

No measurements were taken as the EUT is powered by a battery.

Occupied Bandwidth:

A sample of the transmitter output detected by an antenna was fed into the spectrum analyzer and the attached plot was printed. The vertical scale is set to 10dB per division. The Resolution Bandwidth (RBW) was set to as close to 1% of the span as possible. The Video Bandwidth was set to three times the RBW.

ANSI C63.4-2003 Measurement Procedures:

The EUT was placed in a vertical orientation, on top of a table 80 cm high with a radius of 48cm. The EUT was placed in the center of the table. The table used for radiated measurements is capable of continuous rotation. When an emission was found, the antenna was raised and lowered between 1 and 4 meters, the table was then rotated to produce the maximum signal strength and then the antenna was raised and lowered from 1 to 4 meters again to produce the maximum emission level. The antenna was placed in both the horizontal and vertical planes.

All frequencies were first found using a peak detector and then measured using video averaging to average the signal.

Section III: Report of Measurement of Radiated Emissions

DATE: December 19th, 2011

TEST STANDARD: FCC CFR Title 47, Part 15, Subpart B 15.231(b)

TEST VOLTAGE: 3 V DC, as noted in the individual test records

REQUIREMENTS:
FCC Pt 15.231

Fundamental Frequency (MHz)	Field Strength of Fundamental (µV/m) @ 3m	Field Strength of Spurious Emissions (µV/m) @ 3m
40.66 - 40.70	2250	225
70 – 130	1250	125
130 – 174	1250 to 3750*	125 to 375*
174 – 260	3750	375
260 – 470	3750 to 12500*	375 to 1250*
Above 470	12500	1250

Note: Limits in the above table are based on the average value of the measured emissions.
* Linear interpolation

CALCULATING LIMIT LINE FOR THE FUNDAMENTAL FREQUENCY

FS (microvolts/m) = (41.67 x F)-7083
= (41.67 x 344.92) - 7083
= 7289.82 µV/m

[dBµV/m] = 20*log(7289.82)
= 77.25 dBµV/m @ 3m

[@ 1m] = 77.25 + 9.54
= 86.79 dBµV/m @ 1m

Note: The limit line for all unwanted and spurious emissions is 20 dB lower as per RSS-210 and Section 15.231 of the FCC mandate.

MEASUREMENT DATA: See Appendix A for spurious emission readings within 20dB of the limit.

PERFORMANCE: PASS. The radiated emissions for the EUT meet the requirements for FCC CFR Title 47 Part 15.231. The spectrum was checked to the tenth harmonic. Spurious emissions were looked for between 30 MHz and 3500 MHz. Tables and plots can be found in Appendix A.

NOTES: The plots in appendix A have two traces. The red trace is when the EUT is on, and the black trace is an ambient trace. The letter "A" above any emission on the plots means that emission is an ambient. The frequency, uncorrected peak value, turntable degree location, mast height and delta from the Class B limit line is given above emissions coming from the EUT. The Class B limit lines are not the applicable limit lines for this device. No emissions came above the applicable limit line as given in Part 15.231.

RF EXPOSURE EVALUATION: As per RSS-102 Issue 4 a RF Exposure Evaluation has to be taken.

The RF Field Strength Limit for Devices Used by the General Public (Uncontrolled Environment) at 344.92 MHz for the electric field is given by the following formula: 1.585(f)^0.5

Therefore the limit is set at: 29.43 V/m.

The measured average value of the electric field was measured at: 70.9 dBuV/m = 0.0035 V/m.

Therefore the EUT passes the requirements of the RF Exposure Evaluation.

Section IV: 20dB Bandwidth Testing

Rules Part No.: FCC CFR Title 47 Part 15 Subpart B 15.231(c)

Requirement

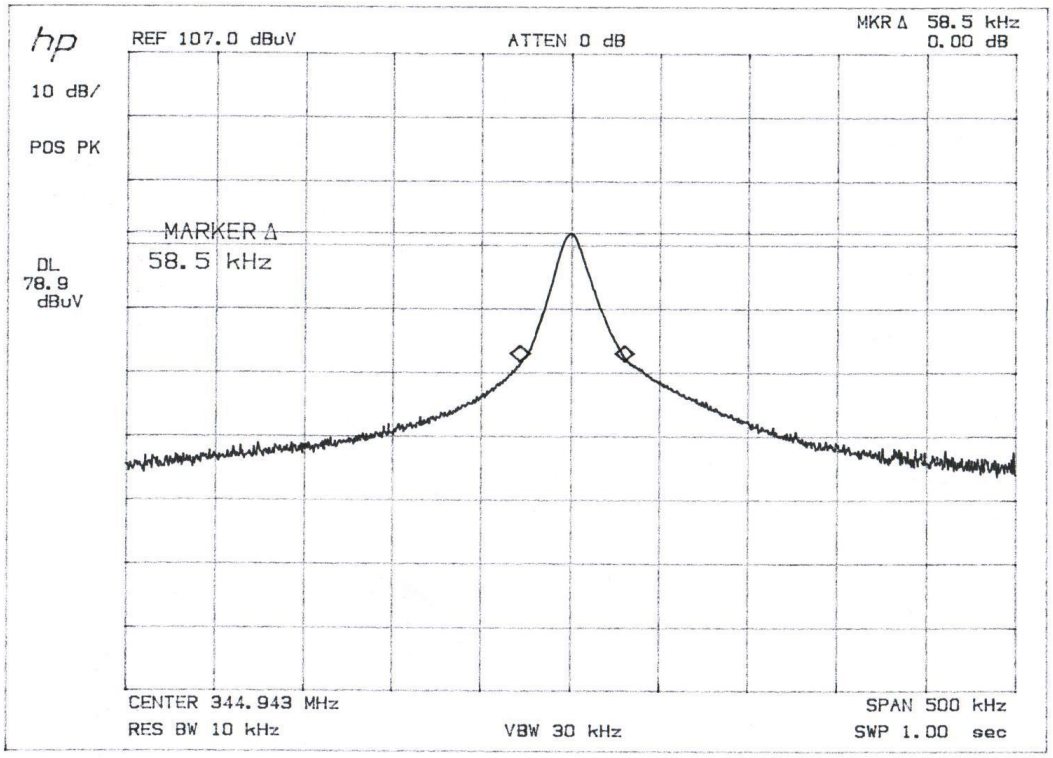
As per the above standard, The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. The bandwidth is determined at the points 20 dB down from the modulated carrier.

20dB bandwidth limit = Fundamental * 0.25%

= 344.92 MHz * 0.25%

= 862.3 kHz

Performance: PASS. As per below, 20 db bandwidth is less than 0.25% of the center frequency (862.3 kHz) for the EUT.



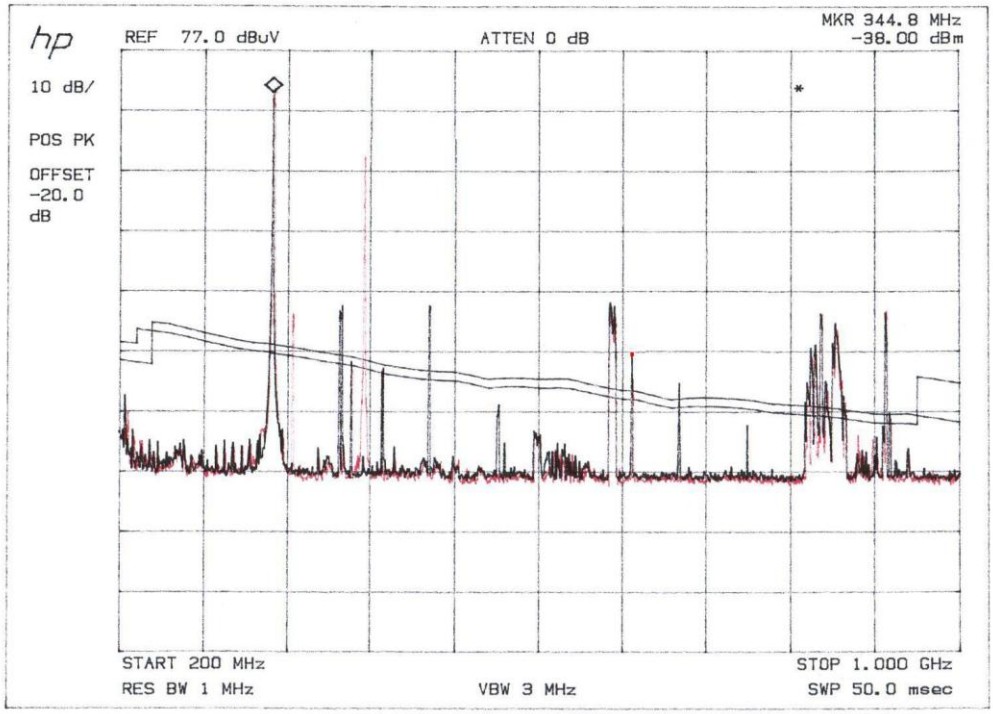
20dB Bandwidth Test: Door Sensor

Appendix A: Fundamental, Harmonics and Spurious Emissions Data and Plots

MEASURED VALUES: All measurable readings between 0.009 MHz and 3500 MHz.

Frequency (MHz)	Measured Value (dBm)	(dBuV)	Total Correction	Field Strength (dBuV/m)	Duty Cycle Averaging (dBuV/m)	Limit (dBuV/m)	Margin (dB)
344.94	-38.1	68.9	19.1	88	21.3	77.25	-10.55
689.88	-80.6	26.4	27.2	53.6	21.3	57.25	-24.95
1034.82	-44.9	62.1	-2.3	59.8	21.3	57.25	-18.75
1379.76	-57.3	49.7	-0.5	49.2	21.3	57.25	-29.35
1724.7	-56.3	50.7	3	53.7	21.3	57.25	-24.85
2069.64	-48.7	58.3	12.4	70.7	21.3	57.25	-7.85
2414.58	-53.8	53.2	16.7	69.9	21.3	57.25	-8.65
2759.52	-56.6	50.4	18.6	69	21.3	57.25	-9.55
3104.46	-54.7	59.3	20.8	72.1	21.3	57.25	-6.45
3449.4	-61.9	45.1	23.5	68.6	21.3	57.25	-9.95

Fundamental and First Harmonic RF Plot



200 MHz – 1000 MHz Vertical