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L. S. Compliance, Inc.

Compliance Testing of:
Recognition Source IRL

Prepared for:
Recognition Source

Test Report Number: 301261-IRL

Date(s) of Testing: May 15-22, June 1, 2001

*All results of this report relate only to the items that were tested.
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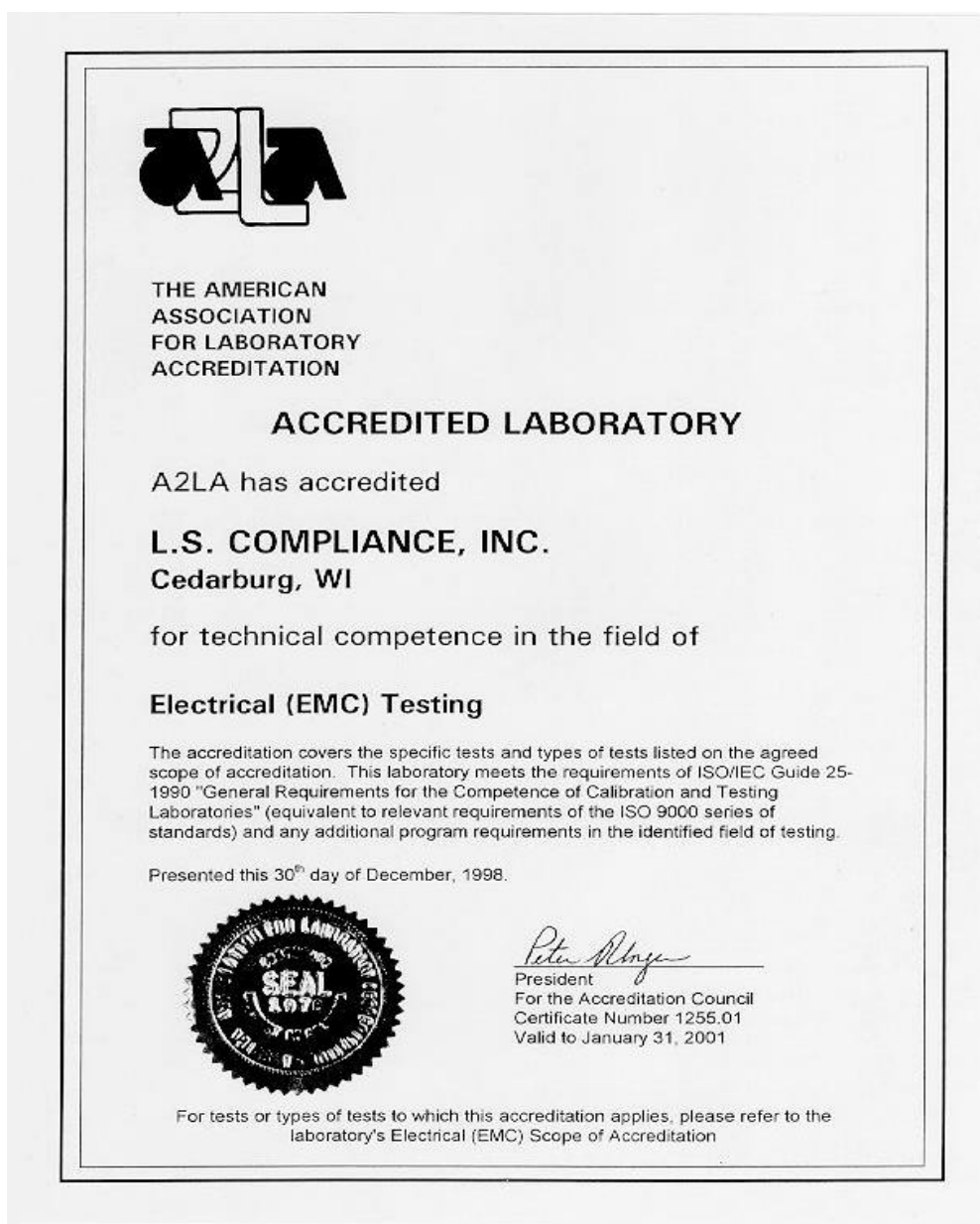
FCC ID: PM7-IRL2001 DESCRIPTION OF MEASUREMENT FACILITIES

Site on File with the FCC

ID Number: 31040/SIT 1300F2

Industry Canada listed site: IC 3088

*"The site referenced above has been found to comply with the test site criteria found in
ANSI C63.4-1992 and 47CFR Section 2.948."*





SIGNATURE PAGE

Testing By:

5 June,
2001

Kenneth L. Boston PE

Prepared by:
Approved by

5 June,
2001

Kenneth L. Boston, EMC Lab Manager

Date

PE #31926

Registered Professional Engineer

(State of Wisconsin)



2.3 SUMMARY OF TEST REPORT

MANUFACTURER:	Recognition Source
MODEL:	IRL
SERIAL:	pre-production
DESCRIPTION:	Spread spectrum data packet transceiver
FREQUENCY RANGE:	902-928 MHz

The IRL was found to **meet** the radiated emission specification of Title 47 CFR FCC, Part 15, subpart C. for an intentional radiator

The IRL was also found to **meet** the radiated emission specification of Title 47 CFR, FCC Part 15, subpart B for emissions with regards to the receiver and digital sections of the product.

This product is a composite device, with the digital sections subject to verification. Therefore this technical report will primary contain data that is pertinent to the certification of the transmitter section of the product.

2.4 INTRODUCTION

During May and June of 2001, a series of Radiated and Conducted Emissions tests were performed on a sample model of the IRL, a spread spectrum transceiver module, designed for wireless data transfer, as part of a door security system. These tests were performed using the test procedures outlined in ANSI C63.4-1992 for intentional radiators, and in accordance with the requirements set forth in FCC Part 15.247 for a spread spectrum transmitter. Tests were also performed as outlined in ANSI C63.4-1992 for non-intentional radiators, in order to verify compliance with the limits set forth in part 15.109 for and to allow verification of emissions for the digital section of the product. These tests were performed by Kenneth L. Boston, PE, of L. S. Compliance, Inc.



2.5 PURPOSE

The above mentioned tests were performed in order to determine the compliance of the IRL transceiver with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.207	15.247b	15.247e
15.205	15.247c	15.109
15.247a2	15.247d	

Various of these tests, including the conducted RF out the antenna port and the jamming margin test are contained in an additional test report that is attached to this report. All radiated emissions tests were performed to measure the emissions in the frequency bands described by the above sections, and to determine whether said emissions are below the limits established by the above sections. These tests were performed in accordance with the procedure described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-1992). Another document used as reference for the EMI receiver specification was the International Special Committee on Radio Interference (CISPR) number 16-1 (1993).

2.6 Conducted (AC Mains) Test and measurements

The IRL transceiver is powered from internal batteries, and does not derive its power from the public mains. Therefore no conducted emissions of Disturbances to the Public mains need to be performed. Conducted emissions of RF signals at the antenna port are covered in a separate section of the technical file. During testing of the spurious emissions, a substitute wall supply was necessary, as the duty cycle of this unit was modified to transmit continuously.



2.7 RADIATED EMISSIONS TEST SETUP

The test sample was operated within the 3 meter Semi-Anechoic, FCC listed chamber located at L.S. Compliance in Cedarburg, WI. The sample was positioned on a small wood pedestal, which was centered on the flush-mounted 2m diameter metal turntable. The test sample was operated on a small auxiliary power supply. When installed, the device will be operating from batteries. The test sample was configured to run in a continuous transmit mode during the 15.247 and 15.205 measurements. The sample was also set to run in a continuous transmit loop. One test sample was set to operate on either channel 1 (low), channel 8 (medium) or channel 15 (high) while being tested as an intentional radiator, in order to determine compliance within a frequency range of 902-928 MHz, as dictated by FCC part 15.31m. The IRL was mounted on the 80 CM high wooden table, centered on the turntable for measurement of spurious signals emanating from the system while in the transmit mode, at 30-1000 MHz.

Please refer to Section 2.11 for pictures of the test setup.

2.8 RADIATED EMISSION TEST PROCEDURE

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to Title 47 CFR, FCC Part 15.247c limits for Direct Sequence Spread Spectrum systems, and the 15.205 general limits, within the restricted bands. For the calculations used to determine the 1 meter limits, see Appendix A. The test sample was tested from the lowest frequency generated by the transmitter to the 10th harmonic of the fundamental frequency generated by the device. The appropriate limits were also observed where any spurious signals were located within any of the restricted bands as described in Part 15.205a. These frequencies, and their associated limits, are referenced in Section 2.10. The sample was placed on a table, or a pedestal, and placed in the 3 Meter chamber and the antenna mast was placed such that the antenna was either 1 meter or 3 meters from the test object. A biconical antenna was used to measure emissions from 30 to 200 MHz, a log periodic was used to measure emissions from 200 to 1000 MHz, and a double ridged waveguide horn was used to measure emissions above 1 GHz. The test object was programmed to operate in continuous transmit, and the resultant signals were maximized by rotating the turntable 360 degrees, and by raising and lowering the antenna between 1 and 4 meters, using both horizontal and vertical antenna polarities. Emissions above about 5 GHz were also measured at a 1 meter separation, using the HP Microwave spectrum analyzer.

No significant emissions were found aside from the transmitter fundamental, harmonics, and some spurious signals. The unit was scanned for emissions in both transmit and receive modes, over the range 30 to 10000 MHz to establish compliance with Part 15.247c and 15.205 for the system. Also, the scans were performed to evaluate the digital controller section of the product, which is subject to verification as a Class B digital device. The same procedures as detailed for the transmitter tests described above were used to perform these measurements. The results of the system measurements are found in Appendix B, with graphs of the signature scans found in Appendix C.



2.9 TEST EQUIPMENT UTILIZED FOR RADIATED EMISSIONS TEST

A list of the test equipment and antennas used for the tests can be found in Section 2.13, which includes the calibration information as well as the equipment description. All equipment is calibrated and used according to the user manuals supplied by the manufacturer. All antenna calibrations were performed at a N.I.S.T traceable site, and the resultant correction factors were entered into the Hewlett Packard 8546A EMI receiver software database. The connecting cables used were also measured for loss using a calibrated signal generator and the HP 8546A EMI receiver. The resulting loss factors were entered into the HP 8546A database. This allowed for automatic changes in the antenna correction factor, as well as cable loss or other corrections, to be added to the EMI receiver display while taking measurements. Thus, the resulting data taken from the HP 8546A is an actual reading and can be entered into the database as a corrected meter reading. The HP 8546A EMI receiver was operated with a bandwidth of 120 kHz when receiving signals below 1 GHz, and with a bandwidth of 1 MHz when receiving signals above 1 GHz, in accordance with CISPR 16. Both the Peak and Quasi-peak detector functions were used.

For measurements in the upper microwave region, an HP E4407B 26.5 GHz spectrum analyzer was used. Antenna factors for the horn antenna, a short jumper cable and a high pass filter were entered into the analyzer as correction factors. This allowed for direct readings to be made of the field strength. During emissions testing, signals where significant levels were noted were measured using the 1 MHz IF bandwidth, and a 10 or 100 Hz video bandwidth, resulting in an average measurement mode of the analyzer. Peak readings were obtained using a 1 MHz IF and 1 MHz video bandwidth.



2.10- Restricted Bands affecting this product

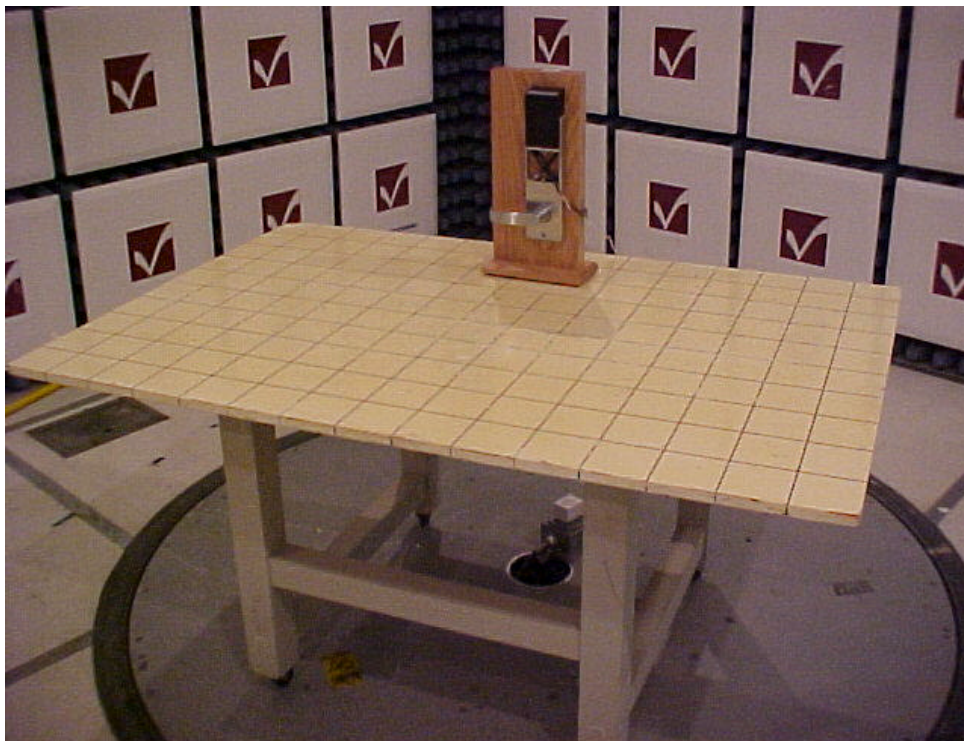
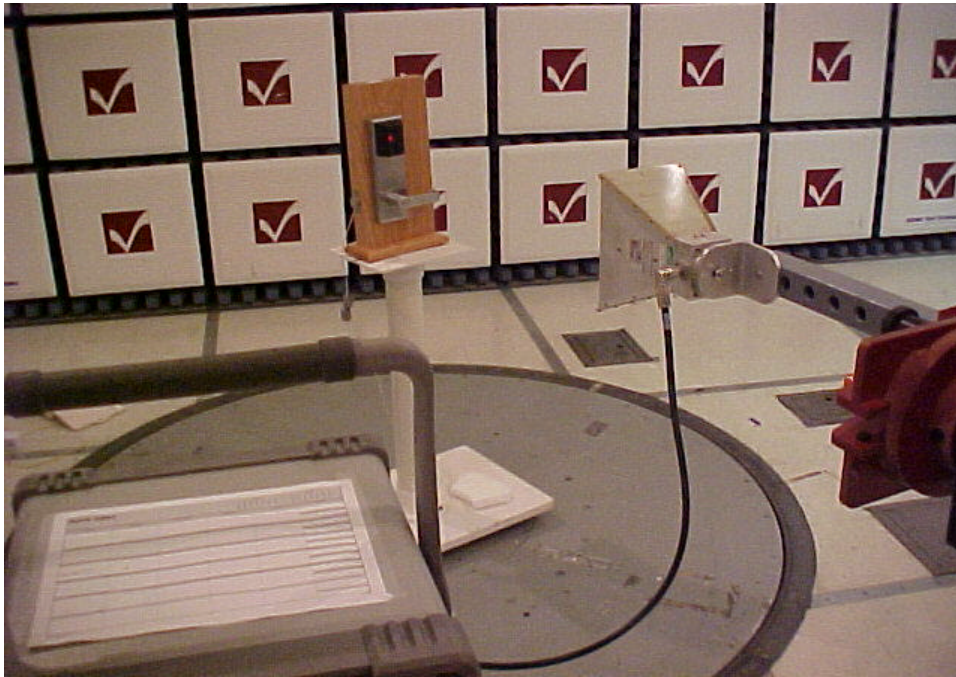
3 Meter limits

Frequency (MHz)	Limit (μ V)	Limit (dB/ μ V/m)
37.5-38.25	100	40.0
73.74.6	100	40.0
74.8-75.2	100	40.0
108-121.94	150	43.5
123-138	150	43.5
149.9-150.05	150	43.5
156.52-156.53	150	43.5
156.7-156.9	150	43.5
162-167.17	150	43.5
167.72-173.2	150	43.5
240-285	200	46.0
322-335.4	200	46.0
399.9-410	200	46.0
608-614	200	46.0
960-1240	500	54.0
1300-1427	500	54.0
1435-1626.5	500	54.0
1645.5-1646.5	500	54.0
1660-1710	500	54.0
1718.8-1722.2	500	54.0
2200-2300	500	54.0
2310-2390	500	54.0
2483.5-2500	500	54.0
2655-2900	500	54.0
3260-3267	500	54.0
3332-3339	500	54.0
3345.8-3358	500	54.0
3600-4400	500	54.0
4500-5150	500	54.0
5350-5460	500	54.0
7250-7750	500	54.0
8025-8500	500	54.0
9000-9200	500	54.0
9300-9500	500	54.0

Plus others in the frequency range below 960 MHz, not listed where spurious signals were not present.



FCC ID: PM7-IRL2001
2.11 – Photos taken during testing



View of the IRL spread spectrum transceiver during the Radiated Emissions tests.



2.12 SUMMARY OF RESULTS AND CONCLUSIONS

Based on the procedures outlined in this report, and the test results included in appendices B and C, it can be determined that the IRL does **meet** the emission requirements of Title 47 CFR, FCC Part 15 Subpart C for an intentional radiator.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed on the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report

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2.13 - Test Equipment

Asset #	Manufacturer	Model	Serial#	Description	Due Date
AA960004	EMCO	3146	9512-4276	Log Periodic Antenna	8/21/01
AA960005	EMCO	3110B	9601/2280	Biconical Antenna	9/28/01
AA960007	EMCO	3115	99111-4198	Double Ridge Horn Antenna	9/18/01
EE960004	EMCO	2090	9607-1164	Mast/Ttable controller	I.O.
EE960003	HP	85460	3617A00320	EMI receiver Display section	11/01/01
EE960003	HP	85462	3205A00103	EMI receiver Preselector section	11/01/01
CC000221	HP	E4407b	Us39160256	26.5 GHz Spectrum Analyzer	11/08/01
AA960008	EMCO	3816/2	9701-1057	16 amp LISN	8/21/01
AA960031	HP	11947A	3107A01708	Limiter	8/10/01
--	LSC	Cable	0011	3 meter Heliax	12/07/01
--	LSC	Cable	0038	1 meter RG214	12/07/01
--	LSC	Cable	0050	10 meter RG214	12/07/01



APPENDIX A:

SAMPLE CALCULATIONS

FCC ID: PM7-IRL2001 Calculation of Radiated Emissions limits for FCC Part 15.209 (above 1 GHz)

The following table depicts the Class B limits for an unintentional radiator: The limits are established at a measurement distance of 3 meters and are corrected for a 1 meter measurement distance, which is extrapolated from the 3 meter limit.

Frequency (MHz)	3m limit (dB mV/m)	1m limit (dB mV/m)
960 MHz up	54	63.54

➤ The 1 meter limits were calculated by adding a factor of 9.54 dB, derived from:

$$20\log_{10}(3/1) = 9.54 \text{ dB } \mu\text{V/m}$$

$$1\text{m limit} = 3\text{m limit} + \text{factor}$$

$$= 54 \text{ dB } \mu\text{V/m} + 9.54 \text{ dB } \mu\text{V/m} = 63.54 \text{ dB } \mu\text{V/m}$$

$$\text{rounded off} = 63.5 \text{ dB } \mu\text{V/m}$$

15.205/15.209 limits:

Frequency (MHz)	Harmonic limit (mV/m)	Harmonic limit (dB mV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-10000	500	54.0



Duty Cycle Correction Factor Calculation

For a graphical presentation of the pulses being transmitted from the IRL spread spectrum transceiver, refer to Appendix C. The DCMI sends a pulse of about 10 milliseconds length in response to a pulse sent out by the IRL unit, whenever a magnetic striped card is swiped through the card slot on the IRL. Cycle timing and human response time lag prevents the transmission of a set of pulses in any period less than 4 seconds. The spread spectrum pulse, including card data is sent only once by the IRL unit, and echoed back only once by the DCMI unit. It does not repeat until the card is swiped again. For derivation of an average value over a 100 millisecond window, the on-time of the DCMI unit pulse is divided by the 15.31 time slot of 100 milliseconds. This is used to develop a relaxation factor to be used in the radiated emissions measurements. Described below is the data packet construction, and the data bit length.

Clock oscillator is 12 MHz, data rate is 62,500 bps

preamble:	176 bits
header:	80 bits
card data	264 bits
trailer	32 bits
	552 bits X 0.016 ms per bit = 8.832 ms total length. (round to 8.83 ms)

Relaxation Factor = $20 \log (8.83/100)$
= 22 dB

Factor cap is at 20 dB, which is used for relaxation factor.



APPENDIX B:

DATA CHARTS

FCC ID: PM7-IRL2001

Measurement of Electromagnetic Radiated Emission within 3 Meter FCC Listed Chamber

Frequency Range inspected: 30 to 1000 MHz

Date of Test: May 15, 21, 2001	Manufacturer: Recognition Source
Location: L. S. Compliance, Inc.	Model No.: IRL
W66 N220 Commerce Court	
Cedarburg, WI 53012	
Specifications: 47CFR FCC Part 15.10	Serial No.: prototype
Distance: 3 meters	Configuration: TX; Channels 1,8, 15
Equipment: HP 8546A EMI Receiver	Detector(s) Used: Quasi-peak
EMCO 3146A Log Periodic	
EMCO 3110B Biconical	

The following table depicts the level of significant spurious emissions found in restricted bands

Frequency (MHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dB μ V/m)	15.205 Limit (dB μ V/m)	Margin (dB)
267.0	H	1.0	70	32.3	46.0	13.7

All other signals seen were greater than 20 dB below the 15.247 or 15.205/209 limits



FCC ID: PM7-IRL2001

Measurement of Electromagnetic Radiated Emission within 3 Meter FCC Listed Chamber

Frequency Range inspected: 1 to 9.5 GHz

Date of Test:	May 15, 21, 2001	Manufacturer:	Recognition Source
Location:	L.S. Compliance, Inc.	Model No.:	I.R.L.
	W66 N220 Commerce Court		
	Cedarburg, WI 53012		
Specifications:	47CFR, FCC Part 15.247(c), 15.205	Serial No.:	prototype
Distance:	1 meter, 3 meter	Configuration:	TX; Channels 1,8, 15
Equipment:	HP 8546A EMI Receiver	Detector(s) Used:	Peak
	EMCO 3115 Double Ridged Waveguide		

The following table depicts the level of significant spurious and harmonic emissions found within 15.205 restricted bands:

Frequency (GHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	Channel	Peak reading	Peak limit	Margin peak	factor	Corrected reading	15.205 Limit (dB μ V/m)	Margin (dB)
1014	V	1.2	220	1	65.1	74.0	8.9	20.0	45.1	54.0	8.9
2710	H	1.35	25	1	59.5	74.0	14.5	20.0	39.5	54.0	14.5
3614	H	1.0	115	1	58.2	74.0	15.8	20.0	38.2	54.0	15.8
4517	H	1.0	225	1	58.0	74.0	16.0	20.0	38.0	54.0	16.0
5421	H	1.15	30	1	65.7	74.0	8.3	20.0	45.7	54.0	8.3
*8130	V	1.0	220	1	69.9	83.5	13.6	20.0	49.9	63.5	13.6
1025	V	1.2	15	8	66.2	74.0	7.8	20.0	46.2	54.0	7.8
2745	V	1.55	350	8	53.3	74.0	20.7	20.0	33.3	54.0	20.7
3660	V	1.15	10	8	54.5	74.0	19.5	20.0	34.5	54.0	19.5
4575	V	1.0	50	8	58.5	74.0	15.5	20.0	38.5	54.0	15.5
1036	V	1.2	65	15	62.4	74.0	11.6	20.0	42.4	54.0	11.6
2777	H	1.1	35	15	57.0	74.0	17.0	20.0	37.0	54.0	17.0
3704	H	1.0	50	15	60.1	74.0	13.4	20.0	40.1	54.0	13.4
4629	H	1.0	120	15	58.2	74.0	15.8	20.0	38.2	54.0	15.8

* measurement performed at 1 meter separation distance, all others at 3 meters.

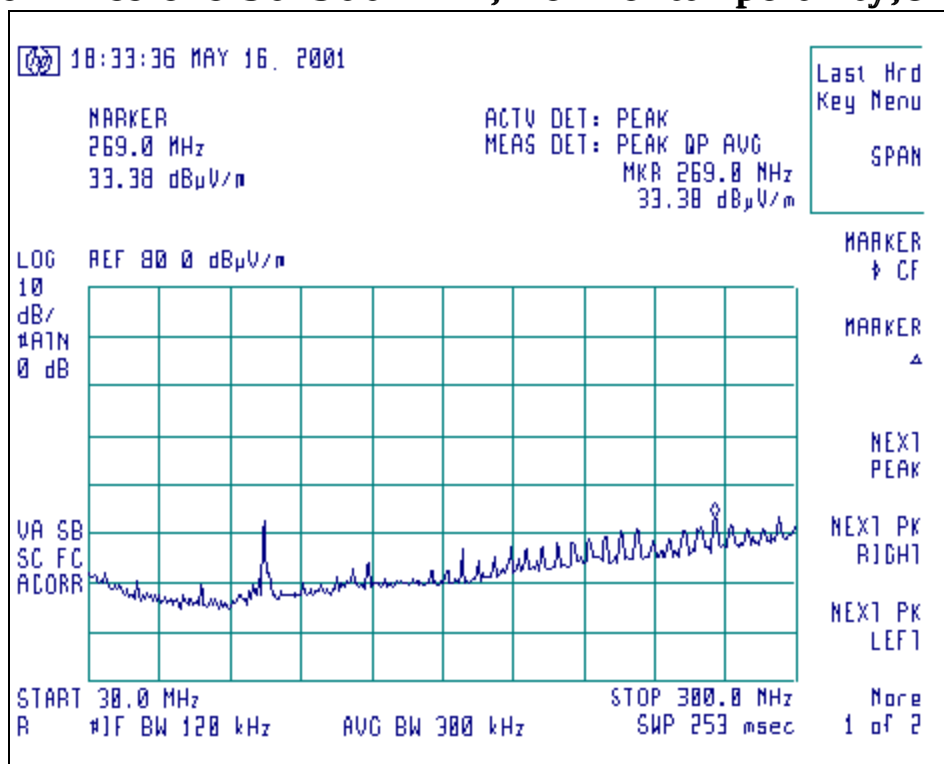


APPENDIX C:

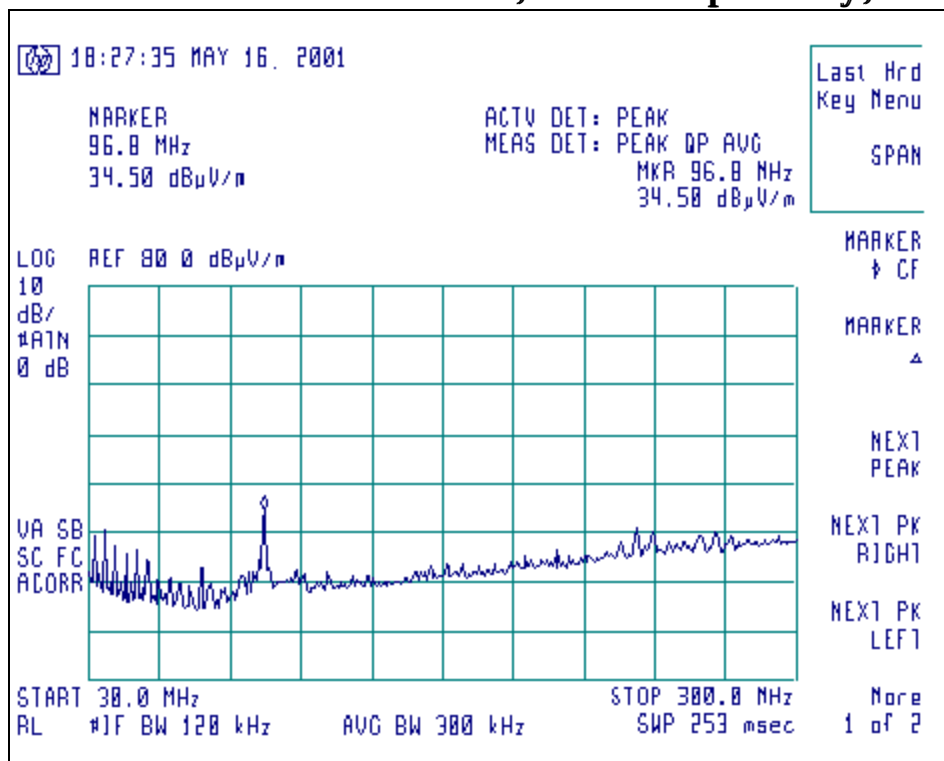
GRAPHS



Radiated Emissions 30-300 MHz, horizontal polarity, channel15

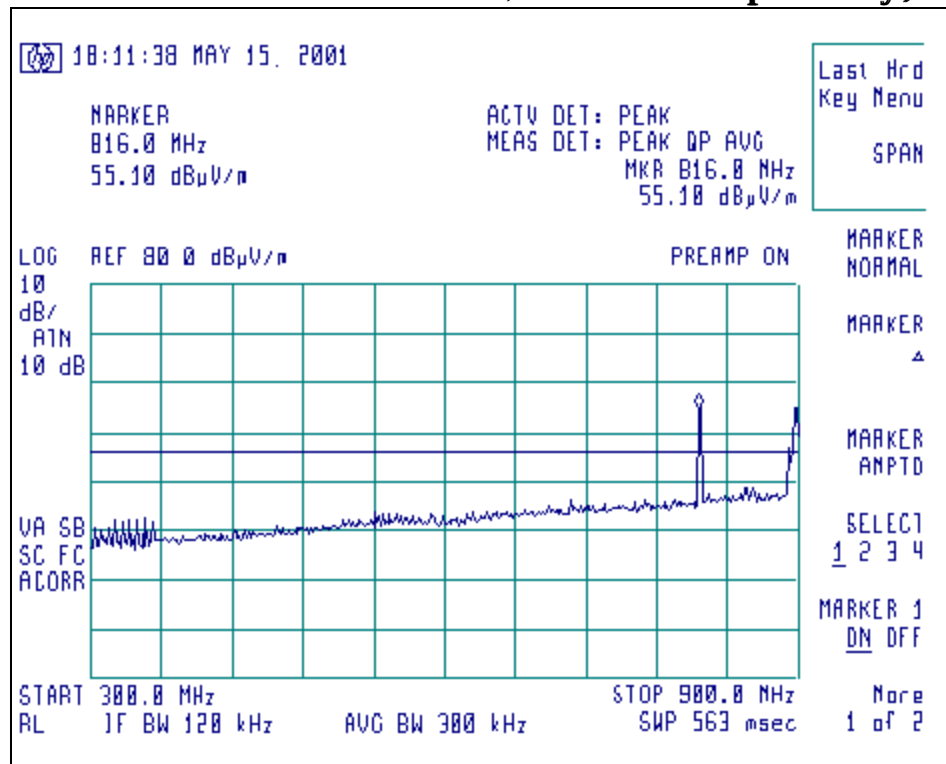


Radiated Emissions 30-300 MHz, vertical polarity, channel15

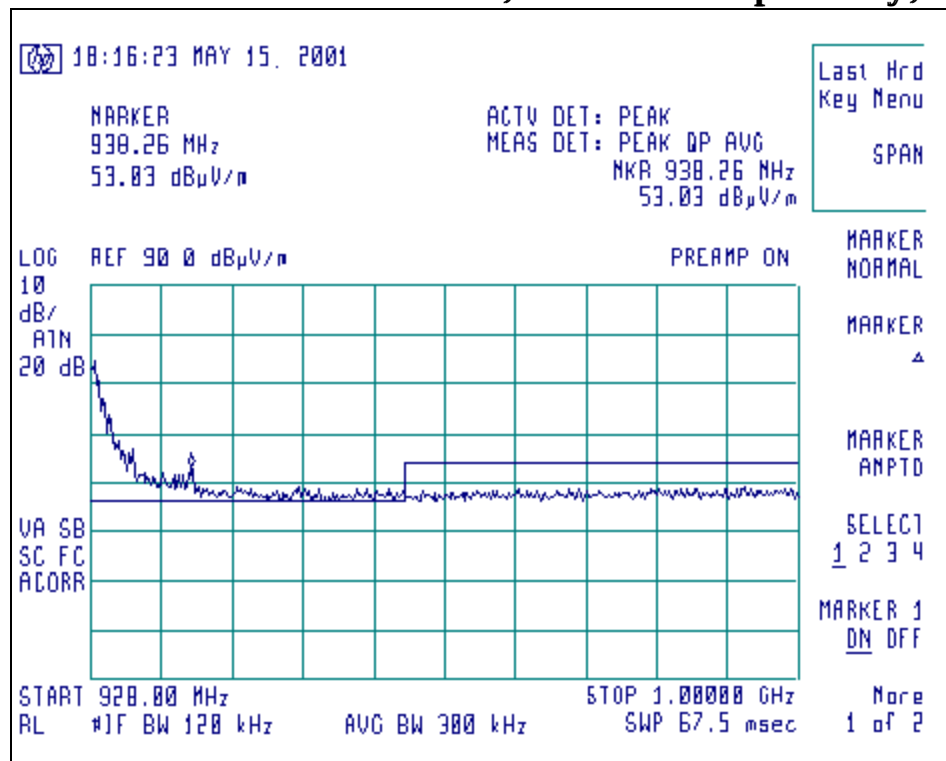




Radiated Emissions 300-900 MHz, horizontal polarity, channel 1

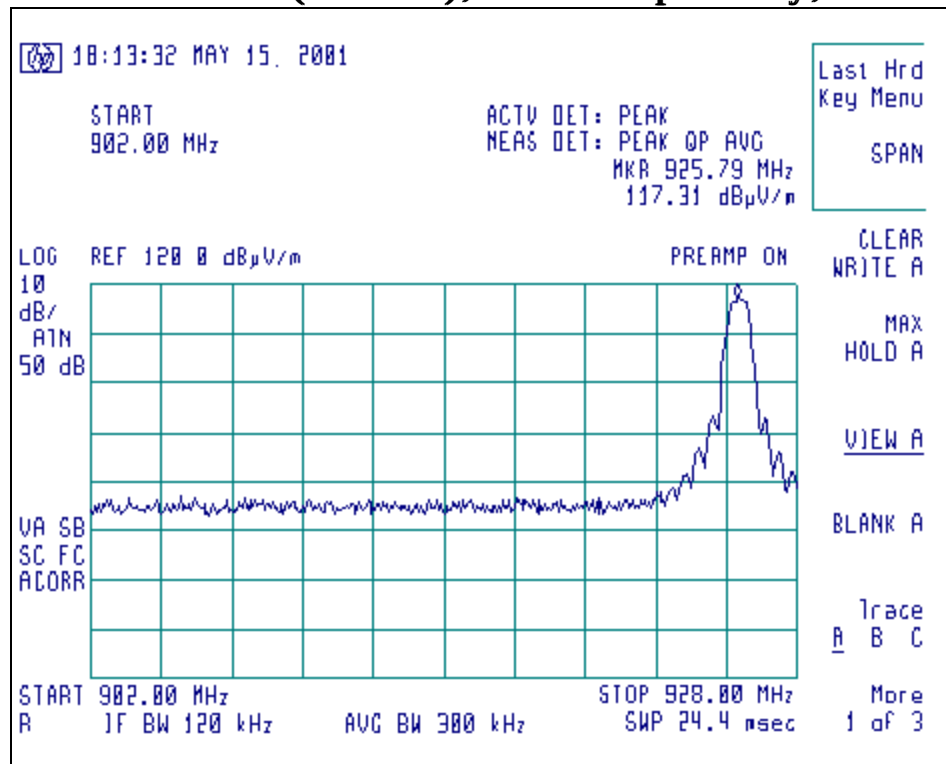


Radiated Emissions 928-1000 MHz, Horizontal polarity, channel 15



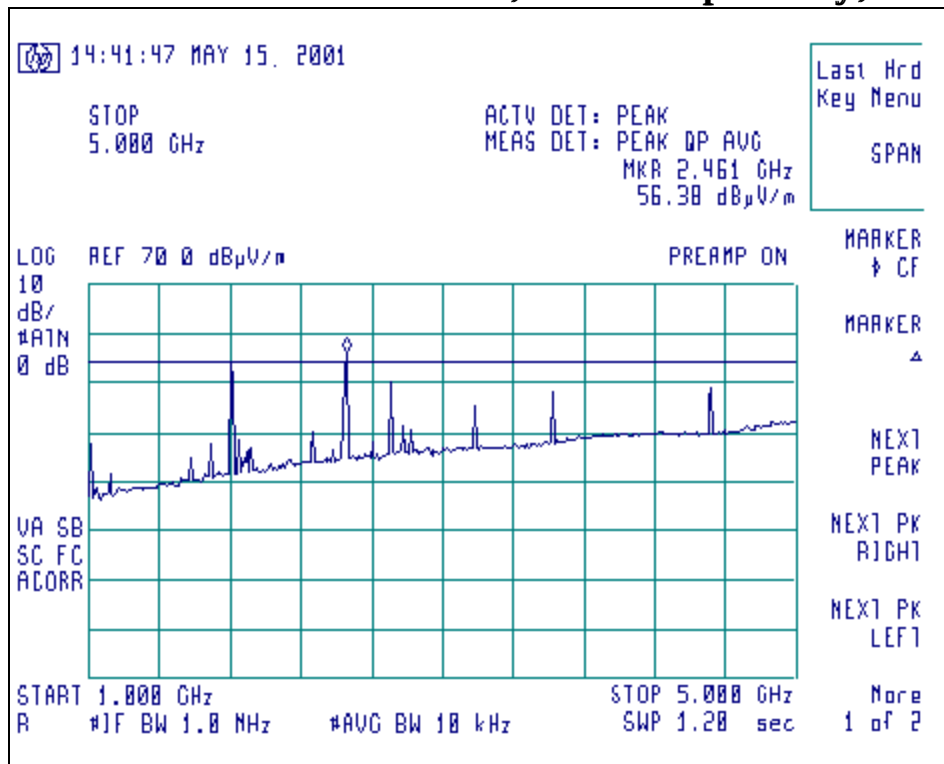


Radiated emissions (inband), vertical polarity, channel 15

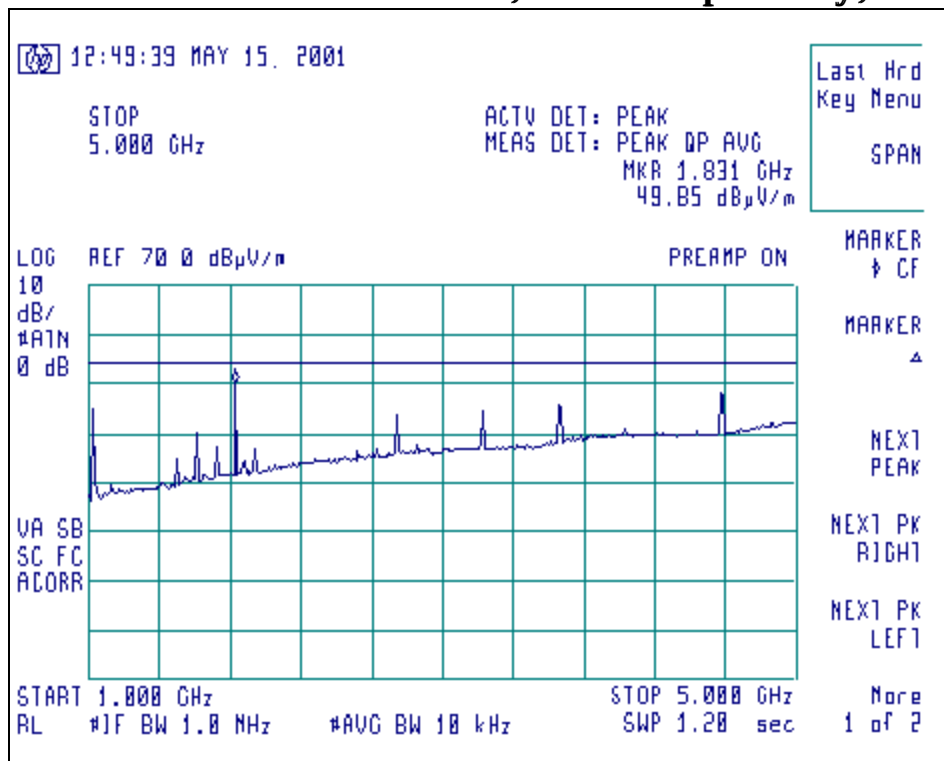




Radiated Emissions for 1-5 GHz, vertical polarity, channel 1

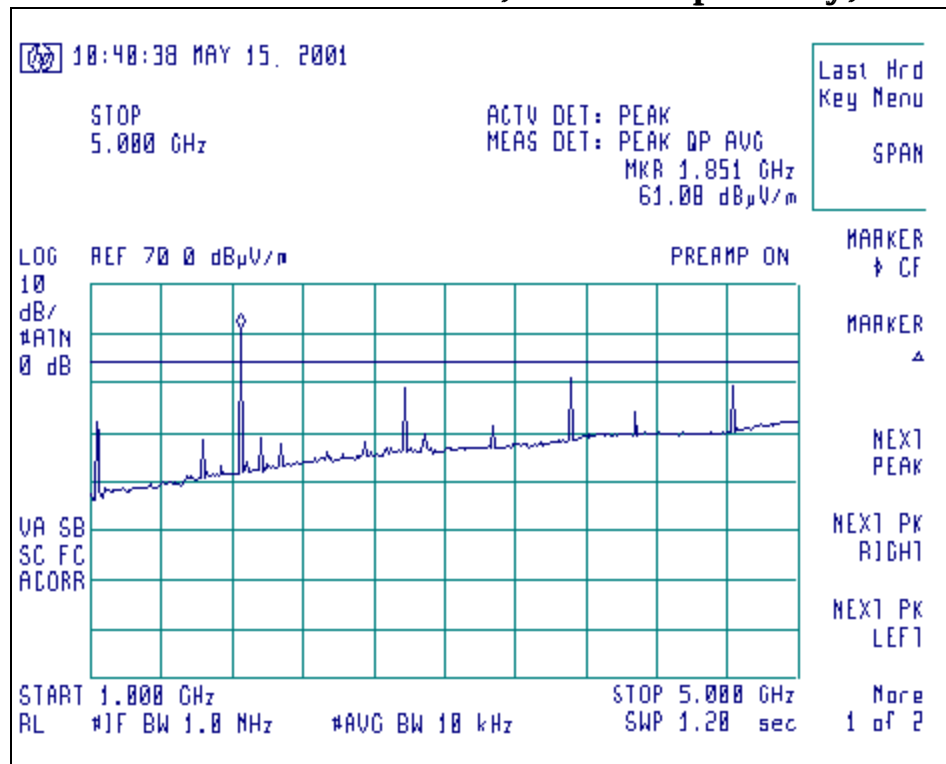


Radiated Emissions for 1-5 GHz, vertical polarity, channel 8

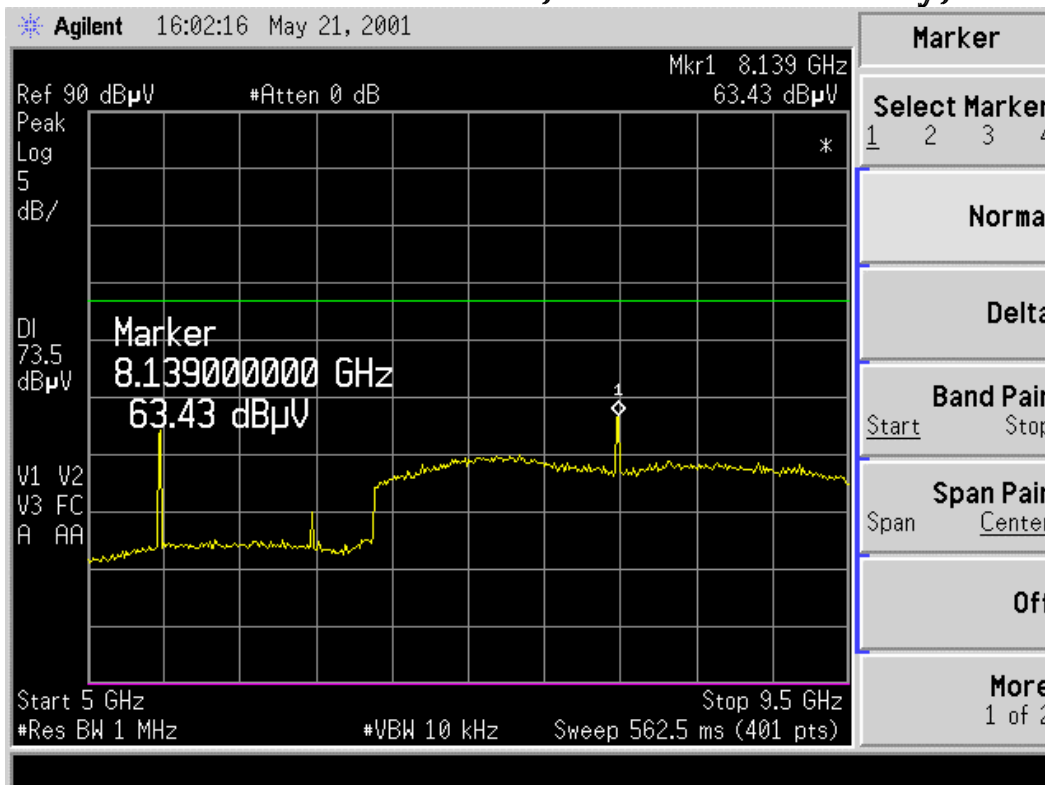




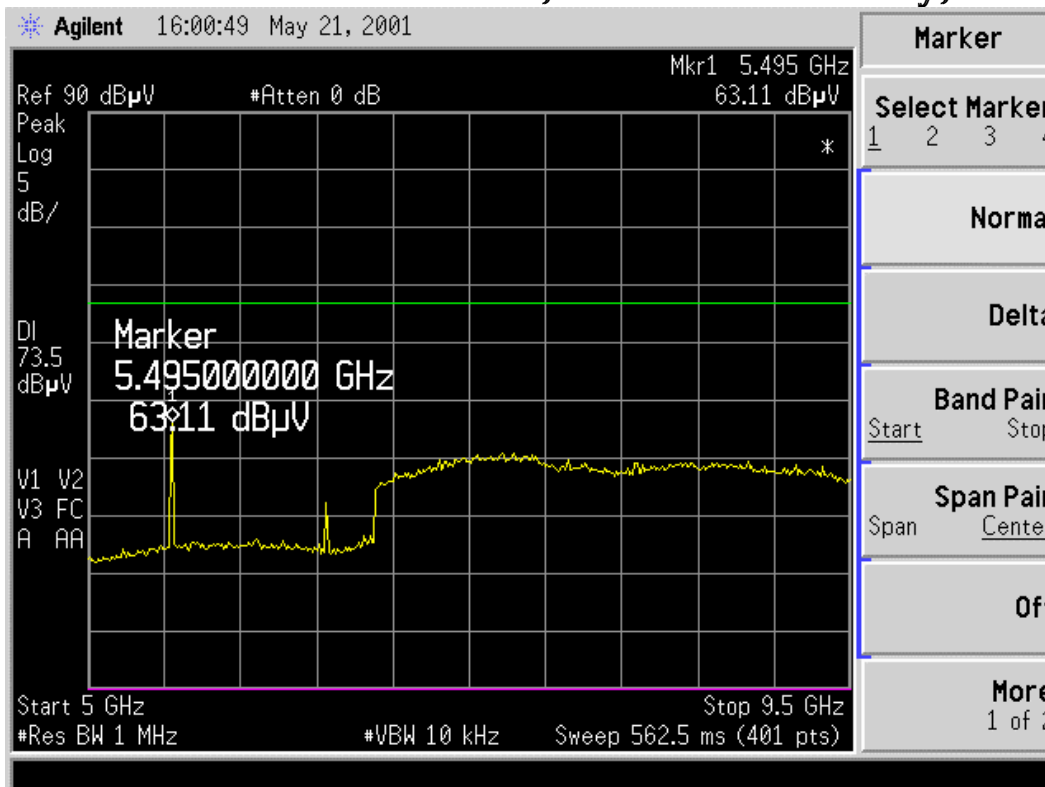
Radiated Emissions for 1-5 GHz, vertical polarity, channel 15



Radiated Emissions 1 to 9.5 GHz, horizontal Polarity, channel 1

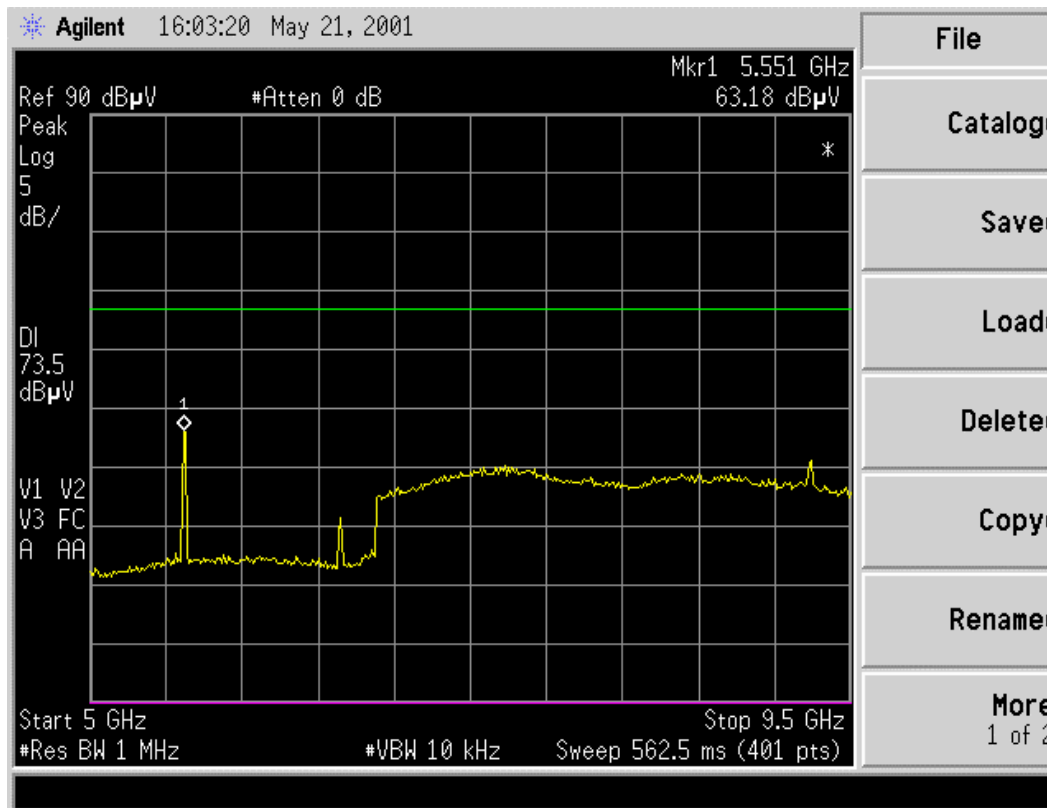


Radiated Emissions 1 to 9.5 GHz, horizontal Polarity, channel 8



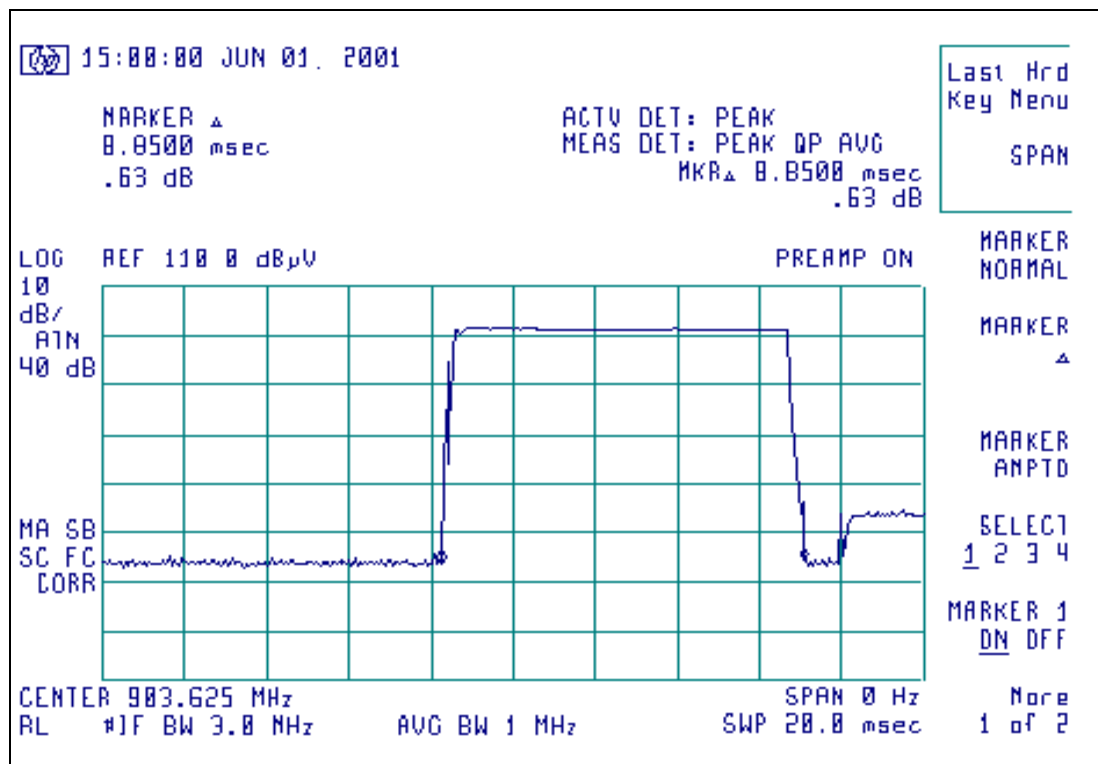


Radiated Emissions 1 to 9.5 GHz, horizontal Polarity, channel 15



FCC ID: PM7-IRL2001

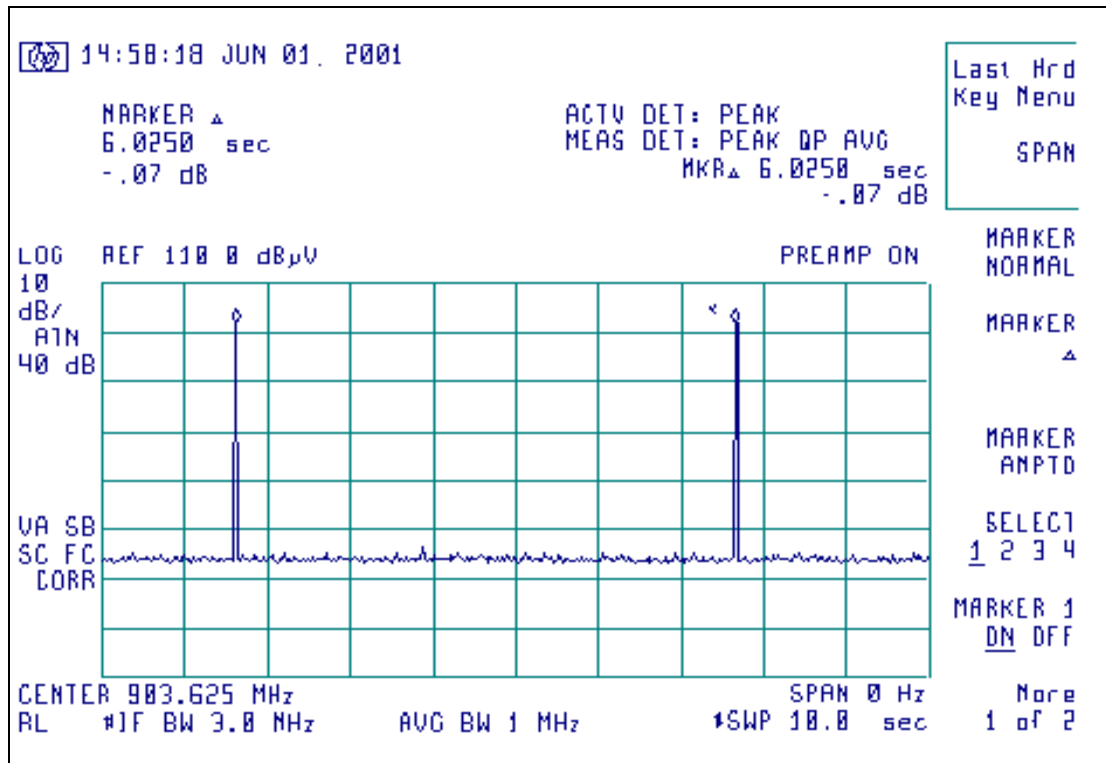
Duty Cycle Correction Factor Plots, channel 1, detail



Duty Cycle Correction Factor Plots, channel 1, showing packet repeat timing



FCC ID: PM7-IRL2001





APPENDIX D:

CONDUCTED EMISSIONS AND JAMMING MARGIN REPORT

REFER TO L.S. RESEARCH REPORT NUMBER: **301261 - IRL APPENDIX D**