COMPANY	Sensormatic Electronics Corp. 6600 Congress Ave Boca Raton, Florida 33487
PRODUCT TESTED	Sensormatic® Agile 2 Reader FCC ID: BVCIDRDR2 IC: 3506A-IDRDR2
FCC RULES	15.207, 15.209, 15.247
TEST DATE	May 6th-August 27th, 2004
SUBMITTED BY	William M. Elliott

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I. Summary of Results

FCC 47 CFR Part [RSS 210 Section]	Testing Requirement	Test Limits	Issues /Comments
15,15 (b)	**User Accessible Controls**	N/A	The product contains no user accessible controls that increase transmission power above permitted levels.
15.31(e)	**Vary Input Power**	N/A	Input was varied from 102 to 138 V AC. Input power to antenna was measured.
15.109 [IC 7.3]	**Radiated Emissions Requirements [Digital Device]**	See Table 15.109. Unintentional digital emissions subject to Class A limits.	Digital emissions determined by turning transmitter off. Complies [Verification].
15.203	**Antenna Requirements**	Permantantly attached or unique coupling.	The antenna connectors are reverse sex TNC connectors, fulfilling the unique connector requirement. Complies.
15.207 (a) (b) [IC 6.6]	**AC Power Line Conducted Measurements**	CISPR Class B Limits	Conducted emissions on AC side of DC supply is provided in this report. Complies.
15.205 (a) (b) [IC 6.3] 15.209 [IC 6.2.2(o)(e1)]	**Restricted Band Compliance**	Must comply with limits Specified in 15.209 (a)	The fundamental is not in a restricted band and the spurious emissions in the restricted bands comply with the general emission limits found in 15.209.
15.247 (a) (1) [IC 6.2.2(o)(a1)]	**Carrier Frequency Separation**	Separated by minimum of 25 kHz or 20 dB BW of the hopping channel, whichever is greater.	The carrier frequencies are separated by at least the 20 dB BW of the hopping channel. Complies.
15.247 (a) (1) (i) [IC 6.2.2(o)(a2)]	**Number of Hopping Frequencies – 900 MHz TX**	If 20 dB BW is 250 kHz or greater, then shall use at least 25 hopping channels.	The EUT has 50 hopping channels and complies with the requirement.
15.247 (a) (1) (i) [IC 6.2.2(o)(a2)]	**Dwell Time – Number of Hopping Frequencies > 25**	< 0.4 sec within a 10 second period	The EUT complies with the requirement. See attached data.
15.247 (a) (1) (i) [IC 6.2.2(o)(a2)]	**Maximum 20dB Bandwidth**	Maximum 20 dB BW of the hopping channel cannot exceed 500 kHz.	The EUT complies with the requirement.
15.247 (b) (2) (3) [IC 6.2.2(o)(a2)]	**Output Power 902-928 MHz Tx**	< 1 W – freq. hopping with 50 channels	The EUT complies with the requirement.
15.247 (b) (4)	**Maximum Antenna Gain**	If directional gain of transmitting antenna greater than 6 dBi, the peak output power of the device shall be reduced below the stated values in 15.247 (b) (2) and b (3)	The antennas used with the device all have gains < 6 dBi.
15.247 (b) (5) [IC Section 14]	**RF Exposure**	Must ensure that RF MPE to the public falls within Commission Guidelines	See RF Exposure Exhibit.
15.247 c [IC 6.2.2(o)(e1)]	**Band-edge Compliance of RF Emissions**	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power	The EUT complies with the band-edge requirements. No band-edge emissions fall within restricted bands. See submitted data.
15.247 c [IC 6.2.2(o)(e1)]	**Radiated Restricted Band Emissions Requirements**	Must comply with limits Specified in 15.209 (a)	The spurious emissions in the restricted bands from this device comply with the emission limits found in 15.209.
15.247 (g) (h)			See appropriate sections of report.

II. General Information

This report is part of the application for Certification of a RFID reader operating in the 902-928 MHz bands under the rules provided for frequency-hopping spread spectrum transmitters found in 47 CFR 15.247. The product covered by this report is the Sensormatic Agile 2 Reader.

Test Methodology

The Agile 2 is a RFID reader designed to operate in the UHF band 902 MHz to 928 MHz. The reader is divided into three sub-modules (1) Digital board and (2) two UHF radio modules connected to the digital board through a 60 pin bus (figure1). The digital board contains all remote interface, data acquisition, processor/DSP, voltage distribution, and two RF slots.

Each UHF module is a full CW radio transceiver with 30 dBm maximum output power . There are currently two versions of the UHF radio module distinguished as a 4-port or a 2-port.

The 4-port UHF module combines the receive path and the transmit path onto a single path through the use of a ferrite circulator. This path is then switched to one of four antennas.

The 2-port UHF module has separate isolated receive and transmit antenna connections. The receive path may be switched to one of two antennas. The transmit path may be also switched to one of two antennas. The receive and transmit antennas are in a single housing, and are isolated from one another.

Other than that, the circuitry is identical for both boards. Each port is functionally identical.

For the purpose of these tests, conducted measurements were made on both boards and the worst case data is reported here. In fact, the difference in the conducted data was imperceptible apart from measurement variance, further supporting the fact that the boards are functionally electrically identical.

The Agile 2 is capable of implementing three UHF protocols namely EPC Class 0, EPC Class 1 or ISO18000. Each UHF module is capable of implementing either air protocol.

Four antennas can be utilized with the reader:

Description	**Product Code**	**Gain**	**MFG**
[All patch antennas – circularly polarized]			
1) OmniWave	OmniWave	5.75 dBi	Tyco
2) Agile OmniPoint Ant - UHF – short	IDANT20TNA	5.75 dBi	Tyco
3) Agile OmniPoint Ant - UHF – Long	IDANT21TNA25	5.75 dBi	Tyco
4) Matrics Series 1 Antenna Model ANT-GP-HP	IDANT30TNA25MX	5.75 dBi	Tyco

All antennas can and will be utilized with the 2-port UHF board. However, only the OmniWave antenna is specified for use with the 4-port UHF board.

The Agile V2 RFID Reader can accommodate up to 8 transmit antennas off of electrically identical transmit ports. However, only one port, and therefore one antenna, can be active at a time. Under no circumstances can more than one transmitter be on at one instance in time.

The device tested contained both the 4 port and the 2 port board. The device was evaluated in a number of ways in accordance to ANSI C63.4 and good engineering practices to make sure that the worst case evaluation was made. These evaluations included:

Conducted
Evaluated the three protocols for worst case
Evaluated both boards – full suite of tests – reported worst case [results identical]

Radiated Measurements
All ports compared for worst case emissions
EUT was tested with modulation and without modulation for worst case
All antennas compared to determine worst case emissions

Radiated evaluations were performed in a pre-screen environment and the worst case was tested on the OATS.

The worst case results are presented in this report.
For radiated testing, the worst case emissions were on the 4-port board, port 4, with the OmniWave antenna. The exception was at the 5th harmonic, where the 2-port board was slightly higher using the OmniPoint Long antenna. Both were evaluated on the open area test site and the worst case emissions are reported.

Maximum conducted transmit power was measured at the end of the standard antenna cable which will be supplied with the Agile V2 Reader [see DeFacto EIRP Limit].

Both conducted and radiated emissions testing were performed according to the procedures in ANSI C63.4-1992, and the requirements of 15.31, 15.33, 15.35, 15.207, 15.209 and 15.247. In addition, 15.247 requirements were measured per FCC document DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems", released March 30, 2000.

Where 15.31 (m) and DA 00-705 calls for measurements to be made at lo, middle, and high channels, measurements were made at 902.726 MHz, 914.773 MHz, and 927.322 MHz.

Test Facility

Measurements were performed at Sensormatic Electronics.

The shielded room conducted emissions measurement facility is located at Sensormatic Electronics Corporation Headquarters at 6600 Congress Avenue, Boca Raton, Florida, 33487. The radiated emissions Open Area Test Site is also located at 6600 Congress Avenue, Boca Raton, Florida 33487. These sites have been found acceptable by and are on file with the FCC per FCC Registration Number 90925, and Industry Canada per file number IC 3506.

EUT Description

EUT Setup / Configuration Details
• Reader Controller Board PN 0311-0091-01 REV 4 • 4 Port Board – p/n 1711-0113-[blank] Rev 4 • 2 Port Board – p/n 1711-0311-[blank]- Rev 3 • Software Version 2.0.34 • Omni-Wave Antenna P/N 0101-0080-02 REV A0 S/N – 105S0344051552 • Omni-Point Long Antenna – [not marked] • Omni Point Antenna – tagged EMC Compliance Test Antenna Benchmark • Matrics Antenna – Ant K00739 – marked #4 • AC Power Adapter – EDAC Model EA10603B

LIST OF PORTS

Function	* Classif.	** Maximum Cable Length	Test Length	Cable Type
AC Mains [line cord to AC / DC Adapter]	ac power		6 ‘	18AWGX3C VW-1 “Wonderful-D” – special end for adapter
T/R 1 - 4	Signal – 4 port	25 foot [required]	25’	LMR-195 Coaxial Cable – Times Microwave Systems 0011906 – Reverse sex TNC
T5	Signal – 2 port	25 foot [required]	25’	LMR-195 Coaxial Cable – Times Microwave Systems 0011906 – Reverse sex TNC
R5	Signal – 2 port		25’	LMR-195 Coaxial Cable – Times Microwave Systems 0011906 – Reverse sex TNC
T6	Signal – 2 port	25 foot [required]	25’	LMR-195 Coaxial Cable – Times Microwave Systems 0011906 – Reverse sex TNC
R6	Signal – 2 port		25’	LMR-195 Coaxial Cable – Times Microwave Systems 0011906 – Reverse sex TNC
Ethernet	[remote] Signal / Control		25.5’	Avaya Type CM 24 AWG 350 MHz Verified TIA/EIA -568A CAT5e UTP KPO2166
RS 232	[remote] Signal / Control		25’	Standard RS232 not marked – DB9

Each product tested used production version digital and UHF modules. The housing was modified to achieve compliance due to unsuspected spurious radiated suppression at the 4^{th} harmonic. These modifications include:

1. The top cover will have three screws per side and two on top.
2. EMI Absorbing foam material was added to the top cover for suppression.
   10.28” x 9.74” x 1/8 inch thick ECCOSORB LS-26 foam with UMSEAL coating and SS-3 pressure sensitive adhesive on one side. Emerson & Cuming drawing number A-5861. Sensormatic Part number 0505-1055-01.

   44 inches of Metalized Fabric Over Foam EMI/RFI Gasket around the perimeter of the unit between the Cover and Chassis. Laird Technologies Part Number: 4186-AB-51K-03100 and 4186-AB-51K-01300. Sensormatic Part numbers: 2500-0046-31 and 2500-0046-13 respectively.

These changes will be implemented in the manufactured product.

III. Frequency Hopping Requirements

Section 15.247 (a)

The device contains a transmitter that modulates a carrier with data, changes carrier frequency in a pseudo-random pattern with a dwell time, channel separation, and hop count that meets the requirements of 15.247. In addition, the receiver tracks the transmitter's pseudo-random hopping sequence and demodulates the signal. Therefore the system is a true frequency hopping spread spectrum system.

Pseudo-random Frequency Hopping Sequence

The order of channels in the hop sequence is pseudorandom.
First, a table of 50 channel numbers is initialized sequentially (table[0] = channel 0, table[1] = channel 1, etc.) to ensure that all channels are present in the hop sequence. The sequence is jittered (to prevent pathologies with even numbers of antennas, e.g. antenna 1 gets half the frequencies; antenna 2 always gets the other half.) in adjacent iterations (i.e., iterate 0-49, then iterate 1-49,0).

Frequency-hopping proceeds in order through the jittered table. For each pass the reader iterates through all 50 channels.

Equal Hopping Frequency Use [Section 15.247 (g)]

The system performs repeated scans on a regular schedule. A frequency hop occurs at the end of each cycle, ensuring that all frequencies are treated equally.

The Agile 2 operation is characterized by periodically repeated "search cycles" during which the RF system is active separated by periods during which the RF system is inactive and processing for user commands. The user has no means of determining which channel is in use at any time nor can the user in any way coordinate commands with the particular channel in use. At the start of each search cycle, the Agile 2 hops to the next channel in the table and begins transmitting and receiving. The length of the search cycle depends on the number of RFID tags present. If the length of the search cycle exceeds 0.4 seconds, the RF system limits its maximum dwell time by forcing a hop to the next channel in the table before 0.4 seconds is reached. Under no circumstances will the RF system dwell more than 0.4 seconds before hopping. When the search cycle completes, the RF system shuts off until the next search cycle. The behavior of the Agile 2 searches is entirely independent from channel selection. Hops are made when necessary, but no decisions are made based on the particular channel in use. As a result, on average during operation all channels will be treated identically.

DeFacto EIRP Limit

Agile 2 can only be ordered and operated with specified patch antennas. Each antenna comes with a 25-foot coaxial cable with reverse threaded TNC connectors on each end and has a 5.75 dBi gain. On the transmitter ports, the maximum output power is set at 30dbm—as measured at the end of the cable. The reader utilizes a software controlled transmit AGC (automatic gain control) to maintain maximum output power level. The maximum radiated energy is then **35.75 EIRP**.

System Receiver Input Bandwidth

The received signal is demodulated by a balanced mixer. The output of this mixer is filter by a fixed 5Mhz low pass 5^{th} order anti-aliasing filter. The output of the anti-aliasing filter is sampled by the ADC – where the samples are passed to the DSP for selective filtering. Depending on the protocol used, the signal is further digitally filtered (by the DSP) as required by the tag protocol.

System Receiver Hopping Capability

Each RF radio module carrier starts from a Synthesizer with an 8 MHz input clock. The synthesizer output (carrier) is passed through a preliminary RF chain of filters and pre-amplifiers. Through a power splitter, the Carrier is sent into two directions—one for the transmit path and the other for the receive path. Through the transmit path, the carrier is further filtered and amplified before passing through an isolator before passing through a 4 port switch—where the signal can be multiplexed onto one of four external antenna ports. The portion of the transmitter split off into the receive path is used to demodulate the received signal from the selected output port—thereby assuring that the demodulation reference is exactly equal to the transmit carrier frequency. The carrier may hop to one of 50 different frequencies and the receive path will always be in synchronization with it.

Section 15.247 (h)

Since the device is programmed to follow a set hopping sequence, regardless of potential interference and it is not programmed to scan the channels for interference, it does not have the ability to coordinate with other FHSS systems in an effort to avoid the simultaneous occupancy of individual frequencies.

RF Exposure Compliance Requirements

Results

EUT Output Power = +30 dBm
Antenna Gain = 5.8 dBi
S = .6 mW / cm^2 (CFR 47 Part 1.1310)

Minimum MPE safe distance (using equation below) = **22.4 cm**

Calculations

E = SQR ROOT (30*P*G) / d
And
S= E^2 / 3770

Where
E = Field Strength in Volts/meter
P= Power In Watts
G = Numeric Antenna Gain
d = Distance in Meters
S = Power Density in mW / square cm

Combining equations and rearranging the terms to express d as a function of the other variables yields:

d = SQR ROOT (30*P*G) / (3770 * S)

Changing to units of mW and cm:

P(mW) = P(W) / 1000

And

d(cm)= 100 *d(m)

Yields

d = 100 * SQR ROOT ((30*P*G) / (3770*S))

Therefore

d = 0.282* SQR ROOT (P*G/S)
d = Distance in Meters
P= Power In mW
G = Numeric Antenna Gain
S= Power Density in mW / cm^2
Substituting the log form of gain and power:
P (mW) = 10^ (P(dBm)/10)
And
G (numeric) = 10 ^ (G(dBi) / 10)

Yields

d = .282 * (10 ^ ((P+G) / 20)) / (SQR ROOT (S))

Where

d = MPE Safe Distance in cm

P= Power In dBm
G = Antenna Gain in dBi
S= Power Density Limit in mW / cm^2

IV. Test Equipment

The equipment used for determining compliance of the Agile 2 system with the requirements of 15.207 and 15.209 is marked with an "X" in the first column of the table below.

	Model	Description	Vendor	Serial #
	ALP -70	Loop Antenna	Electro Metrics	163
	3110B	Biconical Antenna	Electro Metrics	1017
X	3146	Log Periodic Antenna	EMCO	3909
	3825/2	Line Imp Stable Network	EMCO	1562
X	3816/2NM	Line Imp Stable Network	EMCO	9703 1064
	6060B	Frequency Generator	Giga-tronics	5850202
	FM2000	Isotropic Field Monitor	Amplifier Research	15171
	FP2000	Isotropic Field Probe	Amplifier Research	15214
	888	Leveler	Amplifier Research	14998
	75A220	Low Band Amplifier	Amplifier Research	15208
	10W1000A	High Band Amplifier	Amplifier Research	15138
	PEFT Junior	EFT Generator	Haefely Trench	083 180-16
	PEFT Junior	Capacitive Cable Clamp	Haefely Trench	083-078-31
	NSG435	ESD Simulator	Schaffner	1197
	NSG431	ESD Simulator	Schaffner	1267
	HP8591EM	EMC Analyzer	Hewlett - Packard	3520A00190
		Power Source	Pacific Instruments	
	F-2031	EM Injection Clamp	Fischer Cust. Comm.	30
	FCC-801-M3-16	Coupling Decoupling Nwk	Fischer Cust. Comm.	58
	FCC-801-M3-16	Coupling Decoupling Nwk	Fischer Cust. Comm.	59
X	83017	10 GHz Preamp	Mite-Q	937930
X	1.8 – 13 GHz HPF	High Pass Filter	MicroTronics	001
	Roberts Ant	Tunable Dipole Set	Compliance Design	003282
	Roberts Ant	Tunable Dipole Set	Compliance Design	003283
X	3115	Double-Ridged Waveguide Horn	EMCO	3006
X	HP8562	Spectrum Analyzer	Hewlett Packard	2712A00534
X	HP8447F Opt 64	Dual Preamplifier	Hewlett Packard	2805A03473

V. Data

15.31(e) Input Voltage Variation

4 Port Board

Frequency	Voltage	Peak Signal Level
902.726	120	30.0 dBm
902.726	+15%	30.0 dBm
902.726	-15%	30.0 dBm
914.773	120	30.0 dBm
914.773	+15%	30.0 dBm
914.773	-15%	30.0 dBm
927.326	120	29.7 dBm
927.326	+15%	29.7 dBm
927.326	-15%	29.7 dBm

2 Port Board

Frequency	Voltage	Peak Signal Level
902.726	120	29.9 dBm
902.726	+15%	29.8 dBm
902.726	-15%	29.8 dBm
914.773	120	29.7 dBm
914.773	+15%	29.7 dBm
914.773	-15%	29.7 dBm
927.326	120	29.9 dBm
927.326	+15%	29.9 dBm
927.326	-15%	29.8 dBm

15.207 AC Conducted Emissions

Project Name	Agile RFID Reader	Filename	EDAC Final - Pass.mdb
EUT Name		Serial Number	
Engineer	Ron Devoe	Phone Number	
Date of Test	08/18/04	Test Name	Conducted Emission
Reg. Staff	Mac Elliott		

Comments	EDAC Power Supply – DC Output Modulation Off – Worst Case / TX Full Power Limiter used – 10 dB loss measured

Frequency	Pk	QP	Avg	Limit [QP/Avg]	P/F
150 kHz	38.5			66/56	P
2.54 MHz	36.6	32.6	22.5	60/50	P
15.82	52.6	48.6	39.3	60/50	P
16.5	52.7	49.2	40.03	60/50	P
18.81	49.24	44.6	34.4	60/50	P
19.55	49.53	47.9	34.5	60/50	P
22.76	44.9	44.1	32.1	60/50	P

Figure 1. L1 Full Range

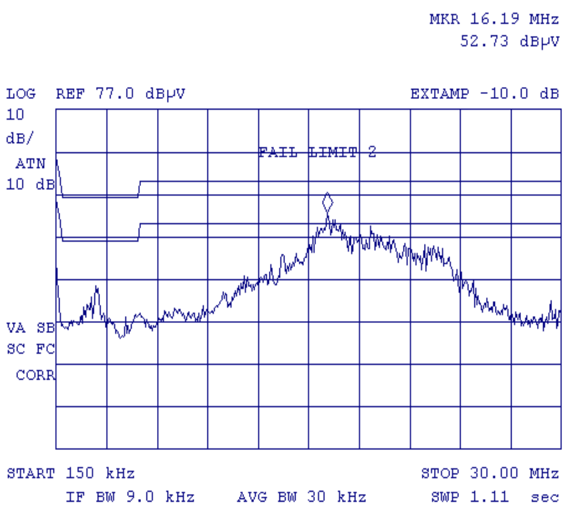
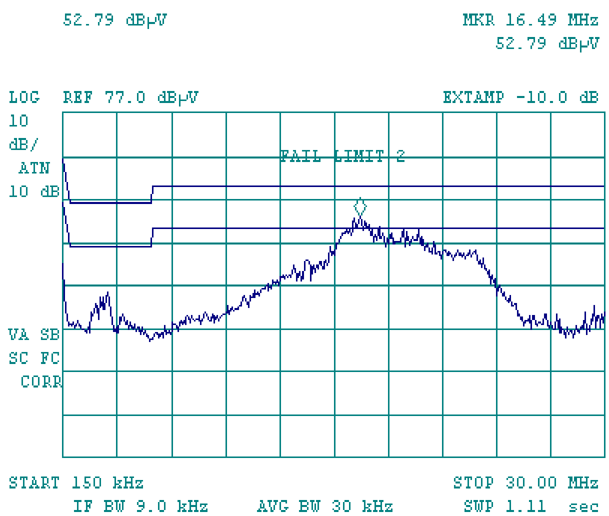


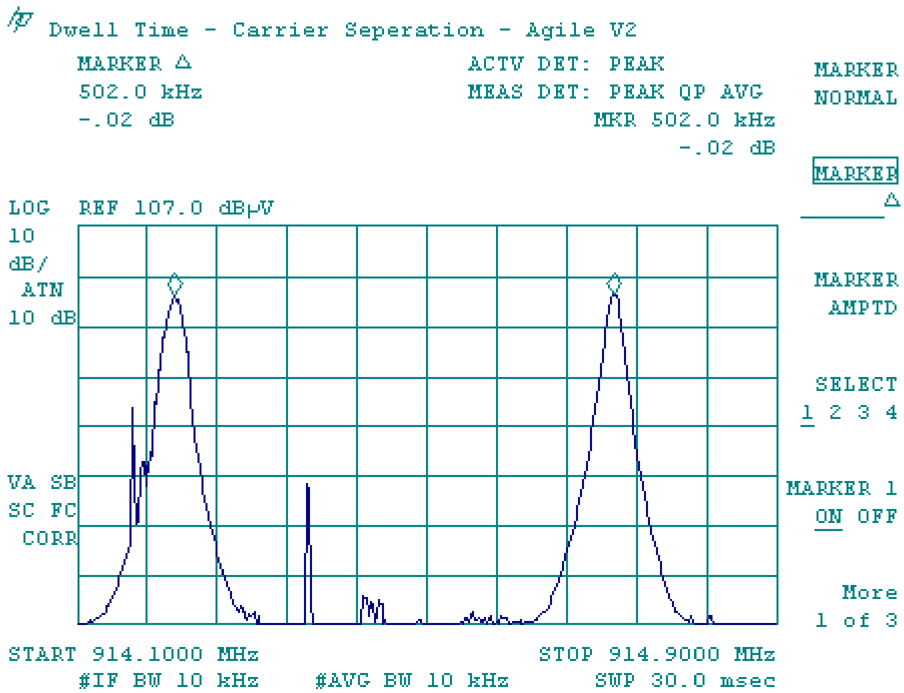
Figure 2. **L2 Full Range**



CARRIER FREQUENCY SEPARATION

15.247 (a)(1)

Carrier separation = 502.0 kHz



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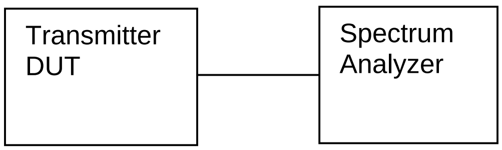
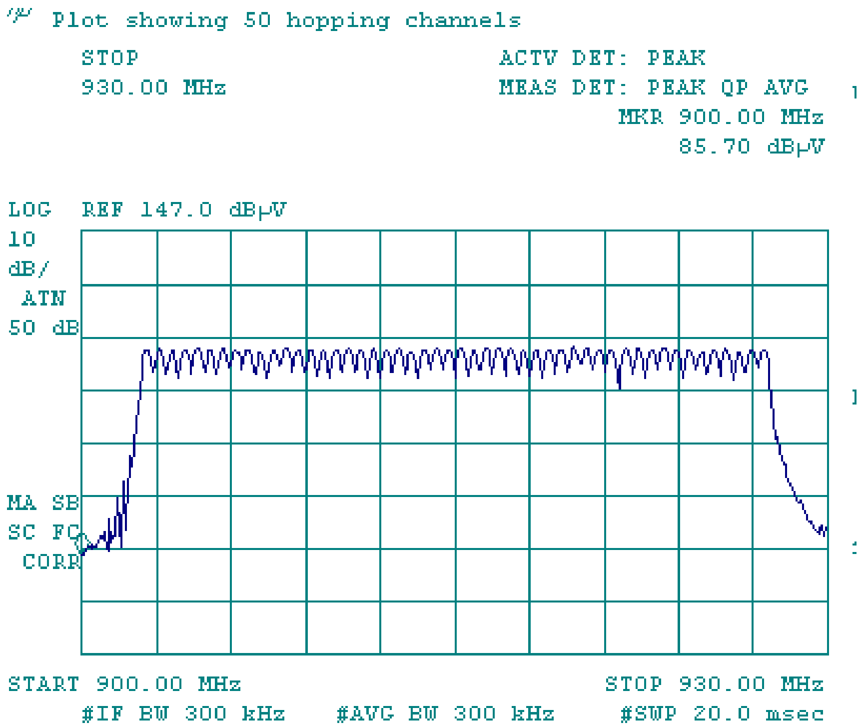


NUMBER OF HOPPING CHANNELS

15.247 (a)(1)(i)

The number of hopping channels = 50; limit , number > 25.



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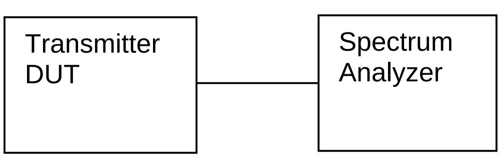
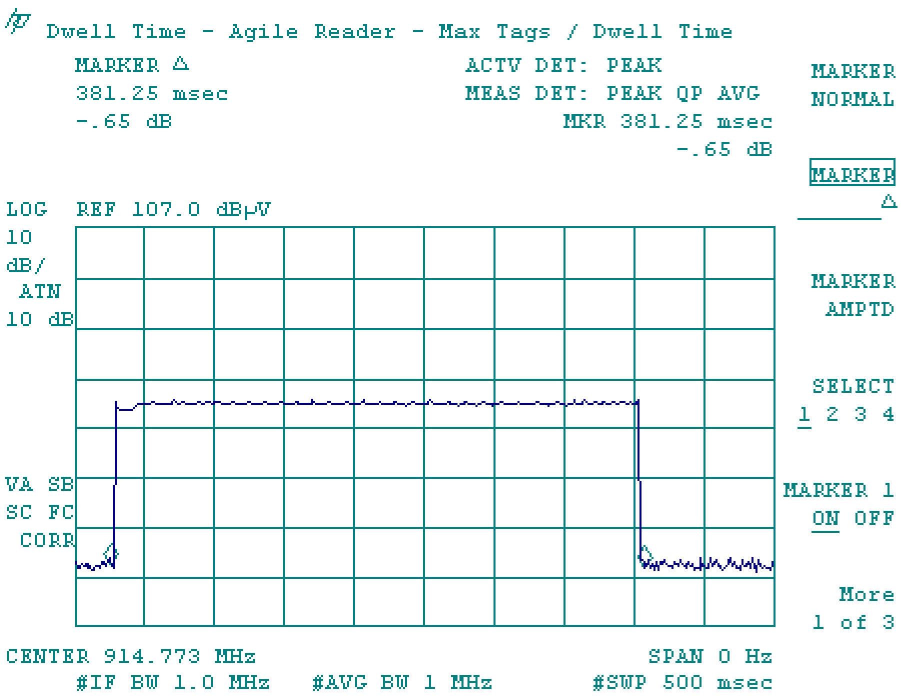


TIME OF OCCUPANCY (DWELL TIME)

RULES PART 15.247 (a)(1)(i)

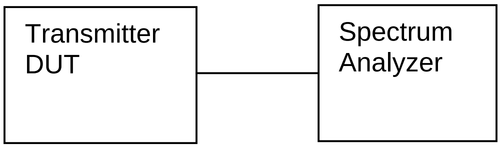
Max Dwell time = 350 ms; limit = 400 ms.

Maximum number tags in field



Note: with 0 tags in field dwell time = 61.75 msec

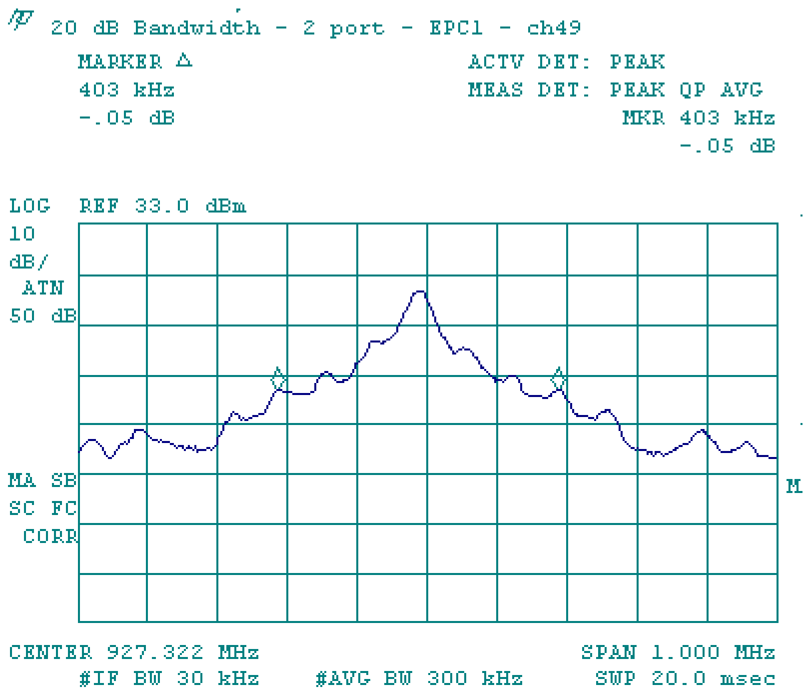
Setup:



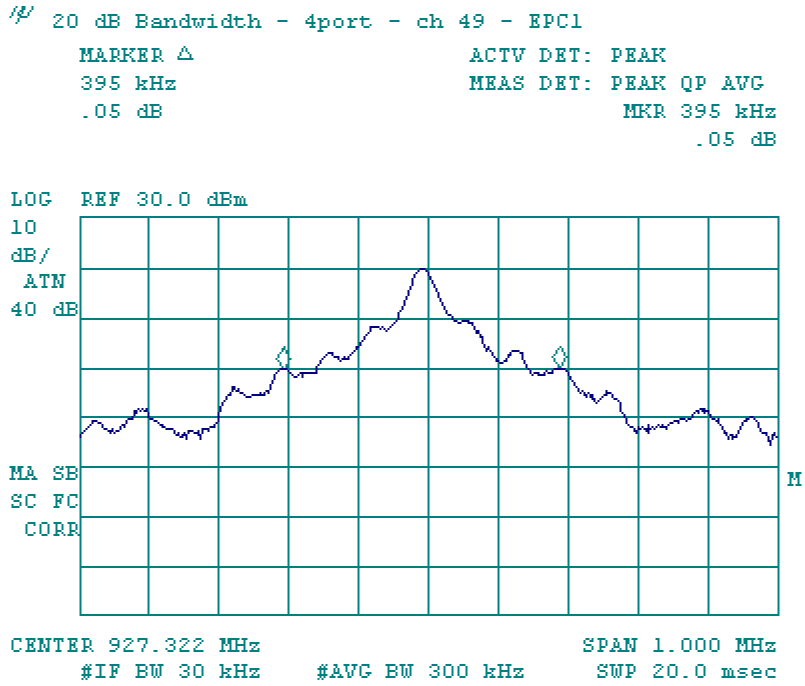
20 DB BANDWIDTH

15.247 (a)(1)

Worst Case 20 dB Bandwidth 2 Port Board 403kHz



Worst Case 20 dB Bandwidth 4 Port Board   395 kHz



PEAK POWER OUTPUT

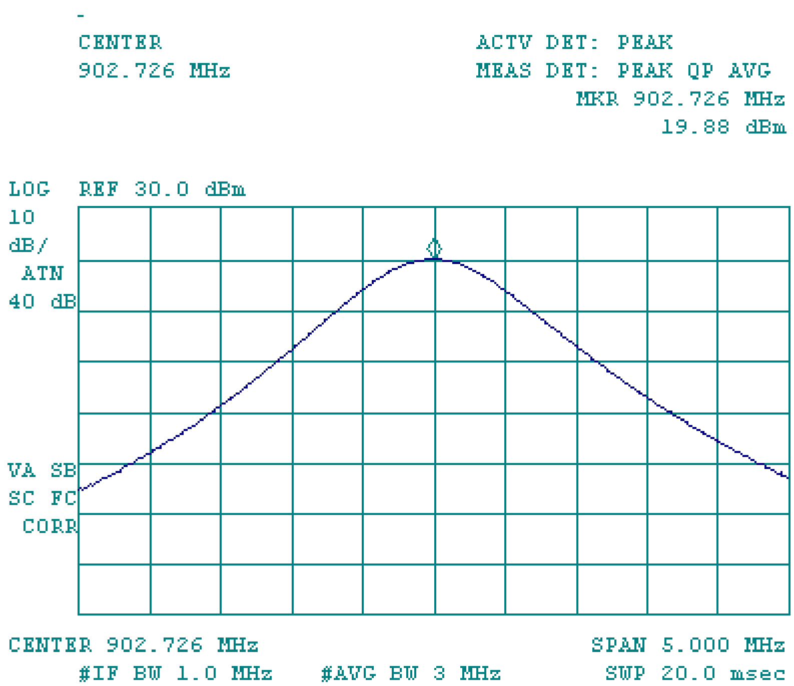
15.247 (b)

Agile 2 can only be ordered and operated with specified patch antennas. Each antenna comes with a 25-foot coaxial cable with reverse sex TNC connectors on each end and has a 5.75 dBi gain. On the transmitter ports, the maximum output power is set at 30dbm—as measured at the end of the cable.

The worst case peak conducted power is reported here and is measured at 19.88 dBm at the end of the cable. A 10 dB attenuator was used to prevent damage to the spectrum analyzer front end and was measured at 10.1 dB.

Therefore, the peak power is 19.88 dBm + 10.1 dBm = 29.98 dBm or 1 Watt.

The EUT complies with the limit.

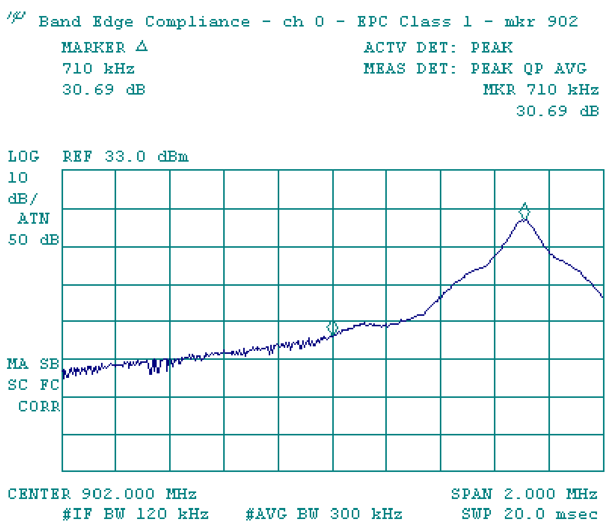


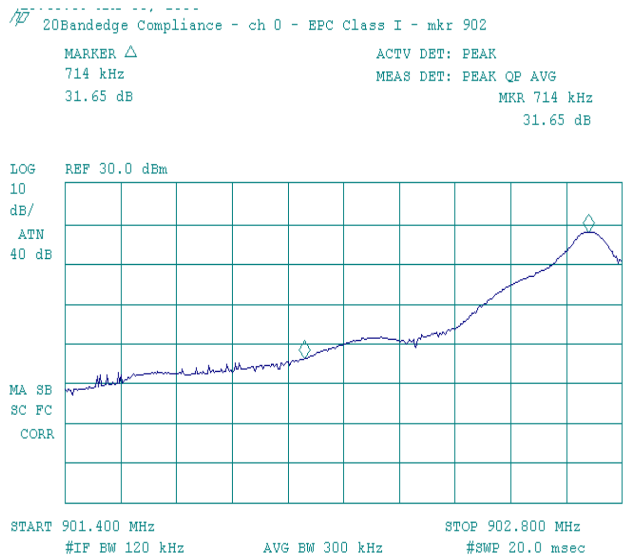
BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

RULES PART 15.247 (c)

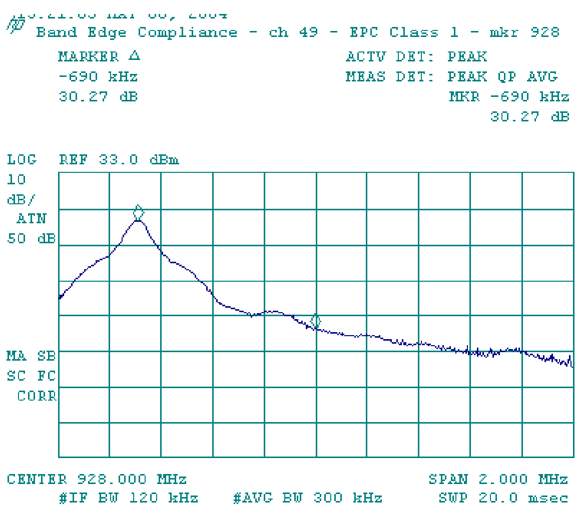
4 plots follow showing band-edge non-hopping high side, band-edge hopping high side, band-edge non-hopping low side, band-edge hopping low side. Limit: > 20 dB below highest inband signal.

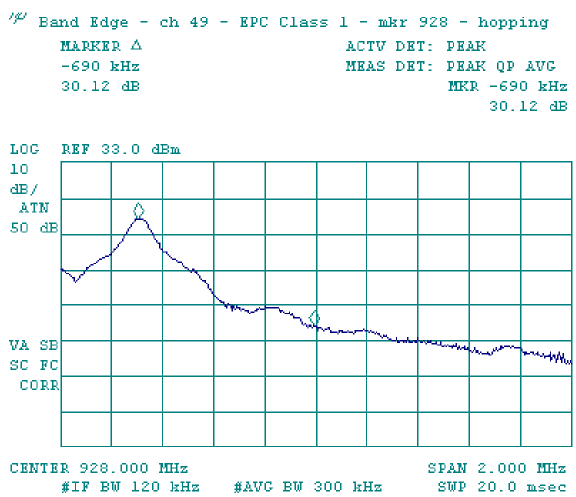
2 Port Board





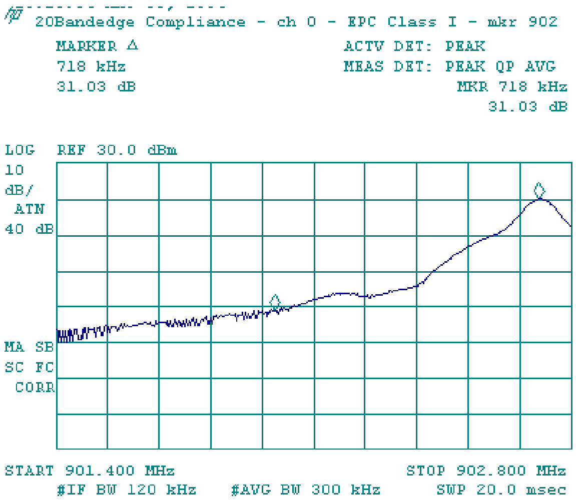
Low side, non-hopping and hopping respectively. Band edge is 902 MHz; emissions are more than 30 dB below the inband signal.

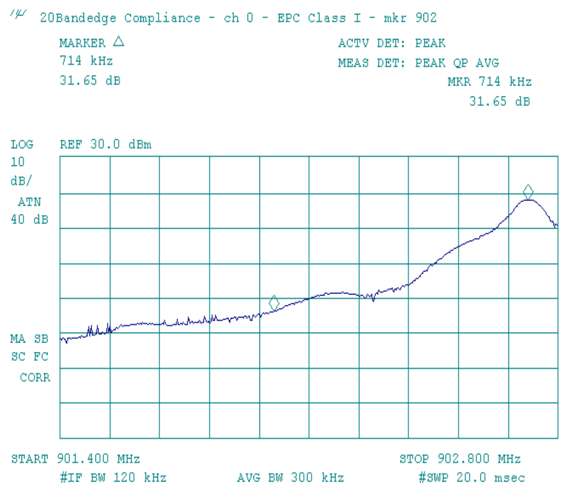




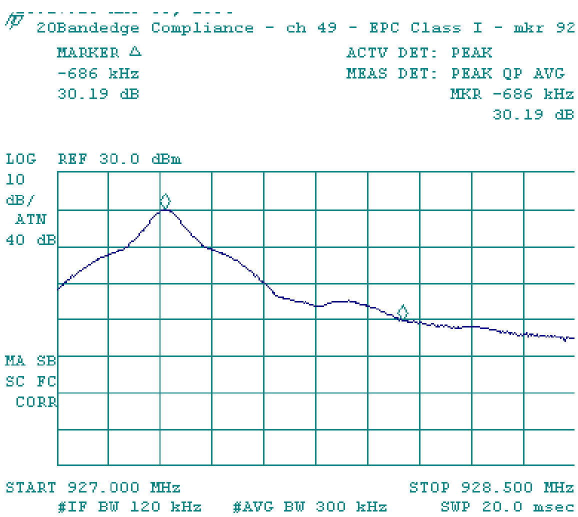
High side, non-hopping and hopping respectively. Band edge is 902 MHz; emissions are more than 30 dB below the inband signal.

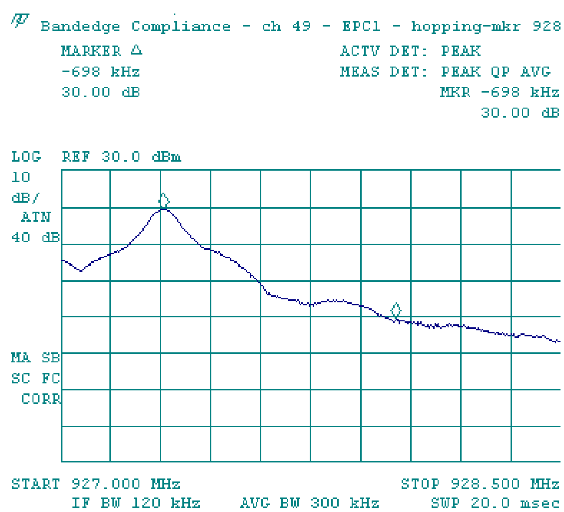
4 Port Board





Low side, non-hopping and hopping respectively. Band edge is 902 MHz; emissions are more than 30 dB below the inband signal.





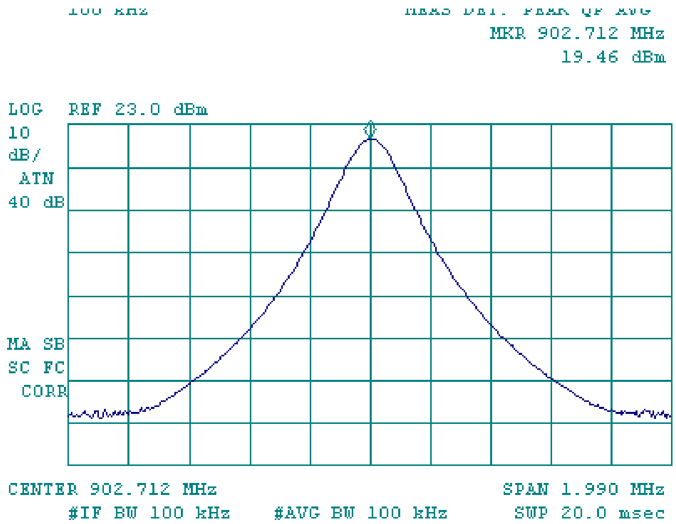
High side, non-hopping and hopping respectively. Band edge is 902 MHz; emissions are more than 30 dB below the inband signal.

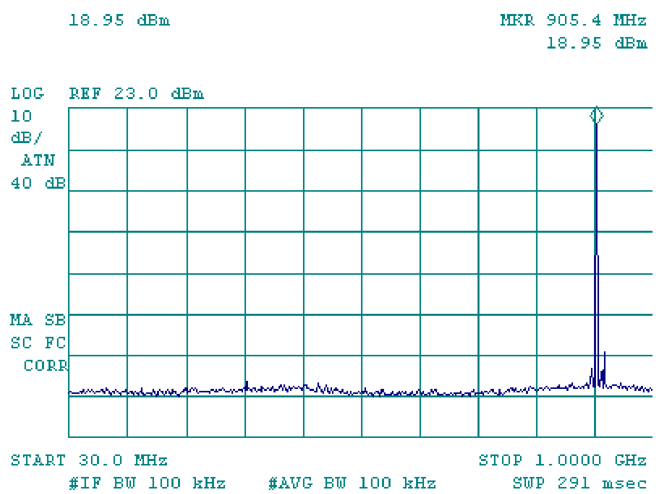
SPURIOUS RF CONDUCTED EMISSIONS

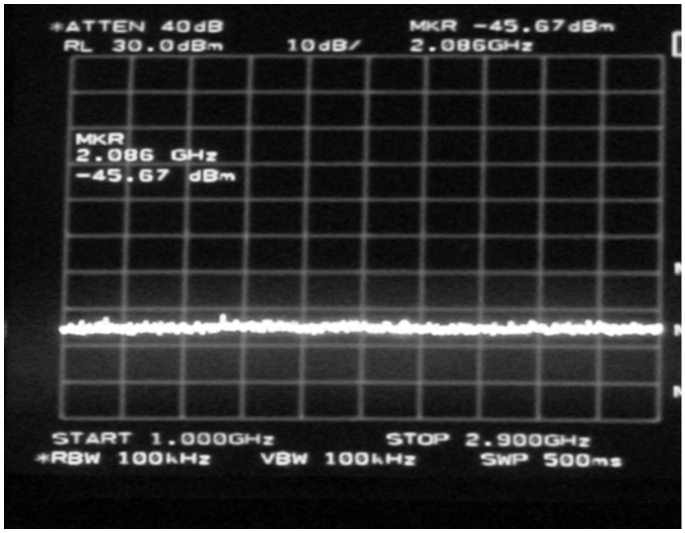
RULES PART 15.247 (c)

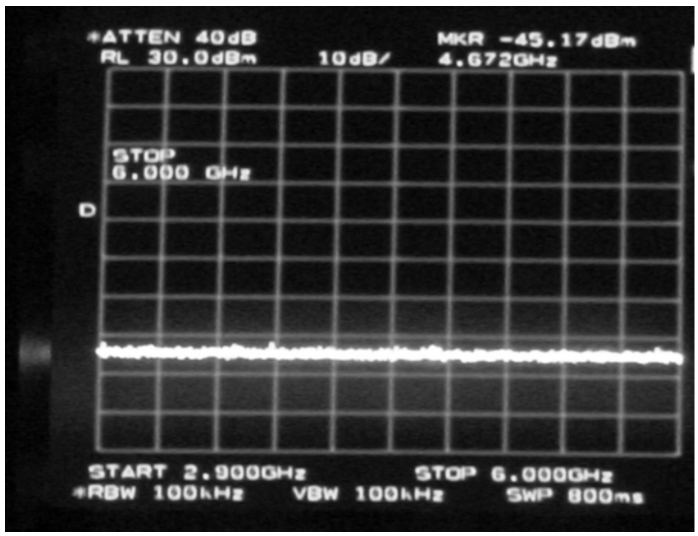
The following plots shows that there are no emissions within 20 dB of the inband signal in any 100 kHz band from 30 MHz all the way to the 10th harmonic.

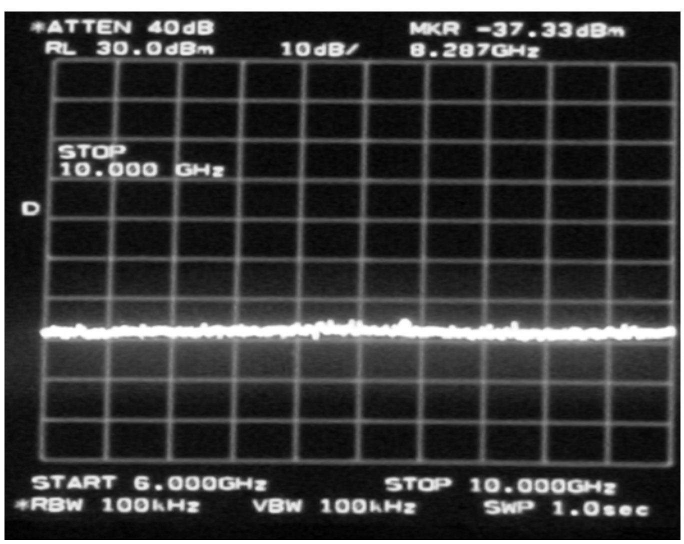
This was true for both boards, at lo / mid, and hi channels.






*ATTEN 40dB
RL 30.0dBm
10dB/
MKR -45.67dBm
2.086GHz
MKR
2.086 GHz
-45.67 dBm
START 1.000GHz
STOP 2.900GHz
*RBW 100kHz
VBW 100kHz
SWP 500ms


*ATTEN 40dB
RL 30.0dBm
10dB/
MKR -45.17dBm
4.672GHz
STOP
6.000 GHz
D
START 2.900GHz
STOP 6.000GHz
*RBW 100kHz
VBW 100kHz
SWP 800ms


*ATTEN 40dB
RL 30.0dBm
10dB/
MKR -37.33dBm
8.287GHz
STOP
10.000 GHz
D
START 6.000GHz
STOP 10.000GHz
*RBW 100kHz
VBW 100kHz
SWP 1.0sec

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Part C SPURIOUS RADIATED EMISSIONS

RULES PARTS 15.247 (c), 15.205, 15.209

Fundamental and Spurious Emissions Above 1 GHz

The EUT was prescreened in the semi-anechoic chamber at Sensormatic per the guidelines in ANSI C63.4-1992. Each port was compared to determine which had the worst case emissions. They were basically all in the same range, with the 4 port board port 4 coming in slightly higher. This was the port selected for full compliance testing on the OATS.

In addition, each antenna type was compared in prescreens to determine the worst case antenna for measurement. For the 4-port, since only the OmniWave is specified for the board, that was the antenna selected. For the 2-port board, the antennas were compared and the Omni-point long was determined to be the worst case emitter at the higher frequencies, but again, the range was fairly tight.

No modulation turned out to return a slightly higher reading than with the modulation on. The tests were done with the modulation off.

The only emissions found to be in restricted bands were the third, fourth, and fifth harmonics. The third and fourth were worse off of the 4 port board and the 5th was higher off of the 2 port board. The 4-port board was tested at the OATS for 3rd, 4th, and 5th

The fundamental was measured on the OmniPoint, OmniWave, and Matrics antennas with very little difference in the highest emission reported. This substantiates the reported gain being identical at 5.75 dBi.

Frequency (MHz)	Corrected dBuV/m Reading	Pad Loss (dB)	Emission (dBuV/m)
Omni Wave - 4 Port Board - Port 4			
914.773-H	123.10	10.00	**133.10**
Omni Point [long] - 2 Port Board - Port "5"			
914.773-H	122.72	10.00	**132.72**
Matrics - 2 Port Board - Port "5"			
914.773-H	122.30	10.00	**132.30**

Spurious Emissions Above 1 GHz

4 Port Board

Radiated Emissions Testing - TX Spurious Above 1 GHz **FCC TEST RESULTS**
Agile Reader V2

4 Port Board - Slot 1 OMNI WAVE ANTENNA

90deg / 65% RH
Antenna = EMCO Model 3115 S/N 3006 8/19/04 - OATS Data
Amplifier = In House Amplifier Kit Engineers - Elliott / Devoe
Path Loss = 9913F (25') + 2-RGS-142 cables + Microtronics HPF S/N 001
Emission Level (dBuV/m) = Emission + Path loss - Preamp Gain + Antenna Factor
Res = Vid = 1 MHz [pk] Vid = 10 Hz [avg]

Frequency Range
Low: 902.726
Middle: 915.000
High: 927.322

Restricted Band Evaluation

RED = RESTRICTED BAND - LIMIT = 54dBuV/m

Frequency (MHz)	Polarization	Max. Emission Pk (dBuV)	Max. Emission Avg (dBuV)	Corrected Pk Emission (dBuV/m)	Corrected Avg Emission (dBuV/m)
1,830.000	Horiz	66.80	66.20	57.17	56.57
	Vert	64.20	63.60	54.57	53.97
2,708.178	Horiz	53.40	50.10	48.07	44.77
	Vert	52.30	49.00	46.97	43.67
3,709.288	Horiz	54.95	52.70	53.28	51.03
	Vert	55.70	**53.50**	54.03	**51.83**
4,575.000	Horiz	50.10	43.95	49.84	43.69
	Vert	50.50	44.90	50.24	44.64

Conclusion – 4 Port Board Complies above 1 GHz

2 Port Board

Radiated Emissions Testing - TX Spurious Above 1 GHz **FCC TEST RESULTS**
Agile Reader V2

2 Port Board - Slot 1 - OMNI POINT LONG ANTENNA

90deg / 65% RH
Antenna = EMCO Model 3115 S/N 3006 8/19/04 - OATS Data
Amplifier = In House Amplifier Kit Engineers - Elliott / Devoe
Path Loss = 9913F (25') + 2-RGS-142 cables + Microtronics HPF S/N 001
Emission Level (dBuV/m) = Emission + Path loss - Preamp Gain + Antenna Factor
Res = Vid = 1 MHz [pk] Vid = 10 Hz [avg]

Frequency Range Restricted Band Evaluation

Low: 902.726
Middle: 915.000
High: 927.322

RED = RESTRICTED BAND - LIMIT = 54dBuV/m

Frequency (MHz)	Polarization	Max. Emission Pk (dBuV)	Max. Emission Avg (dBuV)	Corrected Pk Emission (dBuV/m)	Corrected Avg Emission (dBuV/m)
4,513.630	Horiz	50.30	45.50	50.04	45.24
	Vert	49.40	43.10	49.14	42.84
4,575.000	Horiz	50.90	46.20	50.64	45.94
	Vert	47.90	39.20	47.64	38.94
4,636.610	Horiz	52.50	**48.20**	52.24	**47.94**
	Vert	49.60	42.30	49.34	42.04

Conclusion – 2 Port Board Complies above 1 GHz

Spurious Emissions Below 1 GHz

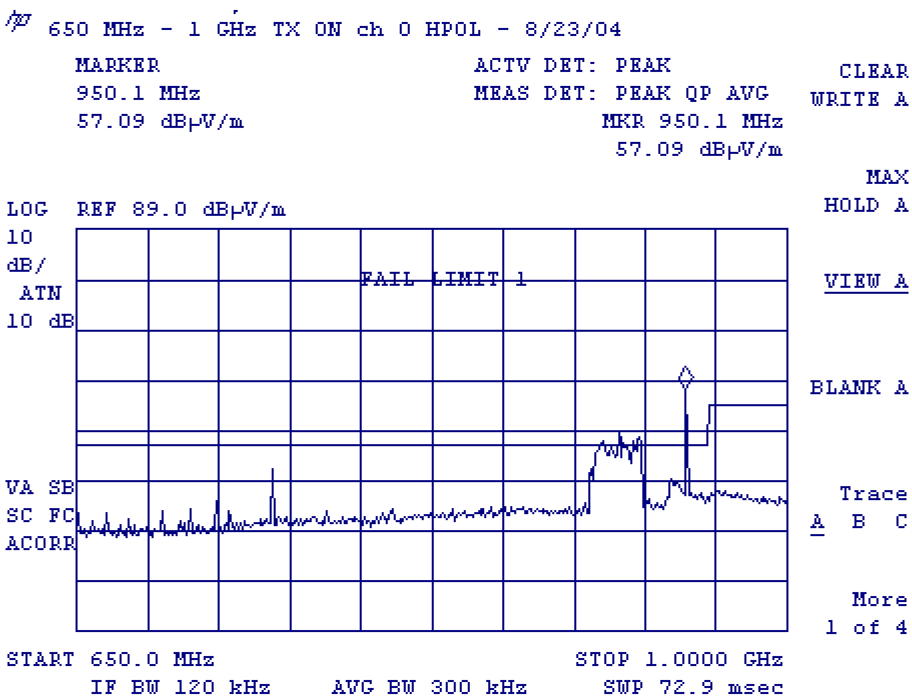
Radiated transmitter spurious emissions below were prescreened in the anechoic chamber below 1 GHz by turning the transmitter on and off. The emissions that were there when the transmitter was on were classified as transmitter spurious. The rest were considered unintentional digital emissions subject to verification

This was done on the lo / mid / and high channels with the same result. There were no discernable spurious emissions that tracked the transmitter, save for one, an emission at 950.1 MHz. This emission was at the same frequency for all three channels.

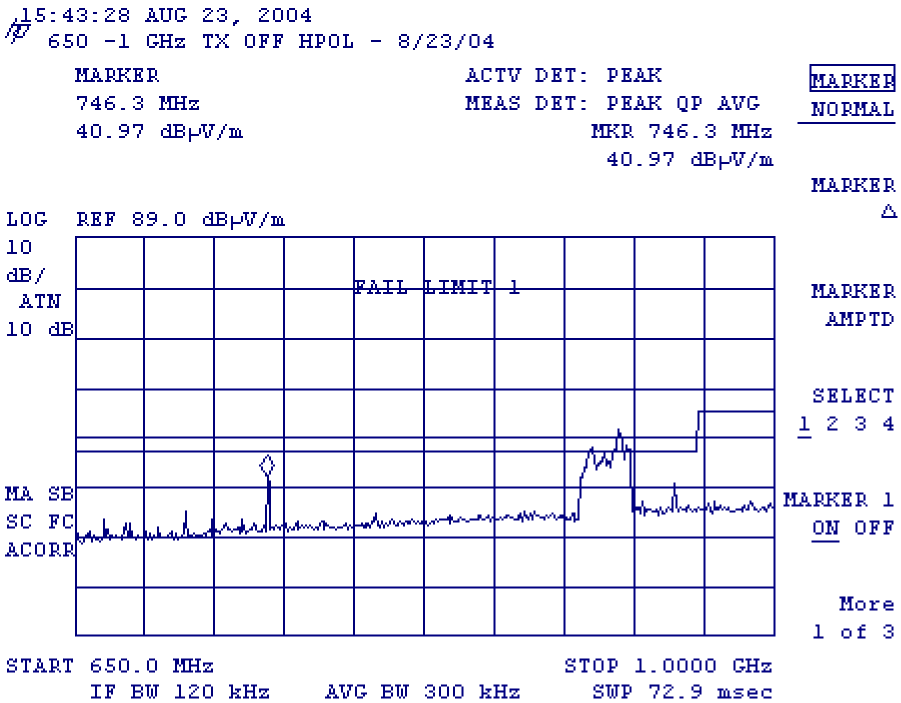
This emission was much higher when the active transmitter was turned on. It appears to almost drop below the noise floor with the transmitter turned off.

The plot depicting this is presented below.

950.1 MHz Emission with Transmitter turned on



950.1 MHz Emission with Transmitter turned off



It appears that the emission drops by close to 20 dB. The source of this emission appears to be the inactive transmitter board. When the transmitter is inactive, it parks at 950.1 MHz. When the active transmitter board is turned on, the signal from the inactive transmitter is amplified by the transmitter that is on.

Since the emission tracks enabling of the active transmitter, this emission was treated as a transmitter spurious emission Also, since it is not in a restricted band, the transmitter spurious emission is subject to the 20 dBc limit.

Even though it is not in a restricted band, it was measured at the OATS for quantification. It was measured at both the lo / mid / and high channels as well as in the normal operating modes.

TX Spurious Emission [<1GHz] Measurement Work Sheet

Date: 8/26/2003 Engineer: Ron Devoe Test Pers: Mac Elliott Proj: Agile V2 Reader

EUT Agile V2 Reader – Transmit Spurious Emission < 1 GHz

Standard 15.247 / ANSI C63.4-1992 Voltage and Frequency 120/60

Transmit Frequency Lo / Mid / Hi Channels Crystal Frequency

Radiated Emission Test Data

Item	Freq in MHz	B.W. in KHz	S.A. Atten.	Detector Pk/QP/Av	S.A. Amplitude in dB v/m	Notch Filter [dB]	Corrected Amplitude in dBuv/m	FCC Limit	Antenna Polarization	TX channel
1	950.1	120	10	Pk/QP	57.5/57.1	7.2	64.7/64.3	-20 dBc	VPOL	Lo
2	950.1	120	10	Pk/QP	63.1/62.6	7.2	70.3/69.8	-20 dBc	HPOL	Lo
3										
4	950.1	120	10	Pk/QP	57.8/57.2	7.2	65/64.4	-20 dBc	VPOL	Mid
5	950.1	120	10	Pk/QP	63.2/62.8	7.2	70.4/70	-20 dBc	HPOL	Mid
6										
7	950.1	120	10	Pk/QP	58.1/57.6	7.2	65.3/64.8	-20 dBc	VPOL	Hi
8	950.1	120	10	Pk/QP	63.1/62.8	7.2	70.3/70.0	-20 dBc	HPOL	Hi

In addition, the emission was measured with the frequencies hopping and the unit in the normal operating mode.

Radiated emissions [worst case] in normal operating mode [frequency hopping]:

10	950.1	120	10	Pk/QP	58.1/57.5	7.2	65.3/64.7	-20 dBc	VPOL	Normal Mode
11	950.1	120	10	Pk/QP	62.7/61.8	7.2	69.9/69.0	-20 dBc	HPOL	Normal Mode

This emission is > 20 dB below the carrier.

Note: For Reference

Lo channel: Fc = 132.6 dBuV/m
Mid Channel: Fc = 133.1 dBuV/m
Hi Channel: Fc = 132.7 dBuV/m

Digital Unintentional Emissions

All other digital emissions were tested and measured on the OATS. All emissions complied with the Class A digital emission limits.

Date: 8/26/2003 Engineer: Ron Devoe Test Pers: Mac Elliott Proj: Agile V2 Reader

EUT Agile V2 Reader w/ all ports hooked up – RS485 / Ethernet operating

Standard 15C / ANSI C63.4-1992 Voltage and Frequency 120 / 60

Transmit Frequency Hopping – Normal Mode Crystal Frequency

Radiated Emission Test Data

Item	Freq in MHz	B.W. in KHz	S.A. Atten.	Detector Pk/QP/Av	S.A. Amplitude in dBuv/m	Notch Filter [dB]	Corrected Amplitude in dBuv/m	Class A Limit FCC	Antenna Polarization	Noise Floor In dBuv
1	237.3	120	10	pk	28.3	.2	28.5	56.9	HPOL	19.8
2	250	120	10	pk	36.2	.3	36.3	56.9	HPOL	19.8
3	376.9	120	10	Pk/QP	45.1/44.4	.3	45.4/44.7	56.9	HPOL	22.4
4	482.4	120	10	Pk/QP	41.4/40.0	.3	41.7/40.3	56.9	HPOL	23.0
5	488.2	9*	10	Pk (QP)	33.8	.3	34.1	56.9	HPOL	20.9
6	501.7	9*	10	Pk (QP)	36.4	.2	36.6	56.9	HPOL	20.9
7	678.0	120	10	Pk	34.9	.3	35.2	56.9	HPOL	24.0
8	735.4	120	10	Pk/QP	48/46	.4	48.4/46.4	56.9	HPOL	24.0
9										
10	237.3	120	10	pk	Down	From	HPOL	56.9	VPOL	19.8
11	250	120	10	pk	33.3	.3	33.6	56.9	VPOL	19.8
12	376.9	120	10	pk	38.0	.3	38.3	56.9	VPOL	22.4
13	482.4	120	10	Pk/QP	41.1	.3	41.4	56.9	VPOL	23.0
14	488.2	120	10	Pk (QP)	39.9/37.7	.3	40.2/38.0	56.9	VPOL	20.9
15	501.7	9*	10	Pk (QP)	36.2	.2	36.5	56.9	VPOL	20.9
16	678.0	120	10	Pk	37.2/34.7	.3	37.5/35.0	56.9	VPOL	24.0
17	735.4	120	10	Pk/QP	47.1/45	.4	47.5/45.4	56.9	VPOL	24.0
18										

NOTES: Emission frequencies may be slightly off prescan freq signature – this is due to freq resolution of prescans – for final readings – span was opened up and the emission was found by rotating the table and maximizing as normal once emission was discerned.
* Ambient present – discerned emission by lowering res BW until could separate the emission out – when could, verified that lowering the res BW did not effect the amplitude of the signal over a wide span of res bws verifying that the peak was captured [QP]