TYCO SAFETY PRODUCTS
SENSORMATIC
EMC
TEST REPORT

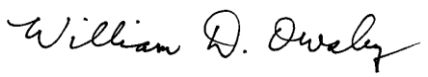
Model:
IDX-9000-US
FCC ID: BVCIDX9000
IC: 3506A-IDX9000

Intentional Radiator

FCC
47 CFR, Part 15, Subpart C

Industry Canada
RSS-210

Date:
Jan. 4, 2010



EMC Engineer

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Summary of Results

FCC 47 CFR Part 15. Subpart C.	Test Requirement	Test Limit	Comments
15,15 (b)	User Accessible Controls	Cannot change output power above limit.	The product contains no user accessible controls that increase transmission power above permitted levels.
15.31 (e)	Vary Input Power	Does not increase the output power above the limit.	Input was varied from 102 to 138 VAC. Input power to antenna was measured. Complies.
15.107	AC Mains Conducted Emissions Requirements [Digital Device]	See Table 15.107. Unintentional digital emissions subject to Class A limits.	Digital emissions determined by turning transmitter off. Complies [Verification].
15.109	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 Connector Requirements	Permanently attached or unique coupling.	The radio to antenna connectors are MCX to RP TNC connectors. Complies.
15.207 (a) (b)	AC Mains Conducted Emissions Requirements.	General Limits. Equivalent to15.109 Class B.	Conducted emissions on AC side of DC supply. . Complies.
15.205 (a) (b) 15.209	Restricted Band Compliance	Must comply with limits specified in 15.209 (a). Equivalent to15.109 Class B.	The spurious emissions in the restricted bands comply with the general emission limits.
15.247 (a) (1)	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)	Number of Hopping Frequencies .	If 20 dB BW is less than 250 kHz, then shall use at least 50 hopping channels, using frequencies in a pseudo random list.	The EUT has 50 hopping channels and complies with the requirement.
15.247 (a) (1) (i)	Dwell Time – Number of Hopping Frequencies > 25	< 0.4 sec within a 20 second period	The EUT complies with the requirement.
15.247 (b) (2) (3)	Output Power 902-928 MHz Tx	Maximum 1 W – frequency 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 by the amount in dB exceeding 6 dBi.	Permanently attached attenuators on each antenna ensure compliance.
15.247 (b) (5)	RF Exposure	Must ensure that RF MPE to the public falls within Commission Guidelines	See RF Exposure Section.
These results are deemed satisfactory evidence of compliance with **Industry Canada Interference-Causing Equipment Standard ICES-003 and Radio Standard RSS-210.**			

General Information

The product covered by this report is the Sensormatic IDX-9000-US Reader.

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 transmitters found in 47 CFR subpart C, 15.247.

The digital portion of the radio was evaluated according to the Verification procedures for a Class A device in subpart B.

The EUT is a RFID radio transceiver with 30 dBm maximum output power and 16 ports that are used one at a time.

The EUT can accommodate up to 16 transmit antennas on 16 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.

Both conducted and radiated emissions testing were performed according to the procedures in ANSI C63.4-2003, as required by 47 CFR Part 15, Subpart A Section 15.31, Subpart C, 15.207, 15.209, 15.247

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.

Accessory Equipment used to terminate ports and communicate are all commercially available FCC DoC or Verified products. This includes ITE power supplies, PC's, network switches and hubs.

Radiated Measurements

List of antennas that can be used with the EUT:
Manufacturer Model Number Type Composite Gain
Symbol AN480-CL66100WR LHCP 6 dBiL
Symbol AN480-CR66100WR RHCP 6 dBiL
Sensormatic IDA-2x00 series CP
Sensormatic IDA-1000 CP

All antennas were evaluated to determine worst case emissions

All ports were evaluated for worst case emissions

EUT was tested with modulation and without modulation for worst case

Radiated evaluations were performed in a pre-screen environment and the worst case was tested on the OATS.
Multiple orientations of antenna and radio were evaluated to determine worst case.

Maximum conducted transmit power was measured at the RF port of the radio using a ~1 ft cable to the spectrum analyzer.

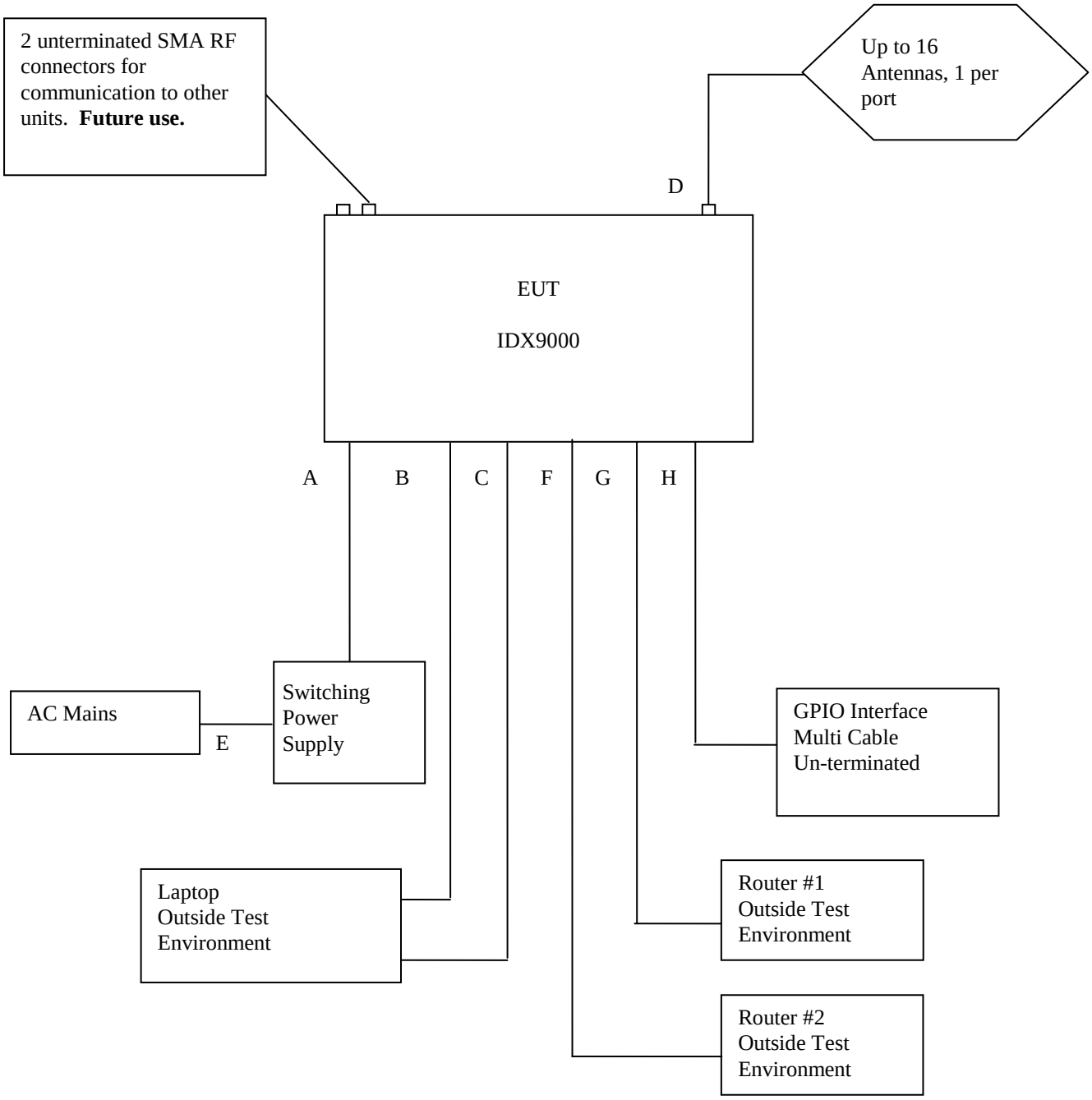
Test Facility:

Measurements were performed at Tyco Safety Products / Sensormatic Electronics, LLC.
The shielded room conducted emissions measurement facility is located at Sensormatic Electronics LLC. 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 889978.

Industry Canada registration number: 3506A-1 for the test site.

EUT Description

EUT Setup / Configuration Details
Reader Controller Board PN 0311-0091-01 REV 4 Software Version 2.0.34 15.204 – List of Antennas: Symbol AN480-CL66100WR LHCP, 865-956 MHz 6dBiL Symbol AN480-CR66100WR RHCP, 865-956 MHz 6dBiL Sensormatic IDA-2x00 series CP Sensormatic IDA-1000 CP AC Power Adapter - AC Power Adapter -



ID	Function	Class	Max Cable Length	Cable Type
A	DC Power Port	DC Power	> 1m <3m	2 wire from EPS
B	RS232 Port	Signal / Telco	> 3m	Standard Shielded serial
C	Ethernet RJ45 Lan #3	Signal / Telco	> 3m	Cat 5
D	Antenna Port Coax	Signal	> 1m, <3m	Coax 50 ohm
E	AC Mains [Supply]	AC Power	> 1m <3m	Common power cord
F	Ethernet RJ45 Lan #2	Signal / Telco	> 3m	Cat 5
G	Ethernet RJ45 Lan #1	Signal / Telco	> 3m	Cat 5
H	GPIO Multi Cable	Signal	> 3m	

* Classify ports as ac power, dc power, or signal/control.
** Classify maximum cable lengths as ≤ 1 m; > 1m but ≤ 3 m; or > 3m

Accessory Equipment Declaration of Conformity

All accessory equipment used during testing is commercially available off-the-shelf (COTS) FCC DoC or Verified devices.

RF Exposure Compliance Requirements

Operating Band Center Frequency = 915 MHz
EUT Output Power = +30 dBm
Antenna Gain = 6 dBi => Numeric Gain = 4
Power Density Limit for General Population is
S = F(MHz) / 1500 = 0.61 mW / cm^2 or 6100 W/m^2
(CFR 47 Part 1.1310, Table 1)

Minimum MPE safe distance (using equation below) = 10.2mm

Calculations:
Assuming 1 watt output power into a maximum 6 dBi gain antenna, neglecting for cable losses to the antenna gives a 2 watt total output.

Power Density Pd = (Pt*G)/(4*pi*d^2)
Pd = (2watt*4gain)/(4*pi*0.25^2) at 25 cm distance
Pd = (8)/(0.785) = 10.2 W/m^2 where limit is 6100 W/m^2

Or to find the safe distance that meets the MPE limit;

Power Density Pd = (Pt*G)/(4*pi*d^2)
Solve for d, the minimum safe distance to meet the MPE limit.
d^2 = (Pt*G)/(4*pi*Pd)
d = SqrRoot((Pt*G)/(4*pi*Pd))
d = SqrRoot((2watt*4gain)/(4*pi*6100watt/m^2)
d = SqrRoot((2/pi*6100)m^2)
d = SqrRoot(2/pi*6100)m
d = 0.0102meters = 10.2 mm

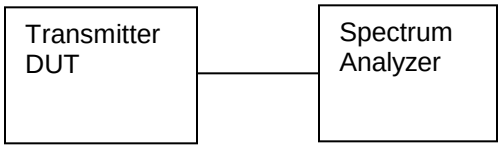
Where
E = Field Strength in Volts/meter
Pt= Transmit Power In Watts
G = Numeric Antenna Gain
d = Distance in Meters
Pd = Power Density in W / square m

INPUT VOLTAGE VARIETION, 15.31(e)

Measured using a connector adapter short cable, MCX to N.
The required cable is longer and has more loss.

Frequency	Voltage	Peak Signal Level
902.74	120	30.00 dBm
902.75	+15%	29.05 dBm
902.75	`-15%	29.08 dBm
915.25	120	30.00 dBm
914.25	+15%	29.97 dBm
915.25	-15%	29.93 dBm
927.25	120	30.00 dBm
927.25	+15%	29.90 dBm
927.25	-15%	30.00 dBm

Setup:

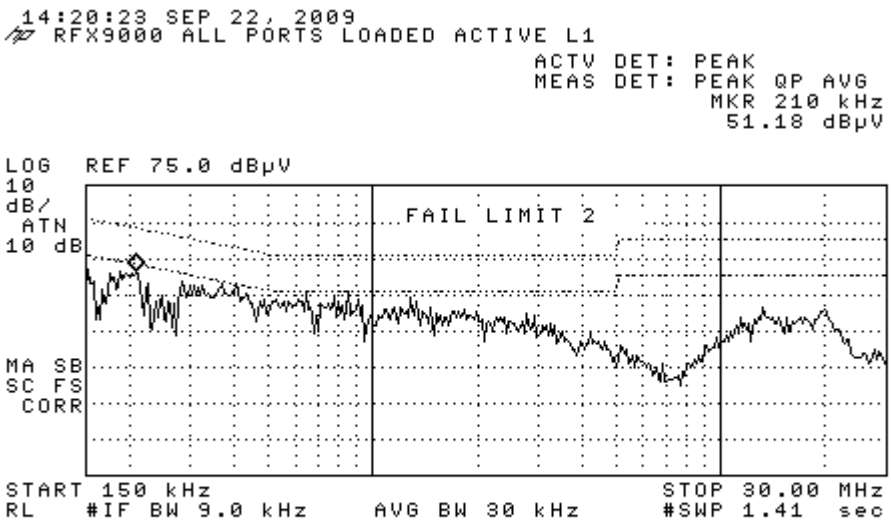


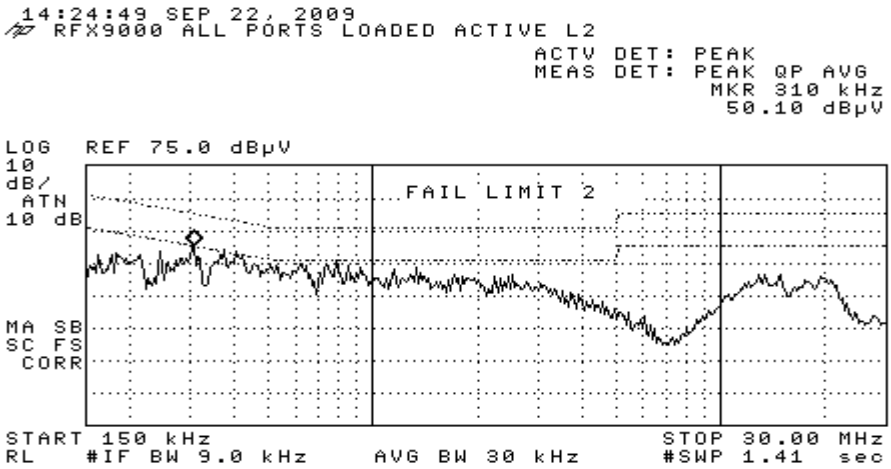
AC CONDUCTED EMISSIONS, 15.207 and 15.107

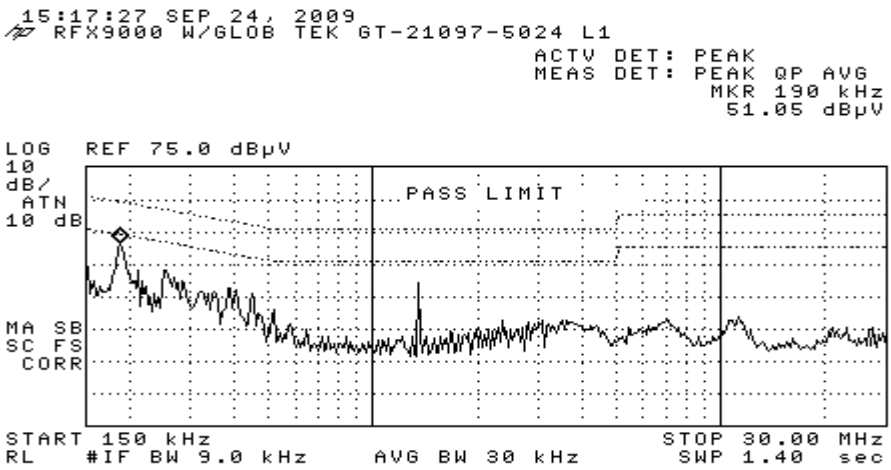
Project Name	Conducted Emissions FCC B Limits	Filename	RFx9000_CondEMI_9-22-09
EUT Name	RFx9000	Serial Number	
Engineer		Part Number	RFx9000
Technician	Paul Tervakoski	Line Voltage	120vac 60Hz
Test Name	Conducted Emissions Profile	Date of Test	9/22/09

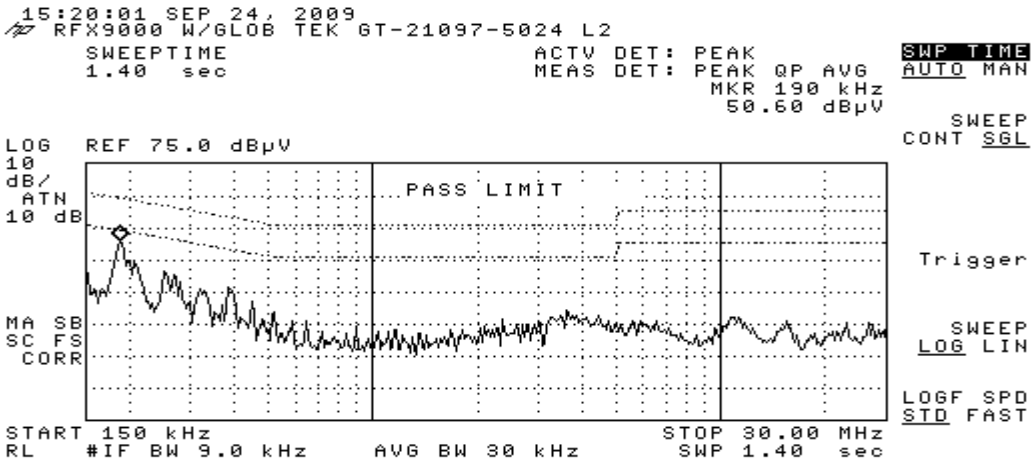
Comments	Tested various power supplies.

Freq (MHz)	Peak Amp (dBuV)	QP Amp (dBuV)	Avg Amp (dBuV)	QP/Avg Limits (dBuV)	L1/L2	Comments
188.8 kHz	53.2	48.3	31.1	64.6//54.6	L1	**Comply**
218 kHz	52.5	47.9	24.3	62.9/52.9	L1	**Comply**
309.7 kHz	52.5	43.1	36.0	60.7/50.7	L2	**Comply**
1.411 MHz	45.5	38.2	30.2	56.0.46.0	L1	**Comply**
1.221 MHz	45.3	38.1	31.4	56.0/46.0	L2	**Comply**
19.84 MHz	42.3	34.9	24.2	60.0/50.0	L1	**Comply**




14:24:49 SEP 22, 2009
RFX9000 ALL PORTS LOADED ACTIVE L2
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 310 kHz
50.10 dBµV
LOG REF 75.0 dBµV
10
dB/
ATN
10 dB
FAIL LIMIT 2
MA SB
SC FS
CORR
START 150 kHz
STOP 30.00 MHz
RL #IF BW 9.0 kHz
AVG BW 30 kHz
#SWP 1.41 sec


15:17:27 SEP 24, 2009
RFX9000 W/GLOB TEK GT-21097-5024 L1
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 190 kHz
51.05 dBµV
LOG REF 75.0 dBµV
10
dB/
ATN
10 dB
PASS LIMIT
MA SB
SC FS
CORR
START 150 kHz
STOP 30.00 MHz
RL #IF BW 9.0 kHz
AVG BW 30 kHz
SWP 1.40 sec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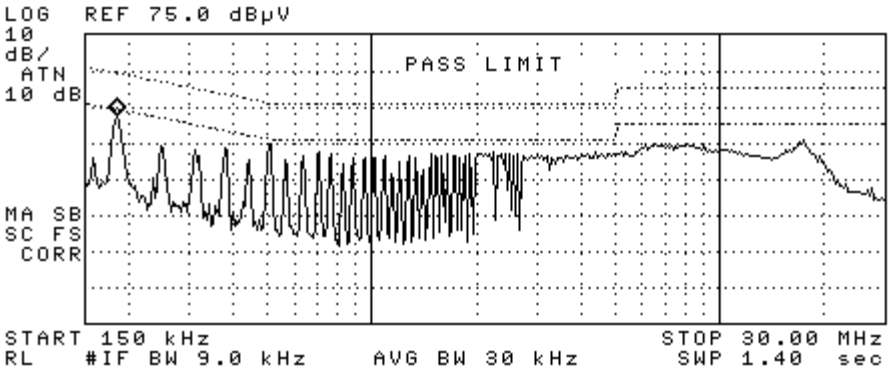
RFX9000 W/GLOB TEK GT-21097-5024 L2
SWEEPTIME
1.40 sec
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 190 kHz
50.60 dBµV
LOG REF 75.0 dBµV
10
dB/
ATN
10 dB
PASS LIMIT
MA SB
SC FS
CORR
START 150 kHz
STOP 30.00 MHz
RL #IF BW 9.0 kHz
AVG BW 30 kHz
SWP 1.40 sec
SWP TIME
AUTO MAN
SWEEP
CONT SGL
Trigger
SWEEP
LOG LIN
LOGF SPD
STD FAST

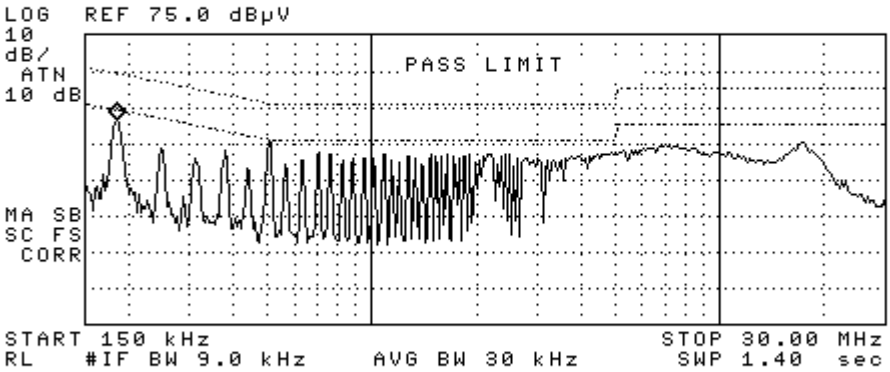
15:34:15 SEP 24, 2009
RFX9000 W/I.T.E. PW173KB2403F01 L1

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 190 kHz
52.25 dBµV



15:36:39 SEP 24, 2009
RFX9000 W/I.T.E. PW173KB2403F01 L2

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 190 kHz
51.16 dBµV



FREQUENCY HOPPING REQUIREMENT, 15.247

Section 15.247 (a)
The EUT 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.
The order of channels in the hop sequence is pseudo random list.
Frequency-hopping proceeds in order through the list.

Equal Hopping Frequency Use [Section 15.247 (g)]
Each Frequency is specified only once in the list and the list is completed before looping back to the beginning.

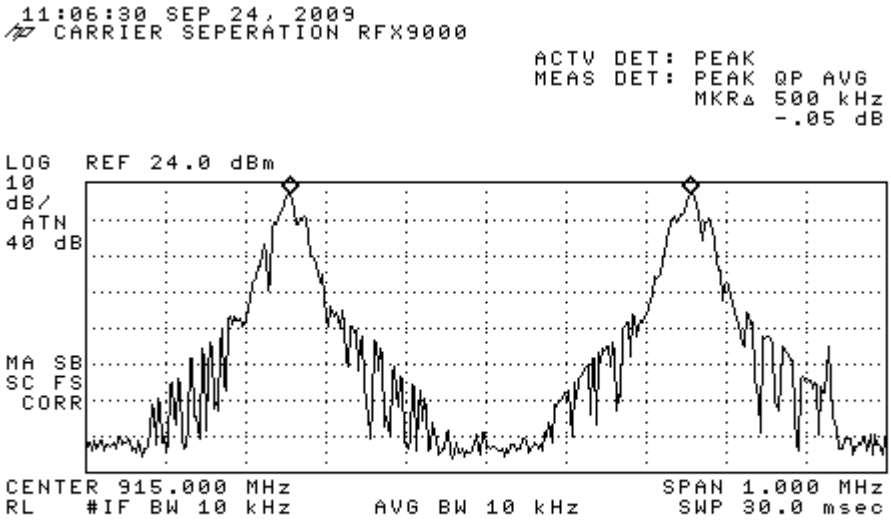
System Receiver Input Bandwidth
The received signal is demodulated by a balanced mixer. The output of this mixer is filter by a fixed 5Mhz low pass 5th order anti-aliasing filter. The output of the anti-aliasing filter is sampled by the ADC – where the samples are passed to the DSP for selective filtering. 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.

CARRIER FREQUENCY SEPARATION, 15.247 (a)(1)

Carrier separation = 500.0 kHz



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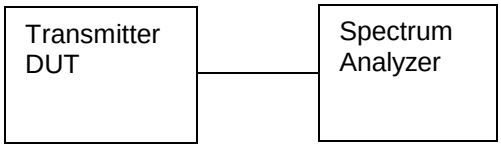
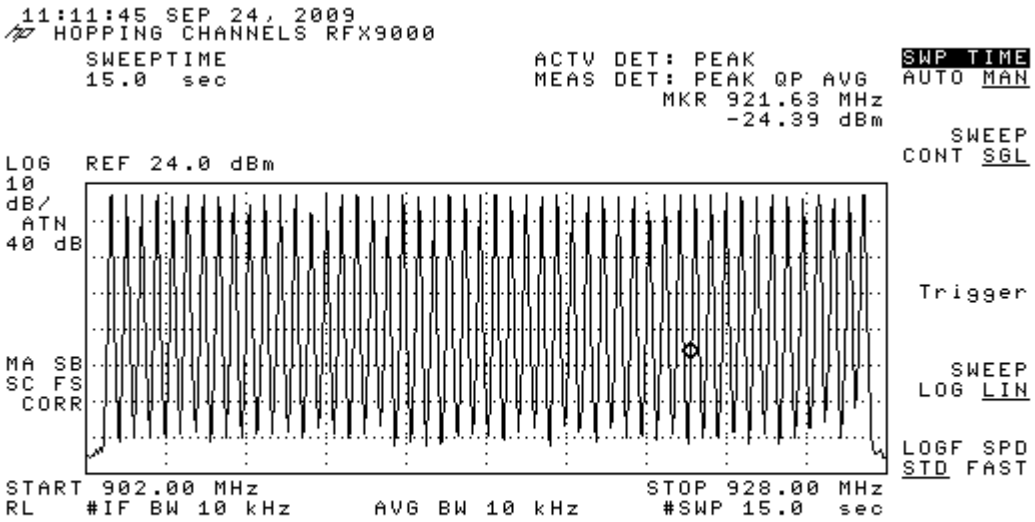


NUMBER OF HOPPING CHANNELS, 15.247 (a)(1)(i)

The number of hopping channels = 50



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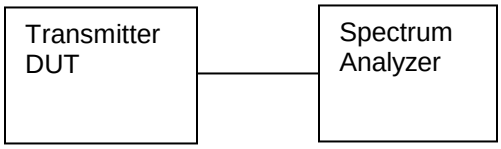
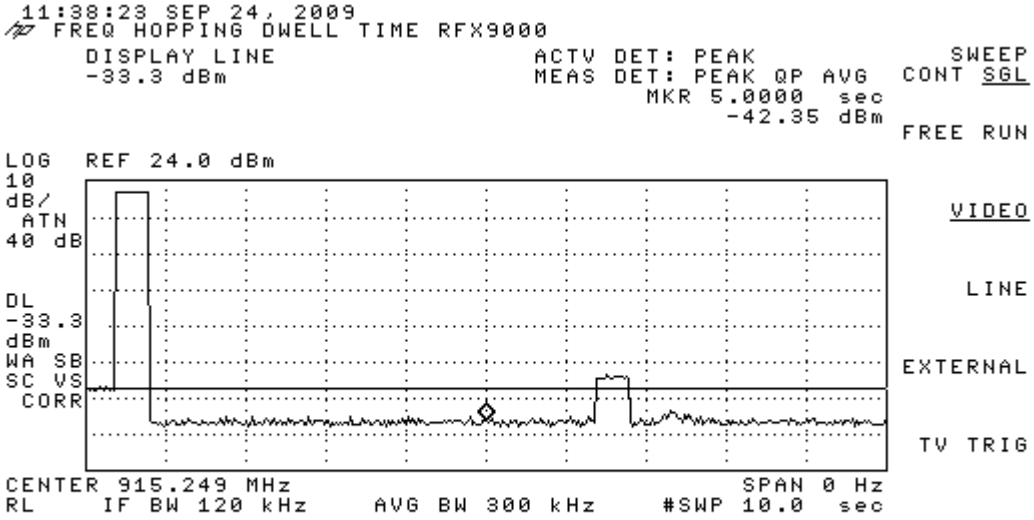


TIME OF OCCUPANCY (DWELL TIME), 15.247 (a)(1)(i)

Limit = 400 ms.



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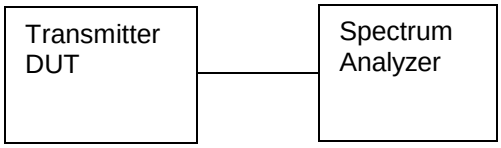
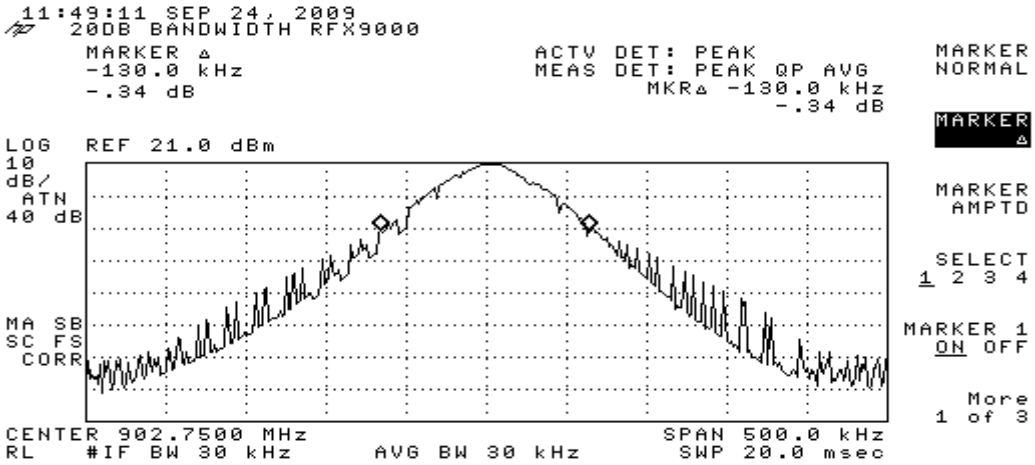
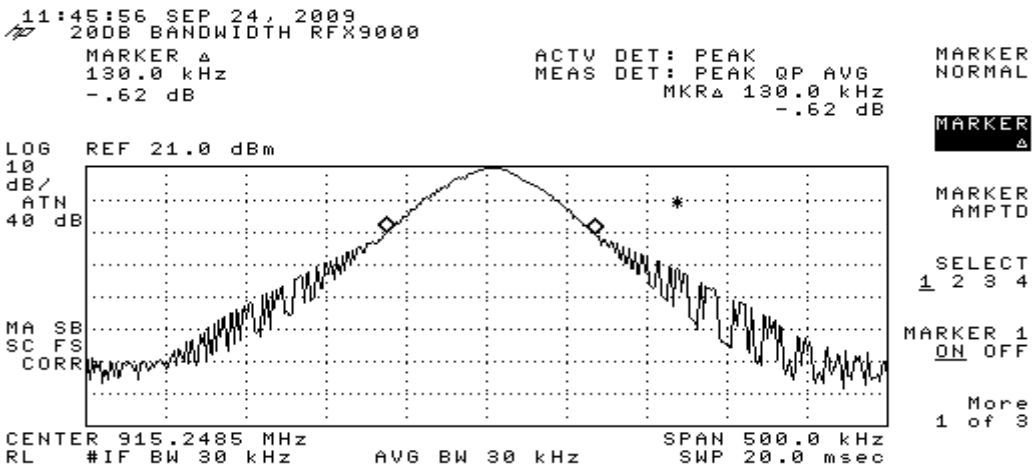
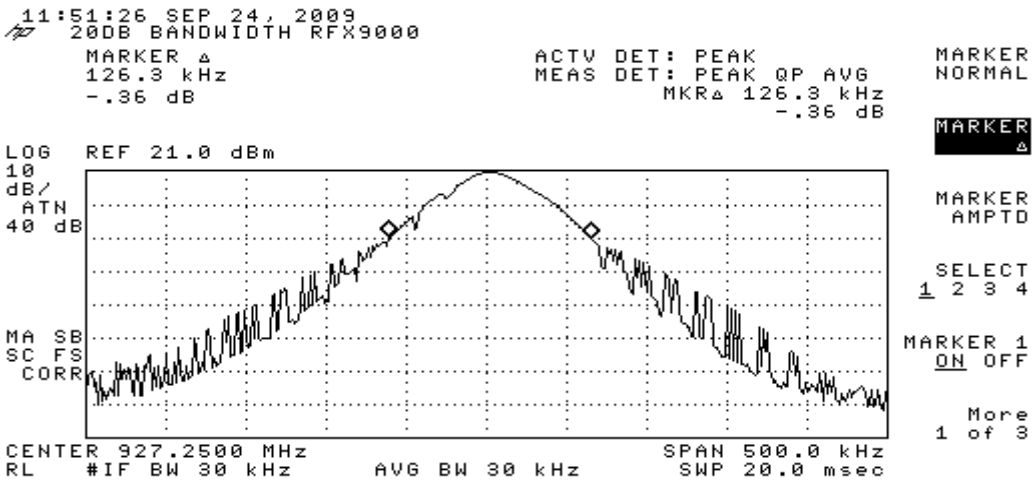


20 DB BANDWIDTH, 15.247 (a)(1)





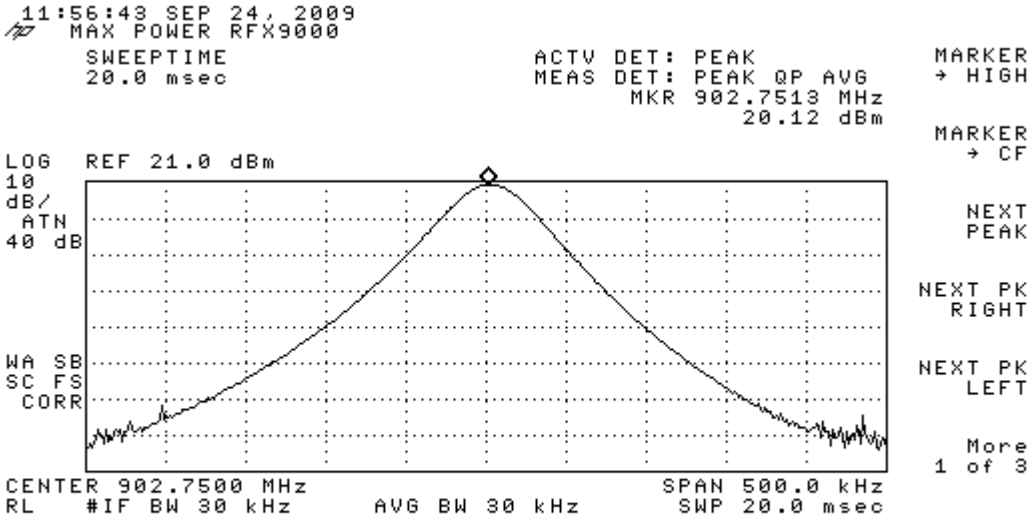


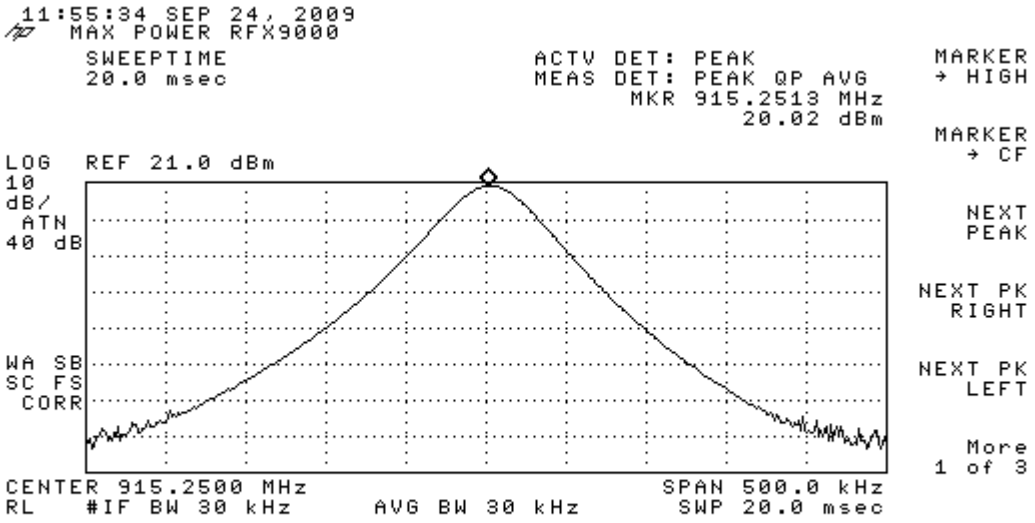
PEAK POWER OUTPUT, 15.247 (b)

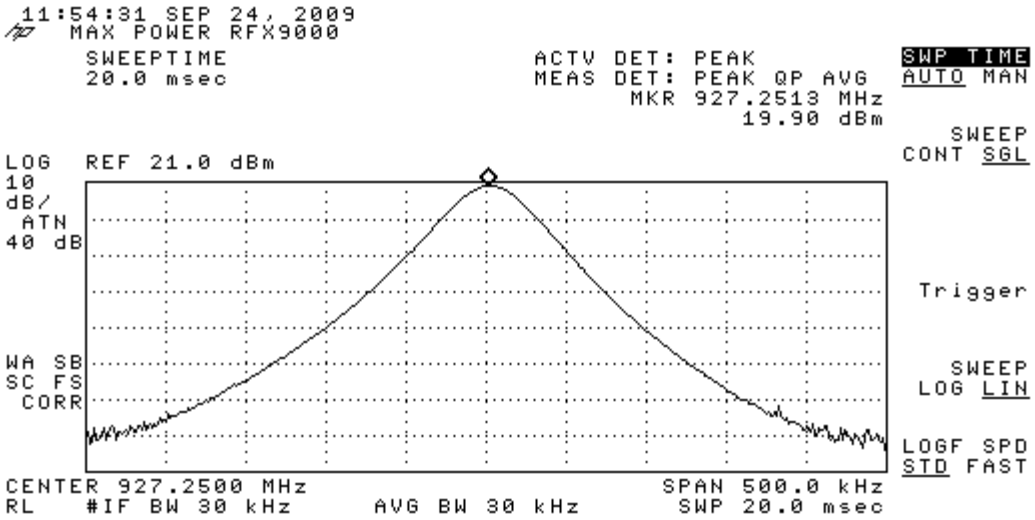
On the transmitter ports, the maximum output power is set at 30 dBm.
The worst case peak conducted power is reported here and is measured at 19.88 dBm. A 10 dB attenuator was used to prevent damage to the spectrum analyzer front end and the loss was measured at 9.8 dB. The short connecting cable loss is 0.4 dB.

Therefore, the peak power is 20.12 dBm + 9.8 dBm = 29.92 dBm or 1 Watt.

The EUT complies with the limit.
The intended use for the EUT is detection of nearby tags. Therefore, maximum output of 30 dBm is not needed at the antennas. Cable loss provides acceptable performance for detecting tags. Thus there is no need to define cable parameters to meet the limit.







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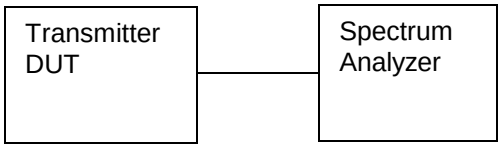
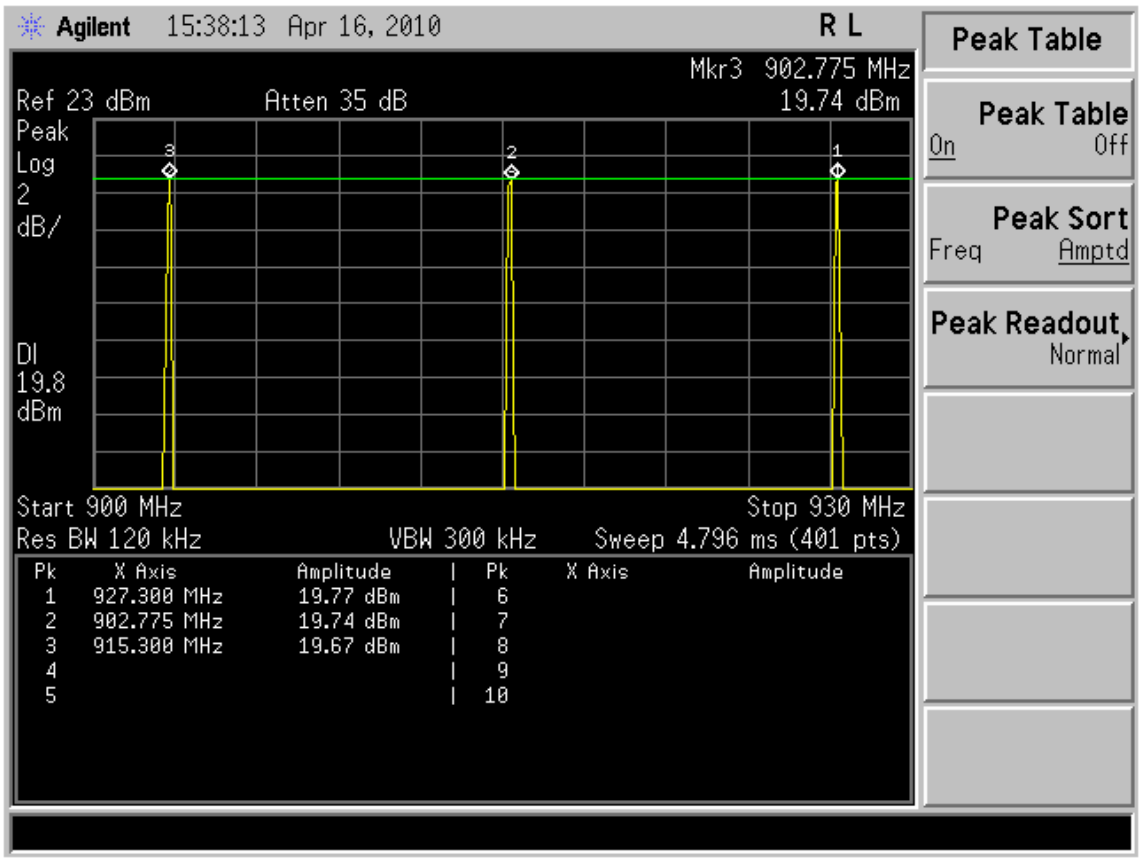


Re-measured to verify. 19.77 dBm + 9.8 dB + 0.4 dB = 29.97 dBm.

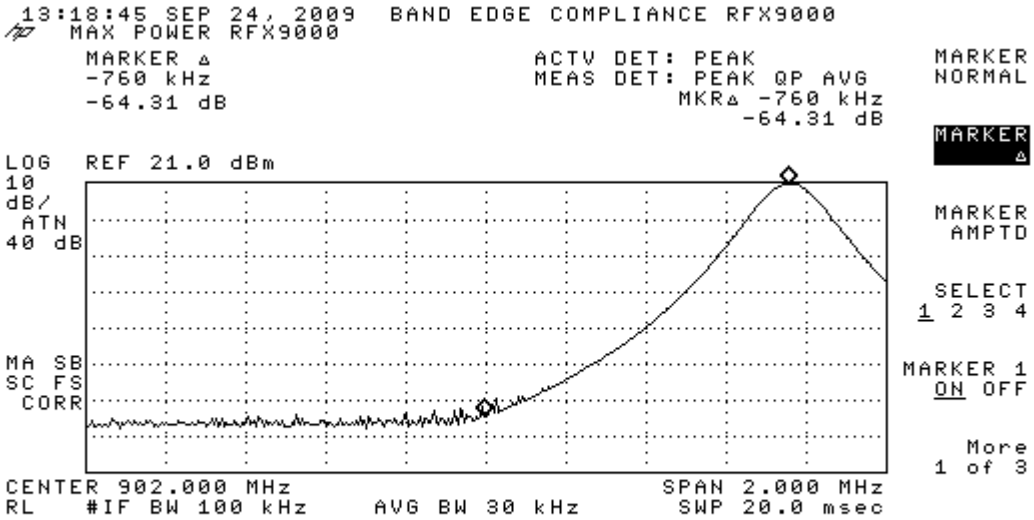



Windows XP
Professional
DELL
ISLES
Sensormatic
OfficeMax
FCC - EMI
Subject Notebook
ISLES

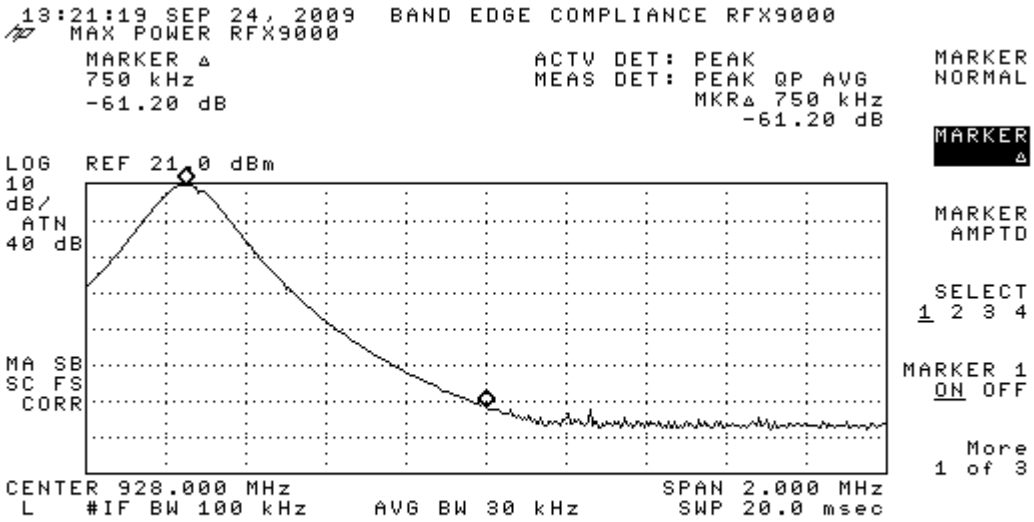
BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS, 15.247 (c)

Limit: > 20 dB below highest inband signal.

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 928 MHz; emissions are more than 30 dB below the inband signal.



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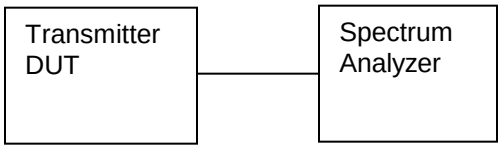
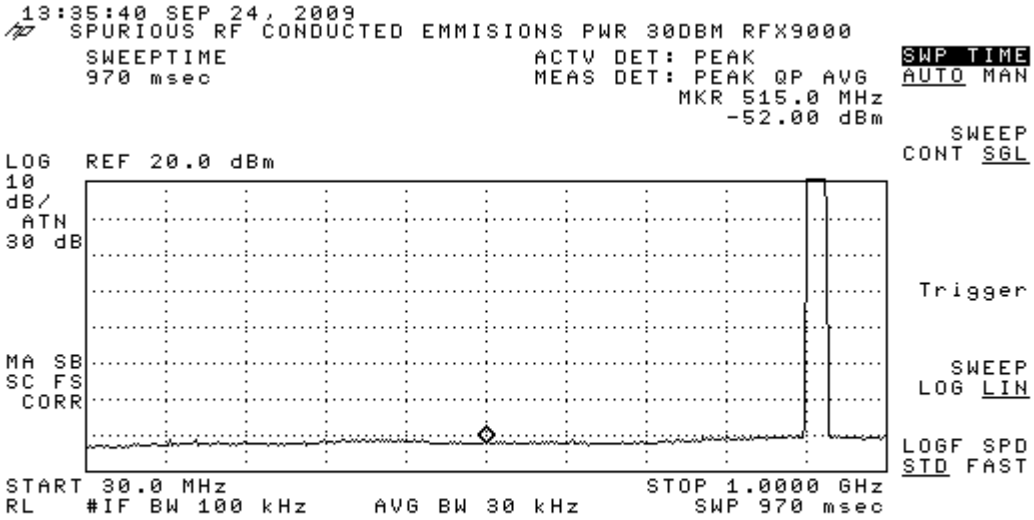


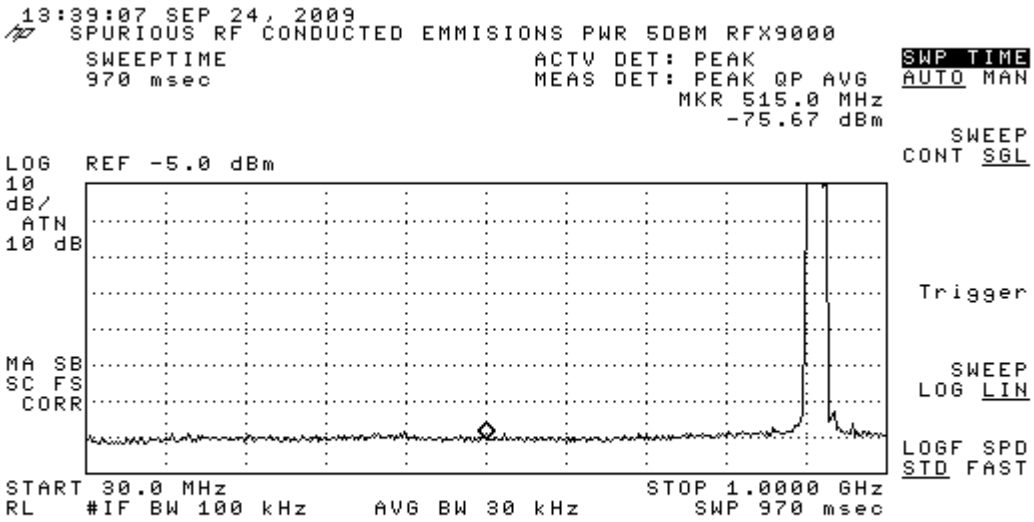
SPURIOUS RF CONDUCTED EMISSIONS, 15.247 (c)

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.

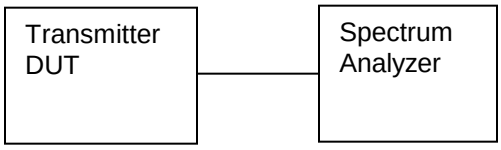
Maximum output power, Below 1 GHz



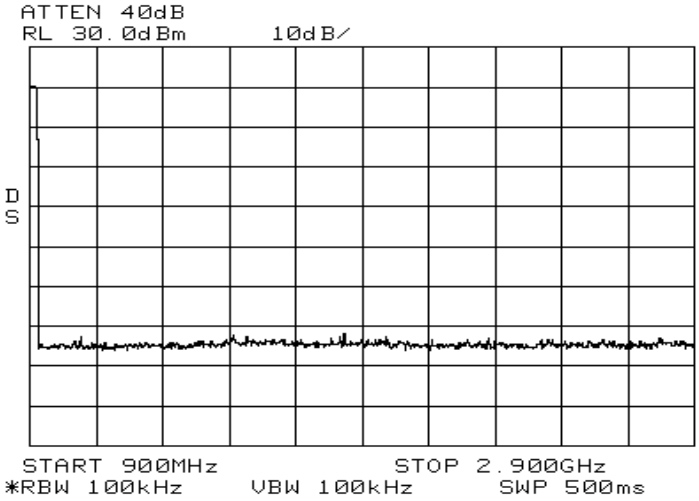
Minimum output power, Below 1 GHz

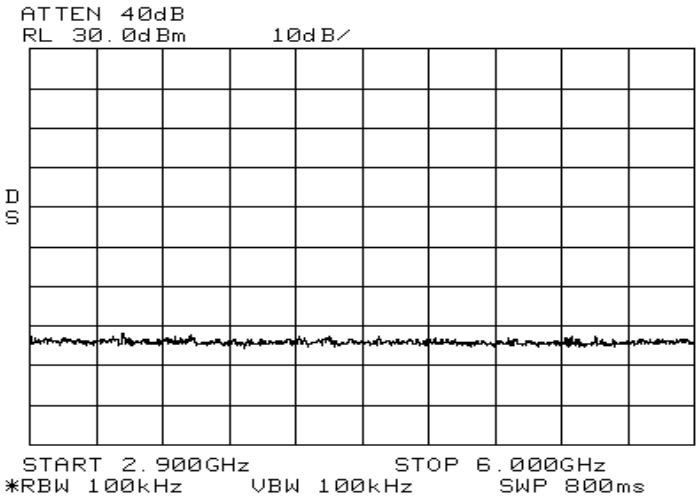


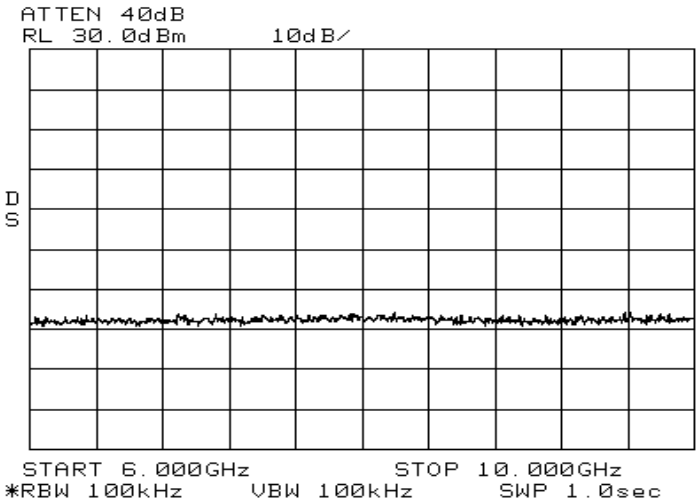
Setup:



Maximum output power, above 1 GHz







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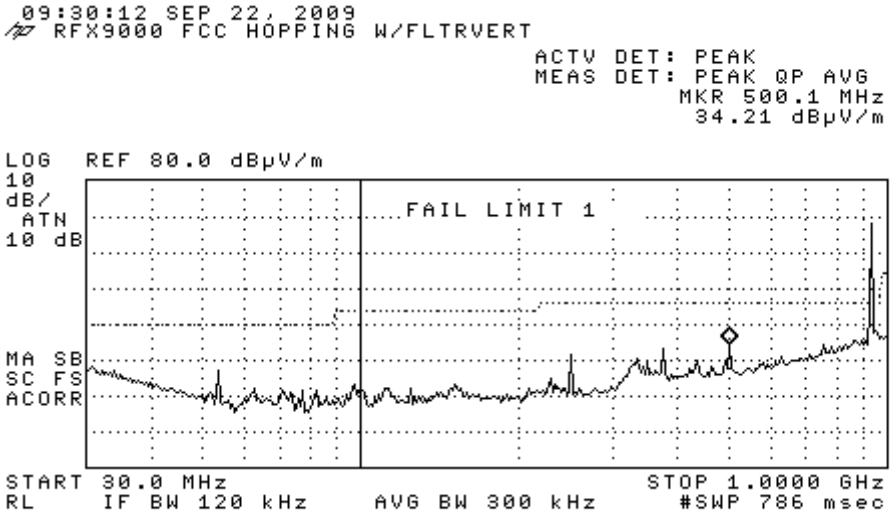
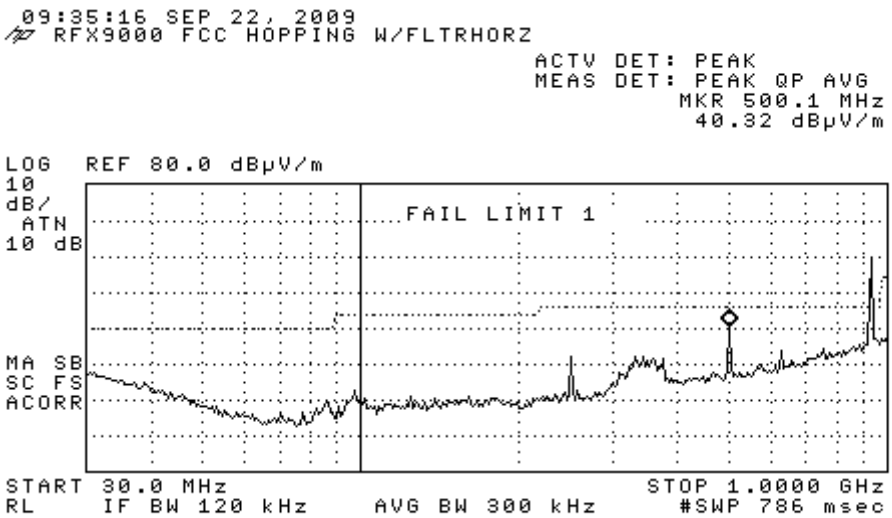
SPURIOUS RADIATED EMISSIONS, 15.247 (c), 15.205, 15.209

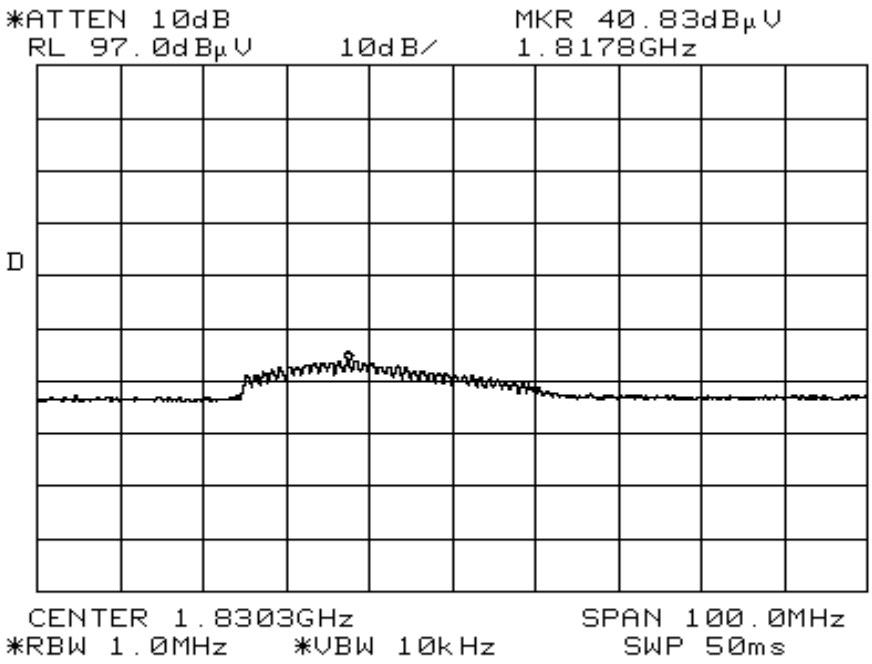
The EUT was prescreened in the semi-anechoic chamber at Sensormatic per the guidelines in ANSI C63.4-1992. Each port was compared to determine which had the worst case emissions.
In addition, each antenna type was compared in prescreens to determine the worst case antenna for measurement.

Pre-compliance scans in chamber.

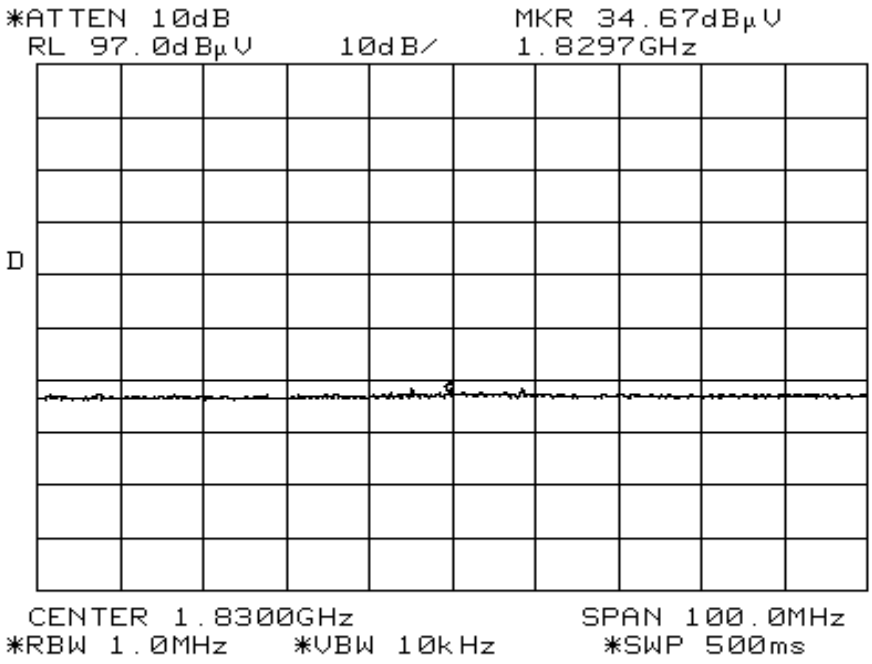




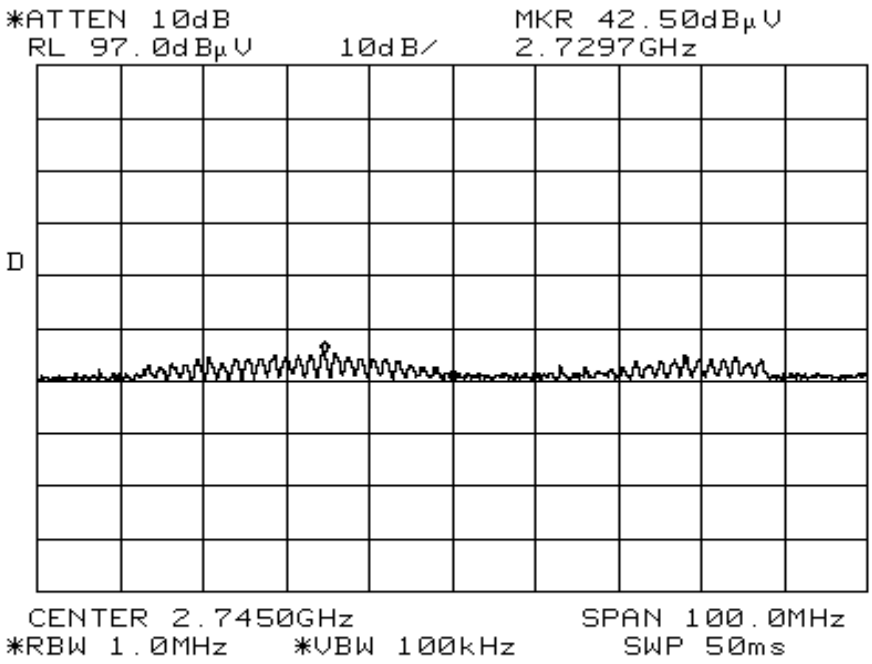
Vertical



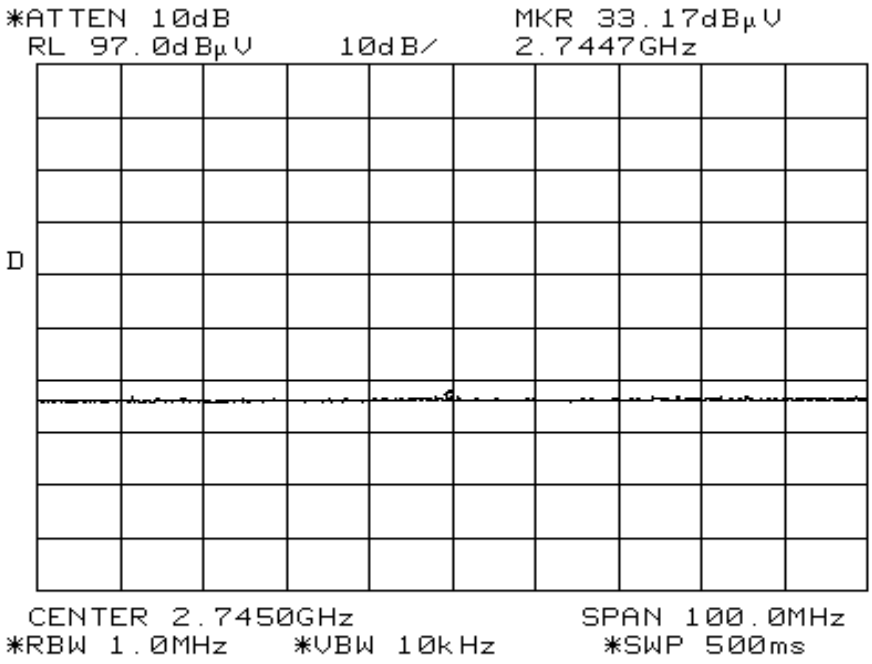
Horizontal



Vertical



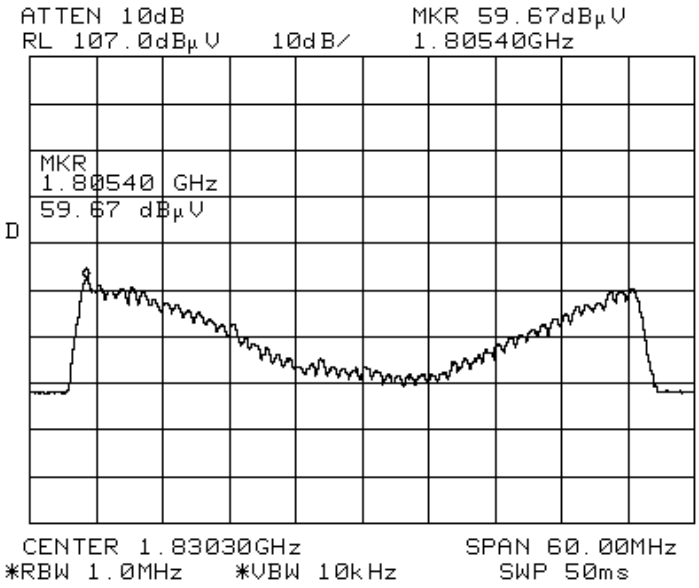
Horizontal



No higher harmonics or other emissions found in either vertical or horizontal in the chamber.

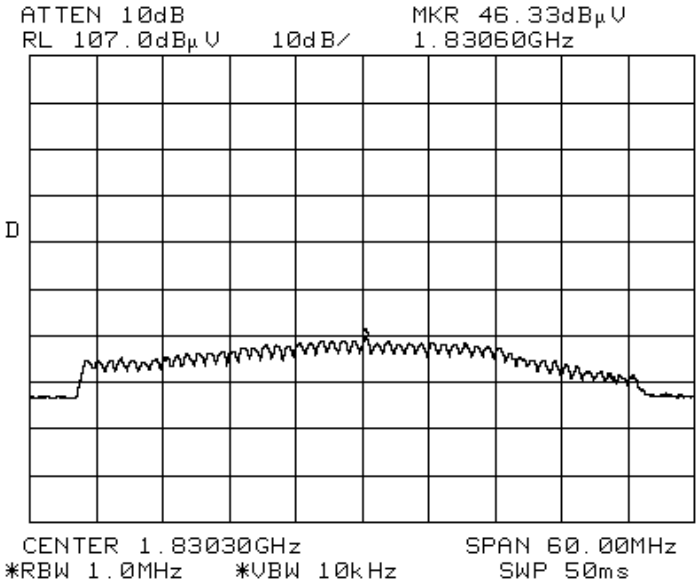
OATS measurements

1 Meter distance, Horz



No detectable harmonics higher than 2nd harmonic

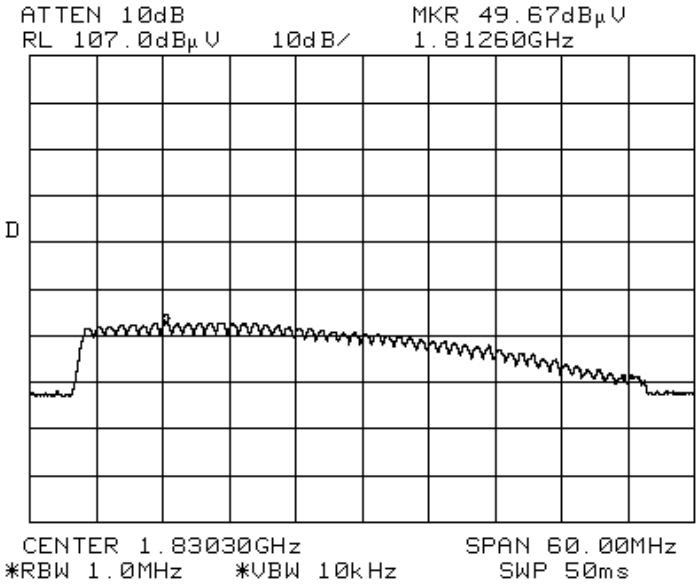
1 Meter distance, Vert



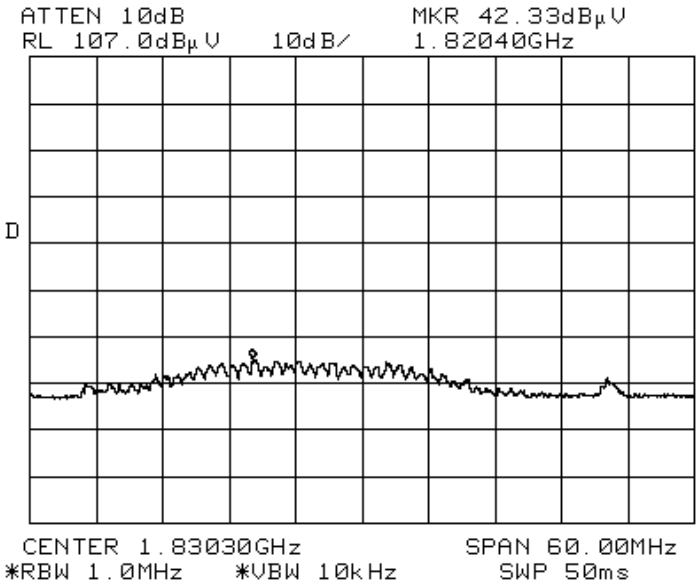
No detectable harmonics higher than 2nd harmonic

Change EUT antenna orientation from vertical to horizontal

1 meter distance, vert



1 meter distance, horz



No higher harmonics were detectable.

FCC TEST RESULTS

Radiated Emissions Testing - TX Spurious Above 1 GHz

90degF / 65% RH at OATS
Measuring Distance = 1 meter. Limit Distance = 3 meter
Distance Correction = -9.54 dB.
Antenna = EMCO Model 3115 S/N 3006
Amplifier = Miteq Amplifier with 900 MHz high pass filter
Cable + Filter Path Loss = 9913F (25') + 2-RGS-142 cables + Microtronics HPF S/N 001
Emission Level (dBuV/m) = Emission + Path loss + Distance Correction - Preamp Gain + Antenna Factor
Res = Vid = 1 MHz [pk] Vid = 10 kHz [avg]

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	47.63	47.03
1,830.000	Vert	64.20	63.60	45.03	44.43

TX 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, results in the next section.
This was done on the lo / mid / and high channels with the same result.

There were no discernable spurious emissions below 1 GHz that tracked with the transmitter.

Test Equipment List

Description	Manufacturer	Model	Serial #	Due	Last
Antenna Bicon	EMCO	3104C	4334	4/3/2010	4/3/2009
Antenna BiLog (Immunity)	Schaffner Chase	CBL6141	4112	verify	
Antenna Double-Ridge Horn	EMCO	3115	3006	4/2/2010	4/2/2009
Antenna Log Periodic	EMCO	3146	4731	5/4/2010	5/4/2009
Antenna Log Periodic	EMCO	3146	3576	4/3/2010	4/3/2009
Antenna Log Periodic	EMCO	3146	3909	5/4/2010	5/4/2009
Antenna Loop	Electro Metrics	ALP-70	163	5/4/2010	5/4/2009
Antenna Loop (Immunity)	Solar Elect	7334-1	73626	verify	
Capacitive Cable Clamp	Haefely Trench	PEFT Junior	083-078-31	verify	
CI 5kv VA AC Power Source	California Inst.	5001ix	54328	10/0610	10/6/2009
CI Electronic Output Switch	California Inst.	EOS-1	72377	10/0610	10/6/2009
CI Power Analyzer System	California Inst.	PACS-1	72376	10/0610	10/6/2009
DMM	Fluke	87IV	174	8/20/2010	8/20/2009
EFT Generator	Haefely Trench	PEFT Junior	083 180-16	7/10/2010	7/10/2009
ESD Simulator	Schaffner	NSG435	1197	7/15/2010	7/15/2009
Humidity & Temperature Meter	Davis Inst	4465CF	10304858	8/20/2010	8/20/2009
Line Imp Stable Network	EMCO	3816/2NM	1018	6/10/2010	6/10/2009
Line Imp Stable Network	EMCO	3816/2NM	1064	2/5/2010	2/5/2009
Pre-Amp .009-1300MHz	HP	8447F	2805A03473	12/2/2010	12/2/2009
Pre-Amp .009-1300MHz	HP	8447F	3113A06072	12/2/2010	12/2/2009
RF Current Probe	FCC	F-33-1	304	6/10/2010	6/10/2009
RF Field Meter	Narda	EMR-200	AN-0055	5/5/2010	5/5/2010
RF Injection Clamp	FCC	F-203I	30	verify	
RF Power Meter	Boonton	4231-30	53701	6/5/2010	6/5/2009
RF Power Sensor	Boonton	51011-EMC	31932	6/5/2010	6/5/2009
Signal Generator	Giga-tronics	6060B	5850202	7/9/2010	7/9/2009
Signal Generator	Marconi	2024	783031	2/6/2010	2/6/2009
Spectrum Analyzer	HP	8562A	2712A00534	11/4/2010	11/4/2009
Spectrum Analyzer	HP	8591EM	3649A01066	11/5/2010	11/5/2009
Spectrum Analyzer	HP	E7401A	US39110103	2/26/2010	2/26/2009
Spectrum Analyzer w/Track Gen	HP	8591EM	3520A00190	11/17/2010	11/17/2009
Surge CDN Signal Line bal	Key Tek	CM-TELCD	9904206	verify	
Surge CDN Signal Line unbal	Key Tek	CM-I/OCD	9904213	verify	
Surge Coupler/Decoupler	Key Tek	CE50	9507535	verify	
Transient Limiter	Electro Metrics	EM 7600	187	12/3/2010	12/3/2009