Test Report

CURTIS-STRAUS Curtis-Straus LLC, *a wholly owned subsidiary of BV CPS*

Report No	EL0230-1
Client	SignalFire Telemetry, Inc
Address	43 Broad Street, Unit A-403 Hudson, MA 01749
Phone	(978) 212-2868
Items tested	Modbus-In-A-Stick
FCC ID	W8V-M655
IC ID	8373A-M655
FRN	001814347
Equipment Type	DSS
Equipment Code	Part 15, Frequency Hopping Spread Spectrum Transmitter
FCC/IC Rule Parts	47 CFR 15.247, RSS 210 issue 8 and RSS GEN issue 3, 47 CFR 15 B
Test Dates	April 11-12, 2011
Results	As detailed within this report
Prepared by	Matthew Burman – Test Engineer
Authorized by	Mairaj Hussain – EMC Supervisor
Issue Date	April 14, 2011
Conditions of Issue	This Test Report is issued subject to the conditions stated in the '*Conditions of Testing*' section on page 31 of this report.

Contents

Form Final Report REV 7-20-07 (DW)

Summary

This test report supports an application for certification of a transmitter operating pursuant to 47 CFR 15.247 and RSS-210. The product is the Modbus-In-A-Stick. It is a frequency hopping transmitter that operates in the range 905-925MHz.

We found that the product met the above requirements without modification. Josh Schadel from Signal Fire Telemetry was present during the testing. The test sample was received in good condition.

Test Methodology

Radiated emission and AC line conducted emission testing was performed according to the procedures specified in ANSI C63.4 (2003), FCC public notice DA00-705 and RSS-GEN. Radiated Emissions were maximized by rotating the device around three orthogonal axes as well as varying the test antenna's height and polarity. The device antenna cannot be maximized separately.

Conducted emission at the antenna port was performed, as required by rule section.

The product will be configured for the transmission to either be in the range of 902-915Mhz, or 915-928MHz.

This report is also for the verification on the digital circuitry.

The following bandwidths were used during radiated spurious and line conducted emissions.

Frequency	RBW	VBW
0.15-30MHz	9kHz	30kHz
30-1000MHz	120kHz	1MHz
1-10GHz	1MHz	3MHz

Release Control Record

Issue No.	Reason for change	Date Issued
1	Original Release	April 29, 2011

Product Tested - Configuration Documentation

EUT Configuration

Work Order: L0230
Company: Signal Fire Telemetry
Company Address: 43 Broad St, Suite A-403
Hudson, MA 01749
Contact: Josh Schadel
Person Present: Josh Schadel

	MN	PN	SN
EUT:	M-6-5-5	---	3016

EUT Description: Modbus
EUT Max Frequency: 8MHz
EUT Tx Frequency: 905-925MHz

Support Equipment:	MN	SN
IBM Laptop	PPX	11958742
Gateway Breakout	840-0048-01	sample 1
CUI Power Supply	EPS090066	sample 1

EUT Ports:

Port Label	Port Type	No. of ports	No. Populated	Cable Type	Shielded	Ferrites	Length	Max Length	In/Out NEBS Type	Unpopulated Reason
Power and Signal (DC mains and RS-485)	DC power and RS-485	1	1	2 pair and twisted pair (6 conductor) 24awg	No	none	5m	1200m	indoor	

Software / Operating Mode Description:

EUT is transmitting at 905-925MHz

Statement of Conformity

The Modbus-In-A-Stick has been found to conform to the following parts of 47 CFR and RSS 210 as detailed below:

RSS-GEN	RSS 210	Part 15	Comments
5.4		15.15(b)	There are no controls accessible to the user that varies the output power.
5.2		15.19	The label is shown in the label exhibit.
7.1.3 7.1.2		15.21	Information to the user is shown in the instruction manual exhibit.
		15.27	No special accessories are required for compliance.
4.1		15.31	The EUT was tested in accordance with the measurement standards in this section.
		15.33	Frequency range was investigated according to this section, unless noted in specific rule section under which the equipment operates.
		15.35	The EUT emissions were measured using the measurement detector and bandwidth specified in this section, unless noted in specific rule section under which the equipment operates.
7.1.2		15.203	The antenna for this device is hardwired to the PCB.
	2.5	15.205 15.209	The fundamental is not in a Restricted band and the spurious and harmonic emissions in the Restricted bands comply with the general emission limits of 15.209.
7.2.4		15.207	EUT meets the AC Line conducted emissions requirements of 15.207.
	Annex 8	15.247	The unit complies with the requirements of 15.247
4.6.1			Occupied Bandwidth measurements were made.

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Modifications Required for Compliance

No Modifications were required for compliance.

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Test Results

Bandwidth

LIMIT

The 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping frequencies. [15.247(a) (1) (i)]

MEASUREMENTS / RESULTS

Bandwidth

Date: 11-Apr-11 **Company:** Signal Fire **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 6Vdc
Temp: 19.1°C **Humidity:** 27% **Pressure:** 1008mBar
Frequency Range: 902-928MHz **Measurement Distance:** Conductive
Notes: RBW = 30kHz RBW > 0.1% of 20dB bandwidth The maximum allowed 20dB badwidth of the hopping channel is 500kHz
VBW = 100kHz if the 20dB badwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping frequenc

							---			FCC Section 15.247(a(i))		
	Frequency (MHz)	Reading (kHz)								Limit (kHz)	Margin (kHz)	Result (Pass/Fail)
low channel	905.0	81.3	---	---	---	---	---	---	---	250.0	-168.8	Pass
mid channel	915.0	82.5	---	---	---	---	---	---	---	250.0	-167.5	Pass
high channel	925.0	80.0	---	---	---	---	---	---	---	250.0	-170.0	Pass

Test Site: 3m Indoor OATS I **Attenuator:** PE7019-20
Analyzer: Asset #1491

Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Rental SA #5	9kHz-26.5 GHz	E4407B	Agilent	MY44220066	1491	I	17-Mar-2012
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
HF 20dB 50W Attenuator	0.009-18 GHz	PE 7019-20	Pasternack	1	791	II	8-May-2011
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
1DCC-OATS-3M-I Thermohygrometer		35519-044	Control Company	72457635	1334	II	18-Aug-2011

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

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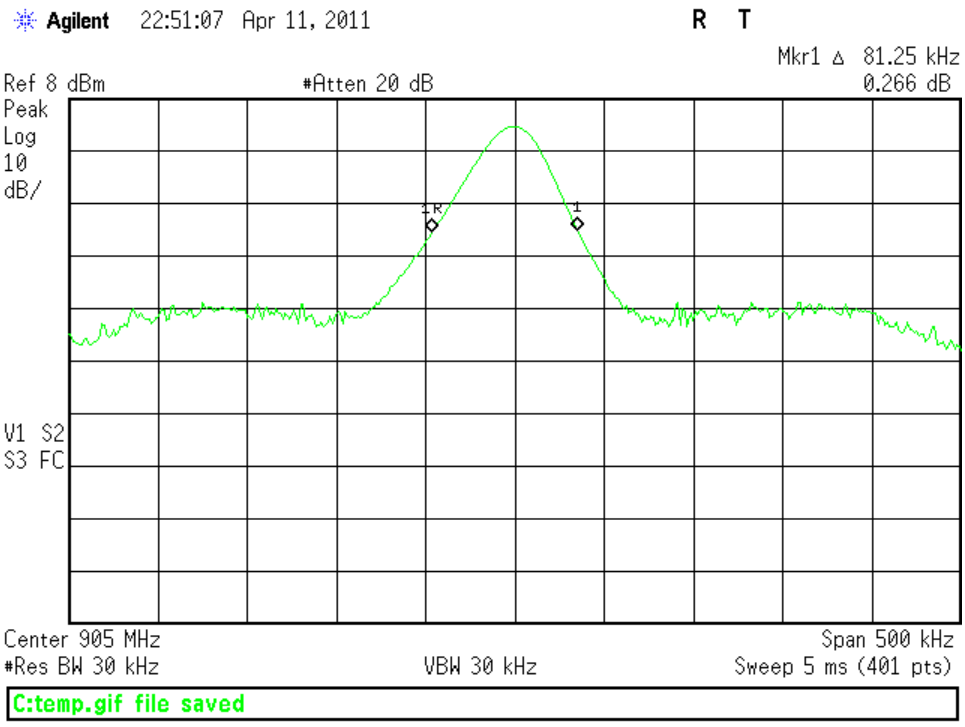
PLOT

Low Channel



Mid Channel

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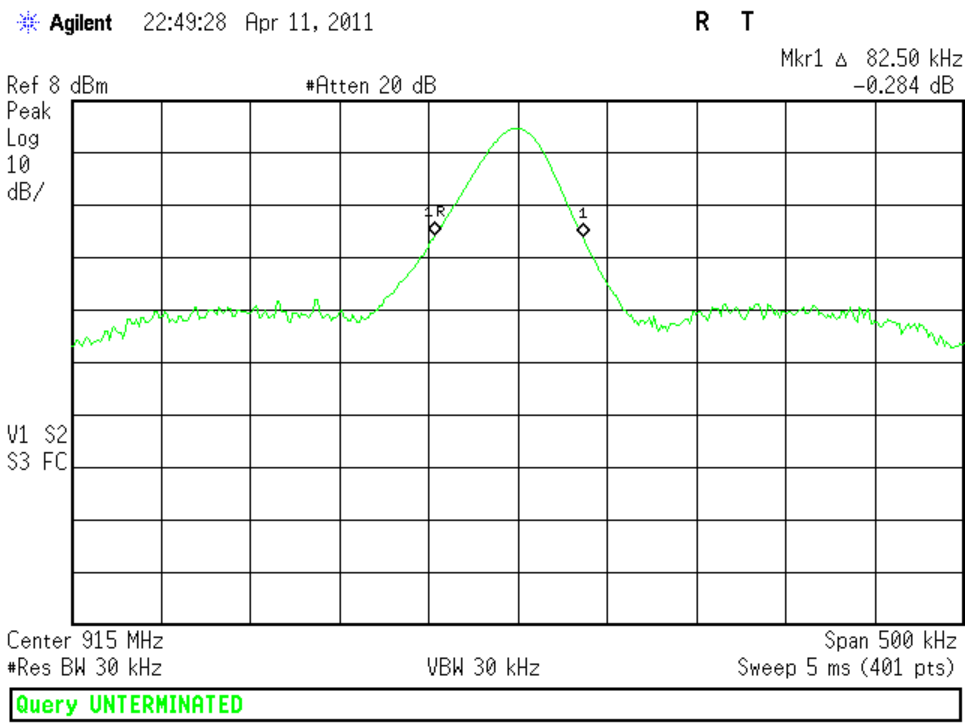
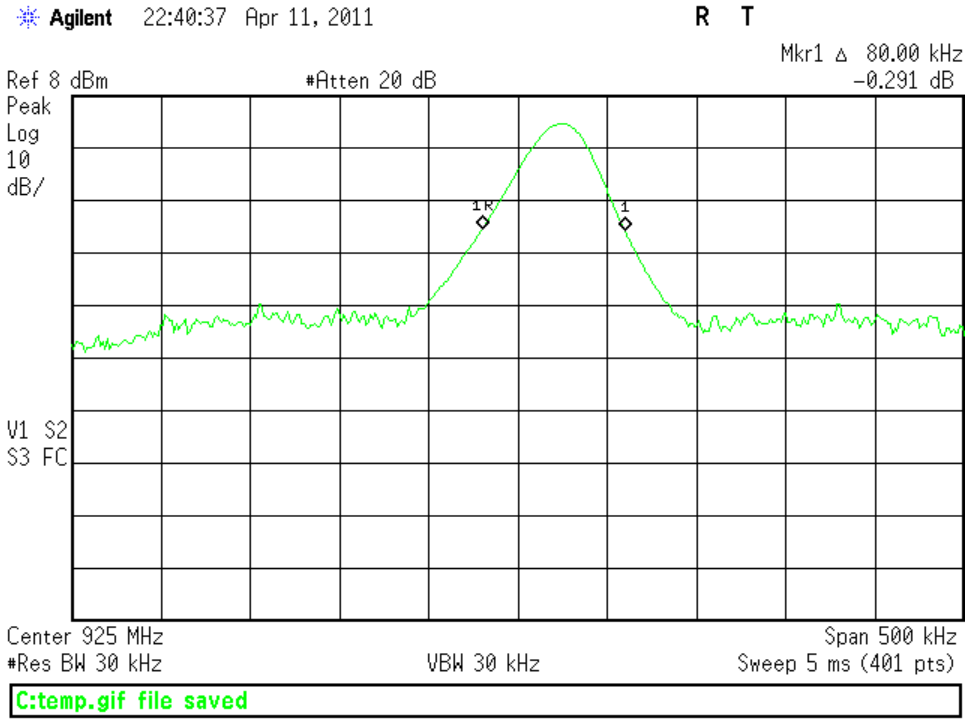


High Channel



Frequency Hopping Requirements

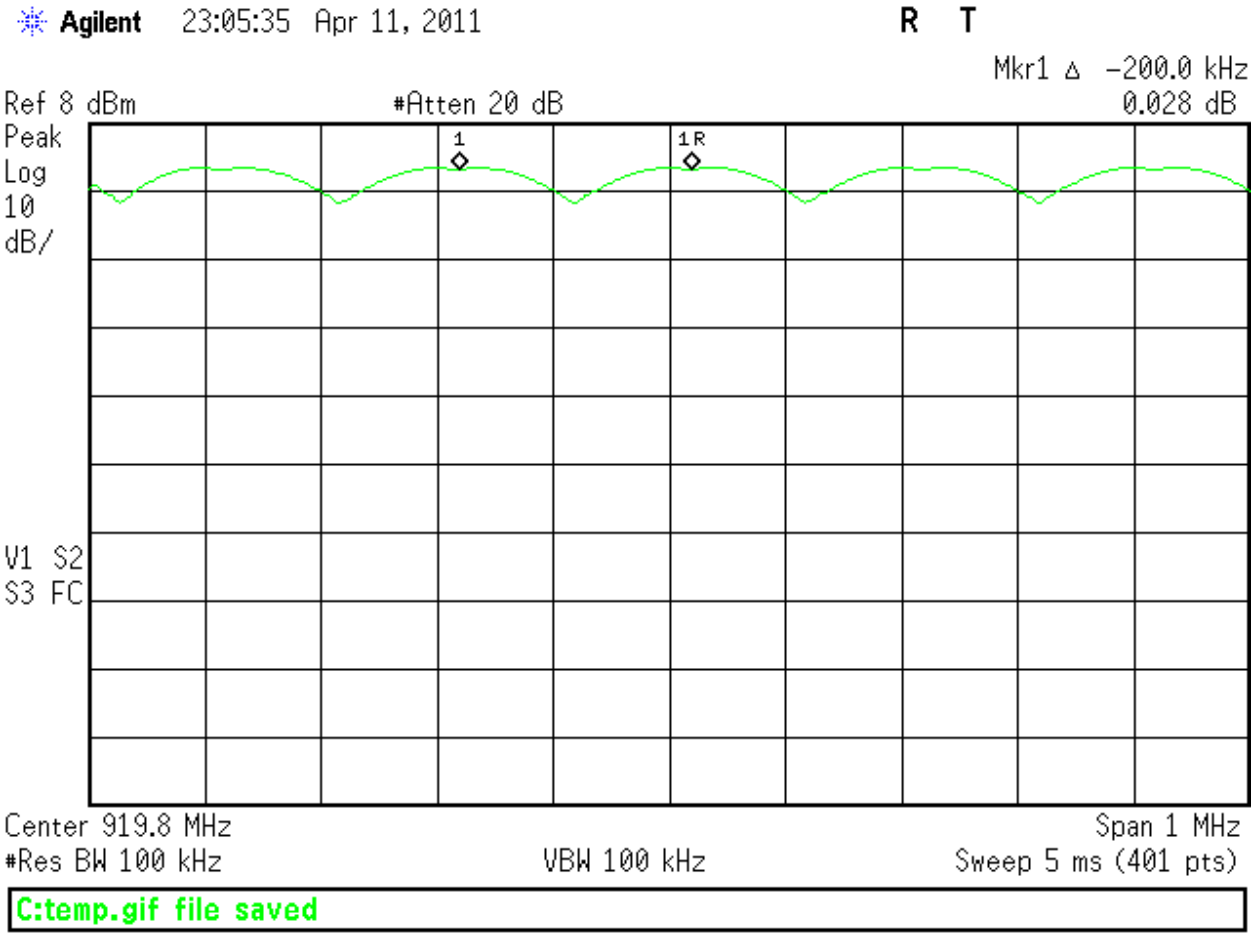
Channel Spacing

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

[15.247 (a) (1)]

Plots

Channel spacing between carrier frequencies of 200kHz > 20dB bandwidth



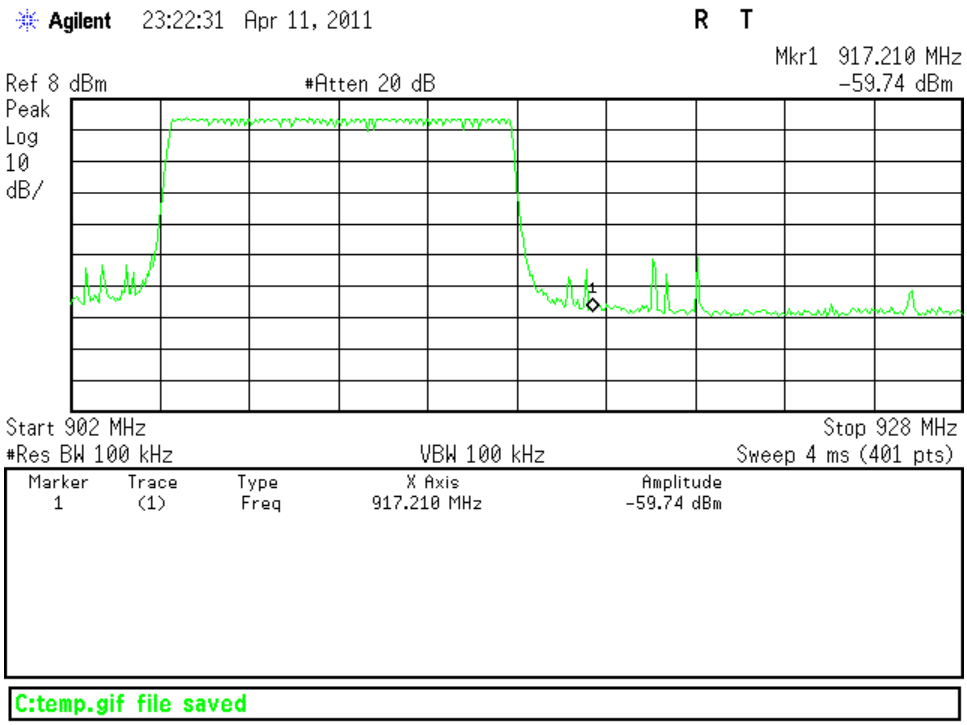
Number of Channels

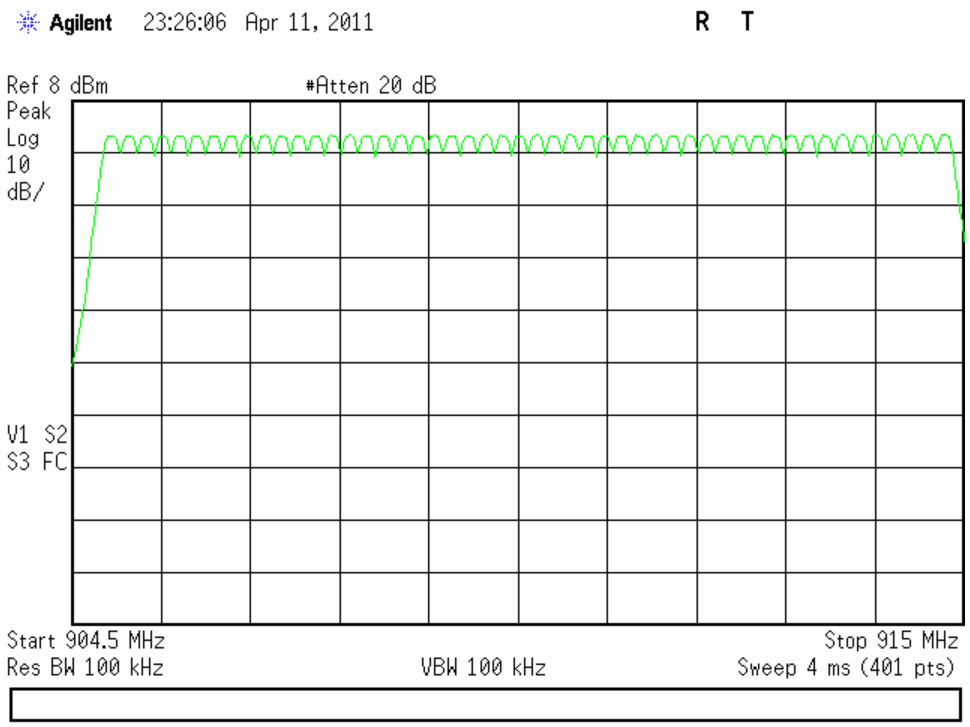
For frequency hopping systems operating in the 902-928MHz band: if the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping frequencies

[15.247 (a) (1) (i)]

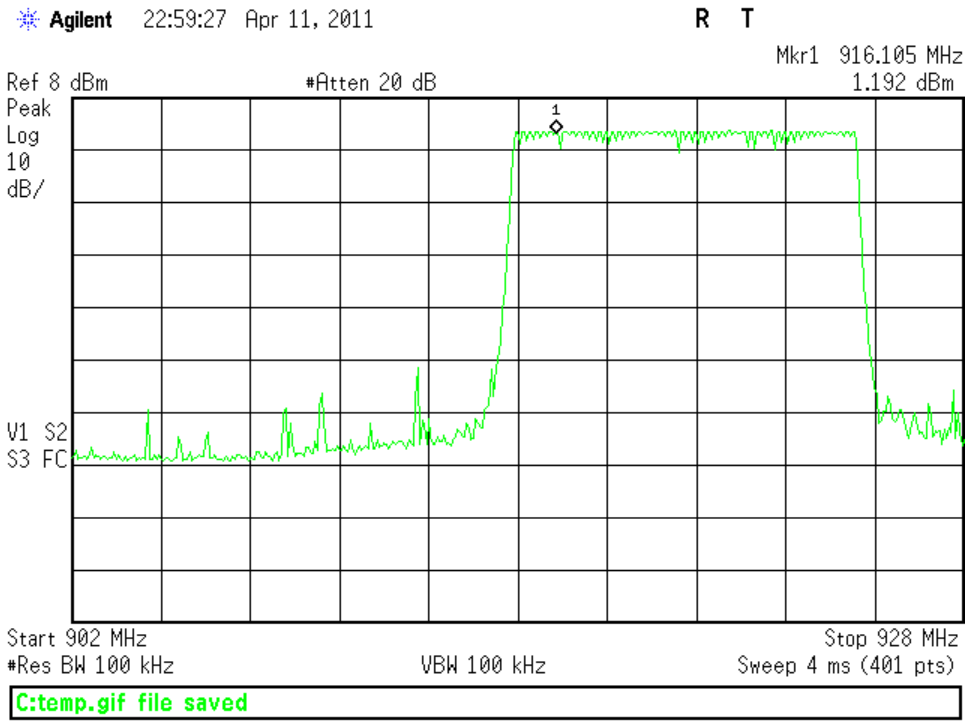
Plots

50 channels – low band





50 channels – high band



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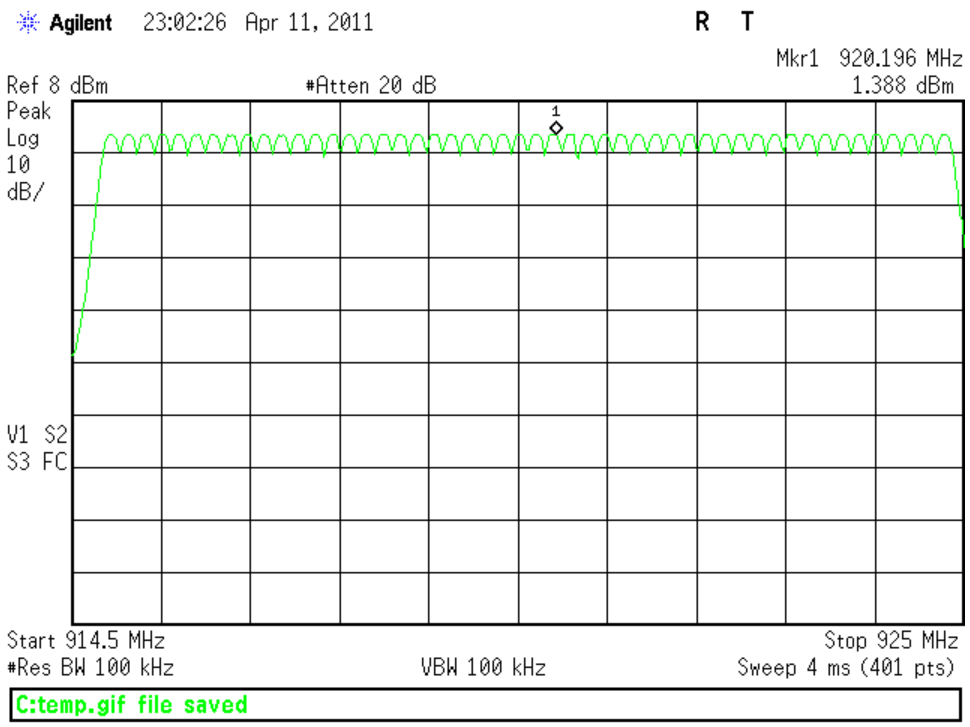
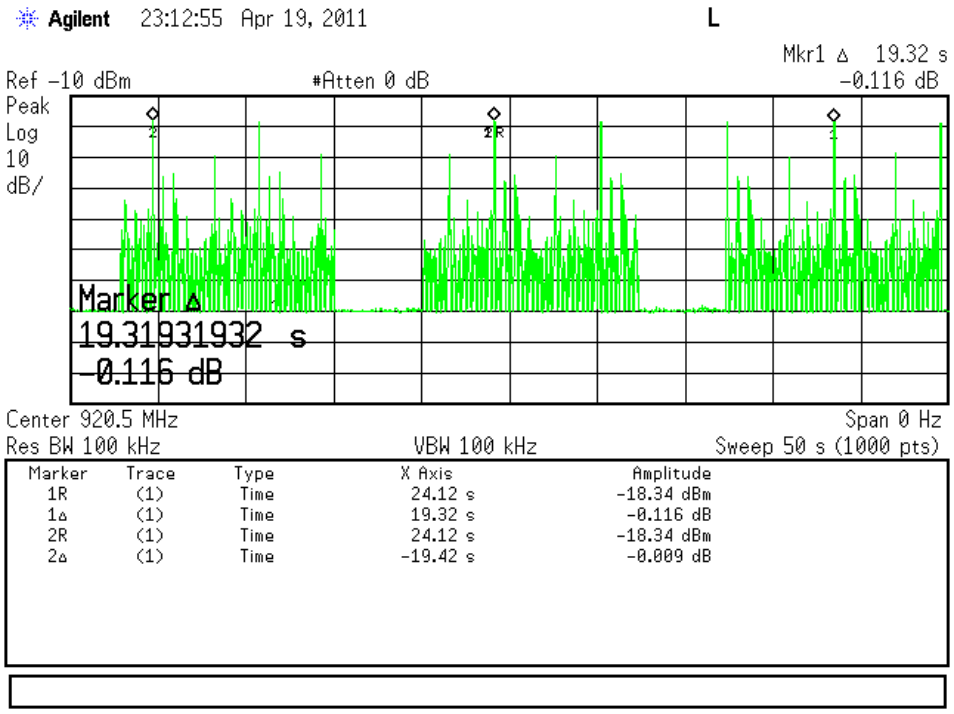

Agilent 23:02:26 Apr 11, 2011
R T
Mkr1 920.196 MHz
1.388 dBm
Ref 8 dBm
#Atten 20 dB
Peak
Log
10
dB/
1
V1 S2
S3 FC
Start 914.5 MHz
#Res BW 100 kHz
VBW 100 kHz
Stop 925 MHz
Sweep 4 ms (401 pts)
C:temp.gif file saved

Occupancy Time

For frequency hopping systems operating in the 902-928MHz band:: if the 20dB bandwidth of the hopping channel is less than 250kHz …the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;

[15.247 (a) (1) (i)]

Plots



The frequency is only transmitted once during a transmission burst

During 50 seconds, the transmission occurs 3 times

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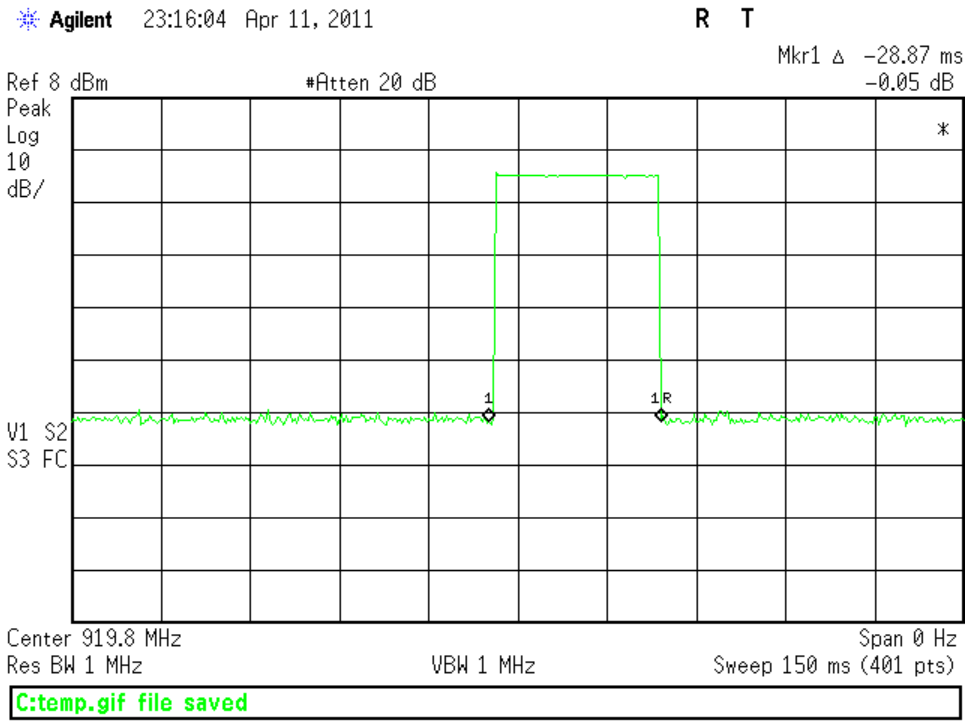
Time dwelled on a carrier frequency is 28.87 milliseconds.



Therefore 3 x 0.029 seconds = 0.087 seconds < 0.4 seconds

So within any 20 second window, either before or after the transmission, it shall be less than 0.4 seconds.

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Peak Power
LIMIT
Conducted Output Power
1 Watt
[15.247(b) (2)]

MEASUREMENTS / RESULTS

Peak Output Power

Date: 11-Apr-11 **Company:** Signal Fire **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 6Vdc
Temp: 19.1°C **Humidity:** 27% **Pressure:** 1008mBar
Frequency Range: 902-928MHz **Measurement Distance:** Conductive
Notes: RBW = 1Mhz
VBW = 3MHz

	Frequency (MHz)	Reading (dBm)	Attenuator Factor (dB)	Adjusted Reading (dB)			---			FCC Section 15.247(b(2)) Limit (dBm)	Margin (dB)	Result (Pass/Fail)
low channel	905.0	3.213	19.440	22.653	---	---	---	---	---	30.0	-7.347	Pass
mid channel	915.0	3.259	19.440	22.699	---	---	---	---	---	30.0	-7.301	Pass
high channel	925.0	3.251	19.440	22.691	---	---	---	---	---	30.0	-7.309	Pass

Test Site: 3m Indoor OATS I **Attenuator:** PE7019-20
Analyzer: Asset #1491

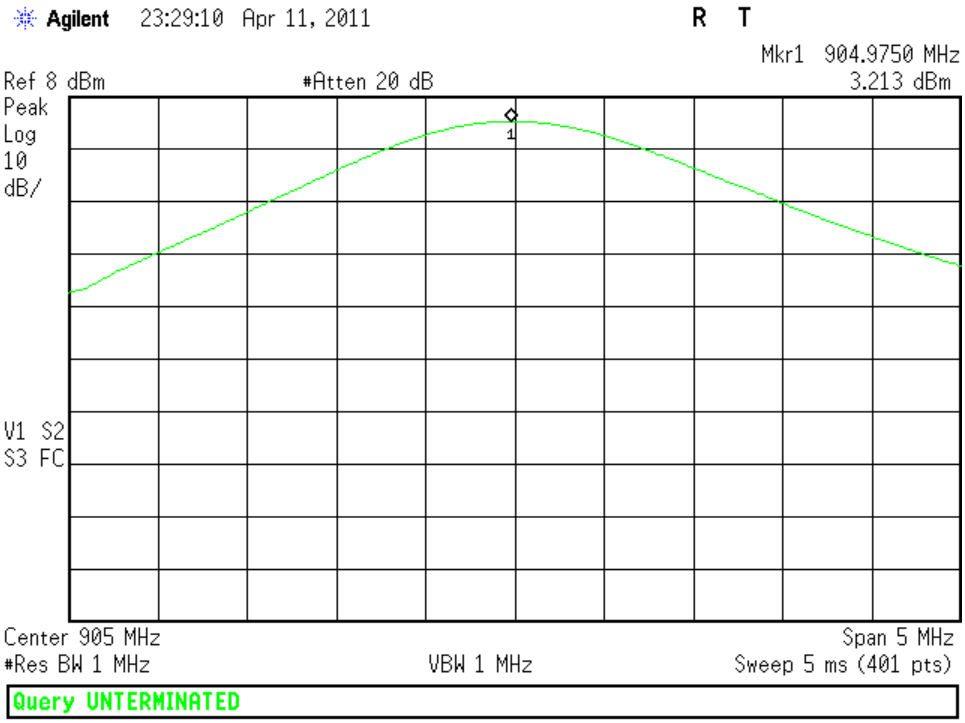
Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Rental SA #5	9kHz-26.5 GHz	E4407B	Agilent	MY44220066	1491	I	17-Mar-2012
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
HF 20dB 50W Attenuator	0.009-18 GHz	PE 7019-20	Pasternack	1	791	II	8-May-2011
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
1DCC-OATS-3M-I Thermohygrometer		35519-044	Control Company	72457635	1334	II	18-Aug-2011

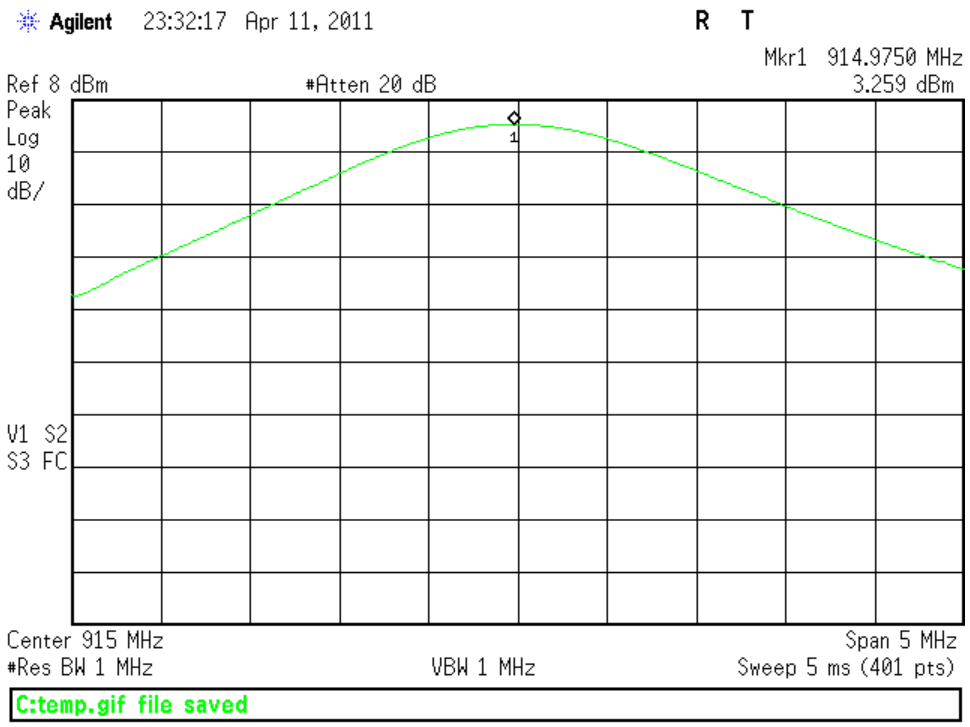
All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

PLOTS

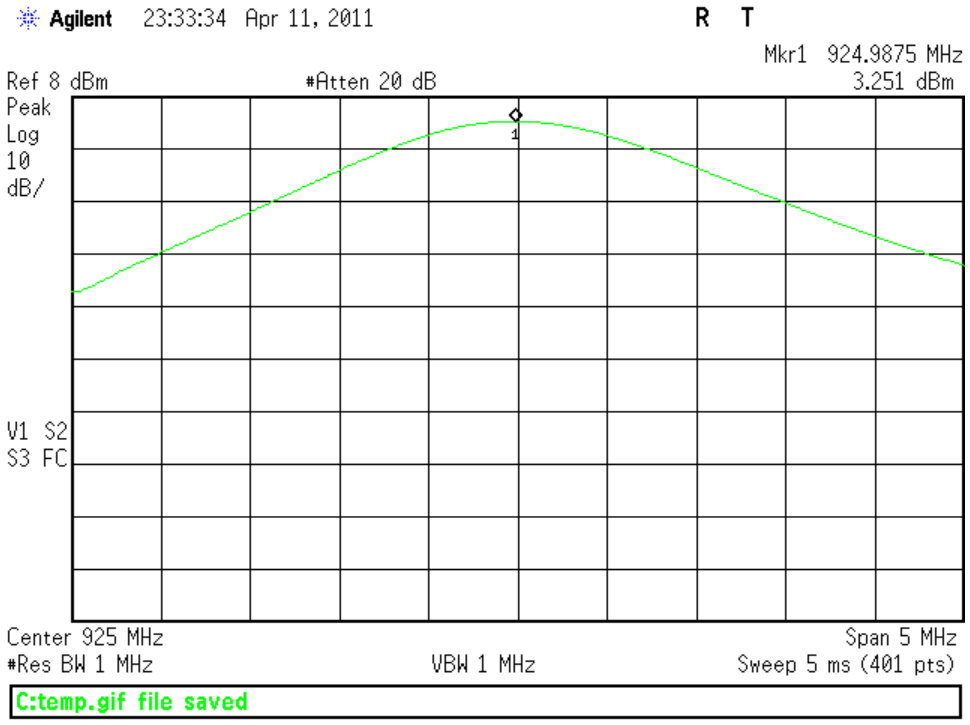
Low Channel



Mid Channel



High Channel



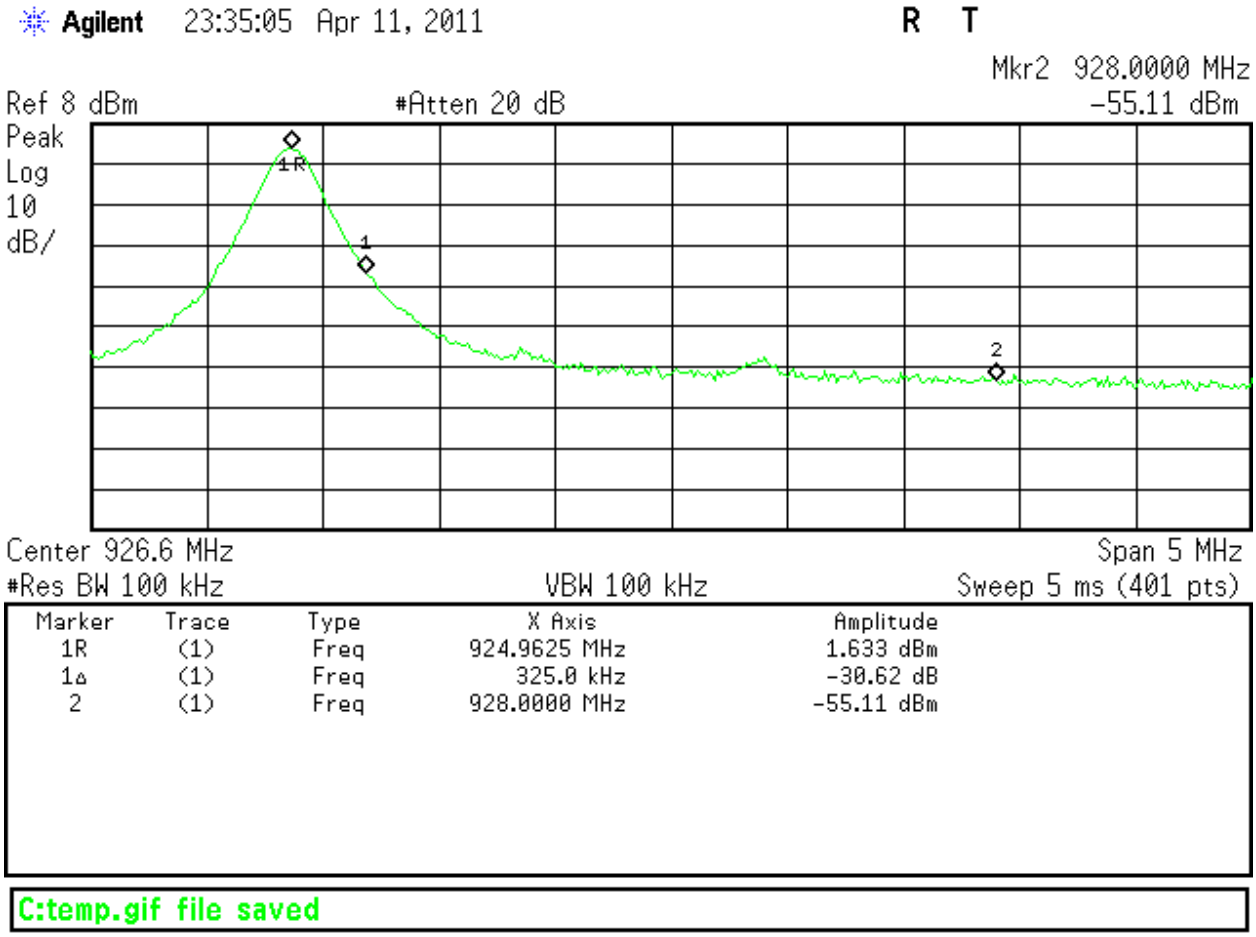
Band Edge Measurements

LIMITS

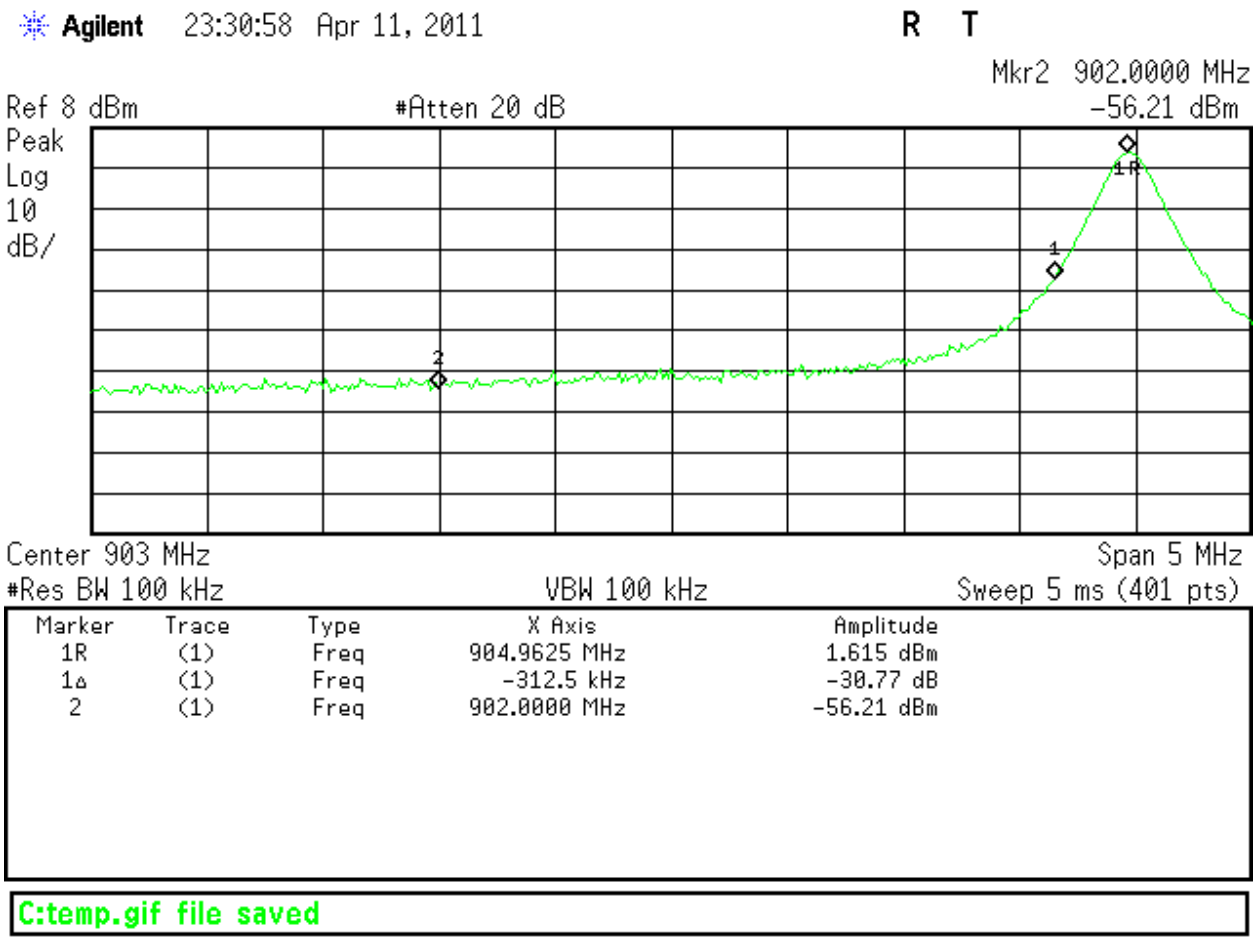
In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either a RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
[15.247(d)]

PLOTS

928MHz Edge



902MHz Band Edge



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Radiated Spurious Emissions

LIMITS

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).
[15.247(d)]

Radiated emission measurements were also taken for the digital circuitry for compliance to FCC part 15 class A products. These emissions were not present during the transmission function being active only.

MEASUREMENTS / RESULTS

Radiated Emissions Table

Date: 12-Apr-11 **Company:** Signal Fire Telemetry **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 120Vac 60Hz / 6Vdc
Temp: 23.6°C **Humidity:** 23% **Pressure:** mBar
Frequency Range: 30-1000MHz **Measurement Distance:** 3 m
Notes: Verification **EUT Max Freq:** 8MHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	FCC Class A Limit (dBµV/m)	FCC Class A Margin (dB)	FCC Class A Result (Pass/Fail)
vbb	76.78	50.4	25.5	7.9	0.7	33.5	---	---	---	49.5	-16.0	Pass
vbb	150.0	57.0	25.5	12.3	0.8	44.6	---	---	---	54.0	-9.5	Pass
vbb	159.9	58.9	25.5	12.1	1.0	46.5	---	---	---	54.0	-7.5	Pass
hbb	168.4	61.9	25.4	11.5	1.0	49.0	---	---	---	54.0	-5.1	Pass
vbb	170.5	56.3	25.4	11.3	1.0	43.2	---	---	---	54.0	-10.8	Pass
vbb	178.9	56.3	25.5	10.7	0.9	42.4	---	---	---	54.0	-11.6	Pass
hbb	203.6	53.6	25.4	11.2	1.1	40.5	---	---	---	54.0	-13.5	Pass
vbb	228.2	53.7	25.4	10.8	1.3	40.4	---	---	---	56.9	-16.5	Pass

Table Result: Pass by -5.1 dB ***Worst Freq:*** 168.4 MHz

Test Site: EMI Chamber 1 **Cable 1:** Asset #1505 **Cable 2:** Asset #1507 **Cable 3:** ---
Analyzer: Asset #1328 **Preamp:** Red-White **Antenna:** Red-Black **Preselector:** ---

Spurious Emissions

Date: 12-Apr-11 **Company:** Signal Fire Telemetry **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 120Vac 60Hz / 6Vdc
Temp: 23.6°C **Humidity:** 23% **Pressure:** 1006mBar
Frequency Range: 30-1000MHz **Measurement Distance:** 3 m
Notes: Fundamental set to 915MHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
h	326.75	35.9	25.4	13.9	1.2	25.6	---	---	---	46.0	-20.4	Pass
h	392.75	39.1	25.6	15.1	1.5	30.1	---	---	---	46.0	-15.9	Pass
h	435.75	37.2	25.3	16.5	1.4	29.8	---	---	---	46.0	-16.2	Pass
vbb	753.0	40.2	25.0	20.7	1.9	37.8	---	---	---	46.0	-8.2	Pass
h	785.0	37.9	24.9	21.2	2.0	36.2	---	---	---	46.0	-9.8	Pass

Table Result: Pass by -8.2 dB ***Worst Freq:*** 753.0 MHz

Test Site: EMI Chamber 1 **Cable 1:** Asset #1505 **Cable 2:** Asset #1507 **Cable 3:** ---
Analyzer: Asset #1328 **Preamp:** Red-White **Antenna:** Red-Black **Preselector:** ---

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Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
SA EMI Chamber (1328)	9kHz-13.2 GHz	E4405B	Agilent	MY44210241	1328	I	4-Mar-2012
Radiated Emissions Sites	**FCC Code**	**IC Code**	**VCCI Code**			**Cat**	**Calibration Due**
EMI Chamber 1	719150	2762A-6	R-3032, G-106			I	12-Mar-2013
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Red-White	0.009-2000MHz	ZFL-1000-LN	CS	N/A	1258	II	21-Mar-2012
Antennas	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Red-Black Bilog	30-2000MHz	JB1	Sunol	A091604-2	1106	I	3-Dec-2012
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
CHAMBER1 Thermohygrometer		35519-044	Control Company	72457642	1345	II	18-Aug-2011
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**
Asset #1505	9kHz - 18GHz		Florida RF			II	18-Aug-2011
Asset #1507	9kHz - 26.5GHz		Florida RF			II	18-Jan-2012

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Spurious Emissions

Date: 11-Apr-11 **Company:** Signal Fire Telemetry **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 120Vac 60Hz
Temp: 19.1°C **Humidity:** 27% **Pressure:** 1008mBar
Frequency Range: 1-7GHz **Measurement Distance:** 3 m
Notes: Spurious Emissions

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Filter Factor (dB)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)
Fundamental set to 915Mhz				---	---	---	---	---	---	---	---	---	---	---	---
no emissions found				---	---	---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: 1DCC-OATS-3M-I **Cable 1:** EMIR-HIGH-22 **High Pass Filter:** Asset #1310
Analyzer: Rental SA#5 **Preamp:** Brown **Antenna:** Yellow Horn

Spurious Emissions

Date: 11-Apr-11 **Company:** Signal Fire Telemetry **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 120Vac 60Hz
Temp: 19.1°C **Humidity:** 27% **Pressure:** 1008mBar
Frequency Range: 7-10GHz **Measurement Distance:** 1 m
Notes: Spurious Emissions

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Filter Factor (dB)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)
Fundamental set to 915Mhz				---	---	---	---	---	---	---	---	---	---	---	---
no emissions found				---	---	---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: 1DCC-OATS-3M-I **Cable 1:** EMIR-HIGH-22 **High Pass Filter:** Asset #1310
Analyzer: Rental SA#5 **Preamp:** Brown **Antenna:** Yellow Horn

Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Rental SA #5	9kHz-26.5 GHz	E4407B	Agilent	MY44220066	1491	I	17-Mar-2012
Radiated Emissions Sites	**FCC Code**	**IC Code**	**VCCI Code**			**Cat**	**Calibration Due**
1DCC-OATS-3M-I	719150	2762A-8	R-3109			II	7-Jul-2011
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Brown	1-18GHz	CS	CS	N/A	1523	II	30-Jul-2011
High Pass Filter	0.03-6.5 GHz	11SH10-1000/T3000-0/0	K&L	1	1310	II	22-Dec-2011
Antennas	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Yellow Horn	1-18GHz	3115	EMCO	9608-4898	37	I	27-May-2011
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
1DCC-OATS-3M-I Thermohygrometer		35519-044	Control Company	72457635	1334	II	18-Aug-2011
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**
REMI-High-22	9kHz - 15GHz		C-S			II	18-Jan-2012

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

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Receiver Spurious Emissions

EUT was tested in receive mode, and no emission were found. For RSS GEN Section 6.1, receiver spurious emissions must meet the limits within table 2.

Spurious Emissions

Date: 12-Apr-11 **Company:** Signal Fire Telemetry **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 120Vac 60Hz / 6Vdc
Temp: 23.6℃ **Humidity:** 23% **Pressure:** 1006mBar
Frequency Range: 30-1000MHz **Measurement Distance:** 3 m
Notes: Rx mode

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
No emissions found			---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: EMI Chamber 1 **Cable 1:** Asset #1505 **Cable 2:** Asset #1507 **Cable 3:** ---
Analyzer: Asset #1328 **Preamp:** Red-White **Antenna:** Red-Black **Preselector:** ---

Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
SA EMI Chamber (1328)	9kHz-13.2 GHz	E4405B	Agilent	MY44210241	1328	I	4-Mar-2012
Radiated Emissions Sites	**FCC Code**	**IC Code**	**VCCI Code**			**Cat**	**Calibration Due**
EMI Chamber 1	719150	2762A-6	R-3032, G-106			I	12-Mar-2013
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Red-White	0.009-2000MHz	ZFL-1000-LN	CS	N/A	1258	II	21-Mar-2012
Antennas	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Red-Black Bilog	30-2000MHz	JB1	Sunol	A091604-2	1106	I	3-Dec-2012
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
CHAMBER1 Thermohygrometer		35519-044	Control Company	72457642	1345	II	18-Aug-2011
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**
Asset #1505	9kHz - 18GHz		Florida RF			II	18-Aug-2011
Asset #1507	9kHz - 26.5GHz		Florida RF			II	18-Jan-2012

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Spurious Emissions

Date: 11-Apr-11 **Company:** Signal Fire Telemetry **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 120Vac 60Hz
Temp: 19.1℃ **Humidity:** 27% **Pressure:** 1008mBar
Frequency Range: 1-10GHz **Measurement Distance:** 1 m
Notes: Spurious Emissions Rx mode

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Filter Factor (dB)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
no emissions found				---	---	---	---	---	---	---	---	---	---	---	---

Table Result: --- by --- dB ***Worst Freq:*** --- MHz

Test Site: 1DCC-OATS-3M-I **Cable 1:** EMIR-HIGH-22 **High Pass Filter:** Asset #1310
Analyzer: Rental SA#5 **Preamp:** Brown **Antenna:** Yellow Horn

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Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Rental SA #5	9kHz-26.5 GHz	E4407B	Agilent	MY44220066	1491	I	17-Mar-2012
Radiated Emissions Sites	**FCC Code**	**IC Code**	**VCCI Code**			**Cat**	**Calibration Due**
1DCC-OATS-3M-I	719150	2762A-8	R-3109			II	7-Jul-2011
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Brown	1-18GHz	CS	CS	N/A	1523	II	30-Jul-2011
High Pass Filter	0.03-6.5 GHz	11SH10-1000/T3000-0/0	K&L	1	1310	II	22-Dec-2011
Antennas	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Yellow Horn	1-18GHz	3115	EMCO	9608-4898	37	I	27-May-2011
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
1DCC-OATS-3M-I Thermohygrometer		35519-044	Control Company	72457635	1334	II	18-Aug-2011
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**
REMI-High-22	9kHz - 15GHz		C-S			II	18-Jan-2012

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Conducted Spurious Emissions

LIMITS

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth that contains the highest level of desired power…
[15.247(d)]

MEASUREMENTS / RESULTS

Spurious Emissions

Date: 11-Apr-11 **Company:** Signal Fire **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **EUT Operating Voltage/Frequency:** 6Vdc
Temp: 19.1°C **Humidity:** 27% **Pressure:** 1008mBar
Frequency Range: 30-10000MHz **Measurement Distance:** Conductive
Notes: RBW = 100kHz
VBW = 300kHz

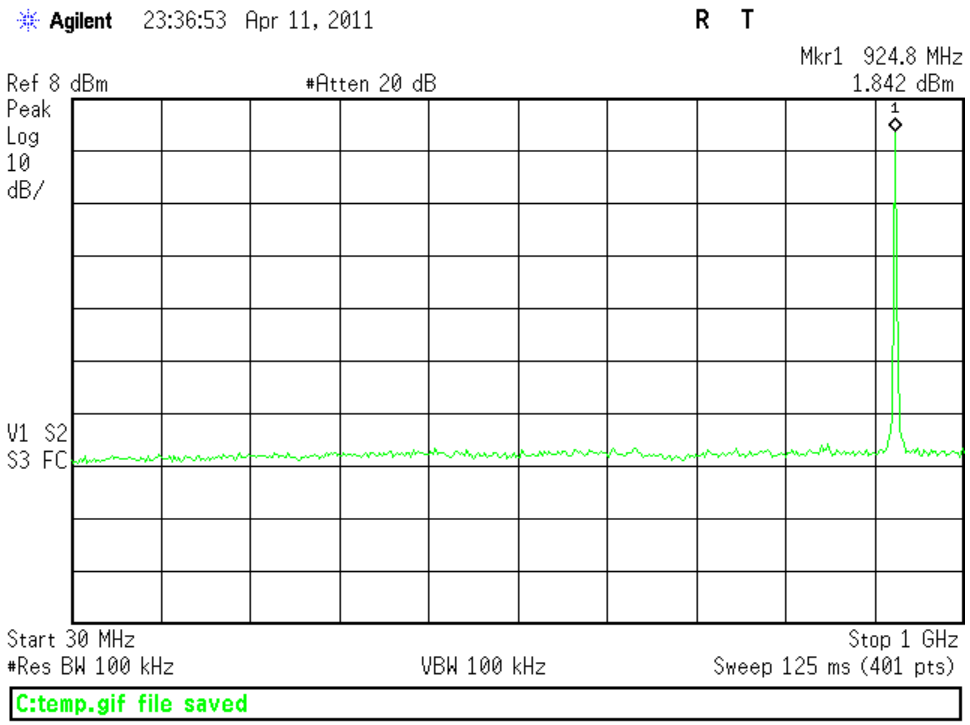
	Frequency (MHz)	Reading (dBm)					---			FCC Section 15.247(d) Limit (dBm)	Margin (dB)	Result (Pass/Fail)
fundamental	915.0	3.259	---	---	---	---	---	---	---	---	---	---
spurious	1855.0	-30.210	---	---	---	---	---	---	---	-16.7	-13.469	Pass

Test Site: 3m Indoor OATS I **Attenuator:** PE7019-20
Analyzer: Asset #1491

Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Rental SA #5	9kHz-26.5 GHz	E4407B	Agilent	MY44220066	1491	I	17-Mar-2012
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
HF 20dB 50W Attenuator	0.009-18 GHz	PE 7019-20	Pasternack	1	791	II	8-May-2011
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
1DCC-OATS-3M-I Thermohygrometer		35519-044	Control Company	72457635	1334	II	18-Aug-2011

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.



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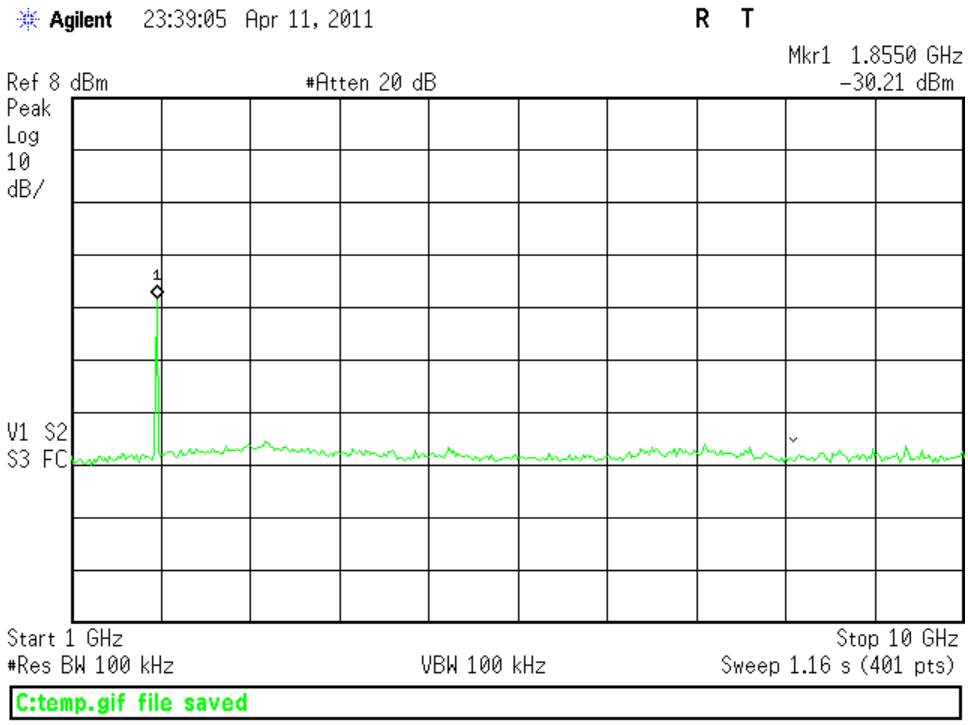
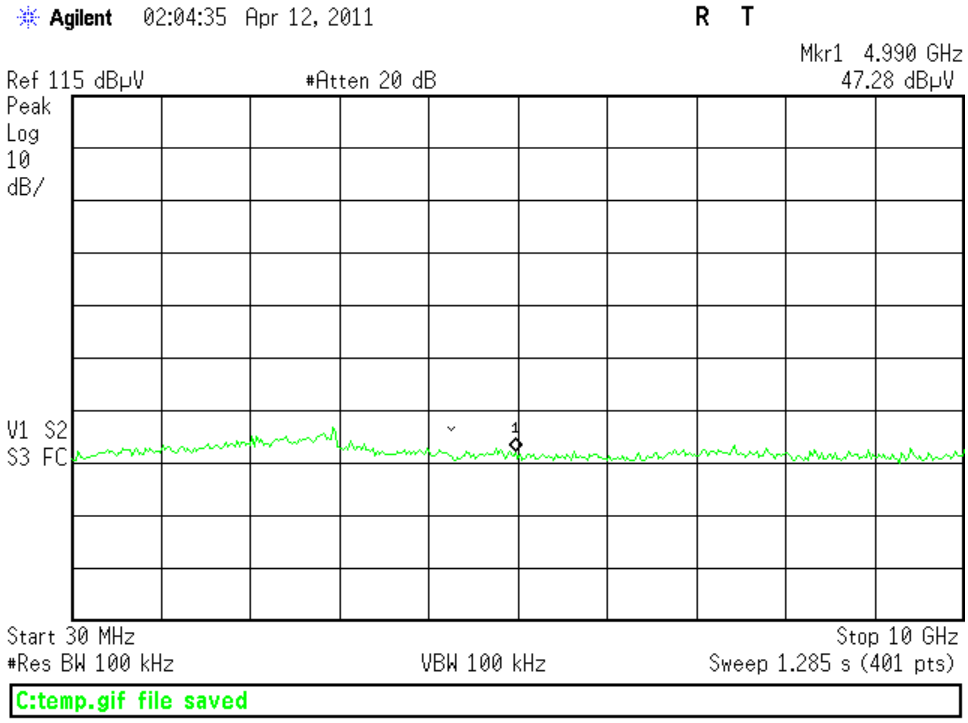


Receive Mode



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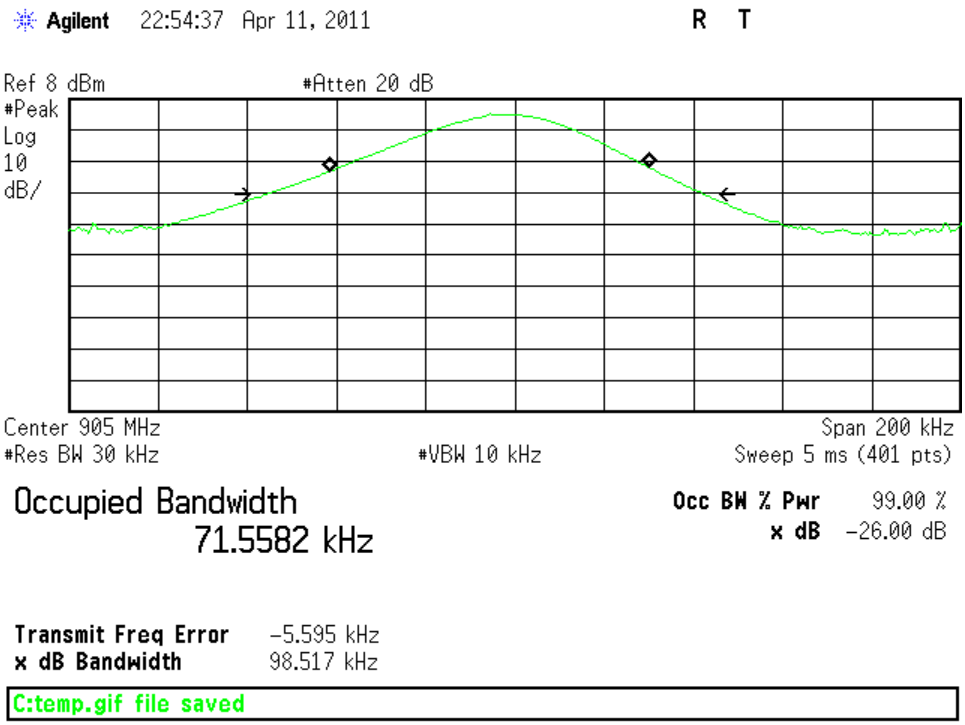
Occupied Bandwidth

REQUIREMENT

When an occupied bandwidth is no specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. [RSS-GEN 4.6.1]

Low Channel



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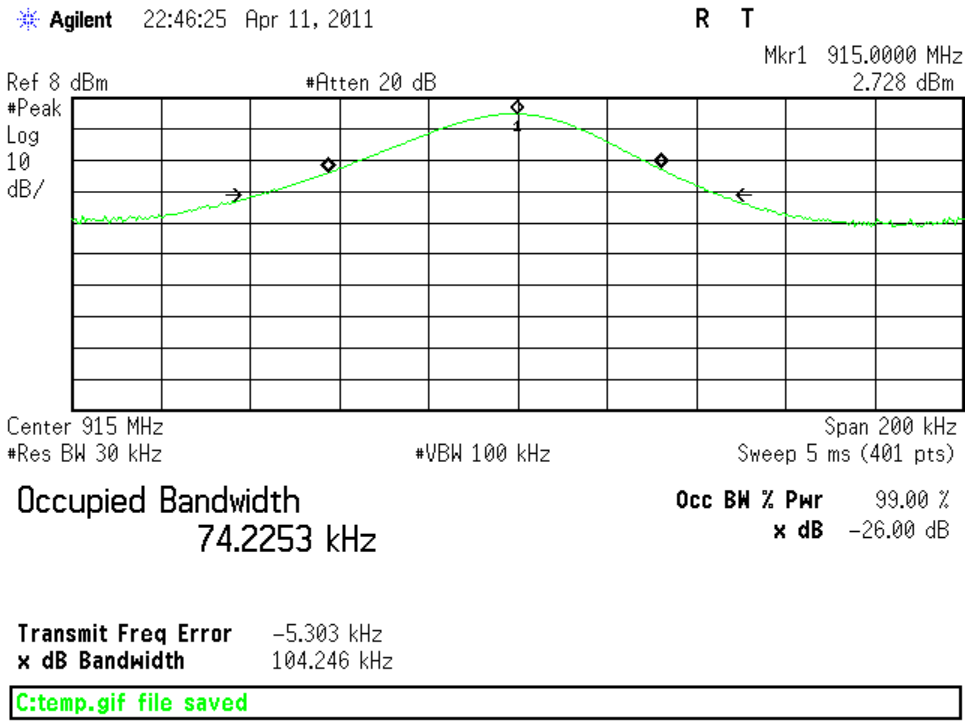
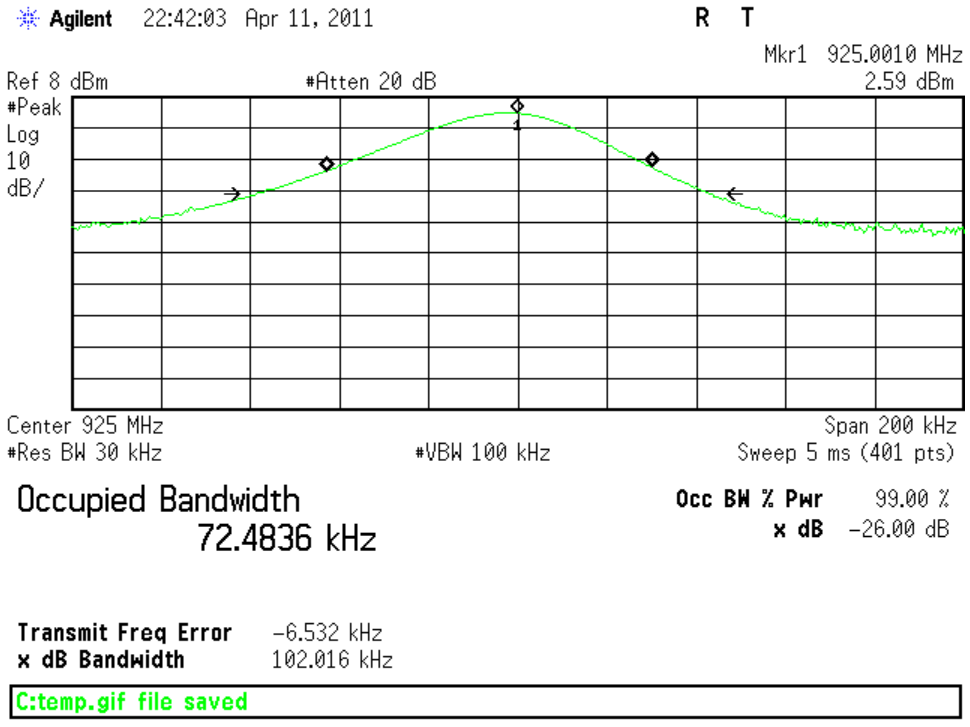
Mid Channel



High Channel



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AC Line Conducted Emissions

LIMITS

Frequency of emission (MHz)	Quasi-peak limit (dBµV)	Average limit (dBµV)
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

[47 CFR 15.207(a)]

MEASUREMENTS / RESULTS

AC Side of DC Supply Conducted Emissions

Date: 11-Apr-11 **Company:** Signal Fire Telemetry **Work Order:** L0230
Engineer: Matthew Burman **EUT Desc:** Modbus-in-a-stick **Test Site:** CEMI2
Temp: 24.7°C **Humidity:** 21% **Pressure:** 1011mBar
Notes:
Measurement Device: Yellow-Black LISN **EUT Operating Voltage/Frequency:** 120Vac 60Hz

Range: 0.15-30MHz **Spectrum Analyzer:** Yellow

	Q.P. Readings		Ave. Readings		Impedance Factor	FCC/CISPR B		FCC/CISPR B		Overall
Frequency	QP1	QP2	AV1	AV2		qp Limit	qp Margin	AVE Limit	AVE Margin	Result
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dBµV)	dB	(dBµV)	dB	(Pass/Fail)
0.28	28.5	30.7	15.6	23.9	20.3	60.7	-9.8	50.7	-6.5	Pass
0.43	20.1	22.5	8.7	17.2	20.2	57.3	-14.6	47.3	-9.9	Pass
0.57	24.0	29.8	12.0	22.4	20.1	56.0	-6.1	46.0	-3.5	Pass
0.71	26.7	30.5	12.9	23.3	20.1	56.0	-5.4	46.0	-2.6	Pass
1.13	23.5	30.9	9.6	20.6	20.1	56.0	-5.0	46.0	-5.3	Pass
13.58	4.2	9.3	-7.9	-3.3	20.1	60.0	-30.6	50.0	-33.2	Pass

Table Result: Pass by -2.60 dB ***Worst Freq:*** 0.71 MHz

Rev: 9-Apr-2011

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Yellow	9kHz-2.9GHz	8594E	Agilent	3523A01958	100	I	21-Mar-2012
LISNs/Measurement Probes	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Yellow-Black LISN	30kHz-50MHz	8012-50-R-24-BNC	Solar	411657	248	I	24-Jun-2011
Conducted Test Sites (Mains / Telco)	**FCC Code**		**VCCI Code**			**Cat**	**Calibration Due**
CEMI 2	719150		C-3361, T-1576			III	NA
Meteorological Meters		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**
Temp./Humidity/Atm. Pressure Gauge		7400 Perception II	Davis	N/A	965	I	4-Apr-2013
CEMI2 Thermohygrometer		35519-044	Control Company	72436083	1336	II	18-Aug-2011
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**
CEMI-07	9kHz - 2GHz		C-S			II	4-Apr-2012

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Product Documentation

The following documentation has been provided by the client for inclusion in this report.

Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("**Client**"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "**Conditions**"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("**Test Report**") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.
2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.
3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.
4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.
5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "**BUREAU VERITAS**," "**BUREAU VERITAS CONSUMER PRODUCTS SERVICES**," "**BVCPS**", "**MTL**", "**ACTS**", "**MTL-ACTS**" and **CURTIS-STRAUS** (collectively, the "**Marks**") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.
6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.
7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.
8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.
9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.
10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.
11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only were such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.
12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims

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including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.

13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.

14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B)NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

17. Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

Rev.160009121(2)_#684340 v13CS

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