EMISSIONS TEST REPORT

Report Number: 3086827BOX.014
Project Number: 3086827

Testing performed on the

150Mbps High-Speed Radio Link
SINELINK 24G

Model: HP5-110100

To

FCC CFR47 Part 15 Subpart C 15.249

For

Hitachi Kokusai Electric Inc.

FCC ID: TTI-SL24G-US-01

Test Performed by:	Test Authorized by:
Intertek – ETL SEMKO	Hitachi Telecom (USA), Inc. #17855
70 Codman Hill Road	3617 Parkway Lane Suite 100
Boxborough, MA 01719	Norcross, GA 30092

Prepared by: _____ Date: 3/9/06
Nicholas Abbondante

Reviewed by: _____ Date: 3/9/06
Michael F. Murphy

1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of:

Company:	Hitachi Telecom (USA), Inc. #17855 3617 Parkway Lane Suite 100 Norcross, GA 30092
Contact:	Nick Yasui
Telephone:	770-797-2530
Fax:	770-797-2555
Email:	nyasui@hitel.com

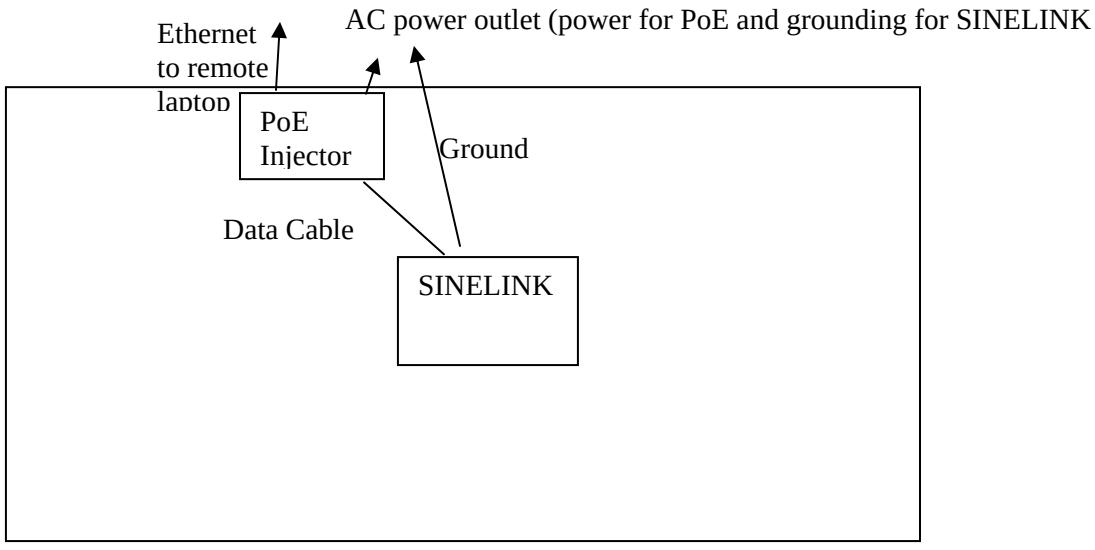
1.2 Equipment Under Test

Equipment Type:	SINELINK 24G 150Mbps High-Speed Radio Link
Model Number(s):	HP5-110100
Serial number(s):	ES001
Manufacturer:	Hitachi Kokusai Electric Inc.
EUT receive date:	12/05/2005
EUT received condition:	Prototype in Good condition
Test start date:	12/05/2005
Test end date:	3/09/2006

1.3 Test Plan Reference: Tested according to the standards listed and ANSI C63.4:2003.

1.4 Test Configuration

1.4.1 Block Diagram



1.4.2. Cables:

Cable	Shielding	Connector	Length (m)	Qty.
Ground Wire	None	Plastic	1.5	1
AC Cable	None	Plastic	1.5	1
Ethernet Cable to PC	None	Plastic	4	1
Ethernet Data Cable from SINELINK to PoE Injector	Foil	Metal/RJ45	1.9	1

1.4.3. Support Equipment:

Name: Buffalo Power over Ethernet Injector
Model No.: BIJ-POE-1P
Serial No.: 36466754310706

Name: Dell Laptop
Model No.: PP10L
Serial No.: N/L

Name: Dell AC Adapter
Model No.: PA-1650-05D
Serial No.: N/L

1.5 Mode(s) of Operation:

The EUT was activated from nominal power, and was transmitting continuously with QPSK, QAM16, or QAM64 modulation during RF output power and spurious emissions testing. During the frequency stability test, the EUT was transmitting a continuous wave carrier. During the AC line-conducted emissions test, the EUT was activated at nominal power from the Buffalo power over ethernet injector and was continuously transmitting. The data terminal of the power over ethernet injector was terminated with a loopback.

2.0 Test Summary

TEST STANDARD	RESULTS	
FCC CFR47 Part 15 Subpart C 15.249		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
RF Output Power FCC 15.249(b)(1),(b)(3)	Field strength of fundamental emissions from fixed point-to-point transmitters operating in the band from 24.05 – 24.25 GHz shall not exceed 2500 mV/m (128 dBuV/m). Antenna gain must be at least 33 dBi, and the main lobe beam width must not exceed 3.5 degrees.	Pass
Occupied Bandwidth FCC 15.215	The 20 dB bandwidth of the fundamental emissions must stay between 24.05 and 24.25 GHz.	Pass
Band Edge Compliance FCC 15.215, 15.249(d)	The average value of spurious emissions at the band edges must be attenuated at least 50 dB below the peak level of the fundamental emission.	Pass
Radiated Spurious Emissions, 30 MHz – 40 GHz FCC 15.205, 15.209, 15.249(a-e)	Harmonic emissions must not exceed 2500uV/m (68 dBuV/m). Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation. Field strength limits are specified at a distance of 3 meters. Emissions falling into the restricted bands of 15.205 must meet the general limits of 15.209.	Pass
Radiated Spurious Emissions, 40 – 100 GHz FCC 15.205, 15.209, 15.249(a-e)	Harmonic emissions must not exceed 2500uV/m (68 dBuV/m). Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation. Field strength limits are specified at a distance of 3 meters. Emissions falling into the restricted bands of 15.205, except for harmonics in the 48.0–48.5 GHz and 72.0–72.75 GHz bands only, must meet the general limits of 15.209.	Pass
Frequency Stability FCC 15.249(b)(2)	The frequency tolerance of the carrier signal shall be maintained within ±0.001% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.	Pass
AC Line-Conducted Emissions FCC 15.207	AC line-conducted emissions must not exceed the limits of FCC 15.207.	Pass

Notes: The EUT operates with QAM16, QAM64, and QPSK modulations.

Antenna Gain: 35 dBi
Antenna Beam Width: 2.8 degrees

Channels 1, 4, and 8 were selected for test.

Channel 1: 24080 MHz
Channel 4: 24140 MHz
Channel 8: 24220 MHz

REVISION SUMMARY – The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s)	Item	**Description of Change**

3.0 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

Level in μV/m = [10(32 dBμV/m)/20] = 39.8 μV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(48.1\ dB\mu V / 20)}$ = 254 μV/m

3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.
The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:

±3.5 dB at 10m, ±3.8 dB at 3m

The expanded uncertainty (k = 2) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

±2.6 dB

The expanded uncertainty (k = 2) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

±3.2 for ISN and voltage probe measurements
±3.1 for current probe measurements

3.2 Site Description

Test Site(s): 2

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

The EMC Lab has two Semi-anechoic Chambers and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference groundplanes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Test Results: Pass

Test Standard: FCC CFR47 Part 15 Subpart C 15.249

Test: RF Output Power FCC 15.249(b)(1), (b)(3)

Performance Criterion: Emissions must be below specified limits

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	Yes		Equipment under Test:		SINELINK 24G	

Maximum Test Disturbance Parameters: Field strength of fundamental emissions from fixed point-to-point transmitters operating in the band from 24.05 – 24.25 GHz shall not exceed 2500 mV/m (128 dBuV/m). Antenna gain must be at least 33 dBi, and the main lobe beam width must not exceed 3.5 degrees. For gains above 33 dBi and beam widths lower than 2.8 degrees, the field strength of the fundamental emission still must not exceed 2500 mV/m.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	11/21/2006
3	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	07/26/2006
4	Horn Antenna, 18-40 GHz	EMCO	3116	9310-2222	03/04/2006
5	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E404	05/13/2006
6	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E405	05/13/2006

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	11/16/05 Revision

Test Details:

Radiated Emissions / Interference

Company: Hitachi Kokusai Electric Inc. | Model #: HP5-110100
Engineer: Nicholas Abbondante | Barometer: BAR2 | Serial #: ES001
Project #: 3086827 | Pressure: 1009 mB | Receiver: R&S FSEK-30 (ROS001)
Date: 12/05/05 | Temp: 19c | N Antenna: LOG2 12-13-05 V10.txt | LOG2 12-13-05 H10.txt
Standard: FCC 15.249 | Humidity: 32% | LF Antenna: NONE. | NONE.
Class: - | Group: - | HF Antenna: HORN2 9-13-06 V1m.txt | HORN2 9-13-06 H1m.txt
Antenna Band: SHF | Bands: N, LF, HF, SHF | SHF Antenna: Horn 213023 3m V 3-4-2006.ant | Horn 213023 3m H 3-4-2006.ant
PreAmp: PRE8 11-21-06.amp | Cable(s): E404 5-13-06.cbl | E405 5-13-06.cbl
Limit Distance: 3 meters | Test Distance: 3 meters | Location: Site 2
Voltage/Frequency: 120V/60Hz | Frequency Range: 18 - 40 GHz
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Note: QPSK Modulation											
PK	V	24080.000	88.5	46.2	13.4	20.2	0.0	127.8	128.0	-0.2	1/3 MHz
PK	V	24140.000	88.4	46.2	13.4	20.4	0.0	127.7	128.0	-0.3	1/3 MHz
PK	V	24220.000	88.7	46.4	13.4	20.5	0.0	128.0	128.0	-0.0	1/3 MHz
Note: 16QAM Modulation											
PK	V	24080.000	87.6	46.2	13.4	20.2	0.0	126.9	128.0	-1.1	1/3 MHz
PK	V	24140.000	88.1	46.2	13.4	20.4	0.0	127.4	128.0	-0.6	1/3 MHz
PK	V	24220.000	88.4	46.4	13.4	20.5	0.0	127.7	128.0	-0.3	1/3 MHz
Note: 64QAM Modulation											
PK	V	24080.000	87.5	46.2	13.4	20.2	0.0	126.8	128.0	-1.2	1/3 MHz
PK	V	24140.000	88.7	46.2	13.4	20.4	0.0	128.0	128.0	-0.0	1/3 MHz
PK	V	24220.000	88.6	46.4	13.4	20.5	0.0	127.9	128.0	-0.1	1/3 MHz

Antenna Gain: 35 dBi
Antenna Beam Width: 2.8 degrees

Notes: Plots of the fundamental emissions from which the raw data readings in the above table are obtained can be found in the occupied bandwidth section.

Test Results: Pass

Test Standard: FCC CFR47 Part 15 Subpart C 15.249

Test: Occupied Bandwidth FCC 15.215

Performance Criterion: Fundamental emissions must stay within the passband.

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	N/A		Equipment under Test:		SINELINK 24G	

Maximum Test Disturbance Parameters: The 20 dB bandwidth of the fundamental emissions must stay between 24.05 and 24.25 GHz.

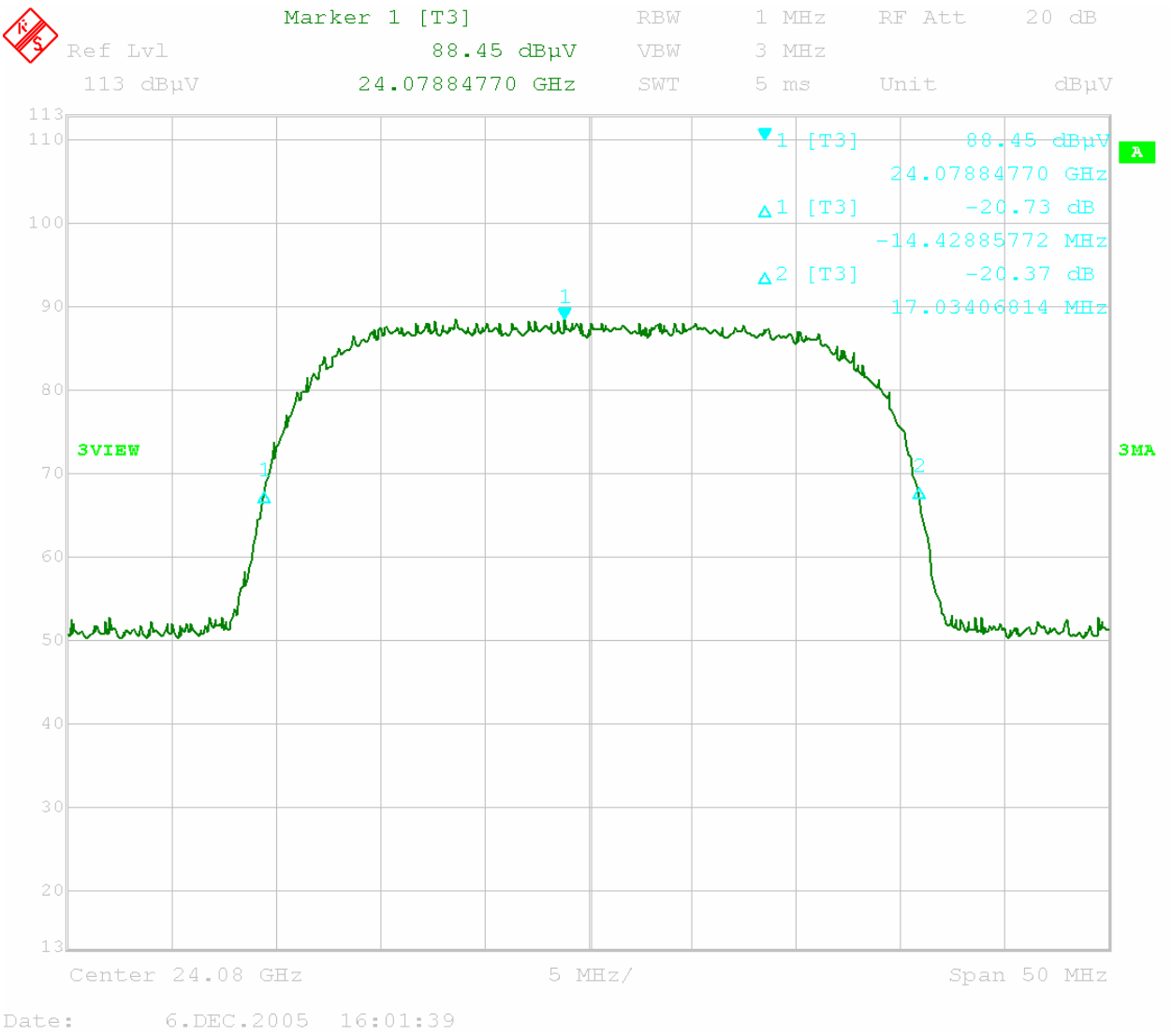
Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	11/21/2006
3	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	07/26/2006
4	Horn Antenna, 18-40 GHz	EMCO	3116	9310-2222	03/04/2006
5	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E404	05/13/2006
6	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E405	05/13/2006

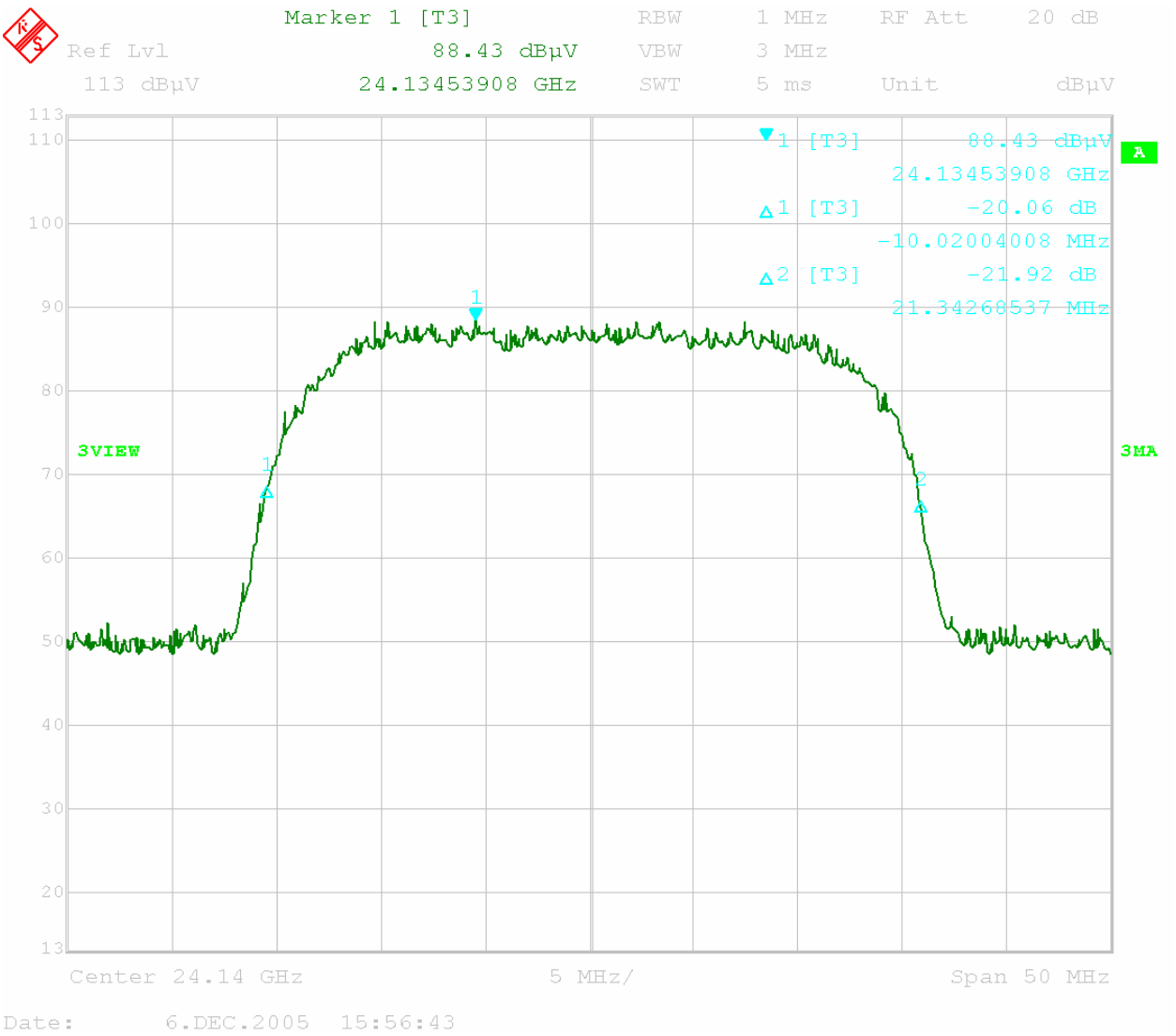
Test Details:

Modulation	Channel	Frequency (MHz)	Bandwidth
QPSK	Channel 1	24080	31.46 MHz
QPSK	Channel 4	24140	31.36 MHz
QPSK	Channel 8	24220	31.46 MHz
QAM16	Channel 1	24080	31.46 MHz
QAM16	Channel 4	24140	31.46 MHz
QAM16	Channel 8	24220	31.46 MHz
QAM64	Channel 1	24080	31.46 MHz
QAM64	Channel 4	24140	31.46 MHz
QAM64	Channel 8	24220	31.36 MHz

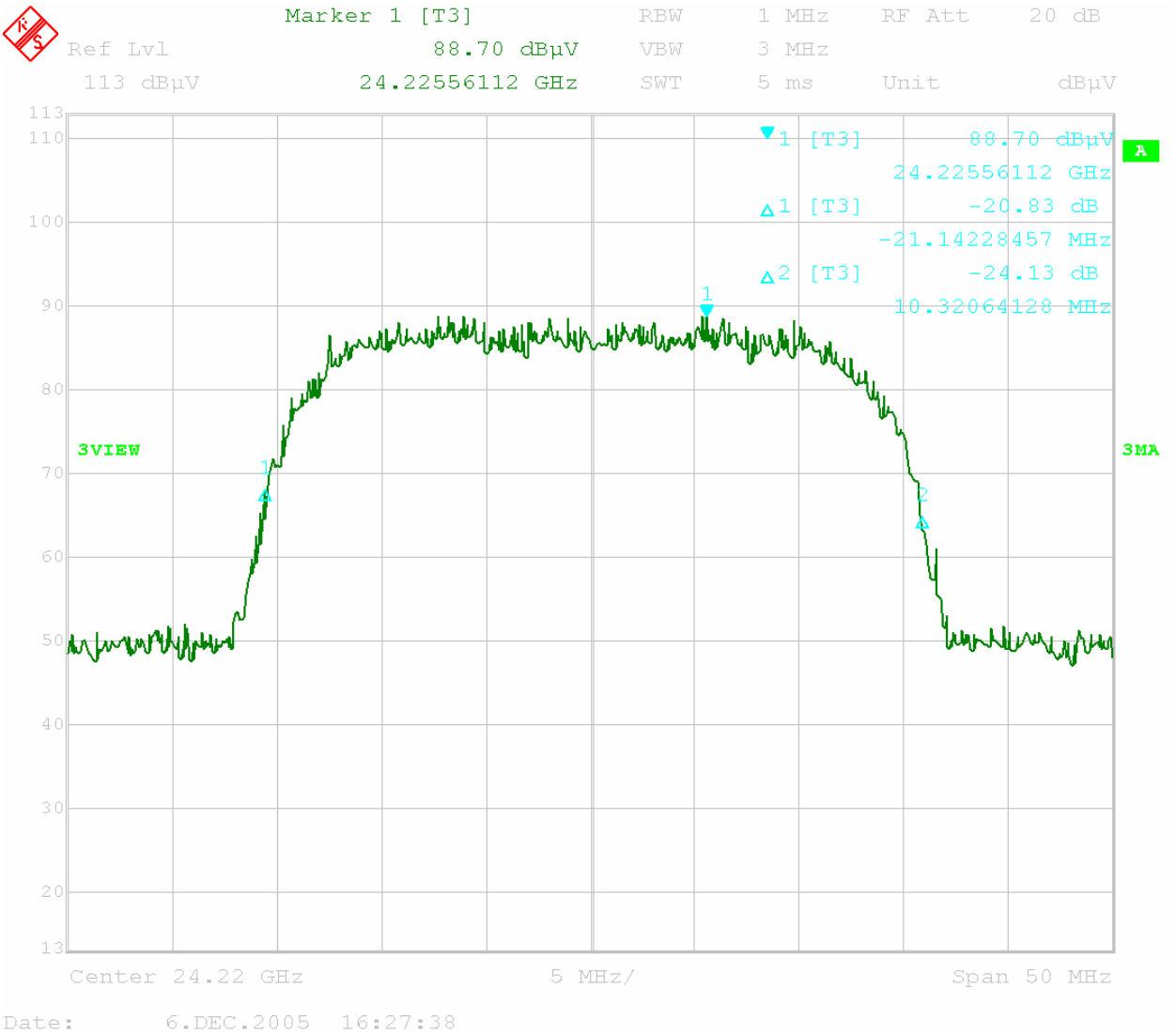
Notes: Power levels in the bandwidth plots are raw values and are uncorrected measurement system losses. Note that channels 1 and 8 are both farther away from the band edges than half of the 20 dB bandwidth, 15.73 MHz.



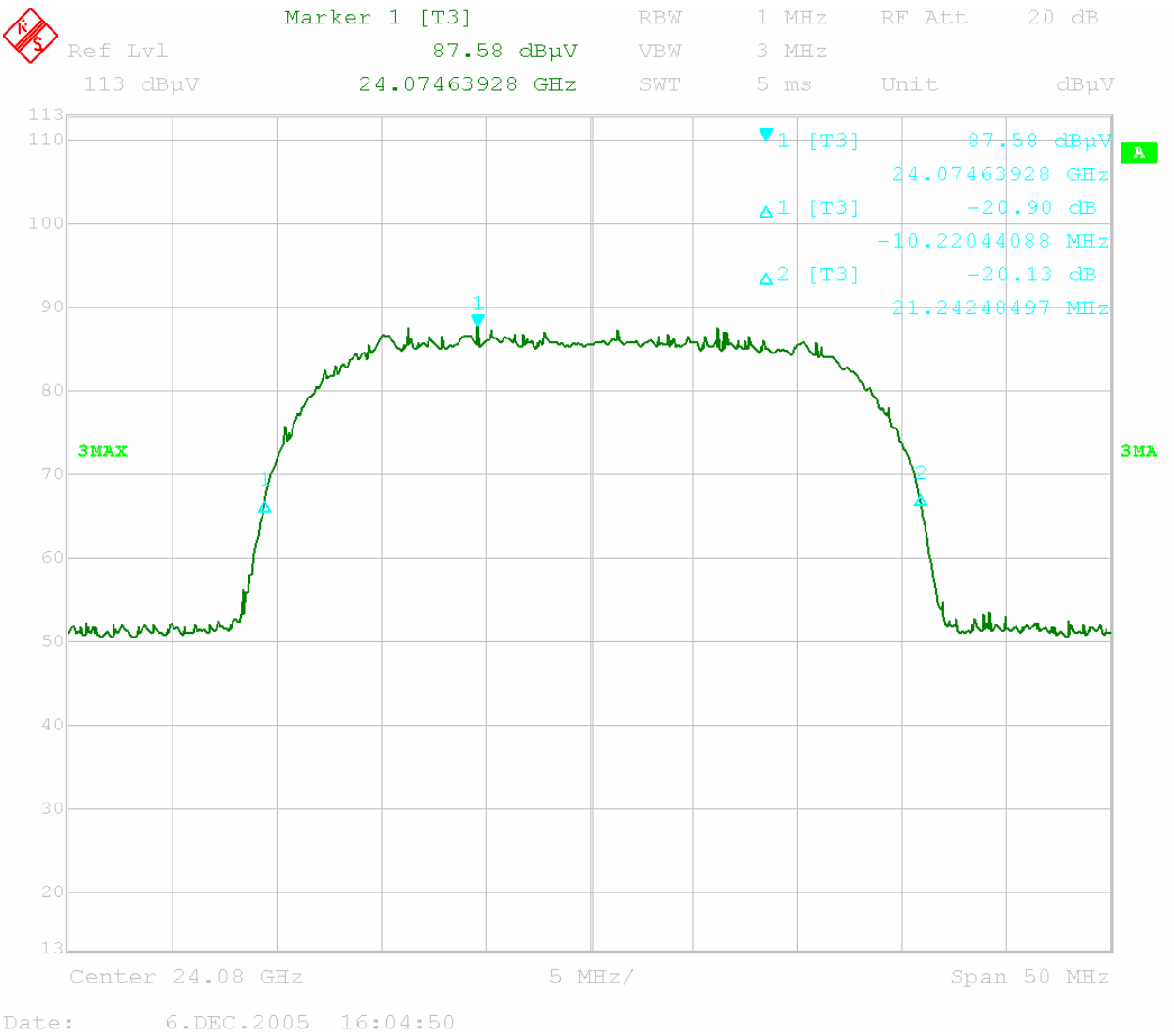
QPSK Channel 1



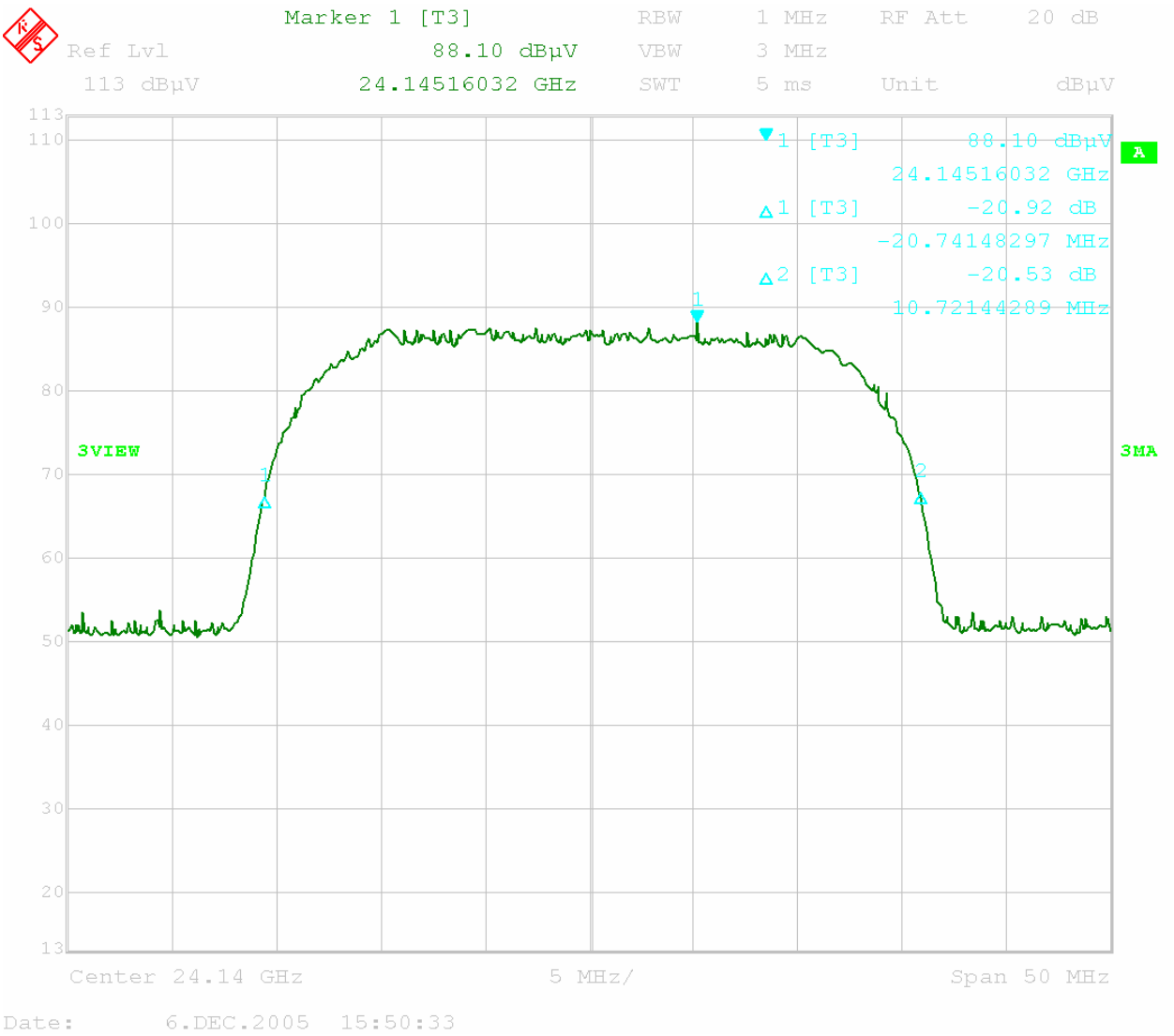
QPSK Channel 4



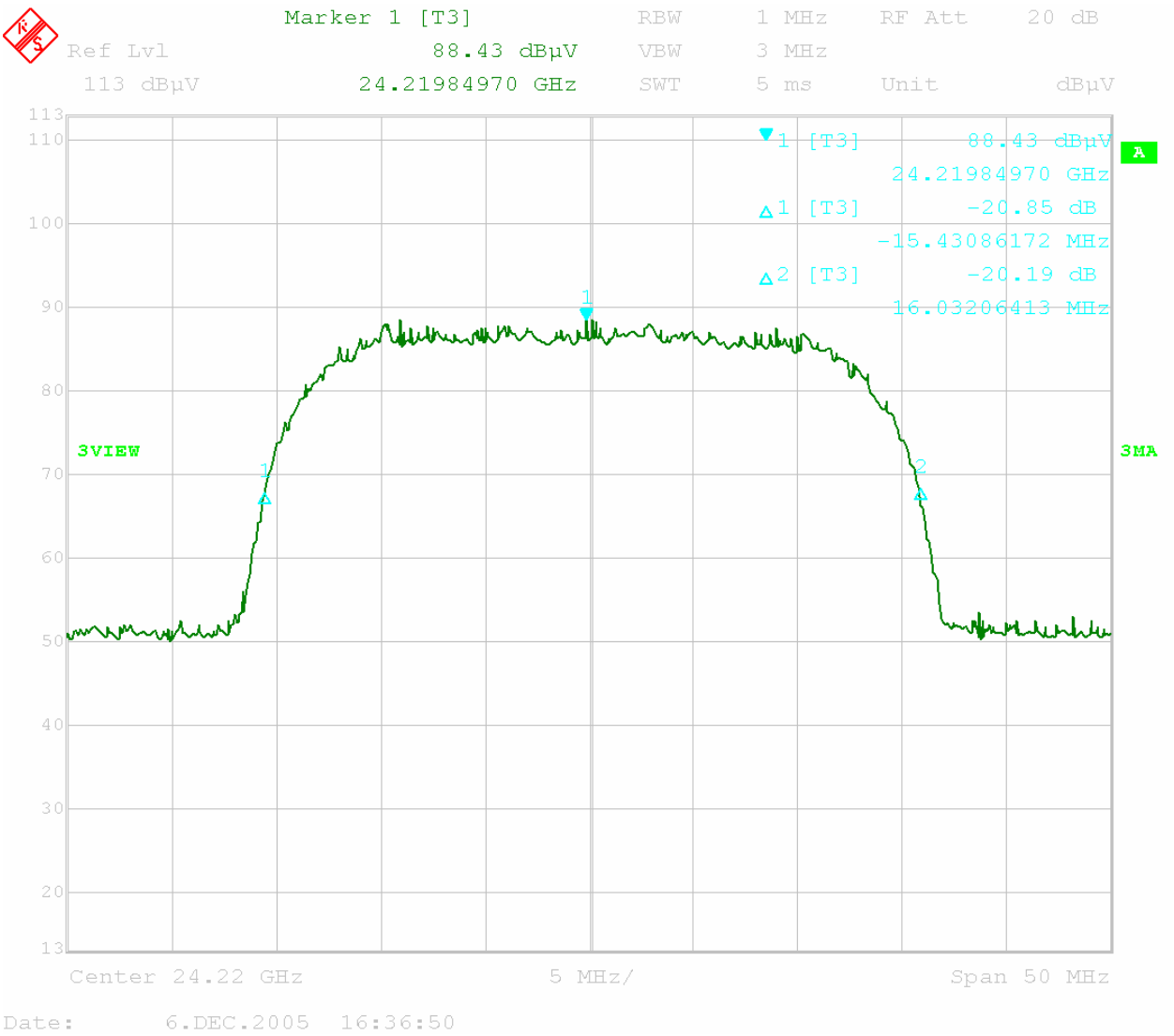
QPSK Channel 8



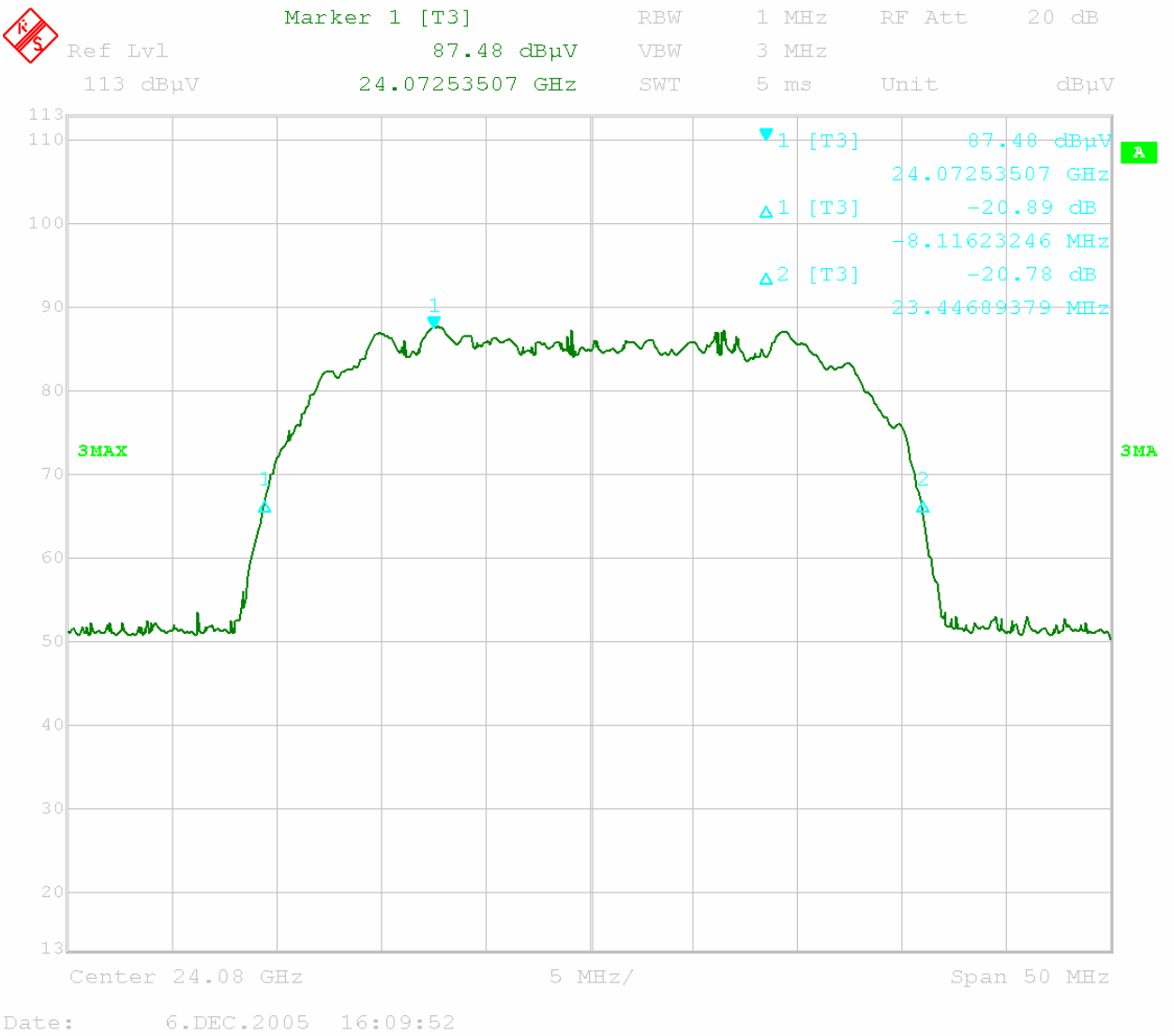
16QAM Channel 1



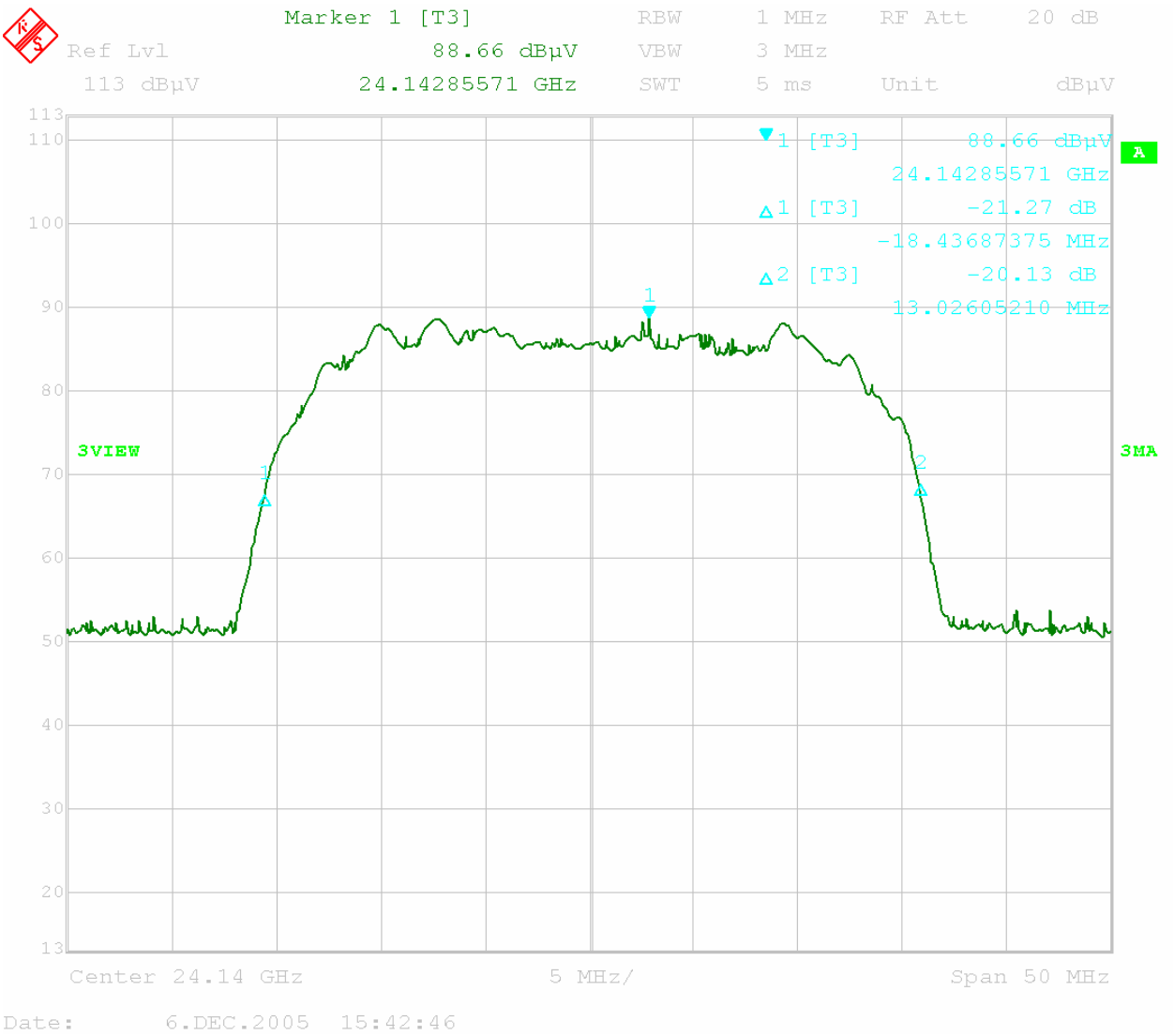
16QAM Channel 4



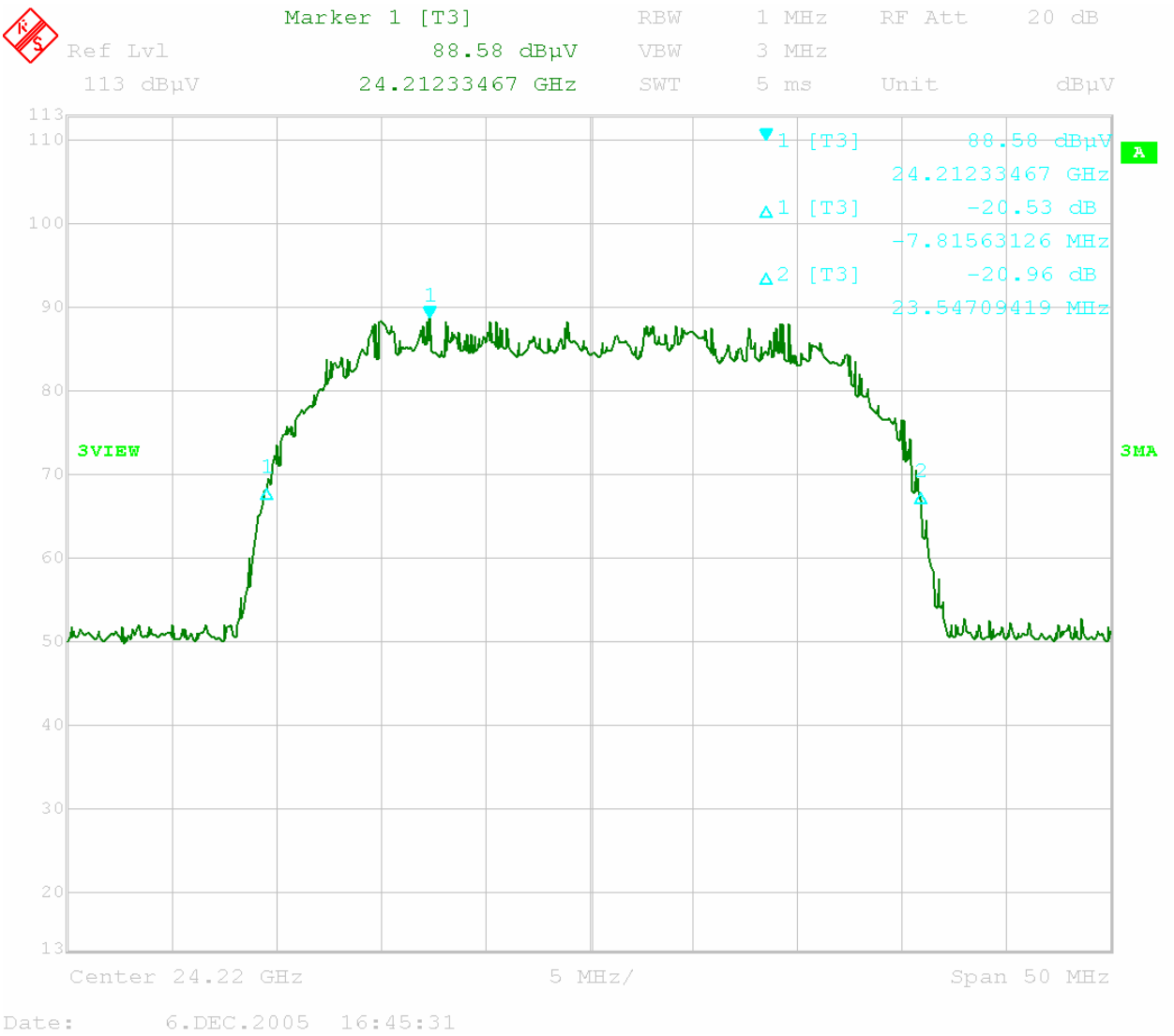
16QAM Channel 8



64QAM Channel 1



64QAM Channel 4



64QAM Channel 8

Test Results: Pass

Test Standard: FCC CFR47 Part 15 Subpart C 15.249

Test: Band Edge Compliance FCC 15.215

Performance Criterion: Emissions must be below specified limits

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	N/A		Equipment under Test:		SINELINK 24G	

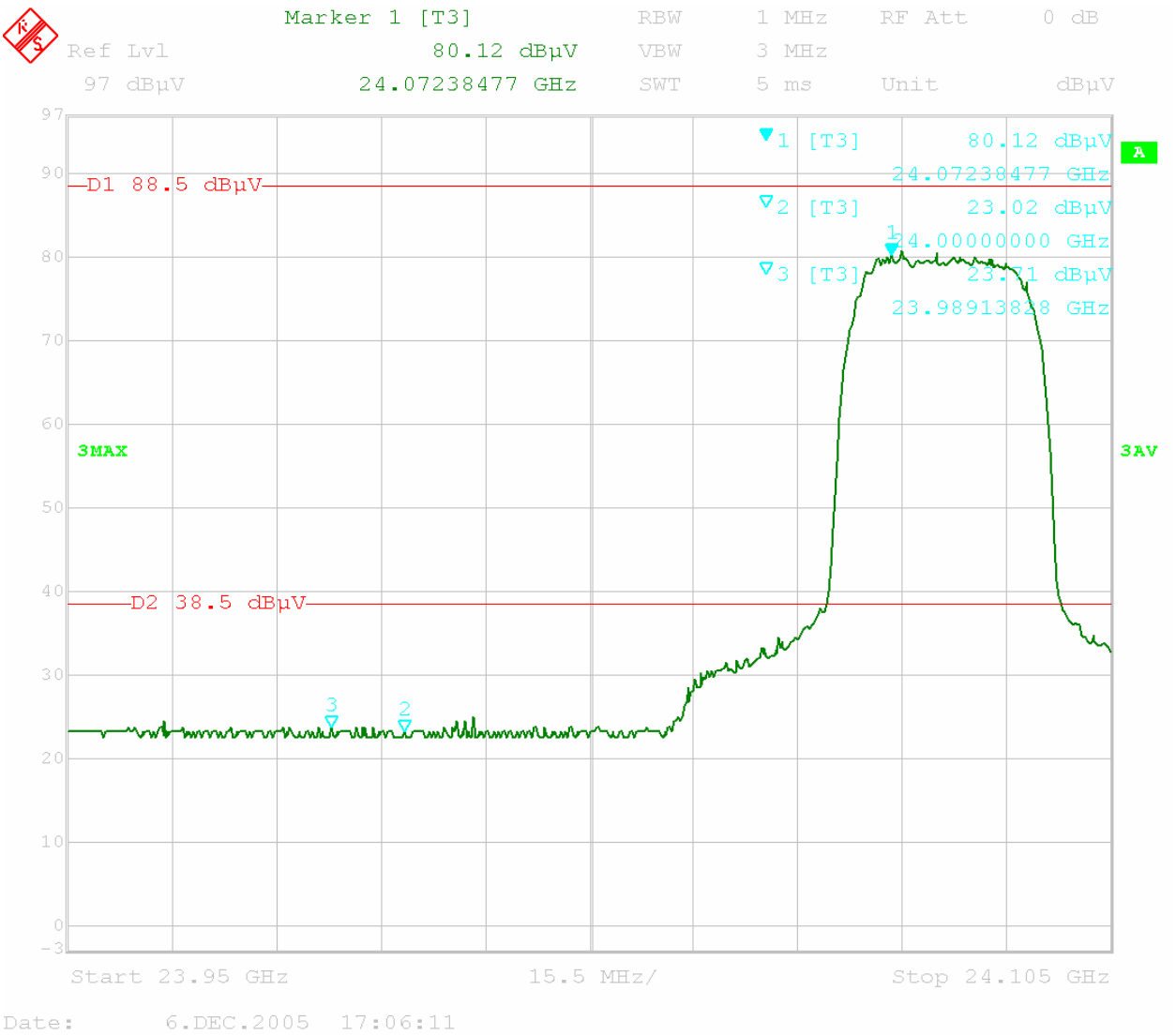
Maximum Test Disturbance Parameters: The average value of spurious emissions at the band edges must be attenuated at least 50 dB below the peak level of the fundamental emission.

Test Equipment Used:

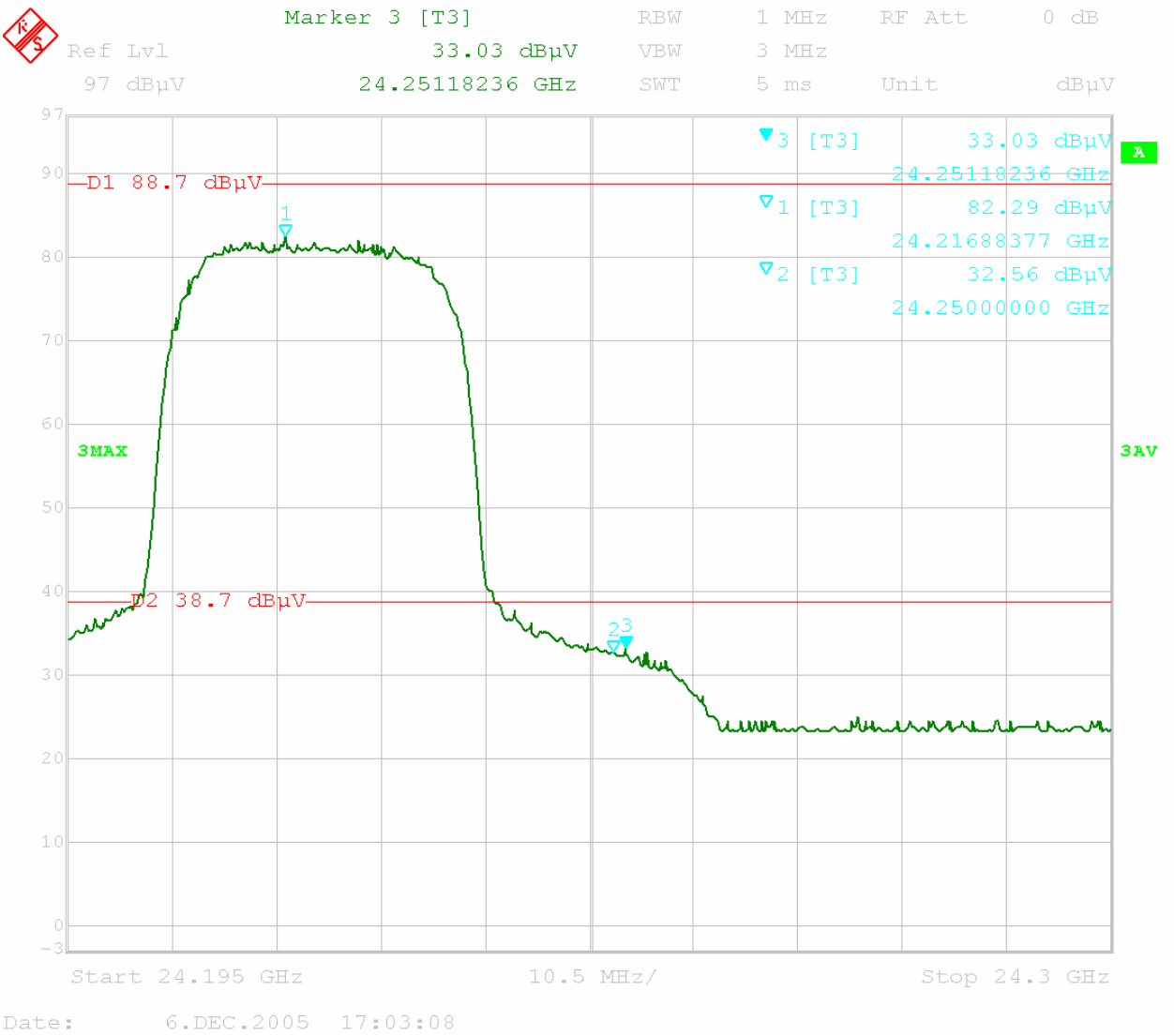
TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	11/21/2006
3	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	07/26/2006
4	Horn Antenna, 18-40 GHz	EMCO	3116	9310-2222	03/04/2006
5	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E404	05/13/2006
6	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E405	05/13/2006

Test Details:

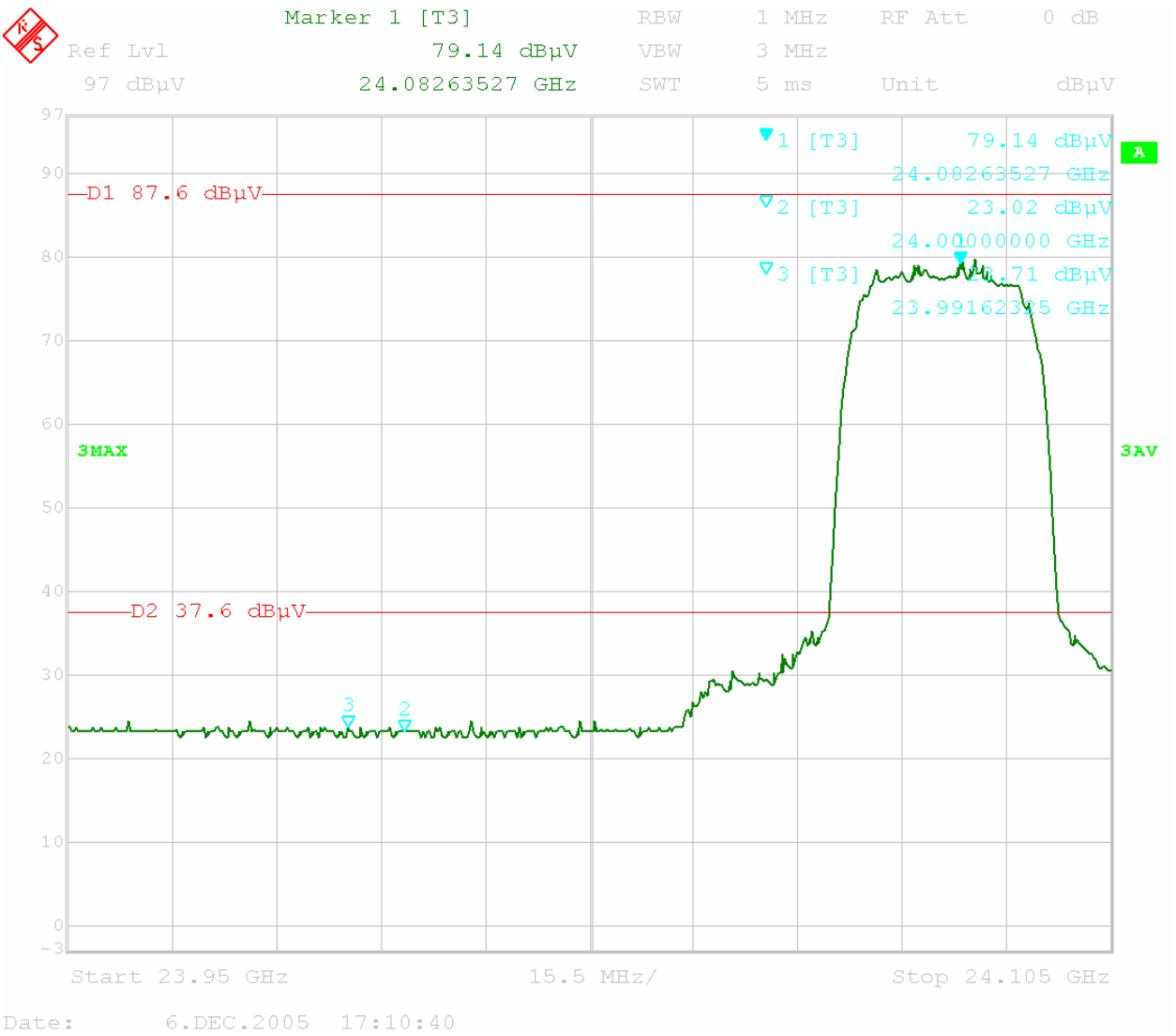
Notes: The fundamental field strength is measured using a peak detector according to FCC 15.249(e), while the spurious emissions above 1 GHz must be measured using an average detector. Therefore, in the subsequent plots of band edge compliance, a display line has been placed at the level of the fundamental when measured with a peak detector. A second display line is placed 50 dB down from this level, in order to denote the spurious emissions limit. The trace was then plotted using an average detector in order to show compliance with the limit. Note that since the trace utilizes an average detector, the level of the fundamental in the plot does not extend as high as the display line which was used to indicate the peak level of the fundamental emission.



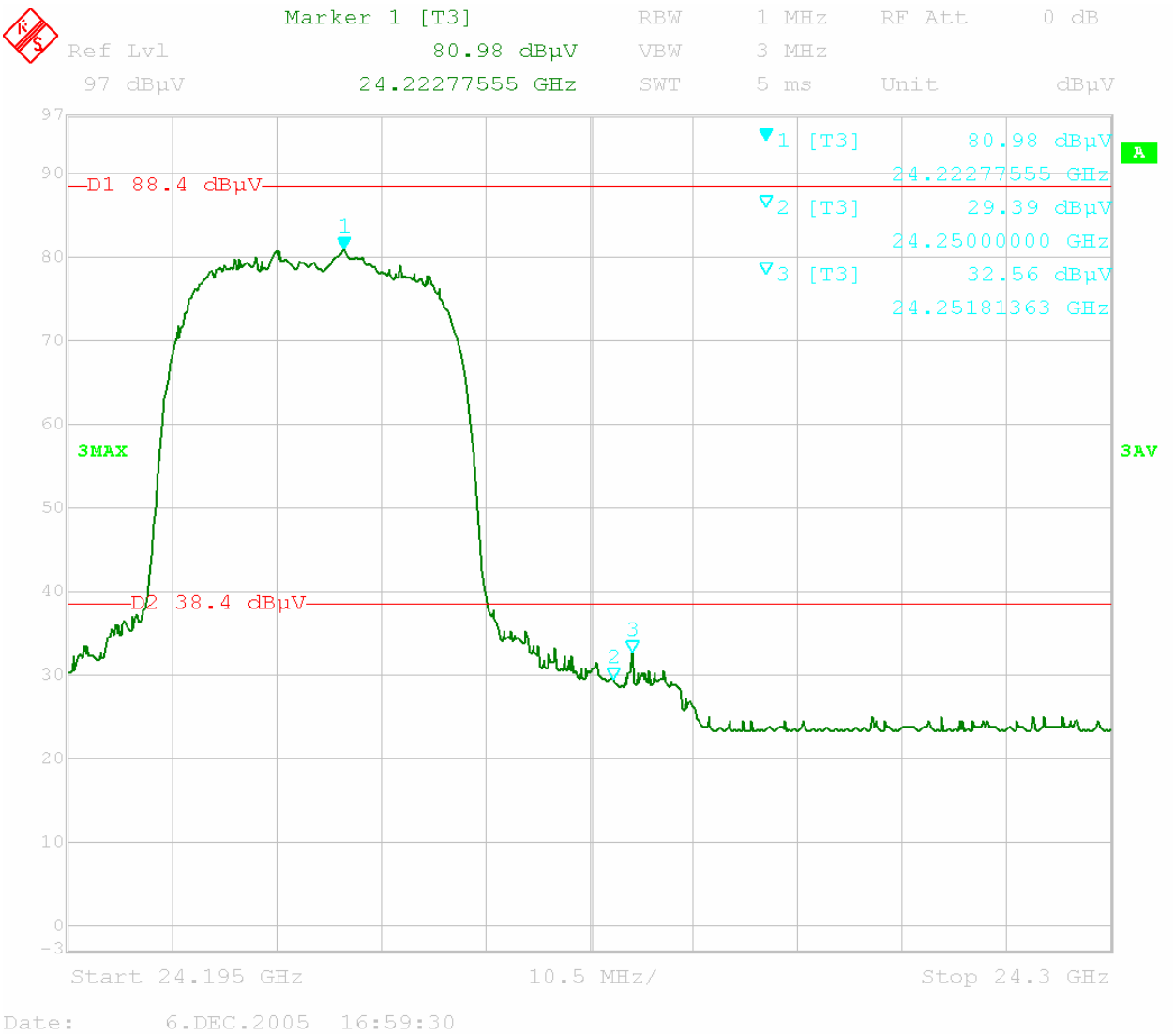
QPSK Channel 1



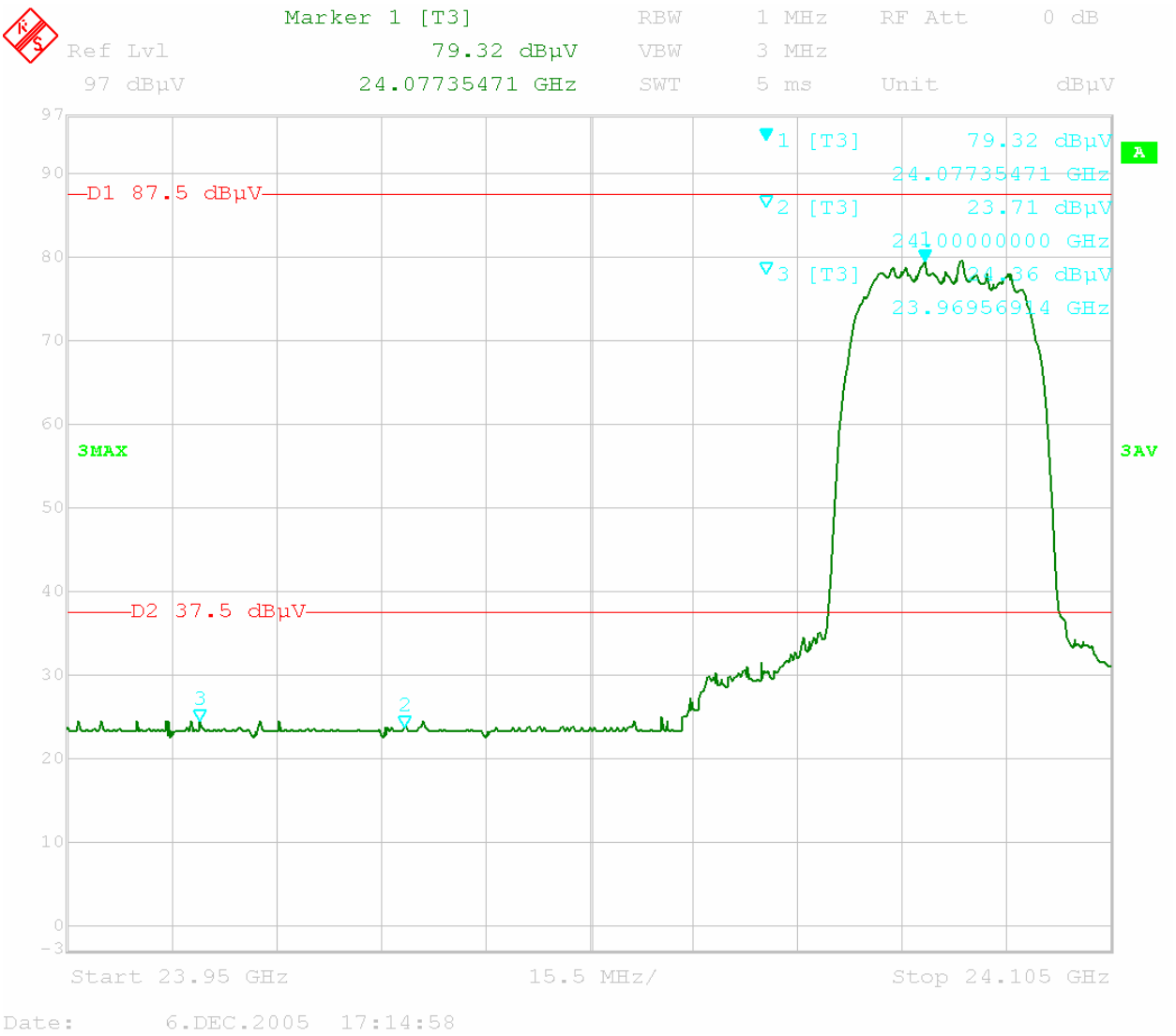
QPSK Channel 8



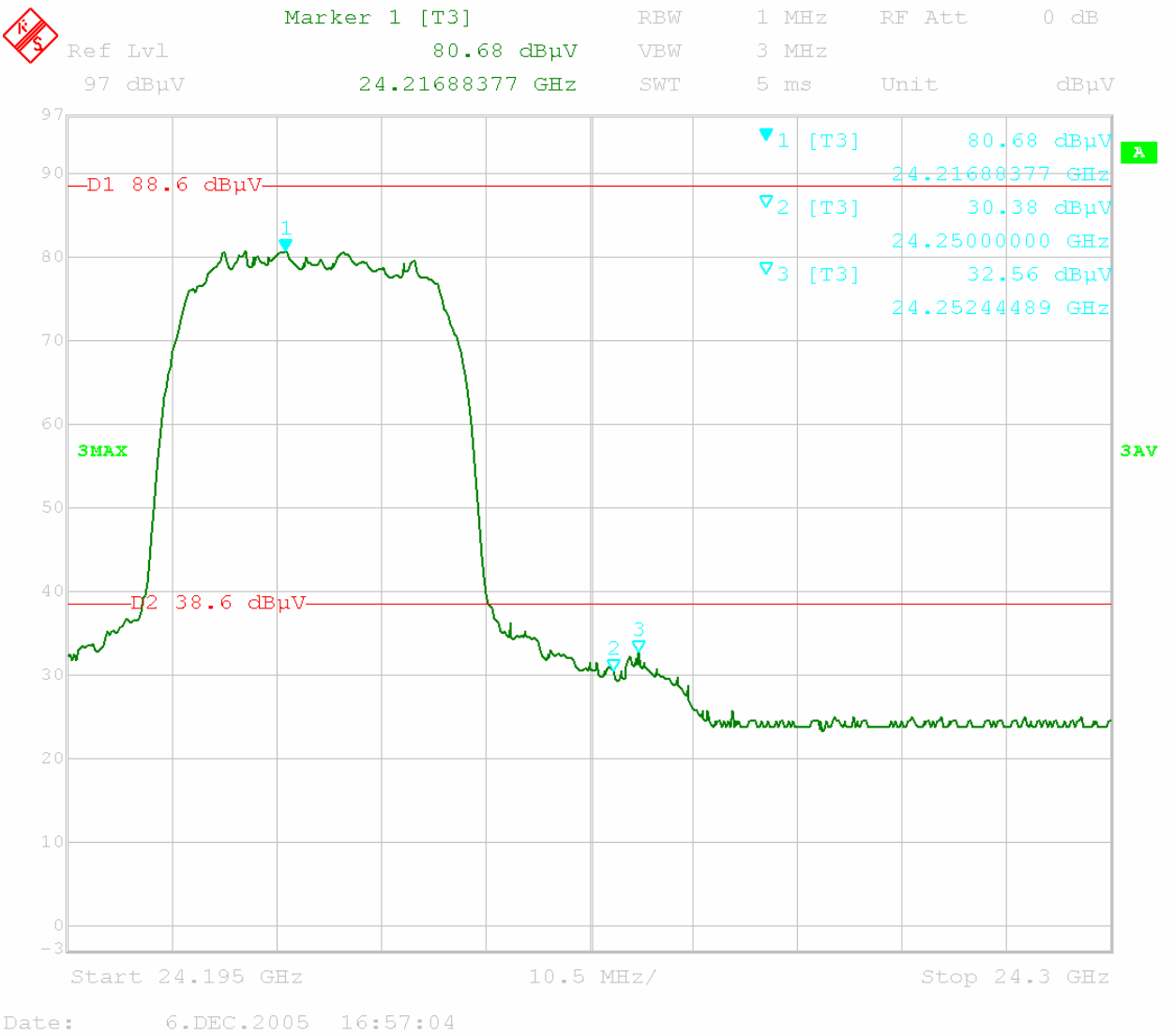
QAM16 Channel 1



16QAM Channel 8



64QAM Channel 1



64QAM Channel 8

Test Results: Pass

Test Standard: FCC CFR47 Part 15 Subpart C 15.249

Test: Radiated Spurious Emissions, 30 MHz – 40 GHz FCC 15.205, 15.209, 15.249(a-e)

Performance Criterion: Emissions must be below specified limits

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	Yes		Equipment under Test:		SINELINK 24G	

Maximum Test Disturbance Parameters: Harmonic emissions must not exceed 2500uV/m (68 dBuV/m). Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation. Field strength limits are specified at a distance of 3 meters. Emissions falling into the restricted bands of 15.205 must meet the general limits of 15.209.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	EMI Receiver Set W/RF Filter	Hewlett Packard	8542E	3520A00125	02/08/2006
3	RF FILTER	Hewlett Packard	85420E	3427A00126	02/08/2006
4	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	07/26/2006
5	ANTENNA	EMCO	3142	9711-1223	01/25/2007
6	HORN ANTENNA	EMCO	3115	9602-4675	09/13/2006
7	10 Meter in floor cable for site 2	ITS	RG214B/U	S2 10M FLR	09/02/2006
8	PREAMPLFIER 1- 40 GHz	MITEQ	NSP4000-NF	507145	11/21/2006
9	Horn Antenna, 18-40 GHz	EMCO	3116	9310-2222	03/04/2006
10	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E404	05/13/2006
11	Super High Frequency Cable	Megaphase	TM40 K1K1 80	E405	05/13/2006
12	Preamplifier, 18-40 GHz	Miteq	JS41800400-30-5P-S	81897	11/21/2006

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	11/16/05 Revision

Test Details:

Notes: In some cases, compliance with the average limits is demonstrated utilizing a peak detector. Noise floor readings are indicated with 'NF' or by a note in the table.

Radiated Emissions / Interference

Company:	Hitachi Kokusai Electric Inc.			Model #:	HP5-110100		
Engineer:	Nicholas Abbondante	Barometer:	BAR2	Serial #:	ES001		
Project #:	3086827	Pressure:	1023 mB	Receiver:	HP 8542E (REC2/RECFL2)		
Date:	12/05/05 12/08/05	Temp:	19c	N Antenna:	LOG2 12-13-05 V10.txt	LOG2 12-13-05 H10.txt	
Standard:	FCC 15.249	Humidity:	26%	LF Antenna:	NONE.	NONE.	
Class:	- Group: -			HF Antenna:	HORN2 9-13-06 V1m.txt	HORN2 9-13-06 H1m.txt	
Antenna Band:	N	Bands:	N, LF, HF, SHF	SHF Antenna:	Horn 213023 3m V 3-4-2006.ant	Horn 213023 3m H 3-4-2006.ant	
PreAmp:	NONE.			Cable(s):	S2 10M FLR 9-2-2006.cbl	NONE.	
Limit Distance:	3 meters			Test Distance:	10 meters	Location:	Site 2
Voltage/Frequency:	120V/60Hz			Frequency Range:	30 - 1000 MHz		

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
QP	V	49.990	15.6	8.5	1.5	0.0	-10.5	36.1	40.0	-3.9	120/300 kHz
QP	V	62.350	3.7	7.0	1.6	0.0	-10.5	22.7	40.0	-17.3	120/300 kHz
QP	V	85.450	14.7	7.3	1.5	0.0	-10.5	34.0	40.0	-6.0	120/300 kHz
QP	V	111.000	7.9	7.4	1.9	0.0	-10.5	27.6	43.5	-15.9	120/300 kHz
QP	V	141.200	17.6	7.6	2.1	0.0	-10.5	37.7	43.5	-5.8	120/300 kHz
QP	V	164.500	13.0	9.3	2.3	0.0	-10.5	35.1	43.5	-8.4	120/300 kHz
QP	V	170.700	11.5	9.3	2.4	0.0	-10.5	33.7	43.5	-9.8	120/300 kHz
QP	V	183.700	11.2	10.1	2.6	0.0	-10.5	34.4	43.5	-9.1	120/300 kHz
QP	V	227.600	4.9	11.4	3.0	0.0	-10.5	29.7	46.0	-16.3	120/300 kHz

Radiated Emissions / Interference

Company: Hitachi Kokusai Electric Inc. Model #: HP5-110100
Engineer: Nicholas Abbondante Barometer: BAR2 Serial #: ES001
Project #: 3086827 Pressure: 1022 mB Receiver: R&S FSEK-30 (ROS001)
Date: 12/08/05 Temp: 18c N Antenna: LOG2 12-13-05 V10.txt LOG2 12-13-05 H10.txt
Standard: FCC 15.249 Humidity: 27% LF Antenna: NONE. NONE.
Class: - Group: - HF Antenna: HORN2 9-13-06 V1m.txt HORN2 9-13-06 H1m.txt
Antenna Band: HF Bands: N, LF, HF, SHF SHF Antenna: Horn 213023 3m V 3-4-2006.ant Horn 213023 3m H 3-4-2006.ant
PreAmp: PRE8 11-21-06.amp Cable(s): E404 5-13-06.cbl E405 5-13-06.cbl
Limit Distance: 3 meters Test Distance: 3 meters Location: Site 2
Voltage/Frequency: 120V/60Hz Frequency Range: 1 - 18 GHz
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

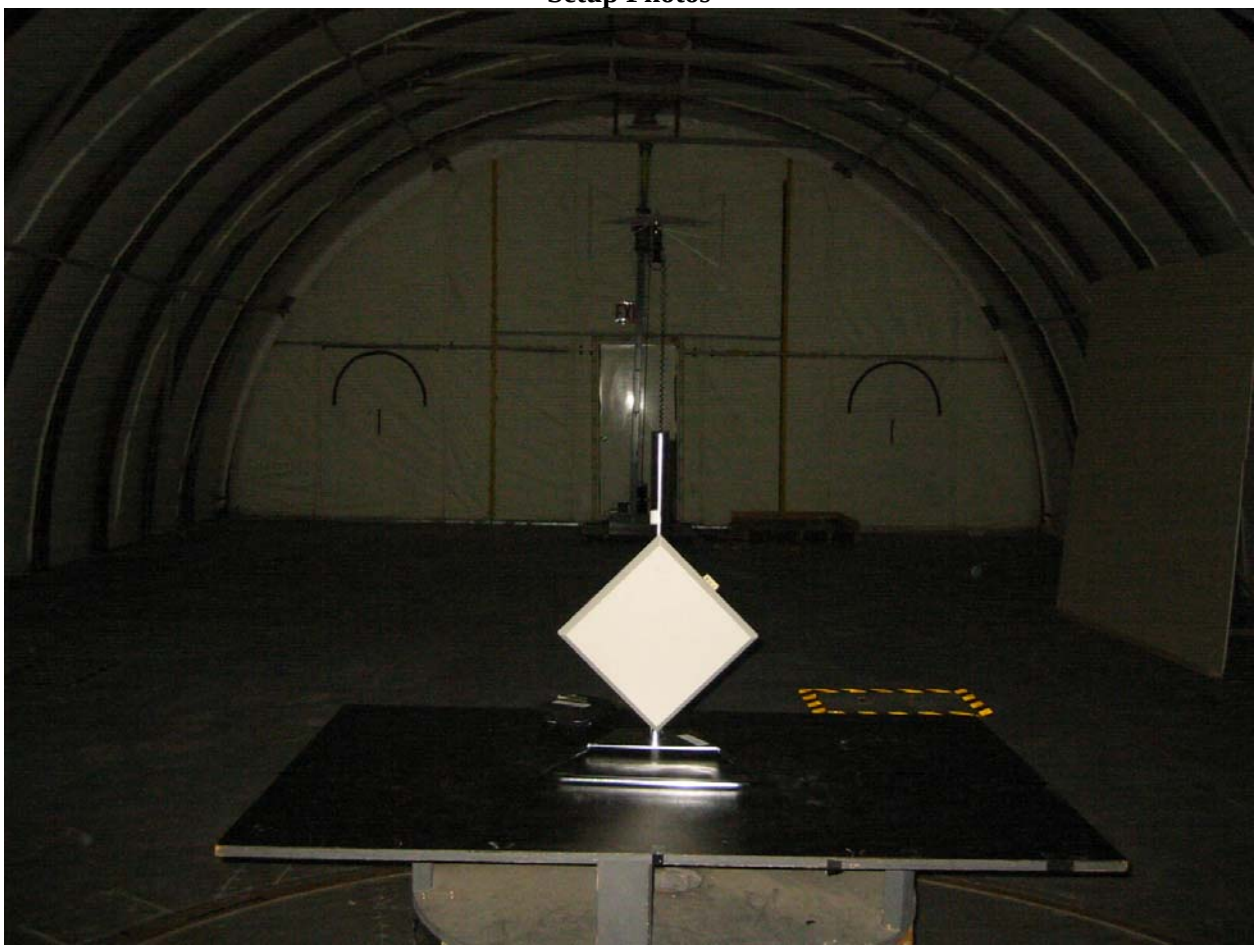
Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	
PK	V	2130.000	36.9	28.2	2.7	21.0	0.0	46.8	78.0	-31.2	1/3 MHz	
PK	V	5520.000	45.2	34.5	6.0	22.7	0.0	63.0	78.0	-15.0	1/3 MHz	
PK	V	5525.000	45.2	34.5	6.0	22.7	0.0	63.0	78.0	-15.0	1/3 MHz	
PK	V	5530.000	42.8	34.5	6.0	22.7	0.0	60.6	78.0	-17.4	1/3 MHz	
PK	V	5535.000	45.6	34.5	6.0	22.7	0.0	63.4	78.0	-14.6	1/3 MHz	
PK	V	5540.000	40.8	34.5	6.0	22.7	0.0	58.6	78.0	-19.4	1/3 MHz	
PK	V	5545.000	40.8	34.5	6.0	22.7	0.0	58.6	78.0	-19.4	1/3 MHz	
PK	V	5550.000	38.8	34.5	6.1	22.7	0.0	56.7	78.0	-21.3	1/3 MHz	
PK	V	5555.000	41.2	34.5	6.1	22.7	0.0	59.0	78.0	-19.0	1/3 MHz	
PK	H	11040.000	38.8	39.1	9.1	19.0	0.0	68.0	78.0	-10.0	1/3 MHz	
PK	V	16560.000	36.7	39.5	11.6	23.5	0.0	64.3	78.0	-13.7	1/3 MHz	
PK	V	17995.000	31.5	47.8	12.0	24.3	0.0	66.8	78.0	-11.2	1/3 MHz	NF
PK	H	11070.000	39.6	39.1	9.1	19.0	0.0	68.9	78.0	-9.1	1/3 MHz	
PK	H	11100.000	37.7	39.2	9.2	19.0	0.0	67.0	78.0	-11.0	1/3 MHz	

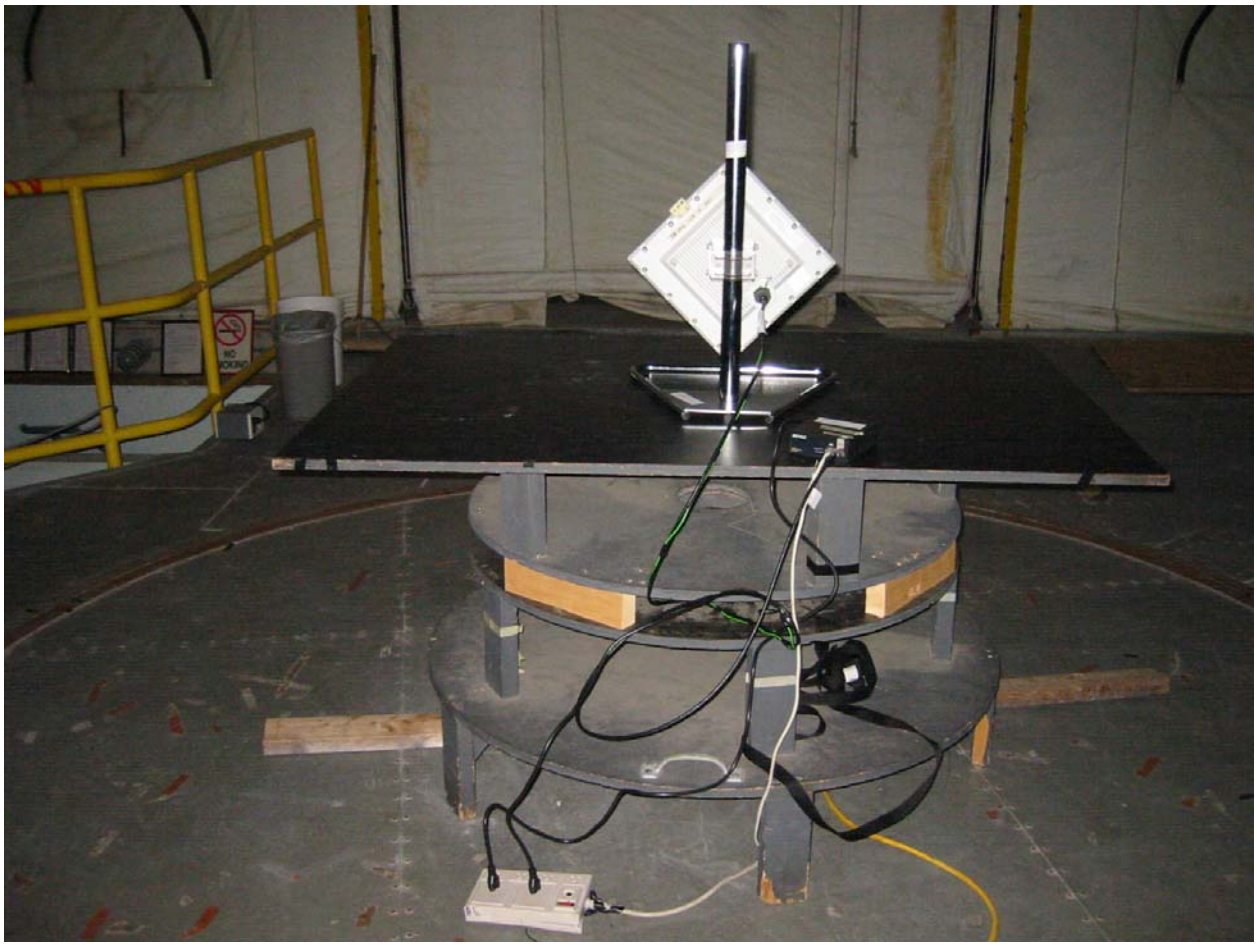
Radiated Emissions / Interference

Company: Hitachi Kokusai Electric Inc. Model #: HP5-110100
Engineer: Nicholas Abbondante Barometer: BAR2 Serial #: ES001
Project #: 3086827 Pressure: 1009 mB Receiver: R&S FSEK-30 (ROS001)
Date: 12/05/05 Temp: 19c N Antenna: LOG2 12-13-05 V10.txt LOG2 12-13-05 H10.txt
Standard: FCC 15.249 Humidity: 32% LF Antenna: NONE. NONE.
Class: - Group: - HF Antenna: HORN2 9-13-06 V1m.txt HORN2 9-13-06 H1m.txt
Antenna Band: SHF Bands: N, LF, HF, SHF SHF Antenna: Horn 213023 3m V 3-4-2006.ant Horn 213023 3m H 3-4-2006.ant
PreAmp: PRE8 11-21-06.amp Cable(s): E404 5-13-06.cbl E405 5-13-06.cbl
Limit Distance: 3 meters Test Distance: 3 meters Location: Site 2
Voltage/Frequency: 120V/60Hz Frequency Range: 18 - 40 GHz
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Note: JS4 (Miteq M/N:JS41800400-30-5P-S S/N:81897 Cal Due:11/21/06) + Miteq PRE8 Preamp Noise Floor Readings											
PK	V	18250.000	54.3	46.6	12.0	64.6	0.0	48.3	74.0	-25.7	1/3 MHz
PK	V	25995.000	51.8	47.1	13.9	61.8	0.0	50.9	74.0	-23.1	1/3 MHz
PK	V	26700.000	68.0	47.3	13.8	80.2	0.0	48.9	74.0	-25.1	1/3 MHz
PK	V	34665.000	70.9	49.7	16.8	81.7	0.0	55.7	74.0	-18.3	1/3 MHz
PK	V	39850.000	67.0	47.9	20.5	79.4	0.0	56.0	74.0	-18.0	1/3 MHz
AVG	V	18250.000	44.4	46.6	12.0	64.6	0.0	38.3	54.0	-15.7	1/3 MHz
AVG	V	25995.000	42.3	47.1	13.9	61.8	0.0	41.4	54.0	-12.6	1/3 MHz
AVG	V	26700.000	57.0	47.3	13.8	80.2	0.0	37.9	54.0	-16.1	1/3 MHz
AVG	V	34665.000	60.5	49.7	16.8	81.7	0.0	45.3	54.0	-8.7	1/3 MHz
AVG	V	39850.000	56.6	47.9	20.5	79.4	0.0	45.5	54.0	-8.5	1/3 MHz

Setup Photos





Test Results: Pass

Test Standard: FCC CFR47 Part 15 Subpart C 15.249

Test: Radiated Spurious Emissions, 40 – 100 GHz FCC 15.205, 15.209, 15.249(a-e)

Performance Criterion: Emissions must be below specified limits

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	N/A		Equipment under Test:		SINELINK 24G	

Maximum Test Disturbance Parameters: Harmonic emissions must not exceed 2500uV/m (68 dBuV/m). Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation. Field strength limits are specified at a distance of 3 meters. Emissions falling into the restricted bands of 15.205, except for harmonics in the 48.0–48.5 GHz and 72.0–72.75 GHz bands only, must meet the general limits of 15.209.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Spectrum Analyzer 20Hz - 40 GHz	Rohde & Schwartz	FSEK-30	100225	07/26/2006
2	Mixer / Antenna	Oleson Microwave Lab	M19HWA	U21011-1	Verified
3	Mixer / Antenna	Oleson Microwave Lab	M08HWA	F21011-1	Verified
4	Mixer / Antenna	Oleson Microwave Lab	M12HWD	E21011-1	Verified
5	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
6	Super High Frequency Cable	Megaphase	TM40 K1K1 197	CBL028	12/12/2006

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	11/16/05 Revision

Test Details:

Notes: The readings shown in the table below are all noise floor readings. No emissions were detected above 40 GHz. Note that the EUT was also examined at a closer distance than the value reported in order to verify that no emissions could be detected.

Radiated Emissions / Interference

Company:	Hitachi Kokusai Electric Inc.			Model #:	HP5-110100				
Engineer:	Nicholas Abbondante	Barometer:	BAR2	Serial #:	ES001				
Project #:	3086827	Pressure:	1007 mB	Receiver:	R&S FSEK-30 (ROS001)				
Date:	03/09/06	Temp:	19c	N Antenna:	NONE.	NONE.			
Standard:	FCC 15.249	Humidity:	25%	LF Antenna:	NONE.	NONE.			
Class:	-	Group:	-	HF Antenna:	NONE.	NONE.			
Antenna Band:	LF	Bands:	N, LF, HF, SHF	SHF Antenna:	NONE.	NONE.			
PreAmp:	NONE			Cable(s):	CBL028 12-12-2006.txt	NONE.			
Limit Distance:	3	meters		Test Distance:	0.01	meters	Location:	Site 2	
Voltage/Frequency:	120V/60Hz			Frequency Range:	40 - 100 GHz				

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Note: 40 - 60 GHz Range using Mixer OML4											
PK	V	40000.000	40.3	38.2	1.6	0.0	49.5	30.6	74.0	-43.4	1/3 MHz
AVG	V	40000.000	29.9	38.2	1.6	0.0	49.5	20.2	54.0	-33.8	1/3 MHz
PK	V	48000.000	39.6	39.8	1.6	0.0	49.5	31.4	74.0	-42.6	1/3 MHz
AVG	V	48000.000	28.6	39.8	1.6	0.0	49.5	20.4	54.0	-33.6	1/3 MHz
PK	V	60000.000	46.7	41.7	1.6	0.0	49.5	40.5	74.0	-33.5	1/3 MHz
AVG	V	60000.000	37.4	41.7	1.6	0.0	49.5	31.2	54.0	-22.8	1/3 MHz
Note: 60 - 90 GHz Range using Mixer OML3											
PK	V	60000.000	48.0	41.7	1.6	0.0	49.5	41.8	74.0	-32.2	1/3 MHz
AVG	V	60000.000	37.7	41.7	1.6	0.0	49.5	31.5	54.0	-22.5	1/3 MHz
PK	V	72000.000	45.4	43.3	1.6	0.0	49.5	40.8	74.0	-33.2	1/3 MHz
AVG	V	72000.000	35.1	43.3	1.6	0.0	49.5	30.5	54.0	-23.5	1/3 MHz
PK	V	90000.000	46.9	45.3	1.6	0.0	49.5	44.3	74.0	-29.7	1/3 MHz
AVG	V	90000.000	37.9	45.3	1.6	0.0	49.5	35.2	54.0	-18.8	1/3 MHz
Note: 90 - 100 GHz Range using Mixer OML2											
PK	V	90000.000	60.4	45.3	1.6	0.0	49.5	57.7	74.0	-16.3	1/3 MHz
AVG	V	90000.000	50.4	45.3	1.6	0.0	49.5	47.7	54.0	-6.3	1/3 MHz
PK	V	96000.000	57.3	45.8	1.6	0.0	49.5	55.2	74.0	-18.8	1/3 MHz
AVG	V	96000.000	46.7	45.8	1.6	0.0	49.5	44.6	54.0	-9.4	1/3 MHz
PK	V	100000.000	48.9	46.2	1.6	0.0	49.5	47.1	74.0	-26.9	1/3 MHz
AVG	V	100000.000	38.3	46.2	1.6	0.0	49.5	36.5	54.0	-17.5	1/3 MHz

Test Results: Pass

Test Standard: FCC CFR47 Part 15 Subpart C 15.249

Test: Frequency Stability FCC 15.249(b)(2)

Performance Criterion: The frequency stability must meet the requirements of FCC 15.249(b)(2).

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Tables	Pressure (hPa):	See Tables	Ambient (°C):	See Tables
Pretest Verification Performed	N/A		Equipment under Test:		SINELINK 24G	

Maximum Test Disturbance Parameters: The frequency tolerance of the carrier signal shall be maintained within ±0.001% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Spectrum Analyzer	Agilent	E7405A	US40240205	08/09/2006
2	Digital Multimeter	Fluke	87 III	75250400	03/22/2006
3	High Frequency Cable 40Ghz	Megaphase	TM40 K1K1 197	CBL028	12/12/2006
4	Variac, 120VAC in, 0-140VAC out, 15A, 2.KV, 50/60 Hz	Powerstat	3PN126	SAF418	Verified

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	11/16/05 Revision

Test Details:

Frequency Stability

Company: Hitachi Kokusai Electric Inc.
Model #: HP5-110100
Serial #: ES001
Engineer(s): Nicholas Abbondante
Project #: 3086827
Standard: FCC Part 15 Subpart C 15.249
Limit: 0.001 %
Nominal f: 24080 MHz

Test Equipment Used:
AGL001 SAF099 CBL028 SAF418

Location: Safety
Date(s): 12/14/05
Voltage: 120 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	102	24079.997073	-0.005	240.80
+0%	120	24079.997078	0.000	240.80
+15%	138	24079.997074	-0.004	240.80

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-20	24080.014632	17.554	240.80
-10	24080.007252	10.174	240.80
0	24080.001806	4.728	240.80
10	24079.999786	2.708	240.80
20	24079.997078	0.000	240.80
30	24079.993581	-3.497	240.80
40	24079.991450	-5.628	240.80
50	24079.993200	-3.878	240.80

Frequency Stability

Company: Hitachi Kokusai Electric Inc.
Model #: HP5-110100
Serial #: ES001
Engineer(s): Nicholas Abbondante
Project #: 3086827
Standard: FCC Part 15 Subpart C 15.249
Limit: 0.001 %
Nominal f: 24140 MHz

Test Equipment Used:
AGL001 SAF099 CBL028 SAF418

Location: Safety
Date(s): 12/14/05
Voltage: 120 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	102	24139.997094	0.002	241.40
+0%	120	24139.997092	0.000	241.40
+15%	138	24139.997100	0.008	241.40

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-20	24140.014717	17.625	241.40
-10	24140.007191	10.099	241.40
0	24140.001836	4.744	241.40
10	24139.999812	2.720	241.40
20	24139.997092	0.000	241.40
30	24139.993650	-3.442	241.40
40	24139.991351	-5.741	241.40
50	24139.993100	-3.992	241.40

Frequency Stability

Company: Hitachi Kokusai Electric Inc.
Model #: HP5-110100
Serial #: ES001
Engineer(s): Nicholas Abbondante
Project #: 3086827
Standard: FCC Part 15 Subpart C 15.249
Limit: 0.001 %
Nominal f: 24220 MHz

Test Equipment Used:
AGL001 SAF099 CBL028 SAF418

Location: Safety
Date(s): 12/14/05
Voltage: 120 VDC

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-15%	102	24219.996917	-0.077	242.20
+0%	120	24219.996994	0.000	242.20
+15%	138	24219.996903	-0.091	242.20

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz
-20	24220.014837	17.843	242.20
-10	24220.007252	10.258	242.20
0	24220.001917	4.923	242.20
10	24219.999866	2.872	242.20
20	24219.996994	0.000	242.20
30	24219.993695	-3.299	242.20
40	24219.991401	-5.593	242.20
50	24219.993106	-3.888	242.20

Test Results: Pass

Test Standard: FCC CFR47 Part 15 Subpart C 15.249

Test: AC Line-Conducted Emissions FCC 15.207

Performance Criterion: Emissions must be below specified limits

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	See Table	Pressure (hPa):	See Table	Ambient (°C):	See Table
Pretest Verification Performed	Yes		Equipment under Test:		SINELINK 24G	

Maximum Test Disturbance Parameters:

Frequency of emission (MHz)	Conducted limit (dBmV)	
	Quasi-peak	Average
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.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR2	08/02/2007
2	LISN, 50uH, .01 - 50MHz, 24A	Solar Electronics	9252-50-R-24-BNC	941713	07/05/2007
3	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS24	08/12/2006
4	Cable, BNC - BNC, 15' long	Belden	RG-58/U	CBL022	01/03/2007
5	EMI Receiver Set W/RF Filter	Hewlett Packard	8542E	3520A00125	02/08/2006
6	RF FILTER	Hewlett Packard	85420E	3427A00126	02/08/2006

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	11/16/05 Revision

Test Details:

Conducted Emissions / Interference

Company:	Hitachi Telecom (USA), Inc. #17855			Model #:	HP5-110100		
Engineer:	Vathana Ven	Barometer:	BAR2	Serial #:	ES001		
Project #:	3086827	Pressure:	1009 mB	Receiver:	HP 8542E (REC2/RECFL2)		
Date:	01/19/06	Temp:	20c	Cable:	CBL022 1-03-07.cbl.txt		
Standard:	FCC 15.207	Humidity:	32%	LISN 1, 2:	LISN11 [1] 7-05-06.lsn	LISN11 [2] 7-05-06.lsn	
Class:	-	Group:	-	LISN 3, N:	NONE.	NONE.	
				Attenuator:	DS24 8-12-06.txt	Location:	Site 2
Voltage/Frequency:	120V/60Hz			Frequency Range:	150 kHz - 30 MHz		
Notes:	With PoE without PC with new RJ-45 cable						

Net is the sum of worst-case lisn, cable, & attenuator losses, and initial reading

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Net dB(uV)	QP Limit dB(uV)	Margin dB	Bandwidth
QP	0.153	15.4			13.7	36.2	65.8	-29.6	9/30 kHz
QP	0.185	24.2			23.7	45.0	64.3	-19.3	9/30 kHz
QP	0.189	24.1			23.0	44.9	64.1	-19.2	9/30 kHz
QP	0.248	26.3			26.9	47.6	61.8	-14.2	9/30 kHz
QP	1.981	18.8			16.8	39.8	56.0	-16.2	9/30 kHz
QP	28.960	16.3			16.7	38.3	60.0	-21.7	9/30 kHz
QP	29.700	17.8			18.0	39.9	60.0	-20.1	9/30 kHz

Detector Type	Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Net dB(uV)	Average Limit dB(uV)	Margin dB	Bandwidth
AVG	0.153	-3.8			-10.0	17.0	55.8	-38.8	9/30 kHz
AVG	0.185	16.7			19.7	40.4	54.3	-13.9	9/30 kHz
AVG	0.189	16.6			18.9	39.6	54.1	-14.5	9/30 kHz
AVG	0.248	24.0			25.8	46.5	51.8	-5.3	9/30 kHz
AVG	1.981	18.7			16.1	39.7	46.0	-6.3	9/30 kHz
AVG	28.960	15.6			14.9	37.6	50.0	-12.4	9/30 kHz
AVG	29.700	17.1			17.3	39.2	50.0	-10.8	9/30 kHz

Setup Photos