FCC & IC Certification Test Report

FCC & IC Certification Test Report
for
ADTRAN, Inc.
FCC ID: HDCTRC6320
IC: 2250A-TRC6320

April 8, 2005

Prepared for:

ADTRAN, Inc.
901 Explorer Blvd
Huntsville, AL 35806

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

FCC & IC Certification Test Report
for the
ADTRAN, Inc.
TRACER
Transceiver 6320
FCC ID: HDCTRC6320

WLL JOB# 8650-51

Prepared by: Brian J. Dettling
Documentation Specialist

Reviewed by: Gregory M. Snyder
Chief EMC Engineer

Abstract

This report has been prepared on behalf of ADTRAN, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digitally Modulated Transceiver under Part 15.247 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 of Industry Canada. This Certification Test Report documents the test configuration and test results for an ADTRAN, Inc. TRACER Model 6320.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The ADTRAN, Inc. TRACER 6320 complies with the limits for a Digitally Modulated Transceiver device under FCC Part 15.247 and Industry Canada RSS-210.

Revision 1 of this report reflects new conducted emissions test data against the Class B limits.

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1 Introduction

1.1 Compliance Statement

The ADTRAN, Inc. TRACER 6320 Spread Spectrum System complies with the limits for a Digitally Modulated intentional radiator device under FCC Part 15.247 and Industry Canada RSS-210.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	ADTRAN, Inc. 901 Explorer Blvd Huntsville, AL 35806
Quotation Number:	62267

1.4 Test Dates

Testing was performed on March 16 and March 21, 2005.

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter, John Rapella

2 Equipment Under Test

2.1 EUT Identification & Description

ADTRAN Part #	Product Name/Description
12806320A	Tracer 6320 Plan A
12806320B	Tracer 6320 Plan B

The 12806320 (Tracer 6320 Radio) Tracer 6320 operates in the 5725 to 5850 MHz unlicensed industrial, scientific, and medical (ISM) band, and serves as a radio frequency converter for 8xT1, 8xE1, and 10/100 Base-T Ethernet digital signals. The aggregate single-sided baseband bandwidth of the product is a maximum of 16.7 MHz, which accounts for 8xT1 plus framing overhead. Three frequency band plans are available: A1/B1, A2/B2, and A3/B3. Frequency plan A radios transmit (receive) in the lower (upper) band, while plan B radios transmit (receive) in the upper (lower) band.

The Tracer 6320 consists of a 6320 Outdoor Unit configured with a Tracer 6200 Modular Indoor Unit. DC power to the Tracer 6320 is provided via the 6200 IDU which gets 48Vdc power from an AC/DC power adapter. The 6320 contains a IF port for connection to the IDU and an RF port for connection to the antenna.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	ADTRAN, Inc.
FCC ID Number	HDCTRC6320
EUT Name:	Tracer
Model:	6320
FCC Rule Parts:	§15.247
Frequency Range:	5744MHz – 5831MHz
Maximum Output Power:	95.5mW
Modulation:	Digital (QPSK)
Bandwidth:	15.92MHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	2 plans (A and B), 3 channels/band
Power Output Level	Fixed
Frequency Tolerance:	N/A
Emission Type(s):	N/A
Power Source & Voltage:	48 VDC

As this device is being sought for certification under §15.247 and operates as a fixed installation point-to-point system at 5.8GHz, the antenna gain can exceed 6dBi without any reduction in output power. The user manual specifies antennas up to 12' in diameter with gains up to 44.2dBi.

Antenna Description of Tested Models:

Manufacturer	Model	Description	Gain
Andrew	PL10F-23-N7A	10' Dish Antenna with 5.8GHz Feed Horn	42.5dBi
Radio Waves, Inc.	SP2-5.8	2' Dish Antenna with 5.8GHz Feed Horn	28.5dBi

2.2 Test Configuration

The EUT was configured with an external power adapter to provide 48Vdc. Cables with loopback connections were connected to Channels A and B, unshielded wires were connected to the alarm I/O and a 50 Ohm coaxial cable was connected to the antenna port.

The EUT firmware was set up to provide continuous random data for Direct Sequence modulation to the output connector.

Two plans are available: "A" and "B". Changing between the plans is accomplished by switching the internal diplexer cables. The channels are then programmed within the plan.

An HP Pavilion Laptop PC, Model Number N3350, S/N: TW02810306 was used to set up the EUT via Hyperterminal. The PC is only used for configuration and was removed during testing.

This test report presents emissions data for the 2' (28.5dBi) dish antenna and 10' dish antenna (42.5dBi). It can be seen from the spurious emission data collected at the antenna terminal and the comparison of the radiated emissions data from the 2' to 10' dish antenna that the spurious emissions are not increased by the use of the high gain antenna.

All testing was first performed with the 2' dish antenna. The 10' dish antenna was evaluated at the lowest and highest frequency of operation.

2.3 Testing Algorithm

The EUT was operated continuously by a firmware test sequence that provided a continuous modulated RF data stream to the output port.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB.

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

Total Uncertainty = $(A^2 + B^2 + C^2)^{1/2}/(n-1)$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, total uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2}$ = ±2.3 dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Equipment	WLL Asset #	Calibration Due
Hewlett-Packard 8568B Spectrum Analyzer	0073	7/08/05
Hewlett-Packard 85650A Quasi-Peak Adapter	0069	7/08/05
Hewlett-Packard 8593A Spectrum Analyzer	0074	8/17/05
Hewlett-Packard 8449B Microwave Preamp	0312	9/29/05
Hewlett-Packard 8672A Signal Generator	0080	3/25/05
ARA LPB-2520 BiconiLog Antenna	0007	9/14/05
ARA DRG118/A Microwave Horn Antenna	0425	4/17/05
Narda V638 Horn Antenna	0210	12/25/08
Hewlett-Packard 85685A RF Preselector	0071	7/08/05
Solar Electronics 8012-50-R-24-BNC LISN	0125	10/01/05
Solar Electronics 8012-50-R-24-BNC LISN	0126	10/01/05
Tektronix TDS 220 Oscilloscope	0476	7/29/05
Rohde & Schwarz SMT06 Signal Generator	0478	11/23/05
Wiltron 75N50 Diode Detector	0475	8/24/05
Hewlett-Packard 8481B Power Head	0390	4/15/05

4 Test Results

4.1 RF Power Output (§15.247(b))

For devices within the scope of FCC §15.247, the peak power conducted from the intentional radiator to the antenna shall not be greater than one watt (30 dBm).

The output from the transmitter was connected to a diode detector and oscilloscope. The peak deflection was measured on the oscilloscope and recorded. A signal generator was then substituted in place of EUT and set to the same frequency as the transmitter. The CW output of the signal generator was increased until the same deflection was noted on the oscilloscope. A power meter was then connected to the output of the signal generator to determine the output power of the signal generator. This level is then recorded as the output power of the EUT at the specified frequency.

The EUT carrier was modulated during this test.

Table 3. RF Power Output

Channel and/or Frequency	Measured Level (dBm)	Measured Level (mWatts)	Rated (mWatts)	Limit (mWatts)
Plan A Chan 1 @ 5.744GHz	19.7	93.33	100	1000
Plan A Chan 2 @ 5.747 GHz	19.6	91.20	100	1000
Plan A Chan 3 @ 5.751 GHz	19.7	93.33	100	1000
Plan B Chan 1 @ 5.824 GHz	19.8	95.50	100	1000
Plan B Chan 2 @ 5.827 GHz	19.7	93.33	100	1000
Plan B Chan 3 @ 5.831 GHz	19.5	89.13	100	1000

RF Output Power Measurement
Diode Detector Method Test Setup Diagram

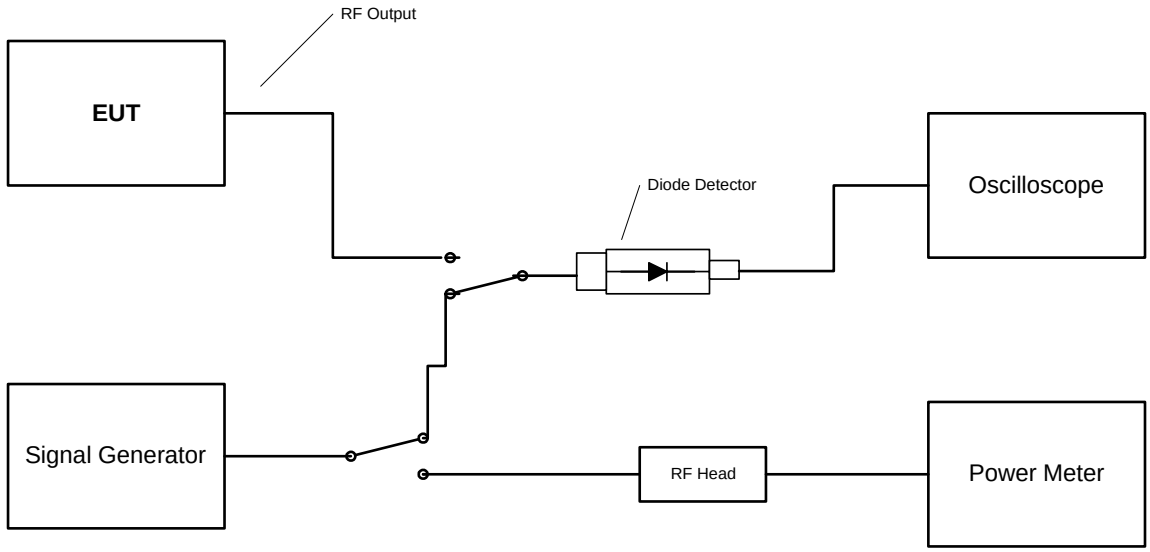

Figure 1. Power Measurement Setup

4.2 Occupied Bandwidth (§15.247(a)(2))

For systems using digital modulation techniques, FCC Part 15.247 requires that the minimum 6dB bandwidth be at least 500 kHz.

Occupied bandwidth was performed by connecting the RF output of the EUT to the input of a spectrum analyzer. The following plots depict the bandwidth measurements. Table 4 lists the measured bandwidths.

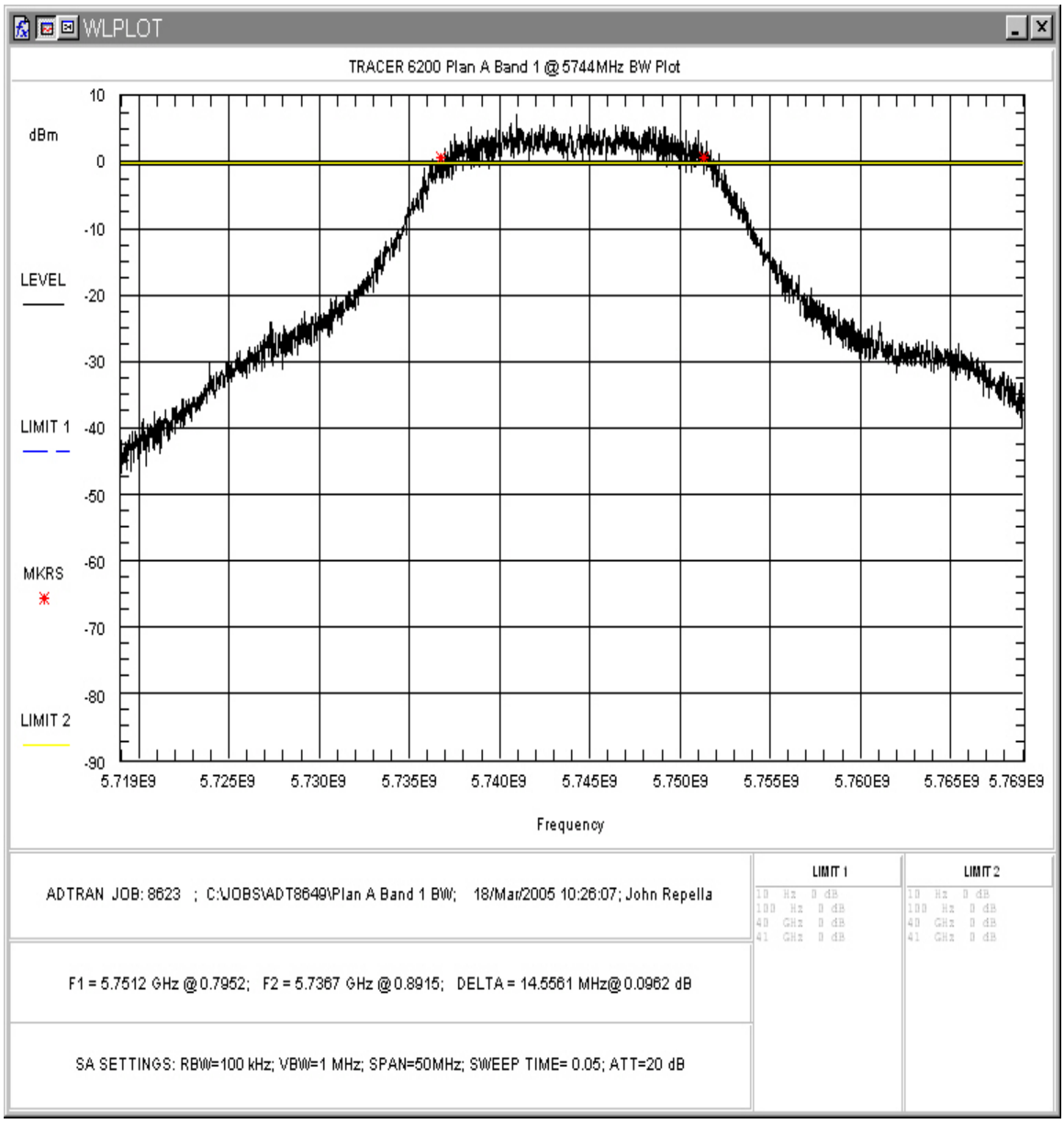

Figure 2. Occupied Bandwidth - Plan A, Band 1

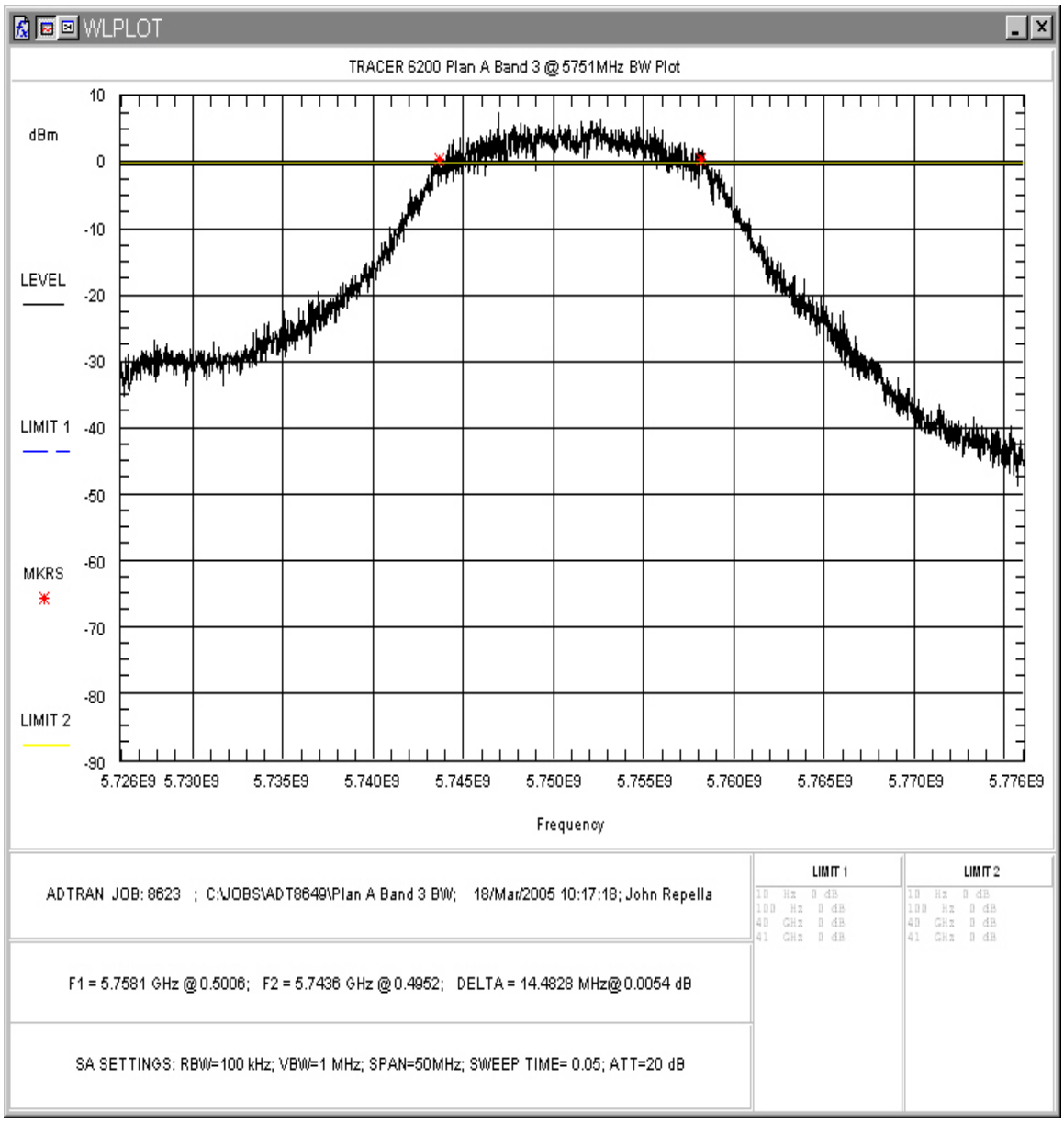

Figure 3. Occupied Bandwidth - Plan A, Band 3

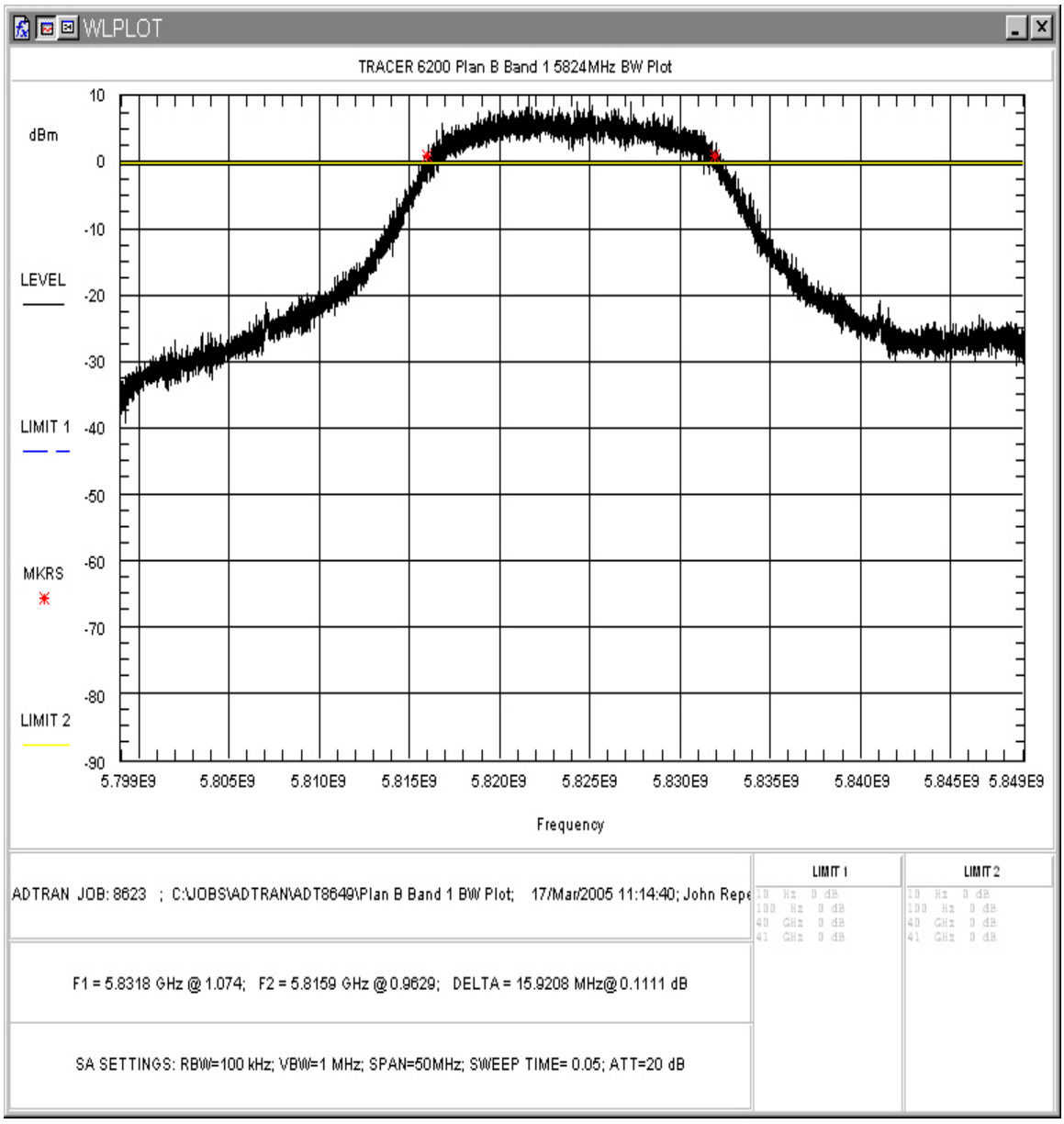

Figure 4. Occupied Bandwidth - Plan B, Band 1

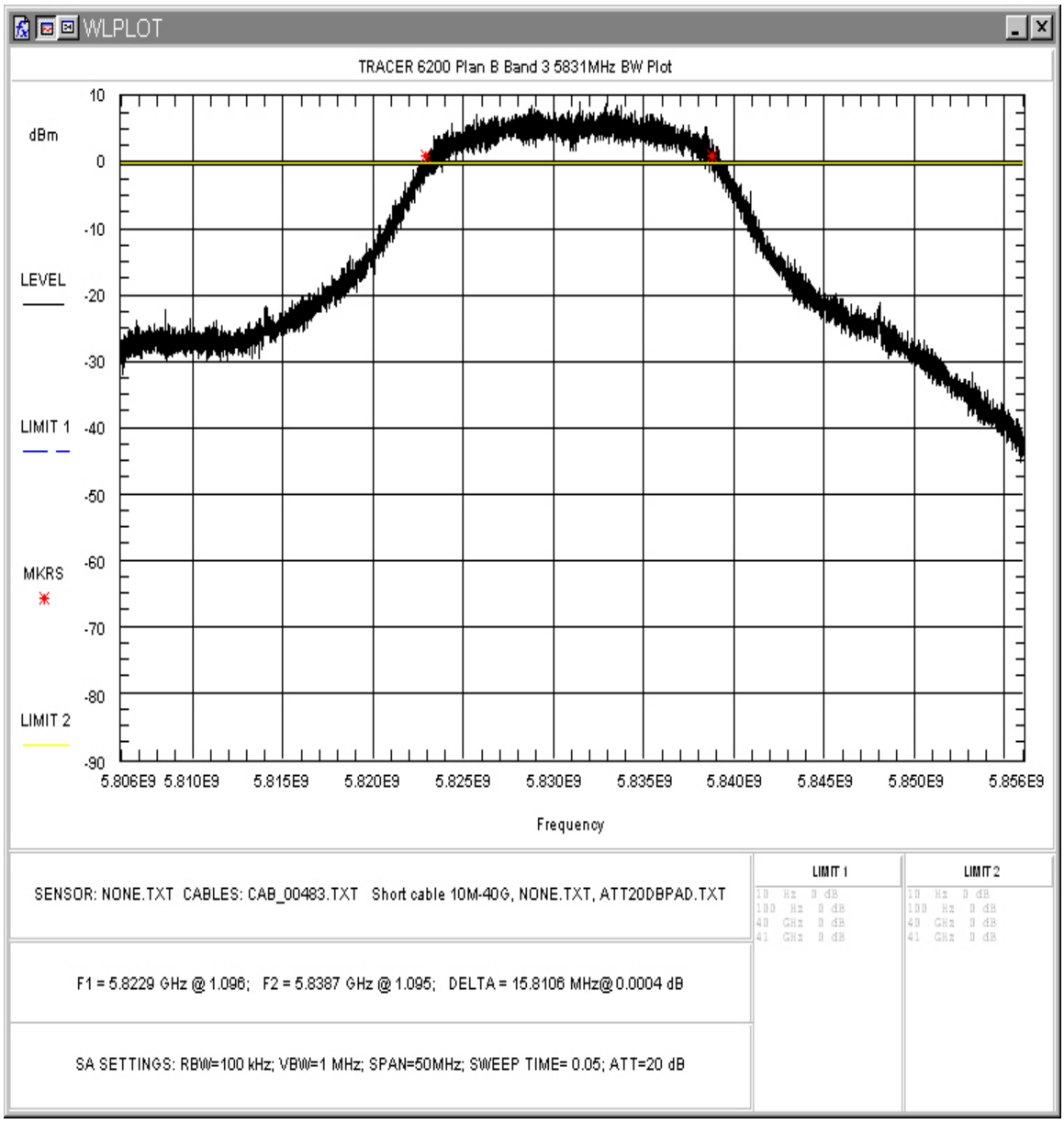

Figure 5. Occupied Bandwidth - Plan B, Band 3

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth (MHz)	Limit	Pass/Fail
Plan A (1)	14.56	> 500 kHz	Pass
Plan A (3)	14.48	> 500 kHz	Pass
Plan B (1)	15.92	> 500 kHz	Pass
Plan B (3)	15.81	> 500 kHz	Pass

4.3 RF Peak Power Spectral Density (§15.247(e))

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system. The resolution bandwidth was set to 3kHz with a span of 1.5MHz. During the sweep, the span was divided into 5 equal segments with the sweep time of each segment set to 100 seconds. Thus the total sweep time for the entire span is 500 seconds.

The highest peak within the transmission was located and measured for the upper and lower channels of Plan A and Plan B. Plots of the PSD were taken as shown in Figure 6 through Figure 9 below. Table 5 provides a summary of the data.

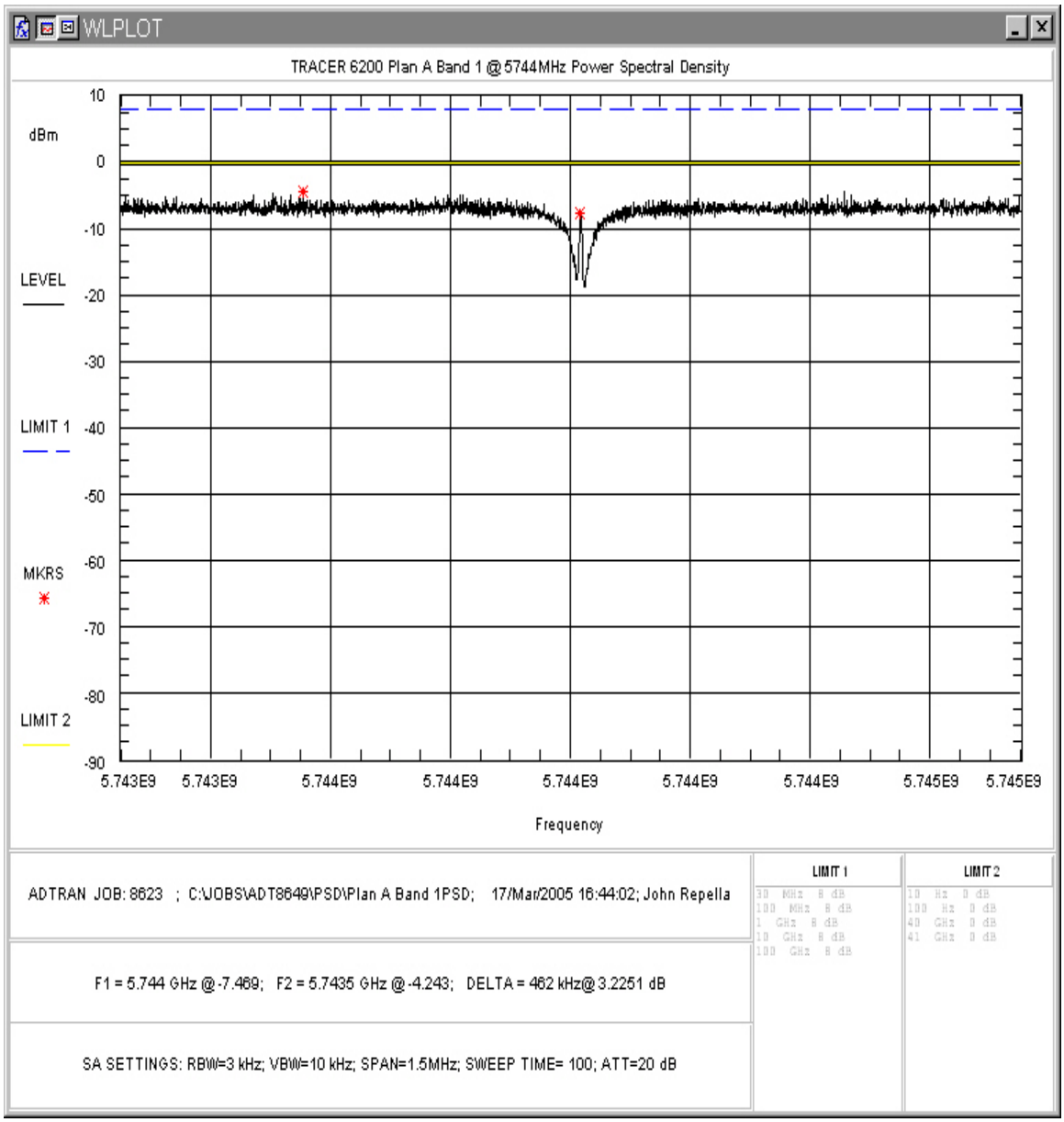

Figure 6. Power Spectral Density Plan A, Band 1

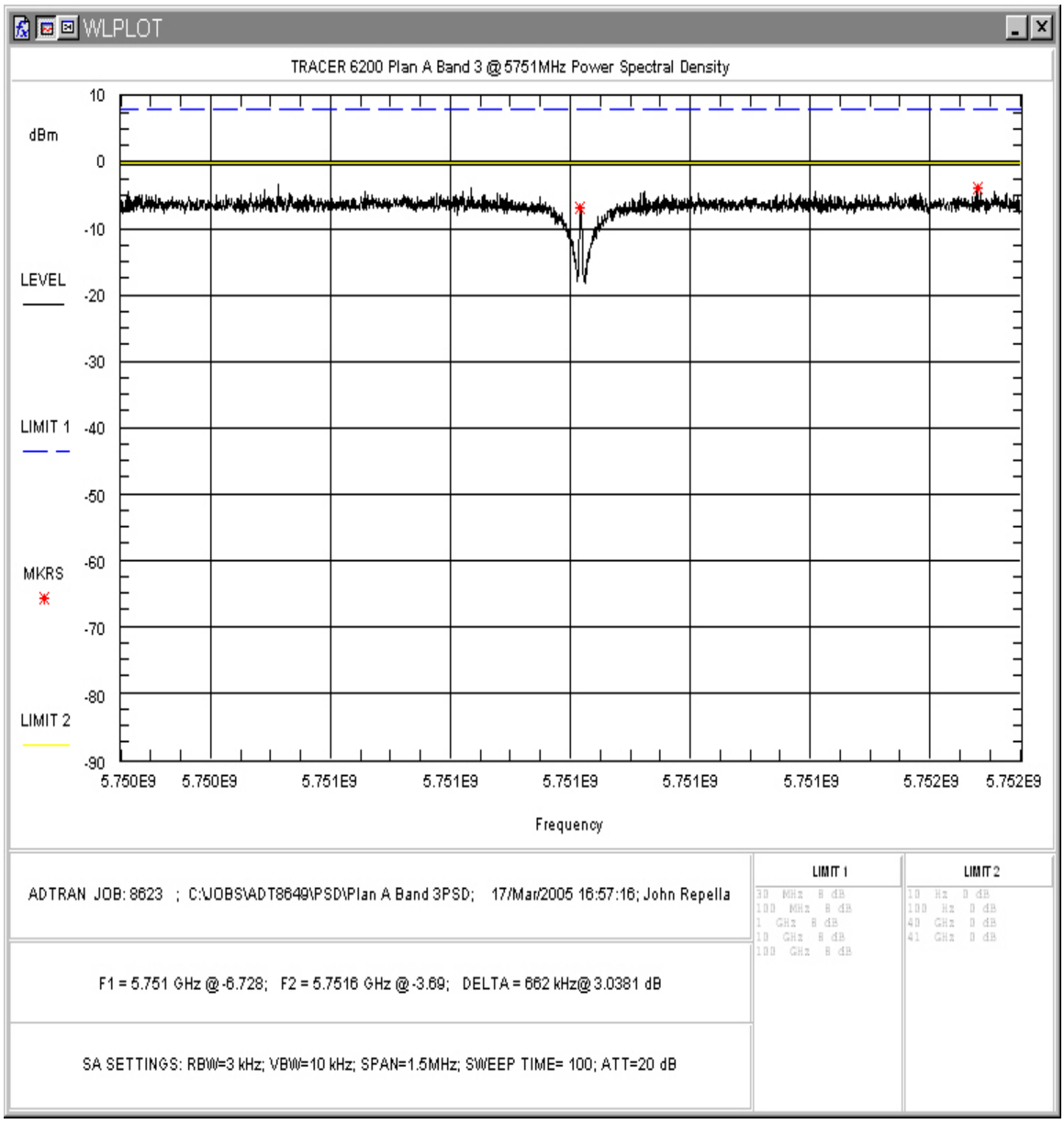

Figure 7. Power Spectral Density Plan A, Band 3

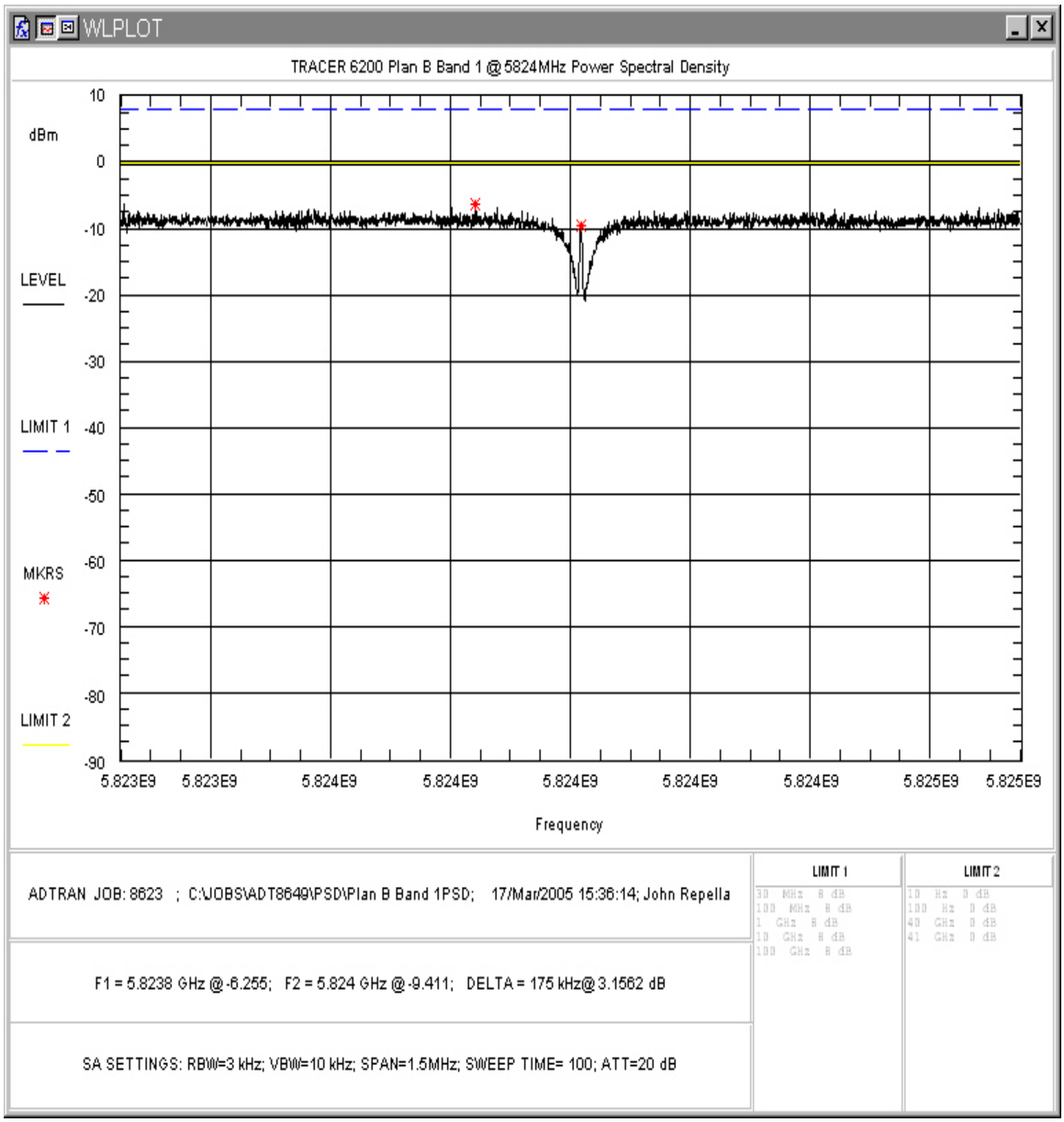

Figure 8. Power Spectral Density Plan B, Band 1

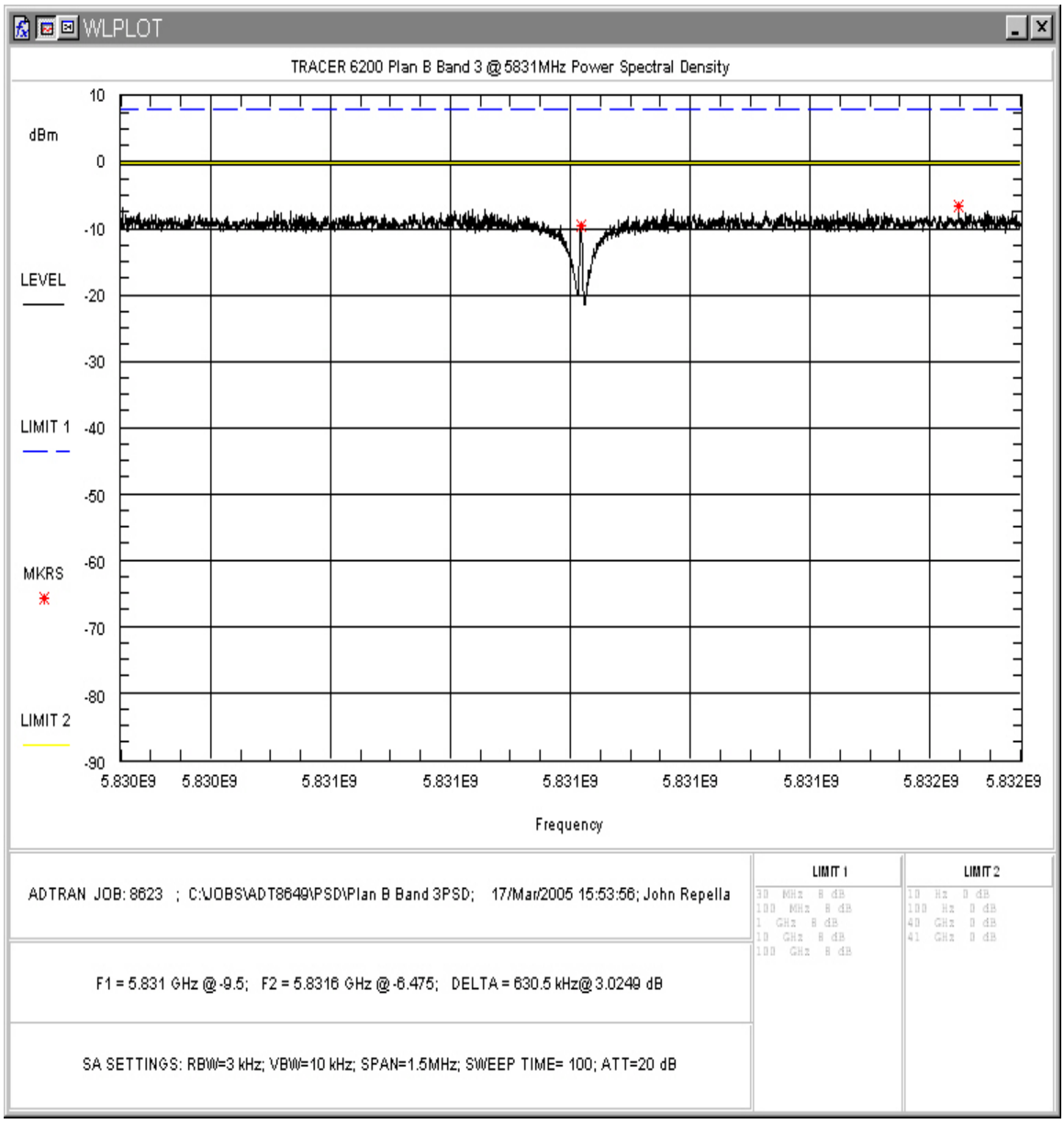

Figure 9. Power Spectral Density Plan B, Band 3

Table 5. RF Power Spectral Density

Frequency	Level (dBm)	Limit (dBm)	Pass/Fail
Plan A (1)	-4.24	8	P
Plan A (3)	-3.69	8	P
Plan B (1)	-9.41	8	P
Plan B (3)	-6.47	8	P

4.4 Spurious Emissions at Antenna Terminals (FCC Part §15.247(d))

In any 100 kHz band outside the frequency band in which the system is operating, the RF power shall be at least 20dB below that in the 100 kHz bandwidth that contain the highest level of the desired power.

All measurements were performed with a measurement bandwidth of 100kHz. The video bandwidth was set to 3MHz during the testing.

See the plots of conducted emissions plots below.

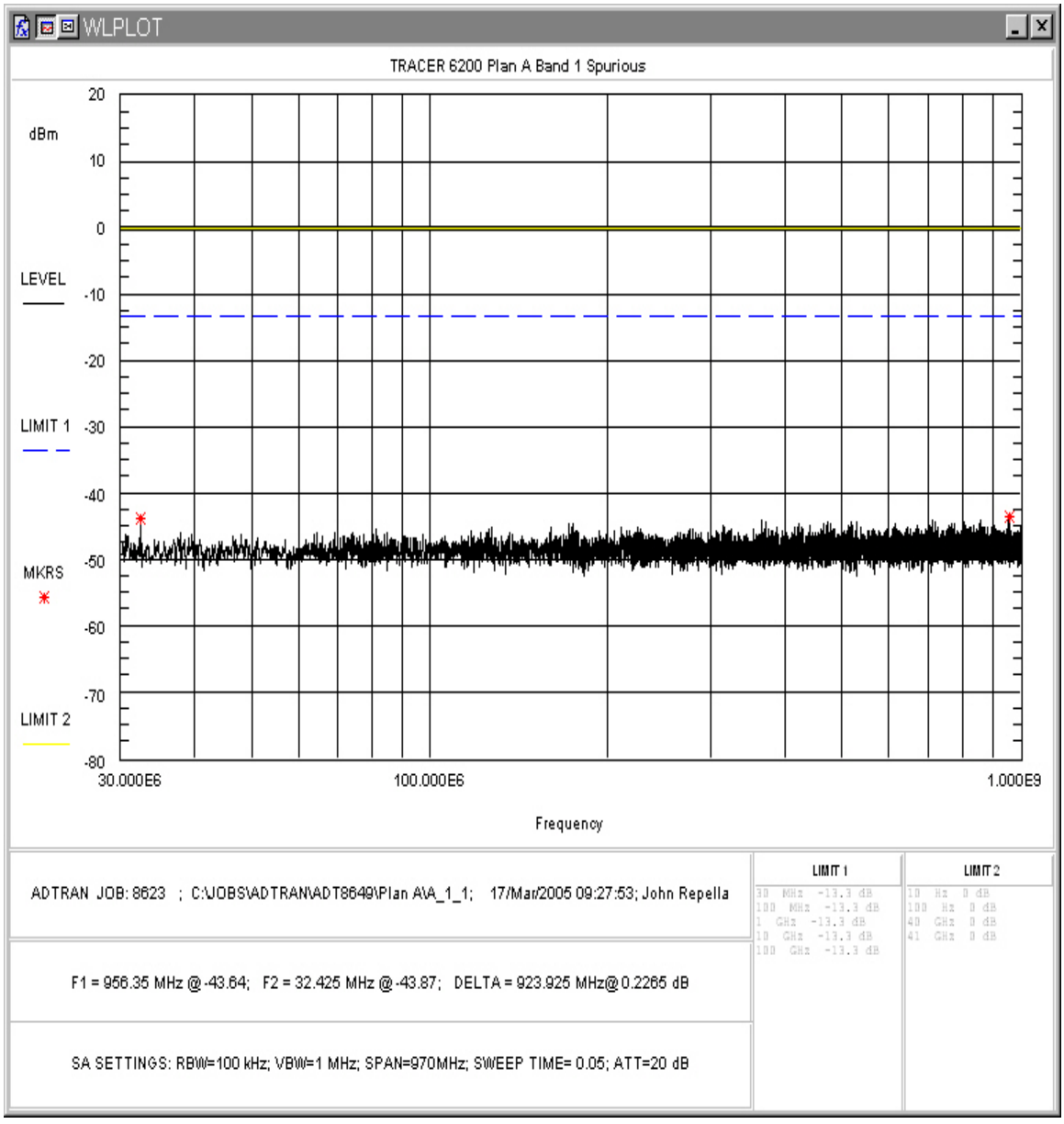

Figure 10. Conducted Spurious Emissions, Plan A Band 1, 30MHz - 1GHz

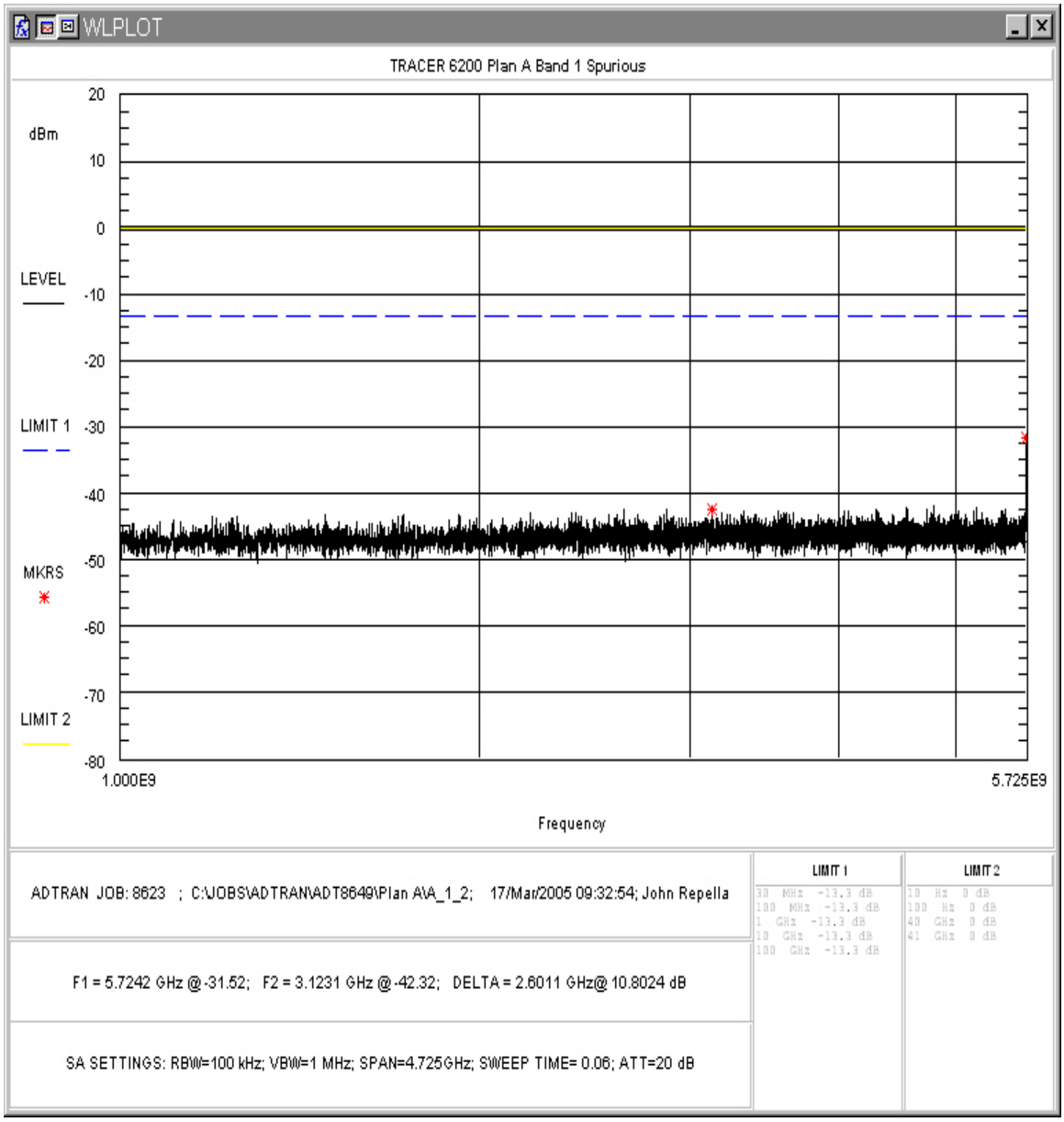

Figure 11. Conducted Spurious Emissions, Plan A Band 1, 1GHz – 5.725GHz

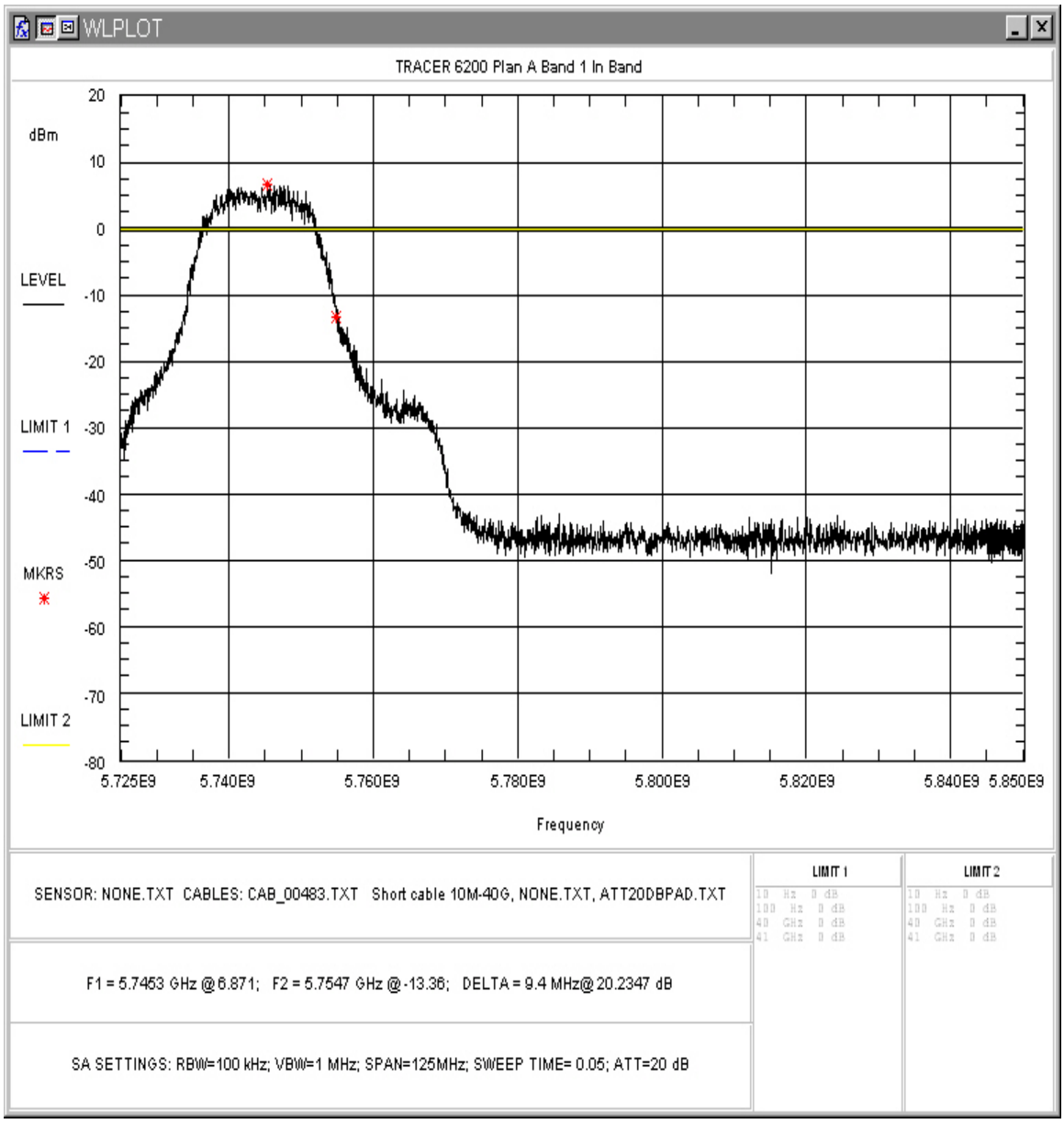

Figure 12. Conducted Spurious Emissions, Plan A Band 1, 5.725 - 5.85GHz, In-band

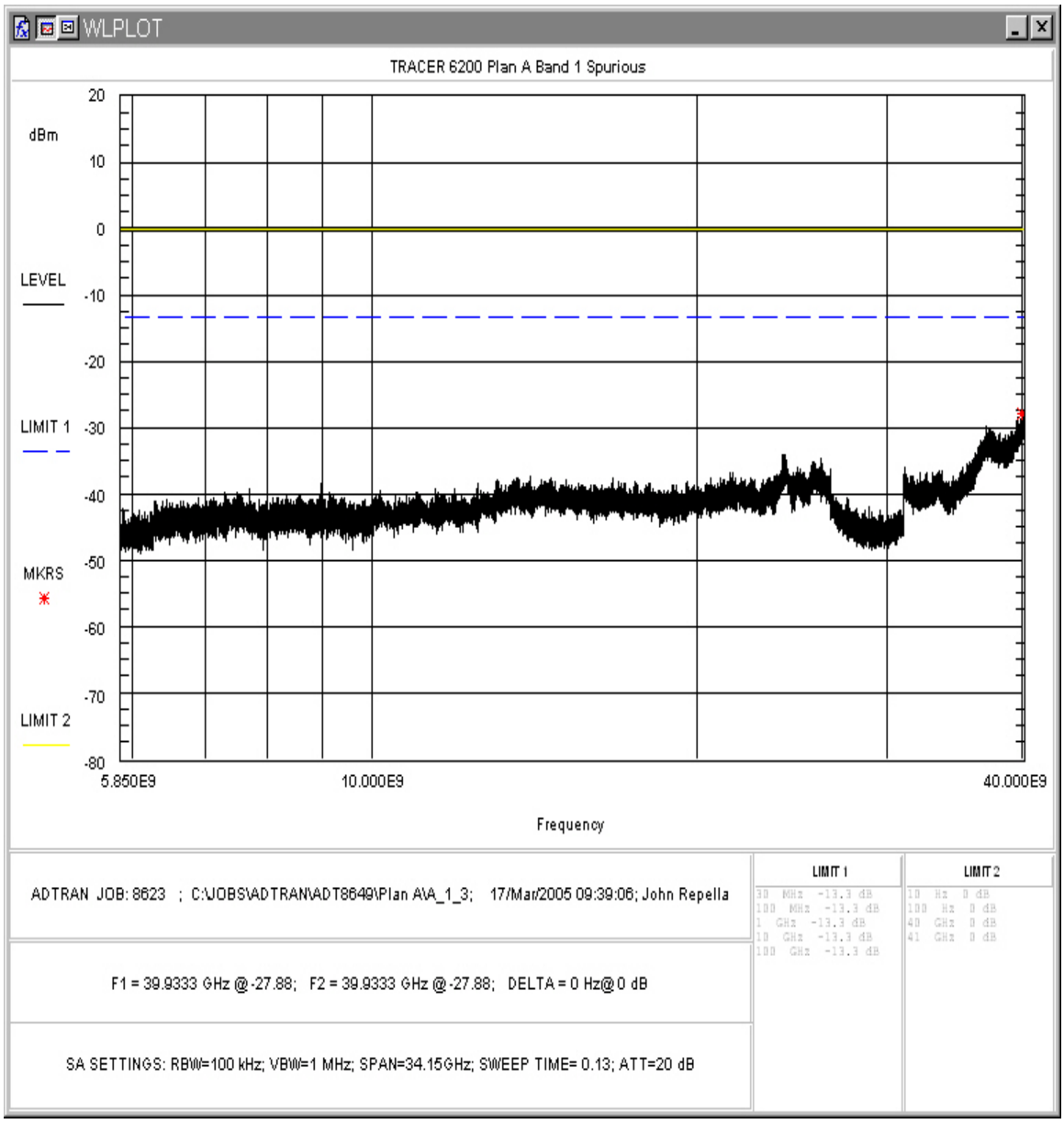

Figure 13. Conducted Spurious Emissions, Plan A Band 1, 5.85 – 40GHz

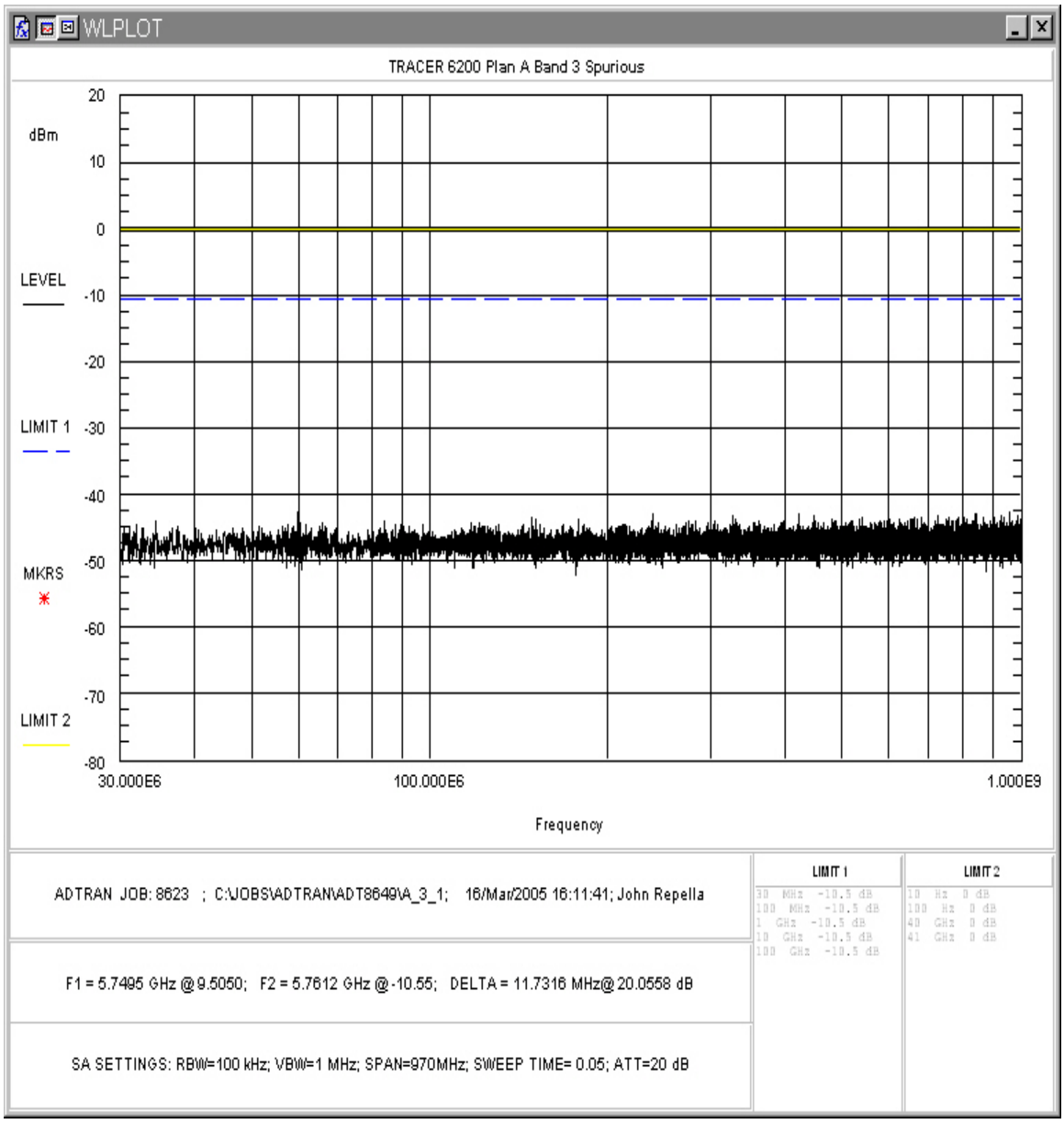

Figure 14. Conducted Spurious Emissions, Plan A Band 3, 30MHz – 1GHz

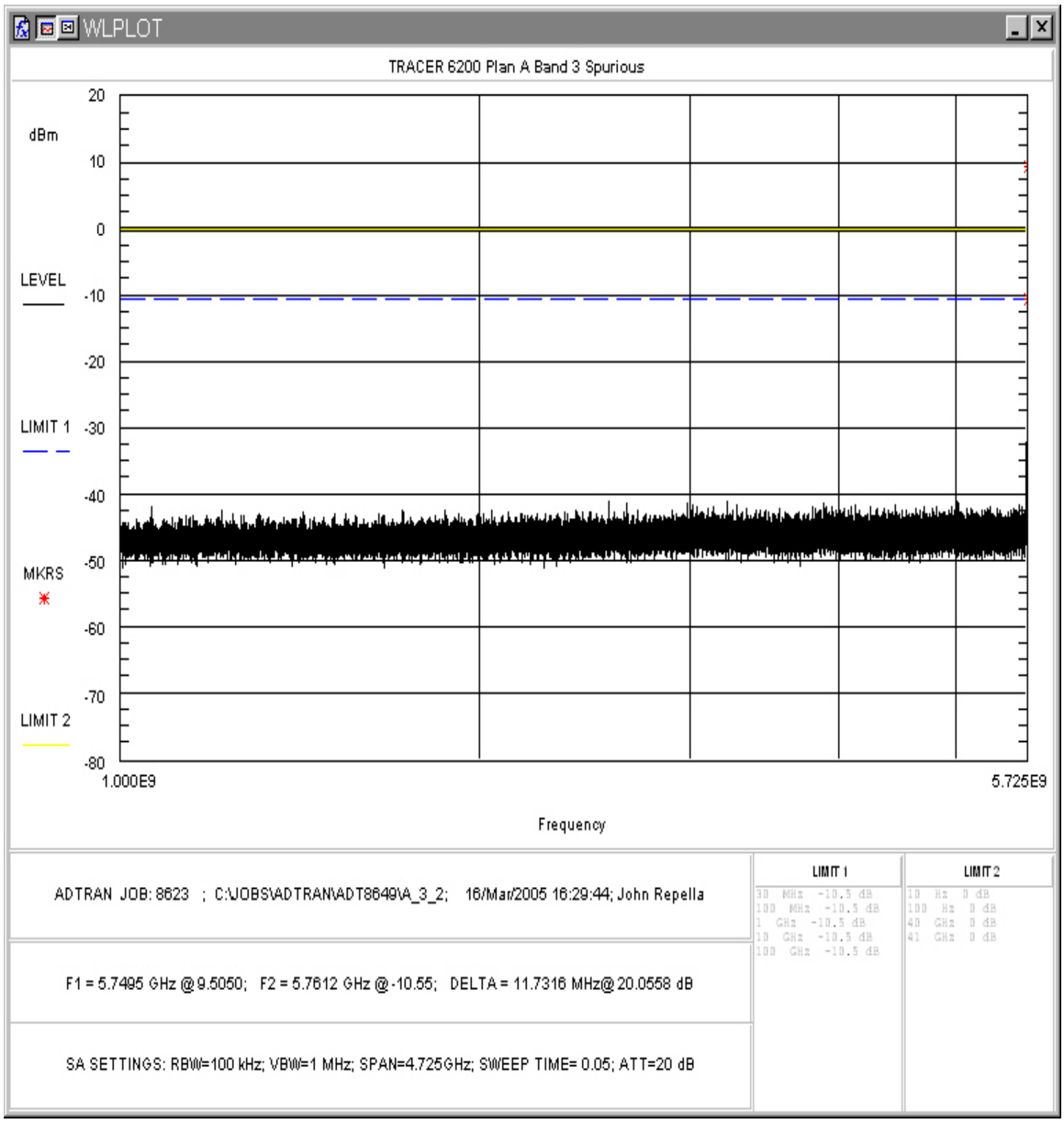

Figure 15. Conducted Spurious Emissions, Plan A Band 3, 1GHz - 5.725GHz

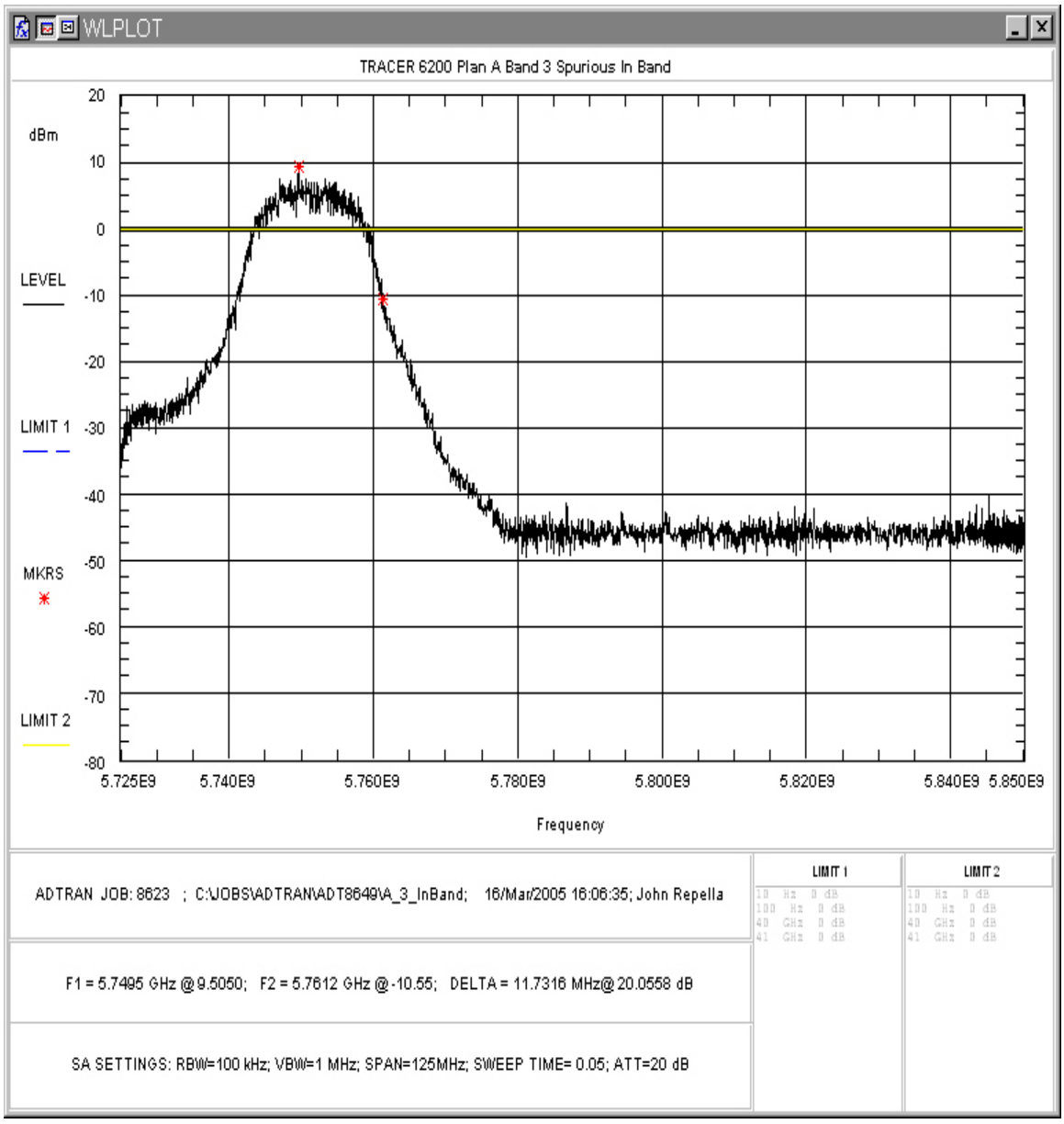

Figure 16. Conducted Spurious Emissions, Plan A Band 3, 5.725 - 5.85GHz, In-band

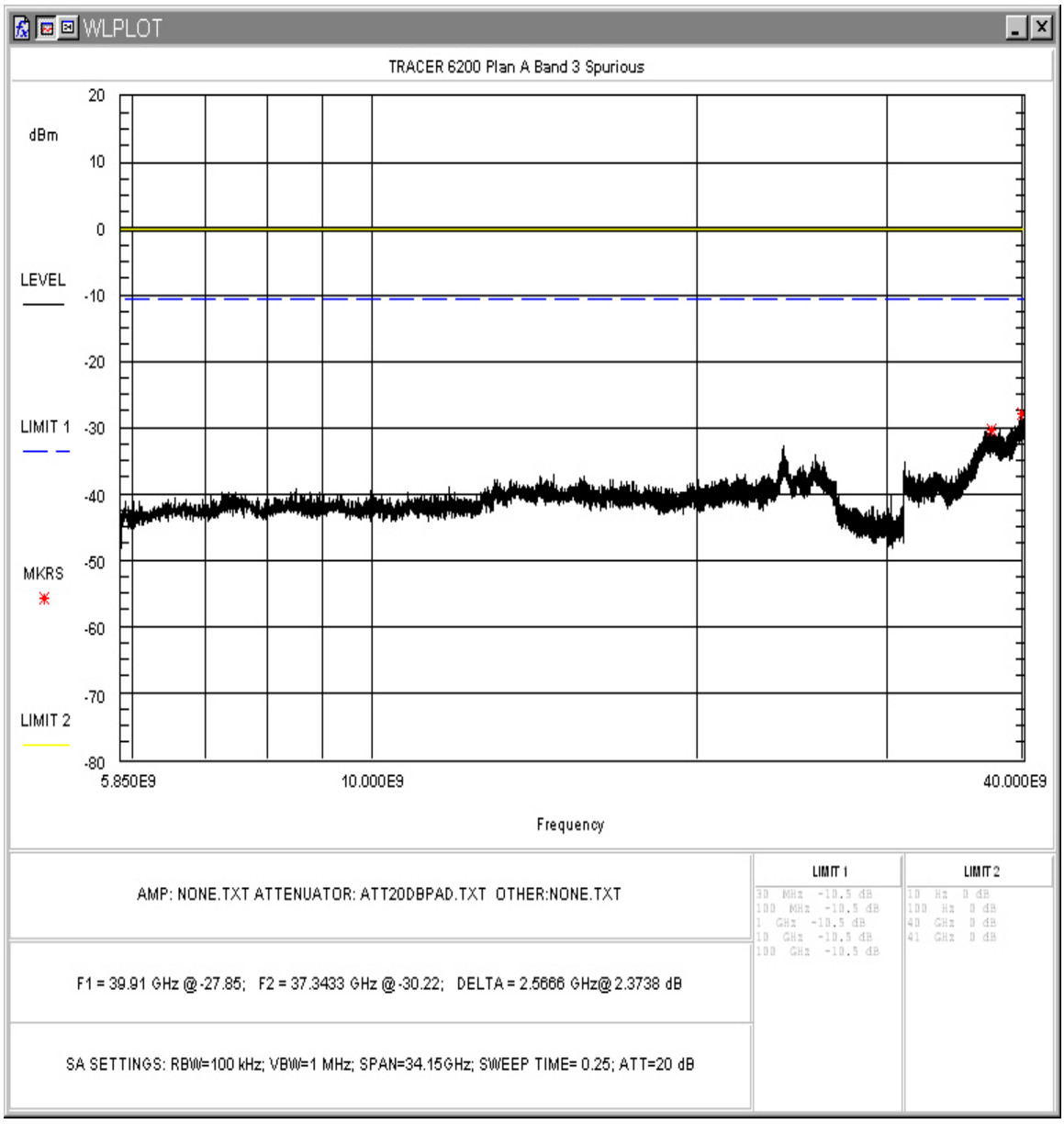

Figure 17. Conducted Spurious Emissions, Plan A Band 3, 5.85GHz - 40GHz

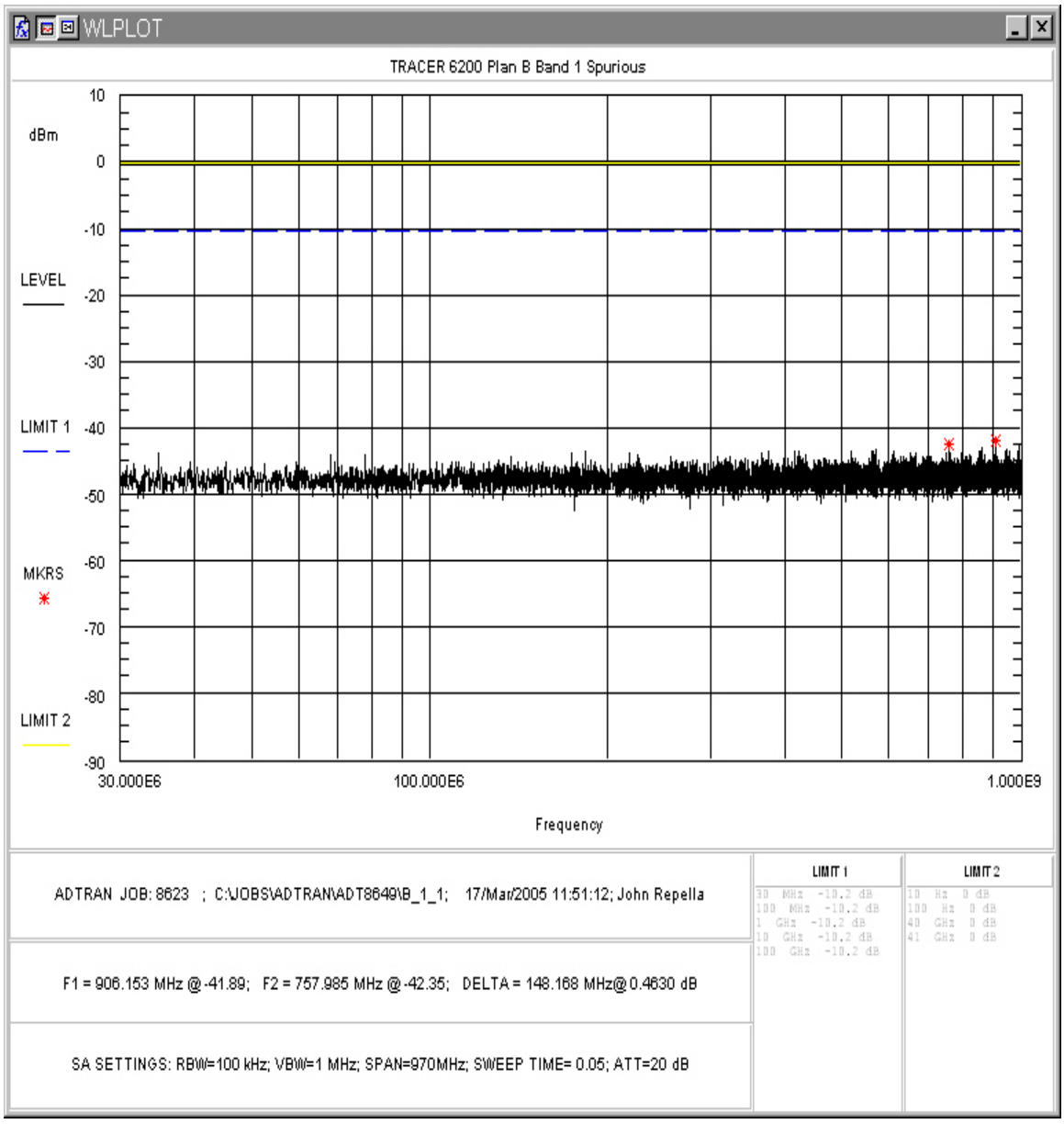

Figure 18. Conducted Spurious Emissions, Plan B Band 1, 30MHz - 1GHz

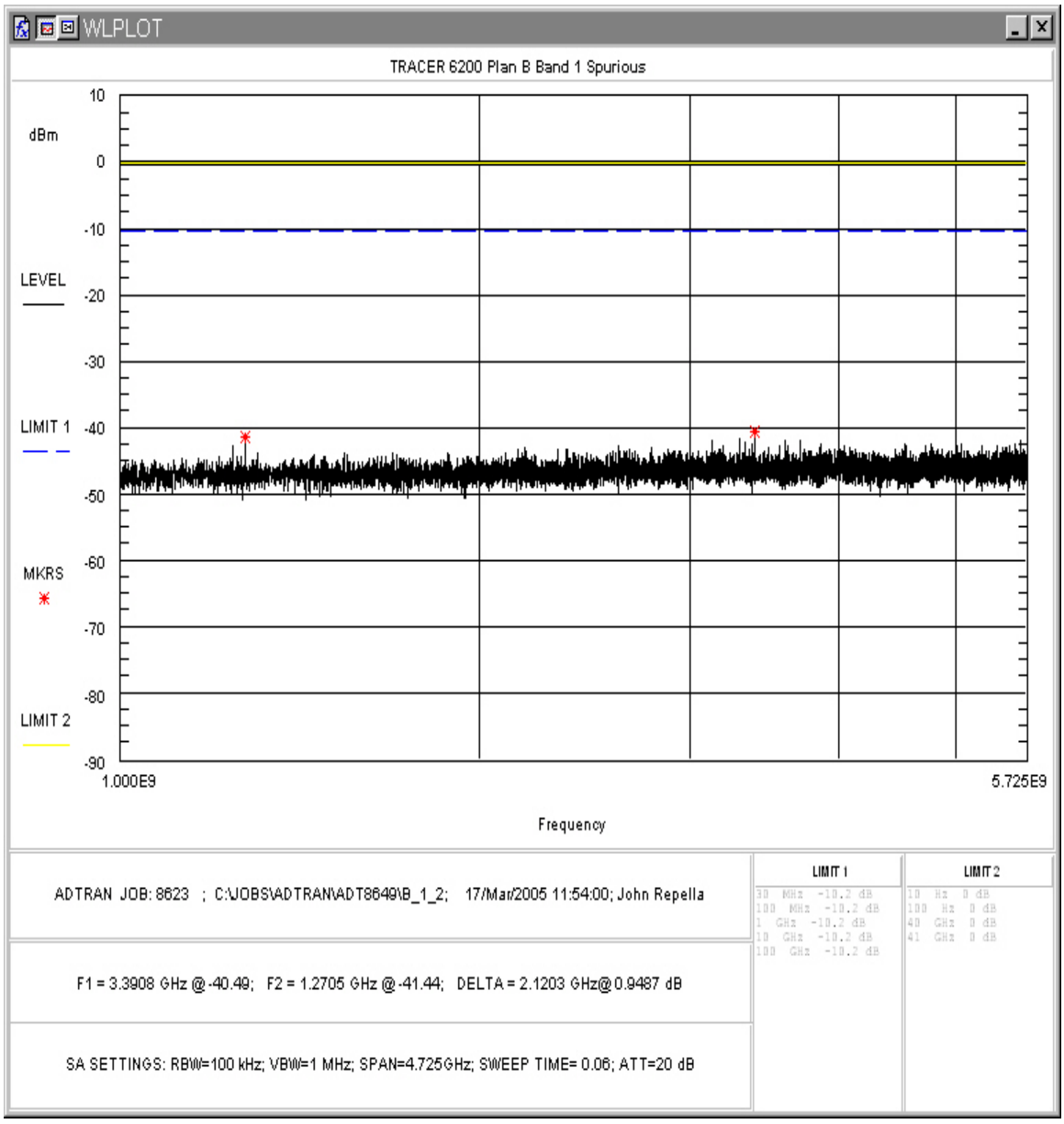

Figure 19. Conducted Spurious Emissions, Plan B Band 1, 1GHz - 5.725GHz

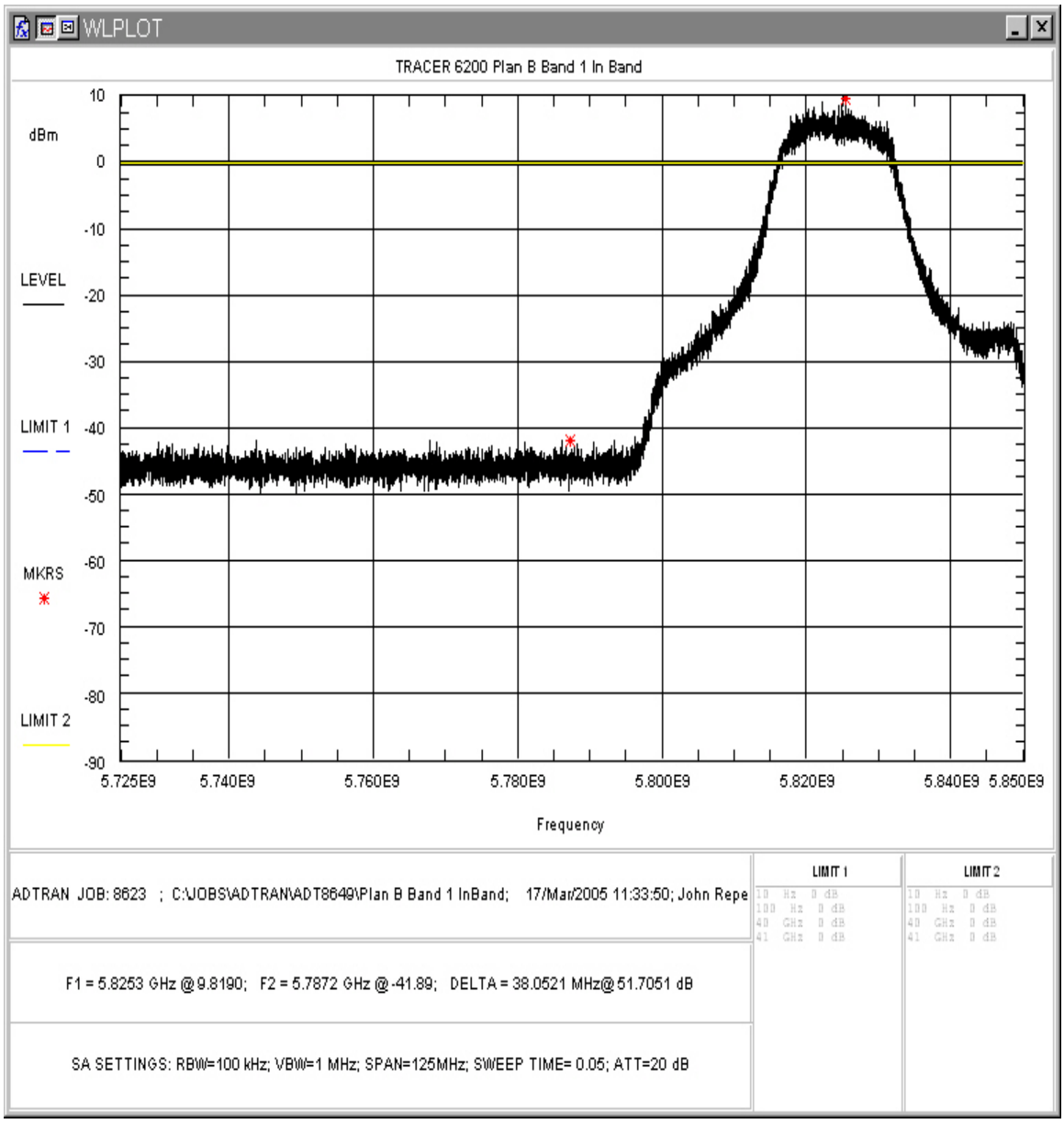

Figure 20. Conducted Spurious Emissions, Plan B Band 1, 5.725 - 5.85GHz, In-band

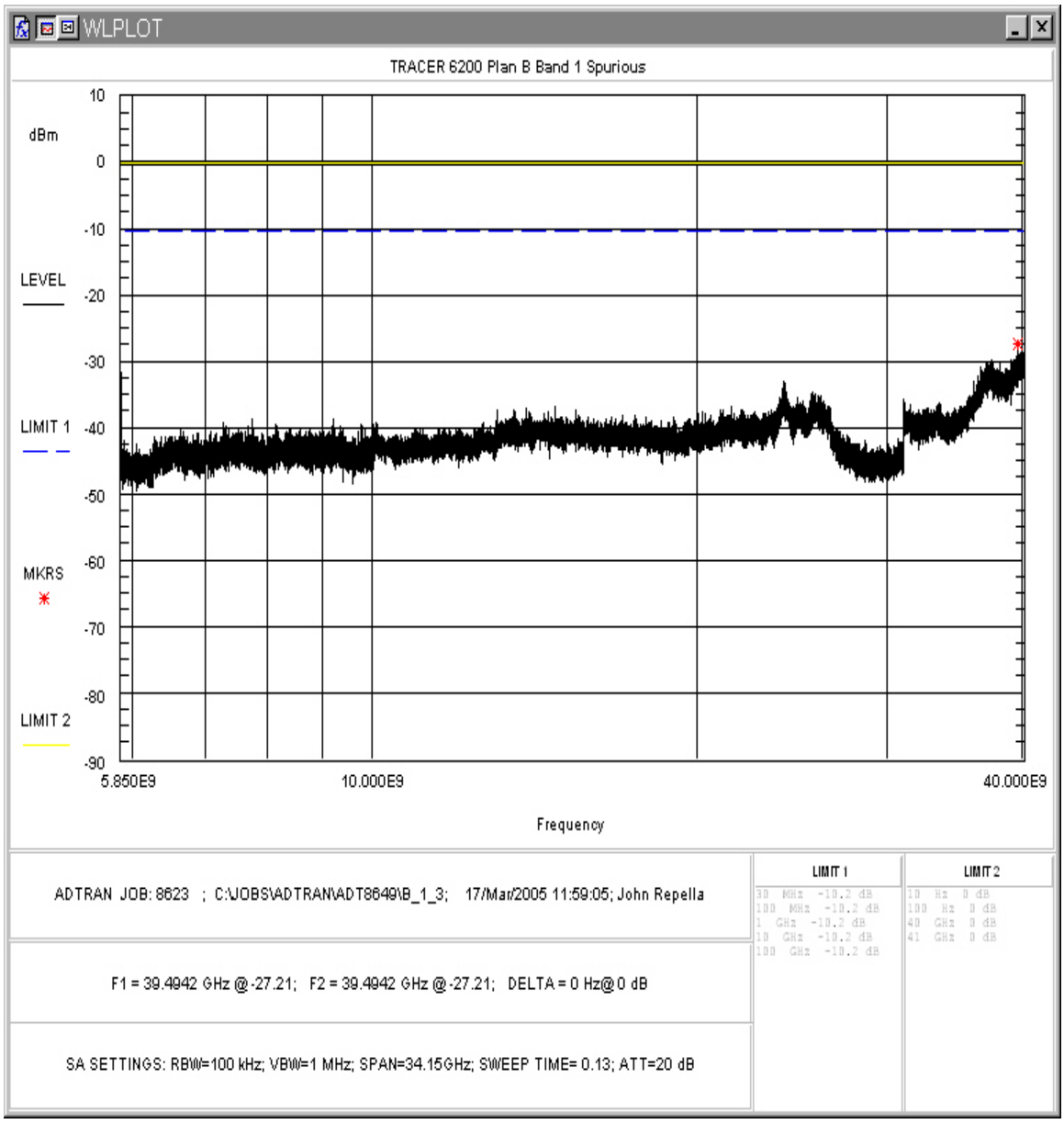

Figure 21. Conducted Spurious Emissions, Plan B Band 1, 5.85GHz - 40GHz

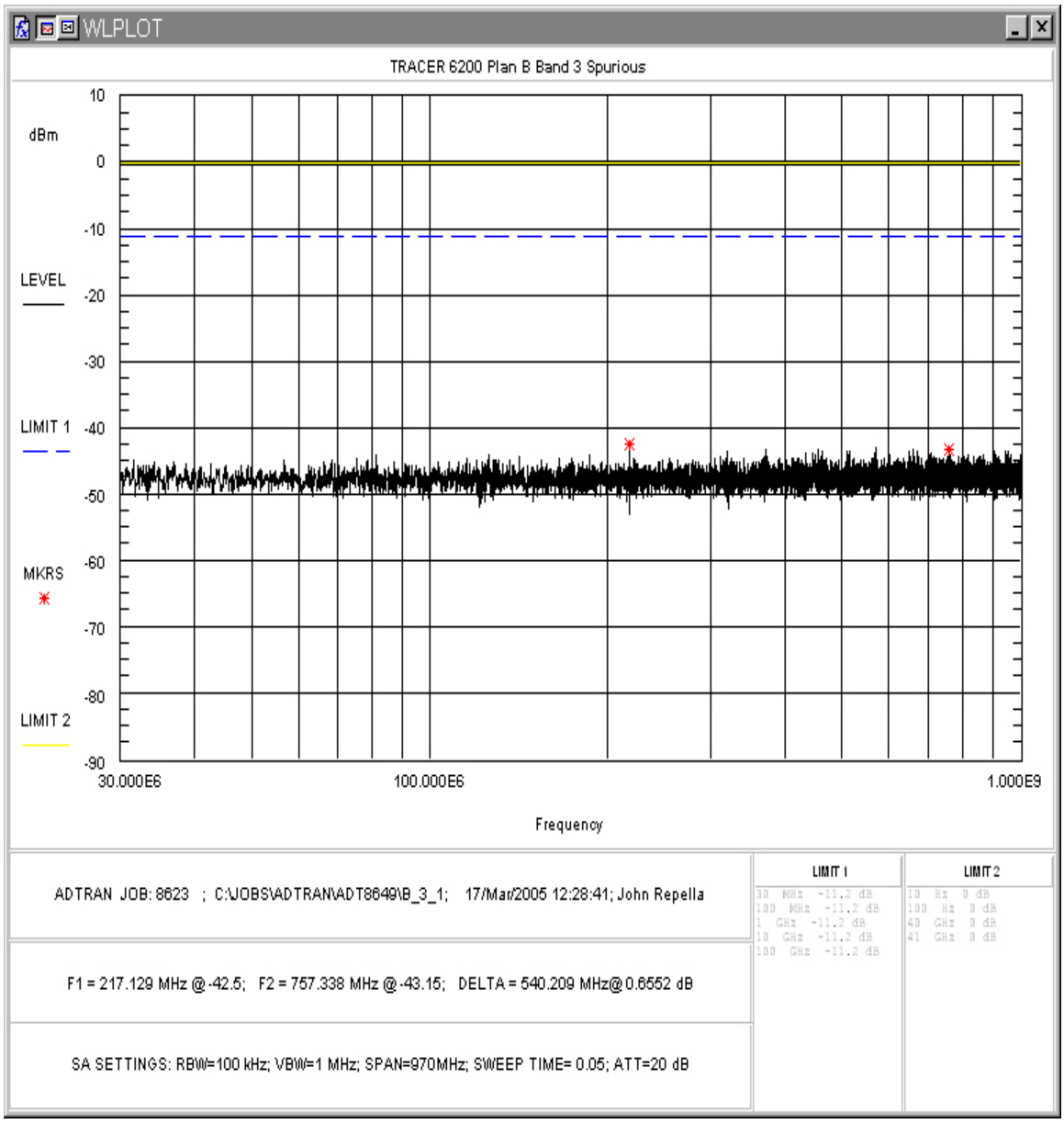

Figure 22. Conducted Spurious Emissions, Plan B Band 3, 30MHz - 1GHz

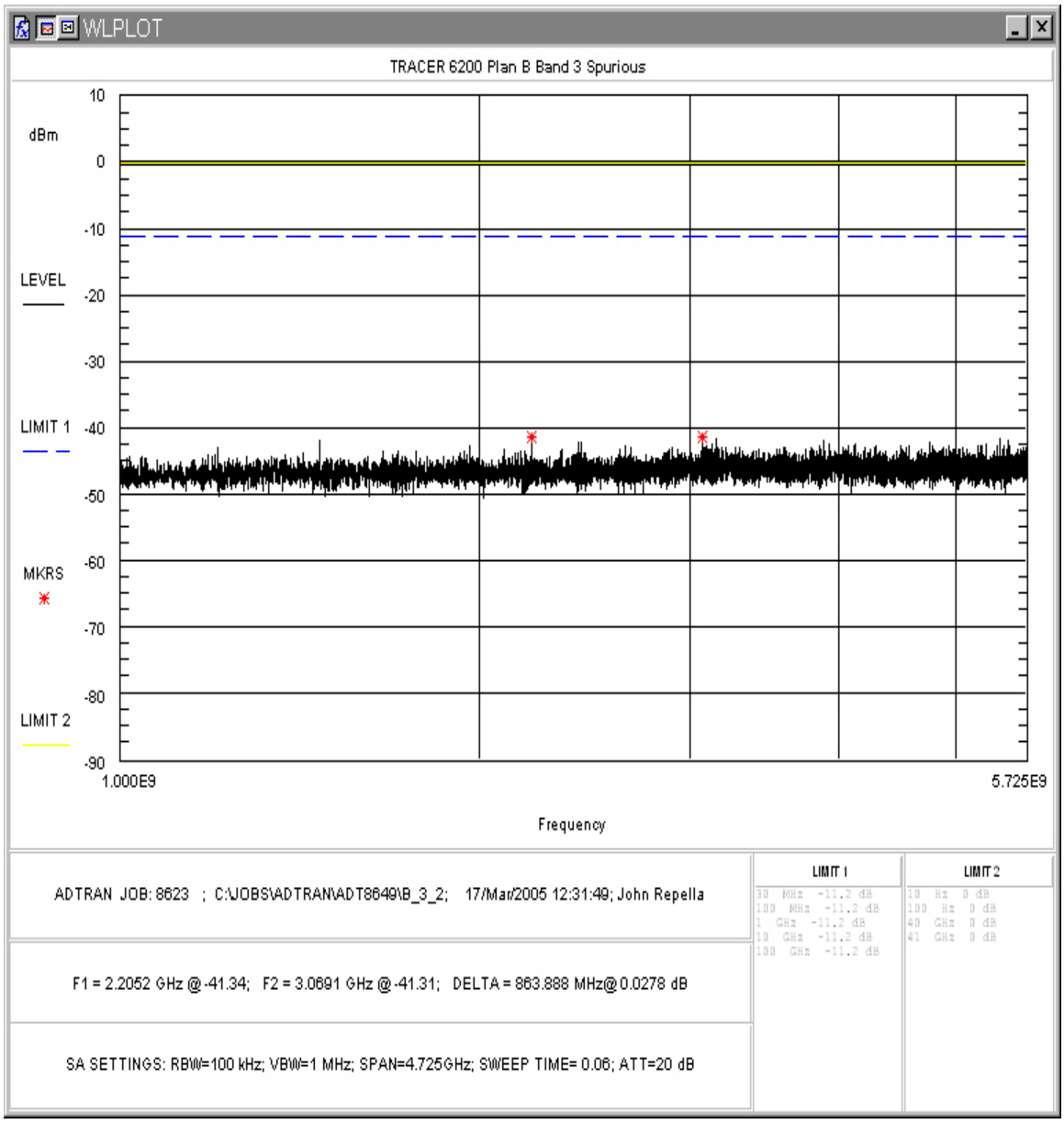

Figure 23. Conducted Spurious Emissions, Plan B Band 3, 1GHz - 5.725GHz

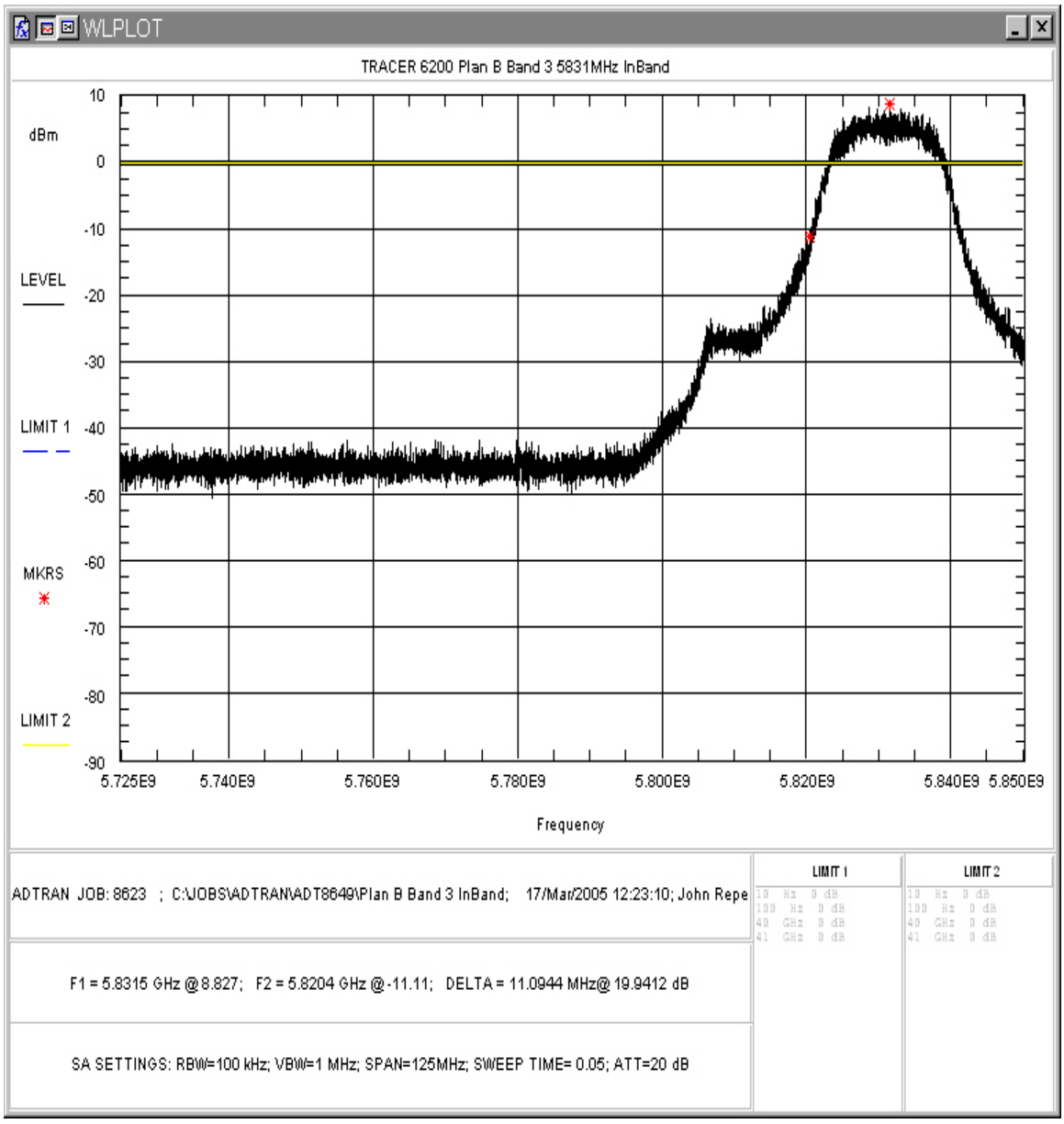

Figure 24. Conducted Spurious Emissions, Plan B Band 3, 5.725 - 5.85GHz, In-band

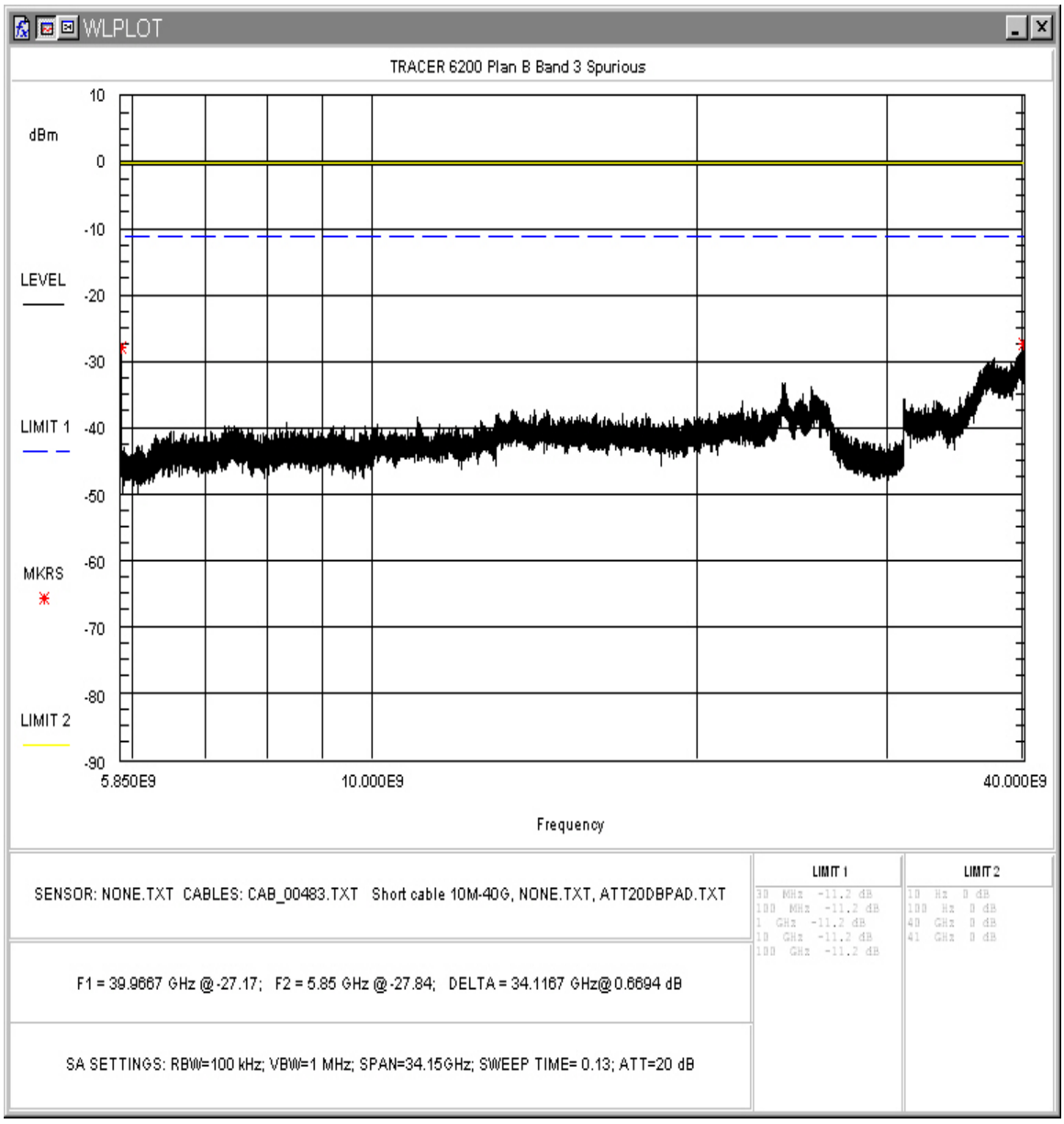

Figure 25. Conducted Spurious Emissions, Plan B Band 3, 5.85GHz – 40GHz

4.5 Radiated Spurious Emissions: (FCC Part §15.247(c))

Radiated emissions that fall in the restricted bands must comply with the general emissions limits in 15.209(a).

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>30 kHz
>1000 MHz	1 MHz	<30 Hz (Avg.) 1MHz (Peak)

Harmonic and Spurious emissions that were identified as coming from the EUT were checked in Peak and in Average Mode. It was verified that the peak-to-average ratio did not exceed 20dB.

Peak measurements and average measurements are made. All emissions were determined to have a peak-to-average ratio of less than 20 dB.

4.5.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

For the 10’ dish antenna the antenna and TRACER 6320 were placed in the parking lot of Washington Laboratories at a location that allowed a clear 10m path to the receive antenna. The EUT was configured with an external power adapter to provide 48Vdc. Cables with loopback connections were connected to the I/O ports. The RF output port was connected to the input of the dish antenna.

The EUT was setup for a continuous transmission at the maximum data rate and output power. Both Plan A lower frequency (5.744GHz) and Plan B upper frequency (5.831GHz) were evaluated.

The EUT was tested in the following configurations and modes:

Antenna	Channel
Dish	A&B

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level):	V dBμV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Amplifier Gain:	GdB
Electric Field (Corr Level):	EdBμV/m = VdBμV + AFdB/m + CCdB - GdB
To convert to linear units:	EμV/m = antilog (EdBμV/m/20)

Data are supplied in the following tables. Testing was performed to 40GHz. No emissions were detected above 12GHz. All detected emissions are reported in the following tables. Both peak and average measurements are listed.

Table 6: Radiated Emission Test Data - Plan A, Band 1

28.5dBi Antenna

Restricted Band Spurious Emissions (§15.205)

CLIENT:	Adtran	DATE:	3/21/2005
TESTER:	James Ritter	JOB #:	8649
EUT Information:		**Test Requirements:**	
EUT:	Tracer 6320	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Plan A Chan 1 @ 5744MHz	DISTANCE:	3m
CLASS:	B		
Test Equipment/Limit:			
ANTENNA:	A_00425	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00066

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB	Notes
				AVG								
1100.700	H	270.0	1.0	37.0	25.7	1.4	36.3	27.8	24.4	500.0	-26.2	
1160.070	H	270.0	1.0	51.3	26.0	1.6	36.3	42.7	135.7	500.0	-11.3	
1200.000	H	190.0	1.0	45.3	26.2	1.7	36.2	37.0	70.9	500.0	-17.0	
1359.170	H	180.0	1.0	39.3	26.9	2.1	36.0	32.3	41.4	500.0	-21.6	
1603.200	H	90.0	1.0	37.0	27.9	2.7	35.8	31.8	38.9	500.0	-22.2	
11489.000	H	0.0	1.0	34.3	40.8	5.0	35.6	44.5	168.4	500.0	-9.5	Amb
1100.700	V	180.0	1.0	37.3	25.7	1.4	36.3	28.1	25.3	500.0	-25.9	
1160.070	V	180.0	1.0	49.6	26.0	1.6	36.3	40.9	111.2	500.0	-13.1	
1200.000	V	190.0	1.0	46.0	26.2	1.7	36.2	37.7	76.6	500.0	-16.3	
1359.170	V	180.0	1.0	39.0	26.9	2.1	36.0	32.0	39.9	500.0	-22.0	
1603.200	V	120.0	1.0	38.0	27.9	2.7	35.8	32.8	43.6	500.0	-21.2	
11489.000	V	0.0	1.0	34.4	40.8	5.0	35.6	44.6	169.7	500.0	-9.4	Amb
				PEAK								
1100.700	H	270.0	1.0	41.1	25.7	1.4	36.3	31.9	39.2	5000.0	-42.1	
1160.070	H	270.0	1.0	54.0	26.0	1.6	36.3	45.3	184.5	5000.0	-28.7	
1200.000	H	190.0	1.0	50.0	26.2	1.7	36.2	41.7	121.4	5000.0	-32.3	
1359.170	H	180.0	1.0	44.0	26.9	2.1	36.0	37.0	71.0	5000.0	-37.0	
1603.200	H	90.0	1.0	49.0	27.9	2.7	35.8	43.8	154.7	5000.0	-30.2	
11488.000	H	0.0	1.0	44.6	40.8	5.0	35.6	54.8	549.1	5000.0	-19.2	Amb
1100.700	V	180.0	1.0	42.0	25.7	1.4	36.3	32.8	43.4	5000.0	-41.2	
1160.070	V	180.0	1.0	55.0	26.0	1.6	36.3	46.3	207.1	5000.0	-27.7	
1200.000	V	190.0	1.0	50.3	26.2	1.7	36.2	42.0	125.7	5000.0	-32.0	
1359.170	V	180.0	1.0	42.2	26.9	2.1	36.0	35.2	57.7	5000.0	-38.8	
1603.200	V	120.0	1.0	48.2	27.9	2.7	35.8	43.0	141.1	5000.0	-31.0	
11488.000	V	0.0	1.0	44.4	40.8	5.0	35.6	54.6	536.6	5000.0	-19.4	Amb

Table 7: Radiated Emission Test Data - Plan A, Band 3

28.5dBi Antenna

Restricted Band Spurious Emissions (§15.205)

CLIENT:	Adtran	DATE:	3/21/2005
TESTER:	James Ritter	JOB #:	8649
EUT Information:		**Test Requirements:**	
EUT:	Tracer 6320	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Plan A Chan 3 @ 5751MHz	DISTANCE:	3m
CLASS:	B		
Test Equipment/Limit:			
ANTENNA:	A_00425	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00066

Frequency (MHz)	Polarity H/V	Az Dege	Ant. Hght (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB	Notes
				AVG								
1100.700	H	280.0	1.0	38.0	25.7	1.4	36.3	28.8	27.4	500.0	-25.2	
1160.070	H	270.0	1.0	50.6	26.0	1.6	36.3	41.9	124.8	500.0	-12.1	
1200.000	H	190.0	1.0	43.2	26.2	1.7	36.2	34.9	55.5	500.0	-19.1	
1359.170	H	180.0	1.0	40.0	26.9	2.1	36.0	33.0	44.8	500.0	-21.0	
1603.200	H	90.0	1.0	37.8	27.9	2.7	35.8	32.6	42.8	500.0	-21.4	
11502.000	H	0.0	1.0	33.8	40.9	5.0	35.6	44.0	159.2	500.0	-9.9	Amb
1100.700	V	270.0	1.0	37.6	25.7	1.4	36.3	28.4	26.2	500.0	-25.6	
1160.070	V	190.0	1.0	48.3	26.0	1.6	36.3	39.6	95.7	500.0	-14.4	
1200.000	V	180.0	1.0	41.0	26.2	1.7	36.2	32.7	43.1	500.0	-21.3	
1359.170	V	190.0	1.0	38.2	26.9	2.1	36.0	31.2	36.4	500.0	-22.8	
1603.200	V	100.0	1.0	35.8	27.9	2.7	35.8	30.6	33.8	500.0	-23.4	
11502.000	V	0.0	1.0	34.0	40.9	5.0	35.6	44.2	162.4	500.0	-9.8	Amb
				PEAK								
1100.700	H	280.0	1.0	42.0	25.7	1.4	36.3	32.8	43.4	5000.0	-41.2	
1160.070	H	270.0	1.0	54.0	26.0	1.6	36.3	45.3	184.5	5000.0	-28.7	
1200.000	H	190.0	1.0	48.5	26.2	1.7	36.2	40.2	102.1	5000.0	-33.8	
1359.170	H	180.0	1.0	46.3	26.9	2.1	36.0	39.3	92.8	5000.0	-34.6	
1603.200	H	90.0	1.0	51.5	27.9	2.7	35.8	46.3	206.3	5000.0	-27.7	
11502.000	H	0.0	1.0	44.3	40.9	5.0	35.6	54.5	533.3	5000.0	-19.4	Amb
1100.700	V	270.0	1.0	41.0	25.7	1.4	36.3	31.8	38.7	5000.0	-42.2	
1160.070	V	190.0	1.0	52.2	26.0	1.6	36.3	43.5	150.0	5000.0	-30.5	
1200.000	V	180.0	1.0	48.0	26.2	1.7	36.2	39.7	96.4	5000.0	-34.3	
1359.170	V	190.0	1.0	41.0	26.9	2.1	36.0	34.0	50.2	5000.0	-40.0	
1603.200	V	100.0	1.0	48.3	27.9	2.7	35.8	43.1	142.7	5000.0	-30.9	
11502.000	V	0.0	1.0	44.0	40.9	5.0	35.6	54.2	513.4	5000.0	-19.8	Amb

Table 8: Radiated Emission Test Data - Plan B, Band 1

28.5dBi Antenna

Restricted Band Spurious Emissions (§15.205)

CLIENT:	ADTRAN	DATE:	3/21/2005
TESTER:	James Ritter	JOB #:	8588
EUT Information:		**Test Requirements:**	
EUT:	Tracer 6320	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Plan B, Band 1, 5824MHz		
DISTANCE:	3m	CLASS:	B
Test Equipment/Limit:			
ANTENNA:	A_00004	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00312

Freq (MHz)	Pol H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB	Notes
				AVG								
1104.500	H	190.0	1.0	36.5	25.7	1.4	36.3	27.3	23.2	500.0	-26.7	
1120.000	H	270.0	1.0	39.7	25.8	1.5	36.3	30.6	34.1	500.0	-23.3	
1160.090	H	100.0	1.0	48.9	26.0	1.6	36.3	40.2	102.6	500.0	-13.8	
1200.010	H	90.0	1.0	36.7	26.2	1.7	36.2	28.4	26.2	500.0	-25.6	
1320.170	H	45.0	1.0	37.0	26.7	2.0	36.1	29.7	30.6	500.0	-24.3	
11649.000	H	0.0	1.0	35.3	41.1	5.0	35.7	45.7	192.1	500.0	-8.3	
17472.000	H	0.0	1.0	34.2	41.3	9.0	35.0	49.4	296.7	500.0	-4.5	Amb
1104.500	V	180.0	1.0	36.1	25.7	1.4	36.3	26.9	22.1	500.0	-27.1	
1120.000	V	190.0	1.0	38.3	25.8	1.5	36.3	29.2	29.0	500.0	-24.7	
1160.090	V	180.0	1.0	49.3	26.0	1.6	36.3	40.7	107.8	500.0	-13.3	
1200.010	V	190.0	1.0	36.8	26.2	1.7	36.2	28.5	26.6	500.0	-25.5	
1320.170	V	180.0	1.0	41.1	26.7	2.0	36.1	33.8	49.0	500.0	-20.2	
				PEAK								
1104.500	H	190.0	1.0	51.3	25.7	1.4	36.3	42.1	127.7	5000.0	-31.9	
1120.000	H	270.0	1.0	53.0	25.8	1.5	36.3	43.9	157.5	5000.0	-30.0	
1160.090	H	100.0	1.0	58.5	26.0	1.6	36.3	49.8	309.8	5000.0	-24.2	
1200.010	H	90.0	1.0	47.0	26.2	1.7	36.2	38.7	85.9	5000.0	-35.3	
1320.170	H	45.0	1.0	44.4	26.7	2.0	36.1	37.1	71.7	5000.0	-36.9	
11649.000	H	0.0	1.0	42.0	41.1	5.0	35.7	52.4	415.5	5000.0	-21.6	
17472.000	H	0.0	1.0	47.0	41.3	9.0	35.0	62.2	1295.2	5000.0	-11.7	Amb
1104.500	V	180.0	1.0	46.7	25.7	1.4	36.3	37.5	74.7	5000.0	-36.5	
1120.000	V	190.0	1.0	48.1	25.8	1.5	36.3	39.0	89.6	5000.0	-34.9	
1160.090	V	180.0	1.0	52.7	26.0	1.6	36.3	44.0	158.3	5000.0	-30.0	
1200.010	V	190.0	1.0	58.2	26.2	1.7	36.2	49.9	311.0	5000.0	-24.1	
1320.170	V	180.0	1.0	49.8	26.7	2.0	36.1	42.5	133.5	5000.0	-31.5	

Table 9: Radiated Emission Test Data - Plan B, Band 3

28.5dBi Antenna

Restricted Band Spurious Emissions (§15.205)

CLIENT:	ADTRAN	DATE:	3/21/2005
TESTER:	Steve Koster	JOB #:	8588
EUT Information:		**Test Requirements:**	
EUT:	Tracer 6320	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Plan B, Band 1, 5831MHz		
DISTANCE:	3m	CLASS:	B
Test Equipment/Limit:			
ANTENNA:	A_00004	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE2_HF	AMPLIFIER (dB)	A_00312

Freq (MHz)	Pol H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB	Notes
				AVG								
1104.500	H	180.0	1.0	36.2	25.7	1.4	36.3	27.0	22.4	500.0	-27.0	
1120.000	H	270.0	1.0	40.0	25.8	1.5	36.3	30.9	35.3	500.0	-23.0	
1160.090	H	100.0	1.0	47.2	26.0	1.6	36.3	38.5	84.4	500.0	-15.5	
1200.010	H	190.0	1.0	42.2	26.2	1.7	36.2	33.9	49.5	500.0	-20.1	
1320.170	H	45.0	1.0	38.1	26.7	2.0	36.1	30.8	34.7	500.0	-23.2	
1359.070	H	90.0	1.0	38.3	26.9	2.1	36.0	31.3	36.9	500.0	-22.6	
11661.930	H	0.0	1.0	33.5	41.1	5.0	35.7	43.9	156.4	500.0	-10.1	Amb
1104.500	V	180.0	1.0	36.2	25.7	1.4	36.3	27.0	22.4	500.0	-27.0	
1120.000	V	190.0	1.0	36.5	25.8	1.5	36.3	27.4	23.6	500.0	-26.5	
1160.090	V	180.0	1.0	48.3	26.0	1.6	36.3	39.6	95.7	500.0	-14.4	
1200.010	V	190.0	1.0	37.0	26.2	1.7	36.2	28.7	27.2	500.0	-25.3	
1320.170	V	180.0	1.0	40.0	26.7	2.0	36.1	32.7	43.2	500.0	-21.3	
11649.000	V	180.0	1.0	34.2	41.1	5.0	35.7	44.6	169.3	500.0	-9.4	Amb
				PEAK								
1104.500	H	180.0	1.0	51.0	25.7	1.4	36.3	41.8	123.0	5000.0	-32.2	
1120.000	H	270.0	1.0	53.2	25.8	1.5	36.3	44.1	161.2	5000.0	-29.8	
1160.090	H	100.0	1.0	58.0	26.0	1.6	36.3	49.3	292.5	5000.0	-24.7	
1200.010	H	190.0	1.0	55.2	26.2	1.7	36.2	46.8	219.6	5000.0	-27.1	
1320.170	H	45.0	1.0	44.0	26.7	2.0	36.1	36.7	68.4	5000.0	-37.3	
1359.070	H	90.0	1.0	44.8	26.9	2.1	36.0	37.8	77.8	5000.0	-36.2	
11661.930	H	0.0	1.0	41.5	41.1	5.0	35.7	51.9	392.9	5000.0	-22.1	Amb
1104.500	V	180.0	1.0	46.0	25.7	1.4	36.3	36.8	69.1	5000.0	-37.2	
1120.000	V	190.0	1.0	47.2	25.8	1.5	36.3	38.1	80.8	5000.0	-35.8	
1160.090	V	180.0	1.0	53.0	26.0	1.6	36.3	44.3	164.5	5000.0	-29.7	
1200.010	V	190.0	1.0	56.1	26.2	1.7	36.2	47.8	245.0	5000.0	-26.2	
1320.170	V	180.0	1.0	47.2	26.7	2.0	36.1	39.9	98.9	5000.0	-34.1	
11649.000	V	180.0	1.0	42.0	41.1	5.0	35.7	52.4	415.5	5000.0	-21.6	Amb

4.5.2 Test Procedure for 10' Dish Antenna

Guidance provided by the FCC on measurements of the 10' dish antenna was used for performing these measurements. A copy of the e-mail providing the guidance follows the test data.

A receive antenna was placed 10m from the EUT antenna. As the EUT antenna is very large it was determined that maximum emissions would be best detected by moving the receive antenna around.

Maximum emissions were found at the bore sight of the antenna. Both the horizontal and vertical field components were measured. The restricted bands were scanned for spurious emissions. Additionally, the band edge emissions were measured although they do not fall within a restricted band.

All data collected was interpolated to 3m. The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level):	V dBμV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Amplifier Gain:	GdB
Distance Correction Factor:	20*LOG(10/3) = 10.45dB
Electric Field (Corr Level):	EdBμV/m = VdBμV + AFdB/m + CCdB – GdB+10.45dB
To convert to linear units:	EμV/m = antilog (EdBμV/m/20)

4.5.3 Test results

Data are supplied in the following table. Testing was performed to 40GHz. No emissions were detected above 12GHz. All detected emissions are reported in the following tables. Note that bandedge tests were performed here for informational purposes only. These do not fall within the restricted bands. The measurements were made to show the 20dBc requirement is met although this was done at the antenna terminal.

Table 10: Radiated Emission Test Data – 10 Foot Dish Antenna

Restricted Band Spurious Emissions (§15.205)

CLIENT:	ADTRAN	DATE:	3/24/2005
TESTER:	Greg Snyder	JOB #:	8650

EUT Information: **Test Requirements:**

EUT:	Tracer 6320 w/10'Dish	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Transmitting on Plan B, Band 3, 5.831GHz		
DISTANCE:	10m	CLASS:	B

Test Equipment/Limit:

ANTENNA:	00425	LIMIT:	LFCC_3m_Class_B
CABLE:	Assem#1	AMPLIFIER (dB)	A_00066

Plan B, Band 3: Tx = 5831MHz

Freq (MHz)	Pol H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Distance Corr.	Amp Gain (dB)	Corr. Level dBµV/m	Corr. Level µV/m	Limit (µV/m)	Margin dB	Notes
				Avg.									
1160.09	V	0	1.8	30.6	26.0	2.3	10.5	36.3	33.1	45.3	500.0	-20.9	
1320.17	H	0	1.8	28.9	26.7	2.3	10.5	36.1	32.4	41.6	500.0	-21.6	
1320.17	V	0	1.8	30.1	26.7	2.3	10.5	36.1	33.6	47.7	500.0	-20.4	
5831.00	H	0.0	1.5	80.4	35.0	1.3	10.5	0.0	127.2	2292915.7	N/A	N/A	Avg
5831.00	V	0.0	1.5	67.3	35.0	1.3	10.5	0.0	114.1	507444.0	N/A	N/A	Avg
11662.00	H	0.0	1.5	31.9	41.1	2.3	10.5	35.7	50.1	319.0	500.0	-3.9	NF
11662.00	V	0.0	1.5	32.0	41.1	2.3	10.5	35.7	50.2	322.7	500.0	-3.8	NF
				Peak									
1160.09	V	0	1.8	42.8	26.0	2.3	10.5	36.3	45.3	184.6	5000.0	-28.7	
1320.17	H	0	1.8	40.6	26.7	2.3	10.5	36.1	44.1	159.8	5000.0	-29.9	
1320.17	V	0	1.8	44.2	26.7	1.3	10.5	36.1	46.7	216.6	5000.0	-27.3	
5831.00	H	0.0	1.5	89.6	35.0	1.3	10.5	0.0	136.4	6612841.1	N/A	N/A	Peak
5831.00	V	0.0	1.5	73.2	35.0	1.3	10.5	0.0	120.0	1000894.0	N/A	N/A	Peak
5850.00	H	0.0	1.5	46.6	35.0	1.3	10.5	0.0	93.4	46944.6	661284.1	-23.0	20dBc
5850.00	V	0.0	1.5	34.2	35.0	1.3	10.5	0.0	81.0	11261.2	100089.4	-19.0	20dBc
11662.00	V	0.0	1.5	43.8	41.1	2.3	10.5	35.7	62.0	1255.4	5000.0	-12.0	NF
11662.00	H	0.0	1.5	43.8	41.1	2.3	10.5	35.7	62.0	1255.4	5000.0	-12.0	NF

NF = Noise Floor; No detectable signal

Plan A, Band 1: Tx = 5744MHz

Freq (MHz)	Pol H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Distance Corr.	Amp Gain (dB)	Corr. Level dBµV/m	Corr. Level µV/m	Limit (µV/m)	Margin dB	Notes
				Avg.									
1160.07	H	270	1	38.5	26.0	2.3	10.5	36.3	41.0	112.5	500.0	-13.0	
1160.07	V	180	1	37.1	26.0	2.3	10.5	36.3	39.6	95.7	500.0	-14.4	
1200.00	H	190	1	36.4	26.2	1.3	10.5	36.2	38.2	81.4	500.0	-15.8	
1200.00	V	190	1	34.4	26.2	2.3	10.5	36.2	37.2	72.2	500.0	-16.8	
5744.00	H	0.0	1.5	76.9	34.8	1.3	10.5	0.0	123.6	1510299.8	N/A	N/A	Avg
5744.00	V	0.0	1.5	61.7	34.8	1.3	10.5	0.0	108.4	262460.0	N/A	N/A	Avg
11489.00	H	0	1	32.9	40.8	2.3	10.5	35.6	50.9	350.9	500.0	-3.1	NF
11489.00	V	0	1.8	32.9	40.8	2.3	10.5	35.6	50.9	350.9	500.0	-3.1	NF
				Peak									
1160.07	H	270	1	44.6	26.0	2.3	10.5	36.3	47.1	227.1	5000.0	-26.9	
1160.07	V	180	1	49.0	26.0	2.3	10.5	36.3	51.5	376.8	5000.0	-22.5	
1200.00	H	190	1	48.4	26.2	1.3	10.5	36.2	50.2	324.0	5000.0	-23.8	
1200.00	V	190	1	46.2	26.2	2.3	10.5	36.2	49.0	280.9	5000.0	-25.0	
5725.00	H	0.0	1.5	38.9	34.8	1.3	10.5	0.0	85.6	18954.0	942026.6	-33.9	20dBc
5725.00	V	0.0	1.5	27.8	34.8	1.3	10.5	0.0	74.5	5280.8	111960.1	-26.5	20dBc
5744.00	H	0.0	1.5	92.8	34.8	1.3	10.5	0.0	139.5	9420265.8	N/A	N/A	
5744.00	V	0.0	1.5	74.3	34.8	1.3	10.5	0.0	121.0	1119600.7	N/A	N/A	
11490.00	V	0.0	1.5	39.3	40.9	2.3	10.5	35.6	57.3	733.3	5000.0	-16.7	NF
11490.00	H	0.0	1.5	39.5	40.9	2.3	10.5	35.6	57.5	750.4	5000.0	-16.5	NF

NF = Noise Floor; No detectable signal

4.6 E-Mail From FCC Referencing Testing of Large Dish

From: Rich Fabina [Rich.Fabina@fcc.gov]

Sent: Friday, February 18, 2005 2:54 PM
To: mikev@wll.com
Subject: RE: Big old antenna

Mike,

Attached are the guidelines for testing a 10 foot dish with as Part 15, spread spectrum device.

Remember we are concerned about band edge compliance particularly in the 2.4 GHz band at 2.4835 MHz in the restricted band. If the device is a 2.4 GHz device, you will have to use the delta method (posted on our KDB) to determine the level of the emission at the band edge.

We are also concerned with the defacto EIRP limits in the 900 MHz and 2.4 GHz bands listed in the rules. Be careful with those.

For EMC/EMI Measurements:

Place the 10' parabolic antenna on a 10 meter OATS and bore-site the parabolic antenna to the receive antenna. To ensure measuring a maximized signal, with the transmission system transmitting rotate the EUT (left and right) slightly while monitoring the transmission - this is to ensure measuring in the center of the transmission beam. Then, with the transmission system still transmitting, raise and lower the receive antenna 1 to 4 meters to ensure that a maximized signal is being measured. Note: both horizontal and vertical polarities of the receiver antenna should be used to ensure a maximized signal will be measured. You will have to perform this for the fundamental to measure band edge compliance and for all the restricted band emissions. A look at the conducted emissions from this device should give you some guidance on where to look for spurious emissions from the system.

During all measurements, the measurement equipment requirements defined in Part 15, section 15.35 Measurement detector functions and bandwidths should be met.

These 10 meter measurements will then have to be extrapolated to 3 meters for comparison to the limits.

Let me know if we can be of further help.

Rich

4.7 AC Powerline Conducted Emissions: (FCC Part §15.207)

The EUT was placed on an 80 cm high 1 x 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 μH Line Impedance Stabilization Network bonded to a 3 x 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power and data cables were moved about to obtain maximum emissions.

The 50Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth for peak measurements.

Data is recorded in the following table.

Table 11: Conducted Emissions Test Data; §15.207

CLIENT:	Adtran	DATE:	4/22/2005
TESTER:	Greg Snyder	JOB #:	8650
EUT:	6320		
TEST STANDARD:	CIS22_B	LISN 1:	A_00125
TEST SITE:	CSITE1_CE		
VOLTAGE:	120VAC	LISN 2:	A_00126

LINE 1 - NEUTRAL (LISN 1)

Frequency MHz	Level QP dBuV	Cable Loss dB	LISN Corr dB	Corr Level dBuV	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Corr Level dBuV	Limit AVG dBuV	Margin AVG dB
0.15	31.8	10.3	1.9	44.0	65.9	-21.9	31.8	44.0	55.9	-11.9
0.21	28.4	10.2	1.3	39.9	63.1	-23.3	28.4	39.9	53.1	-13.3
0.52	25.9	10.2	0.7	36.8	56.0	-19.2	25.9	36.8	46.0	-9.2
0.87	24.8	10.3	0.5	35.5	56.0	-20.5	24.8	35.5	46.0	-10.5
1.45	36.4	10.4	0.3	47.1	56.0	-8.9	26.4	37.1	46.0	-8.9
4.52	32.6	10.8	0.4	43.8	56.0	-12.2	22.1	33.3	46.0	-12.7
10.93	23.8	11.3	0.6	35.6	60.0	-24.4	23.8	35.6	50.0	-14.4
17.00	20.2	11.6	1.0	32.8	60.0	-27.2	20.2	32.8	50.0	-17.2

LINE 2 - PHASE (LISN 2)

Frequency MHz	Level QP dBuV	Cable Loss dB	LISN Corr dB	Corr Level dBuV	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Corr Level dBuV	Limit AVG dBuV	Margin AVG dB
0.15	31.3	10.3	1.5	43.1	65.9	-22.8	31.3	43.1	55.9	-12.8
0.21	25.5	10.2	0.8	36.5	63.1	-26.6	25.5	36.5	53.1	-16.6
0.52	25.3	10.2	0.6	36.1	56.0	-19.9	25.3	36.1	46.0	-9.9
0.87	25.2	10.3	0.4	35.9	56.0	-20.1	25.2	35.9	46.0	-10.1
1.19	37.3	10.4	0.3	48.0	56.0	-8.0	28.2	38.9	46.0	-7.1
3.97	32.2	10.7	0.4	43.3	56.0	-12.7	21.8	32.9	46.0	-13.1
11.30	24.2	11.3	0.6	36.1	60.0	-23.9	24.2	36.1	50.0	-13.9
16.40	20.5	11.6	0.8	32.9	60.0	-27.1	20.5	32.9	50.0	-17.1