ITS Intertek Testing Services
ETL SEMKO

FCC Part 15 Test Report

for

Preco, Inc.

on the

Preview Object Detection System

Model: PV2000

FCC ID: OXZPV2000A

Test Report #: 30059451
Date of Report: September 14, 2001

Job #: 3005945
Date of Test: August 27 to September 13, 2001

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Lab Code 200201-0

Test Engineer: _____ Date: 09/20/01
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FCC ID: OZPV2000

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		108.8 dB(μV/m) Margin: 5.2 dB	75.2 dB(μV/m) Margin: 18.8 dB	
15.249a	Field Strength of Harmonics	Worst case: 60.3 dB(uV/m) @ 17.4 GHz. Margin: 13.7 dB		9
15.249c 15.109	Radiated Emissions outside the band	Worst case: 71.9 dB(uV/m) @ 5.725 GHz. Margin: 2.1 dB		9
15.205	Radiated Emissions in restricted bands	Worst case: 43.0 dB(uV/m) @ 23.2 GHz Margin: 11.0 dB		9
15.107	Line Conducted Emissions	Not Applicable. The device is battery operated.		-
15.203	Antenna requirement	Complies. The antenna is permanently installed inside the device		12

2.0 General Description

2.1 Product Description

The PreView Object Detection System is a system that detects both moving and stationary objects in a pre-defined area and reports the distance of the closest detected object via visual range indicators and an audible signal to a vehicle operator. The PreView system is designed as a back up and is not to be the sole method for rear collision avoidance.

2.2 Related Submittal(s) Grants

This report is for use with an application for certification of a low power transmitter to FCC Part 15.249 Requirements. One transmitter is included in the application. This specific report details the emission characteristics of transmitter.

2.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.4 (1992). All measurements were performed in Open Area Test Sites. Preliminary scans were performed in the Open Area Test Sites only to determine worst case modes. For each scan, the procedure for maximizing emissions in Appendices D and E were followed. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

2.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is Site 3. This test facility and site measurement data have been fully placed on file with the FCC and NVLAP accredited.

3.0 System Test Configuration

3.1 Justification

For emission testing, the equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst case emissions.

For the measurements, the EUT is attached to a cardboard box (if necessary) and placed on the wooden turntable. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). The EUT is wired to transmit full power.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

3.2 EUT Exercising Software

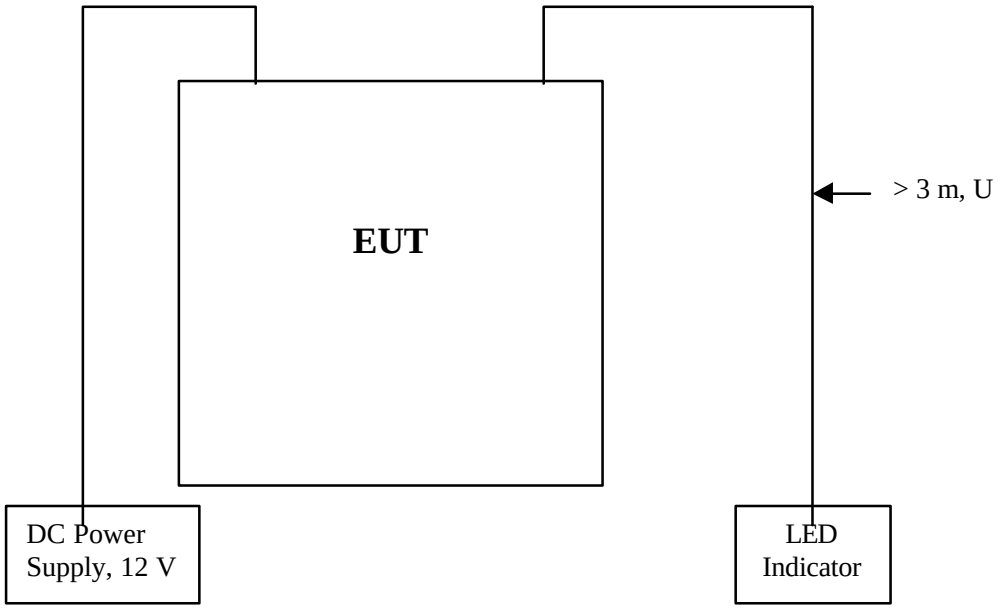
The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

3.3 System Test Configuration

3.3.1 Support Equipment

HP E-3631-A DC Power Supply

3.3.2 Block Diagram of Test Setup



***** = EUT	**S** = Shielded;	**F** = With Ferrite
****** = No Ferrite on video cable	**U** = Unshielded	**M** = Length in Meters

3.4 Equipment Modification

No modifications were installed by Intertek Testing Services during compliance testing in order to bring the product into compliance (please note that this does not include changes made specifically by Preco, Inc. prior to compliance testing).

Any modifications installed previous to testing by Preco, Inc. will be incorporated in each production model sold/leased in the United States.

3.5 Additions, deviations and exclusions from standards

No additions, deviations or exclusions from the standard were made.

4.0 Emission Results

Radiated emission measurements were performed from 30 MHz to 40 GHz. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz, 1 MHz - for frequencies above 1000 MHz.

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included. All measurements were performed with peak detection unless otherwise specified.

4.1 Test Procedure

Test was performed on the open site. The horn antenna was placed at 1 m distance from the device. To calculate the Field Strength at 3 m, the Distance Correction Factor of -9.5 dB was used.

The Spectrum Analyzer was set to measure "Line spectrum", For this purpose the Resolution Bandwidth (RB) was set to 100 kHz , e.g. less than the Pulse Repetition Frequency (PRF). In this case the spectrum lines of the pulsed carrier can be observed. The highest level of these "lines" is the average reading.

The Peak Value is calculated by subtracting the Duty Factor from the "Line spectrum" level. The Duty Cycle is calculated from the "Line spectrum". As the Null of spectrum theoretically occurs at the point where the frequency equals **1/t,** where **t** is the pulse duration, the **t** is calculated as $1/f$, where f is the frequency at which the first Null spectrum occurs (119 MHz, see plot #2). As a result, **t= 8.4 ns.**

The Duty Cycle (DC) is calculated as **DC= t ´ PRF.** The **Duty Factor is 20´Log(DC).**
According to the plots #' 3, the PRF is 2.47 MHz. Duty Factor = -33.6 dB.
The procedure described above was used to evaluate the average and peak of the Field Strength at fundamental frequency. For out-of-band emissions (including harmonics and emissions on the band-edge frequencies), the spectrum analyzer Resolution Bandwidth and Video Bandwidth were set to 1 MHz and 7 MHz to measure a Peak value. The Average value was calculated by adding Duty Factor to the Peak value.

Radiated emissions test below 1 GHz was performed according to the procedures in ANSI C63.4 (1992).

4.2 Field Strength Calculation

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 dB (μV/m)
RA = Receiver Amplitude (including preamplifier) in dB (μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB/m
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: -

FS = RR + LF

Where FS = Field Strength in dB (μV/m)
RR = RA - AG in dB (μV)
LF = CF + AF in dB

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

RA = 52.0 dB (μV) AF = 7.4 dB/m
RR = 23.0 dB (μV) CF = 1.6 dB
LF = 9.0 dB AG = 29.0 dB

FS = RR + LF
FS = 23 + 9 = 32 dB (μV/m)

Level in μV/m = Common Antilogarithm {[32 dB (μV/m)]/20} = 39.8 μV/m

4.3 Radiated Emission Data

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Results:	**Pass** by 2.1 dB at 5725 MHz

Note: a) For the test result above 1 GHz, see table #1 and plots in section 4.4, for the test result above 1 GHz, see table #2
a) All emissions not reported are at least 6 dB below the limits

Table 1

Radiated Emissions Test Data

Company:	Preco Inc	**Model #:**	PV2000	**Standard**	**FCC § 15.249**
EUT:	PreView Object Detection System	**S/N #:**		**Limits**	12
Project #:	3005945	**Test Date:**	Sep 06,2001	**Test Distance**	1 meter
Test Mode:	Transmitting at 5.8 GHz	**Engineer:**	Suresh K		

	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used
Number:	14	21	22	10	13	0	21	0	0	0
Model:	EMCO 3115	3160-9	3160-10	AFT 18855	ACO/400	None	Grn_ M+L	None	None	None

Frequency	Reading	Detector	Ant	Amp.	Ant. Pol.	Ant. Factor	Pre-Amp	Cable Loss	D. C. F.	Net	Limit @3m	Margin
MHz	dB(µV)	P/A/Q	#	#	H/V	dB(1/m)	DB	dB	dB	dB(µV/m)	dB(µV/m)	dB
5800.0	44.8 [1]	Ave.	14	0	H	36.2	0.0	3.7	-9.5	75.2	94.0	-18.8
5800.0	-	Peak [2]	-	-	-	-	-	-	-	108.8	114.0	-5.2
5875.0	40.4 [3]	Peak [4]	14	0	H	36.2	0.0	3.7	-9.5	70.8	74.0	-3.2
5875.0	-	Ave. [5]	-	-	-	-	-	-	-	37.2	54.0	-16.8
5725.0	41.5[6]	Peak [4]	14	0	H	36.2	0.0	3.7	-9.5	71.9	74.0	-2.1
5725.0	-	Ave. [5]	-	-	-	-	-	-	-	38.3	54.0	-15.7
11600	56.7 [7]	Peak [4]	14	10	H	41.9	38.8	5.8	-9.5	56.1	74.0	-17.9
11600	-	Ave. [5]	-	-	-	-	-	-	-	22.5	54.0	-31.5
17400	58.1 [8]	Peak [4]	14	10	H	43.0	38.8	7.5	-9.5	60.3	74.0	-13.7
17400	-	Ave. [5]	-	-	-	-	-	-	-	26.7	54.0	-27.3
23200	26.9 [9]	Ave. [10]	21	13	H	40.4	23.3	8.5	-9.5	43.0	54.0	-11.0
29000	35.0 [9]	Ave. [10]	22	13	H	43.5	25.9	8.7	-9.5	51.8	54.0	-2.2
34800	34.0 [9]	Ave. [10]	22	13	H	43.6	24.8	9.0	-9.5	52.3	54.0	-1.7

Notes:

a) D.C.F.: Distance Correction Factor

b) Net (dB) = Reading + Antenna Factor - Pre-amp + Cable. Loss.

c) Negative signs (-) in Margin column signify levels below the limits.

[1] Spectrum analyzer reading (see plot #1)
[2] Calculated: **Peak = Average - Duty Factor**.
[3] Spectrum analyzer reading (see plot #4)
[4] Measured with RB=1 MHz
[5] Calculated: **Average = Peak + Duty Factor**
[6] Spectrum analyzer reading (see plot #5)
[7] Spectrum analyzer reading (see plot # 6)
[8] Spectrum analyzer reading (see plots #7)
[9] Noise floor
[10] Measured with reduced video bandwidth. Peak reading is not more than 12 dB above the average.

Table 2

Radiated Emissions Test Data

Company:	Preco Electronics Inc	**Model #:**	PV2000	**Standard**	**FCC § 15B**
EUT:	Preview Object detection system	**S/N #:**	**Not labeled**	**Limits**	2
Project #:	3005945	**Test Date:**	Sep 11, 2001	**Test Distance**	3 meters
Test Mode:	Rx	**Engineer:**	Suresh K		

	Antenna Used			Pre-Amp Used			Cable Used			Transducer Used
Number:	1	7	2	5	0	0	3	0	0	0
Model:	EMCO 3143	EM LPA-25	EMCO 3143	CDI_P950	None	None	Site 3 10m	None	None	None

Frequency	Reading	Detector	Ant	Amp	Ant. Pol.	Ant. Factor	Pre-Amp	Insert. Loss	D. C. F.	Net	Limit @3m	Margin
MHz	dB(µV)	P/A/Q	#	#	H/V	dB(1/m)	dB	dB	dB	dB(µV/m)	dB(µV/m)	dB
30.00	37.3	Peak	2	5	V	11.5	18.4	1.5	0.0	31.9	40.0	-8.1
160.00	33.2	Peak	2	5	V	9.4	18.1	3.2	0.0	27.7	43.5	-15.8
45.00	33.2	Peak	2	5	V	8.0	18.8	1.9	0.0	24.3	40.0	-15.7
50.00	36.1	Peak	2	5	V	5.7	18.5	2.1	0.0	25.4	40.0	-14.6
150.00	29.1	Peak	2	5	V	11.8	18.2	3.1	0.0	25.8	43.5	-17.7
220.00	32.1	Peak	2	5	V	11.1	19.5	3.3	0.0	27.0	46.0	-19.0
260.00	30.1	Peak	2	5	V	12.4	19.6	3.8	0.0	26.7	46.0	-19.3
275.00	30.5	Peak	2	5	V	12.5	19.2	3.9	0.0	27.7	46.0	-18.3
350.00	29.5	Peak	2	5	H	15.4	17.9	4.6	0.0	31.6	46.0	-14.4
590.00	27.8	QP	2	5	H	19.3	15.6	5.2	0.0	36.7	46.0	-9.3
600.00	31.4	Peak	2	5	H	19.4	15.0	5.2	0.0	41.0	46.0	-5.0

Notes:

a) D.C.F.:Distance Correction Factor

b) Insert. Loss (dB) = Cable A + Cable B + Cable C .

c) Net (dB) = Reading + Antenna Factor - Pre-amp + Insert. Loss. - Transducer Loss - Duty Relaxation (transmitter only).

d) Negative signs (-) in Margin column signify levels below the limits.

e) All other emissions not reported are below the equipment noise floor which is at least 20 dB below the limits.

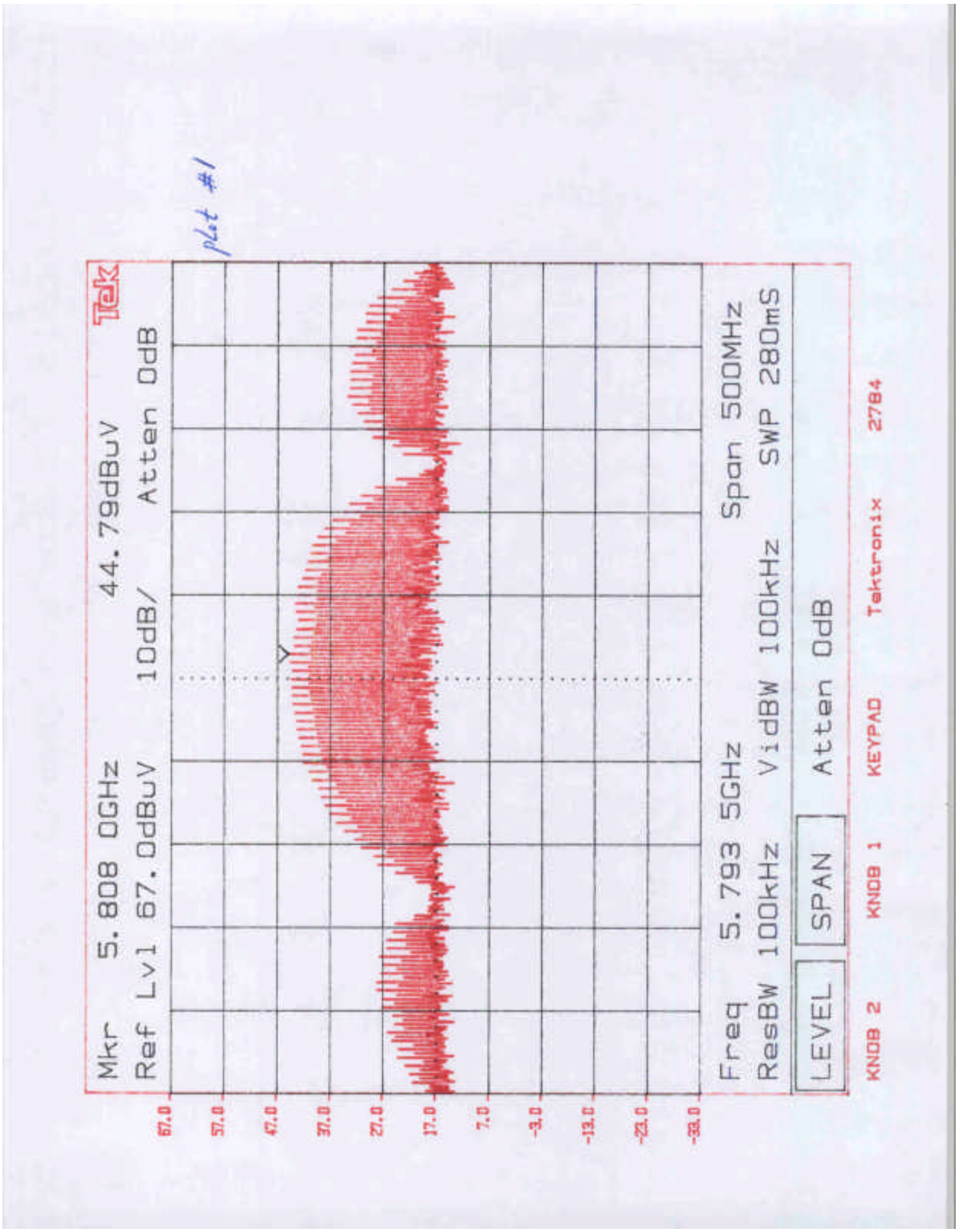
4.3 AC Line Conducted Emission Data

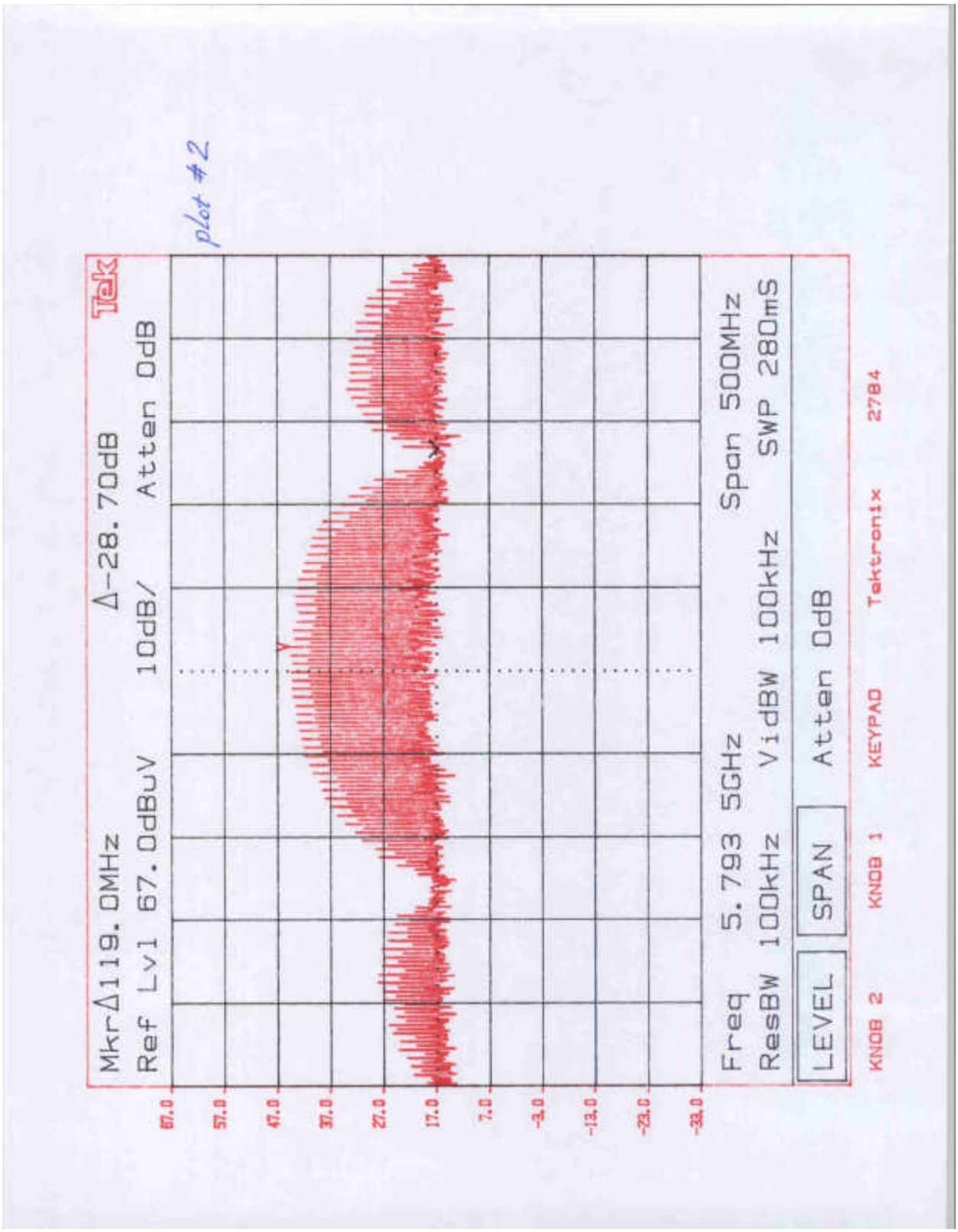
Not Applicable. The EUT is battery operated

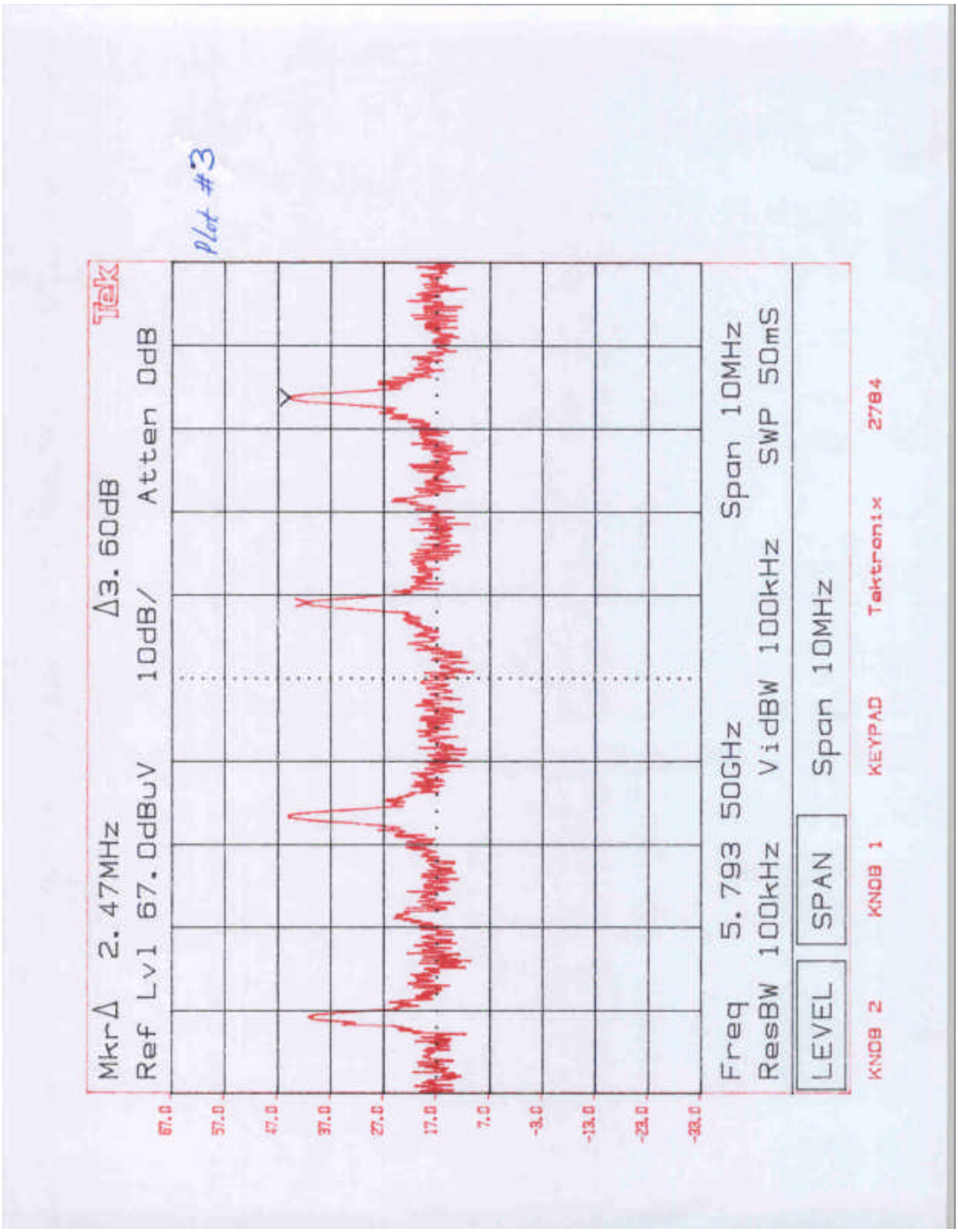
4.4 Emission Plot

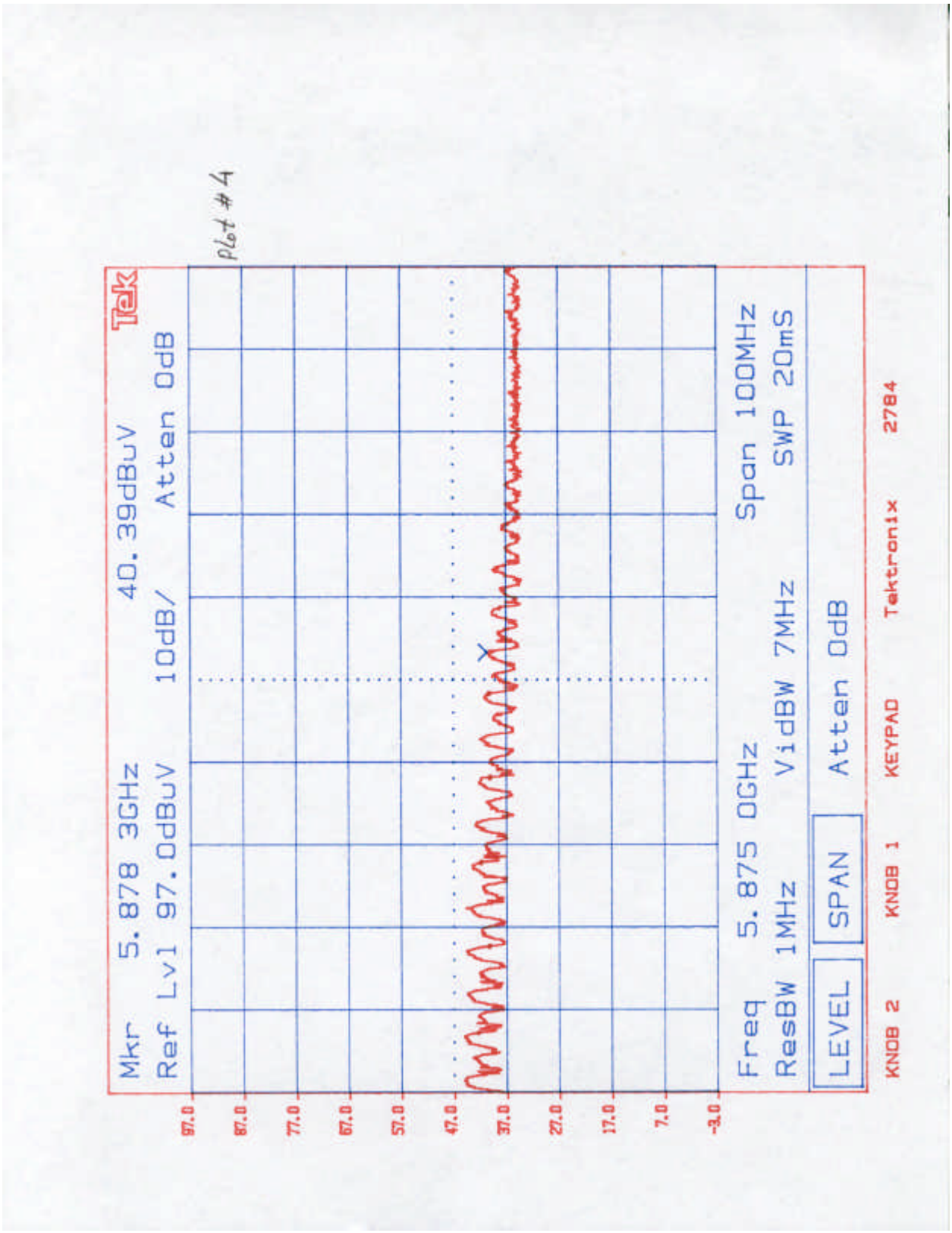
The following plots show the emission level of the transmitter.

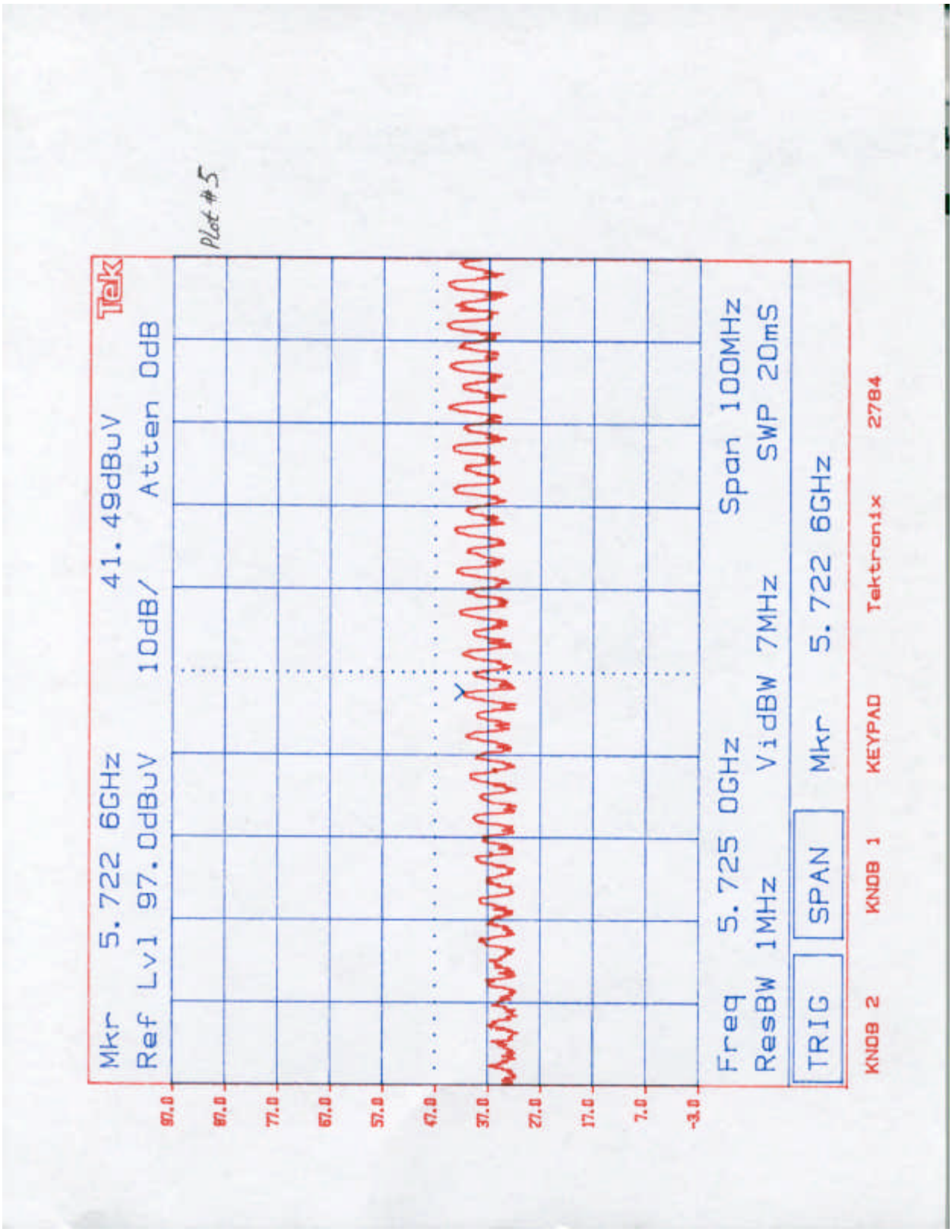
Plot #	Description
1	"Line spectrum" at Fundamental frequency
2	"Line spectrum" at Fundamental frequency (to verify the pulse duration)
3	"Line spectrum" at Fundamental frequency (to verify the PRF)
4	Emission at upper band-edge frequency
5	Emission at lower band-edge frequency
6	Second Harmonic Emission
7	Third Harmonic Emission
8	Scan from 6 GHz to 18 GHz


Plot #1
Tek
Mkr 5.808 0GHz 44.79dBuV
Ref Lvl 67.0dBuV 10dB/ Atten 0dB
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
Freq 5.793 5GHz Span 500MHz
ResBW 100kHz VidBW 100kHz SWP 280mS
LEVEL SPAN Atten 0dB
KNOB 2 KNOB 1 KEYPAD Tektronix 2784


plot #2
Tek
MkrΔ119.0MHz
Ref Lvl 67.0dBuV
Δ-28.70dB
10dB/
Atten 0dB
Freq 5.793 5GHz
ResBW 100kHz
VidBW 100kHz
Span 500MHz
SWP 280mS
LEVEL
SPAN
Atten 0dB
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0


Plot #3
MkrΔ 2.47MHz
Ref Lvl 67.0dBuV
Δ3.60dB
10dB/
Atten 0dB
Freq 5.793 50GHz
ResBW 100kHz
VidBW 100kHz
Span 10MHz
SWP 50mS
LEVEL
SPAN
Span 10MHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0


Plot # 4
Tek
Mkr 5.878 3GHz 40.39dBuV
Ref Lvl 97.0dBuV 10dB/ Atten 0dB
Freq 5.875 0GHz Span 100MHz
ResBW 1MHz VidBW 7MHz SWP 20mS
LEVEL SPAN Atten 0dB
KNOB 2 KNOB 1 KEYPAD Tektronix 2784
97.0
87.0
77.0
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0


Plot #5
Tek
Mkr 5.722 6GHz 41.49dBuV
Ref Lvl 97.0dBuV 10dB/ Atten 0dB
Freq 5.725 0GHz Span 100MHz
ResBW 1MHz VidBW 7MHz SWP 20mS
TRIG SPAN Mkr 5.722 6GHz
KNOB 2 KNOB 1 KEYPAD Tektronix 2784
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77.0
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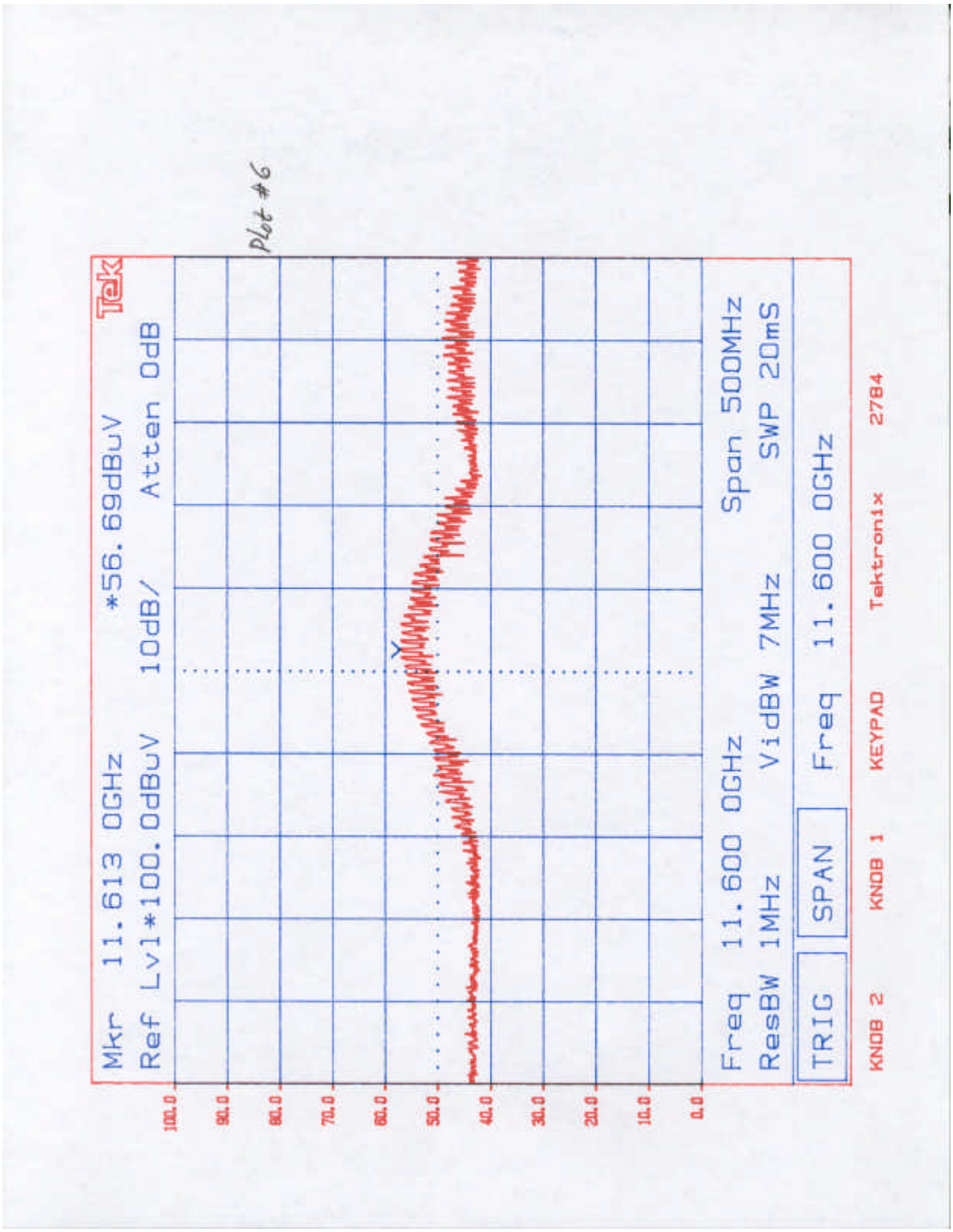
Plot #6
Tek
Mkr 11.613 0GHz
*56.69dBuV
Ref Lvl*100.0dBuV
10dB/
Atten 0dB
Span 500MHz
SWP 20mS
Freq 11.600 0GHz
VidBW 7MHz
ResBW 1MHz
TRIG
SPAN
Freq 11.600 0GHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
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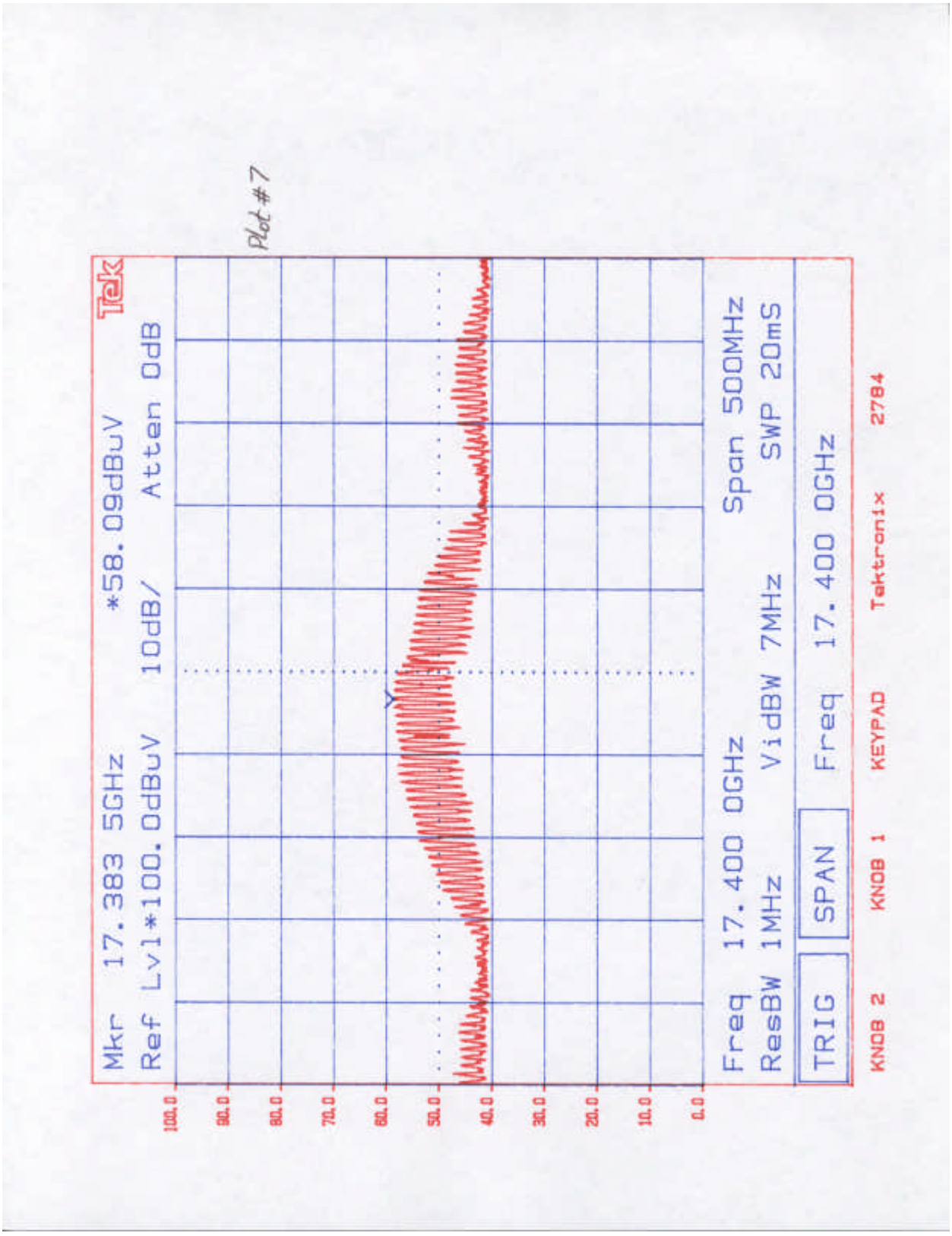
20.0
10.0
0.0


Plot #7
Tek
Mkr 17.383 5GHz
Ref Lvl*100.0dBuV
*58.09dBuV
10dB/
Atten 0dB
Freq 17.400 0GHz
ResBW 1MHz
VidBW 7MHz
Span 500MHz
SWP 20mS
Freq 17.400 0GHz
TRIG
SPAN
Freq
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
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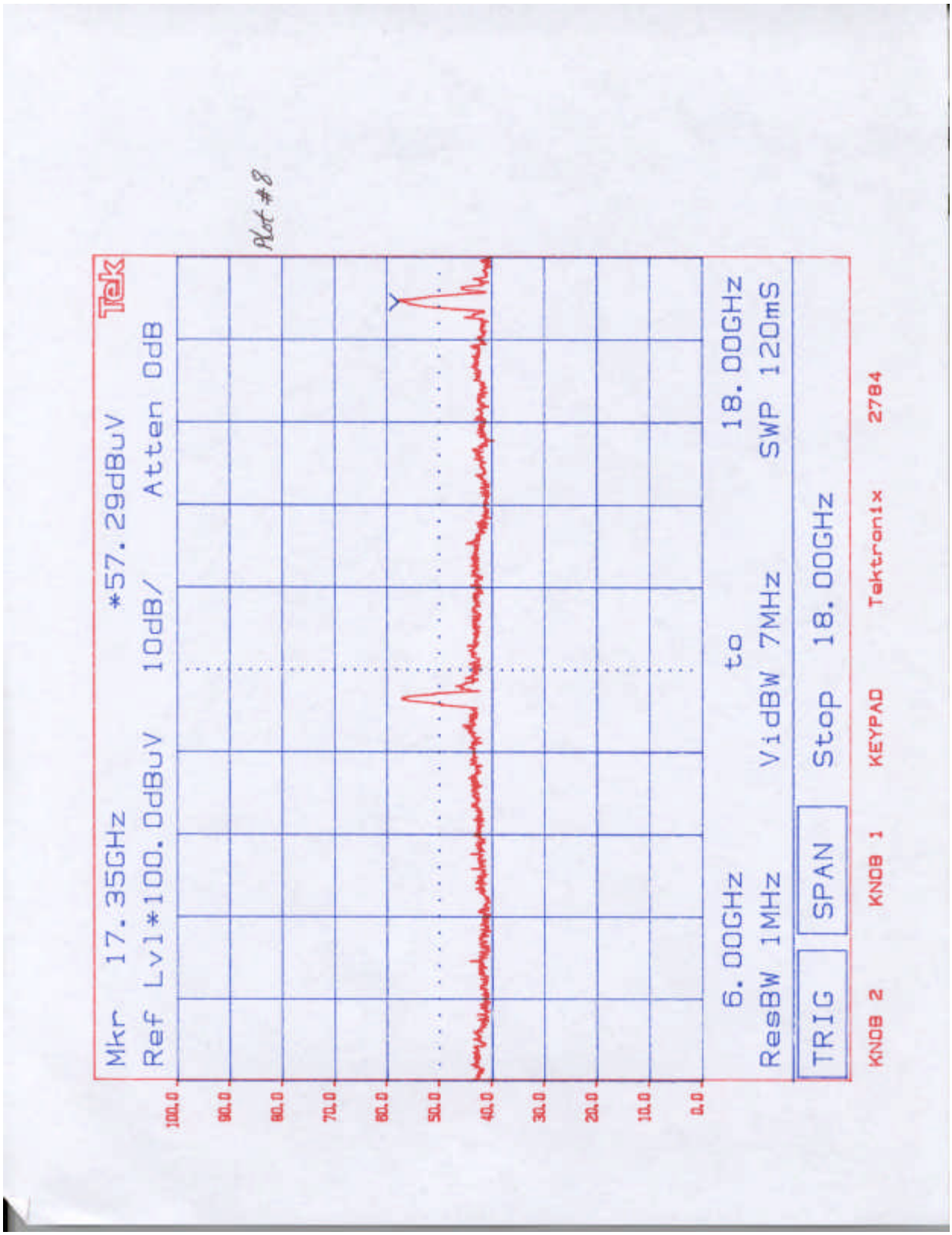
0.0


Plot #8
Tek
Mkr 17.35GHz
Ref Lvl*100.0dBuV
*57.29dBuV
10dB/
Atten 0dB
6.00GHz
to
18.00GHz
ResBW 1MHz
VidBW 7MHz
SWP 120mS
TRIG
SPAN
Stop 18.00GHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0

6.0 List of test equipment

EQUIPMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. INTERVAL	CAL. DUE
Spectrum Analyzer w/85650 QP Adapter	Hewlett Packard	8566B	2416A00317 2043A00251	12	4/6/02
Spectrum Analyzer	Tektronix	2784	B3020108	12	8/08/02
Spectrum Analyzer	Hewlett Packard	8591EM	3536A00451	12	7/17/02
Bi-Log Antenna	EMCO	3143	9509-1160	12	7/12/02
Double-ridged Horn Antenna	EMCO	3115	9107-3712	12	3/17/02
Horn Antenna	EMCO	3160-09	Not Labeled	#	#
Horn Antenna	EMCO	3160-10	Not Labeled	#	#
Pre-Amplifier	CDI	P950	ITS009	12	7/02/02
Pre-Amplifier	CDI	P1000	N/A	12	10/06/01
Pre-Amplifier	Avantek	AFT-18855	8723H705	12	10/5/02
Pre-amplifier	CTT	ACO/400	47526	12	10/5/02

No Calibration Required

7.0 Antenna Requirement

The transmitter uses a permanently connected antenna which is integrated part of the EUT.