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 #: 30059451a
Date of Report: April 25, 2002

Job #: 3005945
Date of Test: August 27 to September 13, 2001
Date of Retest: April 25, 2002

Total No of Pages Contained in this Report: 25

NVLAP®

Lab Code 200201-0

Test Engineer: _____ Date: 04/25/02
Suresh Kondapalli

EMC Technical Manager: David Chernomordik Date: 4/25/02
David Chernomordik, Ph.D.

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1.0 Summary of Test Results

MODEL: PV2000
FCC ID: OXZPV2000A

FCC RULE	DESCRIPTION OF TEST	RESULT		PAGE
15.249a	Field Strength of Fundamental	Peak	Average	9
		92.9 dB(μV/m) Margin: 21.2 dB	63.4 dB(μV/m) Margin: 30.6 dB	
15.249a	Field Strength of Harmonics	Worst case: 73.6 dB(uV/m) @ 17.4 GHz. Margin: 0.4 dB		9
15.249c 15.109	Radiated Emissions outside the band	Worst case: 51.9 dB(uV/m) @ 5.911 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 1. 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

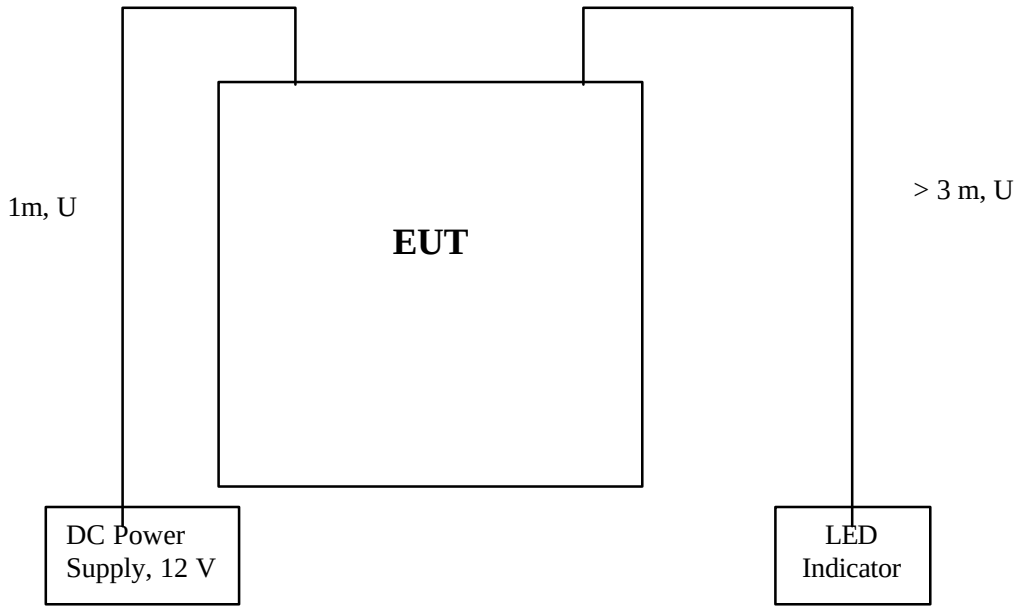
The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

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.

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 and in an anechoic chamber. 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.

For the testing at fundamental frequency and its harmonic, 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 adding the Duty Factor to the "Line spectrum" level. The Duty Factor is defined as 20Log (1/DC). The Duty Cycle (DC) 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.

The Duty Cycle is calculated as **DC= t ´ PRF.**

For spurious emissions (excluding harmonics), the spectrum analyzer Resolution Bandwidth and Video Bandwidth were set to 1 MHz and 7 MHz to measure a Peak value, and to 1 MHz and 10 Hz to measure an Average value.

Radiated emissions test below 1 GHz was performed at 3 m distance according to the procedures described 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 0.4 dB at 17.4 GHz

Note: a) For the test result above 1 GHz, see table #1 and plots in section 4.4, for the test result below 1 GHz, see table #2

a) All emissions below 23 GHz 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**		
Project #:	**3005945**	**Test date:**	**April 25, 2002**	**Test Distance**	**1**	**meter**
Test Mode:	**Transmitting at 5.8 GHz**	**Engineer:**	**David C.**			

Frequency MHz	SA Reading dBµV	Detection Peak/Ave	Antenna Factor dB(1/m)	Polariz. H/V	Correction Factor dB	DCF dB	Net dB(µV/m)	Limit @ 3m dB(µV/m)	Margin dB
5800	36.7 [1]	Ave	35.0	H	1.2 *	-9.5	63.4	94.0	-30.6
5800	-	Peak	-	-	-	-	92.9 [2]	114.0	-21.1
5911	60.7 [4]	Peak	35.0	H	-33.1	-9.5	53.1	74.0	-20.9
5911	59.5 [5]	Ave	35.0	H	-33.1	-9.5	51.9	54.0	-2.1
11600	37.8 [6]	Ave	39.7	H	-34.2	-9.5	33.8	54.0	-20.2
11600	-	Peak	-	-	-	-	63.3 [2]	74.0	-10.7
17400	40.4 [7]	Ave	44.0	H	-30.8	-9.5	44.1	54.0	-9.9
17400	-	Peak	-	-	-	-	73.6 [2]	74.0	-0.4
23200	26.9 [8]	Ave. [9]	40.4	H	-14.8	-9.5	43.0	54.0	-11.0
29000	35.0 [8]	Ave. [9]	43.5	H	-17.2	-9.5	51.8	54.0	-2.2
34800	34.0 [8]	Ave. [9]	43.6	H	-15.8	-9.5	52.3	54.0	-1.7

	* no preamplifier was used
Notes:	a) Correction Factor (dB) = Cable Loss - Preamplifier Gain (calibrated together prior the testing)
	b) DCF.: Distance Correction Factor
	c) Net (dB) = SA Reading + Antenna Factor + Correction Factor + DCF
	d) Negative signs (-) in Margin column signify levels below the limits.
	[1] Spectrum analyzer reading (see plot #1)
	[2] Calculated: **Peak = Average + Duty Factor** [3] .
	[3] Duty Factor = 20 Log (Δ_1 / $2\Delta_2$);
	Δ_1 = 148 MHz from plot #5,
	Δ_2 = 2.46 MHz from plot # 4.
	DF = 29.5 dB
	[4] Spectrum analyzer reading (see plot # 7)
	[5] Spectrum analyzer reading (see plot # 8)
	[6] Spectrum analyzer reading (see plot # 9)
	[7] Spectrum analyzer reading (see plot # 10)
	[8] Noise floor
	[9] Measured with reduced video bandwidth. Peak reading is no 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 gain + Insert. Loss
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.

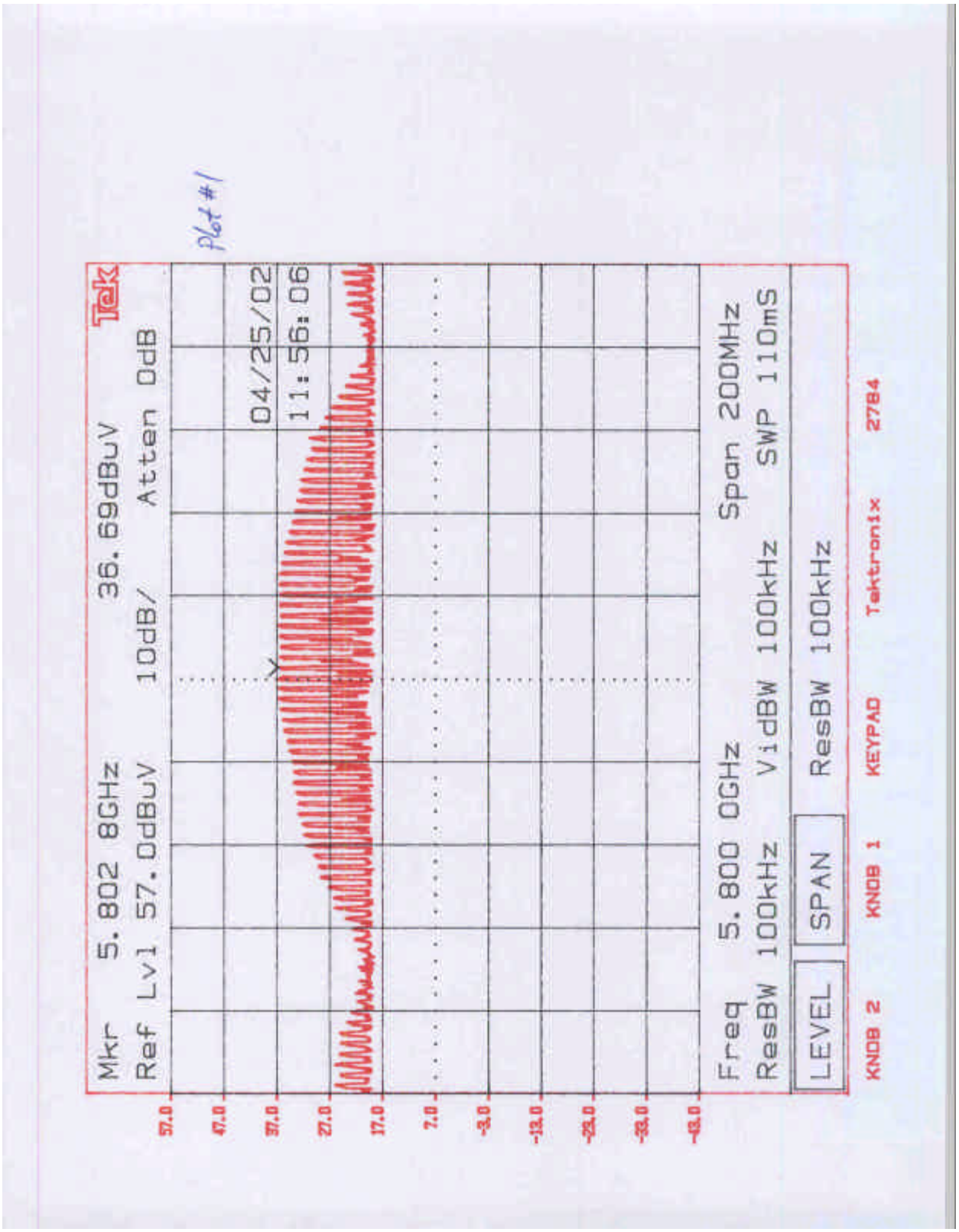
4.3 AC Line Conducted Emission Data

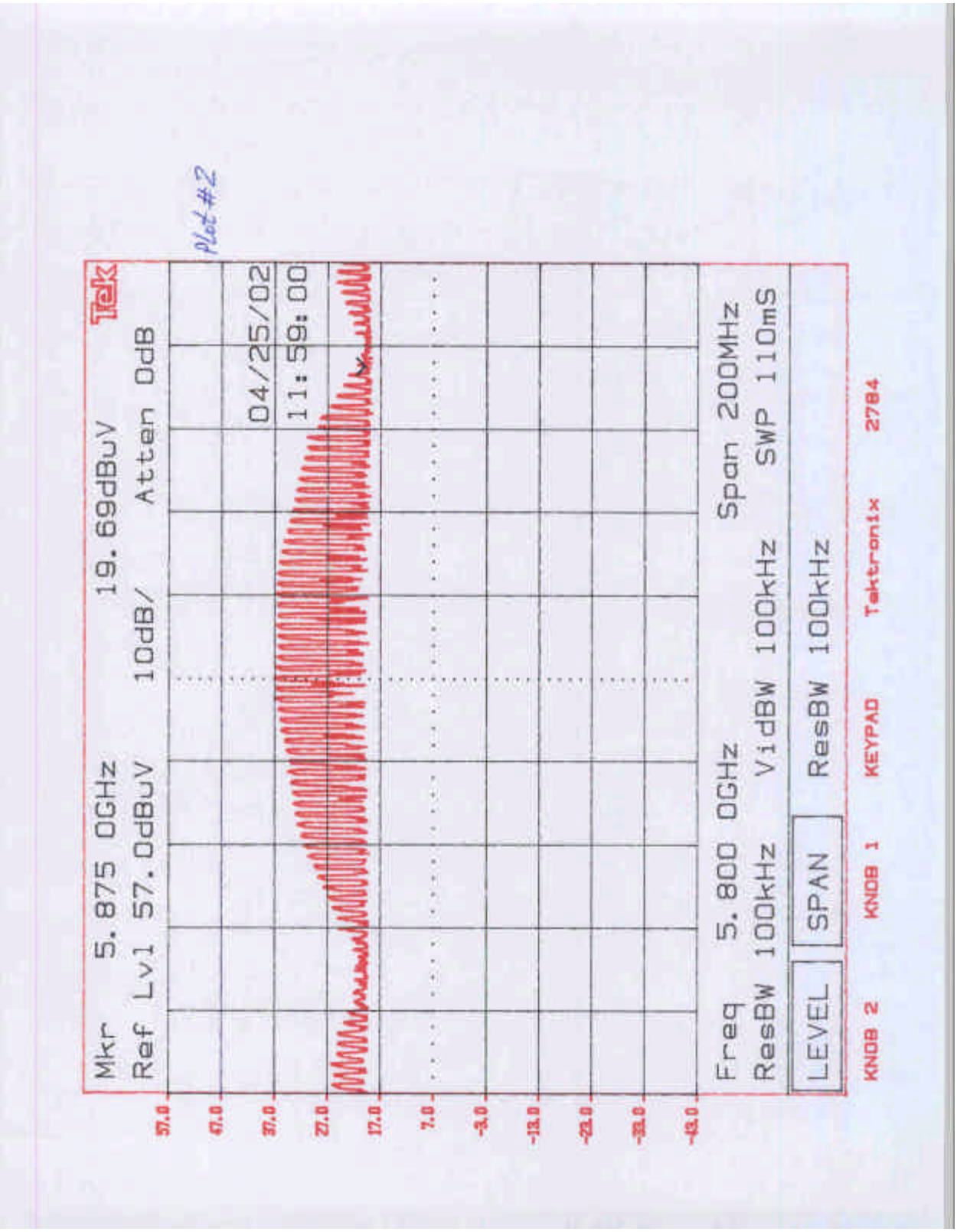
Not Applicable. The EUT is battery operated

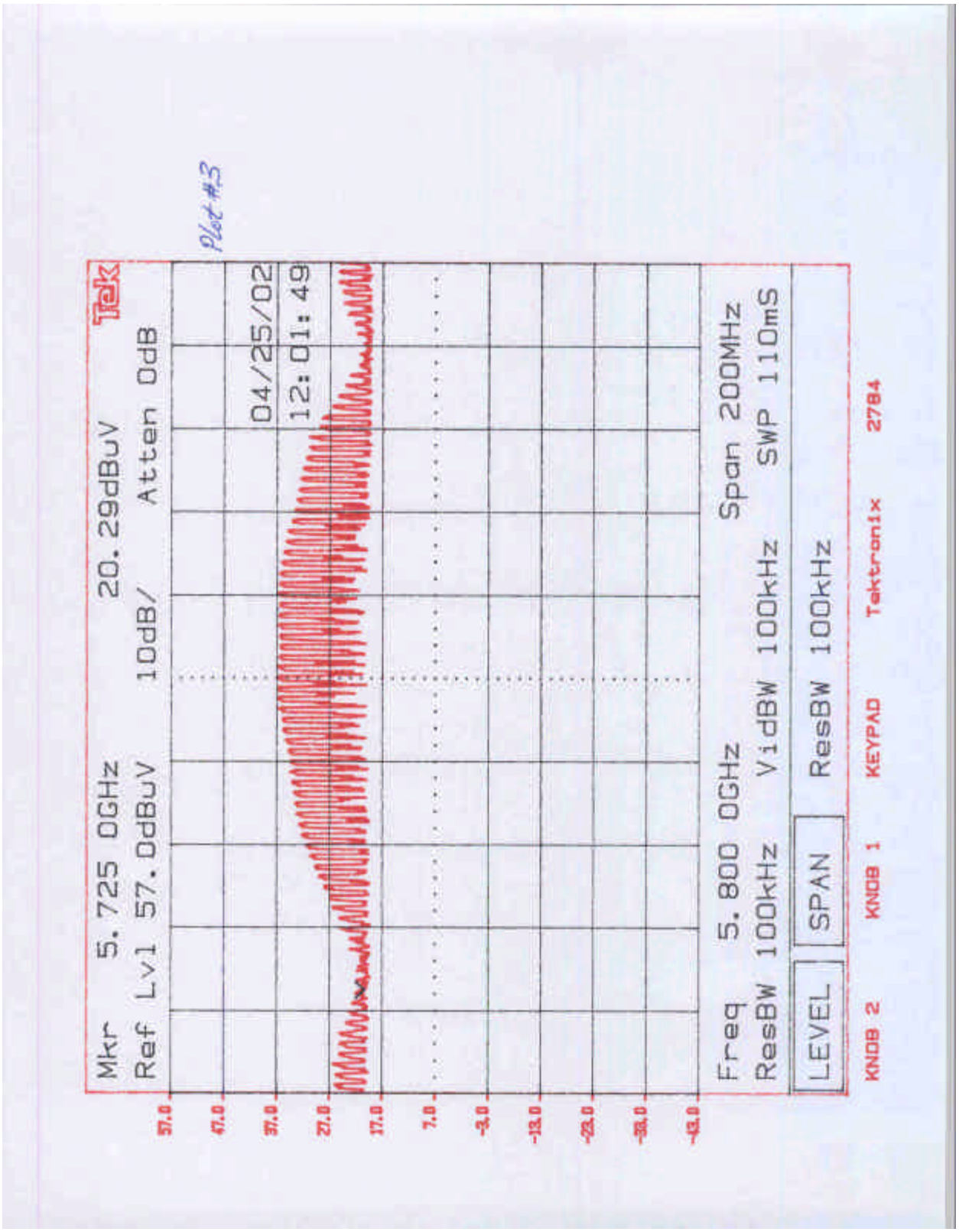
4.4 Emission Plot

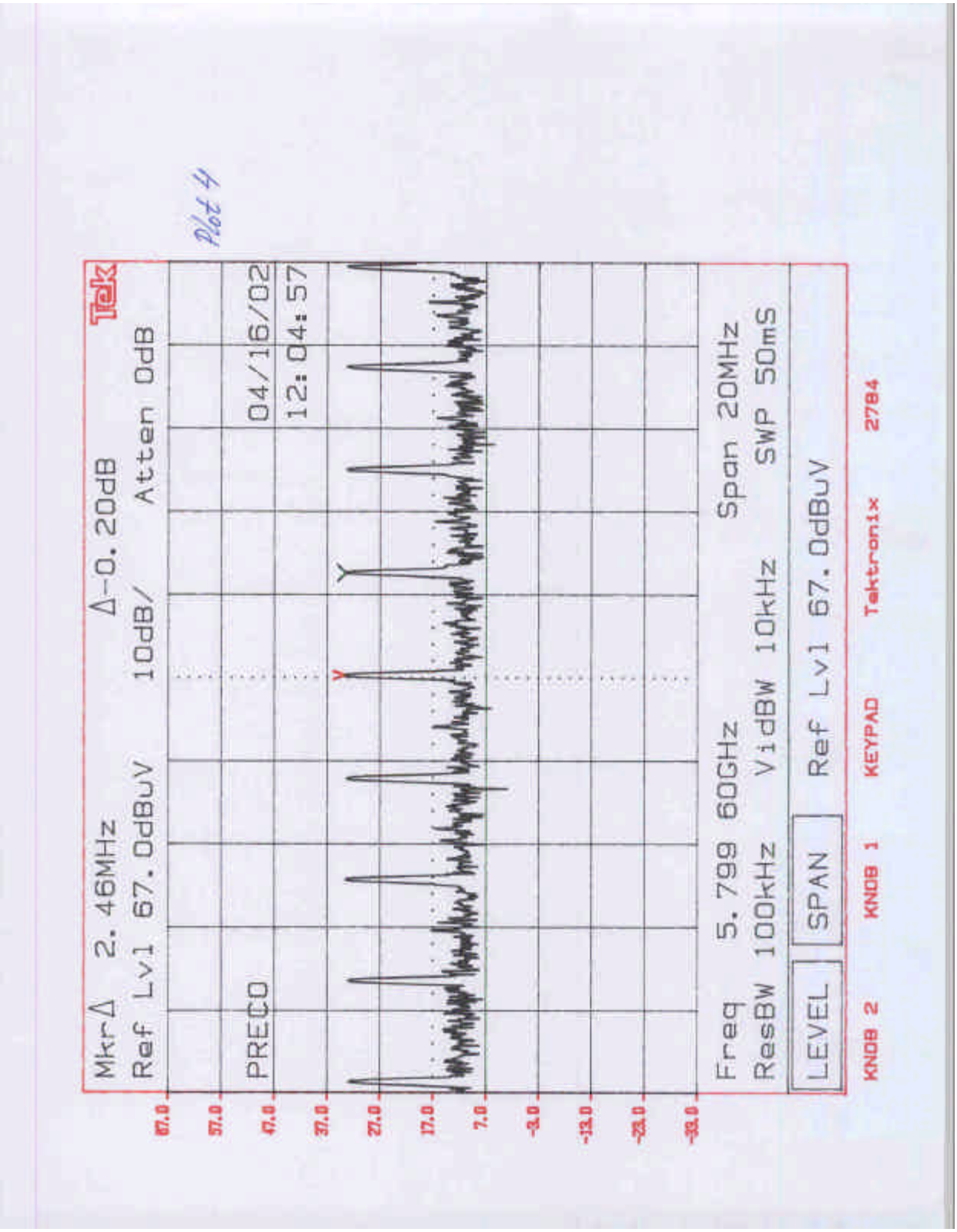
The following plots show the emission level of the transmitter.

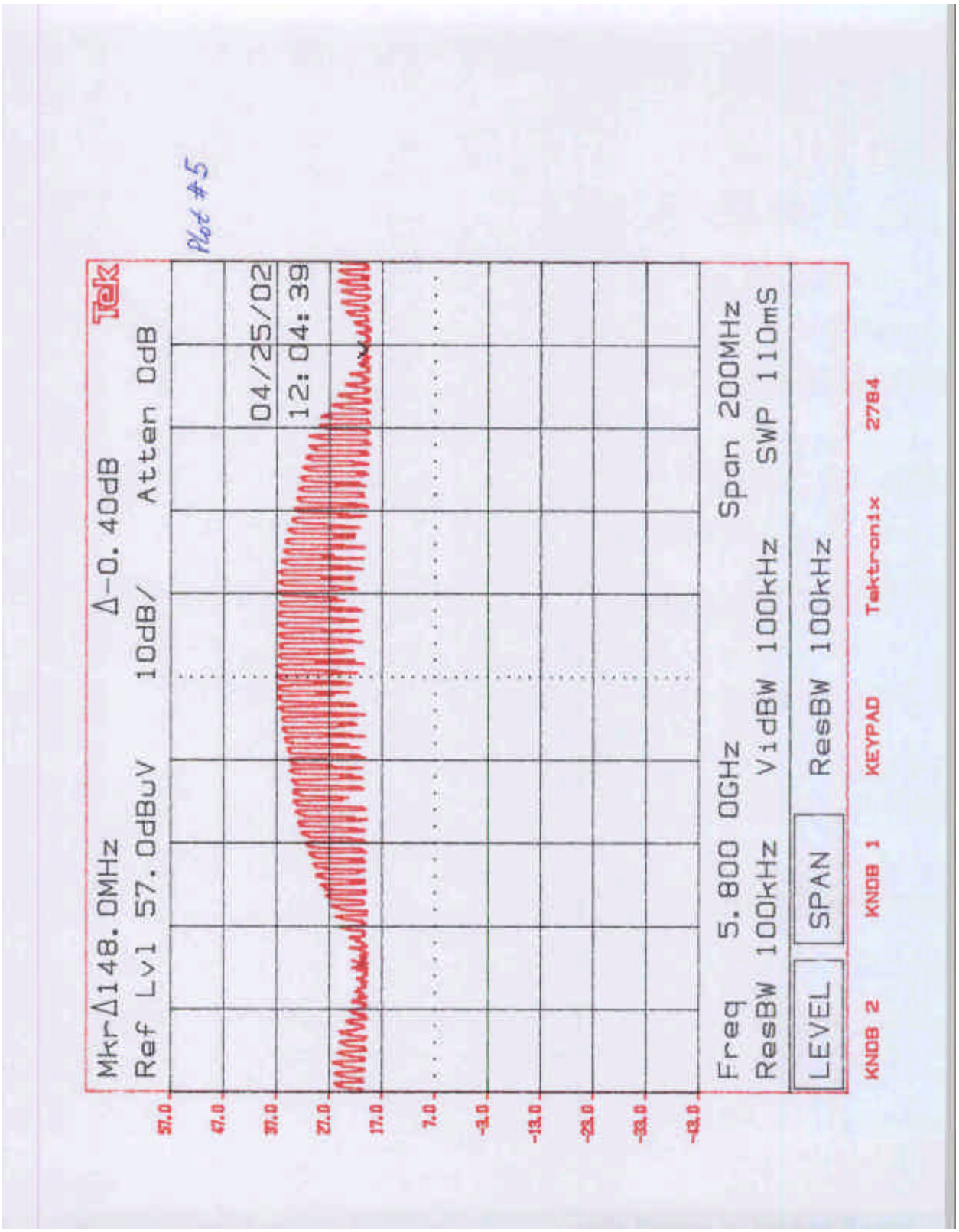
Plot #	Description
1	Emission in "Line spectrum mode" at Fundamental frequency
2	Emission in "Line spectrum mode" at Fundamental frequency, marker at band-edge frequency 5875 MHz
3	Emission in "Line spectrum mode" at Fundamental frequency, marker at band-edge frequency 5725 MHz
4	Emission in "Line spectrum mode" at Fundamental frequency (to verify PRF)
5	Emission in "Line spectrum mode" at Fundamental frequency (to verify pulse duration)
6	Emission in "Line spectrum mode" at side-lobe frequency, with no pre-amp.
7	Peak measurement at side-lobe frequency, with pre-amp.
8	Average measurement at side-lobe frequency, with pre-amp.
9	Emission in "Line spectrum mode" at second harmonic, average measurement
10	Emission in "Line spectrum mode" at third harmonic, average measurement

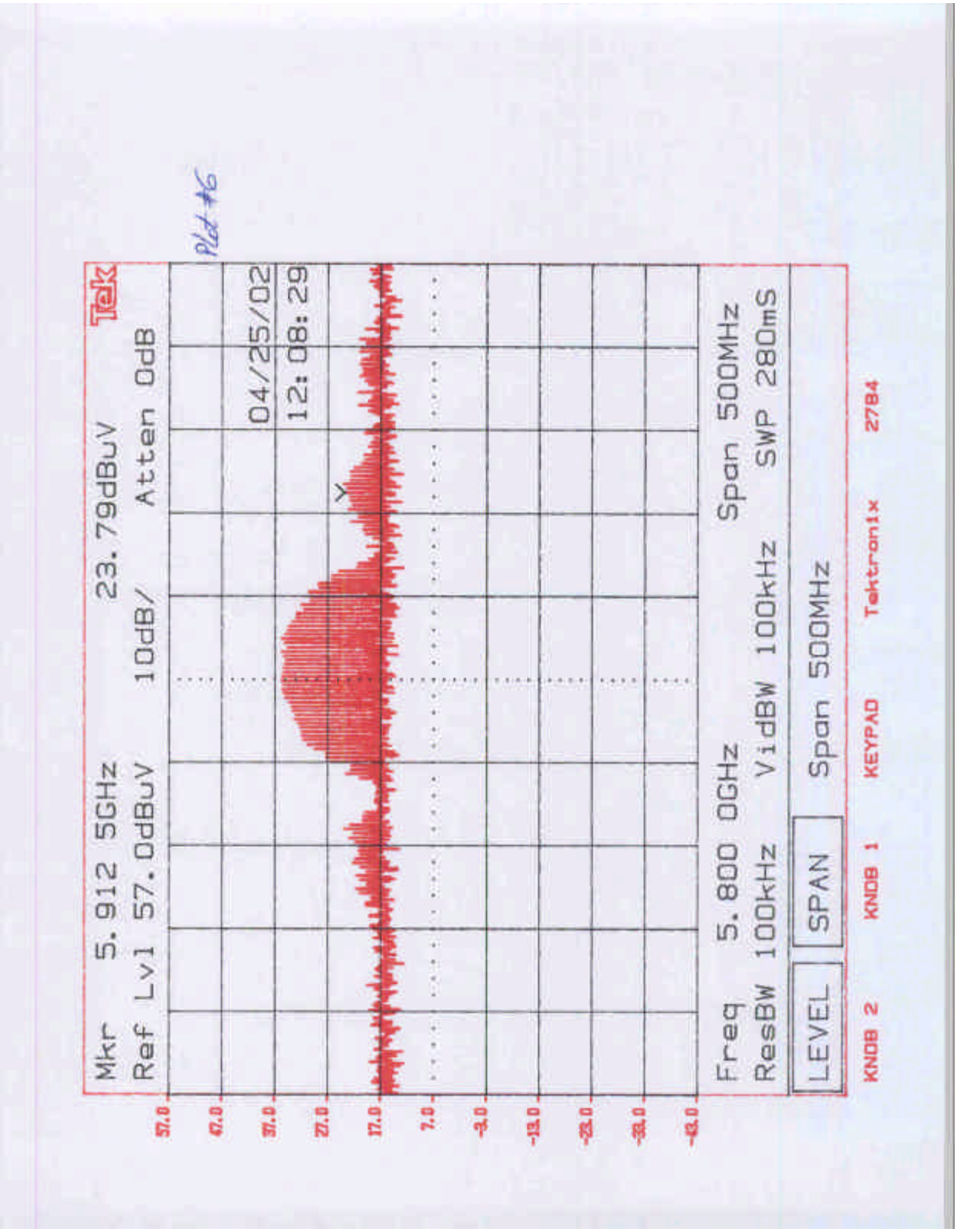

Plot #1
Tek
MKr 5.802 8GHz
Ref Lvl 57.0dBuV
36.69dBuV
10dB/
Atten 0dB
04/25/02
11:56:06
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0
Freq 5.800 0GHz
ResBW 100kHz
VidBW 100kHz
Span 200MHz
SWP 110mS
LEVEL
SPAN
ResBW 100kHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784

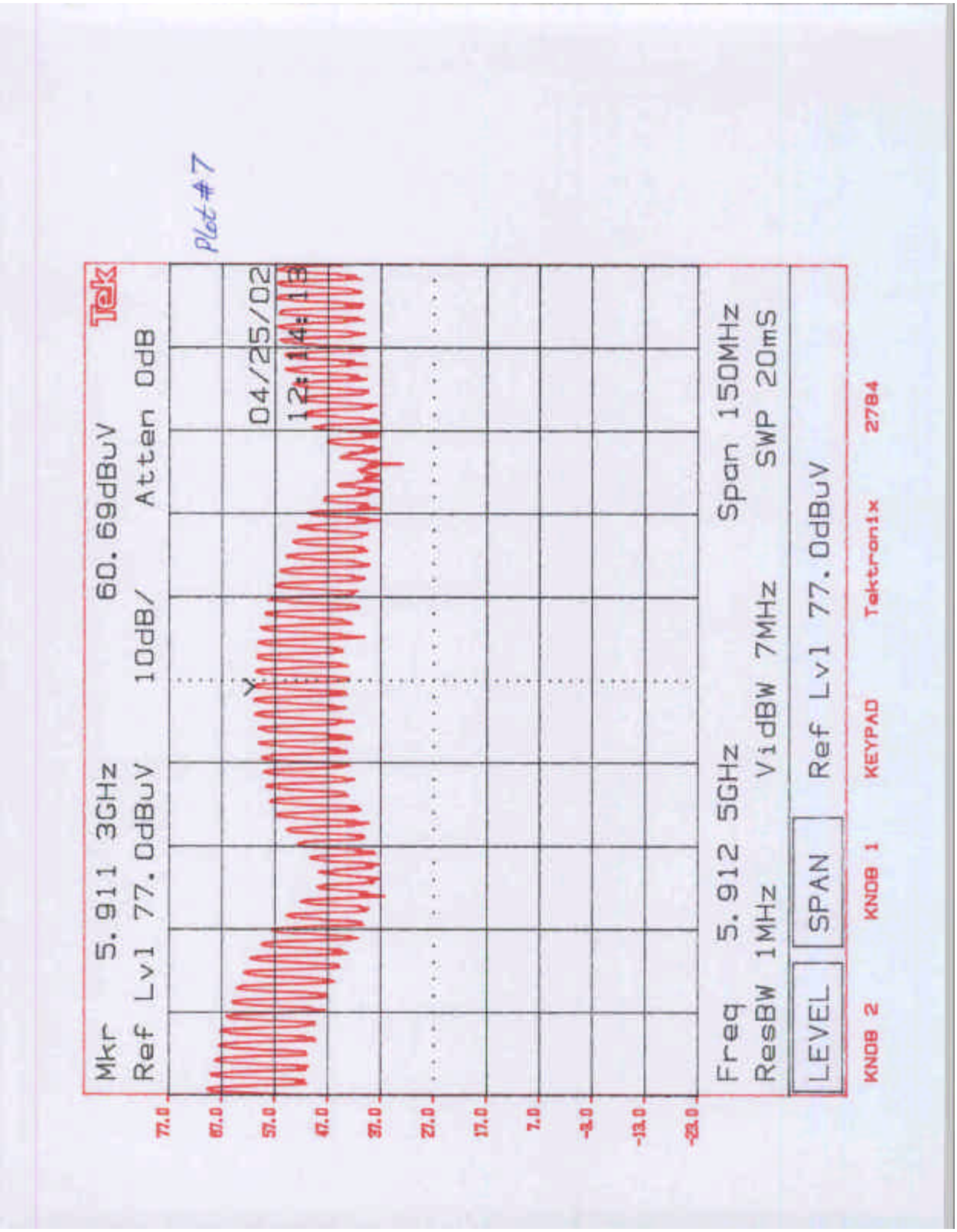

Plot #2
Tek
Mkr 5.875 0GHz
Ref Lvl 57.0dBuV
19.69dBuV
10dB/
Atten 0dB
04/25/02
11:59:00
Freq 5.800 0GHz
ResBW 100kHz
VidBW 100kHz
Span 200MHz
SWP 110mS
LEVEL
SPAN
ResBW 100kHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0

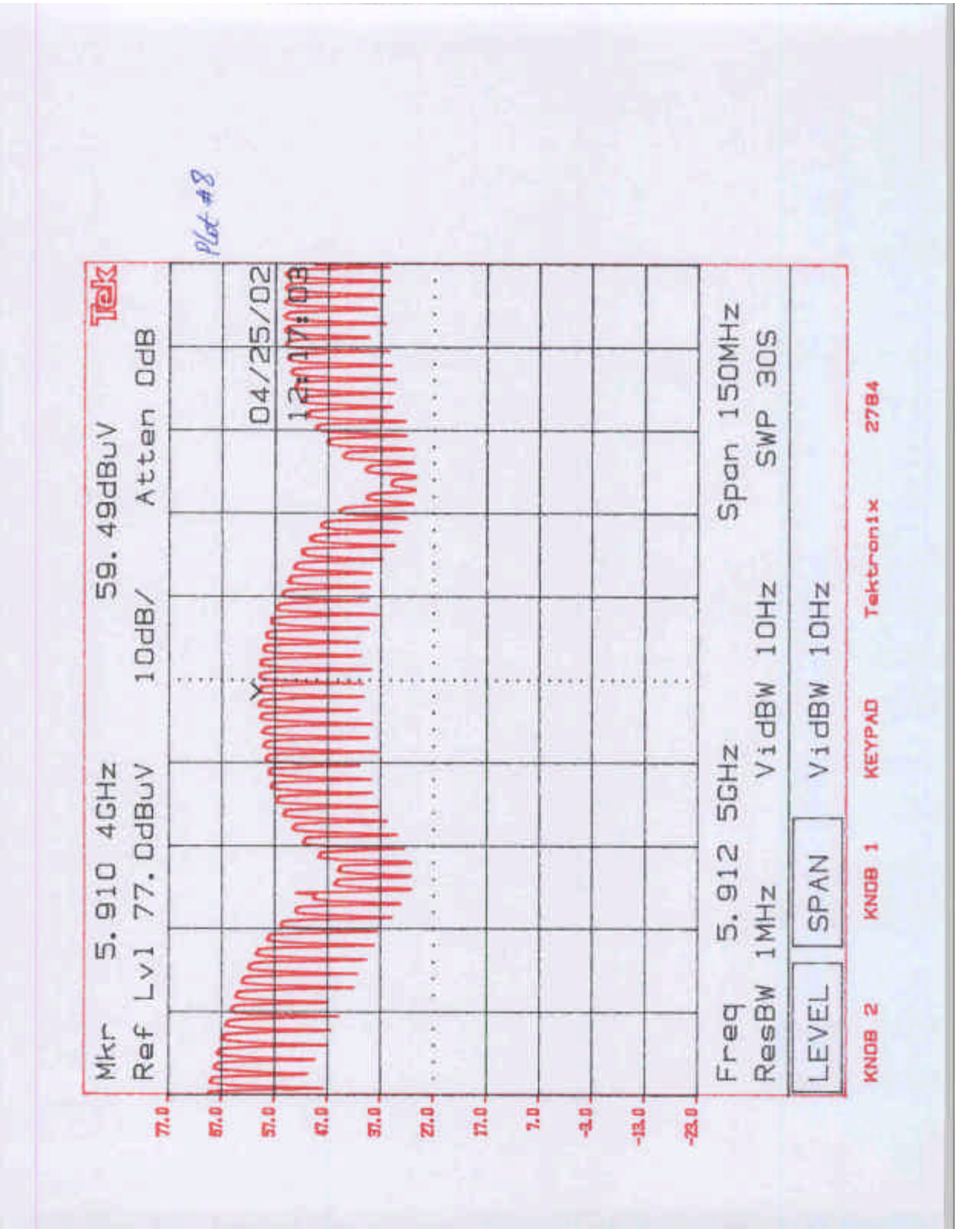

Plot #3
Tek
Mkr 5.725 0GHz
Ref Lvl 57.0dBuV
20.29dBuV
10dB/
Atten 0dB
04/25/02
12:01:49
Freq 5.800 0GHz
ResBW 100kHz
VidBW 100kHz
Span 200MHz
SWP 110mS
LEVEL
SPAN
ResBW 100kHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0

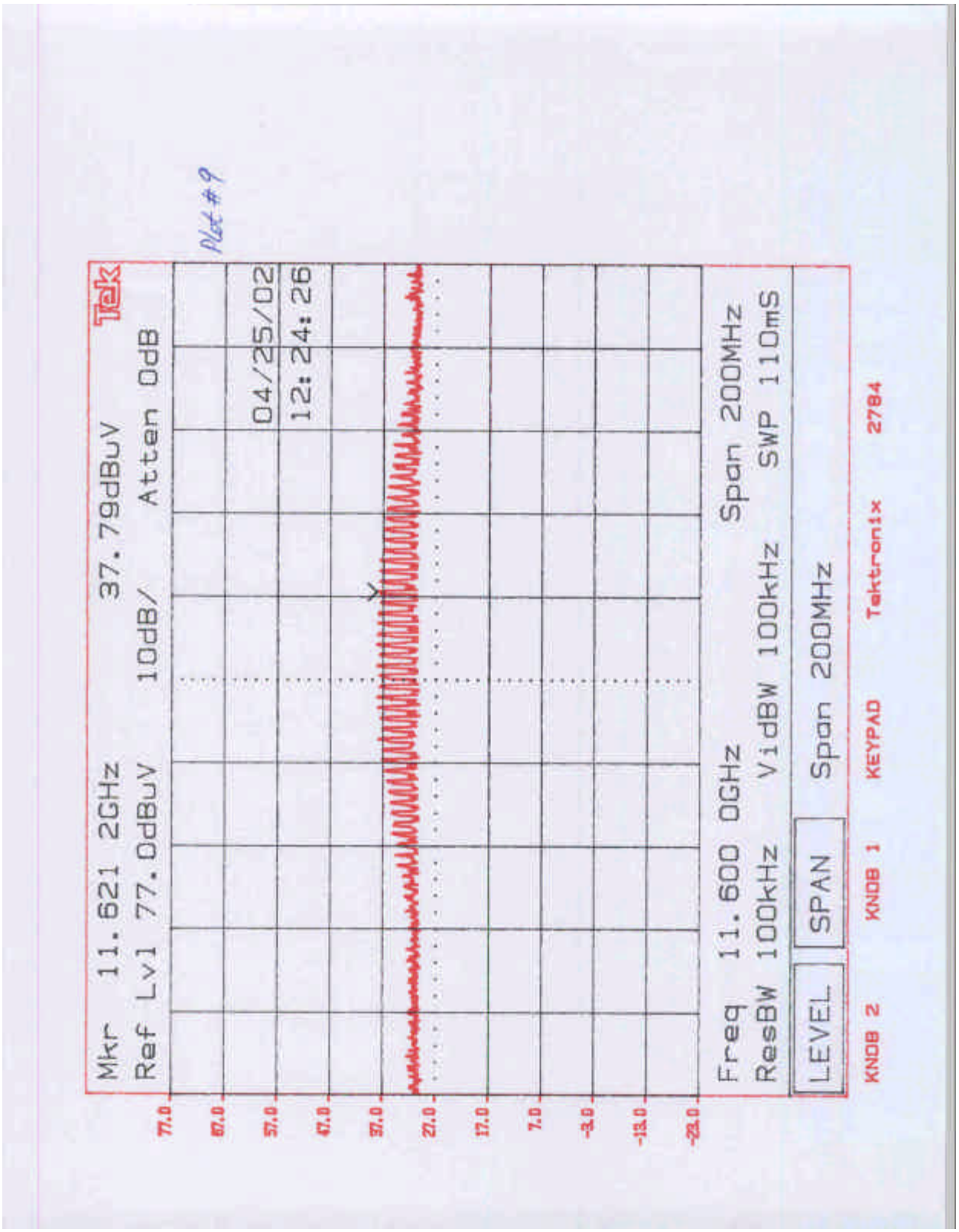

Plot 4
MkrΔ 2.46MHz
Δ-0.20dB
Ref Lvl 67.0dBuV
10dB/
Atten 0dB
PRECO
04/16/02
12:04:57
Freq 5.799 60GHz
Span 20MHz
ResBW 100kHz
VidBW 10kHz
SWP 50mS
LEVEL
SPAN
Ref Lvl 67.0dBuV
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0

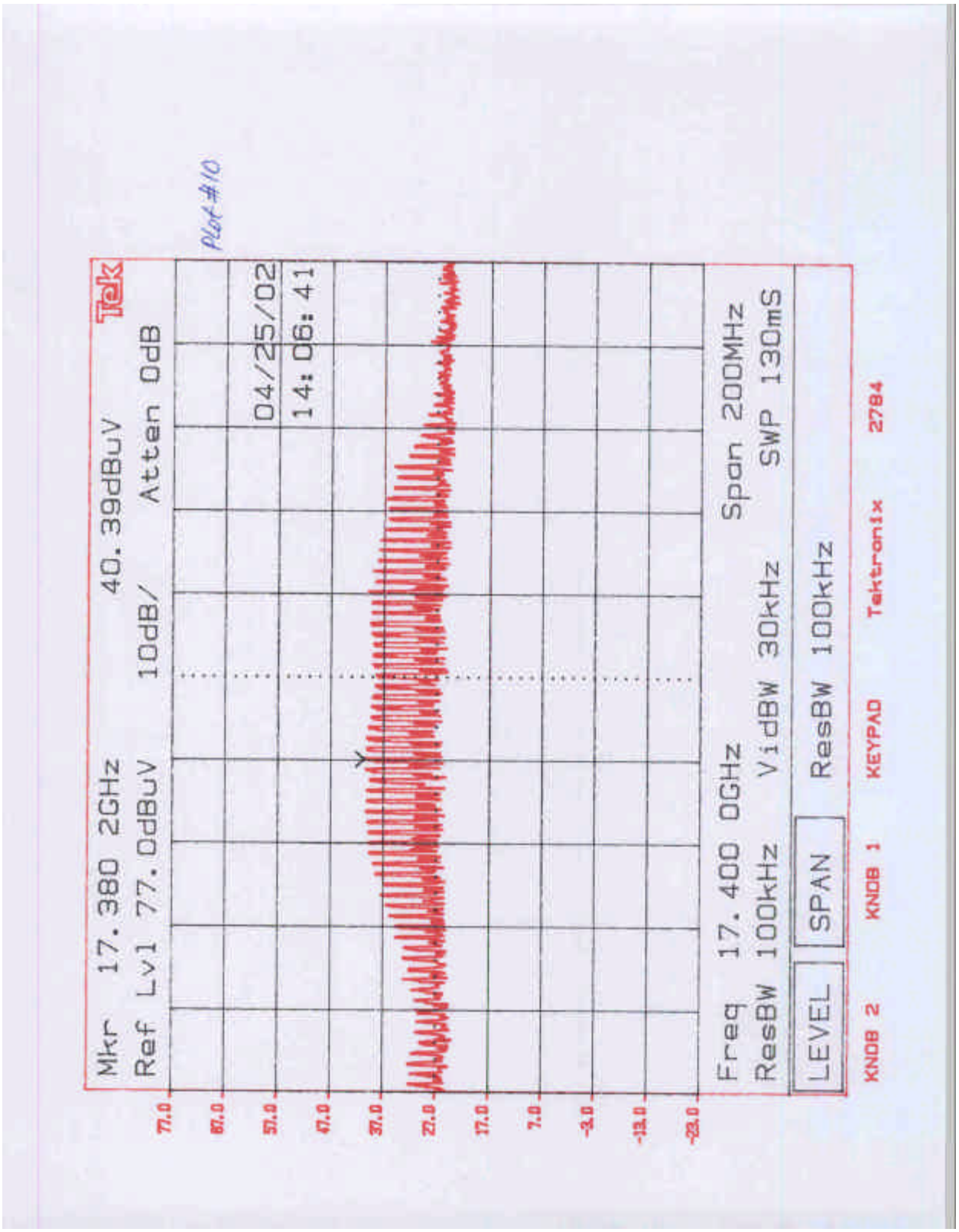

Plot #5
Tek
Mkr Δ148.0MHz
Ref Lvl 57.0dBuV
Δ-0.40dB
10dB/
Atten 0dB
04/25/02
12:04:39
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0
Freq 5.800 0GHz
Span 200MHz
ResBW 100kHz
VidBW 100kHz
SWP 110mS
LEVEL
SPAN
ResBW 100kHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784


Plot #6
Tek
Mkr 5.912 5GHz 23.79dBuV
Ref Lvl 57.0dBuV 10dB/ Atten 0dB
04/25/02
12:08:29
Freq 5.800 0GHz Span 500MHz
ResBW 100kHz VidBW 100kHz SWP 280mS
LEVEL SPAN Span 500MHz
KNOB 2 KNOB 1 KEYPAD Tektronix 2784
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
-33.0
-43.0


Plot #7
Tek
Mkr 5.911 3GHz 60.69dBuV
Ref Lvl 77.0dBuV 10dB/ Atten 0dB
04/25/02
12:14:18
Freq 5.912 5GHz Span 150MHz
ResBW 1MHz VidBW 7MHz SWP 20mS
LEVEL SPAN Ref Lvl 77.0dBuV
KNOB 2 KNOB 1 KEYPAD Tektronix 2784
77.0
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0


Plot #8
Tek
MKr 5.910 4GHz 59.49dBuV
Ref Lvl 77.0dBuV 10dB/ Atten 0dB
04/25/02
12:17:03
Freq 5.912 5GHz Span 150MHz
ResBW 1MHz VidBW 10Hz SWP 30S
LEVEL SPAN VidBW 10Hz
KNOB 2 KNOB 1 KEYPAD Tektronix 2784
77.0
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0


Plot #9
Tek
Mkr 11.621 2GHz
Ref Lvl 77.0dBuV
37.79dBuV
10dB/
Atten 0dB
04/25/02
12:24:26
77.0
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0
Freq 11.600 0GHz
ResBW 100kHz
VidBW 100kHz
Span 200MHz
SWP 110mS
LEVEL
SPAN
Span 200MHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784


Plot #10
Tek
Mkr 17.380 2GHz
Ref Lvl 77.0dBuV
40.39dBuV
10dB/
Atten 0dB
04/25/02
14:06:41
Freq 17.400 0GHz
ResBW 100kHz
VidBW 30kHz
Span 200MHz
SWP 130mS
LEVEL
SPAN
ResBW 100kHz
KNOB 2
KNOB 1
KEYPAD
Tektronix
2784
77.0
67.0
57.0
47.0
37.0
27.0
17.0
7.0
-3.0
-13.0
-23.0

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.