Application for Type Acceptance for an RF Power Amplifier

TPL Communications

3370 San Fernando Rd. # 206

Los Angeles, CA 90065

RF Power Amplifier:

Part # PA6-1EE-LMS

FCC ID: BBD6-1EE-L

Report # RA054489/80112

This report was prepared in accordance with the requirements of FCC rules and regulations Part 2, Subpart J, 2.981 thru 2.1005, Part 22, Part 90, and other applicable sections of the rules as indicated herein..

Prepared By:

Jake Tynes

DNB ENGINEERING, INC.
3535 W. Commonwealth Ave.
Fullerton, Ca 92833

27 February 1998

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1.0 ADMINISTRATIVE DATA

1.1 Certifications and Qualifications

I certify that the tests performed in order to obtain the technical data presented in this application were performed by **DNB ENGINEERING, INC.** Also, based on the results of the enclosed data, I have concluded that the equipment tested meets or exceeds the requirements of the Rules and Regulations governing this application.

1.2 Measurement Repeatability Information

The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2.981 through 2.1005, Part 22, and Part 90. The test results presented in this document are valid only for the equipment identified herein under the test conditions described. Repeatability of these test results will only be achieved with identical measurement conditions. These conditions include the same test distance, EUT height, measurement site characteristics, and the same EUT and system components. The system must have the same interconnecting cables arranged in identical placement to that shown in the setup photos, with the system and/or EUT functioning in the identical mode of operation (i.e. software and so on) as on the date of the test. Any deviation from the test conditions and environment on the date of test may result in measurement repeatability difficulties.

All changes made to the EUT during the course of testing as identified in this report must be incorporated in the EUT or identical models to ensure compliance with the FCC regulations.

Bryan Broaddus Par. 1.1
Manager, Test Department
DNB ENGINEERING, INC.
Phone # (714) 870-7781

2.983(a) Request For Type Acceptance

Name of Applicant: TPL Communications
3370 San Fernando Rd. # 206
Los Angeles, CA 90065

Applicant is:
_X_ Manufacturer
____ Vendor
____ Licensee
____ Prospective Licensee
____ Other

Name of Manufacturer: TPL Communications

2.983(b) Equipment Description

The EUT is an RF Power Amplifier.

Part Number: PA6-1EE-LMS

FCC ID: BBD6-1EE-L

2.983(c) Anticipated Production Quantity

____ One Unit
_X_ Multiple Units

2.983(d) **Technical Description**

See the Service Manual Included in Appendix B herein for the complete description.

2.983(d)(1) **Type(s) of Emissions**

F3E

2.983(d)(2) **Frequency Range**

450 - 470 MHz

2.983(d)(3) **Operating Power Level**

100 Watts

100 mW Input Power

2.983(d)(4) Maximum Power Allowed in Applicable Part(s) of the Rules

Rules Part	Maximum Power (Watts)
Part 22	500 Watts
Part 90	500 Watts

2.983(d)(5) Final RF Amplifier Input Power

Measurement	450 MHz	460 MHz	470 MHz
Driver Voltage	10 V	7.8 V	8.0 V
Final Voltage	13.8 V	13.7 V	13.7 V
A Current	2.0 A	1.6 A	1.6 A
B Current	16.6 A	15.6 A	15.1 A
Total Current	18.6 A	17.2 A	16.7 A

2.983(d)(6) Function of all Active Circuit Devices

Please refer to Appendix B.

2.983(d)(7) **Circuit Diagram**

Refer to Figure in Appendix B.

2.983(d)(8) **Instruction Book(s)**

See Appendix B

2.983(d)(9) **Tune-Up Procedure**

Refer to Appendix B.

Circuit Diagram
2.983(d)(7)

SEE FIGURE IN APPENDIX B

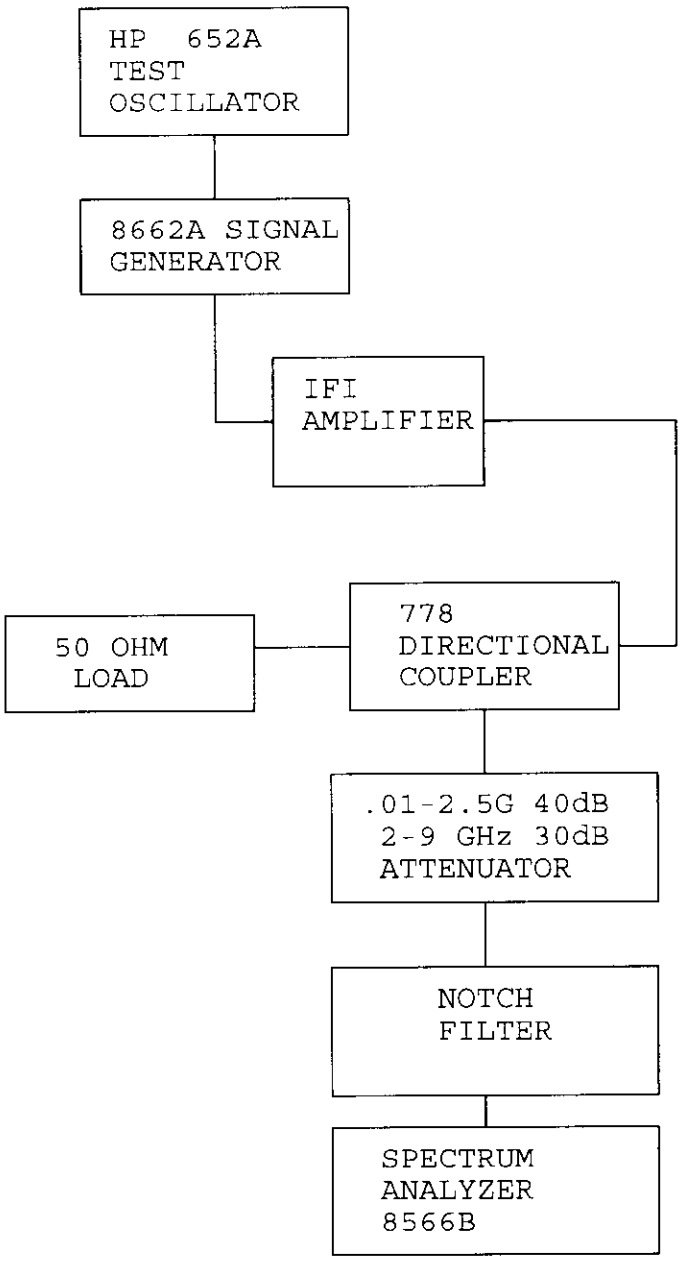


FIGURE 2. BLOCK DIAGRAM.
(POWER INPUT/OUTPUT TESTS)

2.983(e) **Test Data**

Refer to 2.983(e)(1) through 2.983(e)(7)

2.983(e)(1) **Measurement of RF Power Output per 2.985**

Definition: For RF Power Amplifiers.

Test Method: See Figure 2.
Output power is measured across a precision 50 ohm load with a wide-band sampling RF voltmeter.

Test Results:

	POWER OUTPUT		
Frequency	Nominal Voltage 115 VAC	85% Voltage 97.75 VDC	115% Voltage 132.25 VDC
450 MHz	100.0 W	100.0 W	100.0 W
460 MHz	100.0 W	100.0 W	100.0 W
470 MHz	100.0 W	100.0 W	100.0 W

2.983(e)(2) **Measurement of Modulation Characteristics per 2.987(b)(1)**

This EUT is a power amplifier and contains no circuitry to modify the RF signal provided by the driver except to raise the power level.

2.983(e)(3) Measurement of Occupied Bandwith per 2.989

Definition: Occupied bandwith, that is the frequency bandwith such that, below its lower and above its upper frequency limits, the mean power radiated by a given emission.

Test Method: Connect the equipment per Figure 3.

Measurements were made with the modulating signal at 2.5 kHz with 5 kHz of FM deviation.

Test Results: See Plots following Figure 3.

The center frequency of the signal did not shift with modulation. The spectrum bandwith was well within the limits specified in the FCC regulations

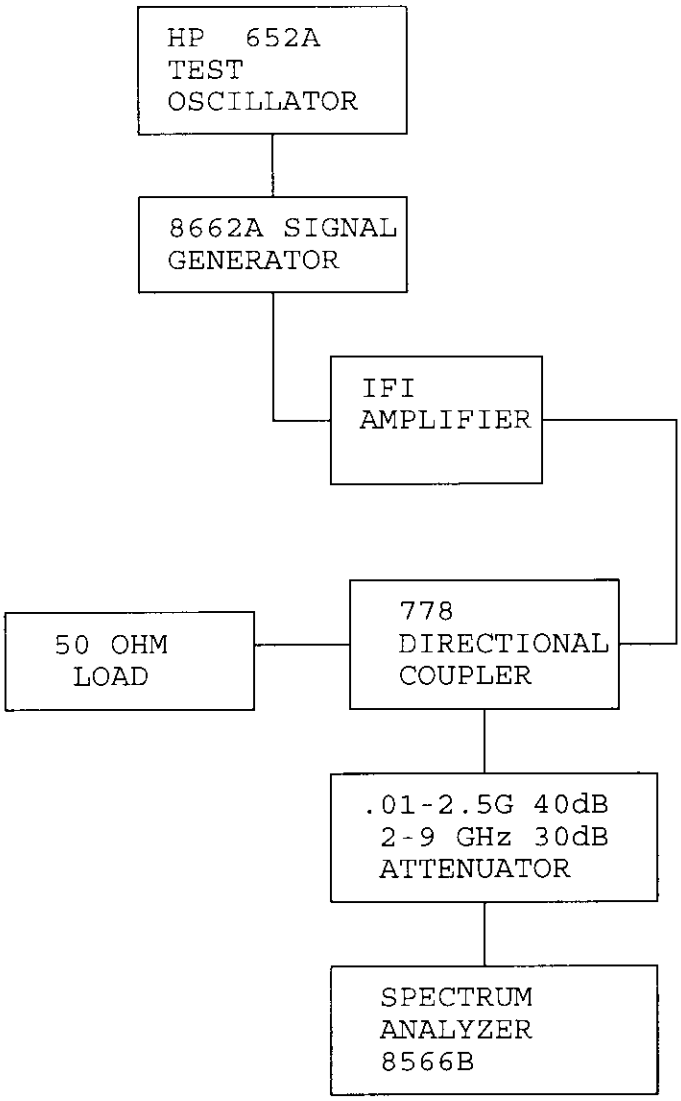
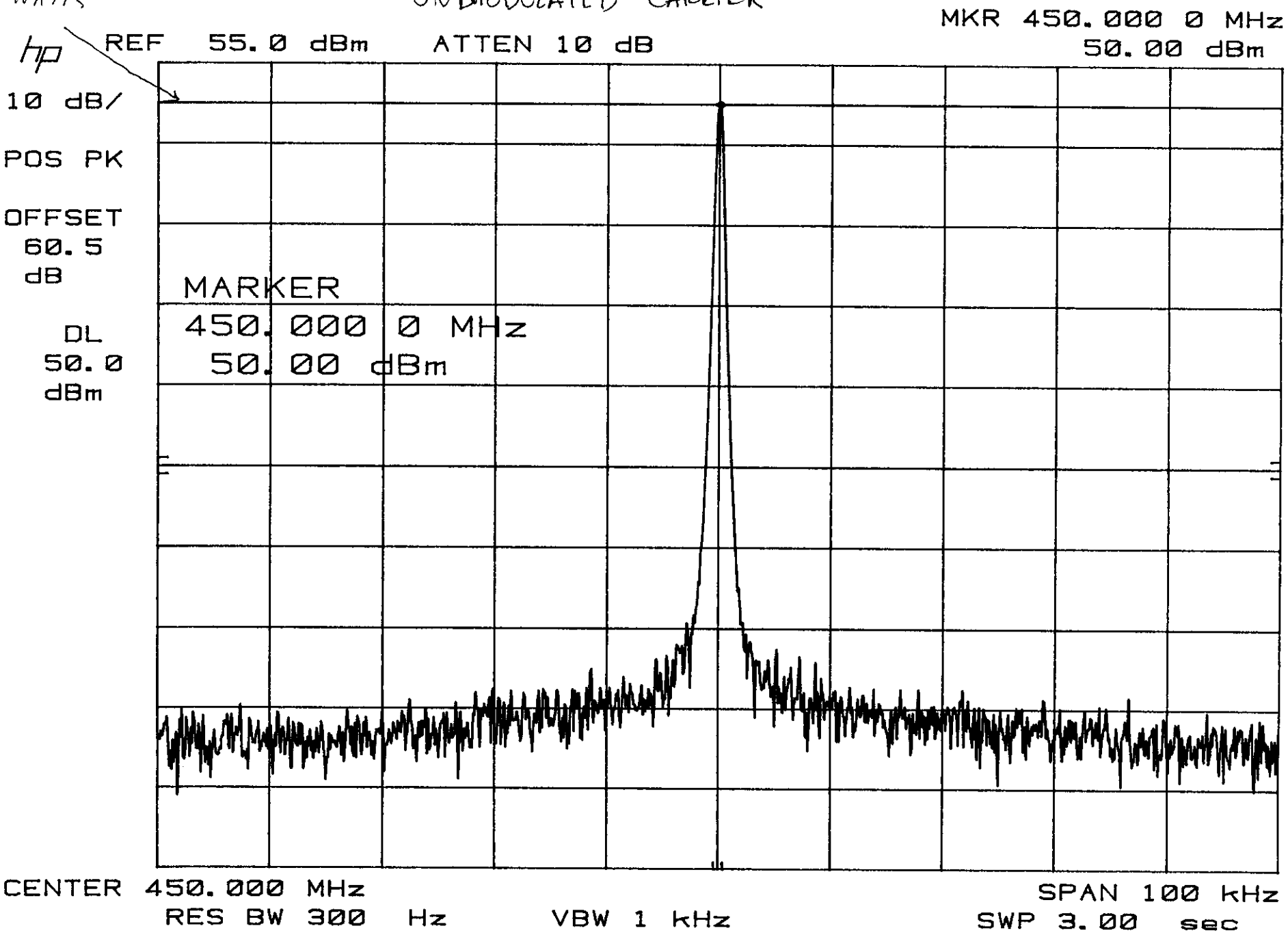


FIGURE 3. BLOCK DIAGRAM.
(OCCUPIED BANDWITH)

PAG - IEE - LMS

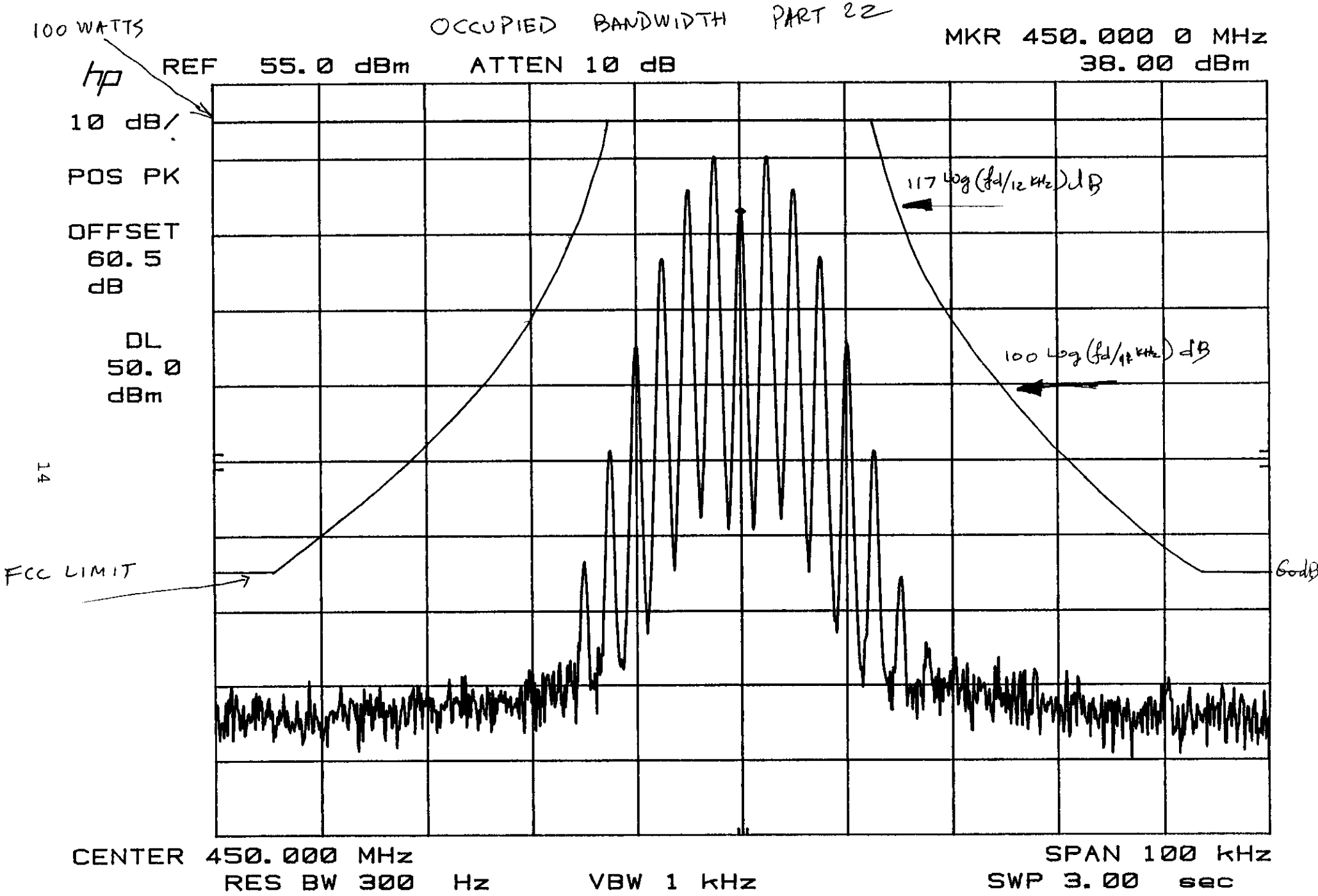
UNMODULATED CARRIER

100 WATTS



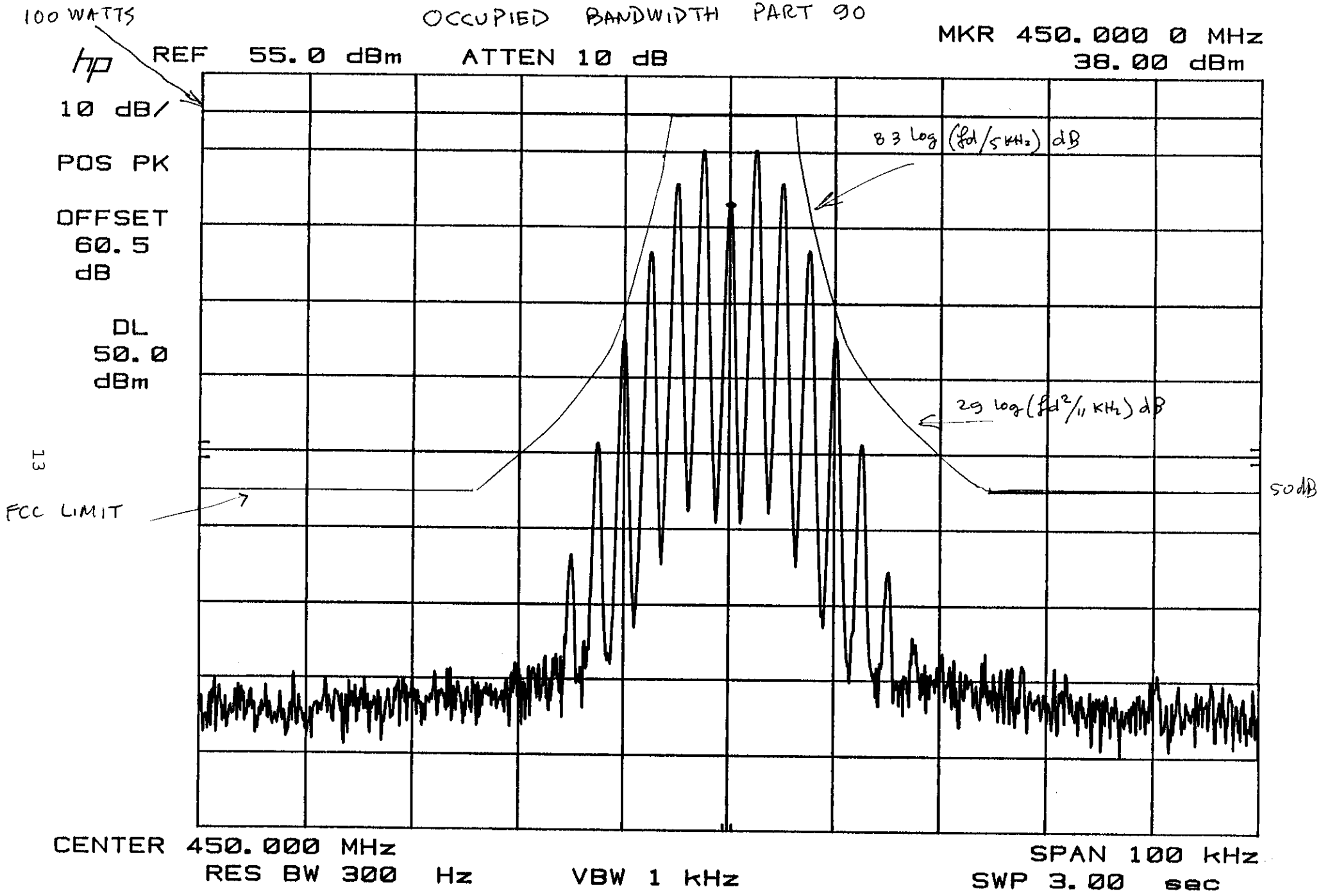
PA6_IEE-LMS

OCCUPIED BANDWIDTH PART 22

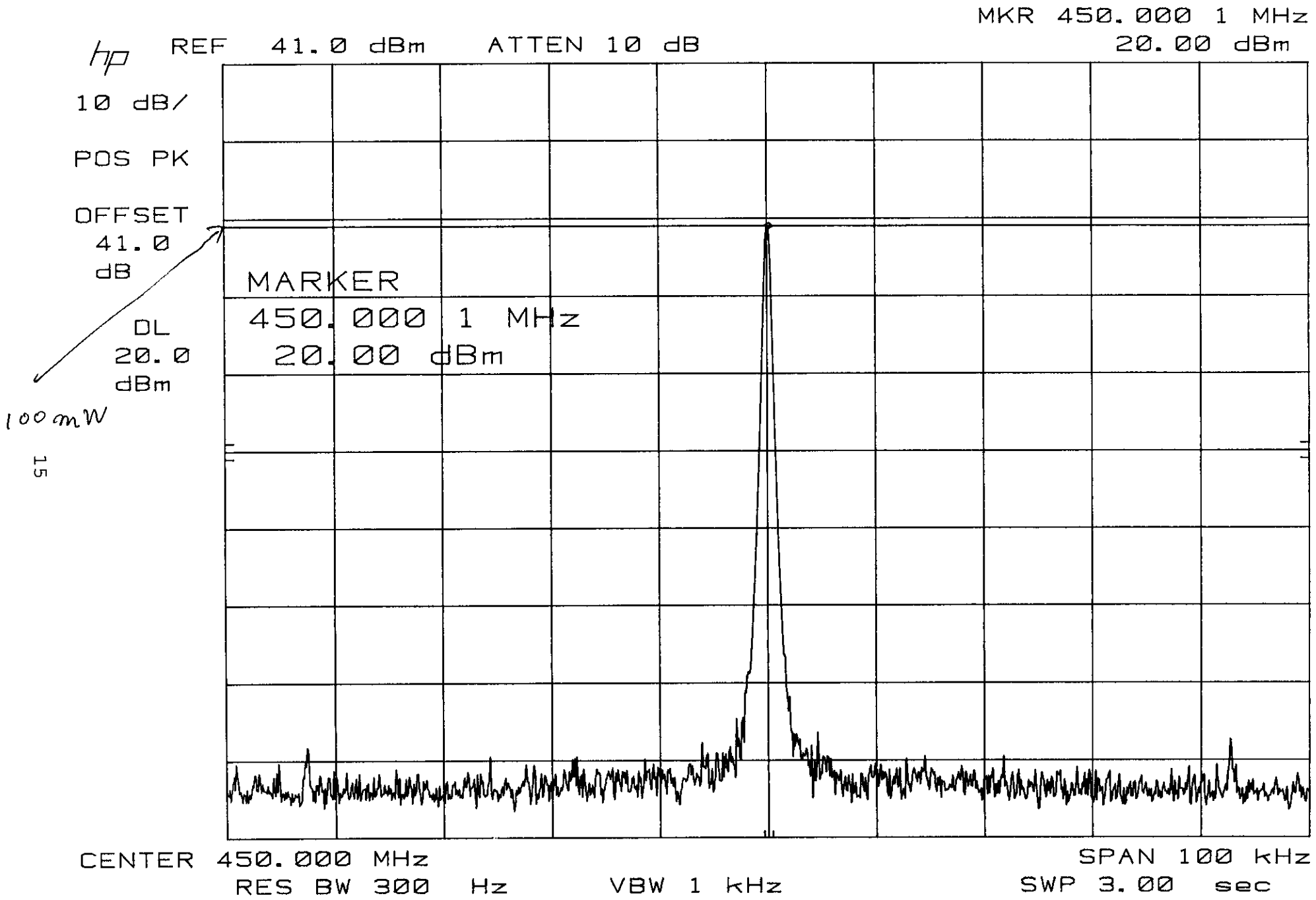


PAG_IEE-LMS

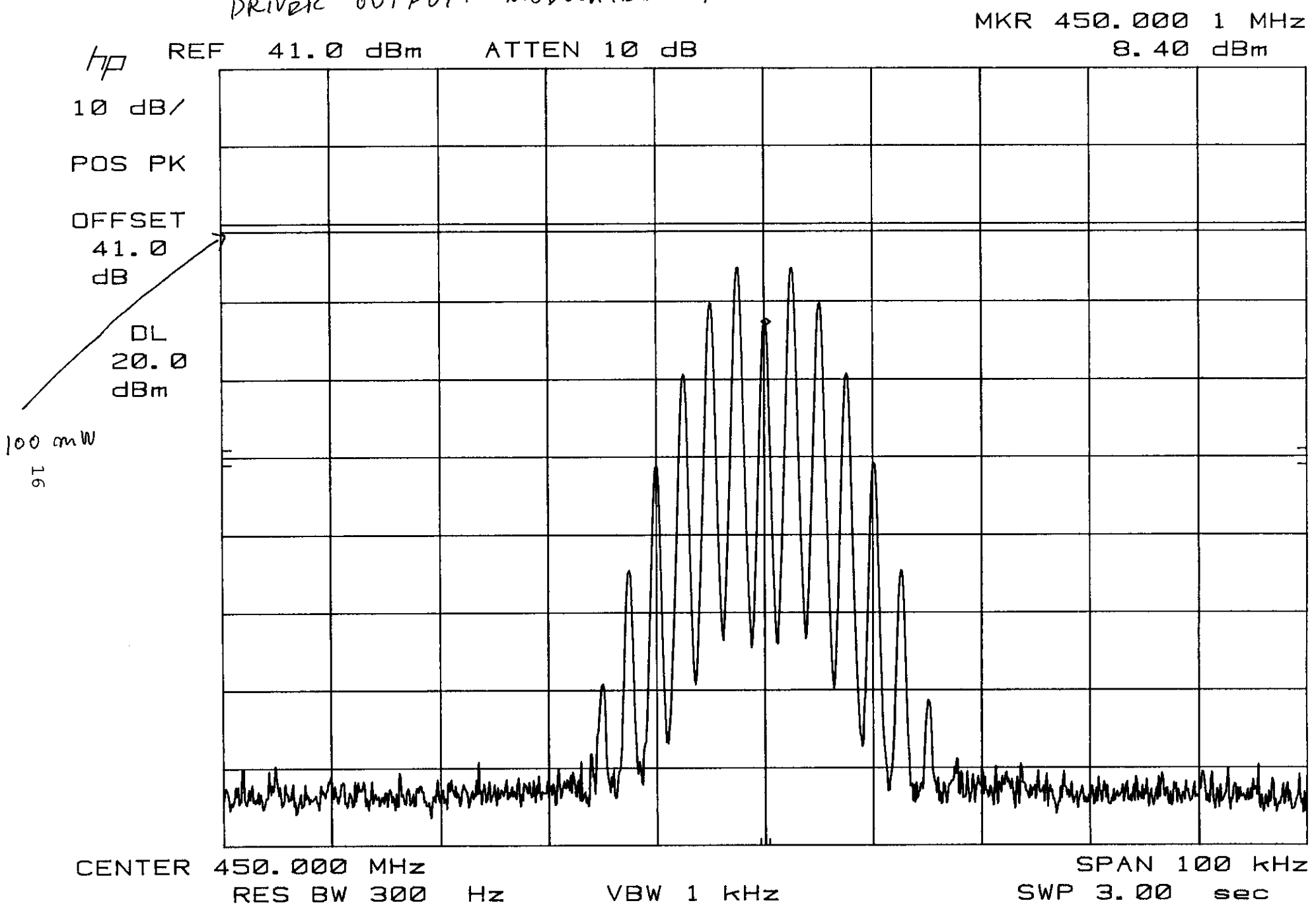
OCCUPIED BANDWIDTH PART 90



DRIVER OUTPUT : UNMODULATED CARRIER

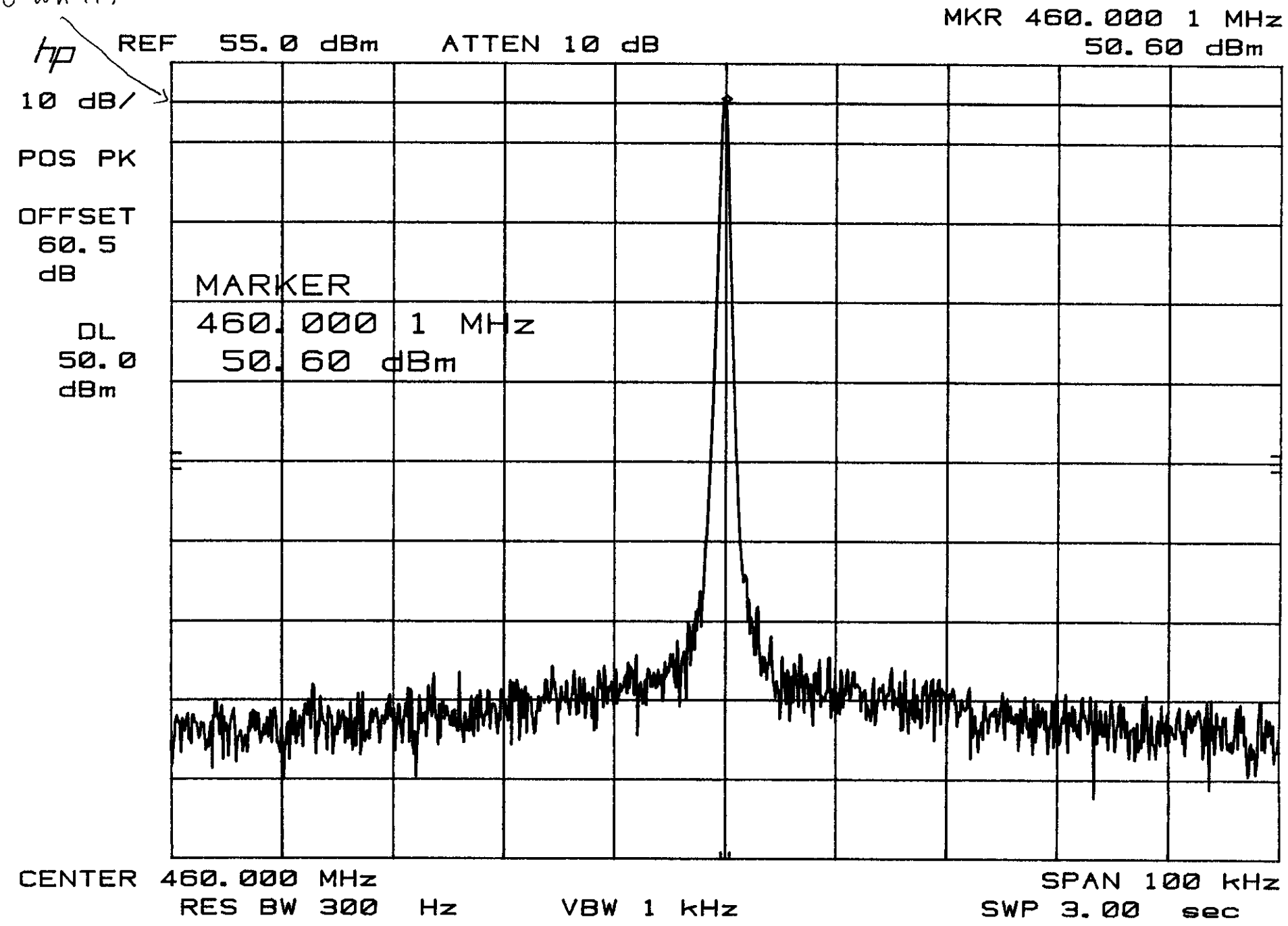


DRIVER OUTPUT: MODULATED CARRIER

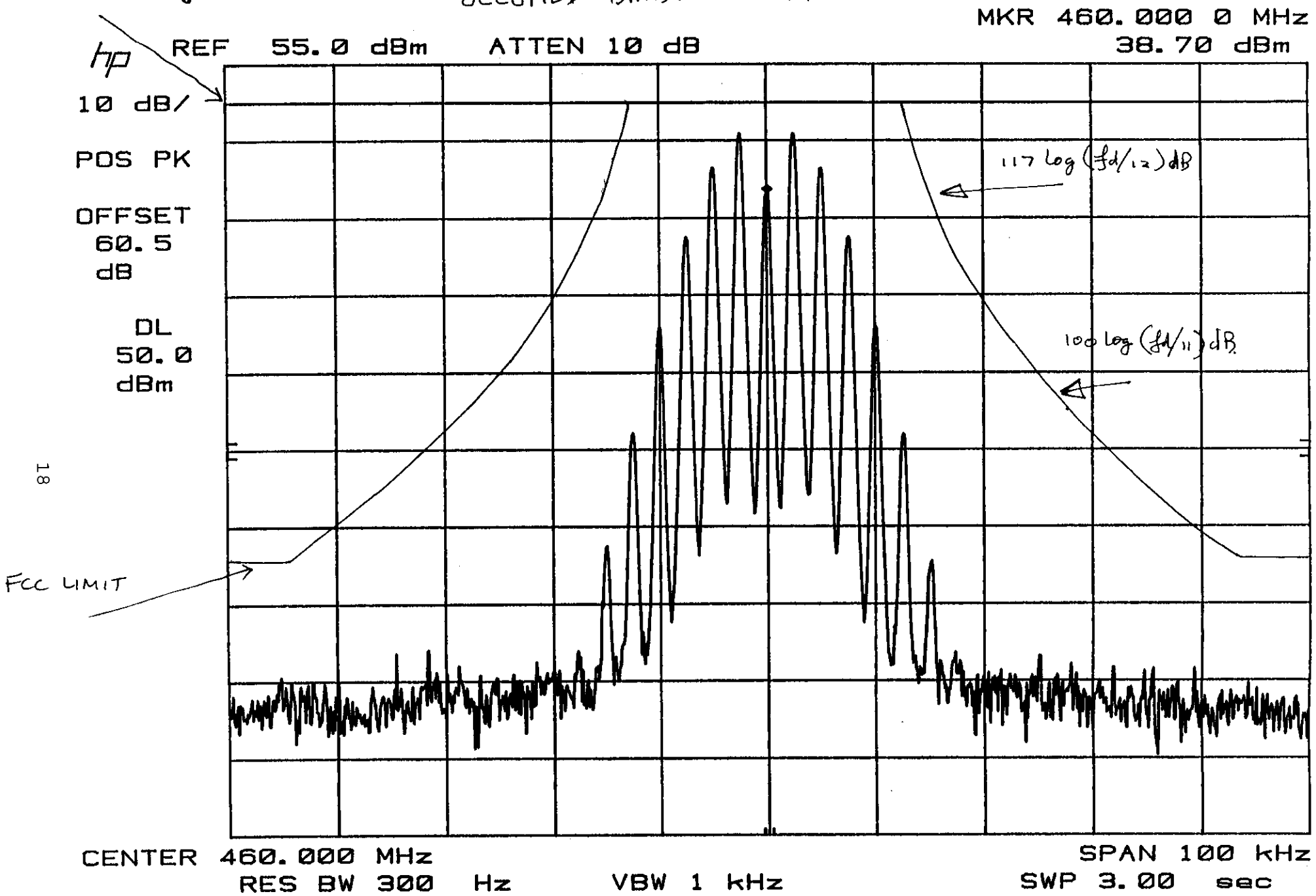


PAG - IEE - LMS
UNMODULATED CARRIER.

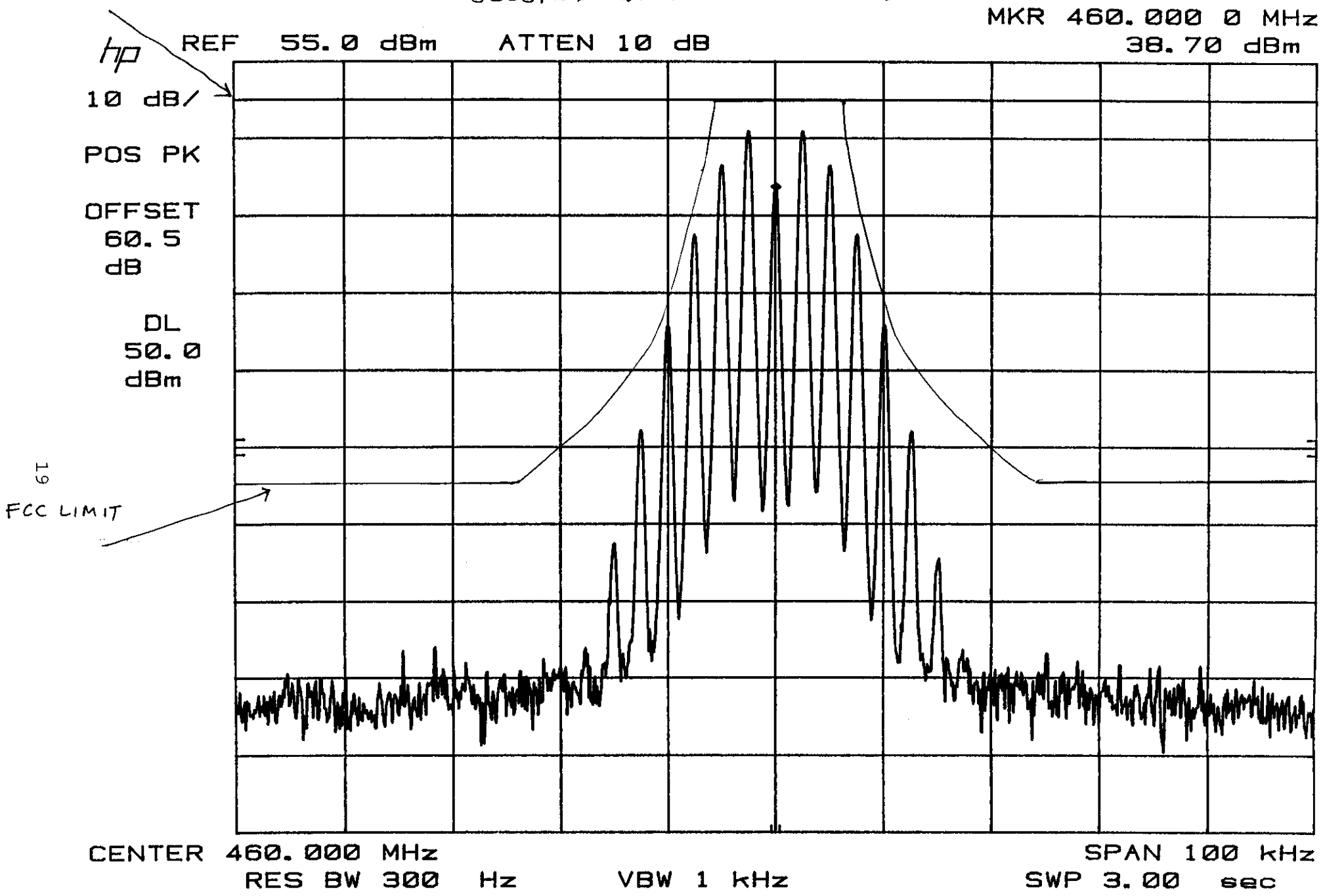
100 WATTS



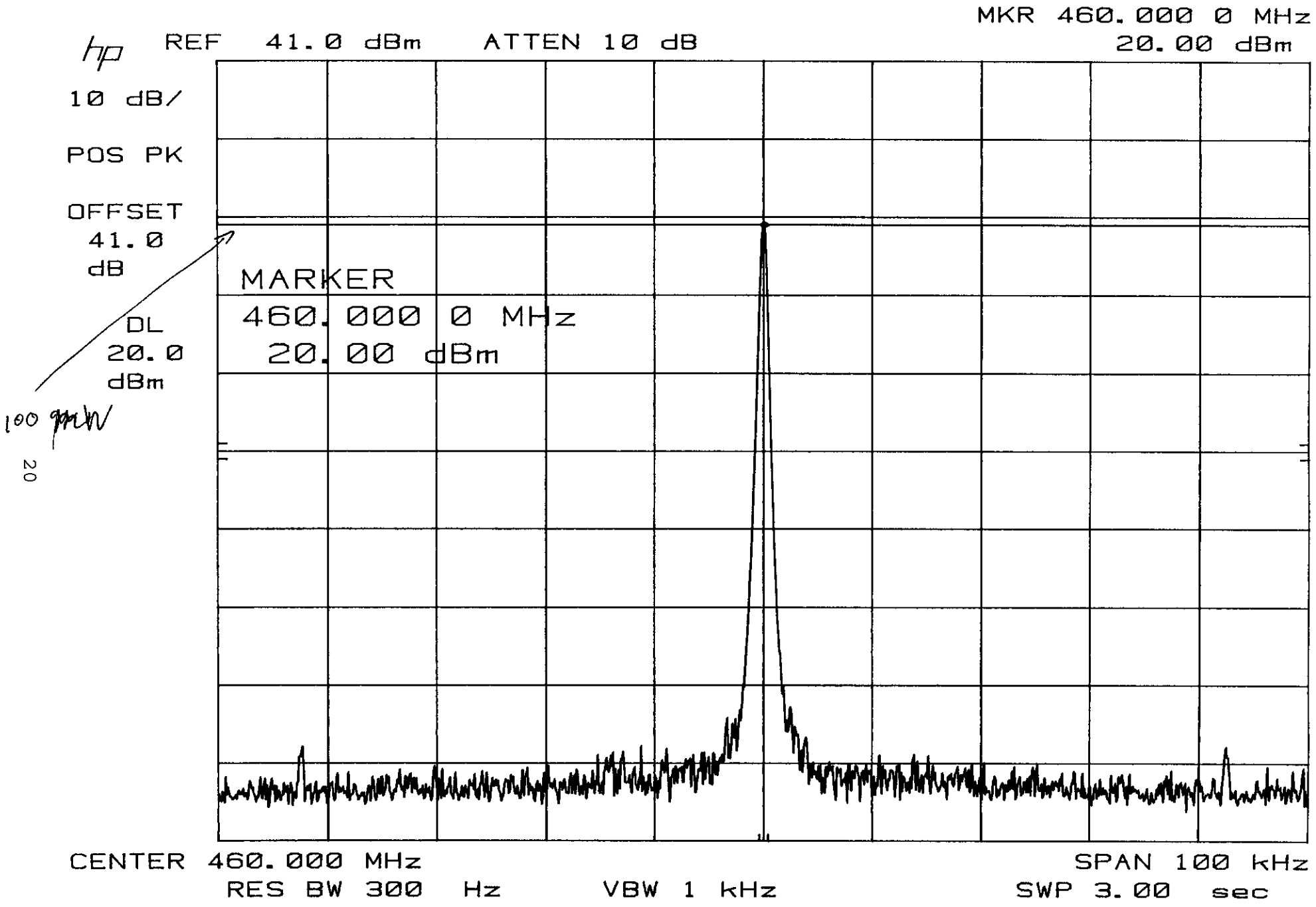
PA6 - IEE - LMS
OCCUPIED BANDWIDTH PART 22



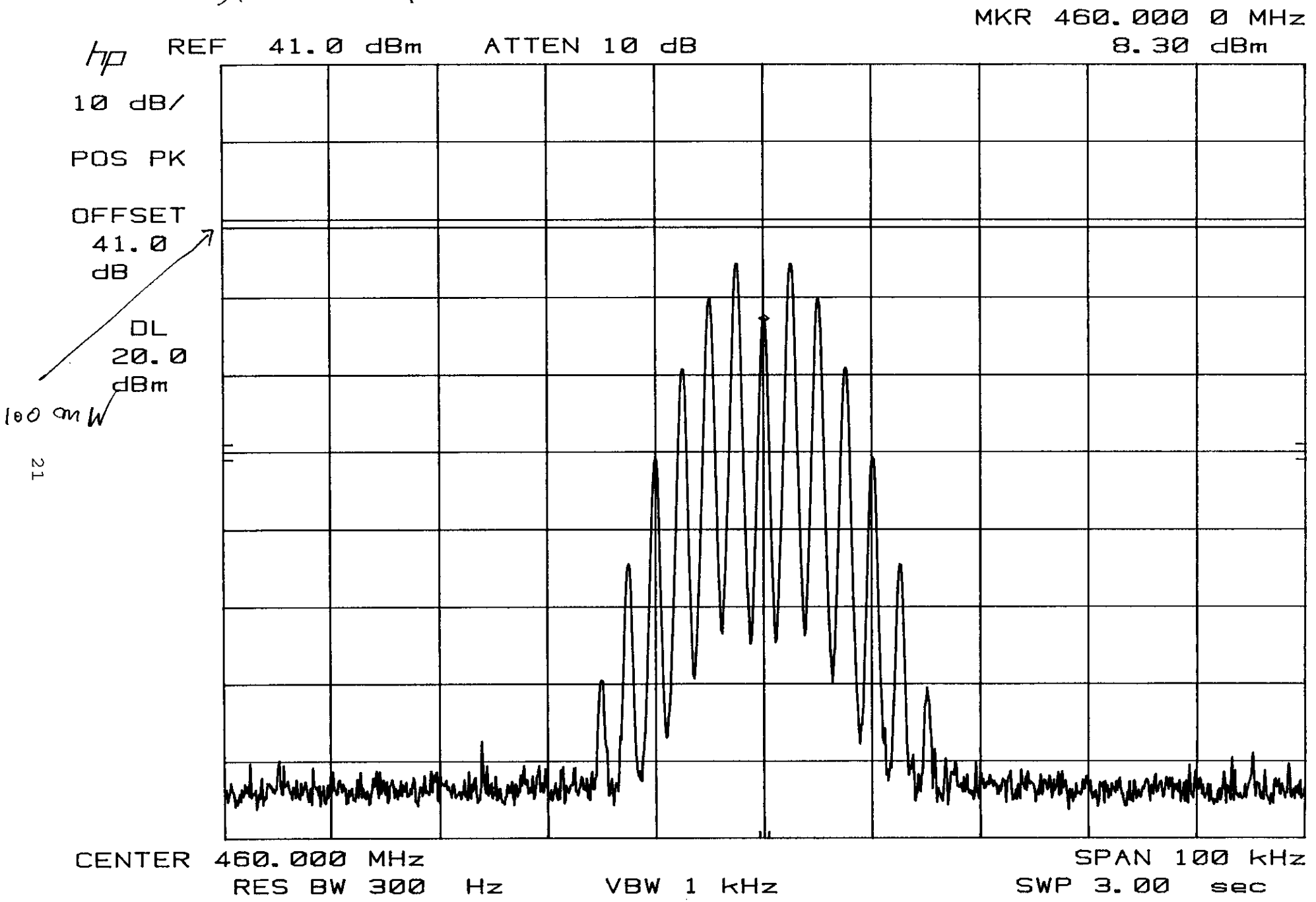
PA6 - IEE - LMS
OCCUPIED BANDWIDTH PART 90



DRIVER OUTPUT : UNMODULATED CARRIER

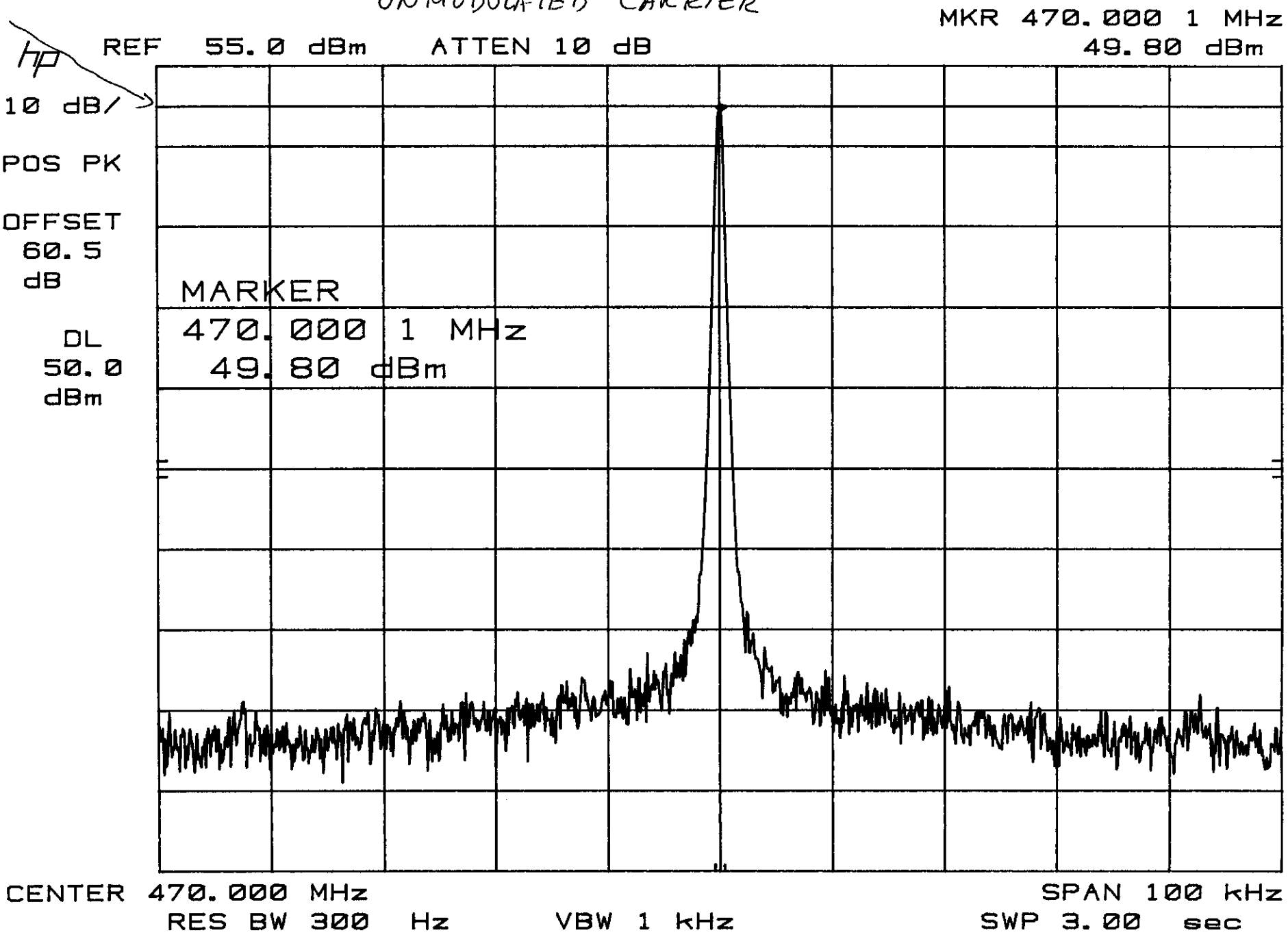


DRIVER OUTPUT : MODULATED CARRIER



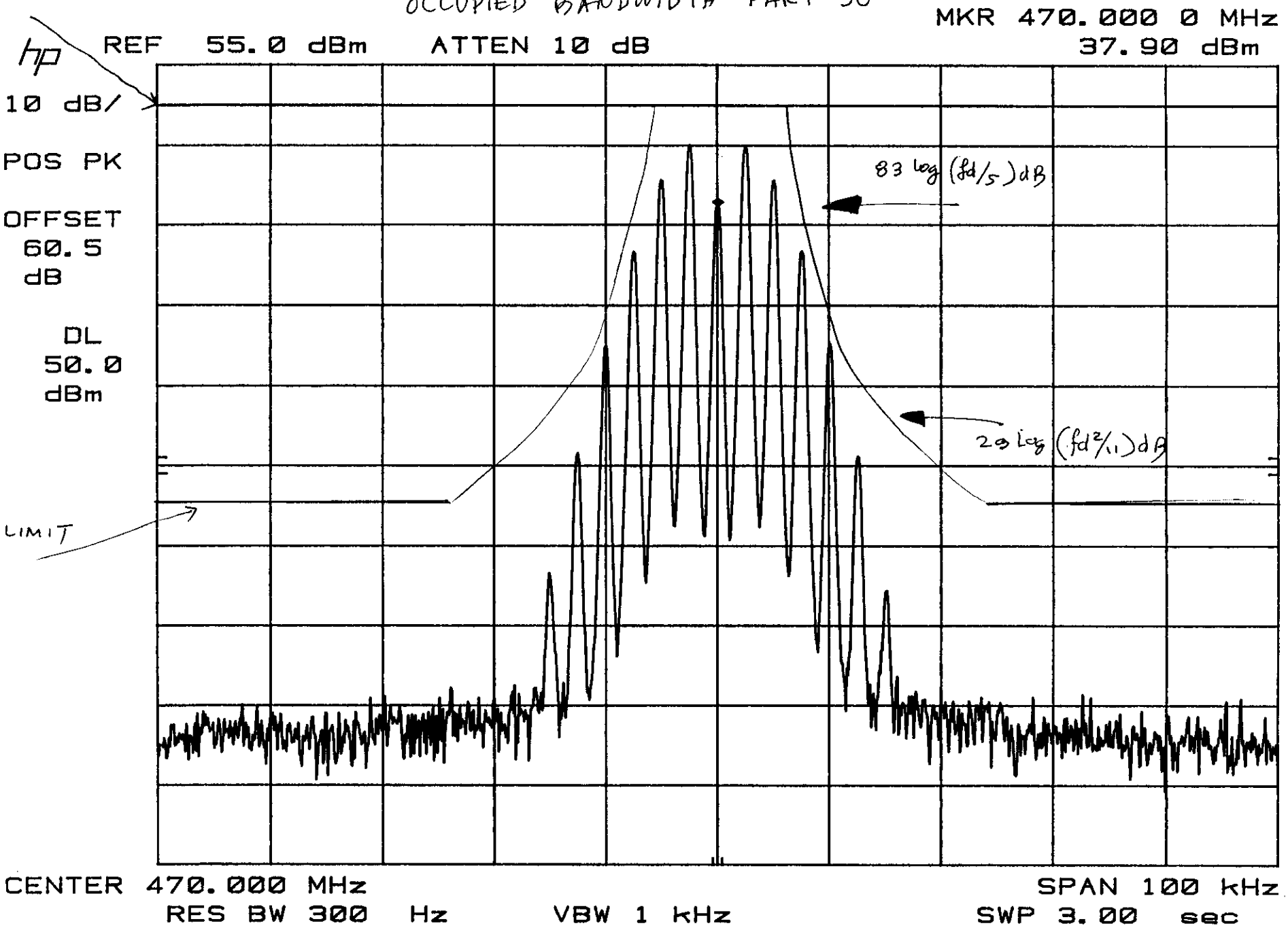
100 WATTS

PAG - IEE - LMS
UNMODULATED CARRIER



100 WATTS

PA6-IEE-LMS
OCCUPIED BANDWIDTH PART 90



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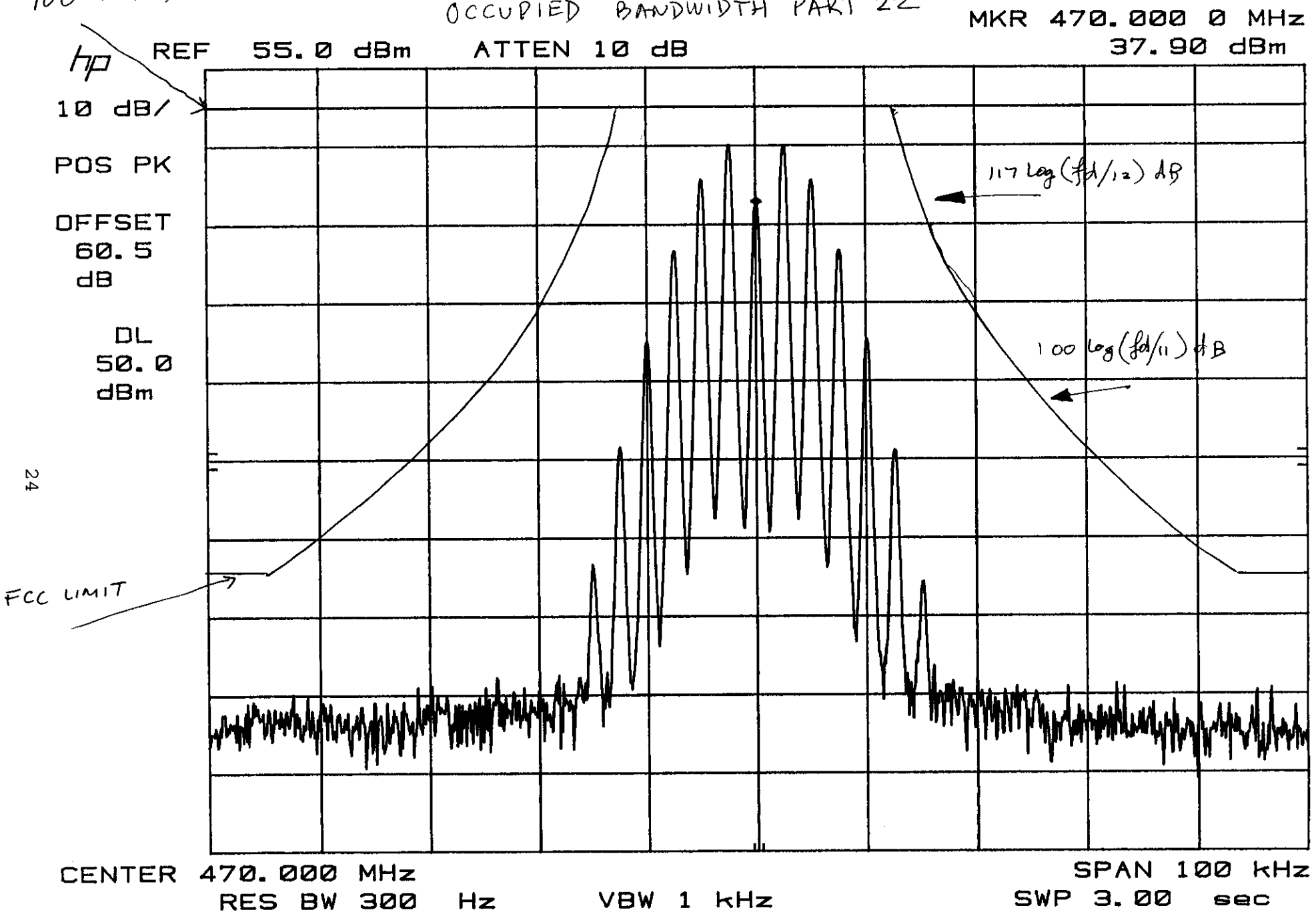
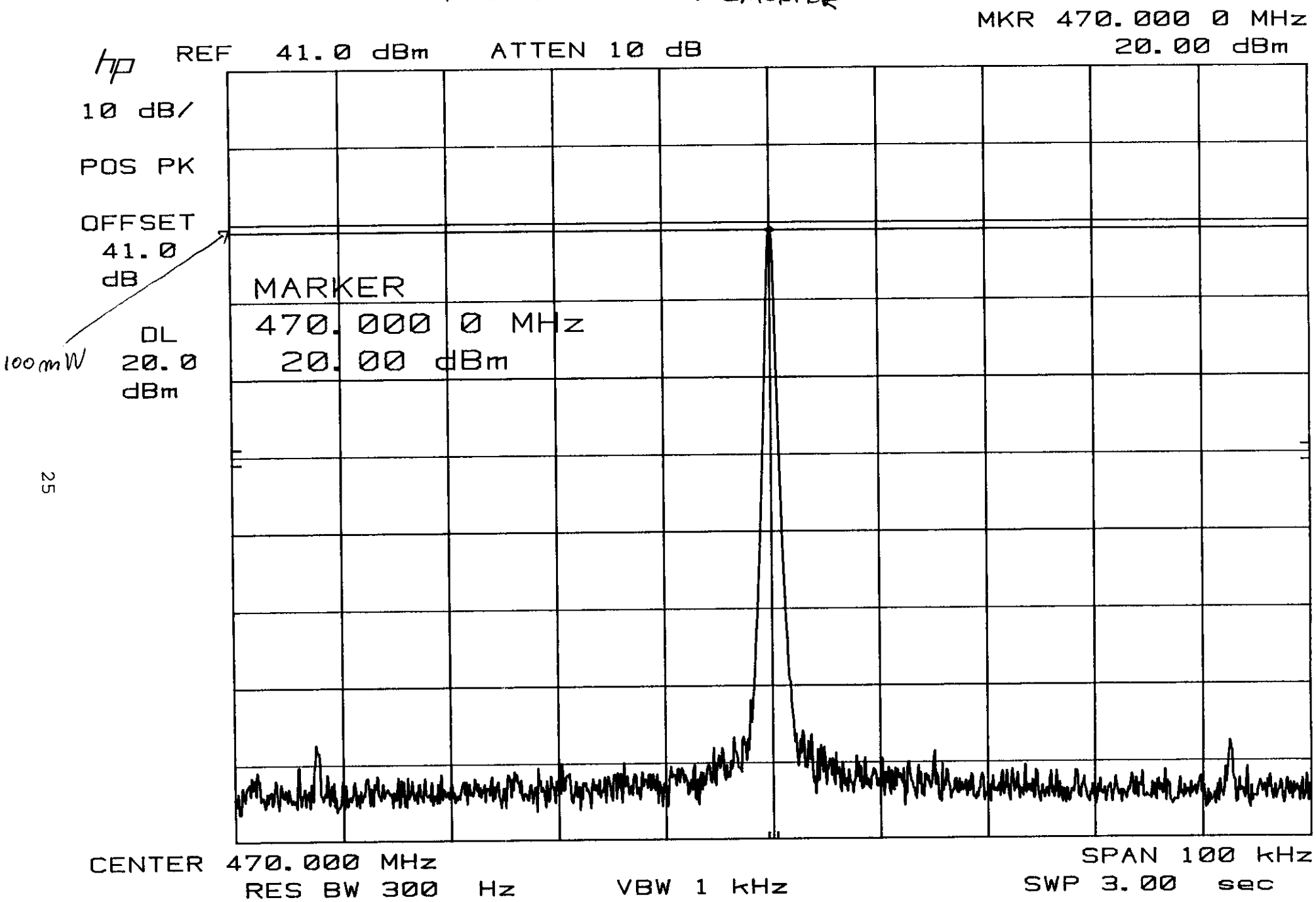
100 WATTS

PA6-IEE-LMS

OCCUPIED BANDWIDTH PART 22



DRIVER OUT PUT : UNMODULATED CARRIER



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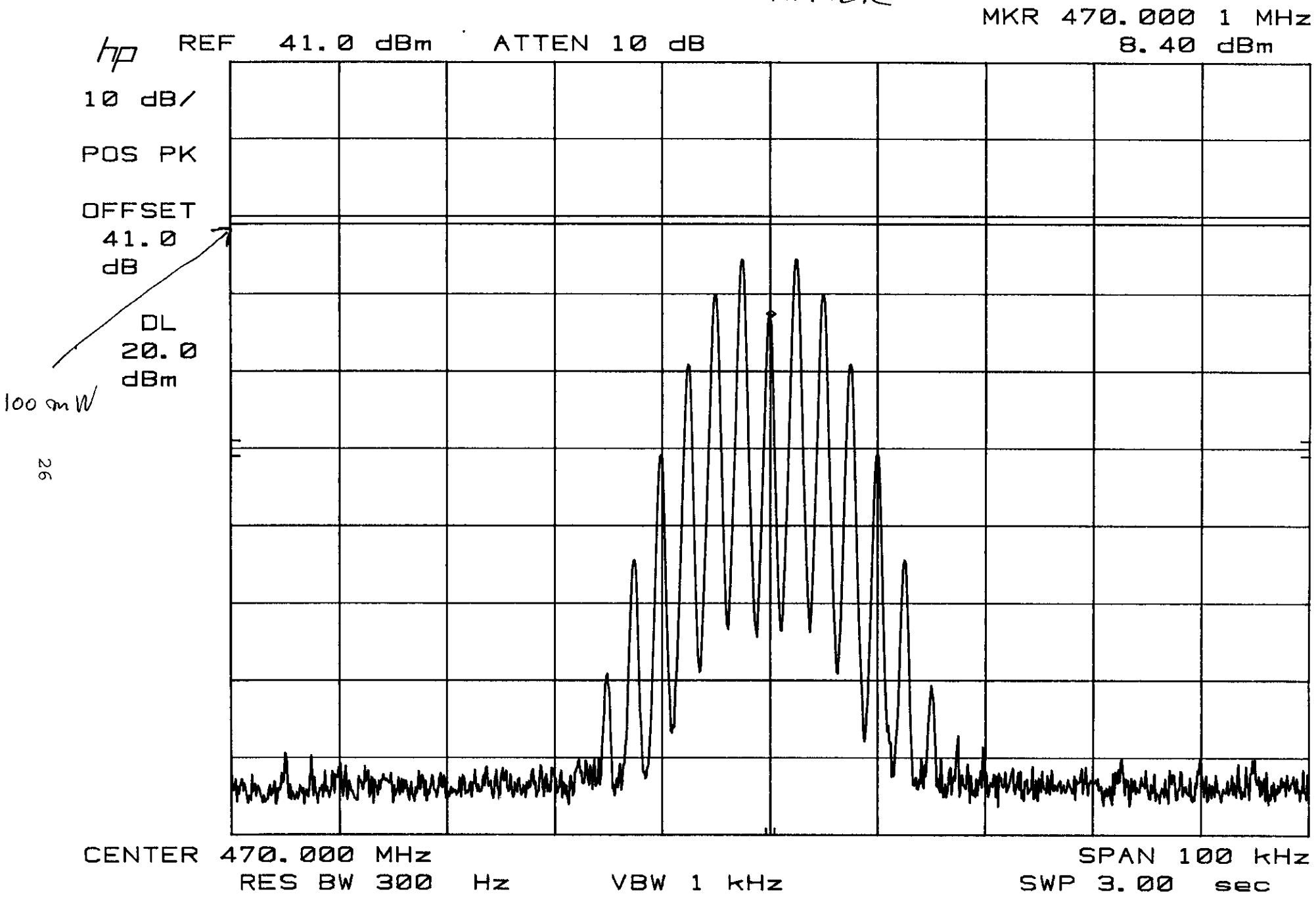
DRIVER OUTPUT : MODULATED CARRIER



2.983(e)(4) **Measurement of Antenna Conducted Spurious Emissions Per 2.991**

Definition: Conducted Spurious Emissions are emissions at the antenna terminals on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communication desired. The reduction in the level of these spurious emissions will not affect the quality of the information being transmitted.

Conducted spurious emissions shall be attenuated below the maximum level of the carrier frequency in accordance with the following formula:

Spurious attenuation in dB = $43 + 10 \log_{10} Po$

Where Po = output in watts

$= 43 + 10 \log_{10} (100)$

$= 63.0$ dB

Test Method: Per EIA RS 152-B, Paragraph 4.

Connect the equipment as shown in FIGURE 4.

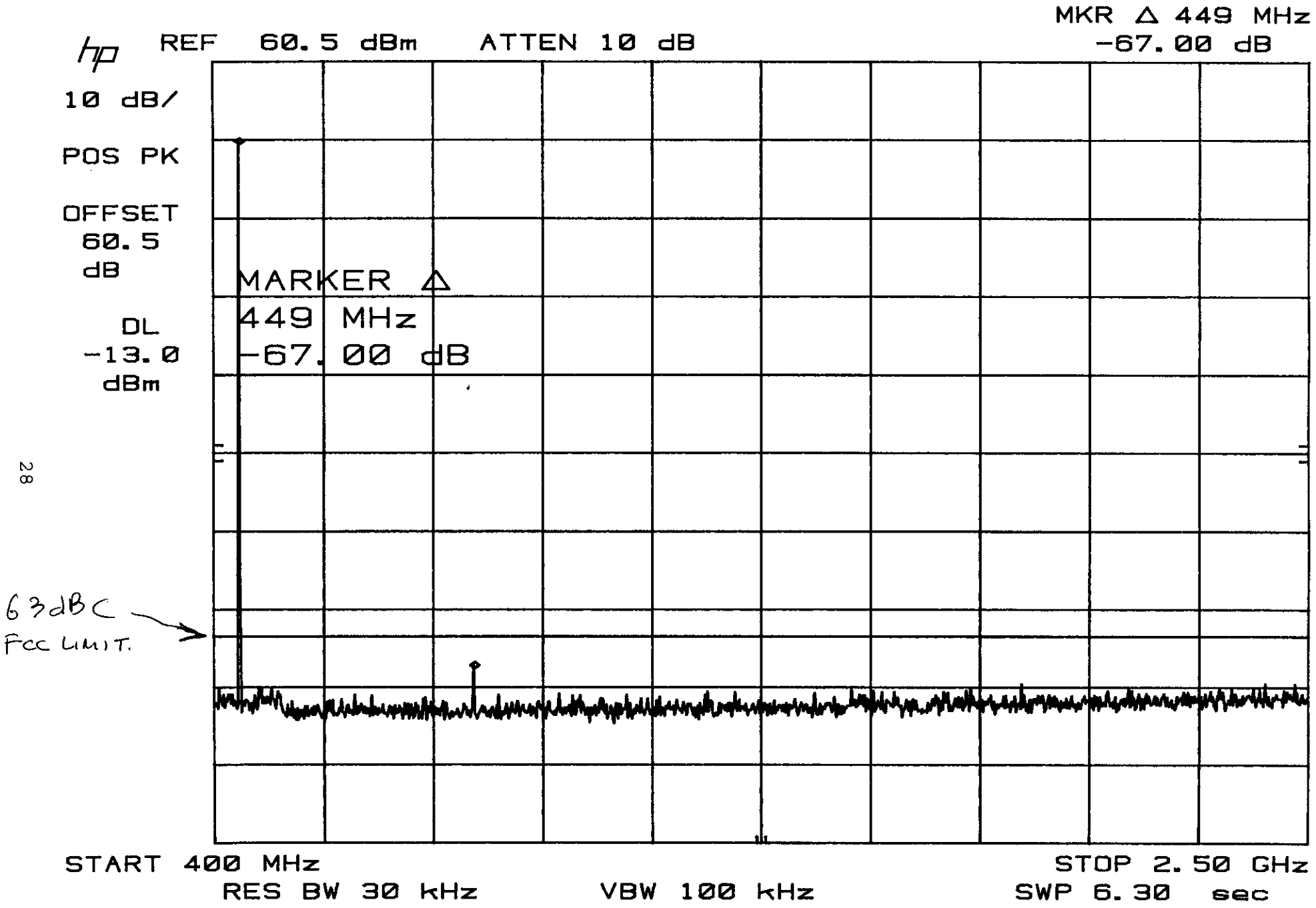
Adjust the audio oscillator so that the frequency deviation of the transmitter is 5 kHz at a modulation frequency of 2.5 kHz. Adjust the spectrum analyzer to display the modulated carrier.

Scan the frequency spectrum from the lowest radio frequency generated in the equipment through the 10th harmonic of the carrier frequency.

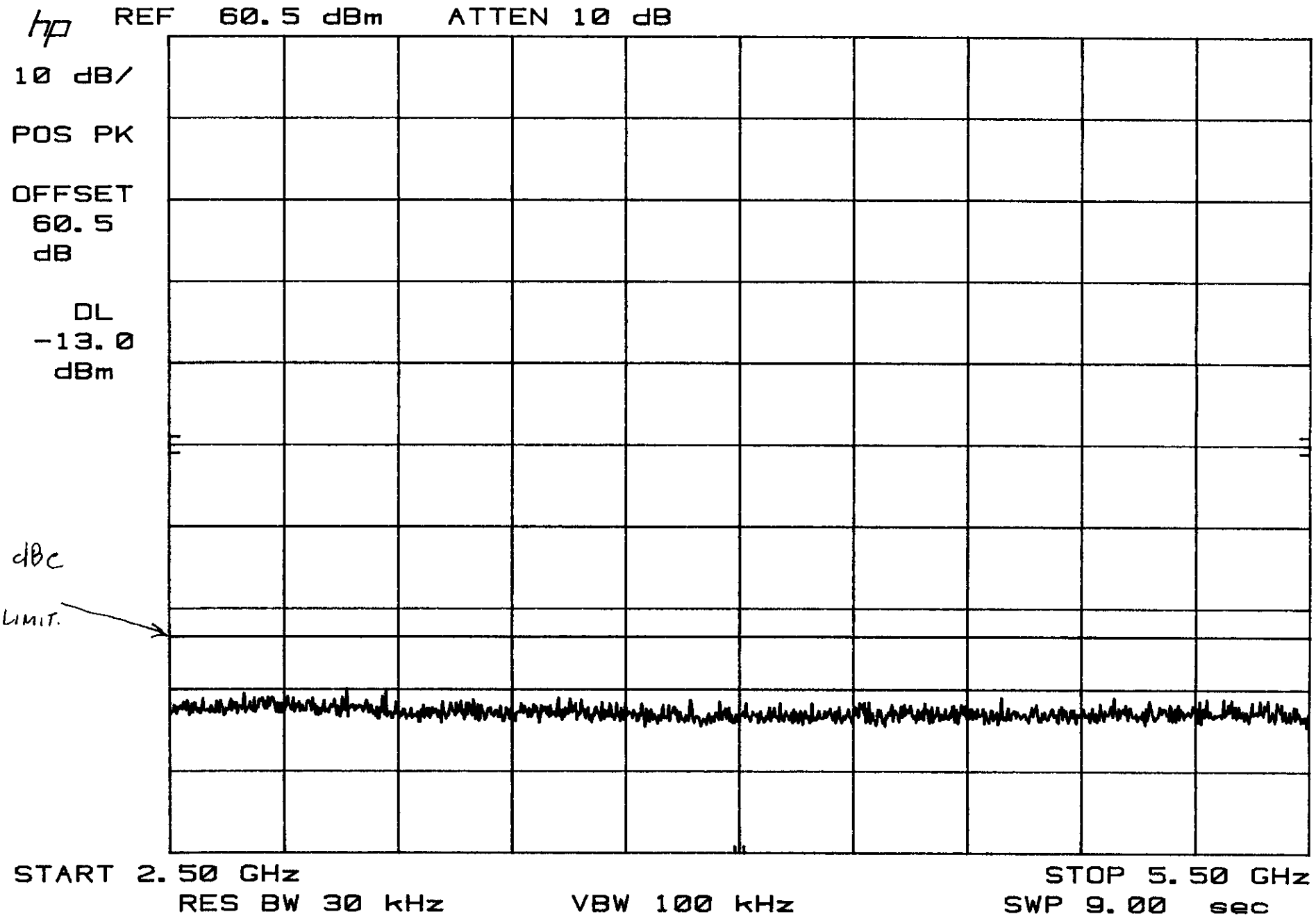
Test Results: See Plots Following Figure 4.

All spuirious antenna conducted emissions are below the FCC specifications.

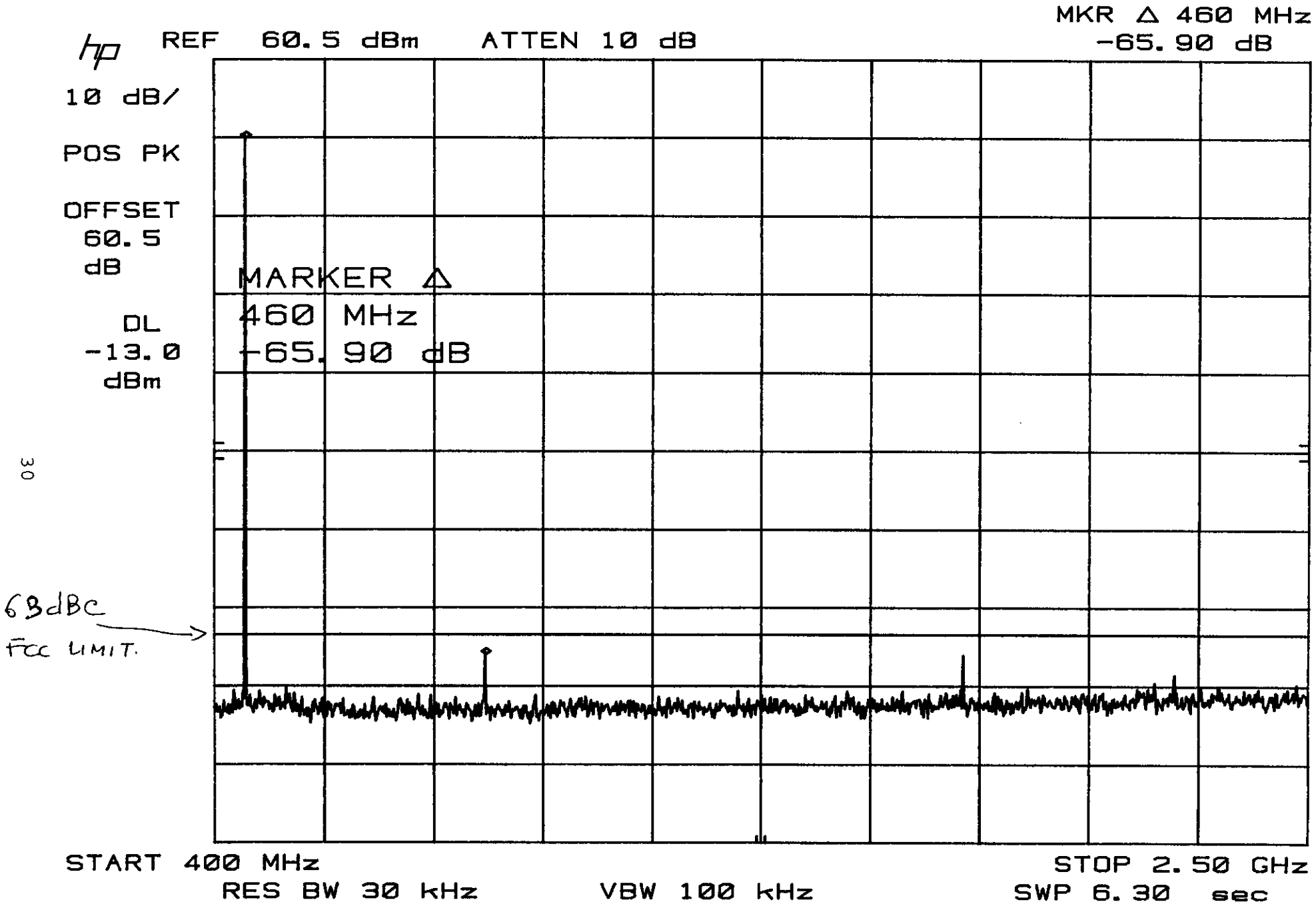
PAG - IEE - LMS


MKR Δ 449 MHz
-67.00 dB
REF 60.5 dBm
ATTEN 10 dB
10 dB/
POS PK
OFFSET
60.5
dB
DL
-13.0
dBm
MARKER Δ
449 MHz
-67.00 dB
63dBC
FCC LIMIT.
START 400 MHz
STOP 2.50 GHz
RES BW 30 kHz
VBW 100 kHz
SWP 6.30 sec

ANTENNA CONDUCTED SPURIOUS
PA6 - IEE - LMS



ANTENNA CONDUCTED STUDIES
PAG-IEE-LMS



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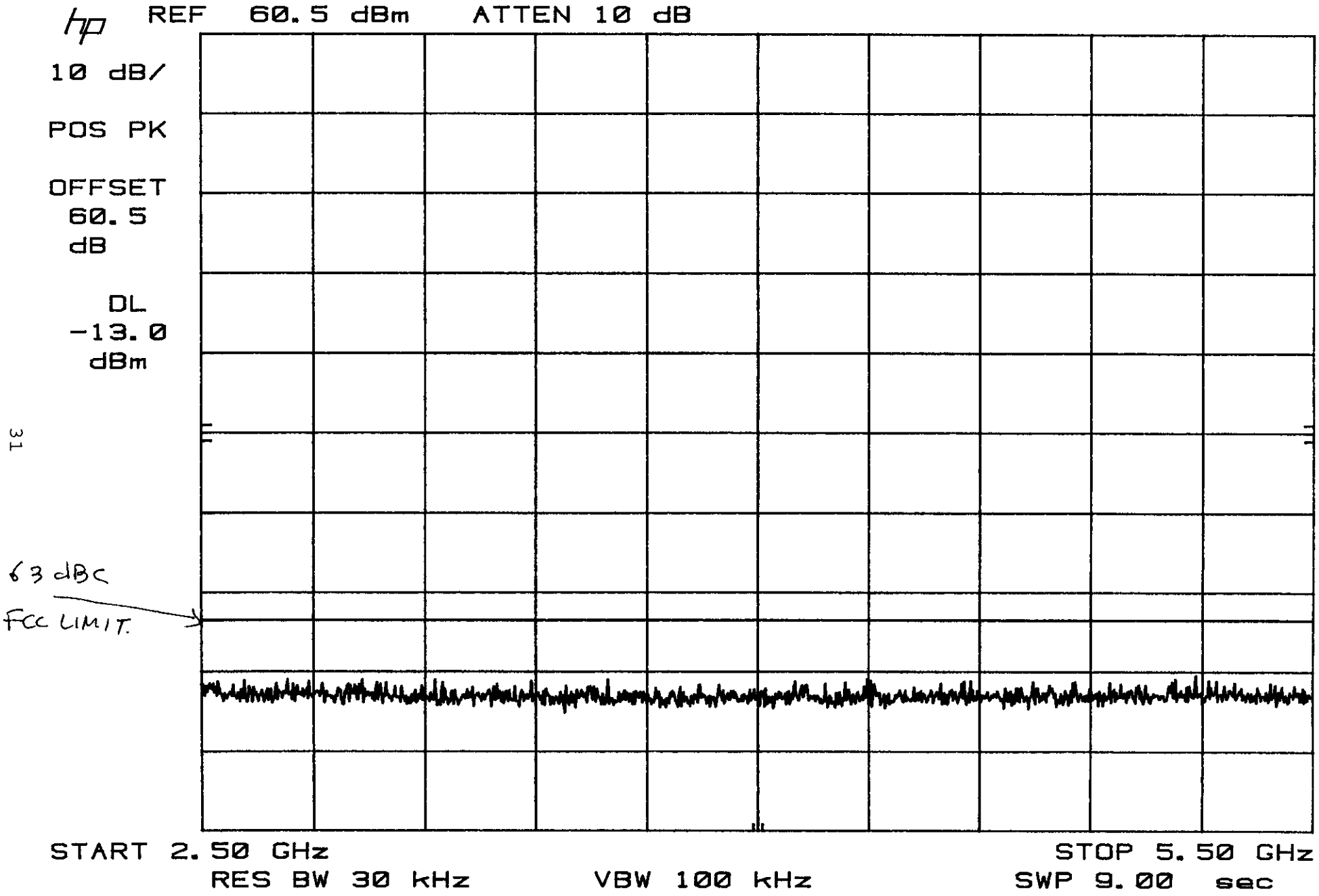
ANTENNA CONDUCTED SPURIOUS
PAG - 1EE LMS



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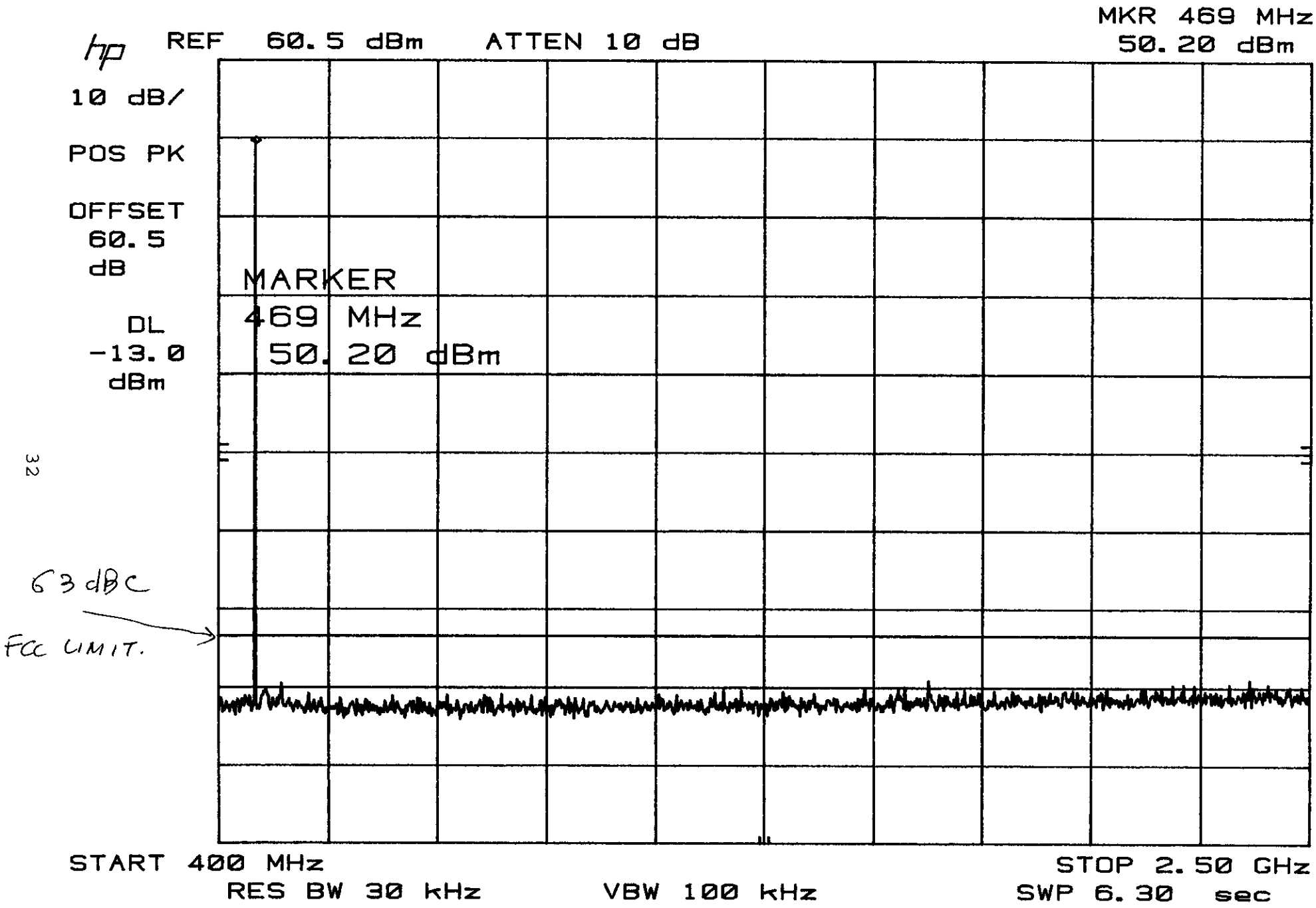
ANTENNA CONDUCTED SPURIOUS
PA6 - IEE - LMS

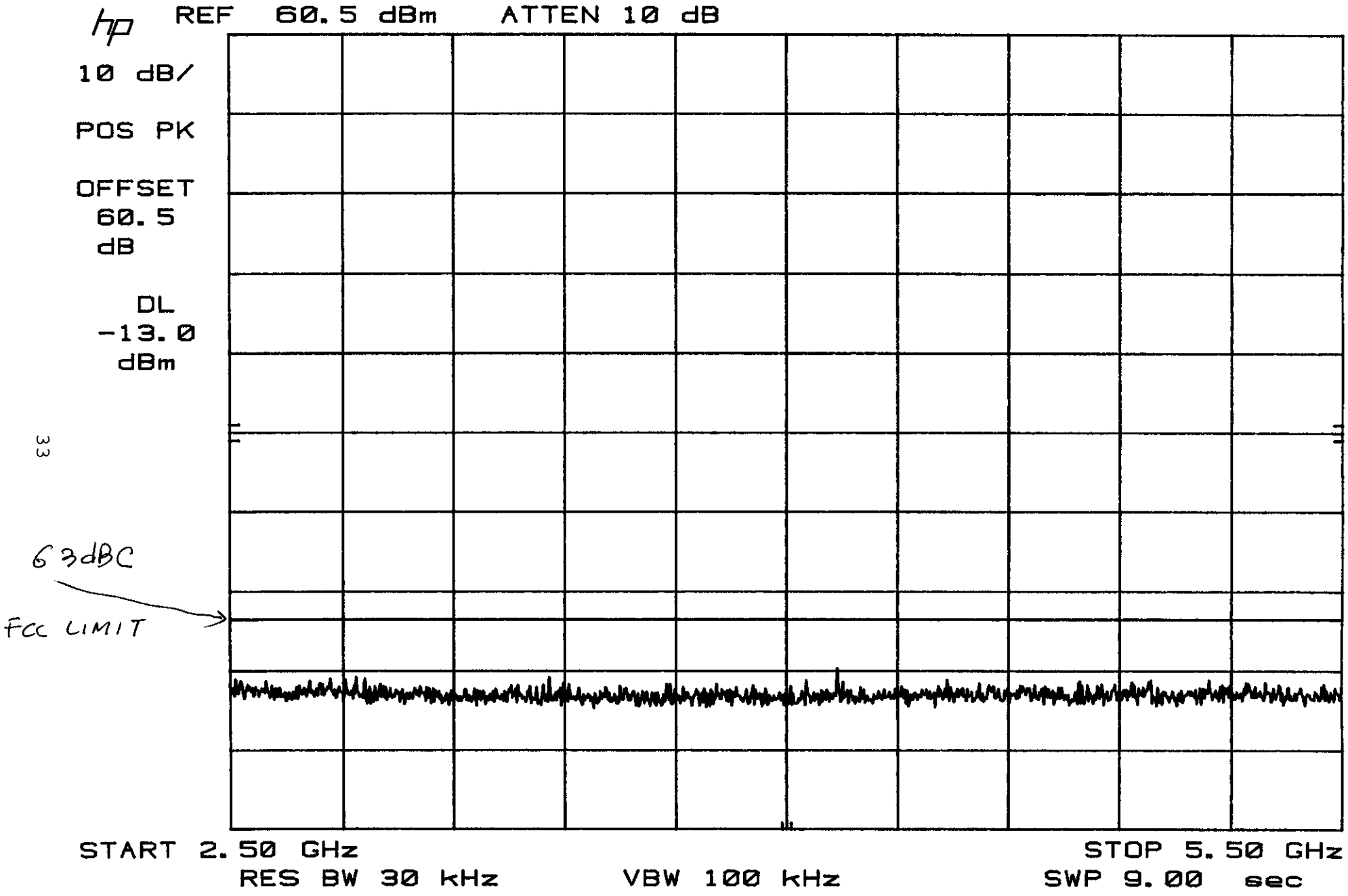


63 dBC

FCC LIMIT.

ANTENNA CONDUCTED SPURIOUS

PA6 - IEE - LMS



63dBC

FCC LIMIT

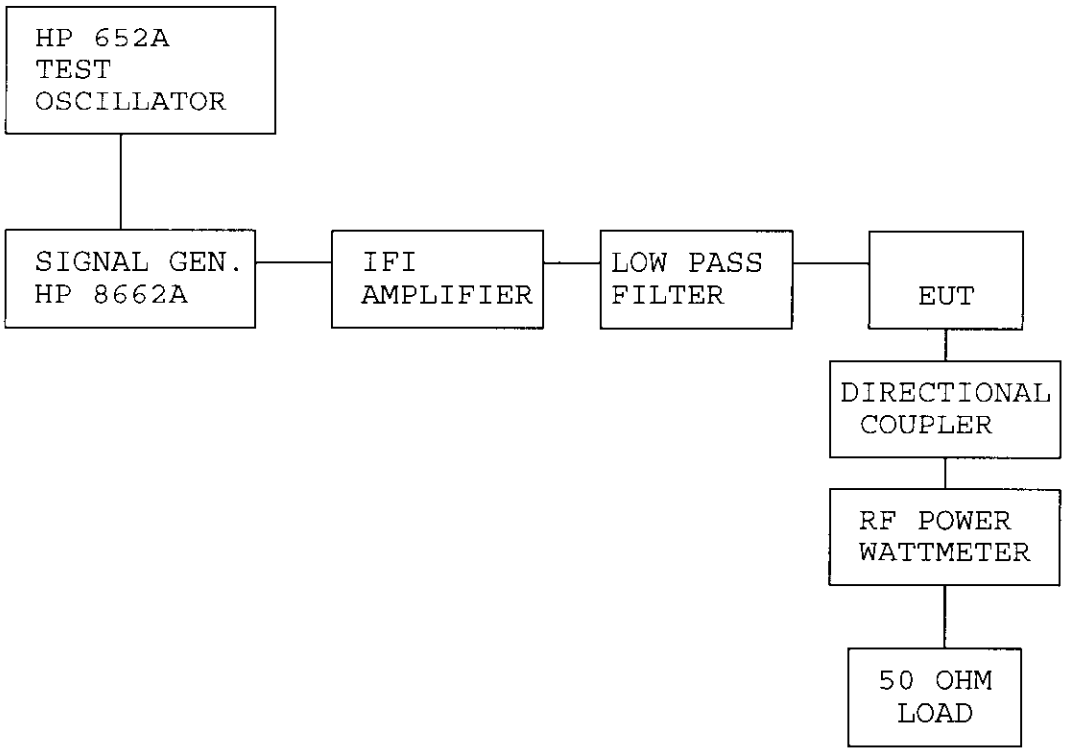


FIGURE 4. BLOCK DIAGRAM.
(SPURIOUS EMISSIONS TEST)

2.983(e)(5) Measurement of Radiated Spurious Emissions Per 2.993

Definition: Emissions from the equipment when connected into a non-radiating load on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired. The reduction in the level of these spurious emissions will not effect the quality of the information being transmitted.

Test Method: Per EIA RS 152-B.

Connect the equipment and follow the procedure described in paragraph 2.2.1.1 and paragraph 5.0. Measure the amplitude of each spurious radiated signal through the 10th harmonic. The level in dBuV/m is calculated on the following page. The spurious signals are then measured on the 3 meter range.

$$\text{Spurious attenuation dB} = 10 \log \frac{\text{Po Watts}}{\text{Calc spurious pwr}}$$

Test Results: See TABLE I.

All Radiated spuirious emissions are below the FCC specifications.

SPURIOUS RADIATED SIGNAL MEASUREMENTS

(Ref: Part 2, Subpart J, 2.991 & 2.993)

Date 2-26-98 Pass X Fail _____ (at Freq. ~~460MHz~~)

EUT Power Amplifier Operating Power 100 watts

Part No. PAG-1EE-LMS Operating Mode Saturated

Serial No. _____ Test Engineer Bryan Broadus

FREQUENCY TUNED TO 460 MHz

ANT POL	FREQ MHz	SPECTRUM ANALYZER (dBµV)	ANT. FACTOR (dB)	CABLE LOSS (dB)	AMP GAIN (dB)	dBµV/m	FUND FIELD STRENGTH dBµV/m	SPUR BELOW CARR-IER (dBc)
H	460						147.43	
	920	73.2	23.7	2.3	22	77.2		70.2
	1380	76.3	25.7	3.6	30	75.6		71.8
	1840	73.7	28.5	4.1		76.3		71.1
	2300	66.3	29.5	5.3		71.1		76.3
	2760	67.2	29.5	5.9		72.6		74.8
	3220	62.4	31.0	6.4		69.8		77.6
	3680	59.9	32.0	7.2		69.1		78.3
	4140	57.5	33.5	7.7		68.7		78.7
	4600	54.7	33.5	8.3		66.5		80.9

Fundamental Field Strength (V/m) = 1/3 (Ro x Po)$^{1/2}$

Ro = Amplifier Output Impedance (Ohms) $1/3(50 \cdot 100)^{1/2} = 23.54$ V/m

Po = Amplifier Output Power (Watts)

Conversion From V/m to dBµV/m = (V/m)$^{\log}$ x 20

$(23.54 \cdot 10^6)^{\log} \cdot 20 = 147.43$ dBµV/m

SPURIOUS RADIATED SIGNAL MEASUREMENTS

(Ref: Part 2, Subpart J, 2.991 & 2.993)

Date 2-26-98 Pass X Fail ____ (at Freq. ~~460~~)

EUT Power Amplifier Operating Power 100 Watts

Part No. PA6-1EE-LMS Operating Mode Saturated

Serial No. ____ Test Engineer Bryan Brandes

FREQUENCY TUNED TO 460 MHz

ANT POL	FREQ MHz	SPECTRUM ANALYZER (dBμV)	ANT. FACTOR (dB)	CABLE LOSS (dB)	AMP GAIN (dB)	dBμV/m	FUND FIELD STRENGTH dBμV/m	SPUR BELOW CARR-IER (dBc)
V	460						117.43	
	920	76.4	23.7	2.3	22	80.4		67.0
	1380	77.4	25.7	3.6	30	76.7		70.7
	1840	74.7	28.5	4.1		77.3		70.1
	2300	69.4	29.5	5.3		74.2		73.2
	2760	71.1	29.5	5.9		76.5		70.9
	3220	63.7	31.0	6.4		71.1		76.3
	3680	61.4	[redacted]32.0	7.2		70.6		76.8
	4140	59.6	33.5	7.7		70.8		76.6
	4600	57.9	33.5	8.3		69.7		77.7

Fundamental Field Strength (V/m) = 1/3 (Ro x Po)$^{1/2}$

Ro = Amplifier Output Impedance (Ohms)

Po = Amplifier Output Power (Watts)

Conversion From V/m to dBμV/m = (V/m)$^{\log}$ x 20

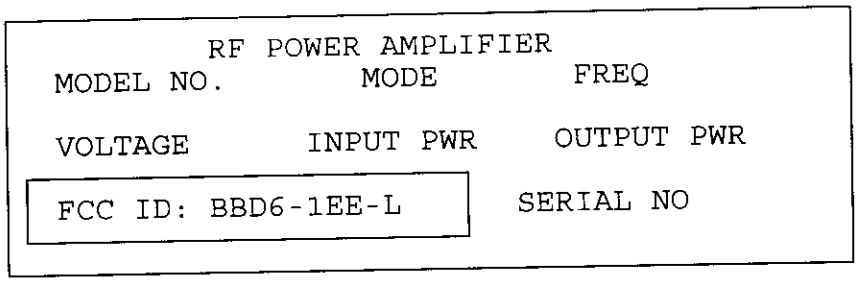
2.983(e)(6) Measurement of Frequency Stability Per 2.995

The EUT is a power amplifier and contains no circuitry for generating or stabilizing the RF signal. The driver will be responsible for this task.

2.983(e)(7) Frequency Spectrum to be Investigated per 2.997

The frequency was searched from the lowest radio frequency generated in the equipment through the 10th harmonic of the carrier frequency.

2.983(f) FCC ID: Label



NOTE:
Label will be constructed of 0.02 inch aluminum as shown on the equipment with permanent adhesive.

All information on the label will be etched or stamped. Both methods will exceed the expected lifetime of the equipment.

The label will be large enough to allow all information to be legible.

2.983(g) **Photographs and/or drawings showing equipment construction techniques.**

Note: The Main Circuit Board shown in these photos has no components on the reverse side.

Photo 1 Main Circuit Board (Overall View)

Photo 2 Main Circuit Board (View A)

Photo 3 Main Circuit Board (View B)

Photo 4 External Front View

Photo 5 External Side (3/4) View

Photo 6 External Rear View

Photo 7 Additional Component Photo

Photo 8 Additional Component Photo

Photo 9 Additional Component Photo

2.983(h) **Description and Test Data For Encoding Device(s)**

This section does not apply.

2.983(i) **Type acceptance Data For an External Power Amplifier Used In Amateur Radio Service - Part 97**

This section does not apply

APPENDIX A

TEST EQUIPMENT

DNB ENGINEERING, INC.
EMC TEST EQUIPMENT

MANUFACTURER	DESCRIPTION	MODEL
Hewlett Packard	Spectrum Analyzer	8566B
Hewlett Packard	Spectrum Analyzer	8568B
Hewlett Packard	Quasi Peak Adapter	85650A
Hewlett Packard	Computer/Controller	9825T
Hewlett Packard	Frequency Counter	5245L
Hewlett Packard	Printer	9876A
Hewlett Packard	Counter Plug-in	5253B
Hewlett Packard	Plotter	9872C
Hewlett Packard	Plotter	7470A
Hewlett Packard	Frequency Synthesizer	9662A
Hewlett Packard	Sweep Main Frame	8620C
Hewlett Packard	Plug-in 2-22 GHz	26290B
Polarad	Signal Generator 3.7 to 8.4 GHz	1107E
Telonics	Sweep Generator	4053A
Wiltron	Sweep Generator	6653A
Hewlett Packard	Signal Generator	614A
Hewlett Packard	Signal Generator	616B
Hewlett Packard	Signal Generator	618B
Hewlett Packard	Signal Generator	620B
Hewlett Packard	Signal Generator	626A
Hewlett Packard	Signal Generator	628A
Hewlett Packard	Signal Generator	8654A

DNB ENGINEERING, INC.
EMC TEST EQUIPMENT

Hewlett Packard	Signal Generator	8662A
Hewlett Packard	RF Voltmeter	3406A
Solar	Pulse Generator	8282-1
Solar (2)	Clamp on Probe	6747-1
Electro-Metrics	Clamp on Probe	PCL-10
Electro-Metrics	Clamp on Probe	PCL-25
Electro-Metrics	Loop Sensor	ELS-10
Electro-Metrics	Electro-Static Field Probe	EFP-25
Electro-Metrics	LISN	FCC-5-2
Solar	LISN	8012-50-r-24 BNC
Solar	Audio Isolation Transformer	6220-1A
Solar	Isolation Transformer	7032-1
Solar (14)	10 mfd Capacitors	6212-106R
Schaffner EMC, Inc.	Absorbing Clamp	MDS 21
Solar	100 W Audio Amplifier	6552-1A
Solar (2)	LISN	8018-50-TS-24 BNC
Stoddart	FIM	NM-12T
Krohn-Hite	Audio Oscillator	4400
Stoddart	FIM	URM-6
IFI	Field Strength Meter	EFS-1
Solar	Precision Resistor	7144-1.0
Solar	Precision Resistor	7144-10.0
Solar	Coupling Network	7835-891

DNB ENGINEERING, INC.
EMC TEST EQUIPMENT

Solar	Coupling Network	7835-896
Solar	LISN (5 μh)	6338-5
Solar	LISN (50 μh)	6338-57
Solar	High Pass Filter	7205-.35
Solar	High Pass Filter	7205-2.4
Mini Circuits	Amplifier Wide Band	ZHL42
Mini Circuits	Amplifier Wide Band	ZHL-1042J
Mini Circuits	Amplifier Wide Band	ZHL32A
Mini Circuits	Amplifier Wide Band	ZHL-1A
Mini Circuits	Amplifier Wide Band	ZHL2-8
ENI	Amplifier	510L
ENI	Amplifier	350L
Hewlett Packard	Preamplifier	11975A
Hewlett Packard	Preamplifier	8349A
IFI	1 kHz - 200 MHz Amplifier (15 Watt)	5300L
Narda	400 W 50Ω Load	376NM
Eaton	WBA 500 - 1000 MHz	15100B
ENI	WBA 250 KHz - 150 MHz	3100LA
ENI	WBA 1.5 - 500 MHz	550l
Avantek	Low Noise Amplifier 6-12.4 GHz	AFT12635
Hewlett Packard	500 MHz Digitizing Oscilloscope	54111D
Tenney	Temperature Chamber	THjr

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Hewlett Packard	5 Hz - 200 MHz Network Analyzer	3577A
Hewlett Packard	Frequency Doubler	11721A
Hewlett Packard	Harmonic Mixers	11970A
Hewlett Packard	Harmonic Mixers	11970K
Hewlett Packard	Computer/Controller	9836
Hewlett Packard	Computer/Controller	9826
Avantest	Spectrum Analyzer	TR4131E
Hewlett Packard	Spectrum Analyzer	8558B
Hewlett Packard	Spectrum Analyzer	8554L
Hewlett Packard	Pulse Generator	212A
Hewlett Packard	Pulse Generator	214A
Hewlett Packard	Pulse Generator	215A
Tektronix	Oscilloscope	453A
John Fluke	High Voltage power Supply	408A
LeCroy	Digital Storage Scope (125 MHz)	9400
Biddle	Micro Ohm Meter	247800
Hewlett Packard	Pulse Modulator	11720A
Topaz	Ultra Isolation Transformer (2.5 kVA)	0211T21SR
ENI	Ultra Isolation Transformer (2.5 kVA)	91002-22
Singer (5)	Current Probe	91550-2
Stoddart (4)	Current Probe	91550-1

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Hewlett Packard	Dual Directional Coupler	778D
Narda	Dual Directional Coupler	3022
Narda	Directional Coupler	3045C-20
Narda	Directional Coupler	3003-20
Narda	Directional Coupler	3002-10
Narda	Directional Coupler	23964
Narda (2)	Directional Coupler	22355
Narda	Power Divider	4326-2
Narda	Power Divider	4035C
Narda	Power Divider	4033C
Englemann	Power Divider	PSK-210
Bird	50Ω Load 10 W 50's	80-53
Stoddart	50Ω Load	90514
Micro Lab	50Ω Load	TB-5MN
Tekscan	50Ω Attenuator Kit	FP-50
Tenuline	50Ω 100 W 20 dB Attenuator	8343-200
Micro Lab	50Ω 40 dB Attenuator	AD-40N
Hughes	20 Watt TWT L Band	1277H04
Hughes	20 Watt TWT C Band	1277H04
Hughes	10 Watt TWT S Band	1177H
Hughes	10 X/Ku Band	1177H
IFI	2kW cw 1 kHz - 200 MHz Wide Band Power Amp	410ULP
DNB Engineering	EMP Pin/Wire Test Set	844

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EMC TEST EQUIPMENT

ANTENNAS

MANUFACTURER	DESCRIPTION	MODEL
AIL (3)	Dipole	DM105A-T1, T2, & T3
EMCO	Biconical	3109
EMCO	Log Periodic	3146
EMCO	Parallel Element	3107
Eaton	Vertical Rod	74607-1
Eaton (2)	Vertical Rod	75492-1
Ailtech	Loop	94608-1
Singer	Loop	LP-105 ASC
Electro-Metrics (2)	Biconical	BIA-25
Electro-Metrics (2)	Conical Log Spiral	LCA-25
Electro-Metrics (2)	Loop	ALP-10
Electro-Metrics (2)	Loop	ARL-25
Electro-Metrics (2)	Broadband Dipole	DBA-25
Electro-Metrics (3)	Turnable Dipole	TA-25, 25-1, & 25-2
EMCO	Double Ridge Guide	311525
Electro-Metrics (2)	Vertical Rod	RVR-25
Alpha	Standard Gain Horn	K861
Alpha	Standard Gain Horn	A861
Alpha	Standard Gain Horn	KV861
Solar	Loop Antenna	7429-1
Electro-Metrics	E Field SensorHorn	EFP-25