



EMC Measurement / Technical Report

Test Specification : FCC Part 90,
Private Land Mobile Radio Services
Equipment Authorization : Type Acceptance
Manufacturer : ElectroCom Communication Systems
Equipment Under Test : DT450
400MHz Data Mobile Radio
Test Report No. : 56547
Purchase Order No. : P009757

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Instrument Specialties Company, Inc. — World Compliance Center

EMC Measurement / Technical Report

Document No.: 56547

from

Instrument Specialties Co. Inc.

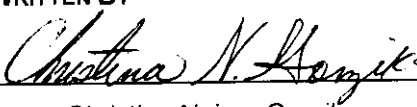
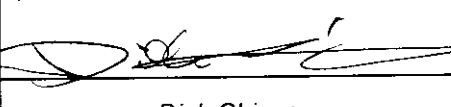
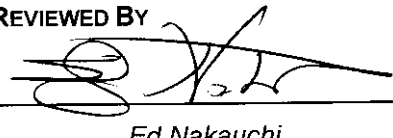
World Compliance Center

Test for

ElectroCom Communication Systems

DT450 Data Mobile Radio

FCC ID: MI7-ECSDT450TX

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Test Personnel	Test Dates
Dick P. Chiang	18, 21, 22 July 1997

Test Facility Address City, State, Zip Code Country Phone Fax	Instrument Specialties Company Incorporated 545 Porter Way Placentia, CA 92870 USA (714) 579-7100 (714) 961-2752
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MEASUREMENT/TECHNICAL REPORT SUMMARY

Representative Manufacturer Address City, State, Zip Phone Fax	Louis Chagoya ElectroCom Communication Systems 10400 Pioneer Blvd., Bldg. E-2 Santa Fe Springs, CA 90670 (562) 946-9493 (562) 946-7483
Type of Authorization	Type Acceptance for 400MHz Data Mobile Radio
Applicable FCC Rules	PART 90 – Private Land Mobile Radio Services Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 (10-1-96 Edition). The following subparts are applicable to the results in this test report: Part 90, Subpart I – General Technical Standards Part 2, Subpart J – Equipment Authorization Procedures for Type Acceptance The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2 section §2.981 through §2.1005 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.
Equipment Under Test	400MHz Data Mobile Radio
Production Quantity	Multiple Units
Identification of EUT	Model: DT450 FCC ID: MI7-ECSDT450TX
Testing Date	18, 21, 22 July 1997

Test Facility Address City, State, Zip Code Country Phone Fax	Instrument Specialties Company Incorporated 545 Porter Way Placentia, CA 92870 USA (714) 579-7100 (714) 961-2752
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1. GENERAL INFORMATION

1.1 Product Description

Equipment Under Test	400MHz Data Mobile Radio
Model Number	DT450
Serial Number	Prototype
Description of EUT	The DT450 is a 400MHz data mobile radio with integral diversity reception system. The transmitter portion of the DT450 operates in the frequency range of 470 – 490MHz, transmit power 40 watts. The receiver side of the DT450 is a post-detection diversity reception system.
Clock Frequencies	10MHz, 44.545MHz

Refer to the product specification data that has been included as an attachment of this report for additional details

1.2 Tested System Details

The following table lists all of the components of the tested system. FCC ID numbers are included if available for a tested system component. Refer to the table following Tested System Details for cabling information.

Tested System Details					
Item	Manufacturer	Description	Model No.	Serial No.	FCC ID
1	ElectroCom	Data Mobile Radio	DT450	N/A	MI7-ECSDT450TX

The following table lists all of the cabling details for the tested system.

Cabling of the Tested System					
Item	Description	Length (m)	Type	Connected from	Connected to
A	Power Cords	1.2	8 gauge wires	EUT	Power Supply
B	DB25 Shielded Cable	2.0	RS232	EUT	Test Fixture
C	RF Coaxial Cable	0.2	RG214	EUT	Directional Coupler
D	RF Coaxial Cable	1.2	RG214	EUT (RX Port)	50 ohm Terminator
E	RF Coaxial Cable	0.5	RG214	Directional Coupler	Spectrum Analyzer
F	RF Coaxial Cable	1.2	RG214	Directional Coupler	50 ohm Terminator



1.3 Test Facility

The open area test site and measurement facility used to collect the test data is located at the Instrument Specialties Co., Inc. test facility in Placentia, CA. This site has been fully described in a report submitted to the FCC and accepted in a letter dated 5, February 1997 (31040/SIT 1300F2). The test facility is also recognized and accredited from the following accreditation organizations.

ISO 9001 (SGS ICS)	Registration Number: US94/0022 MIL-I-45208A, MIL-STD-45662A	Dated: 02/07/1994
NVLAP (NIST)	NVLAP Lab Code: 200119-0 FCC, CISPR	Dated: 12/31/1996
AUSTEL (NATA)	Listing Test House: A97/TH/014 AS / NZS 3548	Dated: 03/27/1997
I²T (Interference Tech. International)	Certificate Number: 7619 CE Mark for European Country	Dated: 03/11/1997
Acemark (Acemark Europe)	Laboratory Number: 0007 CE Mark for European Country	Dated: 03/21/1997
VCCI (Voluntary Control Council)	Registration Number: C-574-6, R-561 VCCI for Japan	Dated: 07/04/1997



2. Technical Description

<i>Type of Emission</i>	20K0F1D
<i>Frequency Range</i>	470 ~ 490 MHz
<i>Range of Operating Power</i>	40W
<i>Maximum output Power Level</i>	40W
<i>Maximum Specified Output Power Rating</i>	Location Dependant per Part 90 Subpart S
<i>Final Stage Amplifier DC Voltage, Current</i>	Voltage: 13.8 Vdc, Current: 8.5 Amps

2.1 Function of All Active Circuit Devices

Please refer to Attachment (Exhibits).

2.2 Circuit Diagram

Refer to Figure in Attachment (Exhibits).

2.3 Instruction Manual(s)

See Attachment (Exhibits).



3. PRODUCT LABELING

3.1 FCC ID Label

FCC ID: MI7-ECSDT450TX

3.2 Location of Label on EUT

See Photo on Page 21 for the location of the FCC ID label on the EUT.

3.3 Information to User

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



4. SYSTEM TEST CONFIGURATION

4.1 Justification

The EUT was used in a system configured for testing in a typical installation as a customer would normally use it.

4.2 EUT Exercise Software/Equipment

The EUT requires exercise software program used during testing to activate data from PC to modem and deliver to test fixture by manually switch EUT turned on or off.

4.3 Special Accessories

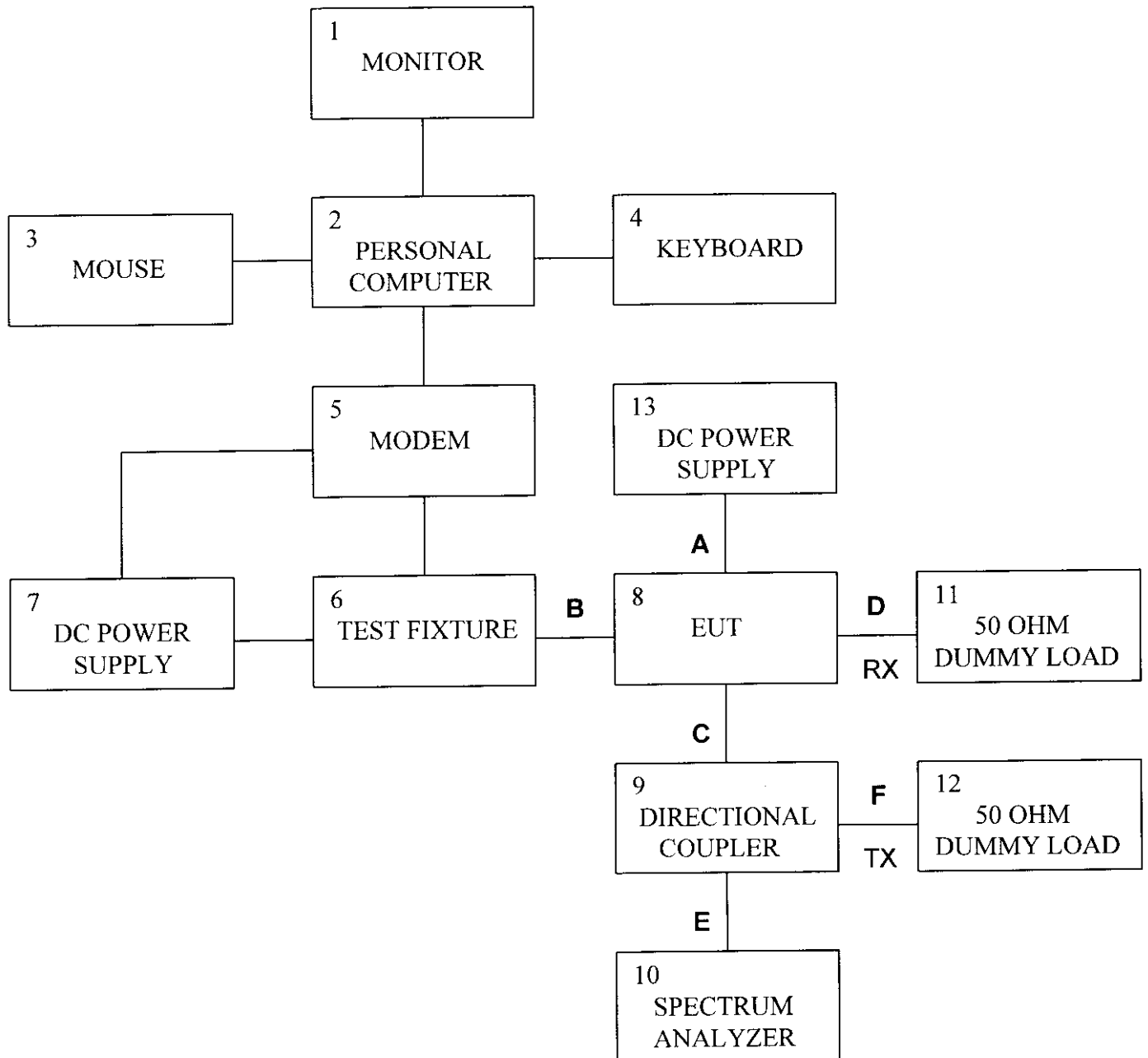
The EUT requires no special accessories to comply with the FCC regulations.

4.4 Equipment Modifications

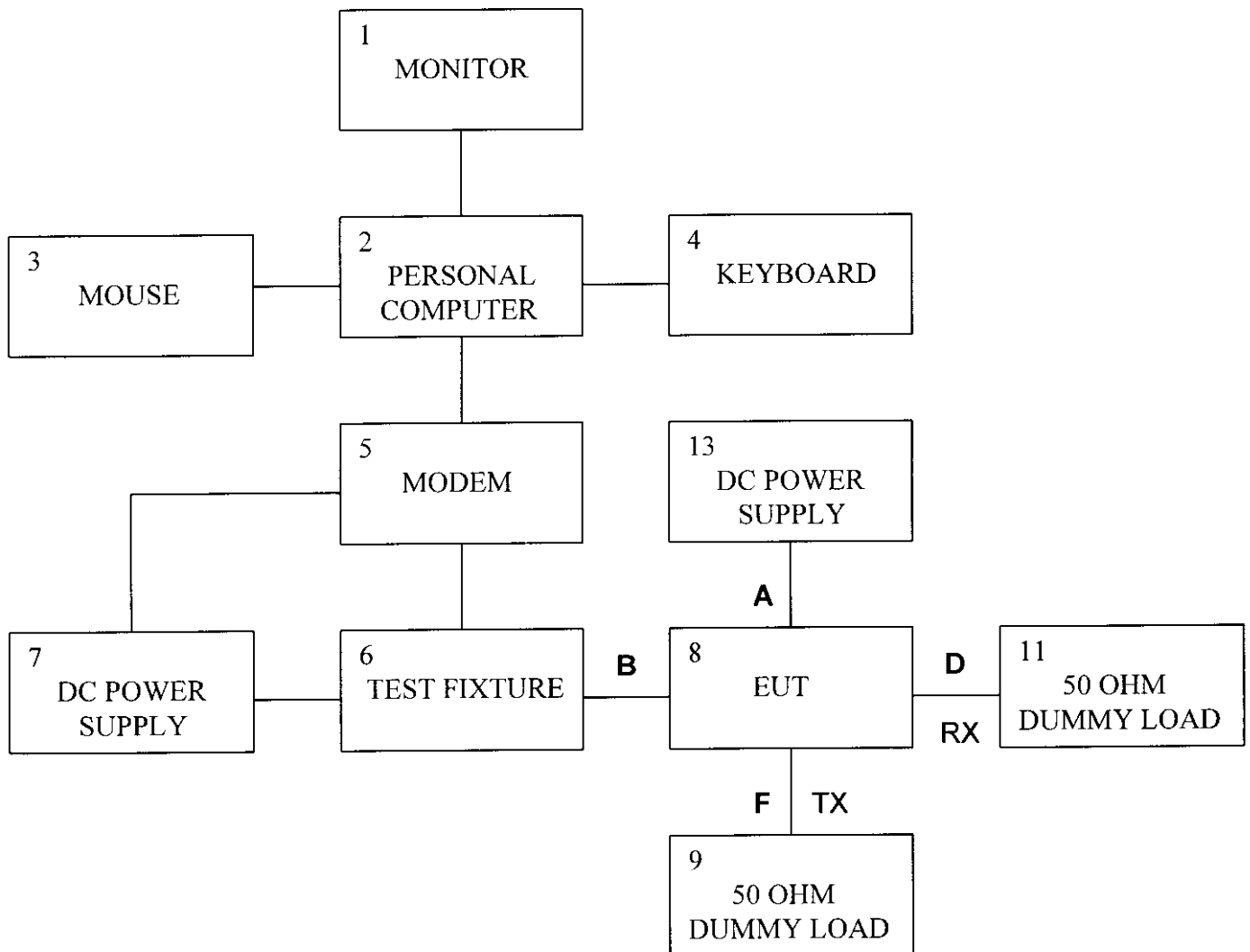
No modifications and or adjustments were made to the EUT during compliance testing to achieve the required specification limits.



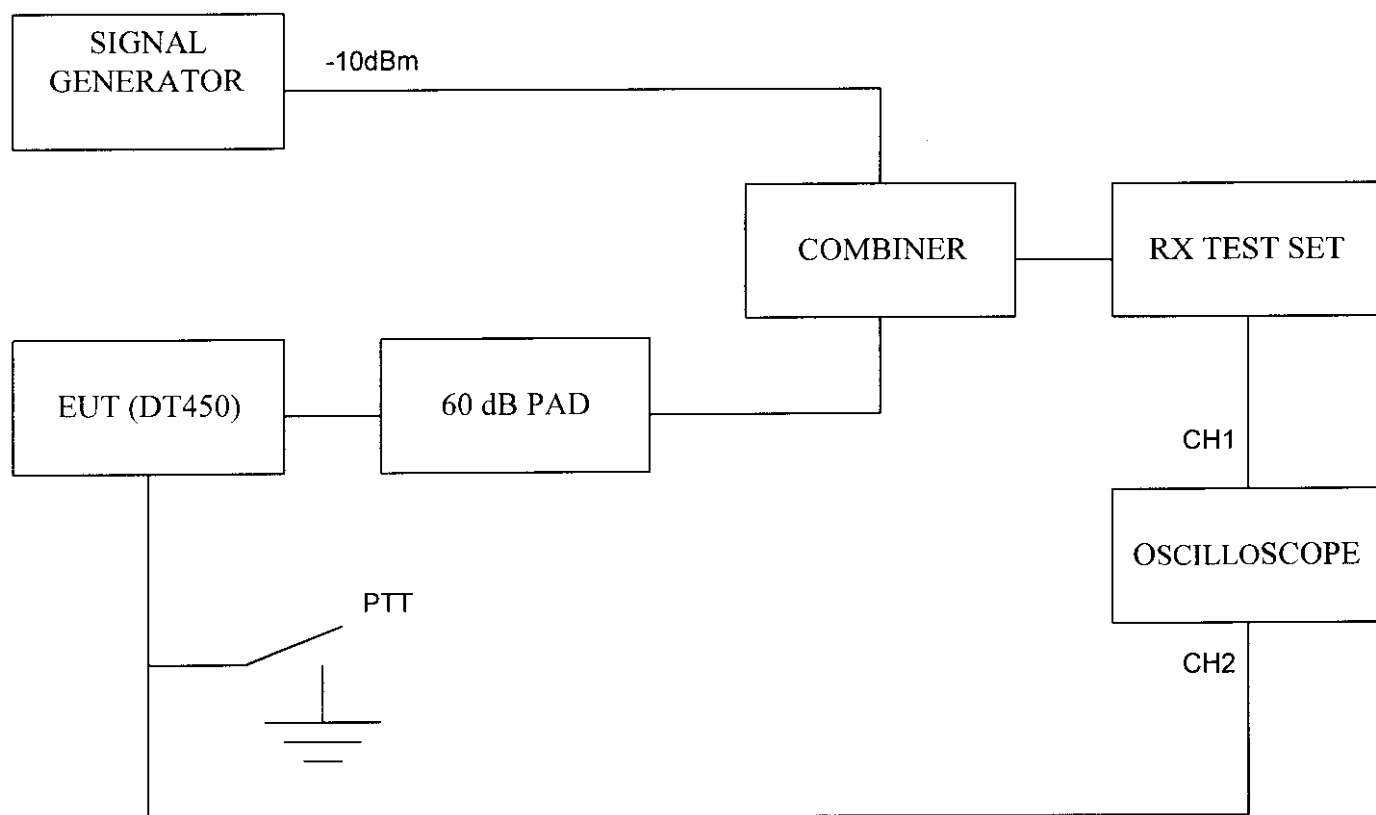
4.5 Configuration of Tested System



Test Setup Configuration 1



Test Setup Configuration 2



Test Setup Configuration 3



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Legend:

Item	Manufacturer	Description	Model No.	Serial No.	FCC ID
1	Dell Computer	Monitor	D1728D-LS	4036A0UJGA5	A3LCMG737
2	Dell Computer	Personal Computer	MMS-P75T	60NCN	E2KHNTMT
3	Logitech	Mouse	M-S34-6MD	LCA51603467	DZL210472
4	Dell Computer	Keyboard	SK-1000RE	M950401343	GYUR10SK
5	ElectroCom	Modem	Prototype	N/A	N/A
6	ElectroCom	Test Fixture	Prototype	N/A	N/A
7	Elenco	DC Power Supply	XP581	N/A	N/A
8	Werlatone	Directional Coupler	C3271	5320	N/A
9	ElectroCom	Data Mobile Radio	DT800	N/A	N/A
10	Hewlett Packard	Spectrum Analyzer	HP8566B	2747A05747	N/A
11	Bird Electronics	50 ohm Load	50-T-FN	9708	N/A
12	Bird Electronics	50 ohm Load	8833-300	2109	N/A
13	DC Power Supply	Lambda	ZT-803	N/A	N/A

Item	Description	Length (m)	Type	Connected from	Connected to
A	Power Cords	1.2	8 gauge wires	EUT	Power Supply
B	DB25 Shielded Cable	2.0	RS232	EUT	Test Fixture
C	RF Coaxial Cable	0.2	RG214	EUT	Directional Coupler
D	RF Coaxial Cable	1.2	RG214	EUT (RX Port)	50 ohm Terminator
E	RF Coaxial Cable	0.5	RG214	Directional Coupler	Spectrum Analyzer
F	RF Coaxial Cable	1.2	RG214	Directional Coupler	50 ohm Terminator



5 TEST DATA

5.1 RF Power Output

Output power was measured at the Transmitter Module RF output terminal. The test setup and method as shown in Fig. 1

The output power was measured at each frequency 470MHz, 480MHz, 490MHz tuned with nominal voltage 13.6V, and the output power was measured at the DC power supply was adjusted to $\pm 15\%$ of nominal voltage. The HP437B power meter and HP8481H power sensor was used to measure RF output power.

Freq. tuned	85% nominal voltage (11.56V)	nominal voltage (13.60V)	115% nominal voltage (15.64V)
470 MHz	23.5W	31.7W	37.2W
480 MHz	22.4W	36.4W	37.2W
490 MHz	19.1W	28.3W	34.0W



5.2 Modulation Characteristics

Please refer to attachment C; MX919B, DT450 Product Specification and DT450 Product Support Manuals for description details. The modulation characteristics test results are enclosed in appendix B pages B7-9.



5.3 Occupied Bandwidth

Occupied bandwidth is the frequency bandwidth below its lower and above its upper frequency limits, the mean power radiated by a given emission, the measurements were made with the modulating signal. The authorized occupied bandwidth for emission mask C is 20KHz. The measured occupied bandwidth that was the manufacturer intended to design for sufficient data transmission. Test setup was connected the equipment per Fig. 1. The test result plots are enclosed in appendix B pages B4-6.

Necessary bandwidth: $B_n = 2M + 2D = 19.6\text{KHz}$
Where $M = 4.8\text{KHz}$
 $D = 5.0\text{KHz}$



5.4 Spurious Emissions at Antenna Terminals

Antenna 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 or required quality for the class of communication desired. The reduction in the level of the spurious emissions will not affect the quality of the information being transmitted. Conducted spurious emissions shall be attenuated at least; $43 + 10 \log (P_o) = 59\text{dB}$ (where P_o is 40W output power) below the maximum level of the carrier frequency in accordance with the transmitter was authorized. Connect the equipment as shown in Fig. 1. Adjust the spectrum analyzer to display the modulated carrier, and scan the frequency spectrum from the lowest radio frequency generated in the equipment through the 10th harmonic of the carrier frequency. The plots are enclosed in appendix B pages B10-39.



5.5 Radiated Spurious Emission

Emissions from the equipment when connected into a non-radiating load on a frequency of 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. Connect the equipment as shown in Fig. 2. All cables connected to generate maximum emissions from the EUT. The EUT was placed 80 centimeters above the ground plane on a non-conductive tabletop 1.0 meters wide by 1.5 meters long. The amplitude levels of the emissions were maximized by varying the configuration of the EUT and cables. The highest emissions were maximized by rotating the turntable 360 degrees and varying the antenna height 1 to 4 meters. The frequency range was measured up to 10th harmonic utilizing a BiLog antenna. measurements were made in vertical and horizontal polarizations. The distance between EUT and measuring antenna is 3 meters. Amplitude levels were recorded in dB μ V/m. All spurious emissions were attenuated at least 63 dB below each tuned carrier field strength. The tabulated data was enclosed in appendix B pages B40-42.

$$\begin{aligned} \text{* Field strength} &= 1/D \times (P_o \times R_L)^{1/2}, \text{ where } D = 3 \text{ meters, } P_o = 40\text{W, } R_L = 50.2 \text{ ohm} \\ &= 1/3 \times (40 \times 50.2)^{1/2} \\ &= 143.5 \text{ dB}\mu\text{V/m} \end{aligned}$$

$$\begin{aligned} \text{** FCC Limit} &= 43 + 10 \log (P_o), \text{ where } P_o = 40\text{W} \\ &= 59\text{dB} \end{aligned}$$



5.6 Frequency Stability

The EUT carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency over the variations of extreme ambient temperature. The DT450 was placed in the temperature chamber and measured the power output with the variation of DC power input in room temperature. The temperature was set to the lowest requirement -30°C and wait for a period of at least 2 hours to reach stability inside the unit. Once the chamber temperature and inside unit thermocouple temperatures reach the -30°C , the unit was turned on and output power was measured within one minute with the variations of DC input power from 85% to 115% of nominal voltage. Increasing the temperature by every 10°C step to the maximum extreme temperature of this test is $+50^{\circ}\text{C}$. For each temperature setting, wait for both chamber and unit inside thermocouple reach desired temperature and repeat the measurement. Please refer to pages B20–23 in appendix B for the test results.



5.7 Transient Frequency Behavior

In the frequency band 470 to 490MHz, transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

$t_1 = 10 \text{ ms}$

$t_2 = 25 \text{ ms}$

$t_3 = 10 \text{ ms}$

Where

t_1 is the time period immediately following t_{on} .

t_2 is the time period immediately following t_1 .

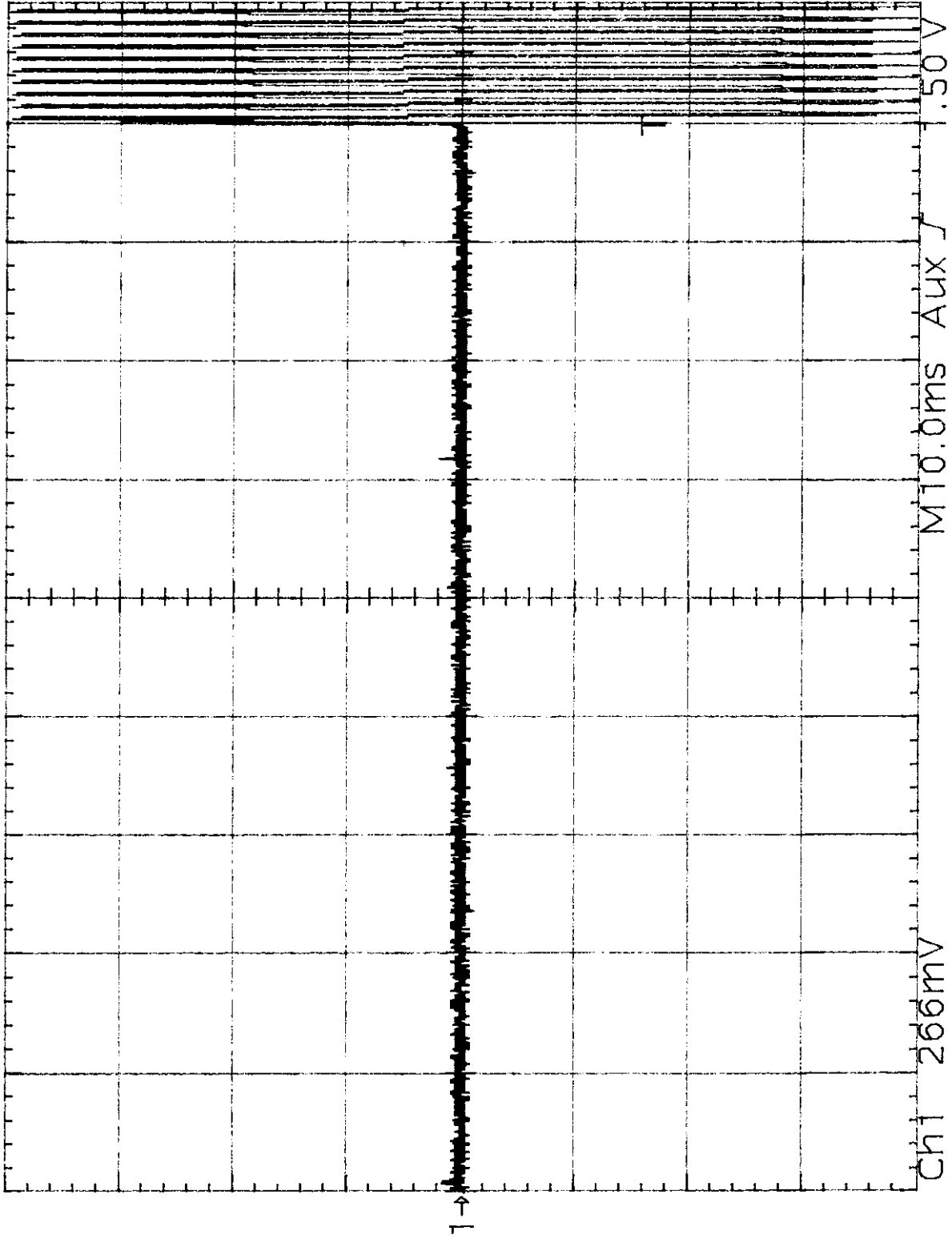
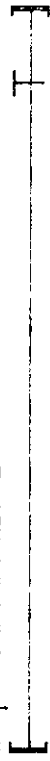
t_3 is the time period from the instant when the transmitter is turned off until t_{off} .

t_{on} is the instant when 1 KHz test signal is completely suppressed, including any capture time due to phasing.

t_{off} is the instant when the 1 KHz test signal starts to rise.

Test methods refer to test setup fig. 3 on page 12. The signal generator was set to the transmit frequency of the EUT with a 1KHz test tone. The EUT RF power output was attenuated to a level approximately 30dB greater than the signal generator. The two signals are combined and fed to a measuring receiver at the same frequency. A digital oscilloscope will monitor the recovered audio from the receiver and also triggered from the transmit switch of the EUT to measure t_1 , t_2 and t_3 , and test results as shown in plotted data in appendix B page B46-51.

Tek Stop: Single Seq 50.0kS/s

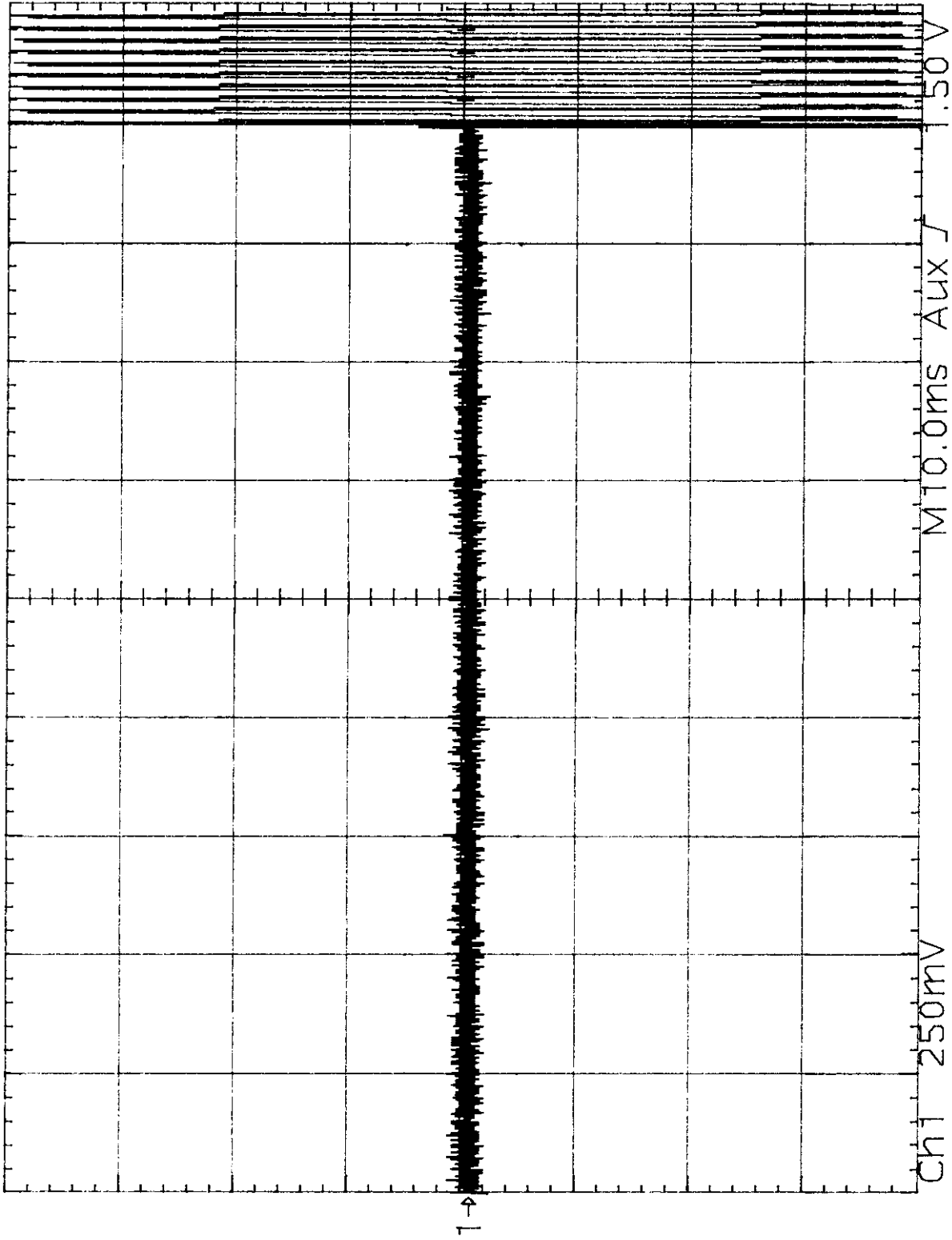


23 Oct 1998
14:59:38

SC 10/22/98

Tek Stop: Single Seq 50.0kS/s

┌──────────┐
└──────────┘

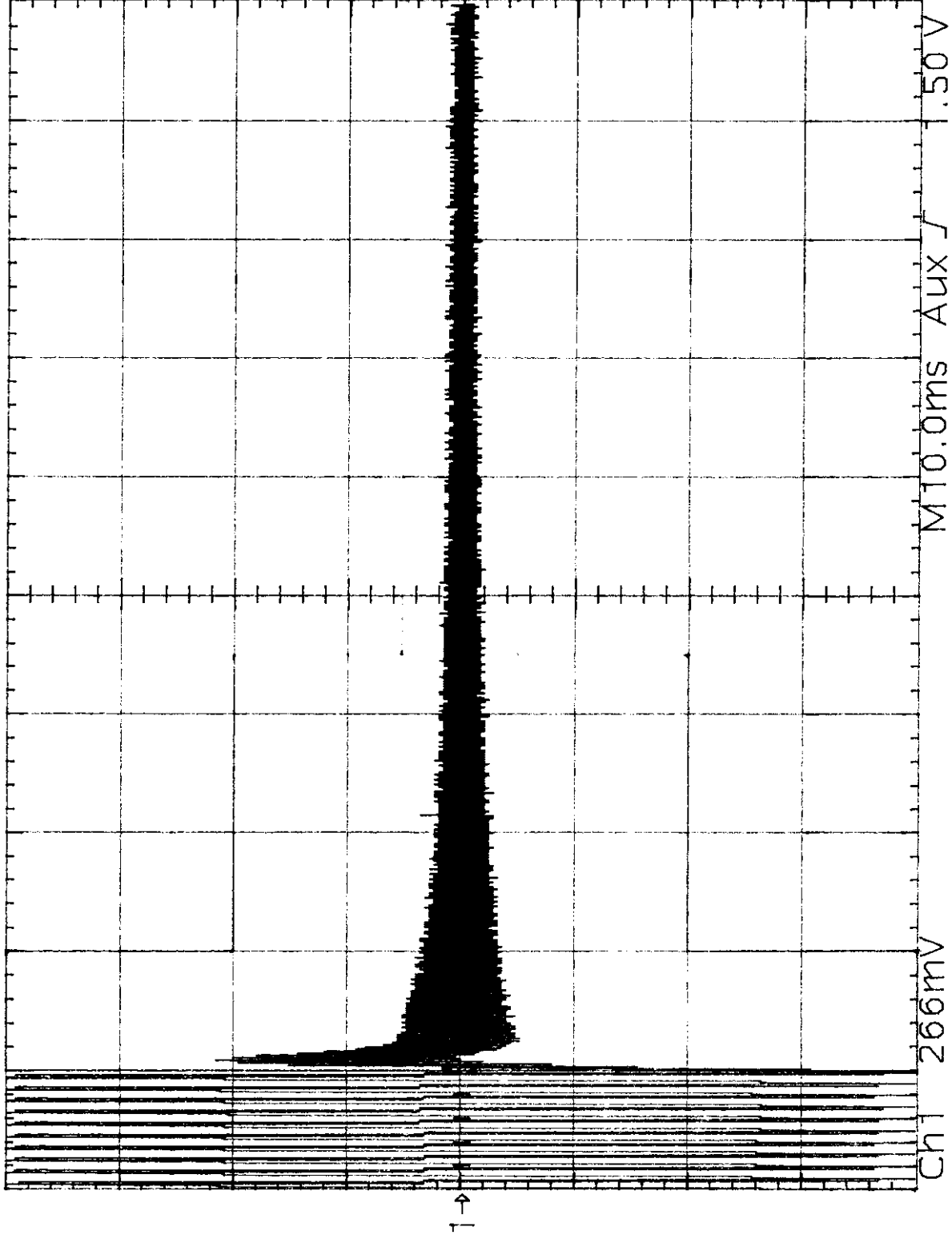


SR 10/22/98

21 Oct 1998
12:11:05

Tek Stop: Single Seq 50.0kS/s

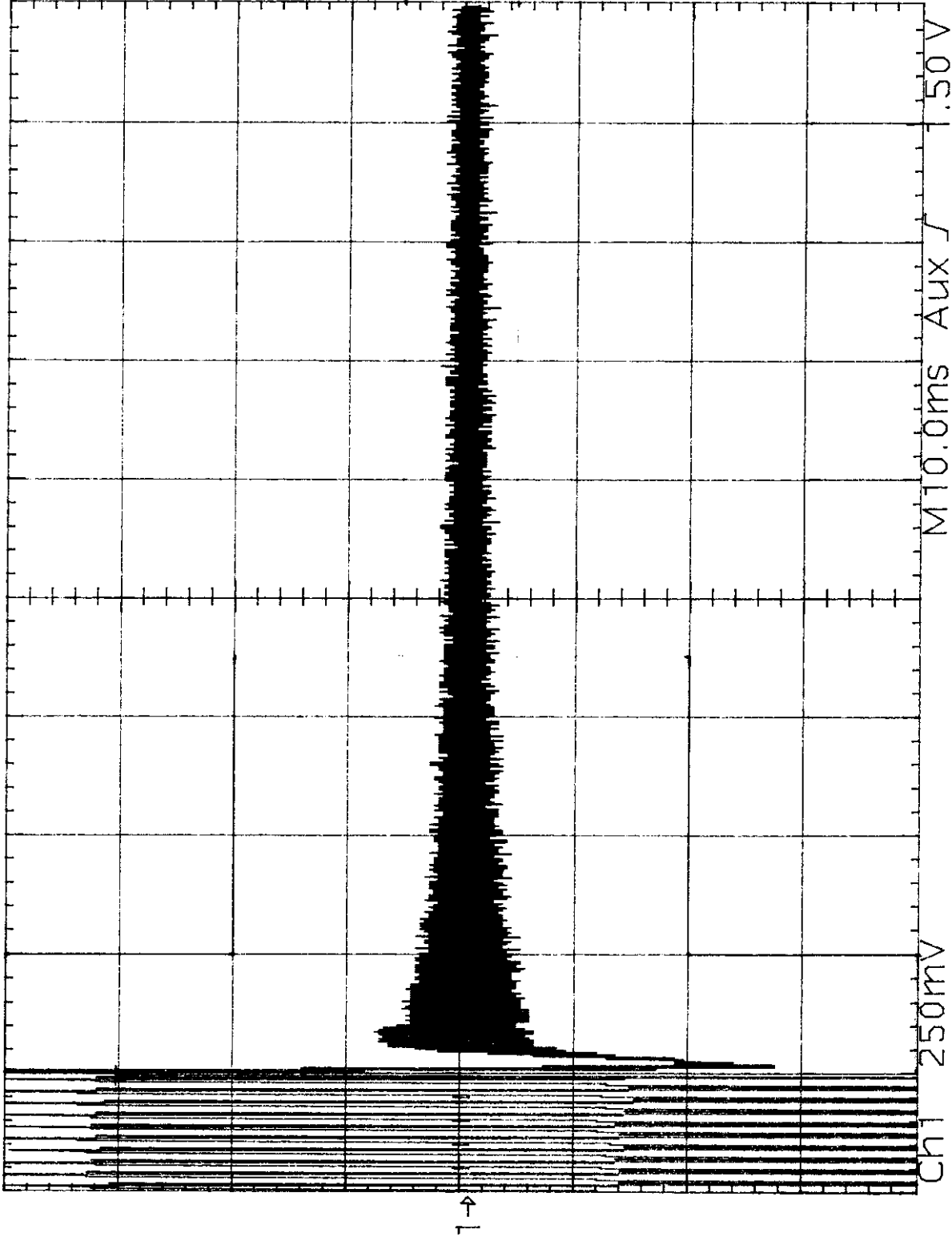
1 μ s



23 Oct 1998
14:51:55

Sc 10/22/98

Tek Stop: Single Seq 50.0kS/s



21 Oct 1998

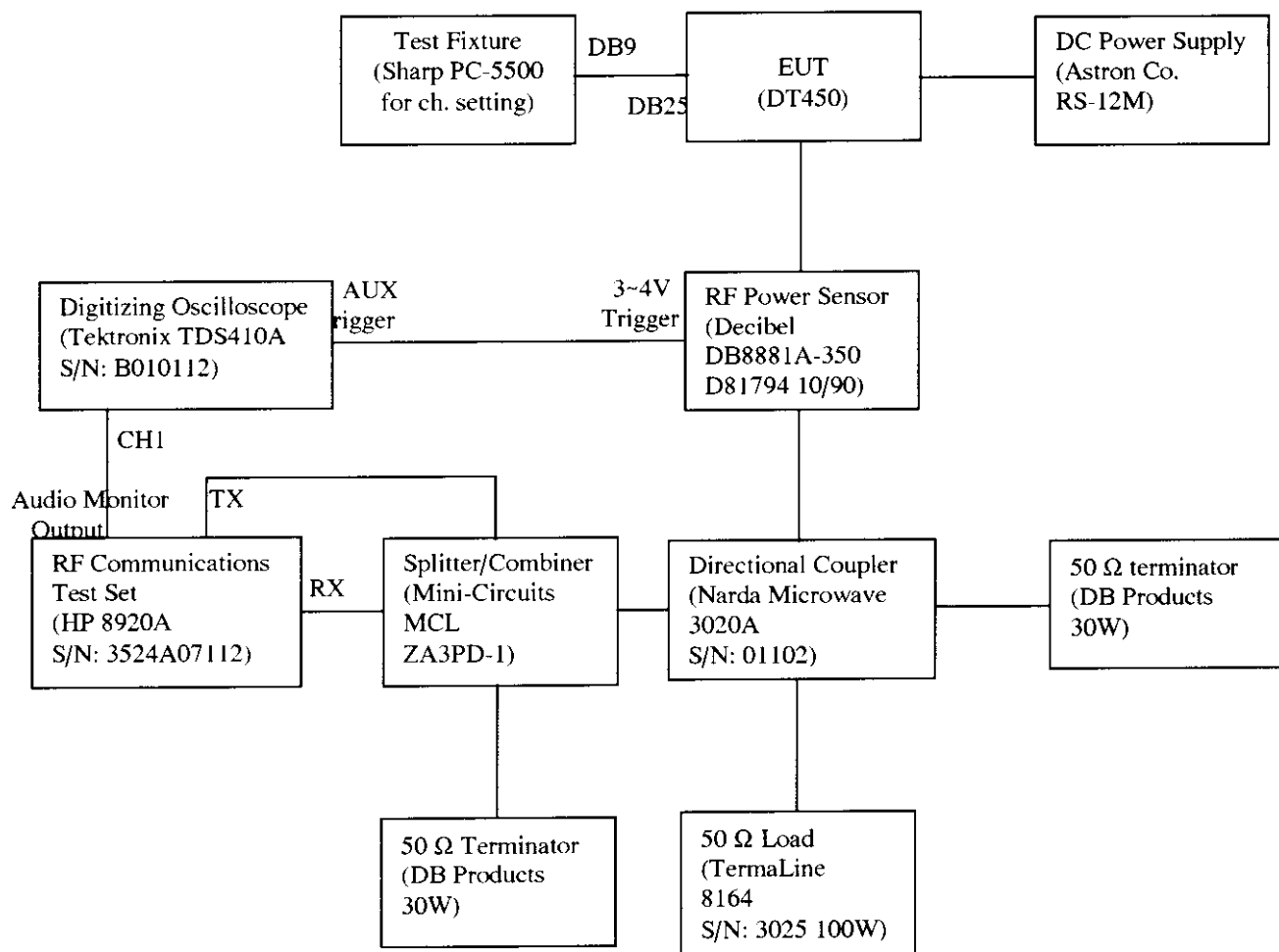
12:06:42

Sgt 10/22/98



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Test Setup Configuration:



Tek Stop: Single Seq 25.0kS/s



+25kHz

+12.5kHz

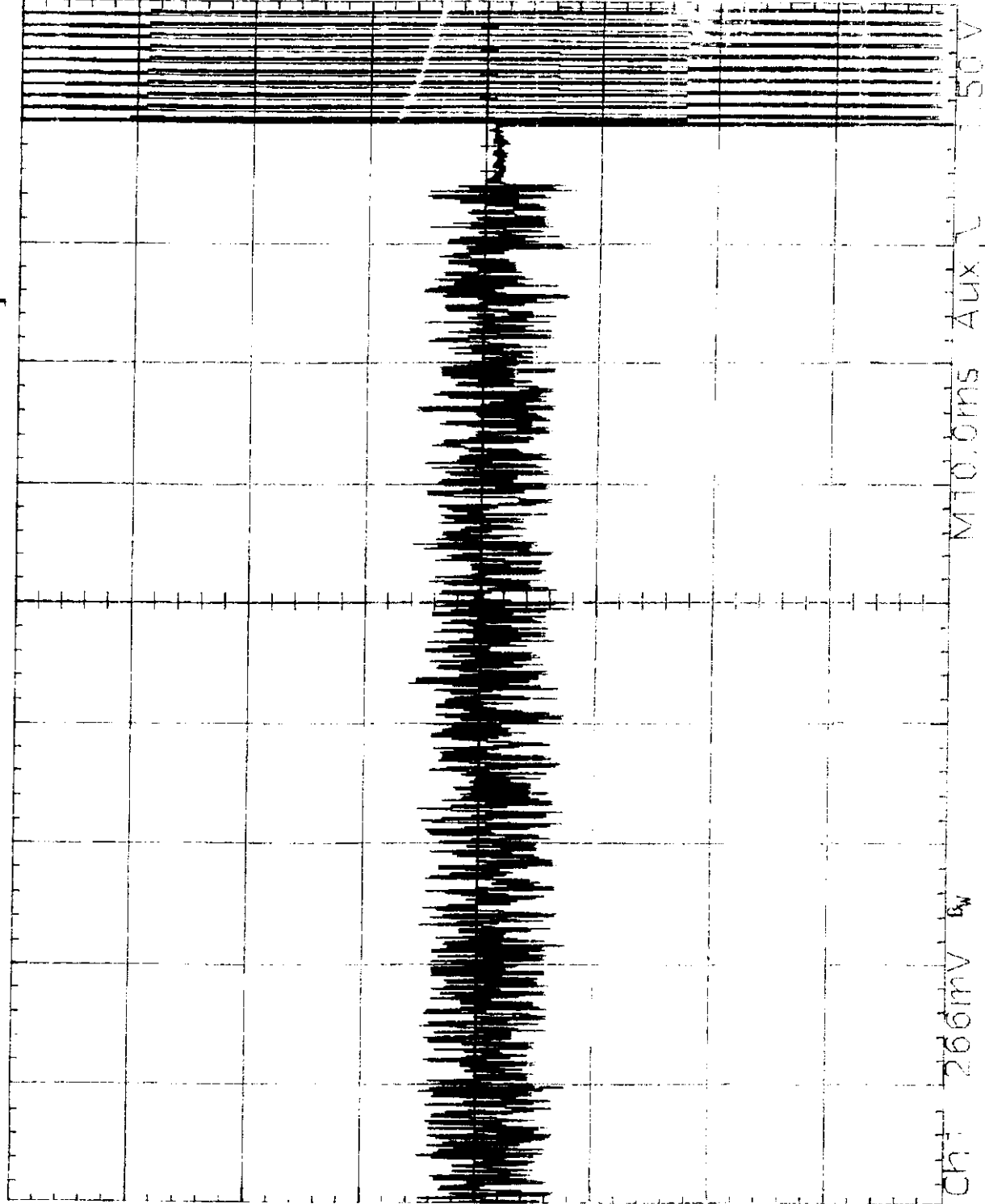
470MHz
19200bps FSK

-12.5kHz

-25kHz

21 NOV 1998

12:16:48



CH1 260mV

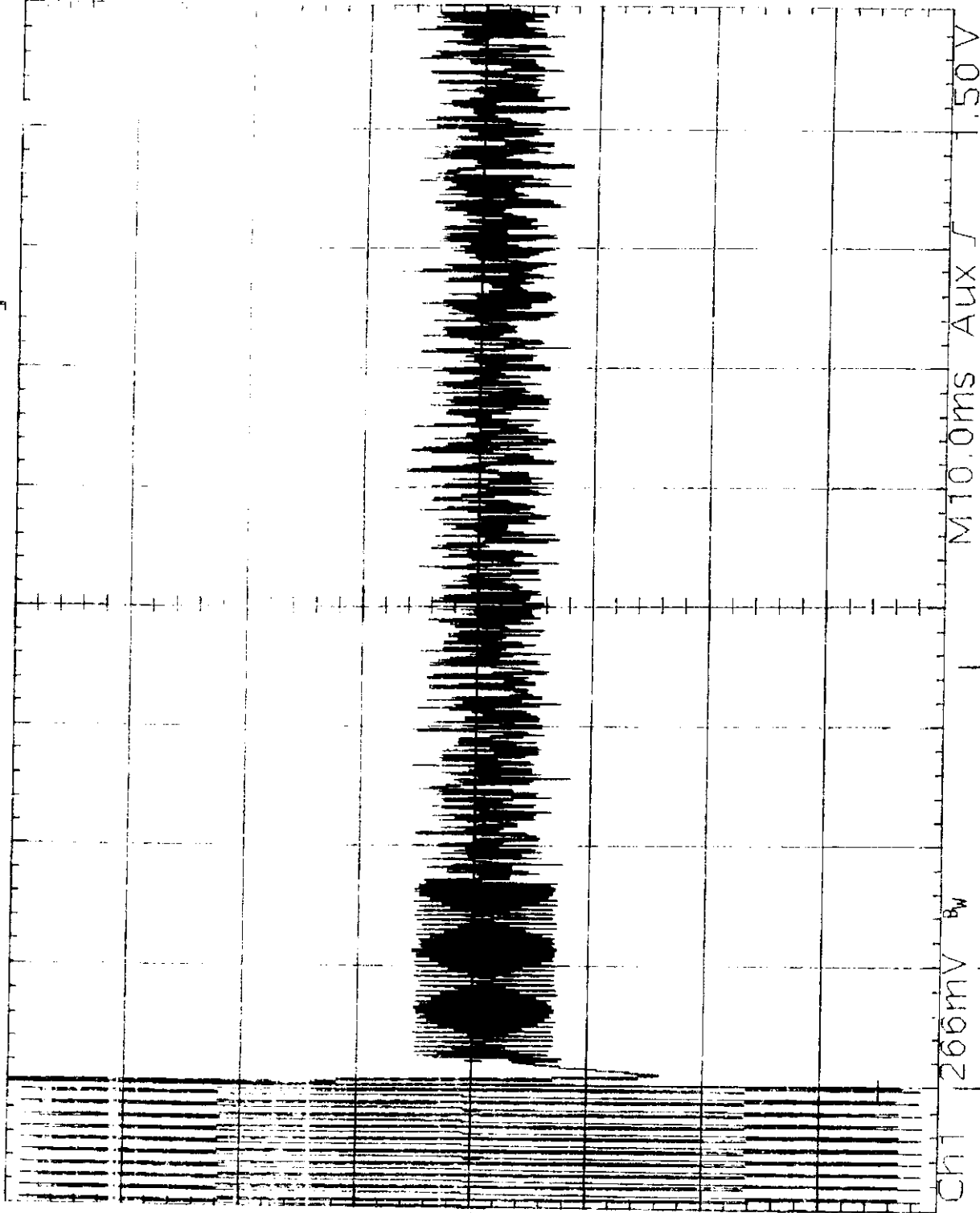
M10.0ms

50V

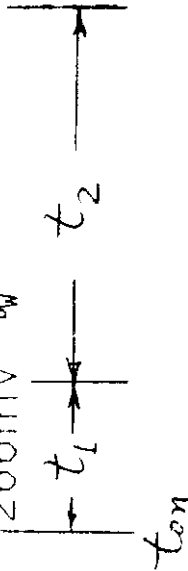
t_3

t_{off}

Tek Stop: Single Seq 25.0KS/s



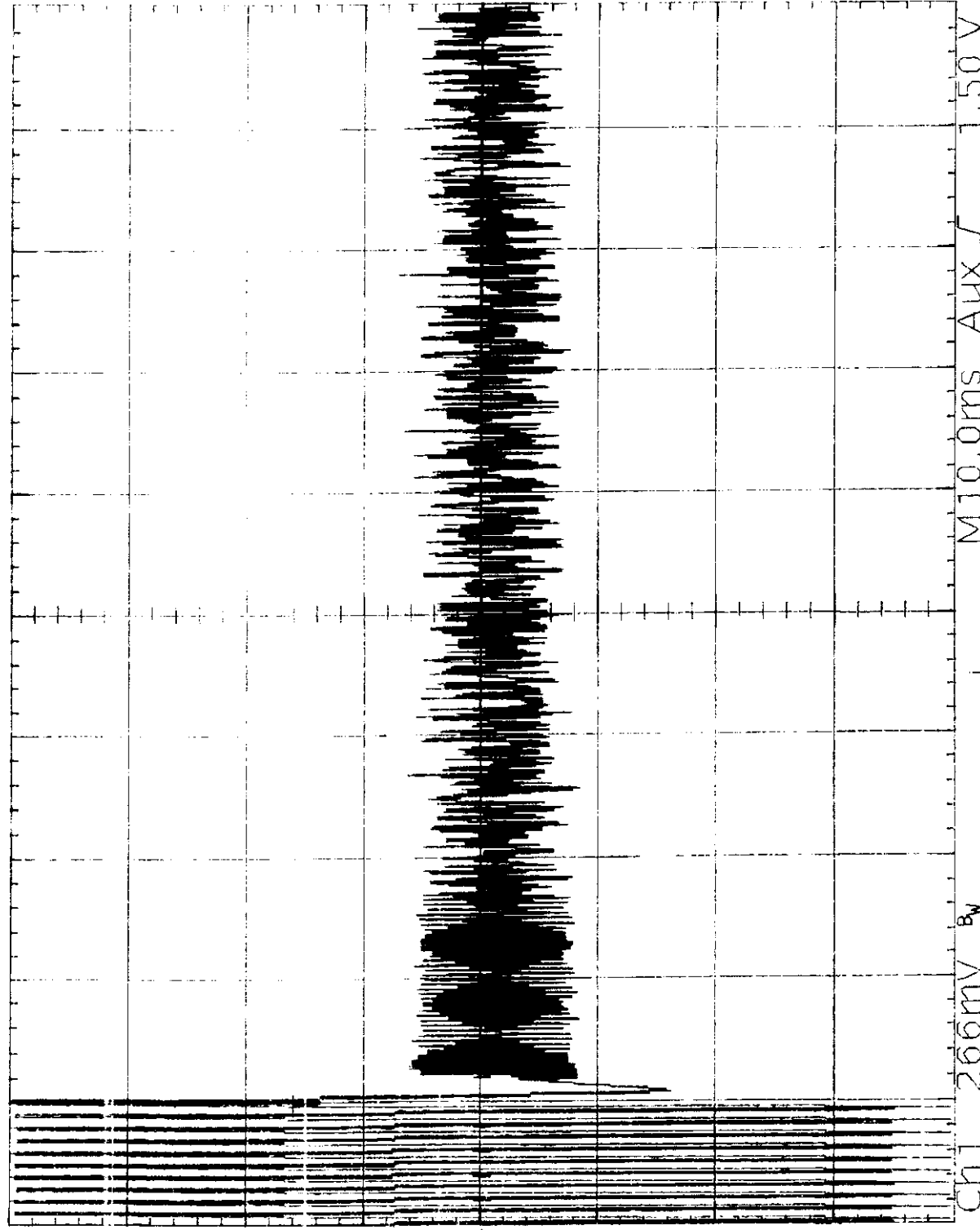
25 kHz
21 NOV 1998
12:10:46



Tek Run: 25.0kS/s

Hi Res

Trig?



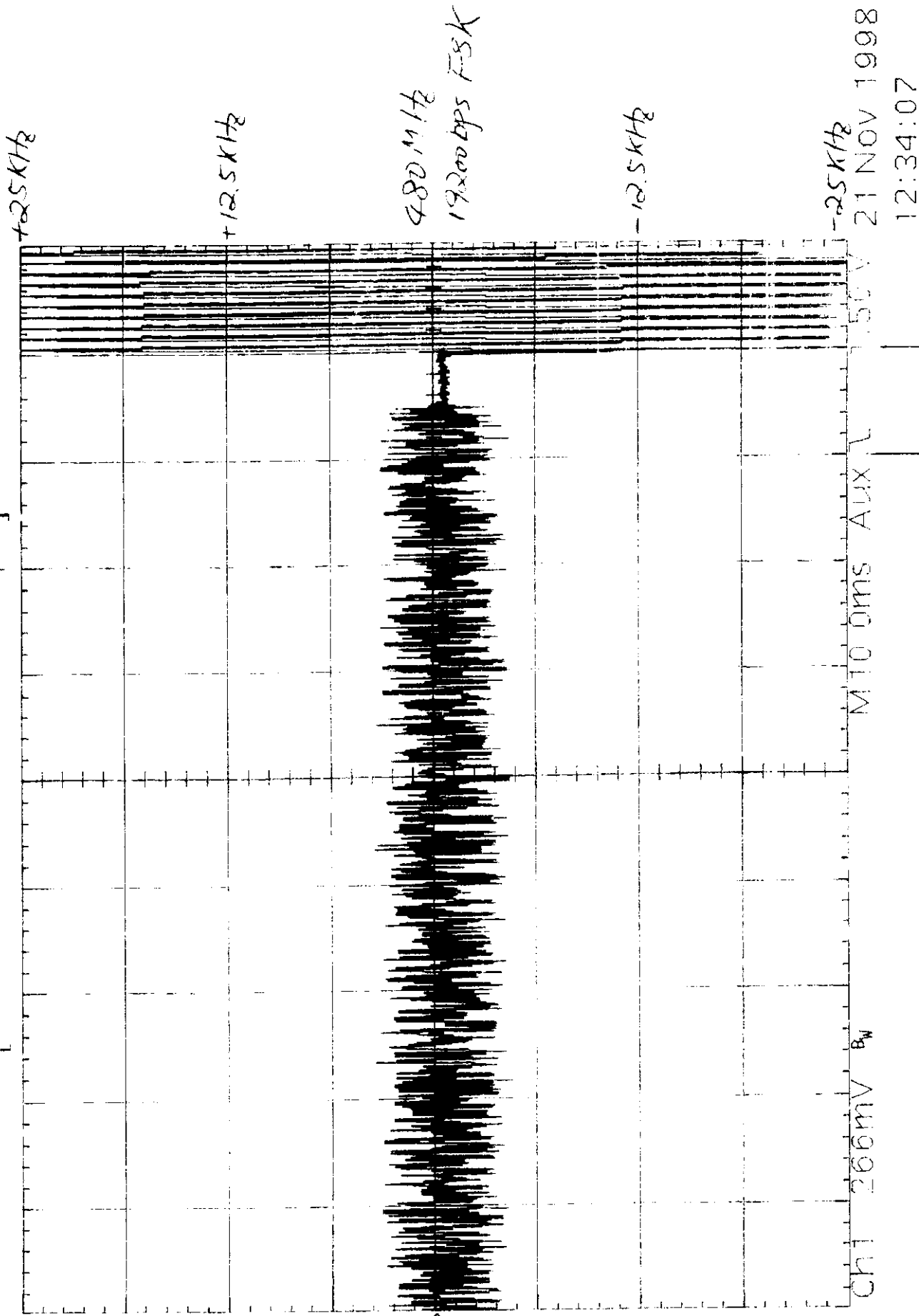
-25 kHz

21 NOV 1998

12:27:39

Tek Stop: Single Seq 25.0kS/s

1 →



21 NOV 1998
12:34:07

Tek Stop: Single Seq 25.0kS/s



+25kHz

+12.5kHz

490MHz

19200 bps FSK

-12.5kHz

-25kHz

1.50 V

M10.0ms

Aux J

Ch1

266mV

SW

1

21 NOV 1998

13:11:50

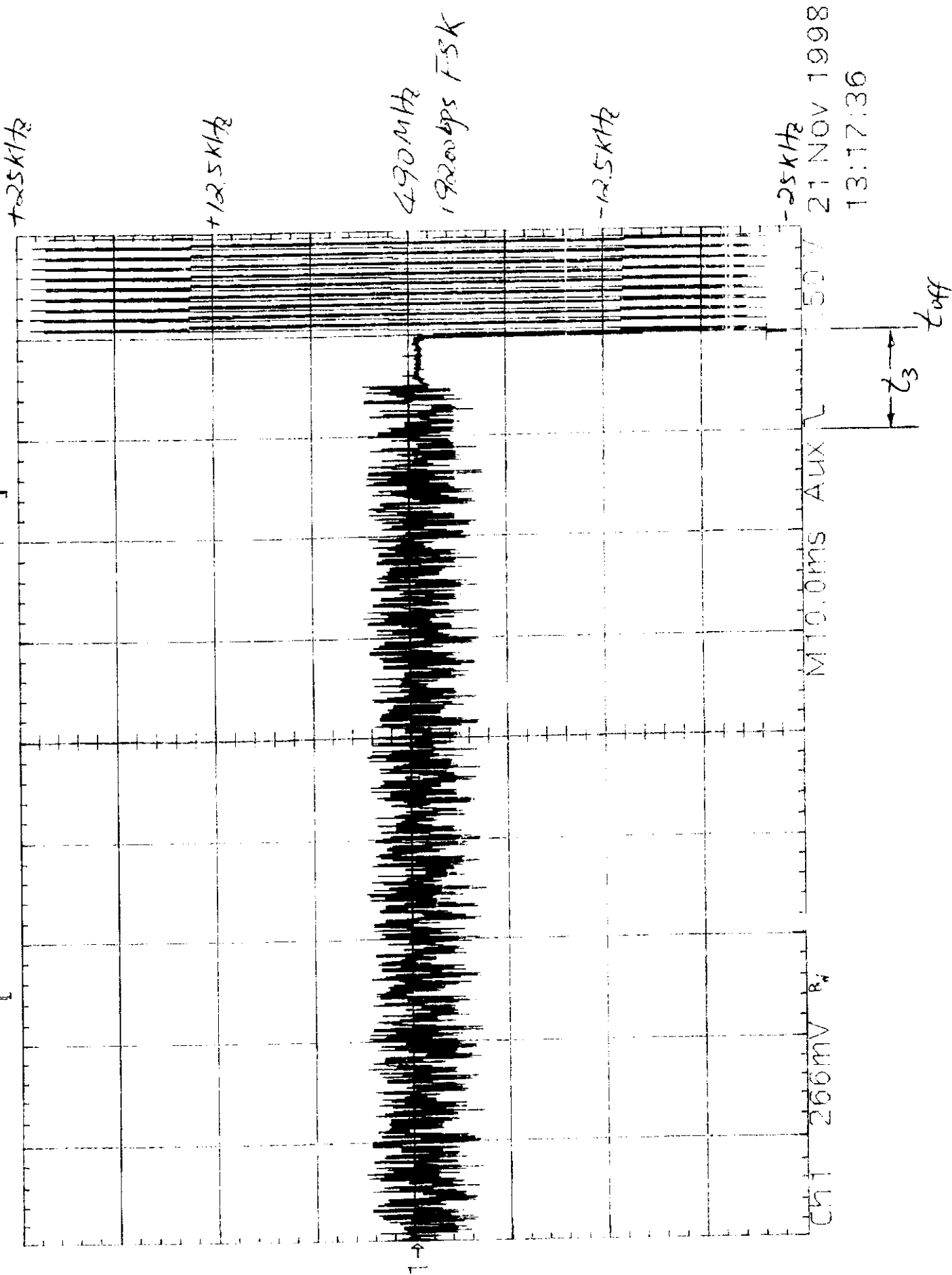
t_1

t_2

t_{on}

Tek Stop: Single Seq 25.0kS/s

1



21 NOV 1998

13:17:36



APPENDIX A - TEST EQUIPMENT USED

A complete list of test equipment used for each test can be found in their perspective test procedure. The equipment absolute performance calibration, of the equipment requiring calibration, is performed on an as needed basis in accordance with MIL-STD-45662. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least +/- 2 dB amplitude and +/-2% frequency deviation. Equipment certifications showing traceability to NIST (National Institute of Standards and Technology) are maintained on file at Instrument Specialties Corporate offices in Delaware Water Gap, PA or Placentia CA. All equipment is checked and verified for proper operation before and after each series of tests.

A.1 Specific Equipment Used

<i>Test Instrument</i>	<i>Mfg</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Freq. or Range</i>	<i>Cal. Due Date</i>
EMI Spectrum Analyzer	Hewlett Packard	8566B	2747A05747	100 Hz – 22 GHz	11/23/97
Communication Test Set	Hewlett Packard	8920A	3524A07112	.4 – 1000 MHz	12/06/97
Digital Oscilloscope	Tektronix	TDS460A	B010220	400MHz, 100Ms/s	12/06/97
Directional Coupler	Hewlett Packard	11692D	1212A02005	2 – 18 GHz	11/27/97
Directional Coupler	Werlatone	C3271	5320	80 – 2000 MHz	12/13/97
Digital Power Meter	Hewlett Packard	437B	3125U23484	0.1 MHz – 110 GHz	01/20/98
Power Sensor	Hewlett Packard	8481H	3318A17843	.01 – 18 GHz	12/19/97
RF Preamplifier	Hewlett Packard	8449B	3008A00357	1 – 26 GHz	09/13/97
Double Ridged Antenna	EMCO	3115	9511-4575	1 – 18 GHz	11/27/97
Signal Generator	Macorni	2022	119006-050	10 KHz – 1 GHz	10/08/97
50 ohm Resistive Load	Bird Electronics	50-T-FN	9708	50W	CIP
50 ohm Resistive Load	Bird Electronics	8833-30	2109	1KW	CIP
RF Combiner	Mini-Circuits	ZA3PD-1	N/A	0.4 – 1 GHz	CIP
DC Power Supply	Elenco	XP581	N/A	0 – 18V	CIP
DC Power Supply	Lambda	ZT803	N/A	0 – 36V, 0 – 34.5A	12/06/97
RF Coax Cable	Pasternack	PE-142LL	038	.02 – 10 GHz	CIP

* CIP – calibrate in place



APPENDIX B – SUPPLEMENTS TEST DATA

<i>Basic Standard</i>	<i>Details</i>	<i>Data Format</i>	<i>Page No.</i>
Part 90 Subpart I Part 2 Subpart J	Power Output	Plotted	B1 – B3
	Occupied Bandwidth	Plotted	B4 – B6
	Modulation Characteristics	Plotted	B7 – B9
	Antenna Terminal Spurious	Plotted	B10 – B39
	Radiated Spurious	Tabulated	B40 – B42
	Frequency Stability	Tabulated	B43 – B45
	Transient Frequency	Plotted	B46 – B51



ATTACHMENTS

INDEX OF ATTACHMENTS

<i>Description of Contents</i>	<i>Page No.</i>
DT450 Product Specification Manual	Exhibit A
DT450 Product Support Manual	Exhibit B
MX919B FSK Modem Manual	Exhibit C

ELECTROCOM DT450 OUTPUT POWER
MKR 470.000 MHz
REF 50.0 dBm
ATTEN 10 dB
45.50 dBm

hp

10 dB/

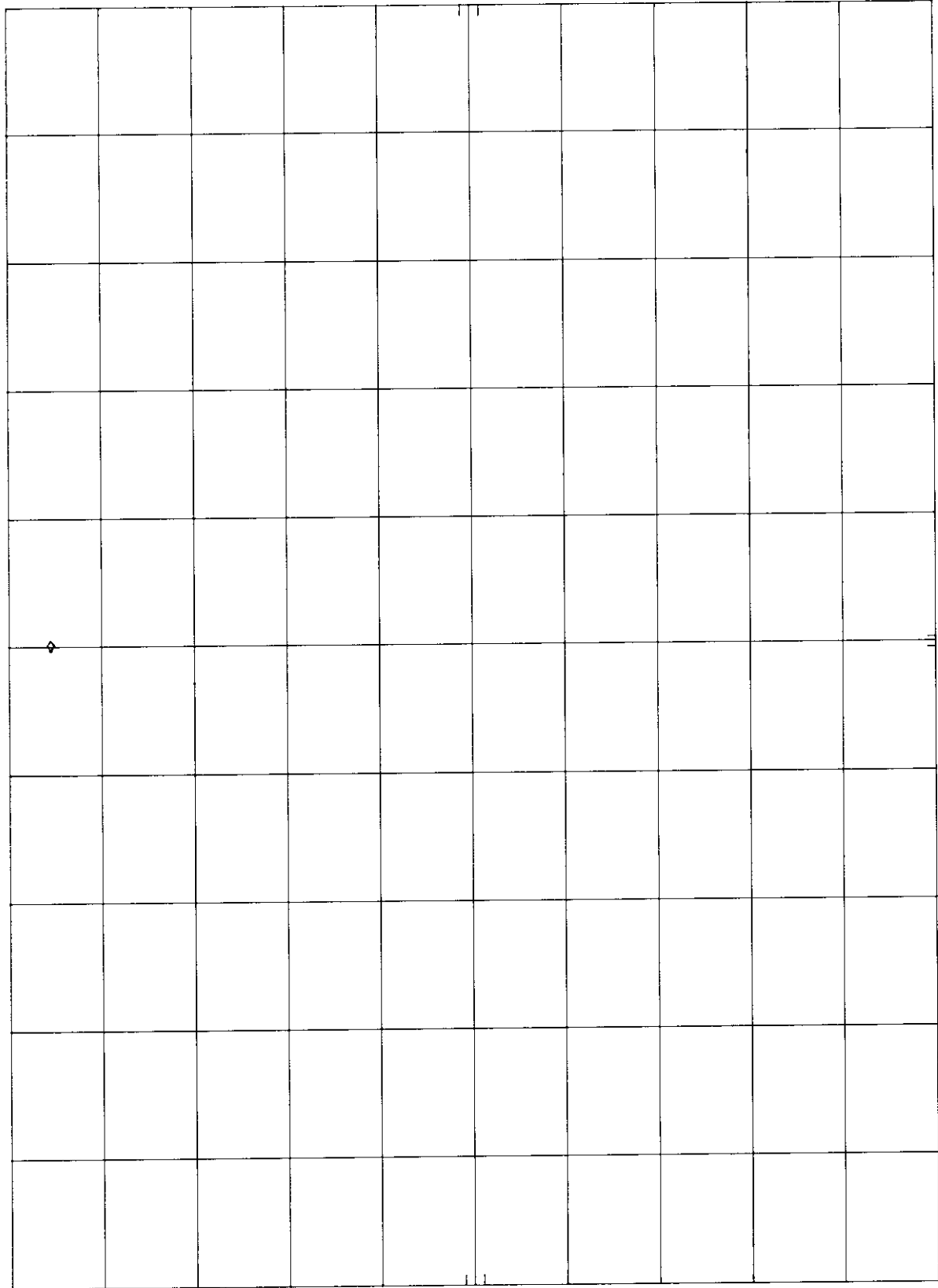
POS PK

OFFSET

50.0

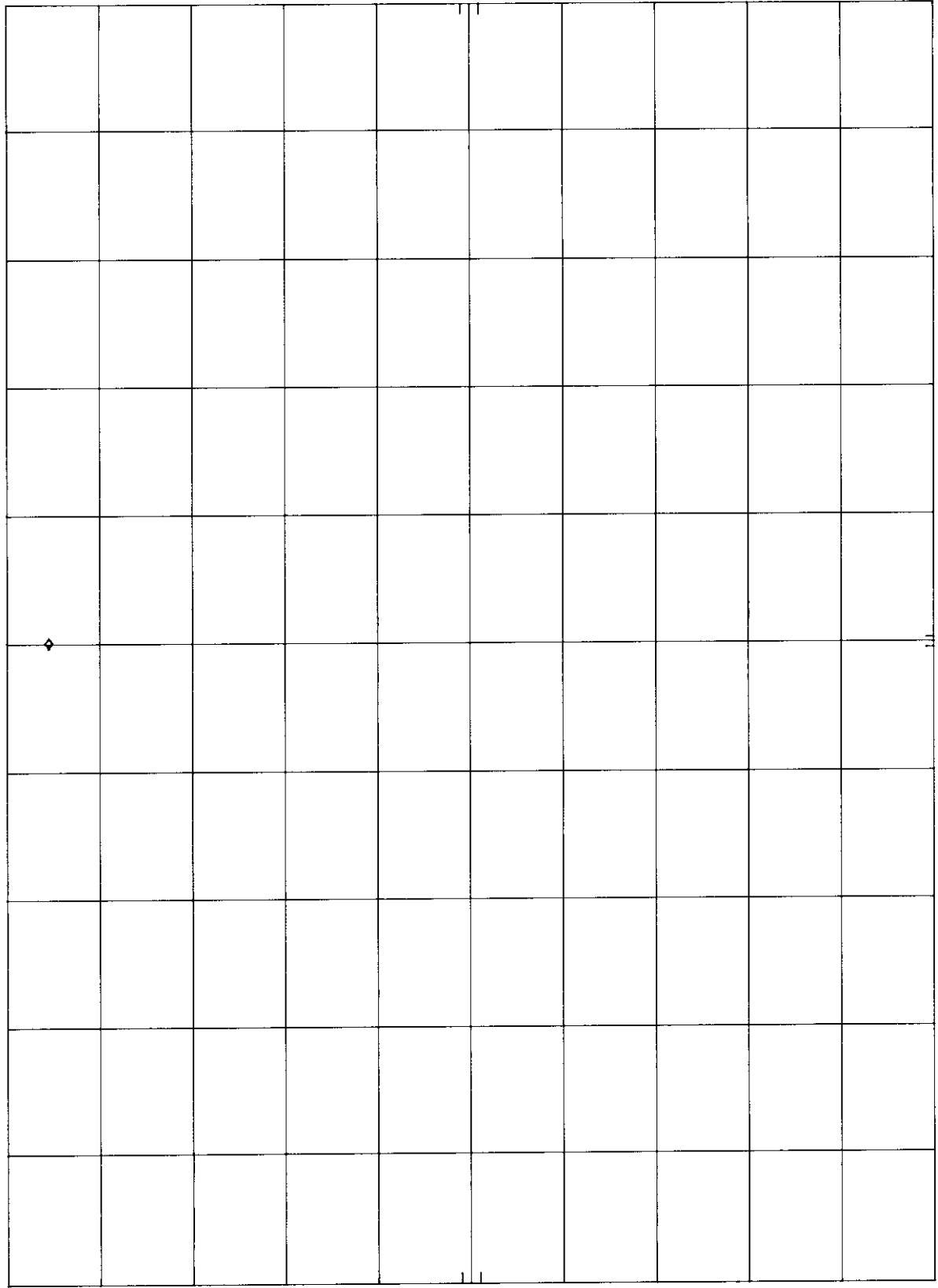
dB

CORR'D



CENTER 470.00 MHz
RES BW 100 kHz
SPAN 5.00 MHz
SWP 20.0 msec
VBW 100 kHz

hp ELECTROCOM DT450 OUTPUT POWER MKR 480.000 MHz
REF 50.0 dBm ATTN 10 dB 45.50 dBm

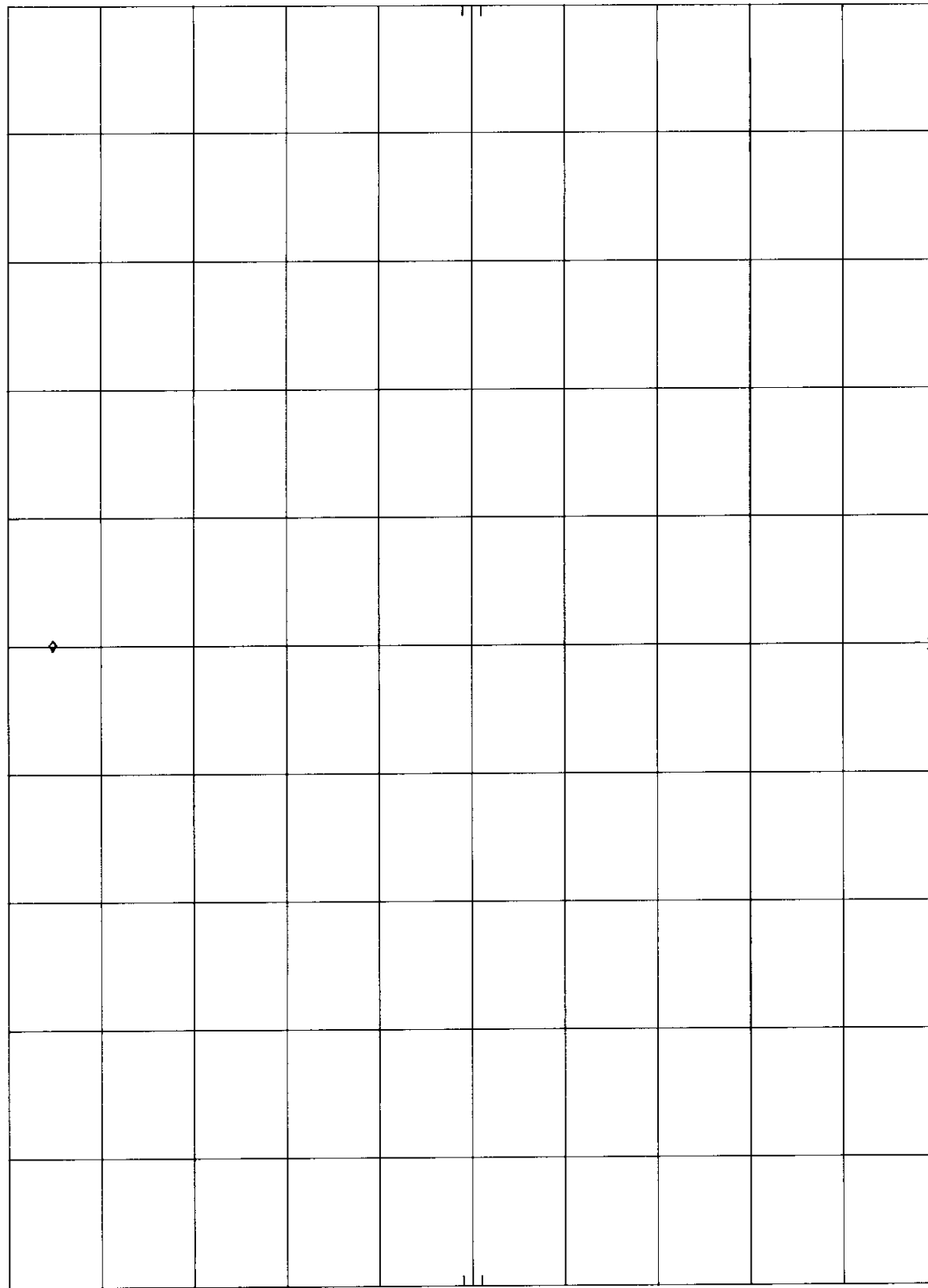


10 dB/
POS PK
OFFSET
50.0
dB

CORR'D

CENTER 480.00 MHz RES BW 100 kHz VBW 100 kHz SPAN 5.00 MHz SWP 20.0 msec

HP
ELECTROCOM DT450 OUTPUT POWER
REF 50.0 dBm ATTN 10 dB
MKR 490.000 MHz
45.20 dBm



10 dB/
POS PK
OFFSET
50.0
dB

CORR'D

CENTER 490.00 MHz
RES BW 100 kHz
SPAN 5.00 MHz
SWP 20.0 msec
VBW 100 kHz

ELECTROCOM DT450 OCCUPIED BANDWIDTH MKR 470.000 0 MHz
REF 50.0 dBm ATEN 10 dB 45.70 dBm

hp

10 dB/

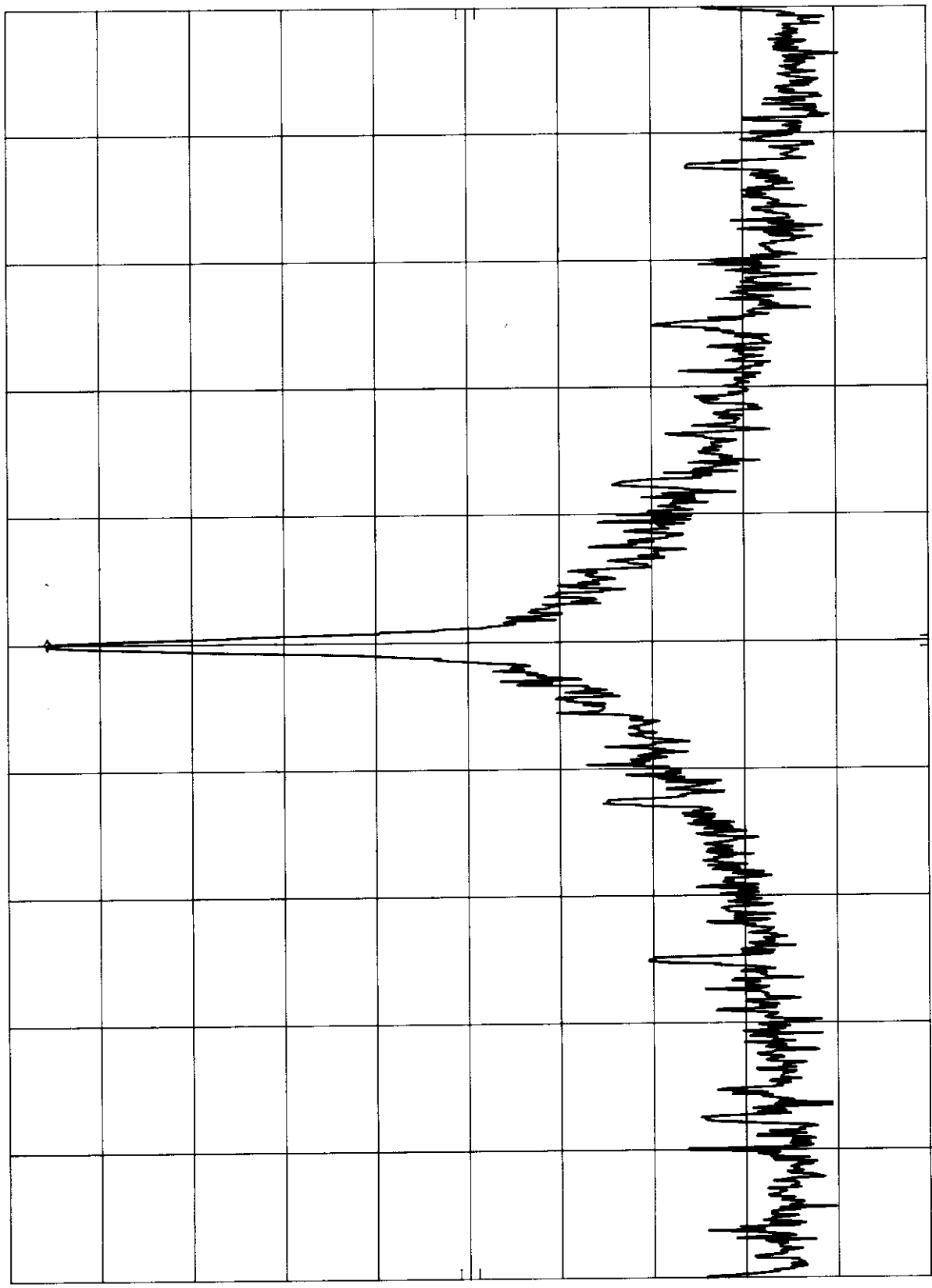
POS PK

OFFSET

50.0

dB

CORR'D



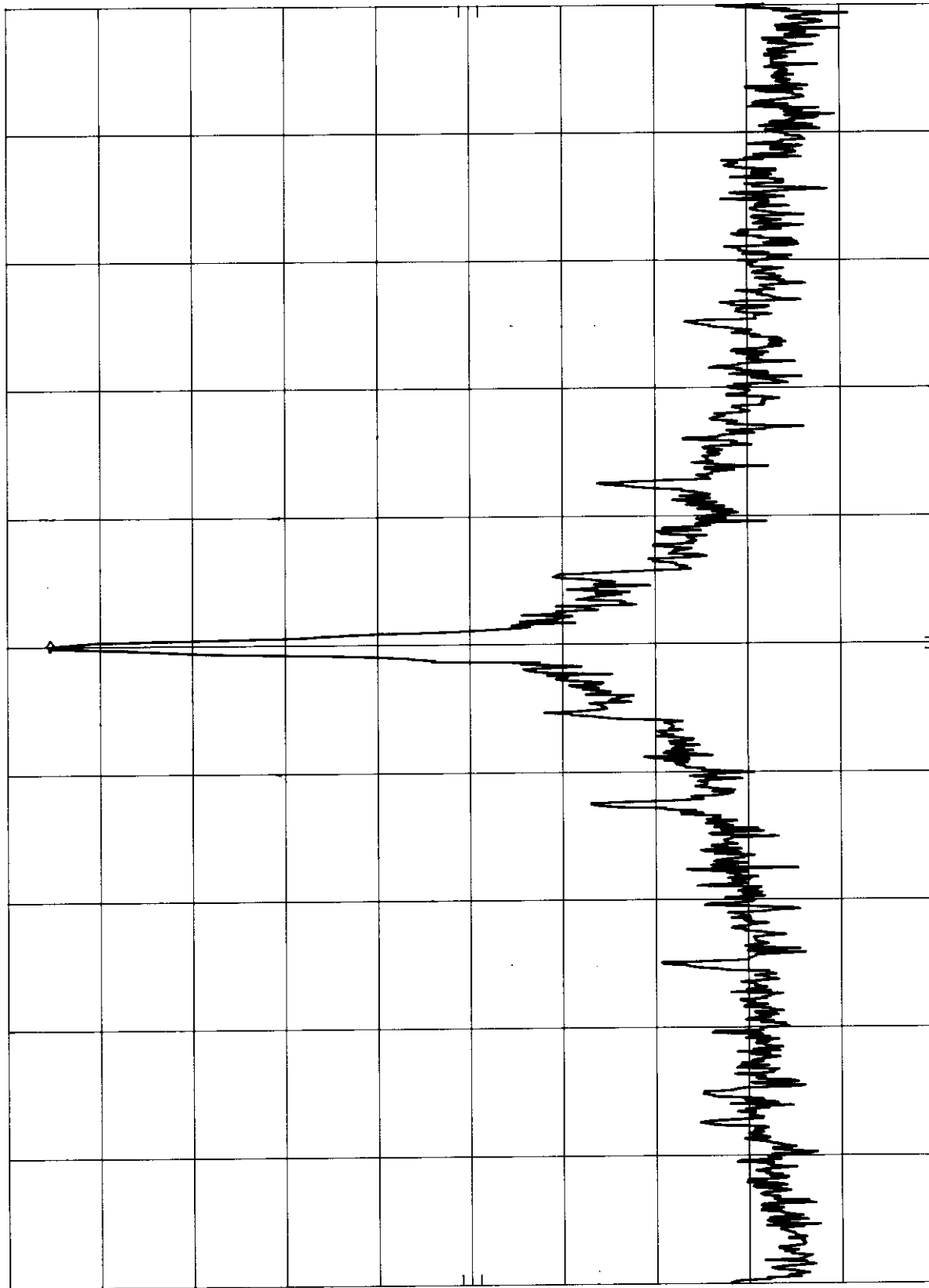
CENTER 470.000 MHz RES BW 300 Hz VBW 300 Hz SPAN 100 KHZ SWP 3.00 sec

ELECTROCOM DT450 OCCUPIED BANDWIDTH
REF 50.0 dBm ATTEN 10 dB MKR 480.000 0 MHz
45.40 dBm

hp

10 dB/
POS PK
OFFSET
50.0
dB

CORR'D

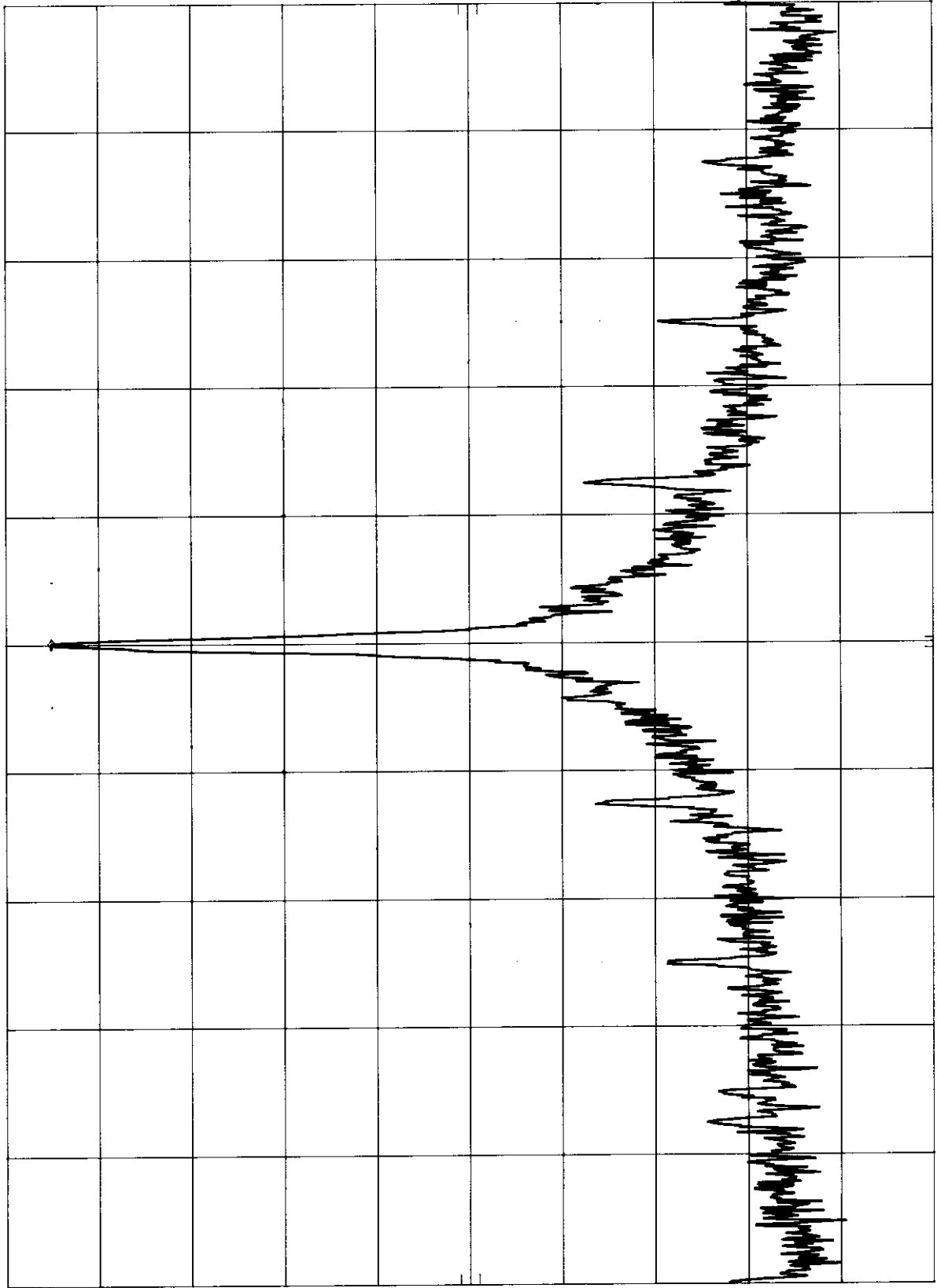


CENTER 480.000 MHz RES BW 300 Hz VBW 300 Hz HZ SPAN 100 KHz SWP 3.00 sec

h_p ELECTROCOM DT450 OCCUPIED BANDWIDTH MKR 490.000 0 MHz
 REF 50.0 dBm ATEN 10 dB 45.10 dBm

10 dB/
 POS PK
 OFFSET
 50.0
 dB

CORR'D



CENTER 490.000 MHz SPAN 100 KHz
 RES BW 300 Hz SWP 3.00 sec
 VBW 300 Hz

h_p MKR 470.000 0 MHz
42.80 dBm

ELECTROCOM DT450 MODULATION
REF 50.0 dBm ATTEN 10 dB

h_p

10 dB/

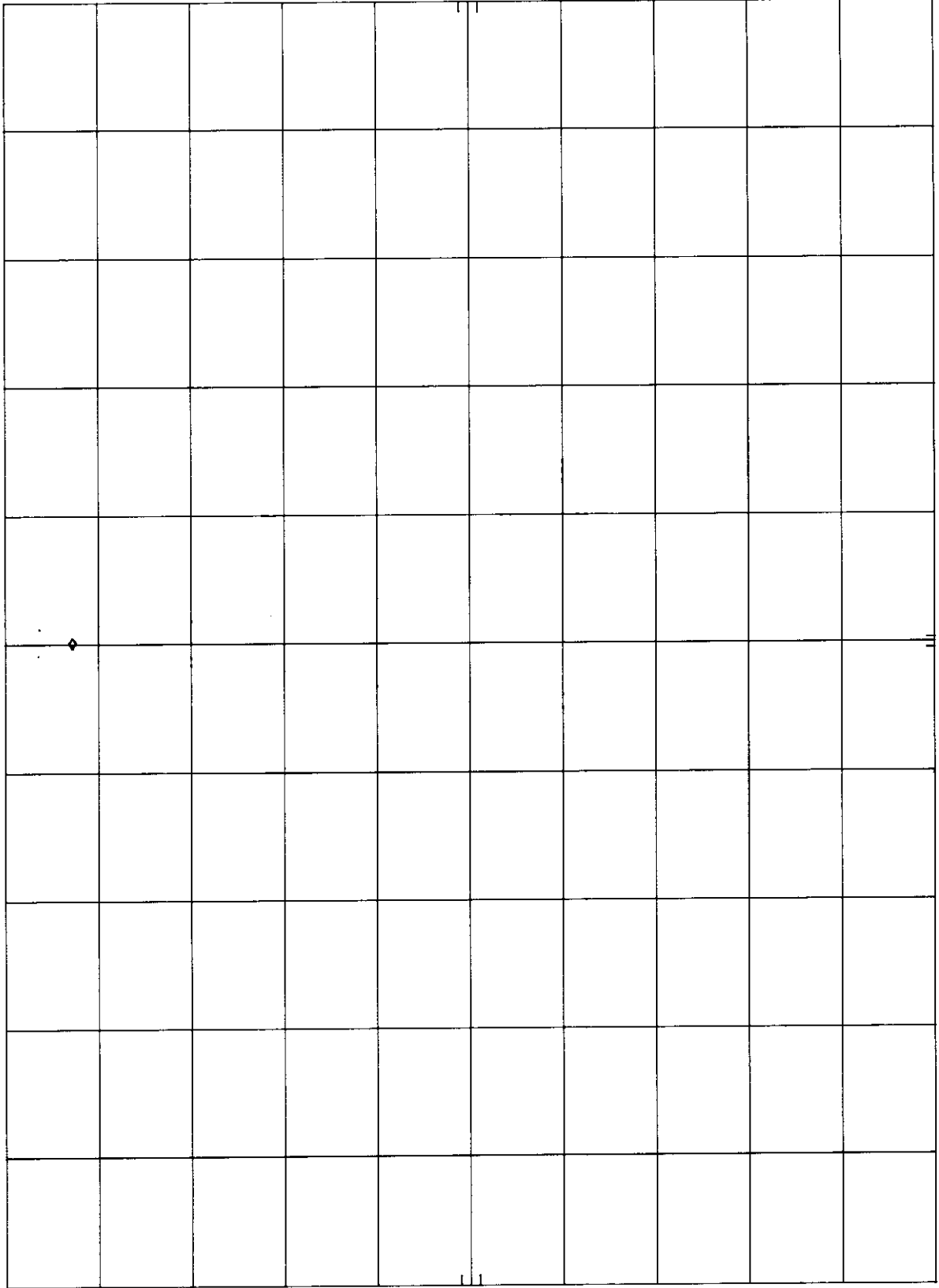
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 470.000 MHz
RES BW 1 KHZ
SPAN 500 KHZ
SWP 1.50 sec
VBW 1 KHZ

ELECTROCOM DT450 MODULATION
MKR 480.000 0 MHz
REF 50.0 dBm ATTEN 10 dB
42.20 dBm

HP

10 dB/

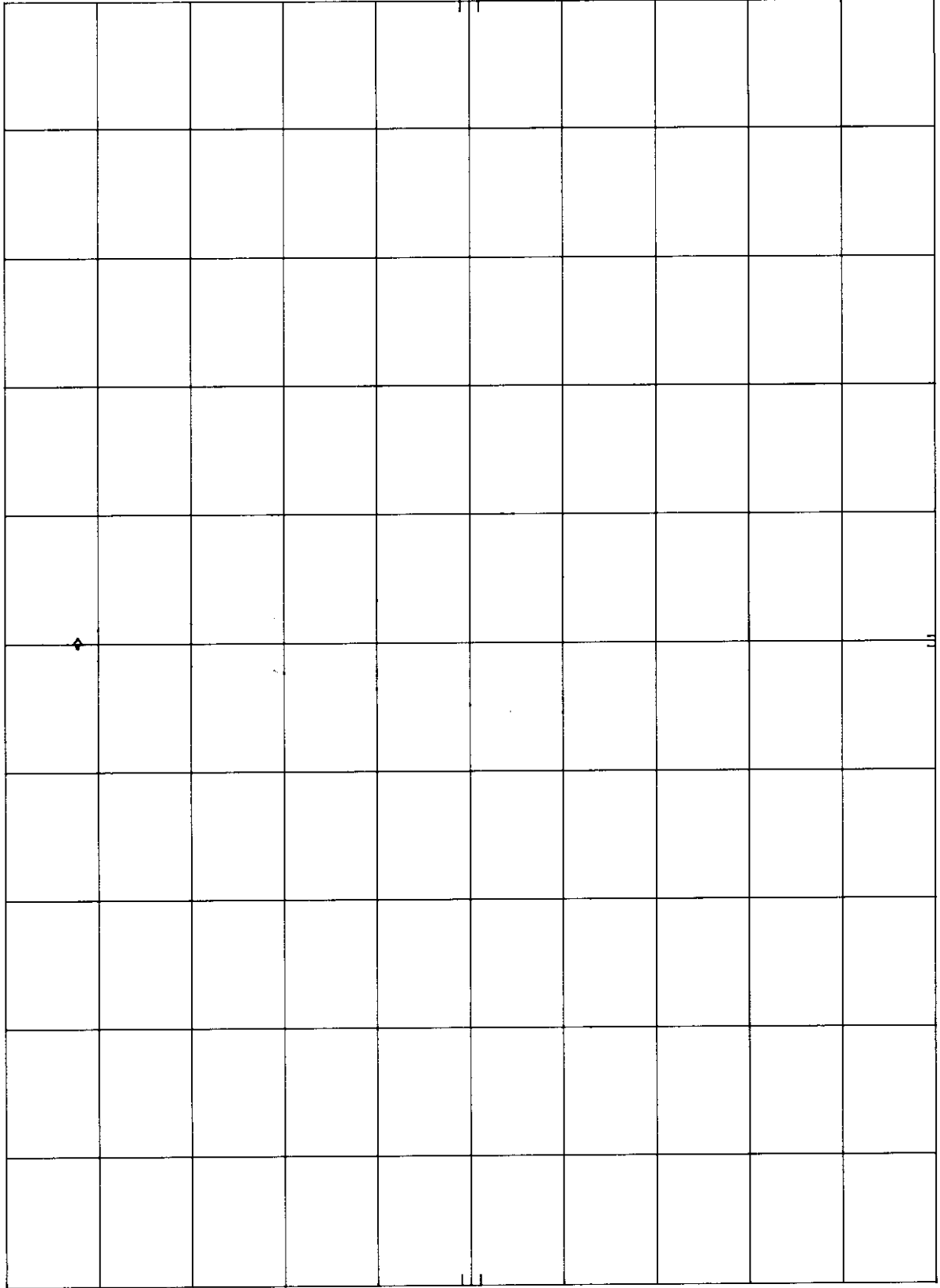
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 480.000 MHz
RES BW 1 kHz
SPAN 500 kHz
SWP 1.50 sec
VBW 1 kHz

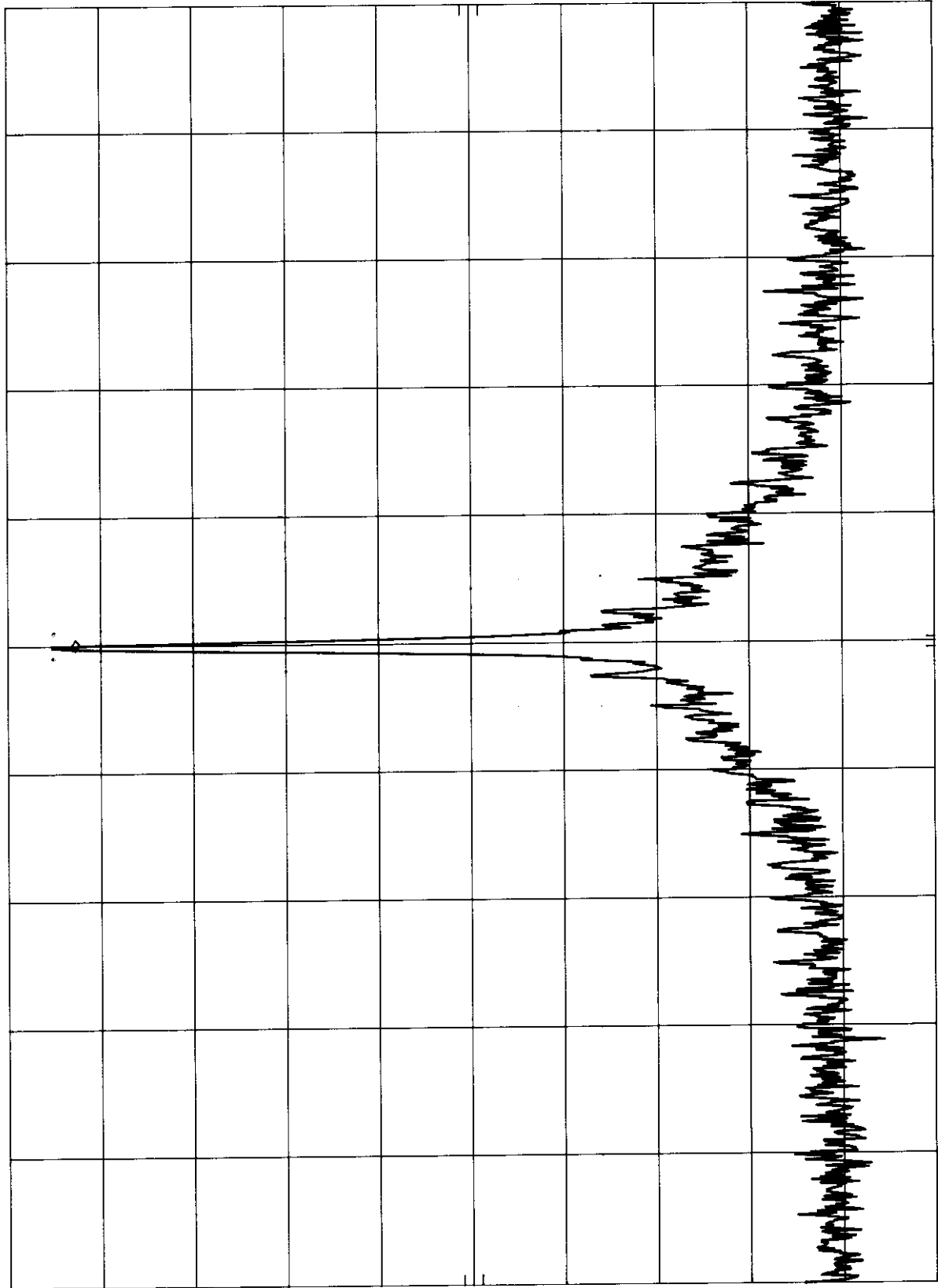
MKR 490.000 0 MHz
42.70 dBm

ELECTROCOM DT450 MODULATION
REF 50.0 dBm ATTN 10 dB

hp

10 dB/
POS PK
OFFSET
50.0
dB

CORR'D



CENTER 490.000 MHz
RES BW 1 KHZ
SPAN 500 KHZ
SWP 1.50 sec
VBW 1 KHZ

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 470.000 MHz
REF 50.0 dBm ATTEN 10 dB 45.40 dBm

hp

10 dB/

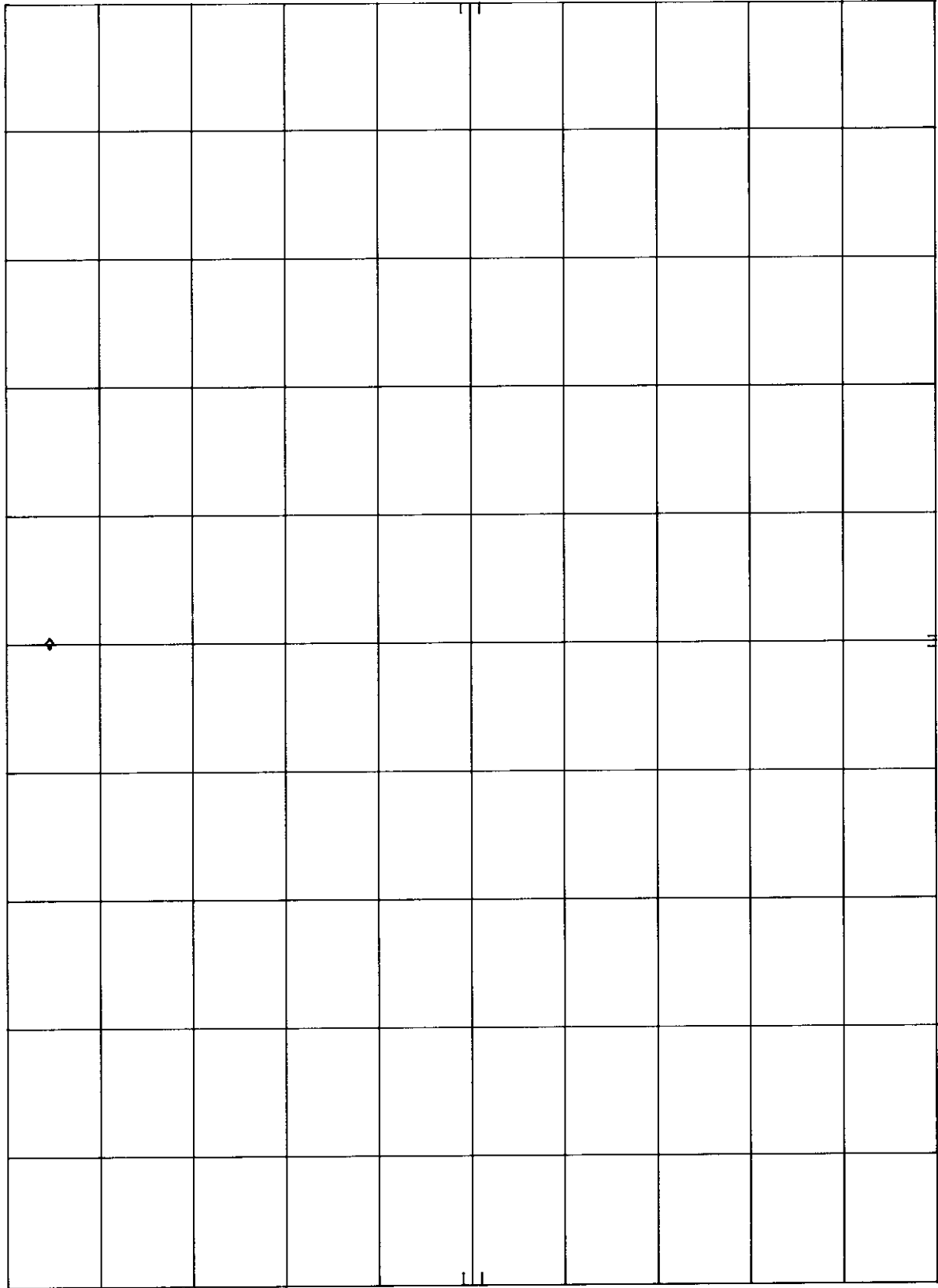
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 470.00 MHz RES BW 100 kHz VBW 100 kHz SPAN 5.00 MHz SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 940.000 MHZ
REF 50.0 dBm ATTEN 10 dB -18.40 dBm

h_p

10 dB/

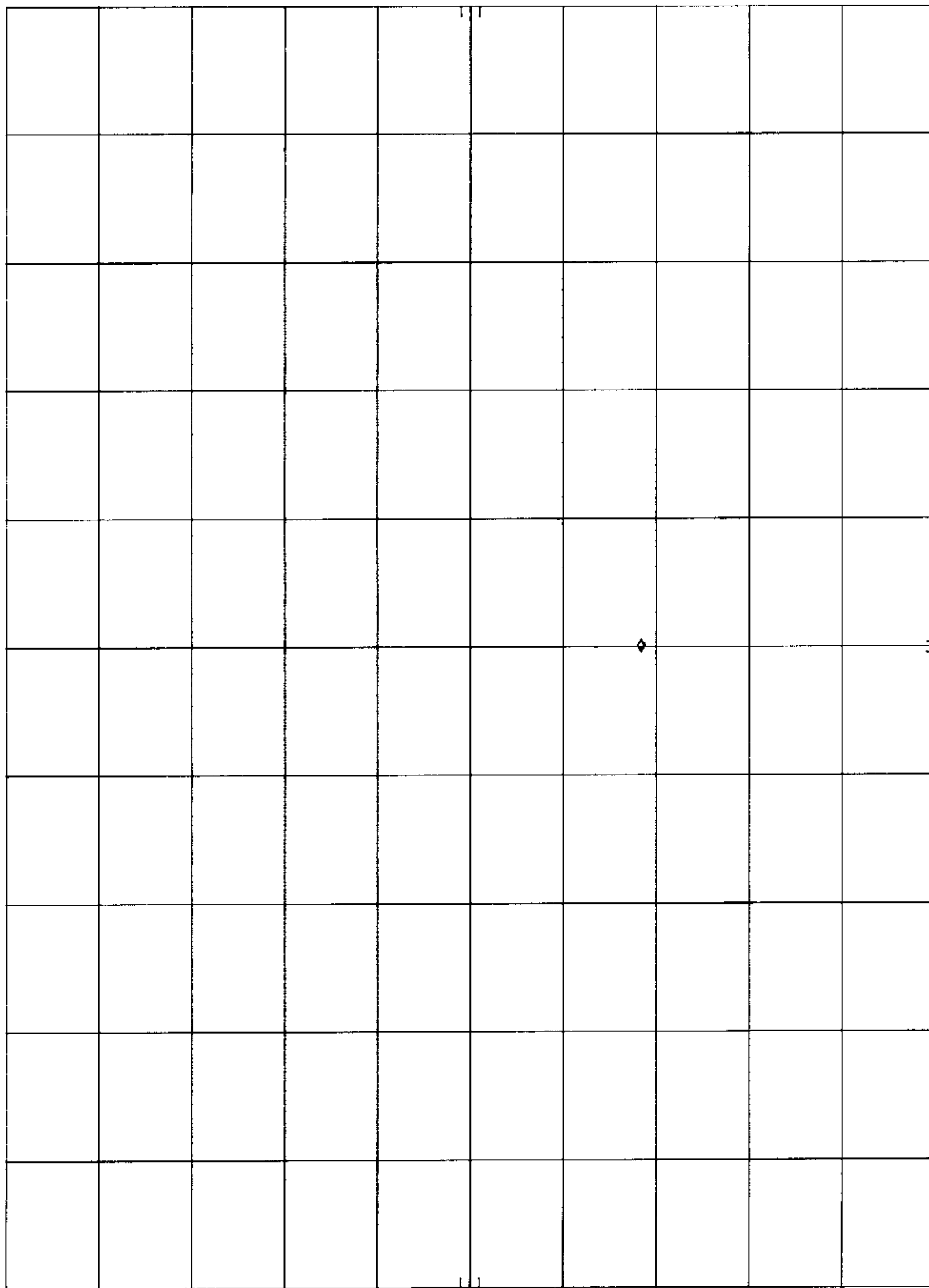
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 940.00 MHZ
RES BW 100 KHZ
SPAN 5.00 MHZ
SWP 20.0 msec
VBW 100 KHZ

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 1.410 000 GHZ
 REF 50.0 dBm ATTEN 10 dB -25.30 dBm

hp

10 dB/

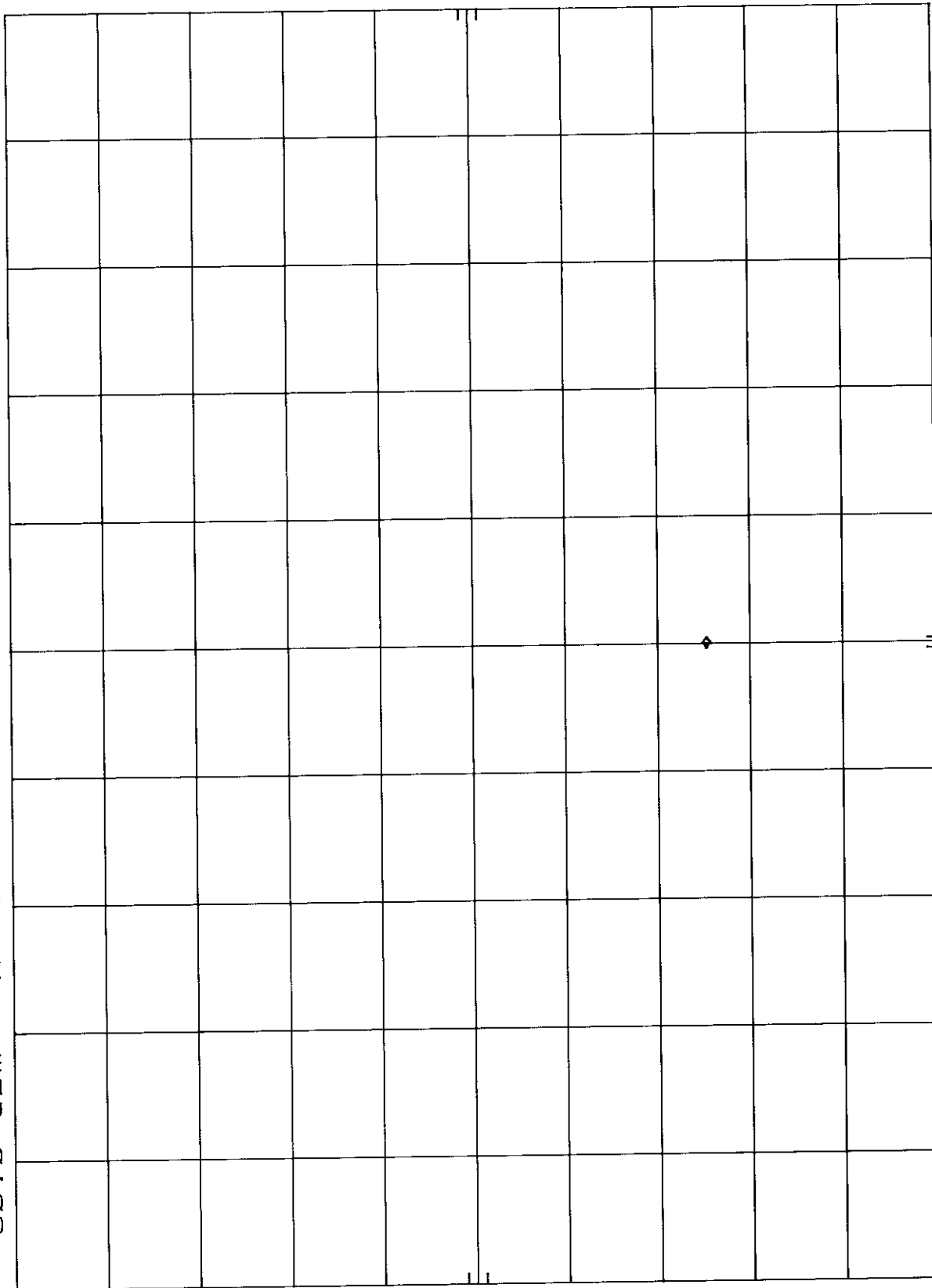
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 1.410 00 GHZ
 RES BW 100 KHZ
 VBW 100 KHZ
 SPAN 5.00 MHZ
 SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 1.880 000 GHZ
 REF 50.0 dBm ATTEN 10 dB -23.10 dBm

hp

10 dB/

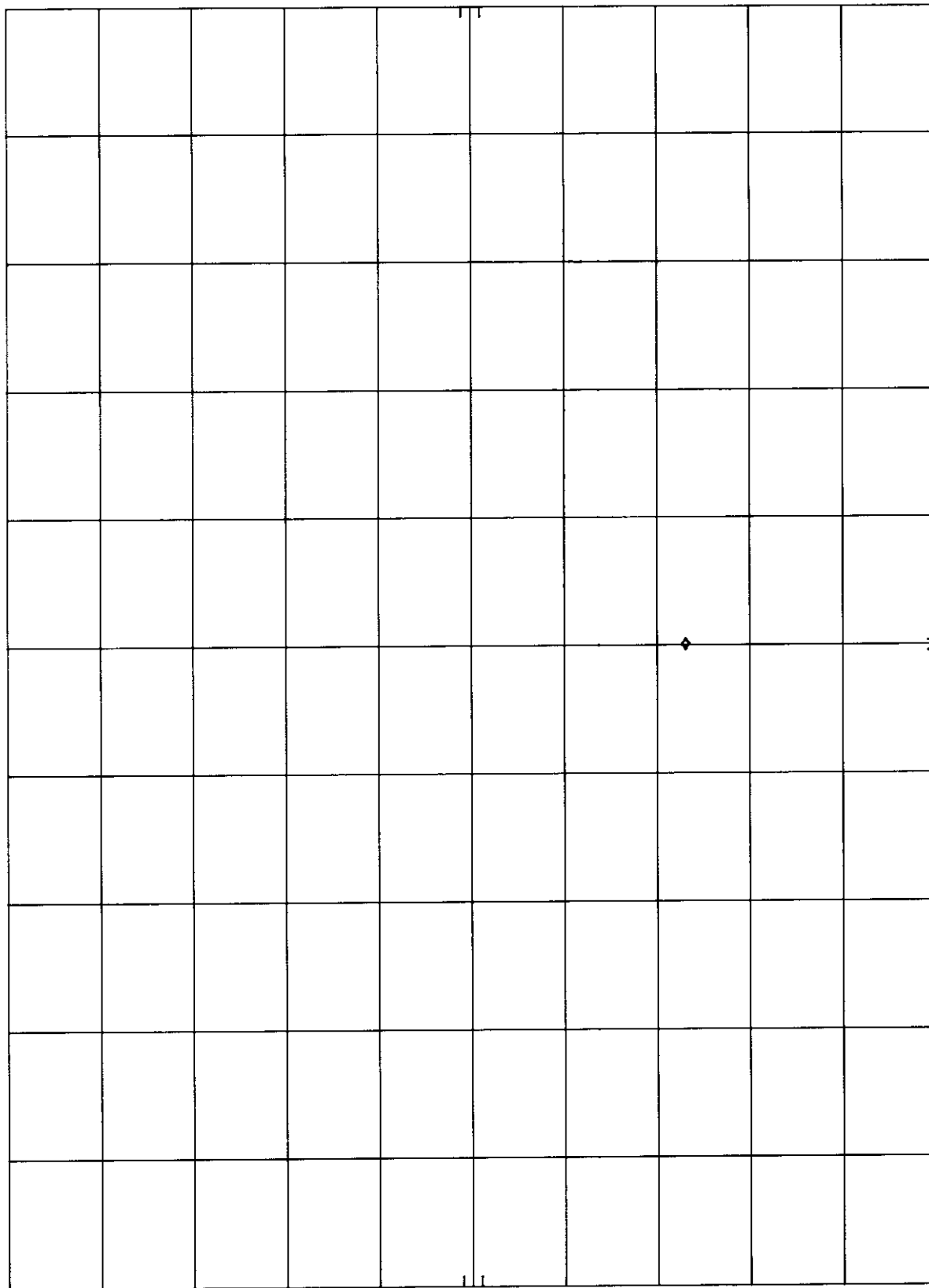
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 1.880 000 GHZ RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHZ SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 2.350 000 GHz
 REF 50.0 dBm ATTEN 20 dB -19.50 dBm

hp

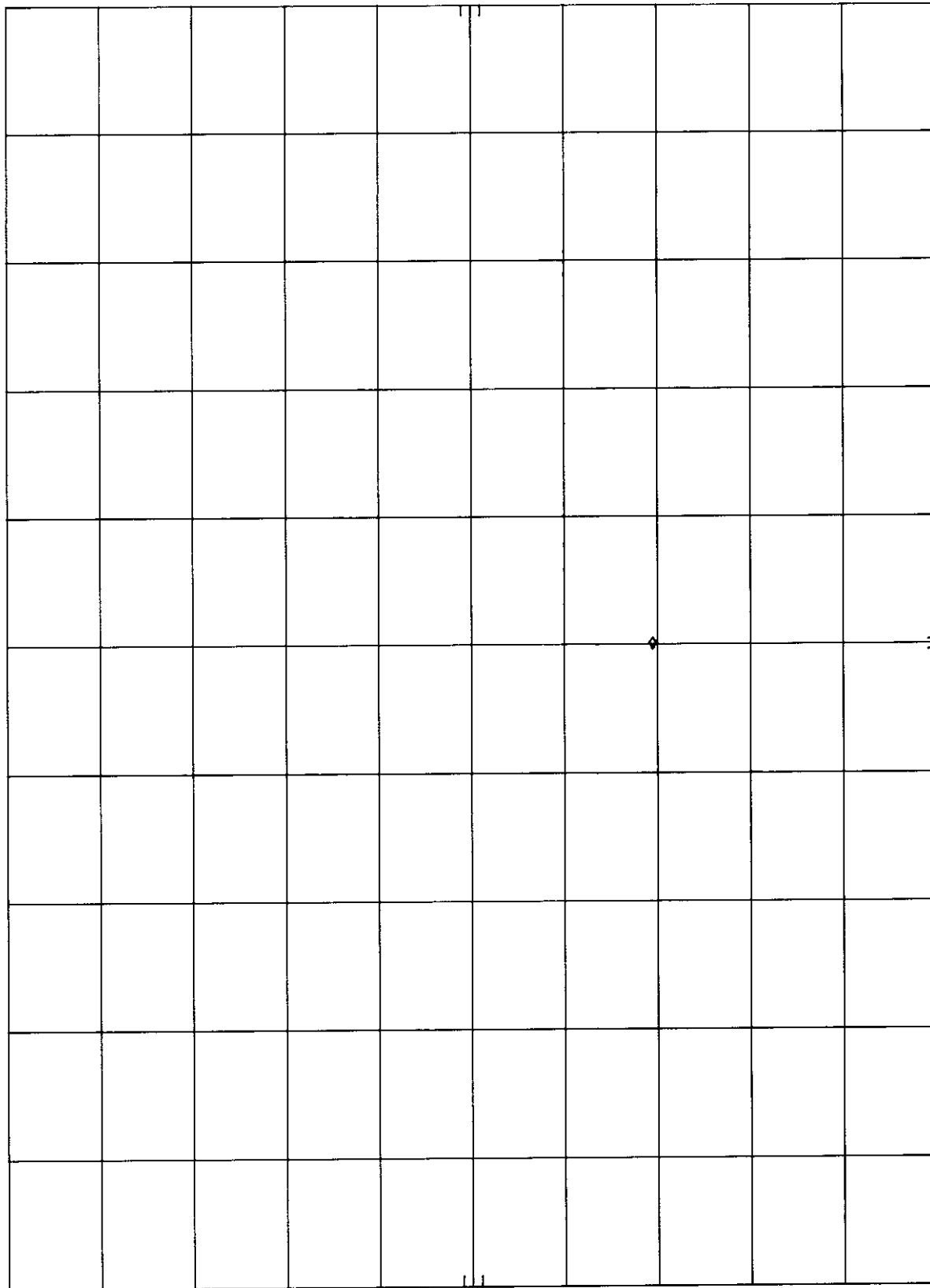
10 dB/

POS PK

OFFSET

45.0
dB

CORR'D



CENTER 2.350 00 GHz

RES BW 100 KHz

VBW 100 KHz

SPAN 5.00 MHz

SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 2.820 000 GHZ
 REF 50.0 dBm ATTEN 20 dB -25.70 dBm

hp

10 dB/

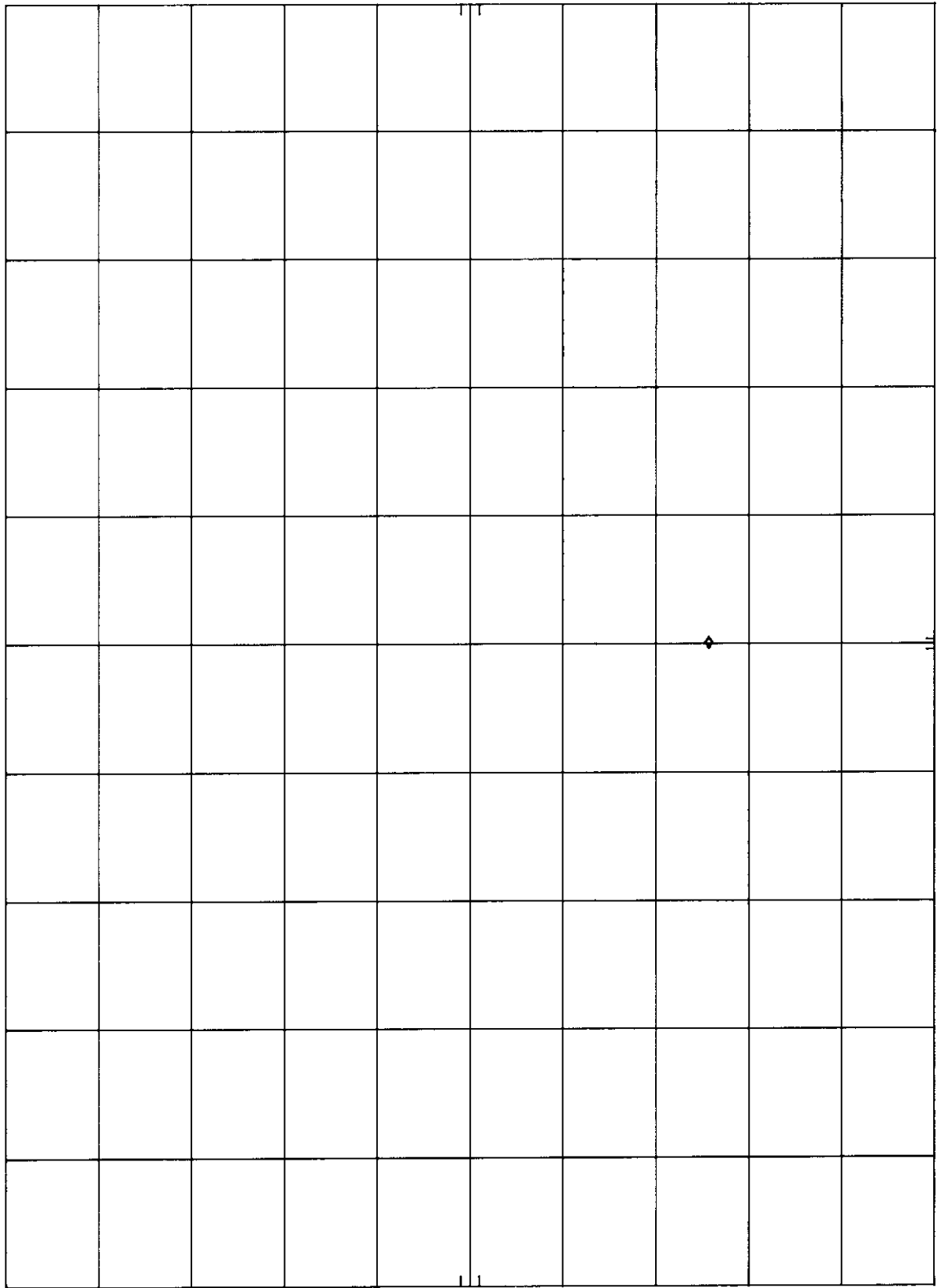
POS PK

OFFSET

40.0

dB

CORR'D



CENTER 2.820 00 GHZ
 RES BW 100 KHZ
 VBW 100 KHZ
 SPAN 5.00 MHZ
 SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 3.290 000 GHZ
 REF 50.0 dBm ATTEN 20 dB -23.60 dBm

hp

10 dB/

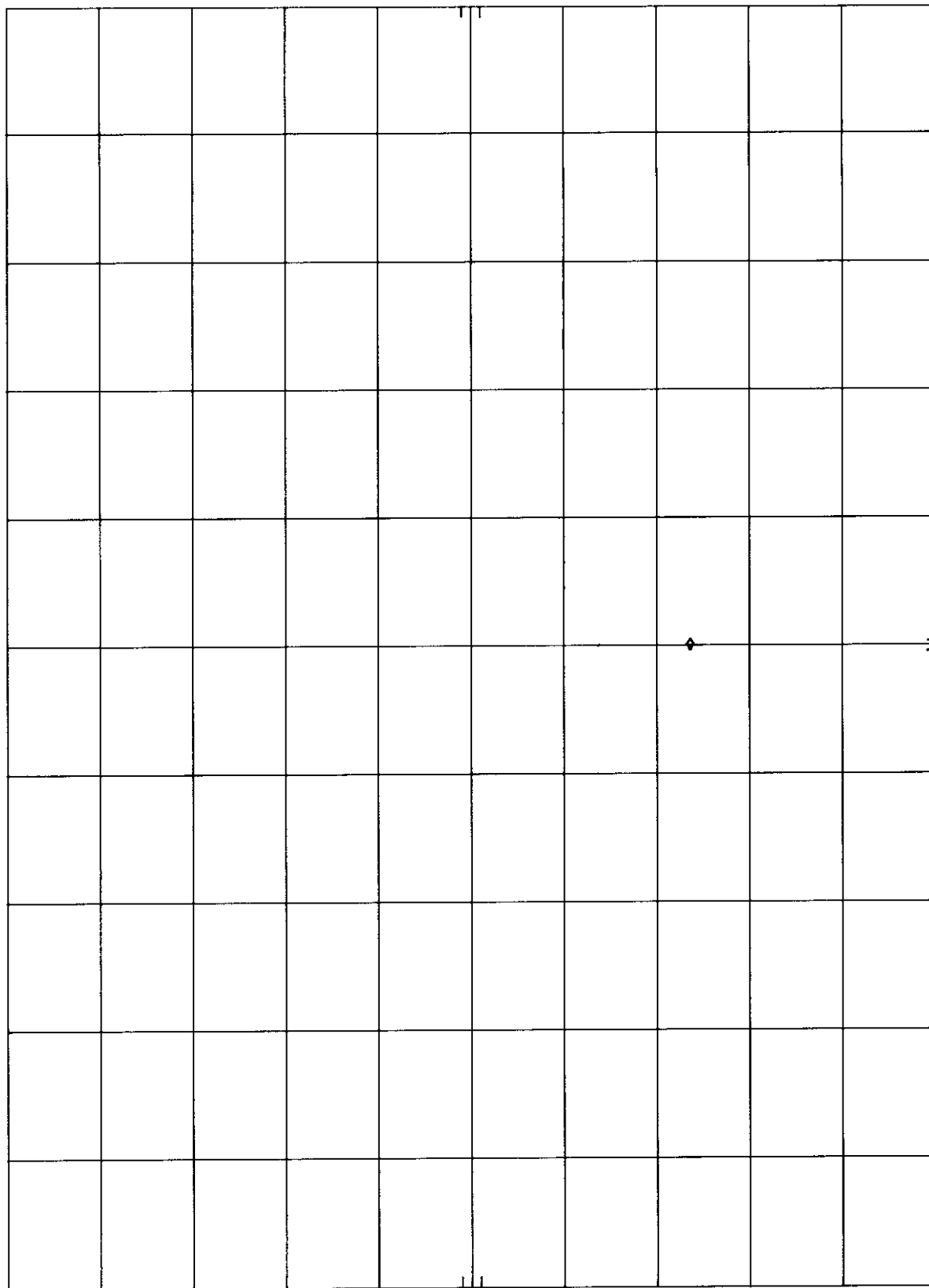
POS PK

OFFSET

45.0

dB

CORR'D



CENTER 3.290 000 GHZ
 RES BW 100 KHZ
 VBW 100 KHZ
 SPAN 5.00 MHZ
 SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 3.760 000 GHZ
 REF 50.0 dBm ATTN 20 dB -14.90 dBm

hp

10 dB/

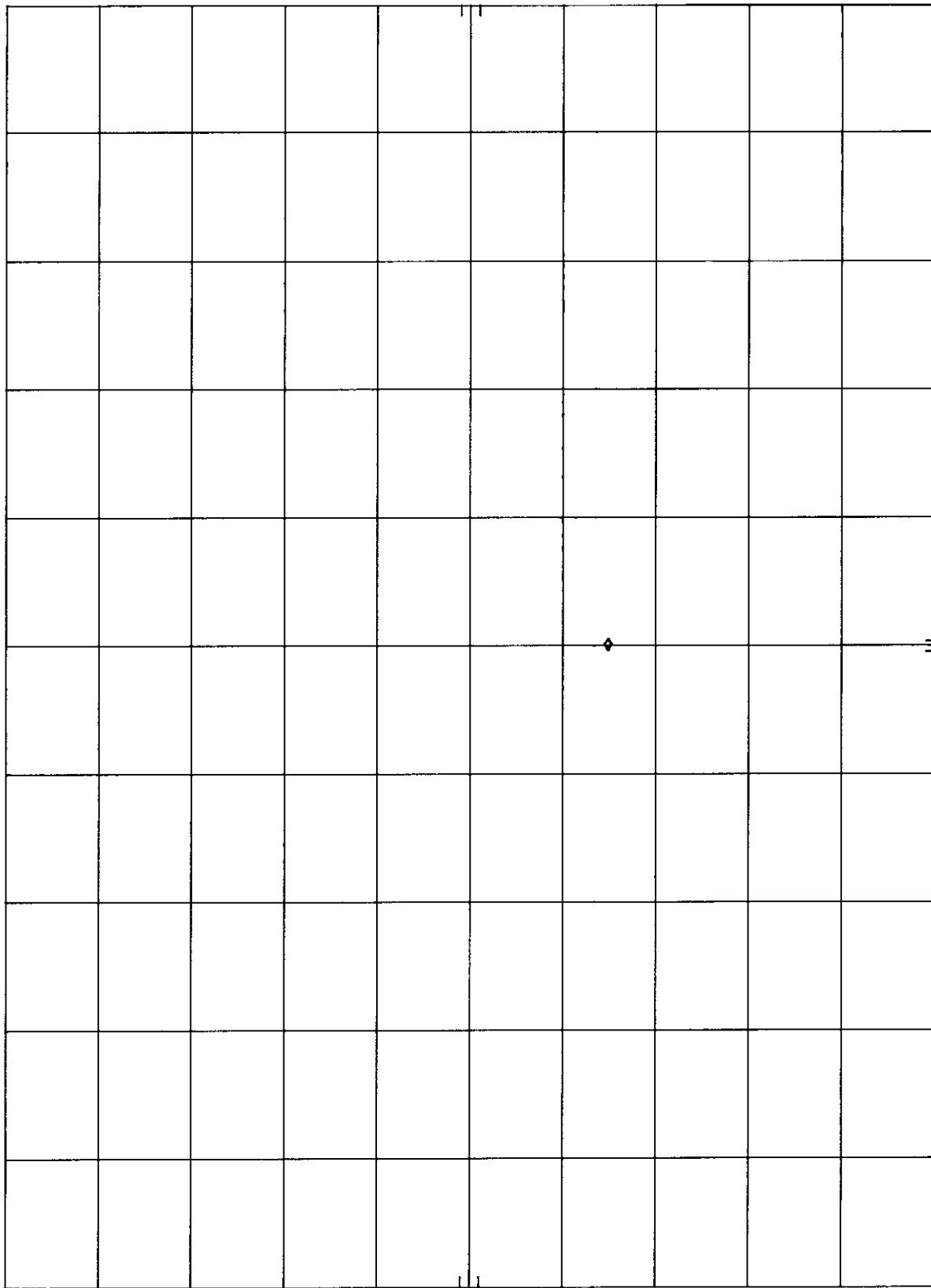
POS PK

OFFSET

45.0

dB

CORR'D



CENTER 3.760 00 GHZ RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHZ SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 4.230 000 GHZ
 REF 50.0 dBm ATTEN 20 dB -25.60 dBm

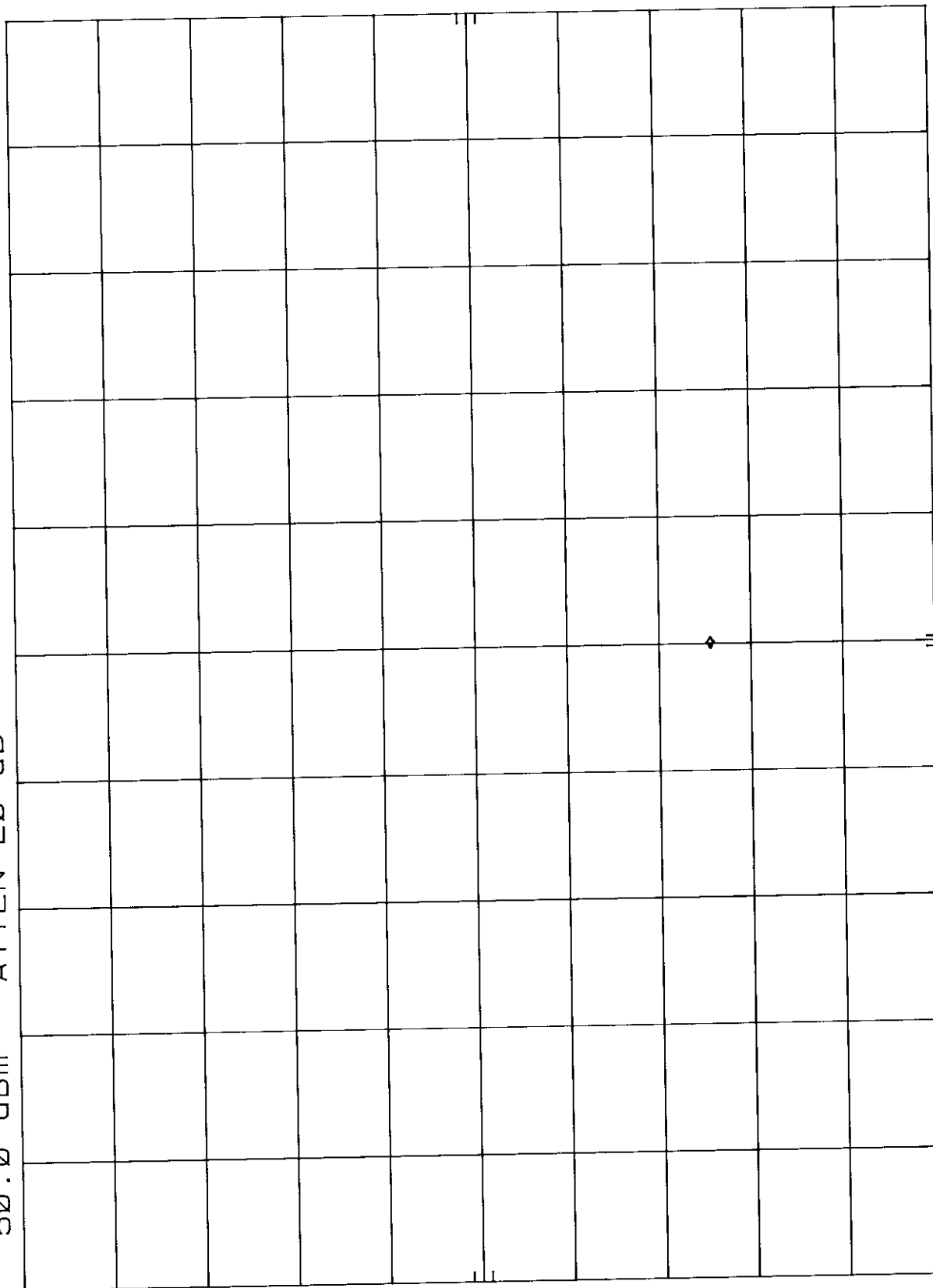
hp

10 dB/

POS PK

OFFSET

40.0
dB



CORR'D

CENTER 4.230 000 GHZ
 RES BW 100 KHZ
 VBW 100 KHZ
 SPAN 5.00 MHZ
 SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 4.700 000 GHz
 REF 50.0 dBm ATTEN 10 dB -19.20 dBm

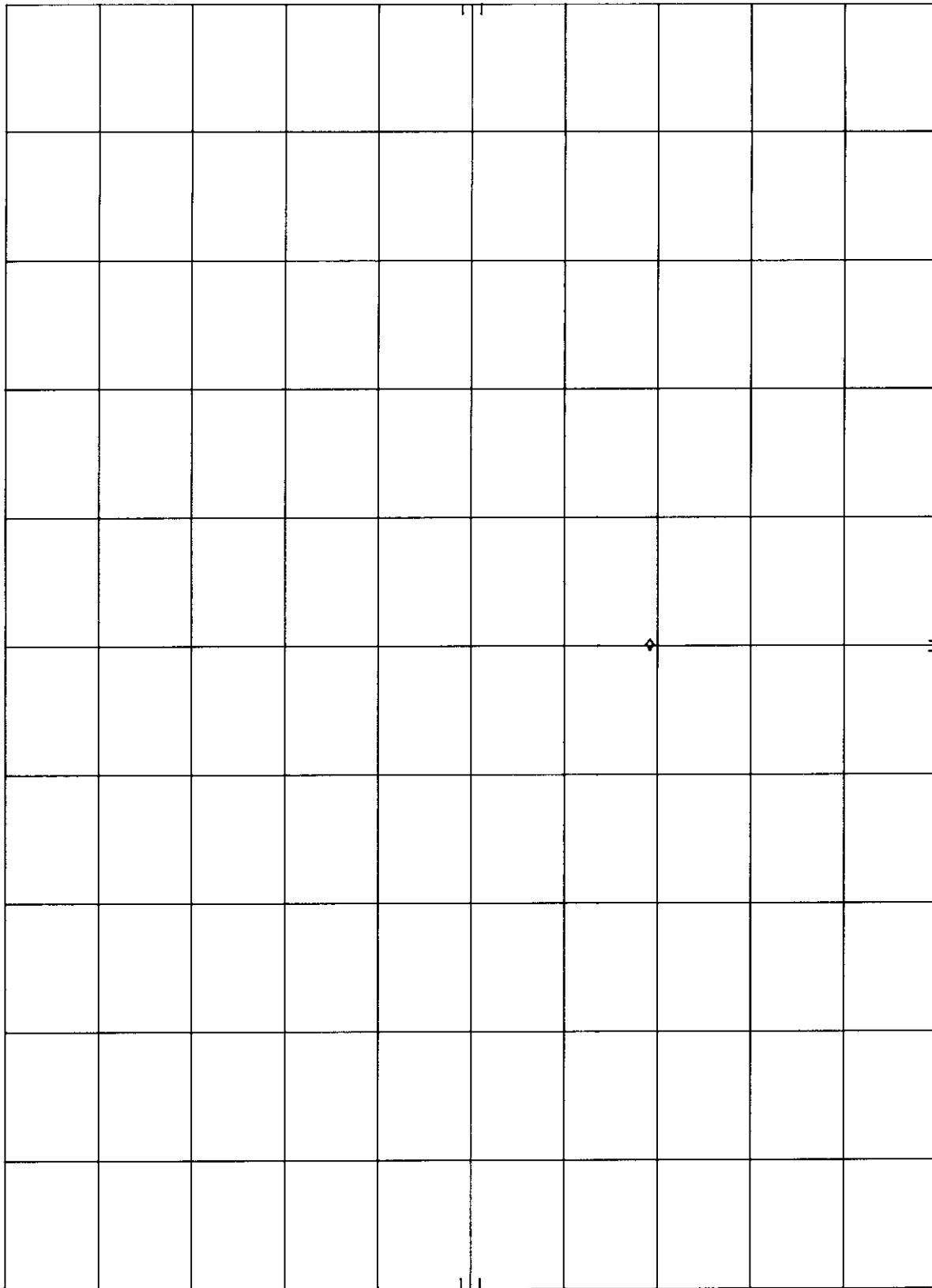
HP

10 dB/

POS PK

OFFSET
 50.0
 dB

CORR'D



CENTER 4.700 00 GHz RES BW 100 KHz
 SPAN 5.00 MHz SWP 20.0 msec
 VBW 100 KHz

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 480.000 MHZ
REF 50.0 dBm ATEN 10 dB 45.30 dBm

hp

10 dB/

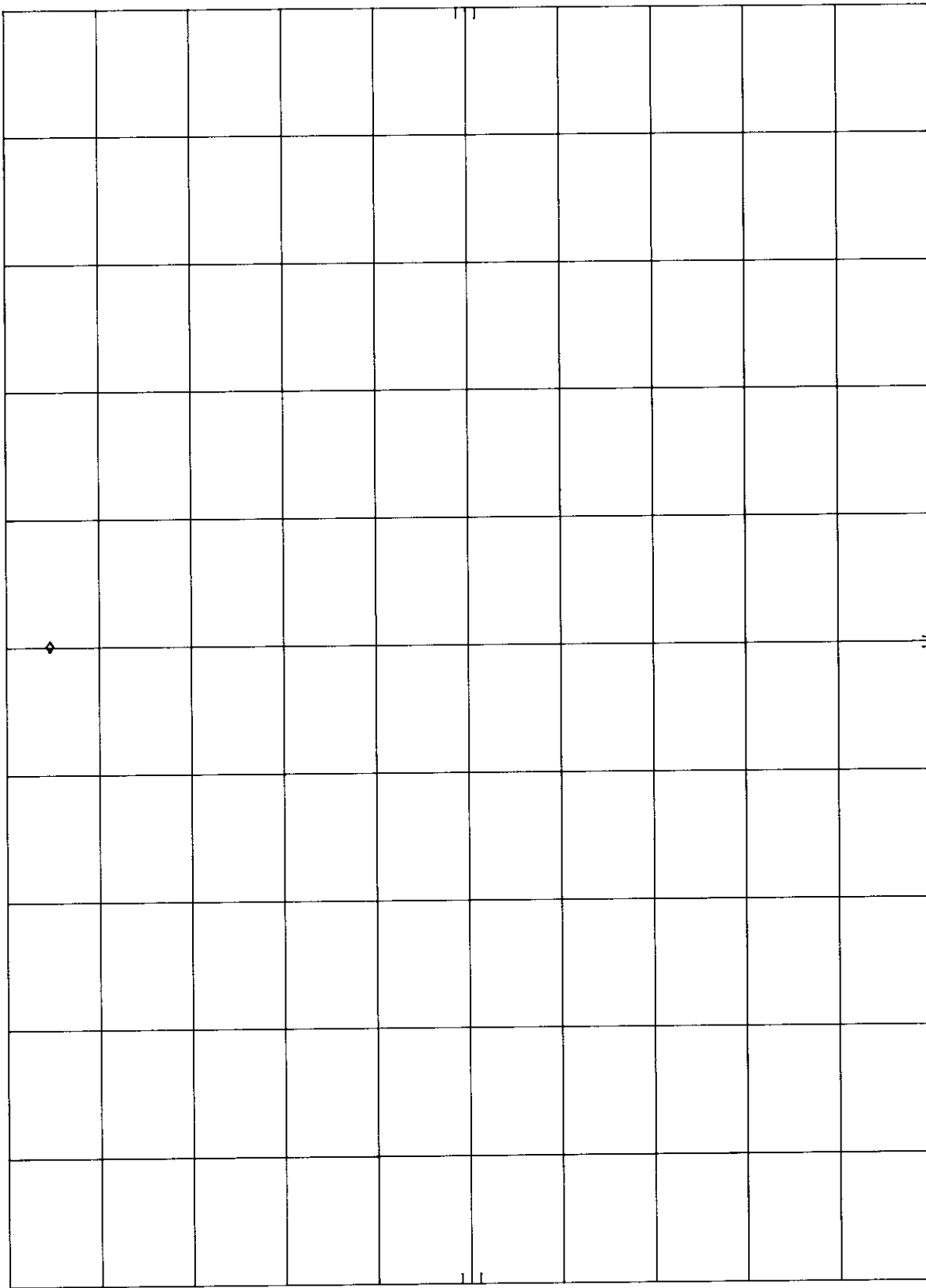
POS PK

OFFSET

50.0

dB

CORR'D



SPAN 5.00 MHZ
SWP 20.0 msec

VBW 100 KHZ

RES BW 100 KHZ

CENTER 480.00 MHZ

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 960.000 MHZ
REF 50.0 dBm ATEN 10 dB -25.20 dBm

hp

10 dB/

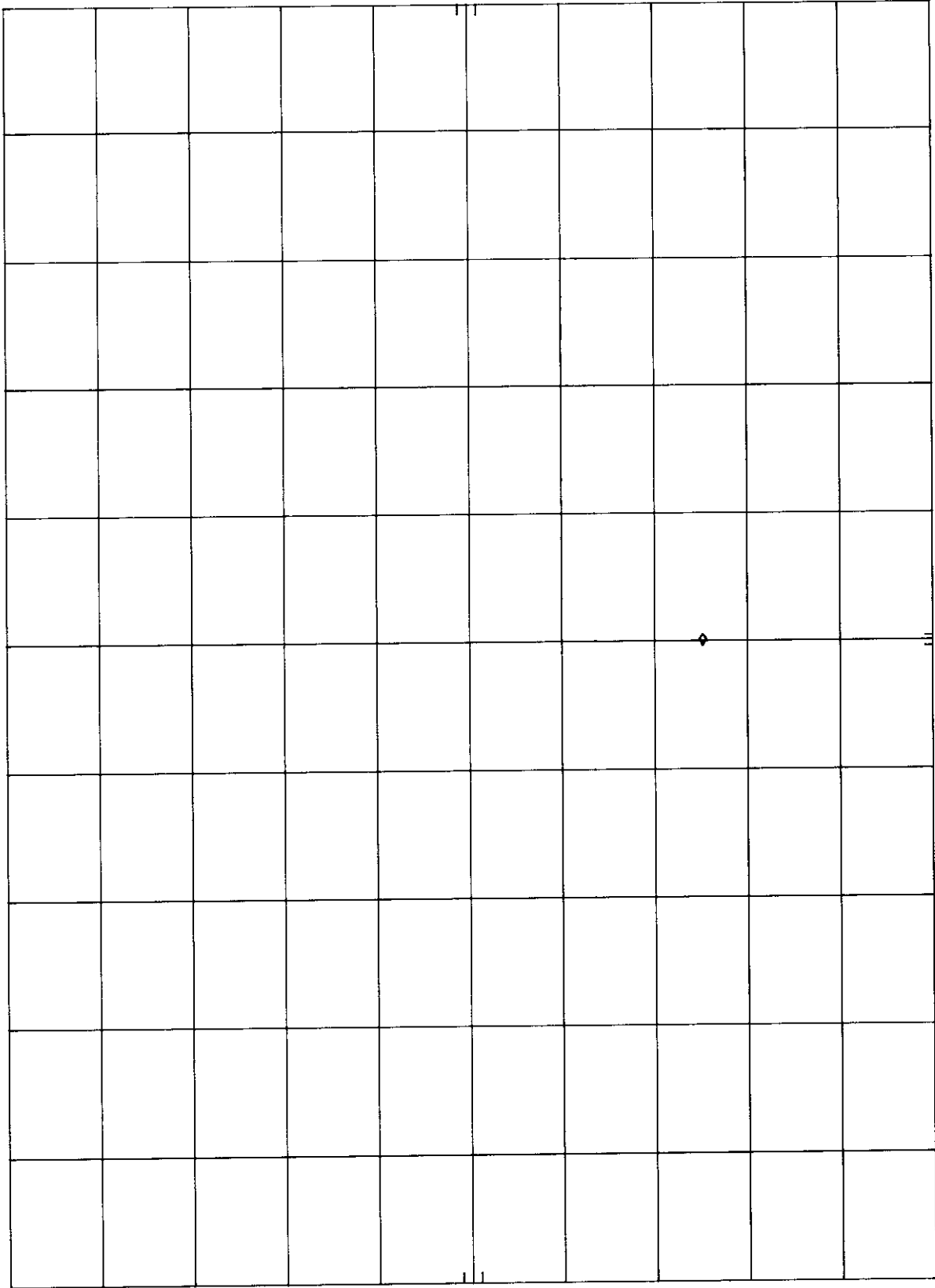
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 960.00 MHZ RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHZ SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 1.440 000 GHz
 REF 50.0 dBm ATTEN 10 dB -24.10 dBm

hp

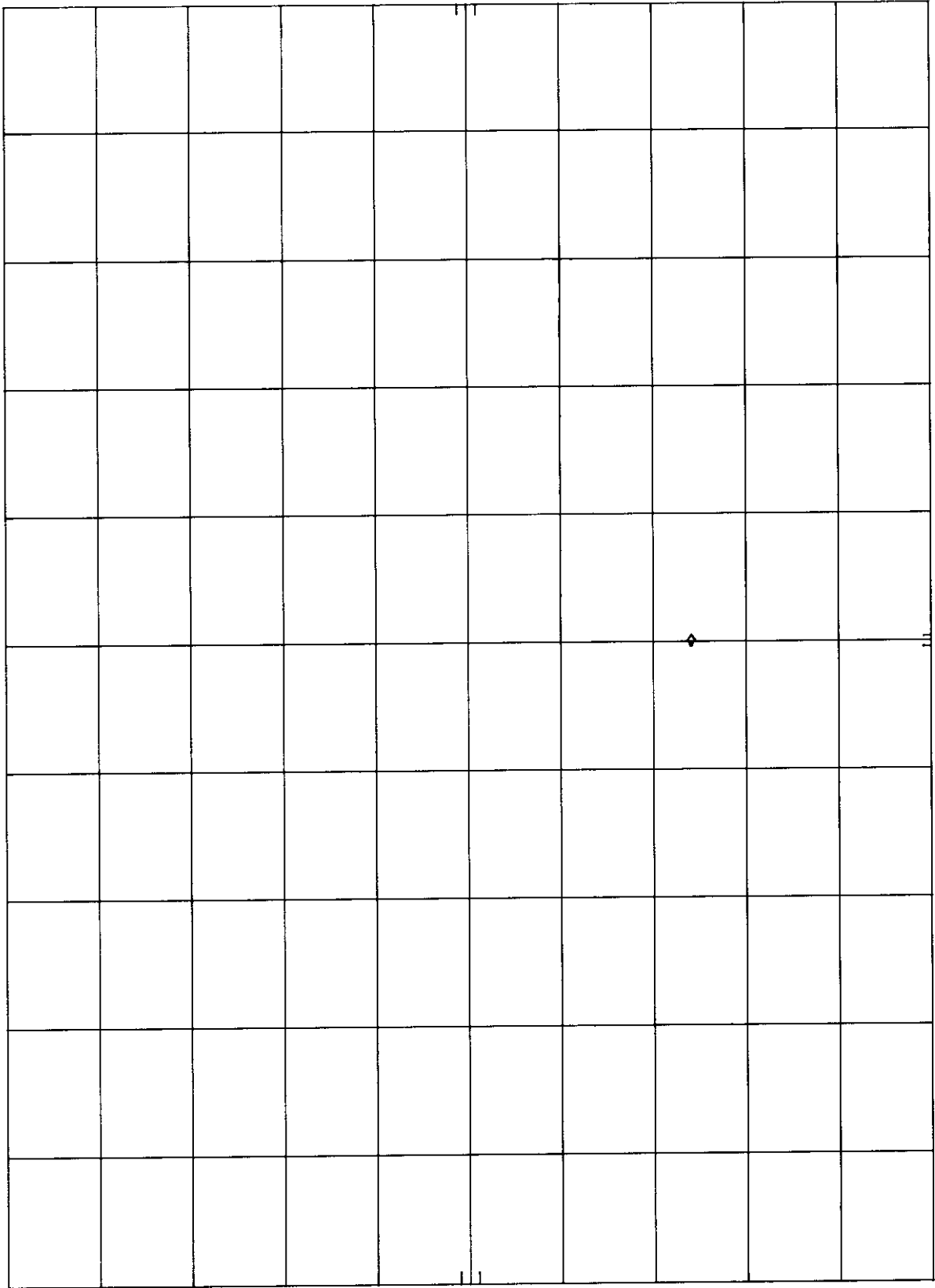
10 dB/

POS PK

OFFSET

50.0
dB

CORR'D



CENTER 1.440 00 GHz RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHZ SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 1.920 000 GHZ
 REF 50.0 dBm ATTEN 10 dB -25.20 dBm

hp

10 dB/

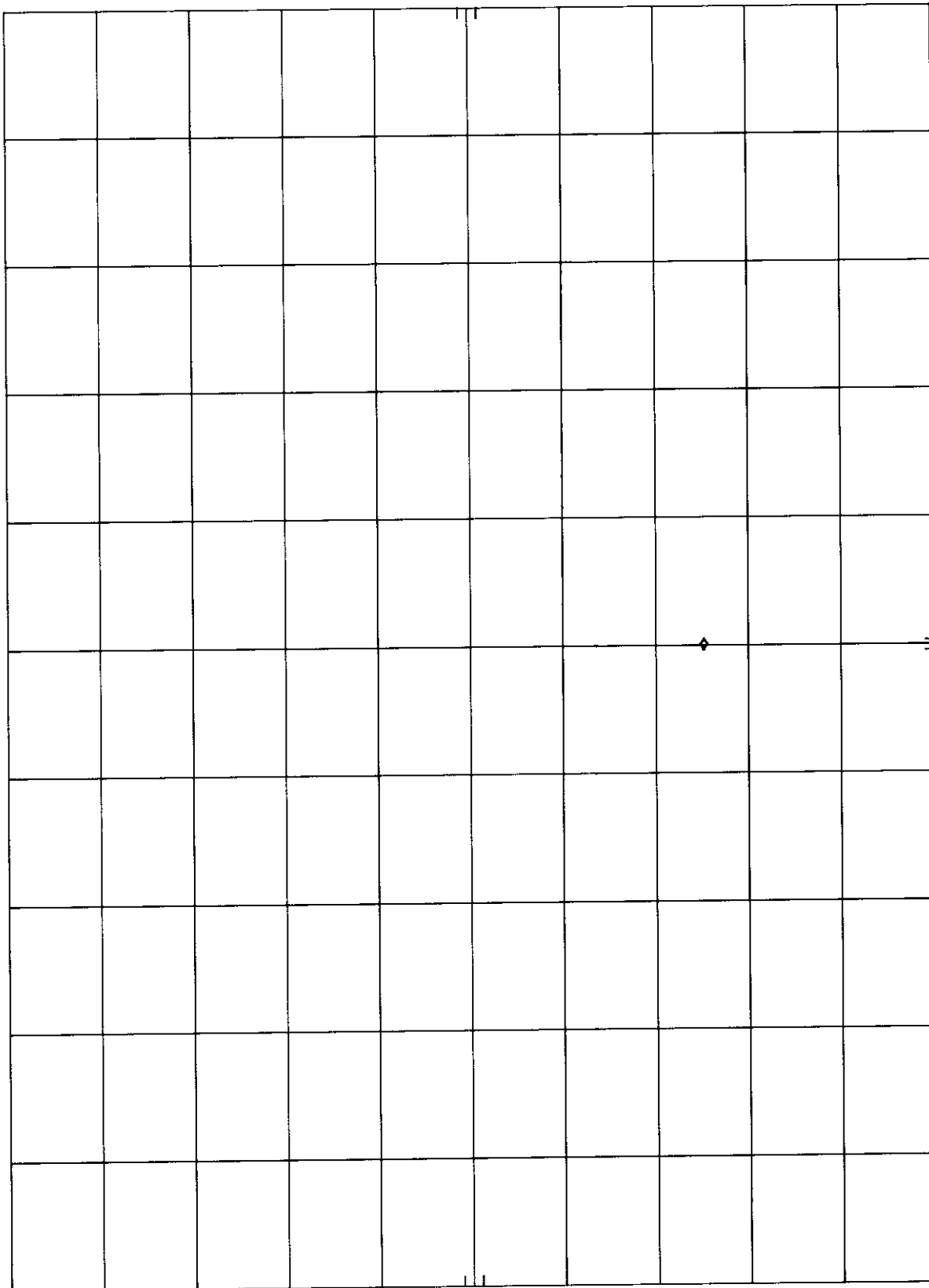
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 1.920 00 GHZ

RES BW 100 KHZ

VBW 100 KHZ

SPAN 5.00 MHZ
SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 2.400 000 GHZ
REF 50.0 dBm ATTEN 20 dB -19.30 dBm

hp

10 dB/

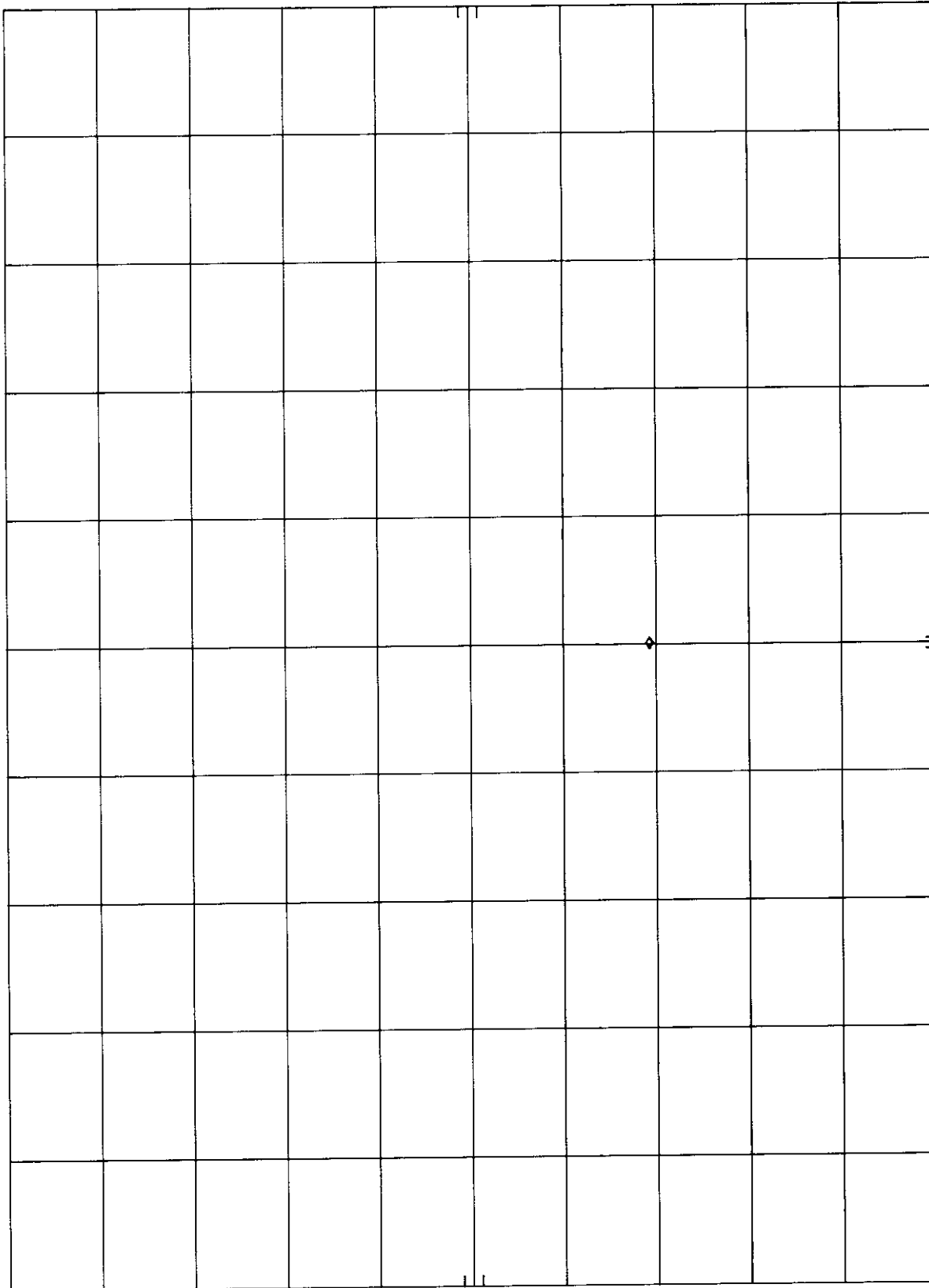
POS PK

OFFSET

45.0

dB

CORR'D



CENTER 2.400 00 GHZ

RES BW 100 KHZ

VBW 100 KHZ

SPAN 5.00 MHZ
SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 2.880 000 GHZ
 REF 50.0 dBm ATEN 20 dB -24.20 dBm

hp

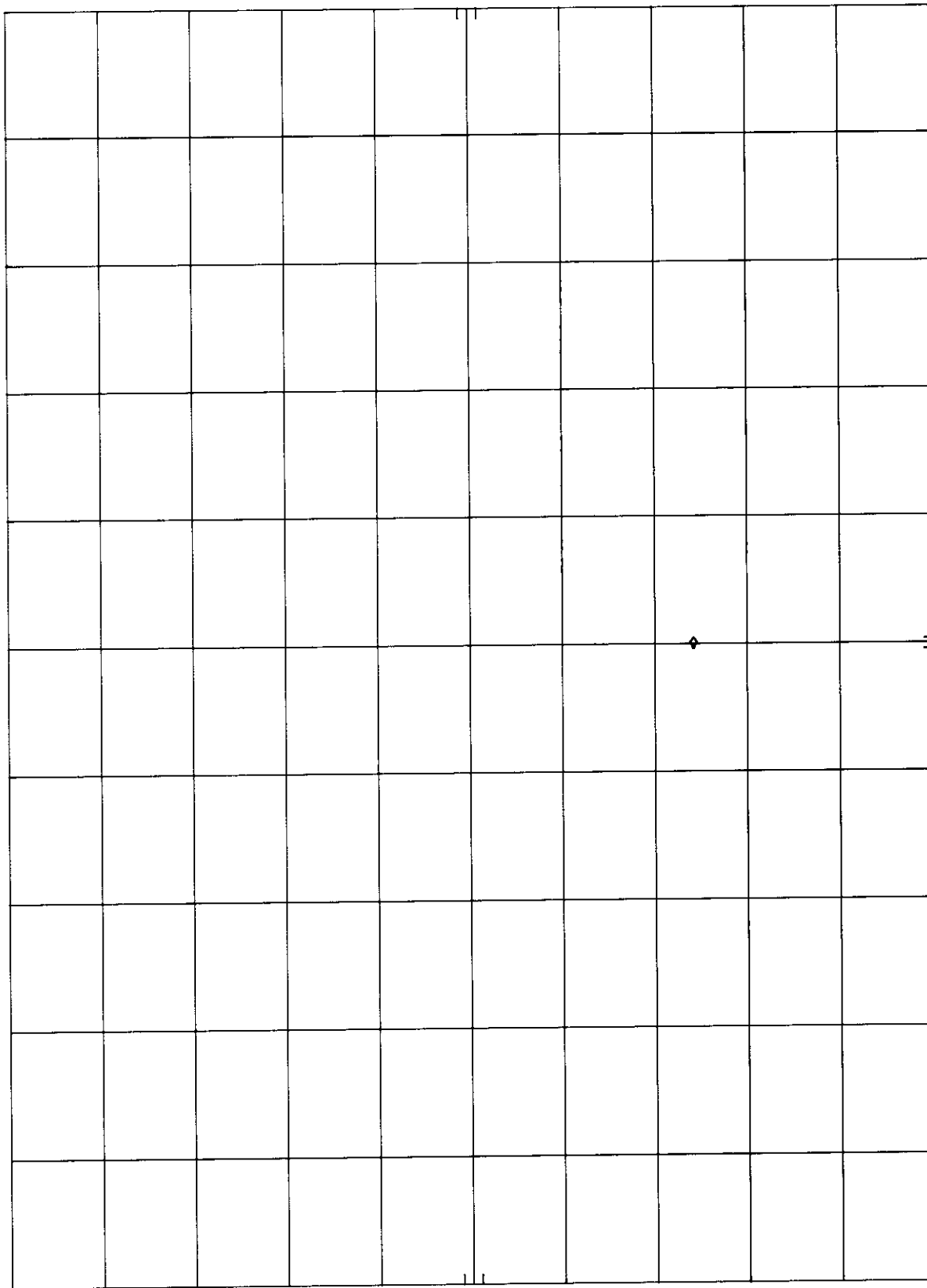
10 dB/

POS PK

OFFSET

40.0
dB

CORR'D



CENTER 2.880 00 GHZ

RES BW 100 KHZ

VBW 100 KHZ

SPAN 5.00 MHZ
SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 3.360 000 GHZ
REF 50.0 dBm ATEN 20 dB -22.50 dBm

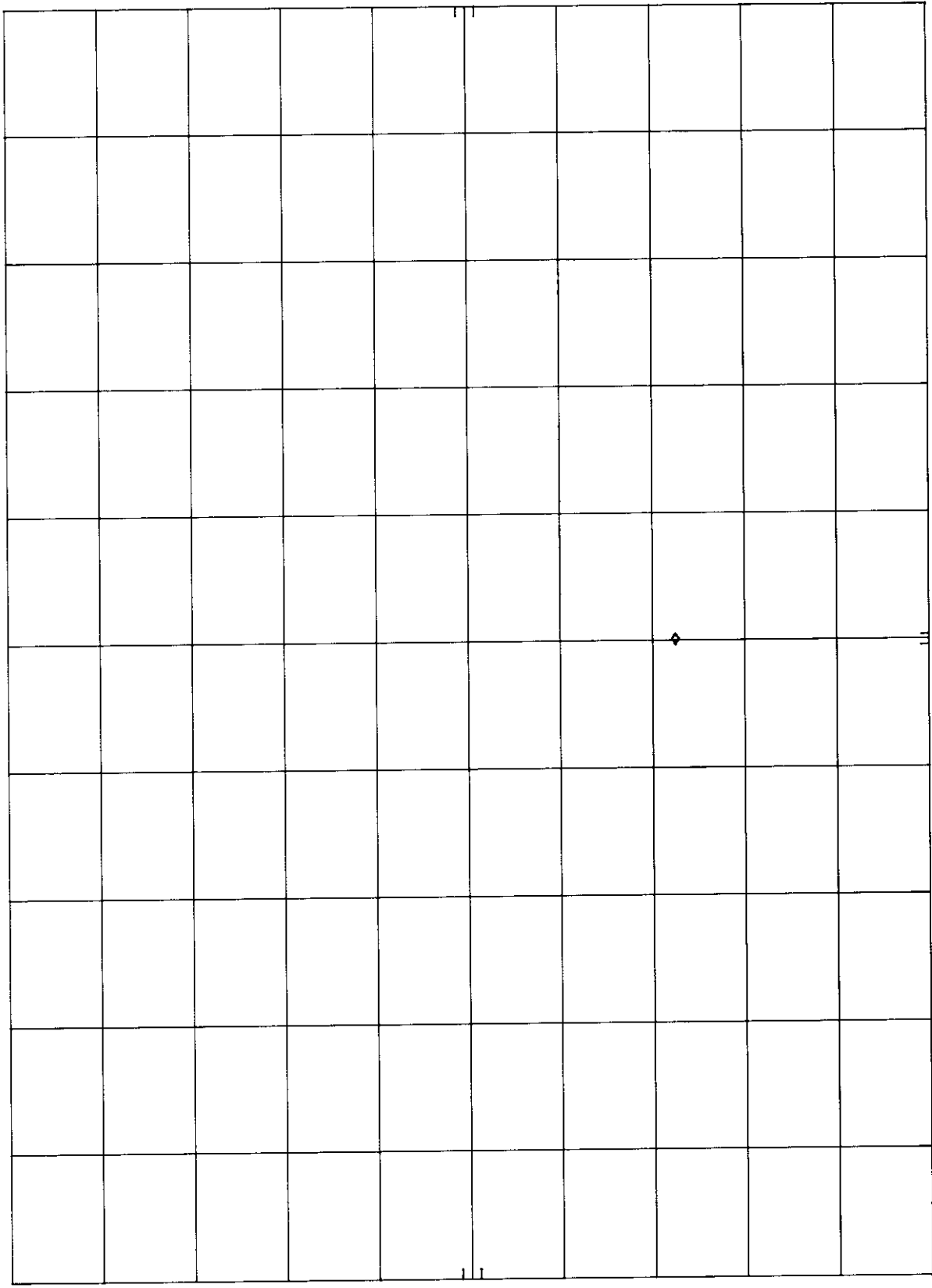
hp

10 dB/

POS PK

OFFSET
45.0
dB

CORR'D



CENTER 3.360 00 GHZ RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHZ SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 3.840 000 GHZ
REF 50.0 dBm ATTEN 20 dB -19.10 dBm

hp

10 dB/

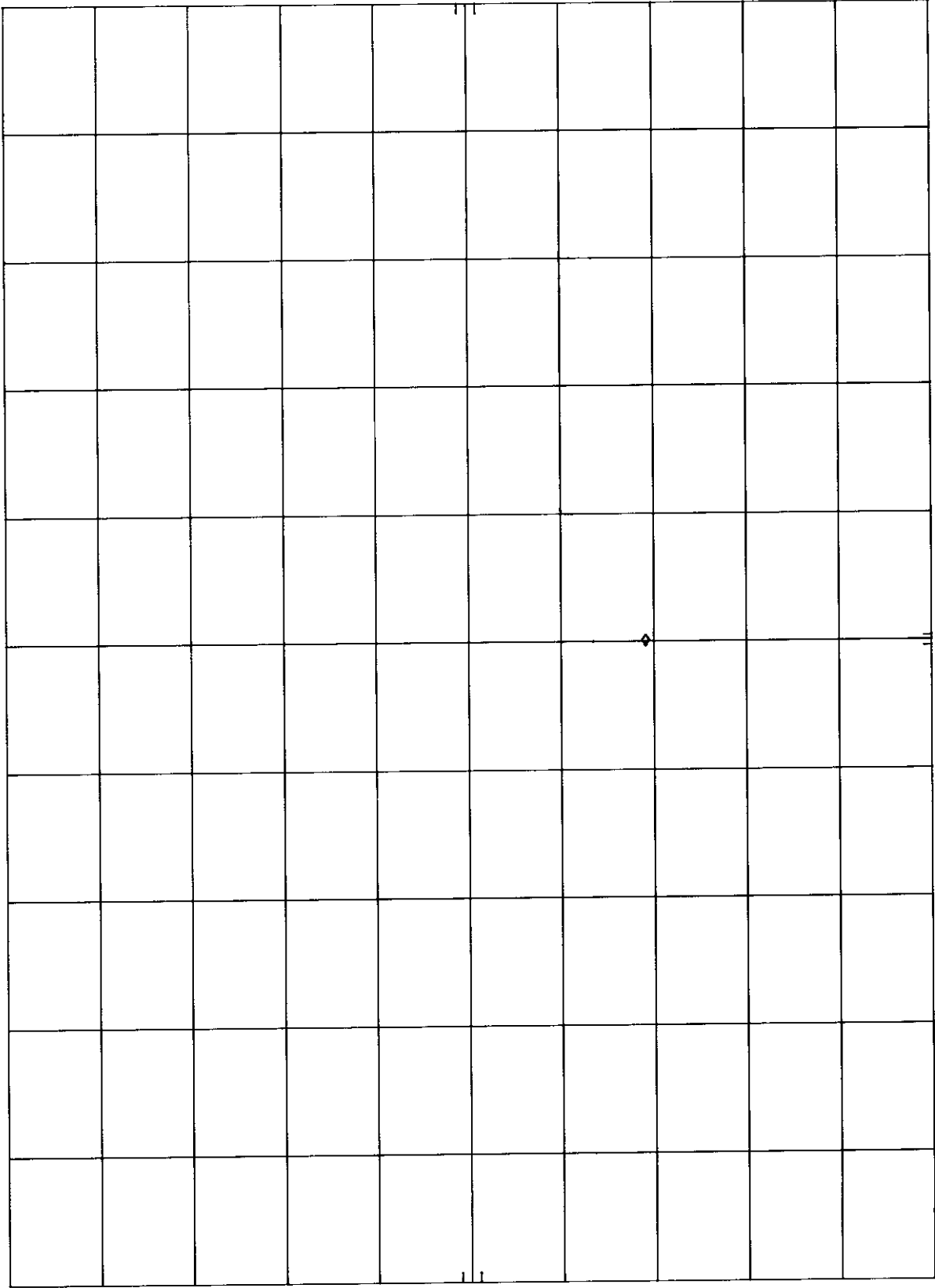
POS PK

OFFSET

45.0

dB

CORR'D



CENTER 3.840 00 GHZ

RES BW 100 KHZ

VBW 100 KHZ

SPAN 5.00 MHZ

SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 4.320 000 GHz
 REF 50.0 dBm ATTEN 20 dB -23.80 dBm

hp

10 dB/

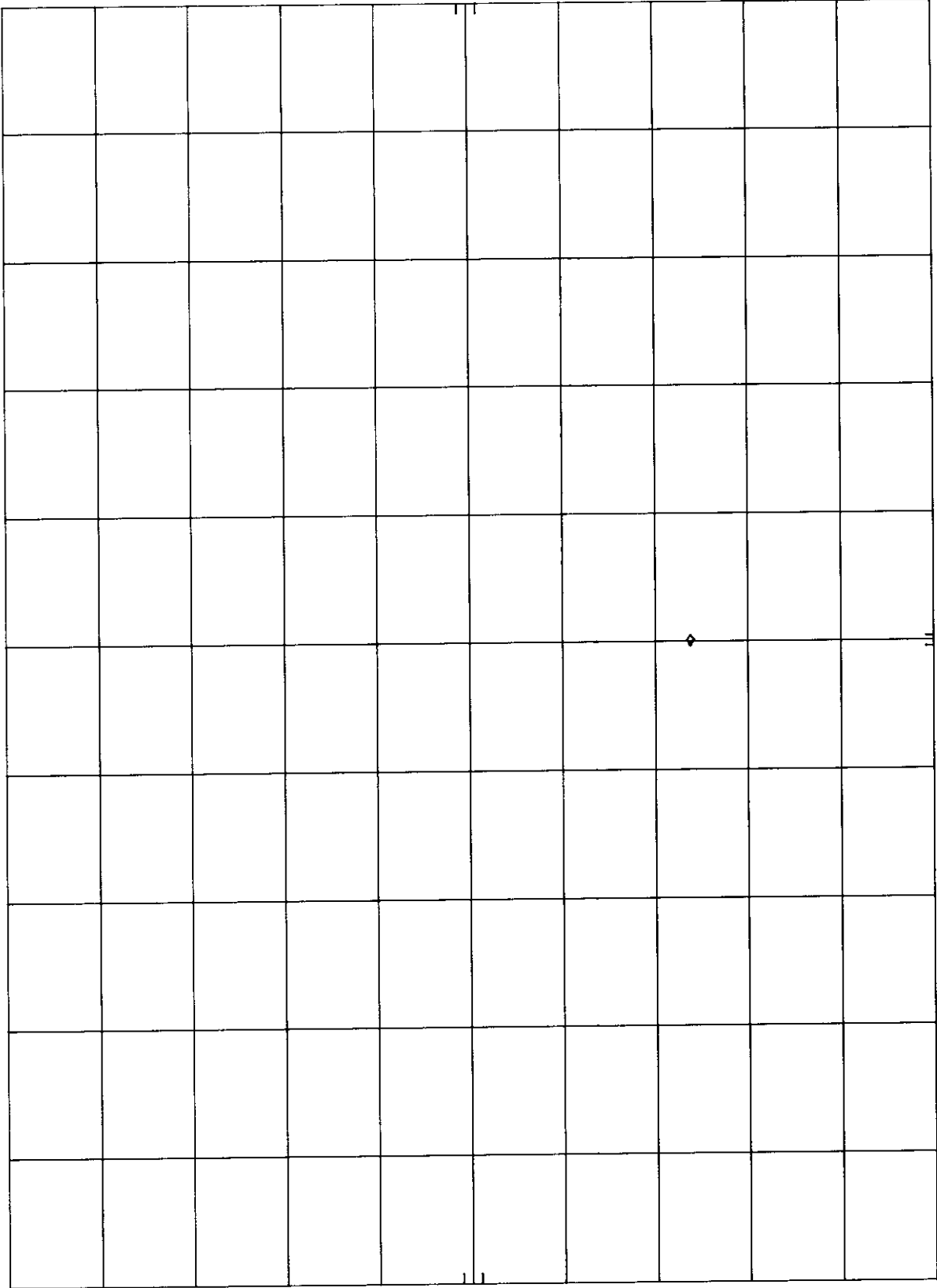
POS PK

OFFSET

40.0

dB

CORR'D



CENTER 4.320 00 GHz

RES BW 100 KHz

VBW 100 KHz

SPAN 5.00 MHz
 SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 4.800 000 GHZ
 REF 50.0 dBm ATTEN 10 dB -26.10 dBm

h/p

10 dB/

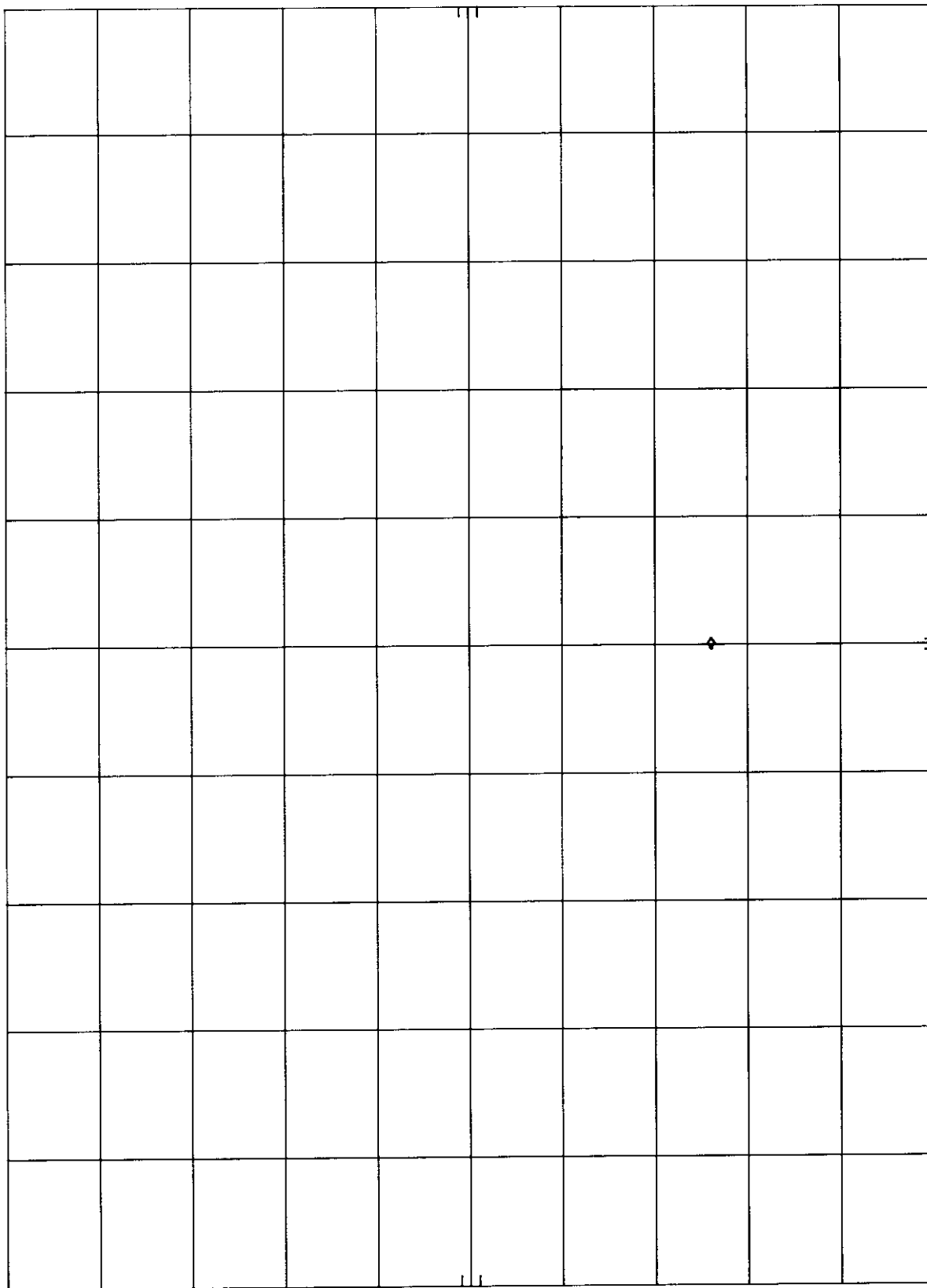
POS PK

OFFSET

50.0

dB

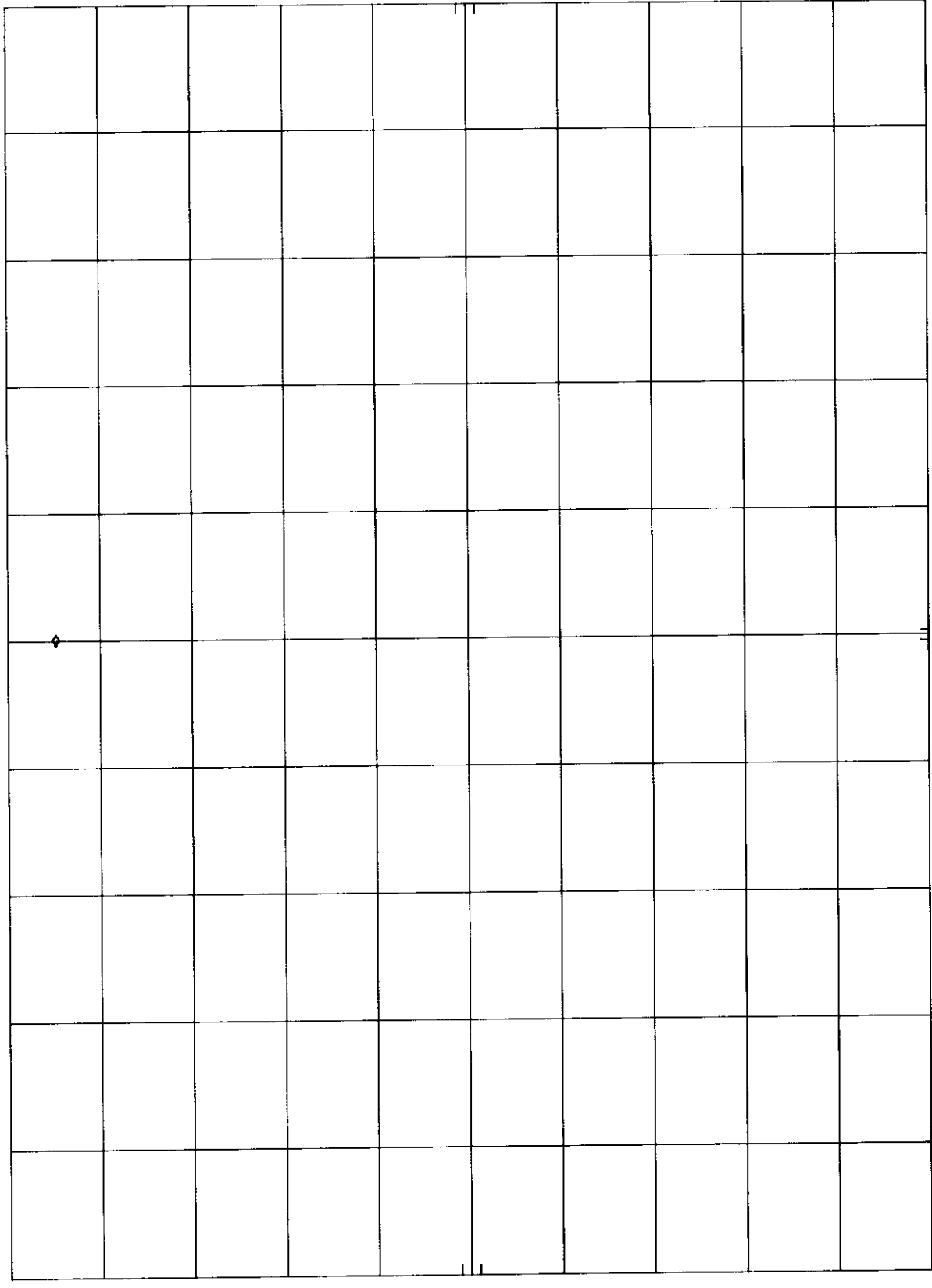
CORR'D



CENTER 4.800 00 GHZ RES BW 100 KHZ
 SPAN 5.00 MHz SWP 20.0 msec
 VBW 100 KHZ

hp ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 490.000 MHz
REF 50.0 dBm ATTEN 10 dB 44.80 dBm

10 dB/
POS PK
OFFSET
50.0
dB



CORR'D

CENTER 490.00 MHz RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHz SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 980.000 MHz
 REF 50.0 dBm ATEN 10 dB -24.20 dBm

hp

10 dB/

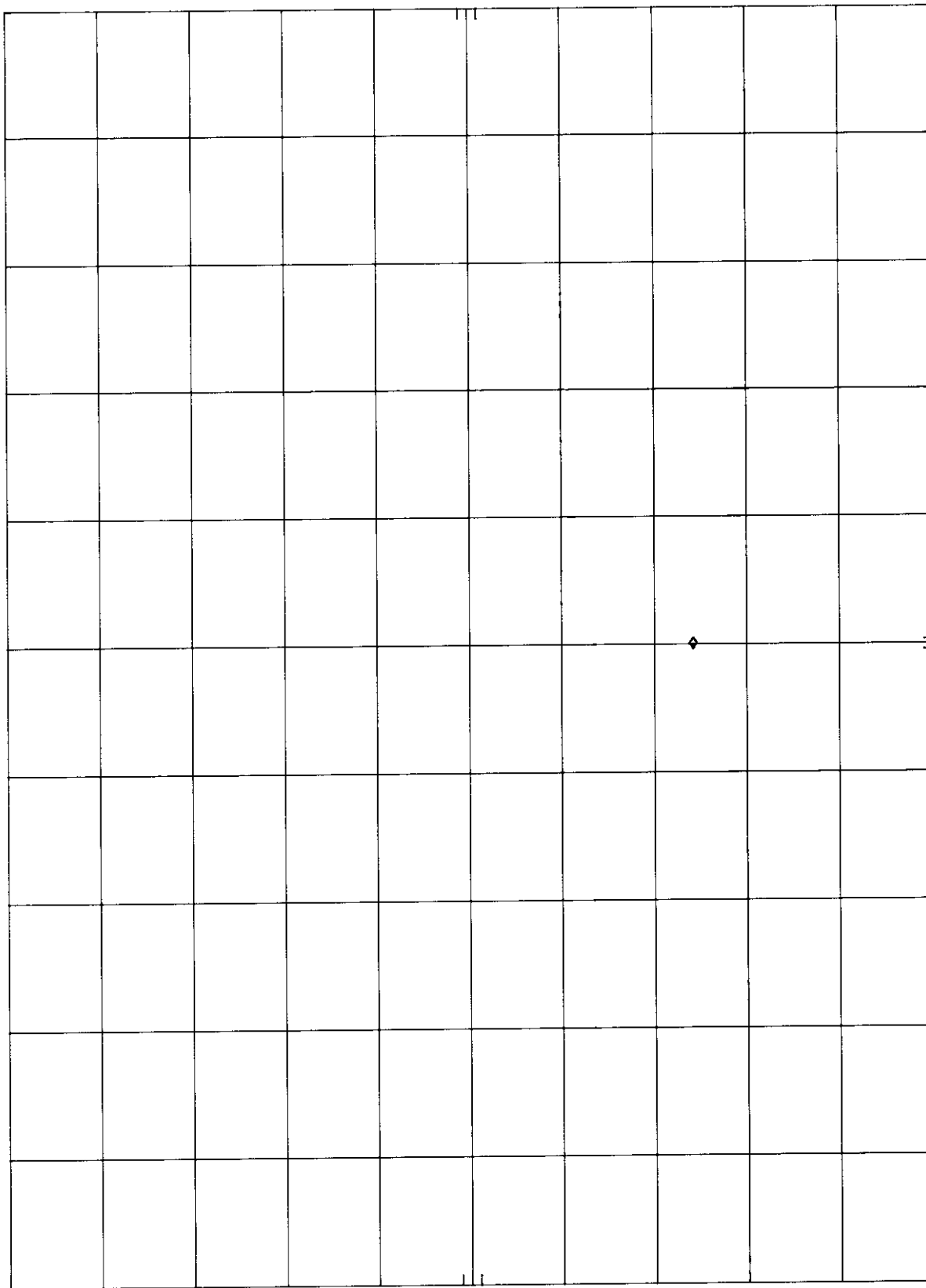
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 980.00 MHz RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHz SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 1.469 985 GHz
 REF 50.0 dBm ATTEN 10 dB -23.00 dBm

h_p

10 dB/

POS PK

OFFSET

50.0

dB

CORR'D

CENTER 1.470 00 GHz RES BW 100 KHz VBW 100 KHz SPAN 5.00 MHz SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 1.959 980 GHz
 REF 50.0 dBm ATTEN 10 dB -18.80 dBm

hp

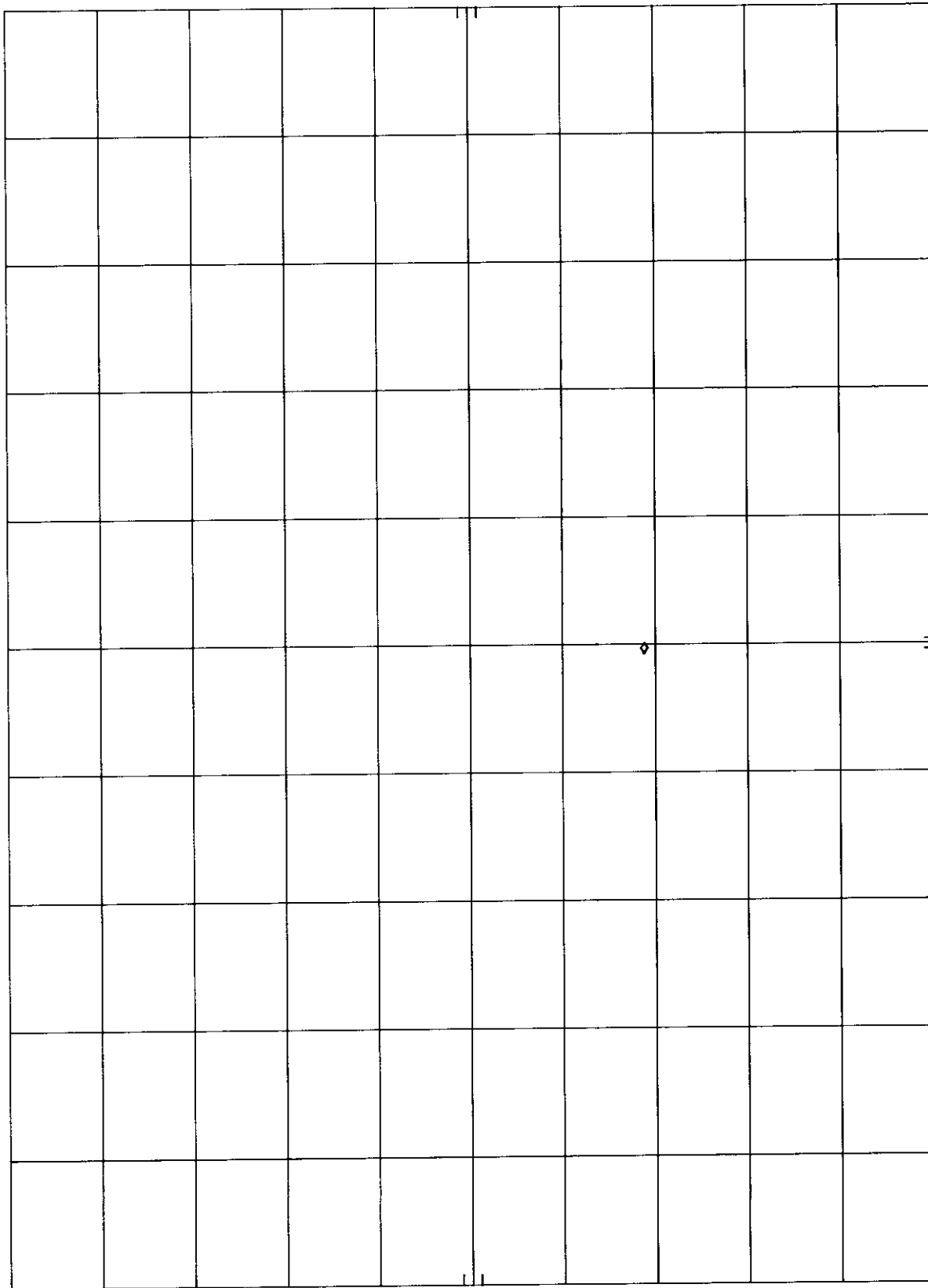
10 dB/

POS PK

OFFSET

50.0
dB

CORR'D



CENTER 1.960 00 GHz

RES BW 100 KHz

VBW 100 KHz

SPAN 5.00 MHz
SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 2.449 990 GHZ
 REF 50.0 dBm ATTN 20 dB -20.20 dBm

hp

10 dB/

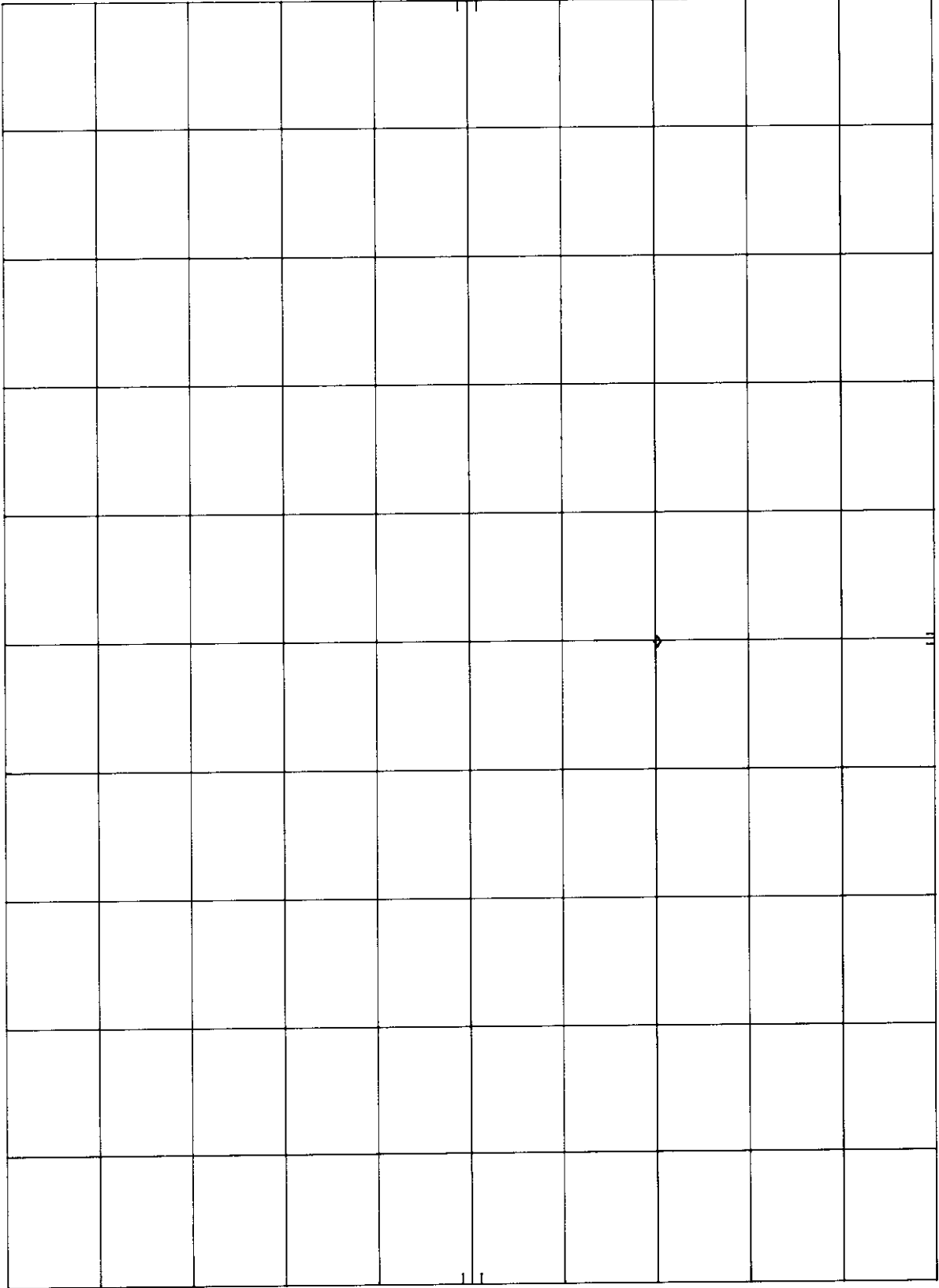
POS PK

OFFSET

45.0

dB

CORR'D



CENTER 2.450 00 GHZ

RES BW 100 KHz

VBW 100 KHz

SPAN 5.00 MHz

SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 2.939 990 GHZ
 REF 50.0 dBm ATTEN 20 dB -26.20 dBm

hp

10 dB/

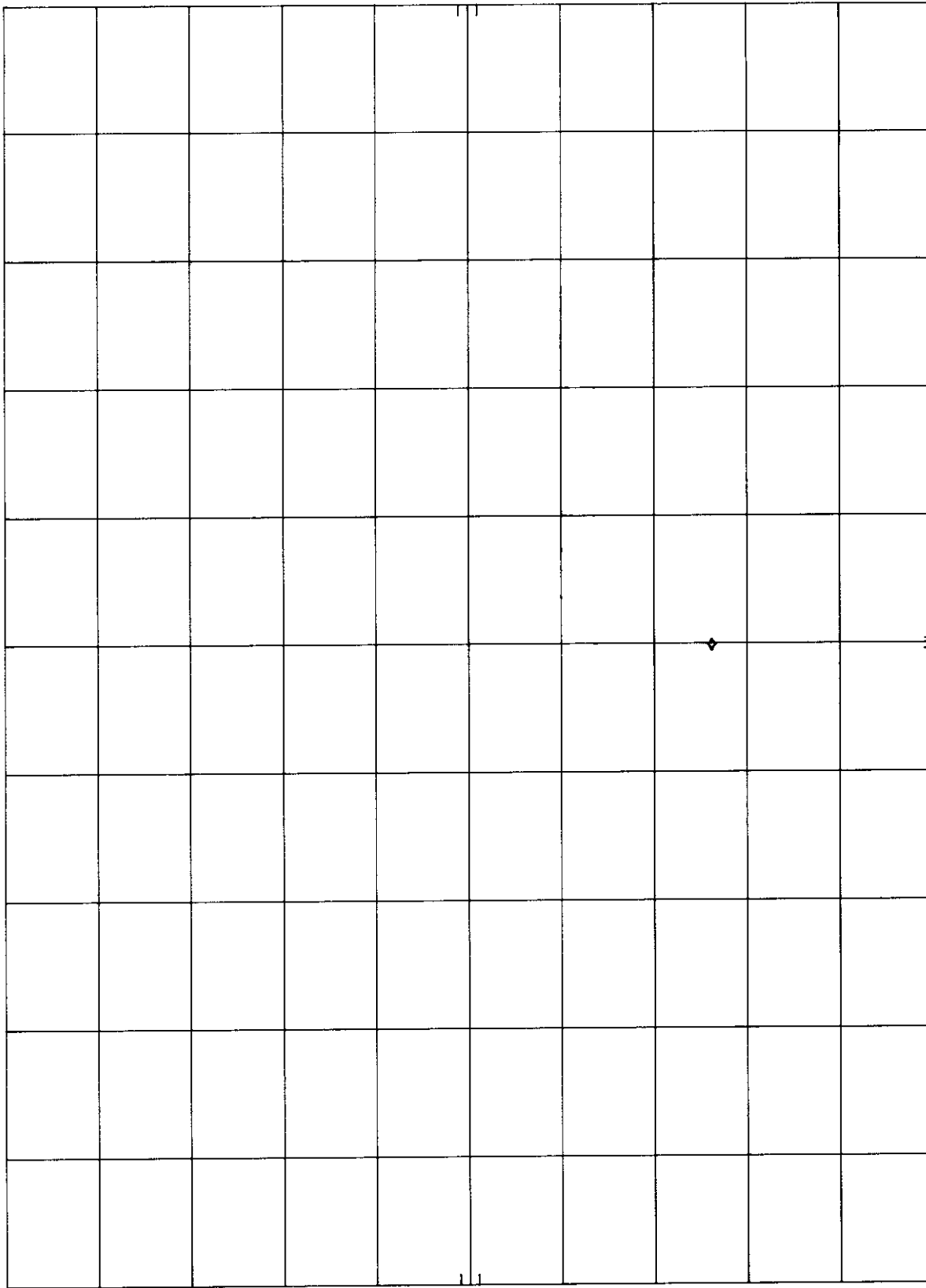
POS PK

OFFSET

40.0

dB

CORR'D



CENTER 2.940 00 GHZ

RES BW 100 KHz

VBW 100 KHz

SPAN 5.00 MHz

SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 3.429 990 GHZ
 REF 50.0 dBm ATTEN 20 dB -23.80 dBm

hp

10 dB/

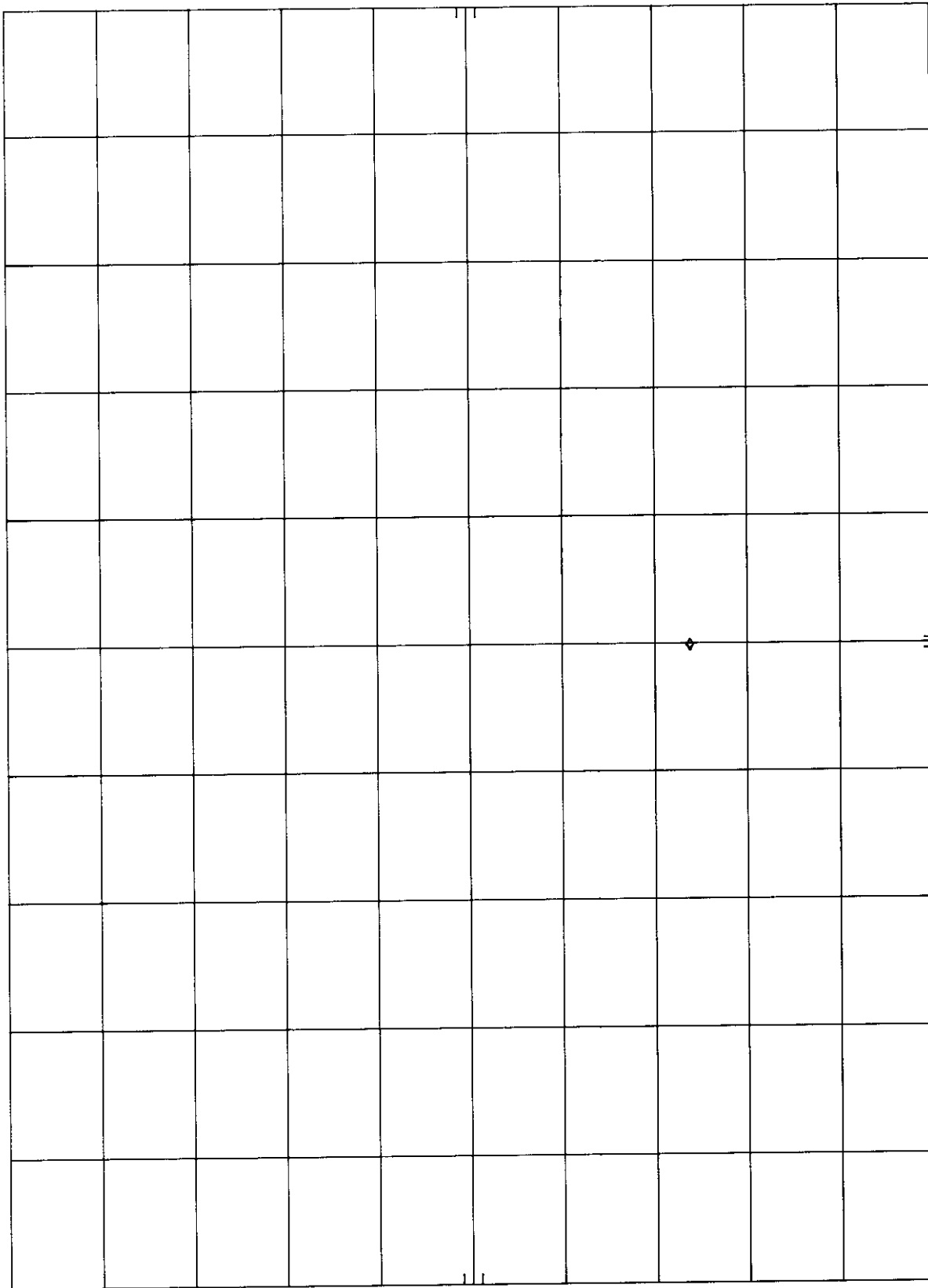
POS PK

OFFSET

45.0

dB

CORR'D



CENTER 3.430 00 GHZ RES BW 100 KHZ VBW 100 KHZ SPAN 5.00 MHZ SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 3.919 990 GHZ
REF 50.0 dBm ATTEN 20 dB -21.30 dBm

hp

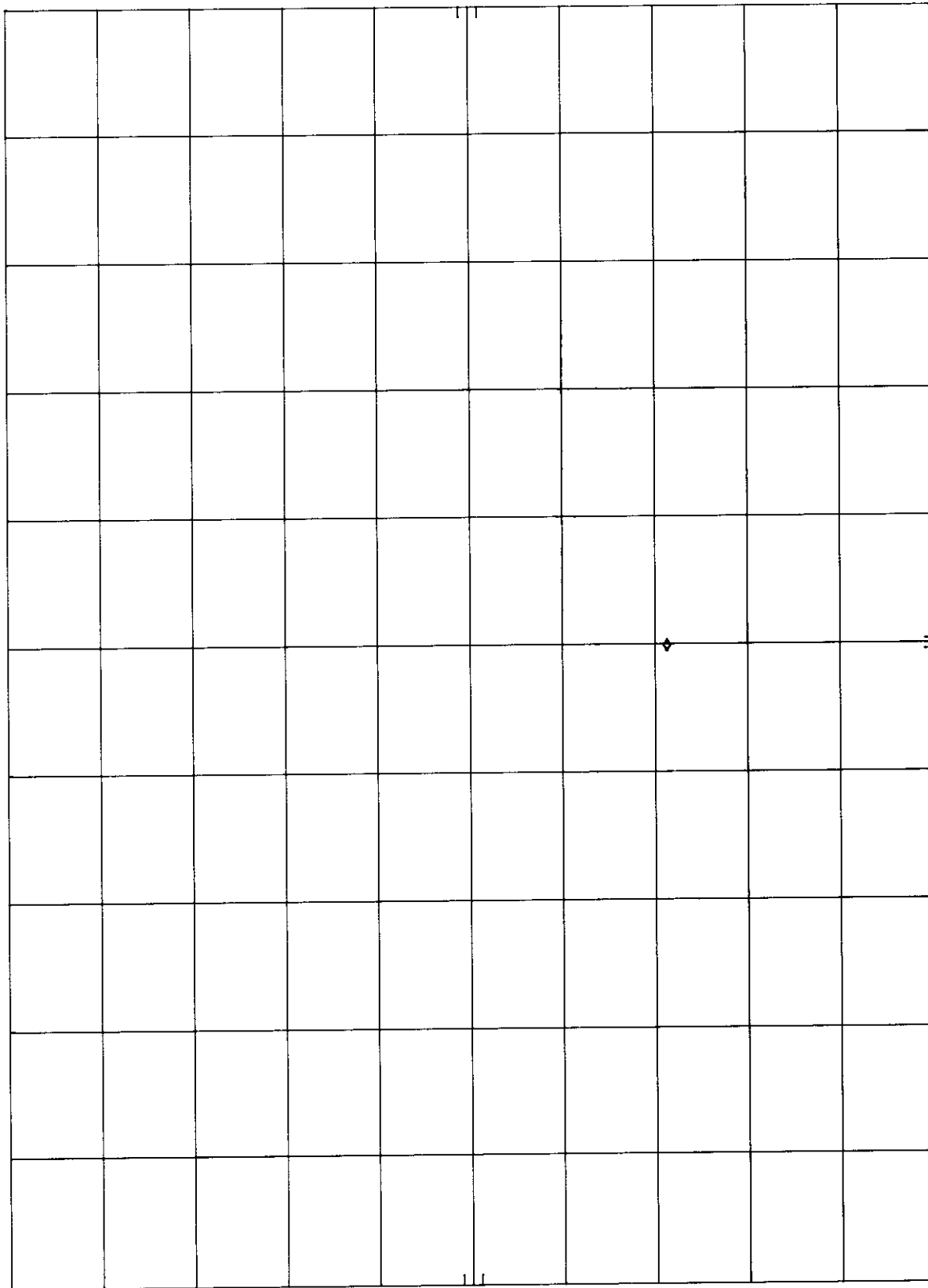
10 dB/

POS PK

OFFSET

45.0
dB

CORR'D



CENTER 3.920 00 GHZ

RES BW 100 KHZ

VBW 100 KHZ

SPAN 5.00 MHz
SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 4.410 000 GHZ
REF 50.0 dBm ATEN 20 dB -21.10 dBm

hp

10 dB/

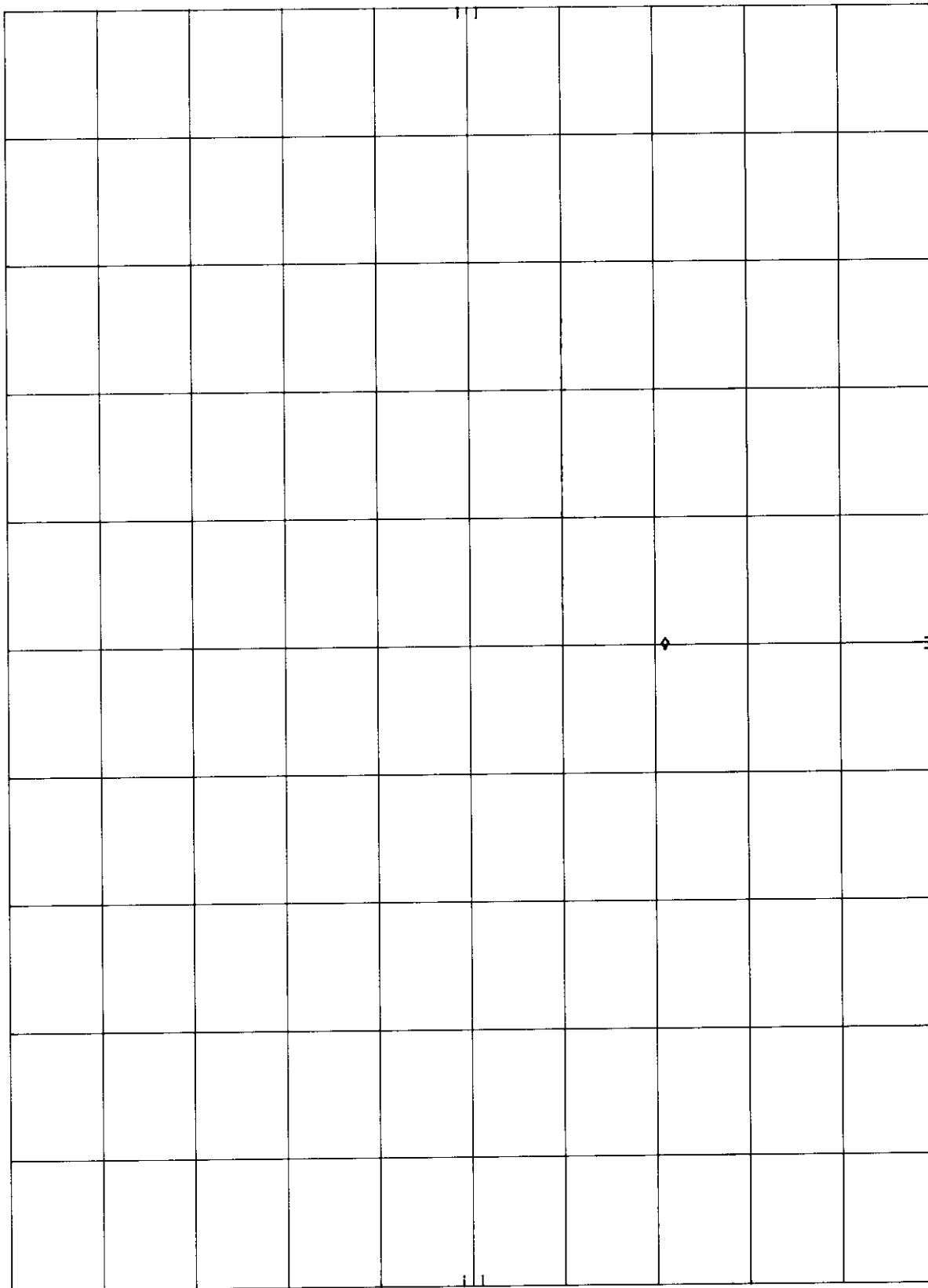
POS PK

OFFSET

40.0

dB

CORR'D



CENTER 4.410 00 GHZ

RES BW 100 KHZ

VBW 100 KHZ

SPAN 5.00 MHZ
SWP 20.0 msec

ELECTROCOM DT450 ANTENNA COND. SPURIOUS MKR 4.900 000 GHZ
 REF 50.0 dBm ATTEN 10 dB -26.90 dBm

hp

10 dB/

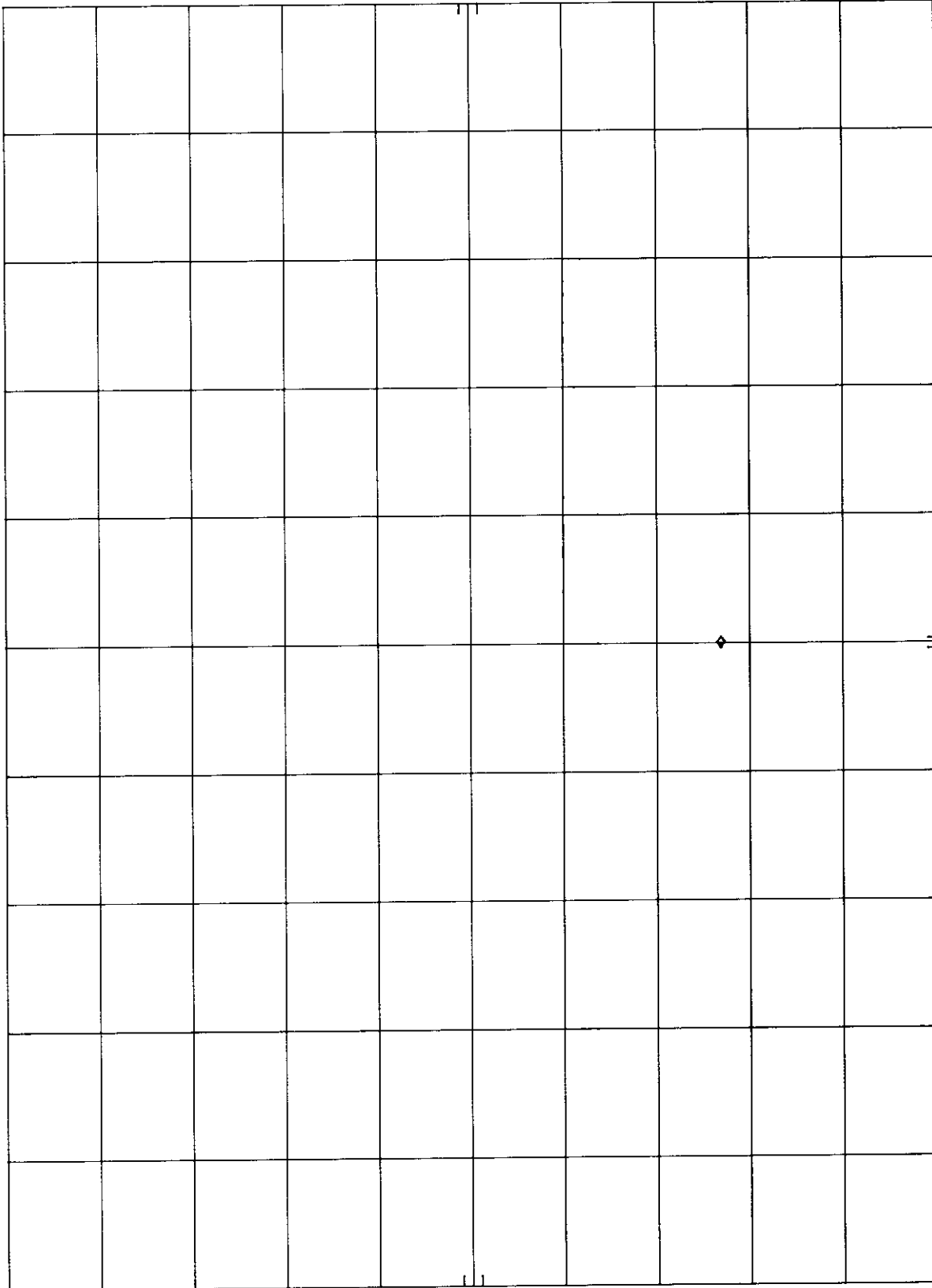
POS PK

OFFSET

50.0

dB

CORR'D



CENTER 4.900 00 GHZ

RES BW 100 KHZ

VBW 100 KHZ

SPAN 5.00 MHZ

SWP 20.0 msec

Test Results: Spurious Radiated Signal Measurements (Reference: Part 2, Subpart J, §2.993)

Frequency Tuned at : 470.0 MHz

FCC OATS Radiated Emission Data Sheet

Date: 07/22/97

Antenna Polarity (V or H)	Frequency of Emission (MHz)	S. A. Reading (dB μ V)	Antenna Factor (dB)	Cable Loss (dB)	Preamp. Gain (dB)	Field Strength @ 3 meter (dB μ V/m)	Field Strength @ 3 meter (dBc)	FCC Limit @ 3 meter (dBc)
	470.0	---	---	---	---	143.5 *	0	**
V	940.0	30.6	24.5	4.5	22.5	37.1	-106.4	-59.0
H	940.0	28.4	24.5	4.5	22.5	34.9	-108.6	-59.0
V	1410.0	38.9	25.3	9.0	36.0	37.2	-106.3	-59.0
H	1410.0	40.5	25.3	9.0	36.0	38.8	-104.7	-59.0
V	1880.0	42.5	28.4	11.0	36.0	45.9	-97.6	-59.0
H	1880.0	38.5	28.4	11.0	36.0	41.9	-101.6	-59.0
V	2350.0	36.9	29.4	13.0	36.0	43.3	-100.2	-59.0
H	2350.0	37.6	29.4	13.0	36.0	44.0	-99.5	-59.0
V	2820.0	34.7	30.2	14.0	36.0	42.9	-100.6	-59.0
H	2820.0	34.0	30.2	14.0	36.0	42.2	-101.3	-59.0
V	3290.0	38.9	30.5	15.0	35.0	49.4	-94.1	-59.0
H	3290.0	36.8	30.5	15.0	35.0	51.5	-92.0	-59.0
V	3760.0	44.0	31.2	16.0	35.0	56.2	-87.3	-59.0
H	3760.0	40.8	31.2	16.0	35.0	53.0	-90.5	-59.0
V	4230.0	34.2	32.1	17.5	34.5	49.3	-94.2	-59.0
H	4230.0	34.6	32.1	17.5	34.5	49.7	-93.8	-59.0
V	4700.0	***	32.7	19.0	34.5	---	---	-59.0
H	4700.0	***	32.7	19.0	34.5	---	---	-59.0

* Field Strength = 143.5dB μ V/m, **FCC Limit = 59dBc, *** No Detectable Signal, Signal Level below S.A. Noise Floor

Test Results: Spurious Radiated Signal Measurements (Reference: Part 2, Subpart J, §2.993)

Frequency Tuned at : 480.0 MHz

FCC OATS Radiated Emission Data Sheet

Date: 07/22/97

Antenna Polarity (V or H)	Frequency of Emission (MHz)	S. A. Reading (dB μ V)	Antenna Factor (dB)	Cable Loss (dB)	Preamp. Gain (dB)	Field Strength @ 3 meter (dB μ V/m)	Field Strength @ 3 meter (dBc)	FCC Limit @ 3 meter (dBc)
	480.0	---	---	---	---	143.5 *	0	**
V	960.0	28.6	24.5	4.5	22.5	35.1	-108.4	- 59.0
H	960.0	30.2	24.5	4.5	22.5	36.7	-106.8	- 59.0
V	1440.0	40.8	25.4	9.0	36.0	39.2	-104.3	- 59.0
H	1440.0	41.0	25.4	9.0	36.0	39.4	-104.1	- 59.0
V	1920.0	40.0	29.3	11.0	36.0	44.3	- 99.2	- 59.0
H	1920.0	35.9	29.3	11.0	36.0	40.2	-103.3	- 59.0
V	2400.0	39.0	29.5	13.0	36.0	45.5	- 98.0	- 59.0
H	2400.0	39.1	29.5	13.0	36.0	45.6	- 97.9	- 59.0
V	2880.0	35.1	30.3	14.0	36.0	43.4	-100.1	- 59.0
H	2880.0	35.4	30.3	14.0	36.0	43.7	- 99.8	- 59.0
V	3360.0	36.6	30.3	15.0	35.0	46.9	- 96.6	- 59.0
H	3360.0	34.8	30.3	15.0	35.0	45.1	- 98.4	- 59.0
V	3840.0	46.6	30.3	16.0	35.0	57.9	- 85.6	- 59.0
H	3840.0	45.1	30.3	16.0	35.0	56.4	- 87.1	- 59.0
V	4320.0	35.4	32.1	17.5	34.5	50.5	- 93.0	- 59.0
H	4320.0	33.2	32.1	17.5	34.5	48.3	- 95.2	- 59.0
V	4800.0	***	32.9	19.0	34.5	---	---	- 59.0
H	4800.0	***	32.9	19.0	34.5	---	---	- 59.0

Test Results: Spurious Radiated Signal Measurements (Reference: Part 2, Subpart J, §2.993)
 Frequency Tuned at : 490.0 MHz

FCC OATS Radiated Emission Data Sheet

Date: 07/22/97

Antenna Polarity (V or H)	Frequency of Emission (MHz)	S. A. Reading (dB μ V)	Antenna Factor (dB)	Cable Loss (dB)	Preamp. Gain (dB)	Field Strength @ 3 meter (dB μ V/m)	Field Strength @ 3 meter (dBc)	FCC Limit @ 3 meter (dBc)
	490.0	---	---	---	---	143.5 *	0	**
V	980.0	29.4	25.0	4.5	22.5	36.4	-107.1	-59.0
H	980.0	30.4	25.0	4.5	22.5	37.4	-106.1	-59.0
V	1470.0	47.2	25.5	9.0	36.0	45.7	-97.8	-59.0
H	1470.0	48.0	25.5	9.0	36.0	46.5	-97.0	-59.0
V	1960.0	45.1	29.0	11.0	36.0	49.1	-94.4	-59.0
H	1960.0	42.3	29.0	11.0	36.0	46.3	-97.2	-59.0
V	2450.0	40.0	29.5	13.0	36.0	46.5	-97.0	-59.0
H	2450.0	40.5	29.5	13.0	36.0	47.0	-96.5	-59.0
V	2940.0	33.4	30.5	14.0	36.0	41.9	-101.6	-59.0
H	2940.0	33.7	30.5	14.0	36.0	42.2	-101.3	-59.0
V	3430.0	36.3	30.3	15.5	35.0	47.1	-96.4	-59.0
H	3430.0	37.8	30.3	15.5	35.0	48.6	-94.9	-59.0
V	3920.0	48.9	31.8	17.0	35.0	62.7	-80.8	-59.0
H	3920.0	48.6	31.8	17.0	35.0	62.4	-81.1	-59.0
V	4410.0	37.2	32.1	18.5	34.5	53.3	-90.2	-59.0
H	4410.0	33.6	32.1	18.5	34.5	49.7	-93.8	-59.0
V	4900.0	***	33.2	19.5	34.5	---	---	-59.0
H	4900.0	***	33.2	19.5	34.5	---	---	-59.0

FREQUENCY STABILITY MEASUREMENT (Reference : FCC Part 2, Subpart J, §2.995)

FREQUENCY TUNED : 470.0 MHz

Date: 07/23/97

TEMPERATURE °C	DC POWER SUPPLY VOLTAGE						FCC LIMIT 5.0ppm Δf = 0.002350MHz
	-15% Nominal Voltage (11.56V)		Nominal Voltage (13.60V)		+15% Nominal Voltage (15.64V)		
	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	
+25°C (Room Temp.)	470.000038	43.7	470.000060	45.0	470.000036	45.7	0.000060
-30°C	470.000176	43.4	470.000106	46.0	470.00206	46.1	0.000206
-20°C	470.000518	43.8	470.000445	46.0	470.000542	46.0	0.000542
-10°C	470.000622	43.7	470.000656	45.9	470.000612	46.0	0.000656
+ 0°C	470.000516	43.7	470.000532	45.8	470.000508	45.8	0.000532
+10°C	470.000320	43.8	470.000322	45.7	470.000308	45.7	0.000322
+20°C	470.000153	43.7	470.000132	45.7	470.000120	45.7	0.000153
+30°C	470.000087	43.6	470.000018	45.5	470.000102	45.7	0.000102
+40°C	470.000153	43.4	470.000118	45.4	470.000172	45.6	0.000172
+50°C	470.000156	43.3	470.000147	45.2	470.000154	45.8	0.000156

FREQUENCY STABILITY MEASUREMENT (Reference : FCC Part 2, Subpart J, §2.995)

FREQUENCY TUNED : 480.0 MHz

TEMPERATURE °C	DC POWER SUPPLY VOLTAGE						FCC LIMIT 5.0ppm Δf = 0.002400MHz
	- 15% Nominal Voltage (11.56V)		Nominal Voltage (13.60V)		+15% Nominal Voltage (15.64V)		
	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	
+25°C (Room Temp.)	480.000047	43.5	480.000072	45.6	480.000037	45.7	0.000072
-30°C	480.000156	43.5	480.000086	45.8	480.000228	46.0	0.000228
-20°C	480.000502	43.6	480.000468	45.7	480.000575	45.9	0.000575
-10°C	480.000650	43.5	480.000676	45.3	480.000640	45.6	0.000676
+ 0°C	480.000516	43.6	480.000553	45.5	480.000513	45.6	0.000553
+10°C	480.000338	43.6	480.000337	45.4	480.000304	45.6	0.000338
+20°C	480.000158	43.5	480.000145	45.4	480.000118	45.6	0.000158
+30°C	480.000084	43.4	480.000036	45.2	480.000105	45.8	0.000105
+40°C	480.000156	43.2	480.000126	45.0	480.000184	45.8	0.000184
+50°C	480.000162	42.9	480.000156	44.7	480.000158	46.0	0.000162

FREQUENCY STABILITY MEASUREMENT (Reference : FCC Part 2, Subpart J, §2.995)

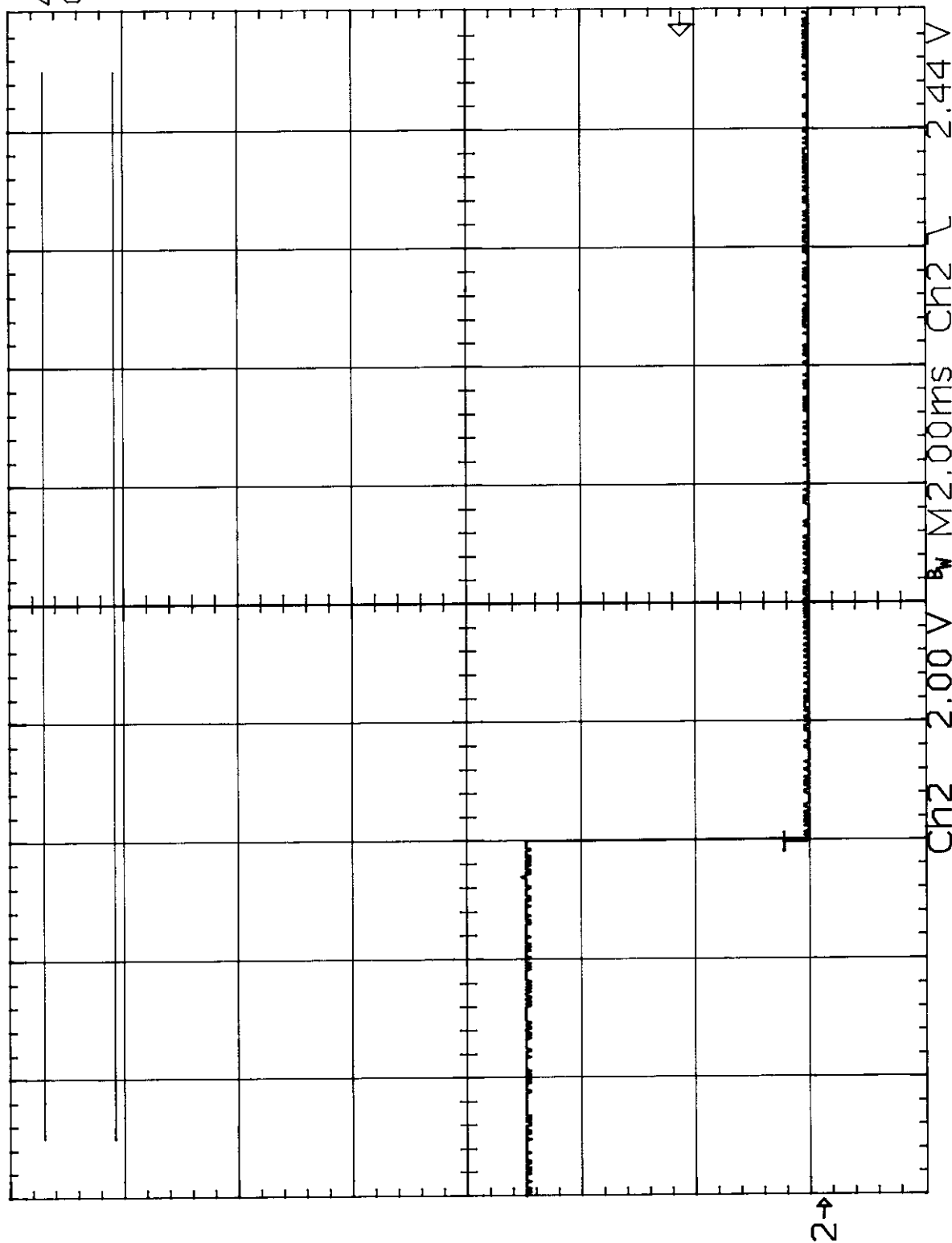
FREQUENCY TUNED : 490.0 MHz

TEMPERATURE °C	DC POWER SUPPLY VOLTAGE						FCC LIMIT 5.0ppm Δf = 0.002450MHz
	-15% Nominal Voltage (11.56V)		Nominal Voltage (13.60V)		+15% Nominal Voltage (15.64V)		
	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	Frequency (MHz)	Output (dBm)	
+25°C (Room Temp.)	490.000053	42.8	490.000065	44.5	490.000038	45.3	0.000065
-30°C	490.000145	43.0	490.000089	45.0	490.000236	45.1	0.000236
-20°C	490.000501	43.1	490.000480	45.0	490.000582	44.9	0.000582
-10°C	490.000668	43.1	490.000686	44.8	490.000654	44.8	0.000686
+ 0°C	490.000554	43.1	490.000564	44.7	490.000516	44.8	0.000564
+10°C	490.000348	43.0	490.000343	44.8	490.000311	44.9	0.000348
+20°C	490.000163	42.9	490.000156	44.6	490.000122	45.1	0.000163
+30°C	490.000068	42.5	490.000045	44.3	490.000108	45.4	0.000108
+40°C	490.000154	42.2	490.000136	44.0	490.000205	45.2	0.000205
+50°C	490.000168	41.7	490.000162	43.5	490.000152	44.7	0.000168

Tek Run: 50.0ks/s Sample Trig?

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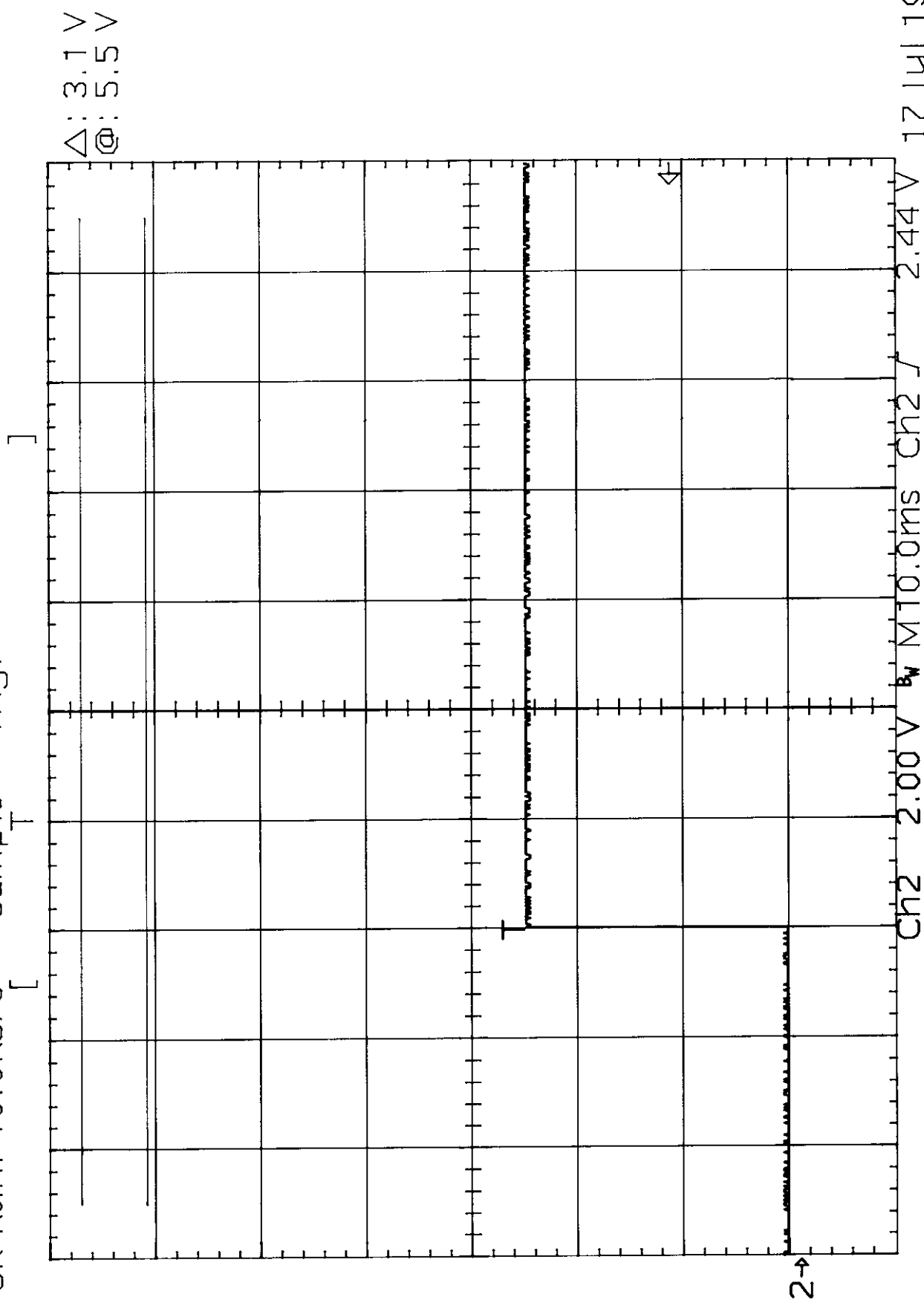
Δ : 3.1 V
@: 5.5 V



B46

17 Jul 1997
15:34:33

Tek Run: 10.0ks/s Sample T Trig?

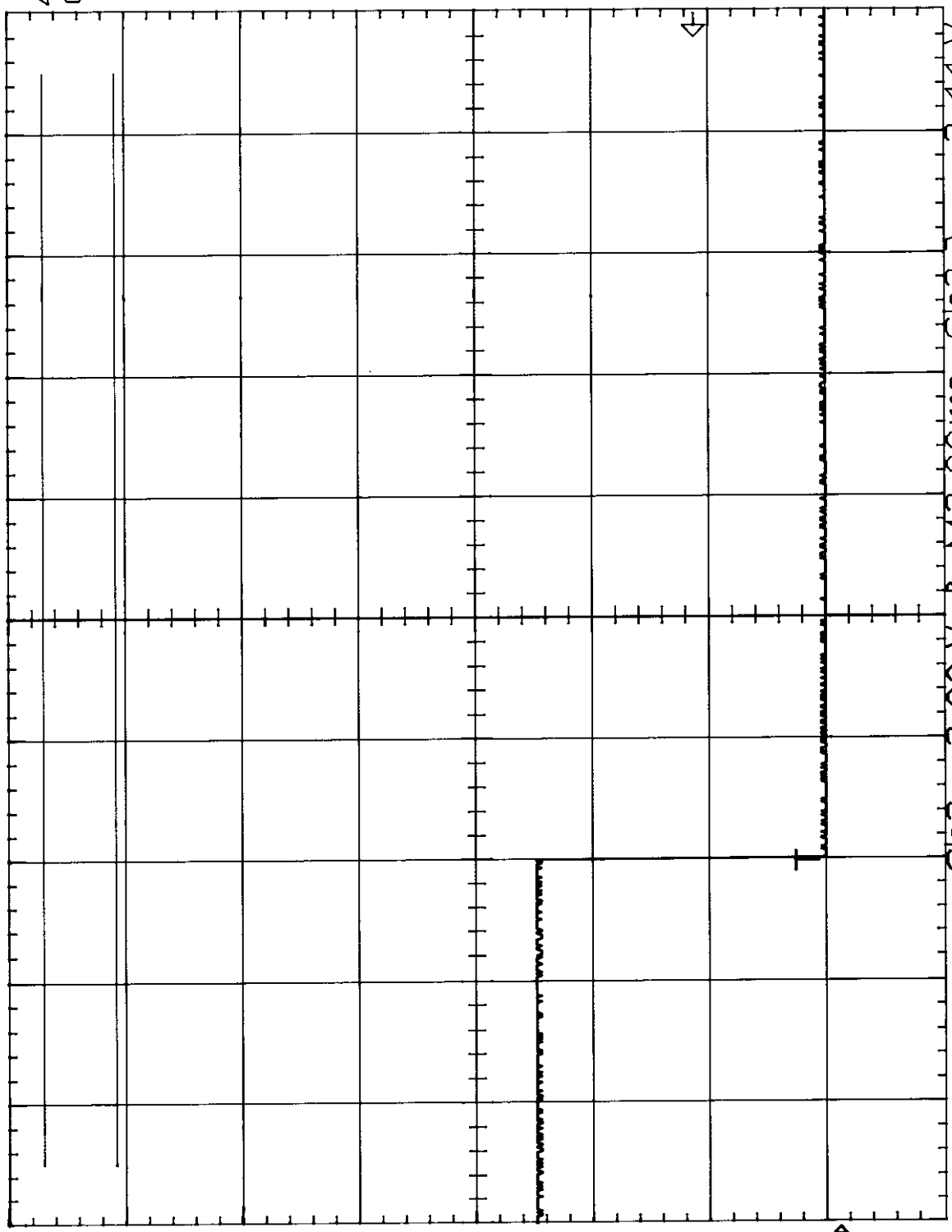


B47

17 Jul 1997
15:27:20

Tek Run: 50.0kS/s Sample Trig?

J



Δ : 3.1 V
@: 5.5 V

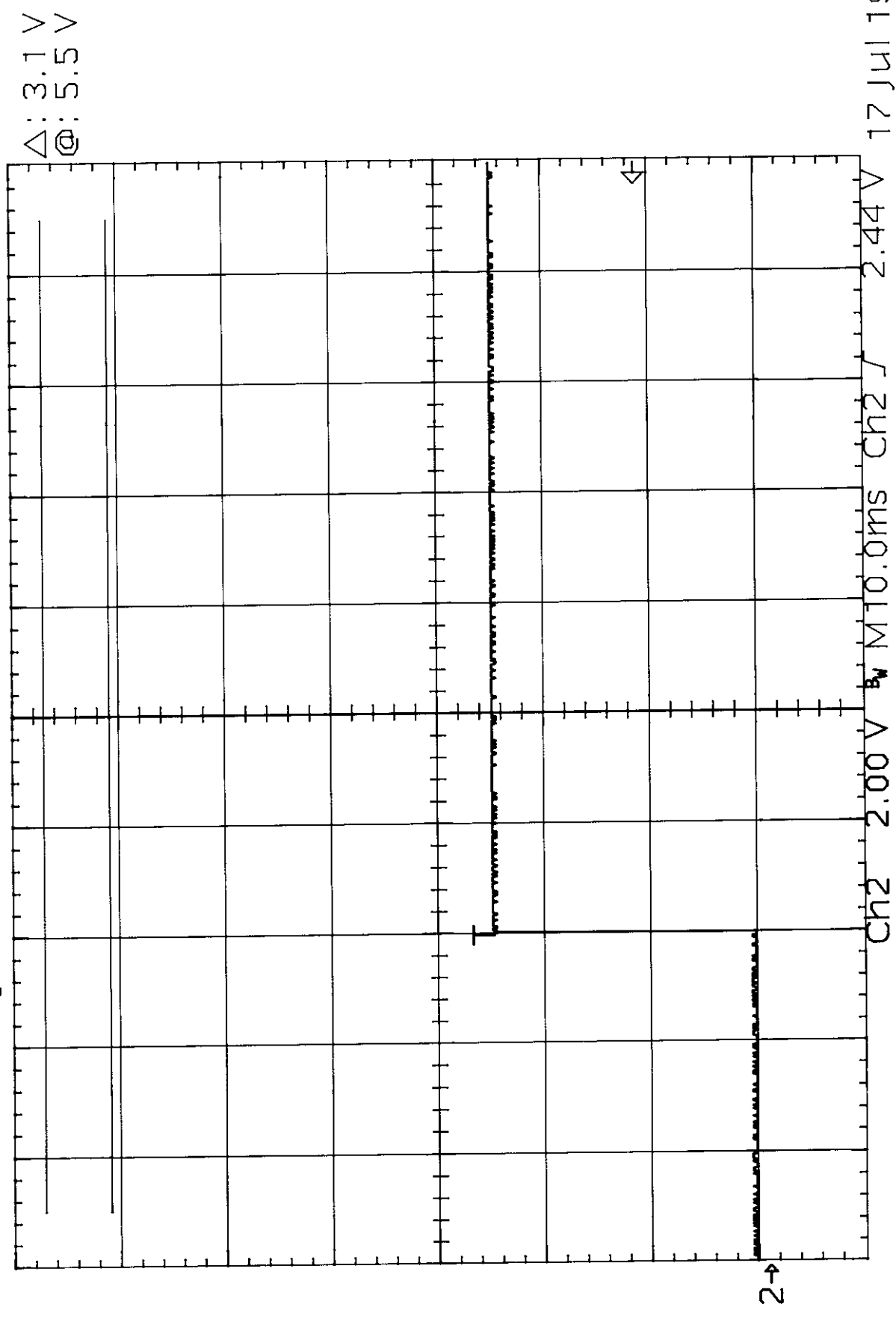
Ch2 2.00 V BW M2.00ms Ch2 V 2.44 V

B49

17 Jul 1997
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17 Jul 1997
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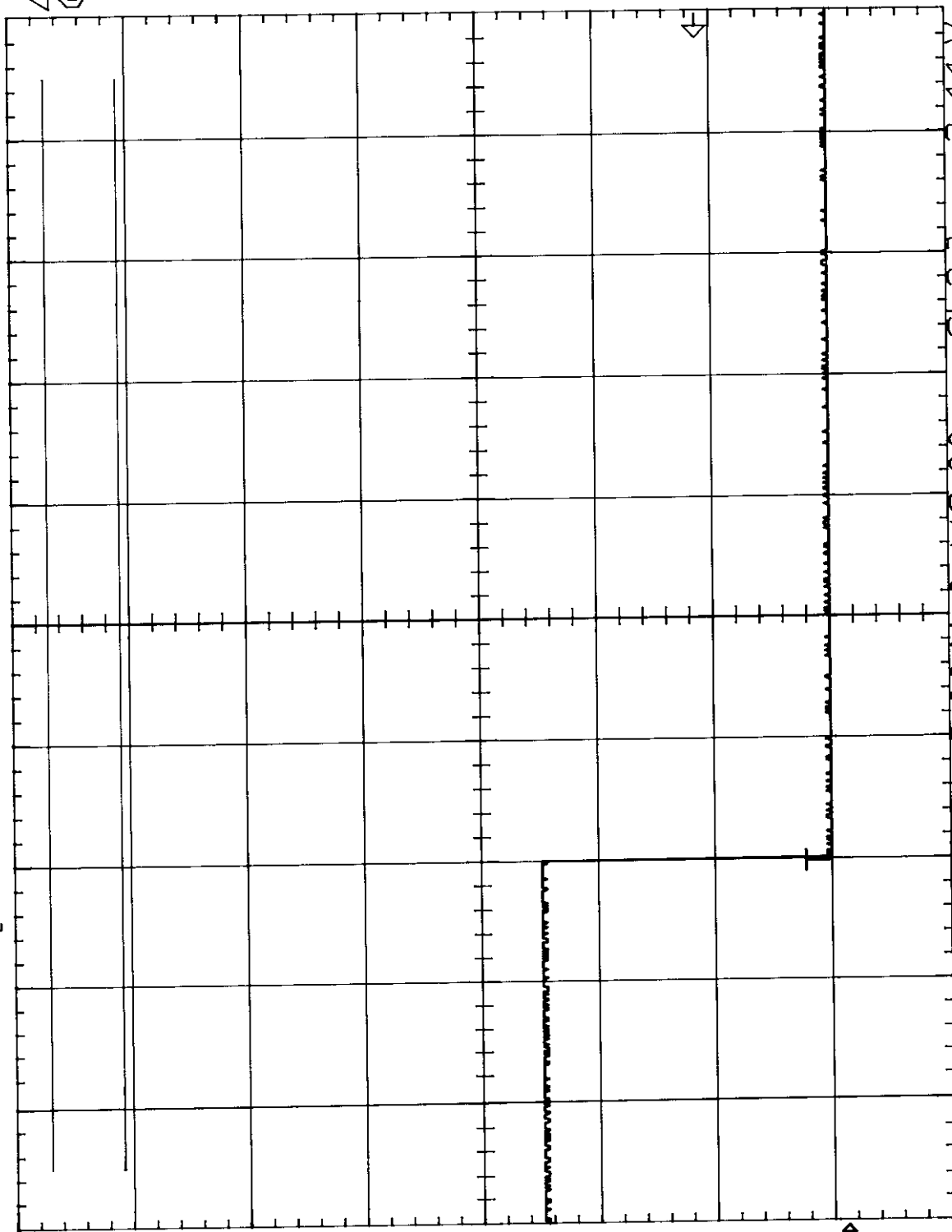
Tek Run: 10.0kS/s Sample Trig?



Tek Run: 50.0ks/s Sample Trig?

]

[



Δ: 3.1 V
@: 5.5 V

2→

Ch2 2.00 V M2.00ms Ch2 V 2.44 V

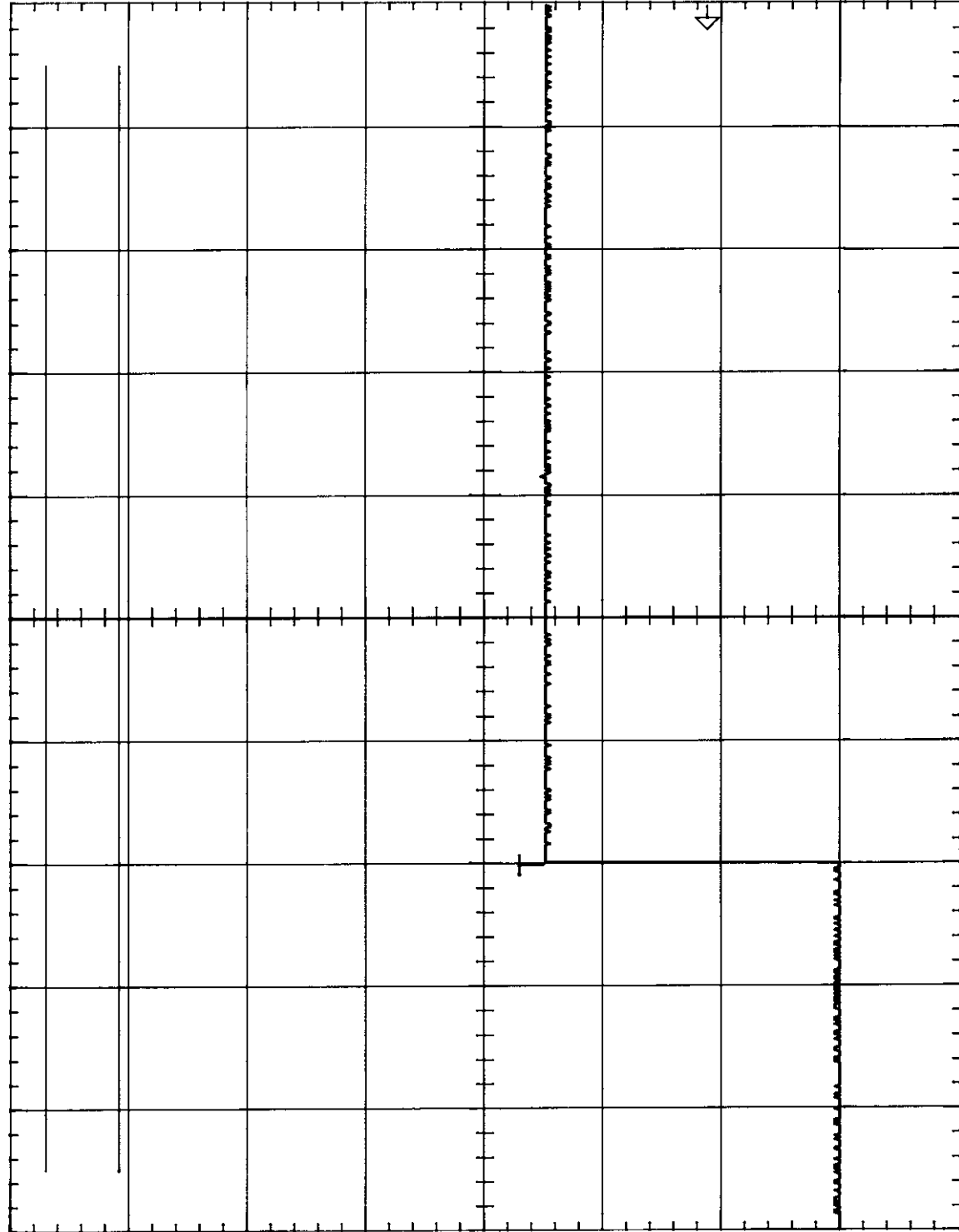
17 Jul 1997

15:49:51

Tek Run: 10.0kS/s Sample Trig?

]

[



Δ : 3.1 V
@: 5.5 V

2→

Ch2 2.00 V 10.0ns CH2

2.44 V

17 Jul 1997

15:46:14