Explanation for internal behavior of ET-0405-U/ET-0405-R

1999/4/23

1. As instructed, we have performed the radiated emission measurements from this device for frequency below 30MHz.

2. The intentionally radiated frequency is 750kHz. All the other frequencies are unintentionally radiated.
In order to understand better, we would like to provide further explanation in addition to the previously provided information. Please refer to the attached block diagram.

A. Sensor coils
As shown in the photograph and the circuit diagram, the sensor board has two groups of multiple loop coils in X (horizontal) and Y (vertical) directions. Radio frequency energy is radiated from these coils.
Each coil is approximately 30mm wide and as long as the height, for X-axis, and width, for the Y-axis, of the effective area of the tablet as shown in the photograph. Each coil consists of 6 turns (loops) of copper conductor.

B. Original oscillation frequency and intentional radiated frequency
The intentional radiated frequency is created by dividing the original oscillation frequency of 6MHz in CPU. This signal is supplied to the sensor coils in a time-sharing manner.

C. Operation
The tablet looks for a pointing device, such as a stylus or a puck, by feeding electrical current of above-mentioned frequency through the coils in both X-axis and Y-axis.
The current fed through each coil is not more than 40mA.
The tablet is able to detect the position of a pointing device because of the induction caused between the coil of the pointing device and two coils, one from X-axis and the other from Y-axis, of the sensor board.
The tablet is designed in such a way that not more than one coils, X-axis or Y-axis, is used at same time to detect the position of the pointing device. The signal is emitted for about 50usec up to about 2msec from one coil and the duration is controlled by the firmware on the sensor board.

D. Comment on pointing device
The device operates completely passively and has no battery or active oscillator.

Lucy tablet Specifications (E7- 0405-R /-U)

Items	Specificications	
	Serial	USB
General		
External dimension	206x227x10mm	
Weight	400g	
Operating temperature	5℃ to 40℃	
Operating relative humidity	20% to 80% noncondensing	
Storage temperature	-10℃ to 60℃	
Storage relative humidity	20% to 90% noncondensing	
Performance and interface		
Operation method	Electro-magnetic give and receive	
Active area	127.6x92.8mm	
Coordinate data resolution	40 lpmm (1000 lpi)	
Coordinate data accuracy	+/-0.5mm	
Maximum reading height	0.3mm or less	
Title allowance for guraranteed coord. data	40 degress from vertical	
Data transfer rate	100(default)/200(max) points/sec	
Command system	WACOM4	
Output data format	WACOM4	
Pressure levles	512 levels	
Eraser-pen support	Yes	
Interface	EIA RS-232	USB
Baud rate	9600 or 19,200 bps	USB
Communication method	Full duplex	USB
Data lenth, parity, stop bit	8 bit, none, 1 bit	USB
Cable length	2m	
Connector type	9-pin, DSUB, female	USB type B
LED colors	Amber/Green	
Pointing device	Lucy pen/Mouse	
Power Requirement		
Power intake method	Through P/S2 port	USB
Input voltage	DC 5V +/-5%	
Input current	100mA or less	
Others		
International certificate compliance	FCC class B, CE, VCCI class 2	
Standard accessories	Pen, Mouse, guide, CD-ROM	

This is a low power transmitter.
The frequencies are 750KHz and 753KHz

6 . 8 FUNDERMENTAL FREQUENCY TEST

6.8.1   TEST EQUIPMENT

EQUIPMENT	MANUFACTURER	MODEL #
LOOP ANTENNA	R & S	HFH 2-Z2
RECEIVER	R & S	ESHS 30
SPECTRUM ANALYZER	HP	8568B
PRE-AMPLIFIER	HP	8447D

6.8.2   CONFIGURATION OF THE EUT
SAME AS SECTION 4.5 OF THIS REPORT

6.8.3   EUT OPERATING CONDITION
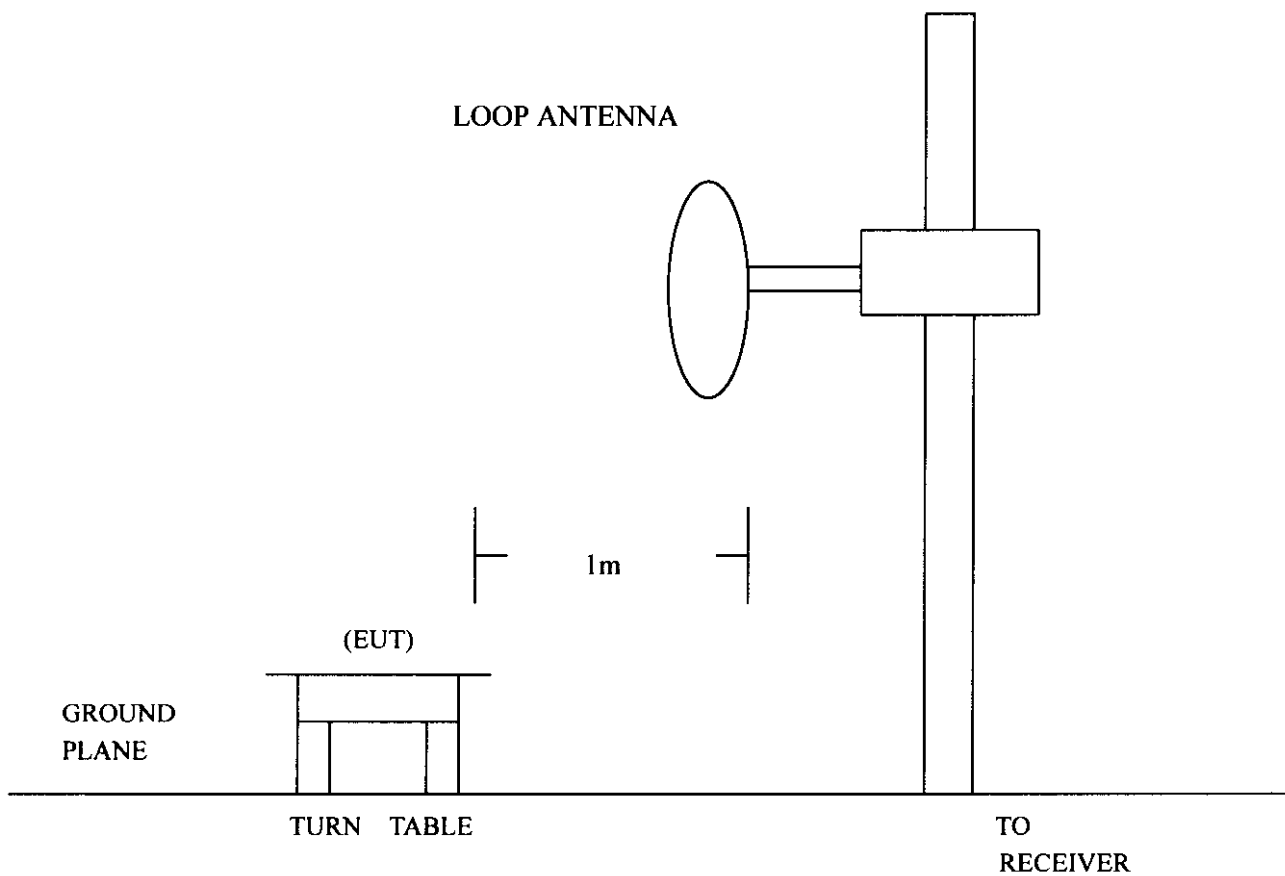SAME AS SECTION 4.6 OF THIS REPORT

6.8.4   TEST PROCEDURE

    1.   SET-UP LOOP ANTENNA AT 3m DISTANCE.
    2.   THE SIGNAL IS TOO SMALL TO DETECT.
    3.   MOVE LOOP ANTENNA AT 1m DISTANCE.
    4.   TURN THE TURN TABLE.
    5.   AFTER FIND THE MAX. DATA THEN CHANGED THE HEIGHT OF
       ANTENNA FROM 1m TO 2m TO FIND THE MAX. OF EMISSION.
    6.   TURN THE TURN TABLE AGAIN.
    7.   CHANGED THE LOOP ANTENNA TO POLARIZATION.

NOTE :

1. BOTH POLARIZATIONS (VERTICAL AND HORIZONTAL WERE TESTED) .

2. THE TESTING DISTANCE IS UNDER 15 cm BETWEEN Tx AND Rx. WE
   CAN NOT PICK UP ANY EMISSION IF THE DISTANCE IS OVER 15 cm.
   WE FOUND THE MAX. SIGNAL IS ON THE VERTICAL AND PEN TOUCH
   TO THE Tx (BOARD).

6.8.5   TEST SETUP

LOOP ANTENNA

1m

(EUT)

GROUND
PLANE

TURN   TABLE

TO
RECEIVER

6.8.6   RADIATED EMISSION LIMIT

FREQUENCY (MHz)	FIELD STRENGTH (MICROVOLTS/METER)	MEASUREMENTDISTANCE (METERS)
0.009 - 0.490	2400/F (KHz)	300
0.490 - 1.705	24000/F (KHz)	30
1.705 - 30.0	30	30

NOTE : SAME AS SECTION 5.6 OF THE REPORT.
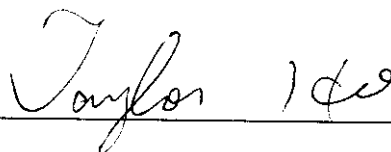
6.8.7 RADIATED EMISSION TEST RESULT

The frequency spectrum from __450__ KHz to __30__ MHz was investigated. The values __under 30MHz__ with a resolution bandwidth of 10KHz. The distance was 1 meter. The following reading data were changed from original 1 meter's data to 30 meter's data.

Temperature : ___25___ C   Humidity : ___50___ %RH

0.750	0.2	20	5.2	-12.7	25.4	7.5	30.1

: (1). *=Measurement does not apply for this frequency.
(2). Uncertainty in radiated emission measured is <+/-4dB
(3). Any departure from specification : N/A
(4). Limits : 20 log 24000 / 753 = 30.1dBuV
(5). Sample calculation
   20 log (emission) uV/m = Factor(dB)+Ant. factor(dB/m)+reading(dBuV)
(6). The calculation of reading data that changed from 1 meter to 3 meters is : 1 meter reading data (uV) x 1/30 = 30 meters reading data(uV)
(7). Example : Vertical reading data is 16.8dBuV at 1m
   ⇒ 16.8dBuV = 6.9uV
      6.9uV / 30 = 0.23uV at 30m
      ⇒ 20log 0.23uV = -12.7dBuV
(8). ET-0405-U → USB port
(9). Pen

SIGNED BY TESTING ENGINEER : _____

6.8.7 RADIATED EMISSION TEST RESULT

The frequency spectrum from __450__ KHz to __30__ MHz was investigated.
The values __under 30MHz__ with a resolution bandwidth of 10KHz.
The distance was 1 meter. The following reading data were changed
from original 1 meter's data to 30 meter's data.

Temperature : __25__ C   Humidity : __50__ %RH

0.750	0.2	20	5.1	-16.3	25.3	3.9	30.1

: (1). *=Measurement does not apply for this frequency.
  (2). Uncertainty in radiated emission measured is <+/-4dB
  (3). Any departure from specification : N/A
  (4). Limits : 20 log 24000 / 753 = 30.1dBuV
  (5). Sample calculation
       20   log (emission) uV/m = Factor(dB)+Ant. factor(dB/m)+reading(dBuV)
  (6). The calculation of reading data that changed from 1 meter to
       3 meters is : 1 meter reading data (uV) x 1/30 = 30 meters reading
       data(uV)
  (7). Example : Vertical reading data is 13.2dBuV at 1m
       $\Rightarrow$ 13.2dBuV = 4.57uV
           4.57uV / 30 = 0.15uV at 30m
             $\Rightarrow$ 20log 0.15uV = -16.3dBuV
  (8). ET-0405-U $\rightarrow$ USB port
  (9). Mouse

SIGNED BY TESTING ENGINEER : _____

6.8.7 RADIATED EMISSION TEST RESULT

The frequency spectrum from _450_ KHz to _30_ MHz was investigated.
The values _under 30MHz_ with a resolution bandwidth of 10KHz.
The distance was 1 meter. The following reading data were changed
from original 1 meter's data to 30 meter's data.

Temperature : _25_ C   Humidity :   _50_ %RH

0.753	0.2	20	3.7	-13.9	23.9	6.3	30.1

■ : (1).   *=Measurement does not apply for this frequency.
   (2).   Uncertainty in radiated emission measured is <+/-4dB
   (3).   Any departure from specification : N/A
   (4).   Limits :   20 log 24000 / 753 = 30.1dBuV
   (5).   Sample calculation
       20   log (emission) uV/m = Factor(dB)+Ant. factor(dB/m)+reading(dBuV)
   (6).   The calculation of reading data that changed from 1 meter to
       3 meters is : 1 meter reading data (uV) x 1/30 = 30 meters reading
       data(uV)
   (7).   Example : Vertical reading data is 15.6dBuV at 1m
       $\Rightarrow$ 15.6dBuV = 6uV
         6uV / 30 = 0.2uV at 30m
         $\Rightarrow$ 20log 0.2uV = -13.9dBuV
   (8).   ET-0405-R $\rightarrow$ Serial port
   (9).   Pen

SIGNED BY TESTING ENGINEER : _____

6.8.7 RADIATED EMISSION TEST RESULT
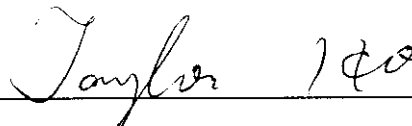
The frequency spectrum from __450__ KHz to __30__ MHz was investigated.
The values __under 30MHz__ with a resolution bandwidth of 10KHz.
The distance was 1 meter. The following reading data were changed
from original 1 meter's data to 30 meter's data.

Temperature : ___25___ C   Humidity :   ___50___ %RH

0.753	0.2	20	5.4	-11.7	25.9	8.5	30.1

: (1). *=Measurement does not apply for this frequency.
   (2). Uncertainty in radiated emission measured is <+/-4dB
   (3). Any departure from specification : N/A
   (4). Limits :   20 log 24000 / 753 = 30.1dBuV
   (5). Sample calculation
         20   log (emission) uV/m = Factor(dB)+Ant. factor(dB/m)+reading(dBuV)
   (6). The calculation of reading data that changed from 1 meter to

         3 meters is : 1 meter reading data (uV) x 1/30 = 30 meters reading

         data(uV)

   (7). Example : Vertical reading data is 17.8dBuV at 1m

         $\Rightarrow$ 17.8dBuV = 7.76uV

             7.76uV / 30 = 0.26uV at 30m

                $\Rightarrow$ 20log 0.26uV = -11.7dBuV

   (8). ET-0405-R $\rightarrow$ Serial port
   (9). Mouse

SIGNED BY TESTING ENGINEER : _____

monoc

H (Near field)

19: 17 SEP 15, 1999

107.0 dBµV   AT 10 dB

MKR 753 kHz
35.64 dBµV

CLEAR
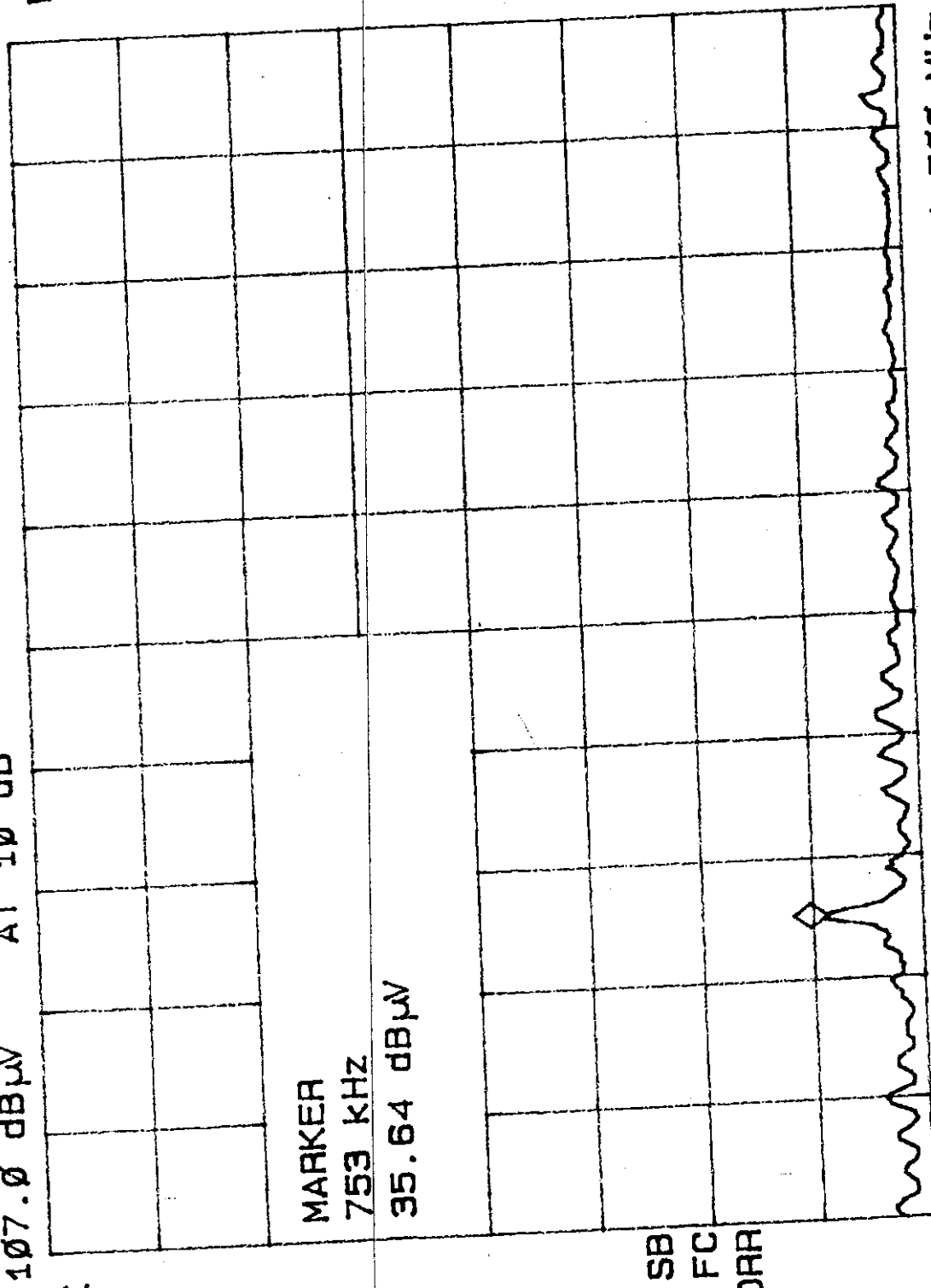WRITE A

MAX
HOLD A

VIEW A

BLANK A

Trace
A B C
A

More
1 of 3

MARKER
753 kHz
35.64 dBµV

SB
FC
ORR

START 500 kHz   STOP 1.500 MHz
#RES BW 10 kHz   VBW 10 kHz   #SWP 200 msec

PE,N
H (Nearfield)

34:33 SEP 15, 1999

107.0 dBμV   AT 10 dB

MKR 753 KHz
36.04 dBμV

MARKER
753 KHz
36.04 dBμV

IT 500 KHz   VBW 10 kHz   STOP 1.500 MHz
#RES BW 10 KHz   #SWP 200 msec

18: 13: 55 SEP 15, 1999

hp

REF 107.0 dBμV   AT 10 dB

MKR 750 kHz
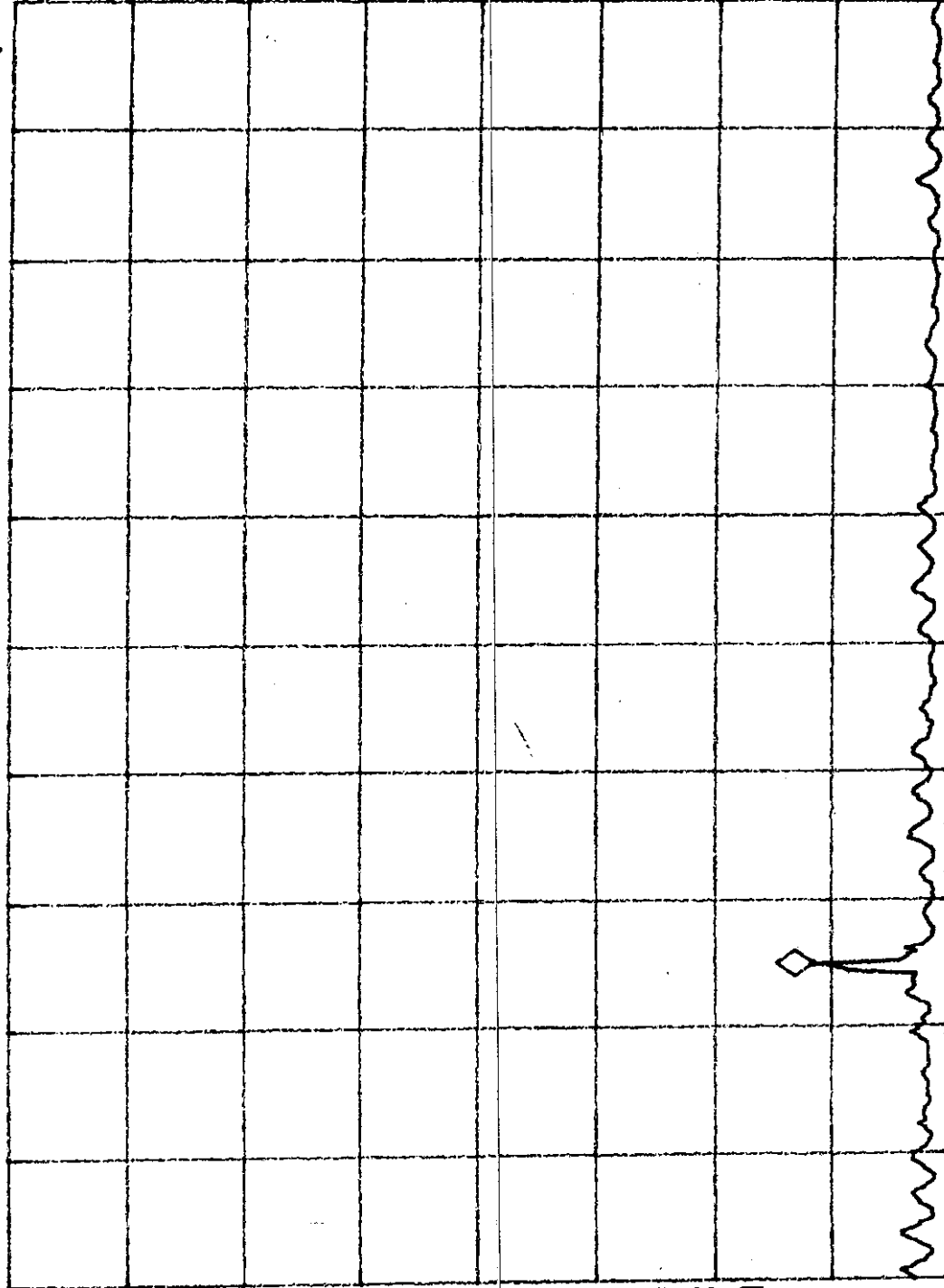38.50 dBμV

PEAK

LOG
10
dB/

CLEAR
WRITE A

MAX
HOLD A

VIEW A

BLANK A

VA SB
SC FC
CORR

Trace
A B C

A

More
1 of 3

START 500 kHz
#RES BW 10 kHz

VBW 10 kHz

STOP 1.500 MHz
#SWP 200 msec