33A1-8-105-1

AN 16-45-398

HANDBOOK
OPERATING INSTRUCTIONS

VARIABLE MASTER OSCILLATOR TYPE 115 MODEL 1

(NORTHERN RADIO CO., INC.)

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND THE CHIEF OF THE BUREAU OF AERONAUTICS

D'Arcy Ptg. & Litho Corp., New York, N. Y. 4800—12/17/52

7 OCTOBER 1952

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

* The asterisk indicates pages revised, added or deleted by the current revision.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

USAF ACTIVITIES.—In accordance with Technical Order No. 00-5-2. USAF

NAVY ACTIVITIES.—Submit request to nearest supply point listed below, using form NavAer-140: NAS, Alameda, Calif.; ASD, Orote, Guam; NAS, Jacksonville, Fla.; NAS, Norfolk, Va.; NASD, Oahu; NASD, Philadelphia, Pa.; NAS, San Diego, Calif.; NAS, Seattle, Wash.

For listing of available material and details of distribution see Naval Aeronautics Publications Index NavAer 00-500.

A

TABLE OF CONTENTS

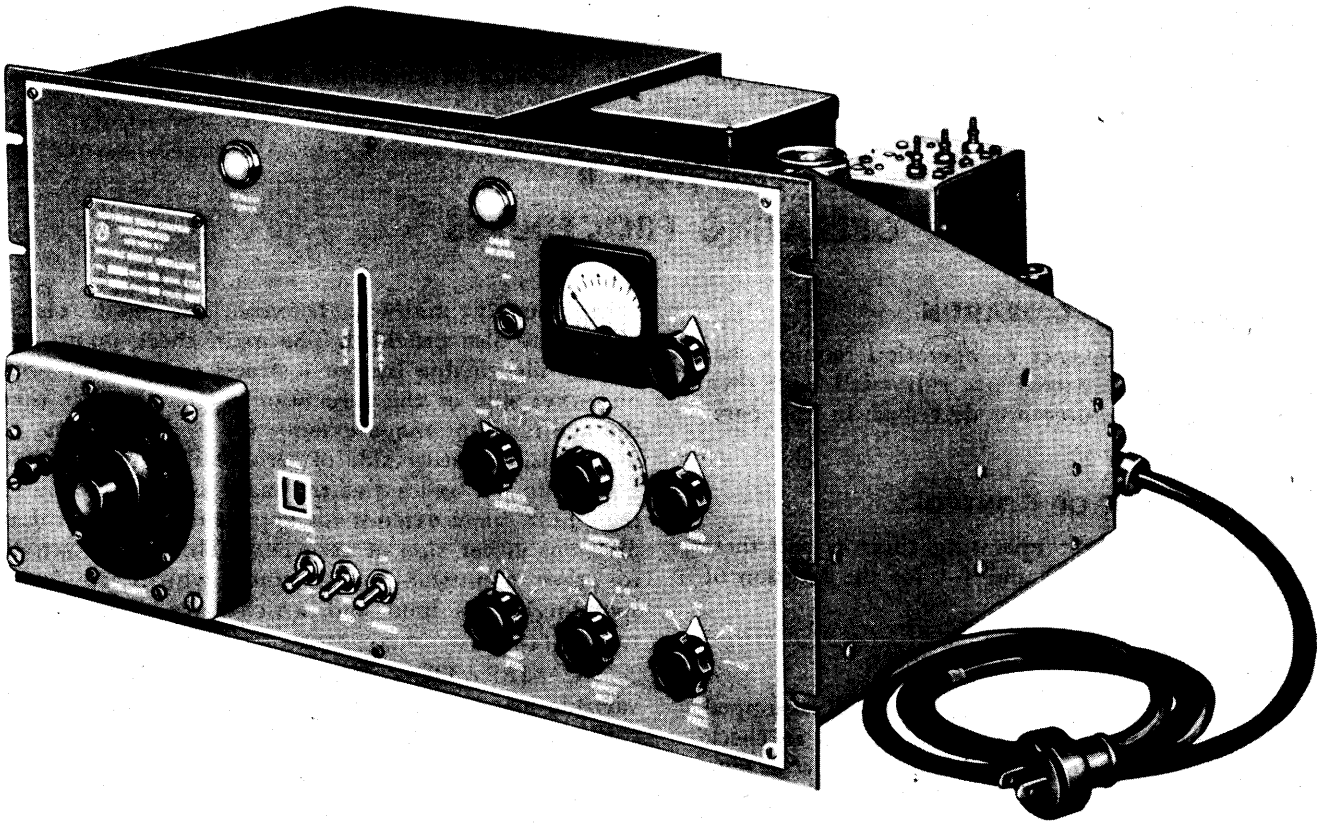


Figure 1-1. Variable Master Oscillator Type 115 Model 1

SECTION I
GENERAL DESCRIPTION

1-1. SCOPE OF HANDBOOK.

1-2. This handbook describes the operating procedures for the Variable Master Oscillator Type 115 Model 1, manufactured by the Northern Radio Company, Incorporated, New York, N. Y. Minor repair that the operator can perform is also covered.

1-3. GENERAL DESCRIPTION.

1-4. The variable master oscillator, shown in figure 1-1, is designed principally to supply local oscillator injection voltage to receivers in diversity reception systems. It can also be used in any application where highly stable r-f signals are required (i.e., bfo injection voltage in receivers, exciter signal voltage in transmitters, measuring, testing, and aligning purposes, etc.).

1-5. The master oscillator can operate either as a fixed source, or a continuously variable source, of r-f signals in the frequency range of 2 to 32 mc. When operated as a continuously variable generator, signals in the range of 2 to 4 mc are generated by a Hartley oscillator. These signals are applied through a cathode follower and two buffer amplifiers to three cascade-connected frequency-multipliers. One, two, or all three of these frequency-multipliers are made operative, as determined by the setting of the front panel FREQUENCY RANGE selector switch. Thus, signals whose frequency multiplication is 1, 2, 4, or 8 times the Hartley oscillator fundamental frequency, are made available at three parallel-connected high-frequency oscillator output jacks.

1-6. The operation of the master oscillator as a fixed-frequency generator is as follows: One of three quartz crystals in the frequency range of 2 to 4 mc is selected by a front panel crystal selector switch to determine the operating frequency of a crystal oscillator. The crystal oscillator output is applied to the same buffer amplifiers and frequency-multipliers that the output of the variable oscillator is applied to. These stages function the same for both crystal and variable oscilla-

tor operation. Therefore, the output frequency range is, again, 2 to 32 mc. A separate bfo oscillator, whose output frequency is determined by one of two quartz crystals, applies its output through a buffer amplifier to three parallel-connected bfo output jacks. The bfo oscillator operates in the range of 450 to 475 kc. A portion of the variable oscillator output is applied to a mixing circuit that is used to obtain check points for accurately determining the frequency of the variable oscillator at selected points in the tuning range.

SECTION II
OPERATING PROCEDURES

2–1. SEQUENCE OF OPERATION.

2–2. The normal sequence of operation requires that the equipment be warmed up, calibrated, and then tuned. These procedures are described in the paragraphs that follow.

2–3. DESCRIPTION OF CONTROLS.

2–4. Table 2–1 lists the operating controls and their functions. See figures 2–1 and 4–1 for the location of these controls.

2–5. CALIBRATION.

2–6. GENERAL. The master oscillator is equipped with a 100-kc crystal oscillator that is used to check the oscillator fundamental frequencies (2 to 4 mc). The operation of the 100-kc oscillator is such that 20 main check points, spaced 100 kc apart (i.e., at 2.0 mc, 2.1 mc, etc.), are provided. Sub-check points, located approximately mid-way between the main check points, are also provided. The main check points are readily identifiable by the loudness of the beat note on either side of the zero beat and by the fact that the audible beat range extends for approximately 20 dial divisions either side of zero beat. The sub-check points are not as loud as the main check points, and their beat range extends for approximately eight dial divisions either side of zero beat. This is in contrast to other non-useable beat notes, which are correspondingly less loud and which have very limited tuning ranges.

2–7. CALIBRATION PROCEDURE. To calibrate the variable master oscillator, proceed as follows:

a. Turn POWER switch to ON.

Note

This switch must not be turned to OFF, unless the variable master oscillator is to be removed for maintenance purposes.

TABLE 2–1

OPERATING CONTROLS

Control	Function
DIAL UNITS dial	Varies frequency of variable HFO.
HFO switch	Turns HFO (high frequency oscillator) section ON or OFF.
BFO switch	Turns BFO (beat frequency oscillator) section ON or OFF.
POWER switch	In ON position applies a-c power to equipment.
HFO XTAL switch	Switches either the variable hf oscillator or one of the three crystals of the fixed circuit into operation.
FREQUENCY RANGE switch	Connects frequency-doubling circuits, as required, to obtain given output frequency.
HF XTAL FREQUENCY switch	Vernier frequency control for crystal hf oscillator.

TABLE 2–1

OPERATING CONTROLS (cont)

Control	Function
METER SELECTOR switch	Switches various circuits across meter.
OUTPUT FREQUENCY dial	Tunes hf oscillator output circuit for maximum response.
HFO OUTPUT knob	Varies the hf oscillator signal output level.
CAL. OUTPUT knob	Varies calibration signal output level.
BFO–XTAL SELECTOR switch	Rear panel control. Switches one of two bfo crystals into bfo circuit.
BFO OUT. CONT. screwdriver adjustment	Rear panel control. Adjusts magnitude of bfo output signal.

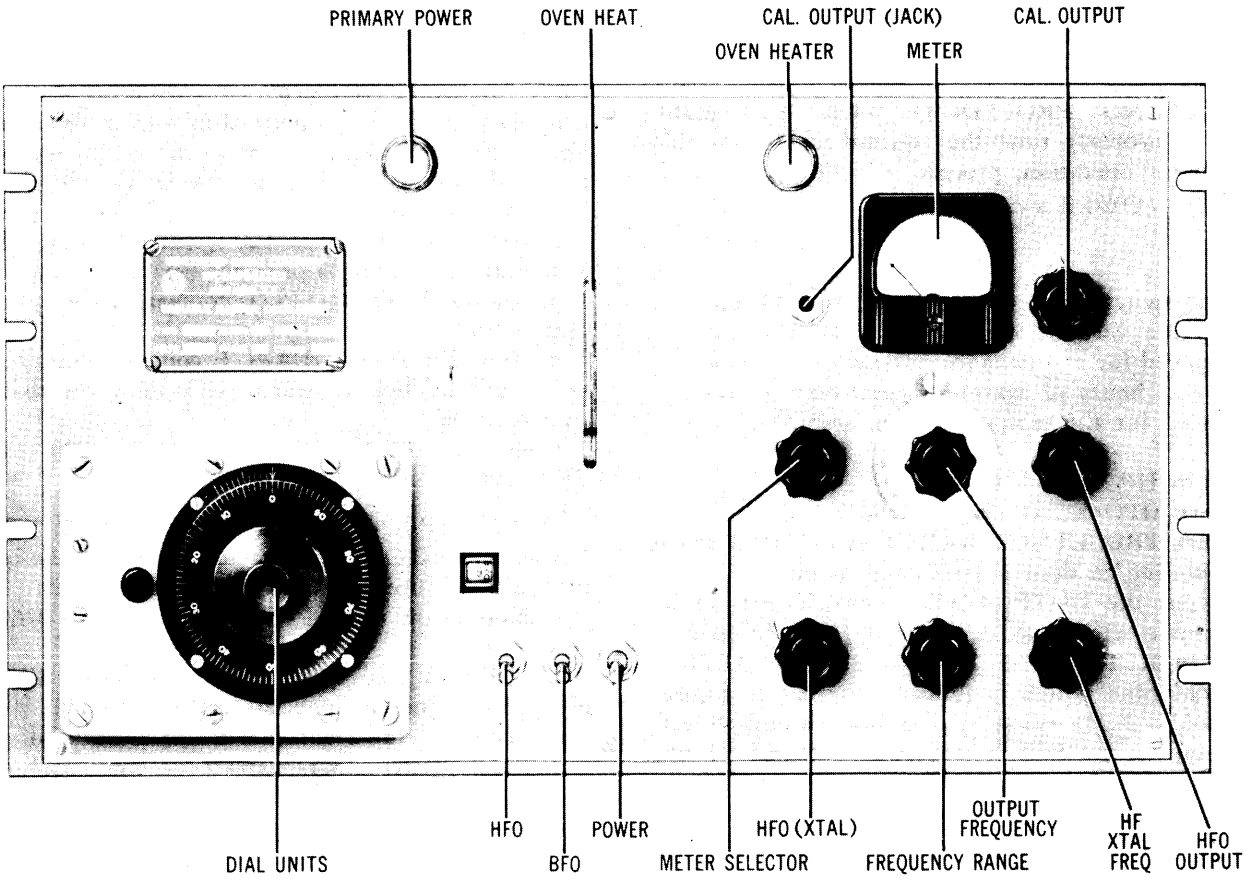


Figure 2-1. Variable Master Oscillator, Front Panel Controls

TABLE 2-2

OUTPUT FREQUENCY DIAL APPROXIMATE SETTINGS

Assigned Frequency (mc)				OUTPUT FREQUENCY Dial Settings
2.0	4.0	8.0	16.0	90
2.5	5.0	10.0	20.0	65
3.0	6.0	12.0	24.0	46
3.5	7.0	14.0	28.0	29
4.0	8.0	16.0	32.0	10

b. Wait at least one hour for the oven temperature to stabilize.

c. Turn the HFO switch to ON.

d. Set the HFO XTAL switch to MO.

e. Set the FREQUENCY RANGE switch to 2-4.

f. Turn the CAL. OUTPUT control fully clockwise.

g. Connect a pair of headphones to the CAL. OUTPUT jack.

h. Vary the DIAL UNITS knob until a reading of 00 is obtained in the DIAL HUNDREDS window and a reading of 00.0 is obtained on the DIAL UNITS vernier dial.

i. Adjust L2, accessible through a slot in the rear of the oven assembly, until a zero beat is obtained. See figure 4-1.

j. Vary the DIAL UNITS knob until a reading of 47 is obtained on the DIAL HUNDREDS window, and a reading of 00.0 is obtained on the DIAL UNITS vernier dial.

Note

Approach all settings from a clockwise direction to reduce the error due to mechanical backlash.

k. Adjust C2, accessible through a slot in the rear of the oven assembly, until a zero beat is obtained. See figure 4-1.

l. Repeat steps h through k until both ends of the band are aligned.

2-8. OPERATING PROCEDURE.

2-9. GENERAL. Different tuning procedures are used for operation with the variable and crystal hf oscillators. These procedures are described in paragraphs

2–10 through 2–13. Approximate settings for a desired output frequency are obtainable from Table 2–2 and figure 2–22. More exact settings are obtainable from figures 2–2 through 2–21.

2–10. TUNING PROCEDURE FOR VARIABLE HFO. To properly tune the equipment for variable hf oscillator operation, proceed as follows:

a. Turn POWER switch to ON.

Note

This switch must not be turned to OFF unless the variable master oscillator is to be removed for maintenance purposes, otherwise several hours of warm-up time may be required for the temperatures to stabilize.

b. Turn HFO switch to ON.

c. Turn HFO XTAL switch to MO.

d. Turn FREQUENCY RANGE switch to position corresponding to desired frequency range.

e. Adjust the OUTPUT FREQUENCY dial to its approximate setting, as determined from Table 2–2.

f. Turn METER SELECTOR switch to HF OUT.

g. Determine which calibration curve (see figures 2–2 through 2–20) to use by dividing the desired output frequency by 8 if it is between 16 and 32 mc, dividing by 4 if it is between 8 and 16 mc, dividing by 2 if it is between 4 and 8 mc, or by using the frequency directly if it is between 2 and 4 mc. This gives the oscillator's fundamental frequency for any assigned frequency.

h. Refer to the calibration curve corresponding to the desired frequency of operation, as determined in step g above.

i. Obtain the number of divisions to be added to the lower calibration point by projecting a line from either the upper or lower (as required) frequency axis to its corresponding curve. Then project across to the vertical axis to obtain the number of divisions to be added.

j. Note the approximate check point corresponding to Curve A or Curve B. These check points are printed in the upper left corner of each calibration curve.

k. Turn the CAL. OUTPUT control approximately to mid-scale. Connect a pair of headphones to the CAL. OUTPUT jack.

l. Adjust the oscillator circuit to the approximate check point by rotating the DIAL UNITS knob until the first two digits of the check point number are indicated in the DIAL HUNDREDS window, and the remaining three digits in the check point number are indicated on the DIAL UNITS vernier scale.

Note

Always approach the dial settings by rotating the DIAL UNITS knob in a clockwise direction. This reduces errors due to the mechanical backlash of the gearing system.

m. Obtain the exact check point by rotating the DIAL UNITS control (in a clockwise direction) until the zero beat is obtained in the headphones. Record this check point on the corresponding calibration curve for future reference.

n. Add the reading obtained in step m to the reading obtained in step i to obtain the actual setting of the oscillator tuning dial. Set the DIAL UNITS control for this setting.

o. Adjust the OUTPUT FREQUENCY control until a maximum reading is obtained on the meter.

p. Set the HFO OUTPUT control to the required output level.

q. Turn the CAL. OUTPUT control counterclockwise until a click is heard. This indicates that the control is off.

r. Remove the headphones from the CAL. OUTPUT jack.

2–11. EXAMPLE OF TUNING PROCEDURE USING VARIABLE HFO. The following is an example of the tuning procedure described in paragraph 2–10:

a. Assume the desired output frequency is 2762.500 kc.

b. Refer to step g of paragraph 2–10. Variable master oscillator fundamental frequency is 2762.500 kc.

c. Turn to figure 2–9, locate 2762.5 kc at top of page.

d. Refer to step i paragraph 2–10. The reading obtained (for Curve B) is 29.4.

e. Since the 2750-kc approximate check point is 1772, set the DIAL UNITS control until 17 appears in the DIAL HUNDREDS window and 72 is read on the DIAL UNITS vernier.

f. Refer to step m of paragraph 2–10. Adjust the DIAL UNITS tuning control until zero beat is obtained. The actual check point, as read, will usually be within ± 10 divisions of the indicated approximate check point. Assume the actual check point in this case to be 1775.3 divisions.

g. Add the reading obtained in step d above to the reading obtained in step f above. The sum is equal to 1804.7 divisions. Set the DIAL UNITS control until a reading of 18 is obtained in the DIAL HUNDREDS window, and a reading of 04.7 is obtained on the DIAL UNITS vernier.

h. The master oscillator is now set to provide an output frequency of 2762.5 kc.

2–12. TUNING PROCEDURE FOR CRYSTAL HFO. To properly tune the equipment for crystal hf oscillator operation, proceed as follows:

a. Determine the frequency of a quartz crystal by dividing the desired output frequency by 8 if it is between 16 and 32 mc, dividing by 4 if it is between 8 and 16 mc, dividing by 2 if it is between 4 and 8 mc, or by using the frequency directly when it is between 2 and 4 mc.

b. Insert the crystal into any one of the three hf crystal oscillator sockets located on the top of the chassis. These sockets are labeled XY15, XY16, and XY17.

c. Repeat steps a and b of paragraph 2–10.

d. Set the HF XTAL FREQ. control to 50.

e. Set the HFO XTAL selector switch to 1, to select the crystal mounted in crystal socket XY15. Set it to 2, to select the crystal mounted in socket XY16. Set it to 3, to select the crystal mounted in socket XY17.

f. Set the FREQUENCY RANGE switch to the position corresponding to the desired output frequency. In position 2–4, the output frequency is equal to the crystal frequency. In position 4–8, the output frequency is twice the crystal frequency. In position 16–32, the output frequency is eight times the crystal frequency.

g. Set the OUTPUT FREQUENCY dial to its approximate setting, as determined from Table 2–2.

h. Turn the METER SELECTOR switch to HF OUT.

i. Adjust the OUTPUT FREQUENCY control until a maximum reading is obtained on the meter.

j. Connect the r-f output cables, as required, and readjust the OUTPUT FREQUENCY control for maximum deflection on the meter.

k. Turn the HFO output control to give desired output.

2–13. TUNING PROCEDURE USING BFO. The proper tuning procedure for bfo operation is as follows:

a. The bfo crystal frequency required for any application is determined by the application.

b. Place crystals of the desired frequencies into crystal sockets XY18 and XY19.

c. If the crystal in socket XY18 is desired, throw the BFO XTAL selector switch to its up position.

d. If the crystal in socket XY19 is desired, throw the switch to its down position.

e. Set the BFO OUT. CONT. on the rear apron to desired output.

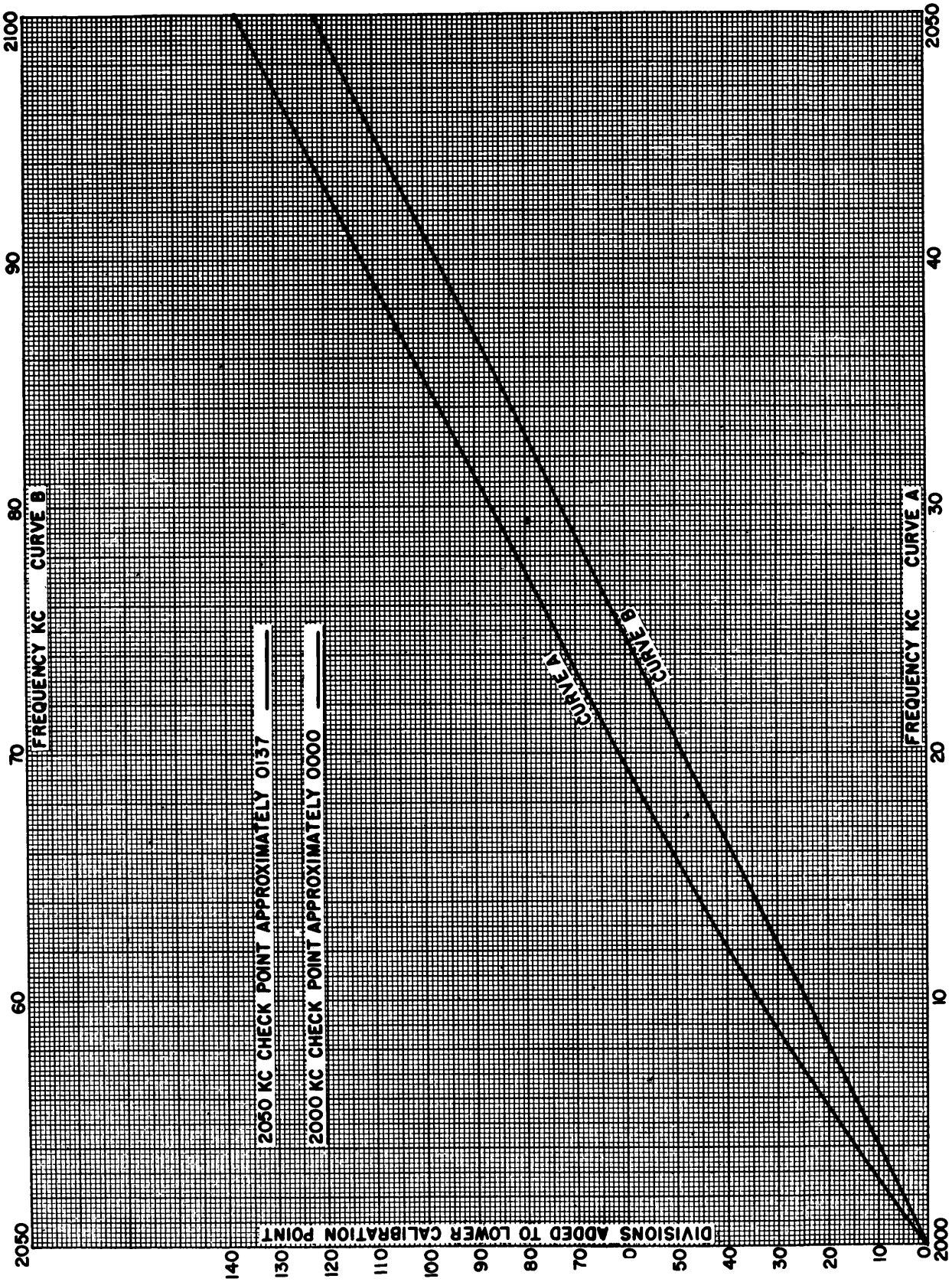
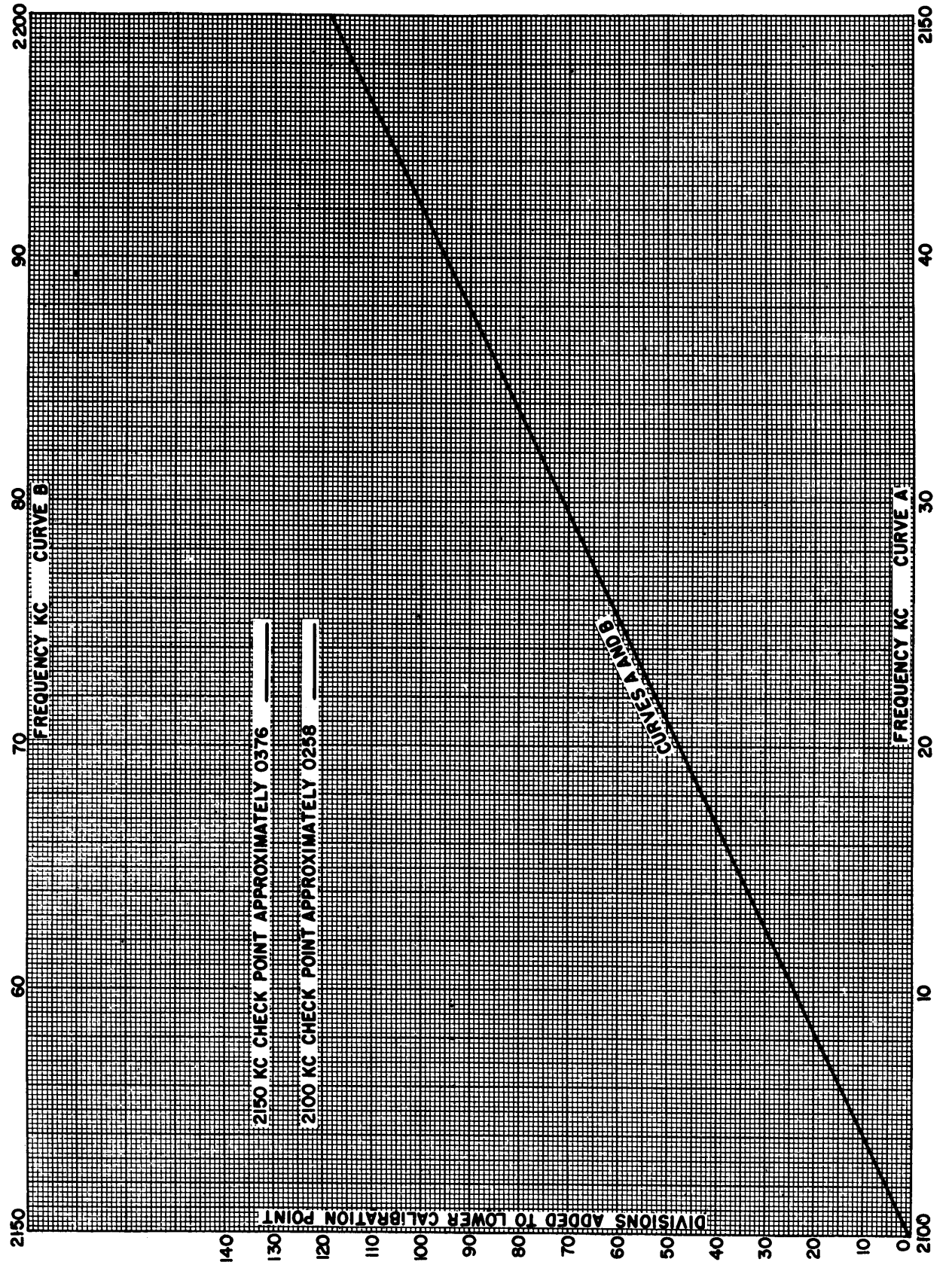


Figure 2-2. Calibrati n Curv , 2000 to 2100 kc



Figur 2-3. Calibration Curv , 2100 to 2200 kc

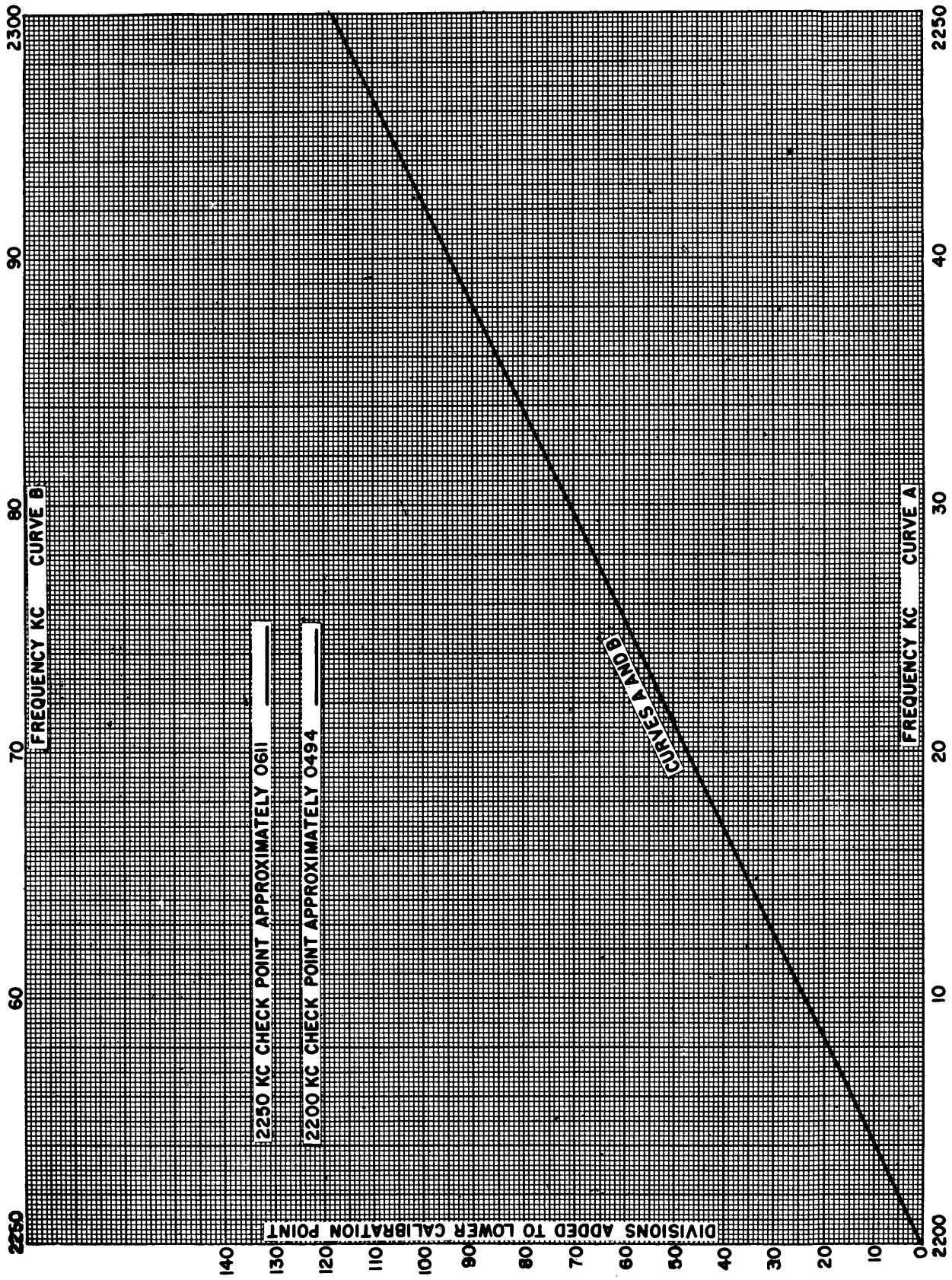


Figure 2–4. Calibrati n Curv , 2200 to 2300 kc

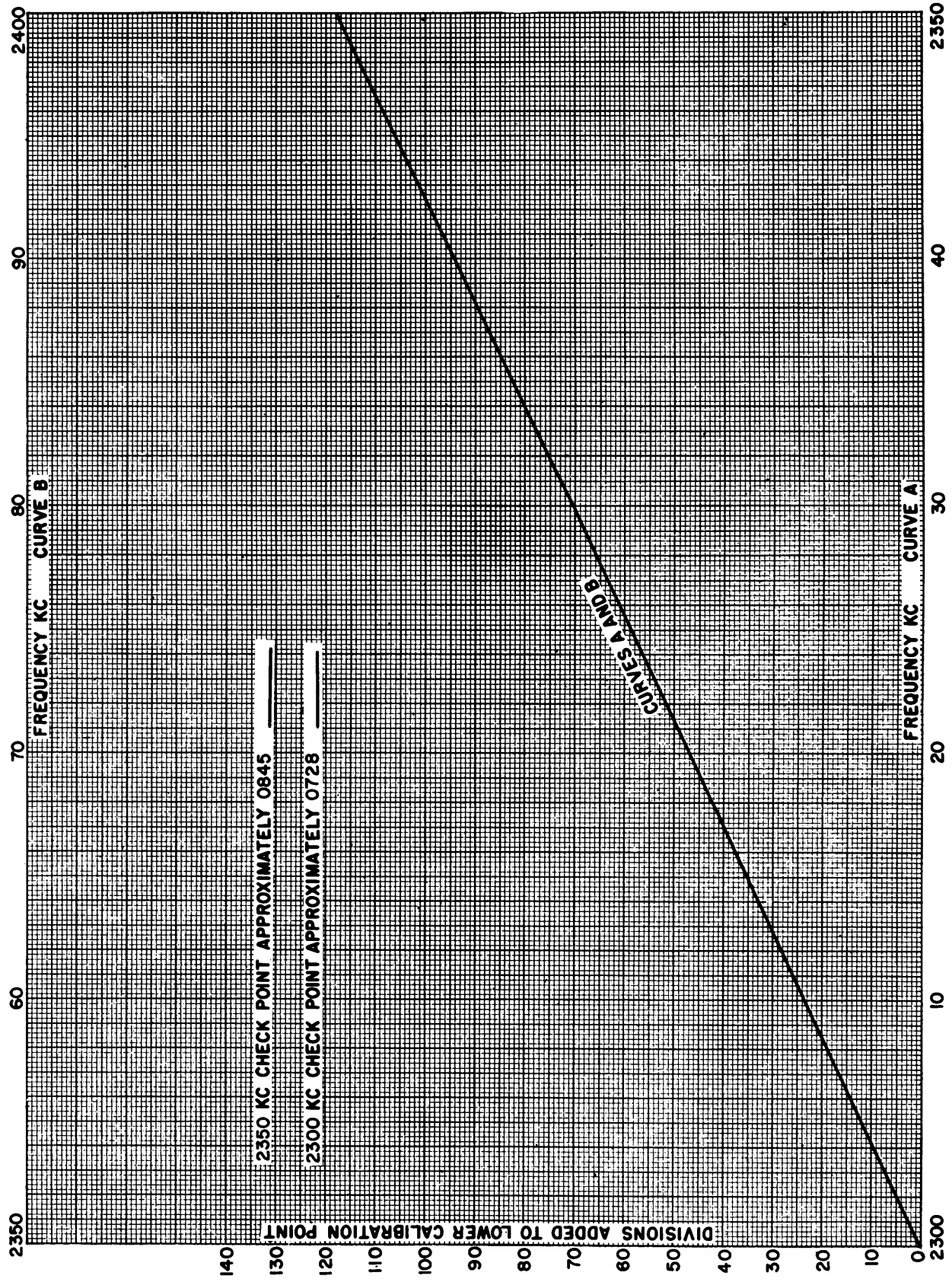


Figure 2-5. Calibration Curve, 2300 to 2400 kc

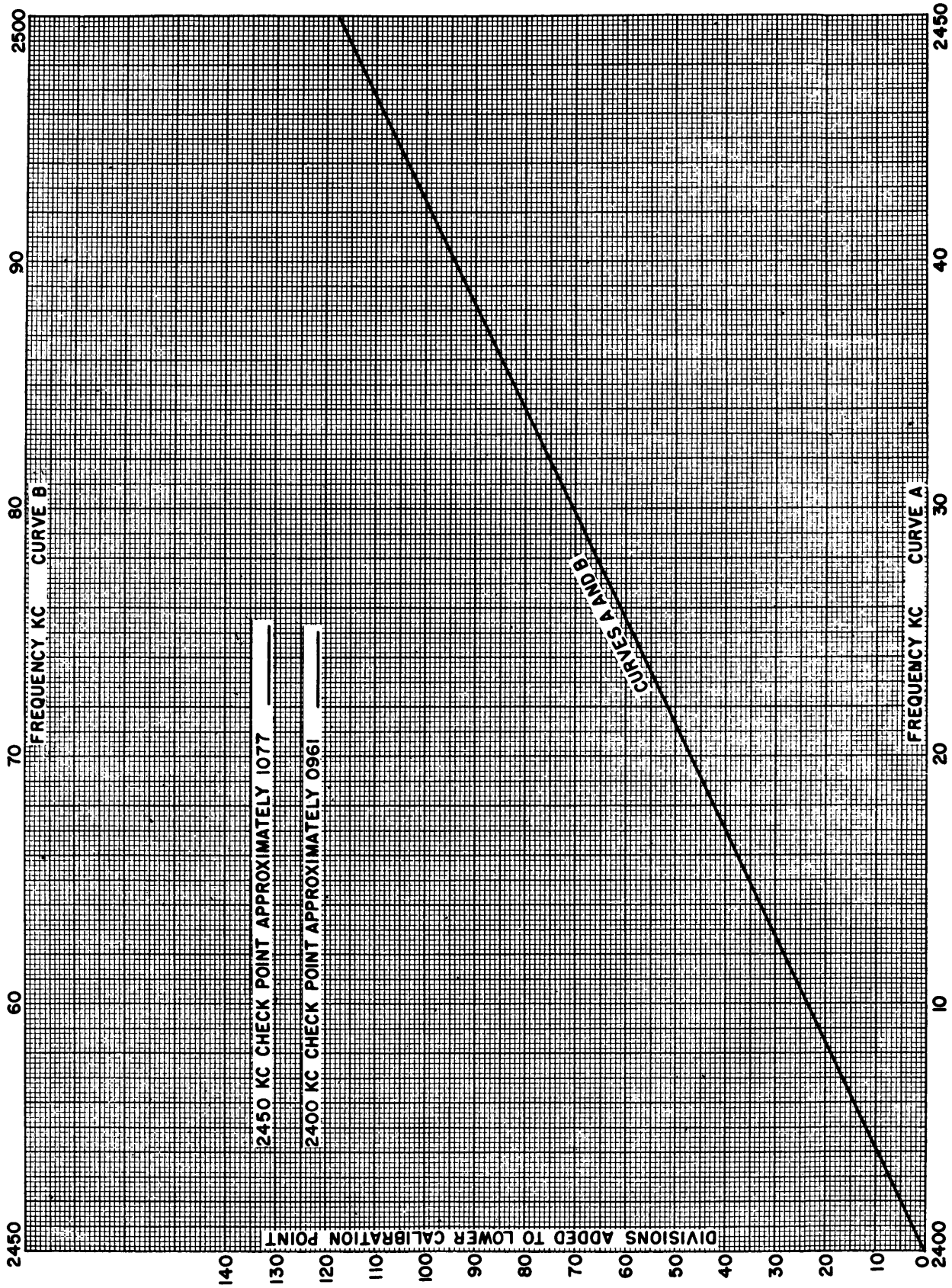


Figure 2-6. Calibration Curve, 2400 to 2500 kc

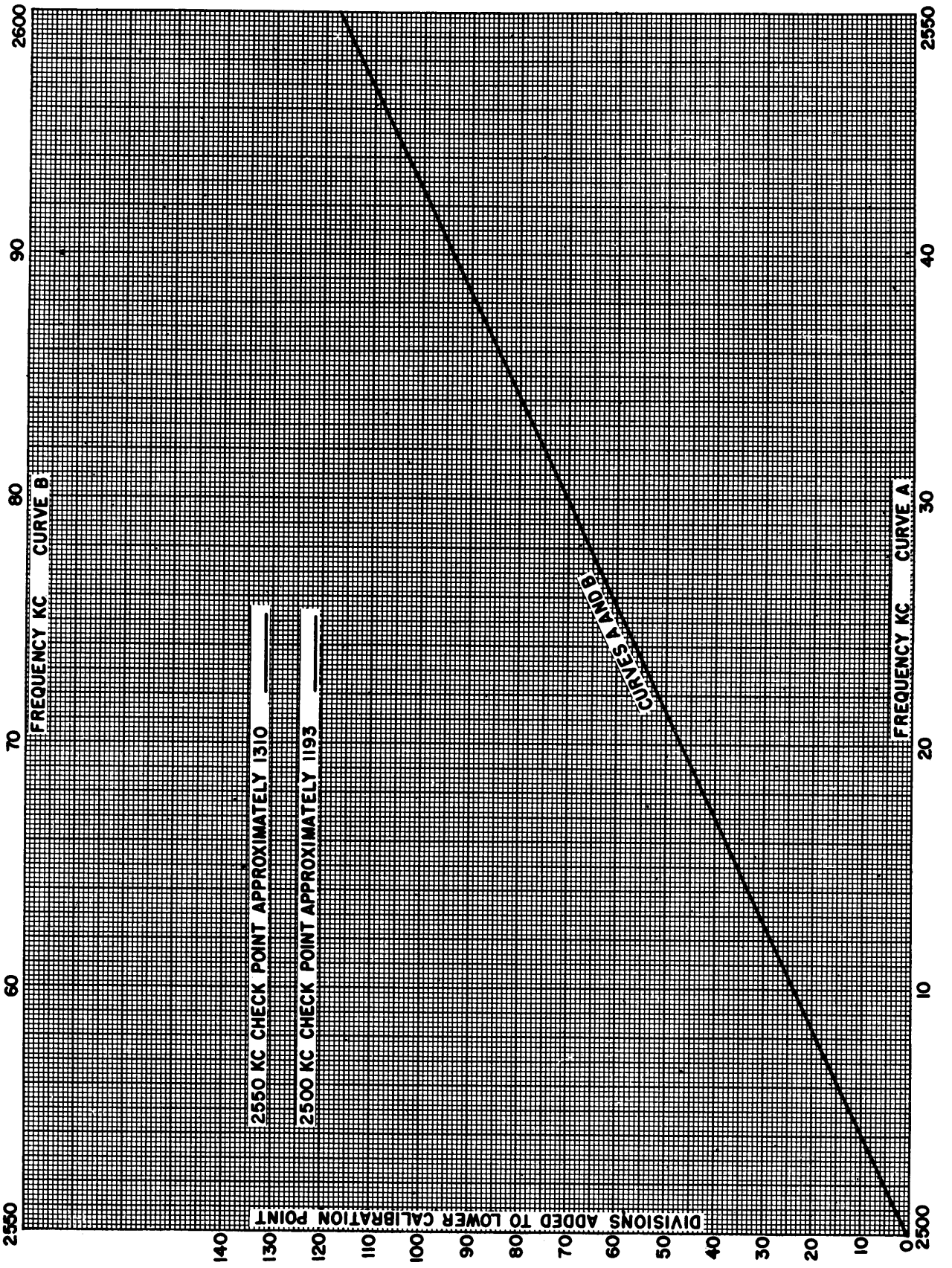


Figure 2-7. Calibration Curve, 2500 to 2600 kc

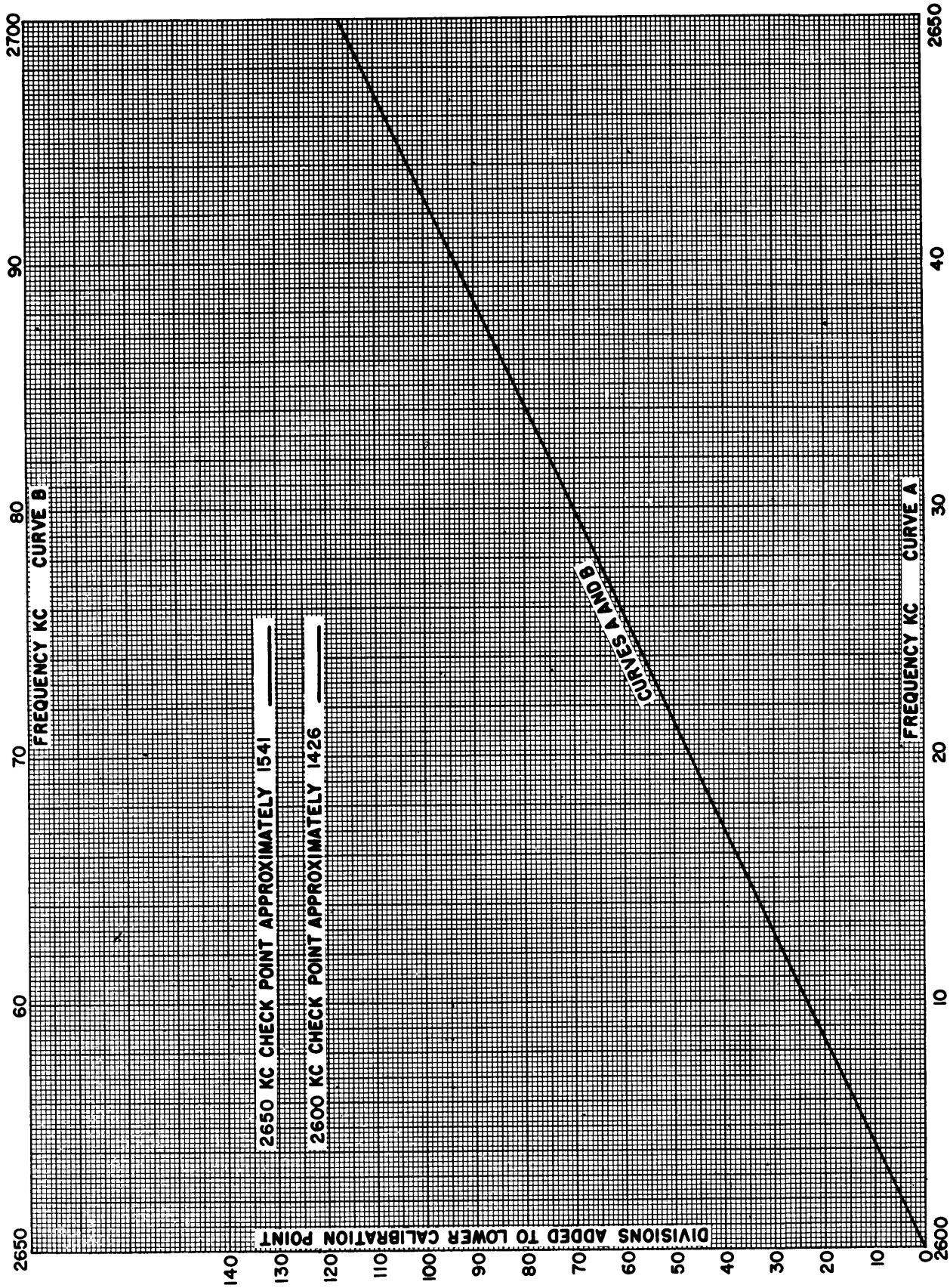


Figure 2-8. Calibration Curve, 2600 to 2700 kc

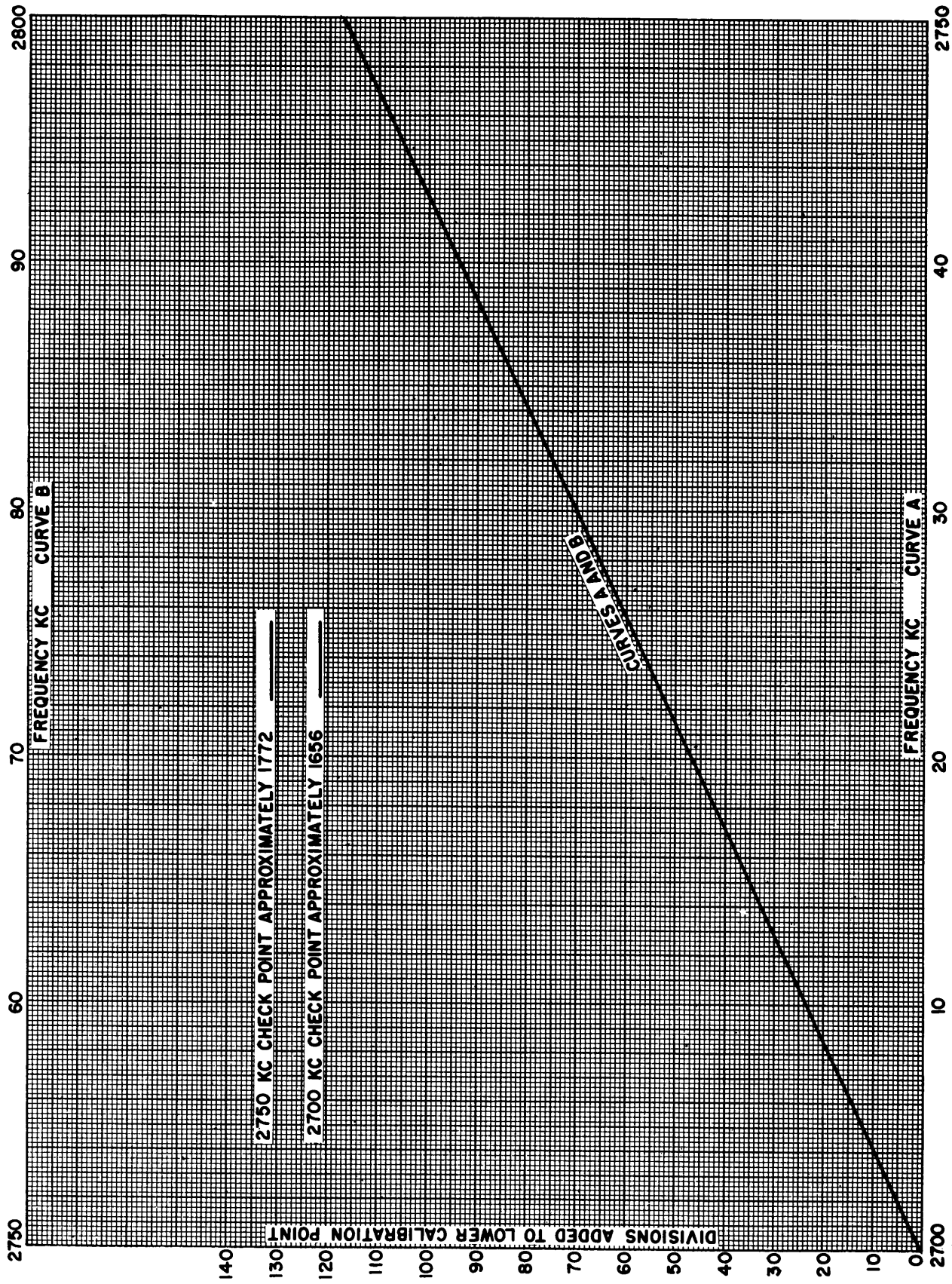


Figure 2-9. Calibration Curve, 2700 t 2800 kc

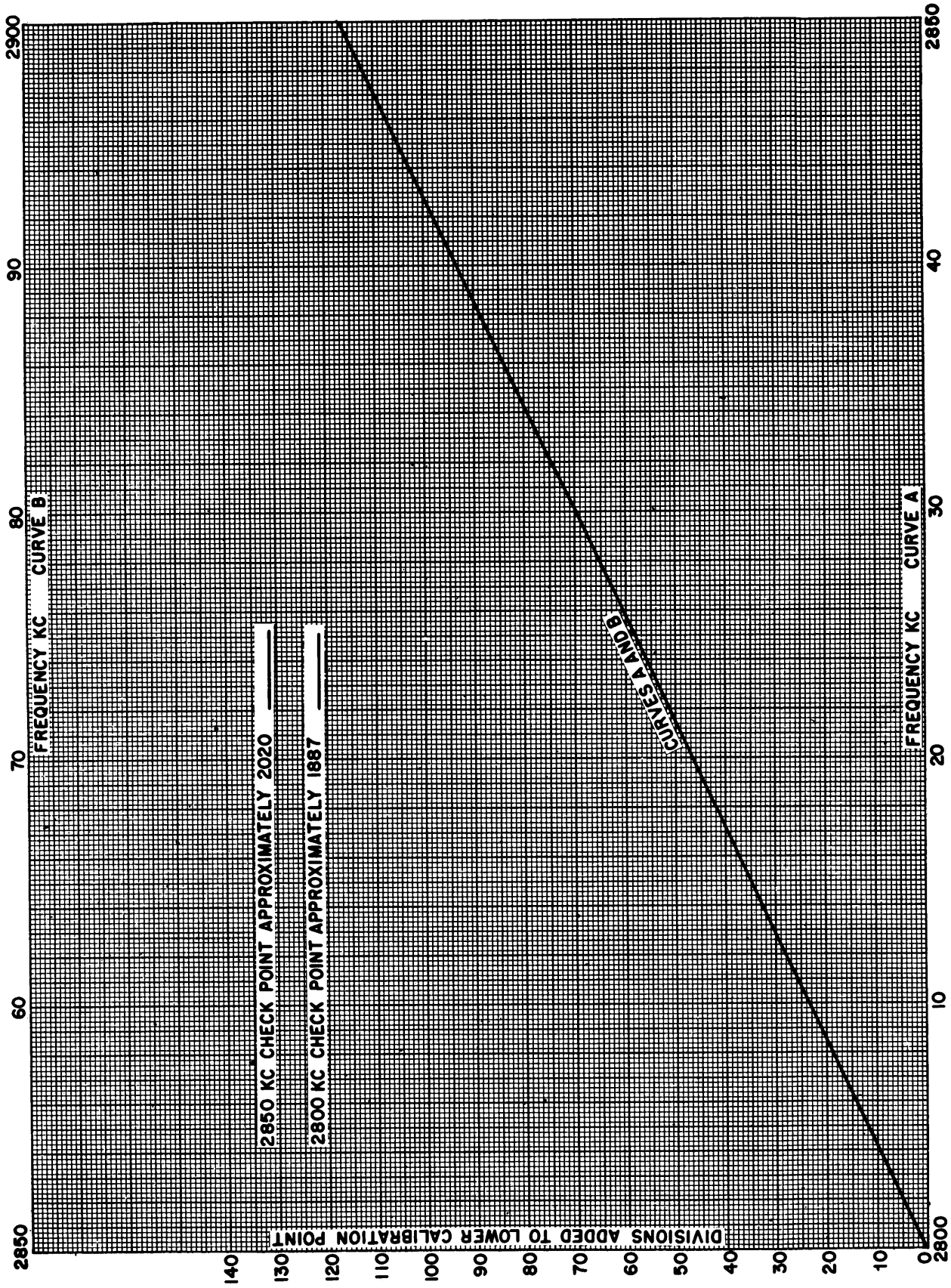


Figure 2–10. Calibration Curve, 2800 t 2900 kc

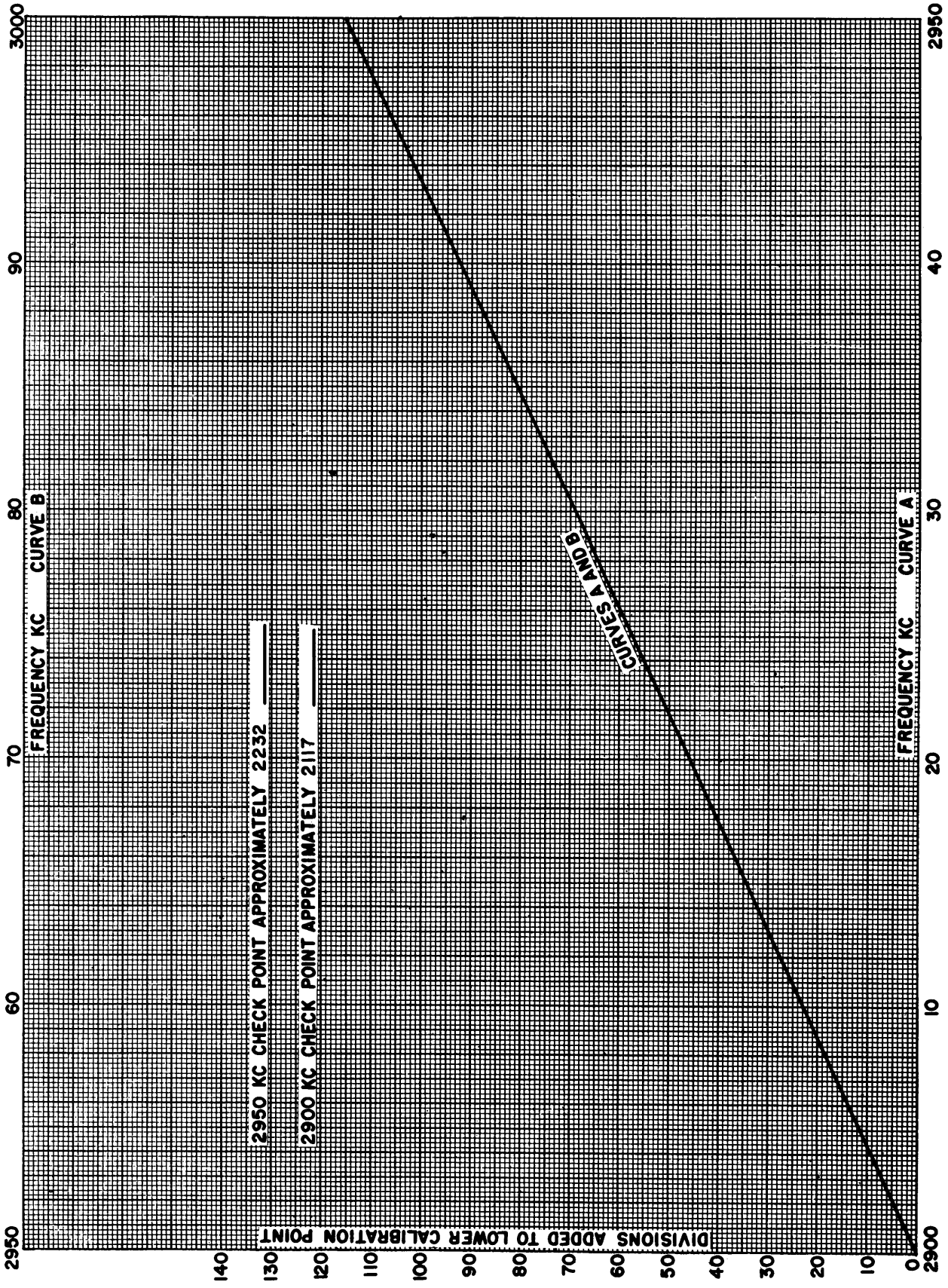


Figure 2–11. Calibration Curv , 2900 to 3000 kc

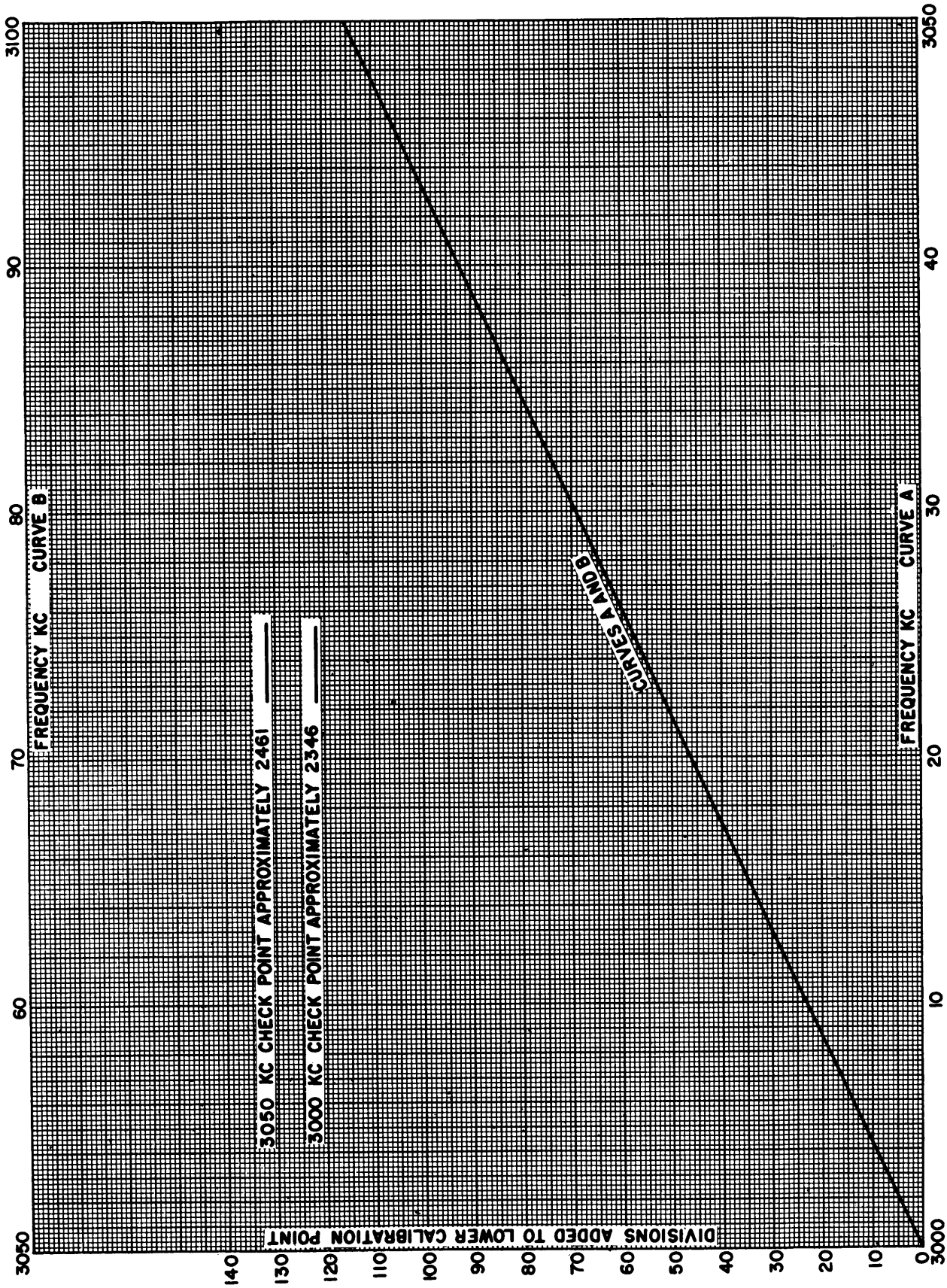


Figure 2–12. Calibration Curve, 3000 t 3100 kc

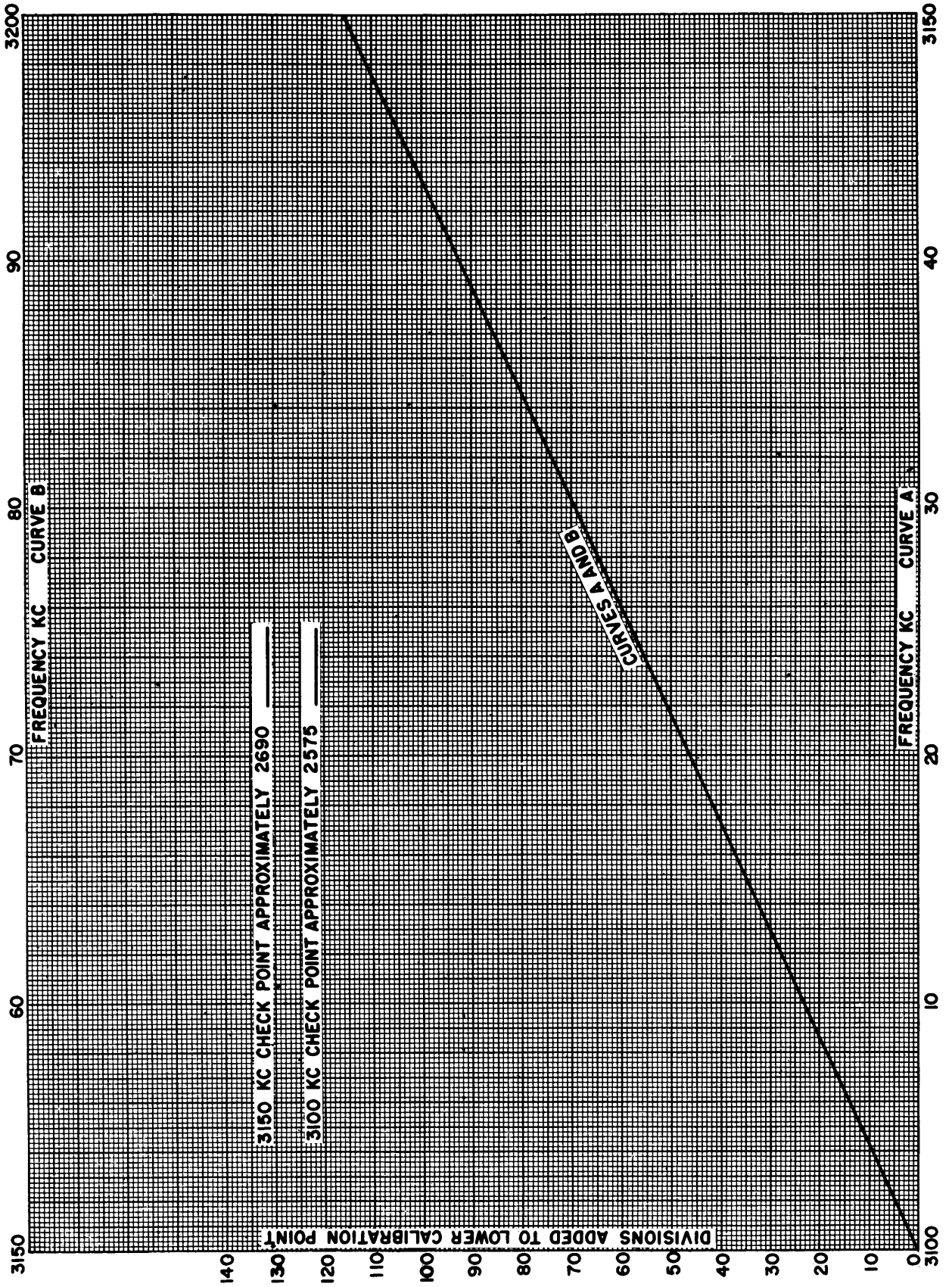


Figure 2-13. Calibration Curve, 3100 to 3200 kc

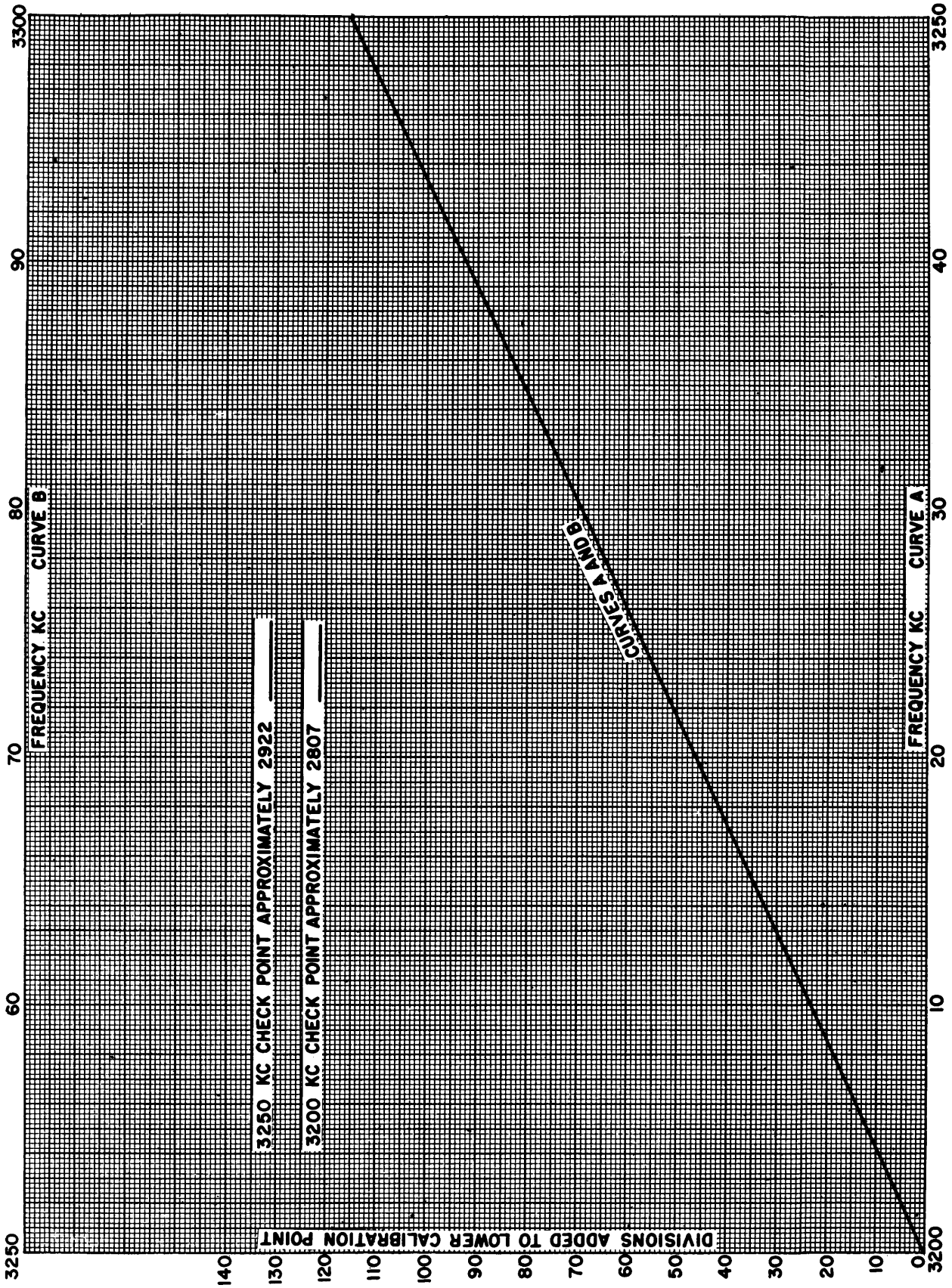


Figure 2-14. Calibration Curve, 3200 t 3300 kc

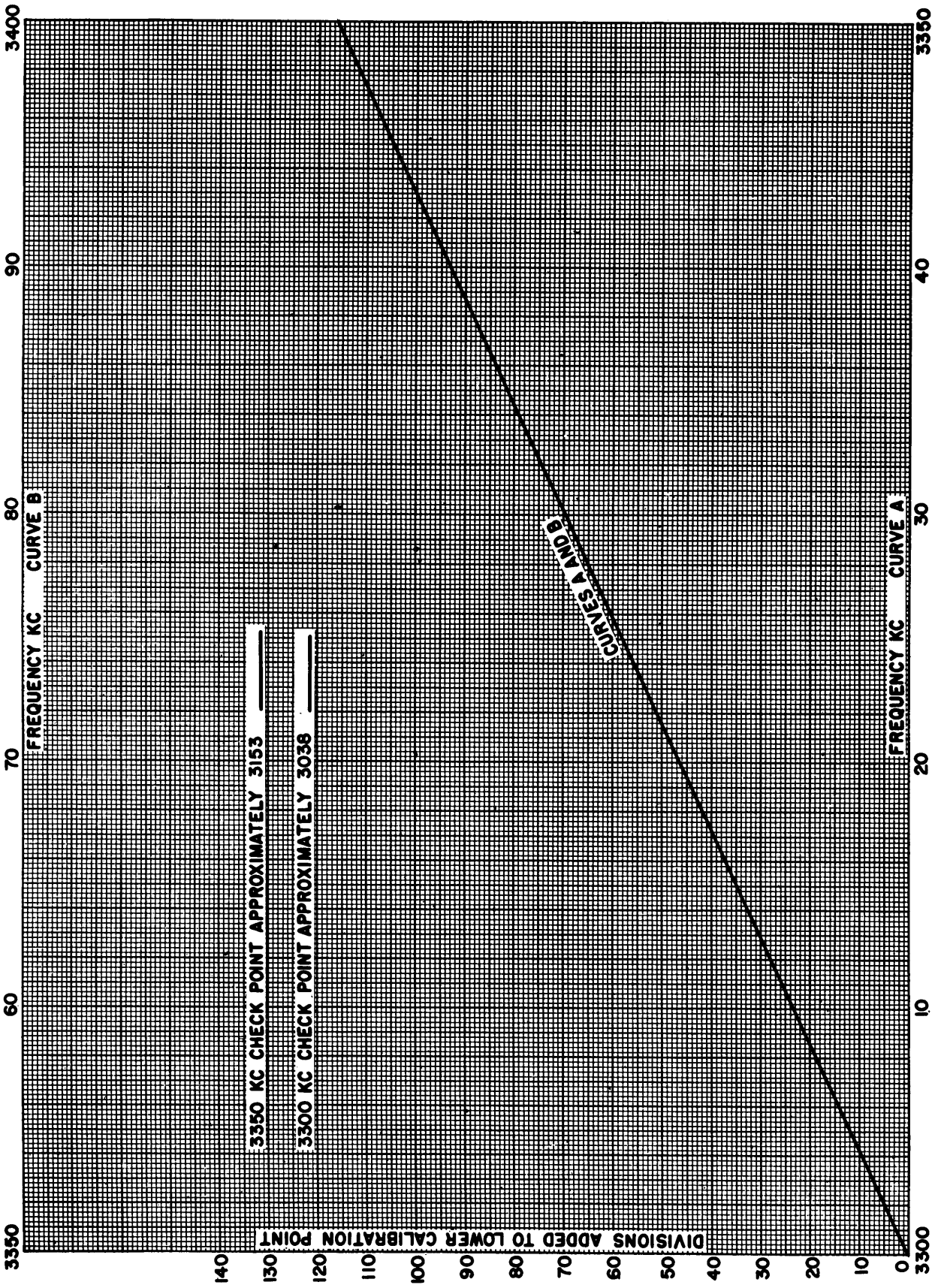
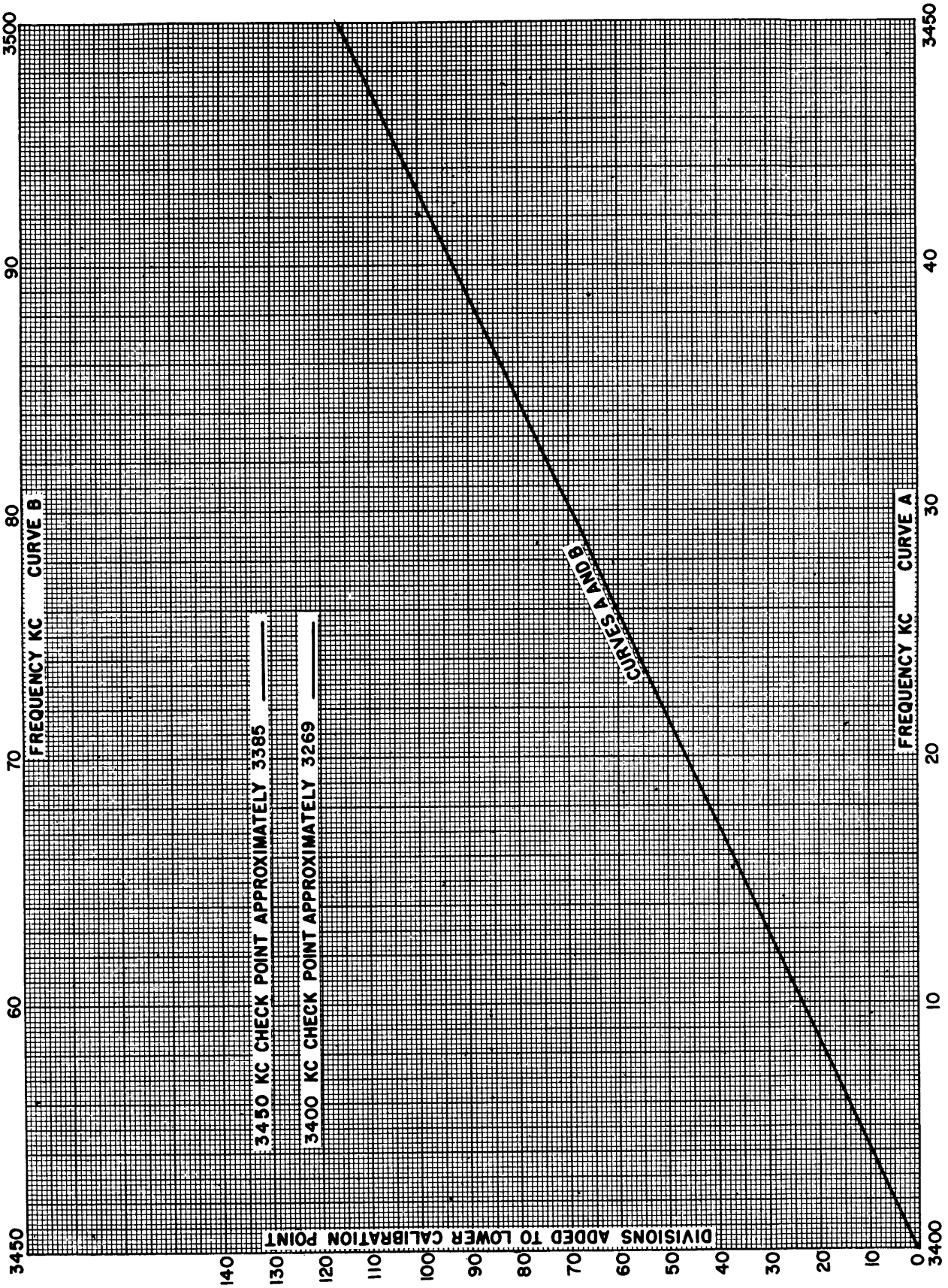


Figure 2-15. Calibration Curv , 3300 to 3400 kc



Figur 2–16. Calibration Curve, 3400 t 3500 kc

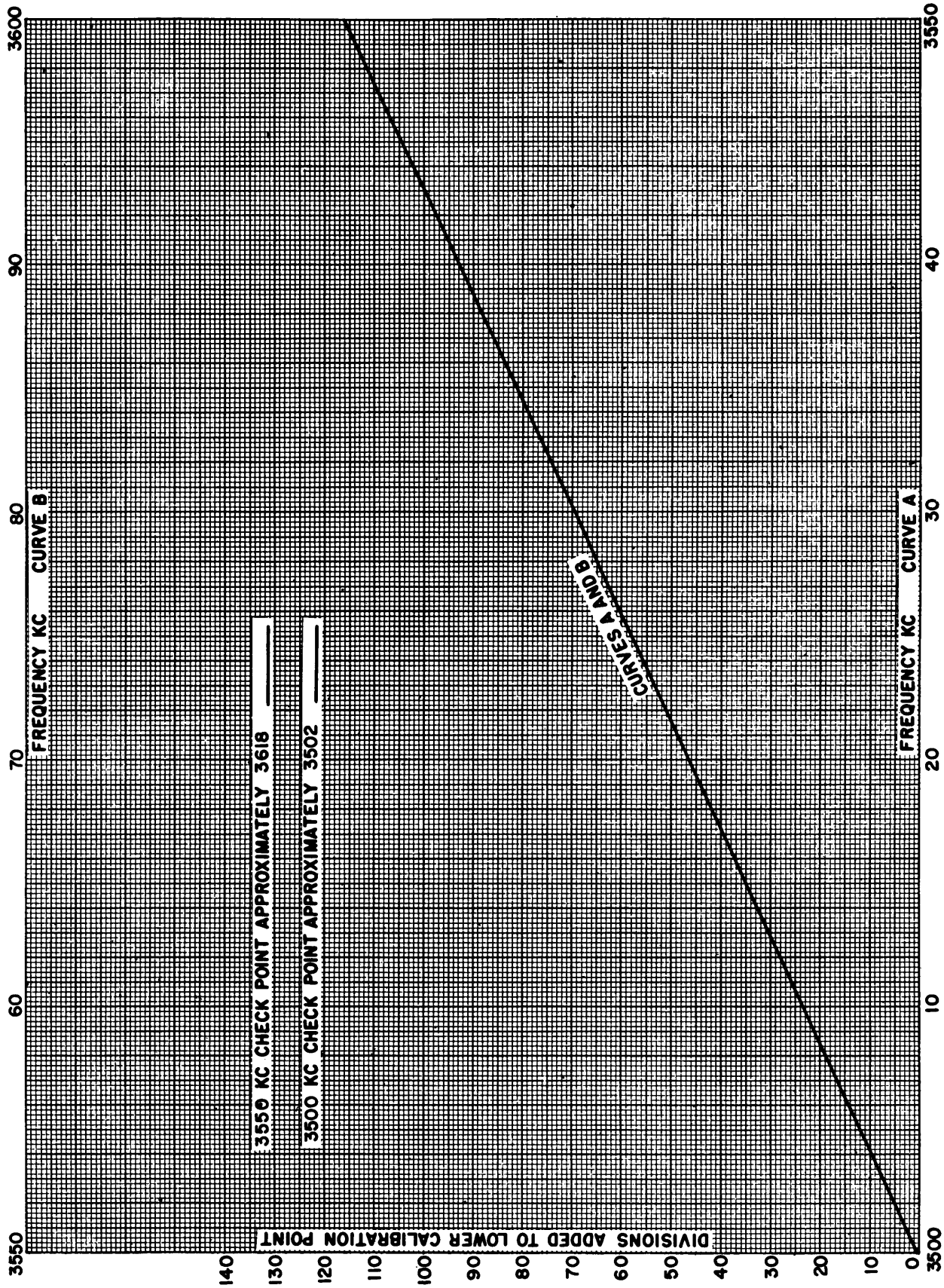
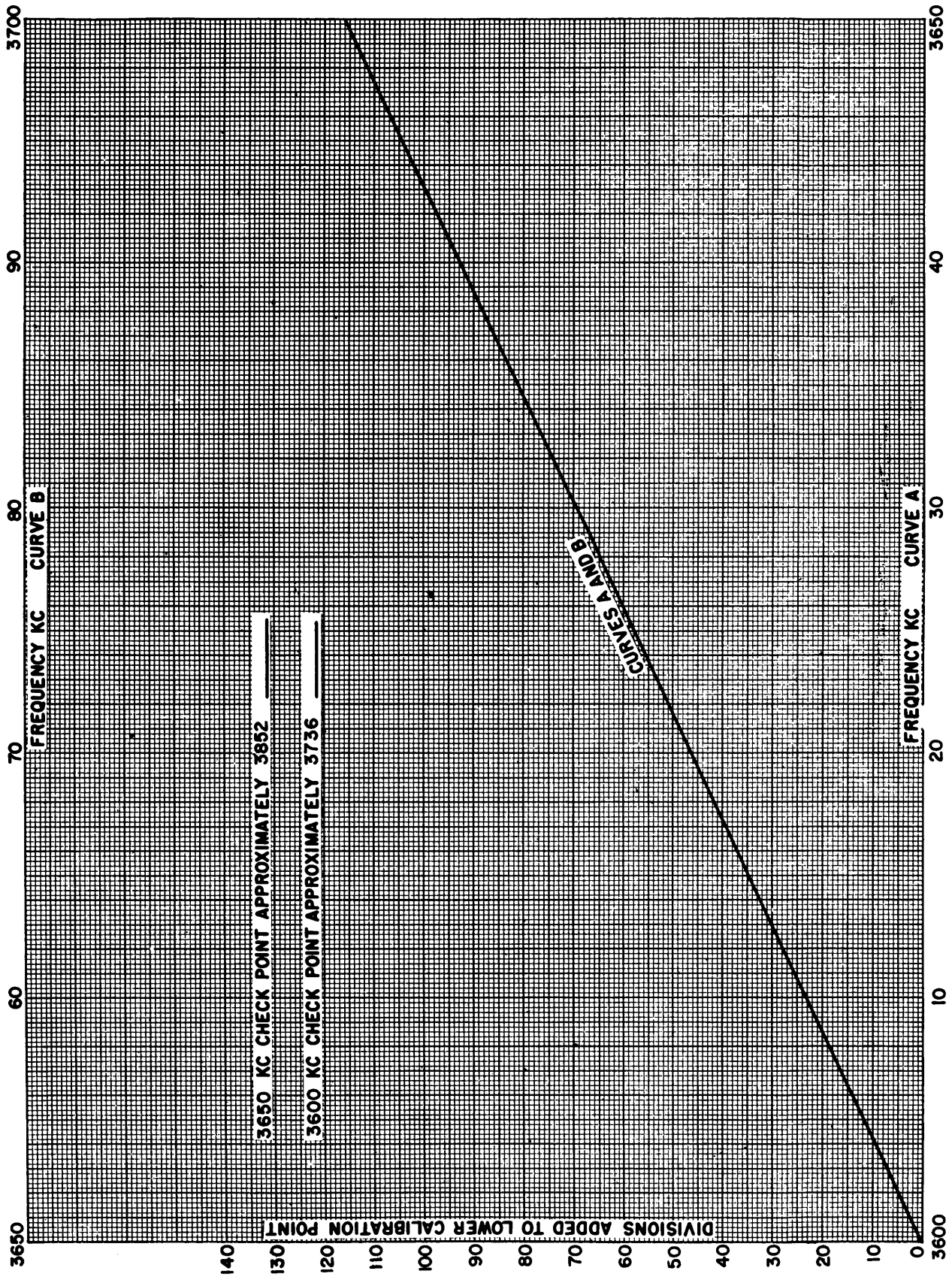


Figure 2–17. Calibration Curve, 3500 to 3600 kc



Figur 2–18. Calibration Curve, 3600 t 3700 kc

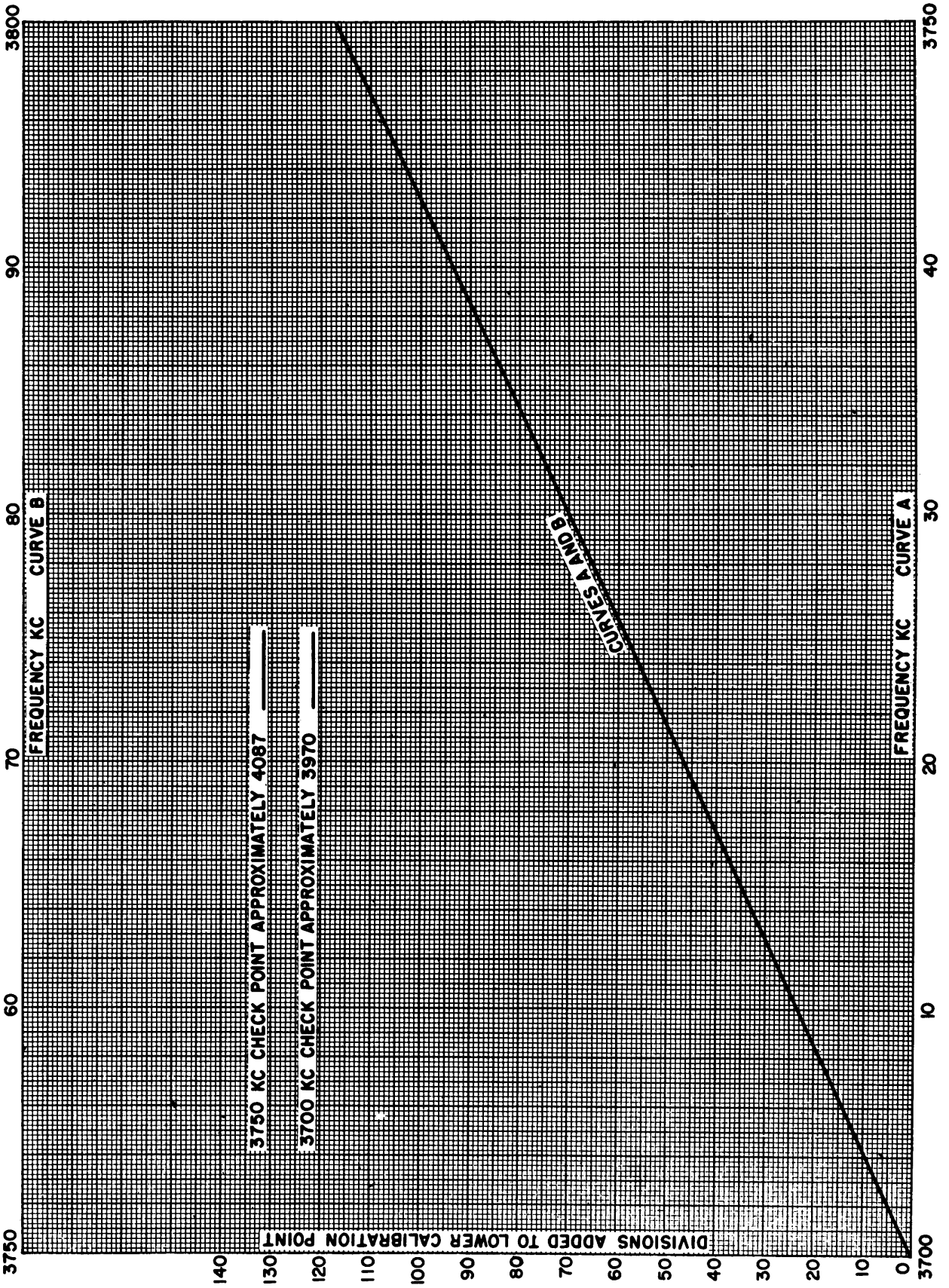
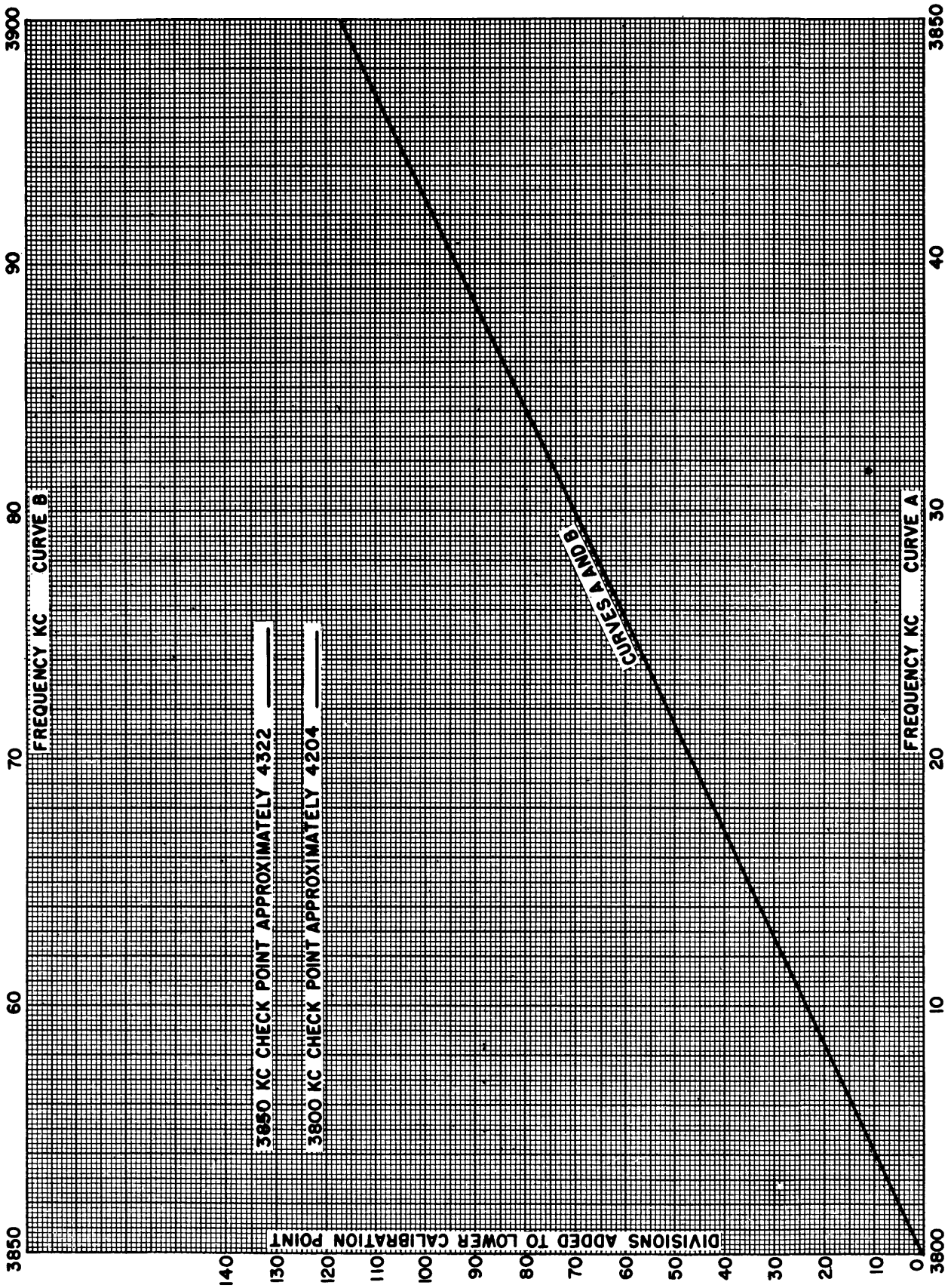


Figure 2-19. Calibration Curve, 3700 to 3800 kc



Figur 2–20. Calibration Curve, 3800 to 3900 kc

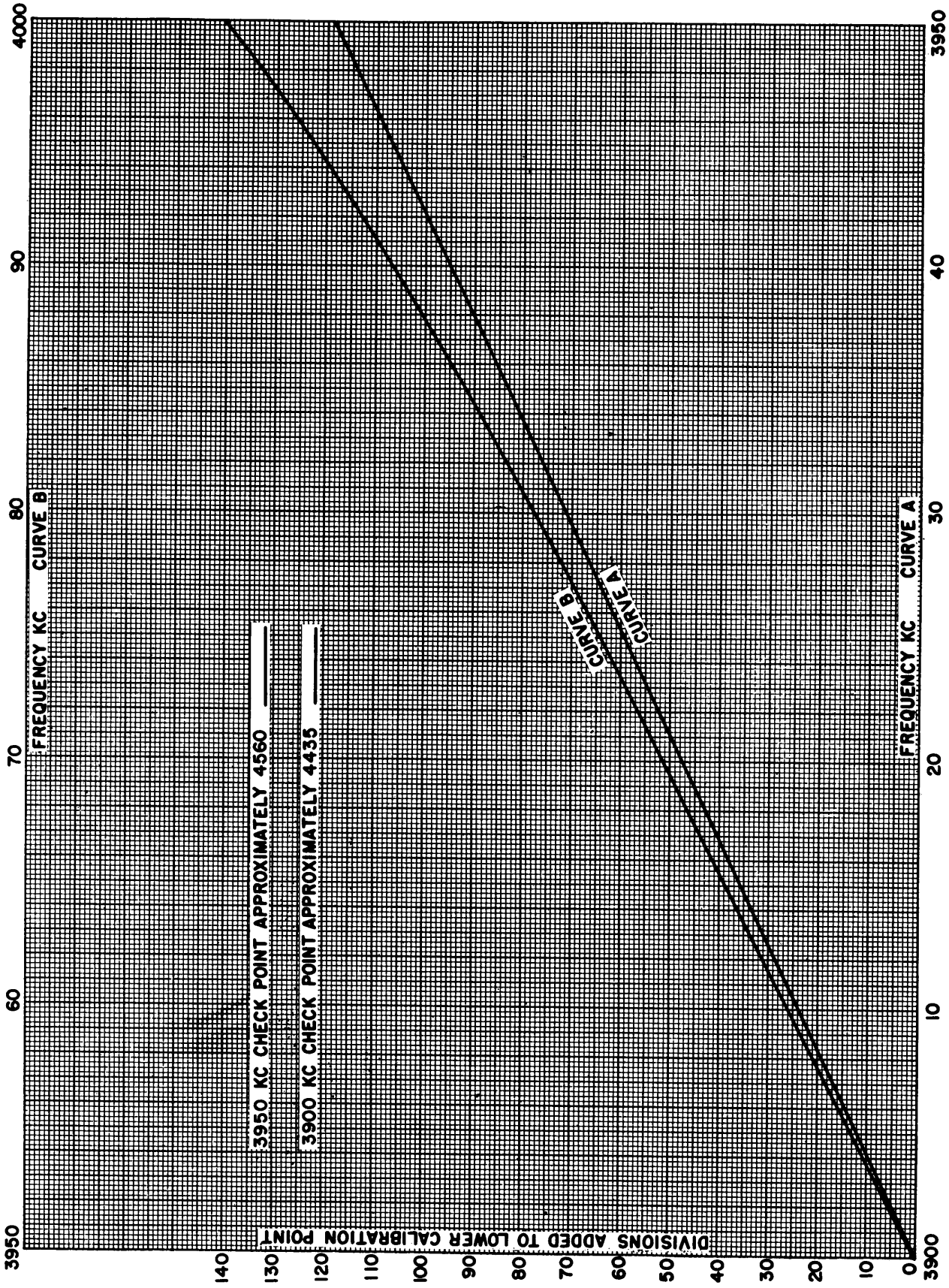
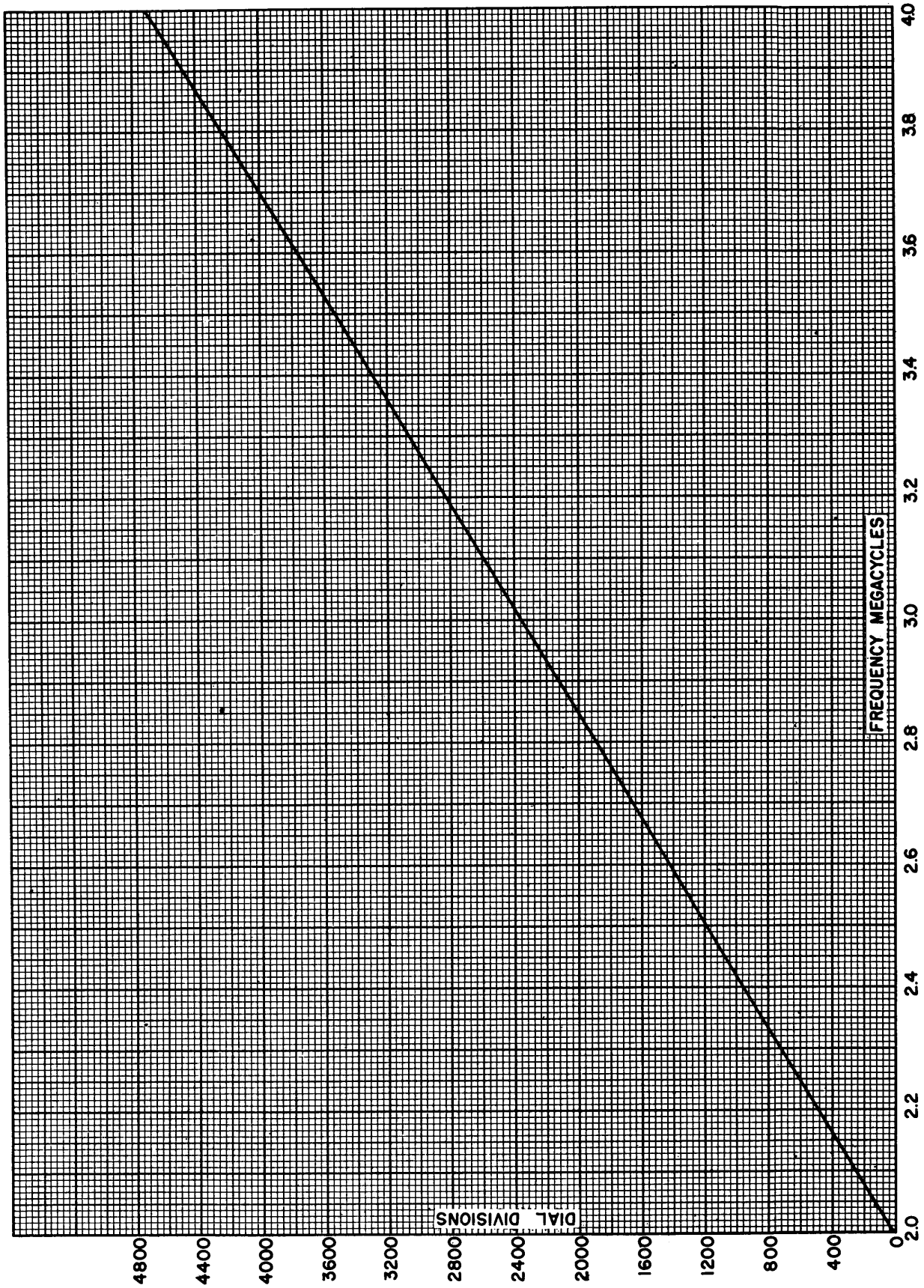


Figure 2-21. Calibration Curv , 3900 to 4000 kc



Figur 2–22. Calibration Curve, Ov rall, 2000 to 4000 kc

SECTION III
OPERATING CHECKS AND ADJUSTMENTS

3-1. OPERATING CHECKS.

3-2. Check for the following periodically:

a. OVEN HEAT thermostat reading near 60° C.

b. PRIMARY POWER and OVEN HEATER lamps operative.

c. Meter reading at same level, as obtained when tuned to present frequency. If not, perform tuning and adjusting procedures described in Section II.

3-3. OPERATING ADJUSTMENTS.

3-4. There are no adjustments to be made during operation.

SECTION IV
EMERGENCY OPERATION AND REPAIR

4-1. EMERGENCY OPERATION.

4-2. If the variable hf oscillator fails during operation, switch to operation using the crystal hf oscillator. If the crystal hf oscillator fails during operation, switch to operation using the variable hf oscillator.

4-3. REPAIR.

4-4. FUSE REPLACEMENT. (See figure 4-1.) To replace either the P.P. (primary power fuse F1) or the P.S. (power supply fuse F2), turn the fuseholders counterclockwise until they unscrew. Replace the de-

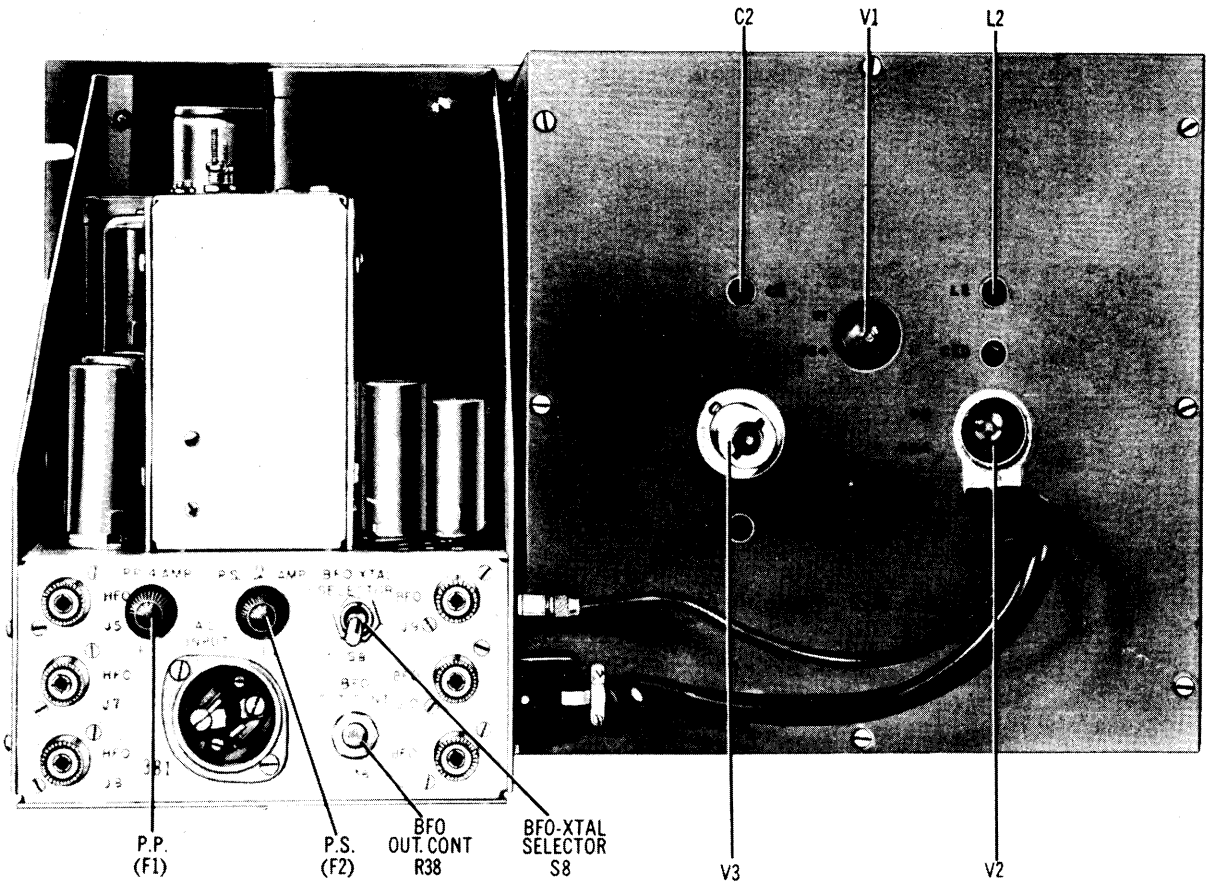


Figure 4-1. Variabl Master Oscillator, R ar Vi w, Tube and Fus Locations

fective fuse.

4–5. PILOT LAMP REPLACEMENT. (See figure 2–1.) To replace the PRIMARY POWER or OVEN HEATER pilot lamps, unscrew the glass jewel of the pilot lamp assembly by turning the metal encircling ring and pulling away from panel. Turn the exposed bayonet-base lamp a quarter of a turn counterclockwise. It will pop out of its holder. Replace the lamp by pushing down gently and turning clockwise.

4–7. TUBE REPLACEMENT. (See figures 4–1 and 4–2.) All tubes are replaceable from the top of the chassis or the rear of the oven assembly. Do not replace V1, because the oscillator may have to be recalibrated if this is done.

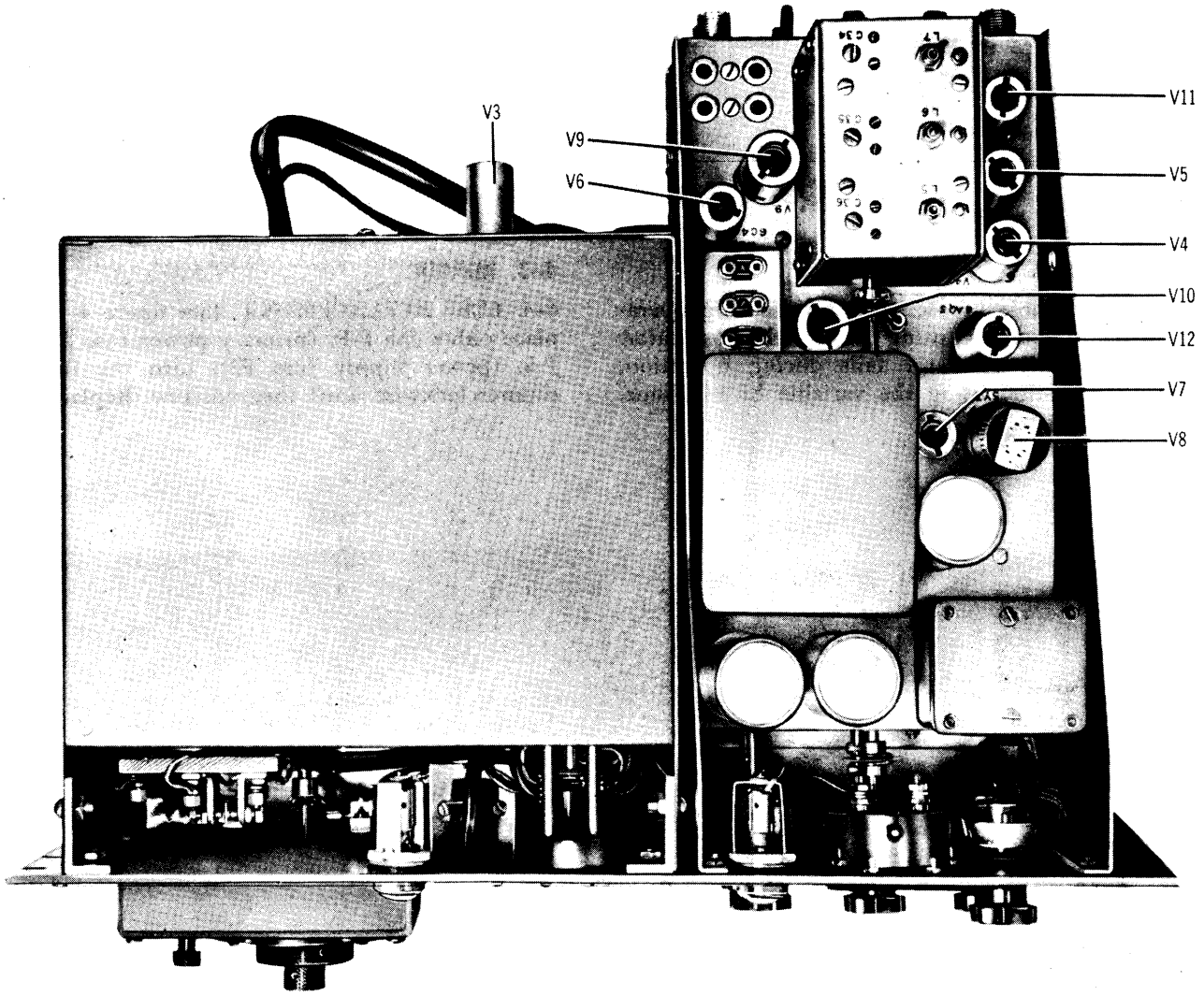


Figure 4–2. Variable Master Oscillator, Top View, Tube Locations