TYPE O AND ON CARRIER TELEPHONE SYSTEMS — TERMINALS AND JUNCTIONS
TWIN CHANNEL UNIT LINE-UP
RECEIVING REGULATOR ADJUSTMENT, RECEIVED CARRIER FREQUENCY TEST, AND ON2 FAILURE ALARM CIRCUIT ADJUSTMENT

This section describes the tests and adjustments required in the line-up of twin channel units used in type O and ON carrier telephone systems.

This section has been reissued to add a received carrier frequency test and trouble investigation procedures and to specify the use of the O/ON unit extender in test procedures. Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

The tests covered are:

Receiving Regulator Adjustment: The twin channel receiving regulator provides a nearly constant output level of the sidebands, thus supplementing the regulation of the group receiving circuit. The gain of the amplifier is variable, being controlled by the input carrier signal amplitude and by the setting of the REG potentiometer. The REG potentiometer is adjusted to produce a specified plate current in the amplifier circuit as indicated by the voltages measured between the +130 volt supply and the REG pin jack.

Received Carrier Frequency Test: If the received carrier frequency deviates too far from its nominal value, serious variations in the channel net gain occur in both channels associated with the twin channel unit. The received carrier frequency test and trouble investigation procedures described in this section are intended to help prevent this problem or to correct the problem if it occurs.

ON2 Failure Alarm Circuit Adjustment: The ON2 carrier terminal transmission failure alarm circuit is a transistorized detector circuit which initiates an alarm to indicate loss of the received carrier. Adjustment of the BIAS potentiometer determines the level at which the alarm circuit is activated.

APPARATUS:

1 — KS-14510 Volt-Ohm-Milliammeter (VOM)
1 — O/ON Unit Extender, J98705AY, or Channel Unit Test Stand, J98705M
1 — 5232A or 5532A Electronic Frequency Counter (Hewlett-Packard), or equivalent
4 — P1M Cords
1 — P19A Cord (if Channel Unit Test Stand is used)
1 — 20-Ohm Resistor
1 — SOS3 Tube Shield (used on 408A tube)

Note: A simple substitute for the tube shield consists of several turns of wire solder formed into a cylinder of the diameter of a 408A electron tube (3/4 inch) and slipped over the tube in place of its tube shield.

STEP	PROCEDURE
	Receiving Regulator Adjustment
	Note: The transmitting circuit tests must be completed at the distant office before making these tests.
1	Remove the group from service to make these tests.
2	If an adjustment is being made to the regulator, move the unit to the unit extender or to the test stand. To make a maintenance check only, the unit may remain in the terminal.
	Note: Any cord or plug in the E_B jack in the channel unit test stand should be removed (if the test stand is used).
3	At the distant end, ground all the T jacks associated with the group under test.
	Note: At the near end, wait at least 3 minutes after the T jacks have been grounded before proceeding with the following measurement. This enables the group and twin channel regulators to stabilize.
4	Set the VOM scale selector to the 300V dc scale, and measure the voltage between the REG pin jack and +130V jack as follows:
	Caution: The voltage on these jacks is approximately 125 volts.
	If the unit is in the terminal or unit extender, connect the positive (+) terminal of the VOM to the +130V jack on the terminal. If the unit is in the test stand, connect the positive (+) terminal of the VOM to the +130V jack on the test stand. Connect the negative (—) terminal of the VOM to the REG jack located on the face of the twin channel unit.
5	Set the VOM scale selector to the 3-volt dc scale and observe the meter indication.
	Requirement: Test 0.4 to 2.0V Line-up 1.0V
6	If the requirement of Step 5 is not met, adjust the REG potentiometer (Fig. 1) to meet the requirement. Meter reading will be slightly lower if adjustment is made in the test stand.
7	Remove the test connections.
	Note: If tube checks are required in locating trouble, refer to Section 362-110-503.
	Received Carrier Frequency Test
	Note: Measurement is required when the terminal is initially installed, at routine intervals, and during trouble investigations.

STEP	PROCEDURE
8	To make this measurement, the shielded input cord to the frequency counter must be equipped with a coupling device. Remove the spring from the inside of a SOS3 tube shield and connect the ungrounded side of the frequency counter input cord to the top of the tube shield (Fig. 1). A suitable alternate consists of several turns of wire solder wound into a cylinder to fit over the tube.
9	Slip the coupling device over V3 (408A tube) of the regulator amplifier and position it so that it does not ground on the unit face plate. V3 is located in the lower right corner of the face of the twin channel unit.
10	Ground the shield of the counter input cord by connecting it to the face of the twin channel unit.
11	Measure the carrier frequency using the frequency counter. ***Requirement:*** (a) 184 or 192 kc (as required) ±65 cycles for an ON system or O terminal connected to an ON junction. (b) 184 or 192 kc (as required) ±30 cycles for an O system. ***Note:*** If the requirement is not met, the frequency of one or more of the various oscillators used throughout the system is out of limits, generally caused by aging of the crystal unit. In this case, the oscillator or oscillators which are off frequency must be located and adjusted or replaced. Adjustment of frequency within moderate limits is possible on the various oscillators located at the O/ON terminals and O repeaters; however, the frequency of N line and ON terminal repeater oscillators cannot be adjusted in the field. N line and ON terminal repeaters that are off frequency must be replaced. Procedures for locating oscillators that are out of limits are given in this section under Carrier Frequency Shift Trouble Investigation. ***ON2 Failure Alarm Circuit Adjustment***
12	Remove V31 (313C gas tube) from its socket. V31 is located on the terminal mounting in the alarm circuit.
13	Turn the BIAS potentiometer (on terminal mounting) fully counterclockwise.
14	Connect a 20-ohm resistor between the GRD jack on the group receiver circuit and the positive (+) terminal of the C64 capacitor (Fig. 1).
15	Set the VOM scale selector to the 300-volt dc scale.
16	Connect the negative (—) terminal of the VOM to the GRD pin jack on the battery supply unit. Connect the positive (+) lead of the VOM to terminal 1 on the tube socket for V31.
17	Slowly turn the BIAS potentiometer clockwise until the C relay releases, as indicated by a reading on the VOM. ***Note:*** The VOM reading should build up slowly to about 80 to 100 volts.

STEP	PROCEDURE
18	To check that the adjustment is at its threshold, slowly adjust the potentiometer in the reverse direction until the C relay operates and repeat Step 17.
19	Disconnect the VOM, remove the 20-ohm resistor, and replace the V31 tube (313C) in its socket.
20	In order to simulate a carrier failure and check the audible alarm, connect a 20-ohm resistor between the GRD jack on the group receiver circuit and the positive (+) terminal of the C64 capacitor (Fig. 1). When the 313C tube fires, remove the 20-ohm resistor. The CA relay should operate, bringing in a visual and audible alarm.

Carrier Frequency Shift Trouble Investigation

If the received carrier deviates from its nominal frequency (184 or 192 kc) by about ±100 cycles or more for ON or by ±40 cycles or more for O terminals, the carrier falls outside of the essentially flat passband of the twin channel pick-off filter. The amplitude of the received carrier signal is then modified by the twin channel filter skirt characteristic.

Small normal variations in repeater oscillator frequencies caused by temperature changes are thus translated into large received carrier amplitude changes introducing serious (but generally slowly changing) day-to-night net gain variations in both channels associated with the twin channel unit.

When the frequency error is caused primarily by one or more of the line repeaters, variations in net gain occur in all channels of the system and in both directions of transmission. Table A lists the various oscillators which control the frequency of the received carriers, the number of channels affected, the direction of transmission affected by each oscillator, and the sections which give frequency measuring procedures.

The following procedure may be helpful in locating the cause of excessive frequency shift of the received carriers in ON systems.

STEP	PROCEDURE
1	At both the transmitting and receiving terminals, measure the frequency of the terminal group oscillators (HI and LO OSC), both terminal twin channel oscillators, and the 304-kc oscillator in the ON terminal repeater. If any of the measured frequencies is out of limits, adjust (if an adjustment is provided) or replace the unit and arrange for its repair.
2	If the received carrier is still out of limits, the frequency shift error is caused primarily by one or more of the line repeaters. In an ON system, the frequency of the 304-kc oscillator located at each line repeater should be measured. The repeater should be replaced if the frequency is out of limits.

TABLE A

OSCILLATOR	NUMBER OF CHANNELS AFFECTED	DIRECTION OF TRANSMISSION AFFECTED	SECTION
Terminal Group HI-LO OSC	4	Transmit or Receive	362-130-501
Terminal Twin Channel	2	Transmit	362-120-501
ON Terminal Repeater	All	Transmit or Receive	362-410-503
N1 and N1A Repeaters	All	Transmit and Receive	362-410-503
N2 Repeater	All	Transmit and Receive	362-465-503
O Repeater (OB, OC, OD)	4	Transmit and Receive	(to be issued)
Junction Group Open Wire, HI-LO OSC	4	Transmit or Receive	362-130-501
Junction Group Cable, HI-LO OSC	4	Transmit and Receive	362-130-501

STEP	PROCEDURE
3	When a severe frequency shift trouble exists on an ON system (i.e., the received carrier deviates from its nominal frequency by about ±100 cycles or more), severe variations in channel net gain occur which should be eliminated as soon as possible. In this case, looping the repeatered line, in accordance with Section 362-420-502, may be helpful in quickly locating the repeater(s) at fault. When this looping patch is made, the carriers from a given terminal A, instead of being sent to the distant terminal B, are looped back and are received at terminal A. Similarly, the carriers being sent from terminal B are received at terminal B.
4	Remove the system from service and have the line looped at some convenient place at about the center of the line.
5	Remeasure the received carrier frequency which was out of limits. It will be found much farther out of limits if the defective repeater is located in the section of the looped line associated with ***this*** terminal (referred to as the near terminal). If the defective repeater is located in the section of the looped line associated with the far terminal, the received carrier frequency at the near terminal will be closer to nominal while the carrier at the far terminal will be farther out of limits.

STEP	PROCEDURE
6	By progressively looping the line at other convenient repeater points, the trouble can usually be localized. Once this has been done, frequency measurements need to be made only on a few 304-kc repeater oscillators to locate the repeater(s) in serious trouble. Once the faulty repeater(s) is replaced, the deviation in the received carrier frequency should be considerably less than ± 100 cycles, thus providing satisfactory operation on a temporary basis. In order to properly clear the line of frequency shift troubles, it is important that all repeaters on the line be measured subsequently and that all repeaters out of limits be replaced.
7	It should be noted that replacement of a faulty repeater may, in some cases, make the overall frequency shift problem worse. This is true because the repeater which is out of limits may be located in a position in the line so as to compensate for another repeater which is also out of limits. It is important, therefore, that all repeaters on the line that are out of limits are replaced.

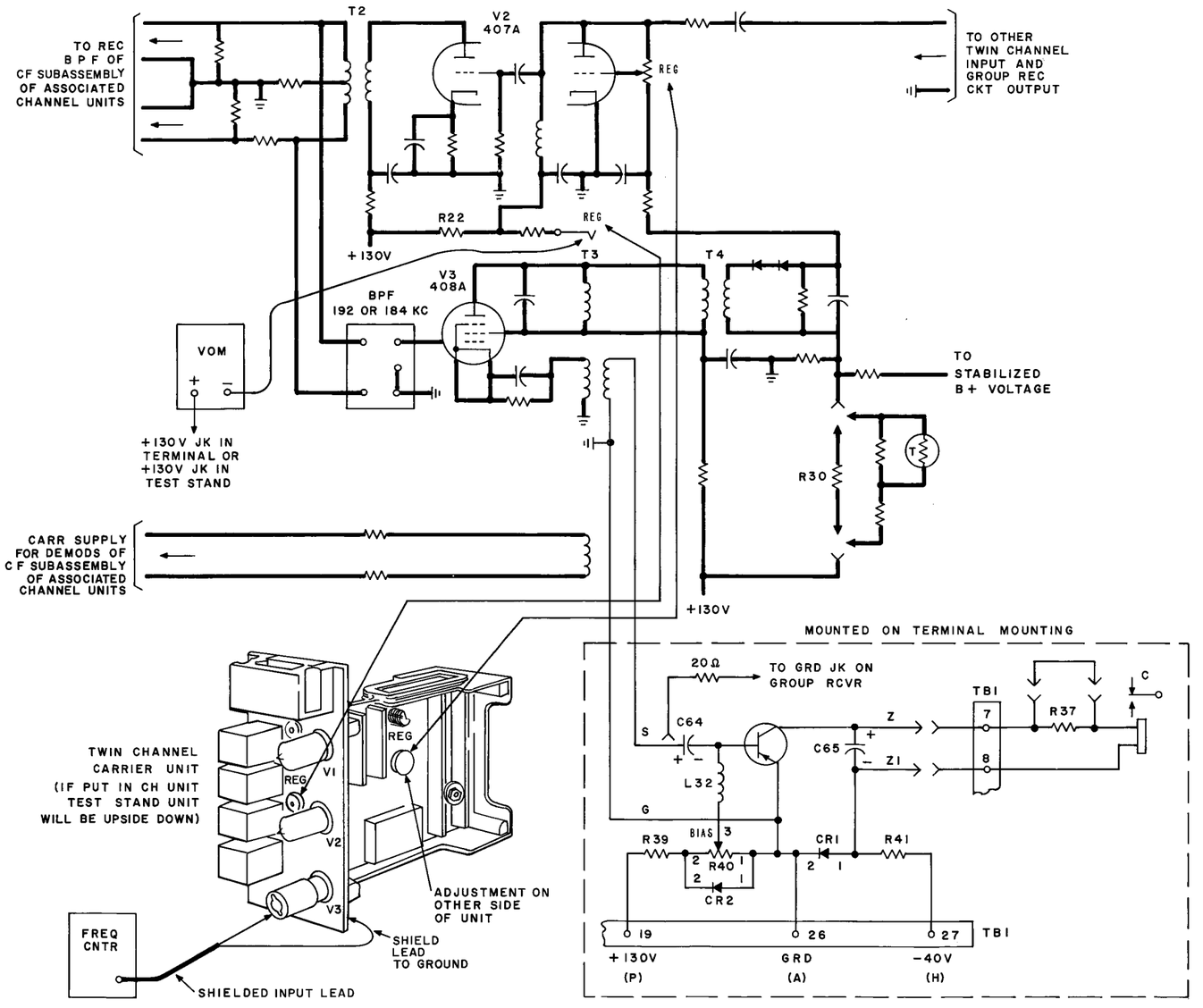

Fig. 1 — Twin Channel Unit — Regulator and ON2 Failure Alarm Circuit