

COMMON SYSTEMS
"O" AND "ON" CARRIER TELEPHONE
O1, ON1, AND ON2 TWIN-CHANNEL
CARRIER CKT.

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Additional wiring has been included in this circuit to allow carrier voltage to be connected to the ON2 alarm circuit located in the terminal mounting.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 A pair is connected from terminals 1 and 2, formerly unused, of transformer (T3) to pins 12 and 1, respectively, of the 20-pin connector.

D.2 Fig. 2 was added to show the circuit configuration of the 532A and 532B filters and the 532D and 532E filters.

D.3 All "D1" wiring notations on pigtail leads have been removed from the drawing. All critical wiring is covered by Equipment Requirements (note 202).

D.4 Note 204 has been added to cover special treatment of antising resistor (R5).

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 The transmitting portion of the circuit provides a source of carrier frequency (184 or 192 kc) for the two associated channel modulators and an adjustable source for the transmitted carrier reinserted at the transmitting multiple point. It also provides temperature compensation for the transmitting channel band filter.

1.2 The receiving portion of the circuit provides regulation of the incoming signal level. It also picks off the received carrier frequency and amplifies it for use in the two associated channel demodulators. Carrier voltage can also be supplied to the ON2 alarm circuit when necessary. The receiving portion of the circuit provides temperature compensation for the receiving channel band filter.

2. WORKING LIMITS

2.1 None

3. FUNCTIONS

3.1 Transmitting

3.1.1 Generates a carrier of 192 or 184 kc for the two channel modulators.

3.1.2 Permits adjustment of the transmitted carrier.

3.1.3 Provides temperature compensation for the transmitting channel band filter.

3.2 Receiving

3.2.1 Receives the incoming signal from the group receiving circuit and further regulates the signal under control of one received carrier, 184 or 192 kc.

3.2.2 Provides a supply of received carrier for the two channel demodulators.

3.2.3 Provides a hybrid balance to minimize interaction between the two channel units.

3.2.4 Provides temperature compensation for the receiving channel band filter.

3.2.5 Provides carrier voltage for the ON2 alarm circuit when necessary.

4. CONNECTING CIRCUITS

4.1 N1 and O1 Channel Ckt. - SD-95118-01

4.2 OBI, OCl, OD1 Group Receiving Ckt. or Repeater Amplifier Ckt. and ON1 Group Receiving Ckt. - SD-95152-01

4.3 Application Schematic - O1, ON1, & ON2 Carrier Terminal - SD-95150-01

DESCRIPTION OF OPERATION

5. GENERAL

5.1 The twin-channel unit consists of a transmitting section and a receiving section, both fed from the terminal plate and filament battery.

5.2 The transmitting portion consists essentially of a crystal oscillator with three outputs; a potentiometer controls one of the three outputs.

5.3 The receiving portion consists of a regulating amplifier, a pickoff filter, and a control amplifier and rectifier. The control amplifier and rectifier constitute a regulator. The control amplifier also delivers carrier to the channel demodulators and to the ON2 alarm circuit.

6. TRANSMITTING SECTION - CARRIER SUPPLY CIRCUIT

6.1 The 184- or 192-kc carrier is generated by a crystal-controlled, electron-coupled oscillator consisting of tube (V1), crystal (Y1), and associated parts. The screen grid of (V1) functions as the plate of a triode crystal oscillator of the Colpitts type. Crystal (Y1) and variable capacitor (C4) act as an inductance at the oscillating frequency. The remainder of the tank circuit consists of capacitors (C8) and (C9), the tube output voltage from screen to cathode being applied across (C8), and the voltage across (C9) being applied to the grid of the tube. As the amplitude of oscillation builds up, grid current flowing through grid leak (R6) biases the tube back and reduces the gain to unity. Even though the effective Q of the tank circuit is very low, the fact that the apparent inductance of the crystal changes very rapidly for small frequency deviations means that the phase shift around the loop changes very rapidly for small frequency deviations and consequently the oscillator is very stable. Variable capacitor (C4) permits a small adjustment of frequency, about ± 25 cycles. Resistor (R5) is an anti-parasitic resistor to prevent the circuit from oscillating at spurious high frequencies. The coupling to the plate of (V1) is purely by the electron stream. This type of operation effectively isolates the frequency-determining part of the circuit from the output circuit where the power is delivered. Resistor (R4) isolates the tank circuit from the power supply. Resistors (R8) and (R9) and capacitors (C6) and (C7) are elements of decoupling circuits for the plate and screen supplies.

6.2 Output transformer (T1) feeds two channel modulators from windings "1-2" and "3-7." Capacitor (C5) tunes the primary of this transformer to approximately the operating frequency. Winding "4-5" supplies the transmitted carrier circuit consisting of resistors (R26) and (R1) and potentiometer (TC) which is used to adjust the resupplied carrier level. Option "S," consisting of resistor (R7) and thermistor (RT2), provides temperature compensation for the transmitting channel band filter. The filter, consisting of capacitor (C1) and retardation coil (L1), suppresses second harmonic of the carrier to prevent it from interfering with other "0" carrier systems on the open-wire pair. The level is read at jack (TC).

7. RECEIVING SECTION

7.1 The inputs of the receiving sections of the two twin-channel carrier circuits of the 0 terminal are connected in multiple to the output of the group receiving circuit. Applied to both twin-channel inputs is the signal consisting of two carriers and four sidebands. Since regulation in the group receiving circuit and in the repeaters is done on the basis of total power of the two

carriers, it is quite likely that the two carriers (and their associated sidebands) may differ in level by several db because of line slope. The difference between the two carriers is also a variable depending on weather conditions along the line. One twin-channel circuit regulates on the 184-kc carrier to hold it (and the two associated sidebands) approximately constant at the twin-channel output. The other twin-channel circuit regulates on the 192-kc carrier to hold it (and the two associated sidebands) also approximately constant at the same level. Thus, the effect of line slope and changes in line slope are nearly eliminated.

7.2 The incoming signal consisting of two carriers and four sidebands enters the unit on terminals 19 and 16. Capacitor (C14) provides dc blocking. Series resistor (R19) and potentiometer (REG) introduce a variable loss to permit line-up of the circuit. DC voltage across capacitor (C13), introduced from the control circuit, controls the gain of the first section of double triode (V2), thus accomplishing the regulating action.

7.3 The double triode (V2) forms a 2-stage impedance-coupled amplifier. The plate load of the first half of (V2) is composed of retardation coil (L2) in parallel with (R18), plus the circuit capacities. Capacitor (C11) couples the two stages of the amplifier. (R22) and (C12) provide decoupling from the plate battery circuit. (R17), bypassed by (C18), provides bias for the second half of (V2) which works into output transformer (T2). (R21) and (C10) also provide decoupling from the plate battery circuit. Jack (REG) permits a voltage-drop measurement across (R22) for lining up.

7.4 The output of the (T2) is connected to the two L pads made up of resistors (R10), (R11), (R12), and (R16) which provide good output impedances and introduce some loss. (R13) is a balancing resistor for the output transformer (T2) and provides isolation between the two receiving band filter inputs. The two channel units are fed from terminals 9, 6 and 3, 0.

7.5 The carrier pickoff filter (FL1) is bridged across the output of (T2) and has a passband of approximately 80 cycles for 0 and 200 cycles for ON. Its center frequency is 184 or 192 kc, depending upon which carrier is to be regulated. The output of the pickoff filter is applied to the grid of (V3), which amplifies the carrier. Cathode resistor (R27) furnishes grid bias and (C15) provides bypassing for (R27). (R28) and (C16) act as a decoupling filter for the screen circuit of (V3).

7.6 The output of (V3) is supplied to the two transformers (T3) and (T4) whose primaries are connected in parallel. Transformer (T3) has three secondaries, one of which, "4-5," supplies about 20-db negative feedback to stabilize this amplifier stage. Another secondary, "3-7," supplies carrier

voltage to the demodulators in the two channel units through terminals 7 and 10. (R31) and (R32) reduce the demodulator carrier voltage. The third secondary, "1-2," supplies carrier voltage through terminals 12 and 1 to the ON2 alarm circuit.

7.7 Transformer (T4) couples (V3) to the rectifier circuit composed of varistors (CR2) and (CR3), resistor (R29), and capacitor (C19). With "R" option, the dc output of this rectifier is connected in series with a positive reference voltage obtained from the plate battery through (R30) and (R24). With option "S," the positive reference voltage is obtained through a temperature compensating circuit for the receiving channel band filter consisting of resistors (R2), (R3), and (R24) and thermistor (RT1). The difference of the rectifier voltage and the reference voltage is supplied through (R23) to the grid of the first section of (V2) across capacitor (C13).

7.8 If the incoming carrier increases in level, the output of the 2-stage amplifier increases, which in turn increases the amount of the rectified ac across (R29). This opposes the dc reference voltage from the divider and increases the negative bias on the first section (V2), thus decreasing the gain of this amplifier. Similarly, if the incoming carrier level decreases, the bias on the first stage of (V2) is decreased, thus increasing the gain of the amplifier.

The effect is to maintain the output level of the amplifier essentially constant.

7.9 The whole regulator may be considered as a dc feedback circuit of which the input is the positive reference voltage, the net input voltage after feedback is the resultant dc voltage across capacitor (C13), and the feedback voltage (mu beta times the net input voltage) is the control circuit output voltage. The amount of dc feedback at the normal operating point is about 25 db. The carrier to be regulated appearing at the input of the twin-channel circuit is a factor affecting the gain of the mu part of the circuit (similar to plate voltage). Thus, small variations are reduced in the output by a factor of about 19. Because of the variability of feedback with input carrier, an input change of 10 db appears as a 1-db change in the output. On the other hand, variations in the positive reference voltage are reflected directly as variations of the output.

8. FILAMENT CIRCUIT

8.1 The filament supply is obtained from an office 48-volt battery through a common resistor, external to this circuit, dropping the voltage to approximately 40 volts. The heater of (V2) is connected directly from ground to the 40-volt bus. The heaters of (V1) and (V3) are connected in series between the same points.

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