1600- OR 2000-CYCLE SINGLE FREQUENCY SIGNALING CIRCUIT SD-56202-01

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section describes the method of applying potentiometer and filament resistor adjustments to the signaling circuit, J68602CH, and the blocking amplifier, J68602CF of the single frequency signaling circuit (SD-56202-01). These adjustments compensate for normal variations in the characteristics of vacuum tubes, varistors, capacitors, and certain relays.

1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

1.03 Procedures for making these adjustments and the potentiometer used are:

(A) Adjustment of Filament Voltage

(B) Adjustment of Blocking Amplifier Gain - P Potentiometer

(C) Adjustment of Voice Amplifier Gain - P1 Potentiometer

(D) Adjustment of Signaling Amplifier Gain - P2 Potentiometer and Adjustment of Maximum Plate Current - P3 Potentiometer

(E) Adjustment of Sensitivity Relay S - P4 Potentiometer

(F) Adjustment of Rering Relay RR - P5 Potentiometer

(G) Adjustment of Output of Regenerative Relay RG - P6 Potentiometer

1.04 The adjustments, with exception of those for vacuum tube filaments, are made by varying the settings of P to P6 potentiometers from front of the unit. The adjustment of filament voltage for signaling circuit vacuum tubes is made at rear of unit by changing short circuiting straps around R22 and R23 resistors. Blocking amplifier filament voltage is adjusted by means of R6 variable resistor at rear of unit.

1.05 Adjustment (D), P2 and P3 potentiometers, is used where the receiver fails to meet its sensitivity requirements. These are operate or non-operate high sensitivity test or test for maximum saturation of the receiver of Section 179-217-501.

1.06 Adjustment (E), P4 Potentiometer, is used where the receiver fails to meet the operate or non-operate rering test of Section 179-217-501.

1.07 Adjustment (F), P5 potentiometer, is used where the RR relay fails to meet its hold or release test of Section 179-217-501.

1.08 Adjustment (G), P6 Potentiometer, is used where the receiver fails to meet the pulsing performance test for operate long pulses or operate short pulses of Section 179-217-501.

1.09 All relay covers must be in place during the adjustment and during the heating periods specified in this section.

1.10 These adjustments are made at the miscellaneous jack equipment SD-56137-01, at the test jacks of the single frequency signaling bays, and at the test jacks of the blocking amplifier bays. Either the No. 2B signaling test set SD-56134-02 (J64730B) having positive lamp supervision, or the No. 2A signaling test set SD-56134-01 (J64730A) having negative lamp supervision, may be used.

1.11 Two values of signaling power in dbm are usually specified in this section. The selection of the correct value for the particular single frequency signaling equipment under test is made as follows:

(a) +4 Line, -13 Line: Where receiver connects at a transmission level point of +4 db and transmitter connects at a transmission level point of -13 db, value relating to receiver is designated "+4 Line" and value relating to transmitter is designated "-13 Line".

(b) +7 Line, -16 Line: Where receiver connects at a transmission level point of +7 db and transmitter connects at a transmission level point of -16 db, value relating to receiver is designated "+7 Line" and value relating to transmitter is designated "-16 Line".

1.12 The gain of the test amplifier associated with the AMP IN and AMP OUT jacks of the miscellaneous jack equipment is approximately 30 db at 1600 cycles.

1.13 The loss of the test keyer associated with the KEYER IN and KEYER OUT jacks of the miscellaneous jack equipment is approximately 7.2 db at 1600 cycles.

1.14 The No. 13A transmission measuring set and the No. 40B transmission measuring system will be referred to in the text as TMS.

1.15 In the tables showing patching connections, the abbreviations used and their meanings, are as follows:
(misc) - miscellaneous jack equipment
(sig) - signaling circuit under test
(tst set) - signaling test set

1.16 Where reference is made to the 1600 SEND or 2000 SEND jacks, use whichever frequency is required by the receiver of the circuit under adjustment.

2. APPARATUS

2.01 The apparatus required for each test is shown in the following list. The details of each item are covered in the indicated paragraphs.

Apparatus	Number Required for Adjustment						
	A	B	C	D	E	F	G
Meter (2.02)	1	-	-	-	-	-	-
Test Set (2.03)	-	-	1	1	1	1	1
TMS (2.04)	-	1	1	1	1	-	1
Test equipment (2.05)	-	1	1	1	1	-	1
Patching cord (2.06)	-	2	2	3	4	-	4
Patching cord (2.07)	-	-	1	-	2	1	1
Patching cord (2.08)	-	-	-	-	1	-	1
Patching cord (2.09)	-	-	-	1	-	1	1
**Testing cord (2.10)	-	1	1	1	1	-	1
Testing cord (2.11)	-	-	-	-	-	-	1
Testing cord (2.12)	-	-	-	-	1*	-	-
Clip (2.13)	-	-	-	-	1*	-	2
Plug (shorting) (2.14)	-	-	-	-	-	-	1
Plug (dummy) (2.15)	-	-	1	1	1	1	1
Screwdriver (2.16)	1	1	1	1	1	1	1
Tube puller (2.17)	-	-	-	1	-	-	-
Soldering equipment (2.18)	1	-	-	-	-	-	1

**Used with the No. 13A TMS. Omit when the No. 40B TMS is used.

*Required only where the 48V jack is not provided in the miscellaneous jack equipment, in which case one less No. 2P1D cord (2.07) will be required.

2.02 No. M9B meter with a pair of KS-9291 test clip leads, or equivalent voltmeter with 30 volt scale.

2.03 No. 2B signaling test set J64730B (SD-56134-02) or No. 2A signaling test set J64730A (SD-56134-01).

2.04 No. 13A transmission measuring set, or No. 40B transmission measuring system, or equivalent capable of reading to -35 dbm or lower.

2.05 Test equipment on bay, including test amplifier, attenuator and jacks as shown on SD-56137-01.

2.06 P4H cord, 6 feet long, equipped with two No. 327A plugs (4P18D).

Note: Although No. 4P18D cords (6 feet) are specified in the testing methods, it is intended that shorter cords such as the No.4P18B cord (4 feet) and the No. 4P18A cord (2 feet) may be used where the mounting positions of the equipment make a short cord desirable.

2.07 P2A cord, 6 feet long equipped with two No. 347A plugs (red shells) (2P1D).

2.08 P2A cord, 6 feet long equipped with two No. 347B plugs (black shells) (2P3B).

2.09 P3K cord, 12 feet long, equipped with two No. 310 plugs (3P15B).

2.10 W2CA cord 5 feet 6 inches long equipped with one No. 327A plug at one end (2W36A).

2.11 893 cord, 6 feet long, equipped with two No. 360A tools (1W13A).

2.12 W1H cord, 10 feet long, equipped with one No. 347B plug and one No. 360A tool (1W8A).

2.13 KS-6278 connecting clip for use with No. 1W8A and No. 1W13A cords.

2.14 No. 310 plug with tip and ring short circuited.

2.15 No. 258D dummy plug (red).

2.16 3 inch H cabinet screwdriver.

2.17 Tube puller, rubber tip sure grip, M.P. King Co.

2.18 Where strapping changes are necessary, the following tools and materials are required.

(a) Soldering tools and materials as required.

(b) Bell System pliers as required.

(c) 22 gauge bare strap wire.

3. PREPARATION

All Adjustments

3.01 If not already arranged for, obtain from the toll test board, the release of the single frequency signaling circuit upon which adjustments are to be made.

3.02 At the beginning of each adjustment it is assumed that no patching or testing cords are connected to the test jacks or to the test set.

Adjustments (C), (D), (E), (F) and (G)

3.03 Restore all lever keys of the signaling test set to normal. Operate the SCALE SEL switch to the PPS position. Connect the TST BAT B (-24 +130) cord of the test set to the TST BAT B jack of the miscellaneous jack equipment. Connect the TST BAT A (-48) cord of the test set to the TST BAT A jack of the miscellaneous jack equipment.

3.04 Allow the test set to warm for one minute.

3.05 Observe that a reading other than 0 is obtained on the PULSES PER SECOND meter.

Note: Adjustments of the percent break of pulses to values above 70 must be made slowly enough to allow the highly damped PERCENT BREAK meter to follow the adjustment since the maximum percent break available from the signaling test set may be as low as 80. If an adjustment of 80 is exceeded, the pulsing rate may suddenly drop to half that indicated by the PULSES PER SECOND meter. Once this has occurred, it may persist even though a very nominal percent break is indicated by the PERCENT BREAK meter. This situation is easily recognized since it causes the rate of vibration of the pointer on the PERCENT BREAK meter to be half that of the pointer on the PULSES PER SECOND meter. Normal operation may be restored by turning the ADJ % BK control fully counterclockwise and then slowly turning it clockwise to produce the desired percent break.

3.06 On the No. 2B signaling test set operate the CONT PLS key to the DIAL PLS position.

3.07 On the No. 2A signaling test set operate the PPS key to the DIAL SUPV position.

3.08 Observe that the PERCENT BREAK meter reads 0 on its black scale. If it does not, carefully set it to 0 by means of the pointer adjustment screw of the meter.

3.09 Insert a No. 258D dummy plug (red) into the P jack of the test set and observe that the PERCENT BREAK meter reads 100 (full scale) on its black scale. If it reads other than 100, unlock the CAL % BK control and adjust this control to give a full scale reading. Relock the CAL % BK control, being careful not to disturb the full scale setting of the meter.

3.10 Remove the dummy plug and restore to normal the CONT PLS or PPS key depending upon which signaling test set is used.

Note: The 0 and 100 readings of the PERCENT BREAK meter shall be rechecked occasionally during the adjusting procedures.

Adjustments (C), (D), (E) and (G)

3.11 These procedures are based upon the use of either the No. 13A or the No. 40B TMS.

Using a No. 13A TMS

3.12 Connect the TMS to a power source of 105 to 125 volts (d-c or 25 to 60 cycles a-c) and turn the dial switch to the desired setting. Wait 5 minutes for the set to warm.

3.13 At the miscellaneous jack equipment of the signaling circuit being adjusted, make the following connections:

From	Using Cord No.	To
E TST) (misc) M TST)	2W36A	IN of NO.13A TMS

Note: Insert the No.327A plug of the No. 2W36A cord into the left hand vertical pair of jacks E TST and M TST. These two jacks connect to the tip conductors of the E and M jacks of the miscellaneous jack equipment. Under Part 4 (Method), where connection to "JK to TMS" is indicated, insert the plug of the patching cord involved into these E and M jacks at the miscellaneous jack equipment.

Using a No. 40B TMS

3.14 At the jack appearance of an idle TMS, use patching cords to connect the TMS to a testing trunk that terminates in a SEND jack at the miscellaneous jack equipment of the signaling circuit being adjusted. Operate keys on the TMS as required for connection to the proper scale.

Note 1: Connection to the TMS may be made after all other patching connections have been set up to avoid tying up the TMS unduly.

Note 2: Under Part 4 (Method), where connection to "JK to TMS" is specified, insert the plug of the patching cord into the SEND jack.

4. METHOD

(A) Adjustment of Filament Voltage

4.01 This covers the adjustments of the voltages across the filament terminals

of the vacuum tubes of the signaling circuit (tubes V1, V2, V3) and when provided, the blocking amplifier (tube V).

4.02 Obtain the nominal battery voltage at the filament distributing fuse panel of the circuit being adjusted.

Note: For the purpose of this section, the nominal battery voltage is considered to be the voltage measured at the filament distributing fuse panel when the regulating contact of the filament battery voltage regulator is halfway between its two limiting contacts.

Signaling Circuit

4.03 On the No. M9B meter, operate the toggle switches to the DC and VM-AM positions. Using the meter, with its associated test clip leads connected to meter jacks -V and 30V, measure the voltage at the distributing fuse panel for the circuit being adjusted. Record the difference, if any, between this voltage and the nominal voltage for this distributing panel.

4.04 Using the No. M9B meter and its associated test clip leads, connect the 30V jack of the meter to punching 4 on the V1 vacuum tube card on the rear of the signaling unit. Connect the -V jack of the meter to punching 3 on the card of the V1 vacuum tube.

4.05 Allow the filaments of the V1, V2 and V3 tubes to heat for a minimum period of one minute where new vacuum tubes are required or if the filament supply has been opened for any reason. Observe that, for the deviation from the nominal value which was recorded in 4.03, the reading on the meter is in accordance with Table 1.

TABLE 1

Deviation from Nominal Battery Voltage at Distributing Fuse Panel	Voltage
+0.5	20.0 to 21.0V
+0.4	19.9 to 20.9V
+0.3	19.8 to 20.8V
+0.2	19.7 to 20.7V
+0.1	19.6 to 20.6V
0	19.5 to 20.5V
-0.1	19.4 to 20.4V
-0.2	19.3 to 20.3V
-0.3	19.2 to 20.2V
-0.4	19.1 to 20.1V
-0.5	19.0 to 20.0V

4.06 If the reading is not within the above limits, rearrange the strapping of the R22 and R23 resistors, which are mounted on the rear of the signaling unit, until the proper voltage is obtained. Use No. 22 gauge bare strap wire for the strapping.

Blocking Amplifier

4.07 On the No. M9B meter, operate the toggle switches to the DC and VM-AM positions. Using the meter, with its associated test clip leads connected to meter jacks -V and 30V, measure the voltage at the distributing fuse panel for the circuit being adjusted. Record the difference, if any, between this voltage and the nominal voltage for this distributing panel.

4.08 Using the No. M9B meter and its associated test clips leads, connect the 30V jack of the meter to terminal 4 of the V tube socket on the rear of the blocking amplifier unit. Connect the -V jack of the meter to terminal 3 of the V tube socket.

4.09 Allow the filament of the V tube to heat for one minute where a new vacuum tube is required or if the filament supply has been opened for any reason. Observe that, for the deviation from the nominal value which was recorded in 4.03, the reading on the meter is in accordance with Table 2.

TABLE 2

Deviation from Nominal Battery Voltage at Distributing Fuse Panel	Voltage
+0.5	20.25 to 20.75
+0.4	20.15 to 20.65
+0.3	20.05 to 20.55
+0.2	19.95 to 20.45
+0.1	19.85 to 20.35
0	19.75 to 20.25
-0.1	19.65 to 20.15
-0.2	19.55 to 20.05
-0.3	19.45 to 19.95
-0.4	19.35 to 19.85
-0.5	19.25 to 19.75

4.10 If the reading is not within the above limits, use a screwdriver to readjust the band on the R6 resistor, mounted on the rear of the blocking amplifier unit, until the proper voltage is obtained.

(B) Adjustment of Blocking Amplifier Gain - P Potentiometer

4.11 This is an adjustment of the blocking amplifier, V tube, to provide a gain of approximately 0 db at 1000 cycles.

Using the No. 13A TMS

4.12 Connect the TMS to a power source of 105 to 125 volt (d-c or 25 to 60 cycles a-c). Turn the dial switch to the desired setting. Wait 5 minutes for the set to warm.

4.13 At the test jack equipment of the blocking amplifier circuit being adjusted, make the following connections:

From	Using Cord No.	To
SEND 1 MW (misc)	2W36A	IN of No.13A TMS

4.14 At the TMS, measure the level of the power received. Observe that the reading of the TMS is 0 ± 1.0 dbm. Record the actual reading.

4.15 At the test jack equipment, remove the plug of the cord from the SEND 1 MW jack and make the following connections to the circuit under test:

From	Using Cord No.	To
OUT	2W36A	IN of No.13A TMS
SEND 1 MW (misc)	4P18D	IN

4.16 Observe that the TMS reads within ± 0.1 db of the value recorded in 4.14. If it does not, use a screwdriver to adjust the P potentiometer on the front of the blocking amplifier unit so that the level of power in dbm recorded in 4.14 is obtained.

Using the No. 40B TMS

4.17 At the test jack equipment associated with the blocking amplifier being adjusted, make connection to a testing trunk extending to an appearance of a No. 40B TMS as follows:

From	Using Cord No.	To
SEND 1 MW (misc)	4P18D	SEND (misc)

4.18 At the TMS reached via this testing trunk, use patching cords to connect the testing trunk to an idle TMS. Using keys as required at the TMS to select the desired scale, measure the level of the power received. Observe that the reading of the TMS is 0 ± 1.0 dbm. Record the actual reading.

4.19 At the test jack equipment of the blocking amplifier bay, remove the plug of the patching cord from the SEND jack of the testing trunk and make the following connections to the circuit under test:

From	Using Cord No.	To
SEND 1 MW (misc)	4P18D	IN
OUT	4P18D	SEND (misc)

4.20 Observe that the TMS reads within ± 0.1 db of the value recorded in 4.18. If it does not, use a screwdriver to adjust the P potentiometer on the front of the blocking amplifier unit so that the value of power in dbm recorded in 4.18 is obtained. Remove all patching cords.

(C) Adjustment of Voice Amplifier Gain - P1 Potentiometer

4.21 This is an adjustment of the voice amplifier gain, V1 tube, to provide a gain of approximately 0 db at 1000 cycles.

4.22 At the miscellaneous jack equipment of the signaling circuit being adjusted, make the following connections:

From	Using Cord No.	To
SEND 1 MW (misc)	4P18D	JK to TMS (misc)

4.23 At the TMS, observe that the level of the power received is 0. ± 1.0 dbm. Record the actual reading.

4.24 On the signaling test set, operate the TWD L key to ON HK. Using a No. 2P1D cord, patch the M jack to the EQ M jack of the signaling circuit being adjusted. Operate the TWD L key of the signaling test set to OFF HK.

4.25 At the miscellaneous jack equipment, remove the plug of the patching cord from the "JK to TMS" and make the following connections:

From	Using Cord No.	To
SEND 1 MW (misc)	4P18D	LINE REC (misc)
EQ REC (misc)	4P18D	JK to TMS (misc)

4.26 Observe that the TMS reads within ± 0.1 db of the value recorded in 4.23. If it does not, use a screwdriver to adjust the P1 potentiometer so that the level of power in dbm recorded in 4.23 is obtained. Remove all patching cords and restore to normal the TWD L key of the signaling test set.

(D) Adjustment of Signaling Amplifier Gain-P2 Potentiometer and Adjustment of Maximum Plate Current - P3 Potentiometer

4.27 This procedure covers the adjustment of the sensitivity of the receiver (operate and non-operate at high sensitivity and maximum saturation of the receiver).

4.28 On the miscellaneous jack equipment, turn the controls of the attenuator fully counterclockwise. On the signaling test set, turn the SCALE SEL to 20 MA. On the signaling circuit, turn the P2 and P3 potentiometers fully clockwise by use of a

screwdriver. Insert a No. 258D dummy plug (red) into the R jack. Make the following connections:

From	Using Cord No.	To
MA (tst)	3P15B	DC (sig)
LINE REC (misc)	4P18D	ATTEN IN (misc)

4.29 Observe that the milliammeter of the signaling test set indicates a value which is less than 0.3 ma. If a value greater than 0.3 ma is indicated, remove the V3 tube from its socket with the tube puller and replace the tube.

Note: It may be necessary to try several tubes in order to obtain one that will meet these requirements. Tubes that are unsuitable for this use may still be satisfactory for use as a voice or signaling amplifier.

4.30 At the miscellaneous jack equipment of the signaling circuit being adjusted, remove the plug of the patching cord from the LINE REC jack and make the following connections:

From	Using Cord No.	To
1600 SEND or 2000 SEND (misc)	4P18D	ATTEN IN (misc)
ATTEN OUT (misc)	4P18D	AMP IN (misc)
AMP OUT (misc)	4P18D	JK to TMS (misc)

4.31 Adjust the controls of the attenuator so that the TMS indicates the following values.

+4 Line	+7 Line
-2 ± 0.1 dbm	+1 ± 0.1 dbm

Record the setting now shown by the controls of the attenuator in order that these controls may be reset later to the same position.

4.32 Remove the plug of the patching cord from "JK to TMS" and insert it into the LINE REC jack of the signaling circuit under test.

4.33 Observe that the milliammeter of the signaling test set indicates a value greater than 11.5 ma on its 0-20 scale. Wait three minutes to allow the circuit to stabilize. Observe that the reading is still greater than 11.5 ma. Adjust the signaling circuit P3 potentiometer, with a screwdriver, so that the meter of the signaling test set indicates 10.5 ma.

4.34 Remove the plug of the patching cord from the LINE REC jack of the signaling circuit and connect it to the "JK to TMS". Adjust the controls of the attenuator so that the TMS indicates the following values.

+4 Line	+7 Line
-24 ± 0.1 dbm	-21 ± 0.1 dbm

Record the setting now shown by the controls of the attenuator in order that these controls may be reset later to the same position.

4.35 At the miscellaneous jack equipment, remove the plug of the patching cord from "JK to TMS" and insert it into the LINE REC jack of the signaling circuit. Allow the circuit to stabilize for one minute. Using a screwdriver, adjust the P2 potentiometer so that the milliammeter of the signaling test set indicates 7 ma on its 0-20 scale.

4.36 Set the attenuator to the reading that was recorded in 4.31 and again check for 10.5 ma, adjusting the P3 potentiometer with a screwdriver, if necessary, to obtain this value. Then set the attenuator to the reading that was recorded in 4.34 and again check for 7 ma, adjusting the P2 potentiometer with a screwdriver, if necessary, to obtain this value. Repeat this procedure until these values are obtained.

4.37 Remove all patching cords. Remove the dummy plug from the R jack of the signaling circuit. Restore the SCALE SEL switch of the test set to the PPS position.

(E) Adjustment of Sensitivity Relay S - P4 Potentiometer

4.38 This adjustment covers the control relays which, in conjunction with the receiver, insure that the signaling circuit will have the proper "talk off" protection and will still receive and register a rering signal.

Note: The adjustment of the S relay is affected by the adjustment of the R relay. Therefore, if the R relay requires readjustment in accordance with Section 040-514-701 as referred to in Adjustment (G), the procedure covered by Adjustment (E) must be made.

4.39 At the miscellaneous jack equipment, make the following connections:

From	Using Cord No.	To
1600 SEND or 2000 SEND (misc)	4P18D	KEYER IN (misc)

From	Using Cord No.	To
KEYER OUT (misc)	4P18D	ATTEN IN (misc)
ATTEN OUT (misc)	4P18D	AMP IN (misc)
AMP OUT (misc)	4P18D	JK to TMS(misc)
M (tst)	2P1D	M (keyer)(misc)
E (tst)	2P3B	EQ E (sig)

4.40 On the signaling test set operate the TWD L key to ON HK.

4.41 At the miscellaneous jack equipment adjust the controls of the attenuator so that the TMS reads:

+4 Line	+7 Line
-2 ± 0.1 dbm	+1 ± 0.1 dbm

4.42 On the signaling test set, operate the TWD L key to OFF HK. Remove the plug of the patching cord from "JK to TMS" at the miscellaneous jack equipment and insert it into the LINE REC jack of the signaling circuit.

4.43 On the signaling test set, adjust the ADJ PPS control so that the PULSES PER SECOND meter reads 4 on its 0-20 scale. Operate the ADJ % BK switch to the L position. Adjust the ADJ % BK control so that the PERCENT BREAK meter reads 44 on its black scale.

4.44 If a 48V jack is provided in the miscellaneous jack equipment, first connect one end of a No. 2P1D cord to the EQ M jack of the signaling circuit and then connect the other end of this cord to the 48V jack.

4.45 If a 48V jack is not provided in the miscellaneous jack equipment, connect the plug end of a No. 1W8A cord into the EQ M jack of the signaling circuit. Connect the other end of the No. 1W8A cord to a source of -48V battery, using a KS-6278 connecting clip attached to the No. 360A tool in which the cord terminates.

4.46 Wait ten minutes to allow the S relay to reach its normal operating temperature. Then, observe on the No. 2B test set that lamp L remains extinguished (steadily lighted on the No. 2A test set.

4.47 On the No. 2B Signaling test set, operate the CONT PLS key to the DIAL PLS position. Operate the PLS key to LINE.

4.48 On the No. 2A Signaling test set, operate the PPS key to DIAL SUPV. Operate the PLS key to LINE.

4.49 Using the dial of the signaling test set, dial the digit 1 repeatedly with an interval of approximately 3 seconds between each digit. Observe the action of the L lamp and adjust the P4 potentiometer of the signaling circuit as directed below.

4.50 If the L lamp flashes as each digit is dialed, turn the P4 potentiometer in a clockwise direction with a screwdriver until the L lamp does not flash. Then turn the P4 potentiometer in a counterclockwise direction until the L lamp just flashes as each digit 1 is dialed.

4.51 If the L lamp does not flash as each digit is dialed, turn the P4 potentiometer in a counterclockwise direction with a screwdriver until the L lamp just flashes as each digit 1 is dialed.

4.52 Taking care to disconnect the battery end of the cord first to avoid the possibility of blowing a fuse, remove the cord connecting the -48V battery to the EQ M jack of the signaling circuit. Remove all other patching cords. Restore all keys on the test set to normal.

(F) Adjustment of Rering Relay RR - P5 Potentiometer

4.53 This adjustment assures that the RR relay releases slowly enough so that the transmitter extends the duration of its rering pulses to a minimum of 165 milliseconds when the single frequency signaling circuit is in its talking condition.

4.54 On the signaling test set operate the TWD L key to ON HK.

4.55 Make the following connections:

From	Using Cord No.	To
M (tst)	2P1D	EQ M (sig)
RR (tst)	3P15B	DC (sig)

4.56 On the signaling test set operate the TWD L key to OFF HK. Wait ten minutes to allow the RR relay to reach its normal operating temperature.

4.57 On the signaling test set, adjust the ADJ PPS control so that the PULSES PER SECOND meter reads 4 on its 0-20 scale. Operate the ADJ % BK switch to the L position. Adjust the ADJ % BK control so that the PERCENT BREAK meter reads 70 on its black scale.

4.58 Turn the ADJ PPS control fully counterclockwise. Disregard the resulting change in the reading of the PERCENT BREAK meter. Turn the SCALE SEL control to 20 V. Operate the PLS key to LINE.

4.59 If the pointer of the PULSES PER SECOND meter "kicks" regularly, turn the P5 potentiometer fully counterclockwise with a screwdriver. Then, turn the P5 potentiometer slowly in a clockwise direction until the pointer of the PULSES PER SECOND meter "kicks" from 1/4 to 1/2 volt on the 0-20 scale (1/2 to 1 scale division).

4.60 If the pointer of the PULSES PER SECOND meter does not "kick" regularly, slowly turn the P5 potentiometer with a screwdriver in a clockwise direction until "kicks" are obtained of 1/4 to 1/2 volt on the 0-20 scale (1/2 to 1 scale division).

4.61 If "kicks" are not obtained even with the P5 potentiometer in its extreme clockwise position, leave the P5 potentiometer at this position. Then very slowly turn the ADJ % BK control of the signaling test set in a counterclockwise direction until the "kicks" are obtained. Restore the PLS key to normal. Turn the SCALE SEL control to the PPS position. Adjust the ADJ PPS control so that the PULSES PER SECOND meter reads 4. If the PERCENT BREAK meter now indicates 66 or greater on its black scale, the circuit is satisfactory.

4.62 Remove all patching cords. Restore all test set keys to normal.

(G) Adjustment of Output of Regeneration Relay RG - P6 Potentiometer

4.63 This adjustment covers release time of RG relay. The RG relay controls percent break of pulses on E lead. In addition a check and an adjustment of R relay is provided which must be made before applying RG relay potentiometer adjustment. Before Adjustment (G) is applied either receiver should meet the operate high sensitivity, non-operate high sensitivity, and maximum saturation tests covered in Section 179-217-501, or the receiver should meet Adjustment (D) of this section which covers sensitivity adjustment.

R Relay Check and Adjustment

4.64 On the miscellaneous jack equipment, make the following connections:

From	Using Cord No.	To
1600 SEND or 2000 SEND(misc)	4P18D	KEYER IN (misc)
KEYER OUT(misc)	4P18D	ATTEN IN (misc)
ATTEN OUT(misc)	4P18D	AMP IN (misc)
AMP OUT (misc)	4P18D	JK to TMS(misc)
M (tst)	2P1D	M (KEYER) (misc)
L (tst)	3P15B	R (sig)

4.65 On the signaling test set, operate the TWD L key to ON HK.

4.66 On the miscellaneous jack equipment, adjust the controls of the attenuator so that the TMS indicates the following:

+4 Line	+7 Line
-2 ± 0.1 dbm	+1 ± 0.1 dbm

4.67 On the signaling test set, operate the TWD L key to OFF HK. At the miscellaneous jack equipment, remove the plug from the "JK to TMS" and insert it into the LINE REC jack of the signaling circuit.

4.68 On the signaling test set adjust the ADJ PPS control so that the PULSES PER SECOND meter reads 10 on its 0-20 scale. Operate the ADJ % BK switch to the M position. Adjust the ADJ % BK control so that the PERCENT BREAK meter reads 60 on its black scale.

4.69 On the signaling test set, operate the MEAS % BK key to LINE. Operate the PLS key to LINE. Observe that the PERCENT BREAK meter indicates not less than 30 nor more than 44 on its black scale. If these limits are met, proceed as described in 4.79. If they are not met, check the electrical adjustment of relay R as covered in 4.70 to 4.75 inclusive.

4.70 Record the setting now shown by the controls of the attenuator in order that these controls may be reset later to the same position.

4.71 On the signaling test set, restore the PLS key and the MEAS % BK key to normal. Operate the TWD L key to ON HK. Turn the SCALE SEL control to 20 MA.

4.72 Remove the cord connecting the R jack of the signaling circuit to the L jack of the signaling test set. Insert into the R jack of the signaling circuit the No. 310 plug which has the tip and ring short-circuited. Using the No. 1W13A cord equipped with a KS-6278 connecting clip at each end, strap terminals 7 and 8 of the RF relay. Make the following connections:

From	Using Cord No.	To
MA (tst)	3P15B	DC(sig)
E (tst)	2P3B	EQ E (MISC)

4.73 Using a No. 2B Signaling Test Set: At the miscellaneous jack equipment, turn the 0.1 DB ATTEN control fully counterclockwise. Turn the 2 DB ATTEN control slowly in a counterclockwise direction until the L lamp of the signaling test set is extinguished. Then, slowly turn the

0.1 DB ATTEN control in a clockwise direction until the L lamp of the signaling test set is lighted. This indicates that the R relay of the signaling circuit has operated. If the L lamp is not lighted by the time the 0.1 DB ATTEN control reaches its fully clockwise position, return this control to its fully counterclockwise position and turn the 2 DB ATTEN control one step in the clockwise direction. Again slowly advance the 0.1 DB ATTEN control clockwise until the L lamp is lighted. Repeat if necessary until the L lamp is lighted.

4.74 Using a No. 2A Signaling Test Set: At the miscellaneous jack equipment, turn the 0.1 DB ATTEN control fully counterclockwise. Turn the 2 DB ATTEN control slowly in a counterclockwise direction until the L lamp of the signaling test set is lighted. Then, slowly turn the 0.1 DB ATTEN control in a clockwise direction until the L lamp of the signaling test set is extinguished. This indicates that the R relay of the signaling circuit has operated. If the L lamp is not extinguished by the time the 0.1 DB ATTEN control reaches its fully clockwise position, return this control to its fully counterclockwise position and turn the 2 DB ATTEN control one step in a clockwise direction. Again slowly advance the 0.1 DB ATTEN control clockwise until the L lamp is extinguished. Repeat if necessary until the L lamp is extinguished.

4.75 When a satisfactory lamp indication is obtained, current indicated on the 0-20 scale of milliammeter should be between 5.9 and 7 MA. If not, readjust R relay before proceeding, using requirements given in circuit requirements table.

Note: Any change in adjustment of R relay will affect S relay and P4 potentiometer setting. Therefore, apply Adjustment (E) if R relay adjustment is changed.

4.76 Remove No. 310 plug from R jack of signaling circuit and remove strap between terminals 7 and 8 of RF relay. At miscellaneous jack equipment, reset attenuator control to positions noted in 4.70. Remove cord connecting E jack of signaling test set to EQ E jack of signaling circuit. Remove cord connecting MA jack of signaling test set to DC jack of signaling circuit. Using a No. 3P15B cord, patch R jack of signaling circuit to L jack of signaling test set. Operate TWD L key to OFF HK and turn SCALE SEL control to PPS.

4.77 Now proceed as in 4.68 and 4.69 to check whether the 30 to 44 percent break limit can be obtained. If the limit is met proceed as described in 4.79. If the limit still cannot be met, proceed as covered in 4.78.

4.78 If the indication is below 30, on the signaling circuit remove the strap ("X" wiring) connecting terminal punchings W and X where they are provided. Where these punchings are not provided, remove this strap ("X" wiring) at the R9 resistor of the signaling circuit. If the indication is above 44, connect terminal punchings W and X, where they are provided, by means of 24 gauge bare strap wire. Where these punchings are not provided, connect a short-circuiting strap around the R9 resistor using 24 gauge bare strap wire. If the preceding wiring changes are already made or if when made the limits still cannot be met, a trouble condition may exist in the receiver. When the correct percent break is obtained proceed as in 4.79.

Note 1: Removal of "X" strap causes an increase of about 5 percent in the percent break output of R relay.

Note 2: Any change in the above strapping will affect the S relay and the setting of the P4 potentiometer. Therefore, apply adjustment (E) if this strapping is changed.

RG Relay Adjustment

4.79 Remove the cord connecting the L jack of the signaling test set to the R jack of the signaling circuit. Insert into the R jack of the signaling circuit, a No. 310 plug with tip and ring short-circuited. Using a No. 2P3B cord, patch the E jack of the signaling test set to the EQ E jack of the signaling circuit. On the signaling test set, restore the PLS and MEAS % BK keys to normal.

4.80 On the signaling test set, check that the PULSES PER SECOND meter reads 10 on its 0-20 scale and that the PERCENT BREAK meter reads 60 on its black scale. Note that the TWD L key is in the OFF HK position. Operate the MEAS % BK key to LINE. Operate the PLS key to LINE. On the signaling circuit, using a screwdriver, turn the P6 potentiometer so that the PERCENT BREAK meter reads 58 on its red scale. If this adjustment can be made by means of the P6 potentiometer, proceed as described in 4.82. If the adjustment cannot be made, straps at terminal punchings E, F and G ("V" and "W" wiring) of the signaling circuit should be changed as covered in 4.81.

4.81 If the nearest reading obtained in 4.80 is less than 58 on the red scale, restrap terminal punchings E, F and G to add capacitance to the circuit. If

the nearest reading obtained in 4.80 is more than 58 on the red scale, restrap terminal punchings E, F and G to remove capacitance from the circuit. Capacitance should be added or removed in steps of one mf in accordance with the following table until, by means of the P6 potentiometer, a reading of 58 can be obtained on the PERCENT BREAK meter.

Capacitance	Strap Punchings	Wiring Option
1 mf	E to F	V
2 mf	G to F	W
3 mf	E to F & G to F	V & W

If the capacitance is changed and potentiometer P6 still cannot be correctly set, replace the RG relay. When the correct percent break is obtained, proceed as in 4.82.

Check of Pulsing Performance

4.82 On the signaling test set, restore the PLS and MEAS % BK keys to normal. Note that the PULSES PER SECOND meter reads 10 on its 0-20 scale. Adjust the ADJ % BK control so that the PERCENT BREAK meter reads 45 on its black scale. Operate the MEAS % BK key to LINE. Operate the PLS key to LINE. Check that the PERCENT BREAK meter reads between 50 and 60, inclusive on its red scale.

4.83 On signaling test set, restore PLS and MEAS % BK keys to normal. Note that PULSES PER SECOND meter reads 10 on its 0-20 scale. Adjust ADJ % BK control so that PERCENT BREAK meter reads 70 on its black scale. Operate PLS key to LINE. Operate MEAS % BK key to LINE. Check that PERCENT BREAK meter reads between 58 and 68 on its red scale.

4.84 If the requirements in 4.82 and 4.83 are not met, recheck the adjustment covered in 4.80 and 4.81 using a different "V" and "W" strapping, if possible, since another combination of the strapping of "V" and "W" wiring, together with the setting of the P6 potentiometer, may permit meeting these requirements.

4.85 Remove all patching cords and the No. 310 plug from the R jack. Restore all test set keys to normal.

5. REPORTS

5.01 The required record of the tests should be entered on the proper form.