DEPARTMENT OF TRANSPORTATION

COAST GUARD

OPERATORS GUIDE

FOR

COLLINS 514S-1/651S-1A

REMOTE CONTROLLED RECEIVER

SYSTEM

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U.S. COAST GUARD STATION ALEXANDRIA

ELECTRONICS ENGINEERING LABORATORY

ALEXANDRIA, VIRGINIA

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OPERATORS GUIDE FOR THE COLLINS 514S-1/651S-1A REMOTE CONTROLLED RECEIVER SYSTEM

GENERAL OPERATION

Use of the remotely controlled COL-651S-1A Radio Receiver is identical to use of the locally controlled COL-651S-1A. There are, however, several minor differences. After all units in the system have been energized, the operator should ascertain that the "CONTROL" switches on both the COL-651S-1A Radio Receiver and COL-514S-1 Remote Control Unit are in the "REMOTE" position before commencing normal operation. A short delay, (less than one second) between the time a control is initiated and the time a corresponding change in the receiver audio output results, is observed when discrete frequency or mode information is entered. This delay represents the time needed to generate, transmit, and decode the control signals to the COL-651S-1A. When the scan control is used to make slight adjustments in frequency, response is almost instantaneous.

RF GAIN CONTROL

Another difference in operation of the remote control system is that the "RF GAIN" control of the COL-514S-1 Remote Control Unit is a 15-position switch rather than a potentiometer. Each switch step corresponds to an approximately 6 dB change in RF gain. The operator can estimate the

strength of the received signal by reducing the RF gain until the receiver audio output just begins to decrease (this occurs at the knee of the AGC curve) and then reading the RF level on the panel meter.

STANDBY OPERATION

If the "CONTROL" switch on the 514S-1 is placed in the "STANDBY" position, the 651S-1A is placed in an inactive mode which for all practical purposes is OFF. When this switch is returned to the "REMOTE" position, the 651S-1A will be re-energized and tuned to the frequency indicated on the 514S-1.

SELECTING NEW FREQUENCY

It is also possible, while continuing to operate on one frequency, to set up a second frequency/mode combination and switch to it immediately when necessary. This is accomplished by placing the CONTROL switch of the 514S-1 Remote Control Unit to the "MONITOR" position. In this condition, the 651S-1A continues operating but is no longer controlled by the 514S-1. The operator may select a new frequency and mode at the Remote Control Unit and then place the "CONTROL" switch to the "REMOTE" position when he desires to shift the receiver to them.

FAULT CONDITION

A red "FAULT" light is located to the left of the meter on the 514S-1. This light illuminates when the 651S-1A and the 514S-1 are out of

synchronization. This could be due to loss of the tone control circuit, loss of power in the 651S-1A, or selection of the monitor mode at the 514S-1 or the 651S-1A. When the fault is cleared, the red lamp will extinguish. Some faults, such as those resulting from improperly decoded data, appear as momentary faults. Each time the fault light is extinguished, the data is retransmitted. If the operator does not hear what he expects to hear, it is possible that the system has faulted and failed to reset properly. If this is the case, switching the 514S-1 "CONTROL" switch to "MONITOR" then back to "REMOTE" will cause a transmission of control data to the 651S-1A which should put it back in agreement with the 514S-1.

LOCAL RECEIVER OPERATION

When the 651S-1A has been removed from the remote control mode for service or local operation, the unit will lose synchronization with the 514S-1 as indicated by a steady fault condition. Regardless of what frequency and mode is selected during local receiver operation, the receiver will automatically update to the frequency and mode as indicated on the 514S-1 when the control switch on the 651S-1A is returned to the "REMOTE" position.

PRINCIPLES OF OPERATION

The COL-651S-1A is a completely solid state receiver featuring a direct reading digital display. It operates over a range of 250 kHz to 29,999 MHz in 100 Hz increments. When the COL-651S-1A Receiver is paired with the COL-514S-1 Remote Control Unit, the receiver can be controlled from any distance via common carrier. To accommodate this type of operation, the two receiver interconnect cards must be removed and replaced with a DCFE (Device Control Functional Element) card and a TCU (Teletype Control Unit) card. The COL-514S-1 converts frequency and mode control information to teletype character coded data. The coded data is transmitted to the COL-651S-1A via common carrier and monitor information is returned to the Remote Control Unit from the receiver via the same common carrier. The COL-514S-1 is capable of remotely controlling the following receiver functions:

Frequency
Mode
Bandwidth
AGC
BFO (fixed/variable)
Variable BFO
RF gain
Local audio
Receiver standby

The remote control unit generates control information as ASCII-coded teletypewriter characteristics.

Signal flow through the system can be followed on Figures 1 and 2. RFL series 2056 voice plus data terminal equipment is used to interface

between the Remote Control Unit, the common carrier, and the receiver. In Figure 1, the remote control unit is shown with the appropriate RFL terminal at the operators site. Modules in the RFL terminal are used to convert a dc control loop from the remote control unit to frequency shifted audio tones and transmit them to the receiver over a voice-grade common carrier. The RFL voice-plus data terminal also separates receiver audio and frequency shift MONITOR DATA from the voice-grade common carrier.

A 20 mA DC CONTROL DATA loop is taken out of the Remote Control Unit on pins 1 and 2 of J62. The Loop Power Supply provides 12 Vdc for the loop and the current is adjusted by R1 in the RFL terminal. A panel meter is provided for ease in adjusting the loop current. This dc loop keys the FS transmitter which generates an audio tone that is shifted $\pm$42.5 Hz from 2635 Hz. This mark and space information is adjusted to 0 dBm and transmitted on the send pair of the common carrier. The receive pair of the common carrier contains receiver audio and MONITOR DATA (audio tones shifted $\pm$42.5 Hz from 2635 Hz). These signals are applied to the low-pass filter and the FS Receiver filter in the RFL terminal. The low-pass filter having a cut-off frequency of 2200 Hz eliminates the MONITOR DATA tones from the receiver audio. The output of the low pass filter (receiver audio) is connected to the "sig in" terminals of the Remote Control Unit. The FS receiver filter passes the MONITOR DATA tones to the FS receiver and eliminates the receiver audio. The FS receiver converts the mark and

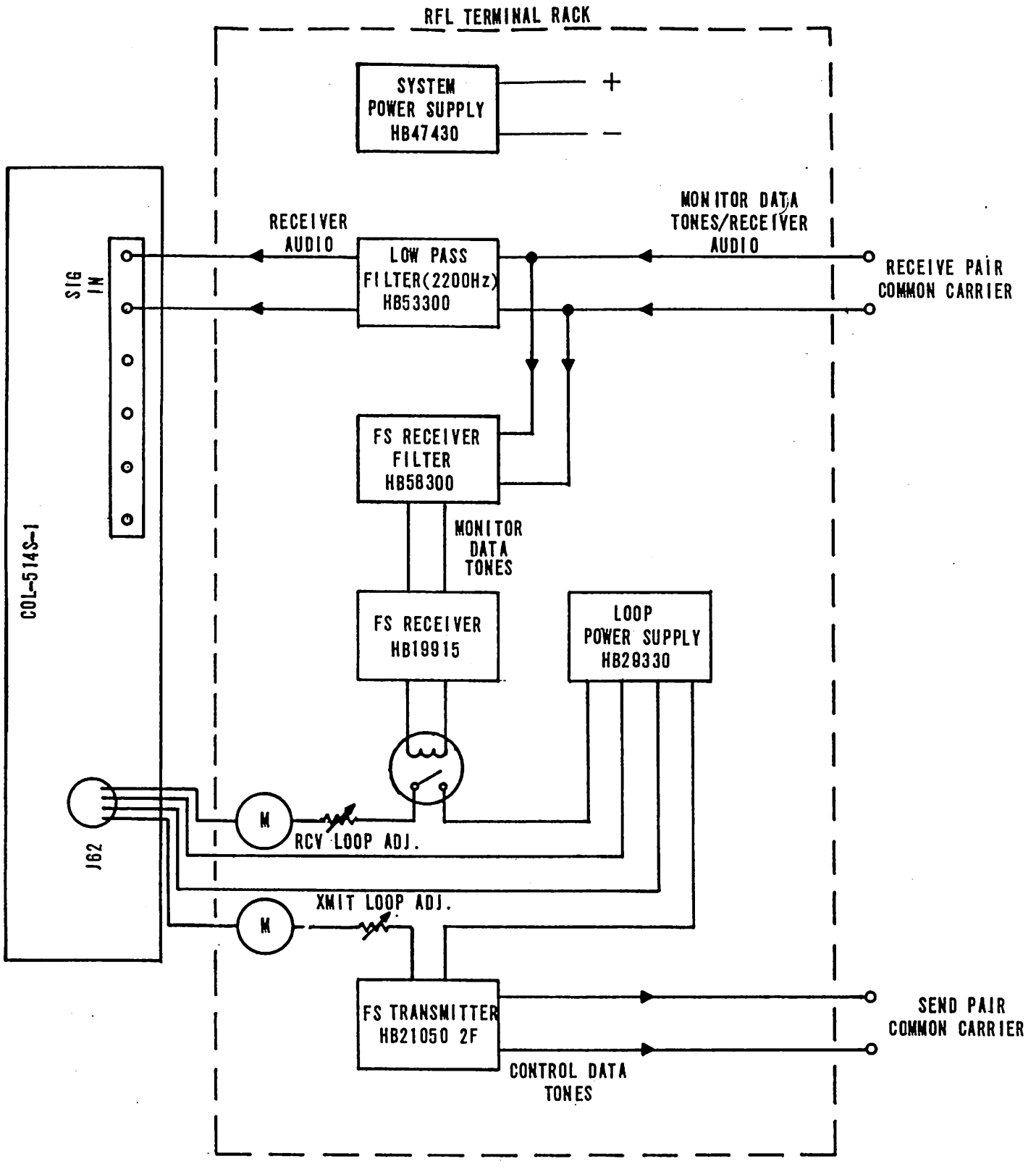


FIGURE 1 BLOCK DIAGRAM OF REMOTE CONTROL SYSTEM (CONTROL SITE)

space tones to dc signals that control a relay that makes and breaks a 20 mA dc loop. The Loop Power Supply provides 12 Vdc to the loop and the loop current is controlled by R2. This MONITOR DATA loop is connected to the Remote Control Unit through pins 4 and 5 of J62 and is monitored by a panel meter.

Referring to Figure 2, which shows the system at the remote receiver site, CONTROL DATA is received on the recieve pair (send pair of Figure 1) of the common carrier. These CONTROL DATA tones are passed by the FS Receiver Filter to the FS Receiver which converts the mark and space tones to dc signals that operate a relay making and breaking a 20 mA dc loop. The Loop Power Supply provides 12 Vdc to the loop and the loop is connected to the receiver through pins 4 and 5 of J62. The CONTROL DATA ASCII-coded teletypewriter information is decoded and converted to the appropriate digital information necessary to operate the receiver by the DCFE and TCU cards. Operation of the receiver is monitored by circuits on these boards and MONITOR DATA is generated and passed through pins 1 and 2 of J62 to the FS Transmitter on a 20 mA dc loop. The Loop Power Supply provides 12 Vdc to the loop and the loop current is limited by R1. Receiver Audio is sent to the Limiter Amplifier which is adjusted for a maximum output of -6 dBm. This audio is filtered by the Low Pass Filter and only the receiver audio below 2200 Hz is passed. The FS tone (2635 Hz $\pm$42.5 Hz) is adjusted to -6 dBm and is combined with the receiver audio in the Jack and Transformer Panel. The output of this panel contains both MONITOR DATA (tones) and receiver

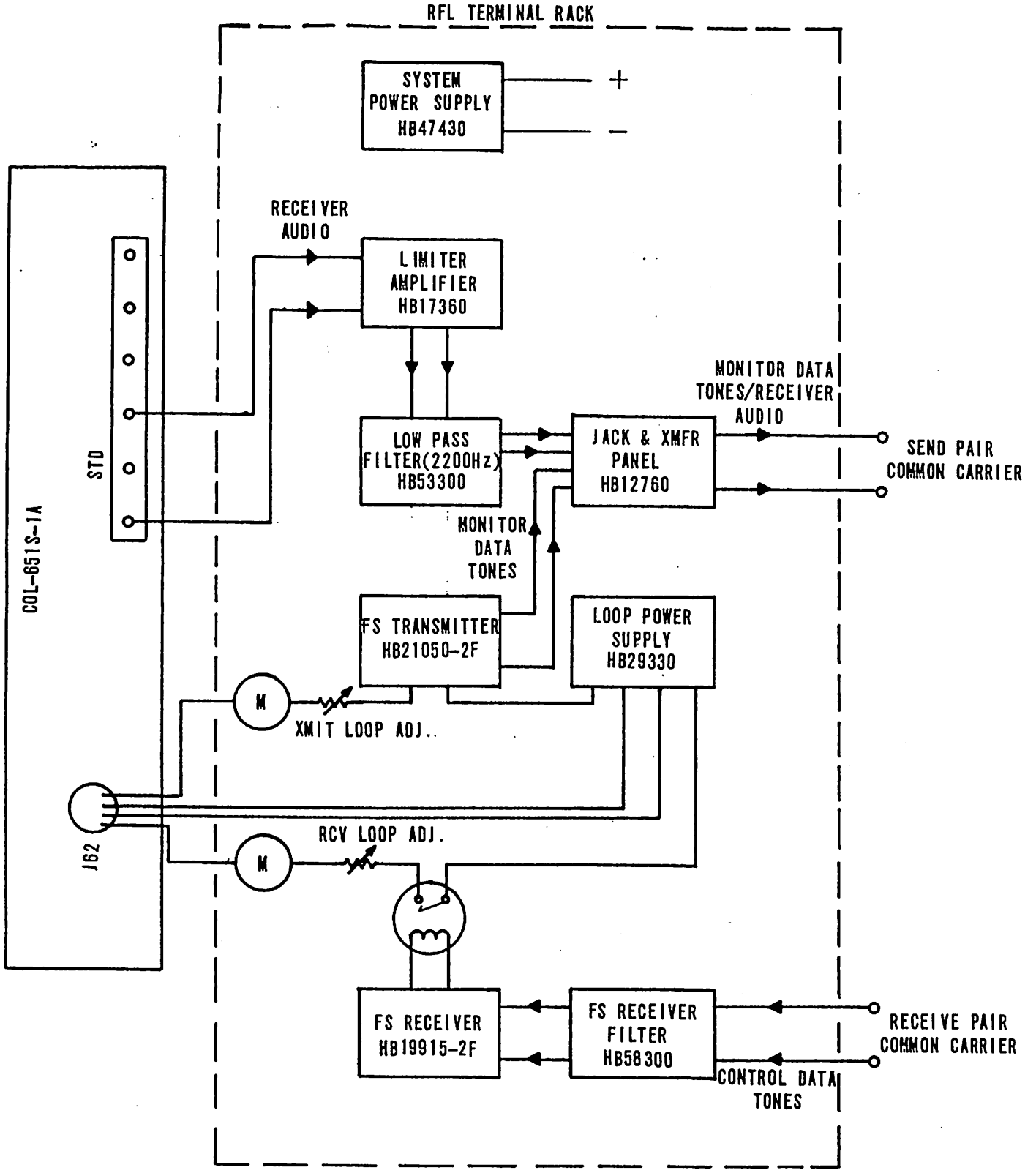


FIGURE 2 BLOCK DIAGRAM OF REMOTE CONTROL SYSTEM (REMOTE SITE)

audio (below 2200 Hz) and is transmitted at 0 dBm peak on the send pair of the common carrier.

SYSTEM CHARACTERISTICS

The FS Receiver is specified to operate at tone levels as low as -40 dBm. If a level below -43 dBm is received, the FS Receiver will automatically shift to a mark-hold condition. CONTROL DATA is adjusted to 0 dBm at the control site and must be received at no less than -40 dBm. This permits nearly 40 dB of insertion loss between sites for CONTROL DATA. MONITOR DATA, on the other hand is adjusted to -6 dBm at the receiver site, and can only accept approximately 34 dB of insertion loss. These figures assume quiet line conditions. Figures 3 through 5 are trouble-shooting charts that may be used to isolate faults in the system. These faults only relate to the control system and not receiver operation difficulties unrelated to the remote control functions.

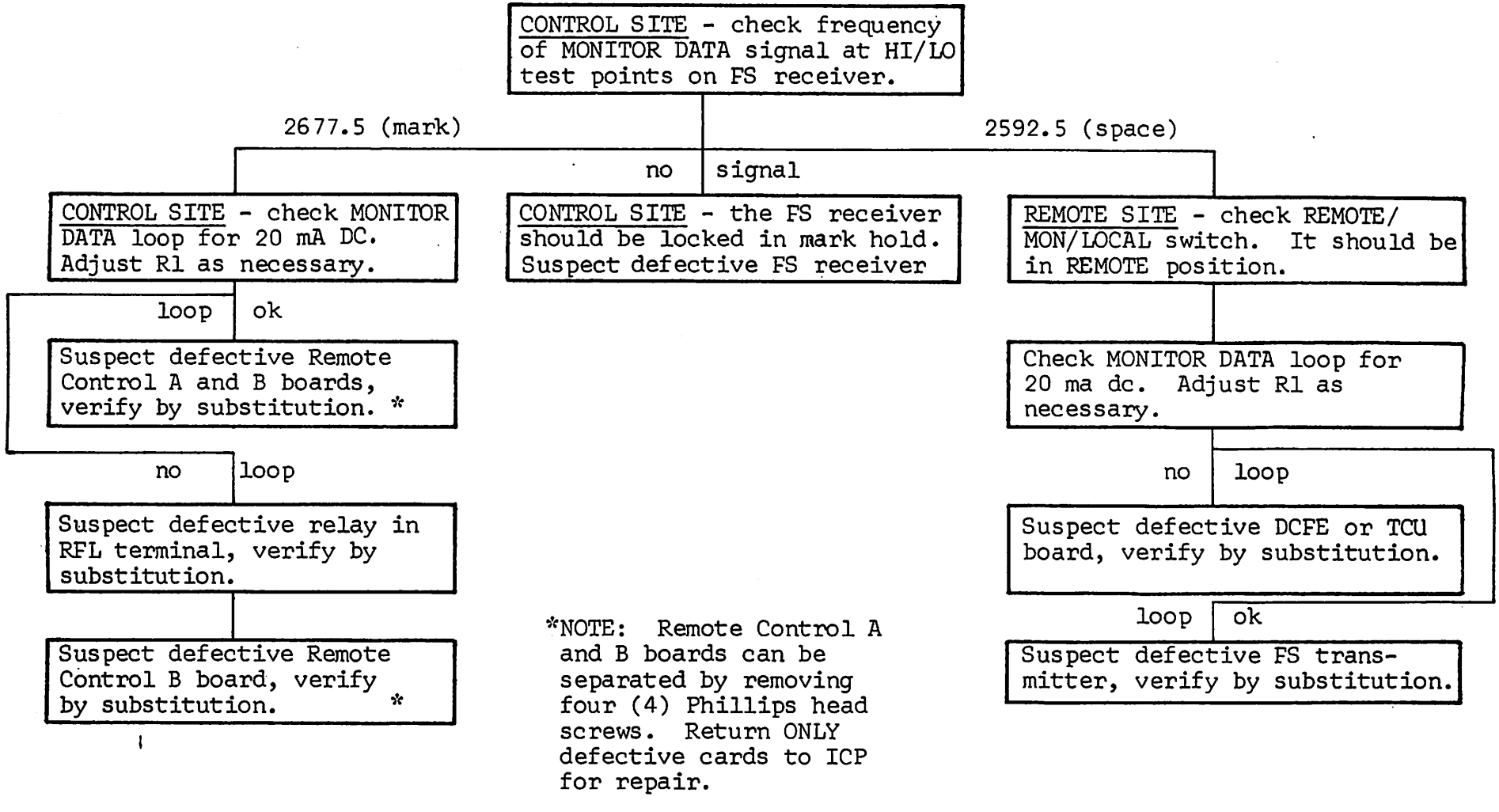
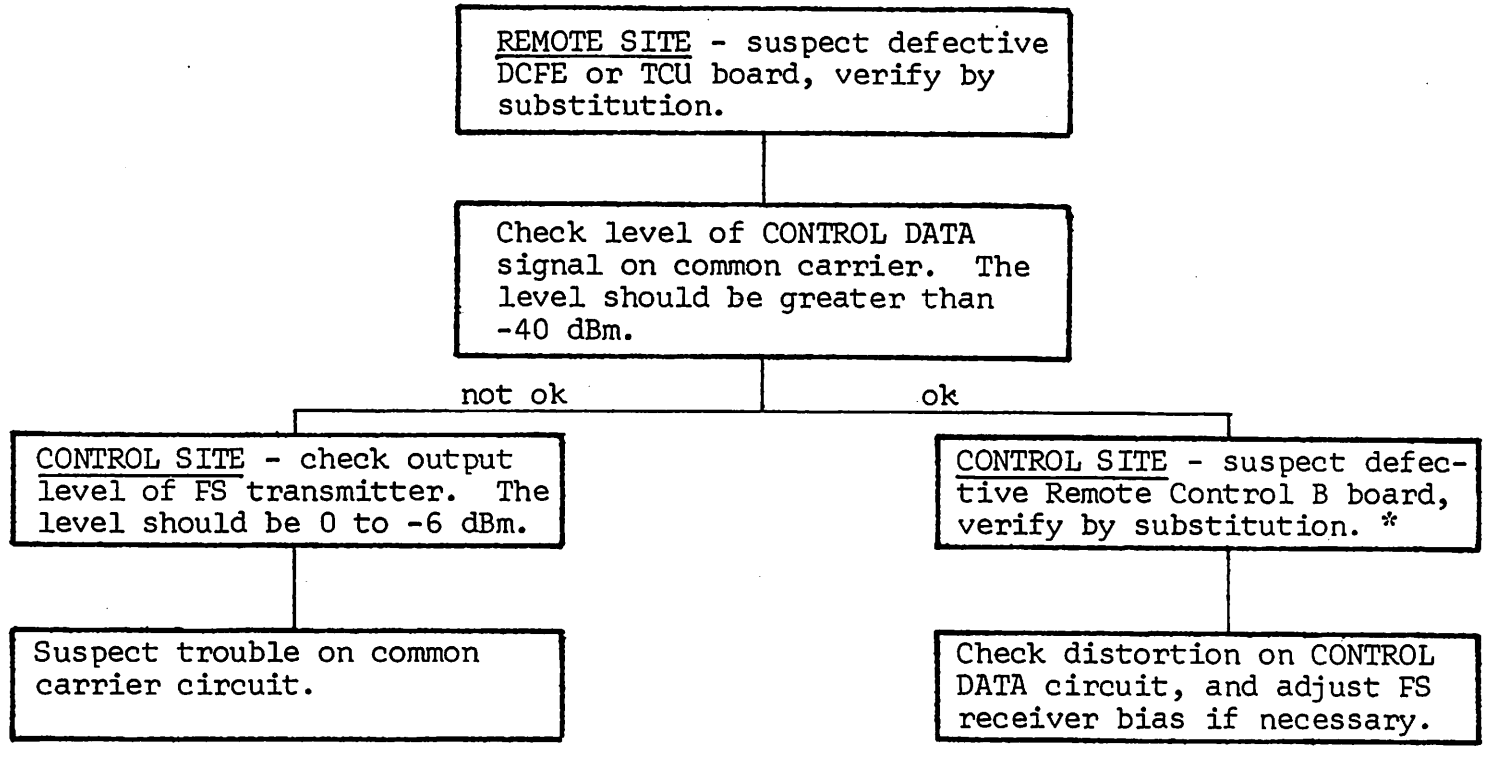
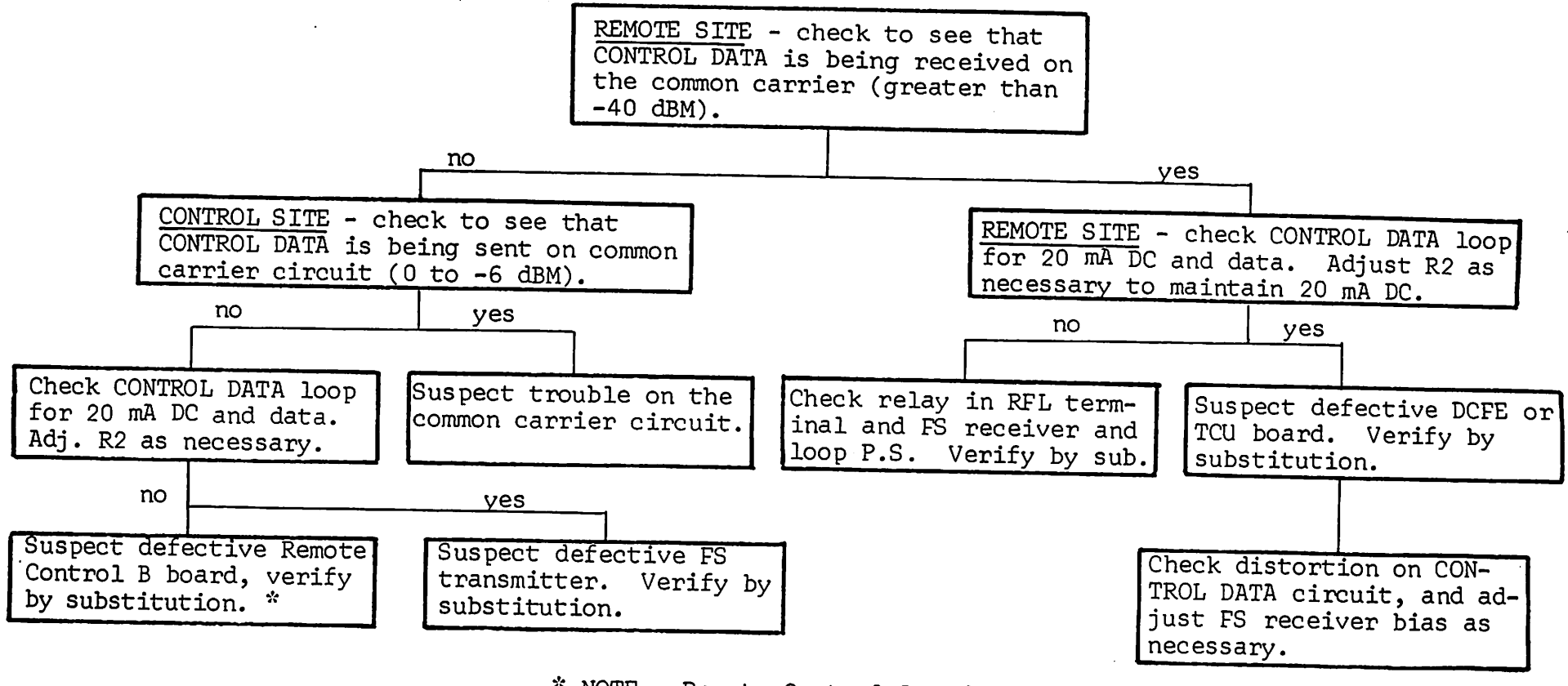


FIGURE 3 STEADY FAULT LIGHT ON COL-514S-1



* NOTE: REMOTE Control A and B boards can be separated by removing four (4) Phillips head screws. Return ONLY defective cards to ICP for repair.

FIGURE 4 BLINKING FAULT LIGHT ON COL-514S-1



* NOTE: Remote Control A and B boards can be separated by removing four (4) Phillips head screws. Return ONLY defective cards to ICP for repair.

FIGURE 5 RECEIVER DOES NOT RESPOND TO COMMANDS

651S-1A TERMINAL (REMOTE RECEIVER SITE) LINE LEVEL ADJUST

1. Equipment required - Oscilloscope
   Floating ac voltmeter (or dB meter)
   RF signal generator (or strong local Bcst station)

2. Turn the receiver RF GAIN fully CCW.

3. On the HB-17360 Limiter Amplifier, turn the ATTENUATOR OUTPUT control fully CCW and the INPUT LEVEL control fully CW.

4. Connect the ac voltmeter to the output line (red and green on the interconnecting cable), and the oscilloscope to the OUTPUT test point (blue) on the Limiter Amplifier.

5. Adjust the HB-21050 FS Transmitter LEVEL control for a voltmeter indication 6 dB below the desired line level. *

6. Remove the FS Transmitter from the rack.

7. Adjust the 651S-1A for maximum RF gain, SSB mode, 2.7U bandwidth and tune in a strong local broadcast carrier (or supply a strong carrier from the signal generator). Adjust the frequency for maximum signal on the oscilloscope (between one and two kHz tone).

8. Turn the INPUT LEVEL control on the Limiter Amplifier CCW until flattopping just disappears.

9. Turn the ATTENUATOR OUTPUT control CW until the same level is obtained on the voltmeter as obtained in step 5 above. *

10. Replace the FS Transmitter in the rack.

11. Remove all test equipment.

* The desired line level is determined by the type of common carrier being used. Normally for telephone circuits, the desired line level is 0 dBm. Because this is a voice plus data terminal, it is treated as a two tone device. Thus the data and voice components must be reduced to 6 dB below the desired line level in order to maintain a peak output level within the desired limits. In addition, the following relationships apply.

dBm	PEAK TO PEAK	RMS
0	2.2 volts	.7 volts
-6	1.1 volts	.35 volts
-12	.55 volts	.175 volts
-20	.2	.07 volts

514S-1 TERMINAL (CONTROL SITE) LINE LEVEL ADJUST

1. Equipment required - Floating ac voltmeter (or dB meter)

2. Connect the ac voltmeter to the output line (violet and grey on interconnecting cable).

3. Adjust the HB-21050 FS Transmitter LEVEL control for a voltmeter indication of the desired line level. *

4. Remove the ac voltmeter.

* The desired line level is determined by the type of common carrier being used. Normally for telephone circuits, the desired line level is 0 dBm. The following relationships apply.

dBm	PEAK TO PEAK	RMS
0	2.2 volts	.7 volts
-6	1.1 volts	.35 volts
-12	.55 volts	.175 volts
-20	.2 volts	.07 volts
-40	.02 volts	.007 volts

PROCEDURES FOR SETTING RECEIVER BIAS

A. NECESSARY EQUIPMENT

1. OSCILLOSCOPE

2. FUNCTION GENERATOR capable of providing a 10-millisecond square wave varying between 0 V and -6 V.

B. PROCEDURE

1. Disconnect the telephone circuit and jumper the transmit lines directly to the receive lines (red to violet and green to grey on the interconnection cable).

2. Remove the LOOP POWER SUPPLY (RFL HP-29330) from the RFL equipment rack, then energize the remainder of the RFL equipment.

3. Adjust the FUNCTION GENERATOR to give a square wave of 10-millisecond pulsewidths with one level at 0 V and the other between -5 V and -10 V. Connect the Function Generator output to the FS TRANSMITTER (RFL HB-21050-2 2F) through a 10 K ohm resistor to the "FS KEY" (BLUE) test point.

4. Connect the oscilloscope to the FS RECEIVER (RFL HB-19915 2F) "DC OUT NOR" (BLUE) testpoint.

5. Vary the receiver "BIAS" screwdriver adjustment to obtain 10-millisecond pulses as observed on the oscilloscope.

6. Secure the RFL equipment and remove the test set-up. Replace the LOOP POWER SUPPLY and reconnect the telephone circuit.

7. This completes the bias adjustment.

LOOP CURRENT ADJUSTMENT

PROCEDURE:

1. This procedure is the same for both the local and remote sites.

2. Place the 651S-1A or 514S-1 in the remote mode.

3. Remove the F.S. Receiver Filter HB58300 from its slot.

4. Adjust R1 on the RFL panel to get a 20 mA reading on the Transmit Loop Meter.

5. Adjust R2 on the RFL panel to get a 20 mA reading on the Receive Loop Meter.

6. Replace the F.S. Receiver Filter in its slot.

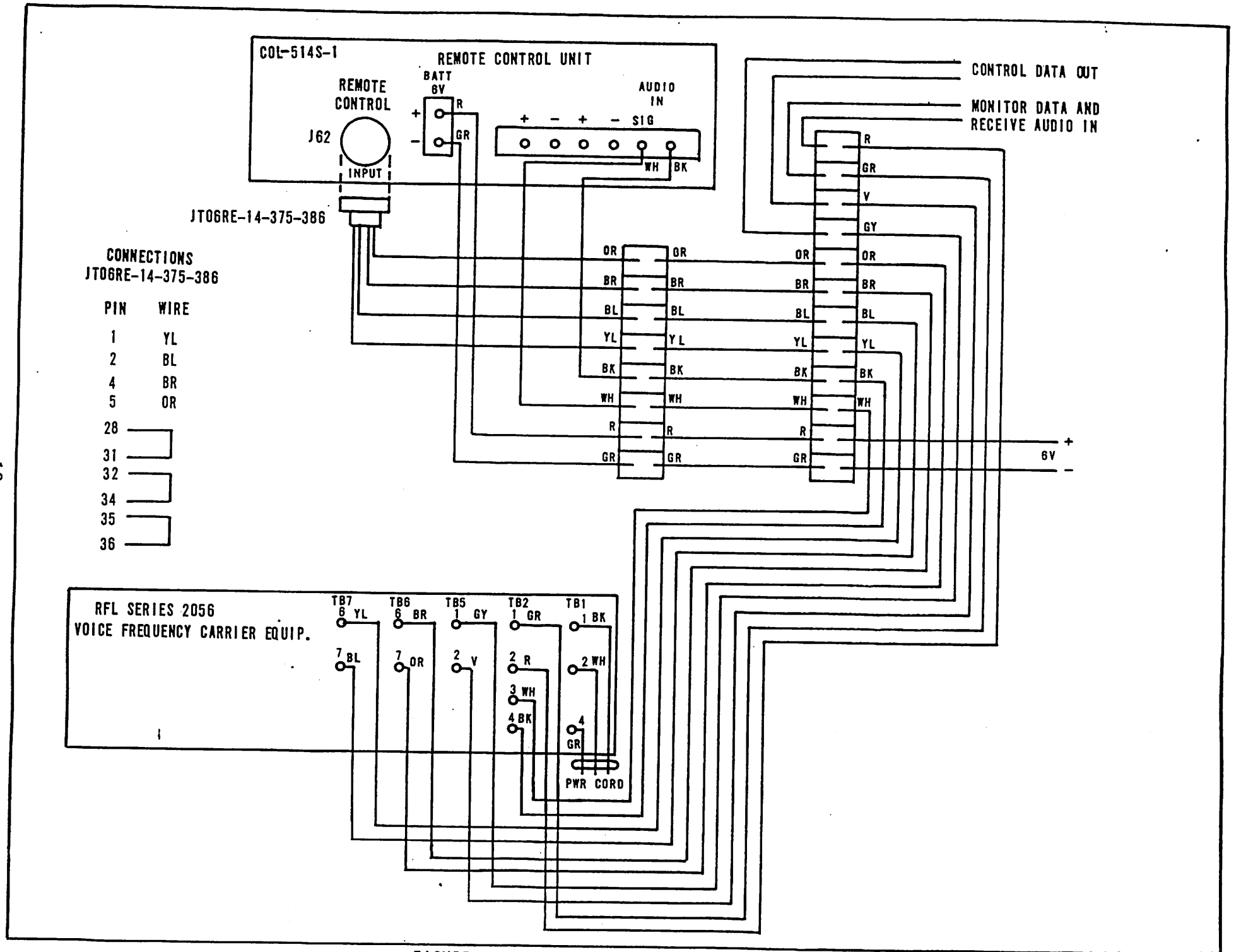


FIGURE 6 CONTROL SITE INTERCONNECTION DIAGRAM

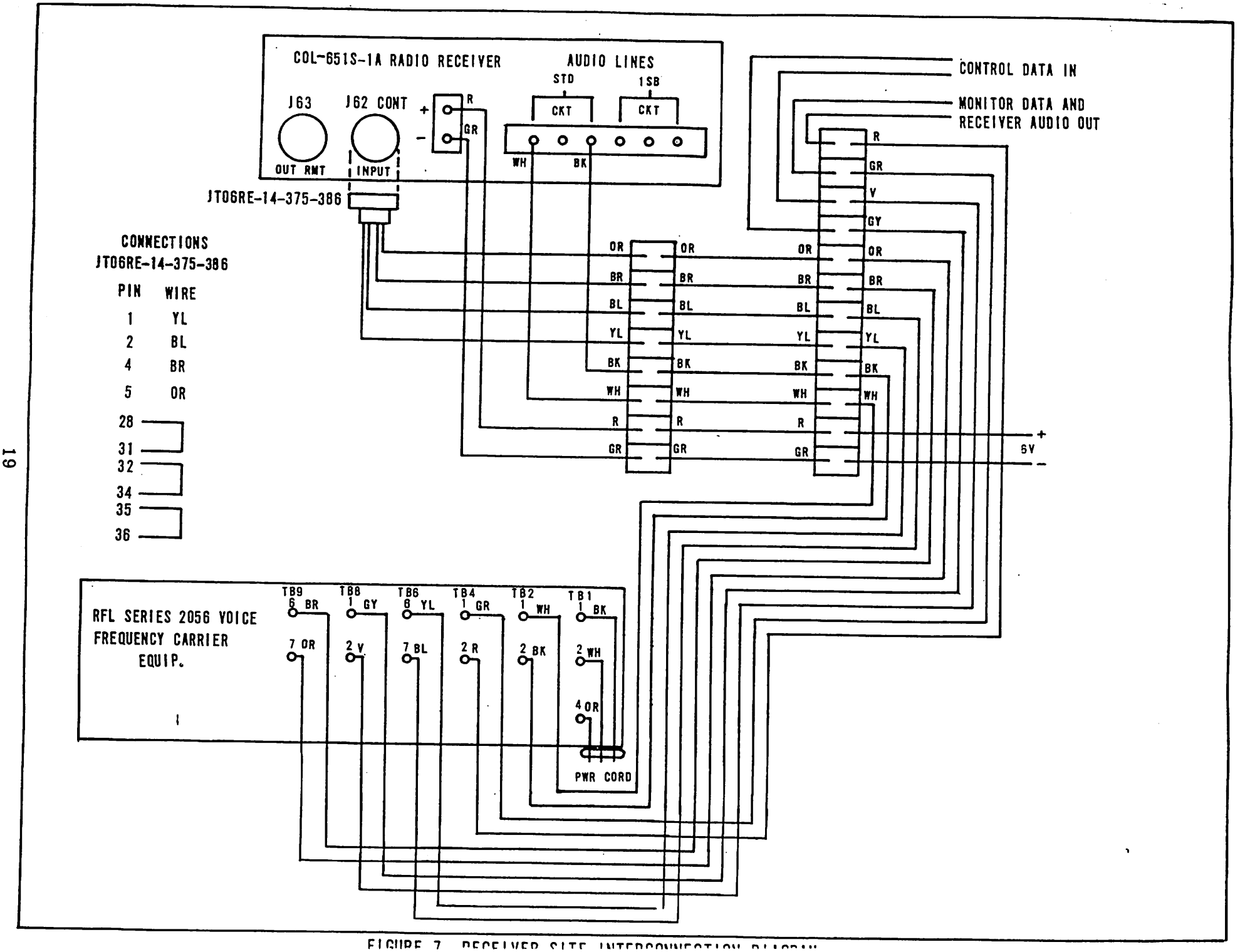


FIGURE 7 RECEIVER SITE INTERCONNECTION DIAGRAM