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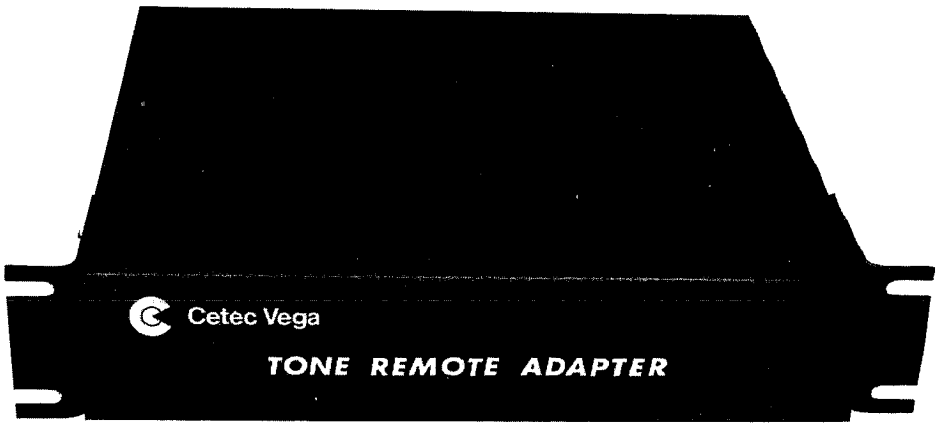
Instruction Manual

Cetec Vega

Model 215
Tone Remote Control Panel



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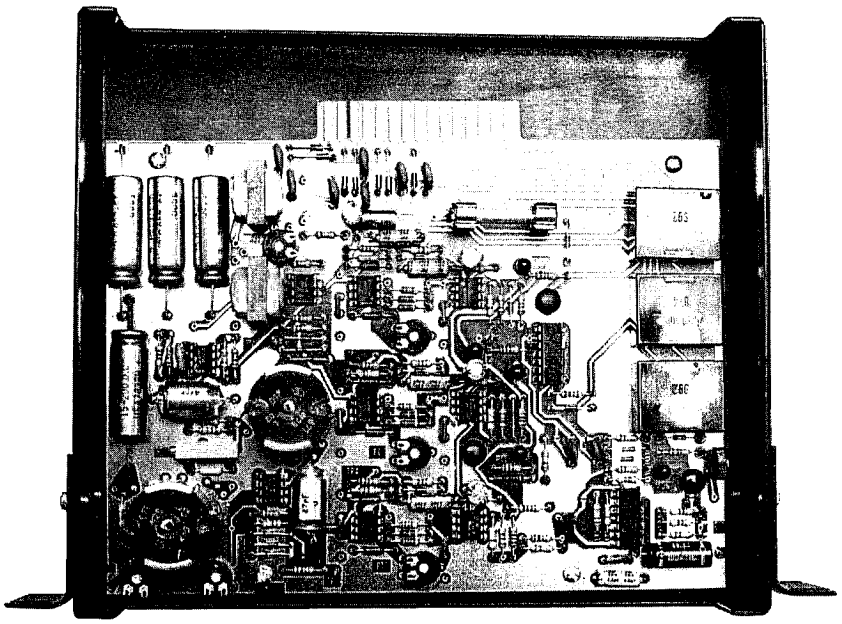

COVER REMOVED
(215FM MODEL)

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MODEL 215
TECHNICAL SPECIFICATIONS

LINE IMPEDANCE:	600 ohm nominal, or 1800 ohm maximum bridging. (Field - selectable)
INPUT LEVEL SENSITIVITY:	Adjustable to - 40dBm min. on PTT tone. Adjustable to - 30dBm min. on voice and control tones. System will tolerate -6, +12 level variations (within the above extremes) from originally selected operating level.
RECEIVER AUDIO INPUT IMPEDANCE AND LEVEL:	1.8 VRMS maximum; Input impedance equal to phone-line impedance (600 Ω, typical).
TRANSMIT AUDIO OUTPUT:	Adjustable to 2 V across 600 ohms, with 250 Vdc isolation (DC blocking). PTT tone attenuated at least 40 dB.
HYBRID BALANCE (Rejection):	Greater than 30dB.
DISTORTION:	Less than 2%.
TRANSMIT TONE FREQUENCY:	2175 Hz ± 0.3%
MONITOR BURST FREQUENCY:	1975 Hz ± 0.3%
F1 - F2 BURST FREQUENCIES: (Optional)	1975 Hz, 2375 Hz respectively. (In this option, the MONITOR burst = last selected F1, F2)
OUTPUTS (Relay Contacts):	All contacts are 2A @ 26 VDC or 1A @ 115 VAC: PTT (Keying) — DPDT MONITOR — DPDT F1 - F2 (Combined) — DPDT
CURRENT DRAIN STANDBY: TX:	130 mA (maximum) 320 mA (maximum)
INPUT VOLTAGE REQUIREMENT:	+10 to +18 VDC unregulated
POWER REQUIREMENT:	5 Watts maximum @ +12 VDC input.
OPERATING TEMPERATURE RANGE:	−30 to +70° C
FUSING:	Standard 3AG fuse on P.C. Board.
TELEPHONE LINE SURGE PROTECTION:	Available as a field-installable option.
CASE DIMENSIONS:	½ standard (19") rack-panel width, 1.75" height, and 7.25" depth.

INTRODUCTION

The Cetec Vega Model 215 tone remote adaptor provides a reliable means of remotely controlling the various functions of a radio communications base station.

The 215 is normally used in conjunction with Cetec Vega's functionally matching Model 504 tone remote console, located at the control site. The 215 is interconnected to the control site by means of any voice grade or better circuit. The 215 is compatible with private or leased telephone circuits, including microwave systems. Metallic or DC continuity is not required.

The 215 is offered in two versions. The first is a Model 215M. This model provides the decoding of the control tone mixed with the voice transmission from the control site. The tone is used to key the transmitter in the base station for the duration of the voice message. At the same time, a notch filter in the 215 removes the tone from the voice path prior to modulation of the transmitter so only voice is actually transmitted. Audio from the receiver is muted when transmitting. It also provides a monitor function for base stations that are protected by a tone coded squelch system.

Upon receiving a short tone burst from the control site on a specific frequency, it will unmute the protected base station receiver for approximately 6 seconds (adjustable). During this time, the operator can monitor the channel for other communications before initiation of his own transmission (FCC regulation).

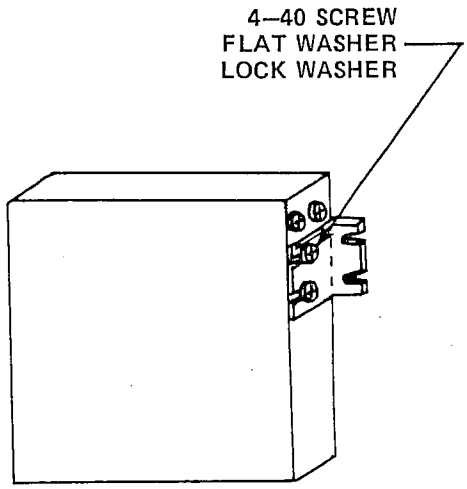
The second version is the Model 215 FM. This model provides the same functions as stated above, plus a two-mode selection. This is a set/reset function in which one of two modes is always engaged, and selection of one mode automatically disengages the other. A large variety of uses exist for this option, such as F1/F2 switching, and these are discussed in the "typical applications" section of this manual.

The 215 case is ½ standard-rack wide, one rack unit high and 7¼ inches deep (see specifications section of this manual for exact dimensions). A width extension to match 19" rack mounting can be ordered separately. The brackets can be attached to the 215 in several configurations to meet a variety of mounting requirements (see illustrations below).

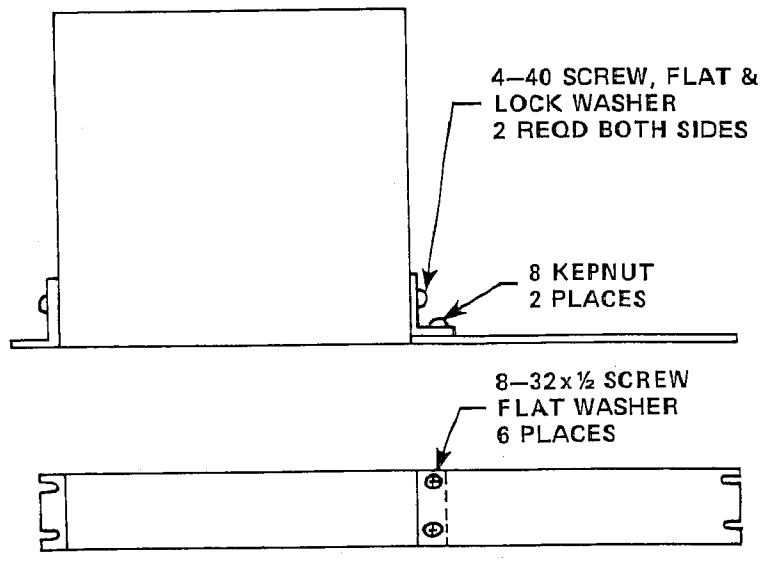
TYPICAL APPLICATIONS

The Model 215 can receive control tones and voice transmissions from single or multiple (parallel) tone remote consoles. The Model 215 FM can select two frequencies, unmute the tone squelch system and key the transmitter (see Figure 1). If desired, the F1/F2 function can be used for any set/reset functions such as turning on tower lights, changing from remote base configuration to a repeater mode at the remote site, or other on-off functions.

The Model 215 is intended to provide for both the reception and transmission of voice signals and the control tone decoding required to maintain full control over a remote base station.



215 WALL MOUNTING



215 WITH 19 IN. RACK ADAPTER (OPTIONAL)

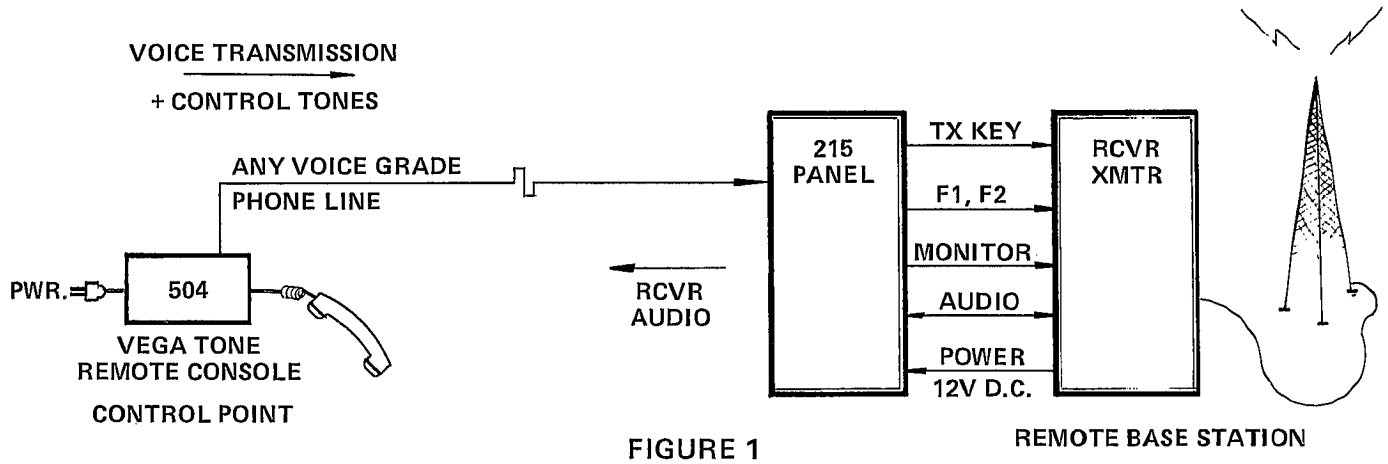


FIGURE 1

INSTALLATION

The 215 Panel can be located in any convenient location at the remote site using the hardware and brackets supplied. Areas of exposure to extreme dampness, temperature, and strong radio frequency radiation should be avoided for maximum life and reliability. Although not required for normal operation, installation of the following is recommended for maximum operator safety and equipment protection: (1) a low-resistance ground connection to the chassis of the 215 and (2) a telephone line surge-protection kit (available from Cetec Vega). Shielding of audio signals is always recommended in a remote site environment.

Refer to Figure 2 which illustrates a typical remote site installation of a Model 215 FM equipped with both factory options previously discussed. (This is intended as a guide only; several methods of interconnection are achievable with the 215).

Interfacing the 215 to radios with high gain, high impedance microphone inputs involves the following:

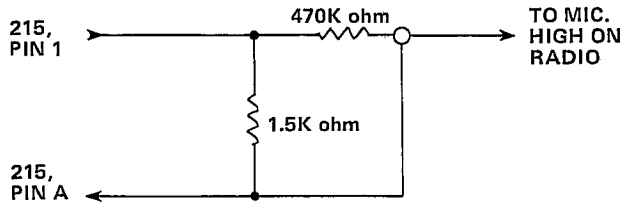
SYMPTON: 2175 Hz tone is excessive on the modulated output of the radio.

CAUSE: The 215 "TX audio" output at Pin 1 was designed to accommodate a wide range of microphone circuits, including carbon microphone types.

In some radios, even with the "TX level" adjustment at minimum, a very low level of 2175 Hz tone present is sufficient to modulate the radio greatly. Due to the audio limiters in the radio, the voice level (which is much greater than the 2175 Hz residual tone) does not modulate the radio's output proportionally.

SOLUTION: Reduce all levels taken from Pin 1 "TX audio" by using a simple resistive pad.

TYPICAL PAD:



Power consumption of the 215 is relatively low (less than 5 watts) enabling the user, in most applications, to tap off a +10 to +18VDC unregulated line inside the receiver/transmitter. If a +10 to +18VDC source is not available, a Cetec Vega wall-type power supply can be employed (available from Cetec Vega). Typically, "Receiver Audio", "TX Audio", and "Transmit Key" are available on the radio set connector. To enable optimum hybrid balance, the receiver audio should be from a 600 ohm source, and level not to exceed 1.8 VRMS. If the speaker output is used a resistive pad should be added. In Figure 2, negative keying is illustrated (i.e., transmit mode occurs with the key line grounded). As can be seen, any keying logic could be easily implemented using the relay contacts available.

To implement the dual frequency function, receiver/transmitter frequency control lines are alternately grounded through the 215 relay contacts to enable the selected frequency. Again, several logic schemes are possible utilizing the relay contacts.

For systems protected by tone squelch, the monitor relay contacts can be connected in such a manner as to disable the receiver tone squelch circuits when the "Monitor" function is activated.

ADJUSTMENTS

After installation is complete, verify the presence of a complete signal-path by reception at P1-2 and P1-B of transmissions initiated at the control site. This is necessary to insure proper connection at both ends of the line which is mandatory in the execution of the line termination procedure discussed next.

Model 215 panels utilize a hybrid transformer network to separate the receive and transmit signals. These hybrid transformers must be terminated by an impedance that matches the connected line for optimum operation. All untreated (un-equalized or un-conditioned) telephone lines carrying speech plus tone signals have an attenuation and an impedance which varies with frequency. The longer the line, the greater its distributed capacitance. This distributed capacitance between the conductors lowers the line impedance and increases the attenuation as frequency increases.

The characteristics of the customer's line cannot be predicted in advance; therefore, Model 215 panels are supplied with a variable resistor (R74) and pads to accommodate the installation of a capacitor, C35 (C35 is normally not required). The proper termination network must be determined and appropriate connections and adjustments made to the P.C. board during installation. To adjust the hybrid for optimum line termination, connect the telephone line to P1-2 and P1-B per Figure 2. Insert a 2175 Hz ± 10 Hz modulated RF signal into the receiver antenna connector such that a continuous tone appears across P1-3 and P1-C. Adjust the receiver for normal operating output level to a maximum of 1.8 VRMS (An alternate method would be injection of the audio signal to P1-3 and P1-C with an audio generator). Monitor the audio level at TP6 (see Figure 3 and 4) in the following steps: For short lines (less than 25 ft.) adjust R74 (LINE MATCH) for a null (minimum signal level) at TP6. Longer lines usually require selection of the proper shunt capacitor, C35. This is facilitated by temporarily connecting a switchable decade capacitor substitution box. Set the capacitor box for zero-capacitance and adjust R74 for a null, then increase the capacitance for an improvement in the depth of the null. Re-adjust R74 for minimum signal. Typical values of shunt capacitance range from .01 to 0.5 uF. For example, ten miles of uncompensated open-wire line will require about 0.1 uF. Multiconductor exchange cables have much higher shunt capacitance; however, this is usually compensated for by the telephone company at each repeater-amplifier. The hybrid-network is typically capable of providing greater than 45 dB separation at the PTT frequency if adequate care is used in selection of terminating impedances. Proper selection of the network can only be determined with the entire system connected for operation. Preliminary adjustments with the input/output lines replaced with artificial loads is generally not worthwhile. Full duplex or sidetone radios may cause feedback in transmit if maximum hybrid balance null is not achieved or if transmit and receive levels are set too high in the panel.

After completion of the line-termination adjustment, adjust the **output** level of the **504 remote console** with the PTT button pressed to achieve the desired received line level at P1-2 and P1-B of −10Bm.

Note that, due to the telephone company regulations, the maximum allowable signal input level to the telephone system at the control site must not exceed +18dBm. Since the PTT tone is typically 10 dB lower than the control tones and voice transmission, +8dBm is the maximum allowable line input level for the PTT tone. If it takes greater than +5dBm input in order to achieve −10dBm at the remote site, set the output of the 504 remote console for +5dBm and leave it. The sensitivity adjustment range of the 215 panel will adequately compensate for the losses in the phone lines.

Monitor input level TP6 and adjust the sensitivity of the 215 panel as follows: With the PTT tone being received, set (R81) input level adjust for .077 VRMS and observe illumination of the PTT indicator on the PC board. A meter must be used to insure continouous keying during voice in transmit. The sensitivity is now adjusted and it should be observed that the optional functions such as "Monitor" and "F1-F2" selection operate in a similar fashion when commanded at the control site.

The TX LEVEL is adjusted by R80 (TX LEVEL) to provide the proper transmitter modulation specified by the receiver/transmitter manufacturer as follows: At the 504 control site, insert a 1-kHz tone at the previously selected transmit audio level. If no generator is available the 504 will put out a continuous function tone by jumpering TP5 to the 504 chassis ground, which will be suitable for TX LEVEL setup. At the remote site, key the transmitter (contacts of the PTT relay can be jumpered) and adjust R80 (TX LEVEL) for proper modulation level per the manufacturer's specifications.

The receiver output level can be adjusted (to a maximum of 1.8 VRMS) at P1-3 and P1-C, to attain the desired received level at the control site. Refer to Figure 2 for typical remote site installation.

The adjustments remaining are specific field options which are dependent on the configuration of the panel as shipped from the factory. These options are summarized and tabulated here:

Bridged Input — allows reduced loading of telephone lines up to approximately 18 K ohm maximum. This option is implemented by removal of solder-bridge jumper, J5, and installation of R1 at the desired resistance value. The receiver output level must be increased in proportion to the input impedance increase to maintain normal line levels. The value of R74 must be changed to match the new impedance value and the hybrid balance procedure repeated. In some cases, sensitivity and drive levels at the control console may have to be increased.

De-sensitization — bridging J6 reduces sensitivity for adjustment ease in the presence of strong line signals. Typically J6 is bridged with inputs greater than -6dBm.

Monitor-Latch — In this configuration, the F1 or F2 burst sets the monitor-latch. The "Monitor" function will remain enabled until the PTT button is depressed. At the end of transmission and upon release of the PTT button, the "Monitor" function will again be enabled, but will drop out automatically at the end of its normally preset time period. To implement this function, open J2, J3 and J4, and Jumper J1.

Line Surge Protection— Cetec Vega offers a transient voltage suppressor kit which can be easily installed at the pins of the circuit card connector P1.

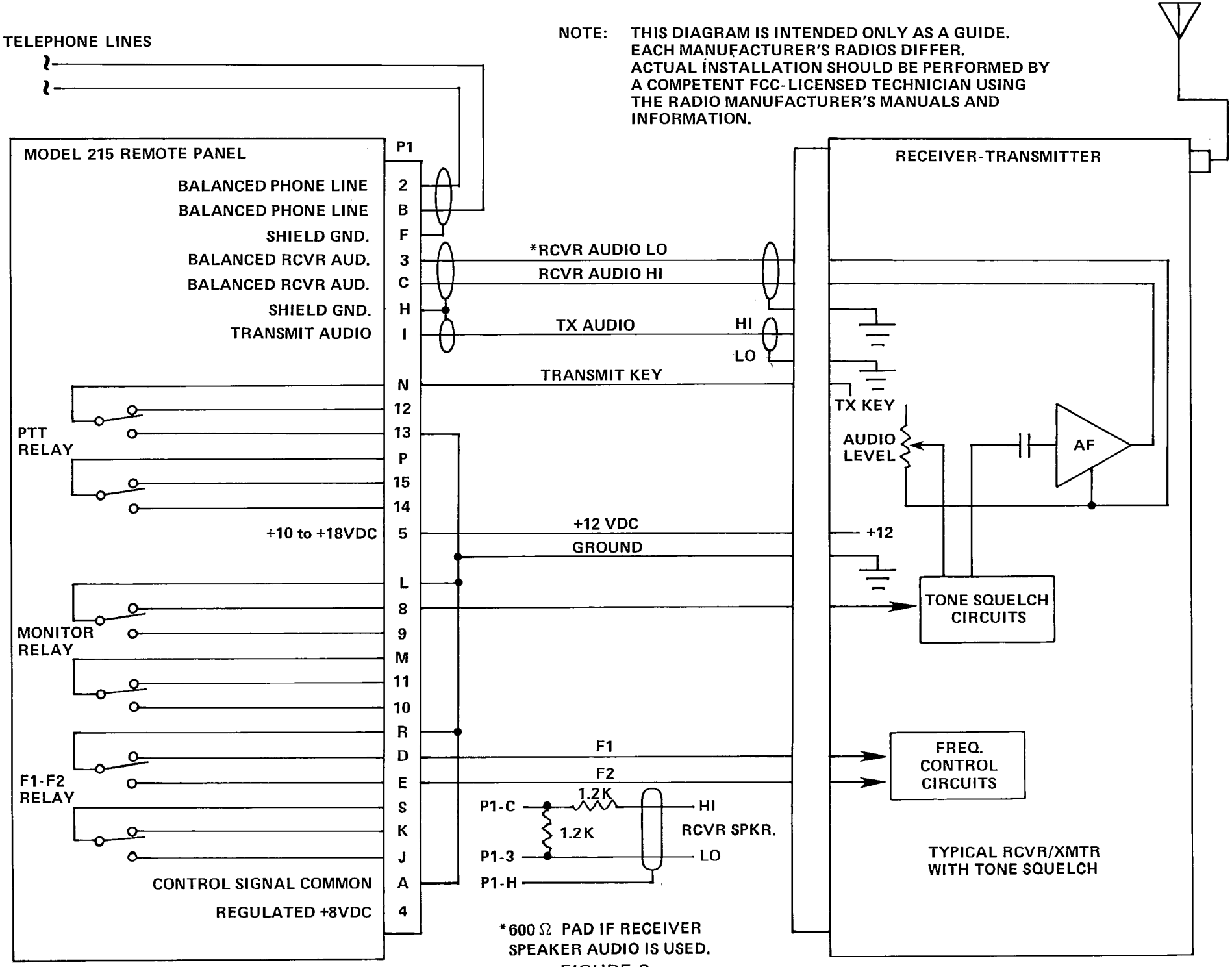

TELEPHONE LINES
NOTE: THIS DIAGRAM IS INTENDED ONLY AS A GUIDE. EACH MANUFACTURER'S RADIOS DIFFER. ACTUAL INSTALLATION SHOULD BE PERFORMED BY A COMPETENT FCC-LICENSED TECHNICIAN USING THE RADIO MANUFACTURER'S MANUALS AND INFORMATION.
MODEL 215 REMOTE PANEL
P1
BALANCED PHONE LINE 2
BALANCED PHONE LINE B
SHIELD GND. F
BALANCED RCVR AUD. 3
BALANCED RCVR AUD. C
SHIELD GND. H
TRANSMIT AUDIO I
N
12
13
P
15
14
+10 to +18VDC 5
L
8
9
M
11
10
R
D
E
S
K
J
CONTROL SIGNAL COMMON A
REGULATED +8VDC 4
PTT RELAY
MONITOR RELAY
F1-F2 RELAY
*RCVR AUDIO LO
RCVR AUDIO HI
TX AUDIO
HI
LO
TRANSMIT KEY
+12 VDC
GROUND
F1
F2
P1-C
1.2K
HI
1.2K
RCVR SPKR.
P1-3
LO
P1-H
*600 Ω PAD IF RECEIVER SPEAKER AUDIO IS USED.
RECEIVER-TRANSMITTER
TX KEY
AUDIO LEVEL
AF
+12
TONE SQUELCH CIRCUITS
FREQ. CONTROL CIRCUITS
TYPICAL RCVR/XMTR WITH TONE SQUELCH

FIGURE 2

THEORY OF OPERATION

Signals on the telephone line enter the Model 215 through a passive hybrid network consisting of T1, T2, R74 and C36. When the line impedance is properly matched by R74 and C36, incoming signals appear only across R81 (INPUT LEVEL ADJ.), and outgoing signals (receiver audio at T1-1 and T1-6) appear only on the phone line. The net effect is that of a high degree of isolation between receiver audio and transmitter audio. This allows both transmission and reception of signals on the same line.

The line signal is tapped off R81 (INPUT LEVEL) and appears amplified 20dB at TP6 by U1A (0dB gain is achieved by jumpering J6). The signal at TP6 consisting of the PTT tone and voice transmission received from the control site is further amplified by U1B after the PTT tone is removed by the notch filter, L1 and associated circuitry. The depth of the notch (attenuation of the PTT frequency) is adjusted for maximum by R10 (NOTCH DEPTH). The amplified voice signal out of U1-B appears on P1-1 as the transmitter audio drive and is adjustable by R80 (TX LEVEL) to achieve proper transmitter modulation. Control tones will also appear on P1-1, but never during the transmit function.

The signal at TP6 also appears at the input of U3B and the bandpass filter circuit comprised of L2 and U2A. This circuit prevents line audio from dominating the PTT limiter, U2B, during voice plus PTT tone conditions. The signal at TP6 is limited by U2B and U3B to provide a constant amplitude squarewave of approximately 45mV P-P at the input of the decoder-filters and 3.5 VP-P at TP2 or TP3.

The PTT decoder-filter consisting of U4A, U4B, and U5A typifies the three state-variable decoder-filters. The bandpass center frequency is adjusted by R17 and a signal of the correct frequency (2175 Hz) will appear at TP4 at approximately .85 VRMS. The bandwidth is determined by the ratio of R5 to R11 and is approximately 4% of the center frequency.

The bandpassed signal at TP4 is detected by U5B, a comparator circuit typical of two others. When the decoded tone is present, U5B pin 7 goes high, turning on Q1 which activates the PTT relay, K1, and PTT indicator DS1. The F1-F2 detectors are disabled during PTT activation by R26, CR8, and CR6 and monitorlatch (U11C, U11D) reset occurs. When the PTT tone ceases, the output of U5B goes low, de-activating the PTT relay and triggering the monitor-timer circuit consisting of Q4, U11A, U11B.

The F1-F2 detectors set and reset the F1-F2 latch (U10A, U10B). In the F1 state, U10C drives Q2 which activates K2 and illuminates the F1 indicator, DS2. In the F2 state, U10D drives Q3 which illuminates the F2 indicator, DS3. The F1 or F2 detector also sets the monitor-latch (U11C, U11D) or triggers the monitor-timer (U11A, U11B) depending on the state of jumpers J1, 2, 3, and 4.

The monitor-latch field option (J1 bridged, J2, 3, and 4 open) allows the F1, F2 or MONITOR tone to activate the monitor-relay, K3, so that it stays on until the initiation of the PTT tone resets it. The monitor-relay is then reactivated for only the timer period upon termination of the PTT (end of transmission).

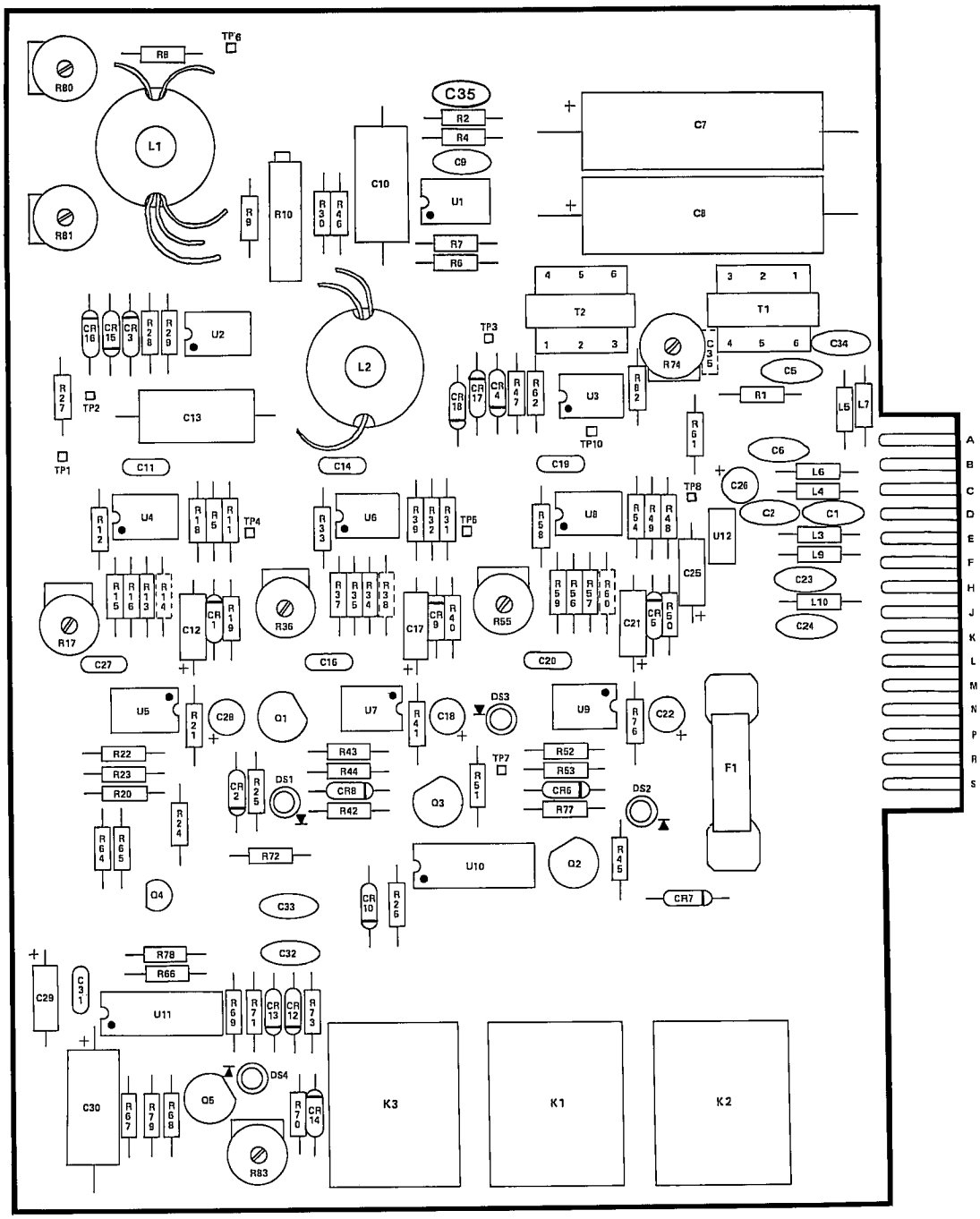
The monitor-timer field option, (J1 open, J2, 3, 4, bridged) provides a timed "Monitor" period for the operator upon transmission of any control tone burst (F1, F2 or MONITOR) and upon termination of the PTT tone (end of transmission). The timing period (set at the factory for 3 seconds) is determined by the values of C30, R83, and the threshold of the Schmitt-trigger circuit, U11A and U11B.

MAINTENANCE

In the event that output functions do not result from control tones transmitted from the control site, first check the D.C. power into the 215 panel at P1-5. if +10 to +18 VDC is present, measure the regulated voltage at test point TP7, which should be +8.0 VDC. Assuming the voltage is correct, monitor the INPUT LEVEL test point (TP6).The AC voltage of a received PTT tone at this point should be approximately .25 VRMS, the level set up per procedure during the original installation. If this level has changed, it would be advisable, before readjusting the INPUT LEVEL pot (R81), to check the hybrid operation per the installation procedure. A possible change on the condition of the phone-line connecting the 215 to the control site or modifications at the control site (such as the improper addition or removal of a parallel control-console) may have altered the line impedance presented to the 215 panel. If this is the case, the telephone line will have to be re-terminated per the installation procedure; after that, the INPUT LEVEL pot may also need adjustment to achieve .25 VRMS at TP6. These same problems would also be suspected if transmitter audio drive were suddenly inadequate.

Assuming signals are being received at the correct levels and the voltage at TP7 is correct, the limiter circuits can be observed with an oscilloscope. Refer to the schematic, Figure 5. TP2 and TP3 should show the approximate levels and frequencies indicated on the schematic when the associated control tones are received. These signals are next processed by their associated state-variable filter circuits, the outputs of which appear at TP4, 5, and 8 at the indicated levels on the schematic. If the signals are present, then detector outputs (pin 7 of U5, 7 and 9) should be greater than 5.5 VDC, and the associated function relays should be activated through the latch circuits by Q1, 2, and 5.

The Cetec Vega Service and Engineering Staff is always available for consultation. Problems can often be solved in a timely fashion through a simple phone call. Cetec Vega signaling products are guaranteed to be free from defects in material and workmanship for a period of three years from the date of shipment. Waranty is for factory repair or replacement only.



NOTES: THE ABOVE PARTS LAYOUT REPRESENTS THE MODEL 215FM.

SOME PARTS WILL NOT BE PRESENT IN THE 215M MODEL. REFER TO SCHEMATIC DIAGRAM.

FIGURE 3

PARTS LAYOUT DIAGRAM

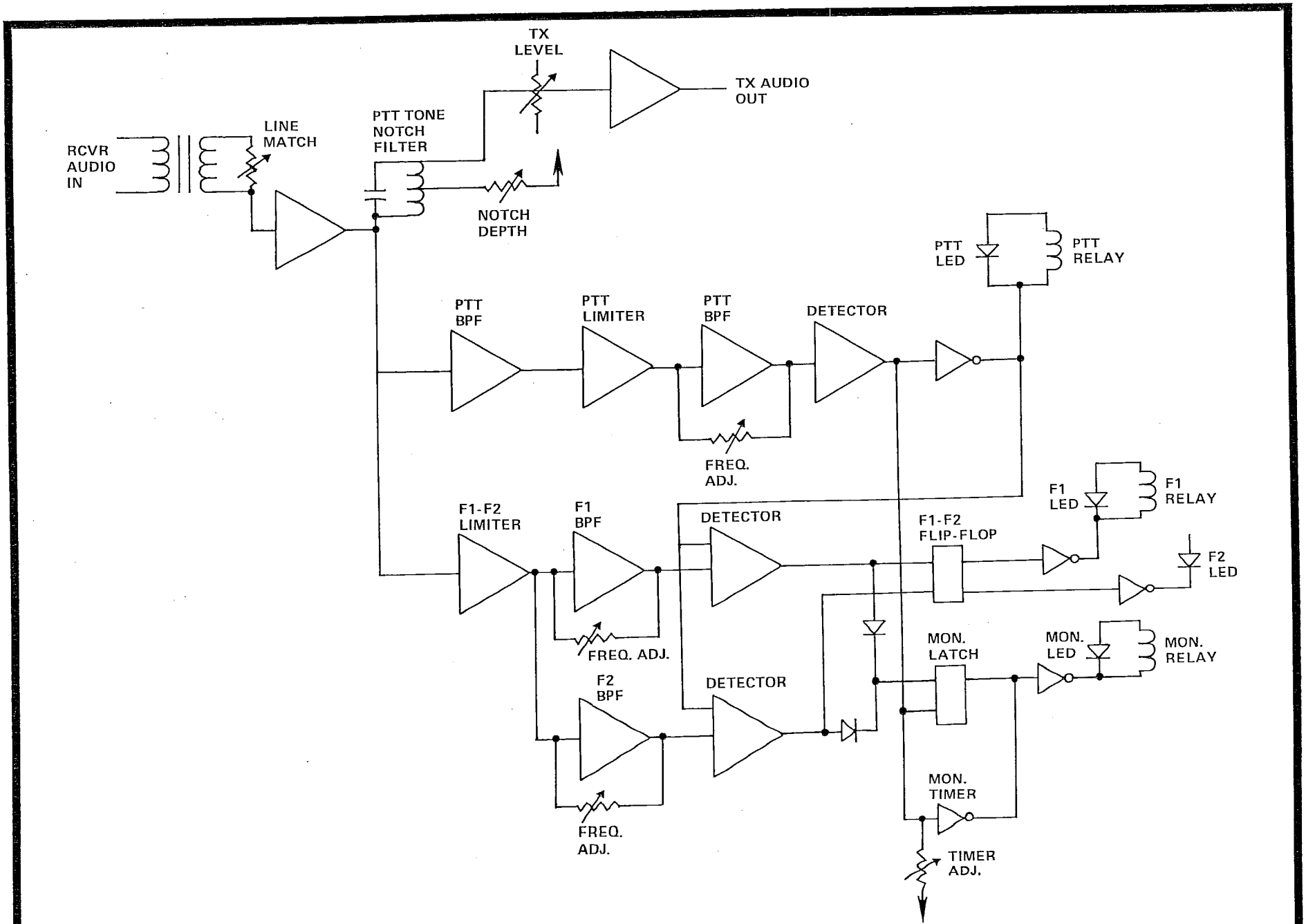


FIGURE 4 – BLOCK DIAGRAM

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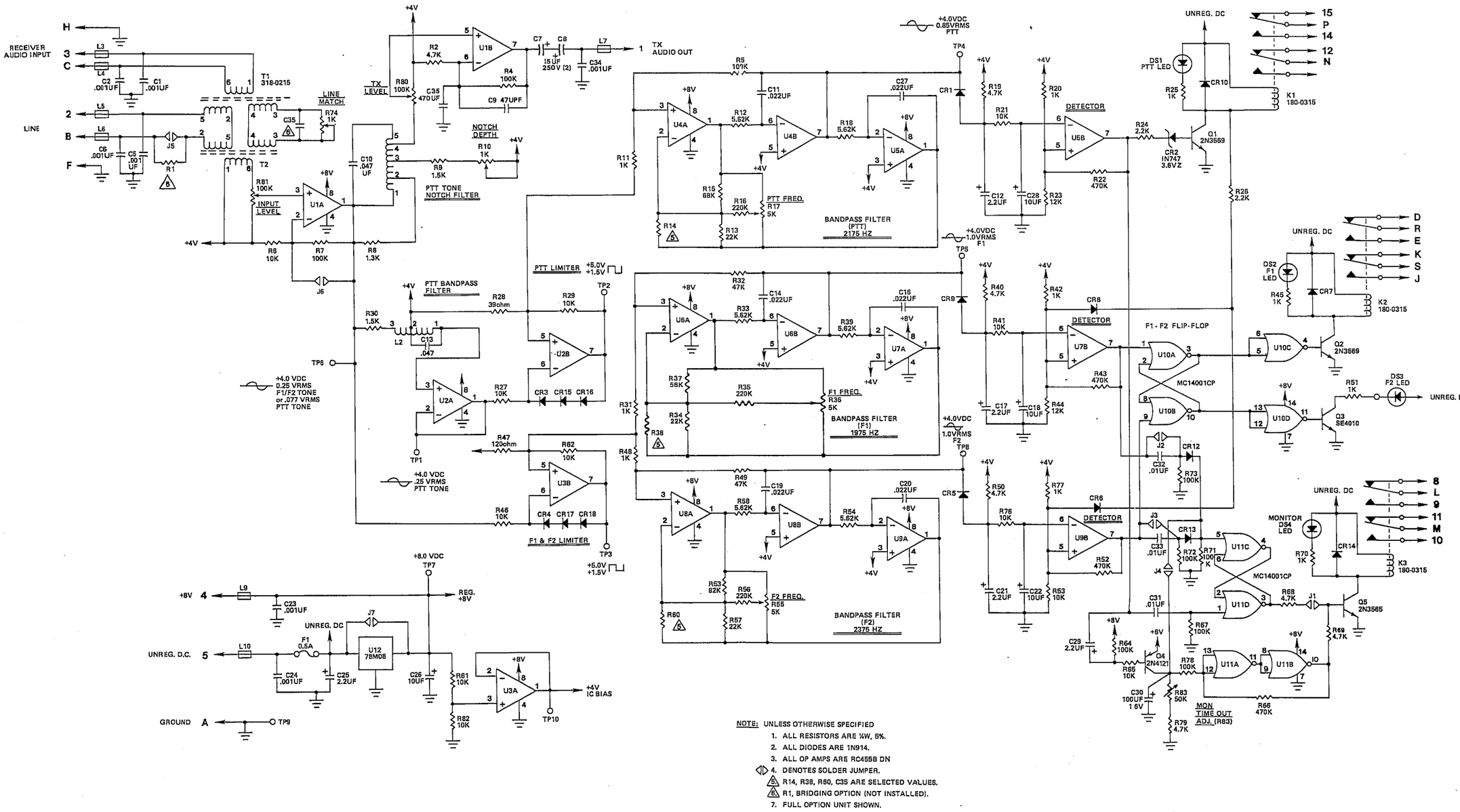

NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE ¼W, 5%.
2. ALL DIODES ARE 1N914.
3. ALL OP AMPS ARE RC4558 DN
4. ◁▷ DENOTES SOLDER JUMPER.
5. ⚠5 R14, R38, R60, C35 ARE SELECTED VALUES.
6. ⚠6 R1, BRIDGING OPTION (NOT INSTALLED).
7. FULL OPTION UNIT SHOWN.

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SCHEMATIC DIAGRAM — 215 REMOTE PANEL
FIGURE 5