



a Mark IV company  
Signaling Products Group

## Instruction Manual

098-0314

### Model C-514B Four-Frequency Tone-Remote Control Console



## Introduction

Vega's tone-remote consoles provide reliable remote control of the various functions of a two-way-radio base station.

The Model C-514B console is normally used in conjunction with a functionally matching Vega Model RP-223-4 tone-remote control panel, located at the base-station site. The C-514B is compatible with GE, Motorola, and other radio tone-remote control systems which employ similar tone formats.

A Vega tone-remote console is connected to the remote base station by means of any voice-grade or better network, and is compatible with private or leased telephone circuits, including microwave links in the connecting network. Metallic or DC continuity is not required.

The basic C-514B tone-remote console is supplied and ready to operate in the two-wire mode with handset and speaker, and with push-to-talk, CTCSS monitor, notch filter, and four frequency-select functions installed and operational.

Jumpers are provided for simplex or duplex four-wire operation, for enabling the speaker when off-hook, and for proper line-terminating impedance with multiple consoles per line. A jumper has also been provided to change from 1-of-N four-frequency operation to paired F1/F2 and F3/F4 operation (whereby the F3/F4 control tones are generated only by F3 or F4 switch operation and not by PTT switch operation). Wide-range DIP-switch frequency programming of the F3 and F4 function tones has also been provided.

## Operation and Controls

The C-514B tone-remote console is designed for maximum ease of operation. Minimum operator familiarization is required. The following controls and indicators are provided and can be identified from the front-cover photograph:

- **Volume Control:** Adjusts both speaker and earpiece audio level.
- **Transmit PTT Switch:** Push to talk (generates PTT tone) and release to listen; located inside the handset handle.
- **Transmit Lamp:** When lighted, indicates console (or a parallel console) is transmitting (required by FCC rules).
- **Intercom:** When pushed, removes control tones and allows the operator to talk into the network (such as to a parallel console or to a technician at the remote base station) without keying the remote transmitter. Pushing the PTT switch on the handset is not required.
- **CTCSS Monitor:** When pushed momentarily, causes the base-station receiver equipped with a subaudible-tone (CTCSS) decoder to monitor all activity on the radio channel, by disabling the CTCSS decoder. This function reduces the

possibility of accidentally interfering with other cochannel users, and is required by FCC rules for stations equipped with subaudible signaling. The monitor function is also activated when the handset is lifted off hook.

- **Parallel-Console Notch Filter:** Removes the PTT tone from receive audio when a parallel console is transmitting. This circuit is required whenever two or more consoles are controlling the same base station, and is supplied as standard.
- **Frequency Selection:** As shipped (1-of-N mode), when an F1, F2, F3, or F4 switch is pressed momentarily, it will latch on and release the other channel, and cause a four-frequency station to switch to the desired channel. LED indicators show which channel is selected.

**NOTE:** When a console switches from one channel to the other, that change is not indicated on parallel consoles. However, when a PTT, F1, F2, F3, or F4 switch is pushed on a parallel console, a new frequency command is generated, thereby placing the remote station on the channel indicated on that console. (The monitor switch does not generate a new frequency command.)

**NOTE:** Monitor and frequency-selection commands and voice signals are audible at parallel consoles, thereby providing an audible indication of activity or that commands are being generated elsewhere in the radio system. (The continuous PTT tone is notched out and cannot be heard on parallel consoles; however, a PTT tone detector ahead of the notch filter causes the transmit LED to glow.)

- **Frequency Selection in Paired Mode:** In this mode of operation, F1 and F2 will operate the same as in the 1-of-N mode, with F1 or F2 frequency-select tone bursts from F1, F2, or PTT switch operation. The F3 and F4 switches, however, are now isolated from the F1, F2, and PTT switches and will not be affected by their operation. When the F3 or F4 switch is pressed momentarily, it will latch on, generate a function-tone burst, and release the other F3 or F4 latch.

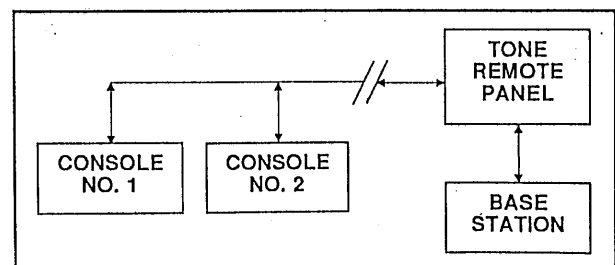


Figure 1. Overall system block diagram.

NUMBER OF CONSOLES	TWO-WIRE LINE				FOUR-WIRE LINE				
	J18	R93	RX LOSS	TX LOSS	J18	R93	R94	RX LOSS	TX LOSS
1	CLOSED	820 $\Omega$	0 dB	0 dB	CLOSED	820 $\Omega$	680 $\Omega$	0 dB	0 dB
2	CLOSED	1.5 k $\Omega$	0 dB	0 dB	CLOSED	1.3 k $\Omega$	680 $\Omega$		
3	OPEN	X	0 dB	0 dB	CLOSED	2.7 k $\Omega$	750 $\Omega$		
4	↑	X	1 dB	1 dB	OPEN	X	820 $\Omega$	↑	0 dB
5		X	2 dB	2 dB		X	1 k $\Omega$		1.0 dB
6	OPEN	X	3 dB	3 dB	↓	X	1.1 k $\Omega$	↓	1.9 dB
7						X	1.2 k $\Omega$		2.7 dB
8					OPEN	X	1.5 k $\Omega$	0 dB	3.4 dB

Chart 1. Programming for line-terminating mode. Jumpers in this chart are for the first console only. All parallel consoles should have J18 open for a two-wire line and J18, J15 open for a four-wire line.

## Typical Applications

The C-514B console can be used as a single unit or in parallel with other consoles on the same network, to control a remote base station (as shown in Figure 1). Referring to Figure 1, two consoles are tied to a single leased telephone line feeding a Vega tone-remote control panel at the base station. Either console can exercise full control over the remote base station by use of the push buttons and the handset. With the C-514B, a sequence of tones is generated each time the PTT switch on the handset is pushed, insuring security and constant status updating of the remote base station.

All base-station activity, whether from a radio or from a parallel console, can be monitored over either the speaker or the handset. Thus, it is unlikely that one console operator would inadvertently interfere with any other console operator. One console operator can talk with another console operator, without keying the remote base transmitter, simply by pushing the INTERCOM switch on the front panel.

The interconnections shown in Figure 1 are typical. Additional consoles may be connected to the common leased telephone line to control the remote base station. (Custom Vega consoles are available for selecting lines to other remote base stations, selecting additional frequencies, controlling other functions, status monitoring, etc. Contact the Vega factory for assistance with your special system requirements.)

## Installation

The C-514B tone-remote console may be installed in any location convenient to the operator. Exposure to extreme dampness, temperature, and radio-frequency energy should be avoided for maximum life and reliability.

If the console is to be used in the factory-prepared, single-console, two-wire-line, line-terminating, "simplex" (actually, half-duplex), 1-of-N mode of operation, the only installation required is to plug the wall power supply into a wall socket and connect the modular line plug to the modular jack of a leased line or audio pair.

For multiple consoles, four-wire line, line bridging, paired mode, or duplex operation, refer to DISASSEMBLY instructions, to Chart 1 or Chart 2, and to the schematic.

NOTE: The console units are not designed to operate on lines carrying direct current. If direct current is on the line, isolate with external capacitors or with a 600-600-ohm transformer designed for the current involved.

## Disassembly and Setup

Access to internal jumpers and controls is obtained by loosening two large screws on the bottom of the console and "folding" the case forward. This procedure opens up the entire unit for setup or maintenance. Make sure that the wall power supply is unplugged before opening the console, to prevent accidental short circuits during assembly and disassembly.

### Two-Wire-Line Operation

J16 and J19 are closed, and J17 and J20 are open, per factory programming.

### Four-Wire-Line Operation

J17 and J20 are closed, and J16 and J19 are open. (Open J16 and J19 with an Exacto knife, and close J17 and J20 with a small soldering iron.)

### Line-Bridging Operation

When other equipment is loading the line, open J15 and J18 (open J18 with an Exacto knife). Refer to Chart 2 for losses introduced. The loss shown in the RX column is also the loss introduced into the other equipment if the source and terminating impedance of the other equipment is 600 ohms.

NUMBER OF CONSOLES	TWO-WIRE LINE J18 OPEN		FOUR-WIRE LINE J15, J18 OPEN	
	RX LOSS	TX LOSS	RX LOSS	TX LOSS
1	1.2 dB	0.3 dB	0.3 dB	0.0 dB
2	2.3 dB	1.4 dB	0.6 dB	0.9 dB
3	3.3 dB	2.3 dB	0.9 dB	1.6 dB
4	4.2 dB	3.2 dB	1.2 dB	2.4 dB
5			1.5 dB	3.0 dB
6			1.8 dB	3.6 dB
7			2.0 dB	4.2 dB
8			2.3 dB	4.8 dB

Chart 2. Programming for line-bridging mode.

## Multiple-Console Operation

Open J15 and J18 on all except one console. Refer to Chart 1 for programming that one console.

## Duplex Operation

Close J5 for duplex operation on four-wire lines (not designed for two-wire duplex operation).

## Level Adjustments

The C-514B console is factory-adjusted for +10 dBm guard tone, 0 dBm function tone, and -20 dBm PTT tone into a 600-ohm resistive load. Leased lines or audio-pair lines seldom present an exact 600-ohm load to the console, and the measured levels probably will be somewhat different. R42 allows adjustment of all output levels simultaneously if other levels are desired.

For continuous PTT tone output for measurement or adjustment purposes, press the PTT switch. For a continuous guard tone, jumper TP2 to TP8 (GND) and press the F1 switch. For a continuous function tone, jumper TP1 to TP8 (GND) and press the F1, F2, F3, F4, or MON switch, depending upon which function tone is desired. (Note: Upon pressing the MON switch, a lockup occurs until the jumper is removed.)

Voice level is factory-preset for a peak-to-peak output level typically equal to the function-tone peak-to-peak level. An oscilloscope and typical voice should be used to measure the voice level. The compressor limits the line output power, and a sinewave, if used for this check, would have much greater power for a given peak-to-peak voltage output.

Output from the auxiliary input is controlled only by the input level, and gives about a 2-dB gain from auxiliary input to line output.

## Input-Level Adjustment

Input-level sensitivity is factory-adjusted to just above the threshold of compression with typical line loss. If greater sensitivity is required, adjust the LINE INPUT SENS control (R73) clockwise. If less sensitivity is required, adjust R73 counter-clockwise.

Compressor sensitivity should not be increased beyond that required by line loss, because increased sensitivity amplifies line and background noises during pauses in voice transmissions—without increasing the level of voice reception.

## Microphone-Sensitivity Adjustment

Microphone sensitivity has been factory-adjusted to cause about 10 dB of compression from a typical male voice directly into the microphone. If greater sensitivity is required, adjust the MIC SENS control (R71) clockwise. Microphone sensitivity should not be advanced beyond that required for the operator's voice, because increased sensitivity increases transmitted room background noise during pauses in voice transmissions—without increasing the level of the transmitted voice.

## Timer Adjustments

The C-514B guard-tone and function-tone duration is factory-adjusted for 130 ms and 40 ms, respectively. If tones of other durations are desired, adjust the guard tone with R11 and the function tone with R10.

## Tone-Burst Frequencies

Console tone frequencies are factory-programmed by a diode matrix to 2175 Hz (PTT/guard), 2050 Hz (monitor), 1950 Hz (F1), and 1850 Hz (F2), and DIP-switch programmed to 1750 Hz (F3) and 1650 Hz (F4). Refer to Chart 3 to program F3 and F4 to other frequencies. Other PTT, MON, F1, and/or F2 fre-

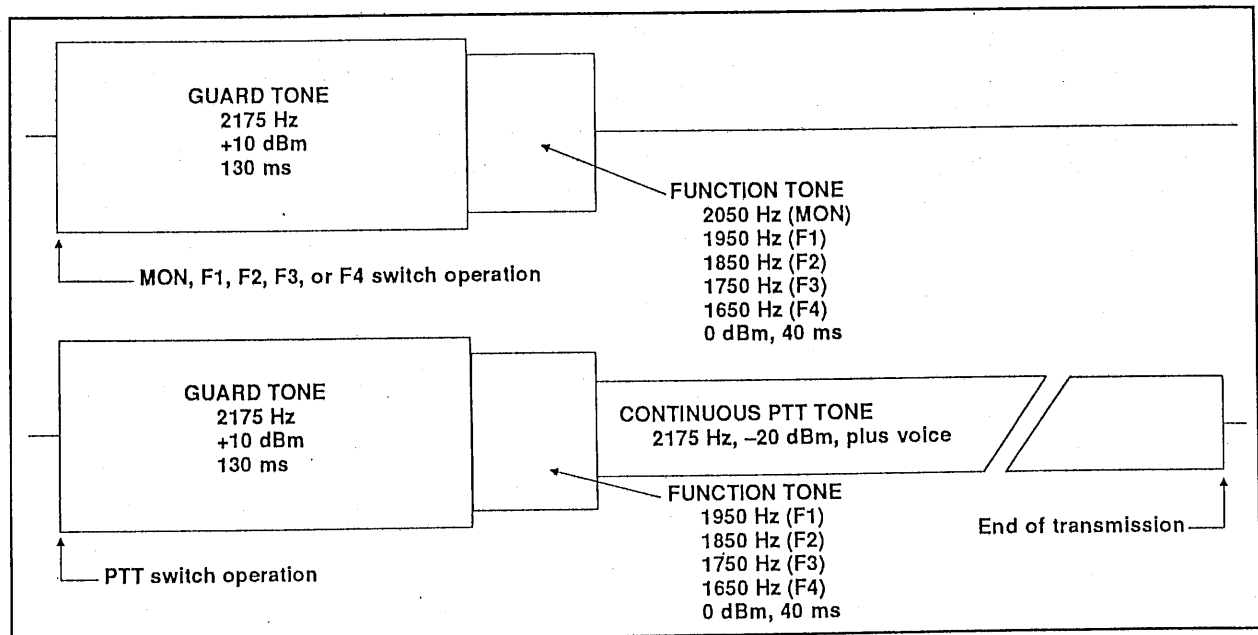


Figure 2. C-514B tone sequence chart.

quencies may be obtained on special order and at extra cost.

### Paired Operational Mode

To change mode of operation from the 1-of-N mode to the paired mode, close J4. If an automatic switch to F4 is desired upon going off hook, close J3.

### Speaker Mute

The speaker is normally muted when the handset is lifted off-hook. If off-hook speaker operation is desired, close J7.

### Theory of Operation

Crystal oscillator Y1 and U8-2,9 drives an 8-bit programmable divider U1. The most significant bit at U1-14 is wired high, causing the programmable division range to be 255 to 128. This provides an output at U1-15 of from 11.088 kHz to 22.09 kHz. U5, U6-8,9,10,11,12,13 and U4-1,2 comprise a programmable divide-by-2 counter. U15 is a divide-by-10 counter used to synthesize a sine wave. The output frequency range of U15 is therefore 554.4 Hz to 2209 Hz. The synthesized sine wave has a strong tenth harmonic, which is greatly attenuated at the low-pass filter output U16-1.

At idle, the crystal oscillator is disabled by a high at U8-1. Going off-hook or operation of a MON, F1, F2, F3, or F4 switch triggers guard-tone timer (U2-3,4,13), which then enables the crystal oscillator and the "+10 dB" gate at U11-13. The 2175-Hz programming diode (CR2) is enabled by the "off" state of the function-tone timer at U2-1. A "+10 dB" 2175-Hz output therefore is delivered to the line through R23, U16-6,7, LINE LVL potentiometer R42, line driver U22, and transformer T2.

Timeout of the guard-tone timer after 130 ms triggers the function-tone timer at U2-15, which enables the 0-dB gate at U11-5, disables the 2175-Hz programming diode, and enables MON, F1, F2, F3, or F4 programming, depending upon which switch has been pressed. Timeout of the function-tone timer after 40 ms of operation returns conditions to the idle state.

PTT switch operation causes the same sequence of operation as above, except that upon function-tone timer timeout, the crystal oscillator remains enabled and the "-20 dB" 2175-Hz PTT tone is delivered to the line through R22 for as long as the PTT switch is held.

Going off-hook or monitor-switch operation triggers the guard-tone timer and sets the monitor latch at U2-7, which then lights the monitor LED through U13-2,15. The low at U13-15 is also applied to U12-5. This disables all U12 latch outputs without changing the logic of any of the latches. F1, F2, F3, and F4 programming and LEDs therefore are disabled. Monitor-frequency programming diodes CR6 and CR7 are enabled by the combination of a set monitor latch and function-tone timer operation. Timeout of the function-tone timer resets the monitor latch, which then reenables output from the U12 latches.

Operation of one of the frequency-select switches (F1, F2, F3, F4) sets one of the U12 latches and applies a reset logic to all four of the latches through DN5, CR17, and RN4. When a U12 latch is simultaneously set and reset, set dominates and Q goes high. Upon release of the frequency-select switch, the set input of U12 remains high for about 1 ms longer than the reset input, due to the charge on one of the 0.01-μF capacitors, the associated latch remains set, and whichever of the other latches which had been previously set has now been reset.

FUNCTION TONE FREQUENCY	S1 OR S2 SWITCH POSITION								PERCENT ERROR
	1	2	3	4	5	6	7	8	
1750	0	0	1	0	0	0	1	0	-0.265
1650	0	0	1	0	1	0	1	1	+0.213
1550	0	0	1	1	0	1	1	0	+0.230
1450	0	1	0	0	0	0	1	1	±0.000
1350	0	1	0	1	0	0	0	1	+0.213
1250	0	1	1	0	0	0	1	0	+0.088
1150	0	1	1	1	0	1	1	0	-0.053
1050	1	0	0	0	0	1	1	1	-0.265
950	1	0	0	1	0	1	0	1	-0.124
850	1	0	1	0	0	1	1	0	+0.195
	1/2	64	32	16	8	4	2	1	
		BINARY VALUE							
		0 = SWITCH OFF							
		1 = SWITCH ON							

Other function-tone frequencies may be obtained by using the formulas below, where

$f$  = function-tone frequency, and

$N$  = binary value of switch positions 2 through 8

$f = 282,750 / (N + 128)$  when switch position 1 is off

$f = 141,375 / (N + 128)$  when switch position 1 is on

$N = (282,750 / f) - 128$  when switch position 1 is off  
(program to the nearest whole number)

If the desired  $N$  is greater than 255, switch position 1 must be on, and the following formula used:

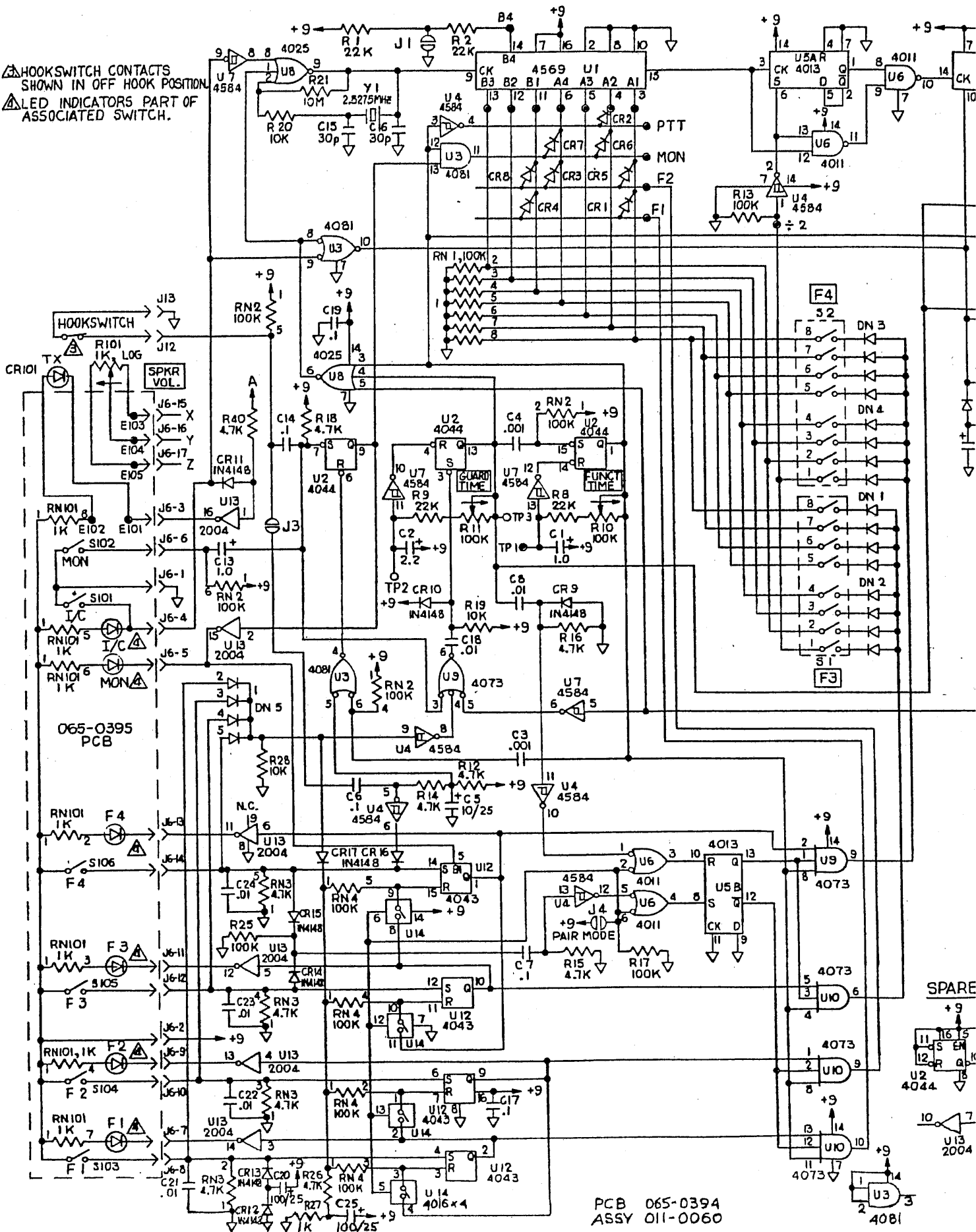
$N = (141,375 / f) - 128,$

and program to the nearest whole number

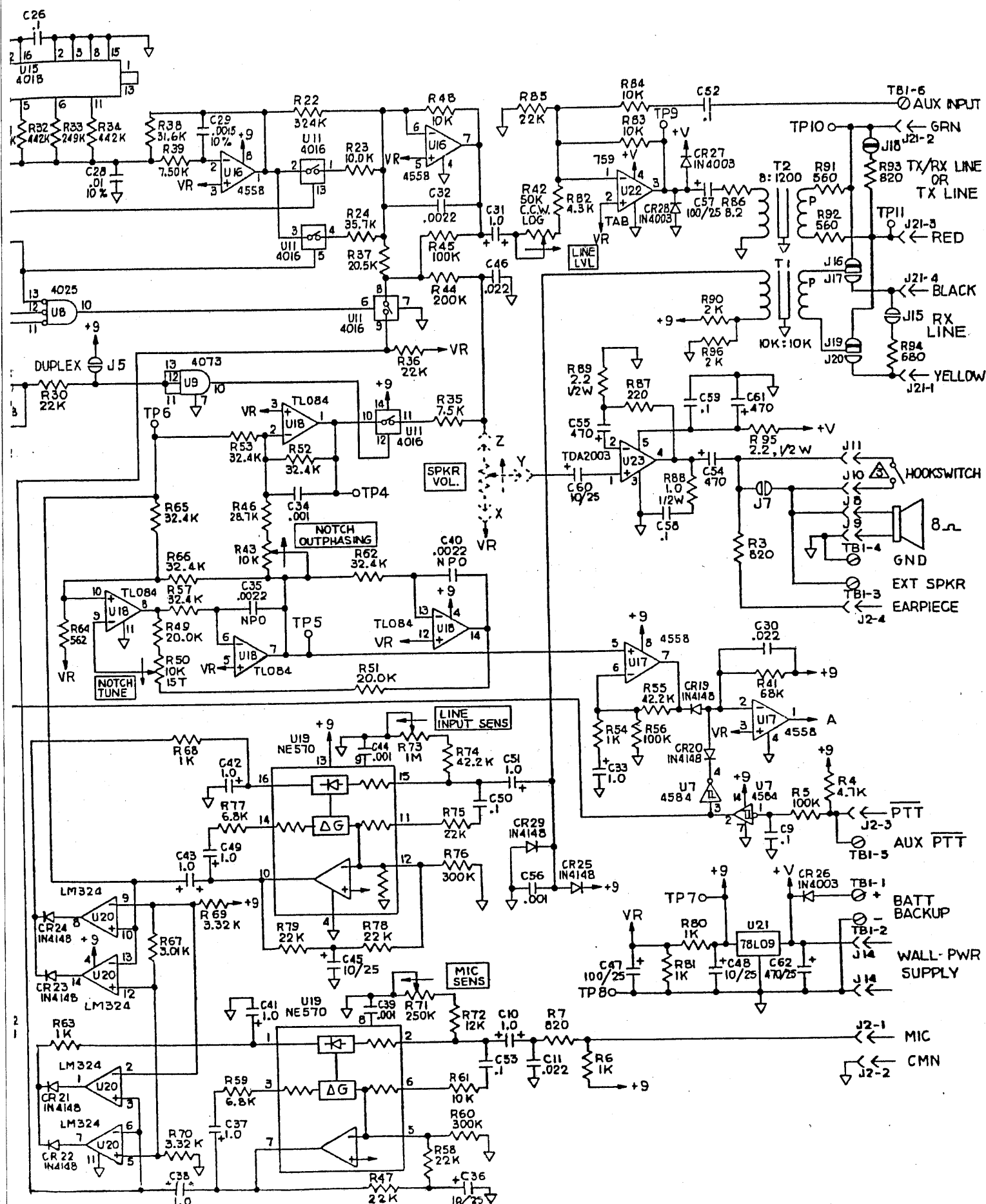
Although the maximum frequency range is from 554.4 Hz to 2209 Hz, the maximum frequency range used in any one system must not exceed 3 to 1 minus 100 Hz. This is due to the strong third harmonic generated by typical decoder limiters at the base station. (Exception: Model D-342C-type decoders do not have this limitation.)

Chart 3. DIP-switch settings for F3 and F4 function-tone frequency programming.

△ HOOKSWITCH CONTACTS  
SHOWN IN OFF HOOK POSITION.  
△ LED INDICATORS PART OF  
ASSOCIATED SWITCH.



PCB 065-0394  
ASSY 011-0060



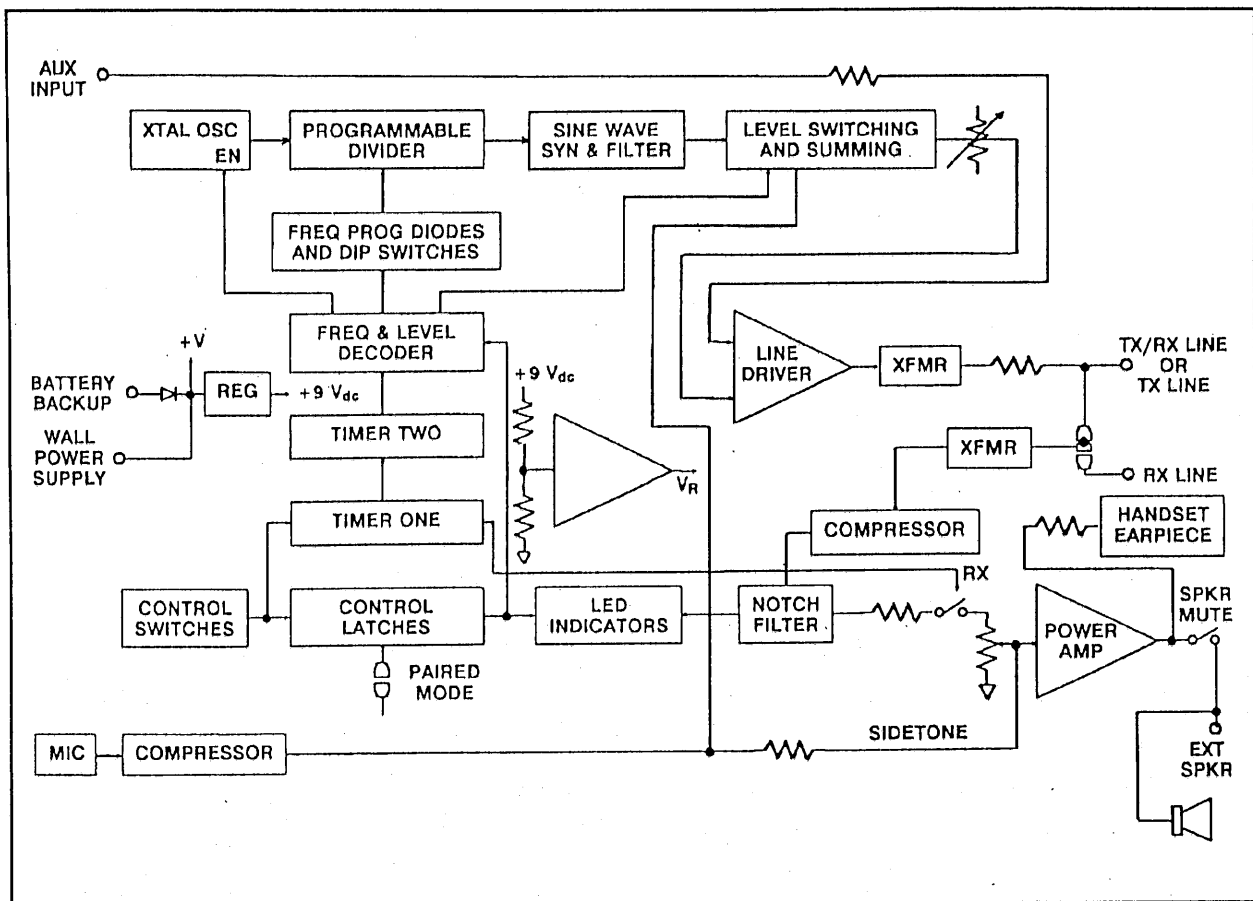


Figure 3. C-514B block diagram.

A frequency-select LED is energized through U13 and one of the U10 or U9-2 inputs is high from the set latch. When the function-tone timer is triggered, one of the U10 or U9-9 outputs goes high, enabling F1, F2, F3, or F4 programming. (U9-1, U10-3,2,12 are all high, due to the highs at U5-8 and U5-10.)

When J4 is closed (paired mode), U5-8 and U5-10 are low at idle. F3 or F4 switch operation applies a set pulse to U5-8 through CR14 or CR15, C7, U4-13;12, and U6-5,4. Simultaneously, the guard-tone timer is triggered, which applies a reset pulse to U5-10 through C8, U4-11;10, and U6-1,3. The set pulse is 10 times longer than the reset pulses. The set pulse prevails and only F3 or F4 programming is enabled during function-tone operation. F1 or F2 switch operation generates only the reset pulse, which resets U5B, if set, and enables only the F1 or F2 programming. PTT-switch operation also generates only the reset pulse, which insures that only F1 or F2 programming is enabled during function-tone timer operation. Closing J4 also activates U14, which connects Q to the reset input of the other latch of the pair. If one of the pair of latches is set, the other, consequently, is reset.

In the 1-of-N mode, upon power up, the F1 latch is set with a 470-ms pulse at U12-4 by C20 through CR13. A 47-ms set pulse is also applied to the F4 latch by C5 through U4-5,6 and CR16. A 100-ms reset pulse

generated by C25 is applied to all latch reset inputs. Only the F1 latch, therefore, is set.

In the paired mode, the C25-to-latch reset input path is short-circuited effectively by the activated analog gates (U14). Both the F1 and F4 latches, therefore, are set.

In the receive mode, signals present on the 600-ohm line are coupled through T1 to the input of compressor U19 at pins 11 and 15. Maximum gain of the compressor is determined by the bias voltage on capacitor C42. This bias voltage is determined by the resistance from U19-15 to ground, which is set by LINE INPUT SENS control R73. Input signals are full-wave rectified within U19. When this rectified input signal exceeds the bias set by R73, it charges C42 to a higher voltage level, which lowers stage gain and thus maintains a near-constant average output signal at U19-10 for all inputs above the bias threshold.

Output signals from compressor U19-10 drives the 2175-Hz notch/bandpass filter U18. Bandpass output at U18-7 is amplified and rectified by U17 to light the TX LED. The TX LED is also energized by the PTT switch through U7-1,2,3,4, CR20, U17-2,1, and U13-1,16. This causes TX LED activation from the PTT switch when the system is operated over a four-wire line.

Bandpass output is summed with an unfiltered signal at U18-2, causing a sharp notch at the U18-1 output



when the two signals have been adjusted for equal amplitude by R43 and for 180° phase shift by R50.

Notched output signals from U18-1 are conducted through analog gate U11-10,11 and R35 to the high side of volume control R101, and then to the speaker and earpiece through power amplifier U23. Analog gate U11-10,11 is disabled during PTT, intercom, and tone burst, unless the unit has been solder-bridged for duplex operation.

In the transmit mode, audio from the handset microphone is compressed by the other section of U19 in the same manner as receive signals. Compressor maximum gain set by MIC SENS control R71 has been factory-adjusted to be typically 10 dB into compression from a loud male voice directly into the microphone. Compressor output at U19-7 is conducted through analog gate U11-9,8 and R37 to the transmit audio summing point at U16-6. Transmit voice audio from U11-8 through R44 to the high side of the volume control provides sidetone voice audio to the earpiece and speaker. Low-level guard-tone and function-tone signals are also heard in the earpiece and speaker from U16-7, through R45 and R44, since analog gate U11-9,8 is off during these tones.

When J5 is closed for duplex operation (four-wire line only), the receive audio path is enabled at all times by a high at U11-12, but the microphone-to-line path is enabled at U11-6 only from PTT-switch operation after tone-burst completion or from intercom-switch operation.

## Technical Assistance

Vega products are engineered to meet your requirements of performance, reliability, and compatibility. Technical assistance is offered by correspondence or telephone, should it be required, to assure your satisfaction.

## Warranty (Limited)

All Vega signaling products are guaranteed against malfunction due to defects in materials and workmanship for three years, beginning at the date of original purchase. If such a malfunction occurs, the product will be repaired or replaced (at our option) without charge during the three-year period, if delivered to the Vega factory. Warranty does not extend to damage due to improper repairs, finish or appearance items, or malfunction due to abuse or operation under other than the specified conditions, nor does it extend to incidental or consequential damages. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. This warranty gives the customer specific legal rights, and there may be other rights which vary from state to state.

## Claims

No liability will be accepted for damages directly or indirectly arising from the use of our materials or from any other causes. Our liability shall be expressly limited to replacement or repair of defective materials.

## SPECIFICATIONS

### Input Impedance

**Two-Wire:** 600  $\Omega$  or 2.6 k $\Omega$ , transformer-isolated

**Four-Wire:** 600  $\Omega$  or 8 k $\Omega$ , transformer-isolated

**Line Input Level:** -28 dBm to +12 dBm, adjustable

**Output Impedance:** 600  $\Omega$  or 2.6 k $\Omega$ , transformer-isolated

**Line Output Level:** -25 to +12 dBm into a 600- $\Omega$  line

**Audio Compression (Receive and Transmit):** Less than 3 dB change in output level for a 20-dB change in input above threshold

**Distortion:** 2% maximum at full compression

**Hum and Noise:** 50 dB below operating levels

**Speaker:** 4 inch, 8  $\Omega$ , heavy-duty

**Amplifier Power:** 1.7 W at 10% THD into 8 ohms; 2.25 W at 10% THD into 4  $\Omega$  (8- $\Omega$  internal speaker plus external 8- $\Omega$  speaker); 5 W (intermittent-duty speech) at 10% THD into 4  $\Omega$  (external speaker) with optional power supply

**Handset Earpiece Level:** Volume-control adjustable

**Sidetone Level:** About 25 dB below receive level

**Audio Frequency Response:**  $\pm 1.5$  dB, 300 to 3000 Hz, except at the transmit tone notch frequency

**Notch Filter:** 2175 Hz; typically attenuates the parallel console PTT tone by 45 dB

**Tone Frequencies and Accuracies:** PTT, 2175 Hz, 0.01%; MON, 2050 Hz, 0.1%; F1, 1950 Hz, 0.01%; F2, 1850 Hz, 0.2%; F3, 1750 Hz, 0.3%; F4, 1650 Hz, 0.2%

**Operating Temperature Range:** 0 to +50°C

**Power Requirements:** 117 V<sub>ac</sub>, 60 Hz, 8 W, or 11.5 to 18 V<sub>dc</sub> at 105 mA idle to 500 mA at 2.25 W output and 600 mA at 5 W output

**Visual Indicators:** LEDs for MON, F1, F2, F3, F4, INTERCOM, and TX

**Line Interface:** Two-wire or four-wire, line-terminating or line-bridging, solder-bridge selectable

**Operating Modes:** Simplex with two-wire line, simplex or duplex with four-wire lines

**Miscellaneous:** Crystal-controlled, DIP-switch-programmable F3 and F4 tone frequencies; adjustable duration of tones; electret microphone element; modular-cord line connector; auxiliary audio input terminals; external-speaker terminals; battery-backup input terminals; speaker mute when off-hook (defeatable)

## C-514B Parts List

Part No.	Description	Ckt Sym			
105-1002	CAP MYLAR .0015MF 10% 100				C29
105-1009	CAP MYLAR .022MF 10% 100V				C11
					C30
					C46
105-1099	CAP MYLAR .01MF 10% 100V				C 8
					C18
010-0566	C-514B 4-F TONE CNTL CNSL				C21
011-0060	TOP ASSY C-514B				C22
098-0314	MAN INST C-514B				C23
					C24
012-0007	SUB ASSY PHONE BASE				C28
012-0016	PCB ASSY C-514B MAIN				C 6
021-6589	PANEL FRT C-514 FINISHED		110-1340	CAP CER .1MF SMALL	C 7
021-6597	SPEAKER FOR C-514				C 9
031-0196	TEST SPEC C-514B				C12
065-0395	PCB C-514B SWITCH				C14
071-0513	SCHEMATIC C-514B				C17
130-0751	RES VAR 1K LOG	R101			C19
138-0044	RNET CMN 7X1K SIP	RN101			C26
161-0564	LED RED 250 MTG 6"WIRES	CR101			C50
249-0121	HANDSET ELECTRET PTT				C52
296-0588	SWITCH PCB PUSH MOM W/LED	S101			C53
		S102			C58
		S103			C59
		S104			C32
		S105	110-1345	CAP CER .0022MF 5% NPO	C35
		S106			C40
450-0016	PWR SUPPLY 12DC .5A UNREG				C 5
475-1403	LUG SPADE #5 26-22GA(TIN)		112-1606	CAP ELEC 10MF 25V	C36
517-0183	WASH FLAT NYLON3/8ODX5132				C45
528-0003	SCREW PH 4-40X1/4				C48
528-0022	SCREW PH 6-32 X 1/4				C60
528-0259	SCREW PH 3-28X1/4 TYPE B				C 1
536-0357	NUT TINNEMAN 1/4 DIA		112-1608	CAP ELEC 1.0MF 20% 25V	C13
536-0358	NUT TINNEMAN .187ID PERM				C33
550-0243	KNOB BLACK1/2OD 1/8I				C37
561-0654	SPACER #6 3/8SELFRETA1				C41
674-0226	CORD PWR 2C 24 GA				C42
674-0239	CORD TEL MDULR 7'PLG-PLG				C49
674-0242	CABLE FLAT 17POS .1S 6"L				C51
850-0331	LABEL ID TONE CONSOLE				C20
869-0024	CASE TELEPHONE BEIGE		112-1609	CAP ELEC 100MF 20% 25V	C25
					C47
012-0007	SUB ASSY PHONE BASE				C57
523-0081	RIVET 1/8 X 1/4 POP				C2
523-0107	RIVET FOOT ATTACHING		112-1673	CAP ELEC 2.2MF 20% RAD	C10
531-0272	SCREW CABINET LOCK CA		112-1678	CAP ELEC 1.0UF 50V NP	C31
					C38
012-0016	PCB ASSY C-514B MAIN				C43
031-0196	TEST SPEC C-514B				C54
065-0394	PCB C-514B MAIN		112-1689	CAP ELEC 470MF 25V RAD	C55
071-0513	SCHEMATIC C-514B				C61
102-0160	CAP CER 30P S2L 5% 50V	C15			C62
		C16			C27
105-1001	CAP MYLAR .001MF 10% 100V	C 3	112-1703	CAP ELEC 0.22UF 50V 20%	
		C 4	130-0529	RES VAR 50K HOR MT	R43
		C34	130-0629	RES VAR 10K HOR MT	R10
		C39	130-0643	RES VAR 100K HOR MT	R11
		C44			R50
		C56	130-0673	RES VAR 10K 20T 3/8SQ	

130-0684	RES VAR 250K HOR MT	R71		R48
130-0742	RES VAR 1MEG-OHM V-ADJ	R73		R61
132-0004	RES RN55C 32.4K 1% 1/4W	R52		R83
		R53		R84
		R57	136-0045 RES COMP 12K 5% 1/4W	R72
		R62	136-0048 RES COMP 22K 5% 1/4W	R 1
		R65		R 2
		R66		R 8
133-0001	RES CRBN 1.0 OHM 5% 1/2W	R88		R 9
133-0002	RES CRBN 2.2 OHM 5% 1/2W	R89		R30
		R95		R36
134-0212	RES RN55D 10.0K 1% 1/4W	R23		R47
134-2859	RES RN55D 35.7K 1% 1/4W	R24		R58
134-2867	RES RN55D 7.50K 1% 1/4W	R35		R75
		R39		R78
134-2877	RES RN55D 20.0K 1% 1/4W	R49		R79
		R51		R85
134-2885	RES RN55D 562. 1% 1/4W	R64	136-0054 RES COMP 68K 5% 1/4W	R41
134-2894	RES RN55D 3.01K 1% 1/4W	R67	136-0056 RES COMP 100K 5% 1/4W	R 5
134-2947	RES RN55D 249K 1% 1/4W	R31		R13
		R33		R17
134-2996	RES RN55D 3.32K 1% 1/4W	R69		R25
		R70		R45
134-3010	RES RN55D 324.K 1% 1/4W	R22		R56
134-3017	RES RN55D 442K 1% 1/4W	R32	136-0080 RES COMP 10M 5% 1/4W	R21
		R34	136-0096 RES COMP 2K 5% 1/4W	R90
134-3042	RES RN55D 31.6K 1% 1/4W	R38		R96
134-3043	RES RN55D 20.5K 1% 1/4W	R37	136-0289 RES COMP 200K 5% 1/4W	R29
134-3045	RES RN55D 42.2K 1% 1/4W	R55		R44
		R74	136-1956 RES COMP 300K 5% 1/4W	R60
134-3046	RES RN55D 28.7K 1% 1/4W	R46		R76
136-0003	RES COMP 8.2 5% 1/4W	R86	136-1958 RES COMP 4.3K 5% 1/4W	R82
136-0024	RES COMP 220 5% 1/4W	R87	138-0017 RNET CMN 7X100K SIP	RN1
136-0029	RES COMP 560 5% 1/4W	R91	138-0048 RNET CMN 5X4.7K SIP	RN3
		R92	138-0053 RNET CMN 5X100K SIP	RN2
136-0030	RES COMP 680 5% 1/4W	R94		RN4
136-0031	RES COMP 820 5% 1/4W	R 3	161-0366 DIODE 1N4003	CR26
		R 7		CR27
		R93		CR28
136-0032	RES COMP 1K 5% 1/4W	R 6	161-0426 DIODE 1N4148	CR 1
		R27		CR 2
		R54		CR 3
		R63		CR 4
		R68		CR 5
		R80		CR 6
		R81		CR 7
136-0040	RES COMP 4.7K 5% 1/4W	R 4		CR 8
		R12		CR 9
		R14		CR10
		R15		CR11
		R16		CR12
		R18		CR13
		R26		CR14
		R40		CR15
136-0042	RES COMP 6.8K 5% 1/4W	R59		CR16
		R77		CR17
136-0044	RES COMP 10K 5% 1/4W	R19		CR18
		R20		CR19
		R28		CR20

		CR21				U14
		CR22	425-0105	IC OPAMP	4558 DUAL	U16
		CR23				U17
		CR24	425-0158	IC CMOS	4013 DUAL D FF	U5
		CR25	425-0164	IC CMOS	4011 QUAD 2NAND	U6
		CR29	425-0171	IC CMOS	4081 QUAD 2AND	U3
162-0001	DNET CMNA QUAD DIODE SIP	DN1	425-0178	INT CKT	NE570N	U19
		DN2	425-0181	IC OPAMP	TL084 QUAD BFET	U18
		DN3	425-0186	IC CMOS	4018 PROG CNTR	U15
		DN4	425-0203	IC CMOS	4569 PROG CNTR	U1
162-0002	DNET CMNC 4XCR	DN5	425-0204	IC CMOS	4025 TRIP 3NOR	U8
165-1216	XTAL 2.8275MHZ HC-18	Y1	425-0206	IC CMOS	4584 HEX TRIG	U4
286-1773	TERM STRIP 6 PIN MINI	TB1				U7
286-1784	PWR JACK PC BD 2.5MM	J14	425-0207	IC OPAMP	LM324 QUAD	U20
286-1830	CONN PCB MODULAR HANDSET	J2	425-0215	INT CKT	ULN2004A	U13
286-1831	CONN PCB MODULAR LINE	J21	425-0235	INT CKT	UA759	U22
286-1851	RECPT PCB SPADE LUG DUAL	J 8	425-0262	IC CMOS	4044 QUAD LATCH	U2
		J 9	425-0273	INT CKT	CD4073B	U 9
		J10				U10
		J11	425-0274	INT CKT	CD4043B	U12
		J12	425-0448	IC REG-P	78L09 9V .1A	U21
		J13	425-0454	IC PWRAMP	TDA-2003V	U23
286-1855	RECPT PCB 17 POS SIP	J6	517-0186	WASH FLAT #4	NYLON 3/64 T	
299-0315	SWITCH 8 POSITION DIP	S1	528-0004	SCREW PH 4-40	X 5/16	
		S2	538-0075	NUT KEP	4-40	
318-0246	XFORMER 10K CT-10K CT	T1	561-0651	SWAGE STD F	4-40X3/8	
318-0260	XFORMER 8-1200 OHM	T2	561-0654	SPACER #6 3/8	SELFRETA1	
425-0104	IC CMOS 4016 QUAD SW	U11	614-0432	HEATSINK TO-220	30C/W	



a Mark IV company

Signaling Products Group

9900 Baldwin Place • El Monte, California 91731-2204  
 Telephone: (818) 442-0782 • Toll-Free: 800-877-1771  
 Fax: (818) 444-1342

Printed in USA  
 February 1992