



a MARK IV company

Signaling Products Group

Instruction Manual

099-9061

Model C-504AR Tone-Remote Control Console

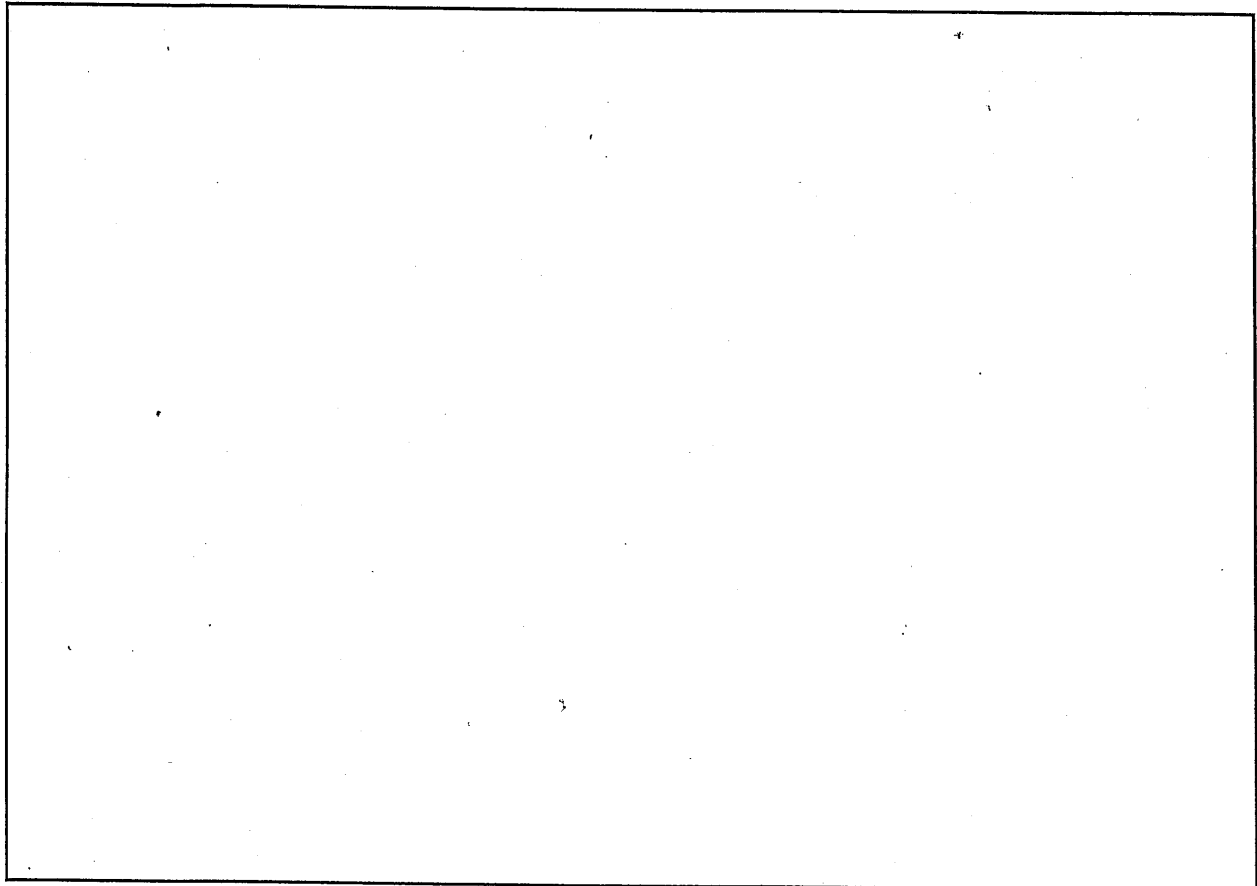


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Introduction

The Vega Model C-504AR tone-remote control console remotely controls a radio communications base station equipped with a functionally matching tone decoder. It operates in a mode typically used in the air-transportation industry (normally with a 2300-Hz push-to-talk tone and no function tones). The C-504AR is typically located at an operator position some distance from the communications base station, with control being accomplished via a voice-grade audio link, such as a wire pair, leased telephone line, or a microwave carrier channel. The base station must be equipped with a compatible tone decoder or tone-remote adapter unit (not the sequential tone type common to Motorola, GE, and similar tone-control equipment) to interface the radio equipment with the audio channel and to appropriately detect and decode the control signals from the C-504AR. The primary functions of the control system are to provide PTT (push-to-talk) control of the base station transmitter and to route receiver audio to the remote console when PTT is not active.

In addition to the basic control functions, the C-504AR console includes a large number of interface features and options to allow it to be customized for many types of specialized applications and interfaces. The C-504AR may be internally programmed by means of DIP switches, solder jumpers, wire and terminal-strip strapping, and the use of alternate interface connections to accommodate a wide variety of specialized needs. Some of the many options available include: 2-wire, 4-wire, or 6-wire operation; high- and low-impedance modes for parallel console operation; DC local control operation; connection to a telephone coupler for dial-up telephone operation; interface points for standard headset jackboxes; recorder output; and intercom modes for console-to-console communications.

The C-504AR is supplied with a wall-type AC adapter (DC power supply) which supplies +14 V_{dc} to operate the unit. The console also has connections for battery-backup operation in the event of a AC power loss. Audio line connections are normally via a six-pin modular telephone connector inside the unit. For the most common configurations of the C-504AR, only DC power from the AC

adapter and a line connection to the modular connector are required for full operation.

Front-panel controls and indicators for the C-504AR include a speaker volume control, a "TX" LED which indicates that a PTT command is being generated (in some modes, may also indicate that a PTT is being generated by a parallel console), and an intercom switch ("I/C"). The intercom-switch function varies with the programmed operating mode for the console, but is most commonly used to allow audio transmission without generating a PTT command to the remote-base transmitter, thus implementing a simple intercom system for paralleled C-504ARs.

Operation

In most instances, operation of the C-504AR will be straightforward. For the most common configurations of the unit, operation is as follows:

- 1) When the console is not actively in use, the handset will normally be on-hook ("hung up"). Unlike a standard telephone, the remote audio (from the radio base-station receiver) can be heard while the handset is on-hook by means of the console speaker. If the console volume control is turned "up", receiver audio will be heard on the speaker whenever the remote radio is active.

- 2) If the handset is removed from the hook, speaker audio is disabled and the radio receiver audio can now be heard on the handset earpiece. The console volume control can be used to adjust the earpiece volume, if desired.

- 3) If a radio transmission is desired, it is necessary to depress the push button on the console handset. The "TX" LED on the console will illuminate, indicating that a transmit (PTT) command is being generated. After a very short delay, handset microphone audio will be sent to the remote base station and transmitted. However, during actual transmission, receiver audio is usually disabled, so it is not possible to talk and listen simultaneously, as can be done with a telephone.

- 4) When the radio transmission is complete, the push button on the handset must be released in order to hear the response. If no additional transmissions are expected immediately, the handset may be returned to the hook. This will enable the console speaker once again, allowing

the response to heard on the speaker, rather than the handset.

5) For some modes of operation, the "TX" LED will illuminate whenever a parallel console generates a transmit command. This indicates that the system is in use and that the transmit function should not be used until the LED is "off". In some cases, the transmit audio from the parallel console will be audible on the console speaker; in other cases, it may not be.

6) If parallel consoles exist, the C-504AR may (in most cases) be used as an intercom to talk to the operators of the other consoles. Simply press and hold the intercom ("I/C") pushbutton on the console whenever it is desired to communicate with the other consoles. It is not necessary to depress the handset push button in order to talk, and the base-station radio does not transmit as long as the intercom push button is held. However, it is necessary to release the intercom push button to hear responses from the other consoles.

NOTE: The operating modes for the C-504AR are internally programmable. Accordingly, operation may differ from the above description in specific cases.

Installation, Setup, and Adjustment

Because the C-504AR has a large number of user-programmable modes and optional interfaces, a completely general installation, setup, and adjustment procedure is impractical. Accordingly, separate sections are provided for programming and mode selection, interfacing, and operational level adjustment.

Programming

The functions of the various programming and mode selection switches and jumpers are detailed below. Following the detailed listing, a setup chart for a few of the more common configurations is presented.

Switch #1:

Programs various line modes (2W/4W, Hi/Lo Z, DC closure) and enables or disables intercom function.

S1-1	2W/4W select	"On" = 2W
S1-2	2W/4W select	"On" = 2W
S1-3	Hi/Lo Z select (2W or 4W TX)	"On" = Lo Z
S1-4	Hi/Lo Z select (4W RX only)	"On" = Lo Z
S1-5	"I/C" enable function	"On" = I/C enabled
S1-6	"DC Loop" (relay operated)	"On" = loop closure

Switch S2:

Programs tone frequency; sets DC-only mode.

	Counter ratio (hard wired)	"On" = "128" (all cases)
S2-1	Counter ratio (hi group)	"On" = "64"
S2-2	Counter ratio (hi group)	"On" = "32"
S2-3	Counter ratio (hi group)	"On" = "16"
S2-4	Counter ratio (lo group)	"On" = "8"
S2-5	Counter ratio (lo group)	"On" = "4"
S2-6	Counter ratio (lo group)	"On" = "2"
S2-7	Counter ratio (lo group)	"On" = "1"
S2-8	"DC Only" (disables tone)	"On" = disable tone
(2300 Hz = S2-2, 4, 5 and 6 "on"; all others "off").		
(2175 Hz = S2-2, 3 and 4 "on"; all others "off").		

Switch S3:

Programs line and microphone sensitivity, simplex or full-duplex mode, sidetone selection, and miscellaneous functions.

S3-1	Input sensitivity	"On" = low sens (1)
S3-2	Input sensitivity	"On" = normal (1)
S3-3	Mic sensitivity	"On" = low sens (2)
S3-4	Mic sensitivity	"On" = normal (2)
S3-5	Full duplex select	"On" = full duplex (3)
S3-6	Mute select	"On" = mute enabled
S3-7	Sidetone select	"On" = sidetone "on"
S3-8	I/C disables relay	"On" = disable on I/C
S3-9	"Tone Only" (disables relay)	"On" = disable DC
S3-10	Full duplex select	"On" = full duplex (3)

(1) S3-2 is normally "on" and S3-1 is normally "off". Set both switches to "off" to increase sensitivity about 10 dB. Set S3-2 to "off" and S3-1 to "on" to decrease sensitivity about 10 dB. Set both S3-1 and S3-2 to "on" to decrease sensitivity about 13 dB.

(2) S3-4 is normally "on" and S3-3 is normally "off". Set both switches to "off" to increase sensitivity about 6 dB. Set S3-4 to "off" and S3-3 to "on" to decrease sensitivity about 6 dB. Set both S3-3 and S3-4 to "on" to decrease sensitivity about 8 dB.

(3) For full-duplex mode, set both S3-5 and S3-10 to "on". Notch filter will be in receive path only.

Switch S4:

Disables hook switch (closed), allows use of an external speaker disable switch.

Jumpers (JP1 thru JP4):

JP1	Activates auxiliary hook-switch contacts (closed)
JP2	Increases handset receiver level (closed)
JP3	Normal relay mode when closed
JP4	Relay operates on I/C only (for 4W intercom)

Common Configurations

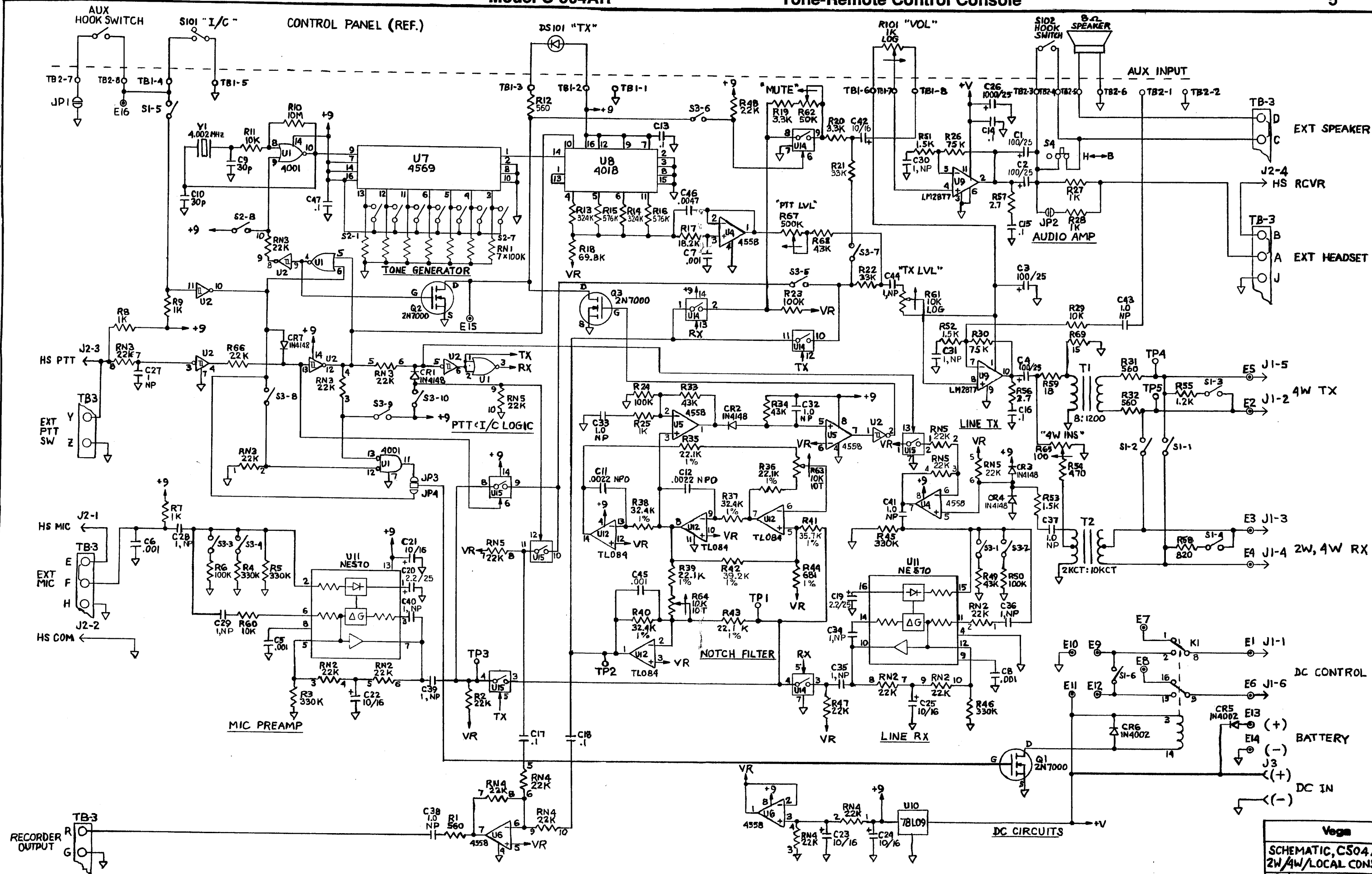
Below is a chart showing switch settings and programming for the most common operational modes for the C-504AR. Additional interface and operational options may be available for several of the below-listed configurations.

DIP SWITCH	S1-1	S1-2	S1-3	S1-4	S3-9	S2-8	S1-5	S1-6
Normal 4W Tone	0	0	X	X	X	0	X	-
Inhibit IC 4W Tone	0	0	X	X	X	0	0	-
Normal 2W Tone	X	X	X	0	X	0	X	-
Inhibit IC 2W Tone	X	X	X	0	X	0	0	-
Normal 4W DC	0	0	X	X	0	X	X	X
Inhibit IC 4W DC	0	0	X	X	0	X	0	X
Normal 2W DC	X	X	X	0	0	X	X	X
Inhibit IC 2W DC	X	X	X	0	0	X	0	X
4W 600 ohm TX	0	0	X	#	#	#	#	#
4W 600 ohm RX	0	0	#	X	#	#	#	#
4W Hi Z TX	0	0	0	#	#	#	#	#
4W Hi Z RX	0	0	#	0	#	#	#	#
2W 600 ohm	X	X	X	0	#	#	#	#
2W Hi Z	X	X	0	0	#	#	#	#

X = Switch Closed; 0 = Switch Open;

= See other chart entries; "-" = Don't Care.

CONTROL PANEL (REF.)



To achieve these commonly used operational modes, the other switches should be set as follows (all switches not shown as "on" are assumed to be "off"): S2-2, 4, 5, and 6 are "on"; S3-2, 4, 7 and 8 are "on". NOTE: When S4 is closed, S3-7 sidetone select must be "off".

These settings provide simplex operation, normal receive line and microphone sensitivity, sidetone "enabled", 2300-Hz tone frequency, and I/C (if not inhibited) to disable the relay in the DC mode.

Adjustments

1) The "TX LVL" control (R61) adjusts the transmission level of the composite signal (voice plus tone, if present). The maximum line level is approximately +12 dBm, however, the recommended adjustment is for a output line level of 0 to -4 dBm peak (-8 to -12 dBm at normal speech levels).

2) The "4W INS" control (R65) adjusts the insertion of transmit audio onto the receive pair in the 4-wire mode of the console. This feature, when activated, allows the "intercom" and "parallel key detect" features to work in the 4-wire mode when multiple consoles are paralleled. This control should be set to minimum (fully CCW) except when 4-wire operation with parallel consoles is desired. For the 4-wire mode, the control should be set so that the transmit audio on the receive pair is 14 to 18 dB below the level on the transmit pair, but not higher than audio from the remote receiver.

3) The "MUTE" control (R62) adjusts the muting of receive audio to the speaker and handset earpiece for the transmit mode (duplex operation) or when parallel keying is detected. This control is effective only if S3-6 is closed, enabling the muting function. R62 is adjusted for the desired degree of muting; clockwise rotation reduces the degree of muting (i.e., audio becomes louder when mute is engaged). The control range is approximately -5 to -40 dB.

4) R67 adjusts the tone injection level for the console (the ratio between voice signals and the control tone). This control is preset at the factory (10 dB below speech level) and should not normally need adjustment. Certain specialized applications of the C-504AR (such as use through dial-up telephone lines) may require higher tone injection levels for proper operation. Clockwise rotation of R67 will decrease the tone injection level without affecting the transmit audio level. NOTE: adjusting R61 "TX LVL" will affect the R67 level; therefore, always adjust R61 first.

5) Receive line gain and microphone gain are preprogrammed by DIP switches S3-1 through S3-4. If different sensitivities are required (such as for Plantronics headset operation), change the settings as follows:

(A) Receive line gain: S3-2 is normally "on" and S3-1 is normally "off"; setting both switches "off" increases line sensitivity by about 10 dB. Setting S3-2 "off" and S3-1 "on" decreases sensitivity by about 10 dB. With both S3-1 and S3-2 "on", sensitivity decreases by about 13 dB.

(B) Microphone gain: S3-4 is normally "on" and S3-3 is normally "off"; setting both switches "off" increases sensitivity by about 6 dB. With S3-4 "off" and S3-3 "on" sensitivity decreases by about 6 dB. With both S3-3 and S3-4 "on", sensitivity decreases by about 8 dB.

Interfaces

For most modes of operation, line connections will be via the six-pin modular jack, J1. Pin connections for J1 are as follows:

Pins 1, 6	DC control (if used)
Pins 2,	4-Wire transmit (if used)
Pins 3, 4	2-wire line; 4-wire receive (4-W mode only)

The connections to J1 are duplicated on solder pads on the unit PCB (E1 through E6), corresponding to the pins on J1. Other functions appear on terminals E7 through E16, as follows:

E7	"DC" relay, "1NC" contact
E8	"DC" relay, "2NC" contact
E9	"DC" relay, "1NO" contact
E10	Ground for "DC" relay
E11	Plus voltage supply "DC" mode
E12	"DC" relay, "2NO" contact
E13	(+) battery-backup input
E14	(-) battery-backup input
E15	PTT driver access (active "low")
E16	Auxiliary hook-switch contact access

Provisions for an auxiliary audio input (such as a signaling encoder, DTMF dialer, auxiliary operator audio, etc.) appear on TB2-1 (signal input) and TB2-2 (ground). Terminal strip TB3 has interface points for several secondary inputs and outputs, as follows:

TB3-D, C	External speaker (1)
TB3-B, A	External Headset (1)
TB3-E, F	External microphone (1)
TB3-Y	External PTT input (active "low")
TB3-R	Recorder audio output
TB3-J, Z, G, H	Ground

(1) TB3 terminals D and C, B and A, and E and F must be jumpered for normal operation of the console.

Theory of Operation

The C-504AR consists of several functional blocks, some of which are common to both the receive and transmit functions. The primary functional circuit blocks are: microphone preamplifier and compression amplifier; line input amplifier and compression amplifier; notch filter and tone detector; crystal-controlled frequency generator; summing line driver; speaker amplifier; and a small amount of control and switching logic. The C-504AR is capable of duplex operation; however, simplex operation is more commonly used. The unit operates from an external DC source (usually the supplied AC adapter). Much of the circuitry operates directly from the unregulated DC input; however, some of the critical audio circuitry and the CMOS control logic is supplied from a +9 V_{dc} regulator (U10).

The microphone preamplifier consists of one-half of U11, an integrated gain control and amplifier device. The output level at compression is fixed by the component

values in this circuit, while the gain before compression is set by the gain-select resistors and switches. The line receiver is a similar design, except that a separate transformer-coupled input amplifier (U4) is inserted prior to the compressor (the second half of U11). The gain of U4 is decreased during transmission by U15 to prevent overdriving U11.

The notch filter and tone detector (U12 and U5) removes audio components at the PTT frequency (usually 2300 Hz) from its input and applies the output to either the summing line driver or the speaker amplifier, depending upon the console programming and the mode. The notch filter consists of a precision tunable active filter coupled to a rejection amplifier, thus synthesizing a very sharp notch circuit (U12). If significant energy is detected at the PTT frequency by U5, an output is generated to illuminate the "TX" LED on the unit. This circuit implements the parallel key detect function.

The summing line driver consists of a passive summing network and one-half of U9, a medium-power amplifier IC. The output of U9 is coupled through T1 to the output line network and mode programming circuits. Signal voltage may also be applied to the receive amplifier through a coupling network to provide the intercom and parallel key detect functions in the 4-wire mode. The speaker amplifier consists of the other half of U9, driven from the front-panel volume control and the mute gate (U14). The output of U9 is also applied to the handset receiver via a level adjustment circuit.

The frequency generator consists of a crystal oscillator (U1, Y1) which is gated on and off by the control logic via U2. U7 implements a programmable frequency divider whose divide ratio is programmed by S2. The output of U7 is a digital signal at ten times the desired final frequency (usually 2300 Hz). U8 is a digital synthesizer which generates a 10-step approximation of a sine wave via the weighted resistor network at its output. This waveform is filtered by U4 to remove unwanted high frequencies, yielding a crystal-accurate, low-distortion sine-wave output.

The control logic consists of a few digital gates and logic inverters (U2 and U1), two analog gates (U14, U15), plus a few discrete components and several programming switches. Although the operation of the logic varies considerably with the mode programming, it basically interfaces the PTT signal and the intercom switch with the frequency generator and the audio switching circuits in the console. The logic also controls the "DC" relay (K1), which provides isolated switching for several console control modes.

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

Specifications

Line Impedance

2-wire: 600 or 2400 Ω , selectable

4-wire TX: 800 or 2400 Ω , selectable

4-wire RX: 600 or 5000 Ω , selectable

Line Output Level: -25 to +12 dBm, adjustable

Line Input Level: -30 to +12 dBm, programmable

Line Compression Range: Controlled compression, less than 3 dB change in output for 20 dB change in input

Microphone Compression Range: Controlled compression, less than 3 dB change in output for 20 dB change in input

Distortion: Less than 2% at rated compression

Hum and Noise: More than 50 dB below adjusted operating levels

Speaker Audio Drive: Adjustable to 1.0 W, minimum

Earpiece Drive Level: Adjustable to 25 mW (in two ranges)

Audio Frequency Response: ± 1.5 dB from 300 to 3000 Hz, except at notch frequency

Notch Filter: 2300 Hz (adjustable); attenuates notch frequency by 40 dB, minimum

Tone Frequency: Standard: 2300 Hz, $\pm 0.02\%$ (crystal controlled)

Relay Rating: 2 A at 30 V_{dc}

Operating Temperature Range: -10°C to +60°C

Power: 105 to 130 V_{ac}, 50/60 Hz, 10 W (maximum); or +11 to +18 V_{dc} at 130 mA (standby), 500 mA maximum (peak audio)

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.

C-504AR Parts List					
Part No.	Description	Ckt Sym			
011-9061	TOP ASSY 504AR		136-0048	RES COMP 22K 5% 1/4W	R2
012-0007	SUB ASSY PHONE BASE				R47-R48
021-9061	PANEL FRT 504AR FINISHED		136-0050	RES COMP 33K 5% 1/4W	R66
031-9061	TEST SPEC 504AR		136-0056	RES COMP 100K 5% 1/4W	R21-R22
065-9061	PC BD 504AR				R6
071-9061	SCHEMATIC 504AR		136-0062	RES COMP 330K 5% 1/4W	R23-R24
102-0160	CAP CER 30P S2L 5% 50V	C9-C10	136-0080	RES COMP 10M 5% 1/4W	R50
105-1001	CAP MYLAR .001MF 10% 100V	C5-C-8	136-0281	RES COMP 43K 5% 1/4W	R3-R5
		C45			R45-R46
105-1102	CAP MYLAR .0047MF 10% 100	C46	136-0284	RES COMP 75K 5% 1/4W	R10
110-1340	CAP CER .1MF SMALL	C13-C18			R33-R34
		C47	138-0017	RNET CMN 7X100K SIP	R49
110-1345	CAP CER .0022MF 5% NPO	C11-C12	138-0033	RNET ISO 5X22K SIP	R68
112-1609	CAP ELEC 100MF 20% 25V	C1-C4	144-0001	XSTR NDMOS2N7000 TO92 SW	R26
112-1623	CAP ELEC 10MF 16V	C21-C25	161-0422	DIODE 1N4002	R30
		C42	161-0426	DIODE 1N4148	RN1
112-1673	CAP ELEC 2.2MF 20% RAD	C19-C20	161-0564	LED RED 250 MTG 6"WIRES	RN2-RN5
112-1678	CAP ELEC 1.0UF 50V NP	C27-C-41	165-1217	XTAL 4.002MHZ HC-18	Q1-Q3
		C43-C44	180-0321	RELAY DPDT PCB 12V	CR5-CR6
112-1684	CAP ELEC 1000MF 25V RAD	C26	249-0119	SPEAKER 4"SQ 3W	CR1-CR4
130-0529	RES VAR 50K HOR MT	R62	249-0121	HANDSET ELECTRET PTT	CR7
130-0533	RES VAR 500K HOR MT LIN	R67	286-1719	TERM STRIP12 PIN MINI	DS101
130-0673	RES VAR 10K 20T 3/8SQ	R63-R-64	286-1770	TERM STRIP 8 PIN MINI	Y1
130-0724	RES VAR 10K LOG V-ADJ	R61	286-1778	JUMPER .1 MALE GOLD	K1
130-0741	RES VAR 100 V-ADJ	R65	286-1784	PWR JACK PC BD 2.5MM	TB3
130-0751	RES VAR 1K LOG W/BLK NUTS	R101	286-1830	CONN PCB MODULAR HANDSET	TB1-TB2
132-0004	RES RN55C 32.4K 1% 1/4W	R37-R38	286-1850	CONN PCB MOD LINE 6-WIRE	J3
		R40	296-0592	SWITCH SP MOM SNAP IN	J2
134-2842	RES RN55D 22.1K 1% 1/4W	R35-R36	299-0298	SWITCH 10PST DIP	J1
		R39	299-0303	SWITCH 6PST DIP	S101
		R43	299-0315	SWITCH 8 POSITION DIP	S3
134-2859	RES RN55D 35.7K 1% 1/4W	R41	299-0345	SWITCH PC SPDT MINI SLIDE	S1
134-2875	RES RN55D 18.2K 1% 1/4W	R17	318-0260	XFORMER 8-1200 OHM	S2
134-2879	RES RN55D 39.2K 1% 1/4W	R42	318-0264	XFORMER 2KCT-10KCT	S4
134-2888	RES RN55D 681 1% 1/4W	R44	425-0104	IC CMOS 4016 QUAD SW	T1
134-2963	RES RN55D 69.8K 1% 1/4W	R18	425-0105	IC OPAMP 4558 DUAL	T2
134-3010	RES RN55D 324.K 1% 1/4W	R13-R14	425-0157	IC CMOS 4001 QUAD 2NOR	U14-U15
134-3011	RES RN55D 576.K 1% 1/4W	R15-R16	425-0178	INT CKT NE570N	U4-U6
136-0001	RES COMP 2.7 5% 1/4W	R56-R57	425-0181	IC OPAMP TL084 QUAD BFET	U1
136-0010	RES COMP 15 5% 1/4W	R69	425-0186	IC CMOS 4018 PROG CNTR	U11
136-0011	RES COMP 18 5% 1/4W	R59	425-0203	IC CMOS 4569 PROG CNTR	U12
136-0028	RES COMP 470 5% 1/4W	R54	425-0206	IC CMOS 4584 HEX TRIG	U8
136-0029	RES COMP 560 5% 1/4W	R1	425-0448	IC REG-P 78L09 9V .1A	U7
		R12	425-0462	IC PWR LM2877P DUAL 4W	U2
		R31-R32	450-0016	PWR SUPPLY 12DC .5A UNREG	U10
136-0031	RES COMP 820 5% 1/4W	R58	517-0183	WASH FLAT NYLON3/8ODX5132	U9
136-0032	RES COMP 1K 5% 1/4W	R7-R9	518-0070	WASH LOCK 4 INT	
		R25	528-0004	SCREW PH 4-40 X 5/16	
		R27-R28	528-0022	SCREW PH 6-32 X 1/4	
136-0033	RES COMP 1.2K 5% 1/4W	R55	536-0358	NUT TINNEMAN .187ID PERM	
136-0034	RES COMP 1.5K 5% 1/4W	R51-R53	550-0243	KNOB BLACK1/2OD 1/8I	
136-0038	RES COMP 3.3K 5% 1/4W	R19-R20	561-0651	SWAGE STDF 4-40X3/8	
136-0044	RES COMP 10K 5% 1/4W	R11	561-0654	SPACER #6 3/8SELFRETA1	
		R29	674-0226	CORD PWR 2C 24 GA	
		R60	869-0024	CASE TELEPHONE BEIGE	



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