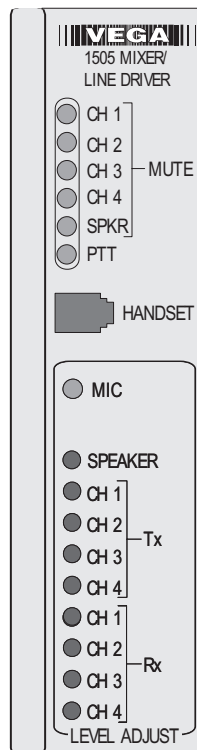




## 1505 Audio Line Driver

### Service Manual



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### 1. General

The Vega Model 1505 Audio Line Driver is a general purpose card that provides a reliable means of remotely controlling a variety of customer specified devices. The card is flexible. It can perform basic switching functions, customized switching functions (via jumpers), or special user-defined functions. It plugs into a Tellabs Type 10 or equivalent open frame rack and can be used in conjunction with any remote control console.

### 2. Standard Features

- Four balanced line inputs, switchable
- Four single-ended inputs, switchable
- One microphone input from front panel or connector
- Jumper options for carbon, electret, or dynamic microphone elements
- Four balanced 600-ohm line outputs
- One-watt eight-ohm speaker output
- 12 Vdc operation
- All receive inputs can be individually muted by rear panel switch low inputs

#### 2.1 Optional Features include:

- Jumper-selected receive input compression
- User switch-programmable mixing function, for example one input can be switched to any or all outputs
- Jumper selectable 600 ohm or 10K ohm high input impedance

### 3. Installation

#### Caution - ESD Sensitive

**This piece of electronic equipment contains electronic components known to be susceptible to Electro-Static Discharge (ESD). Precautions have been taken to avoid the effects of ESD, however the user is encouraged to promote safe handling techniques in the handling, storage and service of this equipment.**

#### 3.1 Introduction

Only experienced technicians familiar with similar types of equipment should attempt to install the 1505. Only basic hand tools are required to remove the card, change jumper settings, connect phone, signal, and power lines. Read this section thoroughly before attempting to install the card. Exercise care to prevent wiring errors and equipment damage.

#### 3.2 Inspection

Carefully unpack the equipment and inspect it thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in shipment, report the extent of the damage to the transportation company immediately.

This unit has been inspected and adjusted to its recommended operation condition at the factory. Unless it has been handled roughly in shipment, abused or tampered with, it won't require further adjustments. Simply make the installation connections as described in the following sections.

### 3.3 Mounting

This card is intended to be mounted in a Tellabs Type 10 or equivalent open frame rack. To avert erroneous operation, don't install the card adjacent to equipment that generates high temperature or electromagnetic radiation. Always provide an appropriate service loop on interconnecting cables.

### 3.4 Access for Installation/Service

When installing into a Tellabs Type 10 or equivalent open frame rack, ensure the front and rear of the rack have clear access for card installation and wiring.

To service, remove the 1505 from the rack or place on a circuit card extension for access while troubleshooting.

### 3.5 Power

Primary power for the card is a regulated source of 12 Vdc.

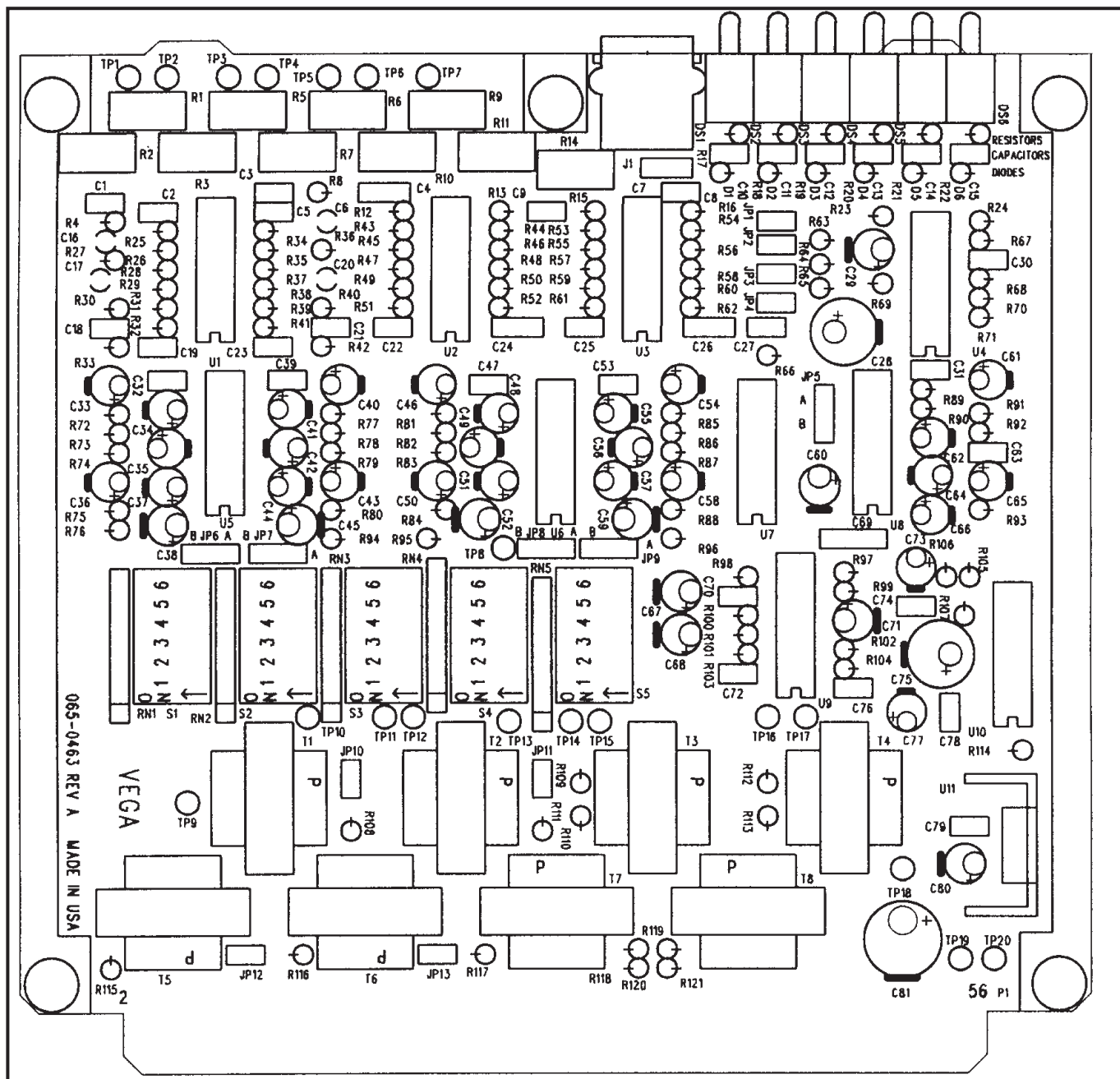


Figure 1. 1505 Component Location

## 4. Connections

### **Warning - High Voltage! Remove Power Before Servicing!**

High voltage may be present on this card (if used for switching phone lines with superimposed dc current signaling) which could cause serious injury or loss of life. Only qualified personnel familiar with this type of circuitry should work on this equipment. To prevent injury, damaging the card or other equipment, remove power before making connections.

### 4.1 Power connections

Connect positive 12 Vdc to pins 55 and 56. Connect the 12 Vdc return (normally ground) to pins 39 and 40. For best performance, use at least 20 AWG or larger wire for power connections.

## 4.2 Signal Connections and Card Edge Connector Pin Assignment

Refer to the schematic and Table 4 (shows the 1505's pin assignments and has a blank for any customized functions that might be configured) for the appropriate pin number to make connections. Use at least 24 AWG wire for signal connections.

## 4.3 Special considerations for optional wiring

### 4.3.1 Receive Compressor/Limiter Jumpers

Each receive channel has a compressor/limiter circuit which helps provide a consistent audio level. If some external equipment already includes compressor/limiters, these circuits may be bypassed by changing the associated jumper's position. For example, moving JP6 from the "A" (in) to the "B" position (out) bypasses Rx Ch #1's Compressor/Limiter. Refer to Table 1 and the schematic for the appropriate jumper selection.

JP#	Function	Jumper Status				Notes
		In	Out	A	B	
1	Mic PTT/Speaker Mute	Coupled	Separate	N/A	N/A	PTT mutes Speaker
2	Mic, Carbon Element	In	-	N/A	N/A	
3	Mic, Electret Element	In	-	N/A	N/A	
N/A	Mic, Dynamic, High Out	-	-	N/A	N/A	JP2, 3, 4 out
4	Mic, Dynamic, Low Out	In	-	N/A	N/A	
5	Mic, Comp./Lim.	N/A	N/A	In	Bypass	
6	Rx Ch #1 Comp./Lim.	N/A	N/A	In	Bypass	
7	Rx Ch #2 Comp./Lim.	N/A	N/A	In	Bypass	
8	Rx Ch #4 Comp./Lim.	N/A	N/A	In	Bypass	
9	Rx Ch #3 Comp./Lim.	N/A	N/A	In	Bypass	
10	RX Ch #3 600Ω/10KΩ	600Ω	10KΩ	N/A	N/A	
11	RX Ch #1 600Ω/10KΩ	600Ω	10KΩ	N/A	N/A	
12	RX Ch #4 600Ω/10KΩ	600Ω	10KΩ	N/A	N/A	
13	RX Ch #2 600Ω/10KΩ	600Ω	10KΩ	N/A	N/A	

Table 1. Jumper Options

### 4.3.2 Microphone Jumpers

Depending on which microphone you are using, the following jumpers must be installed:

JP2 - carbon element; JP3 - electret element; JP4 - dynamic element with a low output.

No jumpers are installed for a dynamic microphone with a high output.

### 4.3.3 Receive Line Input Impedance

A 600 $\Omega$  terminating resistor is provided for each receive line input. Refer to the schematic and Table 1 for the proper jumper installation.

### 4.3.4 Switch Settings

Switches S1 to S5 provide the means to program the signal inputs to the output circuits. Any input can be programmed to any output. Multiple inputs can be combined to a single output, or conversely a single input can be programmed to one output. Refer to the schematic and Table 2 for the proper jumper installation. Refer to the schematic and Table 2 for proper switch closures.

### 4.3.5 Parallel Transmit Line Impedance Matching

If the occasion arises where the transmit line output must operate in parallel with another line terminating device, an impedance mismatch to the phone line will result. To maintain a 600 $\Omega$  termination, it will be necessary to create a resistive pad on the output of the 1505 line driver. A similar pad must be installed in each parallel device. This resistive pad creates a matching network with the phone line, however it induces a loss in the transmission path which lowers the line level and may affect the ultimate performance.

In order to easily insert the pad, a provision has been made in the circuit to allow the user to alter the value of two resistors in the transmit line output. The 1505 is shipped from the factory for single line termination without a pad, resulting in the balanced transmit line output having a 0  $\Omega$  resistor in each leg of the transformer without loss. To add the pad, both 0  $\Omega$  resistors must be replaced with a value corresponding to the number of parallel lines. Refer to the schematic and Table 3 for proper resistor values and corresponding insertion loss.

**Table 2. Output Programming Switch Settings/Associated Switch**

Input	Outputs				
	Tx Ch #1	Tx Ch #2	Tx Ch #3	Tx Ch #4	Speaker
Rx Ch #1	S-1	S-1	S-1	S-1	S-1
Rx Ch #2	S-2	S-2	S-2	S-2	S-2
Rx Ch #3	S-3	S-3	S-3	S-3	S-3
Rx Ch #4	S-4	S-4	S-4	S-4	S-4
Mic Input	S-5	S-5	S-5	S-5	S-5
Sum Audio In	S-6	S-6	S-6	S-6	S-6

**Table 3. Parallel Transmit Line Resistor Network Selection**

Tx Ch #	Resistor Designation	Parallel Lines, Resistor Value / Line Loss (dB)		
		2	3	4
1	R112, R113	300 $\Omega$ / 6 dB	620 $\Omega$ / 9.5 dB	910 $\Omega$ / 12.0 dB
2	R119, R121	300 $\Omega$ / 6 dB	620 $\Omega$ / 9.5 dB	910 $\Omega$ / 12.0 dB
3	R109, R110	300 $\Omega$ / 6 dB	620 $\Omega$ / 9.5 dB	910 $\Omega$ / 12.0 dB
4	R118, R120	300 $\Omega$ / 6 dB	620 $\Omega$ / 9.5 dB	910 $\Omega$ / 12.0 dB

## 4.4 Securing the Connections

After all power and line connections are made, the wires should be neatly bundled and secured in place to prevent accidental breakage when in service. Use one or more of the cable guides supplied with the card rack, or tie in place with appropriate wire ties.

## 4.5 Interface connector Numbering

The Tellabs (or equivalent) card cage interface connector pins may have a different numbering scheme than the 1505. Table 4 depicts the card edge pin numbers as shown in the schematic, which is also the same as one type of connector, followed by two alternate numbering schemes as used on other connectors. Diligently review the actual connections being used, to Table 4, to ensure proper connections are made for optimum performance. Record the external connections made during installation in the blanks rows in Table 4's "User Connection" column (make copies of Table 4 and keep records for each 1505).

## 5. Operation

### 5.1 Description

This 1505 module has up to four, receive balanced 600  $\Omega$  line inputs or high impedance unbalanced inputs, along with a Mic/Handset input, that is user configurable by dip switch setting, to drive from one to four 600  $\Omega$  balanced transmit line outputs, or an 8  $\Omega$  remote speaker. The module is also capable of summing up to four receive channel inputs and/or a Mic/Handset input, into one or more transmit line outputs or the speaker output.

A compressor/limiter circuit is available by jumper selection for each receive circuit, to limit the input level to a predetermined setting, which assists in maintaining proper system levels. This module also contains a summed input circuit, and a summed output circuit, to allow it to be used in a matrix, i.e. three modules can be configured to allow a single input to drive twelve outputs, or conversely twelve inputs can be summed to one output.

Active switch input circuits allow for muting individual receive input channels, or the speaker. A PTT input activates the microphone circuit.

## 5.2 Operating Capabilities

The 1505 accepts up to four balanced or unbalanced inputs, switch selectable by the user, to four balanced line driver outputs. These inputs are also externally mutable by switched low inputs at the rear panel connection. In addition, the module will accept a microphone or handset input through the front panel jack or the rear panel connector.

The transmit amplifier is a 600-ohm balanced line output. The module has four balanced line outputs. Each amplifier output is adjustable with a range of -15 to 10 dBm.

The module has a speaker amplifier output that may drive an eight ohm external speaker with an output level of 1 watt. The level is adjustable.

Any line or microphone input may be switched (through a module dip switch) to any line output or the speaker output. Three 1505s can be connected so one line input may drive up to twelve 600-ohm line outputs. Each input is mutable and the control is a switched low on the rear panel connector. A PTT from the microphone or handset will gate on the microphone amplifier and is also jumper selectable to mute the speaker to inhibit crosstalk.

### 5.3 Controls and Indicators

Front panel LEDs light when the corresponding receive channel or speaker is muted and when the microphone or handset PTT switch is activated.

**Table 4. Card Edge Connector Pin Assignments (Solder Side)**

Card Edge	Alt #1 Conn	Alt #2 Conn	Function	User Connection
1	A	A	Ch #4 Rx Bal. Line In (-)	
3	B	B	Ch #4 Rx Mute	
5	C	C	Ch #4 Rx Bal. Line In (+)	
7	D	D	Ch #4 Rx UnBal Line In	
9	E	E	Ch #3 Rx UnBal Line In	
11	F	F	Ch #3 Rx Bal Line In (+)	
13	H	H	Ch #3 Rx Bal. Line In (-)	
15	J	J	Ch #2 Rx Bal. Line In (-)	
17	K	K	Ch #3 Rx Mute	
19	L	L	Ch #2 Rx UnBal Line In	
21	M	M	Ch #2 Rx Bal Line In (+)	
23	N	N	Ch #2 Rx Mute	
25	P	P	Ch #1 Rx Unbal Line In	
27	R	R	Ch #1 Rx Bal Line In (+)	
29	S	S	Ch #1 Rx Bal. Line In (-)	
31	T	T	Ch #1 Rx Mute	
33	U	U	Ch #4 Tx Bal. Line Out (+)	
35	V	V	Ch #3 Tx Bal. Line Out (+)	
37	W	W	Ch #2 Tx Bal. Line Out (+)	
39	X	X	Pos. 12 Vdc Return (Gnd)	
41	Y	Y	Ch #1 Tx Bal. Line Out (+)	
43	Z	Z	No Connection	
45	A	AA	Sum Audio Out	
47	B	BB	Mic Audio In	
49	C	CC	Mic PTT	
51	D	DD	N/A	
53	E	EE	No Connection	
55	F	FF	Position 12 Vdc Input	

**(Component Side)**

Card Edge	Alt #1 Conn	Alt #2 Conn	Function	User Connection
2	1	1	No Connection	
4	2	2	Ch #4 RXAGND	
6	3	3	Ch #4 Mute Gnd	
8	4	4	No Connection	
10	5	5	No Connection	
12	6	6	Ch #3 RXAGND	
14	7	7	Ch #3 Mute Gnd	
16	8	8	No Connection	
18	9	9	No Connection	
20	10	10	Ch #2 RXAGND •	
22	11	11	Ch #2 Mute Gnd	
24	12	12	No Connection	
26	13	13	No Connection	
28	14	14	Ch #1 RXAGND •	
30	15	15	Ch #1 Mute Gnd	
32	16	16	No Connection	
34	17	17	Ch #4 Tx Bal. Line Out (-)	
36	18	18	Ch #3 Tx Bal. Line Out (-)	
38	19	19	Ch #2 Tx Bal. Line Out (-)	
40	20	20	Pos. 12 Vdc Return (Gnd)	
42	21	21	Ch #1 Tx Bal. Line Out (-)	
44	22	22	Sum Audio In	
46	23	23	Earpiece Audio Out	
48	24	24	Speaker Mute	
50	25	25	MICAGND	
52	26	26	No Connection	
54	27	27	N/A	
56	28	28	Pos. 12 Vdc Input	



## 6. Theory of Operation

### 6.1 General

The 1505 module uses a low loss, wide band transformer for each channel to interface to the phone line. Gain elements are low noise, low distortion, high gain operational amplifiers for quality performance. Each channel utilizes one half of dual compandor IC, configured as a compressor/limiter, to amplify and limit the maximum receive input signal, in order to maintain operator adjusted system levels.

Each receive amplifier output is routed through a user programmed switch matrix, to summing amplifiers. The output of the summing amplifiers are transmit line amplifiers, and a low loss, wide band transformer for each channel to interface to the respective phone line.

A handset/microphone amplifier circuit is included, with provision for jumper selection of carbon, electret, or dynamic microphone elements. Also included is a compressor/limiter circuit to maintain system levels. The output of the handset/microphone amplifier circuit is routed to the switch matrix.

An on board voltage regulator maintains proper voltages for optimum performance.

### 6.2 Receive Amplifier

This amplifier is a jumper-selectable, 600 ohm or 10k ohm, high impedance balanced input that is adjustable from a range of -30 dBm to 10 dBm.

Each receive amplifier has an unbalanced input with an input level of 0.025 Vac to 2.5 Vac each. The amplifier output is adjustable and is accessed through the front panel. The output level for each receive amplifier is normally setup for a level of 0.776 Vrms at the test point. For example, channel one's test point is TP3. Operation is the same for all four receive inputs.

### 6.3 Compression Limiter Circuit

This circuit amplifies and limits the output of the receive inputs ensuring uniform audio levels from all channels regardless of the input level received from the external line input. For a 30 dB gain, once achieving the compression level, only a 3 dB increase in output level, without distortion, results in the circuit. Normally the input level, at 0 dB, allows the limiter to amplify in a linear fashion below that level, and above the 0.776 will limit the output to no more than a 3 dB rise above that point. A jumper allows the bypass of the compressor circuit. The compressor circuit is the same for all four receive channel circuits. Each receive input can be muted by an external switched low input from the rear panel. A front panel LED mute indicator alerts the operator that the channel is muted. The output from each receive channel is bussed through various switches and is switch selectable by the user to have the audio appear at any one of four line outputs or a speaker output.

### 6.4 Transmit Line Amplifier

This bridging amplifier drives a 600 ohm balanced line with an output level adjustable from -15 dBm to 10 dBm. The output level is adjustable through the front panel. Each transmit amplifier is also a mixer which allows the mixing of any one or all four receive channels mixed into one transmit line amplifier.

#### NOTE

The speaker amplifier circuit is no longer useable, the IC required to drive this circuit has been obsolete by the manufacture and there is no substitute being manufactured at this time. Should you have any questions regarding the speaker amplifier circuit please call: 1-800-752-7560 Ext 291 for further information;



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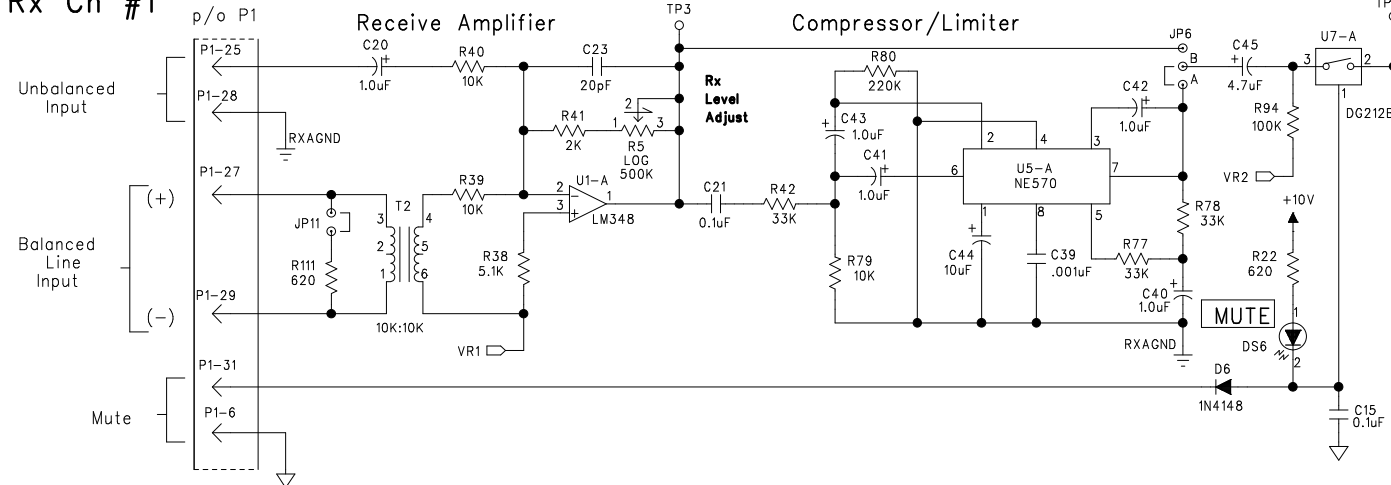
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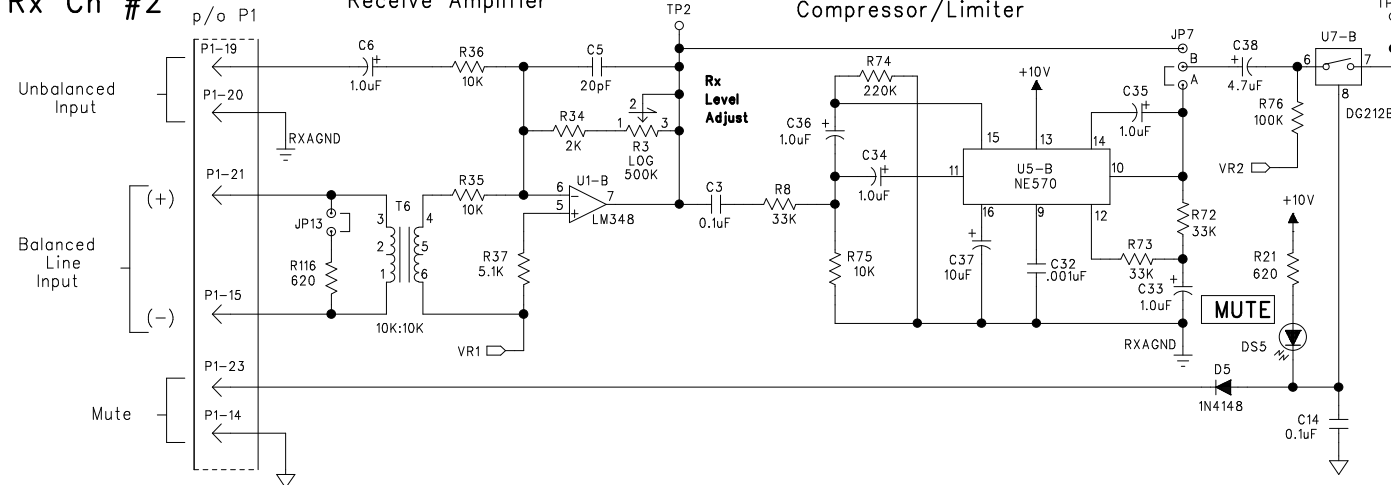
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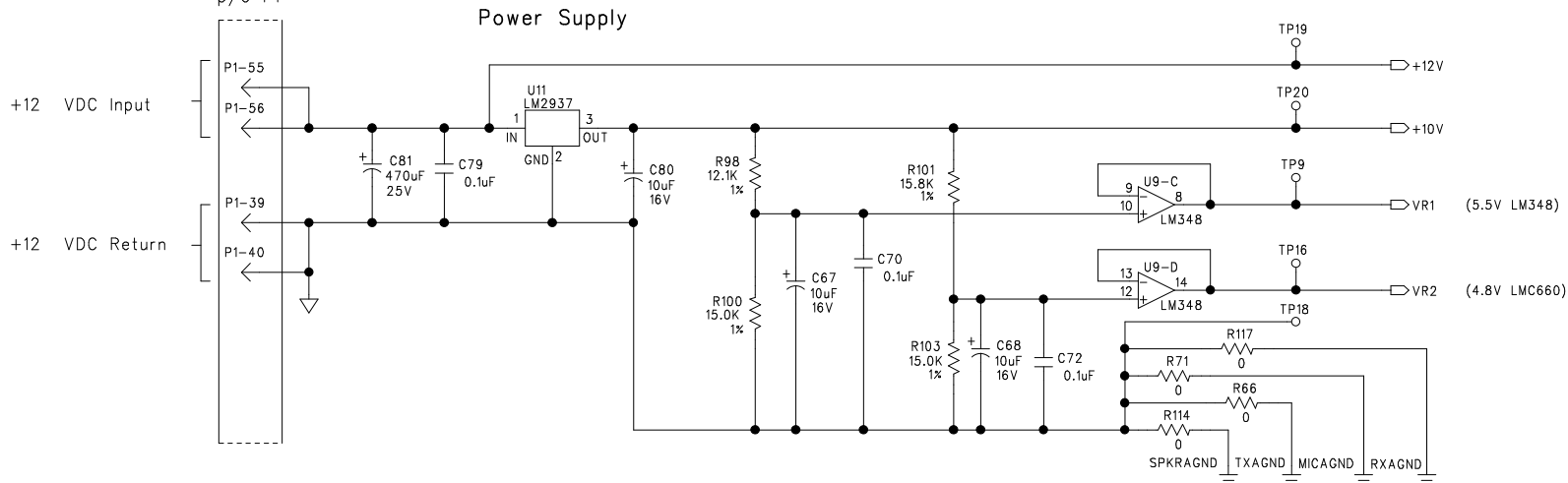
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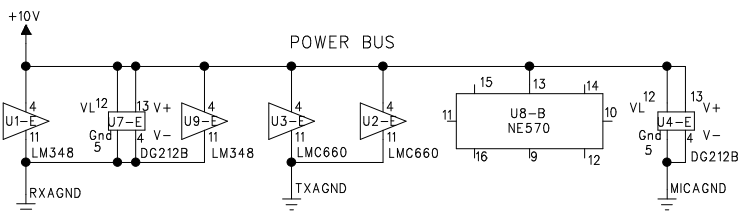
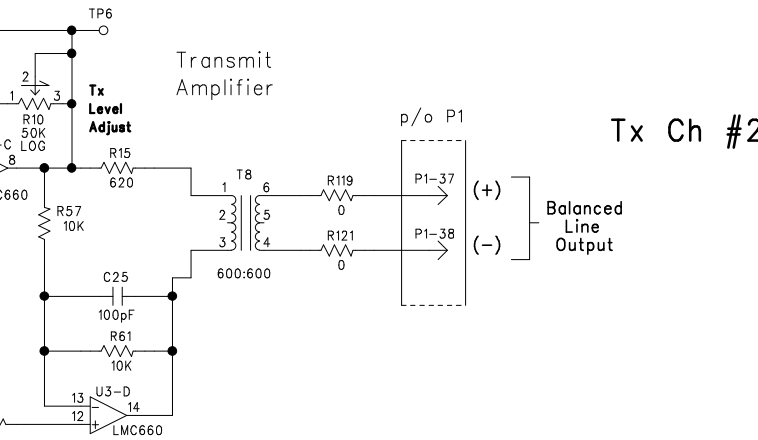
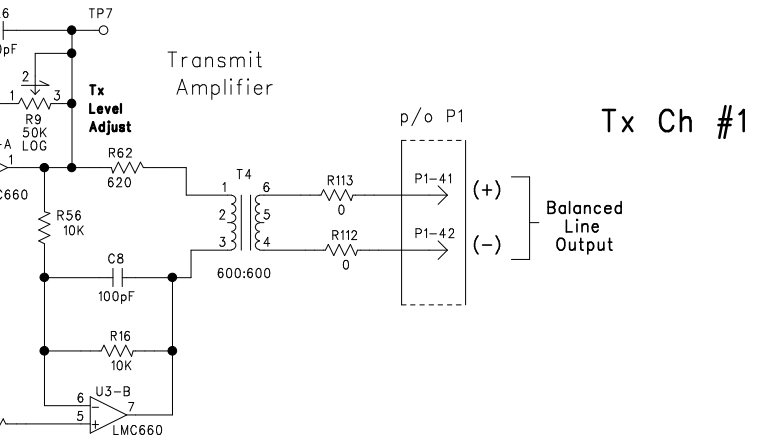
Rx Ch #2



Power Supply

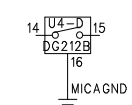


Pg. 2 - D4



- NOTES: 1. Unless other specified:  
Resistors are 1/4 watt, 5%, and values are in ohms.  
Capacitor values are in microfarads.
2. Receive channels are jumper selected for input impedance of 10K ohm bridging, or 600 ohm line termination. i.e. Channel #1, JP1 omitted for bridging, and installed for line termination.
3. Receive channels are jumper selectable to include or bypass the Compressor/Limiter circuit, i.e. channel 1, JP2-A includes the circuit, JP2-B bypasses the circuit.
4. Text located in an outline box, indicates front panel labels.

SPARE GATES



Last Used	Not Used	DRAWN	John Mika	3/7/95
C	C81	CHECK		
D	D6	ENG		
R	R121	APP		
RN	RN5			
Q				
U	U11			
JP	JP13			

MODEL	NEXT ASSY.
1505	012-0085

NO INFORMATION GIVEN HEREIN MAY BE DISCLOSED TO OTHERS WITHOUT WRITTEN PERMISSION FROM MARK IV CORPORATION.
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VEGA	A MARK IV COMPANY
1505 Audio	Mixer/Line Driver
D	071-0566
SCALE: 1:1	SHEET 1 OF 2

PCB:065-0463

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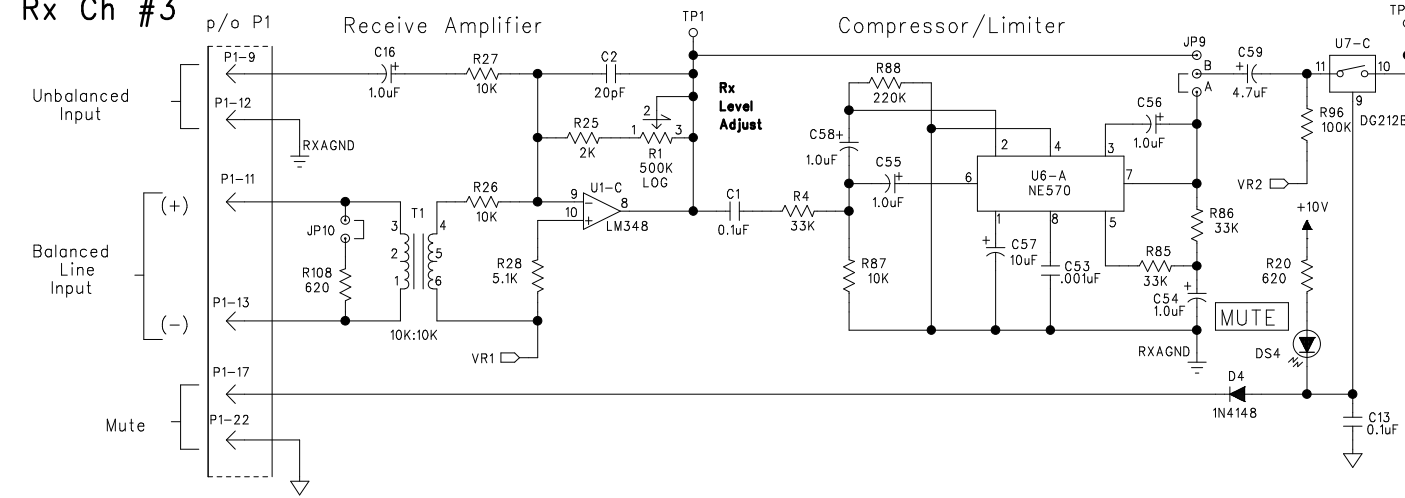
D

C

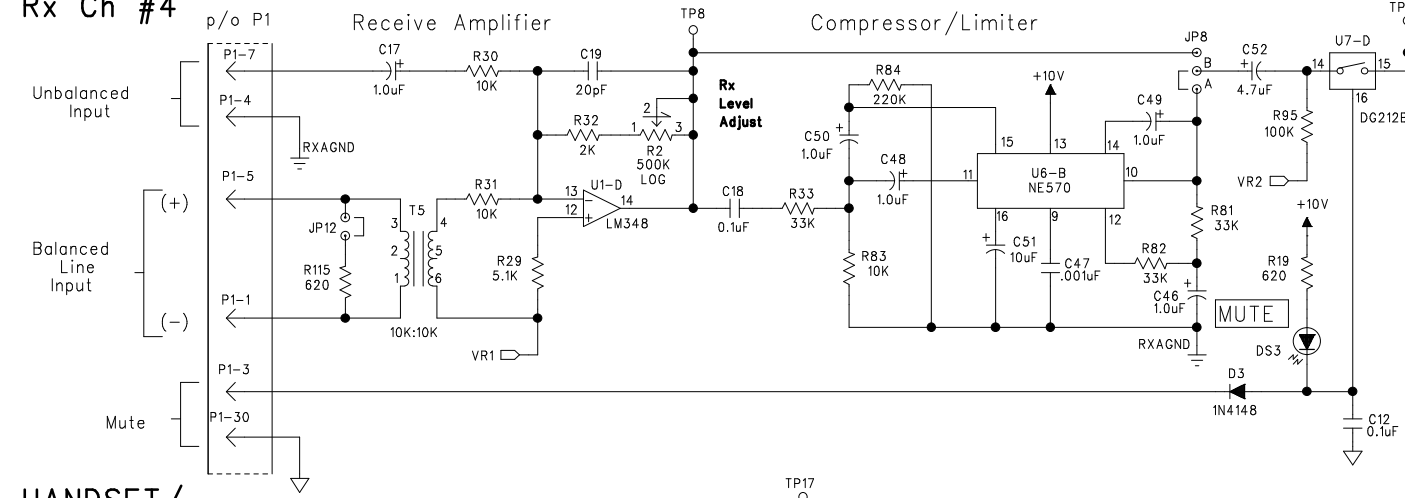
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A

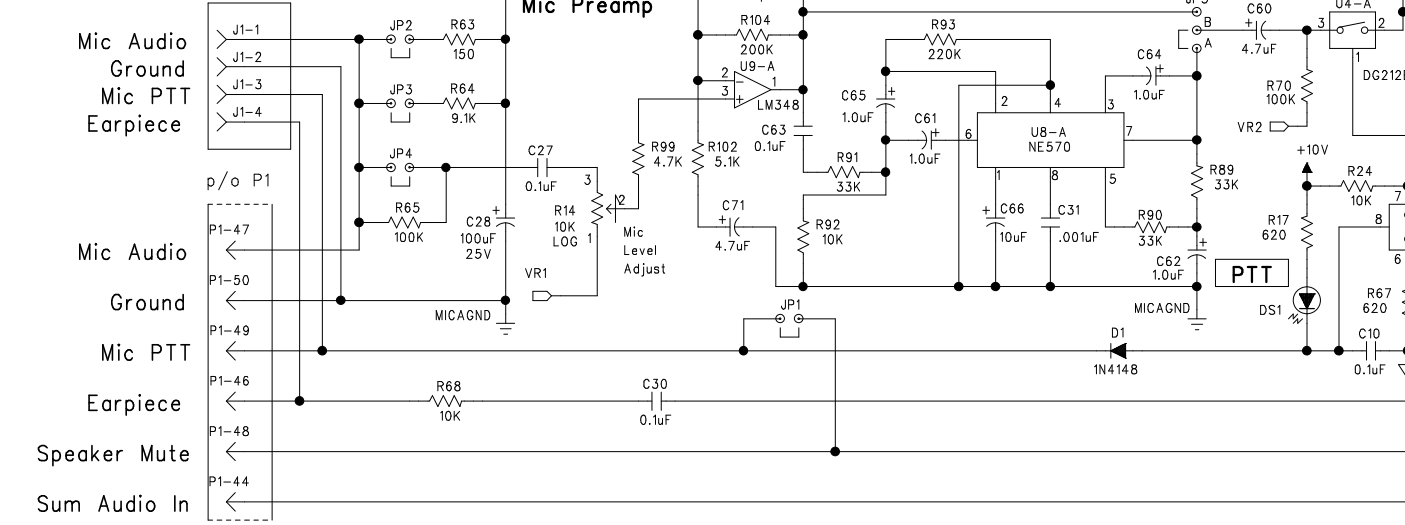
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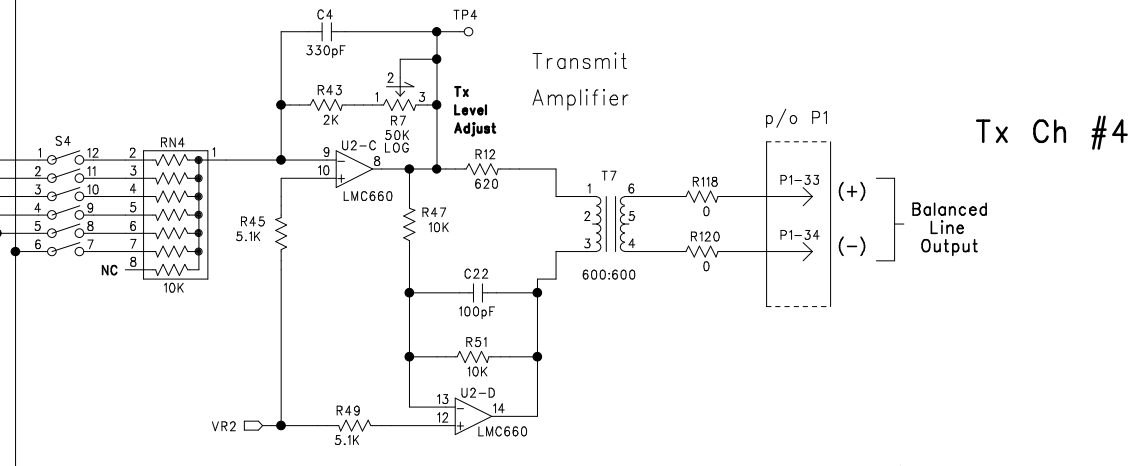
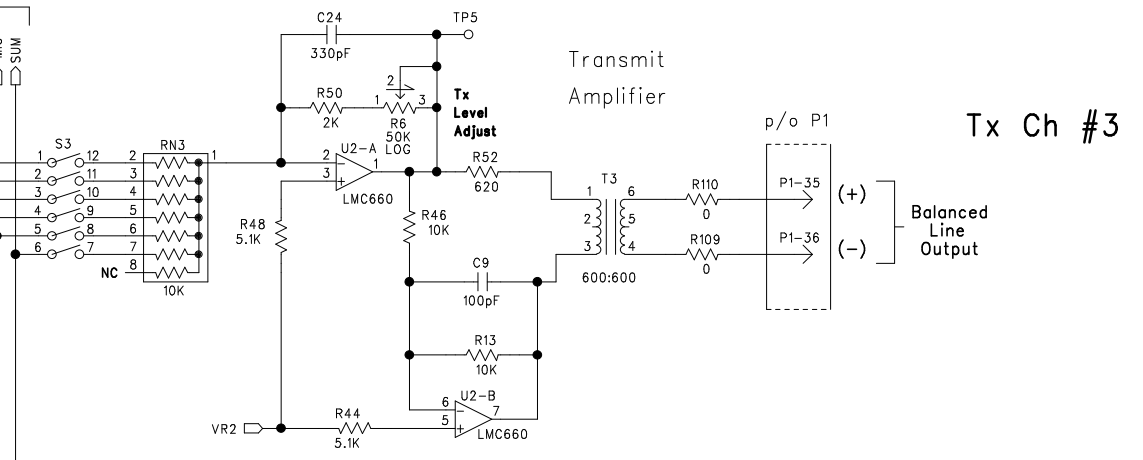
Rx Ch #4



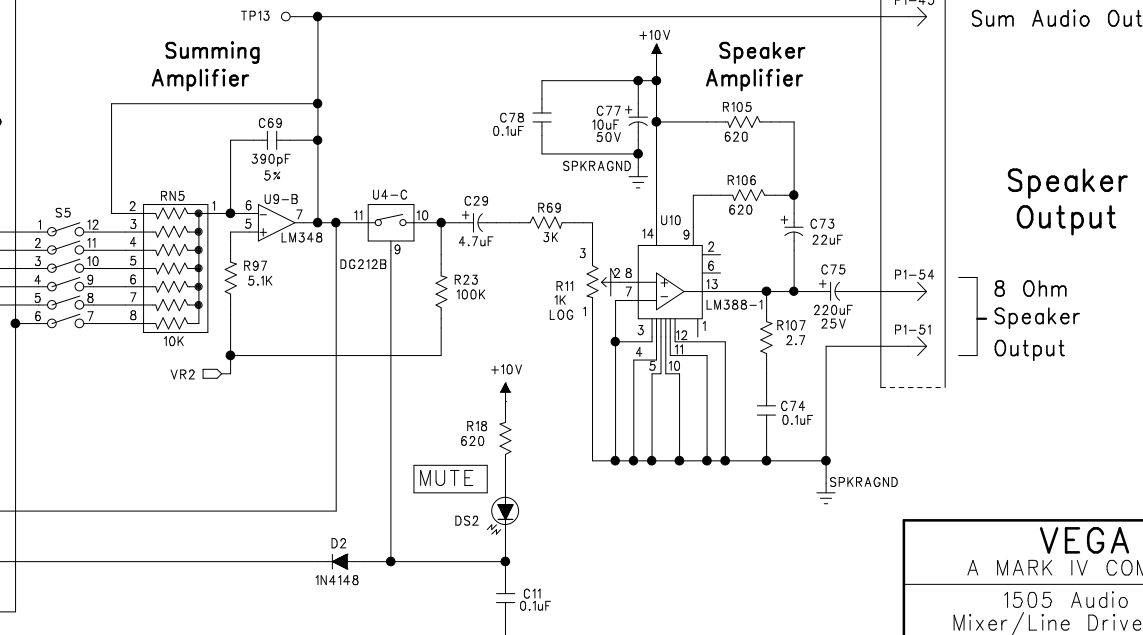
HANDSET/MICROPHONE

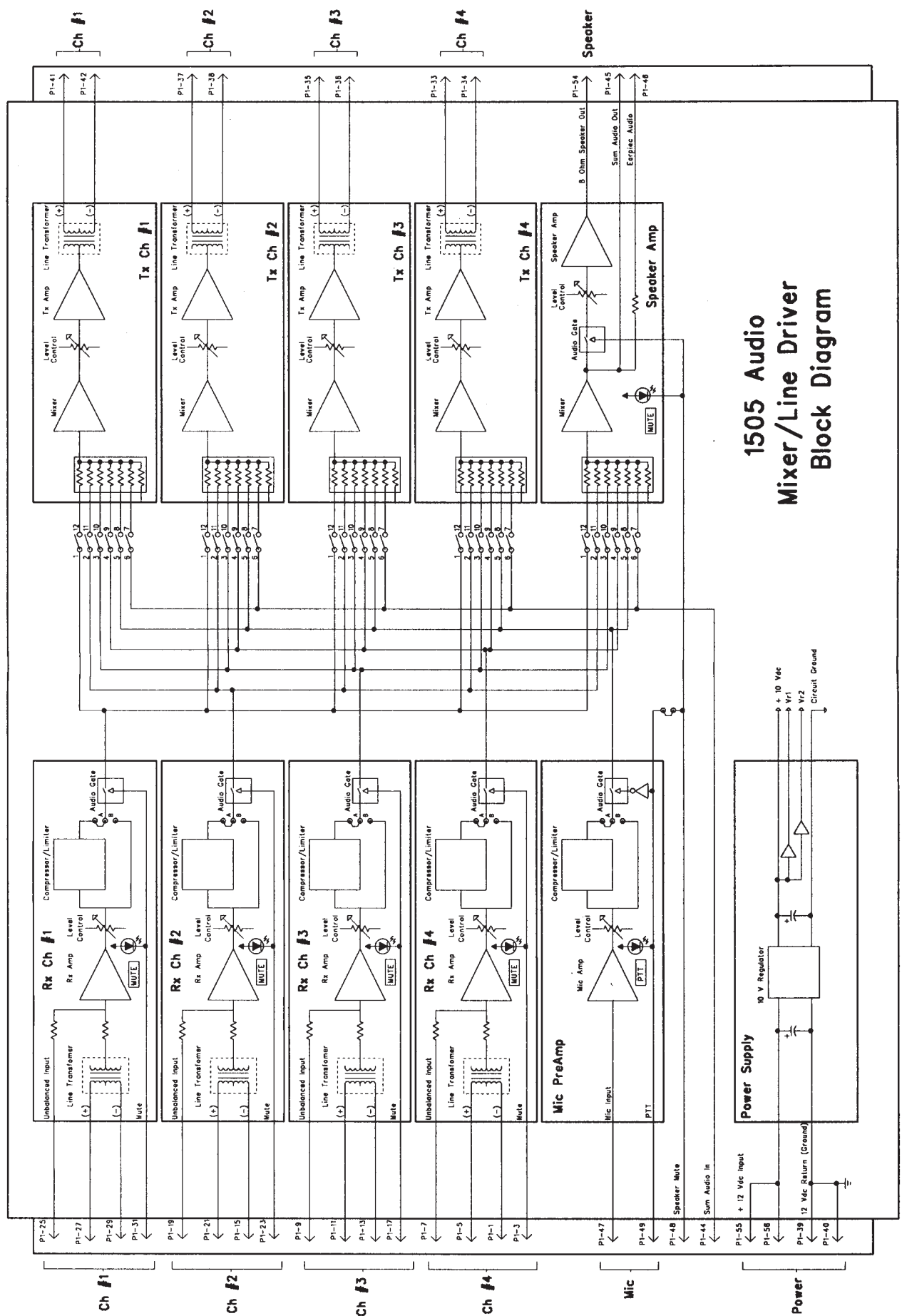


Pg. 1 - B4



U10 May not exist on All boards





1505 Audio  
Mixer/Line Driver  
Block Diagram

## 6.5 Microphone Input

A microphone input is available through a jack on the front panel. It allows connection of a handset or palm type microphone through a standard modular phone connection. The jumper options allow the use of a carbon, electret, or dynamic element. The microphone amplifier is adjustable to accommodate the full range of microphones. It's routed through a compression limiter similar to the receiver circuits. This compressor operates in a linear fashion below 0.776 Vrms input or will have a limit of 3 dBm increase if that level is exceeded. This limiter may also be bypassed by a jumper selection. The output of the microphone circuits is normally muted and is gated on by the PTT switched in the handset or microphone. A jumper is available to simultaneously mute the speaker during the time the PTT is initiated so that audio feedback is eliminated. The output of the microphone circuit is bussed through switches to the transmit line output amplifiers and to the speaker amplifier output so that the user may select which line or the speaker that the microphone input circuit can be applied to.

## 6.6 Sum Audio

The 1505 has a sum audio input circuit and a sum audio output circuit which allows matrix operation with several modules. This allows the expansion of receive input channels or transmit line channels. For example, using three 1505s, one receive input channel can be switch-selected for up to twelve channels output or conversely twelve receive channels may be mixed into one transmit channel.

## 6.7 Controls

Each receive input and microphone input can be muted externally from the rear panel by a switched low input, this allows remote muting by an external source of the various inputs. A PTT unmutes the microphone audio amplifier by the PTT switch on the handset or the microphone. This PTT is also routed to the rear connector panel and is activated by a switched low input.

## 6.8 Indicators

The speaker and each receive input channel can be muted. The front panel has an indicator to visibly indicate which channels have been muted. The front panel also has a PTT LED which is illuminated when the PTT switch has been activated on the handset or microphone.

## 6.9 Power Supply

The 1505 is intended for operation with a 12 Vdc semi-regulated power supply. The onboard regulator limits the input voltage and regulates the output voltages to operate the module under various input voltages. The power supply is fixed and non-adjustable. The regulator safely limits the output current through the module. Reverse input protection is also provided in case of an inadvertent reverse voltage input.

## 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.

7.

## 1505 Specifications

**Operating Temperature Range:** ..... 0°C to 60°C

**Power Requirements:** ..... 11 to 16 V<sub>rms</sub> semi-regulated,  
250 mA nominal 600 Ω/10K Ω

**Balanced Receive Line Input Level:** .... -30 dBm to +10 dBm, adjustable 10 K Ω/10 K Ω

**Unbalanced Receive Input Level:** ..... 0.025 V<sub>rms</sub> to 2.5 V<sub>rms</sub>, adjustable 10 K Ω/10K Ω

**Mic Input Sensitivity:**..... 0.010 V<sub>rms</sub> to 1.0 V<sub>rms</sub>, adjustable 10K Ω/10K Ω

**Summing Input Level:** ..... 0 dBm (0.776 V<sub>rms</sub>) nominal

**Receive Amplifier Distortion:**..... 1% THD max.

**Receive Frequency Response:** ..... +1/-2 dB, 100 Hz to 10 KHz

**Compression Range:** ..... 30 dB increase in signal, output increases less than 3 dB

**Summing Level:** ..... 0 dBm (0.776 V<sub>rms</sub>) nominal

**Balanced Transmit Line Output Level:** ..... -15 dBm to +10 dBm, 600 Ω Line

**Transmit Amplifier Distortion:** ..... 1% THD max. @ 0 dBm

**Transmit Frequency Response:** ..... +1/-2 dB, 100 Hz to 10KHz

**Summing Amplifier Output Level:**..... 0 dBm (0.776 V<sub>rms</sub>) nominal

**Summing Amplifier Distortion:** ..... 1% THD max. @ 0 dBm

**Summing Amplifier Frequency Response:** ..... +1/-2 dB, 100 Hz to 10 KHz

**Crosstalk Line to Line:** ..... -55 dB min.

**S/N @ -10 dBm Input:**..... -65 dB min.

## 8. 1505 Parts List

Part No.	Description	Ckt Sym	Part No.	Description	Ckt Sym
012-0085	PCB SUB ASSY 1505MIX/LINE		112-1608	CAP ELEC 1.0MF 20% 25V	C33
031-0226	TEXT SPEC 1505 AUD MIX/LD				C34
065-0463	PCB 1505 AUD MIX/LIN DR				C35
071-0566	SCHEMATIC 1505 MIX/LINE D	REF			C36
102-0120	CAP CER 20P 5% 50V S2L	C2			C40
		C5			C41
		C19			C42
		C23			C43
102-0290	CAP CER100P S2L 5% 50V	C8			C46
		C9			C48
		C22			C49
		C25			C50
		C76			C54
102-0400	CAP CER 330P S2L 5% 50V	C4			C55
		C7			C56
		C24			C58
		C26			C61
102-0420	CAP CER 390P S2L 5% 50V	C69			C62
103-0001	CAP CER.001 10% 50V Y5P	C31			C64
		C32			C65
		C39	112-1609	CAP ELEC 100MF 20% 25V	C28
		C47	112-1645	CAP ELEC 4.7UF 25V MINI	C29
		C53			C38
104-0767	CAP TANT 1UF 35V	C6			C45
		C16			C52
		C17			C59
		C20			C60
110-1340	CAP CER .1MF SMALL	C1			C71
		C3	112-1671	CAP ELEC 22 UF 25V 10%RD	C73
		C10	112-1675	CAP ELEC 10UF 16V RAD	C67
		C11			C68
		C12			C80
		C13	112-1689	CAP ELEC 470 MF25V RAD	C81
		C14	112-1691	CAP ELEC 220UF 25V	C75
		C15	130-0777	RES VAR 1.0K LOG CERMET	R11
		C18	130-0778	RES VAR 10K LOG CERMET	R14
		C21	130-0779	RES VAR 50K LOG CERMET	R6
		C27			R7
		C30			R9
		C63			R10
		C70	130-0780	RES VAR 500K LOG CERMET	R1
		C72			R2
		C74			R3
		C78			R5
		C79	132-0009	RES 1/4W ZERO-OHM JUMPER	R66
112-1606	CAP ELEC 10MF 25V	C37			R71
		C44			R109
		C51			R110
		C57			R112
		C66			R113
		C77			R114
					R117
					R118
					R119
					R120
					R121



Part No.	Description	Ckt Sym	Part No.	Description	Ckt Sym
134-2837	RES RN55D 15.0K 1% 1/4W	R100	136-0090	RES COMP 650 5% 1/4W	R12
		R103			R15
134-2967	RES RN55D 12.1K 1% 1/4W	R98			R17
134-3032	RES RN55D 15.8K 1% 1/4W	R101			R18
136-0001	RES COMP 2.7 5% 1/4W	R107			R19
136-0022	RES COMP 150 5% 1/4W	R63			R20
136-0040	RES COMP 4.7K 5% 1/4W	R99			R21
136-0044	RES COMP 10K 5% 1/4W	R13			R22
		R16			R52
		R24			R62
		R26			R67
		R27			R105
		R30			R106
		R31			R108
		R35			R111
		R36			R115
		R39			R116
		R40	136-0096	RES COMP 2K 5% 1/4W	R25
		R46			R32
		R47			R34
		R51			R41
		R56			R43
		R57			R50
		R61			R53
		R68			R60
		R75	136-0289	RES COMP 200K 5% 1/4W	R104
		R79	136-1765	RES COMP 3K 5% 1/4W	R69
		R83	136-1955	RES COMP 5.1K 5% 1/4W	R28
		R87			R29
		R92			R37
136-0050	RES COMP 33K 5% 1/4W	R4			R38
		R8			R44
		R33			R45
		R42			R48
		R72			R49
		R73			R54
		R77			R55
		R78			R58
		R81			R59
		R82			R97
		R85			R102
		R86	136-1983	RES COMP 9.1K 5% 1/4W	R64
		R89	138-0029	RNET CMN 7X10K SIP	RN1
		R90			RN2
		R91			RN3
136-0056	RES COMP 100K 5% 1/4W	R23			RN4
		R65			RN5
		R70	161-0426	DIODE 1N4148	D1
		R76			D2
		R94			D3
		R95			D4
		R96			D5
		R74			D6
136-0060	RES COMP 220K 5% 1/4W	R80	161-0630	LED PCB RDT1 3/4 D1F RED	DS1
		R84	161-0631	LED PCB YLT1 3/4 D1F YEL	DS2-6
		R88			
		R93			

Part No.	Description	Ckt Sym	Part No.	Description	Ckt Sym
286-1766	CONN JUMPER PLUG	JP1	286-2011 299-0303	CONN PCB MODULAR 4PIN HS SWITCH 6PST DIP	J1
		JP2			S1
		JP3			S2
		JP4			S3
		JP5			S4
		JP6			S5
		JP7	318-0246	XFORMER 10K CT-10K CT	T1
		JP8			T2
		JP9			T5
		JP10	318-0259	XFORMER 600CT-600CT	T6
		JP11			T3
		JP12			T4
		JP13			T7
286-1772	CONNECTOR 36PIN STRIP TIN	JP1	425-0178	INT CKT NE570N	T8
		JP2			U5
		JP3			U6
		JP4			U8
		JP5	425-0210	IC OPAMP LM348 QUAD	U1
		JP6			U9
		JP7	425-0488	OPAMP QUAD LMC660 OV INP	U2
		JP8			U3
		JP9	425-0529	IC CMOS SW DG212B 4XSPST	U4
		JP10			U7
		JP11	425-0530 534-0001 538-0075	IC LM2937 ET-10 VOLT REG SCREW PH 4-40X1/4 NYLOK NUT KEP 4-40	U11
		JP12			
		JP13			
286-1964	TEST POINT YELLOW .055 MNT	TP1	614-0434	HEAT SINK TO-220 21C/W	
		TP2			
		TP3			
		TP4			
		TP5			
		TP6			
		TP7			
		TP8			
		TP9			
		TP10			
		TP11			
		TP12			
		TP13			
		TP14			
		TP15			
		TP16			
		TP17			
		TP18			
		TP19			
		TP20			



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