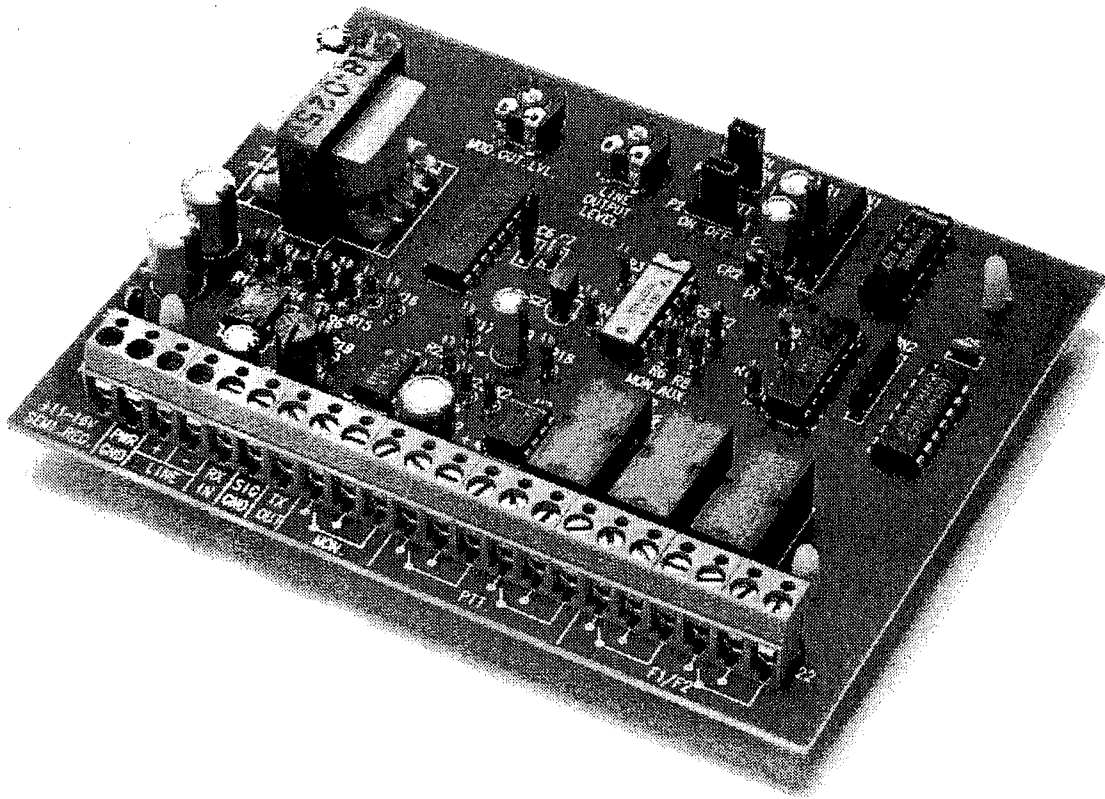




Signaling Products Group

# **Vega Model RA-230A/RA-231A DC-Remote Station Adapter Manual**



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## General

The Vega Model RA-230A\RA-231A DC remote control adapter is a reliable means of remotely controlling a two-way-radio base station. The adapter can be used in conjunction with the Vega Model C-530 DC-remote console or most other DC-remote consoles.

The RA-230A\RA-231A is a PC-board assembly which may be mounted in any convenient location at the base station. It provides PTT and monitor relay-contact outputs by the precise sensing of amplitude and polarity of the DC currents generated by the distant DC control console (the RA-231A also includes F1, F2 output). The DC control voltages are transformer- and optocoupler-isolated from all other circuits. Amplification and adjustment is provided for line transmit and line receive. Transient protection is provided at all inputs and outputs. The line connecting the RA-230A\RA-231A to the control console(s) may be from as little as a few feet to as much as 25 miles long. This line may be a 600-ohm twisted pair of wires or a leased telephone-company metallic line.

## Please Note

The Model RA-230 detects a positive current for PTT and a negative current for the monitor function. The Model RA-231 provides all the of the RA-230's functions, and in addition, the capability of selecting F1 or F2 operation. The following description of the RA-231 is provided, in order to include all circuits.

## Typical Operation

The operator at a DC control console lifts the handset "off hook", causing a negative current to flow through the line to the RA-231A. The RA-231A senses this current and closes the monitor relay, which disables the CTCSS circuit in the radio. The operator hears any radio traffic on the channel (this is an FCC requirement for shared channel users). If the channel is clear, the console operator presses the PTT switch, which causes a reversal of the line current from a negative to a positive polarity. The RA-231A senses this current change and closes the PTT relay, which switches the radio from receive to transmit, and, when the F2 positive current is sensed, also switches the radio to F2.

## Installation

The RA-231A inputs are diode protected from line transients up to certain limitations. Lightning-induced high voltages and currents have not been provided for. Vega will not provide repairs under warranty for damage obviously caused by high voltages.

If the DC line is a leased telephone-company metallic pair, lightning protection is usually provided. However, it may be some distance from the point of connection to the RA-231A. Therefore, it is recommended that gas-discharge-tube lightning protectors such as a North Supply part # S-561034 or equal be installed near the line input terminals to the RA-231A. Gas-discharge tubes such as a North Supply S-568015 or MOV devices such as a GE # V100ZA15 may be connected directly to the line input terminals; however, they offer a lesser degree of protection.

## Programming and Connections

As shipped, the RA-231A will detect and provide PTT relay operation from a positive 5 to 20 mA line current. The F1/F2 relay also operates and latches if the positive line current is 8 mA or above. This latch remains set during zero-current (receive) periods so that it may be used with two separate radios or certain two-frequency radios. The F1/F2 relay is deenergized (the latch is reset) by a positive 6 mA (5 to 7 mA) F1 current. The monitor relay responds to a negative 2.5 mA (2 to 20 mA) line current.

Plug jumpers have been provided to defeat the F1/F2 relay latch and to change the mode of operation from separate PTT and F1/F2 relays to PTT-F1 and PTT-F2 relays. Solder-jumper pads have also been provided for speaker-level receive output from the radio.

Move plug jumper P1 from "on" to "off" to defeat the F1/F2 latch.

Move plug jumper P2 from "off" to "on" to change the mode of operation from PTT and F1/F2 relay outputs to PTT-F1 and PTT-F2 relay outputs. Do not move both jumper plugs to the "on" position since this causes a PTT-F2 latch-up.

Connect the DC line to TB1-3 and TB1-4 with the positive side of the line to TB1-3 and a DC-current meter in series with TB1-4. Check DC line currents by having the console operator momentarily switch to TX-F1, TX-F2 and monitor. Usually TX-F1 should be +6 mA, TX-F2 should be +15 mA, and monitor should be 2.5 mA. Most DC current programming formats can be used. For instance, TX-F1 may be +5.5 or +6. Additionally it may be +9, +11, +12.5, or +15 mA if connections to the F1/F2 relay are interchanged. TX-F2 may be +9, +11, +12.5, or +15 mA. Additionally, +5.5, or +6 mA may be used if connections to the F1/F2 relay are interchanged. Monitor may be -2.5, -5.5, -6, -9, -11, -12.5, or -15 mA.

In the PTT-F1/PTT-F2 mode of operation, monitor, PTT-F1, and PTT-F2 radio connections may be interchanged, allowing, for example, monitor from +5 to 7 mA, PTT-F1 from +8 to +20 mA, and PTT-F2 from -2 to -20 mA.

There are also a large number of different modes of operation possible by routing the output of one relay through the extra set of contacts on another relay. For example, in the PTT and F1/F2 relay mode with F1/F2 latching and two separate base station radios, route the PTT output through the F1/F2 relay contacts to the two radios. Then use the other set of F1/F2 relay contacts to route receiver one or receiver two audio to the RA-231A RX input. Receive audio will then be heard from only the radio last used to transmit.

If DC line current needs adjustment, a DC current meter in series with the line at the console makes the adjustment much faster and easier. Note: Continuous current in excess of 50 mA should not be allowed to flow through the RA-231A (some consoles use a variable-voltage source instead of a variable-current source).

Connect +11 to +16 Vdc power to TB1-1 and power ground to TB1-2. Connect the radio receiver audio to TB1-5 and the audio modulation input to TB1-7. Use TB1-6 as a common audio ground unless the RA-231A and the radio are powered from the same source. If a mobile radio is used as the base-station radio, connect TB1-5 to the radio speaker (high) and close P1 with a small soldering iron. Connect TB1-7 to the mic input using shielded cable. If the mic input is for low-level dynamic microphones, replace R22 (39 k ohms) with a 6.8-k-ohm, 1/4 W, 5% resistor to reduce the gain by 14 dB.

Connect PTT, F1/F2, and monitor relay contacts to the radio to effect proper operation.

On some radios, it may be necessary to route the radio receive outputs through the extra set of PTT relay contacts to TB1-5 on the RA-231A.

## Level Adjustments

Level adjustments are normally required only at the time of installation.

Unsquench the receiver so that noise is present continuously. Connect an AC volt meter (use the meter output terminals) to TB1-3 and 4. Adjust the line output level control (R2) for 0 dBm or 0.8 Vrms. If the line length is longer than 10 miles, and the line is not a leased telephone-company pair, adjust R2 for +10 dBm or 2.5 Vrms. Note that if a speaker output is used to drive the RA-231A, the radio volume control will affect the line drive level. With voice or 1-kHz tone present from the console, adjust the modulation output level control (R1) for proper deviation.

## Theory Of Operation

Referring to the schematic, a direct current from the DC control line flows through the split primary of transformer T1, through part of opto-coupler U4, through the diode bridge to the junction of R13 and R14. This junction will always develop a positive voltage in respect to the detector circuit common, regardless of line polarity, this due to the diode bridge.

A small part of the line current flows through the voltage divider R13, R3, R4, and R6. Most, however, flows through R14. At U3-14, 5 V is developed from a very low current flow, due to the use of a CMOS opamp for U-3. When line current rises above this small "house keeping" current, U3-12,13,14 start to conduct and maintain 5 V at U3-14 due to the precision 2.5-V zener, CR3, and the voltage divider R5 and R8.

When line current rises to about 1.6 mA, the voltage at U4-2 is slightly above 2.5 V at U3-3, developed by zener CR3. U3-1 goes low, causing current flow through R9 and the LED in the quad optocoupler, U4. This causes U4-14 to go low and the 2.5-mA detection has taken place.

As the line current rises above 1.6 mA, U3-14 conducts the excess current until the line current reaches about 4.5 mA, at which time U3-6 is slightly higher than the 2.5 V at U4-5. This causes U3-7 to go low, sinking additional current through R7 and pins 5,6 of the opto LED. This causes the 6-mA detector output at U4-11.

In the same manner as before, when line current reaches about 7.5 mA, U3-8 goes low, causing the 9 to 15 mA detection output at U4-10.

As line current rises above 7.5 mA, U3-14 sinks the excess current. Line current should not exceed 20 mA for proper operation. The optocoupler may be damaged by continuous line current above 50 mA.

Opto inputs U4-1,2 are outside the bridge and cause output at U4-15 with all negative line currents and no output with positive line currents.

At line currents above about 7.5 mA, all three other opto outputs are low.

U4-15 goes low from all negative currents, U4-14 goes low from 2 mA or higher current, U4-11 goes low from 5 mA or higher line current, and U4-10 goes low from 8 mA or higher line current. A negative 2 mA or higher line current causes U5A-1,2 to go low, U5A-3 and U2B-5 to go high, and U2B-14 to go low, operating the monitor relay K1.

U5B-6 and U5C-8 are low during all positive line currents due to the low at U5A-3. U5B-5 goes high when line current is +5 mA or above, and U5C-10 goes high when line current is +8 mA or above.

With jumper plug P2 in the "off" position, as shown in the schematic, any positive current above 5 mA causes a high at U5B-4, which operates the PTT relay, K2, through U1A,B and U2-F. TX-F1 (+6 mA) and TX-F2 (+15 mA) both therefore operate PTT relay K2.

At line currents above 8 mA, U5C-10 goes high, operating the F1/F2 relay, K3, through U5D, U1D, and U2G.

In the latching mode as shown in the schematic, upon a current change from +15 to 0 mA (TX-F2 to RX-F2), capacitor C3 maintains U1D-12 low for about 100 ms and as long as the line current drops to below 4.5 mA within this 100-ms window, causing U1A-3 and U1C-9 to go high through CR2; latch U1-C,D will remain set. A +6-mA current (TX-F1), however, will cause U1C to go low after a 100-ms delay and cause the latch to reset. In the nonlatching mode, (P1 to off) U1D-13 is always high and a latch cannot take place.

In the alternate PTT mode (P2 to "on", P1 to "off"), a +6-mA detect operates K2 as before, but a +15-mA detect not only operates K3, but also disables relay K2 at U1A-1. Therefore, only the PTT-F1 relay operates from +6 mA and only the PTT-F2 relay operates from +15 mA.

## Audio Circuits

Line signals are induced into the secondary of T1. The level is adjusted by modulation output control R1, amplified by U6-B, and applied to the TX output terminal TB1-7 through R25 and C12. U2-11, 15, 16, 17 and 18 are used to protect circuits from externally applied transients since U2 has internal protective diodes with relatively high current capability.

Receive audio at TB1-5 is applied to line-output-level control R2 through R20 and C7. If JP1 is closed, this signal is attenuated by about 20 dB. Signal level is adjusted by R2, amplified by U6A, and applied to U7. U7 is in a bridge configuration driving the top of T1 at 0 degrees phase angle and the center tap of T1 through R18 at 180 degrees phase angle. This allows double the maximum signal current to flow through the transformer winding as would occur with a single-ended line driver. A maximum line output of at least +12 dBm without distortion is therefore achieved.

## Service, Repair, and Comments

### Important!

Be sure the exact return address and a description of the symptoms are enclosed inside the package with your equipment.

It is also advisable to return the transmitter and receiver together for full system performance test when practical.

### Factory Service Center

Vega  
9900 E. Baldwin Place  
El Monte, CA 91731-2294  
(818) 442-0782

### Vega Fax Library

Information including more detailed procedures, schematics, and other Vega products is available 24 hours a day from Vega's fax library. Simply call the number below then follow the voice instructions.

(818) 444-2017 or 800-274-2017

### 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.

## Model RA-231A Parts List

RA-231A contains parts in addition to it's RA-230A's base. Those additional parts are shown below.

PART NUMBER: 011-0071		DESCRIPTION: TOP ASSY RA-231A	
PART NO	QTY	DESCRIPTION	CKT SYM
011-0064	1	TOP ASSY RA-230A	
031-0204	0	TEST SPEC RA-231A	
112-1606	2	CAP ELEC 10MF 25V	C3
			C4
134-3049	1	RES RN55D 1.58K 1% 1/4W	R10
138-0014	1	RNET ISO 4X10K SIP	RN1
161-0366	2	DIODE 1N4003	CR1
			CR2
180-0329	1	RELAY PCB 12V DPDT MDX12	K3
286-1766	2	CONN JUMPER PLUG	P1
			P2
286-1932	1	TERM STRIP 6PIN MINI PCB	TB2
425-0255	1	IC CMOS 4093 QUAD TRIG	U1

## Model RA-230A/RA-231A Parts List

PART NUMBER: 011-0064		DESCRIPTION: TOP ASSY		RA-230A
PART NO	QTY	DESCRIPTION	CKT SYM	
031-0200		TEST SPEC RA-230A		
065-0405	1	PCB RA-230A, RA-231A		
071-0522	0	SCHEMATIC RA-231		
102-0430	2	CAP CER 470P S2L 5% 50V	C13	
			C14	
105-1001	1	CAP MYLAR .001MF 10% 100V	C6	
110-1319	1	CAP CER .01MF SM 50V	C15	
110-1340	2	CAP CER .1MF SMALL	C5	
			C7	
112-1606	2	CAP ELEC 10MF 25V	C 9	
			C11	
112-1609	2	CAP ELEC 100MF 20% 25V	C 8	
			C10	
112-1696	1	CAP ELEC 10UF 50V NP	C12	
112-1717	1	CAP ELEC 22UF 25V NP	C1	
130-0724	2	RES VAR 10K LOG V-ADJ	R1	
			R2	
131-1853	1	RES WW 68 5% 2W	R20	
134-0212	5	RES RN55D 10.0K 1% 1/4W	R 5	
			R 8	
			R15	
			R23	
			R24	
134-2850	1	RES RN55D 4.87K 1% 1/4W	R9	
134-2903	4	RES RN55D 1.00K 1% 1/4W	R 4	
			R12	
			R17	
			R19	
134-2940	1	RES RN55D 10.7K 1% 1/4W	R13	
134-2946	1	RES RN55D 953. 1% 1/4W	R3	
134-3049	1	RES RN55D 1.58K 1% 1/4W	R 7	
134-3051	1	RES RN55D 243. 1% 1/4W	R14	
134-3068	1	RES RN55D 7.32K 1%	R 6	
136-0003	1	RES COMP 8.2 5% 1/4W		
			R21	
136-0012	1	RES COMP 22 5% 1/4W	R25	
136-0022	1	RES COMP 150 5% 1/4W	R18	
136-0033	1	RES COMP 1.2K 5% 1/4W	R11	
136-0051	2	RES COMP 39K 5% 1/4W	R16	
			R22	
138-0032	1	RNET CMN 5X22K SIP	RN1	
			RN2	
161-0366	2	DIODE 1N4003	CR6	
161-0602	1	DIODE REF LM385Z-2.5	CR3	
161-0603	1	DIODE ZEN 1N4742A 12V 1W	CR4	
163-0001	1	DIODE BRDG FULL WAVE 1A	CR5	
180-0329	2	RELAY PCB 12V DPDT MDX12	K1	
			K2	
286-1766	1	CONN JUMPER PLUG	P3	
286-1772	3	CONNECTOR 36PIN STRIP TIN	P1	
			P2	
			P3	
286-1862	1	TERM STRIP 16 PIN MINI	TB1	
318-0256	1	XFORMER 600SPLIT-600	T1	
425-0105	1	IC OPAMP 4558 DUAL	U6	
425-0157	1	IC CMOS 4001 QUAD 2NDR	U5	
425-0202	1	IC OPAMP 5532 DUAL RL600	U7	
425-0263	1	INT CKT ULN2804A	U2	
425-0420	1	OPTO CPLR QUAD ILQ-30	U4	
425-0464	1	IC OPAMP TLC27L4C	U3	

## Model RA-230A/RA-231A Specifications

**Operating Temperature Range:** -20 to +55°C

**Power Requirements:** +11 to +16 V<sub>dc</sub>, 16 mA idle, 65 mA maximum (at +12 V<sub>dc</sub>)

**Relay-Contact Ratings:** 2 A, 24 V<sub>dc</sub>, maximum

**Frequency Response:** 100 Hz to 13.5 kHz (3dB down from 1 kHz reference)

**Line to TX Output Gain:** 0 to 30 dB into 600  $\Omega$ , adjustable

**TX Output Level:** -30 to +6 dBm into 600  $\Omega$ , adjustable

**TX Output Impedance:** 27 to 55  $\Omega$

**RX Input Level:** 100 mV<sub>rms</sub> to 13 V<sub>rms</sub> in two ranges, adjustable

**Line Output Level:** -30 to +14 dBm, adjustable

**Line Input/Output Impedance:** 600  $\Omega$ , nominal

**Dimensions:** 0.9 in (2.3 cm) H X 3.5 in (8.9 cm) W X 4.5 in (11.4 cm) D

### Line Control Current

**PTT:** +5 to +20 mA

**RX F1:** 0 mA (0 to 1.3 mA)

**MON:** -2.5 to -6 mA nominal currents

### Line Control Current (RA-231A Only)

**TX F1:** +5 to +7 mA

**TX F2:** +9 and +15 mA nominal currents



a MARK IV company

9900 East Baldwin Place • El Monte, California 91731-2294

Telephone: (818) 442-0782 • Toll-Free: 800-877-1771

Fax: (818) 444-1342 • CompuServe: 73513,1417

FaxBack: (818) 444-2017 • Toll-Free FaxBack: 800-274-2017

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