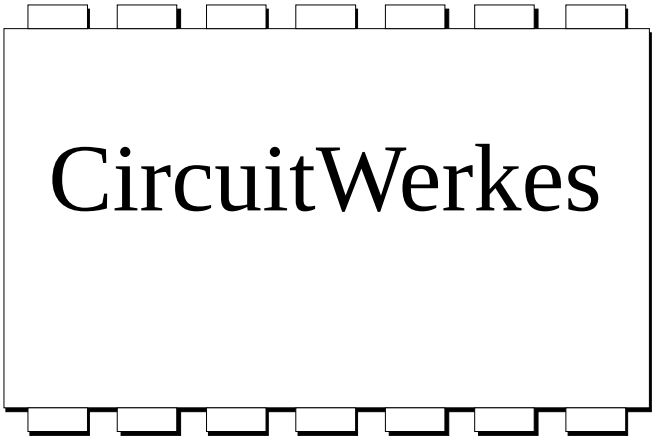
HC-3 Combo Auto Coupler

with ComboLok



Technical Manual

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The technical manuals for all CircuitWerkes current (& many older) products are available via the Internet at http://www.circuitwerkes.com/. E-mail links and product info can be found there as well.

INTRODUCTION

Thanks for buying the CircuitWerkes HC-3 autocoupler with ComboLok.
The HC-3 is a hybrid autocoupler with provisions for remotely controlling and monitoring its functions. The integral analog hybrid provides for some separation of incoming and outgoing audio. Built-in audio compression on the send line keeps outbound levels from exceeding -10 dBm into the phone line while keeping average levels high. The ComboLok option gives you secured access and a set of two form C relay closures that energize when the coupler answers the line and the proper password is entered.

SPECIFICATIONS

Power : supplied wall transformer or other 12 volt or higher (AC or DC) supply.
Polarity is unimportant. On-line current draw <100mA. Off-line current draw is approx. 20mA.

Audio In: Active balanced 50k input impedance.

Audio Out: Low impedance (approx. 250 Ohm) active balanced output with approximately 10dB of gain over normal phone line levels (which brings the output level up to about 0dBm on peaks).

Note: When connecting unbalanced audio into the HC-3, we suggest feeding the (-) input and grounding the (+) input.
When connecting the output to an unbalanced load, you can connect the load from either output to ground. You should not ground the unused output. Doing so may decrease output performance and may cause excessive heating of the output circuits.

Relay contacts: The N.O. contacts from SIP relay K2 close either when the unit is UNLOCKED or upon pickup (jumper J3 selects whether the closure is momentary or latching for the duration of the call) and are good for 10VA up to 30 volts. Higher voltages or currents should be slaved to a suitably large relay. If you slave a big relay off K2's contacts be sure to use a snuffer diode so the inductive kick from the coil of the slave relay won't weld K2's contacts. By default K2 is activated by the unit being UNLOCKED. To change K2's operation so that it gets energized at pickup see DTMF functions on page 7.

K3's form-c contacts are good for up to 2 amps. K3 is energized after the calling party has entered the unlock code (combination) properly. It remains energized until the end of the call.

The ComboLok option also provides you with various setup options not available on a stock HC-3 autocoupler. Remote forced hang-up, dtmf triggered tone generator, the option of making K2's action follow the lock status or coupler pickup, and the ability to remotely turn on or off whether the HC-3 requires a password to be unlocked. None of these dtmf operated functions are available until the unit is unlocked.

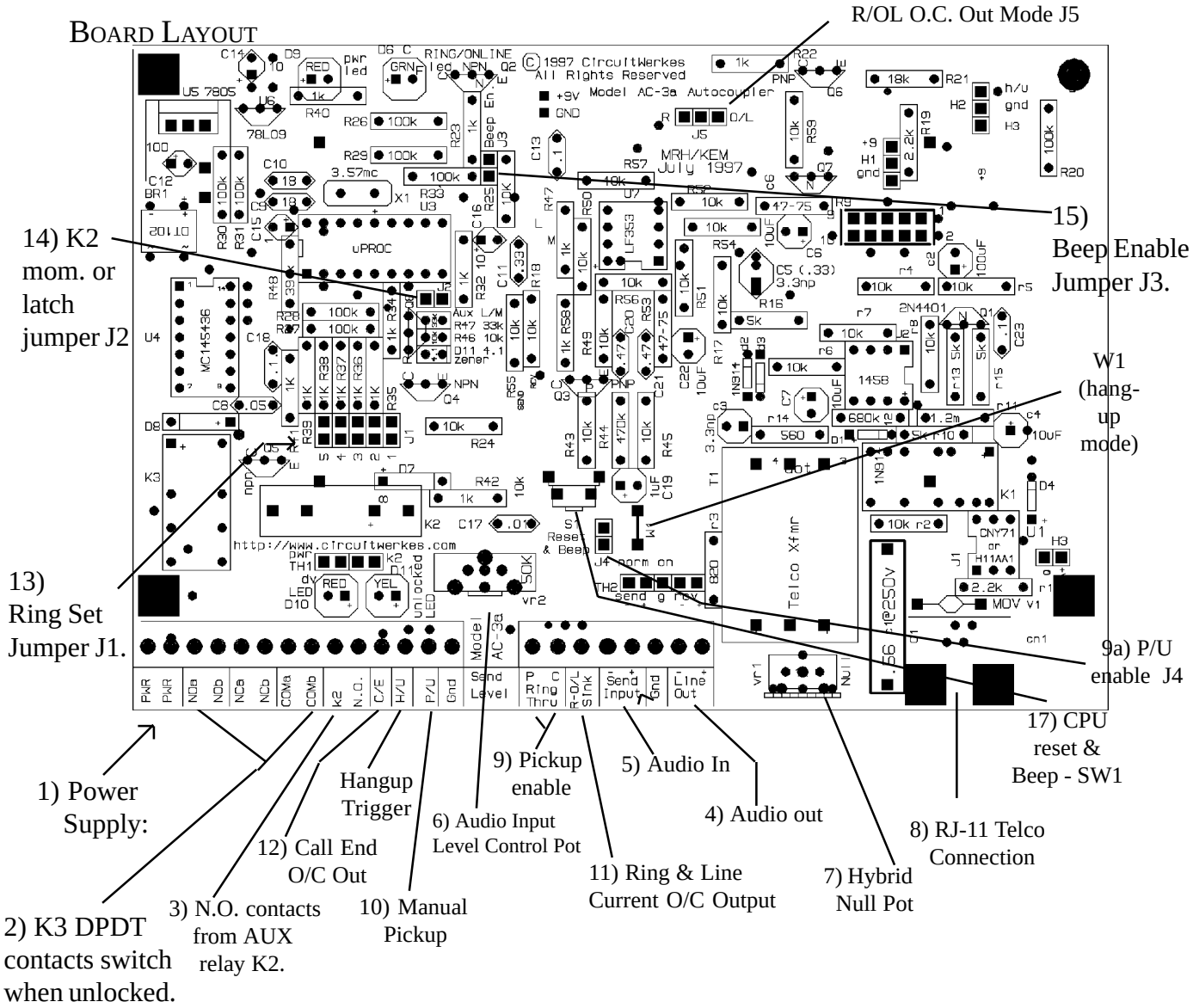
The ComboLok's UNLOCK password is four digits long and can be easily changed by the user.

The factory default UNLOCK code is 6736 (spells OPEN on the telephone keypad).

CONNECTIONS

Installation is fairly straight forward. Captive-wire screw terminals make all connections to the unit except for the Telco line which attaches to the RJ-11 jack. Mount your HC-3 away from excessive high temperatures and humidity, wire it up and operate it as follows:

BOARD LAYOUT



DESCRIPTION OF CONNECTIONS:

1) Power. The stripped and tinned leads of the supplied wall transformer go here. Polarity of the supply leads is not important.

2) K3 DPDT dry relay contacts that switch when proper combination is entered. Contacts rated 1A max.

3) N.O. contacts for AUX Relay (K2). Jumper J3 determines whether this relay closure is momentary (about 200 milliseconds) or latching for the duration of the call.

4) Audio Out. Approximately 250 Ohm line level output. Active balanced. 0dBm peak level. Do not ground unused output when wiring to unbalanced loads.

5) Audio In. Approximately 50k input impedance. Can be driven with straight -10 to +10 balanced audio. Integral active limiter keeps average levels high while limiting maximum to legal FCC level of -9dBm. Adjust input level control for desired compression/level. When feeding from an unbalanced source, drive (-) input & ground (+) input.

6) Input Level Control. Single turn pot.

7) Hybrid Null. Should be adjusted upon initial installation. Built in tone generator makes setting the null easy. See "Hybrid Null," on page 6.

8) RJ-11. Telco connection here. Center two conductors are tip and ring. Any standard/generic line cord (like the one we provide) will work fine. Normal dial-up "Loop Start" lines only. Ground start PBX telephone lines are not directly compatible with autocouplers. If you are hooking the HC-3 up to a PBX analog extension (an analog extension from a telephone system that emulates a normal dial-up phone line) you may want to read about the CircuitWerkes CP-1 in the Options section at the end of this manual.

9) Ring Thru / Pickup enable. This pair of contacts must be shorted (normally jumpered by J4 just behind the terminal strip) for the unit to detect incoming rings. The contacts must also be shorted for the HC-3 to detect line current. If line current detection is interrupted during a call, the coupler will hang up.
A remote mounted switch attached to these two conductors could be used to control whether the coupler answers and to force a hang-up of an already-answered call. The pin labelled 'p' is the microprocessor pull-up while the pin labelled 'c' is the collector of the ring/line optocoupler.

10) Manual pick up. Connected in parallel to S1 (behind the terminal strip), these two conductors can be shorted while the unit is OFF Line to initiate an instant pick up. If the switch is closed during power up (or the contacts shorted during power up) the coupler will reload its default UNLOCK password, 6736, erasing any custom UNLOCK code programmed in by the user.

11) Opto O/C. Ring detect and line current detect optocoupler U1 drives this open collector output. When a ring occurs, or when line current is flowing, this open collector transistor output will be energized.

12) Call end. A momentary open collector output that occurs at the end of each call.

13) Ring select J1. Jumper positions for setting how many rings the HC-3 should answer on. Unit comes factory strapped to answer after the second ring.

14) AUX L/M J2. Jumper position for selecting momentary or latching action on AUX relay, K2. If jumper shorted, K2 is momentary and closes for about 200 milliseconds. If J2 is open, K2's contacts remain closed until the unit hangs up. J2's function is independent of whether K2 is tied to pickup or lock status.

15) Beep Enable J3. This jumper can be removed if you wish to have no beeps. If the jumper is left on, beeps will occur at pickup, upon entry of the UNLOCK password, and at various other times.

16) LED Indicators: Red indicates that a valid dtmf tone is being received. Yellow indicates that the HC-3 is unlocked.

17) S1. Manual pick-up & beep & CPU Reset. Can be pushed while the unit is OFF Line to initiate an instant pick up. On HC-3 units without ComboLoks, this switch also initiates a 10-sec. tone output for nulling purposes if the unit is ON-LINE. Push & hold while toggling power to reset CPU to factory defaults.

18) H/U. Hang up control. When momentarily grounded, forces the HC-3 to hang up the line. If desired, a jumper wire may be installed at W1. That will force the coupler to stay off line as long as H/U is grounded. If W1 is not jumpered, the coupler will be ready to answer the next call, even if a constant low is applied to the H/U terminal however, momentarily re-grounding the terminal will always force a hang-up.

INSTALLATION / HYBRID NULL:

Once you've mounted your HC-3 and wired it for power and Telco line, it is ready for the next-to-last step, the hybrid null adjustment. This is accomplished by monitoring the HC-3's audio output connection with a console input, an amplified speaker, or even an analog voltmeter. Dial up the coupler, enter the UNLOCK password, then trigger the built-in tone generator (press #5 on the telephone keypad to start the tone generator). Adjust the Null Pot (VR1, beside the RJ-11 connector) pot for a visible or audible null. The null adjustment may have to be repeated if you change phone lines attached to the HC-3 or if your phone lines are modified, changed , or repaired by your telephone company. After the null is adjusted, connect your audio in and/or out wiring. Your HC-3 is now ready to use.

OPERATION of the HC-3 with ComboLok

Your installed HC-3 will remain dormant until it either detects incoming rings or you press the manual pickup switch S1, or its remote control equivalent. If the proper number of rings occur as the pickup trigger, the unit will pickup in the LOCKED state. The UNLOCK password must be entered within approximately fifteen second (only three tries are permitted) or the unit will hang up on the caller, still locked. If S1 is used to force the coupler on-line it will also automatically UNLOCK the coupler.

Unless the BEEP Enable jumper (J3) is removed, the unit will beep down the telephone line at pickup. It beeps twice if locked and once again when the UNLOCK code is entered correctly or once if already unlocked (as when S1 is pushed to force a pickup or when password checking is turned off ... see DTMF FUNCTIONS on this page for details).

The Yellow Unlocked LED lights up and relay K3 is energized when the unit is unlocked .

You can stay ON-LINE as long as you want after the password is entered.

When the caller hangs up - your HC-3 should hang up either instantly or within about twelve seconds depending on the variety of Central Office switching gear your telephone company uses. If it just hangs on the line interminably, you may be in one of the very few areas where the local telephone company does not employ what is typically known as CPC, short for Calling Party Control. If this occurs see Appendix A near the end of the manual for your options.

DTMF FUNCTIONS

While online (and UNLOCKED) the caller can access several special functions with preset dtmf codes. Remember that you must first be UNLOCKED to perform any of these functions.

7764 (spells PROG on the telephone keypad) initiates a programming mode for setting a new UNLOCK password. After entering 7764 you will hear long beep, short beep, long beep, short beep (a Morse code 'C') signalling you to enter the new unlock code. After you've entered the new unlock password you will hear two short beeps prompting you to enter the new password again for verification. After you enter the same password again the system acknowledges the new password by beeping long, short (Morse code N). Once your call is complete and the HC-3 has hung up, subsequent access will require the new password to UNLOCK the HC-3
Example 7764 (beeps:long,short,long,short) 1234 (beep beep) 1234 (long beep, short beep)
Changes the UNLOCK password to 1234 for subsequent calls. UNLOCK passwords cannot start with the pound symbol (#) as it is reserved as a prefix for other special functions as follows:

DTMF Functions cont'd

#1 turns off password checking for subsequent calls allowing unrestricted access.
#2 turns on password checking for subsequent calls. FACTORY DEFAULT

#3 makes K2 operate based on the lock status. K2 will be energized upon entry of the correct UNLOCK password. J2 (AUX L/M jumper) determines whether K2 is momentary or if it stays latched until the call ends. FACTORY DEFAULT
#4 makes K2 operate based on the HC-3 initially picking up a call. J2's function doesn't change.

#5 starts a 16 second "test tone" which gets sent down the phone line for setting levels or nulls.

#6 forces the HC-3 to hang up immediately.

NOTES and Ideas:

Try using the K3 (form-c) contacts to switch audio to or from the unit ONLY after the unit is UNLOCKED. If you set K3 to operate from lock status you can use it as a signal that an authorized caller is online.

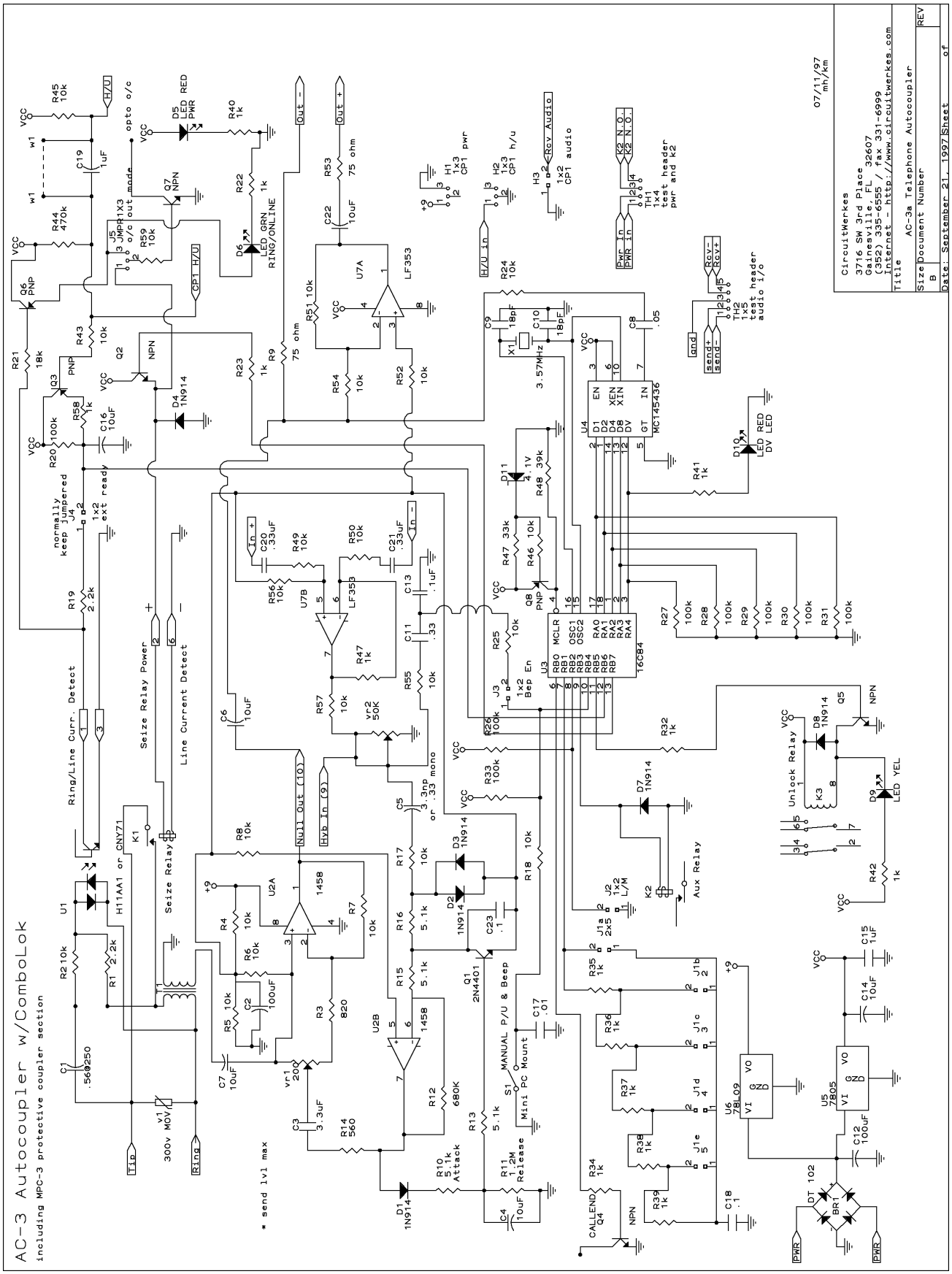
If you'd like to slave a relay on the OPTO O/C output or the callend output, remember that the emitters of Q3 (the opto's slaved transistor) and Q4 (callend) are tied to the HC-3's ground buss.

Troubleshooting

If you are having trouble with your HC-3 please try to characterize the trouble before calling for tech support. Things to check:

Observations:	***Likely Cause***
NO Power LED (the red LED that sticks through the flat front panel).	Power supply dead. (Measure DC output of LM7805.) LED is bad.
Unit doesn't pick up after prescribed number of rings and ring LED doesn't light during rings.	Optocoupler U1 dead.
Unit picks up then immediately hangs up.	1/2 of U1 dead. Your telco Voltage is low.
Unit refuses to hang up.	You're on a PBX or telco line without CPC. See above on this page for details.
Ring/Online (green) LED not on, but unit picks up phoneline anytime phone line is connected.	MOV shorted or K1 stuck -try tapping K1.
Passwords don't work to unlock unit, but red 'dv' LED does light up when dtmf tones are entered	Password memory is glitched reset to defaults (page 5)

HC-3C SCHEMATIC DIAGRAM



RINGS, BEEPS, AND SUCH

Changing which ring the HC-3 answers on is accomplished by moving the ring set jumper J1. The unit comes factory set for two rings. The five positions of J1 are marked 1-5. If the jumper is completely removed the unit will answer after ten rings. *The microprocessor reinitializes at the end of each call, so changes will not take effect until the **next time** the coupler hangs up. You can also reinitialize the processor by pulling the power for a few seconds after changing this jumper.*

To disable the HC-3's beep upon pickup, remove the beep enable jumper, labelled "Beep En J3," near the green LED.

To make the HC-3's auxiliary relay (K2) operate in a latched fashion (for the duration of the call) remove the "Aux L/M" jumper located next to U3 (the microprocessor). The Aux relay is factory set to operate in momentary mode at pickup.

If you intend to monitor the line-current / ring optocoupler's open-collector output AND control when it is presented to the microprocessor for signalling, remove Jumper J4, beside the RJ-11 jack. For normal Autocoupler operation this jumper MUST be left ON. This jumper is accessible with the HC-3's top on.

Changing the mode jumpers requires removing the top cover of the HC-3's enclosure.

To remove the top cover of the HC-3, first remove the optional rack mount panel (if so equipped) then press the Red and Green LEDs on the front panel in with your fingertip so the fronts of their lenses are even with the front of the case. Next remove the four (keps) nuts from the case and remove the top half. You now have access to the main board.

The board layout on page four gives you the locations of the jumper positions noted above, and more.

Reassembling the case: Gently pull the two, front-panel LEDs straight forward about 1/4" so the flat edges (where the leads come out) are roughly even with front edge of the bottom plate. Next angle the fronts of the leds down just slightly, somewhere around 30 degrees. Place the top of the box on with the front angled down to roughly match the angle of the leds and position it so the LEDs enter their round holes in the front edge of the box. Gently move the box-top into position over the front two 6-32 studs (at each side of the bottom plate) and lower the top onto the front studs first then the back. With just a little luck your LEDs will have made it through the front panel with no problem. If one or both of them don't quite make it through, take a long, thin, regular screwdriver and gently push them through from behind; you can do this with the top on. Replace the (keps) nuts that hold the top in place and reattach your rack plate, if so equipped.

APPENDIX A

What can I do if the phone company does not provide an end of call line reversal (CPC)?

Depending upon the type of service that you intend to use the coupler for, there are a few options:

1. If your telephone line does provide dial-tone or a busy (aka reorder) signal after the calling party hangs up the easiest and best cure is to buy a CP-1 call progress decoder board and install it in your HC-3. The CP-1 "listens" to the incoming audio stream and detects the presence of dial-tone or busy/ reorder signals. When they are detected the CP-1 forces the HC-3 to hang up.

2 If you are going to use the coupler as an outgoing message center (concert line, etc.) and if the associated device that has an end of message (EOM) output (like the secondary or tertiary tones of many cart decks) you could use those outputs to force the coupler to hang up the phone. If you don't have an EOM output available, you may still be able to provide the same function with the device's ready output. A momentary or latching closure can be used between the H/U terminal and ground to force a hang-up.

3. If your messages are all of the same length, you can build a simple timer from a 555 or other device which will output a +5V pulse (referenced to the pcb ground) to the 'c' pin of the ring thru terminals after the appropriate interval.

REPAIR OR SERVICE INFORMATION

In the event of the need for service or repair, call CircuitWerkes at (352) 335-6555 for a Return Merchandise Authorization number (RMA). Then carefully package the unit along with a note of the problem and send it to the address below. Clearly indicate the RMA number on the outside of the box. We cannot accept returns without an RMA. Be sure to include a note with a brief description of the problem, your address (not a PO box), telephone number and best time to call.

CircuitWerkes
ATTN: CUSTOMER SERVICE DEPT.
2805 NW 6TH STREET
GAINESVILLE, FL 32607

CIRCUITWERKES LIMITED WARRANTY

This product is warranted against defects for two years from date of purchase from CircuitWerkes and CircuitWerkes authorized distributors. Within this period, we will repair it without charge for parts and labor. Proof of purchase-date required. Warranty does not cover transportation costs, or a product subjected to misuse, accidental damage, alteration (except as authorized by CircuitWerkes), improper installation, or consequential damages.
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