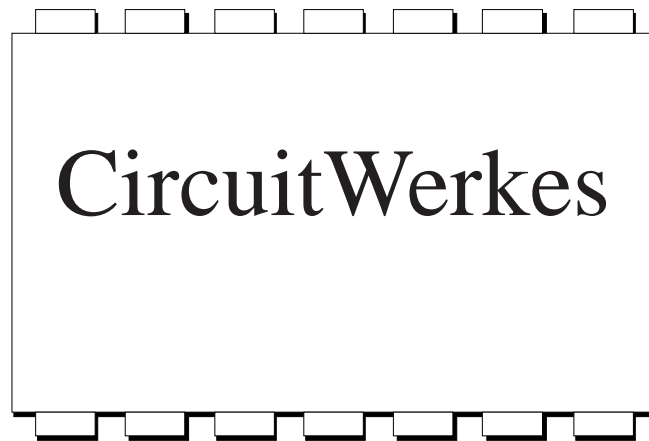


AC-2c Auto Coupler



Technical Manual

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The CircuitWerkes AC-2c Telephone Auto-Coupler Installation and Service Manual

Operational Description

The AC-2c autocoupler is designed to detect incoming rings and automatically answer telephone lines. The coupler provides a transformer coupled audio path either to or from a single phone line. When the calling party hangs up, the AC-2 will release the line and be ready for the next call. The circuit also includes an isolated relay closure that can occur either momentarily at the beginning of the call or stay latched for the duration of the call. This closure can be used to signal the start of a call or start and stop external equipment. Provisions for remote pick-up and hang-up switches are included as are LED's for RING and ONLINE indication. An external pick-up inhibit is available to prevent the coupler from answering until you are ready. The circuit includes an on-board regulated power supply that can operate on an AC or DC input.

Initial testing

The AC-2c is factory set to operate as a standard autocoupler out of the box. All you need to do is connect power, audio, and phone line to the autocoupler. Connect 12 to 18 Volts (AC or DC) to the POWER jack. When power is applied the two relays will energize for about one second, then drop out. This indicates the initial operation of the one-shot and S-R latch circuits.

If the initial power-up occurs as we've described, you are ready to test the device on the phone line. Remember that the phone line carries ring voltages that are high enough to give you a nasty jolt if you happen to be touching the tip and ring conductors during a ring. Connect the RJ-11 jack of the AC-2c to your phone line with a standard modular cord. Have someone call your line. As soon as the phone starts ringing, you should see the ring LED light up. The coupler should answer at the beginning of the ring that you have selected. When it does, the online LED will light up. If you have an audio source such a tape player or signal generator you can connect it to the 1/4" audio jack. *Tip* and *ring* are the active pair. The sleeve is not used and may be tied to the ring. Adjust the audio level until the clipping LED just begins to light. Your calling party should hear the audio loud and clear. Shortly after the caller hangs up, the coupler should automatically drop the line. Almost every modern CO in the country generates a zero-crossing (commonly known as "Calling Party Control" or "CPC", in the telephone line battery voltage about eight seconds after dial tone is applied to the line (if no activity is detected in that period of time). This occurs after a calling party has terminated a call by hanging up their end of the line and if the line is picked up (as if to dial out) but no dialing is initiated.

Note: If your local central office is one of the rare systems that does not support this signalling, you may have to resort to a preset timer or, preferably, a dial-tone detector to hang up your autocoupler automatically. We will be happy to advise you on how to implement such a feature, but since the need is so rare, we do not support a product that does not rely on a zero-crossing in the line voltage to signal the end of a call.

The remote connections can be tested using a VOM. When the coupler first picks up, pin 5 of the db25 connector will go low for a moment. Depending upon which way you set jumper j-2, the relay contacts at 1 & 2 and 4 & 6 will close either momentarily or will latch as the unit picks up. A ringing signal will produce a low output at pin 9.

You should be able to force the coupler to pick up by momentarily grounding pin 5. You can force the coupler to hang up by grounding pin 7. Test the external inhibit by connecting a jumper between pins 11 & 13. Next, remove jumper J1 call the coupler. It should not answer. Connect pin 10 to ground (pins 15-25). The coupler should answer as normal.

Connections

The AC-2 connects to the phone line via a standard RJ-11 jack which is mounted in the front panel and marked "line".

The power connection is made at the coaxial jack on the back panel marked "Power". The AC-2 is designed to accept from 12 to 18 Vac (or 14 to 18Vdc) and the supply should be able to provide at least 150ma.

Your audio connection is made at the rear connector marked "audio". The connector is a tip, ring & sleeve type with the tip and ring being the active contacts. Since the audio is transformer coupled to the phone line, you may connect to the AC-2 with either balanced or unbalanced lines. To simultaneously send and receive audio, an external hybrid must be used.

The D-25 remote connector provides all other input and output connections to the AC-2.

Pins 1, 2 & 3 are relay closure "A", a form "c" contact while pins 4 & 6 are n. o. relay closure "B". Both sets of relay closures are dry contacts rated at 1 Ampere and 125 Volts.

Pin 5 is the pick-up trigger that causes the AC-2c to seize the line when an external low is applied.

Pin 7 provides remote hang-up control. By momentarily connecting this pin to ground, you will force the AC-2 to hang up the line. You may use this function any time you wish to manually hang up the line. If you are using the coupler as a concert line, etc. on a player with an end of message output (like a tertiary tone on a cart deck), you could force the unit to hang up as soon as the message is over.

Pin 8 is the on-line status output (ground sink).

Pin 9 is the ring detector ground sink output.

Pins 10 & 11 are used in conjunction with J-1 to remotely enable the auto-answer portion of the coupler. When J-1 is removed, you can remotely enable the auto-answer circuit by applying 5 to 24 volts ac or dc to these pins. A typical application of this function might be to prevent the coupler from answering the line until another device, like a cart machine, has recued. In this case, the ready light output from the cart or other device could be connected to pins 10 & 11. The unit would pick up the line only after the ready light comes on. This prevents the next caller from getting the end of a message if the previous caller hangs up before the playback device is recued.

Pin 12 is a momentary low output which happens when the AC-2 first picks up the line. This output is independent of the J-2 position, is TTL compatible and can sink up to 100 mA. It may be used to start an external machine, reset a timer, or increment a call counter.

Pin 13 is a current limited +12Vdc source for driving external indicators, the opto-isolated remote inhibit, etc.

Pin 14 is a factory test point

Pins 15 through 25 are ground.

Jumpers

J1 is the external pickup inhibit function. When this jumper is off, an external voltage of 5 to 25 Volts dc must be applied to pins 10 & 11 before the coupler will detect an incoming ring signal.

J2 is the auxiliary relay mode selector. When in the "a" position the relay will be energized as long as the coupler is on line. The "b" mode momentarily energizes the relay when the coupler first picks up.

The ring selector jumper allows you to set the number of rings on which the coupler answers.

Board Headers & Connectors

Header H1 is a 4 pin connector that is used for attaching an optional combination lock to the coupler.

Header H2 is a 3 pin connector that may be used with a CircuitWerkes DTMF-16 decoder to cause an audible beep to occur when the unit first answers the line. Specific instructions for interfacing the two boards is available upon request from us.

Theory of operation

The AC-2c consists of two separate sections - the logic section and the type approved protective coupler section, which is designated MPC-2.

MPC-2 type approved section: The telephone line tip and ring connect through an RJ-11c jack to the MPC-2 circuit board. An MOV across the line suppresses any hazardous transients. Two 0.1 uF DC blocking capacitors pass audio to the telco transformer when the unit is off-line. One input of an h11aa1 ac input optocoupler is connected to tip through normally closed contacts on the dpdt relay; the other input connects to ring through a .47uF capacitor and a 22k resistor. When a ring occurs the optocoupler's output transistor turns on and provides an open collector output, which is the ring detect output of the MPC-2. When 12vdc is applied to the field of the dpdt relay, the ring detect optocoupler is taken off line and the relay closures make a dc path from tip and ring to one side of the transformer. The line current detect optocoupler is then also connected between tip and ring through a 1k current limiting resistor. When the caller hangs up the optocoupler turns off, signalling that the

call is over. FCC required signal limiting is accomplished with special back to back diodes across the user side of the telco transformer. While removing these diodes may result in improved audio performance, we do not recommend their removal because it will void the unit's warranty, the FCC type approval and possibly allow excessive signals to pass through the coupler. Additionally, excessively high audio passages with peak amplitudes in excess of several Volts may exceed the dc potential of the phone line during negative peaks. If this happens, the coupler will be fooled into believing that a CPC signal has been sent by the central office and will release the line. Because of FCC regulations, any modification of the MPC-2 voids the unit's type approval. The MPC-2 board connects to the logic board via the top layer pc board traces. The eight conductors include emitter and collector for the ring detect optocoupler, emitter and collector for the line current detect optocoupler, two lines for relay power (12Vdc) and two lines for audio connection.

Logic & Control section: The ring detect output of the MPC-2 is pulled up by resistor R3, smoothed by capacitor C5 and fed to the input of U3C, a 4093 Schmitt-triggered NAND gate which provides a clean square wave output. The cleaned-up output from U3c is routed through J1/U5 to a 4017 which operates as a ring counter. U3b is configured as a timer that resets the 4017 counter if the line stops ringing before the coupler picks up. The incoming ring signal also drives ring indicator transistor, Q2. Several outputs from the 4017 are brought out to a five position jumper block. When the ring count reaches the selected (jumpered) output, it is passed along to inverter U4c and also to Q1 which provides a momentary ground sink to drive the aux. relay and Db-25 connector. The output of U4c drives an SR latch made from U4b, U4d which, when latched energizes the MPC-2 seize relay. The smoothed ring pulse remains low long enough for the line current detector output of the MPC-2 to keep nand gate U3d from resetting the s-r latch. When the calling party hangs up, the Telco Central Office (CO) signals with a momentary zero-crossing (the line voltage momentarily reverses or drops to zero). The line current detector output goes high during this zero crossing and forces the output of nand gate u3d low, which resets the R-S latch, hanging up the line. U4a is a reset timer which prevents the AC-2c from erroneously seizing the line when the power is first applied. U3a is a simple inverter which provides a high output to seize the line when the pick-up switch is thrown. Audio peak detection is provided by U7. The first stage is a balanced amplifier with a voltage gain of 10. The second stage is a comparator whose threshold level is fixed at -9dBm. The output of the comparator section drives the yellow clipping diode which illuminates when the audio reaches the clipping threshold.

The seize switch on the front panel and pin 5 on the db-25 both connect to the trigger input of the monostable through inverter U3a & steering diode D9, so J1's position has no effect on the external pickup control or the seize switch.

Auxiliary relay k1 provides 2 sets of dry contacts for the user. K1's operation mode is controlled by J2. In position a, k1 is energized by transistor q3 for the duration of the monostable set-pulse. When J2 is in position b, k1 is energized by q4 for the duration of the call.

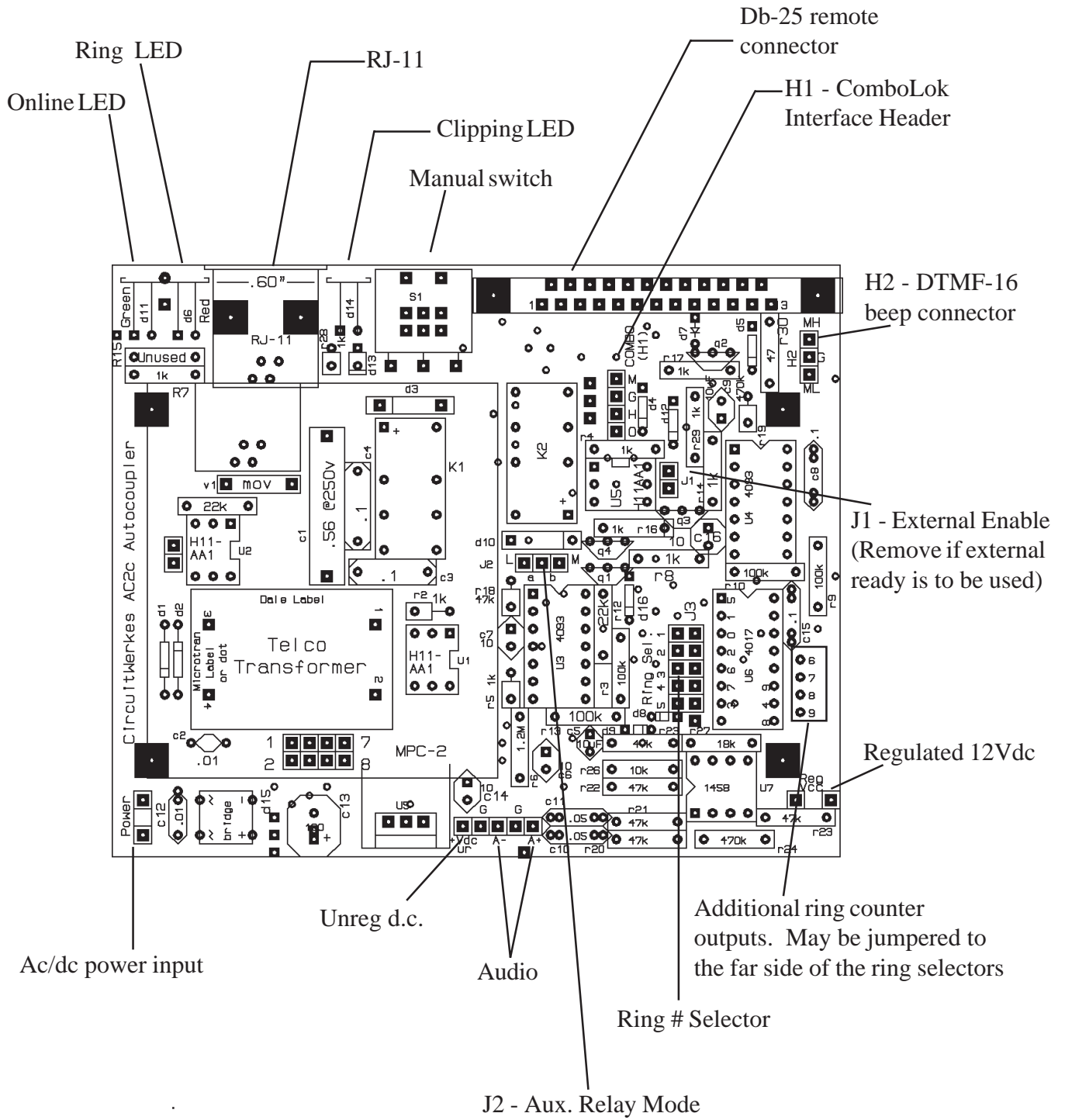
When Q3 turns on, it sources 12Vdc for the MPC-2 line seize relay and momentarily charges capacitor C16 which, in turn, momentarily biases Q1 on. Q1 provides a momentary O-C output on pin 12 of the Db-25. This output is independent of the position of J2.

The external hang up trigger and the front panel release switch both connect directly to the reset input of the S-R latch formed by nand gates U4b and U4d. A momentary ground resets the S-R latch, hanging up the line and resetting the coupler.

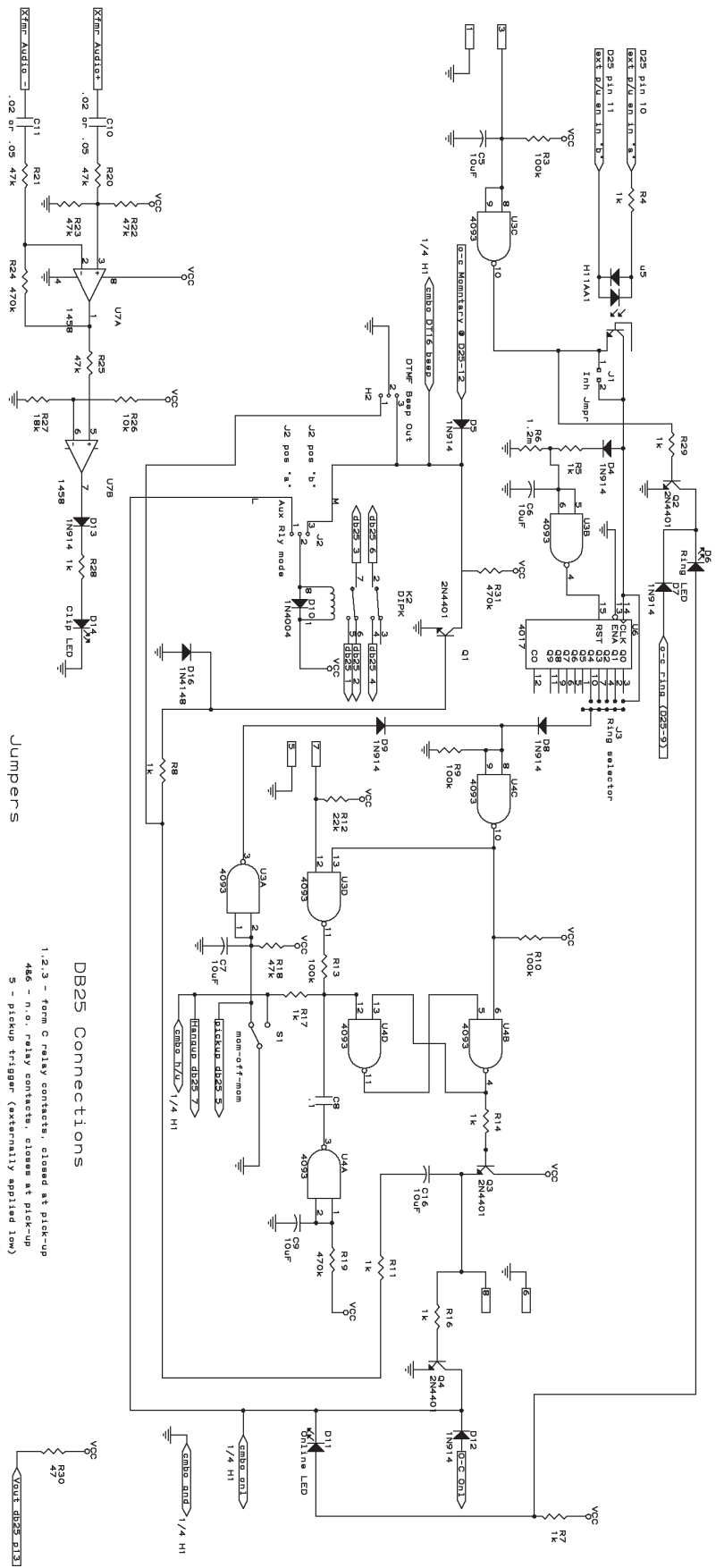
Pin 13 of the db25 provides a current limited 12vdc supply capable of 50mA MAX. Limiting is accomplished through the use of a 47 Ohm series dropping resistor.

Pins 15 through 25 are connected to ground.

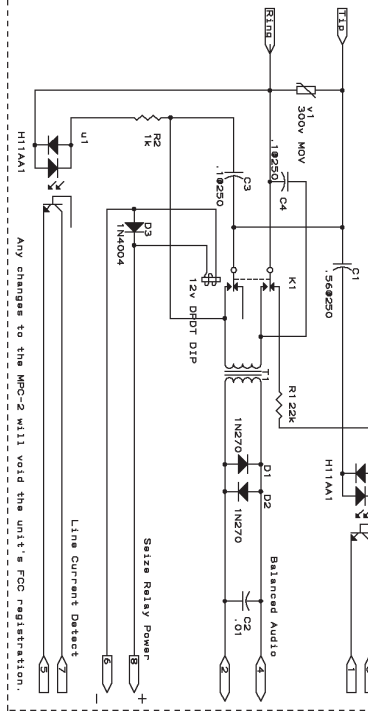
AC-2c PC Board Layout & Parts Locator



CircuitWerkes AC2c Enhanced Autocoupler



MPC-2 Type Approved Section



Any changes to the MPC-2 will void the unit's FCC registration.

Jumpers

- J1 - Bypasses external pickup enable when jumpered
- J2 - Aux relay mode momentary or latching
- J3 - select answer on ring #

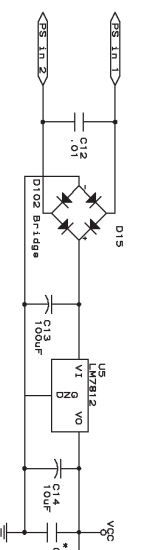
DB25 Connections

- 1,2,3 - form C relay contacts, closed at pickup
- 4&6 - n.o. relay contacts, closed at pickup
- 5 - pickup trigger (externally applied low)
- 7 - Hangup trigger (externally applied low)
- 8 - online status out, open collector and sink
- 9 - Ring detect out, open collector and sink
- 10 - optional ring detect enable input a
- 11 - optional ring detect enable input b
- 12 - Momentary open collector and sink (at pickup)
- 13 - Vec. +12V regulated, do not exceed 60mA
- 14 - Factory test pin (clip indicator raw output)
- 15 thru 24 - ground

Headers

- H1 - Combulok interface pins
- H2 - +12V Regulated DMPT16 Bump

Power Pins: U3,4 = 14, U6 = 16, U7 = 8



* C14 is a supply filter near the 4017.

OPTIONAL POWER LED	
<input type="checkbox"/>	@ 1994 CircuitWerkes
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CircuitWerkes	
2716 SW 3rd Place	
Sarasota, FL 34237	
(941) 331-5999 / Fax 232-5713	
Title (Vap. C) Autocoupler using the MPC-2	
Size Document Number	
Date Document 15, 1994 SHWA	
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Appendix A

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

Most phone companies either already provide battery reversal or can do so on request. This end of call signal goes by several names including CPC & COD. If you wish to connect your coupler to the house side of a pbx, you may not be able to get a battery reversal. There are several options depending on your type of service.

1. If you are going to use the coupler as an outgoing message center (concert line, etc.) and 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. You would connect a low going output to pin 7 of the db-25 remote connector. The unit would then hang up as soon as the cart stopped. If your cart or other device outputs a voltage instead of a ground, you can drive an optocoupler or relay to get the required ground sink.
2. Purchase a call progress decoder option from CircuitWerkes. The call progress decoder listens for dial tone or busy signals and then hangs up the AC-2.
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 low to pin 7 of the remote connector after the appropriate interval.
4. Call us at our customer service number and we will discuss your other options.

Appendix B

{ Information the FCC makes us include... }

NOTIFICATION TO THE TELEPHONE COMPANY

This equipment complies with Part 68 of the FCC Rules. You will find the label located on the solder side of the PCB, and on the bottom or back of the equipment enclosure if device is enclosed. This label contains the FCC Registration Number and Ringer Equivalence Number (REN) for this equipment. You must, upon request, provide this information to your telephone company. The REN is useful to determine the quantity of devices you may connect to your telephone line and still have all of those devices ring when your telephone number is called. In most, but not all areas, the sum of the RENs of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should contact your local telephone company to determine the maximum REN for your calling area.

JACK TYPES NEEDED

Connection to the telephone network should be made by using standard modular telephone jack type RJ11C.

INCIDENCE OF HARM

If your telephone equipment causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notice is not practical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

RIGHTS OF THE TELEPHONE COMPANY

Your telephone company may make changes in its facilities, equipment, operations or procedures that could affect the proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

MALFUNCTION OF THE EQUIPMENT

In the event this equipment should fail to operate properly, disconnect the unit from the telephone line. Try using another FCC approved telephone in the same telephone jack. If the trouble persists, call the telephone company repair service bureau. If the trouble does not persist and appears to be with this unit, disconnect the unit from the telephone line and discontinue use of the unit until it is repaired. Please note that the telephone company may ask that you disconnect this equipment from the telephone network until the problem has been corrected or until you're sure that the equipment is not malfunctioning.

COIN SERVICE OR PARTY LINE USE

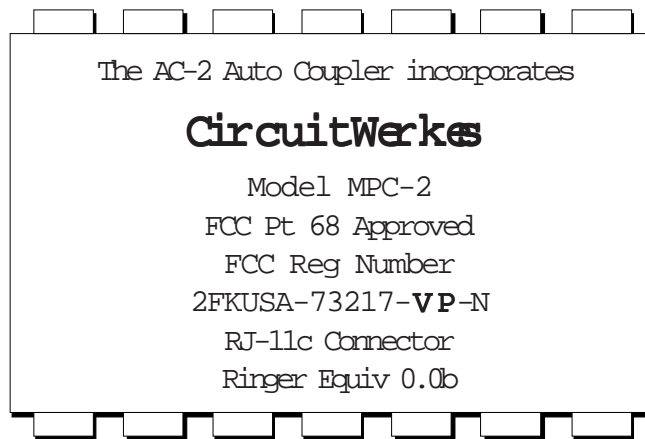
This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

REPAIR OR SERVICE INFORMATION

In the event of the need for service or repair, call CircuitWerkes at (352) 331-5999 or 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 brief note describing the problem and include your street address (not a PO box), telephone number and best time to call.

CircuitWerkes

ATTN: CUSTOMER SERVICE DEPT.
3716 SW 3RD PL
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.

Except as provided herein, CircuitWerkes makes no warranties, express or implied, including warranties of merchantability and fitness for a particular purpose. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.