

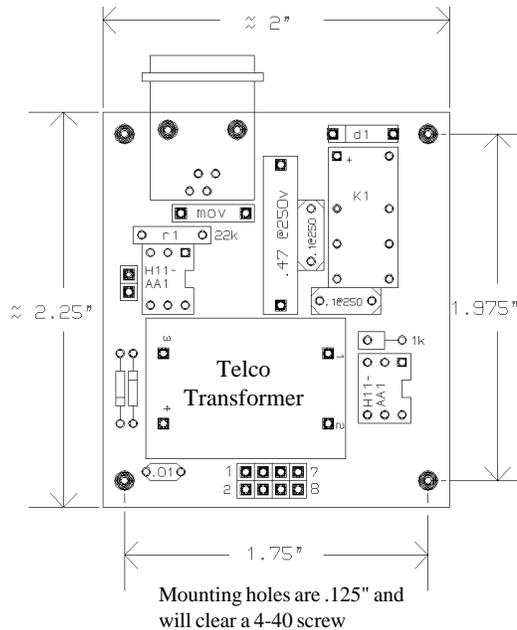
## CircuitWerkes MPC-2

The MPC-2 is an FCC part 68 registered voice protective coupler that provides legal interface to the Public Switched Telephone Network. The FCC registration is transferable to the end user if the user adheres to some simple guidelines including labeling, mechanical clearances, and inclusion of FCC required customer information in the unit's documentation.

### SPECIFICATIONS:

FCC PART 68 REGISTERED Voice Protective Coupler. Registration number 2FKUSA-73217-VP-N

### Dimensions:



The MPC-2 is not potted in epoxy. The two optocouplers, used for ring detection and line current monitoring, are socketed and accessible.

The face of the PC-mounted RJ-11 is approx 0.62" square. It projects approximately 0.325" past the "front" edge of the MPC-2 board.

Maximum vertical dimension is 0.75".

Non conductive standoffs required. Must maintain a minimum of .20" between bottom of the MPC-2 and any conductive material. A minimum .20" clearance must also be maintained between any surface of any of the components on the MPC-2 and any conductive material. No specific horizontal clearance is required to an edge of the MPC-2 printed circuit board.

Audio in/out impedance: 600 ohms

Audio level: limited to -9 dBm max. (not guaranteed to be high enough for (outgoing) DTMF tone dialing on all CO's)

Passes audio when on or off hook, making the MPC-2 **caller ID compatible**.

### Connections:

RJ-11c right-angle pc-mounted jack standard; 5-3/4" pig-tailed panel-mount RJ-11 optionally available.  
8 pin (2x4) .10" spaced header pins for user interface.

### User interface includes:

Open collector ring detect output.  
600 ohm audio input/output path

Open collector line-current detect output.  
12V dc input (5V version optional) for line seize relay.

The MPC-2 can be incorporated in your product in a number of different ways. It can be attached to your enclosure mounted on stand-offs, or optionally mounted directly to your printed circuit board.

## HOW YOUR PHONE LINE WORKS

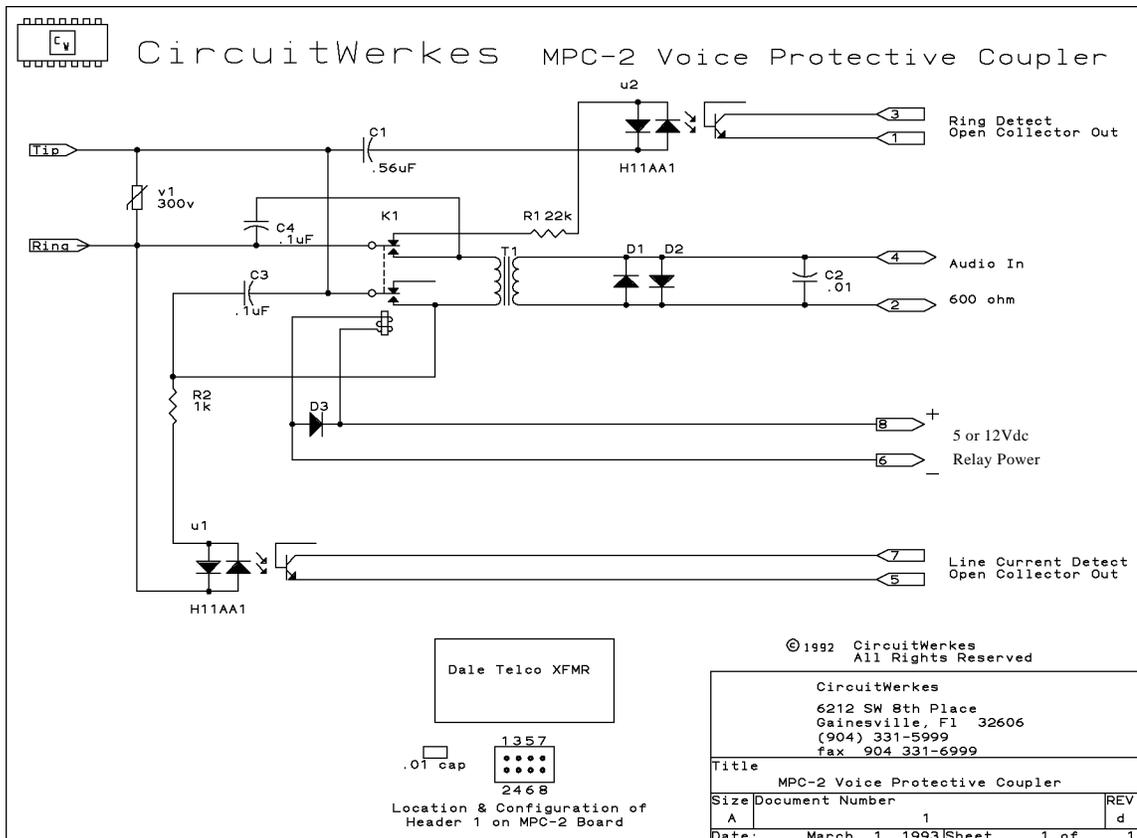
The phone line coming into your home or office ends up attached to an RJ-11 (modular) jack. For a single-line installation, two conductors called Tip and Ring make up the phone line that connects your telephone equipment to the phone company's Central Office, CO for short. When your telephone instrument is on-hook (hung up) the tip and ring conductors have about 48 volts dc, called battery voltage, between them. Note that this voltage is current limited, varies between companies and is NOT referenced to ground. When your phone is picked up, the battery voltage is loaded down and the voltage drop on your line is detected by the CO. The CO takes this drop in battery voltage as a signal that you want to make a call; it switches dial tone onto the line and waits for the dial pulses or DTMF tones that make up your dialing. When you are on the receiving end of a call, the CO switches a ring generator onto your line that makes your phone ring until you pick up. The ring signal is a low frequency ac pulse that rides on the dc voltage. When you pick up the phone the CO gets the dc voltage drop signal, stops ringing your line, and hooks you up to the calling party. An obscure but important note...when the calling party hangs up, the vast majority of CO's in the US send a short battery reversal or zero voltage signal to the receiving party (if it's still off hook) followed by another one about eight seconds later. Most CO's also dump dial tone back on the line after a short time as well.

We acknowledge that we've left out much of HOW THE PHONE COMPANY WORKS. If you are really interested in the rather complicated total operation of the phone company, we heartily recommend John L. Fike's Understanding Telephone Electronics, published by Howard W. Sams & Co. It is an extremely well-written, thorough, and very inexpensive.

## MPC-2 THEORY OF OPERATION

**MPC-2 type approved DAA (Protective Voice Coupler):** 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 .56uF 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 MPC2. When supply voltage 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. Because of FCC regulations, any modification of the MPC2 voids the unit's type approval.

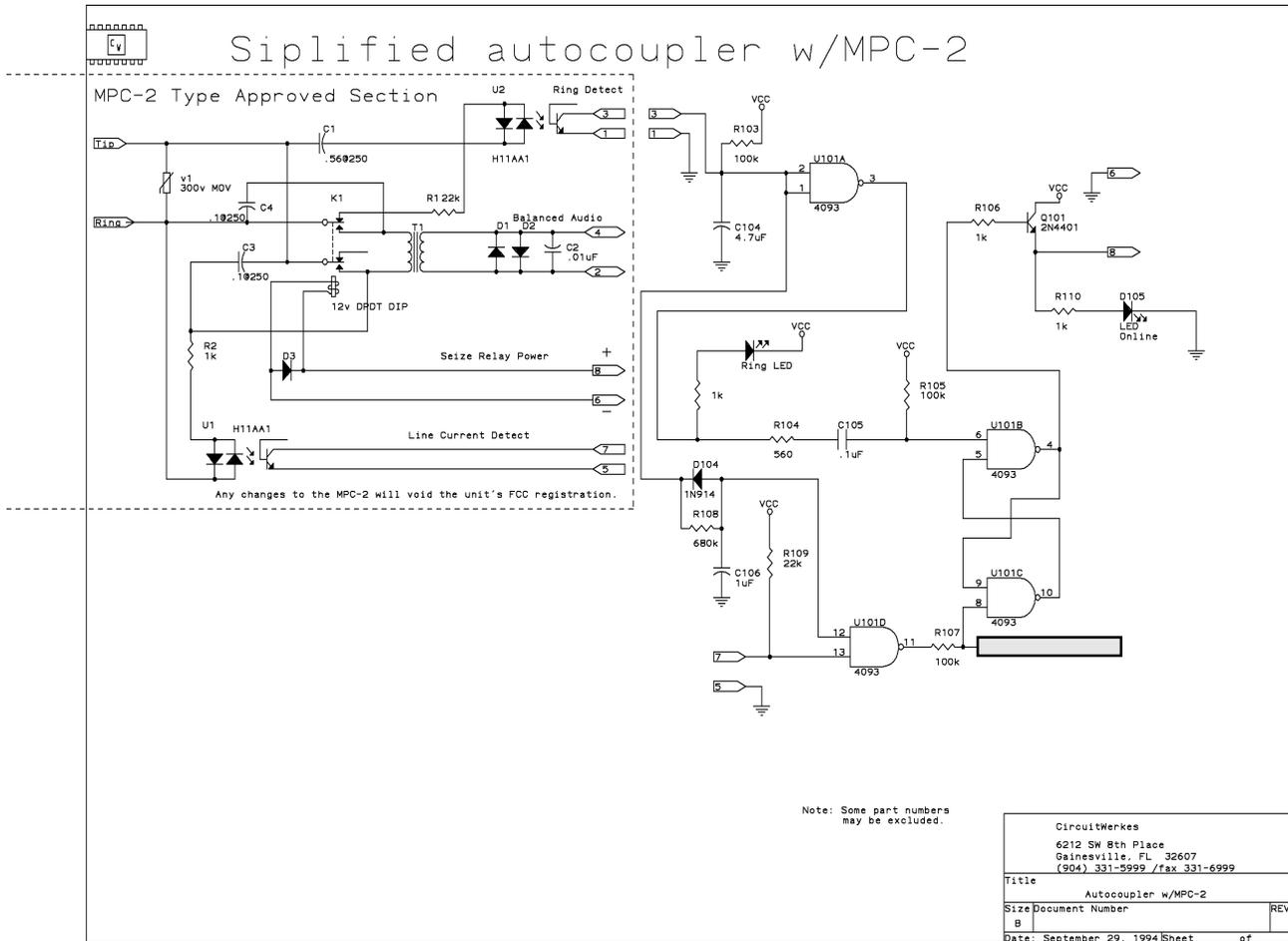
## MPC-2 Schematic Diagram



### Notes:

- 1) The line-current and ring-detect outputs (pins 7,5 and pins 3,1 respectively) are of the open collector variety and can be used with CMOS or TTL circuitry. It is imperative that input filtering on TTL or CMOS gates be employed; Schmitt-type gates are recommended also as their inherent hysteresis takes the slop out of the slow-response outputs of the MPC-2. We have found that a simple 47k pullup resistor and a 4.7uF cap to ground makes an admirable ring detect filter for taking the pulses (indicating the approx 20Hz frequency of the ring signal) out of the ring detector's output. The line current detector output feeds a shmitt trigger gate (like a 4093, etc.) well with just a 22k pullup resistor on the gate's input.
- 2) Be aware that a low level (approx. -9dBm) ring signal is present on the audio output pins (4&2) during an incoming ring.
- 3) The seize relay requires 12Vdc (optionally 5Vdc) if you wish to seize the line with the MPC-2.
- 4) DTMF tones applied to the audio terminals of the MPC-2 are generally of sufficient level for outbound dialing however, some C.O.s may require greater than the permitted -9dBm level.
- 5) Applied DTMF tones should be kept below -10dBm to avoid distortion. Disorted DTMF tones WIL NOT signal most CO's. Some common DTMF transmitters (such as the 5089) require a low impedance output buffer such as an opamp or LM386, etc. to drive the MPC-2's 600 Ohm input.

Sample schematic of an auto-answer/auto-disconnect telephone coupler using the MPC-2.



NOTES:

If your MPC-2 is the 5 Volt version, be sure that your supply in the above circuit uses a 7805 regulator for a 5 Volt power supply. You'll also want to change r15's value from 1k to 470 ohms. R15 is the current limiting resistor for D5, the ONLINE LED.

This circuit was taken from another CircuitWewrkes product, so part numbers may be out of order.

## **Appendix A**

{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

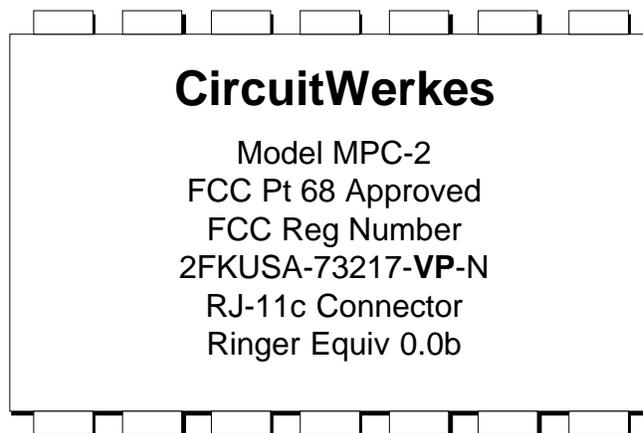
This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

## REPAIR OR SERVICE INFORMATION

In the event of the need for service or repair, call CircuitWerkes at (352) 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 your address (not a PO box), telephone number and best time to call.

### **CircuitWerkes**

ATTN: CUSTOMER SERVICE DEPT.  
3716 SW 3<sup>RD</sup> PLACE  
GAINESVILLE, FL 32607



**OEM CUSTOMER INFORMATION - Appendix B**  
**Additional Information Applicable to OEM customers.**

- The mounting of the MPC-2 in the final assembly must be made so that the MPC-2 is isolated from exposure to and hazardous voltages within the assembly. Adequate separation and restraint of cables and cords must be provided.
- The circuitry from the MPC-2 to the telephone line must be provided in wiring that carries no other circuitry and that is specifically allowed in the rules, such as PR and PC leads.
- Pc board traces carrying tip and ring leads shall have sufficient spacing to avoid surge breakdown.

The following are specifications for operation of the MPC-2:

1) Ring detect output	Pins 1 & 3 1=emitter 3=collector	Open collector current sink Compatible with TTL or CMOS logic inputs (pullups req'd).
2) Nominal audio input	Pins 2 & 4	Average audio levels must be maintained at or below -9dBm into the phone line.
3) Line current detect	Pins 5 & 7 5=emitter 7=collector	Open collector current sink goes low when line is off-hook. TTL or CMOS (pullups req'd).
4) Line seize relay	Pins 6 & 8 8= +Vcc 6=ground	12Vdc relay supply. Optionally 5Vdc.

- If the MPC-2 is enclosed in an assembly, and not readily accessible, a label shall be placed on the exterior of the cabinet listing the registration number(s) and RENs of the registered device contained therein.
- The final assembler shall provide, in the consumer instructions, all applicable Appendix A & B Information.