ETI-291 TELEPHONE INTERCOM POWER UNIT

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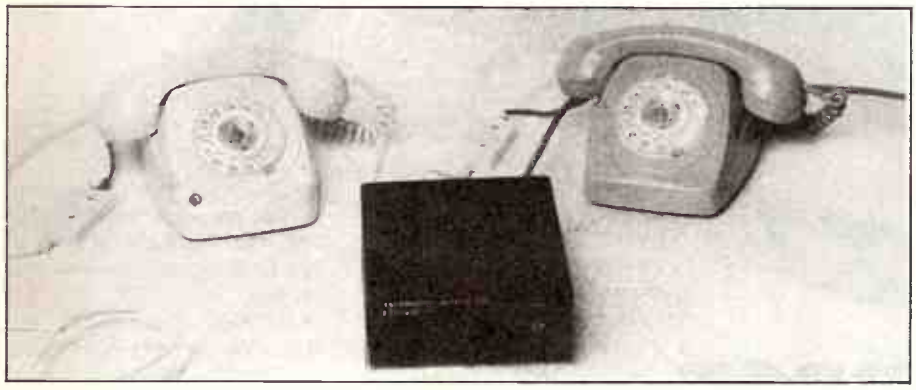
If you have just substituted the latest in touch dial wonders for your old series 800 rotary dial phone from Telecom, don't throw them away. We show you how to turn them to good use.



IN AN AGE when fancy phones are all the rage, the space for the Plain Old Phone (POP) seems to be shrinking. Today you can buy phones that almost do the talking for you, and what's more, they are relatively cheap. Even more amazing, Telecom hasn't banned them yet.

The question is, what happens to all the POPs (Plain Old Phones). This project is one answer. For the price of two cheapish transformers, a voltage regulator, a bit of cable and few other odds and sods, you can have a practical home intercom system. Just connect two phones to the output of the ETI-291, spin the dial on one phone to tinkle the bell on the other, and talk.

We wanted something that would support a standard telephone with no modification at all, would never run down, that would operate over reasonable distances, and that, in fact, would duplicate the conditions of a telecom line as closely as possible.

This design accomplishes our goals. Its intended to be shoved in the bottom of a cupboard and forgotten about. In the standby mode it consumes a few milliamps, so it won't affect the power bill. We believe it has sufficient current and voltage capacity to drive two phones separated by a few kilometres, although we never tested that for obvious reasons. The longest separation we could get (the longest bit of wire we had) was 18 metres, and it worked perfectly over that distance.

The Plain Old Phone

A series 800 POP consists of three circuits: a bell path, a dialling circuit and a speech path. The bell path is switched by the action of raising the handset, and operating the gravity switch. It consists of the bell (a large inductor) and a 1.5 µF capacitor which blocks the nominal 50 Vdc sitting on the line.

The bells will ring in response to an ac impressed on this line voltage. A minimum of 4 mA needs to pass through the coil for satisfactory operation according to the specification.

The speech path is normally disconnected from the line. However, when the handset is raised, the earpiece and microphone are connected across the line in parallel, together with associated components. This action provides a dc path for the line current. The measured voltage across the line falls to about six volts. This acts as a bias voltage for the microphone and speaker, so that when the user talks into the mic, an ac is impressed on the dc voltage and communications take place.

The dial mechanism consists of two switches and a spring assembly. The spring actually shorts and opens the telephone line as the dial returns to its normal position when a digit is dialed. One of the switches is used to short out the receiver whilst the dial is turned from its normal rest position. The other is used to connect the spring to the line. Dialing the digit zero will transmit ten pulses. In the ETI-291 these pulses actuate the bell.

Design

A power supply for a POP needs to meet a couple of specifications. For a start, it must provide a nominal 50 Vdc for the standby mode. It must then have an internal resistance such that when the line is looped by one of the phones, the voltage drops to about 6 Vdc. Then it must have a high impedance to ac so that audio information is not shorted by it. It must also have sufficient current to drive the bells.

We cheated a bit in our design, by electing to generate only 33 Volts on the line. This figure is convenient given the common type of mains transformer we used and the regulator. A little experimenting on the lab bench showed that 33 volts will drive the phones quite adequately. Had

TELEPHONE INTERCOM ETI–291

POWER

we tried to achieve exactly 50 Vdc, more expensive components like higher voltage capacitors, would have been the order of the day.

We achieved a high resistance to ac in the traditional way, by placing an inductor in the path. It turns out that rather a lot of inductance is required, so the easiest, and probably the cheapest way to achieve that was via another transformer. We used a 2851 type. The windings are connected in series to achieve the maximum possible inductance.

The inductor actually performs a dual purpose. Not only does it shield the speech path from the low impedance of the power supply, but it also allows a full strength ring ac to be presented to the bell using the back emf of the windings. The simplest way to do this is to loop the line with the dialing pulses. it's not particularly elegant. but it (a) makes a noise and (b) its cheap.

PARTS LIST

Resistors.....all 0.25 W 5% unless shown otherwise
- R1.....270R
- R2.....6k8
- R3.....2k2 (1 Watt)
- R4.....100R

Capacitors
- C1.....1000µ/50V electrolytic
- C2.....100n greencap
- C3.....10µ/63V electrolytic pc mount
- C4.....22µ/63 V axial electrolytic

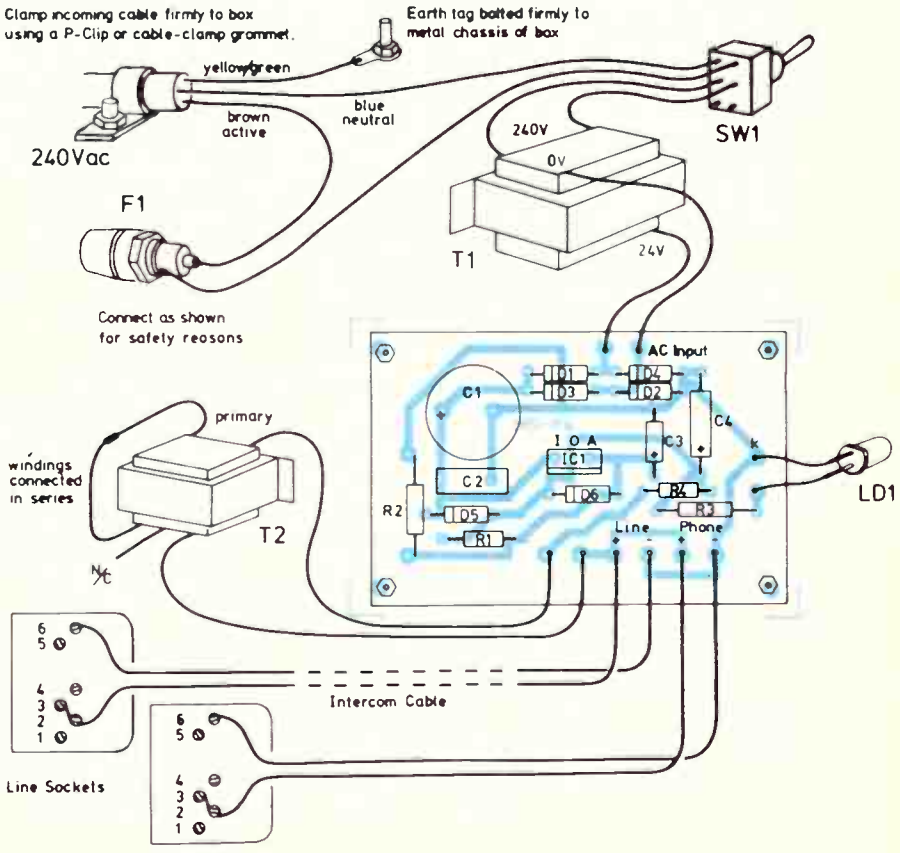
Semiconductors
- D1-D6.....1N4004
- IC1.....LM317T
- D1.....5mm red LED

Miscellaneous
T1 6672 or similar (24V mains transformer); T2 2851 type mains transformer; F1 M205 panel type fuse holder and 500 mA fuse; SW1 miniature toggle switch mains rated, DPDT; 2 telephone in-line sockets, metal box (184 x 70 x 160 mm), pc board, two core intercom cable.

Construction

All the components are mounted on the 67mm x 45mm pc board except the two transformers. Start with the pc board. Its small and there is not much to go wrong, but clean it and check for broken or shorted tracks, nevertheless. Be careful to observe the polarities of the capacitors and diodes, and as per usual, leave the semiconductor to last.

When you have mounted all the components, put the board to one side and start work on the box. It is very important to locate the mains transformer as far away



from the inductor as possible to minimize hum pickup. The impedance across the intercom cable increases with frequency due to the action of T2, and hum may be induced into the telephone speech path.

A simple solution is to mount T2 on the back panel of the box, and T1 near the front panel. We found that orientating T2 at a 45 degree angle produced minimum hum. (See photograph)

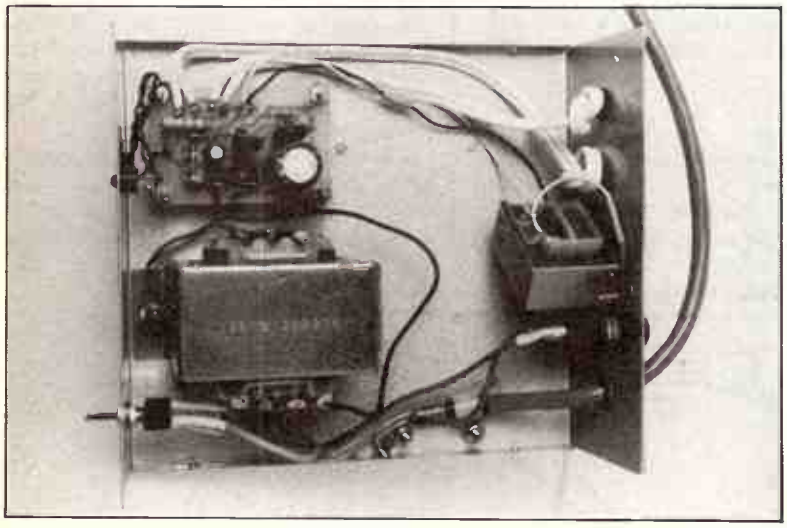
Once the transformers are in place, you can commence wiring the thing together. There are several points to watch. Firstly, ensure that the 240 Vac leads cannot physically touch any of the components that connect to the line. This is a good safety feature that Telecom insist on in their equipment, and its worthwhile observing the practice. Ensure that all exposed 240 Vac connections are adequately sleeved for insulation. Also, fasten the incoming main cable using a cable clamp or a cord grip grommet.

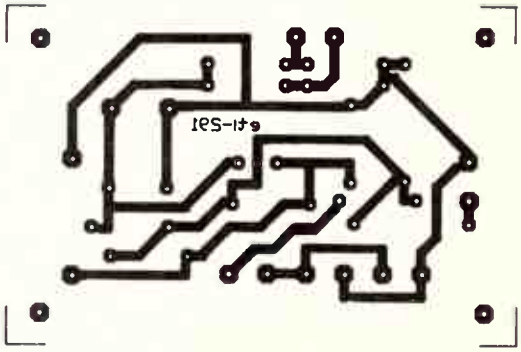
Ensure that all the 240 Vac wiring to the switch SW1, fuse and transformer is correct. The mains earth must be soldered onto a tag and bolted onto the metal body of the box. Once you are certain everything is in order switch on with the phones disconnected. Using a voltmeter set to measure dc, check that the voltage across the intercom line is around 33 V. Don't forget to put a fuse in the fuse holder. If the LED does not light it is probably wired in the wrong way around.

Wiring in the telephone line sockets and cable should not present any problems. It was decided to wire the intercom cable directly onto the pc board thus eliminating the cost of a line socket. The 0 V line is connected to pin 6 and the +33 V line to pin 2 of the line sockets. To avoid tampering with the telephone circuit, pin 2 must be connected to pin 3 in the line socket to put the bell in the circuit. (See the wiring diagram).

The transformer T2 functions as an inductor, not a transformer, so its windings need to be connected in series. However, you must get the polarity correct to maximize the inductance. If you connect it the wrong way around, you will actually reduce the inductance available. You can use an oscilloscope for this. However, its probably just as easy to connect it up, tinkle the bell by dialling, change polarity, and see if it gets any louder. You want the connection that gives the loudest ring.

Finally check over your work carefully, looking at the wiring and polarity of all the components, plug in the phones and turn on. Pick up either phone and it should be active. If you can't hear yourself, or someone on the other phone, switch off and check over everything again. ●



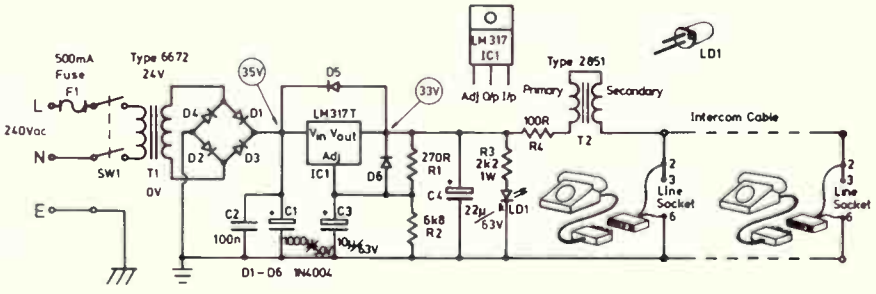


ETI-291 — HOW IT WORKS

The 240 Vac mains is transformed down to 24 V RMS by T1, and rectified and filtered by D1-D4 and C1. This presents 33.9 volts dc to the input of IC1, the voltage regulator.

The regulator is designed to maintain a nominal 1.2 V reference voltage between its output pin and ADJ. Thus the resistor R1 becomes in effect a constant current source, and the output voltage can be set arbitrarily by selecting the correct value for R2. R2 = 6k8 gives us the voltage we want on the output.

The output, however, offers a low impedance to both dc and ac. R4 and the dc resistance of the winding of the transformer T2 help raise the dc resistance somewhat. The measured dc resistance of T2 is around 1 k. The ac resistance consists mainly of the inductance in the windings of T2.



The remaining components are there to protect the supply in the likely event of a momentary short developing. In the event that the input to the regulator is pulled down, D5 will act to stop the voltage across the regulator from exceeding 600 mV. D6 functions to prevent the ADJ terminal becoming more positive than the output, the other fatal condition for the regulator.

DI with its current limit resistor R3 indicates the presence of power supplies.