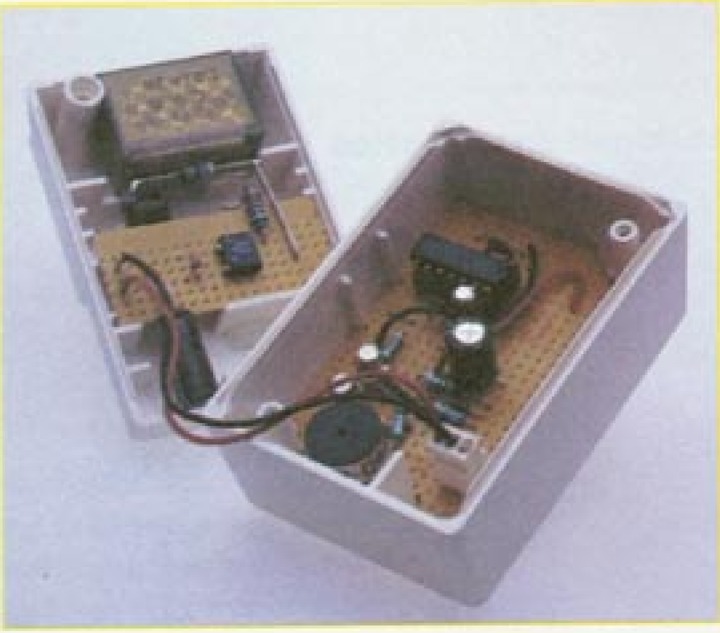

This handy unit, designed by Michael Dranfield, can left permanently connected to the mains supply ready to check any suspect IR remote-control unit

A Mains-operated Remote Control Tester

The problem with battery-operated test equipment is that you can get caught out by a flat battery. It's most frustrating to decide to use something and find that it doesn't work. We needed a new remote control tester for the workshop, so I gave thought to the idea of a mains-operated one.

It would be handy if the tester were to plug straight into the mains supply without any trailing leads. I looked through the instrument-case section of our Farnell catalogue and found a case with a built-in 13A plug, the sort commonly used to house multi-output DC adaptors. I started off by ordering one.

The Wattless Dropper

It was obvious, when the case arrived, that it would not be large enough to house a transformer as well as the electronics required. So the tester would have to be run straight from the mains supply. The easiest solution would be to use a capacitor to reduce the mains voltage to 12V. This idea is sometimes referred to as a 'wattless dropper'. It was used by Thorn back in the Sixties to supply the heater chain in early versions of the 960 series 16in. portable chassis. Unlike a resistor, the capacitor dropper dissipates no power. Hence the name.

The idea is to use a capacitor's reactance at a given frequency to provide a voltage drop.

Capacitive reactance is given by the formula

$$X_C = 1/2\pi fC$$

where f is the frequency and C is the capacitor's value in Farads. In the UK the mains frequency is 50Hz. If we use a capacitor of say 0·47µF, the reactance works out at

$$1/2 \times 3{\cdot}142 \times 50 \times 0{\cdot}47 \times 10^{-6}$$

$$= 1/0{\cdot}000147674$$

$$= 6{,}771\Omega \text{ or say } 6{\cdot}77k\Omega.$$

So at 50Hz the capacitor will have an impedance of 6·77kΩ. By applying Ohm's Law, we have

$$230V - 12V = 218V/6771 = 0{\cdot}032, \text{ i.e. } 32mA.$$

Thus by using an 0·47µF capacitor and a 12V zener diode we can draw 32mA at 12V straight from the mains supply. This supply isn't mains isolated of course, so the device must under no circumstances be housed in a metal case.

The Power Supply Circuit

The power supply circuit is shown in Fig. 1. The live side of the mains supply is taken to a 100mA Wickman fuse (F1). C1 is the capacitive dropper. R1 is included to discharge C1 at switch off – without it, the charge across C1 would be present across the pins of the mains plug at switch off.

C1 has to be a special, Class X2 capacitor, designed for direct connection to the mains supply. Under no circumstances should any type other than that specified in the parts list be used. R1 is also critical to the safety of the unit: only an 0·75W metal-film resistor rated at 350V should be used. This should ensure that the resistor does no go high in value or open-circuit, as ordinary carbon resistors tend to do.

R2 is included to limit the surge current via the bridge rectifier at switch on. Again, the use of a metal-film resistor will add to the overall safety. The bridge rectifier itself could be any 50V PIV 1A type. I have chosen one rated at 800V simply because it is readily available to one-off order – lower-voltage bridge rectifiers come in fives from Farnell. C2 is the reservoir capacitor, while D1 provides stabilisation at 12V. The value of C2 is larger than theoretically needed, but this will provide a longer service life.

Receiver Circuit

Fig. 2 shows the circuit diagram of the receiver section of the unit. Photodiode D1 detects infra-red light. Note that it's reverse biased. When it conducts, an input appears at pin 14 of the TBA2800 chip IC1. This is a dedicated IR amplifier chip that contains three separate amplifier stages and an output inverter. In this application however the positive-going output at pin 8 is used. C1 decouples the first amplifier stage while C2 and C3 provide coupling between the successive stages.

The output at pin 8 of IC1 is fed to the base of Tr1, which drives the piezo transducer connected to its collector. Note that the transducer is polarised. Tr2, the LED driver, is held off by R4. When the voltage at the collector of Tr1 falls falls however Tr2 conducts and the LED flashes. R5 limits the LED current. As the LED is driven in short bursts, R5 can have quite a low value without any threat of LED damage.

To maximise the audible output from the piezo transducer, the output circuit is fed directly from the 12V supply. The TDA2800 chip requires a good-quality supply of not more than 5·5V however. So the 12V supply is connected to R2 which feeds the 5·1V zener diode D2. The following low-pass filter (R1 and C4) removes any 100Hz ripple.

Construction

The accompanying photograph shows the internal construction of the unit. The 12V supply is built into the bottom half of the case, with direct connection to the mains input. The receiver is built into the top half. The whole lot is built on Veroboard. As there's nothing critical, no layout or constructional diagrams are included. The only point to watch is that the anode of the photodiode is as close as possible to pin 14 of IC1, to minimise stray pickup. A flat-topped LED was used so that it sits flush in the top of the case.

A small hole was cut in the case, at the bottom, to enable the sound to emerge. To prevent anything being poked into the unit, a small piece of plastic was glued over the hole.

Various photodiodes were tried. The SFH203PFA was found to give the best results. It blocks out IR radiation from the overhead fluorescent lights without need for any external filtering. The small square of IR filter stuck on the front of the case was added for the sake of appearance – it plays no part in the operation of the unit.

Use of a plastic case with no shielding means that the unit is prone to picking up timebase radiation. It should therefore not be used in close proximity to a TV set. A distance of one metre will avoid any problems.

Testing

The two sections of the finished unit are best tested separately. Check the receiver section with a 12V battery or a bench power supply. The power supply section should be checked with a multimeter.

If all is well, connect the two sections together and plug the unit in. At switch on the unit should produce a bleep, with a momentary flash from the LED. You can then leave the tester permanently plugged into the mains supply.

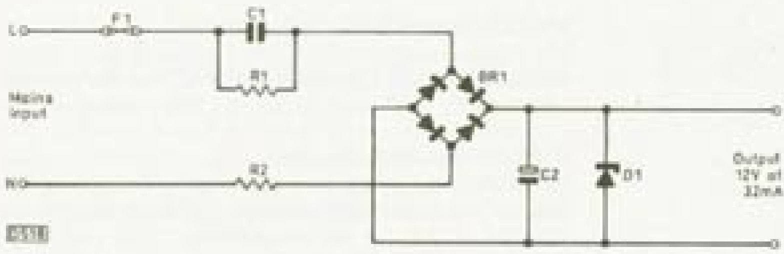

Fig. 1: Circuit diagram of the 'wattless dropper' power supply.

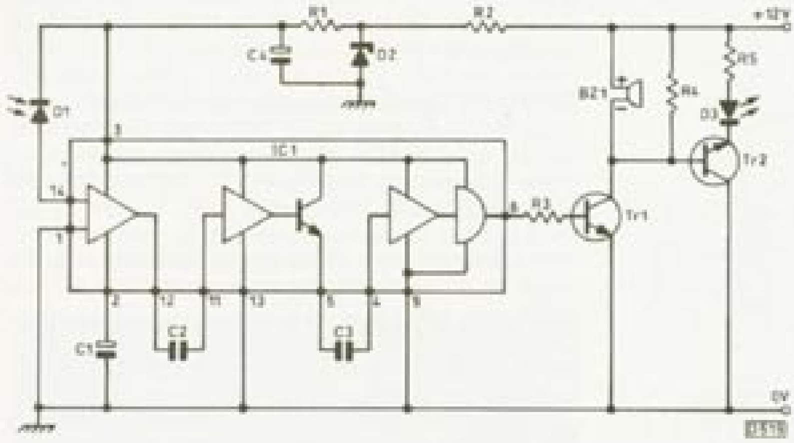

Fig. 2: Circuit diagram of the receiver unit.

Parts list

Power supply

C1	0·47µF	Farnell 772-847
C2	470µF, 16V, 105°C	
R1	470kΩ	Farnell 337-493
R2	220Ω	Farnell 337-079
D1	12V, 400mW	
BR1	1A, 800V	Farnell 371-180
F1	100mA Wickman fuse	

Note that C1 and R1 are safety components. See text.

Receiver

R1	100Ω	R2	680Ω
R3	47kΩ	R4	10kΩ
R5	100Ω		
C1	2·2µF, 16V, 105°C		
C2	1·2nF disc ceramic		
C3	10nF disc ceramic		
C4	47µF, 16V, 105°C		
D1	SFH203PFA	Farnell 212-738	
D2	5·1V, 400mW		
D3	Green LED	Farnell 621-006	
Tr1	BC107		
Tr2	BC179		
IC1	TBA2800		
BZ1	Piezo transducer	Farnell 561-010	
Plug-style case		Farnell 301-693	

Veroboard as required

Author: Michael Dranfield
PDF conversion by www.keithjones.net