PHANTOM POWER CHECKER

Hugh Robjohns MIBS describes the construction of a very simple but extremely handy little device.

The most useful 'audio tester' I own cost less than a pound to make when I built it the best part of twenty years ago – and I still use it every time I go out to make a recording. In broadcasting circles it is often called a 'Bright Eyes' but elsewhere is known simply as a 'phantom power checker.'

Obviously, this device indicates the presence of phantom power, so is not strictly an 'audio tester' – but it also doubles up as a handy cable checker too. The best part is that it is very easy to make and only involves half a dozen components, all of which are wired directly to each other inside an XLR shell – so anyone with a modicum of soldering skills should be able to knock one up easily within an hour.

Sadly, though, inflation has pushed the price up a bit since I built my original... but you can still make one for less than £3.00!

Design

The diagram shows the circuit design which, at its simplest, involves just a pair of green LEDs and a pair of Zener diodes – and I should say that thanks are due to Chris Woolf MIBS for his assistance and advice with this design. Optionally, additional red and yellow LEDs can be added to provide the ability to detect any significant DC bias voltage across the balanced audio interface, as well as to indicate the presence of an alternative form of mic powering still often used in TV and film location sound work called Tonader, T-Powering or A-B powering. It is important to be able to test for the presence of a DC bias since this can affect or even damage moving coil and ribbon microphones.

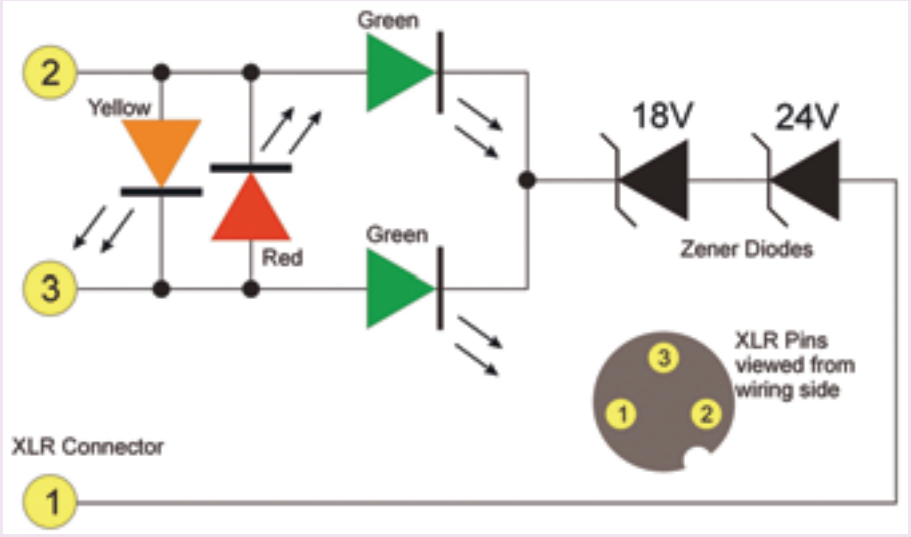
Standard phantom power provides 48V (±4V) applied equally on the hot and cold audio signal wires, referenced to the screen connection. The maximum current that can be drawn from a standard microphone input is about 14mA, controlled by series resistors in the input circuitry of the mic preamp. The 'Bright Eyes' indicates the presence of phantom power with the two green LEDs as current flows along both signal conductors (via XLR pins 2 and 3) through the two green LEDs, and on through the reverse-biased Zener diodes to be returned along the cable screen connection (XLR pin 1).

The Zener diodes ensure that the LEDs only illuminate when the phantom power equals or exceeds the minimum voltage tolerance for standard phantom power (44V) since they maintain a fixed DC voltage across themselves when current flows through them. In this case the two Zener diodes connected in series have a combined Zener voltage of 42V. The LEDs also develop a voltage across themselves when current flows – amounting to about 2V – and hence a minimum of 44V is required to illuminate the two LEDs fully. The use of two Zener diodes connected in series is partly to get the reference voltage value right, and partly to spread the power dissipation – which is just over 0.5W – so the 1.3W rating of the specified Zener diodes is therefore quite generous.

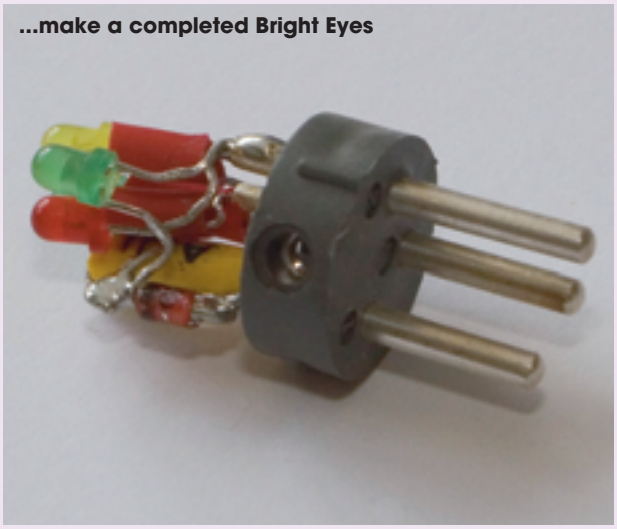
The yellow and red LEDs are entirely optional, but the disastrous effect that a significant DC bias could have on moving coil or ribbon microphone makes their inclusion worthwhile in my opinion. Any voltage differential across pins 2 and 3 of more than 2V will illuminate the appropriate red or yellow – meaning danger for dynamic mics! The yellow LED also serves to indicate the presence (and correct polarity) of the 12V Tonader powering standard.

Construction

Although any male XLR cable connector can be used, the parts list below specifies a Cannon-style connector. The advantage of



The seven starting components...



...make a completed Bright Eyes

the Cannon design is that the external cable clamp and strain relief can be removed and one of the threaded fixing holes carefully drilled out to allow the XLR to be mounted on a key ring for handy convenience!

All of the diodes – the LEDs and the Zeners – are directional and must be connected the right way around... but they all have identification marks to allow that. The cathode ends of the Zener diodes (shown on the circuit diagram as the bent bars across the tips of the triangles) are identified by a dark ring on the body. The cathode ends of the LEDs (shown by the cross bars again) are indicated by a flattened side to the coloured LED body plus a slightly shorter connecting lead.

I found it easiest to start by fixing the four LEDs alongside one another using a small amount of contact adhesive. Once the leads have been bent appropriately with pliers, cut to length and soldered to each other as required, the LED group will be quite stable. Short lengths of suitable diameter insulating sleeves on the LED wires are useful to prevent shorts when the assembly is installed in the XLR shell.

I placed the two green LEDs next to each other, with the yellow and red LEDs on either side – but however you arrange them, take care to ensure they are mounted parallel to one another so that they are always viewed from the same angle, and thus appear equally bright. The idea is to arrange the lead lengths such that the group of LEDs sit centrally just below the opening at the cable end of the XLR body, where they can be seen clearly but are protected from being knocked. To prevent dust and dirt collecting inside the XLR body it might be a good idea to glue a piece of clear plastic sheet inside the XLR body across the opening – although I didn't do that for my original design and it has never been a problem.

The anodes of the two green LEDs are connected directly to pins 2 and 3 of the XLR. The cathode leads (on the side with the flat) can be cut short and soldered together. This joint must also include the cathode lead from one of the Zener diodes. It doesn't matter which one – their order is not important.

The anode of this first Zener is connected directly to the cathode of the second, and the anode of the second is connected to pin 1 of the XLR. I arranged the Zeners so that one stands vertically from pin 1, with the second laid alongside, soldered to it at the top. The bottom end of the second Zener is soldered to the common junction of the two LEDs. Again, some sleeving will ensure the component wires don't short out on one another, or the XLR pins.

If you are installing the red and yellow LEDs, then connect the anode of the yellow, and the cathode of the red to pin 2 of the XLR (along with the anode of one of the green LEDs), and their opposite ends to pin 3 (with the second green LED). The XLR pins are plenty big enough to accommodate three diode leads, but take care to ensure that the leads can't short out against the metal XLR body shell.

Parts List

The order codes and prices listed below are those used by Maplin Electronics in the UK (www.maplin.co.uk), but none of the components are unusual in any way, and all electronics components suppliers should be able to furnish the requisite parts.

1x	Cannon-style XLR Male Connector	BW89W		£2.13
1x	Standard brightness Red 3mm LED	WL32K		£0.12
1x	Orange 3mm LED	YY38R		£0.12
2x	Green 3mm LEDs	WL33L	(x2)	£0.24
(LED cathodes denoted by flat on body plus shorter lead)				
1x	1.3Watt BZV85C Zener Diode 24V	QF62S		£0.08
1x	1.3Watt BZV85C Zener Diode 18V	QF59P		£0.08
(Zener cathodes marked with ring on body)				
		TOTAL COST:		£2.77

Additional parts and tools optionally required: Contact adhesive or insulating tape to bond LEDs together. Sleeving to insulate component leads. Multicored solder and soldering iron. Fine-nose pliers and side cutters. Small vice or other means to support parts while working. Good lighting and ventilation of working area.

Testing

To test the Bright Eyes you'll need a source of phantom power along with a known good XLR cable. It is also useful to have some means of breaking the connection to individual pins – I made up a temporary cable using some spare XLR plugs and sockets, and three short lengths of wire. A 9V battery is also useful, as is a DC voltmeter.

Plugging the Bright Eyes into a phantom power source should result in the two green LEDs illuminating. If one of the LEDs doesn't illuminate check that you have connected it the right way around.

Using the temporary 'bodge' XLR cable between the phantom power source and the Bright Eyes, break the pin 2 connection and check that one of the LEDs goes out. Restore the pin 2 connection and repeat for the pin 3 connection to check that the other LED goes out. Finally, restore pins 2 and 3 and break the pin 1 connection to check that both LEDs go out. If all is well that completes the phantom power tests.

If you have incorporated the yellow and red LEDs, you can check their operation with the 9V battery. Connect wires to the battery and hook the positive terminal to pin 2, and the negative terminal to pin 3. The yellow LED should light. Reverse the battery connections and the yellow LED should go out and the red LED should light. If not, check the orientation of the LEDs.

In Use

To test for phantom power, simply plug the Bright Eyes into the microphone end of the cable that you want to check. It would be wise to make sure that the corresponding microphone channel fader is turned down since there will be a loud 'splat' when the Bright Eyes is plugged in! Two bright green LEDs indicate that all is well with both the phantom supply and the cable.

Any other condition – absent, dim or unbalanced green LEDs, or the illumination of the red or yellow LEDs (if fitted) – indicate something is wrong either with the cable (most likely) or the phantom supply (unlikely, but possible). Both green LEDs illuminated but dimmer than normal suggests either a low phantom power voltage or limited current availability. The most likely cause is a defective power supply which will probably compromise the performance of any capacitor microphones in use. One green LED much brighter than the other suggests a voltage imbalance problem. Again, this is likely to compromise the operation of capacitor microphones, and may also upset the performance of the microphone preamp circuitry.

A far more common indication is when only one green LED lights up, and the most likely problem here is that one of the two signal wires in the cable (or in one of the connectors) is broken. If neither green LED lights up then either phantom power is not present at all or the cable screen connection is broken in one of the XLRs. To check, simply plug the Bright Eyes directly into the microphone socket on the preamp or mixer – if both greens come on then the cable screen is probably broken.

If installed, the extra red and yellow LEDs provide useful additional information. In the case where one signal wire is broken in the cable, it is likely that either the red or yellow LED will illuminate along with the green LEDs. This is normal and happens because of the way current diverts through the various LEDs. If either the red or yellow LEDs illuminates brightly there is a significant DC voltage between the two signal wires – so don't connect ribbon or moving coil microphones!

When Tonader power is present, it should illuminate only the yellow LED. If only the red LED lights when checking for T-power, then the cable is wired with a polarity reversal (the connections to pins 2 and 3 are swapped at one end).

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