EDITION 1

Assembly Manual

Go/No-Go Crystal Checker

K-7228

(PCB & components only)

DICK SMITH ELECTRONICS

ACN 000 445 956

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This simple circuit will help you sort through that pile of crystals lying on your work bench. If the crystal works, the LED lights. Best off all, it can use parts which you probably already have in your junkbox.

If you've had a go at building any RF projects in the past you'll probably have a couple or maybe quite a few crystals lying around. Crystals are quite fragile components because of their construction. Unlike a resistor or capacitor, if you drop one on the ground from a decent height, it's a 50-50 bet whether it will work again.

Testing them is not a breeze either. You just can't take out your trusty multimeter and plug the crystal in. In fact, the only real way is to try it in an oscillator circuit. And that's exactly what this little Crystal Checker does. The crystal is placed in the feedback network of a transistor oscillator. If it oscillates, meaning that the crystal works, a LED lights up. If the crystal doesn't work, the LED stays off. You can't get much simpler than that.

Note that if you have overtone crystals, the circuit will not tell you whether or not the crystal is operating at the designated frequency, just whether or not it will oscillate at its fundamental frequency.

Circuit description

Let's take a look at the circuit in Fig.1. As you can see, there are only two transistors, a couple of diodes, a LED and a few other components. Q1 is a BF199 RF transistor and with its associated components forms an untuned Colpitts oscillator. The crystal forms the main element of the circuit. Positive feedback comes from the emitter through the .001µF capacitor back to the crystal and base.

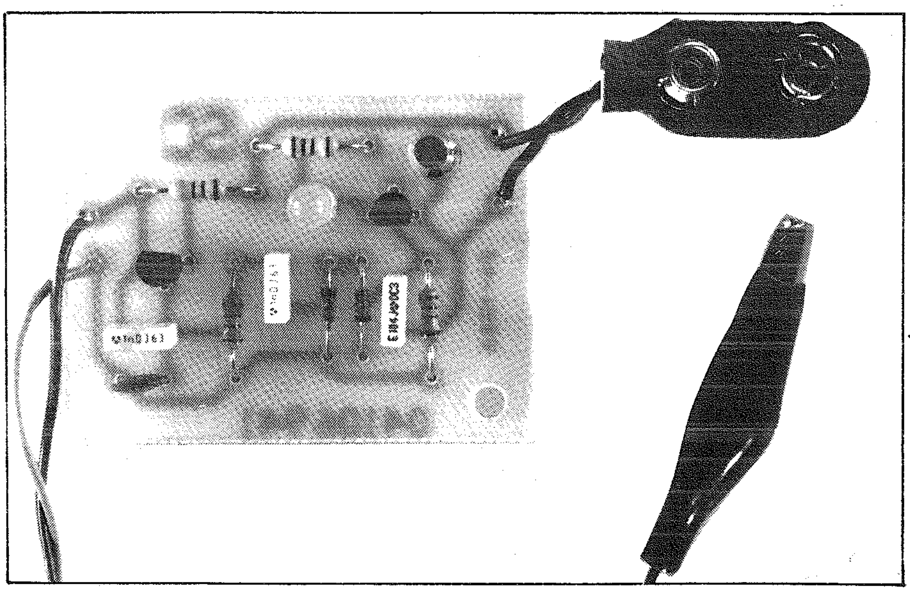
If the crystal works, the circuit will begin oscillating immediately and a waveform will appear at the emitter of Q1. If you look at this on your oscilloscope, you could expect to see a rough sinewave with and an amplitude of about 2V peak-to-peak, depending on the frequency.

Diodes D1 and D2 rectify the signal from the emitter of Q1 and the resulting DC voltage is fed to the base of transistor Q2. Once this voltage exceeds 0.6V, transistor Q2 turns on and lights LED 1. As soon as the crystal is removed, the circuit stops oscillating and the LED goes out.

As a point of interest, if the crystals you have are less than 10MHz, then you could probably get away with a BC548 for Q1. The BC548-series transistors have a high F_T (gain-bandwidth product) of about 100MHz or so but they don't tend to work well in oscillator circuits above about 10MHz. FM microphones often get away with a BC548 but the output at the required 100MHz or so is quite low – in the order of millivolts which is too low for our application. Below 10MHz, they work quite well with a good output voltage. Why not try one out and see what you get. You can't damage the crystal and it's always fun to experiment!

Power is supplied by a 9V battery which is bypassed by a 10µF electrolytic capacitor. We haven't specified a power switch mainly for the reason that it would double the cost of the parts! Besides, once you've checked all your crystals, you can unclip the battery and use it on something else.

You could also experiment with different supply rails. The circuit should work well with any voltage between



This photo shows the completed Crystal Checker. If the crystal is working, the LED will light up.

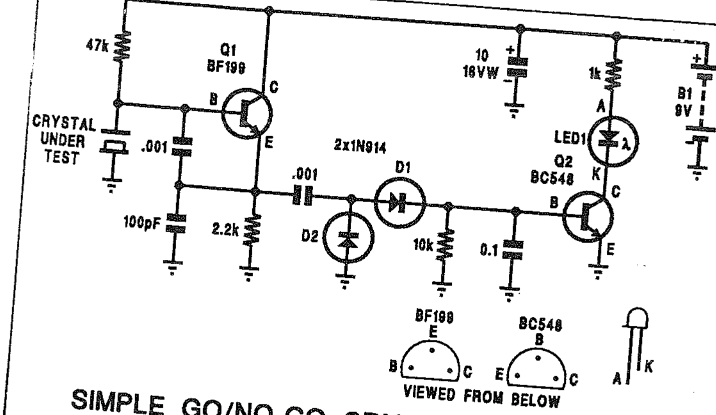


Fig.1: the circuit of the Crystal Checker is shown with a BF199 for Q1 but a BC548 will work with many crystals under 10MHz.

SIMPLE GO/NO-GO CRYSTAL CHECKER

6V and 15V although if you are using a BC548 for Q1 and a supply voltage of less than 9V, it may not like the higher crystal frequencies. Again, experiment and see for yourself! The quiescent current should be around 3mA, pushing up to 6-8mA with the LED on.

Construction

Construction of the Crystal Checker is a snap and shouldn't take you any more than an hour or so. All of the components except the 9V battery (not supplied) fit on a small PC board coded ZA 1288, and measuring only 52 x 40mm.

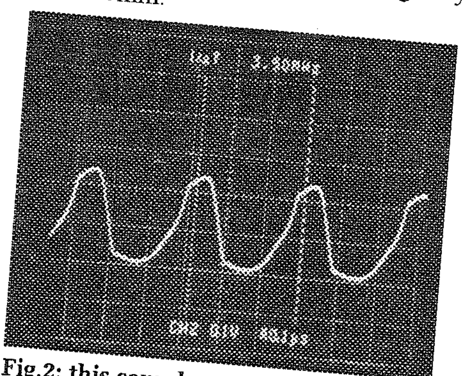


Fig.2: this sample waveform was taken from the emitter of Q1 with the scope probe set to 10:1 division. The crystal was an American TV intercarrier type with a frequency marking of 3.579545MHz. The on-screen measurement shows the frequency as 3.5MHz, well within the accuracy of most oscilloscopes. As you can see, the signal amplitude is about 2.4V peak-peak.

Before you begin any soldering, check the board thoroughly for any shorts or breaks in the copper tracks. These should be repaired with a small artwork knife or a touch of the soldering iron where appropriate.

When you're satisfied that the board is OK, start by installing the resistors and diodes, followed by the capacitors and transistors. Be sure to follow the overlay diagram (Fig.3) carefully, as some of these components are polarised and won't work if you install them the wrong way around.

Finally, solder in the LED and the PC stakes for the battery and the crystal. You might like to make up a pair of short alligator clip leads to connect the crystal – see photo.

Testing

Testing the circuit is pretty much the same as normal use. Find a crystal that you know works, preferably something between 32kHz to 4Mhz, pop it in and connect the 9V battery. If the circuit works, you should see the LED light.

If it doesn't, check that the components are in their correct locations and check the orientation of the components such as the LED, transistors and diodes. In addition, check the solder connections for dry joints or shorts between tracks.

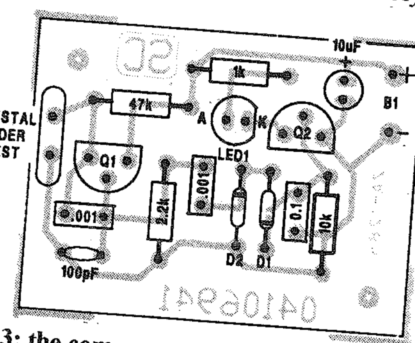


Fig.3: the component layout diagram for the PC board. We suggest connecting a pair of leads with alligator clips to makes connections to the crystal.

Parts List

1 PC board, code ZA1288, 52 x 40mm
4 PC stakes
1 Battery clip
1 Red and black alligator clip

Semiconductors
1 BF199 RF NPN transistor (Q1)
1 BC548 NPN transistor (Q2)
2 1N914/1N4148 signal diodes (D1, D2)
1 5mm green LED (LED1)

Capacitors
1 10uF 16/25VW electrolytic
1 0.1uF/100n/104k 63VW MKT polyester
2 .001uF /1n/102k 63VW MKT polyester
1 100pF ceramic

Resistors
1 47kΩ (yel-vio-org)
1 10kΩ (brn-blk-org)
1 2.2kΩ (red-red-red)
1 1kΩ (brn-blk-red)

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