CIRCUIT FRAGMENTS

One of the best ways to begin your mastery of electronic circuitry construction is to work with discrete components before diving headlong into integrated circuit construction. After all, integrated circuits are nothing more than these individual components and circuits in a more compact package. The only problem is that they don't come in see-through packages to help you identify the individual working areas.

We don't feel that it's of much value to simply "plug in" black boxes without the understanding of what actually goes on inside them. If you can learn what the circuitry of an integrated circuit is supposed to do, then it frees you to come up with your own innovations, and to accurately troubleshoot your creations when you run into the inevitable bugs or "glitches."

This brings up another point. While some ICs are relatively sensitive to miswiring and are easily destroyed, these discrete components, as a rule, are not. It's a lot better to make your mistakes here than on an integrated circuit project, where ruining an IC due to a reversed diode polarity might set you back two or three dollars. So have fun, but learn!

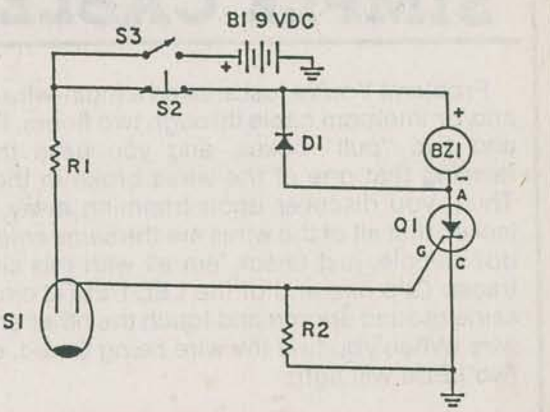
EQUIPMENT THEFT ALARM

As an electronics hobbyist, you very likely own one or more pieces of expensive equipment, and these can be very tempting targets for thieves or vandals. To protect your investment, why not install the simple alarm pictured here in some of your more valuable possessions? Things like Amateur or CB transceivers, computers, oscilloscopes and stereo equipment are ali excellent candidates.

In the schematic, mercury switch S1 is normally open. However, should the equipment in which the alarm has been installed be picked up and tilted, S1 closes and thereby supplies gate current to the SCR. Q1 then latches in a conducting state, causing current to flow through buzzer BZ1. The buzzer will sound until pushbutton S2 is pushed to reset the circuit. For best results, use an electromechanical, rather than piezoelectronic buzzer, since it will emit more noise.

PARTS LIST FOR EQUIPMENT THEFT ALARM

B1—6,9, or 12-volt battery
BZ1—6,9, or 12-volt buzzer
D1—1N4002 diode
Q1—2N5060 SCR
R1, R2—4,700-ohm, ½-watt resistor
S1—normally open SPST mercury switch
S2—normally closed pushbutton switch
S3—SPST toggle swtich

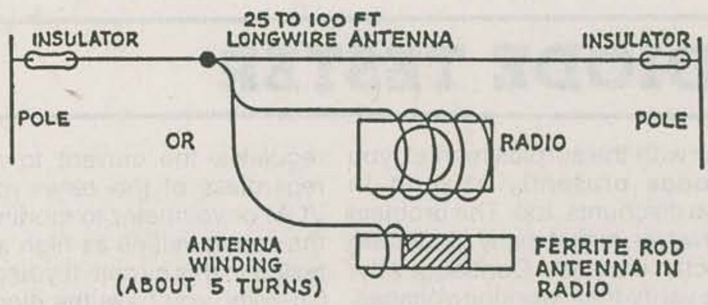


PASSIVE AM BOOSTER

Your transistor radio antenna system is designed to pull in local broadcast-band stations that are either local or very high power—you need a signal with oomph! Now you can make that "one lunger" more sensitive and try some DX with the Passive BC Booster. Also, for those people who work in or live in buildings that effectively kill BC signals, this Passive BC Booster can bring life to that transistor radio that could only detect the noise from fluorescent lamps.

All you have to do is simply bring in the end of an outdoor "longwire" antenna and wrap the end around the radio about 5 times.

Even better reception is possible if you open the radio and wrap about 5 turns around the rod antenna immediately adjacent to the antenna coil mounted on the rod. Make certain the ends of the outdoor antenna are insulated with glass or ceramic insulators. In fact, often an insulated wire about 10-to 20-feet long that is left dangling out a high-story window is all that is needed for an antenna.

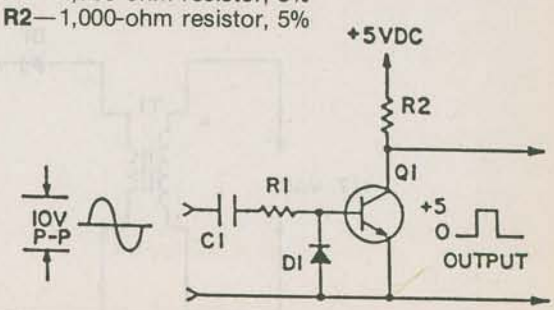


SQUARE WAVE CONVERTER

Got a yen to go digital but few bucks to spend? Well, if you happen to have an old audio signal generator at hand, you can convert its sinewave output to a squarewave and save yourself the expense of a squarewave generator. The converter consists of an ordinary saturating transistor switch which, when driven by a large amplitude (about 10-VDC peak-to-peak or greater) sinewave, yields squarewaves with reasonably fast rise and fall times. Be certain to use as large an input amplitude as possible. Certain edge-triggered ICs, TTL flip-flops in particular, may fail to clock on a waveform whose rise and fall times are too long; however, the majority of ICs will clock readily when driven by this converter.

PARTS LIST FOR SQUARE WAVE CONVERTER

C1—1.0-uF, 25 VDC non-polarized mylar capacitor
Q1—2N3904 NPN transistor
R1—4,700-ohm resistor, 5%
R2—1,000-ohm resistor, 5%



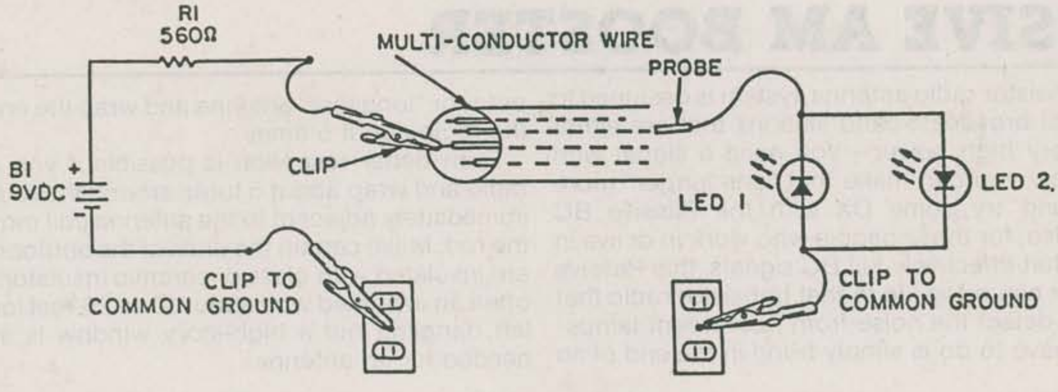
SIMPLE CABLE TRACER

Problem! You've just snaked a multi-wire computer and/or intercom cable through two floors, five bends, and two "pull" boxes, and you have the creepy feeling that one of the wires broke in the process. Then, you discover upon trimming away the outer jacket, that all of the wires are the same color. What to do? Simple, just check 'em all with this simple wire tracer. Clip one end of the LED1/LED2 circuit to the same ground source and touch the other end to each wire. When you find the wire being tested, one of the two LEDs will light.

It doesn't matter which LED lights. We use two only to prevent confusion in the event a polarity gets reversed. This way, one LED is certain to light. The LEDs can be any "general purpose" type available. Battery B1 is a 9-volt transistor radio-type.

PARTS LIST FOR CABLE TRACER

B1—9 volt transistor radio battery
LED1, LED2—general purpose LED, 0.02 mA
R1—560-ohm, ¼-watt resistor
Misc.—3 alligator clips, 1 test probe



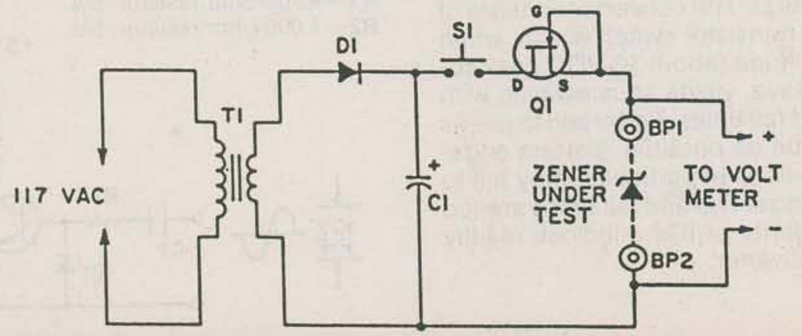
ZENER DIODE TESTER

If you're at all familiar with the surplus market, you know that zener diodes presently abound in surplus—at tremendous discounts, too. The problem with buying surplus, however, is that many diodes are unmarked or incorrectly marked. Consequently, these must be tested to verify their working voltages. Another problem crops up when you buy so-called "grab bags" of components. The zeners you find may be legibly marked, but unless you happen to have a data sheet for those particular diodes, they will require testing to identify the zener voltages. You can do your testing quickly and easily with the circuit presented here.

T1, D1 and C1 comprise a simple half-wave rectifier system. Pressing S1 sends a DC current through current limiter Q1 and the diode under test. Q1 regulates the current to a value of about 10 mA regardless of the zener voltage. You can use your VOM or voltmeter to monitor the voltage drop across the zener; values as high as 25-volts can be reliably tested in this circuit. If you get a very low reading, say 0.8-volts, you have the diode in reverse. Interchange the zener's connections.

PARTS LIST FOR ZENER DIODE TESTER

BP1, BP2—binding posts
C1—500-uF, 50-VDC capacitor
D1—1N4002 diode
Q1—2N5363 n-channel JFET
S1—normally open SPST switch
T1—120-VAC to 24-VAC @ 300 mA power transformer



AM RADIO RF BOOSTER

You can greatly increase the pickup distance of your transistor radio (or even an AM table radio) by adding an RF (radio frequency) stage and then coupling that boosted signal to the receiver's built-in antenna loopstick (ferrite rod). This is a low-cost project that can pack a lot of extra sensitivity into an ordinary radio and it'll let you do broadcast-band DX'ing with that little radio you thought was just for listening to local stations.

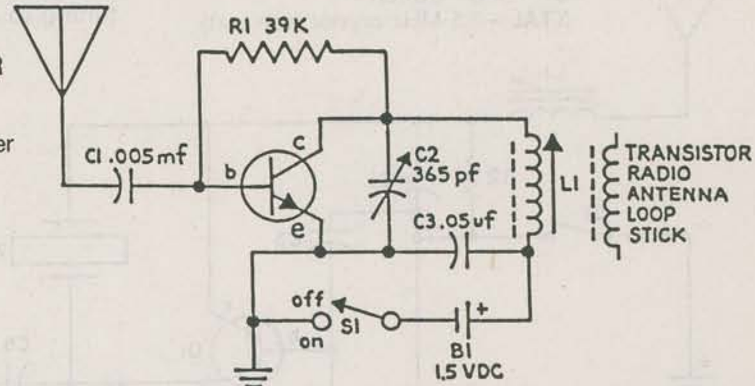
Assemble the circuit in a small plastic cabinet with coil L cemented to the side or back of the cabinet. You can use almost any epoxy, adhesive, or cement.

Connect at least 15 feet (up to 80 feet is even better) of antenna wire (even covered telephone wire or flat TV wire will do temporarily) to input capacitor C1. Position the booster case flat against your radio with L1 as close to the set's loopstick antenna which is built into the radio. Now tune capacitor C2 to the frequency of the station you want to pick up.

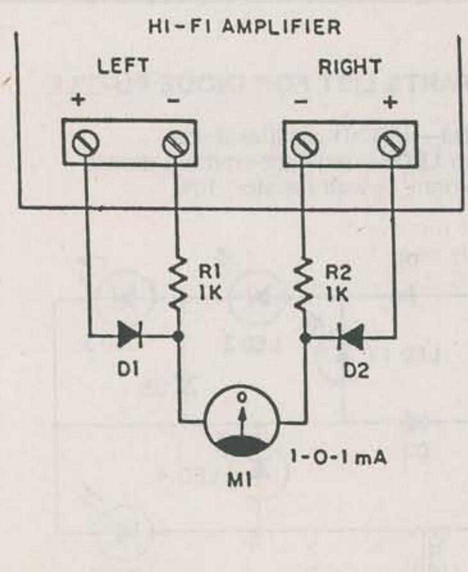
Then turn on the radio and listen to the signals booming in. Remember that the radio set's AVC action will cut down normally-loud local signals.

PARTS LIST FOR AM BOOSTER

B1—1.5-volt penlight AA battery
C1—0.005-uF disc capacitor, 25 VDC or better
C2—365-pF miniature tuning capacitor
C3—0.05-uF capacitor, 25 VDC or better
L1—Loopstick for C1
Q1—2N1304 NPN transistor
R1—39,000-ohm, ½-watt resistor
S1—Spst switch (on-off)



STEREO BALANCE METER



The only way to be certain your sound system is in perfect electrical balance is to use a power amplifier stereo balance meter to substitute for guesswork.

Meter M1 can be a zero-center DC milliammeter rated 1-0-1 mA or less. Alternatively, you could use a standard meter but the pointer might be driven off-scale to the left while making adjustments, though the meter won't be damaged—it will just be an inconvenience.

Play any disc or tape and then set the amplifier to *mono.* Adjust the left and right channel balance until meter M1 indicates zero; meaning the left and right output level are identical—that's balance.

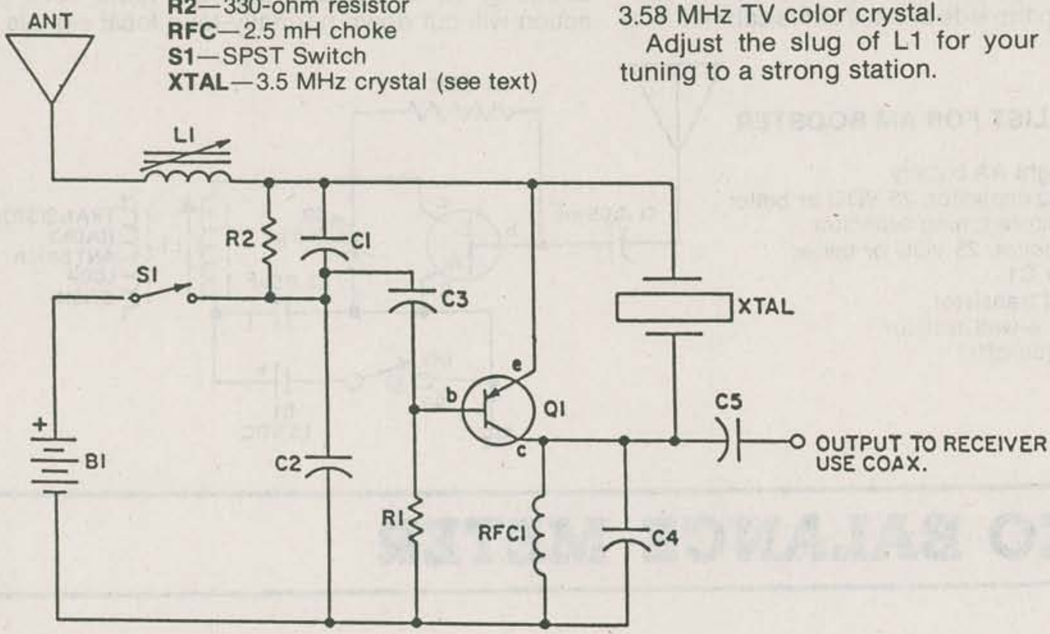
PARTS LIST FOR STEREO BALANCE METER

D1, D2—Silicon rectifiers rated 100 PIV at any low current
M1—Zero-center DC mA meter (see text)
R1, R2—1000-ohm resistors, 5% or 1%

ADD LONG WAVE TO SHORT WAVE SET

PARTS LIST FOR SHORT WAVE SET

B1—9VDC battery
C1, C4—470-pf capacitor
C2—.1-uF capacitor
C3—.001-uF capacitor
C5—50-pf capacitor
L1—Loopstick coil
Q1—PNP transistor, 2N3906 or equiv.
R1—470,000-ohm resistor
R2—330-ohm resistor
RFC—2.5 mH choke
S1—SPST Switch
XTAL—3.5 MHz crystal (see text)



Ever listen in on the long waves, from 25-500 kHz? It's easy with this simple converter. It'll put those long waves between 3.5 and 4.0 MHz on your SWL receiver.

Q1 acts as a 3.5 MHz crystal oscillator, mixing the crystal frequency with the long wave input from the antenna and forwarding the mix to your receiver.

L1 is a standard broadcast loop stick antenna coil. The crystal is available from many companies by mail order, or at a ham radio store. You could also use a 3.58 MHz TV color crystal.

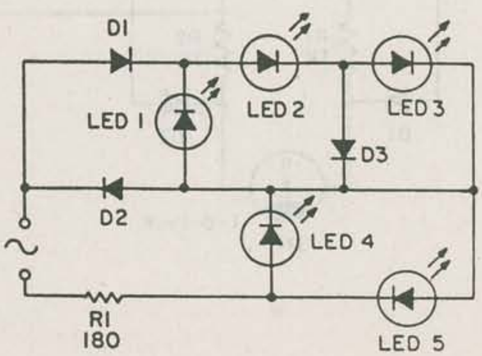
Adjust the slug of L1 for your best signal after tuning to a strong station.

DIODE PUZZLE

This innocuous-looking little circuit will provide a good indication of how well you really understand the rectifier diode and the light-emitting diode. Your task is to determine which of the five LEDs will light up when 6.3 volts AC is applied to the circuit. We won't give you the answer; to find that out, just breadboard the circuit. However, we will supply you with a couple of hints. First, the forward voltage drop of a rectifier diode is approximately .8 volt, while that of an LED is about 2 volts. Naturally, rectifiers conduct in one direction only. LEDs will light up only when their anodes (arrows) are 2 volts more positive than their cathodes (bars). Finally, you can expect to find 3 LEDs lit and 2 LEDs dark. Pencils sharpened? OK, begin.

PARTS LIST FOR DIODE PUZZLE

D1, D2, D3—1N4001 rectifier diode
LED1 thru LED5—red light-emitting diodes
R1—180-ohm, ½-watt resistor, 10%



FREQUENCY DIVIDER

Mention the topic of frequency division, and immediately most of us start thinking in terms of TTL, CMOS or some similar family of digital integrated circuits. In fact, surprising though it may seem, frequency division can be readily accomplished without ICs using common discrete semiconductors-in this case, a unijunction transistor.

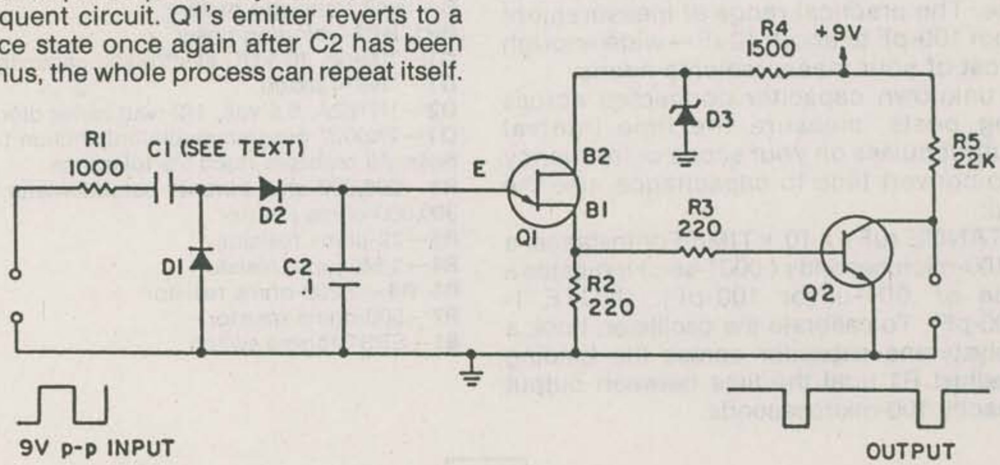
Capacitors C1 and C2 together with diodes D1 and D2 constitute a simple *charge pump*, which feeds the emitter of UJT Q1. Normally, C1 is chosen to be smaller than C2, and in this circuit values of C1 between .02 and .1 mf should be satisfactory. With each positive-going transition of the digital input signal, C1 transfers a small amount of charge to C2, which acts as a reservoir. This accumulated electronic charge is prevented from leaking away by D2. As successive input pulses transfer more and more charge to C2, the voltage across C2 naturally rises.

Eventually, the voltage on C2 will become high enough to cause Q1's emitter to break down and discharge C2 through R2. When this happens, Q2 amplifies and inverts the voltage pulse appearing across R2. This amplified pulse may then be used to clock a subsequent circuit. Q1's emitter reverts to a high-impedance state once again after C2 has been discharged. Thus, the whole process can repeat itself.

The ratio of C2 to C1 will determine the number of positive-going input pulses needed to accumulate the necessary threshold potential on C2. With C2 equal to C1, the frequency will be divided by a factor of 1. The higher the C2:C1 ratio, the more input pulses needed and, as a result, the greater the frequency division obtained. This circuit is sensitive to the magnitude of its input pulses, so keep the input amplitude at 9 volts, or thereabouts. Satisfactory performance with input signals as high as 10 kHz will be obtained with the parts listed.

PARTS LIST FOR FREQUENCY DIVIDER

C1—capacitor, .02-.1 uF (see text)
C2—.1 uF capacitor
D1,D2—1N914 silicon diode
D3—1N751A 5.1V, ½W zener diode
Q1—2N2646 unijunction transistor
Q2—2N3904 NPN transistor
R1—1,000-ohm resistor
R2, R3—220-ohm resistor
R4—1,500-ohm resistor
R5—22,000-ohm resistor



A VOM THERMOMETER

Almost all electronic components change characteristics as temperatures change. In the case of silicon diodes, like the 1N914, the characteristic that changes is the amount of *forward voltage drop.*

Diodes aren't perfect conductors, you see, because they must take advantage of the bias (voltage) across a semiconductor junction (the place where the two different kinds of semiconductor material, p and *n*, meet) in order to operate.

Almost every semiconductor device shows a junction voltage drop of about ½ Volt when forward biased, as the diodes here are.

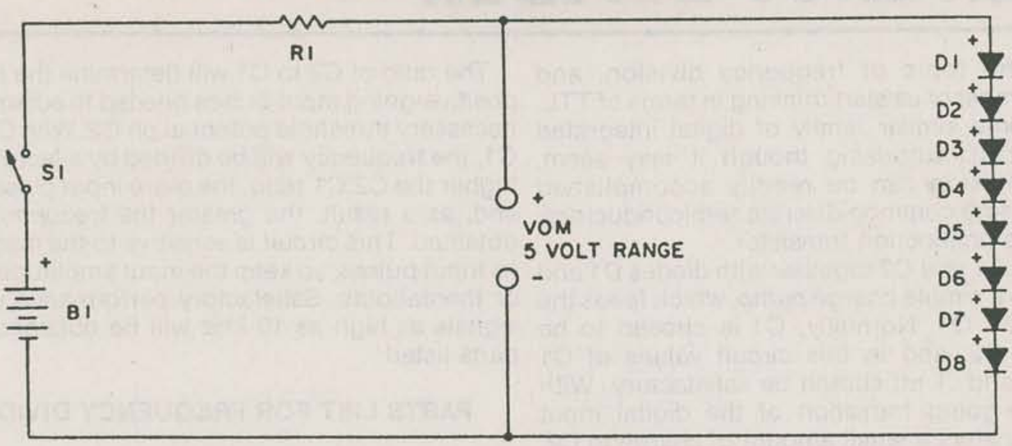
So if you string eight diodes in series, like these, and measure the voltage across the string on the 5 Volt scale of your VOM, you'll see the voltage varying up and down around 4 Volts as you change the temperature the diodes are exposed to.

You could calibrate a separate meter to give you actual degree readings, but for many purposes, just knowing the temperature is changing is enough.

PARTS LIST FOR A VOM THERMOMETER

B1—9 VDC battery
D1, D2, D3, D4, D5, D6, D7, D8, D9—Diode, 1N914 or equiv.
R1—4700-ohm resistor, ½-watt
S1—SPST switch

A VOM THERMOMETER



CAPACITANCE METER

If you own a triggered-sweep oscilloscope or a frequency counter capable of making frequency measurements, you can use this PUT (programmable unijunction transistor) oscillator to measure capacitance. The practical range of measurement extends from 100-pF to about 10uF—wide enough to cover most of your measurements needs.

With an unknown capacitor connected across the binding posts, measure the time interval between output pulses on your scope or frequency counter. To convert time to capacitance, use the relationship:

CAPACITANCE (uF) = 10 × TIME For instance, a reading of 100-microseconds (.0001-sec.) indicates a capacitance of .001-uF(or 100-pF). (NOTE 1-uF=1,000,000-pF). To calibrate the oscillator, hook a 1000-pF polystyrene capacitor across the binding posts and adjust R1 until the time between output pulses is exactly 100-microseconds.

PARTS LIST FOR CAPACITANCE METER

B—9volt transistor battery
BP1, BP2—binding posts
C1—100-uF, 10-VDC electrolytic capacitor
D1—1N914 diode
D2—1N752A, 5.6 volt, 1/2-watt zener diode
Q1—2N6027 programmable unijunction transistor
Note: All resistors rated 5% tolerance
R1—200,000-ohm trimmer potentiometer R2—390,000-ohms resistor
R3—22-ohms resistor
R4—1 Megohm resistor
R5, R6—2,200-ohms resistor
R7—560-ohms resistor
S1—SPST toggle switch