Fig. 4. RCA's C30121 optically coupled isolator: (A) driver circuit; (B) lead connections.

their own test instruments. According to Tom, his design is accurate to within ±10% and is capable of measuring units ranging in value from 10 pF to 10 μF. Tom also indicates that his circuit, illustrated in Fig. 5, can be assembled for well under 20 dollars, exclusive of the external meter used as a null indicator.

Referring to the schematic, Tom has used the ubiquitous 555 timer, *IC1*, as an oscillator. Transistor *Q1* provides a discharge path for range capacitor *CK* complementary to the IC's internal discharge circuit (pin 7) across the unknown test capacitor, *Cx*. The *RK-CK* and *RF-Cx* networks are connected from *IC1*'s output terminal 3 to each side of the power source, *B1*, with the voltage here applied through "L" filter *R4C2* to an external zero-center meter, *M*, where it is compared to the source's mid-point voltage, established by voltage-divider *R2-R3*. Shunt diodes *D1* and *D2* limit the maximum voltage across the meter.

The values of capacitor *CK* and resistor *RF* are preselected for the desired measurement range. In operation, then, potentiometer *RK* is adjusted for a 50% duty cycle, as indicated by a "0" reading on the null meter, *M*. At this point, *RK*'s value will be directly proportional to the value of the unknown test capacitor, *Cx*, permitting it to be calibrated directly in the desired capacitance values.

Neither layout nor lead dress should be overly critical, so the circuit can be duplicated using point-to-point wiring on perf board, wire-wrap, or a suitable board, at the builder's option. The fixed resistors are half-watt types, *C1* a low-voltage ceramic or plastic film capacitor, and *C2* a 10- to 15-volt electrolytic. Jacks *J1* through *J4* may be binding post or plug-in types. Standard general purpose diodes are used for *D1* and *D2*, but the 555 timer, *IC1*, and type 2N2222 *npn* transistor, *Q1*, should be high-quality, low-leakage devices. The critical components are *CK*, *RK*, *RF*, *R2* and *R3*. Of these, *CK* should be a high-quality, low-tolerance polystyrene or Mylar plastic film capacitor, while *RK* consists of a 68K fixed resistor in series with a 1-megohm potentiometer, the latter a good-quality unit with a linear taper. Resistors *RF*, *R2* and *R3* should be low tolerance (5%, 2%, or lower) types. Different values are used for *CK* and *RF*, depending on the measurement range needed, as specified in the table below. If a full-range instrument is preferred, the basic design may be modified by adding a multi-section, multi-position rotary switch, wired to select any of the listed values in order.

RANGE	Cx	RF	CK
A	8 pF - 130 pF	820K	100 pF
B	80 pF - 1300 pF	82K	100 pF
C	800 pF - 0.013 μF	82K	1000 pF
D	0.008 μF - 0.13 F	8200	1000 pF
E	0.08 μF - 1.3 μF	8200	0.001 μF
F	0.8 μF - 13 μF	820	0.001 μF

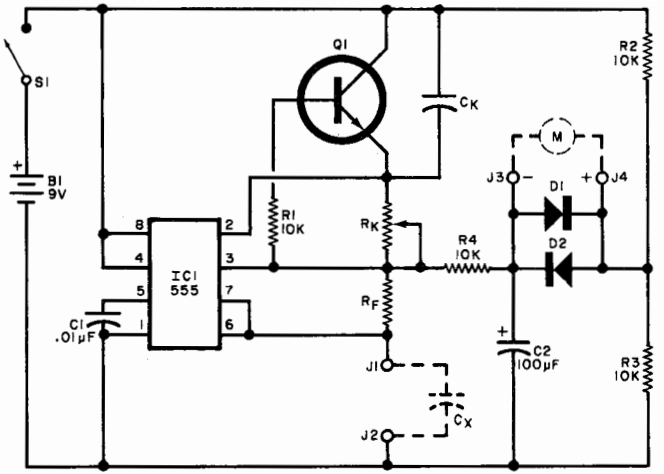

Fig. 5. Capacitance measurement circuit is said to be accurate to within 10%, in either direction, and will measure values from 10 picofarads to 10 microfarads.

Once the instrument's assembly and wiring have been completed and double checked for errors, shorts, opens and correct polarities, *RK*'s scale may be calibrated by measuring known capacitors within each range. Intermediate values may be interpolated easily as needed to complete the scale. The external null meter, *M*, should be a high impedance VTVM or FET voltmeter with a 1.5 V range, adjusted to zero at the center of the scale. ◇