ADC-42 WINNER

Open line break finder

Time-domain reflectometry or capacitance measurement are, in most circumstances, successful methods of finding breaks in cable pairs But, if the lines are loaded at intervals with inductors to improve frequency response, those methods are often useless at the frequencies used.

This problem is overcome in this arrangement by the use of a very low-frequency capacitance measurement, in practice a long *CR* with a capacitance multiplier for magnification. A 15s *CR* eliminates the line inductances and the multiplier confers better accuracy on an expanded scale.

Figure 1 shows the multiplier using a Miller circuit, where the effective value of the capacitor is increased by the gain of the transistor There is, however, leakage to cope with and the **Fig**. 2 circuit is a bridge arrangement to balance out dc leakages.

Figure 3 is the practical circuit Discharge the line capacitance and adjust VR_1 until voltmeter D is reading just below the knee of the curve in Fig. 2**a**), point Q, logging the reading which is the balance point to be made before any further readings. You may like to practice this procedure using a 0.1μF capacitor.

With S_2 set to 'balance', set the voltmeter to point Q. Switching to 'measure', temporarily closing S_1 zeros the meter and discharges the cable; releasing the switch, the fixed offset of the bridge causes the meter reading to rise slowly as long as the cable is charging When the meter stops moving, log the reading

Ranges are 3, 10 and 30km, corresponding to 1.5, 5 and 15s to reach full scale with a 30mV offset and a constant 1mA current. Accuracy is better than 5%, which is sufficient to place the fault near enough for a tdr method to be used, if necessary.

As regards components, K_1 is a normally-open dual reed relay; VR_3 adjusts the op-amp gain to make full-scale reading match analogue voltmeter scale on calibration; $VR_{4,5,6}$ are for scale adjustment; and the *2N3906* is in a constant-current circuit to measure charging time using a low-leakage 18μF capacitor

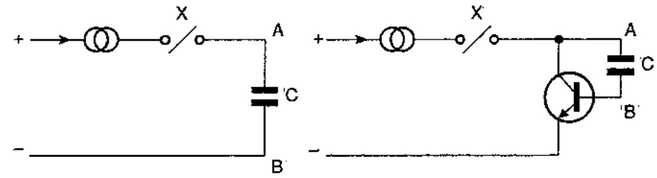
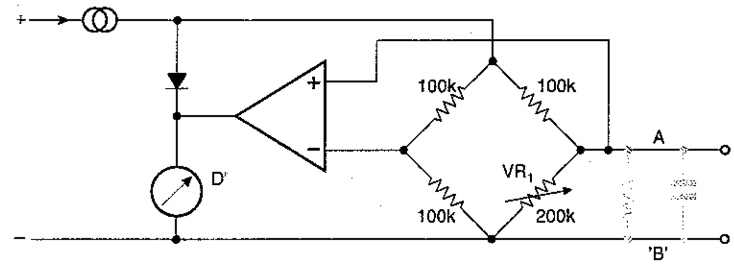


Fig. 1. Measuring the rise time of a long **CR** *avoids the problem of inductance found in high-frequency methods of detecting line breaks. The Miller circuit magnifies the capacitance.*



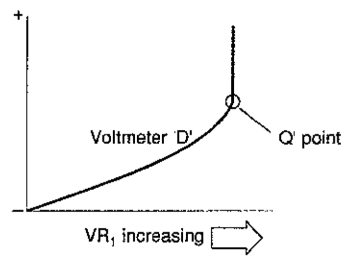
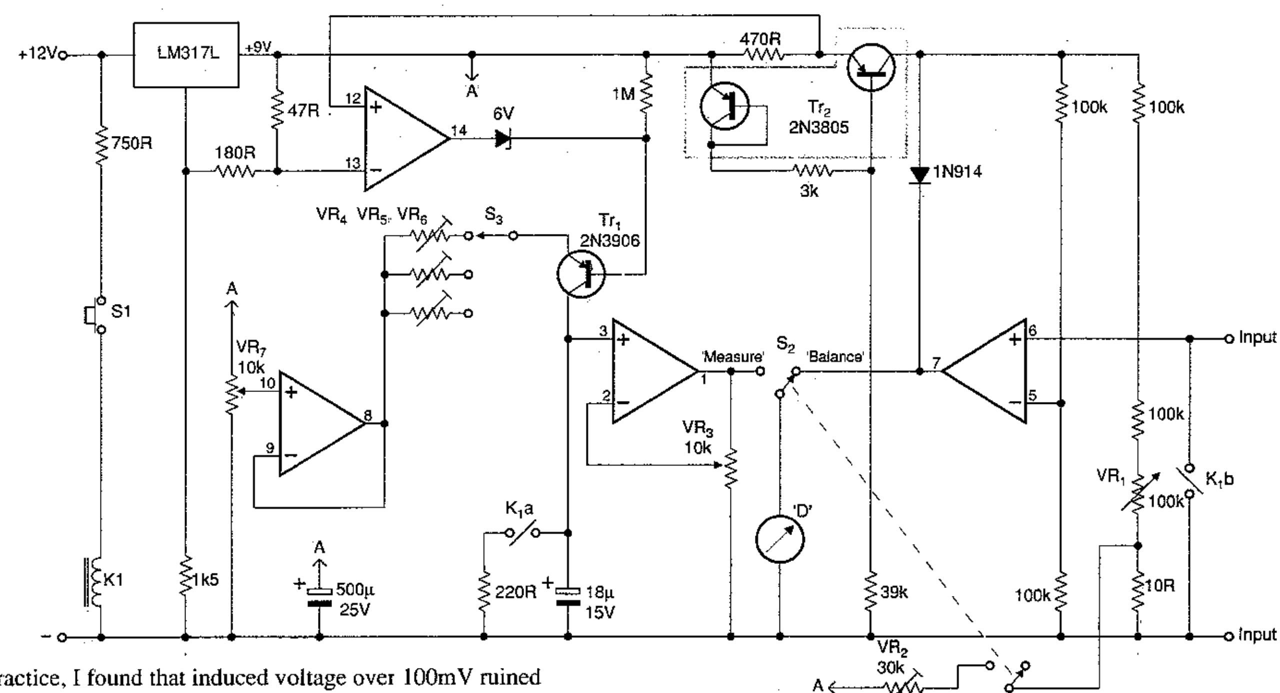


Fig. 2. Bridge circuit balances out leakages in line capacitance. At (a), the meter characteristic; point Q is the meter reading point.



In practice, I found that induced voltage over 100mV ruined the readings, so the low-pass filter shown at the bottom of Fig. 3a) was used to avoid the problem The filter capacitor is equal to one scale unit, with the result that one unit must be subtracted from readings.

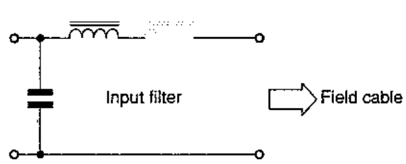


Fig. 3. Practical circuit and filter to reduce induced noise.

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