# Telephone tester detects line distortion

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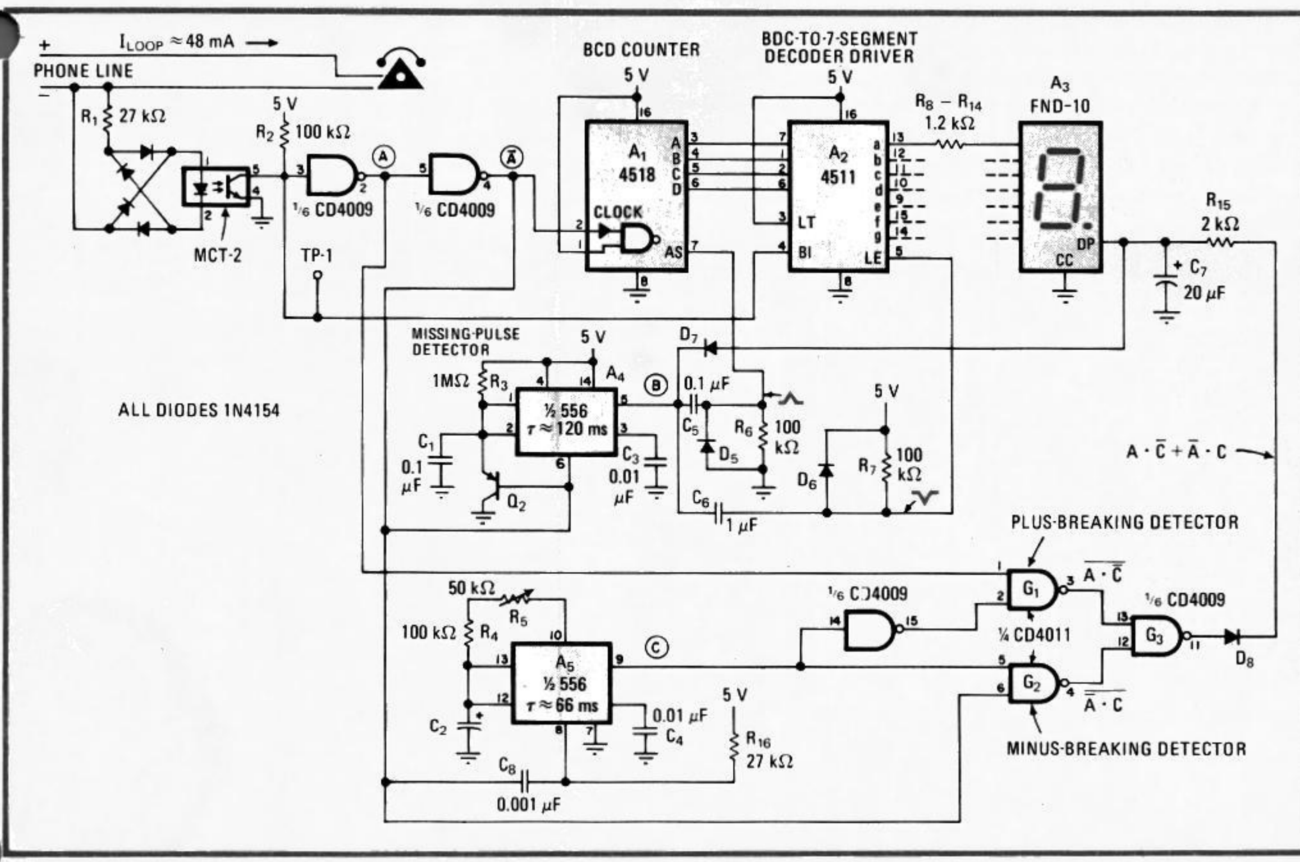
This telephone tester monitors each dial pulse sent along a two-wire telephone line in order to detect the existence of pulse distortion—the ratio of a pulse's break interval to the sum of the make and break times. It is invaluable for checking the signaling parameters of the various rotary-dial systems found in the U. S., since in many cases it can serve as a stand-in for the more sophisticated test sets.

An optically isolated input circuit presents the outgoing pulses to counter $A_1$ and decoder-driver $A_2$ so that the number represented by each group of pulses dialed can be displayed by $A_3$. $A_4$ detects the start and end of the pulse train for any particular digit, and differentiators $R_6C_5$ and $R_7C_6$ derive positive- and negative-going pulses, respectively, for resetting $A_1$ and latching $A_2$. The numbers displayed can thus be checked against the known numbers dialed to determine if the telephone set, the line, or points in between are generating faults.

Meanwhile, one-shot $A_5$ is triggered through $R_{16}C_8$ for every pulse received. $A_5$'s output is used as a reference signal to be compared with the actual break time of the pulses on the line. Note that $A_5$'s time constant can be selected over the range of 51 to 77 milliseconds with potentiometer $R_5$, so that the unit can be made test-compatible with the system under measurement. Thus, in modern Bell System links (pulse rate of $10 \pm 0.5$/second), $A_5$ is set for an on-time of 58 to 64 ms. For dated Bell links, E & M (receive and transmit) loops, and old switchboards, $A_5$ assumes the range 59.5 to 67.5 ms. The break times become 57 to 64 ms for E & M senders, and 62 to 66 ms for new switchboard systems.

If the break pulse is wider than the reference signal, $G_1$ generates a signal whose width is proportional to the distortion; similarly, $G_2$ generates a corresponding signal if the break is less than the reference. Thus, $A_2$'s decimal point will be driven by a current via $G_3$ if either condition exists. Neither condition necessarily indicates that the distortion is excessive, since the break width can never be expected to be exactly equal to the reference width. Thus, the detector's integrator ($R_{15}C_7$) is designed to pass an average current sufficient to activate the decimal point when the break distortion exceeds about 10%. Note that the distortion measurement is not




**Break boundaries.** Test unit displays numbers generated by rotary-dial telephone and detects dial-up distortion created in systems that generate variations in the nominal make-to-break ratio of dial pulses. Unit monitors signaling parameters of all U. S. standard systems.

affected by the time interval between dialed digits—the interdigital interval.

Several other display or decimal-point conditions may occur during operation, and it is advantageous to know them in order to prevent misinterpretation of the test results. For instance, when the telephone set is on the hook, the display will be off and the decimal point will be active. A flashing display and decimal point indicate a ring signal on the line. Also, the display may flash if the distortion on the line greatly exceeds 10%.

A square wave having a period of 100 ms and a [illegible] cycle of 50 ms can be injected at test point TP-1 to verify the monitor's performance. The opto-isolator input must be disconnected from the phone line at this time. □

## Calculator notes