nterface between a 4-by-4 keypad and one microcomputer pin

ADC42 WINNER

Used with a microcomputer having an i/o pin that may be shorted to ground while in the high state, such as one of the 8051 family, this circuit enables a 4-by-4 keypad to use only that pin, instead of the four or five normally needed.

Neglecting, for the moment, the effect of R_9, current through R_{10} is small. Shorting Col_1 and Row_1 via the keypad, Q_1 being low and Q_5 high, causes current to flow from +5V through R_1, D_5 and D_1 through R_{10}, the consequent voltage drop being detected by comparator A_4.

Most states of the counter give either no path for the current to R_{10} or several but, for every switch sition, there is one counter state ving an unambiguous indication of the switch state. For example, if Col_1 and Row_1 are shorted by the keypad, the counter code is 00011110 and for Col_2 and Row_1, 00101110 etc. The process of testing a switch therefore requires the computer to advance the counter to the desired count and to monitor A_4 output. *LM339* op-amps are open-circuit comparators; when on, the output is a short to ground and when off, open-circuit.

Initial conditions are such that point X_1 is held low by the computer for 100µs or more, A_3 has switched off and C_2 is charging to reset the counter. Current through R_9 drops a small voltage across R_{10} and the output of A_2 and therefore the negative input of A_4 are grounded and A_4 is off.

When the computer takes X_1 high, A_1 discharges C_1, A_2 goes high and A_4 pulls X_1 low again. Switching delays allow C_1 to discharge completely so that when A_4 switches A_1 off, it takes about 10µs for the voltage across C_1 to switch A_2 high again. For a count state and switch position causing the extra current to flow in R_{10}, A_4 does not switch on and X_1 stays high.

After driving X_1 high, the computer monitors it to detect the presense or absence of current through the keypad and then forces X_1 low again, notwithstanding the state of A_4. After 14µs, the trailing edge of the pulse at A_2 has incremented the counter, A_4 has switched off and the computer drives X_1 high to start the whole thing again until the counter holds the desired count for the switch under test.

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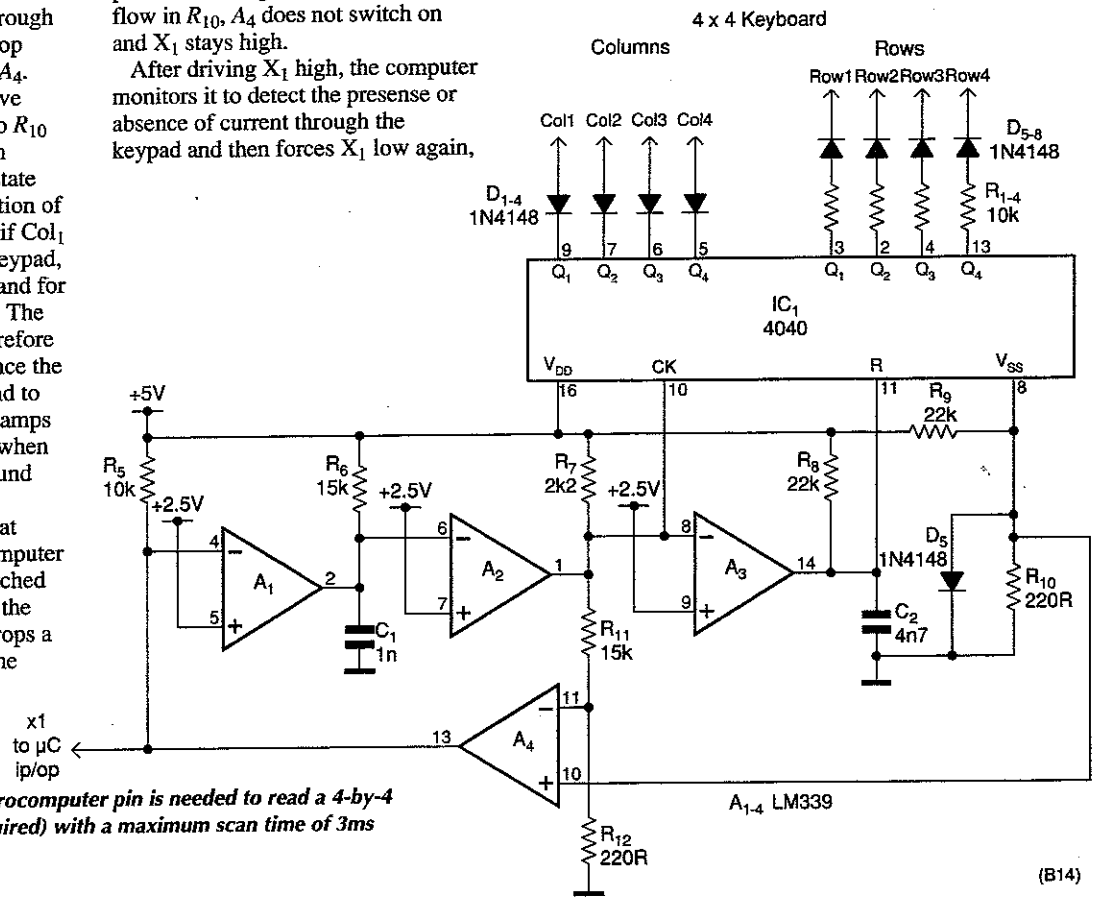

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Only a single input/output microcomputer pin is needed to read a 4-by-4 keypad (or up to 6-by-6, if required) with a maximum scan time of 3ms (42ms for 6-by-6).

under 100Ω and both the values and voltage ratings of $C_{2,5}$ are increased. Minor adjustments in crossover frequency may be effected by replacing C_3 with 100pF across a 20pF trimmer; crossover time constant of 20µs should not be reduced to become comparable with the optocoupler time constant of about 1.5µs.

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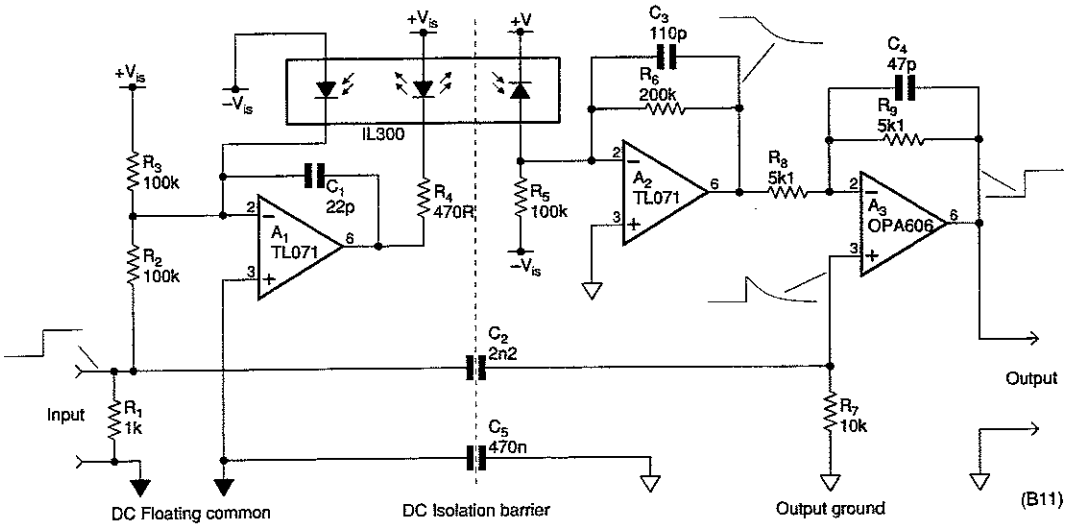

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