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TC7109 Records Remote Data Automatically

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INTRODUCTION

A Microchip Technology analog-to-digital converter, a 2K-byte CMOS static RAM, and some gates and counters can be combined to form a low-cost, flexible, standalone data logging system. All the ICs are CMOS and the clock frequency is low, so power supply current is only a couple of milliamperes. The unit will store a 13-bit conversion (12-bit plus sign) in two consecutive bytes of memory, with a programmable time interval between measurements. The circuit is useful for logging temperature or other process control variables in remote locations or hostile environments. It is also useful in the lab for making unattended, repetitive measurements of long-term drift, component aging, etc.

The heart of the circuit is a TC7109 (IC1), a 12-bit plus sign CMOS A/D converter. The TC7109 has a handshake mode in which the result of the latest conversion is output, in two consecutive bytes, each time the MODE input is strobed high. The data logger stores each byte in sequential RAM locations for later processing by a host computer. The IDT6116 CMOS static RAM stores 2048 bytes and, therefore, can store 1024 readings. This permits, for example, one 13-bit measurement per hour for seven weeks.

Timing for the circuit is provided by IC3 operating with an inexpensive 32kHz crystal. The crystal can be replaced with a resistor and capacitor if precise timing is not required. The Q4 output of IC3 provides a clock frequency to the A/D converter that produces excellent 50Hz, 60Hz, and 400Hz noise rejection. The Q12 output of IC3 is a 2Hz square wave, which is divided by two in IC4A. The resulting 1Hz output is applied to the input of IC5, a 12-stage counter. The outputs of IC5 are decoded by a NAND gate to produce any desired interval between readings, to a maximum of 68 minutes. At the end of the time interval, IC4B generates a pulse which resets the counter and places the TC7109 in the handshake mode.

When the TC7109's MODE input is pulsed high, the result of the latest conversion is output in two bytes. First, $\overline{\text{HBEN}}$ goes low, outputs B9 through B12, POL and OR become active, and $\overline{\text{CE/LOAD}}$ goes low. After one clock cycle, $\overline{\text{CE/LOAD}}$ goes high and the high byte of the conversion is latched into memory. The rising edge of $\overline{\text{CE/LOAD}}$ also increments IC6, to address the next memory location. Then $\overline{\text{HBEN}}$ goes high, $\overline{\text{LBEN}}$ goes low, outputs B1 through B8 become active, and $\overline{\text{CE/LOAD}}$ again goes low for one clock cycle. After $\overline{\text{CE/LOAD}}$ goes high, the low byte of the conversion is latched into memory, IC6 is again incremented, $\overline{\text{LBEN}}$ goes high, and the data outputs return to their high- impedance state.

Data can be read out of RAM by any micro- or minicomputer. An I/O port with handshaking makes the task easy. The I/O port is simply programmed to produce a handshake strobe when the port is read. The strobe then increments IC6 after each byte is read and sequences through RAM automatically. Figure 1 shows pin connections for a PIC16C62A I/O device.

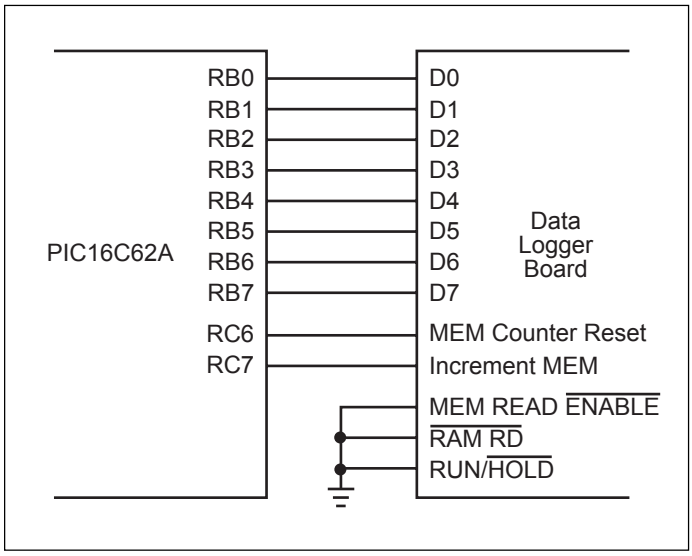


FIGURE 1: Connecting 13-bit remote data logger to 6552 I/O port for data readout.

Because of CMOS's low power requirements, battery power is ideal for the data logger. Average power dissipation of the TC7109 is only 10.5mW, and the IDT 6116 is in its power-down mode (Isy = 20μA), except for the time when CS is low. Power dissipation, therefore, is only about 15mW. On-board battery operation allows modules to be exchanged at remote locations and returned to a central location for data removal and analysis without danger of data loss.

The TC7660, a DC-to-DC converter, permits the circuit to operate from a single power supply. This CMOS device contains a switch matrix and on-board oscillator which convert a positive voltage to negative polarity with a power efficiency of about 98%. Using the TC7660, as shown in Figure 2, permits the circuit to operate, for example, on two small 3V lithium cells.

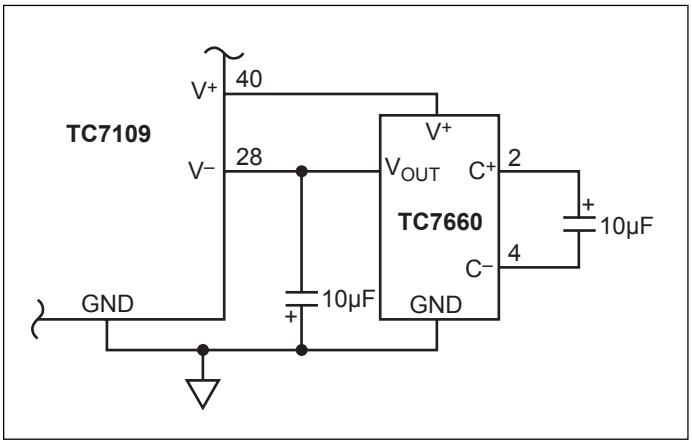


FIGURE 2: For single-supply operation, use the TC7660 DC-to-DC converter.

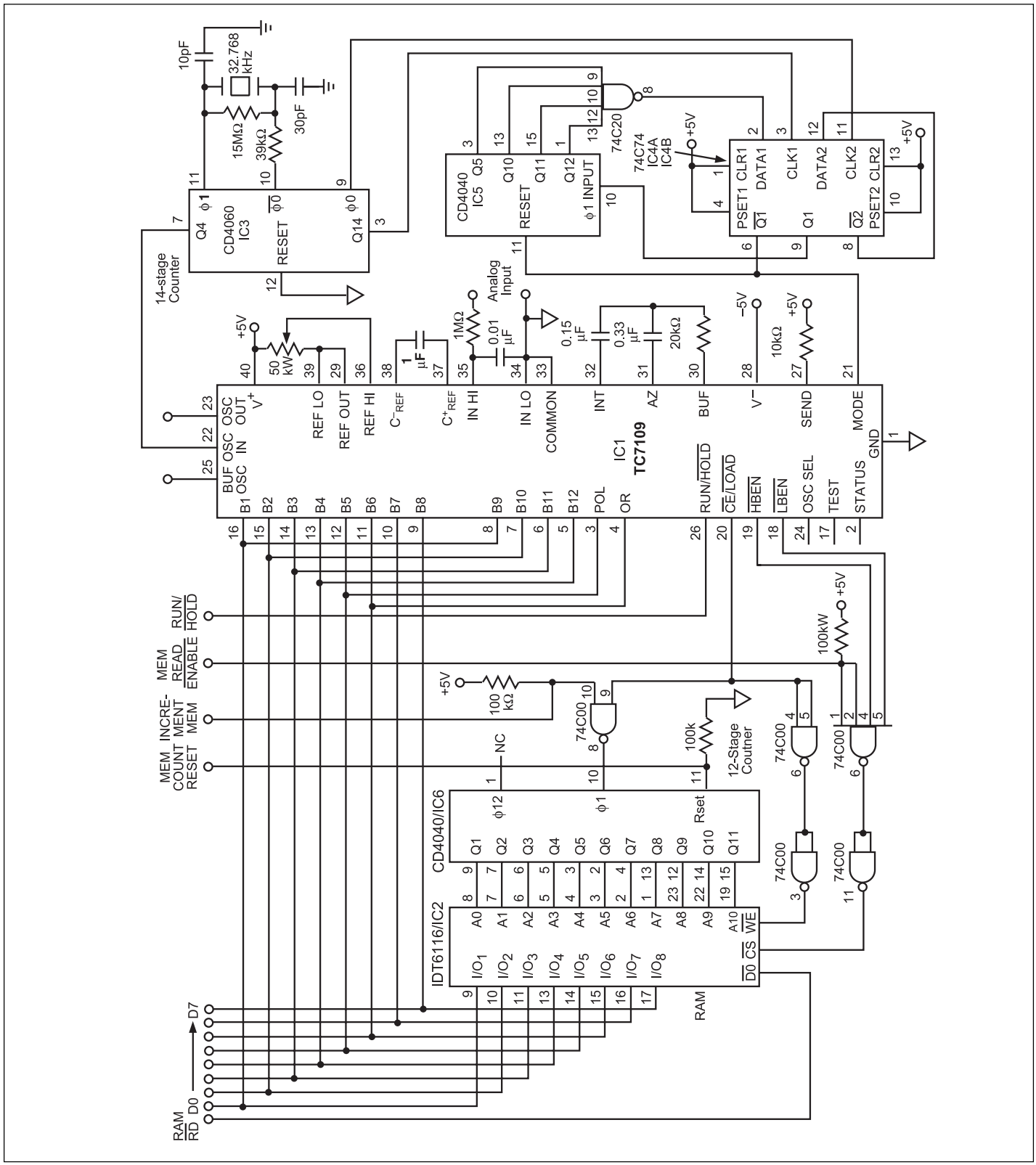
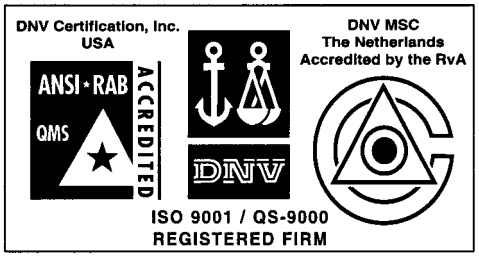


FIGURE 3: 13-bit remote data logger.

NOTES:



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