

# DESIGN SHOWCASE

## 12-bit ADC upgrades $\mu\text{C}$ 's internal 8-bit ADC

The simple circuit of **Figure 1** (plus a software routine) lets you substitute a multi-channel, 12-bit A/D converter for the 8-bit A/D converter internal to an 87C752 microcontroller. Thus, a single assembly can implement both the low- and high-performance versions of a system. The software mentioned may be downloaded from EDN's free electronic bulletin board service (BBS)\*.

A socket lets you plug in the external A/D converter when you need it; otherwise you plug in the network of ten  $100\Omega$  resistors. At power-up, the  $\mu\text{C}$  executes a routine that looks for the external converter. If present, it is used; if not, the internal 8-bit converter is used. (Internally, the chip handles all conversion results as 12-bit values.)

This idea relies on the fact that the 87C752's five A/D-input pins can also serve as the bidirectional pins of an 8051 port (port 1). The resistor network connects the internal A/D converter directly to the applied analog inputs. Or, replacing the network with the external A/D converter connects those inputs to corresponding channels on that converter, and the  $\mu\text{C}$ 's A/D-input pins (now acting as a bidirectional port) serve as a digital interface to the converter. By fortune and design, the change from external to internal converter is effected by simple pin-for-pin jumpers across the socket.

The assembly-language software routine "looks" for the external converter by triggering a conversion and noting whether the converter's busy flag (SSTRB) goes low. If it does, the  $\mu\text{C}$  sets an internal global flag (AD12) that tells it to use its external-converter routines for each subsequent conversion. This action is transparent to the calling routine. The conversion result, returned as bytes ADHI and ADLO, has the same format in either case except the four LSBs are zero for 8-bit-converter data.

Note that the  $\mu\text{C}$ 's full scale is 5V, but the converter shown (MAX186) sets its full-scale input range with an internal reference of 4.096V. Software resolves the incompatibility in this example. Otherwise, you can replace the MAX186 with a MAX188 (a similar device with no internal reference) plus a separate 5V reference.

\* Set modem to 2400 baud, eight data bits, no parity, and one stop bit. Dial (617) 558-4241 and log on. (New users must set up an account; this is free.) Type **SS/DI\_SIG** to select the Design Ideas section, **RK1554** to select this idea, and **D** for downloading the file. Select protocol, download the file, log off, and then "unzip" the file.

A related idea appeared in the 7/7/94 issue of EDN.

(Circle 4)

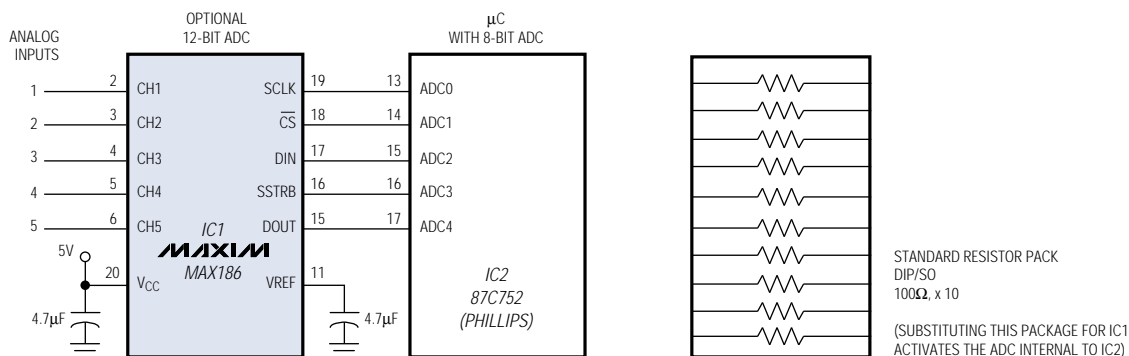


Figure 1. The connections shown enable this  $\mu\text{C}$  to substitute an external 12-bit A/D converter for its internal 8-bit converter. Replacing the external converter with the resistor network causes the  $\mu\text{C}$  to resume use of its internal converter.