Order this document
by EB370/D

Motorola Semiconductor Engineering Bulletin

EB370

In-Circuit Programming of FLASH Memory Using the Monitor Mode for the MC68HC908MR32

By Timothy J. Airaudi
Applications Engineering, Microcontroller Division
Austin, Texas

Introduction

This engineering bulletin describes how to perform in-circuit programming (ICP) of the FLASH memory using monitor mode.

Two methods are discussed here:

- Using the M68ICS08MR in-circuit simulator (ICS) with P&E Microsystems software
- Using P&E Microsystems software with an external communications circuit

ICP is a process where user code is programmed into the device's FLASH memory after the part has been assembled into the application. ICP also allows the original users code to be erased and re-programmed. This method can be used in development, production/manufacturing and in a field environment.

Using Monitor Mode for FLASH Programming

Motorola's current solution for ICP is the in-circuit simulators and P&E's software.

The software and ICS allow programming of the parts on the simulator or in the target circuit via a MON08 ribbon cable. The software also allows programming of the part, without the ICS, with an external communications circuit.

All of the programming described here is accomplished by placing the part into monitor mode. In this mode, erasing and programming are done through a single-wire interface with the host computer.

The two ways to enter monitor mode are:

- The ICS provides the entry requirements to enter standard monitor mode. These entry requirements must be implemented on the target board if the ICS is not used.
- A second way to enter monitor mode, that does not require a high voltage on the $\overline{\text{IRQ}}$ pin, is forced monitor mode. This mode does not need to meet all the monitor mode entry conditions of the standard monitor mode, but it does require the part to be blank (erased).

This engineering bulletin describes how to connect the part, communicate at different baud rates, place it into monitor mode, pass security, and erase and program the part. If the security code is not known, the contents of the FLASH can't be read, but the FLASH can be erased and reprogrammed.

Information on the M68HC908MR32 can be found at http://mcu.motsps.com. P&E Microsystems software can be downloaded free from that company's Web site.

NOTE: *All of the oscillators used in this engineering bulletin are the 4-pin "powered" or "canned" type oscillators. Discussing all the different vendors of crystals, ceramic oscillators, other required external components, and component layout variables would be too extensive.*

ICP Using the M68ICS08MR's MON08 Interface

Use this procedure for performing ICP using the ICS's MON08 cable to the target application.

1. Materials required:
   a. PC with P&E software installed
   b. M68ICS08MR simulator
   c. Adapter/connector to connect the female end of the MON08 cable to the part on the target application
   d. Pin assignment diagram (see **Figure 1** and **Figure 2**)
   e. Monitor mode entry requirements (see **Table 1**)
   f. Crystal oscillator on the target or from an external clock source with a value from **Table 2**
   g. Target board must have the ability to perform a power-on reset (POR) not just a reset (required to enter monitor mode).
2. Connections (see **Figure 3**):
   a. 5-pin serial cable from PC to the ICS
   b. 5 volts to the ICS
   c. MON08 cable from J7 of the ICS to the target board with these connections:
      — MON08 GND to the V_{SS} pin on the part
      — MON08 RST to the $\overline{RST}$ pin on the part
      — MON08 IRQ to the $\overline{IRQ}$ pin on the part
      — MON08 PTA0 to the PTA0 pin on the part
      — MON08 PTC2 to the PTC2 pin on the part
      — MON08 PTC3 to the PTC3 pin on the part
      — MON08 PTC4 to the PTC4 pin on the part
   d. It is assumed that all V_{DD} and V_{SS} pins on the part are already connected.
3. Operation — Standard monitor mode entry:
   a. Launch P&E's WINIDE in the ICS08MRZ software.
   b. Open desired file. (Demo file can be used.)

c. Assemble/Compile the file (see **Figure 6**).

d. Plug in power to the ICS.

e. Turn on power to the target.

f. Launch the programmer.

g. From “Target Hardware Type,” select “Class II” (see **Figure 7**).

h. From “PC Serial Port Configuration,” select the PC port you are using and the appropriate baud rate (see **Table 2**).

i. From “Target MCU Security Bytes,” select appropriate security code (blank part = FF).

j. Select “Contact Target with these Settings…”

k. Follow the instructions in the “Power Down/Up Dialog” windows.

l. Select appropriate algorithm for the part.

m. Double click on “Erase Module” – EM (see **Figure 8**).

n. Double click on “Program Module” – PM.

o. Record security bytes. This information can be seen by quitting and then re-entering the programmer. The S19 record will have the same security bytes as the part just programmed as long as it is not changed. The security bytes consist of the information stored in the interrupt vectors, $FFF6–$FFFD.

4. Operation — Forced monitor mode:

   a. This mode of operation currently is not supported with this ICS. However, this mode can be entered by using the procedure found in **ICP Using the External Communications Circuit (No ICS)**.

ICP Using the External Communications Circuit (No ICS)

Use this procedure for performing ICP via an external communications circuit in place of this ICS to the target application.

1. Materials required:
   a. PC with P&E software installed
   b. Adapter/connector to connect the male end of the 9-pin serial cable to the part on the target application
   c. RS-232 communications circuit. Also needed is a 5-volt power source to power this circuit (see **Figure 4** and **Figure 5**).
   d. Pin assignment diagram (see **Figure 1** and **Figure 2**)
   e. Monitor mode entry requirements (see **Table 1**)
   f. Crystal oscillator on the target or from an external clock source with a value from **Table 2**
   g. Target board must have the ability to perform a power-on reset (POR) not just a reset of the part (required to enter monitor mode).
2. Connections (see **Figure 4**):
   a. 9-pin serial cable from PC to the communications circuit
   b. V+ pin of the RS-232 part to the $\overline{IRQ}$ pin of the part
   c. Communications pin of HC125 to PTA0 of the part
   d. Target pin requirements:
      — PTC4 of part to V_{SS}
      — PTC3 of the part to V_{DD} via a pullup resistor
      — PTC2 of the part to V_{SS} (crystal frequency ÷ 2) or V_{DD} via pullup resistor (crystal frequency ÷ 4). See **Table 2**.
      — $\overline{RESET}$ does not have an internal pullup resistor, so it must be pulled up to V_{DD} in the application.
   e. It is assumed that all V_{DD} and V_{SS} pins on the part are already connected.
3. Operation — Standard monitor mode entry:
   a. Launch P&E's WINIDE in the ICS08MRZ software.

b. Open desired file (demo file can be used).

c. Assemble/Compile the file (see **Figure 6**).

d. Apply power to the Communications Circuit.

e. Turn on power to the target.

f. Launch the programmer.

g. From “Target Hardware Type,” select “Class III” (see **Figure 7**).

h. From “PC Serial Port Configuration,” select the PC port you are using and the appropriate baud rate (see **Table 2**).

i. From “Target MCU Security Bytes,” select appropriate security code (blank part = FF).

j. Select “Contact Target with these Settings…”

k. Follow the instructions in the “Power Cycle Dialog” window.

l. Select appropriate algorithm for the part. The high-speed algorithm will not work at 28,800 baud.

m. Double click on “Erase Module” – EM (see **Figure 8**).

n. Double click on “Program Module” – PM.

o. Record security bytes. This information can be seen by quitting and then re-entering the programmer. The S19 record will have the same security bytes as the part just programmed as long as it is not changed. The security bytes consist of the information stored in the interrupt vectors, $FFF6–$FFFD.

4. Operation — Forced monitor mode entry:

   a. Blank part with oscillator value from **Table 2**. See **Figure 5**.

      — Remove connection to the $\overline{\text{IRQ}}$ pin from V+ of the RS-232 communications circuit.

      — No connections to PTC2, PTC3, and PTC4 are necessary in this mode.

      — $\overline{\text{IRQ}}$ does not have an internal pullup resistor, so it must be pulled up to V_{DD} in the application.

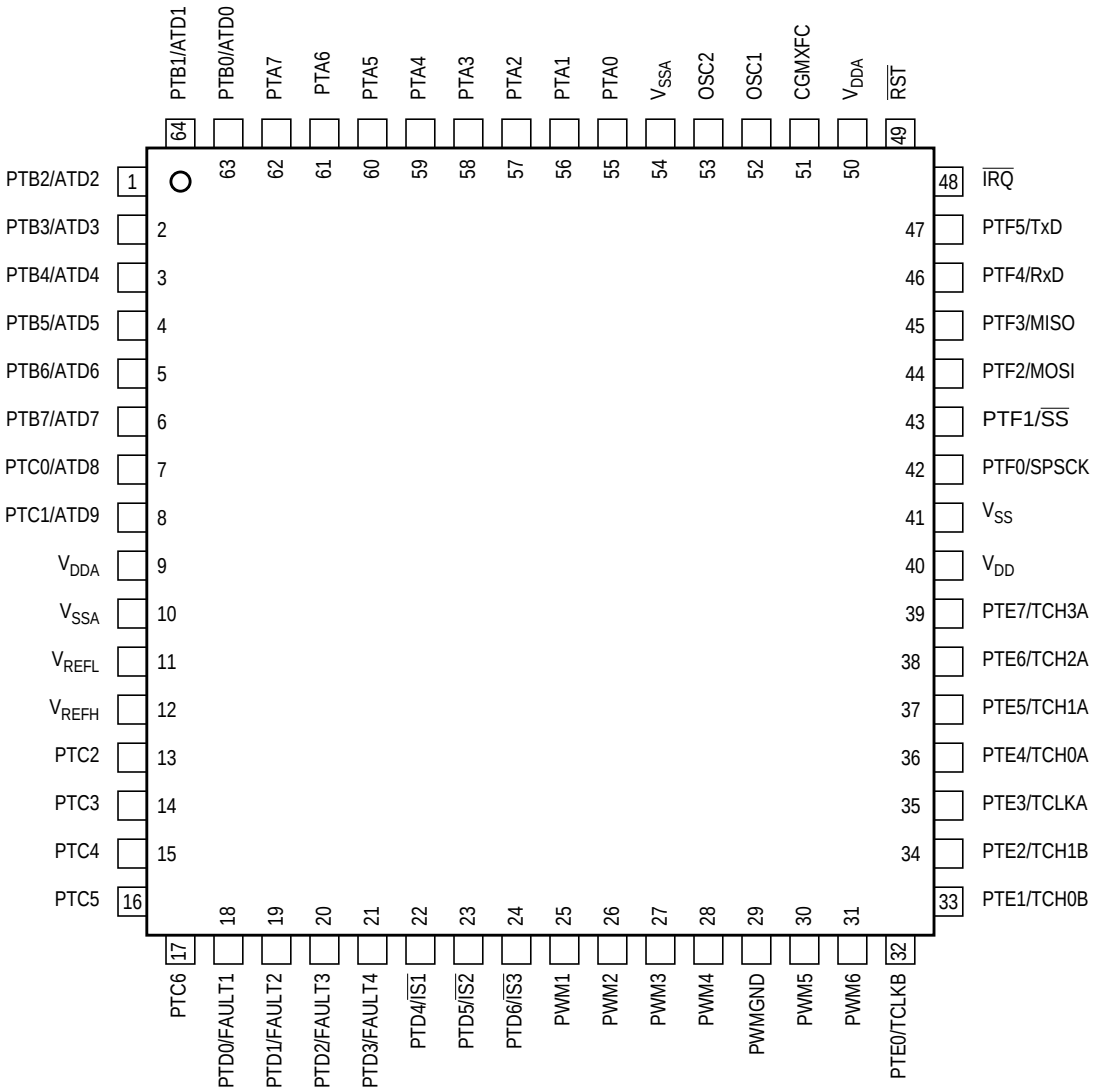
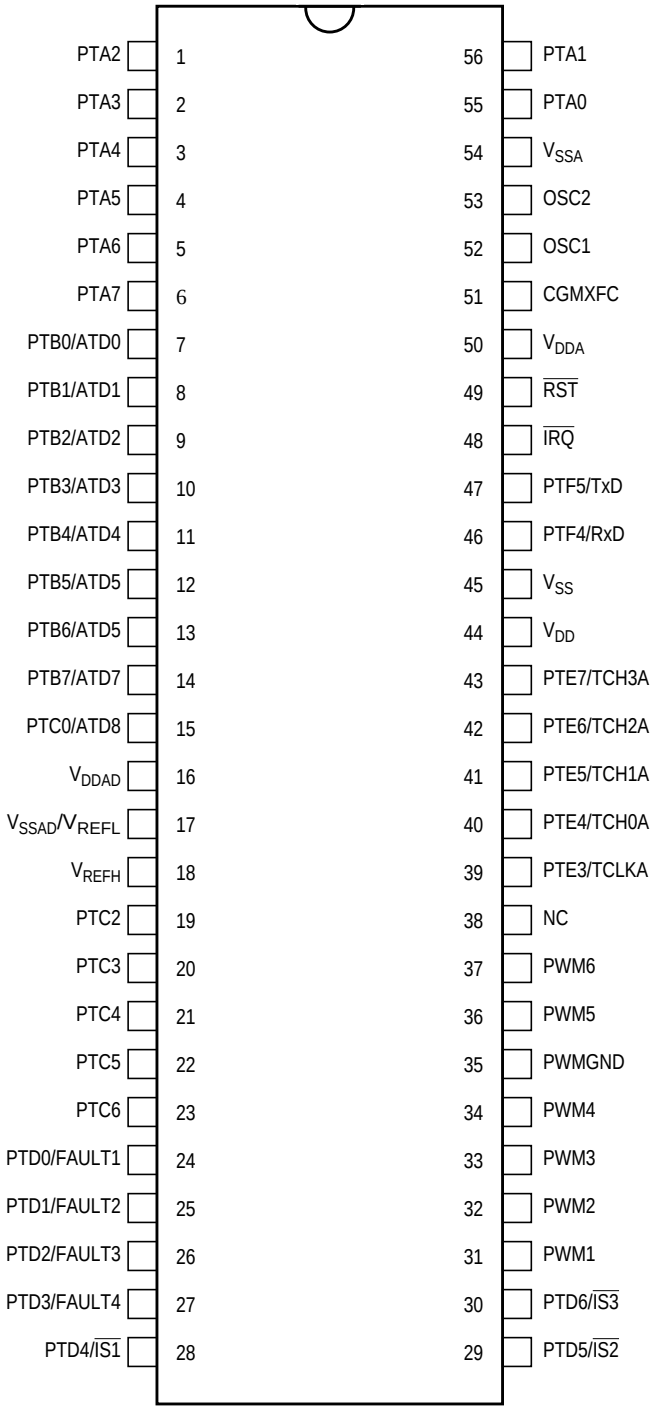


Figure 1. 64-Pin QFP Pin Assignments



Note: PTC1, PTE0, PTE1, PTE2, PTF0, PTF1, PTF2, and PTF3 are removed from this package.

Figure 2. 56-Pin SDIP Pin Assignments

Table 1. Monitor Mode Entry

Mode	$\overline{IRQ1}$ Pin	$\overline{RST}$ Pin	PTC3 Pin	PTC4 Pin	PTA0 Pin	PTA0 Pin	CGMOUT	Bus Frequency	COP
Normal monitor	$V_{DD} + V_{HI}$	V_{DD} or $V_{DD} + V_{HI}$	1	0	1	1	$\frac{CGMXCLK}{2}$ or $\frac{CGMVCLK}{2}$	$\frac{CGMXCLK}{2}$	Disabled
Forced monitor	V_{DD}	V_{DD}							
Normal monitor	$V_{DD} + V_{HI}$	V_{DD} or $V_{DD} + V_{HI}$	1	0	1	0	CGMXCLK	$\frac{CGMXCLK}{2}$	Disabled
User	V_{DD}	V_{DD}	X	X	X	X	—	—	Enabled

Table 2. Crystal Frequency vs. Baud Rate

Divide by 2 Option (PTC2 to ICS or V_{SS})		
Crystal Frequency (MHz)	**Internal Bus Frequency (MHz)**	**Baud Rate**
2.4576	1.2288	4800
4.9152	2.4576	9600
7.3728	3.6864	14,400
9.8304	4.9152	19,200
14.7456	7.3728	28,800
Divide by 4 Option (PTC2 to V_{DD})		
4.9152	1.2288	4800
9.8304	2.4576	9600
14.7456	3.6864	14,400
19.6608	4.9152	19,200
29.4912	7.3728	28,800

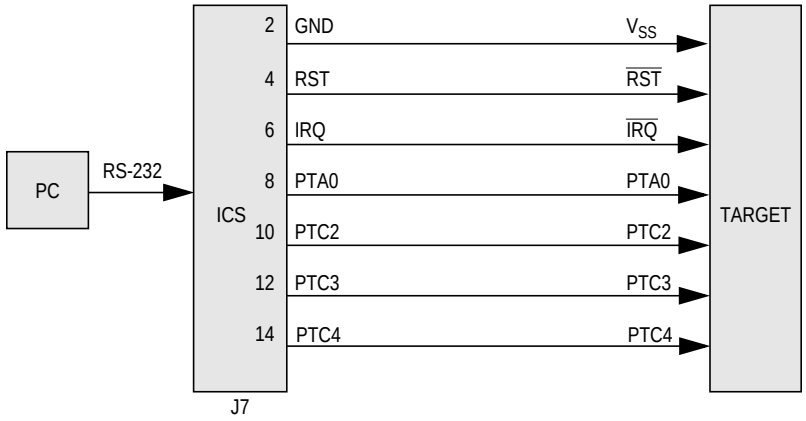


Figure 3. MC68HC908MR32 MON08 Connections

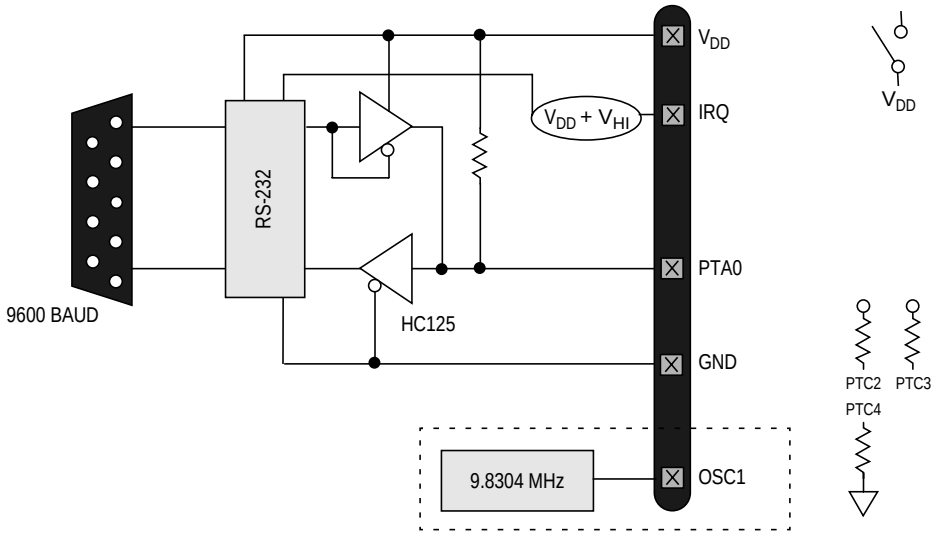


Figure 4. MC68HC908MR32 Standard Monitor Mode (9.8304 MHz)

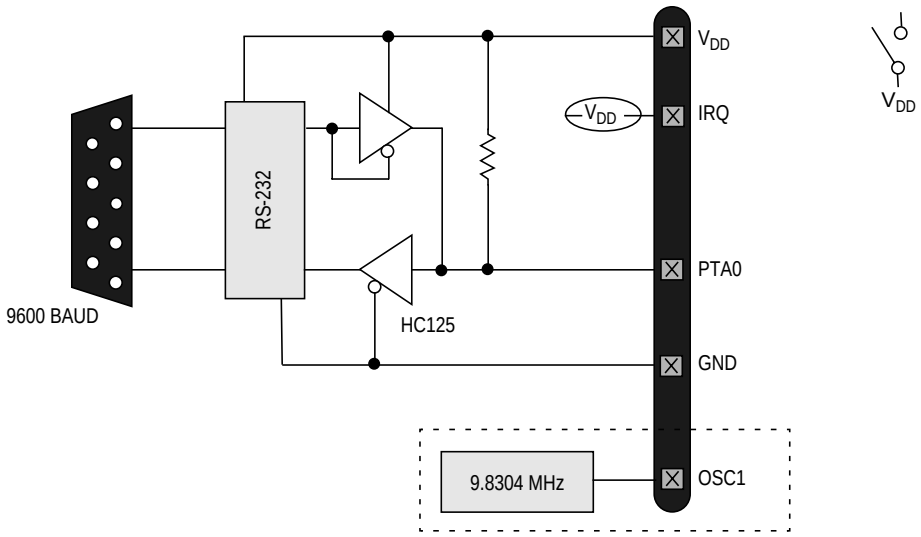


Figure 5. MC68HC908MR32 Forced Monitor Mode (9.8304 MHz)

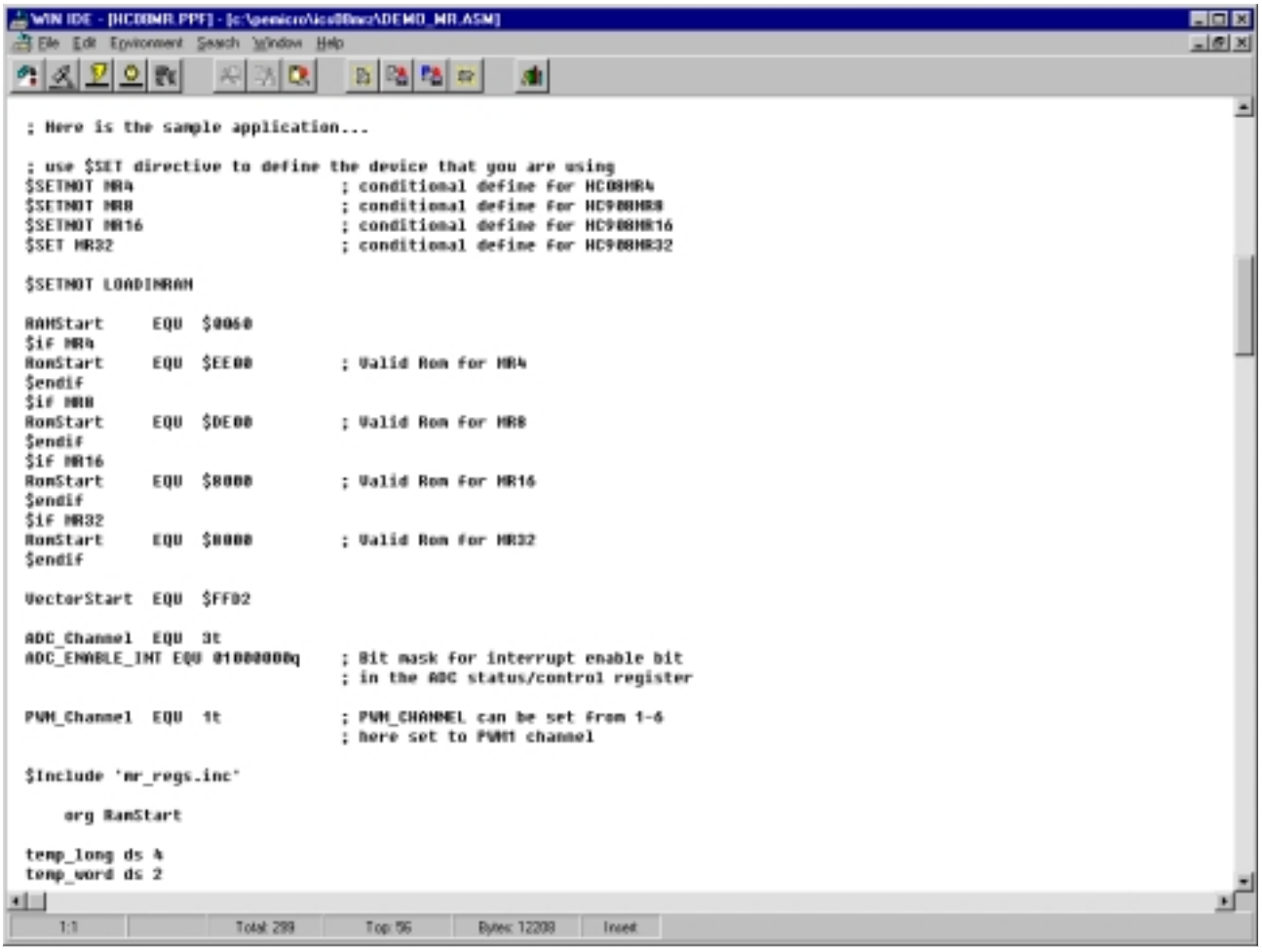


Figure 6. P&E's WINIDE Window

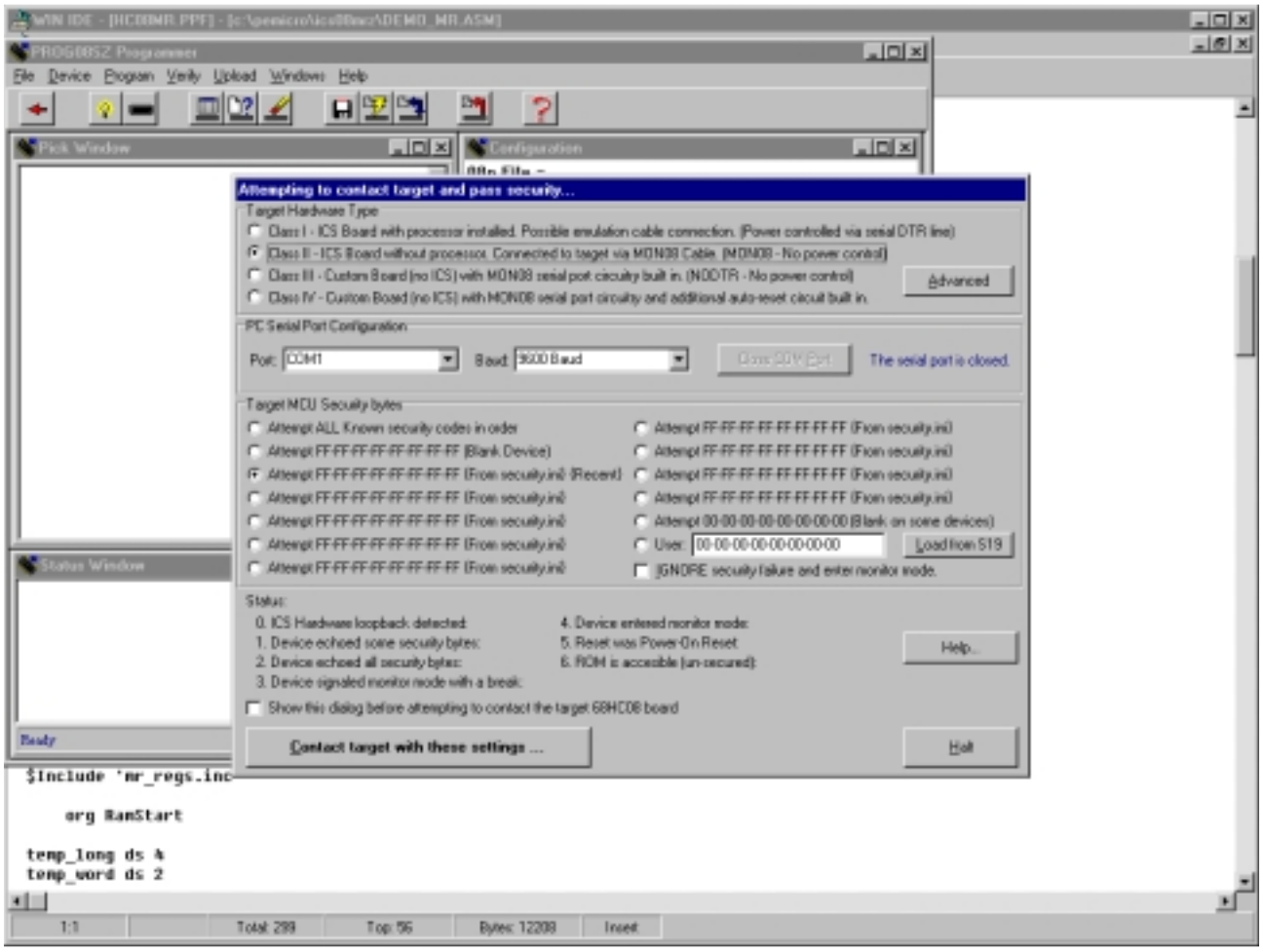


Figure 7. P&E's Target and Security Window

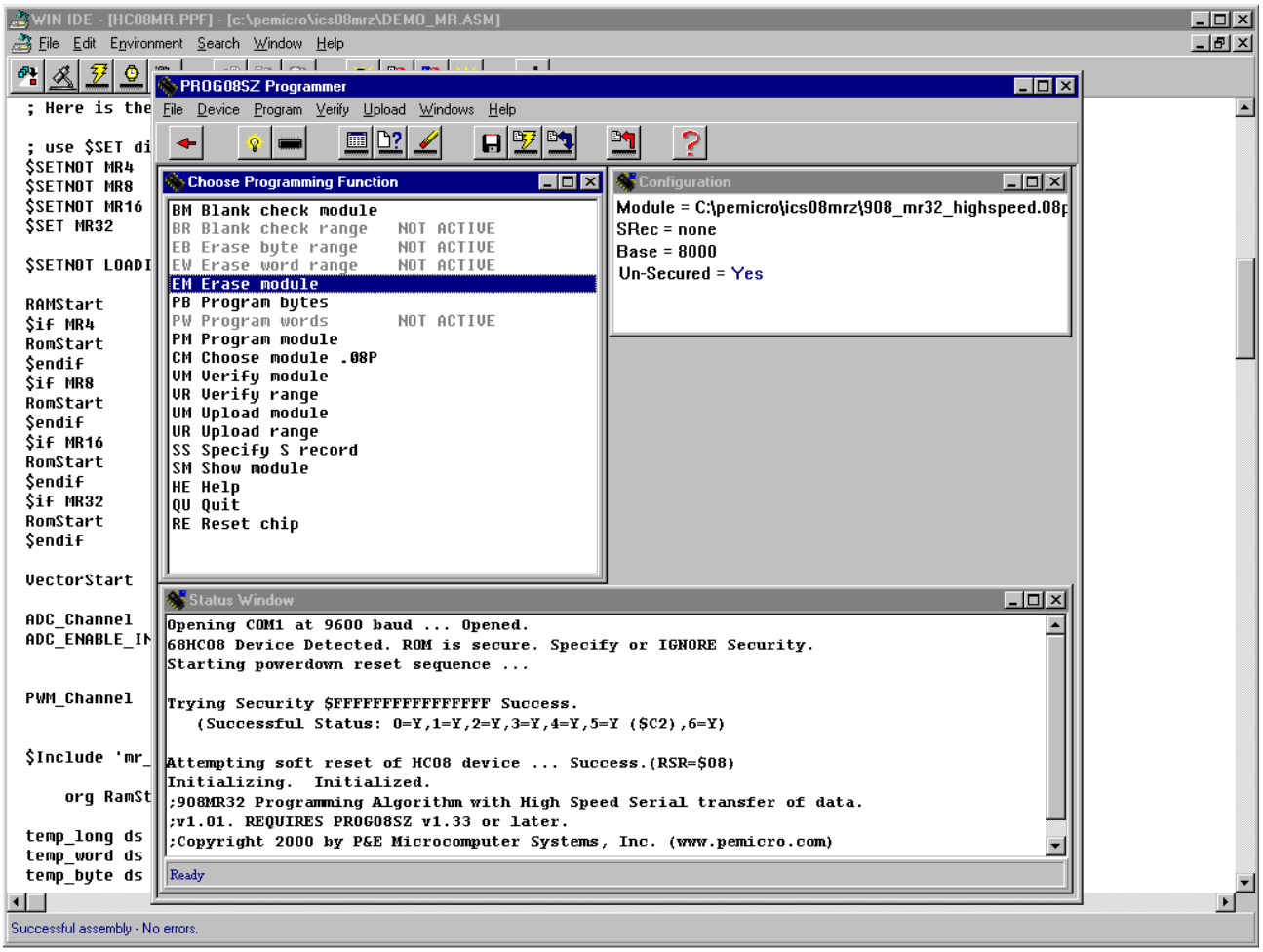


Figure 8. P&E's Programmer Window

How to reach us:

USA/EUROPE/Locations Not Listed: Motorola Literature Distribution; P.O. Box 5405, Denver, Colorado 80217. 1-303-675-2140 or 1-800-441-2447

JAPAN: Motorola Japan Ltd.; SPS, Technical Information Center, 3-20-1, Minami-Azabu, Minato-ku, Tokyo 106-8573 Japan. 81-3-3440-3569

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre, 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong. 852-26668334

Technical Information Center: 1-800-521-6274

HOME PAGE: http://www.motorola.com/semiconductors/