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AN–ELNEC–EN–ISP-HC08

Application note for In-System Programming of Motorola/Freescale HC08 microcontrollers

Introduction

In system programming (ISP) of HC08 microcontrollers is performed via the Monitor ROM mode (also called MON08 mode or monitor mode) that allows programming of the MCU memory through a single-wire interface. *Figure 1* shows an example circuit used for MCU to enter **Normal Monitor Mode** and communicate with a host via Serial Communication Interface (UART - Universal Asynchronous Receiver/Transmitter).[1]
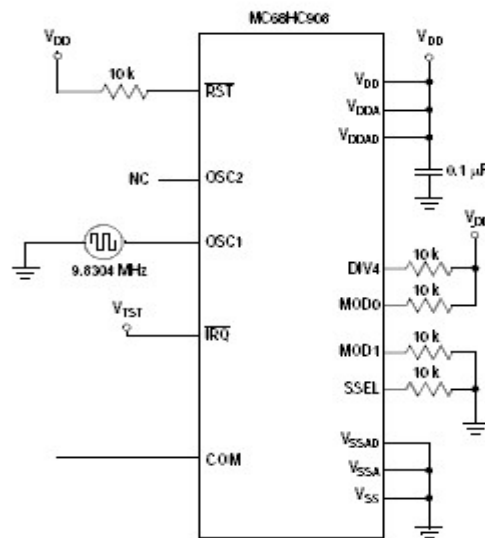

Figure 1. Monitor mode circuit

Used signals:

Pin name	Function	Signal level
VDD, VDDA, VDDAD	supply voltage	3.3–5.0 V
VSS, VSSA, VSSAD	ground	0 V
/IRQ	monitor mode entry voltage	7–9 V
OSC1	MCU clock	H, L
/RST	MCU reset	H, L
COM	serial communication pin	H, L
SSEL	serial select pin	H, L
MOD0	mode selection pin	H, L
MOD1	mode selection pin	H, L
DIV4	frequency divider pin	H, L

Depending on the MCU, actual pin name for entering monitor mode are different and represents certain port pin of the MCU.[1]

Note 1: Detailed description of Monitor ROM mode for particular MCU can be found in MCU's datasheet.

Signal description:

- **V_{DD}, V_{DDA}, V_{DDAD}** - Supply voltage pin. The programmed MCU have to be powered from your target system. The range of operating voltage is typically 3.3–5.0 V according to the MCU. Not every HC08 MCU has V_{DDA} and V_{DDAD} pins.

- **V_{SS}, V_{SSA}, V_{SSAD}** – This pin must be connected to the ground to provide the proper voltage reference. Not every HC08 MCU has V_{SSA} and V_{SSAD} pins.

- **/IRQ** - Normal monitor mode is entered after a power on reset (POR) with a high voltage, typically called V_{TST} (pronounced V test), on the MCU's IRQ pin. V_{TST} ranges from 7 V to 9 V, depending on operating V_{DD} level.

- **OSC1** – The OSC1 pin is the MCU clock input. This pin can be over-driven by a programmer's oscillator even if a crystal resonator circuit or RC network is connected to the OSC1 and OSC2 pins.

- **/RST** – Reset input pin of MCU.

- **COM** - The single-wire communication line, that usually corresponds to PORTA0 or PORTB0 pin.

- **SSEL** - If implemented in the MCU, allows serial or parallel entry of security code bytes.

- **MOD0, MOD1** - The mode select pins must be at their prescribed levels if the V_{TST} voltage is applied to the IRQ pin. These pins select monitor mode. They are also used for synchronizing communication, if is selected device with all monitor mode pins connected to the programmer (see **Recommended target circuit design**).

- **DIV4** – If implemented in the MCU, holding this pin low when entering monitor mode, causes a bypass of a divide-by-two stage at the oscillator.

Device operation options

You can edit the Device operation options in menu *Operation options* of control program (Device->Device options->Operation options *<Alt+O>*).

In the case that your programmer supports target system power supply and you intend to use this option, it is needed to set supply voltage parameters according to your requirements.

You may also select level of ISP signals after operation (see *Figure 2*). Description of particular parameters you can find in the menu *Help* <F1>.

Figure 2. Settings ISP target supply <Alt+O>

In the case you use "5-wire" programming interface, it is needed to select appropriate level of pin DIV4 (e. g. for MC68HC908GT16 its name is PTC3 as shown in *Figure 3*) according to your target system connection. The correct level of DIV4 pin is needed for calculating communication baud rate speed.

Figure 3. Baud rate settings <Alt+O>

Recommended target circuit design

In the following, you can find important notices applying to recommended connection of target MCU to the target system. In order to satisfy the most of the customers, we have made two possibilities of MCU programming: "5-wire" programming interface (the programmer with target board is connected using 5 wires) and "all-wire" programming interface (the programmer with target board is connected with all wires that are required for MCU to enter monitor mode). It can be 7, 8 or 9 wires depending on the target HC08 microcontroller.

1. Programming using "5-wire" interface:

"5-wire" programming interface is intended to use, if you want to use less amount of signals to interconnect programmer with target system, or if your target board doesn't allow connection by "all-wire" programming interface (e. g. isolating resistors R3..R6 from *Figure 5* don't have required values). In this case, pin DIV4 (if implemented in the MCU) may be at L or H level, MOD0 must be at H level, MOD1 must be at L level and SSEL (if implemented in the MCU) must be at L level in the target system, according to the *Figure 4*. It is important, that all this implemented signals must be at stable level for a short time after programmer rises RST pin to H in order to MCU enter the monitor mode.

Purpose of the R1..R2 resistors is to isolate the programmed chip from rest of target system. Recommended value of resistors for particular programmer is specified in *Device info (see Figure 6)*. You can also use jumpers instead of the resistors.
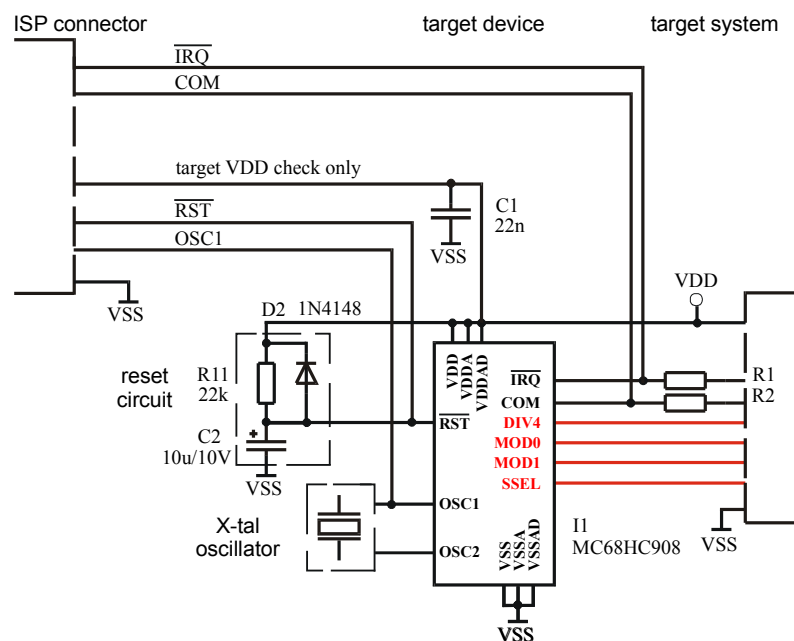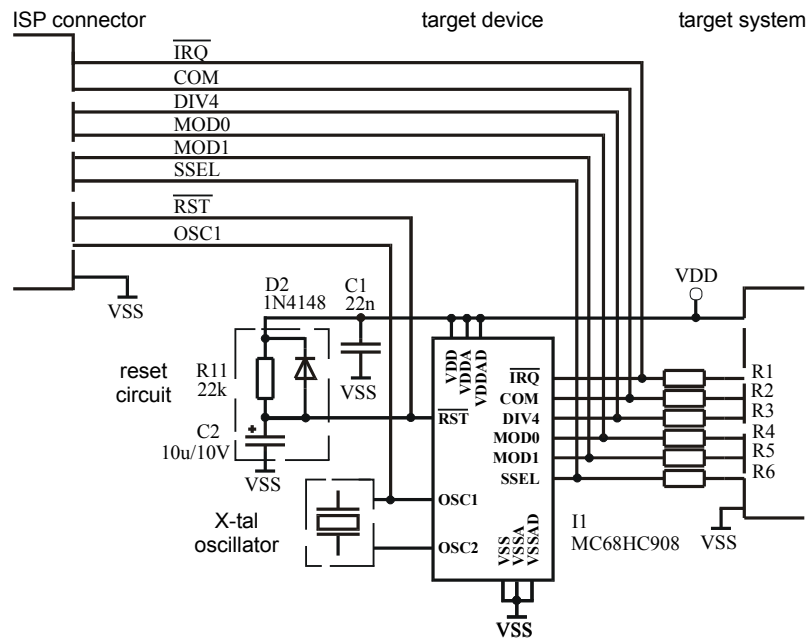

Figure 4. Recommended target circuit design using "5-wire" interface

In this case, select device with suffix **(ISP 5-wire)** in the control program.

Note: Because communication with target board is performed only by 1 wire (pin COM), programming speed is very low (especially when pin DIV4 is at H level – communication baud rate is a half in comparison with the situation when the pin is at L level).

2. Programming using "all-wire" interface:

"All-wire" programming interface is recommended to use due to the programming speed. In this case, all monitor mode entry wires of MCU must be connected according to the *Figure 5*. Purpose of the R1..R6 resistors is to isolate the programmed chip from rest of target system. Recommended value of resistors for particular programmer is specified in *Device info (see Figure 6)*. You can also use jumpers instead of the resistors.

Figure 5. Recommended target circuit design using "all-wire" interface

In this case, select device with suffix **(ISP all-wire)** in the control program.

3. Design notes:

For more information about entering **Normal monitor mode**, please refer to device specific datasheet (usually, the section name is "Development support").

For example of Freescale's proposed and verified target system connection, look at Freescale's application note:

AN-HK-32:
  In-Circuit Programming of FLASH Memory in the MC68HC908GP32
    Figure 3: Programming setup

or

AN-HK-33:
  In-Circuit Programming of FLASH Memory in the MC68HC908JL3
    Figure 3: Programming setup

Device information

Additional information about selected MCU, such as ISP connector pin numbering, recommended target circuit design for particular MCU etc., you can find in the menu *Device info* of control program (Device->Device info <Ctrl+*F1*>) (see *Figure 6*).

Figure 6. Device info

Good advices and troubleshooting

Connecting programmer to target system:

⚠️ **Turn off power supply of system** before connecting/ disconnecting programmer to/from system.

Before starting an operation:

⚠️ Before starting an operation with target MCU, please make sure, that the **ISP cable is correctly connected** to the target system and programmer. Also make sure that no device is inserted to *ZIF* socket of the programmer.

ℹ️ **Details about pins assign for each MCU** and short description of circuit design you can find in control program (*Device Info <Ctrl+F1>).*

ℹ️ Correctly selected values of resistors R1, R2 for "5-wire interface" or R1-R6 for "all-wire" interface, provide reliable signal level recognition (for both, programmer and system) and ensure successful finishing of desired operation (see **Recommended target circuit design**).

If something goes wrong:

❓ If the programmer reports **signal interference error**, may be, a signal interference occurred between programmer and target system. Please make sure, your design meets connection recommendations. Check the minimal values of resistors R1, R2 for "5-wire interface" or R1-R6 for "all-wire" interface, from programmer's point of view (in order to programmer be able to put L/H level on the pin).

❓ If the programmer reports that the **device does not respond**, check the following:
1. in the case of "5-wire" interface, check whether monitor mode entry pins (DIV4, MOD0, MOD1, SSEL) are at required and stable level for a short time after programmer rises RST pin to H.
2. in the case of "5-wire" interface and if the MCU has implemented DIV4 pin, check whether level of DIV4 pin is selected according to the connection of the target board.
3. in the case of "all-wire" interface, check whether resistors R1-R6 have required values.

❓ Be aware, that longer ISP cable (longer than 20cm/0,7ft) may cause an unpredictable signal interference. Make sure you are using correct cable.

<u>Revision history</u>

05/2006:

Added sections:
– Recommended target circuit design / 3. Design notes
Changes of figures:
– *Fig. 4 Circuit design* for "5-wire" – *minor changes*
– *Fig. 5 Circuit design* for "all-wire" – *minor changes*
– *Fig. 6 Device info – minor changes*

03/2005:

Initial Release.