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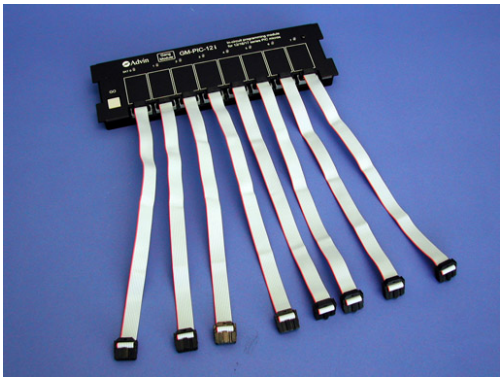
In-Circuit Programming of Microchip PICs Using GM-PIC12i or GM-PIC08SNi

1.0 Introduction



GM-PIC12i or GM-PIC08SNi are designed for multi-site, in-circuit programming (or sometimes referred to as "in-system programming" or ISP) of Microchip PICs.

GM-PIC12i is designed mainly for in-circuit programming, whereas the GM-PIC08SNi also has 8-pin SOIC sockets. The later can be used for programming of 8-pin PICs directly on the programmer.

These GM modules support devices including: PIC12Cxx, 12LCxx, 16C6xx, 16LC6xx, 16C7xx, 16LC7xx, 16Fxx, 16LFxx, 17C7xx, 17LCxx, 18Cxx, 18LCxx, 18Fxx, 18LFxx, etc.

(The devices which are not supported are first generation PICs, including 16C54, C55, C56, C57, and their LC counter parts.)

These GM modules are meant to be used with a PILOT-series base programmer. The following table shows the base programmers which can be used.

Table 1.

# of GM Modules (Either 12i or 08Sni)	Can be used on these programmers	Max # of sites programmed simultaneously
1	PILOT-MVP, PILOT-U44+, PILOT-U84+, PILOT-U128+, PILOT-1600	8
2	PILOT-U84+, PILOT-U128+, PILOT-1600	16

2.0 Installation of GM Module

The module should be plugged into the 50-pin expansion port that is right next to the ZIP socket on the programmer. (On PILOT-MVP and U44+, there is **one** expansion port. On PILOT-U84+, U128+ and 1600 models, there are **two** expansion ports.)

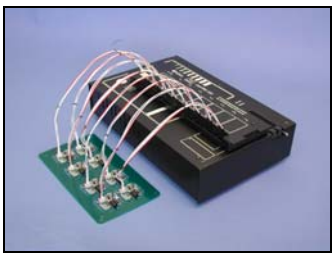
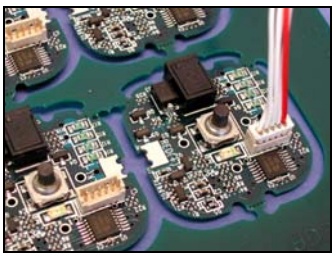
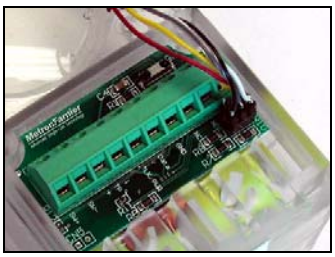
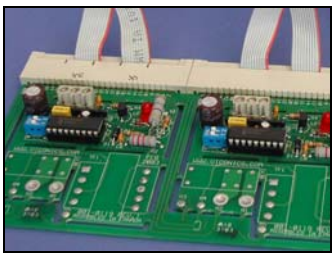
3.0 Connection to User Circuit Boards

A set of 8 flat ribbon cables (comes with the GM module) connects the GM module to the user circuit boards. The terminators at both ends of cables are 10-pin, 2x5, 0.1" center-to-center, square-post female receptacles. You can

use standard male square post headers to interface with them. One example would be an AMP part # 4-102973-0, which can be purchased from Digi-Key as Digi-Key part # A26535-ND at

http://www.digikey.com

If your circuit board does not have a 2x5 square post male connector, you can make your own small cable to plug into the cables that we supplied. Example of connection schemes include bed-of-nails, pogo pins, edge connectors, cable plugs, etc. The following pictures shows some ways our customers used to make their signal connections:

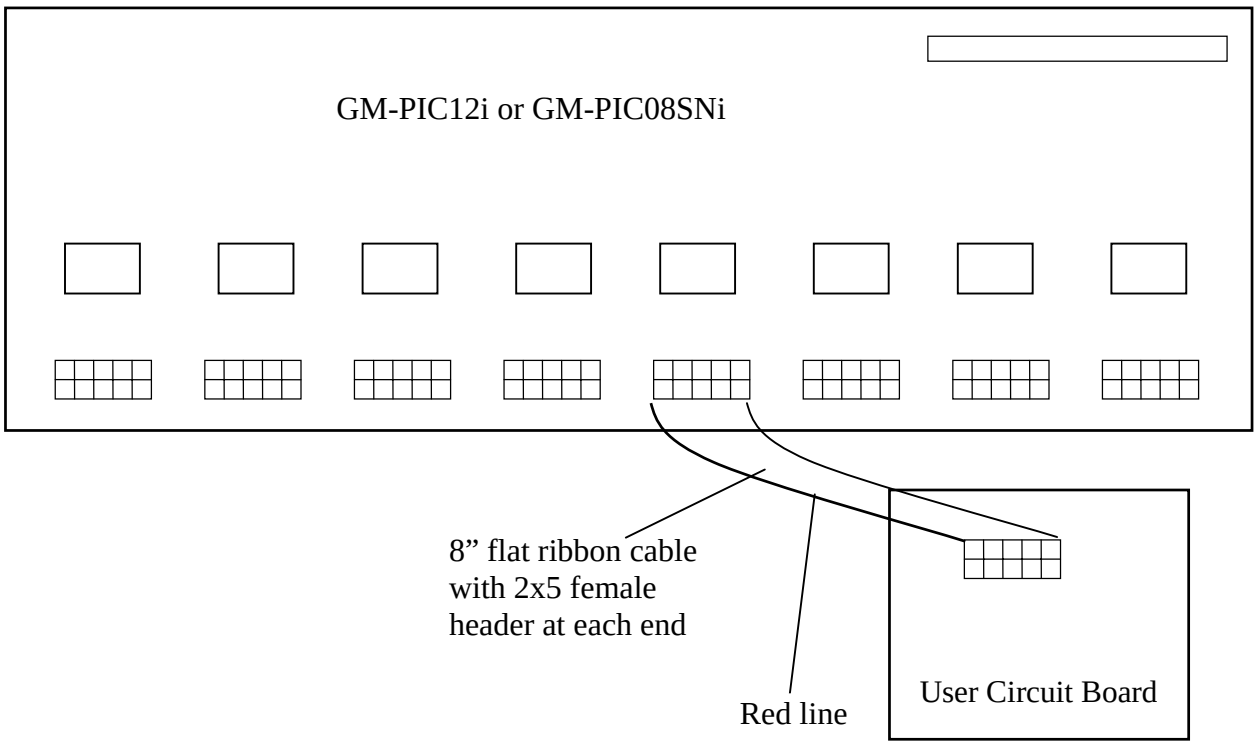
4.0 Pin assignment of connector

Each of the user circuit board is expected to have a 10-pin square-post male header, with 0.1" centers, arranged as shown in the following diagram. The following signals are to be connected:

CLK	Labeled as RB6 on PIC pin out diagrams.
DATA	Labeled as RB7 on PIC pin out diagrams.
VDD	This signal is optional. If it is present then programmer does not drive VDD. If is absent, then programmer provides VDD. Current capability 200ma. (This signal is also known as VCC)
VPP	Programming voltage supply pin. Programmer sets this to 9v-13v. (Also called MCLR/)
VSS	Common ground between programmer and user circuit.
TST	Required by certain devices only. Please see: "Table 2. Operations regarding different Vdd and Vpp levels" For certain devices, TST needs to be connected to RB3, RB4 or TEST.
RES	Reserved pin. Do not connect.

Below is the layout of each of the eight 10-pin square-post male header on the GM module and on each user circuit board. Each cable should be placed with the red strip at Pin 1 of the header.

2 VPP, MCLR/	4 VDD	6 TST	8 RB7 DATA	10 RB6 CLK
1 VSS	3 VSS	5 RES	7 VSS	9 VSS


GM-PIC12i or GM-PIC08SNi
8” flat ribbon cable
with 2x5 female
header at each end
Red line
User Circuit Board

5.0 Voltage requirements

At the beginning of the programming operation (or any other operation such as reading from device, device verify, erase, etc.), the programmer measures the level of Vdd from the user circuit via the Vdd pin. The programmer compares this measured value with an arbitrary value of **1.0v**, and determines if the user circuit is supplying Vdd or not.

Source of Vdd

If Vdd is less than **1.0v**, the programmer assumes user circuit is not supplying Vdd and will then provide Vdd to the user circuit.

If the measured Vdd is more than 1.0v, the programmer assumes user circuit is supplying Vdd and therefore will NOT provide Vdd to the circuit lest it will create conflicts by supplying an undesirable level of Vdd (e.g. User circuit may have peripheral circuits which cannot tolerate a certain voltage).

When User Circuit Supplies Vdd

If the user circuit supplies Vdd, it should supply the proper level of Vdd as required by Microchip programming specs. For your convenience, the minimum level of Vdd required is shown in the following table (as MinVdd). Since programming specs change from time to time, you should always check with Microchip to make sure the right level of Vdd is used instead of depending on the following table.

When Programmer Supplies Vdd

For non-LF and non-LC devices (e.g. 16F870, 17C752), the programmer supplies 5v via the 10-pin connector to the user circuit.

For LF and LC devices (e.g. 16LF870, 17LC752), the programmer supplies either 3.3v or 5v to the user circuit. Some LF or LC devices can be programmed at low voltages of Vdd whereas others cannot. If the device can use 3.3v, the programmer supplies 3.3v, otherwise it supplies 5v.

In either case, the software will display the voltage being supplied so that you know what is being used.

Verification Voltages, Vdd Low and Vdd High

According to Microchip programming specs, a production programmer (versus a prototype programmer) needs to verify the device at Vdd Low and Vdd High after programming. These are the low and high operating limits of the device as specified in the Microchip data sheets.

At device selection time, the software automatically sets the Vdd Low and Vdd High values.

For non-LF and non-LC devices (e.g. 16F870, 17C752), the typical values are 2v to 3v for Vdd Low and 5.5v for Vdd High. If these values are not acceptable to the user circuit, you can change them via the **[Configure] [ISP Options]** menu in the Captain software.

Table 2. Operations regarding different Vdd and Vpp levels:

	Vdd				Vpp
If user selects this device:	If user circuit supplies Vdd and Vdd is: 4.5v <= Vdd <= 5.5v	If user circuit supplies Vdd and Vdd is: MinVdd <= Vdd <= 4.5v	If user circuit does NOT supply Vdd:	Low Vpp supported by device: (Note 3)	Notes about **TST** (pin 6 of the 10-pin connector):
16F870-877 (MinVdd=2.2v)	Erase operation allowed	Erase operation NOT allowed (Note 1)	Programmer supplies **Vdd=5v**	Yes	If using Low Vpp Option, user needs to connect **RB3** to **TST.**
16LF870-877 (MinVdd=2.2v)	Erase operation allowed	Erase operation NOT allowed (Note 1)	Programmer supplies **Vdd=3.3v**. Erase operation not allowed. (Note 1) (Note 2)	Yes	Same as above.
16F873A-877A (MinVdd=2.0v)	Erase operation allowed	Erase operation NOT allowed (Note 1)	Programmer supplies **Vdd=5v**	Yes	If using Low Vpp Option, user needs to connect **RB3** to **TST.**
16LF873A-877A (MinVdd=2.0v)	Erase operation allowed	Erase operation NOT allowed (Note 1)	Programmer supplies **Vdd=3.3v**. Erase operation not allowed. (Note 1) (Note 2)	Yes	Same as above.

	Vdd		Vpp
If user selects this device:	If user circuit supplies Vdd:	If user circuit does NOT supply Vdd:	Low Vpp Option supported by device: (Note 3) (Note 4)	Notes about **TST** (pin 6 of the 10-pin connector):
16F627, 628, 627A, 628A, 648A (MinVdd=4.5v)	Programmer does not supply Vdd.	Programmer supplies **Vdd=5v**	Yes	If using Low Vpp Option, user needs to connect **RB4** to **TST**. (Note 6)
16LF627, 628, 627A, 628A, 648A (MinVdd=4.5v)	Programmer does not supply Vdd.	Programmer supplies **Vdd=5v.**	Yes	Same as above.
16F73-77 (MinVdd=4.75v)	Programmer does not supply Vdd.	Programmer supplies **Vdd=5v**	No .	
16LF73-77 (MinVdd=4.75v)	Programmer does not supply Vdd.	Programmer supplies **Vdd=5v**	No	
17C752-766 (MinVdd=3.0v)	Programmer does not supply Vdd.	Programmer supplies **Vdd=5v**	No	User needs to connect the **TEST** pin of the device (pin 17 if device is in PLCC pkg) to **TST**. Programmer supplies high voltage to Vpp pin and TST pin of 10-pin connector. (Note 5)
17LC752-766 (MinVdd=3.0v)	Programmer does not supply Vdd.	Programmer supplies **Vdd=3.3v**	No	Same as above.

This table and actions of the software are subject to change at anytime without notice to users.

Note 1: 16F87x, 16LF87x, etc., user circuit supplying Vdd less than 4.5v:
Bulk erase operation not supported by device if programming Vdd is less than 4.5v.

This means, when Vdd is less than 4.5v:

a. The **/PR** command in DOS, or the **PROM Erase** (bulk erase) in Captain are not allowed.
b. During programming, **each word** in the device will be erased when it is being programmed.
c. If device is **secured**, it cannot be reprogrammed again (because the Bulk erase command is needed to erase the security bits).

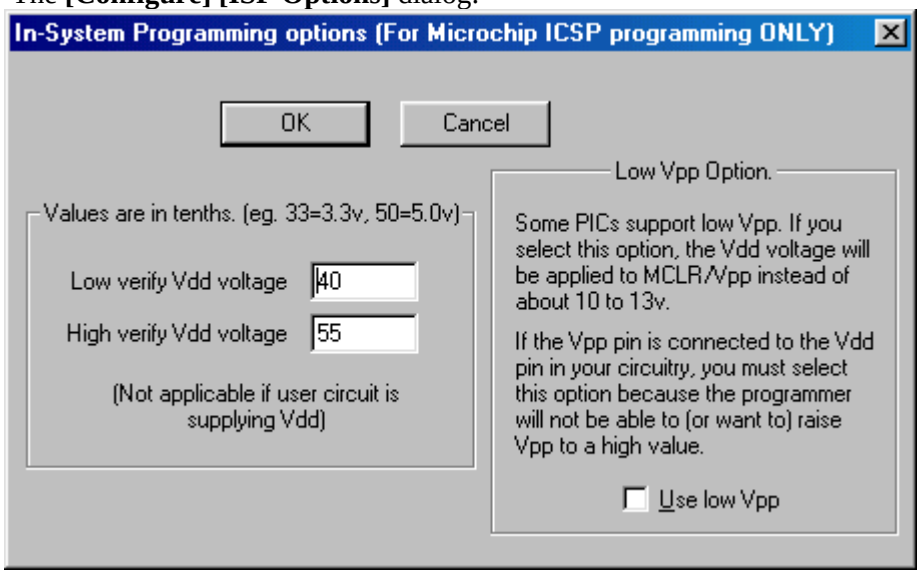
Note 2: 16LF87x, etc., programmer supplying Vdd at 3.3v:

A device can be programmed and re-programmed, as long as the security bits are not set. Once security bits are set, they can only be cleared by a **bulk** erase, which is what the erase operation does. But **bulk** erase operations cannot be done at 3.3v (per Microchip data sheet), these LF devices cannot be reprogrammed once they are secured. If a device is not secured, then it still can be reprogrammed --- the s/w is smart enough to know that Vdd is too low for a **bulk** erase to take effect, and therefore changes to use **word-by-word erase-and-then-program**.

Note 3: Low Vpp option

A "Yes" under this column means Microchip spec allows this device to be programmed using a low Vpp (i.e. same as Vdd, instead of the more than 10v Vpp). The Low Vpp Option is defaulted to be DISABLED (i.e. not used) at device selection time (i.e. programmer will use high voltage Vpp).
If you desire to use the Low Vpp Option, you can inform the S/W via the **[Configure] [ISP Options]** dialog menu under Captain.

The **[Configure] [ISP Options]** dialog:



You should also be aware of the status of "LVP enable" bit in a device. This bit is enabled when the device is shipped new from Microchip or when the device is erased. If this bit has been disabled, then the device will not be readable or programmable or erasable using low Vpp. This means that if you need to depend on low Vpp you should always keep the LVP bit enabled

Note 4: Compulsory Low Vpp option

If you connect Vpp to Vdd in your circuit, you must select the Low Vpp Option under the **[Configure] [ISP Options]** menu, since the programmer will not be able (or want to) raise Vpp to a high level.

Note 5: 17C75x, etc.:

These devices need high voltages for both Vpp and TEST. Ref: Microchip programming spec.

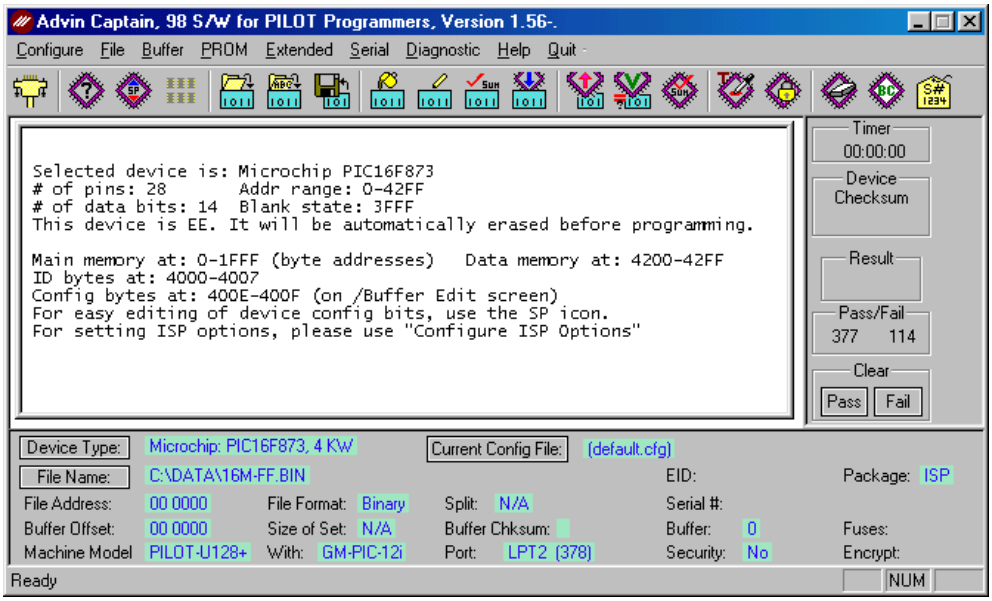
Note 6: LVP pin:

The LVP pin (RB4 on 16F627 family of devices) cannot be left floating. If the Low Vpp Option is not used: you can either connect this pin to TST (the programmer will pull it low), or you can pull it low within your circuit board. It cannot be left floating.

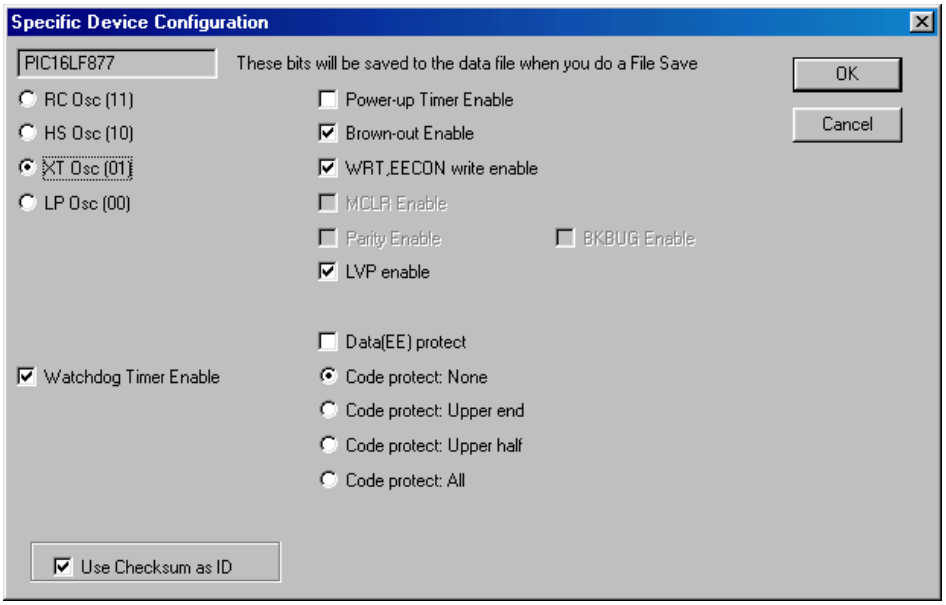
6.0 Software

Either the DOS software or the Windows based Captain software can be used. However, the afore mentioned **[Configure] [ISP Options]** dialog has no equivalent in the DOS software.

Here is a screen example of Captain:



The **[Configure] [Specific Device Configuration]** screen can be used to easily select the many configuration choices of Microchip PICs:



This document revision corresponds to Windows S/W Captain version 1.70. Current software can be downloaded at no charge from our website at **www.advin.com**. This document is also available on the web at **http://www.advin.com/isp.htm.**