TEAclipper/PIC ™

Firmware delivery for Microchip PIC® microcontrollers

Summary

TEAclipper/PIC is a portable, target-powered firmware programmer for Microchip's PIC microcontrollers. About the same weight and size as a nickel (US 5¢ coin), it can be readily transported and plugged in to the PCB or prototyping board containing the PIC requiring programming.

TEAclipper/PIC makes it easy to sell code written for PICs and also to deliver updates to products already delivered to customers.

Features

TEAclipper/PIC features:

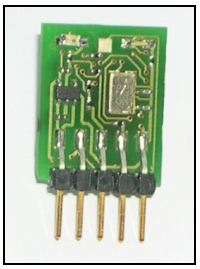
- Support for most 8-bit PICs.
- In-the-field reflash for your TEAclippers as we add capability to program other PICs.
- High-voltage (*Vpp*) generator option.
- Limited-download feature that counts the number of devices programmed. When the limit is reached the TEAclipper refuses to program any more, allowing firmware to be sold on a per-copy basis
- Encrypted delivery secures against copying.
- Unique serial numbers and license codes can be written to each PIC programmed.
- No other components required for programming. Can connect to the PIC via, for example:
  - 5 plate-though PCB holes (for light duty use)
  - 0.1" header (for heavy duty use)
  - Prototyping board
- Powered in-situ by target circuit
- TEAclipper USB adapter required for charging TEAclippers with firmware.
- Compatible with *www.hexwax.com* firmware publishing service.

Ordering Information

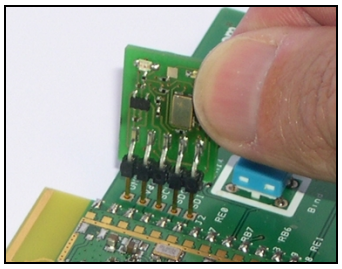
Part No	***Description***
TEACL-PIC-H	TEAclipper/PIC high voltage programming clip
TEACL-PIC-L	TEAclipper/PIC low voltage programming clip
TEACL-USB	TEAclipper USB adapter
EVAL-TEACL	TEAclipper evaluation / test board
TEACL-PIC-DB	TEAclipper/PIC debugging adapter

FlexiPanel Ltd
2 Marshall St, 3rd Floor
London W1F 9BB, UK
www.flexipanel.com
email: support@flexipanel.com

Manufactured to RoHS, WEEE & ISO9001:2001 standards



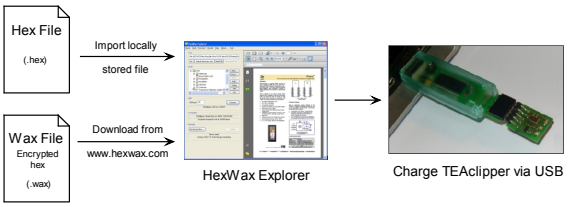
TEAclipper/PIC



Programming a target PCB

How It Works

The *HexWax Explorer* application is used to load TEAclippers with firmware, either stored locally or downloaded from *www.hexwax.com* via the TEAclipper USB adapter.



HexWax Explorer

Charge TEAclipper via USB

PICs are then programmed by temporarily inserting the TEAclipper into the target device's circuit. The connection can be a PCB header or simply leaning against plate-through holes on a PCB. For prototyping, TEAclippers can be inserted into breadboards.

Applications

- Firmware programming & archiving
- Firmware sales through physical dispatch of TEAclippers to customers
- Protection from design theft by subcontractors
- Delivery of in-the-field firmware updates for already-deployed products. Costs nothing to implement at product design-time.
- Firmware sales through web marketing by *www.hexwax.com*, FlexiPanel's firmware publishing service.

TEAclipper system

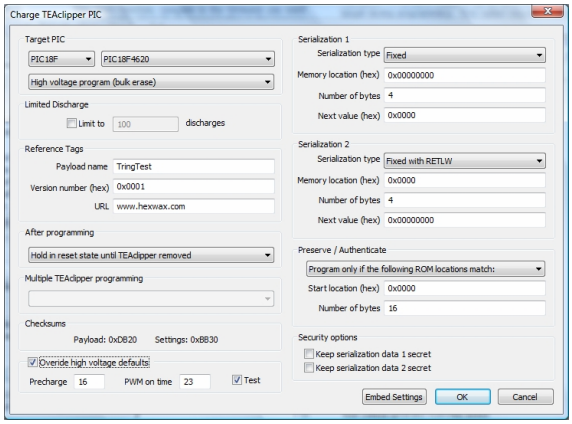
TEAclipper/PIC is part of the FlexiPanel TEAclipper system, which provides:

- TEAleaf authentication tags
- TEAclippers for Microchip PICs and Parallax BASIC Stamps available now.
- Planned rollout for major microcontroller, CPLD, FPGA brands. (Manufacturers should contact us to schedule TEAclipper support for their products.)

Loading Firmware onto the TEAclipper

To load a TEAclipper with a firmware data payload, start the *HexWax Explorer* application (downloaded from *www.hexwax.com*). Import the .hex or .wax file containing the firmware you want into the Local Files section of *HexWax Explorer*. To import local files held on your computer, press the *Add…* button. To import files from HexWax, navigate to the firmware you want and press the *Click To Download* button in the browser area.

Insert the TEAclipper into the TEAclipper USB adapter. The LEDs should be face upwards, although you will not damage the TEAclipper if you insert it incorrectly. Select the .hex or .wax file you wish to load and press the *Charge Now…* button. The Charge TEAclipper PIC dialog will appear:



You will be given the following options:

Target PIC: Specifies the type of PIC for which the hex data is intended. This information is not contained in .hex files and so must be specified here. It is not always possible to cross-check that the PIC type is correct, so be careful to set it correctly.

Either high-voltage or low-voltage programming may be specified, depending on the target device. Some PICs require high-voltage (7V-13V) programming; others require low-voltage programming; some may be programmed by either method. High-voltage programming is only possible using TEAclippers incorporating high-voltage generator components.

If low-voltage programming is specified, there may be a supply voltage minimum below which bulk erase operations cannot be performed. Programming is only possible below this limit with high voltage erase.

LF series devices identical to F series are identical to F series devices, *e.g.* PIC18LF4520 is the same as PIC18F4520, except that LF series devices may be operated at lower voltage. To specify an LF device, simply specify its F series equivalent.

Serialization: Serialization options allow you to set certain memory locations to unique values.

The memory locations may not cross a page write-byte boundary and must be word aligned. Dummy values must be declared in the source code for these locations.

When the TEAclipper attempts to write the dummy values, it will substitute the serialization values.

The values can be stored directly or as literals in RETLW instruction (i.e. in the same manner as the Microchip PM3 SQTP facility programmer).

Fixed: A fixed value of up to 4 bytes (Stamps) or 16 bytes (PICs) to each target during programming. This option requires limited discharge to be enabled.

Random: A random value of up to 16 bytes to each target during programming. This option requires limited discharge to be enabled.

Increment: An incrementing value of up to 4 bytes (Stamps) or 16 bytes (PICs) to each target during programming. This option requires limited discharge to be enabled. The value is written little-endian, i.e. least significant byte first. Note that PIC increments do not carry beyond the fourth byte.

Limited Discharge: Allows you to limit the number of discharges of the payload for licensing purposes. Note that each 16 discharges will require an erase cycle.

Payload name: This name will appear in the Explorer view Payload information area when the TEAclipper is inserted into the TEAclipper USB adapter.

Version number: If non-zero, this version number will appear in the Explorer view Payload information area when the TEAclipper is inserted into the TEAclipper USB adapter. The value is a two-byte hex number.

URL: The URL which will be navigated to when the TEAclipper is inserted into the TEAclipper USB adapter and the Lookup button is pressed.

After Programming: Specify whether the TEAclipper should hold the target in a reset state until it is removed, or whether to tri-state immediately and allow the target to execute.

Security Options: Specify whether or not the serialization information can be read out of the TEAclipper.

Checksums: The checksums are a shorthand method of verifying that you have the correct payload and dialog settings. (They are not the same checksums as used by MPLAB.)

Preserve / Authenticate: You have the options of leaving certain areas of ROM or EEPROM unchanged during programming (preserve), or of only programming if the ROM or EEPROM locations match the values specified in the hex file (authenticate). The first of these options is useful if you wish to leave serial numbers, MAC addresses, calibration data unchanged. The second is useful when upgrading to ensure that the right target device is being upgraded.

Note for 10F, 12F and 16F devices, two bytes are used for each 12-bit or 14-bit ROM location and each 8-bit EEPROM location. Addresses are specified in bytes, so address values and lengths may be double what you would expect.

Dummy values must be declared in the source code for the preserve / authenticate memory locations.

Preserve / Authenticate of code protected ROM is not possible.

Override High Voltage Defaults: Refer to High Voltage Programming section below.

Embed Settings: Writes settings to hex file so if another user opens the file, it will default to the settings selected.

HexWax Explorer may also be used to determine the payload currently resident on a TEAclipper. When you insert it into TEAclipper USB, *HexWax Explorer* will display information about the resident firmware. Press the *Details…* button for more information.

Refer to the HexWax Explorer HW050 data sheet for more information about the software.

Note: High Voltage TEAclipper/PICs with the marking TCPr3 need a few moments to discharge in order to reset properly. After loading the firmware onto the PIC, you may need to remove it for about 5 seconds and then re-insert it.

Programming PICs

To discharge the payload data into a PIC, connection must be made as detailed in the Pinout Table. A PCB header or series of plate-though holes is usually provided on a target PCB for programming. Payloads can be set for limited discharge, in which case they can only program a limited number of PICs.

The TEAclipper has a limited life due to the low-cost nature of the flash memory used. It can be reloaded with firmware a maximum of 100 times. In addition, if the limited-download or serialization features are used, the total maximum number of downloads is 1600.

Red & Green LED Indicator Guide	
Red & Grn on continuously	Initializing
Red & Grn flash every 2s	Connected to HexWax Explorer
Alternate Red & Grn	Programming PIC
Occulting Green	Programming complete
2 Red flashes	PIC not found
3 Red flashes	Authenticate failure
4 Red flashes	Erase limit reached
5 Red flashes	Limited discharge limit reached
6 Red flashes	No payload to discharge
8 Red flashes	Program verify failure

Evaluation and Development Guide

To experiment with TEAclippers, try downloading the *Eval1* and *Eval2* firmware files from *www.hexwax.com*. They don't do much – flash LEDs once and twice respectively on P0 and P1 – but they are enough for you to become familiar with how TEAclippers are used. You'll find them by visiting the *Products* section of the web site and downloading the *PICeval* pack.

A TEAclipper Evaluation Board is available. It includes zero-insertion-force test sockets which may be useful for programming a large quantity of PICs

The TEAclipper/PIC Debugging adapter is available which translates the TEAclipper programming connections to an RJ11 socket. This is designed for development and debugging of applications using the Microchip ICD2 In-Circuit Debugger.

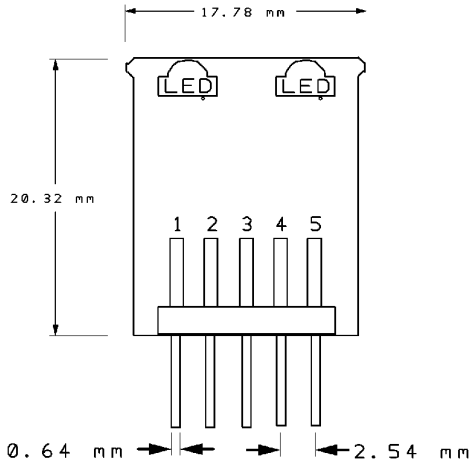
Pinout Table

Pin	***Name***	***Description***
1	Vdd	Power input *Vmin* – 5.5V DC†
2	PGD	Program data (Bidirectional)
3	PGC	Program clock (Output)
4	Vpp/NMCLR	Programming voltage / reset (Output)
5	Vss	Power Ground reference
†Refer to Compatibility Chart for *Vmin* values		

Specifications

Voltage on *Vdd*	*Vmin* – *Vmax* DC †
Current, low voltage programming	10mA max
Current, high voltage programming	80mA max
Maximum erase cycles	100
Maximum high volt current I_{Vpp}	1mA
† Refer to Compatibility Chart for *Vmin* and *Vmax* values	

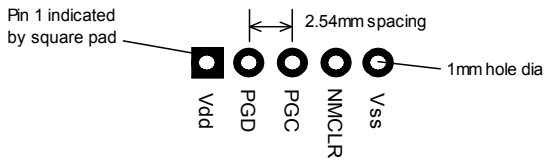
Mechanical Drawing



Target Board Design Guide

When designing a PCB to facilitate frequent in-circuit programming of PICs, a five pin 0.1" header socket should be provided. For compact PCBs, it may be necessary to devise an adapter cable.

If it is anticipated that the board will only need to be programmed once or twice in its lifetime, and the PIC is small enough that the programming duration is quite short, leaning the TEAclipper against five plate-through holes will be sufficient.



Recommended plate-through connector design

Since the plate-through connector costs nothing, it's worth integrating it in every PIC PCB you design, just in case you might want to use it to update the firmware at a later date.

If any of the Vpp, PGC or PGD pins serve another purpose in the circuit, these connections must be isolated so that they do not interfere with, nor are affected by, the programming process. Capacitance on these connections should be sufficiently low to allow digital transitions of up to 1MHz in frequency.

If implementing Low-Voltage Programming, consider the requirements for the PGM pin as detailed below in the Low-Voltage Programming section. We typically implement a 4k7 pull-down resistor and a pair of co-located pads, one on either side of the board near the edge, which allow the PGM pin to be temporarily shorted high using a crocodile clip.

File Formats

PIC firmware must be in INHX32 32-bit Intel Extended Hex format. (This is the standard `.hex` file format generated by MPLAB.) Any EEPROM or configuration data must be embedded in the hex file.

Configuration, ID and EEPROM data must be embedded in the hex data as recommended by Microchip programming specifications. Refer to the evaluation applications' source code for examples.

Large Hex Images

Hex images greater than 64Kbyte. require one TEAclipper per 64Kbyte or part thereof. Each TEAclipper will program a separate 64K section of memory.

The TEAclippers should be numbered TC1, TC2, etc. During programming, they must be applied in the order in which they are numbered.

TC1 will erase the microcontroller and program the highest memory locations. The 'last' (i.e. highest numbered) TEAclipper will program the lowest memory locations, EEPROM, ID locations and configuration bits. The following restrictions apply:

- The memory is not code protected prior to the use of the last TEAclipper.
- Serialization values must reside in the lowest 64K of memory.
- Authenticate may only be used on TC1.
- Preserve and authenticate should only be specified on the TEAclipper which programs the locations specified. Bits 16 and higher of the preserve / authenticate location address will be ignored.
- Only the 'last' TEAclipper is limited-write. If the firmware is paid-for, this is the TEAclipper which holds financial value.
- TEAclippers other than the 'last' are unlimited write and the payload has no financial value.

Low-Voltage Programming

Some PIC devices implement low voltage programming using a PGM pin. The pin is pulled low during normal use. When the TEAclipper is to be used to program the device, a specific sequence of actions needs to be followed:

1. Ensure no power is applied to the target PCB
2. Connect the PGM pin so it will be pulled high when power is applied
3. Insert the TEAclipper
4. Power up the board
5. Wait for programming to complete.
6. Power down the board
7. Remove the TEAclipper
8. Disconnect the pull-up on the PGM pin

Note that for some LF parts, there is a minimum supply voltage below which low voltage programming is not permitted.

High-Voltage Programming

High voltage programming is only possible with TEAclippers which include the high voltage programming option. This option uses switched-mode boost generator to provide required *Vpp* programming voltage.

The boost generator performance is governed by two parameters. The *Precharge* time governs the voltage at the instant the high voltage is applied. The *PWMonTime* governs the asymptotic voltage level.

The default *Precharge* and *PWMonTime* values assume a 10K-22K pullup resistor to Vdd. This is the recommended load and should be suitable for most circuits. A very weak pullup may result in overvoltage; too strong a voltage may result in undervoltage.

In cases of abnormal loads on Vpp, it is possible to override *Precharge* and *PWMonTime* in HexWax Explorer. A test mode is also provided, where a Vpp square wave is output at 25Hz approx. The aim is to enter programming mode with a voltage Vpp inside the range specified in the device's programming specification.

Security

TEAclippers can be used to buy and sell firmware on a per-copy basis. The degree of security offered by

TEAclipper/PIC varies with the type of PIC that can be programmed.

On 10F, 12F, 16F, 18F, PIC24H, dsPIC30F and dsPIC33F devices, the code protection bit is set when programming is complete. If programming is interrupted the device remains in an unprotected state. They are recommended for use only in trusted environments or with low-valued firmware

On 18FJ and PIC24FJ devices, the code protection bit is set when programming begins. The only way to read the devices is to decrypt the programming signals. They are much more tightly protected and are suitable for medium-valued firmware.

The TEAclipper/Crypto product uses a decrypting bootloader to transfer data from the TEAclipper. It may be used with any microcontroller (PIC or not) which has self-write capability. There is no known way to intercept these programming signals. This product is recommended for the highest valued firmware, e.g. gaming systems, banking, etc.

Copyright

TEAclippers can be used as a licensing system to allow firmware to be bought and sold. When used in this way, trade is protected by the WIPO Copyright Treaty and the Digital Millennium Copyright Act. The following are punishable by fines or imprisonment:

- Any attempt to interfere with the programming process or intercept or record or reproduce the programming signals
- Any attempt to disseminate unlicensed copies of firmware carried by TEAclippers

Compatibility Chart

The PICs listed below are currently compatible with TEAclipper. We intend to prioritize the addition of further PIC devices according to customer demand, so let us know what you need. HexWax Explorer is able to reflash the firmware in the TEAclippers, so as we enhance the product your existing TEAclippers are updated automatically.

Note that many PICs are near-identical siblings. We do not test all members of the family. Devices marked * are family members which have been tested exhaustively. Devices marked † have been tested, but less exhaustively. These devices have corresponding evaluation and test files available for download from *www.HexWax.com*. To create evaluation and test files for other devices, simply recompile a test file with the same programming specification, setting the target to the desired microcontroller.

Our intention is to support as many 8-bit and 16-bit PICs as possible in due course. Testing new devices is labor intensive and so support will be progressive. Contact us if there is a particular PIC you would like prioritized.

Serialization values may not cross the page write memory boundaries specified.

Except where listed separately, 'LF' series parts are considered identical to their 'F' series equivalents, except that different supply voltages apply. Some devices have a minimum permitted supply voltage as indicated. *Vmin* is the minimum supply voltage shown permitted during programming (assuming an LF part where applicable.)

The high voltage TEAclipper is capable of both high and low voltage programming. The low voltage TEAclipper is only capable of low voltage programming.

Target	*Prog Spec*	*Test Dev*	*From Version*	*Page write bytes*	*High/Low Volt Prog*	*Vmin (HVP / LVP)*
PIC10F200	F		1.00		HVP	4.50
PIC10F202	F	*	1.00		HVP	4.50
PIC10F204	F		1.00		HVP	4.50
PIC10F206	F	*	1.00		HVP	4.50
PIC10F220	V		1.00		HVP	4.50
PIC10F222	V	*	1.00		HVP	4.50
PIC12F508	Y	*	1.36		HVP	4.50
PIC12F509	Y	*	1.36		HVP	4.50
PIC12F510	G	*	1.36		HVP	4.50
PIC12F615	X	*	1.36		HVP	4.50
PIC12HV615	X		1.36		HVP	4.50
PIC12F629	Z	*	1.36		HVP	4.50
PIC12F635	W	*	1.36		HVP	4.50
PIC12F675	Z	*	1.36		HVP	4.50
PIC12F683	W		1.36		HVP	4.50
PIC16F616	X		1.36		HVP	4.50
PIC16HV616	X		1.36		HVP	4.50
PIC16F630	Z		1.36		HVP	4.50
PIC16F630-ICD	Z		1.36		HVP	4.50
PIC16F631	W		1.36		HVP	4.50
PIC16F636	W		1.36		HVP	4.50
PIC16F639	W		1.36		HVP	4.50
PIC16F676	Z		1.36		HVP	4.50
PIC16F677	W		1.36		HVP	4.50
PIC16F684	W		1.36		HVP	4.50
PIC16F685	W		1.36		HVP	4.50
PIC16F687	W		1.36		HVP	4.50
PIC16F688	W		1.36		HVP	4.50
PIC16F689	W		1.36		HVP	4.50
PIC16F690	W		1.36		HVP	4.50
PIC16F73	Q	*	1.37		HVP	4.75
PIC16F74	Q		1.37		HVP	4.75
PIC16F76	Q		1.37		HVP	4.75
PIC16F77	Q		1.37		HVP	4.75
PIC16F737	A2		1.40		HVP	4.75
PIC16F747	A2		1.40		HVP	4.75
PIC16F767	A2		1.40		HVP	4.75
PIC16F777	A2	*	1.40		HVP	4.75
PIC16F818	J		1.34		HVP / LVP	4.50
PIC16F819	J	*	1.34		HVP / LVP	4.50
PIC16F87	Q2	*	1.39		HVP / LVP	4.50
PIC16F870	S2		1.35		HVP / LVP	4.50
PIC16F871	S2	*	1.35		HVP / LVP	4.50
PIC16F872	S2		1.35		HVP / LVP	4.50
PIC16F873	S2		1.35		HVP / LVP	4.50
PIC16F874	S2		1.35		HVP / LVP	4.50
PIC16F874A	R2		1.35		HVP / LVP	4.50
PIC16F875	S2		1.35		HVP / LVP	4.50
PIC16F875A	R2		1.35		HVP / LVP	4.50
PIC16F876	S2		1.35		HVP / LVP	4.50
PIC16F876A	R2		1.35		HVP / LVP	4.50
PIC16F877	S2		1.35		HVP / LVP	4.50
PIC16F877A	R2	*	1.35		HVP / LVP	4.50
PIC16F88	Q2		1.39		HVP / LVP	4.50
PIC16F882	M		1.39		HVP / LVP	4.50
PIC16F883	M	*	1.39		HVP / LVP	4.50
PIC16F884	M		1.39		HVP / LVP	4.50
PIC16F886	M		1.39		HVP / LVP	4.50
PIC16F887	M		1.39		HVP / LVP	4.50
PIC18F1220	J2		1.10	8	HVP / LVP	2.00 / 4.50
PIC18F1230	G2		1.30	8	HVP	3.00
PIC18F1320	J2		1.10	8	HVP / LVP	2.00 / 4.50
PIC18F1330	G2	*	1.30	8	HVP	4.50
PIC18F2220	J2		1.10	8	HVP / LVP	2.00 / 4.50

Target	Prog Spec	Test Dev	From Version	Page write bytes	High/Low Volt Prog	Vmin (HVP / LVP)
PIC18F2221	A		1.00	8	HVP / LVP	2.00 / 3.00
PIC18F2320	J2		1.10	8	HVP / LVP	2.00 / 4.50
PIC18F23K20	K		1.32	8	HVP / LVP	TBD
PIC18F2321	A	*	1.00	8	HVP / LVP	2.00 / 3.00
PIC18F2331	Y2		1.10	8	HVP / LVP	2.00 / 4.50
PIC18F2410	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F242	N		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F2420	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F24K20	K		1.32	32	HVP / LVP	TBD
PIC18F2431	Y2		1.10	8	HVP / LVP	2.00 / 4.50
PIC18F2450	A		1.00	16	HVP / LVP	2.00 / 3.00
PIC18F2455	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F248	N		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F2480	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F2510	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F2515	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F252	N	*	1.41	8	HVP / LVP	2.00 / 4.50
PIC18F2520	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F25K20	K	*	1.32	32	HVP / LVP	TBD
PIC18F2525	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F2550	A	†	1.00	32	HVP / LVP	2.00 / 3.00
PIC18F258	N		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F2580	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F2585	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F2610	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F2620	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F26K20	K		1.32	64	HVP / LVP	TBD
PIC18F2680	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F2682	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F2685	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F4220	J2		1.10	8	HVP / LVP	2.00 / 4.50
PIC18F4221	A		1.00	8	HVP / LVP	2.00 / 4.50
PIC18F4320	J2	*	1.10	8	HVP / LVP	2.00 / 4.50
PIC18F43K20	K		1.32	8	HVP / LVP	TBD
PIC18F4321	A	*	1.00	8	HVP / LVP	2.00 / 3.00
PIC18F4331	Y2	*	1.10	8	HVP / LVP	2.00 / 4.50
PIC18F4410	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F442	N		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F4420	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F44K20	K		1.32	32	HVP / LVP	TBD
PIC18F4431	Y2		1.10	8	HVP / LVP	2.00 / 4.50
PIC18F4450	A		1.00	16	HVP / LVP	2.00 / 3.00
PIC18F4455	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F4480	A		1.00	32	HVP / LVP	2.00 / 3.00
PIC18F448	N		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F4510	A	*	1.00	32	HVP / LVP	2.00 / 3.00
PIC18F4515	A	*	1.00	16	HVP / LVP	2.00 / 3.00
PIC18F452	N		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F4520	A	*	1.00	32	HVP / LVP	2.00 / 3.00
PIC18F45K20	K		1.32	32	HVP / LVP	TBD
PIC18F4525	A	*	1.00	64	HVP / LVP	2.00 / 3.00
PIC18F4550	A	*	1.00	32	HVP / LVP	2.00 / 3.00
PIC18F458	N		1.41	8	HVP / LVP	2.00 / 4.50

Target	Prog Spec	Test Dev	From Version	Page write bytes	High/Low Volt Prog	Vmin (HVP / LVP)
PIC18F4580	A	*	1.00	32	HVP / LVP	2.00 / 3.00
PIC18F4585	A	*	1.00	64	HVP / LVP	2.00 / 3.00
PIC18F4610	A	*	1.00	64	HVP / LVP	2.00 / 3.00
PIC18F4620	A	*	1.00	64	HVP / LVP	2.00 / 3.00
PIC18F46K20	K		1.32	64	HVP / LVP	TBD
PIC18F4680	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F4682	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F4685	A		1.00	64	HVP / LVP	2.00 / 3.00
PIC18F6310	P		1.10	16	HVP	4.50
PIC18F6390	P		1.10	16	HVP	4.50
PIC18F6410	P		1.10	16	HVP	4.50
PIC18F6490	P	*	1.10	16	HVP	4.50
PIC18F6520	N2		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F6527	H2		1.10	64	HVP / LVP	4.50
PIC18F6620	N2		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F6622	H2		1.10	64	HVP / LVP	4.50
PIC18F6627	H2		1.10	64	HVP / LVP	4.50
PIC18F6680	L	*	1.32	8	HVP / LVP	4.50
PIC18F6685	L		1.32	8	HVP / LVP	4.50
PIC18F6720	N2	*	1.41	8	HVP / LVP	2.00 / 4.50
PIC18F6722	H2	*	1.10	64	HVP / LVP	4.50
PIC18F8310	P		1.10	16	HVP	4.50
PIC18F8390	P		1.10	16	HVP	4.50
PIC18F8410	P		1.10	16	HVP	4.50
PIC18F8490	P		1.10	16	HVP	4.50
PIC18F8520	N2		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F8527	H2		1.10	64	HVP / LVP	4.50
PIC18F8620	N2		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F8622	H2		1.10	64	HVP / LVP	4.50
PIC18F8627	H2		1.10	64	HVP / LVP	4.50
PIC18F8680	L		1.32	8	HVP / LVP	4.50
PIC18F8685	L		1.32	8	HVP / LVP	4.50
PIC18F8720	N2		1.41	8	HVP / LVP	2.00 / 4.50
PIC18F8722	H2		1.10	64	HVP / LVP	4.50
PIC18F24J10	B		1.00	64	LVP	3.60
PIC18F25J10	B		1.00	64	LVP	3.60
PIC18F44J10	B		1.00	64	LVP	3.60
PIC18F45J10	B	*	1.00	64	LVP	3.60
PIC18LF24J10	B		1.00	64	LVP	3.60
PIC18LF25J10	B		1.00	64	LVP	3.60
PIC18LF44J10	B		1.00	64	LVP	3.60
PIC18LF45J10	B	*	1.00	64	LVP	3.60
PIC18F63J11	U		1.10	64	LVP	2.00
PIC18F63J90	U		1.10	64	LVP	2.00
PIC18F64J11	U		1.10	64	LVP	2.00
PIC18F64J90	U		1.10	64	LVP	2.00
PIC18F65J10	U		1.10	64	LVP	2.00
PIC18F65J11	U		1.10	64	LVP	2.00
PIC18F65J15	U		1.10	64	LVP	2.00
PIC18F65J50	U		1.10	64	LVP	2.00
PIC18F65J90	U		1.10	64	LVP	2.00
PIC18F66J10	U		1.10	64	LVP	2.00
PIC18F66J11	U		1.10	64	LVP	2.00

Target	Prog Spec	Test Dev	From Version	Page write bytes	High/Low Volt Prog	Vmin (HVP / LVP)
PIC18F66J15	U	†	1.10	64	LVP	2.00
PIC18F66J16	U		1.10	64	LVP	2.00
PIC18F66J50	U		1.10	64	LVP	2.00
PIC18F66J55	U		1.10	64	LVP	2.00
PIC18F67J10	U	*	1.10	64	LVP	2.00
PIC18F67J11	U		1.10	64	LVP	2.00
PIC18F67J50	U		1.10	64	LVP	2.00
PIC18F83J11	U		1.10	64	LVP	2.00
PIC18F83J90	U		1.10	64	LVP	2.00
PIC18F84J11	U		1.10	64	LVP	2.00
PIC18F84J90	U		1.10	64	LVP	2.00
PIC18F85J10	U		1.10	64	LVP	2.00
PIC18F85J11	U		1.10	64	LVP	2.00
PIC18F85J15	U		1.10	64	LVP	2.00
PIC18F85J50	U		1.10	64	LVP	2.00
PIC18F85J90	U		1.10	64	LVP	2.00
PIC18F86J10	U		1.10	64	LVP	2.00
PIC18F86J11	U		1.10	64	LVP	2.00
PIC18F86J15	U		1.10	64	LVP	2.00
PIC18F86J16	U		1.10	64	LVP	2.00
PIC18F86J50	U		1.10	64	LVP	2.00
PIC18F86J55	U		1.10	64	LVP	2.00
PIC18F87J10	U		1.10	64	LVP	2.00
PIC18F87J11	U		1.10	64	LVP	2.00
PIC18F87J50	U		1.10	64	LVP	2.00

Programming specification notes	
Spec	**Notes**
A	Based on Microchip's data sheet DS39622 *PIC18F2XX0/2X21/2XX2/2XX3/2XX5/4XX0/4X21/4XX2/4XX3/4XX5*
A2	Based on Microchip's data sheet DS30492 *PIC16F7X7*
	ID locations programming not implemented
	Verifies memory locations with VddApp = target Vdd (refer to data sheet)
B	Based on Microchip's data sheet DS39687 *PIC18F45J10 Family*
F	Based on Microchip's data sheet *DS41228 PIC10F200/202/204/206*
	ID locations programming not implemented
	If Oscillator Calibration Bits (0x0FF / 0x1FF) do not contain a valid MOVLW instruction prior to programming, an MOVLW 0xFE instruction will be inserted
G	Based on Microchip's data sheet *DS41257 PIC12F510*
	ID locations programming not implemented
	If Oscillator Calibration Bits (0x3FF) do not contain a valid MOVLW instruction prior to programming, an MOVLW 0x80 instruction will be inserted
G2	Based on Microchip's data sheet DS39752 *PIC18F1230/1330*
H2	Based on Microchip's data sheet DS39643 *PIC18F8722 Family*
J	Based on Microchip's data sheet DS39603 *PIC16F818/819*
	ID locations programming not implemented
J2	Based on Microchip's data sheet DS39592 *PIC18FX220/X320*
K	Based on Microchip's data sheet DS39606 *PIC18F2XK20/4XK20* *Problems may exist programming EEPROM. Contact us if you have difficulties.*
L	Based on Microchip's data sheet DS39606 *PIC18FXX80/XX85*
M	Based on Microchip's data sheet DS41287 *PIC16F88X*
	ID locations programming not implemented

Programming specification notes	
Spec	**Notes**
	Verifies memory locations with VddApp = target Vdd (refer to data sheet)
N	Based on Microchip's data sheet DS39576 *PIC18FXX2/XX8*
N2	Based on Microchip's data sheet DS39583 *PIC18FXX20*
P	Based on Microchip's data sheet DS39624 *PIC18FX310/X410/X390/X490* The specification implies ability to program down to Vmin = 2.75V but we have not been able to achieve this. Please let us know if you are able to.
Q	Based on Microchip's data sheet DS30324 *PIC16F7X*
	ID locations programming not implemented
	Verifies memory locations with VddApp = target Vdd (refer to data sheet)
Q2	Based on Microchip's data sheet DS39607 *PIC16F87/88*
	ID locations programming not implemented
	Verifies memory locations with VddApp = target Vdd (refer to data sheet)
R2	Based on Microchip's data sheet DS39589 *PIC16F87XA*
	ID locations programming not implemented
S2	Based on Microchip's data sheet DS39025 *PIC16F87X*
	ID locations programming not implemented
U	Based on Microchip's data sheet DS39644 *PIC18F6XJXX/8XJXX Family*
V	Based on Microchip's data sheet *DS41266 PIC10F220/222*
	ID locations programming not implemented
	If Oscillator Calibration Bits (0x0FF / 0x1FF) do not contain a valid MOVLW instruction prior to programming, an MOVLW 0xFE instruction will be inserted
W	Based on Microchip's data sheet DS41204 *PIC12F6XX/PIC16F6XX*
	ID locations programming not implemented
X	Based on Microchip's data sheet DS41284 *PIC12F61X/PIC16F61X*
	ID locations programming not implemented
Y	Based on Microchip's data sheet *DS41221 PIC12F508/509*
	ID locations programming not implemented
	If Oscillator Calibration Bits (0x1FF / 0x3FF) do not contain a valid MOVLW instruction prior to programming, an MOVLW 0x80 instruction will be inserted
Y2	Based on Microchip's data sheet DS30500 *PIC18F2331/2431/4331/4431*
Z	Based on Microchip's data sheet DS41191 *PIC12F629/675/PIC16F630/676*
	ID locations programming not implemented