



PROG12Z

USER MANUAL





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1 OVERVIEW

PROG12Z is PE micro's programming software for Flash/EEPROM modules that are attached to a 68HC(S)12(X) processor. PROG12Z talks to the processor's background debug module using one of PE micro's compatible hardware interfaces. These interfaces connect a PC running Windows XP/Vista/7/8/10 to a debug connector on the target system. This connector provides access to the debug signals of the processor chip mounted on your target system hardware board.

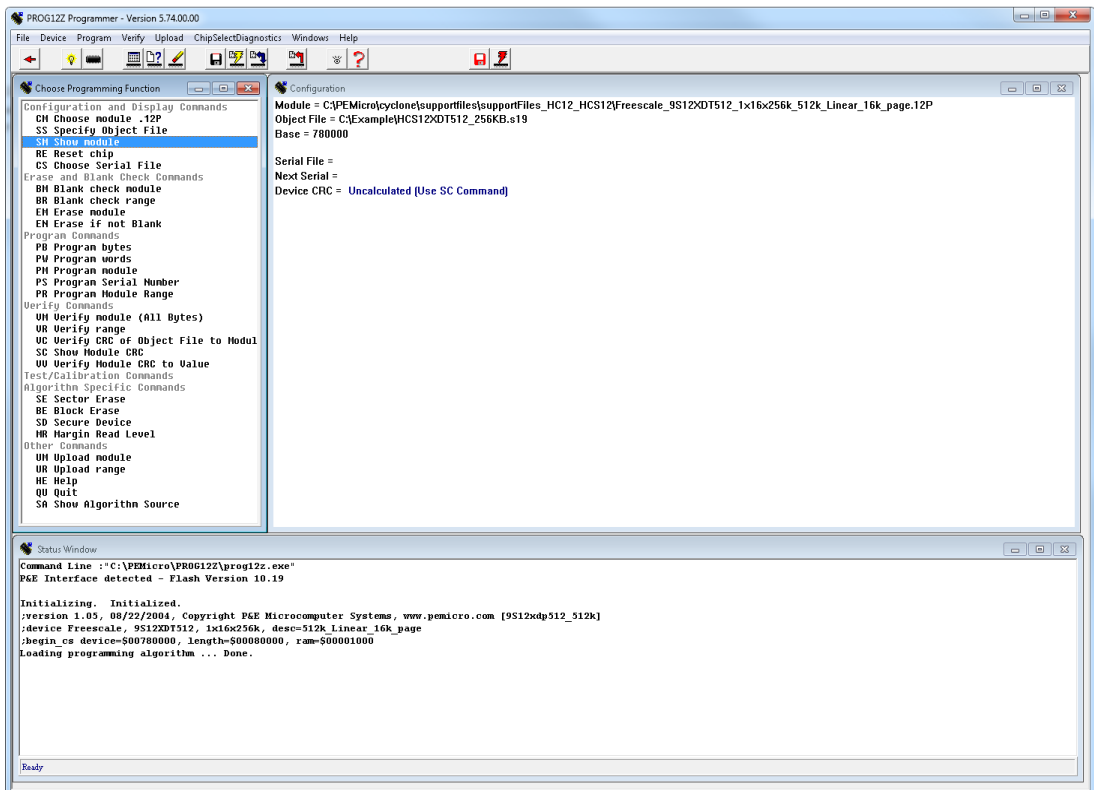


Figure 1-1: PROG12Z User Interface

As part of the programming procedure, the user will need to select a programming algorithm that will enable the PROG12Z software to properly manage their specific target device during programming. The user may also choose to set certain

programming parameters before beginning to program. This chapter presents a brief overview of the programming procedure.

1.1 Programming Algorithms (.12P Files)

PROG12Z runs on the PC and provides a set of general interface functions and processor-specific user functions that are used to control the erasing, verifying, programming and viewing of modules to be programmed. These general functions are implemented for a particular target configuration and chip set by using specific Programming Algorithm (.12P) files that the user can modify to reflect the setup of their particular target interface. PROG12Z includes a library of these programming algorithms. For the most recent version of this library of algorithms, please visit our website, www.pemicro.com.

Programming algorithm files can also be modified by the user according to specific conventions. In addition, PEmicro can create programming algorithms upon request if you are working with a device whose corresponding algorithm is not included in the current library. Some additional information about the contents and modification of programming algorithms is included in **CHAPTER 2 – PROGRAMMING ALGORITHMS**.

1.2 Start-Up Configuration

Certain programming parameters can be adjusted when launching the PROG12Z software by using the executable command-line to input the appropriate parameters. These may include settings related to the type of hardware interface you are using, S-record verification, and more, depending on your target device. A list of specific parameters with examples of their usage is included in **CHAPTER 4 – START-UP CONFIGURATION**.

1.3 Manual Programming

PROG12Z lists commands that are available to execute. Any of the programmer's enabled features can be selected by using the mouse, the up and down arrow keys, or by typing the selection letters to the left of the selection display. Pressing ENTER or double clicking the mouse will execute the highlighted entry if it is enabled. The user will be prompted for any additional information that is required to execute the selected function. Before you can program a module from an S record file, you must select such a file. If you try to do a program module function and you have not selected an S-record file, you will be asked to select one. A list of programming commands and their functions may be found in **CHAPTER 6 – MANUAL PROGRAMMING**.

1.4 Scripted Programming

Programming commands, in addition to being executed manually, may also be collected into script files which can be used to automate the programming process. These scripts are executed by a command-line programming application called CPROG12Z, which is included with the PROG12Z software. More information about scripted programming is located in the accompanying CPROG12Z User Guide..

1.5 Hardware Interfaces

In addition to PROG12Z programming procedures, this manual discusses hardware interfaces that may be used in conjunction with the PROG12Z. For supported NXP processors, PEmicro typically offers both value-oriented development solutions and more robust and versatile production solutions. You can learn about these interfaces in **CHAPTER 8 – HARDWARE INTERFACES**.

1.6 Programming Utilities

PEmicro also offers some no-cost programming utilities to help the user perform certain tasks. More information is available in **CHAPTER 9 – PROGRAMMING UTILITIES**.

2 PROGRAMMING ALGORITHMS

PEmicro's .12P programming algorithm files define the functions necessary for PROG12Z to program an 68HC(S)12(X) processor's internal flash or connected external Flash/EEPROM. After you choose the appropriate algorithm, it will appear in the Configuration Window.

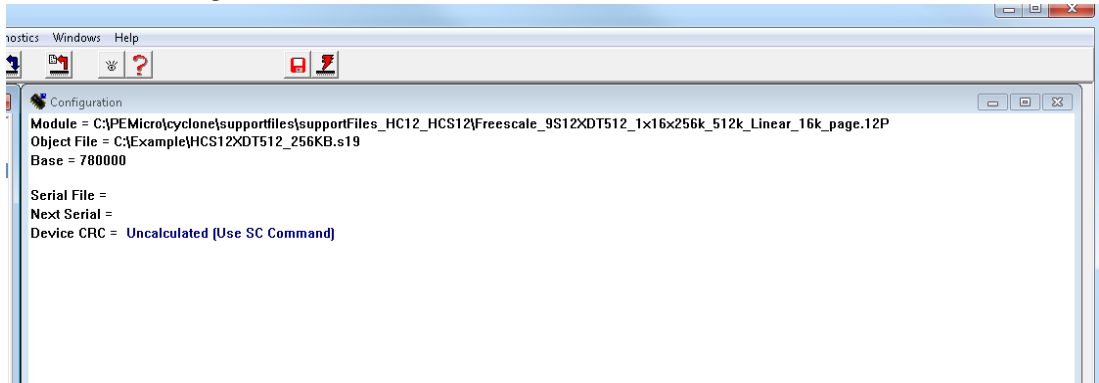


Figure 2-1: Configuration Window

2.1 Algorithm File Contents

You may view and, if necessary, modify the contents of an algorithm by opening it in any text editor. A .12P programming algorithm file consists of four parts:

1. Comments
2. User-specified functions
3. Setup commands
4. S-records

2.1.1 Comments

Comments are usually placed in the file to identify the target system for which the .12P file was written and what module on the target system it programs, as well as other useful information. If a specific .12P file is selected in PROG12Z, these comments are shown in the window at the bottom of the PC screen. Within the algorithm file a semicolon is used to designate the beginning of a comment.

The S records are loaded into on chip RAM on the 68HC(S)12(X) microcontroller and provide the functions necessary to carry out the functions specified below. All other records are written to the screen when the .12P file is selected for programming. PROG12Z programming algorithm files must have the DOS filename extension ".12P" in order for PROG12Z to find them. The files are in ASCII and are thus readable using most text editors. The S records for a .12P file can be generated using most assemblers.

2.2 Algorithm Timing Considerations

Most current flash devices have an on-chip programming monitor. The processor passes a command to the flash device, such as Program Word, and the flash device executes this command. On all processors with On-Chip flash, and on some external flash devices, the timing is provided by the processor. In order to program the flash device according to specification, the programming software on the PC has to know how fast the target processor is running. By default, the PROG12Z software tries to determine automatically how fast the target is running by loading a delay routine in the processor and timing how long it takes to execute. Under a multitasking environment, such as Windows XP/Vista/7/8/10, although they are usually very accurate, these timing measurements are not always correct.

PEmicro addresses this by providing a command-line mechanism that allows the user to inform the PROG software how fast the target processor is running. This ensures that the timing in the algorithms is always correct. To do this, the user would include the `FREQ` identifier on the executable command-line, followed by the `INTERNAL` clock frequency in Hertz. For instance, if your processor is an NXP 68HC12B32 with a bus frequency of 20MHz, your command-line parameters should look like this:

```
PROG12Z freq 20000000
```

See **CHAPTER 4 – START-UP CONFIGURATION** for more information about how to use command-line parameters.

2.3 Creating A Programming Algorithm

In certain situations, a user may wish to either create their own programming algorithm or make significant modifications to an existing file.

A .12P file is a structured file which contains a table of essential system constants and routine addresses. This table is followed by the definitions of the routines. Register

and memory usage conventions must be followed when you insert your own set of routines. Any routine which can not or need not be provided is given a zero (0) address in the table. The table, routines, stack and buffer reside in the CPU on chip RAM during the execution of PROG12Z. Registers IX and IY contain timing information and should not be disturbed if you need them to perform execution timing. Routines return to PROG12Z by executing a background (BGND) instruction.

The table contains several long word (32-bit) entries listed in an exactly specified order. In addition, the table is assembled at the starting address at which the on chip RAM will be configured during execution of PROG12Z. Furthermore, the table must be the first thing assembled to insure that it is the first S record in the .12P file.

Examples of the assembler files (.ASM files) used to produce the .12P files for external flash are available upon request. The first part of each file is the table that generates S records. The origin of the table tells the PC program where the on chip RAM should be configured during the programming process. The choice is made in a manner that does not conflict with other things in the target system, such as the module to be programmed.

The programming routines for a particular module are loaded into the 68HC(S)12(X) processor's on-chip RAM for execution during erasure, programming, verification and showing of the module. The routines and associated comments are in the form of Motorola S-records stored in the .12P programming algorithm.

3 PROGRAMMING COMMANDS

When the user performs manual programming, commands are executed by selecting them from the Choose Programming Function Window pick list. The user may either use the up/down arrow keys or type the two-letter abbreviation for the command (listed below) on the command line to select a command. Pressing ENTER causes the selected command to execute. Commands can also be executed from the Menus or from the Button Bar. If there is any additional information needed in order to execute the command, the user will be prompted for this information in a new window. Errors caused by a command or any other responses will be presented in the Status Window.

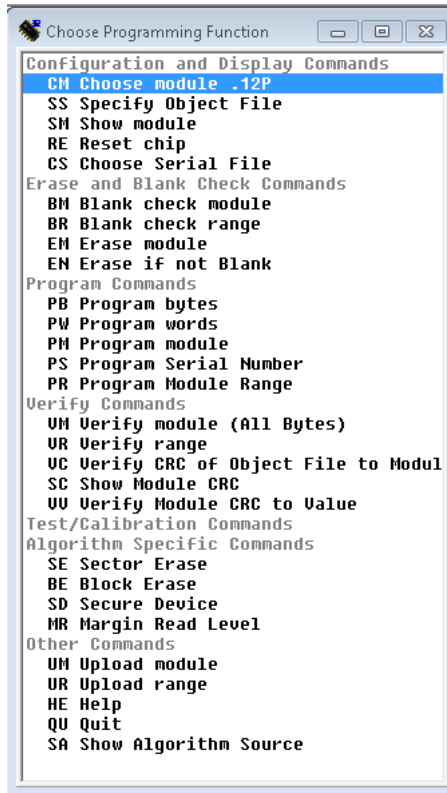


Figure 3-1: Choose Programming Function Window

At any given time, or for a particular module, some of the commands may not be active. Inactive commands are indicated as such in the Choose Programming Functions Window and will not execute.

Below is a description of each of the PROG12Z commands used in manual programming. These same commands are also used in scripted programming. For more information about scripted programming, see the **CPROG12Z User Guide**.

3.1 BM - Blank Check Module

This command checks the entire module to see if it has been erased. If not, the address of the first non-blank location is given along with its contents.

3.2 BR - Blank Check Range

This command checks to see if a specified range of locations has been erased. The user is prompted for the starting and ending addresses. These addresses must lie within the addressing range of the module or an error will be returned. If the range is not erased, the first non-blank location is given along with its contents.

3.3 CHANGEV - Change the voltage provided to the target

(Cyclone only)

The user will be prompted to enter a value between 0.00 and 5.00, inclusive, that specifies the new voltage. When CHANGEV is executed the Cyclone will immediately change to that voltage. If the Cyclone relays are off prior to calling this command, then the relays will turn on and set the new voltage value when this command is executed. Note that too low of a voltage value may put the device into low-power mode which can lose debug communication altogether. The user should make sure the Cyclone's jumper settings are set correctly to send the power to the right ports.

3.4 CM - Choose Module .12P

The user is presented with a list of available .12P files. Each .12P file contains information on how to program a particular module. Usually, the name of the file indicates what kind of module it relates to. For example, the file 9B32__32K.12P specifies how to program the 32K block on a 68HC12B32 processor. Setup information and further descriptions of the module are provided in ASCII text within the module file. This information is presented in the status window when a .12P file is selected. The user can also look at this information inside of the module itself by using

any standard text editor to view the module contents.

A particular .12P file is selected by using the arrow keys to highlight the file name and then pressing ENTER. The currently selected .12P file is shown in the .12P file selected window. After a .12P file is selected, the user is prompted for the base address of the module. This address is used as the beginning address for the module during programming and verification. Certain .12P files, such as those for external flash algorithms, will prompt the user for the base address of the module.

3.5 EB - Erase Byte Range

This command erases bytes in a specified range of locations. The user is prompted for the starting and ending addresses. These addresses must lie within the addressing range of the module or an error will be returned. If the range is not erased, the first non-blank location is given along with its contents.

3.6 EM - Erase Module

This command erases the entire module. If the entire Module is not erased, an error message will be returned.

3.7 EN - Erase If Not Blank

A blank check is performed to determine whether the flash is already erased. If not, an erase command is executed.

3.8 EW - Erase Word Range

This command erases words in a specified range of locations. The user is prompted for the starting and ending addresses. These addresses must lie within the addressing range of the module or an error will be returned. If the range is not erased, the first non-blank location is given along with its contents.

3.9 HE - Help

Opens this PROG12Z user manual.

3.10 PB - Program Bytes

The user is prompted for a starting address, which must be in the module. The user is then shown an address and a byte. Pressing ENTER shows the next location. The

user can also enter in hex a byte to be programmed into the current location. In addition, the symbols +, -, or = may be appended to the value being written. They correspond respectively to increase the address (default), decrease the address, and hold the address constant. Failure to program a location, entering an invalid hex value or exceeding the address range of the module will exit the program bytes window. If a location fails to program, an error message will be returned.

3.11 PM - Program Module

For this command to work, the user must have previously selected an S-record file. The S-records are then checked to see if they all reside in the module to be programmed. If not, the user is asked if they want to continue. If the answer is yes, only those S-record addresses which lie in the module are programmed. If a location cannot be programmed, an error message will be returned.

3.12 PS - Program Serial Number

Program the .SER file selected using the CS command.

3.13 PR - Program Module Range

Program the object file within specified starting and ending addresses

3.14 PW - Program Words

This command may be active, depending on the device/algorithm you are using. The user is prompted for a starting address, which must be in the module. The user is then shown an address and a word. Pressing ENTER shows the next location. The user can also enter in hex a word to be programmed into the current location. In addition, the symbols +, -, or = may be appended to the value being written. They correspond respectively to: increase the address (default), decrease the address, and hold the address constant. Failure to program a location, entering an invalid hex value or exceeding the address range of the module will exit the program words window. If a location fails to program, an error message will be returned.

3.15 QU - Quit

Terminates PROG12Z and returns to Windows.

3.16 RE - Reset chip

This causes a hardware reset to the microcontroller. This command can be used to recover from errors which cause the programmer not to be able to talk to the processor through the background debug mode.

3.17 RELAYSOFF - Turn off the relays that provide power to the target

(Multilink FX & Cyclone only)

Includes a power down delay if specified. Especially useful for users who want to power cycle their board before running tests, allow their bootloader to run, or have the application code run after programming.

3.18 RELAYSON - Turn on the relays to provide power to the target

(Multilink FX & Cyclone only)

Includes a power up delay if specified. The voltage supplied will be based on the last voltage setting specified. For Cyclone users, the CHANGEV command can change the voltage value. Especially useful for users who want to power cycle their board before running tests, allow their bootloader to run, or have the application code run after programming.

3.19 SM - Show Module

The user is prompted for a starting address. If this address is not in the module and error is given. A window is opened which shows the contents of memory as hex bytes and ASCII characters if printable. Non-printing characters are shown as periods ("."). This window stays on the screen until the user presses ESCAPE.

3.20 SS - Specify S-Record

If the file is not found, an error message is given. The currently selected file is shown in the S19 file selected window. The programmer accepts S1, S2, and S3 records. All other file records are treated as comments. If the user does not specify a file name extension, a default of .S19 is used.

3.21 UM - Upload Module

The user is asked for a filename into which to upload S-records. The default filename extension is set to .S19 if none is specified by the user. S-records for the entire

module are then written to the specified file.

3.22 UR - Upload Range

The user is prompted for a starting address, which must be in the module. Next, the user is asked for an ending address, which must also be in the module. The user is then asked for a filename into which to upload S-records. The default filename extension is set to .S19 if none is specified by the user. S-records are then written to the specified file.

3.23 VM - Verify Module

For this command to work, the user must have previously selected an S-record file. The S-records are then checked to see if they all reside in the module to be programmed. If not, the user is asked if they want to continue. If the answer is yes, only those S-record addresses which lie in the module are verified. If a location cannot be verified, an error message will be returned which indicates the address, the contents of that address, and the contents specified in the S-record file.

3.24 VR - Verify Range

For this command to work, the user must have previously selected an S-record file. The user is prompted for a starting address, which must be in the module. Next, the user is asked for an ending address, which must also be in the module. S-record addresses which lie in the module are verified. If a location cannot be verified, an error message will be returned which indicates the address, the contents of that address, and the contents specified in the S-record file.

In addition, there is one function that is allowed to be unique to the module being programmed. The selection menu name and the length of up to one hexadecimal parameter may be specified in a supporting .12P file.

3.25 VC - Verify CRC Of Object File To Module

Verify the flash against the object file using CRC calculations.

3.26 SC - Show Module CRC

Calculate and display the Checksum of the whole flash. Calculation also includes the blank addresses. Trim values are ignored.

3.27 VV - Verify Module CRC to Value

Verify against a specified CRC value. Used with the SC command to ensure each chip is programmed with the same data.

3.28 SD - Secure Device

Secures the chip after a power-on-reset. Please read the chip's reference manual for more information. Depending on the chip's architecture, the method of unsecuring the chip will differ. Unsecuring the chip will erase the flash on the next attempt to enter debug mode, in order to prevent flash data from being viewed.

3.29 EP - Erase Page

Erase a specific page of memory. Please read the chip's reference manual to determine the size of each flash page.

3.30 SA - Show Algorithm Source

Show the algorithm's source

4 START-UP CONFIGURATION

The PROG12Z software may be started in a way that enables certain optional parameters, which can assist the programming process. To set these command-line parameters, highlight the Windows Icon for the PROG12Z executable, right-click, and select “Properties” from the pop-up File Menu. The “General” Properties tab should open by default. There are several parameters that you may then include on the command line. A description of each is listed below, followed by specific examples of how these parameters are used.

Syntax:

```
PROG12Z [freq n] [io_delay_cnt n] [v] [interface=x]
        [port=y]
```

Where:

Optional parameters are in brackets []. The parameters are described as follows:

- | | |
|-------------------------|--|
| [freq n] | This allows the user to specify the exact speed of the target. If this is not specified, the programmer tries to calculate the target's speed. The frequency specified is the INTERNAL clock frequency of the target. See Section 2.2 - Algorithm Timing Considerations for more information. |
| [io_delay_cnt n] | The optional <i>io_delay_cnt</i> 'n' parameter causes the background debug mode clock to be extended by 'n' cycles where 'n' is between 1 and 64k, inclusive. Used when using a very fast PC or a slow CPU clock. (default = 1). |
| [v] | If the optional parameter v is specified as either V or v, then the range of S-records is not verified during the programming or verification process. This can help speed up these functions. |
| [interface=x] | where x is one of the following: (See examples section)
USBMULTILINK (supports Multilink Universal,
Multilink Universal FX, and OSJtag)
CYCLONE |

[port=y]

PARALLEL

Where the value of y is one of the following (see the showports command-line parameter for a list of connected hardware; always specify the "interface" type as well):

USBx Where x = 1,2,3, or 4. Represents an enumeration number for each piece of hardware starting at 1. Useful if trying to connect to a Cyclone or Multilink product. If only one piece of hardware is connected, it will always enumerate as USB1.

An example to select the first Multilink found is:

```
INTERFACE=USBMULTILINK  
PORT=USB1
```

Ethernet IP address ###. Each # symbol represents a decimal number between 0 and 255. Valid for Cyclone and Tracelink interfaces.

Connection is via Ethernet.

```
INTERFACE=CYCLONE PORT=10.0.1.223
```

NAME

Some products, such as the Cyclone and Tracelink, support assigning a name to the unit, such as "Joe's Max". The Cyclone may be referred to by it's assigned name. If there are any spaces in the name, the whole parameter should be enclosed in double quotes (this is a Windows requirement, not a PEmicro requirement).

Examples:

INTERFACE=CYCLONE

PORT=MyCyclone99

INTERFACE=CYCLONE "PORT=Joe's Max"

UNIQUEID USB Multilink products all have a unique serial number assigned to them, such as PE5650030. The Multilink may be referred to this number. This is useful in the case where multiple units are connected to the same PC.

Examples:

INTERFACE=USBMULTILINK

PORT=PE5650030

COMx Where x = 1,2,3, or 4. Represents a COM port number. Valid for Cyclone interfaces.

To connect to a Cyclone on COM1 :

INTERFACE=CYCLONE PORT=COM1

x Where x = 1,2,3, or 4. Represents a parallel port number

To select a parallel interface on Parallel Port #1 :

INTERFACE=PARALLEL PORT=1

PCIx Where x = 1,2,3, or 4. Represents a BDM Lightning card number. (Note: this is a legacy product)

To select a parallel cable on BDM Lightning #1 :

INTERFACE=PARALLEL PORT=PCI1

Example 1

CPROG12Z C:\ENGINE.CFG Interface=USBMULTILINK Port=USB1

Opens CPROG12Z with the following options:

- Run the C:\ENGINE.CFG script
- Interface is USB Multilink Universal, first cable detected.

Example 2

CPROG12Z C:\ENGINE.CFG Interface=CYCLONE Port=209.61.110.251

Opens CPROG12Z with the following options:

- Run the C:\ENGINE.CFG script
- Interface is Cyclone LC/FX Universal via the Ethernet Port with an IP address of 209.61.110.251

Example 3

CPROG12Z C:\ENGINE.CFG Interface=USBMULTILINK Port=USB1 bdm_speed 0

Opens CPROG12Z with the following options:

- Run the C:\ENGINE.CFG script
- Interface is USB Multilink Universal, first cable detected.
- BDM shift clock speed set to 1,000,000 Hz. [bdm_speed n] = USB Multilink Universal: (1,000,000/(N+1)) Hz. For n = 0, BDM shift clock speed for USB Multilink Universal = (1,000,000/(0+1)) Hz = 1,000,000 Hz

5 CONNECTION MANAGER

Before programming your device, you will need to connect to your target using a hardware interface. Interface options for PROG12Z are discussed in **Section 8 - HARDWARE INTERFACES**.

Once you have physically connected your PC to your target using the hardware interface, and the appropriate drivers are installed, the following Connection Manager dialog will appear:

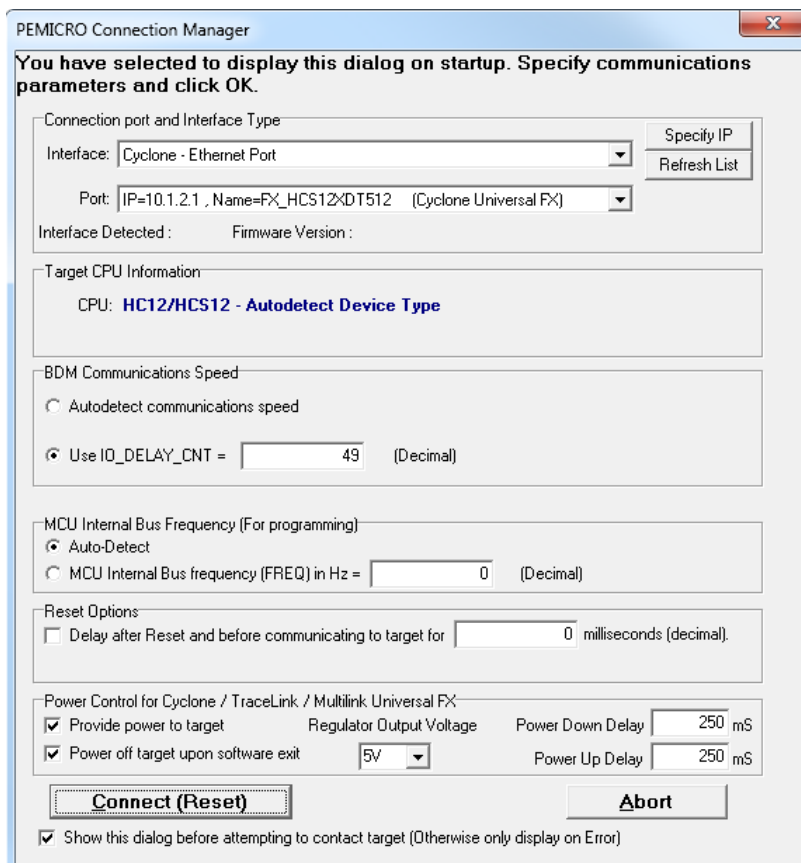


Figure 5-1: Connection Manager Dialog

The Connection Manger allows you to choose the interface that you wish to use and

configure the connection.

Use the Interface drop-down menu to choose the type of interface that you plan to use.

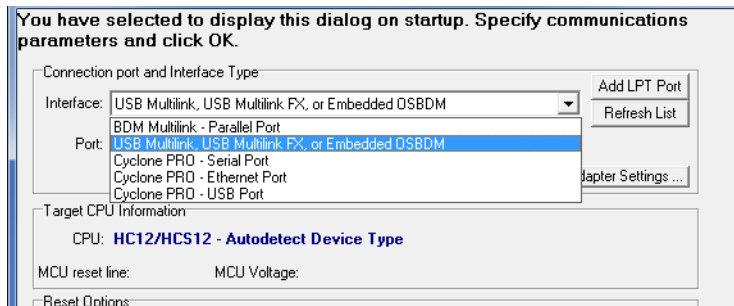


Figure 5-2: Connection Manager - Select Interface

Then select the interface from those available, which are listed in the Port drop-down list. The Refresh List button to the right may be used to update the list of available interfaces.

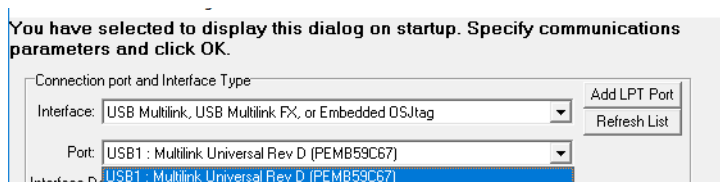


Figure 5-3: Connection Manager - Select Port

Beneath that section, in the Connection Manager, the BDM Debug Shift Frequency can be selected from the drop-down list in the BDM Communication Speed section.

The password can be either 64-bit (16 hex characters) or 256-bit (64 hex characters) depending on the device. The user should read their chip's reference manual for more details.

5.1 Additional Settings

The remainder of the PEMICRO Connection Manager allows the user to make settings related to BDM Communications Speed, MCU Internal Bus Frequency, and Power Control (for interfaces that can provide power to the target device)..

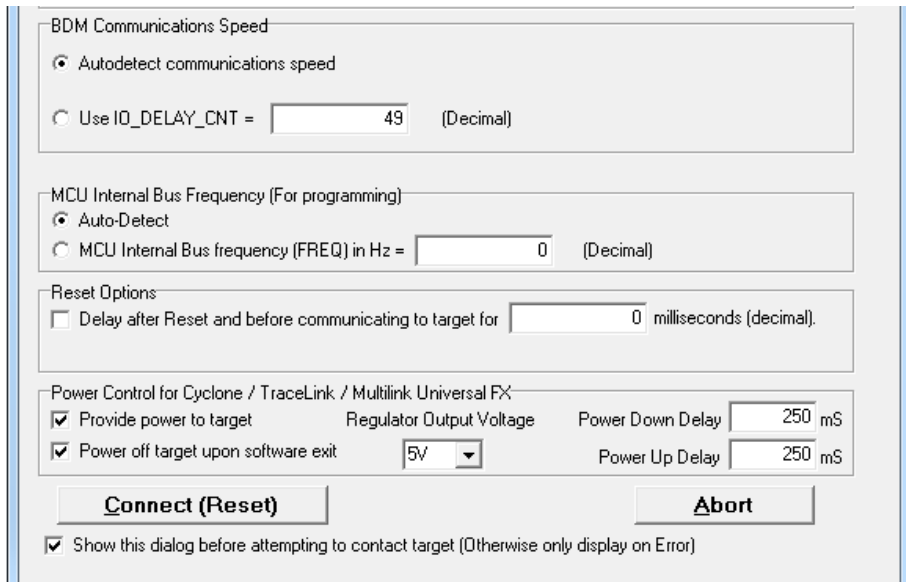


Figure 5-4: Connection Manager - BDM Shift Freq

Figure 5-5:

5.1.1 BDM Communications Speed

This software can automatically detect the proper communication speed to establish a connection with the target. For HC12/HCS12 devices, the BDM communication speed may be set (instead of being auto-detected) by setting the value of the IO_DELAY_CNT variable. If the software takes a long time to detect the proper value for IO_DELAY_CNT, it can be set manually.

5.1.2 MCU Internal Bus Frequency (For programming)

This option can be set to auto-detect in most situations.

5.1.3 Reset Options

If your board has any active components connected to your RESET signal such as a supply voltage supervisory circuit or a reset monitor, the RESET signal may have a longer rise time. This option can set a delay before beginning communication to give time for RESET to stabilize. A typical value is 300 milliseconds.

5.1.4 Power Control for Cyclone / TraceLink / Multilink Universal FX

This option controls how power is provided to the target board (only on supported debug interfaces).

5.2 Connect and Choose Algorithm

Once you have made all your selections in the PEMICRO Connection Manager, Click the Connect (Reset) button to connect to the target. If you are successful, you will be prompted to choose a programming algorithm for your target using the following browse window:

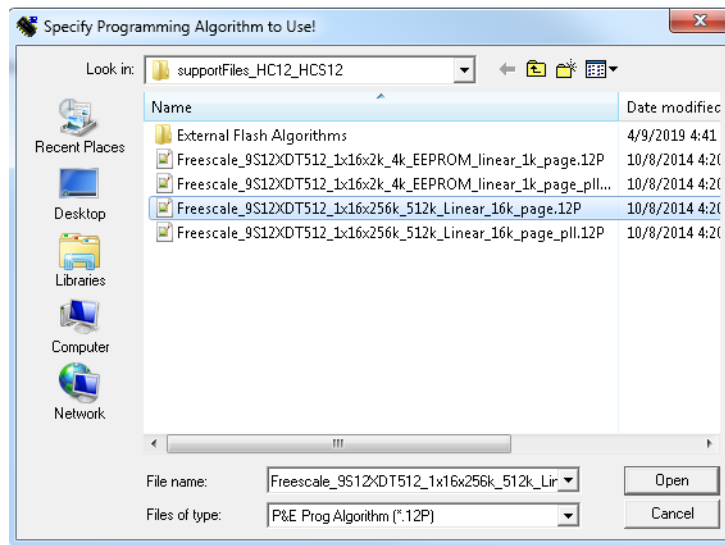
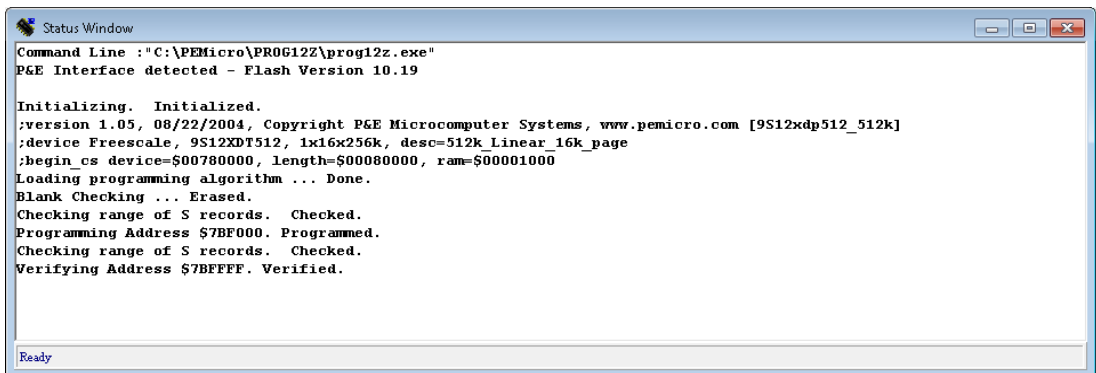


Figure 5-6: Select Algorithm

Once you have selected the appropriate algorithm, you are ready to begin programming.

6 MANUAL PROGRAMMING

The Choose Programming Function Window (see **Figure 3-1**) lists commands that are available to execute. Any of the programmer's enabled features can be selected using the mouse, the up and down arrow keys, or by typing the two-letter command abbreviations that appear to the left of the list of programming functions into the Status Window. The Status Window also displays any error messages that might result from the commands that you perform.



```

Status Window
Command Line : "C:\PEMicro\PROG12Z\prog12z.exe"
P&E Interface detected - Flash Version 10.19

Initializing.  Initialized.
;version 1.05, 08/22/2004, Copyright P&E Microcomputer Systems, www.pemicro.com [9S12xdp512_512k]
;device Freescale, 9S12XDT512, 1x16x256k, desc=512k Linear 16k_page
;begin_cs device=$00780000, length=$00080000, ram=$00001000
Loading programming algorithm ... Done.
Blank Checking ... Erased.
Checking range of S records.  Checked.
Programming Address $7BF000.  Programmed.
Checking range of S records.  Checked.
Verifying Address $7BFFFF.  Verified.

Ready
  
```

Figure 6-1: Status Window

Pressing ENTER or double clicking the mouse in the Choose Programming Function Window will execute the highlighted entry if it is enabled. The user will be prompted for any additional information that is required to execute the selected function. Before you can program a module from an S record file, you must select such a file. If you try to execute a program module function and you have not selected a file, you will be asked to select one.

6.1 Manual Programming Procedure

Here is the procedure for performing manual programming:

1. Before turning on your power supply, check that the target power supply is on and the interface cable is connected to your target board. Be sure to apply proper target voltage before programming the flash. If you lose contact with your target board at any time during the procedure, you may double-click the "RE" command (Reset) to begin again.
2. Using the PROG12Z software, choose the programming algorithm by

- selecting the appropriate .12P file. Double clicking the "CM" (Choose Module) command will allow you to select the algorithm you wish to use.
3. After you select the .12P file, you may be asked for the base address. This is the address at which you would like to program the code. Enter the appropriate base address.
 4. a) Use the "EM" (Erase Module) command to erase the module at that location. The process of erasing the module will vary according to the size of the flash, but should take no longer than 30 seconds. If this procedure seems to be taking much longer than 30 seconds, then the computer is probably not getting a proper response from the board. If this is the case:
 - b) Check the jumper setting on your target board, as well as the programming voltage.
 5. Some programming algorithms have a special command, such as "BE," for block erase. If you are unable to double-click the "EM" (Erase Module) command, try using the "BE" (Block Erase) command. Some commands are hidden and you may need to use the scroll bar to scroll down to these commands.
 6. You may check to see whether or not the module has been erased by double-clicking the "BM" command (Blank Check Module). If the flash is not properly erased then this command will give you an error message. You may also check the contents of the memory locations by double-clicking the "SM" (Show Module) command. If the flash has been erased properly then all the memory locations will display "FF".
 7. Now use the "SS" command (Specify S Record) to load the object file (.S19), which you should have generated previously by using a compiler or an assembler. This command will ask for the name of the .S19 file.
 8. Now you ready to program the flash. Double click the "PM" command (Program Module) to begin the programming process.
 9. In order to check the results, use the "SM" command (Show Module) with the appropriate base address to view the contents of the flash. You should see that the flash has been correctly programmed. You may also double-click the "VM" command (Verify Module) to verify that all the bytes of the flash are correctly programmed.

7 SCRIPTED PROGRAMMING (CPROG12Z)

Programming commands, in addition to be executed manually, may also be collected into script files which can be used to automate the programming process. These scripts are executed by a command-line programming application called CPROG12Z, which is included with the PROG12Z software. When you run the CPROGDSC.EXE application, it will look for the *prog.cfg* script file and automatically execute the commands in that file.

For complete instructions on how to configure and execute the CPROG12Z scripted programmer, please see the **CPROG12Z User Guide**.

8 HARDWARE INTERFACES

PEmicro's Multilink Universal, Multilink Universal FX, and Cyclone LC/FX Universal are compatible hardware interfaces for use with PROG12Z. The USB Multilink Universal and USB Multilink Universal FX are development tools that communicate via USB and will enable you to debug your code and program it onto your target. The Cyclone LC/FX Universal are more versatile and robust development tools that communicate via Ethernet, USB, or Serial Port, and include advanced features and production programming capabilities, as well as Ethernet support.

Below is a review of their features and intended usage.

8.1 Multilink and Multilink FX

PEmicro's Multilink and Multilink FX debug probes offer an affordable and compact solution for your development needs, and allows debugging and programming to be accomplished simply and efficiently. Those doing rapid development will find the Multilink and Multilink FX easy to use and fully capable of fast-paced debugging and programming.



Figure 8-1: Multilink debug probe

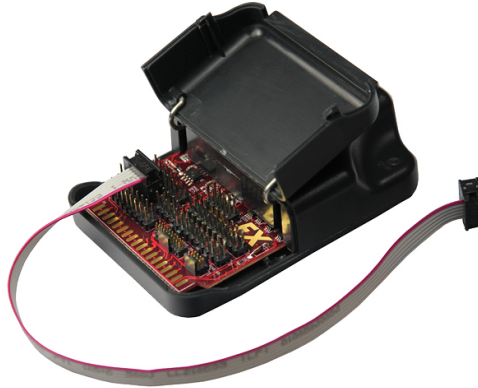


Figure 8-2: Multilink FX debug probe (open for access to headers)

8.1.1 Key Features

- Programming and debugging capabilities
- Compact and lightweight
- Communication via high-speed USB 2.0
- Supported by PEmicro software, NXP's MCUXpresso IDE, Kinetis® Design Studio, S32 Design Studio for ARM, S32 Design Studio for Vision, S32 Design Studio for Power, and other third-party software

8.1.2 Product Features & Implementation

PEmicro's Multilink debug probes allow a Windows XP/Vista/7/8/10 PC access to the debug mode on the target device via JTAG/SWD protocols (where applicable). Multilink ACP supports ARM Cortex-M devices from several manufacturers.. The Multilink Universal and Multilink FX debug probes also support ARM Cortex-M devices from several manufacturers, and in addition they support NXP's Kinetis®, LPC, i.MX, ColdFire® V1/ColdFire+ V1, ColdFire V2-4, MPC55xx-57xx, DSC, HC(S)12(X), HCS08 and RS08 microcontrollers, and STMicroelectronics' SPC5. The Multilink FX also supports a few legacy NXP architectures.

By using a Multilink debug probe, the user can take advantage of debug mode to halt normal processor execution and use a PC to control the processor. The user can then directly control the target's execution, read/write registers and memory values, debug code on the processor, and program internal or external FLASH memory devices. The

Multilink Universal enables you to debug, program, and test your code on your board.

8.1.3 Software

Multilink debug probes work with NXP's MCUXpresso, Kinetis and S32 Design Studios, Codewarrior, as well as PEmicro's flash programmer, PROG12Z.

8.2 Cyclone LC and Cyclone FX

PEmicro's Cyclone LC and Cyclone FX programmers are extremely flexible tools designed for in-circuit flash programming, debugging, and testing of many **8-/16-/32-bit microcontrollers from NXP & STMicroelectronics**, as well as **ARM® Cortex® devices from a variety of manufacturers**, including NXP, STMicroelectronics, Texas Instruments, Atmel, Infineon, Cypress, Silicon Labs, OnBright, and more. These Cyclones include a 4.3" touchscreen LCD and an access panel which provides easy access to all debug headers. Cyclones programmers offer multiple communications interfaces (including USB, Ethernet, and Serial), stand-alone programming functionality, high speed data transfer, a status LCD, and many other advanced capabilities.

Cyclones include, or can add, these additional advanced features:

- ProCryption Security (RSA/AES image encryption and programming limits)
- Advanced Automation and Control Features (e.g., gang programming)
- SDHC Port Activation (external storage via SD memory cards)

These items are all standard with the more advanced Cyclone FX model, which also features significantly larger internal storage, security, and speed enhancements, and the ability to launch programming via barcode scanner. This helps make the Cyclone FX PEmicro's premier production programming solution.

8.2.1 Supported Devices

ARM Cortex devices (all Cyclone part numbers):

NXP:	Kinetis®, LPC, i.MX, Automotive, Sensors, Vybrid
Atmel:	SAMxxx
Cypress:	CCG2, CCG3PA, EZ-BLE, FM3, PRoC-BLE, PSoC® 4, PSoC 5, PSoC 6
Infineon:	XMC
Silergy (Maxim):	AM0, AM1x, MAX716xx
Nordic Semi:	nRF51, nRF52

OnBright:	OB90Rxx
Silicon Labs:	EFM32, EFR32, SiM3
STMicroelectronics:	STM32
Texas Instruments:	LM3S, LM4, TM4C12x, SimpleLink
Toshiba:	TX00, TX03, & TX04

NXP 8-/16-/32-bit devices (“Universal” part number only):

S32, MPC55xx-57xx, ColdFire +/V1, ColdFire V2/3/4, DSC, HC(S)12(X), S12Z, HCS08, RS08, HC08 (MON08), MAC7xxx, Power MPC5xx/8xx. Also: STMicroelectronics’ SPC5 and STM8 (with STM8 adapter).

The Cyclone FX Universal also supports Renesas’ R8C, H8, H8S/Tiny, M16C, M16C80, M32C, RL78, RX, RX63T, RH850 device families (with Renesas adapter).



Figure 8-3: Cyclone LC Models

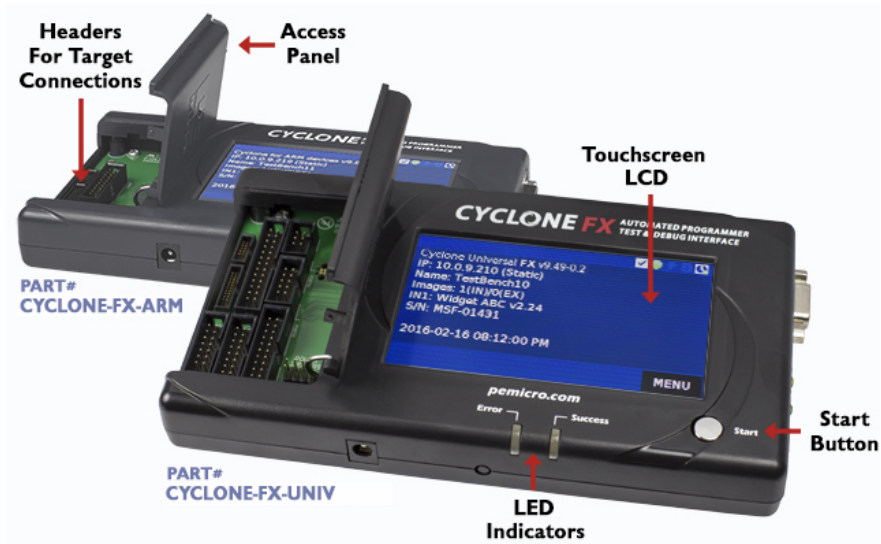


Figure 8-4: Cyclone FX Models

8.2.2 Key Features

- Many Supported Architectures
- Multiple Communications Interfaces
- USB 2.0 (Universal: Full-Speed; FX: High-Speed), Ethernet, and Serial interfaces
- On-Board Storage -- Cyclone LC: 16MB internal memory, Cyclone FX: 1GB internal memory. The Cyclone may be pre-programmed with non-volatile programming images and controlled via the touchscreen LCD, start button, or remotely from a PC (serial, USB, ethernet). Stand-alone programming operation does not require a PC.
- High-Speed Target Communications (FX Only): Cyclone FX improves on the already fast target communications speed of the Cyclone LC. The Cyclone FX is capable of download rates up to 75Mb/s.
- Power Switching: Allows switching of the target's power supply via Cyclone "power-in" and "power-out" jacks. On-board electromechanical relays handle the power switching. Power can also be provided to the target via the debug connection.

- Multiple Image Support: Multiple programming images may be stored in Cyclone memory. Cyclone LC: 8 images max; Cyclone FX: no practical limit.
- Touchscreen LCD Display: The 4.3" touchscreen display, in conjunction with the status LEDs and Start button, allows stand-alone control and configuration of the Cyclone.
- Serial Number Programming: The Cyclone can program dynamic data, such as serial numbers.
- Expansion Ports (FX Only): The Cyclone Universal FX includes these expansion ports:
 - - Programming control header (trigger programming/read status via pins)
 - - USB host/device port (for external USB peripherals such as barcode scanners)
- Cyclone FX advanced features that can be added to the Cyclone LC:
 - ProCryption Security - RSA/AES encryption of programming images and the ability to set limits on programming operations help keep valuable IP safe
 - External Storage: The SDHC port supports SDHC memory cards, for added storage capacity and flexibility.
 - Advanced Control/Automation - adds gang programming capability and more

8.2.3 Product Implementation

By connecting to a debug header on the target, the Cyclone can program, test, or debug internal memory on a supported processor or external flash connected to the processor's address/data bus, in-circuit. The processor or memory device can be mounted on the final printed circuit board before programming.

The Cyclone LC and Cyclone FX may be operated interactively via Windows-based programming applications, as well as under batch or dll commands from a PC. Once loaded with data by a PC a Cyclone can be disconnected and operated manually in a completely stand-alone mode via the touchscreen LCD menu and start button. The Cyclone's internal non-volatile memory allows the on-board storage of multiple programming images. The Cyclone FX also includes support for expandable memory via SDHC memory cards. When connected to a PC for programming or loading the

Cyclone can communicate via Ethernet, USB, or serial interfaces.

8.2.4 Software

The Cyclone LC and Cyclone FX come with intuitive configuration software and interactive programming software, as well as easy to use automated control software call. These Cyclones also function as full-featured debug interfaces, and are supported by software from PEmicro and third-party vendors.