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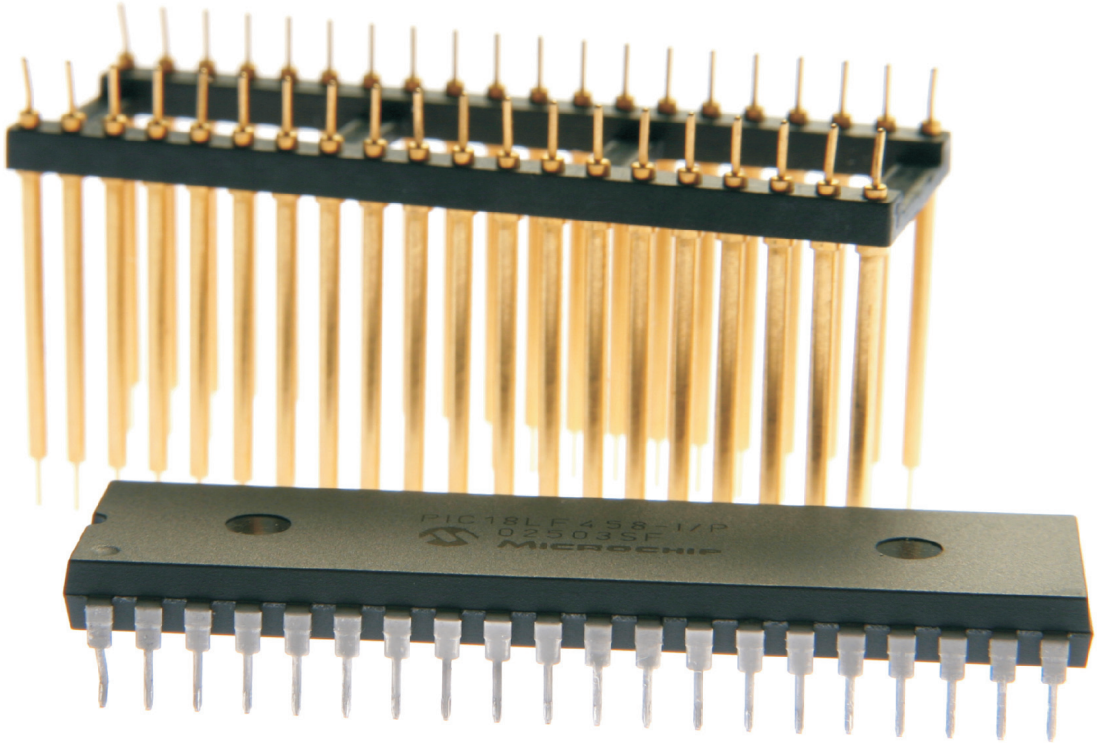
HI-TECH
SOFTWARE

PICC18™ STD

ANSI C COMPILER



HI-TECH PICC-18 STD Compiler

HI-TECH Software.

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Chapter 1

Introduction

1.1 Typographic conventions

Different fonts and styles are used throughout this manual to indicate special words or text. Computer prompts, responses and filenames will be printed in `constant-spaced` type**.** When the filename is the name of a standard header file, the name will be enclosed in angle brackets, e.g. `<stdio.h>`. These header files can be found in the `INCLUDE` directory of your distribution.

Samples of code, C keywords or types, assembler instructions and labels will also be printed in a `constant-space` type. Assembler code is printed in a font similar to that used by C code.

Particularly useful points and new terms will be emphasized using *italicized type*. When part of a term requires substitution, that part should be printed in the appropriate font, but in *italics*. For example: `#include <`*`filename.h`*`>`.

Chapter 2

PICC-18 Command-line Driver

PICC18 is the driver invoked from the command line to compile and/or link C programs. PICC18 has the following basic command format:

```
PICC18 [options] files [libraries]
```

It is conventional to supply the options (identified by a leading *dash* "-" or *double dash* "–") before the filenames.

The options are discussed below. The files may be a mixture of source files (C or assembler) and object files. The order of the files is not important, except that it will affect the order in which code or data appears in memory. *Libraries* are a list of library names, or -L options, see Section 2.4.7. Source files, object files and library files are distinguished by PICC18 solely by the *file type* or *extension*. Recognized file types are listed in Table 2.1. This means, for example, that an assembler file must always have a .as extension (alphabetic case is not important).

PICC18 will check each file argument and perform appropriate actions. C files will be compiled; assembler files will be assembled. At the end, unless suppressed by one of the options discussed later,

Table 2.1: PICC18 file types

File Type	Meaning
.c	C source file
.as	Assembler source file
.obj	Relocatable object code file
.lib	Relocatable object library file
.hex	Intel HEX file

all object files resulting from compilation or assembly, or those listed explicitly on the command line, will be linked together with the standard runtime code and libraries and any user-specified libraries. Functions in libraries will be linked into the resulting output file only if referenced in the source code.

Invoking `PICC18` with only object files specified as the file arguments (i.e. no source files) will mean only the link stage is performed. It is typical in Makefiles to use `PICC18` with a `-C` option to compile several source files to object files, then to create the final program by invoking `PICC18` again with only the generated object files and appropriate libraries (and appropriate options). If a .lib output file type is selected, the object files will be stored in a library instead of going through to the final link.

When a HEX file is given on the command line, `PICC18` will invoke the Hexmate utility and will merge the named hex file with the hex file currently being generated. This feature can be useful when, for example, a single hex file is desired which contains a bootloader and application program.

2.1 Long Command Lines

The PICC18 driver is capable of processing command lines exceeding any operating system limitation. To do this, the driver may be passed options via a command file. The command file is read by using the `@` symbol. For example:

```
PICC18 @xyz.cmd
```

2.2 Default Libraries

PICC18 will search the appropriate standard C library by default for symbol definitions. This will always be done last, after any user-specified libraries. The particular library used will be dependent on the processor selected.

2.3 Standard Runtime Code

PICC18 will automatically generate standard runtime start-up code appropriate for the processor and options selected unless you have specified to disable this via the `--RUNTIME` option. If you require any special powerup initialization, you should use the *powerup* routine feature (see Section 3.3.5.4).

2.4 PICC18 Compiler Options

Most aspects of the compilation can be controlled using the command-line driver, PICC18. The driver will configure and execute all required applications, such as the code generator, assembler and linker.

PICC18 recognizes the compiler options listed in the table below. The case of the options is not important, however command shells in UNIX based operating systems are case sensitive when it comes to names of files.

PICC18 Command-line Options

Option	**Meaning**
-C	Compile to object files only
-D*macro*	Define preprocessor macro
-E+*file*	Redirect and optionally append errors to a file
-G*file*	Generate source-level debugging information
-I*path*	Specify a directory pathname for include files
-L*library*	Specify a library to be scanned by the linker
-L-*option*	Specify *-option* to be passed directly to the linker
-M*file*	Request generation of a MAP file
-N*size*	Specify identifier length
-O*file*	Output file name
-P	Preprocess assembler files
-Q	Specify quiet mode
-S	Compile to assembler source files only
-U*symbol*	Undefine a predefined preprocessor symbol
-V	Verbose: display compiler pass command lines
-X	Eliminate local symbols from symbol table
--ASMLIST	Generate assembler .LST file for each compilation
--CALLGRAPH=*type*	Control the level of information displayed in the call graph
--CHAR=*type*	Make the default char signed or unsigned
--CHIP=*processor*	Selects which processor to compile for
--CHIPINFO	Displays a list of supported processors
--CODEOFFSET=*address*	Offset program code to address
--CP=*size*	Set size of pointers to code space
--CR=*file*	Generate cross-reference listing
--DEBUGGER=*type*	Select the debugger that will be used
continued...	

PICC18 Command-line Options

Option	**Meaning**
--DOUBLE=*type*	Selects size/kind of double types
--EMI=*type*	Select the type of external memory interface used
--ERRATA=*type*	Add or remove specific software workarounds for silicon errata issues.
--ERRFORMAT<=*format*>	Format error message strings to the given style
--ERRORS=*number*	Sets the maximun number of errors displayed
--FILL=*opcode*	Specify a hexadecimal opcode to program in all unused program memory locations.
--GETOPTION=*app*,*file*	Get the command line options for the named application
--HELP<=option>	Display the compiler's command line options
--IDE=*ide*	Configure the compiler for use by the named IDE
--LANG=*language*	Specify language for compiler messages
--MAPFILE<=*file*>	Generates a map file
--MEMMAP=*file*	Display memory summary information for the map file
--MSGFORMAT<=*format*>	Format general message strings to the given style
--NODEL	Do not remove temporary files generated by the compiler
--NOEXEC	Go through the motions of compiling without actually compiling
--OPT<=*type*>	Enable general compiler optimizations
--OUTDIR	Specify output files directory
--OUTPUT=*type*	Generate output file type
--PRE	Produce preprocessed source files
--PROTO	Generate function prototype information
--RAM=lo-hi<,lo-hi,...>	Specify and/or reserve RAM ranges
--ROM=lo-hi<,lo-hi,...>	Specify and/or reserve ROM ranges
--RUNTIME=*type*	Configure the C runtime libraries to the specified type
--SCANDEP	Generate file dependency ".DEP files"
--SERIAL=*code*@*address*	Store this hexadecimal code at an address in program memory
--SETOPTION=*app*,*file*	Set the command line options for the named application
--SETUP=argument	Setup the product
continued...	

PICC18 Command-line Options

Option	Meaning
`--STRICT`	Enable strict ANSI keyword conformance
`--SUMMARY=`*`type`*	Selects the type of memory summary output
`--VER`	Display the compiler's version number
`--WARN=`*`level`*	Set the compiler's warning level
`--WARNFORMAT=`*`format`*	Format warning message strings to given style

All single letter options are identified by a leading *dash* character, "-", e.g. `-C`. Some single letter options specify an additional data field which follows the option name immediately and without any whitespace, e.g. `-Ddebug`.

Multi-letter, or word, options have two leading *dash* characters, e.g. `--ASMLIST`. (Because of the double *dash*, you can determine that the option `--ASMLIST`, for example, is not a `-A` option followed by the argument `SMLIST`.) Some of these options define suboptions which typically appear as a *comma*-separated list following an *equal* character, `=`, e.g. `--OUTPUT=hex,cof`. The exact format of the options varies and are described in detail in the following sections.

Some commonly used suboptions include `default`, which represents the default specification that would be used if this option was absent altogether; `all`, which indicates that all of the available suboptions should be enabled as if they had each been listed; and `none`, which indicates that all suboptions should be disabled. Some suboptions may be prefixed with a plus character, `+`, to indicate that they are in addition to the other suboptions present, or a minus character "-", to indicate that they should be excluded. In the following sections, *angle brackets,* < >, are used to indicate optional parts of the command.

2.4.1 `-B`*`model`*: Select Memory Model

The `-B`*`model`* option tells PICC18 that this build is configured for memory model, *`model`*. The memory models available for selection are *`s`* (*small*) and *`l`* (*large*). See Section 3.6.3 for details on the differences between each of these memory models. If unspecified the default memory model selection is *large*, which is the same as specifying `-Bl`.

2.4.2 `-C`: Compile to Object File

The `-C` option is used to halt compilation after generating a relocatable object file. This option is frequently used when compiling multiple source files using a "make" utility. If multiple source files are specified to the compiler each will be compiled to a separate `.obj` file. The object files will be placed in the directory in which PICC18 was invoked, to handle situations where source files are

located in read-only directories. To compile three source files `main.c`, `module1.c` and `asmcode.as` to object files you could use a command similar to:

```
PICC18 --CHIP=18F242 -C main.c module1.c asmcode.as
```

The compiler will produce three object files `main.obj`, `module1.obj` and `asmcode.obj` which could then be linked to produce an *Intel* HEX file using the command:

```
PICC18 --CHIP=18F242 main.obj module1.obj asmcode.obj
```

2.4.3 -D*macro*: Define Macro

The `-D` option is used to define a preprocessor macro on the command line, exactly as if it had been defined using a `#define` directive in the source code. This option may take one of two forms, `-Dmacro` which is equivalent to:

```
#define  macro  1
```

placed at the top of each module compiled using this option, or `-Dmacro=`*text* which is equivalent to:

```
#define  macro  text
```

where ***text*** is the textual substitution required. Thus, the command:

```
PICC18 --CHIP=18F242 -Ddebug -Dbuffers=10 test.c
```

will compile `test.c` with macros defined exactly as if the C source code had included the directives:

```
#define  debug    1
#define  buffers 10
```

2.4.4 -E*file*: Redirect Compiler Errors to a File

Some editors do not allow the standard command line redirection facilities to be used when invoking the compiler. To work with these editors, PICC18 allows an error listing filename to be specified as part of the `-E` option. Error files generated using this option will always be in `-E` format. For example, to compile `x.c` and redirect all errors to `x.err`, use the command:

```
PICC18 --CHIP=18F242 -Ex.err x.c
```

The -E option also allows errors to be appended to an existing file by specifying an *addition* character, +, at the start of the error filename, for example:

```
PICC18 --CHIP=18F242 -E+x.err y.c
```

If you wish to compile several files and combine all of the errors generated into a single text file, use the -E option to create the file then use -E+ when compiling all the other source files. For example, to compile a number of files with all errors combined into a file called project.err, you could use the -E option as follows:

```
PICC18 --CHIP=18F242 -Eproject.err -O -C main.c
PICC18 --CHIP=18F242 -E+project.err -O -C part1.c
PICC18 --CHIP=18F242 -E+project.err -C asmcode.as
```

The file project.err will contain any errors from main.c, followed by the errors from part1.c and then asmcode.as, for example:

```
main.c 11 22: ) expected
main.c 63 0: ; expected
part1.c 5 0: type redeclared
part1.c 5 0: argument list conflicts with prototype
asmcode.as 14 0: Syntax error
asmcode.as 355 0: Undefined symbol _putint
```

2.4.5 -G*file*: Generate Source-level Symbol File

The -G option generates a *source-level symbol file* (i.e. a file which allows tools to determine which line of source code is associated with machine code instructions, and determine which source-level variable names correspond with areas of memory, etc.) for use with supported debuggers and simulators such as *HI-TIDE*® and *MPLAB*®. If no filename is given, the symbol file will have the same base name as the first source or object file specified on the command line, and an extension of .sym. For example the option -GTEST.SYM generates a symbol file called test.sym. Symbol files generated using the -G option include source-level information for use with source-level debuggers.

Note that all source files for which source-level debugging is required should be compiled with the -G option. The option is also required at the link stage, if this is performed separately. For example:

```
PICC18 --CHIP=18F242 -G -C test.c
PICC18 --CHIP=18F242 -C module1.c
PICC18 --CHIP=18F242 -Gtest.sym test.obj module1.obj
```

will include source-level debugging information for `test.c` only because `module1.c` was not compiled with the `-G` option.

The `--IDE` option will typically enable the `-G` option.

2.4.6 `-Ipath`: Include Search Path

Use `-I` to specify an additional directory to use when searching for header files which have been included using the `#include` directive. The `-I` option can be used more than once if multiple directories are to be searched. The default include directory containing all standard header files is always searched even if no `-I` option is present, and will be searched after any user-specified directories have been searched. For example:

```
PICC18 --CHIP=18F242 -C -Ic:\include -Id:\myapp\include test.c
```

will search the directories `c:\include` and `d:\myapp\include` for any header files included into the source code, then search the default include directory (the include directory where the compiler was installed).

2.4.7 `-Llibrary`: Scan Library

The `-L` option is used to specify additional libraries which are to be scanned by the linker. Libraries specified using the `-L` option are scanned before the standard C library, allowing additional versions of standard library functions to be accessed.

The argument to -L is a library keyword to which the prefix `pic8`; numbers and letters representing the build configuration and applicable errata workarounds; and the suffix `.lib` are added. Thus the option `-LL` when compiling for a 18F452 will, for example, scan the library `pic861-l.lib` and the option `-Lxx` will scan a library called `pic86c-xx.lib`. All libraries must be located in the LIB subdirectory of the compiler installation directory. As indicated, the argument to the `-L` option is *not* a complete library filename.

If you wish the linker to scan libraries whose names do not follow the above naming convention or whose locations are not in the LIB subdirectory, simply include the libraries' names on the command line along with your source files. Alternatively, the linker may be invoked directly allowing the user to manually specify all the libraries to be scanned.

2.4.8 `-L-option`: Adjust Linker Options Directly

The `-L` option can also be used to specify an extra "-" option which will be passed directly to the linker by PICC18. If `-L` is followed immediately by any text starting with a *dash* character "-", the text will be passed directly to the linker without being interpreted by PICC18. For example, if the option `-L-FOO` is specified, the `-FOO` option will be passed on to the linker when it is invoked.

The -L option is especially useful when linking code which contains extra program sections (or *psects*), as may be the case if the program contains C code which makes use of the #pragma psect directive or assembler code which contains user-defined psects. See Section 3.12.3.3 for more information. If this -L option did not exist, it would be necessary to invoke the linker manually to link code which uses the extra psects.

One commonly used linker option is -N, which sorts the symbol table in the map file by address, rather than by name. This would be passed to PICC18 as the option -L-N.

The -L option can also be used to replace default linker options. If the string starting from the first character after the -L up to the = character matches a default option, then the default option is replaced by the option specified. For example, -L-preset=100h will inform the linker to replace the default option that places the reset psect to be one that places the psect at the address 100h. The default option that you are replacing must contain an *equal* character.

2.4.9 -M*file*: Generate Map File

The -M option is used to request the generation of a map file. The map is generated by the linker and includes information about where objects are located in memory. If no filename is specified, then the name of the map file will have the same name as the first file listed on the command line, with the extension .map.

2.4.10 -N*size*: Identifier Length

This option allows the C identifier length to be increased from the default value of 31. Valid sizes for this option are from 32 to 255. The option has no effect for all other values.

2.4.11 -O*file*: Specify Output File

This option allows the name of the output file(s) to be specified. If no -O option is given, the output file(s) will be named after the first source or object file on the command line. The files controlled are any produced by the linker or applications run subsequent to that, e.g. CROMWELL. So for instance the HEX file, map file and SYM file are all controlled by the -O option.

The -O option can also change the directory in which the output file is located by including the required path before the filename, e.g. -Oc:\project\output\first.hex. This will then also specify the output directory for any files produced by the linker or subsequently run applications.

2.4.12 -P: Preprocess Assembly Files

The -P option causes the assembler files to be preprocessed before they are assembled thus allowing the use of preprocessor directives, such as #include, with assembler code. By default, assembler