

IAR Linker and Library Tools

Reference Guide

Version 4.59

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Preface

Welcome to the IAR Linker and Library Tools Reference Guide. The purpose of this guide is to provide you with detailed reference information that can help you to use the IAR Systems linker and library tools to best suit your application requirements.

Who should read this guide

This guide provides reference information about the IAR XLINK Linker version 4.59, the IAR XAR Library Builder, and the IAR XLIB Librarian. You should read it if you plan to use the IAR Systems tools for linking your applications and need to get detailed reference information on how to use the IAR Systems linker and library tools. In addition, you should have working knowledge of the following:

- The architecture and instruction set of your target microcontroller. Refer to the chip manufacturer's documentation.
- Your host operating system.

For information about programming with the IAR Compiler, refer to the *IAR Compiler Reference Guide*.

For information about programming with the IAR Assembler, refer to the *IAR Assembler Reference Guide*.

How to use this guide

When you first begin using IAR Systems linker and library tools, you should read the *Introduction to the IAR XLINK Linker* and *Introduction to the IAR Systems library tools* chapters in this reference guide.

If you are an intermediate or advanced user, you can focus more on the reference chapters that follow the introductions.

If you are new to using the IAR Systems toolkit, we recommend that you first read the initial chapters of the *IAR Embedded Workbench® IDE User Guide*, where you will find information about installing the IAR Systems development tools, product overviews, and tutorials that will help you get started. The *IAR Embedded Workbench® IDE User Guide* also contains complete reference information about the IAR Embedded Workbench IDE and the IAR C-SPY® Debugger.

What this guide contains

Below is a brief outline and summary of the chapters in this guide.

Part 1: The IAR XLINK Linker

- *Introduction to the IAR XLINK Linker* describes the IAR XLINK Linker, and gives examples of how it can be used. It also explains the XLINK listing format.
- *XLINK options* describes how to set the XLINK options, gives an alphabetical summary of the options, and provides detailed information about each option.
- *XLINK output formats* summarizes the output formats available from XLINK.
- *XLINK environment variables* gives reference information about the IAR XLINK Linker environment variables.
- *XLINK diagnostics* describes the error and warning messages produced by the IAR XLINK Linker.

Part 2: The IAR Library Tools

- *Introduction to the IAR Systems library tools* describes the IAR Systems library tools—IAR XAR Library Builder and IAR XLIB Librarian—which are designed to allow you to create and maintain relocatable libraries of routines.
- *The IAR XAR Library Builder* describes how to use XAR and gives a summary of the XAR command line options.
- *XAR diagnostics* describes the error and warning messages produced by the IAR XAR Library Builder.
- *IAR XLIB Librarian options* gives a summary of the XLIB commands, and complete reference information about each command. It also gives reference information about the IAR XLIB Librarian environment variables.
- *XLIB diagnostics* describes the error and warning messages produced by the IAR XLIB Librarian.

Document conventions

This guide uses the following typographic conventions:

| Style | Used for |
|-----------|---|
| computer | Text that you type in, or that appears on the screen. |
| parameter | A label representing the actual value you should type as part of a command. |
| [option] | An optional part of a command. |
| {option} | A mandatory part of a command. |
| a b c | Alternatives in a command. |

Table 1: Typographic conventions used in this guide


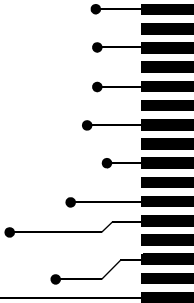
| Style | Used for |
|---|---|
| bold | Names of menus, menu commands, buttons, and dialog boxes that appear on the screen. |
| reference | Cross-references to another part of this guide, or to another guide. |
|  | Identifies instructions specific to the versions of the IAR Systems tools for the IAR Embedded Workbench interface. |

Table 1: Typographic conventions used in this guide (Continued)

Part I: The IAR XLINK Linker

This part of the IAR Linker and Library Tools Reference Guide contains the following chapters:

- Introduction to the IAR XLINK Linker
- XLINK options
- XLINK output formats
- XLINK environment variables
- XLINK diagnostics.





Introduction to the IAR XLINK Linker

The following chapter describes the IAR XLINK Linker, and gives examples of how it can be used.

Note: The IAR XLINK Linker is a general tool. Therefore, some of the options and segment types described in the following chapters may not be relevant for your product.

Key features

The IAR XLINK Linker converts one or more relocatable object files produced by the IAR Systems Assembler or Compiler to machine code for a specified target processor. It supports a wide range of industry-standard loader formats, in addition to the IAR Systems debug format used by the IAR C-SPY® Debugger.

The IAR XLINK Linker supports user libraries, and will load only those modules that are actually needed by the program you are linking.

The final output produced by the IAR XLINK Linker is an absolute, target-executable object file that can be programmed into an EPROM, downloaded to a hardware emulator, or run directly on the host computer using the IAR C-SPY Debugger Simulator.

The IAR XLINK Linker offers the following important features:

- Unlimited number of input files.
- Searches user-defined library files and loads only those modules needed by the application.
- Symbols may be up to 255 characters long with all characters being significant. Both uppercase and lowercase may be used.
- Global symbols can be defined at link time.
- Flexible segment commands allow full control of the locations of relocatable code and data in memory.
- Support for over 30 output formats.

MISRA C

MISRA C is a subset of C, suited for use when developing safety-critical systems, supported by some versions of IAR Embedded Workbench. The rules that make up MISRA C were published in “Guidelines for the Use of the C Language in Vehicle Based Software”, and are meant to enforce measures for stricter safety in the ISO standard for the C programming language [ISO/IEC 9899:1990].

If your version of IAR Embedded Workbench supports checking for adherence to the MISRA C rules, you can set up the linker checking using the options `--misrac` and `--misrac_verbose`, see `--misrac`, page 38 and `--misrac_verbose`, page 39.

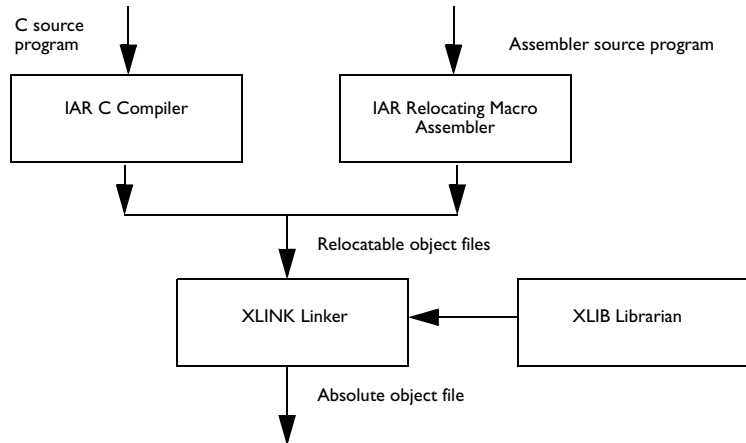
The implementation of the MISRA C rules does not affect code generation, and has no significant effect on the performance of IAR Embedded Workbench. The rules apply to the source code of the applications that you write and not to the code generated by the compiler. The compiler and linker only generate error messages, they do not actually prevent you from breaking the rules you are checking for.

The linking process

The IAR XLINK Linker is a powerful, flexible software tool for use in the development of embedded-controller applications. XLINK reads one or more relocatable object files produced by the IAR Systems Assembler or Compiler and produces absolute, machine-code programs as output.

It is equally well suited for linking small, single-file, absolute assembler programs as it is for linking large, relocatable, multi-module, C/C++, or mixed C/C++ and assembler programs.

The following diagram illustrates the linking process:



OBJECT FORMAT

The object files produced by the IAR Systems Assembler and Compiler use a proprietary format called UBROF, which stands for Universal Binary Relocatable Object Format. An application can be made up of any number of UBROF relocatable files, in any combination of assembler and C/C++ programs.

XLINK FUNCTIONS

The IAR XLINK Linker performs four distinct functions when you link a program:

- It loads modules containing executable code or data from the input file(s).
- It links the various modules together by resolving all global (i.e. non-local, program-wide) symbols that could not be resolved by the assembler or compiler.
- It loads modules needed by the program from user-defined or IAR-supplied libraries.
- It locates each segment of code or data at a user-specified address.

LIBRARIES

When the IAR XLINK Linker reads a library file (which can contain multiple C/C++ or assembler modules) it will only load those modules which are actually needed by the program you are linking. The IAR XLIB Librarian is used for managing these library files.

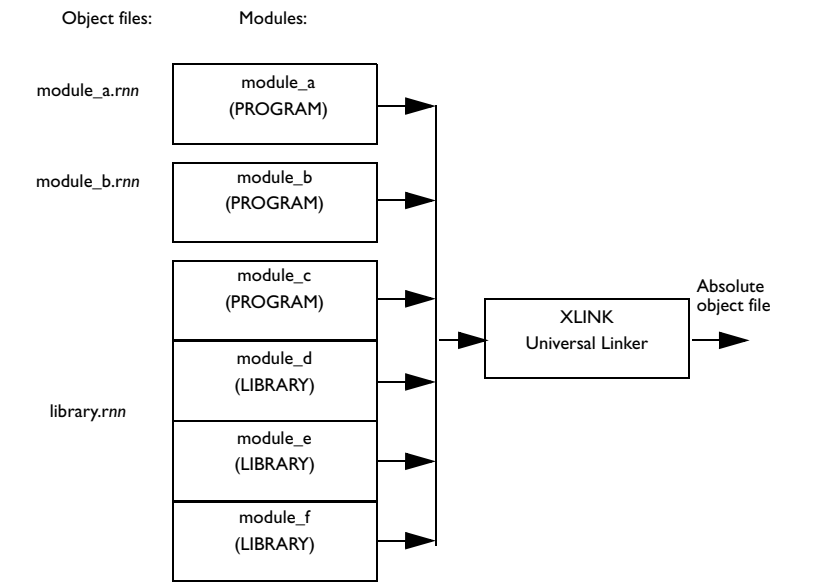
OUTPUT FORMAT

The final output produced by the IAR XLINK Linker is an absolute, executable object file that can be put into an EPROM, downloaded to a hardware emulator, or executed on your PC using the IAR C-SPY Debugger Simulator.

Note: The default output format in IAR Embedded Workbench is `DEBUG`.

Input files and modules

The following diagram shows how the IAR XLINK Linker processes input files and load modules for a typical assembler or C/C++ program:



The main program has been assembled from two source files, `module_a.snn` and `module_b.snn`, to produce two relocatable files. Each of these files consists of a single module `module_a` and `module_b`. By default, the assembler assigns the `PROGRAM` attribute to both `module_a` and `module_b`. This means that they will always be loaded and linked whenever the files they are contained in are processed by the IAR XLINK Linker.

The code and data from a single C/C++ source file ends up as a single module in the file produced by the compiler. In other words, there is a one-to-one relationship between C/C++ source files and C/C++ modules. By default, the compiler gives this module the same name as the original C/C++ source file. Libraries of multiple C/C++ modules can only be created using the IAR XAR Library Builder or the IAR XLIB Librarian.

Assembler programs can be constructed so that a single source file contains multiple modules, each of which can be a program module or a library module.

LIBRARIES

In the previous diagram, the file `library.rnn` consists of multiple modules, each of which could have been produced by the assembler or the compiler.

The module `module_c`, which has the `PROGRAM` attribute will *always* be loaded whenever the `library.rnn` file is listed among the input files for the linker. In the run-time libraries, the startup module `cstartup` (which is a required module in all C/C++ programs) has the `PROGRAM` attribute so that it will always get included when you link a C/C++ project.

The other modules in the `library.rnn` file have the `LIBRARY` attribute. Library modules are only loaded if they contain an entry (a function, variable, or other symbol declared as `PUBLIC`) that is referenced in some way by another module that is loaded. This way, the IAR XLINK Linker only gets the modules from the library file that it needs to build the program. For example, if the entries in `module_e` are not referenced by any loaded module, `module_e` will not be loaded.

This works as follows:

If `module_a` makes a reference to an external symbol, the IAR XLINK Linker will search the other input files for a module containing that symbol as a `PUBLIC` entry; in other words a module where the entry itself is located. If it finds the symbol declared as `PUBLIC` in `module_c`, it will then load that module (if it has not already been loaded). This procedure is iterative, so if `module_c` makes a reference to an external symbol the same thing happens.

It is important to understand that a library file is just like any other relocatable object file. There is really no distinct type of file called a library (modules have a `LIBRARY` or `PROGRAM` attribute). What makes a file a library is what it contains and how it is used. Put simply, a library is an `rnn` file that contains a group of related, often-used modules, most of which have a `LIBRARY` attribute so that they can be loaded on a demand-only basis.

Creating libraries

You can create your own libraries, or extend existing libraries, using C/C++ or assembler modules. The compiler option `--library_module` (`-b` for some IAR Systems products) can be used for making a C/C++ module have a `LIBRARY` attribute instead of the default `PROGRAM` attribute. In assembler programs, the `MODULE` directive is used for giving a module the `LIBRARY` attribute, and the `NAME` directive is used for giving a module the `PROGRAM` attribute.

The IAR XLIB Librarian is used for creating and managing libraries. Among other tasks, it can be used for altering the attribute (`PROGRAM/LIBRARY`) of any other module after it has been compiled or assembled.

SEGMENTS

Once the IAR XLINK Linker has identified the modules to be loaded for a program, one of its most important functions is to assign load addresses to the various code and data segments that are being used by the program.

In assembler language programs the programmer is responsible for declaring and naming relocatable segments and determining how they are used. In C/C++ programs the compiler creates and uses a set of predefined code and data segments, and the programmer has only limited control over segment naming and usage.

Each module contains a number of segment parts. Each segment part belongs to a segment, and contains either bytes of code or data, or reserves space in RAM. Using the XLINK segment control command line options (`-Z`, `-P`, and `-b`), you can cause load addresses to be assigned to segments and segment parts.

After module linking is completed, XLINK removes the segment parts that were not required. It accomplishes this by first including all `ROOT` segment parts in loaded modules, and then adding enough other segment parts to satisfy all dependencies. Dependencies are either references to external symbols defined in other modules or segment part references within a module. The `ROOT` segment parts normally consists of the root of the C run-time boot process and any interrupt vector elements.

Compilers and assemblers that produce UBROF 7 or later can put individual functions and variables into separate segment parts, and can represent all dependencies between segment parts in the object file. This enables XLINK to exclude functions and variables that are not required in the build process.

Segment control

The following options control the allocation of segments.

| | |
|--------------------------------|--|
| <code>-Ksegs=inc, count</code> | Duplicate code. |
| <code>-Ppack_def</code> | Define packed segments. |
| <code>-Zseg_def</code> | Define segments. |
| <code>-bbank_def</code> | Define banked segments. |
| <code>-Mrange_def</code> | Map logical addresses to physical addresses. |

For detailed information about the options, see the chapter *XLINK options*, page 23.

Segment placement using `-z` and `-p` is performed one placement command at a time, taking previous placement commands into account. As each placement command is processed, any part of the ranges given for that placement command that is already in use is removed from the considered ranges. Memory ranges can be in use either by segments placed by earlier segment placement commands, by segment duplication, or by objects placed at absolute addresses in the input fields.

For example, if there are two data segments (Z1, Z2) that must be placed in the zero page (0-FF) and three (A1, A2, A3) that can be placed anywhere in available RAM, they can be placed like this:

```
-Z (DATA) Z1, Z2=0-FF
-Z (DATA) A1, A2, A3=0-1FFF
```

This will place Z1 and Z2 from 0 and up, giving an error if they do not fit into the range given, and then place A1, A2, and A3 from the first address not used by Z1 and Z2.

The `-p` option differs from `-z` in that it does not necessarily place the segments (or segment parts) sequentially. See page 41 for more information about the `-p` option. With `-p` it is possible to put segment parts into holes left by earlier placements.

Use the `-z` option when you need to keep a segment in one consecutive chunk, when you need to preserve the order of segment parts in a segment, or, more unlikely, when you need to put segments in a specific order. There can be several reasons for doing this, but most of them are fairly obscure.

The most important is to keep variables and their initializers in the same order and in one block. Compilers using UBROF 7 or later, output attributes that direct the linker to keep segment parts together, so for these compilers `-z` is no longer required for variable initialization segments.

Use `-p` when you need to put things into several ranges, for instance when banking.

When possible, use the `-P` option instead of `-b`, since `-P` is more powerful and more convenient. The `-b` option is supported only for backward compatibility reasons.

Bit segments are always placed first, regardless of where their placement commands are given.

ADDRESS TRANSLATION

XLINK can do logical to physical address translation on output for some output formats. Logical addresses are the addresses as seen by the program, and these are the addresses used in all other XLINK command line options. Normally these addresses are also used in the output object files, but by using the `-M` option a mapping from the logical addresses to physical addresses as used in the output object file is established.

ALLOCATION SEGMENT TYPES

The following table lists the different types of segments that can be processed by XLINK:

| Segment type | Description |
|--------------|--|
| STACK | Allocated from high to low addresses by default. The aligned segment size is subtracted from the load address before allocation, and successive segments are placed below the preceding segment. |
| RELATIVE | Allocated from low to high addresses by default. |
| COMMON | All segment parts are located at the same address. |

Table 2: Allocation segment types

If stack segments are mixed with relative or common segments in a segment definition, the linker will produce a warning message but will allocate the segments according to the default allocation set by the first segment in the segment list.

Common segments have a size equal to the largest declaration found for the particular segment. That is, if module A declares a common segment `COMSEG` with size 4, while module B declares this segment with size 5, the latter size will be allocated for the segment.

Be careful not to overlay common segments containing code or initializers.

Relative and stack segments have a size equal to the sum of the different (aligned) declarations.

MEMORY SEGMENT TYPES

The optional *type* parameter is used for assigning a type to all of the segments in the list. The *type* parameter affects how XLINK processes the segment overlaps. Additionally, it generates information in some of the output formats that are used by some hardware emulators and by C-SPY.

| Segment type | Description |
|----------------------|---|
| BIT | Bit memory.* |
| CODE | Code memory. |
| CONST | Constant memory. |
| DATA | Data memory. |
| FAR | Data in FAR memory. XLINK will not check access to it, and a part of a segment straddling a 64 Kbyte boundary will be moved upwards to start at the boundary. |
| FARC, FARCONST | Constant in FAR memory (behaves as above). |
| FARCODE | Code in FAR memory. |
| HUGE | Data in HUGE memory. No straddling problems. |
| HUGECONST, HUGECONST | Constant in HUGE memory. |
| HUGECODE | Code in HUGE memory. |
| IDATA | Internal data memory. |
| IDATA0 | Data memory. This segment type is only used with the OKI 65000 microcontroller. |
| IDATA1 | Internal data memory. This segment type is only used with the OKI 65000 microcontroller. |
| NEAR | Data in NEAR memory. Accessed using 16-bit addressing, this segment can be located anywhere in the 32-bit address space. |
| NEARCONST, NEARCONST | Constant in NEAR memory. |
| NPAGE | External data memory. This segment type is only used with the Mitsubishi 740 and Western Design Center 6502 microcontrollers. |
| UNTYPED | Default type. |
| XDATA | External data memory. |
| ZPAGE | Data memory. |

Table 3: Memory segment types

* The address of a BIT segment is specified in bits, not in bytes. BIT memory is allocated first.

OVERLAP ERRORS

By default, XLINK checks to be sure that the various segments that have been defined (by the segment placement option and absolute segments) do not overlap in memory.

If any segments overlap, it will cause error 24: *Segment segment overlaps segment segment*. These errors can be reduced to warnings, as described in -z, page 54.

RANGE ERRORS

Some instructions do not work unless a certain condition holds after linking, for example, that a branch target must be within a certain distance or that an address must be even. The compiler or assembler generates tests and XLINK verifies that the conditions hold when the files are linked. If a condition is not satisfied, XLINK generates a range error or warning and prints a description of the error.

Example

```
Error[e18]: Range error, chip's branch target is out of range
  Where $ = vectorSubtraction + 0xC [0x804C]
           in module "vectorRoutines" (vectorRoutines.r99),
           offset 0xC in segment part 5, segment NEARFUNC_A
What: vectorNormalization - ($ + 8) [0x866B3FC]
Allowed range: 0xFDFEFFF0 - 0x2000000
Operand: vectorNormalization [0x8673450]
           in module VectorNorm (vectorNormalization.r99),
           Offset 0x0 in segment part 0, segment NEARFUNC_V
```

Error[e18]: Range error

The first section is often the most important. The text after *Range error* is generated by the compiler and describes of what is being tested. In this case XLINK tests if the target of a branch instruction is in range.

Where

This is the location of the instruction that caused the range error. \$, the address of the instruction, is 0x804c, or 0xC bytes after the label *vectorSubtraction*.

The instruction is in the module *vectorRoutines* in the object file *vectorRoutines.r99*. Another way to express the address where the instruction is located is as 0xC bytes into segment part 5 of segment *NEARFUNC_A* of the *vectorRoutines* module. This can be helpful in locating the instruction in the rare cases when no label can be supplied.

What

This is the symbolic expression that XLINK evaluated and the value it resulted in. In this case, XLINK performs the calculation $0x8673450 - (0x804C + 8)$ and gets the result $0x866B3FC$.

Allowed range

This is the range that the computed value was permitted to fall within. If the left hand side of the expression is greater than the right hand side, it should be interpreted as a negative value. In this case the range is $-0x2000004-0x2000000$ and represents the reach of the processor's branch and link instruction.

Operand

Each symbolic operand in the expression is described in detail here. The format used is the same as in the definition of \$.

Possible solutions

In this case the distance from the instruction in `vectorSubtraction` to `vectorNormalization` is too large for the branch instruction.

Possible solutions include placing the `NEARFUNC_V` segment closer to the segment `NEARFUNC_A` or using some other calling mechanism that can reach the required distance. It is also possible that the referring function tried to refer to the wrong target and that this caused the range error.

Different range errors have different solutions. Usually the solution is a variant of the ones presented above, in other words modifying either the code or the segment placement mechanism.

Note: Range error messages are not issued for references to segments of all types. See *-R*, page 45, for more information.

SEGMENT PLACEMENT EXAMPLES

To locate `SEGA` at address 0, followed immediately by `SEGB`:

```
-Z (CODE) SEGA, SEGB=0
```

To allocate `SEGA` downwards from `FFFH`, followed by `SEGB` below it:

```
-Z (CODE) SEGA, SEGB#FFF
```

To allocate specific areas of memory to `SEGA` and `SEGB`:

```
-Z (CODE) SEGA, SEGB=100-1FF, 400-6FF, 1000
```

In this example *SEGA* will be placed between address 100 and 1FF, if it fits in that amount of space. If it does not, *XLINK* will try the range 400–6FF. If none of these ranges are large enough to hold *SEGA*, it will start at 1000.

SEGB will be placed, according to the same rules, after segment *SEGA*. If *SEGA* fits the 100–1FF range then *XLINK* will try to put *SEGB* there as well (following *SEGA*). Otherwise, *SEGB* will go into the 400 to 6FF range if it is not too large, or else it will start at 1000.

`-Z (NEAR) SEGA, SEGB=19000-1FFFF`

Segments *SEGA* and *SEGB* will be dumped at addresses 19000 to 1FFFF but the default 16-bit addressing mode will be used for accessing the data (i.e. 9000 to FFFF).

Listing format

The default *XLINK* listing consists of the sections below. Note that the examples given here are still generic. They are only used for purposes of illustration.

HEADER

Shows the command-line options selected for the *XLINK* command:

Link time

Target CPU type

Output or device name for the listing

Absolute output

Output file format

Full list of options

#####

#

IAR Universal Linker Vx.xx

#

#

Link time = dd/Mmm/yyyy hh:mm:ss

Target CPU = chipname

List file = demo.map

Output file 1 = aout.ann

Output format = motorola

Command line = demo.rnn

#

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#

#####

The full list of options shows the options specified on the command line. Options in command files specified with the `-f` option are also shown, in brackets.

CROSS-REFERENCE

The cross-reference consists of the entry list, module map and/or the segment map. It includes the program entry point, used in some output formats for hardware emulator support; see the assembler `END` directive in the *IAR Assembler Reference Guide*.

Module map (-xm)

The module map contains a list of files. For each file, those modules that were needed are listed. For each module, those segment parts that were included are listed. To also list the segment parts that were not included, use the `-xi` option. See `-x`, page 50.

If the module contains any non-relocatable parts, they are listed before the segments.



Segment map (-xs)

The segment list gives the segments in increasing address order:

| List of segments | SEGMENT | SPACE | START ADDRESS | END ADDRESS | TYPE | ALIGN |
|------------------|----------|-------|---------------|-------------|-------|-------|
| | ===== | ===== | ===== | ===== | ===== | ===== |
| | CSTART | CODE | 0000 - 0011 | | rel | 0 |
| | <CODE> 1 | CODE | 0012 - 00FE | | rel | 0 |
| | INTGEN | CODE | 00FF - 0115 | | rel | 0 |
| | <CODE> 2 | CODE | 0116 - 01DF | | rel | 0 |
| | INTVEC | CODE | 01E0 - 01E1 | | com | 0 |
| | <CODE> 3 | CODE | 01E2 - 01FE | | rel | 0 |
| | FETCH | CODE | 0200 - 0201 | | rel | 0 |

Diagram labels for the table above:

- Segment name (points to SEGMENT)
- Segment address space (points to SPACE)
- Segment load address range (points to START ADDRESS and END ADDRESS)
- Segment type (points to TYPE)
- Segment alignment (points to ALIGN)

This lists the following:

| Parameter | Description |
|---------------|---|
| SEGMENT | The segment name. |
| SPACE | The segment address space, usually CODE or DATA. |
| START ADDRESS | The start of the segment's load address range. |
| END ADDRESS | The end of the segment's load address range. |
| TYPE | The type of segment: rel Relative stc Stack. bnk Banked. com Common. dse Defined but not used. |
| ALIGN | The segment is aligned to the next 2^{ALIGN} address boundary. |

Table 4: Segment map (-xs) XLINK option

Module summary (-xn)

The *module summary* summarizes the contributions to the total memory use from each module. Each segment type that is used gets a separate column, with one or two sub-columns for relocatable (Rel) and absolute (Abs) contributions to memory use.

Only modules with a non-zero contribution to memory use are listed. Contributions from COMMON segments in a module are listed on a separate line, with the title + common.

Contributions for segment parts defined in more than one module and used in more than one module are listed for the module whose definition was chosen, with the title + shared:

```

*****
*                               *
*                               *
*****

```

| Module | CODE | DATA | CONST |
|-----------------|-------|-------|-------|
| ----- | ---- | ---- | ----- |
| | (Rel) | (Rel) | (Rel) |
| ?CSTARTUP | 152 | | |
| ?Fclose | 308 | | |
| ?Fflush | 228 | | |
| ?Fputc | 156 | | |
| ?Free | 252 | | |
| ?INITTAB | | | 8 |
| ?Malloc | 348 | 8 | |
| ?Memcpy | 36 | | |
| ?Memset | 28 | | |
| ?Putchar | 28 | | |
| ?RESET | | | |
| + common | 4 | | |
| ?Xfiles | | 376 | 296 |
| + shared | | | 12 |
| ?Xfwprep | 284 | | |
| ?Xgetmemchunk | 96 | 1 | |
| ?_EXIT | 72 | | |
| ?__dbg_Break | 4 | | |
| ?__exit | 28 | | |
| ?close | 36 | | |
| ?cppinit | 100 | 4 | |
| ?d_write | 44 | | |
| ?div_module | 100 | | |
| ?exit | 20 | | |
| ?heap | | | 8 |
| ?low_level_init | 8 | | |
| ?remove | 36 | | |
| ?segment_init | 120 | | |

| | | | |
|----------|-------|-----|-----|
| ?write | 20 | | |
| atutor | 88 | 4 | |
| + shared | | | 12 |
| atutor2 | 364 | 40 | |
| | ----- | --- | --- |
| Total: | 2 960 | 433 | 336 |

Static overlay system map (-xo)

If the **Static overlay system map** (-xo) option has been specified, the list file includes a listing of the static overlay system.

Static overlay is a system used by some IAR Systems compilers, where local data and function parameters are stored at static locations in memory. The linker's static overlay process lays out the overlay areas—memory areas for parameters and local data—for each function so they do not overlap the overlay areas for other functions that might be called at the same time.

The listing is separated into one section for each sub-tree of the function call tree. At the top of each section, the stack segment and overlay segment used are listed.

Each sub-tree section shows either the functions that can be reached from a root function or the functions that can be reached from a function that can be called indirectly. Called functions are listed before the calling function, and relationships are displayed using indentation and numbering.

For each function, information is listed first about stack usage and then about the overlay area. The stack usage information includes previous stack usage and how much stack the current function block uses. The static overlay information includes the start location of the area where parameters and local data are placed, and the amount of memory used in the current function. The most important information is the static overlay address; it is used by your application and must be correct.

Example of a sub-tree section:

```
->Sub-tree of type: Function tree
                                CALLSTACK
  | Stack used (prev) : 00000000
                                <OVERLAY0,WRKSEG> 1
  | Stat overlay addr : 00000066
03  func_1
    | Stack used (prev) : 00000000
    | + function block : 00000002
    | Stat overlay addr : 00000066
    | + in function    : 00000002
03  func_2
    | Stack used (prev) : 00000000
    | + function block : 00000002
```



```

        | Stat overlay addr : 00000066
        | + in function      : 00000001
        | Already listed
02    main
        | Stack used (prev) : 00000002
        | + function block  : 00000004
        | Stat overlay addr : 00000068
        | + in function      : 00000006
01    __CSTARTUP
        | Stack used (prev) : 00000006
        | + function block  : 00000000
        | Stat overlay addr : 0000006E
        | + in function      : 00000000
<-Sub-tree of type: Function tree
    | Stack used          : 00000006
    | Static overlay acc. : 0000006E

```

In this example, `main` calls the functions `func_1` and `func_2`. `__CSTARTUP` is the root of this function call sub-tree and is a function in the runtime library which calls the `main` function of your application.

`func_1` needs 2 bytes of stack in the stack segment—`CALLSTACK`—and a 2-byte overlay area in the overlay segment `<OVERLAY0,WRKSEG> 1` (the result of packed placement of `OVERLAY0` and `WRKSEG`). The parameters and local variables (2 bytes) of `func_1` are placed at address `0x66`.

`func_2` also needs 2 bytes of stack, but a 1-byte overlay area. The parameters and local variables of `func_2` are also placed at address `0x66`, as `func_1` and `func_2` are independent of each other.

`main` needs 4 bytes of stack and a 6-byte overlay area. Because the overlay area of the `main` function must not overlap the overlay area of either `func_1` or `func_2`, it is placed at address `0x68`.

CHECKSUMMED AREAS AND MEMORY USAGE

If the **Generate checksum** (-J) and **Fill unused code memory** (-H) options have been specified, the listing includes a list of the checksummed areas, in order:

```
*****
CHECKSUMMED AREAS, IN ORDER
*****

00000000 - 00007FFF in CODE memory
0000D414 - 0000D41F in CODE memory
Checksum = 32e19
*****
END OF CROSS REFERENCE
*****
2068 bytes of CODE memory (30700 range fill)
2064 bytes of DATA memory (12 range fill)
Errors: none
Warnings: none
```

This information is followed, irrespective of the options selected, by the memory usage and the number of errors and warnings.

XLINK options

The XLINK options allow you to control the operation of the IAR XLINK Linker.



The *IAR Embedded Workbench® IDE User Guide* describes how to set XLINK options in the IAR Embedded Workbench IDE, and gives reference information about the available options.

Setting XLINK options

To set options from the command line, either:

- Specify the options on the command line, after the `xlink` command.
- Specify the options in the `XLINK_ENVPAR` environment variable; see the chapter *XLINK environment variables*.
- Specify the options in an extended linker command (`xcl`) file, and include this on the command line with the `-f file` command.

Note: You can include C-style `/* . . . */` or `//` comments in linker command files.

Summary of options

The following table summarizes the XLINK command line options:

| Command line option | Description |
|-----------------------------|--------------------------|
| <code>-!</code> | Comment delimiter |
| <code>-A file,...</code> | Loads as program |
| <code>-a</code> | Disables static overlay |
| <code>-B</code> | Always generates output |
| <code>-bbank_def</code> | Defines banked segments |
| <code>-C file, ...</code> | Loads as library |
| <code>-ccpu</code> | Specifies processor type |
| <code>-Dsymbol=value</code> | Defines symbol |
| <code>-d</code> | Disables code generation |
| <code>-E file,...</code> | Inherent, no object code |

Table 5: XLINK options summary

| Command line option | Description |
|--|--|
| <code>-enew=old[,old] ...</code> | Renames external symbols |
| <code>-Fformat</code> | Specifies output format |
| <code>-f file</code> | Specifies XCL filename |
| <code>-G</code> | Disables global type checking |
| <code>-gsymbol1[,symbol2,symbol3,...]</code> | Requires global entries |
| <code>-Hhexstring</code> | Fills unused code memory |
| <code>-h[(seg_type)]{range}</code> | Fills ranges. |
| <code>-Ipathname</code> | Includes paths |
| <code>--image_input</code> | Links pure binary files |
| <code>-Jsize,method[,flags]</code> | Generates checksum |
| <code>-Ksegs=inc,count</code> | Duplicates code |
| <code>-Ldirectory</code> | Lists to directory |
| <code>-l file</code> | Lists to named file |
| <code>-Mrange_def</code> | Maps logical addresses to physical addresses |
| <code>--misrac</code> | Enables MISRA C-specific error messages |
| <code>--misrac_verbose</code> | Enables verbose logging of MISRA C checking |
| <code>-n[c]</code> | Ignores local symbols |
| <code>-Oformat[,variant][=filename]</code> | Multiple output files |
| <code>-o file</code> | Output file |
| <code>-Ppack_def</code> | Defines packed segments |
| <code>-plines</code> | Specifies lines/page |
| <code>-Q</code> | Scatter loading |
| <code>-q</code> | Disables relay function optimization |
| <code>-R[w]</code> | Disables range check |
| <code>-r</code> | Debug information |
| <code>-rt</code> | Debug information with terminal I/O |
| <code>-S</code> | Silent operation |
| <code>-s symbol</code> | Specifies new application entry point |
| <code>-U[(address_space)]range=[(address_space)]range</code> | Address space sharing |
| <code>-V(type)name[,align]</code> | Declares relocation areas for code and data |
| <code>-w[n s t ID[=severity]]</code> | Sets diagnostics control |

Table 5: XLINK options summary (Continued)

| Command line option | Description |
|-------------------------------|---------------------------|
| -x[e] [h] [i] [m] [n] [s] [o] | Specifies cross-reference |
| -Y[char] | Format variant |
| -y[chars] | Format variant |
| -Z[@] seg_def | Defines segments |
| -z | Segment overlap warnings |

Table 5: XLINK options summary (Continued)

Descriptions of XLINK options

The following sections describe each of the XLINK command line options in detail.

-! -! comment -!

A -! can be used for bracketing off comments in an extended linker command file. Unless the -! is at the beginning of a line, it must be preceded by a space or tab.

Note: You can include C-style and C++-style comments in your files; the use of these is recommended since they are less error-prone than -!.

-A -A file,...

Use -A to temporarily force all of the modules within the specified input files to be loaded as if they were all program modules, even if some of the modules have the LIBRARY attribute.

This option is particularly suited for testing library modules before they are installed in a library file, since the -A option will override an existing library module with the same entries. In other words, XLINK will load the module from the *input file* specified in the -A argument instead of one with an entry with the same name in a library module.



This option is identical to the **Load as PROGRAM** option in the linker category in the IAR Embedded Workbench IDE.

-a -a{i|w}[function-list]

Use -a to control the static memory allocation of variables. The options are as follows:

| Option | Description |
|--------|--|
| -a | Disables overlaying totally, for debugging purposes. |

Table 6: Disabling static overlay options

| Option | Description |
|--------|--|
| -ai | Disables indirect tree overlaying. |
| -aw | Disables warning I6, Function is called from two function trees. Do this only if you are sure the code is correct. |

Table 6: Disabling static overlay options

In addition, the -a option can specify one or more function lists, to specify additional options for specified functions. Each function list can have the following form, where *function* specifies a public function or a *module: function* combination:

| Function list | Description |
|----------------------------------|--|
| (<i>function, function...</i>) | Function trees will not be overlaid with another function. |
| [<i>function, function...</i>] | Function trees will not be allocated unless they are called by another function. |
| { <i>function, function...</i> } | Indicates that the specified functions are interrupt functions. |

Table 7: Disabling static overlay function lists

Several -a options may be specified, and each -a option may include several suboptions, in any order.

-B -B

Use -B to generate an output file even if a non-fatal error was encountered during the linking process, such as a missing global entry or a duplicate declaration. Normally, XLINK will not generate an output file if an error is encountered.

Note: XLINK always aborts on fatal errors, even with -B specified.

The -B option allows missing entries to be patched in later in the absolute output image.



This option is identical to the **Always generate output** option in the linker category in the IAR Embedded Workbench IDE.

-b -b [*addrtype*] [(*type*)] *segments=first,length,increment[, count]*

where the parameters are as follows:

| | |
|-----------------|--|
| <i>addrtype</i> | The type of load addresses used when dumping the code: |
| mitted | Logical addresses with bank number. |
| : | Linear physical addresses. |
| l | 64180-type physical addresses. |

| | | | | | |
|------------------|--|---------|--|---------|---|
| <i>type</i> | Specifies the memory type for all segments if applicable for the target microcontroller. If omitted it defaults to <code>UNTYPED</code> . | | | | |
| <i>segments</i> | <p>The list of banked segments to be linked.</p> <p>The delimiter between segments in the list determines how they are packed:</p> <table> <tr> <td>(colon)</td><td>The next segment will be placed in a new bank.</td></tr> <tr> <td>(comma)</td><td>The next segment will be placed in the same bank as the previous one.</td></tr> </table> | (colon) | The next segment will be placed in a new bank. | (comma) | The next segment will be placed in the same bank as the previous one. |
| (colon) | The next segment will be placed in a new bank. | | | | |
| (comma) | The next segment will be placed in the same bank as the previous one. | | | | |
| <i>first</i> | The start address of the first segment in the banked segment list. This is a 32-bit value: the high-order 16 bits represent the starting bank number while the low-order 16 bits represent the start address for the banks in the logical address area. | | | | |
| <i>length</i> | The length of each bank, in bytes. This is a 16-bit value. | | | | |
| <i>increment</i> | The incremental factor between banks, i.e. the number that will be added to <i>first</i> to get to the next bank. This is a 32-bit value: the high-order 16 bits are the bank increment, and the low-order 16 bits are the increment from the start address in the logical address area. | | | | |
| <i>count</i> | Number of banks available, in decimal. | | | | |

The option `-b` can be used to allocate banked segments for a program that is designed for bank-switched operation. It also enables the banking mode of linker operation. However, we recommend that you instead use `-P` to define packed segments. See page 42.

There can be more than one `-b` definition.

Logical addresses are the addresses as seen by the program. In most bank-switching schemes this means that a logical address contains a bank number in the most significant 16 bits and an offset in the least significant 16 bits.

Linear physical addresses are calculated by taking the bank number (the most significant 16 bits of the address) times the bank length and adding the offset (the least significant 16 bits of the address). Specifying linear physical addresses affects the load addresses of bytes output by XLINK, not the addresses seen by the program.

64180-type physical addresses are calculated by taking the least significant 8 bits of the bank number, shifting it left 12 bits and then adding the offset.

Using either of these simple translations is only useful for some rather simple memory layouts. Linear physical addressing as calculated by XLINK is useful for a bank memory at the very end of the address space. Anything more complicated will need some post-processing of XLINK output, either by a PROM programmer or a special program. See the `simple` subdirectory for source code for the start of such a program.

For example, to specify that the three code segments `BSEG1`, `BSEG2`, and `BSEG3` should be linked into banks starting at 8000, each with a length of 4000, with an increment between banks of 10000:

```
-b (CODE) BSEG1,BSEG2,BSEG3=8000,4000,10000
```

For more information see, *Segment control*, page 9.

Note: This option is included for backward compatibility reasons. We recommend that you instead use `-P` to define packed segments. See page 42.

`-C` `-C file,...`

Use `-C` to temporarily cause all of the modules within the specified input files to be treated as if they were all library modules, even if some of the modules have the `PROGRAM` attribute. This means that the modules in the input files will be loaded only if they contain an entry that is referenced by another loaded module.



This option is identical to the **Load as LIBRARY** option in the linker category in the IAR Embedded Workbench IDE.

`-c` `-cprocessor`

Use `-c` to specify the target processor.

The environment variable `XLINK_CPU` can be set to install a default for the `-c` option so that it does not have to be specified on the command line; see the chapter *XLINK environment variables*.



This option is related to the **Target** options in the General category in the IAR Embedded Workbench IDE.

`-D` `-Dsymbol=value`

The parameter *symbol* is any external (`EXTERN`) symbol in the program that is not defined elsewhere, and *value* the value to be assigned to *symbol*.

Use `-D` to define absolute symbols at link time. This is especially useful for configuration purposes. Any number of symbols can be defined in a linker command file. The symbol(s) defined in this manner will belong to a special module generated by the linker called `?ABS_ENTRY_MOD`.

XLINK will display an error message if you attempt to redefine an existing symbol.



This option is identical to the **#define** option in the linker category in the IAR Embedded Workbench IDE.

`-d -d`

Use `-d` to disable the generation of output code from XLINK. This option is useful for the trial linking of programs; for example, checking for syntax errors, missing symbol definitions, etc. XLINK will run slightly faster for large programs when this option is used.

`-E -E file,...`

Use `-E` to empty load specified input files; they will be processed normally in all regards by the linker but output code will not be generated for these files.

One potential use for this feature is in creating separate output files for programming multiple EPROMs. This is done by empty loading all input files except the ones you want to appear in the output file.

In the following example a project consists of four files, `file1` to `file4`, but we only want object code generated for `file4` to be put into an EPROM:

```
-E file1,file2,file3
file4
-o project.hex
```



This option is related to the **Input** options in the linker category in the IAR Embedded Workbench IDE.

`-e -enew=old [,old] ...`

Use `-e` to configure a program at link time by redirecting a function call from one function to another.

This can also be used for creating stub functions; i.e. when a system is not yet complete, undefined function calls can be directed to a dummy routine until the real function has been written.

-F *-F format*

Use **-F** to specify the output format.

The environment variable `XLINK_FORMAT` can be set to install an alternate default format on your system; see the chapter *XLINK environment variables*.

The parameter should be one of the supported XLINK output formats; for details of the formats see the chapter *XLINK output formats*.

Note: Specifying the **-F** option as `DEBUG` does not include C-SPY debug support. Use the **-r** option instead.



This option is related to the **Output** options in the linker category in the IAR Embedded Workbench IDE.

-f *-f file*

Use **-f** to extend the XLINK command line by reading arguments from a command file, just as if they were typed in on the command line. If not specified, an extension of `xcl` is assumed.

Arguments are entered into the linker command file with a text editor using the same syntax as on the command line. However, in addition to spaces and tabs, the Enter key provides a valid delimiter between arguments. A command line may be extended by entering a backslash, `\`, at the end of line.

Note: You can include C-style `/* . . . */` or `//` comments in linker command files.



This option is related to the **Include** options in the linker category in the IAR Embedded Workbench IDE.

-G *-G*

Use **-G** to disable type checking at link time. While a well-written program should not need this option, there may be occasions where it is helpful.

By default, XLINK performs link-time type checking between modules by comparing the external references to an entry with the `PUBLIC` entry (if the information exists in the object modules involved). A warning is generated if there are mismatches.



This option is identical to the **No global type checking** option in the linker category in the IAR Embedded Workbench IDE.

`-g -gsymbol1[, symbol2, symbol3, ...]`

XLINK normally only includes segment parts (usually functions and variables) that are needed, to satisfy all references from segment parts that must be included. Use the `-g` option to add to this set so that something is included even if it appears not to be needed.

`-H -Hhexstring`

Use `-H` to fill all gaps between segment parts introduced by the linker with the repeated *hexstring*.

The linker can introduce gaps because of alignment restrictions, or to fill ranges given in segment placement options. The normal behavior, when no `-H` option is given, is that these gaps are not given a value in the output file.

The following example will fill all the gaps with the value `0xbeef`:

```
-HBEEF
```

Even bytes will get the value `0xbe`, and odd bytes will get the value `0xef`.



This option corresponds to the **Fill unused code memory** option in the linker category in the IAR Embedded Workbench IDE.

`-h -h[(seg_type)] {range}`

Use `-h` to specify the ranges to fill. Normally, all ranges given in segment-placement commands (`-Z` and `-P`) into which any actual content (code or constant data) is placed, are filled. For example:

```
-Z (CODE) INTVEC=0-FF
-Z (CODE) RCODE, CODE, SHORTAD_ID=0-7FFF, F800-FFFF
-Z (DATA) SHORTAD_I, SHORTAD_Z=8000-8FFF
```

If `INTVEC` contains anything, the range `0-FF` will be filled. If `RCODE`, `CODE` or `SHORTAD_ID` contains anything, the ranges `0-7FFF` and `F800-FFFF` will be filled. `SHORTAD_I` and `SHORTAD_Z` are normally only place holders for variables, which means that the range `8000-8FFF` will not be filled.

Using `-h` you can explicitly specify which ranges to fill. The syntax allows you to use an optional segment type (which can be used for specifying address space for architectures with multiple address spaces) and one or more address ranges.

For example,

```
-h (CODE) 0-FFFF
```

or, equivalently, as segment type CODE is the default,

```
-h0-FFFF
```

will cause the range 0-FFFF to be filled, regardless of what ranges are specified in segment-placement commands. Often -h will not be needed.

The -h option can be specified more than once, in order to specify fill ranges for more than one address space. It does not restrict the ranges used for calculating checksums.

```
-I -Ipathname
```

Specifies a path name to be searched for object files.

By default, XLINK searches for object files only in the current working directory. The -I option allows you to specify the names of the directories which it will also search if it fails to find the file in the current working directory.

For example, to read object files from v:\general\lib and c:\project\lib:

```
-Iv:\general\lib;c:\project\lib\
```

This option is equivalent to the XLINK_DFLTDIR environment variable; see the chapter *XLINK environment variables*.



This option is related to the **Include** option in the linker category in the IAR Embedded Workbench IDE.

```
--image_input --image_input=filename, symbol, segment, alignment
```

Use this option to link pure binary files in addition to the ordinary input files.

| Parameter | Description |
|------------------|--|
| <i>filename</i> | The pure binary file you want to link |
| <i>segment</i> | The segment where the binary data will be placed. |
| <i>symbol</i> | The symbol defined by the segment part where the binary data is placed |
| <i>alignment</i> | The alignment of the segment part where the binary data is placed |

Table 8: Arguments to --image_input

The file's entire contents is placed in the segment, which means it can only contain pure binary data (for instance, the raw-binary output format, see *Single output file*, page 55).

The segment part where the contents of the *filename* file is placed, is only included if the symbol *symbol* is required by your application. Use the `-g` option if you want to force a reference to the segment part, see `-g`, page 31.

Example

```
--image_input=bootstrap.rnn,Bootstrap,CSTARTUPCODE,4
```

The contents of the pure binary file `bootstrap.rnn` is placed in the segment `CSTARTUPCODE`. The segment part where the contents is placed will be 4-byte aligned and will only be included if your application (or the command line option `-g`) includes a reference to the symbol `Bootstrap`.



This option corresponds to the **Raw binary image** option in the linker category in the IAR Embedded Workbench IDE.

```
-J -Jsize,method[,flags[, symb[, segm[, align]]]] [=ranges[;ranges...]]
```

Use the `-J` option to calculate a checksum for all generated raw data bytes. This option can only be used if the `-H` option has been specified.

size

size specifies the number of bytes in the checksum, and can be 1, 2, or 4.

method

method specifies the algorithm used, and can be one of the following:

| Method | Description |
|---------------|--|
| sum | Simple arithmetic sum. |
| crc16 | CRC16 (generating polynomial 0x11021). |
| crc32 | CRC32 (generating polynomial 0x104C11DB7). |
| crc= <i>n</i> | CRC with a generating polynomial of <i>n</i> . |

Table 9: Checksumming algorithms

flags

flags can be used to specify complement and/or the bit-order of the checksum.

| Flag | Description |
|------|-----------------------------|
| 1 | Specifies one's complement. |
| 2 | Specifies two's complement. |

Table 10: Checksumming flags

| Flag | Description |
|------|--|
| m | Mirrored bytes. Reverses the order of the bits within each byte when calculating the checksum. You can specify just m, or m in combination with either 1 or 2. |

Table 10: Checksumming flags

In all cases it is the least significant 1, 2, or 4 bytes of the result that will be output, in the natural byte order for the processor. The CRC checksum is calculated as if the following code was called for each bit in the input, with the most significant bit of each byte first as default, starting with a CRC of 0:

```
unsigned long
crc(int bit, unsigned long oldcrc)
{
    unsigned long newcrc = (oldcrc << 1) ^ bit;
    if (oldcrc & 0x80000000)
        newcrc ^= POLY;
    return newcrc;
}
```

POLY is the generating polynomial. The checksum is the result of the final call to this routine. If the m flag is specified, the checksum is calculated with each byte bit-reversed—i. e. with the least significant bit first. Notice that the whole result will also be bit-reversed. If the 1 or 2 flag is specified, the checksum is the one’s or two’s complement of the result.

symb

symb is an optional user-defined symbol name for the checksum. If you specify the symbol name yourself, the checksum it symbolizes is only included in the final application if it is referenced by any included parts of the application, or if the -g (require global entries) command line option is used for the symbol. If you do not specify a symbol explicitly, the name __checksum is used. In this case the symbol is always included in the final application.

segm

segm is an optional user-defined name for the segment to put the checksum in. If you do not specify a segment name explicitly, the name CHECKSUM is used. This segment must be placed using the segment placement options like any other segment.

align

align is an optional user-defined alignment for the checksum. If you do not specify an alignment explicitly, an alignment of 1 is used.

ranges

ranges are optional user-defined byte ranges to include in the checksum calculation. If you do not specify any ranges explicitly, all bytes in the final application are included in the calculation.

Example 1

For example, to calculate a 2-byte checksum using the generating polynomial 0x11021 and output the one's complement of the calculated value, specify:

```
-J2,crc16,1
```

The checksum will be located in the segment `CHECKSUM`, defining the symbol `__checksum`. All available bytes in the application are included in the calculation.

Example 2

```
-J2,crc16,2m,lowsum=(CODE)0-FF
```

This example calculates a checksum as above, located in a 2-byte segment part in the `CHECKSUM` segment, with the following differences: The output is the mirrored 2's complement of the calculation. The symbol `lowsum` is defined and only bytes in the range 0x0-FF in the `CODE` address space are included.

Example 3

```
-J2,crc16,,highsum,CHECKSUM2,2=(CODE)F000-FFFF;(DATA)FF00-FFFF
```

This example calculates a checksum as above, now based on all bytes that fall in either of the ranges given. It is placed in a 2-byte segment with an alignment of 2 in the segment `CHECKSUM2`, defining the symbol `highsum`.



This option corresponds to the **Generate checksum** option in the linker category in the IAR Embedded Workbench IDE.

```
-K -Ksegs=diff,count
```

Use `-K` to duplicate any raw data bytes from the segments in *segs count* times, adding/subtracting *diff* to/from the addresses each time. This will typically be used for segments mentioned in a `-Z` option.

This can be used for making part of a PROM be non-banked even though the entire PROM is physically banked. Use the `-b` or `-P` option to place the banked segments into the rest of the PROM.

Example 1

To copy the contents of the `RCODE0` and `RCODE1` segments four times, using addresses `0x20000` higher each time, specify:

```
-KRCODE0,RCODE1=20000,4
```

This will place 5 instances of the bytes from the segments into the output file, at the addresses `x`, `x+0x20000`, `x+0x40000`, `x+0x60000`, and `x+0x80000`.

Example 2

If the segment `MYSEG` is placed at `0x10000`, to create 4 duplicates placed at `0xE000`, `0xC000`, `0xA000`, and `0x8000`, specify:

```
-KMYSEG=-0x2000,4
```

For more information, see *Segment control*, page 9.

`-L` `-L[directory]`

Causes the linker to generate a listing and send it to the file `directory\outputname.lst`. Notice that you must not include a space before the prefix.

By default, the linker does not generate a listing. To simply generate a listing, you use the `-L` option without specifying a directory. The listing is sent to the file with the same name as the output file, but extension `lst`.

`-L` may not be used as the same time as `-l`.



This option is related to the **List** options in the linker category in the IAR Embedded Workbench IDE.

`-l` `-l file`

Causes the linker to generate a listing and send it to the named file. If no extension is specified, `lst` is used by default. However, an extension of `map` is recommended to avoid confusing linker list files with assembler or compiler list files.

`-l` may not be used as the same time as `-L`.



This option is related to the **List** options in the linker category in the IAR Embedded Workbench IDE.

```
-M -M[(type)] logical_range=physical_range
```

where the parameters are as follows:

| | |
|---------------------------------|--|
| <i>type</i> | Specifies the memory type for all segments if applicable for the target processor. If omitted it defaults to UNTYPED. |
| <i>range start-end</i> | The range starting at <i>start</i> and ending at <i>end</i> . |
| <i>[start-end]*count+offset</i> | Specifies <i>count</i> ranges, where the first is from <i>start</i> to <i>end</i> , the next is from <i>start+offset</i> to <i>end+offset</i> , and so on. The <i>+offset</i> part is optional, and defaults to the length of the range. |
| <i>[start-end]/pagesize</i> | Specifies the entire <i>range</i> from <i>start</i> to <i>end</i> , divided into pages of size and alignment <i>pagesize</i> . <i>Note</i> : The <i>start</i> and <i>end</i> of the range do not have to coincide with a page boundary. |

XLINK can do logical to physical address translation on output for some output formats. Logical addresses are the addresses as seen by the program, and these are the addresses used in all other XLINK command line options. Normally these addresses are also used in the output object files, but by using the `-M` option, a mapping from the logical addresses to physical addresses, as used in the output object file, is established.

Each occurrence of `-M` defines a linear mapping from a list of logical address ranges to a list of physical address ranges, in the order given, byte by byte. For example the command:

```
-M0-FF,200-3FF=1000-11FF,1400-14FF
```

will define the following mapping:

| Logical address | Physical address |
|-----------------|------------------|
| 0x00-0xFF | 0x1000-0x10FF |
| 0x200-0x2FF | 0x1100-0x11FF |
| 0x300-0x3FF | 0x1400-0x14FF |

Table 11: Mapping logical to physical addresses (example)

Several `-M` command line options can be given to establish a more complex mapping.

Address translation can be useful in banked systems. The following example assumes a code bank at address 0x8000 of size 0x4000, replicated 4 times, occupying a single physical ROM. To define all the banks using physically contiguous addresses in the output file, the following command is used:

```
-P(CODE) BANKED=[8000-BFFF]*4+10000 // Place banked code
-M(CODE) [8000-BFFF]*4+10000=10000 // Single ROM at 0x10000
```

The -M option only supports some output formats, primarily the simple formats with no debug information. The following list shows the currently supported formats:

| | | |
|---------------|-----------------|-----------|
| aomf80196 | ashling-z80 | pentica-a |
| aomf8051 | extended-tekhex | pentica-b |
| aomf8096 | hp-code | pentica-c |
| ashling | intel-extended | pentica-d |
| ashling-6301 | intel-standard | rca |
| ashling-64180 | millenium | symbolic |
| ashling-6801 | motorola | ti7000 |
| ashling-8080 | mpds-code | typed |
| ashling-8085 | mpds-symb | zax |

```
--misrac --misrac[={tag1,tag2-tag3,...|all|required}]
```

If your version of IAR Embedded Workbench supports MISRA C, use this option to enable the linker to check for deviations from the rules described in the MISRA *Guidelines for the Use of the C Language in Vehicle Based Software*. By using one or more arguments with the option, you can restrict the checking to a specific subset of the MISRA C rules. The possible arguments are described in this table:

| Command line option | Description |
|----------------------|---|
| --misrac | Enables checking for all MISRA C rules |
| --misrac= <i>n</i> | Enables checking for the MISRA C rule with number <i>n</i> |
| --misrac= <i>m,n</i> | Enables checking for the MISRA C rules with numbers <i>m</i> and <i>n</i> |
| --misrac= <i>k-n</i> | Enables checking for all MISRA C rules with numbers from <i>k</i> to <i>n</i> |

Table 12: Enabling MISRA C rules (--misrac)

| Command line option | Description |
|----------------------------|---|
| --misrac= <i>k, m, r-t</i> | Enables checking for MISRA C rules with numbers <i>k</i> , <i>m</i> , and from <i>r</i> to <i>t</i> |
| --misrac=all | Enables checking for all MISRA C rules |
| --misrac=required | Enables checking for all MISRA C rules categorized as required |

Table 12: Enabling MISRA C rules (*--misrac*) (Continued)

If the linker is unable to check for a rule, specifying the option for that rule has no effect. Because most rules are concerned with either compiling or documenting, only rules 11, 23, 25, and 26 can be checked by the linker. As a consequence, specifying, for example, `--misrac=15` has no effect.

When a rule is violated, XLINK generates an error. This can be changed by using the usual diagnostics control mechanism. See the chapter *XLINK diagnostics*.



This option is related to the **MISRA C** options in the General category in the IAR Embedded Workbench IDE.

--misrac_verbose --misrac_verbose

If your version of IAR Embedded Workbench supports MISRA C, use this option to generate a MISRA C log during linking. This is a list of the rules that are enabled—but not necessarily checked—and a list of rules that are actually checked.

If this option is enabled, the linker displays a text at sign-on that shows both enabled and checked MISRA C rules.



This option is related to the **MISRA C** options in the General category in the IAR Embedded Workbench IDE.

-n -n[c]

Use `-n` to ignore all local (non-public) symbols in the input modules. This option speeds up the linking process and can also reduce the amount of host memory needed to complete a link. If `-n` is used, locals will not appear in the list file cross-reference and will not be passed on to the output file.

Use `-nc` to ignore just compiler-generated local symbols, such as jump or constant labels. These are usually only of interest when debugging at assembler level.

Note: Local symbols are only included in files if they were compiled or assembled with the appropriate option to specify this.



This option is related to the **Output** options in the linker category in the IAR Embedded Workbench IDE.

`-O -Oformat[, variant] [=filename]`

Use the `-O` option to create one or more output files of the *format* format, possibly with the *variant* variant (just as if you had used the `-Y` or `-y` option). If no filename is specified, the output file will be given the same name as a previously specified output file, or the name given in a `-o` option, with the default extension for the format. (Typically you would want all output files specified using the `-O` option to have the same filename.) If the first character of *filename* is a `.` (a period), *filename* is assumed to be an extension, and the file receives the same name as if no name was specified, but with the specified extension. Any number of `-O` command line options can be specified.

Example

```
-Odebug=foo
-OMotorola=.s99
-Ointel-extended,l=abs.x
-Oelf,as=..\MyElfCode\myApp.elf
```

This will result in:

- one output file named `foo.dbg`, using the UBROF format
- one output file named `foo.s99`, using the MOTOROLA format
- one output file named `abs.x`, using the INTEL-EXTENDED format just as if `-Y1` had also been specified
- one output file named `myApp.elf` created in the overlying directory `MyElfCode`, using the ELF format just as if `-yas` had also been specified

Output files produced by using `-O` will be in addition to those produced by using the `-F`, `-o`, or `-y` options. This means that extra output files can be added to the linker command file despite that this feature is not supported in the IAR Embedded Workbench IDE.

Note: If `-r` is specified—or its corresponding option in the IAR Embedded Workbench IDE—only one output file is generated, using the UBROF format and selecting special runtime library modules for IAR C-SPY.

`-o -o file`

Use `-o` to specify the name of the XLINK output file. If a name is not specified, the linker will use the name `about.hex`. If a name is supplied without a file type, the default file type for the selected output format will be used. See *-F*, page 30, for additional information.

If a format is selected that generates two output files, the user-specified file type will only affect the primary output file (first format).



This option is related to the **Output** options in the linker category in the IAR Embedded Workbench IDE.

```
-P -P [ (type) ] segments=range[ , range] ...
```

where the parameters are as follows:

| | |
|------------------------------------|---|
| <i>type</i> | Specifies the memory type for all segments if applicable for the target processor. If omitted it defaults to UNTYPED. |
| <i>segments</i> | A list of one or more segments to be linked, separated by commas. |
| <i>range</i> <i>start-end</i> | The range starting at <i>start</i> and ending at <i>end</i> . |
| <i>[start-end] *count+offset</i> | Specifies <i>count</i> ranges, where the first is from <i>start</i> to <i>end</i> , the next is from <i>start+offset</i> to <i>end+offset</i> , and so on. The <i>+offset</i> part is optional, and defaults to the length of the range. |
| <i>[start-end] /pagesize</i> | Specifies the entire range from <i>start</i> to <i>end</i> , divided into pages of size and alignment <i>pagesize</i> . <i>Note:</i> The <i>start</i> and <i>end</i> of the range do not have to coincide with a page boundary. |
| <i>start:+size</i> | The range starting at <i>start</i> with the length <i>size</i> . |
| <i>[start:+size] *count+offset</i> | Specifies <i>count</i> ranges, where the first begins at <i>start</i> and has the length <i>size</i> , the next one begins at <i>start+offset</i> and has the same length, and so on. The <i>+offset</i> part is optional, and defaults to the length of the range. |

[start:+size]/pagesize

Specifies the entire range beginning at *start* and with the length *size*, divided into pages of size and alignment *pagesize*. *Note*: The beginning and end of the range do not have to coincide with a page boundary.

Use `-P` to pack the segment parts from the specified segments into the specified ranges, where a segment part is defined as that part of a segment that originates from one module. The linker splits each segment into its segment parts and forms new segments for each of the ranges. All the ranges must be closed; i.e. both *start* and *end* (or *size*) must be specified. The segment parts will not be placed in any specific order into the ranges.

The following examples show the address range syntax:

0-9F,100-1FF

Two ranges, one from zero to 9F, one from 100 to 1FF.

[1000-1FFF]*3+2000

Three ranges: 1000-1FFF,3000-3FFF,5000-5FFF.

[1000-1FFF]*3

Three ranges: 1000-1FFF,2000-2FFF,3000-3FFF.

[50-77F]/200

Five ranges: 50-1FF,200-3FF,400-5FF,600-77F.

1000:+1000

One range from 1000 to 1FFF.

[1000:+1000]*3+2000

Three ranges: 1000-1FFF,3000-3FFF,5000-5FFF.

All numbers in segment placement command line options are interpreted as hexadecimal unless they are preceded by a `.` (period). That is, the numbers written as 10 and .16 are both interpreted as sixteen. If you want, you can put `0x` before the number to make it extra clear that it is hexadecimal, like this: `0x4FFF`.

For more information see *Segment control*, page 9.

-p

-plines

Sets the number of lines per page for the XLINK list files to *lines*, which must be in the range 10 to 150.

The environment variable `XLINK_PAGE` can be set to install a default page length on your system; see the chapter *XLINK environment variables*.



This option is related to the **List** options in the linker category in the IAR Embedded Workbench IDE.

```
-Q -Qsegment=initializer_segment
```

Use `-Q` to do automatic setup for copy initialization of segments (scatter loading). This will cause the linker to generate a new segment (*initializer_segment*) into which it will place all data content of the segment *segment*. Everything else, e.g. symbols and debugging information, will still be associated with the segment *segment*. Code in the application must at runtime copy the contents of *initializer_segment* (in ROM) to *segment* (in RAM).

This is very similar to what compilers do for initialized variables and is useful for code that needs to be in RAM memory.

The segment *initializer_segment* must be placed like any other segment using the segment placement commands.

Assume for example that the code in the segment `RAMCODE` should be executed in RAM. `-Q` can be used for making the linker transfer the contents of the segment `RAMCODE` (which will reside in RAM) into the (new) segment `ROMCODE` (which will reside in ROM), like this:

```
-QRAMCODE=ROMCODE
```

Then `RAMCODE` and `ROMCODE` need to be placed, using the usual segment placement commands. `RAMCODE` needs to be placed in the relevant part of RAM, and `ROMCODE` in ROM. Here is an example:

```
-Z (DATA) RAM segments, RAMCODE, Other RAM=0-1FFF
-Z (CODE) ROM segments, ROMCODE, Other ROM segments=4000-7FFF
```

This will reserve room for the code in `RAMCODE` somewhere between address 0 and address 0x1FFF, the exact address depending on the size of other segments placed before it. Similarly, `ROMCODE` (which now contains all the original contents of `RAMCODE`) will be placed somewhere between 0x4000 and 0x7FFF, depending on what else is being placed into ROM.

At some time before executing the first code in `RAMCODE`, the contents of `ROMCODE` will need to be copied into it. This can be done as part of the startup code (in `CSTARTUP`) or in some other part of the code.

Example

This example is not intended as a guide to writing code that is copied from ROM to RAM, but as an example of how it *can* be done without using the assembler. All you need to add to the example is the `-Q` command and the placement commands for the segments `RAMCODE` and `ROMCODE`.

```
/* include memcpy */
#include <string.h>
```

```

/* declare that there exist 2 segments, RAMCODE and ROMCODE */
#pragma segment="RAMCODE"
#pragma segment="ROMCODE"

/* place the next function in RAMCODE */
#pragma location="RAMCODE"

/* this function is placed in RAMCODE, it does nothing useful,
   it's just an example of an function copied from ROM to RAM */

int adder(int a, int b)
{
    return a + b;
}

/* enable IAR extensions, this is necessary to get __sfb and
   __sfe, it is of course possible to write this function in
   assembler instead */
#pragma language=extended

void init_ram_code()
{
    void * ram_start   = __sfb("RAMCODE"); /* start of RAMCODE */
    void * ram_end     = __sfe("RAMCODE"); /* end of RAMCODE */
    void * rom_start   = __sfb("ROMCODE"); /* start of ROMCODE */

    /* compute the number of bytes to copy */
    unsigned long size = (unsigned long)(ram_end) - (unsigned
long)(ram_start);

    /* copy the contents of ROMCODE to RAMCODE */
    memcpy( ram_start, rom_start, size );
}

/* restore the previous mode */
#pragma language=default

int main()
{
    /* copy ROMCODE to RAMCODE, this needs to be done before
       anything in RAMCODE is called or referred to */
    init_ram_code();

    /* call the function in RAMCODE */
    return adder( 4, 5 );
}

```


-q -q

When used with version 4.10 or later of the ARM IAR C/C++ Compiler, XLINK performs relay function optimization. Using the -q option disables this optimization, retaining all used relay functions in the program. The option has no effect if there are no relay functions to optimize.

-R -R[w]

Use -R to specify the address range check.

If an address is relocated out of the target CPU’s address range (code, external data, or internal data address) an error message is generated. This usually indicates an error in an assembler language module or in the segment placement.

The following table shows how the modifiers are mapped:

| Option | Description |
|-----------|--------------------------------------|
| (default) | An error message is generated. |
| -Rw | Range errors are treated as warnings |
| -R | Disables the address range checking |

Table 13: Disable range check options

Note: Range error messages are never issued for references to segments of any of the following types:

NEAR
NEARC, NEARCONST
NEARCODE
FAR
FARC, FARCONST
FARCODE
HUGE
HUGE, HUGECONST
HUGECODE

All banked segments.



This option is related to the **Range checks** options in the linker category in the IAR Embedded Workbench IDE.

-r -r

Use -r to output a file in DEBUG (UBROF) format, with a dnn extension, to be used with the IAR C-SPY Debugger. For emulators that support the IAR Systems DEBUG format, use -F ubrof.

Specifying `-r` overrides any `-F` option.



This option is related to the **Output** options in the linker category in the IAR Embedded Workbench IDE.

`-rt -rt`

Use `-rt` to use the output file with the IAR C-SPY Debugger and emulate terminal I/O.



This option is related to the **Output** options in the linker category in the IAR Embedded Workbench IDE.

`-S -S`

Use `-S` to turn off the XLINK sign-on message and final statistics report so that nothing appears on your screen during execution. However, this option does not disable error and warning messages or the list file output.

`-s -s symbol`

This option adds a new way to specify the entry point for an application.

If the option is used, the specified *symbol* will be used as the application entry point, and there must be a definition for the symbol in the application, or an Undefined External error (error 46) will be generated. This symbol definition will also be included in the final link image.

`-U -U [(address_space)] range = [(address_space)] range`

where the parameters are as follows:

| | | |
|----------------------|------------------|---|
| <i>address_space</i> | | Specifies the address space if applicable for the target processor. If omitted it defaults to CODE. |
| <i>range</i> | <i>start-end</i> | The range starting at <i>start</i> and ending at <i>end</i> . |

Each `-U` command line option declares that the memory given by the range on the left side of the `=` is the same memory as that given by the range on the right side. This has the effect that, during segment placement, anything occupying some part of either memory will be considered to reserve the corresponding part of the other memory as well.

The optional segment type parameter (*address_space*) that can be included on each side of the = can be used to specify the address space for architectures with multiple address spaces.

Example

This example assumes an architecture with separate code and address spaces, where the CODE segment type corresponds to the code address space and the DATA segment type to the data address space.

```
-U (CODE) 4000-5FFF= (DATA) 11000-12FFF
-P (CODE) MYCODE=4000-5FFF
-P (DATA) MYCONST=11000-12FFF
```

The first line declares that the memory at 4000-5FFF in the code address space is also mapped at 11000-12FFF in the data address space.

The second line places the MYCODE segment at 4000-5FFF in the code address space. The corresponding bytes in the data address space will also be reserved. If MYCODE occupies the addresses 4000-473F, the range 11000-1173F in the data address space will also be reserved.

The third line will place the MYCONST segment into whatever parts of the 11000-12FFF memory range are not reserved. In this case it will behave as if we had written:

```
-P (DATA) MYCONST=11740-12FFF
```

-U is not transitive. This means that overlapping address spaces specified by the same placement option will not be distributed correctly to all involved address ranges. See this example:

```
-U (CODE) 1000-1FFF= (DATA) 20000-20FFF
-U (DATA) 20000-20FFF= (CONST) 30000-30FFF
```

In this example, if some bytes are placed in the CODE space at address 1000, the corresponding bytes in the DATA space will be reserved, but not the corresponding bytes in the CONST space. The workaround is to specify the third (“missing”, so to speak) address space sharing:

```
-U (CODE) 1000-1FFF= (CONST) 30000-30FFF
```

```
-V (type) name[, align]
```

where the parameters are as follows:

| | |
|-------------|--|
| <i>type</i> | Specifies the memory type for all segments placed into the relocation area, if applicable for the target processor. If omitted it defaults to UNTYPED. |
|-------------|--|

| | |
|--------------|---|
| <i>name</i> | The name you give the area you are defining. |
| <i>align</i> | The minimum power of two alignment of the relocation area. For instance, a value of 2 means that the area will always be placed at an address that is an even multiple of 4 bytes. This value must be <i>at least</i> as high as that of any segment that will be placed into the relocation area, but preferably higher. |

The `-v` option specifies a relocation area to place memory segments in.

Relocation areas are a way of partitioning the set of segments in such a way that a loader can place them in different parts of memory. Each relocation area has a start address that is assigned a value at load time.

When producing non-relocatable output, XLINK assigns addresses to all symbols and segment parts. When producing *relocatable* output, however, each symbol and segment part can instead be assigned an offset from the start of a relocation area. This is then turned into a regular address at load time, when the loader determines the location of each relocation area.

Relocation areas can be used instead of segment types in segment placement commands (`-Z`, `-P`).

Example

```
// Declare relocation areas for code, constants and data.
-V(CODE)CODE_AREA,12
-V(CONST)CONST_AREA,12
-V(DATA)DATA_AREA,12

// Place segments into the relocation areas
-Z(CODE_AREA)RCODE,CODE=0-FFFFFF
-Z(CONST_AREA)DATA_C,DATA_ID=0-FFFFFF
-Z(DATA_AREA)DATA_Z,DATA_I=0-FFFFFF
```

If the relocation areas share the same memory, this must be explicitly declared using the `-U` option, for example like this:

```
-U(CODE_AREA)0-FFFF=(CONST_AREA)0-FFFF
```

Note: Avoid mixing segment placement using relocation areas with placement using segment types. This would result in an executable file where parts are relocatable and parts are absolute, which is unlikely to be very useful.

`-w` `-w[n|s|t|ID[=severity]]`

Use just `-w` without an argument to suppress warning messages.

The optional argument `n` specifies which warning to disable; for example, to disable warnings 3 and 7:

`-w3 -w7`

Specifying `-ws` changes the return status of XLINK as follows:

| Condition | Default | -ws |
|------------------------|---------|-----|
| No errors or warnings | 0 | 0 |
| Warnings but no errors | 0 | 1 |
| One or more errors | 2 | 2 |

Table 14: Diagnostic control conditions (`-ws`)

Specifying `-wt` suppresses the detailed type information given for warnings 6 (type conflict) and 35 (multiple structs with the same tag).

Specifying `-wID` changes the severity of a particular diagnostic message. `ID` is the identity of a diagnostic message, which is either the letter `e` followed by an error number, the letter `w` followed by a warning number, or just a warning number.

The optional argument `severity` can be either `i`, `w`, or `e`. If omitted it defaults to `i`.

| Severity | Description |
|----------------|---|
| <code>i</code> | Ignore this diagnostic message. No diagnostic output. |
| <code>w</code> | Report this diagnostic message as a warning. |
| <code>e</code> | Report this diagnostic message as an error. |

Table 15: Changing diagnostic message severity

`-w` can be used several times in order to change the severity of more than one diagnostic message

Fatal errors are not affected by this option.

Some examples:

`-w26`
`-ww26`
`-ww26=i`

These three are equivalent and turn off warning 26.

`-we106=w`

This causes error 106 to be reported as a warning.

If the argument is omitted, all warnings are disabled.

As the severity of diagnostic messages can be changed, the identity of a particular diagnostic message includes its original severity as well as its number. That is, diagnostic messages will typically be output as:

Warning[w6]: Type conflict for external/entry ...

Error[e1]: Undefined external ...



This option is related to the **Diagnostics** options in the linker category in the IAR Embedded Workbench IDE.

-x -x[e] [h] [i] [m] [n] [s] [o]

Use -x to include a segment map in the XLINK list file. This option is used with the list options -L or -l. See page 36 for additional information.

The following modifiers are available:

| Modifier | Description |
|----------|--|
| e | An abbreviated list of every entry (global symbol) in every module. This entry map is useful for quickly finding the address of a routine or data element. See <i>Symbol listing (-xe)</i> , page 18. |
| h | The list file will be in HTML format, with hyperlinks. |
| i | Includes all segment parts in a linked module in the list file, not just the segment parts that were included in the output. This makes it possible to determine exactly which entries that were not needed. |
| m | A list of all segments, local symbols, and entries (public symbols) for every module in the program. See <i>Module map (-xm)</i> , page 15. |
| n | Generates a module summary. See <i>Module summary (-xn)</i> , page 19. |
| s | A list of all the segments in dump order. See <i>Segment map (-xs)</i> , page 17. |
| o | If the compiler uses static overlay, this modifier includes a listing of the static overlay system in the list file. See <i>Static overlay system map (-xo)</i> , page 20. |

Table 16: Cross-reference options

When the -x option is specified without any of the optional parameters, a default cross-reference list file will be generated which is equivalent to -xms. This includes:

- A header section with basic program information.
- A module load map with symbol cross-reference information.
- A segment load map in dump order.

Cross-reference information is listed to the screen if neither of the -l or -L options has been specified.



This option is related to the **List** options in the linker category in the IAR Embedded Workbench IDE.

`-Y` `-Y[char]`

Use `-Y` to select enhancements available for some output formats. For more information, see the chapter *XLINK output formats*.



This option is related to the **Output** options in the linker category in the IAR Embedded Workbench IDE.

`-y` `-y[chars]`

Use `-y` to specify output format variants for some formats. A sequence of flag characters can be specified after the option `-y`. The affected formats are ELF, IEEE695, and XCOFF78K.

For more information, see the chapter *XLINK output formats*.



This option is related to the **Output** options in the linker category in the IAR Embedded Workbench IDE.

`-Z` `-Z[@] [([SPLIT-] type)] segments [= | #] range [, range] ...`

The parameters are as follows:

`@`

Allocates the segments without taking into account any other use of the address ranges given. This is useful if you for some reason want the segments to overlap.

`type`

Specifies the memory type for all segments if applicable for the target processor. If omitted it defaults to UNTYPED.

`segments`

A list of one or more segments to be linked, separated by commas. The segments are allocated in memory in the same order as they are listed. Appending `+nnnn` to a segment name increases the amount of memory that XLINK will allocate for that segment by `nnnn` bytes.

| | | |
|--|---------------------------------------|---|
| = or # | Specifies how segments are allocated: | |
| | = | Allocates the segments so they begin at the start of the specified range (upward allocation). |
| | # | Allocates the segment so they finish at the end of the specified range (downward allocation). |
| If an allocation operator (and range) is not specified, the segments will be allocated upwards from the last segment that was linked, or from address 0 if no segments have been linked. | | |
| range | <i>start-end</i> | The range starting at <i>start</i> and ending at <i>end</i> . |
| | <i>[start-end] * count+offset</i> | Specifies <i>count</i> ranges, where the first is from <i>start</i> to <i>end</i> , the next is from <i>start+offset</i> to <i>end+offset</i> , and so on. The <i>+offset</i> part is optional, and defaults to the length of the range. |
| | <i>[start-end] / pagesize</i> | Specifies the entire <i>range</i> from <i>start</i> to <i>end</i> , divided into pages of size and alignment <i>pagesize</i> . Note: The <i>start</i> and <i>end</i> of the range do not have to coincide with a page boundary. |
| | <i>start:+size</i> | The range starting at <i>start</i> with the length <i>size</i> . |
| | <i>[start:+size] * count+offset</i> | Specifies <i>count</i> ranges, where the first begins at <i>start</i> and has the length <i>size</i> , the next one begins at <i>start+offset</i> and has the same length, and so on. The <i>+offset</i> part is optional, and defaults to the length of the range. |

`[start:+size]/pagesize`

Specifies the entire range beginning at *start* and with the length *size*, divided into pages of size and alignment *pagesize*. *Note:* The beginning and end of the range do not have to coincide with a page boundary.

Use `-z` to specify how and where segments will be allocated in the memory map.

If the linker finds a segment in an input file that is not defined either with `-z`, `-b`, or `-p`, an error is reported. There can be more than one `-z` definition.

Placement into far memory (the `FAR`, `FARCODE`, and `FARCONST` segment types) is treated separately. Using the `-z` option for far memory, places the segments that fit entirely into the first page and range sequentially, and then places the rest using a special variant of sequential placement that can move an individual segment part into the next range if it did not fit. This means that far segments can be split into several memory ranges, but it is guaranteed that a far segment has a well-defined start and end.

The following examples show the address range syntax:

| | |
|----------------------------------|---|
| <code>0-9F, 100-1FF</code> | Two ranges, one from zero to 9F, one from 100 to 1FF. |
| <code>[1000-1FFF]*3+2000</code> | Three ranges: 1000-1FFF, 3000-3FFF, 5000-5FFF. |
| <code>[1000-1FFF]*3</code> | Three ranges: 1000-1FFF, 2000-2FFF, 3000-3FFF. |
| <code>[50-77F]/200</code> | Five ranges: 50-1FF, 200-3FF, 400-5FF, 600-77F. |
| <code>1000:+1000</code> | One range from 1000 to 1FFF. |
| <code>[1000:+1000]*3+2000</code> | Three ranges: 1000-1FFF, 3000-3FFF, 5000-5FFF. |

All numbers in segment placement command-line options are interpreted as hexadecimal unless they are preceded by a `.` (period). That is, the numbers written as `10` and `.16` are both interpreted as sixteen. If you want, you can put `0x` before the number to make it extra clear that it is hexadecimal, like this: `0x4FFF`.

SPLITTING SEGMENTS

Normally, when you place segments sequentially with the `-z` option, each segment is placed in its entirety into one of the address ranges you have specified. If you use the modifier `SPLIT-`, each part of the segment is placed separately in sequence, allowing address gaps between different segment parts.

Example

```
-Z (SPLIT-CONST) DATA_Z=4000-7FFF, 8000-BFFF
```

Assume that at the moment of placement, addresses 4000–7003 have been reserved for other purposes. If the `DATA_Z` segment consists of 100 segment parts, each 50 bytes long, the entire `DATA_ID` segment does not fit into the range 7004–7FFF. Normally, this means that XLINK places the segment starting at address 8000. If you instead use the `SPLIT-` modifier, the first 81 segment parts are placed sequentially from address 7004, and the remaining 19 from address 8000.

Normally, using packed segment placement (`-P`) is better. The only case where using `-Z` (`SPLIT-type`) is better is when the start and end addresses of the segment are important, for example, when the entire segment must be initialized to zero at program startup, and individual segment parts cannot be placed at arbitrary addresses.

The result of using the `SPLIT-` modifier is similar to the effect of using the `-Z` option for far memory (the `FAR`, `FARCODE`, and `FARCONST` segment types). The differences are that:

- using a far segment type implicitly divides the specified address ranges into 64-Kbyte sections (similar to what would happen if the range had been written $[start-end] / 10000$).
- the `SPLIT-` modifier can be used with any address space, but a far segment type can only be used with the address spaces denoted by the segment types `CODE`, `CONST`, and `DATA`.

For more information see *Segment control*, page 9.

`-Z` `-Z`

Use `-z` to reduce segment overlap errors to warnings, making it possible to produce cross-reference maps, etc.



This option is related to the **Diagnostics** options in the linker category in the IAR Embedded Workbench IDE.

XLINK output formats

This chapter gives a summary of the IAR XLINK Linker output formats.

Single output file

The following formats result in the generation of a single output file:

| Format | Type | Filename extension | Address translation support | Addressing capability |
|-----------------------|--------|--------------------|-----------------------------|-----------------------|
| AOMF8051 | binary | from CPU | Yes | 16 bits |
| AOMF8096 | binary | from CPU | Yes | 16 bits |
| AOMF80196 | binary | from CPU | Yes | 32 bits |
| AOMF80251 | binary | from CPU | No | 32 bits |
| ASHLING | binary | none | Yes | 16 bits |
| ASHLING-6301 | binary | from CPU | Yes | 16 bits |
| ASHLING-64180 | binary | from CPU | Yes | 16 bits |
| ASHLING-6801 | binary | from CPU | Yes | 16 bits |
| ASHLING-8080 | binary | from CPU | Yes | 16 bits |
| ASHLING-8085 | binary | from CPU | Yes | 16 bits |
| ASHLING-Z80 | binary | from CPU | Yes | 16 bits |
| DEBUG (UBROF) | binary | dbg | No | 32 bits |
| ELF* | binary | elf | No | 32 bits |
| EXTENDED-TEKHEX | ASCII | from CPU | Yes | 32 bits |
| HP-CODE | binary | x | Yes | 32 bits |
| HP-SYMB | binary | 1 | Yes | 32 bits |
| IEEE695* | binary | 695 | No | 32 bits |
| INTEL-EXTENDED | ASCII | from CPU | Yes | 32 bits |
| INTEL-STANDARD | ASCII | from CPU | Yes | 16 bits |
| MILLENIUM (Tektronix) | ASCII | from CPU | Yes | 16 bits |
| MOTOROLA** | ASCII | from CPU | Yes | 32 bits |
| MOTOROLA-S19** | ASCII | from CPU | Yes | 16 bits |
| MOTOROLA-S28** | ASCII | from CPU | Yes | 32 bits |
| MOTOROLA-S37** | ASCII | from CPU | Yes | 32 bits |

Table 17: XLINK formats generating a single output file

| Format | Type | Filename extension | Address translation support | Addressing capability |
|-----------------------|--------|--------------------|-----------------------------|-----------------------|
| MPDS-CODE | binary | tsk | Yes | 32 bits |
| MPDS-SYMB | binary | sym | Yes | 32 bits |
| MSD | ASCII | sym | No | 16 bits |
| MSP430_TXT | ASCII | txt | No | 16 bits |
| NEC-SYMBOLIC | ASCII | sym | No | 16 bits |
| NEC2-SYMBOLIC | ASCII | sym | No | 16 bits |
| NEC78K-SYMBOLIC | ASCII | sym | No | 16 bits |
| PENTICA-A | ASCII | sym | Yes | 32 bits |
| PENTICA-B | ASCII | sym | Yes | 32 bits |
| PENTICA-C | ASCII | sym | Yes | 32 bits |
| PENTICA-D | ASCII | sym | Yes | 32 bits |
| RAW-BINARY† | binary | bin | Yes | 32 bits |
| RCA | ASCII | from CPU | Yes | 16 bits |
| SIMPLE | binary | raw | No | 32 bits |
| SIMPLE-CODE | binary | sim | No | 32 bits |
| SYMBOLIC | ASCII | from CPU | Yes | 32 bits |
| SYSROF | binary | abs | No | 32 bits |
| TEKTRONIX (Millenium) | ASCII | hex | Yes | 16 bits |
| TI7000 (TMS7000) | ASCII | from CPU | Yes | 16 bits |
| TYPED | ASCII | from CPU | Yes | 32 bits |
| UBROF†† | binary | dbg | No | 32 bits |
| UBROF5 | binary | dbg | No | 32 bits |
| UBROF6 | binary | dbg | No | 32 bits |
| UBROF7 | binary | dbg | No | 32 bits |
| UBROF8 | binary | dbg | No | 32 bits |
| UBROF9 | binary | dbg | No | 32 bits |
| UBROF10 | binary | dbg | No | 32 bits |
| XCOFF78k* | binary | lnk | No | 32 bits |
| ZAX | ASCII | from CPU | Yes | 32 bits |

Table 17: XLINK formats generating a single output file (Continued)

* The format is supported only for certain CPUs and debuggers. See `xlink.htm` and `xman.htm` for more information.

** The MOTOROLA output format uses a mixture of the record types S1, S2, S3 (any number of each), S7, S8, and S9 (only one of these record types can be used, and no more than once), depending on the range of addresses output.

XLINK can generate three variants of the MOTOROLA output format, each using only a specific set of record types:

MOTOROLA-S19 uses the S1 and S9 record types, which use 16-bit addresses.

MOTOROLA-S28 uses the S2 and S8 record types, which use 24-bit addresses.

MOTOROLA-S37 uses the S3 and S7 record types, which use 32-bit addresses.

† RAW-BINARY is a binary image format. It contains no header, starting point, or address information, only pure binary data. The first byte of the file is the first byte in the application. A .bin file contains all bytes between the first and the last byte in the application, including any and all gaps. Note that there is no way to identify the entry address of the application from the contents of the file. This information must be tracked of in some other way, for instance, in the filename. To link raw binary files with your application, see *--image_input*, page 32.

†† Using -FUBROF (or -FDEBUG) will generate UBROF output matching the latest UBROF format version in the input. Using -FUBROF5 – -FUBROF9 will force output of the specified version of the format, irrespective of the input.

UBROF VERSIONS

XLINK reads all UBROF versions from UBROF 3 onwards, and can output all UBROF versions from UBROF 5 onwards. There is also support for outputting something called *Old UBROF* which is an early version of UBROF 5, close to UBROF 4. See *Output format variants*, page 59.

Normally, XLINK outputs the same version of UBROF that is used in its input files, or the latest version if more than one version is found. If you have a debugger that does not support this version of UBROF, XLINK can be directed to use another version. See *-F*, page 30.

For the IAR C-SPY® Debugger, this is not a problem. The command line option *-r*—which in addition to specifying UBROF output also selects C-SPY-specific library modules from the IAR Systems standard library—always uses the same UBROF version as found in the input.

Debug information loss

When XLINK outputs a version of UBROF that is earlier than the one used in its input, there is almost always some form of debug information loss, though this is often minor.

This debug information loss can consist of some of the following items:

| UBROF version | Information that cannot be fully represented in earlier versions |
|---------------|---|
| 5 | Up to 16 memory keywords resulting in different pointer types and different function calling conventions. |
| 6 | Source in header files. Assembler source debug. |
| 7 | Support for up to 255 memory keywords. Support for target type and object attributes. Enum constants connected to enum types. Arrays with more than 65535 elements. Anonymous structs/unions. Slightly more expressive variable tracking info. |
| 8 | C++ object names. Added base types. Typedefs used in the actual types. C++ types: references and pointers to members. Class members. Target defined base types. |
| 9 | Call frame information. Function call step points. Inlined function instances. |
| 10 | C++ template information. |

Table 18: Possible information loss with UBROF version mismatch

In each case, XLINK attempts to convert the information to something that is representable in an earlier version of UBROF, but this conversion is by necessity incomplete and can cause inconsistencies. However, in most cases the result is almost indistinguishable from the original as far as debugging is concerned.

Two output files

The following formats result in the generation of two output files:

| Format | Code format | Ext. | Symbolic format | Ext. |
|-----------------|-------------|------|-----------------|------|
| DEBUG-MOTOROLA | DEBUG | ann | MOTOROLA | obj |
| DEBUG-INTEL-EXT | DEBUG | ann | INTEL-EXT | hex |
| DEBUG-INTEL-STD | DEBUG | ann | INTEL-STD | hex |
| HP | HP-CODE | x | HP-SYMB | l |

Table 19: XLINK formats generating two output files

| Format | Code format | Ext. | Symbolic format | Ext. |
|------------|----------------|------|-----------------|------|
| MPDS | MPDS-CODE | tsk | MPDS-SYMB | sym |
| MPDS-I | INTEL-STANDARD | hex | MPDS-SYMB | sym |
| MPDS-M | Motorola | s19 | MPDS-SYMB | sym |
| MSD-I | INTEL-STANDARD | hex | MSD | sym |
| MSD-M | Motorola | hex | MSD | sym |
| MSD-T | MILLENIUM | hex | MSD | sym |
| NEC | INTEL-STANDARD | hex | NEC-SYMB | sym |
| NEC2 | INTEL-STANDARD | hex | NEC2-SYMB | sym |
| NEC78K | INTEL-STANDARD | hex | NEC78K-SYMB | sym |
| PENTICA-AI | INTEL-STANDARD | obj | Pentica-a | sym |
| PENTICA-AM | Motorola | obj | Pentica-a | sym |
| PENTICA-BI | INTEL-STANDARD | obj | Pentica-b | sym |
| PENTICA-BM | Motorola | obj | Pentica-b | sym |
| PENTICA-CI | INTEL-STANDARD | obj | Pentica-c | sym |
| PENTICA-CM | Motorola | obj | Pentica-c | sym |
| PENTICA-DI | INTEL-STANDARD | obj | Pentica-d | sym |
| PENTICA-DM | Motorola | obj | Pentica-d | sym |
| ZAX-I | INTEL-STANDARD | hex | ZAX | sym |
| ZAX-M | Motorola | hex | ZAX | sym |

Table 19: XLINK formats generating two output files (Continued)

Output format variants

The following enhancements can be selected for the specified output formats, using the **Format variant** (-Y) option:

| Output format | Option | Description |
|-------------------------------------|--------|--|
| PENTICA-A, B, C, D and MPDS-SYMB | Y0 | Symbols as <i>module:symbolname</i> . |
| | Y1 | Labels and lines as <i>module:symbolname</i> . |
| | Y2 | Lines as <i>module:symbolname</i> . |

Table 20: XLINK output format variants

| Output format | Option | Description |
|----------------|--------|---|
| AOMF8051 | Y0 | Extra type of information for Hitex. |
| | Y1 | This non-standard extension of the format can be specified to make XLINK use the SEGID field to contain the bank number (0x0–0xFF) of addresses greater than 0xFFFF. If the option is not used, the SEGID field will always be 0. |
| INTEL-STANDARD | Y0 | End only with :00000001FF. |
| | Y1 | End with PGMENTRY, else :0000001FF. |
| MPDS-CODE | Y0 | Fill with 0xFF instead. |
| DEBUG, -r | Y# | Old UBROF version. |
| INTEL-EXTENDED | Y0 | Segmented variant. |
| | Y1 | 32-bit linear variant. |

Table 20: XLINK output format variants (Continued)

Refer to the file `xlink.htm` for information about additional options that may have become available since this guide was published.

Use **Format variant** (`-y`) to specify output format variants for some formats. A sequence of flag characters can be specified after the option `-y`. The affected formats are IEEE695 (see page 60), ELF (see page 61), and XCOFF78K (see page 63).

IEEE695

For IEEE695 the available format modifier flags are:

| Modifier | Description |
|----------|--|
| -yd | Do not emit any <code>#define</code> constant records. This can sometimes drastically reduce the size of the output file. |
| -yg | Output globally visible types in a BB2 block at the beginning of the output file. |
| -yl | Output the globally visible types in a BB1 block at the beginning of each module in the output file. |
| -yb | XLINK supports the use of IEEE-695 based variables to represent bit variables, and the use of bit addresses for bit-addressable sections. Turning on this modifier makes XLINK treat these as if they were byte variables or sections. |
| -ym | Turning on this modifier adjusts the output in some particular ways for the Mitsubishi PDB30 debugger. <i>Note:</i> You will need to use the <code>l</code> and <code>b</code> modifiers as well (<code>-ylbm</code>). |
| -ye | Using this modifier will cause XLINK to not emit any block-local constant in the output file. One way these can occur is if an <code>enum</code> is declared in a block. |

Table 21: IEEE695 format modifier flags

| Modifier | Description |
|----------|---|
| -yv | Use the <i>variable life time</i> support in IEEE-695 to output more accurate debug information for variables whose location vary. |
| -ys | Output IEEE-695 <i>stack adjust</i> records to indicate the offset from the stack pointer of a virtual frame pointer. |
| -ya | Output information about module local symbols in BB10 (assembler level) blocks as well as in the BB3 (high level) blocks, if any. |
| L-yr | Change the source line information for the last return statement in a function to refer to the last line of the function instead of the line where it is located. |

Table 21: IEEE695 format modifier flags (Continued)

The following table shows the recommended IEEE695 format variant modifiers for some specific debuggers:

| Processor family | Debugger | Format variant modifier |
|------------------|-----------------------------|-------------------------|
| 6812 | Noral debugger | -ygvS |
| 68HC16 | Microtek debugger | -y1b |
| 740 | Mitsubishi PD38 | -y1bma |
| 7700 | HP RTC debugger | -ygbr |
| 7700 | Mitsubishi PD77 | -y1bm |
| H8300 | HP RTC debugger | -ygbr |
| H8300H | HP RTC debugger | -ygbr |
| H8S | HP RTC debugger | -ygbr |
| M16C | HP RTC debugger | -ygbr |
| M16C | Mitsubishi PD30/PDB30/KDB30 | -y1bm |
| T900 | Toshiba RTE900 m25 | -ygbe |
| T900 | Toshiba RTE900 m15 | -ygbed |

Table 22: IEEE695 format variant modifiers for specific debuggers

ELF

For ELF the available format modifier flags are:

| Modifier | Description |
|----------|---|
| -ya | Adjusts the output to suit ARM Ltd. debuggers. This changes the flag values for some debug sections in ELF and pads all sections to an even multiple of four bytes. It also has the effect of setting the -yp option. |

Table 23: ELF format modifier flags

| Modifier | Description |
|----------|---|
| -yc | Outputs an <code>address_class</code> attribute for pointer types based on the UBROF memory attribute number. This format variant option requires a DWARF reader (debugger) that understands these attributes. |
| -yf | Prevents the output of a <code>.debug_frame</code> section (DWARF call frame information). Note that a <code>.debug_frame</code> section is only generated if enough information is present in the linker input files. |
| -ym | Normally, all types are output once, in the first compilation unit, and global debug info references are used to refer to them in the rest of the debug information. If <code>-ym</code> is specified, all types are output in each compilation unit, and compilation unit relative references are used to refer to them. |
| -yn | Outputs an ELF/DWARF file without debug information. |
| -yp | Outputs one ELF program section for each segment, instead of one section for all segments combined. |
| -yr | When this option is specified XLINK produces a relocatable executable ELF file, a file that is both executable but also contains relocation directives to make it possible to execute the image at an address other than that at which it was linked. You also need a compiler that supports relocation (consult your compiler reference guide if in doubt). Note: To be able to use relocatable output you also need an ELF-reader capable of reading relocatable ELF files and placing them in memory. |
| -ys | Normally, global debug info references (used for references to type records when <code>-ym</code> is not specified) are offsets into the entire file, in compliance with the DWARF specification. Specifying <code>-ys</code> causes XLINK to use <code>.debug_info</code> section offsets for these references, instead. This was the default behavior in previous XLINK versions (up to version 4.51R). |
| -yv | The DWARF standard specifies a <code>use_location</code> semantics that requires passing complete objects on the DWARF expression stack, which is ill-defined. Specifying this option causes XLINK to emit <code>use_location</code> attributes where the addresses of the objects are passed instead. This format variant option requires a DWARF reader (debugger) that understands these attributes. |
| -yx | Strips the file path of all path information so the reference is only a filename, <code>C:\MySource\MyProject\MyFile.c</code> and <code>/home/myuser/mysource/myproject/MyFile.c</code> would both become references to <code>MyFile.c</code> . |

Table 23: ELF format modifier flags (Continued)

The XLINK ELF/DWARF format output includes module-local symbols. The command line option `-n` can be used for suppressing module-local symbols in any output format.

The following table shows the recommended ELF format variant modifiers for some specific debuggers:

| Processor family | Debugger | Format variant modifier |
|------------------|------------------------|-------------------------|
| ARM | Any ELF/DWARF debugger | -yas |
| M16C | Mitsubishi PD30 | -yspc |
| M32C | Mitsubishi KD30 | -yspc |

Table 24: ELF format variant modifiers for specific debuggers

The XLINK output conforms to ELF as described in *Executable and Linkable Format (ELF)* and to DWARF version 2, as described in *DWARF Debugging Information Format*, revision 2.0.0 (July 27, 1993); both are parts of the Tools Interface Standard Portable Formats Specification, version 1.1.

Note: The ELF format is currently supported for the 68HC11, 68HC12, 68HC16, ARM®, M16C, MC80, M32C, SH, and V850 products.

XCOFF78K

For XCOFF78K the available format modifier flags are:

| Modifier | Description |
|----------|--|
| -ys | Truncates names. Use this modifier flag to truncate names longer than 31 characters to 31 characters. Irrespective of the setting of this modifier, section names longer than 7 characters are always truncated to 7 characters and module names are truncated to 31 characters. |
| -yp | Strips source file paths from source file references. Use this modifier flag to strip source file paths from source file references, if there are any, leaving only the file name and extension. |
| -ye | Includes module enums. Normally XLINK does not output module-local constants in the XCOFF78K file. The way IAR Systems compilers currently work these include all #define constants as well as all SFRs. Use this modifier flag to have them included. |
| -yl | Hobbles line number info. When outputting debug information, use this modifier flag to ignore any source file line number references that are not in a strictly increasing order within a function. |

Table 25: XCOFF78K format modifiers

| Modifier | Description |
|----------|---|
| -yn | Sorts line numbers in ascending order. Normally, XLINK will output the debug information for each function in ascending <i>address</i> order. Some debuggers prefer to have the debug information in ascending <i>line number</i> order instead. Use this modifier flag to make XLINK produce debug information that is sorted in ascending line number order. |

Table 25: XCOFF78K format modifiers (Continued)

If you want to specify more than one flag, all flags must be specified after the same `-y` option; for example, `-yvsp`.

Restricting the output to a single address space

It is possible to restrict output in the simple ROM output formats—`intel-standard`, `intel-extended`, `motorola`, `motorola-s19`, `motorola-s28`, `motorola-s37`, `millenium`, `ti7000`, `rca`, `tektronix`, `extended-tekhex`, `hp-code`, and `mpds-code`—to include only bytes from a single address space. You do this by prefixing a segment type in parentheses to the format variant. This segment type specifies the desired address space. This feature is particularly useful when used in combination with the multiple output files option, see *-O*, page 40.

Example

```
-Ointel-extended, (CODE)=file1
-Ointel-extended, (DATA)=file2
```

This will result in two output files, both using the `INTEL-EXTENDED` output format. The first (named `file1`) will contain only bytes in the address space used for the `CODE` segment type, while the second (named `file2`) will contain only bytes in the address space used for the `DATA` segment type. If these address spaces are not the same, the content of the two files will be different.

XLINK environment variables

The IAR XLINK Linker supports a number of environment variables. These can be used for creating defaults for various XLINK options so that they do not have to be specified on the command line.

Except for the `XLINK_ENVPAR` environment variable, the default values can be overruled by the corresponding command line option. For example, the `-FMPDS` command line argument will supersede the default format selected with the `XLINK_FORMAT` environment variable.

Summary of XLINK environment variables

The following environment variables can be used by the IAR XLINK Linker:

| Environment variable | Description |
|----------------------|--|
| XLINK_COLUMNS | Sets the number of columns per line. |
| XLINK_CPU | Sets the target CPU type. |
| XLINK_DFLTDIR | Sets a path to a default directory for object files. |
| XLINK_ENVPAR | Creates a default XLINK command line. |
| XLINK_FORMAT | Sets the output format. |
| XLINK_PAGE | Sets the number of lines per page. |

Table 26: XLINK environment variables

XLINK_COLUMNS

Sets the number of columns per line.

Use `XLINK_COLUMNS` to set the number of columns in the list file. The default is 80 columns.

Example

To set the number of columns to 132:

```
set XLINK_COLUMNS=132
```

| | |
|---------------|--|
| XLINK_CPU | <p>Sets the target processor.</p> <p>Use <code>XLINK_CPU</code> to set a default for the <code>-c</code> option so that it does not have to be specified on the command line.</p> <p>Example</p> <p>To set the target processor to <i>Chipname</i>:</p> <pre>set XLINK_CPU=chipname</pre> <p>Related commands</p> <p>This is equivalent to the <code>XLINK -c</code> option; see <i>-c</i>, page 28.</p> |
| XLINK_DFLTDIR | <p>Sets a path to a default directory for object files.</p> <p>Use <code>XLINK_DFLTDIR</code> to specify a path for object files. The specified path, which should end with <code>\</code>, is prefixed to the object filename.</p> <p>Example</p> <p>To specify the path for object files as <code>c:\iar\lib</code>:</p> <pre>set XLINK_DFLTDIR=c:\iar\lib\</pre> |
| XLINK_ENVPAR | <p>Creates a default XLINK command line.</p> <p>Use <code>XLINK_ENVPAR</code> to specify XLINK commands that you want to execute each time you run XLINK.</p> <p>Example</p> <p>To create a default XLINK command line:</p> <pre>set XLINK_ENVPAR=-FMOTOROLA</pre> <p>Related commands</p> <p>For more information about reading linker commands from a file, see <i>-f</i>, page 30.</p> |
| XLINK_FORMAT | <p>Sets the output format.</p> <p>Use <code>XLINK_FORMAT</code> to set the format for linker output. For a list of the available output formats, see the chapter <i>XLINK output formats</i>.</p> |

Example

To set the output format to Motorola:

```
set XLINK_FORMAT=MOTOROLA
```

Related commands

This is equivalent to the XLINK `-F` option; see *-F*, page 30.

XLINK_PAGE Sets the number of lines per page.

Use XLINK_PAGE to set the number of lines per page (20–150). The default is a list file without page breaks.

Examples

To set the number of lines per page to 64:

```
set XLINK_PAGE=64
```

Related commands

This is equivalent to the XLINK `-p` option; see *-p*, page 42.

XLINK diagnostics

This chapter describes the errors and warnings produced by the IAR XLINK Linker.

Introduction

The error messages produced by the IAR XLINK Linker fall into the following categories:

- XLINK error messages
- XLINK warning messages
- XLINK fatal error messages
- XLINK internal error messages.

XLINK WARNING MESSAGES

XLINK warning messages will appear when XLINK detects something that may be wrong. The code that is generated may still be correct.

XLINK ERROR MESSAGES

XLINK error messages are produced when XLINK detects that something is incorrect. The linking process will be aborted unless the **Always generate output** (-B) option is specified. The code produced is almost certainly faulty.

XLINK FATAL ERROR MESSAGES

XLINK fatal error messages abort the linking process. They occur when continued linking is useless, i.e. the fault is irrecoverable.

XLINK INTERNAL ERROR MESSAGES

During linking, a number of internal consistency checks are performed. If any of these checks fail, XLINK will terminate after giving a short description of the problem. These errors will normally not occur, but if they do you should report them to the IAR Systems Technical Support group. Please include information enough to reproduce the problem from both source and object code. This would typically include:

- The exact internal error message text.
- The object code files, as well as the corresponding source code files, of the program that generated the internal error. If the file size total is very large, please contact IAR Systems Technical Support before sending the files.

- A list of the compiler/assembler and XLINK options that were used when the internal error occurred, including the linker command file. If you are using the IAR Embedded Workbench IDE, these settings are stored in the `prj/pew/ewp` and `dtc` files of your project. See the *IAR Embedded Workbench® IDE User Guide* for information about how to view and copy that information.
- Product names and version numbers of the IAR Systems development tools that were used.

Error messages

If you get a message that indicates a corrupt object file, reassemble or recompile the faulty file since an interrupted assembly or compilation may produce an invalid object file.

The following table lists the IAR XLINK Linker error messages:

| | |
|---|--|
| 0 | Format chosen cannot support banking Format unable to support banking. |
| 1 | Corrupt file. Unexpected end of file in module <i>module (file)</i> encountered XLINK aborts immediately. Recompile or reassemble, or check the compatibility between XLINK and C compiler. |
| 2 | Too many errors encountered (>100) XLINK aborts immediately. |
| 3 | Corrupt file. Checksum failed in module <i>module (file)</i>. Linker checksum is <i>linkcheck</i>, module checksum is <i>modcheck</i> XLINK aborts immediately. Recompile or reassemble. |
| 4 | Corrupt file. Zero length identifier encountered in module <i>module (file)</i> XLINK aborts immediately. Recompile or reassemble. |
| 5 | Address type for CPU incorrect. Error encountered in module <i>module (file)</i> XLINK aborts immediately. Check that you are using the right files and libraries. |
| 6 | Program module <i>module</i> redeclared in file <i>file</i>. Ignoring second module XLINK will not produce code unless the Always generate output (<code>-B</code>) option (forced dump) is used. |

- 7 **Corrupt file. Unexpected UBROF – format end of file encountered in module *module* (*file*)**
XLINK aborts immediately. Recompile or reassemble.
- 8 **Corrupt file. Unknown or misplaced tag encountered in module *module* (*file*). Tag *tag***
XLINK aborts immediately. Recompile or reassemble.
- 9 **Corrupt file. Module *module* start unexpected in file *file***
XLINK aborts immediately. Recompile or reassemble.
- 10 **Corrupt file. Segment no. *segno* declared twice in module *module* (*file*)**
XLINK aborts immediately. Recompile or reassemble.
- 11 **Corrupt file. External no. *ext no* declared twice in module *module* (*file*)**
XLINK aborts immediately. Recompile or reassemble.
- 12 **Unable to open file *file***
XLINK aborts immediately. If you are using the command line, check the environment variable `XLINK_DFLTDIR`.
- 13 **Corrupt file. Error tag encountered in module *module* (*file*)**
A UBROF error tag was encountered. XLINK aborts immediately. Recompile or reassemble.
- 14 **Corrupt file. Local *local* defined twice in module *module* (*file*)**
XLINK aborts immediately. Recompile or reassemble.
- 15 **This is no error message with this number.**
- 16 **Segment *segment* is too long for segment definition**
The segment defined does not fit into the memory area reserved for it. XLINK aborts immediately.
- 17 **Segment *segment* is defined twice in segment definition `-Zsegdef`**
XLINK aborts immediately.
- 18 **Range error, *compiler/assembler_message***
Some instructions do not work unless a certain condition holds after linking. XLINK has verified that the conditions do not hold when the files are linked. For information about how to interpret the error message, see *Range errors*, page 12.

The check can be suppressed by the `-R` option.
- 19 **Corrupt file. Undefined segment referenced in module *module* (*file*)**
XLINK aborts immediately. Recompile or reassemble.

- 20 Corrupt file. External index out of range in module *module* (file)**
The object file is corrupt. Contact IAR Systems Technical support.
- 21 Segment *segment* in module *module* does not fit bank**
The segment is too long. XLINK aborts immediately.
- 22 Paragraph no. is not applicable for the wanted CPU. Tag encountered in module *module* (file)**
XLINK aborts immediately. Delete the paragraph number declaration in the `xc1` file.
- 23 Corrupt file. T_REL_FI_8 or T_EXT_FI_8 is corrupt in module *module* (file)**
The tag `T_REL_FI_8` or `T_EXT_FI_8` is faulty. XLINK aborts immediately. Recompile or reassemble.
- 24 Segment *segment* overlaps segment *segment***
The segments overlap each other; i.e. both include the same address.
- 25 Corrupt file. Unable to find module *module* (file)**
A module is missing. XLINK aborts immediately.
- 26 Segment *segment* is too long**
This error should never occur unless the program is extremely large. XLINK aborts immediately.
- 27 Entry *entry* in module *module* (file) redefined in module *module* (file)**
There are two or more entries with the same name. XLINK aborts immediately.
- 28 File *file* is too long**
The program is too large. Split the file. XLINK aborts immediately.
- 29 No object file specified in command-line**
There is nothing to link. XLINK aborts immediately.
- 30 Option *option* also requires the *option* option**
XLINK aborts immediately.
- 31 Option *option* cannot be combined with the *option* option**
XLINK aborts immediately.
- 32 Option *option* cannot be combined with the *option* option and the *option* option**
XLINK aborts immediately.
- 33 Faulty value *value*, (range is 10-150)**
Faulty page setting. XLINK aborts immediately.

- 34 **Filename too long**
The filename is more than 255 characters long. XLINK aborts immediately.
- 35 **Unknown flag *flag* in cross reference option *option***
XLINK aborts immediately.
- 36 **Option *option* does not exist**
XLINK aborts immediately.
- 37 **- not succeeded by character**
The - (dash) marks the beginning of an option, and must be followed by a character. XLINK aborts immediately.
- 38 **Option *option* must not be defined more than once**
XLINK aborts immediately.
- 39 **Illegal character specified in option *option***
XLINK aborts immediately.
- 40 **Argument expected after option *option***
This option must be succeeded by an argument. XLINK aborts immediately.
- 41 **Unexpected '-' in option *option***
XLINK aborts immediately.
- 42 **Faulty symbol definition -*Dsymbol definition***
Incorrect syntax. XLINK aborts immediately.
- 43 **Symbol in symbol definition too long**
The symbol name is more than 255 characters. XLINK aborts immediately.
- 44 **Faulty value *value*, (range 80-300)**
Faulty column setting. XLINK aborts immediately.
- 45 **Unknown CPU *CPU* encountered in context**
XLINK aborts immediately. Make sure that the argument to -c is valid. If you are using the command line you can get a list of CPUs by typing `xlink -c?`.
- 46 **Undefined external *external* referred in module (*file*)**
Entry to *external* is missing.
- 47 **Unknown format *format* encountered in context**
XLINK aborts immediately.
- 48 **This error message number is not used.**
- 49 **This error message number is not used.**
- 50 **Paragraph no. not allowed for this CPU, encountered in option *option***
XLINK aborts immediately. Do not use paragraph numbers in declarations.

- 51** ***Input base value expected in option option***
XLINK aborts immediately.
- 52** ***Overflow on value in option option***
XLINK aborts immediately.
- 53** ***Parameter exceeded 255 characters in extended command line file file***
XLINK aborts immediately.
- 54** ***Extended command line file file is empty***
XLINK aborts immediately.
- 55** ***Extended command line variable XLINK_ENVPAR is empty***
XLINK aborts immediately.
- 56** ***Non-increasing range in segment definition segment def***
XLINK aborts immediately.
- 57** ***No CPU defined***
No CPU defined, either in the command line or in `XLINK_CPU`. XLINK aborts immediately.
- 58** ***No format defined***
No format defined, either in the command line or in `XLINK_FORMAT`. XLINK aborts immediately.
- 59** ***Revision no. for file is incompatible with XLINK revision no.***
XLINK aborts immediately.

If this error occurs after recompilation or reassembly, the wrong version of XLINK is being used. Check with your supplier.
- 60** ***Segment segment defined in bank definition and segment definition.***
XLINK aborts immediately.
- 61** ***This error message number is not used.***
- 62** ***Input file file cannot be loaded more than once***
XLINK aborts immediately.
- 63** ***Trying to pop an empty stack in module module (file)***
XLINK aborts immediately. Recompile or reassemble.
- 64** ***Module module (file) has not the same debug type as the other modules***
XLINK aborts immediately.
- 65** ***Faulty replacement definition -e replacement definition***
Incorrect syntax. XLINK aborts immediately.

- 66 Function with F-index *index* has not been defined before indirect reference in module *module (file)***
Indirect call to an undefined in module. Probably caused by an omitted function declaration.
- 67 Function *name* has same F-index as *function-name*, defined in module *module (file)***
Probably a corrupt file. Recompile file.
- 68 External function *name* in module *module (file)* has no global definition**
If no other errors have been encountered, this error is generated by an assembler-language call from C where the required declaration using the `$DEFFN` assembler-language support directive is missing. The declaration is necessary to inform XLINK of the memory requirements of the function.
- 69 Indirect or recursive function *name* in module *module (file)* has parameters or auto variables in nondefault memory**
The recursively or indirectly called function name is using extended language memory specifiers (bit, data, idata, etc) to point to non-default memory, memory which is not allowed.
- Function parameters to indirectly called functions must be in the default memory area for the memory model in use, and for recursive functions, both local variables and parameters must be in default memory.
- 70 This error message number is not used.**
- 71 Segment *segment* is incorrectly defined (in a bank definition, has wrong segment type or mixed with other segment types)**
This is usually due to misuse of a predefined segment; see the explanation of *segment* in the *IAR Compiler Reference Guide*. It may be caused by changing the predefined linker command file.
- 72 Segment *name* must be defined in a segment option definition (-Z, -b, or -P)**
This is caused either by the omission of a segment in XLINK (usually a segment needed by the C system control) file or by a spelling error (segment names are case sensitive).
- 73 Label ?ARG_MOVE not found (recursive function needs it)**
In the library there should be a module containing this label. If it has been removed it must be restored.
- 74 There was an error when writing to file *file***
Either XLINK or your host system is corrupt, or the two are incompatible.

- 75 SFR address in module *module (file)*, segment *segment* at address *address*, value *value* is out of bounds**
A special function register (SFR) has been defined to an incorrect address. Change the definition.
- 76 Absolute segments overlap in module *module***
XLINK has found two or more absolute segments in *module* overlapping each other.
- 77 Absolute segments in module *module (file)* overlaps absolute segment in module *module (file)***
XLINK has found two or more absolute segments in *module (file)* and *module (file)* overlapping each other.
- 78 Absolute segment in module *module (file)* overlaps segment *segment***
XLINK has found an absolute segment in *module (file)* overlapping a relocatable segment.
- 79 Faulty allocation definition -a *definition***
XLINK has discovered an error in an overlay control definition.
- 80 Symbol in allocation definition (-a) too long**
A symbol in the -a command is too long.
- 81 Unknown flag in extended format option *option***
Make sure that the flags are valid.
- 82 Conflict in segment *name*. Mixing overlayable and not overlayable segment parts.**
These errors only occur with the 8051 and converted PL/M code.
- 83 The overlayable segment *name* may not be banked.**
These errors only occur with the 8051 and converted PL/M code.
- 84 The overlayable segment *name* must be of relative type.**
These errors only occur with the 8051 and converted PL/M code.
- 85 The far/farc segment *name* in module *module (file)* is larger than size**
The segment *name* is too large to be a far segment.
- 86 This error message number is not used.**
- 87 Function with F-index *i* has not been defined before tiny_func referenced in module *module (file)***
Check that all tiny functions are defined before they are used in a module.

- 88 Wrong library used (compiler version or memory model mismatch). Problem found in *module (file)*. Correct library tag is *tag***
Code from this compiler needs a matching library. A library belonging to a later or earlier version of the compiler may have been used.
- 89 This error message can only be encountered with demo products.**
- 90 This error message can only be encountered with demo products.**
- 91 This error message can only be encountered with demo products.**
- 92 Cannot use this format with this CPU**
Some formats need CPU-specific information and are only supported for some CPUs.
- 93 Non-existent warning number *number*, (valid numbers are 0-*max*)**
An attempt to suppress a warning that does not exist gives this error.
- 94 Unknown flag *x* in local symbols option -*nx***
The character *x* is not a valid flag in the local symbols option.
- 95 Module *module (file)* uses source file references, which are not available in UBROF 5 output**
This feature cannot be filtered out by XLINK when producing UBROF 5 output.
- 96 Unmatched -! comment in extended command file**
An odd number of -! (comment) options were seen in a linker command file.
- 97 Unmatched -! comment in extended command line variable XLINK_ENVPAR**
As above, but for the environment variable XLINK_ENVPAR.
- 98 Unmatched /* comment in extended command file**
No matching */ was found in the linker command file.
- 99 Syntax error in segment definition: *option***
There was a syntax error in the option.
- 100 Segment name too long: *segment* in *option***
The segment name exceeds the maximum length (255 characters).
- 101 Segment already defined: *segment* in *option***
The segment has already been mentioned in a segment definition option.
- 102 No such segment type: *option***
The specified segment type is not valid.
- 103 Ranges must be closed in *option***
The -P option requires all memory ranges to have an end.

- I04 Failed to fit all segments into specified ranges. Problem discovered in segment *segment*.**
The packing algorithm used by XLINK did not manage to fit all the segments.
- I05 Recursion not allowed for this system. One recursive function is *functionname*.**
The runtime model used does not support recursion. Each function determined by the linker to be recursive is marked as such in the module map part of the linker list file.
- I06 Syntax error or bad argument in option**
There was an error when parsing the command line argument given.
- I07 Banked segments do not fit into the number of banks specified**
XLINK did not manage to fit all of the contents of the banked segments into the banks given.
- I08 Cannot find function *function* mentioned in -a#**
All the functions specified in an indirect call option must exist in the linked program.
- I09 Function *function* mentioned as callee in -a# is not indirectly called**
Only functions that actually can be called indirectly can be specified to do so in an indirect call option.
- I10 Function *function* mentioned as caller in -a# does not make indirect calls**
Only functions that actually make indirect calls can be specified to do so in an indirect call option.
- I11 The file *file* is not a UBROF file**
The contents of the file are not in a format that XLINK can read.
- I12 The module *module* is for an unknown CPU (tid = *tid*). Either the file is corrupt or you need a later version of XLINK**
The version of XLINK used has no knowledge of the CPU that the file was compiled/assembled for.
- I13 Corrupt input file: *symptom* in module *module* (*file*)**
The input file indicated appears to be corrupt. This can occur either because the file has for some reason been corrupted after it was created, or because of a problem in the compiler/assembler used to create it. If the latter appears to be the case, please contact IAR Systems Technical Support.

- I14 This error message number is not used.**
- I15 Unmatched "" in extended command file or XLINK_ENVPAR**
 When parsing an extended command file or the environment variable XLINK_ENVPAR, XLINK found an unmatched quote character.
 For filenames with quote characters you need to put a backslash before the quote character. For example, writing
`c:\iar\"A file called \"file\""`
 will cause XLINK to look for a file called
 A file called "file"
 in the c:\iar\directory.
- I16 Definition of symbol in module *module1* is not compatible with definition of symbol in module *module2***
 The symbol *symbol* has been tentatively defined in one or both of the modules. Tentative definitions must match other definitions.
- I17 Incompatible runtime modules. Module *module1* specifies that attribute must be *value1*, but module *module2* has the value *value2***
 These modules cannot be linked together. They were compiled with settings that resulted in incompatible run-time modules.
- I18 Incompatible runtime modules. Module *module1* specifies that attribute must be *value*, but module *module2* specifies no value for this attribute.**
 These modules cannot be linked together. They were compiled with settings that resulted in incompatible run-time modules.
- I19 Cannot handle C++ identifiers in this output format**
 The selected output format does not support the use of C++ identifiers (block-scoped names or names of C++ functions).
- I20 Overlapping address ranges for address translation. address type address address is in more than one range**
 The address *address* (of logical or physical type) is the source or target of more than one address translation command.
 If, for example, both `-M0-2FFF=1000` and `-M2000-3FFF=8000` are given, this error may be given for any of the logical addresses in the range `2000-2FFF`, for which to separate translation commands have been given.

- I21 Segment part or absolute content at logical addresses *start* – *end* would be translated into more than one physical address range**
 The current implementation of address translation does not allow logical addresses from one segment part (or the corresponding range for absolute parts from assembler code) to end up in more than one physical address range.
 If, for example, `-M0-1FFF=10000` and `-M2000-2FFF=20000` are used, a single segment part is not allowed to straddle the boundary at address 2000.
- I22 The address *address* is too large to be represented in the output format *format***
 The selected output format *format* cannot represent the address *address*. For example, the output format `INTEL-STANDARD` can only represent addresses in the range `0-FFFF`.
- I23 The output format *format* does not support address translation (`-M`, `-b#`, or `-b@`)**
 Address translation is not supported for all output formats.
- I24 Segment conflict for segment *segment*. In module *module1* there is a segment part that is of type *type1*, while in module *module2* there is a segment part that is of type *type2***
 All segment parts for a given segment must be of the same type. One reason for this conflict can be that a `COMMON` segment is mistakenly declared `RSEG` (relocatable) in one module.
- I25 This error message number is not used.**
- I26 Runtime model attribute “`__cpu`” not found. Please enter at least one line in your assembly code that contains the following statement: `RTMODEL “__cpu”, “I6C6I”`. Replace `I6C6I` with your chosen CPU. The CPU must be in uppercase.**
 The `__cpu` runtime model attribute is needed when producing COFF output. The compiler always supplies this attribute, so this error can only occur for programs consisting entirely of assembler modules.
 At least one of the assembler modules must supply this attribute.
- I27 Segment placement command “*command*” provides no address range, but the last address range(s) given is the wrong kind (bit addresses versus byte addresses).**
 This error will occur if something like this is entered:

```
-Z (DATA) SEG=1000-1FFF
-Z (BIT) BITVARS=
```


Note: The first uses byte addresses and the second needs bit addresses. To avoid this, provide address ranges for both.

- I28 Segments cannot be mentioned more than once in a copy init command: “-Qargs”**
Each segment must be either the source or the target of a copy init command.
- I29 This error message number is not used.**
- I30 Segment placement needs an address range: "command"**
The first segment placement command (-Z, -P) must have an address range.
- I31 Far segment type illegal in packed placement command: "command". Use explicit address intervals instead. For example: [20000-4FFFF] / 10000**
Using a far segment type (FARCODE, FARDATA, FARCONST) is illegal in packed placement (-P).
- I32 Module *module* (*file*) uses UBROF version 9.0. This version of UBROF was temporary and is no longer supported by XLINK**
Support for UBROF 9.0.0 has been dropped from XLINK starting with XLINK 4.53A.
- I33 The output format *format* cannot handle multiple address spaces. Use format variants (-Y -O) to specify which address space is wanted**
The output format used has no way to specify an address space. The format variant modifier used can be prefixed with a segment type to restrict output to the corresponding address space only. For example, -Fmotorola -Y(CODE) will restrict output to bytes from the address space used for the CODE segment type.

See Restricting the output to a single address space, page 64 for more information.
- I34 The left and right address ranges do not cover the same number of bytes: *range1 range2***
The left and right address ranges of this command line option must cover exactly the same number of bytes.
- I35 A module in the file *file* has an empty module name, which is not supported in the *format* output format.**
This output format cannot handle empty module names. Avoid this error by giving the module a name when you compile the source file.
- I36 The output format '*format*' does not support the use of relocation areas (-V option). Did you forget a format modifier flag?**
This output format does not support relocatable output. Either the option -Y was specified without the appropriate format modifier flag, or else the output format does not support relocatable output at all.

- I37 Duplicate relocation area: *relocArea1 relocarea2***
A relocation area was defined twice. Each relocation area needs a unique identifier.
- I38 Module *module (file)* contains operations that cannot be used with relocation areas: *error text***
Somewhere in the module an address (relocation area + offset) is used as if it were an absolute address. Since relocation areas usually are aligned, this is not always an error. Parts of the address could be acceptable to use.
- Possible causes for this are:
- The module was compiled or assembled with a compiler or assembler that does not support relocatable output (consult your compiler reference guide if in doubt). Old IAR Systems compilers or assemblers perform checks in ways that can trigger this error (relocatable output will not work with old IAR Systems compilers).
 - The alignment of your relocation area is too small. See *-V*, page 47, for details.
 - If the module contains handwritten assembler code, it is possible that it uses some unknown expression that causes this error.
- If the module was compiled with a modern compiler, your relocation areas has a sufficient alignment, and you get this message, contact IAR Systems Technical Support.
- I39 Module *module (file)* uses relocations (*relocation*) in ways that are not supported by the *format* output format.**
The object file contains a relocation that cannot be represented in this output format. This can be the result of assembler code that uses an instruction format which is not supported by the relocation directives in this output format.
- I40 The range declaration used in *range declaration* is illegal since *start > end*.**
A range must have a positive size; the end address cannot be lower than the start address.
- I41 The *SPLIT-* keyword in the packed segment placement command *placement command* is illegal, *SPLIT-* is only allowed in sequential placement commands (*-Z*).**
Only the *-Z* placement option can use the modifier *SPLIT-*. Either use *-Z* or remove the *SPLIT-* modifier. See *Splitting segments*, page 53.

- I42 Entries included in PUBWEAK/PUBLIC resolution must be in a named segment (RSEG or ASEGN). Discovered when resolving the PUBWEAK entry in module *module* against the PUBLIC entry in module *module*.**

All symbols involved the PUBWEAK/PUBLIC resolution must be placed in segments using either the RSEG or the ASEGN directive. Locate the assembler source code that defines the involved symbol in an absolute segment—using the ASEG directive—and replace it with a segment definition using the ASEGN directive.

See the *IAR Assembler Reference Guide* for information about the ASEG and ASEGN directives.

- I43 There is more than one PUBWEAK definition in the segment part *segment part description*.**

PUBWEAK definitions must be perfectly interchangeable. Segment parts with multiple PUBWEAK definitions cannot not always be interchanged with other definitions of the same symbols.

- I44 The conditional reference at offset *offset* in segment *segment* could not use its definition of last resort, the entry in segment *segment*.**

In order for XLINK to be able to optimize the use of relay functions, each module must supply relay functions that can be used by every call site in that module. This error occurs when that precondition is not met. The distance between the reference and the definition might be too large, or the definition might be unsuitable because it is in the wrong processor mode, or for some other reason.

If this occurs for a module produced by a compiler (as opposed to in assembler code), this is an indication of a problem in either the compiler or the linker. To test if the problem is in the linker, try linking with the option **Relay Function Optimization** disabled (`-q`).

- I45 The banked segment *segment* contains segment parts that have properties that are unsafe when placed with `-b` (banked segment placement). Use `-P` (packed segment placement) instead.**

The segment contains at least one segment part with a property that XLINK might be unable to handle when the segment is placed using the placement option `-b`. Use the placement option `-P` instead.

- I46 Type conflict for external/entry “entry1”, in module *module1* against external/entry *entry2* in module *module2* — if objects or functions are declared more than once, they shall have compatible declarations. (MISRA C rule 26)**
- I47 External “external” is declared in “*file1*” and in “*file2*” — external objects should not be declared in more than one file “ ”. (MISRA C rule 27)**
- I48 The names “*name1*” and “*name2*” differ only in characters beyond position 31 — identifiers (internal and external) shall not rely on significance of more than 31 characters. (MISRA C rule 11)**
- I49 The symbol “*symbol*” in module *module* (*file*) is public but is only needed by code in the same module — all declarations at file scope should be static where possible. (MISRA C rule 23)**
- I50 The stack depth for the call tree with root *root* is too large, *number* bytes.**
 The call tree uses more than the allowed number of stack bytes. You must either increase the maximum allowed call depth, or decrease the depth of the call tree.
- I51 Internal consistency check failure, “*error description*”.**
 An internal consistency check failed. This is an internal error, but you can force XLINK to generate output using the -B option.
- I52 The input file '*file*' could not be found.**
 The input file could not be found. Check the include path.
- I53 The input file '*file*' has several forced properties which are mutually exclusive.**
 The input file has both the conditional and forced load properties. Locate the mutually exclusive -A and -C options and remove the filename from one of them.
- I54 The increment argument to -K for the segment *SEGMENTNAME* resulted in an invalid (negative or above 0xFFFFFFFF) address.**
 The duplication command for *SEGMENTNAME* results in at least one duplicated segment that has an address below 0 or above 0xFFFFFFFF. You must either modify the -K command (the difference or the number of duplications) or move the segment to another address, to prevent this from happening.
- I55 This error message number is not used.**

- 156 Negative addresses are not allowed. The range declaration used in *range description* is illegal as *range start* is negative. Check the range specification for superfluous parentheses, (*START-END*) is an expression, not a range, *START-END* is a range.**

The range declaration has a negative start value. This is not allowed. Check the range specification for superfluous parentheses and check that the value of *START* and *END* are valid and that *START* ≤ *END*.

Warning messages

The following section lists the IAR XLINK Linker warning messages:

- 0 Too many warnings**
Too many warnings encountered.
- 1 Error tag encountered in module *module* (*file*)**
A UBROF error tag was encountered when loading file *file*. This indicates a corrupt file and will generate an error in the linking phase.
- 2 Symbol *symbol* is redefined in command-line**
A symbol has been redefined.
- 3 Type conflict. Segment *segment*, in module *module*, is incompatible with earlier segment(s) of the same name**
Segments of the same name should have the same type.
- 4 Close/open conflict. Segment *segment*, in module *module*, is incompatible with earlier segment of the same name**
Segments of the same name should be either open or closed.
- 5 Segment *segment* cannot be combined with previous segment**
The segments will not be combined.
- 6 Type conflict for external/entry *entry*, in module *module*, against external/entry in module *module***
Entries and their corresponding externals should have the same type.
- 7 Module *module* declared twice, once as program and once as library. Redeclared in file *file*, ignoring library module**
The program module is linked.
- 8 This warning message number is not used.**
- 9 Ignoring redeclared program entry in module *module* (*file*), using entry from module *module1***
Only the program entry found first is chosen.

- 10 No modules to link**
XLINK has no modules to link.
- 11 Module *module* declared twice as library. Redeclared in file *file*, ignoring second module**
The module found first is linked.
- 12 Using SFB in banked segment *segment* in module *module* (*file*)**
The SFB assembler directive may not work in a banked segment.
- 13 Using SFE in banked segment *segment* in module *module* (*file*)**
The SFE assembler directive may not work in a banked segment.
- 14 Entry *entry* duplicated. Module *module* (*file*) loaded, module *module* (*file*) discarded**
Duplicated entries exist in conditionally loaded modules; i.e. library modules or conditionally loaded program modules (with the `-C` option).
- 15 Predefined type sizing mismatch between modules *module* (*file*) and *module* (*file*)**
The modules have been compiled with different options for predefined types, such as different sizes of basic C types (e.g. `integer`, `double`).
- 16 Function *name* in module *module* (*file*) is called from two function trees (with roots *name1* and *name2*)**
The probable cause is *module* interrupt function calls another function that also could be executed by a foreground program, and this could lead to execution errors.
- 17 Segment name is too large or placed at wrong address**
This error occurs if a given segment overruns the available address space in the named memory area. To find out the extent of the overrun do a dummy link, moving the start address of the named segment to the lowest address, and look at the linker map file. Then relink with the correct address specification.
- 18 Segment *segment* overlaps segment *segment***
XLINK has found two relocatable segments overlapping each other. Check the segment placement option parameters.
- 19 Absolute segments overlaps in module *module* (*file*)**
XLINK has found two or more absolute segments in module *module* overlapping each other.
- 20 Absolute segment in module *module* (*file*) overlaps absolute segment in module *module* (*file*)**
XLINK has found two or more absolute segments in module *module* (*file*) and module *module* (*file*) overlapping each other. Change the `ORG` directives.

- 21 Absolute segment in module *module (file)* overlaps segment segment**
 XLINK has found an absolute segment in module *module (file)* overlapping a relocatable segment. Change either the `ORG` directive or the `-Z` relocation command.
- 22 Interrupt function *name* in module *module (file)* is called from other functions**
 Interrupt functions may not be called.
- 23 limitation-specific warning**
 Due to some limitation in the chosen output format, or in the information available, XLINK cannot produce the correct output. Only one warning for each specific limitation is given.
- 24 num counts of warning total**
 For each warning of type 23 emitted, a summary is provided at the end.
- 25 Using -Y# discards and distorts debug information. Use with care. If possible find an updated debugger that can read modern UBROF**
 Using the UBROF format modifier `-Y#` is not recommended.
- 26 No reset vector found**
 Failed in determining the `LOCATION` setting for XCOFF output format for the 78400 processor, because no reset vector was found.
- 27 No code at the start address**
 Failed in determining the `LOCATION` setting for XCOFF output format for the 78400 processor, because no code was found at the address specified in the reset vector.
- 28 Parts of segment *name* are initialized, parts not**
 Segments should not be partially initialized and partially uninitialized, if the result of the linking is meant to be promable.
- 29 Parts of segment *name* are initialized, even though it is of type *type* (and thus not promable)**
 DATA memory should not be initialized if the result of the linking is meant to be promable.
- 30 Module *name* is compiled with tools for *cpu1* expected *cpu2***
 You are building an executable for CPU *cpu2*, but module *name* is compiled for CPU *cpu1*.
- 31 Modules have been compiled with possibly incompatible settings: more information**
 According to the contents of the modules, they are not compatible.

- 32 Format option set more than once. Using format *format***
The format option can only be given once. XLINK uses the format *format*.
- 33 Using -r overrides format option. Using UBROF**
The -r option specifies UBROF format and C-SPY® library modules. It overrides any -F (format) option.
- 34 The 20 bit segmented variant of the INTEL EXTENDED format cannot represent the addresses specified. Consider using -Y1 (32 bit linear addressing).**
The program uses addresses higher than 0xFFFFF, and the segmented variant of the chosen format cannot handle this. The linear-addressing variant can handle full 32-bit addresses.
- 35 There is more than one definition for the struct/union type with tag *tag***
Two or more different structure/union types with the same tag exist in the program. If this is not intentional, it is likely that the declarations differ slightly. It is very likely that there will also be one or more warnings about type conflicts (warning 6). If this is intentional, consider turning this warning off.
- 36 There are indirectly called functions doing indirect calls. This can make the static overlay system unreliable**
XLINK does not know what functions can call what functions in this case, which means that it cannot make sure static overlays are safe.
- 37 More than one interrupt function makes indirect calls. This can make the static overlay system unreliable. Using -ai will avoid this**
If a function is called from an interrupt while it is already running, its params and locals will be overwritten.
- 38 There are indirect calls both from interrupts and from the main program. This can make the static overlay system unreliable. Using -ai will avoid this**
If a function is called from an interrupt while it is already running, its params and locals will be overwritten.
- 39 The function *function* in module *module* (file) does not appear to be called. No static overlay area will be allocated for its params and locals**
As far as XLINK can tell, there are no callers for the function, so no space is needed for its params and locals. To make XLINK allocate space anyway, use -a(*function*).
- 40 The module *module* contains obsolete type information that will not be checked by the linker**
This kind of type information is no longer used.

- 41 The function *function* in module *module (file)* makes indirect calls but is not mentioned in the left part of any *-a#* declaration**
If any *-a#* indirect call options are given they must, taken together, specify the complete picture.
- 42 This warning message number is not used.**
- 43 The function *function* in module *module (file)* is indirectly called but is not mentioned in the right part of any *-a#* declaration**
If any *-a#* indirect call options are given they must, taken together, specify the complete picture.
- 44 C library routine *localtime* failed. Timestamps will be wrong**
XLINK is unable to determine the correct time. This primarily affects the dates in the list file. This problem has been observed on one host platform if the date is after the year 2038.
- 45 Memory attribute info mismatch between modules *module1 (file1)* and *module2 (file2)***
The UBROF 7 memory attribute information in the given modules is not the same.
- 46 External function *function* in module *module (file)* has no global definition**
This warning replaces error 68.
- 47 Range error in module *module (file)*, segment *segment* at address *address*. Value *value*, in tag *tag*, is out of bounds *bounds***
This replaces error 18 when *-Rw* is specified.
- 48 Corrupt input file: *symptom* in module *module (file)***
The input file indicated appears to be corrupt. This warning is used in preference to error 113 when the problem is not serious, and is unlikely to cause trouble.
- 49 Using SFB/SFE in module *module (file)* for segment *segment*, which has no included segment parts**
SFB/SFE (assembler directives for getting the start or end of a segment) has been used on a segment for which no segment parts were included.
- 50 There was a problem when trying to embed the source file *source* in the object file**
This warning is given if the file *source* could not be found or if there was an error reading from it. XLINK searches for source files in the same places as it searches for object files, so including the directory where the source file is located in the XLINK **Include** (*-I*) option could solve the problem.

- 51 Some source reference debug info was lost when translating to UBROF 5 (example: statements in *function* in module *module*)**
 UBROF 6 file references can handle source code in more than one source file for a module. This is not possible in UBROF 5 embedded source, so any references to files not included have been removed.
- 52 More than one definition for the byte at address *address* in common segment *segment***
 The most probable cause is that more than one module defines the same interrupt vector.
- 53 Some untranslated addresses overlap translation ranges. Example: Address *addr1* (untranslated) conflicts with logical address *addr2* (translated to *addr1*)**
 This can be caused by something like this:
- ```
-Z (CODE) SEG1=1000-1FFF
-Z (CODE) SEG2=2000-2FFF
-M (CODE) 1000=2000
```
- This will place SEG1 at logical address 1000 and SEG2 at logical address 2000. However, the translation of logical address 1000 to physical address 2000 and the absence of any translation for logical address 1000 will mean that in the output file, both SEG1 and SEG2 will appear at physical address 1000.
- 54 This warning message has not been implemented yet.**
- 55 No source level debug information will be generated for modules using the UBROF object format version 8 or earlier. One such module is *module* ( *file* )**  
 When generating UBROF 9 output, essential debug information is not present in input files using UBROF 8 or earlier. For these files all debug information will be suppressed in the output file.
- 56 A long filename may cause MPLAB to fail to display the source file: '*pathname*'**  
 When outputting COFF output for the PIC and PIC18 processors on a Windows host, the output file contains a reference to a source file that needs long filenames in order to work. MPLAB cannot handle long filenames.
- 57 The file *filename* is empty and will be ignored.**  
 The file is completely empty (0 bytes). It is not a valid UBROF file, but some IAR Systems assemblers generate completely empty files instead of a valid UBROF file with no content.
- This file will be ignored. If the file was not generated by an IAR Systems assembler, you should find out why it is empty.

**58      The name *name* was too long (more than *number* characters) and has been truncated to fit the chosen output format. This warning is only issued once.**

Normally, this will not affect debugging to any great extent, but if two or more long names are truncated to the same 255-character string, the code can become harder to debug.

The most common case where long names occur is when C++ names are flattened into simple strings, which occurs when translating into UBROF version 7 or earlier, or into other debug formats with limited symbol name length.

**59      Too many COFF format line number records (*number*) needed. All in excess of 65535 will not be accessible.**

There are too many line number records in one COFF section. This can make the application much harder to debug if the original number of records greatly exceeds 65535.

One way to avoid this is to put code in more than one segment, because one COFF section is output for each segment.

This problem is most likely to occur in the MPLAB debugger for the PIC processor family, because it needs one line number record for each instruction in the code.

**60      The entry point label “*label*” was not found in any input file. The image will not have an entry point.**

The chosen entry point label could not be found in any input file. Choose an entry point that exists in the program or make sure that the file that contains the entry point is included in the input files.

**61      The ‘*format*’ output format is not supported for this cpu.**

Support for the chosen output format is experimental for this cpu.

**62      The struct “*struct*” is too large for the ‘*format*’ format, debug information will only be available for the first *maximum size* bytes.**

The program contains a class, struct, or union that is too large to represent in the chosen debug format. Debug information will be generated for as many bytes as the format can represent.

**63      No debug information will be generated for the function “*function* in the module “*module*” as no debug information could be found.**

This likely because of a rename entry operation in the IAR XLIB Librarian.

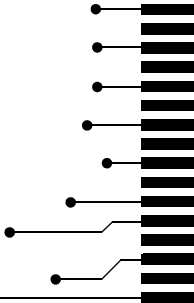




# Part 2: The IAR Library Tools

This part of the IAR Linker and Library Tools Reference Guide contains the following chapters:

- Introduction to the IAR Systems library tools
- The IAR XAR Library Builder
- XAR diagnostics
- IAR XLIB Librarian options
- XLIB diagnostics.





# Introduction to the IAR Systems library tools

This chapter describes XAR Library Builder and IAR XLIB Librarian—the IAR Systems library tools that enable you to manipulate the relocatable object files produced by the IAR Systems assembler and compiler.

Both tools use the UBROF standard object format (Universal Binary Relocatable Object Format).

---

## Libraries

A library is a single file that contains a number of relocatable object modules, each of which can be loaded independently from other modules in the file as it is needed.

Often, modules in a library file have the `LIBRARY` attribute, which means that they will only be loaded by the linker if they are actually needed in the program. This is referred to as *demand loading* of modules.

On the other hand, a module with the `PROGRAM` attribute is *always* loaded when the file in which it is contained is processed by the linker.

A library file is no different from any other relocatable object file produced by the assembler or compiler, it can include modules of both the `LIBRARY` and the `PROGRAM` type.

---

## IAR XAR Library Builder and IAR XLIB Librarian

There are two library tools included with your IAR Systems product. The first of them, IAR XAR Library Builder can only do one thing: combine a set of UBROF object files into a library file. IAR XLIB Librarian, on the other hand, can do a number of things in addition to building libraries: modify the size and contents of existing libraries, list information about individual library modules, and more.

**Note:** XAR does not distinguish between UBROF versions for different processors. It is up to you to make sure that you are not building a library consisting of files from different CPUs.

Also note that XAR allows you to specify the same object file twice or even more times. Make sure to avoid this, as the result would be a library file with multiply defined contents.

### CHOOSING WHICH TOOL TO USE

Whether you should use XAR or XLIB depends on what you want to achieve, and on the complexity of your project. If all you need to do is to combine a number of source object files into a library file, XAR is enough for your purposes, and simpler to use than XLIB. However, if you need to modify a library or the modules it consists of, you must use XLIB.

---

## Using libraries with C/C++ programs

All C/C++ programs make use of libraries, and the IAR Systems compilers are supplied with a number of standard library files.

Most C or C++ programmers will use one or both of the IAR Systems library tools at some point, for one of the following reasons:

- To replace or modify a module in one of the standard libraries. For example, XLIB can be used for replacing the distribution versions of the `CSTARTUP` and/or `putchar` modules with ones that you have customized.
- To add C, C++, or assembler modules to the standard library file so they will always be available whenever a C/C++ program is linked. You use XLIB for this.
- To create custom library files that can be linked into their programs, as needed, along with the IAR DLIB library. You can use both XAR and XLIB for this.

---

## Using libraries with assembler programs

If you are only using assembler you do not *need* to use libraries. However, libraries provide the following advantages, especially when writing medium- and large-sized assembler applications:

- They allow you to combine utility modules used in more than one project into a simple library file. This simplifies the linking process by eliminating the need to include a list of input files for all the modules you need. Only the library module(s) needed for the program will be included in the output file.
- They simplify program maintenance by allowing multiple modules to be placed in a single assembler source file. Each of the modules can be loaded independently as a library module.
- They reduce the number of object files that make up an application, maintenance, and documentation.

You can create your assembler language library files using one of two basic methods:

- A library file can be created by assembling a single assembler source file which contains multiple library-type modules. The resulting library file can then be modified using XLIB.
- A library file can be produced by using XAR or XLIB to merge any number of existing modules together to form a user-created library.

The `NAME` and `MODULE` assembler directives are used for declaring modules as being of `PROGRAM` or `LIBRARY` type, respectively.

For additional information, see the *IAR Assembler Reference Guide*.



# The IAR XAR Library Builder

This chapter describes how to use the IAR XAR Library Builder.

---

## Using XAR

XAR is run from the command line, using the command `xar`.

### BASIC SYNTAX

If you run the IAR XAR Library Builder without giving any command line options, the default syntax is:

```
xar libraryfile objectfile1 ... objectfileN
```

### Parameters

The parameters are:

| Parameter                          | Description                                                            |
|------------------------------------|------------------------------------------------------------------------|
| <i>libraryfile</i>                 | The file to which the module(s) in the object file(s) will be sent.    |
| <i>objectfile1 ... objectfileN</i> | The object file(s) containing the module(s) to build the library from. |

Table 27: XAR parameters

### Example

The following example creates a library file called `mylibrary.r19` from the source object files `module1.r19`, `module2.r19`, and `module3.r19`:

```
xar mylibrary.r19 module1.r19 module2.r19 module3.r19
```

---

## Summary of XAR options

The following table shows a summary of the XAR options:

| Option          | Description                 |
|-----------------|-----------------------------|
| <code>-o</code> | Specifies the library file. |
| <code>-V</code> | Provides user feedback.     |

Table 28: XAR options summary

---

## Descriptions of XAR options

The following sections give detailed reference information for each XAR option.

---

**-o** *-o libraryfile*

By default, XAR assumes the first argument after the `xar` command to be the name of the destination library file. Use the `-o` option if you want to specify the library file you are creating elsewhere on the command line instead.

### **Example**

The following example creates a library file called `mylibrary.r19` from the source modules `module1.r19`, `module2.r19`, and `module3.r19`:

```
xar module1.r19 module2.r19 module3.r19 -o mylibrary.r19
```

---

**-V** *-V*

When this command is used, XAR reports which operations it performs, in addition to giving diagnostic messages. This is the default setting when running XAR from the IAR Embedded Workbench® IDE.



# XAR diagnostics

This chapter lists the messages produced by the IAR XAR Library Builder.

---

## XAR messages

The following section lists the XAR messages.

- 0      Not enough memory**  
XAR was unable to acquire the memory that it needed.
- 1      -o option requires an argument**  
XAR expects an argument after -o.
- 2      Unknown option *option***  
XAR encountered an unknown option on the command line.
- 3      Too few arguments**  
XAR expects to find more arguments
- 4      Same file as both input and output: *filename***  
One of the files is used as both source object file and destination library. This is illegal since it would overwrite the source object file. If you want to give the new library a name that is used by one of the source object files, you must use a temporary filename for the library you are building with XAR and rename that temporary file afterwards.
- 5      Can't open library file *filename* for writing**  
XAR was unable to open the library file for writing. Make sure that the library file is not write protected.
- 6      Can't open object file *filename***  
XAR was unable to open the object file. Make sure that the file exists.
- 7      Error occurred while writing to library file**  
An error occurred while XAR was writing to the file.
- 8      *filename* is not a valid UBROF file**  
The file is not a valid UBROF file.
- 9      Error occurred while reading from *filename***  
An error occurred while XAR was reading the file.
- 10     Error occurred while closing *filename***  
An error occurred while XAR was closing the file.

- I1      XAR didn't find any bytes to read in *filename***  
The object file seems to be empty.
- I2      *filename* didn't end as a valid UBROF file should**  
The file did not end as a UBROF file is supposed to end. Either the file is corrupt or the assembler/compiler produces corrupt output.
- I3      XAR can't fseek in library file**  
The call to `fseek` failed.
- I4      -x option requires an argument**  
You must specify an argument for the `-x` option.
- I5      A file name in the file *filename* exceeds the maximum filename length of *number* characters.**  
A filename in the extended command line file is too long. The only recognized delimiter in the input file is the `newline` character, everything else is interpreted as a part of the filename.

# IAR XLIB Librarian options

This chapter summarizes the IAR XLIB Librarian options, classified according to their function, and gives a detailed syntactic and functional description of each XLIB option.

---

## Using XLIB options

XLIB can be run from the command line or from a batch file.

### GIVING XLIB OPTIONS FROM THE COMMAND LINE

The `-c` command line option allows you to run XLIB options from the command line. Each argument specified after the `-c` option is treated as one XLIB option.

For example, specifying:

```
xlib -c "LIST-MOD math.rnn" "LIST-MOD mod.rnn m.txt"
```

is equivalent to entering the following options in XLIB:

```
*LIST-MOD math.rnn
*LIST-MOD mod.rnn m.txt
*QUIT
```

**Note:** Each command line argument must be enclosed in double quotes if it includes spaces.

The individual words of an identifier can be abbreviated to the limit of ambiguity. For example, `LIST-MODULES` can be abbreviated to `L-M`.

When running XLIB you can press Enter at any time to prompt for information, or display a list of the possible options.

### XLIB BATCH FILES

Running XLIB with a single command-line parameter specifying a file, causes XLIB to read options from that file instead of from the console.

PARAMETERS

The following parameters are common to many of the XLIB options.

| Parameter          | What it means                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>objectfile</i>  | File containing object modules.                                                                                                                                                                                                                                                                                                                                                                             |
| <i>start, end</i>  | The first and last modules to be processed, in one of the following forms: <div><div><i>n</i></div><div>The <i>n</i>th module.</div><div><i>\$</i></div><div>The last module.</div><div><i>name</i></div><div>Module <i>name</i>.</div><div><i>name+n</i></div><div>The module <i>n</i> modules after <i>name</i>.</div><div><i>\$-n</i></div><div>The module <i>n</i> modules before the last.</div></div> |
| <i>listfile</i>    | File to which a listing will be sent.                                                                                                                                                                                                                                                                                                                                                                       |
| <i>source</i>      | A file from which modules will be read.                                                                                                                                                                                                                                                                                                                                                                     |
| <i>destination</i> | The file to which modules will be sent.                                                                                                                                                                                                                                                                                                                                                                     |

Table 29: XLIB parameters

MODULE EXPRESSIONS

In most of the XLIB options you can or must specify a source module (like *oldname* in RENAME-MODULE), or a range of modules (*startmodule, endmodule*).

Internally in all XLIB operations, modules are numbered from 1 in ascending order. Modules may be referred to by the actual name of the module, by the name plus or minus a relative expression, or by an absolute number. The latter is very useful when a module name is very long, unknown, or contains unusual characters such as space or comma.

The following table shows the available variations on module expressions:

| Name           | Description                                  |
|----------------|----------------------------------------------|
| 3              | The third module.                            |
| \$             | The last module.                             |
| <i>name+4</i>  | The module 4 modules after <i>name</i> .     |
| <i>name-12</i> | The module 12 modules before <i>name</i> .   |
| <i>\$-2</i>    | The module 2 modules before the last module. |

Table 30: XLIB module expressions

The option LIST-MOD FILE, , *\$-2* will thus list the three last modules in FILE on the terminal.

## LIST FORMAT

The `LIST` options give a list of symbols, where each symbol has one of the following prefixes:

| Prefix              | Description                                             |
|---------------------|---------------------------------------------------------|
| <code>nn.Pgm</code> | A program module with relative number <code>nn</code> . |
| <code>nn.Lib</code> | A library module with relative number <code>nn</code> . |
| <code>Ext</code>    | An external in the current module.                      |
| <code>Ent</code>    | An entry in the current module.                         |
| <code>Loc</code>    | A local in the current module.                          |
| <code>Rel</code>    | A standard segment in the current module.               |
| <code>Stk</code>    | A stack segment in the current module.                  |
| <code>Com</code>    | A common segment in the current module.                 |

Table 31: XLIB list option symbols

## USING ENVIRONMENT VARIABLES

The IAR XLIB Librarian supports a number of environment variables. These can be used for creating defaults for various XLIB options so that they do not have to be specified on the command line.

The following environment variables can be used by XLIB:

| Environment variable      | Description                                                                                                                                                                                                             |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>XLIB_COLUMNS</code> | Sets the number of list file columns in the range 80–132. The default is 80. For example, to set the number of columns to 132: <p><code>set XLIB_COLUMNS=132</code></p>                                                 |
| <code>XLIB_CPU</code>     | Sets the CPU type so that the <code>DEFINE-CPU</code> option will not be required when you start an XLIB session. For example, to set the CPU type to <code>chipname</code> : <p><code>set XLIB_CPU=chipname</code></p> |

Table 32: XLIB environment variables

| Environment variable | Description                                                                                                                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| XLIB_PAGE            | Sets the number of lines per list file page in the range 10–100. The default is a listing without page breaks. For example, to set the number of lines per page to 66:<br><br>set XLIB_PAGE=66                                                                     |
| XLIB_SCROLL_BREAK    | Sets the scroll pause in number of lines to make the XLIB output pause and wait for the Enter key to be pressed after the specified number of lines (16–100) on the screen have scrolled by. For example, to pause every 22 lines:<br><br>set XLIB_SCROLL_BREAK=22 |

Table 32: XLIB environment variables (Continued)

## Summary of XLIB options for all UBROF versions

The following table shows a summary of the XLIB options:

| Option           | Description                      |
|------------------|----------------------------------|
| COMPACT-FILE     | Shrinks library file size.       |
| DEFINE-CPU       | Specifies CPU type.              |
| DELETE-MODULES   | Removes modules from a library.  |
| DIRECTORY        | Displays available object files. |
| DISPLAY-OPTIONS  | Displays XLIB options.           |
| ECHO-INPUT       | Command file diagnostic tool.    |
| EXIT             | Returns to operating system.     |
| FETCH-MODULES    | Adds modules to a library.       |
| HELP             | Displays help information.       |
| INSERT-MODULES   | Moves modules in a library.      |
| LIST-ALL-SYMBOLS | Lists every symbol in modules.   |
| LIST-CRC         | Lists CRC values of modules.     |
| LIST-DATE-STAMPS | Lists dates of modules.          |
| LIST-ENTRIES     | Lists PUBLIC symbols in modules. |
| LIST-EXTERNALS   | Lists EXTERN symbols in modules. |
| LIST-MODULES     | Lists modules.                   |

Table 33: XLIB options summary

| Option           | Description                       |
|------------------|-----------------------------------|
| LIST-OBJECT-CODE | Lists low-level relocatable code. |
| LIST-SEGMENTS    | Lists segments in modules.        |
| MAKE-LIBRARY     | Changes a module to library type. |
| MAKE-PROGRAM     | Changes a module to program type. |
| ON-ERROR-EXIT    | Quits on a batch error.           |
| QUIT             | Returns to operating system.      |
| REMARK           | Comment in command file.          |
| RENAME-MODULE    | Renames one or more modules.      |
| RENAME-SEGMENT   | Renames one or more segments.     |
| REPLACE-MODULES  | Updates executable code.          |

Table 33: XLIB options summary (Continued)

**Note:** There are some XLIB options that do not work with the output from modern IAR Systems C/C++ compilers or assemblers. See *Summary of XLIB options for older UBROF versions*, page 116.

## Descriptions of XLIB options for all UBROF versions

The following section gives detailed reference information for each option.

|              |                                                                                                                                                                                                                                                                                              |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COMPACT-FILE | COMPACT-FILE <i>objectfile</i>                                                                                                                                                                                                                                                               |
|              | Use COMPACT-FILE to reduce the size of the library file by concatenating short, absolute records into longer records of variable length. This will decrease the size of a library file by about 5%, in order to give library files which take up less time during the loader/linker process. |
|              | <b>Example</b>                                                                                                                                                                                                                                                                               |
|              | The following option compacts the file <code>maxmin.rmn</code> :                                                                                                                                                                                                                             |
|              | COMPACT-FILE maxmin                                                                                                                                                                                                                                                                          |
|              | This displays:                                                                                                                                                                                                                                                                               |
|              | 20 byte(s) deleted                                                                                                                                                                                                                                                                           |

---

DEFINE-CPU    DEFINE-CPU *cpu*

Use this option to specify the CPU type *cpu*. This option must be issued before any operations on object files can be done.

**Examples**

The following option defines the CPU as *chipname*:

DEF-CPU *chipname*

---

DELETE-MODULES    DELETE-MODULES *objectfile start end*

Use DELETE-MODULES to remove the specified modules from a library.

**Examples**

The following option deletes module 2 from the file *math.rnn*:

DEL-MOD *math 2 2*

---

DIRECTORY    DIRECTORY [*specifier*]

Use DIRECTORY to display on the terminal all available object files of the type that applies to the target processor. If no *specifier* is given, the current directory is listed.

**Examples**

The following option lists object files in the current directory:

DIR

It displays:

|         |     |
|---------|-----|
| general | 770 |
| math    | 502 |
| maxmin  | 375 |

---

DISPLAY-OPTIONS    DISPLAY-OPTIONS [*listfile*]

Displays XLIB options.

Use DISPLAY-OPTIONS to list in the *listfile* the names of all the CPUs which are recognized by this version of the IAR XLIB Librarian. After that a list of all UBROF tags is output.



**Examples**

To list the options to the file `opts.lst`:

```
DISPLAY-OPTIONS opts
```

---

ECHO-INPUT ECHO-INPUT

ECHO-INPUT is a command file diagnostic tool which you may find useful when debugging command files in batch mode as it makes all command input visible on the terminal. In the interactive mode it has no effect.

**Examples**

In a batch file

```
ECHO-INPUT
```

echoes all subsequent XLIB options.

---

EXIT EXIT

Use EXIT to exit from XLIB after an interactive session and return to the operating system.

**Examples**

To exit from XLIB:

```
EXIT
```

---

EXTENSION EXTENSION *extension*

Use EXTENSION to set the default file extension.

---

FETCH-MODULES FETCH-MODULES *source destination [start] [end]*

Use FETCH-MODULES to add the specified modules to the *destination* library file. If *destination* already exists, it must be empty or contain valid object modules; otherwise it will be created.

**Examples**

The following option copies the module `mean` from `math.rnn` to `general.rnn`:

```
FETCH-MOD math general mean
```

---

```
HELP HELP [option] [listfile]
```

### Parameters

*option*            Option for which help is displayed.

Use this option to display help information.

If the `HELP` option is given with no parameters, a list of the available options will be displayed on the terminal. If a parameter is specified, all options which match the parameter will be displayed with a brief explanation of their syntax and function. A `*` matches all options. `HELP` output can be directed to any file.

### Examples

For example, the option:

```
HELP LIST-MOD
```

displays:

```
LIST-MODULES <Object file> [<List file>] [<Start module>] [<End
module>]
```

List the module names from [<Start module>] to  
[<End module>].

---

```
INSERT-MODULES INSERT-MODULES objectfile start end {BEFORE | AFTER} dest
```

Use `INSERT-MODULES` to insert the specified modules in a library, before or after the *dest*.

### Examples

The following option moves the module `mean` before the module `min` in the file `math.rnn`:

```
INSERT-MOD math mean mean BEFORE min
```

---

```
LIST-ALL-SYMBOLS LIST-ALL-SYMBOLS objectfile [listfile] [start] [end]
```

Use `LIST-ALL-SYMBOLS` to list all symbols (module names, segments, externals, entries, and locals) for the specified modules in the *objectfile*. The symbols are listed to the *listfile*.

Each symbol is identified with a prefix; see *List format*, page 105.

**Examples**

The following option lists all the symbols in `math.rnn`:

```
LIST-ALL-SYMBOLS math
```

This displays:

```

1. Lib max
 Rel CODE
 Ent max
 Loc A
 Loc B
 Loc C
 Loc ncarry
2. Lib mean
 Rel DATA
 Rel CODE
 Ext max
 Loc A
 Loc B
 Loc C
 Loc main
 Loc start
3. Lib min
 Rel CODE
 Ent min
 Loc carry
```

---

```
LIST-CRC LIST-CRC objectfile [listfile] [start] [end]
```

Use LIST-CRC to list the module names and their associated CRC values of the specified modules.

Each symbol is identified with a prefix; see *List format*, page 105.

**Examples**

The following option lists the CRCs for all modules in `math.rnn`:

```
LIST-CRC math
```

This displays:

```

EC41 1. Lib max
ED72 2. Lib mean
9A73 3. Lib min
```

---

LIST-DATE-STAMPS LIST-DATE-STAMPS *objectfile* [*listfile*] [*start*] [*end*]

Use LIST-DATE-STAMPS to list the module names and their associated generation dates for the specified modules.

Each symbol is identified with a prefix; see *List format*, page 105.

**Examples**

The following option lists the date stamps for all the modules in *math.rnn*:

LIST-DATE-STAMPS *math*

This displays:

|           |             |
|-----------|-------------|
| 15/Feb/98 | 1. Lib max  |
| 15/Feb/98 | 2. Lib mean |
| 15/Feb/98 | 3. Lib min  |

---

LIST-ENTRIES LIST-ENTRIES *objectfile* [*listfile*] [*start*] [*end*]

Use LIST-ENTRIES to list the names and associated entries (PUBLIC symbols) for the specified modules.

Each symbol is identified with a prefix; see *List format*, page 105.

**Examples**

The following option lists the entries for all the modules in *math.rnn*:

LIST-ENTRIES *math*

This displays:

|             |
|-------------|
| 1. Lib max  |
| Ent max     |
| 2. Lib mean |
| 3. Lib min  |
| Ent min     |

---

LIST-EXTERNALS LIST-EXTERNALS *objectfile* [*listfile*] [*start*] [*end*]

Use LIST-EXTERNALS to list the module names and associated externals (EXTERN symbols) for the specified modules.

Each symbol is identified with a prefix; see *List format*, page 105.

**Examples**

The following option lists the externals for all the modules in `math.rnn`:

```
LIST-EXT math
```

This displays:

```
1. Lib max
2. Lib mean
 Ext max
3. Lib min
```

---

```
LIST-MODULES LIST-MODULES objectfile [listfile] [start] [end]
```

Use `LIST-MODULES` to list the module names for the specified modules.

Each symbol is identified with a prefix; see *List format*, page 105.

**Examples**

The following option lists all the modules in `math.rnn`:

```
LIST-MOD math
```

It produces the following output:

```
1. Lib max
2. Lib min
3. Lib mean
```

---

```
LIST-OBJECT-CODE LIST-OBJECT-CODE objectfile [listfile]
```

Lists low-level relocatable code.

Use `LIST-OBJECT-CODE` to list the contents of the object file on the list file in ASCII format.

Each symbol is identified with a prefix; see *List format*, page 105.

**Examples**

The following option lists the object code of `math.rnn` to `object.lst`:

```
LIST-OBJECT-CODE math object
```

---

LIST-SEGMENTS    LIST-SEGMENTS *objectfile* [*listfile*] [*start*] [*end*]

Use LIST-SEGMENTS to list the module names and associated segments for the specified modules.

Each symbol is identified with a prefix; see *List format*, page 105.

### Examples

The following option lists the segments in the module `mean` in the file `math.rnn`:

```
LIST-SEG math,,mean mean
```

Notice the use of two commas to skip the *listfile* parameter.

This produces the following output:

```
2. Lib mean
 Rel DATA
 Repl CODE
```

---

MAKE-LIBRARY    MAKE-LIBRARY *objectfile* [*start*] [*end*]

Changes a module to library type.

Use MAKE-LIBRARY to change the module header attributes to conditionally loaded for the specified modules.

### Examples

The following option converts all the modules in `main.rnn` to library modules:

```
MAKE-LIB main
```

---

MAKE-PROGRAM    MAKE-PROGRAM *objectfile* [*start*] [*end*]

Changes a module to program type.

Use MAKE-PROGRAM to change the module header attributes to unconditionally loaded for the specified modules.

### Examples

The following option converts module `start` in `main.rnn` into a program module:

```
MAKE-PROG main start
```

---

ON-ERROR-EXIT    ON-ERROR-EXIT

Use ON-ERROR-EXIT to make the librarian abort if an error is found. It is suited for use in batch mode.

### Examples

The following batch file aborts if the FETCH-MODULES option fails:

```
ON-ERROR-EXIT
FETCH-MODULES math new
```

---

QUIT    QUIT

Use QUIT to exit and return to the operating system.

### Examples

To quit from XLIB:

```
QUIT
```

---

REMARK    REMARK *text*

Use REMARK to include a comment in an XLIB command file.

### Examples

The following example illustrates the use of a comment in an XLIB command file:

```
REM Now compact file
COMPACT-FILE math
```

---

RENAME-MODULE    RENAME-MODULE *objectfile old new*

Use RENAME-MODULE to rename a module. Notice that if there is more than one module with the name *old*, only the first one encountered is changed.

### Examples

The following example renames the module *average* to *mean* in the file *math.rnn*:

```
RENAME-MOD math average mean
```

---

RENAME-SEGMENT    RENAME-SEGMENT *objectfile old new [start] [end]*

Use RENAME-SEGMENT to rename all occurrences of a segment from the name *old* to *new* in the specified modules.

**Examples**

The following example renames all CODE segments to ROM in the file *math.rnn*:

RENAME-SEG math CODE ROM

---

REPLACE-MODULES    REPLACE-MODULES *source destination*

Use REPLACE-MODULES to update executable code by replacing modules with the same name from *source* to *destination*. All replacements are logged on the terminal. The main application for this option is to update large runtime libraries etc.

**Examples**

The following example replaces modules in *math.rnn* with modules from *newmath.rnn*:

REPLACE-MOD newmath math

This displays:

Replacing module 'max'  
Replacing module 'mean'  
Replacing module 'min'

---

# Summary of XLIB options for older UBROF versions

There are some XLIB options that do not work with output from IAR Systems C/C++ compilers or assemblers that output object files in UBROF 8 format and later. This means that these options cannot be used together with compiler/assembler versions delivered with IAR Embedded Workbench version 3.0 and later, and a few products that were released just before version 3.0. The following table shows a summary of these XLIB options:

| Option          | Description                        |
|-----------------|------------------------------------|
| RENAME-ENTRY    | Renames PUBLIC symbols.            |
| RENAME-EXTERNAL | Renames EXTERN symbols.            |
| RENAME-GLOBAL   | Renames EXTERN and PUBLIC symbols. |

*Table 34: Summary of XLIB options for older compilers*



## Descriptions of XLIB options for older UBROF versions

The following section gives detailed reference information for each option.

---

RENAME-ENTRY    `RENAME-ENTRY objectfile old new [start] [end]`

Use RENAME-ENTRY to rename all occurrences of a PUBLIC symbol from *old* to *new* in the specified modules.

### Examples

The following option renames the entry for modules 2 to 4 in `math.rnn` from `mean` to `average`:

```
RENAME-ENTRY math mean average 2 4
```

**Note:** This option does not work with the output from modern IAR Systems C/C++ compilers or assemblers that produce UBROF 8 or later.

---

RENAME-EXTERNAL    `RENAME-EXTERN objectfile old new [start] [end]`

Use RENAME-EXTERN to rename all occurrences of an external symbol from *old* to *new* in the specified modules.

### Examples

The following option renames all external symbols in `math.rnn` from `error` to `err`:

```
RENAME-EXT math error err
```

**Note:** This option does not work with the output from modern IAR Systems C/C++ compilers or assemblers that produce UBROF 8 or later.

---

RENAME-GLOBAL    `RENAME-GLOBAL objectfile old new [start] [end]`

Use RENAME-GLOBAL to rename all occurrences of an external or public symbol from *old* to *new* in the specified modules.

### Examples

The following option renames all occurrences of `mean` to `average` in `math.rnn`:

```
RENAME-GLOBAL math mean average
```

**Note:** This option does not work with the output from modern IAR Systems C/C++ compilers or assemblers that produce UBROF 8 or later.



# XLIB diagnostics

This chapter lists the messages produced by the IAR XLIB Librarian.

---

## XLIB messages

The following section lists the XLIB messages. Options flagged as erroneous never alter object files.

- 0      Bad object file, EOF encountered**  
Bad or empty object file, which could be the result of an aborted assembly or compilation.
- 1      Unexpected EOF in batch file**  
The last command in a command file must be `EXIT`.
- 2      Unable to open file *file***  
Could not open the command file or, if `ON-ERROR-EXIT` has been specified, this message is issued on any failure to open a file.
- 3      Variable length record out of bounds**  
Bad object module, could be the result of an aborted assembly.
- 4      Missing or non-default parameter**  
A parameter was missing in the direct mode.
- 5      No such CPU**  
A list with the possible choices is displayed when this error is found.
- 6      CPU undefined**  
`DEFINE-CPU` must be issued before object file operations can begin. A list with the possible choices is displayed when this error is found.
- 7      Ambiguous CPU type**  
A list with the possible choices is displayed when this error is found.
- 8      No such command**  
Use the `HELP` option.
- 9      Ambiguous command**  
Use the `HELP` option.
- 10     Invalid parameter(s)**  
Too many parameters or a misspelled parameter.
- 11     Module out of sequence**  
Bad object module, could be the result of an aborted assembly.

- 12 Incompatible object, consult distributor!**  
Bad object module, could be the result of an aborted assembly, or that the assembler/compiler revision used is incompatible with the version of XLIB used.
- 13 Unknown tag: hh**  
Bad object module, could be the result of an aborted assembly.
- 14 Too many errors**  
More than 32 errors will make XLIB abort.
- 15 Assembly/compilation error?**  
The `T_ERROR` tag was found. Edit and re-assemble/re-compile your program.
- 16 Bad CRC, hhhh expected**  
Bad object module; could be the result of an aborted assembly.
- 17 Can't find module: xxxxx**  
Check the available modules with `LIST-MOD` file.
- 18 Module expression out of range**  
Module expression is less than one or greater than \$.
- 19 Bad syntax in module expression: xxxxx**  
The syntax is invalid.
- 20 Illegal insert sequence**  
The specified destination in the `INSERT-MODULES` option must not be within the *start-end* sequence.
- 21 <End module> found before <Start module>!**  
Source module range must be from low to high order.
- 22 Before or after!**  
Bad `BEFORE/AFTER` specifier in the `INSERT-MODULES` option.
- 23 Corrupt file, error occurred in tag**  
A fault is detected in the object file *tag*. Reassembly or recompilation may help. Otherwise contact your supplier.
- 24 Filename is write protected**  
The file *filename* is write protected and cannot be written to.
- 25 Non-matching replacement module name found in source file**  
In the source file, a module *name* with no corresponding entry in the destination file was found.

# A

|                                                               |        |
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