

IAR Linker and Library Tools

Reference Guide



XLINK-64I



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Contents

| | |
|--|----|
| Tables | 7 |
| Preface | 9 |
| Who should read this guide | 9 |
| How to use this guide | 9 |
| What this guide contains | 10 |
| Document conventions | 10 |
| Typographic conventions | 11 |
| Naming conventions | 11 |
| | |
| Part I: The IAR XLINK Linker | 13 |
| Introduction to the IAR XLINK Linker | 15 |
| Key features | 15 |
| Large Address Awareness | 15 |
| Stack usage analysis | 16 |
| MISRA C | 16 |
| The linking process | 17 |
| Object format | 17 |
| XLINK functions | 18 |
| Libraries | 18 |
| Output format | 18 |
| Input files and modules | 19 |
| Libraries | 19 |
| Formatters for printf and scanf | 20 |
| Segments | 21 |
| Noalloc content | 21 |
| Segment control | 22 |
| Address translation | 23 |
| Allocation segment types | 23 |
| Memory segment types | 24 |
| Overlap errors | 25 |

| | |
|---|----|
| Range errors | 25 |
| Segment placement examples | 26 |
| Listing format | 27 |
| Header | 27 |
| Cross-reference | 28 |
| Checksummed areas and memory usage | 35 |
| Checksum calculation | 36 |
| Checksum calculation by the linker | 37 |
| Adding a checksum function to your source code | 38 |
| Things to remember | 40 |
| Checksum value symbol | 40 |
| Bitwise and mirrored initial checksum values | 41 |
| Bitwise initial values | 41 |
| Bitwise initial values | 42 |
| Mirroring | 42 |
| Logging | 43 |
| Logging object files | 43 |
| Logging modules | 44 |
| Logging segment parts | 44 |
| Logging automatic redirections | 46 |
| Logging calls and stack usage | 47 |
| XLINK options | 49 |
| Setting XLINK options | 49 |
| Summary of options | 49 |
| Descriptions of XLINK options | 51 |
| XLINK output formats | 87 |
| Single output file | 87 |
| UBROF versions | 89 |
| Two output files | 91 |
| Output format variants | 92 |
| IEEE695 | 92 |
| ELF | 94 |
| XCOFF78K | 95 |

| | |
|---|-----|
| Restricting the output to a single address space | 96 |
| XLINK environment variables | 99 |
| Summary of XLINK environment variables | 99 |
| XLINK diagnostics | 103 |
| Introduction | 103 |
| XLINK warning messages | 103 |
| XLINK error messages | 103 |
| XLINK fatal error messages | 103 |
| XLINK internal error messages | 103 |
| XLINK stack usage analysis diagnostic messages | 104 |
| Error messages | 104 |
| Warning messages | 125 |
| Stack usage analysis diagnostic messages | 136 |
| | |
| Part 2: The IAR Library Tools | 141 |
| Introduction to the IAR Systems library tools | 143 |
| Libraries | 143 |
| IAR XAR Library Builder and IAR XLIB Librarian | 143 |
| Choosing which tool to use | 144 |
| Using libraries with C/C++ programs | 144 |
| Using libraries with assembler programs | 144 |
| The IAR XAR Library Builder | 147 |
| Using XAR | 147 |
| Basic syntax | 147 |
| Summary of XAR options | 147 |
| Descriptions of XAR options | 148 |
| XAR diagnostics | 149 |
| XAR messages | 149 |

| | |
|--|-----|
| IAR XLIB Librarian options | 151 |
| Using XLIB options | 151 |
| Giving XLIB options from the command line | 151 |
| XLIB batch files | 151 |
| Parameters | 152 |
| Module expressions | 152 |
| List format | 153 |
| Using environment variables | 153 |
| Summary of XLIB options for all UBROF versions | 154 |
| Descriptions of XLIB options for all UBROF versions | 155 |
| Summary of XLIB options for older UBROF versions | 164 |
| Descriptions of XLIB options for older UBROF versions ... | 165 |
| XLIB diagnostics | 167 |
| XLIB messages | 167 |
| Index | 169 |

Tables

| | |
|--|-----|
| 1: Typographic conventions used in this guide | 11 |
| 2: Naming conventions used in this guide | 11 |
| 3: Allocation segment types | 23 |
| 4: Memory segment types | 24 |
| 5: Segment map (-xs) XLINK option | 30 |
| 6: XLINK options summary | 49 |
| 7: Checksumming algorithms | 60 |
| 8: Checksumming flags | 60 |
| 9: Mapping logical to physical addresses (example) | 67 |
| 10: Threaded library redirections for C applications | 77 |
| 11: Threaded library redirections for C++ applications | 78 |
| 12: XLINK formats generating a single output file | 87 |
| 13: Possible information loss with UBROF version mismatch | 90 |
| 14: XLINK formats generating two output files | 91 |
| 15: XLINK output format variants | 92 |
| 16: IEEE695 format modifier flags | 92 |
| 17: IEEE695 format variant modifiers for specific debuggers | 93 |
| 18: ELF format modifier flags | 94 |
| 19: ELF format variant modifiers for specific debuggers | 95 |
| 20: XCOFF78K format modifiers | 95 |
| 21: XCOFF78K format variant modifiers for specific debuggers | 96 |
| 22: XLINK environment variables | 99 |
| 23: XAR parameters | 147 |
| 24: XAR options summary | 147 |
| 25: XLIB parameters | 152 |
| 26: XLIB module expressions | 152 |
| 27: XLIB list option symbols | 153 |
| 28: XLIB environment variables | 153 |
| 29: XLIB options summary | 154 |
| 30: Summary of XLIB options for older compilers | 164 |

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 6.4.1, 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 User 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 IAR Embedded Workbench, we recommend that you first read the initial chapters of the *IDE Project Management and Building Guide* (some products are instead delivered with the *IAR Embedded Workbench® IDE User Guide*), where you will find product overviews and information about installing the IAR Systems development tools. This guide also contains detailed reference information about the IAR Embedded Workbench IDE. The IAR Information Center contains tutorials that will help you get started.

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

When, in the IAR Systems documentation, we refer to the programming language C, the text also applies to C++, unless otherwise stated.

When referring to a directory in your product installation, for example `xxxxx\doc`, the full path to the location is assumed, for example `c:\Program Files\IAR Systems\Embedded Workbench N.n\xxxxx\doc`, where the initial digit of the version number reflects the initial digit of the version number of the IAR Embedded Workbench shared components.

TYPOGRAPHIC CONVENTIONS

This guide uses the following typographic conventions:





| Style | Used for |
|---|---|
| computer | <ul style="list-style-type: none"> • Source code examples and file paths. • Text on the command line. • Binary, hexadecimal, and octal numbers. |
| <i>parameter</i> | A placeholder for an actual value used as a parameter, for example <i>filename.h</i> where <i>filename</i> represents the name of the file. Note that this style is also used for <i>xxxxx</i> , <i>configfile</i> , <i>libraryfile</i> , and other labels representing your product, as well as for the numeric part of filename extensions. |
| [option] | An optional part of a command. |
| [a b c] | An optional part of a command with alternatives. |
| {a b c} | A mandatory part of a command with alternatives. |
| bold | Names of menus, menu commands, buttons, and dialog boxes that appear on the screen. |
| <i>italic</i> | <ul style="list-style-type: none"> • A cross-reference within this guide or to another guide. • Emphasis. |
| ... | An ellipsis indicates that the previous item can be repeated an arbitrary number of times. |
|  | Identifies instructions specific to the IAR Embedded Workbench® IDE interface. |
|  | Identifies instructions specific to the command line interface. |
|  | Identifies helpful tips and programming hints. |
|  | Identifies warnings. |

Table 1: Typographic conventions used in this guide

NAMING CONVENTIONS

The following naming conventions are used for the products and tools from IAR Systems® referred to in this guide:

| Brand name | Generic term |
|-----------------------------|---------------------|
| IAR Embedded Workbench® IDE | the IDE |
| IAR C-SPY® Debugger | C-SPY, the debugger |
| IAR C-SPY® Simulator | the simulator |

Table 2: Naming conventions used in this guide

| Brand name | Generic term |
|-------------------------------|------------------------------|
| IAR C/C++ Compiler™ | the compiler |
| IAR Assembler™ | the assembler |
| IAR XLINK™ Linker | XLINK, the linker |
| IAR XAR Library builder™ | the library builder |
| IAR XLIB Librarian™ | the librarian |
| IAR DLIB Runtime Environment™ | the DLIB runtime environment |
| IAR CLIB Runtime Environment™ | the CLIB runtime environment |

Table 2: Naming conventions used in this guide (Continued)

Note that some of these products and tools might not be available in the product package you are using.

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 might 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 application 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 PC 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.

LARGE ADDRESS AWARENESS

XLINK is *Large Address Aware*, which means that XLINK can address 3 Gbytes of memory instead of the normal 2 if the host computer is prepared for this. Large Address Awareness is only relevant when linking very large projects where the memory

requirements can exceed 2 Gbytes. Refer to Microsoft (*Memory Support and Windows Operating Systems*) for more details about this.

STACK USAGE ANALYSIS

For some IAR Systems products and under the right circumstances, the linker can accurately calculate the maximum stack usage for each call graph root (each function that is not called from another function).

If you enable stack usage analysis, a stack usage chapter will be added to the linker map file, listing for each call graph root the particular call chain which results in the maximum stack depth. See `--enable_stack_usage`, page 55.

This is only accurate if there is accurate stack usage information for each function in the application.

In general, the compiler will generate this information for each C function, but if there are indirect calls (calls using function pointers) in your application, you must supply a list of possible functions that can be called from each calling function. You can do this by using pragma directives in the source file, or by using a separate stack usage control file when linking.

If you use a stack usage control file, you can also supply stack usage information for functions in modules that do not have stack usage information. See `--stack_usage_control`, page 77.

For more information about stack usage analysis (if your product supports it), see the *IAR Compiler User Guide*.

MISRA C

XLINK supports both MISRA C:2004 and MISRA C:1998. However, MISRA C:2004 does not introduce any new rules, only the rule numbers have been changed since MISRA C:1998.

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 to perform these checks, see the *IAR Embedded Workbench® MISRA C:1998 Reference Guide* and the *IAR Embedded Workbench® MISRA C:2004 Reference Guide*.

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

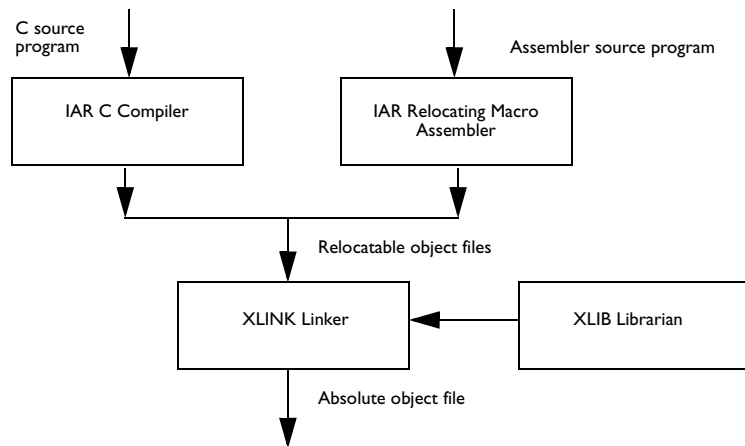
the source code of the applications that you write and not to the code generated by the compiler. The compiler and linker only generate error messages, they do not actually prevent you from breaking the rules you are checking for.

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 applications as output.

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

This 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++ applications.

XLINK FUNCTIONS

The IAR XLINK Linker performs four distinct functions when you link an application:

- 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, application-wide) symbols that could not be resolved by the assembler or compiler.
- It loads modules needed by the application 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 application you are linking. The IAR XLIB Librarian is used for managing these library files.

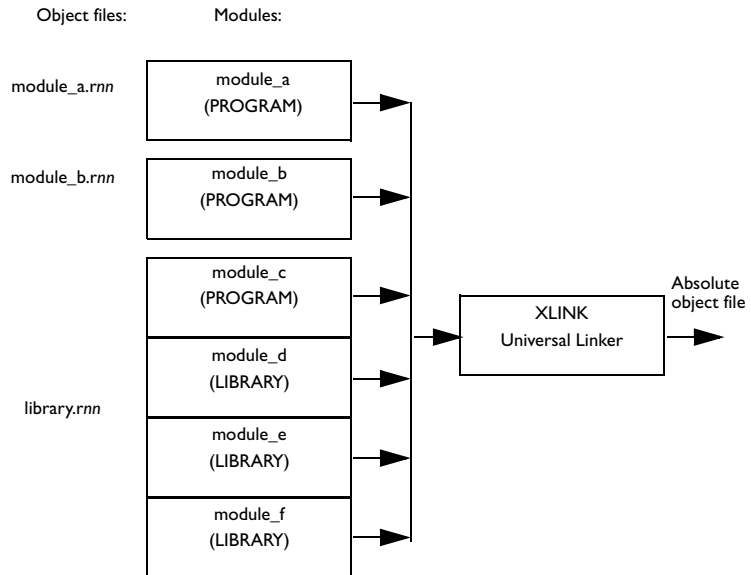
OUTPUT FORMAT

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++ application:



The main application 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 applications 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++ applications) 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 application. 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 applications, 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.

FORMATTERS FOR PRINTF AND SCANF

The linker supports automatic selection of the most suitable formatter for `printf`- and `scanf`-related functions, based on your application's requirements and on information

from the compiler. This feature requires support in the compiler and in the library; see your compiler documentation for information about whether this support exists. If no function satisfies all the requirements of the application, error 177 is generated.

To override this automatic selection, choose a formatter manually using the option `-e`. When automatic selection is used, the map file lists which formatters that were chosen.

SEGMENTS

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

In assembler language applications the programmer is responsible for declaring and naming relocatable segments and determining how they are used. In C/C++ applications 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` or `-P`), 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 runtime 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.

NOALLOC CONTENT

Noalloc content is application content, typically string constants, that resides on the host PC rather than on the target processor. Such content can only be accessed through the debugger (or in a similar way), it cannot be directly accessed by the application.

In XLINK, Noalloc content is treated like this:

- Noalloc properties are already present in the input files. You cannot modify any Noalloc property from XLINK.
- Noalloc segments are not explicitly placed by a placement command. Each such segment is placed starting on address `0x0`.

- Noalloc segments are their own address spaces. A Noalloc segment can never overlap other segments, regardless of whether these are Noalloc or not.
- Noalloc segments, if present, are listed in a separate listing in the map file.
- Noalloc segments are only output in formats that support them, currently UBROF 11 and later and ELF/DWARF. If the format does not support Noalloc, such content will not be output in the image.
- Images that have been linked with Noalloc content, but have had the Noalloc parts removed (for example output in a format that does not support Noalloc) will most likely not work as expected.

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>-Mrange_def</code> | Map logical addresses to physical addresses. |

For detailed information about the options, see the chapter *XLINK options*, page 49.

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 data segments (`A1`, `A2`, `A3`) that can be placed anywhere in the 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 70 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 when you need to put segments in a specific order. (Most reasons for doing this 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.

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 application, 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

This 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 3: 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 that 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. |
| HUGECode, 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. |
| NEARC, NEARCONST | Constant in NEAR memory. |
| NEARCODE | Code 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 4: 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, see the description of *-z*, page 86.

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: 0xFDFEFFFC - 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 75, 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
```

The 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 _____ | <pre>##### # # 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 # # Copyright 1987-2004 IAR Systems. All rights reserved. # #####</pre> |
|--|---|

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 81.

Segment map (-xs)

The segment list gives the segments in increasing address order:

| 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 5: 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 SUMMARY                *
*****

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 linker list file includes a listing of the results of performing static overlay.

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 are in the call chain at the same time.

The **Static overlay system map** option is only supported for processors that use the static overlay system: the 8051, MRK-II, PIC, PIC18, and UC processors. Information collected from using this option for any other processor might be inaccurate, because the static overlay system and stack systems are fundamentally different.

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 that were 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
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), **Fill unused code memory** (-H), and **Checksum summary** (-xr) options have been specified, the listing includes a list of the checksummed areas, in order, and a checksum summary:

```

*****
*                                     *
*                               CHECKSUMS                               *
*                                     *
*****

```

| Symbol | Checksum | Memory | Start | End | Initial | #Initial |
|-------------|------------|--------|-------|--------|------------|-------------|
| __checksum1 | 0x0f | CODE | 0000 | - 000F | 0x00 | #0x00 |
| __checksum2 | 0xf71ec814 | CODE | 0010 | - 00FF | 0xe2b49f35 | #0x00001234 |
| __checksum3 | 0x2d43 | CODE | 0100 | - 0212 | 0x0000 | #0x0000 |
| | | CODE | 0215 | - 0FFF | | |

Checksum summary in the Rocksoft model format

```

Name : __checksum1
Width : 8
Poly : [Not a CRC algorithm]
Init : 00
RefIn : True
RefOut: True
XorOut: 00

```

```

Name : __checksum2
Width : 32
Poly : 04C11DB7
Init : 00001234
RefIn : False
RefOut: False
XorOut: FFFFFFFF

```

```

Name : __checksum3
Width : 16
Poly : 1021
Init : 0000
RefIn : False
RefOut: False
XorOut: [Cannot express 2's complement]

```

```

*****
*                               *
*                     END OF CROSS REFERENCE                     *
*                               *
*****

```

```

2068 bytes of CODE memory   (30700 range fill)
2064 bytes of DATA memory  (12 range fill)
Errors: none
Warnings: none

```

Checksum summary (-xr)

The **Checksum summary** (-xr) option creates a checksum summary that is compatible with the Rocksoft™ Model CRC Algorithm presented in section 15 of *A painless guide to CRC error detection algorithms* by Ross N. Williams. This guide is easy to find on the Internet and can also be requested from IAR Systems technical support.

The Rocksoft™ Model CRC Algorithm defines six fields that together describe all possible CRC checksum configurations:

Width: The size of the checksum value, in bits

Poly: The polynomial's size with the most significant bit omitted, as a binary value expressed in hexadecimal notation

Init: The initial value of the checksum

RefIn: A Boolean value that indicates whether input bytes should be mirrored

RefOut: A Boolean value that indicates whether the final output value should be mirrored

XorOut: The value that should be XOR'ed to the final (possibly mirrored) output value

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

Checksum calculation

XLINK can be set up to generate a checksum that can be compared to a checksum calculated by your application or any other checksum calculating process that can checksum the generated image.

To use checksumming to verify the integrity of your application, you must:

- Set up XLINK to generate a checksum and make sure the checksum bytes are included in the application by placing the checksum in a named segment and giving it a name, for details see the XLINK option -J, page 60. See also the option -Z, page 83 for information about placing the checksum in a segment.
- Choose a checksum algorithm and include source code for the algorithm in your application.

- Decide what memory ranges to verify and set up the source code for it in your application source code.

CHECKSUM CALCULATION BY THE LINKER

Checksum calculation in the linker can be set up in the IDE or by using the `-J` option. By default the calculated checksum is placed in the segment `CHECKSUM`, and the symbol `__checksum` is defined.



To set up calculation of the checksum in the IDE, choose **Project>Options>Linker>Checksum**

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
```

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 part with an alignment of 2 in the segment `CHECKSUM2`, and the symbol `highsum` is defined.

Calculating a Rocksoft™ Model CRC checksum

To calculate a checksum that is compatible with the Rocksoft™ Model CRC Algorithm (see *Checksum summary (-xr)*, page 36), configure the `-J` option like this:

Width: Divide the checksum width by 8 (typically this results in 2 or 4) and set the parameter `size` to this value.

Poly: Leave out the most significant bit if it does not fit in the width and use this value in the parameter `algo`. Some CRC-16 implementations use the polynomial `0x11021`;

the first 1 (which does not fit in a 16-bit value) is usually omitted and the parameter becomes `crc=0x1021`).

Init: Set the parameter `val` to this value. There are two kinds of initial values, direct and indirect. The initial value is probably direct, so it should be specified with a # (for example, `#0xFFFF`).

RefIn: Specify the parameter flag `a`. If both RefIn and RefOut are used, you can specify the parameter flag `m` instead.

RefOut: Specify the parameter flag `z`. If both RefIn and RefOut are used, you can specify the parameter flag `m` instead.

XorOut: XLINK only supports XorOut being all 0's or all F's. If XorOut is all 0's, you do not have to do anything. If the value is all F's, you must use the parameter flag `1`.

Limitations

There are some incompatibilities between the Rocksoft model and the CRC implementation in XLINK.

XLINK only supports:

- Widths of 8, 16 or 32 bits
- XorOut values of all 0's or all F's

If the Rocksoft algorithm you want to calculate has a Width or XorOut value that XLINK does not support, you cannot calculate that checksum in XLINK.

There are also some XLINK options that cannot be expressed as a Rocksoft algorithm:

- 2's complement of CRC checksums
- Non-CRC checksums (for example arithmetic sum)

If any of these are present in a checksum command that a Rocksoft™ Model CRC summary is requested for, those fields will say that they cannot be expressed.

ADDING A CHECKSUM FUNCTION TO YOUR SOURCE CODE

To check the value of the checksum generated by XLINK, the checksum must be compared with a checksum that your application has calculated. This means that you must add a function for checksum calculation (that uses the same algorithm as the checksum generated by XLINK) to your application source code, or use some kind of hardware CRC. Your application must also include a call to this function.

A function for checksum calculation

This function—a slow variant but with small memory footprint—uses the CRC16 algorithm:

```
unsigned short slow_crc16(unsigned short sum, unsigned char *p,
                        unsigned int len)
{
    while (len--)
    {
        int i;
        unsigned char byte = *(p++);
        for (i = 0; i < 8; ++i)
        {
            unsigned long osum = sum;
            sum <<= 1;
            if (byte & 0x80)
                sum |= 1;
            if (osum & 0x8000)
                sum ^= POLY;
            byte <<= 1;
        }
    }
    return sum;
}
```

POLY is the generating polynomial. The checksum is the result of the final call to this routine.

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 `slow_crc16` function 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 (or the specified initial value).

Calculating a checksum in your source code

This source code gives an example of how the checksum can be calculated:

```
/* Start and end of the checksum range */
/* Must exclude the checksum itself */
unsigned long ChecksumStart = 0x8000+2;
unsigned long ChecksumEnd = 0x8FFF;

/* The checksum calculated by XLINK */
extern unsigned short __checksum;
```

```

void TestChecksum()
{
    unsigned short calc = 0;

    /* Run the checksum algorithm */
    calc = slow_crc16(0,
                    (unsigned char *) ChecksumStart,
                    (ChecksumEnd - ChecksumStart+1));

    /* Rotate out the answer */
    unsigned char zeros[2] = {0, 0};
    calc = slow_crc16(calc, zeros, 2);

    /* Test the checksum */
    if (calc != __checksum)
    {
        abort(); /* Failure */
    }
}

```

THINGS TO REMEMBER

When calculating a checksum, you must remember that:

- The checksum must be calculated from the lowest to the highest address for every memory range
- Each memory range must be verified in exactly the same order as defined
- It is OK to have several ranges for one checksum
- If several checksums are used, you should place them in sections with unique names and use unique symbol names
- If the slow CRC function is used, you must make a final call to the checksum calculation with as many bytes (with the value 0x00) as you have bytes in the checksum.

CHECKSUM VALUE SYMBOL

If you want to verify that the contents of the target ROM and the debug file are the same, use the *checksum value symbol*, `__checksum__value`. A generated output file in UBROF or ELF/DWARF format contains a checksum value symbol for each checksum symbol (see *sym*, page 61). The checksum value symbol helps the debugger to see if the code in target ROM corresponds to the code in the debug file. Because this symbol is added after linking, it cannot be accessed from your application, and its only use is to verify that the ROM content in a file is identical to that of the debug file.

The checksum value symbol has the same name as the checksum symbol, with `__value` added at the end. For example, for the default checksum symbol `__checksum`, the checksum value symbol will be `__checksum__value`.

The value of `__checksum__value` is the checksum generated by the checksum option `-J`. It is not the address of the checksum bytes, but the value of the checksum symbol.

If the CRC16 checksum for a certain application is `0x4711`, located at address `0x7FFE`, the output file will, by default, contain the symbol `__checksum` with the value `0x7FFE` and the symbol `__checksum__value` with the value `0x4711`.

Note: In some cases, the code can be different even when the values of the checksum value symbol are identical. One such case is when position-independent code is located at different addresses in different output images, as the checksum only depends on the contents of bytes and not on their addresses.

Bytewise and mirrored initial checksum values

It is possible to specify bitwise initial values and mirrored initial values. Every bitwise and mirrored initial value can be expressed equally well as a bitwise non-mirrored initial value. Specifying bitwise and mirrored initial values is simply a convenient way to specify the same initial value both in XLINK and in the verification step in the application or image loader, in cases where the verification step uses bitwise or mirrored initial values. The application can checksum itself, or an image loader can checksum the application.

Mirroring is the process of reversing all the bits in a binary number, see *Mirroring*, page 42.

BITWISE INITIAL VALUES

If a bitwise initial value is specified in the checksum command, that value is used as the initial value of `sum`, see the classic bit-by-bit calculation in *A function for checksum calculation*, page 39.

For an n -byte checksum you need to feed $n * 8$ zero bits through the bit-by-bit algorithm after the last bit has been entered. This allows the last $n * 8$ bits of the checksum to be rotated out of the checksum algorithm.

Example

This example specifies a 2-byte CRC16 checksum where the initial value of `sum` in the previous bit-by-bit C function is `0x4711`.

```
-J2,crc16,,,,0x4711
```

Note: The bit-by-bit algorithm is also called *slow CRC*. Bitwise initial values are sometimes called *indirect initial values* in texts about CRC.

BYTEWISE INITIAL VALUES

If a bitwise initial value is specified on the command line, that value is used as the initial value of `sum` in this byte-by-byte calculation:

```
unsigned short
byte_by_byte_crc(uint16_t sum, uint8_t *p, unsigned int len)
{
    while (len--)
        sum = table[sum >> 8] ^ *p++ ^ (sum << 8);
    return sum;
}
```

Note: The byte-by-byte algorithm does not need any final zero bits.

Byte-by-byte CRC algorithms execute faster than bit-by-bit CRC algorithms, but use more space. They use a table of precomputed CRC values. For more information about CRC tables, see the examples in *Technical Note 91733* available on the IAR Systems web site.

Example

This example specifies a 2-byte CRC16 checksum where the initial value of `sum` in the byte-by-byte C function is `0x1D0F`:

```
-J2,crc16,,,,#0x1D0F
```

The byte-by-byte algorithm computes exactly the same checksum as the bit-by-bit algorithm (once the final zeros have been fed through the bit-by-bit algorithm). They cannot use the same initial value due to differences in how the initial values are handled.

Note: The byte-by-byte algorithm is called *fast CRC*. Bitwise initial values are sometimes called *direct initial values* in texts about CRC.

MIRRORING

Mirroring is the process of reversing all the bits in a binary number. If the number has n bits, bit 0 and bit $n-1$ are swapped, as are bits 1 and $n-2$ and so on.

To specify a mirrored initial value, use the `m` prefix, see the option `-J`, page 60.

Example 1

```
mirror(0x8000) = 0x0001
mirror(0xF010) = 0x080F
mirror(0x00000002) = 0x40000000
mirror(0x12345678) = 0x1E6A2C48
```

Example 2

This example specifies a 2-byte CRC checksum with the bitwise initial value 0x5012 (0x480A interpreted as a 16-bit binary number and mirrored):

```
-J2,crc16,,,,m0x480A
```

In XLINK, the size of the checksum determines the number of bits in the initial value that will be mirrored. `-J4, . . . ,m0x2000` specifies the bitwise initial value 0x00040000, not 0x0004, because the initial value is treated as a 4-byte quantity when the size of the checksum is 4 bytes.

Note: Mirroring is sometimes called *reflection* in texts about CRC.

Logging

XLINK can be configured to log the linking process. If you enable logging, this can be listed:

- Object files that are used
- Modules that are included
- Segment parts that are included
- Automatically redirected symbols
- Calls and the corresponding stack usage.

To enable logging, use the XLINK option `--log`, see `--log`, page 65.

LOGGING OBJECT FILES

Object files logging lists which object files that are used by the linking process and the order in which they will be processed.

Example log output

```
File      myObject.rnn =>
          C:\Users\TestUser\Documents\IAR Embedded
          Workbench\TestProject\Debug\Obj\myObject.rnn
```

The first line contains the filename used in the linker configuration file or on the command line.

The second line contains the path of the file that was used to satisfy the filename on the first line. This can be helpful when sorting out complex include hierarchies.

The order of the listed files is the order in which the files will be processed.

LOGGING MODULES

Modules logging lists how modules are linked, and why a certain module was included. Modules are included according to these rules:

- PROGRAM modules are always included.
- LIBRARY modules are only included if they supply a definition that is needed by another included module.

Example log output

```

Loading program module c6x(c6x.rnn)
    weak def : CE
    weak def : CKCON (suppressed)
    definition: ce_def
    definition: ce_init
    reference : CeCode
    reference : stretch

```

The module in the example is named `c6x` and resides in the `c6x.rnn` object file. Because it is a program module, it will be included. It defines two weak symbols, `CE` and `CKON`.

`CKON` was already present in the application when `c6x` was linked in so it has been suppressed.

The module contains two definitions, `ce_def` and `ce_init`. The module refers to two externals, `CeCode` and `stretch`.

LOGGING SEGMENT PARTS

Segment parts logging lists how segment parts are linked, and why a certain segment part was included. Segment parts are included according to these rules:

- A ROOT segment part is always included if the module it resides in is included.
- Segment parts that are not ROOT are only included if they are referred to by an included segment part.

Example log output

```

Marking references from command line/config (?ABS_ENTRY_MOD)
[0] __program_start [sp12 ?cstart(clCPUxsf.rnn)]
    [1] sp22 <?cstart_call_main>
        [2] main [sp28 ui_main]

```

```

[3] sp4 <_A_WDTCTL_L>
[3] sp24 <uiMainLcd>
[4] sp24 <uiMainLcd> ***
[4] back_check [sp12 lcd]
[5] ?cstart_init_zero [sp15 ?cstart(clCPUxsf.rnn)]
[6] __data16_memzero [sp4 ?memzero(clCPUxsf.rnn)]
[7] sp4 <__data16_memzero> ***
[6] sfb/sfe(DATA16_Z)
[4] lcdTask [sp78 lcd]
[5] sp12 <task_level>

```

*** denotes previously listed entries. Their references will be ignored after the first listing.

Syntax description

The number in square brackets at the beginning of each line is the depth of the reference tree. Level 0 entries are `ROOT` or referenced from the command line. An entry at a non-zero depth N is always referred to by the immediately preceding entry at depth $N-1$.

The reference depth is followed by one of these:

- A label. The label is followed by text in square brackets `[]` that lists the segment part, the module, and the name of the object file. The name of the object file is only listed if it is different from the name of the module.
- `sp xy` , which describes segment part xy in the current module. It is followed by text in angle brackets `<>` that contains one or more labels in the listed segment part.
- `sfb/sfe(SEGMENT_NAME)`, which describes references to the start or the end of the segment `SEGMENT_NAME`.

Comments on the example

- The label `__program_start` is the root of this reference tree. It is referenced from the command line, most likely a `-s __program_start` command line option. The selected definition for `__program_start` is `sp12` (segment part 12) in the module `?cstart` which resides in the object file `clCPUxsf.rnn`.
- `__program_start` refers to `sp22` which is the function `?cstart_call_main`. It resides in the same module as its referrer. The reference depth 1 and the immediately preceding entry with reference depth 0 is `__program_start`, which resides in the module `?cstart`.
- `sp22` refers to `main`, which is `sp28` in the module `ui_main`.
- `main` refers to `sp4` (`_A_WDTCTL_L`) and `sp24` (`uiMainLcd`) in the module `ui_main`.
- `sp24` refers to itself (denoted by `***`). It also refers to `back_check`, which is `sp12` in the module `lcd`.
- `back_check` refers to `?cstart_init_zero` which is `sp15` in `?cstart`.

- `?cstart_init_zero` refers to `__data16_memzero` (which refers to itself) and also to the start or the end of the segment `DATA16_Z` (zero-initialized memory).
- `lcdTask` is referred from `sp24` (the immediately preceding entry with a depth of 1 lower), it is `sp78` in the module `lcd`.
- `sp12 (task_level)` is called from `lcdTask`. It does not make any references.

LOGGING AUTOMATIC REDIRECTIONS

Redirected symbols logging logs the automatic selection of symbols, why a certain automatic redirection was made. This is logged:

- Alternative suppliers
- Requirements made by the modules
- Default requirements
- Redirections that were actually made.

Example log output

```
### printf/scanf implementation selection
_formatted_read:
  _large_read provides
    "assign_suppressions,floats,n_formatters,scansets"
  _medium_read provides
    "assign_suppressions,n_formatters,scansets"
  scanf establishes default "unknown"
  sscanf establishes default "unknown"
  util requires the feature set ""
  Final requirements: ""
  Best provider: _medium_read
_formatted_write:
  _large_write provides
    "flags,floats,int_specials,n_formatters,qualifiers,widths"
  _medium_write provides
    "flags,int_specials,n_formatters,qualifiers,widths"
  _small_write provides "qualifiers"
  printf establishes default "unknown"
  sprintf establishes default "unknown"
  vprintf establishes default "unknown"
  vsprintf establishes default "unknown"
  teststuff has no requirement info but uses printf
    which requires the feature set "unknown"
  Final requirements: "unknown"
  Best provider: _large_write
```

For `_formatted_read` there are two suppliers, `_large_read` and `_medium_read`. There are no requirements and no use of the defaults. The final requirement is empty so the smallest one, the one with the fewest features, `_medium_read`, is selected.

For `_formatted_write` there are three suppliers, `_large_write`, `_medium_write`, and `_small_write`. There are no requirements from the application but `printf` is used without supplying requirement information. This results in the default for `printf` (which is "unknown") being used. The final requirement is "unknown". Therefore the largest implementation, the one with the most features, `_large_write`, is selected.

LOGGING CALLS AND STACK USAGE

Stack usage logging logs all calls and the corresponding stack usage. This is logged:

- The stack usage when the function was called
- The name of the function, or a single - to indicate stack usage in a function at a point where no call was made (typically in a leaf function)
- The stack usage along the deepest call chain from the logged point. If no such value could be calculated, `[---]` is printed instead.

Example log output

```

Program entry:
0 __program_start [168]
0 __cmain [168]
  0 __data_init [16]
    8 __zero_init [8]
      16 - [0]
    8 __copy_init [8]
      16 - [0]
  0 __low_level_init [0]
  0 main [168]
    8 printf [160]
      32 _PrintfTiny [136]
        88 _Prout [80]
          104 putchar [64]
            120 __write [48]
              120 __dwrite [48]
                120 __sh_stdout [48]
                  144 __get_ttio [24]
                    168 __lookup_ttioh [0]
                      120 __sh_write [24]
                        144 - [0]
              88 __uidiv [0]
                88 __idiv0 [0]
                  88 strlen [0]
            0 exit [8]
              0 _exit [8]
                0 __exit [8]
                  0 __close_ttio [8]
                    8 __lookup_ttioh [0] ***

```

```
0 __exit [8] ***
```

*** indicates functions that have already been displayed.

XLINK options

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



The *IDE Project Management and Building 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 a linker configuration (`.xcl`) file, and include this on the command line with the `-f file` command.

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

Summary of options

The following table summarizes the XLINK command line options:

| Command line option | Description |
|---------------------------|--|
| <code>-A</code> | Loads as program |
| <code>-a</code> | Disables static overlay |
| <code>-B</code> | Always generates output |
| <code>-C</code> | Loads as library |
| <code>-c</code> | Specifies processor type |
| <code>--call_graph</code> | Produces a call graph file in XML format |
| <code>-D</code> | Defines symbol |
| <code>-d</code> | Disables code generation |
| <code>-E</code> | Inherent, no object code |
| <code>-e</code> | Renames external symbols |

Table 6: XLINK options summary

| Command line option | Description |
|---------------------------|---|
| -F | Specifies output format |
| -f | Specifies XCL filename |
| -G | Disables global type checking |
| -g | Requires global entries |
| -H | Fills unused code memory |
| -h | Fills ranges. |
| -I | Includes paths |
| --image_input | Links pure binary files |
| -J | Generates a checksum |
| -K | Duplicates code |
| -L | Lists to directory |
| -l | Lists to named file |
| --log | Enables log output for selected topics |
| --log_file | Directs the log to a file |
| -M | Maps logical addresses to physical addresses |
| --misrac | Enables error messages specific to MISRA-C:1998. This option is a synonym of --misrac1998 and is only available for backwards compatibility. |
| --misrac1998 | Enables error messages specific to MISRA-C:1998. See the <i>IAR Embedded Workbench® MISRA C:1998 Reference Guide</i> . |
| --misrac2004 | Enables error messages specific to MISRA-C:2004. See the <i>IAR Embedded Workbench® MISRA C:2004 Reference Guide</i> . |
| --misrac_verbose | Enables verbose logging of MISRA C checking. See the <i>IAR Embedded Workbench® MISRA C:1998 Reference Guide</i> or the <i>IAR Embedded Workbench® MISRA C:2004 Reference Guide</i> . |
| -n | Ignores local symbols |
| -O | Multiple output files |
| -o | Output file |
| --output_checksum_summary | Includes a checksum summary in the memory summary. |
| -P | Defines packed segments |
| -p | Specifies lines/page |

Table 6: XLINK options summary (Continued)

| Command line option | Description |
|-----------------------|--|
| -Q | Scatter loading |
| -R | Disables range check |
| -r | Debug information |
| -rt | Debug information with terminal I/O |
| -S | Silent operation |
| -s | Specifies new application entry point |
| --segment_mirror | Mirrors memory that can be accessed from two different addresses |
| --stack_usage | Enables stack usage analysis |
| --stack_usage_control | Specifies a stack usage control file |
| --threaded_lib | Sets your embedded system up for use with a threaded library |
| -U | Address space sharing |
| -w | Sets diagnostics control |
| -X | Forces content to be loaded as not root, even if it has the root attribute |
| -x | Specifies cross-reference |
| -Y | Format variant |
| -y | Format variant |
| -Z | Defines segments |
| -z | Segment overlap warnings |

Table 6: XLINK options summary (Continued)

Descriptions of XLINK options

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

-A

Syntax

-A *file*,...

Description

Use this option 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.

-a

Syntax

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

Parameters

| | |
|--------------------------------------|--|
| No parameter | Disables overlaying totally, for debugging purposes. |
| i | Disables indirect tree overlaying. |
| w | Disables warning 16, Function is called from two function trees. Do this only if you are sure the code is correct. |
| <code>(function, function...)</code> | Function trees will not be overlaid with another function. The (and) characters are part of the option and must be included. |
| <code>[function, function...]</code> | Function trees will not be allocated unless they are called by another function. The [and] characters are part of the option and must be included. |
| <code>{function, function...}</code> | Indicates that the specified functions are interrupt functions. The { and } characters are part of the option and must be included. |

Description

Use this option to control the static memory allocation of variables. The option can also specify one or more function lists, to specify additional options for specified functions. Each function list can have the form `function, function...`, where *function* specifies a public function or a `module:function` combination.

You can specify several `-a` options, and each `-a` option can include several parameters, in any order.

Note: Giving a function list is optional, thus the [and] characters in the syntax description, but the brackets that surround a function list must be included on the command line.

-B

Syntax `-B`

Description Use this option 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.

-C

Syntax `-C file,...`

Description Use this option 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.

-c

Syntax `-cprocessor`

Description Use this option 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.

--call_graph

Syntax

--call_graph *filename*

Description

Use this option to produce a call graph file in XML format, in addition to the ordinary output files. If no filename extension is specified, the extension `cgx` is used. This option can only be used once on the command line.

Note: This option requires that your product supports stack usage analysis.

See also



The stack usage analysis documentation in the *IAR Compiler User Guide*.

Project>Options>Linker>Advanced>Call graph output (XML)

-D

Syntax

-D*symbol=value*

Parameters

symbol Any external (`EXTERN`) symbol in the program that is not defined elsewhere.

value The value to be assigned to *symbol*.

Description

Use this option to define absolute symbols at link time. This is especially useful for configuration purposes. Any number of symbols can be defined in a linker configuration 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

Syntax

-d

Description

Use this option 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

| | |
|-------------|--|
| Syntax | <code>-E file,...</code> |
| Description | <p>Use this option 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.</p> <p>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.</p> |
| Example | <p>In a project that consists of four files, <code>file1</code> to <code>file4</code>, we only want object code generated for <code>file4</code> to be put into an EPROM:</p> <pre>-E file1, file2, file3 file4 -o project.hex</pre> |


-e

| | |
|-------------|---|
| Syntax | <code>-enew=old [,old] ...</code> |
| Description | <p>Use this option to configure a program at link time by redirecting a function call from one function to another.</p> <p>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.</p> |


--enable_stack_usage

| | |
|-------------|--|
| Syntax | <code>--enable_stack_usage</code> |
| Description | <p>Use this option to enable stack usage analysis. When enabled, stack usage analysis generates a stack usage report in the linker map file. An optional call graph file (see <code>--call_graph</code>, page 54) and stack usage log (see <code>--log</code>, page 65) can also be created.</p> <p>Note: This option requires that your product supports stack usage analysis.</p> |
| See also | The stack usage analysis documentation in the <i>IAR Compiler User Guide</i> . |

-F

| | |
|-------------|---|
| Syntax | <code>-F format</code> |
| Parameters | <i>format</i> is one of the supported XLINK output formats; see the chapter <i>XLINK output formats</i> . |
| Description | <p>Use this option to specify the output format.</p> <p>The environment variable <code>XLINK_FORMAT</code> can be set to install an alternate default format on your system; see the chapter <i>XLINK environment variables</i>.</p> <p>Note: Specifying the <code>-F</code> option as <code>DEBUG</code> does not include C-SPY debug support. Use the <code>-r</code> option instead.</p> <p> This option is related to the Output options in the linker category in the IAR Embedded Workbench IDE.</p> |

-f

| | |
|-------------|--|
| Syntax | <code>-f file</code> |
| Description | <p>Use this option 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 <code>xc1</code> is assumed.</p> <p>Arguments are entered into the linker configuration 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, <code>\</code>, at the end of line.</p> <p>Note: You can include C-style <code>/* . . . */</code> or <code>//</code> comments in linker configuration files.</p> <p> This option is identical to the Linker configuration file option in the linker category in the IAR Embedded Workbench IDE.</p> |

-G

| | |
|-------------|--|
| Syntax | <code>-G</code> |
| Description | Use this option 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

Syntax `-g $symbol1$ [, $symbol2$, $symbol3$, ...]`

Description 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 this option to add to this set so that something is included even if it appears not to be needed.

-H

Syntax `-H $hexstring$`

Description Use this option 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.

Example This example fills 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


Syntax `-h[' $filler$ '] [($segment_type$)] { $range1$, [$range2$, ...]}`

Parameters

| | |
|-----------------|--|
| $filler$ | A string of bytes to fill the specified range(s) with. |
| $segment_type$ | The type of segment to be filled (optional). |

| | |
|--------------|--|
| <i>range</i> | The range(s) to be filled. |
| Description | <p>Use this option to specify the ranges to fill. Normally, all ranges given in segment-placement commands (<code>-Z</code> and <code>-P</code>) into which any actual content (code or constant data) is placed, are filled. If no <i>filler</i> string is specified, the fill string specified by the <code>-H</code> option will be used.</p> <p>Using <code>-h</code> 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.</p> <p>The <code>-h</code> 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.</p> |
| Examples | <p>In this example, all ranges given will be filled:</p> <pre>-Z (CODE) INTVEC=0-FF -Z (CODE) RCODE, CODE, SHORTAD_ID=0-7FFF, F800-FFFF -Z (DATA) SHORTAD_I, SHORTAD_Z=8000-8FFF</pre> <p>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.</p> <p>Using <code>-h</code> you can explicitly specify which ranges to fill. For example:</p> <pre>-h (CODE) 0-FFFF</pre> <p>or, equivalently, as segment type <code>CODE</code> is the default,</p> <pre>-h0-FFFF</pre> <p>will cause the range 0-FFFF to be filled, regardless of what ranges are specified in segment-placement commands. Often <code>-h</code> will not be needed.</p> <p>To fill the left-over space in the 0x400-0x4FF range with bytes from the filler string EDADBEFE, specify:</p> <pre>-h 'EDADBEFE' (CODE) 400-4FF</pre> <p>And to fill the left-over space in the 0x00-0x3F range with bytes from the filler string 1895:</p> <pre>-h '1895' 0-3F</pre> |

-I

| | |
|-------------|---|
| Syntax | <code>-Ipathname</code> |
| Description | <p>Specifies a path name to be searched for object files.</p> <p>By default, XLINK searches for object files only in the current working directory. The <code>-I</code> 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.</p> <p>This option is equivalent to the <code>XLINK_DFLTDIR</code> environment variable.</p> |
| Example | <p>To read object files from <code>v:\general\lib</code> and <code>c:\project\lib</code>:</p> <pre>-Iv:\general\lib -Ic:\project\lib</pre> |
| See also | <p>The chapter <i>XLINK environment variables</i>.</p> <p> This option is identical to the Search paths option in the linker category in the IAR Embedded Workbench IDE.</p> |

--image_input

| | | | | | | | | | |
|------------------|---|-----------------|---------------------------------------|----------------|---|---------------|--|------------------|---|
| Syntax | <code>--image_input=filename, symbol, segment, alignment</code> | | | | | | | | |
| Parameters | <table> <tr> <td><i>filename</i></td> <td>The pure binary file you want to link</td> </tr> <tr> <td><i>segment</i></td> <td>The segment where the binary data will be placed.</td> </tr> <tr> <td><i>symbol</i></td> <td>The symbol defined by the segment part where the binary data is placed</td> </tr> <tr> <td><i>alignment</i></td> <td>The alignment of the segment part where the binary data is placed</td> </tr> </table> | <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 |
| <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 | | | | | | | | |
| Description | <p>Use this option to link pure binary files in addition to the ordinary input files.</p> <p>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 <i>Single output file</i>, page 87).</p> <p>The segment part where the contents of the <i>filename</i> file is placed, is only included if the symbol <i>symbol</i> is required by your application. Use the <code>-g</code> option if you want to force a reference to the segment part, see <code>-g</code>, page 57.</p> | | | | | | | | |

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

Syntax

```
-Jsize,algo[,flags[,sym[,seg[,align[, [m] [# val] ] ] ] ] ] [ (=|==) ranges]
```

Description

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

Parameters

size

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

algo

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

| Method | Description |
|---------------|--|
| sum | Simple arithmetic sum. |
| crc16 | CRC16 (generating polynomial 0x1021). |
| crc32 | CRC32 (generating polynomial 0x04C11DB7). |
| crc= <i>n</i> | CRC with a generating polynomial of <i>n</i> . |

Table 7: Checksumming algorithms

flags

flags can be used to specify complement, the byte order and the bit-order of the checksum, and the number of bits that are checksummed in each iteration.

| Flag | Description |
|------|---|
| 1 | Specifies one's complement of the final checksum. |
| 2 | Specifies two's complement of the final checksum. |

Table 8: Checksumming flags

| Flag | Description |
|------|---|
| a | Reverses (mirrors) the order of the bits within each byte when calculating the checksum, but only the input bytes and not the final checksum. |
| m | Reverses (mirrors) the order of the bits within each input byte when calculating the checksum. The final checksum is also mirrored (the entire checksum, not the individual bytes). |
| L | Calculates a checksum for 4 input bytes in every iteration. |
| W | Calculates a checksum for 2 input bytes in every iteration. |
| x | Changes the byte order of the final checksum from little-endian to big-endian, or vice versa. |
| z | Reverses (mirrors) the order of the bits within the final checksum, but not the input bytes, when calculating the checksum. |

Table 8: Checksumming flags

Use the `W` or the `L` flag to make the linker produce the same checksum as some hardware CRC implementations that checksum more than 8 bits per iteration. (By default, 8-bit units are checksummed.) Using the `W` or the `L` flag does not add any additional error detection power to the checksum.

Two examples:

```
-J2, crc16, x=4000-7FFF
```

This option calculates a checksum from `0x4000` to `0x7FFF` using the CRC16 algorithm and generates a 2-byte checksum with reversed byte order.

```
-J4, crc32, m2Wx=0-FFFF
```

This option calculates a checksum from `0x0` to `0xFFFF` using the CRC32 algorithm. It checksums 16 bits with reversed bit order in each iteration and generates a 4-byte 2's complement checksum with reversed byte order.

Three examples of reversed byte order:

- If the 1-byte checksum was `0x73`, the reversed byte order checksum will be `0x73`.
- If the 2-byte checksum was `0xC2`, the reversed byte order checksum will be `0xC200`.
- If the 4-byte checksum was `0x3AC25`, the reversed byte order checksum will be `0x25AC0300`.

sym

`sym` 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.

seg

seg 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.

m

m specifies that the initial value *val* will be mirrored before it is used. `m0x2468` is a bitwise initial value that will be mirrored (`0x2468` before mirroring), and `m#0x8C18` is a bitwise initial value that will be mirrored (`0x8C18` before mirroring). See *Mirroring*, page 40.

#

specifies that *val* is a bitwise initial value. `#0x1D0F` is an example of a bitwise initial value. Bitwise initial values are used if the verification step uses the byte-by-byte algorithm with non-zero initial values. See *Bitwise initial values*, page 42.

val

val is the initial value in hexadecimal form. By default, the initial value of the checksum is 0. If you need to change the initial value, supply a different value for *val*. If nothing else is specified, the initial value is a bitwise initial value. For example, `0x4711` is a bitwise initial value. See *Bitwise initial values*, page 41.

ranges

ranges is one of:

- one or more explicit ranges of hexadecimal addresses, like `200-5FF`
- one or more symbolic ranges, like `CHECKSUM_START-CHECKSUM_END`
- one or more segment names inside a `{ }` pair, like `{CODE}`.

If more than one address range is specified, the ranges are comma-separated.

Note: If you do not specify any ranges explicitly, all bytes in the final application are included in the calculation.

=

If one equal sign is used (=), a range is only checksummed once, even if it is specified more than once. An example:

```
-J2, crc16=CRC_START-CRC_END, 40-7F, {CODE}
```

If CRC_START has the value 40, CRC_END has the value 4F, and the segment CODE is placed in the address range 50-113, this checksum command is equivalent to:

```
-J2, crc16=40-4F, 40-7F, 50-113
```

The ranges overlap, so this is equivalent to:

```
-J2, crc16=40-113
```

The checksumming will start on address 40 and end on address 113. The byte on each address will be used exactly once, even though some address ranges were specified more than once.

==

If two equal signs are used (==), a range is checksummed as many times as it is specified and in the specified order. If, for instance, two equal signs are used in the example above:

```
-J2, crc16==CRC_START-CRC_END, 40-7F, {CODE}
```

this checksum command is equivalent to:

```
-J2, crc16==40-4F, 40-7F, 50-113
```

Because two equal signs are used instead of a single equal sign, the bytes will be checksummed in this order:

- 1 The bytes in 40-4F are checksummed
- 2 The bytes in 40-4F are checksummed a second time (the first half of the range 40-7F)
- 3 The bytes in 50-7F are checksummed (the second half of the range 40-7F)
- 4 The bytes in 50-7F are checksummed a second time (the first half of the range 50-113)
- 5 The bytes in 80-113 are checksummed (the second half of the range 50-113).



To set up calculation of the checksum in the IDE, choose **Project>Options>Linker>Checksum**

-K

| | |
|-------------|---|
| Syntax | <code>-Ksegment1[, segment2,...]=diff, count</code> |
| Parameters | <p><i>segment</i> The segment(s) to copy data bytes from.</p> <p><i>diff</i> The difference in address between the original segment and where the copied bytes are placed.</p> <p><i>count</i> The number of times to copy data bytes from the segment(s) <i>segment</i>.</p> |
| Description | <p>Use this option to duplicate any raw data bytes from one or more segments, one or more times, placing each copy at a different address. This will typically be used for segments mentioned in a <code>-Z</code> option.</p> <p>This can be used for making part of a PROM be non-banked even though the entire PROM is physically banked. Use the <code>-P</code> option to place the banked segments into the rest of the PROM.</p> |
| Example 1 | <p>To copy the contents of the <code>RCODE0</code> and <code>RCODE1</code> segments four times, using addresses <code>0x20000</code> higher each time, specify:</p> <pre>-KRCODE0,RCODE1=20000,4</pre> <p>This will place 5 instances of the bytes from the segments into the output file, at the addresses <code>x</code>, <code>x+0x20000</code>, <code>x+0x40000</code>, <code>x+0x60000</code>, and <code>x+0x80000</code>.</p> |
| Example 2 | <p>If the segment <code>MYSEG</code> is placed at <code>0x10000</code>, to create 4 duplicates placed at <code>0xE000</code>, <code>0xC000</code>, <code>0xA000</code>, and <code>0x8000</code>, specify:</p> <pre>-KMYSEG=-0x2000,4</pre> |
| See also | <i>Segment control</i> , page 22. |

-L

| | |
|-------------|---|
| Syntax | <code>-L[<i>directory</i>]</code> |
| Description | <p>Causes the linker to generate a listing and send it to the file <code><i>directory</i>\outputname.lst</code>. Notice that you must not include a space before the prefix.</p> <p>By default, the linker does not generate a listing. To simply generate a listing, you use the <code>-L</code> option without specifying a directory. The listing is sent to the file with the same name as the output file, but extension <code>lst</code>.</p> |

`-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`

Syntax

`-l file`

Description

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.

`--log`

Syntax

`--log {topic}[,topic[,topic[,topic]]]`

Parameters

topic can be one of:

| | |
|-------------------------------------|--|
| <code>files</code> | Lists all object files that are used by the linking process and the order in which they will be processed. |
| <code>modules</code> | Lists each module that is selected for inclusion in the application, and which symbol that caused it to be included. |
| <code>printf_scanf_selection</code> | Lists redirected symbols, and why a certain automatic redirection was made. |
| <code>segments</code> | Lists each segment part that is selected for inclusion in the application, and the dependence that caused it to be included. |
| <code>stack_usage</code> | Lists all calls and the corresponding stack usage. |

Description

Use this option to make the linker log information to `stdout`. The log information can be useful for understanding why an executable image became the way it is.

For a detailed description of the logging process, see *Logging*, page 43.

Example `--log files,modules,segments,printf_scanf_selection`
 This command line will create a complete log of the linking process.

See also *Logging*, page 43 and `--log_file`, page 66.



Project>Options>Linker>List>Generate log

--log_file

Syntax `--log_file filename`

Description Use this option to direct the log output to the specified file.

See also `--log`, page 65 and *Logging*, page 43.



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

-M

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

Parameters

| | |
|---------------------------------------|--|
| <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> . |
| <code>[start-end]*count+offset</code> | 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. |
| <code>[start-end]/pagesize</code> | 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. |

Description

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.

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

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

Example 1

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 9: Mapping logical to physical addresses (example)

Example 1

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
```

-N

Syntax

`N filename[, filename, filename, ...]`

Description

Use this option to specify that all content in one or more files is treated as if it had the `root` attribute. This means that it is included in the application whether or not it is referenced from the rest of the application.

Note: Modules will still be removed at link time if they are not referenced, so `root` content in a non-referenced module will not be included in the application. Use the linker options `-A myFile.r99` and `-N myFile.r99` at the same time to make sure that all modules in the file are kept and that all content in the file is treated as `root`.

-n

Syntax

`-n[c]`

Description

Use this option 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

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

Parameters

| | |
|-----------------|--|
| <i>format</i> | The format of the output file you are creating. |
| <i>variant</i> | A modifier that creates a variant of the specified <i>format</i> . This is the same modifier as given after the <code>-Y</code> or <code>-y</code> option. |
| <i>filename</i> | The name of the output file. 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 <code>-o</code> option, with the default extension for the format. (Typically you would want all output files specified using the <code>-O</code> option to have the same filename.) If <i>filename</i> begins with a <code>.</code> (a period), it will be used as the filename extension and the name of the file will be as if no name was specified. |

Description Use this option to create one or more output files, possibly with in a variant of the specified output format. 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 configuration 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.

See also

`-o`, page 70, and *Output format variants*, page 92.



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

--output_checksum_summary

| | | |
|-------------|---|--------------------------------|
| Syntax | <code>--output_checksum_summary [=verbose]</code> | |
| Parameters | <code>verbose</code> | Includes more detailed output. |
| Description | Use this option to include the checksum information from the linker list file in the <i>memory summary</i> . This summary is produced during linking. If the parameter <code>verbose</code> is not specified, only the names and values of the checksums in your application are included in the summary. | |

-O

| | | |
|-------------|--|--|
| Syntax | <code>-o file</code> | |
| Description | Use this option to specify the name of the XLINK output file. If a name is not specified, the linker will use the name <code>about.hex</code> . If a name is supplied without a file type, the default file type for the selected output format will be used. See <i>-F</i> , page 56, 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

| | | |
|------------|--|---|
| Syntax | <code>-P [(type)] segments=range[, range] ...</code> | |
| Parameters | <code>type</code> | Specifies the memory type for all segments if applicable for the target processor. If omitted it defaults to <code>UNTYPED</code> . |
| | <code>segments</code> | 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. |
| | <i>[start:+size]/pagesize</i> | Specifies the entire range beginning at <i>start</i> and with the length <i>size</i> , divided into pages of size and alignment <i>pagesize</i> . <i>Note</i> : The beginning and end of the range do not have to coincide with a page boundary. |

Description

Use this option 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.

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.

Examples

| | |
|---------------------|---|
| 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. |

See also

Segment control, page 22.

-P

Syntax

`-plines`

Description

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 identical to the **Lines/page** options in the linker category in the IAR Embedded Workbench IDE.

-Q

Syntax

`-Qsegment=initializer_segment`

Parameters

segment

The original segment that contains the data content to be copied.

initializer_segment

The new initializer segment to hold the data content of *segment* until the first code in *segment* is executed.

Description

Use this option to do automatic setup for copy initialization of segments (scatter loading). This will cause the linker to generate a new segment into which it will place all data content of an existing segment *segment*. Everything else, e.g. symbols and

debugging information, will still be associated with the original 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.

Example 1

Assume 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 2

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 );
}

```

-R

Syntax -R[w]

Parameters

| | |
|--------------|--------------------------------------|
| No parameter | Disables the address range checking |
| w | Range errors are treated as warnings |

Description

By default, 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.

Use this option to disable or modify the address range check.



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

-r

Syntax -r

Description

Use this option 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

Syntax -rt

Description

Use this option 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

| | |
|-------------|--|
| Syntax | -S |
| Description | Use this option 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

| | |
|-------------|--|
| Syntax | -s <i>symbol</i> |
| Description | This option adds a new way to specify the entry point for an application. If the option is used, the specified <i>symbol</i> will be used as the application entry point, and there must be a definition for the symbol in the application, or an <code>Undefined External</code> error (error 46) will be generated. This symbol definition will also be included in the final link image. |



This option is identical to the **Override default program entry** option in the linker category in the IAR Embedded Workbench IDE.

--segment_mirror

| | | |
|-------------|--|--|
| Syntax | <code>--segment_mirror [@] <i>segment</i>=[@] <i>content_segment</i></code> | |
| Parameters | @ | Excludes the segment from the summary |
| | <i>segment</i> | The segment that contains the label |
| | <i>content_segment</i> | The segment that contains the actual bytes |
| Description | Use this option to mirror bytes in a memory range that can be accessed from two different addresses. A typical example is when some addresses in RAM (that do not correspond to actual RAM) are mapped by the hardware to addresses in ROM. The part in RAM, <i>segment</i> , contains the label and all debug information. The part in ROM, <i>content_segment</i> , contains the actual bytes. Note: This option does not involve any actual copying of bytes (which makes it different from the <code>-Q</code> option). | |

The segments must be placed on connected addresses. If the address range 0x14000–0x143FF mirrors the range 0x4000–0x43FF, you must place one segment on 0x14000 and the other on 0x4000, using the `-z` placement command. If you move one segment from the start of the mirrored range, you must also move the other segment exactly the same distance.

Use the `@` modifier to exclude one or both of the segment names from the summary. For example, if no modifier is used and the segment contains 200 bytes, 200 bytes will be added to both the `CONST` and the `DATA` summary. This is typically not correct because only 200 bytes of *address space* is used, not 200 actual bytes of RAM.

--stack_usage_control

Syntax

```
--stack_usage_control filename
```

Description

Use this option to specify a stack usage control file. This file controls stack usage analysis, or provides more stack usage information for modules or functions. You can use this option multiple times to specify multiple stack usage control files. If no filename extension is specified, the extension `suc` is used.

Using this option enables stack usage analysis in the linker.

Note: This option requires that your product supports stack usage analysis.

See also



The stack usage analysis documentation in the *IAR Compiler User Guide*.

Project>Options>Linker>Advanced>Control file

--threaded_lib

Syntax

```
--threaded_lib
```

Description

This option makes it possible to use your application with a library that has been prepared for threaded use (for more information about threaded libraries, see the *IAR Compiler User Guide*).

Note: This option requires that your product supports multi-threading.

When this option is specified, XLINK will make these redirections for C applications:

| Label | Redirected label |
|----------------------------------|--------------------------------------|
| <code>__iar_Locksyslock</code> | <code>__iar_Locksyslock_mtx</code> |
| <code>__iar_Unlocksyslock</code> | <code>__iar_Unlocksyslock_mtx</code> |

Table 10: Threaded library redirections for C applications

| Label | Redirected label |
|-----------------------------------|---------------------------------------|
| <code>__iar_Lockfilelock</code> | <code>__iar_Lockfilelock_mtx</code> |
| <code>__iar_Unlockfilelock</code> | <code>__iar_Unlockfilelock_mtx</code> |

Table 10: Threaded library redirections for C applications

For C++ applications, XLINK will make these redirections:

| Label | Redirected label |
|--|--|
| <code>__iar_Initdynamicfilelock</code> | <code>__iar_Initdynamicfilelock_mtx</code> |
| <code>__iar_Dstdynamicfilelock</code> | <code>__iar_Dstdynamicfilelock_mtx</code> |
| <code>__iar_Lockdynamicfilelock</code> | <code>__iar_Lockdynamicfilelock_mtx</code> |
| <code>__iar_Unlockdynamicfilelock</code> | <code>__iar_Unlockdynamicfilelock_mtx</code> |

Table 11: Threaded library redirections for C++ applications

The symbol `__iar_Locksyslock_mtx` is always included.

-U

| | | |
|-------------|--|---|
| Syntax | <code>-U[(address_space)] range= [(address_space)] range</code> | |
| Parameters | <code>address_space</code> | Specifies the address space if applicable for the target processor. If omitted it defaults to CODE. |
| | <code>range</code> <code>start-end</code> | The range starting at <code>start</code> and ending at <code>end</code> . |
| Description | Each <code>-U</code> command line option declares that the memory given by the range on the left side of the <code>=</code> 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 (<code>address_space</code>) that can be included on each side of the <code>=</code> can be used to specify the address space for architectures with multiple address spaces. | |

Example 1

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
```

Example 2

`-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
```

-w

Syntax

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

Parameters

| | |
|--------------|--|
| No parameter | Disables all warning messages. |
| <i>n</i> | Disables warning <i>n</i> , where <i>n</i> is the number of the warning. |
| <i>s</i> | If there are warnings but no errors, the linker’s return value is changed from 0 to 1. |

| | |
|-----------------------|---|
| <code>t</code> | Suppresses the detailed type information given for warning 6 (type conflict) and warning 35 (multiple structs with the same tag). |
| <code>ID</code> | Changes the severity of the diagnostic message <code>ID</code> , which is either the letter <code>e</code> followed by an error number, the letter <code>w</code> followed by a warning number, or just a warning number. |
| <code>severity</code> | The severity of the diagnostic message. Choose between: <code>i</code> – Ignore this diagnostic message. No diagnostic output. (Default.) <code>w</code> – Classify this diagnostic message as a warning. <code>e</code> – Classify this diagnostic message as an error. |

Description This option disables or reclassifies diagnostic messages. The `-w` option can be used several times in order to change the severity of more than one diagnostic message. If no argument is given, all warnings are disabled.

Fatal errors are not affected by this option.

Because 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[e46]: Undefined external ...

Example 1 `-w3 -w7`

Disables warnings 3 and 7.

Example 2 `-w26`
`-ww26`
`-ww26=i`

These three are equivalent and turn off warning 26.

Example 3 `-we106=w`

This causes error 106 to be reported as a warning.



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

-X

Syntax `-X file[, file2,...]`

Description Use this option to temporarily force all content in the specified input files to be loaded as if it was not `root`, even if some content actually has the `root` attribute.

This option can be useful, for example, if you have a library module that contains several entries that are `root` (like interrupt functions), but you are only interested in some of the content in the module. Note that ignoring the `root` property on content can lead to unexpected behavior; `root` content usually has that property for a reason.

-X

Syntax `-x[e][h][i][m][n][s][o][r]`

Parameters

| | |
|---|--|
| 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 31. |
| 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 28. |
| n | Generates a module summary. See <i>Module summary (-xn)</i> , page 32. |
| s | A list of all the segments in dump order. See <i>Segment map (-xs)</i> , page 30. |
| o | If the compiler uses static overlay, this parameter includes a listing of the static overlay system in the list file. See <i>Static overlay system map (-xo)</i> , page 33. |
| r | This parameter includes a checksum summary that is compatible with the Rocksoft™ Model CRC Algorithm. See <i>Checksum summary (-xr)</i> , page 36. |

Description Use this option to include a segment map in the XLINK list file. This option is used with the list options `-L` or `-l`.

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 `-1` or `-L` options has been specified.

See also

`-L`, page 64, and `-l`, page 65.



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

-Y

Syntax

`-Y[char]`

Description

Use this option to select enhancements available for some output formats. The affected formats are `PENTICA`, `MPDS-SYMB`, `AOMF8051`, `INTEL-STANDARD`, `MPDS-CODE`, `DEBUG`, and `INTEL-EXTENDED`.

See also

The chapter *XLINK output formats*.



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

-y

Syntax

`-y[chars]`

Description

Use this option 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`.

See also

The chapter *XLINK output formats*.



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

-Z

Syntax

```
-Z[@] [(type)] segment1[|align[|]] [, segment2[|align[|]] ,
... segmentn[|align[|]] [=|#]range[,range] ...
```

Parameters

| | |
|---|---|
| @ | 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. |
| <i>type</i> | Specifies the memory type for all segments if applicable for the target processor. If omitted it defaults to UNTYPED. |
| <i>segment1</i> , <i>segment2</i> , ... <i>segmentn</i> | 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 + <i>nnnn</i> to a segment name increases the amount of memory that XLINK will allocate for that segment by <i>nnnn</i> bytes. |
| <i>align</i> | Increases the alignment of the segment, see <i>Specifying the alignment of a segment</i> , page 85. |
| = 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. |

| | | |
|--------------|----------------------------------|---|
| <i>range</i> | <i>start-end</i> | The range starting at <i>start</i> and ending at <i>end</i> . |
| | $[start-end] * count + offset$ | 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. |
| | $[start-end] / pagesize$ | 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. |
| | <i>start:+size</i> | The range starting at <i>start</i> with the length <i>size</i> . |
| | $[start:+size] * count + offset$ | 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 <i>start</i> and with the length <i>size</i> , divided into pages of size and alignment <i>pagesize</i> . <i>Note</i> : The beginning and end of the range do not have to coincide with a page boundary. |

Description

Use this option 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` 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`.

Specifying the alignment of a segment

If a segment is placed using the `-Z` placement command, you can increase its alignment.

```
-Z [(type)] segment1 [ | align [ | ] ] [, segment2... ] [=ranges]
```

`align` can be any integer in the range 0-31

`align` is treated as a decimal number (XLINK uses hexadecimal notation by default, so this is an exception). `align` does not specify the desired alignment in bytes, but the number of bits that are forced to zero, starting from the least significant bit of the address. The alignment thus becomes 2 raised to the power of `align`, so 0 means no alignment (or 1-byte aligned), 1 means 2-byte aligned, 2 means 4-byte aligned, and so on. XLINK reports alignment in the segment map part of linker list files in this way.

Example 1

```
-Z (CODE) MY_ALIGNED_CODE | 2 =ROMSTART-ROMEND
```

This aligns the start of the segment `MY_ALIGNED_CODE` to be 4-byte aligned.

Example 2

```
-Z (DATA) MY_ALIGNED_DATA | 8, MY_OTHER_DATA =RAMSTART-RAMEND
```

This aligns the start of the segment `MY_ALIGNED_DATA` to be 256-byte aligned. The alignment of the `MY_OTHER_DATA` segment is not affected.

This option has no effect if the specified alignment is less than or equal to the natural alignment of the segment.

If `align` is surrounded by vertical bars on both sides (like `|2|`), the size of the segment will become a multiple of the segment's alignment in addition to the segment getting the alignment set by `align`.

Example 3

```
-z (CODE) ALIGNED_CODE | 2 | , OTHER_ALIGNED | 3 , MORE_CODE=ROMSTART-ROMEND
```

This will result in `ALIGNED_CODE` becoming 4-byte aligned, and its size will be a multiple of 4. `OTHER_ALIGNED` becomes 8-byte aligned, but its size is not affected. `MORE_CODE` is not affected by the alignment of the others.

-Z

Syntax

```
-z [a] [b] [o] [p] [s]
```

Parameters

- a Ignore overlapping absolute entries
- b Ignore overlaps for bit areas
- o Check overlaps for bit areas
- p Check overlaps for SFR areas
- s Ignore overlaps for the SFR area

Description

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

`-za` suppresses overlap errors between absolute entries. This is useful if you, for example, have several absolutely placed variables on the same address. Note that `-za` only ignores overlaps where both entries are absolutely placed.

All overlaps are reported by default. You can specify `-zb` and `-zs` to ignore overlaps to the bit and SFR area respectively.

For the 8051 processor, only overlaps that do not involve bit segments or SFRs are reported. You can specify `-zo` and `-zp` to report overlaps.

Using the `-zs` option requires that the used processor has a dedicated SFR area that XLINK has been made aware of. The only processor that has a dedicated SFR area for these purposes is the 8051. Using the `-zs` option for any other processor will generate warning 68 but otherwise have no effect.

Use `-zb` to suppress error 24 (segment overlap) for segment overlaps where at least one of the involved segments is a bit segment.



This option is identical to the **Segment overlap warnings** option 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 | Yes | 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 12: 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 |
| UBROF11 | binary | dbg | No | 32 bits |
| XCOFF78k* | binary | lnk | No | 32 bits |
| ZAX | ASCII | from CPU | Yes | 32 bits |

Table 12: XLINK formats generating a single output file (Continued)

* The format is supported only for certain CPUs and debuggers. See `xlink.html` and `xman.html` 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 in some other way, for instance, in the filename. To link raw binary files with your application, see `--image_input`, page 59.

†† Using `-FUBROF` (or `-FDEBUG`) will generate UBROF output matching the latest UBROF format version in the input. Using `-FUBROF5` or `-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 92.

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 56.

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. |
| 11 | Noalloc content. |

Table 13: 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 |
| 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 14: XLINK formats generating two output files

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> . |
| 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 :0000001FF. |
| | Y1 | End with PGMENTRY, else :000001FF. |
| MPDS-CODE | Y0 | Fill with 0xFF instead. |
| DEBUG, -r | Y# | Old UBROF version. |
| INTEL-EXTENDED | Y0 | 20-bit segmented addresses |
| | Y1 | 32 bit linear addresses |
| | Y2 | 32 bit linear addresses with no entry point |
| | Y3 | 20-bit segmented addresses with no entry point |

Table 15: XLINK output format variants

Refer to the file `xlink.html` 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 92), ELF (see page 94), and XCOFF78K (see page 95).

IEEE695

For IEEE695 the available format modifier flags are:

| Modifier | Description |
|----------|--|
| -yd | Do not emit any #define 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. |

Table 16: IEEE695 format modifier flags

| Modifier | Description |
|----------|--|
| -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>-y1bm</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. |
| -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. |
| -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 16: 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 |
| R32C | PD30, PD308, PD77, PD100 debuggers | -y1bm |
| T900 | Toshiba RTE900 m25 | -ygbe |
| T900 | Toshiba RTE900 m15 | -ygbed |

Table 17: IEEE695 format variant modifiers for specific debuggers

ELF

For ELF the available format modifier flags are:

| Modifier | Description |
|-----------------|---|
| -yb | Suppresses the generation of the <code>.debug_pubnames</code> section in the output file. |
| -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. |
| -yo | Generates DWARF call frame information sections that use non-factored CFA offsets instead of factored ones. Information about this will be included in the <code>.note.iar</code> section. |
| -yp | Outputs one ELF program section for each segment, instead of one section for all segments combined. |
| -ys | Normally, global debug information 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). Information about this will be included in the <code>.note.iar</code> section. |
| -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. |
| -yw | Specify the <code>-yw</code> format variant modifier to suppress the <code>.debug_aranges</code> section in the output file. This section contains information about which addresses that a compilation unit places bytes at. |

Table 18: ELF format modifier flags

| Modifier | Description |
|----------|---|
| -yx | Strips the file path of all path information so the reference is only a filename, C:\MySource\MyProject\MyFile.c and /home/myuser/mysource/myproject/MyFile.c would both become references to MyFile.c. |

Table 18: 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 |
|------------------|-----------------------|-------------------------|
| 78K0R | Renesas | -yspc |
| H8 | Renesas HEW | -yspcb |
| M16C | Mitsubishi PD30 | -yspc |
| M32C | Mitsubishi KD30 | -yspc |
| MSP430 | Texas Instruments CCS | -yspco |
| R32C | Renesas | -yspc |
| RL78 | Renesas | -yspc |
| V850 | Lauterbach Trace32 | -ys |

Table 19: 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.

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. |

Table 20: XCOFF78K format modifiers

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

Table 20: 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, `-y sp`.

The following table shows the recommended XCOFF78K format variant modifiers for some specific debuggers:

| Processor family | Debugger | Format variant modifier |
|------------------|----------------|-------------------------|
| 78K0R | NEC ID78K0R-QB | -y sp |

Table 21: XCOFF78K format variant modifiers for specific debuggers

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 69.

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

Table 22: 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 XLINK_CPU 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=<i>chipname</i></pre> <p>Related commands</p> <p>This is equivalent to the XLINK <code>-c</code> option; see <code>-c</code>, page 53.</p> |
| XLINK_DFLTDIR | <p>Sets a path to a default directory for object files.</p> <p>Use XLINK_DFLTDIR 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 XLINK_ENVPAR 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 <code>-f</code>, page 56.</p> |
| XLINK_FORMAT | <p>Sets the output format.</p> <p>Use XLINK_FORMAT 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 56.

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 72.

XLINK diagnostics

This chapter describes the diagnostic messages produced by the IAR XLINK Linker.

Introduction

The diagnostic 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 stack usage analysis diagnostic messages.

XLINK WARNING MESSAGES

XLINK warning messages will appear when XLINK detects something that may be wrong. The code that is generated might 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 configuration file. If you are using the IAR Embedded Workbench IDE, these settings are stored in the `prj/pew/ewp` and `atp` 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.

XLINK STACK USAGE ANALYSIS DIAGNOSTIC MESSAGES

XLINK stack usage analysis diagnostic messages will appear when XLINK detects something that stops stack usage information from being calculated or presented. These messages only contain information about the linker's stack usage analysis, and not about whether the code that is generated is correct.

Note: You can only get these messages if your product supports stack usage analysis.

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</i> (file) 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</i> (file). 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 *module (file)***
XLINK aborts immediately. Recompile or reassemble.
- 5 Address type for CPU incorrect. Error encountered in module *module (file)***
XLINK aborts immediately. Check that you are using the right files and libraries.
- 6 Program module *module* redeclared in file *file*. Ignoring second module**
XLINK will not produce code unless the **Always generate output** (-B) 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 25.

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 The absolute segment on the address addressrange in the module module (file) overlaps the segment segmentname (from module module2, address [addressrange2])**
An absolute segment overlaps a relocatable segment. You must move either the absolute segment or the relocatable segment. You move an absolute segment by modifying the source code. You move relocatable segments by modifying the segment placement command.
- 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 User Guide*. It may be caused by changing the predefined linker configuration 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 The absolute segment on the address *addressrange* in the module *module* (*file*) overlaps the absolute segment on the address *addressrange2* in the module *module2* (*file2*)**
Two absolute segments overlap. You must move at least one of them. You move absolute segments by modifying the source code.
- 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 Too much object code produced (more than *number of bytes bytes*) for this package.**
The size limit for this particular code size limited version of the product was exceeded. Change the code so that the end result is smaller, or upgrade the product. If you have a permanent license for the product, check that:
- you do not also have a code size limited version of the product installed, which is started instead
 - you have rebuilt the entire project if you have upgraded from a code size limited version of the product
 - no runtime libraries (including any non-IAR libraries) were built with a code size limited version of the product. If they were, they must be rebuilt.
- 90 Can only generate UBROF output from these files**
This particular demo version can only generate UBROF output. You must use a KickStart version or a full version of IAR Embedded Workbench if you want to generate output in another format.

- 91 This XLINK version cannot link these files**
These particular files from a demo version cannot be linked with this version of XLINK. Download a more recent version of XLINK.
- 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 This error message number is not used.**
- 97 This error message number is not used.**
- 98 Unmatched */** comment in extended command file**
No matching **/* was found in the linker configuration 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.
- 104 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.
- 105 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 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 96 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).
- 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.

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 The program uses static overlay, this is not allowed in the basemap format.**
Your application contains 1 or more bytes stored in a static overlay frame. Static overlay is currently not supported in the basemap output format.
- I56 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*.
- I57 Debug information must be disabled for the '*cpu*' processor in the '*format*' output format. Use the appropriate `-y` option to suppress the generation of debug information.**
Output for the device you have selected is still experimental in this format. No debug information can currently be generated and the generation must therefore be disabled.

- I58 The directory name *directory* is not valid.**
The specified name is not a valid directory name on this system.
- I59 The file name *file* is not valid.**
The specified name is not a valid filename on this system.
- I60 No valid license found for this product. *Information from the license management system.***
No valid license was found for at least one module that needed a license. You either do not have the required license or XLINK was unable to contact the license server.
- I61 The checksum command defined in *checksum command* specifies an initial value that does not fit in the size of the checksum.**
The initial value specified is too large for the size of the checksum. Use a smaller initial value or increase the size of the checksum.
- I62 Alignment specification (*align[[]]*) is not allowed for segment names here: *use of segment name***
Alignment specification on segments are only allowed in a sequential segment placement command (*-Z*).
- I63 The command line symbol "*symbol*" in *command line option* is not defined.**
The indicated command line option contains a symbol with an undefined value. Define the symbol (*-Dsymbol=value*) or use a symbol that is defined.
- I64 The option *command line option* contains neither a number nor a command line symbol.**
The indicated command line option contains characters that are neither part of a number (0–9 and A–F) nor valid in a symbol name, in a place where a number or a symbol was expected.
- I65 A segment definition in *segment placement command* uses an alignment argument that is larger than the currently supported maximum (31).**
XLINK currently only supports alignments up to and including 2^{31} . Remember that the alignment argument in the segment placement command is the number of bits in the address that are forced to zero, not the byte alignment. 2 results in a 4-byte aligned address, 3 in an 8-byte aligned address, and so on. See *Specifying the alignment of a segment*, page 85.
- I66 In the chosen byte order for the processor processor, you must specify the code fill option (*-hc*) or the range fill option (*-H* without any *-h* option).**
For this particular processor, in this particular byte order, the **Code fill** option must be specified (because of the special requirements of bi-endian code).

167 Generation of bi-endian output files is not supported for the 'output format' output format.

This output format does not currently support generation of bi-endian files. You must choose another format, or use the processor in either big-endian or little-endian mode.

168 Alignment error, segment part *segment part number* ("*symbol*") in the module '*module*' (*file*) that generated the bi-endian content on address *address* does not have the required alignment.

Bi-endian code must be generated in such a way that every word is either code or non-code. In the segment part specified above, this requirement is not met. If the object file was generated by the compiler, this is probably a compiler problem. If the object file was generated by the assembler, the code probably needs to be aligned and/or padded.

169 Processor specific code fill (-hc) requires all ranges to be closed. The placement command "*segment placement command*" contains an open range.

All ranges must be closed when you use this option. Use either `START-END` or `START:+SIZE` to specify a closed range.

170 The segment "*segment*" that is used in a checksum command has not been defined.

The specified segment does not exist. Define it using the option `-z` or use a different segment in the checksum command.

171 The segment "*segment*" that is used in a checksum command is a packed segment.

Segment names used in a checksum command must be sequentially placed. Place the segment using the option `-z` or use an explicit address range (like `0x200-0x37F`) in the checksum command.

172 Output for the processor processor in this byte order will use bi-endian code segments. This requires the code segments to be aligned (both start and size) to *alignment* bytes. The following segments do not have the required alignment: *list of segments*

Bi-endian code that is not properly aligned will not work. Align the listed segments (see *Specifying the alignment of a segment*, page 85) or make sure that the code is aligned in the compiler/assembler.

173 Unable to locate the dll *dll*

XLINK was unable to find the DLL. Make sure that the DLL is present in the expected location and that the path to the location is made available through use of the `-I` option (or use an absolute path).

174 The dll *dll* reports a problem. It will not be able to descramble the file *file*

The DLL encountered a problem while attempting to descramble the file. Some possible explanations are:

- Problems with the file, it might be corrupt.
- Problems with the DLL itself, it might be corrupt.
- Problems with the license checking system in the DLL (if any).

175 Banked segment placement (-b, used in the placement command placement command) is no longer supported. Use packed segment placement (-P) instead.

Banked segment placement (the option `-b`) is not supported in this version of the linker. Instead, you must use an older version (5.0.x or earlier) or use the option `-P`.

176 Relay Function Optimization is no longer supported from XLINK 5.1.0. You have to use an older version of XLINK to link this program. The module 'module' (file) contains at least one MULTWEAK symbol.

Relay Function Optimization (the option `-q`) is not supported in this version of the linker. Instead, you must use an older version of the linker (5.0.x or earlier) or make sure that no required module uses `MULTWEAK` symbols.

177 No definition for *function* provides all needed features: [list of features] Use the -e option if you want to select the function manually.

No supplied object file contains a version of the function that provides all of the required features. You can:

- supply an object file that provides a version of the function that does provide the features
- make sure that your application requires fewer features
- use the option `-e` to manually specify the function you want.

178 This error message number is not used.**179 The -h option “*fill_option*” has an address range that overlaps previous segment fill options.**

You can only specify one filler string per address. Change the fill ranges so that no address is included in more than one fill range.

180 Bad filler string in “*fill_option*”. A filler string must contain an even number of hex digits, and cannot be empty.

Every character in a filler string must be a hexadecimal digit (0–F). Every such character specifies four bits. Filler bytes in XLINK are byte-oriented, so two such characters are needed for every filler byte.

- 181 The checksum range *address_range* has a size that is not a multiple of the specified unit length (*unit_length*).**
The checksum command uses a flag (`L` or `W`) to specify units longer than 8 bits (1 byte). The size of the specified address range is not a multiple of that unit length, so the checksum cannot be computed. Update the range specification to match the unit length or remove the `L` or `W` flag.
- 182 The checksummed segments *segments* have a size (*size*) that is not a multiple of the specified checksum unit length (*unit_length*). Use the aligned size option of the `-Z` segment placement option to extend the size to the desired multiple. For example:
`-Z(CODE)segments|2|`**
The checksum command uses a flag (`L` or `W`) to specify units longer than 8 bits (1 byte). The size of the specified address range is not a multiple of that unit length, so the checksum cannot be computed. The placement modifier `|align|` on segments placed with `-z` can be used for aligning the start and the size of such segments (see `-Z`, page 83, note in particular how alignment is specified).
- 183 Static overlay map generation (`-xo`) is not supported for the processor processor**
The indicated microprocessor does not use static overlay. The `-xo` option is only accurate for static overlay systems, so the generated information is potentially inaccurate, stack usage information in particular. For more information about using this option, see *Static overlay system map (-xo)*, page 33.
- 184 Topic is not a valid log request.**
The requested topic is not supported. See `--log`, page 65 for information about supported topics.
- 185 The workseg segment *segment_name* is not included in the image.**
Your application does not contain a work segment area segment with this name. If you override this error, the start address of the workseg segment will be `0x0`. This will most likely result in incorrect debug information for variables residing in the work segment area.
- 186 The option *option_name* is no longer supported.**
The option is no longer supported. Use a different option that achieves the same or a similar result or use an older version of XLINK.
- 187 The *format_name* output format is no longer supported.**
The output format is no longer supported. Use a different output format or use an older version of XLINK.

- I88 The `cpu_name` processor is no longer supported.**
The microprocessor is no longer supported. Use an older version of XLINK.
- I89 Unable to place the empty segment `segment` (align `alignment`). At the moment of placement there were no available addresses where the segment could be placed. Try changing the order the segments are placed in. *description of the placement command***
The (empty) segment cannot be placed. An empty segment does not occupy any space but the address that is assigned to it must still comply with the requested address range and any alignment requirements must still be satisfied. In this case, all of the allowed ranges from the placement command are occupied by other content and the empty segment could not be placed.
- Empty segments can often be placed before segments with content because they do not take up significant amount of space. If you place segments in the order A, B, C where C is empty and could not be placed, you can try the order A, C, B or C, A, B instead. Provided that segment C does not have to be the last segment in the sequence, the reordering should work.
- If segment C must be placed last, you can try to:
- extend the allowed placement range
 - reduce the space that the earlier segments use
 - reduce the alignment requirement of the empty segment (if it has one).
- I90 The range specification of the fill command "`command`" does not specify any addresses to fill**
The fill command needs an explicit range to fill. The linker option `-h (CODE)` does not instruct the linker to fill all `CODE` segments. Make sure to specify the range that you want to fill. For more information, see `-h`, page 57.
- I91 More than 2 gigabytes of fill could be needed for the specified range: `range`**
A range to be filled is larger than 2 gigabytes; generating that amount of filler bytes would result in a very large output file. If you want to generate that amount of filler bytes, you can disable this error; see `-w`, page 79.
- If this error was caused by the use of the linker option `-h`, you must reduce the size of the range to fill.
- If you have specified the linker option `-H` but not `-h`, you can either use `-h` (because `-h` overrides `-H`) or you can reduce the size of the ranges in question, in the segment placement commands. When you use the linker option `-H`, every ROM address that is listed in a segment placement command gets a filler byte if no content is placed on that address.

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 *module* *l***
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 The absolute segment on the address *addressrange* in the module *module (file)* overlaps the segment *segmentname* (from module *module2*, address [*addressrange2*])**
An absolute segment overlaps a relocatable segment. You must move either the absolute segment or the relocatable segment. You move an absolute segment by modifying the source code. You move relocatable segments by modifying the segment placement command.
- 21 The absolute segment on the address *addressrange* in the module *module (file)* overlaps the absolute segment on the address *addressrange2* in the module *module2 (file2)***
Two absolute segments overlap. You must move at least one of them. You move absolute segments by modifying the source code.

- 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 used output format, or in the debug information available, XLINK cannot produce correct debug output for this application. This only affects the debug information; the generated code remains the same as in an output format where the debug information can be expressed. 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.

- 64**     **The address space used in the command *segment placement command* is incompatible with the address space of the ranges that were inherited from previous placements. Address ranges can only be inherited from compatible address spaces.**  
Addresses should not be inherited from previous placement commands, if those previous commands placed segments in an incompatible address space. This technique was used in some older IAR tools to make sure that segments placed in overlapping address spaces did not overlap each other. Use the `-U` option instead to prevent this.
- 65**     **There are both **MULTWEAK** and **PUBWEAK** definitions for the symbol named *name*. This does not work in the general case. **PUBWEAK** definitions occur in the module(s) *modules*. **MULTWEAK** definitions occur in the module(s) *modules*.**  
*MULTWEAK* definitions were introduced to be used by ARM/Thumb Relay Function Optimization in the ARM® IAR C/C++ Compiler v3.41. *PUBWEAK* definitions were used for the same purpose in earlier versions of the ARM IAR C/C++ Compiler. In order to avoid this problem, ensure that all modules are built for use with the same Relay Function model.
- 66**     **There is a gap between the addresses *address1* and *address2*. This gap of *gap\_size* bytes will be padded with zeroes. Raw-binary might not be the format you want for this particular image.**  
There is a huge “hole” in the image. This might result in an unnecessarily large file. A format that uses address records (like Intel-extended, Motorola or simple-code) might be a better choice for this particular image.
- 67**     **Using “-r” causes **XLINK** to select modules that are adapted for use with the **C-SPY** Debugger. This affects all output files, including those generated by **-O**.**  
The linker command line option `-r` has two effects. It causes **XLINK** to select modules from the IAR standard library designed to work with the IAR **C-SPY**® Debugger and it makes **XLINK** use the IAR **UBROF** object format for its main output file. The first of these effects also changes the contents of any extra output files produced by the use of the `-O` command line option.  
  
If you need extra output files not meant for use with the IAR **C-SPY** Debugger, you need to run **XLINK** separately, without the `-r` command line option.
- 68**     **The option to ignore overlaps in **SFR** areas has been specified but the ‘processor’ processor does not have an **SFR** area. The option has no effect for this processor.**  
The processor you are using does not have a dedicated **SFR** area (an address range in an address space that can only contain **SFR**s). You cannot use the `-zs` option to suppress segment overlap errors when using this processor.

- 69 Address translation (-M, -b# or -b@) has no effect on the output format 'format'. The output file will be generated but no address translation will be performed.**  
 Address translation is not supported for the indicated output format. Output files in that output format will be generated without address translation. However, if there are also output files in a format for which address translation is supported, those files will use translated addresses.
- 70 The segment “segment” on address address overlaps previous content in the raw-binary output file. The previous content will be overwritten.**  
 Your application contains at least one overlap between segments with content. Locate and correct those overlaps.
- 71 This warning message number is not used.**
- 72 The format output format does not support line numbers above number. All line numbers above this limit will be set to number. Source information for such functions will not be available. This will affect the following functions: list of function names, their segment part numbers, the module and file where they were defined**  
 The chosen output format cannot represent line numbers as high as the ones in the specified files. To debug the specified functions on C level, you must take one of these actions:
- Use a different output format
  - Edit the source code file(s) so that no function that you wish to debug resides on a higher line number than the limit (move the function or split the file into two or more smaller files)
- Even if you take neither action, assembly level debugging and variable information is still available.
- 73 Total number of warnings for unsupported line numbers: number of warnings**  
 This warning is connected to warning 72. It is, for example, useful if you suppress warning 72 (because you do not want to list all functions on line numbers that are too high every time you link), but you still want to know if the number of warnings change.

- 74 The checksum polynomial *polynomial* is unsuitable for use with the bitwise initial value *#initial value* as the polynomial can not always generate a bitwise equivalent for the bitwise initial value. Use a bitwise initial value or use a polynomial with the least significant bit set.**

The specified polynomial does not have its least significant bit set. When the least significant bit is not set, it is not always possible to convert a bitwise initial value to a bitwise initial value. This has no real effect on the checksum that XLINK generates, but it can matter if the verification step uses bitwise initial values. Because some bitwise initial values lack a corresponding bitwise initial value for this polynomial, it might be impossible to get the checksums to match.

- 75 The program does not contain any content. If this is not the intent use the content control linker options (-g and -s) or make content `__root` to ensure that it is included.**

The link process resulted in a completely empty application. The linker removes all content that there are no references to, and in this case there were no references to your application.

References can be specified on the command line by using the `-g` option (for any symbol) or `-s` (for the start symbol of the application).

You can also specify that a certain function or variable should always be present in the application by making it `__root` (in C/C++, IAR extensions must be enabled).

An application usually contains something that is always included, for example an interrupt table made `root` or referenced using `-g` or `-s`, which in turn refers to the startup code, which in turn refers to `main`, which in turn refers to the rest of the application.

- 76 The checksum command *checksum\_command* contains more than one specification of checksum unit size. You should use a single **W** or **L** flag.**

The specified checksum command cannot have both a `W` and an `L` flag.

- 77 [stack usage analysis] The module *module* (file) has references to some functions that are not listed as being called in the stack usage control file: *filename***

There are functions that are not listed in the stack usage control file as being called. Update the file with the relevant information or rewrite the referring code in the module(s) in question to remove calls to code for which there is no information.

- 78** [stack usage analysis] The function *function* is defined in both the application and the .suc file. Use the override keyword, remove the function directive from the .suc-file or remove the function from the application.

Use the keyword `override` or remove the `function` directive.

- 79** [stack usage analysis] The segment part number in module *module* contains incorrect stack usage information. The caller name is invalid.

The stack usage information for the function in the specified segment part is corrupt (the name is not available so no information from the function will be used). If the module was assembler-generated, there might be a problem with the name of the function. If the module was compiler-generated, this is an error and should be reported as a problem.

- 80** Modules have different stack names for index *index*. The module “*module 1*” uses “*stack name 1*”, and the module “*module 2*” uses “*stack name 2*”.

The names and indexes of all involved stacks must match across all linked modules. Right now, no stack usage information is reliable because the stack usage information might be using an incorrect stack index. This is most likely a compiler error and should be reported as a problem.

- 81** This warning message number is reserved for future use.

- 82** This warning message number is reserved for future use.

- 83** Segment part *number label information* in the module *module* description contains stack usage information despite being empty. Empty segment parts cannot affect the stack depth so the information will be ignored.

The stack usage of the specified segment part will be ignored. If the file was compiler-generated, this is incorrect output (equivalent to incorrect stack usage information). If the file was assembler-generated, you should rewrite the code (typically the empty segment part should be merged with the immediately succeeding segment part).

---

## Stack usage analysis diagnostic messages

The following table lists the IAR XLINK Linker stack usage analysis diagnostic messages:

- Ls001 Could not open file "*filename*"**  
The file could not be opened. Make sure that the file exists in the specified location, that the tool has the correct include paths set up, and that the directory is not read- or write-protected.
- Ls002 Expected tokens**  
At least one of the listed tokens was expected at the specified location. Use one of the listed tokens.
- Ls003 There is already 'possible calls' information for *function***  
The listed function already has a `possible calls` declaration. Remove all `possible calls` declarations except one.
- Ls004 Value out of range or illegal: *value*,**  
The listed stack usage value is not legal. Use a legal value.
- Ls005 There is already 'function' information for *function***  
The function in question already has a `function` directive. Remove one of the declarations.
- Ls006 The name *name* matches more than one symbol**  
The listed name matches more than one symbol. Use a more specific pattern. Example: `symb*` matches both `symb12` and `symb34`. Using the more specific `symb1*` matches only one of them.
- Ls007 The function *function* is already a call graph root in a different category "*category*"**  
A function cannot be a call graph root in more than one category. Remove all `call graph root` declarations except one.
- Ls008 No function matching "*function*" found**  
No function matching the specified name was found. Make sure that your application actually contains a function with that name. If you tried to match a local function, you must specify the module as well (see the stack usage analysis documentation in the *IAR Compiler User Guide*).
- Ls009 A max recursion depth has already been set for this function (*function*)**  
The specified function already has a maximum recursion depth. Remove all maximum recursion depth specifications except one.



- Ls0010 The function *function* matches both this directive and the one recursion depth specification, but the max depths are different**  
 If a function matches more than one recursion depth specification, the maximum depth must be the same in all of them. Use a more specific pattern or change the recursion depth in at least one of the involved specifications.
- Ls011 This message is for internal use**
- Ls012 Zero depth not allowed**  
 The maximum recursion depth of a recursion nest cannot be 0.
- Ls013 Max recursion depth conflict. "*function*" has a max depth of value, but "*function*", which is in the same recursion nest, has a max depth of value**  
 If two or more functions reside in the same recursion nest, they must use the same maximum recursion depth. Update the recursion depth specifications so that the depth specifications match.
- Ls014 [stack usage analysis] At least one function does not have stack usage information. Example: *function*. A complete list of such functions is in the map file.**  
 The listed function (the complete list of functions can be found in the map file) does not have stack usage information. Only annotated assembler files and C/C++ files compiled with a sufficiently modern compiler supply stack usage information.  
 When a function lacks information, the information can be supplied using the `function` directive in the stack usage control file.
- Ls015 [stack usage analysis] At least one function appears to be uncalled. Example: *function*. A complete list of uncalled functions is in the map file.**  
 The listed function (the complete list of functions can be found in the map file) is included in your application but it does not appear to be called. Typically, a function that is referenced by the application should be called by someone; otherwise it would not have been included.  
 This might be intentional (as with `ROOT` segment parts, interrupt functions, or indirectly called functions), but if it is not, it might be a missing reference (possibly from assembler code from a manual entry/override in the stack usage control file).  
 Various options in the stack usage control file can be used to disable this diagnostic message. The function can be included in the `calls` part of the `function` directive and the `possible calls` directive. You can also use the `no calls from` directive.

- Ls016 [stack usage analysis] The program contains at least one indirect call. Example: from *function*. A complete list of such functions is in the map file.**  
 The listed function (the complete list of functions can be found in the map file) performs unknown indirect calls. The destination of indirect calls can be specified by using pragma directives (see the pragma directives documentation in the *IAR Compiler User Guide*) or in the stack usage control file (see the stack usage analysis documentation in the *IAR Compiler User Guide*).
- Ls017 [stack usage analysis] The program contains at least one instance of recursion for which stack usage analysis has not been able to calculate a maximum stack depth. One function involved is *function*. A complete list of all recursion nests is in the map file.**  
 The listed function (the complete list of functions can be found in the map file) performs recursive calls. The stack depth analysis cannot determine the maximum number of cycles in a recursive nest, but you can specify a maximum number in the stack usage control file (see the stack usage analysis documentation in the *IAR Compiler User Guide*).
- Ls018 [stack usage analysis] The function *function* is a call graph root, but there are calls to it**  
 A call graph root cannot be called; if it is called it is not a root. Remove the call graph root specification or remove the call.
- Ls019 Unable to get size of *block***  
 The size of the specified block (this will typically be the size of a stack segment) could not be computed. Check that the name of the block is correct and that a segment with that name actually exists in your application.
- Ls020 No stack usage could be calculated for at least one function in category "*category*"**  
 The stack usage could not be calculated. The most likely explanations are missing stack usage information, unknown indirect calls, or an unknown maximum recursion depth. These can all be taking care of by using pragma directives or in the stack usage control file.
- Ls021 No call graph root function in category "*category*"**  
 The specified category does not have a call graph root. Specify a call graph root in the stack usage control file (see the stack usage analysis documentation in the *IAR Compiler User Guide*).
- Ls022 Check failed *check failed text***  
 The specified `check that` directive failed. This typically means that whatever the checks are supposed to detect just occurred (like the computed stack size of your application exceeding the size of the allocated stack

including the safety margin). Modify the test expression to allow the detected occurrence, or modify the application to pass the test.

**Ls023 This message is for internal use**

**Ls024 Evaluation error: *expression***

There was an error evaluating the expression. Check the expression carefully and make sure that, for example, sizes are not negative, there are no divisions by zero, etc.

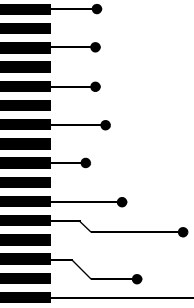


# Part 2: The IAR Library Tools

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 23: 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 24: 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: <table border="0" style="margin-left: 20px;"> <tr> <td><i>n</i></td> <td>The <i>n</i>th module.</td> </tr> <tr> <td>\$</td> <td>The last module.</td> </tr> <tr> <td><i>name</i></td> <td>Module <i>name</i>.</td> </tr> <tr> <td><i>name+n</i></td> <td>The module <i>n</i> modules after <i>name</i>.</td> </tr> <tr> <td><i>\$-n</i></td> <td>The module <i>n</i> modules before the last.</td> </tr> </table> | <i>n</i> | The <i>n</i> th module. | \$ | The last module. | <i>name</i> | Module <i>name</i> . | <i>name+n</i> | The module <i>n</i> modules after <i>name</i> . | <i>\$-n</i> | The module <i>n</i> modules before the last. |
| <i>n</i>           | The <i>n</i> th module.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |                         |    |                  |             |                      |               |                                                 |             |                                              |
| \$                 | The last module.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |                         |    |                  |             |                      |               |                                                 |             |                                              |
| <i>name</i>        | Module <i>name</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |                         |    |                  |             |                      |               |                                                 |             |                                              |
| <i>name+n</i>      | The module <i>n</i> modules after <i>name</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |                         |    |                  |             |                      |               |                                                 |             |                                              |
| <i>\$-n</i>        | The module <i>n</i> modules before the last.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |                         |    |                  |             |                      |               |                                                 |             |                                              |
| <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 25: 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 26: 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                                       |
|----------------|---------------------------------------------------|
| <i>nn</i> .Pgm | A program module with relative number <i>nn</i> . |
| <i>nn</i> .Lib | A library module with relative number <i>nn</i> . |
| Ext            | An external in the current module.                |
| Ent            | An entry in the current module.                   |
| Loc            | A local in the current module.                    |
| Rel            | A standard segment in the current module.         |
| Stk            | A stack segment in the current module.            |
| Com            | A common segment in the current module.           |

Table 27: 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                                                                                                                                                                                                 |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| XLIB_COLUMNS         | 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:<br><br><code>set XLIB_COLUMNS=132</code>                                     |
| XLIB_CPU             | Sets the CPU type so that the DEFINE-CPU option will not be required when you start an XLIB session. For example, to set the CPU type to <i>chipname</i> :<br><br><code>set XLIB_CPU=<i>chipname</i></code> |

Table 28: 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><code>set XLIB_PAGE=66</code>                                                                     |
| 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><code>set XLIB_SCROLL_BREAK=22</code> |

Table 28: 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 29: 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 29: 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 164.

## Descriptions of XLIB options for all UBROF versions

The following section gives detailed reference information for each option.

---

COMPACT-FILE *COMPACT-FILE objectfile*

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.

### Example

The following option compacts the file `maxmin.rmn`:

```
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 153.

**Examples**

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

```
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 153.

**Examples**

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

```
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 153.

**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 153.

**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 153.



**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 153.

**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 153.

**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 153.

### 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 30: 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/compiler 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

|                                                         |         |
|---------------------------------------------------------|---------|
| -A (XLINK option)                                       | 51      |
| -a (XLINK option)                                       | 52      |
| address range check, disabling                          | 75      |
| address space                                           |         |
| restricting output to one                               | 96      |
| sharing                                                 | 78      |
| address translation                                     | 23, 67  |
| addresses, mapping logical to physical                  | 66      |
| alignment for checksums                                 | 62      |
| alignment, of a segment                                 | 85      |
| allocation, segment types                               | 23      |
| Always generate output (XLINK option)                   | 53, 103 |
| anonymous structs/unions, support for in UBROF versions | 90      |
| AOMF80196 (linker output format)                        | 87      |
| AOMF80251 (linker output format)                        | 87      |
| AOMF8051 (linker output format)                         | 87, 92  |
| AOMF8096 (linker output format)                         | 87      |
| arrays (large), support for in UBROF versions           | 90      |
| ASCII format, of object code listing                    | 161     |
| ASHLING (linker output format)                          | 87      |
| ASHLING-Z80 (linker output format)                      | 87      |
| ASHLING-6301 (linker output format)                     | 87      |
| ASHLING-64180 (linker output format)                    | 87      |
| ASHLING-6801 (linker output format)                     | 87      |
| ASHLING-8080 (linker output format)                     | 87      |
| ASHLING-8085 (linker output format)                     | 87      |
| assembler directives                                    |         |
| MODULE                                                  | 145     |
| NAME                                                    | 145     |
| assembler symbols, defining at link time                | 54      |
| assumptions (programming experience)                    | 9       |

## B

|                           |         |
|---------------------------|---------|
| -B (XLINK option)         | 53, 103 |
| -b (XLINK option)         | 122     |
| banked segments, defining | 70      |

|                                      |    |
|--------------------------------------|----|
| binary files, linking                | 59 |
| BIT (segment type)                   | 24 |
| bold style, in this guide            | 11 |
| byte order of checksum, reversing    | 61 |
| byte-wise initial value, of checksum | 62 |

## C

|                                                       |         |
|-------------------------------------------------------|---------|
| -C (XLINK option)                                     | 53      |
| -c (XLINK option)                                     | 53, 100 |
| call frame information, support for in UBROF versions | 90      |
| call graph file, specifying in XLINK                  | 54      |
| --call_graph (XLINK option)                           | 54      |
| checksum                                              |         |
| generating in XLINK                                   | 60      |
| initial value of                                      | 62      |
| mirroring initial value                               | 42, 62  |
| summary in list file                                  | 36      |
| __checksum (default label)                            | 62      |
| checksum calculation, included bytes                  | 63      |
| checksum summary, producing                           | 70      |
| checksum value symbol                                 | 40      |
| CHECKSUM (default segment name)                       | 62      |
| checksummed areas                                     | 35      |
| __checksum__value (default checksum value symbol)     | 41      |
| class members, support for in UBROF versions          | 90      |
| code duplication, in XLINK                            | 64      |
| code generation, disabling in XLINK                   | 54      |
| code memory, filling unused                           | 57      |
| CODE (segment type)                                   | 24      |
| command file comments, including in XLIB              | 163     |
| command files, debugging                              | 157     |
| command line options                                  |         |
| typographic convention                                | 11      |
| XAR                                                   | 148     |
| XLIB                                                  | 155     |
| XLINK                                                 | 49      |
| command prompt icon, in this guide                    | 11      |
| comments, including in XLIB command files             | 163     |

|                                                                   |        |
|-------------------------------------------------------------------|--------|
| COMMON (segment type) . . . . .                                   | 23     |
| COMPACT-FILE (XLIB option) . . . . .                              | 155    |
| computer style, typographic convention . . . . .                  | 11     |
| CONST (segment type) . . . . .                                    | 24     |
| conventions, used in this guide . . . . .                         | 10     |
| copyright notice . . . . .                                        | 2      |
| CPU, defining in XLIB . . . . .                                   | 156    |
| CRC value of modules, listing . . . . .                           | 159    |
| crc=n (checksum algorithm) . . . . .                              | 60     |
| crc16 (checksum algorithm) . . . . .                              | 60     |
| crc32 (checksum algorithm) . . . . .                              | 60     |
| cross-reference, in XLINK listing . . . . .                       | 28, 81 |
| <i>See also -x (XLINK option)</i>                                 |        |
| C++ object names, support for in UBROF versions . . . . .         | 90     |
| C++ pointers to members, support for in UBROF versions . . . . .  | 90     |
| C++ references, support for in UBROF versions . . . . .           | 90     |
| C++ template information, support for in UBROF versions . . . . . | 90     |
| C++ terminology . . . . .                                         | 10     |

## D

|                                                    |        |
|----------------------------------------------------|--------|
| -D (XLINK option) . . . . .                        | 54     |
| -d (XLINK option) . . . . .                        | 54     |
| DATA (segment type) . . . . .                      | 24     |
| data, storing locals at static locations . . . . . | 33     |
| debug information                                  |        |
| generating in XLINK . . . . .                      | 75     |
| loss of . . . . .                                  | 90     |
| DEBUG (linker output format) . . . . .             | 87, 92 |
| DEBUG-INTEL-EXT (linker output format) . . . . .   | 91     |
| DEBUG-INTEL-STD (linker output format) . . . . .   | 91     |
| DEBUG-MOTOROLA (linker output format) . . . . .    | 91     |
| default extension, setting in XLIB . . . . .       | 157    |
| #define (XLINK option) . . . . .                   | 54     |
| DEFINE-CPU (XLIB option) . . . . .                 | 156    |
| DELETE-MODULES (XLIB options) . . . . .            | 156    |
| diagnostics                                        |        |
| XAR . . . . .                                      | 149    |
| XLIB . . . . .                                     | 167    |

|                                          |     |
|------------------------------------------|-----|
| XLINK . . . . .                          | 103 |
| diagnostics control, XLINK . . . . .     | 79  |
| direct initial values . . . . .          | 42  |
| DIRECTORY (XLIB option) . . . . .        | 156 |
| directory, specifying in XLINK . . . . . | 64  |
| disclaimer . . . . .                     | 2   |
| DISPLAY-OPTIONS (XLIB option) . . . . .  | 156 |
| document conventions . . . . .           | 10  |
| dtp (file type) . . . . .                | 104 |
| duplicating code, in XLINK . . . . .     | 64  |
| DWARF (linker output format) . . . . .   | 94  |

## E

|                                                                                 |         |
|---------------------------------------------------------------------------------|---------|
| -E (XLINK option) . . . . .                                                     | 55      |
| -e (XLINK option) . . . . .                                                     | 55      |
| ECHO-INPUT (XLIB option) . . . . .                                              | 157     |
| edition, of this guide . . . . .                                                | 2       |
| ELF (linker output format) . . . . .                                            | 87, 94  |
| --enable_stack_usage (XLINK option) . . . . .                                   | 55      |
| endianness. <i>See</i> byte order                                               |         |
| entry list, XLINK . . . . .                                                     | 31      |
| entry point for applications, specifying in XLINK . . . . .                     | 76      |
| enum constants connected to enum types, support for in UBROF versions . . . . . | 90      |
| environment variables                                                           |         |
| XLIB, summary of . . . . .                                                      | 153     |
| XLINK . . . . .                                                                 | 99      |
| XLINK_COLUMNS . . . . .                                                         | 99      |
| XLINK_CPU . . . . .                                                             | 53      |
| XLINK_DFLTDIR . . . . .                                                         | 59      |
| XLINK_ENVPAR . . . . .                                                          | 49      |
| XLINK_FORMAT . . . . .                                                          | 56, 100 |
| XLINK_PAGE . . . . .                                                            | 72, 101 |
| error messages                                                                  |         |
| range . . . . .                                                                 | 25      |
| segment overlap . . . . .                                                       | 25      |
| XAR . . . . .                                                                   | 149     |
| XLIB . . . . .                                                                  | 167     |

XLINK. . . . . 103  
 ewp (file type). . . . . 104  
 EXIT (XLIB option). . . . . 157  
 experience, programming . . . . . 9  
 EXTENDED-TEKHEX (linker output format). . . . . 87  
 EXTENSION (XLIB option) . . . . . 157  
 extension, setting default in XLIB . . . . . 157  
 EXTERN symbols, renaming in XLIB . . . . . 165  
 external symbols  
     defining at link time . . . . . 54  
     listing. . . . . 160  
     renaming in XLIB . . . . . 165  
     renaming in XLINK. . . . . 55  
 Extra output (XLINK option) . . . . . 70

## F

-F (XLINK option) . . . . . 56, 75, 101  
 -f (XLINK option) . . . . . 56, 100  
 far memory, placing segments in. . . . . 84  
 FAR (segment type) . . . . . 24  
 FARC (segment type). . . . . 24  
 FARCODE (segment type). . . . . 24  
 FARCONST (segment type). . . . . 24  
 fast CRC . . . . . 42  
 features, XLINK. . . . . 15  
 FETCH-MODULES (XLIB option) . . . . . 157  
 file types  
     dtp . . . . . 104  
     ewp . . . . . 104  
     hex . . . . . 70  
     lst. . . . . 65  
     map . . . . . 65  
     pew . . . . . 104  
     prj . . . . . 104  
     xcl . . . . . 49  
 filename  
     specifying for XLINK listing. . . . . 65  
     specifying for XLINK log . . . . . 66

Fill unused code memory (XLINK option). . . . . 57  
 filler bytes . . . . . 57  
 filling ranges . . . . . 57  
 filling unused code memory . . . . . 57  
 Format variant (XLINK option) . . . . . 92  
 format variant, specifying in XLINK . . . . . 82  
 formats  
     assembler object file . . . . . 17  
     assembler output . . . . . 18  
     compiler object file . . . . . 17  
     UBROF . . . . . 17  
     XLIB list file . . . . . 153, 161  
     XLINK listing . . . . . 27  
     XLINK output . . . . . 87  
     variants . . . . . 92  
 formatter for printf, choosing . . . . . 20  
 formatter for scanf, choosing . . . . . 20  
 function call step points, support for in UBROF versions . . 90  
 function instances (inlined), support  
     for in UBROF versions . . . . . 90  
 functions, in XLINK. . . . . 18

## G

-G (XLINK option). . . . . 56  
 -g (XLINK option) . . . . . 57  
 global entries . . . . . 56  
 global type checking, disabling. . . . . 57

## H

-H (XLINK option). . . . . 35, 57, 60  
 -h (XLINK option) . . . . . 57  
 help information, displaying in XLIB . . . . . 158  
 HELP (XLIB option) . . . . . 158  
 hex (file type) . . . . . 70  
 HP (linker output format) . . . . . 91  
 HP-CODE (linker output format) . . . . . 87  
 HP-SYMB (linker output format) . . . . . 87

|                                     |    |
|-------------------------------------|----|
| HUGE (segment type) . . . . .       | 24 |
| HUGE C (segment type) . . . . .     | 24 |
| HUGE CODE (segment type) . . . . .  | 24 |
| HUGE CONST (segment type) . . . . . | 24 |

## I

|                                                           |        |
|-----------------------------------------------------------|--------|
| -I (XLINK option) . . . . .                               | 59     |
| IAR XAR Library Builder. <i>See</i> XAR                   |        |
| IAR XLIB Librarian. <i>See</i> XLIB                       |        |
| IAR XLINK Linker. <i>See</i> XLINK                        |        |
| icons, in this guide . . . . .                            | 11     |
| IDATA (segment type) . . . . .                            | 24     |
| IDATA0 (segment type) . . . . .                           | 24     |
| IDATA1 (segment type) . . . . .                           | 24     |
| IEEE695 (linker output format) . . . . .                  | 87     |
| IEEE695 (XLINK output format) . . . . .                   | 92     |
| --image_input (XLINK option) . . . . .                    | 59     |
| include paths, specifying to XLINK . . . . .              | 59     |
| included modules, logging (--log) . . . . .               | 65     |
| included segment parts, logging (--log) . . . . .         | 65     |
| indirect initial values . . . . .                         | 42     |
| Init (Rocksoft CRC algorithm field) . . . . .             | 36     |
| initial value, of checksum . . . . .                      | 62     |
| inlined function instances, support for in UBROF versions | 90     |
| input files and modules, XLINK . . . . .                  | 19     |
| INSERT-MODULES (XLIB option) . . . . .                    | 158    |
| instruction set of microcontroller . . . . .              | 9      |
| INTEL-EXTENDED (linker output format) . . . . .           | 87, 92 |
| INTEL-STANDARD (linker output format) . . . . .           | 87, 92 |
| introduction                                              |        |
| MISRA C . . . . .                                         | 16     |
| XAR . . . . .                                             | 143    |
| XLIB . . . . .                                            | 143    |
| XLINK . . . . .                                           | 15     |
| italic style, in this guide . . . . .                     | 11     |

## J

|                             |        |
|-----------------------------|--------|
| -J (XLINK option) . . . . . | 35, 60 |
|-----------------------------|--------|

## K

|                             |        |
|-----------------------------|--------|
| -K (XLINK option) . . . . . | 22, 64 |
|-----------------------------|--------|

## L

|                                                    |           |
|----------------------------------------------------|-----------|
| -L (XLINK option) . . . . .                        | 64        |
| -I (XLINK option) . . . . .                        | 65        |
| large address awareness . . . . .                  | 15        |
| librarian. <i>See</i> XLIB or XAR                  |           |
| libraries . . . . .                                | 143       |
| <i>See also</i> library modules                    |           |
| building . . . . .                                 | 148       |
| file size, reducing . . . . .                      | 155       |
| module type, changing . . . . .                    | 162       |
| threaded . . . . .                                 | 77        |
| using with assembler programs . . . . .            | 144       |
| using with C programs . . . . .                    | 144       |
| library modules                                    |           |
| adding . . . . .                                   | 157       |
| building and managing . . . . .                    | 143       |
| inserting . . . . .                                | 158       |
| loading . . . . .                                  | 18–19, 53 |
| removing . . . . .                                 | 156       |
| lightbulb icon, in this guide . . . . .            | 11        |
| Lines/page (XLINK option) . . . . .                | 72        |
| linker configuration file . . . . .                | 49        |
| specifying . . . . .                               | 56        |
| Linker configuration file (XLINK option) . . . . . | 56        |
| linker. <i>See</i> XLINK                           |           |
| linking . . . . .                                  | 17        |
| list file formats                                  |           |
| XLIB . . . . .                                     | 153       |
| XLINK . . . . .                                    | 27        |
| List (XLINK option) . . . . .                      | 65, 82    |

- listings
    - generating in XLINK . . . . . 64
    - lines per page . . . . . 72
  - LIST-ALL-SYMBOLS (XLIB option) . . . . . 158
  - LIST-CRC (XLIB option) . . . . . 159
  - LIST-DATE-STAMPS (XLIB option) . . . . . 160
  - LIST-ENTRIES (XLIB option) . . . . . 160
  - LIST-EXTERNALS (XLIB option) . . . . . 160
  - LIST-MODULES (XLIB option) . . . . . 161
  - LIST-OBJECT-CODE (XLIB option) . . . . . 161
  - LIST-SEGMENTS (XLIB option) . . . . . 162
  - local data, storing at static locations . . . . . 33
  - local symbols, ignoring . . . . . 68
  - log (XLINK option) . . . . . 65
  - logging . . . . . 43
    - output example . . . . . 43–44, 46
    - log . . . . . 65
    - log\_file . . . . . 66
  - log\_file (XLINK option) . . . . . 66
  - lst (file type) . . . . . 65
- ## M
- M (XLINK option) . . . . . 22, 66
  - MAKE-LIBRARY (XLIB option) . . . . . 162
  - MAKE-PROGRAM (XLIB option) . . . . . 162
  - map (file type) . . . . . 65
  - memory
    - accessing from two different addresses . . . . . 76
    - code, filling unused . . . . . 57
    - far, placing segments in . . . . . 84
    - segment types . . . . . 24
  - microcontroller instruction set . . . . . 9
  - MILLENIUM (linker output format) . . . . . 87
  - mirroring memory to be accessed
    - from two different addresses . . . . . 76
    - mirroring the initial value of checksums . . . . . 42, 62
  - MISRA C . . . . . 16
  - misrac (XLINK option) . . . . . 50
  - misrac\_verbose (XLINK option) . . . . . 50
  - misrac1998 (XLINK option) . . . . . 50
  - misrac2004 (XLINK option) . . . . . 50
  - module summary, XLINK . . . . . 32
  - MODULE (assembler directive) . . . . . 145
  - modules
    - adding to library . . . . . 157
    - changing to program type . . . . . 162
    - generation date, listing . . . . . 160
    - inserting in library . . . . . 158
    - library, loading in XLINK . . . . . 18–19
    - listing . . . . . 161
      - CRC value . . . . . 159
      - EXTERN symbols . . . . . 160
      - PUBLIC symbols . . . . . 160
      - segments . . . . . 162
      - symbols in . . . . . 158
    - loading as library . . . . . 53
    - loading as program . . . . . 51
    - logging included when linking . . . . . 44
    - logging included (--log) . . . . . 65
    - removing from library . . . . . 156
    - renaming . . . . . 163
    - replacing . . . . . 164
    - type, changing to library . . . . . 162
  - MOTOROLA (linker output format) . . . . . 87, 89
  - MOTOROLA-S19 (linker output format) . . . . . 87, 89
  - MOTOROLA-S28 (linker output format) . . . . . 87, 89
  - MOTOROLA-S37 (linker output format) . . . . . 87, 89
  - MPDS (linker output format) . . . . . 91
  - MPDS-CODE (linker output format) . . . . . 88, 92
  - MPDS-I (linker output format) . . . . . 91
  - MPDS-M (linker output format) . . . . . 91
  - MPDS-SYMB (linker output format) . . . . . 88, 92
  - MSD (linker output format) . . . . . 88
  - MSD-I (linker output format) . . . . . 91
  - MSD-M (linker output format) . . . . . 91
  - MSD-T (linker output format) . . . . . 91
  - MSP430\_TXT (linker output format) . . . . . 88

## N

|                                                          |     |
|----------------------------------------------------------|-----|
| -N (XLINK option) . . . . .                              | 68  |
| -n (XLINK option) . . . . .                              | 68  |
| NAME (assembler directive) . . . . .                     | 145 |
| naming conventions . . . . .                             | 11  |
| NEAR (segment type) . . . . .                            | 24  |
| NEARC (segment type) . . . . .                           | 24  |
| NEARCODE (segment type) . . . . .                        | 24  |
| NEARCONST (segment type) . . . . .                       | 24  |
| NEC (linker output format) . . . . .                     | 91  |
| NEC-SYMBOLIC (linker output format) . . . . .            | 88  |
| NEC2 (linker output format) . . . . .                    | 91  |
| NEC2-SYMBOLIC (linker output format) . . . . .           | 88  |
| NEC78K (linker output format) . . . . .                  | 91  |
| NEC78K-SYMBOLIC (linker output format) . . . . .         | 88  |
| No global type checking (XLINK option) . . . . .         | 57  |
| Noalloc content, support for . . . . .                   | 21  |
| Noalloc content, support for in UBROF versions . . . . . | 90  |
| NPAGE (segment type) . . . . .                           | 24  |

## O

|                                                              |     |
|--------------------------------------------------------------|-----|
| -O (XLINK option) . . . . .                                  | 69  |
| -o (XLINK option) . . . . .                                  | 70  |
| -o (XAR option) . . . . .                                    | 148 |
| object attributes, support for in UBROF versions . . . . .   | 90  |
| object code                                                  |     |
| listing in ASCII format . . . . .                            | 161 |
| suppressing in XLINK . . . . .                               | 55  |
| object files                                                 |     |
| displaying available . . . . .                               | 156 |
| format . . . . .                                             | 17  |
| used by linker, logging . . . . .                            | 43  |
| used by linker, logging (--log) . . . . .                    | 65  |
| object names in C++, support for in UBROF versions . . . . . | 90  |
| Old UBROF (linker output format) . . . . .                   | 89  |
| ON-ERROR-EXIT (XLIB option) . . . . .                        | 163 |

|                                                          |                    |
|----------------------------------------------------------|--------------------|
| option summary                                           |                    |
| XAR . . . . .                                            | 147                |
| XLIB . . . . .                                           | 151                |
| XLINK . . . . .                                          | 49                 |
| options (XLINK), setting from the command line . . . . . | 49                 |
| output file name (XLINK), specifying . . . . .           | 70                 |
| output files, multiple . . . . .                         | 69                 |
| output format                                            |                    |
| XLINK . . . . .                                          | 18, 87             |
| specifying . . . . .                                     | 56                 |
| variant, specifying . . . . .                            | 82                 |
| Output (XLINK option) . . . . .                          | 56, 68, 70, 75, 82 |
| --output_checksum_summary (XLINK option) . . . . .       | 70                 |
| output, generating in XLINK also on error . . . . .      | 53                 |
| overlap errors . . . . .                                 | 25                 |
| overlay system map . . . . .                             | 33                 |
| Override default program entry (XLINK option) . . . . .  | 76                 |

## P

|                                             |         |
|---------------------------------------------|---------|
| -P (XLINK option) . . . . .                 | 22, 70  |
| -p (XLINK option) . . . . .                 | 72, 101 |
| packed segments, defining . . . . .         | 70, 83  |
| parameters                                  |         |
| storing at static locations . . . . .       | 33      |
| typographic convention . . . . .            | 11      |
| part number, of this guide . . . . .        | 2       |
| PENTICA-A (linker output format) . . . . .  | 88, 92  |
| PENTICA-AI (linker output format) . . . . . | 91      |
| PENTICA-AM (linker output format) . . . . . | 91      |
| PENTICA-B (linker output format) . . . . .  | 88, 92  |
| PENTICA-BI (linker output format) . . . . . | 91      |
| PENTICA-BM (linker output format) . . . . . | 91      |
| PENTICA-C (linker output format) . . . . .  | 88, 92  |
| PENTICA-CI (linker output format) . . . . . | 91      |
| PENTICA-CM (linker output format) . . . . . | 91      |
| PENTICA-D (linker output format) . . . . .  | 88, 92  |
| PENTICA-DI (linker output format) . . . . . | 91      |
| PENTICA-DM (linker output format) . . . . . | 91      |

|                                                  |     |
|--------------------------------------------------|-----|
| pew (file type) . . . . .                        | 104 |
| Poly (Rocksoft CRC algorithm field) . . . . .    | 36  |
| prerequisites (programming experience) . . . . . | 9   |
| printf, choosing formatter for . . . . .         | 20  |
| prj (file type) . . . . .                        | 104 |
| processor type                                   |     |
| specifying in XLIB . . . . .                     | 156 |
| specifying in XLINK . . . . .                    | 53  |
| program modules                                  |     |
| changing module type . . . . .                   | 162 |
| loading as . . . . .                             | 51  |
| programming experience, required . . . . .       | 9   |
| PUBLIC symbols                                   |     |
| listing . . . . .                                | 160 |
| renaming in XLIB . . . . .                       | 165 |
| publication date, of this guide . . . . .        | 2   |

## Q

|                              |     |
|------------------------------|-----|
| -Q (XLINK option) . . . . .  | 72  |
| QUIT (XLIB option) . . . . . | 163 |

## R

|                                                         |       |
|---------------------------------------------------------|-------|
| -R (XLINK option) . . . . .                             | 75    |
| -r (XLINK option) . . . . .                             | 75    |
| Range checks (XLINK option) . . . . .                   | 75    |
| range check, disabling . . . . .                        | 75    |
| range errors . . . . .                                  | 25    |
| ranges, filling . . . . .                               | 57    |
| Raw binary image (XLINK option) . . . . .               | 60    |
| RAW-BINARY (linker output format) . . . . .             | 88–89 |
| RCA (linker output format) . . . . .                    | 88    |
| redirected symbols, logging (--log) . . . . .           | 65    |
| reference information, typographic convention . . . . . | 11    |
| RefIn (Rocksoft CRC algorithm field) . . . . .          | 36    |
| reflection . . . . .                                    | 43    |
| RefOut (Rocksoft CRC algorithm field) . . . . .         | 36    |
| registered trademarks . . . . .                         | 2     |

|                                                     |     |
|-----------------------------------------------------|-----|
| RELATIVE (segment type) . . . . .                   | 23  |
| REMARK (XLIB option) . . . . .                      | 163 |
| RENAME-ENTRY (XLIB option) . . . . .                | 165 |
| RENAME-EXTERNAL (XLIB option) . . . . .             | 165 |
| RENAME-GLOBAL (XLIB option) . . . . .               | 165 |
| RENAME-MODULE (XLIB option) . . . . .               | 163 |
| RENAME-SEGMENT (XLIB option) . . . . .              | 164 |
| REPLACE-MODULES (XLIB option) . . . . .             | 164 |
| Rocksoft™ Model CRC Algorithm . . . . .             | 36  |
| incompatibilities with XLINK . . . . .              | 38  |
| using in XLINK . . . . .                            | 37  |
| root content, loading as if not root (-X) . . . . . | 81  |
| root, treating all content as (-N) . . . . .        | 68  |
| -rt (XLINK option) . . . . .                        | 75  |
| runtime libraries, updating . . . . .               | 164 |

## S

|                                                   |            |
|---------------------------------------------------|------------|
| -S (XLINK option) . . . . .                       | 76         |
| -s (XLINK option) . . . . .                       | 76         |
| safety-critical systems, developing . . . . .     | 16         |
| scanf, choosing formatter for . . . . .           | 20         |
| scatter loading, in XLINK . . . . .               | 72         |
| Search paths (XLINK option) . . . . .             | 59         |
| segment allocation . . . . .                      | 22, 70, 83 |
| segment control options (XLINK) . . . . .         | 22         |
| segment map                                       |            |
| including in XLINK listing . . . . .              | 81         |
| XLINK . . . . .                                   | 28–30      |
| segment overlap errors . . . . .                  | 25         |
| reducing . . . . .                                | 86         |
| Segment overlap warnings (XLINK option) . . . . . | 86         |
| segment overlaps, creating . . . . .              | 83         |
| segment parts                                     |            |
| logging included when linking . . . . .           | 44         |
| logging included (--log) . . . . .                | 65         |
| segment types                                     |            |
| allocation . . . . .                              | 23         |
| BIT . . . . .                                     | 24         |

|                                      |          |
|--------------------------------------|----------|
| CODE                                 | 24       |
| COMMON                               | 23       |
| CONST                                | 24       |
| DATA                                 | 24       |
| FAR                                  | 24       |
| far memory                           | 84       |
| FARC                                 | 24       |
| FARCODE                              | 24       |
| FARCONST                             | 24       |
| HUGE                                 | 24       |
| HUGECD                               | 24       |
| HUGECODE                             | 24       |
| HUGECONST                            | 24       |
| IDATA                                | 24       |
| IDATA0                               | 24       |
| IDATA1                               | 24       |
| memory                               | 24       |
| NEAR                                 | 24       |
| NEARC                                | 24       |
| NEARCODE                             | 24       |
| NEARCONST                            | 24       |
| NPAGE                                | 24       |
| RELATIVE                             | 23       |
| STACK                                | 23       |
| UNTYPED                              | 24       |
| XDATA                                | 24       |
| ZPAGE                                | 24       |
| segments                             | 21       |
| banked, defining                     | 70       |
| copy initialization                  | 72       |
| listing in modules                   | 162      |
| packed, defining                     | 70, 83   |
| placing in far memory                | 84       |
| renaming                             | 164      |
| --segment_mirror (XLINK option)      | 76       |
| silent operation, in XLINK           | 76       |
| SIMPLE (linker output format)        | 88       |
| SIMPLE-CODE (linker output format)   | 88       |
| slow crc                             | 42       |
| stack usage                          |          |
| logging                              | 47       |
| logging (--log)                      | 65       |
| stack usage analysis                 | 16       |
| diagnostic messages                  | 104, 136 |
| enabling                             | 55       |
| stack usage control file, generating | 77       |
| STACK (segment type)                 | 23       |
| --stack_usage_control (XLINK option) | 77       |
| static memory, storing local data in | 33       |
| static overlay system map            | 33       |
| static overlay, disabling            | 52       |
| structs/unions (anonymous), support  |          |
| for in UBROF versions                | 90       |
| suc (filename extension)             | 77       |
| sum (checksum algorithm)             | 60       |
| support, technical                   | 104      |
| symbol listing, XLINK                | 31       |
| SYMBOLIC (linker output format)      | 88       |
| symbols                              |          |
| defining at link time                | 54       |
| EXTERN, listing                      | 160      |
| ignoring local at link time          | 68       |
| in modules, listing                  | 158      |
| logging redirected (--log)           | 65       |
| logging redirection when linking     | 46       |
| PUBLIC, listing                      | 160      |
| renaming EXTERN                      | 165      |
| renaming PUBLIC                      | 165      |
| SYSROF (linker output format)        | 88       |

## T

|                                        |     |
|----------------------------------------|-----|
| target processor, specifying in XLINK  | 53  |
| target ROM, comparing to debug file    | 40  |
| technical support, reporting errors to | 104 |
| TEKTRONIX (linker output format)       | 88  |
| template information (C++), support    |     |
| for in UBROF versions                  | 90  |



|                                                           |    |
|-----------------------------------------------------------|----|
| terminal I/O, emulating . . . . .                         | 75 |
| terminology . . . . .                                     | 10 |
| threaded library, specifying use of . . . . .             | 77 |
| --threaded_lib (XLINK option) . . . . .                   | 77 |
| TI7000 (linker output format) . . . . .                   | 88 |
| TMS7000 (linker output format) . . . . .                  | 88 |
| tools icon, in this guide . . . . .                       | 11 |
| trademarks . . . . .                                      | 2  |
| translation, address . . . . .                            | 23 |
| type attributes, support for in UBROF versions . . . . .  | 90 |
| type checking, disabling global . . . . .                 | 57 |
| type definitions, support for in UBROF versions . . . . . | 90 |
| TYPED (linker output format) . . . . .                    | 88 |
| typographic conventions . . . . .                         | 11 |

## U

|                                                       |        |
|-------------------------------------------------------|--------|
| -U (XLINK option) . . . . .                           | 78     |
| UBROF                                                 |        |
| generating debug information in output file . . . . . | 75     |
| object file format . . . . .                          | 17     |
| properties . . . . .                                  | 88     |
| UBROF 7 or later . . . . .                            | 21, 23 |
| version . . . . .                                     | 89     |
| specifying . . . . .                                  | 89     |
| XLIB options dependent of . . . . .                   | 164    |
| UBROF5 (linker output format) . . . . .               | 88     |
| UBROF6 (linker output format) . . . . .               | 88     |
| UBROF7 (linker output format) . . . . .               | 88     |
| UBROF8 (linker output format) . . . . .               | 88     |
| UBROF9 (linker output format) . . . . .               | 88     |
| UBROF10 (linker output format) . . . . .              | 88     |
| UBROF11 (linker output format) . . . . .              | 88     |
| Universal Binary Relocatable Object Format . . . . .  | 17     |
| UNTYPED (segment type) . . . . .                      | 24     |

## V

|                           |     |
|---------------------------|-----|
| -V (XAR option) . . . . . | 148 |
|---------------------------|-----|

|                         |   |
|-------------------------|---|
| version                 |   |
| of this guide . . . . . | 2 |
| XLINK . . . . .         | 9 |

## W

|                                                |     |
|------------------------------------------------|-----|
| -w (XLINK option) . . . . .                    | 79  |
| warning messages, XLINK . . . . .              | 125 |
| controlling . . . . .                          | 79  |
| warnings icon, in this guide . . . . .         | 11  |
| Width (Rocksoft CRC algorithm field) . . . . . | 36  |

## X

|                                             |           |
|---------------------------------------------|-----------|
| -X (XLINK option) . . . . .                 | 81        |
| -x (XLINK option) . . . . .                 | 28–32, 81 |
| XAR                                         |           |
| basic syntax . . . . .                      | 147       |
| differences from XLIB . . . . .             | 143       |
| error messages . . . . .                    | 149       |
| introduction to . . . . .                   | 143       |
| verbose mode . . . . .                      | 148       |
| XAR options                                 |           |
| summary . . . . .                           | 147       |
| -o . . . . .                                | 148       |
| -V . . . . .                                | 148       |
| xcl (file type) . . . . .                   | 49        |
| XCOFF78K (linker output format) . . . . .   | 88, 95    |
| XDATA (segment type) . . . . .              | 24        |
| XLIB                                        |           |
| differences from XAR . . . . .              | 143       |
| error messages . . . . .                    | 167       |
| introduction to . . . . .                   | 143       |
| XLIB help information, displaying . . . . . | 158       |
| XLIB list file format . . . . .             | 153       |
| XLIB options                                |           |
| COMPACT-FILE . . . . .                      | 155       |
| DEFINE-CPU . . . . .                        | 156       |
| DELETE-MODULES . . . . .                    | 156       |

|                                              |         |                                          |                    |
|----------------------------------------------|---------|------------------------------------------|--------------------|
| DIRECTORY . . . . .                          | 156     | Output . . . . .                         | 56, 68, 70, 75, 82 |
| displaying . . . . .                         | 156     | Override default program entry . . . . . | 76                 |
| DISPLAY-OPTIONS . . . . .                    | 156     | Range checks . . . . .                   | 75                 |
| ECHO-INPUT . . . . .                         | 157     | Raw binary image . . . . .               | 60                 |
| EXIT . . . . .                               | 157     | Search paths . . . . .                   | 59                 |
| EXTENSION . . . . .                          | 157     | Segment overlap warnings . . . . .       | 86                 |
| FETCH-MODULES . . . . .                      | 157     | Target processor . . . . .               | 53                 |
| HELP . . . . .                               | 158     | -A . . . . .                             | 51                 |
| incompatible with modern compilers . . . . . | 164     | -a . . . . .                             | 52                 |
| INSERT-MODULES . . . . .                     | 158     | -B . . . . .                             | 53, 103            |
| LIST-ALL-SYMBOLS . . . . .                   | 158     | -b . . . . .                             | 122                |
| LIST-CRC . . . . .                           | 159     | -C . . . . .                             | 53                 |
| LIST-DATE-STAMPS . . . . .                   | 160     | -c . . . . .                             | 53, 100            |
| LIST-ENTRIES . . . . .                       | 160     | -D . . . . .                             | 54                 |
| LIST-EXTERNALS . . . . .                     | 160     | -d . . . . .                             | 54                 |
| LIST-MODULES . . . . .                       | 161     | -E . . . . .                             | 55                 |
| LIST-OBJECT-CODE . . . . .                   | 161     | -e . . . . .                             | 55                 |
| LIST-SEGMENTS . . . . .                      | 162     | -F . . . . .                             | 56, 75, 101        |
| MAKE-LIBRARY . . . . .                       | 162     | -f . . . . .                             | 56, 100            |
| MAKE-PROGRAM . . . . .                       | 162     | -G . . . . .                             | 56                 |
| ON-ERROR-EXIT . . . . .                      | 163     | -g . . . . .                             | 57                 |
| QUIT . . . . .                               | 163     | -H . . . . .                             | 35, 57, 60         |
| REMARK . . . . .                             | 163     | -h . . . . .                             | 57                 |
| RENAME-ENTRY . . . . .                       | 165     | -I . . . . .                             | 59                 |
| RENAME-EXTERNAL . . . . .                    | 165     | -J . . . . .                             | 35, 60             |
| RENAME-GLOBAL . . . . .                      | 165     | -K . . . . .                             | 22, 64             |
| RENAME-MODULE . . . . .                      | 163     | -L . . . . .                             | 64                 |
| RENAME-SEGMENT . . . . .                     | 164     | -l . . . . .                             | 65                 |
| REPLACE-MODULES . . . . .                    | 164     | -M . . . . .                             | 22, 66             |
| summary . . . . .                            | 151     | -N . . . . .                             | 68                 |
| XLINK options                                |         | -n . . . . .                             | 68                 |
| Always generate output . . . . .             | 53, 103 | -O . . . . .                             | 69                 |
| Extra output . . . . .                       | 70      | -o . . . . .                             | 70                 |
| Fill unused code memory . . . . .            | 57      | -P . . . . .                             | 22, 70             |
| Format variant . . . . .                     | 92      | -p . . . . .                             | 72, 101            |
| Lines/page . . . . .                         | 72      | -Q . . . . .                             | 72                 |
| Linker configuration file . . . . .          | 56      | -R . . . . .                             | 75                 |
| List . . . . .                               | 65, 82  | -r . . . . .                             | 75                 |
| No global type checking . . . . .            | 57      | -rt . . . . .                            | 75                 |

|                                       |           |
|---------------------------------------|-----------|
| -S                                    | 76        |
| -s                                    | 76        |
| -U                                    | 78        |
| -w                                    | 79        |
| -X                                    | 81        |
| -x                                    | 28–32, 81 |
| -Y                                    | 82, 92    |
| -y                                    | 82        |
| -Z                                    | 22, 83    |
| -z                                    | 86        |
| --call_graph                          | 54        |
| --image_input                         | 59        |
| --log                                 | 65        |
| --log_file                            | 66        |
| --output_checksum_summary             | 70        |
| --segment_mirror                      | 76        |
| --threaded_lib                        | 77        |
| #define                               | 54        |
| XLINK_COLUMNS (environment variable)  | 99        |
| XLINK_CPU (environment variable)      | 53, 100   |
| XLINK_DFLTDIR (environment variable)  | 59, 100   |
| XLINK_ENVPAR (environment variable)   | 49, 100   |
| XLINK_FORMAT (environment variable)   | 56, 100   |
| XLINK_PAGE (environment variable)     | 72, 101   |
| XorOut (Rocksoft CRC algorithm field) | 36        |

## Y

|                   |        |
|-------------------|--------|
| -Y (XLINK option) | 82, 92 |
| -y (XLINK option) | 82     |

## Z

|                              |        |
|------------------------------|--------|
| -Z (XLINK option)            | 22, 83 |
| -z (XLINK option)            | 86     |
| ZAX (linker output format)   | 88     |
| ZAX-I (linker output format) | 91     |
| ZAX-M (linker output format) | 91     |
| ZPAGE (segment type)         | 24     |

# Symbols

|                                                   |             |
|---------------------------------------------------|-------------|
| __checksum (default label)                        | 62          |
| __checksum__value (default checksum value symbol) | 41          |
| -A (XLINK option)                                 | 51          |
| -a (XLINK option)                                 | 52          |
| -B (XLINK option)                                 | 53, 103     |
| -b (XLINK option)                                 | 122         |
| -C (XLINK option)                                 | 53          |
| -c (XLINK option)                                 | 53, 100     |
| -D (XLINK option)                                 | 54          |
| -d (XLINK option)                                 | 54          |
| -E (XLINK option)                                 | 55          |
| -e (XLINK option)                                 | 55          |
| -F (XLINK option)                                 | 56, 75, 101 |
| -f (XLINK option)                                 | 56, 100     |
| -G (XLINK option)                                 | 56          |
| -g (XLINK option)                                 | 57          |
| -H (XLINK option)                                 | 35, 57, 60  |
| -h (XLINK option)                                 | 57          |
| -I (XLINK option)                                 | 59          |
| -J (XLINK option)                                 | 35, 60      |
| -K (XLINK option)                                 | 22, 64      |
| -L (XLINK option)                                 | 64          |
| -l (XLINK option)                                 | 65          |
| -M (XLINK option)                                 | 22, 66      |
| -N (XLINK option)                                 | 68          |
| -n (XLINK option)                                 | 68          |
| -o (XAR option)                                   | 148         |
| -O (XLINK option)                                 | 69          |
| -o (XLINK option)                                 | 70          |
| -P (XLINK option)                                 | 22, 70      |
| -p (XLINK option)                                 | 72, 101     |
| -Q (XLINK option)                                 | 72          |
| -R (XLINK option)                                 | 75          |
| -r (XLINK option)                                 | 75          |
| -rt (XLINK option)                                | 75          |
| -S (XLINK option)                                 | 76          |
| -s (XLINK option)                                 | 76          |

|                                                    |           |
|----------------------------------------------------|-----------|
| -U (XLINK option) . . . . .                        | 78        |
| -V (XAR option) . . . . .                          | 148       |
| -w (XLINK option) . . . . .                        | 79        |
| -X (XLINK option) . . . . .                        | 81        |
| -x (XLINK option) . . . . .                        | 28–32, 81 |
| -Y (XLINK option) . . . . .                        | 82, 92    |
| -y (XLINK option) . . . . .                        | 82        |
| -Z (XLINK option) . . . . .                        | 22, 83    |
| -z (XLINK option) . . . . .                        | 86        |
| --call_graph (XLINK option) . . . . .              | 54        |
| --enable_stack_usage (XLINK option) . . . . .      | 55        |
| --image_input (XLINK option) . . . . .             | 59        |
| --log (XLINK option) . . . . .                     | 65        |
| --log_file (XLINK option) . . . . .                | 66        |
| --misrac (XLINK option) . . . . .                  | 50        |
| --misrac_verbose (XLINK option) . . . . .          | 50        |
| --misrac1998 (XLINK option) . . . . .              | 50        |
| --misrac2004 (XLINK option) . . . . .              | 50        |
| --output_checksum_summary (XLINK option) . . . . . | 70        |
| --segment_mirror (XLINK option) . . . . .          | 76        |
| --stack_usage_control (XLINK option) . . . . .     | 77        |
| --threaded_lib (XLINK option) . . . . .            | 77        |
| #define (XLINK option) . . . . .                   | 54        |