C51 Primer

An Introduction To The Use Of The Keil C51 Compiler On The 8051 Family

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by

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0 About The C51 Primer

If you've looked at a few 8051 datasheets, other 8051 books or flicked through the chapters in this guide, you may be left thinking that it is necessary to be an 8051 expert to produce workable programs with C51. Nothing could be further from the truth. It is perfectly possible to write real commercial programs with nothing more than a reasonable knowledge of the ISO C language and some appreciation of hardware.

However, to get the maximum performance from the 8051 family, knowing a few tricks is very useful. This is particularly true if you are working on a very cost-sensitive project where needing a bigger RAM or EPROM can result in an unacceptable cost. After all, if cost was not a consideration, we would all be using 80C166s and 68040s!

Whilst the C51 Primer is really aimed at users of the Keil C51 Compiler, it is applicable in part to compilers such as IAR and Tasking. However, as these compilers do not allow such low-level access and have fewer 8051-specific extensions, they are less likely to be used on projects where getting maximum performance is essential.

This edition of the C51 Primer will use the Keil C51 PK51 package version 6.0.2, released in June 2000.

The C51 Primer Will Help You

Find your way around the basic 8051 architecture.
Make a sensible choice of memory model and special things to watch out for.
Locate things at specific addresses.
Make best use of structures.
Use bit-addressable memory.
Think in terms of chars rather than ints.
Get the best out of the various pointer types.
Get a modular structure into programs.
Access on and off-chip ports and peripherals.
Deal with interrupts.
Use registerbanks.
Deal with the stack.
Understand RAM overlaying.
Interface C to assembler code.
Use some of the special versions.
Use efficient C.
Help the optimiser to produce the smallest, fastest code.

The C51 Primer Will Not Help You:

Program in ISO C - get a good reference. Look on the Association of C and C++ Users web site (www.accu.org) where they have independent reviews of several thousand C, C++ and SW Engineering book reviews includinig an embedded section.
NOTE:-Whilst many swear by the Kernighan & Ritchie book it is not really the best book to learn C for embedded use. The K&R book is more of a language definition, it was written over 25 years ago for UNIX programmers. It has now been superseded by the International ISO C standards in 1989 and 1999. The syntax used in the K&R First Edition is now obsolete and should not be used. The K&R 2nd Edition followed the ISO C 1989 standard.

Write portable code - simply use the compiler without using any extensions. NOTE:- 100% portable code is difficult to write for the 8051 and will be inefficient. Although C is widely

touted as "portable" the vast majority of embedded applications will never be ported (other than to another, usually more powerful, part in the same family)

Set-up each and every on-chip peripheral on all of the 400 plus different 8051 variants! Some are, however, covered in the appendices.

This guide should be read in association with a good C reference and is not meant to be a definitive work on the C language. It covers all the Keil 8051-specific language extensions and those areas where the CPU architecture has an impact on coding approach.

0.1 History

The C51 Primer was first concived and written by Mike Beach in 1989 as a guide to both the 8051 and the Keil compiler. Since it's initial publication it has been given away with all Keil C51 compiler sold by Hitex, put on the Hitex BBS and later on the web site www.Hitex.co.uk, www.hitex.de, www.keil.co.uk and numerous others it has become one of the standard texts on the 8051.

Issue I	1991	M Beach	
Issue II	*not issued*	M Beach	
Issue III	1994	M Beach	Based on Keil C51 V3.02
Issue 3.5	January 2002 (Issued I Draft form only)	Chris Hills	Revised for Keil C51 V6 Major re-write
Issue 3.6	October 2003	Chris Hills	Revised for Keil C51 V7 (and academic year)

One of the main changes since Issue III is the change in C syntax between C51 V4 and C51 V5. The declaration for variables before Version 5 was:

```
code unsigned char name;
xdata int name;
```

this was changed for version 5 to

```
unsigned char code name;
int xdata name;
```

bl (banked linker) is now standard

floating point maths improved

The other major visable change is the uVision IDE. The uVuision 1 series IDE was a 16 bit system that ran under Win 3.1 (and 9*, NT) This was available with Version 5 compilers. The current IDE , uVision2, is a wholly 32-bit system that will work with C51 V6 onwards Despite the IDE all the tools remain command line driven. This permits their use, as in the past, with most forms of make, other IDE's and script files.

Disclaimer and contact details

This book has been written by several humans and therefore may have errors and omissions. Should you find any errors and omissions please email the current editor, Chris Hills at chills@hitex.co.uk or chris@phaedsys.org The first person to report a particular error will receive the highly prized Hitex ASCII Table mug (subject to availability) this excludes Hitex and Keil employees and distributors.

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