



Keil Quick Start Tutorial

Version 1.1

*Using the Keil Software Development Tools
with the Siemens C504 Evaluation Board from Phytex*

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This tutorial will instruct you on how to use the Keil Microsoft Windows based software development tools with the Siemens C504 based evaluation board. This tutorial will also provide general information regarding any C500 or 8051 microcontroller. The source code for this application note can be found in file 113.zip on this CD.

For more information you may visit these Web sites:

<http://www.keil.com> - main Keil Software web page.

<http://www.keil.com/~market> - Technical Marketing page and errata to this document.

<http://www.siemens.com> - main USA Siemens web page. See www.siemens.de for Germany.

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Notes:

- 1) This document is continually being updated. For the latest version check www.keil.com/appnotes or Email rboys@keil.com or phone (800) 348-8051. Check the Keil Marketing Web site www.keil.com/~market for any late developments.
- 2) Every effort has been made to ensure that the information contained here actually works. Please report any errors or omissions to the author at the addresses listed above.

INTRODUCTION

The Siemens C504 uses a 8051 core and is targeted to AC/DC motor control applications. The entire Siemens C500 microcontroller line is fully supported by the Keil Tool Chain. This includes a C Compiler, Macro Assembler, Code Banking Linker/Locator, μ Vision IDE and the dScope Simulator.

The Keil Tool Chain supports all In-circuit emulators that support the Intel OMF51 debugging specification. The Keil OH51 Object to Hex Converter converts an absolute object file into an Intel HEX file and is suitable for programming into an Eeprom.

The Keil tool chain consists of the following executables:

μVision	uvw51e.exe
C Compiler	C51.exe
Assembler	A51.exe
Linker	bl51.exe
Converter	oh51.exe
dScope	dsw51.exe

These files are located in the c:\c51eval\bin directory for the evaluation version. The full version is located in the c:\c51\bin directory. They are DOS programs. Access to these programs from Windows is accomplished with μ Vision. The entire tool set can be run from μ Vision or directly from DOS. The Evaluation version is limited in code size to 2Kbytes. The starting address must be greater than 0x4000. Other than these restrictions, all features operate normally.

μ Vision IDE

μ Vision is a Windows based front end for the C Compiler and Assembler. It was developed in the USA as were the printed manual set. Compiler, Assembler and Linker options are set with simple mouse clicks. μ Vision runs on Windows 3.1, 95 and NT. This Integrated Development Environment (IDE) has been expressly designed with the user in mind. A full function editor is included. All IDE functions are intuitive via pull down menus with prompted selections. An extensive Help utility is included. External executables can be run from within μ Vision. This includes emulator software.

C51 C Compiler for the entire 8051 Family including the Siemens C500 Family

The C51 ANSI compiler with the A51 assembler are designed specifically for the 8051 microcontroller family, including the C500 series. The C51 is 100% compatible with existing 8051 programs. C51 supports code banking. The compiler can be run in either DOS mode or called from the Windows based front end μ Vision.

A51 Macro Assembler

This Macro Assembler is included with each Compiler package or is available separately. All utilities needed to complete your project are included for all members of the 251 family. This Assembler is DOS based or can be run from μ Vision which is included with every Assembler and Compiler package available from Keil Software.

BL51 Code Banking Linker/Locator

The BL51 Linker/Locator is used to join relocatable object modules and library files together. The object files were created with the C51 compiler or the A51 Assembler and the library files are provided by Keil. This process results in absolute object modules. The BL51 is DOS based and can be run from DOS or through Windows using μ Vision. A MAP file is also produced giving details of the memory structure. This object file may be specified to contain debugging information as required by simulators, debuggers and emulators. The BL51 can overlay important internal RAM for variables to greatly increase the speed of processing.

OH51 Object Hex Converter

The Keil OH51 Object to Hex Converter converts an absolute object file produced by the BL51Banking Linker into a standard Intel HEX file. This file is suitable for programming into an Eprom or as an input to an emulator. OH51 is a DOS file and can be called as such with suitable argument(s) or run by μ Vision.

dScope Simulator

dScope is a software simulator. Your code can be debugged either in software on your PC or in your target hardware. When operated in conjunction with the Keil monitor installed in your target hardware, dScope becomes tScope. You have the ability to run/halt, set breakpoints, examine/change memory, view the stack, view/set peripheral information and apply virtual external signals. dScope has a Performance Analysis feature to ensure your code runs efficiently. dScope has a disassembler/assembler allowing you to make changes in your code without recompiling.

The evaluation version of the Keil tool set is restricted to a 2K code size and the code must be located at 0x4000. Useful object code is produced. Other than these restrictions, the tool set works exactly as the full version does. This allows you to fully evaluate the features and power of Keil products. The full version has no restrictions and is fully ANSI compliant.

ABOUT THIS TUTORIAL

This tutorial consists of several sessions illustrating the features of the Keil Tool Set. The C language program shown above will be compiled and run using various features of the Keil C51 Tool Set. The focus is on using Keil's μ Vision integrated development environment. It explains how to create and build a new project using a source code example provided in this tutorial.

The following steps below show you how to configure the tools, assemble and link the code, and invoke the debugger, dScope. Before you begin this tutorial, you need the Keil software development tools. The Evaluation version is on the Siemens CD ROM or is available from the Web: www.keil.com. You may need an update disk to update μ Vision to 1.24. Call Keil if this is not on the Siemens disk. Or check www.keil.com/~market.

STARTING THE TUTORIAL

Installing the Keil Software

Install the Keil Software development tools by completing the following steps:

After you install the Keil development tools to Windows 3.11, a Keil program group or icons appears on your desktop. (the Windows 95 version is shown in Figure 1). Recall dScope is the Keil Simulator and μ Vision is the Keil Windows based user interface (or IDE = Integrated Development Environment).

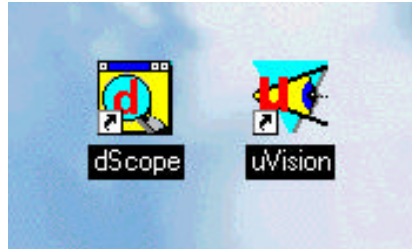


FIGURE 1

For Windows 95 you must install the two icons manually as follows. If the two icons are visible in a small window drag them onto the desktop. If they are not visible, follow these instructions:

- 1) right mouse click while in the Desktop
- 2) select New/Shortcut
- 3) The executable file you want to enter as the Command Line is *c:\c51eval\bin\uvw51.exe*
- 4) The suggested name is μ Vision.
- 5) Repeat this process for *c:\c51eval\bin\dsw51.exe* and name it dScope.

The full version of the software installs these icons to the Windows 95 desktop.

Starting the Software:

Double-click on the μ Vision icon to start the user interface. The compiler, assembler, linker and dScope will be called from within μ Vision in this tutorial. After you invoke μ Vision, the window shown in Figure 2 appears. From this window, you can create projects, edit files, configure the tool, assemble, link, and invoke the debugger. Other 3rd party software such as emulators can also be started from here.



FIGURE 2

CREATING A NEW PROJECT

1. Open the Project menu and choose New Project. The window shown in Figure 3a appears except that *.prj shows under *File name* instead of newp.prj.
2. Enter the name of the project you are creating. For this tutorial, enter the name *newp.prj* and press *OK*. *Newp.prj* will be entered under File name: as shown in Figure 3a. Figure 3b will open up.

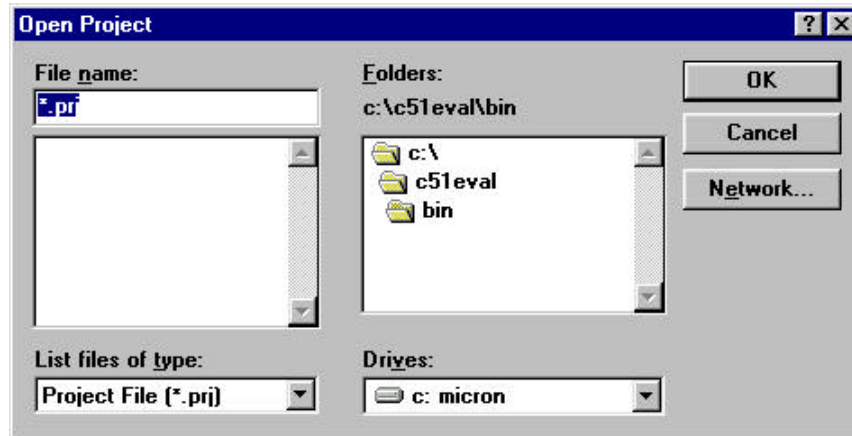


FIGURE 3a

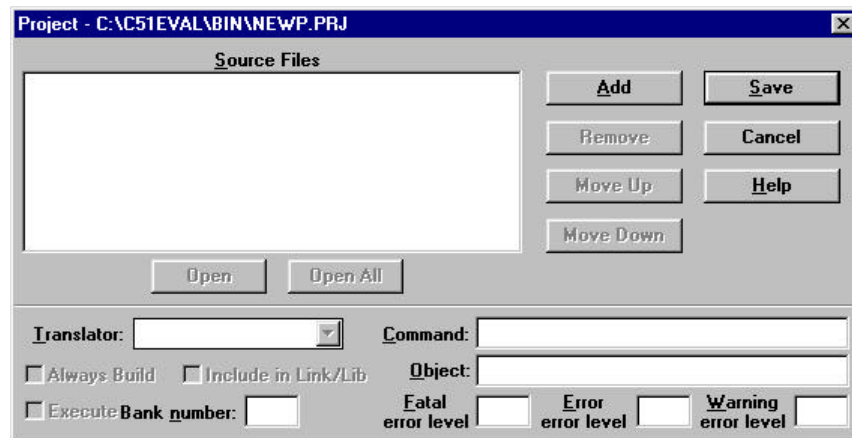


FIGURE 3b

This window is used to add various files to your project. These include ASCII files, C and assembly source and macros. The list is quite extensive and is found in the Translator window if any files are present in the project. Note this window is blanked out at this time. This window is accessible at any time by selecting Project/Edit Project and you may easily edit your file list. Note that any assembler files must be last in this list. If they are not, changes made to them will not be reflected in the final object file.

When creating a new project in this manner no source files are yet available. Therefore, select *save* to close this window. Your project newp.prj will be active. Click on Project and confirm newp.prj is visible at the bottom of this pull down menu.

CREATING A NEW SOURCE CODE FILE

- 1) Open the File menu and choose *New* to go to the integrated editor. If you already have the source listing, choose *Load* instead.
 - 2) An editor window appears in the μ Vision window. Use the editor to type in the example program in Figure 5. This simple program uses a number of C instructions to demonstrate various functions of the C504. Another program is used to demonstrate the Performance Analysis function. The source code and project files are included with this application note.
 3. After you finish typing the code, open the File menu and choose *Save*. The window shown in Figure 4 appears.
 4. Select the directory where you saved the project. This tutorial uses the directory: *c:\c51eval\bin*
 5. Enter the name of the file you are saving and press *OK*. This tutorial uses the name: *demo.c*.
 6. At this point you have created a project called *newp.prj* and a C source file called *demo.c*.
- The next step is to build your project. This includes compiling (not done here), assembling, linking and locating and creating the hex file.

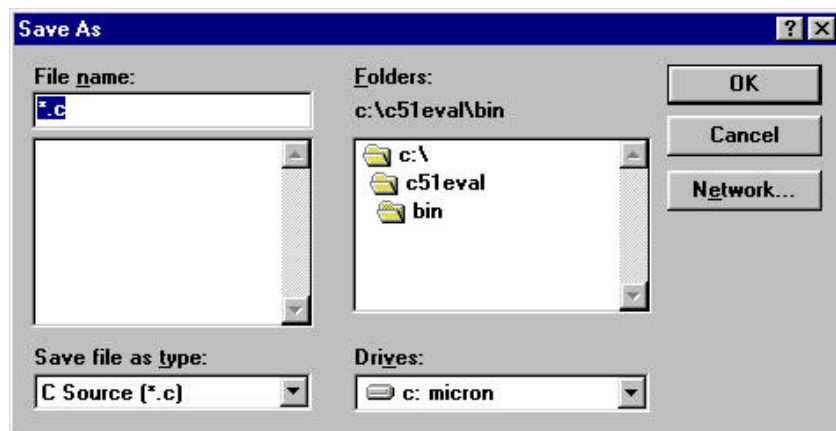


Figure 4

```

/* Siemens C504 example - Robert Boys, Copyright 1997 Keil Software Dallas, Texas */
/* This is a simple program used to demonstrate the Keil debugger dScope */

#include <reg51.h>          /* declare 8051 SFRs */
#include <stdio.h>          /* not -really- needed, but here it is anyhow ! */

int var = 1;                /* declare an integer variable to be pointed to */
int *ptr;                  /* declare a pointer to point to an integer */

void stepout(int q)         /* declare a simple function called stepout */
{                           /* does not really do much but demonstrate the */
    int count;              /* stepout, stepin and stepover functions of dScope */
    int total = 0;

    for (count = 1; count <= 10; count++)
        q = q*2;
}

struct cord {               /* declare the structure named cord */
    int x;                  /* with member variables x and y */
    int y;
} first, second;           /* declare two structures with members x and y */

void main(void) {           /* start of the main program here */
    int b = 0;              /* declare a few integer local variables */
    int count = 0;
    long bigcount = 0;

    ptr = &var;             /* declare ptr to point to the variable var */
    *ptr = 3;               /* and initialize them */
    first.x = 5;
    first.y = 5;
    second.x = 2;
    second.y = 2;

    while(1) {              /* start an endless loop here */
        first.x++;          /* increment all the pointers */
        second.y++;         /* just for something to do */
        first.y++;
        second.x++;

        count++;            /* increment this thing while we are here */
        stepout(b);         /* pay a visit to the function for a time */
        bigcount=bigcount+2; /* add two to this long variable */

        *ptr=*ptr*3;        /* multiply var by three using its pointer */
    }
}

```

Figure 5. Example Program

BUILDING THE PROJECT

- 1) Open the Options menu and choose Make.
- 2) Click on After Make. The window shown in Figure 6 appears.
- 3) Make sure Run dScope Simulator/Debugger deselected and click on OK. The debugger will not run at the conclusion of the Make utility. If you prefer to invoke the debugger automatically, leave this selected later. You can look under some of the other tabs to see some of the options that can be set but do not change anything from the defaults at this time.

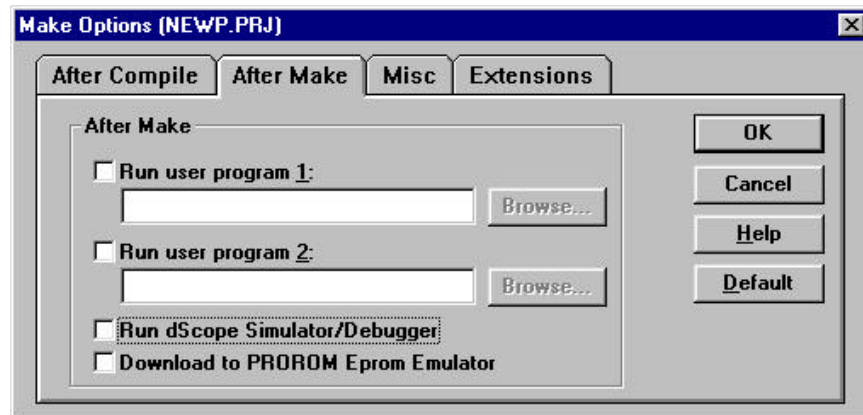


FIGURE 6

- 4) Open the Project menu and choose *Edit Project*. The window shown in Figure 7 appears. This is where you add various files to your project. Note there are no files in the project yet.

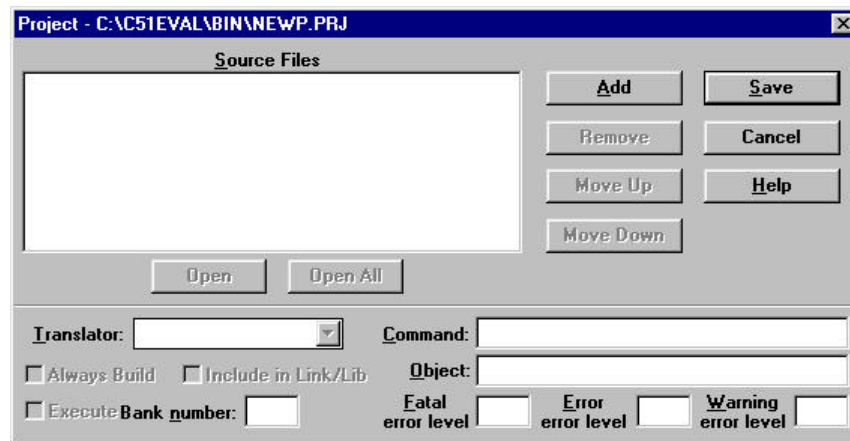


FIGURE 7

- 5) Choose *Add*. The window shown in Figure 8 appears. This is where you add the files to your project.

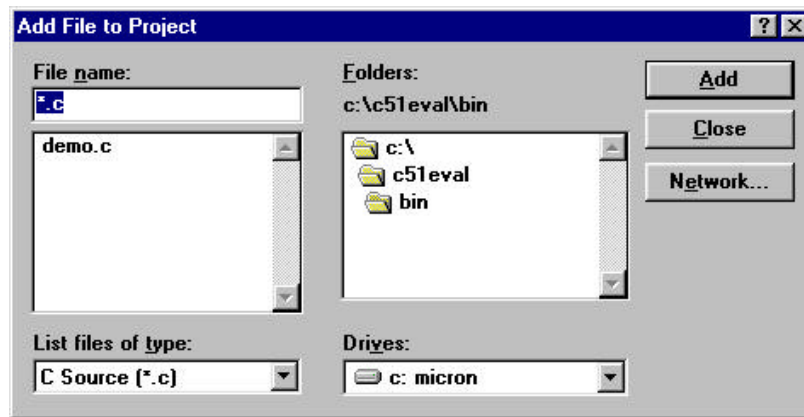


FIGURE 8

- 6) Make sure you are in the correct directory: *c:\c51eval\bin*.
- 7) Select the file: *demo.c* and press *Enter*.
- 8) Choose *Add* then *Close*. *DEMO.C* will be listed in the Source Files window.
- 9) Click on *Always Build* so this is activated. This feature forces a build of the selected file if an UPDATE (rather than the full build) is done even if this file has never been modified since the last build. *Include in Link/Lib* should also be active.
- 10) Choose *Save*.

CONFIGURING THE MAKE UTILITY, COMPILER, AND LINKER

Keil Software has a Make utility that can compile and link C and/or assembly coded files. It also has other configuration and default setting features. Before using the make utility, configure the make options. Make the changes as indicated and leave all other options set to their default values. μ Vision allows you to set various options with mouse clicks and these are all saved in your project file.

- 1) **Configure the Make utility.**
 - Open the Options menu and choose *Make*.
 - Configure the options in the window as shown in Figure 9 and press *OK*.

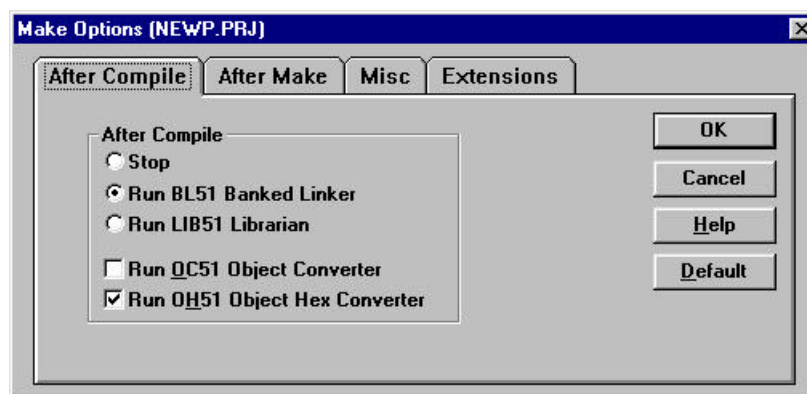


FIGURE 9

2) Configure the Compiler.

- Open the Options menu and choose *C51 Compiler*. Note the Command line options string.
- Configure the options in the window under Object as shown in Figure 10 and press *OK*. Select *Include symbols* under the Listing tab.

NOTE: if you use the assembler (we will not in this tutorial) you will want to turn on the debug information (include debug information) under the Object tab under A51 Assembler.

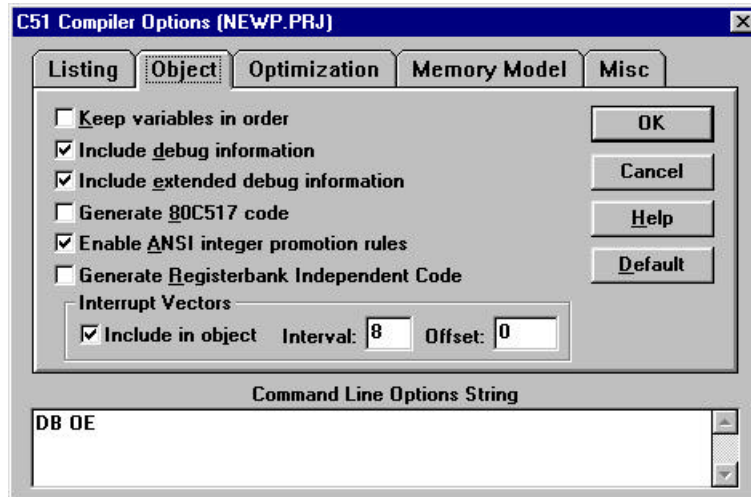


FIGURE 10

3) Configure the Linker.

- Open the Options menu and choose *BL51 Code Banking Linker* and choose the *Linking* tab.
- Configure the options in the window as shown in Figure 11 and press *OK*.
- You can view the other tabs but leave everything set to the default values.

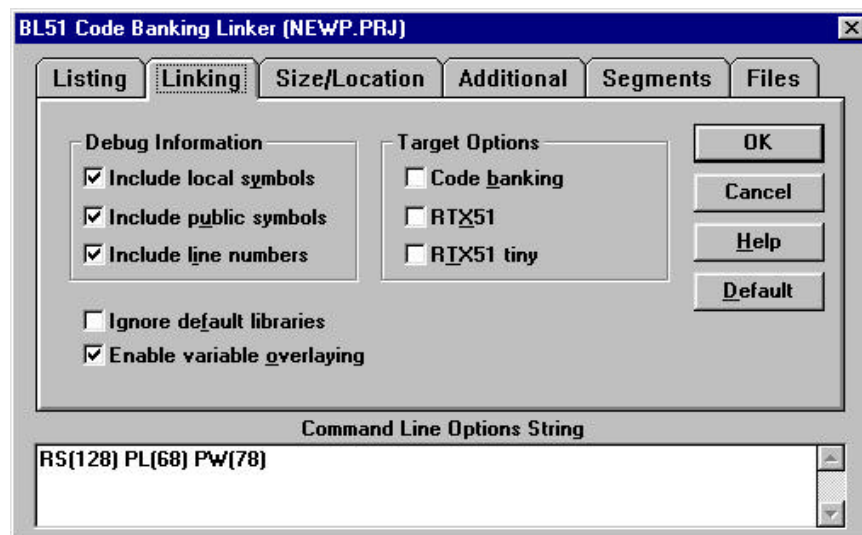


FIGURE 11

4) Additional Notes:

- You must have a directory called c:\tmp on your hard drive. This is created by Windows during its installation and is used by Keil for storing temporary files.

COMPILING THE CODE AND CREATING AN EXECUTABLE FILE

Once you have configured the tool, you are ready to run the compiler and linker using the Make utility. We will not be using the assembler for this tutorial.

1. Click on the *Build All* icon (it has three arrows pointing downwards) or open Options and select Make.
 2. If the program specified (demo.c) contains any errors, they will be shown on the screen.
- If there are no errors, the code is assembled and linked and the executable code is ready to be downloaded to the board. The code to be downloaded to the board will be the name of the project with no filename extension. In this case this will be *newp*. Click on OK in the *Project Status* dialog box and continue to the next section. Note a HEX file has been created. Other files are created to help the debugging process.
 - If a list of errors appears, use the editor to correct the error(s) in the source code and save the file. Then, repeat this section: beginning at step 1.

DOWNLOADING THE CODE TO THE C504 EVALUATION BOARD

You are now ready to run the dScope debugger to download code to the evaluation board.

Connect the serial cable from a COM port on your PC to the 9 Pin serial port X4 on the Phytex board. Supply regulated 5 volts to X2 & X5 on the board. Please carefully apply the correct polarity.

Use the default board jumper locations.

Click on the debugger icon on the μ Vision toolbar. This icon is a “d” seen through a magnifying glass and is yellow and blue in colour. This is the same icon installed for dScope in your desktop area. If you leave the mouse pointer on an icon for a few seconds, the word “debug” will appear. A window similar to that shown in Figure 12 is displayed. You may want to move and resize the windows. The window marked “*Module: <none>*” is the Debug window. The Command window can be used to enter commands. It will not be used during this portion of the tutorial.

You may need to open, resize and /or move some windows to make your screen look something like Figure 12. The Debug, Memory, Watch, Command and Regs windows will be used. You may want to open the Commands menu in the Debug Window and select Show Toolbar.

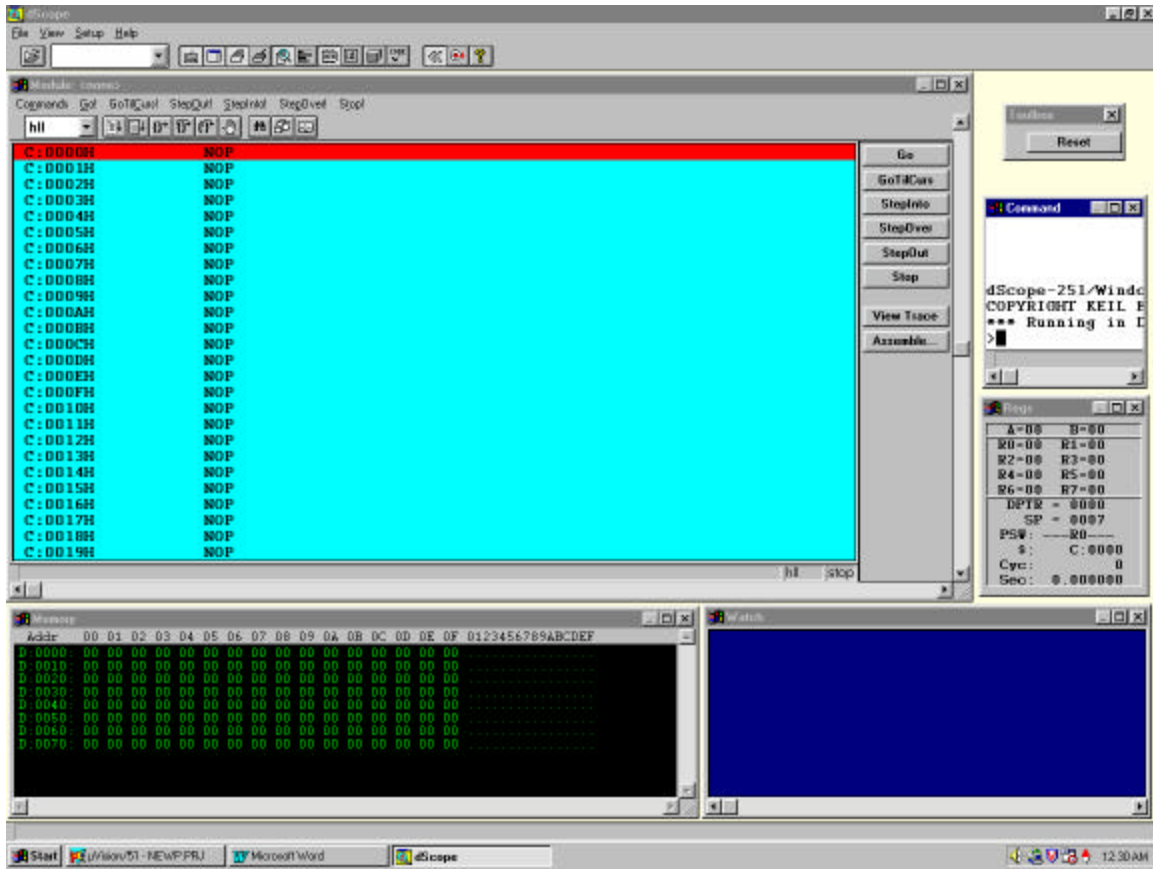


FIGURE 12
INTERFACE SETUP

Before you can load the executable file to the debugging environment and to the evaluation board, make sure you have the correct driver and interface. dScope is a software debugger and simulator. tScope is the debugger but connected to a hardware system. Programs are run on the target hardware rather than in the virtual microcontroller in your PC. The Keil debugger tScope will communicate with the monitor contained in the FLASH memory on the evaluation board. For additional or updated monitor software, contact Keil Software.

The upper left hand corner of Figure 12 shows that dScope is active in this case. This will change to tScope if the appropriate dll (i.e. mon51.dll) is chosen. If you select *8051.dll*, you will get dScope. Your simulation will not be run on the board but in your PC as already stated.

- 1) To establish communication with the evaluation board, choose the correct driver using the pulldown list on the left portion of the debugger toolbar. In this example, mon51.dll is chosen.
- 2) mon51.dll: When the serial link is connected and the mon51.dll is selected dScope will try and communicate with the kernel located in the FLASH memory on the board. tScope should be displayed in the upper left hand corner. If you get this far, things are working properly.
- 3) If you open the View menu and select *Command Window*, you can type commands in here. If you type help - you will get an error message returned. This confirms the monitor is working.
- 4) This will happen only if communication is established. If the wrong COM port or speed is selected a *No Target System Found !* dialog box will open. The correct speed for a 40 Mhz crystal is 19,200. If this happens; follow the instructions under Communications Setup.

COMMUNICATIONS SETUP

You need to follow these instructions if proper communication was not established. After a series of attempts dScope will error out as indicated in the *No Target System Found !* dialog box.

Select the appropriate configuration.. Select the appropriate COM port for your system. The speed must be 19,200 for the 40 Mhz crystal. For the 20 Mhz version, select 9600 if 19,200 does not work..

After you set the COM port and baud rate correctly, click on *Try Again*.

LOADING THE EXECUTABLE FILE TO THE DEBUGGER ENVIRONMENT

- 1) Open the File menu and choose *Load Object file*.
- 2) In the Window provided, select the file: newp. The file is downloaded to the board and the debugger. You will see the source code on your screen. Note with some code, you might not see your source code because the program starts at 002000H which is a condition of the evaluation version of the Keil Compiler. You may see the LJMP instruction at C:0000H. The full version of the Keil Toolset will start at 0x0000 or wherever you set it.
- 3) If necessary, to see the code enter the following command in the Command window: `$=0x201F`
Note: this command sets the Program Counter (\$) to hex 201F. You can also use the command `$=main` if you prefer. The program counter will advance to *main*. Note you can press the up arrow key to get the history of keys typed in the Command Window.
- 4) To see the Command window if not already visible, select View/Command Window. To see the source code, select the Debug window in the same fashion.
- 5) You should now see the source in the Debug window as in Figure 13 depending on how you set your windows. You can single step using the StepInto icon. You are now ready to use the dScope window (really tScope) to step through code, set breakpoints, and issue the Go command to start program execution. You can examine special function registers, memory locations, and register values, etc.

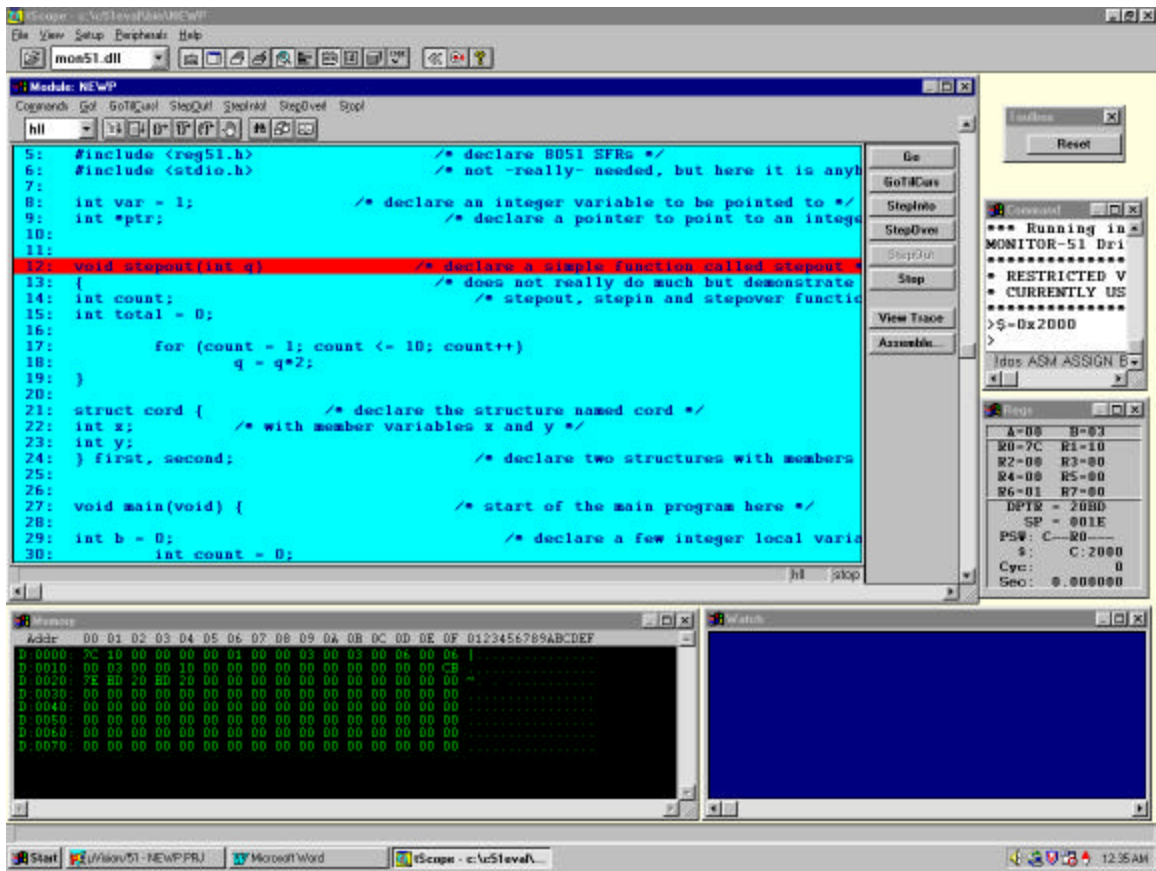


FIGURE 13

SAMPLE SESSIONS

Breakpoints

- 1) Click on a memory location such as line number 42 `first.xx++` and a colored bar appears marking this position.
- 2) You could click on *Go Til Curs!* to reach this point or you could double-click and a breakpoint is set. Set a breakpoint here with the double click. The [BR0] indicates the first breakpoint.
- 3) Click on GO and the program will run and stop at the breakpoint.
- 4) Double click on the breakpoint to remove it.

In Line Assembler

- 1) Open the Commands option and click on Inline Assembler or if Show Dialogbar is active, click on the Assemble button in the Debug window.
- 2) The Inline Assembler windows opens as in Figure 14.
- 3) Note that you could enter mnemonics in the window titled *enter MCS-51 instruction:* Do not do this at this time. Just note the ability to make small changes in the program without recompiling the program.
- 4) Click on Close.

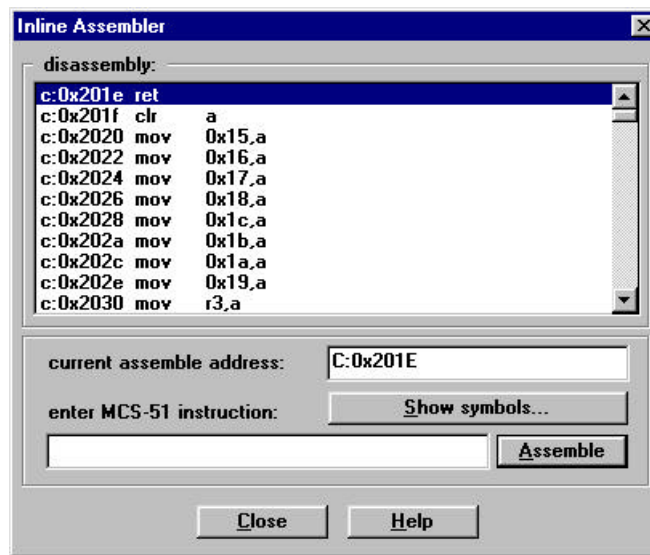


Figure 14

Single Stepping

- 1) dScope uses “*Step Into*” to single step one instruction at a time. “*Step Into*” is also used to enter a function in the same fashion.
- 2) “*Step Over*” means to skip over a function that you are not interested in.
- 3) “*Step Out*” is used to exit a function you are currently in. “*Step Out*” is very useful if you find yourself in a function you are not interested in and need to return quickly to your intended function.
- 4) If dScope gets stuck - do a reset using the RESET box on the Toolbox or click on the button next to the Help “?”, reload the file and/or the DLL. You can also try the 8051.dll to isolate any problems from the evaluation board. You can also use the hardware RESET button on the board.
- 5) With the cursor on line 42 click on StepInto until you enter the function Stepout. Note that you must click on StepInto 10 times to exit the loop.
- 6) Repeat the process using StepOver and you will not enter the function although it will be executed. This is useful to skip function calls you are not interested in debugging.
- 7) Note that the StepOut button is grayed out and not available in tScope. StepOut is available in the simulator dScope and provides a quick escape from a function by executing the next *return* instruction.

Memory Window

- 1) The Memory Window shows as the default the data space starting at D:0x0000. This is the area where data variables are kept in this example.
- 2) Note that as you step through the program that the contents of the memory changes as the variable values are adjusted.
- 3) You can change the memory area with the DISPLAY command in the Command window. Enter d c:0x00 and the code area will be displayed.
- 4) Change back to the data area with d d:0x00

Watch Window

- 1) The Watch Window displays memory contents as specified by their name. Structures can also be displayed.
- 2) Open the Setup menu and select *Watchpoints*. In the Expr.: window, enter the following symbols each then followed by clicking on *Define watch*. ::
bigcount, *first*, *second* and *var*. Note that if you also select *0xnn* the values will be displayed in decimal rather than hexadecimal notation. Try this for one or two of the variables.
- 3) These variables will now be displayed in the Watchpoint windows.
- 4) Click on *StepOver* and the variable values will change as appropriate.
- 5) Note: when are using dScope (i.e. the software debugger) and if in the *Update Memory Window* and *Update Watch Window* (in the Setup menu) are activated - the variable values will change as the program is running. This feature is not possible with tScope running on a hardware board.
- 6) Open the Peripherals menu and select Configuration. Activate *use serial interrupt* and click on *Apply* then *Close*.
- 7) Do a RESET and start over as before. Press GO and then STOP and note that the values change in both the Watch and Memory windows when the processor is stopped.

Performance Analysis

This option displays the relative processor time spent in user specified modules. This feature is available only in dScope and not on a target board using tScope. Before beginning this section, close dScope and return to uVision.

- 1) The program is listed in Figure 15. It is called *main.c*.
- 2) Using μ Vision File menu, enter this program and save it as *c:\c51eval\bin\main.c*.
- 3) Open the Project menu and start a new project called *keilex.prj*. Add *main.c* to the project and save this in the usual manner. This is illustrated in Figure 16.
- 4) Note that no options need to be set as they are set with the *#pragma* statement in *main.c*.
- 5) Click on Build All.
- 6) Open dScope and close the Watch and Memory windows. Open the performance and Serial I/O windows and position similar to Figure 17 or to your own preferences.
- 7) Select the 8051.dll and the object file *keilex*. Remember you can not select *mon51.dll*.
- 8) Enter *\$=main* in the Command Window. This step is optional but allows you to see the source.
- 9) Open the Setup menu and select *Setup Performance Analyzer*.
- 10) Enter the following function names in the Expr.: box::
indirect0, *indirect1*, *indirect2* and *main* each followed by clicking on *Define Range*.
- 11) Close this window.
- 12) Press *GO* and stand back !
- 13) The Serial Window displays some text and the Performance Analyzer will display three red lines showing the relative processor time spent in each of the four modules.
- 14) Click on RESET in the Toolbox box and the process will start over.

```

/* Siemens C504 example - David Lively,*/
/* main.c */

#pragma db oe sb cd
/* db == debug in OBJ */
/* oe == extended debug in OBJ */
/* sb == include symbols in OBJ */
/* cd == include assembly code in LST */
#include <reg51.h> */
#include <stdio.h> */
#include <stdlib.h> */

void indirect0(long d) {
    long count=0;

    for(count=0;count<d;count++);
}

void indirect1(long d) {
    long count=0;

    for(count=0;count<d;count++);
}

void indirect2(long d) {
    long count=0;

    for(count=0;count<d;count++);
}

void (*f)(long i); /* function pointer */
/* used to call a function at random */

void *farr[3] = {indirect0,indirect1,indirect2}; // array of function
addresses

void main(void) {
    long count=0;

    //initialize 8051 serial port
    SCON = 0x50;
    TMOD |= 0x20;
    TH1 = 0xf3;
    TR1 = 1;
    TI = 1;

    srand(64); // reseed random number generator

    printf("-- Start Execution -- \n");
    while(1) {
        f= farr[rand()%3]; // pick a function at random
        f(10000); // call the function and let it loop
    }
}

```

Figure 15

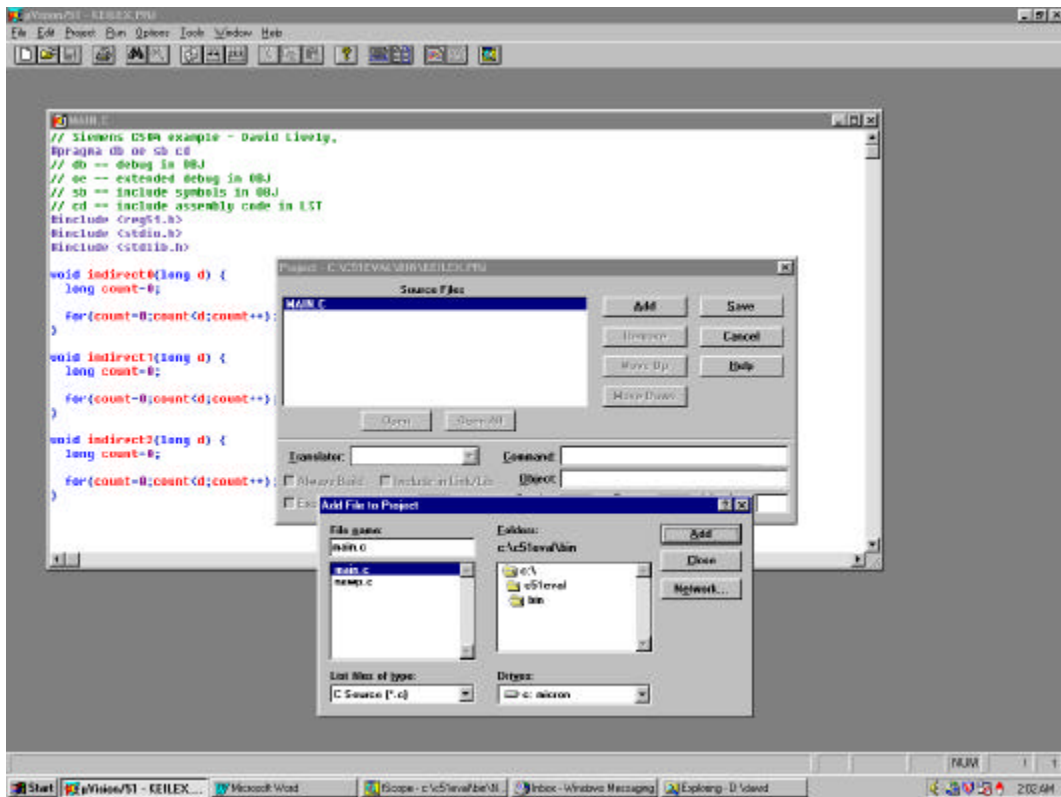


Figure 16

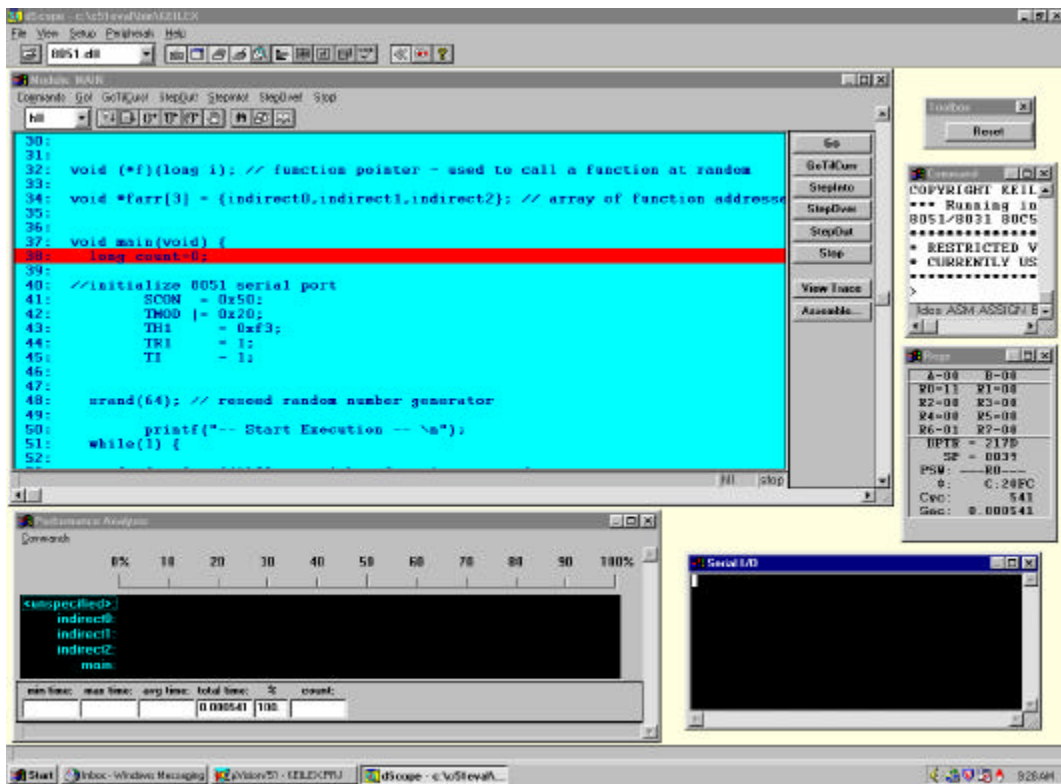


Figure 17

CONCLUSION

What else is there ?

Plenty...

- Open the Command option in the Debug window and notice you can select High Level Language, assembler or both (mixed) to be displayed and the trace. Note the trace only works for software simulation - tScope is unable to determine the actual bus values in your hardware.
- Open View and note the many windows you can open such as Watchpoints, Register, Performance Analysis and Code Coverage.
- Open Peripherals and you can see windows illustrating values of I/O Ports, Timers and counters.
- Open the Setup window and you can set many options such as the Performance Analyzer, Register sets, breakpoints and Watchpoints.
- On line Help is also available.
- An Application Note giving instructions on how to replace the RISM Eprom in the Intel evaluation board with your own code produced with Keil software. Get Application Note 111 from www.keil.com

What is next ?

Plenty...

- More sessions using C code will be prepared. More dScope features will be explored with more sophisticated programs.
- These will be available in October or November. Check www.keil.com/~market for further details.

For additional information on Keil software development tools, visit the Keil web site at : www.Keil.com. Check the Keil Marketing Group Web page at www.keil.com/~market for the latest in software for the C504 Starter Kit or the latest version of this document

For more information regarding the entire Keil tool chain.....see the Help file Evalkit.hlp located in the root of the Keil CD-ROM available free from Keil.

Any problems or questions ? Call us. We are here to help you with your Siemens C504 project.

Robert Boys, BBA, MIS, CMA
Shelley Potter, BBA, Marketing Assistant
Dallas, Texas
August 15, 1997

Siemens Support from Keil Software Inc. Dallas, Texas

Keil Software develops, manufactures, and distributes embedded software development tools for the C501 and the C166 microcontroller families. Tools include C compilers, Assemblers, Real-time Executives, Debuggers and Simulators, Integrated Environments, and Evaluation Boards. Keil has a training facility in Dallas for 8051 and 166 products. Keil provides distribution, product development, and technical support from its office in Dallas, Texas.

Keil's web site [www.keil.com] provides the latest information about our development tools, demo programs, software updates, application notes, example programs, and links to other sources of information. Also see www2.keil.com for our latest Beta site.

C51 and C166 C Compiler for the entire 8051 family and the C166 Family

The C51 and C166 is a full ANSI C compiler with assembler. μ Vision is the Windows User Interface that drives the optimizing C51 and C166. The Compiler, Assembler and Linker options are point and click. μ Vision and the manuals are written in the USA and extensive on-line help is included. Free technical support from Dallas via a 1-800 line is included for one year.

A51, A51: Macro Assemblers for all Keil supported microcontrollers

These three Macro Assemblers are included with their respective Compiler package or are available separately. All utilities needed to complete your project are included for all members of the assembler's family. These Assemblers are DOS based or can be run from μ Vision which is included with every Assembler and Compiler package.

μ Vision Integrated Development Environment - Windows based User Interface.

μ Vision is a USA developed Windows-based front end for all Keil Compilers and Assemblers. It includes an editor, project manager, and make facility. Compiler, assembler, and linker options are set by pointing and clicking on prompted selections. Program Manager conveniently accesses your files, and 3rd party executables and also calls the Keil Simulator dScope easing the transition from utility to utility. Works with Windows 3.11, 95 and NT.

dScope-Debugger and Simulator for the 8051 and 166. Windows or DOS based.

dScope is a source-level debugger that lets you debug programs created by Keil compilers. dScope simulates your program either in stand-alone mode or in your target using the monitor. External hardware, signals, and interrupts can be simulated. Viewable windows include View Program from I/O, Trace, Stack, Watch and CPU registers plus more.

TR51/FR51/FR166 Full-Function RTOS for the entire 8051 and 166 families

The RTX51 and RTX166 are a multitasking Real-time Operating Systems for the entire 8051 and 166 families. This powerful tool lets you manage multiple tasks on a single CPU. The RTX51 Full and RTX166 FULL includes CAN libraries. The RTX51 Tiny is a subset of the RTX51 Full as are the 166 versions. Functions include interrupt and memory management, clock, and semaphores. Royalty-free.

CAN Library

The RTX51 and RTX166 Full RTOS supports CAN controllers with the included libraries. The CAN libraries are sold with the RTOS. The CAN interface is becoming popular for automotive and industrial markets. 11 and 29 bit identifiers are supported. Keil 8051 C compilers interface with the RTOS and CAN libraries. Keil supports all CAN microcontrollers based on the Siemens C515C, C505C, C167CR the Philips 592 and the Intel 526 and 527.

Upgrades

Free updates for Keil compilers are available from the Web to registered users. Special upgrade prices are available for selected Franklin and Archimedes compilers. Call Keil for details on how to save money using this special program.

Keil Software

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