

TOPAS 900/L1 Starter Kit User Guide

Features:

- ✓ Installation instructions
- ✓ How to use the IDE
- ✓ Programming/debugging the MCU
- ✓ Starter kit PCB schematics

User Guide Category

- Flash Programmer
- Debugger/Simulator
- Starter Kit
- MCU

Introduction

This user guide describes how to install & utilize the TOPAS 900/L1 starter kit.

Inside are instructions on how to simulate, program & debug your application to one of the four-microcontroller units (TMP91FY12AF, TMP91FY22F, TMP91FY27U or the TMP91FY42F) supplied with this kit.

You will also find detailed hardware information, schematics & software examples enclosed to help aid you in your development process.

Toshiba 16-bit Series

- TLCS - 900/L1
- TLCS - 900/L
- TLCS - 900/H

**TMP91FY12AF
TMP91FY22F
TMP91FY27U
TMP91FY42F**

By:
Toshiba Electronics Europe GmbH
European LSI Design Eng. Center -
ELDEC
Support-MCU@tee.toshiba.de

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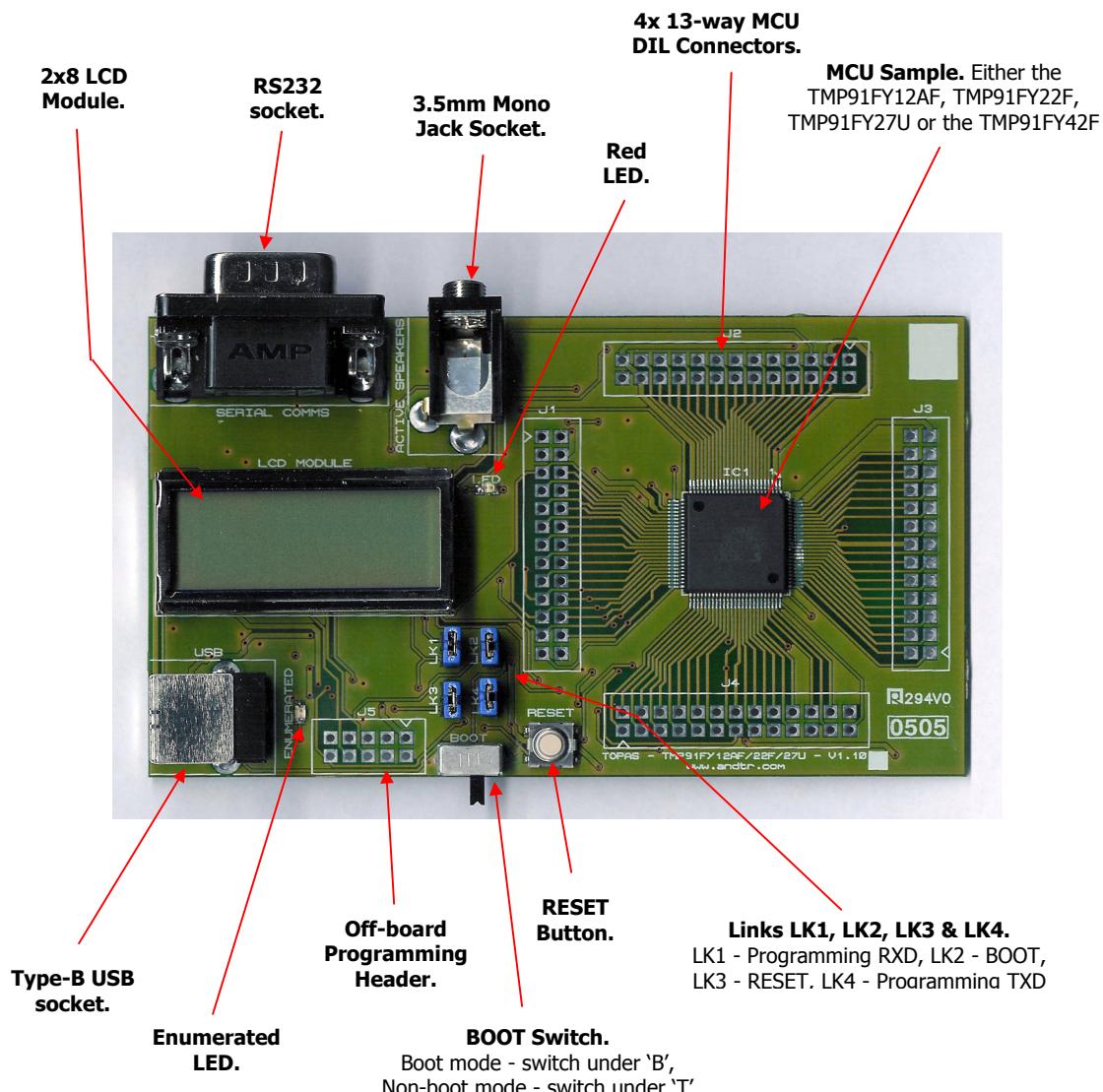
1. Starter Kit Contents

The Toshiba TOPAS 900/L1 Starter Kit contains:

- a. TOPAS 900/L1 evaluation board populated with one of the following MCU samples:
TMP91FY12AF, TMP91FY22F, TMP91FY27U or the TMP91FY42F.
- b. A/B USB cable.
- c. 4x 13-way straight double row header on a 0.1 inch pitch.
- d. 1x 5-way straight double row header on a 0.1 inch pitch.
- e. CD-ROM containing:
 - User guide.
 - Toshiba IDE with an integrated limited version of TLCS-900 compiler (3000 lines of code per file).
 - Flash programming utility (ToshLoad).
 - Data sheets & application notes.
 - Reference manuals for the compiler & simulator software.

If any of the above items are missing from this kit please contact your Toshiba distributor.

1.1. PCB



2. Installation

2.1. STARTER KIT

The Toshiba TOPAS 900/L1 Starter Kit connects to the PC via USB connection; therefore an appropriate driver installation process will need to take place in order for the computer to communicate with the kit.

To begin the USB driver installation process, insert the TOPAS 900/L1 CD-ROM into your drive. The CD should autorun & load up an introduction screen. Plug one end of the supplied USB cable into the starter kit's USB port & the other into a free USB port on the PC.

2.1.1. WINDOWS 2000/ME

- a. This should bring up the "Found New Hardware Wizard"; click the "Next" button. The new window will ask you "What do you want the wizard to do?" Select the "Search for a suitable driver for my device (recommended)" option & click the "Next" button.
- b. The subsequent window will ask you to "Locate Driver files". Select the "CD-ROM drives" option & click the "Next" button.
- c. The wizard should automatically find the driver for device, click "Next" to install. *If the wizard does not detect the driver files, they are located on the CD under the following path: ..\Software\USB Driver Installation Utility\TOPAS900L1 USB Driver Files*
- d. A Hardware Installation warning window will appear, alerting you that the Toshiba 900/L1 STK has not passed Windows Logo testing to verify its compatibility with Windows 2000/ME.



After reading the warning, click the Continue Anyway button.

- e. Click the "Finish" button, this completes the first part of installation during which the USB to serial converter is installed. The second part involves the installation of a serial port. This should follow on automatically once the converter installation is complete.
- f. To install the serial port part repeat steps b, c, d, & e. The driver files for the serial port are located in the same place as those just used to install the USB communication. Upon clicking the "Finish" button at stage e, all driver file installation will be complete. The Starter Kit will now be able to communicate with the PC.

2.1.2. WINDOWS XP

- a. A "Found New Hardware, Toshiba TOPAS 900/L1 STK" bubble will appear above the notification area on the Taskbar.
- b. If running Windows XP with Service Pack 2 (SP2) installed proceed onto step c, otherwise jump to step d.
- c. This should bring up the "Welcome to the Hardware Update Wizard" window, it will then ask you whether Windows can connect to Windows Update to search for software. Select the "No, not this time" option & click the Next button.
- d. The "Found New Hardware Wizard" window will activate. Select the "Install from a list or specific location (Advanced)" option & then click the Next button.

- e. Select the "Search removable media (floppy, CD-ROM...) option & click the "Next" button. The wizard should automatically find the driver for the device. *If the wizard does not detect the driver files, they are located on the CD under the following path:*
.. |Software|USB Driver Installation Utility|TOPAS900L1 USB Driver
- f. A Hardware Installation warning window will appear, alerting you that the Toshiba 900/L1 STK has not passed Windows Logo testing to verify its compatibility with Windows XP.

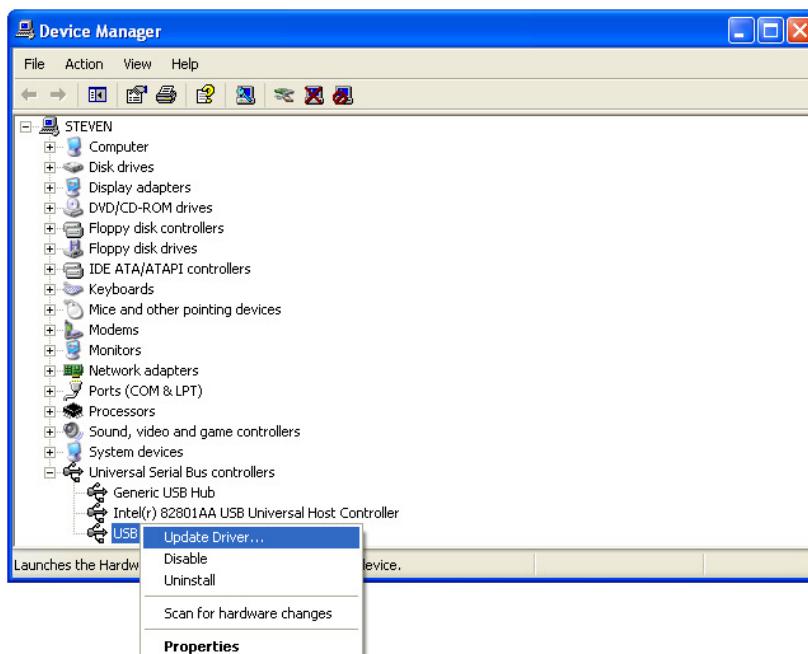


After reading the warning, click the Continue Anyway button.

- g. Click the "Finish" button, this completes the first part of installation during which the USB to serial converter is installed. The second part involves the installation of a serial port. This should follow on automatically once the converter installation is complete.
- h. To install the serial port part repeat steps d, e, f & g. The driver files for the serial port are located in the same place as those just used to install the USB communication. Upon clicking the "Finish" button at stage g, all driver file installation will be complete. The Starter Kit will now be able to communicate with the PC.

2.1.3. WINDOWS XP - AUTOMATICALLY INSTALLED DRIVERS

- a. Occasionally Windows XP will automatically recognise the starter kit & install it own pre-installed driver files to enable communication between the board & PC. However, we recommend using the manufacturer's driver files which are located on the CD (..|Software|USB Driver Installation Utility|TOPAS900L1 USB Driver Files).
- b. Keep the starter kit connected to the PC.
- c. From the Window XP Control Panel double click the "System" icon.
- d. Select the Hardware tab, & then click the "Device Manager" button.
- e. Expand both the Ports (COM & LPT) & Universal Serial Bus controllers headings.



- f. For the USB Serial Converter (located under the Universal Serial Bus controllers heading) right click & select the "Update driver..." option.
- g. This should bring up the Hardware Update Wizard. Select the "Install from a list or specific location (Advanced) option" & click the Next button.
- h. The next window will ask you to Locate Driver files. Select the "Search for the best driver in these locations" option. Depending on whether you decided to install the USB driver files to your Hard Disk drive or not affects which step to proceed with next.
 - i. **Installed driver files onto Hard Disk drive** - Select the "Include this location in the search" option & click the Browse button. On the next screen select the directory into which you copied the USB driver files & click ok. The wizard should find the driver for device, click Next to install.
 - ii. **Did NOT install USB driver files onto Hard Disk drive** - Select the "Search removable media (floppy, CD-ROM...)" option (ensure the TOPAS 900/L1 CD-ROM is in the drive) and click the Next button. The wizard should automatically find the driver for device, click Next to install. *If the wizard does not detect the driver files, they are located on the CD under the following path: ..\Software\USB Driver Installation Utility\TOPAS900L1 USB Driver Files*
- i. Click the finish button; updating of the USB Serial Converter driver will be complete.
- j. Carry out steps f, g, h & i except this time for the USB Serial Port (located under the Ports (COM & LPT heading). Upon clicking the Finish button at stage i, updating of necessary driver files will be complete.

2.2. TOSHIBA IDE

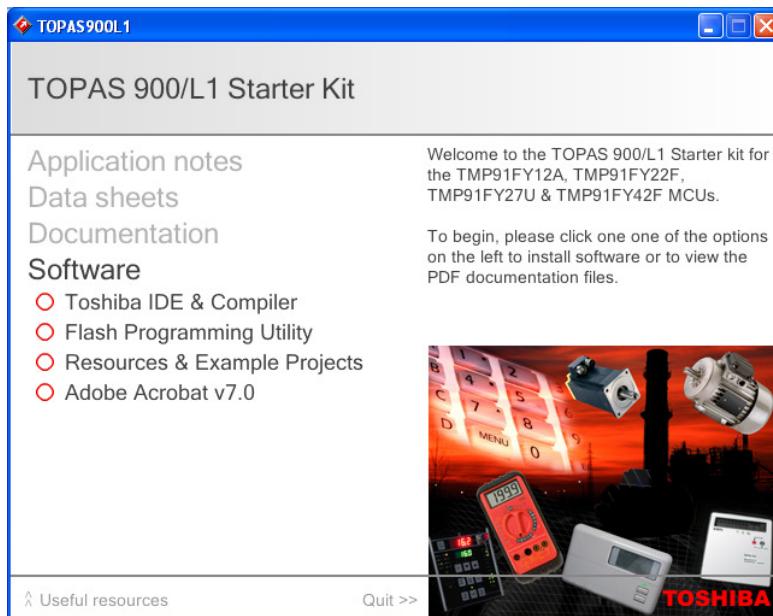
The Toshiba IDE is a complete embedded application development environment for the TOPAS 900/L1 Starter kit, offering project management, compiling, editing & debugging features. With a single mouse click your project can be re-compiled & linked to either a debug-able or programmable file ready for download to the TOPAS 900/L1 PCB.

Important points to note BEFORE installing the Toshiba IDE

- a. Ensure you are logged in to the "Administrator" account on the PC.
- b. If your PC already has the "TLCS-900 Family C Compiler Limited Version", or the "TLCS-900 Family IDE Limited Version" installed, please uninstall it before installing this version.
- c. If your PC already has the "TLCS-900 Family Integrated Development Environment" (normal version) installed, please beware that installation of the Toshiba IDE contained on the TOPAS 900/L1 CD-ROM will cause your normal version to be overwritten with the limited version contained on the CD.

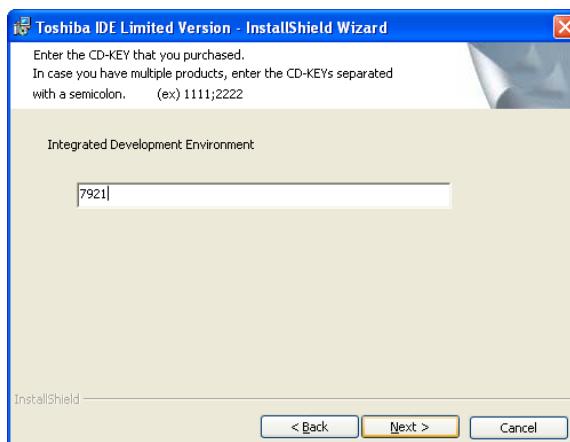
To install the limited version of the Toshiba IDE included with this kit, re-insert the TOPAS900/L1 CD, if you have removed it since hardware installation. The CD should begin its autorun sequence, if it does not:

- a. Start My Computer.
- b. Locate & open the CD/DVD ROM drive containing the TOPAS 900/L1 CD.
- c. Double-click the "TOPAS900L1.exe" icon.



Once the Installation utility is running select the "Software" option & then choose the Toshiba IDE & Compiler sub-option. Following your selection the Toshiba IDE InstallShield Wizard will begin.

- a. Click the "Next" button.
- b. Read the License agreement & select the "I accept the terms in the license agreement" option (providing you do accept the terms). Click the "Next" button.
- c. This screen requires you to enter the CD-KEY, which for the TOPAS 900/L1 starter kit is: 7921.



- d. Type in the number & then click the "Next" button.
- e. This screen shows that you have chosen to install the TLCS-900 Family Software Set for Starter Kit, click the "Next" button.
- f. Type in a User Name & Organisation & click the "Next" button.

- f. Choose the destination folder you would like the IDE to install into. *We recommend that you use the default setting.* Click the "Next" button.
- g. Finally click the "Install" button.

On completing these steps the limited version of the Toshiba IDE will be installed, ready for use.

2.3. FLASH PROGRAMMING SOFTWARE (ToshLoad)

ToshLoad is a software application that allows you to program the internal flash memory of the TOPAS 900/L1 starter kit's microcontroller.

To install the ToshLoad software included with this kit, re-insert the TOPAS900/L1 CD, if you have removed it since a previous hardware/software installation. The CD should begin its autorun sequence, if it does not:

- a. Start My Computer.
- b. Locate & open the CD/DVD ROM drive containing the TOPAS 900/L1 CD.
- c. Double-click the "TOPAS900L1.exe" icon.

Once the Installation utility is running select the "Software" option & then choose the Flash Programming Utility sub-option. Following your selection the ToshLoad Wise Solutions Installation Wizard will begin.

- a. Read the License agreement & agree to the terms by pressing the "Yes" button (providing you do accept the terms).
- b. Click the "Next" button.
- c. Choose the destination folder you would like ToshLoad to install into. *We recommend that you use the default setting.* Click the "Next" button.
- d. Decide which shortcut options you require. *We recommend that you use the default setting.* Click the "Next" button.
- e. Finally click the "Install" button.

On completing these steps the ToshLoad software will be installed, ready for use.

2.4. RESOURCES & EXAMPLE PROJECTS

The Toshiba TOPAS 900/L1 starter kit is bundled with a convenient utility that if selected saves a copy of all the resources, datasheets, schematics & example projects provided on the CD onto your hard drive. As well has having these resources saved to your hard disk, the utility will also create shortcuts to these objects in the MS Window Start Menu, providing you with effortless navigation to them.

To install the Resources & Example Projects included with this kit, re-insert the TOPAS900/L1 CD, if you have removed it since a previous hardware/software installation. The CD should begin its autorun sequence, if it does not:

- a. Start My Computer.
- b. Locate & open the CD/DVD ROM drive containing the TOPAS 900/L1 CD.
- c. Double-click the "TOPAS900L1.exe" icon.

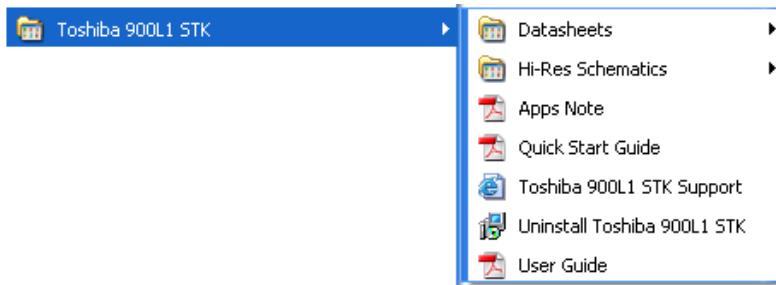
Once the Installation utility is running select the "Software" option & then choose the Resources & Example Projects sub-option. Following your selection the STK Documentation Setup Wizard will begin.

- a. Click the "Next" button to begin.
- b. Read the License agreement & select the "I accept the agreement" option (providing you do accept the terms). Click the "Next" button.
- c. Enter in your User Name & Organization, & then Click the "Next" button.
- d. Choose the destination folder you would like TOPAS 900/L1 resources to be installed into. *We recommend that you use the default setting.* Click the "Next" button.

- e. Decide which shortcut options you require. *We recommend that you use the default setting.* Click the "Next" button.
- f. Review the options that have you selected. If you unhappy with any of your choices click the "< Back" to amend. Otherwise click the "Install" button.

On completing these steps the TOPAS900/L1 Resources & Example Projects will be installed, ready for use.

The Resource can then be accessed in two ways, either via the Start Menu...



... or through MS Windows Explorer:



3. Description of STK Operation Modes

The Toshiba TOPAS 900/L1 starter kit it able to function in a number of different operation modes, allowing you greater flexibility when it comes to designing, debugging & running your embedded program code.

3.1. FLASH PROGRAMMING

Enables you to directly program your code, into the Flash memory of the MCU supplied with your kit via the USB connection. Once programmed the chip is then ready to run your code.

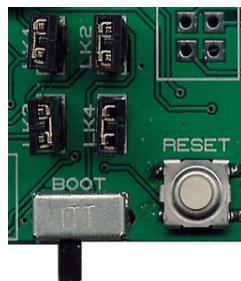
In order to begin Flash programming the device, you will need to make sure the PC is connected to the TOPAS 900/L1 PCB via the supplied USB cable & ensure links IK1 & IK4 are fitted while IK2 & IK3 are removed. Ensure the BOOT switch is in its boot mode position (see sub section below) & press the RESET button. Then simply use ToshLoad to download your code to the device.

Note: If you have installed version 1.26 or higher of the flash programming utility ToshLoad, then all links can remain fitted on the PCB as this & subsequent versions of the utility control the processor lines. However LK2 & LK3 **MUST** still be removed when using the ROM Monitor (see sub section below).

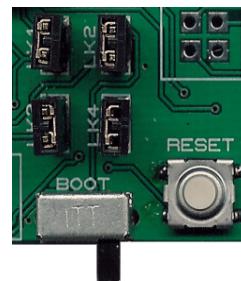
3.2. ROM MONITOR DEBUGGER (Int. RAM)

Enables you to step through & debug code as it is running in the hardware in real-time. Much like the software equivalent, you can set break points, step into & out of functions, giving you greater visibility to your code & insight into how it will perform when it is eventually ported to the device.

In order to run the ROM monitor you will need to make sure the PC is connected to the TOPAS 900/L1 PCB via the supplied USB cable & ensure links LK1 & LK4 are fitted, while LK2 & LK3 are removed. It is important to also make sure that the BOOT switch is in the non-boot mode position.



Boot switch: boot mode



Boot switch: non-boot mode,
required for ROM monitor

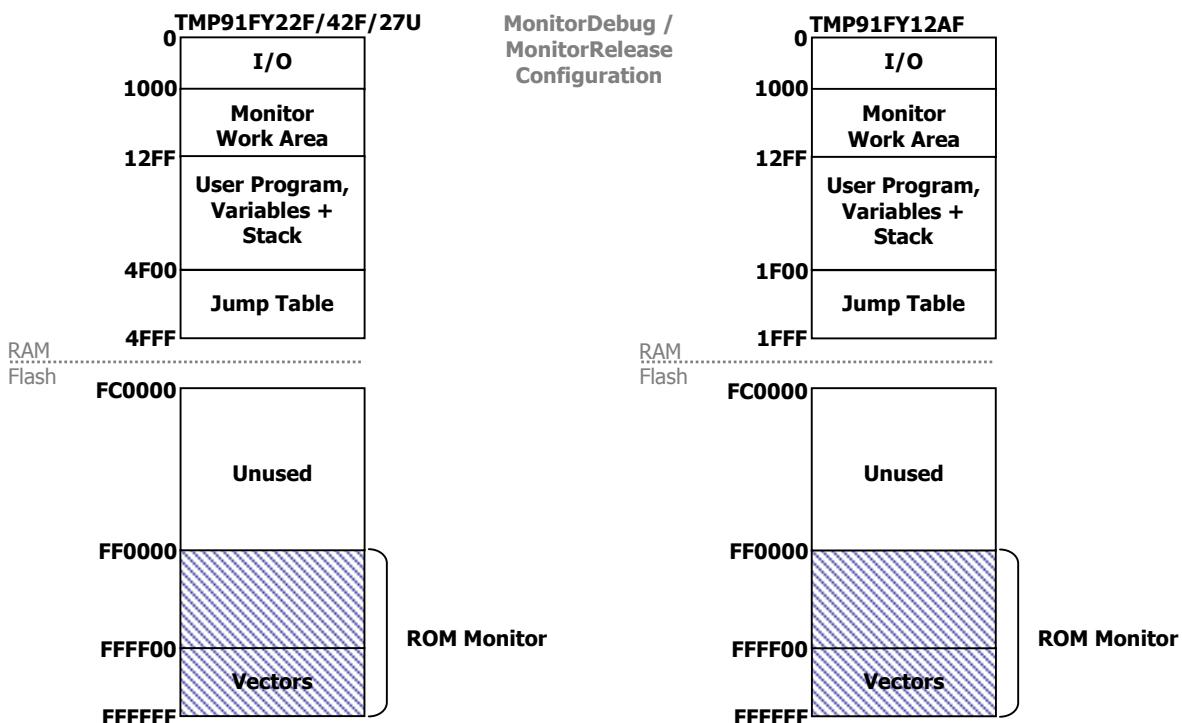
3.3. SIMULATOR DEBUGGER (Int. Flash)

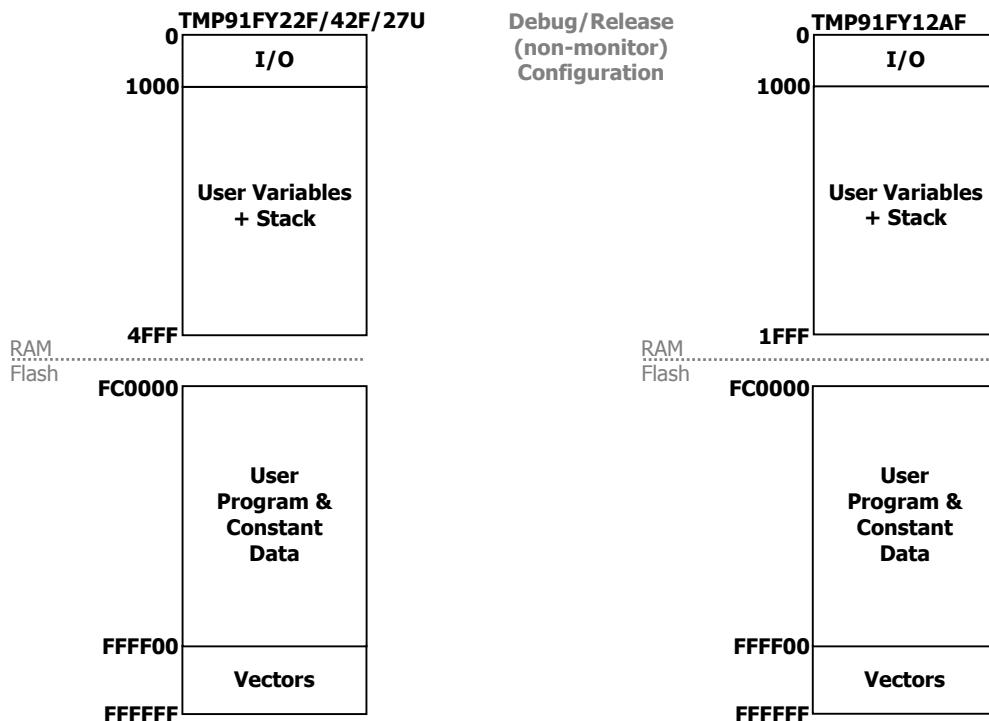
Enables you to replicate how your program code would run in the device but without actually having to download it to the TOPAS 900/L1 MCU. Because your program code is actually running in software you can utilise all of the IDE's debugging tools to debug & step through your code.

4. Description of ROM Monitor

4.1. MEMORY MAP

Below are the significant address locations for particular sections of memory relating to the ROM monitor.





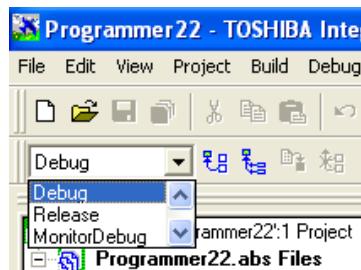
- ROM monitor (FF0000-FFFFFF) - Location in which the ROM monitor is stored (Flash Mem.).
- Variables & stack (1000-12FF) - ROM monitor's work area DO NOT write here.
- Interrupt vectors
 - TMP91FY12AF (1F00-1FFF)
 - TMP91FY22F/42F/27U (4F00-4FFF)

4.2. CONFIGURATION & PROJECT SETTINGS

All the software examples provided with the TOPAS900/L1 starter kit have a range of prepared configurations for use with the Toshiba IDE that the user can choose from, these include:

- Debug (does not require ROM monitor)
- Release (does not require ROM monitor)
- MonitorDebug (requires ROM monitor for internal debugging)
- MonitorRelease (requires ROM monitor for internal debugging)

To switch between the different configurations simply click on the Select Active Configuration drop-down box, located in the top right-hand corner of the screen, click on the desired configuration from the list & finally select Build & then Rebuild from the IDE main menu.



4.2.1. DEBUG

This is the default configuration used by the Toshiba IDE. The project source code is compiled & built with optimisations turned off, allowing for easier debugging, producing a Motorola S-

32 file (.s32) that can be programmed down to the TOPAS 900/L1 MCU using the flash programming utility ToshLoad.

_DEBUG is defined in the compiler options.

The Motorola S-32 file produced from the build process will be placed in a debug folder, located in the root of the project's workspace directory.

4.2.2. RELEASE

The project source code, when in Release configuration, is compiled & built with optimisations turned on. Producing a Motorola S-32 file that is ready for stand-alone deployment once programmed into the target microcontroller on the TOPAS 900/L1 PCB.

NDEBUG is defined in the compiler options.

The Motorola S-32 file produced from the build process will be placed in a release folder, located in the root of the project's workspace directory.

4.2.3. MONITORDEBUG

The project source code, when in MonitorDebug configuration, is compiled & built with optimisations turned off, allowing for easier debugging.

The MonitorDebug configuration requires the ROM monitor program to be download & installed into the TOPAS 900/L1 MCU first before the project source code can be executed, if you are unsure how to do this please consult the subsequent ROM MONITOR DEBUGGING section in this user manual.

_MONITOR,_DEBUG is defined in the compiler options.

The Motorola S-32 file produced from the build process will be placed in a MonitorDebug folder, located in the root of the project's workspace directory.

4.2.4. MONITORRELEASE

The project source code, when in MonitorRelease configuration, is compiled & built with optimisations turned on.

The MonitorRelease configuration requires the ROM monitor program to be download & installed into the TOPAS 900/L1 MCU first before the project source code can be executed, if you are unsure how to do this please consult the subsequent ROM MONITOR DEBUGGING section in this user manual.

_MONITOR,NDEBUG is defined in the compiler options.

The Motorola S-32 file produced from the build process will be placed in a MonitorRelease folder, located in the root of the project's workspace directory.

4.3. JUMP TABLE

When the ROM monitor is being used in the target micro the normal interrupt vectors are not directly accessible to the user, therefore a jump table has been implemented using TLCS-900 instructions in order to allow modification to the vectors.

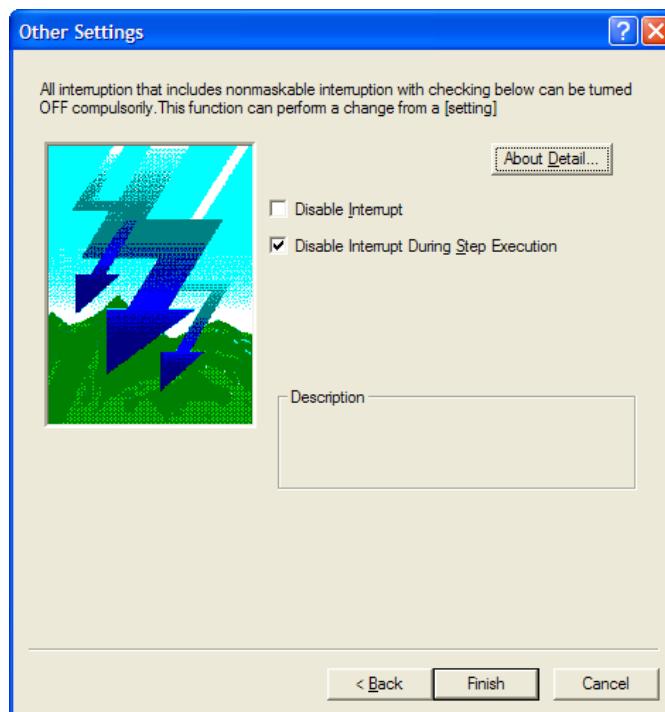
This procedure is implemented when MonitorDebug or MonitorRelease configurations are used. When in this mode the interrupt vectors for the TMP91FY12AF are located from 1F00-1FFF & for the TMP91FY22F/42F/27U are located from 4F00-4FFF in RAM, via the jump table.

If a non-monitor configuration is used the normal interrupt vector table is generated. Please see the Ini91FY12A.c, Ini91FY22.c, Ini91FY42.c & Ini91FY27.c files contained in the individual software examples for more information & also the MEMORY MAP section above.

4.4. RESTRICTIONS ON USE

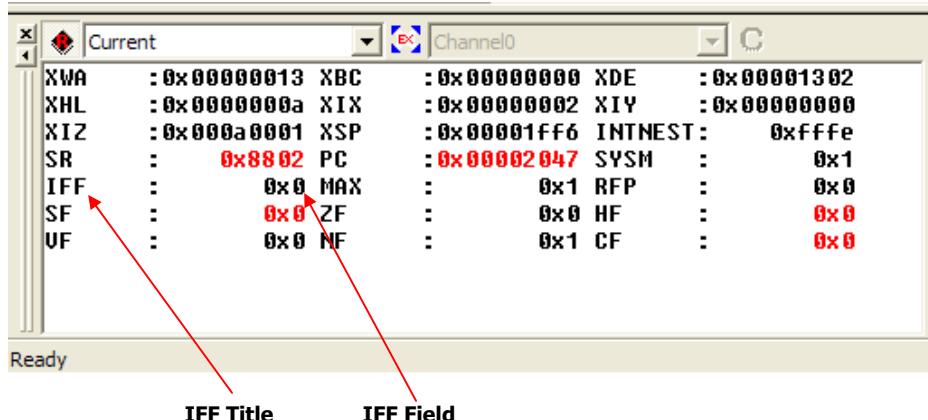
Additional to the limited memory space available the ROM monitor will also allocate some resources for itself. The following should be considered when using this optimised ROM monitor:

- a. Only 10 breakpoints should be active at any one time.
- b. 4 additional mappings only (instead of 16).
 - i. TMP91FY12AF. Internal RAM: 3328 bytes of free internal user RAM incl. vector table with a size of 256 bytes (monitor covers 18.8% of RAM address space only).
 - ii. TMP91FY22F/42F/27U. Internal RAM: 15616 bytes of free internal user RAM incl. vector table with a size of 256 bytes (monitor covers 4.7% of RAM address space only).
- c. The ROM monitor adds 42 bytes onto the user stack. Please note, when calculating stack size for debugging purposes.
- d. There is a guarded and write-protected area from 0x1000-12FF, utilised for the ROM monitor as its work area.
- e. The ROM monitor uses UART channel 1, TxD1 and RxD1.
- f. Interrupt priority level 6 must not be used by user program
- g. There is an additional interrupt latency of 80ns @ 25 MHz (all interrupts are re-routed via the jump table).
- h. The difference between a software and hardware reset should be considered:
 - i. All SFRs (Special Function Registers) are pre-initialised on hardware reset, during a software reset; only the PC (program counter) is reset. It is important to note that the SFRs after software-reset are in possibly faulty state, so that peripherals that are controlled by these SFRs may not work as expected. If you wish to debug your software under "real" conditions, like after performing a hardware reset, you must initialise all needed SFRs in the start-up routine (as early as possible in program execution after reset). This initialisation code can be located where the project is compiled for non-debugging environment.
- i. When creating a new ROM monitor debug profile, the Disable Interrupt & Disable Interrupt During Step Execution tick box options, do not directly affect the ROM monitor supplied with this version of the TOPAS 900/L1 starter kit.



In order to disable interrupts during step execution or indeed to disable interrupts altogether, you need to manually modify the IFF flag whilst debugging your project code, simply:

- i. Select View & then Register, to open the IDE's Register Window.
- ii. Locate the area of code you wish to disable interrupts to.
- iii. Note the current IFF value from the Register Window.
- iv. Set the IFF flag by directly clicking on the 0x? field to the right of the IFF title & type in your desired value (0x07 disables all interrupts).



- v. Continue stepping through your code.
- vi. Once you have finished debugging, restore the IFF flag to the value you noted down earlier BEFORE performing a GO action.

Important.

Ensure the IFF value is restored to its original value BEFORE performing a GO action, as there is a risk of disabling the UART & RX interrupts. This will prevent the ROM monitor receiving any commands from the Toshiba IDE utility.

5. Description of Development Stages

The Toshiba TOPAS 900/L1 starter kit offers numerous different development stages in order to get your project from the design stage into full implementation.

5.1. IDE: NEW PROJECT GENERATION WITH OPT. SETTINGS & FILE REGISTRATION

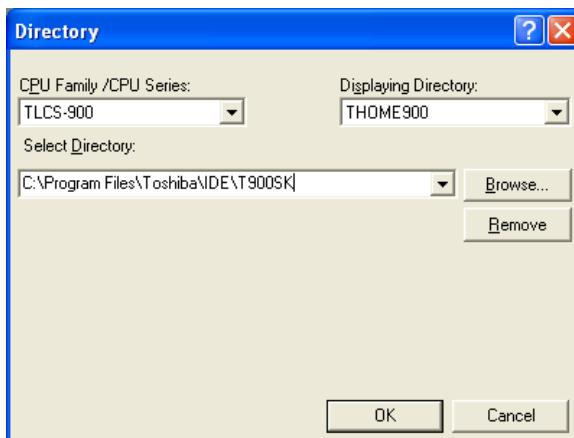
To begin, launch the Toshiba IDE by proceeding to the Start button on the Microsoft Windows Task Bar. Located the TOSHIBA IDE folder & click on the TOSHIBA IDE program title.

Important.

If this is the first time you have run the Toshiba IDE limited version after initially installing the software, it is important to make sure that the tool path setting for the IDE is set correctly, otherwise the following error message will appear when trying to compile a project.

E-008-0400:Can't execute "cc900..."

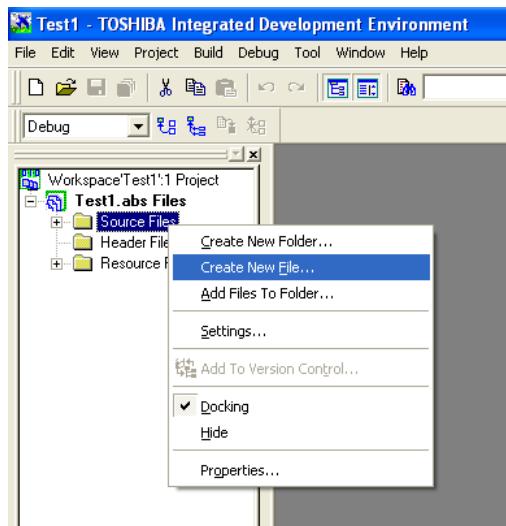
To check this, choose the Tool option from the main menu & select Option & then Directory..., this will launch the Directory window. Set the THOME900 directory to point to the T900SK file, by default this file is located "C:\Program Files\Toshiba\IDE\T900SK". However, if the default path in the Select Directory text box is blank, or points to a different drive from the one you specified when installing the Toshiba IDE, either browse for the T900SK file by clicking the Browse button or directly type in the default path above into the text box (substituting the drive letter, if need be, for the drive you installed the Toshiba IDE software to). Click the OK button.



With the tool path set, select File & then New to begin a new project.

Select Project as the File Type, specify a name for the project & then select a location to save the workspace to. *We recommend that you use the default setting.* On the next screen, select the TLCS-900 family as the CPU family & click the Next button. Finally click the Finish button to create the workspace.

Your workspace is now ready for you to begin code development work, to add a new C source file or C include/header file to the project simply select File & then New from the main menu. Decide upon which type of file it is you require & then name the file, once your happy with your selection click the OK button. An alternative method to the File > New approach is to right-click on the project folders and select Create New File...



5.2. IDE: LOADING AN EXISTING PROJECT

To load an existing project, there are two alternative approaches:

- a. Launch the Toshiba IDE by proceeding to the Start button on the Microsoft Windows Task Bar, Locate the TOSHIBA IDE folder & click on the TOSHIBA IDE program title. Once the program has finished loading, select File & then:
 - i. Open - to browse your hard drive(s) for an existing project.
 - ii. Recent Workspaces - to browse a list of the last 4 (by default) recently opened projects.
- b. Double-click a file with an associated file extension such as a *.tws (Toshiba WorkSpace) file or a *.tpr (Toshiba PProject) file in Windows Explorer.

5.3. REBUILDING PROCESS (ASSEMBLER, COMPILER, LINKER & CONVERTER)

There are three main code-building processes available in the Toshiba IDE, Compile, Build & Rebuild.

The Compile command can only be used to compile individual files. The specific file to be compiled does not have to be part of a project in order to be compiled. To invoke a compile on a file either; double click that file from the tree display in the Workspace window & then select Build & then Compile from the main menu or right-click the file in the same Workspace window & select Compile.

If you require compiling & linking on source file groups in a project in order to produce object files (.abs or .lib), execute Build or Rebuild on that project.

The Build process performs compiling & linking only on files, which have had changes since the previous build.

When executing a Rebuild command, compiling & linking is performed on all files in the specified project. Also, project dependency is checked, & when there is a project on which the specified project depends, the project is built first before the specified project is built.

In order to perform a Build (or Rebuild)

- a. Check that the Active Configuration is set as desired (you can switch easily between configurations by selecting the desired configuration from the drop-down menu located just above the Workspace window).
- b. Select Build from the main menu.
- c. Select Build.
- d. *To stop building select Cancel Build from the Build menu.*

If an `E-008-0400:Can't execute "cc900..."` error message appears in the Build window located toward the bottom of the screen then the tool path setting for the IDE has been set incorrectly. Please see the IDE: NEW PROJECT GENERATION WITH OPT. SETTINGS & FILE REGISTRATION section to resolve the issue.

5.4. JUMPER SETTINGS

LK1, LK2, LK3 & LK4, when connected, routes signals to the processor. Disconnecting these links disables the communications to the processor. Each link controls an associated signal:

- LK1 - Programming RXD
- LK2 - BOOT
- LK3 - RESET
- LK4 - Programming TXD

By default, your starter kit PCB will be shipped with LK1 & LK4 fitted while LK2 & LK3 are not fitted. Please ensure this setting when debugging any applications or project examples.

5.5. ROM MONITOR DEBUGGING

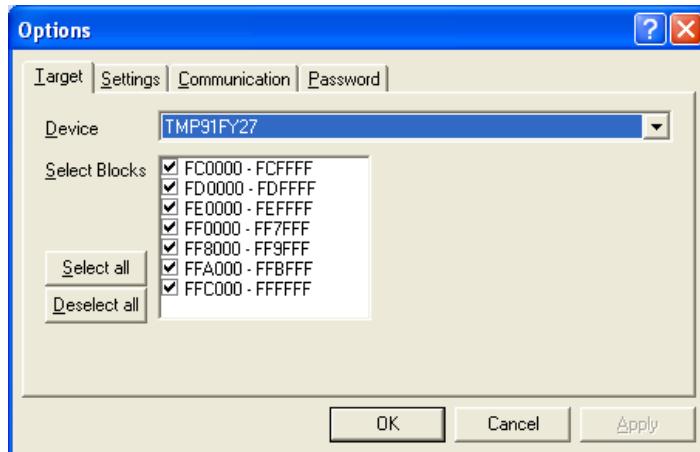
In order to begin using the ROM monitor debugging facilities in the Toshiba IDE, we first need to program the Flash memory on the target microcontroller, with the ROM monitor file.

To begin, connect the TOPAS 900/L1 PCB to the PC via the supplied USB cable. Launch the ToshLoad program by proceeding to the Start button on the Microsoft Windows Task Bar, locate the Segger folder & click on the ToshLoad program title.

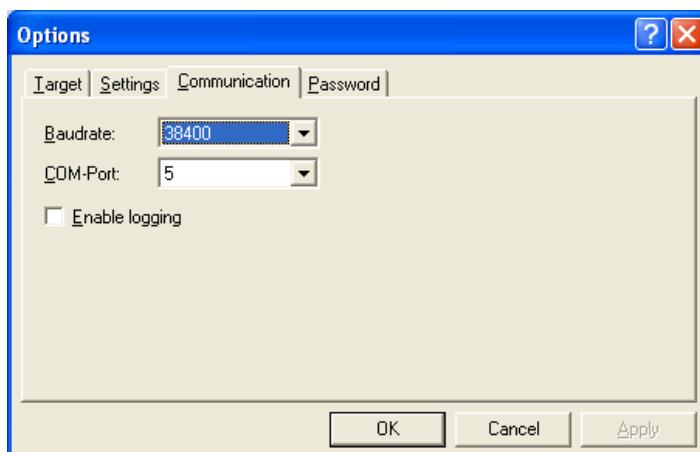
Before we can begin to download the ROM monitor into the Flash memory of the MCU, we need to check/change some of the ToshLoad default settings.

- a. Select Options from the Main Menu in ToshLoad.

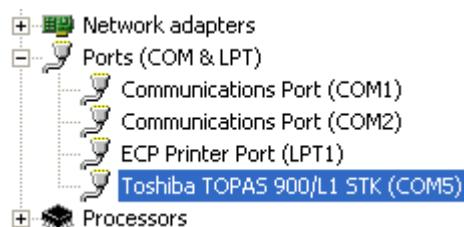
- b. Click on the Target tab & select a device from the drop-down box that corresponds to the device fitted to the Toshiba 900/L1 starter kit, either the TMP91FY12A, TMP91FY22, TMP91FY27 or the TMP91FY42F. Ensure all the Select Block options are selected for the target device.



- c. Click on the Settings tab. Ensure that the User should not be asked to press reset tick-box is selected.
d. Click on the Communication tab. Set the Baudrate to **38400** & ensure the Com-Port is set to the port number the starter kit has been installed & assigned to.



If you are unsure as to which COM port the Toshiba 900/L1 starter kit has been assigned to, load up the Microsoft Windows Control Panel, double-click the System icon & under the Hardware tab select the Device Manager. Locate the Ports (COM & LPT) heading & expand the tree associated with it. Within this sub-heading there will be a Toshiba TOPAS 900/L1 STK (COM?) heading. The COM number specified in the heading is the COM port the Toshiba 900/L1 starter kit has been assigned to.

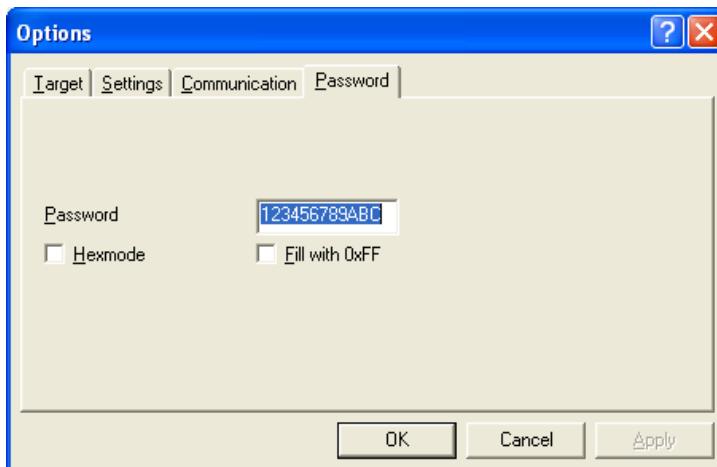


e. Finally, click on the Password tab:

- i. **If you have selected the TMP91FY42F as the target device** - Type in a Password of **123456789ABC**. Ensure the Hexmode & Fill with 0xFF tick-boxes are left blank.

Important.

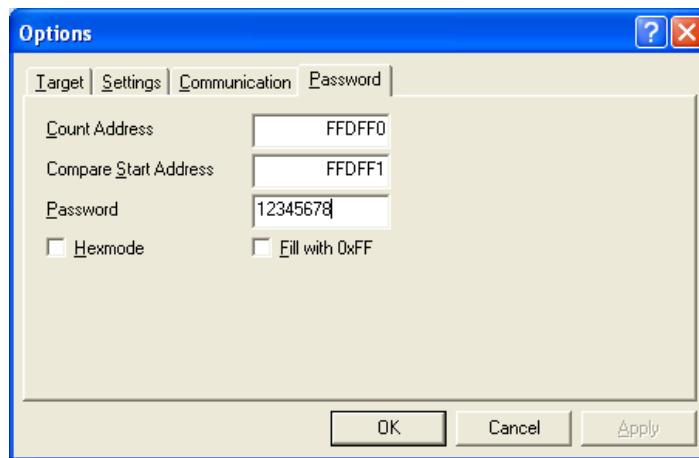
Ensure that the Password is entered correctly, as invalid information could render the microcontroller useless once programmed.



- ii. **If you have selected the TMP91FY12A, TMP91FY22 or TMP91FY27 as the target device** - Type in a Count Address of **FFDFF0**, a Compare Start Address of **FFDFF1** & a Password of **12345678**. Ensure the Hexmode & Fill with 0xFF tick-boxes are left blank.

Important.

Ensure that the Count Address, Compare Start Address & Password data is all entered correctly, as invalid information could render the microcontroller useless once programmed.

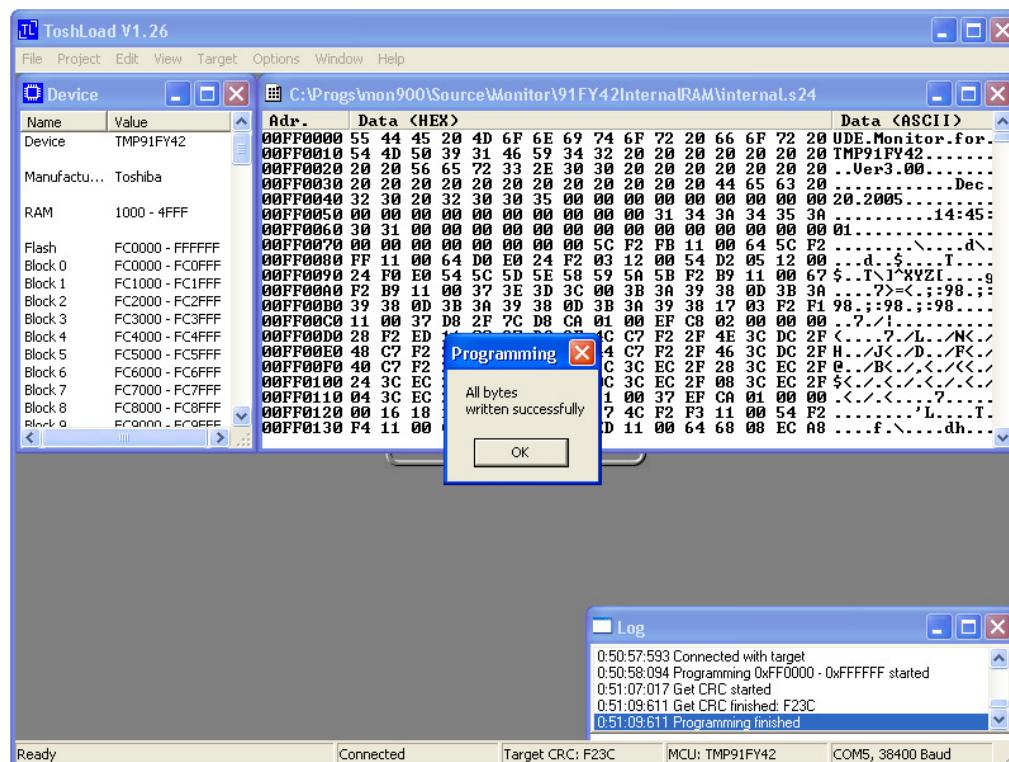


f. Click the OK button.

With the correct ToshLoad settings set, we can now begin the process of programming the Flash memory of the target microcontroller with the ROM monitor file.

- a. Select File & then Open from the Main Menu in ToshLoad.

- b. Locate the Folder containing the ROM monitor file that corresponds to the microcontroller fitted to your starter kit PCB. Depending on whether you decided to install the Resources & Example Projects option from the CD affects which step to proceed with next.
- Installed the Resources & Example Projects option from the CD –**
Open the Program Files folder on your hard drive & locate the Toshiba 900L1 STK folder, double-click to open it. Locate the relevant Monitor sub-folder & open then that.
 - Did NOT install the Resources & Example Projects option from the CD -** Insert the Toshiba 900/L1 CD into your CD-ROM drive, start My Computer & choose to Explore the TOPAS900L1 CD. Locate the Software Folder & double-click to open it. Locate the relevant Monitor sub-folder & then open that.
- c. Select the **internal.s24** file & click Open. The ROM monitor file has now been loaded into ToshLoad ready to be programmed into the MCUs Flash memory.
- d. It is good practise to ensure memory on a device is erased before downloading new code to it so, select Target from the ToshLoad main menu & then select Erase Chip*.
- e. Once the process of erasing the chip has completed select Target again from the main menu, but this time select Program. This command will download the ROM monitor file into the flash memory of the microcontroller fitted to the starter kit PCB.
- f. Once programming has finished successfully, click the ok button.



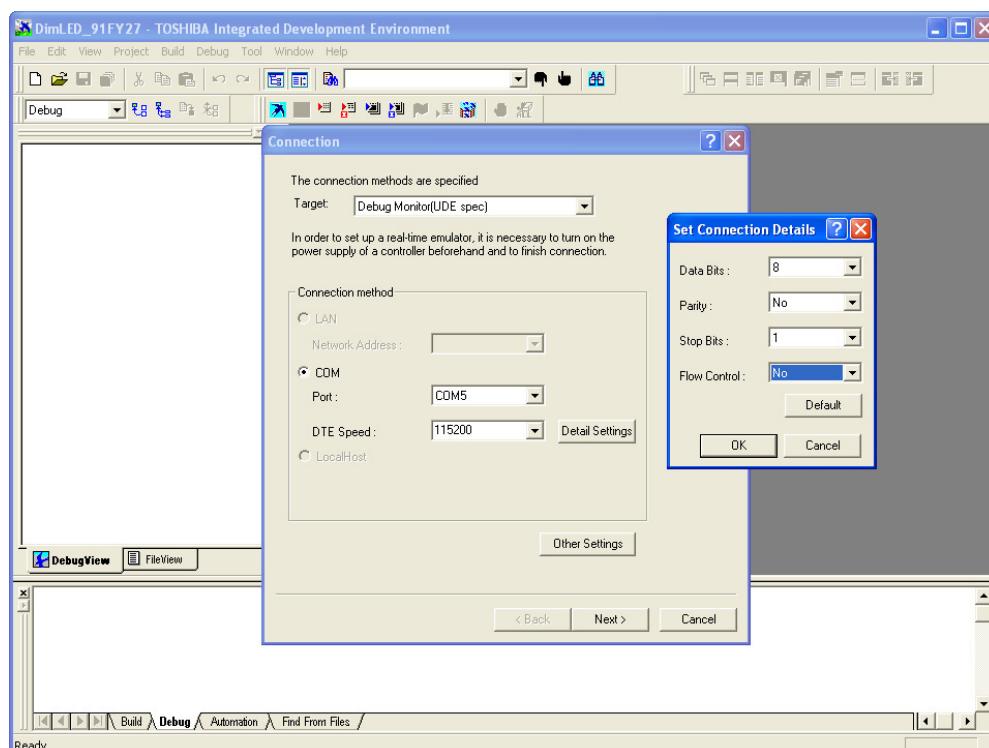
With the ROM monitor successfully installed into the Flash memory of the microcontroller, we now need to setup a debugging profile in the Toshiba IDE to enable ROM monitor debugging of the source code.

- To begin close ToshLoad (if still open).
- Ensure Links LK1 & LK4 are fitted, while LK2 & LK3 are removed.
- Move the BOOT switch on the Toshiba 900/L1 starter kit PCB into the non-boot mode position (See ROM MONITOR DEBUGGER (Int. RAM) section above) & press the reset button to initialise the ROM monitor program. The red LED will begin flashing at a rate of 1Hz as an indication that the ROM monitor is running. If it fails to start flashing try reprogramming the ROM monitor down to the device again.

- d. Launch the Toshiba IDE by proceeding to the Start button on the Microsoft Windows Task Bar, Locate the TOSHIBA IDE folder & click on the TOSHIBA IDE program title.
- e. Open an existing project that you want to debug by selecting File & then Open Workspace from the Toshiba IDE Main Menu.
- f. Ensure that the MonitorDebug target configuration is selected (see the Description of ROM Monitor, CONFIGURATION & PROJECT SETTINGS section above for more information).
- g. In the Workspace Window, located by default to the left of the screen, click on the DebugView tab, then inside that window right-click once on the mouse & select the Create new Debug Profile option. *Alternatively, select Debug & then Start Debugging from the main menu.*



- h. The next step is to specify the connection settings for the debug profile. Set the COM Port to the port number the starter kit has been installed & assigned to also set the DTE Speed to **115200** from the drop-down menu.
- i. Click the Detail Settings button & ensure that the Data Bits have been set to **8**, the Parity to **No**, the Stop Bits to **1** & Flow Control to **No**. Once these settings have been confirmed click OK to close the Detail Settings window & then click Next >.



- j. Click the Next > button on the Detected Target screen.
- k. If a DbgNew warning message appears, click Yes.

- I. The Memory mapping window will appear allowing you to change the memory arrangement. *We recommend that you use the default setting.* Click Next >.
- m. Click the Next > button on the Load setting screen.
- n. Click the Next > button on the Moving control screen.
- o. Finally, click the Finish button. The Toshiba IDE will then probably ask to rebuild some of the project files in light of the changes made to the project, click the Yes button.

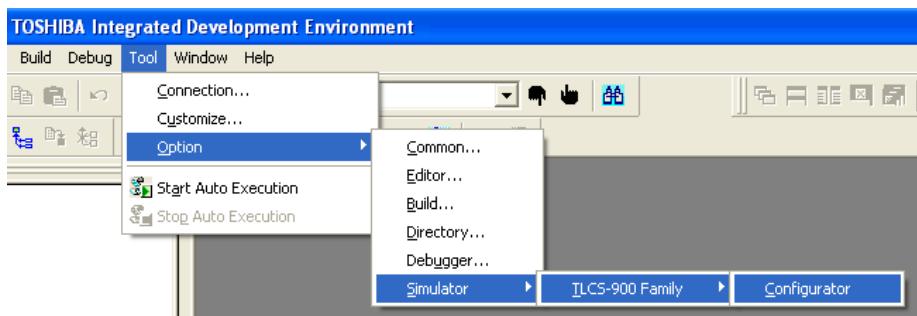
After an initial build process, the integrated debugger will then automatically download the project executable into the RAM area of the Toshiba 900/L1 starter kit device, ready for ROM monitor debugging by the user. To stop the debugger simple select Debug & then Stop Debugging from the main menu in the Toshiba IDE.

*If a communications error appears at this stage remove LK3 & re-try.

5.6. SIMULATOR DEBUGGING

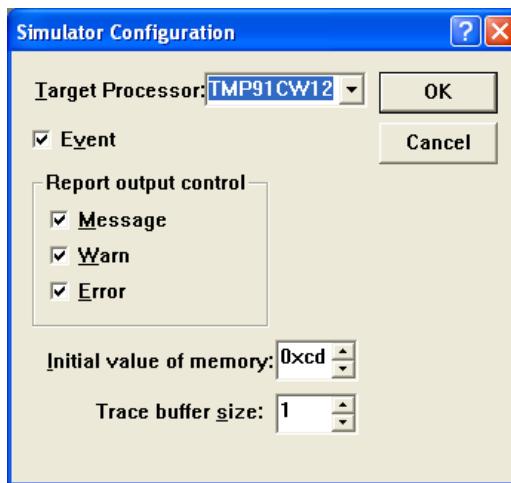
To begin simulator debugging we need to create a simulator debug profile, similar to the ROM monitor debug profile (see above), in the Toshiba IDE. In this instance however, there is no longer the requirement to connect the Toshiba 900/L1 starter kit PCB to the PC because the hardware will be simulated in the IDE.

- a. To begin launch the Toshiba IDE by proceeding to the Start button on the Microsoft Windows Task Bar, Locate the TOSHIBA IDE folder & click on the TOSHIBA IDE program title.
- b. Open an existing project that you want to debug using the simulator by selecting File & then Open Workspace from the Toshiba IDE Main Menu.
- c. Before you can begin to create a simulator debug profile, we need to configure some of the simulator's settings. Select Tools from the Toshiba IDE's main menu, then Option, then Simulator, TLCS-900 Family & then finally Configurator.



- d. In the Simulator Configuration window select the Target Processor that you wish to simulate.
 - i. If you wish to simulate the TMP91FY12AF, TMP91FY22F or TMP91FY42F processors select the **TMP91CW12** option
 - ii. If you wish to simulate the TMP91FY27U processor select the **TMP91FY27U** option.

Ensure that the Event, Message, Warn & Error tick-box options are all selected. Also check that the Initial value of memory is set to 0xcd & the Trace buffer size is set to 1.



- e. Click the OK button.
- f. In the Workspace Window, located by default to the left of the screen, click on the DebugView tab, then inside that window right-click once on the mouse & select the Create new Debug Profile option. *Alternatively, select Debug & then Start Debugging from the main menu.*



- g. In the Connection window select Simulator as the Target & then click Next >.
- h. Ensure the processor you wish to simulate is selected from the Processor Name drop-down box, then click the Next > button.
- i. If a DbgNew warning message appears, click Yes.
- j. The Memory mapping window will appear allowing you to change the memory arrangement. *We recommend that you use the default setting.* Click Next >.
- k. Click the Next > button on the Load setting screen.
- l. Click the Next > button on the Moving control screen.
- m. Finally, click the Finish button. The Toshiba IDE will then probably ask to rebuild some of the project files in light of the changes made to the project, click the Yes button.

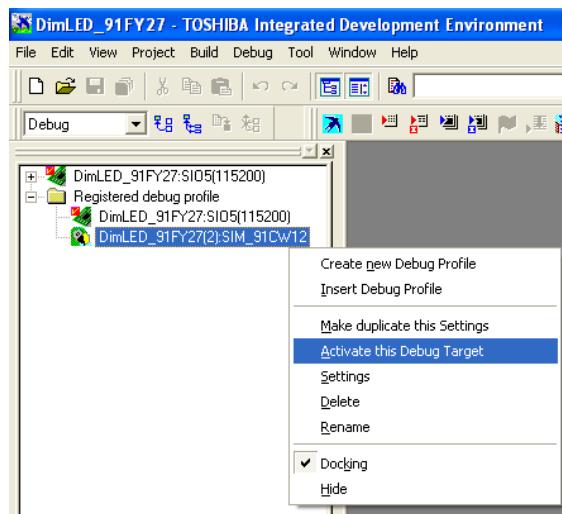
After an initial build process, the simulator will then automatically begin to run, simulating your project code as it would run in the target silicon. To stop the debugger simple select Debug & then Stop Debugging from the main menu in the Toshiba IDE.

5.7. SWITCHING FROM ROM MONITOR TO SIMULATOR DEBUGGING METHOD

The Toshiba IDE allows you to switch between multiple types of debugging methods. To add a second debugging method to your debug view (if you have only 1 setup) simply right-click the Registered debug profile folder in the Workspace Window & select the Create new Debug Profile option. Setup either a simulator debug profile if you have a ROM monitor debug profile created & visa-versa if you already have a simulator debug profile created. *If you are unsure as to how to create either a simulator or ROM monitor debug profile please see above.*

With two different types of debug profile created, switching between the two is relatively straightforward.

- a. Ensure the debugger is not currently running. If it is, select Debug & then Stop Debugging from the main menu in the Toshiba IDE.
- b. Expand the Registered debug profile folder, either by double-clicking on it or by single-clicking the plus-box to the left of it.
- c. Select the debug profile you wish to use by single-clicking on it. (Hint: a simulator debug profile is normally marked with SIM_... in its title)
- d. Right-click the same debug profile you just selected in the step above & select the Activate this Debug Target option.
- e. A small red tick icon will then be added to that profile to signify that this debugging method has been set as the active debug target.
- f. Select Debug & then Start Debugging from the main menu in the Toshiba IDE, to start debugging using that debug profile.



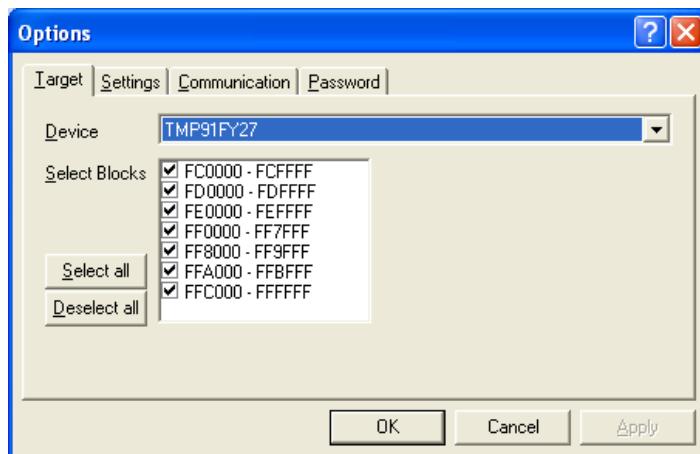
5.8. FLASH PROGRAMMING

To flash programme the memory of the microcontroller fitted to the Toshiba 900/L1 starter kit PCB we need to use the ToshLoad utility.

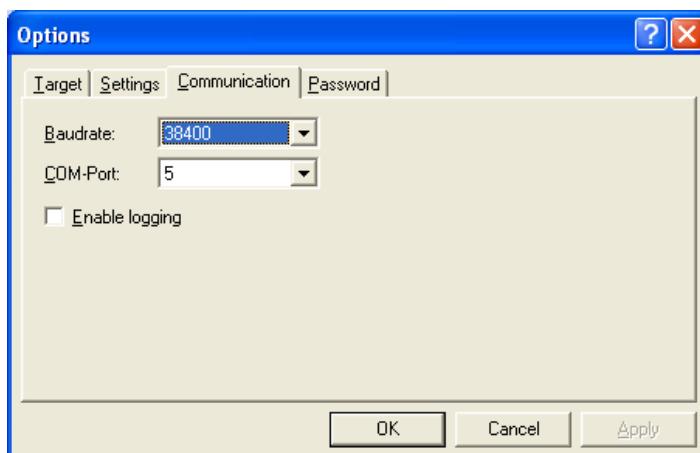
To begin, connect the TOPAS 900/L1 PCB to the PC via the supplied USB cable. Launch the ToshLoad program by proceeding to the Start button on the Microsoft Windows Task Bar, locate the Segger folder & click on the ToshLoad program title.

Before we can begin to download a file into the Flash memory of the MCU, we need to check/change some of the ToshLoad default settings.

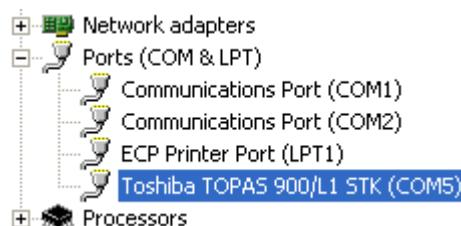
- a. Select Options from the Main Menu in ToshLoad.
- b. Click on the Target tab & select a device from the drop-down box that corresponds to the device fitted to the Toshiba 900/L1 starter kit, either the TMP91FY12A, TMP91FY22, TMP91FY27 or the TMP91FY42F. Ensure all the Select Block options are selected for the target device.



- c. Click on the Settings tab. Ensure that the User should not be asked to press reset tick-box is selected.
- d. Click on the Communications tab. Set the Baudrate to **38400** & ensure the Com-Port is set to the port number the starter kit has been installed & assigned to.



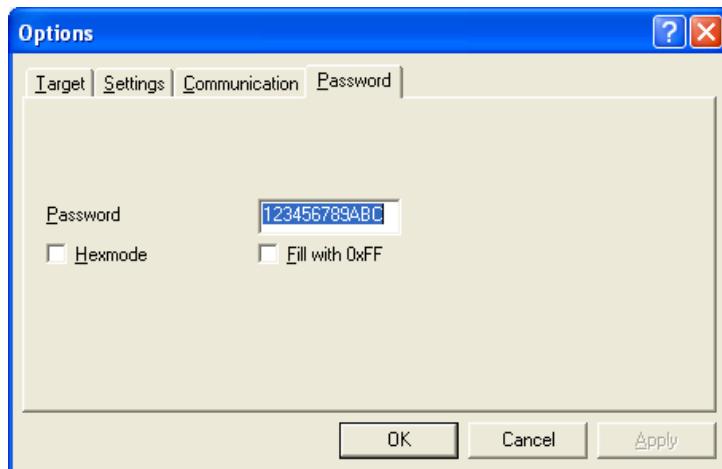
If you are unsure as to which COM port the Toshiba 900/L1 starter kit has been assigned to, load up the Microsoft Windows Control Panel, double-click the System icon & under the Hardware tab select the Device Manager. Locate the Ports (COM & LPT) heading & expand the tree associated with it. Within this sub-heading there will be a Toshiba TOPAS 900/L1 STK (COM?) heading. The COM number specified in the heading is the COM port the Toshiba 900/L1 starter kit has been assigned to.



- e. Finally, click on the Password tab:
 - i. **If you have selected the TMP91FY42F as the target device** - Type in a Password of **123456789ABC**. Ensure the Hexmode & Fill with 0xFF tick-boxes are left blank.

Important.

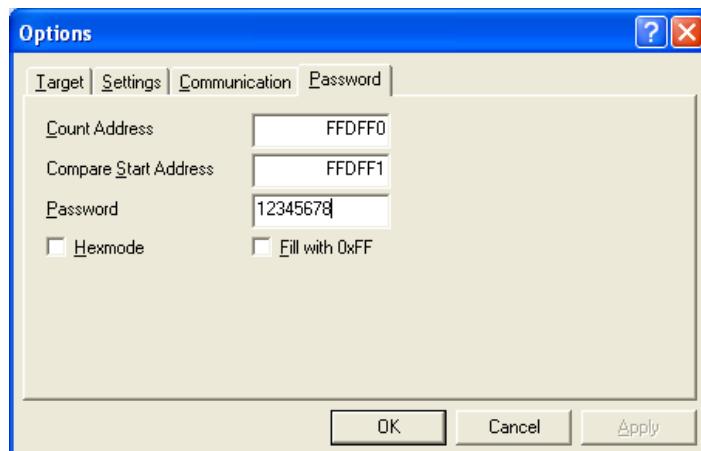
Ensure that the Password is entered correctly, as invalid information could render the microcontroller useless once programmed.



- ii. **If you have selected the TMP91FY12A, TMP91FY22 or TMP91FY27 as the target device** - Type in a Count Address of **FFDFF0**, a Compare Start Address of **FFDFF1** & a Password of **12345678**. Ensure the Hexmode & Fill with 0xFF tick-boxes are left blank.

Important.

Ensure that the Count Address, Compare Start Address & Password data is all entered correctly, as invalid information could render the microcontroller useless once programmed.



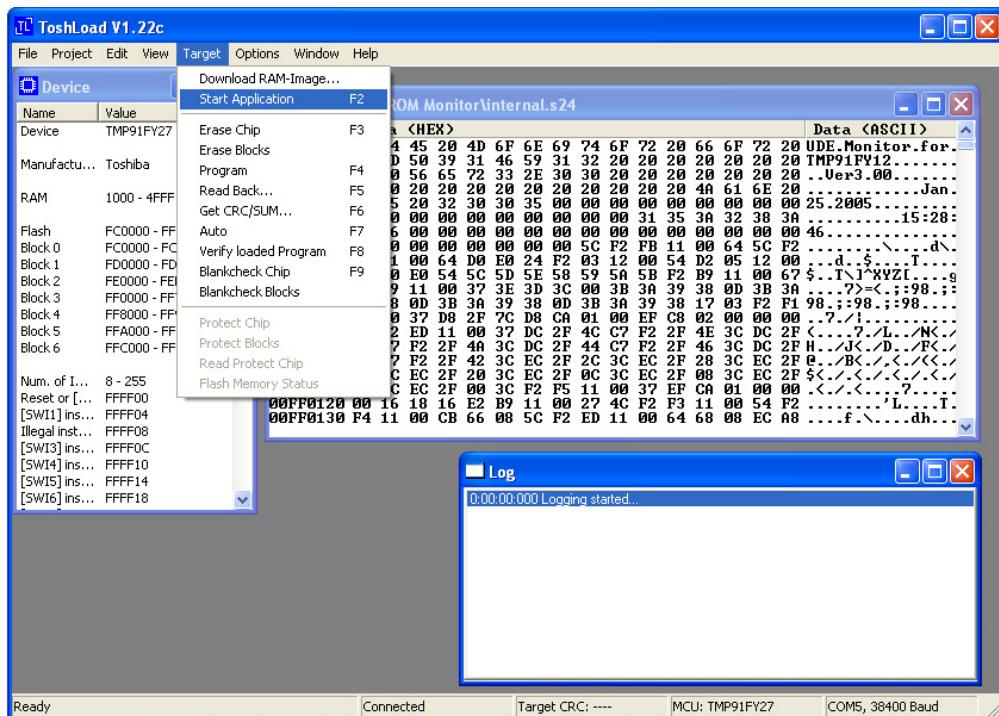
- f. Click the OK button.

With the correct ToshLoad settings set (these will be retained even if ToshLoad is closed down), we can now begin the process of programming the Flash memory of the target microcontroller.

- g. Select File & then Open from the Main Menu in ToshLoad.
- h. Locate the Motorola S-32 or S-24 (.s32 or s.24) format file you wish to download to the target microcontroller & click open. The file will then be loaded into ToshLoad ready to be programmed into the MCUs Flash memory.
- i. It is good practise to ensure memory on a device is erased before downloading new code to it so, select Target from the ToshLoad main menu & then select Erase Chip.
- j. Once the process of erasing the chip has completed select Target again from the main menu, but this time select Program. This command will download the file into the flash memory of the microcontroller fitted to the starter kit PCB.

k. Once programming has finished successfully, click the ok button.

To execute the program you have just downloaded into the flash memory you can either press the RESET button on the PCB or perform a software reset by selecting Target & then Start Application from the ToshLoad main menu.



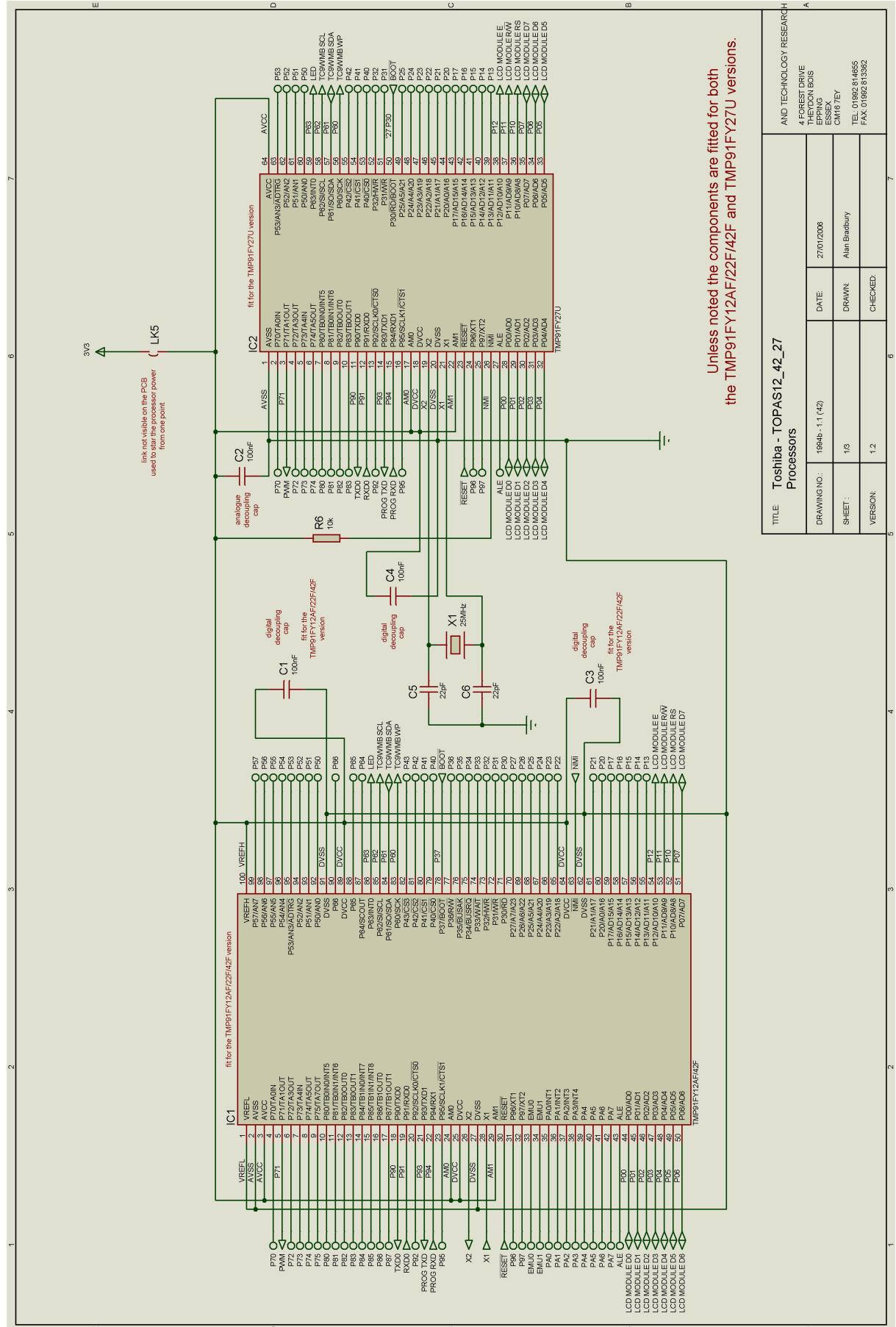
6. Description of Hardware

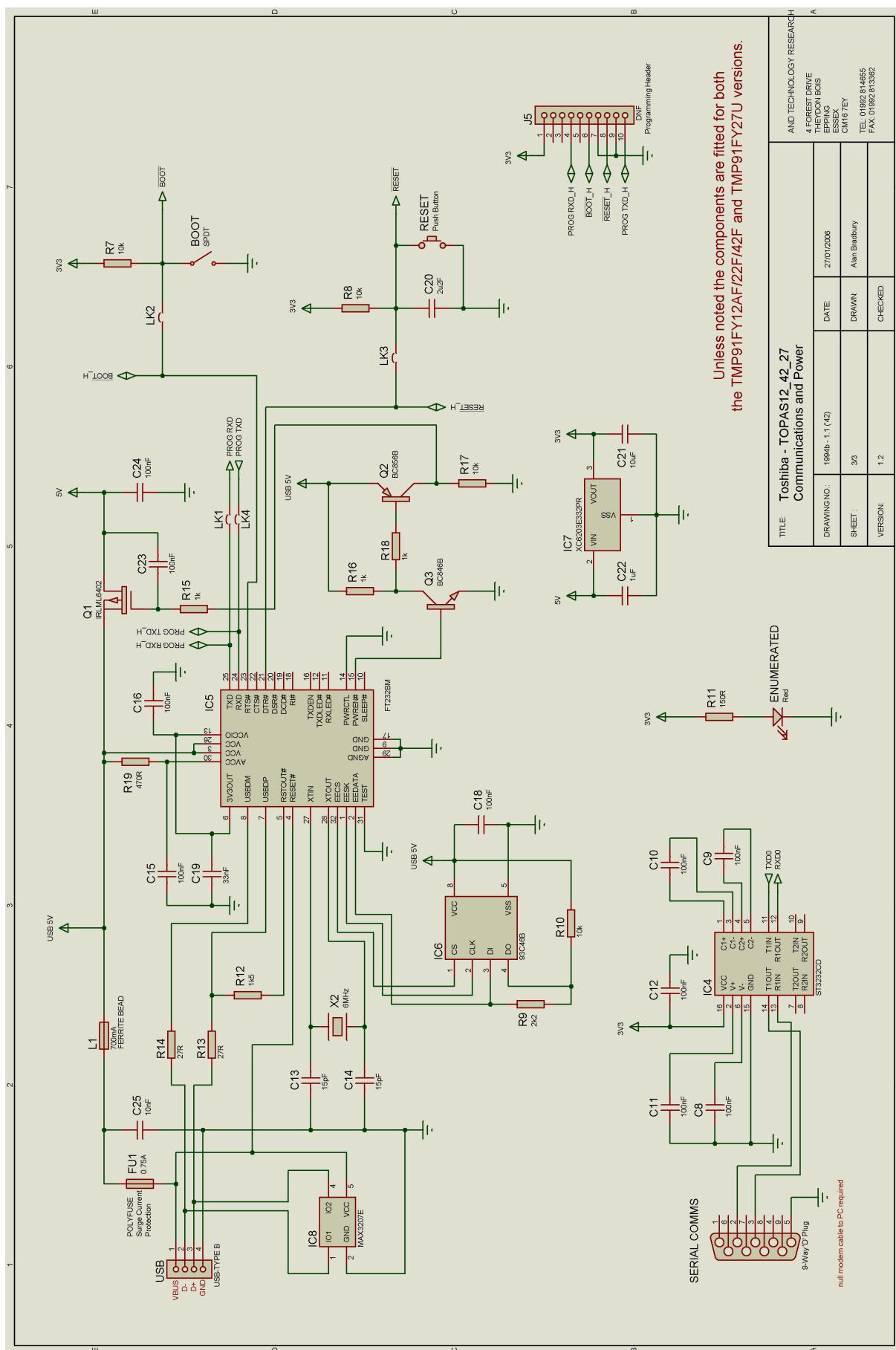
6.1. MEMORY MAP

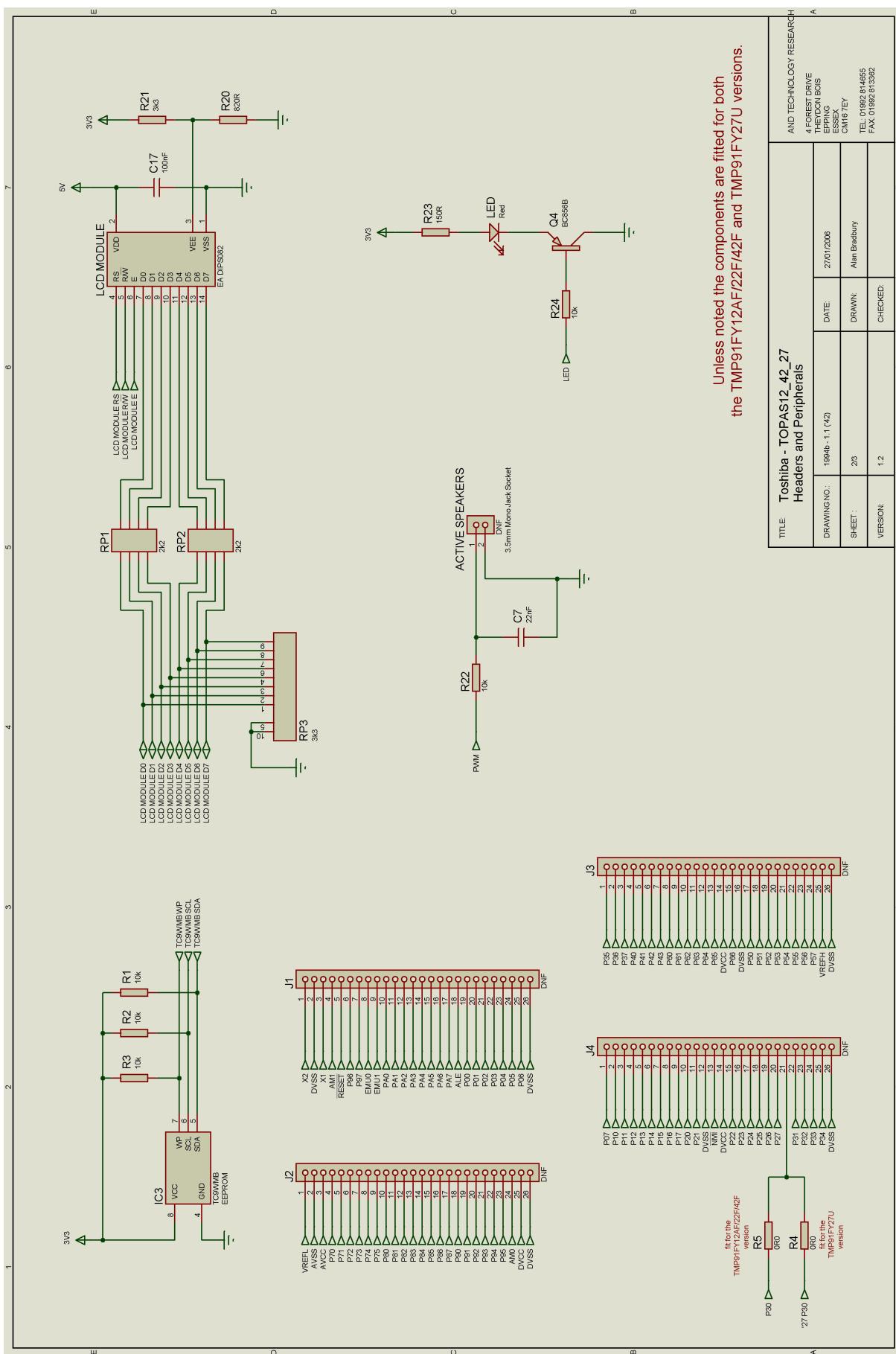
Below are the address locations for particular sections of memory.

- i. Flash 256k (FC0000-FFFFFFFFFF)
- ii. I/O 1k (0000-0FFF)
- iii. RAM
- iv. TMP91FY12AF 4k (1000-1FFF)
- v. TMP91FY22F/42F/27U 16k (1000-4FFF)
- vi. ROM monitor (1000-12FF)
- vii. Interrupt vectors
- iii. TMP91FY12AF (1F00-1FFF)
- iv. TMP91FY22F/42F/27U (4F00-4FFF)

6.2. SCHEMATICS







6.3. CONNECTORS & INTERFACES

6.3.1. TYPE-B USB SOCKET

The Toshiba 900/L1 starter kit is fitted with 1 Type-B USB socket. The socket not only provides a communications link, via the supplied cable, between the PC and evaluation board, but also supplies the PCB with power.

6.3.2. 2x8 LCD MODULE

The Liquid Crystal Display (LCD) module, provides the main visual interface on the starter kit PCB, it is capable of displaying up to 2 lines of 8 characters in any once instance.

6.3.3. RS232 SOCKET

The evaluation board is fitted with a secondary from of communications port via a male RS232 socket. Using a standard null modem serial cable, the PC can communicate with the starter kit PCB via its standard serial COM port using a terminal emulation program such as HyperTerminal.

6.3.4. RESET BUTTON

This surface mounted push-button switch allows the microcontroller to be reset via a touch of a button.

6.3.5. BOOT SWITCH

The Toshiba 900/L1 starter kit is capable of running in two different operational modes, either boot mode, or non-boot mode. The SPDT slide switch is used to interchange between the.

6.3.6. ENUMERATED LED

When lit, the single red surface mount Light Emitting Diode (LED) signifies that the USB port has enumerated.

6.3.7. LED

Single red surface mount user defined diagnostic LED. The red LED will begin flashing as an indication that the ROM monitor is running.

6.4. ELECTRONIC COMPONENTS

6.4.1. FT232BM

The FTDI FT232BM chip operates as a USB to RS232 converter between the PC & the starter kit PCB.

6.4.2. ST3232CD

The ST3232CD chip operates as a standard RS232 converter between the PC's serial port & the male RS232 socket mounted on the starter kit PCB.

6.4.3. TC9WMB

The TC9WMB chip provides the Toshiba 900/L1 starter kit PCB with 2Kb of data storage space.

6.4.4. XC62FP33

The XC62FP33 chip fitted to the Toshiba 900/L1 STK PCB regulates the 5v supply taken in from the USB port to the 3.3v required on the evaluation board.

6.4.5. LINKS

LK1, LK2, LK3 & LK4, when connected, routes signals to the processor. Disconnecting these links disables the communications to the processor. Each link controls an associated signal:

LK3 - <u>RESET</u>	LK1 - Programming RXD
LK4 - Programming TXD	LK2 – <u>BOOT</u>

6.4.6. CRYSTAL

The Toshiba 900/L1 starter kit PCB is fitted with a 25MHz crystal. However, any of the three processors that the PCB supports (TMP91FY12AF, the TMP91FY22F, the TMP91FY27U & the TMP91FY42F) can be run at 27MHz.

7. Description of Restriction on Use

7.1. LIMITATIONS

The starter kit does not include support or maintenance for any of the products contained within it.

The microcontroller device supplied is for use with the starter kit only.

The unit is for evaluation and test purposes only. Care must therefore be taken when using the device to avoid damage from static sources.

The starter kit PCB is uncased & open to the elements; it is also powered via a direct USB connection to the PC. Therefore due care & attention must be taken when using the evaluation board, as contact with certain external elements (liquid, metal surfaces, etc), could cause a short circuit, which may directly affect the PC. While protection measures are in place to protect the evaluation board, PC protection cannot be guaranteed. Therefore, we would recommend using some form of secondary USB power protection to protect both the evaluation PCB & your PC - visit <http://www.andtr.com/Pages/SupportToshSTK.htm> for more information.

Having a serial cable connected between the TOPAS 900/L1 starter kit PCB & a PC may result in reduced sound output quality. If this occurs, disconnect the serial cable.

After plugging the TOPAS 900/L1 starter kit PCB into a USB port it will enumerate with the PC & the LEDs may flash. This is normal. You may then be required to press the RESET button after enumeration for your programmed application to execute.

7.2. TOSHIBA IDE COM PORT LIMITATION

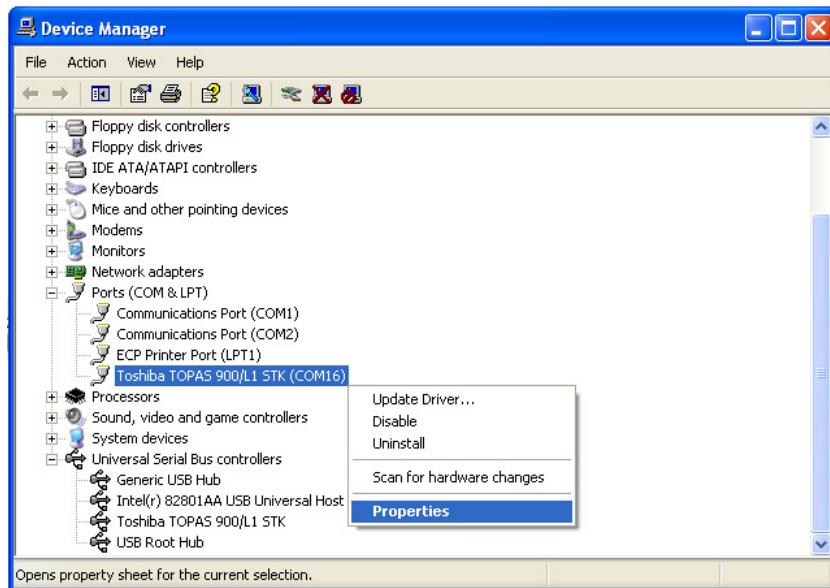
The Toshiba IDE supplied with this kit only supports COM ports up to & including COM port 6. When trying to setup a ROM monitor debug profile for the MCU supplied with the starter kit, you may experience difficulties if the evaluation board has been installed to a higher COM port than is presently supported.

A recommended update, resolving this issue is available for download at:

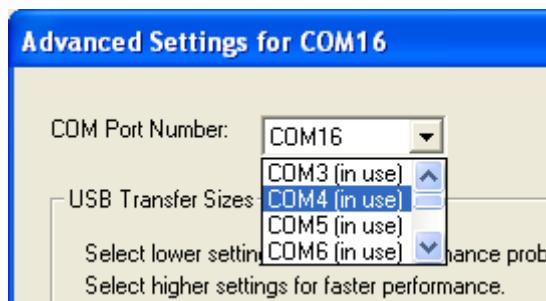
<http://www.andtr.com/Pages/SupportToshSTK.htm>

Alternatively:

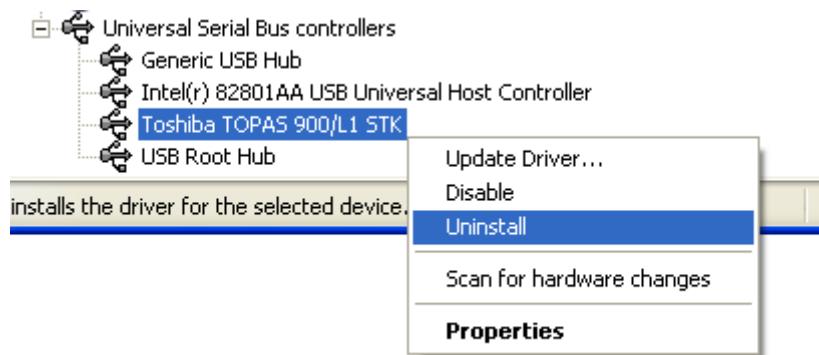
- a. Close ToshLoad & the Toshiba IDE (if currently open).
- b. Run the Microsoft Windows Control Panel, double-click the System icon & under the Hardware tab select the Device Manager. Locate the Ports (COM & LPT) heading & expand the tree associated with it.
- c. If the COM number specified in the Toshiba TOPAS 900/L1 STK title is greater than COM6, proceed to step e.
- d. *The Toshiba IDE will support this COM port, check connection between the starter kit & PC, restart the PC & then run the Toshiba IDE again.*
- e. Right-click the TOPAS 900/L1 STK (COM?) heading & select Properties.



- f. Under the Port Settings tab, click on the Advanced... button.
- g. Expand the COM Port Number drop-down box & select a COM port that is not used & is less than 6 (e.g. COM Port 4). **The drop-down list will state that any COM port number less than the one the starter kit is currently installed on, is in use. However, if you know the COM port you wish to use, that is less than COM 6, is not AT THIS MOMENT currently in use (say by a printer) select that COM port.**



- h. A warning message will appear, click the Yes button.
- i. The TOPAS 900/L1 STK (COM?) heading will now appear with the COM port number you selected. However, the drivers for the starter kit PCB will not be correctly assigned. To rectify this right-click again on the TOPAS 900/L1 STK (COM?) heading & select the Uninstall option.
- j. Click the OK button on the Confirm Device Removal window.
- k. Expand the Universal Serial Bus controllers title in the Device Manager window & locate the Toshiba TOPAS 900/L1 STK sub-heading.
- l. Again, right-click on the heading & select the Uninstall option.



- m. Click the OK button on the Confirm Device Removal window.
- n. Close the Device Manager window & the MS Windows Control Panel.
- o. Unplug the Toshiba 900/L1 starter kit PCB from the PC & wait 5 seconds.
- p. Reconnect the starter kit PCB to the PC via the supplied USB cable.
- q. Finally, carry out the installation of the drivers as documented at the beginning of this manual. The drivers will now be correctly assigned to the designated COM port & because the COM port number is less than COM port 6, the IDE will now be able to communicate with the starter kit PCB.

8. Description of Software Examples

8.1. DIMLED

Each starter kit PCB is pre-loaded with a ROM Monitor, so that when you run an example project for the first time you are provided with instant visibility to the code & are able to debug the source in real-time with multiple debugging facilities.

As an introduction to the Toshiba 900/L1 starter kit we recommend that you run the DimLED example project - a simple application that periodically manipulates the brightness of the red LED. To run simply:

- a. Connect one end of the supplied USB cable to the Type-B USB socket mounted on the starter kit PCB & the other to a PC.
- b. Ensure Links LK1 & LK4 are fitted, while LK2 & LK3 are removed.
- c. On the PCB move BOOT switch into the non-boot mode position (switch underneath the "T" of BOOT) press the reset button. The red LED will flash at a rate of 1Hz to indicate the pre-installed ROM Monitor is running.
- d. Run the Toshiba IDE.
- e. Open the DimLED_[processor].tws file. *Located on hard drive under the following path: ..\Program Files\Toshiba 900L1 STK\Project Examples\DimLED\DimLED_[processor]* (the drive letter for this location is the same one you specified when installing the Resources & Example Projects option above, by default C:)

Important. Your starter kit is supplied with a range of example projects targeted toward three processors, the TMP91FY12AF, the TMP91FY22F, the TMP91FY27U & the TMP91FY42F. Ensure you select the example project folder & file that is associated with the processor you have pre-fitted to your starter kit PCB. E.g. In the case of the DimLED example project, if you have a TMP91FY22F processor fitted to your PCB ensure you use the DimLED_91FY22.tws file from the DimLED_91FY22 folder. Failure to do so could result in the application not running correctly & malfunctioning when trying to download to the microprocessor.

- f. Make sure that the link to the compiler engine is set correctly in the IDE Directory dialogue box: Select the Tool option from the main menu & select Option & then Directory..., set the THOME900 directory to point to the T900SK file, by default this file is located "C:\Program Files\Toshiba\IDE\T900SK".
- g. Ensure that the MonitorDebug target configuration is selected (see the Description of ROM Monitor section in the User Manual for more information).
- h. In the IDE select Build & then Rebuild from the IDE main menu.

- i. In the Workspace Window click on the DebugView tab, then inside that window right-click once on the mouse & select the Create new Debug Profile option. *Alternatively, select Debug & then Start Debugging from the main menu.* Select: DTE Speed: 115200 bps, Data Bits: 8, Parity: No, Stop Bits: 1 & Flow Control: No (see the ROM MONITOR DEBUGGING section in the User Manual on how to create a debugging profile correctly).
- j. Click the Finish button.
- k. After an initial build process, the integrated debugger will then automatically download the project executable into the RAM area of the Toshiba 900/L1 starter kit device, ready for ROM monitor debugging by the user.
- l. To stop the debugger simple select Debug & then Stop Debugging from the main menu in the Toshiba IDE.

8.2. SPEECHIP

The SpeechIP example plays speech samples from the Flash memory of the MCU out through the 3.5mm mono jack socket, mounted on the starter kit PCB - requires external headphones or speakers.

The Software IP Speech Codec was designed for the Toshiba TLCS-870 & TLCS-900 Family of CISC microcontrollers. This embedded software enables you to integrate the codec (signal coding) function for speech recording & playback into your application.

For detailed information about that product please read the attached documents "SpeechCodecDevManual.pdf" & "VoiceCompressionSummary.pdf" located in the "..\Data sheets\SpeechIP" folder on the starter kit CD.

The kit contains a demo version of the Toshiba Software IP Speech Codec. This demo version is limited to the playback function of the IP Speech Codec (there is no record function available).

To run the example, open the SpeechIP.s32 file located in the "..\Program Files\Toshiba 900L1 STK\Project Examples" folder on your hard drive. (Providing that you decided to install the Resources & Example Projects option, if not, you can install it from the Toshiba 900/L1 starter kit CD now.) Download the file to the Flash using the flash programming utility ToshLoad. Connect external headphones or speakers to the 3.5mm mono jack socket on the evaluation board & press the reset button. If all the steps have been carried out correctly you should hear the voice samples.

Note:

The samples were created with a 16kHz-sampling rate. Sound quality can be improved upon by using a high quality filter or by means of a D/S converter.

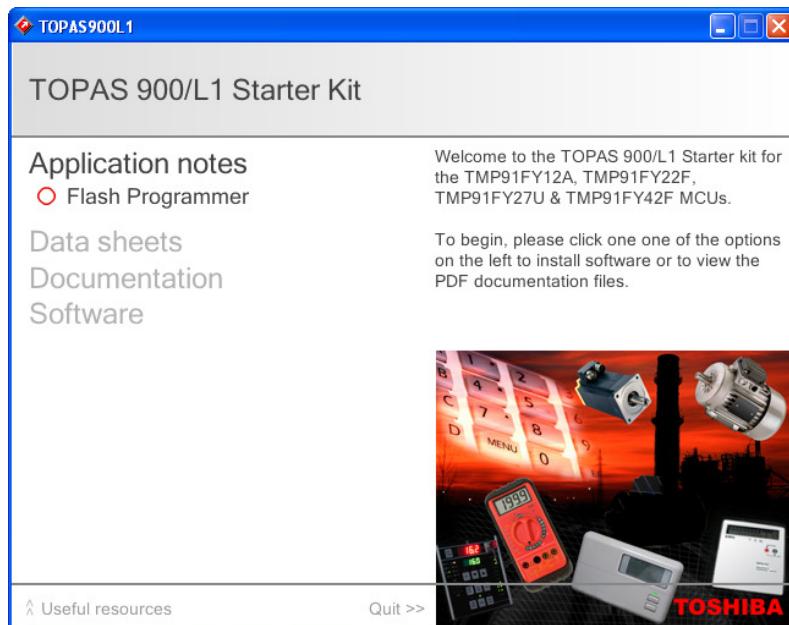
8.3. BILLBOARD

The Billboard example allows the user to set text to be displayed on 2x8 LCD module fitted to the starter kit PCB.

9. Description of Application Note Example

9.1. FLASH PROGRAMMER

The Flash Programmer application note allows the user to program the on-board flash of the microcontroller fitted to the Toshiba 900/L1 starter kit PCB. To learn more about this example & view the supporting documentation please select the Flash Programmer sub-heading located under the Application notes heading on the Toshiba 900/L1 CD.



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OVERSEAS SUBSIDIARIES AND AFFILIATES

Toshiba Electronics Europe GmbH

Düsseldorf Head Office

Hansaallee 181, D-40549 Düsseldorf
Germany
Tel: (0211)5296-0 Fax: (0211)5296-400

München Office

Büro München Hofmannstrasse 52,
D-81378, München, Germany
Tel: (089)748595-0 Fax: (089)748595-42

Toshiba Electronics France SARL

Immeuble Robert Schumann 3 Rue de
Rome,
F-93561, Rosny-Sous-Bois, Cedex, France
Tel: (1)48-12-48-12 Fax: (1)48-94-51-15

Toshiba Electronics Italiana S.R.L.

Centro Direzionale Colleoni
Palazzo Perseus Ingr. 2-Piano 6,
Via Paracelso n.12, 1-20041 Agrate Brianza
Milan, Italy
Tel: (039)68701 Fax:(039)6870205

Toshiba Electronics España, S.A

Parque Empresarial San Fernando Edificio
Europa,
1a Planta, ES-28831 Madrid, Spain
Tel: (91)660-6700 Fax:(91)660-6799

Toshiba Electronics(UK) Limited

Riverside Way, Camberley Surrey,
GU15 3YA, U.K.
Tel: (01276)69-4600 Fax: (01276)69-4800

Toshiba Electronics Scandinavia AB

Gustavslundsvägen 12, 2nd Floor
S-161 15 Bromma, Sweden
Tel: (08)704-0900 Fax: (08)80-8459

Toshiba Electronics Asia

(Singapore) Pte. Ltd.

Singapore Head Office
438B Alexandra Road, #06-08/12 Alexandra
Technopark, Singapore 119968
Tel: (278)5252 Fax: (271)5155

Bangkok Office

135 Moo 5 Bangkadi Industrial Park,
Tivanon Rd.,Bangkadi Amphur Muang
Pathumthani, Bangkok, 12000, Thailand
Tel: (02)501-1635 Fax: (02)501-1638

Toshiba Electronics Trading

(Malaysia)Sdn. Bhd.
Kuala Lumpur Head Office
Suite W1203, Wisma Complant, No.2,
Jalan SS 16/4, Subang Jaya, 47500 Petaling
Jaya, Selangor Darul Ehsan, Malaysia
Tel: (3)731-6311 Fax: (3)731-6307

Penang Office

Suite 13-1, 13th Floor, Menard Penang
Garden,
26th Floor, Citibank Tower, Valero Street,
Makati, Manila, Philippines
Tel: (02)750-5510 Fax: (02)750-5511

Toshiba Electronics Philippines, Inc.

26th Floor, Citibank Tower, Valero Street,
Makati, Manila, Philippines
Tel: (02)750-5510 Fax: (02)750-5511

Toshiba America Electronic Components, Inc.

Headquarters-Irvine, CA

9775 Toledo Way, Irvine, CA 92618, U.S.A.

Tel: (949)455-2000 Fax: (949)859-3963

Boulder, CO

3100 Arapahoe Avenue, Ste. 500,
Boulder, CO 80303, U.S.A.

Tel: (303)442-3801 Fax: (303)442-7216

Boynton Beach, FL(Orlando)

11924 W. Forest Hill Blvd., Ste. 22-337,
Boynton Beach, FL 33414, U.S.A.

Tel: (561)374-6193 Fax: (561)374-6194

Deerfield, IL(Chicago)

One Pkwy., North, Suite 500, Deerfield,
IL 60015-2547, U.S.A.

Tel: (847)945-1500 Fax: (847)945-1044

Duluth, GA(Atlanta)

3700 Crestwood Parkway, Ste. 460,
Duluth, GA 30096, U.S.A.

Tel: (770)931-3363 Fax: (770)931-7602

Edison, NJ

2035 Lincoln Hwy. Ste. #3000, Edison
NJ 08817, U.S.A.

Tel: (732)248-8070 Fax: (732)248-8030

Orange County, CA

2 Venture Plaza, #500 Irvine, CA 92618,
U.S.A.

Tel: (949)453-0224 Fax: (949)453-0125

Portland, OR

1700 NW 167th Place, #240,
Beaverton, OR 97006, U.S.A.

Tel: (503)629-0818 Fax: (503)629-0827

Richardson, TX(Dallas)

777 East Campbell Rd., Suite 650,
Richardson,
TX 75081, U.S.A.

Tel: (972)480-0470 Fax: (972)235-4114

San Jose Engineering Center, CA

1060 Rincon Circle, San Jose, CA 95131,
U.S.A.

Tel: (408)526-2400 Fax:(408)526-2410

Wakefield, MA(Boston)

401 Edgewater Place, Suite #360, Wakefield,
MA 01880-6229, U.S.A.

Tel: (781)224-0074 Fax: (781)224-1095

Toshiba Do Brasil S.A.

Electronic Components Div.

Estrada Dos Alvarengas, 5. 500
09850-550-Sao Bernardo do campo - SP

Tel: (011)7689-7171 Fax: (011)7689-7189

Toshiba Electronics Asia, Ltd.

Hong Kong Head Office

Level 11, Top Glory Insurance Building,
Grand Century
Place, No.193, Prince Edward Road West,
Mong Kok, Kowloon, Hong Kong
Tel: 2375-6111 Fax: 2375-0969

Beijing Office

Rm 714, Beijing Fortune Building,
No.5 Dong San Huan Bei-Lu, Chao Yang
District, Beijing, 100004, China
Tel: (010)6590-8795 Fax: (010)6590-8791

Chengdu Office

Unit F, 18th Floor, New Times Plaza, 42
Wenwu Road, Xinhua Avenue, Chengdu,
610017, China
Tel: (028)675-1773 Fax: (028)675-1065

Shenzhen Office

Rm 3010-3012, Office Tower Shun Hing
Square, Di Wang Commercial Centre, 333
ShenNan East Road, Shenzhen, 518008,
China
Tel: (0755)246-1582 Fax: (0755)246-1581

Toshiba Electronics Korea Corporation

Seoul Head Office
14/F, KEC B/D, 257-7 Yangjae-Dong,
Seocho-ku, Seoul, Korea
Tel: (02)589-4334 Fax: (02)589-4302

Gumi Office

6/F, Ssangyong Investment Securities B/D,
56 Songjung-Dong, Gumi City
Kyeongbuk, Korea
Tel: (82)54-456-7613 Fax: (82)54-456-7617

Toshiba Technology Development (Shanghai) Co., Ltd.

23F, Shanghai Senmao International
Building, 101 Yin Cheng East Road, Pudong
New Area, Shanghai, 200120, China
Tel: (021)6841-0666 Fax: (021)6841-5002

Tsurong Xiamen Xiangyu Trading Co., Ltd.

8N, Xiamen SEZ Bonded Goods Market
Building, Xiamen, Fujian, 361006, China
Tel: (0592)562-3798 Fax: (0592)562-3799

Toshiba Electronics Taiwan Corporation

Taipei Head Office
17F, Union Enterprise Plaza Bldg. 109
Min Sheng East Rd., Section 3, 0446 Taipei,
Taiwan
Tel: (02)514-9988 Fax: (02)514-7892

Kaohsiung Office

16F-A, Chung-Cheng Bldg., Chung-Cheng
3Rd., 80027, Kaohsiung, Taiwan
Tel: (07)222-0826 Fax: (07)223-0046

TOSHIBA Semiconductor Websites

Europe: www.toshiba-components.com

Japan: www.semicon.toshiba.co.jp/eng/index.html

America: www.toshiba.com/taec/