



Tektronix TLA Logic Analyzer

ARM ETM

Support Package Instructions

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1 Introduction

To simplify the connectivity issues of deeply embedded ARM processors, ARM Limited has developed the Embedded Trace Macrocell (ETM). This macrocell monitors the internals of the ARM processor and provides valuable trace data. Dragonfly Software Development LLC has developed a software package which allows the software or firmware engineer to easily utilize this trace data in a three-part combination: using a Tektronix TLA Logic Analyzer, the ARM Developer's Suite, and an ARM processor trace port. This manual describes the installation and configuration of Dragonfly's TLA ETM software.

1.1 Using This Manual

This manual is intended for software and firmware developers who will use Dragonfly's TLA ETM package combined with the ARM Developer's Suite and a Tektronix TLA Logic Analyzer to debug ARM ETM systems. Developers who are not using ARM's ETM technology, the ARM Developer Suite, or a Tektronix TLA Logic Analyzer in their development environment are not capable of using the software package detailed in this manual. Each of these components is required in order to use Dragonfly's TLA ETM package.

This manual is organized into six chapters:

- Chapter 1: Introduction.
- Chapter 2: Overview. A basic discussion of the technology and history behind Dragonfly's ETM software package. Includes a description of Dragonfly's TLA ETM support packages.
- Chapter 3: Installation. A full-length discussion of the installation of Dragonfly's ETM software on the TLA700 and PC.
- Chapter 4: Configuration. A step-by-step guide to configuring the hardware and software necessary for getting started with Dragonfly's ETM software package.
- Chapter 5: Troubleshooting.

This manual does not describe how to use, or install the Tektronix TLA Logic Analyzer, the ARM debugger, the ARM Multi-ICE interface, or the ARM trace port. It does not discuss how to design or test silicon or firmware, except in very general terms.

In addition to this manual, the installation and use documentation for the Tektronix TLA Logic Analyzer, PC, and the ARM Developer's Suite should also be available.

1.2 Typographic and Style Conventions

Keyboard commands are shown on a line by themselves, in bold font. Any punctuation is part of the command:

```
chmod g+x mytest.dir
```

File names and directory names, when used in text, are in line with the text, and bold. For example: The **GetFoo** directory contains the **.configrc** file.

Software application menu names and their pull-down options are in line with the text, bold, and capitalized. For example: To print a file select the **Print** option from the **File** menu.

Product and trade names are not ordinarily highlighted in any fashion.

1.3 Manufacturer Support

When working with the TLA and ARM, there are three vendors available to support working with the Dragonfly TLA ETM software. Be sure to contact them and use their product manuals.

ARM Limited	Provides the compilers, debuggers, ETM, Multi-ICE and other components that allow one write code for an ARM processor, run it, and debug the results.
Tektronix	Provides the logic analyzer, acquisition cards, and cables that monitor signals from the ASIC
Dragonfly Software Development LLC	Provides the software that supports use of the Tektronix TLA Logic Analyzer with ARM devices.

1.4 Copyright Usage

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Item(s)	Owner
Tektronix, TEKTRONIX Tek, TEK TLA700, TLA600, TLA	Tektronix, Inc. P.O. Box 1000 Wilsonville, Oregon 97070-1000 http://www.tek.com
ARM, ETM, Multi-ICE, Thumb	ARM Limited http://www.arm.com
Dragonfly, TLA ETM, ETM-1x, ETM-2x	Dragonfly Software Development LLC 8196 S.W. Hall Blvd., Suite 104 Beaverton, Oregon 97008 http://www.dfsw.com

Table 1: Ownership Acknowledgment

Item(s)	Owner
Microsoft Windows, Windows 98, Windows NT	Microsoft Corporation Redmond Washington http://www.microsoft.com

2 Overview

As a solution for the size and complexity of deeply embedded ARM processors, ARM Limited introduced its Embedded Trace Macrocell (ETM). This macrocell monitors the internals of the ARM processor and provides trace data to a single trace port. This port provides serialized read/write data, branch addresses, and pipeline status. However, this macrocell solution posed another problem; the complexity of processing and interpreting the data.

Dragonfly Software Development LLC and Tektronix formed a partnership to combine their software and hardware into a easy-to-use package for ARM systems with the ETM. The result is a software package which allows software or firmware developers to use a Tektronix TLA Logic Analyzer as a trace capture device, capturing the raw trace data from ARM's Trace Port, and making this raw data available to the ARM Developer's Suite. Dragonfly's TLA ETM software package uses an in-circuit emulator (such as ARM's Multi-ICE), Tektronix's TLA, and the ETM to provide a comprehensive PC-controlled testing environment.

Each component of the TLA ETM package has a set of responsibilities for providing trace information to the software or firmware developer. First, the in-circuit emulator is used by the PC to pass control signals to the target ARM hardware. The PC is also used to control the second component, the TLA Logic Analyzer, which captures information from the ARM trace port. Finally, the ARM Developer's Suite provides the user interface to the ETM and to the TLA. The ARM debugger is used to configure the trace port using a JTAG interface as well as displaying data. The JTAG interface provides a vehicle for control of execution, such as starting and stopping, stepping, modifying registers, or altering code.

TLA ETM Software Model

Conceptually, the Dragonfly TLA ETM software resides in a client-server model in the three shaded areas of Figure 1.

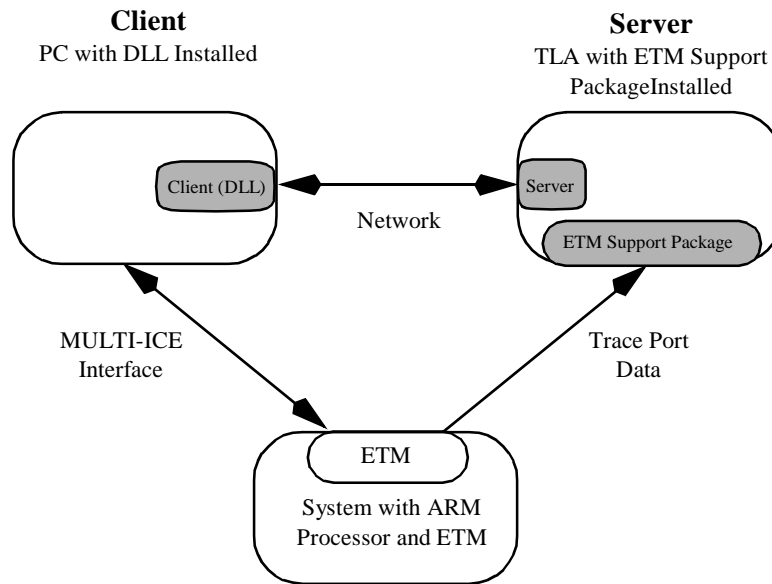


Figure 1: Dragonfly’s ETM Software

These shaded areas represent:

- **Client (DLL):** A Dynamic Link Library (ADSTLA.DLL) that is loaded by the ARM Developer Suite, and is used by the ARM Developer Suite to communicate with the Tektronix TLA Logic Analyzer.
- **Server:** A server application that is run on the TLA. This server application provides a TCP/IP-based communications layer to the Tektronix TLA Logic Analyzer. The DLL loaded by the ARM Developer Suite establishes a TCP/IP-based connection to this server, and uses the server to perform data acquisition tasks on the analyzer.
- **ETM Support Package:** An ETM support package that is run on the TLA. The TLA must be configured so that it can properly interpret the raw data that is transmitted from the ARM trace port. The ETM support package sets up the TLA so that the raw data from the trace port can be properly interpreted.

Support for other vendors’ debuggers may be available in the future. Please contact Dragonfly to discuss the possibility of using other vendors’ debugger tools with an ARM ETM system and Tektronix TLA Logic Analyzer.

TLA ETM Support Packages

Dragonfly offers two customized ETM support packages that can be used with the TLA ETM software. Each package is characterized by its acquisition module, module memory used, and trace data port rate. They are as follows:

- TLA-ETM-1x: This support package provides basic ETM support, and is the simpler of the two support packages. This package works with a TLA acquisition module of any width, and supports ETM trace port data rates of up to 200 MHz.
- TLA-ETM-2x: This package provides advanced ETM support for acquisition modules that are at least 68 channels wide. This package utilizes the additional module memory in the TLA acquisition module to store twice as much ETM trace port data. This package supports trace port data rates of up to 400 MHz.

The two Dragonfly support packages (TLA-ETM-1x and TLA-ETM-2x) work with both 100MHz and 200Mhz acquisition modules. The maximum data rates listed above assume that a 200Mhz acquisition module is used. If a 100Mhz acquisition module is used for trace capture, the maximum data rate listed above will be reduced by one half.

3 Installation

This chapter discusses the installation of the Dragonfly TLA ETM software on the Tektronix TLA Logic Analyzer and PC.

3.1 Installation Requirements

Before installing the TLA ETM software, please ensure that the target system meets all of the installation requirements. To use the TLA ETM software, the following is required:

- PC with Microsoft Windows 98, or Windows NT 4.0 or later.¹
- ARM Developer's Suite, version 1.0.1 or later (<http://www.arm.com>) running on the PC or on the TLA.
- ARM Trace Debug Tools, version 1.0 or later, running on the PC or on the TLA.
- ARM's Multi-ICE (with driver version 2.0 or later), or some other form of JTAG run control (<http://www.arm.com>).
- Tektronix TLA Logic Analyzer, running application software version 3.1 or software version 3.2². (<http://www.tek.com>)
- A single Mictor cable, to connect the target hardware's ETM port to the Tektronix TLA Logic Analyzer.
- Three 3.5-inch floppy disks containing Dragonfly's TLA ETM software (<http://www.dfs.com>)

Dragonfly's TLA ETM software uses TCP/IP to communicate with the TLA Logic Analyzer. For communicating with the TLA Logic Analyzer using a communications network, please ensure that both the PC and the TLA are configured for TCP/IP, and that the machines can "see" each other on the network. For TCP/IP configuration information, contact your system administrator.

-
1. The Tektronix TLA Logic Analyzer is a fully-compatible Windows 98-based PC, it is possible to run the ARM Developer Suite software directly on the TLA. Dragonfly's DLL may work correctly with Windows 2000, but this configuration is not yet supported.
 2. At the time this manual was written, version 3.2 of the Tektronix TLA application software was available. It is possible that release 3.3 and beyond of the Tektronix TLA application software will not correctly communicate with Dragonfly's TLA COM server. Dragonfly will provide upgrades to its server application to ensure that the server continues to work correctly with the latest application software from Tektronix. Contact Dragonfly for upgrade details.

3.2 TLA Software Installation

Two of the three software components in Dragonfly's TLA ETM software package are installed on the Tektronix TLA Logic Analyzer:

- TLA COM Server
- One of the two TLA-ETM Support Packages (TLA-ETM-1x, or TLA-ETM-2x)

Each of these components is installed with essentially the same installation procedure. Follow these steps to install each of these two packages:

1. Insert the floppy disk with the distribution software into the TLA's floppy disk drive.
2. From the **Start** menu, select the **Settings** menu, then select **Control Panel**.
3. From the **Control Panel**, select **Add/Remove Programs**.
4. Click the **Install** button.
5. Choose your floppy disk drive (**A:**) as the source of the install software.
6. Read and agree to the license terms.
7. Click as appropriate to continue and complete the installation.

The install process for the TLA-ETM Support Package copies files to the **C:\Program Files\TLA700\Supports** directory. This installation path is hard-wired into the other software components of Dragonfly's TLA ETM software.

WARNING!
Do not remove any of the files from the C:\Program\Files\TLA\Supports directory. They must appear in this directory for the TLA ETM software to function properly.

The install process for the TLA COM Server installs the server on the TLA, and configures the TLA so that the TLA COM Server will be automatically restarted each time the TLA is rebooted. Once the installation of the server is complete, reboot the TLA to automatically start the server, or you can run the server directly from the **Start** menu, by selecting **Start ->Programs -> TLA COM Server -> TLA COM Server**.

3.3 PC Software Installation

One of the three software components in Dragonfly's TLA ETM software package is installed on the PC that will be running the ARM Developer Suite software:

- TLA-ADS Dynamic Link Library

Follow these steps to install this package:

1. Insert the floppy disk with the distribution software into the PC's floppy disk drive.
2. From the **Start** menu, select the **Settings** menu, then select **Control Panel**.
3. From the **Control Panel**, select **Add/Remove Programs**.

4. Click the **Install** button.
5. Choose your floppy disk drive (**A:**) as the source of your install software.
6. Read and agree to the license terms.
7. Click as appropriate to continue and complete the installation.

This installer will install a single DLL (ADSTLA.DLL) onto the PC. The installer will search on the PC for the installation location of the ARM Developer Suite software. It is recommended, but not required, that ADSTLA.DLL be installed in the same directory as the ARM Developer Suite software.

NOTE

It is important to note the installation directory of this DLL, for it must be made available to the ARM “ADW” Debugger during the debugger’s configuration process. Typically, the DLL will be installed in *C:\Program Files\ARM\ARM Developer\Suite\Bin*.

4 Configuration

There are two parts to the configuration of the Dragonfly TLA ETM Software. The first is hardware configuration. It is important to ensure that the PC, TLA and target hardware are all properly connected to one another. The second is software configuration. Certain steps must be taken in the ARM Debugger to ensure that the trace modules are properly configured. This chapter examines these configurations.

4.1 Hardware Configuration

The connections between the PC, TLA, and target hardware are important to the functionality of the Dragonfly TLA ETM Software. The setup among these three pieces of hardware, shown in Figure 2 below, uses three kinds of cables: ribbon cables, ethernet cables, and a logic analyzer data cable. A ribbon cable connects the system-under-test to the in-circuit emulator. A single logic analyzer data cable connects the system-under-test to the TLA. Both the PC and the TLA should also be connected to the network using whatever network cabling is appropriate.

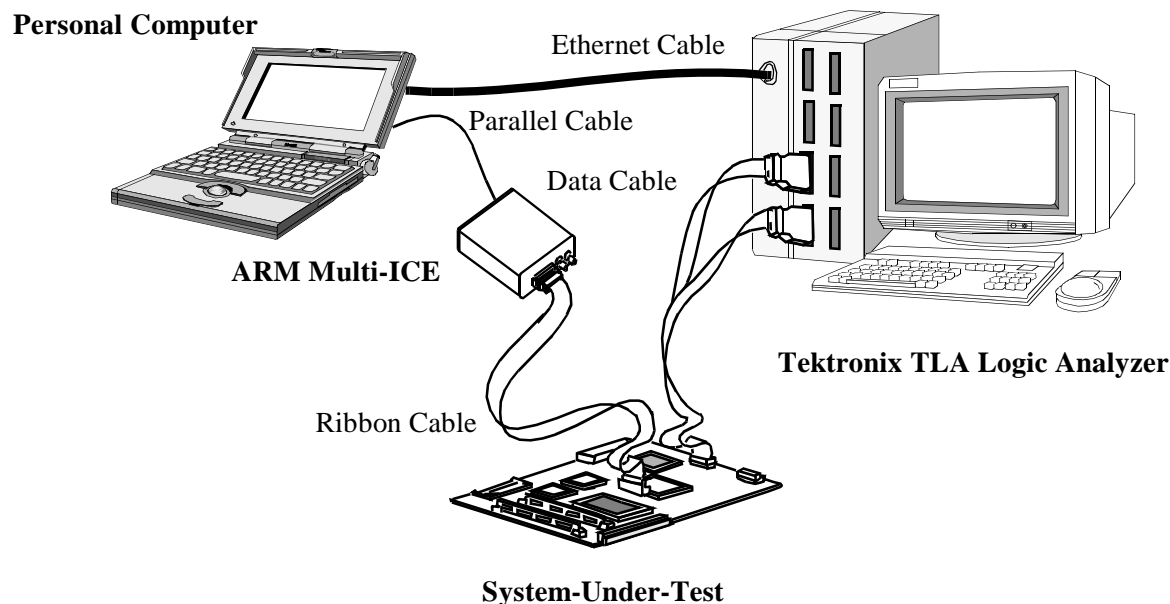


Figure 1: Hardware Configuration

Logic Analyzer Cabling

A single Mictor cable is used to connect the ETM of the system-under-test to the Tektronix TLA Logic Analyzer. This cable is illustrated in Figure 2 below:¹

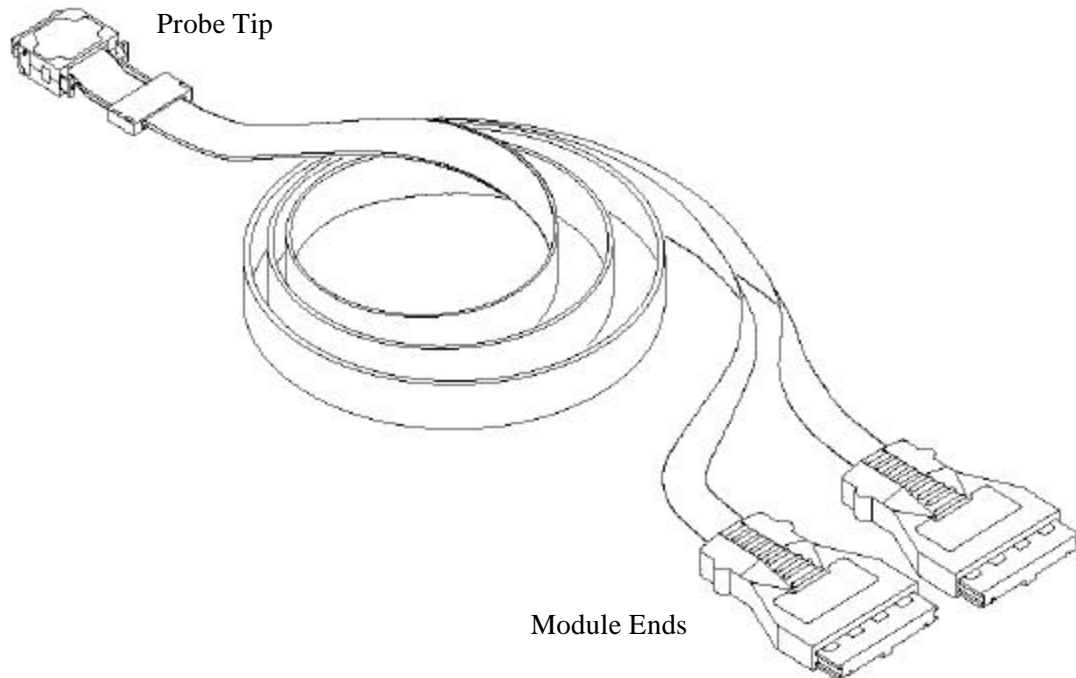


Figure 2: Mictor Cable

1. Tektronix refers to this cable as a P6434 Mass Termination Probe. This cable is available from Tektronix, and is detailed in Tektronix document 070-9793-03 which is available for download at the Tektronix web site (www.tek.com). A link to this document is also available at Dragonfly's web site (www.dfs.com).

The Mictor cable has two ends. The first end consists of a Mictor connector, as is illustrated in Figure 3. Two cables connect the Mictor connector to two larger connectors on the second end. These connectors are known as “module ends.”

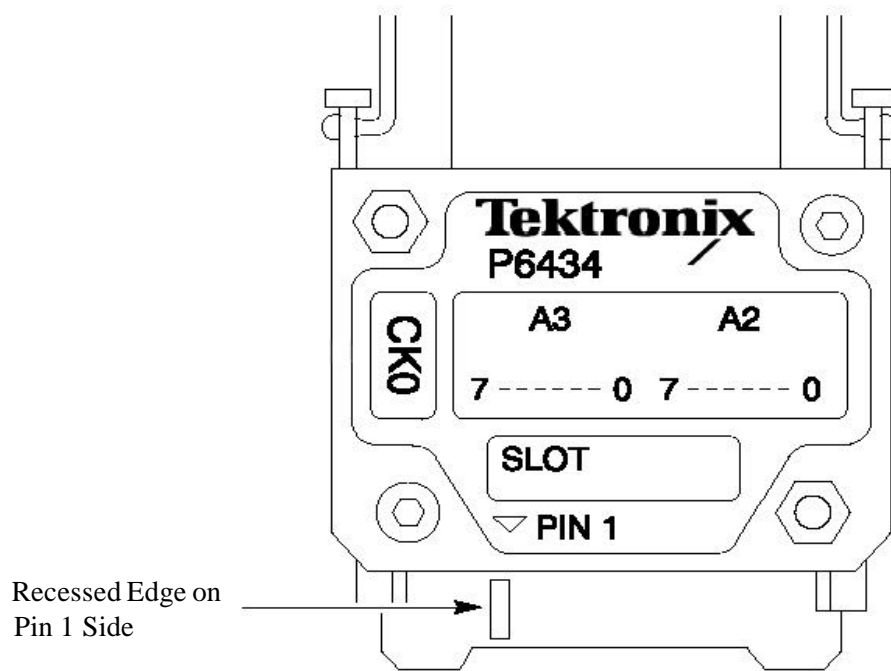


Figure 3: Mictor Connector

The Mictor connector of the Mictor cable is typically labeled in one of the following four ways:

Table 2: Typical Labels for Mictor Connector

Probe	Pin 1 Side	Color	Pin 38 Side	Color
A	A3 A2 CK0	Tan	A1 A0 CK1	Orange
D	D3 D2 Q0	Blue	D1 D0 CK2	Yellow
C	C3 C2 CK3	White	C1 C0 Q1	Gray
E	E3 E2 Q3	Green	E1 E0 Q2	Violet

Confirm that the Mictor connector is labeled according to one of the combinations in the above table. Note that in all four cases, the “Pin 1” side of the Mictor connector contains groups “3 and 2”, while the “pin 38” side of the Mictor connector contains groups “1 and 0”.

To connect the Mictor cable to the ETM port, insert the Mictor connector of the Mictor cable into the trace port’s Mictor connector on your system. The Mictor connector is keyed, so correct polarity is assured.

To connect the Mictor cable to your Tektronix logic analyzer, connect the module ends of the Mictor cable to the logic analyzer as follows:

Table 3: Connecting Mictor cable module ends to TLA Logic Analyzer

Module End to Connect	Connector to use on TLA Logic Analyzer
Group “3 2” Module End of A, C, D, or E cable	Connect to the A3/A2 connector on the TLA
Group “1 0” Module End of A, C, D, or E cable	Connect to the A1/A0 connector on the TLA (For 34 channel TLA modules, connect to the C3/C2 connector)

Once the Mictor cable is connected to both the TLA and the ETM port, the hardware configuration is complete.

4.2 Software Configuration

To configure both the Tektronix TLA Logic Analyzer and ARM’s debugger, perform the following configuration steps:

1. From the Tektronix TLA Logic Analyzer, start the TLA COM Server, if it is not already running. Do so by selecting the **Start->Programs->TLA COM Server->TLA COM Server**.
2. From the PC (or TLA if the ARM Developer’s suite is being run locally), start the ARM Multi-ICE Server by selecting the **Start->Programs->ARM Multi-ICE->Multi-ICE Server**. Refer to the ARM Multi-ICE documentation for Multi-ICE configuration details. Ensure that the Multi-ICE is properly connected to your system under test, and that the Multi-ICE can correctly recognize the ETM on the JTAG scan chain.
3. Open the ARM “ADW” Debugger by selecting **Start->Programs->ARM Developer Suite->ADW Debugger**. Ensure that the target hardware is stopped. Configuration will not be applied if the target hardware is running.
4. From the **Options** pull-down menu, select **Debugger Configuration**. A dialogue window as shown below will appear. Select the “TRACE.DLL” for the **Target Environment**, as shown in Figure 4.



Figure 4: TRACE.DLL Selection

5. With the “TRACE.DLL” selected, click on the **Configure** button in the dialogue window. A second **Remote Configuration** dialogue window will appear as shown below in Figure 5.

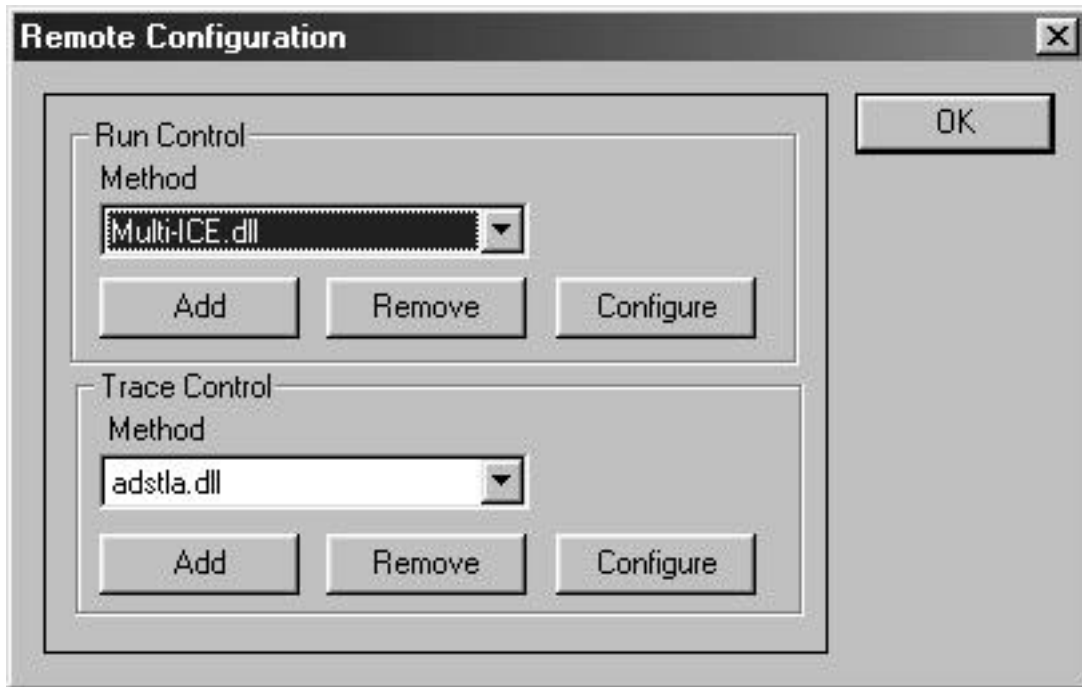


Figure 5: Remote Configuration

6. In the new dialogue window there are two control sections. The first control section in the **Remote Configuration** window is **Run Control**. The default Method for Run Control is the Multi-ICE. If Multi-ICE.DLL is not shown as the Run Control, click on the Add button and browse for Multi-ICE.DLL to select it. Refer to the ARM documentation for Multi-ICE configuration details.
7. The second control section in the **Remote Configuration** window is **Trace Control**. The Method for the Trace Control must be set to the “ADSTLA.DLL.” This is done by clicking on the Add button and browsing for the “ADSTLA.DLL” which was installed when the Dragonfly TLA ETM software package was installed. As was recommended in the installation process, ADSTLA.DLL may be located “C:/Program Files/ARM/Arm Developer Suite/Bin”.

8. With the controls selected, click on the **Configure** button for the **Trace Control**. A third dialogue window for **TLA Configuration** will appear as shown below.

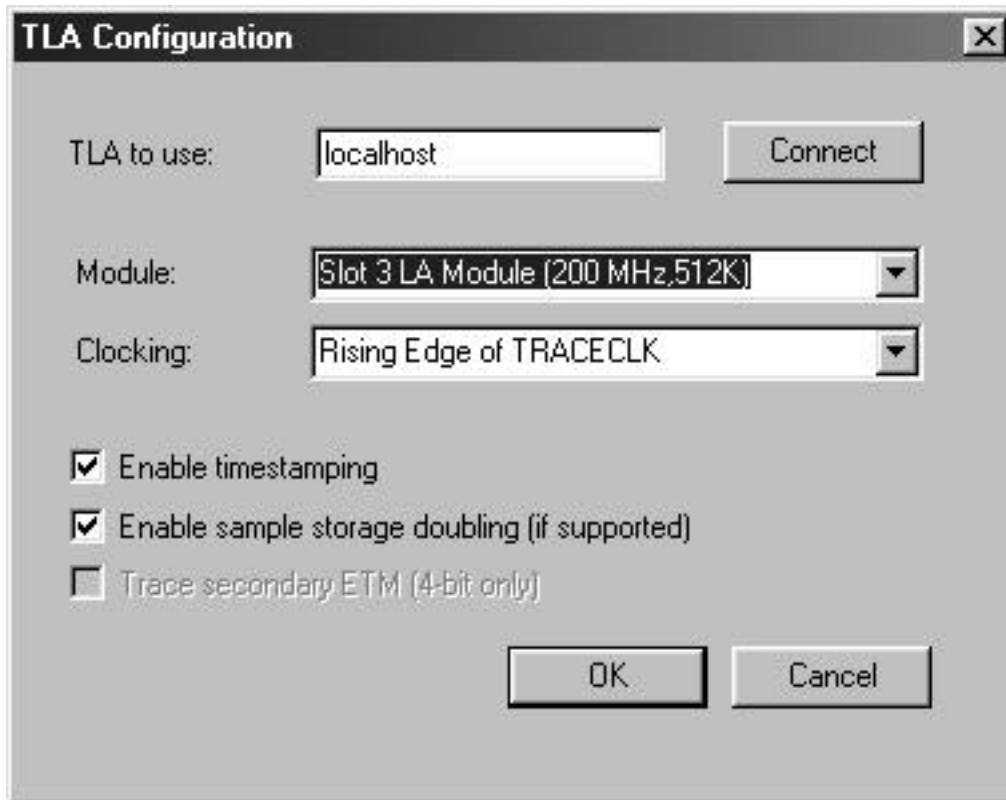


Figure 6: TLA Configuration

9. Select the TLA to use. This is “localhost” if the ARM debugger is running locally on the TLA. Otherwise, this is the network name of the Tektronix TLA Logic Analyzer. Once the **TLA to use** is selected, click the **Connect** button.
10. Once the TLA is connected, the **Module** scroll windows will become available. **Module** selects the specific acquisition module on the TLA to use for tracing. The **Clocking** scroll window selects between full-speed and half-speed clocking. Full-speed clocking logs data on every **rising** edge of the clock. Half-speed clocking logs data on every **rising and falling** edge of the clock.
11. From the **TLA Configuration window**, it is also possible to enable **Timestamping** or **Sample Storage Doubling**. Enabling timestamping will cause a timestamp to appear on the disassembled output of the trace. Enabling sample storage doubling will cause any extra memory modules to be used in the trace data acquisition (TLA-ETM-2x support package only).
12. Configuration is complete. Exit the configuration by clicking on the **OK** button of all the opened dialogue windows. Note that the debugger should automatically restart and apply the new configuration. If not, then the target hardware is running. Stop the target hardware, and repeat the steps above.
13. With the software configured, note that the **Trace** pull-down menu is now available in the ARM Developer’s Suite.

The TLA and the ETM can now be configured from the Developer's suite. For details on using the trace functionality on the ARM Developer's Suite, refer to the following documentation, both available from ARM Ltd.:

- *The ARM Developer's Suite Manual*
- *ADW Trace Debug Tools User's Guide*

4.3 License

The standard software license is for a single user configuration. This includes the software for one TLA COM server, one ETM support module, and one client DLL. It is possible to run the Dragonfly TLA ETM software on multiple TLA's. To do so, it is necessary to purchase additional ETM support modules. Furthermore, it is possible to use multiple clients with a single server. However, to do so, it is necessary to purchase additional TLA COM server/client DLL pairs. Please refer to the license agreement in the appendix for details.

5 Troubleshooting

This chapter discusses common problems and solutions.

5.1 Installation Troubleshooting

It is critical that all cabling is correct for the Dragonfly TLA ETM software package to work. Check the following:

1. The Mictor cable is properly labeled, and is connected to the appropriate channels of the acquisition module.
2. The ARM Multi-ICE is connected to the JTAG connector, and the Multi-ICE server can properly recognize the ETM on the JTAG scan chain.
3. The ARM debugger is configured to use Multi-ICE.DLL as its Run Control, and ADSTLA.DLL as its Trace Control.

If problems persist, please contact Dragonfly Software Development LLC at (877) 641-3440 x 25 during regular business hours (Pacific time) for assistance.

5.2 Operation Troubleshooting

A number of problems can arise without the proper software configuration. These problems and their solutions are as follows:

1. The ARM Developer's Suite reports that "The TLA does not have the required support package." This is likely because the TLA-ETM-1x or TLA-ETM-2x support package has not been properly installed on the TLA logic analyzer. Check that the installation is complete on the Tektronix TLA Logic Analyzer.
2. The ARM Developer's Suite reports a "Data Abort" error when attempting TLA configuration. This is likely because the target hardware is currently running. Ensure that the hardware is stopped when performing TLA configuration.
3. The ARM debugger is unable to establish a connection to the TLA Logic Analyzer. Ensure that the TLA COM Server is running on the TLA Logic Analyzer, and that the PC running the ARM debugger is properly configured for TCP/IP. If connection problems persist, you can use the configured IP address of the Tektronix Logic Analyzer (e.g. "192.1.2.3") in the "TLA to use:" configuration.

If operation problems persist, please contact Dragonfly Software Consulting at (877) 641-3440 x 25 during regular business hours (Pacific time) for assistance.

5.3 Alternate Testing Configurations

It's important to note that to effectively use an ARM processor with an ETM, the ARM processor and ETM components must already function correctly. The ETM requires quite a bit of silicon to function, and if portions of the ASIC don't work, then it's unlikely that the ETM will function properly. If the ETM portion of the ASIC is not yet working, then a more direct testing method is required.

However, for those building their own silicon, the job of connecting the analyzer channels to the pins of the ASIC becomes necessary. This has always been the Achilles heel for logic analyzers connecting to ARM ASICs, since the silicon is nearly always configured for a custom application, and no standard logic analyzer connector pinouts have been recommended by ARM.

However, recently ARM Ltd., has produced a series of ARM “Integrator” boards that all utilize the same logic analyzer connections. ARM’s “Integrator/AM” board is designed to plug directly onto ARM’s other Integrator boards, and to present a standard Mictor pinout for ARM’s AMBA bus. For those creating custom silicon solutions and wish to capture the bus cycles directly from the AMBA bus, it may be desirable to design a system utilizing the same Mictor pinouts that ARM uses for their Integrator/AM hardware. Specifications for this board can be found at ARM’s web site, at <http://www.arm.com/products/Integrator/am.html>

In addition to Dragonfly’s ETM support software, Dragonfly also offers TLA support packages for disassembly of the ARM’s AMBA-ASB and AMBA-AHB data bus. For more information about Dragonfly’s other ARM support packages, please refer to <http://www.dfs.com>.

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