

78M6618 PDU1 Firmware Quick Start Guide

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1 Introduction

The 78M6618 PDU1 Firmware is a turnkey energy measurement solution optimized for use in single-phase AC Power Distribution Units (PDUs). At the sensor interface, the 78M6618 with PDU1 Firmware provides eight sense inputs for current and two sense inputs for voltage (single-phase). At the host interface, either a UART or SPI interface can be used to issue configure the device and access the following measurement data:

- RMS Voltage
- RMS Current (Line1, Line2,..Line8)
- Active Power (Line1, Line2,..Line8)
- Apparent Power (Line1, Line2,..Line8)
- Reactive Power (Line1, Line2,..Line8)
- Power Factor (Line1, Line2,..Line8)
- Energy (Line1, Line2,..Line8)
- Line Frequency

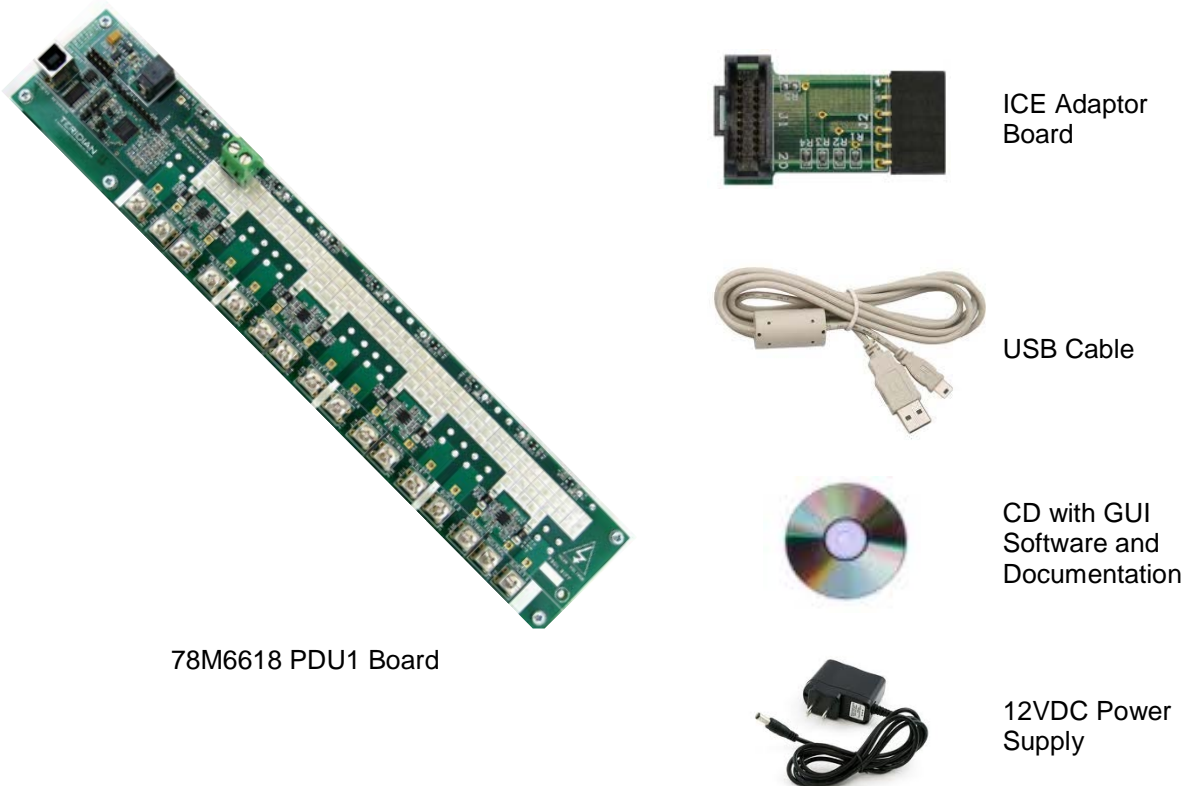
Fully functional demo code can be evaluated in an Evaluation Kit (EVK) and used as is in some applications. It can also serve as starting base for customization and adaptation to different system buses with an optional Software Development Kit (SDK).

This document overviews the steps for

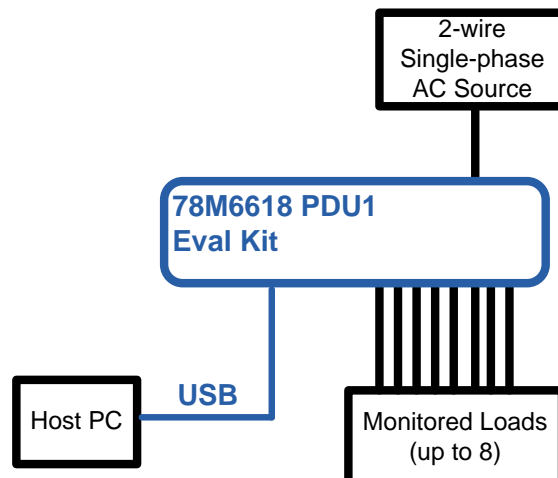
- Getting Started with the EVK
- Getting Started with the SDK
- Getting Started with Flash Programming

1.1 What's Included with an EVK?

The PDU1 Evaluation Kit (EVK) includes the 78M6618 PDU1 Board (P/N 78M6618-PDU-1) demonstrating measurement and relay control of eight outlets using shunt resistors. The board incorporates the 78M6618 power and energy measurement IC, sensors, relays, and an isolated serial port connection to a Windows PC.



The 78M6618 on the board is pre-programmed with PDU1 Demo Code and calibrated at the factory. The energy measurement data and status is read back over the serial UART interface presented to the PC as a virtual COM port. The 78M6618 PDU1 Evaluation Kit requires a PC with Microsoft® Windows XP or later with a USB port and a minimum 1024 x 768 video display resolution. An AC source and load complete the rest of the test setup needed to collect measurements.



1.2 What's included with an SDK?

The SDK contains all the required elements for a variety of usages.

For the user who would like to evaluate the application in their own hardware, **pre-built image files** are available. Loading these image files into a 78M6618 will allow running the application as provided. A demonstration PC-based **graphical user interface (GUI)** is also provided and may be used to send configuration commands to and read out measurement data from the PDU1 application.

Users who would like to develop their own applications have access to application level **source code** to use as a baseline. **Energy measurement functions** are provided in object code format and with a documented application programming interface (**API**). An SDK User Guide describes how to use development tools to modify the project code. Post processing tools, such as CRC insertion also included in the SDK package.

The 78M6618 PDU1 SDK includes the following components:

- This Quick Start Guide
- 78M6618 PDU1 SDK 2.0 User Guide
- 78M6618 PDU1 Demo Application User Guide
- 78M6618 Firmware Boot Loader Functional Specification
- 78M6618 Programmer's Reference Manual
- EMSoc SDK 2.0 Serial Asynchronous Interface Protocol Specification
- EMSoc SDK 2.0 Serial Peripheral Interface (SPI) Protocol Specification

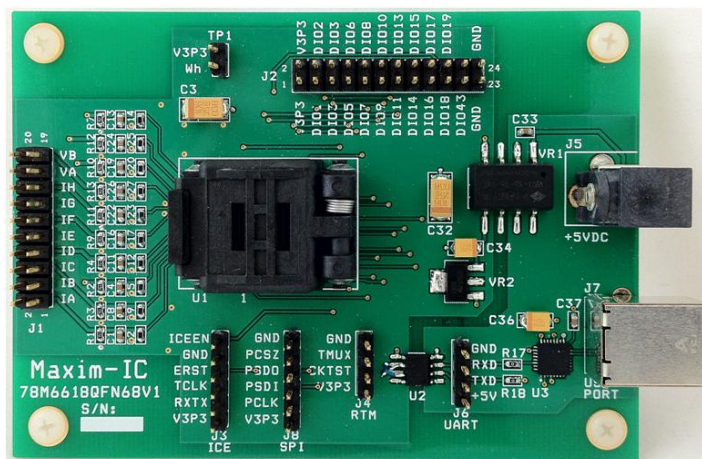
1.3 Other Development Tools

This section describes other items available for purchase through Maxim directly or Maxim's distributors.

1.3.1 Socketed Flash Programming Board

The 78M6618 Socket Board is a socketed fixture for flash programming 78M6618 devices in small quantities. It allows for loading program memory into 78M6618 SoCs via either the In-Circuit Emulator (ICE) interface, TFP2, or the serial Boot Loader (UART) interface if the device already contains the Boot Loader in flash. The 78M6618 Socket Board (P/N 78M6618-SOCKET68) includes:

- 78M6618 Socket Board and power supply
- CD with USB Driver, GUI software, and documentation



1.3.2 Compiler and Integrated Development Environment (IDE)

Maxim recommends using the PK51 Professional Developer's Kit by Keil™ (www.keil.com), containing the μ Vision 4 Integrated Development Environment (IDE), complete with 8051 assembler, editor, C compiler, linker, and locator. The Demo Code shipped with the Demo Kits for Maxim AC Power Monitoring ICs was written using this tool. Keil offers the best support for the memory model of the 80515 core used in the 78M6618 ICs. It is possible to use alternative compilers, but the code for these is not supported by Maxim.

While all Demo Code is written using the standard CA51 tool by Keil, significant improvements in memory usage can be made by using the PK51 "Professional Developer's Kit" by Keil. The PK51 contains the LX51 extended linker that can reduce code size using special optimization techniques.

1.3.3 In-Circuit Emulator (ICE)

The Signum Systems ADM-51 (www.signum.com) is compatible with the Keil symbolic output format and supports the 78M6618. It is useful to perform the following tasks:

- Code emulation with breakpoints, watch windows, etc., with support of source code symbols
- Memory monitoring and manipulation (SFRs, XRAM, I/O RAM)
- Flash erase and code loading into flash memory of the 78M6618

Maxim supplies the ADM-51 to customers at a preferred price (P/N DB6612-ADM51) along with an isolated USB cable.



1.3.4 TFP2 Flash Programmer

The Signum ADM-51 can serve as a programmer for prototyping and small quantities. For programming production quantities, Maxim offers the TFP2 Flash Programming Module (P/N 80515-FPBM-TFP2), which is a stand-alone programmer that can be operated manually or in an ATE environment.



The TFP2 offers the following features:

- Stand-alone or PC-controlled programming
- Variable flash memory size (selectable to match target device's memory size)
- LEDs and signal outputs for PASS and FAIL
- Pushbutton and digital control inputs compatible with ATE
- Can erase and re-program ICs overriding the *SECURE* bit set

For more information, see the *Flash Programmer Model TFP2 User's Manual*.

2 Getting Started with the EVK

This section describes the necessary steps to get the pre-built application up and running. Note that some of the steps are only required once when the setup is installed for the first time.

2.1 USB Driver Installation

The Evaluation Kit includes an isolated USB interface for serial communications with a PC. The FTDI USB controller IC FT232R performs the USB functions. Refer to the *78M6618 PDU1 Evaluation Board User Manual* for information about USB Driver installation.

2.2 Connecting the Evaluation Board to the PC

DO NOT APPLY AC POWER TO THE BOARD YET!

Connect the 78M6618 PDU1 Evaluation Board to a USB port of the PC using the provided USB cable. The USB controller is powered through this connection. If installed for the first time, the PC will prompt you to install a USB-COM driver. Refer to the *78M6618 PDU1 Evaluation Board User Manual* for more information.

2.3 Getting Ready to Measure AC Energy



Refer to the included Safety Precautions application note and *78M6618 PDU1 Evaluation Board User Manual* for detailed instructions if not already familiar with energy measurement, and for trouble shooting tips. Otherwise, connect AC source and loads to evaluation board along with external 12VDC power supply.

2.4 Read Energy Measurement Data

The GUI application is now ready to be used to read energy measurement data and verify that the hardware and software work properly. Refer to the *78M6618 PDU1 Demo Application User Guide* for more information.

2.5 Calibration

All evaluation kits come pre-calibrated to a precision source.

Note: Calibration requires connection of a reference power supply and a reference load that are more accurate than the desired calibrated accuracy. For more information, refer to the *78M661x Calibration Procedure*.

3 Getting Started with the SDK

3.1 Required Hardware and Software Development Tools

3.1.1 Running the PDU1 Application Software

The PDU1 Demo Application can be used without purchasing software development tools. The prebuilt image file can be downloaded to the 78M6618 device via one of the following methods:

- The UART interface using the 78M6618 Boot Loader (target 78M6618 device must already have Boot Loader code resident in the flash memory)
- The ICE interface using TFP2 Flash Programmer tool (sold separately)
- The ICE interface using the ADM-51 Emulator (sold separately by Signum Systems Corporation)

3.1.2 Modifying the Application Code

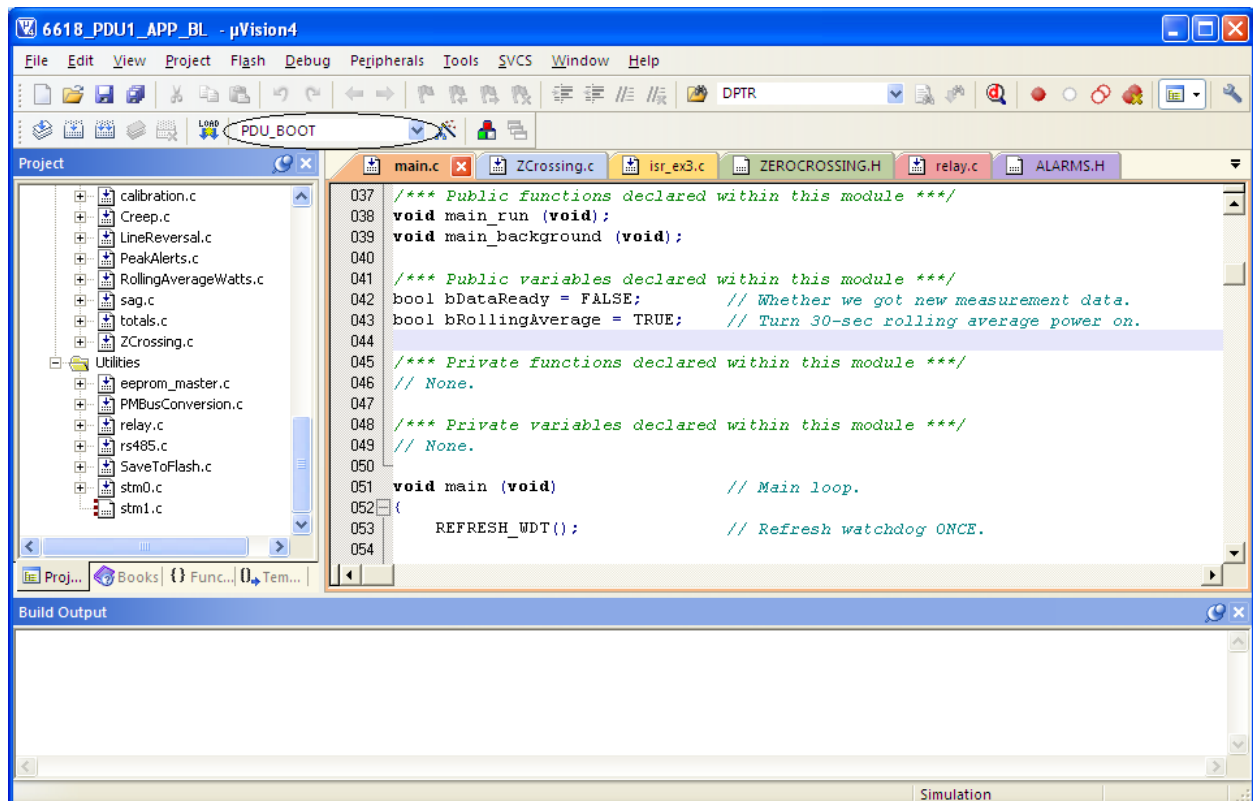
The project application code can be modified and adapted using the Keil development tool suite for the 8051 processor and the ADM-51 Emulator.

- Keil uVision4, version 9.0 and higher (<http://www.keil.com/uvision>)
- ADM-51 Emulator (<http://www.signum.com/Signum.htm>)

3.2 Opening the Project with Keil uVision Tools

The project is loaded into the development tools by opening the `6618_PDU1_APP_BL.uvproj` file in the Application folder.

The project files are organized in folders, such as metrology, drivers, communication, etc, as can be seen below.



3.3 Rebuilding the Application

The application can be built with or without inclusion of the Boot Loader utility.

3.3.1 Without the Boot Loader

Building the application without the Boot Loader entails that software updates in the end product are possible only by connecting the TFP2 or ADM-51 tools to the ICE interface port. However, 1 KB of flash memory is freed when the Boot Loader is not included, which can be used by the application itself.

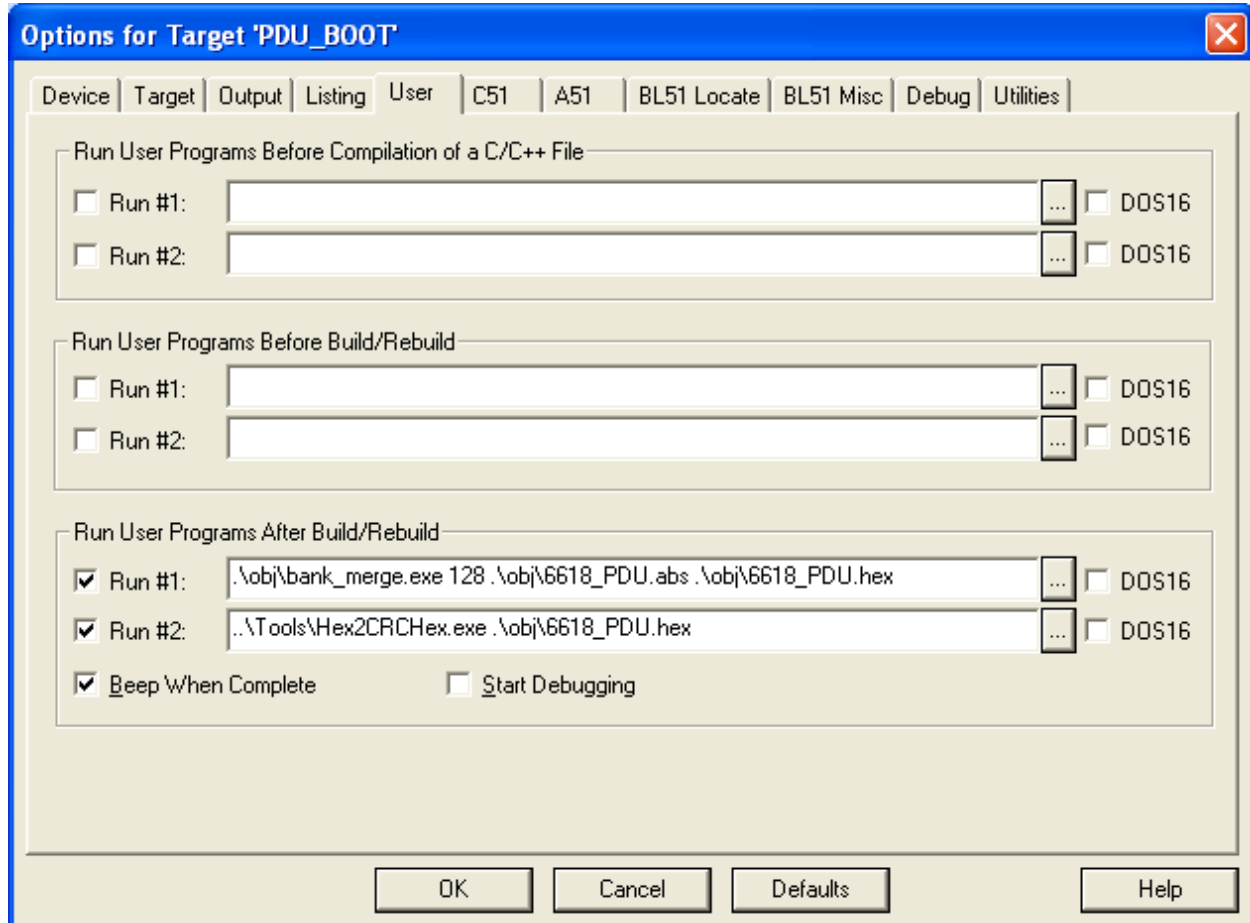
Select target **PDU_NO_BOOT** from the drop down list (encircled in the figure above) and press F7 to build the project. A successful run produces two output files in the \Application\Obj folder. The * **.abs** file is most suited to be used by the emulator for debugging. The * **.hex** file is an image file best suited for the TFP2 programmer, and contains no debugging information. The * **.hex** file, as produced by the Keil compiler, is not suitable for the TFP2 unless the CHKSUM utility is first used to process the file into the proper format.

3.3.2 With the Boot Loader and CRC

The Boot Loader requires 1 KB of memory and insertion of CRC codes into the image file. Building an application with the Boot Loader utility allows for subsequent firmware upgrades via the serial interface (RS-232 or RS-485) connected to the host.

Select target **PDU_BOOT** from the drop-down list (encircled in the figure above) and press F7 to build the project. A successful run produces two output files in the \Application\Obj folder. The * **.abs** file is most suited to be used by the emulator for debugging. The * **.hex** file is an image file best suited for the TFP2 programmer, and contains no debugging information. See the *Flash Programmer Model TFP2 User's Manual* on how to use the CHKSUM utility.

It should be noted that the * **.hex** output file needs to be post-processed in order to calculate and insert the CRC values. The `Hex2CRCHex.exe` application is included, in the tools folder of the SDK, to perform the post-compiling CRC insertion into the hex file. The resulting hex file is renamed with 'CRC' added in the name. For example: `6618_PDU_CRC.hex` is generated by the `Hex2CRCHex.exe` tool using input file `6618_PDU.hex`. The project settings are such that this tool is invoked by default, as shown here:



3.4 Downloading the *.abs File to the Target

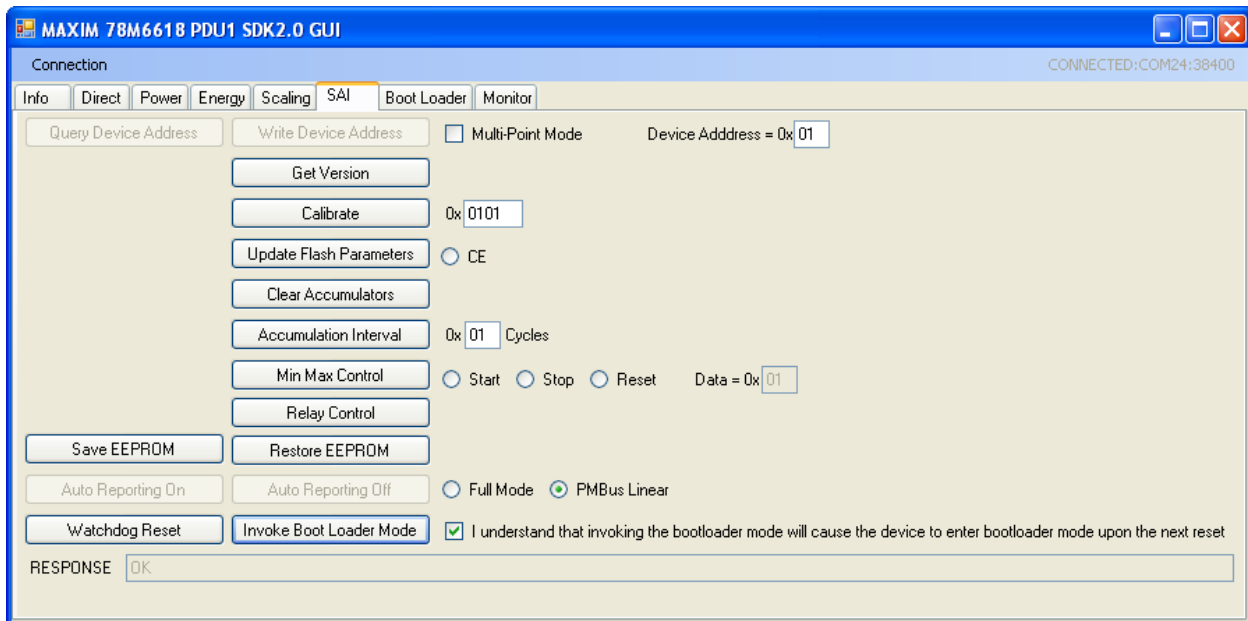
The ADM-51 Emulator is used to download the *.abs file to the EVM board. Once downloaded, the developer can run, stop and debug the application. Familiarity with the ADM-51 debugging tools is assumed for the purpose of this document.

4 Getting Started with Flash Programming

4.1 Via the GUI

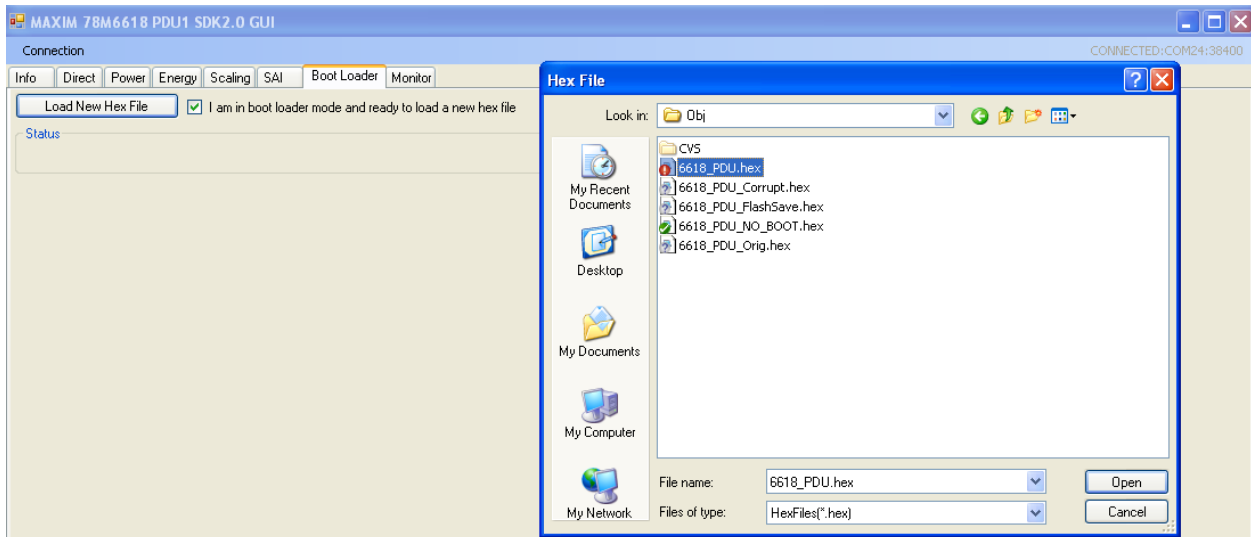
If the Firmware includes a Boot Loader, the following steps describe how to use the GUI to upgrade the Firmware using the Boot Loader:

1. On the **SAI Commands** tab, click the **Invoke Boot Loader Mode** button near the lower-left corner.

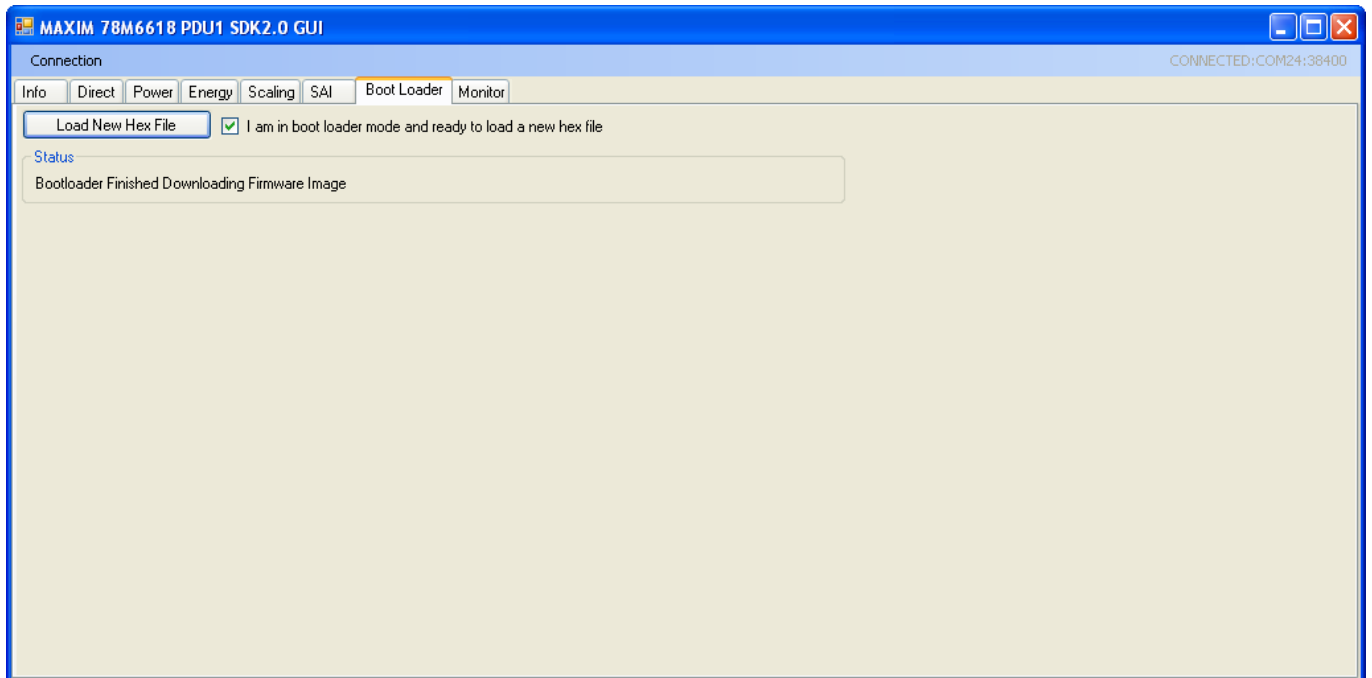


2. Power cycle the device, or send "Watchdog Reset" command. It will enter the Boot Load mode. This can be verified by observing the DIO4 pin, which produces 15 ms pulses when the boot loader is in operation.

3. On the **BootLoader** tab, click the **Load New Hex File** button and select the hex file for the upgrade.



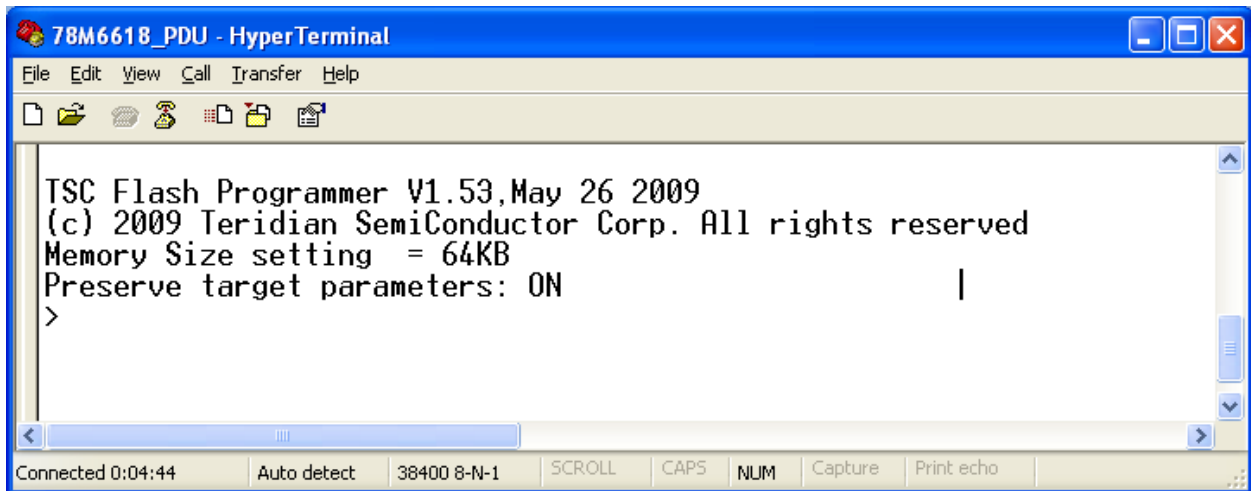
4. The GUI will show progress during the firmware upgrade. After the firmware upgrade is complete the new firmware application is running.



4.2 Via the TFP2 Flash Programming Tool

Refer to the *Flash Programmer Model TFP2 User's Manual* for more detailed instructions if necessary.

1. Connect the TFP2 Programmer to the evaluation board via the ribbon cable and connect the serial cable to the PC. Make sure the 78M6618 is connected to 3.3V. The memory size switch must be set to 64 KB for the 78M6618 target device.
2. Start a terminal program. In the example, Hyper Terminal was used. Set the connection to the proper COM port and set it to 38400, N, 1, XONXOFF. A prompt should appear.

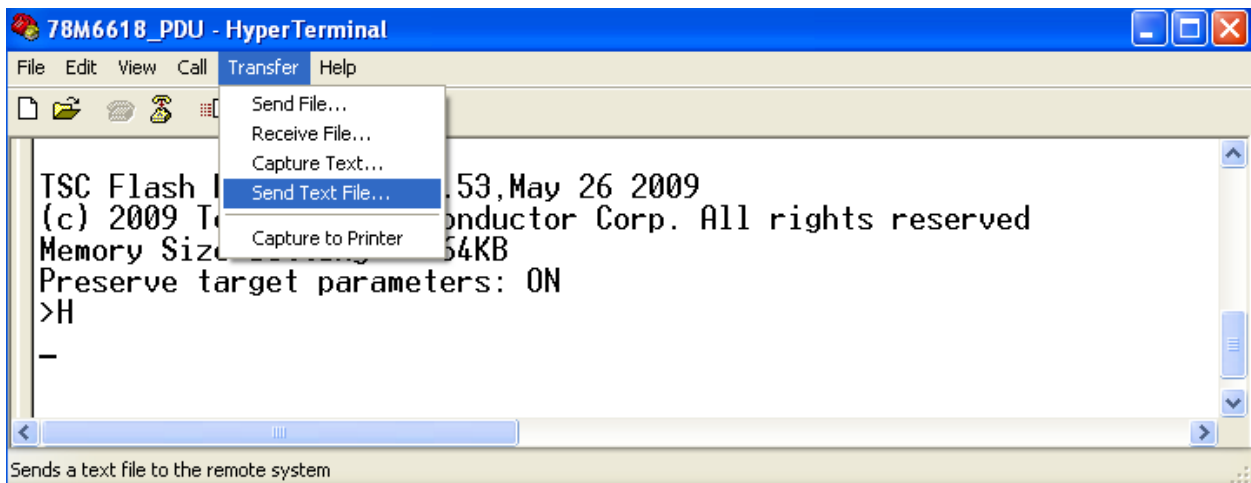


The screenshot shows a HyperTerminal window titled "78M6618_PDU - HyperTerminal". The window contains the following text:

```
TSC Flash Programmer V1.53, May 26 2009
(c) 2009 Teridian Semiconductor Corp. All rights reserved
Memory Size setting = 64KB
Preserve target parameters: ON
>
```

The status bar at the bottom of the window displays: "Connected 0:04:44", "Auto detect", "38400 8-N-1", "SCROLL", "CAPS", "NUM", "Capture", and "Print echo".

3. Type the "H" command at the > prompt on the terminal and select **Transfer** → **Send Text File** (as shown below). Do not select **Send File**. This .hex file must have previously been processed with the CHKSUM.exe utility.

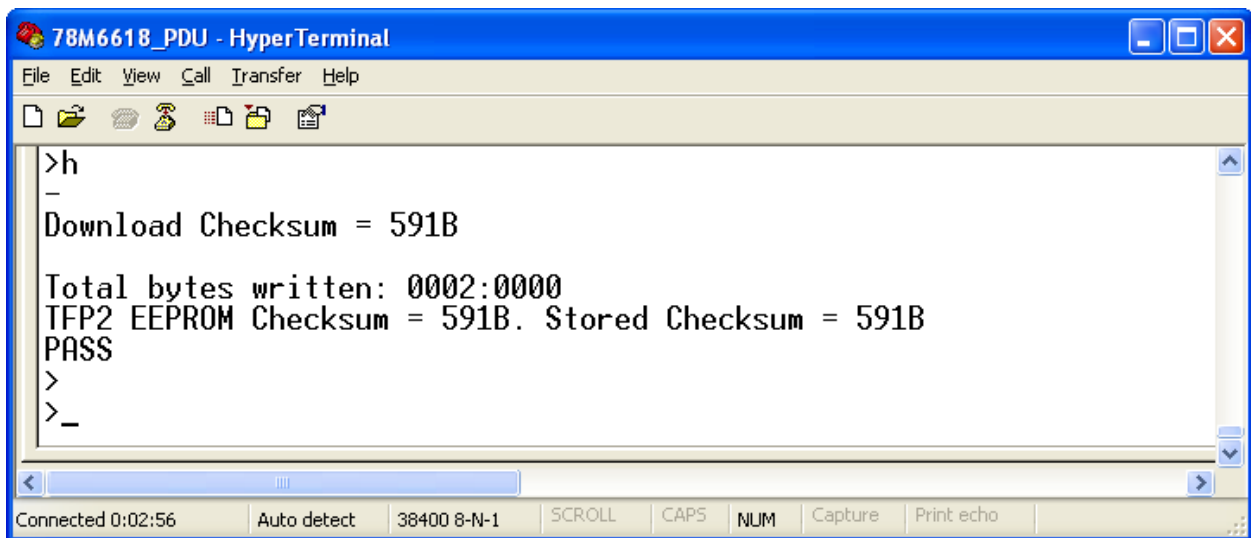


The screenshot shows the same HyperTerminal window as above, but with the "Transfer" menu open. The "Send Text File..." option is highlighted. The text in the terminal is:

```
TSC Flash Programmer V1.53, May 26 2009
(c) 2009 Teridian Semiconductor Corp. All rights reserved
Memory Size setting = 64KB
Preserve target parameters: ON
>H
-
```

The status bar at the bottom of the window displays: "Sends a text file to the remote system".

4. Wait for the hex file to get transferred to TFP2 internal EEPROM. Once complete, a PASS message should appear as seen below.



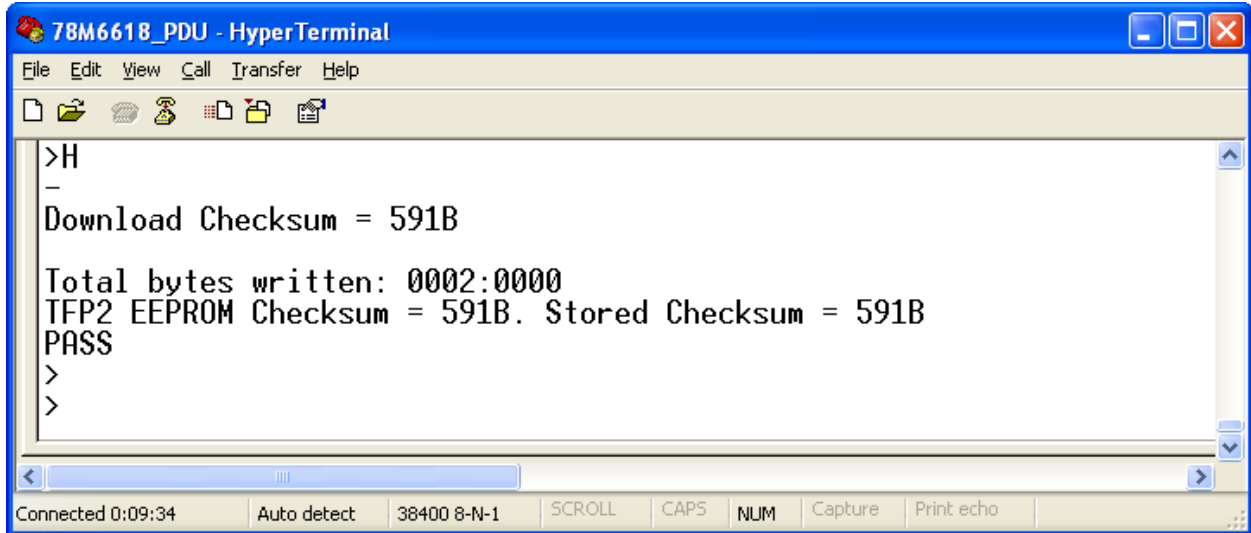
The screenshot shows a HyperTerminal window titled "78M6618_PDU - HyperTerminal". The window contains the following text:

```
>h
-
Download Checksum = 591B

Total bytes written: 0002:0000
TFP2 EEPROM Checksum = 591B. Stored Checksum = 591B
PASS
>
>_
```

The status bar at the bottom of the window displays "Connected 0:02:56", "Auto detect", "38400 8-N-1", "SCROLL", "CAPS", "NUM", "Capture", and "Print echo".

- To program the device's flash using the flash image that was just programmed in the TFP2's EEPROM in steps 3 and 4 above, type the "P" command at the > prompt or simply push the Program button on the TFP2. If the programming is successful, a "PASS" message will be displayed. The Firmware programming is now complete.



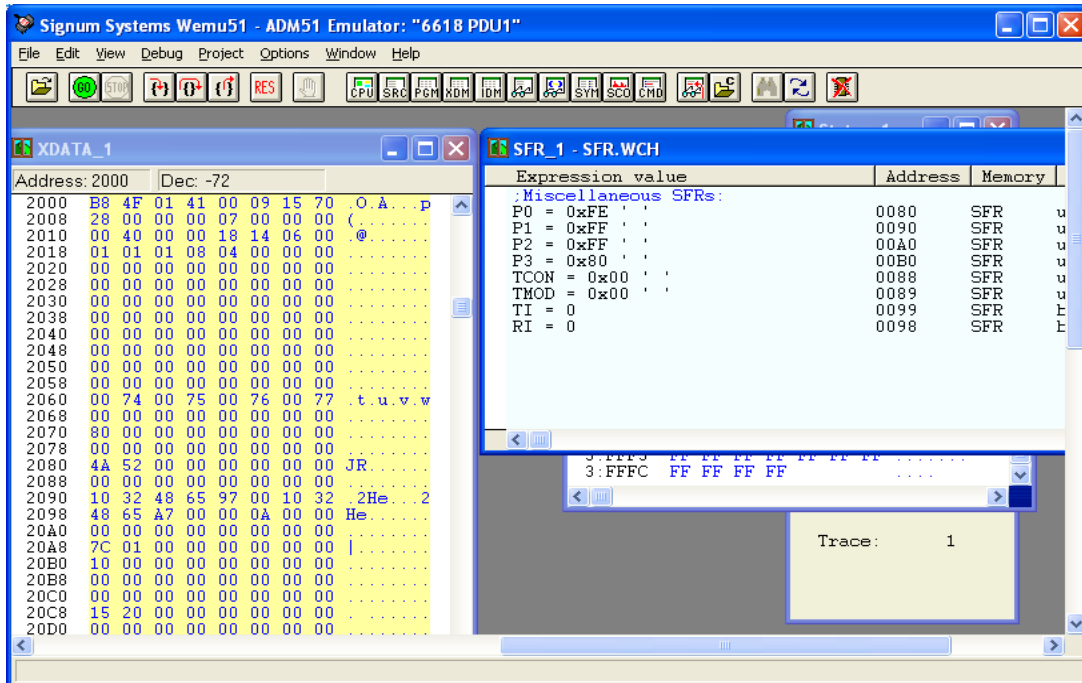
```
>H
-
Download Checksum = 591B
Total bytes written: 0002:0000
TFP2 EEPROM Checksum = 591B. Stored Checksum = 591B
PASS
>
>
```

Connected 0:09:34 Auto detect 38400 8-N-1 SCROLL CAPS NUM Capture Print echo

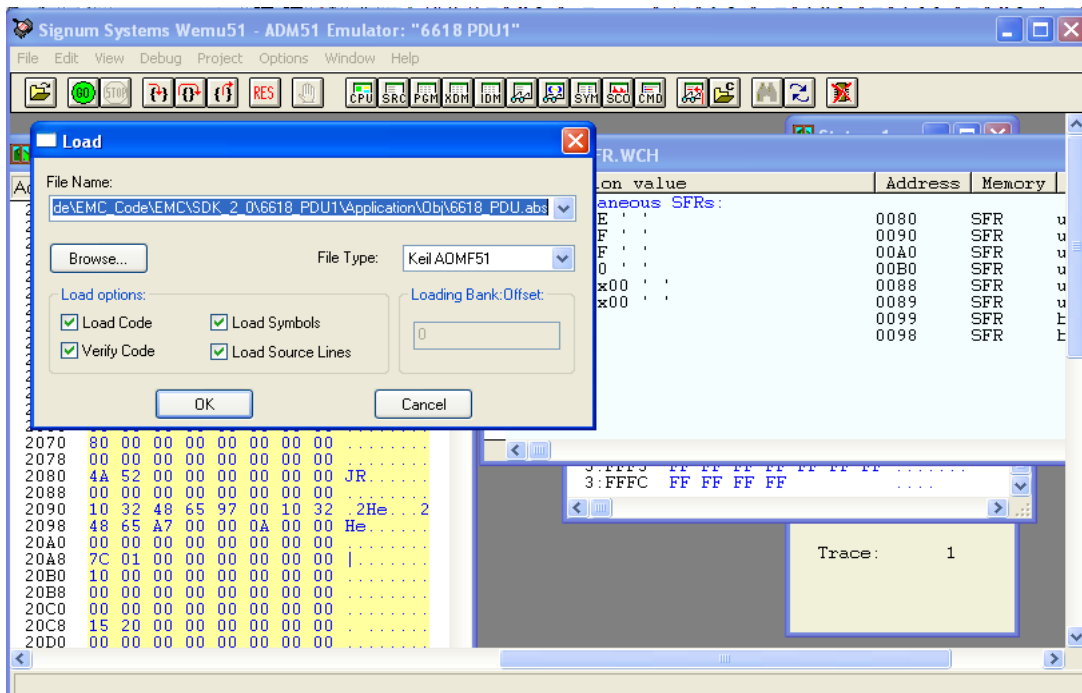
4.3 Via the ADM-51 Emulator

Refer to the Signum System ADM-51 Emulator documentation if necessary.

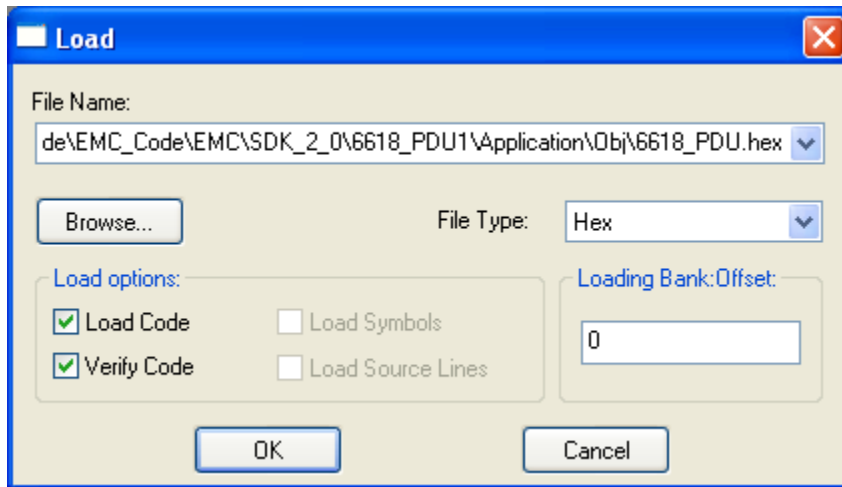
1. Connect the ADM-51 to the PC using the isolated USB cable. Connect the target board to ADM-51 emulator using the ribbon cable and power up the 78M6618 device.
2. Start the Wemu51 program from the connected PC.
3. Stop the CE by writing 0x00 at XRAM address 0x2000 (see the XDATA memory window below).



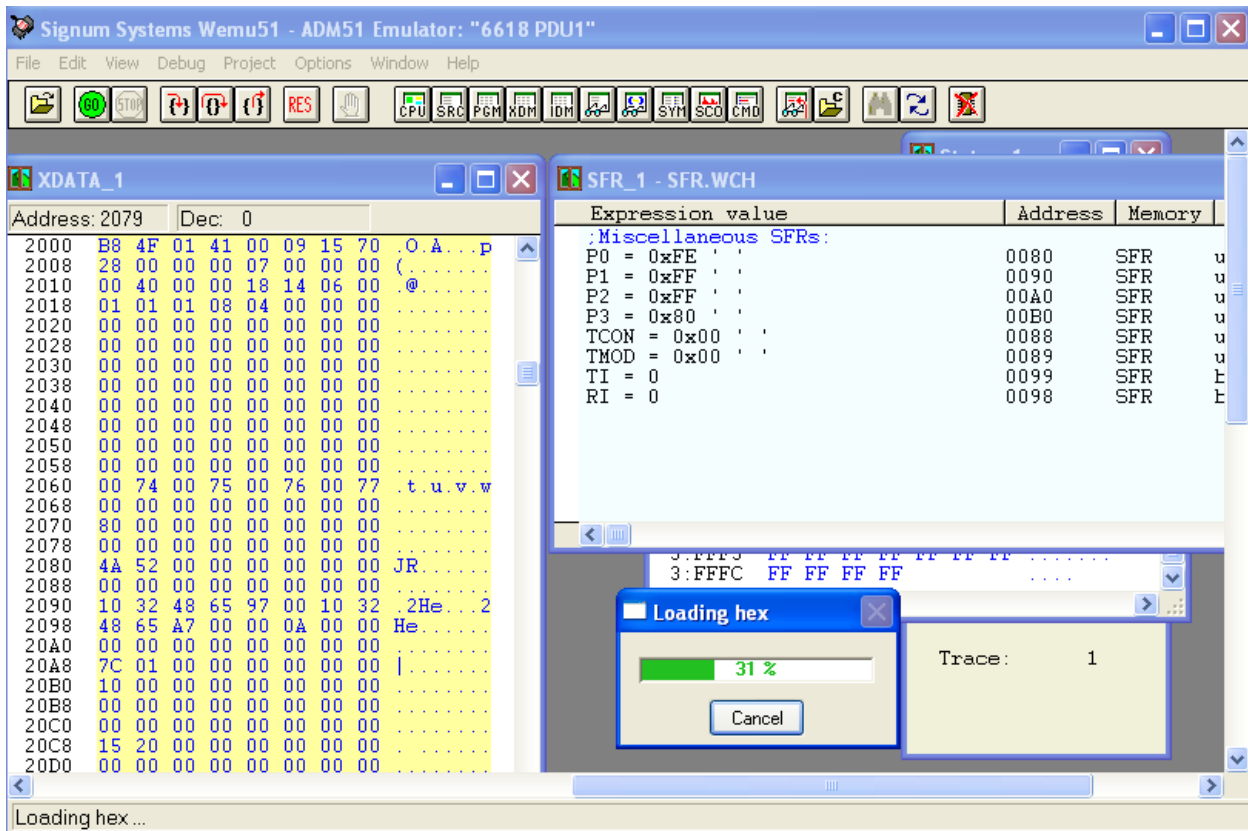
4. Use **File->Load** to select the hex file for programming.



- Browse using the Hex File Type, or ABS file type (see Section 3.4).



- Click **OK** to start the programming. The progress will be shown in the progress bar.



- Once progress is 100%, the firmware programming is complete.

5 Contact Information

For more information about the 78M6618 or other Maxim products, contact technical support at www.maxim-ic.com/support.

Revision History

Revision Number	Revision Date	Description	Pages Changed
0	7/12	First publication.	–

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