TERIDIAN
SEMICONDUCTOR CORP.
A Maxim Integrated Products Brand

78M6613 Evaluation Board
User Manual

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UM_6613_045

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1 Introduction

The Teridian Semiconductor Corporation (TSC) 78M6613 Evaluation Board is an electrical measurement unit for performing measurements of up to two single-phase AC loads. It incorporates the TSC 78M6613 power- and energy-measurement IC and connects to a PC through a USB cable such as the one provided in the demo kit. The Evaluation Board demonstrates the capability of the 78M6613 energy-meter controller chip for measurement accuracy and overall system use.

The board is preprogrammed with Firmware Demo Code (file name 6613_OMU_S2+2_URT_V1_1x.hex) in the flash memory of the 78M6613 IC that allows evaluation of the IC's capabilities.

The 78M6613 energy-measurement data and status is read back over the serial UART interface using a text-based command line interface (CLI) command set. Easy manual operation is performed using HyperTerminal. Refer to the applicable *6613_OMU_S2+2_URT_V1_1x Firmware Description Document* for invocation usage of the CLI commands.
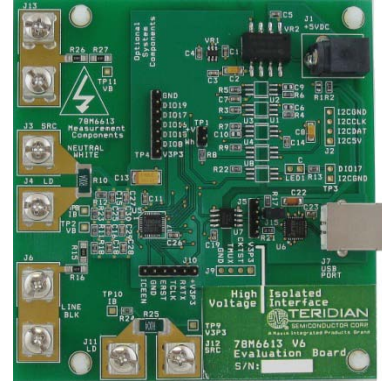
1.1 Package Contents

The 78M6613 Evaluation Board Demo Kit includes:

- 78M6613 Evaluation Board
- USB Cable Assembly USB A-B 28/24 1.8M (Tyco/Amp 1487588-3)
- CD with documentation

1.2 System Requirements

The 78M6613 Evaluation Board requires use of a PC with the following features:

- PC (1 GHz, 1 GB) with Microsoft Windows XP® or Win2000, equipped with USB port.
- Minimum 1024 x 768 video display resolution.

Windows XP is a registered trademark of Microsoft Corp.

1.3 Safety and ESD Notes

CAUTION HIGH VOLTAGE   **EXERCISE CAUTION WHEN LIVE AC VOLTAGES ARE PRESENT!**

Standard ESD precautions must be taken when handling electronic equipment. The 78M6613 contains ESD protected interfaces.

Do not connect test equipment, ICE emulators or external development boards directly to the 78M6613 hardware. Damage to the 78M6613 and external equipment will occur due to the 78M6613's "high side" reference topology. The 78M6613's V3P3 (i.e. "high side") is connected directly to Neutral (Earth Ground) creating a ground reference disparity with any properly grounded external equipment.

1.4 Firmware Demo Code Introduction

The Firmware Demo Code provides the following features:

- Basic energy measurement data such as Watts, Volts, current, VAR, VA, phase angle, power factor, accumulated energy, frequency, date/time, and various alarm statuses.
- Control of alarm thresholds, calibration coefficients, temperature compensation, etc.

The following setup is used to facilitate performance evaluation between the user at the PC host and the firmware code in the board:

- The CLI through HyperTerminal or comparable terminal emulator on a different operating system. For information about the CLI, see the applicable Firmware Description Document.

The 78M6613 is shipped with Firmware Demo Code Revision 1.0 or later loaded in the 78M6613 chip and included on the CD. The code revision can be verified by entering the command **>i** via the command line interface. Firmware for the Demo Unit can be updated using either the Teridian TFP2 or an in-circuit emulator such as the Signum Systems ADM51 (www.signum.com).

The board components and firmware settings are designed to operate with the following nominal AC electrical ranges:

Voltage	Current	Line Frequency
110-240 VAC	10 mA – 20A	46-64 Hz

1.5 Testing the 78M6613 Evaluation Board Prior to Shipping

Before every 78M6613 Evaluation Board is shipped, the following procedures have been performed at the factory:

- Full Calibration – Precise energy source equipment is used to calibrate the current and voltage. The temperature is also calibrated at the same time.
- Accuracy Test – This "bench" level test ensures the energy accuracy is within ±0.5%.

2   Installation

2.1   USB Driver Installation

This evaluation kit includes an isolated USB interface for serial communications with a PC. The FTDI USB controller IC FT232R performs the USB functions. The FTDI driver for Windows® presents a virtual COM port for enabling serial communications. Control of the 78M6613 Evaluation Board can be managed using a terminal emulation program. The FTDI Windows driver is a certified driver for Windows 2000 and Windows XP.

1. Upon attaching the 78M6613 Evaluation Board to the PC, the Found New Hardware Wizard automatically launches and installs the appropriate driver files. If your PC does not find the FTDI driver files on its local hard disk drive, locate and reference the FTDI USB Driver and Utilities subdirectory on the CD. The FT232R controller is powered from the USB cable and is active even when no AC power is applied to the 78M6613 Evaluation Board.
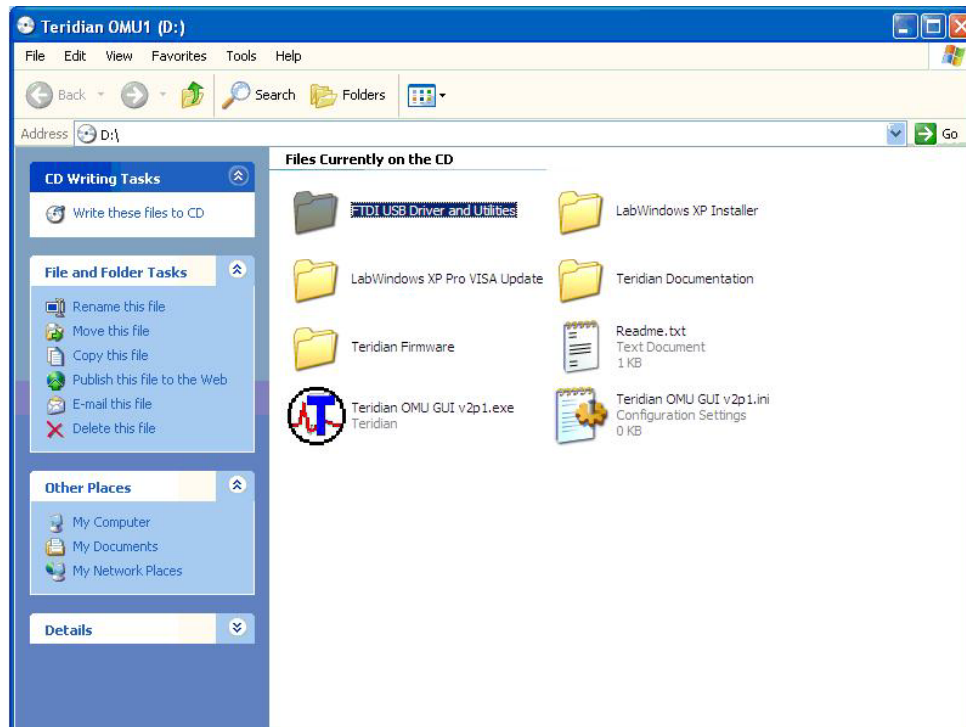
Note: If an older FTDI driver has been previously installed, it is recommended to remove the older version before installing this newer FTDI driver. Execute the **ftdiClean.exe** utility from the FTDI USB Driver and Utilities subdirectory.

For FTDI driver support on other operating systems, refer to FTDI's website at (www.ftdichip.com/FTDrivers.htm).

Windows is a registered trademark of Microsoft Corp.

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2.2 Confirm COM Port Mapping

1. Launch the **Control Panel** and click on the **System** icon.
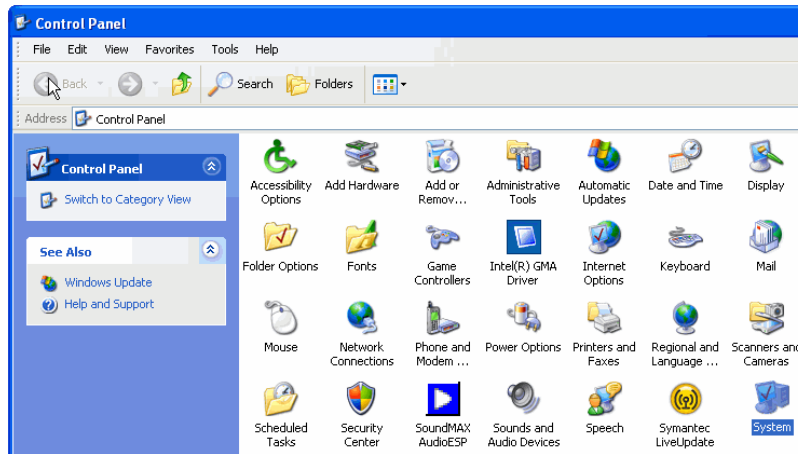
2. The **System Properties** screen appears. Click on the **Hardware** tab. Click on **Device Manager**. Under **Ports (COM & LPT)**, look for the **USB Serial Port** assignment.
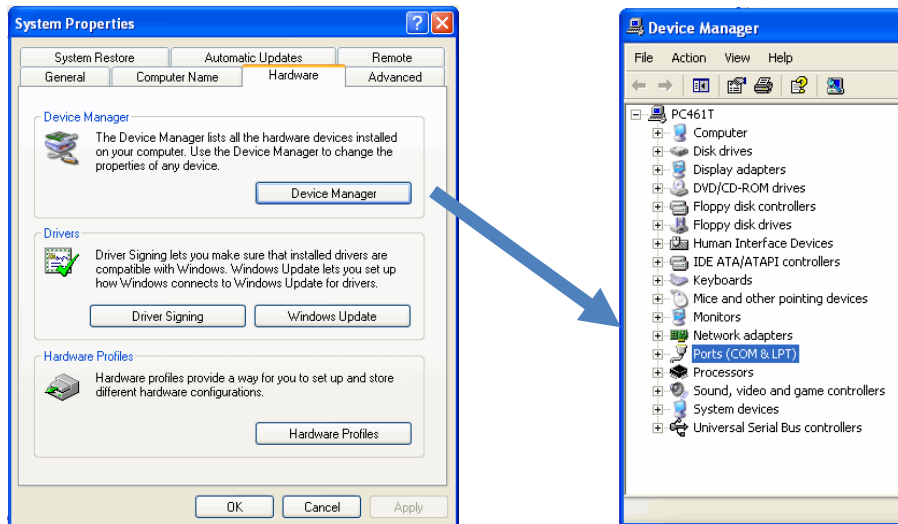
3. Take note of the COM port assignment for the USB Serial Port.

OMU1 COM Port:

2.3 Basic Connection Setup

Figure 1 shows the basic connections of the 78M6613 Evaluation Board for use with external equipment. The 78M6613 Evaluation Board is powered through the USB cable. This same USB cable provides the communications link between the host PC and the 78M6613 Evaluation Board.

The 78M6613 Evaluation Board accepts 120 VAC and 230 VAC (nominal) up to 300 VAC (max).
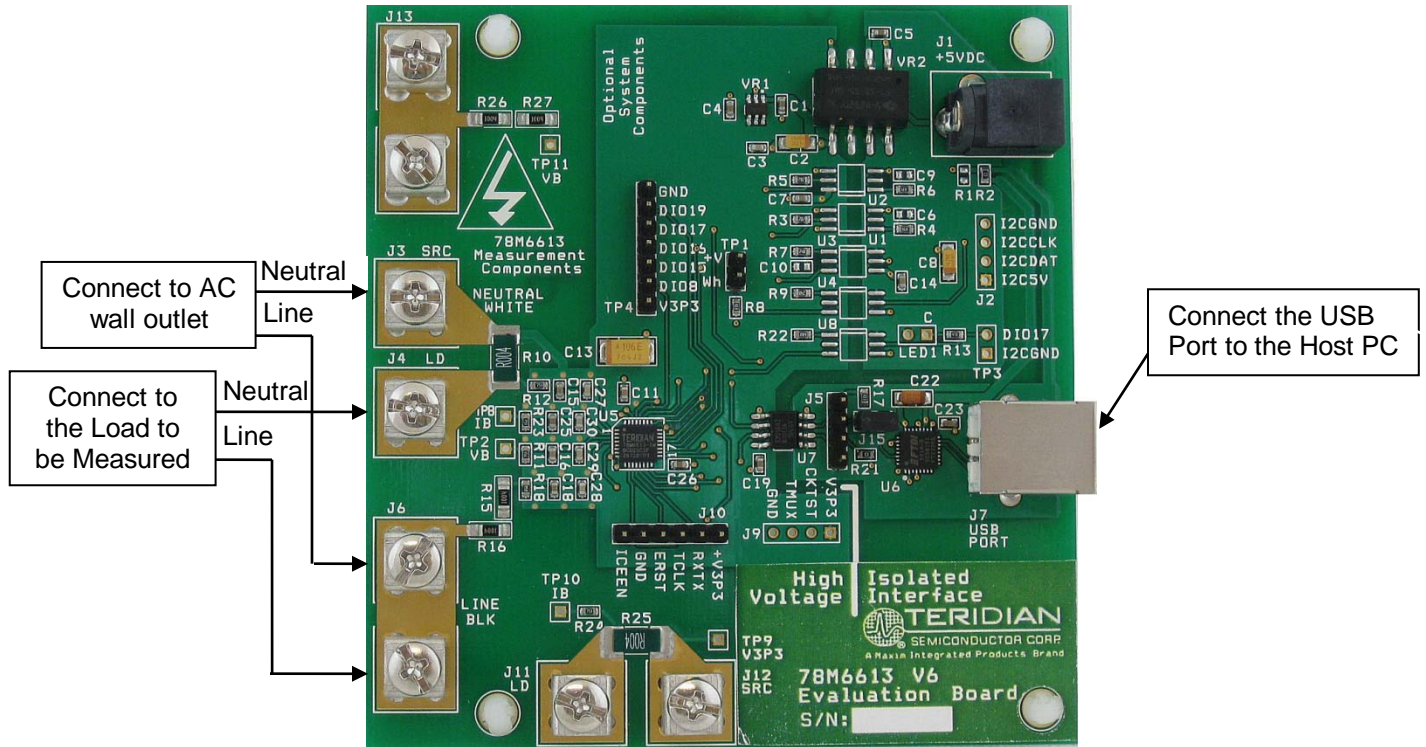
Figure 1: 78M6613 Evaluation Board Connections

Attach an AC source to J3 (Neutral) and J6 (Line). Attach the AC load to J4 (Neutral) and J8 (Line).

Note: The hardware and embedded firmware are capable of measuring two outlets or AC loads. For more information, contact Teridian application support.
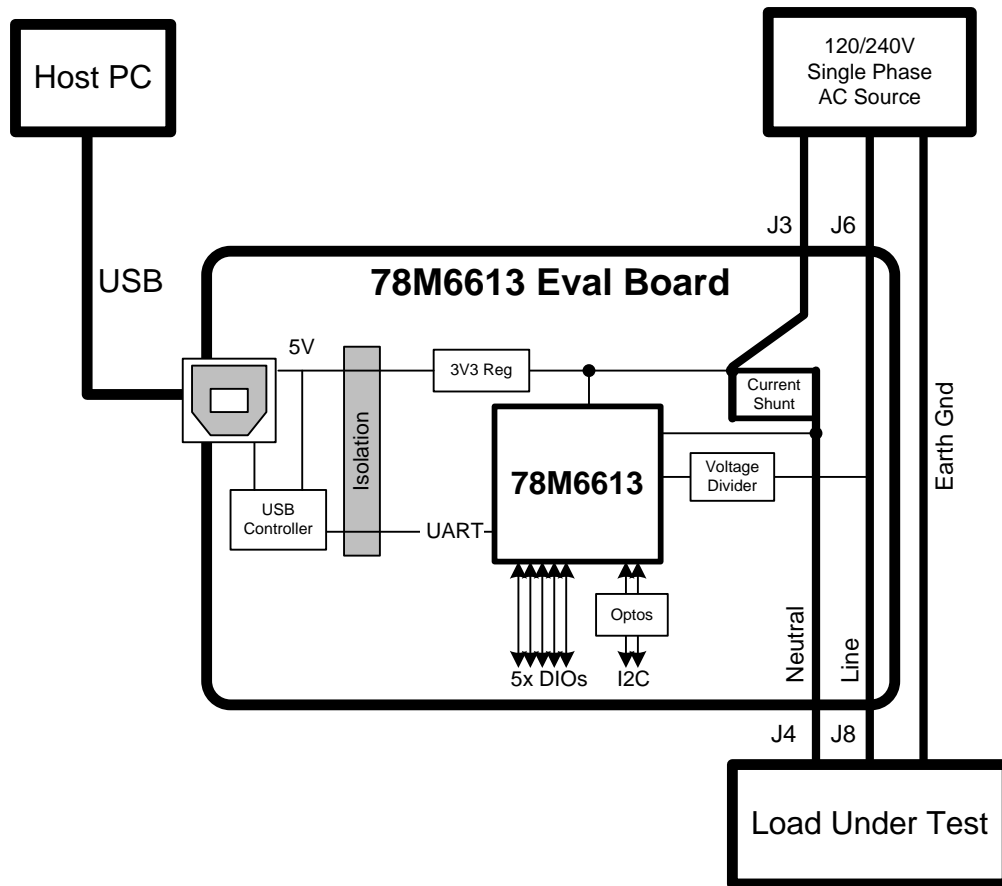
Figure 2: 78M6613 Evaluation Board Application Diagram

2.4 Verify Serial Connection to the PC

After connecting the USB cable from the 78M6613 Evaluation Board to the host PC, start the HyperTerminal application (or another suitable communication program) and create a session using the communication parameters shown in Table 1.

Table 1: COM Port Setup Parameters

Setup Parameter	78M6613
Port speed (baud)	38400
Data bits	8
Parity	None
Stop bits	1
Flow control	Xon/Xoff

HyperTerminal can be found in Windows by selecting **Start** →**All Programs** →**Accessories** → **Communications** →**HyperTerminal**. The connection parameters are configured by selecting **File** → **Properties**. The **New Connection Properties** menu appears.
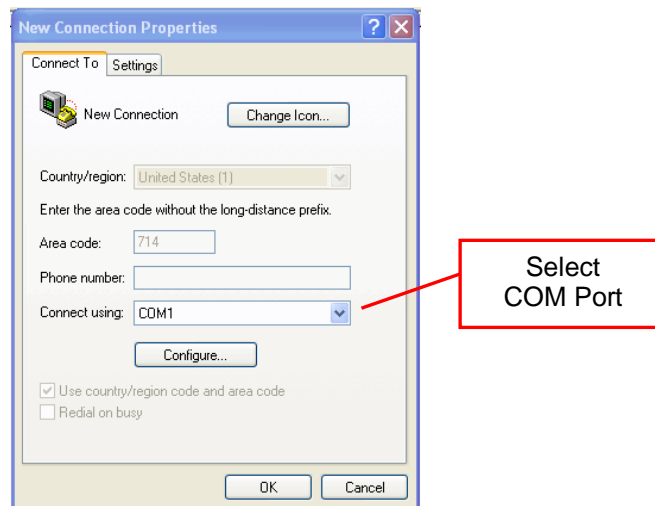
Select the appropriate COM port and click **Configure**. The **COMn Properties** menu appears.
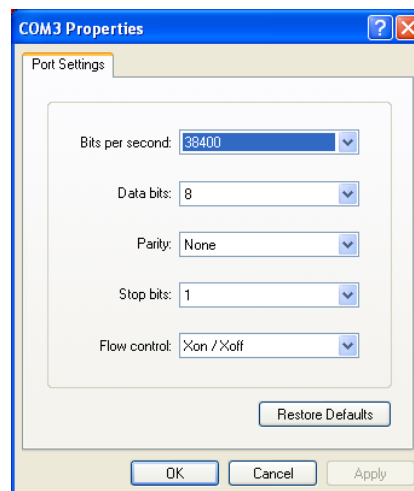
Note that port parameters can only be adjusted when the connection is not active. It may be necessary to click the Disconnect Button to disconnect the port.

FTDI COM Port Trouble-Shooting

If the FTDI device driver did not install properly, there would be no assigned COM port number for the FTDI controller. Repeat the USB Driver Installation, see Section 2.1.

Microsoft Windows may associate a Ball Point device to the FTDI USB controller. When this occurs a FTDI device COM port assignment is available via HyperTerminal but there is no communications data. Verify if a Ball Point device has been added to the "Human Interface Devices" via the Device manager. Refer to Section 2.2 for access to the Device Manager. If a Ball Point device exists, delete it and unplug and replug the evaluation board's USB cable.

CLI measurement can be displayed in two different formats: human readable or twos complement. Both formats are returned as ASCII character strings. The following figure uses CLI commands to return the same data presented in the Auto-Reporting mode.
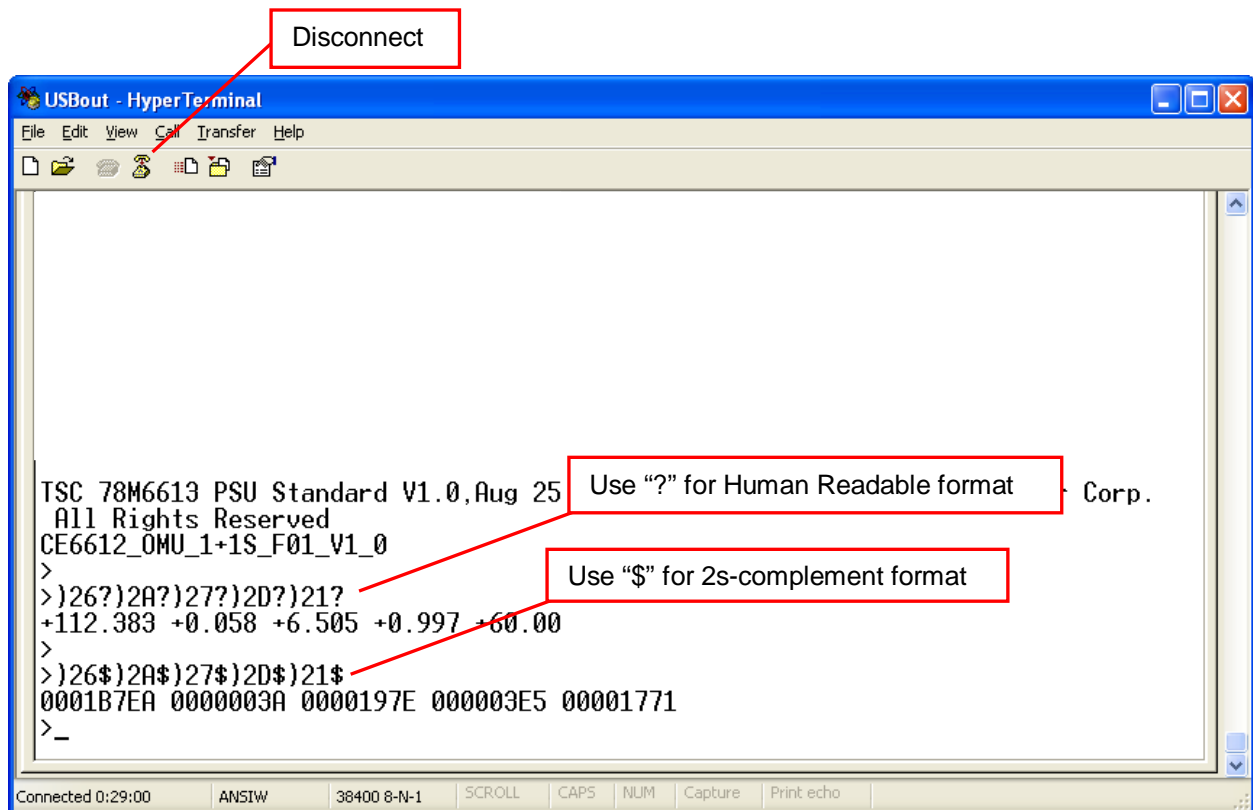
Refer to the applicable Firmware Description Document for a complete description of available CLI commands and their invocation usage.

The 6613_OMU_S2+2_URT_VLIx.hex is compatible with the 78M6612 OMU GUI. Refer to the *OMU1-S-WW Demo Unit User Manual* for installation and operation instructions applicable to the OMU GUI.

2.5   In-Circuit Emulator (ICE) Adaptor

The 78M6613 firmware (stored in internal flash memory) can be updated to accommodate program enhancements. Use the Signum ADM51 or the Teridian TFP-2 to download new firmware to the 78M6613. The supplied ICE Adaptor is required to interface the flat ribbon cable (provided with the ADM51 or TFP-2) to the 78M6613 Evaluation Board.
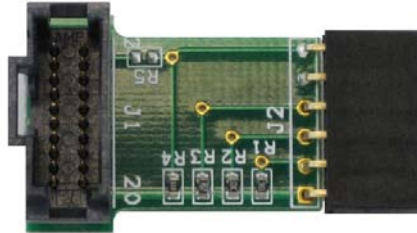

Figure 3: ICE Adaptor

Figure 4 shows how to attach the ICE Adaptor to the 78M6613 Evaluation Board. Please make note of the orientation of the ICE Adaptor as to how it attaches to the 78M6613 Evaluation Board (V3P3 ICE Adaptor pin connects to the +V3P3 Evaluation Board pin).
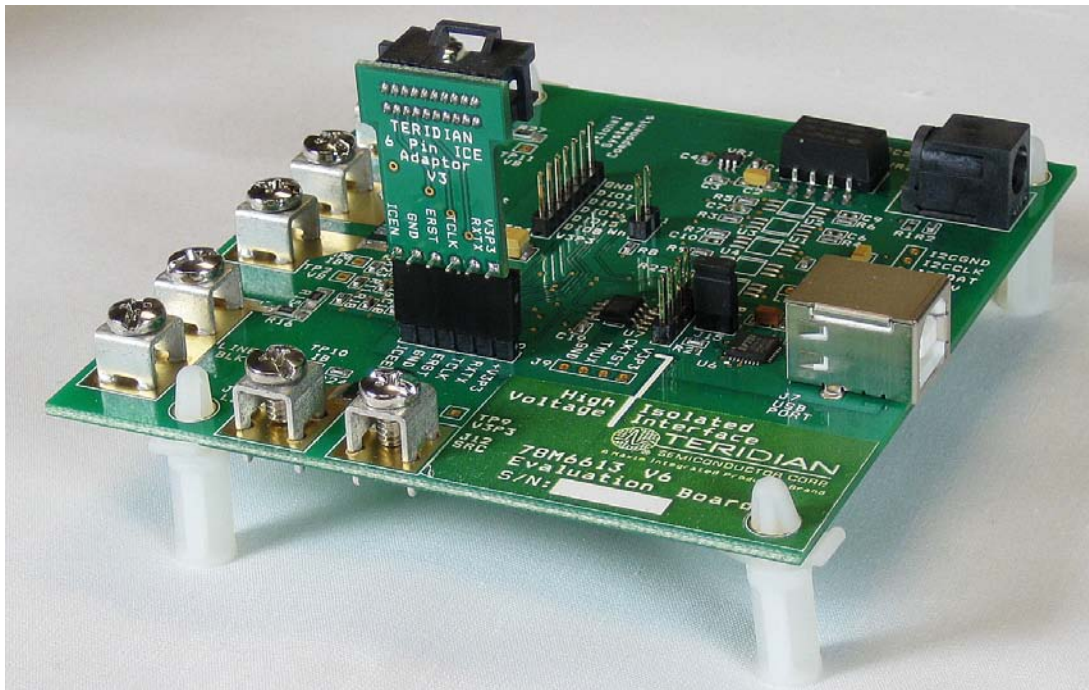
Figure 4: Attaching the ICE Adaptor

Disconnect the 78M6613 Evaluation Board from live AC voltages before connecting the ADM51 or TFP-2. An Earth ground disparity and high AC voltages are present on the 78M6613 Evaluation Board when it is connected to the AC outlet. Equipment damage to the 78M6613, ADM51/TFP-2 and attached PC may occur when live AC voltages are present on the 78M6613 Evaluation Board. Refer to the *78M6613 Safety Precautions Applications Note* for additional information.

It is recommended to always use the supplied flat ribbon cable. Do not use discrete wires in place of the flat ribbon. Poor signal integrity will cause flash memory programming errors. Additional adaptors and flat ribbon cables can be ordered through Teridian.

Power to the 78M6613 is provided via the USB cable. Attach the USB cable during programming.

3 Schematics, Bill of Materials and PCB Layouts

This section includes the schematics, bill of materials and PCB layouts for the 78M6613 Evaluation Board.

3.1 78M6613 Evaluation Board Schematics

Figure 5: 78M6613 Evaluation Board Electrical Schematic (1 of 2)

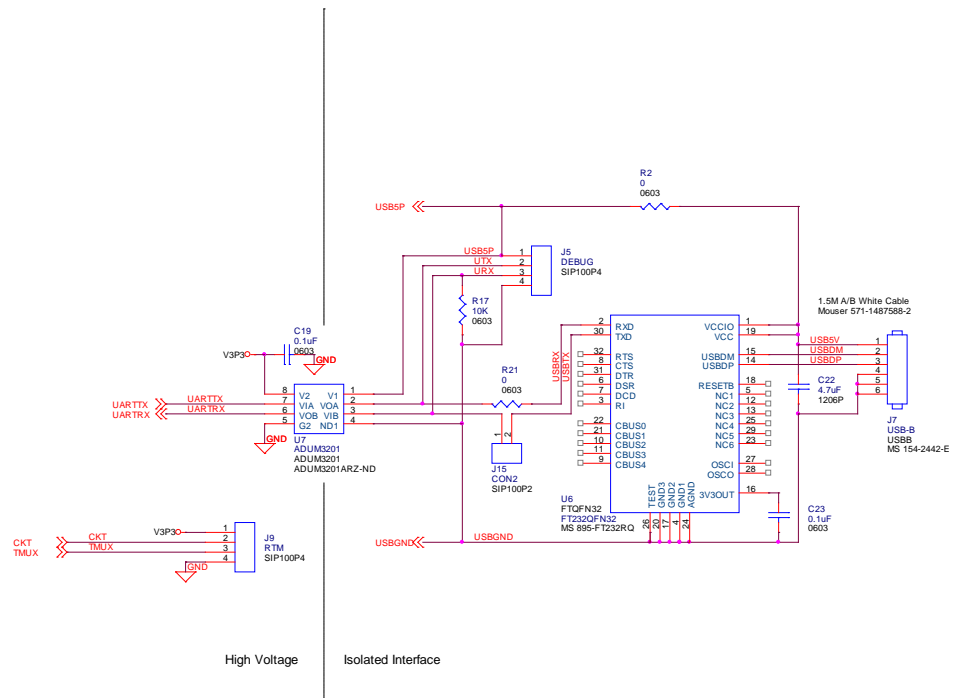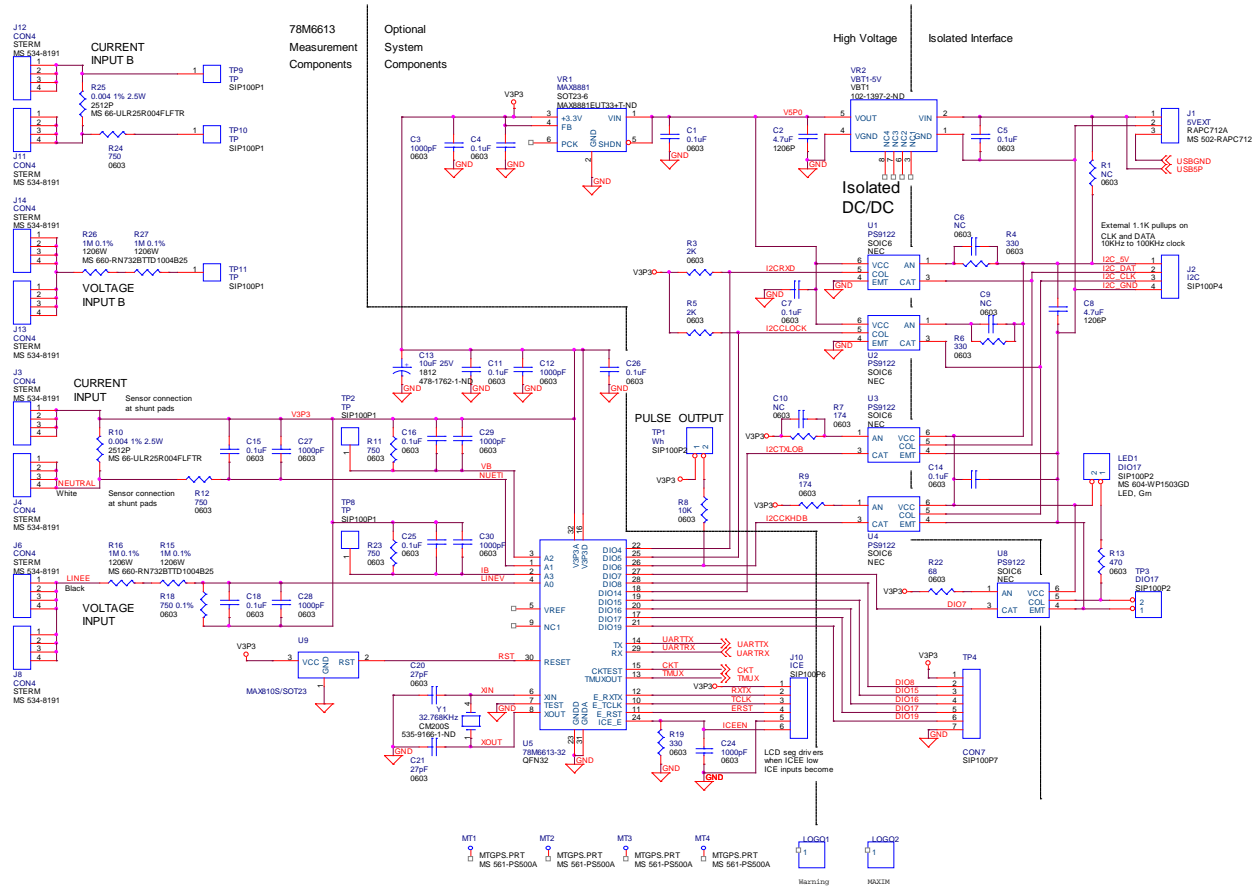**Figure 6: 78M6613 Evaluation Board Electrical Schematic (2 of 2)**

3.2   78M6613 Evaluation Board Bill of Materials

Table 2: 78M6613 Evaluation Board Bill of Materials

Item	Qty	Reference	Part	PCB Footprint	Digi-Key/Mouser Part Number	Part Number	RoHS	Manufacturer
1	7	C3,C12,C24,C27,C28,C29,C30	1000pF	RC0603	445-1298-1-ND	C1608X7R2A102K	X	TDK
2	13	C1,C4,C5,C7,C11,C14,C15,C16,C18,C19,C23,C25,C26	0.1uF	RC0603	445-1314-1-ND	C1608X7R1H104K	X	TDK
3	1	C13	10uF, 25V	RC1812	478-1762-1-ND	TPSC106K025R0500	X	AVX
4	2	C20,C21	27pF	RC0603	445-1274-1-ND	C1608C0G1H270J	X	TDK
5	1	C22	4.7uF	RC1206	445-1606-1-ND	C3216X7R1E475K	X	TDK
6	1	J1	+5VEXT	RAPC	502-RAPC712	RAPC721A	X	Switchcraft
7	1	J5	HEADER 4	4X1PIN	S1011E-36-ND	PBC36SAAN	X	Sullins Connector Solutions
8	1	J10	HEADER 6	6X1PIN	S1011E-36-ND	PBC36SAAN	X	Sullins Connector Solutions
9	1	TP4	HEADER 7	7X1PIN	S1011E-36-ND	PBC36SAAN	X	Sullins Connector Solutions
10	1	TP1	HEADER 2	2X1PIN	S1011E-36-ND	PBC36SAAN	X	Sullins Connector Solutions
11	1	J7	USB	USB-B	154-2442-E	154-2442-E	X	Kobiconn
12	2	R10,R25	0.004, 1%, 2.5W	2512	66-ULR25R004FLFTR	ULR25R004FLFTR	X	IRC
13	4	R18,R11,R12,R23,R24	750, 0.1%	RC0603	RG16P750BCT-ND	RG1608P-751-B-T5	X	Susumu
14	2	R7,R9	174,1%	RC0603	P174HCT-ND	ERJ-3EKF1740V	X	Panasonic
15	1	R13	470	RC0603	P470GCT-ND	ERJ-3GEYJ471V	X	Panasonic
16	4	R15,R16,R26,R27	1M, 0.1%	RC1206	660-RN732BTTD1004B25	RN732BTTD1004B25	X	KOA SPEER
17	1	R22	68	RC0603	P68GCT-ND	ERJ-3GEYJ680V	X	Panasonic
18	4	R2,R20,R21	0	RC0603	P00GCT-ND	ERJ-3GEYJ000V	X	Panasonic
19	3	R4,R6,R19	330	RC0603	P330GCT-ND	ERJ-3GEYJ331V	X	Panasonic
20	2	R8,R17	10K	RC0603	P10KGCT-ND	ERJ-3GEYJ103V	X	Panasonic

Item	Qty	Reference	Part	PCB Footprint	Digi-Key/Mouser Part Number	Part Number	RoHS	Manufacturer
21	2	R3,R5	2K	RC0603	P2.0KGTR-ND	ERJ-3GEYJ202V	X	Panasonic
22	1	U6	FT232	32QFN	895-FT232RQ	FT232QFN32	X	FTDI
23	1	U7	ADUM3201	8SOIC	ADUM3201ARZ-ND	ADUM3201	X	Analog Devices
24	1	U5	78M6613-IM/F	32QFN	–	78M6613-IM/F	X	Teridian
25	5	U1,U2,U3,U4,U8	OPTOCOUPLER	5-MFSOP	TLP112AFCT-ND	TLP112A(TPR,F)	X	Toshiba
26	1	VR2	VBT1-5V	VBT1	102-1397-1-ND	VBT1-S5-S5-SMT	X	CUI
27	1	VR1	3.3V, 500mA	SOT223	511-LD1117S33C	LD1117S33CTR	X	STMicroelectronics
28	1	Y1	32.768 KHZ SMD 12.5Pf	ABS25	535-9166-1-ND	ABS25-32.768KHZ-T	X	Abracon
29	1	U9	MAX810	SOT23	MAX810SEUR+TCT-ND	MAX810SEUR+T	X	Maxim

3.3 78M6613 Evaluation Board PCB Layouts

Figure 7: 78M6613 Evaluation Board PCB Top View

Figure 8: 78M6613 Evaluation Board PCB Bottom View

4   Ordering Information

Part Description	Order Number
78M6613 Evaluation Board	78M6613-EVM-1

5   Included Documentation

The following 78M6613 documents are included on the CD:

78M6613 Data Sheet
6613_PSU_S1_URT_V1_01 Firmware Description Document
6613_OMU_S2+2_URT_V1_1x Firmware Description Document

6   Contact Information

For more information about Maxim products or to check the availability of the 78M6613, contact technical support at **www.maxim-ic.com/support**.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
1.0	1/11	Initial release	—