

# **78M6613 PSU Evaluation Kit User Manual**

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# 1 Introduction

The 78M6613 PSU Evaluation Kit is an electrical measurement unit for performing measurements of a single-phase AC load or power supply. It incorporates the 78M6613 energy measurement IC preprogrammed with PSU Demo Application Firmware. The kit connects to a PC through a USB cable and demonstrates the capability of the 78M6613 energy-meter controller chip for measurement accuracy and overall system use.

## 1.1 Ordering Information

| Part Description           | Order Number  |
|----------------------------|---------------|
| 78M6613 PSU Evaluation Kit | 78M6613-PSU-1 |

## 1.2 Package Contents

The 78M6613 PSU Evaluation Kit includes:

- 78M6613 PSU board
- Shunt adaptor board
- ICE adaptor board
- USB cable assembly USB A-B 28/24 1.8M (Tyco/Amp 1487588-3)
- CD with documentation

## 1.3 System Requirements

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

- PC (1 GHz, 1 GB) with Microsoft Windows XP<sup>®</sup>, Windows Vista<sup>®</sup>, or Windows 7 operating systems equipped with USB port.
- Minimum 1024 x 768 video display resolution.

## 1.4 Safety and ESD Notes



**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.

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       |

*Windows XP is a registered trademark of Microsoft Corp.*

## 1.5 Firmware Demo Code Introduction

The 78M6613 PSU Firmware is a turnkey energy measurement solution optimized for use in AC/DC power supply units (PSUs). At the sensor interface, the 78M6613 with PSU Firmware supports one voltage sense input one current sense input, and an optional input for an external thermistor voltage measurement. At the host interface, ready-to-use data is available over a low baud-rate serial interface for minimal cost of data isolation. Refer to the *78M6613 PSU Demo Application User Guide* for more information.

The Evaluation Kit is shipped with PSU Demo Application Firmware loaded in the 78M6613 chip and included on the CD. Firmware for the Demo Unit can be updated using either the Teridian TFP2 or an in-circuit emulator such as the Signum Systems ADM-51 ([www.signum.com](http://www.signum.com)).

## 1.6 Testing the 78M6613 PSU Evaluation Kit Prior to Shipping

Before every 78M6613 PSU Evaluation Kit 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  $\pm 0.5\%$ .

## 2 Installation

### 2.1 USB Driver Installation

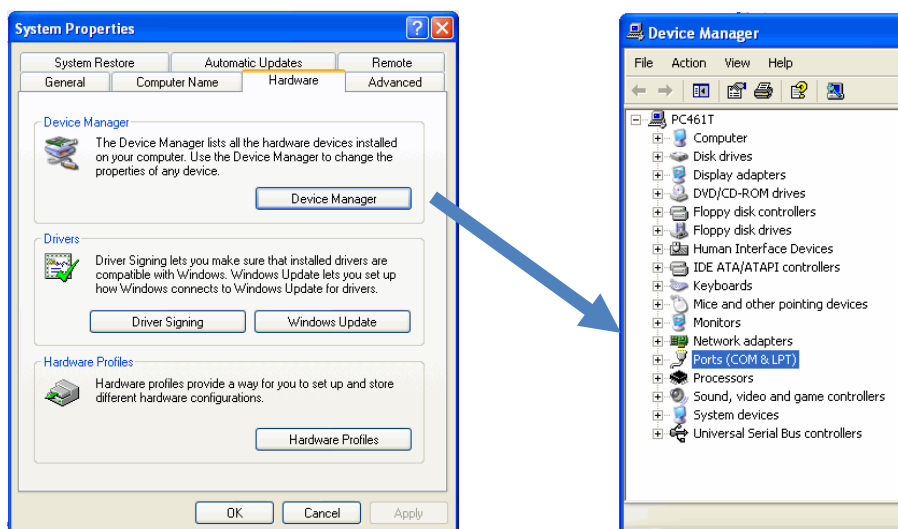
This evaluation kit includes an isolated USB interface for serial communications with a PC. The FTDI USB controller IC FT232R performs the USB functions. The FTDI Windows driver is a certified driver for Microsoft Windows XP®, Windows Vista®, and Windows 7 operating systems that presents a virtual COM port for enabling serial communications.

After attaching the 78M6613 PSU Evaluation Kit 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 power is applied to the 78M6613 PSU Evaluation Kit.

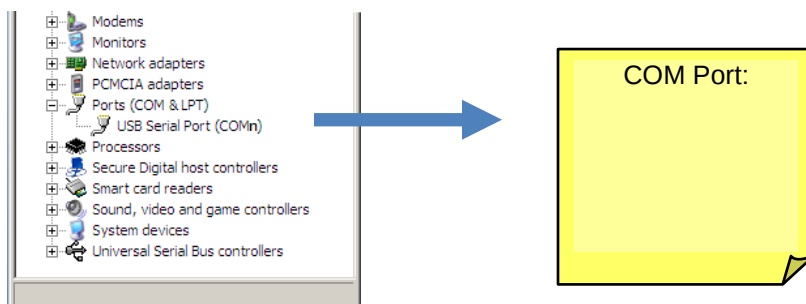
**Note:** If an older FTDI driver has been previously installed, it is recommended to remove the older version before installing this newer FTDI driver. Execute the **ftdiClean.exe** utility from the FTDI USB Driver and Utilities subdirectory. For FTDI driver support on other operating systems, refer to FTDI's website at ([www.ftdichip.com/FTDrivers.htm](http://www.ftdichip.com/FTDrivers.htm)).

#### 2.1.1 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.



### 2.1.2 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 kit's USB cable.

## 2.2 Basic Connection Setup

Figure 1 shows the basic connections of the 78M6613 PSU Evaluation Kit for use with external equipment. The 78M6613 PSU Evaluation Kit is powered through the USB cable. This same USB cable provides the communications link between the host PC and the 78M6613 PSU Evaluation Kit. The shunt adaptor board consists of a USB serial UART controller, serial interface isolator and a DC/DC isolator, current shunt, and AC wiring terminals. Connect J1 and J3 to an external AC power source. Connect J2 and J4 to the load to be measured.

The 78M6613 PSU Evaluation Kit accepts 120 VAC and 230 VAC (nominal) up to 300 VAC (max).

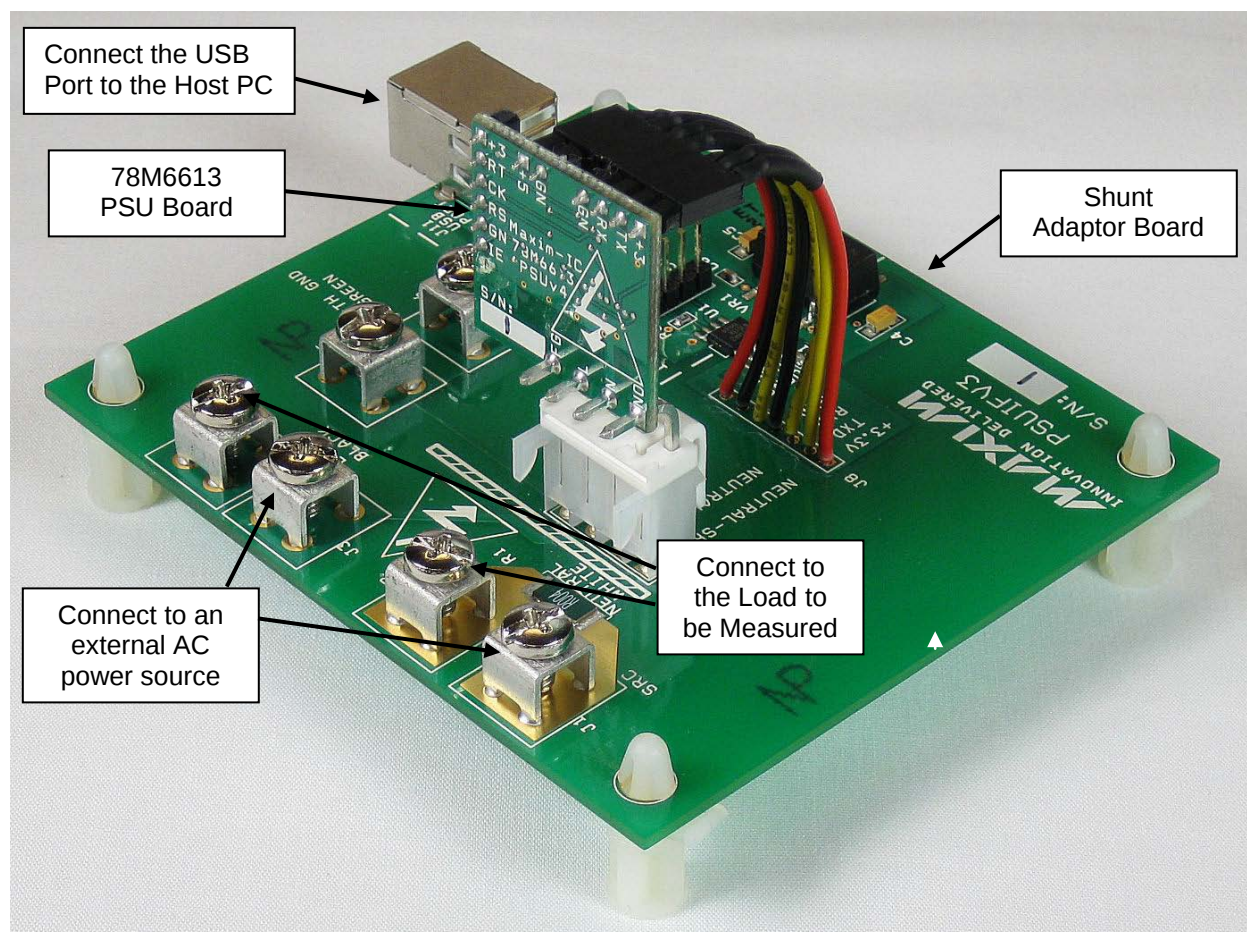


Figure 1: 78M6613 PSU Evaluation Kit Connections

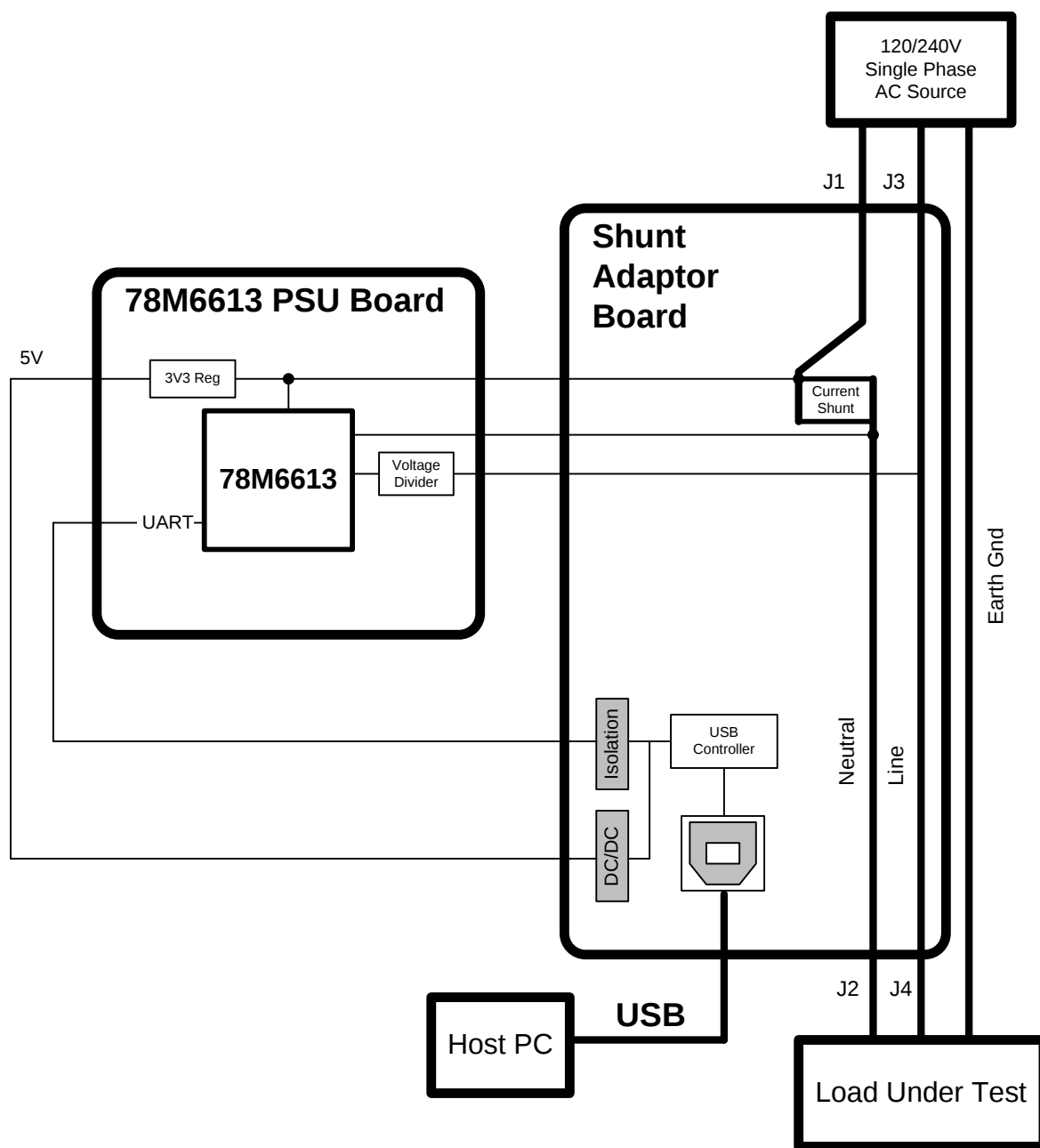
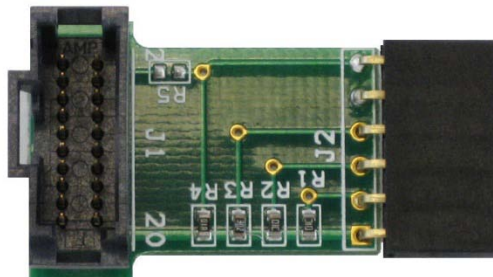


Figure 2: 78M6613 PSU Evaluation Kit Application Diagram

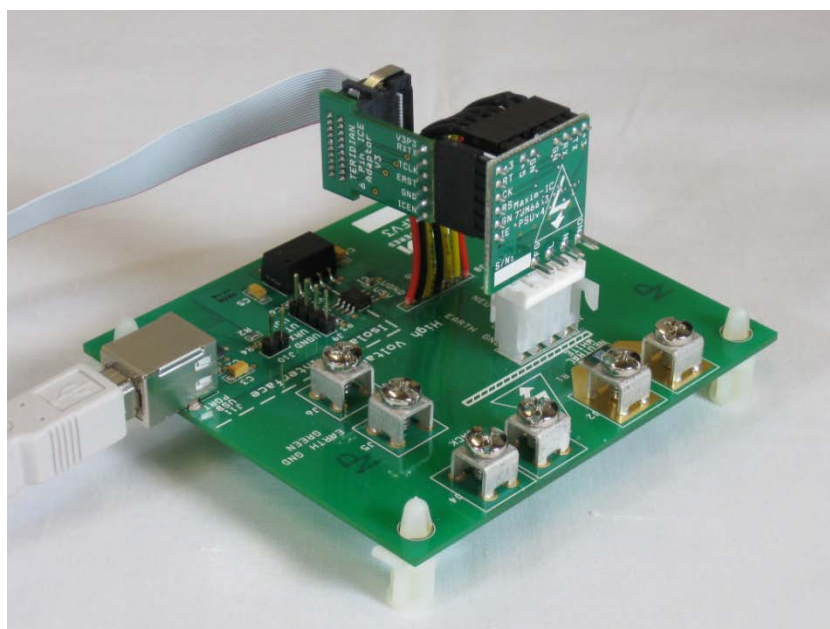
## 2.3 In-Circuit Emulator (ICE) Adaptor

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 PSU Board.



**Figure 3: ICE Adaptor**

Figure 4 shows how to attach the ICE Adaptor to the 78M6613 PSU Board. Make note of the orientation of the ICE Adaptor as to how it attaches to the 78M6613 PSU Board (V3P3 ICE Adaptor pin connects to the +3 PSU Board pin).



**Figure 4: Attaching the ICE Adaptor**



Disconnect the 78M6613 PSU 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 PSU 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 PSU 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 from the USB cable attached to the shunt adaptor board. The ICE adaptor's V3P3 pin is only a sense input to the ADM51.

### 3 Schematics, Bill of Materials and PCB Layouts

This section includes the schematics, bill of materials and PCB layouts for the 78M6613 PSU Board and the Shunt Adaptor Board. Application Notes are also available for hardware design and PCB layout guidelines.

#### 3.1 78M6613 PSU Board Schematics

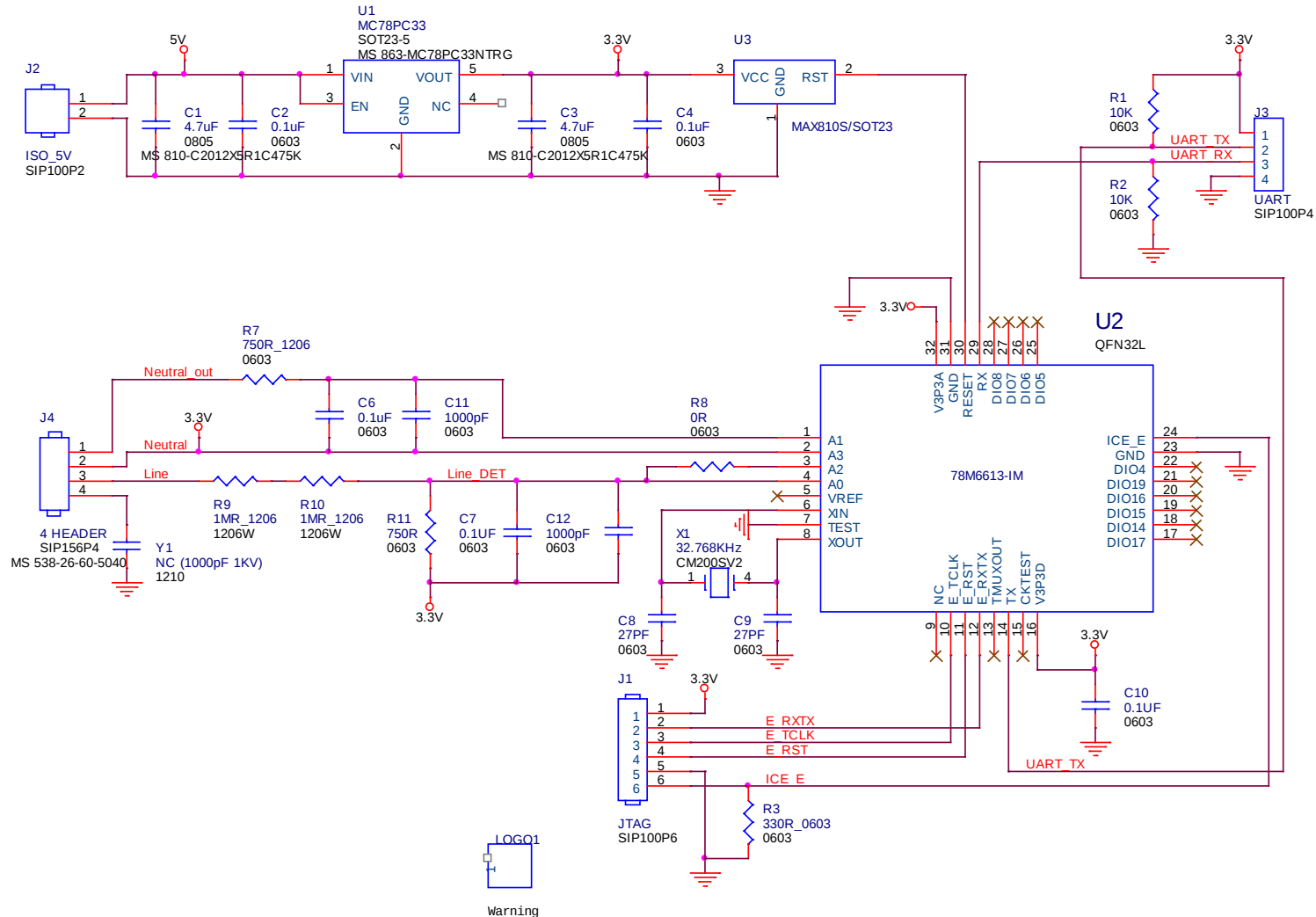


Figure 5: 78M6613 PSU Board Electrical Schematic

### 3.2 78M6613 PSU Board Bill of Materials

Table 1: 78M6613 PSU Board Bill of Materials

| Item | Qty | Reference           | Part                     | PCB Footprint | Digi-Key/Mouser Part Number | Part Number       | Manufacturer                | RoHS |
|------|-----|---------------------|--------------------------|---------------|-----------------------------|-------------------|-----------------------------|------|
| 1    | 2   | C11,C12             | 1000pF                   | RC0603        | 445-1298-1-ND               | C1608X7R2A102K    | TDK                         | X    |
| 2    | 5   | C2,C4,C6,<br>C7,C10 | 0.1uF                    | RC0603        | 445-1314-1-ND               | C1608X7R1H104K    | TDK                         | X    |
| 3    | 2   | C8,C9               | 27pF                     | RC0603        | 445-1274-1-ND               | C1608C0G1H270J    | TDK                         | X    |
| 4    | 2   | C1,C3               | 4.7uF                    | RC1206        | 445-1606-1-ND               | C3216X7R1E475K    | TDK                         | X    |
| 5    | 1   | J3                  | HEADER 4                 | 4X1PIN        | S1011E-36-ND                | PBC36SAAN         | Sullins Connector Solutions | X    |
| 6    | 1   | J1                  | HEADER 6                 | 6X1PIN        | S1011E-36-ND                | PBC36SAAN         | Sullins Connector Solutions | X    |
| 7    | 1   | J2                  | HEADER 6                 | 2X1PIN        | S1011E-36-ND                | PBC36SAAN         | Sullins Connector Solutions | X    |
| 8    | 1   | J4                  | HEADER 4                 | 4X1PIN        | 538-26-60-5040              | 26-60-504         | Molex                       | X    |
| 9    | 2   | R7,R11              | 750, 0.1%                | RC0603        | RG16P750BCT-ND              | RG1608P-751-B-T5  | Susumu                      | X    |
| 10   | 2   | R9,R10              | 1M, 0.1%                 | RC1206        | 660-RN732BTDD1004B25        | RN732BTDD1004B25  | KOA SPEER                   | X    |
| 11   | 1   | R8                  | 0                        | RC0603        | P00GCT-ND                   | ERJ-3GEYJ000V     | Panasonic                   | X    |
| 12   | 1   | R3                  | 330                      | RC0603        | P330GCT-ND                  | ERJ-3GEYJ331V     | Panasonic                   | X    |
| 13   | 2   | R1,R2               | 10K                      | RC0603        | P10KGCT-ND                  | ERJ-3GEYJ103V     | Panasonic                   | X    |
| 14   | 1   | U2                  | 78M6613                  | 32QFN         | –                           | 78M6613           | Teridian                    | X    |
| 15   | 1   | U1                  | 3.3V, 100mA              | SOT23         | 863-MC78PC33NTRG            | MC78PC33NTRG      | ON Semiconductor            | X    |
| 16   | 1   | Y1                  | 32.768 KHZ SMD<br>12.5Pf | ABS25         | 535-9166-1-ND               | ABS25-32.768KHZ-T | Abracon                     | X    |
| 17   | 1   | U3                  | MAX810                   | SOT23         | MAX810SEUR+TCT-ND           | MAX810SEUR+T      | Maxim                       | X    |

### 3.3 78M6613 PSU Board PCB Layouts

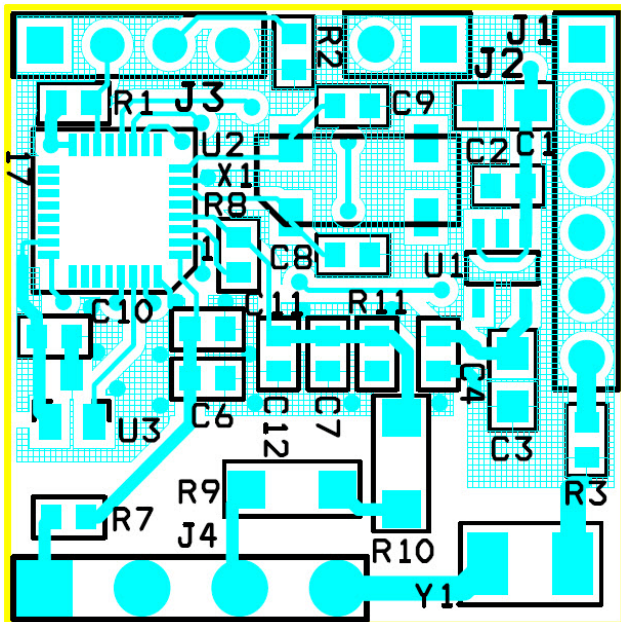


Figure 6: 78M6613 PSU Board PCB Top View

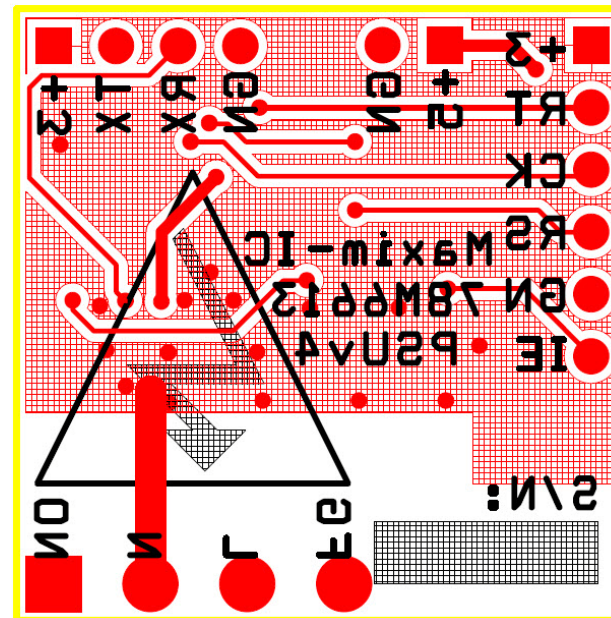


Figure 7: 78M6613 PSU Board PCB Bottom View

### 3.4 Shunt Adaptor Board Schematics

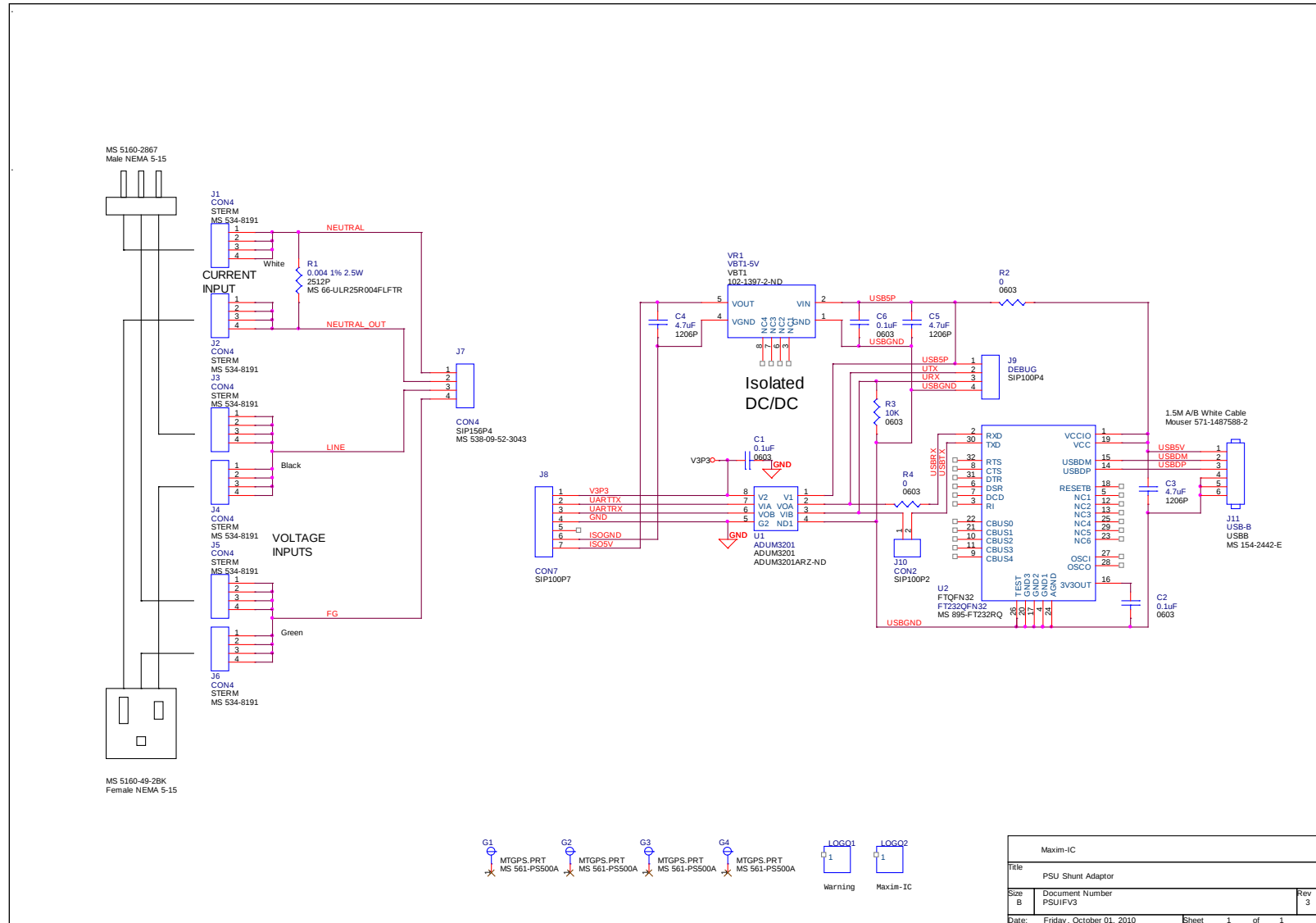


Figure 8: Shunt Adaptor Board Electrical Schematic

### 3.5 Shunt Adaptor Board Bill of Materials

Table 2: Shunt Adaptor Board Bill of Materials

| Item | Qty | Reference         | Part                                                                | PCB Footprint  | Digi-Key/Mouser Part Number | Part Number      | Manufacturer                | RoHS |
|------|-----|-------------------|---------------------------------------------------------------------|----------------|-----------------------------|------------------|-----------------------------|------|
| 1    | 3   | C1,C2,C6          | 0.1uF                                                               | 603            | 399-5089-1-ND               | C0603C104K5RACTU | Kemet                       | X    |
| 2    | 3   | C3,C4,C5          | 4.7uF                                                               | 1206P          | 478-2396-1-ND               | TPSB475K016R1500 | AVX Corporation             | X    |
| 3    | 4   | G1,G2,G3,G4       | STANDOFF                                                            | MTGPS.PRT      | MS 561-PS500A               | 561-PS500A       | Eagle Plastic Devices       | X    |
| 4    | 6   | J1,J2,J3,J4,J5,J6 | CON4                                                                | STERM VERTICAL | MS 534-8191                 | 8191             | Keystone Electronics        | X    |
| 5    | 1   | J7                | CON4                                                                | SIP156P4       | MS 538-09-52-3043           | 09-52-3043       | Molex                       | X    |
| 6    | 1   | J8                | 2 inch 7 wires<br>22 AWG<br>directly to<br>board to female<br>strip | Through holes  | –                           | –                | –                           | X    |
| 7    | 1   | J9                | DEBUG                                                               | SIP100P4       | S1011E-36-ND                | PBC36SAAN        | Sullins Connector Solutions | X    |
| 8    | 1   | J10               | CON2                                                                | SIP100P2       | S1011E-36-ND                | PBC36SAAN        | Sullins Connector Solutions | X    |
| 9    | 1   | J10               | 2 PIN<br>SHORTING<br>BLOCK                                          |                | S9001-ND                    | SPC02SYAN        | Sullins Connector Solutions | X    |
| 10   | 1   | J11               | USB-B                                                               | USBB           | MS 154-2442-E               | 154-2442-E       | Kobiconn                    | X    |
| 11   | 1   | R1                | 0.004 1% 2.5W                                                       | 2512P          | MS 66-ULR25R004FLFTR        | ULR25R004FLFTR   | IRC                         | X    |
| 12   | 2   | R2,R4             | 0                                                                   | 603            | P0.0GCT-ND                  | ERJ-3GEY0R00V    | Panasonic - ECG             | X    |
| 13   | 1   | R3                | 10K                                                                 | 603            | P10.0KHCT-ND                | ERJ-3EKF1002V    | Panasonic - ECG             | X    |
| 14   | 1   | U1                | ADUM3201                                                            | ADUM3201       | ADUM3201ARZ-ND              | ADUM3201ARZ      | Analog Devices Inc          | X    |
| 15   | 1   | U2                | FT232QFN32                                                          | FTQFN32        | MS 895-FT232RQ              | FT232RQ-REEL     | FTDI                        | X    |
| 16   | 1   | VR1               | VBT1-5V                                                             | VBT1           | 102-1397-2-ND               | VBT1-S5-S5-SMT   | CUI Inc                     | X    |

### 3.6 Shunt Adaptor Board PCB Layouts

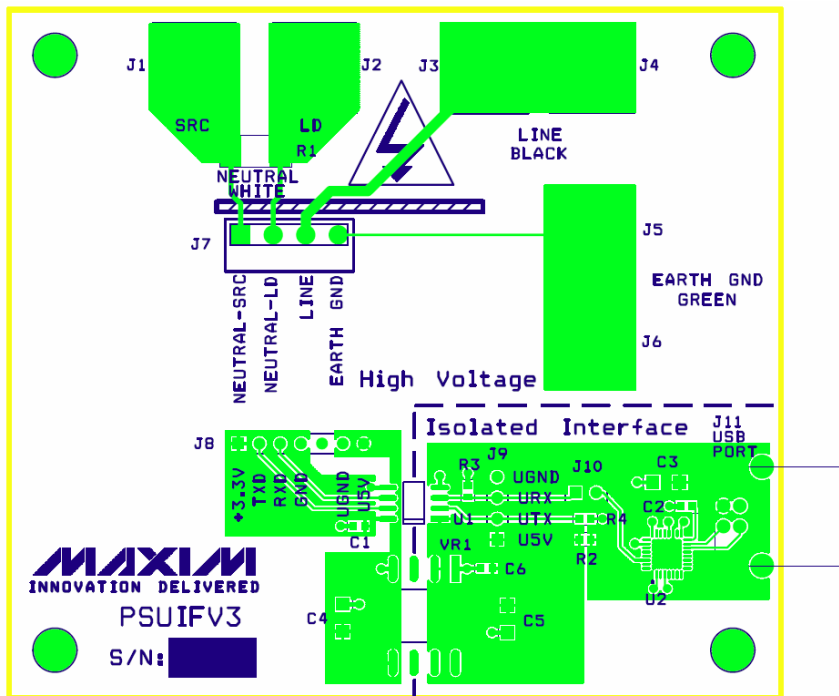


Figure 9: Shunt Adaptor Board PCB Top View

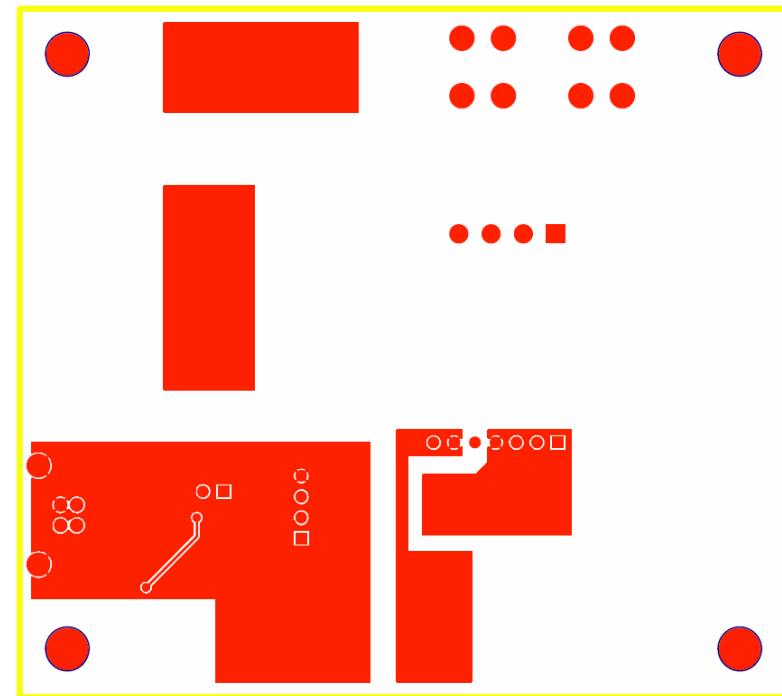


Figure 10: Shunt Adaptor Board PCB Bottom View

## 4 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](http://www.maxim-ic.com/support).

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION                                                                                                                                                                                                                                                                                                                               | PAGES CHANGED             |
|-----------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 1.0             | 1/11          | Initial release                                                                                                                                                                                                                                                                                                                           | —                         |
| 1.1             | 4/11          | Replaced the schematic in Figure 5. The VA, IA, VB, and IB pin names in the old schematic were changed to A0, A1, A2, and A3, respectively, in the new schematic.                                                                                                                                                                         | 15                        |
| 1.2             | 5/11          | Added schematics, bill of materials, and PCB layouts for the Shunt Adaptor Board.                                                                                                                                                                                                                                                         | 18, 19, 20                |
| 2               | 1/12          | Added new Maxim logo.<br>Corrected the connections in Figure 1.<br>Swapped J1 and J2 in Figure 2.                                                                                                                                                                                                                                         | 1<br>9<br>10              |
| 3               | 4/12          | Changed the title from <i>78M6613 PSU Board User Manual</i> to <i>78M6613 PSU Evaluation Kit User Manual</i> .<br>Removed the .hex file name for the PSU Demo Application code.<br>Updated the System requirements.<br>Updated the FTDI Windows driver certification.<br>Removed references to CLI and the Firmware Description Document. | 1<br>5<br>5<br>7<br>6, 13 |