MAX78615+PPM

Evaluation Kit Manual (Revision 1.0)

February 2015

maxim integrated™

Rev. 0, February 2015

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1 Introduction

The MAX78615+PPM evaluation kit demonstrates the capability of the MAX78615+PPM. The MAX78615+PPM chipset monitors up to three voltages and three current through up to three galvanically isolated ADCs. The typical application is source/load monitoring in single and poly-phase systems. The kit connects to a PC through a USB cable that provides both power and data communication to the board. A Windows®-based graphical user interface (GUI) communicates with the device over a virtual COM port for simplified access to measurement data and controls.

The MAX78615+PPM data sheet provides all the details on signal processing, operations and settings. It also includes the registers map with description. The data sheet should be used along with this manual during the setup and evaluation phase of the MAX7815+PPM.

1.1 Ordering Part Number

MAX78615PPM70EVK1#

1.2 Package Contents

The MAX78615+PPM evaluation board demo kit includes:

- MAX78615+PPM evaluation board
- USB cable assembly USB A-B 28/24 1.8M (Tyco/Amp 1487588-3)
- CD with documentation, GUI application, and USB drivers
- Calibration coefficients document (hardcopy only)

1.3 System Requirements

In addition to an AC source and load for measuring, the MAX78615+PPM evaluation kit provides a GUI to be used with a PC with the following features:

- 1GHz processor and 1GB RAM
- Minimum 1024 x 768 video display resolution
- Available USB port
- Microsoft® Windows 7 or Windows XP®

Figure 1 shows a typical connection diagram.

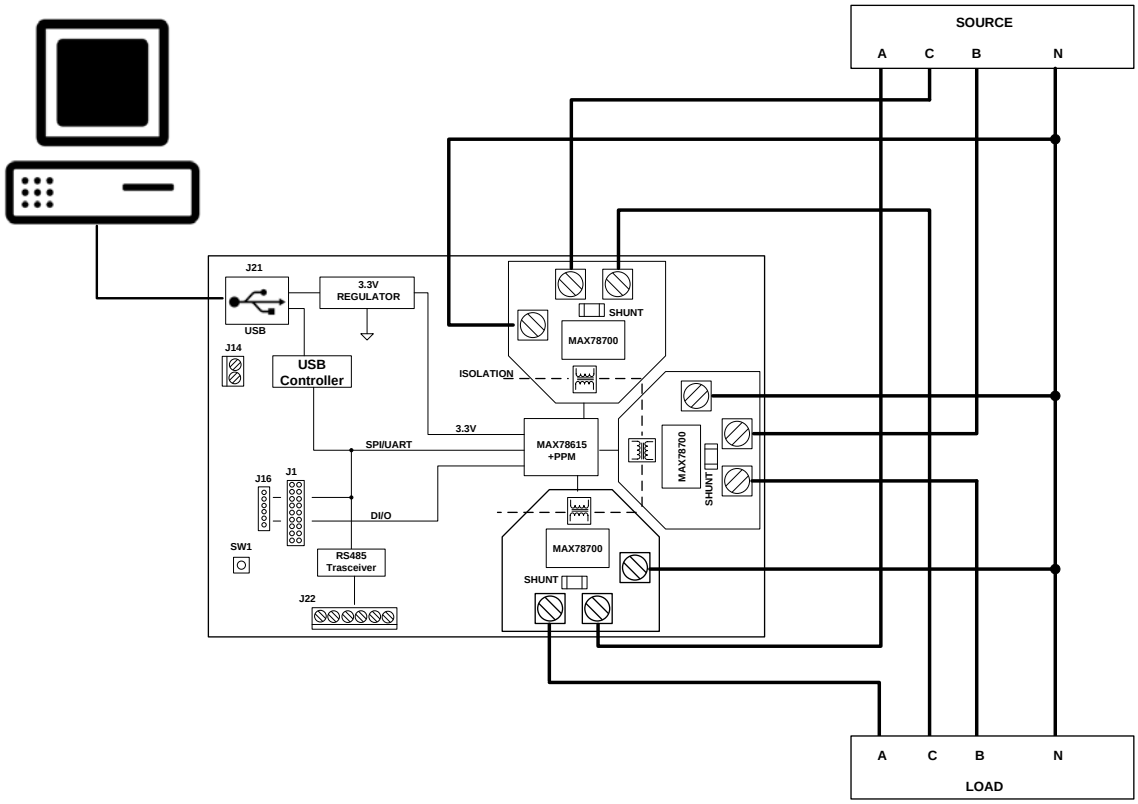


Figure 1. MAX78615+PPM Evaluation Kit Typical Connection Diagram

1.4 Safety and ESD Notes

EXERCISE CAUTION WHEN LIVE AC VOLTAGES ARE PRESENT!

Standard ESD precautions must be taken when handling electronic equipment.

Exercise extreme caution handling the hardware and connecting test equipment to the nonisolated portion of the MAX78615+PPM modem board (highlighted in red below). Ignoring the safety requirements can lead to shock, injury, and damage of the hardware.

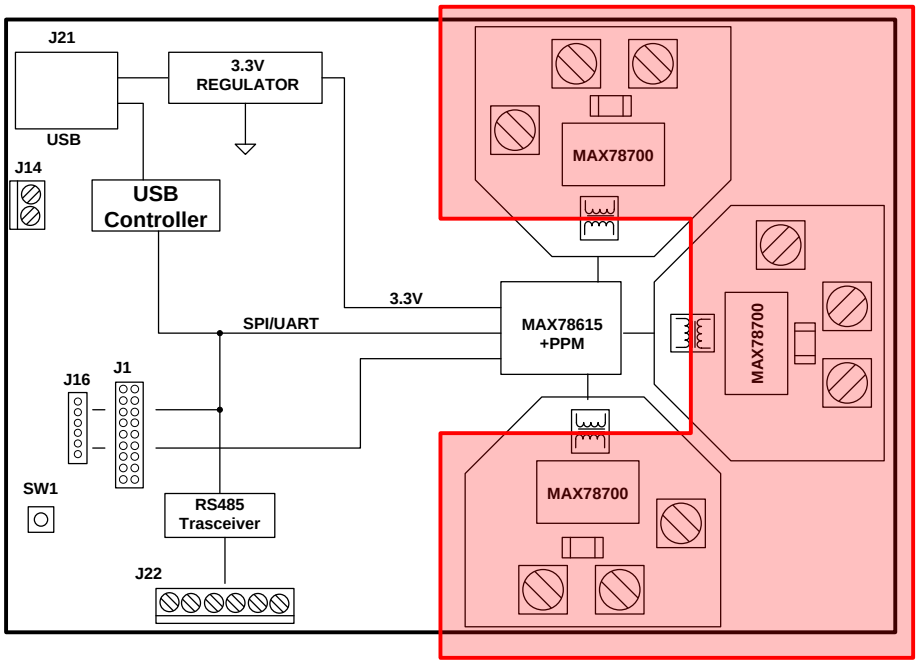


Figure 2. MAX78615+PPM Nonisolated (Shock Hazard) Area in Red

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

Voltage	Current	Line Frequency
10VAC–400VAC	10mA–15A	46Hz–64Hz

1.5 Testing the MAX78615+PPM Evaluation Board Prior to Shipping

Before every kit is shipped, the board (and sensors) undergoes a single-load point calibration using precise energy source equipment. The device temperature is also calibrated at the same time. Results printed out on paper and included with the evaluation kit.

2 Installation and Setup

The MAX78615+PPM evaluation kit connects to a PC through a USB cable that provides both power and data communication to the board. A Windows®-based graphical user interface (GUI) communicates with the device over a USB/SPI virtual COM port. The GUI provides a simple access to measurement data and controls.

2.1 System Description

The MAX78165+PPM is an energy measurement device (host processor) that interfaces to up to three MAX78700 (AFE+ADC). The MAX78615+PPM utilized a pulse transformer for each MAX78700 to establish both bidirectional communications and to power the MAX78700. The pulse transformer also ensures the galvanic isolation between each MAX78700 and the system.

The evaluation kit includes a set of jumpers and connectors to allow different configurations.

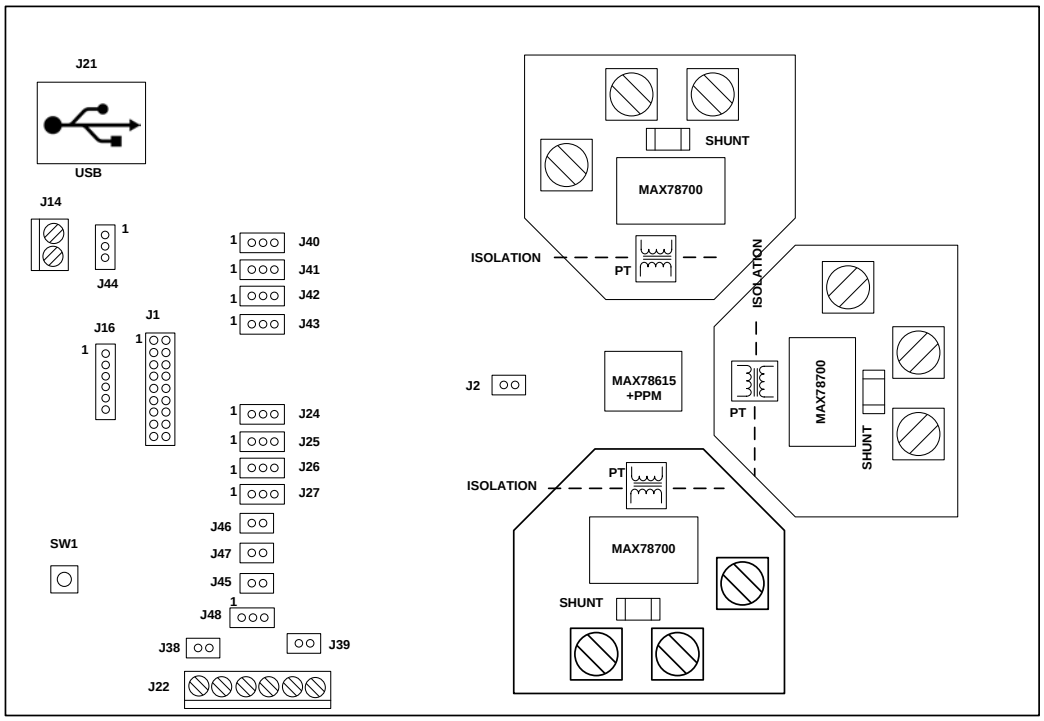


Figure 3. MAX78615+PPM Evaluation Kit

2.2 Powering the Evaluation Kit Board

The MAX78615+PPM evaluation board is normally powered through the USB port (J21). In case the power needs to be supplied from a different source, a 5VDC supply can be connected to the terminal block J14. Jumper J44 selects the power source as in Table 1.

When the MAX78615+PPM evaluation board is powered through USB, the same cable also provides the communications link between the host PC and the MAX78615+PPM evaluation board.

Table 1. J44 Jumper Description

J44 POSITION	DESCRIPTION	DEFAULT
1-2	External 5VDC supply (J14)	Installed 2-3
2-3	USB 5VDC Supply (J21)	

Table 2. J14 Terminal Block Description

PIN	DESCRIPTION
1	5VDC input
2	GND

The evaluation kit has an on-board voltage LDO regulator (VR1) that provides the 3.3VDC supply (V3P3) to the MAX78615. The 3.3VDC supply (V3P3) is also available on the connectors J16, J1, CH1, CH2, and CH3.

The voltage range on J14 is +4.5VDC (minimum) to 12VDC (maximum).

2.3 Serial Interfaces Selection and Configuration

The MAX78615+PPM has integrated UART, SPI (slave), and I^2C (slave) interfaces. Since the serial interfaces share the same digital I/O pins, only one interface can be active at a time. The serial interface signals can be connected to the USB interface device (FTDI chip) or to PMOD connector. The SPI is selected as default interface and the GUI utilizes it for the communication (USB/SPI).

The FTDI chip also supports the UART mode. In order to operate the FTDI chip in UART mode, see section 2.3.3.

2.3.1 Serial Interface Selection

The interface selection is done at reset/power-on by sampling the IFC0/IFC1 interface selection pins.

Table 3 shows the settings of J24 and J25 for the serial interface selection.

Table 3. Serial Interface Selection

INTERFACE MODE	J24 (IFC0)	J25 (IFC1)
SPI	2-3	X (don't care)
UART	1-2	2-3
I^2C	1-2	1-2

The pins IFC0 and IFC1 are sampled at power-on and set as general purpose digital I/O (MP/multipurpose) after the initialization phase.

2.3.2 Serial Interface Signals Connection (All Interfaces)

The serial interface signals can be connected to the USB interface (default configuration) or to the PMOD connector (J16). See Table 4 for the connection of the serial interface signals.

Table 4. Serial Interface Selection

SELECTION	J40 (SDI)	J41 (SSB)	J42 (SCK)	J43 (SDO)
PMOD (J16)	1-2	1-2	1-2	1-2
USB Interface	2-3	2-3	2-3	2-3

The PMOD connector is compatible with the PMOD Type 2 (SPI) or Type 4 respectively. Table 5 and Table 6 show the pin assignment.

Table 5. J16 (PMOD—Type 2) SPI Connector Pin Assignment

PIN	NAME	DESCRIPTION
1	SSB_PMOD	SPI Mode: Slave Select
2	MOSI_PMOD	SPI Mode: Master Output Slave Input
3	MISO_PMOD	SPI Mode: Master Input Slave Output
4	SCK_PMOD	SPI Mode: Serial Clock
5	GND	Ground
6	V3P3	3.3VDC Supply (V3P3)

Table 6. J16 (PMOD—Type 4) UART Connector Pin Assignment

PIN	NAME	DESCRIPTION
1	CTS	Not Used
2	RXD	UART Mode: Data Rx
3	TXD	UART Mode: Data Tx
4	RTS	Not Used
5	GND	Ground
6	V3P3	3.3VDC Supply (V3P3)

2.3.3 UART Interface Settings

Address Selection

The MAX78M6615+PPM implements a UART serial communication protocol (SSI) that supports multipoint communication. The device address (lower bits) is selected through the pin MP0/AD0 and SPCK/AD1 as shown in Table 4. The upper bits of the address are set through the register **DEVADDR** as described in the data sheet. Refer to the MAX78615+PPM data sheet for the device interfaces operations.

A device address of FF is not supported. DEVADDR [23:6] bit are not used and must be set to 1.

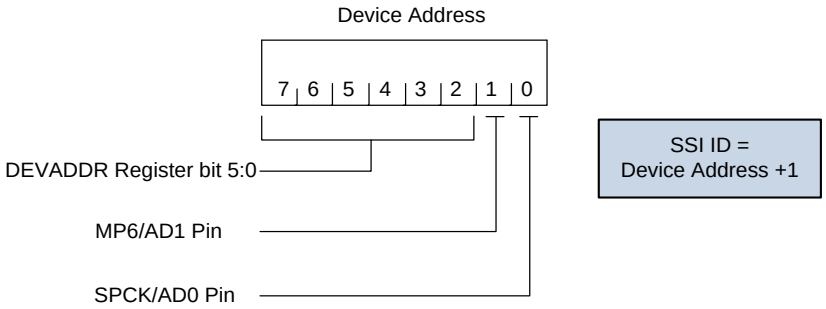


Figure 4. UART Mode Address Selection

Table 7. UART Address Selection

DEVICE ADDRESS			
BIT 1 (AD1)	**BIT 0 (AD0)**	**J26**	**J27**
0	0	2-3	2-3
0	1	2-3	1-2
1	0	1-2	2-3
1	1	1-2	1-2

The evaluation board includes a RS-485/422 transceiver. The MAX78615+PPM serial UART can be connected to the RS-485/422 transceiver when a multi-drop RS-485/422 bus is available.

UART/USB Interface and UART/RS-485/422 Interface Configuration

In order to operate the UART through the USB/FTDI device or RS-485/422, the jumper must be set according to Table 8.

Table 8. Jumper Setting for UART/USB Interface

JUMPER	POSITION
J47	Removed
J46	Removed
J45	Removed

UART/RS-485/422 Interface Configuration

In order to operate the UART through the RS-485/422 transceiver, the jumpers must be set accordingly to Table 9. Table 10 contains the pin assignment of connector J22.

Table 9. Jumpers Settings for UART/RS-485/422

JUMPER	POSITION
J47	Closed (1-2)
J46	Closed (1-2)
J45	Closed (1-2)

Jumpers J38 and J39 are used to insert a 120Ω termination on the RS-485/RS422 bus. The termination should be inserted or removed according to the board location on the RS-485/422 bus.

Table 10. J22 RS-485/422 Connector Pin Assignment

J22 PIN	NAME	DESCRIPTION
1	+5VDC	+5VDC Supply
2	RS485A	Non-inverting Receiver Input
3	RS485B	Inverting Receiver Input
4	RS485Z	Inverting Transmitter Output
5	RS485Y	Non-inverting Transmitter Output
6	GND	GND

Configuring USB/UART operations

The FTDI chip supports USB/UART operations. In order to enable it, a simple modification is necessary on the evaluation kit host board. R45 (0Ω resistor) needs to be removed. R49 needs to be populated with a 0Ω resistor.

2.3.4 SPI Interface Settings

Address Selection

In SPI mode, device address in not relevant. In this case, the jumpers J26 and J27 should be removed.

The SPI interface needs to be selected according to Section 2.3.1. The SPI signals should then be connected to either the USB interface chip or the PMOD connector according to section 2.3.2.

2.3.5 I^2C Interface Settings

Address Selection

The I^2C device address (lower bits) is selected through the pin MP0/AD0 and SPCK/AD1 as shown in Table 11. The upper bits of the address are set through the register **DEVADDR** as described in the data sheet. Refer to the data sheet for the device interfaces operations.

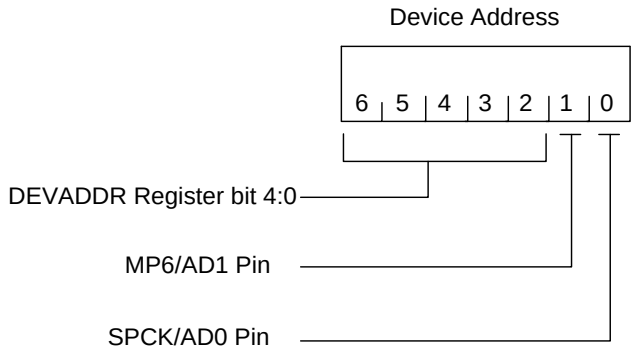


Table 11. I²C Address Selection

DEVICE ADDRESS			
BIT 1 (AD1)	**BIT 0 (AD0)**	**J26**	**J27**
0	0	2-3	2-3
0	1	2-3	1-2
1	0	1-2	2-3
1	1	1-2	1-2

I²C Signals Interface

Note that the USB FTDI interface chip does not support I²C/USB interface. Therefore, the I²C interface is only available on the connector J1 and/or J16 (PMOD).

2.4 Connector J1

Connector J1 allows probing and connection to most of the digital and analog pins of the MAX78615 device. Table 12 includes J1 connector pin assignment.

Table 12: J1 Connector Pin Assignment

PIN	NAME	DESCRIPTION
1	+3.3V	+3.3VDC (V3P3) supply
2	+3.3V	+3.3VDC (V3P3) supply
3	N/C	Not Connected
4	N/C	Not Connected
5	GND	Ground
6	GND	Ground
7	RESETB	Reset (Active Low)
8	IFC0	Interface Selection (Bit0)
9	IFC1	Interface Selection (Bit1)
10	MP6	Multipurpose Digital I/O
11	SSB	SPI Mode: Slave Select UART Mode: RS485 Direction I^2C Mode: Serial Clock
12	MP4	Multipurpose Digital I/O
13	SDO	SPI Mode: MISO UART Mode: Data Tx I^2C Mode: Serial Data (output)
14	SDI	SPI Mode: MOSI UART Mode: Data Rx I^2C Mode: Serial Data (input)
15	SPCK	SPI Mode: SCK (serial data clock) UART Mode: Address Selection 0 I^2C Mode: Address Selection 0
16	MP0 (1)	SPI Mode: Not Utilized UART Mode: Address Selection 1 I^2C Mode: Address Selection 1
17	VCOMP1	Voltage Comparator 1 Input
18	VCOMP2	Voltage Comparator 2 Input

Notes:

1) The input MPO is sampled at power-on/reset and utilized for the selection of the address 0, after the initialization, this pin is utilized/assigned as a digital I/O pin (MP0).

2.5 USB Driver Installation

This evaluation kit includes an isolated USB interface for serial communications with a PC. The FTDI USB controller IC FT2232 performs the USB functions. The FTDI Windows driver presents a virtual COM port for enabling serial communications. The FTDI Windows driver is a certified driver for Windows XP and Windows 7.

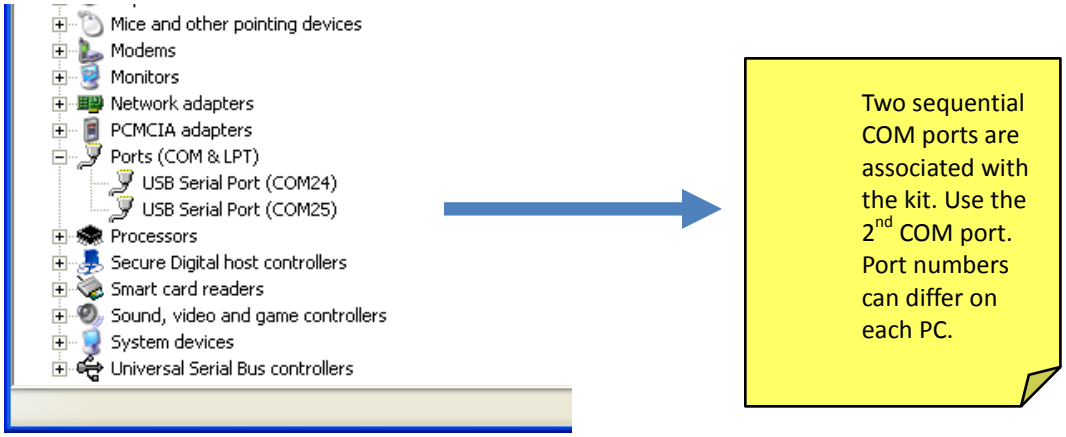
Upon attaching the MAX78615+PPM evaluation board to the PC, the **Found New Hardware Wizard** automatically launches and installs the appropriate driver files. If your PC does not find the FTDI driver files on its local hard disk drive, locate and reference the FTDI USB driver and utilities subdirectory on the CD. The FT2232 controller is powered from the USB cable and is active even when no AC power is applied to the MAX78615+PPM evaluation kit.

Notes: 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, check the FTDI website at *http://www.ftdichip.com/FTDrivers.htm*.

2.5.1 Confirm COM Port Mapping

- Launch the **Control Panel** and click on the **System** icon.
- 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.
- Take note of the COM port assignment for the USB serial port.



2.5.2 FTDI COM Port Troubleshooting

If the FTDI device driver did not install properly, there would be no assigned COM port number for the FTDI controller. To repeat the USB driver installation, see *Section 2.1*.

Windows might associate a ballpoint device to the FTDI USB controller. When this occurs a FTDI device COM port assignment is available through the HyperTerminal, but there is no communications data. Verify whether a ballpoint device has been added to the human interface devices through the device manager. See *Section 2.1.1* for access to the device manager. If a ballpoint device exists, delete it and unplug and replug the evaluation kit's USB cable.

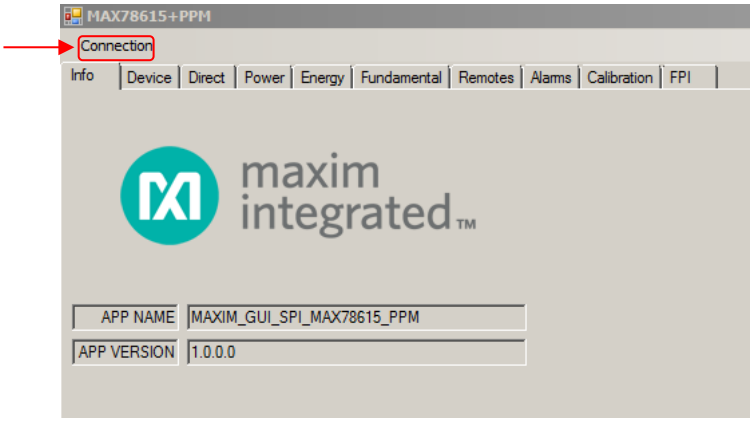
3 Graphical User Interface (GUI)

A graphical user interface (GUI) is included on the MAX78615+PPM evaluation kit CD to facilitate quick evaluation of the MAX78615+PPM energy measurement device. The GUI requires Microsoft.NET Framework 4 on the PC, for which the GUI is to execute on. Upon invoking the GUI executable file, an installation wizard can appear if Microsoft.NET Framework 4 is not installed on the PC. Follow the installation wizard instructions, or download Microsoft.NET Framework 4 from the Microsoft website prior to launching the GUI.

3.1 GUI Initialization

The graphical user interface (GUI) is self-explanatory when used with the MAX78615+PPM data sheet. The user, however, should note the following about the evaluation kit hardware:

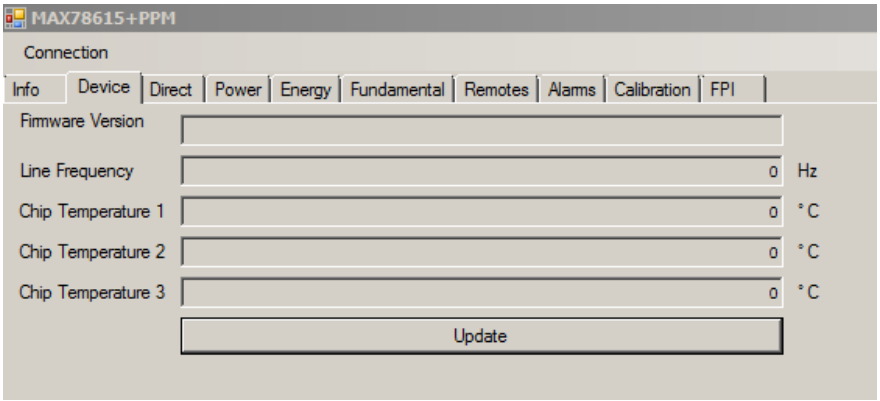
- Serial COM Port:
  - Following the installation instructions in Section 2, launch the GUI executable. Click the **Connection** drop-down menu and select **Connect**.



The GUI auto-detects the presence of an SPI device, if the evaluation kit is not connected or the MAX78615+PPM interface selection is different than SPI an error message is displayed.

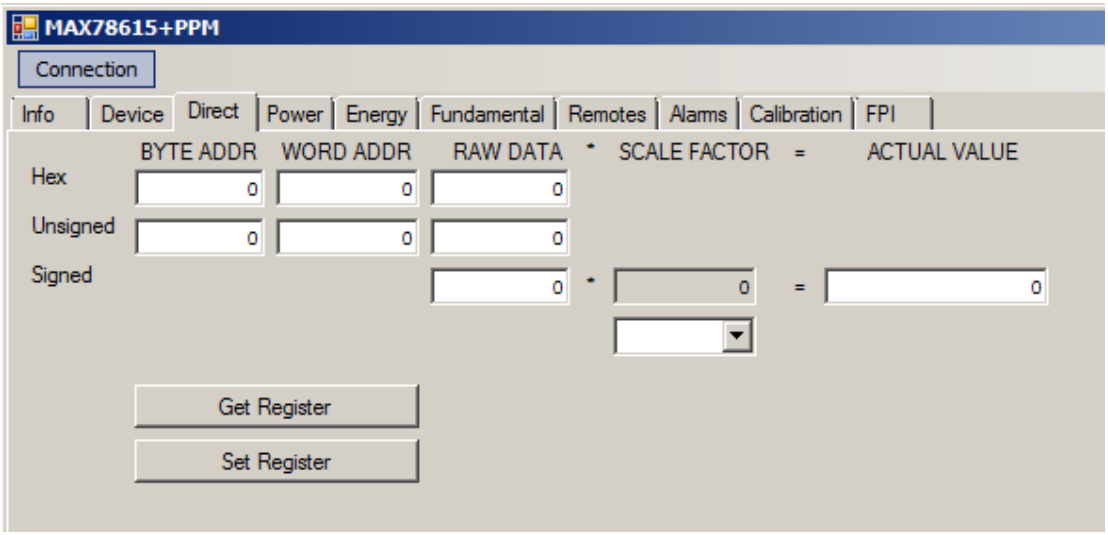
3.1.1 Device Tab

The **Device** tab shows to current firmware build as well as the temperature of the remote ADCs and line frequency being measured.



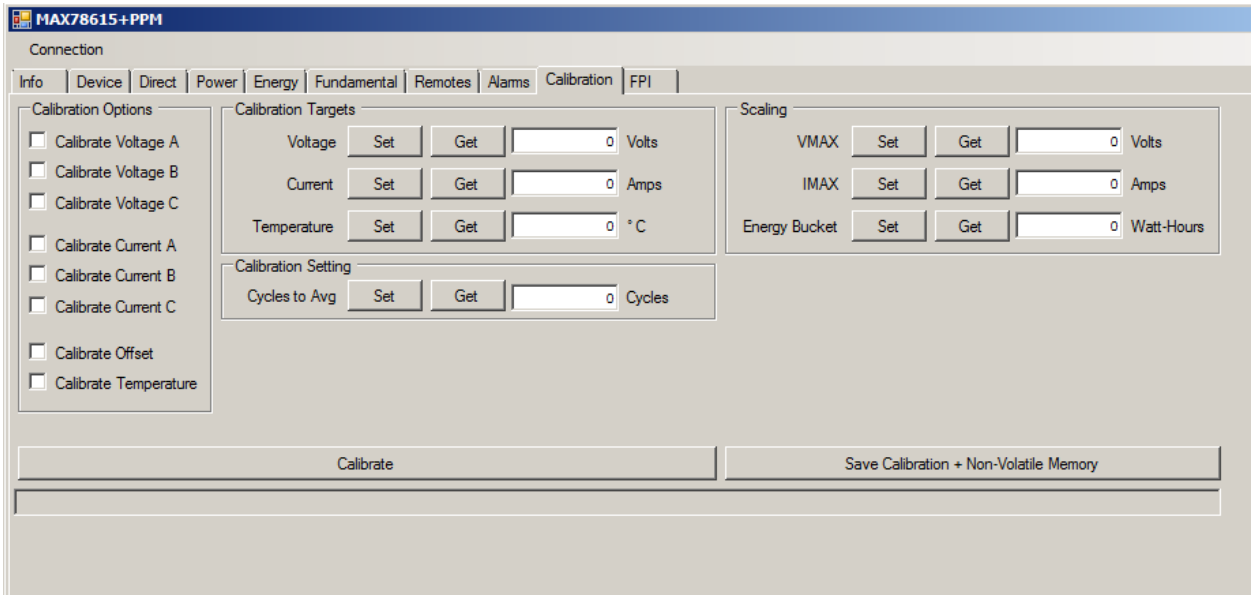
3.1.2 Direct Tab

The **Direct** tab allows access to the all the registers and can both read and write to the registers. The data can be displayed with the scale factor and units applied for convenience. In the example below the voltage register is being read, so the volts option is used to display the data.



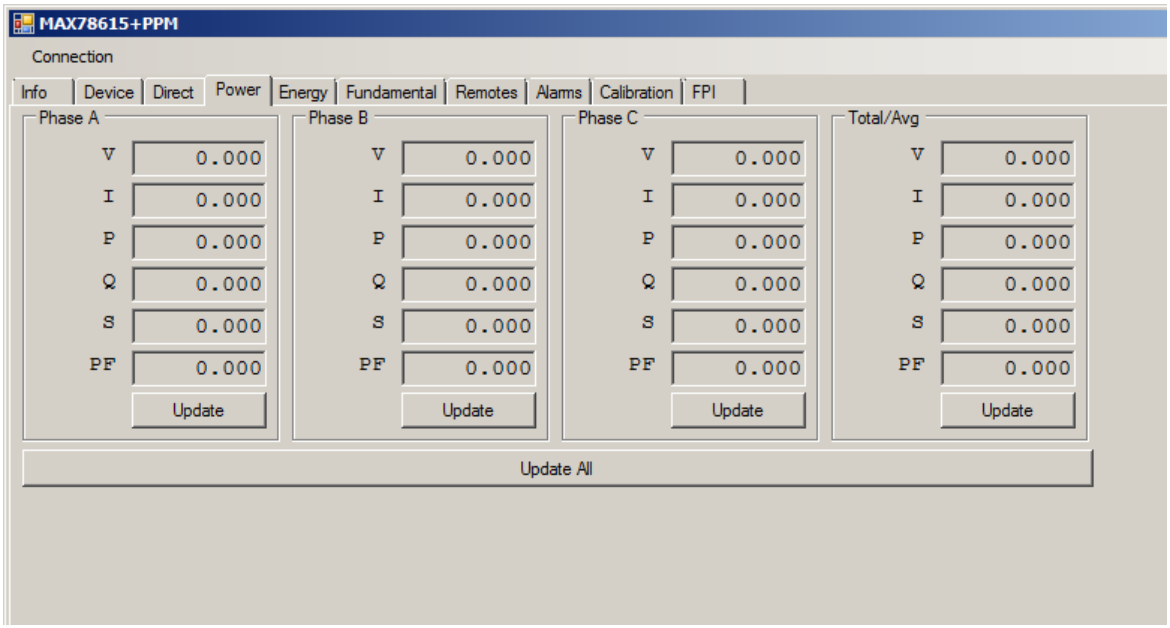
3.1.3 Calibration Tab

The **Calibration** tab is used to calibrate all the measurement channels. The calibration targets can be viewed and changed and the scaling parameters are also displayed for convenience. Use the **Calibration Options** to select the parameters to be calibrated. The calibration and NVRAM are also saved using the provided button.



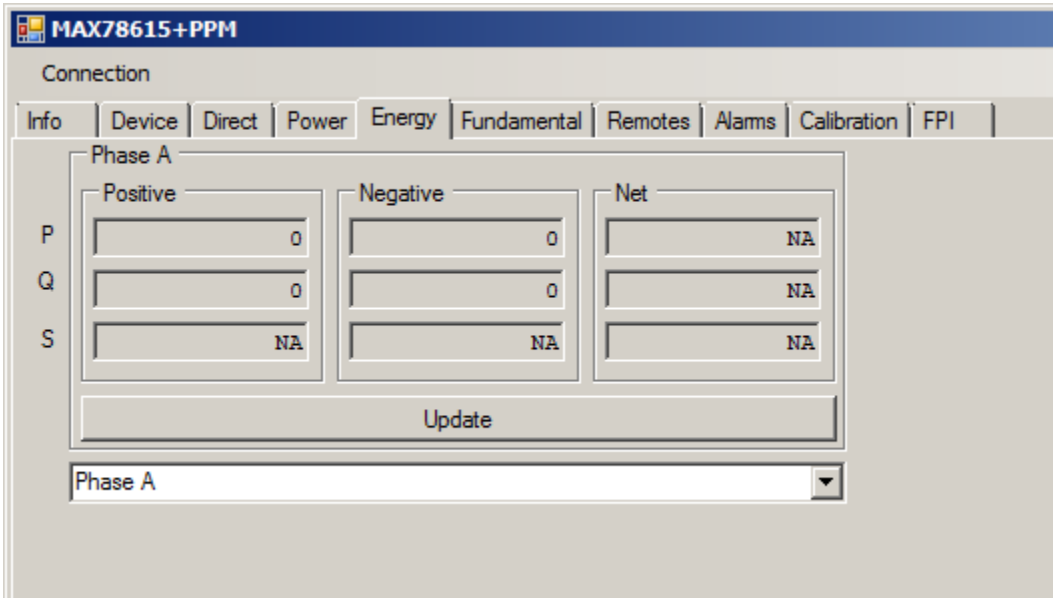
3.1.4 Power Tab

The **Power** tab displays the current power being consumed by the loads. **P** (active power), **Q** (reactive power), and **S** (apparent power) are displayed along with the voltage, current, crest factor, and power factor are also displayed.



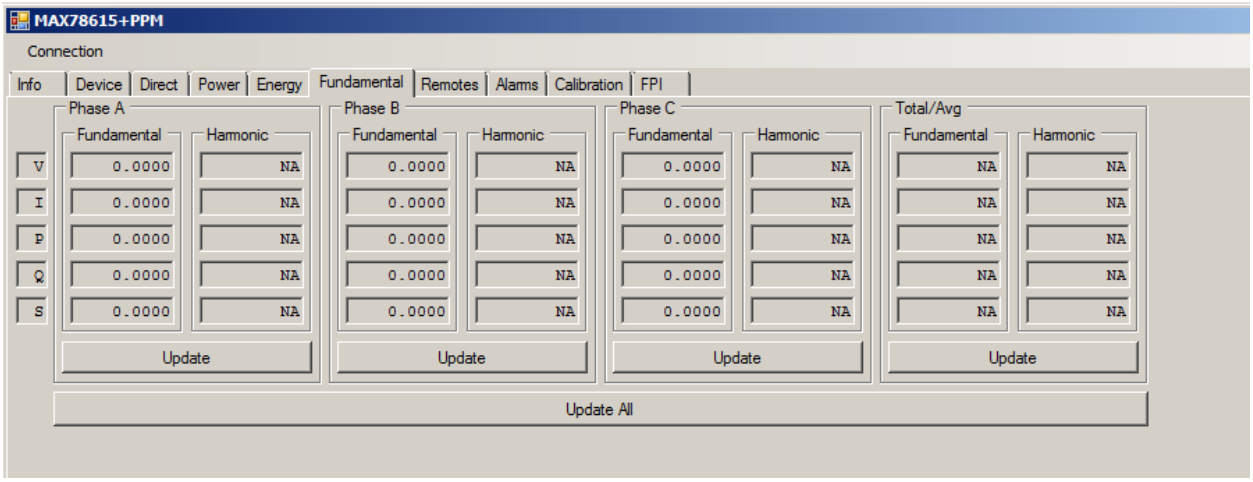
3.1.5 Energy Tab

The **Energy** tab displays the accumulated power both into and out of the load and the balance (net).



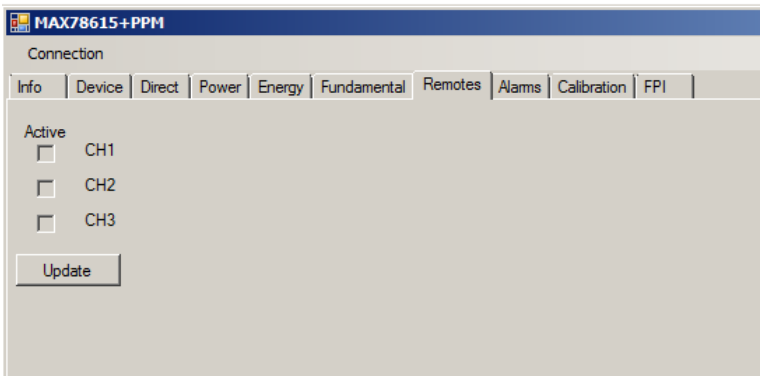
3.1.6 Fundamental Tab

The **Fundamental** tab is used to display the fundamental and harmonic measurements for voltage, current and power. The harmonics displayed can be selected with the get/set harmonic buttons.



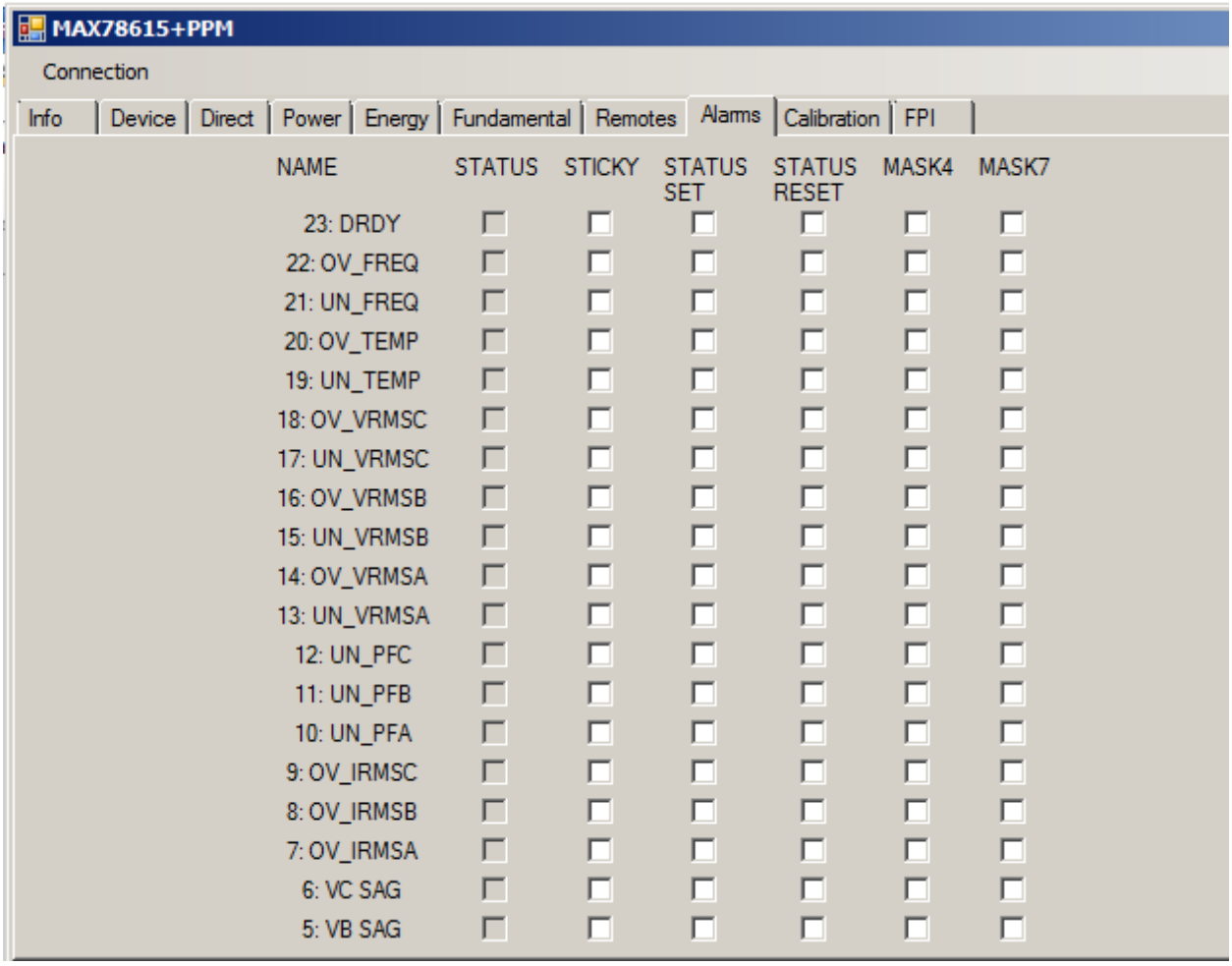
3.1.7 Remotes Tab

The **Remotes** tab is used to display the communication status between host (MAX78615+PPM) and the remote ADCs.



3.1.8 Alarm Tab

The **Alarm** tab is a user definable display of whatever parameters are required in a particular application. The alarms are described in detail in the MAX78615+PPM data sheet.



4 Basic Connection Setup

This section shows examples of basic connections of the MAX78615+PPM evaluation board to Wye and Delta systems. The proper equations are selected by setting the CONFIG register; refer to the MAX78615+PPM data sheet.

Wye-Connected Source, Wye-Connected Load

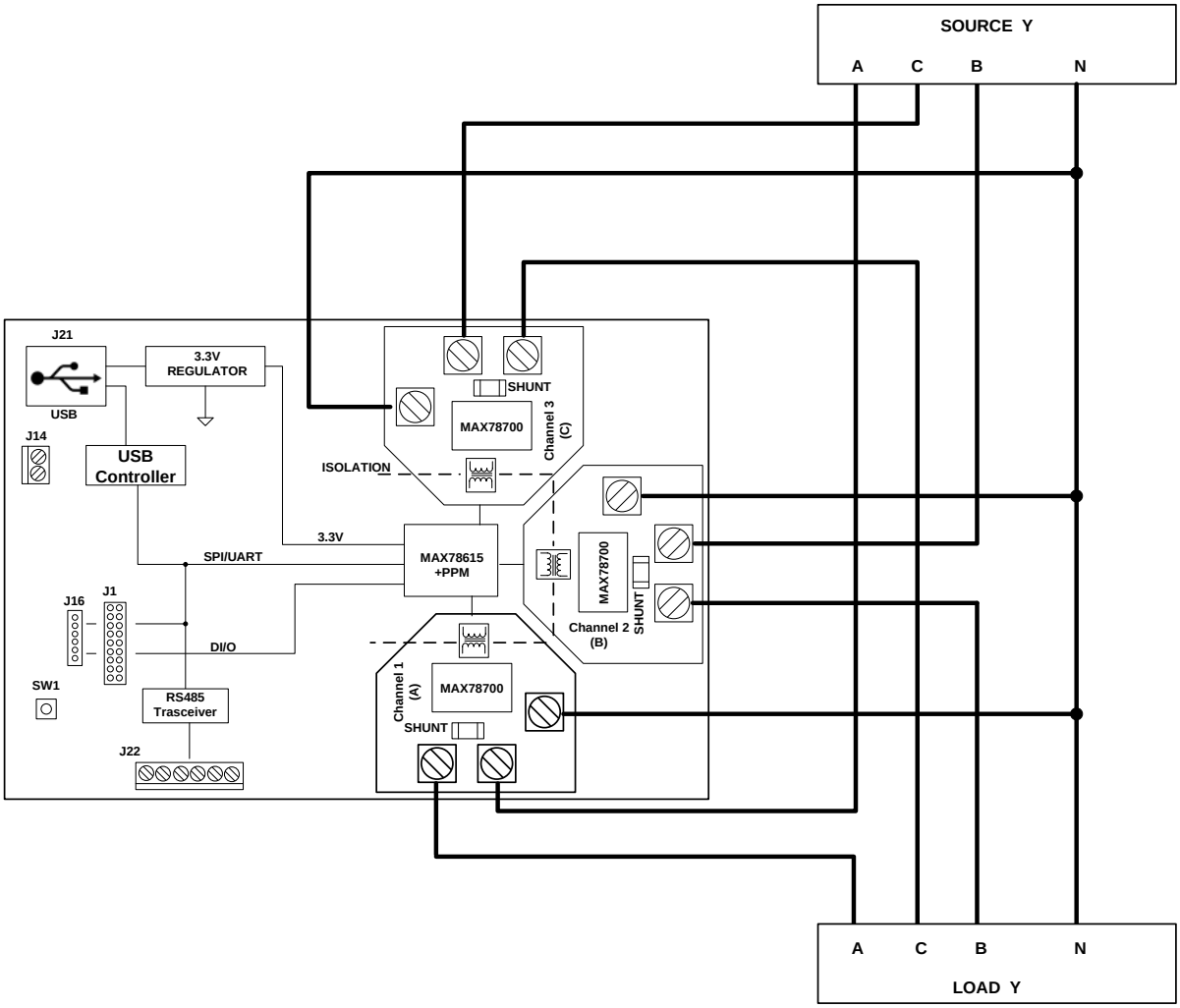


Figure 5. MAX78615+PPM Wye System 4-wires

2V + 2I Delta-Connected Three-Phase Systems

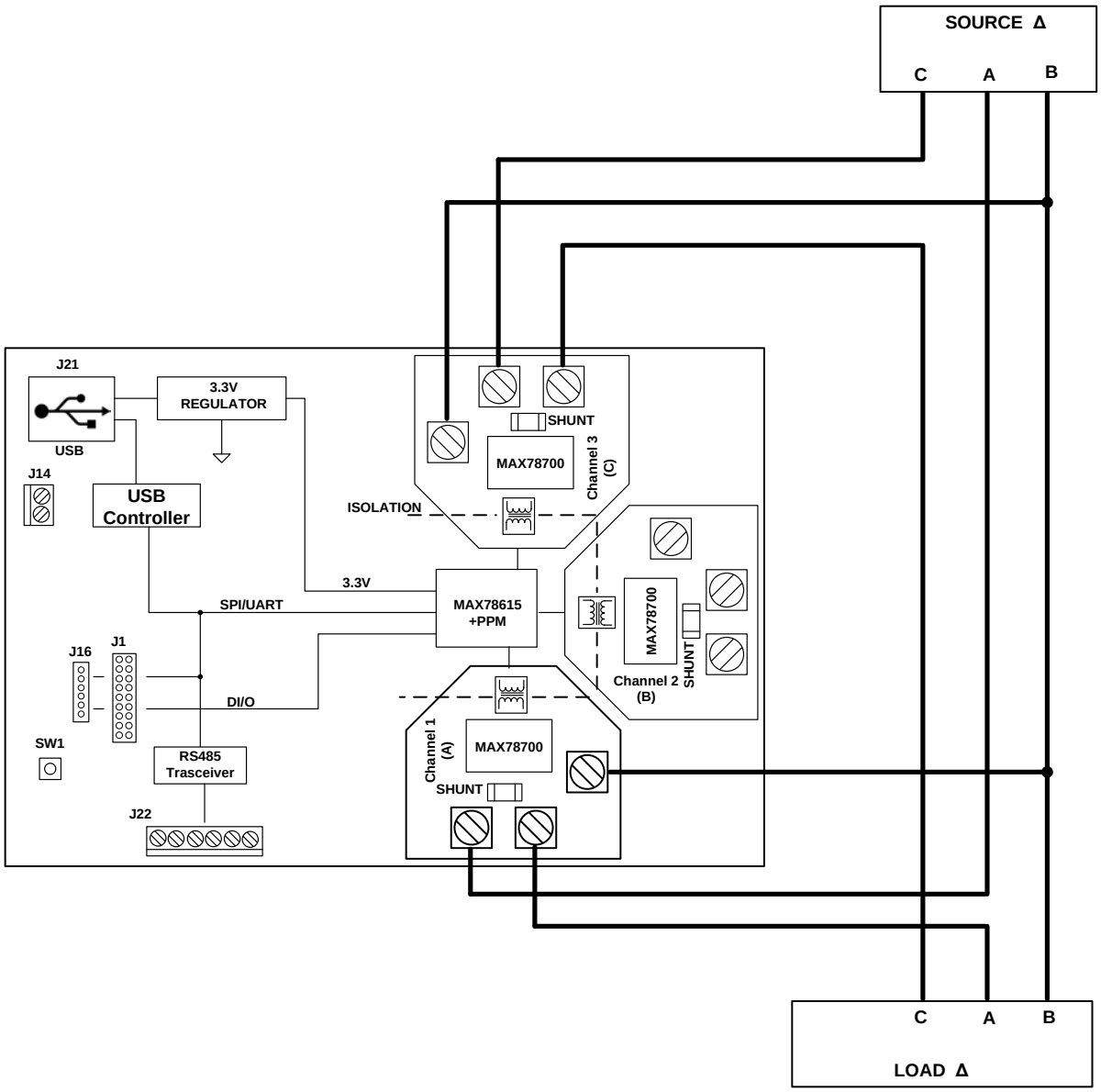


Figure 6. MAX78615+PPM Delta System 2V + 2I

3V + 3I Delta-Connected Three-Phase Systems

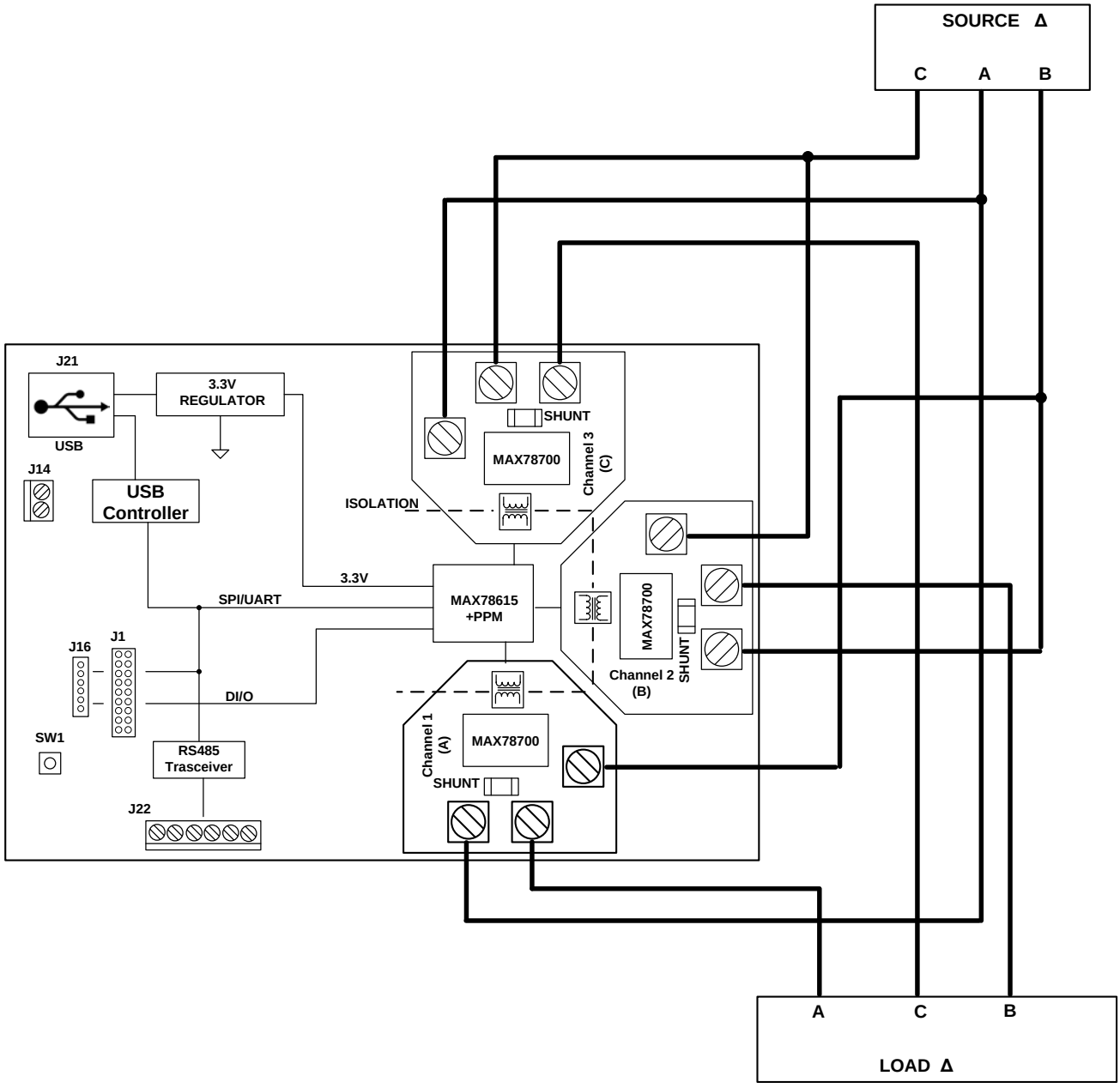


Figure 7. MAX78615+PPM Delta System 3V + 3I

Wye-Connected Source, Delta-Connected Load

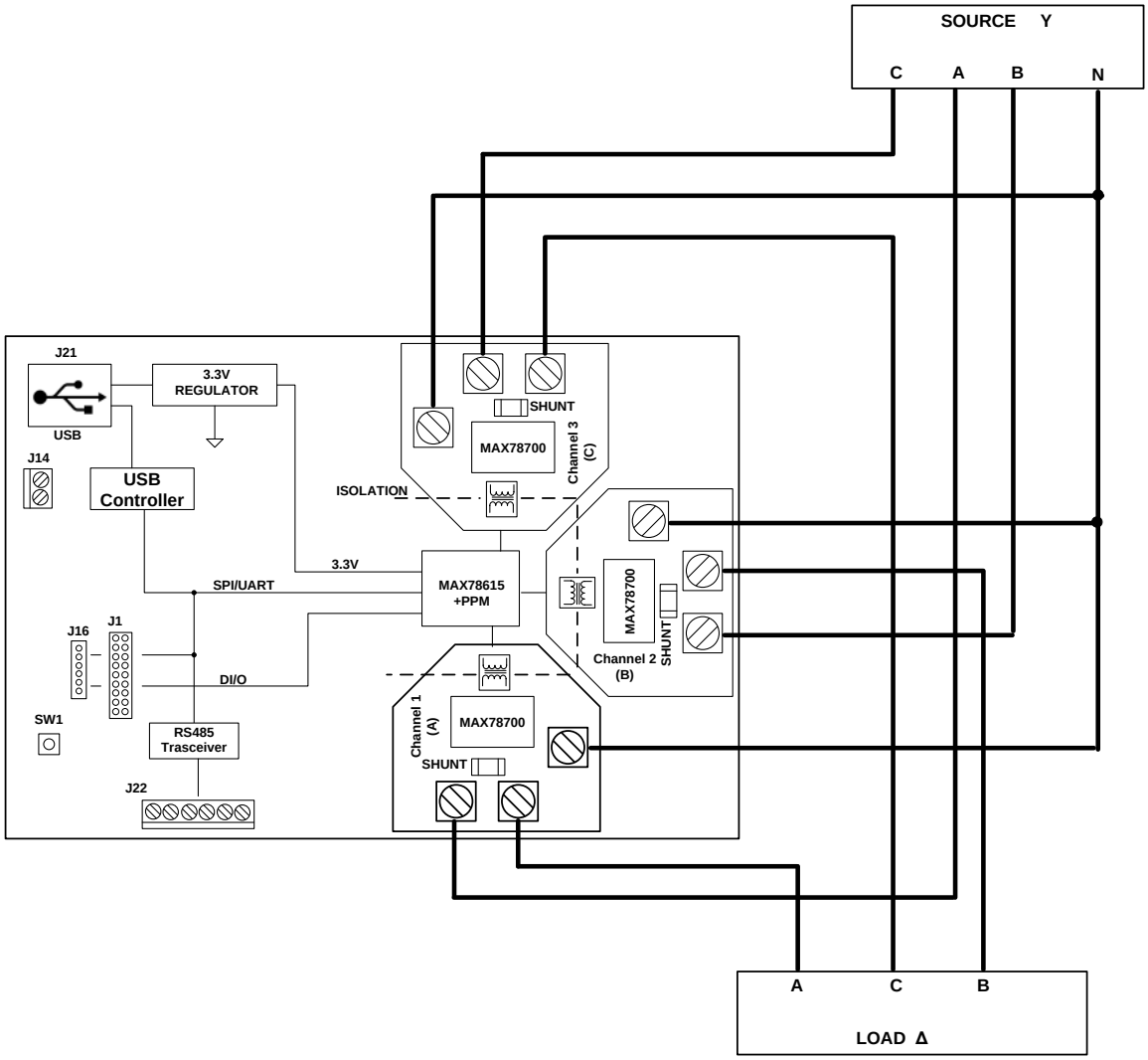


Figure 8. MAX78615+PPM Evaluation Board Connections

5 Schematics, Bill of Materials, and PCB Layouts

This section includes the schematics, bill of materials, and PCB layouts for the MAX78615+PPM evaluation board.

5.1 MAX78615+PPM Evaluation Board Schematics

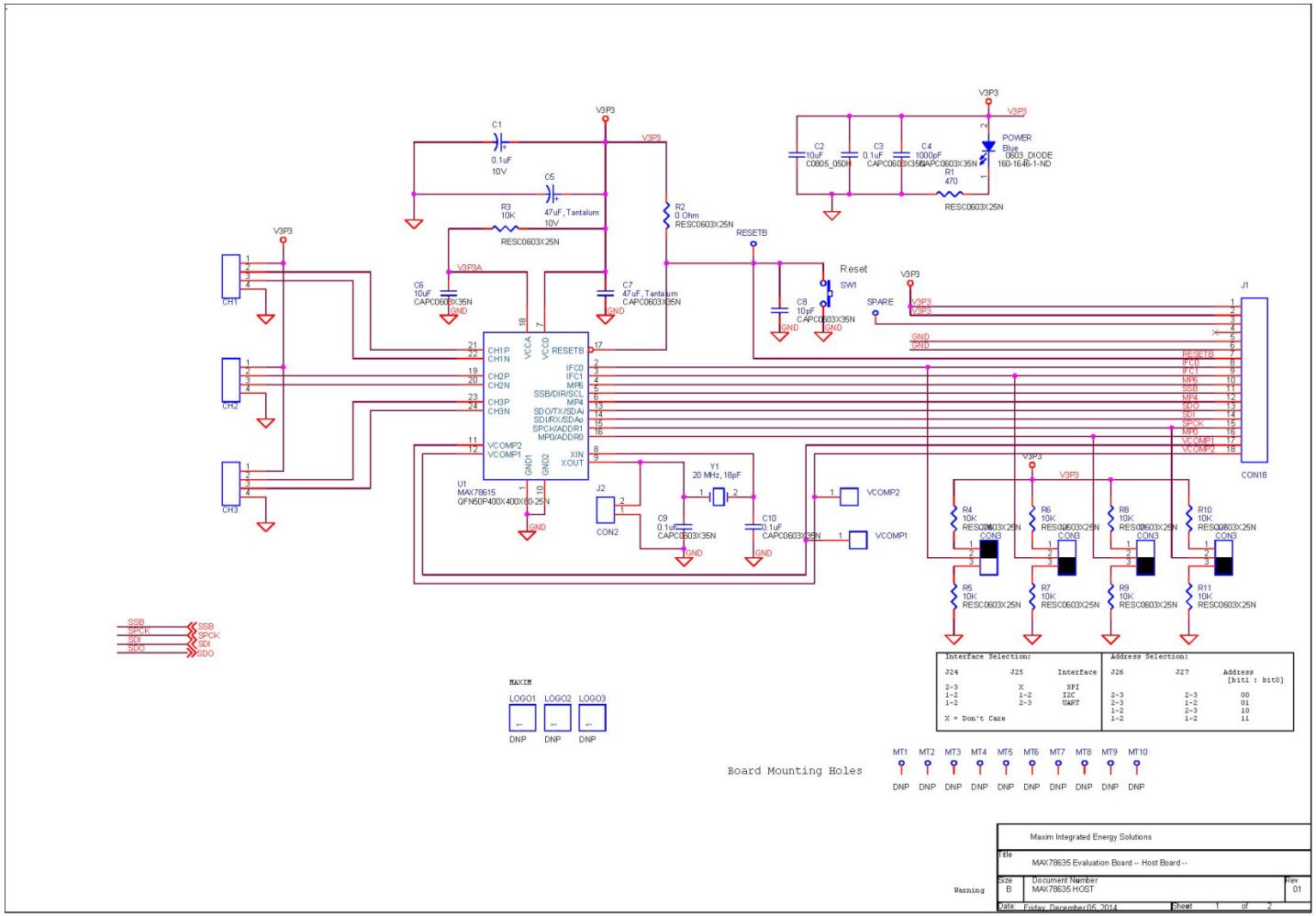


Figure 9. MAX78615+PPM Evaluation Board (Host) Electrical Schematic (1 of 2)

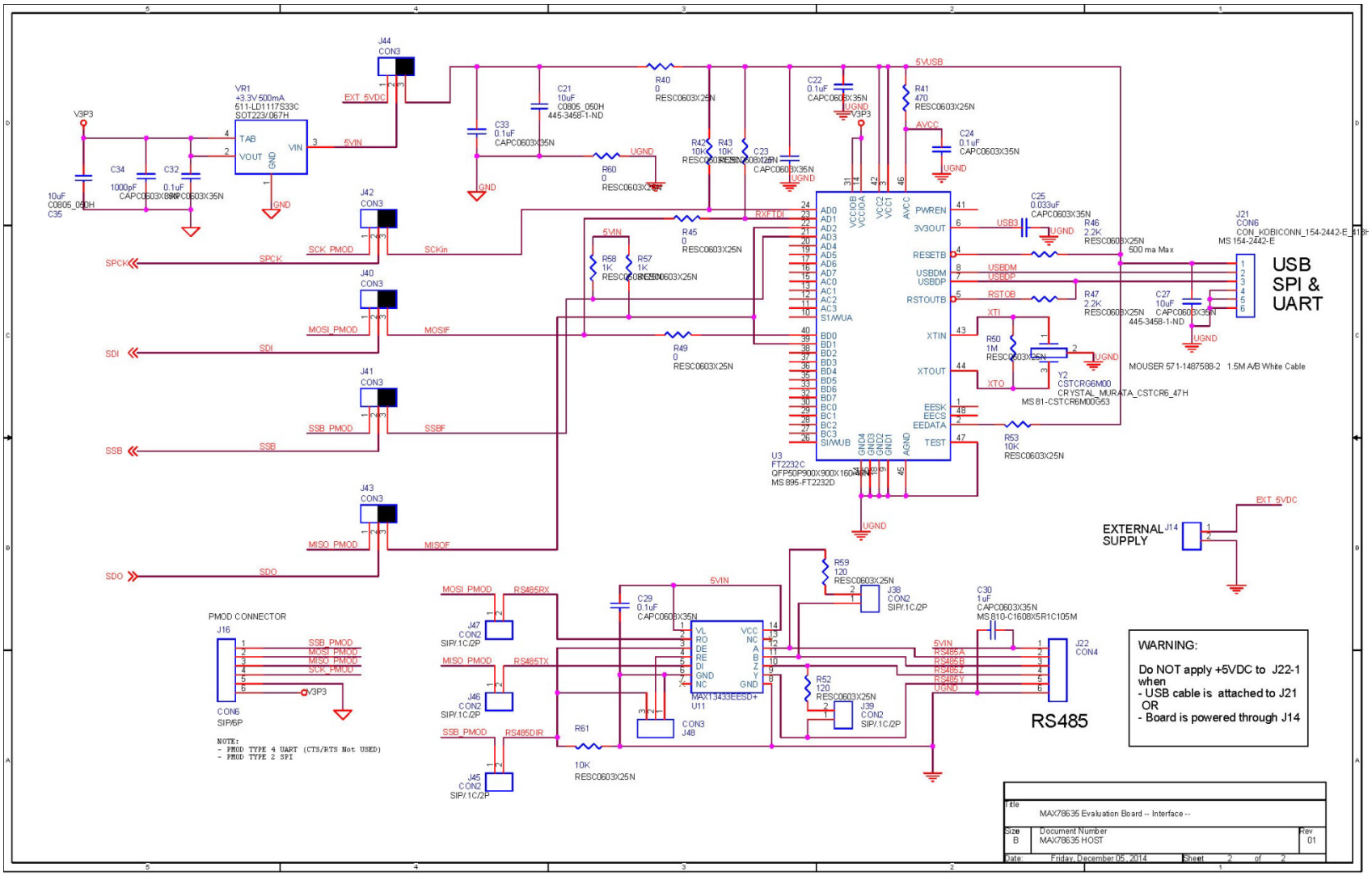


Figure 10. MAX78615+PPM Evaluation Board (Host) Electrical Schematic (2 of 2)

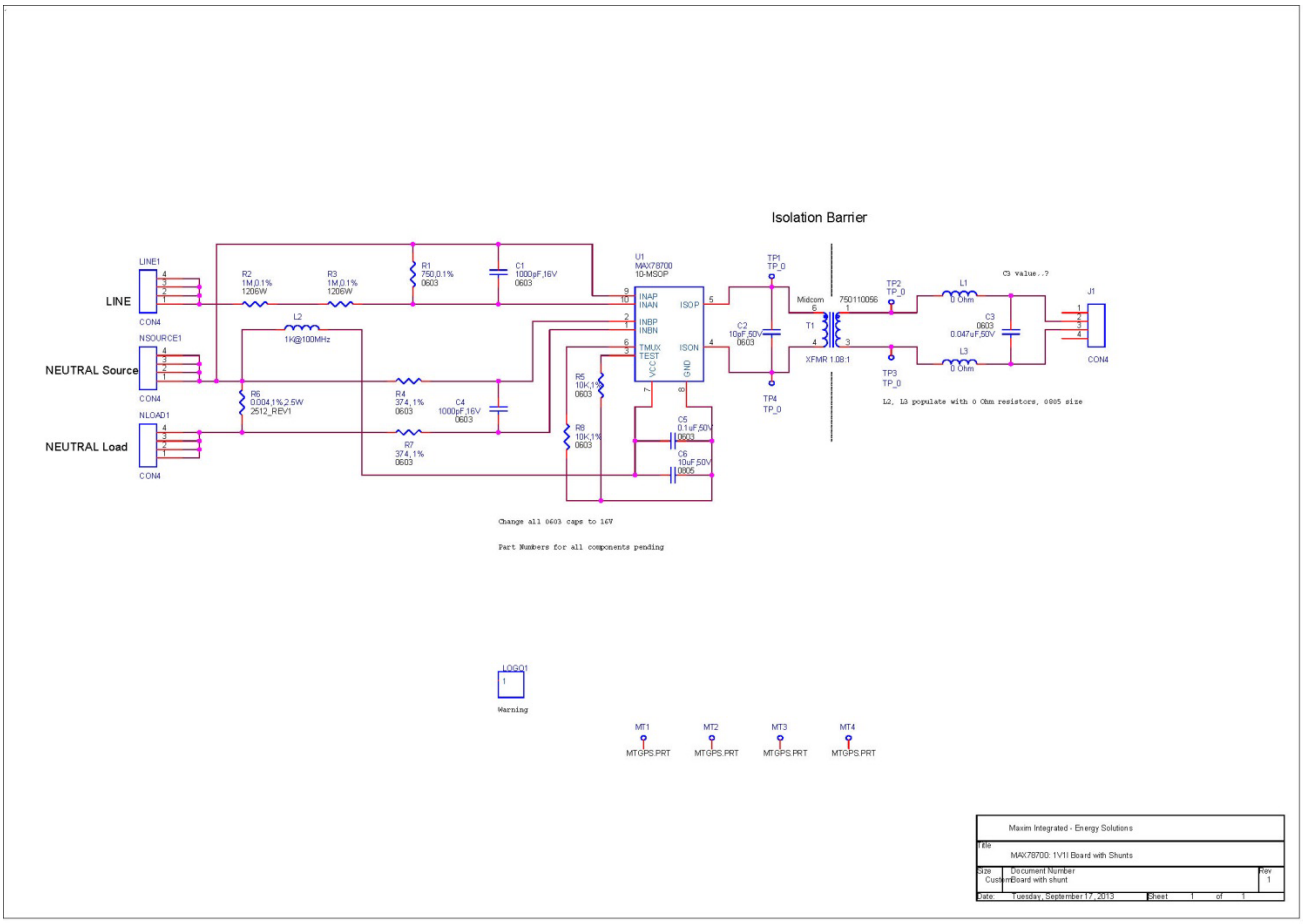


Figure 11. MAX78615+PPM Evaluation Board (Daughter Board) Electrical Schematic

5.2 MAX78615+PPM Evaluation Board Bill of Materials

Table 13. MAX78615+PPM Evaluation Board (Host) Bill of Materials

ITEM	QUANTITY	REFERENCE	PART	PCB FOOTPRINT
1	19	C1, C3, C5, C7, C9, C12, C15, C22, C23, C24, C26, C28, C29, C31, C38, C39, C40, C54, C55	0.1µF	603
2	8	C2, C4, C6, C8, C11, C14, C17, C53	1000pF	603
3	3	C10, C13, C16	0.047µF	603
4	2	C18, C19	18pF	603
5	4	C20, C21, C27, C52	10µF	805
6	1	C25	0.033µF	603
7	1	C30	1µF	603
8	5	J1, J2, J3, J4, J5	CON4	STERM
9	7	J6, J8, J9, J10, J44, J45, J46	CON1	SIP100P1
10	1	J7	CON18	SIP100P18
11	5	J11, J12, J15, J17, J18	CON3	SIP100P3
12	11	J13, J14, J19, J20, J27, J28, J29, J30, J38, J42, J43	CON2	SIP100P2
13	1	J16	CON6	SIP100P6
14	1	J21	USB	USBB
15	1	J22	Block6	TERM BLK 200-6
16	3	J39, J40, J41	Block2	5.08 mm/2
17	4	MT1, MT2, MT3, MT4	PCB Peg	MTGPS.PRT
18	6	R1, R2, R5, R6, R8, R9	1M, 0.1%	1206W
19	9	R3, R33, R36, R38, R39, R42, R43, R53, R54	10K	603
20	10	R4,R7, R10, R12, R14, R15, R17, R18, R20, R22	750, 0.1%	603
21	1	R11	0.004, 1%, 2.5W	2512P
22	3	R13, R16, R19	4.99, 1%	1210
23	4	R21, R40, R45, R49	0	603
24	1	R41	470	603
25	2	R46, R47	2.2K	603
26	1	R50	1M	603
27	2	R52, R59	120	805
28	7	R56, R57, R58, R77, R78, R79, R80	1K	603
29	1	SW1	PUSHBUTTON	EP11
30	2	SW4, SW5	SW DIP-2	DIP4
31	1	U1	MAX78630-32	QFN32L
32	1	U3	FT2232C	TQFP48
33	1	U7	IL516-3E	SO-16 NARROW
34	1	U8	IL510-3E	IL611A
35	1	U11	MAX13433EESD+	SO-14 NARROW

ITEM	QUANTITY	REFERENCE	PART	PCB FOOTPRINT
36	1	VR2	VBT1-5V	VBT1
37	1	VR3	3.3V at 950mA	SOT223
38	1	Y1	20.00MHz	ABLS
39	1	Y2	6MHz	CSTCR

Table 14. MAX78615+PPM Evaluation Board (Daughter Board) Bill of Materials

ITEM	QUANTITY	REFERENCE	PART	PCB FOOTPRINT
1	3	C1, C3, C5	0.047µF, 50V	603
2	1	C2	10pF	603
3	3	C4	0.1µF	603
4	2	C6	10µF	805
5	3	L1, L2, L3	1K at 100MHz	805
6	3	R1, R5, R7	750Ω 0.1%	603
7	2	R2, R3	1MΩ 0.1%	603
8	2	R4, R8	10kΩ 1%	603
9	7	R6	0.004Ω 1% 2.5W	2512
10	1	T1	Transformer	(1)
11	5	U1	MAX78700	TSSOP 10

6 Contact Information

For more information about Maxim products or to check the availability of the MAX78615+PPM, contact technical support at www.maximintegrated.com/support.

Revision History

Revision	Date	Description	Pages Changed
0	2/15	Initial release	—