TI Designs

System on Module for G3 Power Line Communication (CENELEC Frequency Band)

TI Designs

TI Designs provide the foundation that you need including methodology, testing and design files to quickly evaluate and customize the system. TI Designs help *you* accelerate your time to market.

Design Resources

TIDM-SOMPLC-G3-CENELEC	Design Folder
TMDSPLCKIT-V4	Tool Folder
TMS320F28069	Product Folder
AFE031	Product Folder
TPS62240	Product Folder
TPS3828-33	Product Folder
SN74LVC2G07	Product Folder

TI E2E™ Community

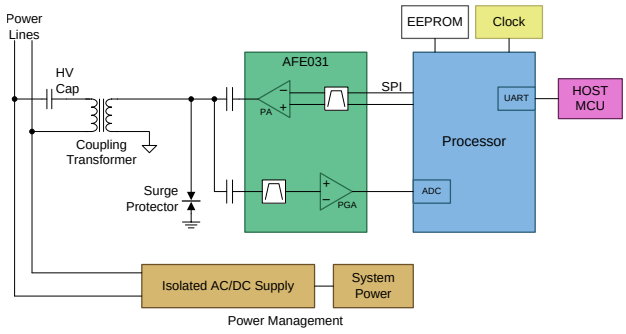
ASK Our Analog Experts
WEBENCH® Calculator Tools

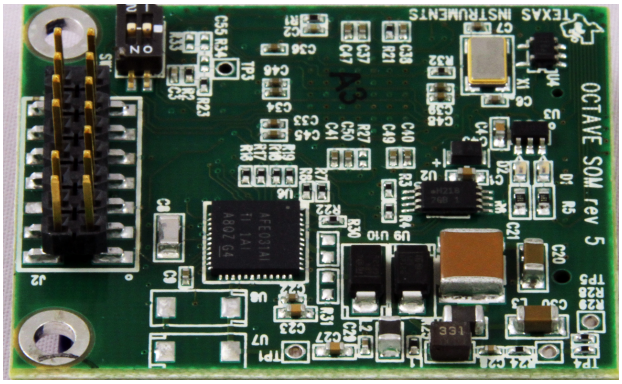
Design Features

- Small Size: 1.5 × 1.9 in
- PRIME and G3 Compatible
- F28PLC83 PLC Engine with VCU
- CENELEC A Functionality
- AFE031 Integrated Analog Front End (AFE)
- 34-Pin Mini Header for Interfacing Other Designs
- Multiple Serial Communications Interfaces Available, Including UART, SPI, I2C, and CAN
- Additional ADC Interface
- Additional GPIO Interfaces

Featured Applications

- Power Line Communication (PLC) Modem
- Smart E-Meter: AMR and AMI
- Solar Power Inverter





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1 SOMPLC Description

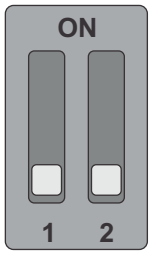
The SOMPLC-F28PLC83 is a single-board system on module (SOM) for PLC in the CENELEC frequency band. This single hardware design supports several popular PLC industry standards including G3. TI's certified PLC software is available along with the SOMPLC-F28PLC83. Engineers can take the SOM design and integrate it into their overall system board or keep the design as an add-on board to their application. The only additional hardware required is the AC mains line coupling circuitry. The included hardware schematics and Gerber files help engineers add PLC to their end system. Original equipment manufacturers (OEMs) will benefit from having the ability to rapidly evaluate and prototype PLC technology in their application.

2 System Description

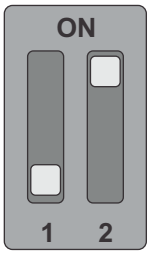
The TMS320F28PLC83 PLC MCU is optimized to meet the requirements for PLC communications networks in smart grid deployments around the world. The F28PLC83 MCU features the C28x 32-bit CPU that can execute the narrowband OFDM PLC modem standards, which adhere to key international and industry standards such as PRIME, G3-PLC, IEEE-1901.2, ITU G.9903, and ITU G.9904 in the CENELEC frequency bands. The F28PLC83 MCU is optimized to work with the AFE031 PLC analog front end. The AFE031 is an integrated PLC AFE that is capable of a transformer coupled connected to the AC mains power line. This AFE is ideal for driving high-current, low-impedance lines driving up to 1.9 A into reactive loads. The AFE031 is compliant to CENELEC A, B, C, and D (EN50065-1, -2, -3, and -7, respectively).

3 Boot Modes (SW1 Positions)

The boot mode can be selected using the switch SW1. The available settings are described below.



FLASH Boot Mode (Default Setting)
Position 1: OFF
Position 2: OFF



SCI-A Boot Mode
Position 1: OFF
Position 2: ON

Figure 1. Boot Modes

4 UART SCI Communication

In order to communicate with the SCI, meet the following requirements:

- Baud rate = 57600
- Message data bits = 8
- Stop bits = 1
- Parity = None
- Handshake = None
- RTS enable = True

NOTE: The SOMPLC does not have a RS-232 driver. Consider communications to RS-232 devices external to this design.

5 SOMPLC 34-Pin Definition

The interfaces are supported on this module.

Table 1. Required and Optional Connections for Interfaces

REQUIRED CONNECTIONS	OPTIONAL CONNECTIONS
• SCI (UART) • Line • 15 V • 3V3 • GND	• ADC • GPIOs • SCI (UART) • CAN • SPI • I2C • Zero cross • Analog GND

Table 2. 34-Pin Connector Details

PIN#	NAME	I/O	ELECTRICAL	DESCRIPTION
1	L1	I/O	0 V (GND)	Neutral (analog ground), connected to the PL coupler
2	L2	I/O	0 V (±6-V Peak)	Analog PLC signal, connected to the PL coupler
3	NC	NC	—	Unused
4	NC	NC	—	Unused
5	GND	—	—	Ground
6	GND	—	—	Ground
7	V15	—	15 to 18 V	Power supply pin (15 V). Peak current 400 mA in transmit mode (average 100 mA).
8	3V3	—	3.14 to 3.47 V	CPU and Logic Digital Power pin (3.3 V). Max current 1000 mA.
9	EN	I-I/O	–0.3 V to VCC+0.3 V	System enable (logical level, active high). Controls power up/down function of the module. When low, the module goes to power down mode. This feature is not yet implemented in software or GPIO13.
10	ZC	I	–0.5 to 6.5 V	Buffered ZC input. This input must be isolated from the power line before entering this pin.
11	RX-A	I	–0.3 V to VCC+0.3 V	Asynchronous serial host-transmit, SCI-A
12	TX-A	O	–0.3 V to VCC+0.3 V	Asynchronous serial host-receive, SCI-A
13	Phase B/GPIO	I-I/O	–0.3 V to VCC+0.3 V	Phase B Enable signal (for 3-phase selection) or GPIO5
14		I/O	–0.3 V to VCC+0.3 V	Phase C enable signal (for 3-phase selection) or GPIO10
15		I/O	–0.3 V to VCC+0.3 V	I2C data pin
16		I	–0.3 V to VCC+0.3 V	I2C clock pin
17		I	–0.3 V to VCC+0.3 V	Unused ADC input. (ADC-B0)
18		—	—	Analog ground
19		I/O	–0.3 V to VCC+0.3 V	Unused multi-purpose I/O, GPIO26
20		—	—	Ground
21		I/O	–0.3 V to VCC+0.3 V	Unused multi-purpose I/O, GPIO27
22		—	—	Ground
23		I-I/O	–0.3 V to VCC+0.3 V	CAN RX interface or GPIO30
24		O-I/O	–0.3 V to VCC+0.3 V	CAN TX interface or GPIO31
25		I	–0.3 V to VCC+0.3 V	SPI clock or general purpose I/O (GPIO18)
26		I	–0.3 V to VCC+0.3 V	SPI slave transmit enable or general purpose I/O (GPIO19)
27		I	–0.3 V to VCC+0.3 V	SPI slave in, master out or general purpose I/O (GPIO16)
28		O	–0.3 V to VCC+0.3 V	SPI master in, slave out or general purpose I/O (GPIO17).
29		I	–0.3 V to VCC+0.3 V	Reset of SOMPLC (active low)
30		I/O	–0.3 V to VCC+0.3 V	Unused multi-purpose I/O pin, GPIO04.
31		NC	—	Unused
32		NC	—	Unused
33		I	–0.3 V to VCC+0.3 V	Asynchronous serial host-receive, SCI-B
34		O	–0.3 V to VCC+0.3 V	Asynchronous serial host-transmit, SCI-B

6 Mechanical Specification

The connectors used on the SOMPLC are as follows:

- A male 0.05-mil header (2 × 17) is placed on the SOMPLC module.
  - This connector is keyed so that the module cannot be placed backwards.
  - An example part that will fit this design is a Sullins Connector Solutions, part number: SBH31-NBPB-D17-SP-BK, Digikey part number: S9108-ND
- A female 0.05-mil receptacle (2 × 17) should be used on the host board to mate with the SOMPLC module.
  - This connector is keyed and should follow the appropriate orientation as the male connector.
  - An example part that will fit this design is a Sullins Connector Solutions, part number: SFH31-NPPB-D17-SP-BK, Digikey part Number:S9117-ND

The top view of the female connector, which would be placed on the host board, is shown in Figure 2.

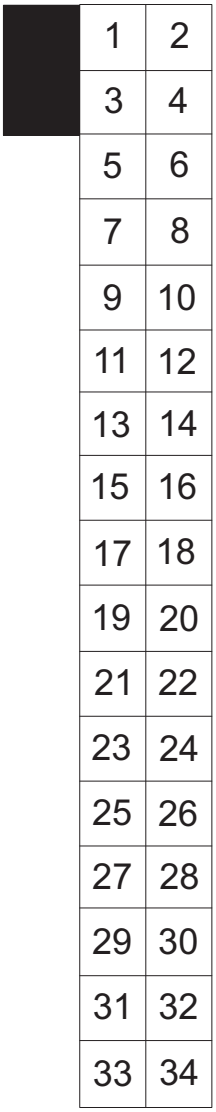


Figure 2. Pin Female Connector Top View

7 PLC SOM Programming

Depending on the end use of the SOM, different versions of the PLC software may be programmed to the module. For this design, you can download the G3-PLC software package from Section 11 and check out the G3-PLC binaries (.hex, .out, and .sbin) under the installation directory.

7.1 Using the XDS100 and CodeSkin to program the F28069 MCU

Programming with this method eliminates the need for CCS to load the release(.out) file. A .hex release file is used instead and therefore the installation of CCS is not necessary.

1. Install the desired Texas Instruments PLC Development Package from www.ti.com/plc.
2. Download, install, and start the latest C2Prog from www.codeskin.com.
3. Set switch SW1 to *FLASH Boot Mode* as described in Section 3.
4. Connect a Texas Instruments XDS100-class emulator to the SOM module using the 14-pin JTAG header.
5. Power up the SOM module by applying both 15 V and 3.3 V through the 34-pin host connector.
6. Program the *.hex (located in c:\Texas Instruments\<PackageName>\SW\bin) as shown in Figure 3. Select *28069,67,66* in the *Target* pull-down and *JTAG* in the *Options* pull-down.

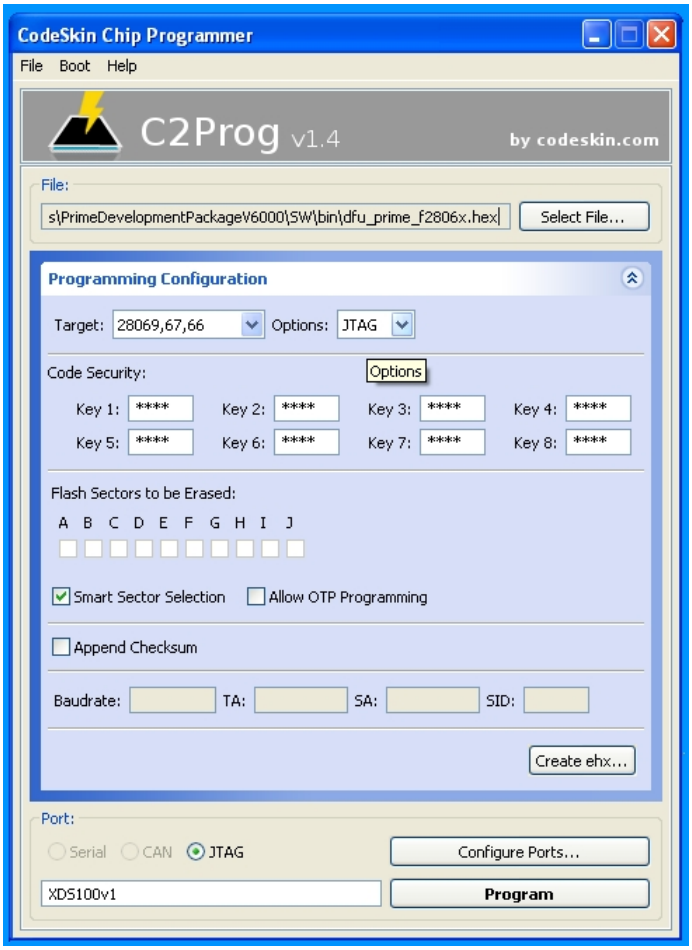


Figure 3. Selecting G3-PLC Binary to Be Flashed (via XDS100)

7. Click on the *Configure Ports* button and set the JTAG port to *XDS100v1.*

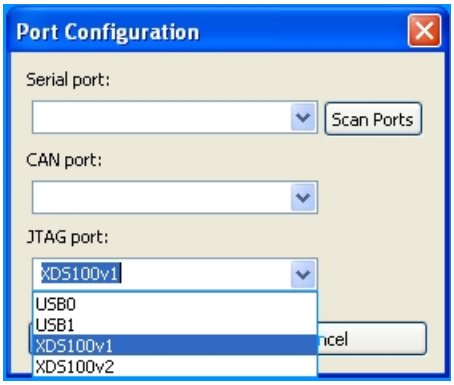


Figure 4. Selecting JTAG Port (via XDS100)

8. Start flashing the F28069.

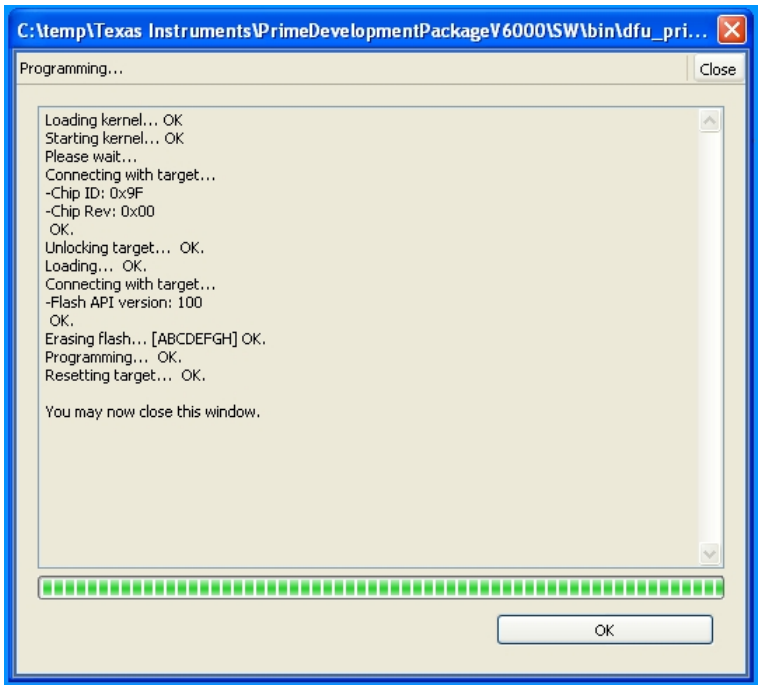


Figure 5. Flashing G3-PLC Firmware (via XDS100)

9. Power cycle the device when the programming procedure completes.

7.2 Using CCS and JTAG Emulator to Program the F28069 MCU

If the XDS100 emulator is not available, use Code Composer Studio (CCS) or higher and a XDS510 or XDS560 emulator to program the device. Install CCS v4.2.4 or higher before following these procedures:

1. Install the desired Texas Instruments PLC Development Package from www.ti.com/plc.
2. Set switch SW1 to *FLASH Boot Mode* as described in Section 3. When used, a JTAG emulator is capable of interrupting the set boot mode to gain control of the MCU. When the programming procedure is complete, set the mode to *FLASH Boot Mode* for the SOM module to continue to work properly.
3. Power up the SOM module by applying both 15 V and 3.3 V through the 34-pin host connector.
4. Connect the emulator to the SOM module with the 14-pin JTAG cable.
5. Open CCS.
6. Create a F28069 target configuration.
7. Connect to the F28069 device.
8. Load the PLC specific .out firmware (located in c:\Texas Instruments\<PackageName>\SW\bin). CCS will automatically flash the firmware onto the F28069 device.

7.3 Using a Serial Port (RS-232/SCI) to Program the F28069 MCU

Some user situations may require the SOM module to connect directly to a computer's serial port using RS-232 communications. In this scenario, have a host board that is capable of converting the RS-232 communications protocol to work with the F28069 SCI-A port. In most cases, this conversion is performed by using an external RS-232 driver device such as the MAX3221ECPWR by Texas Instruments. Once in place, follow these steps:

1. Install the desired Texas Instruments PLC Development Package from www.ti.com/plc
2. Download, install and start the latest C2Prog from www.codeskin.com
3. Make sure the SOM module is not powered on. Set switch SW1 to *SCI-A Boot Mode* as described in Section 3.
4. Connect the SOM module to the RS-232 host using the appropriate cable.
5. Power up the SOM module by applying both 15 V and 3.3 V through the 34-pin host connector.
6. Program the *.hex (located in c:\Texas Instruments\<PackageName>\SW\bin) as shown in Figure 6. If the UART cable is used, select serial port. Otherwise, if the USB-serial cable is used, select JTAG port.

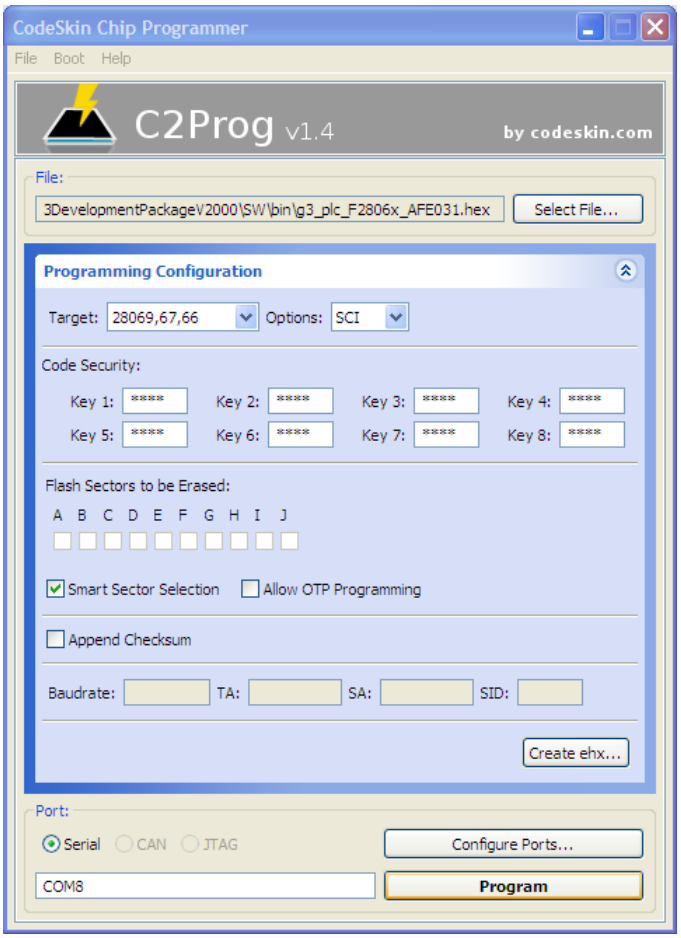


Figure 6. Selecting G3-PLC Binary to Be Flashed (via SCI)

7. Start flashing the F28069.

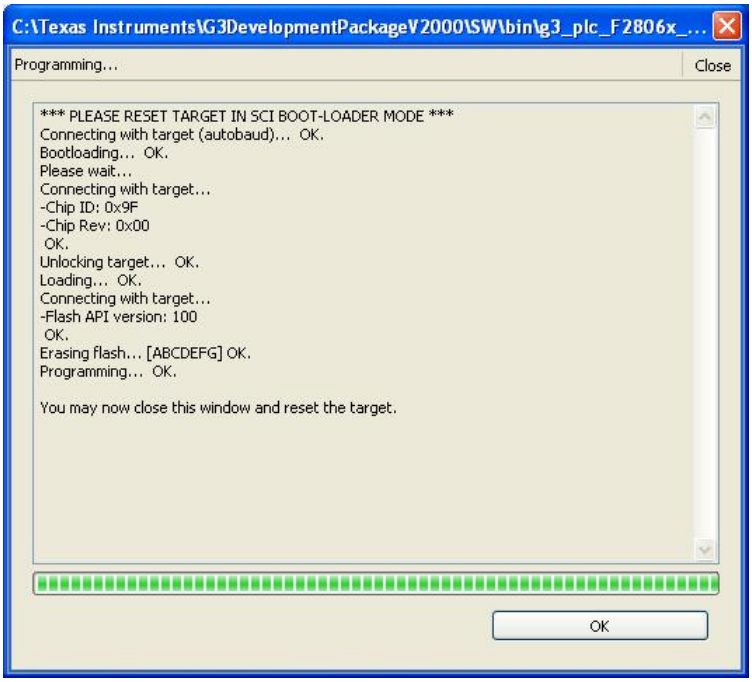


Figure 7. Flashing G3-PLC Firmware (via SCI)

8. Once the flashing is done, close the program and remove the power supply from the SOM module.
9. Make sure the SOM module is not powered off. Set switch SW1 to *FLASH Boot Mode* as described in Section 3.
10. Now that the programming procedure is complete, apply power to the SOM module.

8 Test Setup

To test the SOM modules, the operator will need the following items:

- A host computer running Windows® XP or Windows® 7 and two available USB ports.
- Two SOM docking stations
- A 15-V external power supply for each docking station
- A PLC for each docking station
- A USB cable for connecting to host PC for each docking station
  - A single host PC can be shared between the two kits
- Zero-configuration GUI
  - Requires a modified .config file

8.1 Setup

1. Plug in the included SOM module to each 34-pin SOM module connector.

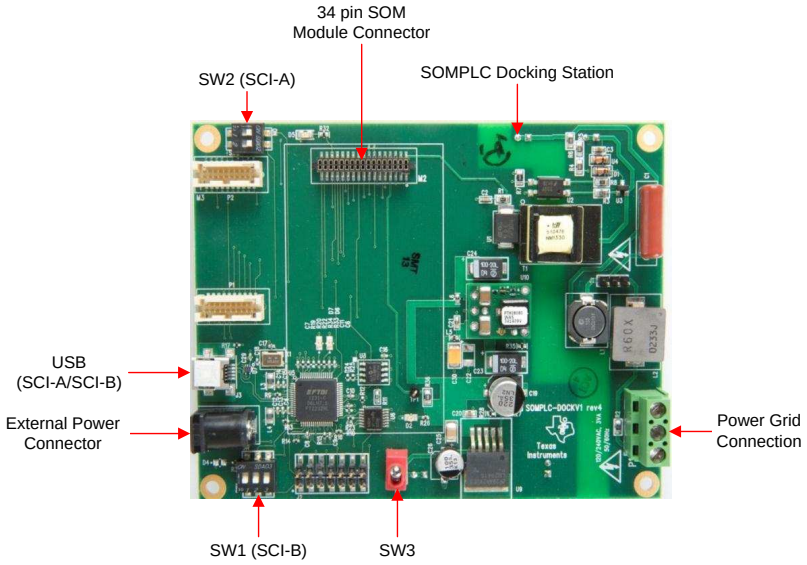


Figure 8. SOMPLC Docking Station

2. Connect *Neutral* and *Line* (marked with words on the AC Power Cable) to the power grid connector P1 of each kit. Make sure the neutral and line connections are not shorted.

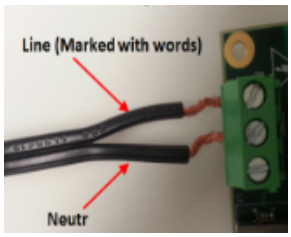


Figure 9. Line Connection

3. Ensure the position of switches SW1 and SW2 are set to their default setting, as shown in Figure 10, to communicate to PC GUI via SCI-A.

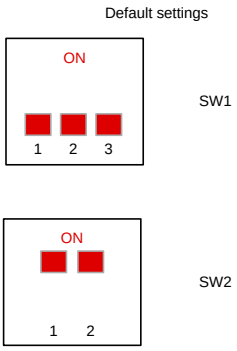


Figure 10. Software Configuration

8.2 Power Up

1. Connect the 15-V wall-mounted power supply to the AC receptacle of each kit.
2. Turn on switch SW3 of each kit to power the boards.

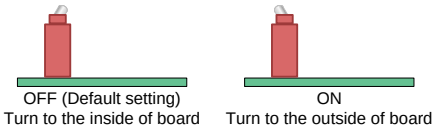


Figure 11. SW3

8.3 Connecting to a PC

1. Plug in the micro-USB to the kit and connect the USB cable to the PC. Repeat this step for the second kit.

NOTE: If asked to install USB-Serial drivers, proceed to install the drivers. The drivers can be found in C:\Texas Instruments\<PackageName>\XDS100 Drivers. Reboot the PC after the drivers are installed, even if Windows does not ask to.

2. Verify the modems have been installed correctly by using the Device Manager (Start→Control Panel→System→Device Manager→Ports).

NOTE: The four ports on picture are for two boards.

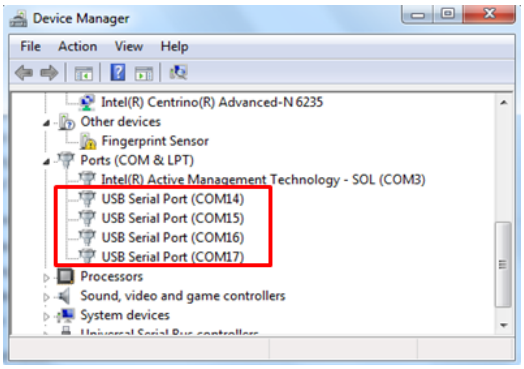


Figure 12. Device Manager: Port Configuration

9 Testing

1. Install the *Zero Configuration* tool from C:\TexasInstruments\<PackageName>\Tools, and launch it. If using one PC to operate, launch two instances, one for each modem.

NOTE: When the zero-configuration GUI opens, it will use the first available COM port to attach to a PLC.

2. Ensure *Diagnostic Port/Data Port* configures to SCI-A by pressing *CTRL+A* in the GUI window.

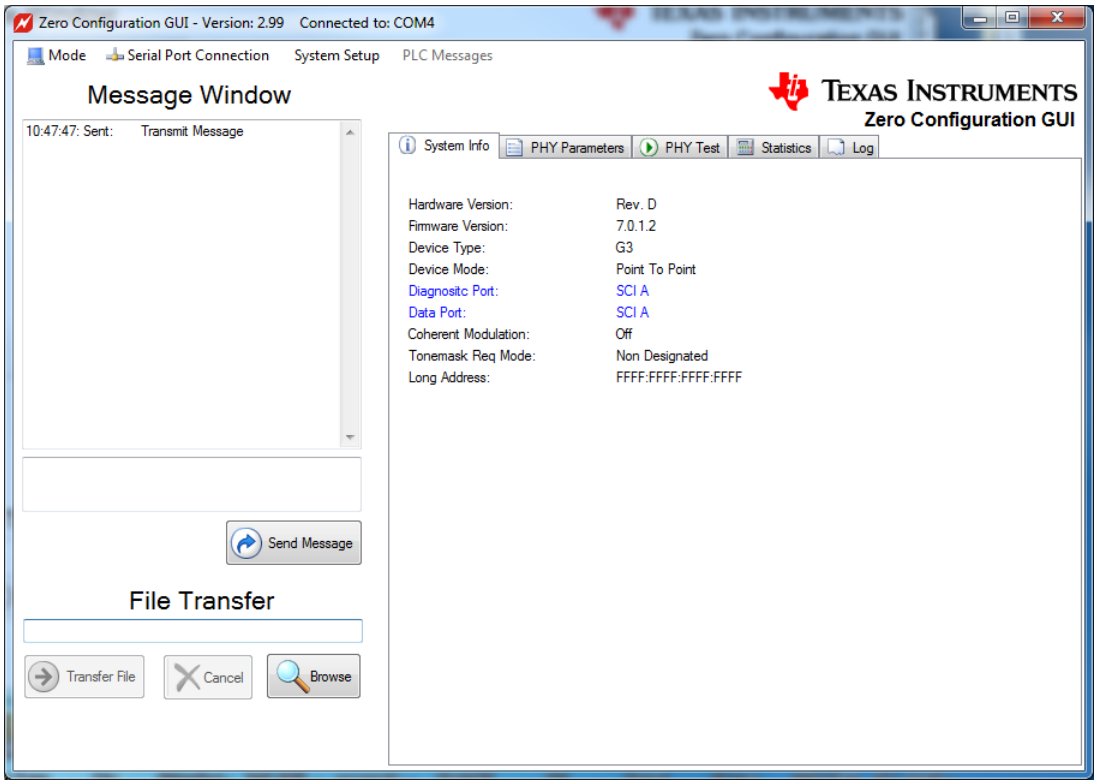


Figure 13. Zero-Configuration GUI

3. Connect each PLC kit to the power line. Ensure that the devices are connected on the same power line phase.

WARNING

HIGH VOLTAGE!

Use caution when connecting to the power grid. If there is concern about connecting to the power grid, use a power strip to connect the two modems together. In this case, the power strip does not need to be plugged into the power grid. Connect each PLC kit to the power line.

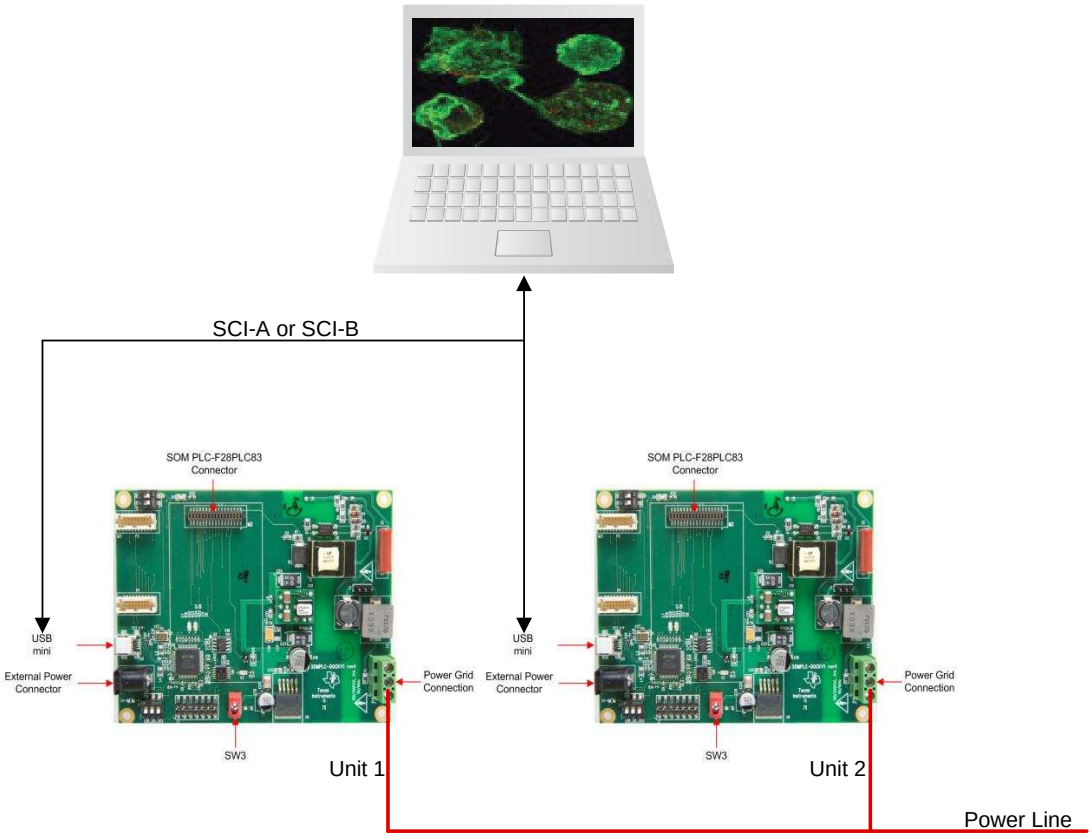


Figure 14. Testing Setup

4. Enter the desired text into the *Message Window*, and press the *Send Message* button. The message will then be received by the other GUI.

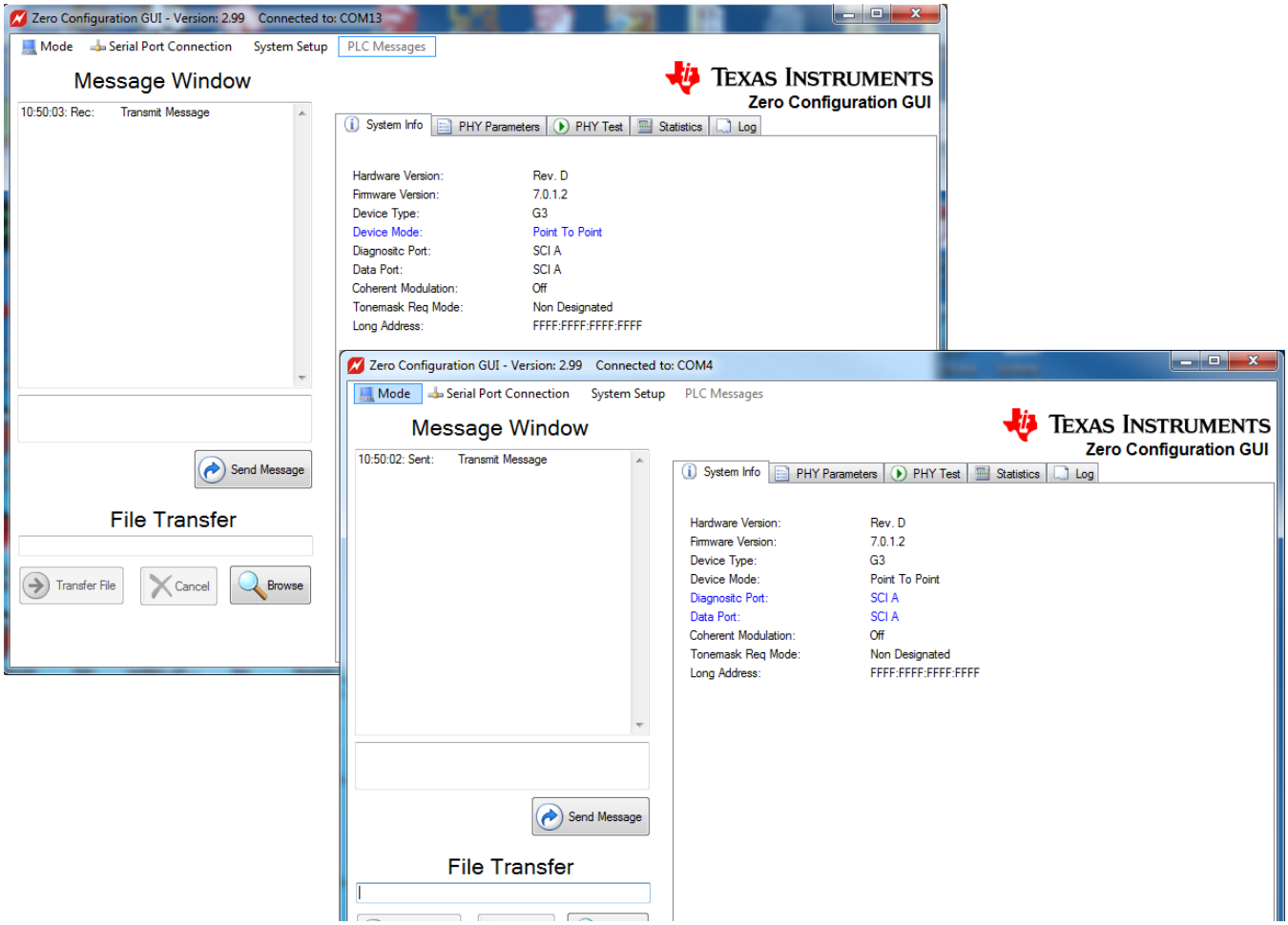


Figure 15. P2P Test with Zero-Configuration GUI

5. Use the *File Transfer* function contained in the bottom left-hand corner of GUI option to transfers files.

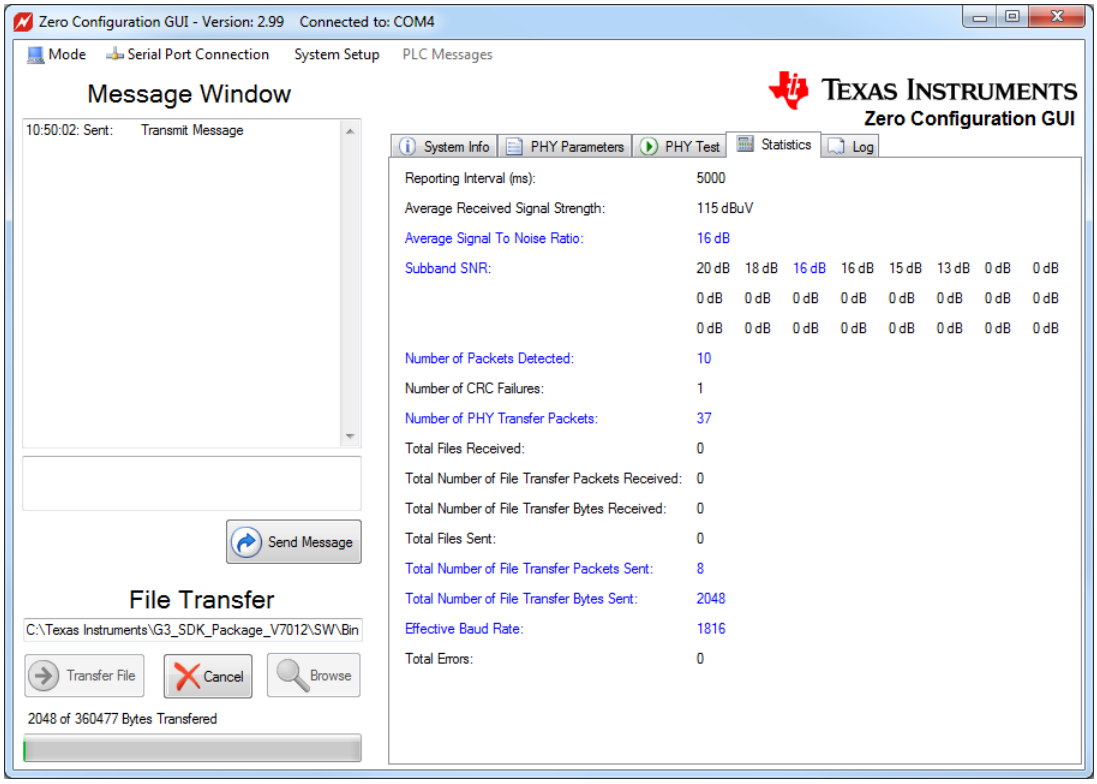


Figure 16. File Transfer TX

6. Click on the *Browse* button to display the standard windows file chooser dialog to choose the file to transfer. Only one file can transfer at a time.
   (a) After the file is chosen, click on the *Transfer File* button.
   (b) The other PLC must also be controlled by the zero-configuration GUI.
   (c) When the transfer starts, the GUI will display a progress bar on both zero-configuration GUIs. The GUI in Figure 17 is the receiving zero-configuration GUI and displays the path and file name where the received file is being copied. The user is not allowed to change the directory path of the received file.

Figure 17. File Transfer RX

When the file transfer completes, the message box below displays on both zero-configuration GUIs.

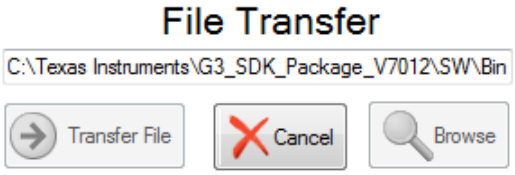


Figure 18. Message Box

If the file transfer fails, the sending GUI displays one of the following message boxes.

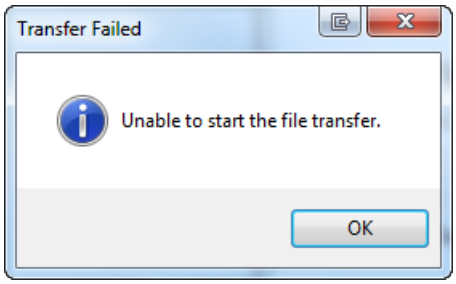


Figure 19. Case 1: File Transfer Failed

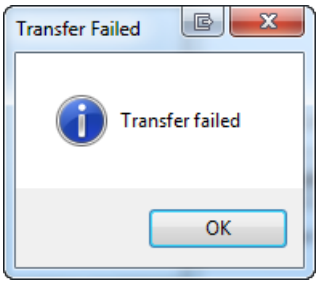


Figure 20. Case 2: File Transfer Failed

Cancel the file transfer by clicking on the *Cancel* button on either GUI.

10 Design Files

10.1 Schematics

To download the schematics for each board, see the design files at TIDM-SOMPLC-G3-CENELEC.

NOTE: The transformer may not be necessary in a production design.

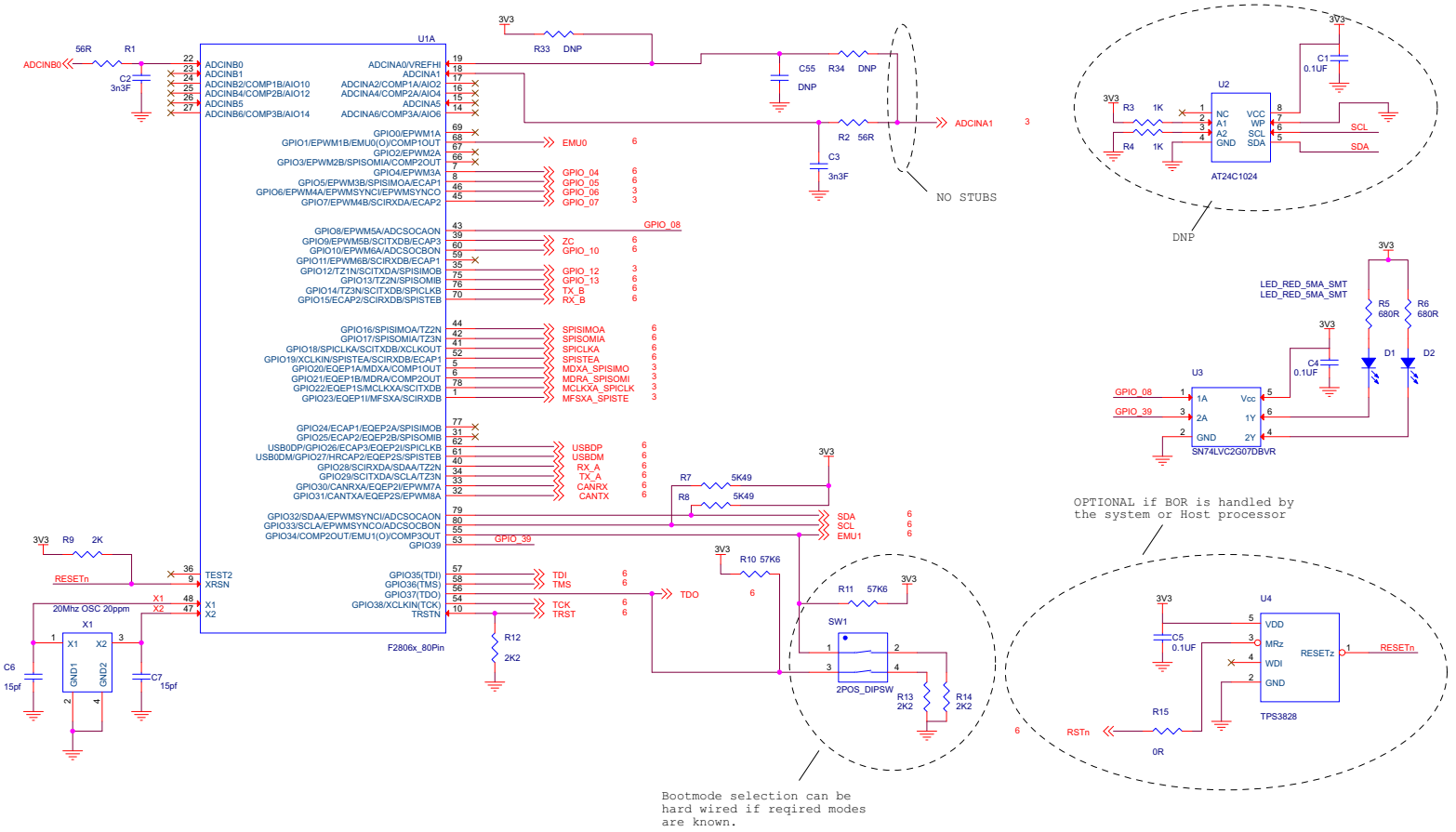
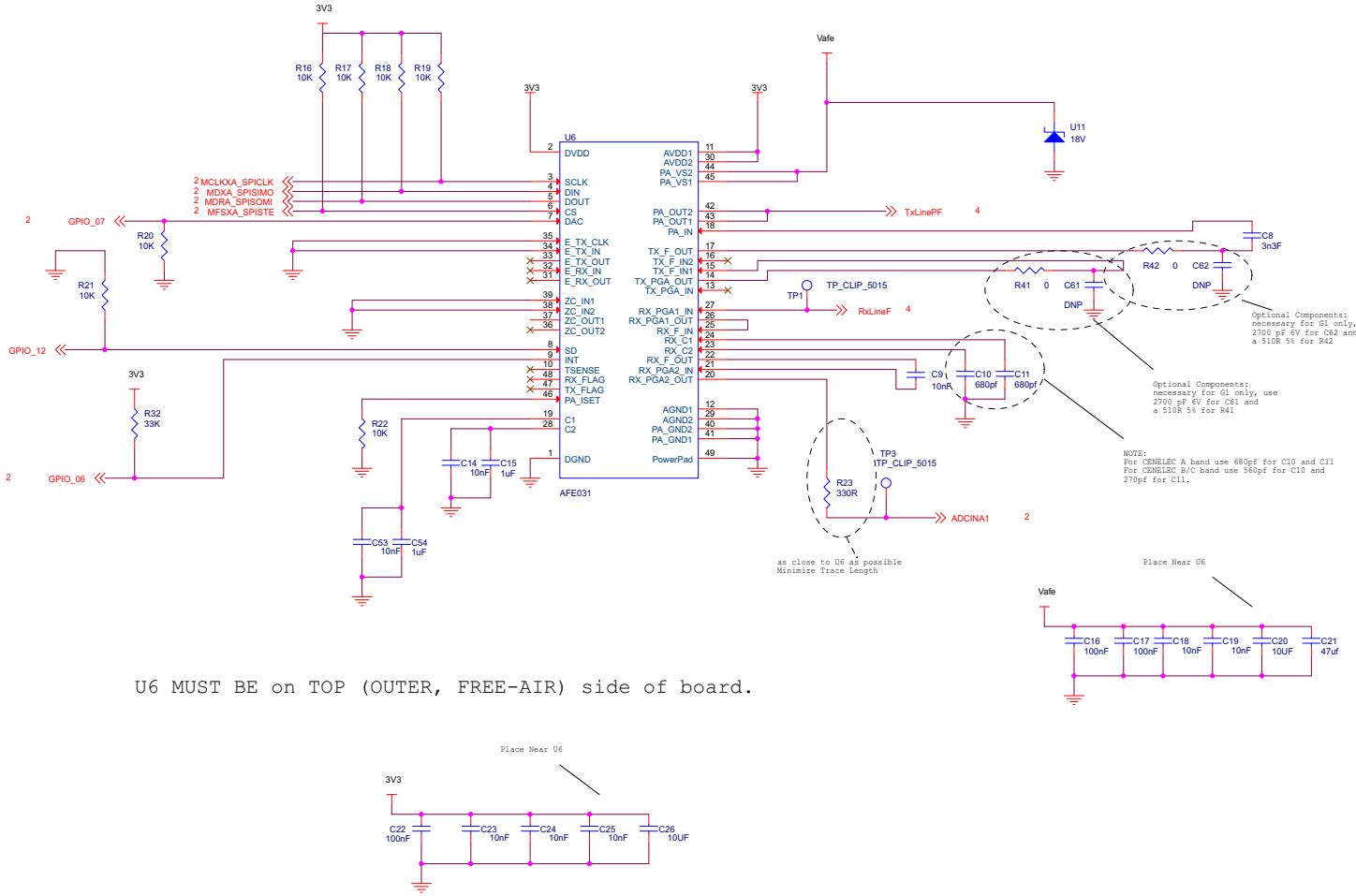
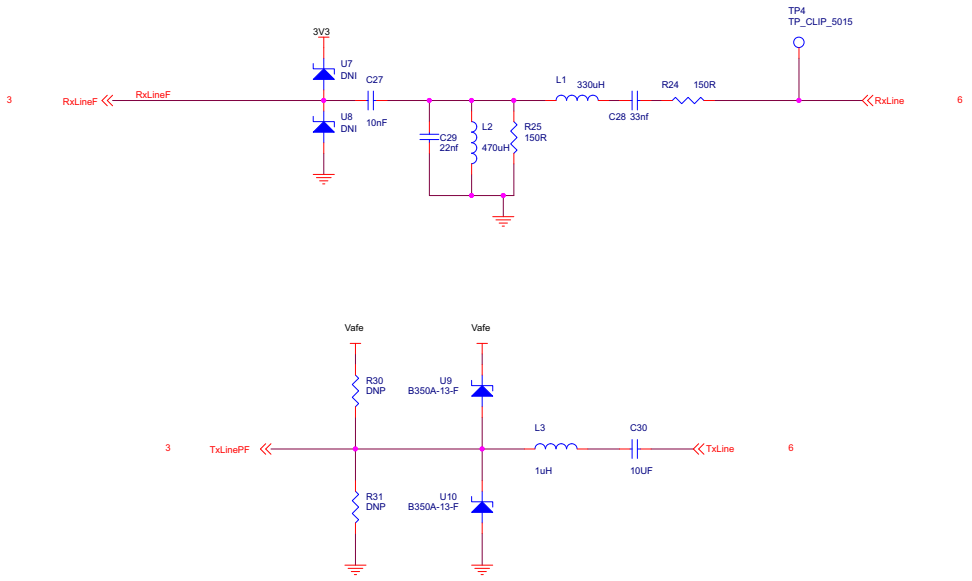


Figure 21. MCU



U6 MUST BE on TOP (OUTER, FREE-AIR) side of board.

Figure 22. AFE031



NOTE: Several components on this page have been removed or changed in the BOM.

Figure 23. AFE1 (Passive RX Filter)

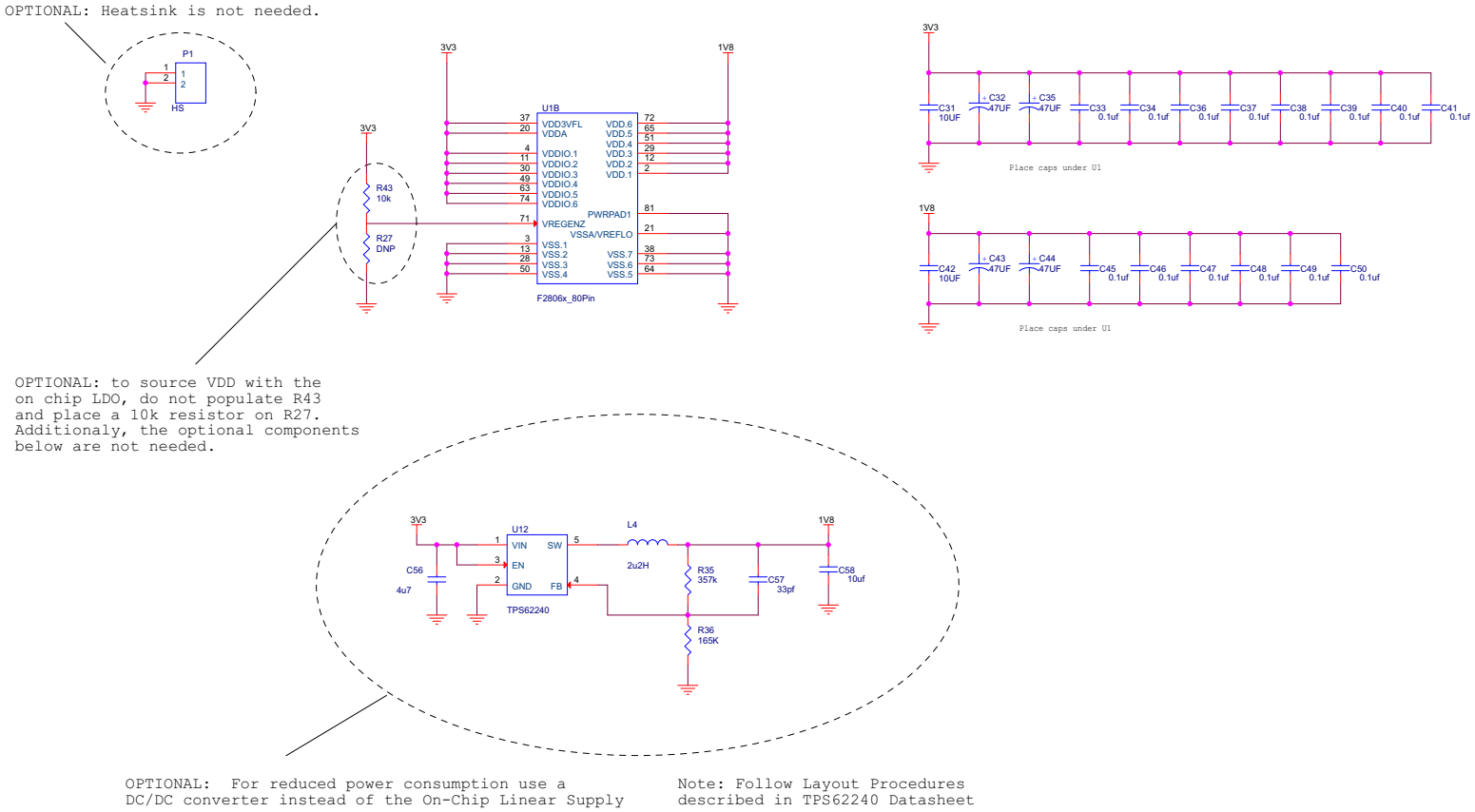


Figure 24. Power

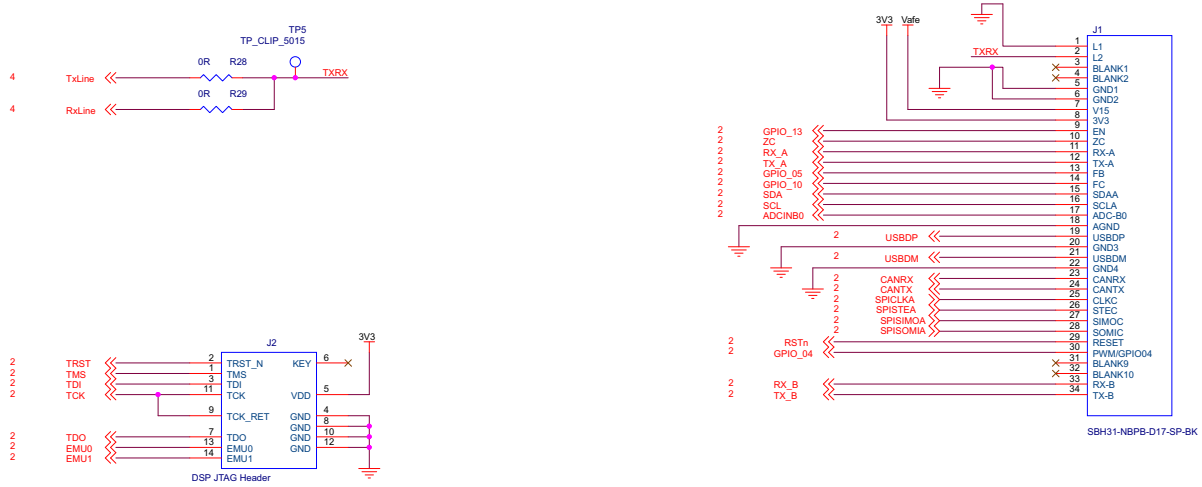


Figure 25. Connector

10.2 Bill of Materials

To download the bill of materials (BOM), see the design files at TIDM-SOMPLC-G3-CENELEC.

Table 3. BOM

ITEM #	PART #	QTY	PART TYPE	PART REF	VENDOR	VENDOR PN	DESCRIPTION	VALUE	PCB FOOTPRINT	TOLER-ANCE	DISTRIBUTOR PN	DISTRI-BUTOR	CROSS REF
1	100-00003	3	CAP	C1, C4, C5	AVX	0603YC104KAT*A	Capacitor, 0.1 µF,16 V, 10 %,X7R, 0603	0.1 µF	C0603	10%	478-1239-2-ND	Digikey	
2	300-00017	2	CAP	C2, C3			Cap Ceramic 10 V SMT 0402	3n3F	C0402	0			
3	300-00056	2	CAP	C6, C7	Murata	GRM1555C1H150JZ01D	Cap Cer 15 pF 50 V 5% C0G 0402	15 pF	C0402	0	490-1280-1-ND	Digikey	
4	300-00038	1	CAP	C8	Panasonic	ECH-U1H332JX5	CAP .0033 µF 50 V PPS Film 1206 5%	3n3F	C1206	0	PCF1334CT-ND	Digikey	
5	300-00013	1	CAP	C9			Cap Ceramic 10 V, SMT 0402	10 nF	C0402	0			
6	300-00085	2	CAP	C10, C11	Yageo	CC0805KRX7R9BB681	Cap 680 pF 50 V Ceramic X7R 0805	680 pF	C0805	0	311-1126-1-ND	Digikey	
7	300-00040	5	CAP	C14, C23, C24, C25, C53	Murata	GRM188R71C103KA01D	Cap Cer 10000 pF 16 V 10% X7R 0603	10 nF	C0603	0	490-1525-2-ND	Digikey	
8	300-00036	2	CAP	C15, C54	Taiyo Yuden	UMK107BJ105KA-T	Cap Ceramic 50 V SMT 0603	1 µF	C0603	0	587-2400-1-ND	Digikey	
9	300-00041	2	CAP	C16, C17	Murata	GRM155F51E104ZA01D	Cap Cer .1 µF (100nf) 25 V Y5V 0402	100 nF	C0402	0	490-3271-1-ND	Digikey	
10	300-00043	2	CAP	C18, C19	Murata	GRM188R71E103KA01D	Cap Cer 10000 pF (10nf) 25 V 10% X7R 0603	10 nF	C0603	0	490-1520-1-ND	Digikey	
11	300-00039	2	CAP	C20, C30	Taiyo Yuden	GMK316F106ZL-T	Cap Ceramic 35 V SMT 1206	10 µF	C1206	0	587-1352-1-ND	Digikey	
12	300-00042	1	CAP	C21	TDK	C5750Y5V1E476Z	Cap Cer 47 µF 25 V Y5V 2220	47 µF	C2220	0	445-3486-2-ND	Digikey	
13	300-00014	1	CAP	C22	Kemet Electronics Corporation	C0402C104K8PACTU	Cap Ceramic 10 V SMT 0402	100 nF	C0402	0	399-3027-2-ND	Digikey	
14	300-00008	1	CAP	C26	Panasonic	ECJ-2FB0J106M	Capacitor,10UF,6.3 V, 20 %, X5R,	10 µF	C0805	0.2			
15	300-00037	1	CAP	C27	AVX	06035C103KAT2A	Cap Ceramic 50 V SMT 0603	10 nF	C0603	0	478-1227-1-ND	Digikey	

Table 3. BOM (continued)

ITEM #	PART #	QTY	PART TYPE	PART REF	VENDOR	VENDOR PN	DESCRIPTION	VALUE	PCB FOOTPRINT	TOLER-ANCE	DISTRIBUTOR PN	DISTRI-BUTOR	CROSS REF
16	300-00028	1	CAP	C28			Cap Ceramic SMT 0402	33 nF	C0402	0			
17	300-00026	1	CAP	C29			Cap Ceramic SMT 0402	22 nF	C0402	0			
18	300-00011	2	CAP	C31, C42	Panasonic	ECJ-1VB0J106M	Cap Ceramic 10 µF 6.3 V X5R 0603	10 µF	C0603	20%	rPCC2395CT-ND	Digikey	
19	300-00012	4	CAP	C32, C35, C43, C44	Vishay	298D476X0010P2T	Cap Tant 47 µF 10 V 20% 0805	47 µF	C0805P	0	718-1608-1-ND	Digikey	
20	300-00044	14	CAP	C33, C34, C36, C37, C38, C39, C40, C41, C45, C46, C47, C48, C49, C50	Murata	GRM155R61A104KA01D	Cap Cer .1 µF 10 V 10% X5R 0402	0.1 µF	C0402	0	490-1318-1-ND	Digikey	
21	300-00057	3	CAP	C55, C61, C62			Cap Ceramic SMT 0402	DNP	C0402	0			
22	300-00063	1	CAP	C56	TDK	C1005X5R0G475K	Cap Cer 4.7 µF 4.0 V X5R 10% 0402	DNI	DNI	0	445-5949-1-ND	Digikey	DNI
23	300-00062	1	CAP	C57	Johanson Dielectrics Inc	250R07S330JV4T	Cap Cer 33pF 25 V S 0402 UHI Q	DNI	DNI	0	712-1298-1-ND	Digikey	DNI
24	300-00064	1	CAP	C58	TDK	C1608X5R0J106M	Cap Cer 10 µF 6.3 V X5R 20% 0603	DNI	DNI	0	445-4112-1-ND	Digikey	DNI
25	200-00010	2	FET_DIODE	D1, D2	Panasonic	LNJ208R8ARA	LED, Red, 3.0 VR, 0.2 IF,Surf. Mount	LED_RED_5MA_SMT	LED0603H35	0			
26	320-00013	1	CONN	J1	Sullins Connector Solutions	SBH31-NBPB-D17-SP-BK	CONN. header 1.27 mm 34-POS GOLD SMD	SBH31-NBPB-D17-SP-BK	Male	0	S9108-ND	Digikey	
27	120-00068	1	CONN	J2	SAMTEC	TSM-107-01-S-DV	CONN. 2 × 7 header, SMT, DSP JTAG, Pin 6 removed	DSP JTAG Header	hdr_14p	0			
28	330-00009	1	MAGNETICS	L1	Panasonic - ECG	ELJ-EA331KF	Inductor 330 µH 10% 1210 SMD	330 uH	IND1210	0	PCD1432CT	Digikey	
29	330-00010	1	MAGNETICS	L2	Taiyo Yuden	CB2518T471K	Inductor power 470 µH 1007	470 uH	IND1007	0	587-2194-1-ND	Digikey	
30	330-00011	1	MAGNETICS	L3	Taiyo Yuden	LB3218T1R0M	Inductor 1.0 µH 1.075 A 20% SMD	1 uH	IND1207	0	587-2032-1-ND	Digikey	
31	330-00021	1	MAGNETICS	L4	TDK	GLCR2012T2R2M-HC	Inductor 2.2 µH 350 ma 20% 0805	DNI	DNI	0	445-3625-1-ND	Digikey	DNI

Table 3. BOM (continued)

ITEM #	PART #	QTY	PART TYPE	PART REF	VENDOR	VENDOR PN	DESCRIPTION	VALUE	PCB FOOTPRINT	TOLER-ANCE	DISTRIBUTOR PN	DISTRI-BUTOR	CROSS REF
32	490-00002	1	Heat_Sink	P1			DNI	DNI		0			DNI
33	310-00041	2	RES	R1, R2			Resistors 56R, 5% - SMD, 0402	56R	R0402	0.05			
34	310-00035	2	RES	R3, R4			Resistors,1K,5%, SMD,0402	1K	R0402	0			
35	310-00011	2	RES	R5, R6			Resistors, 680R, 5% - SMD, 0603	680R	R0603	0.05			
36	310-00042	2	RES	R7, R8			Resistors 5K49 5% - SMD, 0402	5K49	R0402	0			
37	310-00043	1	RES	R9			Resistors 2K 5% - SMD, 0402	2K	R0402	0			
38	310-00044	2	RES	R10, R11			Resistors 57K6 5% - SMD, 0402	57K6	R0402	0			
39	310-00045	3	RES	R12, R13, R14			Resistors 2K2 5% - SMD, 0402	2K2	R0402	0			
40	310-00029	3	RES	R15, R28, R29			Resistors, 0R, 5% - SMD, 0402	0R	R0402	0			
41	310-00049	7	RES	R16, R17, R18, R19, R20, R21, R22			Resistor 10K 5% - SMD,0402	10K	R0402	0			
42	310-00063	1	RES	R23	Vishay	CRCW0402330RJNED	Res 330 Ω 1/16W 5% 0402 SMD	330R	R0402	0	541-330JCT-ND	Digikey	
43	310-00051	2	RES	R24, R25			Resistor 150R 5% - SMD,0402	150R	R0402	0			
44	310-00030	3	RES	R33, R34			Resistors, DNP - SMD, 0402 (Do not populate)	DNP	R0402	0			
45	110-00230	2	RES	R30, R31			Resistors DNP - SMD, 0603	DNP	R0603	0			
46	310-00067	1	RES	R32			Resistor 33-K 5% - SMD,0402	33K	R0402	0			
47	310-00090	1	RES	R35	Panasonic	ERJ-2RKF3573X	RES 357-KΩ 1/10W 1% 0402 SMD	DNI	DNI	0	P357KLCT-ND	Digikey	DNI
48	310-00091	1	RES	R36	Panasonic	ERJ-2RKF1653X	RES 165-KΩ 1/10W 1% 0402 SMD	DNI	DNI	0	P165KLCT-ND	Digikey	DNI
49	310-00102	2	RES	R41, R42	Panasonic - ECG	ERJ-2GE0R00X	RES 0.0 Ω 1/10 W 0402 SMD	0	R0402	0	P0.0JCT-ND	Digikey	

Table 3. BOM (continued)

ITEM #	PART #	QTY	PART TYPE	PART REF	VENDOR	VENDOR PN	DESCRIPTION	VALUE	PCB FOOTPRINT	TOLER-ANCE	DISTRIBUTOR PN	DISTRI-BUTOR	CROSS REF
50	310-00104	1	RES	R43	Panasonic	ERJ-2GEJ103X	RES 10-KΩ 1/10 W 5% 0402 SMD	DNP	R0402	0			
51	206-00010	1	SWITCH	SW1	CTS	218-2LPST	Switch DIP Half Pitch 2POS	2POS_DIPSW	SMT218LP_2POS	0	CT2182LPST-ND	Digikey	
52	280-00005	4	MTG_HOLE_TP	TP1, TP3, TP4, TP5	TI	5015	PC Test Point Miniature SMT	TP_CLIP_5015	TP_5015	0			
53	400-00003	2	FET_DIODE	U10, U9	Diodes Inc	B350A-13-F	Diode Schottky 3-A 50-V SMA	B350A-13-F	DO-214AB	0	B350A-FDICT-ND	Digikey	
54	400-00007	1	FET_DIODE	U11	On Semi	1SMB5931BT3	Diode ZENER 3-W 18-V SMB	18 V	DO-214AA	0	1SMB5931BT3GOSCT-ND	Digikey	
55	402-00037	1	IC	U12	TI	TPS62240	2.25-MHz 300-mA Step Down Converter	DNI	DNI	0			DNI
56	402-00034	1	IC	U1	TI	F2806x	F28069, 80-Pin PFP LQFP	F2806x_80Pin	PFP (80)	0			
57	402-00027	1	IC	U2	Atmel	AT24C1024B-TH-T	IC EEPROM 1-Mb 1-MHz 8TSSOP	AT24C1024	TSSOP8	0	DNP		DNI
58	402-00005	1	IC	U3	TI	SN74LVC2G07DBV	IC,Dual Buffer/Driver with Open-Drain Outputs, SOT23-6	SN74LVC2G07DBVR	DBV6	0	296-13494-2	Digikey	
59	203-00037	1	POWER	U4	TI	TPS3828-33DBV	Reset Supervisor, SOT23-5	TPS3828	DBV5	0	296-2638-1	Digikey	
60	402-00028	1	IC	U6	TI	AFE031	AFE031 TI PLC Integrated AFE, 48-pin QFN RGZ	AFE031	RGZ	0			
61	400-00027	2	FET_DIODE	U7, U8	Diodes Inc	DNI	DNI	DNI	DO-214AB	0			
62	405-00009	1	OSC_XTAL	X1	Abracon Corporation	ABM3B-20.000MHZ-10-1-U-T	Crystal 20.0000-MHz 10-pF SMD	20-Mhz OSC 20ppm	4-SMD (0.197" L x 0.126" W)	0	300-8214-1-ND	Digikey	
63	310-00030	3	RES	R27			Resistors, DNP - SMD, 0402	10K	R0402	0	P10KJTR-ND	Digikey	

10.3 Layer Plots

To download the layer plots, see the design files at TIDM-SOMPLC-G3-CENELEC.

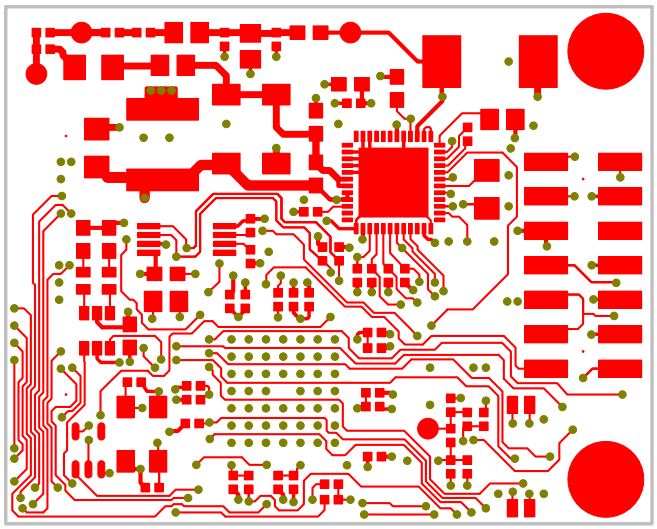


Figure 26. Primary Side

Figure 27. Internal Neg Plane 1

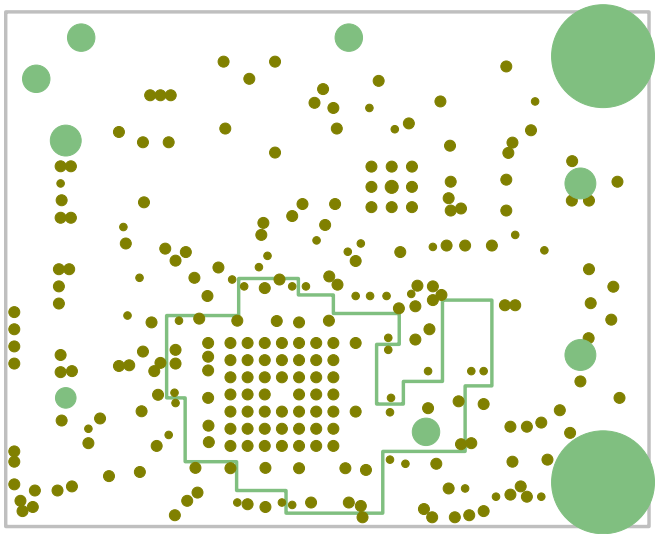


Figure 28. Internal Neg Plane 2

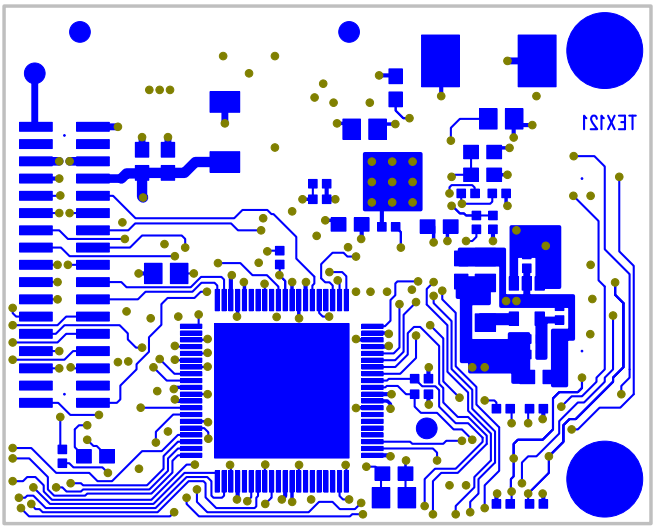


Figure 29. Secondary Side

10.4 Gerber Files

To download the Gerber files, see the design files at TIDM-SOMPLC-G3-CENELEC.

10.5 Assembly Drawings

To download the Gerber files, see the design files at TIDM-SOMPLC-G3-CENELEC.

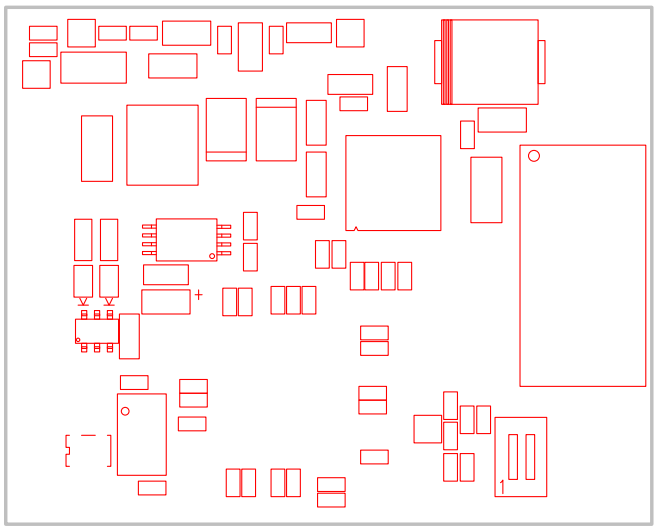


Figure 30. Primary Side

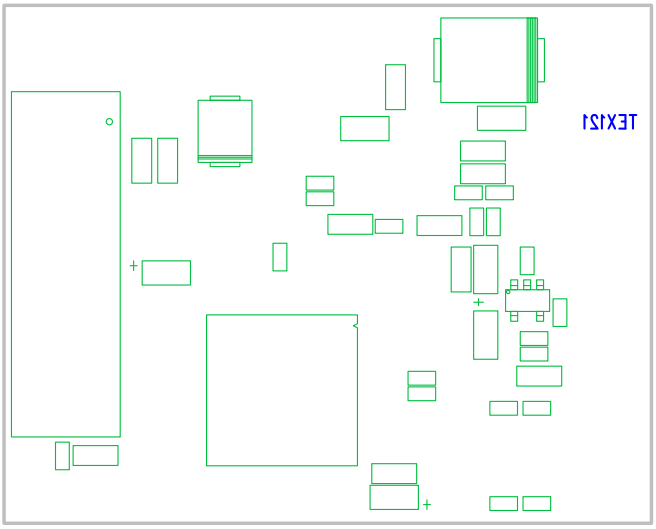


Figure 31. Secondary Side

11 Software Files

To download the software files, see the design files at TIDM-SOMPLC-G3-CENELEC.

12 About the Author

WONSOO KIM is a system applications engineer at Texas Instruments, where he is responsible for providing technical support and training on power-line communication software and systems, driving solutions for Smart Grid and Energy Metering, and working on defining future requirements in roadmap. He received a Ph.D. degree in electrical and computer engineering from the University of Texas at Austin, TX.

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Revision History

Changes from Original (July 2014) to A Revision **Page**

- Changed CENELEC functionality from A, B, C, and D to A 1
- Added note on transformer to Section 10.1 19

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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