TI Designs
Wi-Fi Link for Energy Monitoring

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Design Resources

TIDC-WIFI-METER-READING	Design Folder
MSP430i2040	Product Folder
CC3200MOD	Product Folder
UN2003LV	Product Folder
UCC28910	Product Folder
TIDM-3OUTSMTSTRP	Tools Folder

TI E2E™ Community

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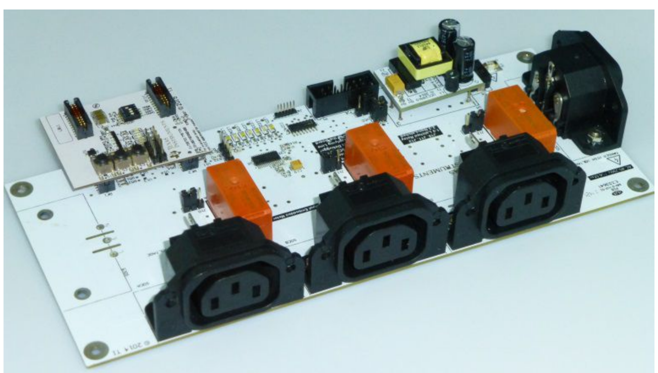
WEBENCH® Calculator Tools

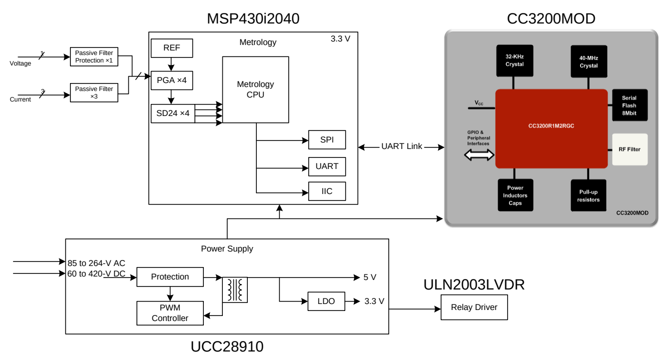
Design Features

- Reading of Energy Monitor's Parameters With Wi-Fi® Link
- Control Relay Switch Over Wi-Fi Link
- Interface to Energy Monitoring Device Through UART

Featured Applications

- Utility Energy Monitoring
- Industrial Embedded Energy Monitoring
- Home Automation
- Home Security
- Appliances





An IMPORTANT NOTICE at the end of this TI reference design addresses authorized use, intellectual property matters and other important disclaimers and information.

1 System Description

1.1 Cautions and Warnings

This TI design operates the hardware powered directly from AC supply; therefore, only professionals who received appropriate technical training should operate the hardware.

Before operating the hardware, read the safety related documents that come with the user's guide before operating the hardware.

CAUTION

Read the user's guide before use.

CAUTION

Do not leave the EVM powered when unattended.

CAUTION

HOT SURFACE: Contact may cause burns. Do not touch.

CAUTION

HIGH VOLTAGE: Electric shock is possible when connecting the board to a live wire. The board should be handled with care by a professional. For safety, use isolated equipment with overvoltage and overcurrent protection.

1.2 System Description

This design guide discusses an application that reads an energy monitor device over a Wi-Fi link. This design uses the Texas Instruments CC3200MOD and MSP430i2040 as the development platform for communication and electrical metering, respectively. Starting from the TI Design TIDM-3OUTSMTSTRP as the metering data source, a communication board designed using the CC3200MOD is added for Wi-Fi communication. The metering data can then be read and the relay can be controlled by using a browser.

This guide explains the process of coding the CC3200 to add the communication to the TIDM-3OUTSMTSTRP.

1.3 MSP430i2040 — 16-Bit Mixed Signal Microcontroller

The MSP430i2040 is used in this design as the metrology processor. Its four 24-bit sigma-delta analog-to-digital converters (ADCs) allow accurate energy measurements, providing read of voltage, current, power (active, reactive, apparent), power factor, and frequency of three AC outlets. The MSP430i2040 requires only a few passive external components to interface directly to the voltage divider and current shunt for voltage and current measurements.

1.4 CC3200 — SimpleLink™ Wi-Fi CC3200 Internet-on-a-Chip™ Wireless MCU Module

The CC3200MOD is used in this design as the Wi-Fi controller that integrates an ARM® Cortex™-M4 MCU, allowing customers to develop an entire application with a single device. With on-chip Wi-Fi, Internet, and robust security protocols, no prior Wi-Fi experience is required for faster development.

2 Block Diagram

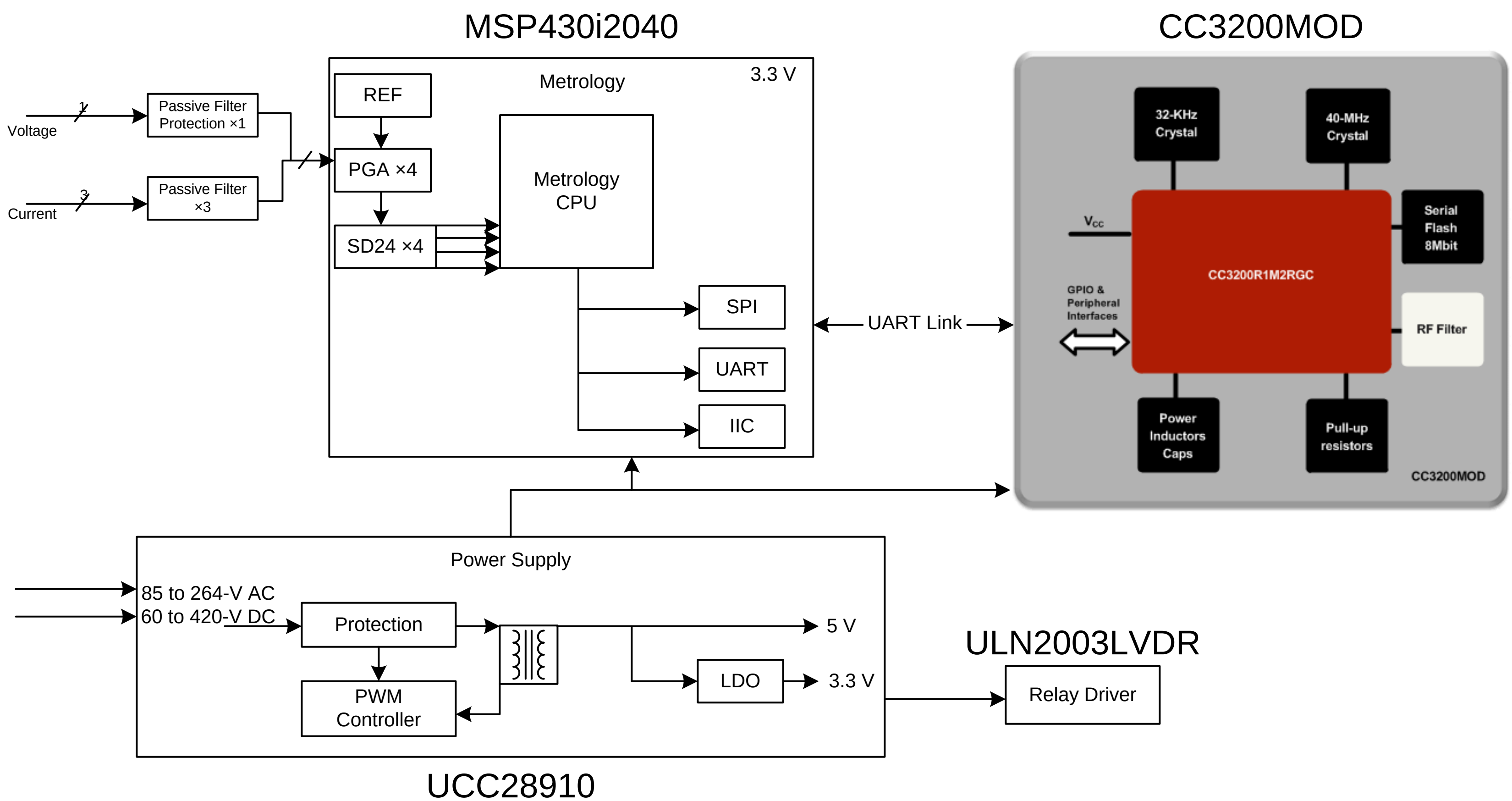


Figure 1. System Block Diagram

2.1 Highlighted Products

2.1.1 MSP430i2040 — 16-Bit Mixed Signal Microcontroller

- Supply voltage range: 2.2 to 3.6 V
- 16-bit RISC architecture, up to 16.384-MHz system clock
- Memory
  - Up to 32KB of Flash main memory
  - 1KB of Flash information memory
  - Up to of 2KB of RAM
- Clock system
  - 16.384-MHz internal DCO
  - DCO operation with internal or external resistor
  - External digital clock source
- Up to four 24-bit sigma-delta ADCs with differential PGA inputs
- Two 16-bit timers with three capture/compare registers each
- Enhanced universal serial communication interfaces (eUSCIs)
  - eUSCI_A0
    - Enhanced UART with automatic baud-rate detection
    - IrDA encoder and decoder
    - Synchronous SPI
  - eUSCI_B0
    - Synchronous SPI
    - I^2C
- 16-bit hardware multiplier

2.1.2 CC3200 — SimpleLink Wi-Fi CC3200 Internet-on-a-Chip Wireless MCU Module

- Consists of the CC3200R1M2RGC single-chip wireless MCU and all required clocks, SPI flash, and passives.
- Modular FCC, IC, and CE certifications save customer effort, time, and money
- Wi-Fi certified modules, with ability to request certificate transfer for Wi-Fi alliance members
- 1.27-mm pitch LGA package for easy assembly and low-cost PCB design
- Efficient code size architecture, placing drivers, *Bluetooth*® low-energy controller, IEEE 802.15.4 MAC, and Bootloader in ROM

2.1.3 UCC28910, UCC28911 High-Voltage Flyback Switcher

- Constant-voltage (CV) and constant-current (CC) output regulation without optical coupler
- ±5% output voltage regulation accuracy
- ±5% output current regulation with AC line and primary inductance tolerance compensation
- 700-V start-up and smart power management enables <30-mW standby power
- 115-kHz maximum switching frequency design for high-power density
- Valley switching and frequency dithering to ease EMI compliance
- Thermal shutdown
- Low line and output overvoltage protection

2.1.4 ULN2003LV 7-Channel Relay and Inductive Load Sink Driver

- 7-channel high current sink drivers
- Supports up to 8-V output pullup voltage
- Supports a wide range of 3- to 5-V relay and inductive coils
- Low output V_{OL} of 0.4 V (typical) with
  - 100-mA/140-mA (typical) current sink per channel at 3.3-V/5.0-V logic input
- Compatible to 3.3-V and 5.0-V MCUs and logic interface
- Internal free-wheeling diodes for inductive kick-back protection
- Input pulldown resistors allows 3-stating the input driver
- Input RC-snubber to eliminate spurious operation in noisy environments
- Low input and output leakage currents
- Easy-to-use parallel interface
- ESD protection exceeds JESD 22: 2-kV HBM, 500-V CDM
- Available in 16-Pin SOIC and TSSOP packages

3 System Design Theory

3.1 Metering

This TI Design uses the MSP430i2040 as the metrology processor. The TI Design TIDM-3OUTSMTSTRP is used as the platform of the metering part. The hardware and firmware are slightly modified to add relay control alighted to zero crossing. Find details on the hardware and firmware of the TIDM-3OUTSMTSTRP in its TI Design folder; the modification to hardware is discussed in Section 4.

NOTE: The software package includes the modified firmware with the source code (except the metrology source code, which is only provided upon request). Please contact a local sales office for details on obtaining the metrology source code.

3.2 Metering Data Access

This TI Design uses the HTTP Web Server on the CC3200 transfer data from the MSP430i2040 metering hardware. This transfer allows metering data to be accessed using a web browser on any platform.

The HTTP server listens on the HTTP socket (default to 80) then handles the request (HTTP GET or HTTP POST) by retrieving the web page files from the serial flash. The server then calls to an HTTP event handler to operate on the variable contents. It then composes an HTTP response and sends back to the client over the Wi-Fi link.

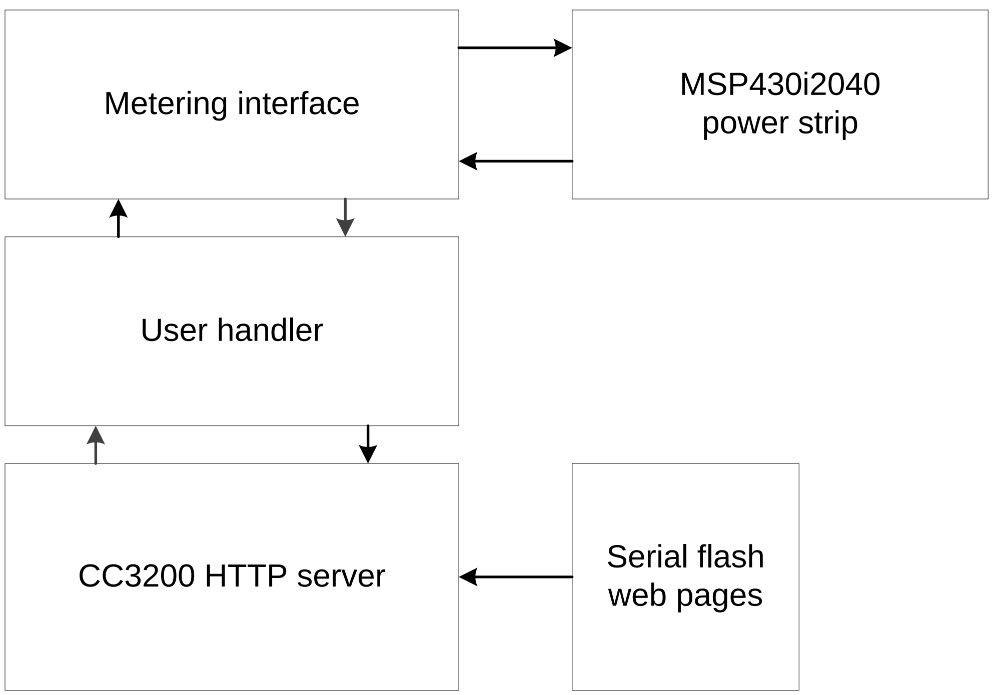


Figure 2. Metering Data Access

3.3 Handling Dynamic Data Items

To allow the metering data to be read with an HTML file with dynamic contents, the HTTP web server supports a set of predefined tokens, which will be replaced on-the-fly by the server, with dynamically generated content. Some tokens are predefined in the HTTP server with additional tokens that can be defined in user application.

The HTTP server scans the HTML page for the "__SL_G_" prefix. If the server finds a prefix, it checks the complete token. Once it matches a known token, it replaces the token in the HTML with the appropriate data (string) that matches that token. If the token is not in the predefined list, the server generates a get_token_value asynchronous event with the token name. This request eventually calls to the HTTP event handler in the main.c code file. The handler then interprets the token and responds to the token value with a send_token_value. The HTTP web server uses this token value and returns it to the client.

To send data from client to the HTTP server, the server will check for the "__SL_P_" prefix. Then the server goes over the parameters list and checks each variable name to see if it matches one of the known predefined tokens. If the variable names match the predefined tokens, the server processes the values. If the HTTP web server receives an HTTP POST request that contains tokens not in the predefined list, the server generates a post_token_value asynchronous event to the host, which contains the following information: form action name, token name, and token value. The host can then process the required information.

3.4 Implementation of HTTP Event Handler

According to Section 3.3, the HTTP event handler is implemented. To facilitate dynamic data, the user-defined token is defined for the set of data to be retrieved:

User defined tokens:

- __SL_G_SST: Get Socket Status
- __SL_G_VSA: Get Socket A Voltage
- __SL_G_VSB: Get Socket B Voltage
- __SL_G_VSC: Get Socket C Voltage
- __SL_G_ISA: Get Socket A Current
- __SL_G_ISB: Get Socket B Current
- __SL_G_ISC: Get Socket C Current
- __SL_G_PSA: Get Socket A Active Power
- __SL_G_PSB: Get Socket B Active Power
- __SL_G_PSC: Get Socket C Active Power
- __SL_G_PFA: Get Socket A Power Factor
- __SL_G_PFB: Get Socket B Power Factor
- __SL_G_PFC: Get Socket C Power Factor
- __SL_G_H.D: Get Meter Name
- __SL_P_ULD: Set Socket Status

The HTTP event handler first checks for the type of event; in this application, only SL_NETAPP_HTTPGETTOKENVALUE_EVENT and SL_NETAPP_HTTPPOSTTOEKNVALUE_EVENT need to be handled. The process of the handling is illustrated in Figure 3.

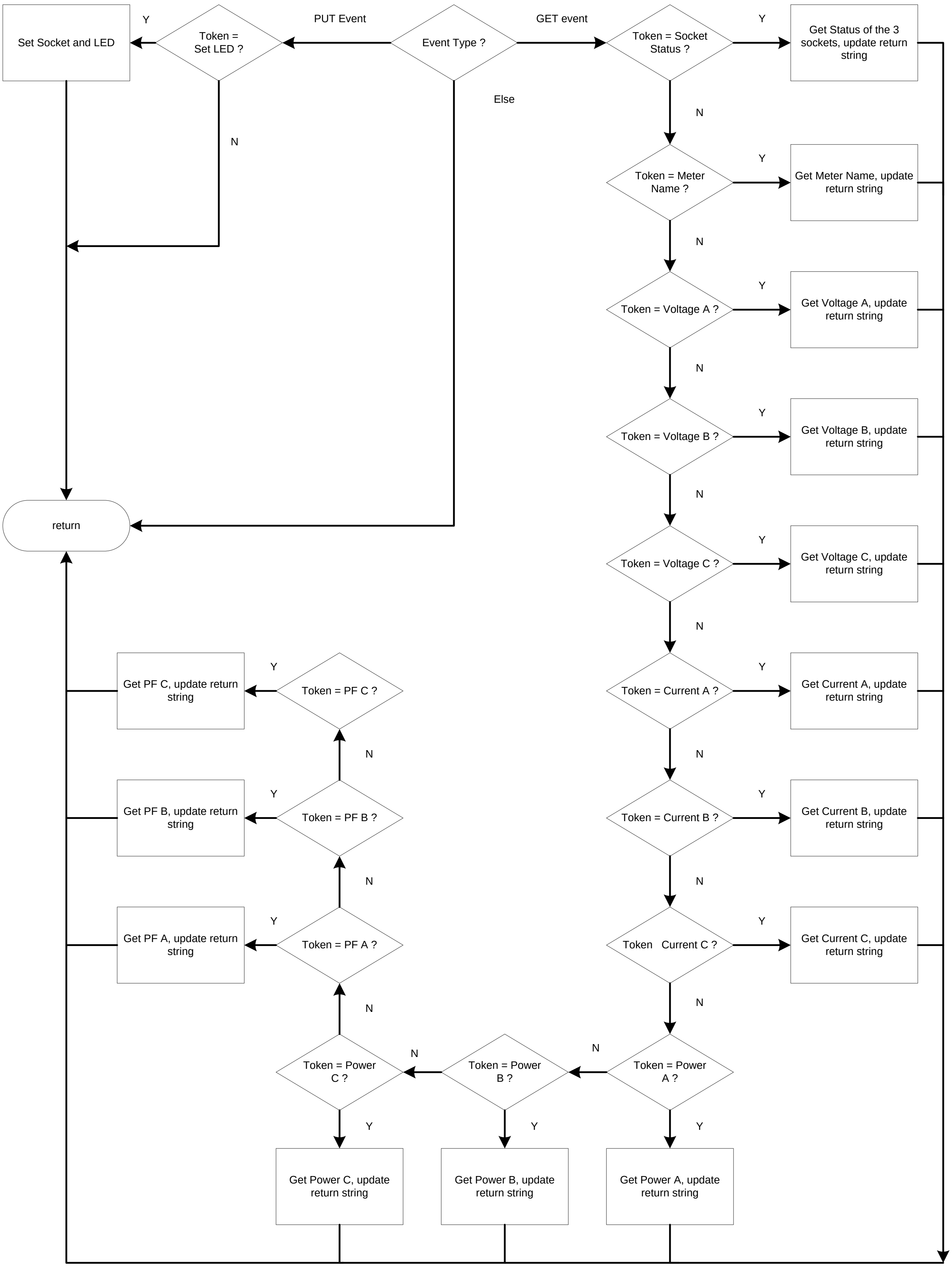


Figure 3. HTTP Event Handler Flow Diagram

4 Getting Started: Hardware

4.1 TIDM-3OUTSMTSTRP Hardware Modification

4.1.1 Power Supply Circuit

The TIDM-3OUTSMTSTRP LDO circuit requires minor modifications to allow for more current to supply the 3.3-V rail for driving the Wi-Fi block.

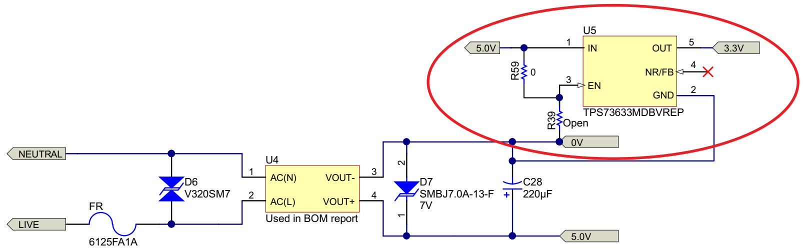


Figure 4. TIDM-3OUTSMTSTRP Hardware Modification

Change the LDO to TPS73633DBVREP . As this LDO is high enabled, the 0-Ω resistor R39 should be opened and R59 should be added to connect pin3 to 5.0 V instead.

In addition to the LDO, replace the original power supply block to provide a more reliable relay operation, although the block power supply in the original TIDM-3OUTSMTSTRP is sufficient to drive the whole circuit.

Figure 5 shows the power supply design. This design is laid out with the same footprint as the original power supply block (see Section 8 for detail of the layout) for drop in replacement.

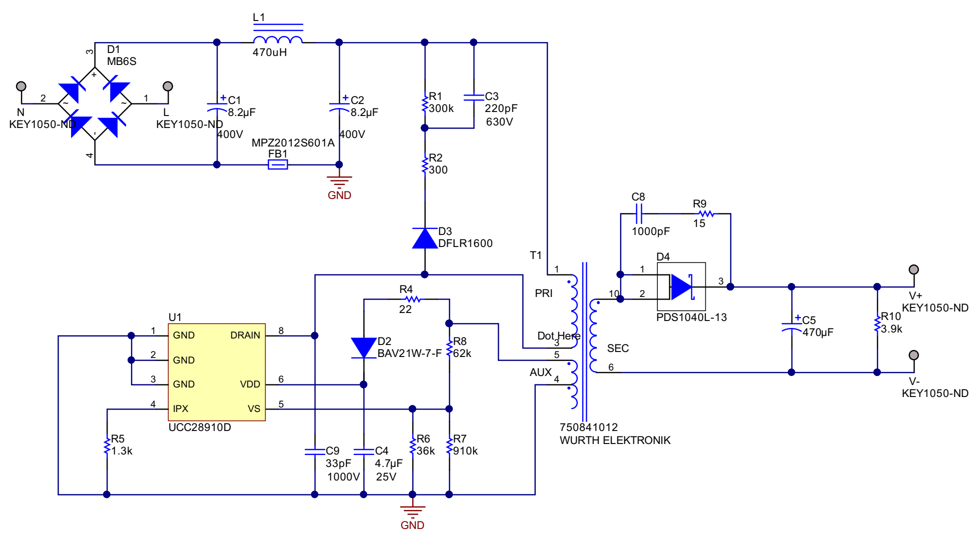


Figure 5. 5-V Power Supply Block Schematic

4.1.2 Protection Circuit

Remove the following protection diodes (MOV) from the TIDM-3OUTSMTSTRP board: D11, D12, D2A, D2B, D2C, D3A, D3B, and D3C.

4.2 Wi-Fi Module

The Wi-Fi module is designed using the CC3200MOD to facilitate attaching to the communication connector on the TIDM-3OUTSMTSTRP board while providing the debugging and programming facility for the CC3200. For details about the design of the Wi-Fi module, see Section 8.

5 Getting Started: Firmware

After the hardware is connected, download the firmware to its corresponding hardware.

5.1 Loading Firmware to Wi-Fi Module

5.1.1 Prerequisites

To debug with the CC3200MOD or to download the firmware to the flash memory on CC3200MOD, the user needs:

- CC3200-LAUNCHXL or CC3200MODLAUNCHXL
- Code Composer Studio™ (CCS) Uniflash for CC3100/CC3200 installed on PC
- CCS 6.0.1 installed on PC
- Example code package unzipped and the folder "httpserver-powerstrip" copied into the cc3200dsk example folder (located as default in C:\ti\CC3200SDK_1.0.0\cc3200-sdk\example\)
- Example code project imported to CCS and built

5.1.2 Connecting Board for Programming

On the CC3200-LAUNCHXL:

1. Disconnect the jumpers as indicated in Figure 6.
2. Locate the pins on J1 and J2 of the Wi-Fi module (Figure 7).
3. Connect the pins with a blue dot to the correspondingly labeled pin on the Wi-Fi module (Figure 6 and Figure 7).

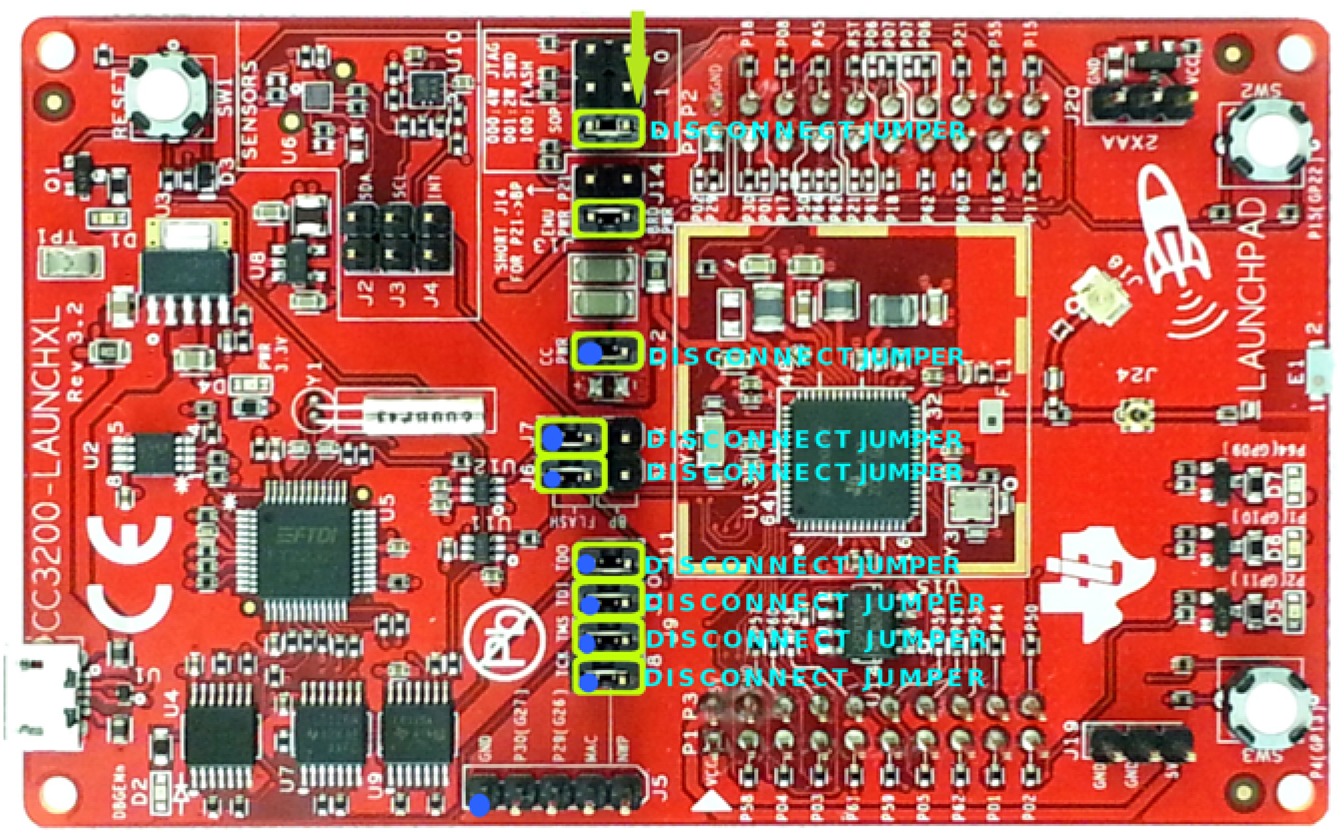


Figure 6. CC3200-LAUNCHXL Jumper Preparation for Connection to Wi-Fi Module

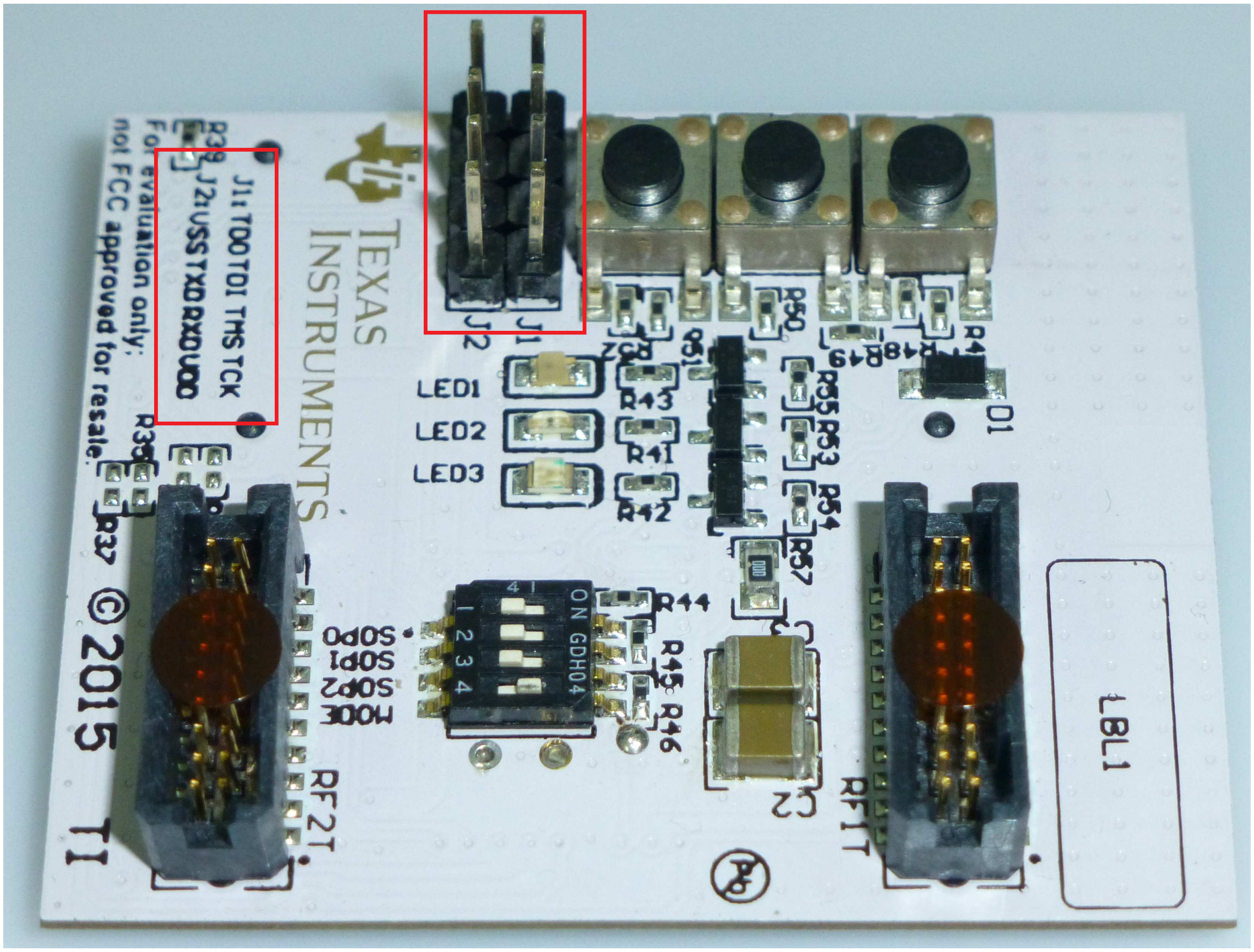


Figure 7. Locate Pins on Wi-Fi Module

5.1.3 Programming

Once connected as described in Section 5.1.2, set the Wi-Fi module to programming mode by switching the SOP2 DIP switch on the Wi-Fi module to the ON position. Then:

1. Connect to the USB on PC with a USB cable to the micro-USB port on the CC3200-LAUNCHXL.
2. Launch CCS UniFlash for CC3100/CC3200 on PC.
3. Click on File → Open Configuration.

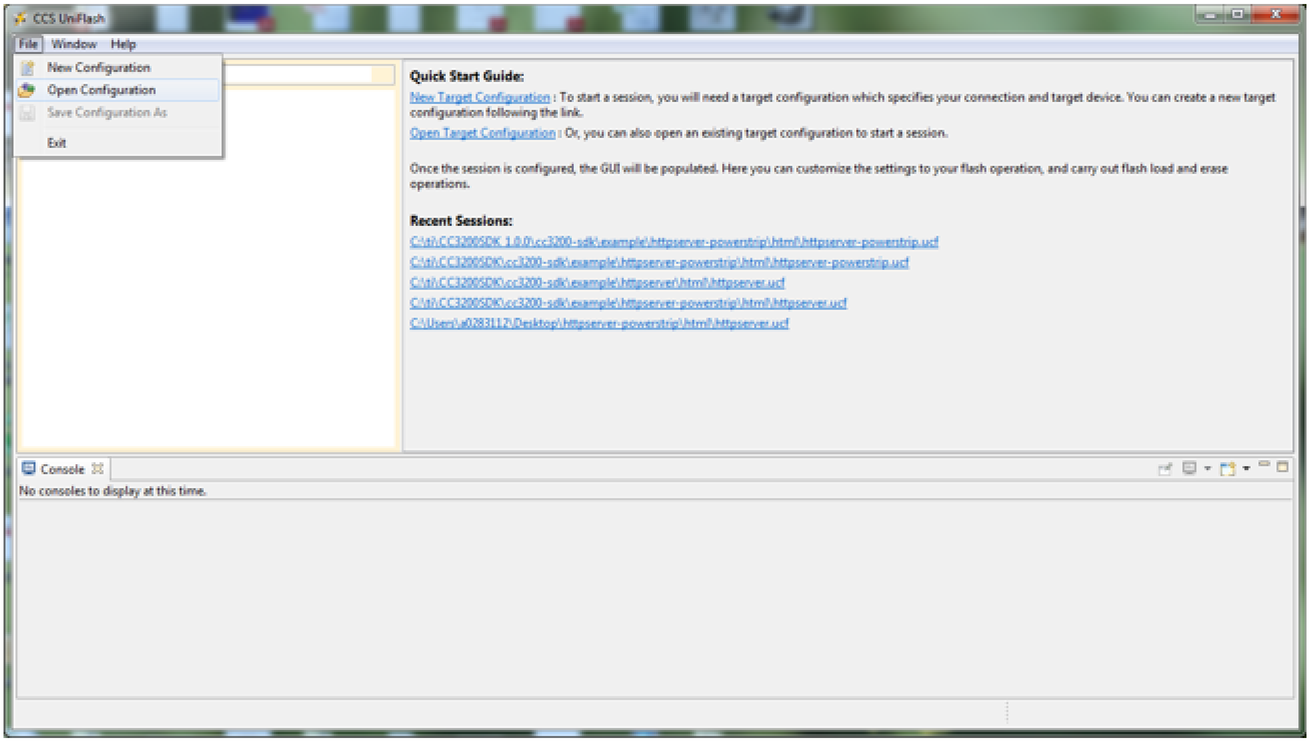


Figure 8. CCS UniFlash Open Configuration

4. Locate the configuration file "httpserver-powerstrip.ucf" (usually located in C:\ti\CC3200SDK_1.0.0\cc3200-sdk\example\httpserver-powerstrip\html).

5. When the screen shown in Figure 9 appears, put the correct COM port number of the LAUNCHXL board connected to the "COM Port" box.

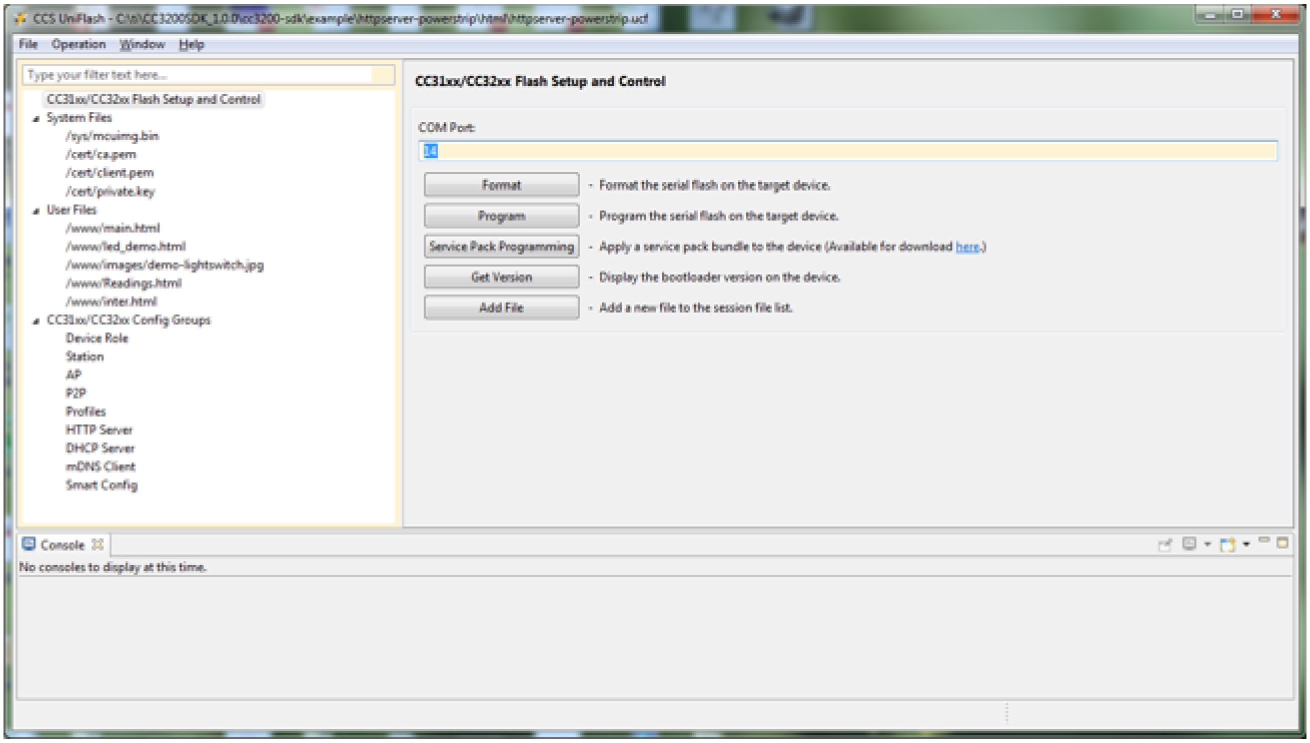


Figure 9. CCS UniFlash Screen After Configuration File Loaded

6. If this is the first time the board is being programmed, click "Format". Otherwise, go to Step 12.
7. When prompted to reset the device, push the button S1 once on the Wi-Fi module.
8. Wait for process to finish with the prompt "Operation Format returned".
9. Click on "Service Pack Programming" and locate the service pack bin file when prompted (located as default in C:\ti\CC31xx_CC32xx_ServicePack_1.0.0.1.1\servicepack_1.0.0.1.1.bin).
10. When prompted to reset the device, push the button S1 once on the Wi-Fi module.
11. Wait for the process to finish with the prompt "Operation ServicePackProgramming returned".
12. Click on "Program" to start programming.
13. When prompted to reset the device, push the button S1 once on the Wi-Fi module.
14. Wait for the process to finish with the prompt "Operation Program returned".
15. Disconnect the Wi-Fi module and set SOP2 on the Wi-Fi board to the OFF position.

The Wi-Fi module is now programmed with the demo code and ready for use.

5.2 Loading Firmware to TIDM-3OUTSMTSTRP

Perform the following steps to download the firmware to the TIDM-3OUTSMTSTRP hardware. Use an MSP-FET430UIF MSP430 USB-Debug-Interface to perform the download.

1. Do not connect the Wi-Fi module to the metering board at this stage to program the TIDM-3OUTSMTSTRP board.
2. Connect the MSP-FET430UIF to P1 of the TIDM-3OUTSMTSTRP and have J8 with position 1-2 shorted with a jumper. C21 may need to be removed temporarily for programming.
3. If Elprotronic FET-Pro-430 Lite is installed on PC, go to Step 7.
4. Go to https://www.elprotronic.com/productdata to download the FET-Pro-430 Lite Software.
5. Unzip the downloaded file and run setup.exe.
6. Follow the instructions to complete the install.
7. Launch FET-Pro-430 Lite.
8. Update the firmware if prompted for the MSP-FET430UIF Firmware Update.
9. Click on "Open Code File" and select "emeter-app-i2041.d43" inside the install folder of this design. Then check the settings in the boxes Microcontroller Type, Power Device from Adapter, and Device Action as shown in Figure 10.

NOTE: To modify code, use IAR 5.52 to compile the project "emeter-app-i2040". A compilation of "emeter-metrology-i2040" and "emeter-toolkit-i2040" is *not required*. The library code of this project is already provided. Contact a local Texas Instruments Sales office if the source code for emeter-metrology-i2040 is required.

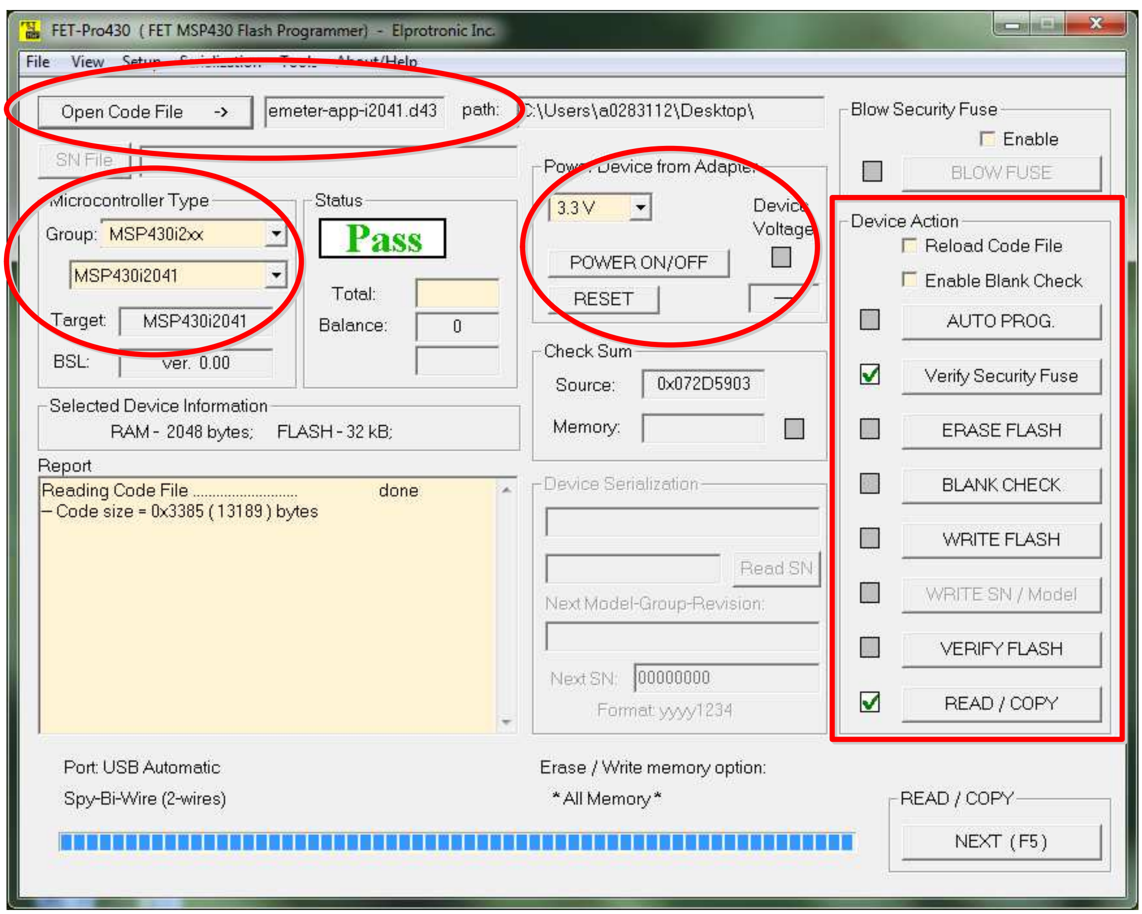


Figure 10. TIDM-3OUTSMTSTRP Programming Setup

10. Click "READ/COPY" to copy the original code. When the Flash Memory Data window appears, click the "Copy" button, paste the data to an open notepad application, and save it as a text file named "original.txt". Use this file to restore the code to original in case of any errors.

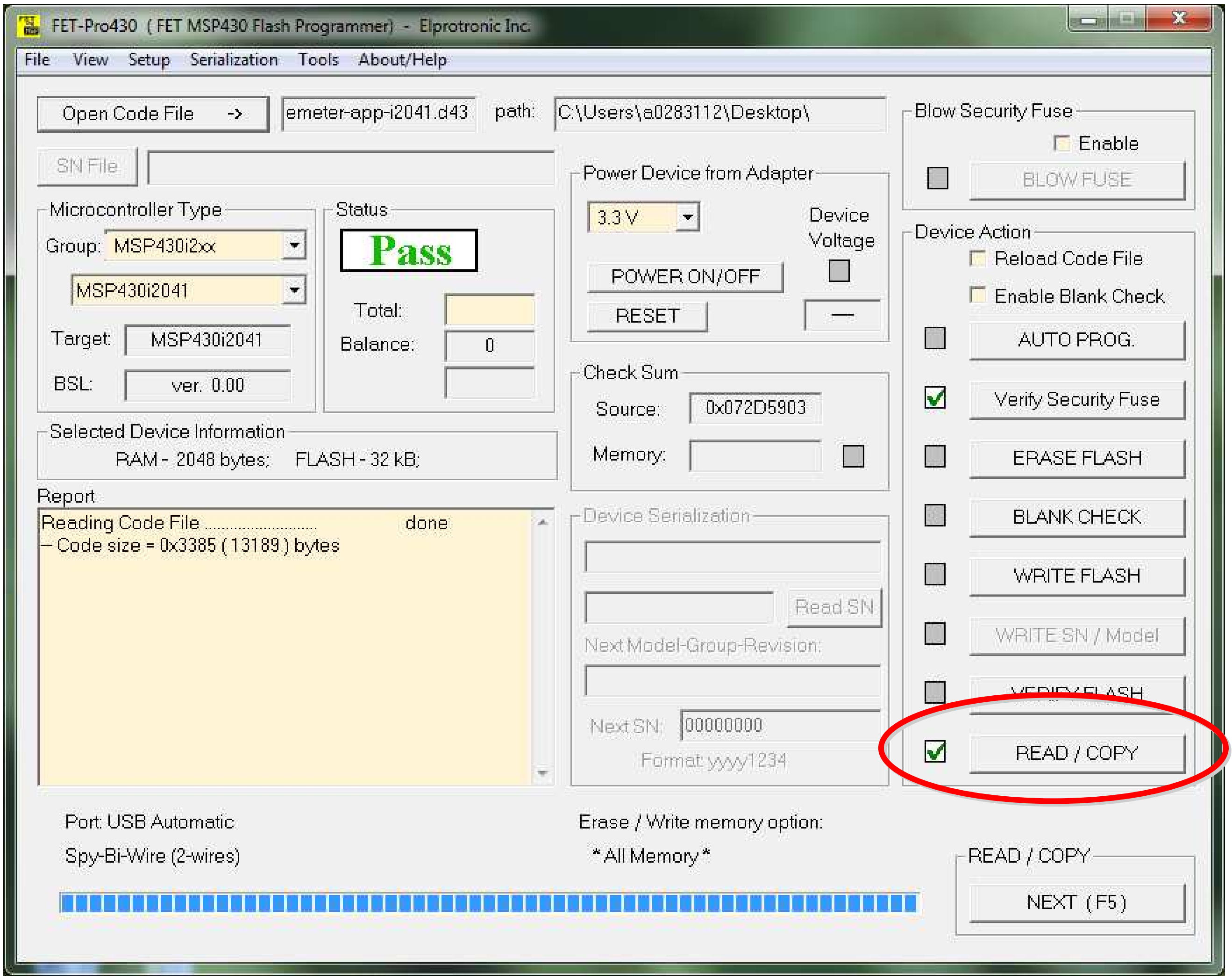


Figure 11. Read Original Firmware

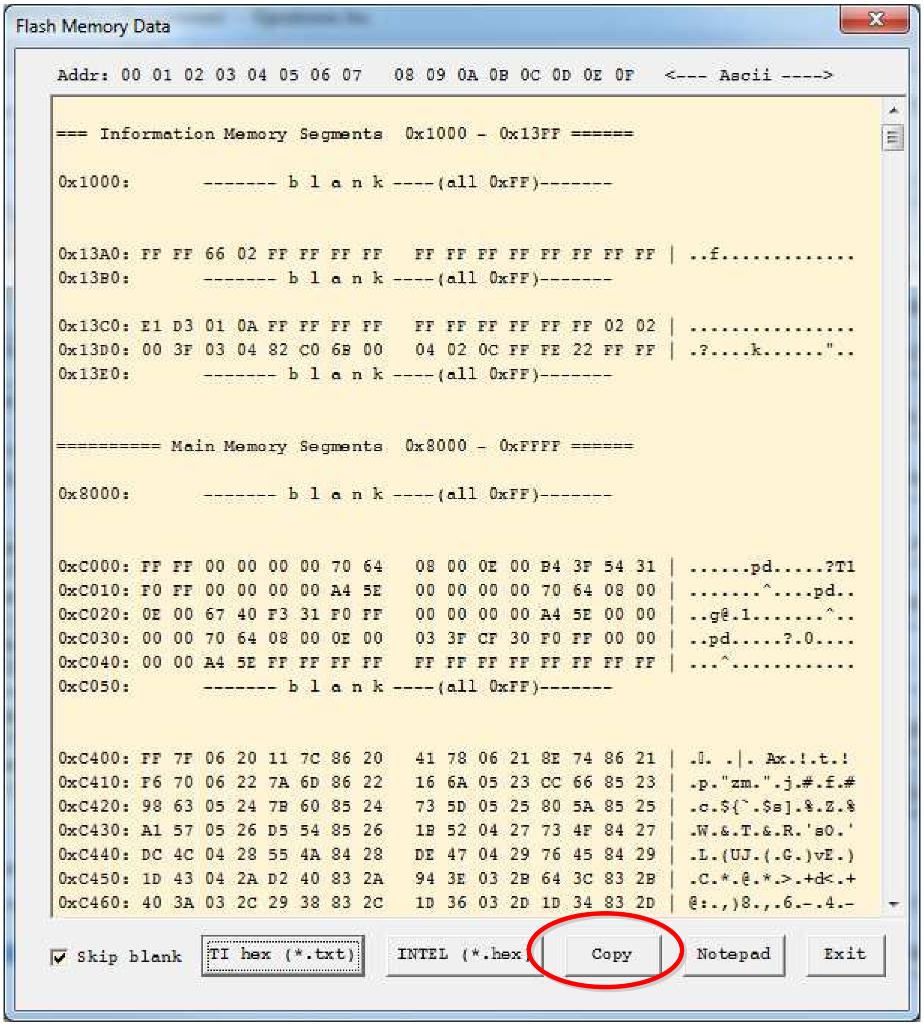


Figure 12. Flash Memory Data Window; Copy and Save Original Firmware

11. Close the Flash Memory Data window and click on "AUTO PROG".

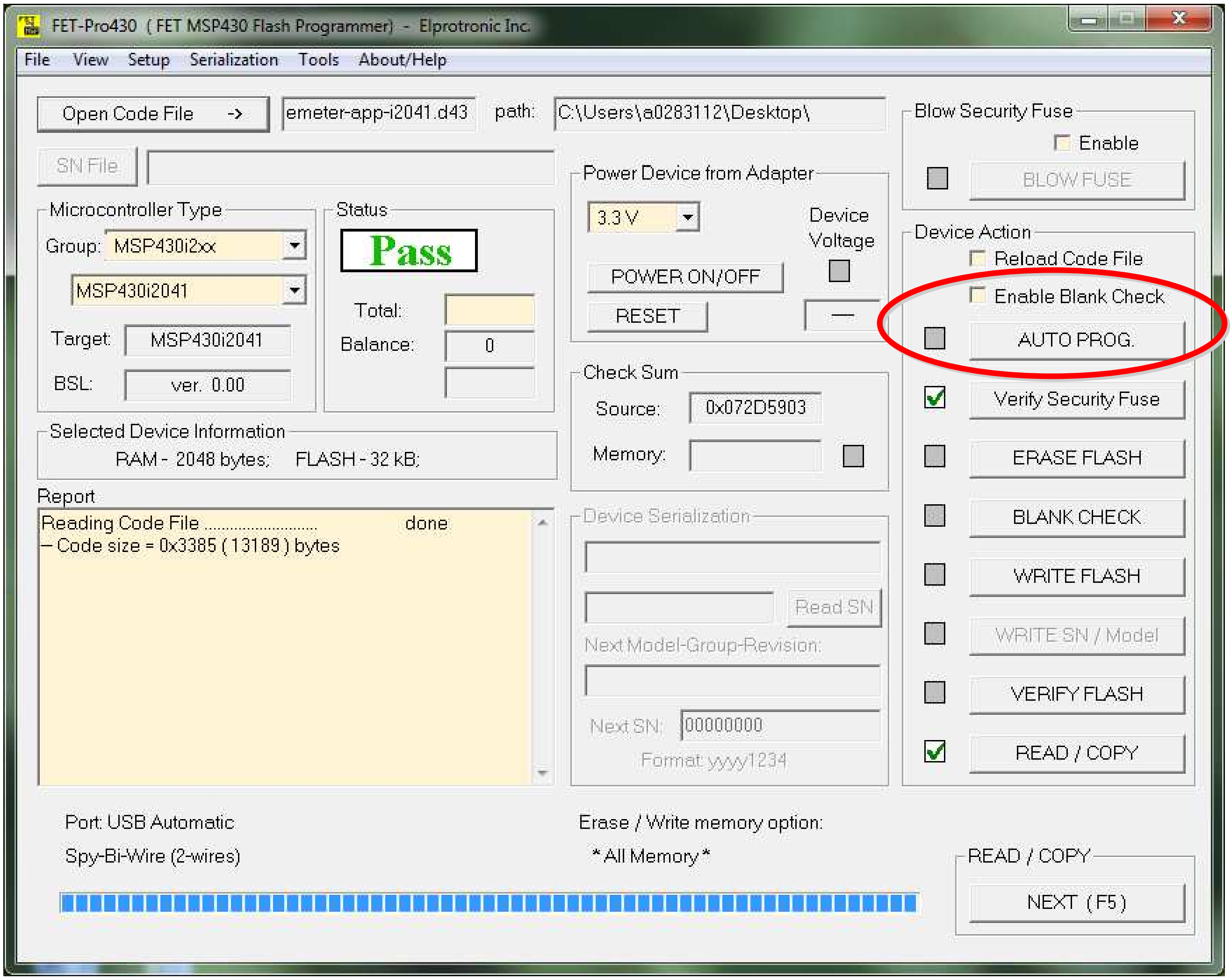


Figure 13. Start Firmware Programming

12. It will prompt the window shown in Figure 14. Check that everything else is okay except for "Verifying Flash Memory".

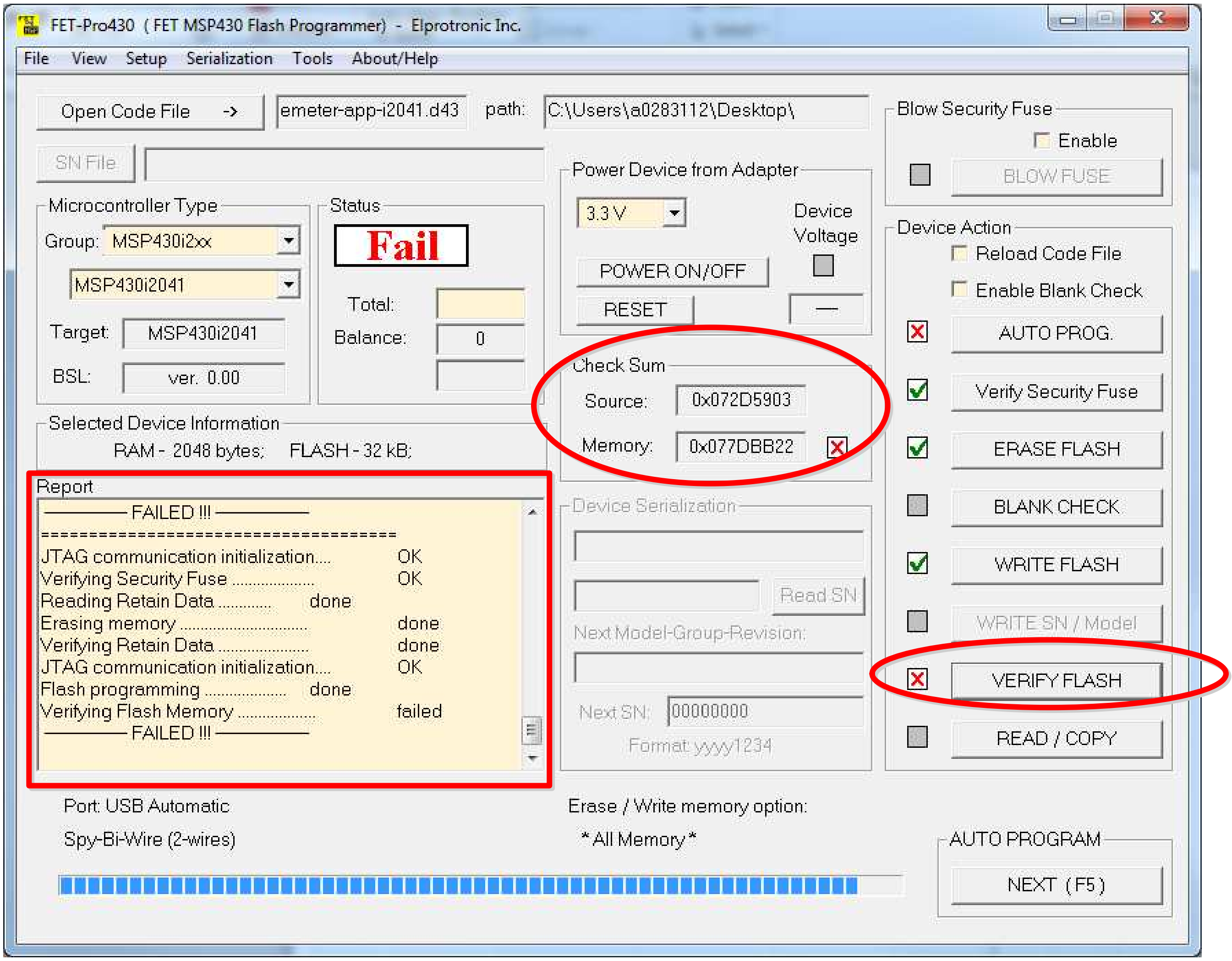


Figure 14. Note Failure on Verify and Confirm Check Sum

13. Click on View → Compare Code File and Flash Data. Select "Yes" when prompted to read the data from the device first. Check for "==== No differencies found. ====" on the last line of the Comparation Code and Flash Memory Data window (see Figure 16).

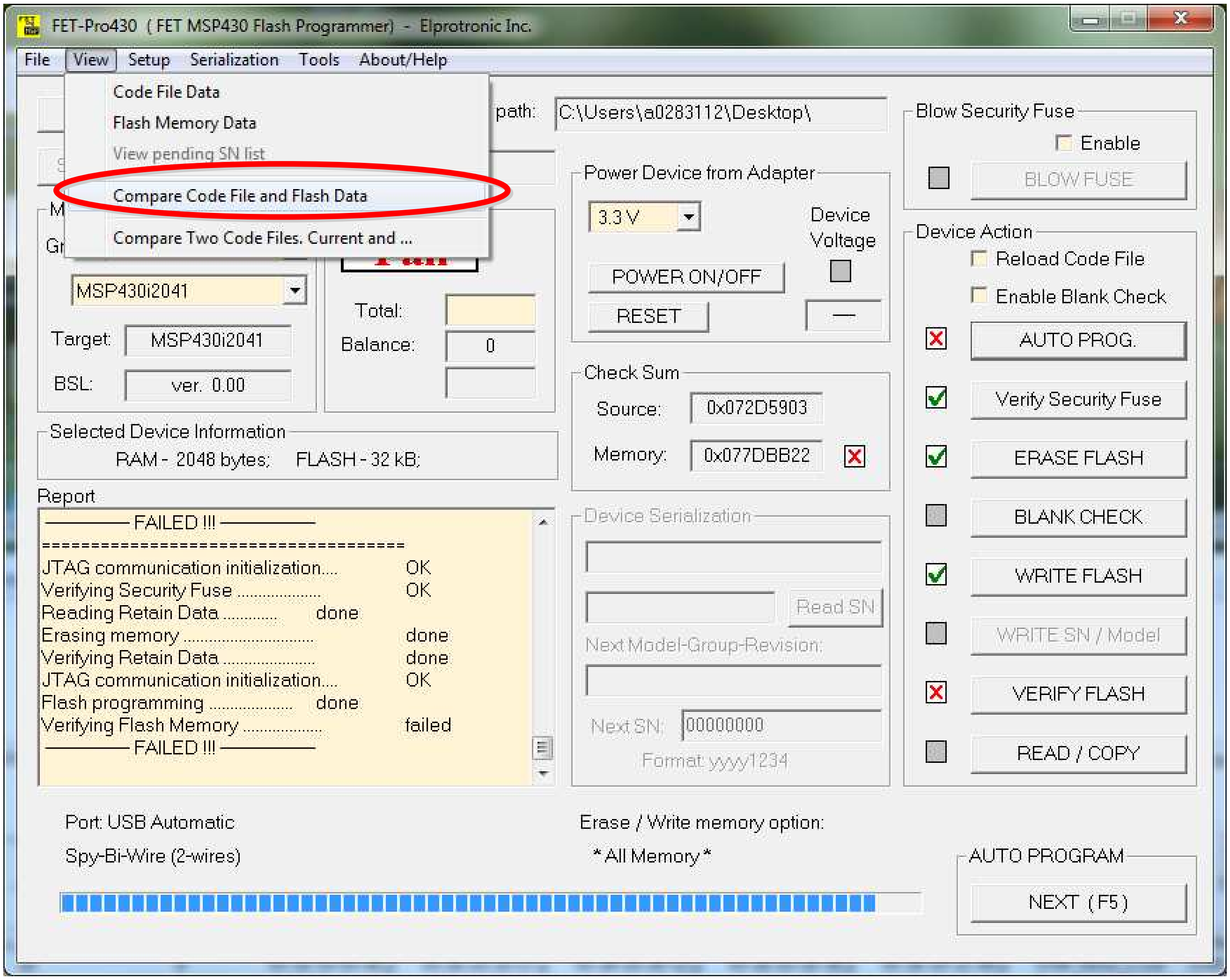


Figure 15. Perform Direct Code Comparison to Verify Written Firmware

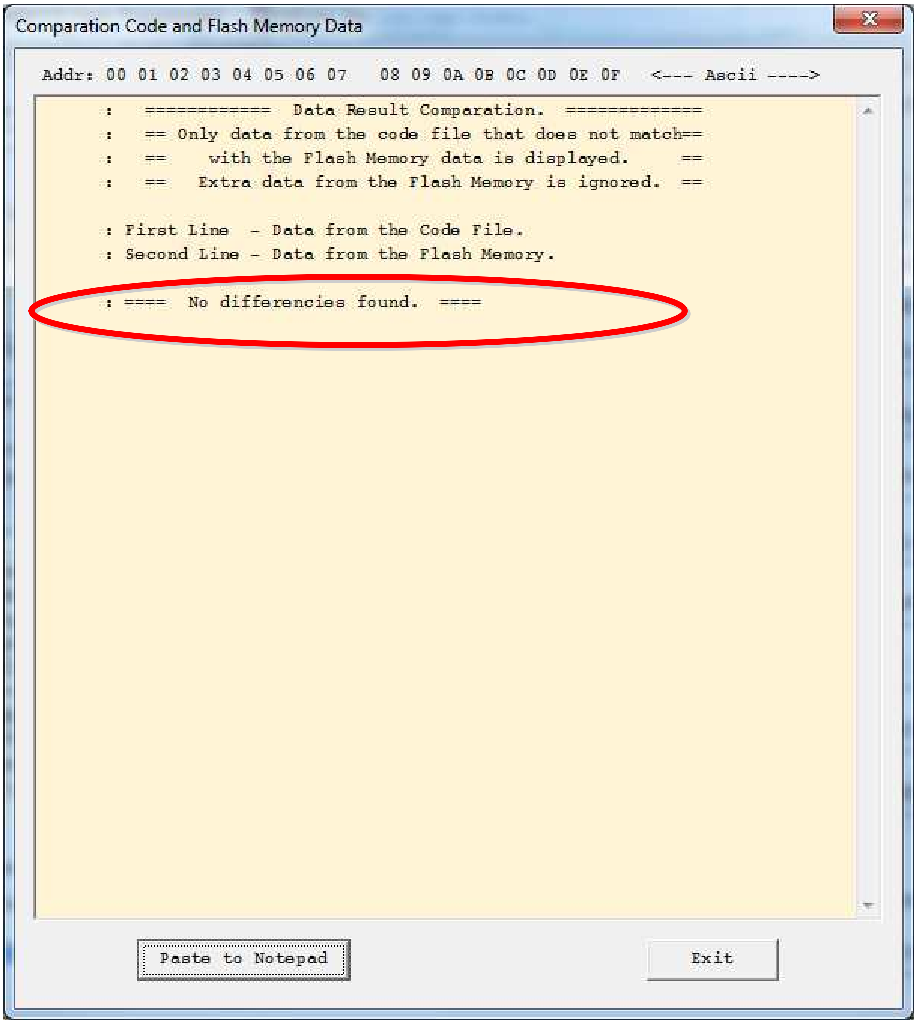


Figure 16. Comparation Code and Flash Memory Data Window

This completes the firmware programming of the TIDM-3OUTSMTSTRP.

14. After the code is downloaded onto both boards, the application is ready to run. Put the Wi-Fi module onto the communication connector of the TIDM-3OUTSMTSTRP board. Set the jumpers as shown in Figure 17 and set DIP switch 4 on the Wi-Fi module to the ON position.

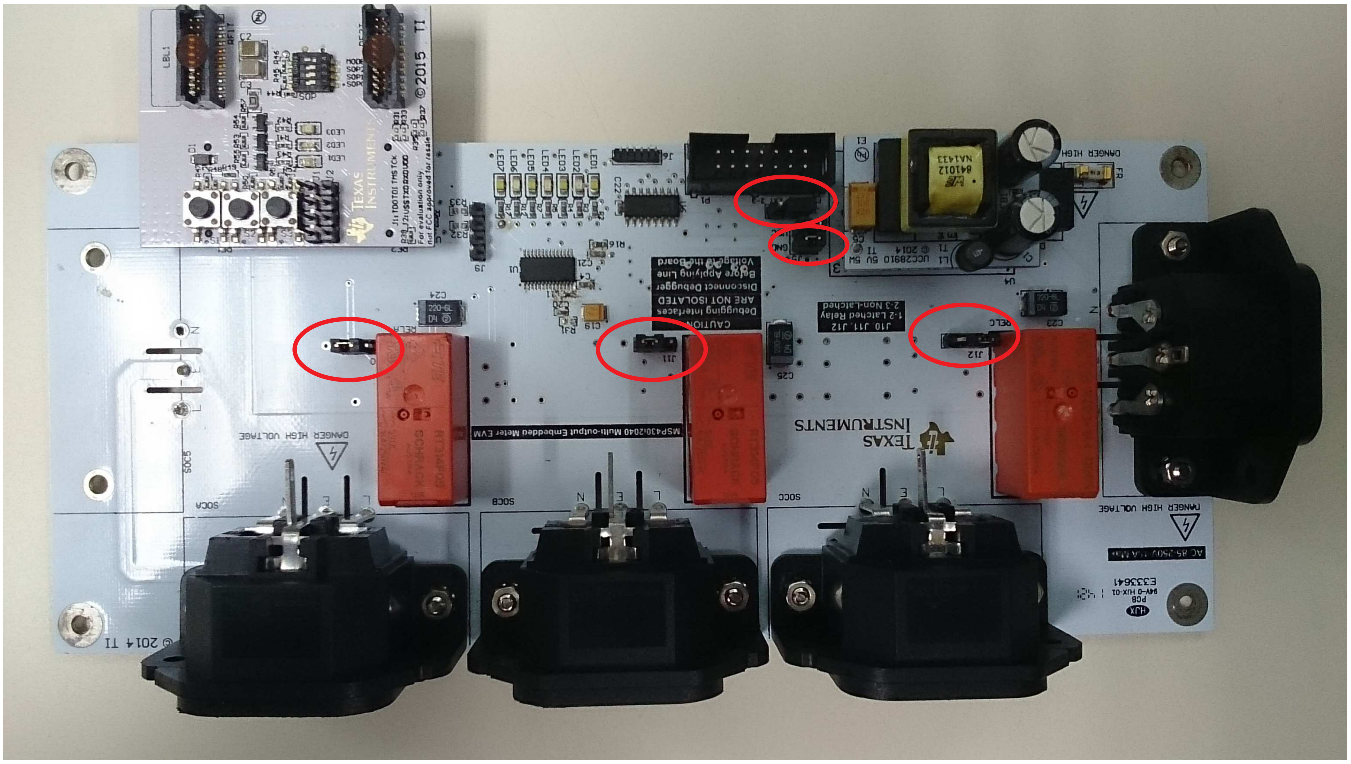


Figure 17. TIDM-3OUTSMTSTRP Board Jumper Settings

6 Test Setup

To test the design, set up the hardware loaded with the firmware as described in Section 4 and Section 5. Then apply AC voltage to the AC input of the power strip. The LEDs on the TIDM-3OUTSMTSTRP will light up; the LED on the Wi-Fi should flash as well.

To start testing, use a smartphone, tablet, or PC with Wi-Fi. Look for the SSID "mysimplelink-XXXXXX" (where "XXXXXX" is a six-digit hexadecimal number) and connect to it. Launch a browser and type in the URL "mysimplelink.net".

The main page will be shown with the name of the meter in the upper left hand corner (which is "MSP430i2040 3 SOCKET POWER STRI"). Then click on "Reading" so the following screen will appear:

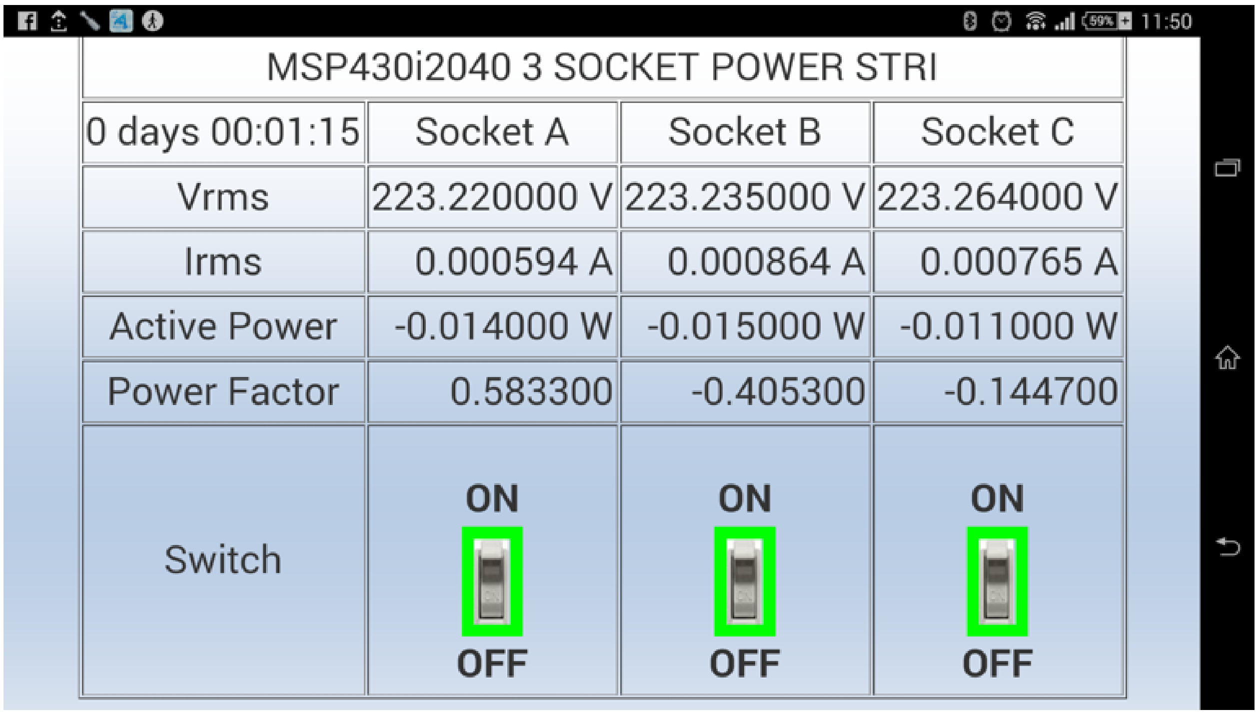


Figure 18. Meter Reading Screen

7 Test Data

7.1 Reading Test

The voltage, current, active power, and power factor on each socket can be read from the displayed page and is updated periodically (five-second intervals). Note if proper calibration is not done with the metering hardware, the reading may not be accurate. To calibrate, follow the instructions in the TIDM-3OUTSMTSTRP user's guide.

7.2 Control Test

The power output to each socket can be controlled by clicking "ON" and "OFF" of the switches on the page.

8 Design Files

8.1 Schematics

To download the schematics, see the design files at TIDC-WIFI-METER-READING.

8.1.1 Metering Board

To download the schematics for the metering board, see the design files at TIDM-3OUTSMTSTRP.

8.1.2 Wi-Fi Module

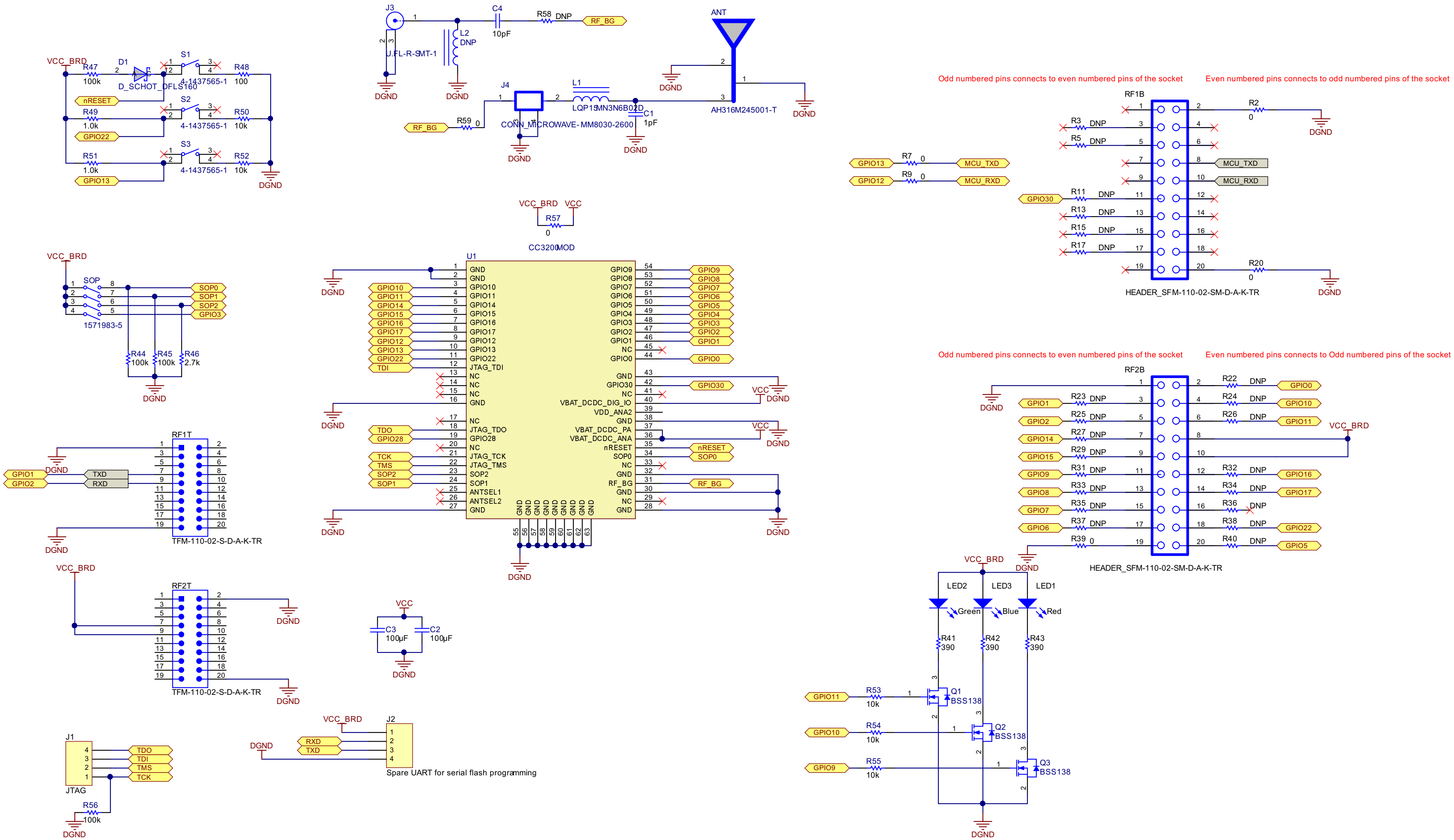


Figure 19. Schematic of Wi-Fi Module

8.1.3 Power Supply Module

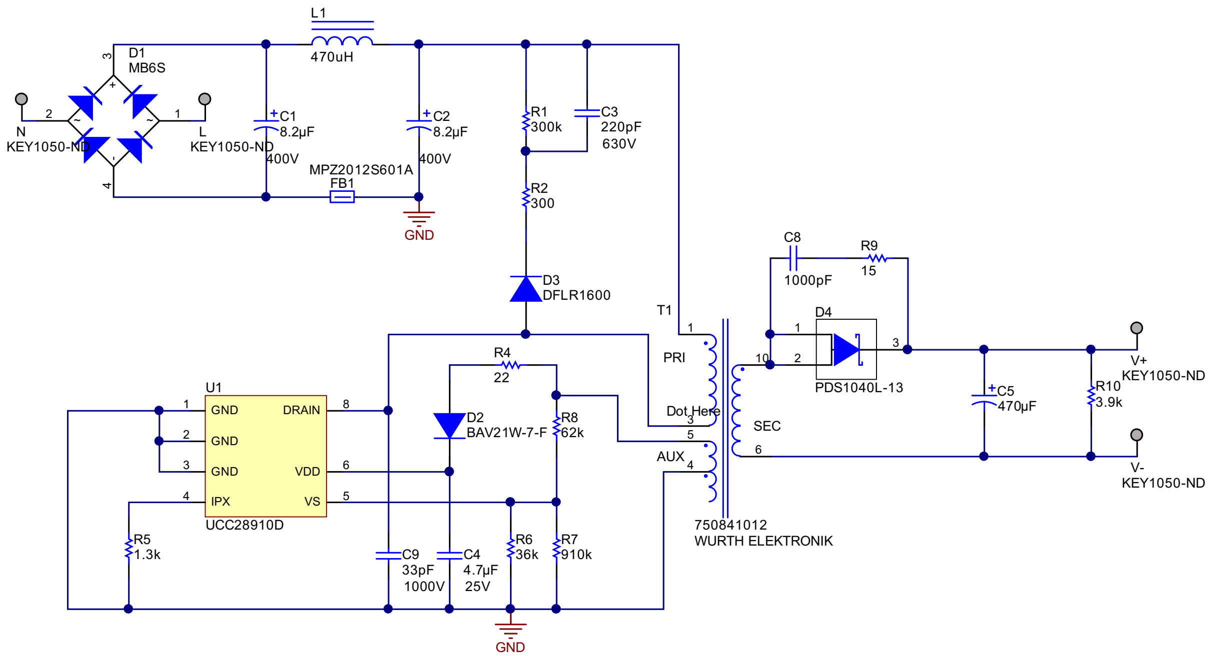


Figure 20. Schematic of Power Supply Module

8.2 Bill of Materials

To download the bill of materials (BOM), see the design files at TIDC-WIFI-METER-READING.

8.2.1 Metering Board

To download the BOM for the metering board, see the design files at TIDM-3OUTSMTSTRP.

8.2.2 Wi-Fi Module

Table 1. Wi-Fi Module BOM

ITEM	QTY	DESIGNATOR	VALUE	DESCRIPTION	MANUFACTURER	PARTNUMBER	FOOTPRINT
1	1	!PCB		Printed Circuit Board	Any	TIDM-CC3200MOD_CONV	
2	1	ANT	2.45-GHz Ant	Chip antenna	Taiyo Yuden	AH316M245001-T	AH316M
3	1	C1	1pF	CAP, CERM, 1 pF, 50 V, +/-10%, C0G/NP0, 0402	MuRata	GRM1555C1H1R0BA01D	0402
4	2	C2, C3	100uF	CAP, CERM, 100 µF, 6.3 V, +/-20%, X5R, 1210	MuRata	GRM32ER60J107ME20L	1210
5	1	C4	DNP	CAP, CERM, 10 pF, 50 V, +/-5%, C0G/NP0, 0402	MuRata	GRM1555C1H100JA01D	0402
6	1	D1	DFLS160	Diode, Schottky, 1A, 60V	Diodes	DFLS160	POWERDI_123
7	1	J1		Header, 4-Pin		3-644456-4	HDR1X4
8	1	J2		Header, 4-Pin		3-644456-4	HDR1X4
9	1	J3		Connector, Ultra-Mini Coaxial, SMD	Hirose Electric Co. Ltd.	U.FL-R-SMT-1	CONN_UFL-R-SMT-1
10	1	J4	MM8030-2600RJ3	Connector, Micrwave, 50 Ohm Coax	murata	MM8030-2600RJ3	CONN_MICRO-MM8030-2600
11	1	L1	3.6nH	Inductor, Film, 3.6 nH, 0.1 A, 1.3 ohm, SMD	MuRata	LQP15MN3N6B02D	LQP_0402
12	1	L2	DNP	Inductor, Film, 3.6 nH, 0.1 A, 1.3 ohm, SMD	MuRata	LQP15MN3N6B02D	LQP_0402
13	1	LBL1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10	Label_650x200
14	1	LED1		Red	Liteon	LTST-C170KRKT	0805-LED
15	1	LED2		Green	Liteon	LTST-S220KGKT	0805-LED
16	1	LED3		Blue	Liteon	LTST-C170TBKT	0805-LED
17	3	Q1, Q2, Q3	50V	MOSFET, N-CH, 50 V, 0.22 A, SOT-23	Fairchild Semiconductor	BSS138	SOT-23
18	6	R2, R7, R9, R20, R39, R59	0	RES, 0, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04020000Z0ED	0402

Table 1. Wi-Fi Module BOM (continued)

ITEM	QTY	DESIGNATOR	VALUE	DESCRIPTION	MANUFACTURER	PARTNUMBER	FOOTPRINT
19	23	R3, R5, R11, R13, R15, R17, R22, R23, R24, R25, R26, R27, R29, R31, R32, R33, R34, R35, R36, R37, R38, R40, R58	DNP	RES, DNP, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04020000Z0ED (Phantom)	0402
20	3	R41, R42, R43	390	RES, 390, 5%, 0.063 W, 0402	Vishay-Dale	CRCW0402390RJNED	0402
21	4	R44, R45, R47, R56	100k	RES, 100 k, 5%, 0.063 W, 0402	Vishay-Dale	CRCW0402100KJNED	0402
22	1	R46	2.7k	RES, 2.7 k, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04022K70JNED	0402
23	1	R48	100	RES, 100, 5%, 0.063 W, 0402	Vishay-Dale	CRCW0402100RJNED	0402
24	2	R49, R51	1.0k	RES, 1.0 k, 5%, 0.063 W, 0402	Vishay-Dale	CRCW04021K00JNED	0402
25	5	R50, R52, R53, R54, R55	10k	RES, 10 k, 5%, 0.063 W, 0402	Vishay-Dale	CRCW040210K0JNED	0402
26	1	R57	0	RES, 0, 5%, 0.125 W, 0805	Vishay-Dale	CRCW08050000Z0EA	0805_HV
27	2	RF1B, RF2B	SFM-110-02-SM-D-A-K-TR	Header, SMT 10X2 pin, Shrouded	Samtec	SFM-110-02-SM-D-A-K-TR	HEADER_TFM-110-02-SM
28	2	RF1T, RF2T		CONN SHRD HDR HDR 20 POS 1.27MM SLDR ST SMD	Samtec	TFM-110-02-S-D-A-K-TR	Samtec_TFM-110-02-S-D-A-K
29	3	S1, S2, S3		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	TE Connectivity	4-1437565-1	SW_FSM4JSMA
30	1	SOP		Switch, SPST, 4 Pos, Top Actuated, SMD	TE Connectivity	1571983-5	SW_1571983-5
31	1	U1					CC3200MOD

8.2.3 Power Supply Module

Table 2. Power Supply Module BOM

ITEM	QTY	DESIGNATOR	VALUE	DESCRIPTION	MANUFACTURER	PARTNUMBER	FOOTPRINT
1	2	C1, C2	6.8uF	CAP, AL, 6.8uF, 400V, +/-20%, TH	Rubycon	400AX6R8M8x11(Alternate: 400AX8.2M8X16	CAPPRD350W60D800H1100
2	1	C3	220pF	CAP, CERM, 220pF, 630V, +/-5%, U2J, 1206	MuRata	GRM31A7U2J221JW31D	1206
3	1	C4	4.7uF	CAP, CERM, 4.7uF, 25V, +/-10%, X6S, 0805	MuRata	GRM21BC81E475KA12L	0805_HV
4	1	C5	470uF	CAP, TA, 470uF, 10V, +/-10%, 0.045 ohm, SMD	AVX	TPSE477K010R0045	7343-43
5	1	C8	1000pF	CAP, CERM, 1000pF, 50V, +/-5%, C0G/NP0, 0603	TDK	C1608C0G1H102J	0603

Table 2. Power Supply Module BOM (continued)

ITEM	QTY	DESIGNATOR	VALUE	DESCRIPTION	MANUFACTURER	PARTNUMBER	FOOTPRINT
6	1	C9	33pF	CAP, CERM, 33pF, 1000V, +/-5%, U2J, 1206	MuRata	GRM31A7U3A330JW31D	1206
7	1	D1	600V	Diode, Switching-Bridge, 100V, 0.5A, SOIC-4	Fairchild Semiconductor	MB6S	TO-269AA
8	1	D2	200V	Diode, Switching, 200V, 0.2A, SOD-123	Diodes Inc.	BAV21W-7-F	SOD-123
9	1	D3	600V	Diode, Superfast Rectifier, 600V, 1A, PowerDI123	Diodes Inc.	DFLR1600	powerDI123
10	1	D4	40V	Diode, Schottky, 40V, 10A, PowerDI5	Diodes Inc.	PDS1040L-13	PowerDI5
11	1	FB1	600 ohm	2A Ferrite Bead, 600 ohm @ 100MHz, SMD	TDK	MPZ2012S601A	0805_HV
12	1	L1	470uH	Inductor, Unshielded Drum Core, Ferrite, 470uH, 0.35A, 1.58 ohm, TH	Wurth Elektronik eiSos	7447462471	IND_WE-TI_XS
13	1	R1	300k	RES, 300k ohm, 1%, 0.25W, 1206	Yageo America	RC1206FR-07300KL	1206
14	1	R2	300	RES, 300 ohm, 1%, 0.25W, 1206	Yageo America	RC1206FR-07300RL	1206
15	1	R4	22	RES, 22 ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW060322R0JNEA	0603
16	1	R5	1.3k	RES, 1.3k ohm, 5%, 0.1W, 0603	Yageo America	RC0603JR-071K3L	0603
17	1	R6	36k	RES, 36k ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW060336K0JNEA	0603
18	1	R7	910k	RES, 910k ohm, 5%, 0.1W, 0603	Vishay-Dale	CRCW0603910KJNEA	0603
19	1	R8	62k	RES, 62k ohm, 5%, 0.125W, 0805	Vishay-Dale	CRCW080562K0JNEA	0805
20	1	R9	15	RES, 15 ohm, 5%, 0.125W, 0805	Panasonic	ERJ-6GEYJ150V	0805_HV
21	1	R10	3.9k	RES, 3.9k ohm, 5%, 0.1W, 0603	Yageo America	RC0603JR-073K9L	0603
22	1	T1		Transformer	WURTH ELEKTRONIK	750841012	
23	1	U1		LOW STAND-BY POWER, CV / CC PWM HV SWITCHER WITH PRIMARY SIDE REGULATION, D0007A	Texas Instruments	UCC28910D	D0007A_N

8.3 PCB Layout

To download the layer plots, see the design files at TIDC-WIFI-METER-READING.

8.3.1 Metering Board

To download the PCB layout for the metering board, see the design files at TIDM-3OUTSMTSTRP.

8.3.2 Wi-Fi Module

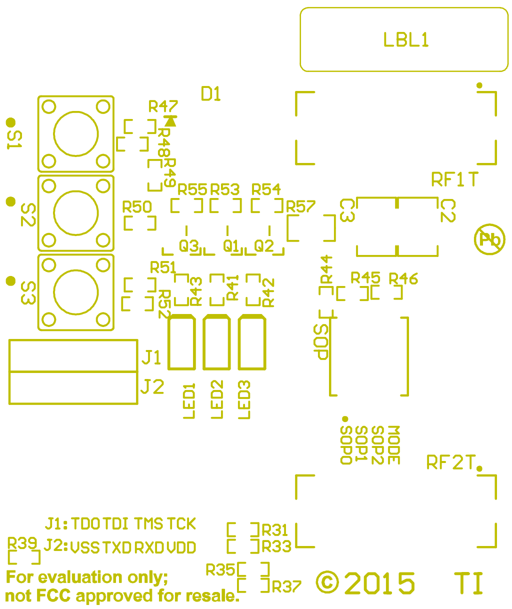


Figure 21. Top Overlay

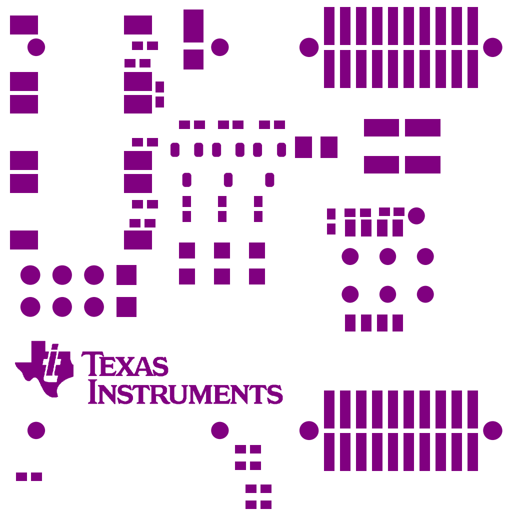


Figure 22. Top Solder

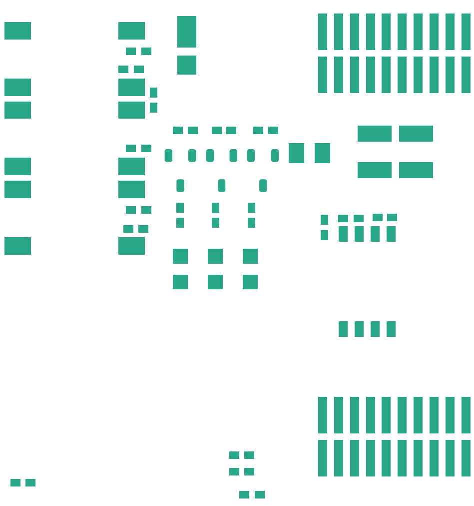


Figure 23. Top Paste

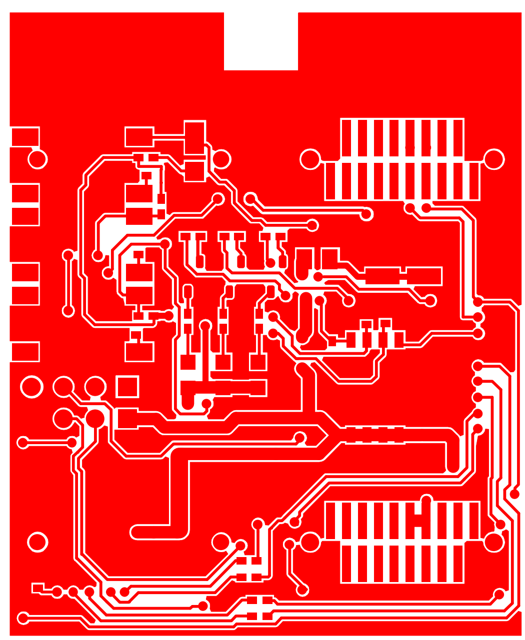


Figure 24. Top Layer

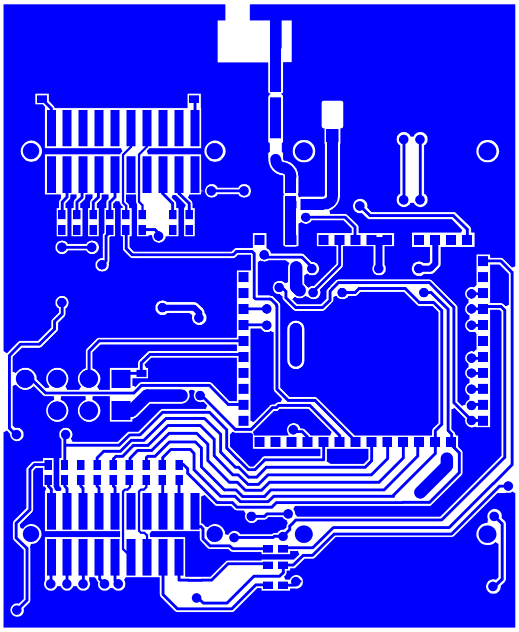


Figure 25. Bottom Layer

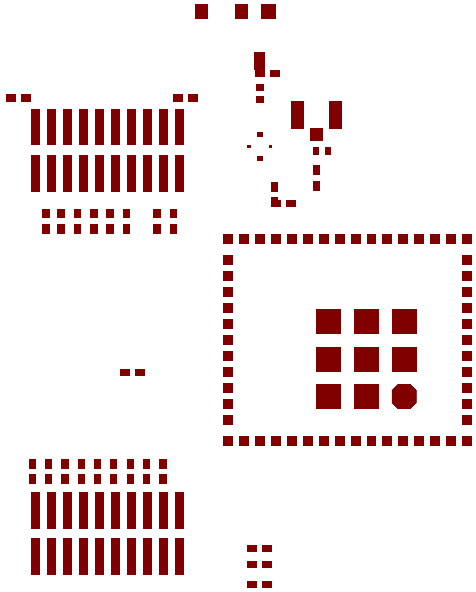


Figure 26. Bottom Paste

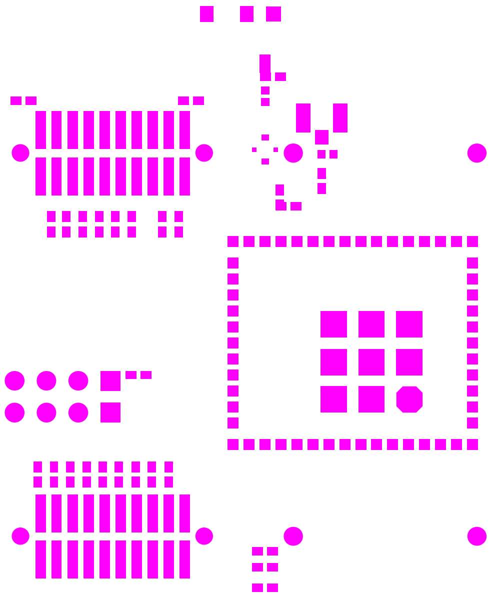


Figure 27. Bottom Solder

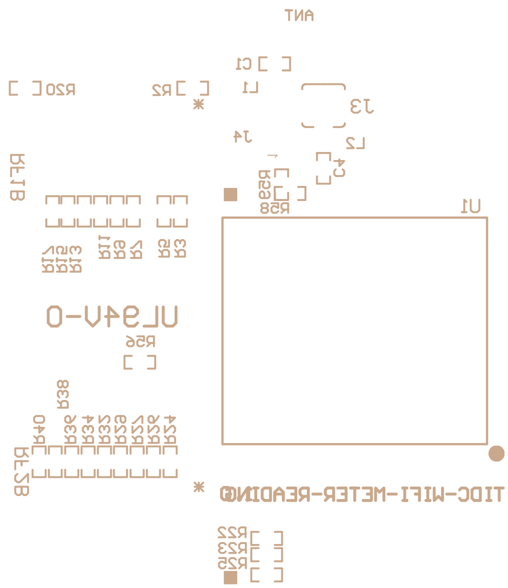


Figure 28. Bottom Overlay

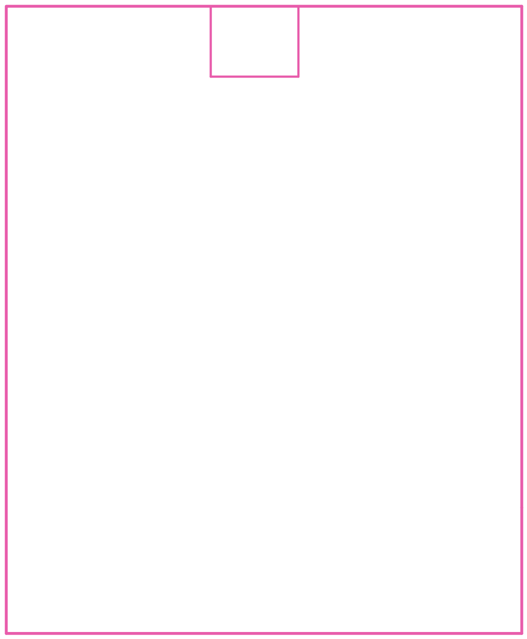


Figure 29. Board Outline

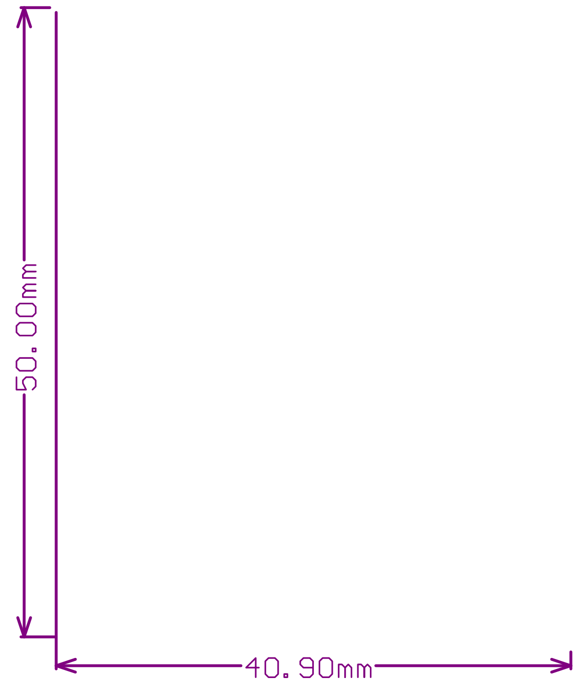


Figure 30. Board Dimensions

8.3.3 Power Supply Module

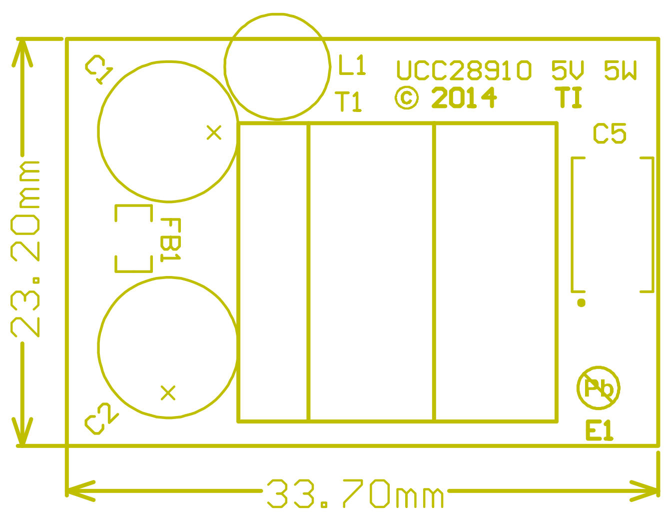


Figure 31. Top Overlay

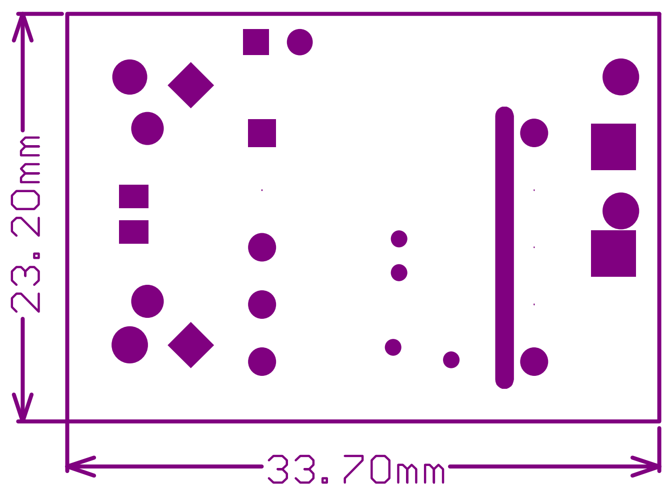


Figure 32. Top Solder

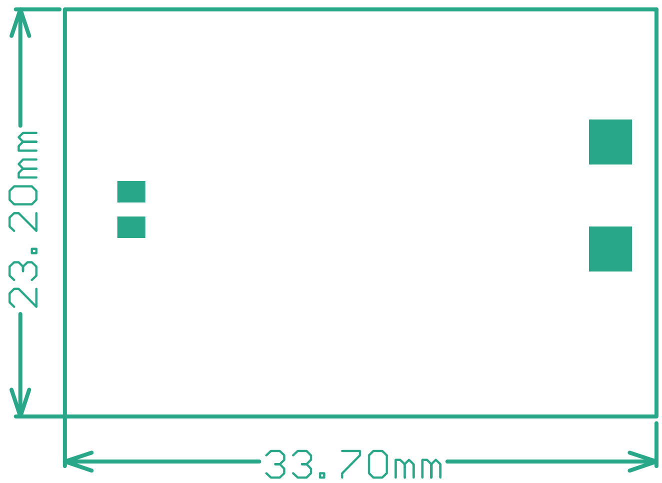


Figure 33. Top Paste

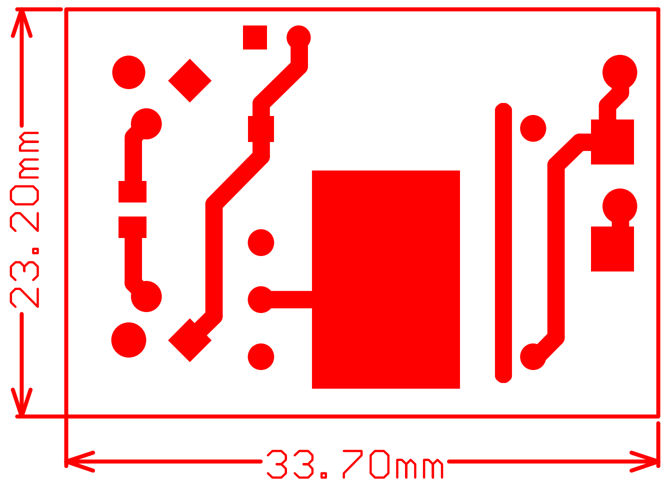


Figure 34. Top Layer

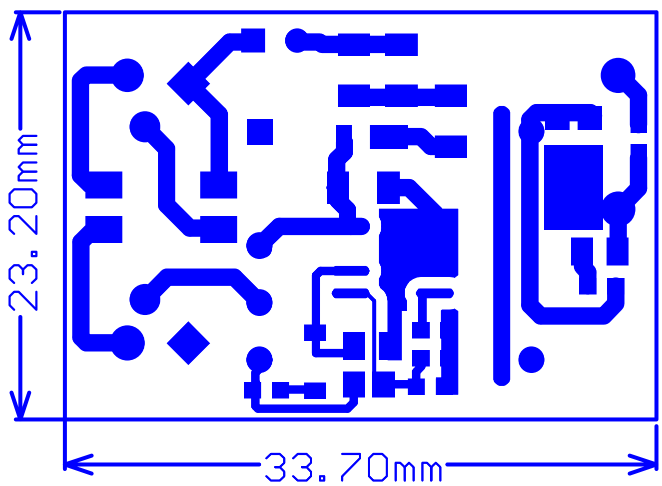


Figure 35. Bottom Layer

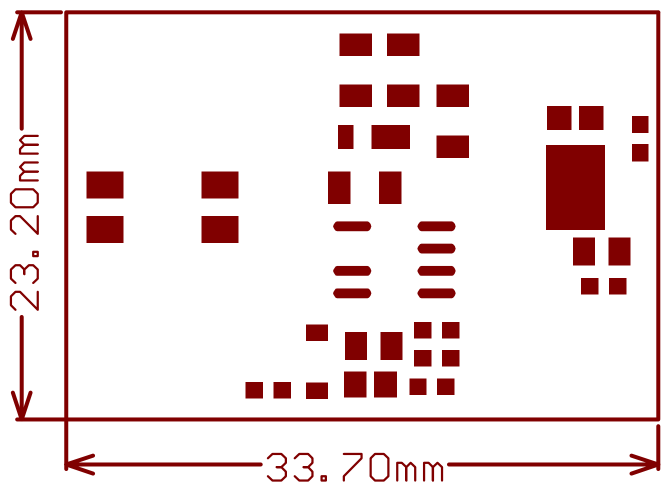


Figure 36. Bottom Paste

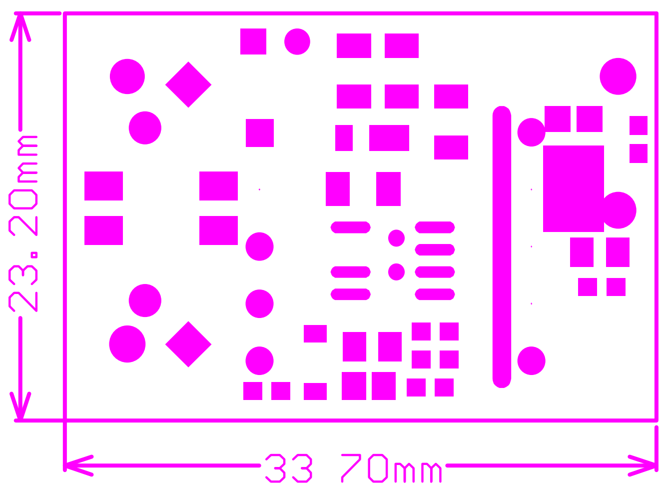


Figure 37. Bottom Solder

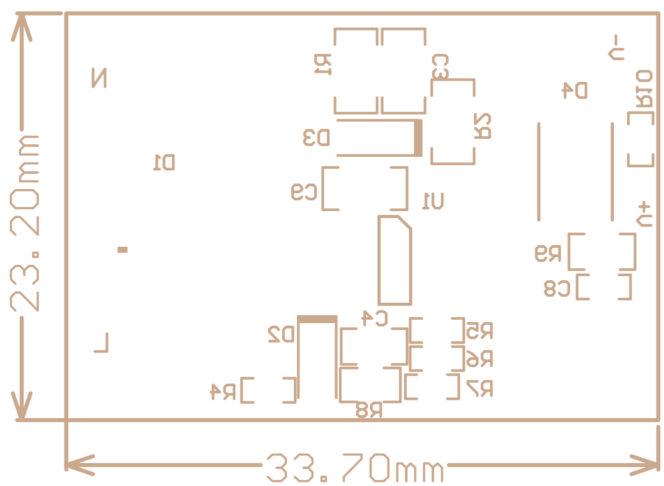


Figure 38. Bottom Overlay

8.4 Altium Project

To download the Altium project files, see the design files at TIDM-3OUTSMTSTRP and TIDC-WIFI-METER-READING.

8.5 Gerber Files

To download the Gerber files, see the design files at TIDM-3OUTSMTSTRP and TIDC-WIFI-METER-READING.

8.6 Assembly Drawings

To download the assembly drawings, see the design files at TIDM-3OUTSMTSTRP and TIDC-WIFI-METER-READING.

9 Distributing Software Files

To download the software files, see the link at TIDC-WIFI-METER-READING.

The software files are distributed using a self-extracting executable file, which default to install onto TIDC-WIFI-METER-READING-SOFTWARE on the user's desktop.

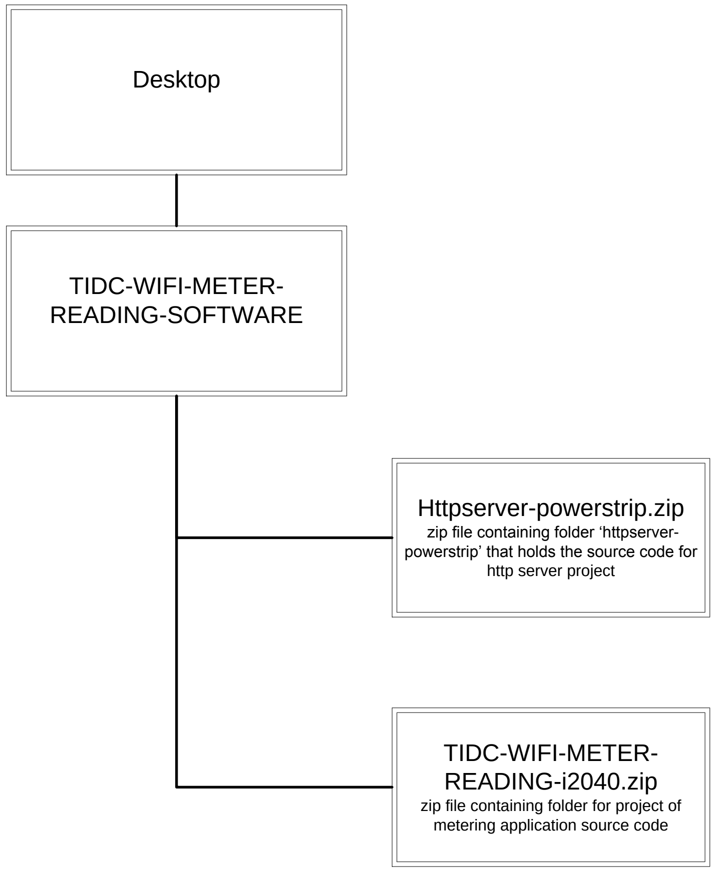


Figure 39. Distribution Software

10 References

1. Texas Instruments, *Three-Output Smart Power Strip Reference Design*, TIDM-3OUTSMTSTRP Design Guide (TIDU453)
2. Texas Instruments, *CC3100/CC3200 SimpleLink™ Wi-Fi® Internet-on-a-Chip User's Guide*, CC3200MOD User's Guide (SWRU368)

11 About the Author

MARS LEUNG received his bachelor of engineering from Hong Kong Polytechnic University and his master of science from Chinese University of Hong Kong. He has been a field application engineer specialized in MCU application support and development; a senior smart card application engineer specialized in smart card payment system definition and implementation; a staff engineer specialized in MCU and new module definition; and a staff engineer in analog system application specialized in digital system and video processing of dynamic LED backlight control. He is now staff engineer in Texas Instruments MSP430 application team specialized in embedded electricity metering application.

Appendix A Importing Example to CCS

Before importing the example CCS project httpserver-powerstrip, it is assumed that:

1. CCS 6.0.1 with CC3200 support has been installed.
2. CC3200SDK 1.0.0 has been installed.
3. The software package for this TI Design has been downloaded and unzipped, and the "httpserver-powerstrip" folder has been copied into the proper directory (default is: C:\ti\CC3200SDK_1.0.0\cc3200-sdk\example).

To import the project:

1. Launch CCS 6.0.1.
2. When prompted for a workspace, select "C:\ti\CC3200SDK_1.0.0\cc3200-sdk\example" and click "OK".

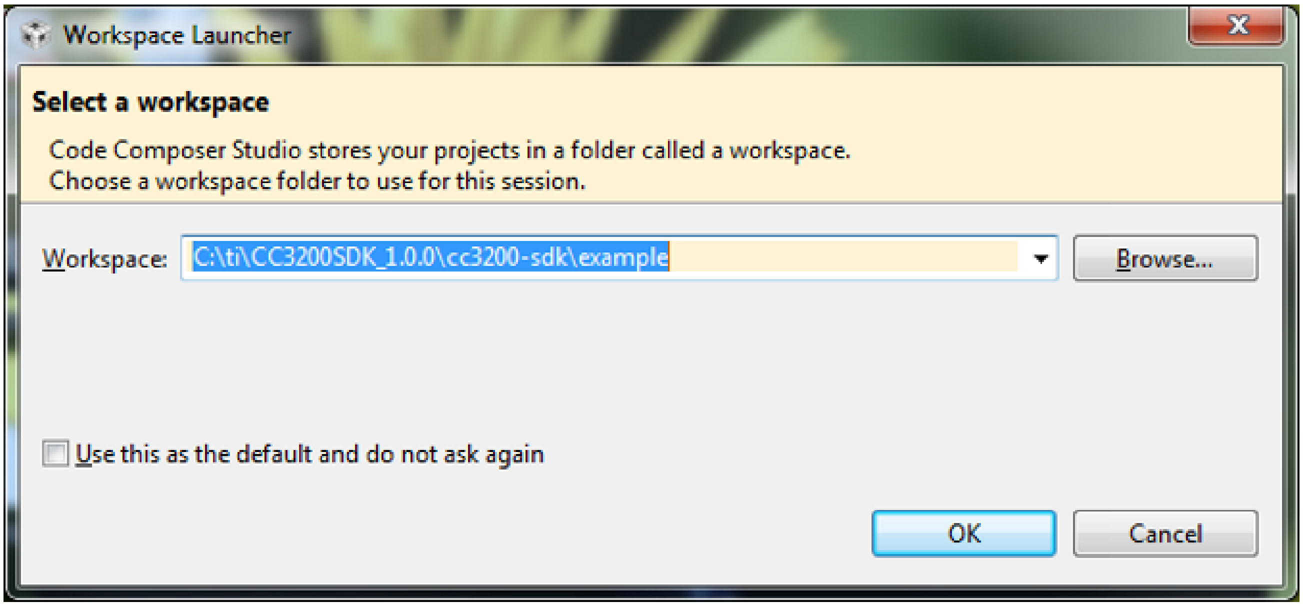


Figure 40. Opening Workspace for CCS

3. Select from Top Menu Project → Import CCS Projects…

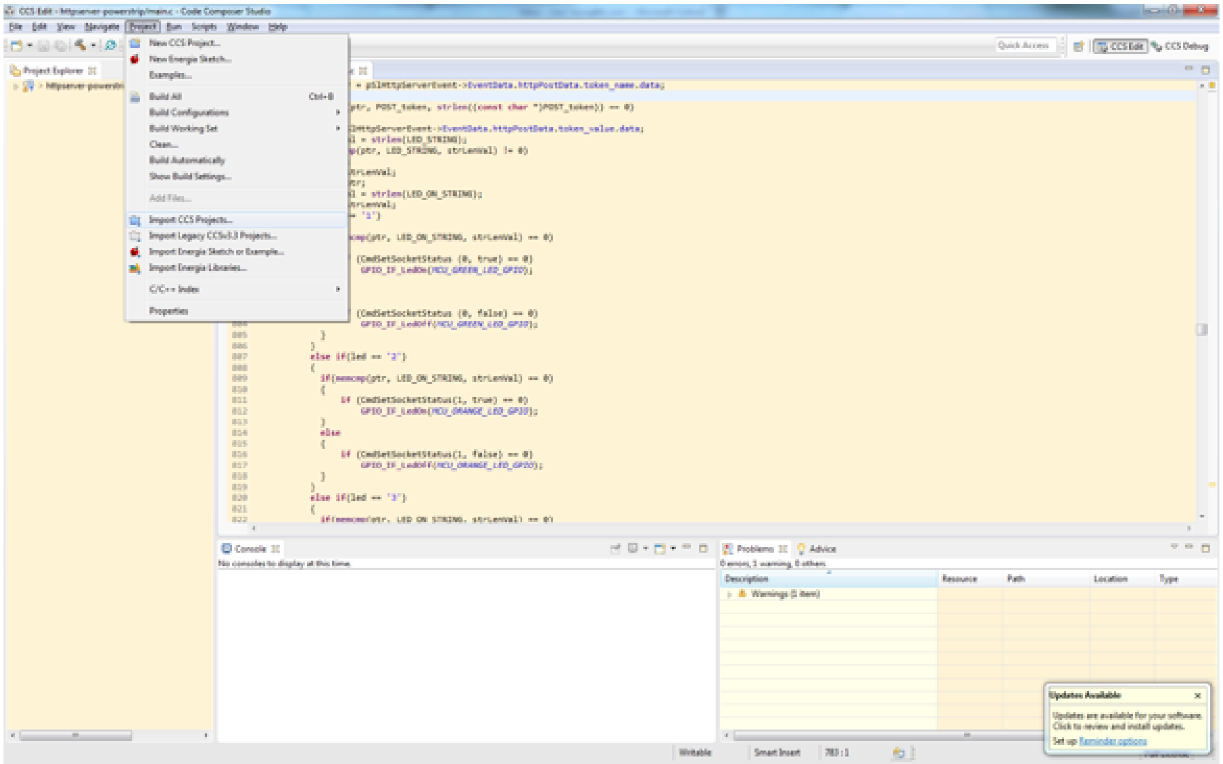


Figure 41. Importing Project to CCS

4. Choose "Select search-directory" and click "Browse" to import the project.

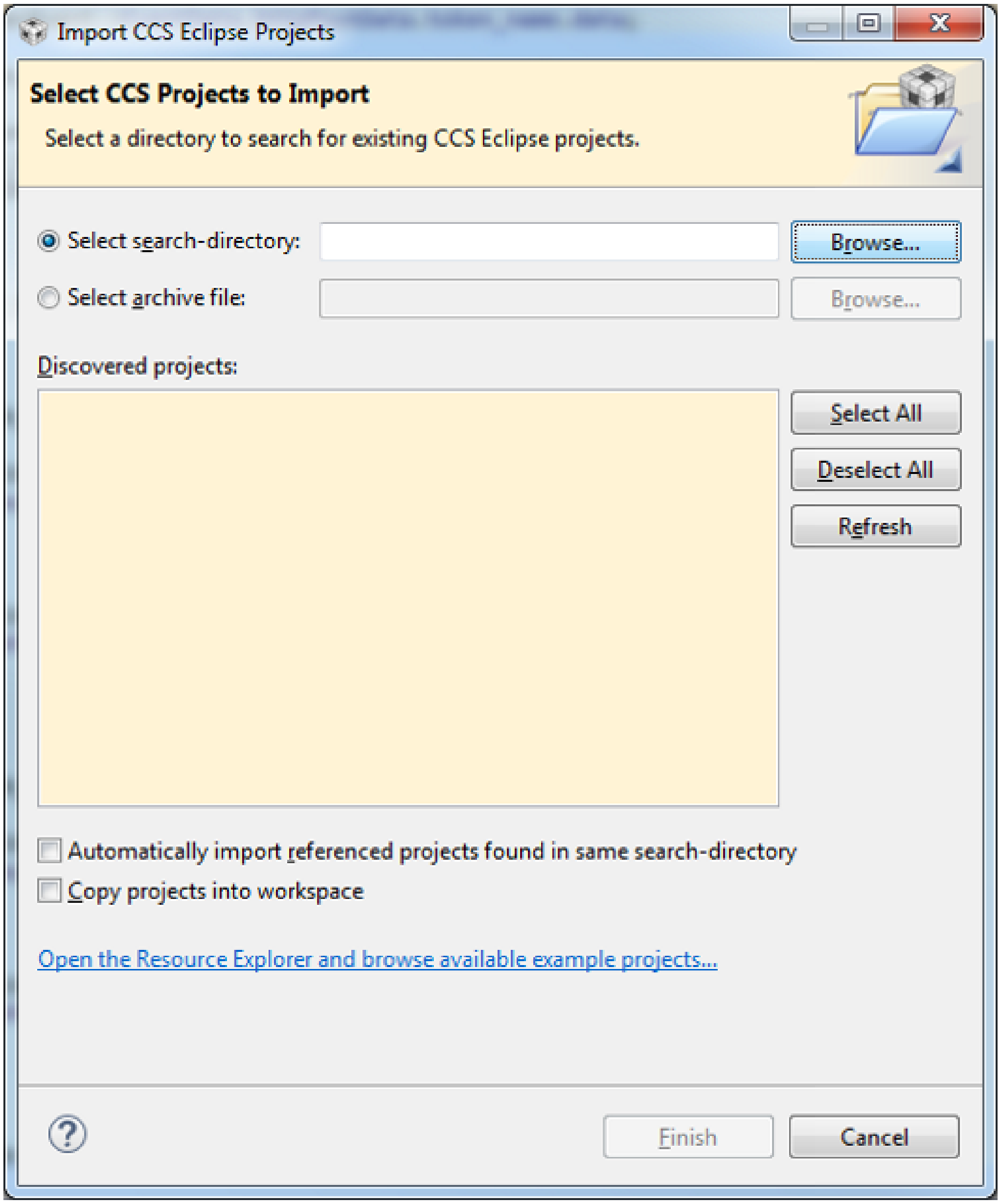


Figure 42. Project Import Window

5. When prompted, select the directory "C:\ti\CC3200SDK_1.0.0\cc3200-sdk\example" and click "OK".
6. In the "Discovered projects" box, check "httpserver-powerstrip" and click "Finish".

Revision History

Changes from Original (September 2015) to A Revision **Page**

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

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