UT36PFD103 Smart Power Switch Controller

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

FEATURES

- 8V-36V Power Bus Switching
  - Single-Supply Stand-Alone Operation
  - Dual-Supply ARDUINO Hosted Operation
- 5ms VOUT Linear Power-Up Ramp Rate
- 2.5ms VOUT Linear Power-Down Ramp Rate
  - Feature for Commanded Stop and Overcurrent Limit Fault Trip
- 2.5A Overcurrent Fault Limit
  - 162ms Overcurrent Fault Timeout
- 5A Short Circuit Fault Threshold
  - 500ns Short Circuit eFusing Response
- Stand-Alone Operation Requires User Jumper Wires to ENABLE Operation and Issue RESET# Command
- Full-Feature Operation Achieved with ARDUINO Host
- ARDUINO Shield Form Factor
  - Host Microcontroller Command & Control of SPSC Accomplished through I^{2}C SerCom using PMBus™ Protocol
  - Software API available for UT32M0R500-EVB
  - (TBD) Software API for ST-NUCLEO L053 EVB
- Analog Telemetry Measured by SPSC Available via PMBus™ Communication Port
  - Telemetry: VIN, VOUT, and LOAD Current
- Dual-Power FET OR'ing Switch Functionality with Reverse Current Fault Protection

Introduction

The Smart Power Switch Controller Evaluation Board SPSC-EVB provides users with a convenient and flexible platform from which to evaluate the manifold features and functions available with the UT36PFD103 SPSC. The SPSC-EVB may be operated in single-supply stand-alone form (i.e. without host microcontroller) and in full-featured operation when installed as an ARDUINO shield onto a compatible host microcontroller evaluation board.

To facilitate rapid evaluation, Cobham provides software API for the UT32M0R500 Arm M0+ evaluation board to service the SPSC host controller along with a run-time executable graphical user's interface (GUI). Refer to the SPSC_SoftwareUsersGuide.pdf for documentation on GUI operation. Additionally, the UT32M0R500 software API is available for download on the Cobham Webpage (https://caes.com/product/ut32m0r500#downloads) along with an application note detailing how to program the UT32M0R500-EVB.

1 Reference Documents

Description	Reference Document
UT36PFD103 SPSC Data Sheet	https://caes.com/sites/default/files/documents/Datasheet-UT36PFD103.pdf
SPSC-EVB GUI User's Guide	https://caes.com/sites/default/files/documents/App-Note-SPSC-Software-User-Guide.pdf
UT32M0R500-EVB User's Guide	https://caes.com/sites/default/files/documents/App-Note-UT32M0R500-EVB-Users-Guide.pdf
UT32M0R500 ARM M0+ Functional Manual	https://caes.com/sites/default/files/documents/Functional-Manual-UT32M0R500.pdf
UT32M0R500-EVB to SPSC-EVB API & SPSC-EVB-GUI Runtime Executable	Fill out the Software Download Request here: https://caes.com/product/ut36pfd103#downloads

2 Evaluation Kit Contents

- SPSC-EVB-R0 UT36PFD103 Evaluation Board (1)
- ARDUINO Male-Male Jumper Wire (3)
- SPSC-EVB-R0-GUI (1 – Download from Cobham Website)
- UT32M0R500-SPSC-API (1 –Download from Cobham Website)
- SPSC-EVB-R0 Evaluation Kit User Guide (1)

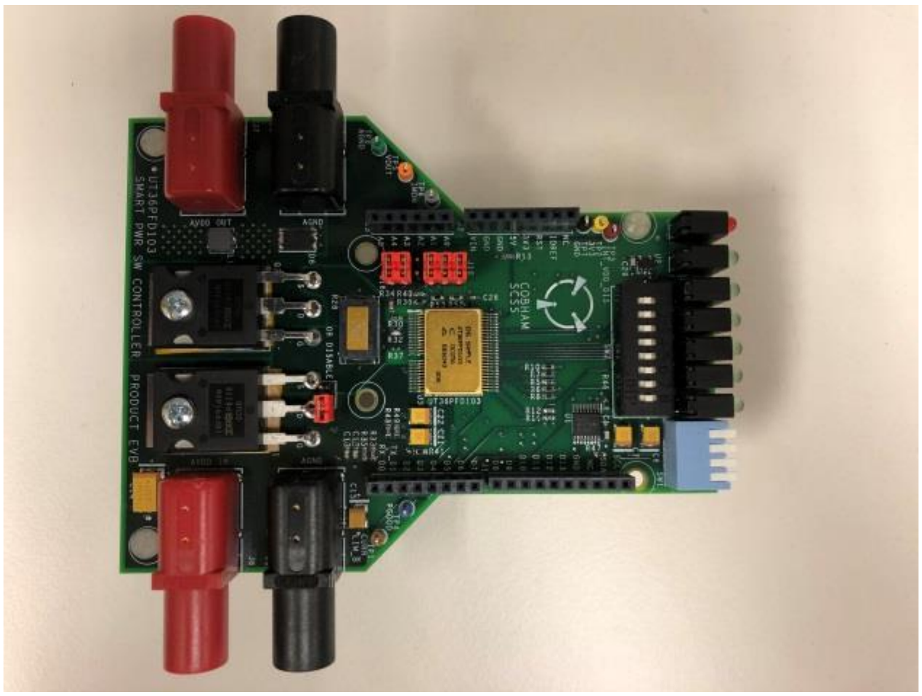

Figure 1a: Stand-Alone SPSC-EVB-R0

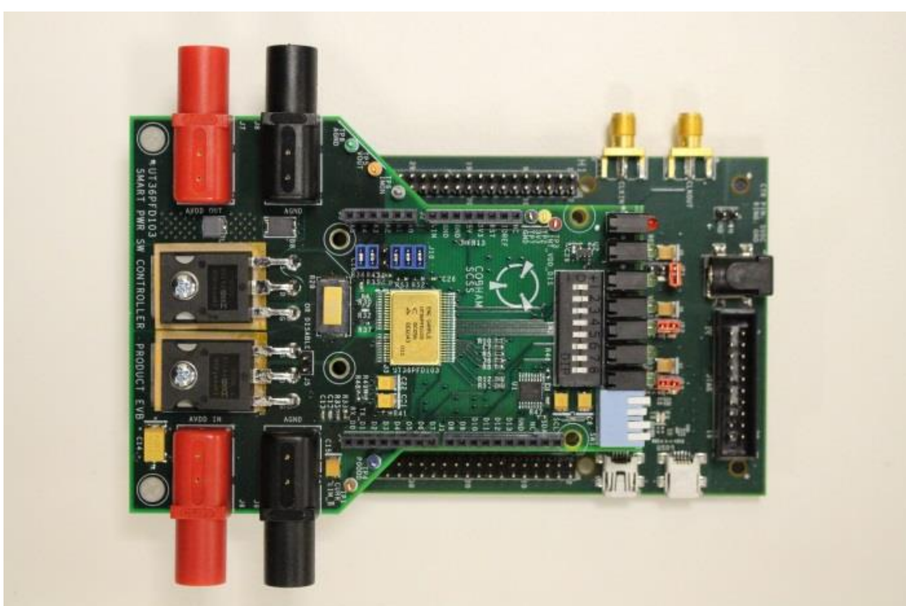

Figure 1b: SPSC-EVB-R0 Installed on UT32M0R500-EVB

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

Table of Contents

APPLICATION NOTE

Ver 1.0.1

7/21/2021

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

3 Evaluation Board (EVB) Configuration

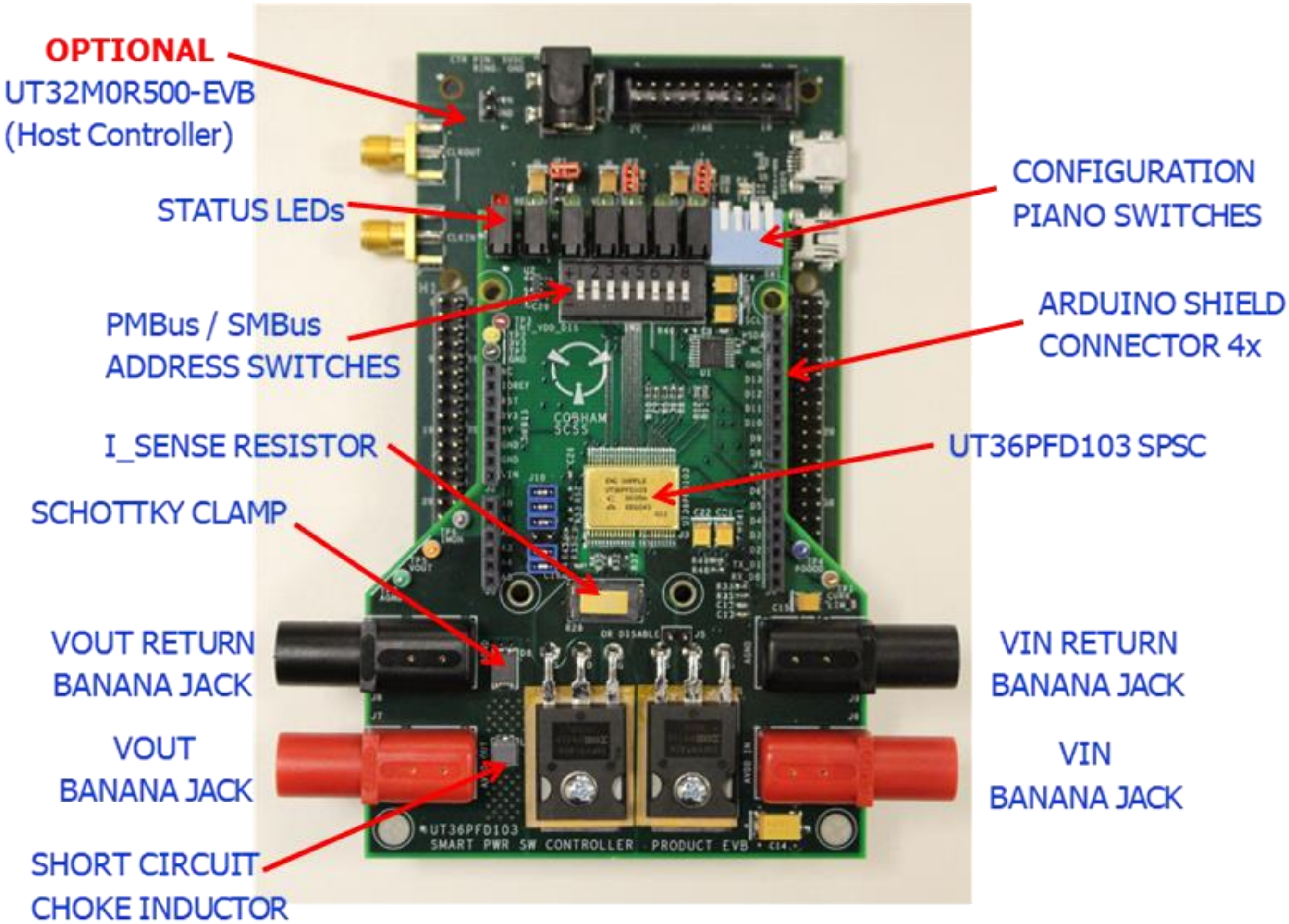

Figure 2: SPSC-EVB-R0 on UT32M0R500-EVB with Labels

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

4 Test Equipment List

Item #	Description	Function/Purpose
1	SPSC-EVB-R0	UT36PFD103 Evaluation Board
2	Differential Output 3.125 Gbps Pattern Generator (PRBS/XAUI/etc.)	Pulse Pattern Generator for Input Stimulus
3	Differential input oscilloscope with input analog bandwidth (BW) ≥8GHz	Oscilloscope for Output Display
4	3 Channel DC Power Supply	DC Power Supply for XPS Evaluation Board (1.2V, 1.5V, 2.5V)
5	MS Windows Laptop Computer + USB Cable	Platform for SW GUI Operation
6	SMP-to-SMA Cable Assemblies	Test Equipment Interface to SMP Connectors on Evaluation Board
7	SMA Cables	High-Speed Signal Connections To/From DUT and Test Equipment
8	DC Banana Plug Power Cables	Evaluation Board DC Power Connections

5 Evaluation Setup Diagram

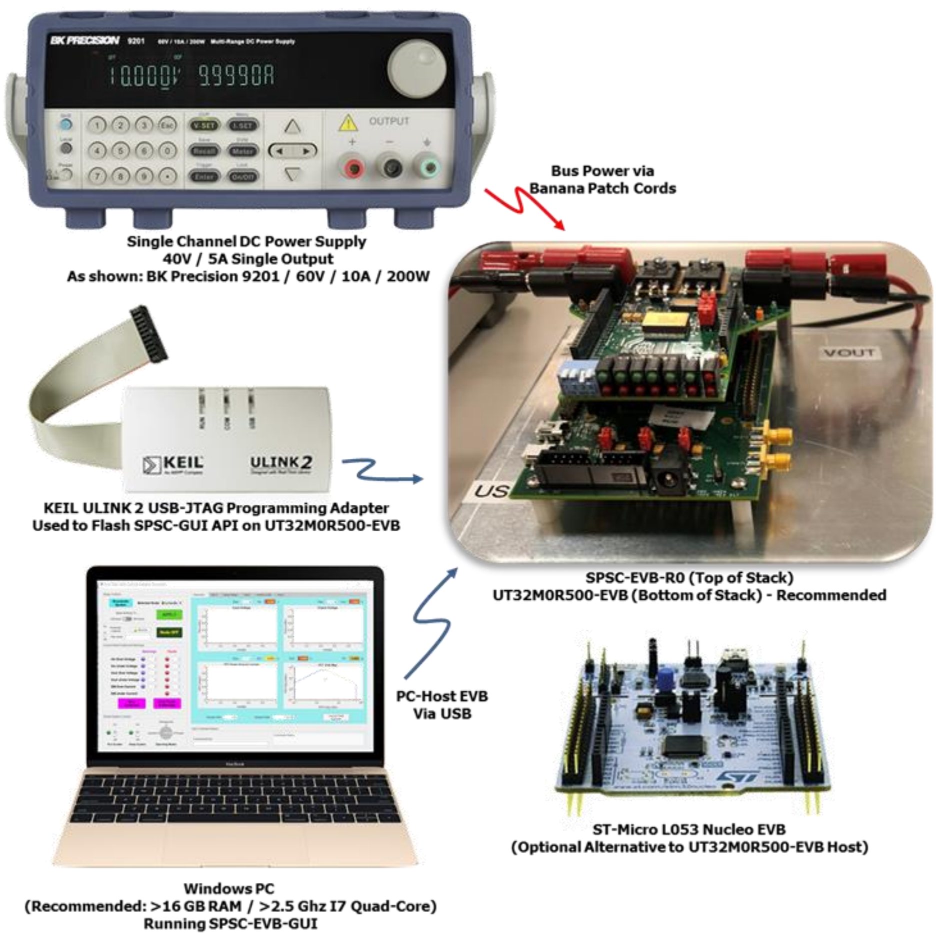

Figure 3: Evaluation Equipment Recommendations

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

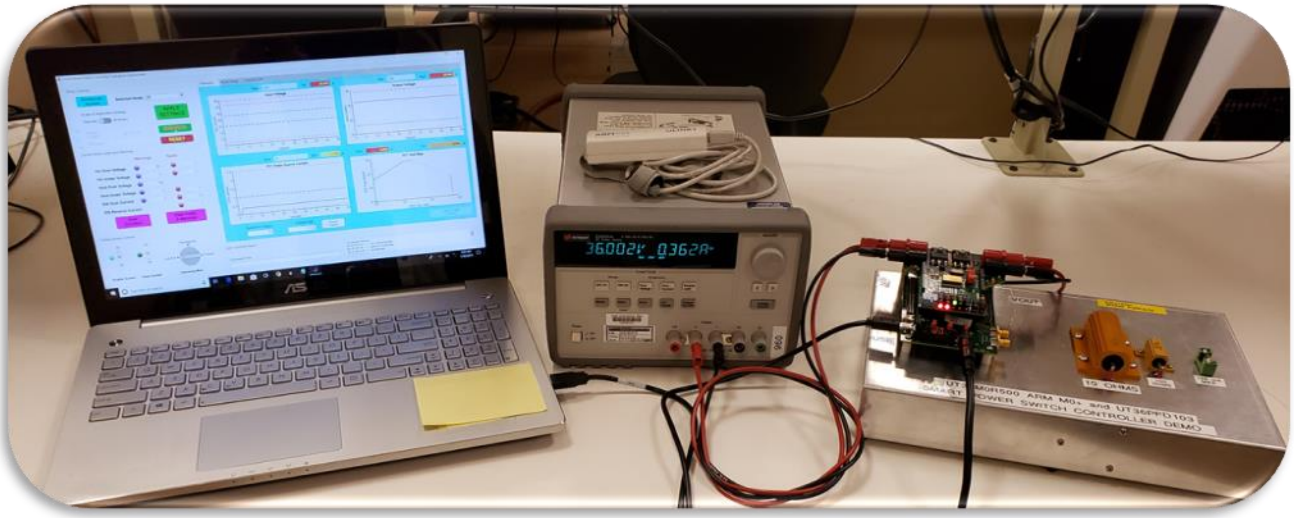

Figure 4: Example Evaluation Platform Setup with Loads

When operating the SPSC-EVB with hosted ARDUINO™ microcontroller base, the full-featured evaluation simply requires a PC with 16GB RAM and 2.5GHz Quad-core processor (recommended) to operate the GUI, a USB Type-A to Mini-B cable, single channel power supply (36V and 2.5A-5A capable output), banana patch cords and output load. As seen in Figure 4, Cobham implemented a simple load box to mount the UT32M0R500-EVB and SPSC-EVB-R0 and switch resistive loads of 10-ohms, 100-ohms, and a fast-blow fused short to ground.

6 Configuring the SPSC-EVB-R0 for Hosted Operation

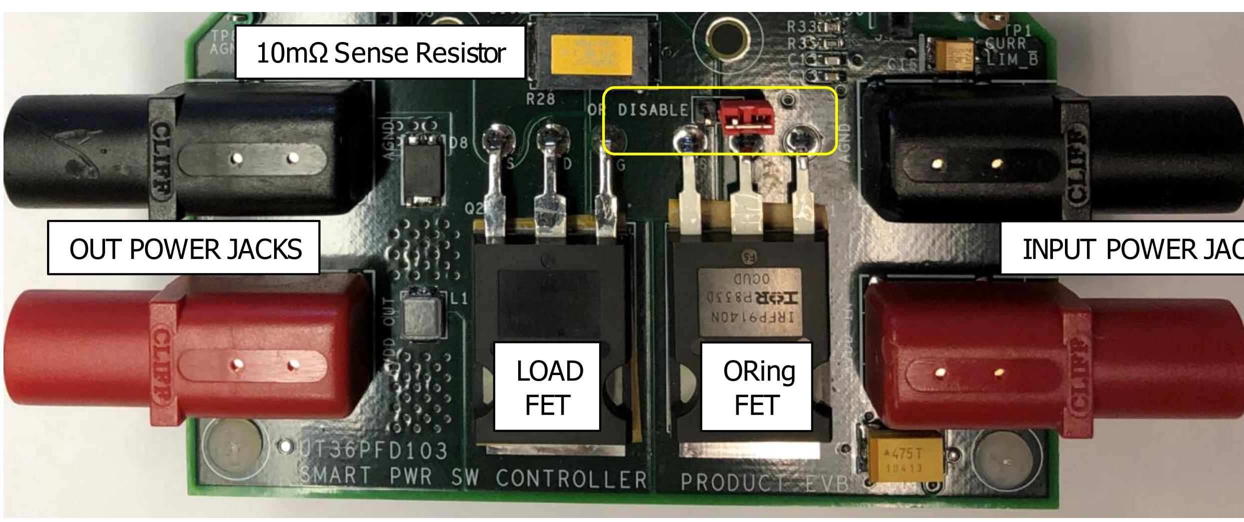

Figure 5: ORing Bypass Option

Step 1) Determine if you will bypass the ORing FET. As shown in Figure 5, the red shunt is NOT connecting across the OR DISABLE header. This configuration allows the SPSC to control the ORing FET. When shunting across this header, the ORing FET source-drain terminals are shorted effectively bypassing the SPSC control of the PowerFET.

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

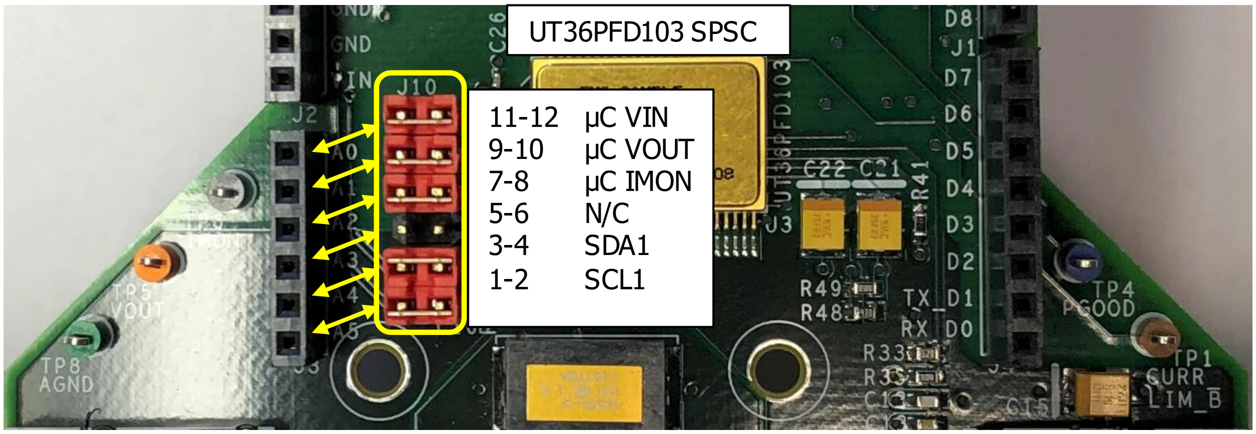

Figure 6: J10 Shunt Configuration

Step 2) Confirm the appropriate jumper shunts are in place on header J10, as shown in Figure 6. The µC VIN, µC VOUT, and µC IMON are analog representations of the corresponding telemetry points on the SPSC-EVB. The SDA1 and SCL1 signals connect the µC multi-function analog/GPIO pins to the SPSC's redundant SMBus Data and Clock IO.

Table 1: Analog Telemetry Scaling for µController ADC

Signal	Arduino Pin	Scaled Factor
µC VIN	A0	(VIN) 26.1 : 1 (µC VIN)
µC VOUT	A1	(VOUT) 26.1 : 1 (µC VOUT)
µC IMON	A2	(IMON) 2 : 1 (µC IMON)

Note the SPSC has an internal 10-bit ADC which also measures these telemetry points and provides the digitized value on a 2V scale to the host microcontroller via PMBus™ commands. These redundant analog telemetry points are provided to allow the user to perform the analog telemetry digitization with the microcontroller if desired. The scale factors provided by the SPSC-EVB-R0 are intended to keep the maximum analog values to remain <1.6V full-scale.

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

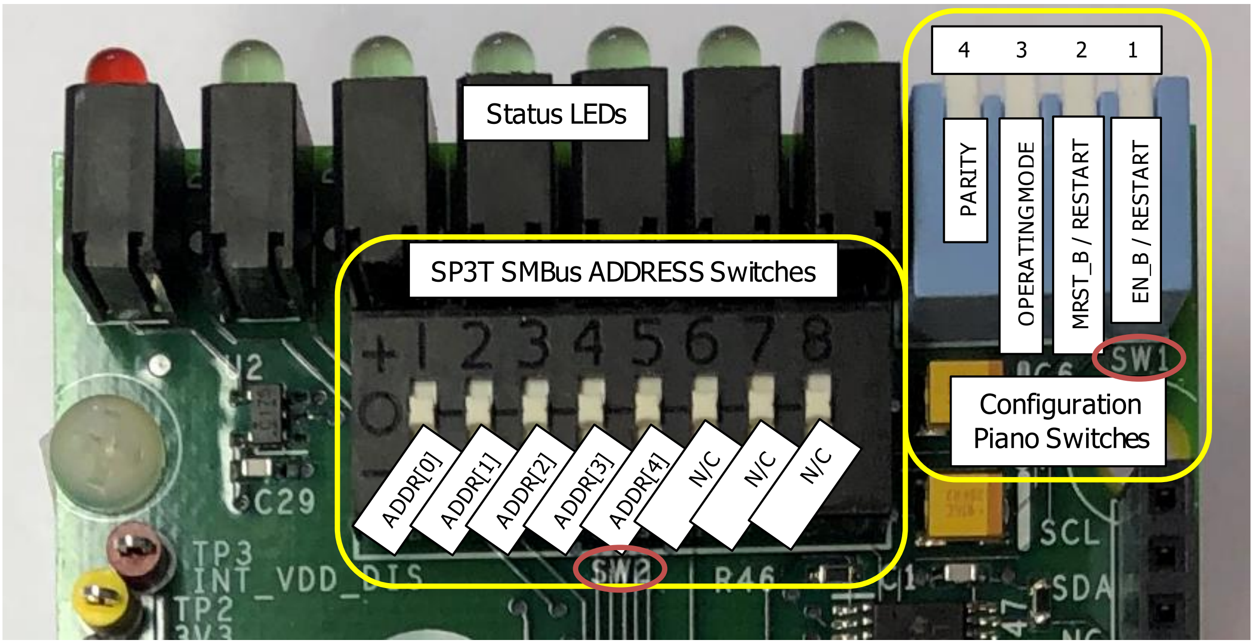

Figure 7: SMBus Address, Parity, and Configuration Switches

Step 3) There are two switch banks on the SPSC-EVB-R0 to configure SMBus addressing, selecting HOSTED or STAND-ALONE operation and facilitating certain operational modes when using the evaluation board in stand-alone mode. When using the SPSC-EVB-R0 in an ARDUINO hosted configuration, the OPERATING MODE piano switch (SW1.3) must be DOWN. The PARITY piano switch (SW1.4) should be set to create ODD parity for the ternary SMBus address set by the SP3T switches on SW2 (Table 2). Leaving PARITY switch UP places the SPSC PARITY input to logic LOW, while depressing SW1.4 in the DOWN position sets PARITY to logic HIGH. Table 4 provides a cross reference of ternary address decoding with appropriate parity setting.

As mentioned, the SMBus address inputs on the SPSC are ternary logic. This means each pin supports three states: LOW, MID, HIGH. The choice of ternary IO was used to provide full 7-bit SMBus addressing with fewer pins. The SPSC supports PMBus™ plug & play through its implementation of the SMBus Address Resolution Protocol (ARP). If the SMBus address and parity are invalid or duplicate, the SPSC-EVB-GUI will issue an enumeration sequence that informs the host microcontroller to invoke the ARP and determine which valid terminals are connected to the bus and assign new addresses to terminals that have an invalid or duplicate address set by the switch bank. The SMBus address switches are read by the SPSC while in reset, only.

The remaining two piano switches on SW1 (Table 3) are intended for STAND-ALONE operation. EN_B / RESTART (SW1.1) is provided to implement a commanded output pulsing function, while MRST_B / RESTART facilitates autonomous retriggering operation when current limit faults are detected. To use the SPSC-EVB-R0 in STAND-ALONE operation, SW1.3 must be UP. When operating the SPSC-EVB-R0 in STAND-ALONE mode, it also runs with a single power supply, drawing its power from the VIN supply and self-regulating the 3V3 supply.

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

Table 2: SP3T Switch SW2 Settings

Signal	Switch	Description	States
ADDR0	SW2.1	SMBus Address 0	— = LOW ⊙ = MID + = HIGH
ADDR1	SW2.2	SMBus Address 1	
ADDR2	SW2.3	SMBus Address 2	
ADDR3	SW2.4	SMBus Address 3	
ADDR4	SW2.5	SMBus Address 4	
N/C	SW2.6	No Connect	
N/C	SW2.7	No Connect	
N/C	SW2.8	No Connect	

Table 3: Piano Switch SW1 Settings

Signal	Switch	Description	States
EN_B / RESTART	SW1.1	Restart Operation via EN_B Input	UP = No Delay on EN_B ↑ DOWN = RC Delay Added to EN_B ↑ *Expected use in Stand-Alone Mode*
MRST_B / RESTART	SW1.2	Restart from Current Fault via MRST_B Input	UP = Output Latched OFF on Current Fault DOWN = Output Retriggers on Current Fault *Expected use in Stand-Alone Mode*
OPERATING MODE	SW1.3	SPSC-EVB Mode of Operation	UP = Stand-Alone Mode of Operation DOWN = Hosted Mode of Operation
PARITY	SW1.4	SMBus Address ODD Parity	UP = Drives Parity input logic LOW DOWN = Drive Parity input logic HIGH *Expected use in Hosted Mode*

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

Table 4: SMBus Address and Parity Decoding

Decimal Value	Ternary Pins (LSB->MSB)	Parity Switch	Decimal Value	Ternary Pins (LSB->MSB)	Parity Switch
16	LLMHM	UP (Logic 0)	70	LHMHM	UP
17	LLMHH	DOWN (Logic 1)	71	LHMHH	DOWN
18	LLHLL	DOWN	76	LHHMM	UP
19	LLHLM	UP	77	LHHMH	DOWN
20	LLHLH	DOWN	78	LHHHL	DOWN
21	LLHML	UP	79	LHHHM	UP
22	LLHMM	UP	80	LHHHH	DOWN
23	LLHMH	DOWN	81	HLLLL	UP
24	LLHHL	DOWN	82	HLLLM	UP
25	LLHHM	UP	83	HLLLH	DOWN
26	LLHHH	UP	84	HLLML	UP
27	LMLLL	DOWN	85	HLLMM	DOWN
28	LMLLM	UP	86	HLLMH	DOWN
29	LMLLH	DOWN	87	HLLHL	UP
30	LMLML	DOWN	88	HLLHM	UP
31	LMLMM	UP	89	HLLHH	DOWN
32	LMLMH	UP	90	HLMLL	DOWN
33	LMLHL	DOWN	91	HLMLM	UP
34	LMLHM	DOWN	92	HLMLH	DOWN
35	LMLHH	UP	93	HLMML	UP
36	LMMLL	DOWN	94	HLMMM	UP
37	LMMLM	UP	95	HLMMH	DOWN
38	LMMLH	UP	96	HLMHL	DOWN
39	LMMML	DOWN	98	HLMHH	UP
41	LMMMH	UP	99	HLHLL	DOWN
42	LMMHL	UP	100	HLHLM	UP
43	LMMHM	DOWN	101	HLHLH	DOWN
46	LMHLM	DOWN	102	HLHML	DOWN
47	LMHLH	UP	103	HLHMM	UP
48	LMHML	DOWN	104	HLHMH	UP
49	LMHMM	UP	105	HLHHL	DOWN
50	LMHMH	UP	106	HLHHM	DOWN
51	LMHHL	DOWN	107	HLHHH	UP
52	LMHHM	UP	108	HMLLL	DOWN
53	LMHHH	DOWN	109	HMLLM	UP
54	LHLLL	DOWN	110	HMLLH	UP
56	LHLLH	UP	111	HMLML	DOWN
57	LHLML	DOWN	112	HMLMM	UP
58	LHLMM	DOWN	113	HMLMH	DOWN
59	LHLMH	UP	114	HMLHL	DOWN
60	LHLHL	DOWN	115	HMLHM	UP
61	LHLHM	UP	116	HMLHH	DOWN
62	LHLHH	UP	117	HMMLL	UP
63	LHMLL	DOWN	118	HMMLM	UP
69	LHMHL	UP	119	HMMLH	DOWN

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

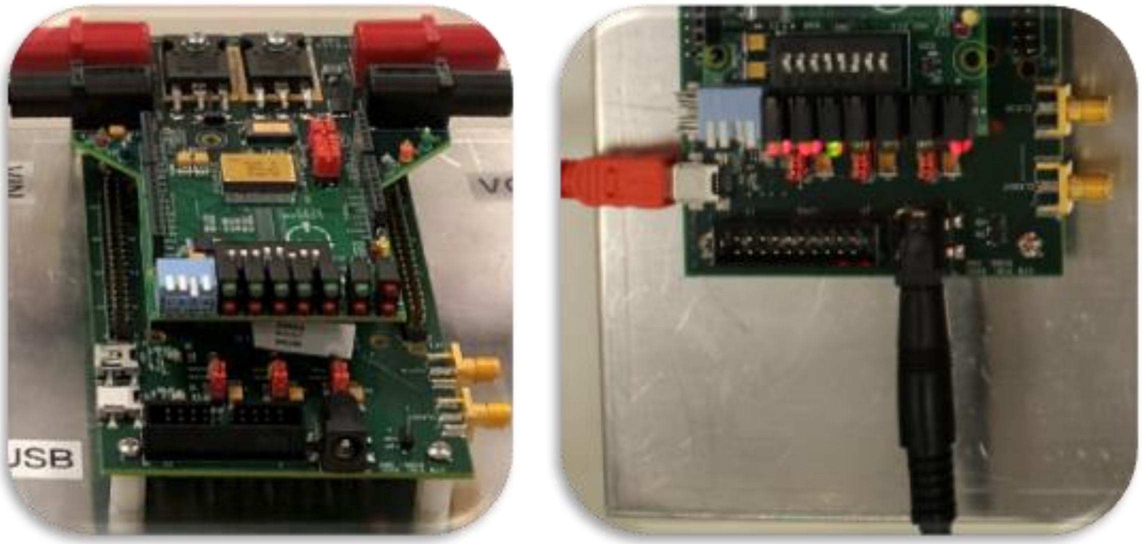

Figure 8: Installing SPSC-EVB-R0 onto UT32M0R500-EVB Host

Step 4) Install the SPSC-EVB-R0 onto the ARDUINO shield connectors located on the target host controller board. Recommended host controller board is Cobham's UT32M0R500-EVB (or STM L053 Nucleo – Cobham API support pending). After installing the SPSC-EVB-R0 onto the host controller board, you are ready to apply power to the host controller and connect its USB Mini-B port to the PC USB Type-A COM port as shown in Figure 8. Once power is applied to the host controller board through its AC/DC power adapter, you should see LED's illuminate to reflect the present configuration and status of the SPSC-EVB-R0.

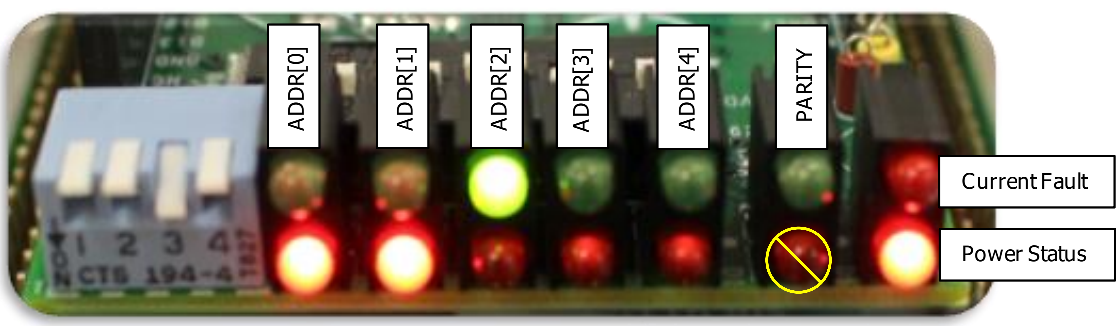

Figure 9: SPSC-EVB-R0 Status and Configuration LEDs

Once the SPSC-EVB-R0 is installed on the ARDUINO host and power is applied to the host, the status and configuration LEDs will illuminate according to SPSC-EVB-R0 settings, as shown in Figure 9, above.

Table 5: SPSC-EVB-R0 LED Legend

ADDR[4:0]	Parity	Current Fault	Power Status
● LOW	● NOT USED	● CURRENT FAULT	● VOUT POWER NOT GOOD
● HIGH	● HIGH		
● MID	● LOW	● No FAULT	● VOUT POWER GOOD

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

The PGOOD LED illuminates when the output voltage (VOUT) is less than 25V indicating output voltage is NOT good. This is an arbitrary threshold that was designed in the SPSC-EVB-R0. PGOOD is derived from a 15.3 : 1 voltage divider on VOUT to the SPSC FEEDBACK input who's HIGH/LOW threshold is 1.6V with hysteresis. The state of PGOOD does not have any effect on SPSC operation; it is simply a discrete telemetry output signal on the SPSC-EVB-R0.

The CURR_LIM_B output from the SPSC asserts LOW when a >2.5A load current is present for ~160ms or when the 500ns short circuit detector is tripped by a load current >5A. Figure 10 depicts a typical over current fault condition time-out, while Figure 11 shows an example short circuit detection response.

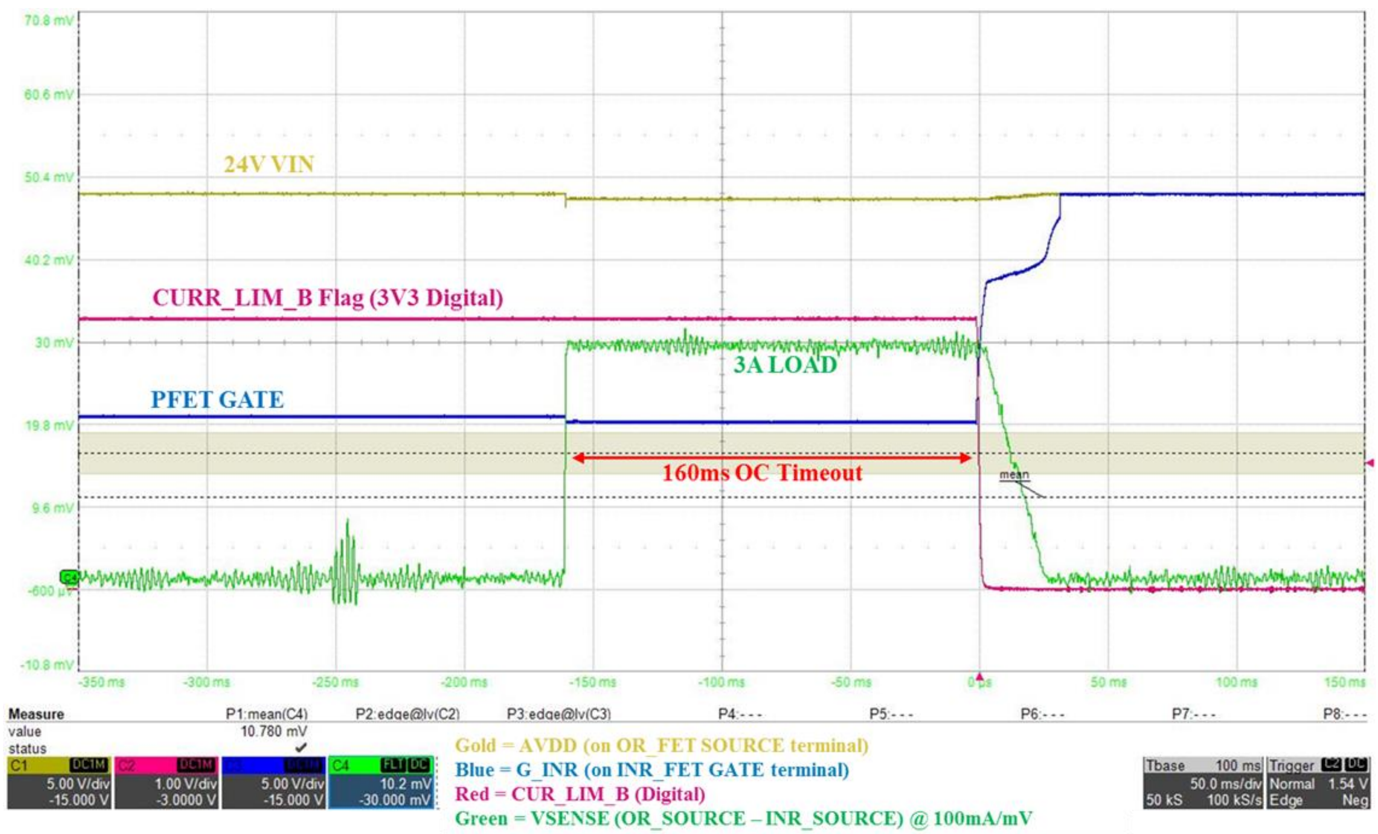

Figure 10: SPSC-EVB-R0 Overcurrent Fault Response

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

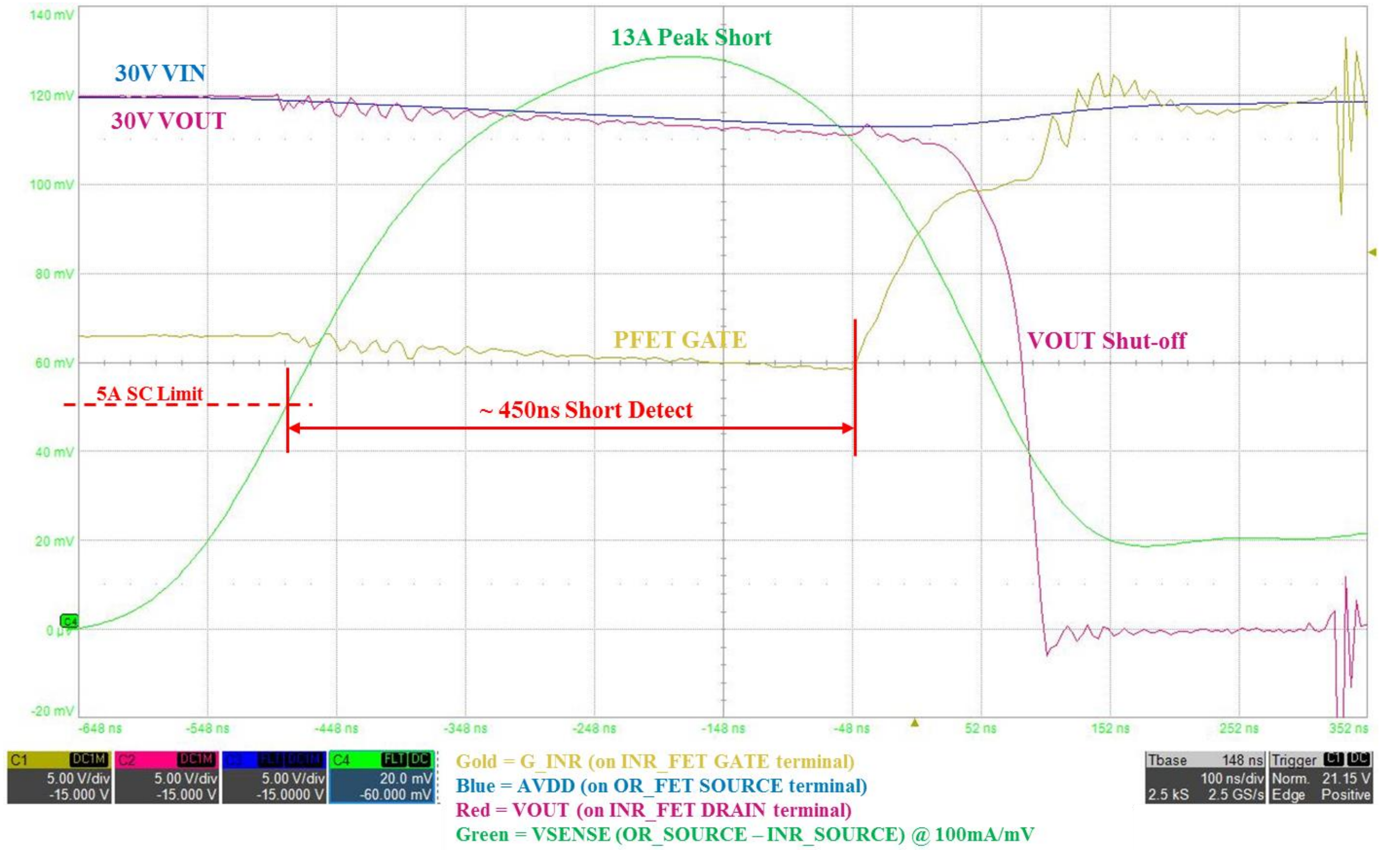

Figure 11: SPSC-EVB-R0 Short Circuit Detection Response

Figure 12: Connect Power Supply to VIN Banana Jacks on SPSC-EVB-R0

Step 5) Using common banana patch cords, connect your power supply positive (RED) and return (BLACK) terminals to the VIN positive (RED) and return (BLACK) banana jacks on the SPSC-EVB-R0.

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

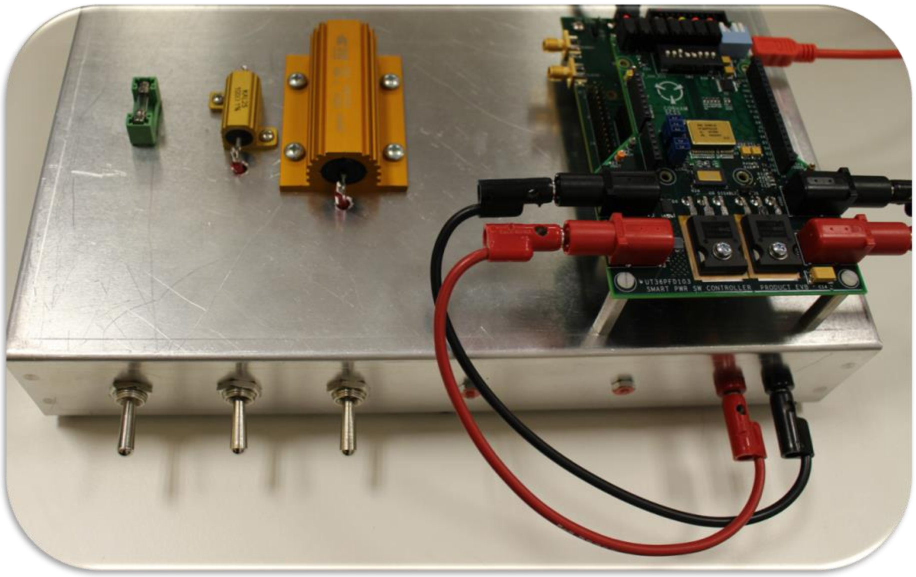

Figure 13: Connecting Target Load to the SPSC-EVB-R0 VOUT Port

Step 6) Connect the SPSC-EVB-R0 VOUT port to your desired load. Figure 13 depicts Cobham's demonstration platform (not included in SPSC-EVB-R0 evaluation kit) with VOUT (RED) and return (BLACK) patched from the SPSC-EVB-R0 VOUT port into the load fixture where it is then switched into 1-to-3 loads via toggle switches.

Figure 14: Turn on Power Supply and Set to Desired Voltage

Step 7) As long as the ARDUINO Host is already powered-up, you can apply power to the VIN port that was connected

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

in Step 5, above. Powering the SPSC-EVB-R0 solely through the VIN port results in the SPSC self-regulating the 3V3 domain shared by the SPSC-EVB-R0 and ARDUINO host EVB which may have adverse effects on the UT36PFD103 SPSC since its 3V3 regulator was not designed with intent to be a full system power regulator and it is undetermined how reverse powering the ARDUINO host EVB will behave.

If the ARDUINO host is already powered prior to applying VIN, the power supply should report 1-2mA of supply current up through 40V. Do NOT increase VIN above 44V. As shown in Figure 14, above, the power supply current is 362mA because the GUI had enabled the output load switch with the 100-ohm load connected.

To proceed further, the SPSC-EVB-R0-GUI must be installed on the PC and the host controller board must be programmed with the UT32M0R500-EVB to SPSC-EVB API, both of which can be downloaded from Cobham's website (https://caes.com/product/ut32m0r500#downloads) An application note is also available on the website to walkthrough the programming process.

Figure 15: SPSC-EVB-R0-GUI Startup Screen

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

Step 8) Once software is installed on the host PC and the ARDUINO host PCB is programmed with the evaluation API, you are ready to operate the SPSC-EVB-R0-GUI and begin evaluating the hardware. Refer to the SPSC-EVB GUI User's Guide for an explanation of the various operational features supported and how to connect the GUI to the target hardware.

With the GUI connected and in control of the hardware, you will be able to switch the power supply to the target load and evaluate voltage, current, fault detection, isolation and recovery capability of the SPSC. The SPSC provides ΔV/Δt control during the VOUT charging phase to prevent inrush current. The ΔV/Δt limit on the SPSC-EVB-R0 is ~6V/ms. If your evaluation load includes a sufficiently large capacitance (~833µF) you will trip the short circuit fault protection. Figure 16 depicts an example VOUT power up to 30V of a 7.5Ω resistive load.

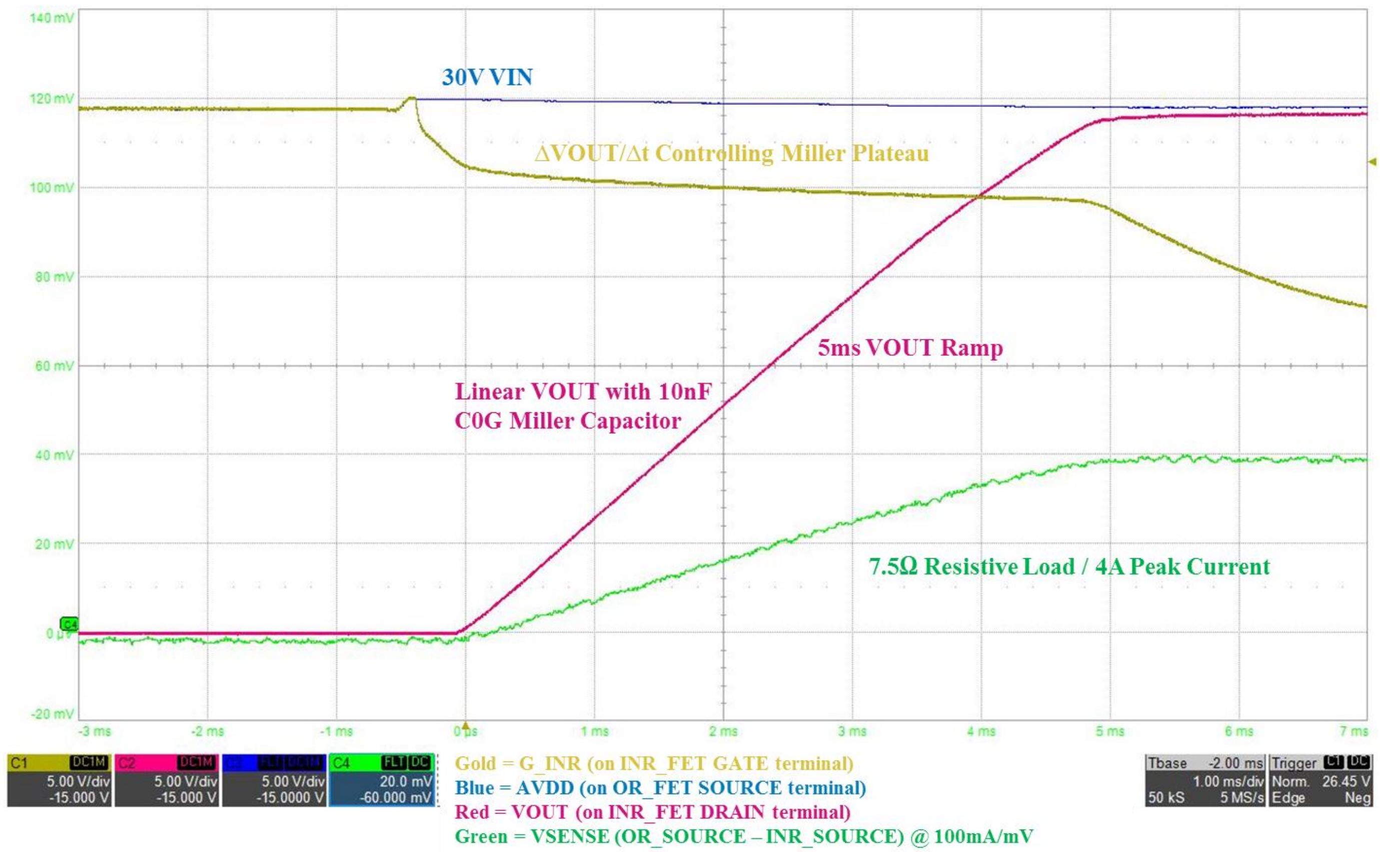

Figure 16: Example VOUT Power-Up with ΔV/Δt Control

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

7 Configuring the SPSC-EVB-R0 for STAND-ALONE Operation

The SPSC-EVB-R0 may be used without an ARDUINO host, which is termed STAND-ALONE operation. The following steps walkthrough setting up and operating the evaluation board in STAND-ALONE mode.

Step 1) Enable/Disable the OR'ing functionality; identical to step 1 for the ARDUINO hosted configuration.

Step 2) J10 shunt settings discussed in step 2 of the ARDUINO hosted configuration is not applicable.

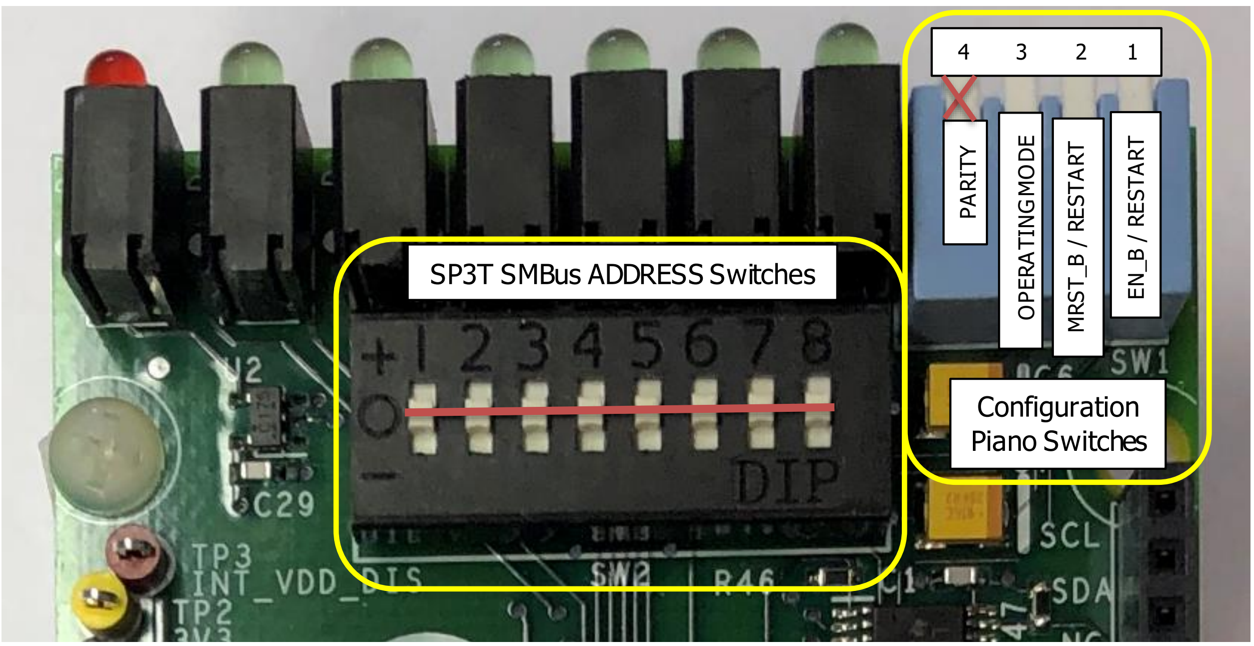

Figure 17: SMBus Address Switches and Configuration Piano Switches

Step 3) In STAND-ALONE mode, the SMBus Address switches are unused. To avoid unnecessary DC power consumptions from the SPSC's regulated 3V3 supply, it is recommended to set these switches to the center (open) position. The PARITY piano switch (SW1.4) is a don't care, but is best left in the "UP" position.

The OPERATING MODE piano switch (SW1.3) MUST be in the "UP" position to enable the STAND-ALONE operating mode.

Placing the MRST_B/RESTART (SW1.2) in the DOWN position enables autonomous retrigger to current faults by connecting the UT36PFD103's open-drain CURR_LIM_B output to its MRST_B input. In the event of a current limit fault, the CURR_LIM_B is driven low, which in turn drives the MRST_B pin low thereby clearing the fault latch and allowing the SPSC to re-engage the output load switch after an RC time delay of ~45ms. It is recommended the user take caution using autonomous retriggering with very low impedance loads (e.g. short circuits) while test equipment like ammeters are in line with the power supply because the repetitive re-assertion of the power supply to the load at 45ms intervals can blow the current protection fuse (typ. 3A) in common DMMs.

Using the MRST_B/RESTART (SW1.2) as a tactile switch (i.e. partially depressing the switch) is a convenient way to manually restart the SPSC following a latched current fault while avoiding the autonomous retriggering option.

UT36PFD103 Smart Power Switch Controller

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

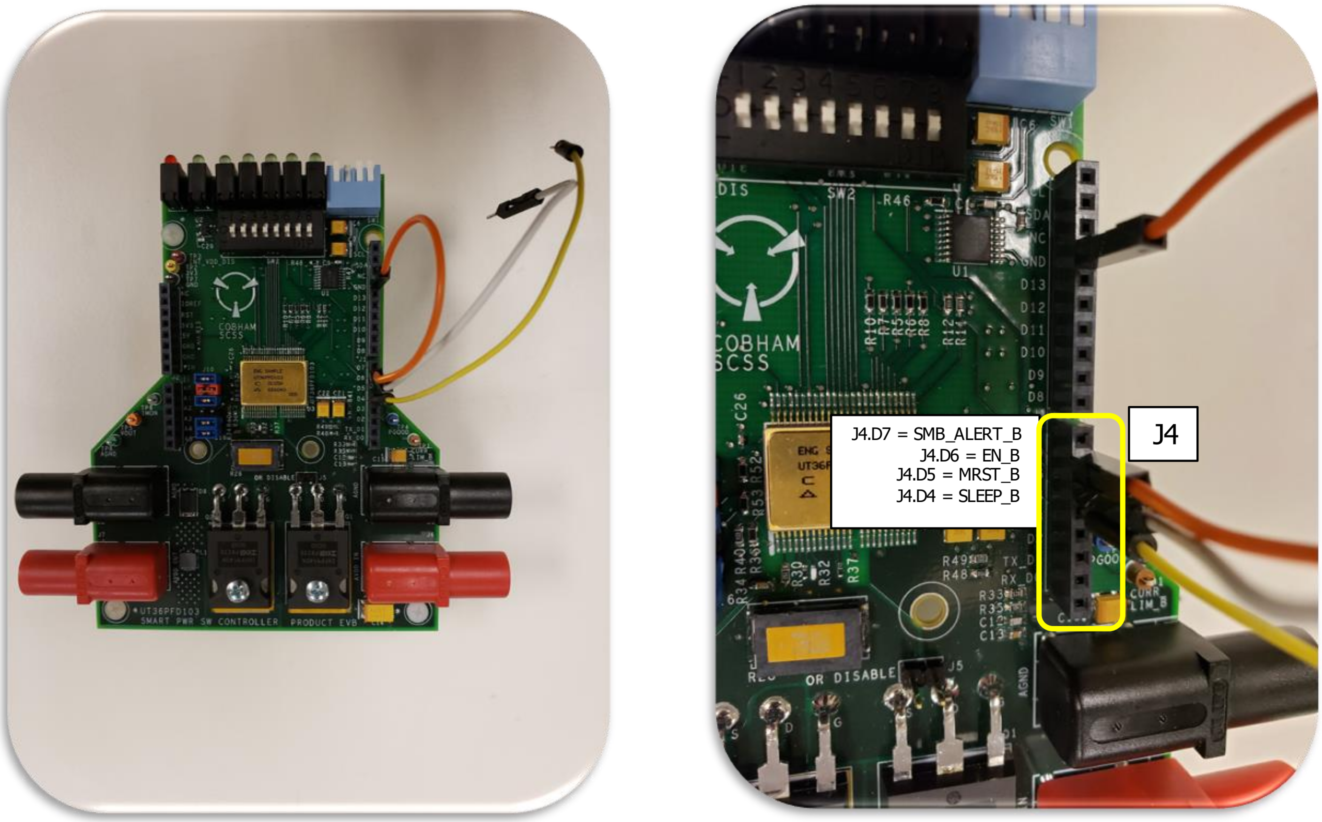

Figure 18: Jumper Wires Required to Invoke Certain Operating Conditions on SPSC-EVB-R0

Step 4) In order to operate the SPSC-EVB-R0, the EN_B input must be LOW. This is most easily accomplished by running a jumper wire from J4.D6 to a nearby GND point. As shown in Figure 18, an orange jumper wire is run from J4.D6 (EN_B) to J1.GND.

Additional features that can be invoked with jumper wires to GND are MRST_B (J4.D5) and SLEEP_B (J4.D4). All 3 of these signals have local pull-ups on the SPSC-EVB-R0 to place them into their inactive states. Therefore all that is required to activate them is to run a jumper to ground as described above.

Step 5) Similar to step 5 in the hosted configuration setup, connect your power supply to the VIN banana jacks on the SPSC-EVB-R0 using banana patch cords.

Step 6) As in step 6 in the hosted configuration, connect the SPSC-EVB-R0 VOUT port to your desired load.

Step 7) In stand-alone mode, the SPSC-EVB will power up in single-supply configuration by regulating the 3V3 domain on the evaluation board through the UT36PFD103 self-regulation. Full regulation will not occur until VIN is ~7V. Typical currents on the VIN power supply will range from 3mA to 20mA during the VIN power-up. Assuming only the PGOOD LED is illuminated in stand-alone mode with VIN >7V the EVB will normally draw ~5mA of current from the VIN supply.

As-long-as EN_B (J4.D6) is grounded on the SPSC-EVB-R0, the UT36PFD103 will automatically switch VIN to VOUT when the power supply crosses the Undervoltage Lockout (UVLO) threshold which is ~7.5V on the positive going threshold. The UVLO input on the SPSC is set by a 4.4 : 1 voltage divider targeting a 1.6V (comparator reference) + 100mV (hysteresis) threshold.

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

With EN_B tied LOW and no current fault, VIN will be switched to VOUT for all VIN levels above UVLO (~7.5V) through the Overvoltage Lockout (OVLO) threshold of ~42.5V. The OVLO input on the SPSC is set by a 25:1 voltage divider targeting a 1.6V (comparator reference) + 100mV (hysteresis) threshold.

***NOTE the SPSC-EVB-R0 has a side effect of the UVLO voltage divider driving the input voltage above 3V3+V_ESD when VIN is >17V. As VIN increases, current flows into the UVLO pin through its ESD protection diode and back out through the OVLO pin creating an effective reduction in the OVLO trip threshold. The result is that OVLO trips around 39.5V on VIN. This situation will be addressed in the SPSC-EVB-R1.*

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

8 EVB Electrical Schematics

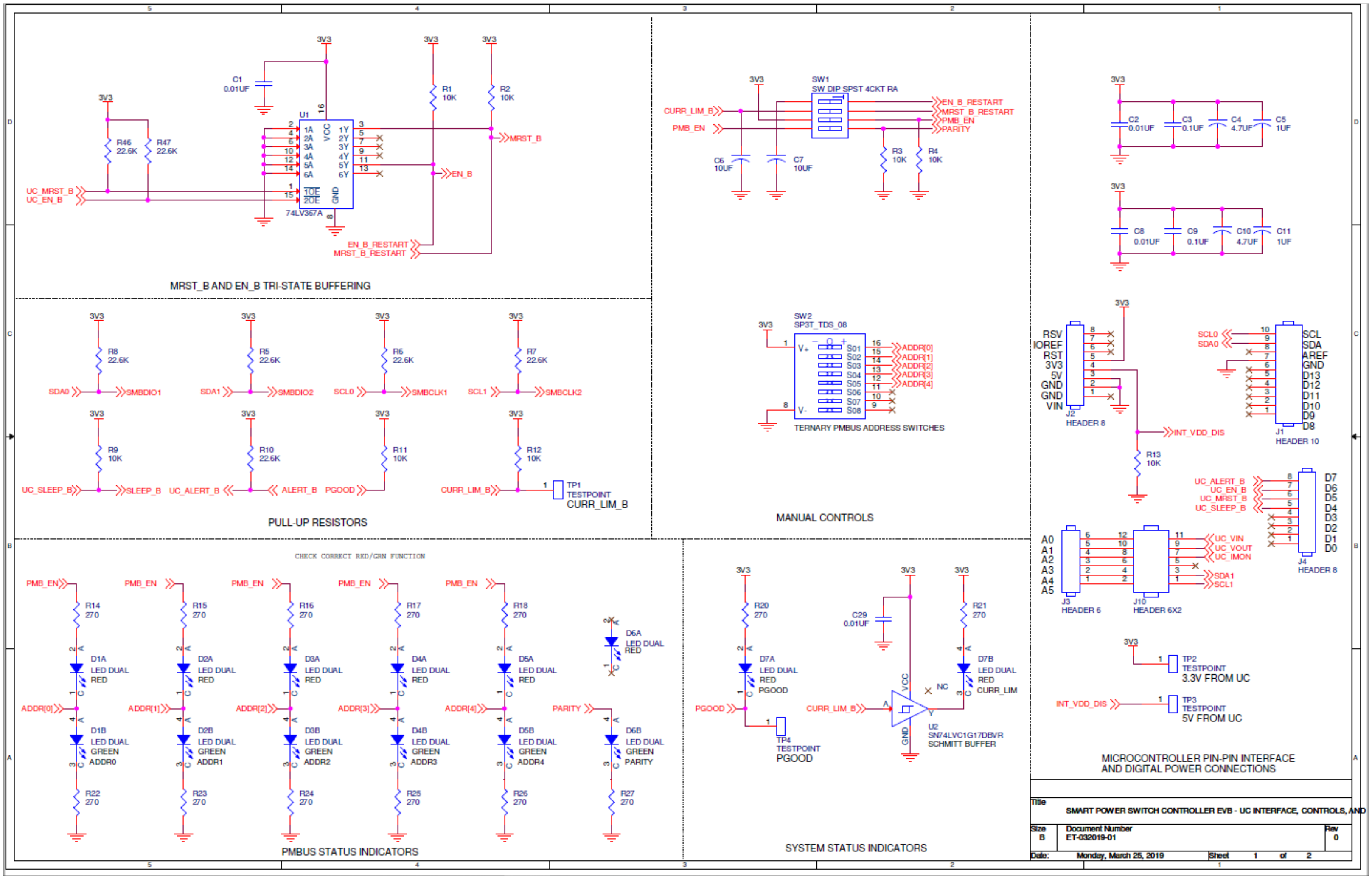

Figure 19: SPSC-EVB-R0 Schematic 1/2

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

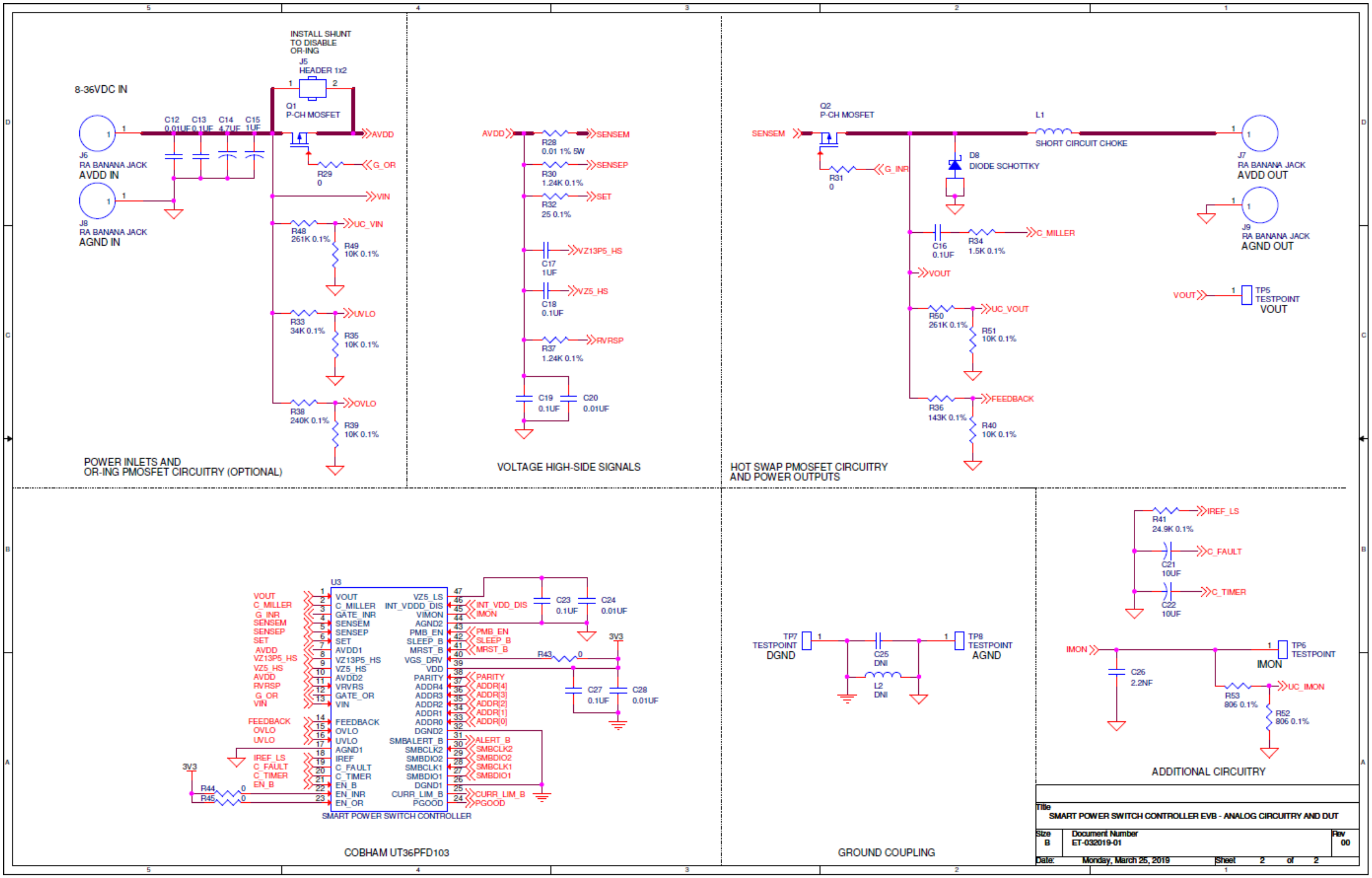

Figure 20: SPSC-EVB-R0 Schematic 2/2

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

9 EVB Components Bill of Materials

Title:	UT36PFD103 SPSC Product EVB BOM								
Rev.	0								
ET#	032019-01								
Date:	20190325								
Author:	Karlson								
Item	Quantity	Reference	Part	Description	PCB Footprint	Vendor	Vendor part number	Manufacturer	Part Number
1	8	C1,C2,C8,(	0.01UF	CAP CER 10000PF 50V C0G/NP0 0603	SMT0603	Digi-Key	490-9666-1-ND	Murata	GRM1885C1H103JA01D
2	8	C3,C9,C13	0.1UF	CAP CER 0.1UF 50V X7R 0603	SMT0603	Digi-Key	311-1779-1-ND	Yageo	CC0603JRX7R9BB104
3	2	C4,C10	4.7UF	CAP TANT 4.7UF 10% 35V 1411	B_CASE	Digi-Key	478-3106-1-ND	AVX	TPSB475K035R0700
4	3	C5,C11,C1	1UF	CAP TANT 1UF 10% 50V 1411	B_CASE	Digi-Key	399-9720-1-ND	Kemet	CL21B105KBFNFNE
5	4	C6,C7,C21	10UF	CAP TANT 10UF 10% 16V 1411	B_CASE	Digi-Key	478-5230-1-ND	AVX	TPSB106K016R0500
6	1	C14	4.7UF	CAP TANT 4.7UF 10% 50V 2917	D_CASE	Digi-Key	478-1738-1-ND	AVX	TAJD475K050RNJ
7	1	C17	1UF	CAP CER 1UF 50V X7R 0805	SMT0805	Digi-Key	1276-2928-1-ND	Samsung	CL21B105KBFNFNE
8	1	C25	DNI	CAP CER 0.1UF 50V X7R 0603	SMT0603	Digi-Key	311-1779-1-ND	Yageo	CC0603JRX7R9BB104
9	1	C26	2.2NF	CAP CER 2200PF 50V X7R 0402	SMT0402	Digi-Key	311-1678-1-ND	Yageo	CC0402JRX7R9BB222
10	6	D1,D2,D3,	LED DUAL	LED 2HI 3MM GREEN OVER RED PCMNT	LED_DUAL_RA	Digi-Key	350-1822-ND	Dialight	5530121F
11	1	D7	LED DUAL	LED 2HI 3MM RED PC MNT	LED_DUAL_RA	Digi-Key	350-1821-ND	Dialight	5530111F
12	1	D8	DIODE SCHOTTKY	DIODE SCHOTTKY 40V 10A POWERDI5	POWERDI5	Digi-Key	PDS1040LDICT-ND	Diodes Inc	PDS1040L-13
13	1	J1	HEADER 10	CONN RCPT 10POS 0.1 GOLD PCB	10x1_HEADER	Digi-Key	SAM15004-ND	Samtec	SSQ-110-04-G-S
14	2	J2,J4	HEADER 8	CONN RCPT 8POS 0.1 GOLD PCB	8x1_HEADER	Digi-Key	SSQ-108-04-G-S-ND	Samtec	SSQ-108-04-G-S
15	1	J3	HEADER 6	CONN RCPT 6POS 0.1 GOLD PCB	6x1_HEADER	Digi-Key	SSQ-106-04-G-S-ND	Samtec	SSQ-106-04-G-S
16	1	J5	HEADER 1x2	CONN HEADER VERT 2POS 2.54MM	2x1_HEADER	Digikey	S1011EC-02-ND	Sullins	PRPC002SAAN-RC
17	2	J6,J7	RA BANANA JACK	BANANA JACK RA RED	CLIFF_FCR7350_RA_BANANA_JACK	Newark	20T2058	Cliff	FCR7350R
18	2	J8,J9	RA BANANA JACK	BANANA JACK RA BLACK	CLIFF_FCR7350_RA_BANANA_JACK	Newark	20T2055	Cliff	FCR7350B
19	1	J10	HEADER 6X2	CONN HEADER VERT 12POS 2.54MM	hdr_2x6_100mil	Digi-Key	S2011EC-06-ND	Sullins	PRPC006DAAN-RC
20	1	L1	SHORT CIRCUIT CHOKE	FIXED IND 470NH 8A 14 MOHM SMD	SRP4020	Digi-Key	SRP4020TA-R47MCT-ND	Bourns	SRP4020TA-R47M
21	1	L2	DNI	FERRITE BEAD 220 OHM 0603 1LN	SMT0603	Digi-Key	490-5221-2-ND	Murata	BLM18PG221SN1D
22	2	Q1,Q2	P-CH MOSFET	MOSFET P-CH 100V 23A TO-247AC	UTO-247AC	Digi-Key	IRFP9140NPBF-ND	Infineon	IRFP9140NPBF
23	8	R1,R2,R3,F	10K	RES SMD 10K OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P10KDBCT-ND	Vishay	ERA-3AEB103V
24	7	R5,R6,R7,F	22.6K	RES SMD 22.6K OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P22.6KDBCT-ND	Panasonic	ERA-3AEB2262V
25	13	R14,R15,R	270	RES SMD 270 0.1% 1/10W 0603 CRGCQ	SMT0603	Digi-Key	YAG1606CT-ND	Yageo	RT0603BRD07270RL
26	1	R28	0.01 1% 5W	RES 0.01 OHM 1% 5W 4527	SMT4527_WSR	Digi-Key	WSRC-.01CT-ND	Vishay	WSR5R0100FEA
27	5	R29,R31,R	0	RES SMD 0 OHM JUMPER 1/4W 0603	SMT0603	Digi-Key	541-0.0SBCT-ND	Vishay	CRCW06030000Z0EAHP
28	2	R30,R37	1.24K 0.1%	RES SMD 1.24KOHM 0.1% 1/16W 0402	SMT0402	Digi-Key	P1.24KDCCT-ND	Panasonic	ERA-2AEB1241X
29	1	R32	25 0.1%	RES 25 OHM 0.1% 1/20W 0402	SMT0402	Digi-Key	764-1328-1-ND	Vishay	FC0402E25R0BTT0
30	1	R33	34K 0.1%	RES 34K OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P34KDBCT-ND	Panasonic	ERA-3AEB3402V

Figure 21: SPSC-EVB-R0 BOM 1/2

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

Title:	UT36PFD103 SPSC Product EVB BOM								
Rev.	0								
ET#	032019-01								
Date:	20190325								
Author:	Karlson								
Item	Quantity	Reference	Part	Description	PCB Footprint	Vendor	Vendor part number	Manufacturer	Part Number
31	1	R34	1.5K 0.1%	RES SMD 1.5K OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P1.5KDBCT-ND	Panasonic	ERA-3AEB152V
32	5	R35,R39,R	10K 0.1%	RES SMD 10K OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P10KDBCT-ND	Vishay	ERA-3AEB103V
33	1	R36	143K 0.1%	RES SMD 143K OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P143KDBCT-ND	Panasonic	ERA-3AEB1433V
34	1	R38	240K 0.1%	RES SMD 240K OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P240KDBCT-ND	Panasonic	ERA-3AEB244V
35	1	R41	24.9K 0.1%	RES SMD 24.9KOHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P24.9KDBCT-ND	Panasonic	ERA-3AEB2492V
36	2	R48,R50	261K 0.1%	RES SMD 261KOHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P261KDBCT-ND	Panasonic	ERA-3AEB2613V
37	2	R52,R53	806 0.1%	RES SMD 806 OHM 0.1% 1/10W 0603	SMT0603	Digi-Key	P806DBCT-ND	Panasonic	ERA-3AEB8060V
38	1	SW1	SW DIP SPST 4CKT RA	SWITCH PIANO DIP SPST 50MA 24V	DIP8_SW_SPST_RA	Digi-Key	CT1944MST-ND	CTS	194-4MST
39	1	SW2	SP3T_TDS_08	Switch, 8 Position, SP3T, 10 PIN DIP	16dip-10pins-100mil	Digi-Key	EG4555-ND	E-Switch	SP3T-TDS-08
40	1	TP1	TESTPOINT	PC TESTPOINT MINIATURE BROWN	TP_40D	Digi-Key	36-5115-ND	Keystone	5115
41	1	TP2	TESTPOINT	PC TESTPOINT MINIATURE YELLOW	TP_40D	Digi-Key	36-5004-ND	Keystone	5004
42	1	TP3	TESTPOINT	PC TESTPOINT MINIATURE RED	TP_40D	Digi-Key	36-5000-ND	Keystone	5000
43	1	TP4	TESTPOINT	PC TEST POINT MINIATURE BLUE	TP_40D	Digi-Key	36-5117-ND	Keystone	5117
44	1	TP5	TESTPOINT	PC TEST POINT MINIATURE ORANGE	TP_40D	Digi-Key	36-5003-ND	Keystone	5003
45	1	TP6	TESTPOINT	PC TEST POINT MINIATURE GRAY	TP_40D	Digi-Key	36-5118-ND	Keystone	5118
46	1	TP7	TESTPOINT	PC TEST POINT MINIATURE BLACK	TP_40D	Digi-Key	36-5001-ND	Keystone	5001
47	1	TP8	TESTPOINT	PC TEST POINT MINIATURE GREEN	TP_40D	Digi-Key	36-5116-ND	Keystone	5116
48	1	U1	74LV367A	IC BUF NON-INVERT 5.5V 16TSSOP	tssop16_o65mm_5mm_4o4mm	Digi-Key	296-12350-1-ND	Texas Instruments	SN74LV367APWR
49	1	U2	SN74LVC1G17DBVR	IC BUF NON-INVERT 5.5V SOT23-5	SOT23-5	Digi-Key	296-11933-1-ND	Texas Instruments	SN74LVC1G17DBVR
50	1	U3	SMART POWER SWITCH CONTROLLER	Smart Power Switch Controller	47CFP_o635mm_10o75mm_16o10mm	Cobham	DC05	Cobham	UT36PFD103
	2		SCREW M3x12 PHILLIPS	MACH SCREW PAN HEAD PHILLIPS M3		Digi-Key	H744-ND	B&F Fastener	MPMS 003 0012 PH
	2		FLATWASHER M3	WASHER FLAT M3 STEEL		Digi-Key	H767-ND	B&F Fastener	MFWZ 003
	2		LOCKWASHER M3	WASHER SPLIT LOCK M3 STEEL		Digi-Key	H772-ND	B&F Fastener	MLWZ 003
	2		HEX NUT M3	HEX NUT 0.217" M3		Digi-Key	H762-ND	B&F Fastener	MHNZ 003
	3		STANDOFF 4-40 3/4"	HEX STANDOFF #4-40 NYLON 3/4"		Digi-Key	36-1902D-ND	Keystone	1902D
	3		SCREW 4-40 3/8"	MACHINE SCREW PAN PHILLIPS 4-40		Digi-Key	H781-ND	B&F Fastener	PMS 440 0038 PH
51	2	NA	TIM pad	THERM PAD 24.13MMX19.05MM ORANGE		Digi-Key	345-1545-ND	Wakefield-Vette	CD-02-05-247
52	1	NA	SHUNTS	SHUNT 2 POS RED 1=STRIP OF 20		Digi-Key	3M11975-ND	3M	929951-00
53	1	NA	ESD BAG	BAG 8X8" ZIP STATIC SHIELD 1=1EA		Digi-Key	SCP357-ND	SCS	30088
54	1	NA	ESD BOX	SHIPPR CIR BD 10-1/2X8-1/2X2-1/2		Digi-Key	37060-ND	Desco	37060
ECO	1	R33	340K 0.1%	RES SMD 340K OHM 0.1% 1/16W 0603		Digikey	A124740CT-ND	TE	RN73C1J340KBTD
ECO	1	R35?	100K 0.1%	RES SMD 100K OHMS 0.1% 1/10W 0603		Digikey	P100KDBCT-ND	Panasonic	ERA-3AEB104V

Figure 22: SPSC-EVB-R0 BOM 2/2

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

10 EVB Layout Information

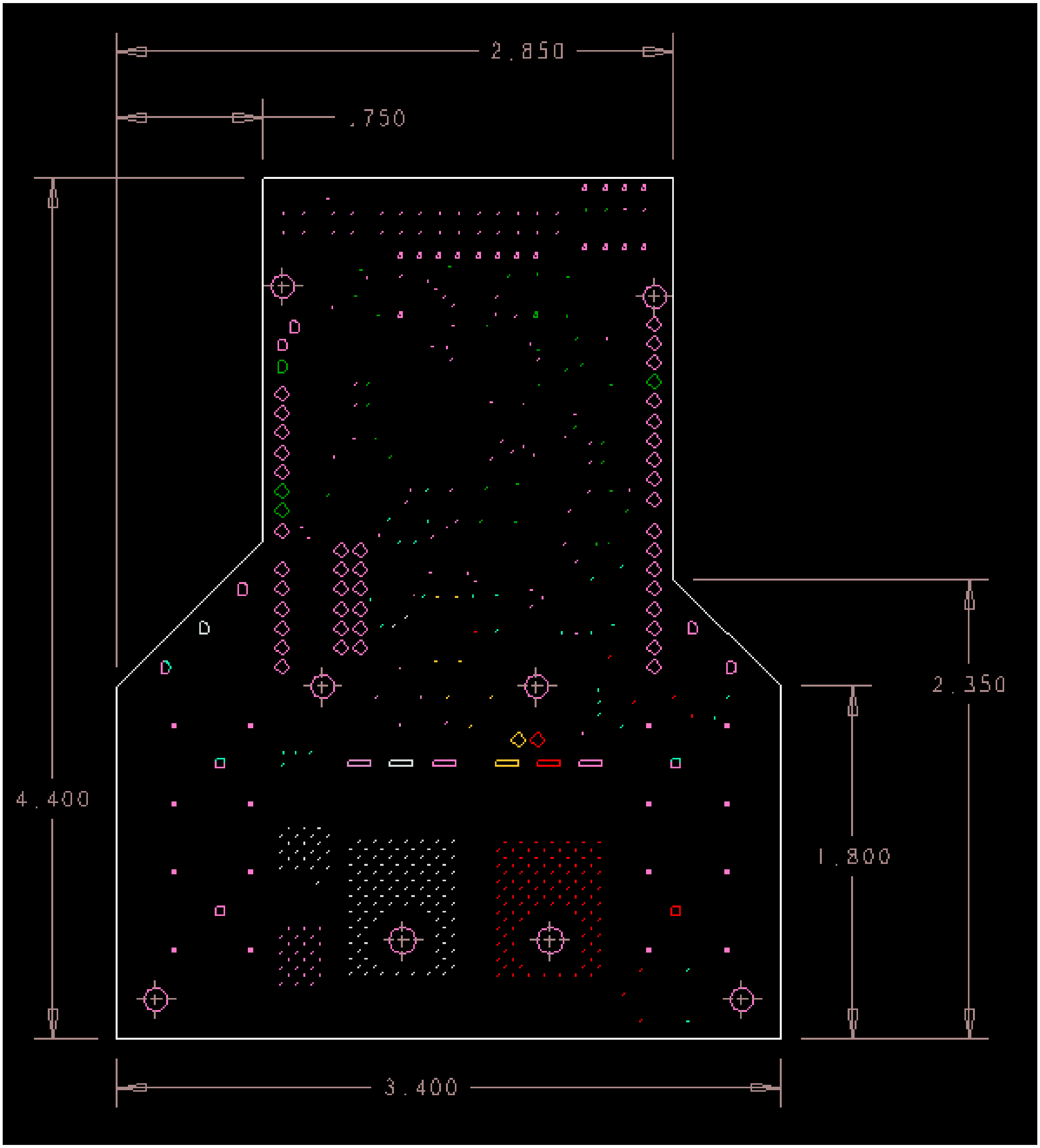

Figure 23: SPSC-EVB-R0 FAB Drawing

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

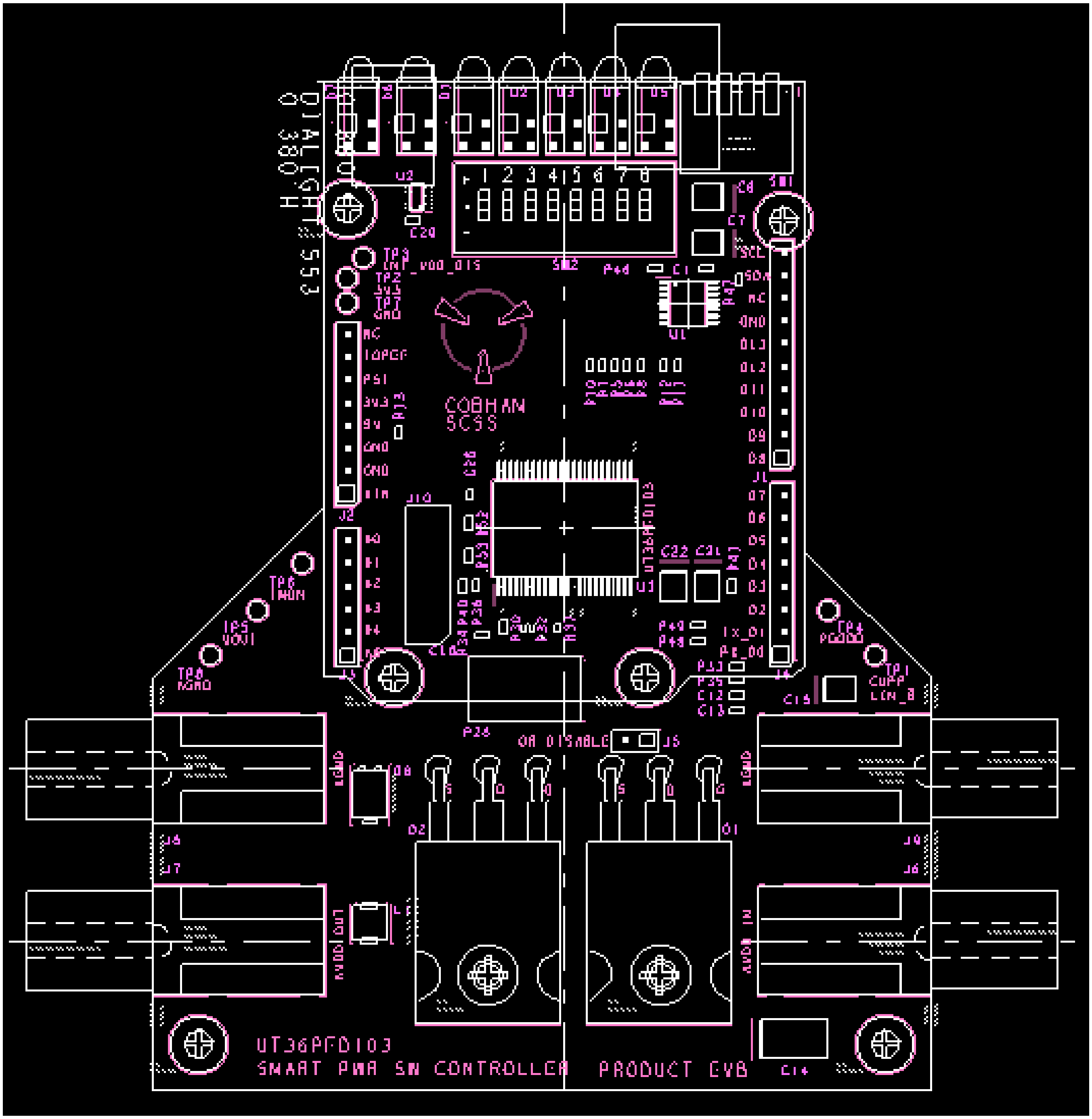

Figure 24: SPSC-EVB-R0 Assembly Top View

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

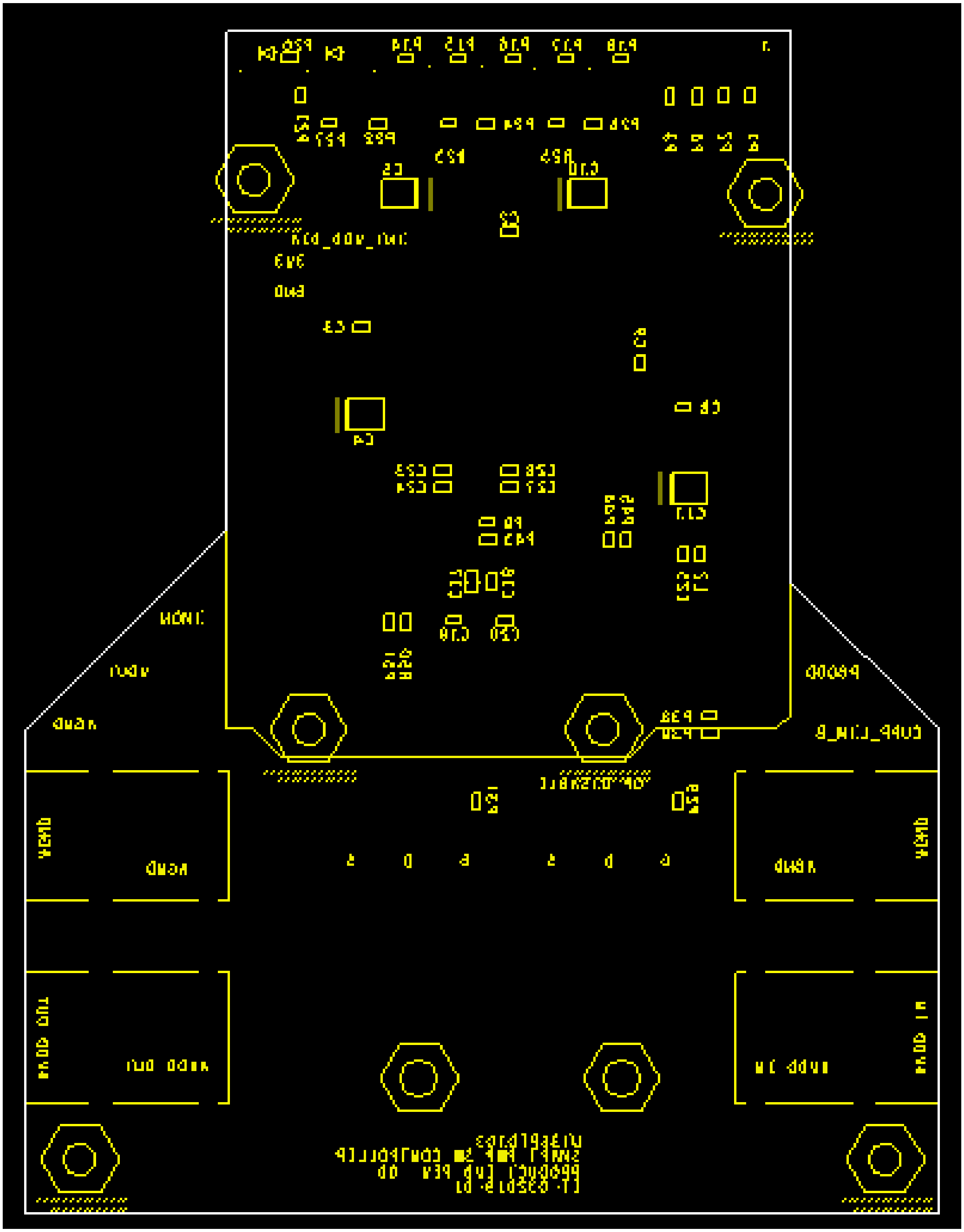

Figure 25: SPSC-EVB-R0 Assembly Bottom View

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

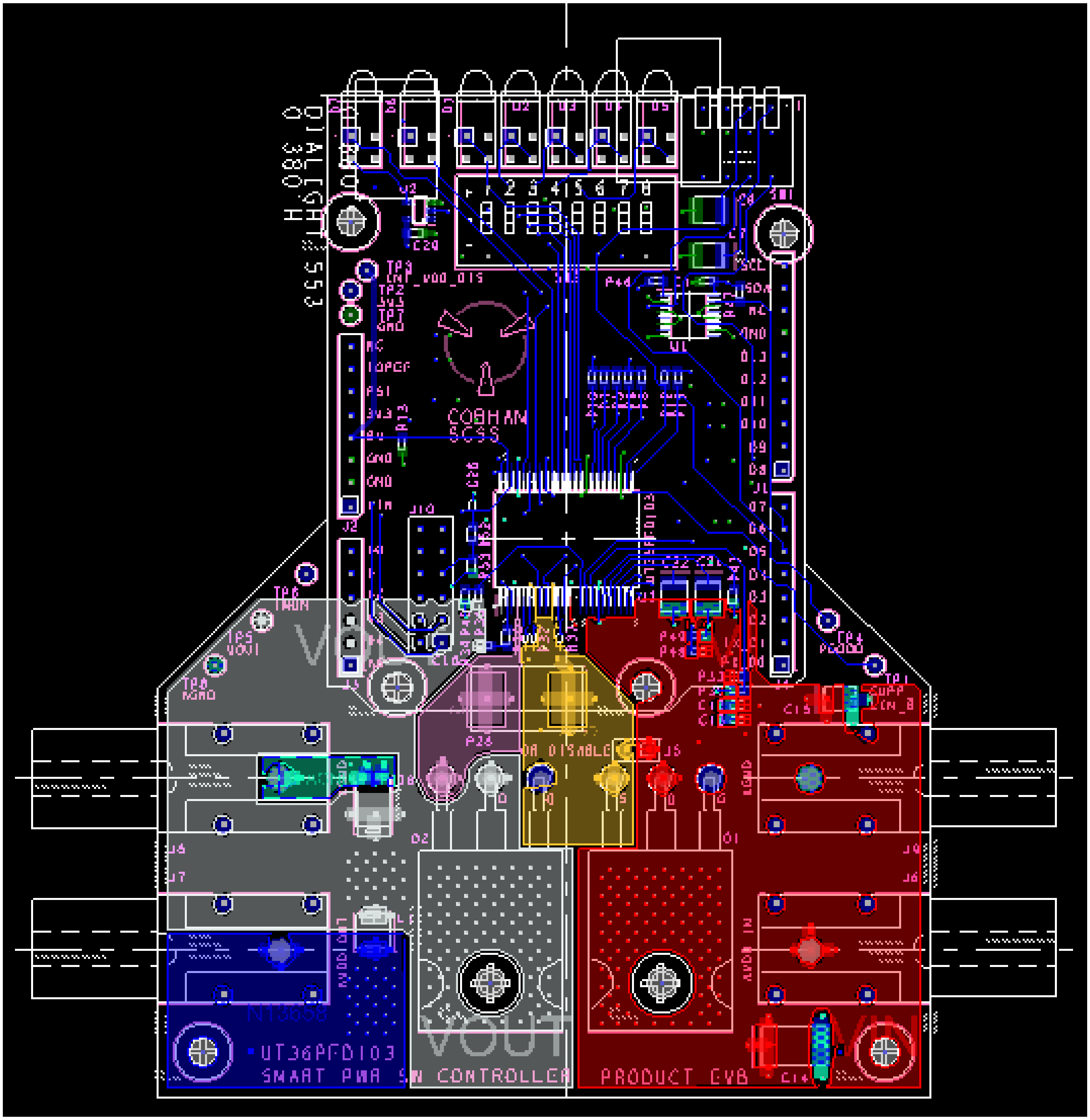

Figure 26: SPSC-EVB-R0 Layer 1 (Top) Etch

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

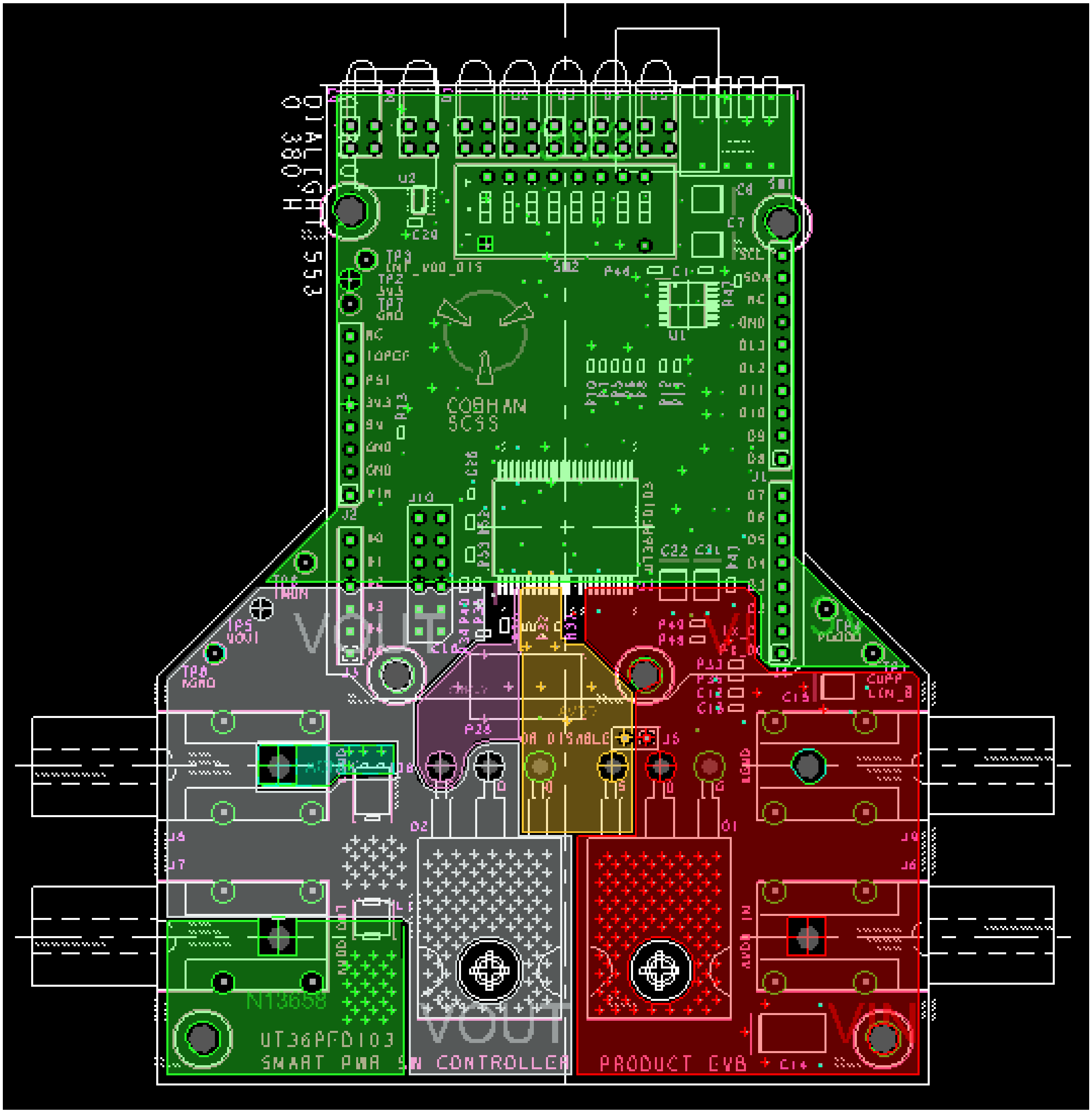

Figure 27: SPSC-EVB-R0 Layer 2 Etch

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

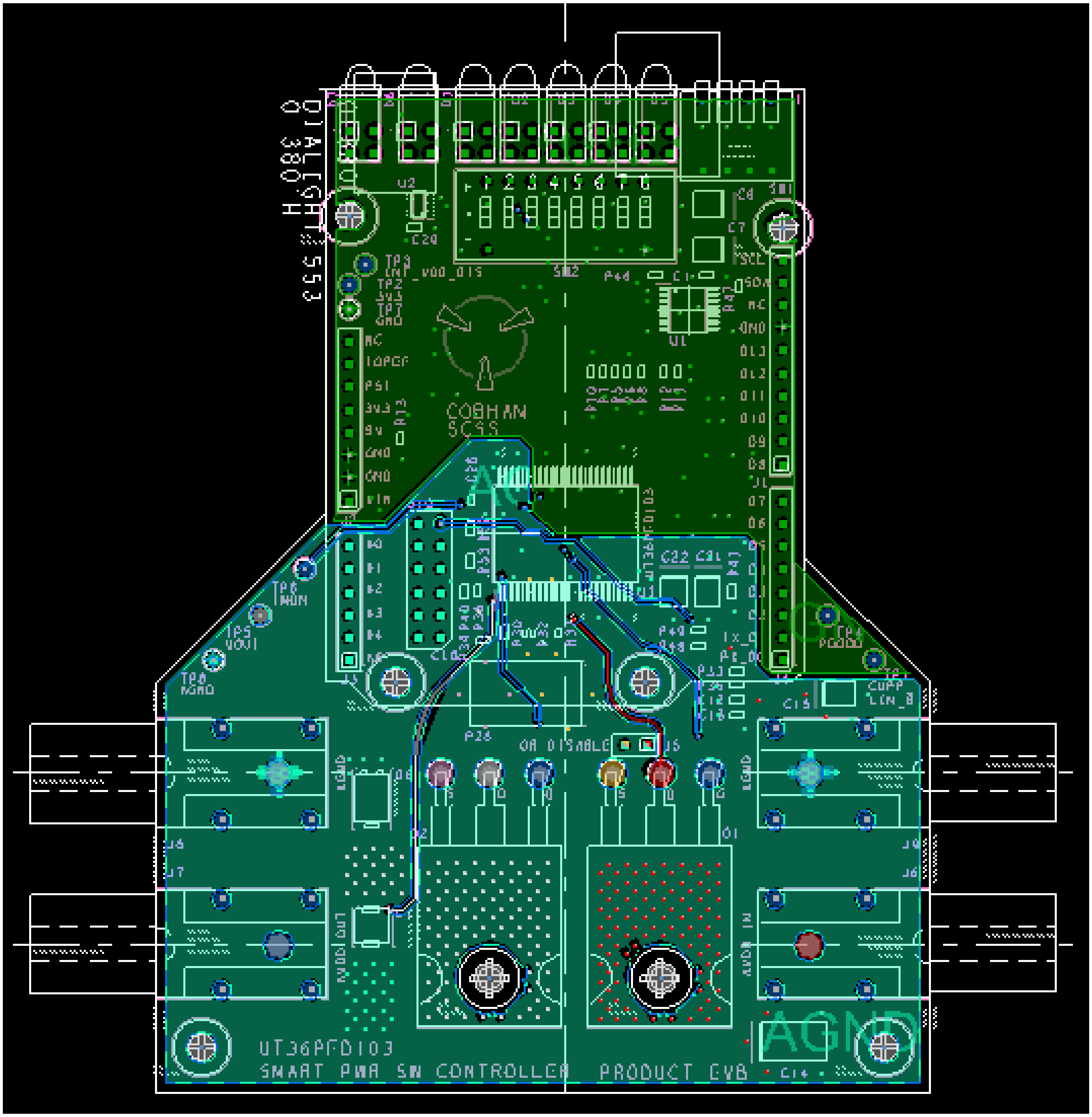

Figure 28: SPSC-EVB-R0 Layer 3 Etch

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

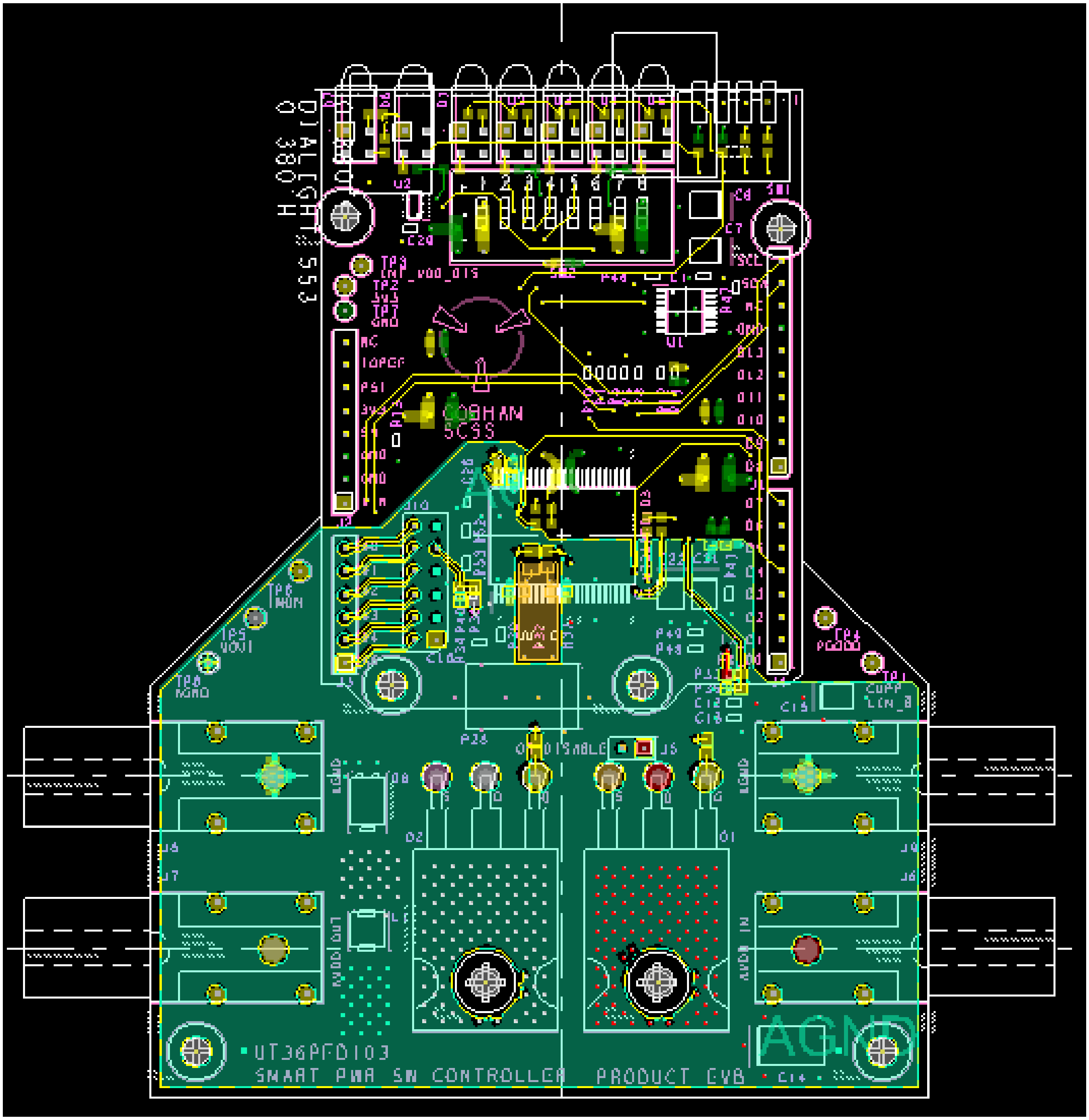

Figure 29: SPSC-EVB-R0 Layer 4 (Bottom) Etch

UT36PFD103 Smart Power Switch Controller

SPSC-EVB-R0 Evaluation Board for UT36PFD103 Smart Power Switch Controller

REVISION HISTORY

Date	Revision	Author	Change Description
August 2019	0	TLM	DRAFT INITIAL VERSION
December 2019	1	TLM	Added links to reference documents. Clarified some figure annotations and made editorial corrections.
7/21/2021	1.0.1	OW	Updated Template; Updated website links

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