

User Guide

3CH-TS13102/3 Combo EVM

Galvanic Isolated Blocking 60V Power Load Switch

Introduction

The Semtech 3CH-TS13102/3 Combo EVM is an evaluation platform for test and experimentation of galvanic isolated blocking 60V power load switch based on the Semtech TS13102 or TS13103 Controller. This evaluation module provides an idea solution for power switch device with bi-directional blocking used for many different application areas, such as power load/rail switching, input supply muxing, isolated supply muxing, HVAC control and so on.

Objectives

The objective of this User Guide is to provide a fast, easy and thorough method to experiment with and evaluate the Semtech solutions for this isolated power switch. Semtech offers a range of solutions to meet the needs of a wide range of system developers. Developers are provided with all the information on how this EVM was built as a starting point for their own designs using the TS13102 or TS13103 and other Semtech components.

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Product Description

TS13102/TS13103 is a galvanic isolated 60V power switch device with bi-directional blocking. The device includes a single integrated 225mOhm high voltage FET, allowing high efficiency switching of power loads or other high current applications. The 3-channel TS13102/3 Combo EVM supports galvanic isolated 3-channel 60V rated switches, which can be independently supplied from 24VAC supply.

TS13102/3 Combo EVM board has the following features:

1. Supports independent 3-channel load switches based on TS13102 or TS13103 devices.
2. Provides the ability for the switch to stay on (latched-on) even when the CLK from micro-controller cease to exist.
3. Dithering feature enabled, where the switch is opened for a time much less than time-constant of relay switch, thereby allowing all 3 TS13102s or TS13103s powered and all 3 switches remain closed.
4. The TS13102/3 Combo includes several protection features. Each FET has an integrated over-current shut-down to prevent device damage during short-circuit or other unusually high load conditions. If an over-current event is detected for a time the FET is latched off until the CLK turn off sequence is given.
5. Only a pair of GPIO pins can manage the command and control for up to 8 loads as long as each TS13102 has a unique address.
The address pins are set for TS13102(AD2/AD1/AD0) or TS13103(AD1/AD0) using hard wired connections according to the Address Configuration Table shown in the Figure1; but In the TS13103 device, only up to 4 loads can be controlled, AD2 must be equal to AD1 in addressing configuration command (A2A1A0) by MCU's firmware.

TS13102 Address Configuration Table			
Load#	AD2(A2)	AD1(A1)	AD0(A0)
0	SYSM	SYSM	SYSM
1	SYSM	SYSM	VDD
2	SYSM	VDD	SYSM
3	SYSM	VDD	VDD
4	VDD	SYSM	SYSM
5	VDD	SYSM	VDD
6	VDD	VDD	SYSM
7	VDD	VDD	VDD

TS13103 Address Configuration Table			
Load#	AD2(A2)	AD1(A1)	AD0(A0)
0	SYSM	SYSM	SYSM
1	SYSM	SYSM	VDD
2	VDD	VDD	SYSM
3	VDD	VDD	VDD

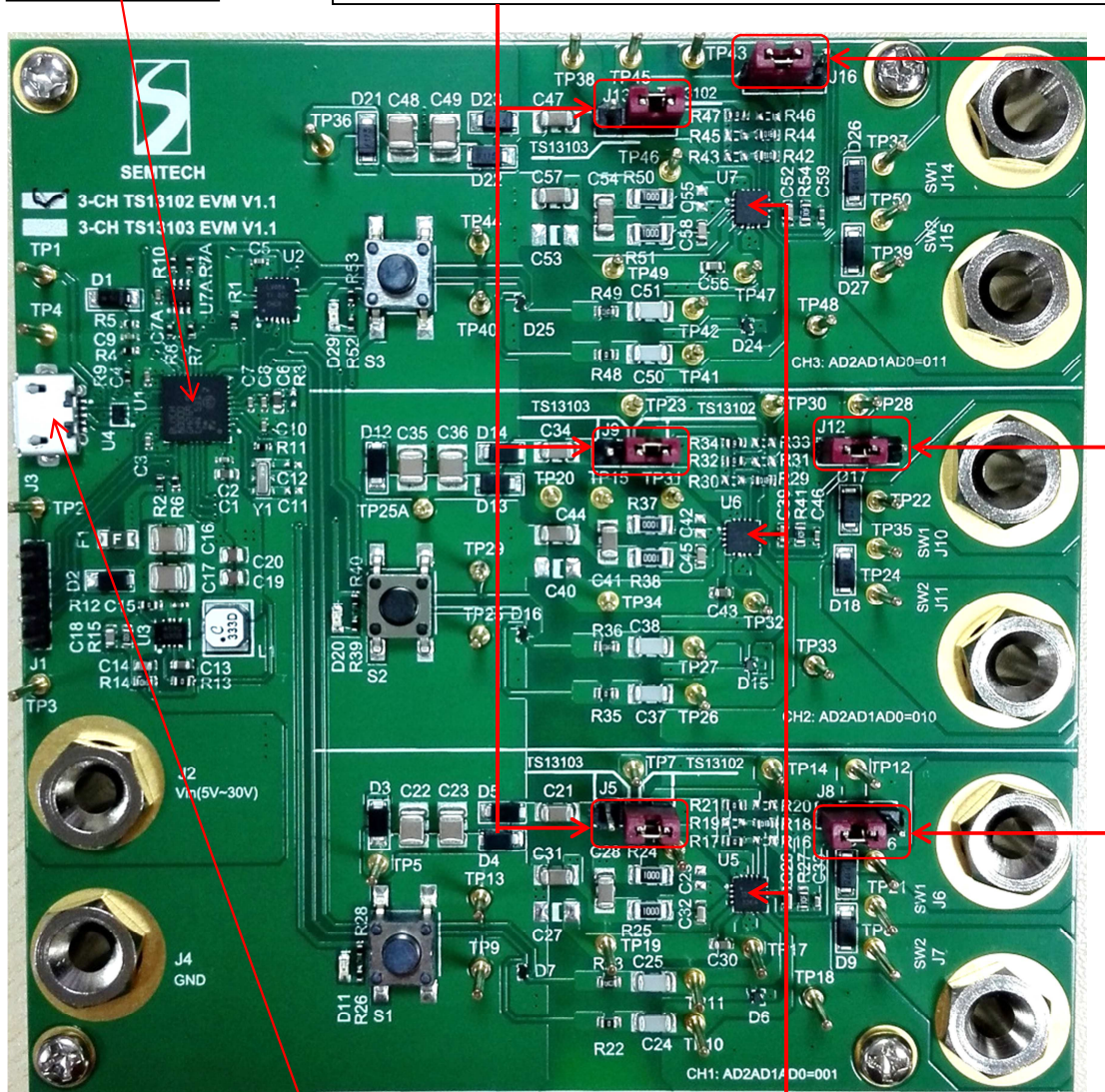
6. The TS13103 offers galvanic power transfer from the system AC supply to provide power to the low voltage controller domain; but there is no such function inside TS13102 device.

3-CH-TS13102/3 Combo EVM Jumper settings for TS13102 device

Chip selection:

1. Short Pin2 and Pin3 on right: TS13102 will be used.
2. Short Pin1 and Pin2 on left: TS13103 will be used.

Microcontroller



USB interface

TS13102

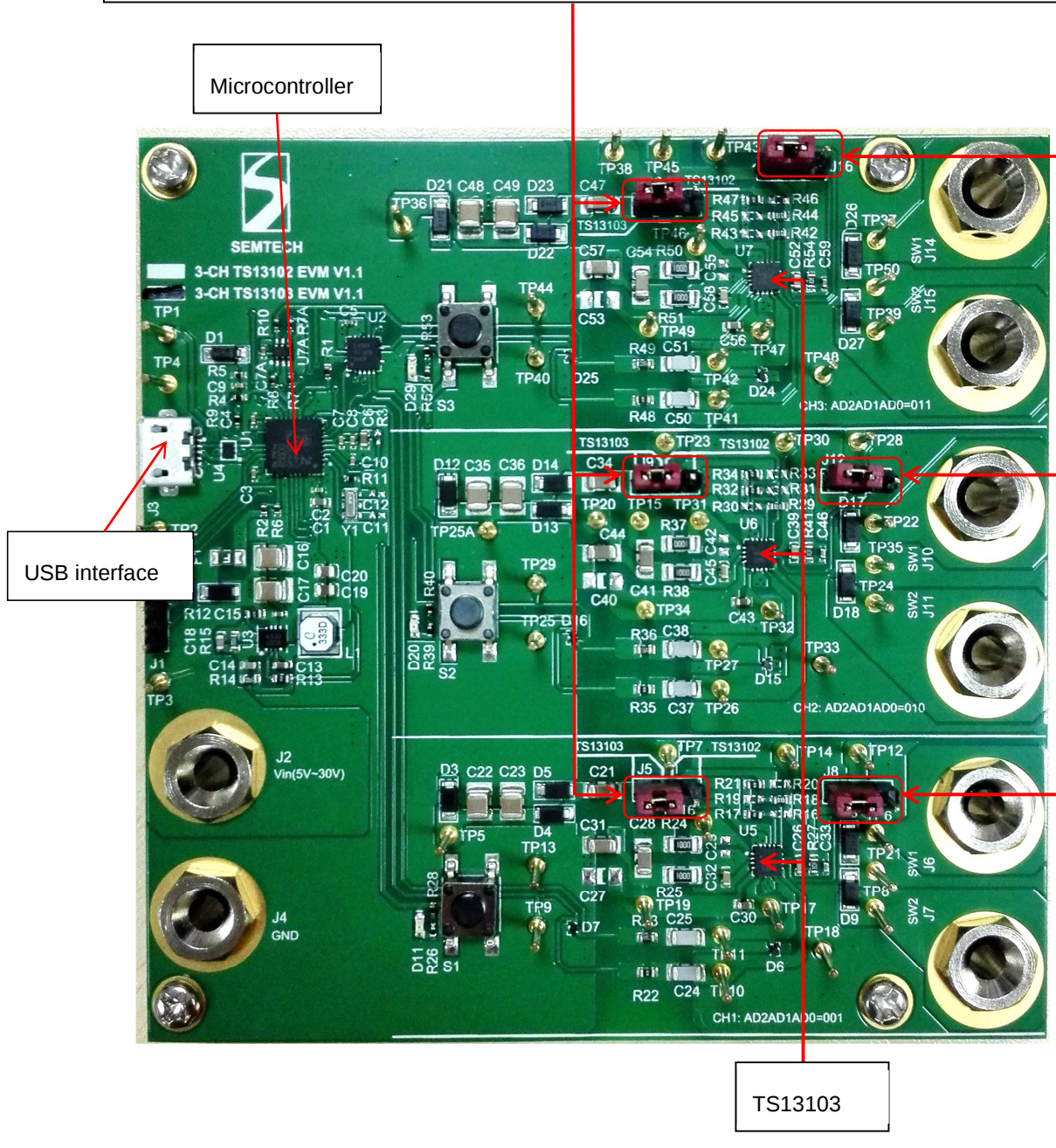
Latching or Non-latching configuration:

1. Short Pin2 and Pin3 on right: Non-latching mode
2. Short Pin1 and Pin2 on left: Latching mode

3-CH-TS13102/3 Combo EVM Jumper settings for TS13103 device

Chip selection:

3. Short Pin2 and Pin3 on right: TS13102 will be used.
4. Short Pin1 and Pin2 on left: TS13103 will be used, Enable power transfer function.

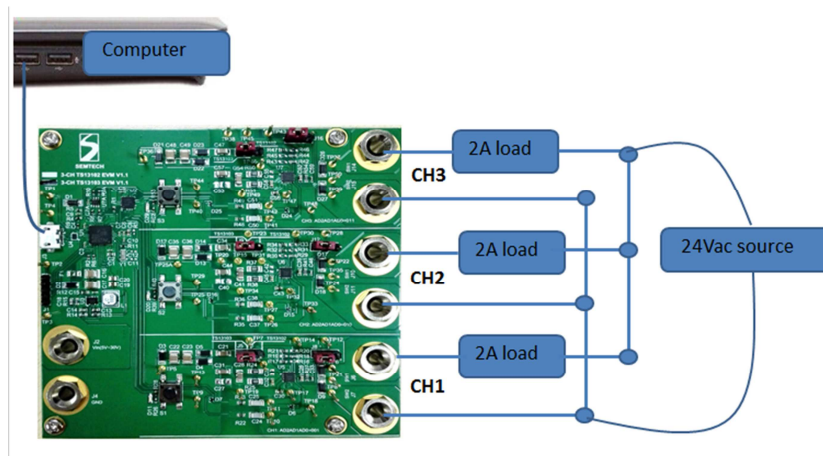
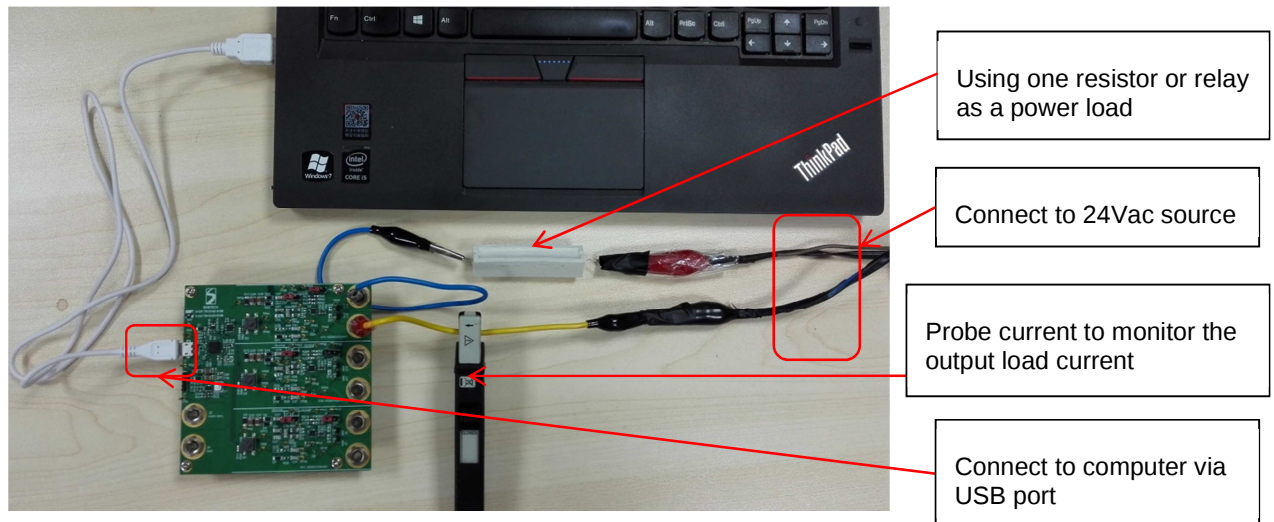


Latching or Non-latching configuration:

3. Short Pin2 and Pin3 on right: Non-latching mode
4. Short Pin1 and Pin2 on left: Latching mode

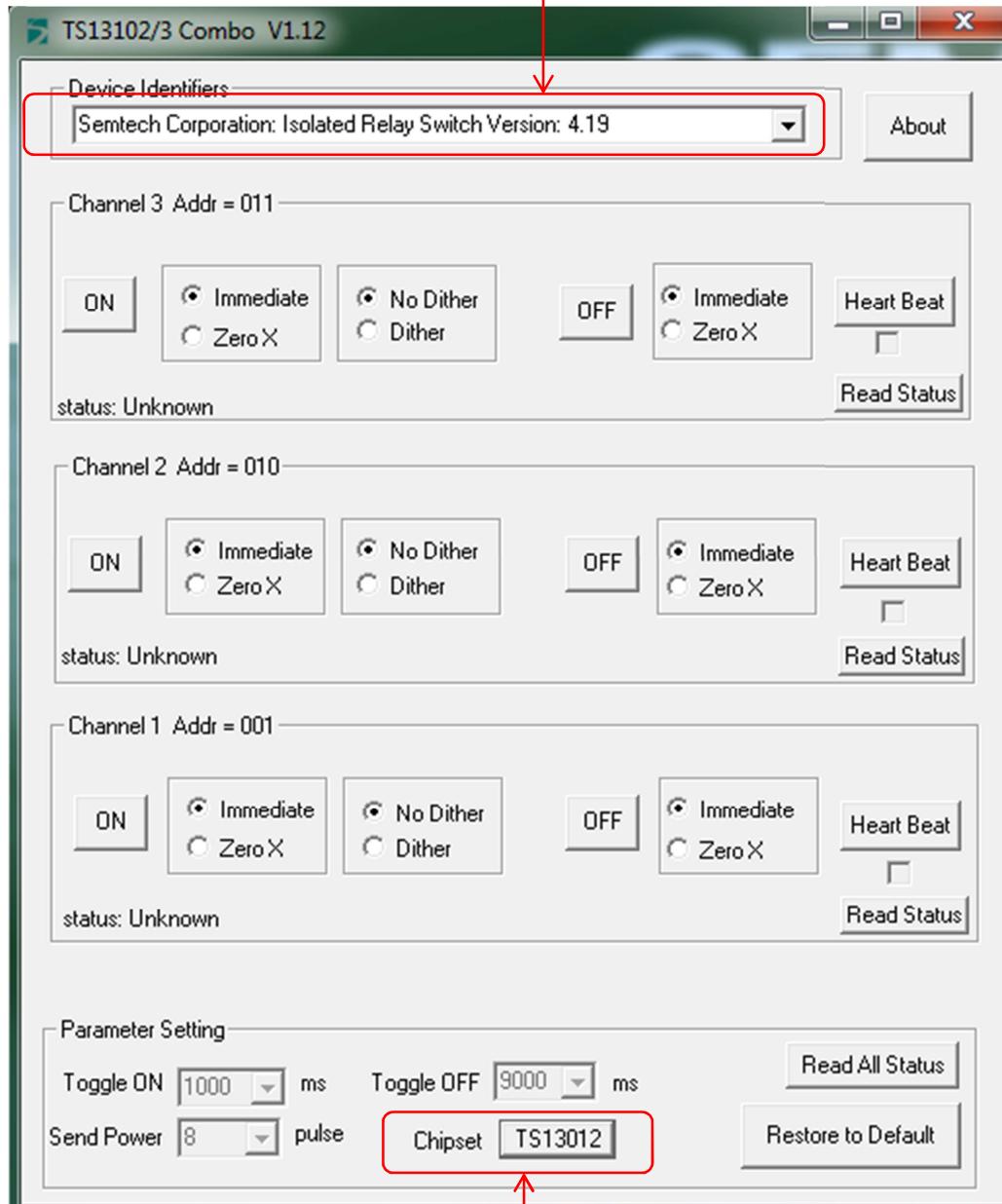
Standard Use

1. Verify that all power sources are either off or have their outputs disabled before proceeding.
2. The test set-up includes wires connection as shown below.



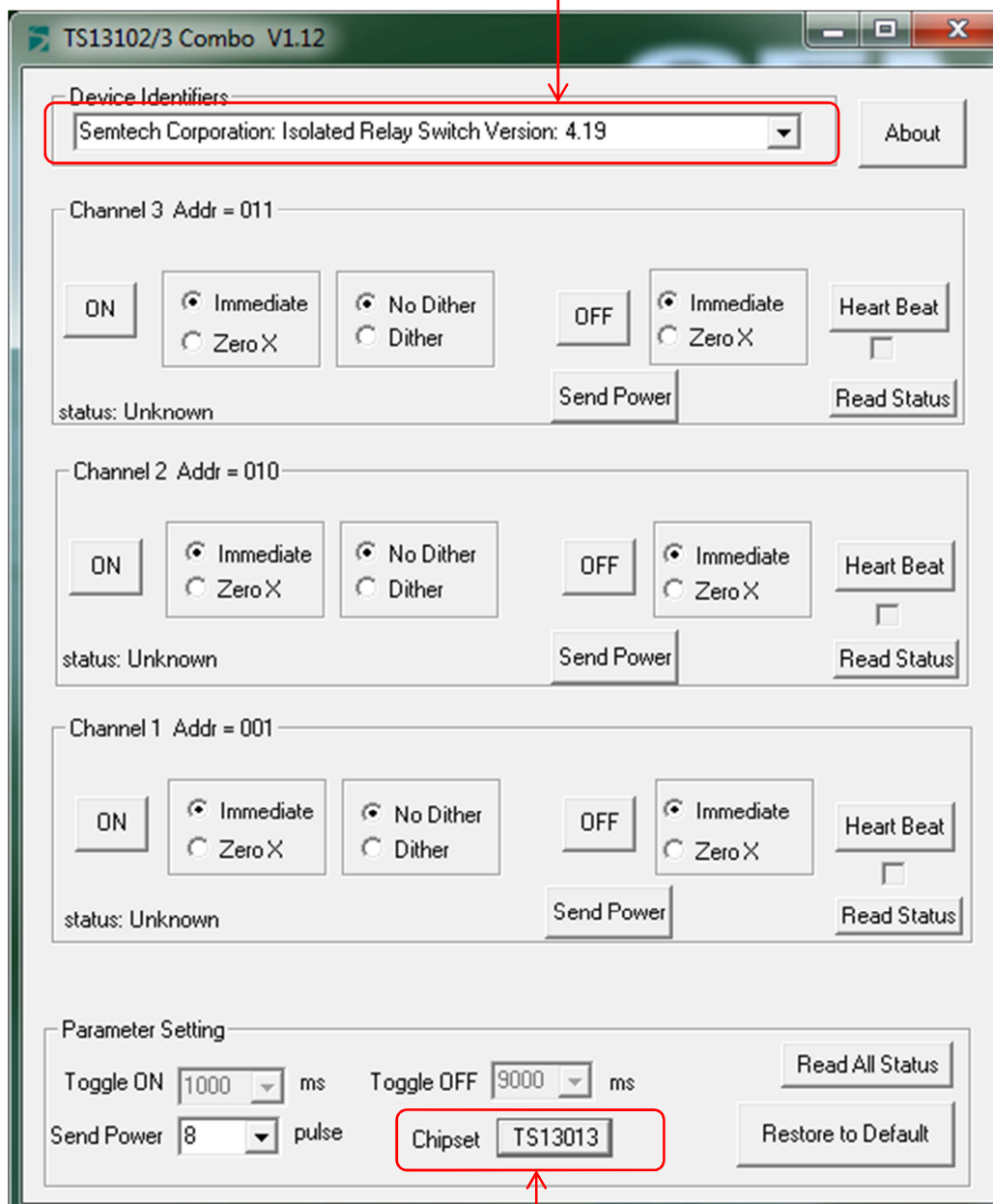
3. Connect the USB cable between TS13102/3 Combo EVM and computer.
4. Connect R-load or Relay and 24V AC source, the max output RMS current is 2A.
5. Adjust the AC source to the desired input voltage range, such as 24Vac/2A.
6. Double-click the icon (TS13102_3_combo) to open the GUI (TS13102/3 Combo V1.12), then one window interface will appear.

If the firmware version appears, Switches communicates with MCU successfully.



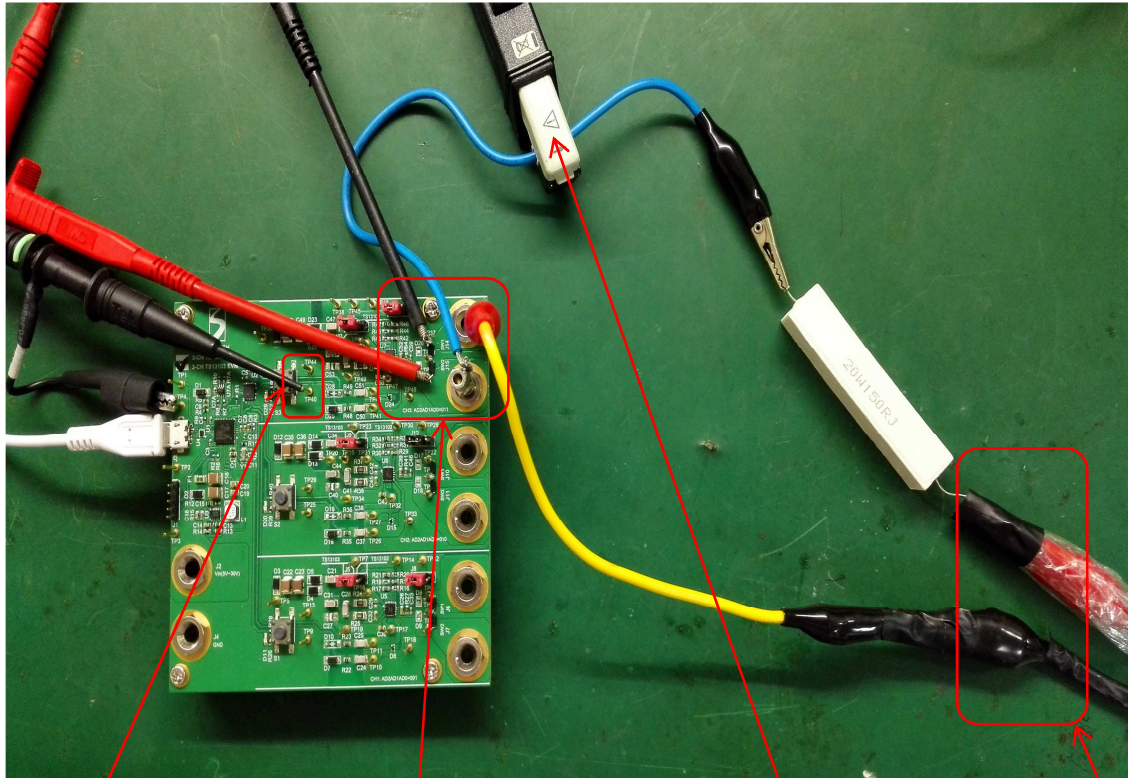
Clicking this button is to select responding device, here TS13102 is selected to evaluate.

If the firmware version appears, Switches communicates with MCU successfully.



Clicking this button is to select responding device, here TS13103 is selected to evaluate.

7. Turn on the AC power source, if it is necessary, by using one current probe observe the output load current and one voltage probe at CLK/DATA pin monitor the clock/Data waveform, or using one diff-probe at SW1 and SW2 for voltage stress on switches.



Voltage probe for CLK/DATA timing

Diff-Voltage probe for SW1/SW2 load terminals

Current probe for output load current

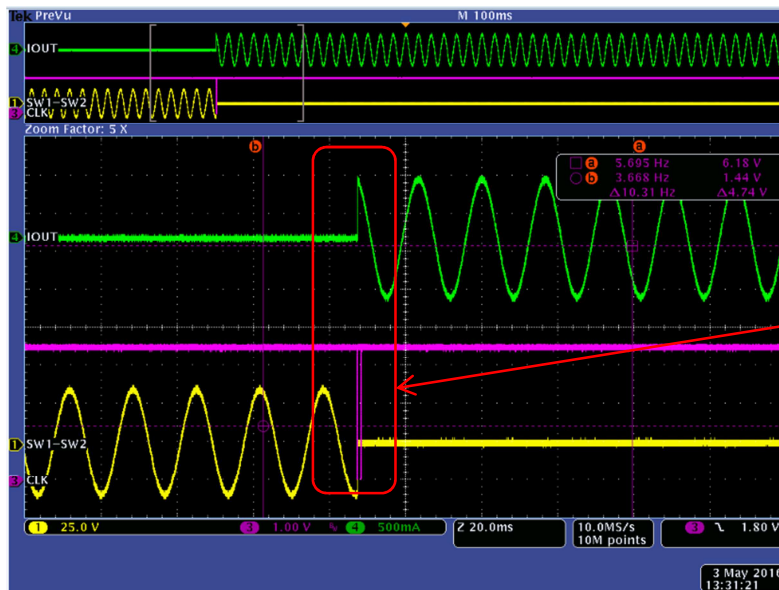
Connected to 24V AC source

8. The GUI only support 3 channels command or control, taking TS13103 for example, channel 3(address configuration:AD2/AD1/AD0=111) selected to demonstrate turn-on or turn-off function; there are too many commands sent to the switches for various operation modes.

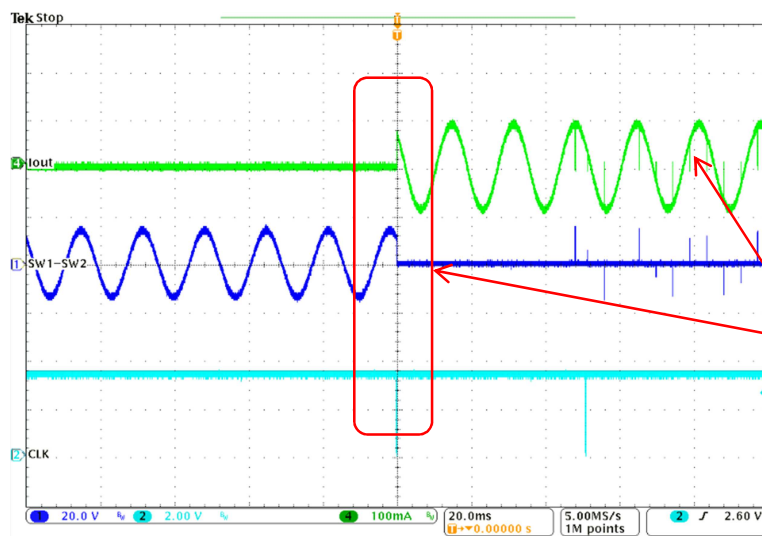
9. immediate turn-on and immediate turn-off function demonstration:

Click the "ON" button after selecting "Immediate" and "No Dither" to switch on the relevant relay without dither mode immediately(the physical push button on the board are not supported).



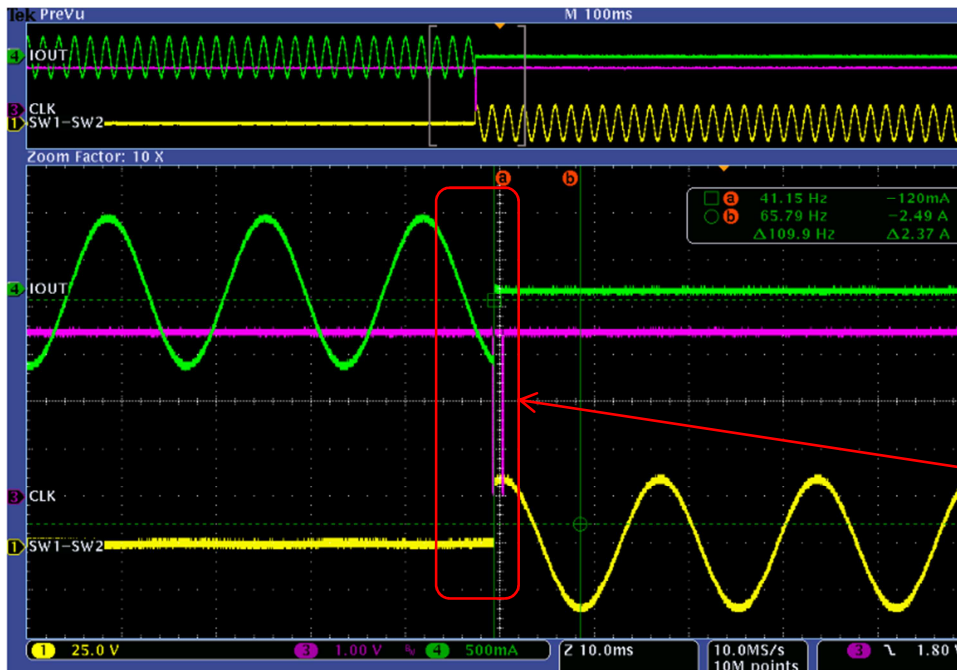
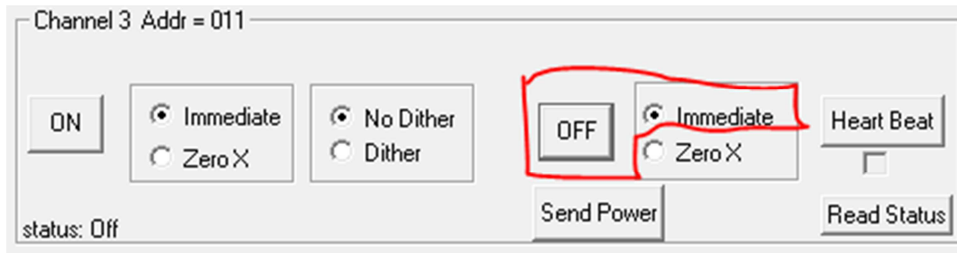


Click the “ON” button after selecting “Immediate” and “Dither” to switch on the relevant relay with dither mode immediately(@Vac<12V);



10.immediate turn-off function demonstration:

Click the “OFF” button after selecting “Immediate” to switch off the relevant relay immediately (the physical push button on the board are not supported).

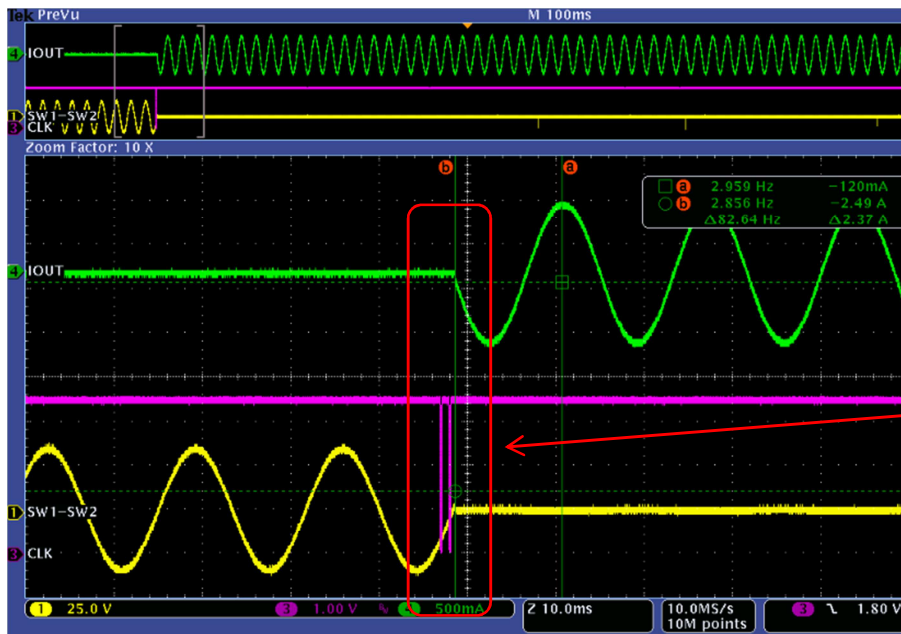


Immediate turn-off

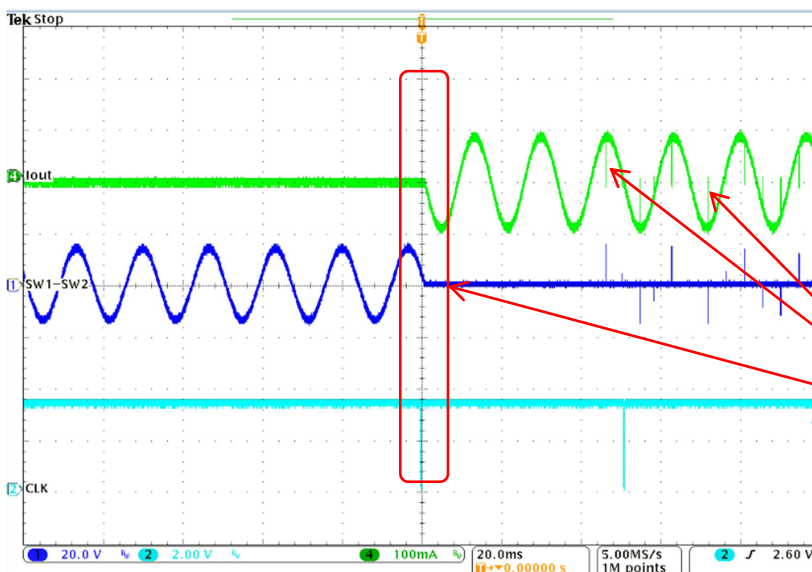
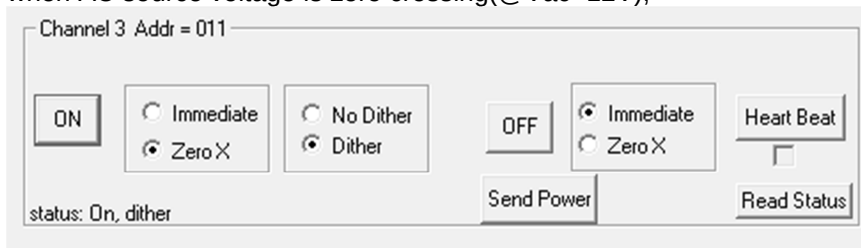
11.zero-crossing turn-on and zero-crossing turn-off function demonstration:

Click the “ON” button after selecting “Zero X” and “No Dither” to switch on the relevant relay without dither mode when AC source voltage is zero crossing;

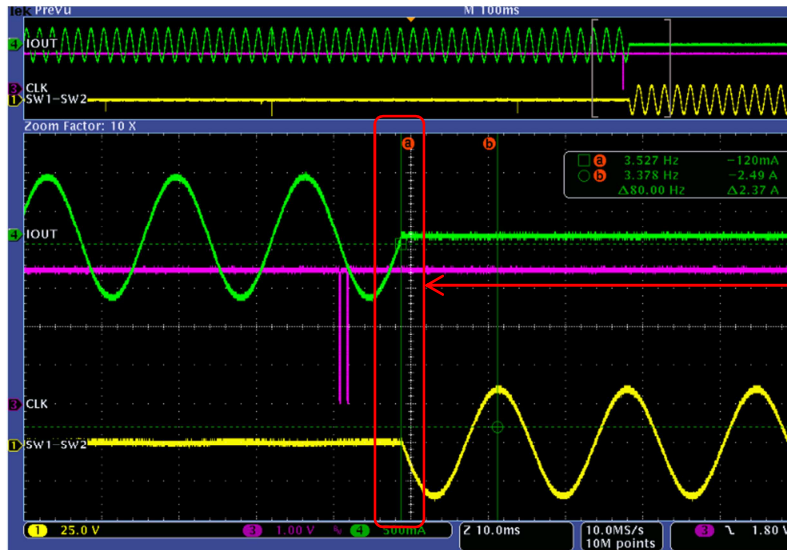
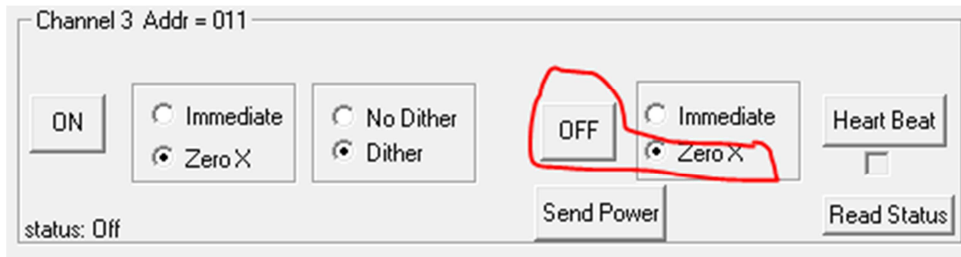




Click the “ON” button after selecting “Zero X” and “Dither” to switch on the relevant relay with dither mode when AC source voltage is zero crossing (@Vac<12V);

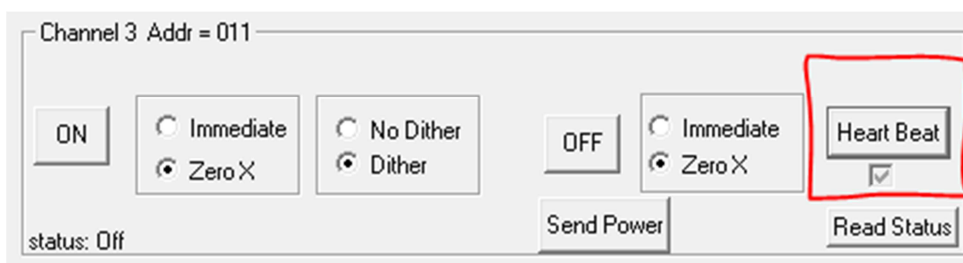


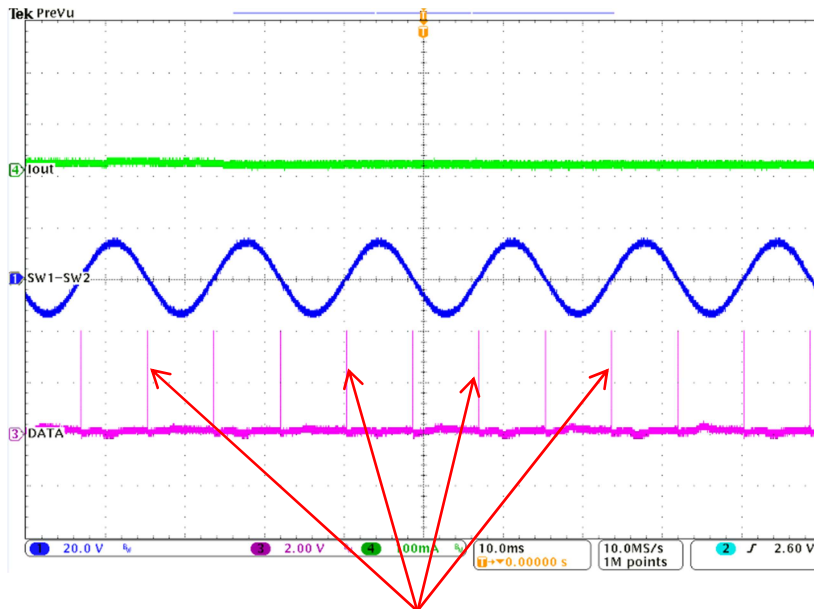
Click the “OFF” button after selecting “Zero X” to switch off the relevant relay immediately when AC source voltage applied to SW1/SW2 is zero crossing.



Zero-crossing turn-off

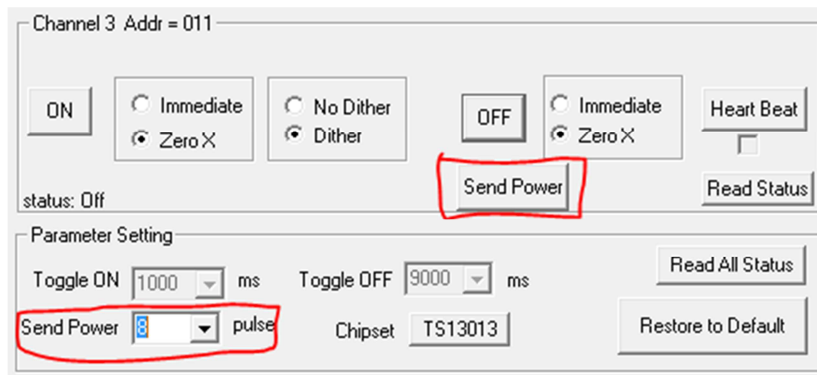
12. Click the “Heart beat” button to activate the heart-beat signal (one pulse) from DATA pin which is synchronous with zero crossings of AC waveform when the switch is off. If detect the heart beat signals, the GUI shows in accordance with the following pattern.

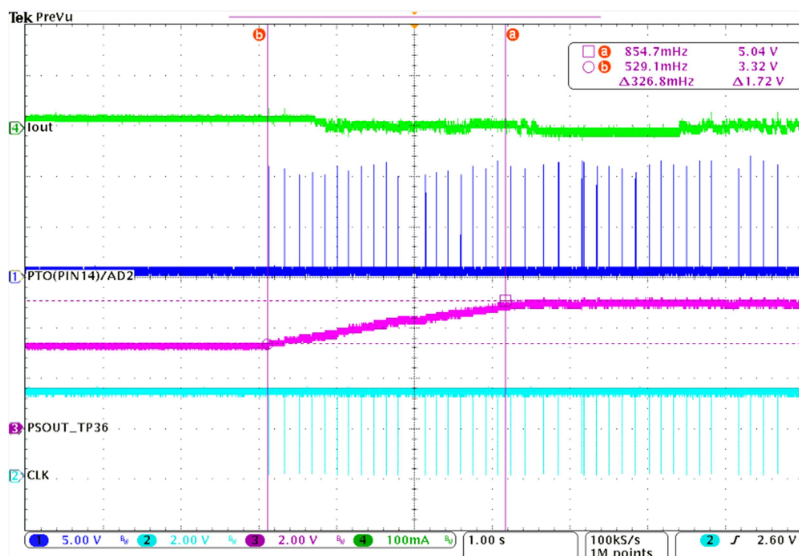
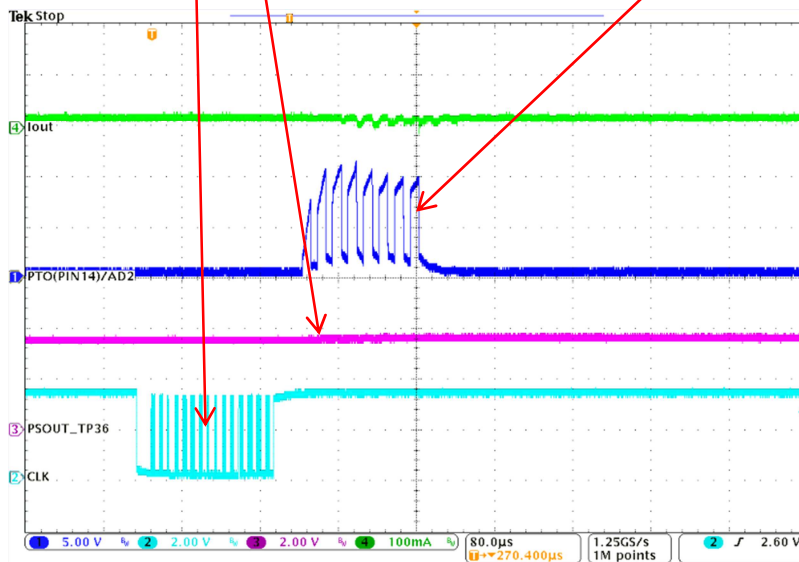
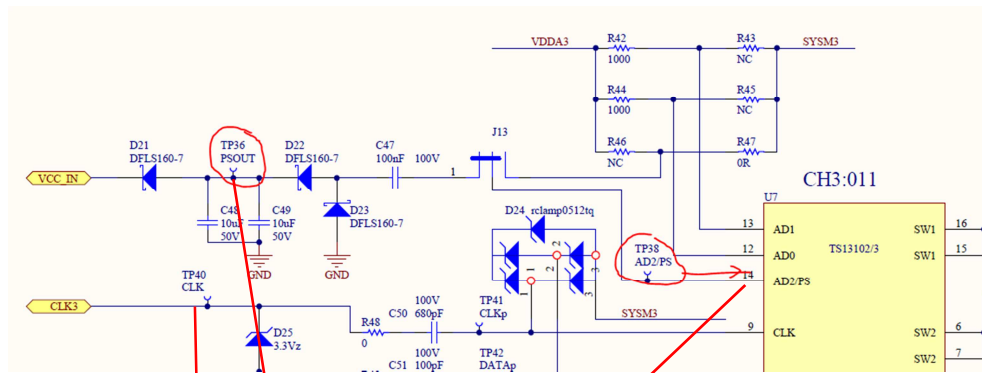




Heart-beat pulses sent from DATA pin when the AC waveform is zero crossing.

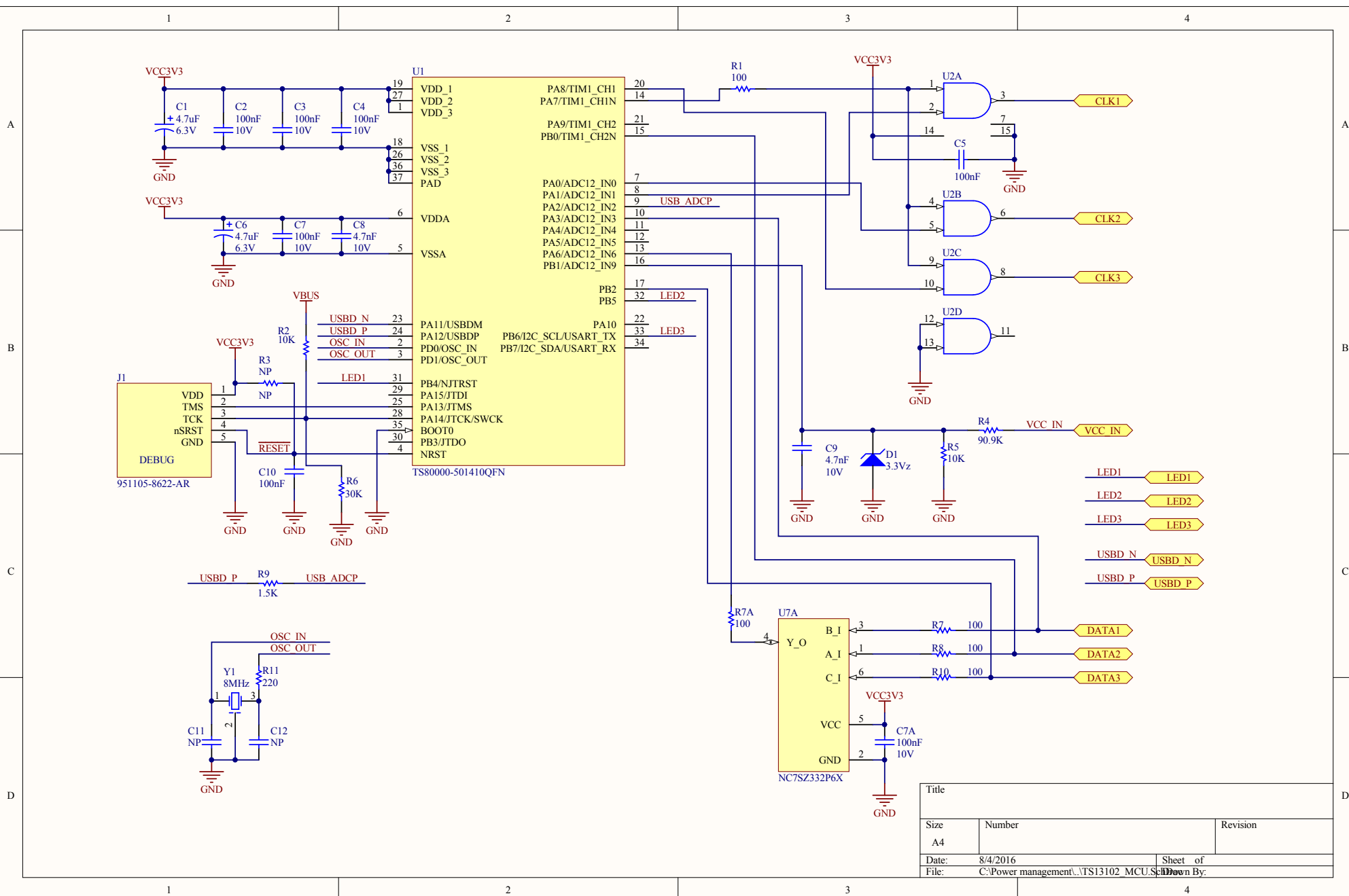
13. Click the “Send Power” button after selecting the numbers of pulses to offer galvanic power from AC supply to low voltage controller or others by PTO (Pin14).

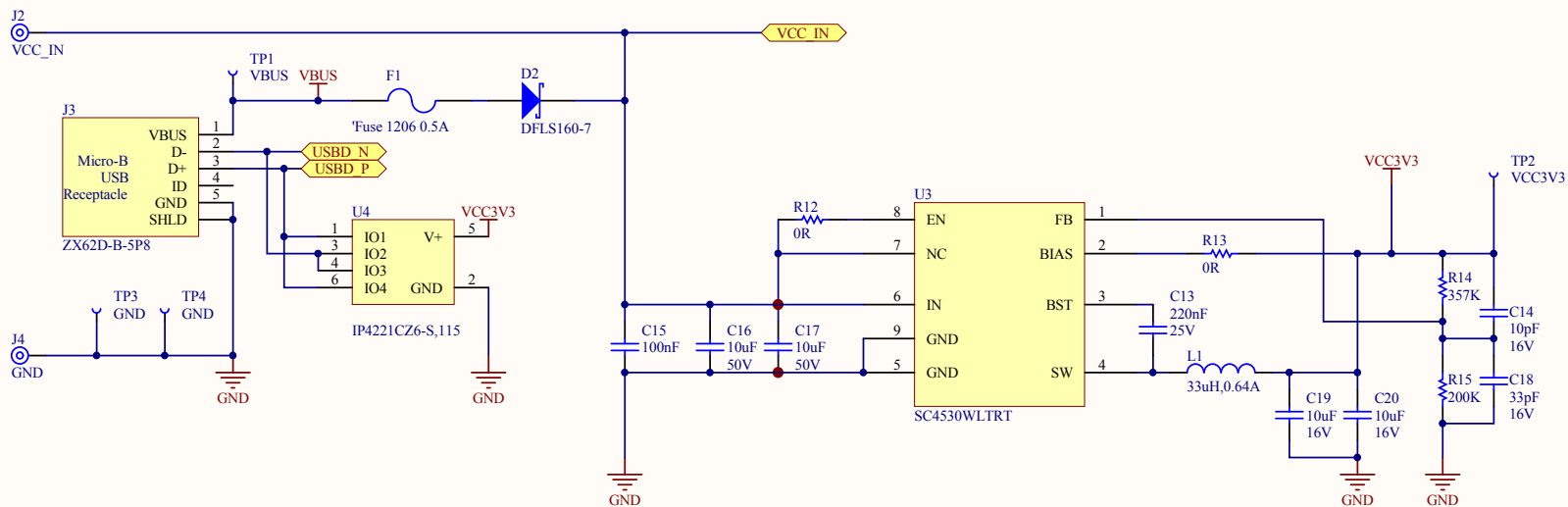




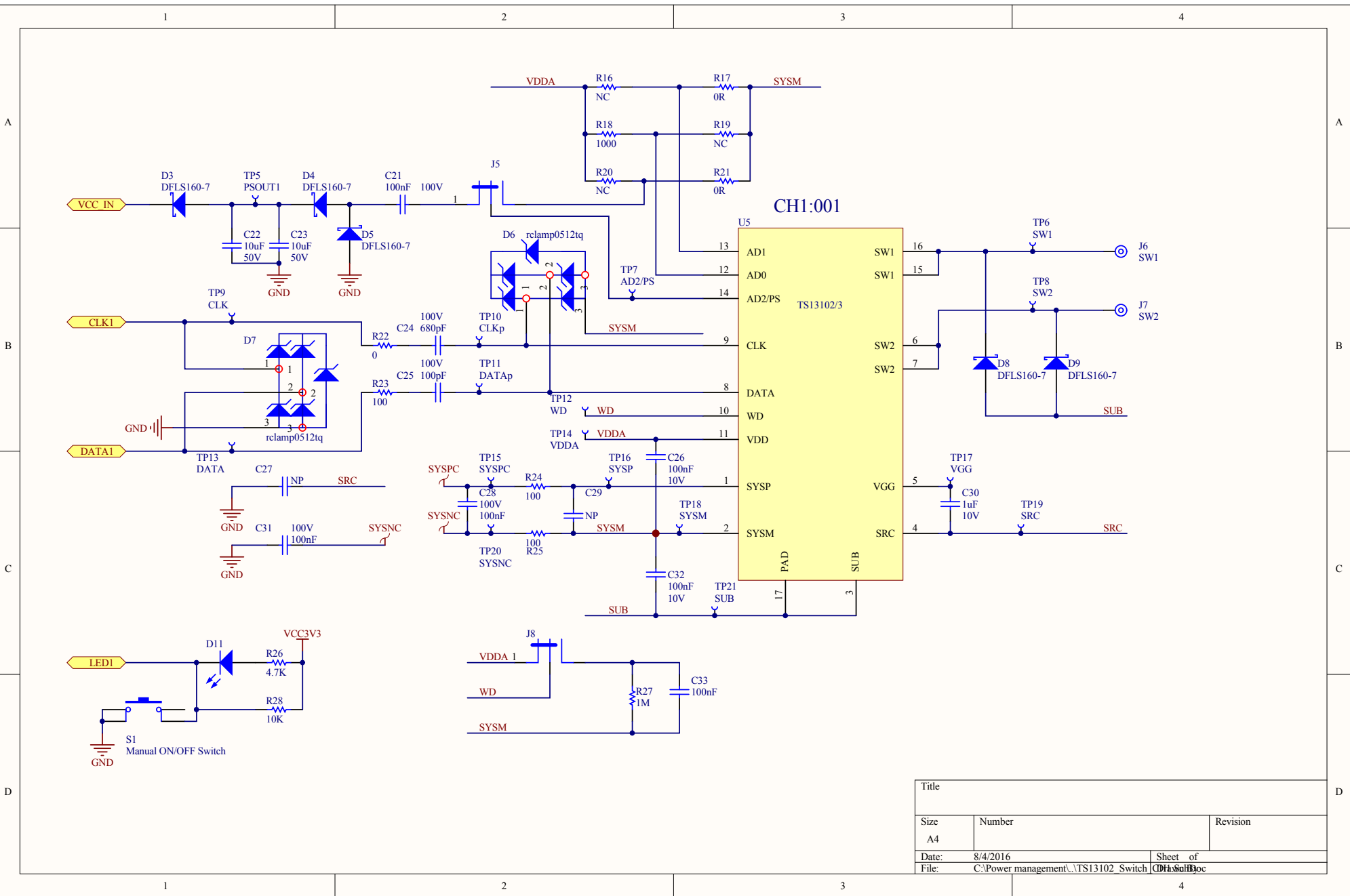
14. Turn off AC power source and disconnect all connections after their function verification for all channels.

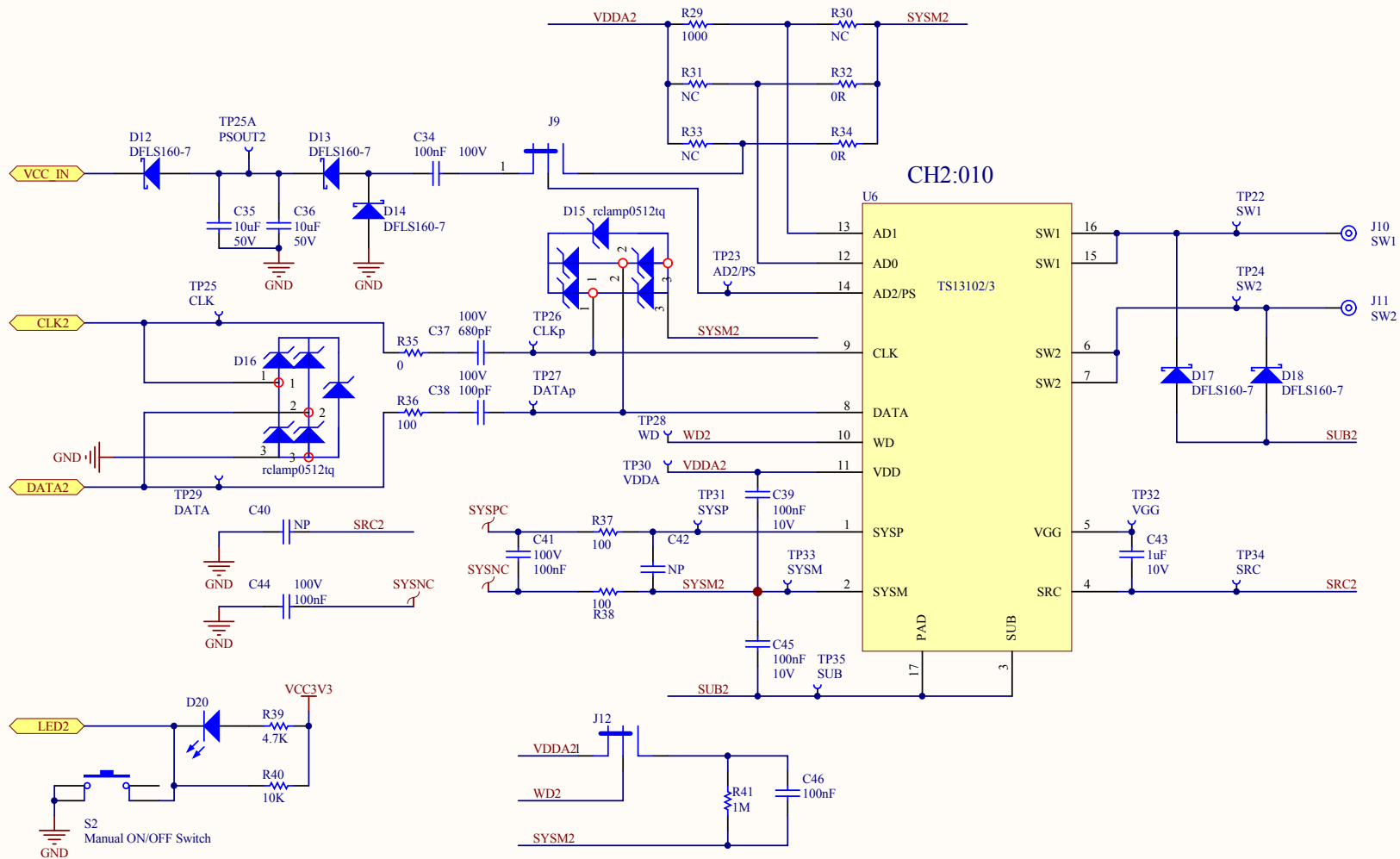
A. Schematic



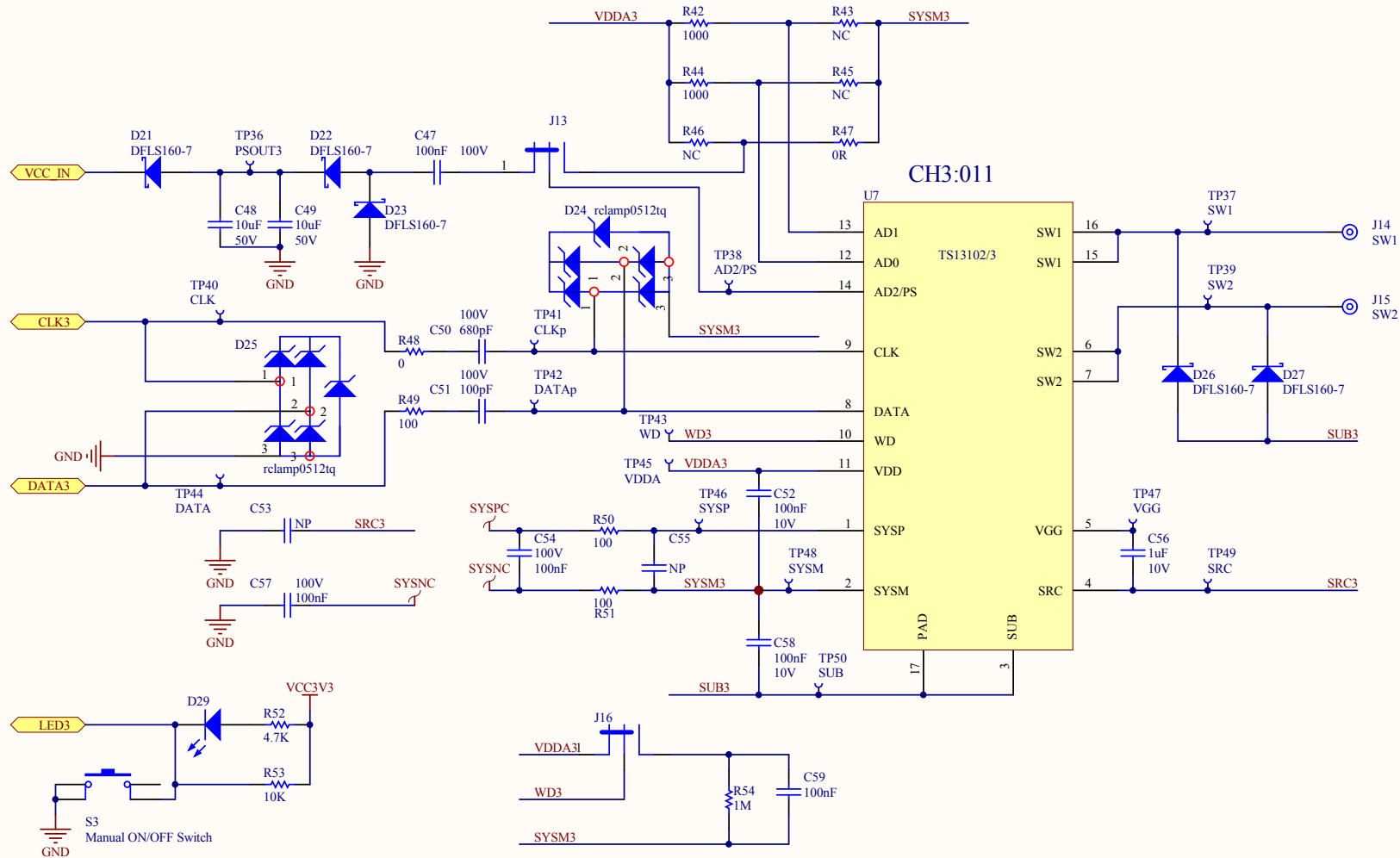


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Date:	8/4/2016	Sheet of
File:	C:\Power management\TS13102 POWER	By:





Title		
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Date:	8/4/2016	Sheet of
File:	C:\Power management\TS13102 Switch	CD3 SubDoc

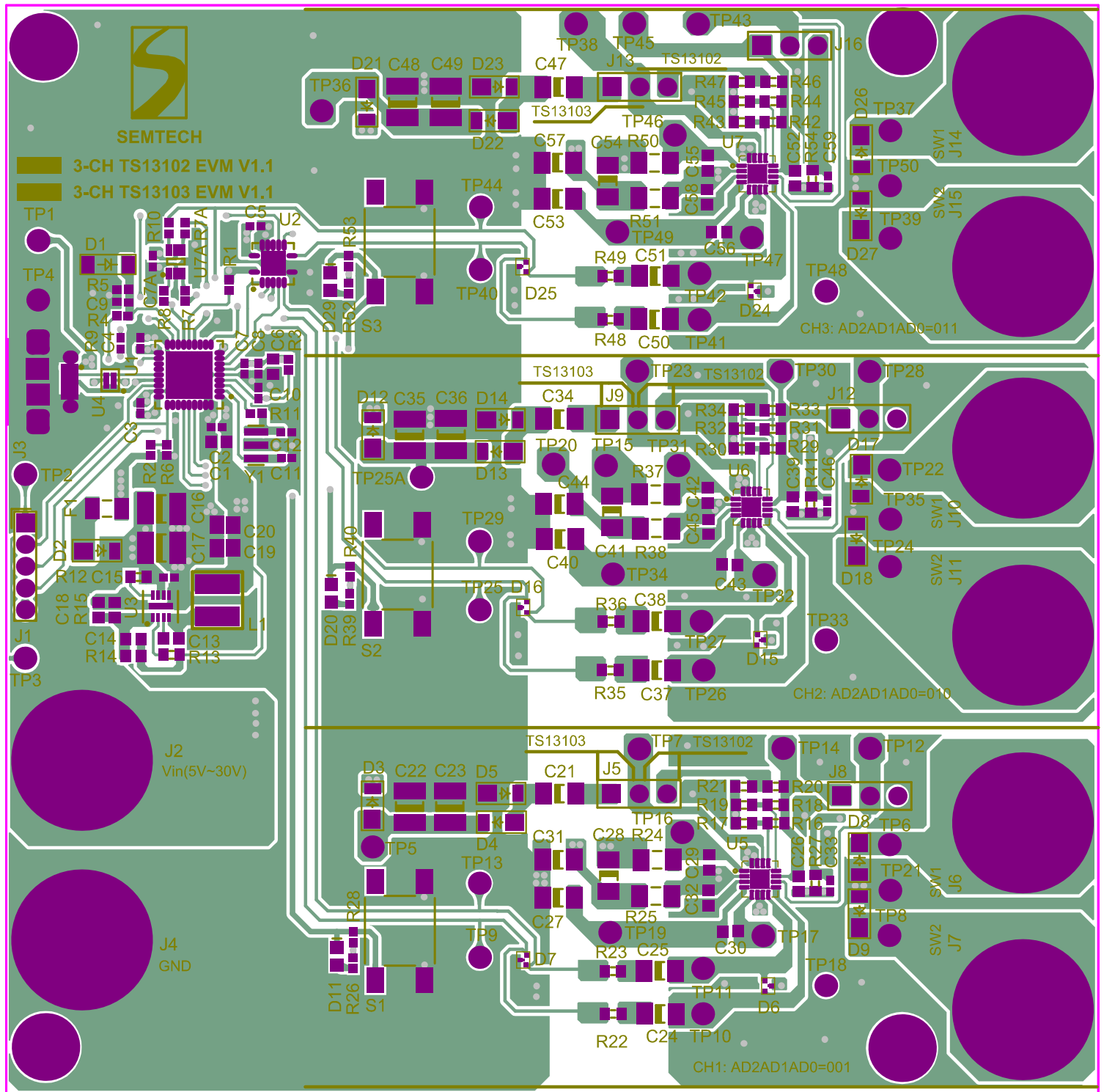


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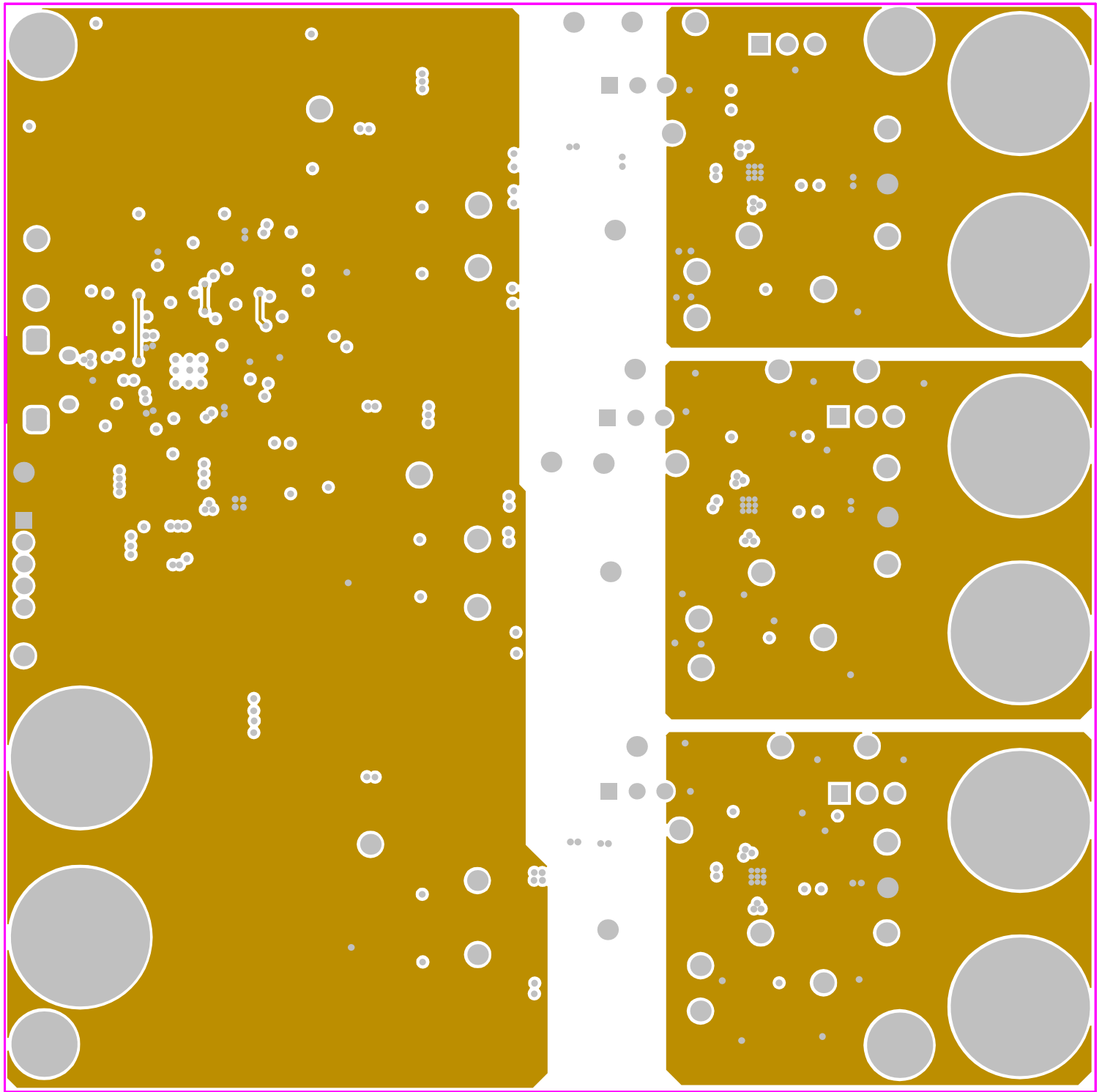
B.Bill Of Materials “BOM”

Designator	Description	Value		Footprint	Manufacturer	ManufacturerCode	Quantity
C1, C6	Capacitor	4.7uF	6.3V	CAPC0603L	Taiyo Yuden	JMK107BJ475KA-T	2
C2, C3, C4, C5, C7,C7A, C10	Capacitor	100nF	10V	CAPC0402L			7
C33, C46, C59	Capacitor	2.2uF	10V	CAPC0402L	'Murata or others	GRM155C71A225KE11D	3
C15	Capacitor	100nF	50V	CAPC0402L			1
C8, C9	Capacitor	4.7nF	10V	CAPC0402L			2
C11, C12	Capacitor	NP	NP	CAPC0402L			2
C13	Capacitor	220nF	10%,0603	CAPC0603L	Murata		1
C14	Capacitor	10pF	10%,COG,0603	CAPC0603L	Murata		1
C16, C17, C22, C23, C35, C36, C48, C49	Capacitor	10uF	10%,1210	CAPC1210N	Murata	GRM32ER71H106KA12L	8
C18	Capacitor	33pF	10%,COG,0603	CAPC0603L	Murata		1
C19, C20	Capacitor	10uF	10%,0805	CAPC0805L	Murata	GRM21BC71C106KE11L	2
C21, C34, C47	Capacitor	100nF	10%,1206	CAPC1206N	Murata	GRM319F72A104KA01D	3
C31, C44, C57	Capacitor	100nF	10%,1206	CAPC1206N	Murata	GRM319F72A104KA01D	3
C24, C37, C50	Capacitor	680pF	10%,1206	CAPC1206N			3
C25, C38, C51	Capacitor	100pF	10%,1206	CAPC1206N			3
C26, C32, C39, C45, C52, C58	Capacitor	100nF	10%, 0603	CAPC0603L			6
C27, C40, C53	Capacitor	NP		CAPC1206N			3
C28, C41, C54	Capacitor	100nF	10%,1206	CAPC1206N	Murata		3
C29, C42, C55	Capacitor	NP		CAPC0603L			3
C30, C43, C56	Capacitor	1uF	10%,0603	CAPC0603L			3
D1	Zener diode	Vz=3.14V~3.47V;500 mW;SOD-123		SOD123-3.3Vz	ON SEMI	MMSZ3V3T1G	1
D7, D16, D25	TVS diode			SGP1006N3T	Semtech	rlamp0512tq	3
D2, D3, D4, D5, D12, D13, D14, D21, D22, D23	Schottky Diode	DFLS160-7		PowerDI-123	Diodes	DFLS160-7, Diode	10
D6, D15, D24	TVS diode			SGP1006N3T	Semtech	rlamp0512tq	3
D8, D9, D17, D18, D26, D27	Schottky Diode	'DFLS160-7		PowerDI-123	Diodes	DFLS160-7, Diode	6
D11, D20, D29	LED	'0603 Green LED		LEDC0603N			3
F1	Fuse	'Fuse 1206 0.5A		RESC1206L			1
J1	JTAG Debug Connector	'Connector, Pin Header, 5-Pin , 2.00mm pitch		CON_JTAG_5p	3M	951105-8622-AR	1
J2	Banana Jack			CON_BANANA			1
J3	Micro-B USB, Receptacle, 5 Position, SMT and Trough-Hole			CON_USB_Micro-B_ZX62D-B-5P8	Hirose	ZX62D-B-5P8	1
J4	Banana Jack			CON_BANANA			1
J5, J8, J9, J12, J13, J16	Jumper	'Connector, Pin Header, 3-Pin , 2.54mm pitch		HDR1X3			6
J6, J10, J14	Banana Jack			CON_BANANA			3
J7, J11, J15	Banana Jack			CON_BANANA			3
L1	Inductor	33uH,0.64A,RDC=420 mR, 4mmX4mm		LPS4018-4X4-33uH	Coilcraft	LPS4018-333MR	1
R2, R5	Resistor	10K	1%, 0402	RESC0402L			2
R3	Resistor	NP	NP	RESC0402L			1
R4	Resistor	90.9K	1%, 0402	RESC0402L			1
R6	Resistor	30K	1%, 0402	RESC0402L			1
R1, 'R7, R7A, R8, R10	Resistor	100	1%,0402	RESC0402L			5
R9	Resistor	1.5K	1%, 0402	CAPC0402L			1
R11	Resistor	220	1%, 0402	RESC0402L			1
R12, R13, R17, R21, R32, R34, R47	Resistor	0R	1%, 0603	RESC0603L			7
R14	Resistor	357K	1%, 0603	CAPC0603L			1
R15	Resistor	200K	1%, 0603	CAPC0603L			1
R16, R19, R20, R30, R31, R33, R43, R45, R46	Resistor	NC		RESC0603L			9
R18, R29, R42, R44	Resistor	1000	1%, 0603	RESC0603L			4
R22, R35, R48	Resistor	0	1%, 0603	RESC0603L			3
R23, R36, R49	Resistor	100	1%, 0603	RESC0603L			3
R24, R25, R37, R38, R50, R51	Resistor	100	1%, 1206	RESC1206N			6
R26, R39, R52	Resistor	4.7K	1%,0402	RESC0402L			3
R28, R40, R53	Resistor	10K	1%,0402	RESC0402L			3
R27, R41, R54	Resistor	20M	1%, 0603	RESC0603L			3
S1, S2, S3	Switch	'Manual ON/OFF Switch;SW_FSM4JS MA		SW_FSM4JSMA	TE Connectivity	FSM4JSMA	3
TP1,TP2,TP3, TP4,TP5,TP6,TP7,TP8,TP9,TP10, TP11,TP12,TP13,TP14,TP15,TP16,TP17,TP18,TP19,TP20,TP21,TP22,TP23,TP24,TP25,TP25A,TP26,TP27,TP28,TP29,TP30,TP31,TP32,TP33,TP34,TP35,TP36,TP37,TP38,TP39,TP40,TP41,TP42,TP43,TP44,TP45,TP46,TP47,TP48,TP49,TP50	Testpoint	'Test Points , single Pin,0.9mm diameter		TESTPOINT_PIN_19			51
MH1,MH2,MH3,MH4	4 pcs locating plunger						4
M3 SCREW	M3 SCREW						3
U1	Single Channel Wireless Power Transmitter Controller			QFN50P600X600-36W3L	Triune Systems	TS80000-501410QFN	1
U2	Quadruple 2-Input Positive-AND Gate			QFN50P350X350-14L	TI	SN74LV08ARGYR	1
U3		30V, 300mA Output step down regulator		SC4530-MLPD-W-8 3x2	Semtech	SC4530WLTRT	1
U4	USB ESD Protection			DFN1410-6N	NXP	IP4221CZ6-S,115	1
U5, U6, U7		60V power load switch,Packaged in a 16pin QFN (3x3)		QFN_16PIN_3X3mm	'Semtech	TS13102 or TS13103	3
U7A	OR gate			SC70 6PIN	Farichild	NC7SZ332P6X	1
Y1	Ceramic Resonator	8MHz		XTAL_CSTCE	Murata	CSTCE8M00G55-R0	1

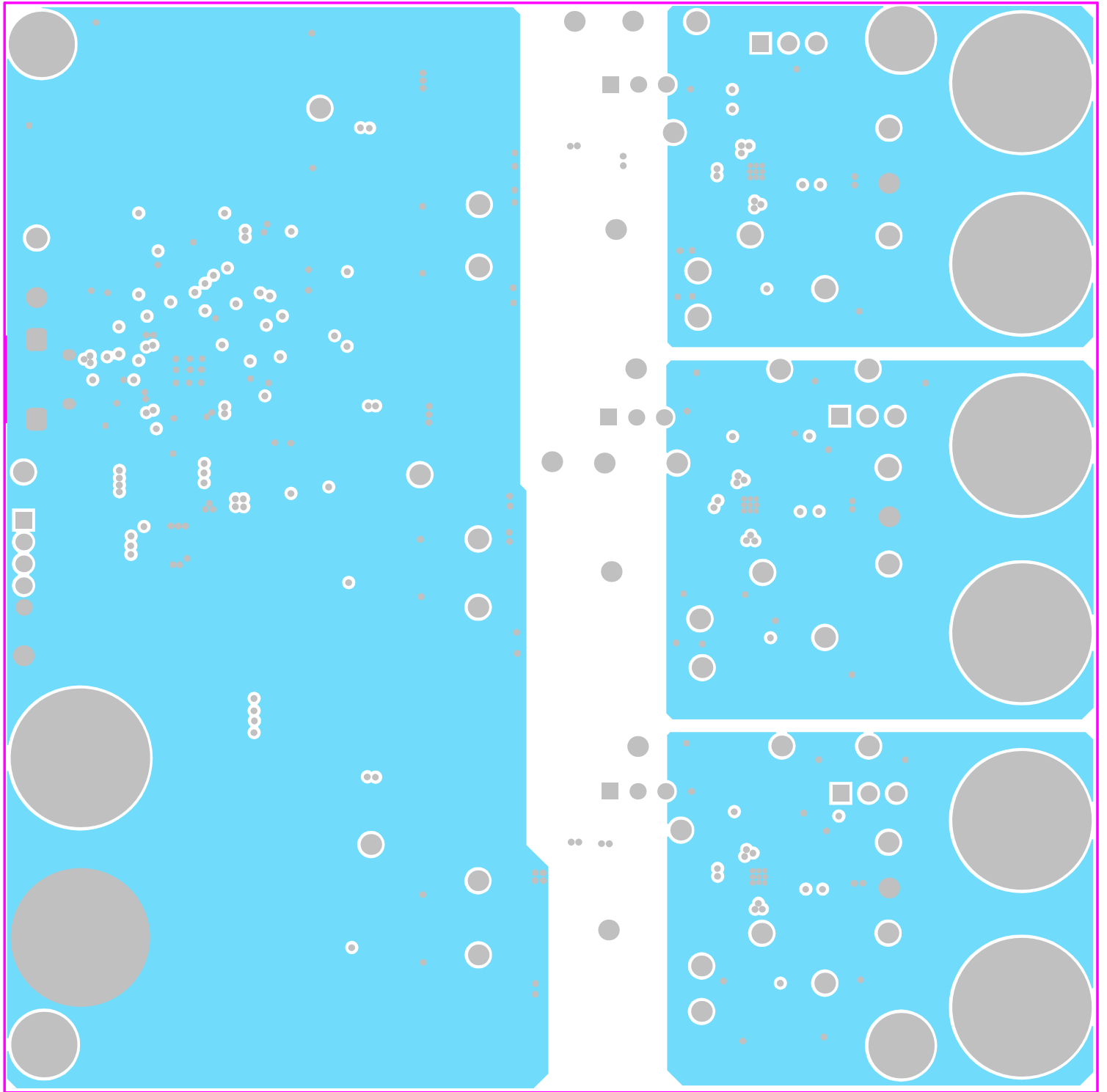
C.Board Layers



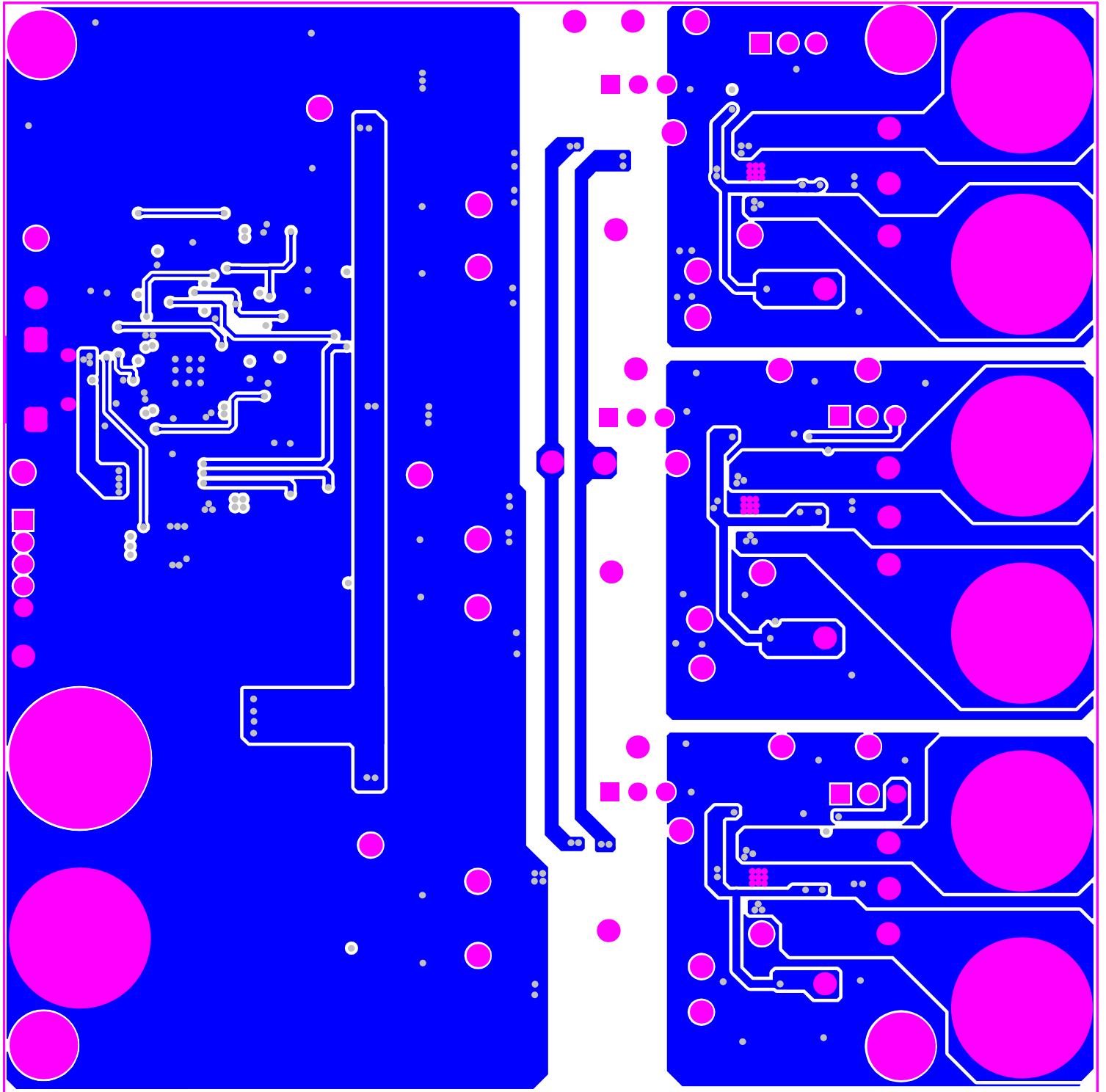
Top Layer



Middle Layer1



Middle Layer2



Bottom Layer



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