

# **User Guide**

## **TS13102/13103 Combo PTO EVM**

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# Introduction

The TS13102/13103 is a galvanically isolated 60V power switch device with bi-directional blocking. The device includes a single integrated 290mΩ high voltage switch allowing high efficiency switching of power loads or other high current applications. The single-pin CLK input pin controls the state of the switch through sequence options which control the way the device switches, including immediate on/off, zero-volt switch-on, zero-current switch-off, dither modes, as well as latching and non-latching behavior.

In addition to features above mentioned, the TS13103 offers galvanic power transfer from system AC supply across the isolation barrier to provide power to the low voltage controller domain.

TS13102/13103 Combo PTO EVM helps the users to evaluate TS13401's different functionalities and features.

## Objectives

The objective of this User Guide is to provide a fast, easy and thorough method to experiment with and evaluate the Semtech solutions. Sufficient information is provided to support the engineer in all aspects of adding support to their products. Developers are provided with all the information on how this EVM was built as a starting point for their own designs based on the TS13102/13103.

# Product Description

The TS13102/13103 is a galvanically isolated 60V power switch device with bi-directional blocking. The device includes a single integrated 290mΩ high voltage switch allowing high efficiency switching of power loads or other high current applications. The single-pin CLK input pin controls the state of the switch through sequence options which control the way the device switches, including immediate on/off, zero-volt switch-on, zero-current switch-off, dither modes, as well as latching and non-latching behavior.

The TS13102/13103 includes several protection features. Each switch has an integrated over-current shutdown to prevent device damage during short-circuit or other unusually high load conditions. If an overcurrent event is detected for a time, the switch is latched off until the CLK turn on sequence is given.

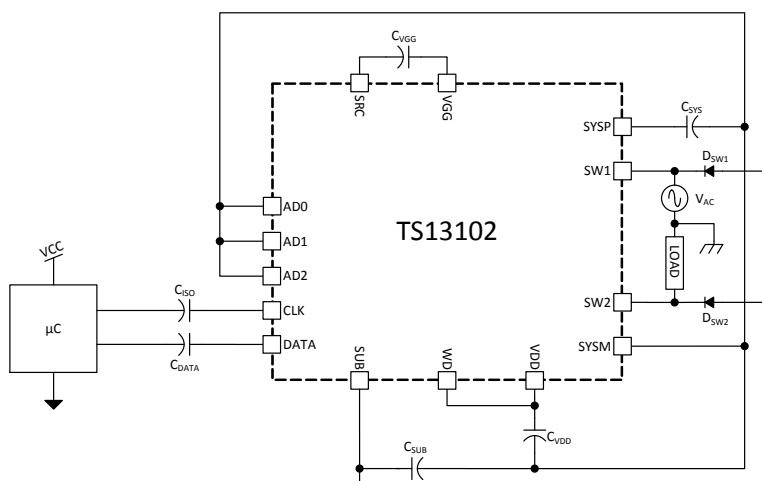


Figure 1 TS13102 Typical Application Circuit

In addition to features above mentioned, the TS13103 offers galvanic power transfer from system AC supply across the isolation barrier to provide power to the low voltage controller domain. Figure 2 shows TS13103's typical application circuit

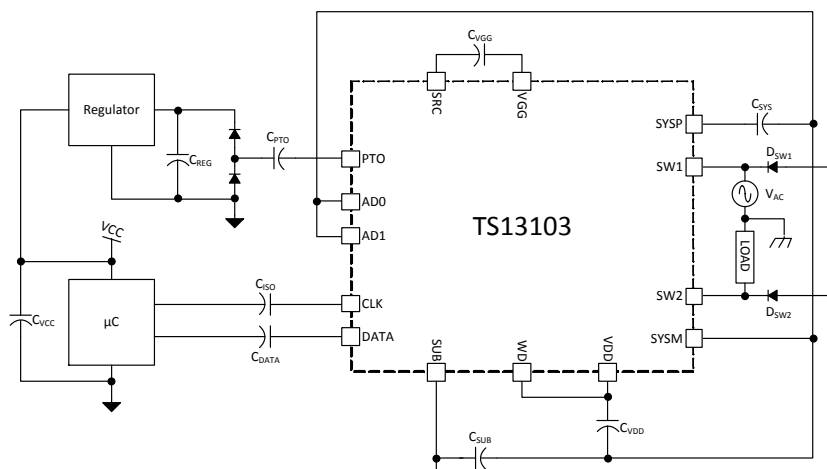


Figure 2 TS13103 Typical Application Circuit

The Semtech TS13102/13103 Combo PTO EVM has 8 channels to emulate 8 mechanical relays. Channel 1 and 5 are employing TS13103 and offer the PTO capability and the the rest of 6 channels are employing TS13102.

# EVM Schematic

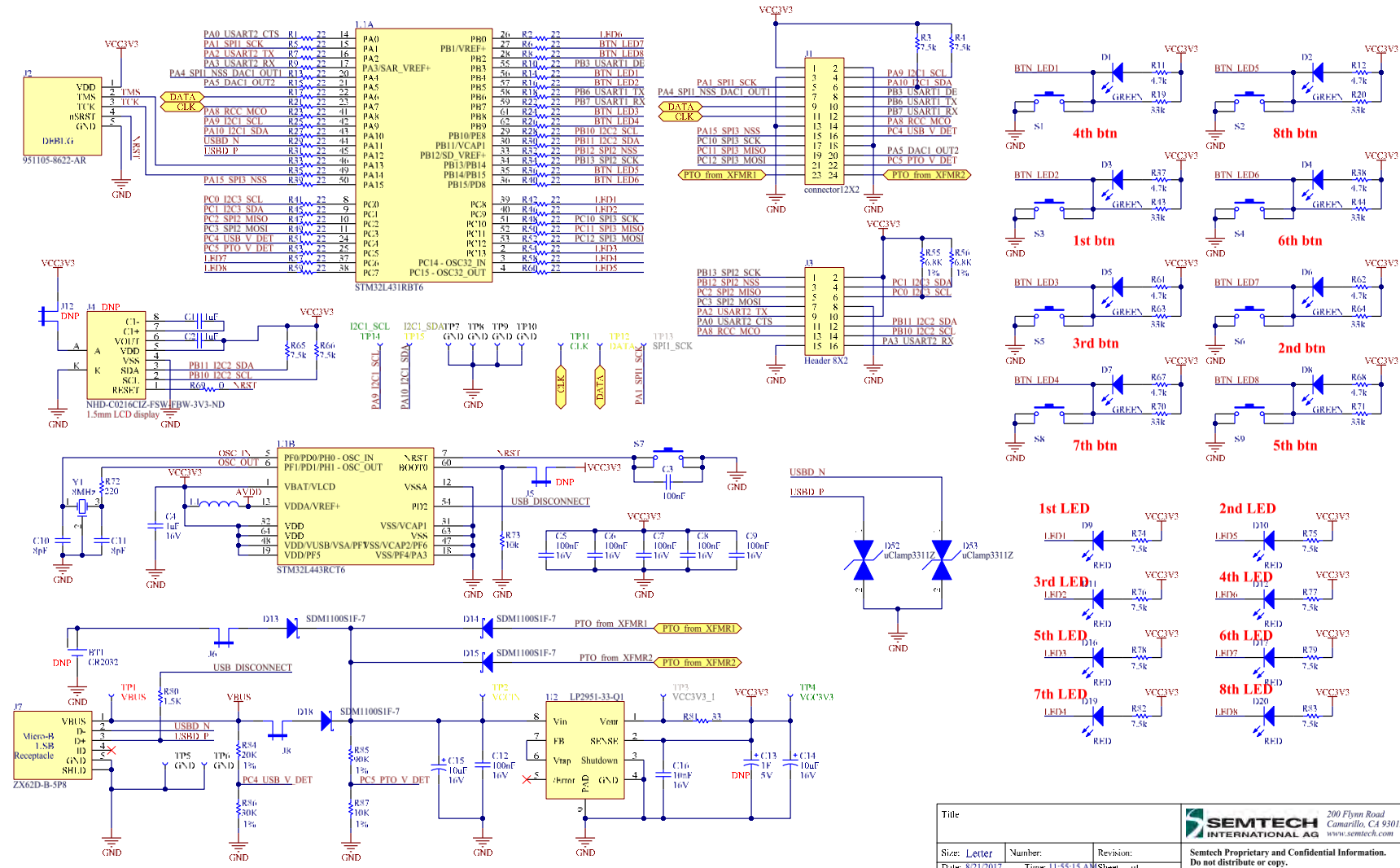


Figure 3 TS13102/13103 Combo PTO EVM Schematics (page 1)

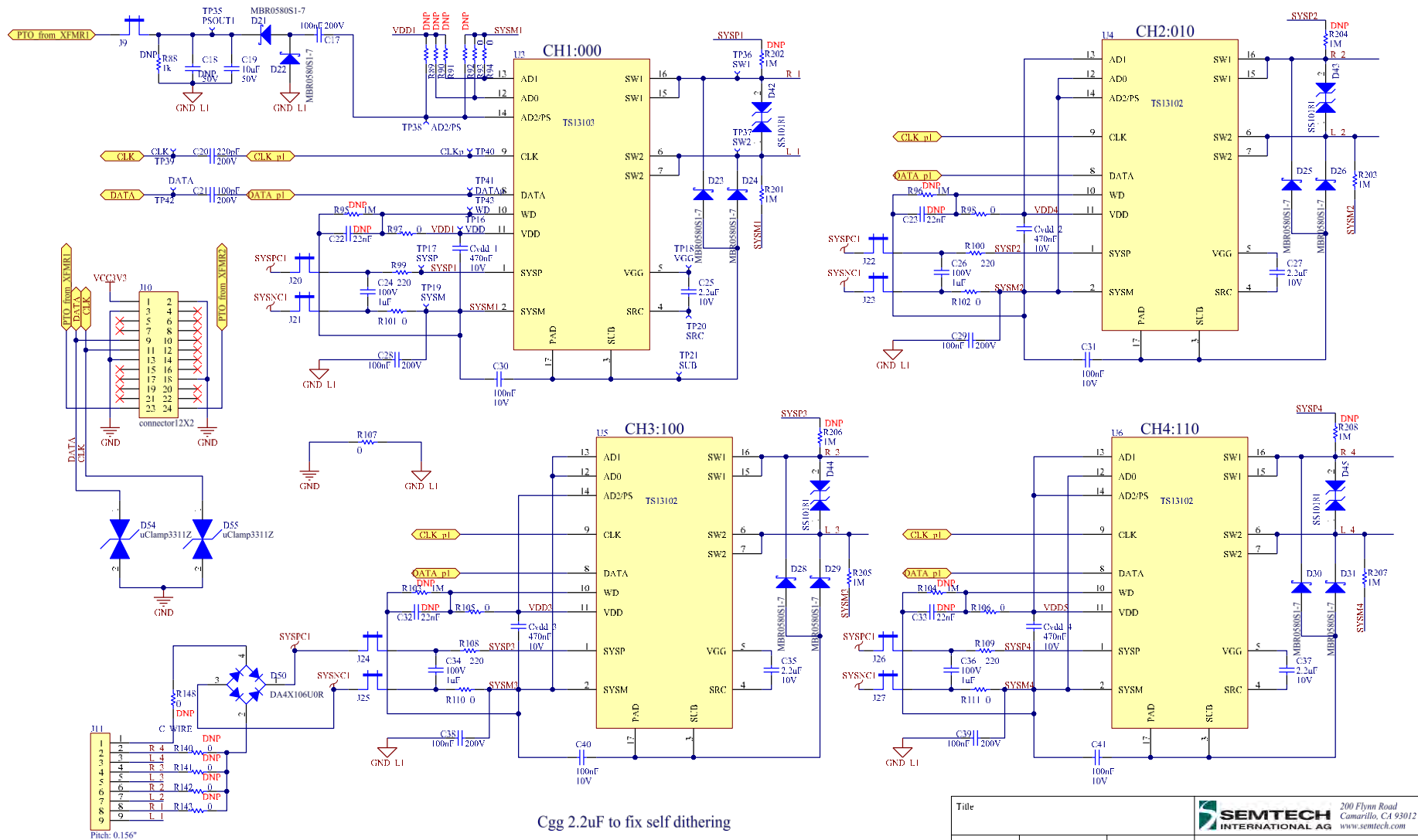


Figure 4 TS13102/13103 Combo PTO EVM Schematics (page 2)



# Bill of Materials

Designator	Footprint	Quantity	Value	Value2	Value3	Manufacturer	ManufacturerCode	Comment	DNP
BT1	BK_912_TR	1				Memory Protection Devices	BK-912-TR	CR2032	DNP
C1, C2, C4	CAPC0402L	3	1uF	16V				Cap	
C3, C12	CAPC0402L	2	100nF	16V				Cap	
C5, C6, C7, C8, C9	CAPC0402L	5	100nF	16V	10%,0402			Cap	
C10, C11	CAPC0402L	2	8pF	10V				Cap	-
C13	PB-5R0V105-R	1	1F	5V				Cap	
C14, C15	CAPC0805L	2	10uF	16V				Cap	
C16	CAPC0402L	1	10nF	16V				Cap	
C17, C42	CAPC1206N	2	100nF	10%,1206	200V	Murata		Cap	
C18, C43	CAPC1210N	2		10%,1210	50V	Murata	GRM32ER71H106 KA12L	Cap	DNP
C19, C44	CAPC1210N	2	10uF	10%,1210	50V	Murata	GRM32ER71H106 KA12L	Cap	
C20, C65	CAPC1206N	2	220pF	10%,1206	200V			Cap	
C21, C66	CAPC1206N	2	100pF	10%,1206	200V			Cap	
C22, C23, C32, C33, C45, C46, C55, C56	CAPC0402L	8	22nF	10V,10%,0402				Cap	DNP
C24, C26, C34, C36, C47, C49, C57, C59	CAPC1206N	8	1uF	10%,1206	100V	Murata		Cap	
C25, C27, C35, C37, C48, C50, C58, C60	CAPC0603L	8	2.2uF	10%,0603	10V			Cap	
C28, C29, C38, C39, C51, C52, C61, C62	CAPC1206N	8	100nF	10%,1206	200V	Murata		Cap	
C30, C31, C40, C41, C53, C54, C63, C64	CAPC0603L	8	100nF	10%,0603	10V				
Cvdd_1, Cvdd_2, Cvdd_3, Cvdd_4, Cvdd_5, Cvdd_6, Cvdd_7, Cvdd_8	CAPC0603L	8	470nF	10%,0603	10V				
D1, D2, D3, D4, D5, D6, D7, D8	LED_0402	8				Rohm Semiconductor	SML-P11MTT86	GREEN	
D9, D10, D11, D12, D16, D17, D19, D20	LED_0402	8				Rohm Semiconductor	SML-P11UTT86	RED	
D13, D14, D15, D18	SOD123_B	4				Diodes	SDM1100S1F-7		
D21, D22, D23, D24, D25, D26, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37, D38, D39, D40, D41	SOD123	20				Diodes	MBR0580S1-7		
D42, D44, D45, D46, D47, D48, D49	SMAJ43A-13-F	7	SMAJ4 3A-13-F			Semtech	SS10181	SS10181	
D43	SMAJ43A-13-F	1	SMAJ4 3A-13-F			Diodes	SS10181	SS10181	
D50, D51	Mini4-G4-B	2				Panasonic		Bridge1	

D52, D53, D54, D55	SLP0603P2X 3A	4				Semtech	uClamp3311Z	uClamp3311Z	
J1, J10	HDR2X12	2				302-S241	On Shore Technology Inc.	connector12X2	
J2	CON_JTAG_5p	1				3M	951105-8622-AR	951105-8622-AR	
J3	HDR2X8	1				On Shore Technology Inc.	302-S161	Header 8X2	
J4	LCD_CON8_1MM5_AK	1	1.5mm LCD display					NHD-C0216CIZ-FSW-FBW-3V3-ND	DNP
J5, J12	CON_Pins_2 p 2.54mm	2							DNP
J6, J8, J9, J13, J20, J21, J22, J23, J24, J25, J26, J27, J28, J29, J30, J31, J32, J33, J34, J35	CON_Pins_2 p 2.54mm	20							
J7	CON_USB_Micro-AB_ZX62D-AB-5P8	1				Hirose	ZX62D-B-5P8	ZX62D-B-5P8	
J11, J14	HDR1x9_26-60-4090	2				Molex Connector Corporation		1x9 connector	
L1	0603L	1	30R	5A		TDK	MPZ1608S300A	BEAD	
R1, R2, R5, R6, R7, R8, R9, R10, R13, R14, R15, R16, R17, R18, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R39, R40, R41, R42, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R57, R58, R59, R60	RESC0402L	48	22					Res	
R3, R4, R65, R66	RESC0402L	4	7.5k	1%				Res	
R11, R12, R37, R38, R61, R62, R67, R68	RESC0402L	8	4.7k						
R19, R20, R43, R44, R63, R64, R70, R71	RESC0402L	8	33k						
R55, R56	RESC0402L	2	6.8K	1%				Res	
R69	RESC0402L	1	0					Res	
R72	RESC0402L	1	220					Res	-
R73	RESC0402N	1	10k					Res	
R74, R75, R76, R77, R78, R79, R82, R83	RESC0402L	8	7.5k						
R80	RESC0402L	1	1.5K					Res	
R81	RESC1206N	1	33					Res	
R84	RESC0402L	1	20K	1%				Res	
R85	RESC0402L	1	90K	1%				Res	
R86	RESC0402L	1	30K	1%				Res	
R87	RESC0402L	1	10K	1%				Res	
R88, R112	RESC1206N	2	1k					Res	DNP
R89, R90, R91, R113, R115	RESC0603L	5						Res	DNP
R92, R116	RESC0603L	2	0	1%, 0603				Res	DNP



R93, R94, R97, R98, R105, R106, R118, R121, R122, R130, R131	RESC0603L	11	0	1%, 0603				Res	
R95, R96, R103, R104, R119, R120, R128, R129, R202, R204, R206, R208, R210, R212, R214, R216	RESC0603L	16	1M	1%, 0603				Res	DNP
R99, R100, R108, R109, R123, R124, R132, R133	RESC1206N	8	220	1%, 1206				Res	
R101, R102, R110, R111, R125, R126, R134, R135	RESC1206N	8	0	1%, 1206				Res	
R107, R127	RESC1206N	2	0	1%, 1206				Res	
R114	RESC0603L	1	0					Res	
R117	RESC0603L	1		1%, 0603				Res	DNP
R140, R141, R142, R143, R144, R145, R146, R147, R148, R149	RESC0805N	10	0					Res	DNP
R201, R203, R205, R207, R209, R211, R213, R215	RESC0603L	8	1M	1%, 0603				Res	
S1, S2, S3, S4, S5, S6, S7, S8, S9	SW_FSM4JS MA	9				TE Con- nectivity	FSM4JSMA	Manual ON/OFF Switch	
TP1	TESTPOINT_ 60_RING	1				Keystone Electron- ics	5000	VBUS	
TP2, TP12, TP15	TESTPOINT_ 60_RING	3				Keystone Electron- ics	5004	DATA, I2C1_SDA , VCCIN	
TP3, TP13	TESTPOINT_ 60_RING	2				Keystone Electron- ics	5002	SP11_SCK , VCC3V3_ 1	
TP4, TP11, TP14	TESTPOINT_ 60_RING	3				Keystone Electron- ics	5116	CLK, I2C1_SCL , VCC3V3	
TP5, TP6, TP7, TP8, TP9, TP10	TESTPOINT_ 60_RING	6				Keystone Electron- ics	5001	GND	
TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36, TP37, TP38, TP39, TP40, TP41, TP42, TP43	TESTPOINT_ 60_RING	28	'Test Points , single Pin,0.9 mm diameter					AD2/PS, CLK, CLKp, DATA, DATAp, PSOUT1, SRC, SUB, SW1, SW2, SYSM, SYSP, VDD, VGG, WD	
U1	lqfp64_10x10 mm	1				STMicroe- lectronics	STM32L431RBT6	STM32L4 31RBT6	
U2	S-PWSON- N8	1				Texas Instru- ments	LP2951-33-Q1	LP2951- 33-Q1	

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U3, U7		2	60V power load switch, Packaged in a 16pin QFN (3x3)			TS13103		TS13103	
U4, U5, U6, U8, U9, U10	QFN_16PIN_3X3mm	6	60V power load switch, Packaged in a 16pin QFN (3x3)			TS13102		TS13102	
Y1	XTAL_CSTCE	1	8MHz			Murata	CSTCE8M00G55-R0	CSTCE8M00G55-R0	-

Table 1 TS13102/13013 Combo PTO EVM BOM

## EVM board appearance

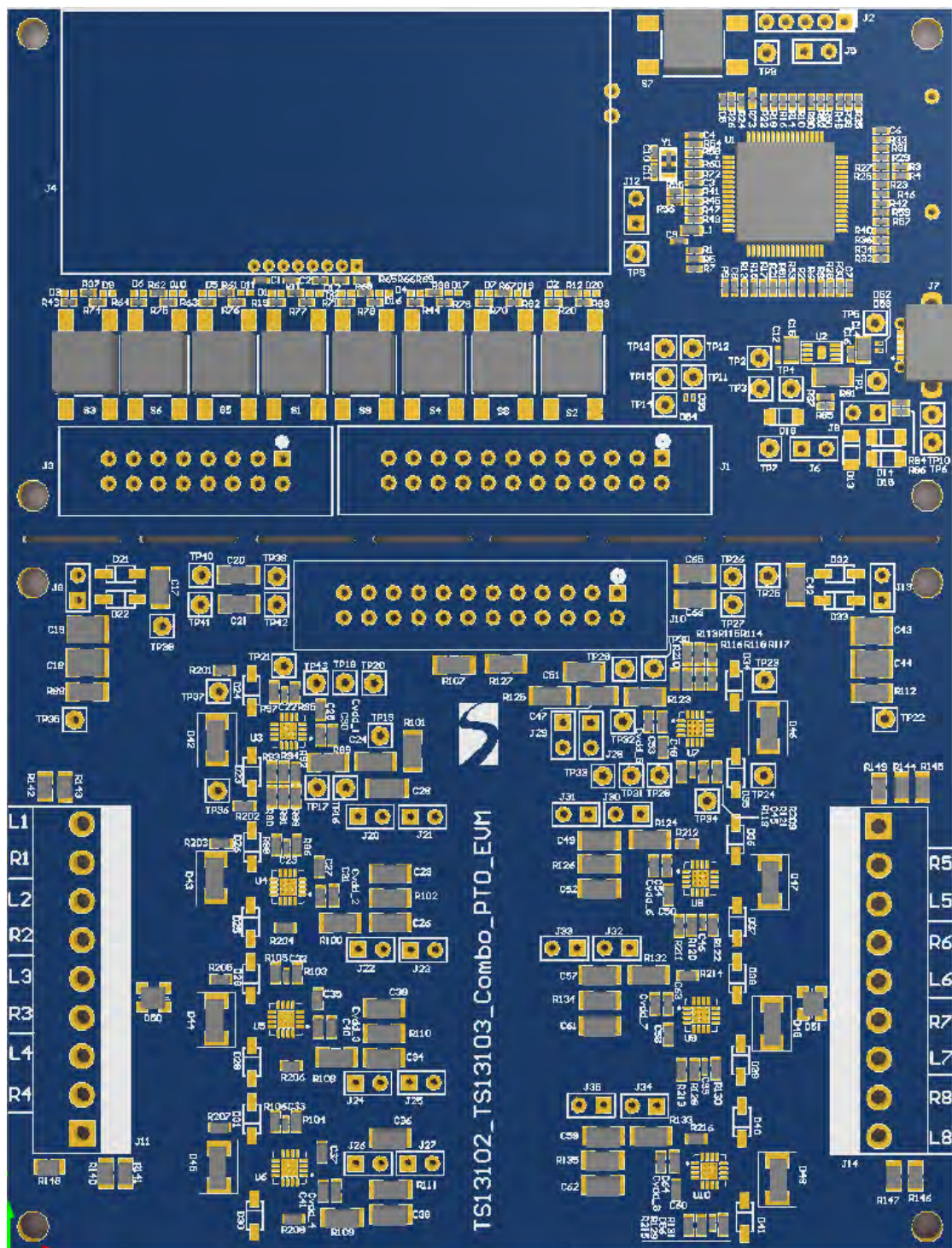


Figure 6 TS13102/13013 Combo PTO EVM

## Operation of TS13102/13013 Combo PTO EVM

For single channel, hook up the 24Vac power source, the contactor as load and “TS13102/13013 Combo PTO EVM” as Figure 7. Connect the EVB with PC with micro-USB cable.

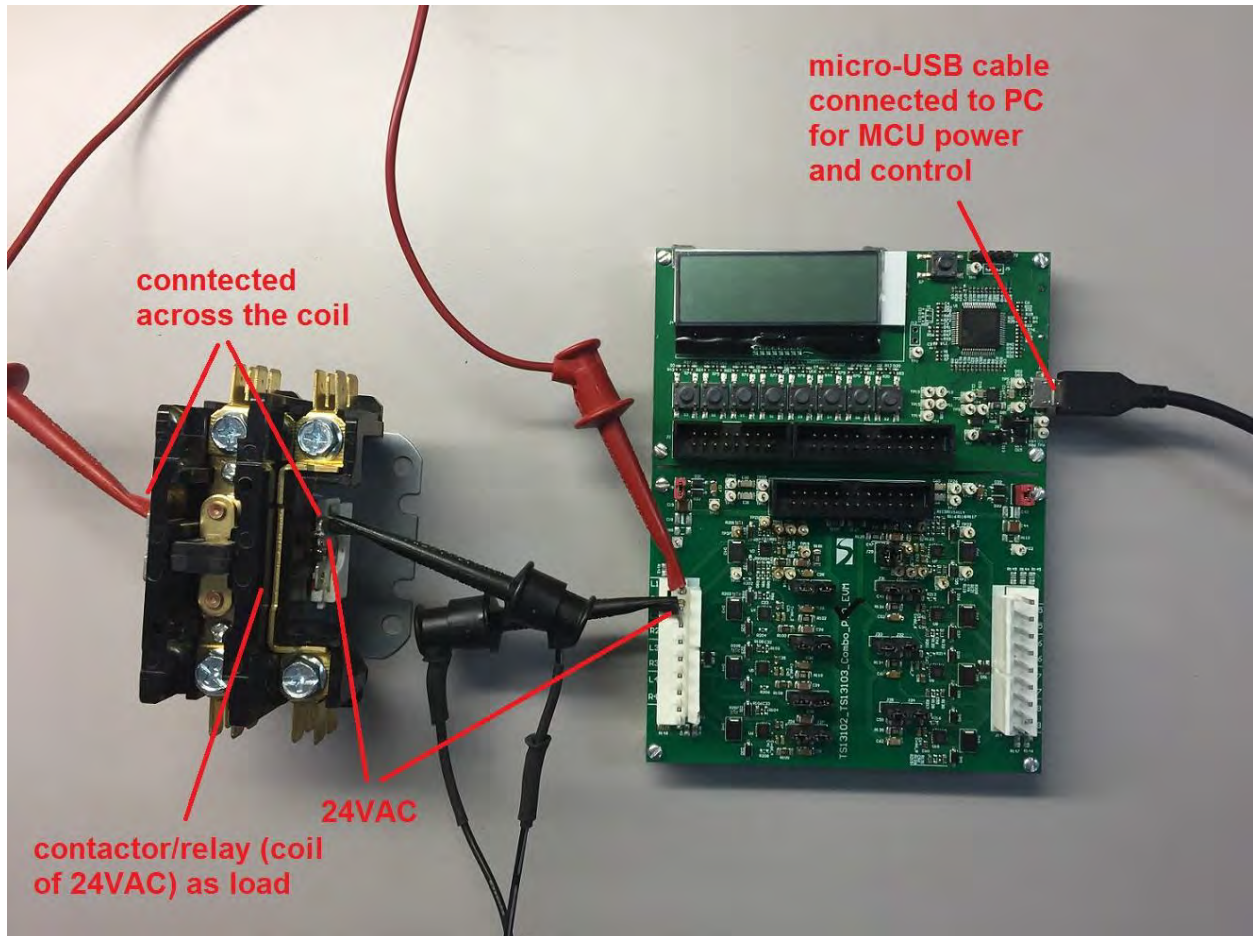


Figure 7 “TS13102/13013 Combo PTO EVM” hook up with single channel



For multiple channels, hook up the 24Vac power source, the contactor as load and “TS13102/13013 Combo PTO EVM” as Figure 8. Connect the EVB with PC with micro-USB cable.

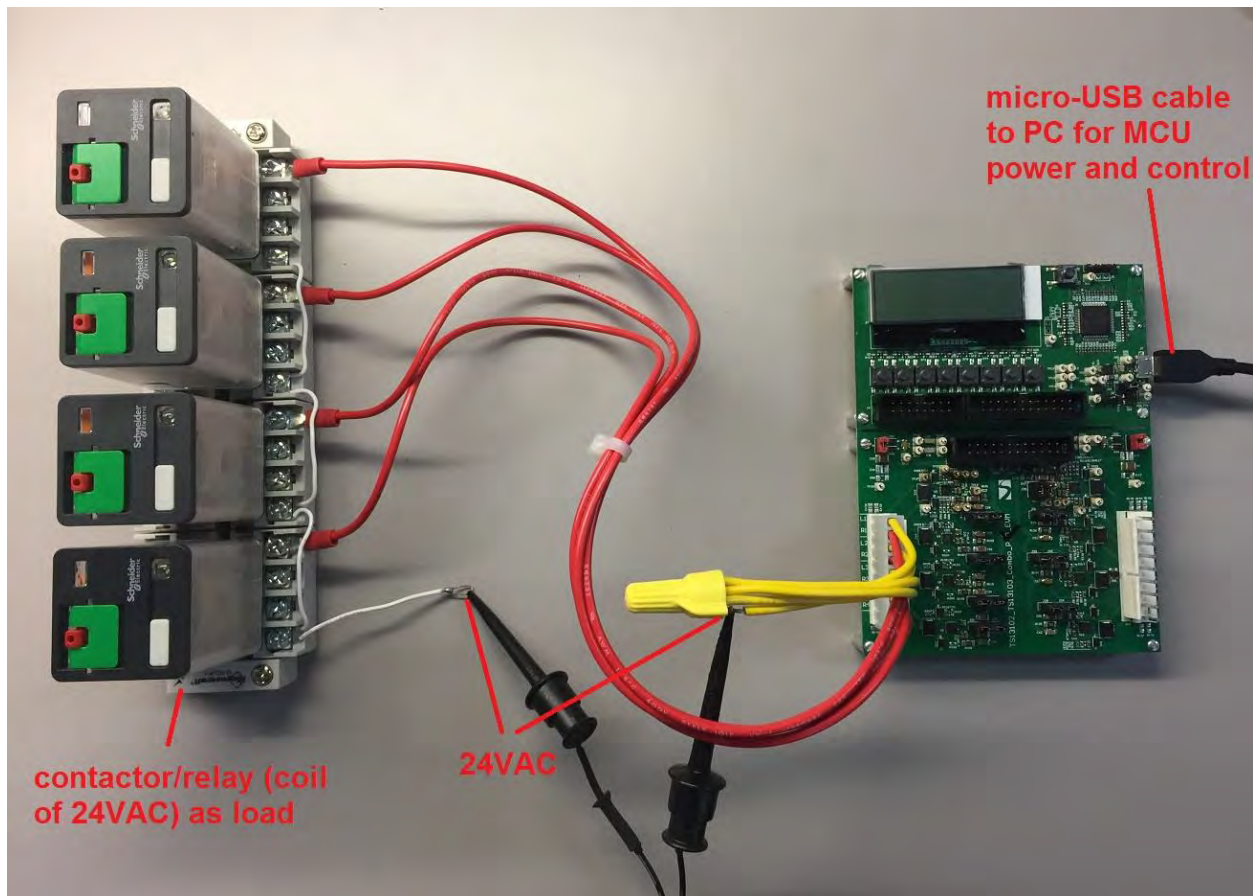


Figure 8 “TS13102/13013 Combo PTO EVM” hook up with multiple channels

The user can use the button on board to operate the EVB, short-push then release the 1<sup>st</sup> button will turn on 1<sup>st</sup> channel; short-push then release the 1<sup>st</sup> button again will turn off 1<sup>st</sup> channel. Same operation for 2<sup>nd</sup>, 3<sup>rd</sup>, and other channels.

Or user can use the GUI on a PC to control EVB operation, as figure 9. GUI offers the capability to control all TS13102/13103 functionalities and features, for which please refer to TS13102/13103 datasheet.

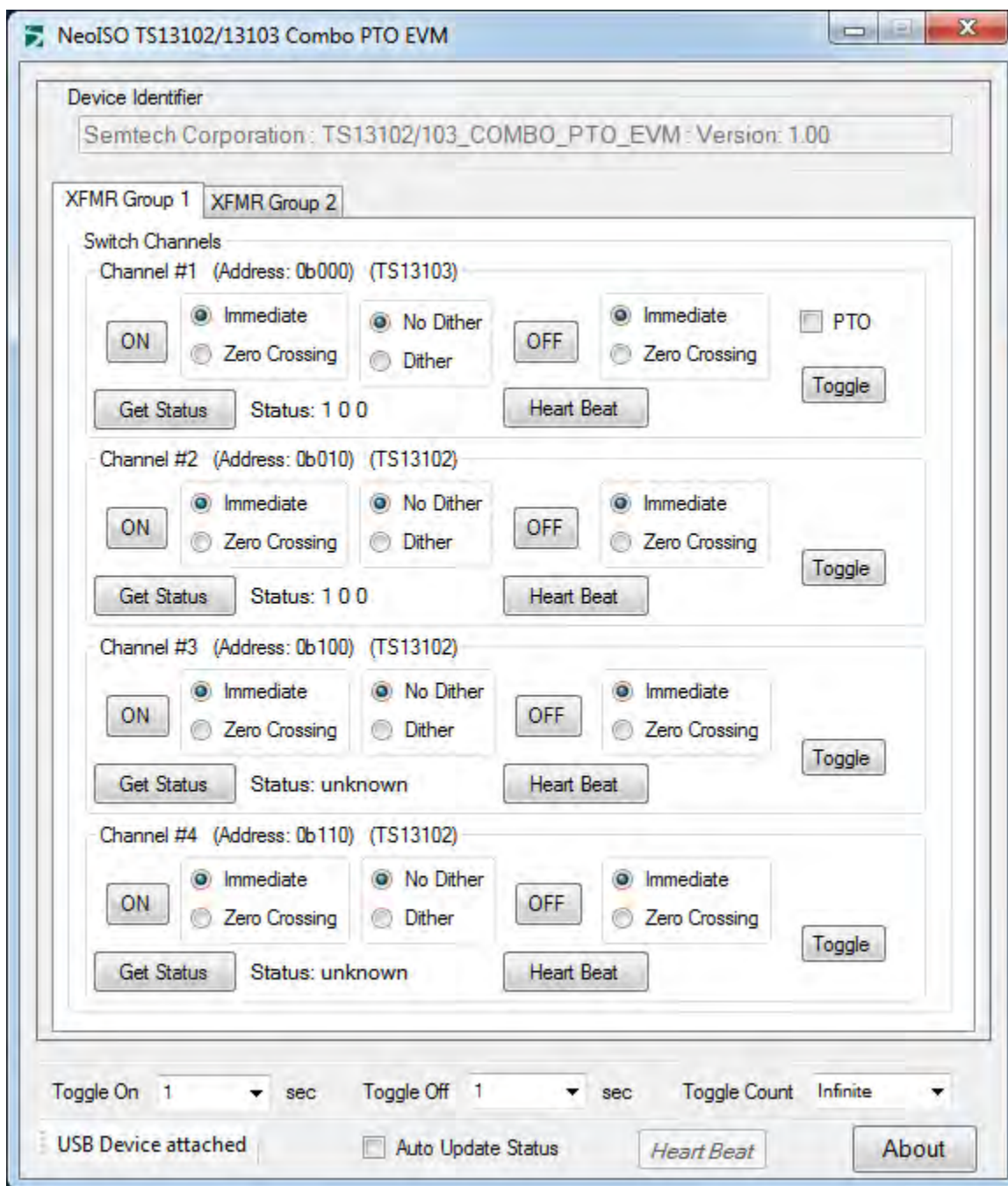
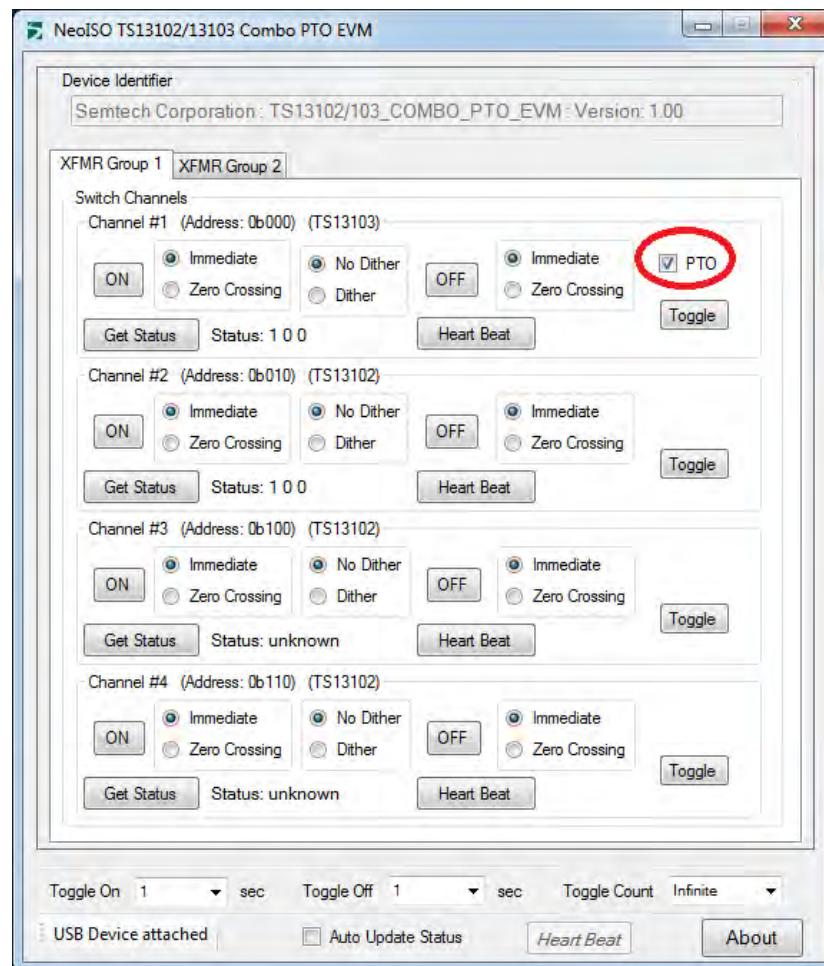


Figure 9 TS13102/13013 Combo PTO EVM GUI

# PTO Feature Demonstration

The following procedure demonstrates one possible usage of TS13103's PTO feature

- 1) Hook up the EVM as Figure 7 or 8
- 2) Connect micro-USB cable between the EVM and PC, to power up the MCU system  
(It might take as long as a minute for the 1<sup>st</sup> time powering up, since the super cap needs to be charged up. The LEDs will be lit up sequentially to indicate the power up)
- 3) Open the GUI, and turn on PTO (by checking PTO, the MCU will send channel 1/5's TS13103 PTO commands of 64 pulses every 2ms)



- 4) Now the user can disconnect the micro-USB cable so that the MCU is getting power totally from the AC load and not from USB power
- 5) The user can use the button to turn on/off each individual channel



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