TS13001

Galvanic Isolated Blocking 56V Power Load Switch

TRIUNE PRODUCTS

Features

- Low Quiescent Operating Currents
  - 2uA in OFF state
  - 15uA in ON state
  - +/- 2KV galvanic isolation from primary to secondary sides of the device
- Single control signal for on/off input (CLK)
  - Operation from 2.9V to 5.5V compatible with standard microcontrollers
- Switch Characteristics
  - High voltage switch with bi-directional blocking in OFF state
  - Single switch device
- 56V switch and 110mohm Rdson
- Over current shutoff
  - 5.5Amp typical, 6.6Amp maximum, 4.4Amp minimum -10C to 65C

Specification

- Junction operating temperature -40 °C to 125 °C
- Packaged in a 20pin QFN (4x4)

Description

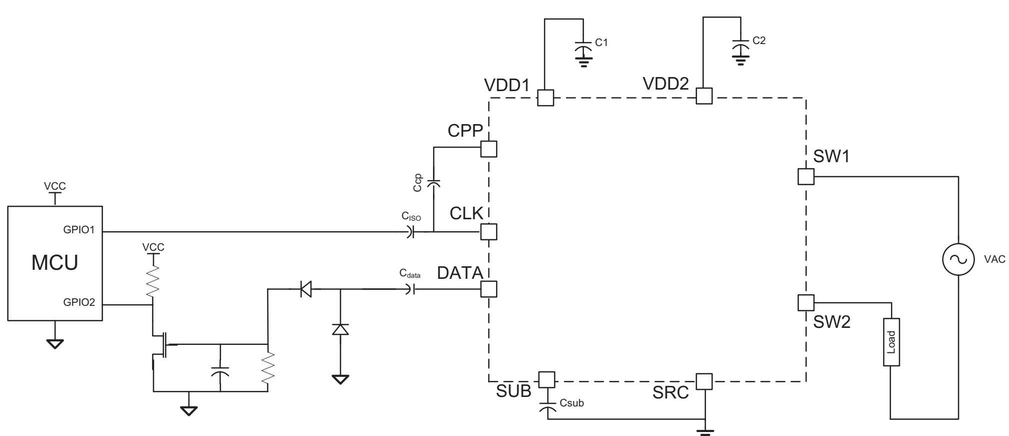
The TS13001 is a galvanic isolated 56V power switch device with bi-directional blocking. The device includes a single integrated 110mOhm high voltage FET allowing high efficiency switching of power loads or other high current applications. The input pin, CLK, controls the turn on/off of the switch.

The TS13001 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 pin is held off and turned on again. While the CLK pin is active after an over-current event or in the event of an incorrect turn-on sequence, the DATA pin is toggled at ¼ the CLK frequency.

Applications

- Power load/rail switching
- Input supply muxing
- Isolated power supplies
- Solid state relays
- HVAC control

Typical Application Circuit



Pin Description

Pin #	Pin Name	Pin Function	Description
1	SW2	Switch Output Node 2	
2	SW1	Switch Output Node 1	
3	SW1	Switch Output Node 1	
4	SW2	Switch Output Node 2	
5	SW2	Switch Output Node 2	
6	SW1	Switch Output Node 1	
7	SW1	Switch Output Node 1	
8	SW2	Switch Output Node 2	
9	SW2	Switch Output Node 2	
10	DATA	Data Output	AC Coupled Data Output
11	CLK	Clock Input	AC Coupled Clock and Power Input
12	CPP	Charge Pump Cap	Additional Cap used for lower voltage Clock drive
13	VDD1	Internal Supply 1	Bypass Capacitor for Internal Supply
14	VDD2	Internal Supply 2	Bypass Capacitor for Internal Supply
15	SRC	GND	
16	SUB	GND2	
17	SW2	Switch Output Node 2	
18	SW1	Switch Output Node 1	
19	SW1	Switch Output Node 1	
20	SW2	Switch Output Node 2	
PAD	PAD	Power PAD	Must be floating or connected to SUB

Functional Block Diagram

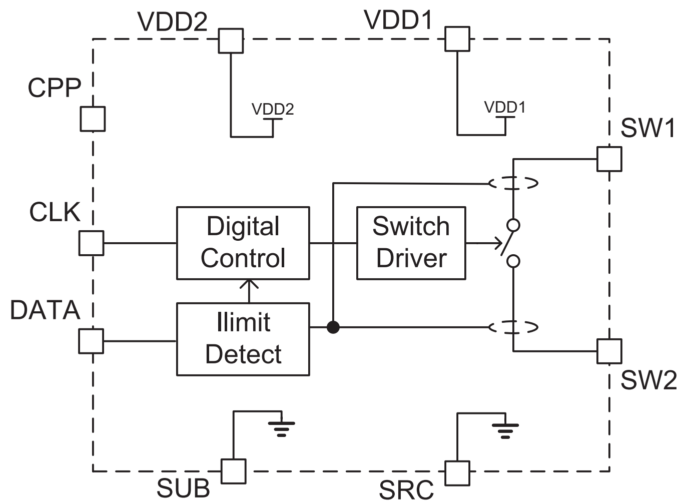


Figure 1: TS13001 Block Diagram

Absolute Maximum Rating

Over operating free–air temperature range unless otherwise noted(1, 2, 3)

Parameter	Range	UNIT
SW1, SW2	-60 to 60	V
CLK, DATA, VDD1, VDD2, CPP	-0.3 to 5.5	V
SUB	-60 to 0.3	V
Operating Junction Temperature Range, TJ	-40 to 125	°C
Storage Temperature Range, TSTG	-65 to 150	°C
Electrostatic Discharge – Human Body Model	±2k	V
Electrostatic Discharge – Machine Model	+/-200	V
Electrostatic Discharge – IEC Contact (SW1 and SW2 pins)	±8k	V
Electrostatic Discharge – IEC Air Discharge (SW1 and SW2 pins)	±15k	V
Lead Temperature (soldering, 10 seconds)	260	°C

Notes:
(1) Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute–maximum–rated conditions for extended periods may affect device reliability.
(2) All voltage values are with respect to SRC terminal.
(3) ESD testing is performed according to the respective JESD22 JEDEC standard.

Thermal Characteristics

Electrical Characteristics, TJ = -40C to 125C (unless otherwise noted)

Symbol	Parameter	Value	Units
Θ_{JA}	Thermal Resistance Junction to Air (Note 1)	34.5	°C/W
Θ_{JC}	Thermal Resistance Junction to Case (Note 1)	2.5	°C/W
T_{STG}	Storage Temperature Range	-65 to 150	°C
$T_{J\ MAX}$	Maximum Junction Temperature	150	°C
T_J	Operating Junction Temperature Range	-40 to 125	°C

Note 1: Assumes 16LD 3x3 QFN with hi-K JEDEC board and 13.5 inch2 of 1 oz Cu and 4 thermal vias connected to PAD

Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V_{SW}	AC Switch Voltage	-24		24	V
C_{DATA}	Data Isolation Capacitor		100		pF
C_{ISO}	Clock Isolation Capacitor		680		pF
C_{CP}	Charge Pump Capacitor		100		pF
C_{VDD1}	VDD1 Bypass Capacitor		10		nF
C_{VDD2}	VDD2 Bypass Capacitor		1		uF
C_{SUB}	Sub Capacitor		100		nF

Electrical Characteristics

Electrical Characteristics, T_J = -40C to 125C, VCC = 12V (unless otherwise noted)

Symbol	Parameter	Condition	Min	Typ	Max	Unit
VCLK Supply Voltage						
V_{CLK}	Clock Drive Voltage				5.5	V
$I_{CLK\text{-}NORM}$	Quiescent current	V_{CLK} = 5.0V, F_{CLK} = 500KHz	2.9	15		uA
$I_{CLK\text{-}NORM}$	Normal Mode	V_{CLK} = 3.0V, F_{CLK} = 1000KHz		50		uA
$I_{CLK\text{-}STBY}$	Quiescent current	V_{CLK} = 0V			3	uA
VCLK Drive						
F_{CLK}	Clock Frequency to Turn on Switch		300		2000	KHz
F_{DATA}	Data Frequency during Current Shutdown			F_{CLK}/4		KHz
$N_{CLKON\text{-}INIT}$	Number of CLK pulses to initialize Turn On		3		8	
$T_{LOW\text{-}ON}$	CLK Low time during Turn On Sequence		10		20	uS
N_{CLKON}	CLK Pulses to Turn on SW After $T_{LOW\text{-}ON}$			15		
$T_{FASTOFF\text{-}INIT}$	CLK Low time to Initialize Fast Turn-Off		10		20	uS
$N_{CLK\text{-}FOEN}$	CLK Pulses to Enable Fast Turn-Off After $T_{FASTOFF\text{-}INIT}$		6		13	
$T_{OFF\text{-}FAST}$	Time for Turn Off	Fast Mode	4		10	uS
$T_{OFF\text{-}NORM}$	Time for Normal Turn Off	Iout < $I_{OFF\text{-}TH}$	60		120	uS
$N_{CLK\text{-}OFFDET}$	CLK Pulses to Detect Incorrect Turn-On Sequence	Resets with $T_{LOW\text{-}ON}$		19		
Output Switch						
R_{ON}	On Resistance	Tj=-10C to 65C	75	105	150	mΩ
R_{ON}	On Resistance	Tj=25C	90	105	130	mΩ
I_{OFF}	Off State Leakage				3	uA
$IOUT_{OC}$	Output Over Current Shutdown	Tj=-40C to 125C	4.0		7.2	A
$IOUT_{OC}$	Output Over Current Shutdown	Tj=-10C to 65C	4.4	5.5	6.6	A
OC_{FILT}	Output Over Current Deglitch			25		uS
$I_{TURN\text{-}OFF}$	Switch Current for Normal Turn-Off		-275		275	mA
$I_{OFF\text{-}TH}$	Normal Turn-Off Current Threshold	Switch will turn off if absolute value of current is below this threshold after CLK stops	125	200	275	mA

Application Waveforms

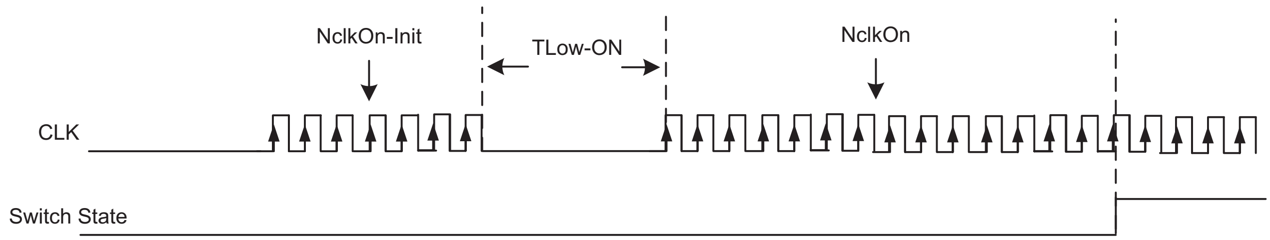


Figure 2: Clock Turn-on Sequence

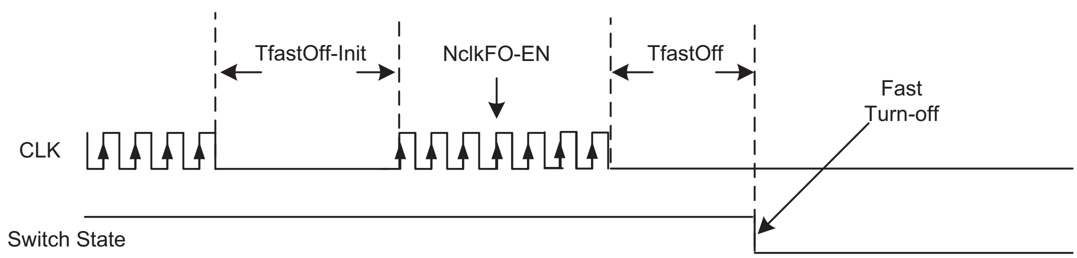


Figure 3: High-speed Turn-off Mode

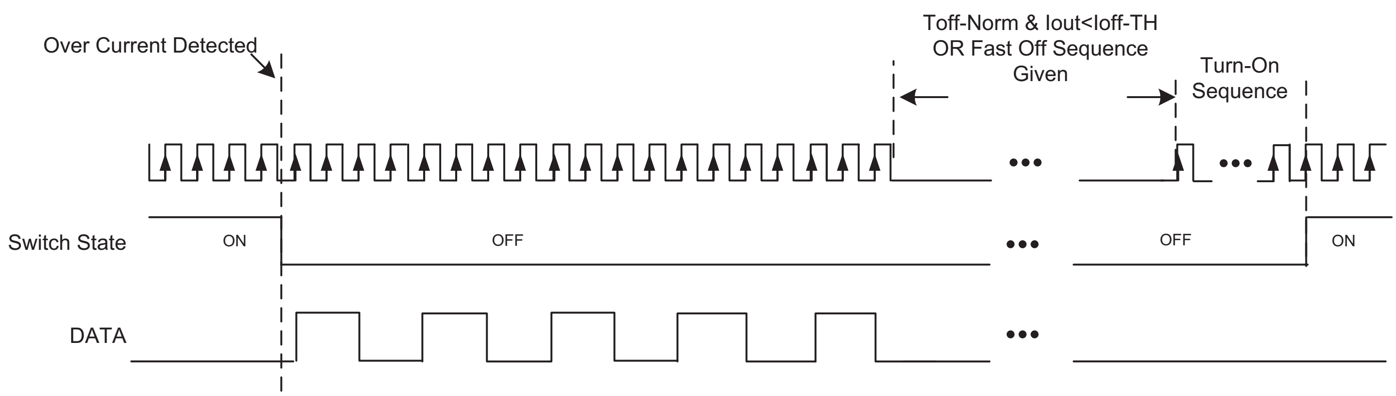
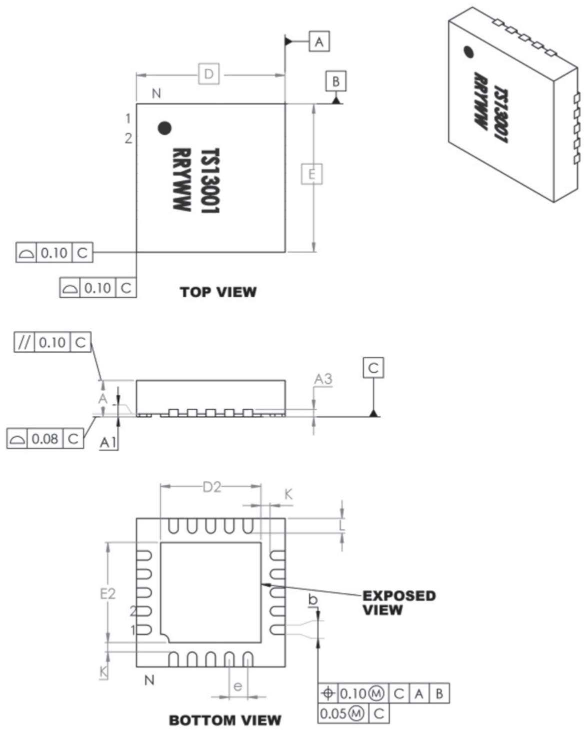


Figure 4: Over-current Shut-down and Restart

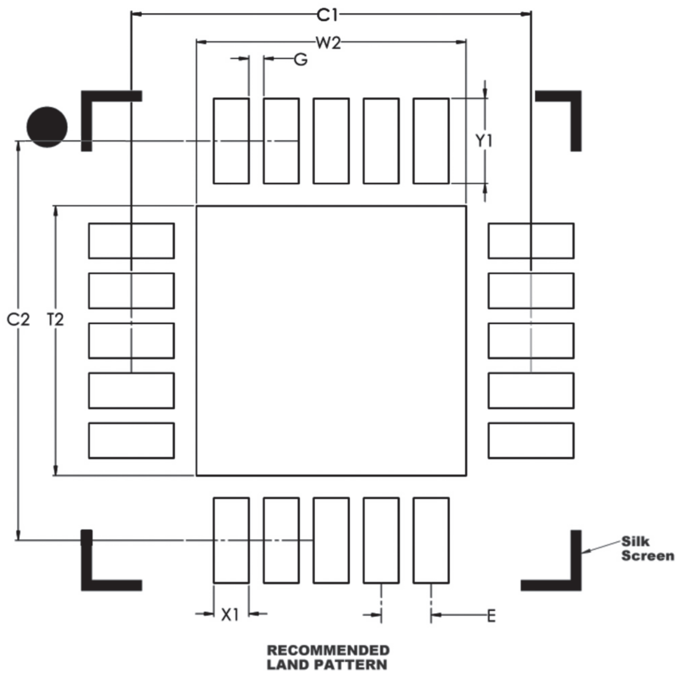
Package Mechanical Drawings



	Units	MILLIMETERS		
	Dimension Limits	MIN	NOM	MAX
Number of Pins	N		20	
Pitch	e		0.50 BSC	
Overall Height	A	0.80	0.90	1.00
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3		0.20 REF	
Overall Length	D		4.00 BSC	
Exposed Pad Width	E2	2.55	2.70	2.80
Overall Width	E		4.00 BSC	
Exposed Pad Length	D2	2.55	2.70	2.80
Contact Width	b	0.20	0.25	0.30
Contact Length	L	0.30	0.40	0.50
Contact-to-Exposed Pad	K	0.20	-	-

Notes:
RR = Revision number
YWW = Year Calendar Week

Package Mechanical Drawings



Units		MILLIMETERS		
	Dimension Limits	MIN	NOM	MAX
Contact Pitch	E	0.50 BSC		
Optional Center Pad Width	W2	-	-	2.70
Optional Center Pad Length	T2	-	-	2.70
Contact Pad Spacing	C1	-	4.00	-
Contact Pad Spacing	C2	-	4.00	-
Contact Pad Width X20	X1	-	-	0.35
Contact Pad Length X20	Y1	-	-	0.35
Distance Between Pads	G	0.15	-	-

Notes:
Dimensions and tolerancing per ASME Y14.5M
REF: Reference Dimension, usually without tolerance, for information only.
BSC: Basic Dimension, Theorically exact value shown with tolerances.

Ordering Information

Part Number	Description
TS13001-QFNR	Non-Latching Galvanic Isolated Switch

RoHS and Reach Compliance

Triune Systems is fully committed to environmental quality. All Triune Systems materials and suppliers are fully compliant with RoHS (European Union Directive 2011/65/EU), REACH SVHC Chemical Restrictions (EC 1907/2006), IPC-1752 Level 3 materials declarations, and their subsequent amendments. Triune Systems maintains certified laboratory reports for all product materials, from all suppliers, which show full compliance to restrictions on the following:

- Cadmium (Cd)
- Chlorofluorocarbons (CFCs)
- Chlorinate Hydrocarbons (CHCs)
- Halons (Halogen free)
- Hexavalent Chromium (CrVI)
- Hydrobromofluorocarbons (HBFCs)
- Hydrochlorofluorocarbons (HCFCs)
- Lead (Pb)
- Mercury (Hg)
- Perfluorocarbons (PFCs)
- Polybrominated biphenyls (PBB)
- Polybrominated Diphenyl Ethers (PBDEs)

IMPORTANT NOTICE

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