

**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 R<sub>dson</sub>
- 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)

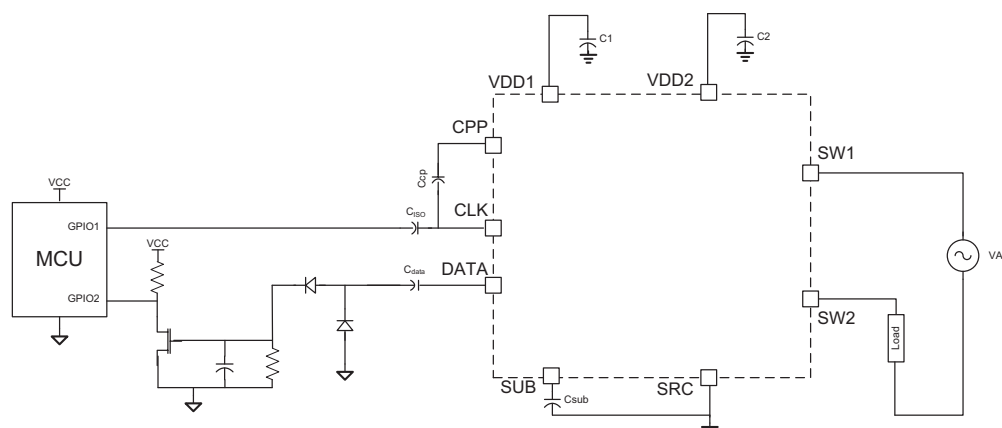
**Description**

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

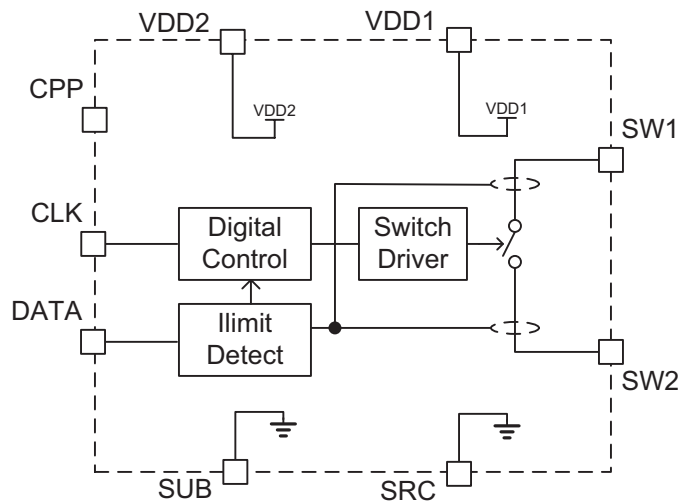


Figure 1: TS13001 Block Diagram

## Absolute Maximum Rating

Over operating free-air temperature range unless otherwise noted<sup>(1, 2, 3)</sup>

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, T <sub>J</sub>	-40 to 125	°C
Storage Temperature Range, T <sub>STG</sub>	-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 JEDEC standard.

## Thermal Characteristics

Electrical Characteristics, T<sub>J</sub> = -40C to 125C (unless otherwise noted)

Symbol	Parameter	Value	Units
$\Theta_{JA}$	Thermal Resistance Junction to Air (Note 1)	34.5	°C/W
$\Theta_{JC}$	Thermal Resistance Junction to Case (Note 1)	2.5	°C/W
T <sub>STG</sub>	Storage Temperature Range	-65 to 150	°C
T <sub>JMAX</sub>	Maximum Junction Temperature	150	°C
T <sub>J</sub>	Operating Junction Temperature Range	-40 to 125	°C

Note 1: Assumes 16LD 3x3 QFN with hi-K JEDEC board and 13.5 inch<sup>2</sup> of 1 oz Cu and 4 thermal vias connected to PAD

## Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V <sub>SW</sub>	AC Switch Voltage	-24		24	V
C <sub>DATA</sub>	Data Isolation Capacitor		100		pF
C <sub>ISO</sub>	Clock Isolation Capacitor		680		pF
C <sub>CP</sub>	Charge Pump Capacitor		100		pF
C <sub>VDD1</sub>	VDD1 Bypass Capacitor		10		nF
C <sub>VDD2</sub>	VDD2 Bypass Capacitor		1		uF
C <sub>SUB</sub>	Sub Capacitor		100		nF

# Electrical Characteristics

Electrical Characteristics,  $T_j = -40C$  to  $125C$ ,  $V_{CC} = 12V$  (unless otherwise noted)

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

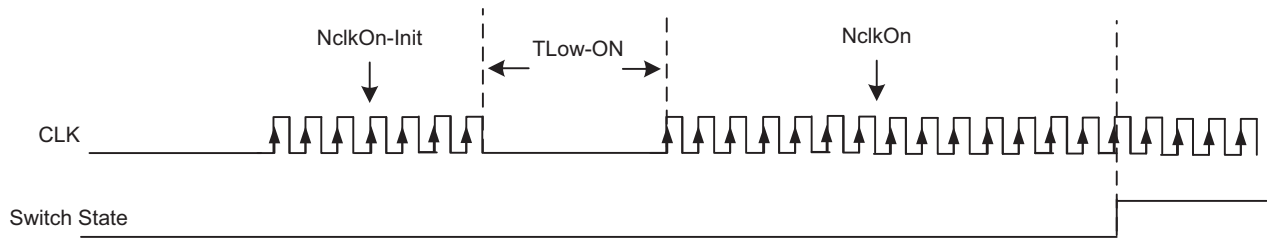


Figure 2: Clock Turn-on Sequence

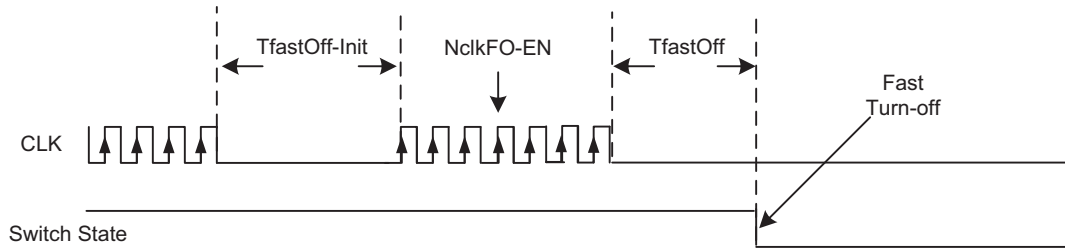


Figure 3: High-speed Turn-off Mode

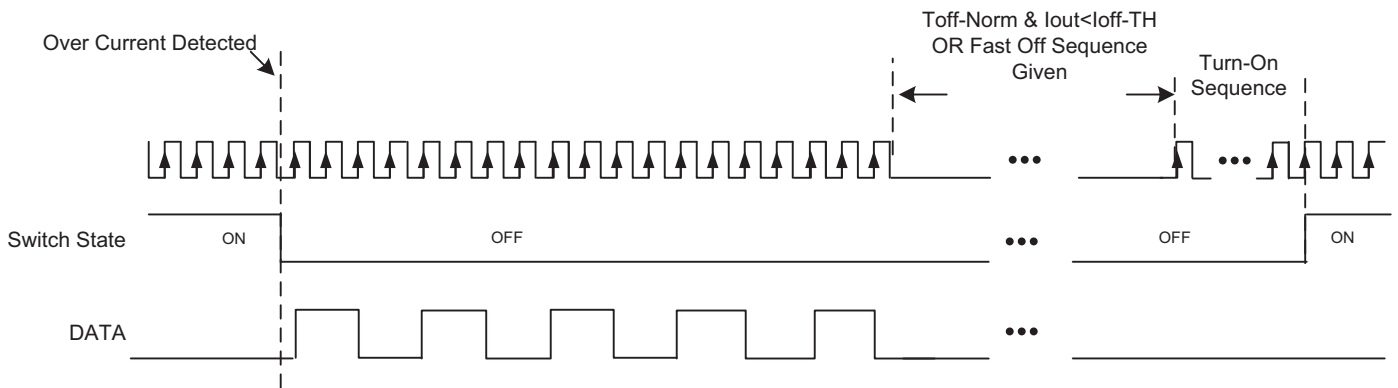
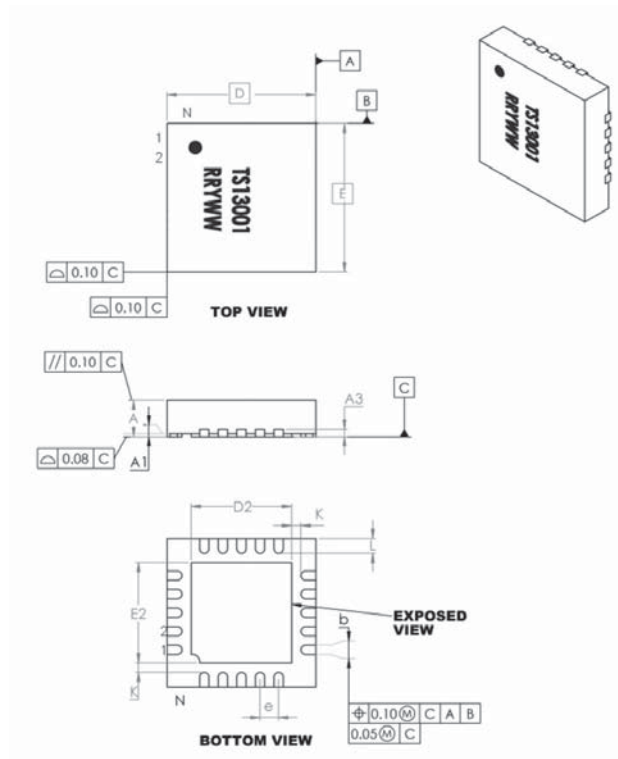


Figure 4: Over-current Shut-down and Restart

# Package Mechanical Drawings

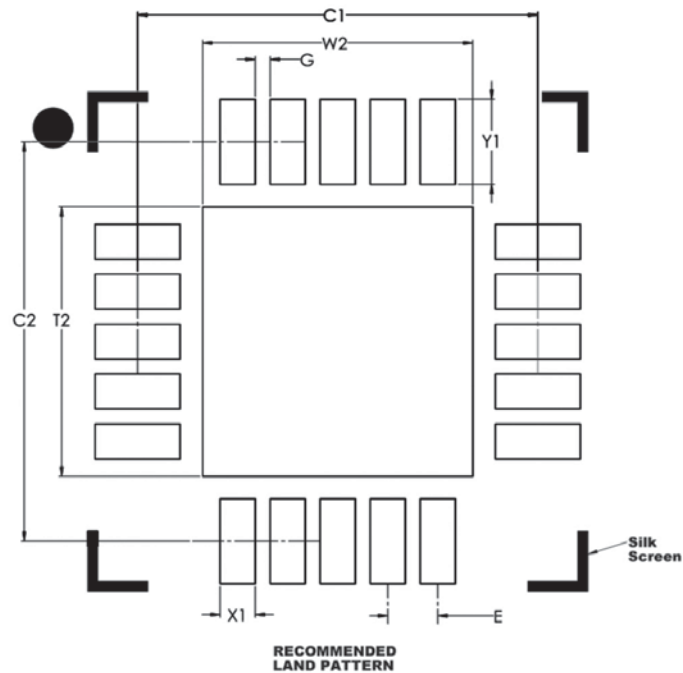


	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	20		
Pitch	e	0.50 BSC		
Overall Height	A	0.80	0.90	1.00
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3	0.20 REF		
Overall Length	D	4.00 BSC		
Exposed Pad Width	E2	2.55	2.70	2.80
Overall Width	E	4.00 BSC		
Exposed Pad Length	D2	2.55	2.70	2.80
Contact 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
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, Theoretically exact value shown with tolerances.



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## Ordering Information

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

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- 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)



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#### Contact Information

Semtech Corporation  
200 Flynn Road, Camarillo, CA 93012  
Phone: (805) 498-2111, Fax: (805) 498-3804  
[www.semtech.com](http://www.semtech.com)