IPS1270H

Datasheet

Single channel high-side switch

Product status link

IPS1270H

Product label

Features

- R_{ON}(max) (@ T_J = 25 °C) = 135 mΩ
- Very low standby current
- CMOS compatible input
- Thermal shutdown protection and diagnosis
- Undervoltage shutdown
- Overvoltage clamp
- Output voltage clamp
- Load current limitation
- Reverse polarity protection
- Electrostatic discharge protection
- Designed to drive DC-13 loads according to EN 60947-5-1
- Designed to meet IEC 61131-2, IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-5
- ECOPACK®: lead free and RoHS compliant
- SO8 Package

Application

- Programmable logic control
- Industrial PC peripheral input/output
- Numerical control machines

Description

The IPS1270H is monolithic device made by using STMicroelectronics™ VIPower™ M0-3 technology, intended for driving any kind of load with one side connected to ground.

Active VCC pin voltage clamp protects the device against low energy spikes.

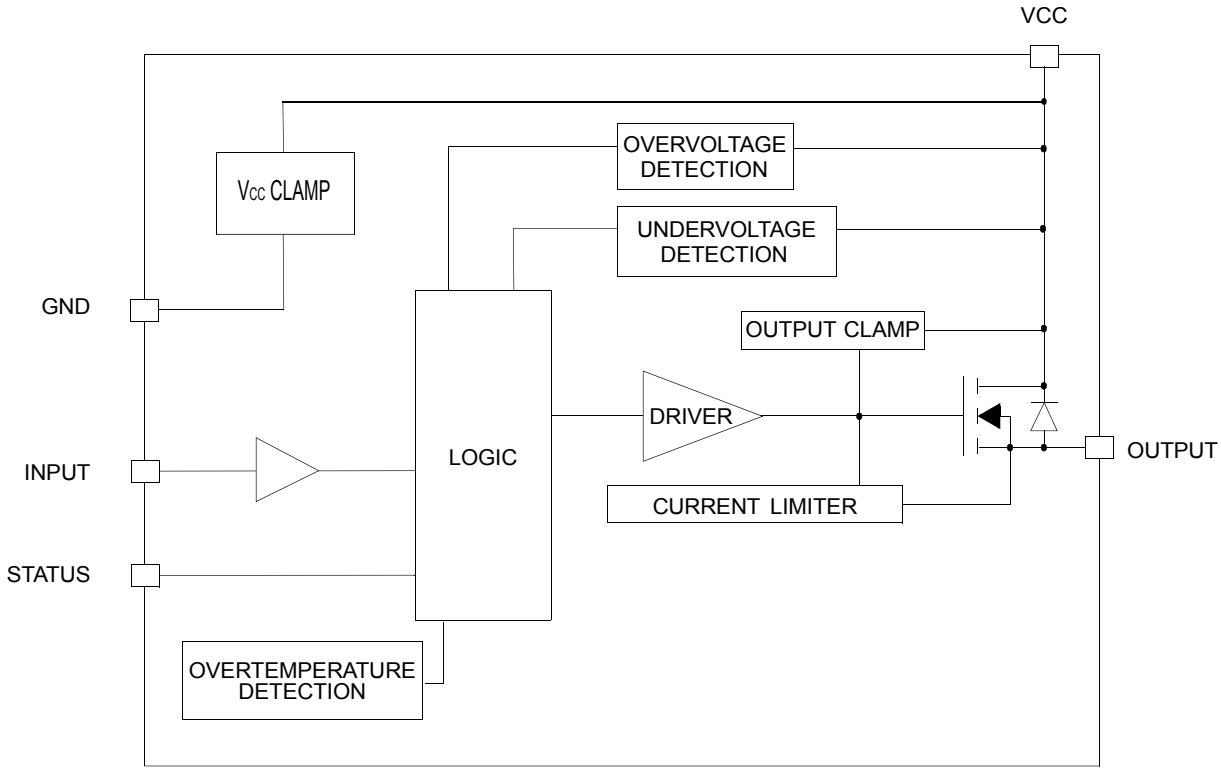
Active current limitation combined with thermal shutdown and automatic restart protect the device against overload.

Active output clamp protects the device against negative voltage at switch-off of inductive loads.

Device automatically turns off in case of ground pin disconnection.

1 Block diagram

Figure 1. **Block diagram**



2 Pin connection

Figure 2. **Pin connection (top view)**

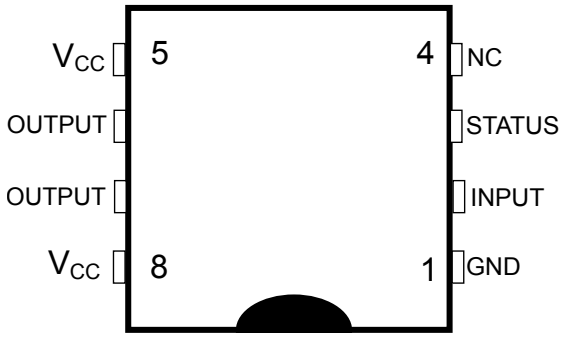


Table 1. **Pin function**

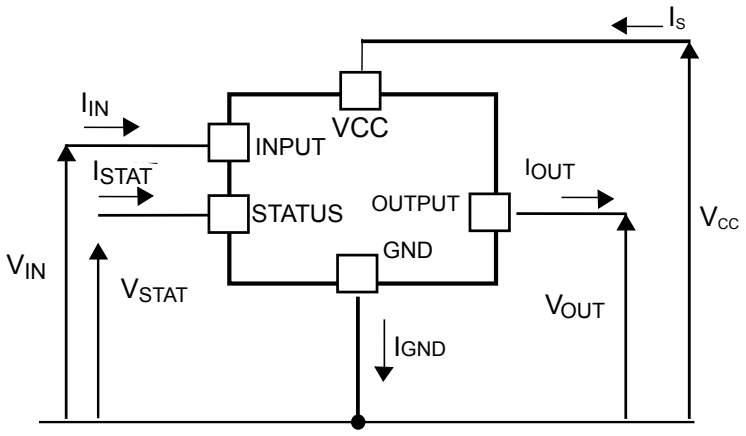
Pin	Name	Type	Function
1	GND	Supply	Ground connection
2	INPUT	Logic input	Voltage controlled input pin with hysteresis. CMOS compatible. It controls embedded output switch state
3	STATUS	Output	Embedded channel overtemperature status (active low)
4	NC	Not connected	
5, 8	VCC	Supply	Power supply
6, 7	OUTPUT	Analog output	Power output

Table 2. **Suggested connections for unused and not connected pins**

Connection/pin	Status	N.C.	Output	Input
Floating	X	X	X	X
To ground	Not allowed	X	Not allowed	Through 10 KΩ resistor

Note: X = don't care

Figure 3. **Current and voltage conventions**



3 Maximum rating

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	DC supply voltage	41	V
$-V_{CC}$	Reverse DC supply voltage	-0.3	V
$-I_{GND}$	DC reverse ground pin current	-200	mA
I_{OUT}	DC output current	Internally limited	A
I_{IN}	DC input current	±10	mA
V_{IN}	Input voltage range	-3 / V_{CC}	V
V_{STAT}	DC status voltage	V_{CC}	V
V_{ESD}	Electrostatic discharge (R = 1.5 kΩ; C = 100 pF)		
	Input	4000	V
	Status	4000	V
	Output	5000	V
	VCC	5000	V
P_{TOT}	Power dissipation @ T_{CASE} = 25 °C	4.2	W
E_{MAX}	Maximum switching energy L = 77.5 mH; R_L = 0 Ω; V_{CC} = 13.5 V; Tjstart = 150 °C; I_L = 1.5 A	121	mJ
T_J	Junction operating temperature	Internally limited	°C
T_{CASE}	Case operating temperature	-40 to 150	°C
T_{STG}	Storage temperature	-55 to 150	°C

Table 4. Thermal data

Symbol	Parameter		Value	Unit
$R_{th(j\text{-}lead)}$	Thermal resistance junction-lead	Max.	30	°C/W
$R_{th(j\text{-}amb)}$	Thermal resistance junction-ambient	Max.	93(1)	°C/W
			82(2)	

1. *When mounted on FR4 printed circuit board with 0.5 cm^2 of copper area (at least 35 µm thick) connected to all VCC pins.*
2. *When mounted on FR4 printed circuit board with 2 cm^2 of copper area (at least 35 µm thick).*

4 Electrical characteristics

8 V < V_{CC} < 36 V; -40 °C < T_J < 150 °C; unless otherwise specified

Table 5. Power section

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{CC}	Operating supply voltage		5.5		36	V
$V_{CC\ CLAMP}$	Clamp on V_{CC}		47	52	57	V
V_{USD}	Undervoltage shutdown		3	4	5.5	V
V_{OV}	Overvoltage shutdown		36	42		V
R_{ON}	On-state resistance	I_{OUT} = 0.5 A @ T_J = 25 °C			135	mΩ
		I_{OUT} = 0.5 A			270	mΩ
I_S	Supply current	Off-state, V_{CC} = 24 V, T_{CASE} = 25 °C		10	20	µA
		On-state, V_{CC} = 24 V, T_{CASE} = 25 °C		1.5		mA
		On-state, V_{CC} = 24 V			2.6	mA
I_{LGND}	Output current at turn-off	V_{CC} = V_{STAT} = V_{IN} = V_{GND} = 24 V; V_{OUT} = 0 V			0.5	mA
$I_{L(off1)}$	Off-state output current	V_{IN} = V_{OUT} = 0 V	0		50	µA
$I_{L(off2)}$	Off-state output current	V_{IN} = V_{OUT} = 0 V; V_{CC} = 13 V; T_j = 125 °C			5	µA
$I_{L(off3)}$	Off-state output current	V_{IN} = V_{OUT} = 0 V; V_{CC} = 13 V; T_j = 25 °C			3	µA

Table 6. Switching (V_{CC} = 24 V)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(ON)}$	Turn-on delay time	R_L = 48 Ω from V_{IN} rising edge to V_{OUT} = 2.4 V		10		µs
$t_{d(OFF)}$	Turn-off delay time	R_L = 48 Ω from V_{IN} falling edge to V_{OUT} = 21.6 V		40		µs
$dV_{OUT}/dt_{(on)}$	Turn-on voltage slope	R_L = 48 Ω from V_{OUT} = 2.4 V to V_{OUT} = 19.2 V (see also Figure 17)		810		V/ms
$dV_{OUT}/dt_{(off)}$	Turn-off voltage slope	R_L = 48 Ω from V_{OUT} = 21.6 V to V_{OUT} = 2.4 V (see also Figure 20)		330		V/ms

Figure 4. Switching time waveforms

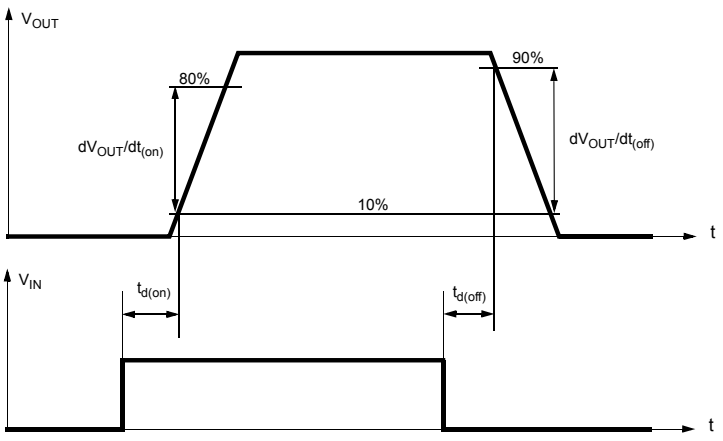


Table 7. INPUT pin

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{INL}	INPUT pin low level				1.25	V
I_{INL}	Low level INPUT pin current	V_{IN} = 1.25 V	1			µA
V_{INH}	INPUT pin high level		3.25			V
I_{INH}	High level INPUT pin current	V_{IN} = 3.25 V			10	µA
V_{INHYST}	INPUT pin hysteresis voltage		0.5			V
I_{IN}	INPUT pin current	$V_{IN} = V_{CC}$ = 36 V			200	µA

Table 8. VCC - OUTPUT diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on voltage	$-I_{OUT}$ = 0.6 A; T_j = 150 °C			0.6	V

Table 9. STATUS pin

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{STAT}	STATUS pin low output voltage	I_{STAT} = 1.6 mA			0.5	V
I_{LSTAT}	STATUS pin leakage current	Normal operation; $V_{STAT} = V_{CC}$ = 36 V			10	µA
C_{STAT}	STATUS pin input capacitance	Normal operation; V_{STAT} = 5 V			30	pF

Figure 5. Overtemperature status timing ($T_j > T_{TSD}$)

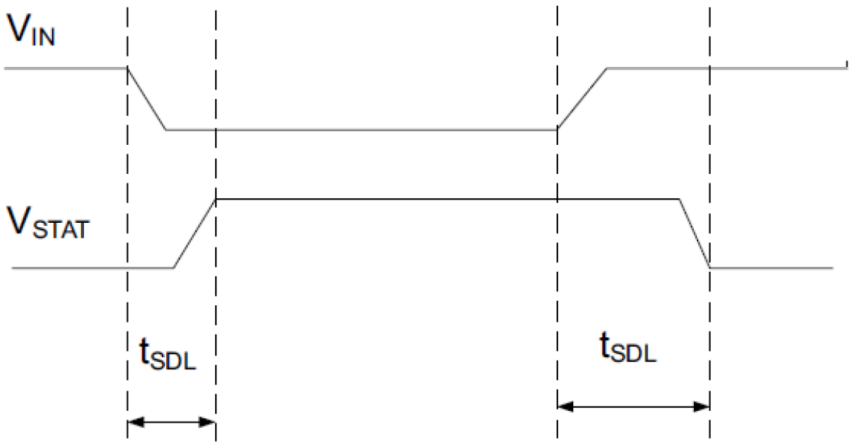


Table 10. Protections[1]

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
T_{TSD}	Shutdown temperature		150	175	200	°C
T_R	Reset temperature		135			°C
T_{hyst}	Thermal hysteresis		7	15		°C
t_{SDL}	Status delay in overload condition	$T_j > T_{TSD}$			20	µs
I_{lim}	DC short circuit current	V_{CC} = 24 V; R_{LOAD} = 10 mΩ	0.7		2	A
V_{DEMAG}	Turn-off output clamp voltage	I_{OUT} = 24 V ; L = 6 mH	V_{CC} - 47	V_{CC} - 52	V_{CC} - 57	V

1. *To ensure long term reliability under heavy overload or short circuit conditions, protection and related diagnostic signals must be used together with a proper software strategy. If the device is subjected to abnormal conditions, this software must limit the duration and number of activation cycles.*

5 Protections

5.1 Current limitation

The device is equipped with an output current limiter in order to protect the silicon from excessive current flow. Consequently, in case of short-circuit or overload, the output current is clamped to a safety level, I_{lim}.

5.2 Thermal shutdown

In case the junction temperature of the device exceeds the thermal shutdown threshold T_{TSD}, it automatically switches off and the STATUS pin goes low.

The embedded channel turns OFF and back ON automatically in order to maintain its junction temperature between T_{TSD} and T_R.

The STATUS pin moves consistently with the embedded channel state.

5.3 Negative output voltage clamp

In case the device drives inductive load, the output voltage reaches a negative value during turn off. A negative voltage clamp structure limits the maximum negative voltage to V_{DEMAG}, allowing the inductor energy to be dissipated without damaging the device (see also Section 10).

6 Signals waveform and functional table

Figure 6. **Waveforms**

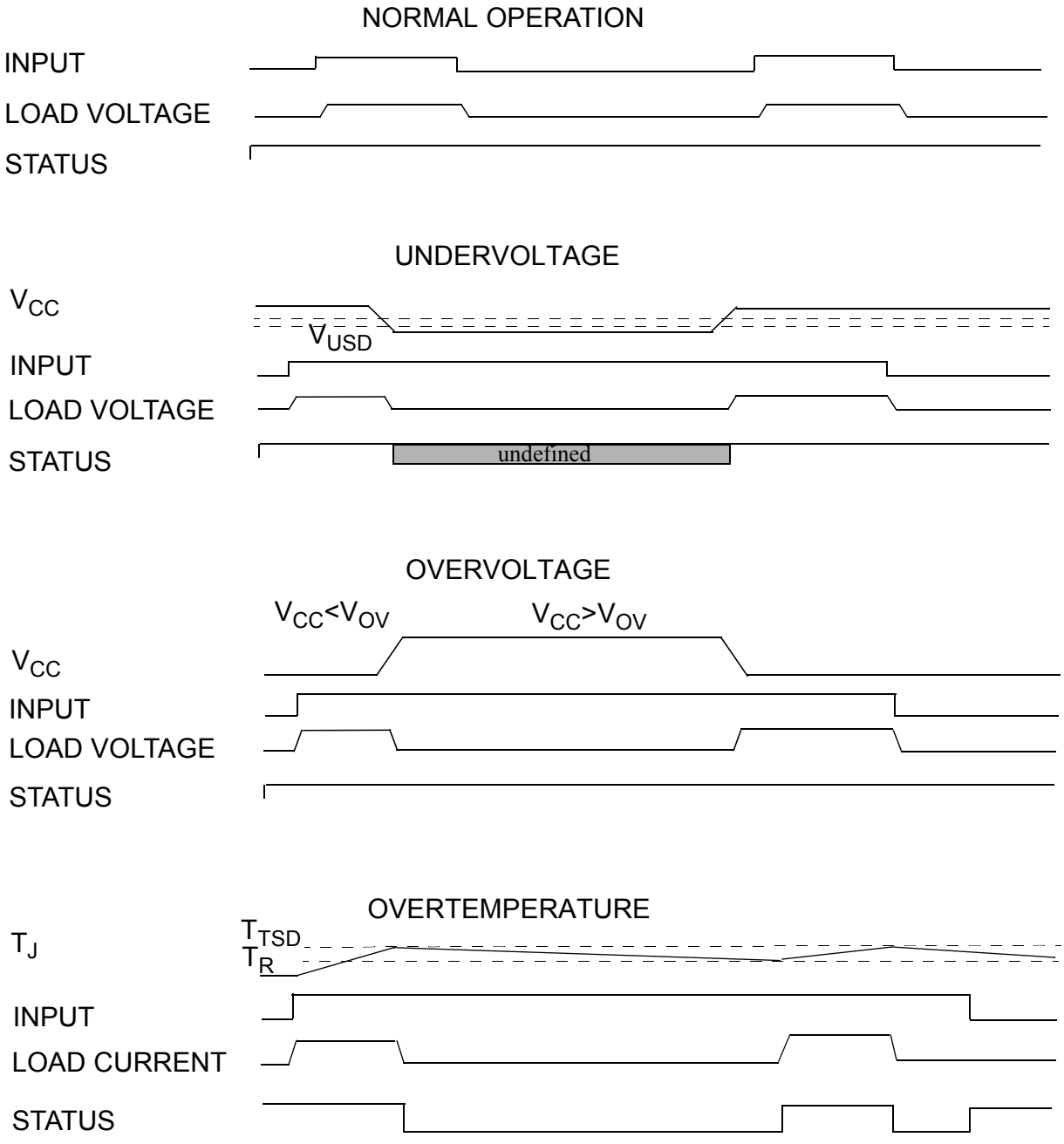


Table 11. Functional table

Device status	Input	Output	Status
Normal operation	L	L	H
	H	H	H
Current limitation	L	L	H
	H	X(1)	(T_J < T_{TSD}) H
	H	X	(T_J > T_{TSD}) L
Overtemperature	L	L	H
	H	L	L
Undervoltage	L	L	X
	H	L	X
Overvoltage	L	L	H
	H	L	H

1. *X = don't care*

7 Test circuits

Figure 7. I_{lim} short-circuit current

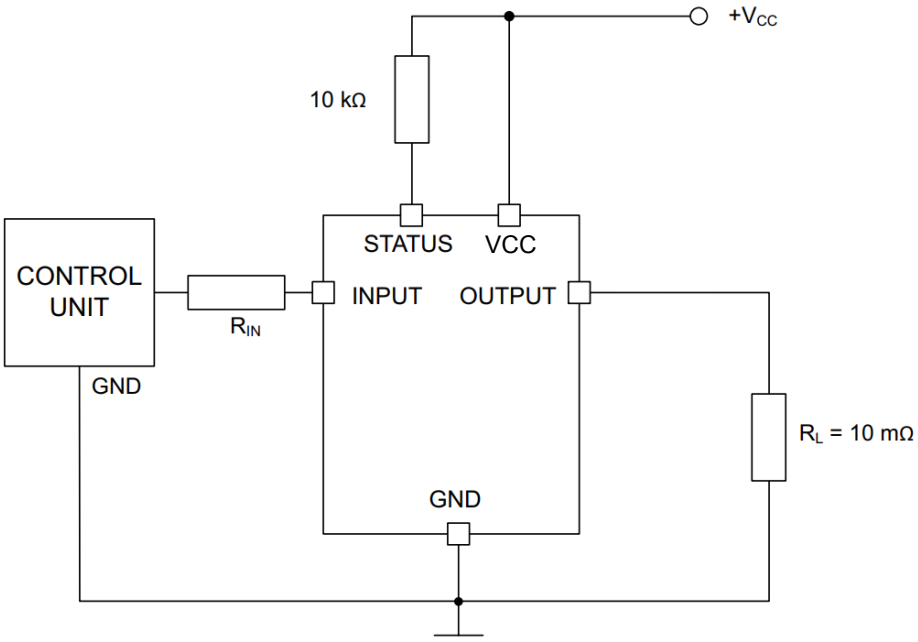
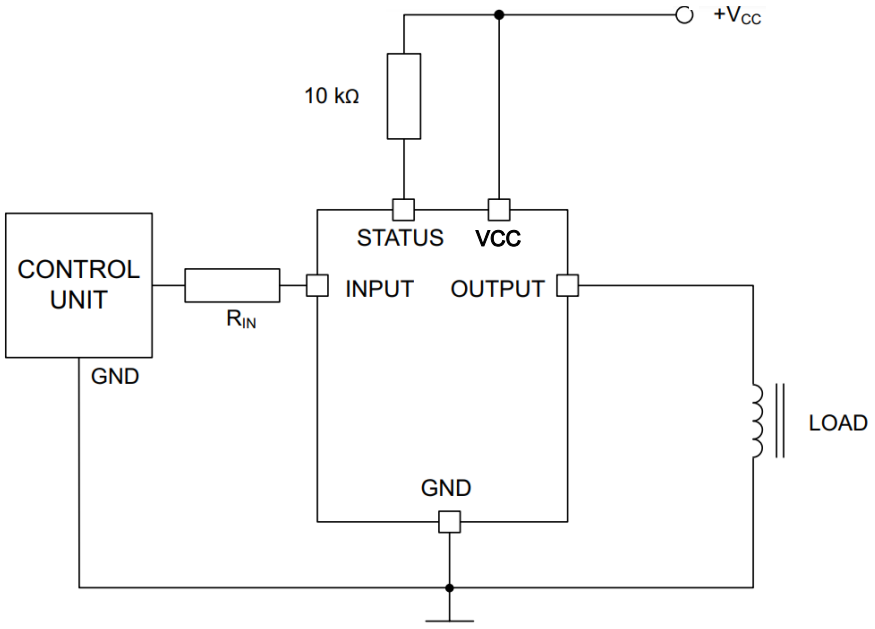
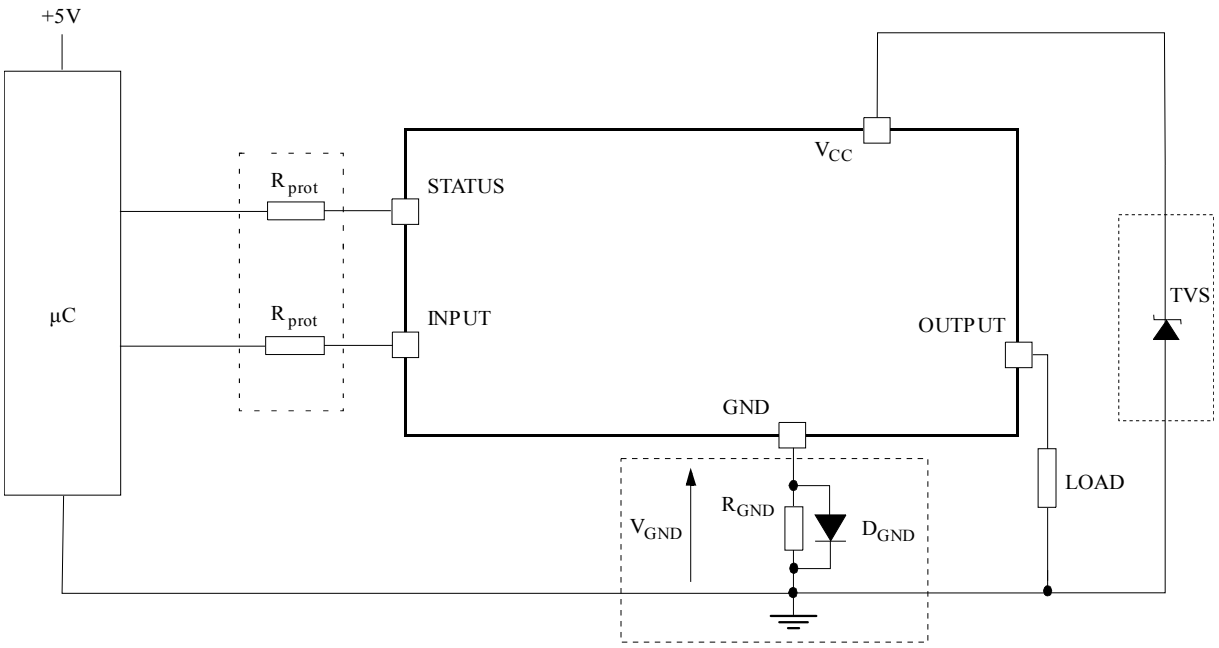


Figure 8. Avalanche energy



8 Application schematics

Figure 9. **Application schematic**



8.1 Reverse polarity protection

Reverse polarity protection can be implemented on the board using two different solutions:

1. Placing a resistor (R_{GND}) between the IC GND pin and load GND
2. Placing a diode between the IC GND pin and load GND

If option 1 is selected, the minimum resistance value has to be selected according to the following equation:

Equation 1:

$R_{GND} \geq V_{CC} / I_{GND}$

where $-I_{GND}$ is the DC reverse ground pin current and can be found in the absolute maximum rating section of the device datasheet.

Power dissipated by R_{GND} (when $V_{CC} < 0$: during reverse polarity situations) is:

Equation 2:

$P_D = (V_{CC})^2 / R_{GND}$

If option 2 is selected, the diode has to be chosen by taking into account $V_{RRM} > |V_{CC}|$ and its power dissipation capability:

Equation 3:

$P_D \geq I_S * V_F$

A resistor (R_{GND} =1 kΩ) should be inserted in parallel to D_{GND} if the device is driving an inductive load.

Note: In normal conditions (no reverse polarity), due to the diode there is a voltage drop between GND of the device and GND of the system.

8.2 Microcontroller I/Os protection

If a ground protection network is used and negative transients are present on the VCC line, the control pins are pulled negative.

ST suggests to insert a resistor (Rprot) in line to prevent the microcontroller I/Os pins to latch-up.

The value of these resistors is a compromise between the leakage current of microcontroller and the current required by the HSD I/Os (Input levels compatibility) with the latch-up limit of microcontroller I/Os.

$-V_{CCpeak} / I_{latchup} \leq R_{prot} \leq (V_{OH\mu C} - V_{IH} - V_{GND}) / I_{IHmax}$

Calculation example:

For V_{CCpeak} = -100 V and $I_{latchup} \geq$ 20 mA; $V_{OH\mu C} \geq$ 4.5 V :

5 kΩ ≤ R_{prot} ≤ 65 kΩ

Recommended R_{prot} value is 10 kΩ.

8.3 Vcc overshoot protection

To protect the device from supply rail overshoot, a TVS is inserted between VCC and GND.

It will be chosen to protect the circuit but not interferes with its normal operations.

For this reason, the TVS must be selected with appropriate V_{BR} and V_{CLAMP} values for the maximum operating voltage of the application.

9 Electrical characteristics curves

Figure 10. **Off-state OUTPUT pin current**

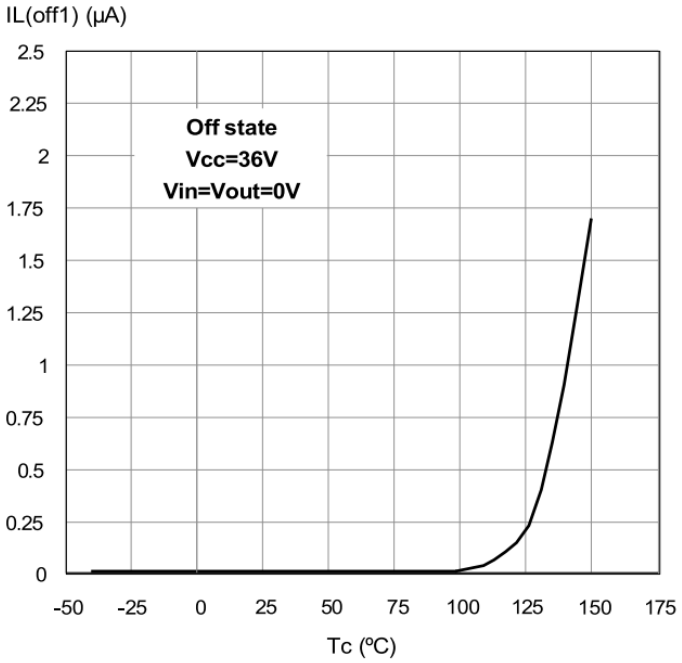


Figure 11. **High level INPUT pin current**

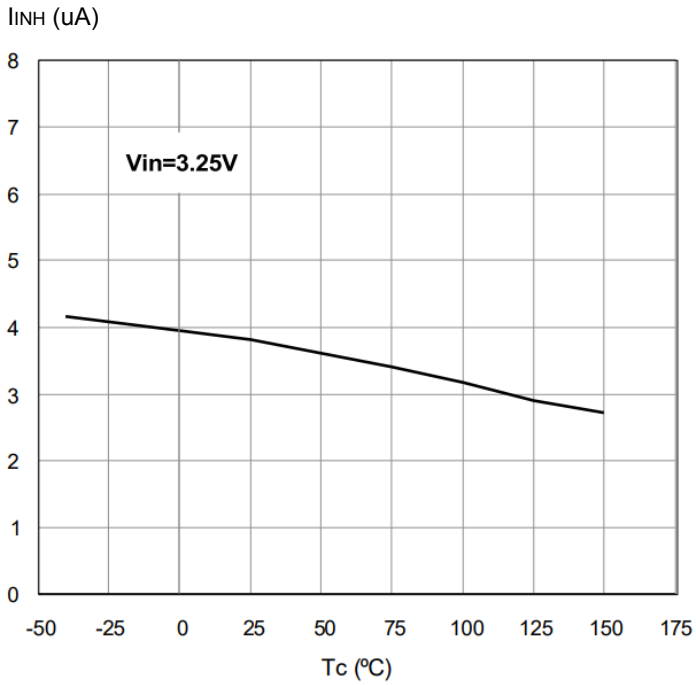


Figure 12. **STATUS pin leakage current**

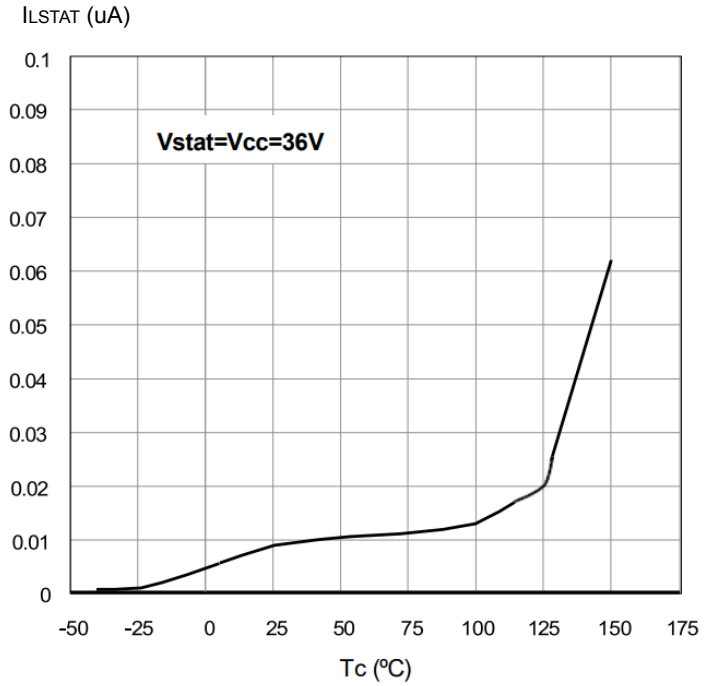


Figure 13. **On-state resistance vs T_{CASE}**

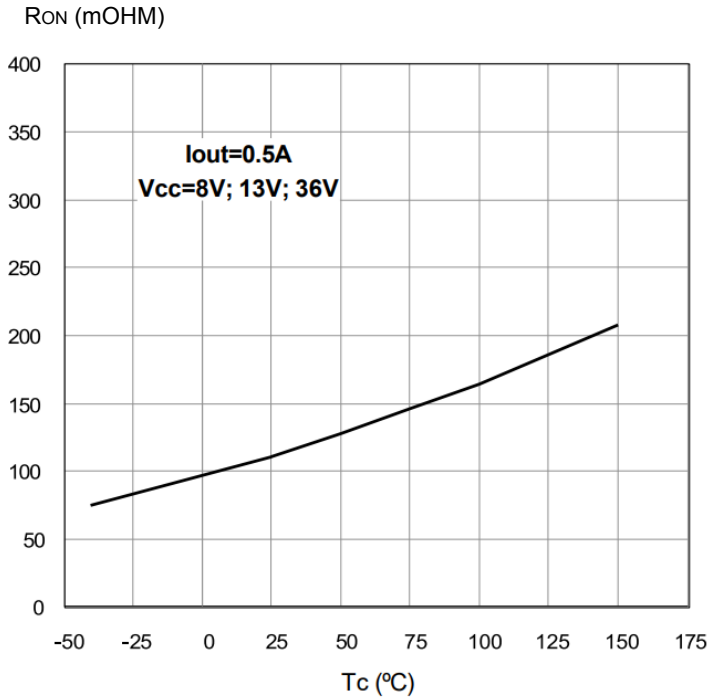


Figure 14. **On-state resistance vs V_{CC}**

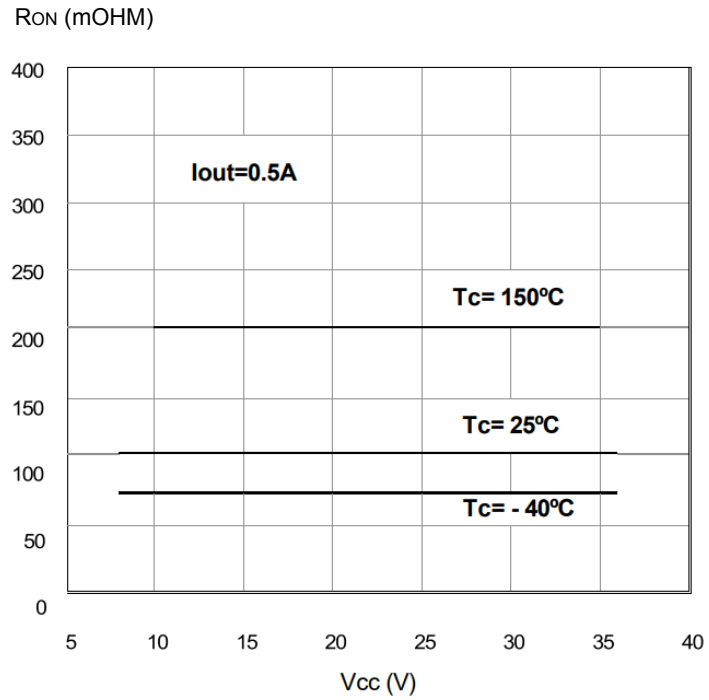


Figure 15. **INPUT pin high level**

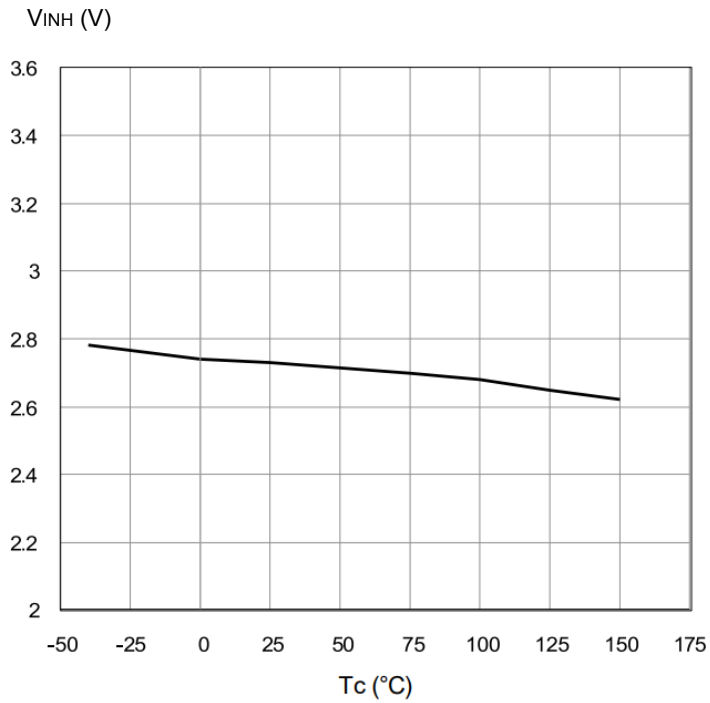


Figure 16. **INPUT pin low level**

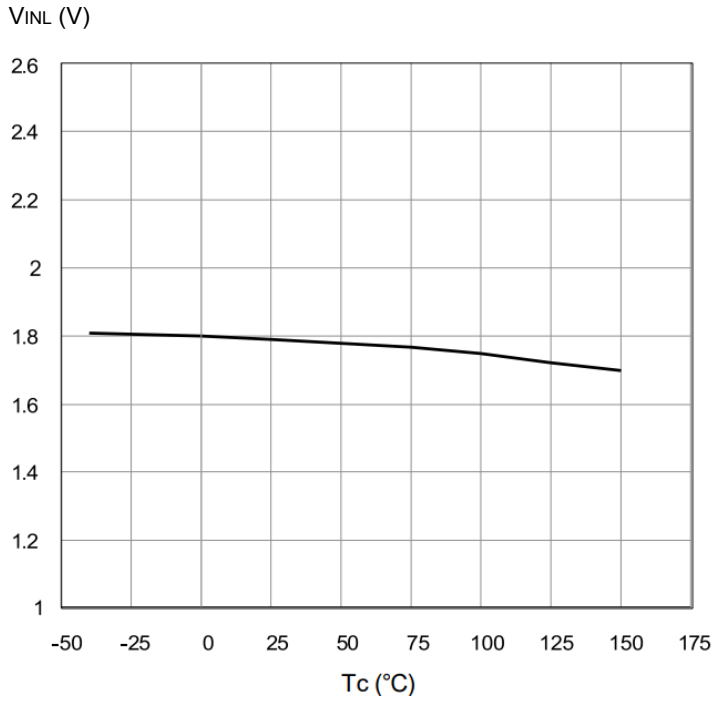


Figure 17. **Turn-on output voltage slope**

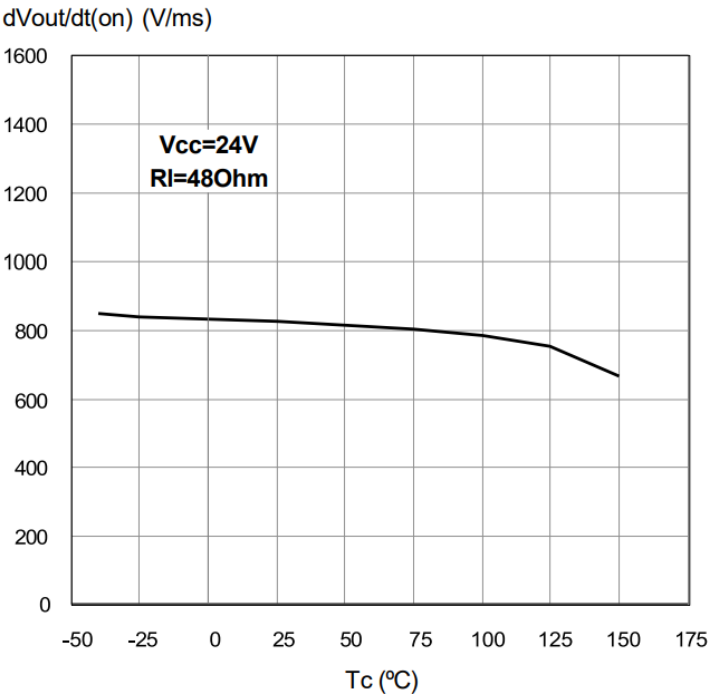


Figure 18. **Output overvoltage shutdown**

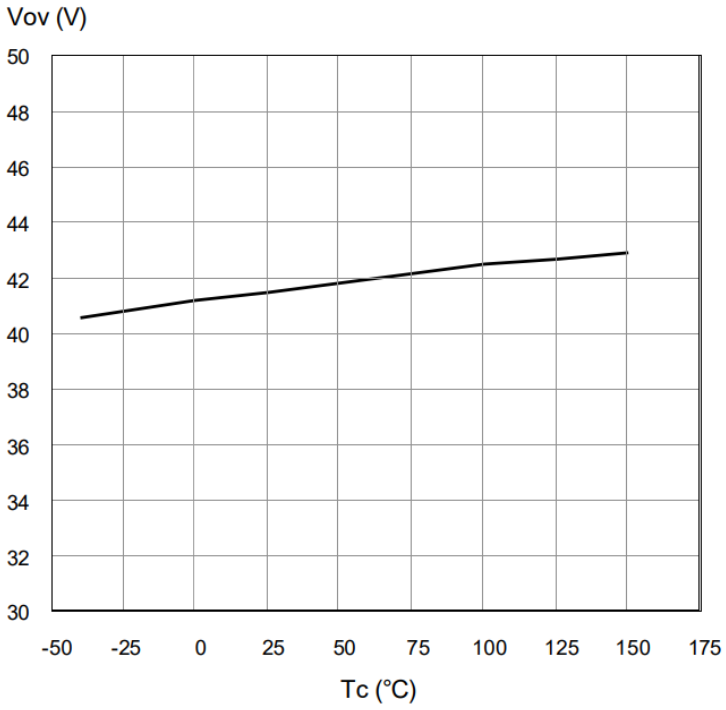


Figure 19. **INPUT pin hysteresis voltage**

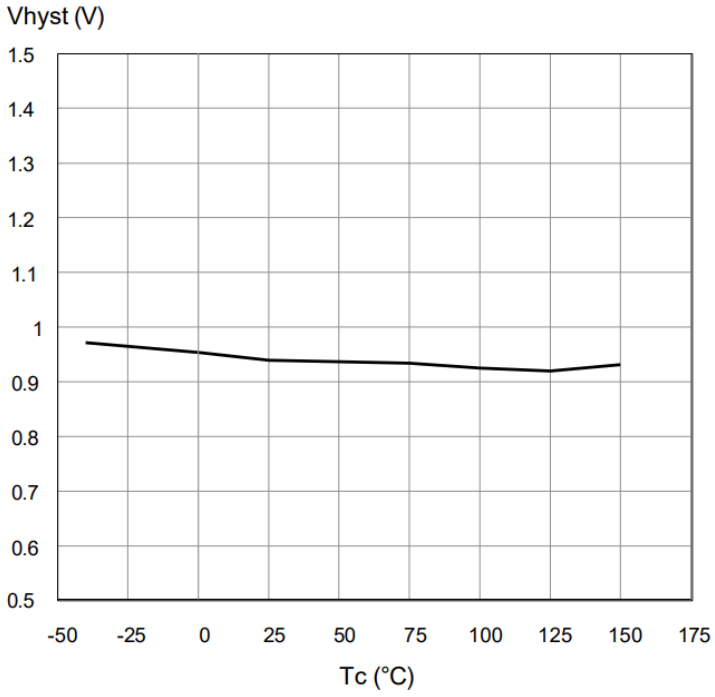


Figure 20. **Turn-off output voltage slope**

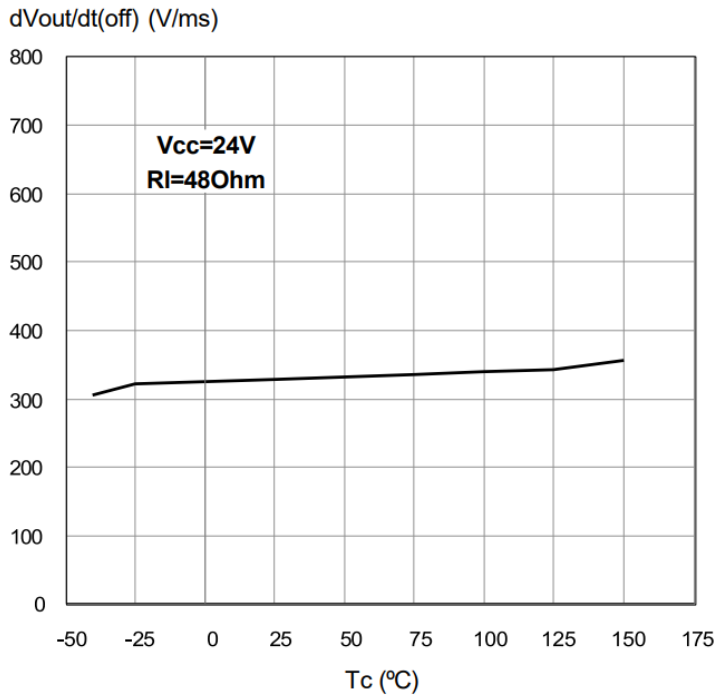
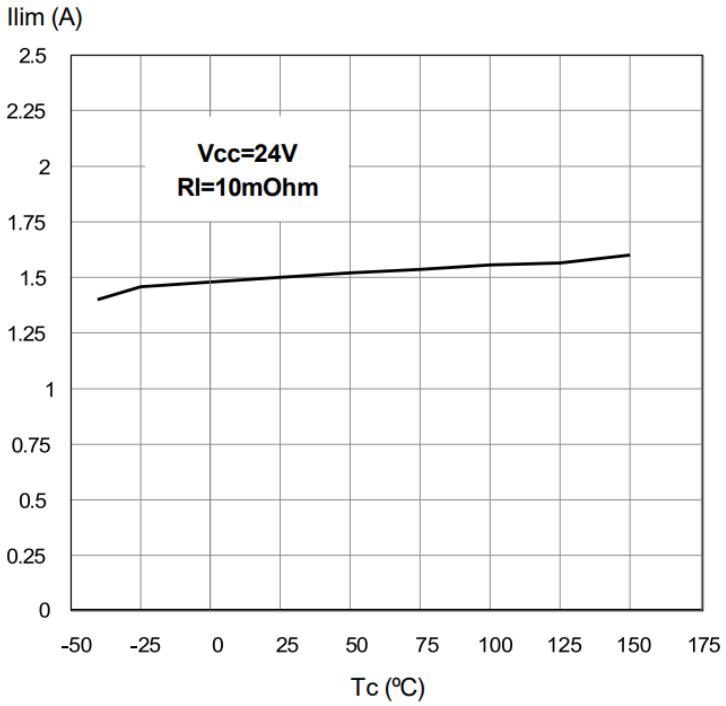


Figure 21. I_{lim} vs T_{CASE}



10 Active clamp

Active clamp is also known as **Fast Demagnetization of inductive loads** or **Fast Current Decay**. When a high-side driver turns off an inductance, an undervoltage on the output is detected (see Figure 22).

The OUTPUT pin is pulled down to V_{CC}-V_{DEMAG}. The conduction state is modulated by an internal circuitry in order to keep the OUTPUT pin voltage at ~V_{DEMAG} until the load energy has been dissipated. The energy is dissipated in both IC internal switch and load resistance.

Figure 22. Active OUTPUT clamp typical waveforms

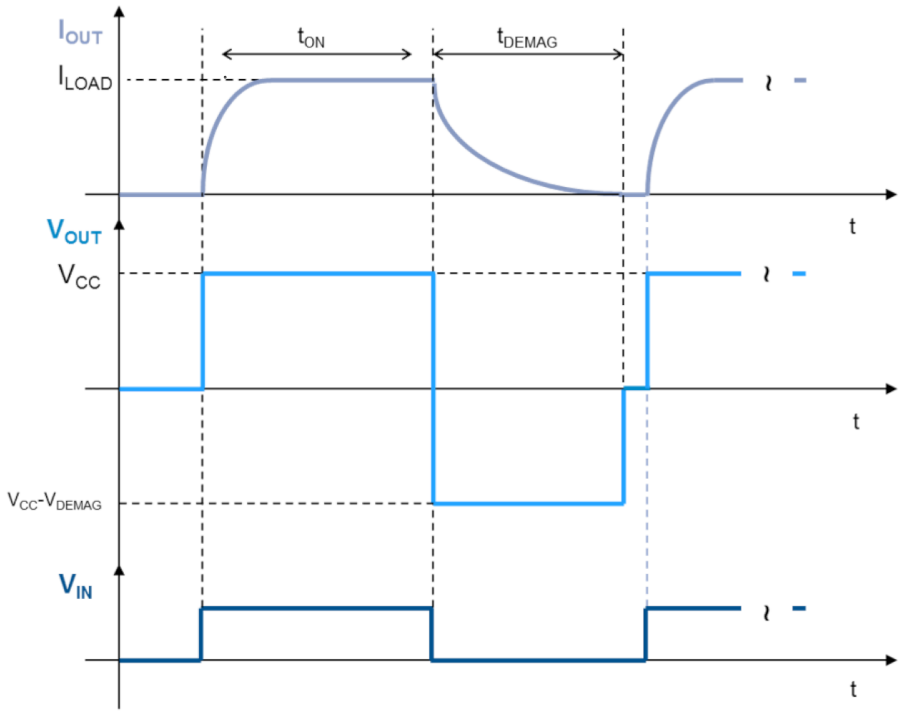
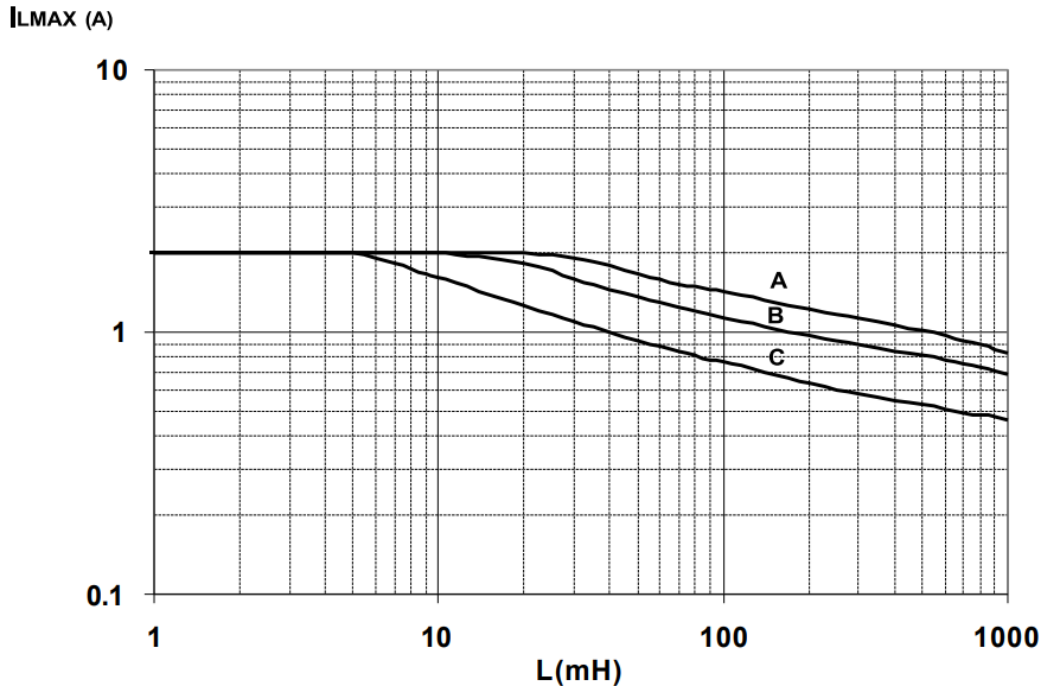


Figure 23. **Maximum turn off current versus inductance**



Note: Legenda

A = Single pulse at T_{Jstart} = 150 °C

B = Repetitive pulse at T_{Jstart} = 100 °C

C = Repetitive Pulse at T_{Jstart} = 125 °C

Conditions:

V_{CC} = 13.5 V

Values are generated with RL = 0 Ω

In case of repetitive pulses, T_{jstart} (at beginning of each demagnetization) of every pulse must not exceed the temperature specified above for curves B and C.

11 Package and PCB thermal data

Figure 24. SO-8 PC board

Figure 25. SO-8 $R_{thj\text{-}amb}$ vs PCB copper area in open box free air condition

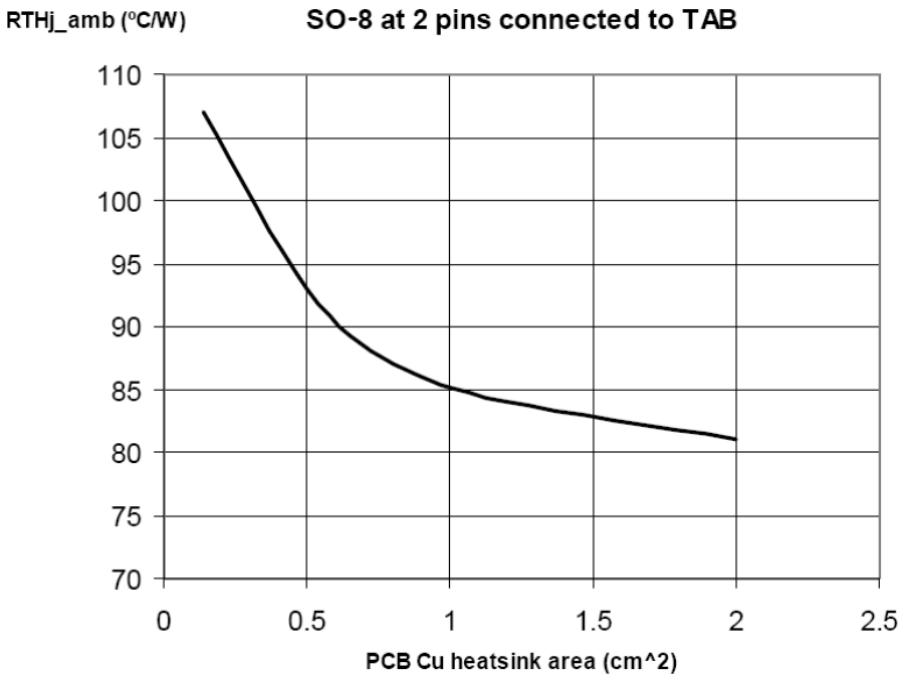


Figure 26. **SO-8 thermal impedance junction ambient single pulse**

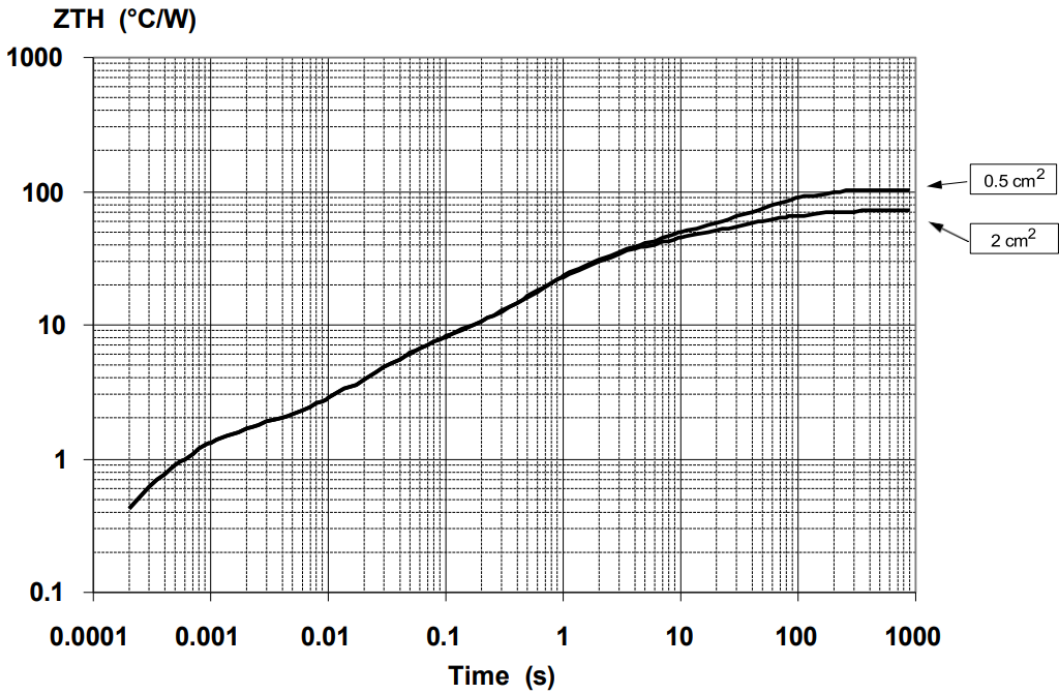
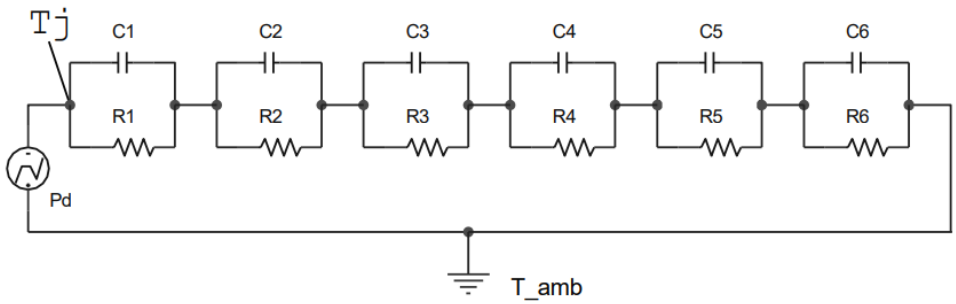


Figure 27. **Thermal fitting model of a single channel HSD in SO-8**



Pulse calculation formula:

$Z_{TH\delta} = R_{TH} * \delta + Z_{THtp} (1 - \delta)$

where:
$\delta = tp / T$

Table 12. **Thermal parameter**

Area/island (cm^2)	0.14	2
R1 (°C/W)	0.24	
R2 (°C/W)	1.2	
R3 (°C/W)	4.5	
R4 (°C/W)	21	
R5 (°C/W)	16	
R6 (°C/W)	58	28
C1 (W.s/°C)	0.00015	
C2 (W.s/°C)	0.0005	
C3 (W.s/°C)	7.50E-03	
C4 (W.s/°C)	0.045	
C5 (W.s/°C)	0.35	
C6 (W.s/°C)	1.05	2

12 Package information

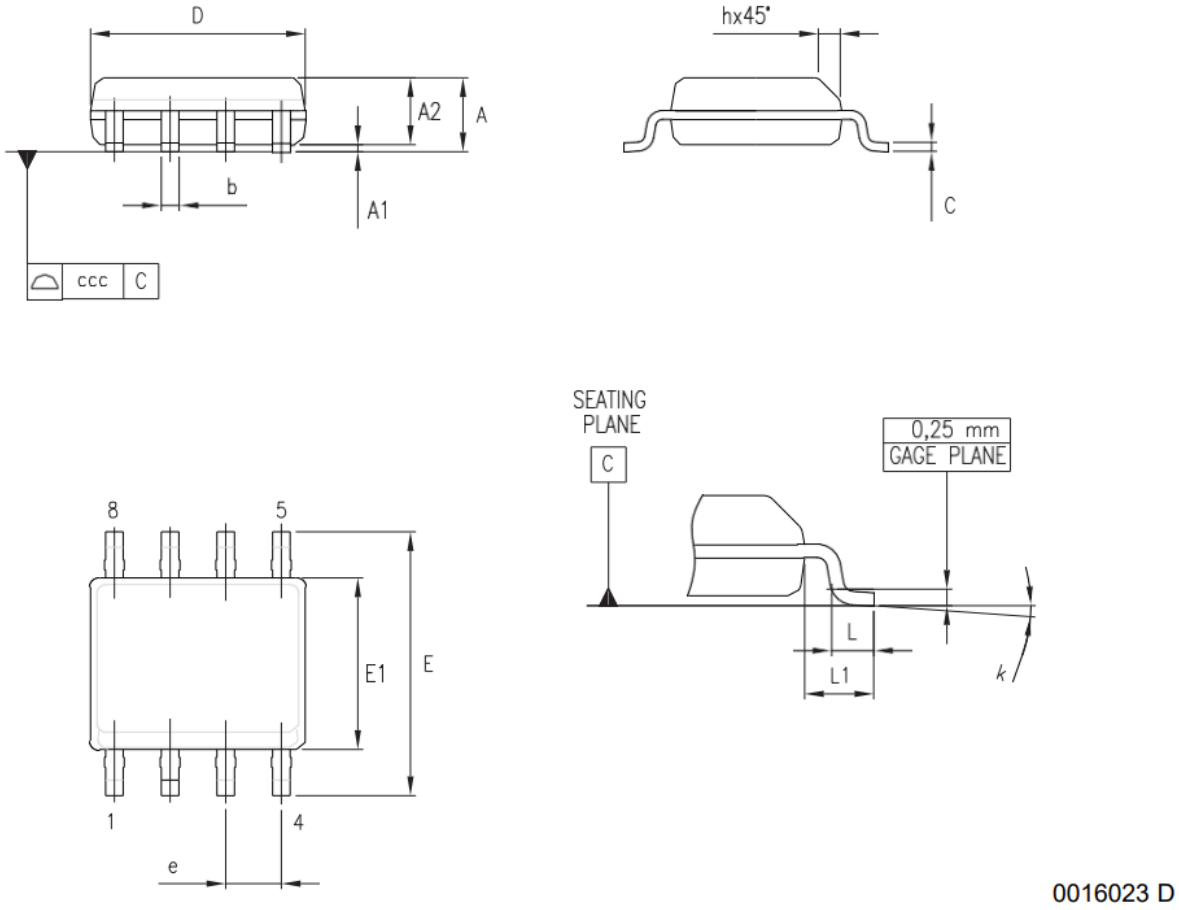
To meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions, and product status are available at: www.st.com. ECOPACK is an ST trademark.

12.1 SO8 package information

Table 13. SO-8 mechanical data

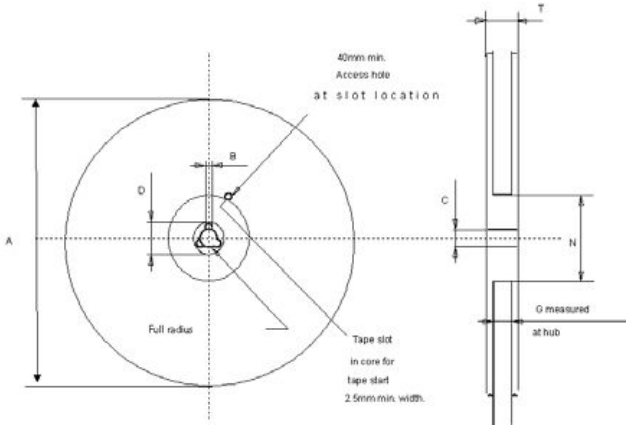
Dim.	mm		
	Min.	Typ.	Max.
A			1.75
a1	0.1		0.25
a2			1.65
a3	0.65		0.85
b	0.35		0.48
b1	0.19		0.25
C	0.25		0.5
c1		45	
D	4.8		5
E	5.8		6.2
e		1.27	
e3		3.81	
F	3.8		4
L	0.4		1.27
M			0.6
S			8
L1	0.8		1.2

Figure 28. **SO-8 package dimensions**



12.2 SO8 packing information

Figure 29. **SO-8 tape and reel shipment**



REEL DIMENSIONS

Base Q.ty	2500
Bulk Q.ty	2500
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	12.4
N (min)	60
T (max)	18.4

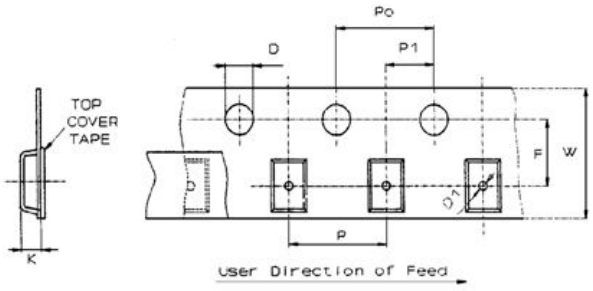
All dimensions are in mm.

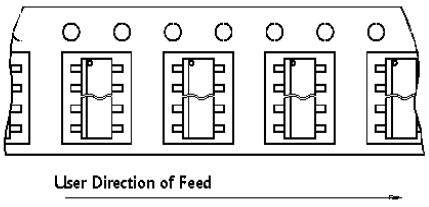
TAPE DIMENSIONS

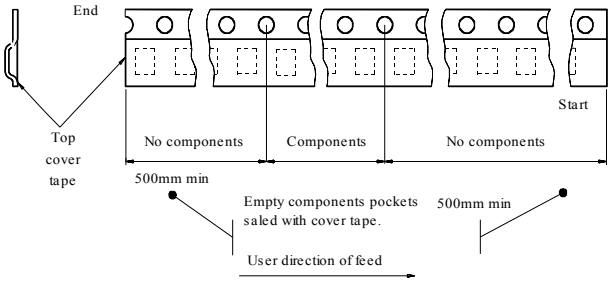
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	12
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	8
Hole Diameter	**D (± 0.1/-0)**	1.5
Hole Diameter	**D1 (min)**	1.5
Hole Position	**F (± 0.05)**	5.5
Compartment Depth	**K (max)**	4.5
Hole Spacing	**P1 (± 0.1)**	2

All dimensions are in mm.







13 Ordering information

Table 14. **Ordering information**

Part number	Package	Packing
IPS1270HS	SO8	Tape and reel

Revision history

Table 15. **Document revision history**

Date	Revision	Changes
08-May-2026	1	Initial release.

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