

Octal channel high-side driver



Features

- $V_{CC}/2$ compatible input
- Junction overtemperature protection
- Case overtemperature protection for thermal independence of the channels
- Current limitation
- Short-circuit load protection
- Undervoltage shutdown
- Protection against loss of ground
- Very low standby current
- Compliance to 61000-4-4 IEC test up to 4 kV

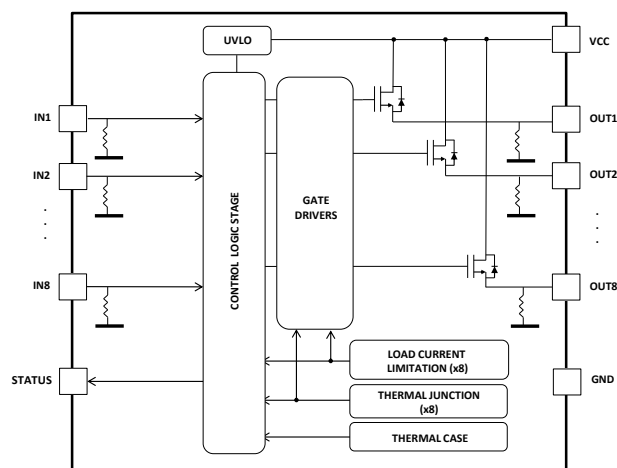
Description

The VN808-E and VN808-32-E are monolithic devices, realized in STMicroelectronics VIPower M0-3 technology, intended to drive any kind of load with one side connected to ground. Active current limitation combined with thermal shutdown and automatic restart, protect the device against overload. In overload conditions, the channel turns OFF and ON again automatically in order to maintain the junction temperature between T_{JSD} and T_R . If this condition causes case temperature reach T_{CSD} , overloaded channels are turned OFF and restart only when case temperature decreases down to T_{CR} . Non-overloaded channels continue to operate normally. The device automatically turns OFF in case of ground pin disconnection. This device is especially suitable for industrial applications conform to IEC 61131.

Product status link			
VN808-E			
VN808-32-E			
Product label			
			
Type	$R_{DS(on)}^{(1)}$	I_{OUT}	V_{CC}
VN808-E	150 m Ω	0.7 A	45 V
VN808-32-E	150 m Ω	1 A	45 V

1. Per channel

Figure 1. Internal schematic



1 Maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Max.	Unit
V _{CC}	DC Supply Voltage	45	V
-I _{GND}	DC Ground Reverse Current	250	mA
	TRAN ground reverse current (pulse duration < 1 ms)	6	A
I _{OUT}	DC Output Current	Internally limited	A
-I _{OUT}	Reverse DC Output Current	5 ⁽¹⁾	A
I _{IN}	DC Input Current	±10	mA
V _{IN}	Input Voltage Range	-3/+V _{CC}	V
V _{ESD}	Electrostatic discharge (R = 1.5K Ω; C = 100pF)	2000	V
P _{TOT}	Power dissipation at T _c = 25°C	10	W
EAS	Single pulse Avalanche Energy per channel, all channels driven simultaneously (T _{amb} = 125 °C, I _{OUT} = 0.6 A per channel)	1.15	J
T _J	Junction Operating Temperature	Internally limited	°C
T _c	Case Operating Temperature	Internally limited	°C
T _{STG}	Storage Temperature	-40 to 150	°C

1. Limit intended with each couple of OUT_x (x = 1...8) pin shorted on the application board

Table 2. Thermal data

Symbol	Parameter	Max. Value	Unit
R _{th(JC)}	Thermal Resistance, Junction-to-case	1.3	°C/W
R _{th(JA)}	Thermal Resistance, Junction-to-ambient ⁽¹⁾	17	

1. When mounted on FR4 printed circuit board with 0.5 cm² of copper area (at least 35 μm thick) connected to all TAB pins.

2 Electrical characteristics

10.5 V < V_{CC} < 32 V; - 40 °C < T_J < 125 °C; unless otherwise specified.

Table 3. Power Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V _{CC}	Operating supply voltage		10.5		45	V
V _{USD}	V _{CC} under-voltage turn-off threshold		7		10.5	V
R _{ON}	On-state resistance	I _{OUT} = 0.5A; T _J = 25 °C I _{OUT} = 0.5A; T _J = 125 °C		150	185 280	mΩ mΩ
I _S	Supply current	OFF-state V _{CC} = 24 V; T _{CASE} = 25 °C ON-state (all channels ON) V _{CC} = 24 V; T _{CASE} = 100 °C			150 12	μA mA
I _{LGND}	Output current at turn-off	V _{CC} = V _{STAT} = V _{IN} = V _{GND} = 24 V; V _{OUT} = 0 V			1	mA
I _{L(OFF)}	OFF-state output current	V _{IN} = V _{OUT} = 0 V	0		5	μA
V _{OUT(OFF)}	OFF-state output voltage	V _{IN} = 0 V; I _{OUT} = 0 A			3	V
t _{d(VCCON)}	Power-on delay time from VCC rising edge	See Figure 7		1		ms

Table 4. Switching (VCC = 24V)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
t _{ON}	Turn-ON time	R _L = 48 Ω from 80% V _{OUT} (see Figure 6)		50	100	μs
t _{OFF}	Turn-OFF time	R _L = 48 Ω to 10% V _{OUT} (see Figure 6)		75	150	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 Figure 6)		0.7		V/μs
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 Figure 6)		1.5		V/μs

Table 5. Input pins

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V _{INL}	Input low level				V _{CC} /2 -1	V
I _{INL}	Low level input current	V _{IN} = V _{CC} /2 -1 V	80		650	μA
V _{INH}	Input high level		V _{CC} /2 +1			V
I _{INH}	High level input current	V _{IN} = V _{CC} /2 +1 V		150	260	μA

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{IN(HYST)}$	Input hysteresis voltage			0.6		V
I_{INL}	Low level input current	$V_{IN} = V_{CC} = 32\text{ V}$			300	μA

Table 6. Protections

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
T_{CSD}	Case shut-down temperature		125	130	135	$^{\circ}\text{C}$
T_{CR}	Case reset temperature		110			$^{\circ}\text{C}$
T_{CHYST}	Case thermal hysteresis		7	15		$^{\circ}\text{C}$
T_{JSD}	Junction shutdown temperature		150	175	200	$^{\circ}\text{C}$
T_R	Junction reset temperature		135			$^{\circ}\text{C}$
T_{HYST}	Junction thermal hysteresis		7	15		$^{\circ}\text{C}$
I_{PEAK}	Maximum DC output current before limitation	$V_{CC} = 24\text{ V}; R_{LOAD} = 10\text{ m}\Omega$	1.1		2.6	A
I_{LIM}	DC short circuit current limitation per channel	$V_{CC} = 24\text{ V}; R_{LOAD} = 10\text{ m}\Omega$	0.7 ⁽¹⁾		1.7	A
			1 ⁽²⁾			
V_{DEMAG}	Turn-OFF output clamp voltage	$I_{OUT} = 0.5\text{ A}; L = 6\text{ mH}$	$V_{CC}-57$	$V_{CC}-52$	$V_{CC}-47$	V

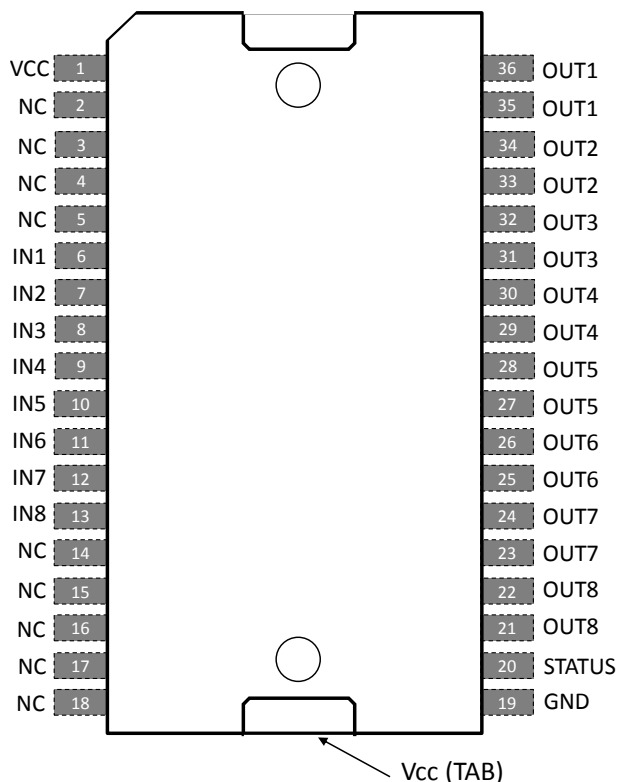
1. VN808-E

2. VN808-32-E

Table 7. Status Pin

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
I_{HSTAT}	STATUS pin high level current	$V_{CC} = 18\text{ to }32\text{ V}; R_{STAT}=1\text{ k}\Omega$ (Fault condition)	2	3	4	mA
I_{LSTAT}	STATUS pin leakage current	Normal operation; $V_{CC} = 32\text{ V}$			0.1	μA
V_{CLSTAT}	STATUS pin clamp voltage	$I_{STAT} = 1\text{ mA}$	6.0	6.8	8.0	V
		$I_{STAT} = -1\text{ mA}$		-0.7		

3 Pin connections

Figure 2. Connection diagram (top view)

Table 8. Pin functions

Pin	Symbol	Description
1	VCC	Positive power supply voltage
6	IN1	Channel 1 input
7	IN2	Channel 2 input
8	IN3	Channel 3 input
9	IN4	Channel 4 input
10	IN5	Channel 5 input
11	IN6	Channel 6 input
12	IN7	Channel 7 input
13	IN8	Channel 8 input
19	GND	Output power ground
20	STATUS	Common open source diagnostic for over-temperature
21	OUT8	Channel 8 power stage output;
22		short the pins on the same net of the application board
23	OUT7	Channel 7 power stage output;
24		short the pins on the same net of the application board

Pin	Symbol	Description
25	OUT6	Channel 6 power stage output; short the pins on the same net of the application board
26		
27	OUT5	Channel 5 power stage output; short the pins on the same net of the application board
28		
29	OUT4	Channel 4 power stage output; short the pins on the same net of the application board
30		
31	OUT3	Channel 3 power stage output; short the pins on the same net of the application board
32		
33	OUT2	Channel 2 power stage output; short the pins on the same net of the application board
34		
35	OUT1	Channel 1 power stage output; short the pins on the same net of the application board
36		
TAB	VCC	Exposed tab internally connected to Vcc, positive power supply voltage
2 to 5; 14 to 18	N.C.	Internally not connected; if necessary, these pins can be routed in the application

4 Current, voltage conventions and internal diagram

Figure 3. Current and voltage conventions

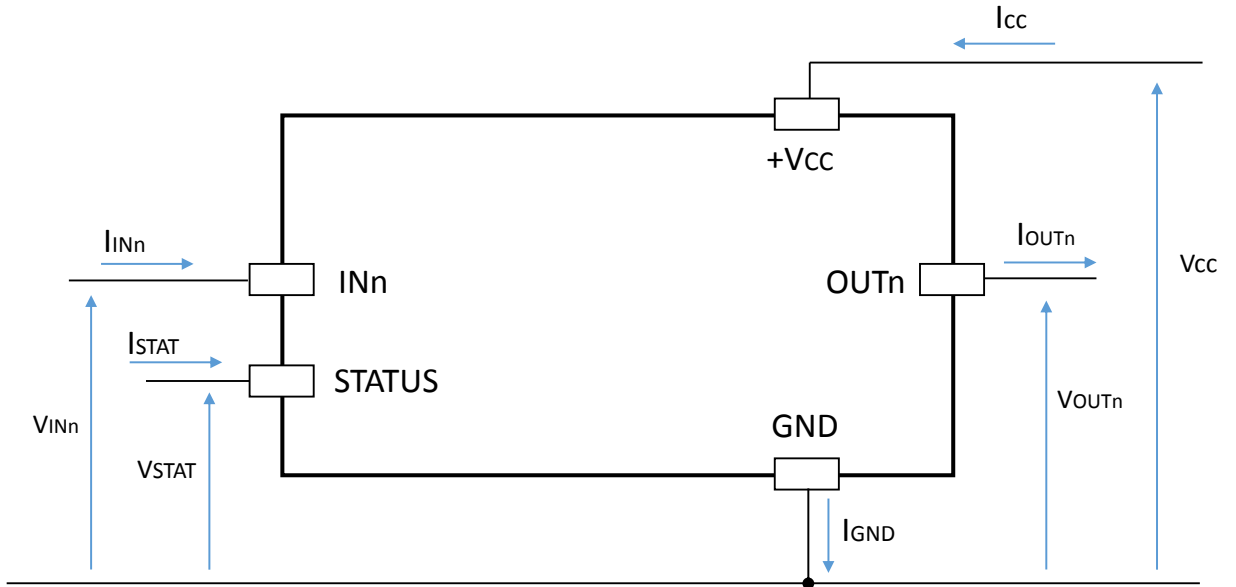


Figure 4. Equivalent internal block diagram (same structure for all channels)

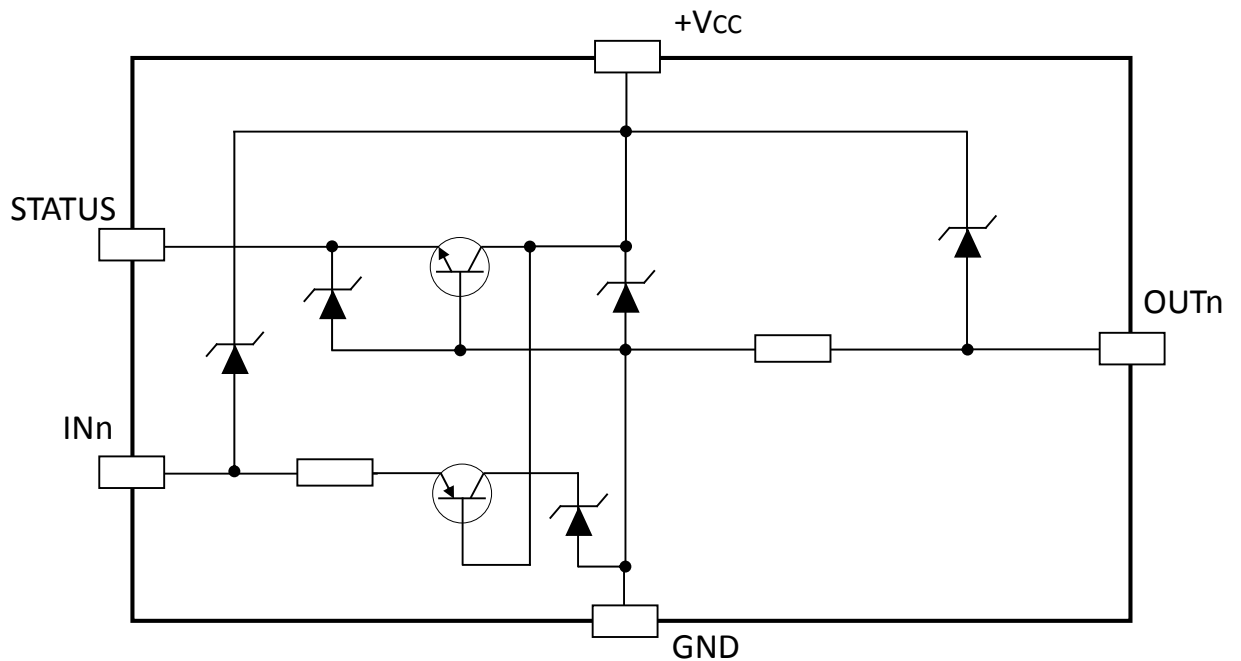


Figure 5. Application example

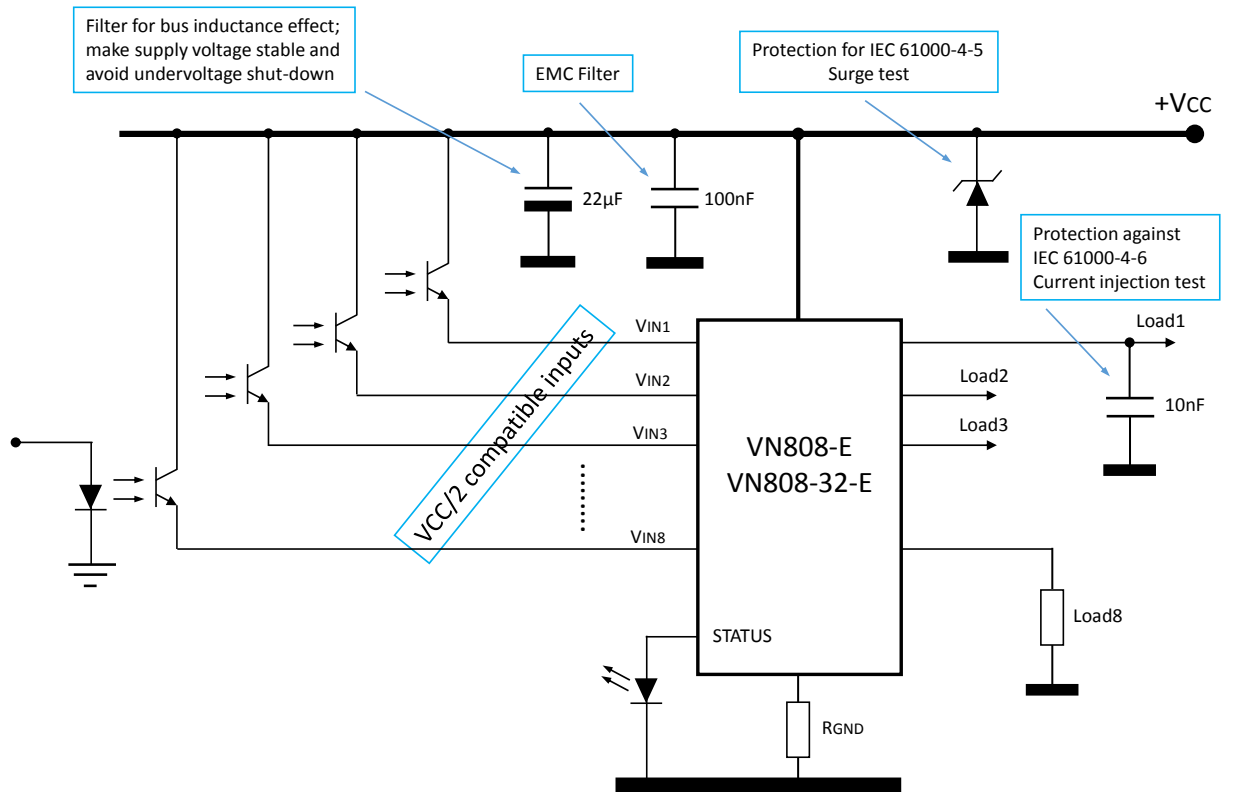


Table 9. Truth table

Conditions	INPUT _n	OUTPUT _n	STATUS
Normal operation	L	L	L
	H	H	L
Current limitation	L	L	L
	H	X	L
Over-temperature (see Figure 12 and Figure 13)	L	L	L
	H	L	H
Undervoltage	L	L	X
	H	L	X

5 Switching time waveforms

Figure 6. Turn-ON and turn-OFF

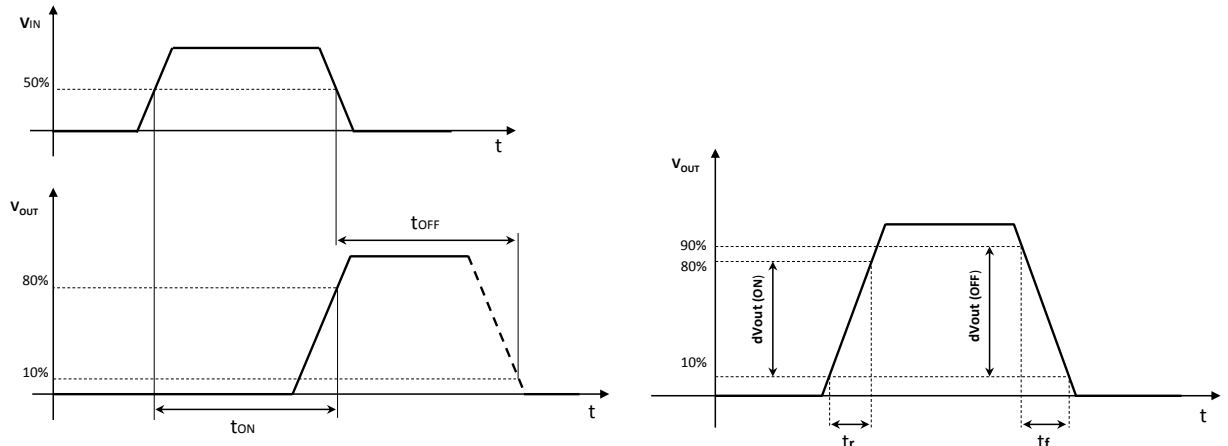
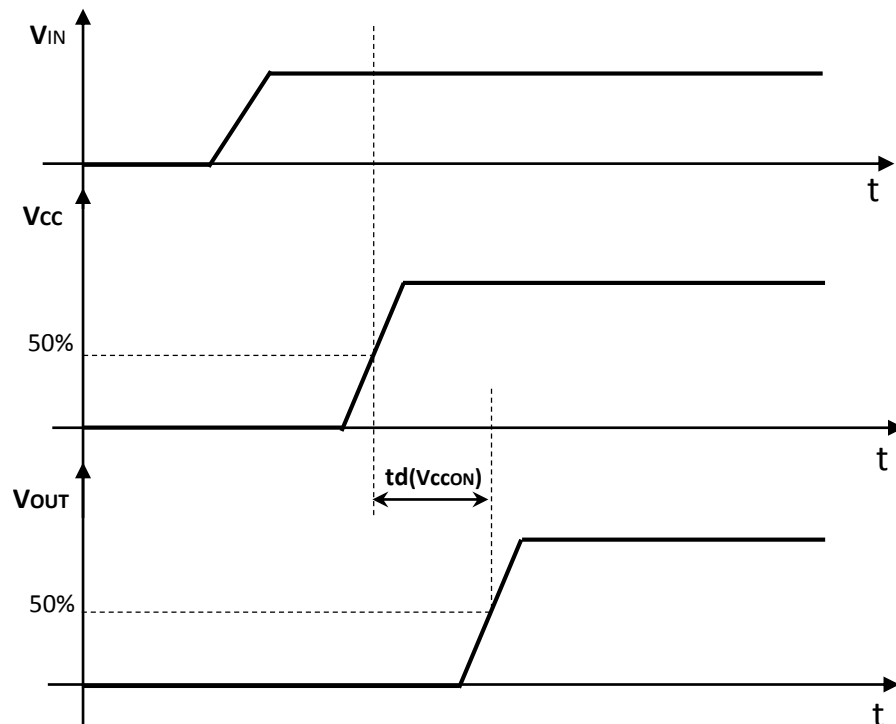


Figure 7. V_{CC} turn-ON



6 Power Section

6.1 Current limitation

Current limitation process is activated when the current sense connected on output stage measures a current value higher than a fixed threshold.

When this condition is verified, the gate voltage is modulated to prevent the output current from rising above to the limitation value.

Figure 8. Switching on resistive and on bulb lamp load

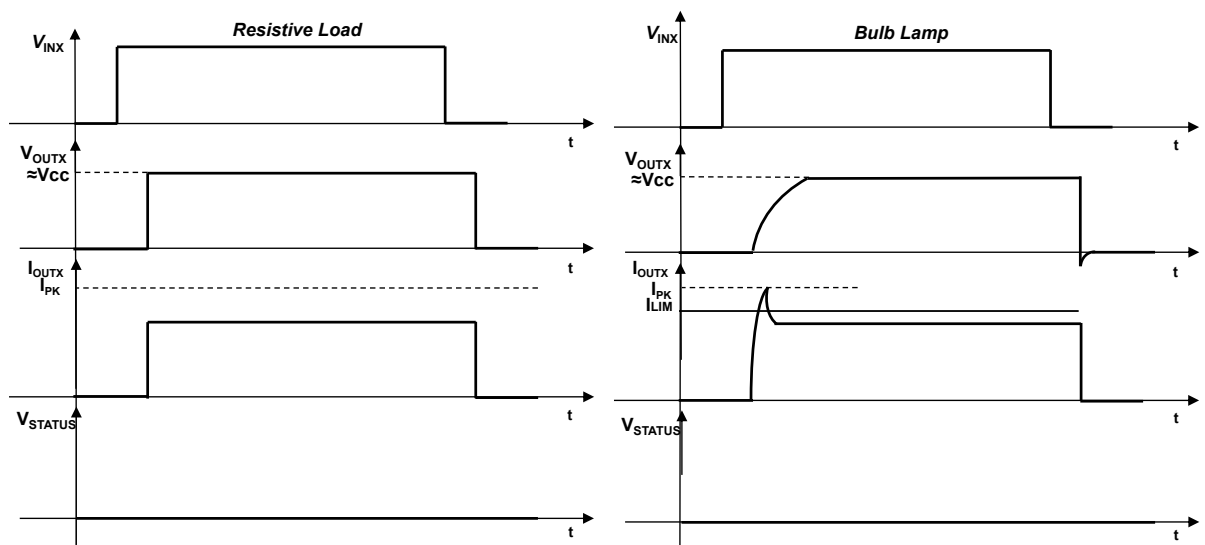


Figure 9. Switching on light and heavy inductive load

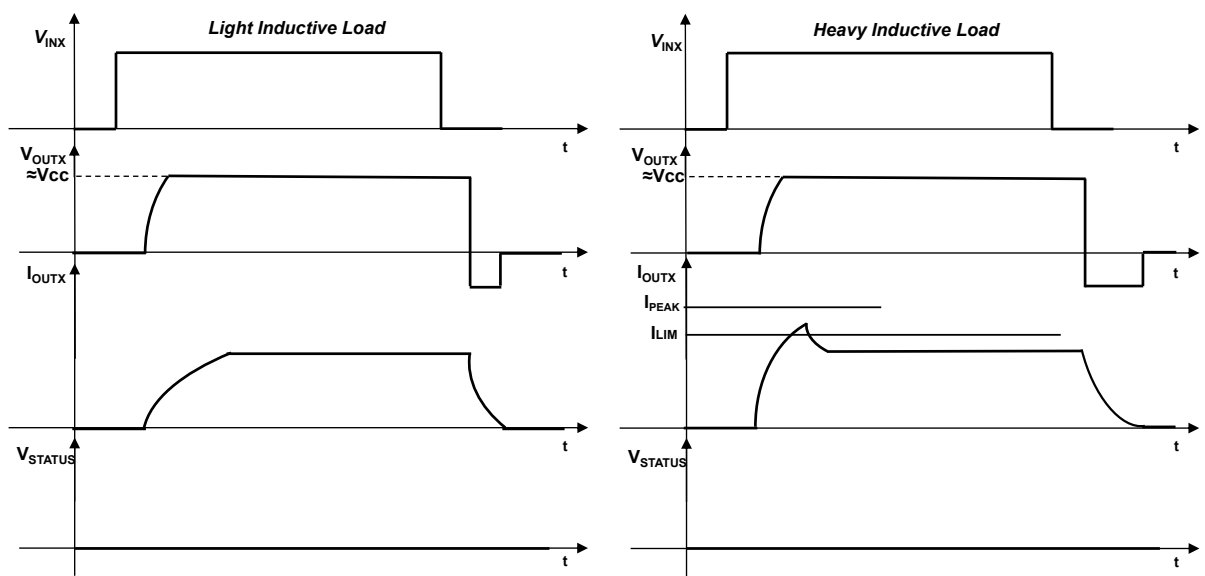
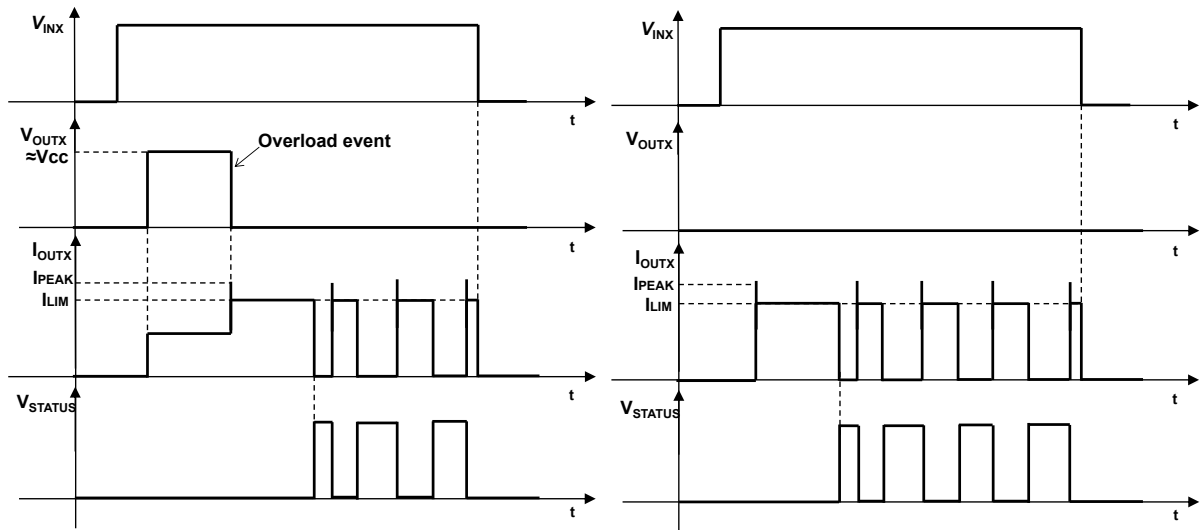


Figure 10. Short circuit during ON-state and Turn on in short circuit



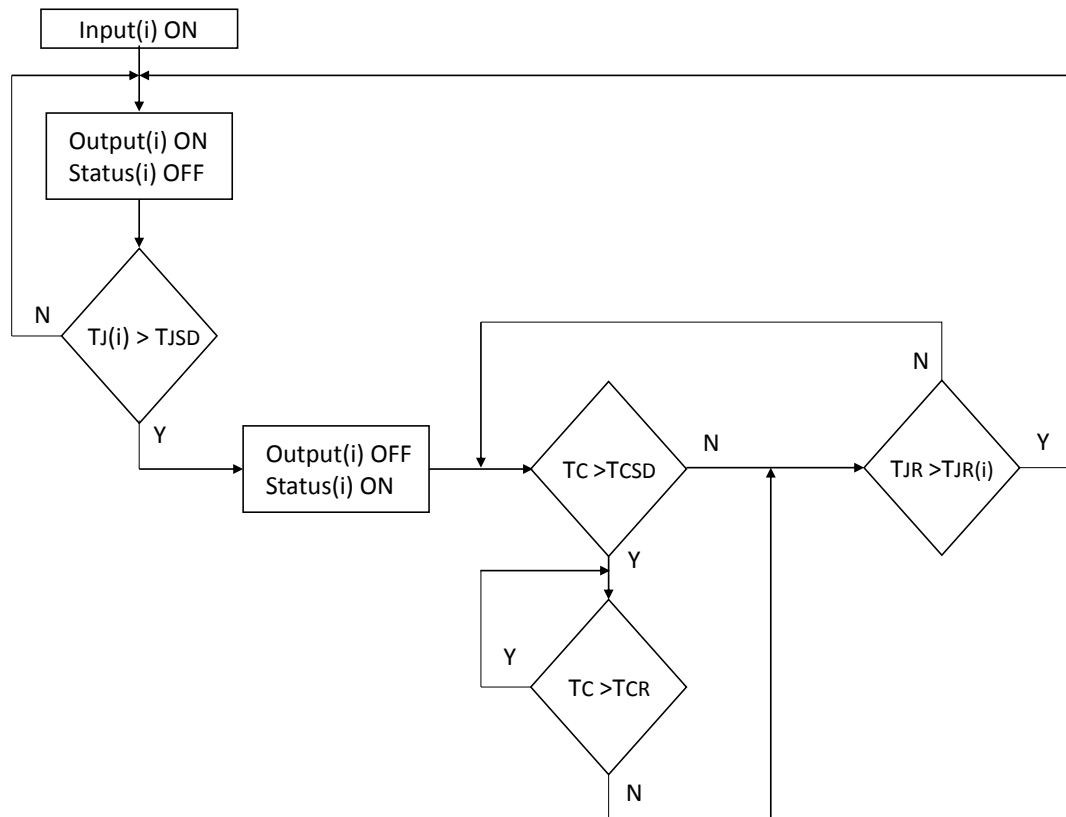
6.2 Thermal protection

The device is protected against overheating due to overload conditions. During driving period, if the output is overloaded, the device suffers two different thermal stresses, the first one related to the junction, and the second related to the case.

The two faults have different trigger thresholds: the junction protection threshold (T_{JSD}) is higher than the case protection one (T_{CSD}); generally the first protection that is activated in thermal stress conditions is the junction thermal shut-down. The output is turned-off when the temperature is higher than the related threshold and turned back on when it goes below the reset threshold (T_{JR}). This behavior continues until the fault on the output is present.

If the thermal protection is active and the temperature of the package increases over the fixed case protection threshold, the case protection will be activated and the output is switched-off and back on when the junction temperature, of each channel in fault and case temperature, are below the respective reset thresholds.

Figure 11. Thermal protection flowchart



6.3 Status indication

The Status pin is an active high common open source output indicating fault conditions. This pin is activated in case of junction over-temperature ($T_{JX} > T_{JSD}$) of one or more output channels. Figure 12 and Figure 13 show the Status behavior when T_{JSD} is triggered before T_{CSD} and when T_{CSD} is triggered before T_{JSD} respectively.

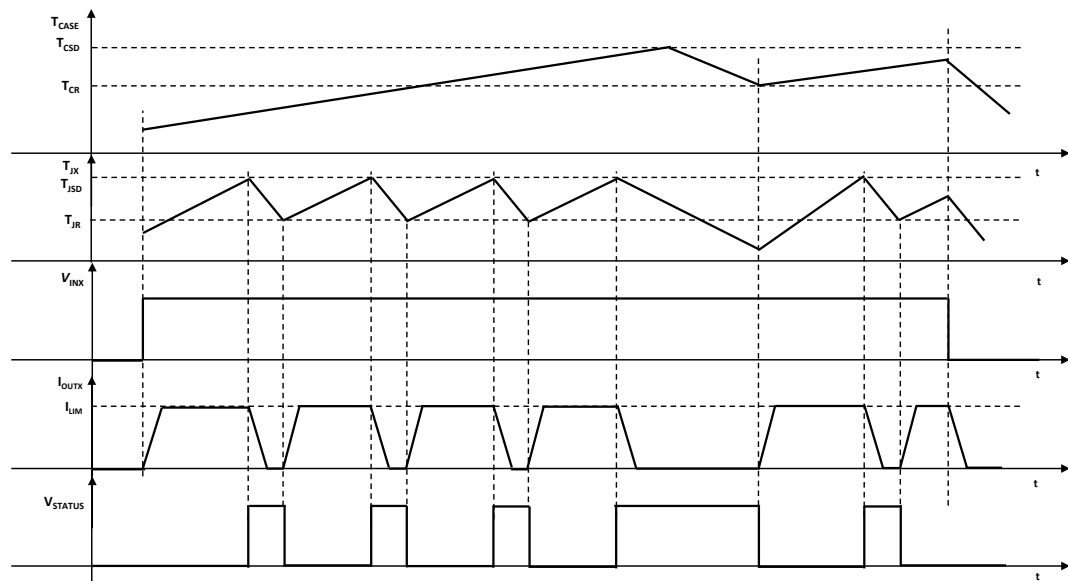
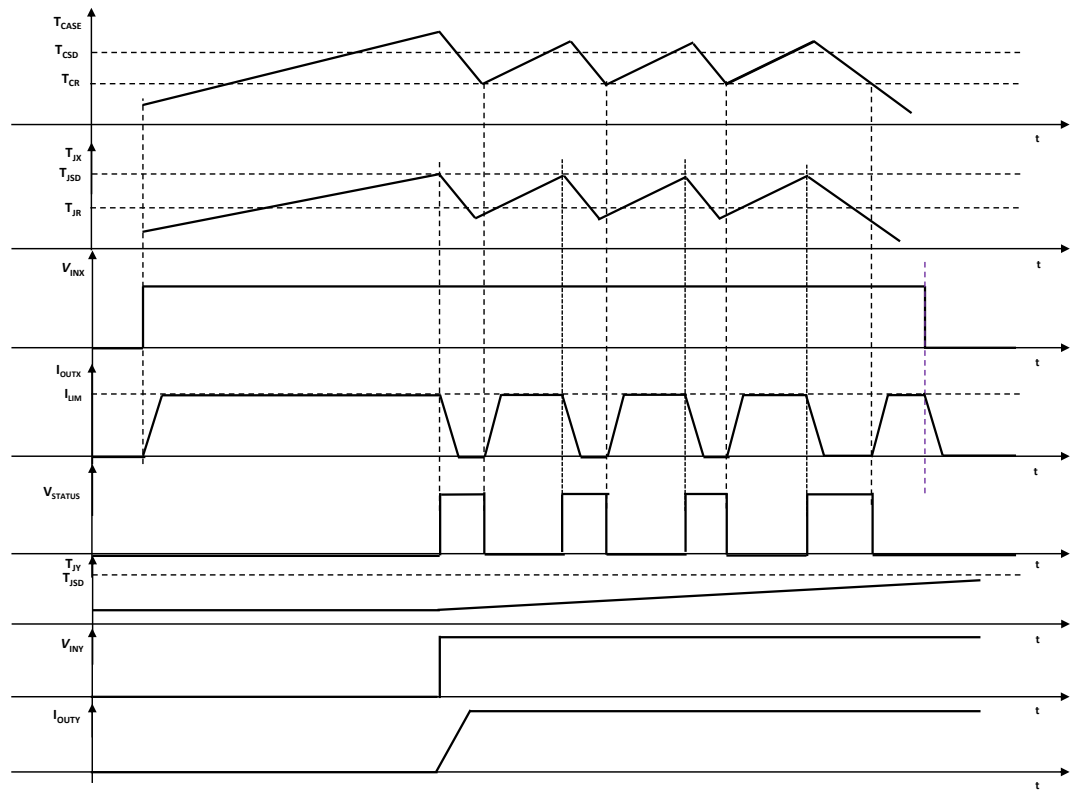
 Figure 12. Thermal Protection and STATUS Behavior (T_{JSD} triggered before T_{CSD})


Figure 13. Thermal Protection and STATUS Behavior (T_{CSD} triggered before T_{JSD})



7 Reverse polarity protection

Reverse polarity protection can be implemented on board using two different solutions:1.

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

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

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

where I_{GND} is the DC reverse ground pin current and can be found in [Section 1 Maximum ratings](#) of this datasheet.

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

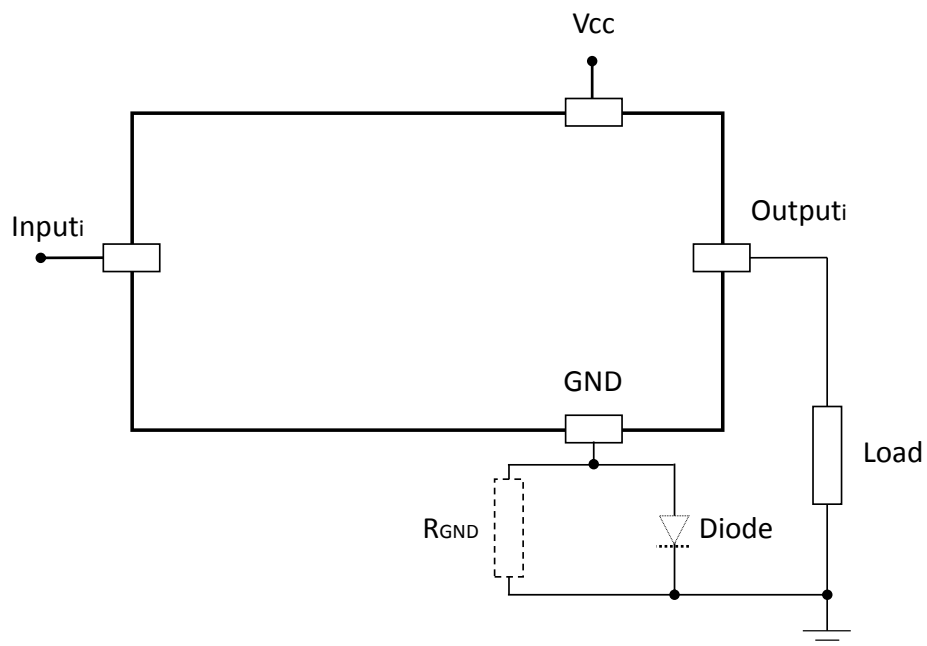
$$P_D = (V_{CC})^2/R_{GND}$$

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

$$P_D \geq I_S * V_f$$

Note: In normal operation (no reverse polarity), there is a voltage drop (ΔV) between GND of the device and GND of the system. Using option 1, ΔV = R_{GND} * I_{cc}. Using option 2, ΔV = V_F@(I_F).

Figure 14. V_{CC} Reverse Polarity Protection

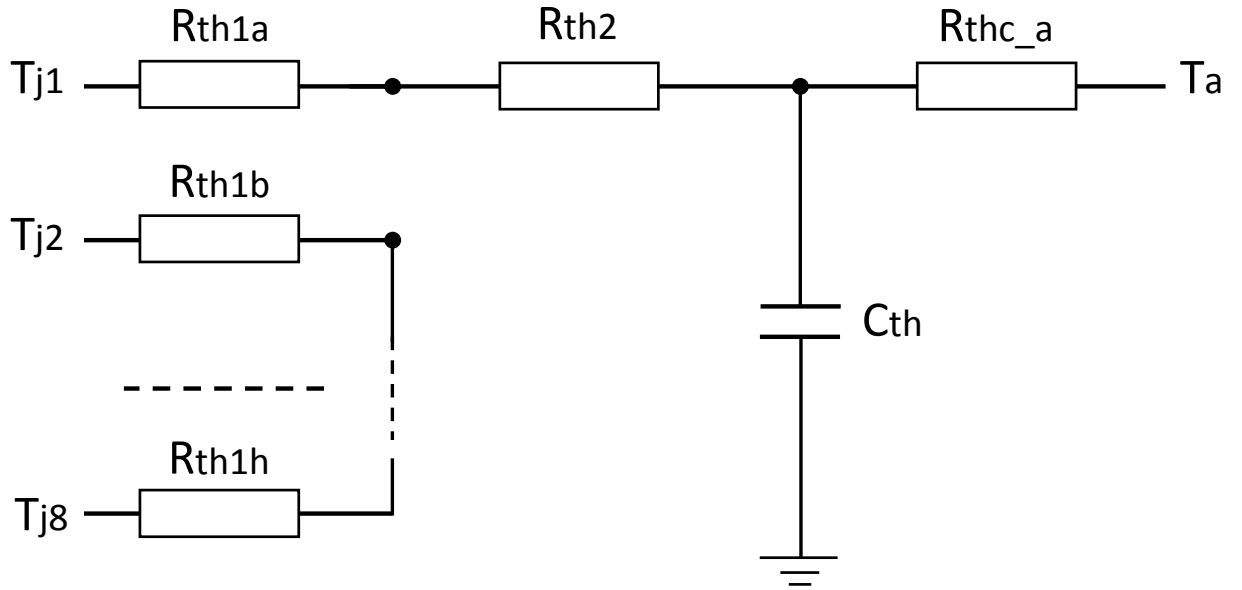


This schematic can be used with any type of load.

8 Thermal information

8.1 Thermal impedance

Figure 15. Simplified thermal model of the process stage



9 Package mechanical data

In order 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.

Figure 16. PowerSO-36 package outline

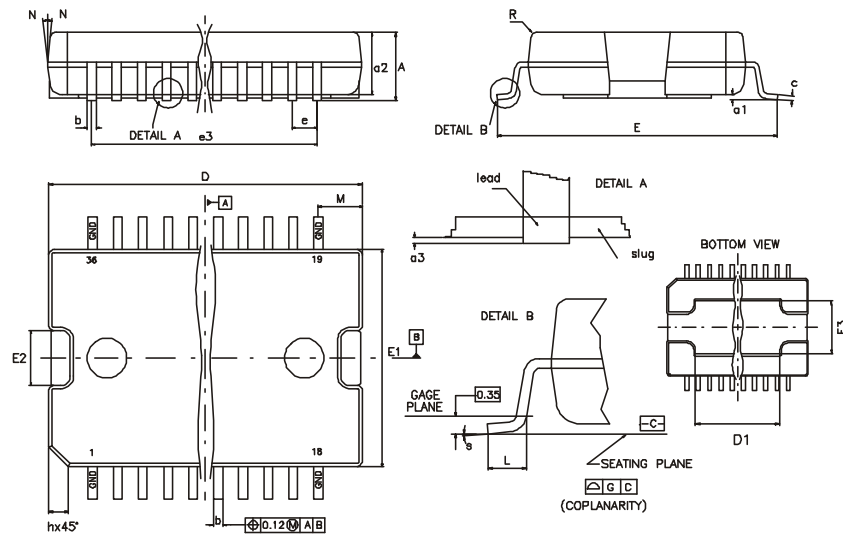


Table 10. PowerSO-36 mechanical data

Dim	mm		
	Min.	Typ.	Max.
A			3.60
a1	0.10		0.30
a2			3.30
a3	0		0.10
b	0.22		0.38
c	0.23		0.32
D ⁽¹⁾	15.80		16.00
D1	9.40		9.80
E	13.90		14.50
E1 ⁽¹⁾	10.90		11.10
E2			2.90
E3	5.80		6.20
e		0.65	
e3		11.05	
G	0		0.10
H	15.50		15.90
h			1.10

Dim	mm		
	Min.	Typ.	Max.
L	0.80		1.10
N			10°
S	0°		8°

1. D and E1" do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm (0.006"). Critical dimensions are "a3", "E" and "G".

9.1 Footprint recommended data

Figure 17. Footprint recommended data

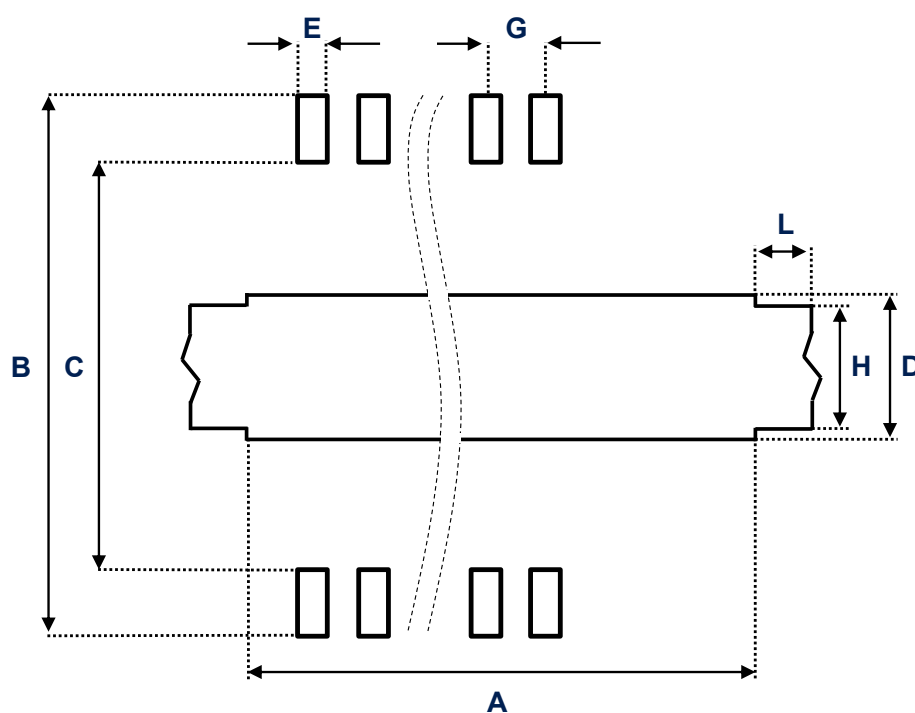


Table 11. Footprint data

Dim.	mm
A	9.5
B	14.7-15.0
C	12.5-12.7
D	6.3
E	0.42
G	0.65
H	4.1
L	3.2

9.2 Tube shipment information

Figure 18. Tube shipment information

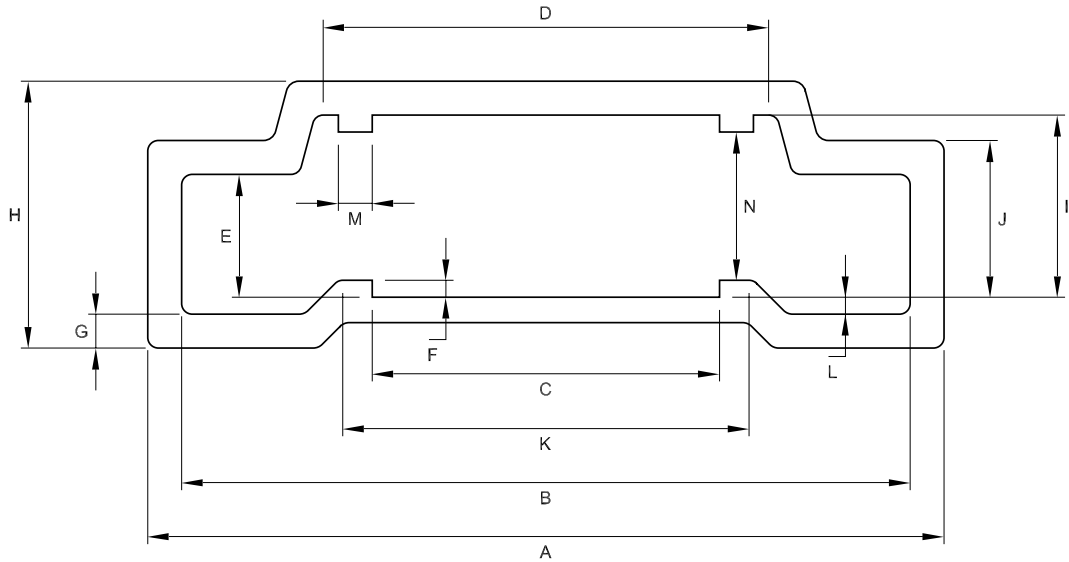


Table 12. Tube mechanical data

Dim.	mm
A	18.80
B	17.2 ±0.2
C	8.20 ±0.2
D	10.90 ±0.2
E	2.90 ±0.2
F	0.40
G	0.80
H	6.30
I	4.30 ±0.2
J	3.7 ±0.2
K	9.4
L	0.40
M	0.80
N	3.50 ±0.2

Base quantity 310 pcs

Bulk quantity 310 pcs

9.3 Tape and reel shipment information

Figure 19. Tape specifications

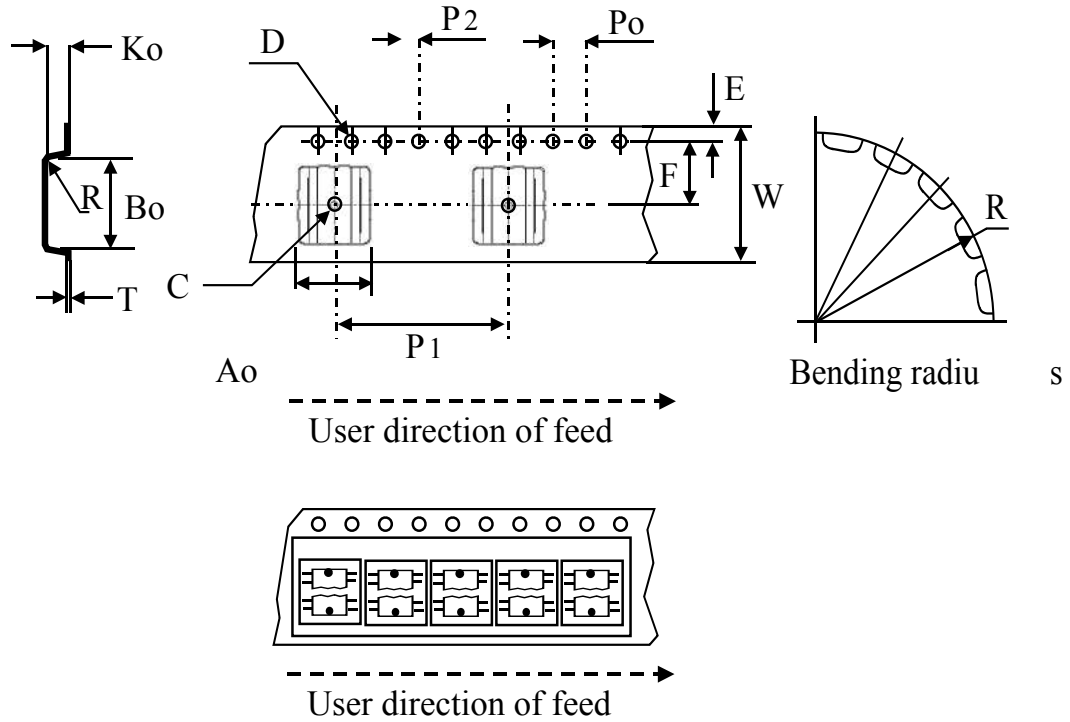


Table 13. Tape mechanical data

Dim.	mm
D	1.50 +0.1/0
E	1.75 ±0.1
Po	4.00 ±0.1
T max.	0.40
D1 min.	1.50
F	11.5 ±0.05
K max.	6.50
P2	2.00 ±0.1
R	50
W	24.00 ±0.30
P1	24.00
Ao, Bo, Ko	0.05 min. to 1.0 max.

Base quantity 600 pcs

Bulk quantity 600 pcs

Figure 20. Reel specifications

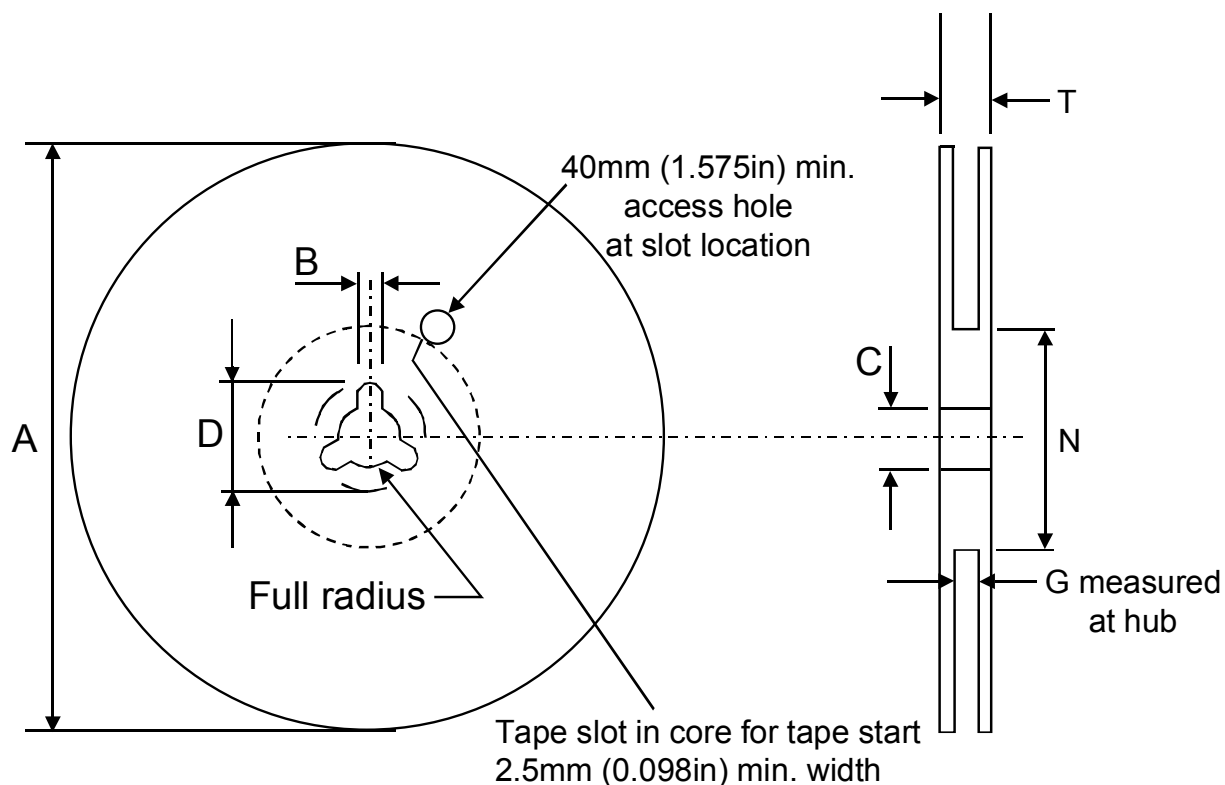


Table 14. Reel mechanical data

Dim.	mm
Tape size	24.0 ±0.30
A max.	330.0
B min.	1.5
C	13.0 ±0.20
D min.	20.2
N min.	60
G	24.4 +2/-0
T max.	30.4

10 Ordering information

Table 15. Ordering information

Part number	Package	Packaging
VN808-E	PowerSO-36	Tube
VN808TR-E		Tape and reel
VN808-32-E		Tube
VN808TR-32-E		Tape and reel

Revision history

Table 16. Document revision history

Date	Version	Changes
13-Sep-2005	1	Initial release.
1-Mar-2007	2	Document reformatted
12-Mar-2007	3	Typo in Figure 3.
26-Mar-2007	4	Typo note Table 2.
07-Jul-2008	5	Added: Section 6 on page 13
04-Aug-2008	6	Added: Figure 12: Footprint recommended data on page 16
25-Aug-2009	7	Updated Section 6: Reverse polarity protection
24-Feb-2010	8	Updated Section 7: Package mechanical data
08-Nov-2012	9	Changed Figure 5. Minor text changes to improve the readability.
19-Nov-2012	10	Added maximum value to I_{INL} parameter in Table 5.
31-Jul-2013	11	Updated Section 7.1: Footprint recommended data.
18-Dec-2013	12	Replaced LMAX parameter by EAS parameter in Table 1. Added TJ condition to Table 3. Updated Section 6.
09- Jun-2020	13	Include VN808-32-E ; Updated Table 6, Table 8; Updated notes in Section 7 ; Added Section 6 Power Section, Section 6.1 Current limitation, Section 6.2 Thermal protection, Section 6.2 Thermal protection, Section 8 Thermal information, Section 8.1 Thermal impedance; minor text update .
08-May-2023	14	Changed and merged Figure 8, Figure 9, Figure 10; Changed $-I_{OUT}$ and P_{TOT} values in Table 1; Changed $R_{th(JA)}$ in Table 2; Changed pins description in Table 8.

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