VN808-E/VN808-32-E

Datasheet

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 toT_{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.

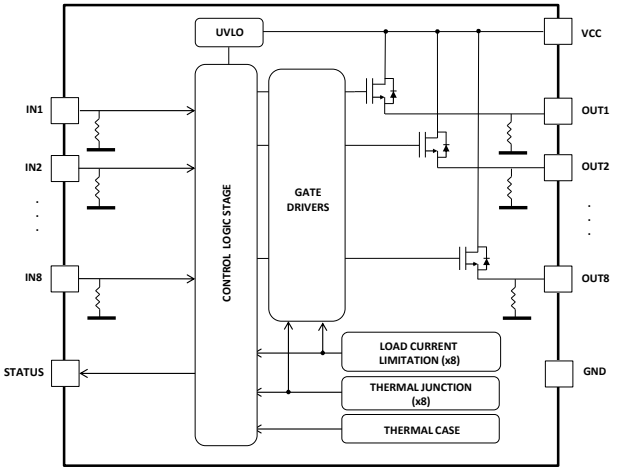
Product status link
VN808-E
VN808-32-E

Product label
SUSTAINABLE TECHNOLOGY

Type	$R_{DS(on)}$ (1)	I_{OUT}	V_{CC}
VN808-E	150 mΩ	0.7 A	45 V
VN808-32-E	150 mΩ	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	2	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 Tc = 25°C	96	W
EAS	Single pulse Avalanche Energy per channel, all channels driven simultaneously (Tamb= 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

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)	50	

1. *When mounted on FR4 printed circuit board with 0.5 cm² of copper area (at least 35 µm think) 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; TJ = 25°C I_{OUT} = 0.5A; TJ = 125°C		150	185 280	mΩ mΩ
I_S	Supply current	OFF-state V_{CC} = 24 V; T_{CASE} = 25 °C			150	µA
		ON-state (all channels ON) V_{CC} = 24 V; T_{CASE} = 100 °C			12	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
$d_{VOUT}/dt_{(ON)}$	Turn-ON voltage slope	RL = 48 Ω from VOUT = 2.4 V to V_{OUT} = 19.2 V (see Figure 6)		0.7		V/µs
$d_{VOUT}/dt_{(OFF)}$	Turn-OFF voltage slope	RL = 48 Ω from VOUT = 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

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

Table 6. Protections

Symbol		Test Condition	Min.	Typ.	Max.	Unit
T_{CSD}	Case shut-down temperature		125	130	135	°C
T_{CR}	Case reset temperature		110			°C
T_{CHYST}	Case thermal hysteresis		7	15		°C
T_{JSD}	Junction shutdown temperature		150	175	200	°C
T_R	Junction reset temperature		135			°C
T_{HYST}	Junction thermal hysteresis		7	15		°C
I_{PEAK}	Maximum DC output current before limitation	V_{CC} = 24 V; R_{LOAD} = 10 mΩ	1.1		2.6	A
I_{LIM}	DC short circuit current limitation per channel	V_{CC} = 24 V; R_{LOAD} = 10 mΩ	0.7 (1) 1 (2)		1.7	A
V_{DEMAG}	Turn-OFF output clamp voltage	I_{OUT} = 0.5A; L= 6 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 to 32 V; R_{STAT}=1kΩ (Fault condition)	2	3	4	mA
I_{LSTAT}	STATUS pin leakage current	Normal operation; V_{CC} = 32V			0.1	µA
V_{CLSTAT}	STATUS pin clamp voltage	I_{STAT} = 1mA I_{STAT} = -1mA	6.0	6.8 -0.7	8.0	V

3 Pin connections

Figure 2. **Connection diagram (top view)**

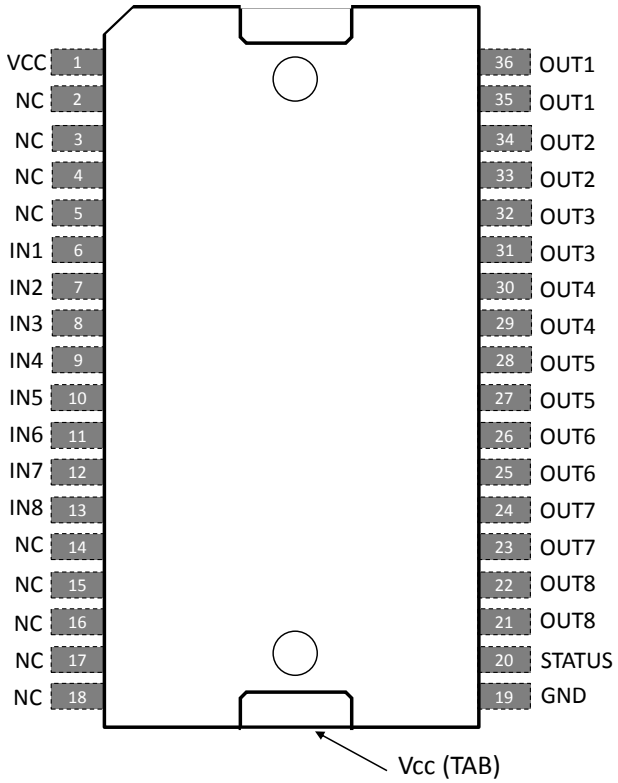


Table 8. **Pin functions**

Pin	Symbol	Description
1	VCC	Positive power supply voltage
2	N.C.	Not Connected
3	N.C.	Not Connected
4	N.C.	Not Connected
5	N.C.	Not Connected
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
14	N.C.	Not Connected
15	N.C.	Not Connected

Pin	Symbol	Description
16	N.C.	Not Connected
17	N.C.	Not Connected
18	N.C.	Not Connected
19	GND	Output power ground
20	STATUS	Common open source diagnostic for over-temperature
21	OUT8	Channel 8 power output
22		
23	OUT7	Channel 7 power output
24		
25	OUT6	Channel 6 power output
26		
27	OUT5	Channel 5 power output
28		
29	OUT4	Channel 4 power output
30		
31	OUT3	Channel 3 power output
32		
33	OUT2	Channel 2 power output
34		
35	OUT1	Channel 1 power output
36		
TAB	VCC	Exposed tab internally connected to Vcc, positive power supply voltage

4 Current, voltage conventions and internal diagram

Figure 3. **Current and voltage conventions**

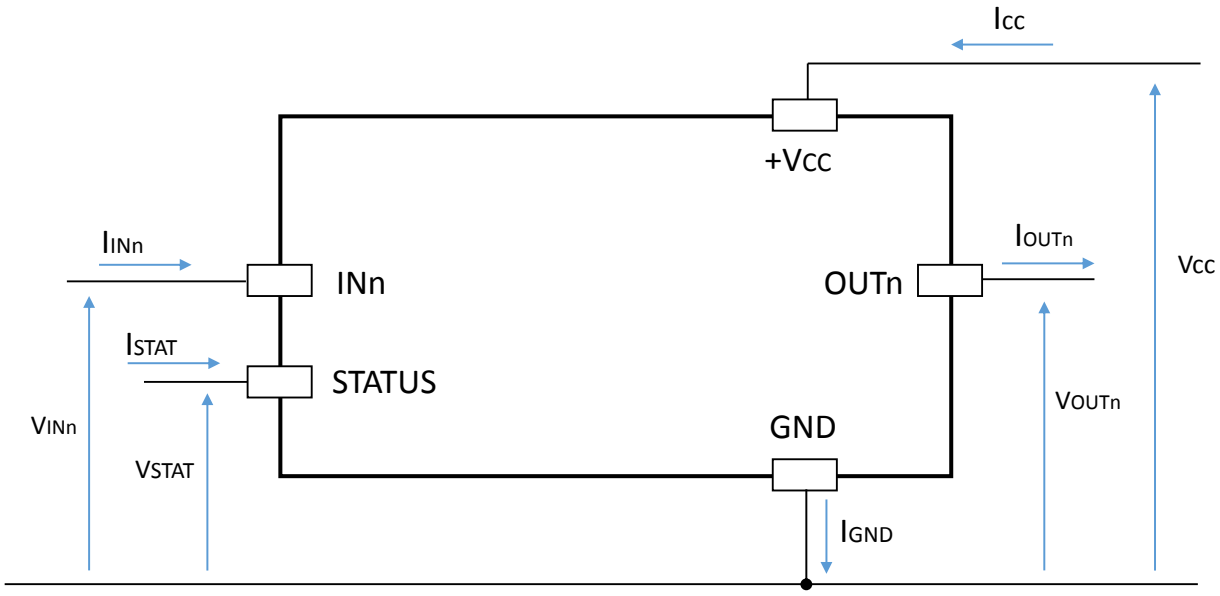


Figure 4. **Equivalent internal block diagram (same structure for all channels)**

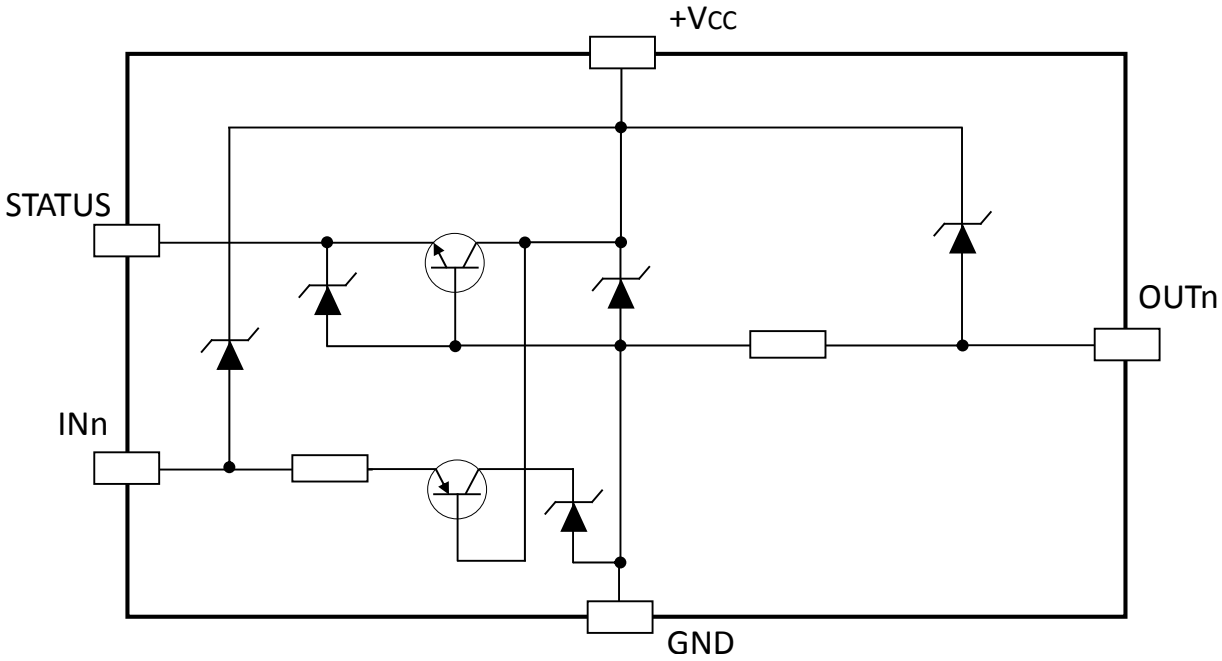


Figure 5. **Application example**

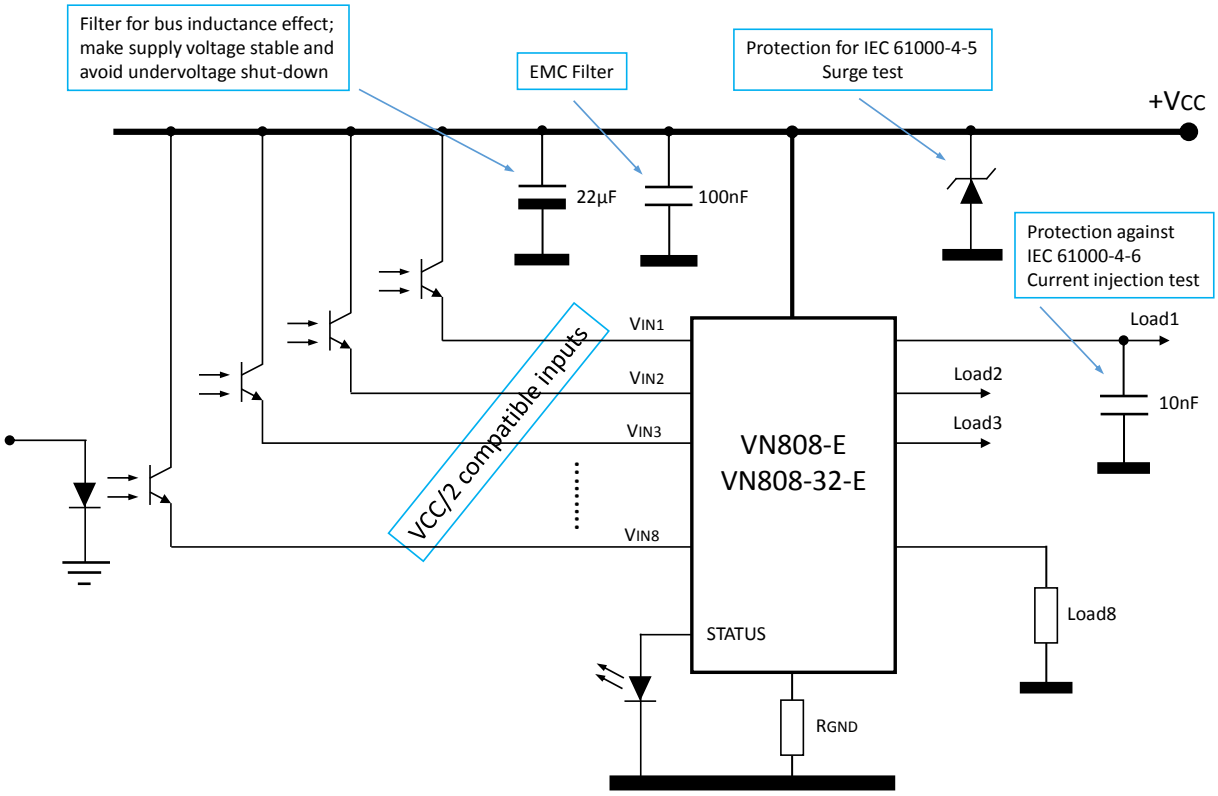


Table 9. **Truth table**

Conditions	INPUTn	OUTPUTn	STATUS
Normal operation	L H	L H	L L
Current limitation	L H	L X	L L
Over-temperature (see Figure 15 and Figure 16)	L H	L L	L H
Undervoltage	L H	L L	X X

5 Switching time waveforms

Figure 6. Turn-ON and turn-OFF

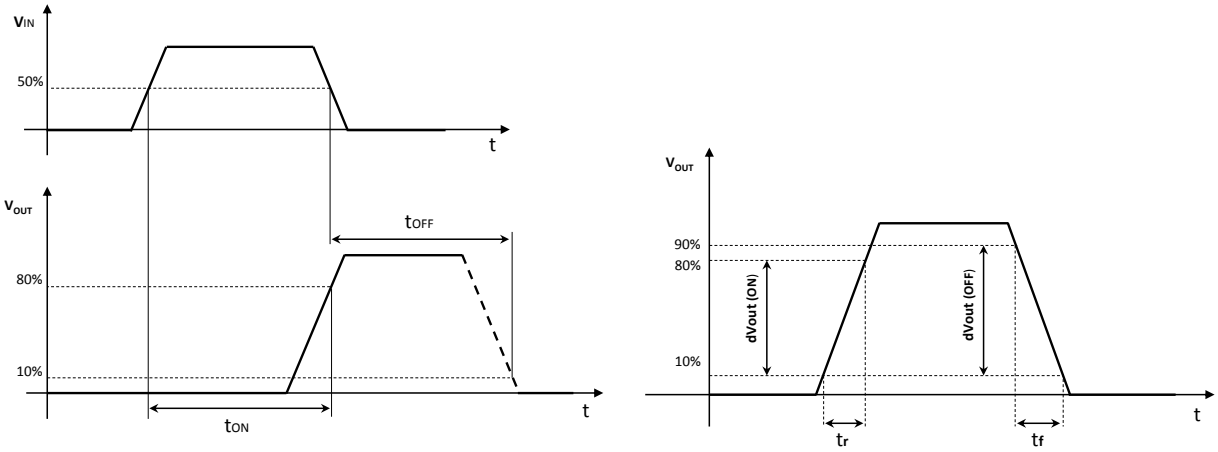
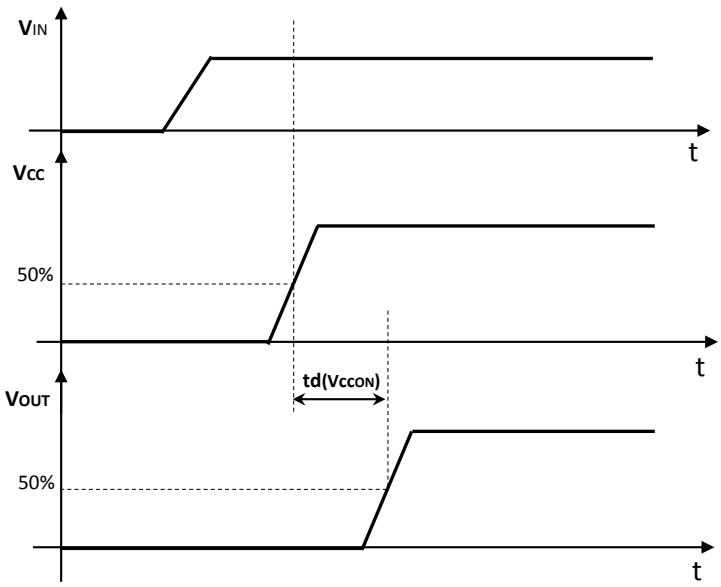


Figure 7. V_{CC} turn-ON



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 Load

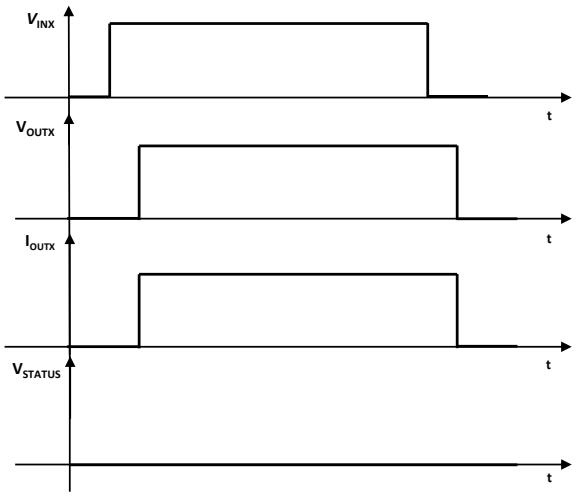


Figure 9. Switching on Bulb Lamp Load

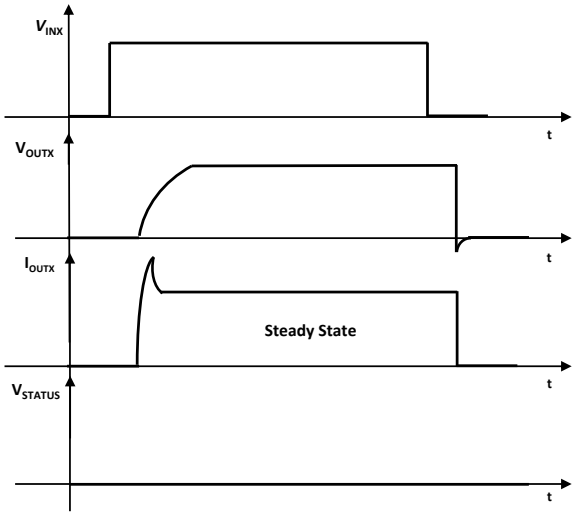


Figure 10. Switching on Light Inductive Load

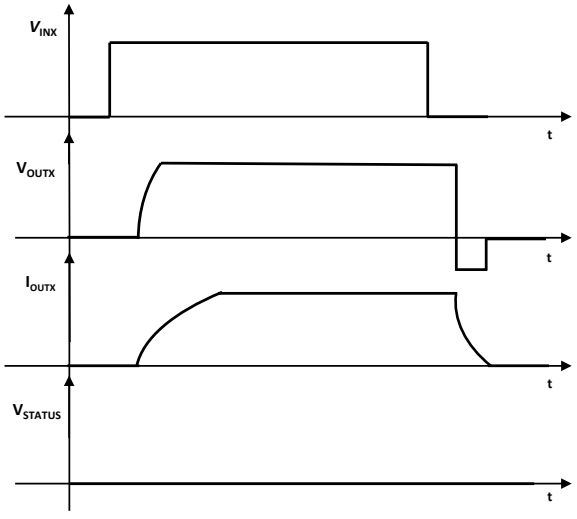


Figure 11. Switching on heavy inductive Load

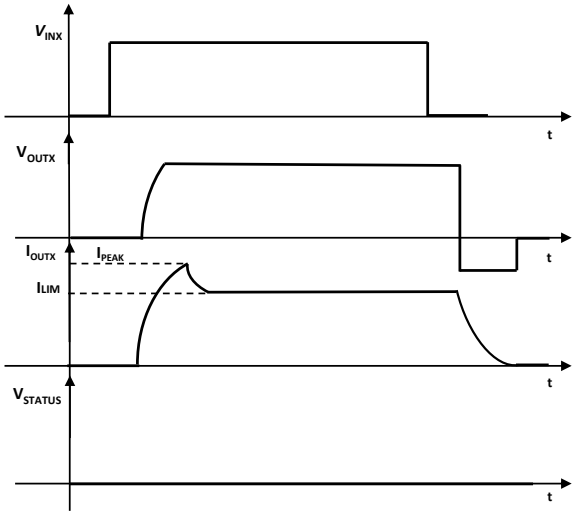


Figure 12. **Short Circuit During ON State**

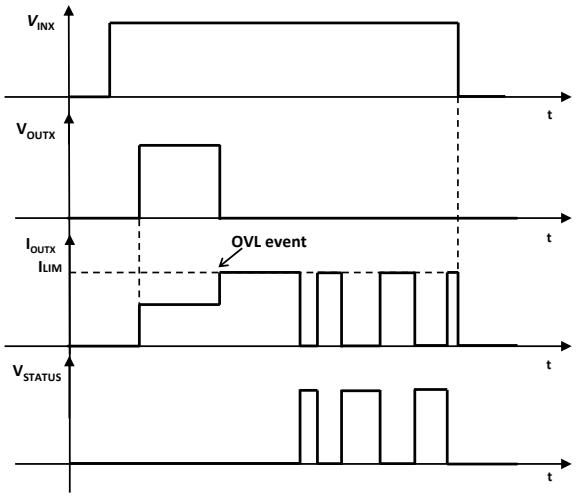
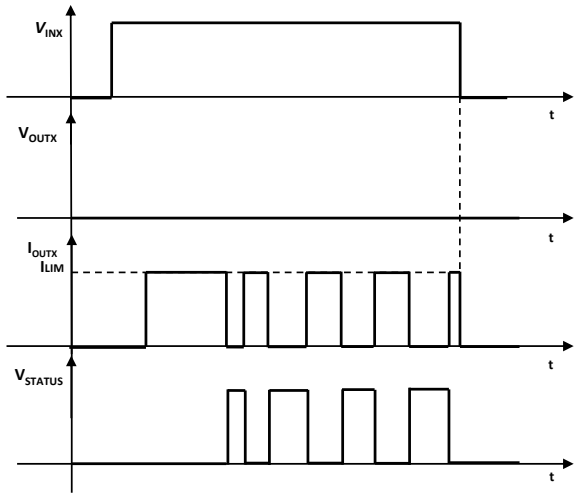


Figure 13. **Switching on Short Circuit**



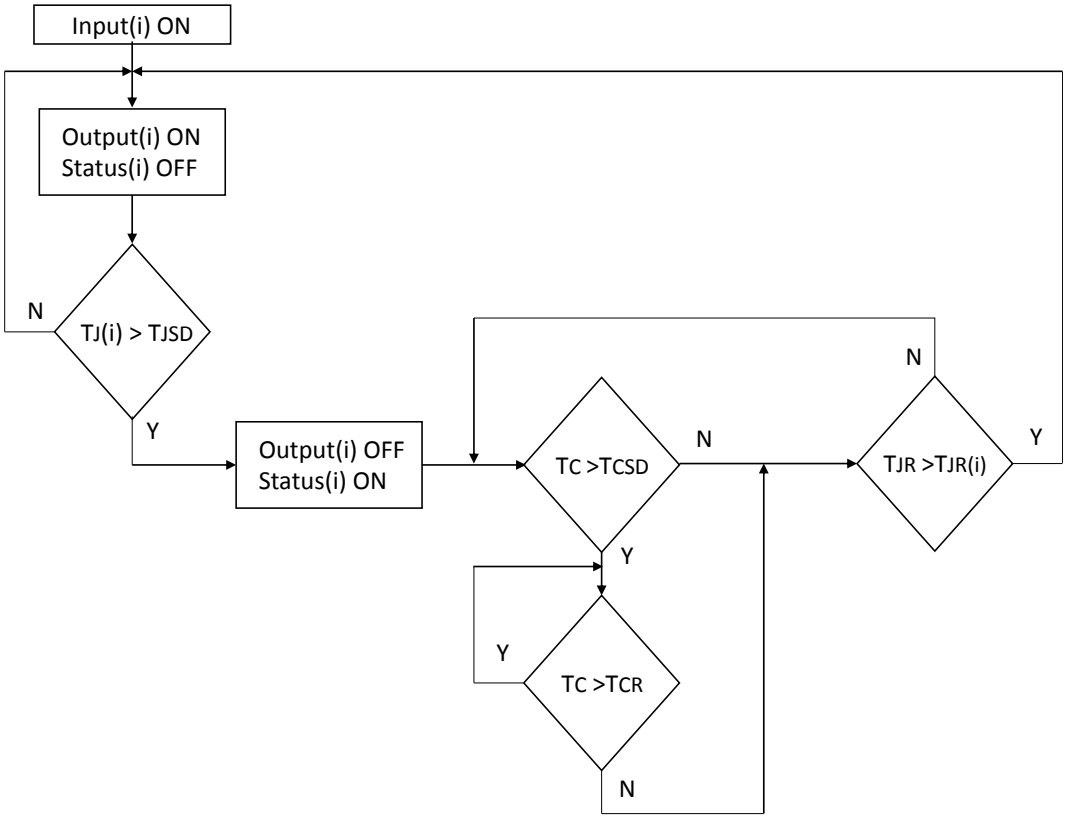
6.2 Thermal protection

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 14. **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 15 and Figure 16 show the Status behavior when T_{JSD} is triggered before T_{CSD} and when T_{CSD} is triggered before T_{JSD} respectively.

Figure 15. **Thermal Protection and STATUS Behavior (T_{JSD} triggered before T_{CSD})**

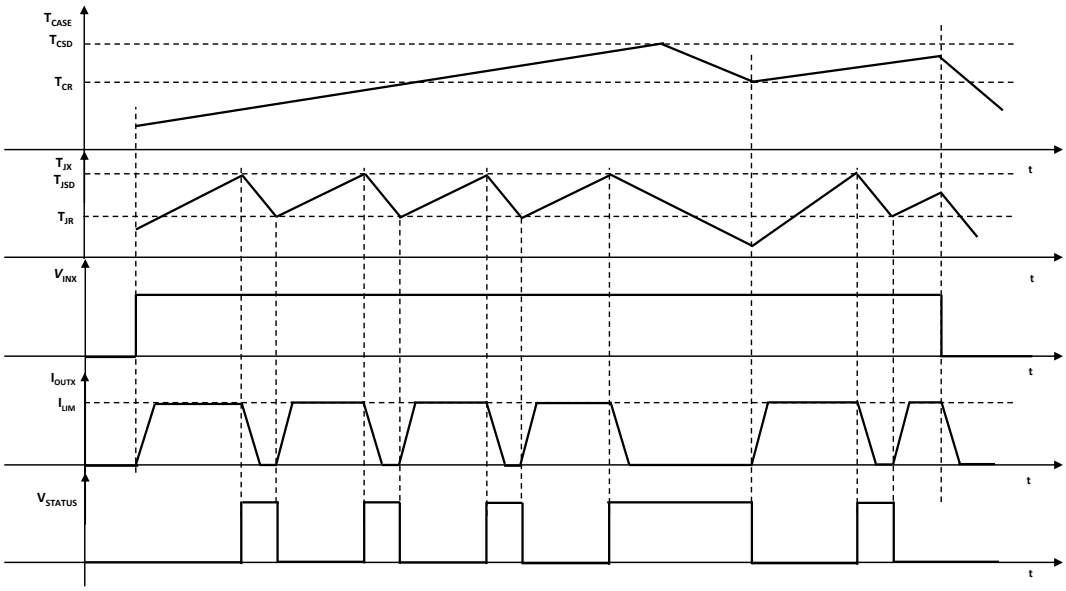
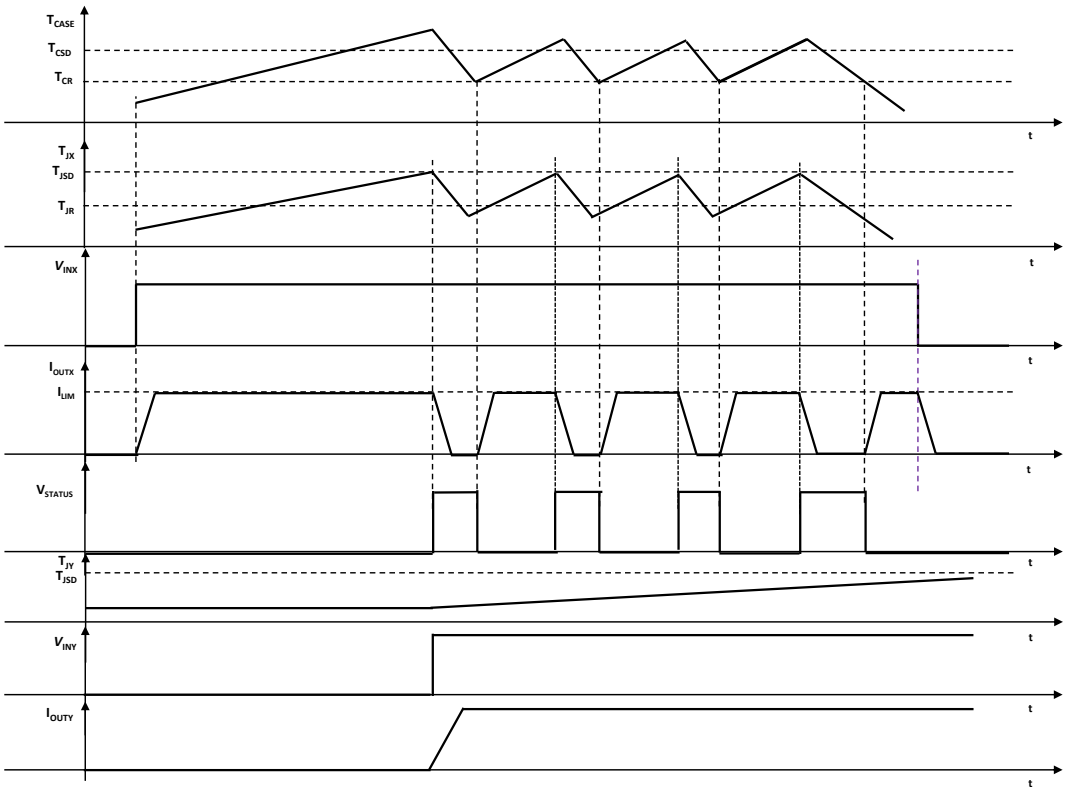


Figure 16. **Thermal Protection and STATUS Behavior (T_{CSD} triggered before T_{JSD})**



7 Reverse polarity protection

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

1. Placing a resistor (RGND) 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:

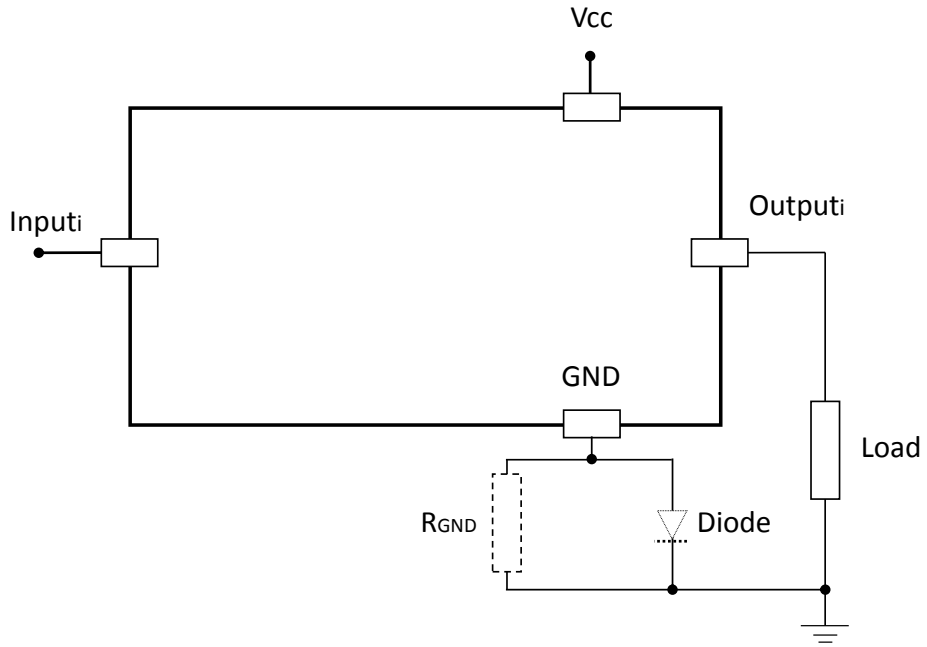
$$P_D = (V_{CC})^2/R_{GND}$$

If option 2 is selected, the diode has to be chosen by taking into account VRRM >$|V_{cc}|$ andits 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} * Icc. Using option 2, ΔV = VF@(IF).*

Figure 17. V_{CC} Reverse Polarity Protection

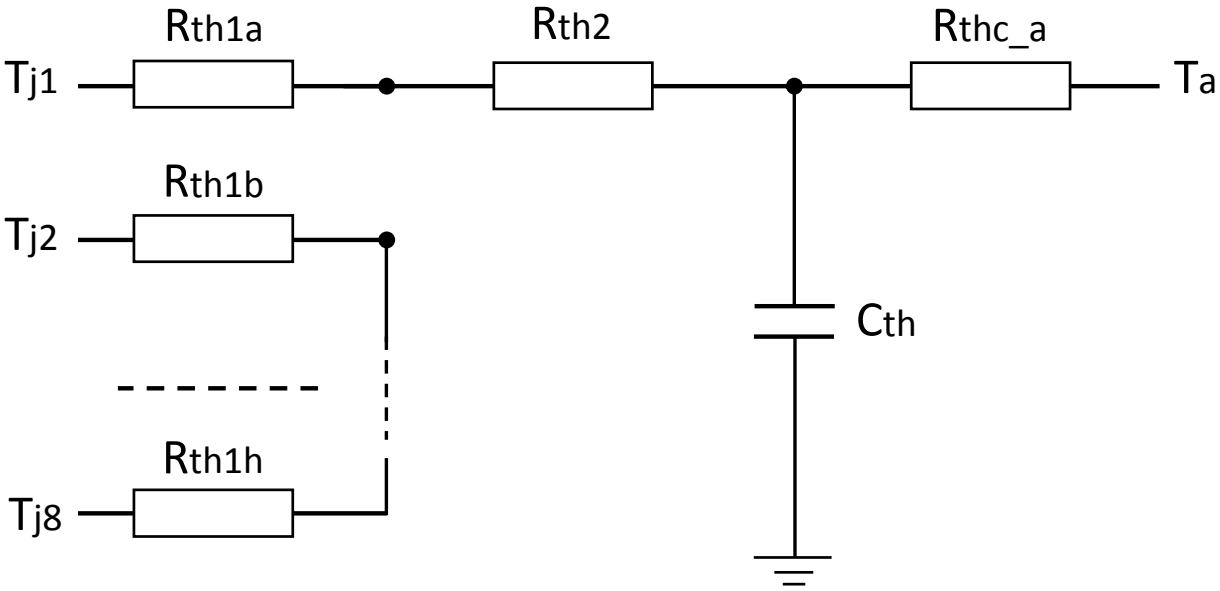


This schematic can be used with any type of load.

8 Thermal information

8.1 Thermal impedance

Figure 18. **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 19. PowerSO-36 package outline

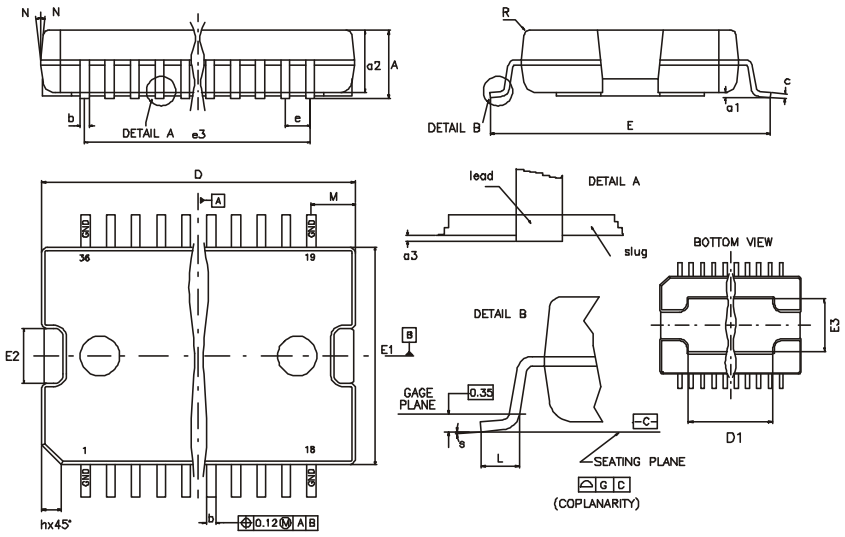


Table 10. PowerSO-36 mechanical data

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

Dim	mm		
	Min.	Typ.	Max.
h			1.10
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 20. Footprint recommended data

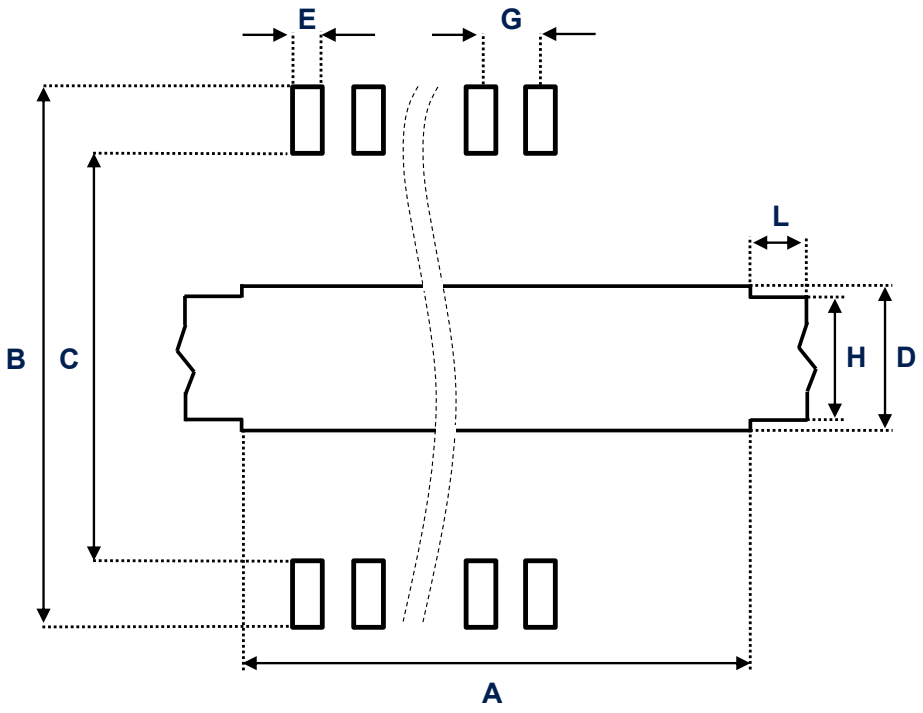


Table 11. Footprint data

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 21. **Tube shipment information**

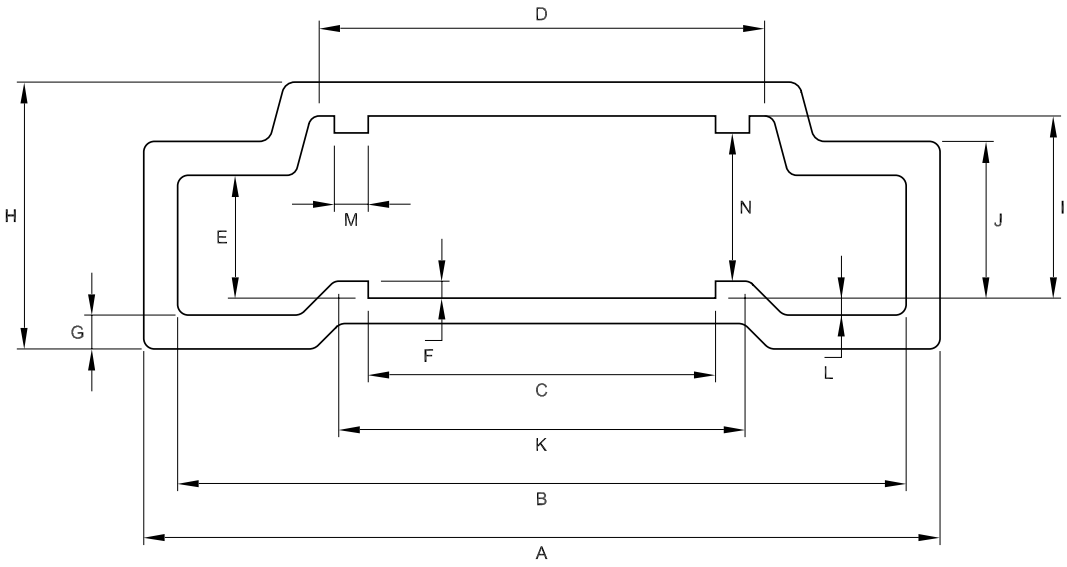


Table 12. **Tube mechanical data**

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 22. **Tape specifications**

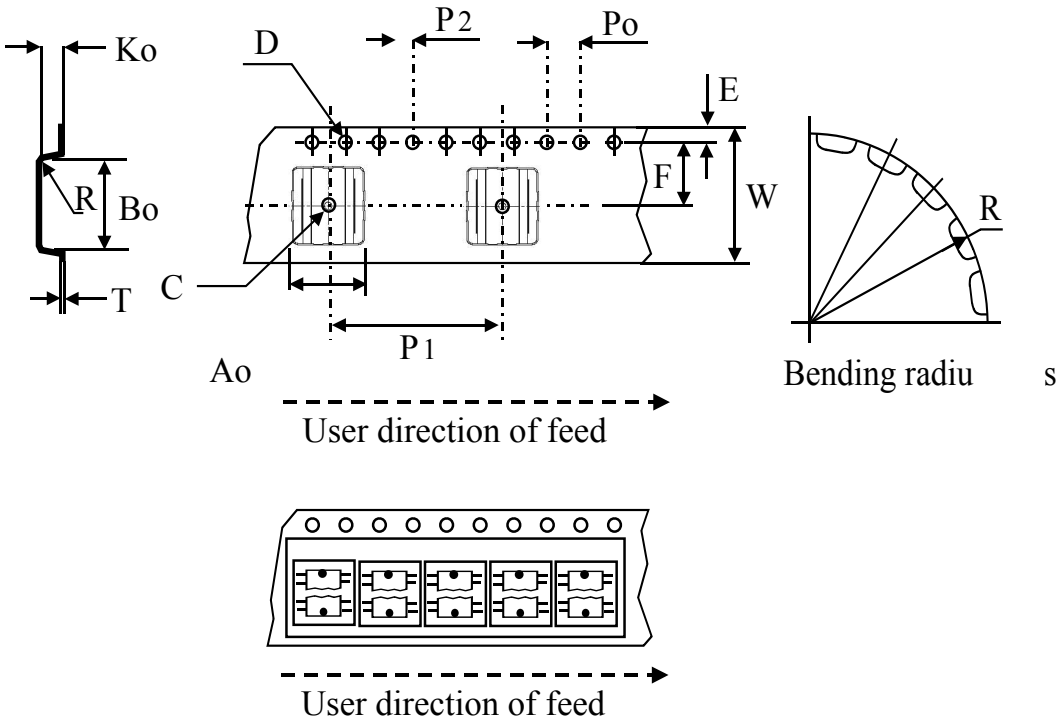


Table 13. **Tape mechanical data**

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 23. **Reel specifications**

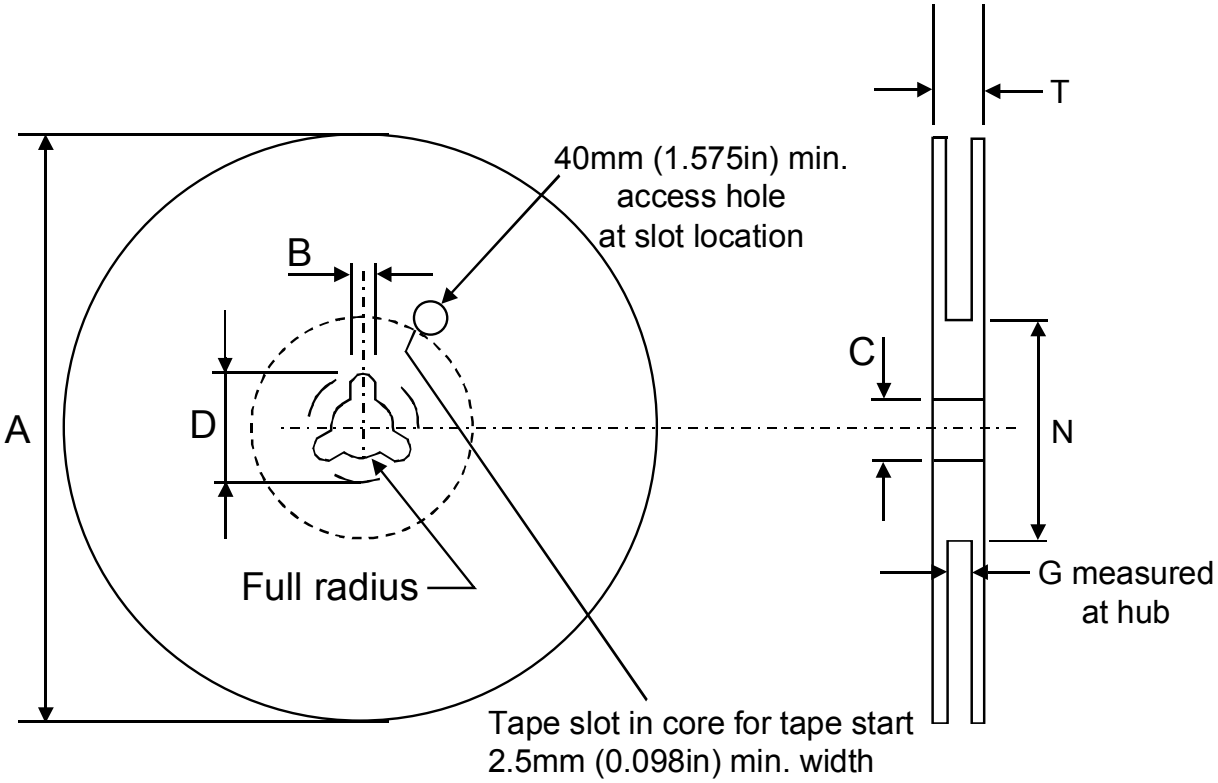


Table 14. **Reel mechanical data**

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.
9- 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 .

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