



VN800S VN800PT

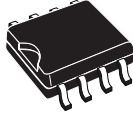
HIGH SIDE DRIVER

| TYPE | $R_{DS(on)}$ | I_{OUT} | V_{CC} |
|-------------------|----------------|-----------|----------|
| VN800S VN800PT | 135 m Ω | 0.7 A | 36 V |

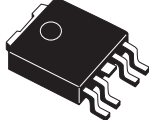
- CMOS COMPATIBLE INPUT
- THERMAL SHUTDOWN
- CURRENT LIMITATION
- SHORTED LOAD PROTECTION
- UNDERVOLTAGE AND OVERVOLTAGE SHUTDOWN
- PROTECTION AGAINST LOSS OF GROUND
- VERY LOW STAND-BY CURRENT
- REVERSE BATTERY PROTECTION (*)

DESCRIPTION

The VN800S, VN800PT are monolithic devices made by using STMicroelectronics VIPower M0-3 Technology, intended for driving any kind of load with one side connected to ground. Active V_{CC} pin voltage clamp protects the device against low energy spikes. Active current limitation combined with thermal shutdown and



SO-8

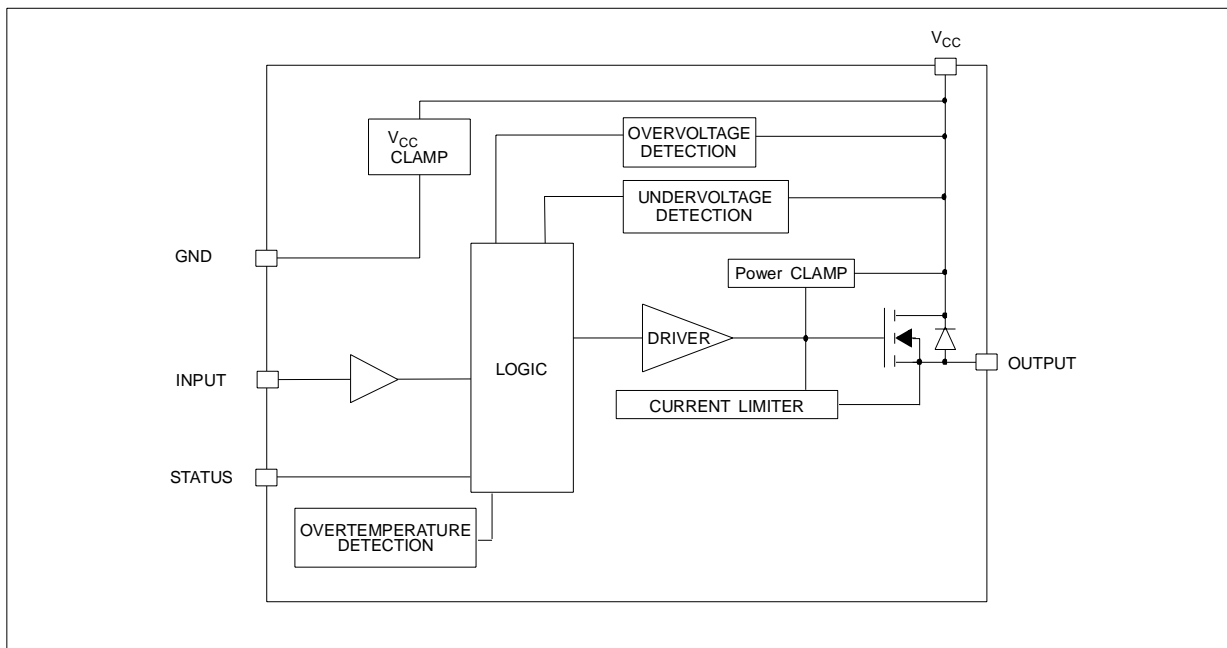


PPAK

| ORDER CODES | | |
|-------------|---------|-------------|
| PACKAGE | TUBE | T&R |
| SO-8 | VN800S | VN800S13TR |
| PPAK | VN800PT | VN800PT13TR |

automatic restart protect the device against overload. Device automatically turns off in case of ground pin disconnection. This device is especially suitable for industrial applications in norms conformity with IEC1131 (Programmable Controllers International Standard).

BLOCK DIAGRAM



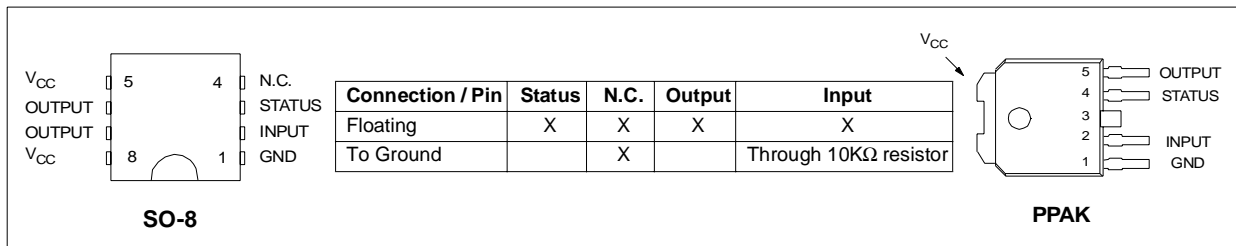
(*) See note at page 7

Rev. 1

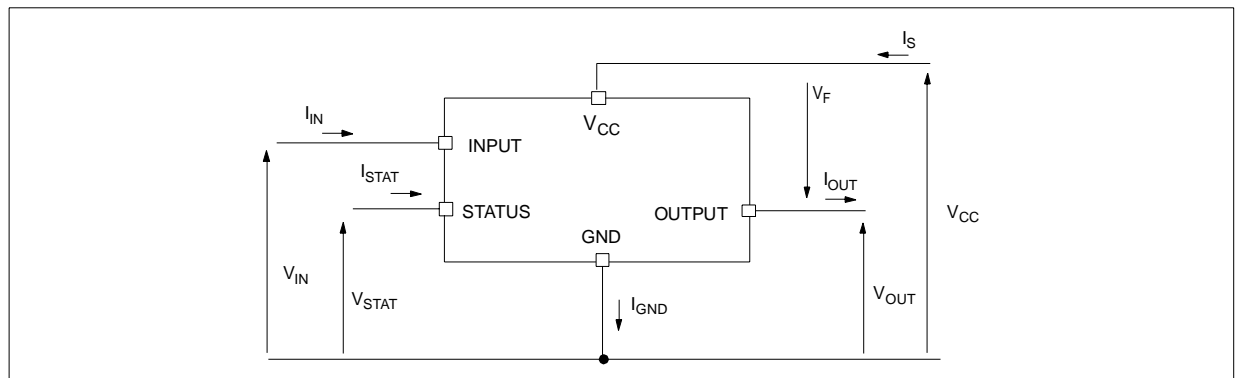
ABSOLUTE MAXIMUM RATING

| Symbol | Parameter | Value | | Unit |
|------------|--|--------------------|------|------------|
| | | SO-8 | PPAK | |
| 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 |
| $-I_{OUT}$ | Reverse DC Output Current | - 6 | | 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 (Human Body Model: $R=1.5K\Omega$; $C=100pF$) | | | |
| | - INPUT | 4000 | | V |
| | - STATUS | 4000 | | V |
| | - OUTPUT | 5000 | | V |
| | - V_{CC} | 5000 | | V |
| P_{tot} | Power Dissipation $T_C=25^\circ C$ | 4.2 | 41.7 | W |
| E_{MAX} | Maximum Switching Energy ($L=77.5mH$; $R_L=0\Omega$; $V_{bat}=13.5V$; $T_{jstart}=150^\circ C$; $I_L=1.5A$) | 121 | | mJ |
| E_{MAX} | Maximum Switching Energy ($L=125mH$; $R_L=0\Omega$; $V_{bat}=13.5V$; $T_{jstart}=150^\circ C$; $I_L=1.5A$) | | 195 | mJ |
| T_j | Junction Operating Temperature | Internally Limited | | $^\circ C$ |
| T_C | Case Operating Temperature | - 40 to 150 | | $^\circ C$ |
| T_{stg} | Storage Temperature | - 55 to 150 | | $^\circ C$ |
| L_{max} | Max Inductive Load ($V_{CC}=30V$; $I_{LOAD}=0.5A$; $T_{amb}=100^\circ C$; $R_{thcase>ambient}\leq 25^\circ C/W$) | | 2 | H |

CONFIGURATION DIAGRAM (TOP VIEW) & SUGGESTED CONNECTIONS FOR UNUSED AND N.C. PINS



CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

| Symbol | Parameter | | Value | | Unit |
|-----------------------|-------------------------------------|-----|-------------------|-------------------|------|
| | | | SO-8 | PPAK | |
| R _{thj-case} | Thermal Resistance Junction-case | Max | - | 3 | °C/W |
| R _{thj-lead} | Thermal Resistance Junction-lead | Max | 30 | - | °C/W |
| R _{thj-amb} | Thermal Resistance Junction-ambient | Max | 93 ⁽¹⁾ | 78 ⁽³⁾ | °C/W |
| | | Max | 82 ⁽²⁾ | 45 ⁽⁴⁾ | °C/W |

⁽¹⁾ When mounted on FR4 printed circuit board with 0.5 cm² of copper area (at least 35μ thick) connected to all V_{CC} pins.

⁽²⁾ When mounted on FR4 printed circuit board with 2 cm² of copper area (at least 35μ thick).

⁽³⁾ When mounted on FR4 printed circuit board with 0.5 cm² of copper area (at least 35μ thick) connected to all V_{CC} pins.

⁽⁴⁾ When mounted on FR4 printed circuit board with 6 cm² of copper area (at least 35μ thick).

ELECTRICAL CHARACTERISTICS (8V < V_{CC} < 36V; -40°C < T_J < 150°C, unless otherwise specified)

POWER

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|----------------------|----------------------------|---|-----|-----------|------------------|----------------|
| V _{CC} | Operating Supply Voltage | | 5.5 | | 36 | V |
| V _{USD} | Undervoltage Shut-down | | 3 | 4 | 5.5 | V |
| V _{OV} | Overvoltage Shut-down | | 36 | 42 | | V |
| R _{ON} | On State Resistance | I _{OUT} = 0.5A; T _J = 25°C I _{OUT} = 0.5A | | | 135 270 | mΩ mΩ |
| I _S | Supply Current | Off State; V _{CC} = 24V; T _{case} = 25°C On State; V _{CC} = 24V On State; V _{CC} = 24V; T _{case} = 100°C | | 10 1.5 | 20 3.5 2.6 | μA mA mA |
| I _{LGND} | Output Current at turn-off | V _{CC} = V _{STAT} = V _{IN} = V _{GND} = 24V; V _{OUT} = 0V | | | 1 | mA |
| I _{L(off1)} | Off State Output Current | V _{IN} = V _{OUT} = 0V | 0 | | 50 | μA |
| I _{L(off2)} | Off State Output Current | V _{IN} = V _{OUT} = 0V; V _{CC} = 13V; T _J = 125°C | | | 5 | μA |
| I _{L(off3)} | Off State Output Current | V _{IN} = V _{OUT} = 0V; V _{CC} = 13V; T _J = 25°C | | | 3 | μA |

SWITCHING (V_{CC} = 24V)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--|------------------------|--|-----|----------------------|-----|------|
| t _{d(on)} | Turn-on Delay Time | R _L = 48Ω from V _{IN} rising edge to V _{OUT} = 2.4V | | 10 | | μs |
| t _{d(off)} | Turn-off Delay Time | R _L = 48Ω from V _{IN} falling edge to V _{OUT} = 21.6V | | 40 | | μs |
| dV _{OUT} /dt _(on) | Turn-on Voltage Slope | R _L = 48Ω from V _{OUT} = 2.4V to V _{OUT} = 19.2V | | See relative diagram | | V/μs |
| dV _{OUT} /dt _(off) | Turn-off Voltage Slope | R _L = 48Ω from V _{OUT} = 21.6V to V _{OUT} = 2.4V | | See relative diagram | | V/μs |

INPUT PIN

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|----------------------|--------------------------|---|------|-----|------|------|
| V _{INL} | Input Low Level | | | | 1.25 | V |
| I _{INL} | Low Level Input Current | V _{IN} = 1.25V | 1 | | | μA |
| V _{INH} | Input High Level | | 3.25 | | | V |
| I _{INH} | High Level Input Current | V _{IN} = 3.25V | | | 10 | μA |
| V _{I(hyst)} | Input Hysteresis Voltage | | 0.5 | | | V |
| I _{IN} | Input Current | V _{IN} = V _{CC} = 36V | | | 200 | μA |

VN800S / VN800PT

ELECTRICAL CHARACTERISTICS (continued)

VCC - OUTPUT DIODE

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|--------------------|-------------------------------------|-----|-----|-----|------|
| V_F | Forward on Voltage | $-I_{OUT}=0.6A$; $T_j=150^\circ C$ | | | 0.7 | V |

STATUS PIN

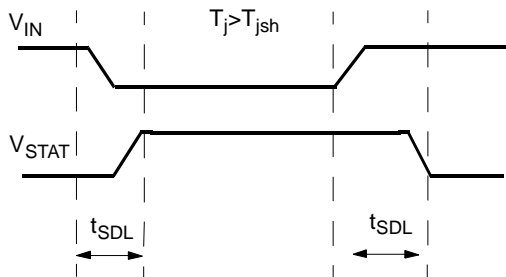
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-------------|------------------------------|---|-----|-----|-----|---------|
| V_{STAT} | Status Low Output Voltage | $I_{STAT}=1.6\text{ mA}$ | | | 0.5 | V |
| I_{LSTAT} | Status Leakage Current | Normal Operation; $V_{STAT}=V_{CC}=36\text{ V}$ | | | 10 | μA |
| C_{STAT} | Status Pin Input Capacitance | Normal Operation; $V_{STAT}=5\text{ V}$ | | | 30 | pF |

PROTECTIONS (see note 1)

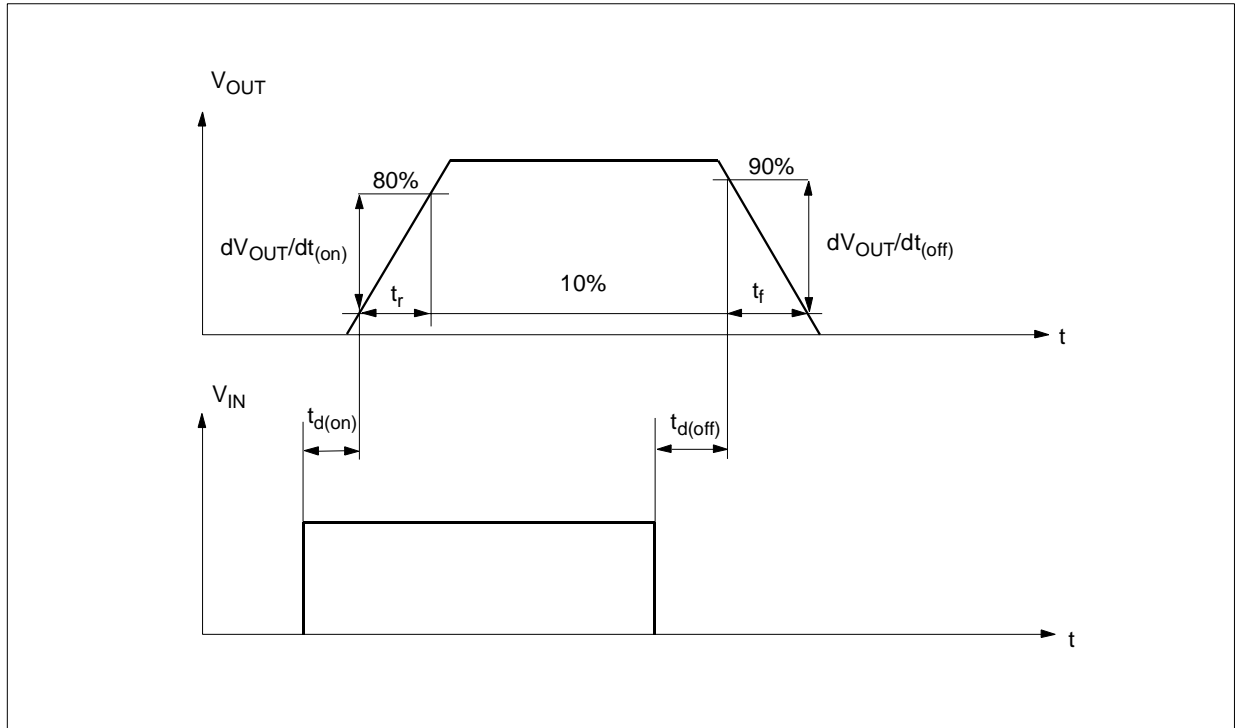
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-------------|------------------------------------|---|-------------|-------------|-------------|------------|
| T_{TSD} | Shut-down Temperature | | 150 | 175 | 200 | $^\circ C$ |
| T_R | Reset Temperature | | 135 | | | $^\circ C$ |
| T_{hyst} | Thermal Hysteresis | | 7 | 15 | | $^\circ C$ |
| T_{SDL} | Status Delay in Overload Condition | $T_j > T_{jsh}$ | | | 20 | μs |
| I_{lim} | DC Short Circuit Current | $V_{CC}=24\text{ V}$; $R_{LOAD}=10\text{ m}\Omega$ | 0.7 | | 2 | A |
| V_{demag} | Turn-off Output Clamp Voltage | $I_{OUT}=0.5\text{ A}$; $L=6\text{ mH}$ | $V_{CC}-47$ | $V_{CC}-52$ | $V_{CC}-57$ | V |

Note 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 operates under abnormal conditions this software must limit the duration and number of activation cycles.

OVERTEMP STATUS TIMING



Switching time Waveforms



TRUTH TABLE

| CONDITIONS | INPUT | OUTPUT | STATUS |
|--------------------|-------|--------|---------------------|
| Normal Operation | L | L | H |
| | H | H | H |
| Current Limitation | L | L | H |
| | H | X | $(T_j < T_{TSD})$ 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 |

Figure 1: Peak Short Circuit Current Test Circuit

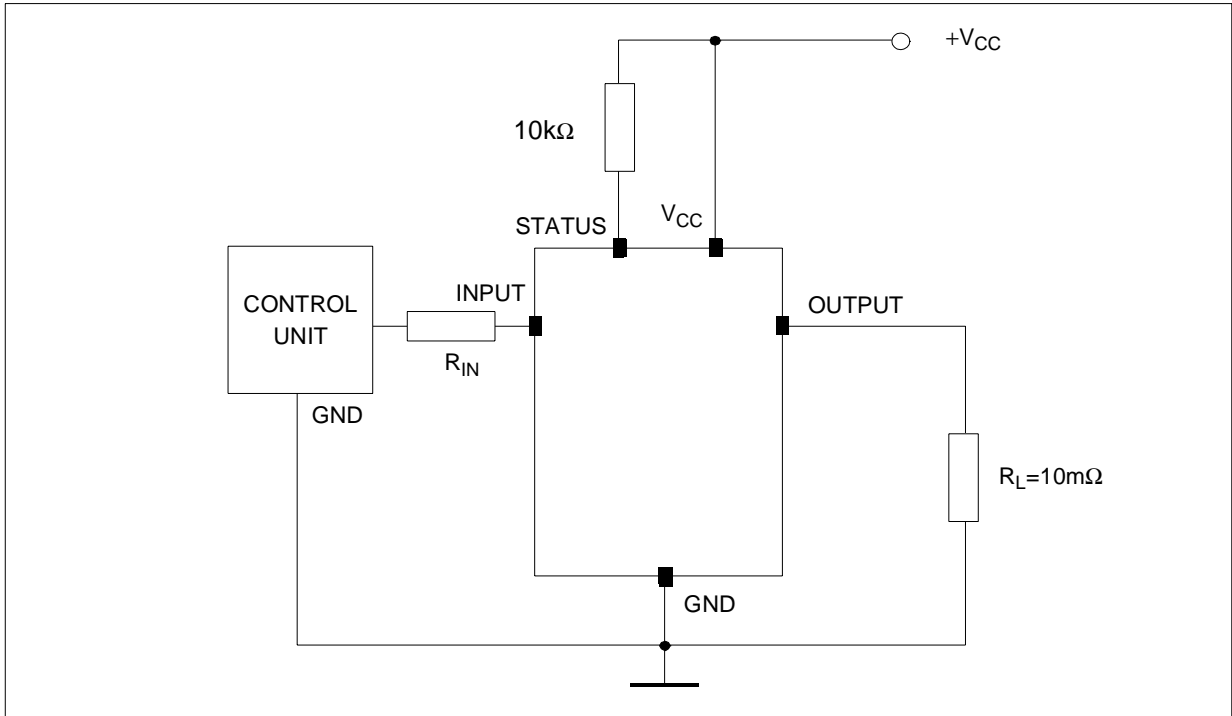
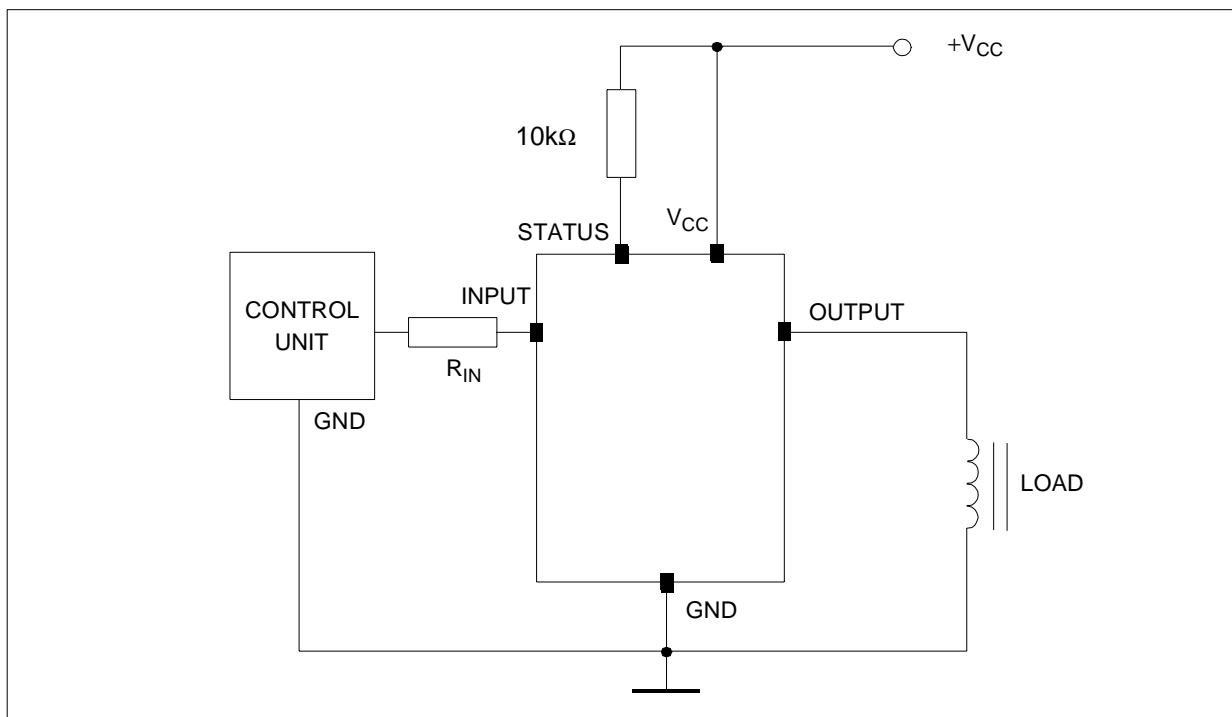
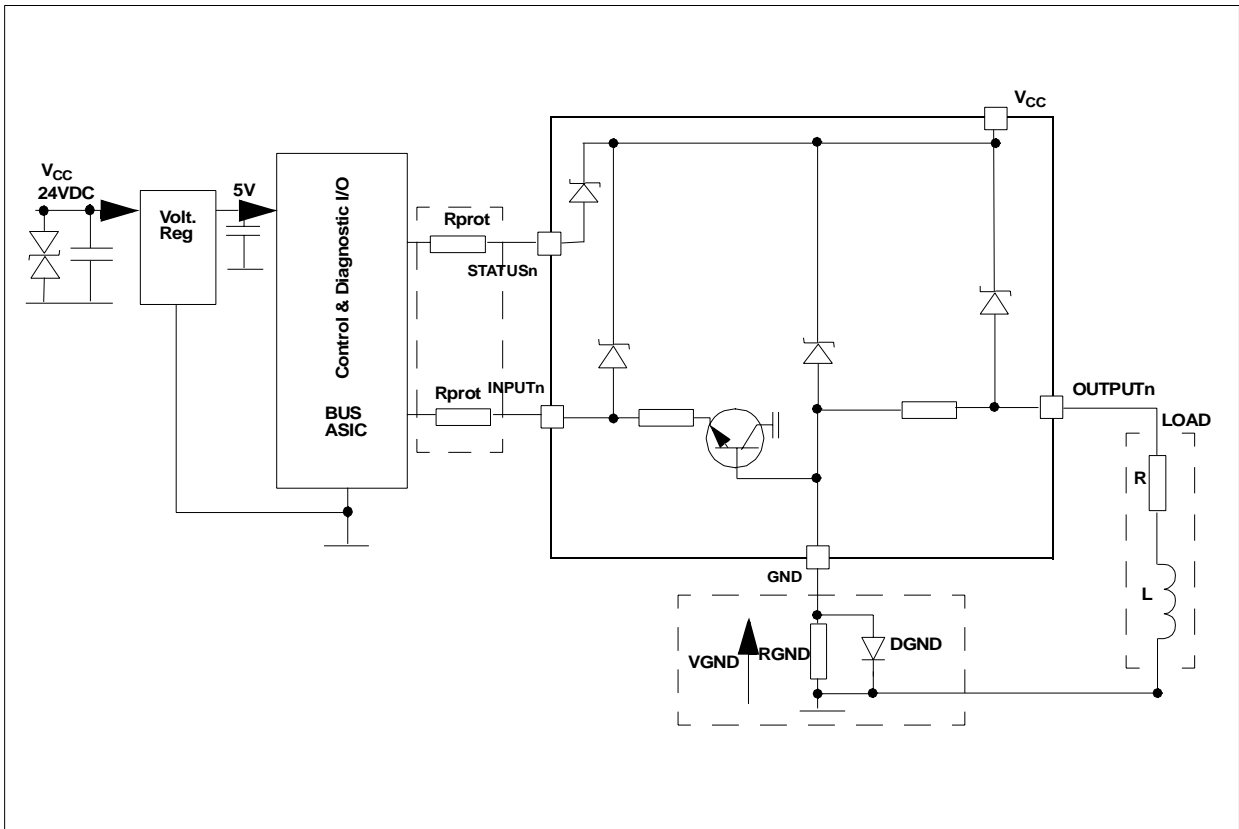


Figure 2: Avalanche Energy Test Circuit



APPLICATION SCHEMATIC



GND PROTECTION NETWORK AGAINST REVERSE BATTERY

Solution 1: Resistor in the ground line (R_{GND} only). This can be used with any type of load.

The following is an indication on how to dimension the R_{GND} resistor.

- 1) $R_{GND} \leq 600\text{mV} / (I_{S(on)max})$.
- 2) $R_{GND} \geq (-V_{CC}) / (-I_{GND})$

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

Power Dissipation in R_{GND} (when $V_{CC} < 0$: during reverse battery situations) is:

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

This resistor can be shared amongst several different HSD. Please note that the value of this resistor should be calculated with formula (1) where $I_{S(on)max}$ becomes the sum of the maximum on-state currents of the different devices.

Please note that if the microprocessor ground is not common with the device ground then the R_{GND} will produce a shift ($I_{S(on)max} * R_{GND}$) in the input thresholds and the status output values. This shift will vary depending on many devices are ON in the case of several high side drivers sharing the same R_{GND} .

If the calculated power dissipation leads to a large resistor or several devices have to share the same resistor then the ST suggests to utilize Solution 2 (see below).

Solution 2: A diode (D_{GND}) in the ground line.

A resistor ($R_{GND} = 1\text{k}\Omega$) should be inserted in parallel to D_{GND} if the device will be driving an inductive load.

This small signal diode can be safely shared amongst several different HSD. Also in this case, the presence of the ground network will produce a shift ($\approx 600\text{mV}$) in the input threshold and the status output values if the microprocessor ground is not common with the device ground. This shift will not vary if more than one HSD shares the same diode/resistor network.

Series resistor in INPUT and STATUS lines are also required to prevent that, during battery voltage transient, the current exceeds the Absolute Maximum Rating.

Safest configuration for unused INPUT and STATUS pin is to leave them unconnected.

μC I/Os PROTECTION:

If a ground protection network is used and negative transients are present on the V_{CC} line, the control pins will be pulled negative. ST suggests to insert a resistor (R_{prot}) in line to prevent the μC I/Os pins to latch-up.

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

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

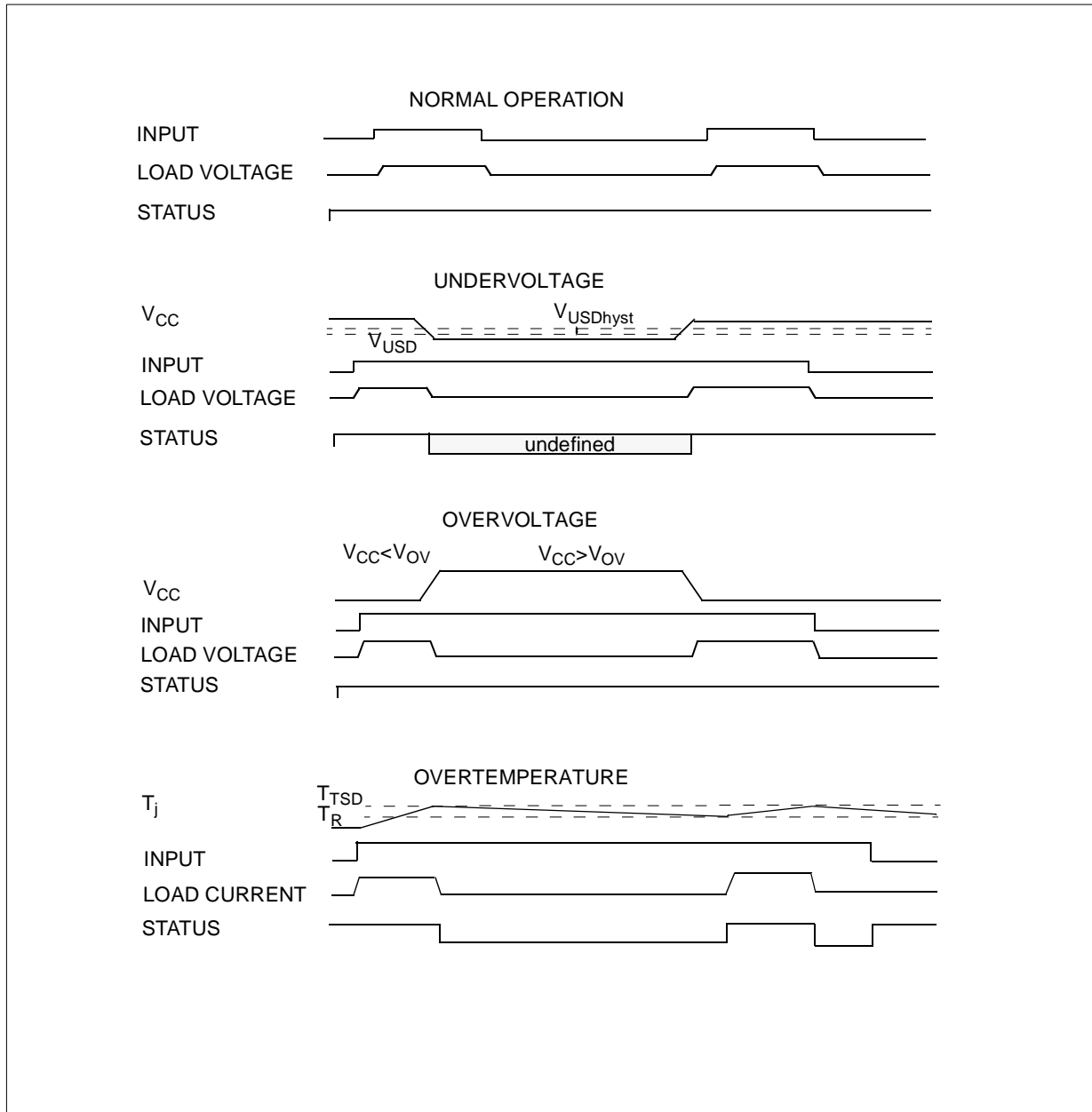
Calculation example:

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

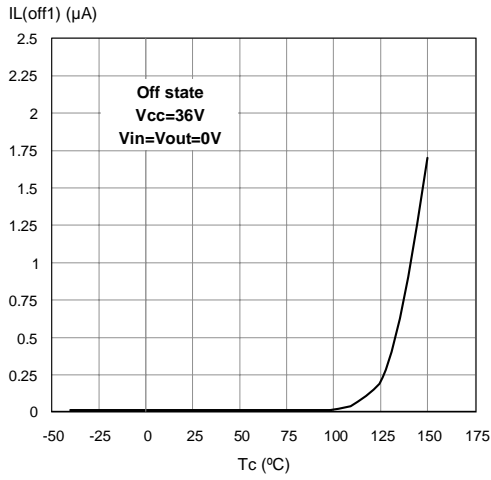
$$5\text{k}\Omega \leq R_{prot} \leq 65\text{k}\Omega$$

Recommended R_{prot} value is $10\text{k}\Omega$.

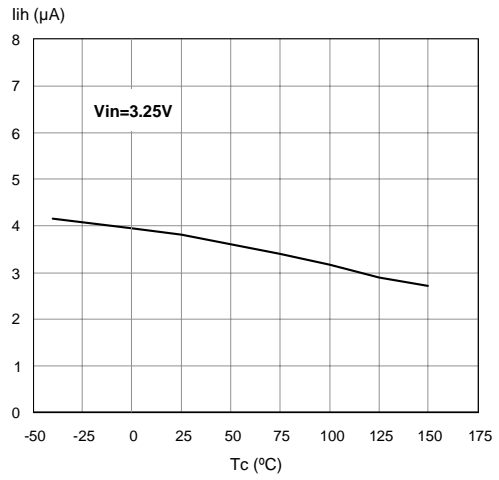
Figure 3: Waveforms



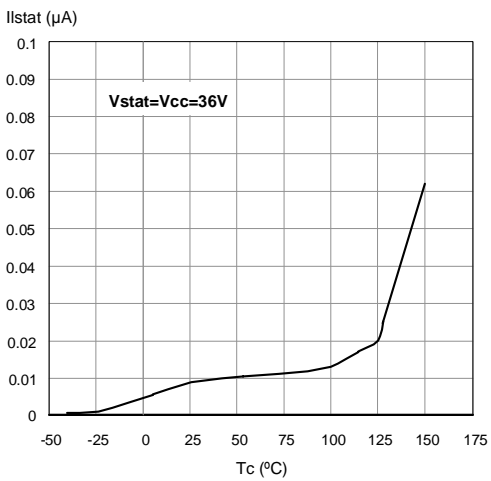
Off State Output Current



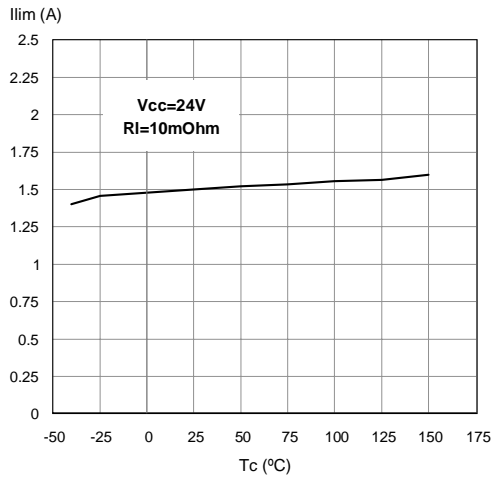
High Level Input Current



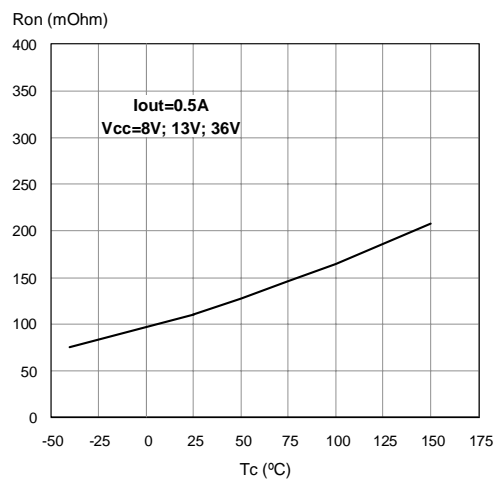
Status Leakage Current



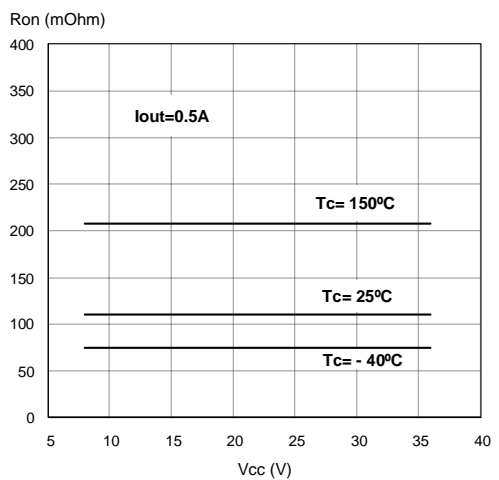
I_{LIM} Vs T_{case}



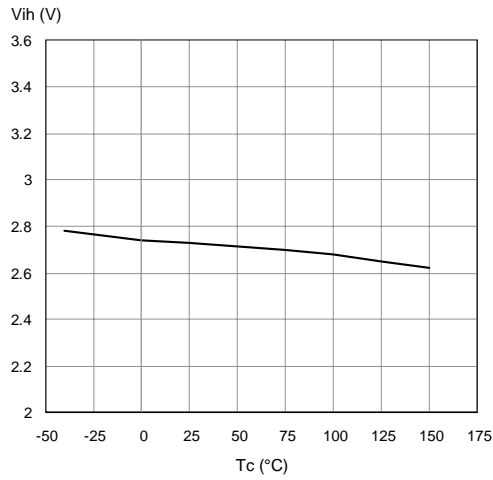
On State Resistance Vs T_{case}



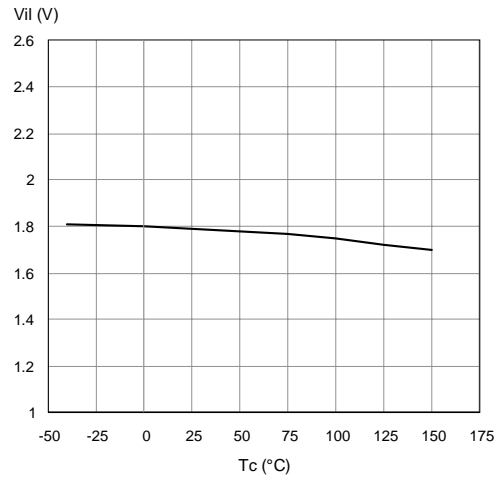
On State Resistance Vs V_{CC}



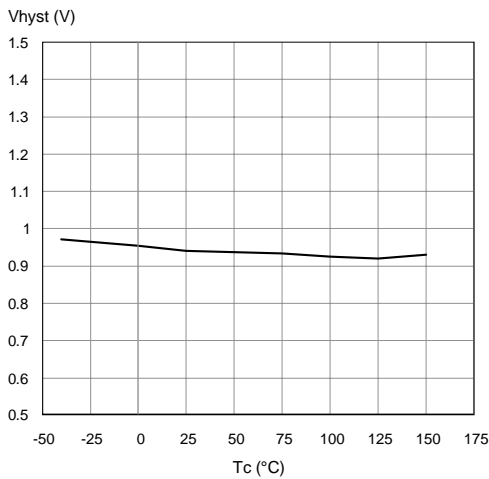
Input High Level



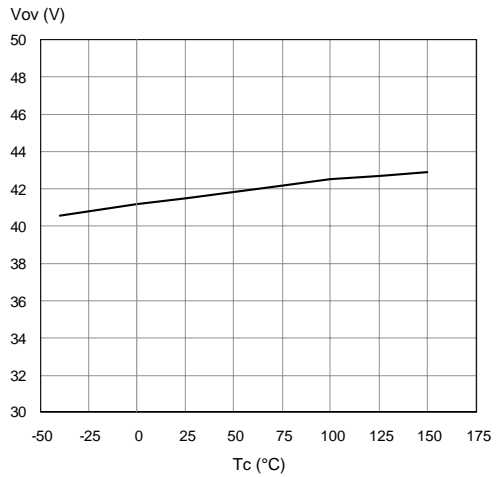
Input Low Level



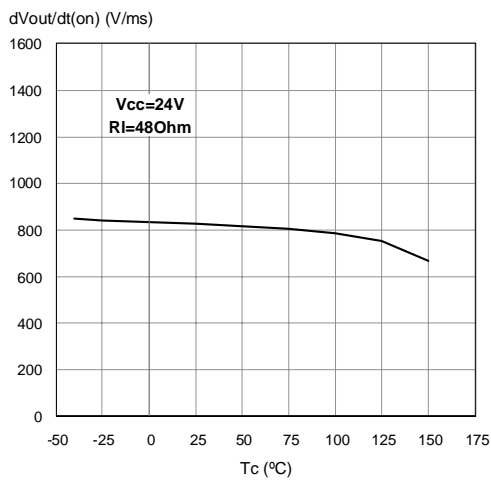
Input Hysteresis Voltage



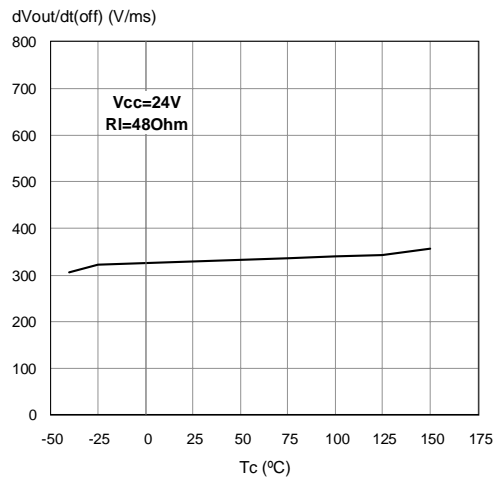
Overvoltage Shutdown



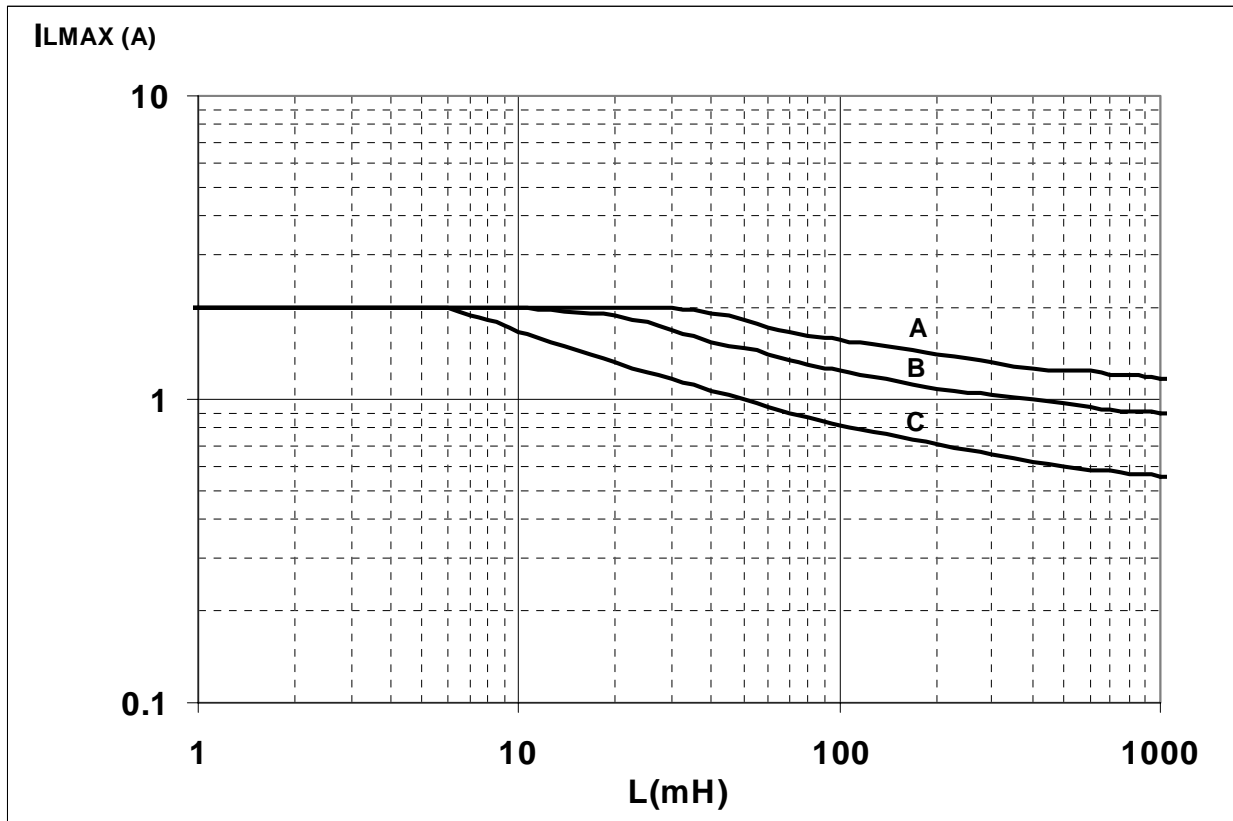
Turn-on Voltage Slope



Turn-off Voltage Slope



PPAK Maximum turn off current versus load inductance



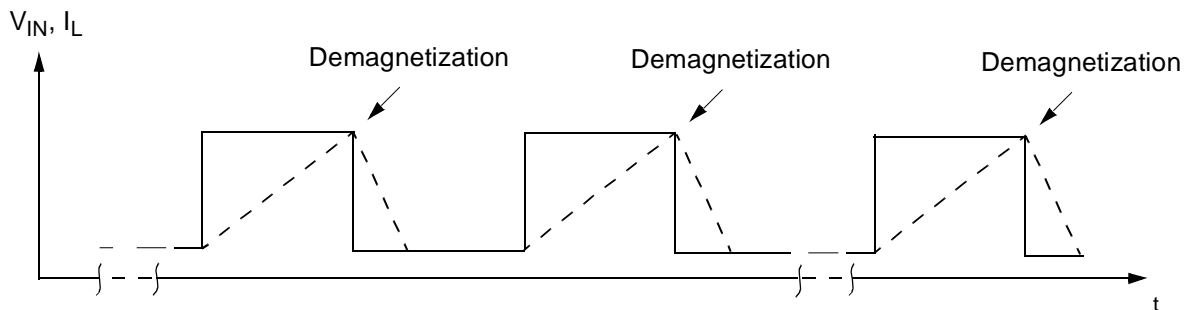
- A = Single Pulse at $T_{Jstart}=150^{\circ}C$
- B= Repetitive pulse at $T_{Jstart}=100^{\circ}C$
- C= Repetitive Pulse at $T_{Jstart}=125^{\circ}C$

Conditions:

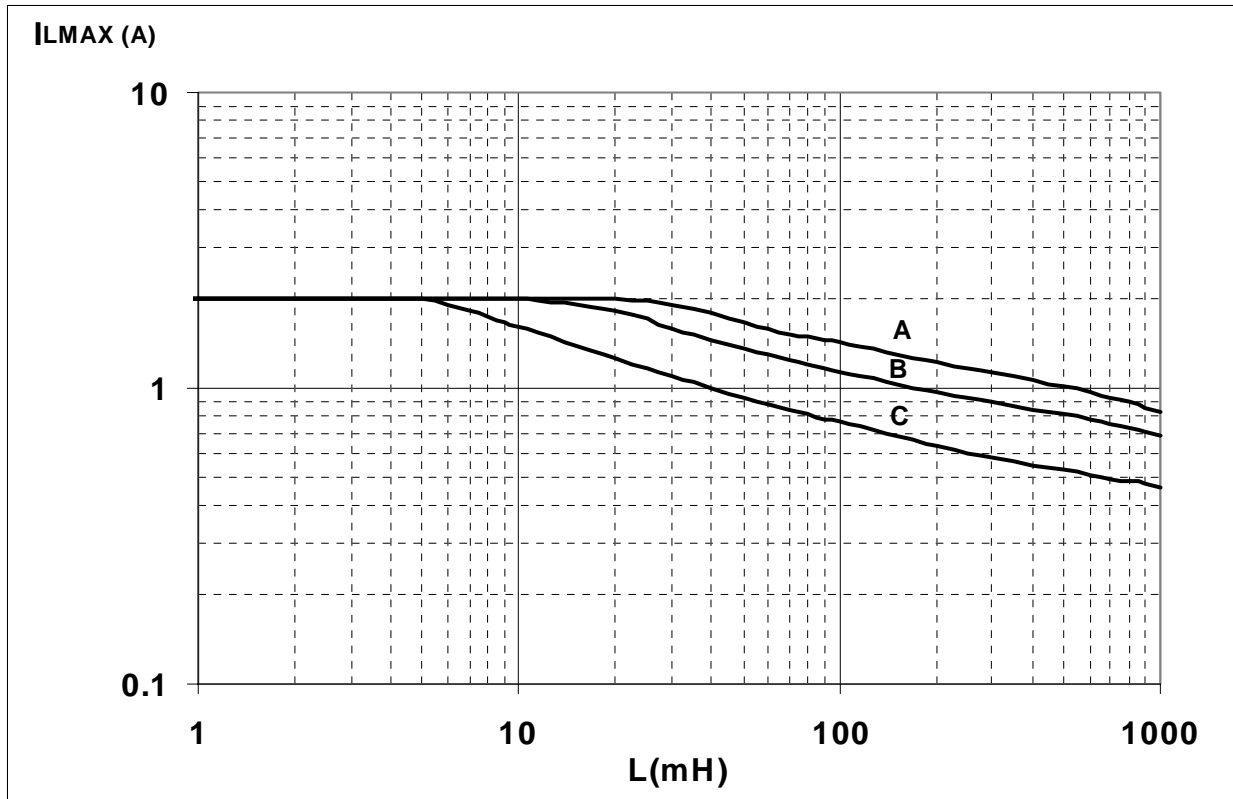
$V_{CC}=13.5V$

Values are generated with $R_L=0\Omega$

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.



SO-8 Maximum turn off current versus load inductance



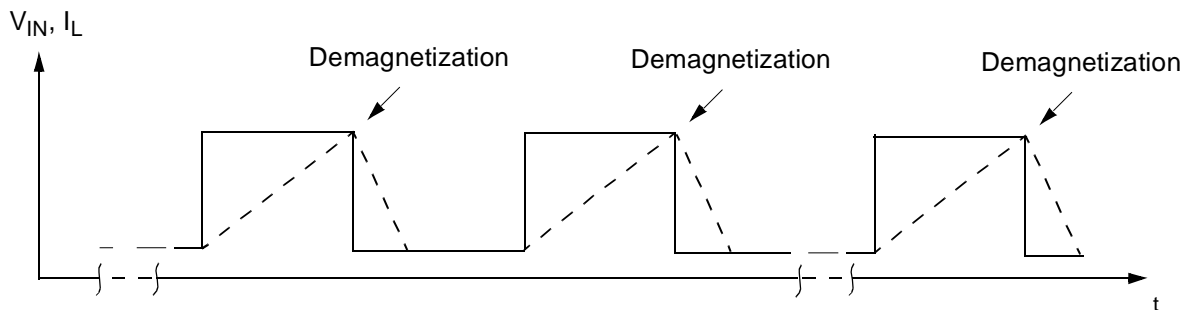
- A = Single Pulse at $T_{Jstart}=150^{\circ}C$
- B= Repetitive pulse at $T_{Jstart}=100^{\circ}C$
- C= Repetitive Pulse at $T_{Jstart}=125^{\circ}C$

Conditions:

$V_{CC}=13.5V$


Values are generated with $R_L=0\Omega$

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.

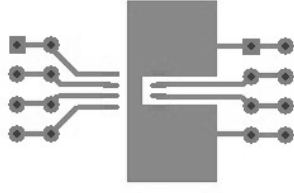


SO-8 THERMAL DATA

SO-8 PC Board



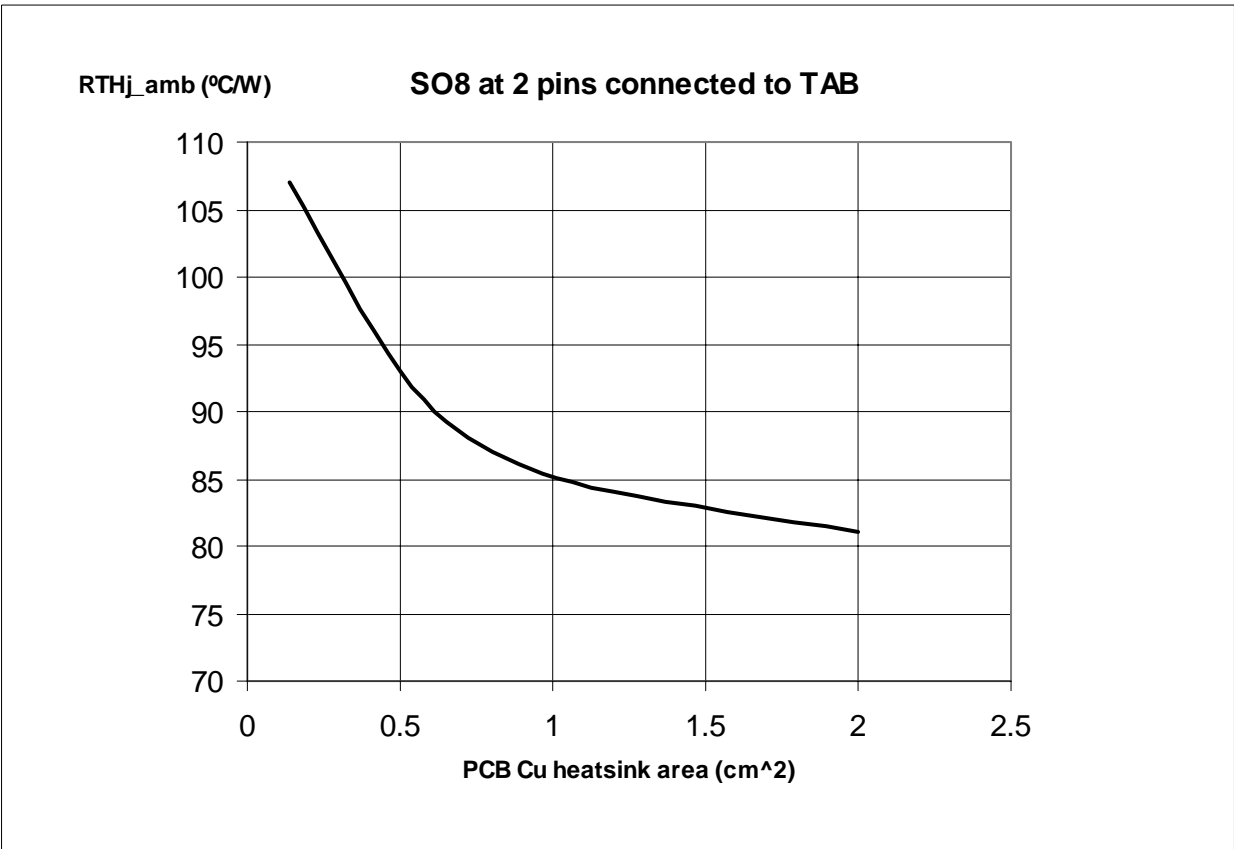
0.14cm²



2cm²

Layout condition of R_{th} and Z_{th} measurements (PCB FR4 area= 58mm x 58mm, PCB thickness=2mm, Cu thickness=35 μ m, Copper areas: 0.14cm², 2cm²).

$R_{thj-amb}$ Vs PCB copper area in open box free air condition

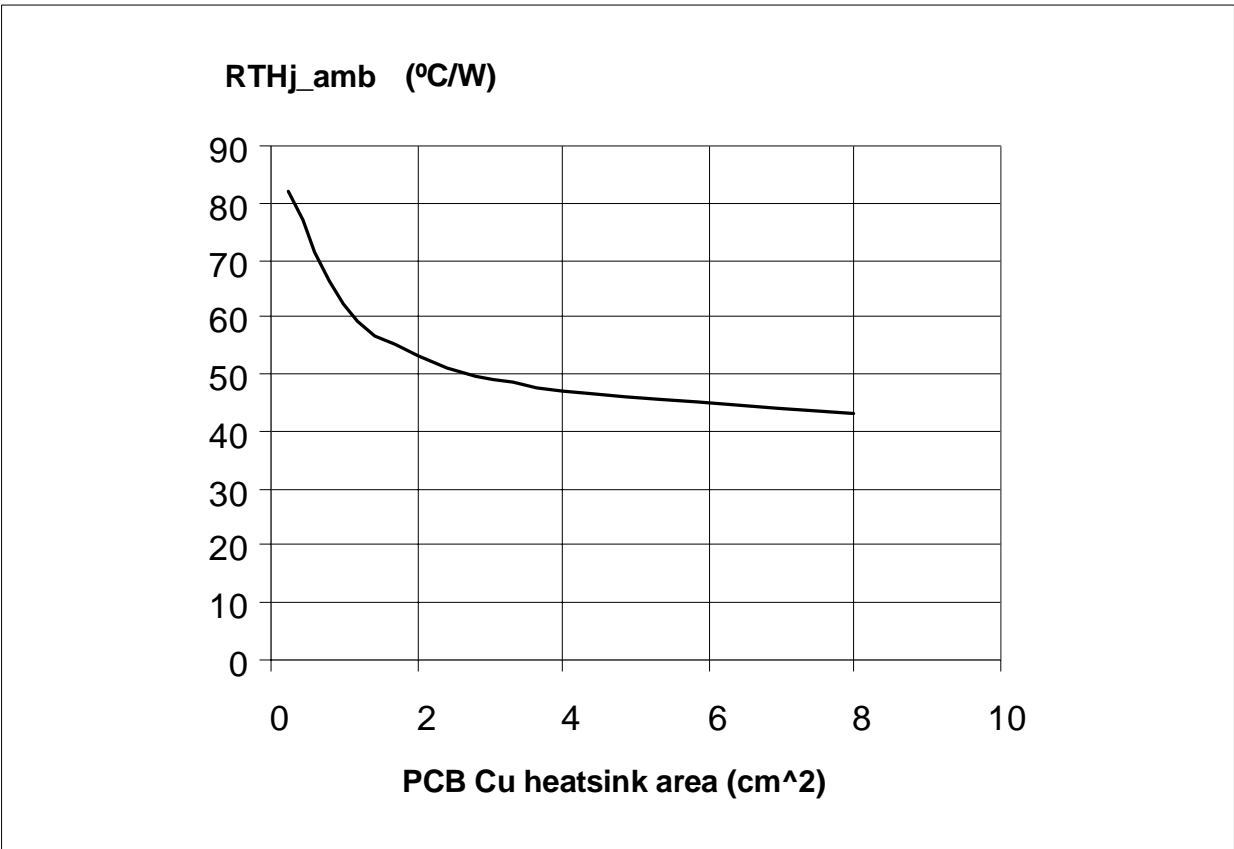


PPAK THERMAL DATA

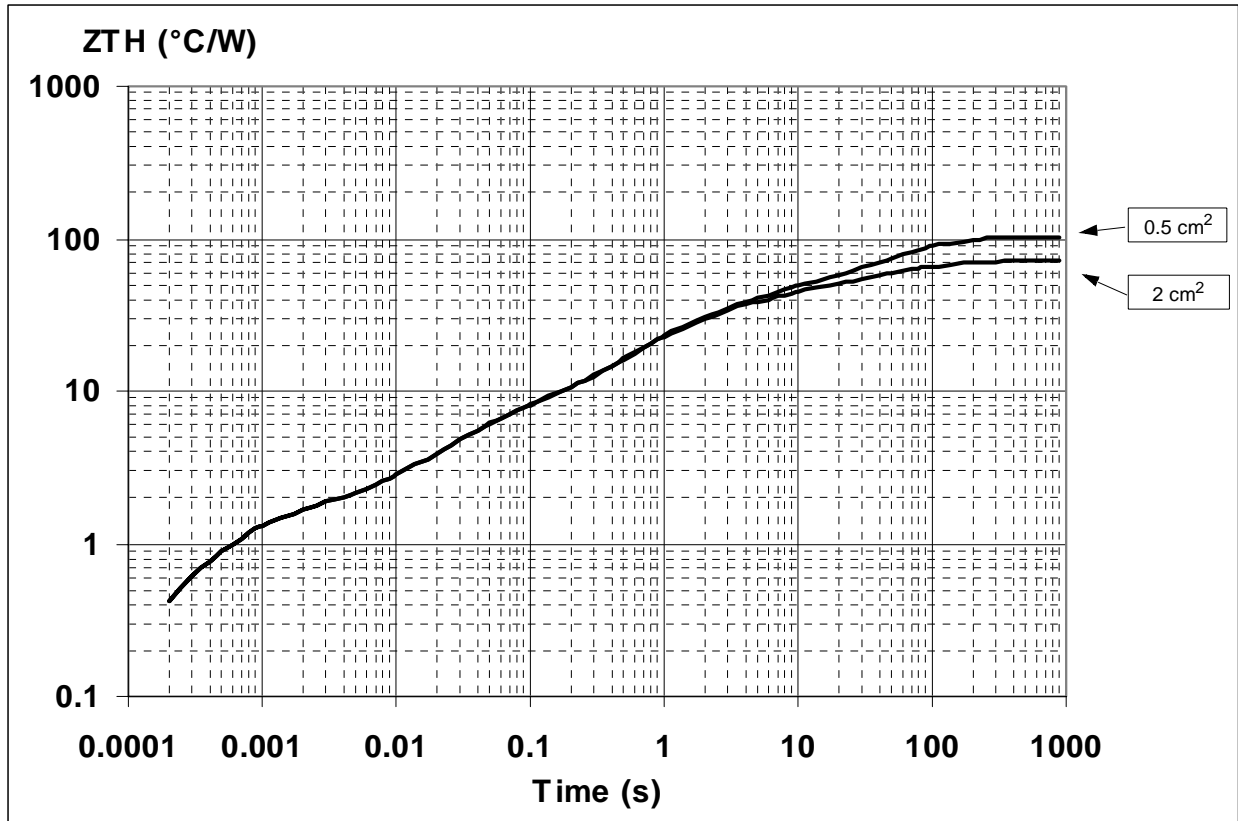
PPAK PC Board

Layout condition of R_{th} and Z_{th} measurements (PCB FR4 area= 60mm x 60mm, PCB thickness=2mm, Cu thickness=35 μ m, Copper areas: 0.44cm², 8cm²).

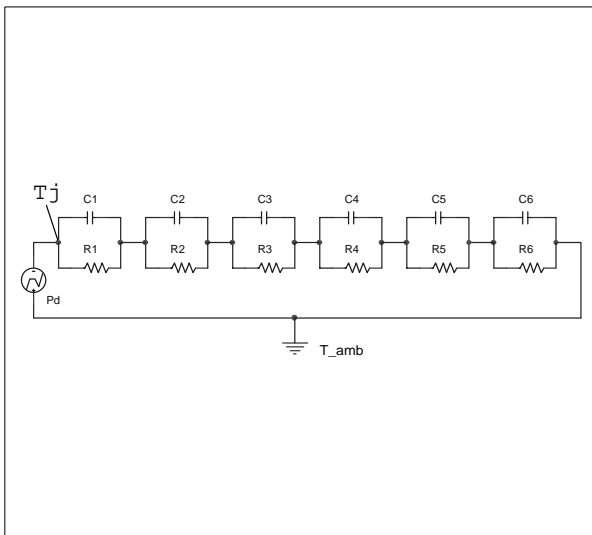
$R_{thj-amb}$ Vs PCB copper area in open box free air condition



SO-8 Thermal Impedance Junction Ambient Single Pulse



Thermal fitting model of a single channel HSD in SO-8



Pulse calculation formula

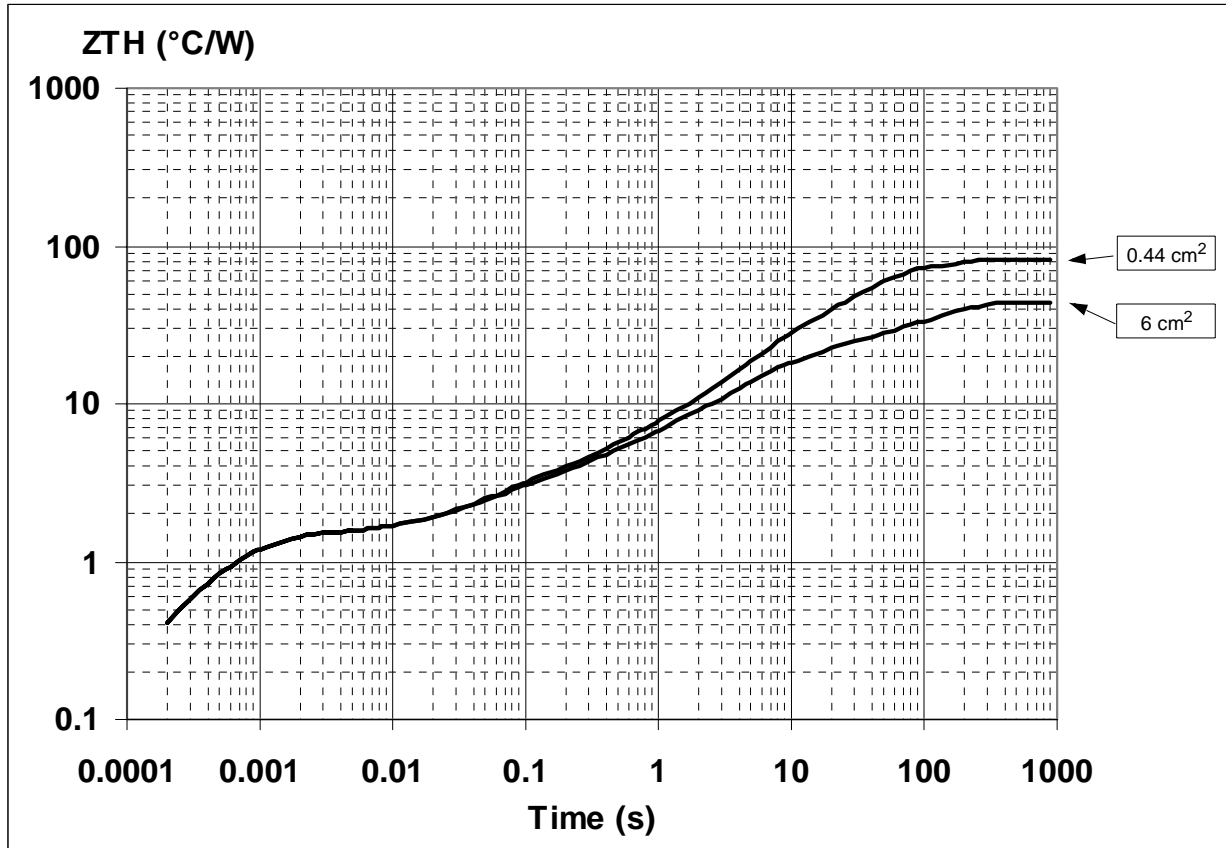
$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where $\delta = t_p/T$

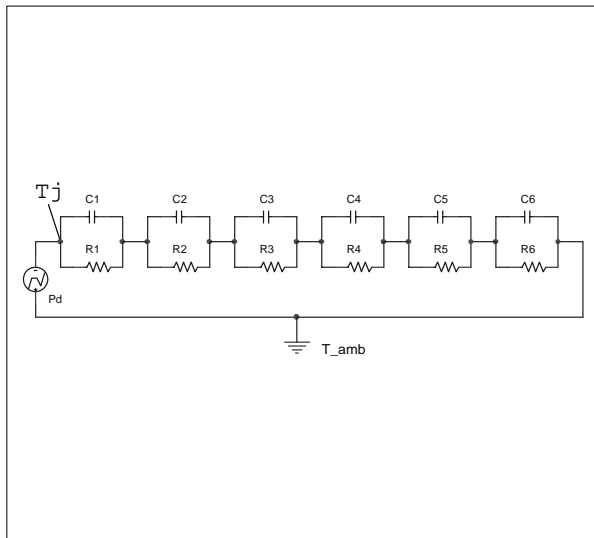
Thermal Parameter

| | 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 |

PPAK Thermal Impedance Junction Ambient Single Pulse



Thermal fitting model of a single channel HSD in PPAK



Pulse calculation formula

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

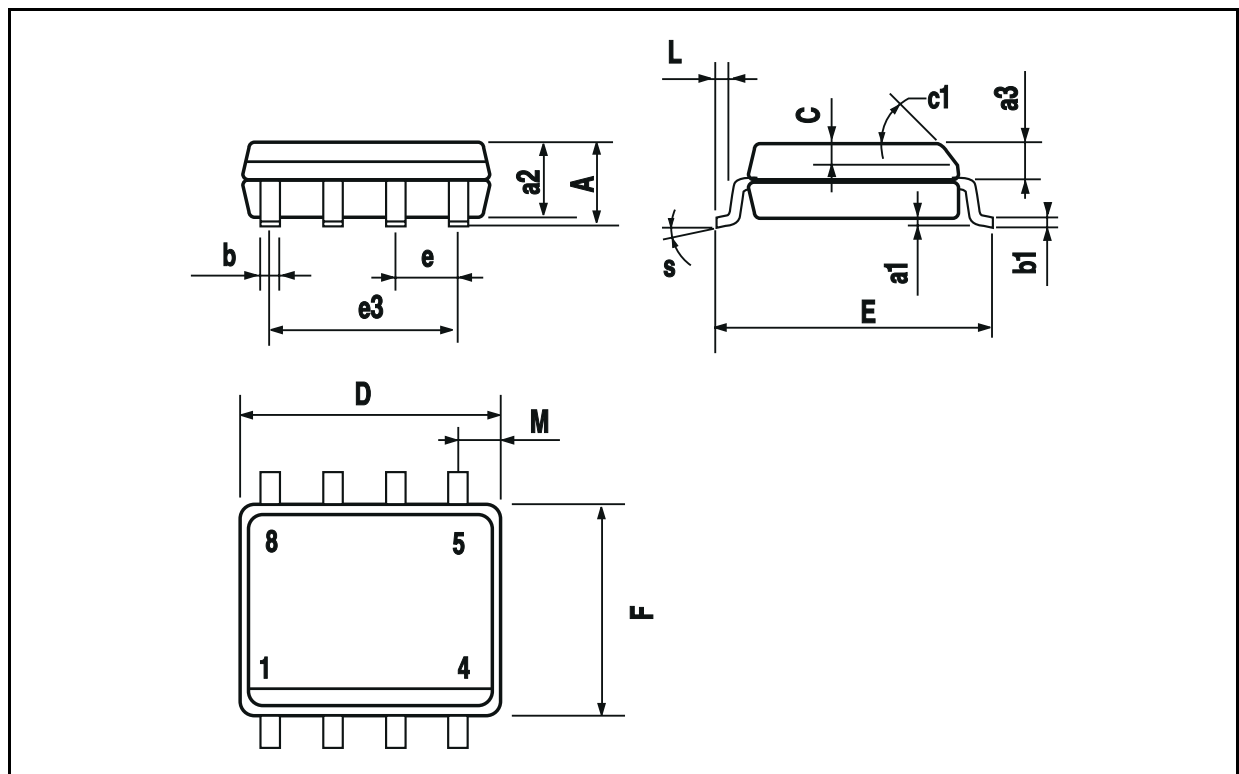
where $\delta = t_p/T$

Thermal Parameter

| Area/island (cm ²) | 0.44 | 6 |
|--------------------------------|--------|----|
| R1 (°C/W) | 0.04 | |
| R2 (°C/W) | 0.25 | |
| R3 (°C/W) | 0.3 | |
| R4 (°C/W) | 2 | |
| R5 (°C/W) | 15 | |
| R6 (°C/W) | 61 | 24 |
| C1 (W.s/°C) | 0.0008 | |
| C2 (W.s/°C) | 0.007 | |
| C3 (W.s/°C) | 0.02 | |
| C4 (W.s/°C) | 0.3 | |
| C5 (W.s/°C) | 0.45 | |
| C6 (W.s/°C) | 0.8 | 5 |

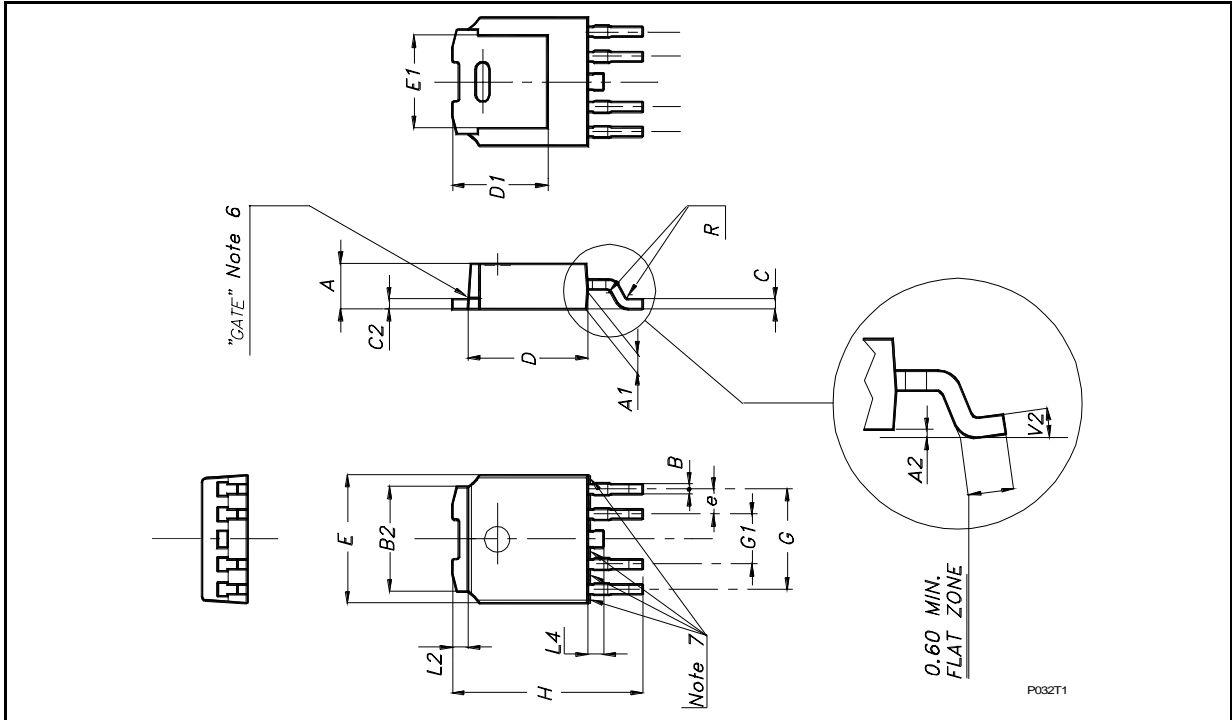
SO-8 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-----------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.25 | 0.003 | | 0.009 |
| a2 | | | 1.65 | | | 0.064 |
| a3 | 0.65 | | 0.85 | 0.025 | | 0.033 |
| b | 0.35 | | 0.48 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | 0.25 | | 0.5 | 0.010 | | 0.019 |
| c1 | 45 (typ.) | | | | | |
| D | 4.8 | | 5 | 0.188 | | 0.196 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 3.81 | | | 0.150 | |
| F | 3.8 | | 4 | 0.14 | | 0.157 |
| L | 0.4 | | 1.27 | 0.015 | | 0.050 |
| M | | | 0.6 | | | 0.023 |
| S | 8 (max.) | | | | | |
| L1 | 0.8 | | 1.2 | 0.031 | | 0.047 |

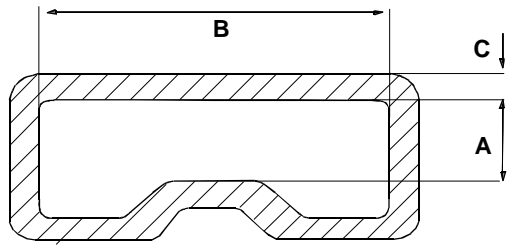


PPAK MECHANICAL DATA

| DIM. | MIN. | TYP | MAX. |
|----------------|---------|------|-------|
| A | 2.20 | | 2.40 |
| A1 | 0.90 | | 1.10 |
| A2 | 0.03 | | 0.23 |
| B | 0.40 | | 0.60 |
| B2 | 5.20 | | 5.40 |
| C | 0.45 | | 0.60 |
| C2 | 0.48 | | 0.60 |
| D1 | | 5.1 | |
| D | 6.00 | | 6.20 |
| E | 6.40 | | 6.60 |
| E1 | | 4.7 | |
| e | | 1.27 | |
| G | 4.90 | | 5.25 |
| G1 | 2.38 | | 2.70 |
| H | 9.35 | | 10.10 |
| L2 | | 0.8 | 1.00 |
| L4 | 0.60 | | 1.00 |
| R | | 0.2 | |
| V2 | 0° | | 8° |
| Package Weight | Gr. 0.3 | | |



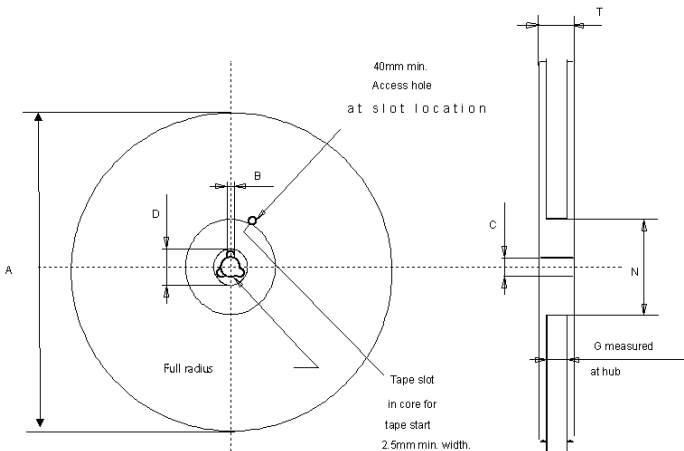
SO-8 TUBE SHIPMENT (no suffix)



| | |
|----------------------------|------|
| Base Q.ty | 100 |
| Bulk Q.ty | 2000 |
| Tube length (± 0.5) | 532 |
| A | 3.2 |
| B | 6 |
| C (± 0.1) | 0.6 |

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix "13TR")



| | |
|---------------------|------|
| 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 |

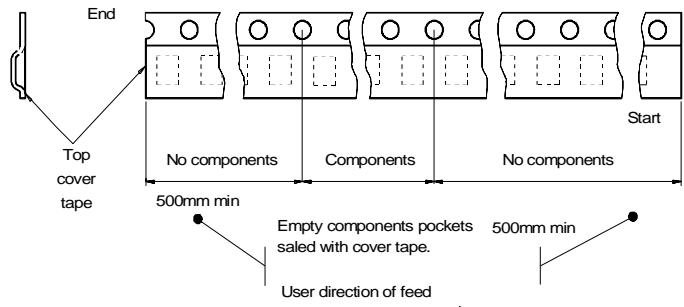
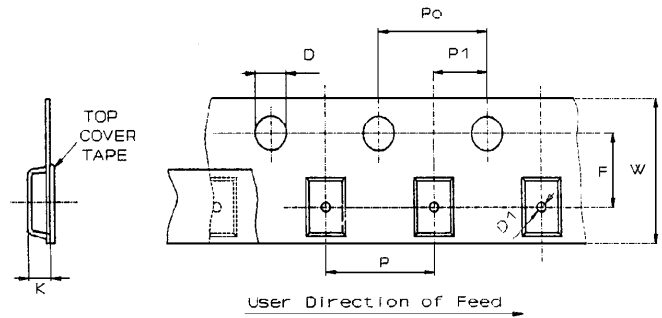
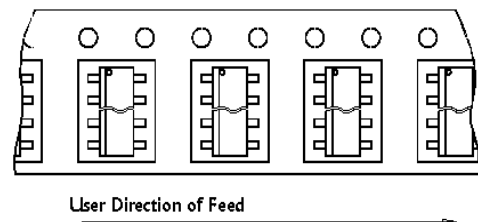
All dimensions are in mm.

TAPE DIMENSIONS

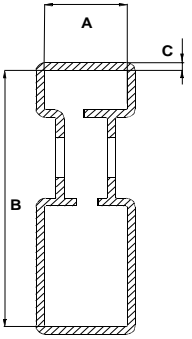
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

| | | |
|--------------------------|---------------------|-----|
| 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.



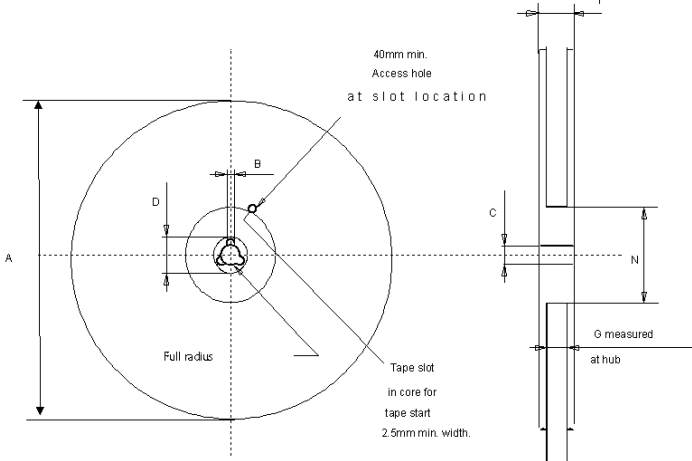
PPAK TUBE SHIPMENT (no suffix)



| | |
|---|------|
| Base Q.ty | 75 |
| Bulk Q.ty | 3000 |
| Tube length (± 0.5) | 532 |
| A | 6 |
| B | 21.3 |
| C (± 0.1) | 0.6 |

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix "13TR")



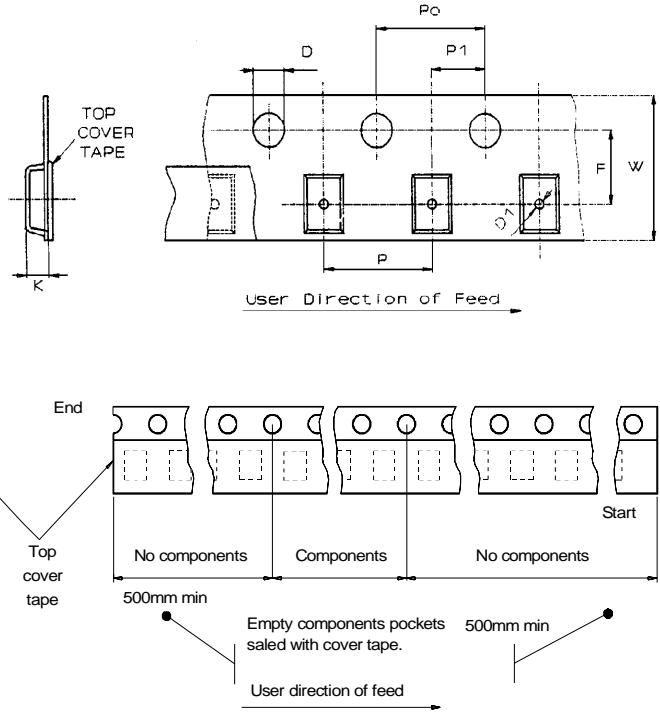
| | |
|---------------------------------|------|
| Base Q.ty | 2500 |
| Bulk Q.ty | 2500 |
| A (max) | 330 |
| B (min) | 1.5 |
| C (± 0.2) | 13 |
| F | 20.2 |
| G (+ 2 / -0) | 16.4 |
| N (min) | 60 |
| T (max) | 22.4 |

All dimensions are in mm.

TAPE DIMENSIONS

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

| | | |
|--------------------------|------------------------------------|-----|
| Tape width | W | 16 |
| Tape Hole Spacing | P0 (± 0.1) | 4 |
| Component Spacing | P | 8 |
| Hole Diameter | D ($\pm 0.1/-0$) | 1.5 |
| Hole Diameter | D1 (min) | 1.5 |
| Hole Position | F (± 0.05) | 7.5 |
| Compartment Depth | K (max) | 6.5 |
| Hole Spacing | P1 (± 0.1) | 2 |



All dimensions are in mm.

REVISION HISTORY

| Date | Revision | Description of Changes |
|-----------|----------|--|
| Jul. 2004 | 1 | <ul style="list-style-type: none">- Current and voltage convention update (page 2).- "Configuration diagram (top view) & suggested connections for unused and n.c. pins" insertion (page 2).- 6cm² Cu condition insertion in Thermal Data table (page 3).- V_{CC} - OUTPUT DIODE section update (page 4).- PROTECTIONS note insertion (page 4).- Revision History table insertion (page 21).- Disclaimers update (page 22). |

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