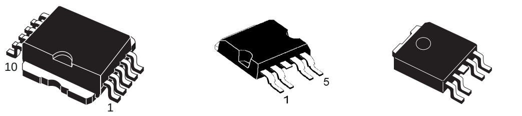
VN820 / VN820SO
VN820SP / VN820-B5 / VN820PT

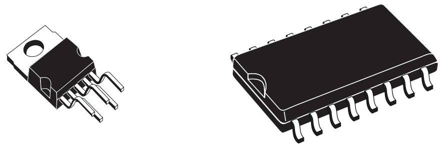
HIGH SIDE DRIVER

TYPE	$R_{DS(on)}$	I_{OUT}	V_{CC}
VN820 VN820SP VN820-B5 VN820SO VN820PT	40 mΩ	9 A	36 V

- CMOS COMPATIBLE INPUT
- ON STATE OPEN LOAD DETECTION
- OFF STATE OPEN LOAD DETECTION
- SHORTED LOAD PROTECTION
- UNDERVOLTAGE AND OVERVOLTAGE SHUTDOWN
- PROTECTION AGAINST LOSS OF GROUND
- VERY LOW STAND-BY CURRENT
- REVERSE BATTERY PROTECTION (*)



PowerSO-10™ **P^2PAK** **PPAK**



PENTAWATT **SO-16L**

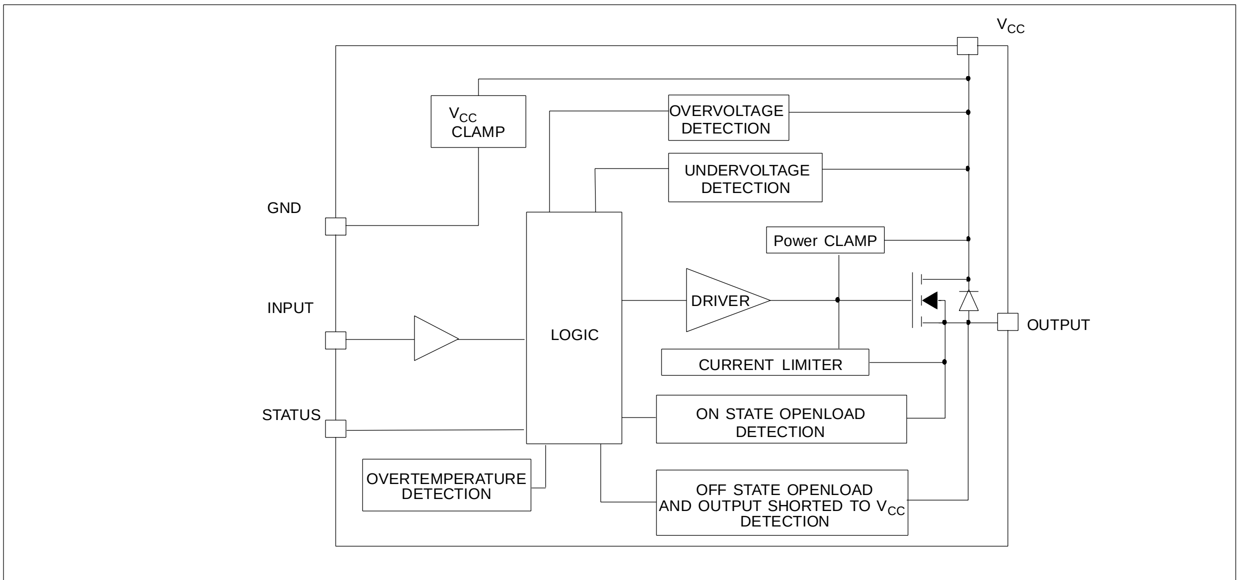
ORDER CODES		
PACKAGE	**TUBE**	**T&R**
PENTAWATT	VN820	-
PowerSO-10™	VN820SP	VN820SP13TR
P^2PAK	VN820-B5	VN820-B513TR
SO-16L	VN820SO	VN820SO13TR
PPAK	VN820PT	VN820PT13TR

DESCRIPTION

The VN820, VN820SP, VN820-B5, VN820SO, VN820PT 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 (see ISO7637 transient compatibility table). Active current limitation combined with thermal shutdown and automatic restart protect the device against overload.

The device detects open load condition both is on and off state. Output shorted to V_{CC} is detected in the off state. Device automatically turns off in case of ground pin disconnection.

BLOCK DIAGRAM

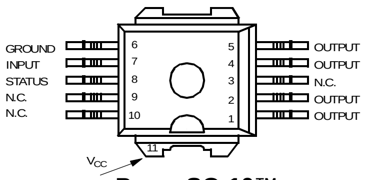


(*) See application schematic at page 9

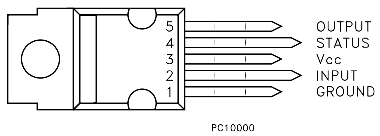
ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value					Unit
		PowerSO-10™	PENTAWATT	P^2PAK	SO-16L	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	- 9					A
I_{IN}	DC Input Current	+/- 10					mA
I_{STAT}	DC Status Current	+/- 10					mA
V_{ESD}	Electrostatic Discharge (Human Body Model: R=1.5KΩ; C=100pF) - INPUT - STATUS - OUTPUT - V_{CC}	 4000 4000 5000 5000					 V V V V
E_{MAX}	Maximum Switching Energy (L=4mH; R_L=0Ω; V_{bat}=13.5V; T_{jstart}=150ºC; I_L=13A)	481		481			mJ
E_{MAX}	Maximum Switching Energy (L=3.7mH; R_L=0Ω; V_{bat}=13.5V; T_{jstart}=150ºC; I_L=13A)				438		mJ
E_{MAX}	Maximum Switching Energy (L=4.48mH; R_L=0Ω; V_{bat}=13.5V; T_{jstart}=150ºC; I_L=13A)					526	mJ
P_{tot}	Power Dissipation T_C=25°C	65.8	65.8	65.8	8.3	65.8	W
T_j	Junction Operating Temperature	Internally Limited					°C
T_c	Case Operating Temperature	- 40 to 150					°C
T_{stg}	Storage Temperature	- 55 to 150					°C

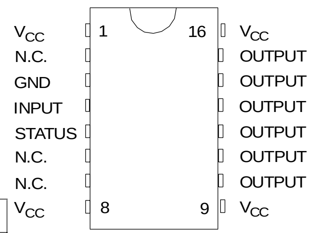
CONFIGURATION DIAGRAM (TOP VIEW) & SUGGESTED CONNECTIONS FOR UNUSED AND N.C. PINS



PowerSO-10™



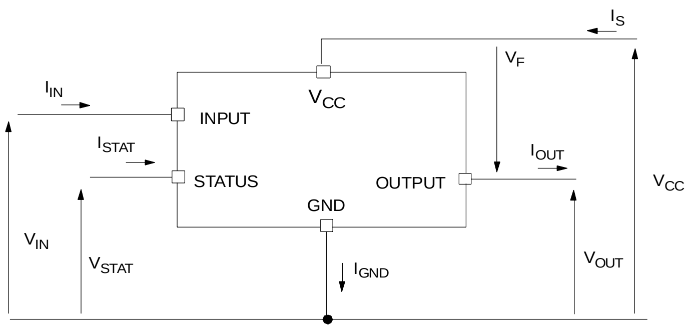
PPAK / P^2PAK / PENTAWATT



SO-16L

Connection / Pin	Status	N.C.	Output	Input
Floating	X	X	X	X
To Ground		X		Through 10KΩ resistor

CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

Symbol	Parameter		Value					Unit
			PowerSO-10	PENTAWATT	P^2PAK	SO-16L	PPAK	
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.9	1.9	1.9	-	1.9	°C/W
$R_{thj-lead}$	Thermal Resistance Junction-lead	Max	-	-	-	15	-	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	51.9 (1)	61.9 (1)	51.9 (1)	65 (2)	76.9 (1)	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	37 (3)	-	37 (3)	48 (4)	45 (3)	°C/W

(1) When mounted on a standard single-sided FR-4 board with 0.5cm² of Cu (at least 35µm thick).
(2) When mounted on FR4 printed circuit board with 0.5cm² of Cu (at least 35µ thick) connected to all V_{CC} pins.
(3) When mounted on a standard single-sided FR-4 board with 6cm² of Cu (at least 35µm thick).
(4) When mounted on FR4 printed circuit board with 6cm² of Cu (at least 35µ thick) connected to all V_{CC} pins.

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	13	36	V
V_{USD}	Undervoltage Shut-down		3	4	5.5	V
$V_{USDhyst}$	Undervoltage Shut-down hysteresis			0.5		V
V_{OV}	Overvoltage Shut-down		36			V
R_{ON}	On State Resistance	I_{OUT}=3A; T_j=25°C; V_{CC}>8V I_{OUT}=3A; V_{CC}>8V			40 80	mΩ mΩ
I_S	Supply Current	Off State; V_{CC}=13V; V_{IN}=V_{OUT}=0V Off State; V_{CC}=13V; V_{IN}=V_{OUT}=0V; T_j=25°C On State; V_{CC}=13V; V_{IN}=5V; I_{OUT}=0A		10 10 2	25 20 3.5	µA µA 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}=0V; V_{OUT}=3.5V	-75		0	µA
$I_{L(off3)}$	Off State Output Current	V_{IN}=V_{OUT}=0V; Vcc=13V; T_j =125°C			5	µA
$I_{L(off4)}$	Off State Output Current	V_{IN}=V_{OUT}=0V; Vcc=13V; T_j =25°C			3	µA

SWITCHING (V_{CC}=13V)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on Delay Time	R_L=4.3Ω from V_{IN} rising edge to V_{OUT}=1.3V		30		µs
$t_{d(off)}$	Turn-off Delay Time	R_L=4.3Ω from V_{IN} falling edge to V_{OUT}=11.7V		30		µs
$dV_{OUT}/dt_{(on)}$	Turn-on Voltage Slope	R_L=4.3Ω from V_{OUT}=1.3 to V_{OUT}=10.4V		See relative diagram		V/µs
$dV_{OUT}/dt_{(off)}$	Turn-off Voltage Slope	R_L=4.3Ω from V_{OUT}=11.7 to V_{OUT}=1.3V		See relative diagram		V/µs

ELECTRICAL CHARACTERISTICS (continued)

INPUT PIN

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IL}	Input Low Level				1.25	V
I_{IL}	Low Level Input Current	V_{IN}=1.25V	1			µA
V_{IH}	Input High Level		3.25			V
I_{IH}	High Level Input Current	V_{IN}=3.25V			10	µA
$V_{I(hyst)}$	Input Hysteresis Voltage		0.5			V
V_{ICL}	Input Clamp Voltage	I_{IN}=1mA I_{IN}=-1mA	6	6.8 -0.7	8	V V

V_{CC} - OUTPUT DIODE

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_F	Forward on Voltage	$-I_{OUT}$=2A; T_j=150°C			0.6	V

STATUS PIN

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{STAT}	Status Low Output Voltage	I_{STAT}=1.6mA			0.5	V
I_{LSTAT}	Status Leakage Current	Normal Operation V_{STAT}=5V			10	µA
C_{STAT}	Status Pin Input Capacitance	Normal Operation V_{STAT}=5V			100	pF
V_{SCL}	Status Clamp Voltage	I_{STAT}=1mA I_{STAT}=-1mA	6	6.8 -0.7	8	V V

PROTECTIONS (see note 1)

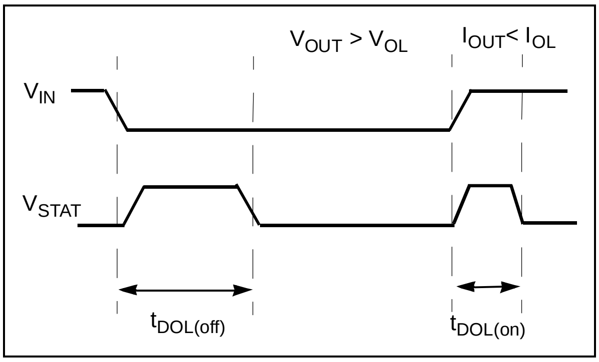
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
T_{TSD}	Shut-down Temperature		150	175	200	°C
T_R	Reset Temperature		135			°C
T_{hyst}	Thermal Hysteresis		7	15		°C
t_{SDL}	Status delay in overload condition	T_j>T_{TSD}			20	µs
I_{lim}	Current limitation	 5.5V<V_{CC}<36V	9	13	20 20	A A
V_{demag}	Turn-off Output Clamp Voltage	I_{OUT}=3A; V_{IN}=0V; L=6mH	V_{CC}-41	V_{CC}-48	V_{CC}-55	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 is subjected to abnormal conditions, this software must limit the duration and number of activation cycles

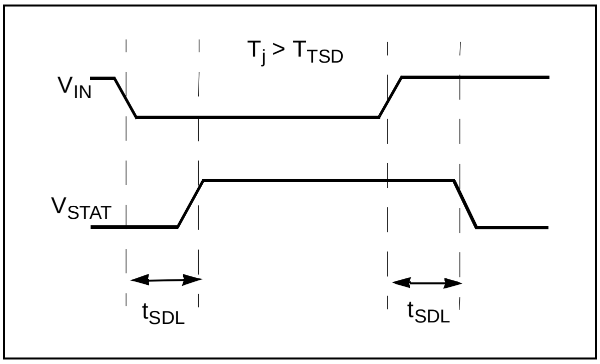
OPENLOAD DETECTION

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{OL}	Openload ON State Detection Threshold	V_{IN}=5V	70	150	300	mA
$t_{DOL(on)}$	Openload ON State Detection Delay	I_{OUT}=0A			200	µs
V_{OL}	Openload OFF State Voltage Detection Threshold	V_{IN}=0V	1.5	2.5	3.5	V
$t_{DOL(off)}$	Openload Detection Delay at Turn Off				1000	µs

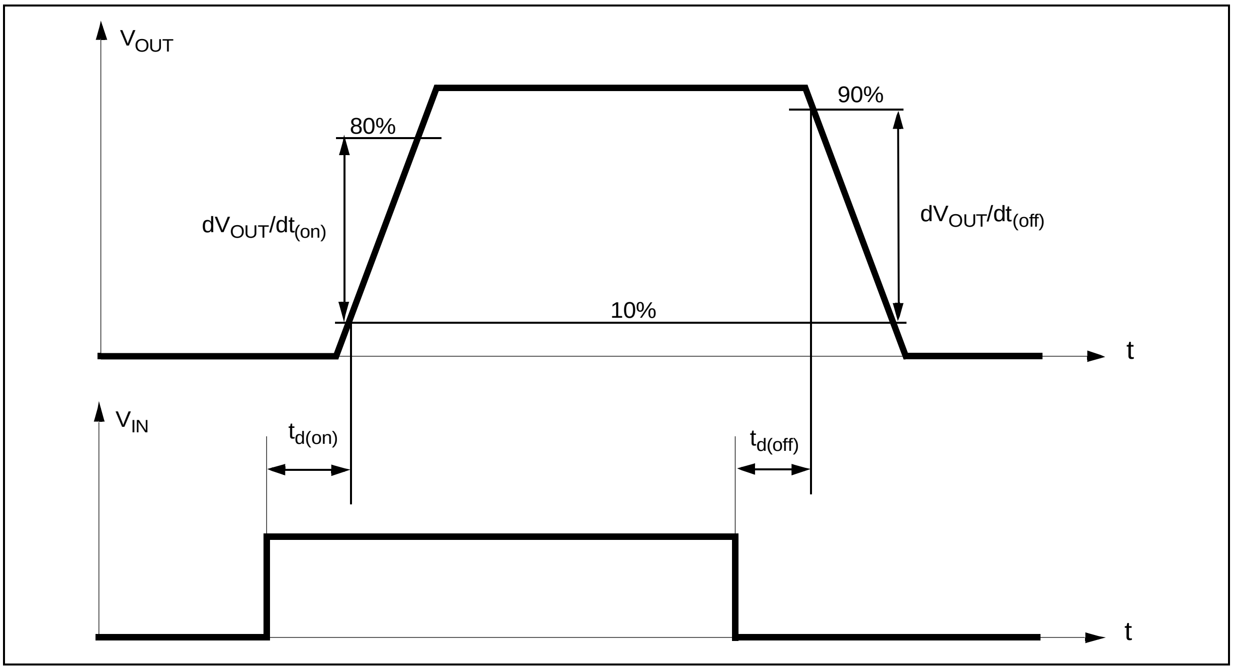
OPEN LOAD STATUS TIMING (with external pull-up)



OVERTEMP STATUS TIMING



SWITCHING TIME WAVEFORMS



TRUTH TABLE

CONDITIONS	INPUT	OUTPUT	STATUS
Normal Operation	L H	L H	H H
Current Limitation	L H H	L X X	H ($T_j < T_{TSD}$) H ($T_j > T_{TSD}$) L
Overtemperature	L H	L L	H L
Undervoltage	L H	L L	X X
Overvoltage	L H	L L	H H
Output Voltage > V_{OL}	L H	H H	L H
Output Current < I_{OL}	L H	L H	H L

OPEN LOAD DETECTION IN OFF STATE

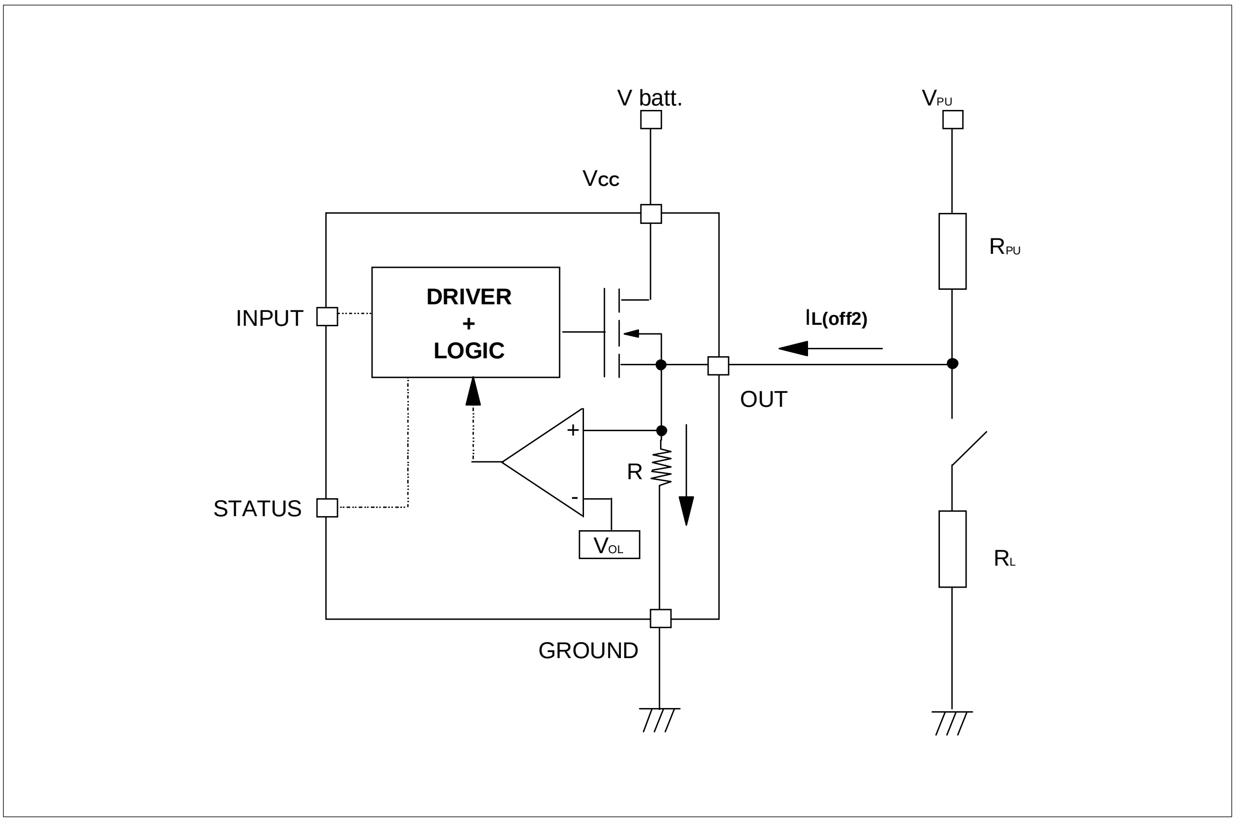
Off state open load detection requires an external pull-up resistor (R_{PU}) connected between OUTPUT pin and a positive supply voltage (V_{PU}) like the +5V line used to supply the microprocessor.
The external resistor has to be selected according to the following requirements:

1) no false open load indication when load is connected: in this case we have to avoid V_{OUT} to be higher than V_{Olmin}; this results in the following condition $V_{OUT}=(V_{PU}/(R_L+R_{PU}))R_L<V_{Olmin}$.

2) no misdetection when load is disconnected: in this case the V_{OUT} has to be higher than V_{OLmax}; this results in the following condition $R_{PU}<(V_{PU}-V_{OLmax})/I_{L(off2)}$.

Because $I_{s(OFF)}$ may significantly increase if V_{out} is pulled high (up to several mA), the pull-up resistor R_{PU} should be connected to a supply that is switched OFF when the module is in standby.
The values of V_{OLmin}, V_{OLmax} and $I_{L(off2)}$ are available in the Electrical Characteristics section.

Open Load detection in off state



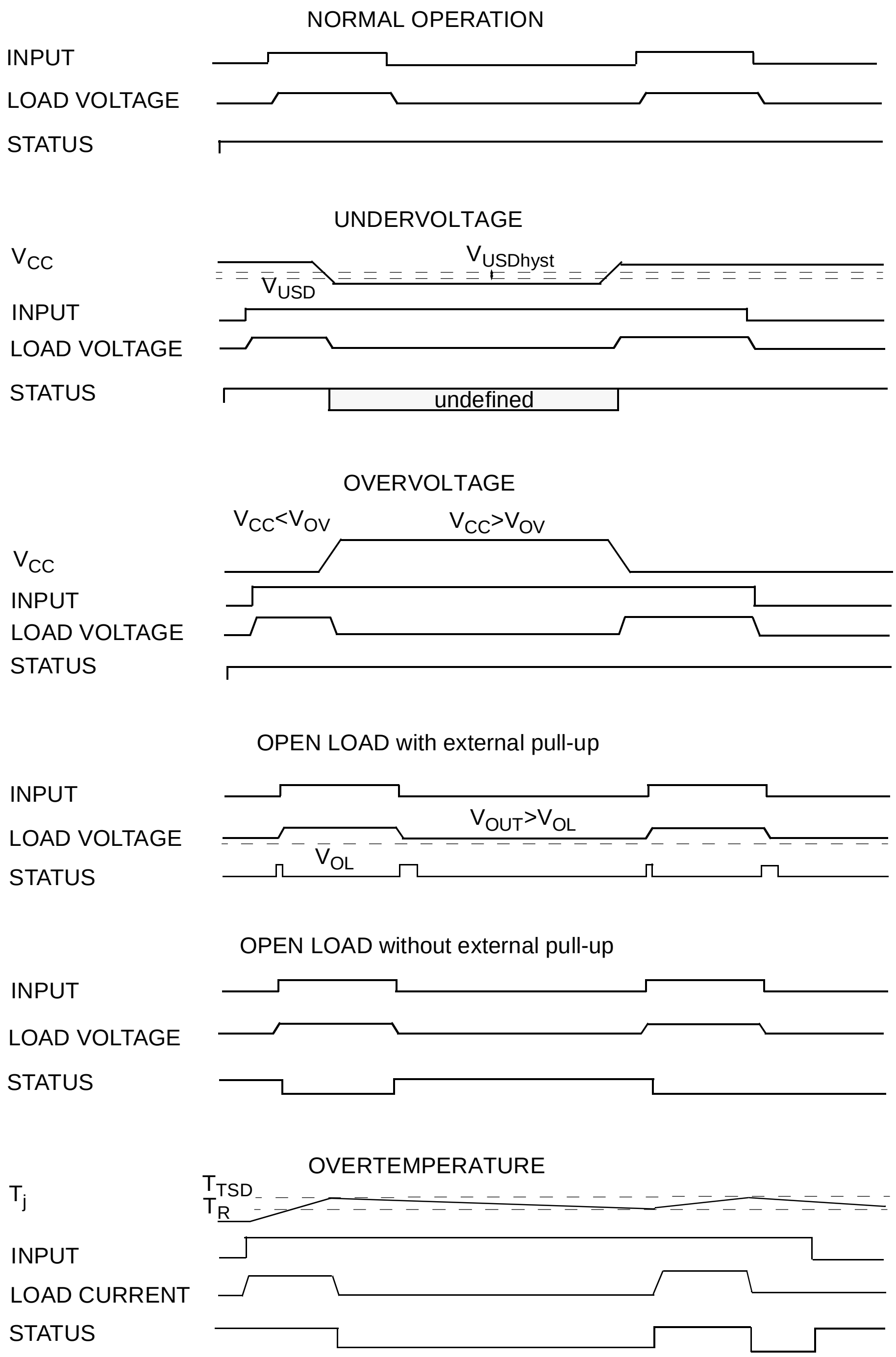
ELECTRICAL TRANSIENT REQUIREMENTS ON V_{CC} PIN

ISO T/R 7637/1 Test Pulse	TEST LEVELS				
	I	II	III	IV	Delays and Impedance
1	-25 V	-50 V	-75 V	-100 V	2 ms 10 Ω
2	+25 V	+50 V	+75 V	+100 V	0.2 ms 10 Ω
3a	-25 V	-50 V	-100 V	-150 V	0.1 µs 50 Ω
3b	+25 V	+50 V	+75 V	+100 V	0.1 µs 50 Ω
4	-4 V	-5 V	-6 V	-7 V	100 ms, 0.01 Ω
5	+26.5 V	+46.5 V	+66.5 V	+86.5 V	400 ms, 2 Ω

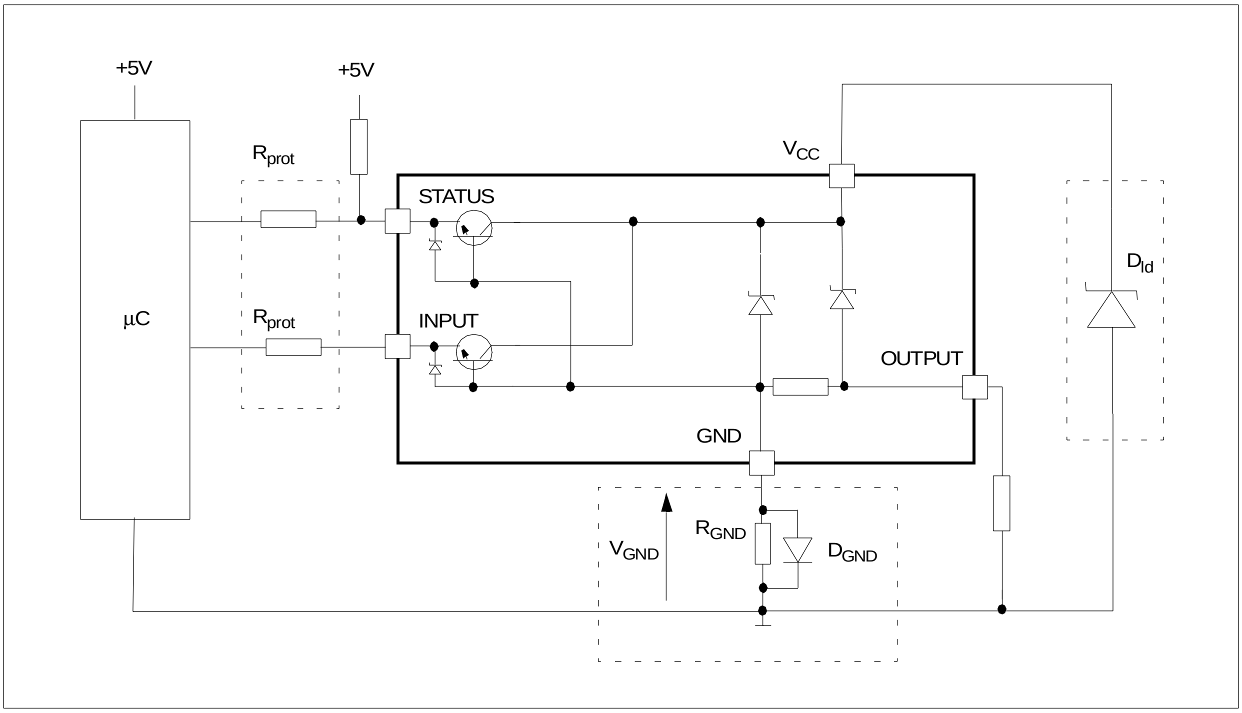
ISO T/R 7637/1 Test Pulse	TEST LEVELS RESULTS			
	I	II	III	IV
1	C	C	C	C
2	C	C	C	C
3a	C	C	C	C
3b	C	C	C	C
4	C	C	C	C
5	C	E	E	E

CLASS	CONTENTS
C	All functions of the device are performed as designed after exposure to disturbance.
E	One or more functions of the device is not performed as designed after exposure to disturbance and cannot be returned to proper operation without replacing the device.

Figure 1: Waveforms



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) $R_{GND} \leq 600mV / (I_{S(on)max})$.

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}=1kΩ) 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 (≃600mV) 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.

LOAD DUMP PROTECTION

D_{ld} is necessary (Voltage Transient Suppressor) if the load dump peak voltage exceeds V_{CC} max DC rating. The same applies if the device will be subject to transients on the V_{CC} line that are greater than the ones shown in the ISO T/R 7637/1 table.

µC I/Os PROTECTION:

If a ground protection network is used and negative transient 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.

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

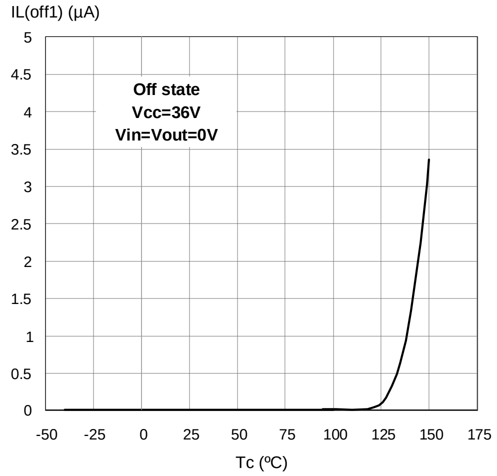
Calculation example:

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

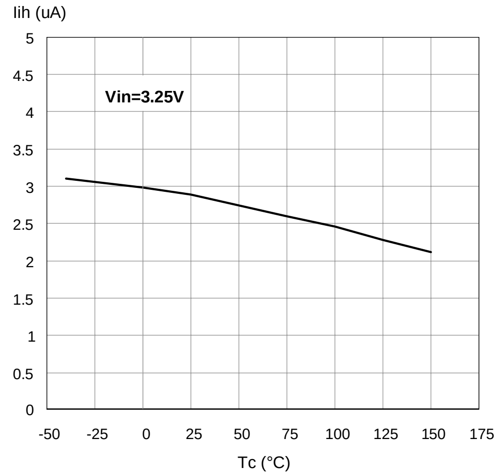
5kΩ ≤ R_{prot} ≤ 65kΩ.

Recommended R_{prot} value is 10kΩ.

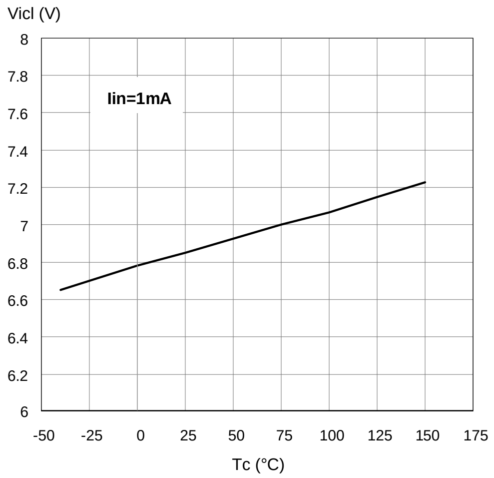
Off State Output Current



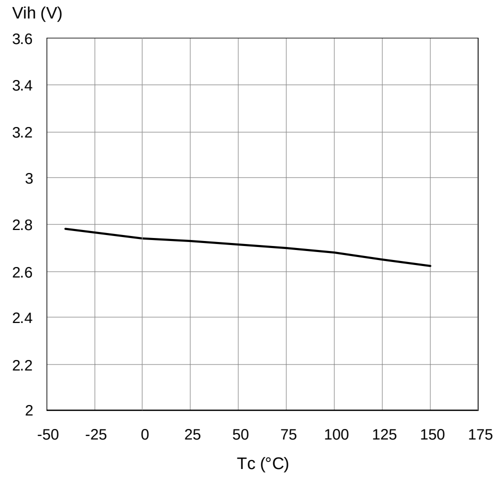
High Level Input Current



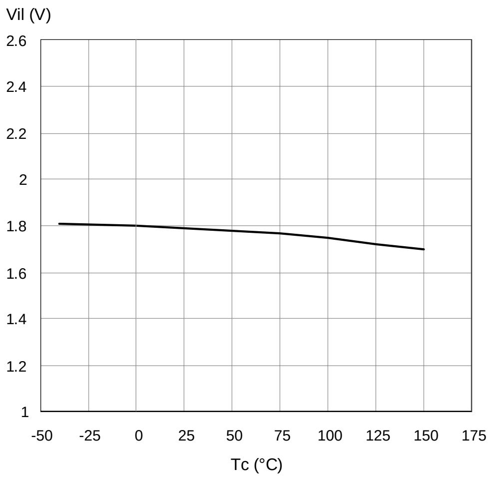
Input Clamp Voltage



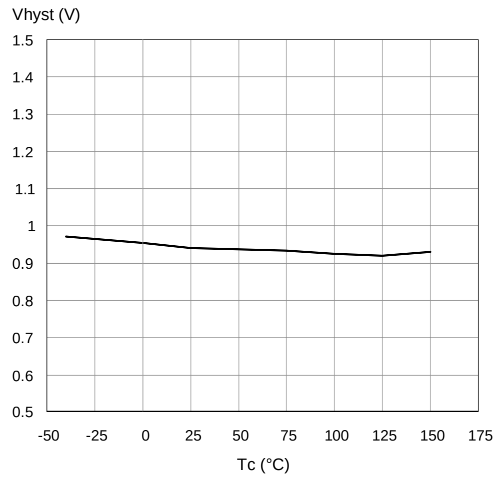
Input High Level



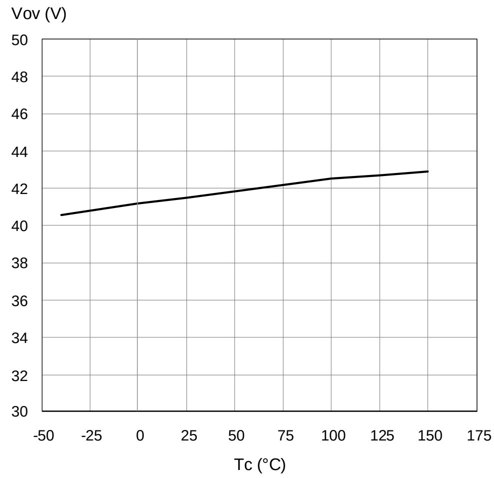
Input Low Level



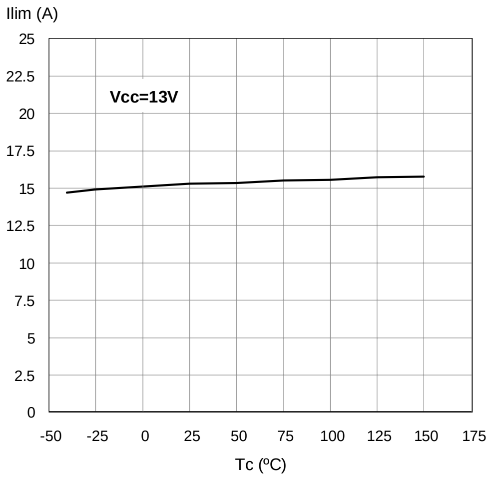
Input Hysteresis Voltage



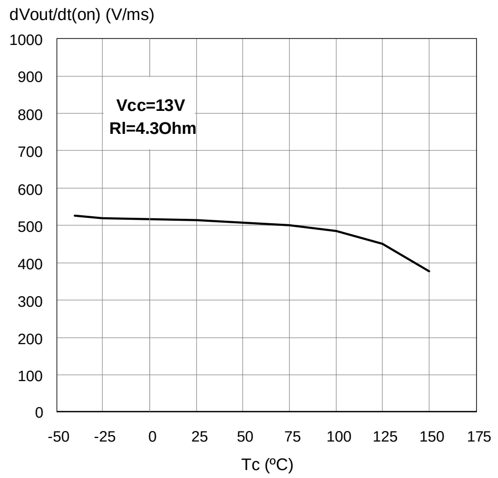
Overvoltage Shutdown



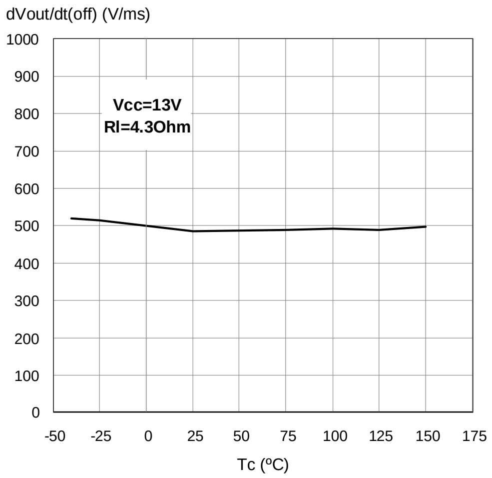
I_{LIM} Vs T_{case}



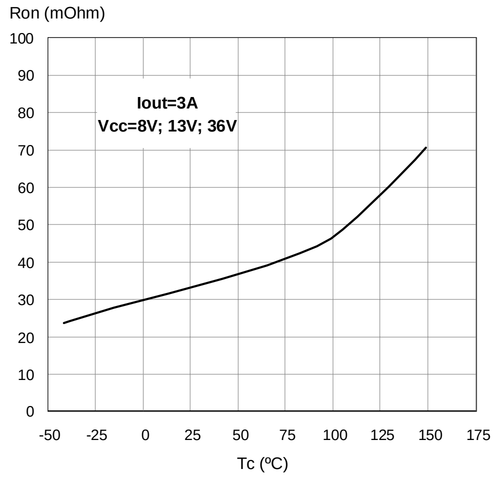
Turn-on Voltage Slope



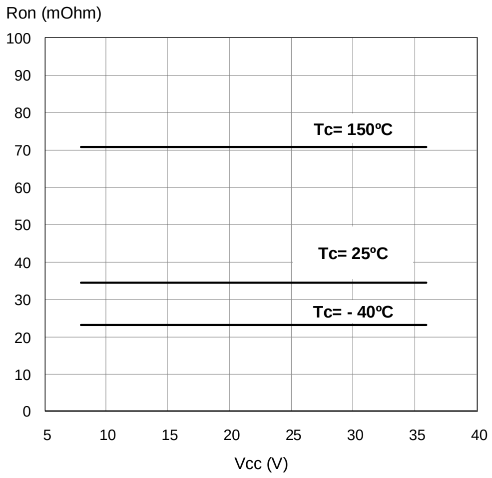
Turn-off Voltage Slope



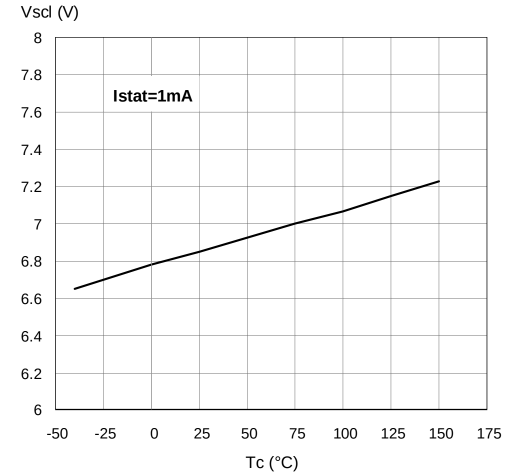
On State Resistance Vs T_{case}



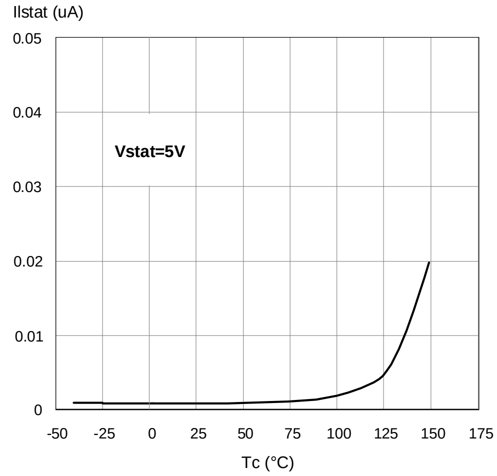
On State Resistance Vs V_{CC}



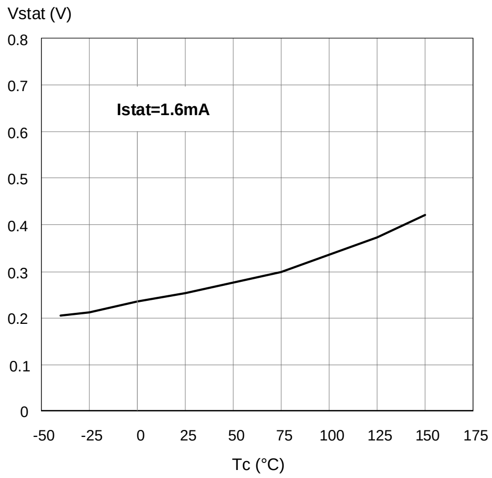
Status Clamp Voltage



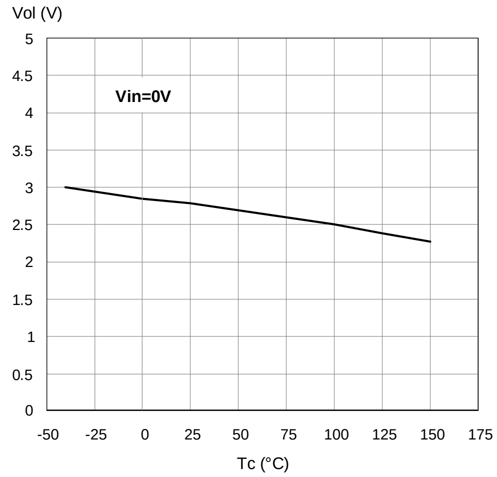
Status Leakage Current



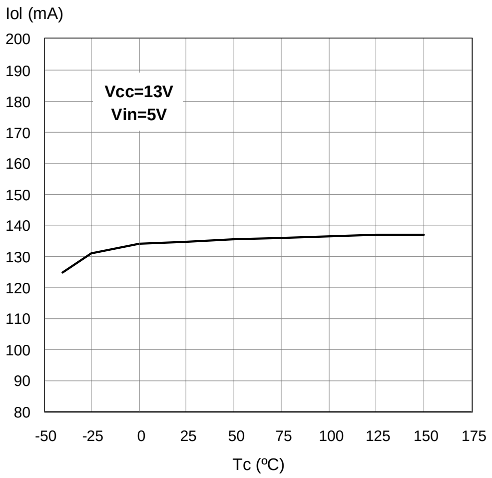
Status Low Output Voltage



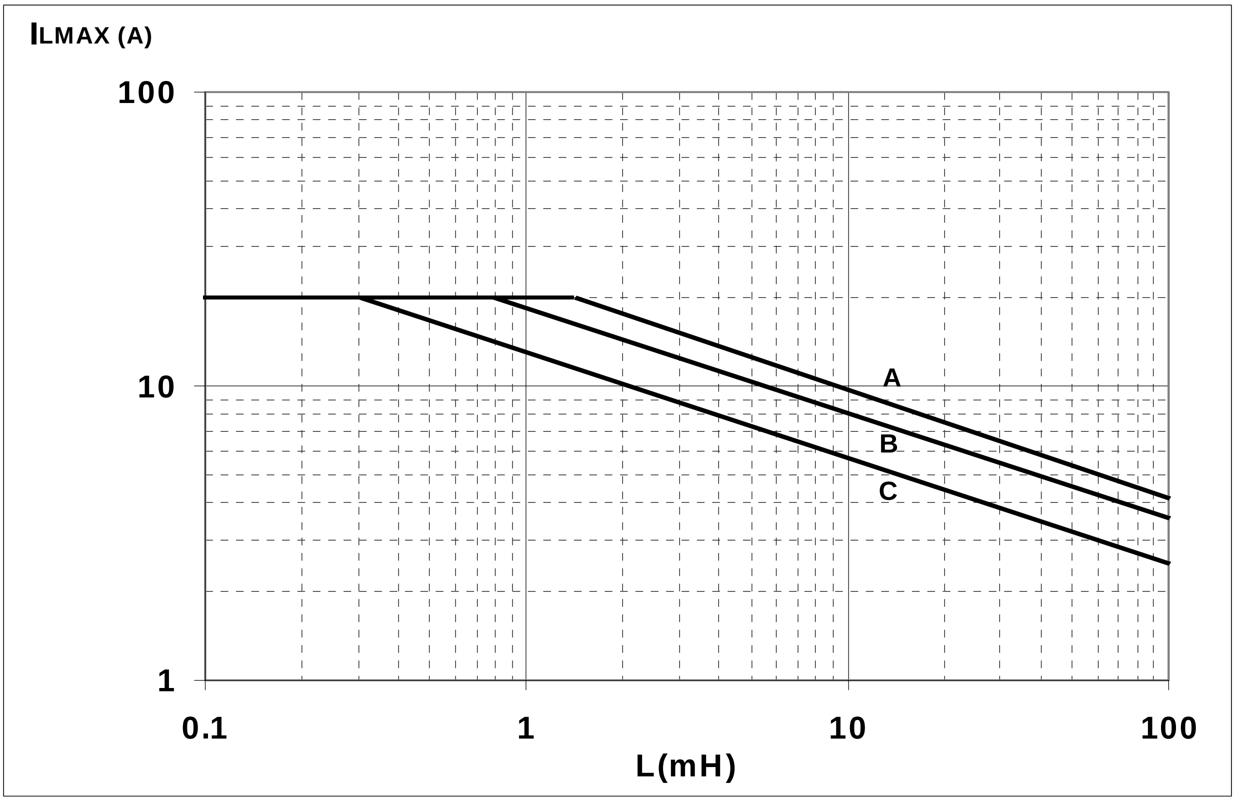
Open Load Off State Voltage Detection Threshold



Open Load On State Detection Threshold



PowerSO-10, P²PAK, PENTAWATT Maximum turn off current versus load inductance



A = Single Pulse at T_{Jstart}=150ºC

B= Repetitive pulse at T_{Jstart}=100ºC

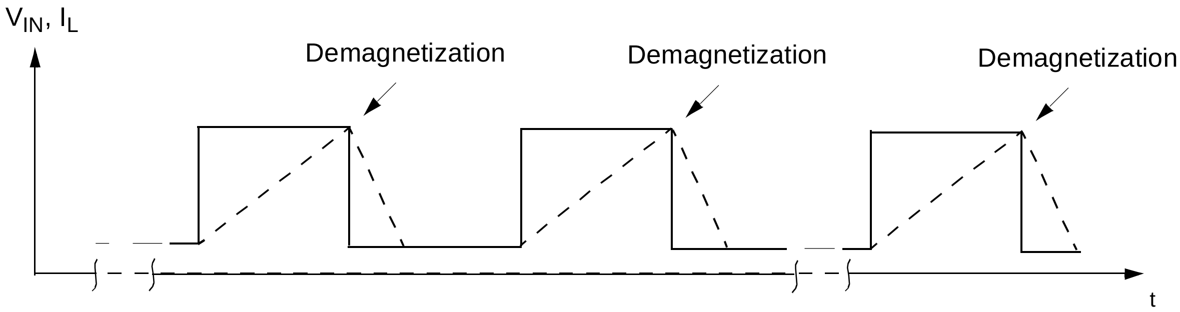
C= Repetitive Pulse at T_{Jstart}=125ºC

<u>Conditions:</u>

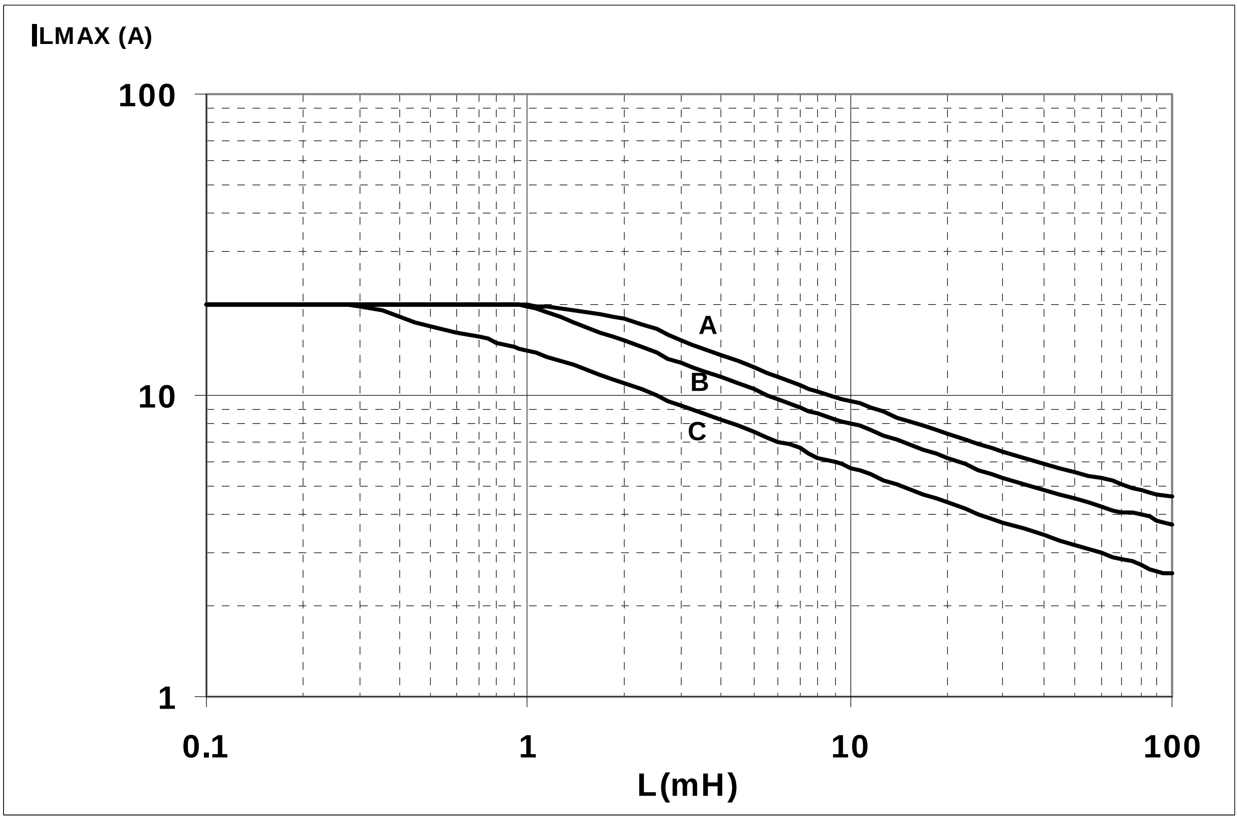
V_{CC}=13.5V

Values are generated with R_L=0Ω

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.



PPAK Maximum turn off current versus load inductance



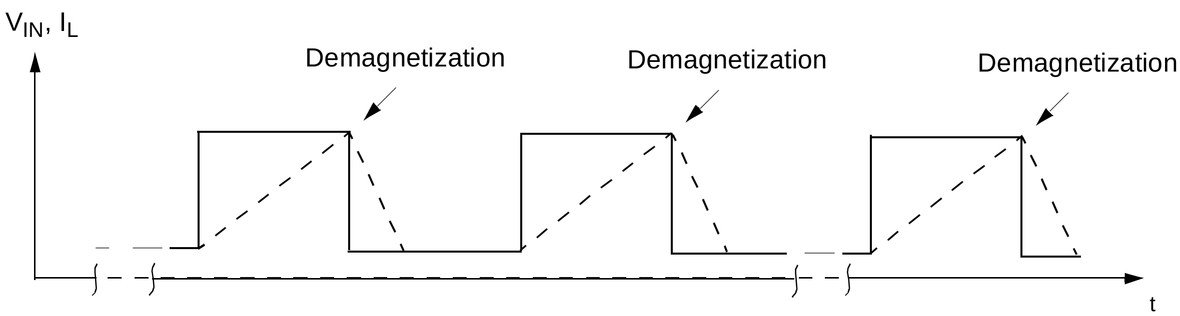
A = Single Pulse at T_{Jstart}=150ºC
B= Repetitive pulse at T_{Jstart}=100ºC
C= Repetitive Pulse at T_{Jstart}=125ºC

Conditions:

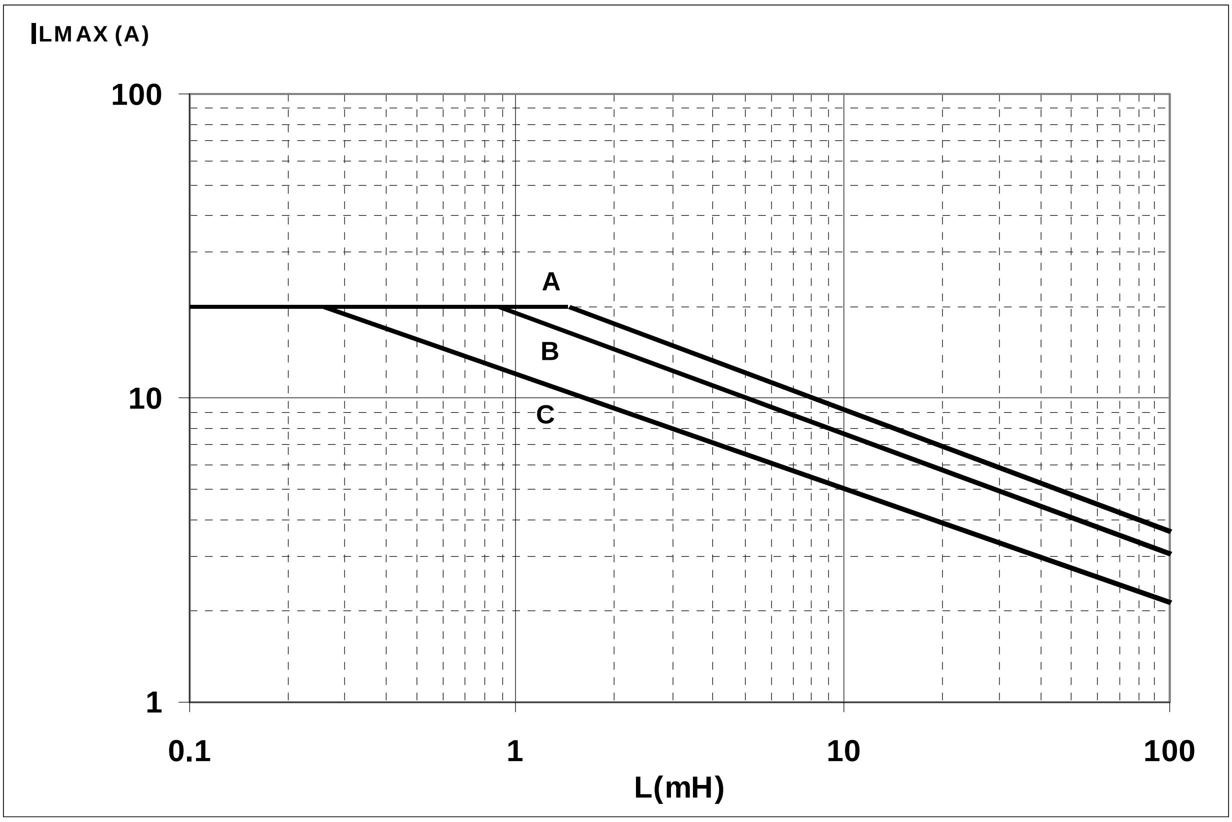
V_{CC}=13.5V

Values are generated with R_L=0Ω

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-16L Maximum turn off current versus load inductance



A = Single Pulse at T_{Jstart}=150ºC

B= Repetitive pulse at T_{Jstart}=100ºC

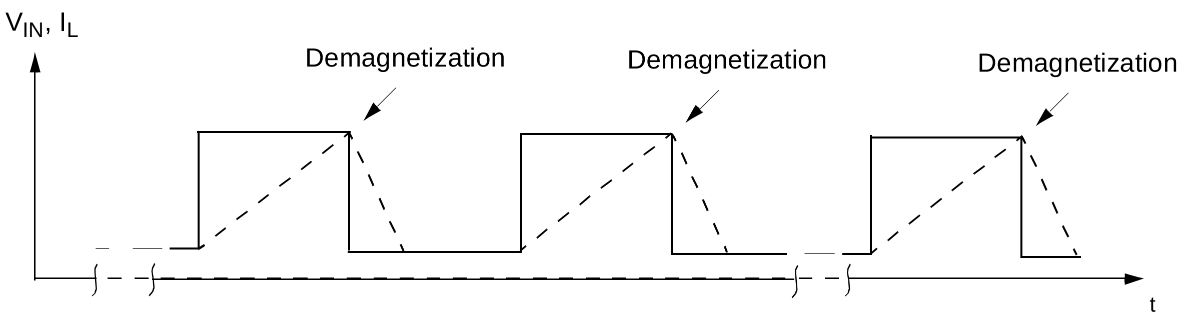
C= Repetitive Pulse at T_{Jstart}=125ºC

<u>Conditions:</u>

V_{CC}=13.5V

Values are generated with R_L=0Ω

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.

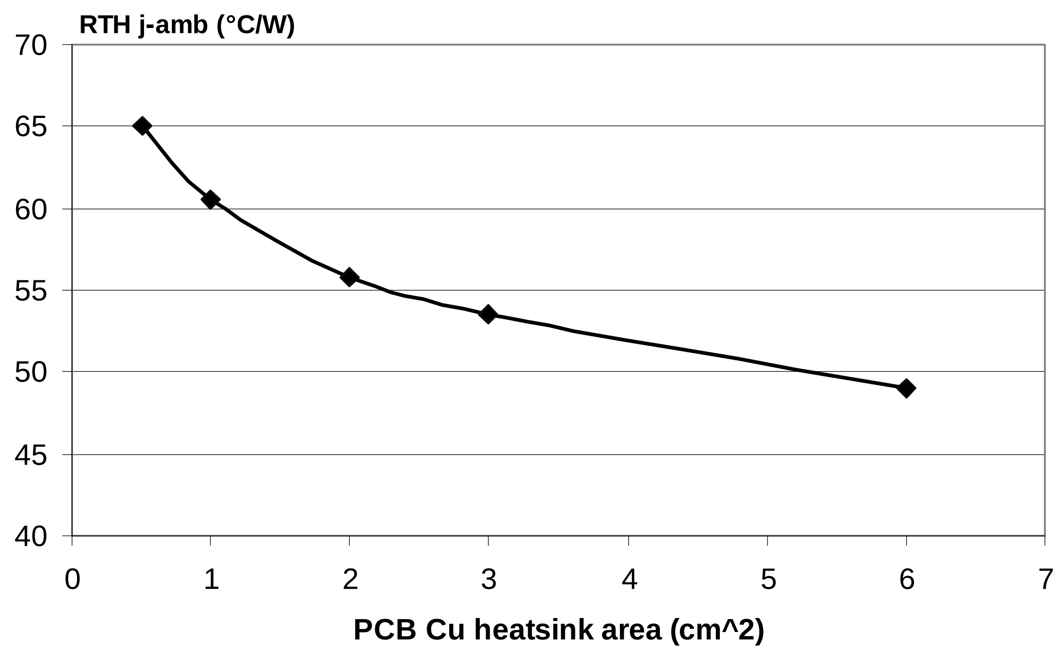


SO-16L THERMAL DATA

SO-16L PC Board

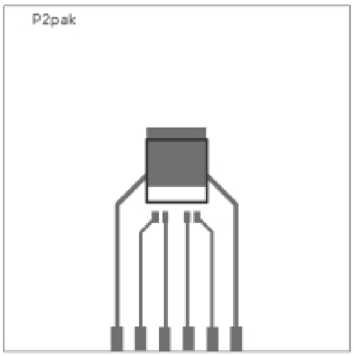
Layout condition of R_{th} and Z_{th} measurements (PCB FR4 area= 41mm x 48mm, PCB thickness=2mm, Cu thickness=35µm, Copper areas: 0.5cm^2, 6cm^2).

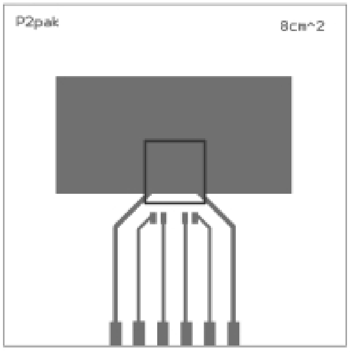
$R_{thj-amb}$ Vs PCB copper area in open box free air condition



P^2PAK THERMAL DATA

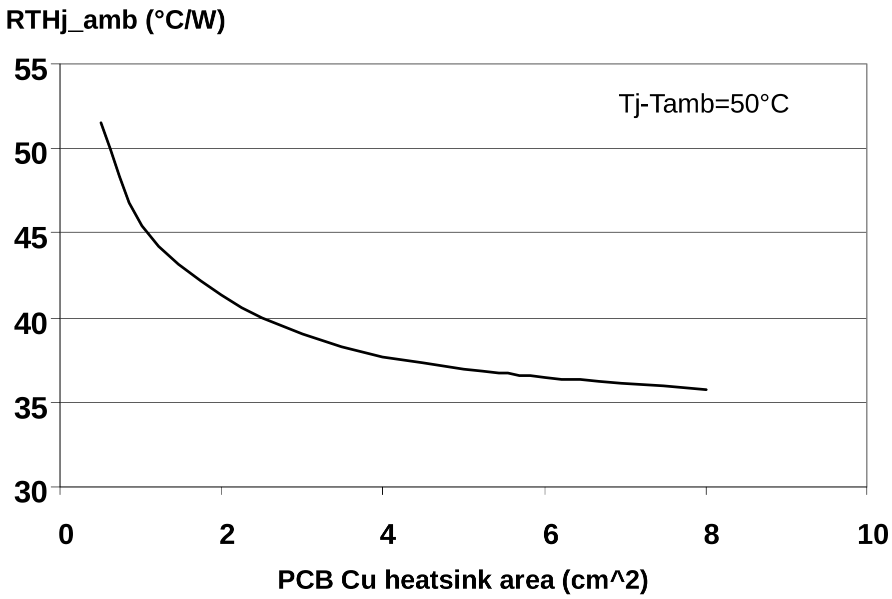
P^2PAK PC Board





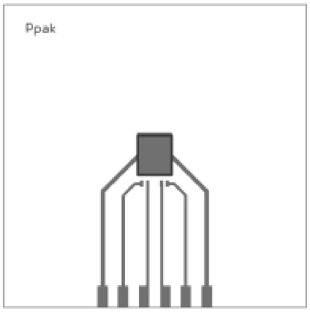
Layout condition of R_{th} and Z_{th} measurements (PCB FR4 area= 60mm x 60mm, PCB thickness=2mm, Cu thickness=35µm, Copper areas: 0.97cm^2, 8cm^2).

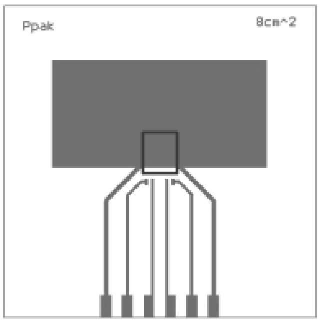
$R_{thj\text{-}amb}$ Vs PCB copper area in open box free air condition



PPAK THERMAL DATA

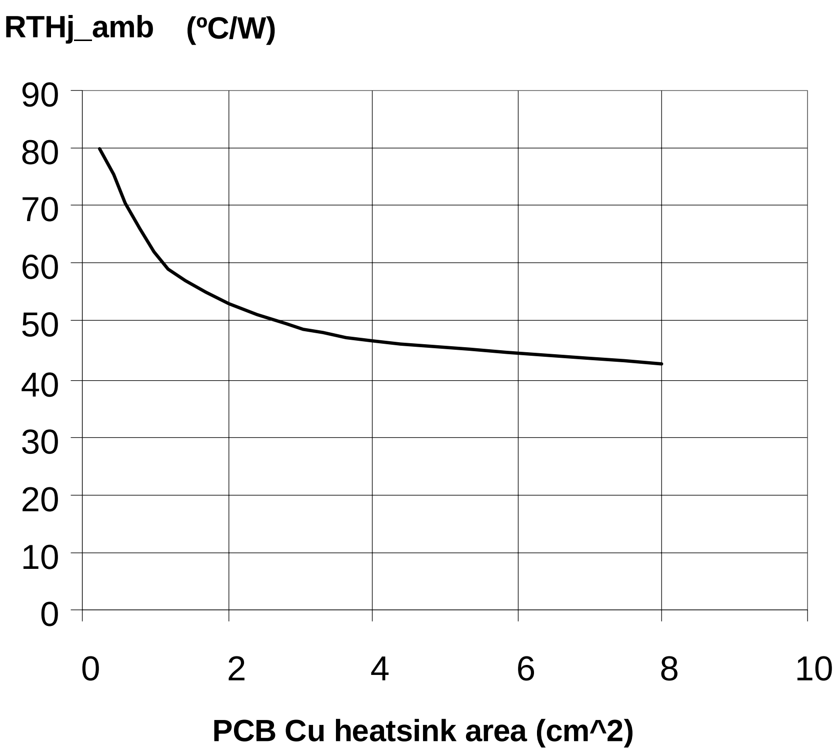
PPAK PC Board





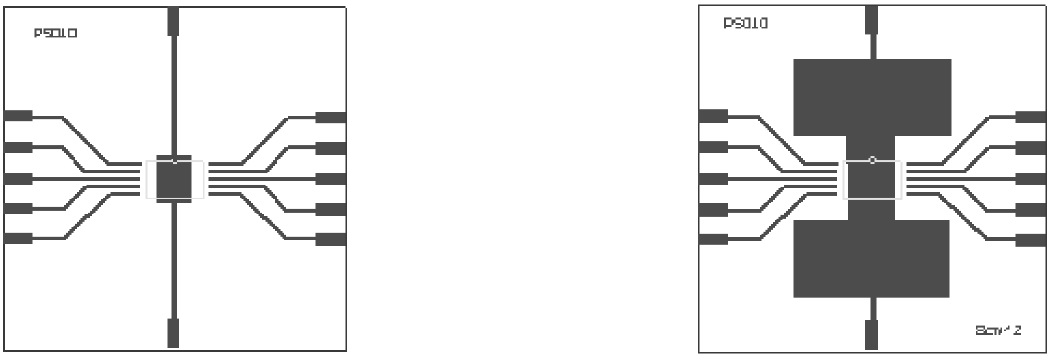
Layout condition of R_{th} and Z_{th} measurements (PCB FR4 area= 60mm x 60mm, PCB thickness=2mm, Cu thickness=35µm, Copper areas: 0.44cm^2, 8cm^2).

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



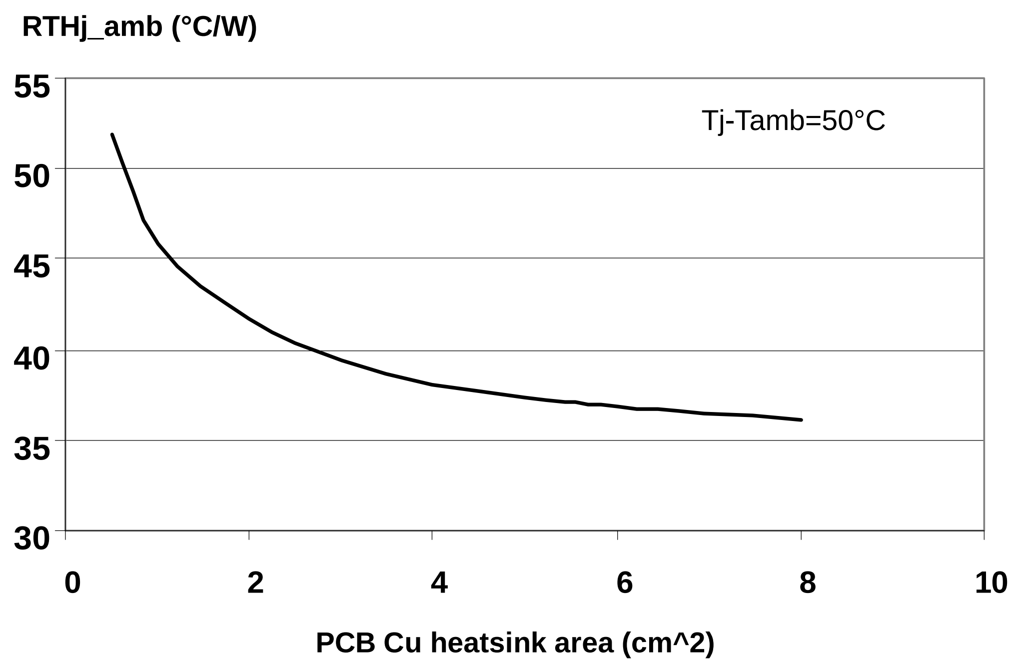
PowerSO-10™ THERMAL DATA

PowerSO-10™ PC Board

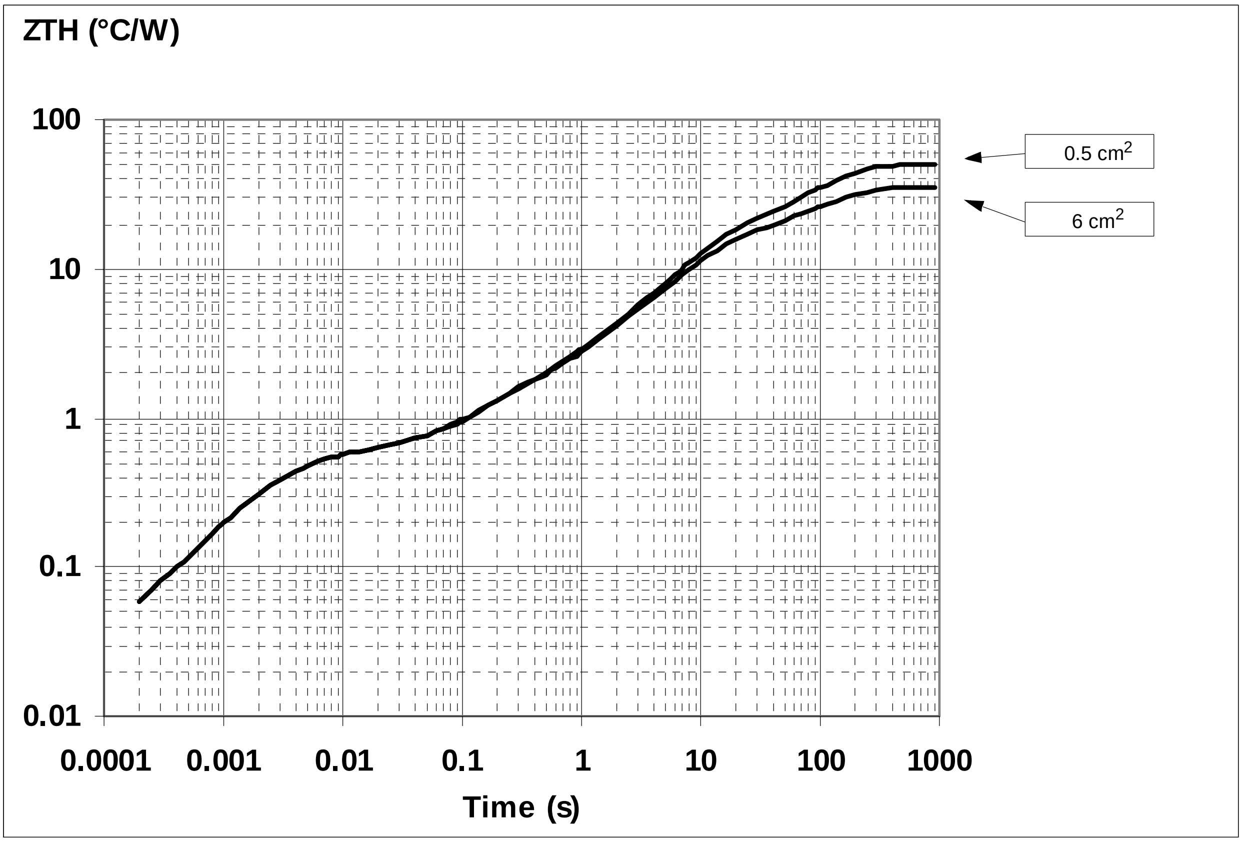


Layout condition of R_{th} and Z_{th} measurements (PCB FR4 area= 58mm x 58mm, PCB thickness=2mm, Cu thickness=35µm, Copper areas: from minimum pad lay-out to 8cm^2).

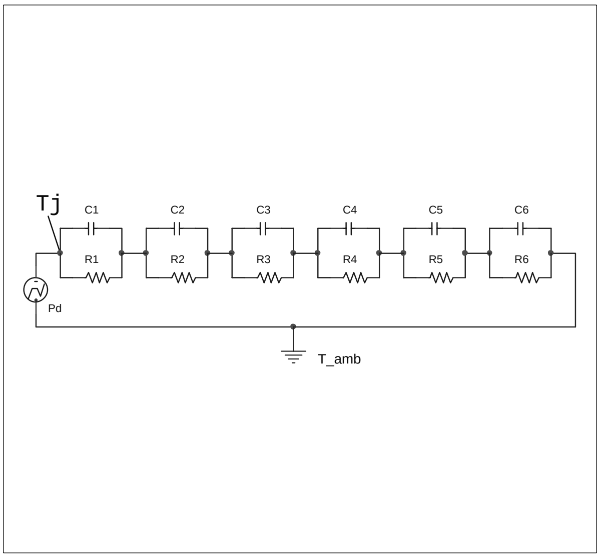
$R_{thj-amb}$ Vs PCB copper area in open box free air condition



PowerSO-10 Thermal Impedance Junction Ambient Single Pulse



Thermal fitting model of a single channel HSD in PowerSO-10



Pulse calculation formula

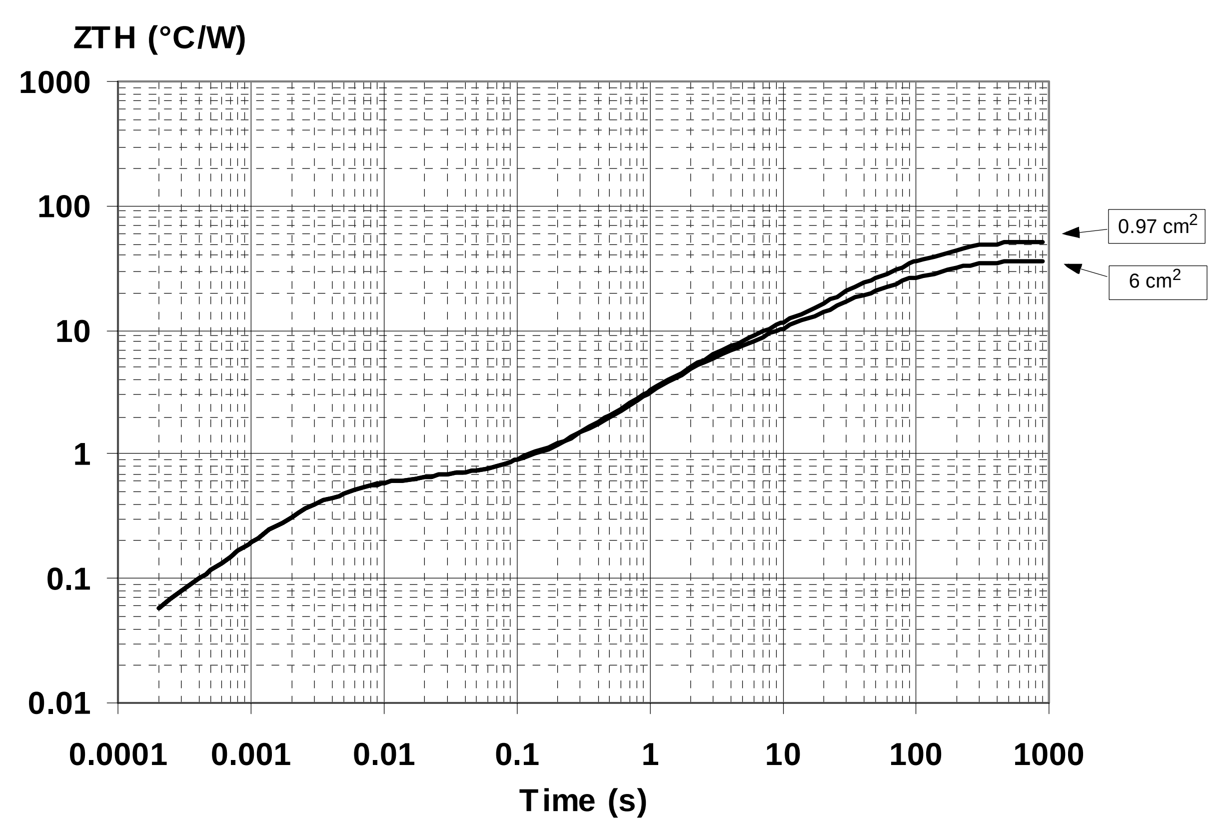
$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where $\delta = t_p / T$

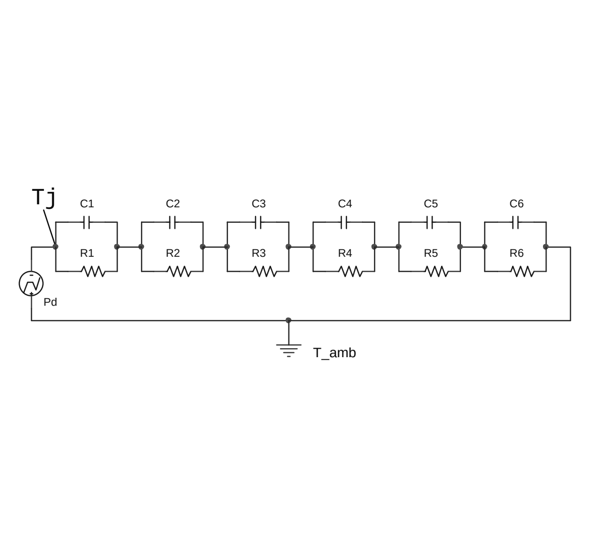
Thermal Parameter

Area/island (cm^2)	0.5	6
R1 (°C/W)	0.04	
R2 (°C/W)	0.25	
R3(°C/W)	0.25	
R4 (°C/W)	0.8	
R5 (°C/W)	12	
R6 (°C/W)	37	22
C1 (W.s/°C)	0.0008	
C2 (W.s/°C)	7.00E-03	
C3 (W.s/°C)	0.015	
C4 (W.s/°C)	0.3	
C5 (W.s/°C)	0.75	
C6 (W.s/°C)	3	5

P^2PAK Thermal Impedance Junction Ambient Single Pulse



Thermal fitting model of a single channel HSD in P^2PAK



Pulse calculation formula

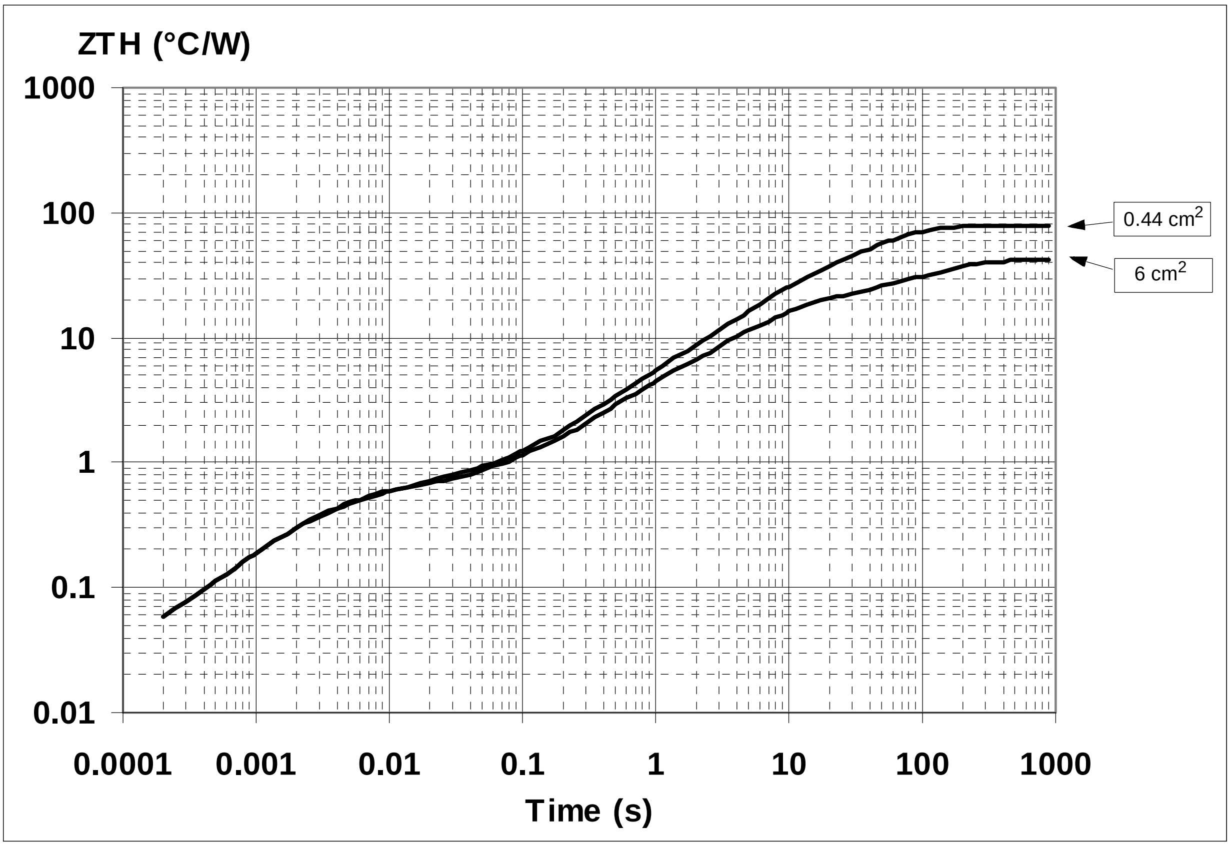
$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where $\delta = t_p / T$

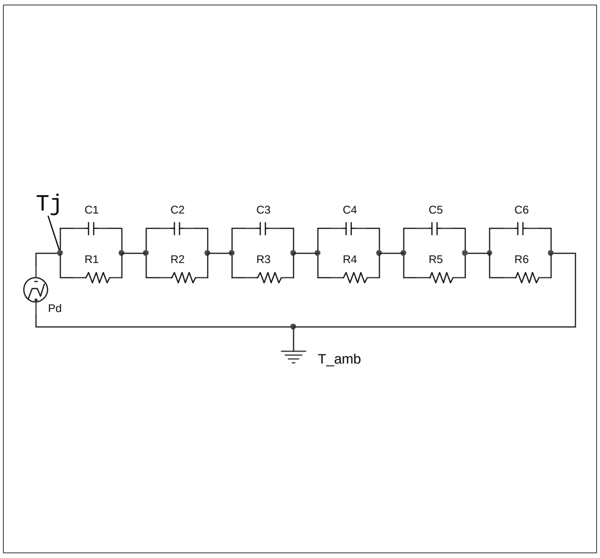
Thermal Parameter

Area/island (cm²)	0.97	6
R1 (°C/W)	0.04	
R2 (°C/W)	0.25	
R3(°C/W)	0.3	
R4 (°C/W)	4	
R5 (°C/W)	9	
R6 (°C/W)	37	22
C1 (W.s/°C)	0.0008	
C2 (W.s/°C)	0.007	
C3 (W.s/°C)	0.015	
C4 (W.s/°C)	0.4	
C5 (W.s/°C)	2	
C6 (W.s/°C)	3	5

PPAK Thermal Impedance Junction Ambient Single Pulse



Thermal fitting model of a single channel HSD in PPAK



Pulse calculation formula

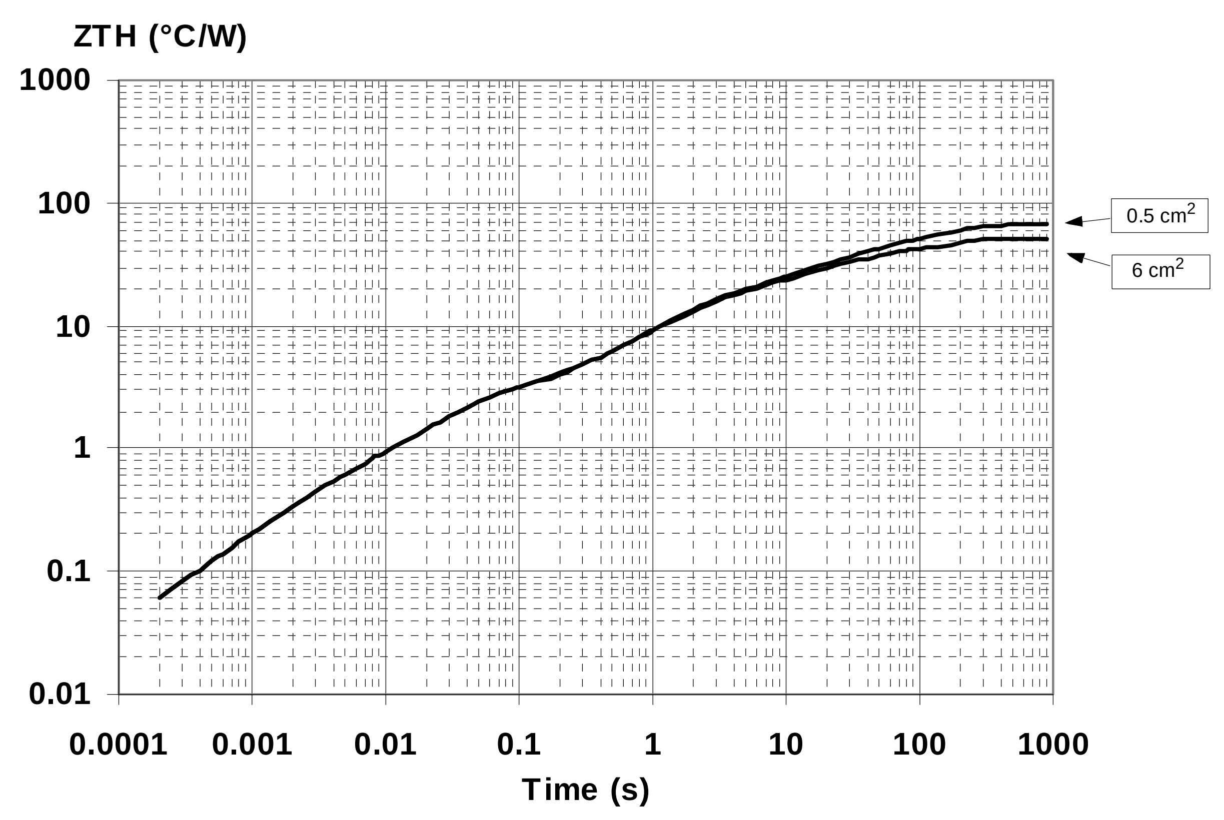
$$Z_{TH\delta} = R_{TH} \cdot \delta + Z_{THtp}(1 - \delta)$$

where $\delta = t_p / T$

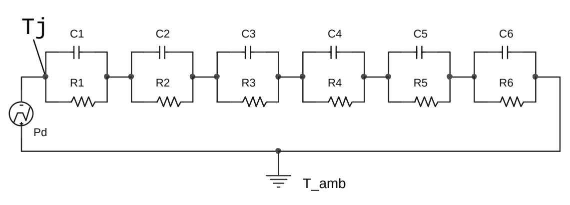
Thermal Parameter

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-16L Thermal Impedance Junction Ambient Single Pulse



Thermal fitting model of a single channel HSD in SO-16L



Pulse calculation formula

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

where $\delta = t_p / T$

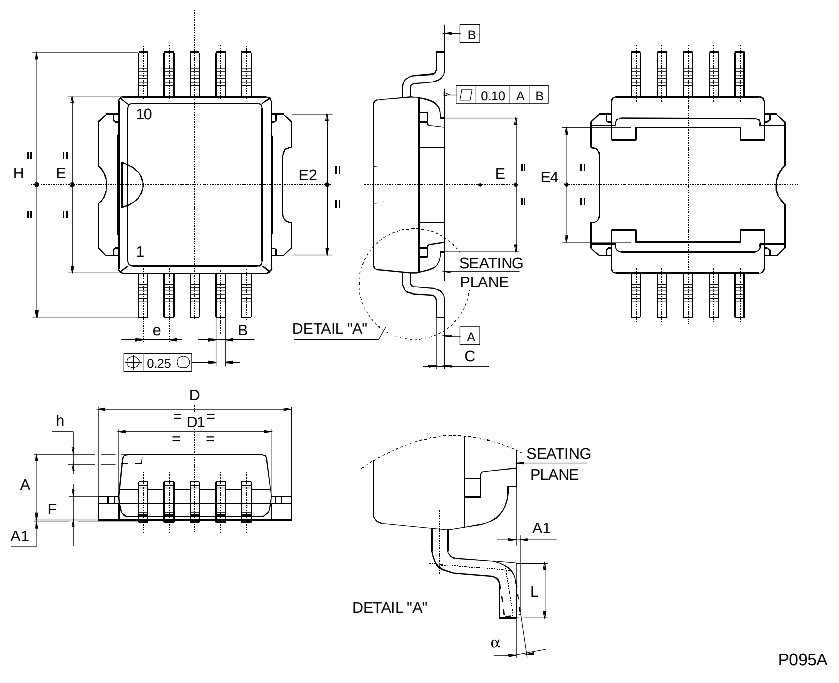
Thermal Parameter

Area/island (cm^2)	0.5	6
R1 (°C/W)	0.04	
R2 (°C/W)	0.25	
R3(°C/W)	2.2	
R4 (°C/W)	12	
R5 (°C/W)	15	
R6 (°C/W)	37	22
C1 (W.s/°C)	0.0008	
C2 (W.s/°C)	7.00E-03	
C3 (W.s/°C)	1.50E-02	
C4 (W.s/°C)	0.14	
C5 (W.s/°C)	1	
C6 (W.s/°C)	3	5

PowerSO-10™ MECHANICAL DATA

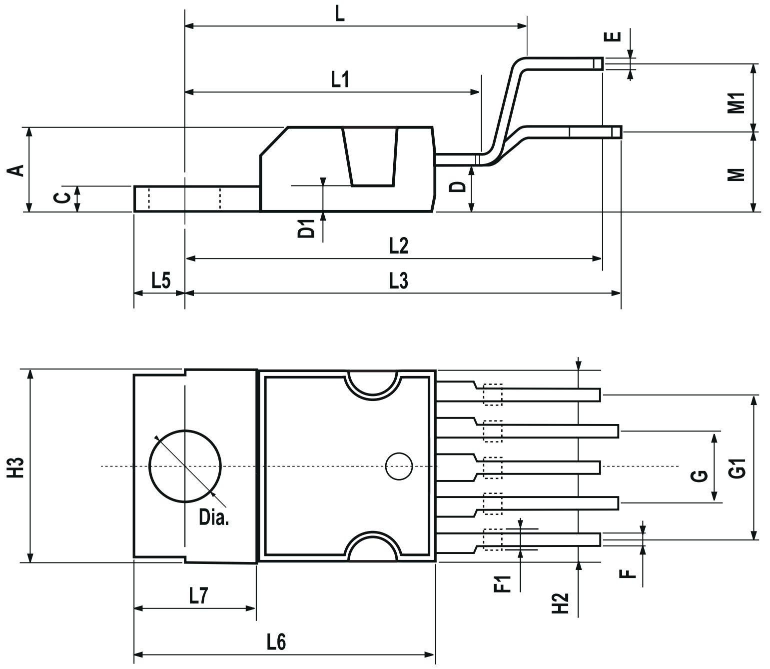
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	3.35		3.65	0.132		0.144
A (*)	3.4		3.6	0.134		0.142
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
B (*)	0.37		0.53	0.014		0.021
C	0.35		0.55	0.013		0.022
C (*)	0.23		0.32	0.009		0.0126
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E2	7.20		7.60	0.283		300
E2 (*)	7.30		7.50	0.287		0.295
E4	5.90		6.10	0.232		0.240
E4 (*)	5.90		6.30	0.232		0.248
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
F (*)	1.20		1.40	0.047		0.055
H	13.80		14.40	0.543		0.567
H (*)	13.85		14.35	0.545		0.565
h		0.50			0.002	
L	1.20		1.80	0.047		0.070
L (*)	0.80		1.10	0.031		0.043
α	0º		8º	0º		8º
α (*)	2º		8º	2º		8º

(*) Muar only POA P013P



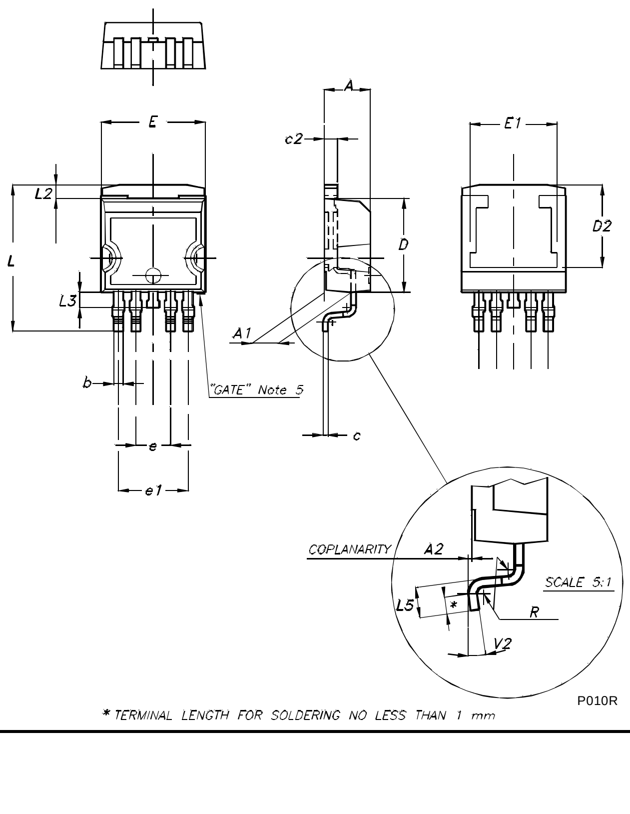
PENTAWATT (VERTICAL) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.8		1.05	0.031		0.041
F1	1		1.4	0.039		0.055
G	3.2	3.4	3.6	0.126	0.134	0.142
G1	6.6	6.8	7	0.260	0.268	0.276
H2			10.4			0.409
H3	10.05		10.4	0.396		0.409
L		17.85			0.703	
L1		15.75			0.620	
L2		21.4			0.843	
L3		22.5			0.886	
L5	2.6		3	0.102		0.118
L6	15.1		15.8	0.594		0.622
L7	6		6.6	0.236		0.260
M		4.5			0.177	
M1		4			0.157	
Diam.	3.65		3.85	0.144		0.152



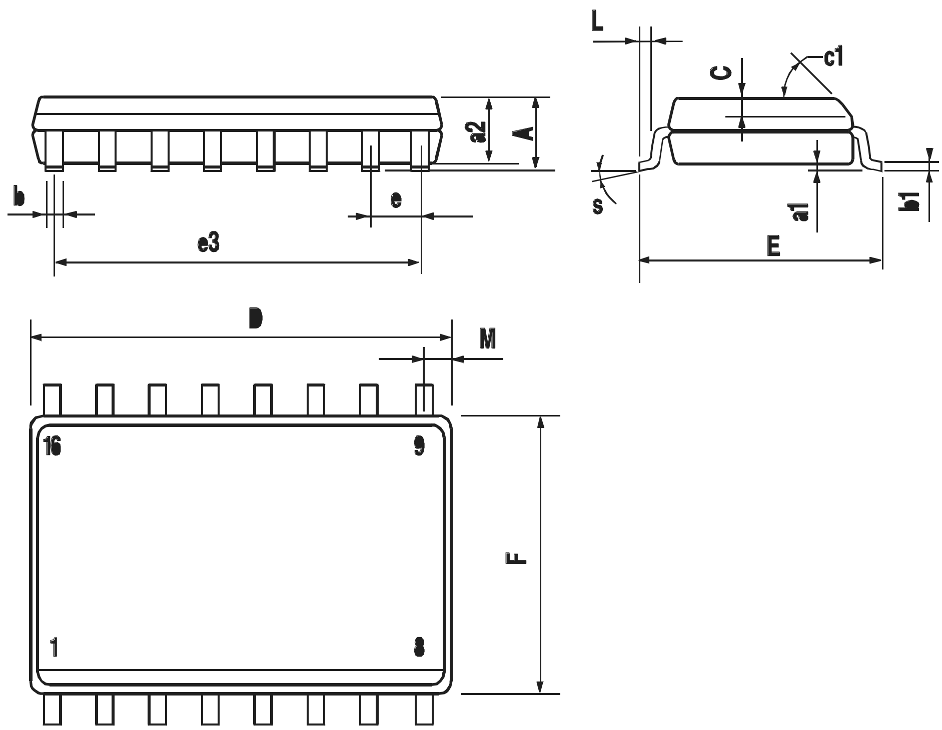
P^2PAK MECHANICAL DATA

DIM.	mm.		
	MIN.	TYP	MAX.
A	4.30		4.80
A1	2.40		2.80
A2	0.03		0.23
b	0.80		1.05
c	0.45		0.60
c2	1.17		1.37
D	8.95		9.35
D2		8.00	
E	10.00		10.40
E1		8.50	
e	3.20		3.60
e1	6.60		7.00
L	13.70		14.50
L2	1.25		1.40
L3	0.90		1.70
L5	1.55		2.40
R		0.40	
V2	0º		8º
Package Weight	1.40 Gr (typ)		



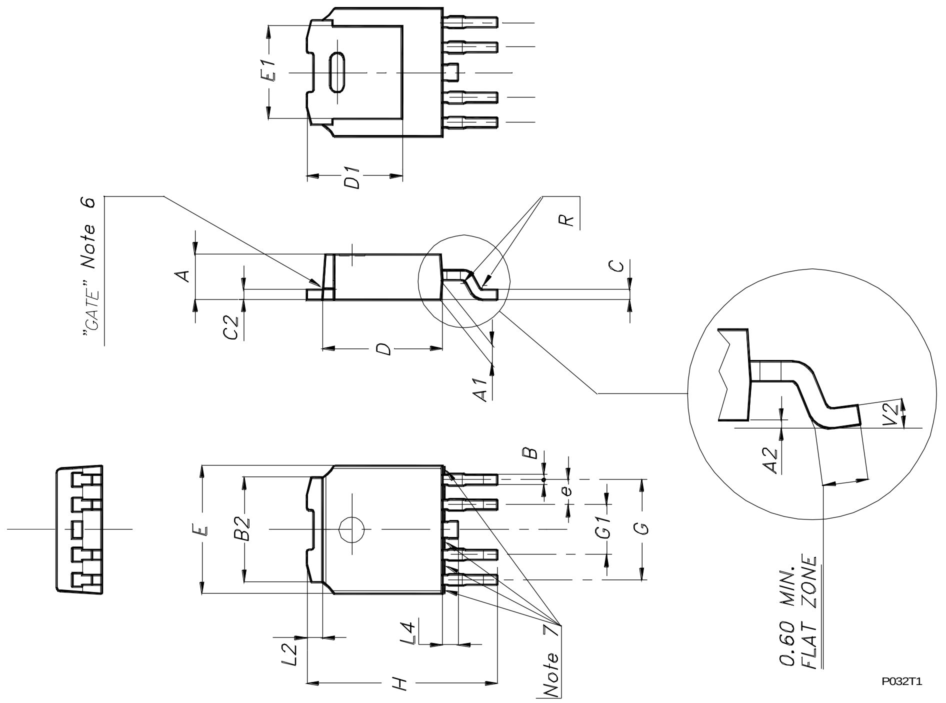
SO-16L MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.012
C		0.5			0.020	
c1	45° (typ.)					
D	10.1		10.5	0.397		0.413
E	10.0		10.65	0.393		0.419
e		1.27			0.050	
e3		8.89			0.350	
F	7.4		7.6	0.291		0.300
L	0.5		1.27	0.020		0.050
M			0.75			0.029
S	8° (max.)					

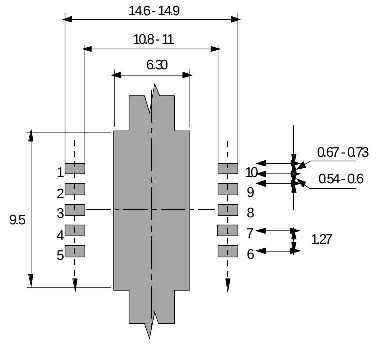


PPAK MECHANICAL DATA

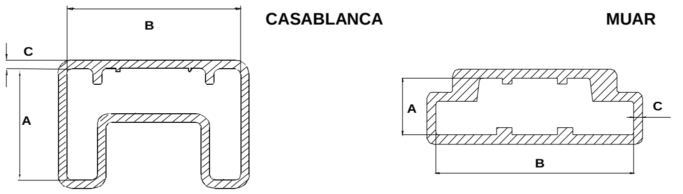
DIM.	MIN.	TYP	MAX.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
B	0.40		0.60
B2	5.20		5.40
C	0.45		0.60
C2	0.48		0.60
D1		5.1	
D	6.00		6.20
E	6.40		6.60
E1		4.7	
e		1.27	
G	4.90		5.25
G1	2.38		2.70
H	9.35		10.10
L2		0.8	1.00
L4	0.60		1.00
R		0.2	
V2	0º		8º
Package Weight	Gr. 0.3		



PowerSO-10™ SUGGESTED PAD LAYOUT



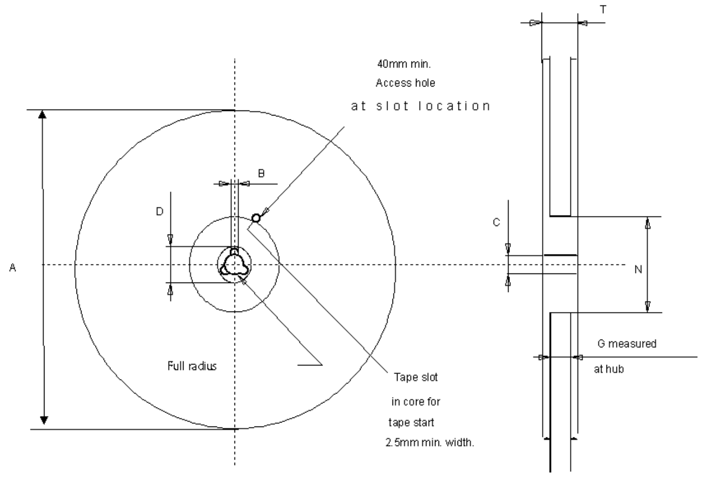
TUBE SHIPMENT (no suffix)



All dimensions are in mm.

	Base Q.ty	Bulk Q.ty	Tube length (± 0.5)	A	B	C (± 0.1)
Casablanca	50	1000	532	10.4	16.4	0.8
Muar	50	1000	532	4.9	17.2	0.8

TAPE AND REEL SHIPMENT (suffix "13TR")



REEL DIMENSIONS

Base Q.ty	600
Bulk Q.ty	600
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	24.4
N (min)	60
T (max)	30.4

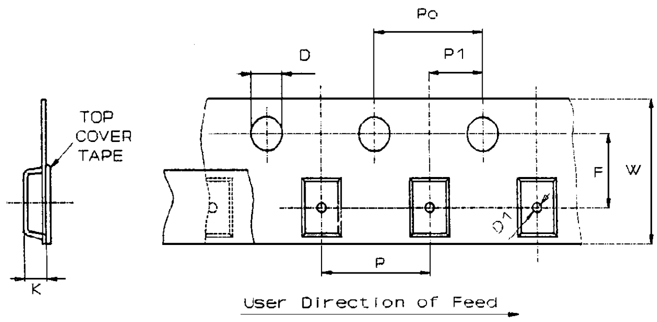
All dimensions are in mm.

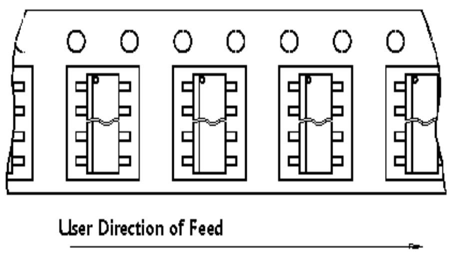
TAPE DIMENSIONS

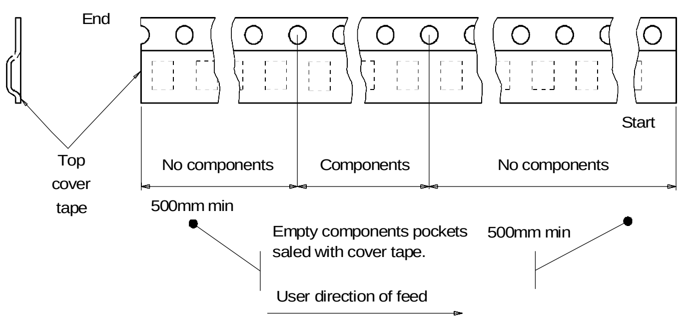
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	24
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	24
Hole Diameter	**D (± 0.1/-0)**	1.5
Hole Diameter	**D1 (min)**	1.5
Hole Position	**F (± 0.05)**	11.5
Compartment Depth	**K (max)**	6.5
Hole Spacing	**P1 (± 0.1)**	2

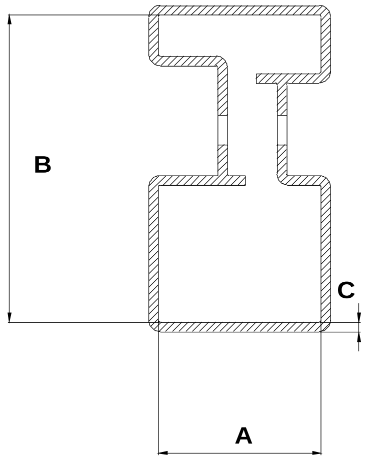
All dimensions are in mm.







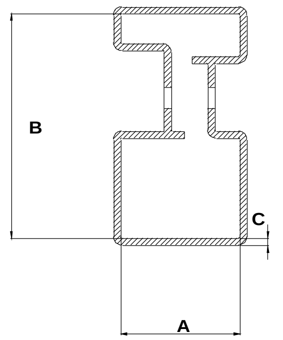
PENTAWATT TUBE SHIPMENT (no suffix)



Base Q.ty	50
Bulk Q.ty	1000
Tube length (± 0.5)	532
A	18
B	33.1
C (± 0.1)	1

All dimensions are in mm.

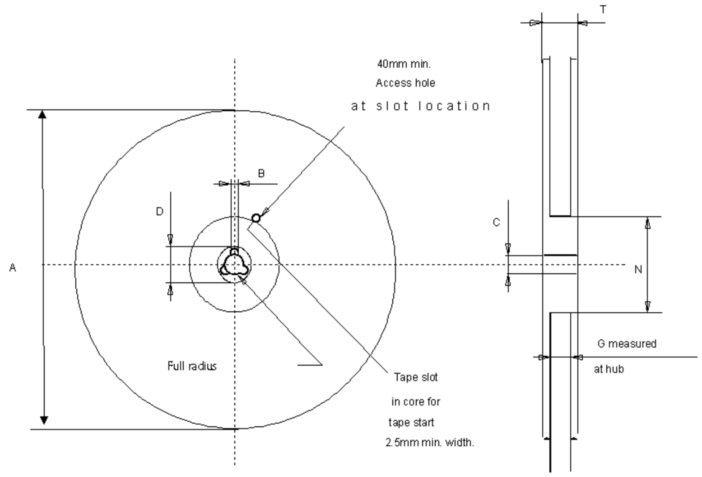
P^2PAK TUBE SHIPMENT (no suffix)



Base Q.ty	50
Bulk Q.ty	1000
Tube length (± 0.5)	532
A	18
B	33.1
C (± 0.1)	1

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix “13TR”)



REEL DIMENSIONS

Base Q.ty	1000
Bulk Q.ty	1000
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	24.4
N (min)	60
T (max)	30.4

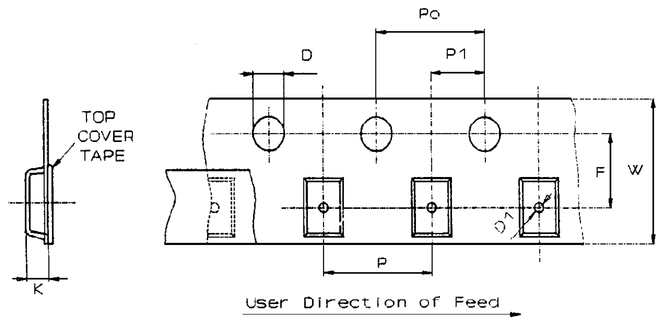
All dimensions are in mm.

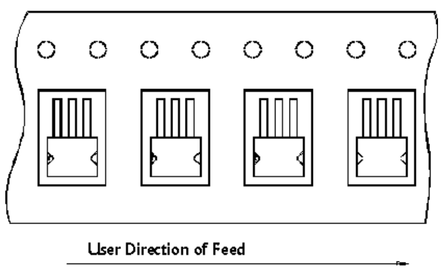
TAPE DIMENSIONS

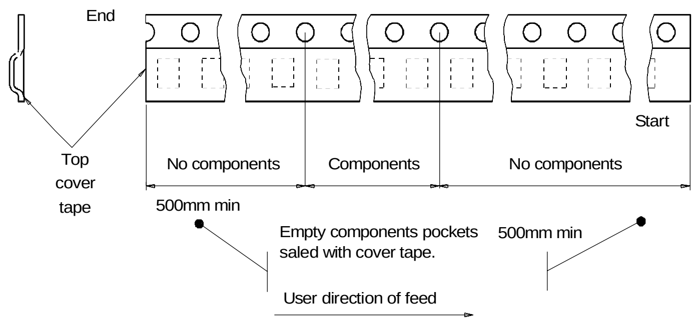
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	24
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	16
Hole Diameter	**D (± 0.1/-0)**	1.5
Hole Diameter	**D1 (min)**	1.5
Hole Position	**F (± 0.05)**	11.5
Compartment Depth	**K (max)**	6.5
Hole Spacing	**P1 (± 0.1)**	2

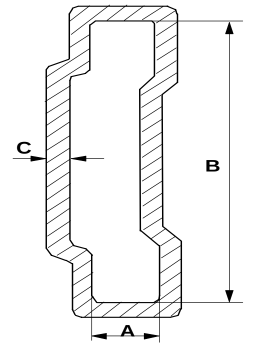
All dimensions are in mm.







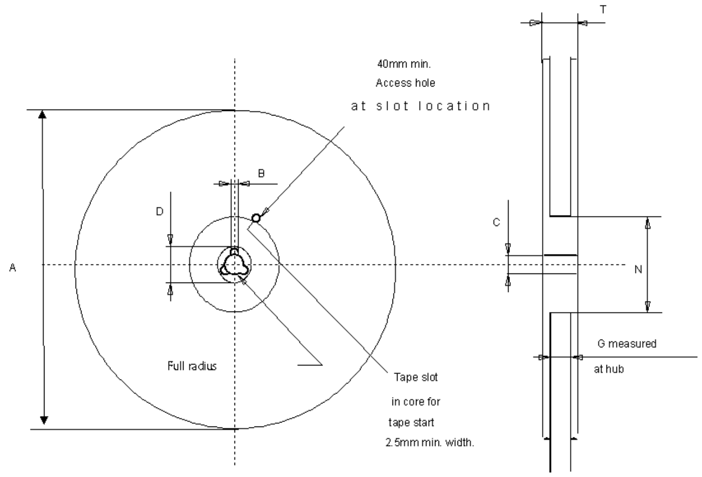
SO-16L TUBE SHIPMENT (no suffix)



Base Q.ty	50
Bulk Q.ty	1000
Tube length (± 0.5)	532
A	3.5
B	13.8
C (± 0.1)	0.6

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix “13TR”)



REEL DIMENSIONS

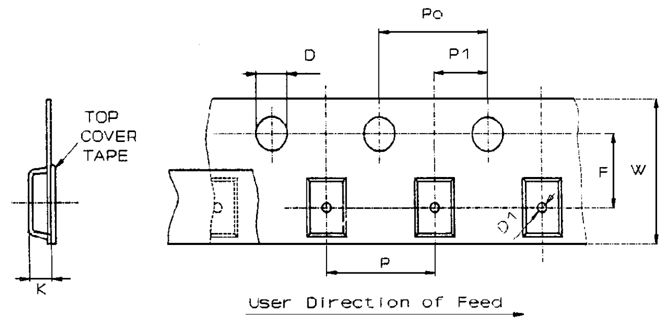
Base Q.ty	1000
Bulk Q.ty	1000
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	16.4
N (min)	60
T (max)	22.4

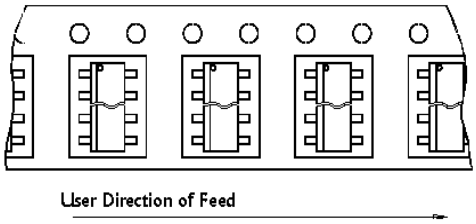
TAPE DIMENSIONS

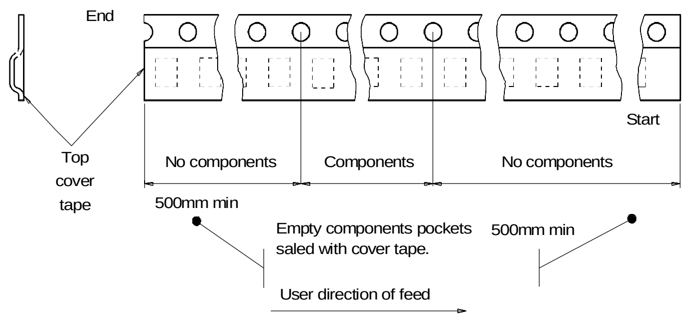
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	16
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	12
Hole Diameter	**D (± 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

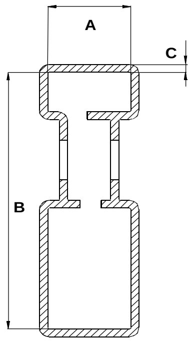
All dimensions are in mm.







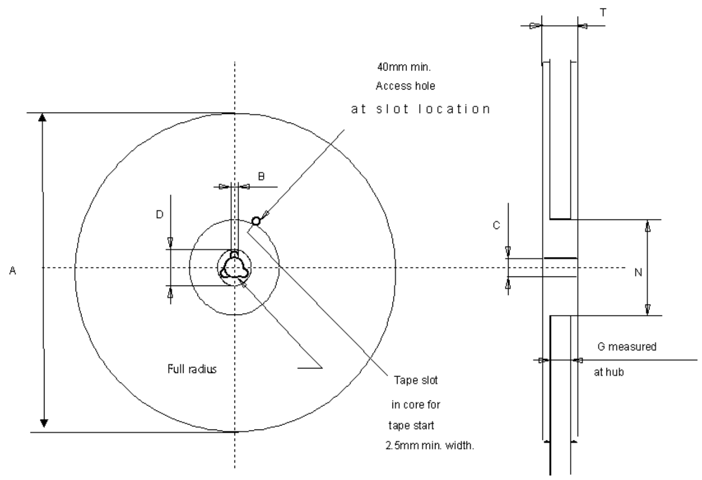
PPAK TUBE SHIPMENT (no suffix)



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")



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)	16.4
N (min)	60
T (max)	22.4

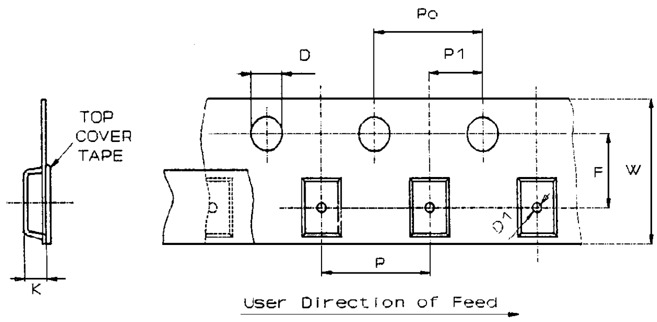
All dimensions are in mm.

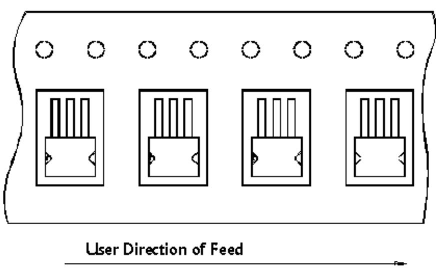
TAPE DIMENSIONS

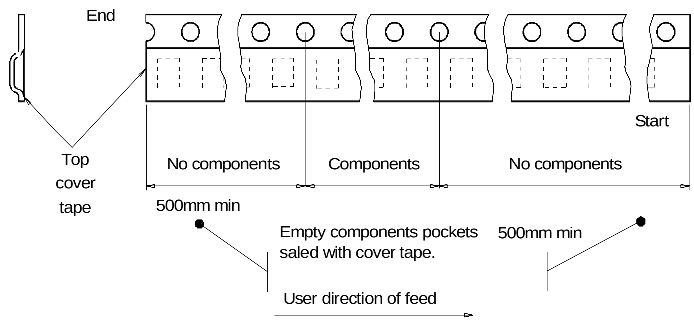
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	16
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	8
Hole Diameter	**D (± 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	- Minor changes - Current and voltage convention update (page 2). - “Configuration diagram (top view) & suggested connections for unused and n.c. pins” insertion (page 2). - 6 cm^2 Cu condition insertion in Thermal Data table (page 3). - V_{CC} - OUTPUT DIODE section update (page 4). - PROTECTIONS note insertion (page 3) - Revision History table insertion (page 34). - Disclaimers update (page 35).