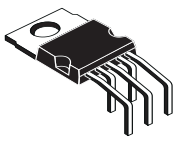
VN540 / VN540SP
VN540(011Y) / VN540(012Y)

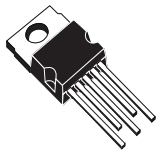
HIGH SIDE SMART POWER SOLID STATE RELAY

TYPE	V_{demag}	$R_{DS(on)}$	I_{OUT}	V_{CC}
VN540 VN540SP VN540(011Y) VN540(012Y)	-55V	50mΩ	2.8A	36 V

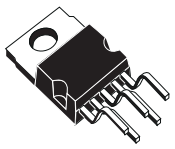
- OUTPUT CURRENT (CONTINUOUS): 2.8A
- DIGITAL INPUT CLAMPED AT 32V
- PROTECTION AGAINST: LOSS OF GROUND, SHORTED LOAD AND OVERTEMPERATURE
- BUILT-IN CURRENT LIMITER
- UNDER VOLTAGE SHUT DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUT
- FAST DEMAGNETIZATION OF INDUCTIVE LOADS.



PENTAWATT(011Y)



PENTAWATT(012Y)



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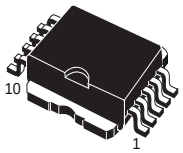


PowerSO-10™

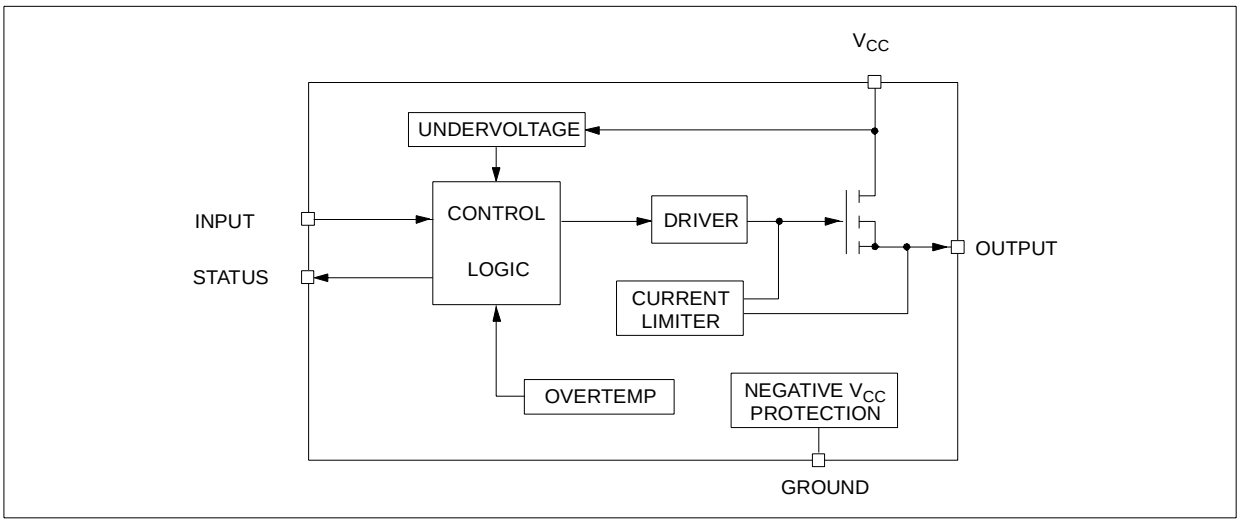
ORDER CODES

PENTAWATT vertical	VN540
PENTAWATT horizontal	VN540(011Y)
PENTAWATT straight	VN540(012Y)
PowerSO-10™	VN540SP

DESCRIPTION

The VN540, VN540SP, VN540(011Y), VN540(012Y) is a monolithic device designed in STMicroelectronics VIPower technology, intended for driving resistive or inductive loads with one side connected to ground. Active current limitation avoids the system power supply dropping in case of shorted load. Built-in thermal shut down protects the chip from over temperature. The open drain diagnostic output indicates over temperature conditions.

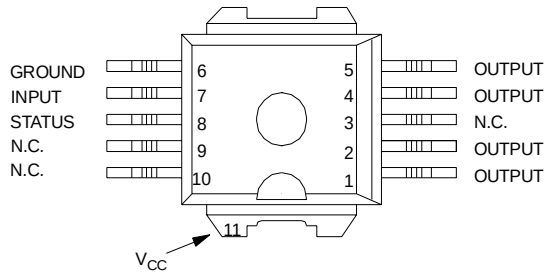
BLOCK DIAGRAM



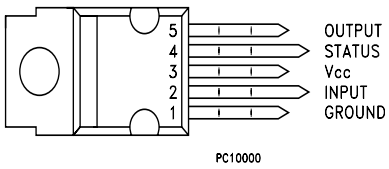
ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{CC}	Power supply voltage	45	V
$-V_{CC}$	Reverse supply voltage	-4.0	V
I_{OUT}	Maximum DC load current	Internally limited	A
I_R	Reverse output current	-10	A
I_{IN}	Input current	+/- 10	mA
I_{STAT}	Status pin current	+/- 10	mA
V_{ESD}	Electrostatic discharge (R=1.5kΩ, C=100pF)	2000	V
P_{TOT}	Power dissipation at T_c=25°C	Internally limited	W
T_j	Junction operating temperature	Internally limited	°C
T_{STG}	Storage temperature	-55 to 150	°C
E_{AS}	Single pulse avalanche energy	500	mJ

CONNECTION DIAGRAM TOP VIEW

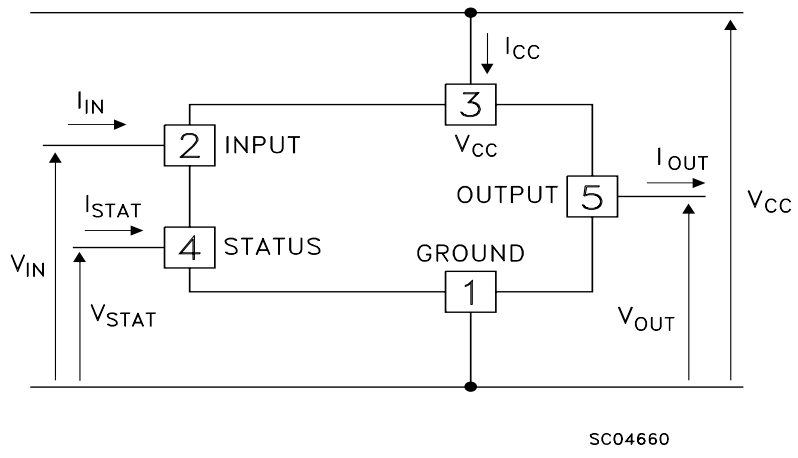


PowerSO-10™



PENTAWATT

CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

Symbol	Parameter		Value		Unit
			PowerSO-10	PENTAWATT	
$R_{thj\text{-}case}$	Thermal resistance junction-case	(MAX)	1.5	2.0	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	(MAX)	50	60	°C/W

ELECTRICAL CHARACTERISTICS (10V<V_{CC}<36V; -25°C<T_j<100°C; unless otherwise specified)

POWER

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{CC}	Operating voltage		10		36	V
R_{ON}	On state resistance	I_{OUT}=2.8A; T_j=25°C I_{OUT}=2.8A;			50 90	mΩ mΩ
I_S	Supply current	OFF state ON state (T_j=125°C) I_{OUT}=0A			1 3	mA mA
I_{LS}	Output leakage current	Channel OFF V_{CC}=45V			100	µA
I_{LGND}	Output current at turn-off	V_{CC}=V_{IN}=V_{GND}=V_{STAT}=24V T_j= -25°C<T_j<100°C			2	mA
V_{OL}	Low state output voltage	V_{IN}=V_{IL}; R_{LOAD}≥10MΩ			1.5	V
V_{demag}	Output voltage at turn-off	I_{OUT}=2.8A; L_{LOAD}=1mH	V_{CC}-65	V_{CC}-55	V_{CC}-45	V

SWITCHING

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on delay on output current	I_{OUT}=2.8A; Resistive Load Input rise time <0.1µs; V_{CC}=24V; T_j=25°C		40		µs
t_r	Rise time of output current	I_{OUT}=2.8A; Resistive Load Input rise time <0.1µs; V_{CC}=24V; T_j=25°C		60		µs
$t_{d(off)}$	Turn-off delay on output current	I_{OUT}=2.8A; Resistive Load Input rise time <0.1µs; V_{CC}=24V; T_j=25°C		60		µs
t_f	Fall time of output current	I_{OUT}=2.8A; Resistive Load Input rise time <0.1µs; V_{CC}=24V; T_j=25°C		25		µs
$dI/dt_{(on)}$	Turn-on current average slope	I_{OUT}=2.8A I_{OUT}=I_{LIM}; 25°C<T_j<140°C			0.5 2	A/µs A/µs
$dI/dt_{(off)}$	Turn-off current average slope	I_{OUT}=2.8A I_{OUT}=I_{LIM}; 25°C<T_j<140°C			2 4	A/µs A/µs

LOGIC INPUT

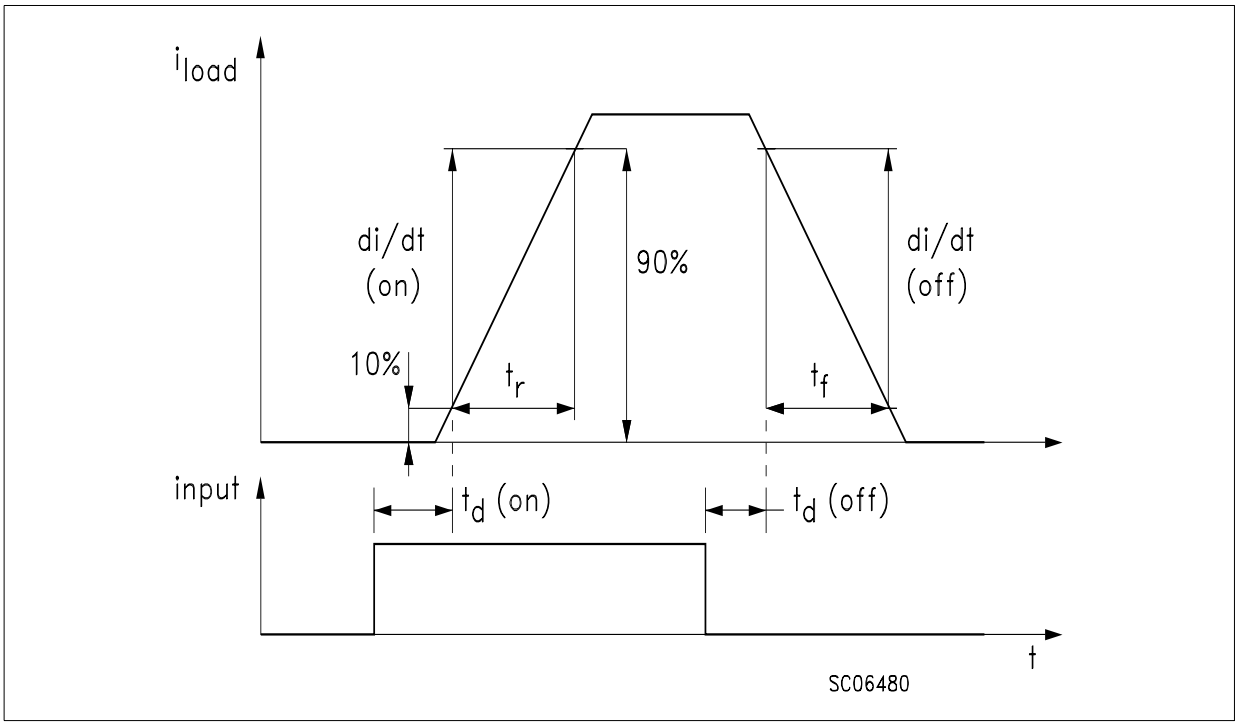
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IL}	Input low level voltage				2.0	V
V_{IH}	Input high level voltage		3.5			V
$V_{I(hyst)}$	Input hysteresis voltage			0.5		V
I_{IN}	Input current	V_{IN}=30V V_{IN}=2.0V	 25		300	µA µA
V_{ICL}	Input clamp voltage (see note 1)	I_{IN}=1mA I_{IN}=-1mA	32	36 -0.7		V V

PROTECTIONS AND DIAGNOSTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{STAT}	Status output voltage	I_{STAT}=5mA (Fault condition)			1	V
V_{SCL} (*)	Status clamp voltage	I_{STAT}=1mA I_{STAT}=-1mA	32	36 0.7		V V
I_{STAT}	Leakage on diagnostic pin in high state	V_{STAT}=5V			10	µA
V_{USD}	Undervoltage shut-down		5.0		8.0	V
I_{LIM}	DC short circuit current	V_{CC}=24V, R_{LOAD}<0.1Ω	2.8	5.0	8.0	A
t_{SC}	Delay time of current limiter				100	µs
T_{TSD}	Thermal shut-down temperature		150	170		°C
T_R	Thermal reset temperature		135	155		°C

(*) Status determination > 100µs after the switching edge.

SWITCHING CHARACTERISTICS



Note 1: The input voltage is internally clamped at 32V minimum, it is possible to connect the input pins to an higher voltage via an external resistor calculate to not exceed 10mA.

Note 2: If INPUT pin is floating the corresponding channel will automatically switch off. If GND pin is disconnected, the channel will switch off provided V_{CC} not exceed 36V.

THRUTH TABLE

	INPUT	OUTPUT	STATUS
Normal operation	L H	L H	H H
Overtemperature	L H	L L	H L
Undervoltage	L H	L L	H H
Shorted load (Current limitation)	L H	L H	H H

Fig. 1: Peak Short Test Circuit

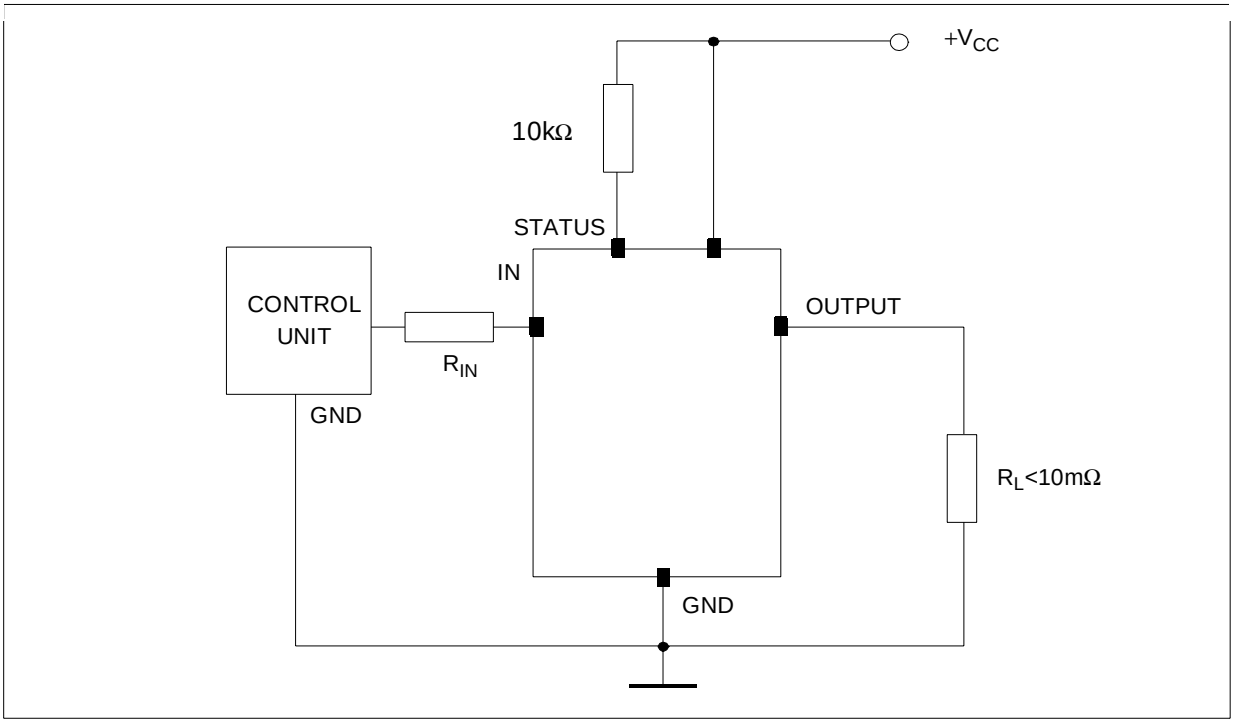


Figure 2: Waveforms

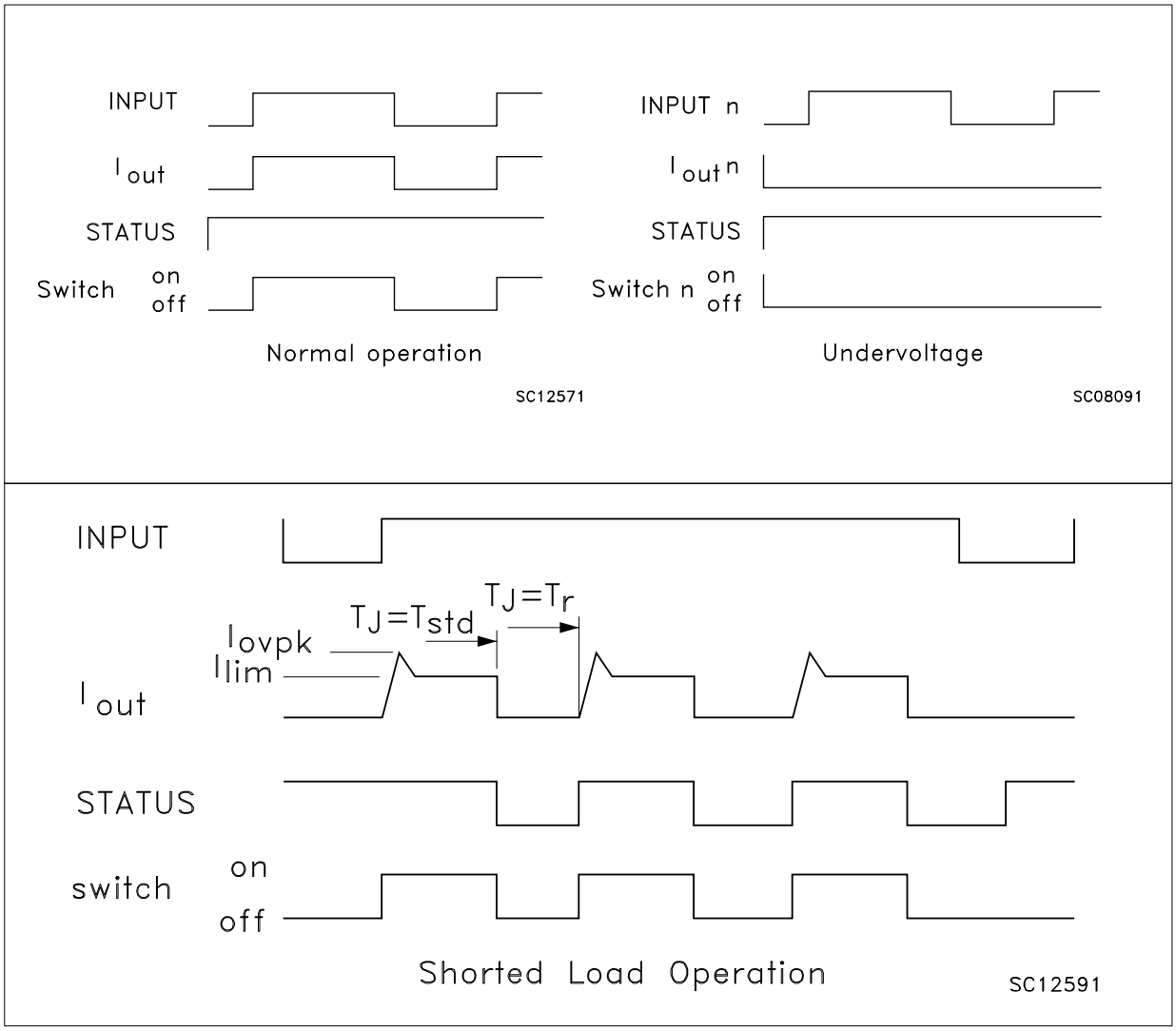
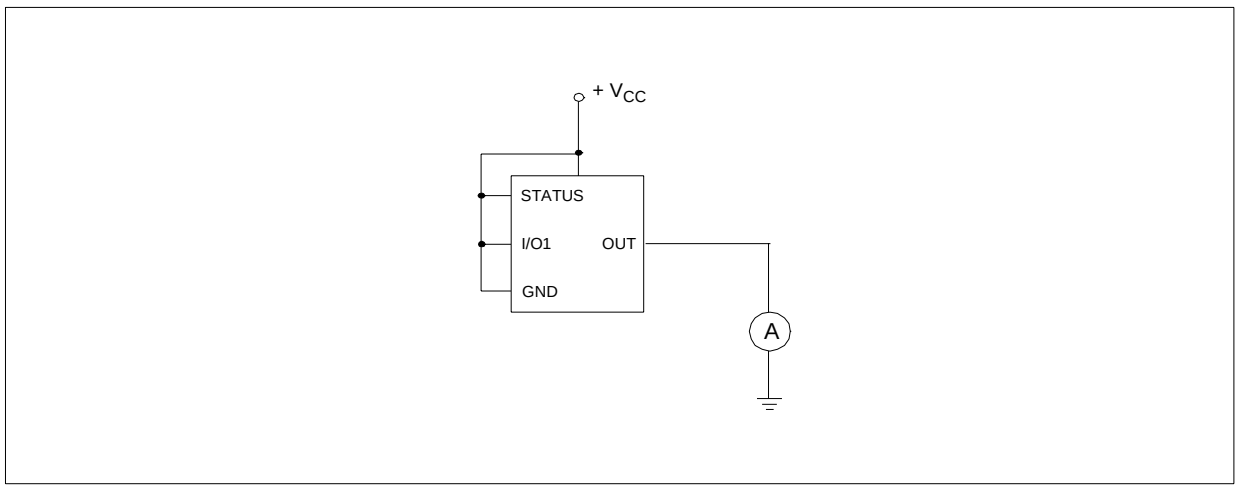
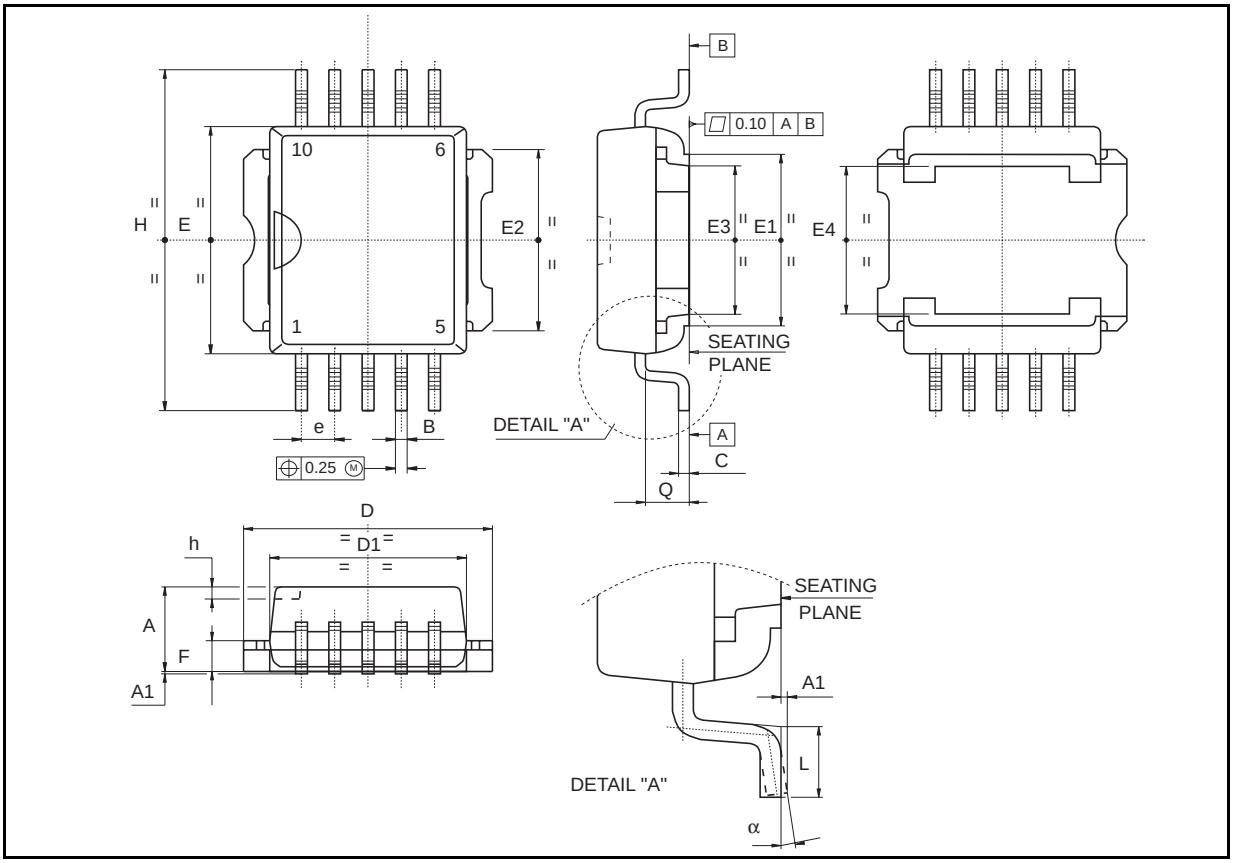


Fig. 3: I_{LGND} Test Configuration



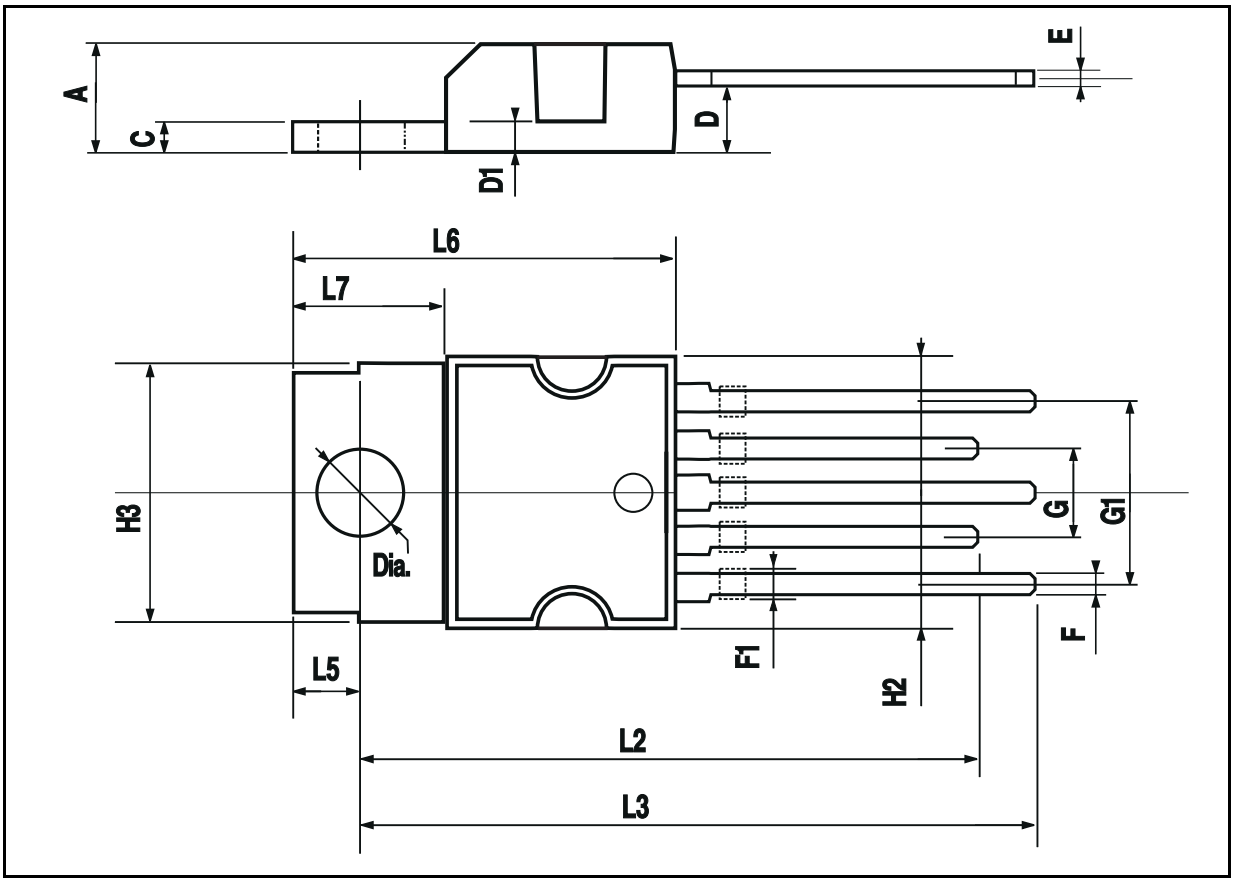
PowerSO-10™ MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	3.35		3.65	0.132		0.144
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
c	0.35		0.55	0.013		0.022
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
E1	7.20		7.40	0.283		0.291
E2	7.20		7.60	0.283		300
E3	6.10		6.35	0.240		0.250
E4	5.90		6.10	0.232		0.240
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
H	13.80		14.40	0.543		0.567
h		0.50			0.002	
Q		1.70			0.067	
α	0º		8º			



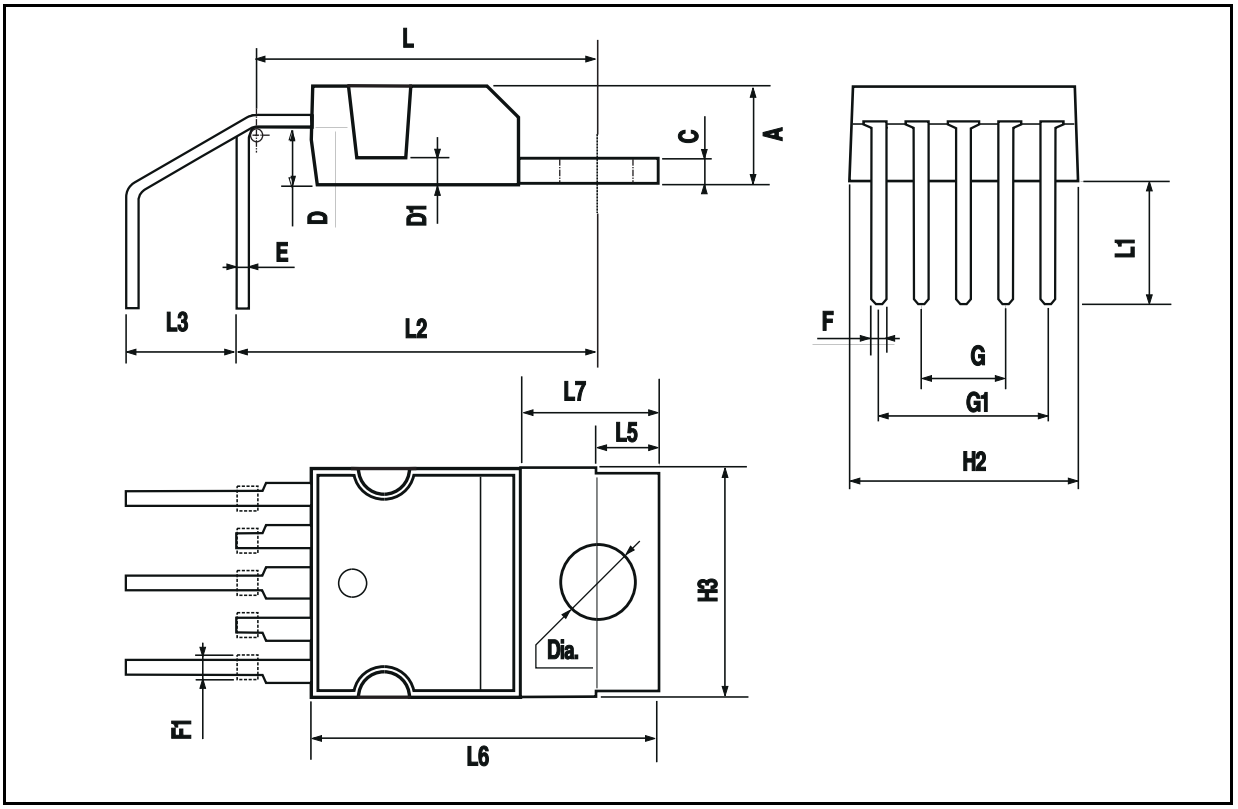
PENTAWATT (IN-LINE) MECHANICAL DATA

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
L2	23.05	23.4	23.8	0.907	0.921	0.937
L3	25.3	25.65	26.1	0.996	1.010	1.028
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
Diam.	3.65		3.85	0.144		0.152



PENTAWATT (HORIZONTAL) 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	14.2		15	0.559		0.590
L1	5.7		6.2			0.244
L2	14.6		15.2			0.598
L3	3.5		4.1	0.137		0.161
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
Diam.	3.65		3.85	0.144		0.152



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