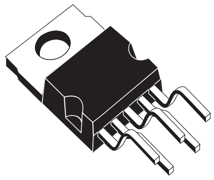
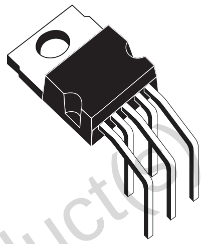
HIGH SIDE SMART POWER SOLID STATE RELAY

TYPE	V_{DSS}	$R_{DS(on)}$	I_{OUT}	V_{CC}
VN02H	60 V	0.4 Ω	6 A	36 V

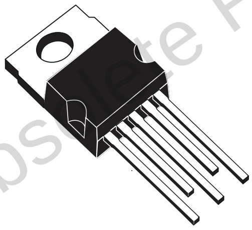
- OUTPUT CURRENT (CONTINUOUS): 6A @ T_c=25^{o}C
- 5V LOGIC LEVEL COMPATIBLE INPUT
- THERMAL SHUT-DOWN
- UNDER VOLTAGE SHUT-DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUT
- VERY LOW STAND-BY POWER DISSIPATION



PENTAWATT (vertical)



PENTAWATT (horizontal)



PENTAWATT (in-line)

ORDER CODES:

PENTAWATT vertical	VN02H
PENTAWATT horizontal	VN02H(011Y)
PENTAWATT in-line	VN02H(012Y)

DESCRIPTION

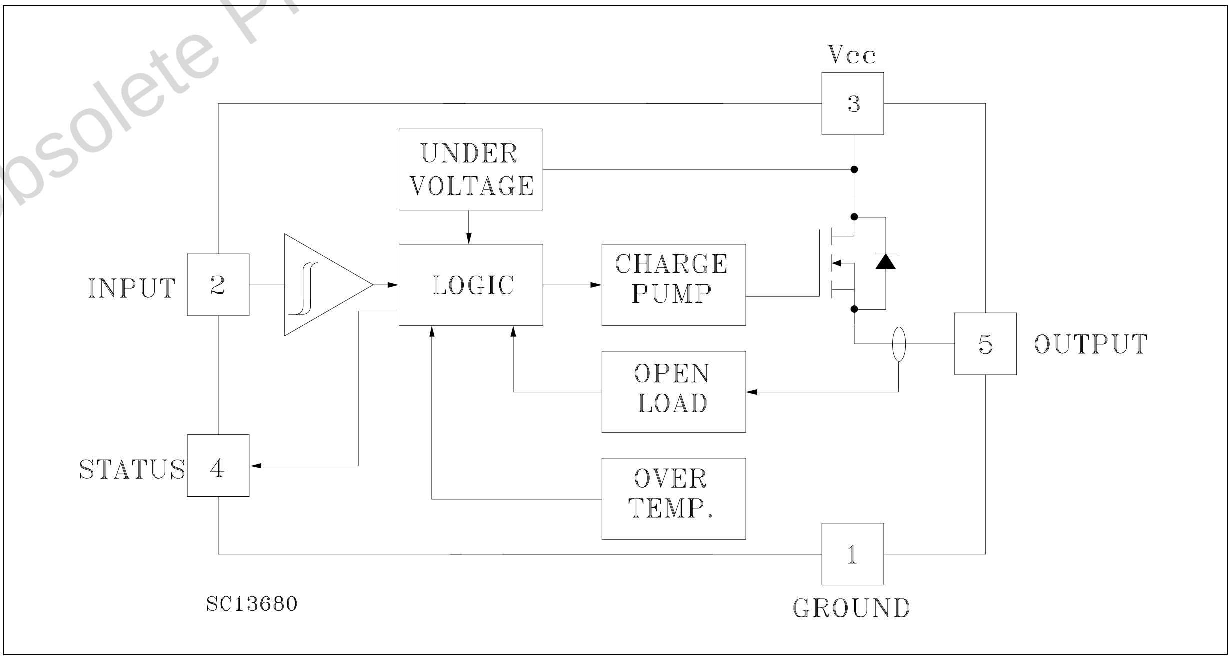
The VN02H is a monolithic devices made using STMicroelectronics VIPower Technology, intended for driving resistive or inductive loads with one side grounded.

Built-in thermal shut-down protects the chip from over temperature and short circuit.

The input control is 5V logic level compatible.

The open drain diagnostic output indicates open circuit (no load) and over temperature status.

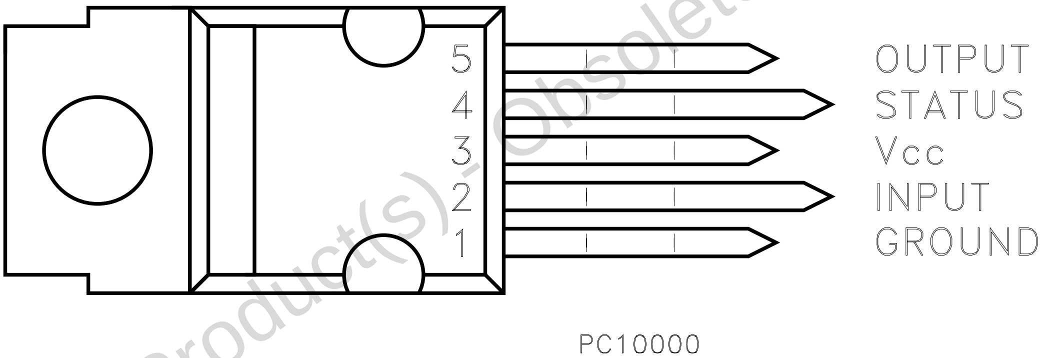
BLOCK DIAGRAM



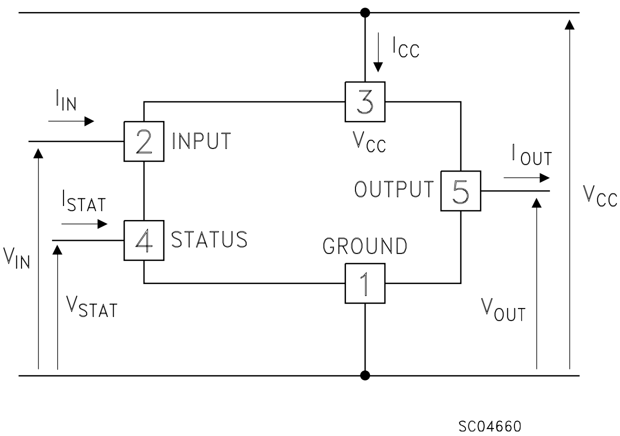
ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	60	V
I_{OUT}	Output Current (cont.)	6	A
I_R	Reverse Output Current	-6	A
I_{IN}	Input Current	±10	mA
V_{CC}	Supply Voltage (for t = 400 ms)	60	V
$-V_{CC}$	Reverse Supply Voltage	-4	V
I_{STAT}	Status Current	±10	mA
V_{ESD}	Electrostatic Discharge (1.5 kΩ, 100 pF)	2000	V
P_{tot}	Power Dissipation at $T_c \leq 25$ °C	28	W
T_j	Junction Operating Temperature	-40 to 150	°C
T_{stg}	Storage Temperature	-55 to 150	°C

CONNECTION DIAGRAMS



CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

$R_{thj-case}$	Thermal Resistance Junction-case	Max	4.4	$^oC/W$
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	60	$^oC/W$

ELECTRICAL CHARACTERISTICS (V_{CC} = 9 to 36 V; -40 ≤ T_j ≤ 125 ^oC unless otherwise specified)

POWER

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply Voltage	see note 1	5		36	V
R_{on}	On State Resistance	I_{OUT} = 3 A I_{OUT} = 3 A T_j = 25 ^oC			0.8 0.4	Ω Ω
I_S	Supply Current	Off State T_j ≥ 25 ^oC On State			50 20	μA mA

SWITCHING

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time Of Output Current	I_{OUT} = 3 A Resistive Load Input Rise Time < 0.1 μs T_j = 25 ^oC	5	10	20	μs
t_r	Rise Time Of Output Current	I_{OUT} = 3 A Resistive Load Input Rise Time < 0.1 μs T_j = 25 ^oC	5	15	45	μs
$t_{d(off)}$	Turn-off Delay Time Of Output Current	I_{OUT} = 3 A Resistive Load Input Rise Time < 0.1 μs T_j = 25 ^oC	5	15	30	μs
t_f	Fall Time Of Output Current	I_{OUT} = 3 A Resistive Load Input Rise Time < 0.1 μs T_j = 25 ^oC	2	6	15	μs
$(di/dt)_{on}$	Turn-on Current Slope	I_{OUT} = 3 A I_{OUT} = I_{OV} 25 ≤ T_j ≤ 140 ^oC	0.05	0.15	0.5 2	A/μs A/μs
$(di/dt)_{off}$	Turn-off Current Slope	I_{OUT} = 3 A I_{OUT} = I_{OV} 25 ≤ T_j ≤ 140 ^oC	0.1	0.4	2 4	A/μs A/μs
V_{demag}	Inductive Load Clamp Voltage	I_{OUT} = 3 A L = 1 mH	-7	-4	-2	V

LOGIC INPUT

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IL}	Input Low Level Voltage				0.8	V
V_{IH}	Input High Level Voltage		2		(*)	V
$V_{I(hyst.)}$	Input Hysteresis Voltage			0.5		V
I_{IN}	Input Current	V_{IN} = 5 V		250	500	μA
V_{ICL}	Input Clamp Voltage	I_{IN} = 10 mA I_{IN} = -10 mA	5.5	6 -0.7	 -0.3	V V

ELECTRICAL CHARACTERISTICS (continued)

PROTECTION AND DIAGNOSTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{STAT} (•)	Status Voltage Output Low	I_{STAT} = 1.6 mA			0.4	V
V_{USD}	Under Voltage Shut Down		2.5		5	V
V_{SCL} (•)	Status Clamp Voltage	I_{STAT} = 10 mA I_{STAT} = -10 mA	5.5	6 -0.7	 -0.3	V V
t_{SC}	Switch-off Time in Short Circuit Condition at Start-Up	R_{LOAD} < 10 mΩ V_{CC} = 13 V T_c = 25 °C		1.5	5	ms
I_{OV}	Over Current	R_{LOAD} < 10 mΩ V_{CC} = 13 V			28	A
I_{AV}	Average Current in Short Circuit	R_{LOAD} < 10 mΩ V_{CC} = 13 V T_c = 85 °C		0.9	1.8	A
I_{OL}	Open Load Current Level	9 < V_{CC} < 32 V	5		70	mA
I_{OUT}	Leakage Current	Off State V_{OUT} = 0 V			60	µA
T_{TSD}	Thermal Shut-down Temperature		140	160		°C
T_R	Reset Temperature		125	145		°C

(*) The V_{IH} is internally clamped at 6V about. It is possible to connect this pin to an higher voltage via an external resistor calculated to not exceed 10 mA at the input pin.

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

Note 1 : Above V_{CC} = 36 V the output voltage is clamped to 36 V. Power dissipation increases and the device turns off if junction temperature reaches thermal shutdown temperature.

FUNCTIONAL DESCRIPTION

The device has a diagnostic output which indicates open circuit (no load) and over temperature conditions. The output signals are processed by internal logic.

To protect the device against short circuit and over-current condition the thermal protection turns the integrated Power MOS off at a minimum junction temperature of 140 °C. When the temperature returns to about 125 °C the switch is automatically turned on again. To ensur the protection in all V_{CC} conditions and in all the junction temperature range it is necessary to limit the voltage drop across Drain and Source (pin 3 and 5) at 29 V. The device is able to withstand a load dump according the test pulse 5 at level III of the ISO TR/1 7631.

Above V_{CC} = 36V the output voltage is clamped to 36V. Power dissipation increases and the device turns off if junction temperature reaches thermal shutdown temperature.

PROTECTING THE DEVICE AGAINST REVERSE BATTERY

The simplest way to protect the device against a continuous reverse battery voltage (-26V) is to insert a Schottky diode between pin 1 (GND) and ground, as shown in the typical application circuit (fig. 3).

The consequences of the voltage drop across this diode are as follows:

- If the input is pulled to power GND, a negative voltage of $-V_F$ is seen by the device. (V_{IL}, V_{IH} thresholds and V_{STAT} are increased by V_F with respect to power GND).
- The undervoltage shutdown level is increased by V_F.

If there is no need for the control unit to handle external analog signals referred to the power GND, the best approach is to connect the reference potential of the control unit to node [1] (see application circuit infig. 4), which becomes the common signal GND for the whole control board.

In this way no shift of V_{IH}, V_{IL} and V_{STAT} takes place and no negative voltage appears on the INPUT pin; this solution allows the use of a standard diode, with a breakdown voltage able to handle any ISO normalized negative pulses that occours in the automotive environment.

TRUTH TABLE

	INPUT	OUTPUT	DIAGNOSTIC
Normal Operation	L H	L H	H H
Open Circuit (No Load)	L H	L H	H L
Over-temperature	L H	L H	H L
Under-voltage	L H	L L	H H

Figure 1: Waveforms

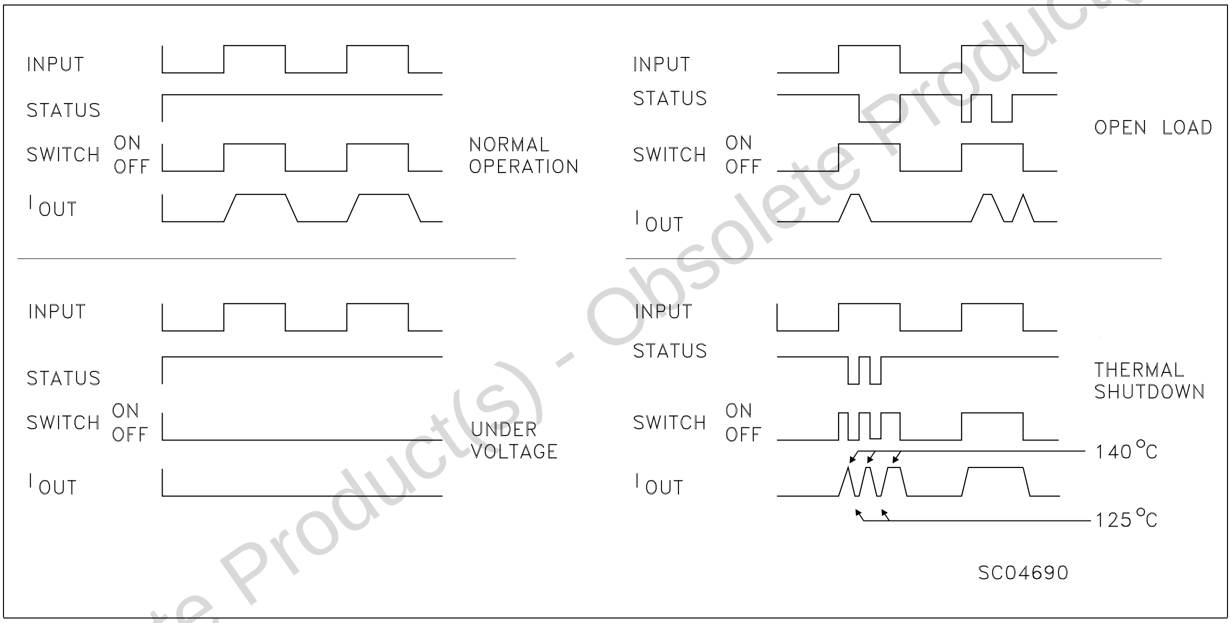


Figure 2: Over Current Test Circuit

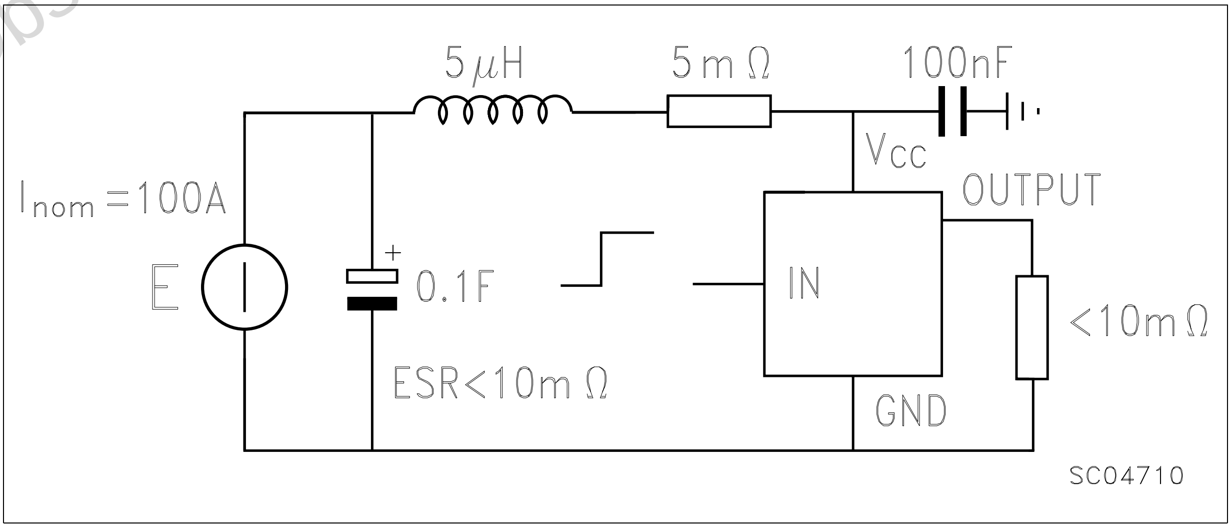


Figure 3: Typical Application Circuit With A Schottky Diode For Reverse Supply Protection

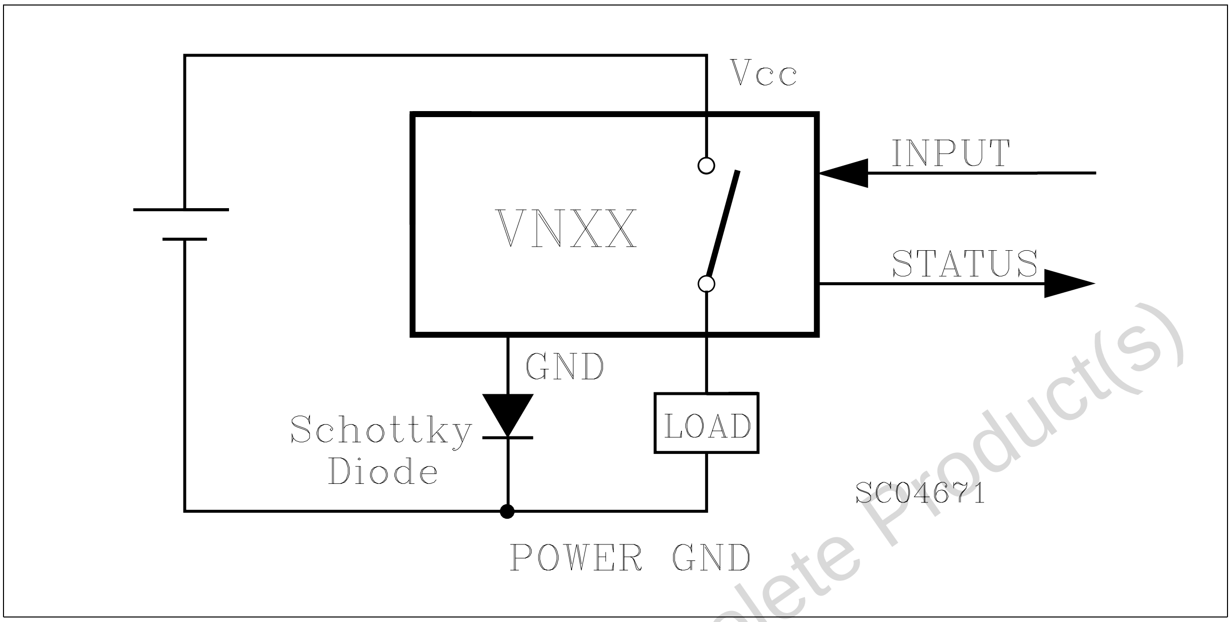
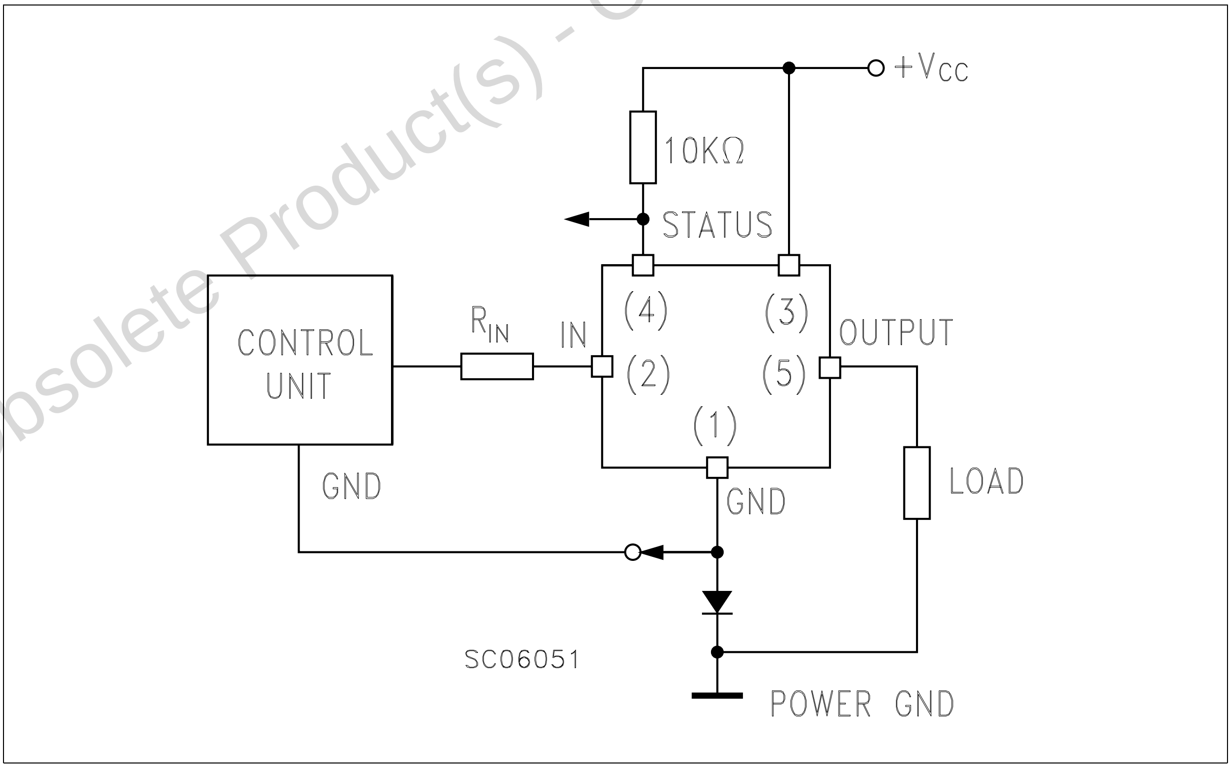
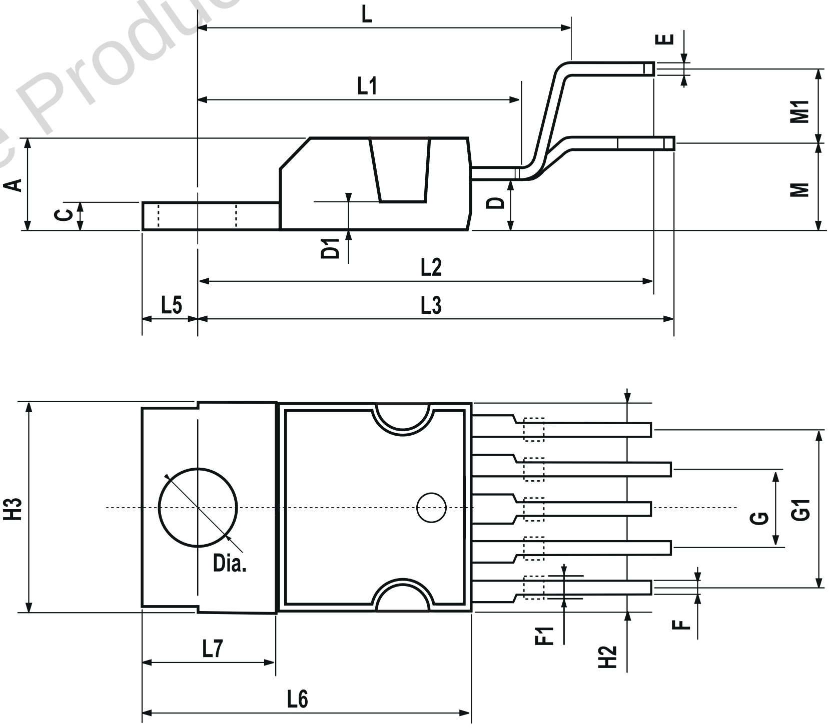


Figure 4: Typical Application Circuit With Separate Signal Ground



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	
Dia	3.65		3.85	0.144		0.152



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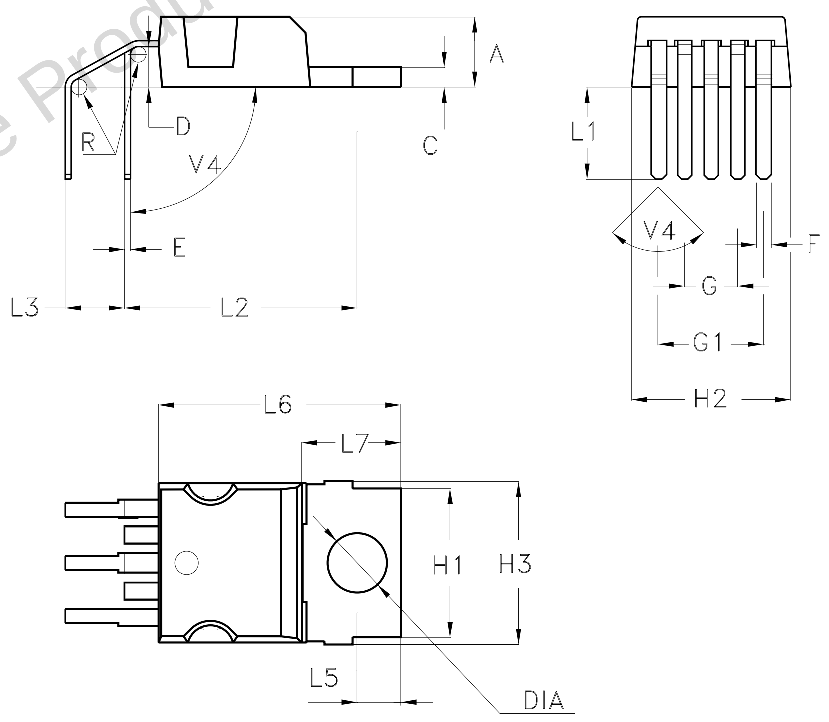
PENTAWATT (HORIZONTAL) MECHANICAL DATA

DIM.	mm			inch		
	MIN	TYP	MAX	MIN	TYP	MAX
A	4.30		4.80	0.169		0.189
C	1.17		1.37	0.046		0.054
D	2.40		2.80	0.094		0.110
E	0.35		0.55	0.014		0.021
F	0.80		1.05	0.031		0.041
G	3.20		3.60	0.126		0.142
G1	6.60		7.00	0.260		0.275
H1	9.30		9.70	0.366		0.382
H2			10.40			0.409
H3	10.05		10.40	0.396		0.409
L2	14.60		15.20	0.575		0.598
L3	3.50		4.10	0.137		0.161
L5	2.60		3.00	0.102		0.118
L6	15.10		15.80	0.594		0.622
L7	6.00		6.60	0.236		0.260
V4		90°			90°	
Diam.	3.65		3.85	0.144		0.151



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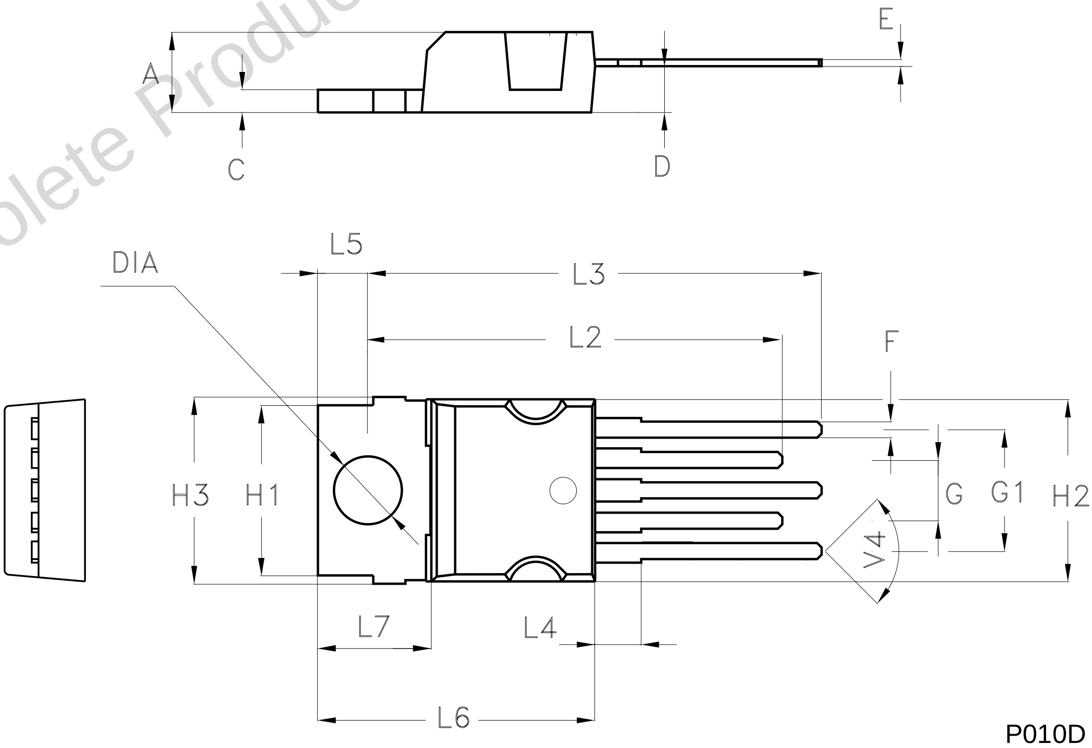
PENTAWATT (IN-LINE) MECHANICAL DATA

DIM.	mm			inch		
	MIN	TYP	MAX	MIN	TYP	MAX
A	4.30		4.80	0.169		0.189
C	1.17		1.37	0.046		0.054
D	2.40		2.80	0.094		0.110
E	0.35		0.55	0.014		0.021
F	0.80		1.05	0.031		0.041
F2	1.10		1.40	0.043		0.055
F3	1.25		1.55	0.049		0.061
G	3.20		3.60	0.126		0.142
G1	6.60		7.00	0.260		0.275
H1	9.30		9.70	0.366		0.382
H2			10.40			0.409
H3	10.05		10.40	0.396		0.409
L2	23.05		23.80	0.907		0.937
L3	25.30		26.10	0.996		1.027
L4	0.90		2.90	0.035		0.114
L5	2.60		3.00	0.102		0.118
L6	15.10		15.80	0.594		0.622
L7	6.00		6.60	0.236		0.260
V4		90°			90°	
Diam.	3.65		3.85	0.144		0.151



P010D

Please Read Carefully: