

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 @ $T_c=25^{\circ}\text{C}$
- 5V LOGIC LEVEL COMPATIBLE INPUT
- THERMAL SHUT-DOWN
- UNDER VOLTAGE SHUT-DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUT
- VERY LOW STAND-BY POWER
DISSIPATION

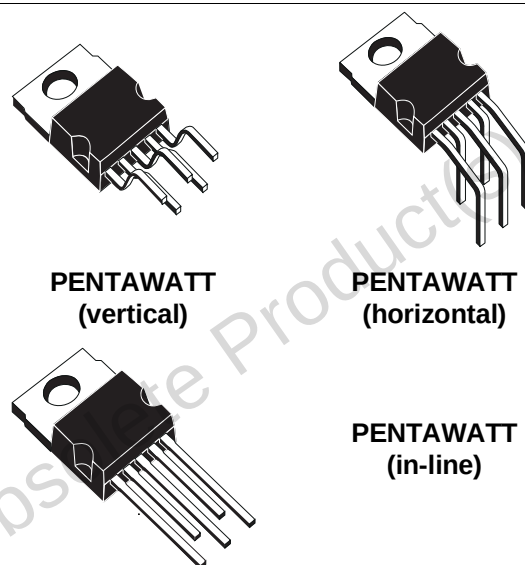
DESCRIPTION

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.

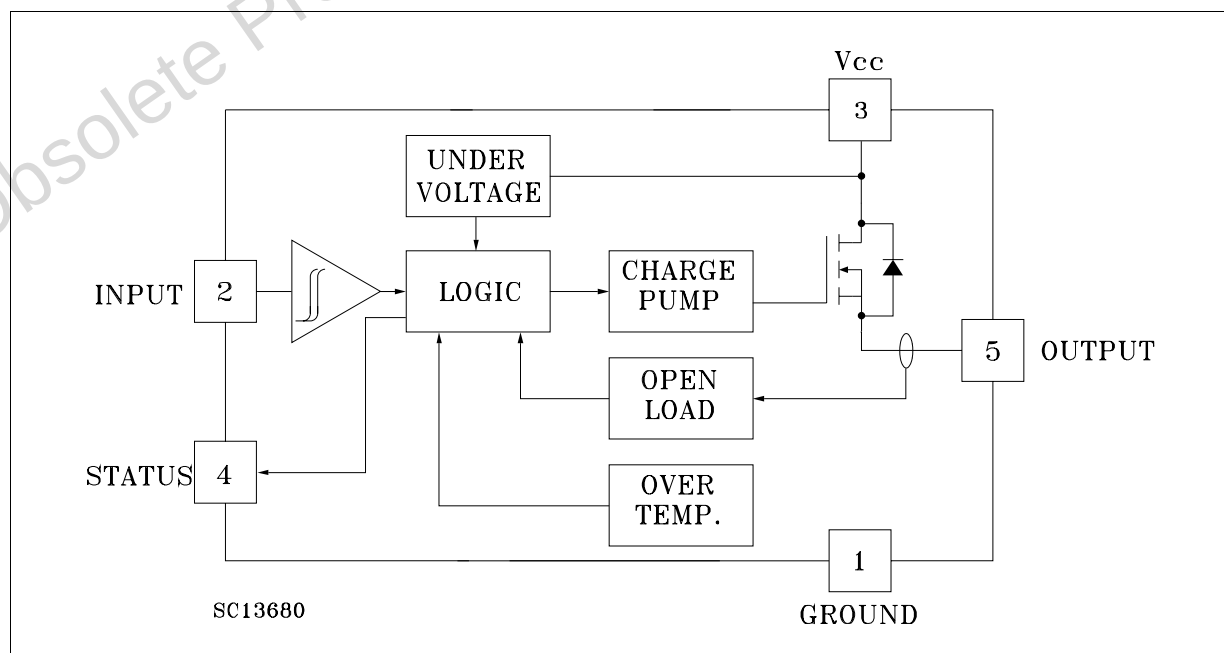
The input control is 5V logic level compatible.

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

**ORDER CODES:**

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

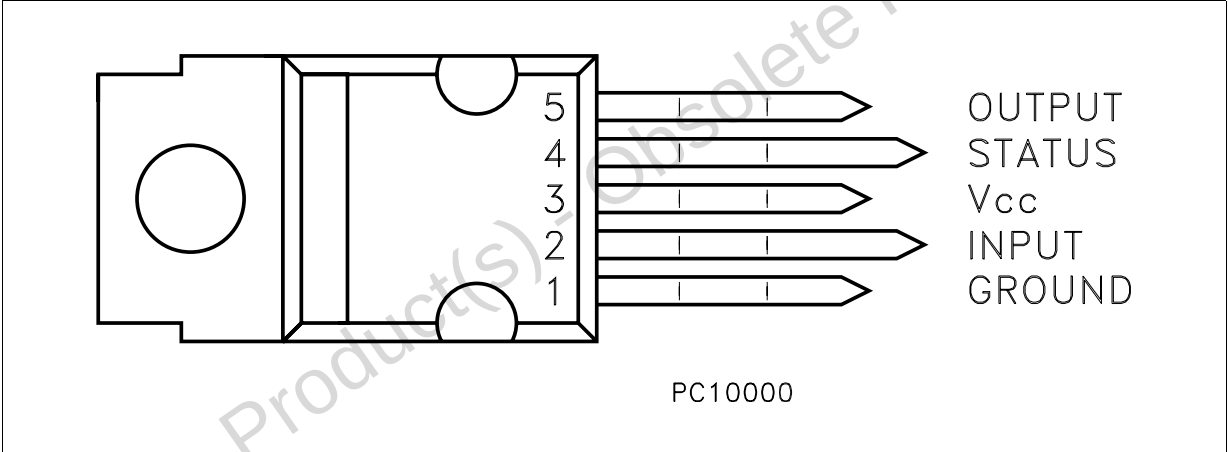
BLOCK DIAGRAM



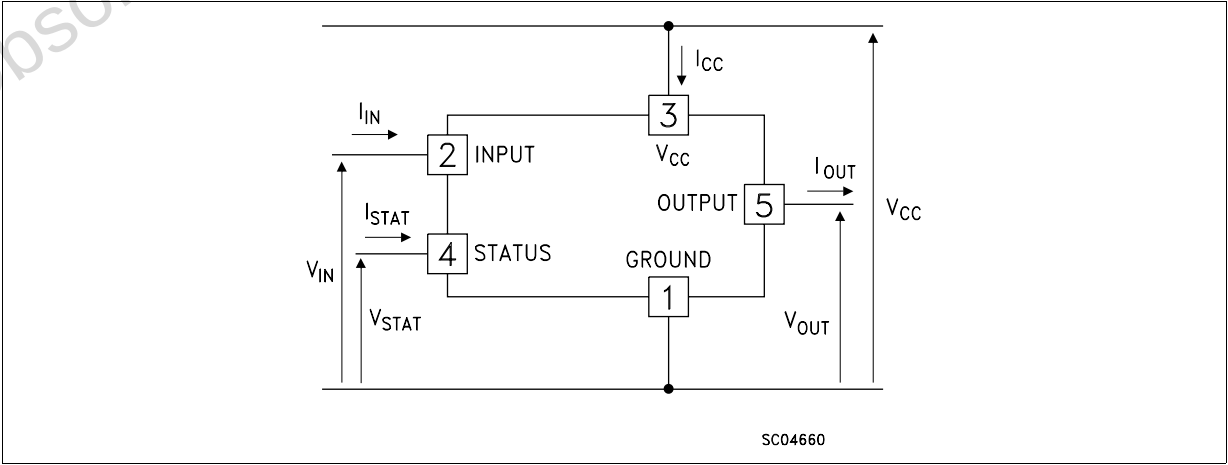
ABSOLUTE MAXIMUM RATING

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 $t = 400\text{ ms}$)	60	V
$-V_{CC}$	Reverse Supply Voltage	-4	V
I_{STAT}	Status Current	± 10	mA
V_{ESD}	Electrostatic Discharge (1.5 k Ω , 100 pF)	2000	V
P_{tot}	Power Dissipation at $T_c \leq 25\text{ }^{\circ}\text{C}$	28	W
T_j	Junction Operating Temperature	-40 to 150	$^{\circ}\text{C}$
T_{stg}	Storage Temperature	-55 to 150	$^{\circ}\text{C}$

CONNECTION DIAGRAMS



CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

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

ELECTRICAL CHARACTERISTICS ($V_{CC} = 9$ to 36 V; $-40 \leq T_j \leq 125$ $^{\circ}C$ 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 $T_j = 25$ $^{\circ}C$			0.8 0.4	Ω Ω
I_s	Supply Current	Off State $T_j \geq 25$ $^{\circ}C$ 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 $T_j = 25$ $^{\circ}C$	5	10	20	μs
t_r	Rise Time Of Output Current	$I_{OUT} = 3$ A Resistive Load Input Rise Time < 0.1 μs $T_j = 25$ $^{\circ}C$	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 $T_j = 25$ $^{\circ}C$	5	15	30	μs
t_f	Fall Time Of Output Current	$I_{OUT} = 3$ A Resistive Load Input Rise Time < 0.1 μs $T_j = 25$ $^{\circ}C$	2	6	15	μs
$(di/dt)_{on}$	Turn-on Current Slope	$I_{OUT} = 3$ A $I_{OUT} = I_{OV}$ $25 \leq T_j \leq 140$ $^{\circ}C$	0.05	0.15	0.5 2	A/ μs A/ μs
$(di/dt)_{off}$	Turn-off Current Slope	$I_{OUT} = 3$ A $I_{OUT} = I_{OV}$ $25 \leq T_j \leq 140$ $^{\circ}C$	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 T _c = 25 °C V _{CC} = 13 V		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 T _c = 85 °C V _{CC} = 13 V		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 ensure 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 occurs in the automotive environment.

TRUTH TABLE

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

Figure 1: Waveforms

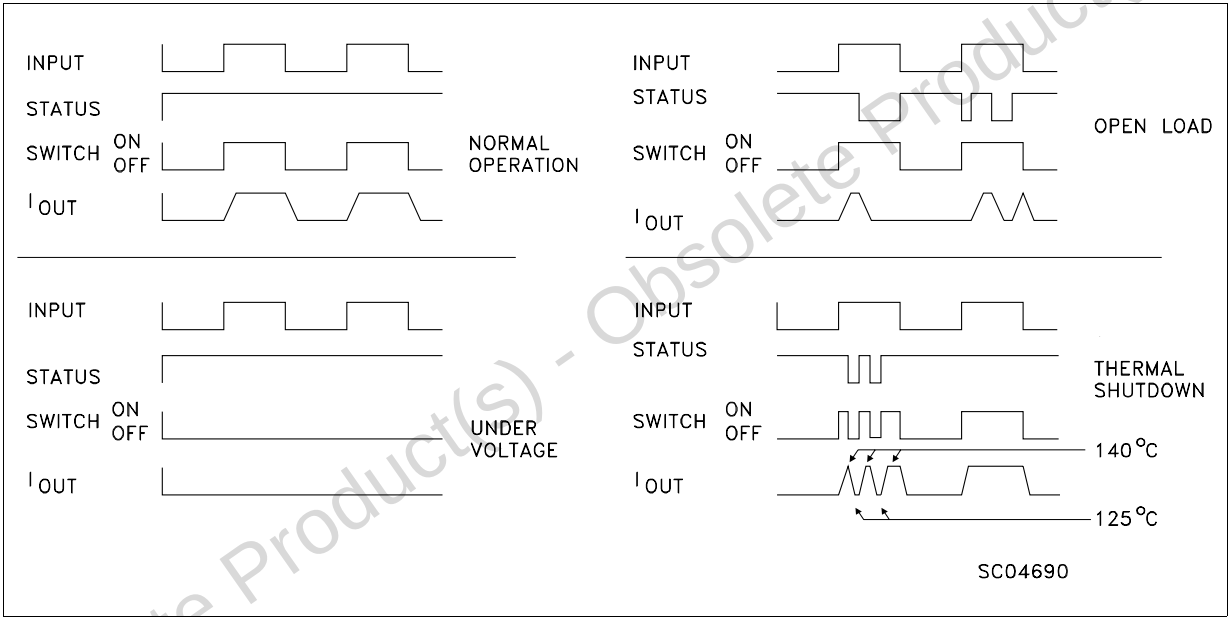


Figure 2: Over Current Test Circuit

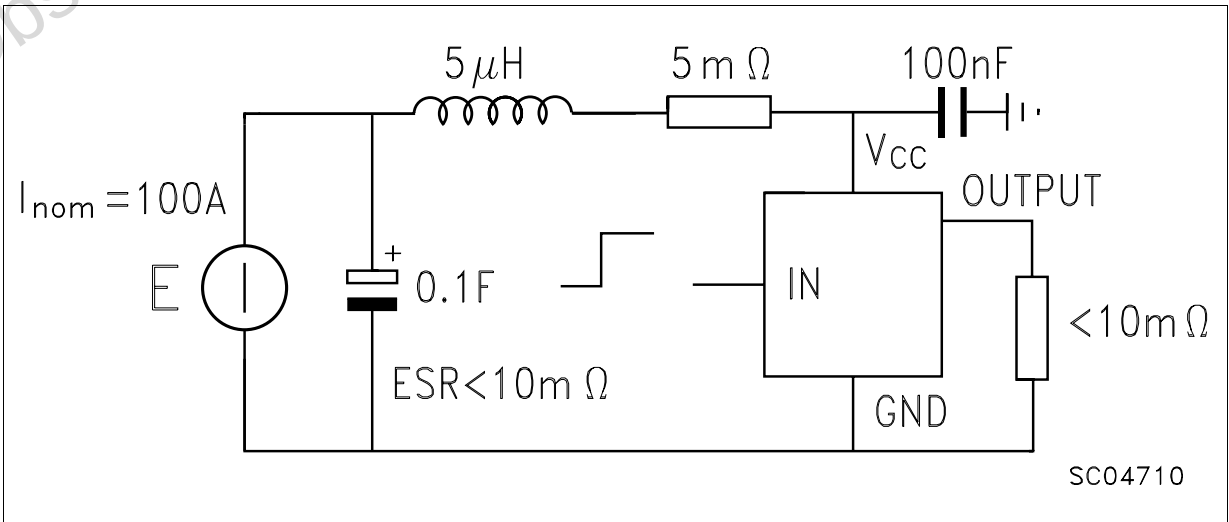


Figure 3: Typical Application Circuit With A Schottky Diode For Reverse Supply Protection

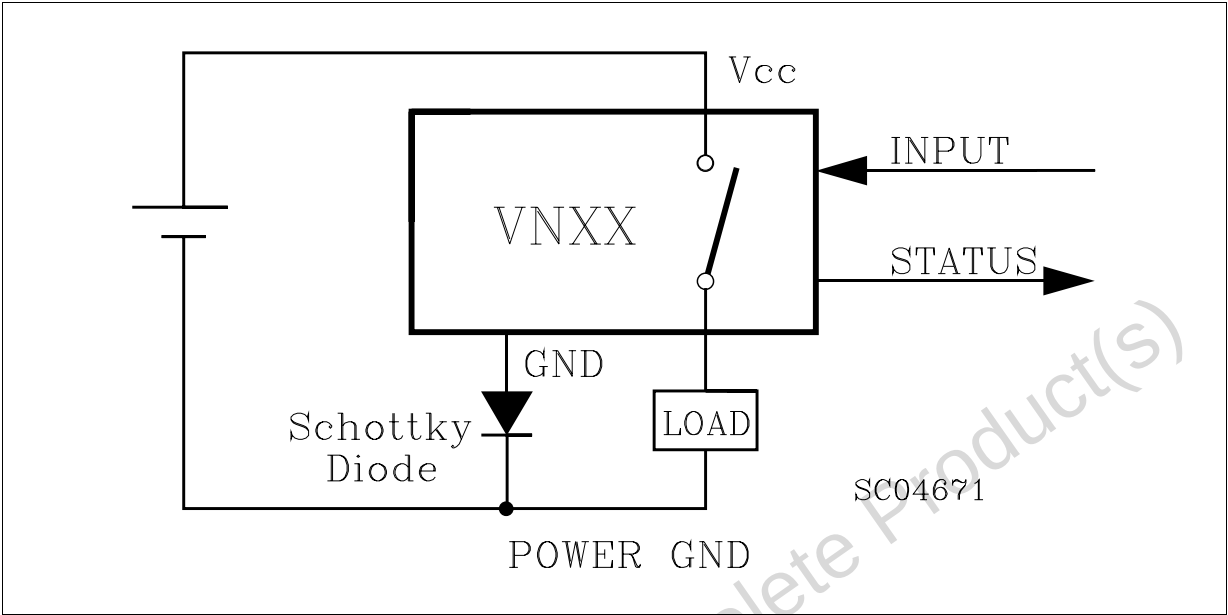
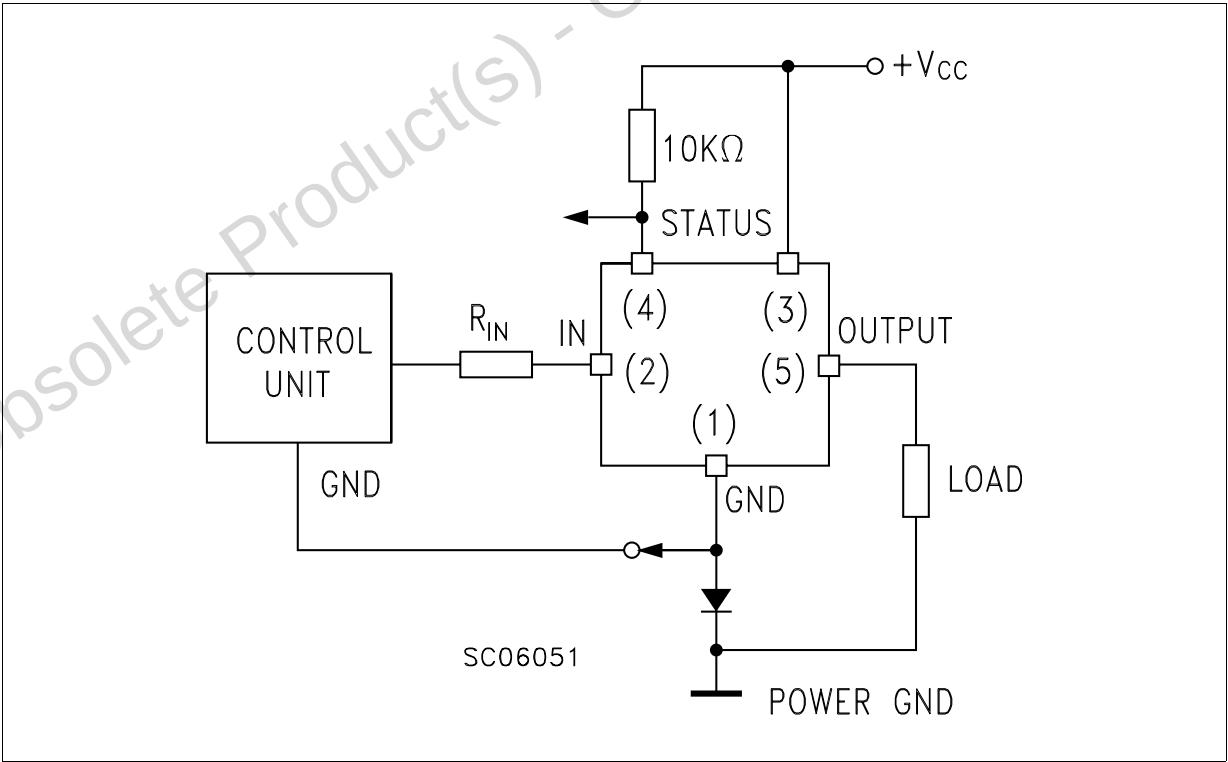
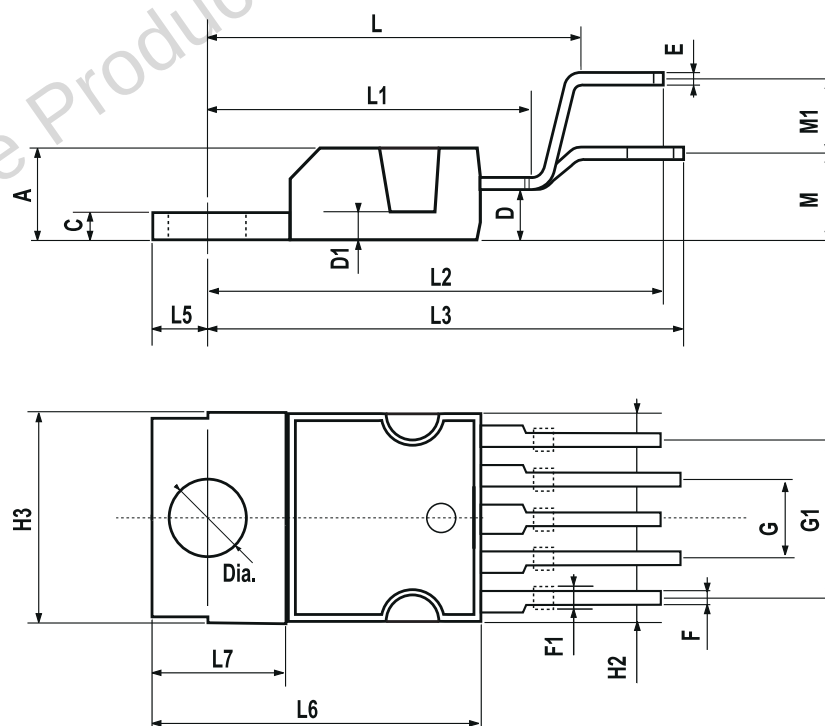


Figure 4: Typical Application Circuit With Separate Signal Ground



PENTAWATT (VERTICAL) MECHANICAL DATA

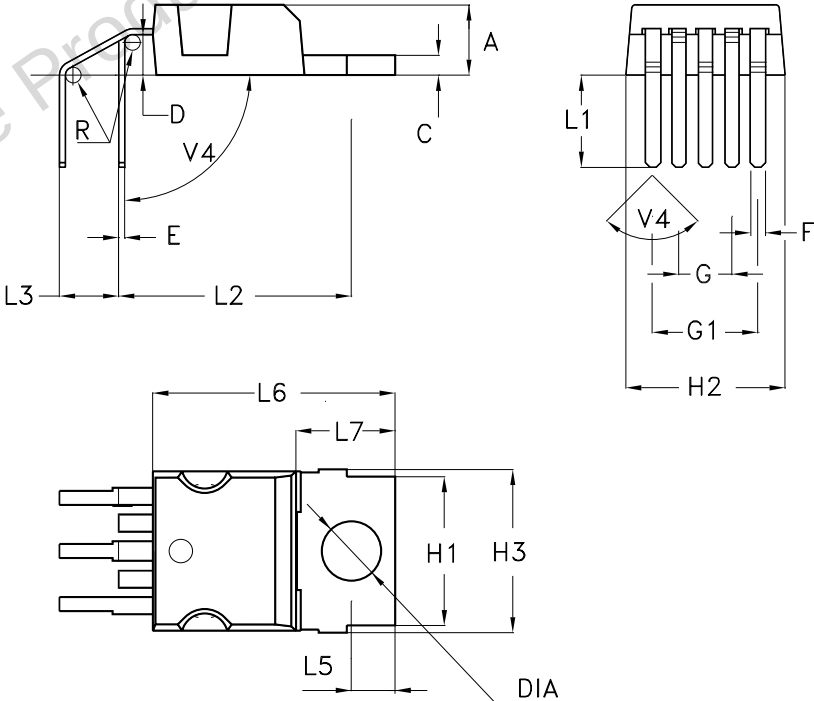
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			4.8			0.189
C			1.37			0.054
D	2.4		2.8	0.094		0.110
D1	1.2		1.35	0.047		0.053
E	0.35		0.55	0.014		0.022
F	0.8		1.05	0.031		0.041
F1	1		1.4	0.039		0.055
G	3.2	3.4	3.6	0.126	0.134	0.142
G1	6.6	6.8	7	0.260	0.268	0.276
H2			10.4			0.409
H3	10.05		10.4	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



P010E

PENTAWATT (HORIZONTAL) MECHANICAL DATA

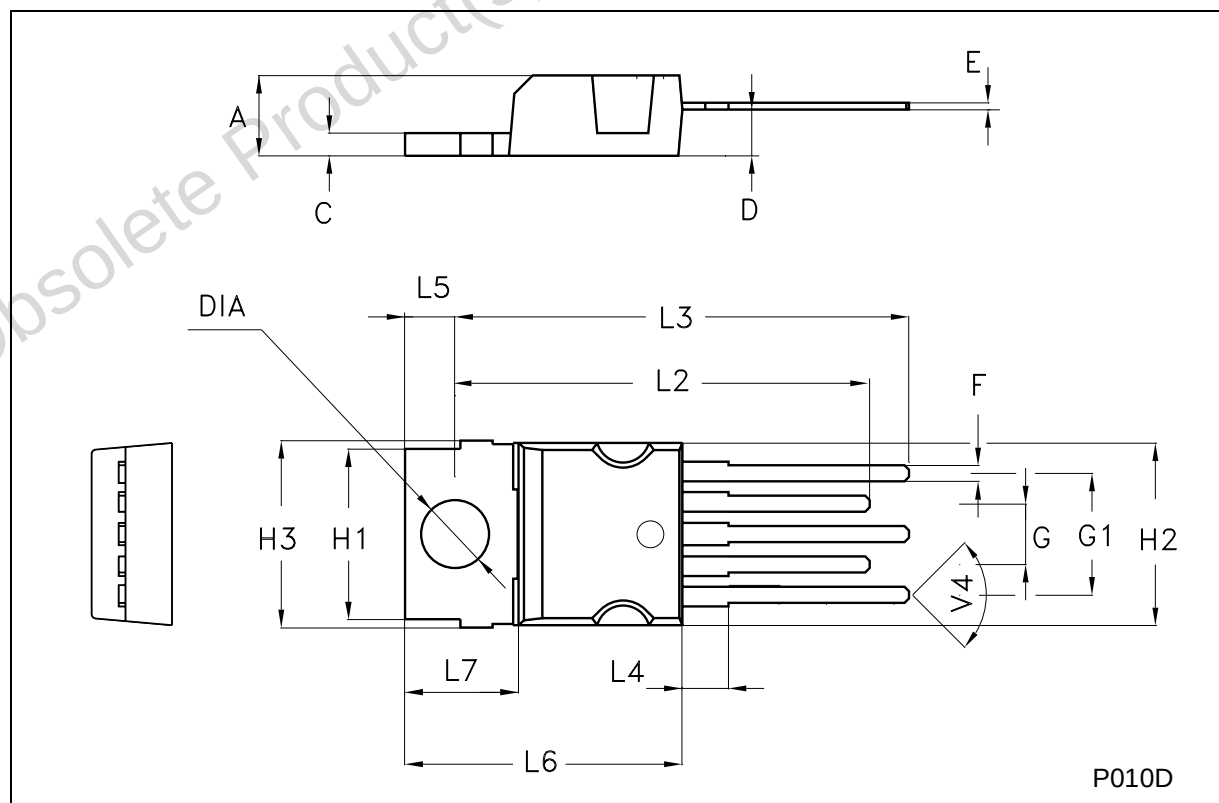
DIM.	mm			inch		
	MIN	TYP	MAX	MIN	TYP	MAX
A	4.30		4.80	0.169		0.189
C	1.17		1.37	0.046		0.054
D	2.40		2.80	0.094		0.110
E	0.35		0.55	0.014		0.021
F	0.80		1.05	0.031		0.041
G	3.20		3.60	0.126		0.142
G1	6.60		7.00	0.260		0.275
H1	9.30		9.70	0.366		0.382
H2			10.40			0.409
H3	10.05		10.40	0.396		0.409
L2	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



PO10L1_E

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



Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2013 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[STMicroelectronics:](#)

[VN02HSP](#) [VN02H](#) [VN02H\(012Y\)](#) [VN02H-12-E](#) [VN02H\(011Y\)](#) [VN02H-11-E](#) [VN02H-E](#) [VN02HSP-E](#) [VN02HSPTR-](#)
[E](#)