



# VN220 VN220(011Y) / VN220(012Y)

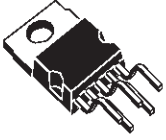
## HIGH SIDE SMART POWER SOLID STATE RELAY

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>OUT</sub>
VN220	60V	0.05Ω	28A
VN220(011Y)			
VN220(012Y)			

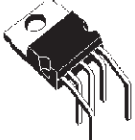
- OUTPUT CURRENT (CONTINUOUS): 28A AT T<sub>C</sub>=25°C
- THERMAL SHUT-DOWN
- UNDERVOLTAGE SHUT-DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUT
- VERY LOW STAND-BY POWER DISSIPATION

### DESCRIPTION

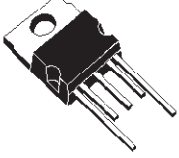
The VN220 is a monolithic device designed in STMicroelectronics VIPOWER™ technology, intended for driving resistive or inductive loads with one side grounded. Built-in thermal shut-down protects the chip from overtemperature and short circuit. The open drain diagnostic output indicates open circuit (no load) and overtemperature status.



**PENTAWATT  
(vertical)**



**PENTAWATT  
(horizontal)**

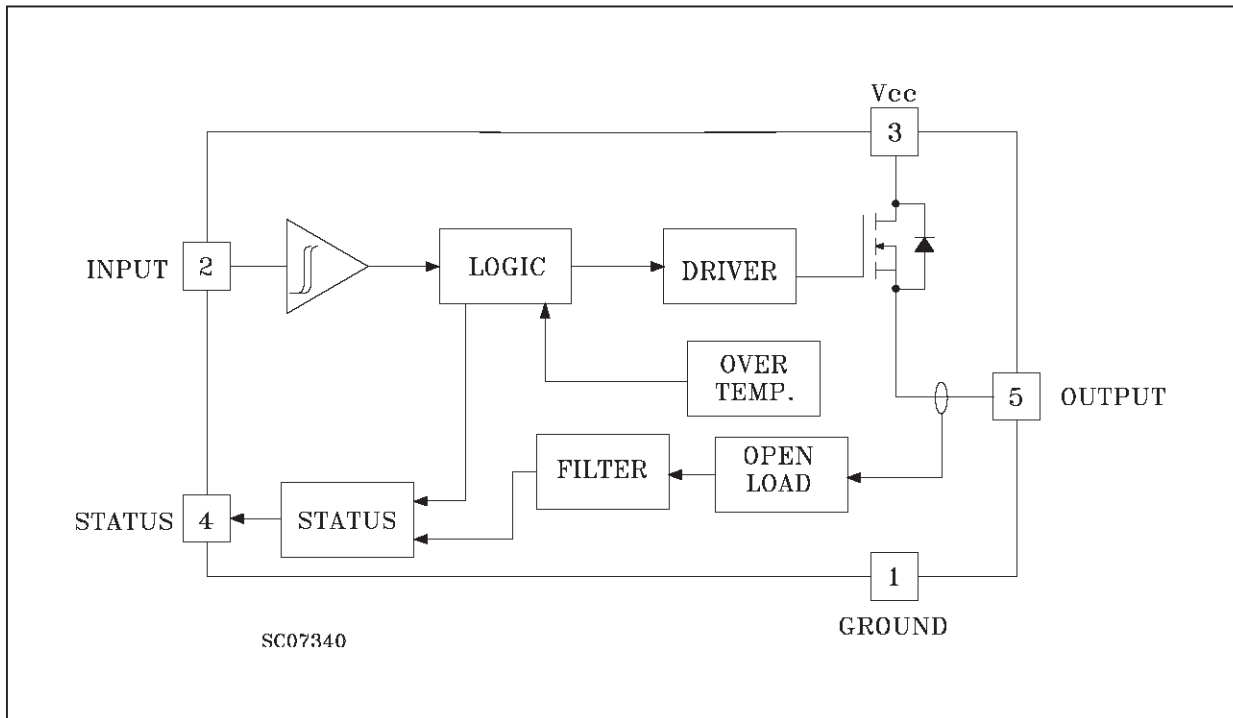


**PENTAWATT  
(in-line)**

**ORDER CODES:**

PENTAWATT vertical	VN220
PENTAWATT horizontal	VN220(011Y)
PENTAWATT in-line	VN220(012Y)

### BLOCK DIAGRAM

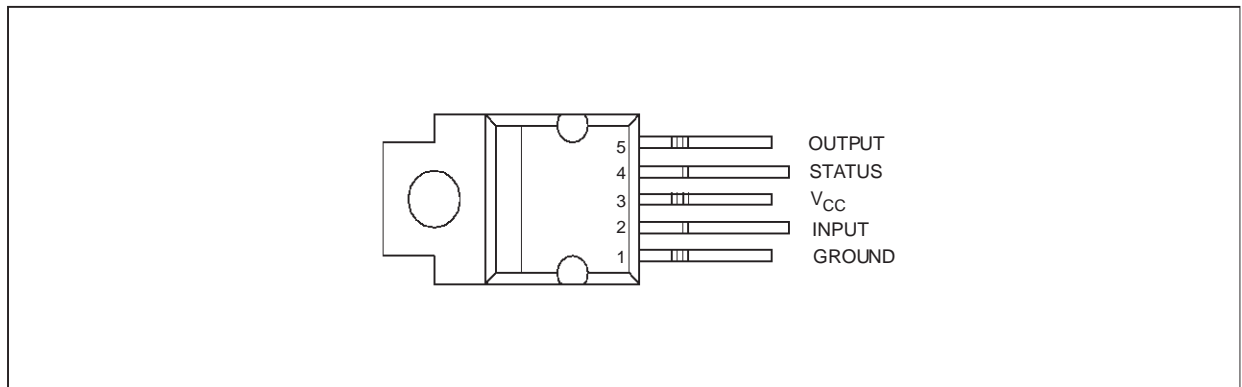


## VN220 / VN220(011Y) / VN220(012Y)

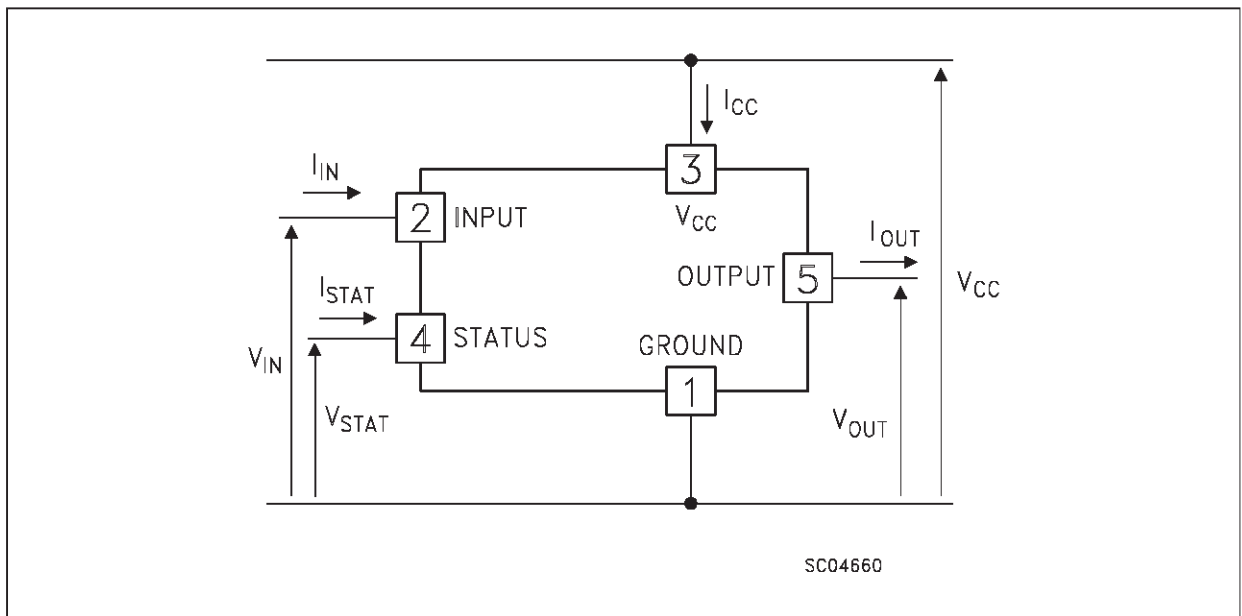
### ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	60	V
$V_{DS(off)}$	Drain-Source Voltage (OFF STATE)	60	V
$V_{DS}$	Drain-Source Voltage (Output Shorted to Ground)	30	V
$I_{OUT}$	Output Current (cont.)	28	A
$I_R$	Reverse Output Current	-28	A
$I_{IN}$	Input Current	+/-10	mA
$V_{IN}$	Input Voltage	35	V
$V_{STAT}$	Status Output Voltage	35	V
$-V_{CC}$	Reverse Supply Voltage	-4	V
$I_{STAT}$	Status Current	+/-10	mA
$V_{ESD}$	Electrostatic Discharge (1.5K $\Omega$ ; 100pF)	2000	V
$P_{tot}$	Power Dissipation at $T_c \leq 25^\circ\text{C}$	60	W
$T_j$	Junction Operating Temperature	-40 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$

### CONNECTION DIAGRAM (TOP VIEW)



### CURRENT AND VOLTAGE CONVENTIONS



## THERMAL DATA

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case (MAX)	2.08	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient (MAX)	60	°C/W

ELECTRICAL CHARACTERISTICS ( $V_{CC}=13V$ ;  $-40^{\circ}C \leq T_J \leq 125^{\circ}C$  unless otherwise specified)

## POWER

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{CC}$	Supply Voltage		12		30	V
$R_{on}$	On State Resistance	$I_{OUT}=3.5A$ $I_{OUT}=100mA$ ; $T_J=25^{\circ}C$			0.05 1.33	$\Omega$ $\Omega$
$I_S$	Supply Current	Off state On State; $T_J=25^{\circ}C$ On State; $T_J=100^{\circ}C$			1 8 6	mA mA mA

## SWITCHING

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on Delay Time of Output Current	$I_{OUT}=3.5A$ ; Resistive Load; Input Rise Time $<0.1\mu s$ ; $T_J=25^{\circ}C$		20		$\mu s$
$t_r$	Rise Time of Output Current	$I_{OUT}=3.5A$ ; Resistive Load; Input Rise Time $<0.1\mu s$ ; $T_J=25^{\circ}C$		200		$\mu s$
$t_{d(off)}$	Turn-off Delay Time of Output Current	$I_{OUT}=3.5A$ ; Resistive Load; Input Rise Time $<0.1\mu s$ ; $T_J=25^{\circ}C$		30		$\mu s$
$t_f$	Fall Time of Output Current	$I_{OUT}=3.5A$ ; Resistive Load; Input Rise Time $<0.1\mu s$ ; $T_J=25^{\circ}C$		5		$\mu s$

## LOGIC INPUT

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{IL}$	Input Low Level Voltage				1.5	V
$V_{IH}$	Input High Level Voltage		6		(*)	V
$V_{I(hyst)}$	Input Hysteresis Voltage			1		V
$I_{IN}$	Input Current	$V_{IN}=10V$			600	$\mu A$
$V_{ICL}$	Input Clamp Voltage	$I_{IN}=1mA$	31	36		V

## PROTECTIONS AND DIAGNOSTIC

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{STAT}$	Status Output Voltage	$I_{STAT}=5mA$ (Fault Condition)		0.9	2.5	V
$I_{STAT}$	Status Output Leakage Current	$V_{STAT}=30V$			100	$\mu A$
$I_{OL}$	Open Load Current Level		3	9	20	mA
$t_{ol}$	Open Load Filtering Time		1		10	ms
$T_{TSD}$	Thermal Shut-down Temperature		150			°C
$T_R$	Reset Temperature		125			°C
$V_{STATCL}(\bullet)$	Diagnostic Input Clamp Voltage	$I_{IN}=1mA$	31	36		V

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

(•) Status determination  $> 100\mu s$  after the switching edge.

### FUNCTIONAL DESCRIPTION

The VN220 provides protection against a short circuit on the output and senses the output current to detect an open load. When one of these two faults is detected the diagnostic output is taken low.

#### OPEN LOAD DETECTION

When the device is first turned on, only the auxiliary DMOS device is turned on. If the load current remains below 9mA (typical), the open load signal is active and the diagnostic output is low. When the load current goes above 9 mA the open load detection becomes inactive and the diagnostic goes high. When the load current exceeds 300 mA, the main DMOS (50 m $\Omega$ ) turns on. When the load current drops below 240 mA, the main DMOS is turned off but no open load signal is generated and the auxiliary DMOS is still turned on. If the load current drops below 9mA, again the open load signal is generated and the diagnostic output goes low.

### SHORT CIRCUIT PROTECTION

Short circuit protection is achieved using the fast response of the thermal shut-down circuit. The only current limitation in this condition is the saturation current of the DMOS devices and the external wiring resistance. Under this condition the device can survive a short circuit up to 30V across DMOS devices.

### THERMAL PROTECTION

The device is internally protected against over temperature by the thermal protection circuit. When the device junction temperature exceeds the protection limit, the output is latched off. To turn on the output again, the input signal must be taken low to reset the latch, then high again to turn on the output. If the junction temperature has not yet cooled below the lower limit set by the thermal sensing hysteresis, the device will remain latched off.

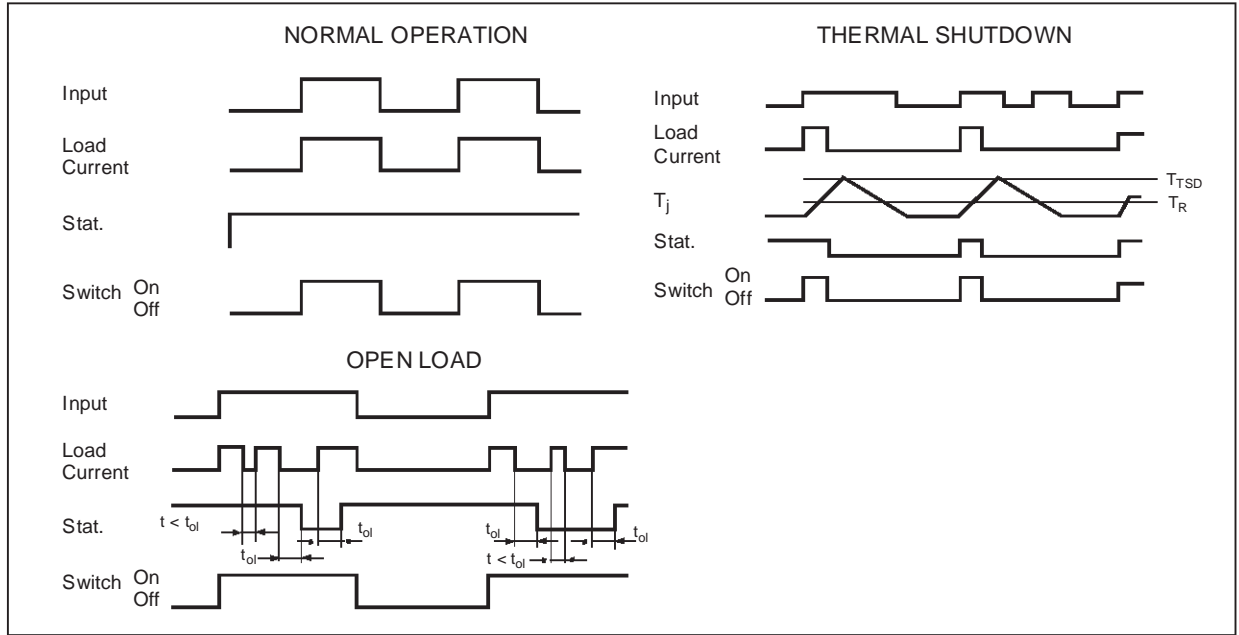
NOTE: When an open load defect appears (or disappears) the state of the diagnostic output changes only after the filtering time ( $t_{\phi}$ ). See open load waveform diagrams.

**TRUTH TABLE**

	INPUT	OUTPUT	DIAGNOSTIC
Normal Operation	L	L	H
	H	H	H
Open Circuit (No Load)	H	H	L (**)
Overtemperature	H	L	L

(\*\*) With filtering operation

**FIGURE 1: Waveforms**



**FIGURE 2: Over Current Test Circuit**

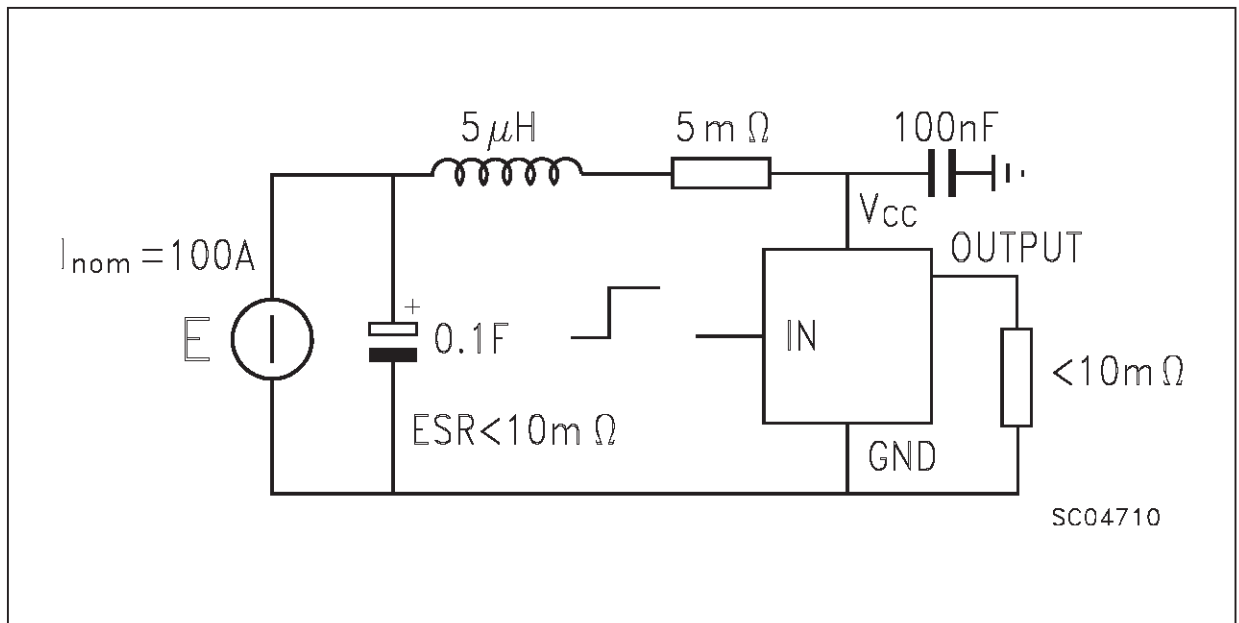


FIGURE 3: Typical Application Circuit with a Schottky Diode for Reverse Supply Protection

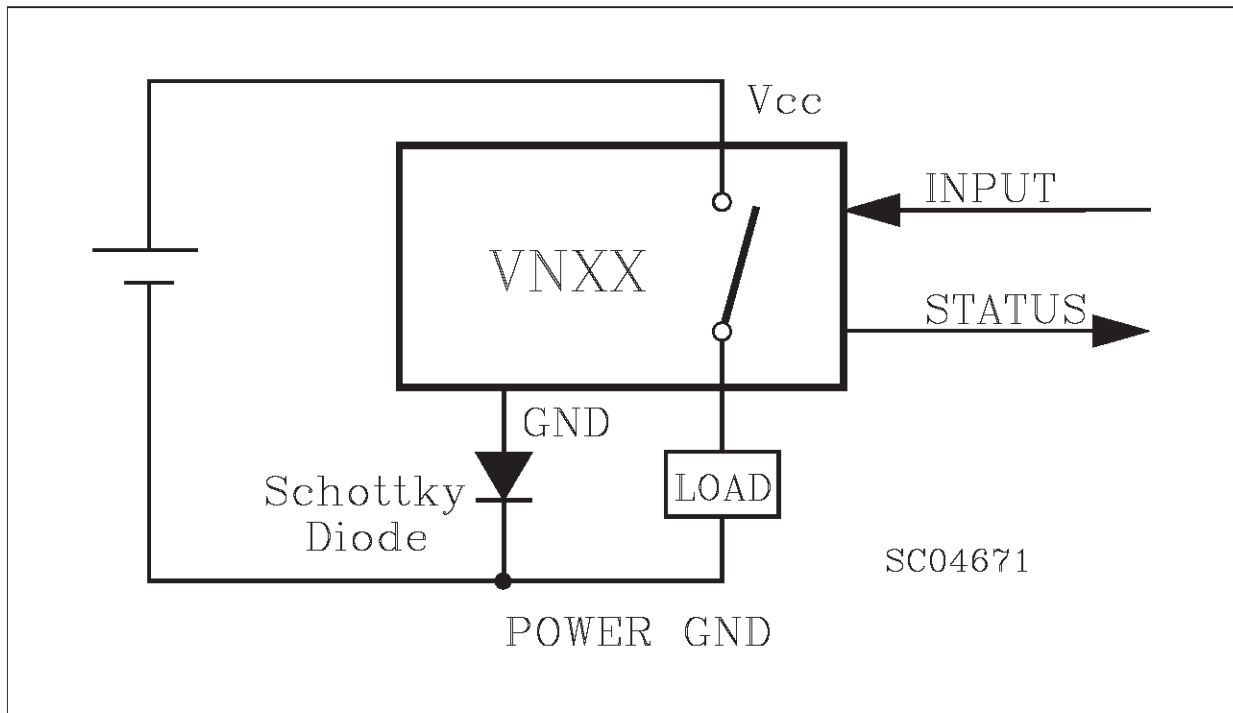
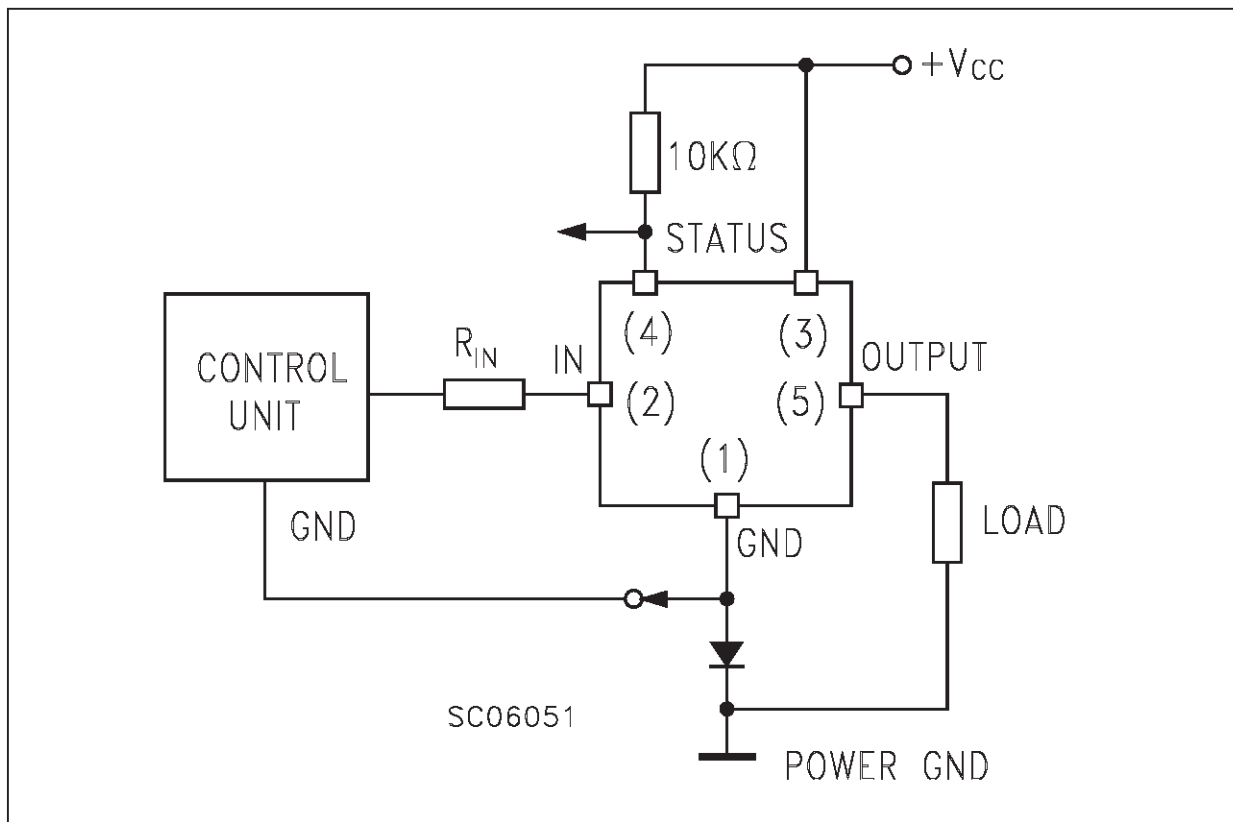
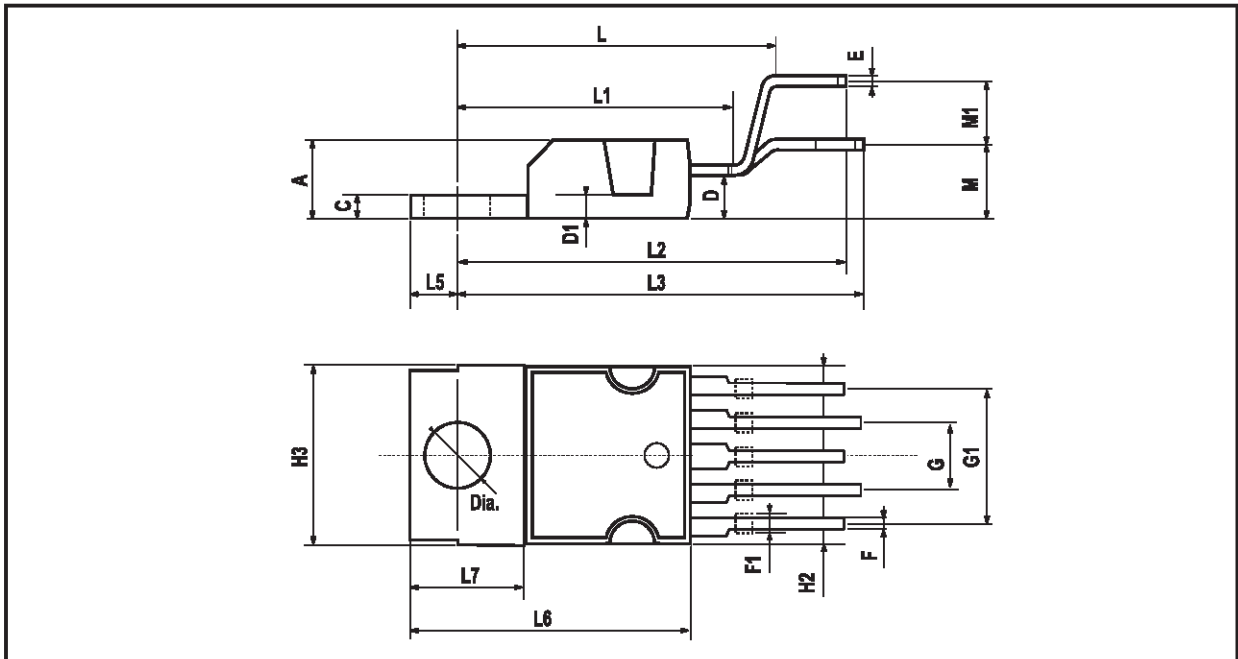


FIGURE 4: Typical Application Circuit with Separate Signal Ground



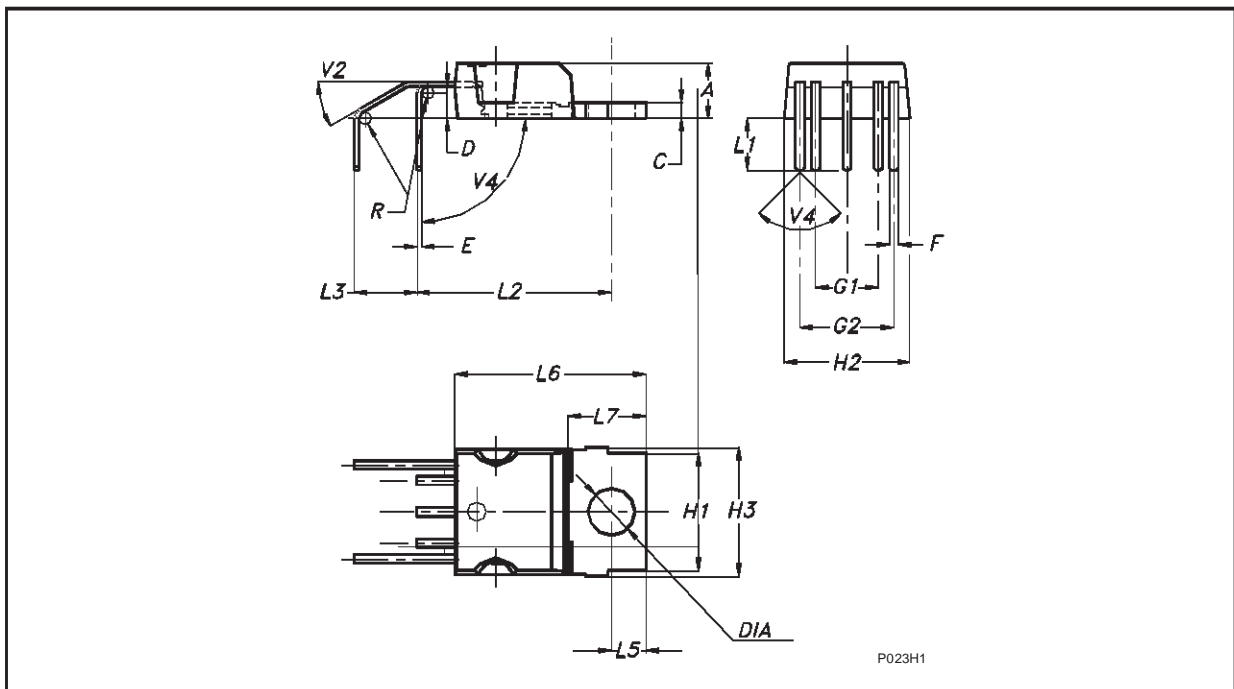
**PENTAWATT (vertical) MECHANICAL DATA**

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	
Diam.	3.65		3.85	0.144		0.152



**PENTAWATT HV 011Y (horizontal) MECHANICAL DATA**

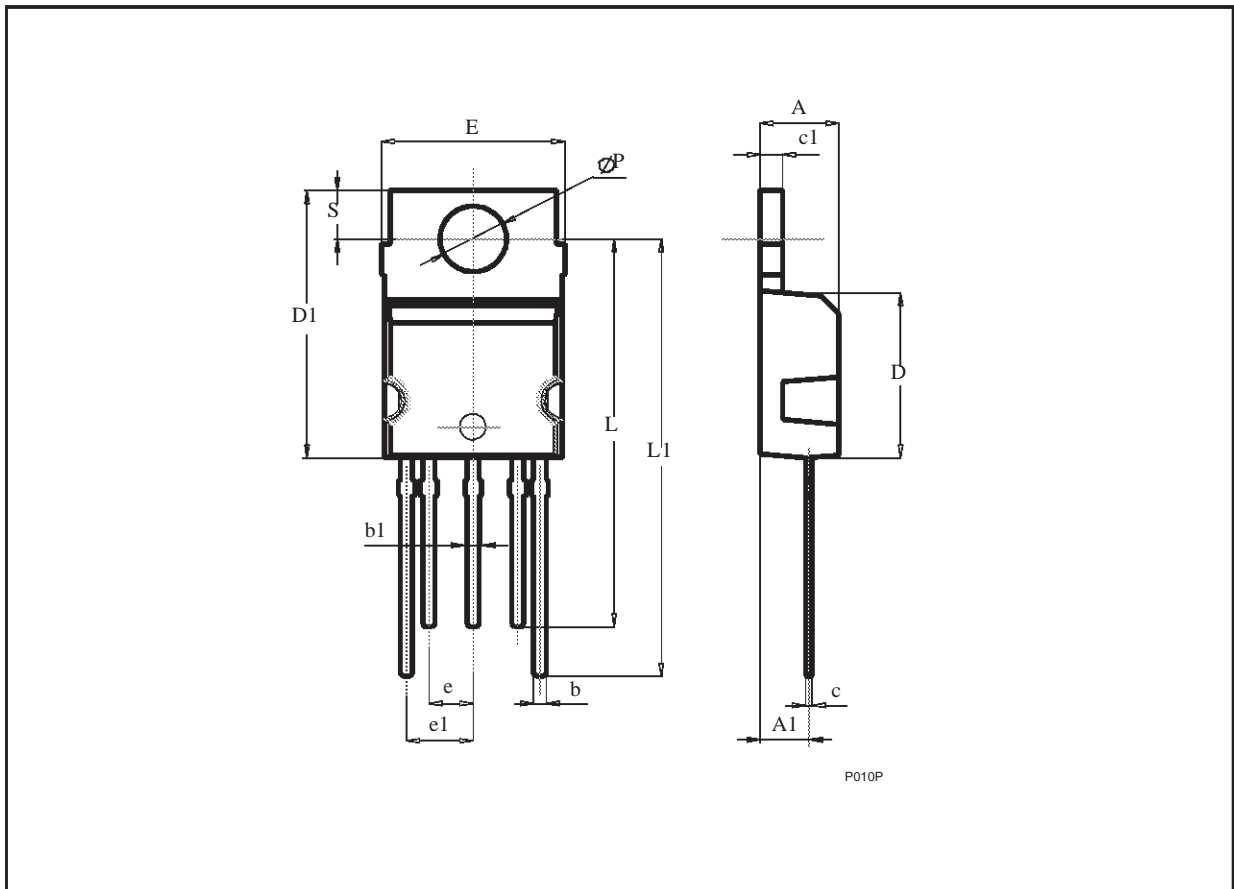
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.30		4.80	0.169		0.189
C	1.17		1.37	0.046		0.054
D	2.40		2.80	0.094		0.11
E	0.35		0.55	0.014		0.022
F	0.60		0.80	0.024		0.031
G1	4.91		5.21	0.193		0.205
G2	7.49		7.80	0.295		0.307
H1	9.30		9.70	0.366		0.382
H2			10.40			0.409
H3		10.05	10.40		0.396	0.409
L1	3.90		4.50	0.154		0.177
L2	15.10		16.10	0.594		0.634
L3	4.80		5.40	0.189		0.213
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		0.26
R		0.5				
V2	30° (typ)					
V4	90° (typ)					
DIA	3.65		3.85	0.144		0.152





**PENTAWATT HV 012Y (in line) MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.3		4.8	0.169		0.189
A1	2.5		3.1	0.098		0.122
b	0.6		0.8	0.024		0.031
b1	0.75		0.9	0.03		0.035
c	0.35		0.55	0.014		0.022
c1	1.22		1.42	0.048		0.056
D	9		9.35	0.354		0.368
D1	15.2		15.8	0.598		0.622
e	2.44		2.64	0.096		0.104
e1	3.71		3.91	0.146		0.154
E	10		10.4	0.394		0.409
L	22.32		22.92	0.879		0.902
L1	25.1		25.7	0.988		1.012
P	3.65		3.95	0.144		0.156
S	2.55		3.05	0.1		0.12



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