



# VB029 / VB029SP VB029(011Y) / VB029(012Y)

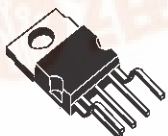
## HIGH VOLTAGE IGNITION COIL DRIVER POWER I.C.

TYPE	V <sub>cl</sub>	I <sub>cl</sub>	I <sub>d(on)</sub>
VB029	320V	12A	230mA
VB029SP			
VB029(011Y)			
VB029(012Y)			

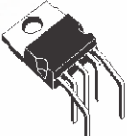
- PRIMARY COIL VOLTAGE INTERNALLY SET
- COIL CURRENT LIMIT INTERNALLY SET
- LOGIC LEVEL COMPATIBLE INPUT
- DRIVING CURRENT QUASI PROPORTIONAL TO COLLECTOR CURRENT
- DOUBLE FLAG-ON COIL CURRENT
- DARLINGTON BASE ACCESSIBLE

### DESCRIPTION


The VB029, VB029SP, VB029(011Y) VB029(012Y) are a high voltage power integrated circuit designed in STMicroelectronics VIPower™ technology, with vertical current flow power darlington and logic level compatible driving circuit. Built-in protection circuit for coil current limiting and collector voltage clamping allows the device to be used as smart, high voltage, high



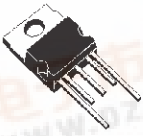
**PENTAWATT HV**



**PENTAWATT HV (011Y)**



**PowerSO-10™**



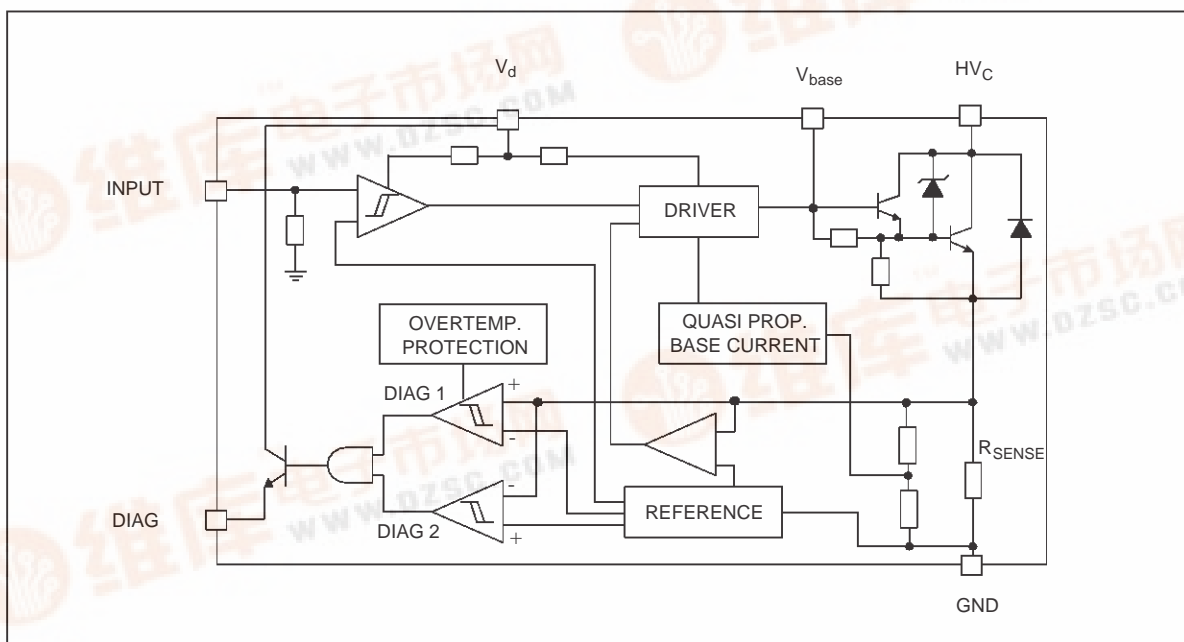
**PENTAWATT HV (012Y)**

**ORDER CODES:**

PowerSO-10™	VB029SP
PENTAWATT HV	VB029
PENTAWATT HV (011Y)	VB029(011Y)
PENTAWATT HV (012Y)	VB029(012Y)

current interface in advanced electronic ignition system.

### BLOCK DIAGRAM



## VB029 / VB029SP / VB029(011Y) / VB029(012Y)

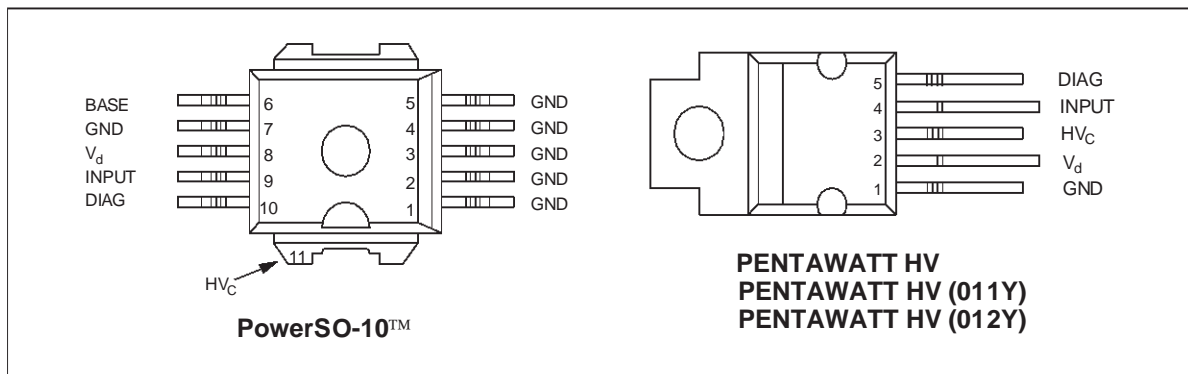
### ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
$HV_C$	Collector voltage	Internally limited	V
$I_C$	Collector current	Internally limited	A
$V_d$	Driving stage supply voltage	7	V
$I_d$	Driving circuitry supply current	230	mA
$V_{IN}$	Input voltage	10	V
$T_j$	Junction operating temperature	-40 to 150	°C
$T_{stg}$	Storage temperature	-55 to 150	°C

### THERMAL DATA

Symbol	Parameter		Value		Unit
			PowerSO-10™	PENTAWATT HV	
$R_{thj-case}$	Thermal resistance junction-case	(MAX)	1.12	1.12	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	(MAX)	62.5	62.5	°C/W

### CONNECTION DIAGRAM (TOP VIEW)



### PIN FUNCTION (PowerSO-10™)

No	Name	Function
1÷5	GND	Emitter power ground
6	BASE	Darlington base
7(*)	GND	Control ground
8	$V_d$	Driving stage supply voltage
9	INPUT	Logic input channel
10	DIAG	Diagnostic output signal
TAB	$HV_C$	Primary coil output signal

(\*) Pin 1÷5=Power GND, Pin 7=signal GND. Pin 7 must be connected to pins 1÷5 externally.

### PIN FUNCTION (PENTAWATT HV)

No	Name	Function
1	GND	Emitter power ground
2	$V_d$	Driving stage supply voltage
3	$HV_C$	Primary coil output signal
4	INPUT	Logic input channel
5	DIAG	Diagnostic output signal

## VB029 / VB029SP / VB029(011Y) / VB029(012Y)

**ELECTRICAL CHARACTERISTICS** ( $V_{CC}=13.5V$ ;  $V_d=5V$ ;  $T_j=25^\circ C$ ;  $R_{coil}=510m\Omega$ ;  $L_{coil}=7mH$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{cl}$	High voltage clamp	$-40^\circ C \leq T_j \leq 125^\circ C$ ; $I_C=6A$	320	360	420	V
$V_{cg(sat)td}$	Power stage saturation voltage derating in temperature	$I_C=7.6A$ ; $V_{IN}=4V$ ; $-40^\circ C \leq T_j \leq 80^\circ C$			2.5	V
		$I_C=7.6A$ ; $V_{IN}=4V$ ; $80^\circ C \leq T_j \leq 125^\circ C$			2.8	V
$I_{d(off)}$	Power-off supply current	$V_{IN}=0.4V$			10	mA
$I_{d(on)}$	Power-on supply current	$V_{IN}=4V$ ; $I_C=7.6A$ ; $-40^\circ C \leq T_j \leq 125^\circ C$			230	mA
$V_d$	Driving stage supply voltage		4.5		5.5	V
$I_{cl}$	Collector current limit	$V_{IN}=4V$ ; $-40^\circ C \leq T_j \leq 125^\circ C$ ; (See note 1)			12	A
$V_{INH}$	High level input voltage		4		5.5	V
$V_{INL}$	Low level input voltage		0		0.8	V
$I_{INH}$	High level input current	$V_{IN}=4V$			200	$\mu A$
$V_{diagH}$	High level diagnostic output voltage	$R_{EXT}=22K\Omega$ (See figure 1)	3.5	(*)	$V_d$	V
$V_{diagL}$	Low level diagnostic output voltage	$R_{EXT}=22K\Omega$ (See figure 1)			0.5	V
$I_{C(diag1)}$	First threshold level collector current		2.15	2.5	2.85	A
$I_{C(diag1)td}$	First threshold level collector current drift with temperature	(See figure 3)				
$I_{C(diag2)}$	Second threshold level collector current		6.1	6.5	6.9	A
$I_{C(diag2)td}$	Second threshold level collector current drift with temperature	(See figure 4)				
$t_{d(off)}$	Turn-off delay time of output current	$I_C=6A$ (See note 2)		25		$\mu s$
$t_{f(off)}$	Turn-off fall time of output current	$I_C=6A$		8		$\mu s$
$t_{d(diag)}$	Delay time of diagnostic current	$R_{EXT}=22K\Omega$ (See figure 1)		1		$\mu s$
$t_{r(diag)}$	Turn-on rise time of diagnostic current	$R_{EXT}=22K\Omega$ (See figure 1)		1		$\mu s$
$t_{f(diag)}$	Turn-off fall time of diagnostic current	$R_{EXT}=22K\Omega$ (See figure 1)		1		$\mu s$
$\Delta I_{th}$	Thermal flag shift on first threshold	$T_j > 125^\circ C$ (**)	1			A
$E_{s/b}$	Single pulse avalanche energy		300			mJ

Note 1: the primary coil current value  $I_{cl}$  must be measured 1ms after desaturation of the power stage.

Note 2: time from input switching  $V_{NEG}$  until collector voltage equal to 200V.

(\*)  $V_d - V_{be(on)}$

(\*\*) This thermal flag shift cannot be activated for lower than  $125^\circ C$ .

## VB029 / VB029SP / VB029(011Y) / VB029(012Y)

### PRINCIPLE OF OPERATION

The VB029, VB029SP, VB029(011Y) VB029(012Y) are mainly intended as high voltage power switch device driven by a logic level input and interfaces directly to a high energy electronic ignition coil.

The input  $V_{IN}$  of the VB029, VB029SP, VB029(011Y) VB029(012Y) are fed from a low power signal generated by an external controller that determines both dwell time and ignition point. During  $V_{IN}$  high ( $\geq 4V$ ) the VB029, VB029SP, VB029(011Y) VB029(012Y) increase current in the coil to the desired, internally set current level.

When the collector current exceeds 4.5A, the diagnostic signal is turned high and it remains so, until the load current reaches 5.8A (second threshold). At that value, the diagnostic signal is turned low, and the  $\mu C$  forces the  $V_{IN}$  to the low state. During the coil current switch-off, the primary voltage  $HV_C$  is clamped by a series of Zener diodes at an internally set value  $V_{cl}$ , typically 360V.

The collector current sensed through the  $R_{sense}$ , is limited thanks to the "Current limiter" block that, as soon as the  $I_{cl}$  level is reached, forces the darlington (using the "Driver" block) to limit the current provided.

The transition from saturation to desaturation, coil current limiting phase, must have the ability to accommodate an overvoltage. A maximum overshoot of 20V is allowed.

There can be some short period of time in which the output pin ( $HV_C$ ) is pulled below ground by a negative current due to leakage inductances and stray capacitances of the ignition coil. This can cause parasitic glitches on the diagnostic output. VB029, VB029SP, VB029(011Y) VB029(012Y) have a built-in protection circuit that allows to lock the p-buried layer potential of the linear stage to the collector power, when the last one is pulled underground.

### THERMAL BEHAVIOUR

You can see in the block diagram of the VB029, VB029SP, VB029(011Y) VB029(012Y) a box called overtemperature protection. The purpose of this circuit is to shift the current level at which the first diagnostic is activated down of about 1A.

This information can be managed by the micro that can take the corrective action in order to reduce the power dissipation. This block is not an effective protection but just an overtemperature detection. The shift down of the first flag level cannot be present for temperatures lower than 125°C.

As an example of its behavior you can suppose a very simple motor management system in which the micro does just a simple arithmetic calculation to decide when to switch-off the device after the first flag threshold.

### EXAMPLE:

$I_{C(DIAG1)}$  info after x ms ( $I_{C(DIAG1)}=2.5A$ )

$I_{switch-off}$  info after kx ms.

As soon as the temperature rises over the overtemp threshold, the first diagnostic is shifted down to about 1.5A and, in this example, the switch-off current will be  $kx \cdot 1.5 / 2.5$ .

### OVERVOLTAGE

The VB029, VB029SP, VB029(011Y) VB029(012Y) can withstand the following transients of the battery line:

-100V / 2ms ( $R_i=10\Omega$ )

+100V / 0.2ms ( $R_i=10\Omega$ )

+50V / 400ms ( $R_i=4.2\Omega$ , with  $V_{IN}=3V$ )

FIGURE 1: Application circuit

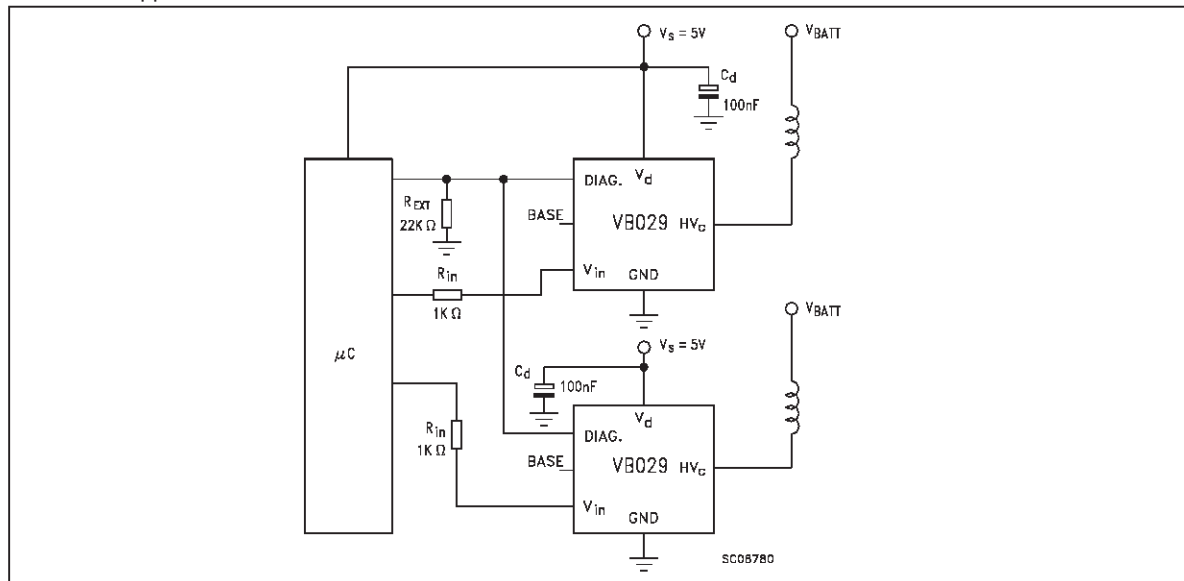


FIGURE 2: Switching waveform

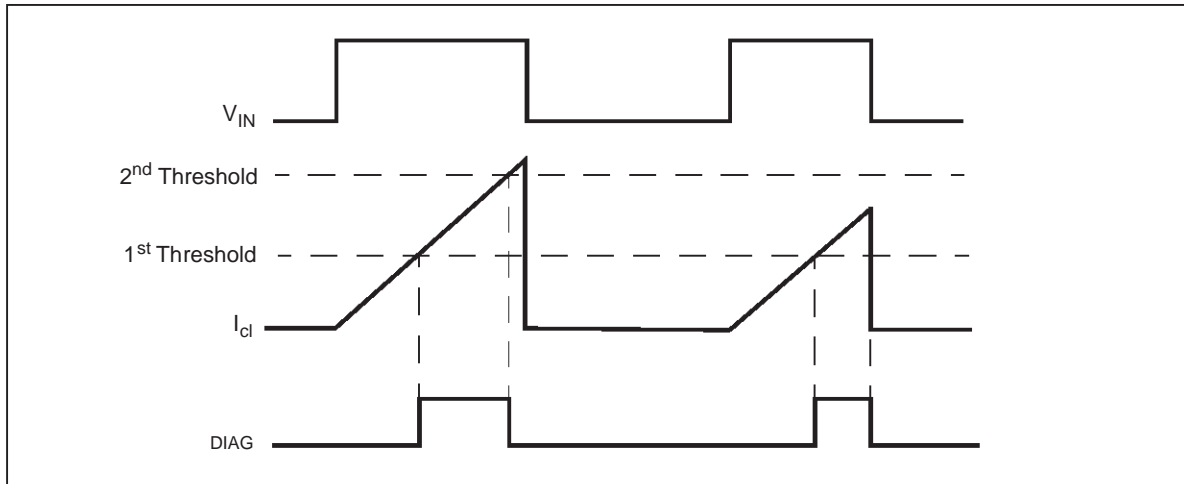


FIGURE 3: Maximum  $I_{C(diag1)}$  VS temperature

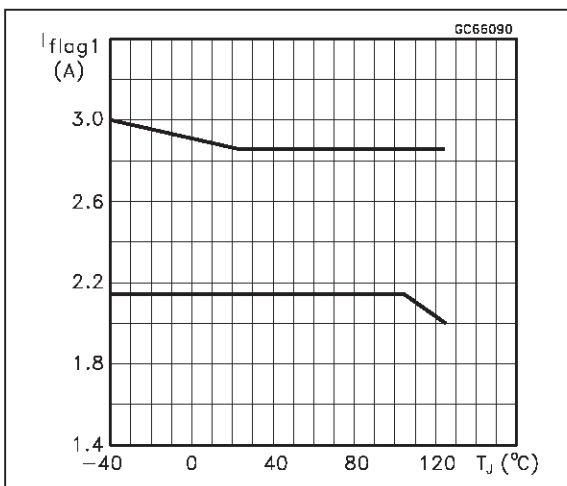


FIGURE 5: Typical  $V_{cg(sat)}$  VS temperature ( $V_d=4.5V$ )

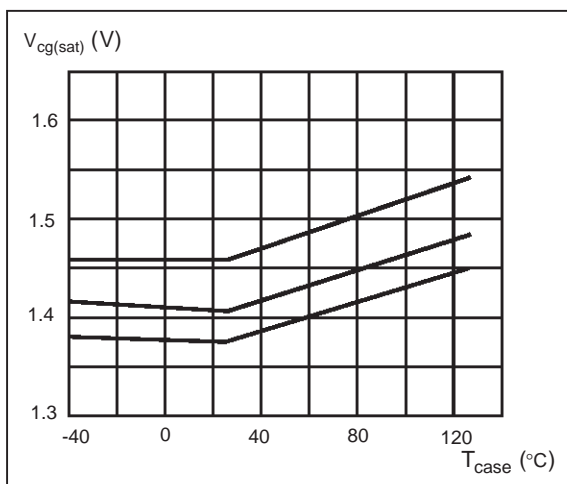


FIGURE 4:  $I_{C(diag2)}$  VS temperature

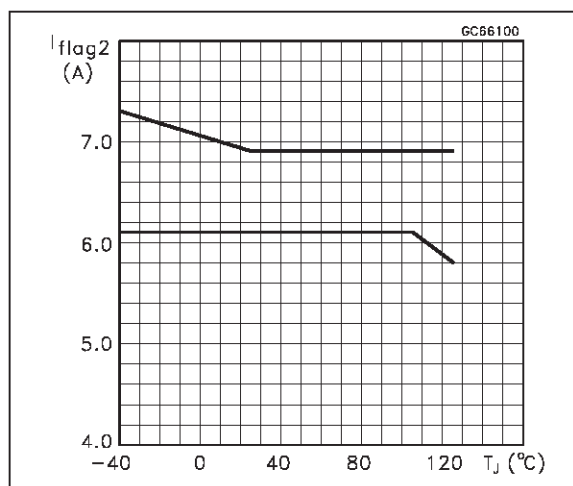
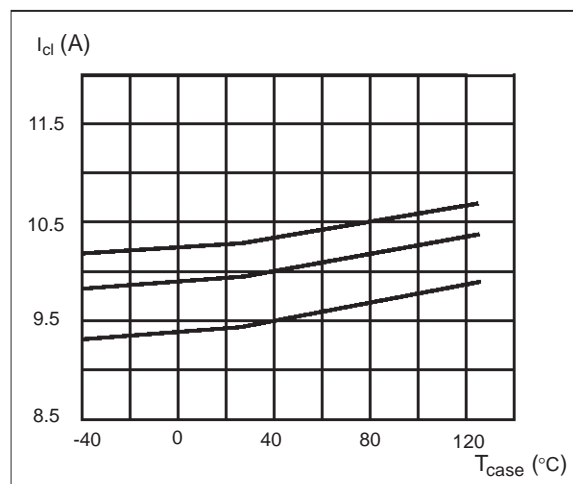
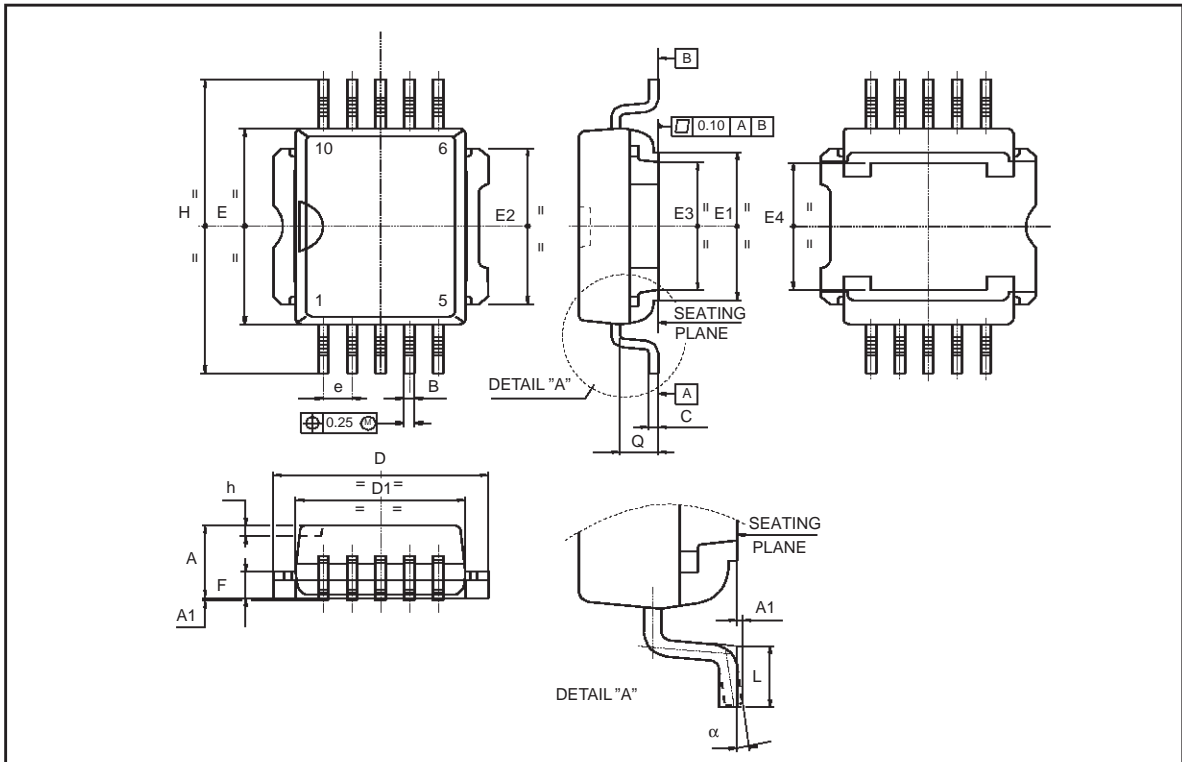


FIGURE 6: Typical  $I_{cl}$  VS temperature



**PowerSO-10™ MECHANICAL DATA**

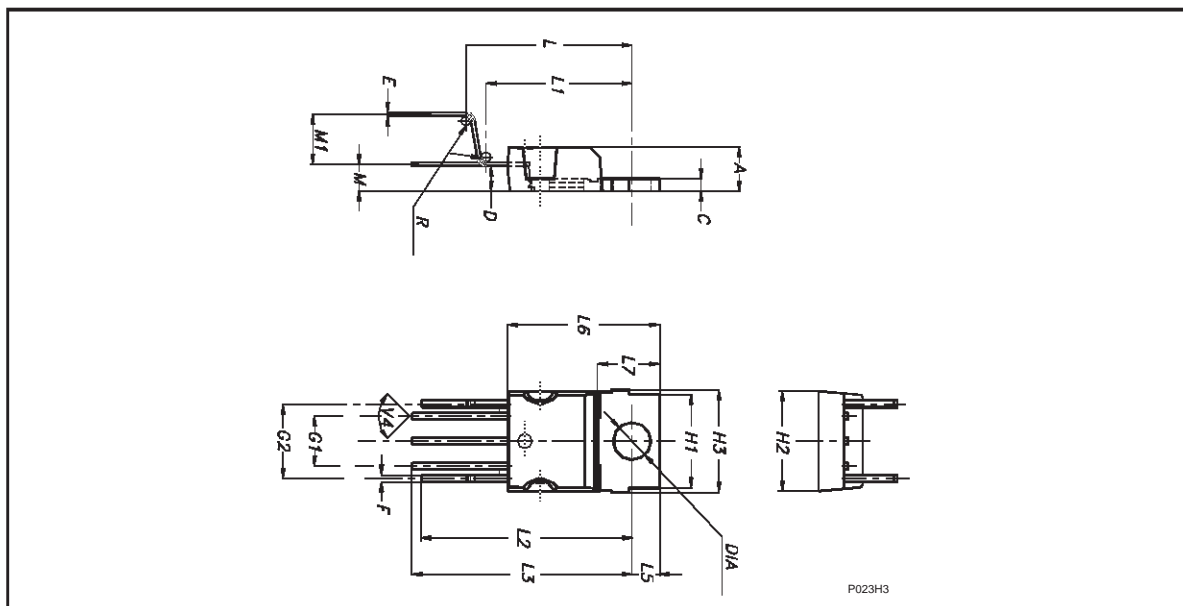
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	3.35		3.65	0.132		0.144
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
c	0.35		0.55	0.013		0.022
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E1	7.20		7.40	0.283		0.291
E2	7.20		7.60	0.283		300
E3	6.10		6.35	0.240		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	
$\alpha$	0°		8°			



VB029 / VB029SP / VB029(011Y) / VB029(012Y)

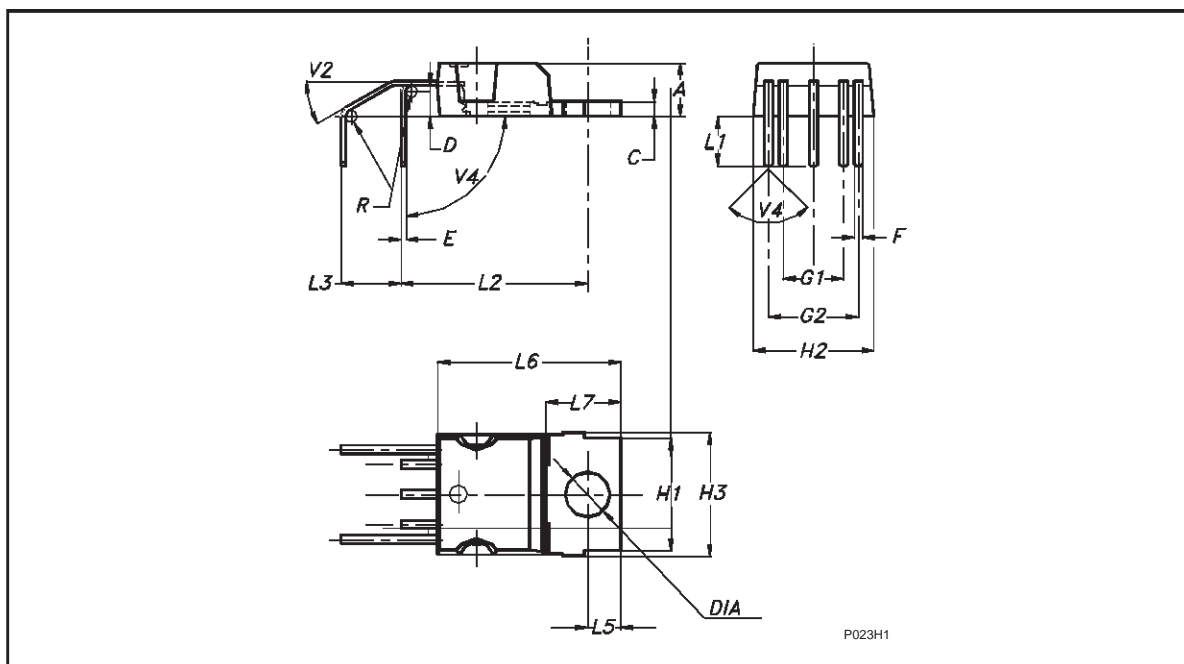
**PENTAWATT HV MECHANICAL DATA**

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
L	15.60		17.30	6.14		0.681
L1	14.60		15.22	0.575		0.599
L2	21.20		21.85	0.835		0.860
L3	22.20		22.82	0.874		0.898
L5	2.60		3	0.102		0.118
L6	15.10		15.80	0.594		0.622
L7	6		6.60	0.236		0.260
M	2.50		3.10	0.098		0.122
M1	4.50		5.60	0.177		0.220
R	0.50			0.02		
V4	90° (typ)					
Diam	3.65		3.85	0.144		0.152



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

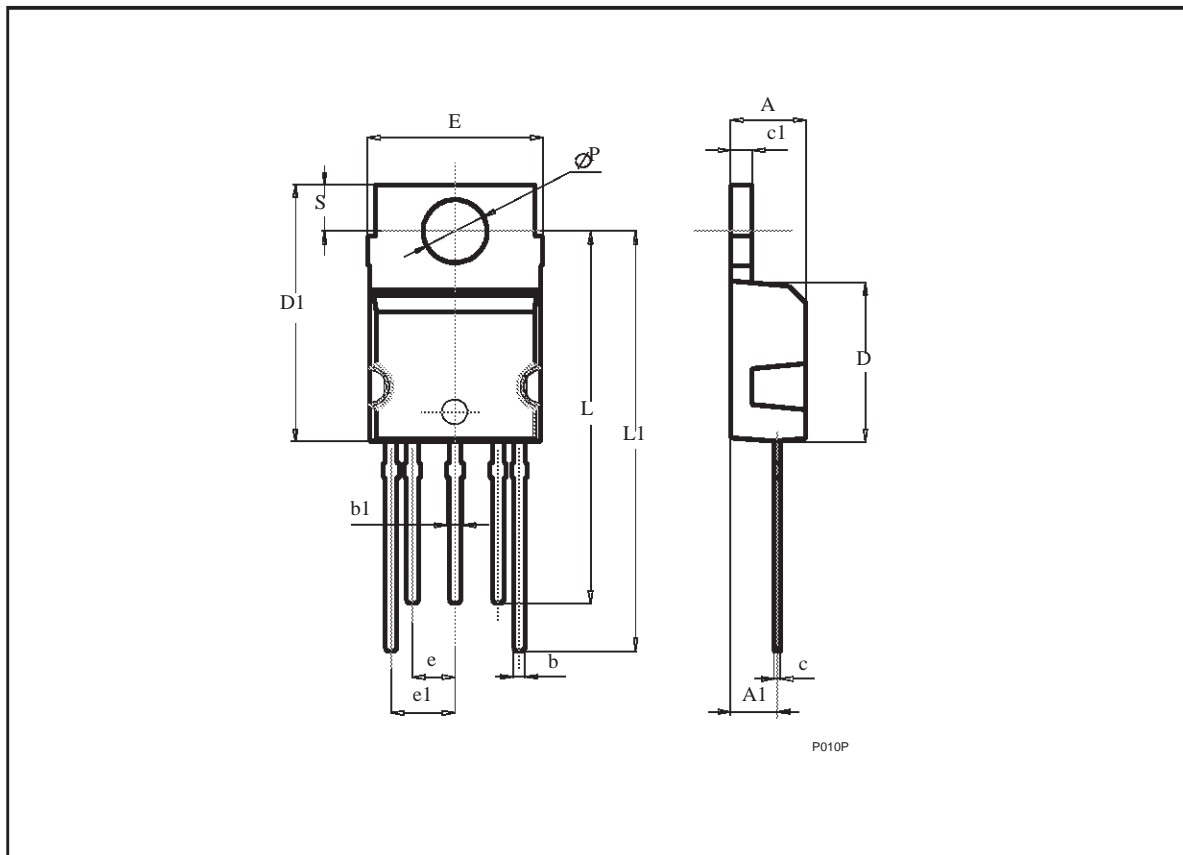
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.30		4.80	0.169		0.189
C	1.17		1.37	0.046		0.054
D	2.40		2.80	0.094		0.11
E	0.35		0.55	0.014		0.022
F	0.60		0.80	0.024		0.031
G1	4.91		5.21	0.193		0.205
G2	7.49		7.80	0.295		0.307
H1	9.30		9.70	0.366		0.382
H2			10.40			0.409
H3		10.05	10.40		0.396	0.409
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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