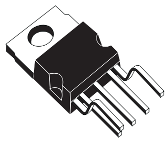
VB027
VB027(011Y) / VB027(012Y)

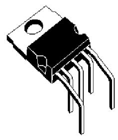
HIGH VOLTAGE IGNITION COIL DRIVER POWER I.C.

TYPE	$V_{cl(min)}$	$I_{cl(max)}$	$I_{d(on)max}$
VB027 VB027(011Y) VB027(012Y)	300V	9A	130mA

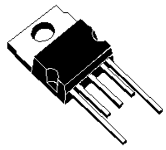
- PRIMARY COIL VOLTAGE INTERNALLY SET
- COIL CURRENT LIMIT INTERNALLY SET
- LOGIC LEVEL COMPATIBLE INPUT
- DRIVING CURRENT QUASI PROPORTIONAL TO COLLECTOR CURRENT
- DOUBLE FLAG-ON COIL CURRENT



PENTAWATT HV



PENTAWATT HV (011Y)



PENTAWATT HV (012Y)

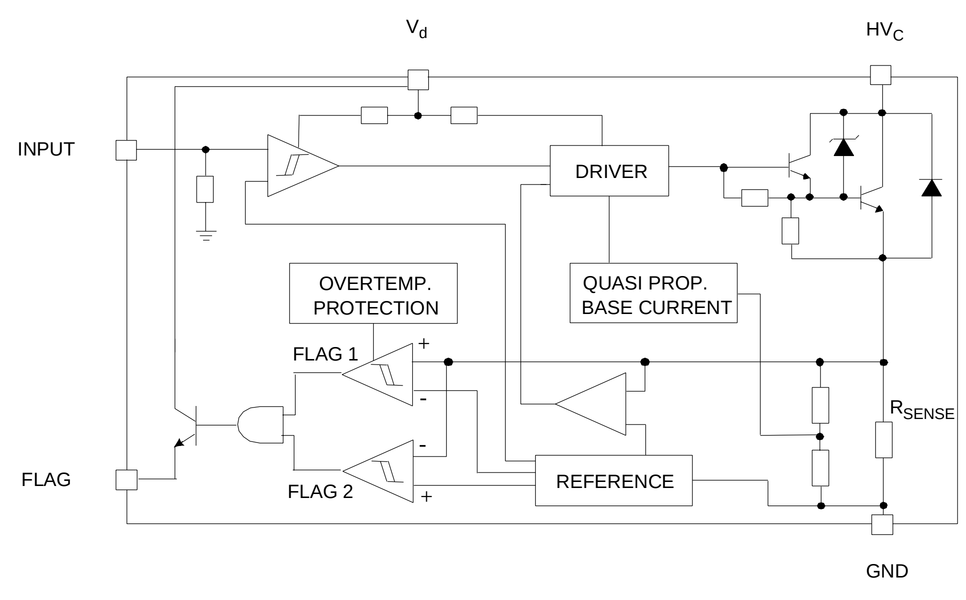
ORDER CODES:

PENTAWATT HV	VB027
PENTAWATT HV (011Y)	VB027(011Y)
PENTAWATT HV (012Y)	VB027(012Y)

DESCRIPTION

The VB027, VB027(011Y), VB027(012Y) is a high voltage power integrated circuit made using the 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 current interface in advanced electronic ignition system.

BLOCK DIAGRAM



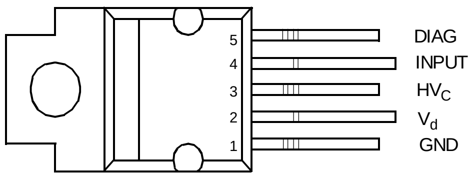
ABSOLUTE MAXIMUM RATING

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	200	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
$R_{thj\text{-}case}$	Thermal resistance junction-case	(MAX)	1.12	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	(MAX)	62.5	°C/W

CONNECTION DIAGRAM (TOP VIEW)



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

ELECTRICAL CHARACTERISTICS (V_{CC}=13.5V; V_d=5V; Tj=25ºC; R_{coil}=510mΩ; L_{coil}=7mH unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{cl}	High voltage clamp	-40°C≤T_j≤125°C; I_C=6A	300	360	400	V
$V_{cg(sat)}$	Power stage saturation voltage	I_C=6A; V_{IN}=4V		1.5		V
$V_{cg(sat)td}$	Power stage saturation voltage derating in temperature	I_C=6A; V_{IN}=4V; -40°C≤T_j≤125°C			2	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=6A; -40°C≤T_j≤125°C			130	mA
V_d	Driving stage supply voltage		4.5		5.5	V
I_{cl}	Collector current limit	V_{IN}=4V (See note 1)	8	8.5	9	A
$I_{cl(td)}$	Collector current limit drift with temperature	See figure 3				
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	µA
V_{diagH}	High level diagnostic output voltage	R_{EXT}=22KΩ (See figure 1)	3.5	(*)	V_d	V
V_{diagL}	Low level diagnostic output voltage	R_{EXT}=22KΩ (See figure 1)			0.5	V
$I_{C(diag1)}$	First threshold level collector current		4.25	4.5	4.75	A
$I_{C(diag1)td}$	First threshold level collector current drift with temperature	See figure 4				
$I_{C(diag2)}$	Second threshold level collector current		5.45	5.8	6.15	A
$I_{C(diag2)td}$	Second threshold level collector current drift with temperature	See figure 5				
$t_{d(off)}$	Turn-off delay time of output current	I_C=6A; (See note 2)		25		µs
$t_{f(off)}$	Turn-off fall time of output current	I_C=6A		8		µs
$t_{d(diag)}$	Delay time of diagnostic current	R_{EXT}=22KΩ (See figure 1)		1		µs
$t_{r(diag)}$	Turn-on rise time of diagnostic current	R_{EXT}=22KΩ (See figure 1)		1		µs
$t_{f(diag)}$	Turn-off fall time of diagnostic current	R_{EXT}=22KΩ (See figure 1)		1		µs

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 200V.
(*) V_d - $V_{be(on)}$

PRINCIPLE OF OPERATION

The VB027, VB027(011Y), VB027(012Y) is 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 VB027, VB027(011Y), VB027(012Y) is fed from a low power signal generated by an external controller that determines both dwell time and ignition point. During V_{IN} high (≥4V) the VB027, VB027(011Y), VB027(012Y) increases 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 µC 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. VB027, VB027(011Y), VB027(012Y) has 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 VB027, VB027(011Y), VB027(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)

$I_{switch\text{-}off}$ 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*1.5 / 2.5.

OVERVOLTAGE

The VB027, VB027(011Y), VB027(012Y) can withstand the following transients of the battery line:

-100V / 2ms (R_i=10Ω)

+100V / 0.2ms (R_i=10Ω)

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

FIGURE 1: Application circuit

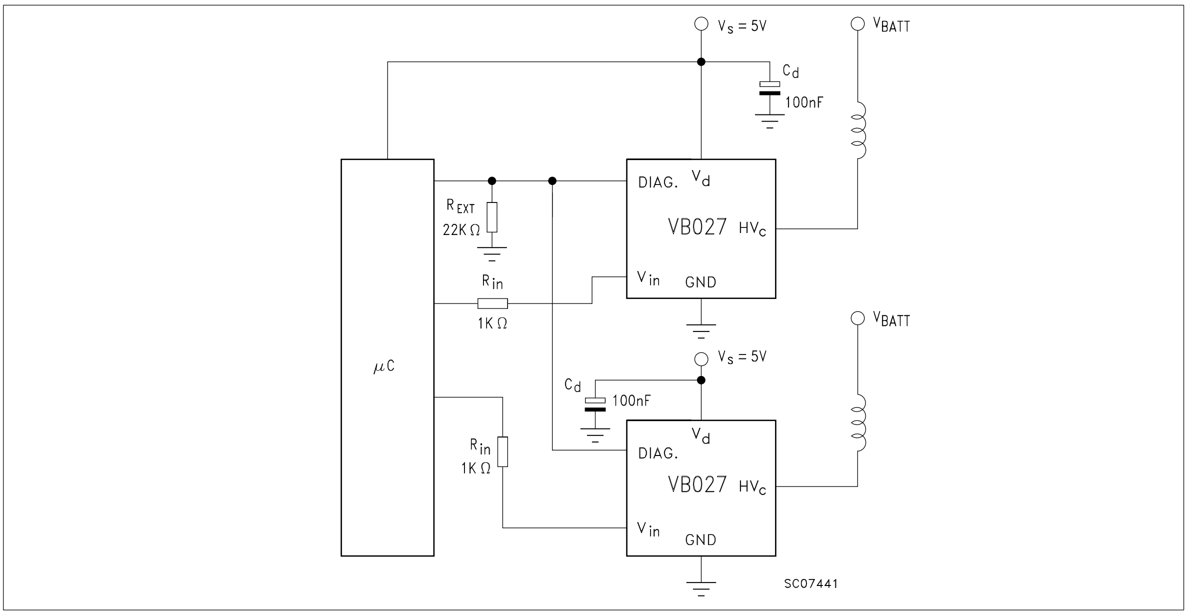


FIGURE 2: Switching waveform

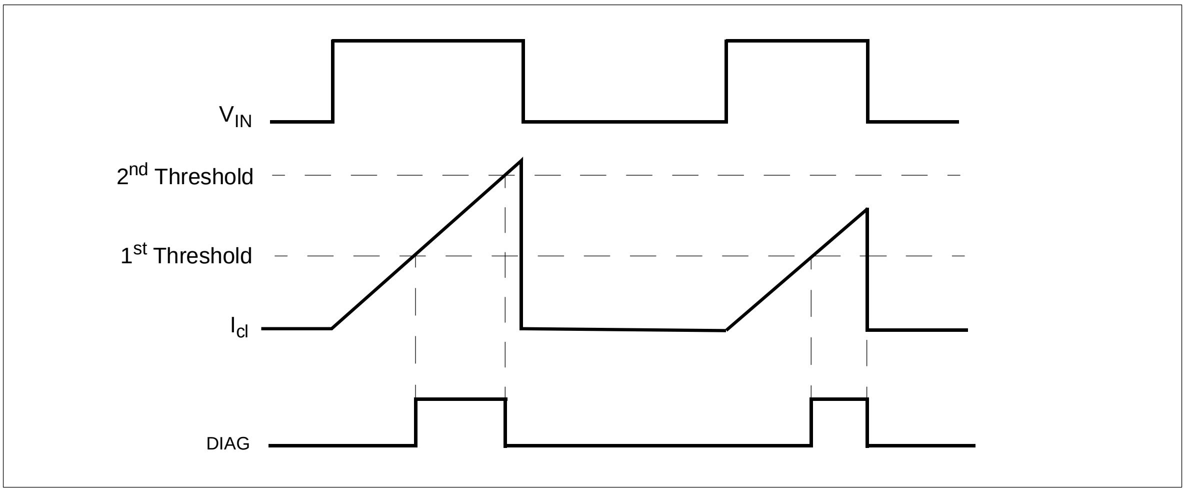


FIGURE 3: Maximum I_{cl} VS temperature

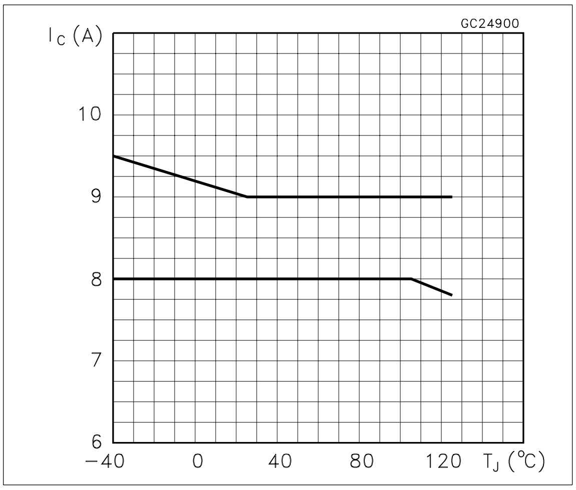


FIGURE 4: $I_{C(diag1)}$ VS temperature

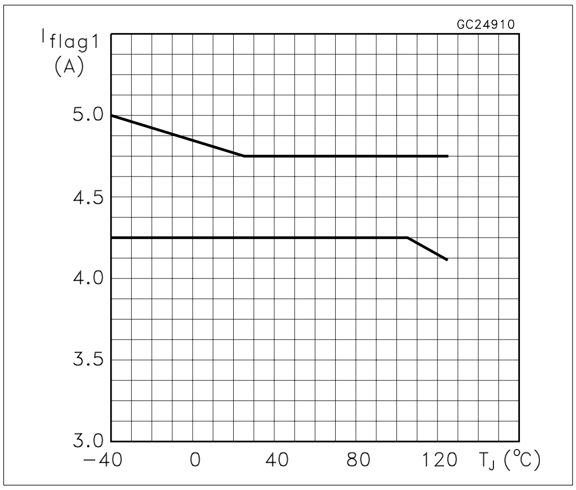
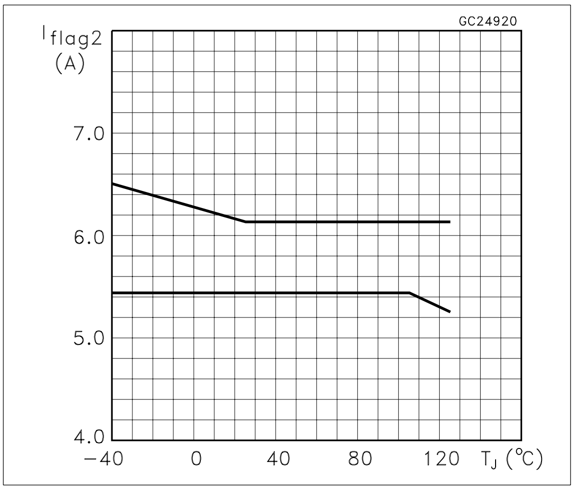
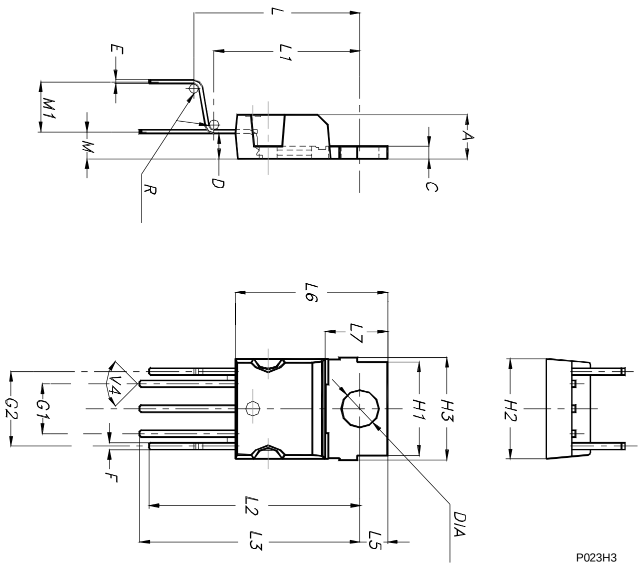


FIGURE 5: $I_{C(diag2)}$ VS temperature



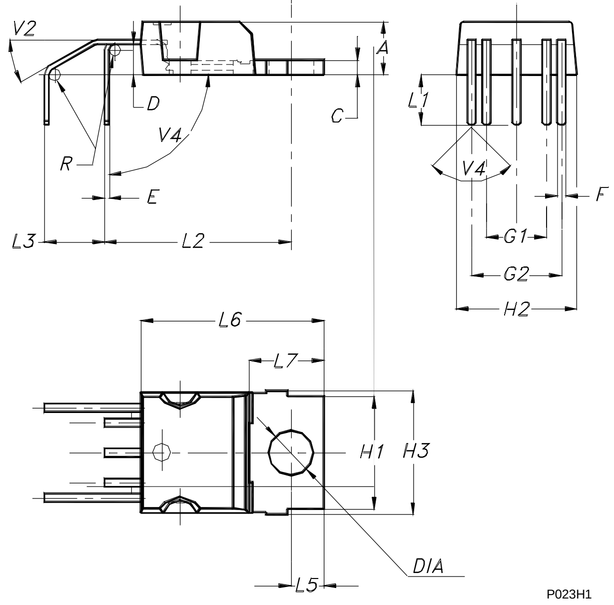
PENTAWATT HV MECHANICAL DATA

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



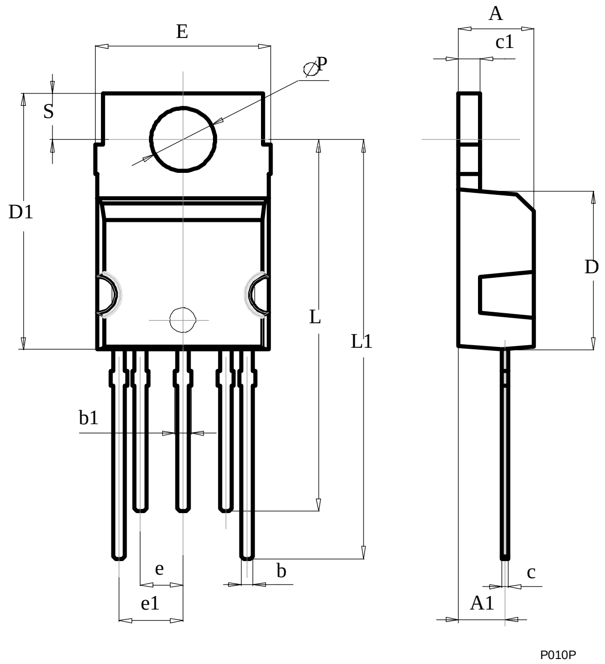
PENTAWATT HV 011Y (horizontal) MECHANICAL DATA

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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