



# VB025SP

## HIGH VOLTAGE IGNITION COIL DRIVER POWER IC

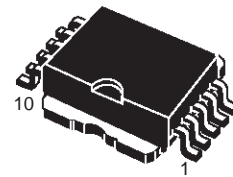
TYPE	V <sub>cl</sub>	I <sub>cl</sub>	I <sub>d</sub>
VB025SP	380 V	9 A	100 mA

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

### DESCRIPTION

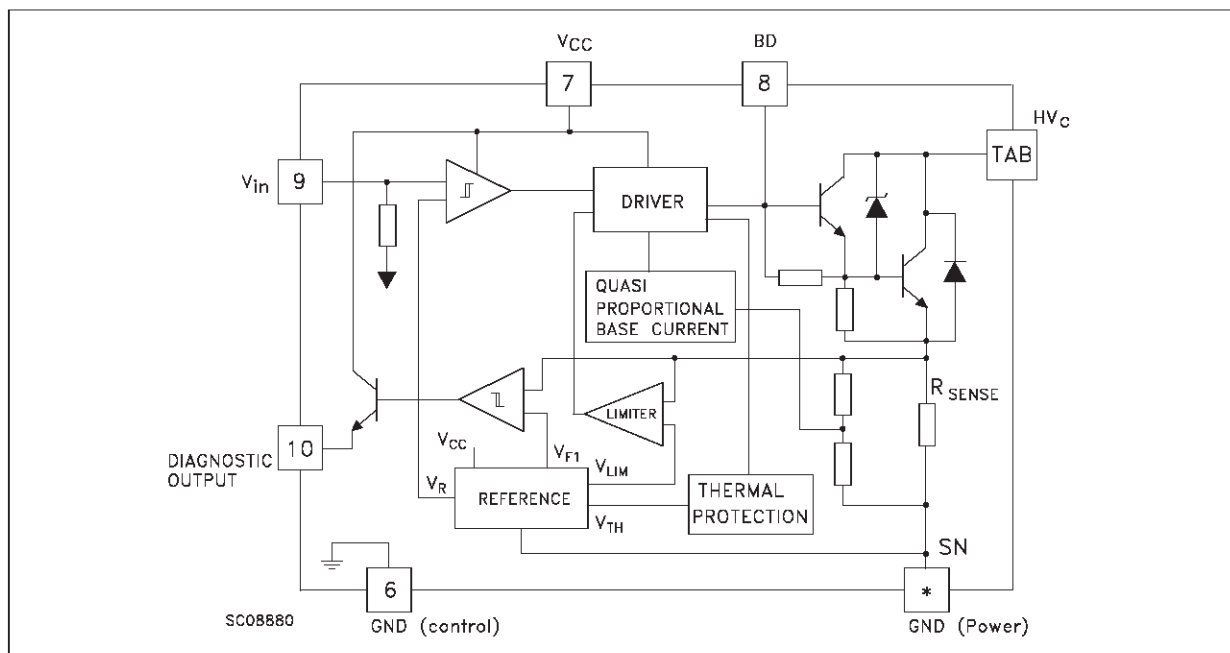
The VB025SP is a high voltage power integrated circuit made using STMicroelectronics VIPower Technology, with vertical current flow power darlington and logic level compatible driving circuit.

Built-in protection circuits for coil current limiting and collector voltage clamping allows the VB025SP to be used as a smart, high voltage, high current interface in advanced electronic ignition systems.



PowerSO-10

### BLOCK DIAGRAM



**ABSOLUTE MAXIMUM RATING**

Symbol	Parameter	Value	Unit
HV <sub>C</sub>	Collector Voltage (Internally Limited)	-0.3 to V <sub>clamp</sub>	V
I <sub>C</sub>	Collector Current (Internally Limited)	10	A
I <sub>C(gnd)</sub>	DC Current on Emitter Power	± 10.5 (*)	A
V <sub>CC</sub>	Driving Stage Supply Voltage	-0.3 to 7	V
I <sub>S</sub>	Driving Circuitry Supply Current	± 200	mA
I <sub>S(gnd)</sub>	DC Current on Ground Pin	± 1	A
V <sub>in</sub>	Input Voltage	-0.3 to V <sub>CC</sub> + 0.3	V
I <sub>in</sub>	Maximum Input Current	100	mA
f <sub>in</sub>	Logic Input Frequency in Operative Mode	DC to 150	Hz
V <sub>out(flag)</sub>	Output Voltage Primary Threshold Current Level	-0.3 to V <sub>CC</sub> + 0.3	V
I <sub>out(flag)</sub>	Flag Output Current	100	mA
P <sub>max</sub>	Power Dissipation (TC = 105 °C)	TBD	W
E <sub>s/b</sub>	Clamped Energy During Output Power Clamping	300	mJ
V <sub>ESD</sub>	ESD Voltage (HVC Pin)	± 4	KV
V <sub>ESD</sub>	ESD Voltage (Other Pins)	± 2	KV
I <sub>BD</sub>	Input Darlington Base Current	150	mA
V <sub>BD</sub>	Input Darlington Base Voltage	Internally Limited	V
T <sub>j</sub>	Operating Junction Temperature	-40 to 150	°C
T <sub>stg</sub>	Storage Temperature Range	-55 to 150	°C

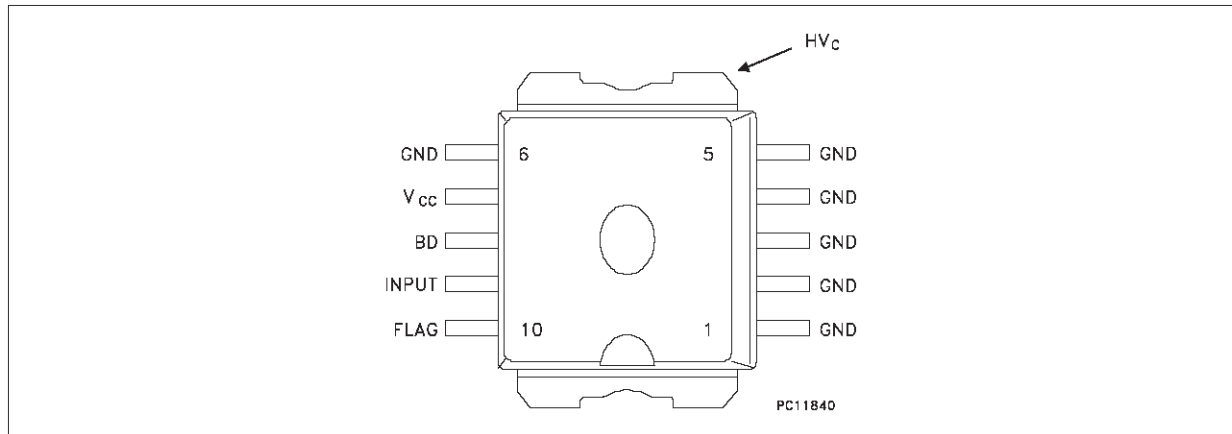
(\*) With 10 mils Al wire

**THERMAL DATA**

R <sub>thj-case</sub>	Thermal Resistance Junction Case (MAX)	1.2	°C/W
R <sub>thj-h</sub>	Thermal Resistance Junction Heatsink with FR4 (MAX)	TBD (★)	°C/W
T <sub>sold</sub>	Lead Temperature During Soldering (MAX)	TBD (★)	°C

(★) see application note AN515/1094 on VIPower data-book 1<sup>st</sup> edition.

## CONNECTION DIAGRAM



## PIN FUNCTION

No	NAME	FUNCTION
1-5	GND	Emitter Power Ground
6	GND	Control Ground (*)
7	V <sub>CC</sub>	Logic Supply Voltage
8	BD	Base Darlington
9	INPUT	Logic Input Channel (Internal Pull Down)
10	FLAG	Diagnostic Output Signal (Open Emitter)
TAB	HVC	Primary Coil Output Driver (Open Collector)

(\*) Pin 6 must be connected to pins 1-5 externally

**ELECTRICAL CHARACTERISTICS** ( $5.3V < V_b < 24V$ ;  $V_{CC} = 5V \pm 10\%$ ;  $-40^{\circ}C < T_j < 125^{\circ}C$ ;  
 $R_{coil} = 580\ m\Omega$ ;  $L_{coil} = 3.75\ mH$ ; unless otherwise specified; see note 1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>cl</sub>	High Voltage Clamp	I <sub>coil</sub> = 6.5 A	320	380	420	V
V <sub>ce(sat)</sub>	Saturation Voltage of The Power Stage	I <sub>c</sub> = 6.5A; V <sub>in</sub> = 4V		1.5	2	V
I <sub>CC(stdby)</sub>	Stand-by Supply Current	IN = OFF			10	mA
I <sub>CC</sub>	DC Logic Current	V <sub>b</sub> = 16 V I <sub>c</sub> = 6.5 A f = 100 Hz Load = Coil V <sub>CC</sub> = 5.5V			40	mA
I <sub>CC(peak)</sub>	Peak DC Logic Current During On Phase	I <sub>c</sub> = 6.5 A (see figure 1)		100	150	mA
V <sub>CC</sub>	DC Logic Voltage		4.5		5.5	V
I <sub>cl</sub>	Coil Current Limit	-40°C < T <sub>j</sub> < 125°C (see note 2 and figure 1)	8.25		10	A
I <sub>c(leak)</sub>	Output leakage Current	IN = OFF V <sub>HVC</sub> = 24V			0.8	mA
I <sub>C(infl)</sub>	Collector Current with Floating Input	V <sub>CC</sub> = 5 V V <sub>Bat</sub> = 13.5 V R <sub>LOAD</sub> = 1KΩ; Input Floating			0.8	mA
T <sub>Ic_ctr</sub>	Thermal Temperature Output Current Control	OUT = ON (see figure 2)	150		(*)	°C

**ELECTRICAL CHARACTERISTICS** (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>inH</sub>	High Level Input Voltage	V <sub>CC</sub> = 4.5V	4		V <sub>CC</sub>	V
V <sub>inL</sub>	Low Level Input Voltage	V <sub>CC</sub> = 5.5V	-0.3		0.8	V
V <sub>in(hys)</sub>	Input Threshold Hysteresis		0.4			V
I <sub>inH</sub>	High Level Input Current	V <sub>in</sub> = 4 V			100	μA
I <sub>inL</sub>	Low Level Input Current	V <sub>in</sub> = 0.8 V			-100	μA
I <sub>inpd</sub>	Input Active Pull-Down	V <sub>in</sub> = 4 V	10		100	μA
V <sub>diagH</sub>	High Level Flag Output Voltage	R <sub>EXT</sub> = 22 KΩ C <sub>EXT</sub> = 1 nF (see note 3)	V <sub>CC</sub> -1		V <sub>CC</sub>	V
V <sub>diagL</sub>	Low Level Flag Output Voltage	R <sub>EXT</sub> = 22 KΩ C <sub>EXT</sub> = 1 nF (see note 3)			0.5	V
I <sub>diagTH</sub>	Coil Current Level Threshold	T <sub>j</sub> = 25°C (see figure 1)	4.25	4.5	4.75	A
I <sub>diagTD</sub>	Coil Current Level Threshold Drift	(see figure 3)				
I <sub>diag</sub>	High Level Flag Output Current	I <sub>C</sub> > I <sub>diagTH</sub> V <sub>diag</sub> = 3 V	0.5	TBD		mA
I <sub>diag(leak)</sub>	Leakage Current On Flag Output	V <sub>in</sub> = LOW V <sub>CC</sub> = 5.5V			10	μA
V <sub>F</sub>	Antiparallel Diode Forward Voltage	I <sub>c</sub> = -1 A			2	V
E <sub>s/b</sub>	Single Pulse Avalanche Energy	L = 6 mH I <sub>C</sub> = 8 A (see figure 4)	180			mJ
t <sub>pHL</sub>	Turn-on Delay Time of Coil Current	R <sub>c</sub> = 0.5 Ω L <sub>c</sub> = 3.75 mH (see figure 5)		TBD		μs
t <sub>pLH</sub>	Turn-off Delay Time of Coil Current	R <sub>c</sub> = 0.5 Ω L <sub>c</sub> = 3.75 mH I <sub>c</sub> = 6.5 A (see figure 5)		TBD		μs

Note 1: Parametric degradation are allowed with 5.3 < V<sub>b</sub> < 10V and V<sub>b</sub> > 24V.

Note 2: The primary coil current value I<sub>cl</sub> must be measured 1ms after desaturation of the power stage.

Note 3: No Internal Pull-Down

(\*) Internally limited

**PRINCIPLE OF OPERATION**

The VB025SP is mainly intended as a high voltage power switch device driven by a logic level input and interfaces directly to a high energy electronic ignition coil.

The input Vin of the VB025SP is fed from a low power signal generated by an external controller that determines both dwell time and ignition point. During Vin high (≥ 4V) the VB025SP increases current in the coil to the desired, internally set current level.

After reaching this level, the coil current remains constant until the ignition point, that corresponds to the transition of Vin from high to low (typ. 1.9V threshold).

During the coil current switch-off, the primary

voltage HVc is clamped at an internally set value Vcl, typically 380V.

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.

**FEEDBACK**

When the collector current exceeds 4.5A, the feedback signal is turned high and it remains so, until the input voltage is turned-off.

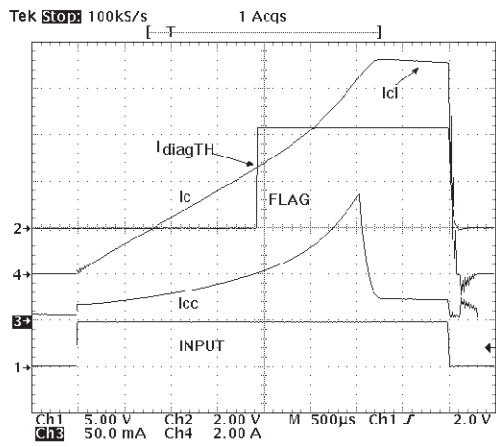
**OVERVOLTAGE**

The VB025SP can withstand the following transients of the battery line:

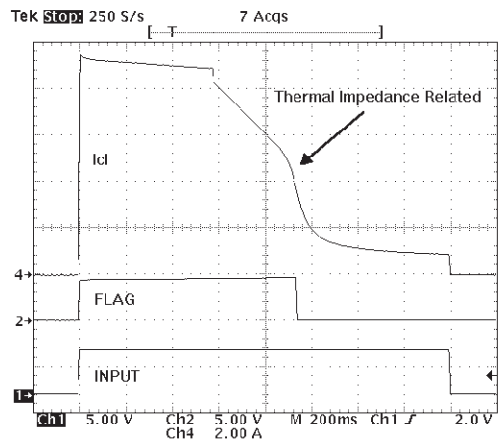
- 100V/2msec (R<sub>i</sub> = 10 Ω)
- +100V/0.2msec (R<sub>i</sub> = 10 Ω)
- +50V/400msec (R<sub>i</sub> = 4.2 Ω, with V<sub>IN</sub> = 3 V)



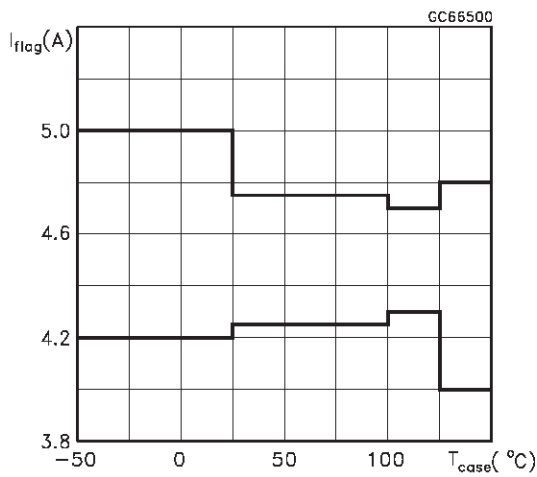
**Fig. 1** Main Waveforms During On Phase



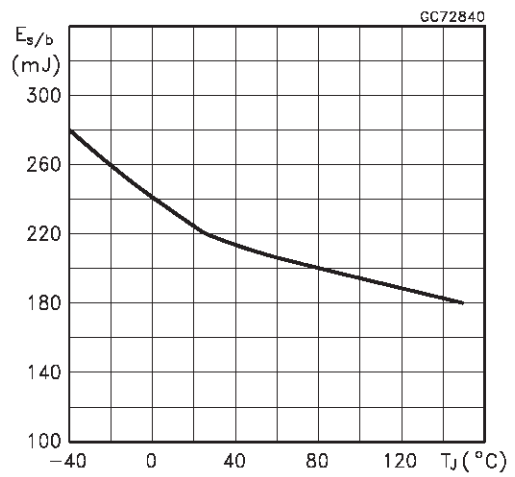
**Fig. 2** Output Current Waveform After Thermal Protection Activation



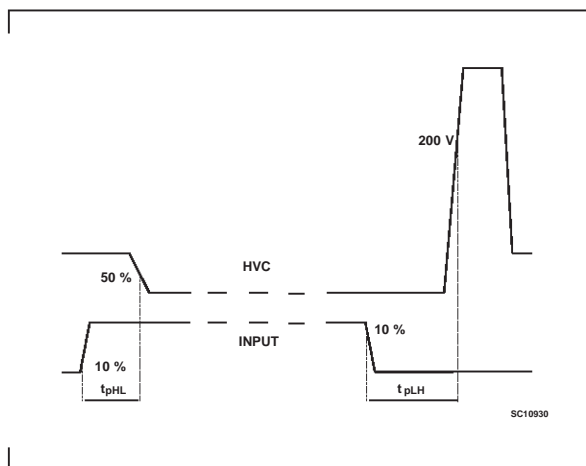
**Fig. 3** Flag Current Versus Temperature



**FIG. 4** Single Pulse Typical  $E_s/b$  Curve

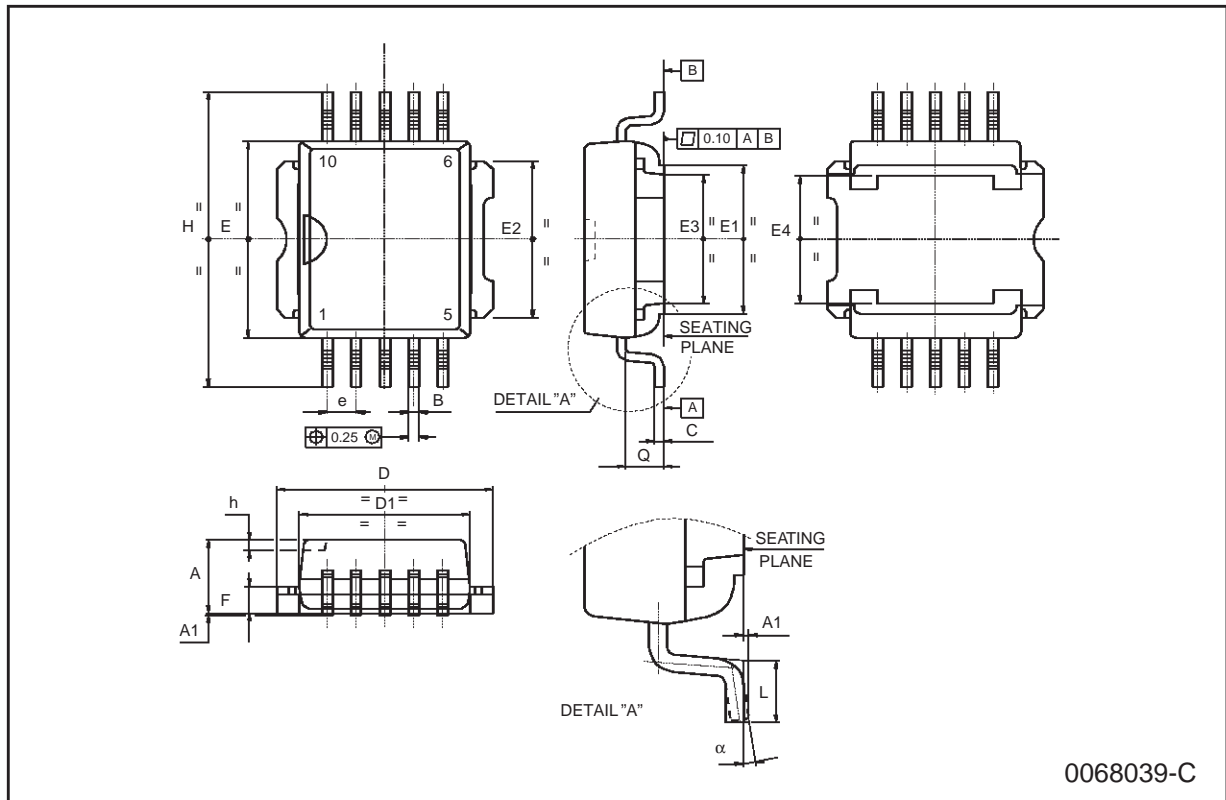


**FIG. 5** Propagation Times Definitions.



**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		0.300
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	
L	1.20		1.80	0.047		0.071
q		1.70			0.067	
$\alpha$	0°		8°			



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