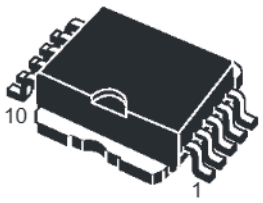
# VB027SP

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

| TYPE | $V_{cl}$ | $I_{cl}$ | $I_{d(on)}$ |
|---|---|---|---|
| VB027SP | 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

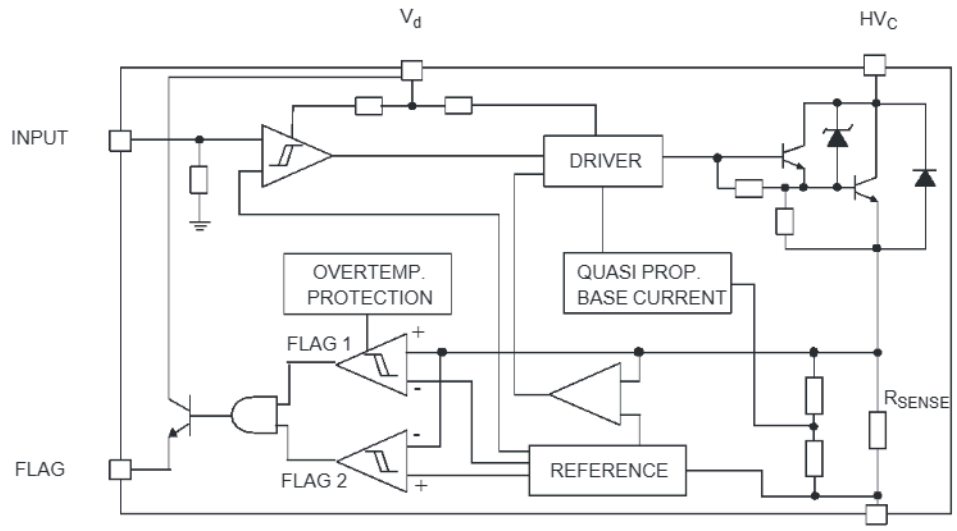



**PowerSO-10™**

### DESCRIPTION

The VB027SP 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



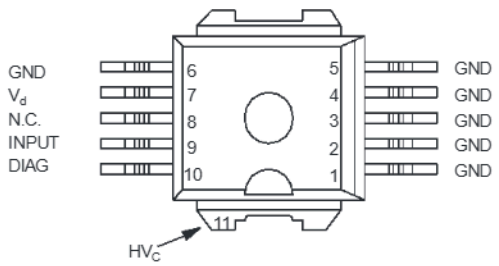
## ABSOLUTE MAXIMUM RATING

| 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

| No | Name | Function |
|---|---|---|
| 1 \|5 | GND | Emitter power ground |
| 6(*) | GND | Control ground |
| 7 | $V_d$ | Driving stage supply voltage |
| 8 | N.C. | |
| 9 | INPUT | Logic input channel |
| 10 | DIAG | Diagnostic output signal |
| TAB | $HV_C$ | Primary coil output signal |

(*) Pin 1 \|5=Power GND, Pin 6=signal GND. Pin 6 must be connected to pins 1 \|5 externally.

**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 | $V_{IN}$=0.4V; -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; $I_d$=80mA | | 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; $I_d$=85mA | | | 2 | V |
| $I_{d(off)}$ | Power-off supply current | $V_{IN}$=0.4V | | | 8 | 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 | $HV_C$<2V | 4 | | 5.5 | V |
| $V_{INL}$ | Low level input voltage | $I_C$<2mA; $HV_C$=$V_{CC}$ | 0 | | 0.8 | V |
| $I_{INH}$ | High level input current | $V_{IN}$=4V | 40 | | 200 | ∝A |
| $V_{diagH}$ | 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 | $I_C$=5.5A | | 25 | | ∝s |
| $t_{f(off)}$ | Turn-off fall time of output current | $I_C$=5.5A | | 8 | | ∝s |
| $t_{d(diag)}$ | Delay time of diagnostic current | $R_{EXT}$=22KΩ (See figure 1) | | 1 | | ∝s |
| $t_{r(diag)}$ | Turn-on rise time of diagnostic current | $R_{EXT}$=22KΩ (See figure 1) | | 1 | | ∝s |
| $t_{f(diag)}$ | Turn-off fall time of diagnostic current | $R_{EXT}$=22KΩ (See figure 1) | | 1 | | ∝s |

Note 1: the primary coil current value $I_{cl}$ must be measured 1ms after desaturation of the power stage.
(*) $V_d$ - $V_{be(on)}$

## PRINCIPLE OF OPERATION

The VB027SP 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 VB027SP 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 VB027SP 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 ∝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. VB027SP 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 VB027SP 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*1.5 / 2.5.

## OVERVOLTAGE

The VB027SP 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

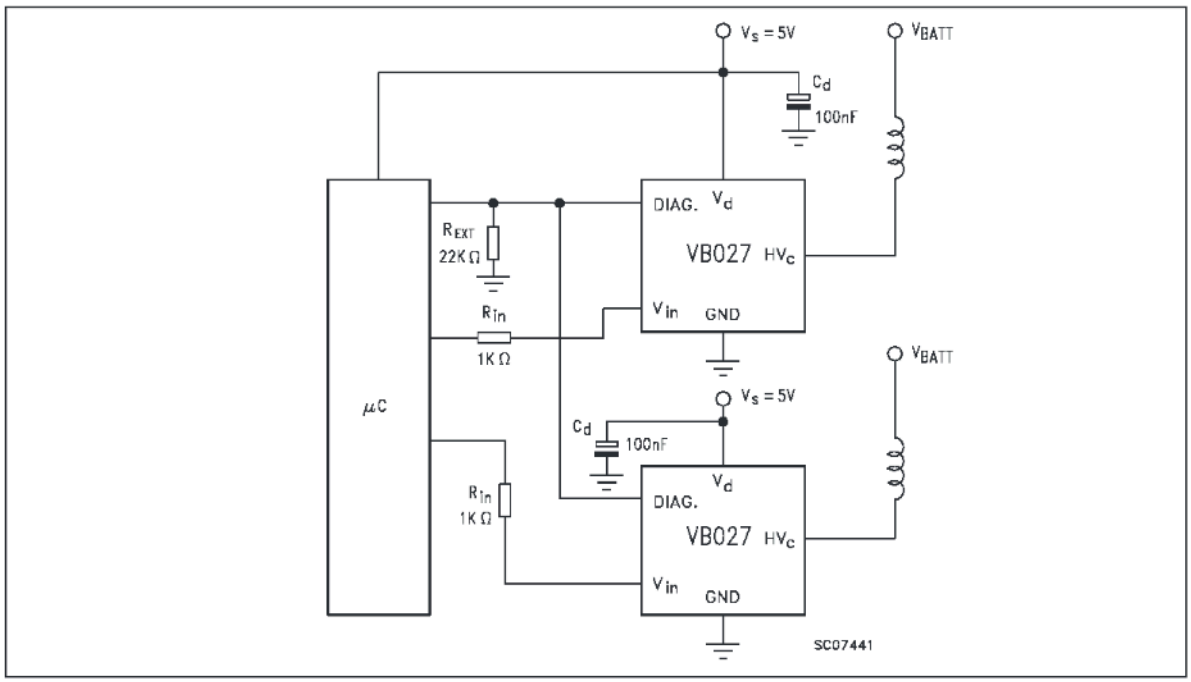


**FIGURE 2:** Switching waveform

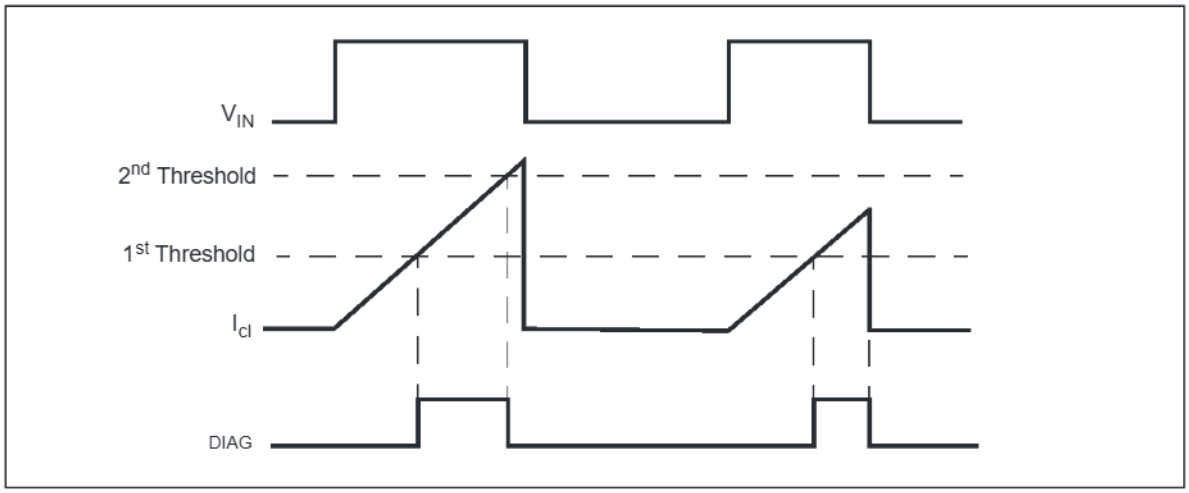



**FIGURE 3:** Maximum $I_{cl}$ VS temperature

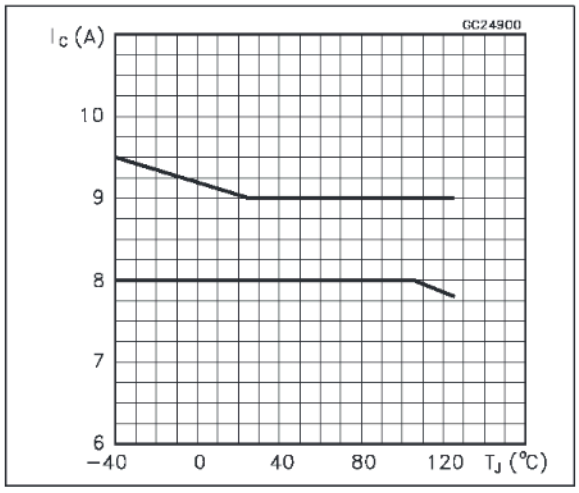



**FIGURE 4:** $I_{C(diag1)}$ VS temperature

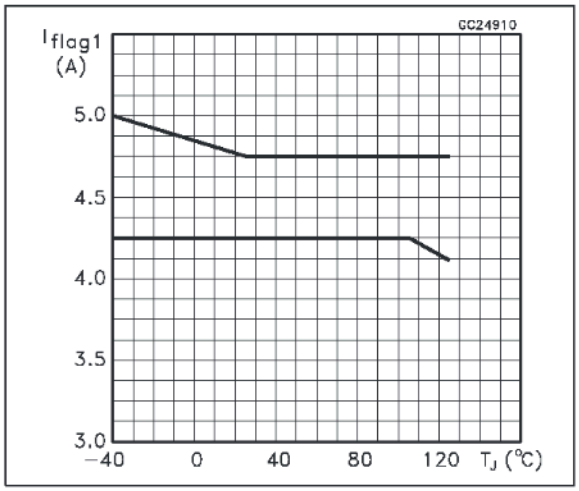
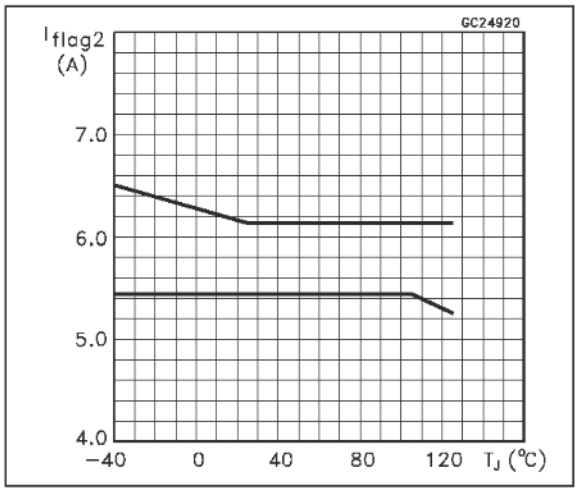
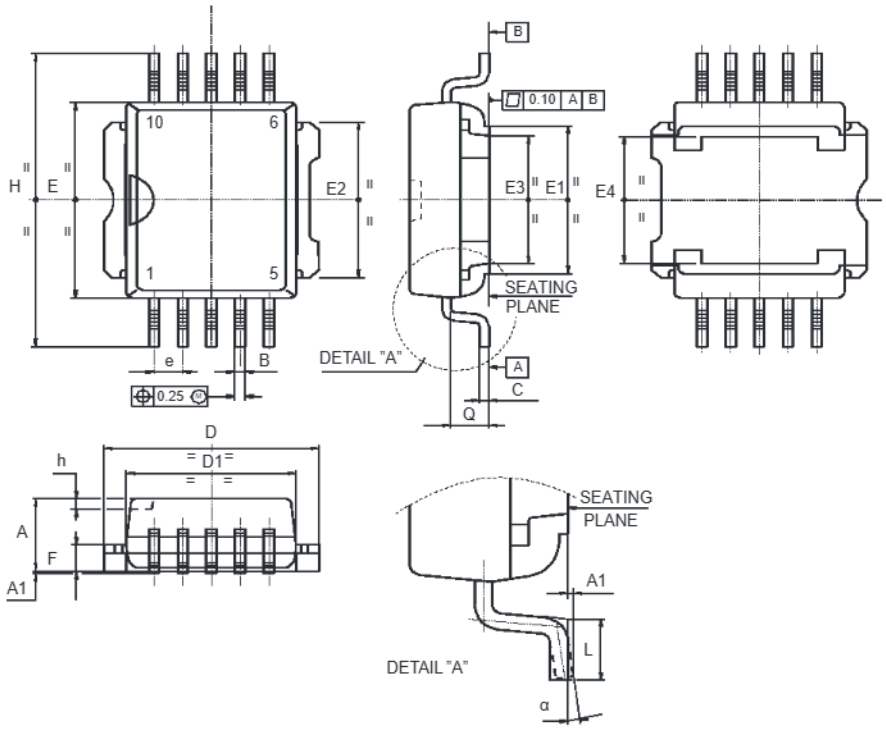



**FIGURE 5:** $I_{C(diag2)}$ VS temperature



# 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 | |
| α | 0º | | 8º | | | |



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