

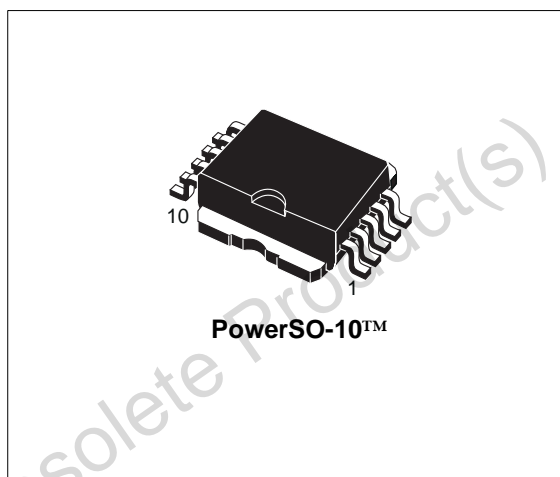


# VB325SP

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

| TYPE    | $V_{cl}$ | $I_{cl}$ | $I_{CC}$ |
|---------|----------|----------|----------|
| VB325SP | 380V     | 10A      | 150mA    |

- 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
- LOW VOLTAGE CLAMP THERMAL SHUTDOWN

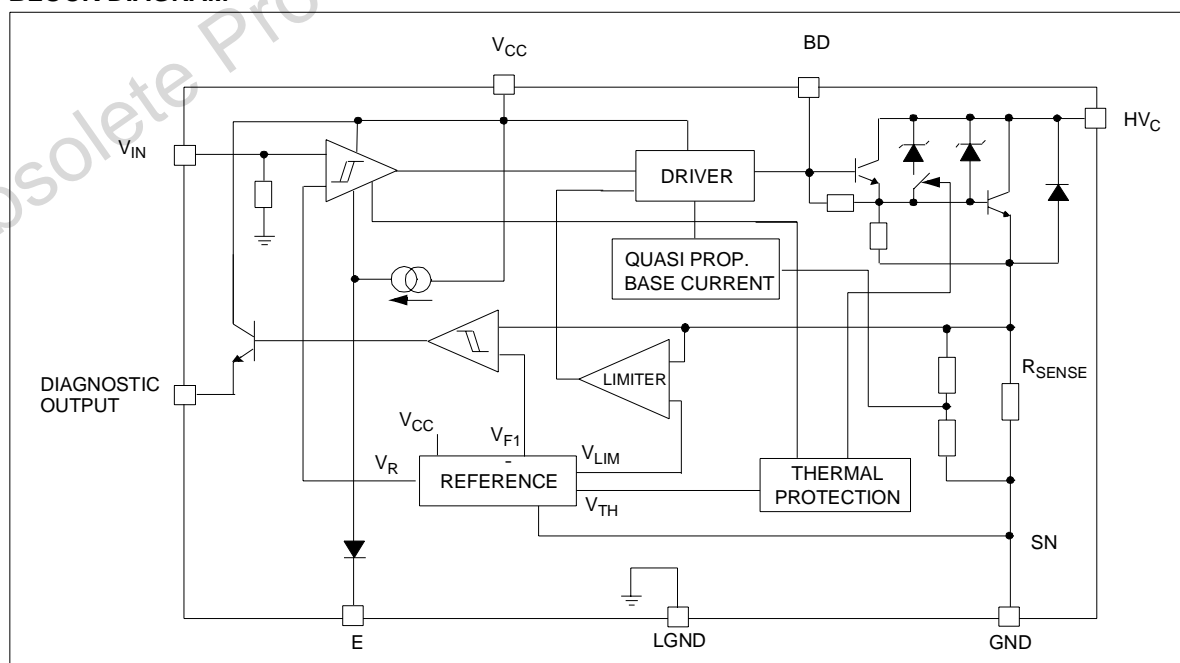


### DESCRIPTION

The VB325SP is a high voltage power integrated circuit made using the STMicroelectronics VIPower™ M1-3 technology, with vertical current flow power darlington and logic level compatible driving circuit. The enable pin allows to externally block the switch when the input is on. 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. If the input signal from the micro happens to remain high, the device protects itself against over-heating by forcing collector current to smooth decrease (low voltage clamp feature) and no undesired spark occurs (see figure 4).

### 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 (T <sub>c</sub> =25°C)                        | 125                           | W    |
| E <sub>s/b</sub>       | Self Clamped Energy during Output Power Clamping (See figure 2) | 275                           | mJ   |
| V <sub>ESD</sub>       | ESD voltage (HV <sub>C</sub> pin)                               | ± 4                           | KV   |
| V <sub>ESD</sub>       | ESD voltage (Enable pin)  | + 1.5 ; -2                    | 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   |
| V <sub>E</sub>         | Maximum Enable Voltage  | -0.3 to 5.5                   | V    |
| I <sub>E</sub>         | Maximum Enable Current  | ± 150                         | µA   |

**THERMAL DATA**

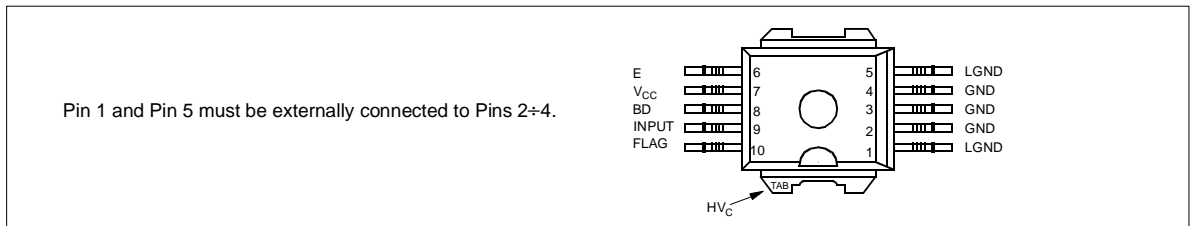
| Symbol                | Parameter                                 | Value | Unit |
|-----------------------|---|-------|------|
| R <sub>thj-case</sub> | Thermal resistance junction-case (MAX)    | 1     | °C/W |
| R <sub>thj-amb</sub>  | Thermal resistance junction-ambient (MAX) | 51    | °C/W |

**PIN FUNCTION**

| No        | Name            | Function                                    |
|-----------|-----------------|---|
| 1 - 5     | LGND            | Signal Ground                               |
| 2 - 3 - 4 | GND             | Emitter Power Ground                        |
| 6         | E               | Enable (*)                                  |
| 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       | HV <sub>C</sub> | Primary Coil Output Driver (Open Collector) |

(\*) When grounded the Input is Enabled

**CONNECTION DIAGRAM (TOP VIEW)**



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

| Symbol           | Parameter                             | Test Conditions  | Min          | Typ | Max      | Unit        |
|------------------|---------------------------------------|--|--------------|-----|----------|-------------|
| $V_{cl}$         | High Voltage Clamp                    | $I_{coil}=6.5A$  | 320          | 380 | 420      | V           |
| $V_{lcl}$        | Low Voltage Clamp                     | $I_{coil}=6.5A$ ; $T_j=T_{sd}$   | 30           | 40  | 50       | V           |
| $V_{ce(sat)}$    | Power Stage Saturation Voltage        | $I_C=6A$ ; $V_{IN}=4V$   |              | 1.5 | 2        | V           |
| $I_{CC(stdb)}$   | Stand-by Supply Current               | IN=Off   |              |     | 11       | mA          |
| $I_{CC}$         | DC Logic Current                      | $V_b=16V$ ; $I_C=6.5A$ ; $f=100Hz$ ; Load = Coil; $V_{CC}=5.5V$                                |              |     | 40       | mA          |
| $I_{CC(peak)}$   | Peak DC Logic Current during On Phase | $I_C=6.5A$   |              | 100 | 150      | mA          |
| $V_{CC}$         | DC Logic Voltage                      |  | 4.5          |     | 5.5      | V           |
| $I_{cl}$         | Coil Current Limit                    | $-40^{\circ}C < T_j < 125^{\circ}C$ (See note 2)   | 9            |     | 11       | A           |
| $I_{c(off)}$     | Output Off State Current              | IN=Off; $V_{HVC}=24V$ ; $V_{CC}=5V$ ; $T_j=25^{\circ}C$  |              |     | 5        | mA          |
| $V_{INH}$        | High Level Input Voltage              | $V_{CC}=4.5V$  | 4            |     | $V_{CC}$ | V           |
| $V_{INL}$        | Low Level Input Voltage               | $V_{CC}=5.5V$  | -0.3         |     | 0.8      | V           |
| $V_{IN(hyst)}$   | Input Threshold Hysteresis            |  | 0.4          |     |          | V           |
| $I_{INH}$        | High Level Input Current              | $V_{IN}=4V$  |              |     | 100      | $\mu A$     |
| $I_{INL}$        | Low Level Input Current               | $V_{IN}=0.8V$  | 0            |     | 30       | $\mu A$     |
| $I_{INpd}$       | Input Active Pull Down                | $V_{IN}=4V$  | 10           |     | 100      | $\mu A$     |
| $V_{diagH}$      | High Level Flag Output Voltage        | $R_{EXT}=22K\Omega$ ; $C_{EXT}=1nF$ (See note 3)   | $V_{CC} - 1$ |     | $V_{CC}$ | V           |
| $V_{diagL}$      | Low Level Flag Output Voltage         | $R_{EXT}=22K\Omega$ ; $C_{EXT}=1nF$ (See note 3)   |              |     | 0.5      | V           |
| $I_{diagTH}$     | Coil Current Level Threshold          | $T_j=25^{\circ}C$  | 4.25         | 4.5 | 4.75     | A           |
| $I_{diagTD}$     | Coil Current Level Threshold Drift    | (See figure 1)   |              |     |          |             |
| $I_{diag}$       | High Level Flag Output Current        | $I_C > I_{diagTH}$ ; $V_{diag}=3V$   | 0.5          |     |          | mA          |
| $I_{diag(leak)}$ | Leakage Current on Flag Output        | $V_{IN}=Low$ ; $V_{CC}=5.5V$   |              |     | 10       | $\mu A$     |
| $V_F$            | Antiparallel Diode Forward Voltage    | $I_C = -1A$  |              |     | 2        | V           |
| $E_{s/b}$        | Single Pulse Avalanche Energy         | $L=6mH$ ; $I_C=8A$   |              | 180 |          | mJ          |
| $t_{ON}$         | Turn-on time                          | $R_C=0.5\Omega$ ; $L_C=3.75mH$ ; $T_j=25^{\circ}C$ ; $V_{bat}=13V$ (See figure 6)              |              | 1   | 5        | $\mu s$     |
| $t_{OFF}$        | Turn-off time                         | $R_C=0.5\Omega$ ; $L_C=3.75mH$ ; $I_C=6.5A$ ; $T_j=25^{\circ}C$ ; $V_{bat}=13V$ (See figure 6) |              | 15  | 25       | $\mu s$     |
| $T_{sd}$         | Thermal shut-down intervention        |  | 150          |     |          | $^{\circ}C$ |
| $V_{EH}$         | High Level Enable Voltage             | $V_{IN}=V_{INH}$ ; OUT=Off (See Note 4)  | 2            |     |          | V           |
| $V_{EL}$         | Low Level Enable Voltage              | $V_{OUT}$ free to follow $V_{IN}$  |              |     | 0.40     | V           |

Note 1: parametric degradation are allowed with  $5.3 < V_b < 10V$  and  $V_b > 24V$ .

Note 2: the primary coil current value  $I_{cl}$  must be measured 1ms after desaturation of the power stage.

Note 3: no internal Pull-down.

Note 4: if ENABLE pin is floating OUT=Off for every input status.

(\*) Internally Limited

## VB325SP

### ELECTRICAL CHARACTERISTICS (continued)

| Symbol        | Parameter                   | Test Conditions                        | Min   | Typ | Max | Unit    |
|---------------|-----------------------------|--|-------|-----|-----|---------|
| $I_{EH}$      | High Level Enable Current   | $V_E=5V$                               |       |     | 500 | $\mu A$ |
| $I_{EL}$      | Low Level Enable Current    | $V_E<0.4V$                             | - 200 |     |     | $\mu A$ |
| $V_{BD(off)}$ | Base Darlington Voltage Off | $V_E=V_{EH}$                           |       |     | 1   | V       |
| $V_{BD(on)}$  | Base Darlington Voltage On  | $V_{IN}=V_{INH}; V_E=V_{EL}; I_C=6.5A$ | 1.8   |     |     | V       |

#### PRINCIPLE OF OPERATION

The VB325SP 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  $V_{IN}$  of the VB325SP is 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 VB325SP 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  $V_{in}$  from high to low (typ. 1.9V threshold).

During the coil current switch-off, the primary voltage  $HV_C$  is clamped at an internally set value

$V_{cl}$ , 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 VB325SP can withstand the following transients of the battery line:

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

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

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

Figure 1: Flag current Vs. temperature

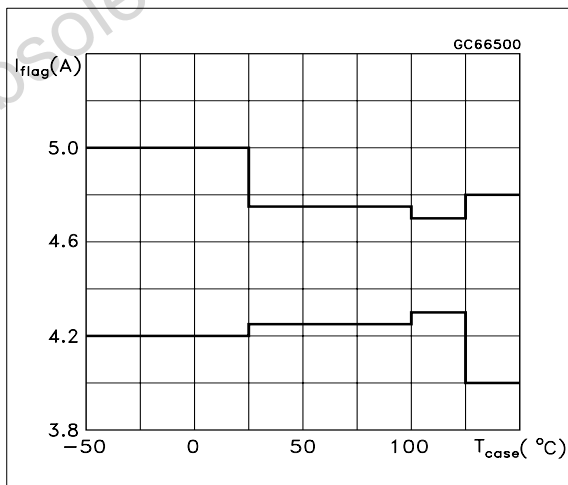
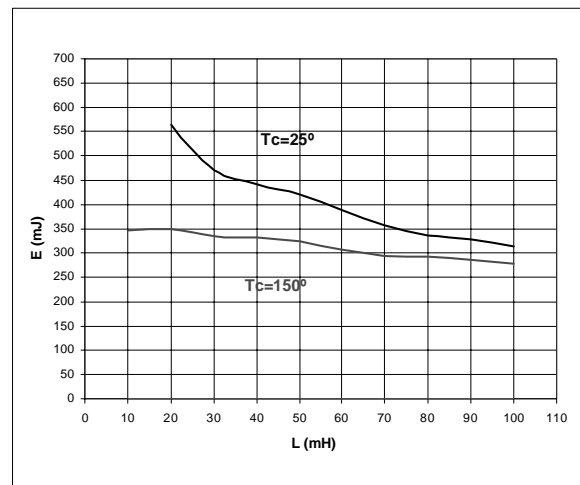
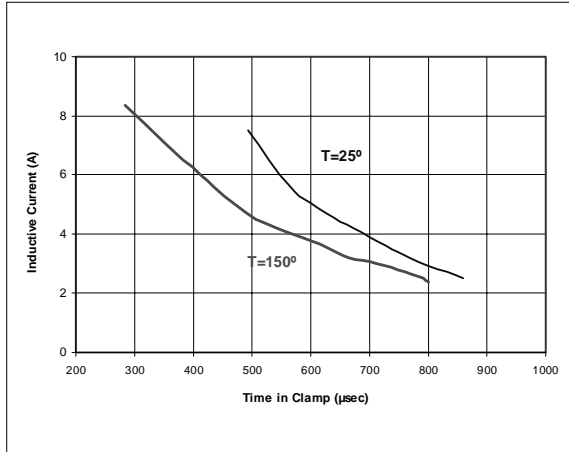


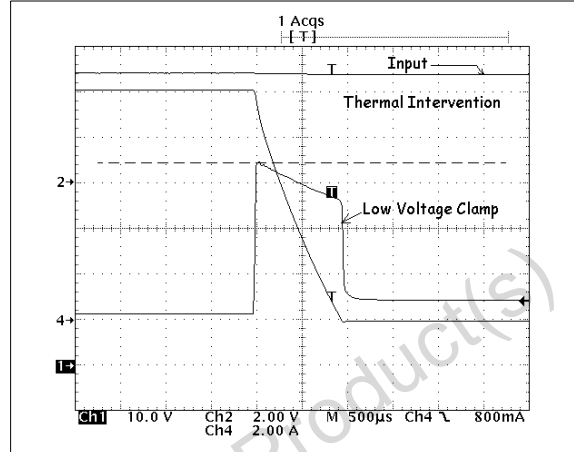
Figure 2: Single pulse avalanche energy capability



**Figure 3:** Self Clamped Inductive Switching Current Vs. Time



**Figure 4:** Low voltage clamp feature



**Figure 5:** Typical application diagram

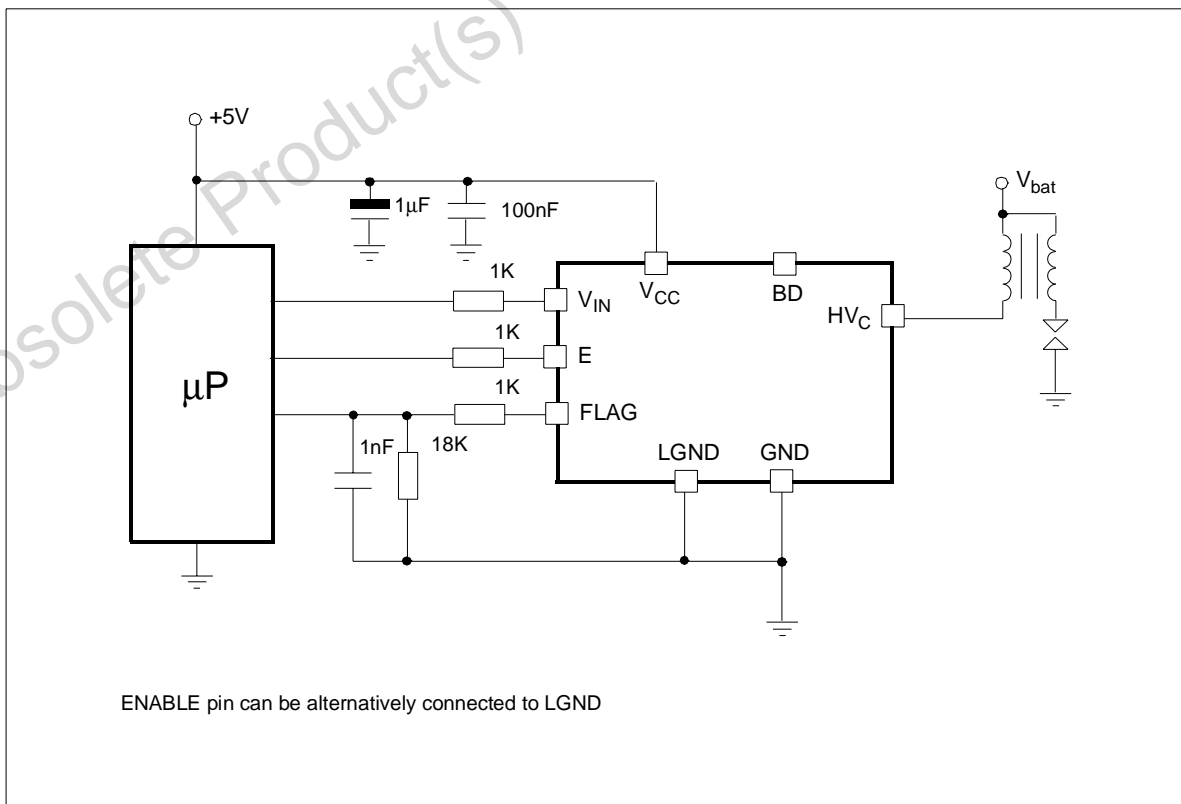
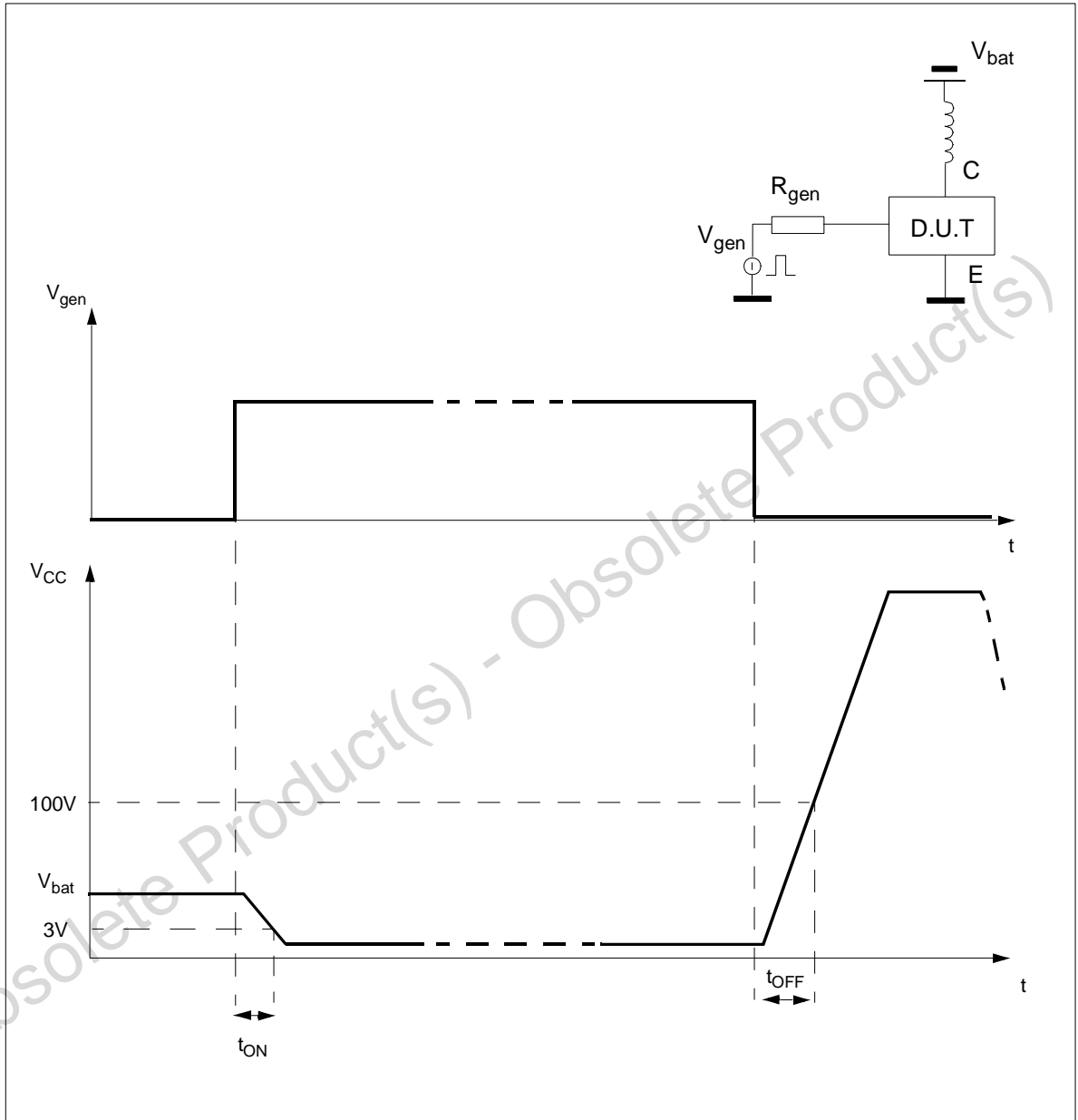


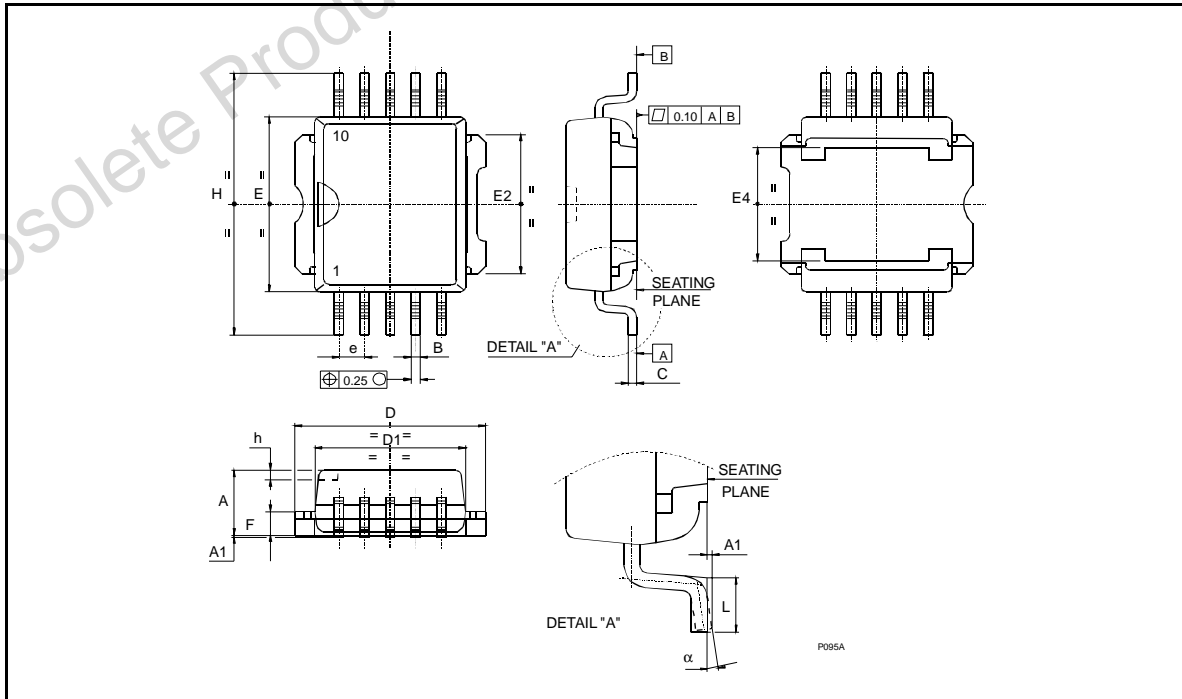
Figure 6: Switching time for inductive load



**PowerSO-10™ MECHANICAL DATA**

| DIM.   | mm.   |      |       | inch  |      |        |
|--------|-------|------|-------|-------|------|--------|
|        | MIN.  | TYP. | MAX.  | MIN.  | TYP. | MAX.   |
| A      | 3.35  |      | 3.65  | 0.132 |      | 0.144  |
| A (*)  | 3.4   |      | 3.6   | 0.134 |      | 0.142  |
| A1     | 0.00  |      | 0.10  | 0.000 |      | 0.004  |
| B      | 0.40  |      | 0.60  | 0.016 |      | 0.024  |
| B (*)  | 0.37  |      | 0.53  | 0.014 |      | 0.021  |
| C      | 0.35  |      | 0.55  | 0.013 |      | 0.022  |
| C (*)  | 0.23  |      | 0.32  | 0.009 |      | 0.0126 |
| 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  |
| E2     | 7.20  |      | 7.60  | 0.283 |      | 300    |
| E2 (*) | 7.30  |      | 7.50  | 0.287 |      | 0.295  |
| E4     | 5.90  |      | 6.10  | 0.232 |      | 0.240  |
| E4 (*) | 5.90  |      | 6.30  | 0.232 |      | 0.248  |
| e      |       | 1.27 |       | 0.050 |      |        |
| F      | 1.25  |      | 1.35  | 0.049 |      | 0.053  |
| F (*)  | 1.20  |      | 1.40  | 0.047 |      | 0.055  |
| H      | 13.80 |      | 14.40 | 0.543 |      | 0.567  |
| H (*)  | 13.85 |      | 14.35 | 0.545 |      | 0.565  |
| h      |       | 0.50 |       | 0.002 |      |        |
| L      | 1.20  |      | 1.80  | 0.047 |      | 0.070  |
| L (*)  | 0.80  |      | 1.10  | 0.031 |      | 0.043  |
| α      | 0°    |      | 8°    | 0°    |      | 8°     |
| α (*)  | 2°    |      | 8°    | 2°    |      | 8°     |

(\*) Muar only POA P013P



# VB325SP

## PowerSO-10™ SUGGESTED PAD LAYOUT



## TUBE SHIPMENT (no suffix)

CASABLANCA

MUAR

All dimensions are in mm.

|                   | Base Q.ty | Bulk Q.ty | Tube length (± 0.5) | A    | B    | C (± 0.1) |
|-------------------|-----------|-----------|---------------------|------|------|-----------|
| <b>Casablanca</b> | 50        | 1000      | 532                 | 10.4 | 16.4 | 0.8       |
| <b>Muar</b>       | 50        | 1000      | 532                 | 4.9  | 17.2 | 0.8       |

## TAPE AND REEL SHIPMENT (suffix "13TR")

### REEL DIMENSIONS

|               |      |
|---------------|------|
| Base Q.ty     | 600  |
| Bulk Q.ty     | 600  |
| A (max)       | 330  |
| B (min)       | 1.5  |
| C (± 0.2)     | 13   |
| F             | 20.2 |
| G (+ 2 / - 0) | 24.4 |
| N (min)       | 60   |
| T (max)       | 30.4 |

All dimensions are in mm.

### TAPE DIMENSIONS

According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

|                   |              |      |
|-------------------|--------------|------|
| Tape width        | W            | 24   |
| Tape Hole Spacing | P0 (± 0.1)   | 4    |
| Component Spacing | P            | 24   |
| Hole Diameter     | D (± 0.1/-0) | 1.5  |
| Hole Diameter     | D1 (min)     | 1.5  |
| Hole Position     | F (± 0.05)   | 11.5 |
| Compartment Depth | K (max)      | 6.5  |
| Hole Spacing      | P1 (± 0.1)   | 2    |

All dimensions are in mm.



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