



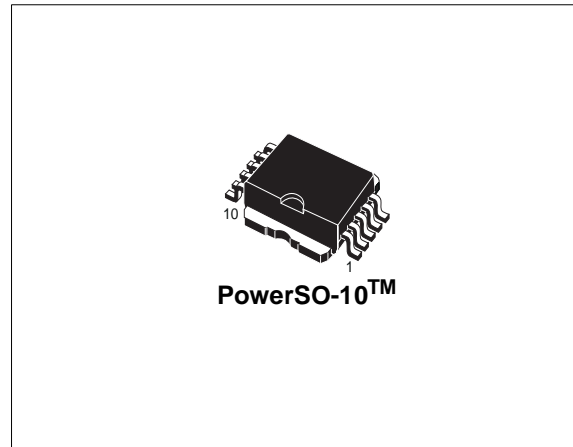
# VN330SP

## QUAD HIGH SIDE SMART POWER SOLID STATE RELAY

| TYPE    | $V_{\text{demag}}^{(*)}$   | $R_{\text{DSon}}^{(*)}$ | $I_{\text{out}}^{(*)}$ | $V_{\text{CC}}$ |
|---------|----------------------------|-------------------------|------------------------|-----------------|
| VN330SP | $V_{\text{CC}}-55\text{V}$ | $0.32\Omega^{(**)}$     | 0.7A                   | 36 V            |

(\*) Per channel  
 (\*\*) at  $T_J=85^\circ\text{C}$

- OUTPUT CURRENT: 0.7A PER CHANNEL
- DIGITAL INPUTS CLAMPED AT 32V MINIMUM VOLTAGE
- SHORTED LOAD AND OVERTEMPERATURE PROTECTIONS
- BUILT-IN CURRENT LIMITER
- UNDERVOLTAGE SHUT-DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUT
- FAST DEMAGNETIZATION OF INDUCTIVE LOADS

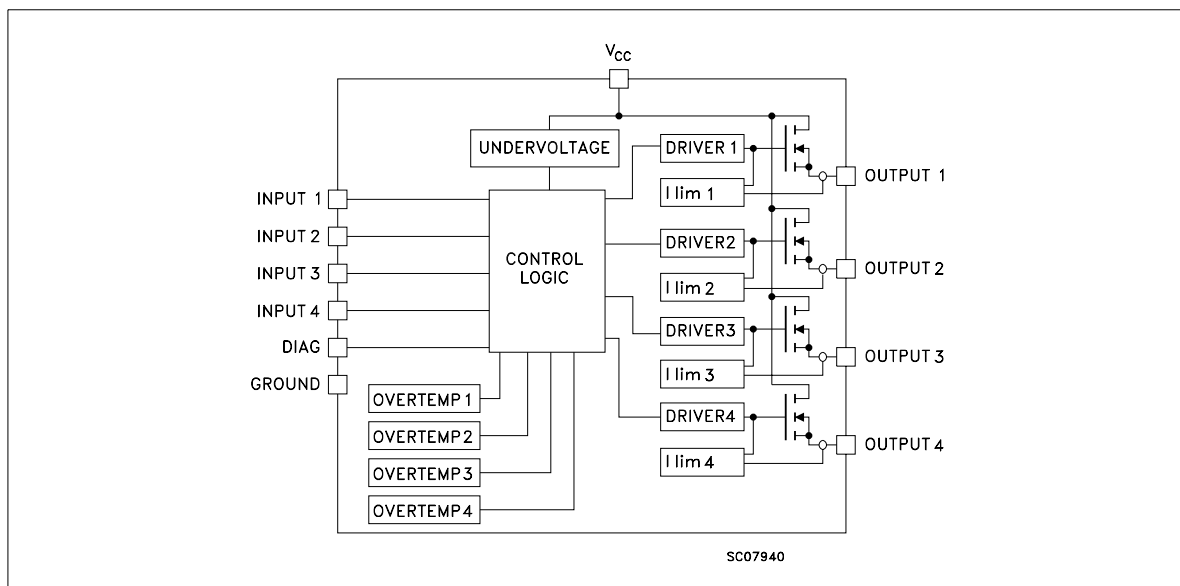


### DESCRIPTION

The VN330SP is a monolithic device made using STMicroelectronics VIPower technology, intended for driving four independent resistive or inductive loads with one side connected to ground. Active current limitation avoids dropping the system power supply in case of shorted load. Built-in thermal shut-down protects the chip from

overtemperature and short circuit. The open drain diagnostic output indicates short circuit and overtemperature conditions.

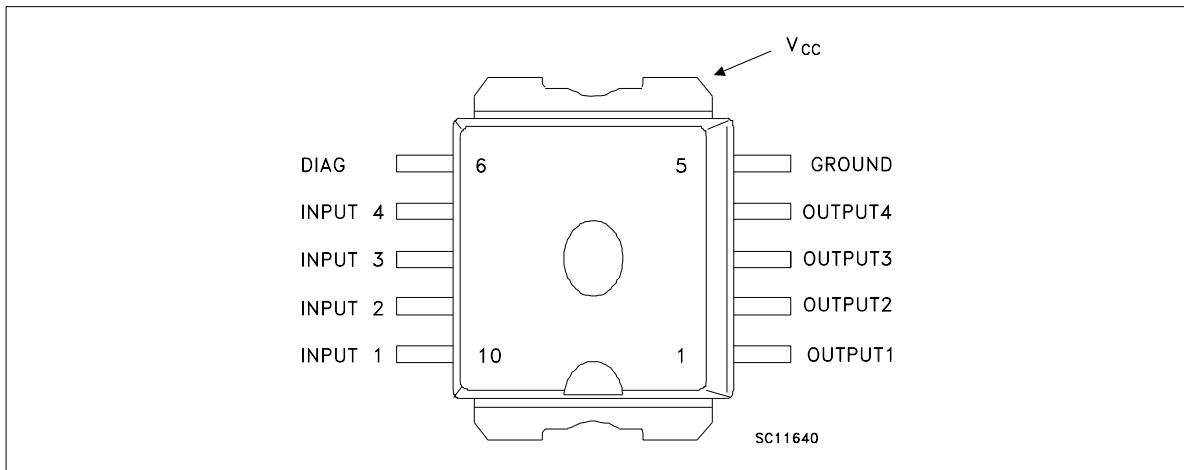
### BLOCK DIAGRAM



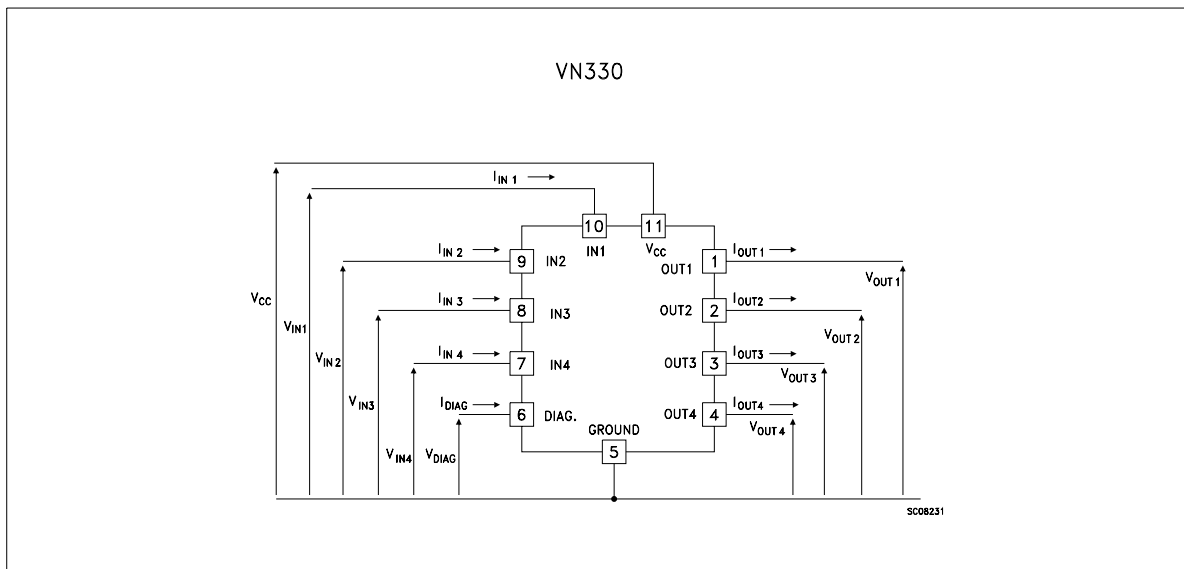
**ABSOLUTE MAXIMUM RATING**

| Symbol     | Parameter   | Value              | Unit             |
|------------|---|--------------------|------------------|
| $V_{CC}$   | Power supply voltage  | 45                 | V                |
| $-V_{CC}$  | Reverse supply voltage  | -0.3               | V                |
| $I_{OUT}$  | Output current (continuous)   | Internally limited | A                |
| $I_R$      | Reverse output current (per channel)  | -6                 | A                |
| $I_{IN}$   | Input current (per channel)   | $\pm 10$           | mA               |
| $I_{DIAG}$ | Diag pin current  | $\pm 10$           | mA               |
| $V_{ESD}$  | Electrostatic discharge (R=1.5K $\Omega$ ; C=100pF)                         | 2000               | V                |
| $E_{AS}$   | Single pulse avalanche energy per channel not simultaneously (see figure 1) | 400                | mJ               |
| $P_{tot}$  | Power dissipation at $T_c \leq 25^\circ\text{C}$                            | Internally limited | W                |
| $T_j$      | Junction operating temperature  | Internally limited | $^\circ\text{C}$ |
| $T_{stg}$  | Storage temperature   | -55 to 150         | $^\circ\text{C}$ |

**CONNECTION DIAGRAM TOP VIEW**



**CURRENT AND VOLTAGE CONVENTIONS**



**THERMAL DATA**

| Symbol         | Parameter                                      | Value | Unit |
|----------------|--|-------|------|
| $R_{thj-case}$ | Thermal resistance junction-case (1) (MAX)     | 2     | °C/W |
| $R_{thj-amb}$  | Thermal resistance junction-ambient (\$) (MAX) | 50    | °C/W |

(1) All channels ON  
 (\$) When mounted using minimum recommended pad size on FR-4 board

**ELECTRICAL CHARACTERISTICS** ( $10V < V_{CC} < 36V$ ;  $-25^{\circ}C < T_j < 125^{\circ}C$ ; unless otherwise specified)

**POWER**

| Symbol      | Parameter                  | Test Conditions   | Min         | Typ         | Max         | Unit                 |
|-------------|----------------------------|---|-------------|-------------|-------------|----------------------|
| $V_{CC}$    | Supply voltage             |   | 10          |             | 36          | V                    |
| $R_{ON}$    | On state resistance        | $I_{OUT}=0.5A$ ; $T_j=125^{\circ}C$<br>$I_{OUT}=0.5A$ ; $T_j=85^{\circ}C$ |             |             | 0.4<br>0.32 | $\Omega$<br>$\Omega$ |
| $I_S$       | Supply current             | All channels off<br>On state; $T_j=125^{\circ}C$ ; $I_{OUTn}=0V$          |             |             | 1<br>10     | mA<br>mA             |
| $V_{demag}$ | Output voltage at turn-off | $I_{OUT}=0.5A$ ; $L_{LOAD}=1mH$   | $V_{CC}-65$ | $V_{CC}-55$ | $V_{CC}-45$ | V                    |

**SWITCHING** ( $V_{CC}=24V$ )

| Symbol          | Parameter                             | Test Conditions  | Min | Typ | Max        | Unit                     |
|-----------------|---------------------------------------|--|-----|-----|------------|--------------------------|
| $t_{d(on)}$     | Turn-on delay time of output current  | $I_{OUT}=0.5A$ , Resistive Load<br>Input rise time $< 0.1\mu s$<br>$T_j=25^{\circ}C$<br>$T_j=125^{\circ}C$ |     | 30  | 40<br>60   | $\mu s$<br>$\mu s$       |
| $t_r$           | Rise time of output current           | $I_{OUT}=0.5A$ , Resistive Load<br>Input rise time $< 0.1\mu s$<br>$T_j=25^{\circ}C$<br>$T_j=125^{\circ}C$ |     | 50  | 100<br>115 | $\mu s$<br>$\mu s$       |
| $t_{d(off)}$    | Turn-off delay time of output current | $I_{OUT}=0.5A$ , Resistive Load<br>Input rise time $< 0.1\mu s$<br>$T_j=25^{\circ}C$<br>$T_j=125^{\circ}C$ |     | 20  | 30<br>40   | $\mu s$<br>$\mu s$       |
| $t_f$           | Fall time of output current           | $I_{OUT}=0.5A$ , Resistive Load<br>Input rise time $< 0.1\mu s$<br>$T_j=25^{\circ}C$<br>$T_j=125^{\circ}C$ |     | 8   | 15<br>20   | $\mu s$<br>$\mu s$       |
| $(di/dt)_{on}$  | Turn-on current slope                 | $I_{OUT}=0.5A$<br>$I_{OUT}=I_{LIM}$ ; $T_j=25^{\circ}C$  |     |     | 0.5<br>2   | A/ $\mu s$<br>A/ $\mu s$ |
| $(di/dt)_{off}$ | Turn-off current slope                | $I_{OUT}=0.5A$<br>$I_{OUT}=I_{LIM}$ ; $T_j=25^{\circ}C$  |     |     | 2<br>4     | A/ $\mu s$<br>A/ $\mu s$ |

**ELECTRICAL CHARACTERISTICS** (continued)**LOGIC INPUT** (Per each channel)

| Symbol        | Parameter                                | Test Conditions  | Min | Typ        | Max | Unit               |
|---------------|--|--|-----|------------|-----|--------------------|
| $V_{IL}$      | Input low level voltage                  |  |     |            | 2   | V                  |
| $V_{IH}$      | Input high level voltage<br>(see note 1) |  | 3.5 |            |     | V                  |
| $V_{I(HYST)}$ | Input hysteresis voltage                 |  |     | 0.5        |     | V                  |
| $I_{IN}$      | Input current                            | $V_{IN}=0$ to 30V<br>$V_{IN}=0$ to 2V                  | 25  |            | 600 | $\mu$ A<br>$\mu$ A |
| $I_{LGND}$    | Output current in ground disconnection   | $V_{CC}=V_{INn}=GND=DIAG=24V$ ; $T_j=25^\circ\text{C}$ |     |            | 25  | mA                 |
| $V_{ICL}$     | Input clamp voltage<br>(see note 1)      | $I_{IN}=1\text{mA}$<br>$I_{IN}=-1\text{mA}$            | 32  | 36<br>-0.7 |     | V<br>V             |

Note 1: The input voltage is internally clamped at 32V minimum, it is possible to connect the input pins to an higher voltage via an external resistor calculate to not exceed 10mA.

**PROTECTION AND DIAGNOSTICS**

| Symbol         | Parameter                         | Test Conditions   | Min | Typ        | Max | Unit             |
|----------------|-----------------------------------|---|-----|------------|-----|------------------|
| $V_{DIAG} (*)$ | Status voltage output low         | $I_{STAT}=5\text{mA}$ (Fault condition)                                     |     |            | 1   | V                |
| $V_{SCL} (*)$  | Status clamp voltage              | $I_{DIAG}=1\text{mA}$<br>$I_{DIAG}=-1\text{mA}$                             | 32  | 36<br>-0.7 |     | V<br>V           |
| $V_{USD}$      | Undervoltage shut down            |   | 5   |            | 8   | V                |
| $V_{OL}$       | Low state output voltage          | $V_{IN}=V_{ILj}$ ; $R_{LOAD}\geq 10\text{M}\Omega$                          |     |            | 1.5 | V                |
| $I_{LIM}$      | DC Short circuit current          | $V_{CC}=24V$ ; $R_{LOAD}<10\text{m}\Omega$                                  | 0.7 |            | 2.5 | A                |
| $I_{OVPK}$     | Peak short circuit current        | $V_{CC}=24V$ ; $V_{IN}=30V$ ; $R_{LOAD}<10\text{m}\Omega$<br>(see figure 2) |     |            | 4   | A                |
| $I_{DIAGH}$    | Leakage on diag pin in high state | $V_{DIAG}=24V$  |     |            | 100 | $\mu$ A          |
| $I_{LOAD}$     | Output leakage current            | $V_{CC}=10$ to 36V; $V_{IN}=V_{IL}$   |     |            | 50  | $\mu$ A          |
| $t_{SC}$       | Delay time of current limiter     |   |     |            | 100 | $\mu$ s          |
| $T_{TSD}$      | Thermal shut down temperature     |   | 150 | 170        |     | $^\circ\text{C}$ |
| $T_R$          | Reset temperature                 |   | 135 | 155        |     | $^\circ\text{C}$ |

(\*) Status determination > 100 $\mu$ s after the switching edge.

Note: If INPUT pin is left floating the corresponding channel will automatically switch off. If GND pin is disconnected, all channels will switch off provided  $V_{CC}$  does not exceed 36V.

FIGURE 1: Avalanche Energy Test Circuit

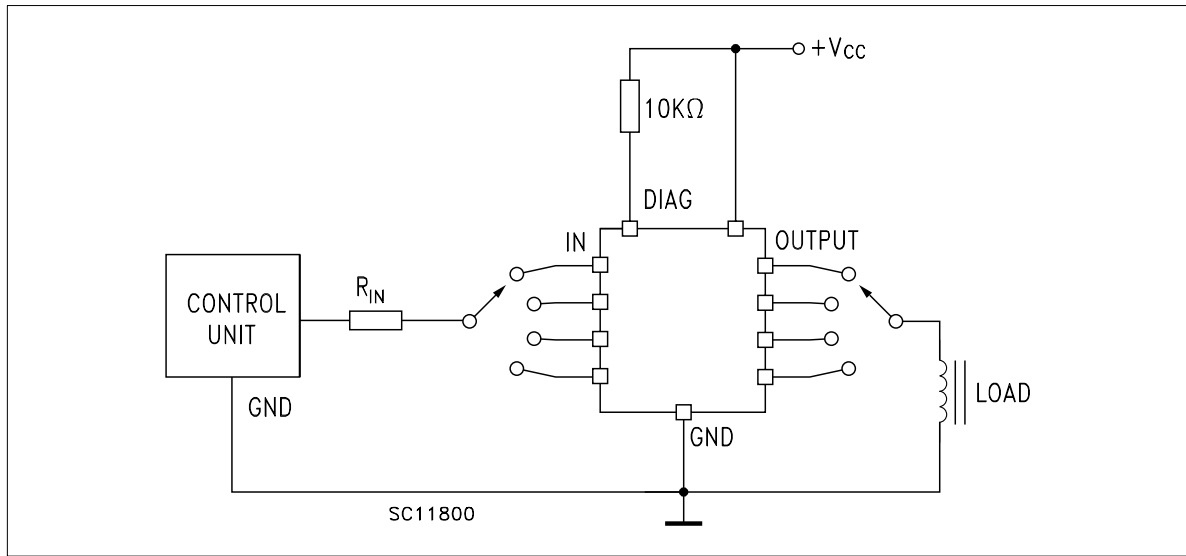
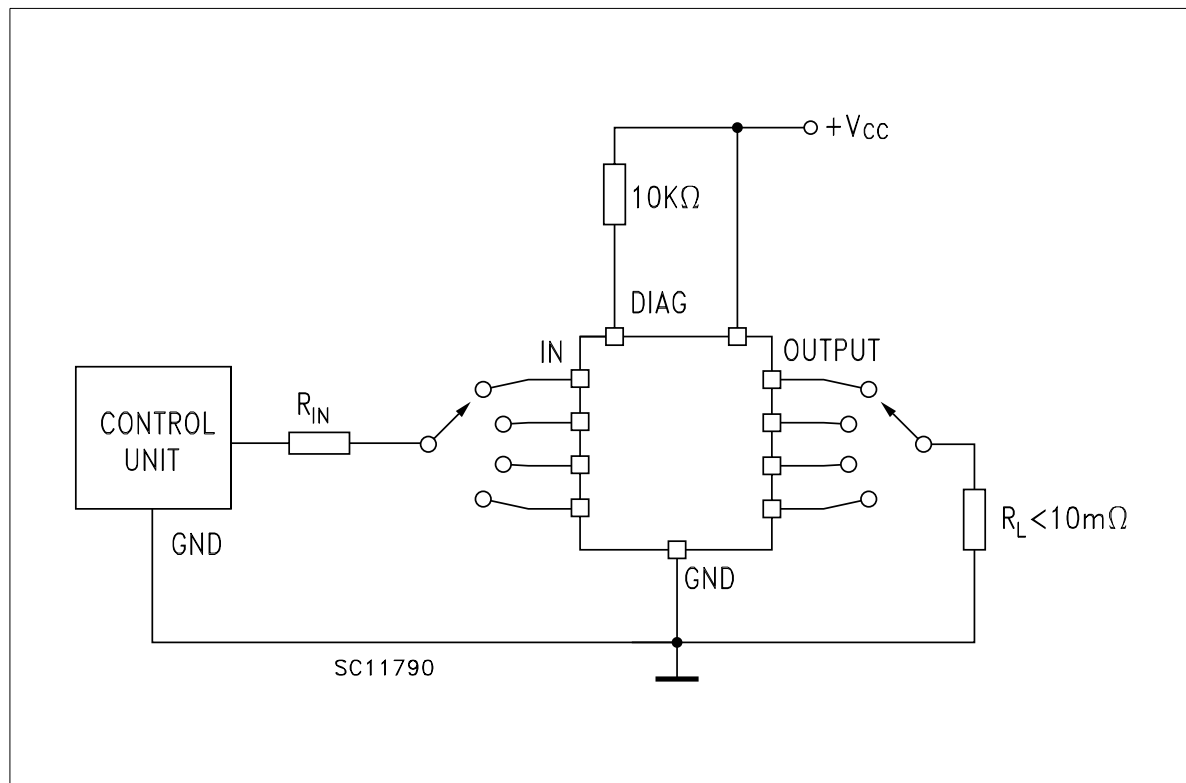


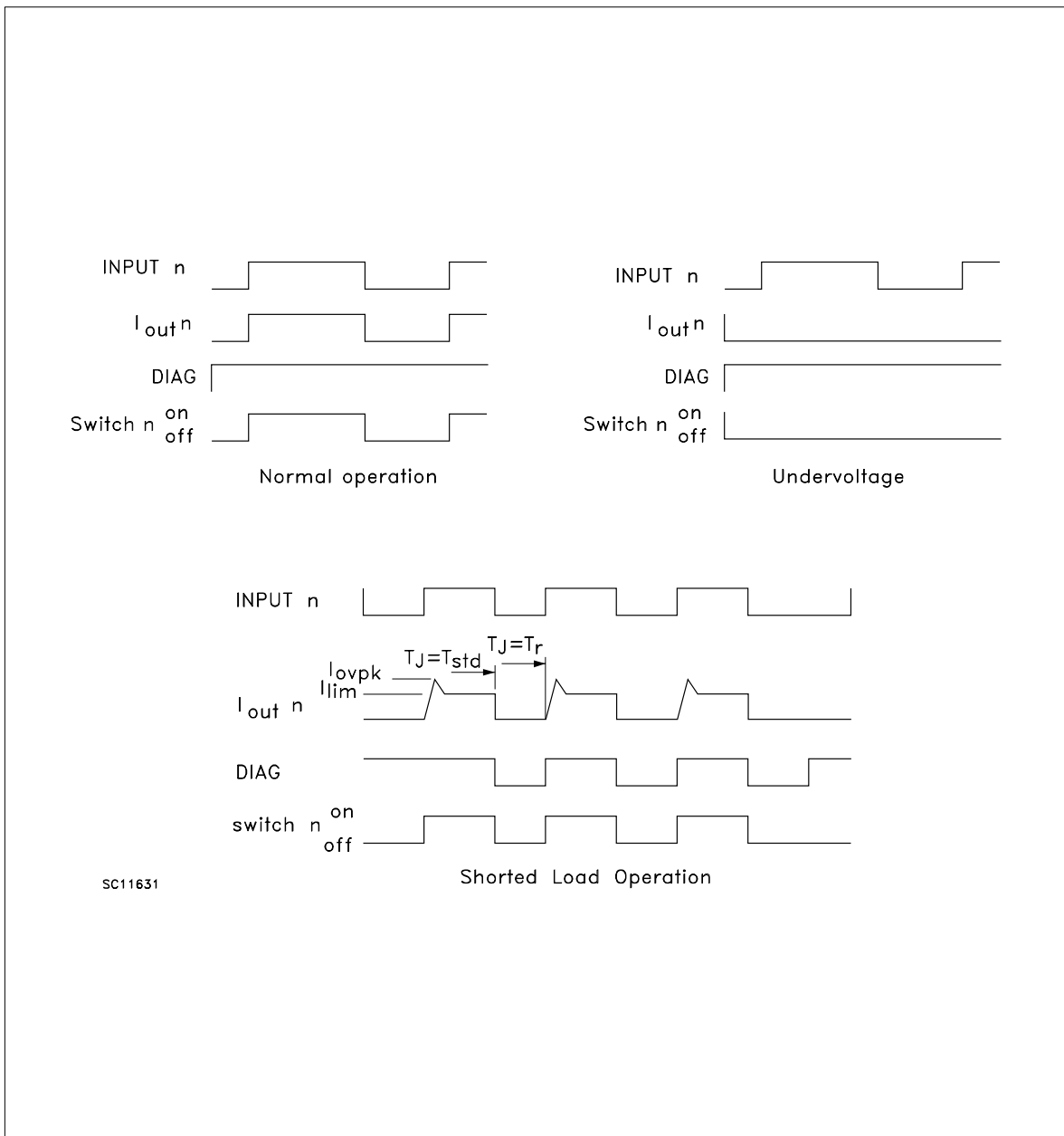
FIGURE 2: Peak Short Circuit Current Test Circuit



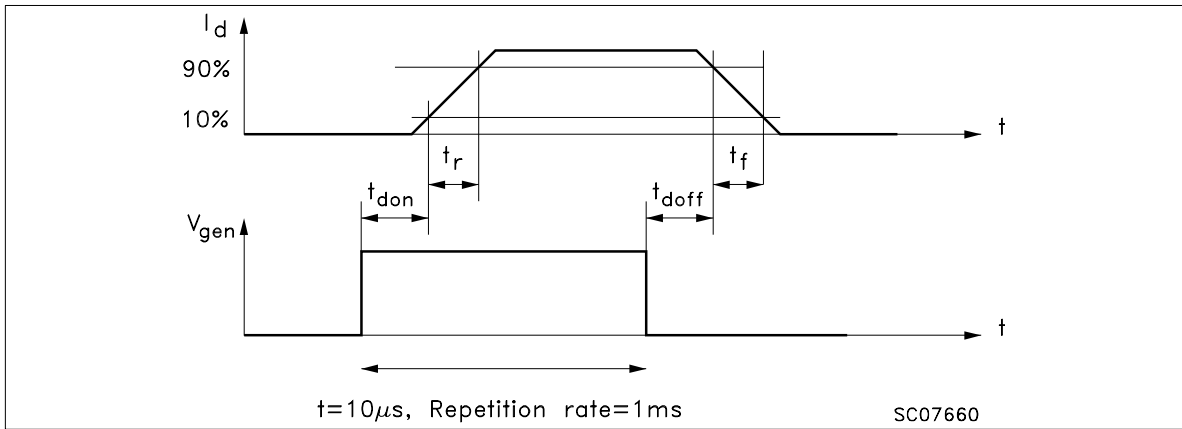
**THRUTH TABLE**

|                                      | INPUTn | OUTPUTn | DIAGNOSTIC |
|--------------------------------------|--------|---------|------------|
| Normal operation                     | L<br>H | L<br>H  | H<br>H     |
| Overtemperature                      | L<br>H | L<br>L  | H<br>L     |
| Undervoltage                         | L<br>H | L<br>L  | H<br>H     |
| Shorted load<br>(Current limitation) | L<br>H | L<br>H  | H<br>H     |

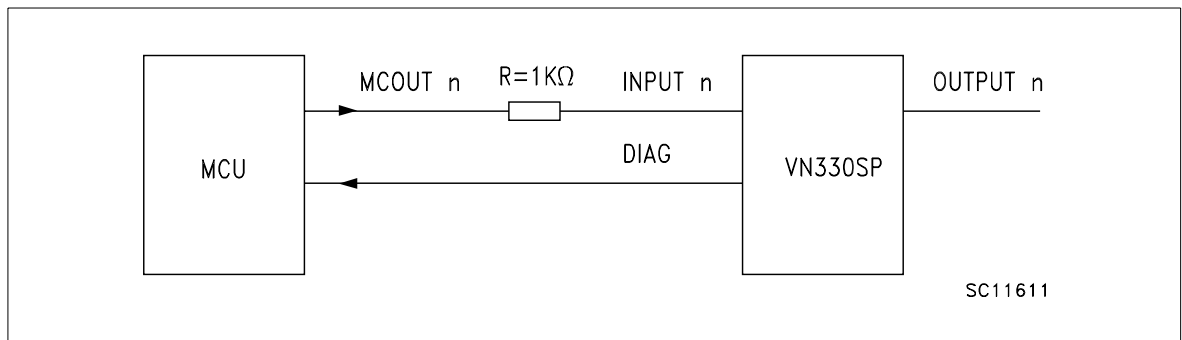
**Figure 3: Switching Waveforms**



**SWITCHING PARAMETERS TEST CONDITIONS**



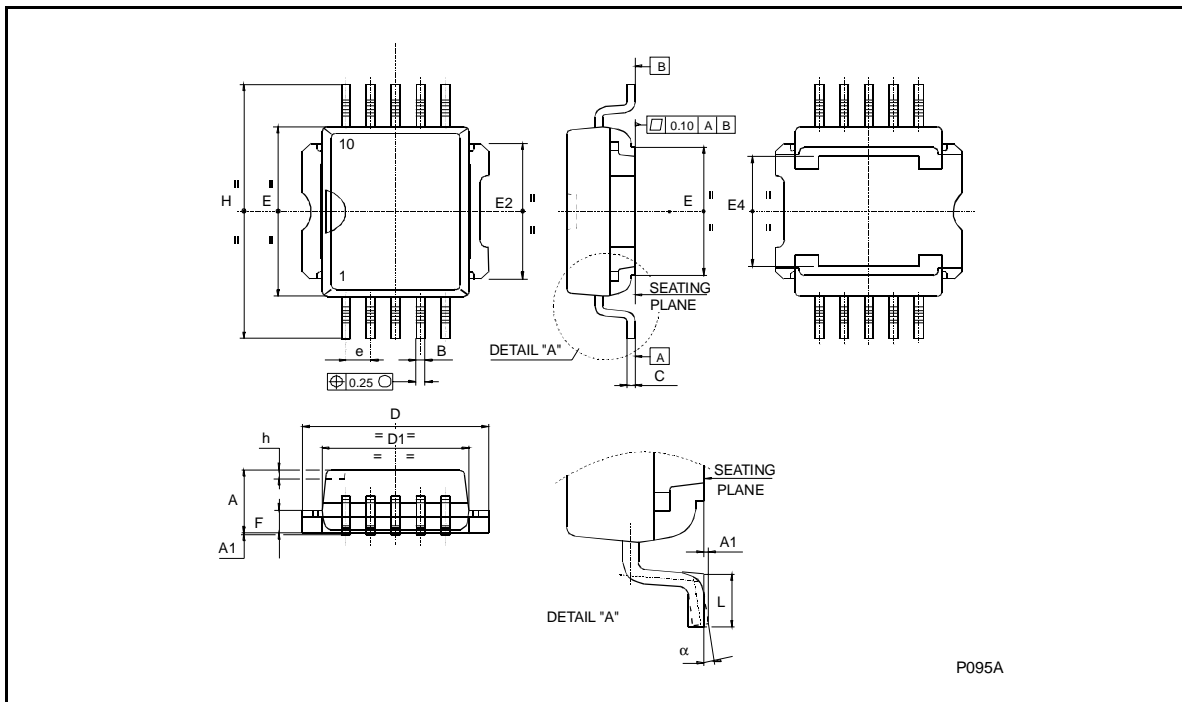
**DRIVING CIRCUIT**



**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





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