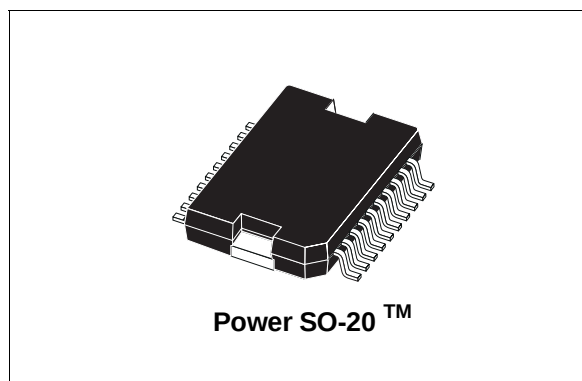


## THREE CHANNELS HIGH SIDE SMART SOLID STATE RELAY

| TYPE  | Channel | R <sub>DS(on)</sub> | I <sub>OUT</sub> | V <sub>CC</sub> |
|-------|---------|---------------------|------------------|-----------------|
| VN450 | 1 & 2   | 40 m $\Omega$       | 10 A             | 36 V            |
|       | 3       | 300 m $\Omega$      | 2 A              | 36 V            |

- OUTPUT CURRENT (CONTINUOUS):  
10 A (CHANNEL 1,2) @ T<sub>C</sub> = 25 °C  
2 A (CHANNEL 3) @ T<sub>C</sub> = 25 °C
- 5 V LOGIC LEVEL COMPATIBLE INPUTS
- UNDER VOLTAGE SHUT-DOWN
- OVER VOLTAGE SHUT-DOWN
- THERMAL SHUT-DOWN
- OPEN DRAIN DIAGNOSTIC OUTPUTS
- VERY LOW STAND-BY POWER DISSIPATION



### DESCRIPTION

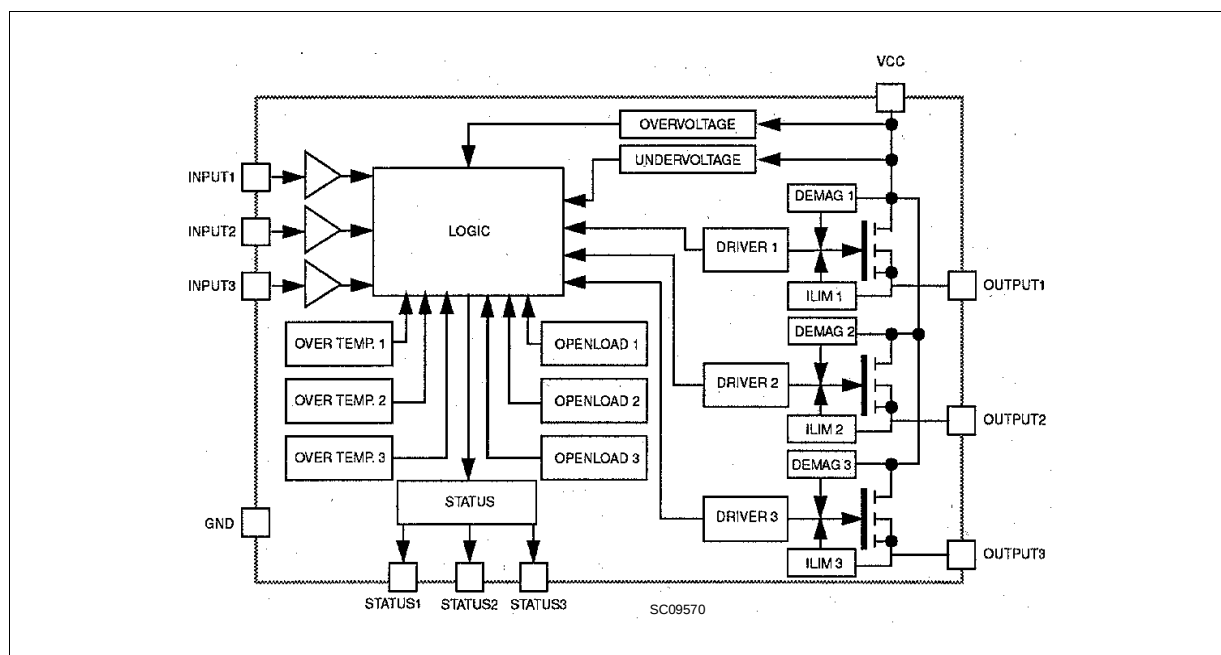
The VN450 is a monolithic device made using SGS-THOMSON Vertical Intelligent Power Technology, intended for driving resistive or inductive loads with one side connected to ground. This device has three independant channels and three diagnostics.

Built-in thermal shut-down protects the chip from over temperature and short circuit.

The control inputs are 5V CMOS logic level compatible.

The open drain diagnostic outputs indicate short circuit (no load) and overtemperature status.

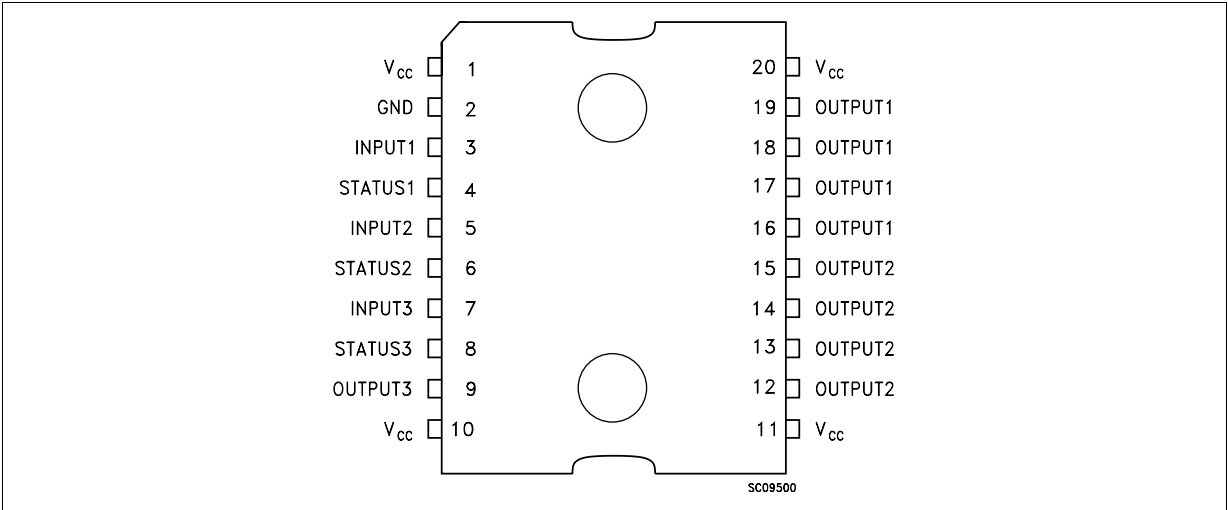
### BLOCK DIAGRAM



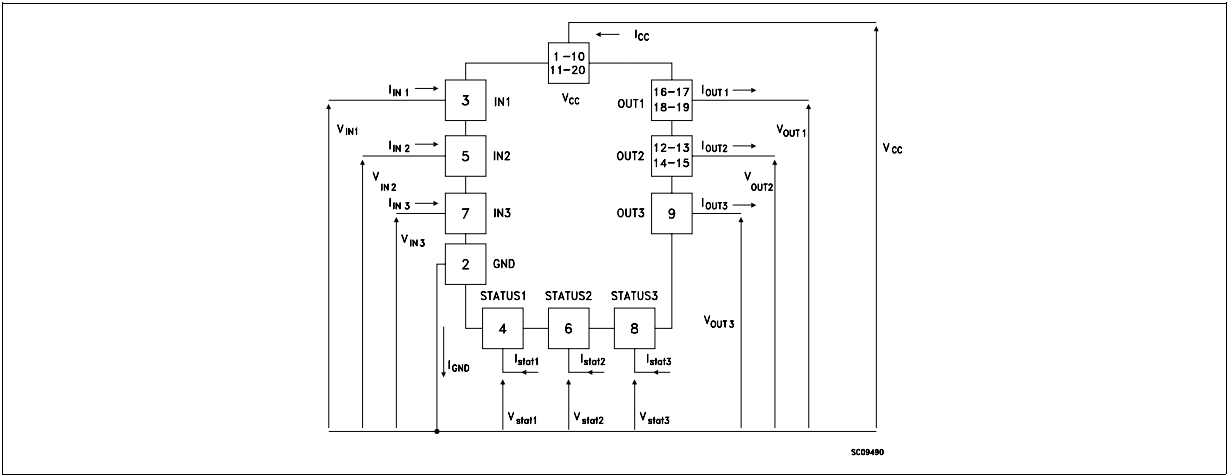
ABSOLUTE MAXIMUM RATING

| Symbol            | Parameter                                                  | Value      | Unit       |
|-------------------|------------------------------------------------------------|------------|------------|
| $V_{CC}$          | Supply Voltage (continuous)                                | 45         | V          |
| $-V_{CC}$         | Reverse Supply Voltage (continuous)                        | -0.3       | V          |
| $-I_{gnd}$        | Reverse Ground Current                                     | -200       | mA         |
| $I_{OUT\ 1,2}$    | Output Current (continuous), channels 1, 2                 | 10         | A          |
| $I_{OUT\ 3}$      | Output Current (continuous), channel 3                     | 2.5        | A          |
| $I_{R\ 1,2}$      | Reverse Output Current (continuous) channels 1, 2          | -10        | A          |
| $I_{R\ 3}$        | Reverse Output Current (continuous) channel 3              | -2.5       | A          |
| $I_{IN\ 1,2,3}$   | Input Current                                              | $\pm 10$   | mA         |
| $I_{STAT\ 1,2,3}$ | Status Output Current                                      | $\pm 10$   | mA         |
| $V_{ESD}$         | Electrostatic Discharge ( $R=1.5\ k\Omega$ , $C=100\ pF$ ) | 2000       | V          |
| $P_{tot}$         | Power Dissipation at $T_c \leq 25\ ^\circ C$               | 95         | W          |
| $T_j$             | Junction Operating Temperature                             | -40 to 150 | $^\circ C$ |
| $T_{stg}$         | Storage Temperature                                        | -55 to 150 | $^\circ C$ |

CONNECTION DIAGRAM



CURRENT AND VOLTAGE CONVENTIONS



**ELECTRICAL TRANSIENTS REQUIREMENTS**

| ISO T/R<br>7637/1<br>Test Pulse | TEST LEVELS |         |         |         |                          |
|---------------------------------|-------------|---------|---------|---------|--------------------------|
|                                 | I           | II      | III     | IV      | Delays and Impedance     |
| 1                               | -25 V       | -50 V   | -75 V   | -100 V  | 2 ms, 10 $\Omega$        |
| 2                               | +25 V       | +50 V   | +75 V   | +100 V  | 0.2 ms, 10 $\Omega$      |
| 3a                              | -25 V       | -50 V   | -100 V  | -150 V  | 0.1 $\mu$ s, 50 $\Omega$ |
| 3b                              | +25 V       | +50 V   | +75 V   | +100 V  | 0.1 $\mu$ s, 50 $\Omega$ |
| 4                               | -4 V        | -5 V    | -6 V    | -7 V    | 100 ms, 0.01 $\Omega$    |
| 5                               | +26.5 V     | +46.5 V | +66.5 V | +86.5 V | 400 ms, 2 $\Omega$       |

| ISO T/R<br>7637/1<br>Test Pulse | TEST LEVELS RESULTS |    |     |    |  |
|---------------------------------|---------------------|----|-----|----|--|
|                                 | I                   | II | III | IV |  |
| 1                               | C                   | C  | C   | C  |  |
| 2                               | C                   | C  | C   | C  |  |
| 3a                              | C                   | C  | C   | C  |  |
| 3b                              | C                   | C  | C   | C  |  |
| 4                               | C                   | C  | C   | C  |  |
| 5                               | C                   | E  | E   | E  |  |

(With a series resistor  $\geq 1$  K $\Omega$  in input and status pins).

| CLASS | CONTENTS                                                                                                                                                 |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| C     | All function of the device are performed as designed after exposure to disturbance.                                                                      |
| E     | One or more functions of the device is not performed as designed after exposure and cannot be returned to proper operation without replacing the device. |

## THERMAL DATA

|                       |                                      |     |     |      |
|-----------------------|--------------------------------------|-----|-----|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case (1) | Max | 1.3 | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient  | Max | 50  | °C/W |

ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 13 V; -40 °C < T<sub>j</sub> < 125 °C unless otherwise specified)

## POWER

| Symbol           | Parameter                | Test Conditions                                                                                                                                                              | Min. | Typ.      | Max.                   | Unit                 |
|------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------|------------------------|----------------------|
| V <sub>CC</sub>  | Operating Supply Voltage |                                                                                                                                                                              | 5.5  | 13        | 36                     | V                    |
| V <sub>USD</sub> | Under Voltage Shut-Down  |                                                                                                                                                                              | 3    | 4         | 5.5                    | V                    |
| V <sub>OV</sub>  | Overvoltage Shut-Down    |                                                                                                                                                                              | 36   | 39        | 45                     | V                    |
| R <sub>ON</sub>  | On State Resistance      | I <sub>OUT 1,2</sub> = 2 A      T <sub>j</sub> = 25 °C<br>I <sub>OUT 1,2</sub> = 2 A<br>I <sub>OUT 3</sub> = 0.5 A      T <sub>j</sub> = 25 °C<br>I <sub>OUT 3</sub> = 0.5 A |      |           | 40<br>75<br>300<br>540 | mΩ<br>mΩ<br>mΩ<br>mΩ |
| I <sub>S</sub>   | Supply Current           | Off state      T <sub>case</sub> = 25 °C<br>On state                                                                                                                         |      | 30<br>4.2 | 60<br>10               | μA<br>mA             |

## LOGIC INPUT (Channel1,2,3)

| Symbol                | Parameter                             | Test Conditions                                      | Min. | Typ.      | Max. | Unit   |
|-----------------------|---------------------------------------|------------------------------------------------------|------|-----------|------|--------|
| V <sub>IL</sub>       | Input Low Level Voltage               | (*)                                                  |      |           | 1.5  | V      |
| V <sub>IH</sub>       | Input High Level Voltage (see note 1) | (*)                                                  | 3.5  |           |      | V      |
| V <sub>I(hyst.)</sub> | Input Hysteresis Voltage              |                                                      | 0.2  | 0.85      | 1.5  | V      |
| I <sub>IN</sub>       | Input Current                         | V <sub>IN</sub> = 5 V      T <sub>case</sub> = 25 °C |      |           | 100  | μA     |
| V <sub>ICL</sub>      | Input Clamp Voltage                   | I <sub>IN</sub> = 10 mA<br>I <sub>IN</sub> = -10 mA  | 5    | 6<br>-0.7 | 7    | V<br>V |

(\*) : The input voltage is internally clamped at 6 V about. It is possible to connect this pin to an higher voltage via an external resistor provided the input current does not exceed 10 mA.

SWITCHING (V<sub>CC</sub> = 13 V; T<sub>j</sub> = 25 °C; input rise time < 0.1 μs)

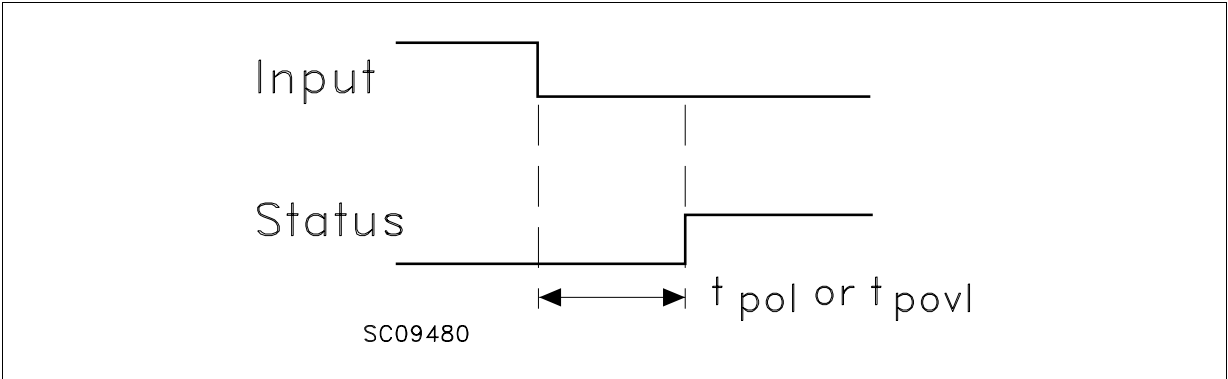
| Symbol                 | Parameter                             | Test Conditions                                                                   | Min.      | Typ.         | Max.         | Unit         |
|------------------------|---------------------------------------|-----------------------------------------------------------------------------------|-----------|--------------|--------------|--------------|
| t <sub>d(on)</sub>     | Turn-on Delay Time Of Output Current  | R <sub>1</sub> = 6.5 Ω      Channels 1,2<br>R <sub>1</sub> = 26 Ω      Channels 3 | 10<br>2   | 40<br>20     | 140<br>70    | μs<br>μs     |
| t <sub>r</sub>         | Rise Time Of Output Current           | R <sub>1</sub> = 6.5 Ω      Channels 1,2<br>R <sub>1</sub> = 26 Ω      Channels 3 | 32<br>8   | 150<br>20    | 300<br>60    | μs<br>μs     |
| t <sub>d(off)</sub>    | Turn-off Delay Time Of Output Current | R <sub>1</sub> = 6.5 Ω      Channels 1,2<br>R <sub>1</sub> = 26 Ω      Channels 3 | 120<br>30 | 300<br>75    | 600<br>150   | μs<br>μs     |
| t <sub>f</sub>         | Fall Time Of Output Current           | R <sub>1</sub> = 6.5 Ω      Channels 1,2<br>R <sub>1</sub> = 26 Ω      Channels 3 | 32<br>8   | 80<br>20     | 160<br>50    | μs<br>μs     |
| di/dt <sub>(on)</sub>  | Turn-on Current Slope                 | R <sub>1</sub> = 6.5 Ω      Channels 1,2<br>R <sub>1</sub> = 26 Ω      Channels 3 |           | 0.02<br>0.02 | 0.05<br>0.05 | A/μs<br>A/μs |
| di/dt <sub>(off)</sub> | Turn-off Current Slope                | R <sub>1</sub> = 6.5 Ω      Channels 1,2<br>R <sub>1</sub> = 26 Ω      Channels 3 |           | 0.02<br>0.02 | 0.05<br>0.05 | A/μs<br>A/μs |

**ELECTRICAL CHARACTERISTICS** (continued)  
**PROTECTIONS AND DIAGNOSTICS**

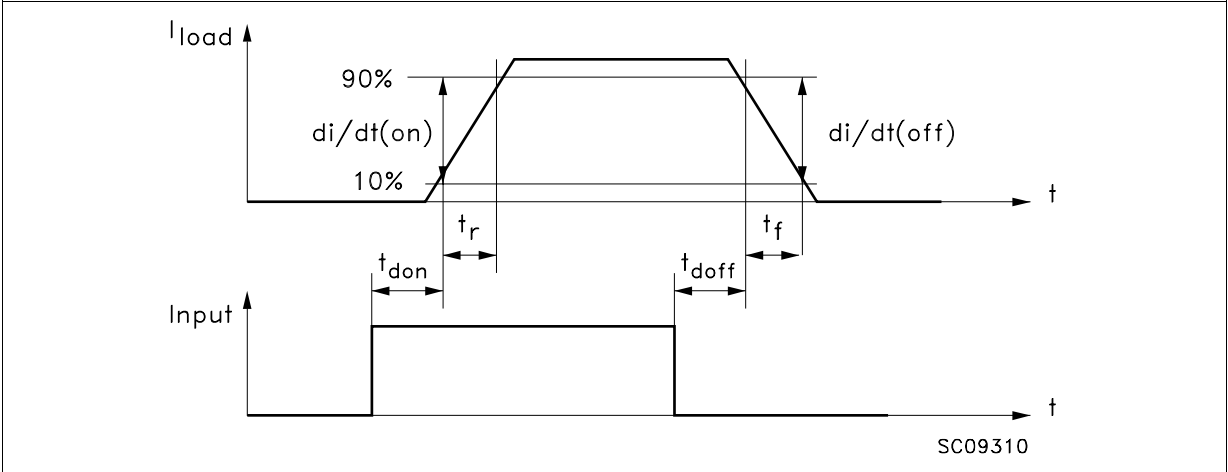
| Symbol              | Parameter                                     | Test Conditions                                                                                                                                                                 | Min.        | Typ.        | Max.        | Unit               |
|---------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|--------------------|
| $T_{TSD}$           | Thermal Shut-down Temperature                 |                                                                                                                                                                                 | 150         | 170         | 190         | $^{\circ}\text{C}$ |
| $T_{TR}$            | Thermal Reset Temperature                     |                                                                                                                                                                                 | 135         |             |             | $^{\circ}\text{C}$ |
| $T_{RSD}$<br>(HYST) | Thermal Hysteresis                            |                                                                                                                                                                                 | 5           | 15          | 30          | $^{\circ}\text{C}$ |
| $V_{ENOL}$          | Output Voltage Authorizing Openload Detection | $8\text{V} \leq V_{CC} \leq 36\text{V}$                                                                                                                                         | 5.2         | 6.6         | 8           | V                  |
| $I_{OL}$            | Open Load Current Level                       | Channels 1,2<br>Channels 3<br>$8\text{V} \leq V_{CC} \leq 18\text{V}$<br>$8\text{V} \leq V_{CC} \leq 30\text{V}$                                                                | 100<br>5    | 450<br>50   | 800<br>100  | mA<br>mA           |
| $I_{OV}$            | Over Current                                  | $R_1 \leq 10\text{ m}\Omega$<br>$R_1 \leq 10\text{ m}\Omega$<br>channels 1,2<br>channel 3                                                                                       | 10<br>2     | 18<br>3.5   |             | A<br>A             |
| $I_{AV}$            | Average Current in Short Circuit              | $R_1 \leq 10\text{ m}\Omega$<br>channels 1,2<br>channel 3<br>$T_{Case} = 85^{\circ}\text{C}$                                                                                    |             | 3.4<br>2    |             | A<br>A             |
| $V_{STAT1,2,3}$     | Status Output Voltage                         | $I_{STAT} = 1.6\text{ mA}$ (Fault Condition)                                                                                                                                    |             |             | 0.4         | V                  |
| $V_{SCL1,2,3}$      | Status Clamp Voltage                          | $I_{STAT} = 10\text{ mA}$<br>$I_{STAT} = -10\text{ mA}$                                                                                                                         | 5.5         | 6<br>-0.7   | 7           | V<br>V             |
| $t_{POL}$           | Status Delay                                  | (*) (see figure 1)                                                                                                                                                              | 50          | 300         | 950         | $\mu\text{s}$      |
| $t_{POVL}$          | Status Delay                                  | (*) (see figure 1)                                                                                                                                                              |             |             | 10          | $\mu\text{s}$      |
| $V_{DEMAG}$         | Turn-off Output Clamp Voltage                 | $I_{OUT1} = 2\text{ A}$ $L = 1\text{ mH}$ $V_{IN1} = 0$<br>$I_{OUT2} = 2\text{ A}$ $L = 1\text{ mH}$ $V_{IN2} = 0$<br>$I_{OUT3} = 0.5\text{ A}$ $L = 1\text{ mH}$ $V_{IN3} = 0$ | $V_{CC}-45$ | $V_{CC}-50$ | $V_{CC}-55$ | V                  |

(\*) ISO definitions     $T_{POL}$  = Status delay in case of open load conditions  
 $T_{POVL}$  = Status delay in case of over load conditions

FIGURE 1



SWITCHING PARAMETERS TEST CONDITIONS

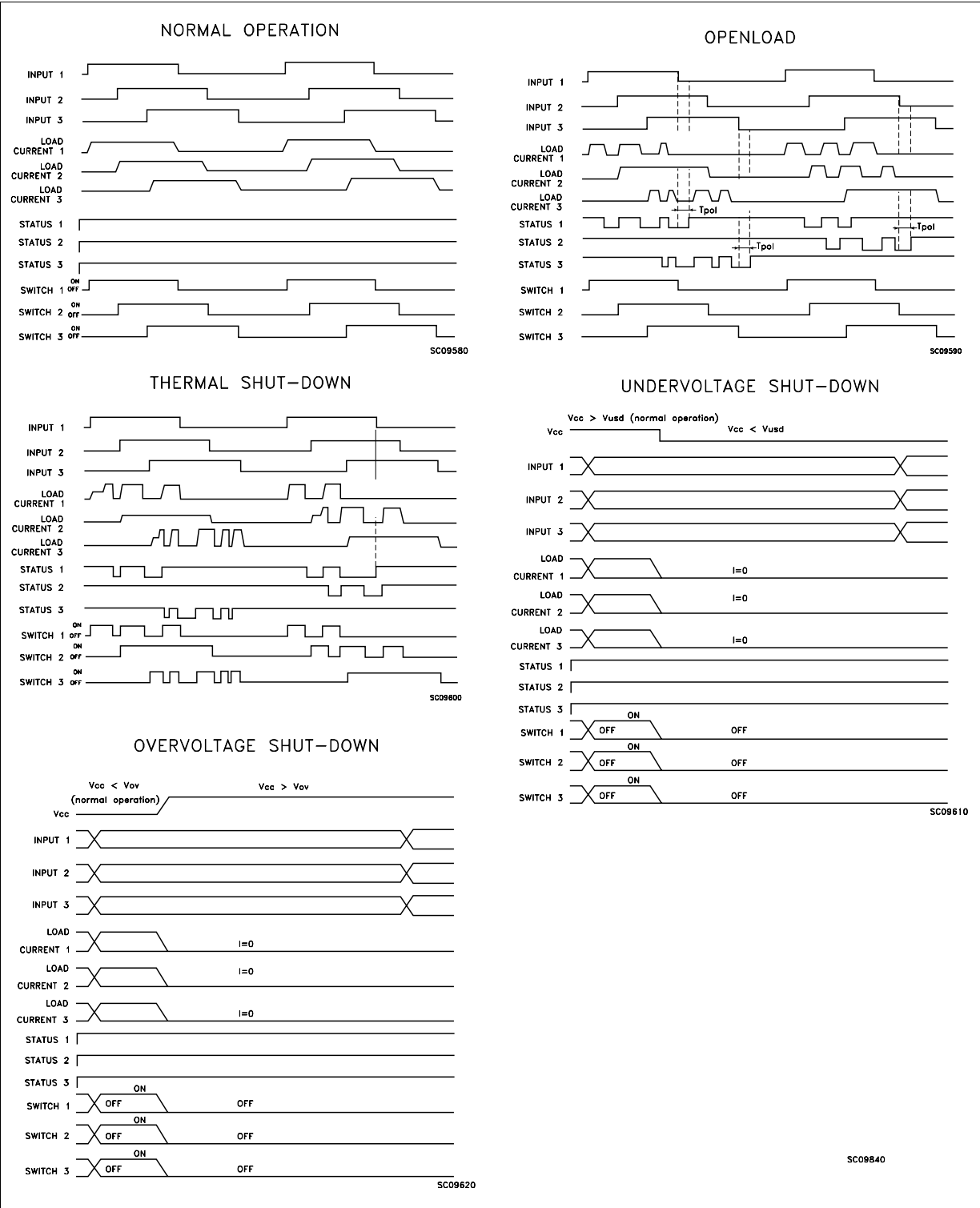


TRUTH TABLE (Channels 1,2,3)

| Conditions        | INPUT | OUTPUT | STATUS |
|-------------------|-------|--------|--------|
| Normal Operation  | L     | L      | H      |
|                   | H     | H      | H      |
| Over-voltage      | X     | L      | H      |
| Under-voltage     | X     | L      | H      |
| Thermal shut-down | H     | L      | L      |
| Open load         | H     | H      | L      |

H = high level, L= low level, X= unspecified

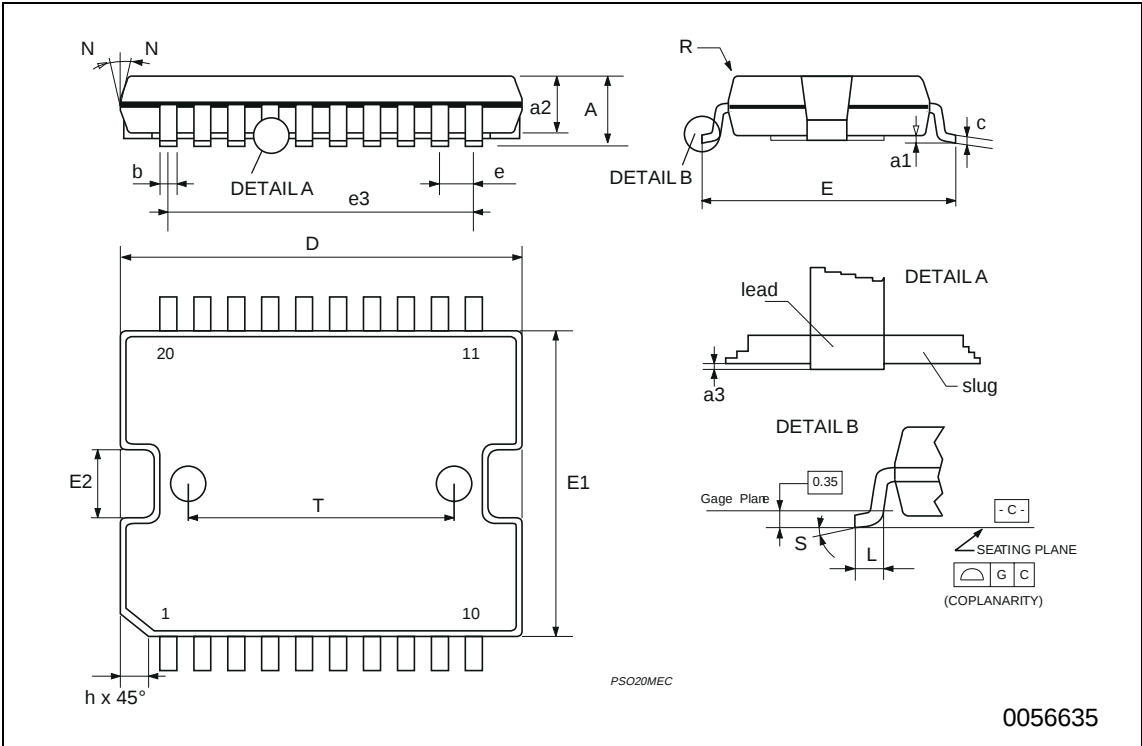
FIGURE 2: Switching Waveforms



# PowerSO-20 MECHANICAL DATA

| DIM.   | mm         |       |       | inch   |        |        |
|--------|------------|-------|-------|--------|--------|--------|
|        | MIN.       | TYP.  | MAX.  | MIN.   | TYP.   | MAX.   |
| A      |            |       | 3.60  |        |        | 0.1417 |
| a1     | 0.10       |       | 0.30  | 0.0039 |        | 0.0118 |
| a2     |            |       | 3.30  |        |        | 0.1299 |
| a3     | 0          |       | 0.10  | 0      |        | 0.0039 |
| b      | 0.40       |       | 0.53  | 0.0157 |        | 0.0209 |
| c      | 0.23       |       | 0.32  | 0.009  |        | 0.0126 |
| D (1)  | 15.80      |       | 16.00 | 0.6220 |        | 0.6299 |
| E      | 13.90      |       | 14.50 | 0.5472 |        | 0.570  |
| e      |            | 1.27  |       |        | 0.050  |        |
| e3     |            | 11.43 |       |        | 0.450  |        |
| E1 (1) | 10.90      |       | 11.10 | 0.4291 |        | 0.437  |
| E2     |            |       | 2.90  |        |        | 0.1141 |
| G      | 0          |       | 0.10  | 0      |        | 0.0039 |
| h      |            |       | 1.10  |        |        | 0.0433 |
| L      | 0.80       |       | 1.10  | 0.0314 |        | 0.0433 |
| N      | 10° (max.) |       |       |        |        |        |
| S      | 8° (max.)  |       |       |        |        |        |
| T      |            | 10.0  |       |        | 0.3937 |        |

(1) "D and E1" do not include mold flash or protusions  
- Mold flash or protusions shall not exceed 0.15mm (0.006")



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