

## DUAL FULL BRIDGE

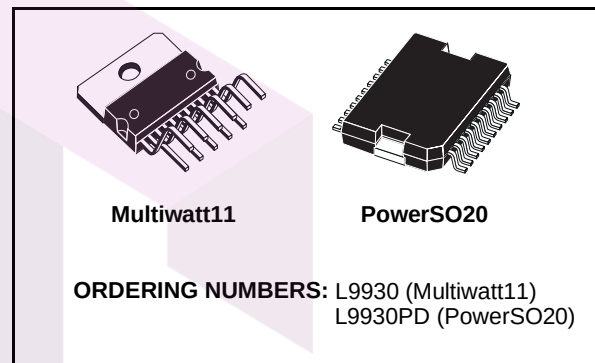
- $R_{DS\ ON} = 2\Omega$
- INTERNAL CLAMPING VOLTAGE = 32V
- INTERNAL FREE WHEELING DIODES
- PARALLEL DRIVE CAPABILITY
- RESISTIVE OR INDUCTIVE LOAD

### PROTECTION:

- TEMPERATURE PROTECTION
- SHORT-CIRCUIT PROTECTION ( $V_{bat}$ , LOAD, GND)

### DETECTION:

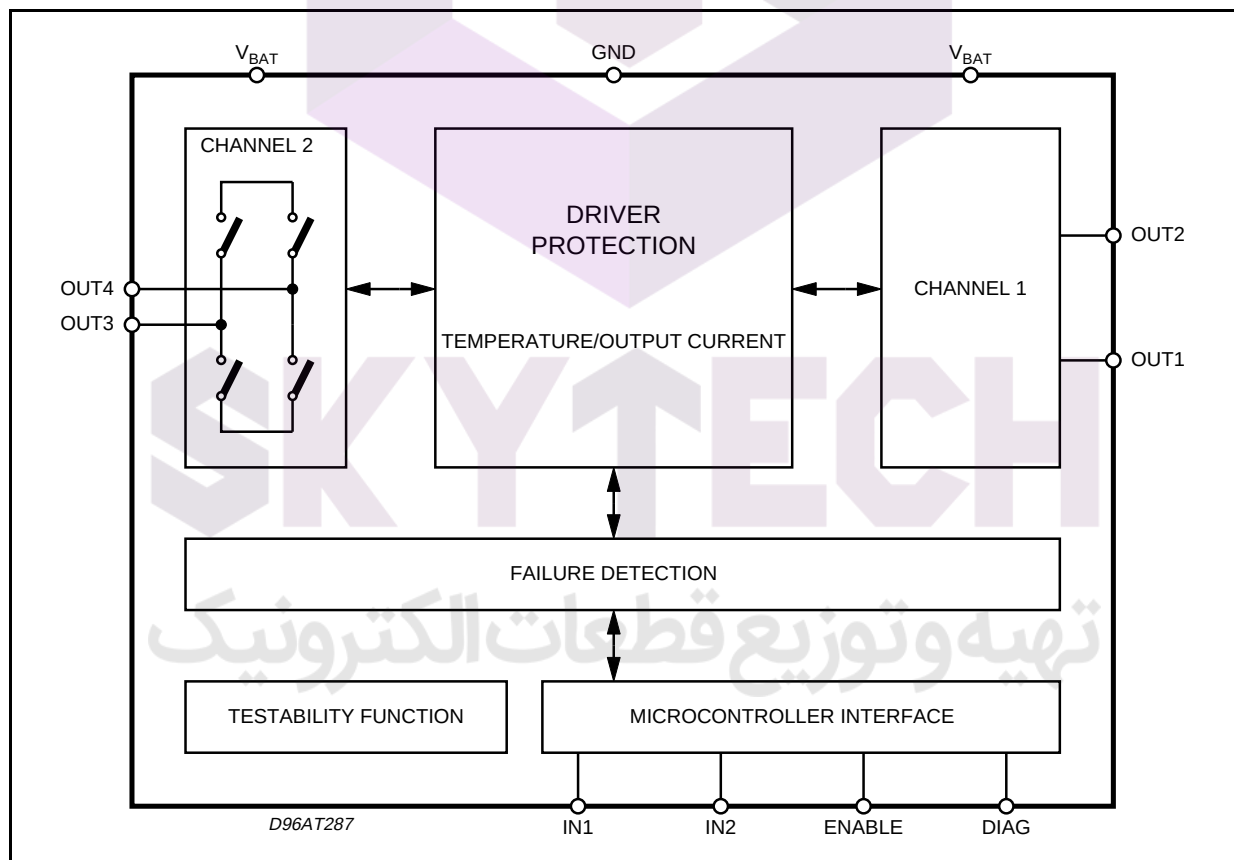
- SHORTED LOAD
- OPEN LOAD
- OVERTEMPERATURE



### DESCRIPTION

The L9930 is a dual full-bridge. The output stages are Power Mos switches.

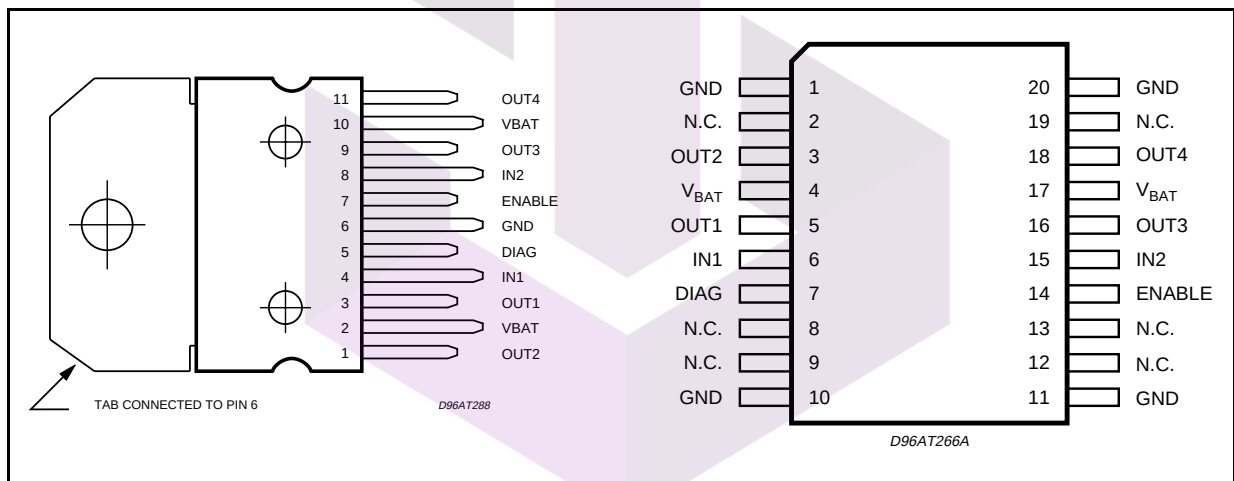
### BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                            | Value       | Unit |
|---------------------|--------------------------------------|-------------|------|
| E                   | Clamped Energy at the Switching off  | 6 (max)     | mJ   |
| V <sub>out DC</sub> | Continuous Output Voltage            | 24 (max)    | V    |
| V <sub>out tr</sub> | Transient Output Voltage             | 32 (max)    | V    |
| V <sub>bat DC</sub> | Continuous Battery Voltage           | 8 to 24     | V    |
| V <sub>bat tr</sub> | Transient Battery Voltage            | 45 (max)    | V    |
| I <sub>out</sub>    | Reverse Output Current               | – 2 (max)   | A    |
| f <sub>in</sub>     | Input Frequency                      | 500 (max)   | Hz   |
| V <sub>in</sub>     | Input Voltage                        | – 0.3 to +7 | V    |
| V <sub>diag</sub>   | Diagnostic Voltage                   | – 0.3 to +7 | V    |
| T <sub>s</sub>      | Storage Temperature                  | – 55 to 150 | °C   |
| T <sub>j</sub>      | Operating Junction Temperature       | – 40 to 150 | °C   |
| V <sub>ESD</sub>    | V <sub>ESD</sub> (Note MIL STD 883C) | 3000        | V    |

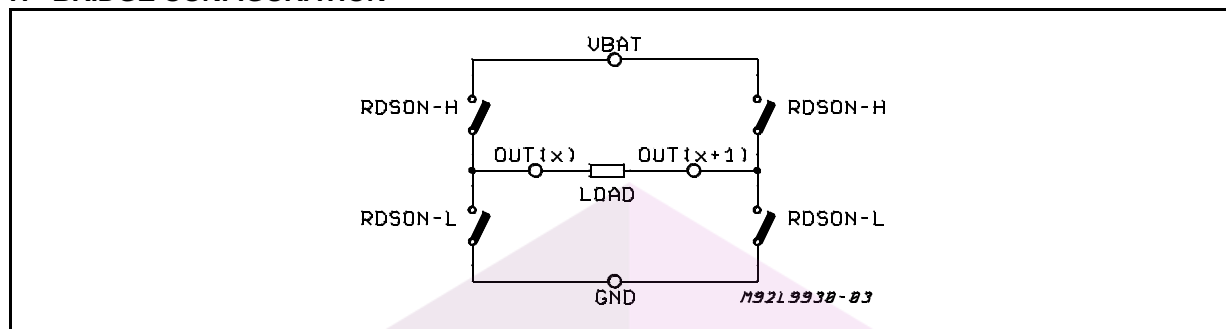
## PIN CONNECTION



## PIN FUNCTIONS

| MW11 | PowerSO20           | Name             | Function                                    |
|------|---------------------|------------------|---------------------------------------------|
| 1    | 3                   | OUT 2            | Output Channel 1                            |
| 2    | 4                   | V <sub>BAT</sub> | Power Supply                                |
| 3    | 5                   | OUT 1            | Output Channel 1                            |
| 4    | 6                   | IN 1             | Input Channel 1                             |
| 5    | 7                   | DIAG             | Diagnostic Output Common for the 2 Channels |
| 6    | 1, 10, 11, 20       | GND              | Ground                                      |
| 7    | 14                  | ENABLE           | Enable                                      |
| 8    | 15                  | IN 2             | Input Channel 2                             |
| 9    | 16                  | OUT 3            | Output Channel 2                            |
| 10   | 17                  | V <sub>BAT</sub> | Power Supply                                |
| 11   | 18                  | OUT 4            | Output Channel 2                            |
|      | 2, 8, 9, 12, 13, 19 | NC               | Not Connected                               |

## H - BRIDGE CONFIGURATION



## THERMAL DATA

| Symbol         | Parameter                              | Value | Unit          |
|----------------|----------------------------------------|-------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction to Case    | max.  | $^{\circ}C/W$ |
| $R_{thj-amb}$  | Thermal resistance Junction to Ambient | max.  | $^{\circ}C/W$ |

ELECTRICAL CHARACTERISTICS ( $V_{bat} = 8$  to  $18V$   $t_J = -40$  to  $+150^{\circ}C$ , unless otherwise specified.)

| Symbol       | Parameter                          | Test Condition                                              | Min. | Typ. | Max. | Unit     |
|--------------|------------------------------------|-------------------------------------------------------------|------|------|------|----------|
| $R_{DSon-H}$ | ON Resistance                      | $I_{out} = 0.5A$                                            |      | 2    | 4.3  | $\Omega$ |
| $R_{DSon-L}$ | ON Resistance                      | $I_{out} = 0.5A$                                            |      | 2    | 4.3  | $\Omega$ |
| $V_{OCL}$    | Clamping Voltage                   | $I_{out} = 0.1A$                                            |      | 32   |      | V        |
| $V_F$        | Clamp Diode Forward Voltage        | $I_{out} = 0.5A$                                            |      | 1.3  |      | V        |
| $T_R$        | Output Voltage Rise Time           | $V_{out}$ ; 0.1 to 0.9 $V_{out}$ (see fig. 1)<br>NOT LOADED |      | 50   | 100  | $\mu s$  |
| $T_F$        | Output Voltage Fall Time           | $V_{out}$ ; 0.9 to 0.1 $V_{out}$ (see fig. 1)<br>NOT LOADED |      | 50   | 100  | $\mu s$  |
| $T_{DR}$     | Input to Output Rising edge Delay  | 0.5 $V_{IN}$ to 0.1 $V_{out}$ (see fig. 1)<br>NOT LOADED    |      |      | 50   | $\mu s$  |
| $T_{DF}$     | Input to Output Falling Edge Delay | 0.5 $V_{IN}$ to 0.9 $V_{out}$ (see fig. 1)<br>NOT LOADED    |      |      | 50   | $\mu s$  |

## OUTPUT PROTECTIONS CHARACTERISTICS

|            |                                                                   |                          |      |    |     |             |
|------------|-------------------------------------------------------------------|--------------------------|------|----|-----|-------------|
| $I_{SC}$   | Short Circuit Typical Application (see fig 2)                     | $T_{amb} = -40^{\circ}C$ | 0.45 |    | 2.6 | A           |
|            |                                                                   | $T_{amb} = 25^{\circ}C$  | 0.38 |    | 2.6 | A           |
|            |                                                                   | $T_{amb} = 125^{\circ}C$ | 0.28 |    | 2.6 | A           |
| $I_{SC}$   | Short Circuit Typical Application with Shottky Diodes (see fig 3) |                          | 0.8  |    | 2.6 | A           |
| $T_{SD}$   | Temperature                                                       |                          | 160  |    |     | $^{\circ}C$ |
| $T_{HYST}$ | Temperature Hysteresis                                            |                          |      | 20 |     | $^{\circ}C$ |

These protections switch off the full bridge.

## OUTPUT DETECTIONS CHARACTERISTICS

|             |                              |  |     |  |  |          |
|-------------|------------------------------|--|-----|--|--|----------|
| $R_{OPL-L}$ | Open-load Threshold Resistor |  | 80  |  |  | $\Omega$ |
| $R_{OPL-H}$ |                              |  | 100 |  |  | $\Omega$ |

## SUPPLY CHARACTERISTICS

|           |                |                                                                                           |  |  |     |    |
|-----------|----------------|-------------------------------------------------------------------------------------------|--|--|-----|----|
| $I_{QHI}$ | Supply Current | $R_{LOAD1} = R_{LOAD2} = \infty$<br>$V_{BAT} = 14V$ ,<br>$IN1 = IN2 = ENABLE = 5V$        |  |  | 15  | mA |
| $I_{QLO}$ |                | $R_{load1} = R_{load2} = 50\Omega$<br>$V_{BAT} = 12V$ , $ENABLE = 0V$<br>$IN1 = IN2 = 0V$ |  |  | 0.5 | mA |

**ELECTRICAL CHARACTERISTICS**

INPUTS CHARACTERISTICS (normal and standby mode)

| Symbol    | Parameter       | Test Condition | Min. | Typ. | Max. | Unit    |
|-----------|-----------------|----------------|------|------|------|---------|
| $V_{IH}$  | High Threshold  |                |      |      | 4    | V       |
| $V_{IL}$  | Low Threshold   |                | 1    |      |      | V       |
| $I_{NH}$  | Input Current 1 | $V_{IN} = 4V$  |      |      | 200  | $\mu A$ |
| $I_{NLO}$ | Input Current 2 | $V_{IN} = 1V$  |      |      | 50   | $\mu A$ |

**DIAGNOSTIC CHARACTERISTICS**

|             |                   |                    |  |     |     |         |
|-------------|-------------------|--------------------|--|-----|-----|---------|
| $V_{DIAGL}$ | Low Level Voltage | $I_{DIAG} = 2mA$   |  | 0.6 | 0.8 | V       |
| $I_{DIAGH}$ | Leakage Current   | $V_{DIAG} = 5.25V$ |  | 5   | 10  | $\mu A$ |

**INITIALIZATION CHARACTERISTICS**

|             |                       |                 |    |  |  |         |
|-------------|-----------------------|-----------------|----|--|--|---------|
| $T_{INIT}$  | Initialization Timing | $V_{BAT} = 12V$ | 10 |  |  | $\mu s$ |
| $T_{STUP}$  | Start-Up Timing       | $V_{BAT} = 12V$ | 1  |  |  | ms      |
| $T_{RESET}$ | Reset                 |                 | 10 |  |  | $\mu s$ |

**FILTER CHARACTERISTICS**

|              |  |  |    |     |     |         |
|--------------|--|--|----|-----|-----|---------|
| $T_{FILTER}$ |  |  | 64 | 112 | 170 | $\mu s$ |
| $T_{DIAG}$   |  |  | 4  | 6   | 10  | $\mu s$ |
| $T_{SYNC}$   |  |  | 4  | 6   | 10  | $\mu s$ |

**TRUE TABLE**

| ENAB | IN1 | IN2 | OUT1 | OUT2 | OUT3 | OUT4 | MODE    | DIAG  |
|------|-----|-----|------|------|------|------|---------|-------|
| 0    | 0   | 0   | HZ   | HZ   | HZ   | HZ   | STANDBY | ?     |
| 0    | 0   | 1   | HZ   | HZ   | HZ   | HZ   | NORMAL  | ?     |
| 0    | 1   | 0   | HZ   | HZ   | HZ   | HZ   | NORMAL  | ?     |
| 0    | 1   | 1   | HZ   | HZ   | HZ   | HZ   | NORMAL  | ?     |
| 1    | 0   | 0   | HSD  | LSD  | HSD  | LSD  | NORMAL  | VALID |
| 1    | 0   | 1   | HSD  | LSD  | LSD  | HSD  | NORMAL  | VALID |
| 1    | 1   | 0   | LSD  | HSD  | HSD  | LSD  | NORMAL  | VALID |
| 1    | 1   | 1   | LSD  | HSD  | LSD  | HSD  | NORMAL  | VALID |

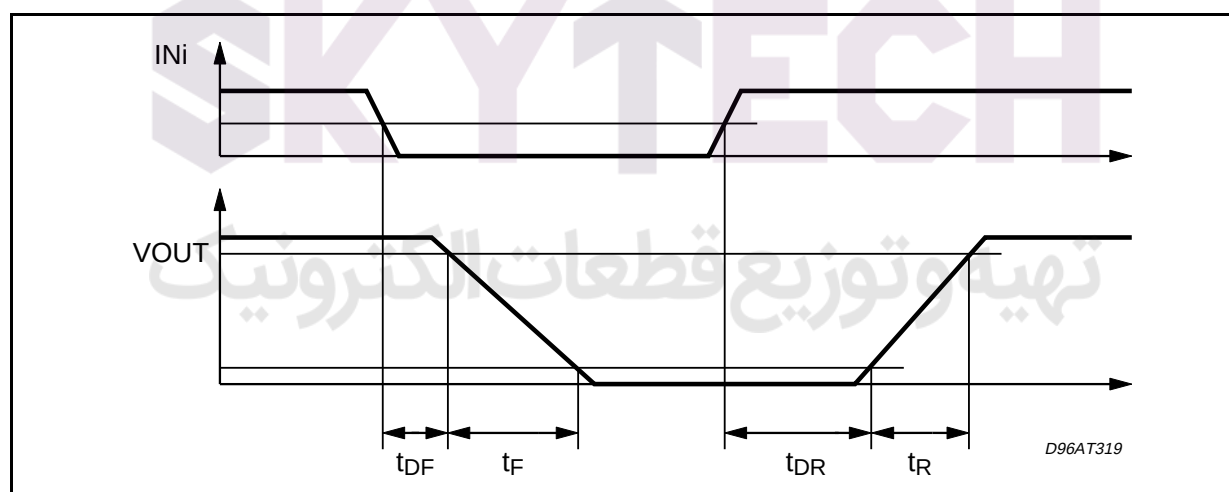
**Figure 1:**

Figure 2: Typical Application

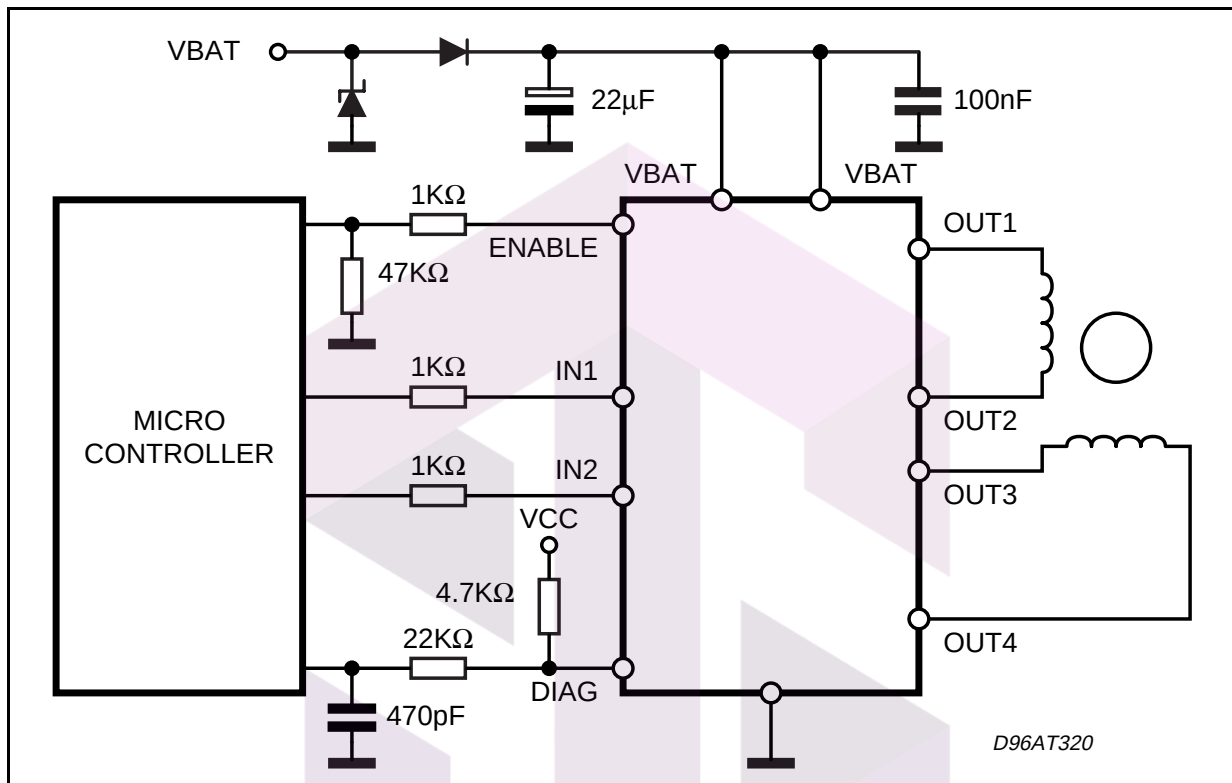


Figure 3: Typical Application with Shottky Diodes

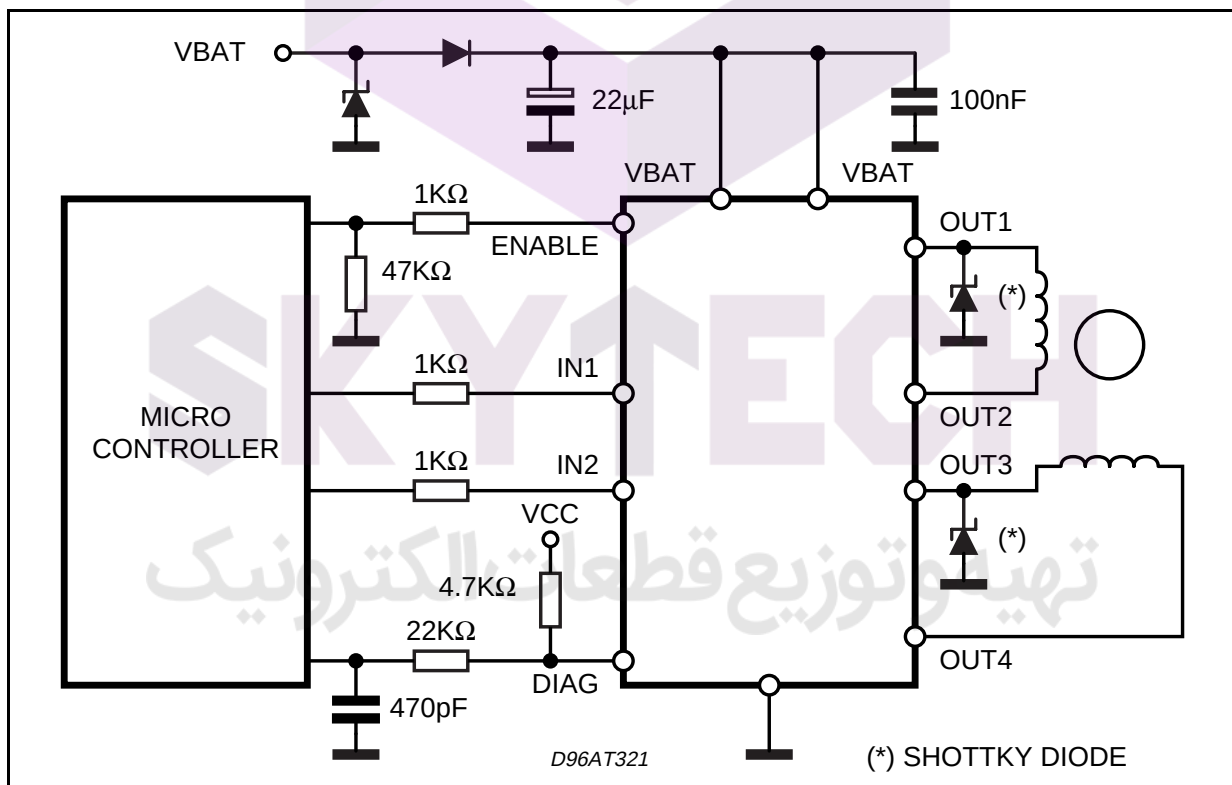


Figure 4: Initialization.

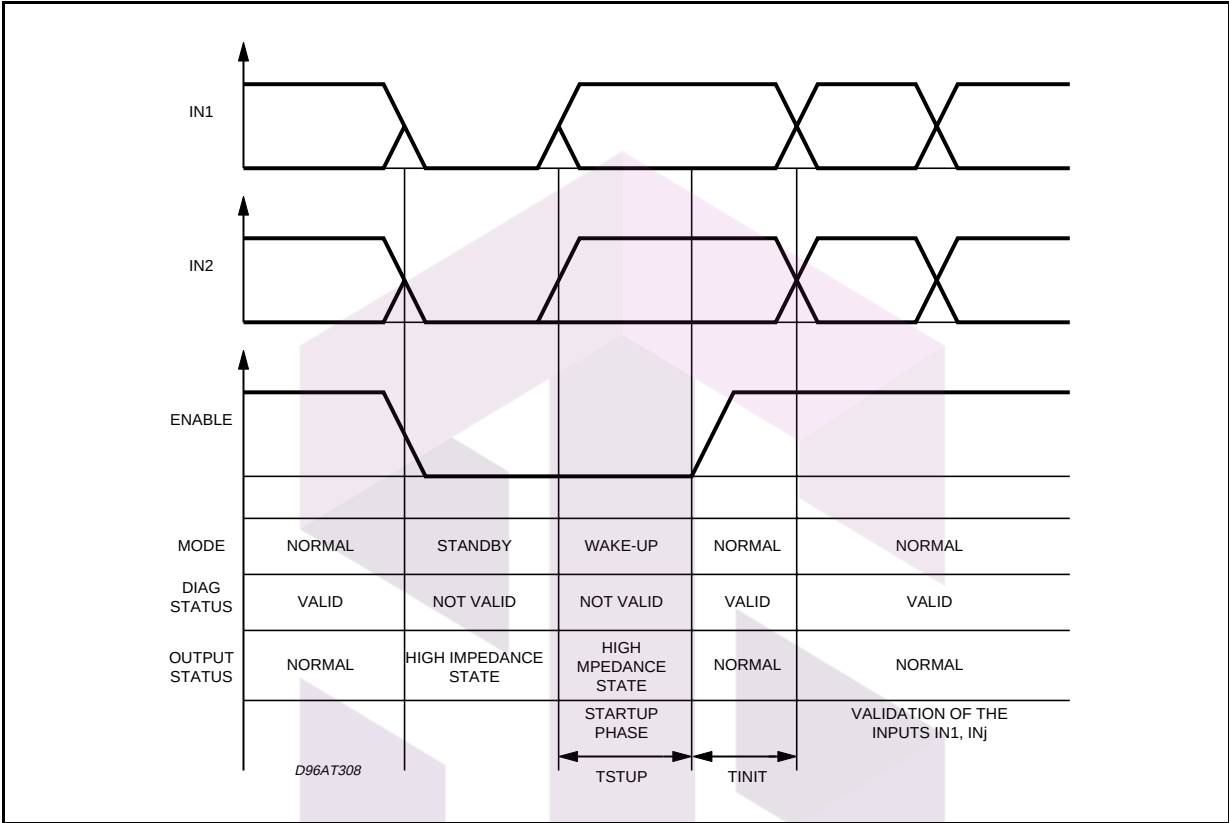
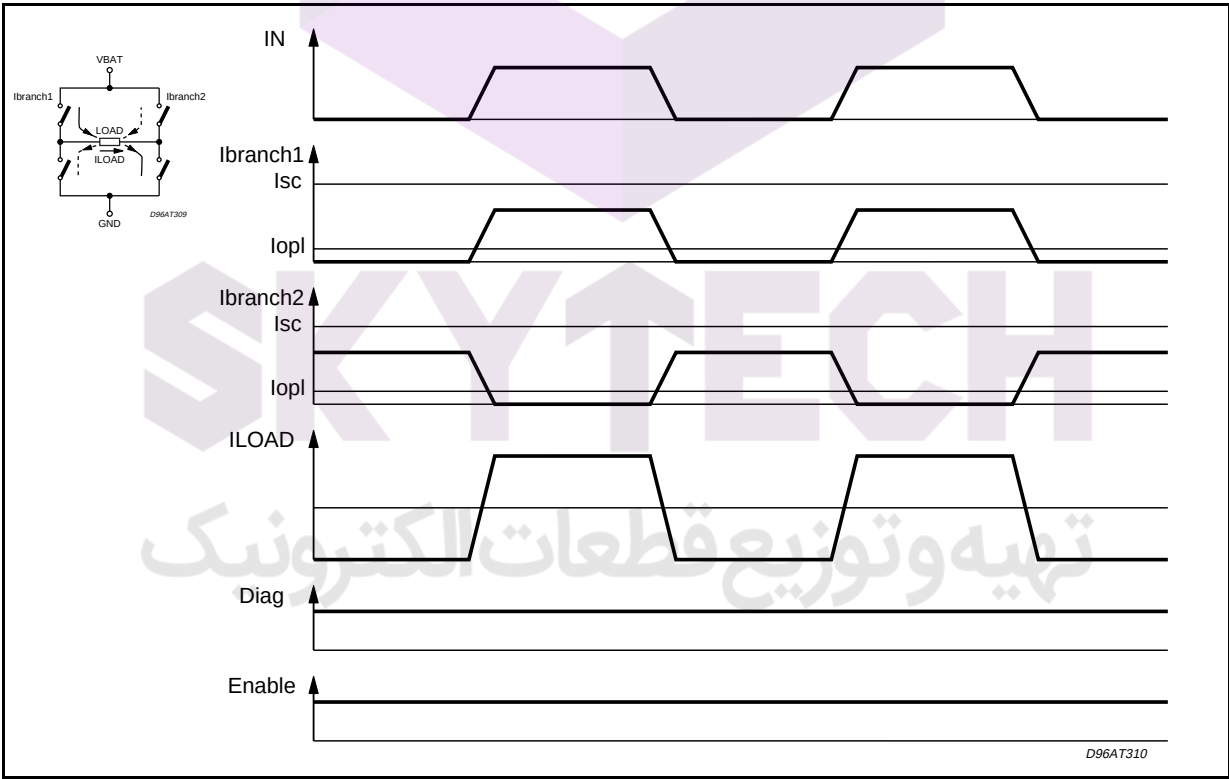


Figure 5: Normal Condition.



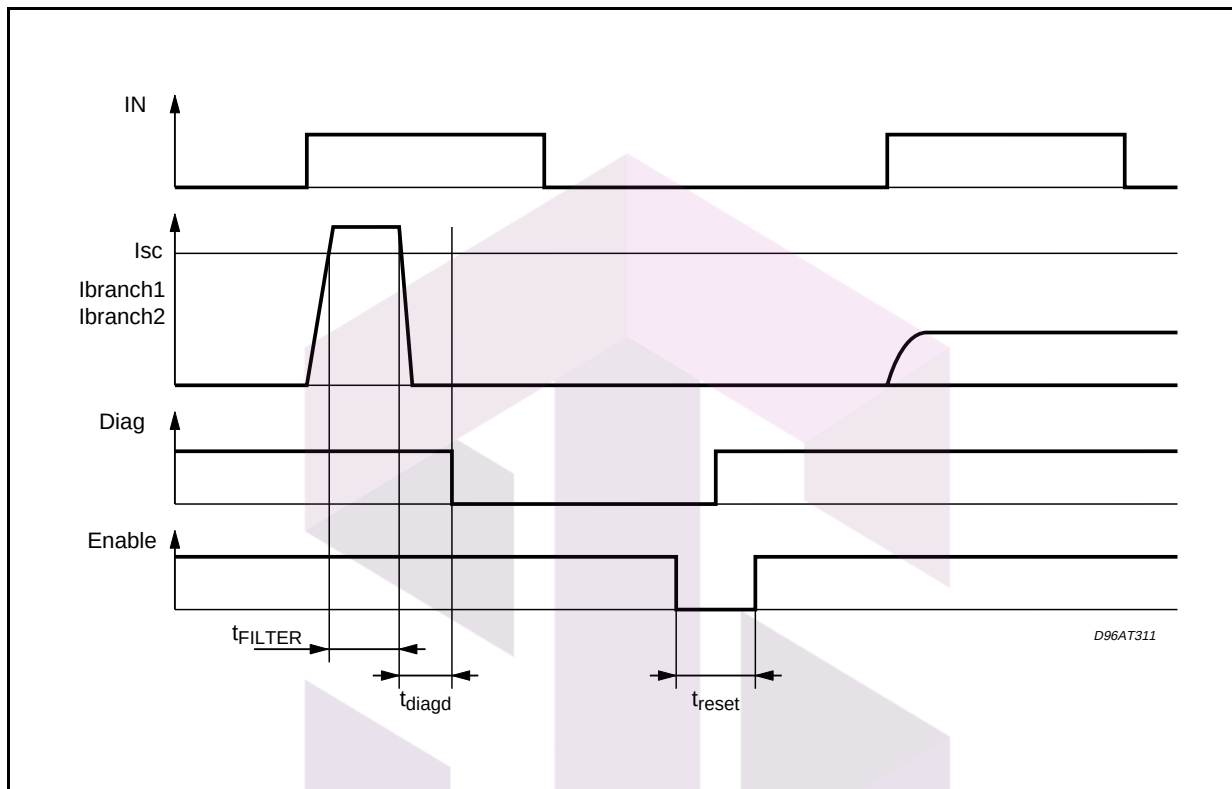
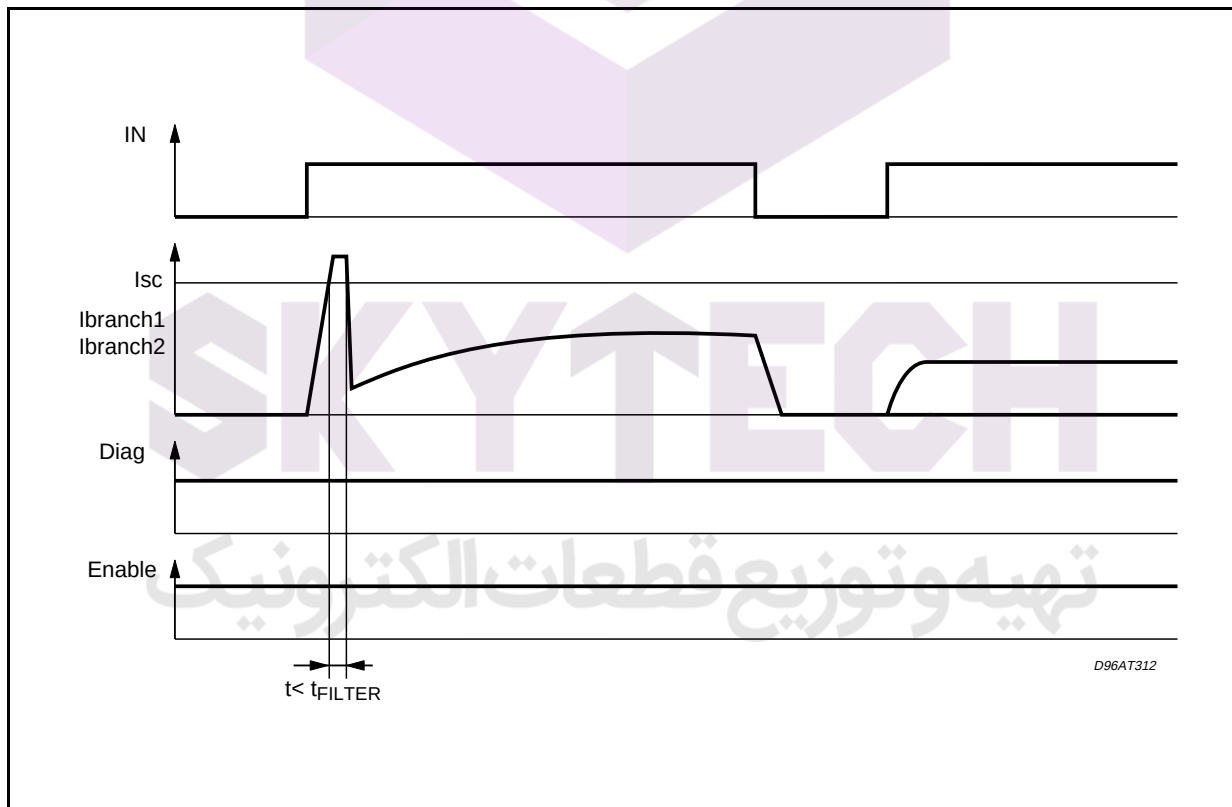
**Figure 6:** Short-circuit Condition.**Figure 7:** short circuit condition: no detection (NOT TESTED)

Figure 8: Open Load Condition 1: Detection

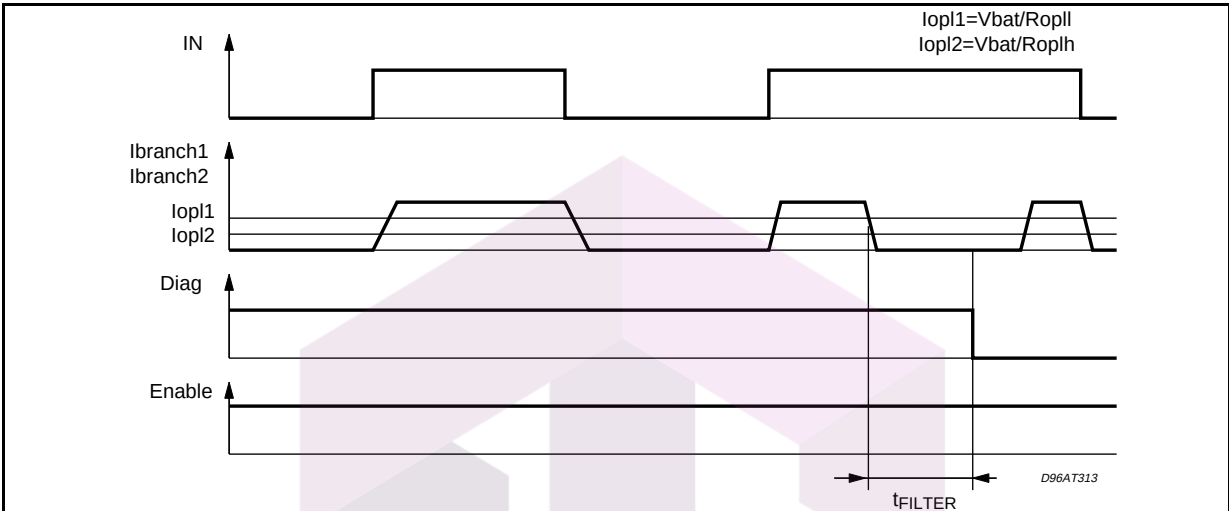


Figure 9: Open Load Condition 1: No Detection (NOT TESTED)

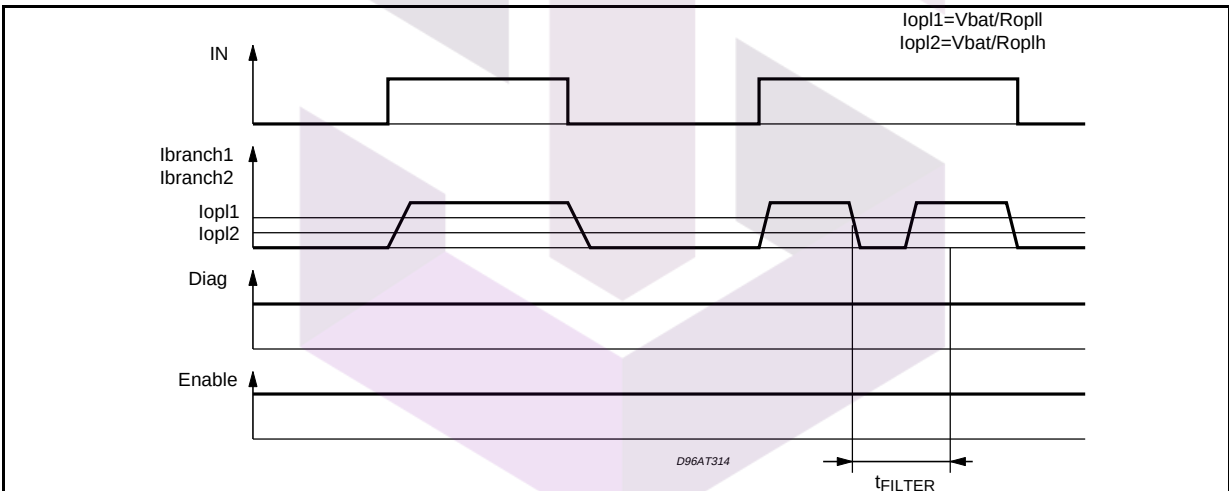
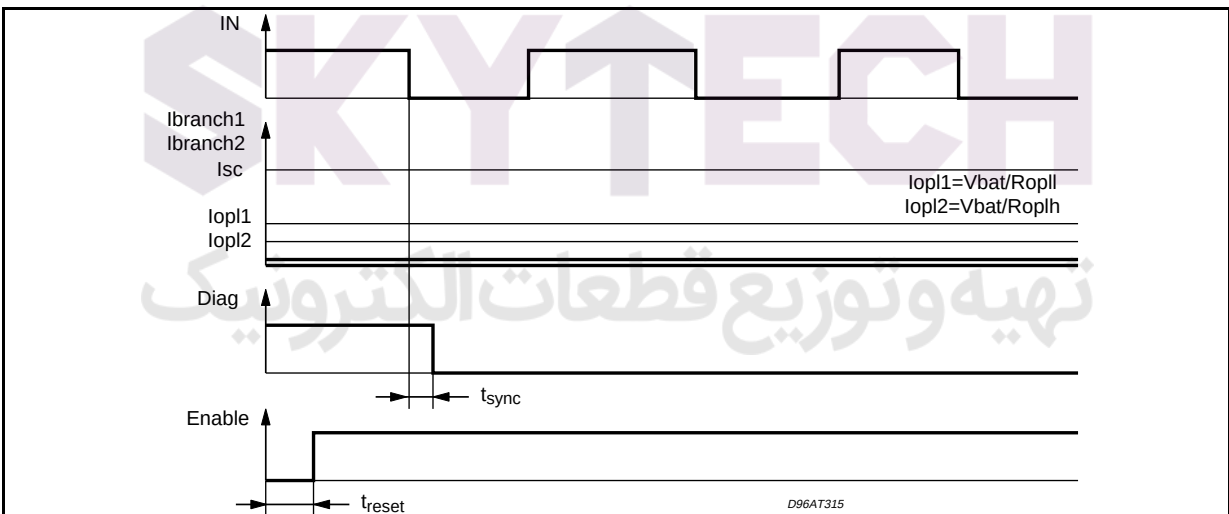
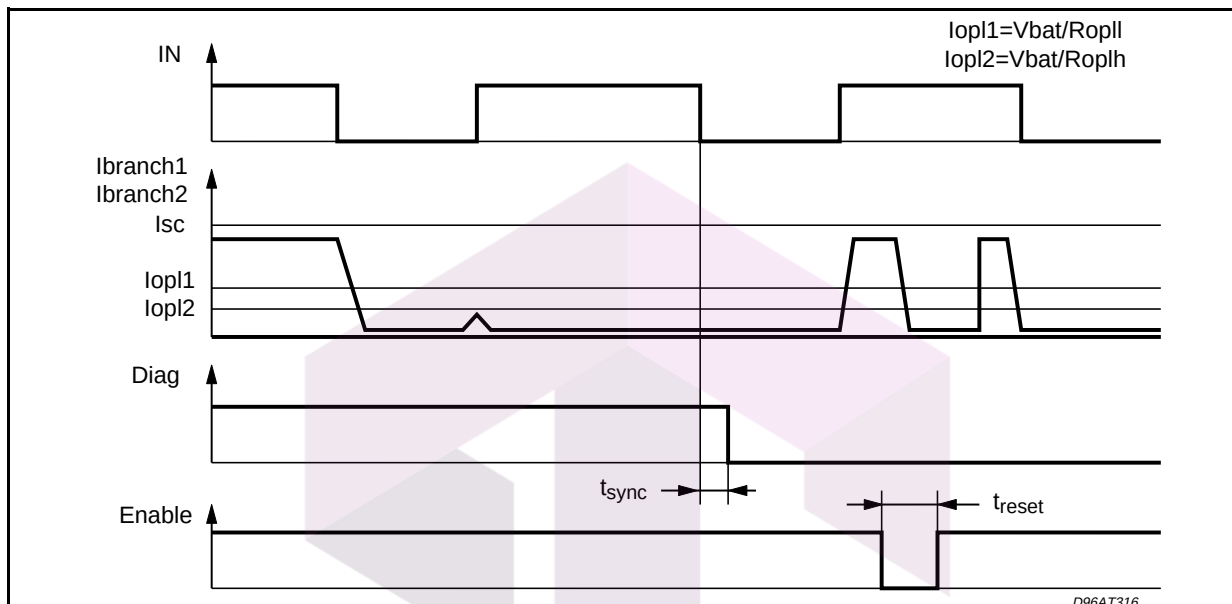
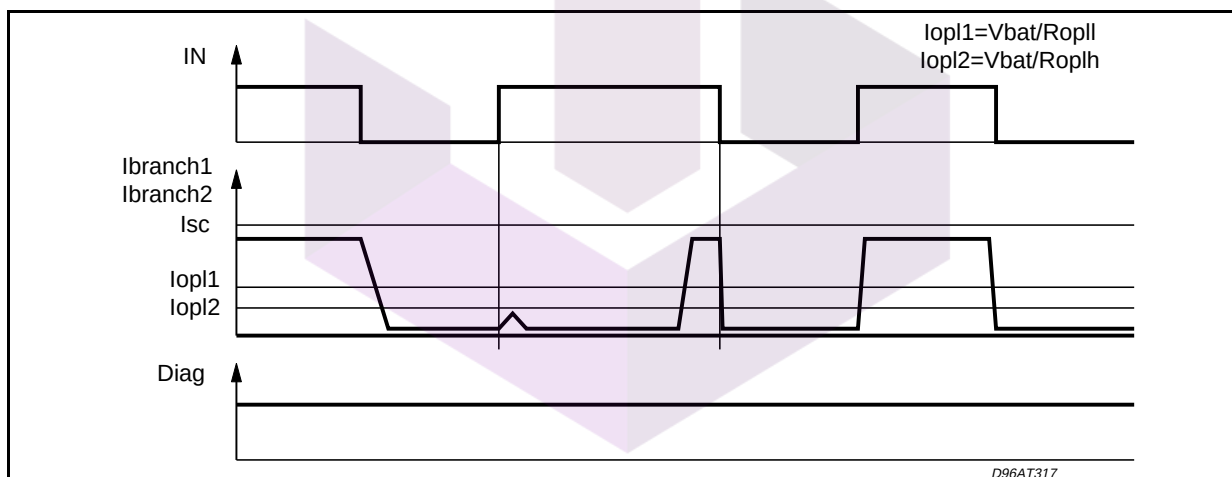
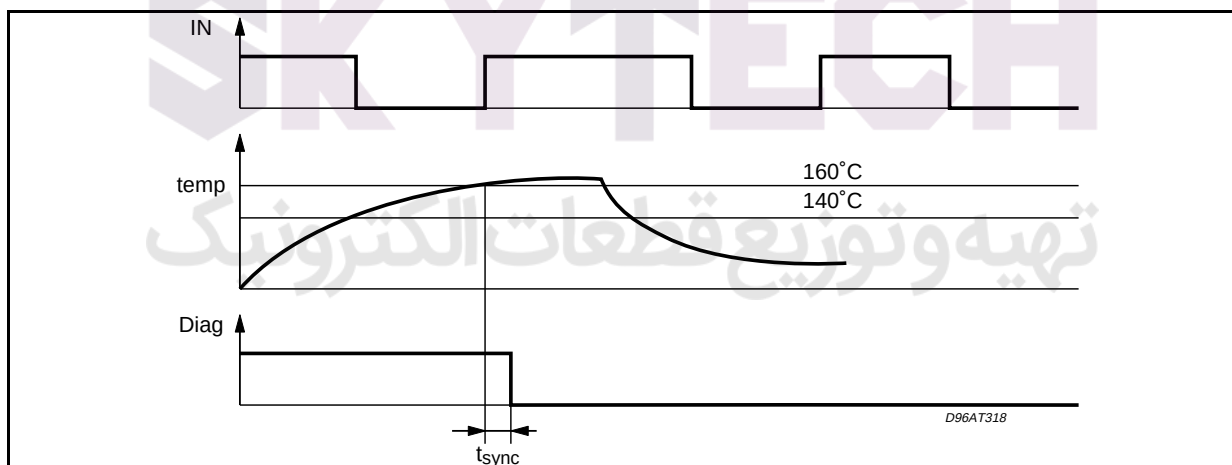


Figure 10: Open Load Condition 2: No Current after (ENABLE)

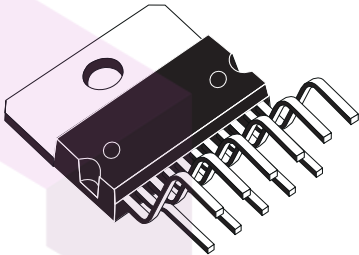




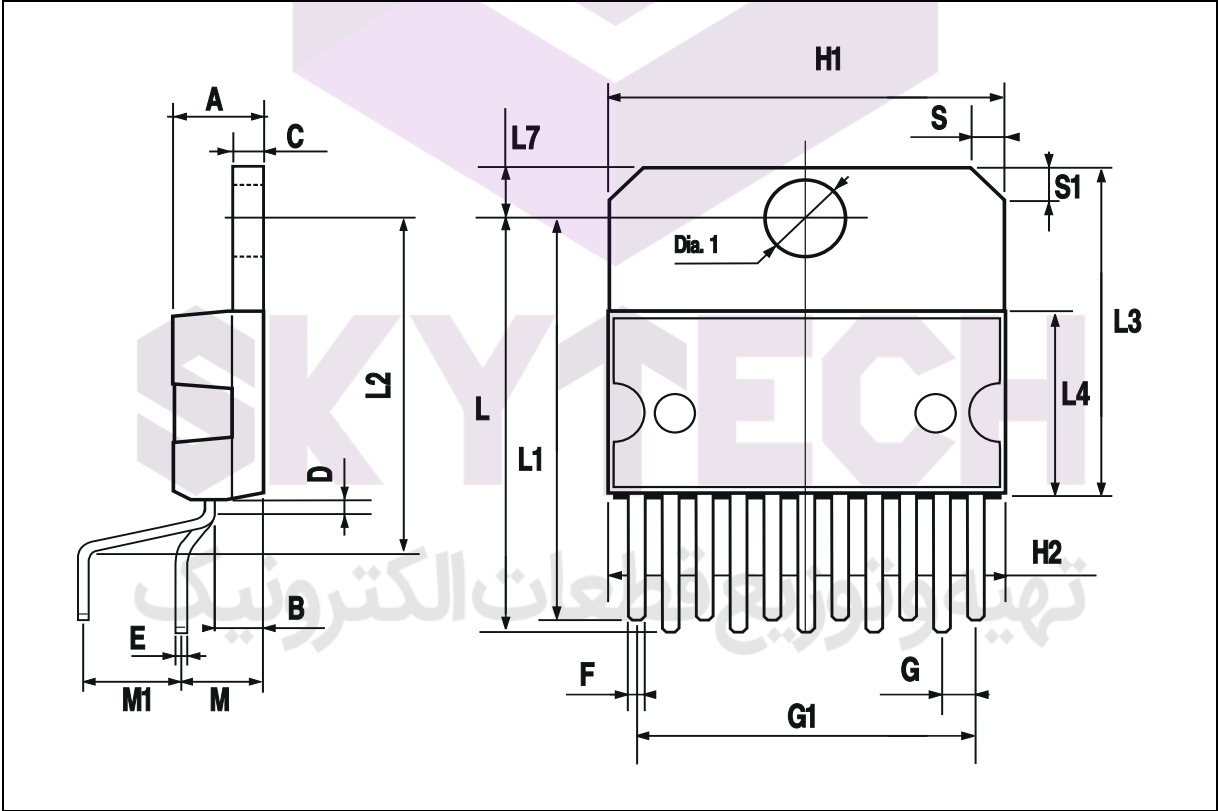
**Figure 11:** Open Load Condition 3**Figure 12:** Open Load Condition 4: No Detection**Figure 13:** Overtemperature Detection

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |       |      | 5     |       |       | 0.197 |
| B    |       |      | 2.65  |       |       | 0.104 |
| C    |       |      | 1.6   |       |       | 0.063 |
| D    |       | 1    |       |       | 0.039 |       |
| E    | 0.49  |      | 0.55  | 0.019 |       | 0.022 |
| F    | 0.88  |      | 0.95  | 0.035 |       | 0.037 |
| G    | 1.45  | 1.7  | 1.95  | 0.057 | 0.067 | 0.077 |
| G1   | 16.75 | 17   | 17.25 | 0.659 | 0.669 | 0.679 |
| H1   | 19.6  |      |       | 0.772 |       |       |
| H2   |       |      | 20.2  |       |       | 0.795 |
| L    | 21.9  | 22.2 | 22.5  | 0.862 | 0.874 | 0.886 |
| L1   | 21.7  | 22.1 | 22.5  | 0.854 | 0.87  | 0.886 |
| L2   | 17.4  |      | 18.1  | 0.685 |       | 0.713 |
| L3   | 17.25 | 17.5 | 17.75 | 0.679 | 0.689 | 0.699 |
| L4   | 10.3  | 10.7 | 10.9  | 0.406 | 0.421 | 0.429 |
| L7   | 2.65  |      | 2.9   | 0.104 |       | 0.114 |
| M    | 4.25  | 4.55 | 4.85  | 0.167 | 0.179 | 0.191 |
| M1   | 4.73  | 5.08 | 5.43  | 0.186 | 0.200 | 0.214 |
| S    | 1.9   |      | 2.6   | 0.075 |       | 0.102 |
| S1   | 1.9   |      | 2.6   | 0.075 |       | 0.102 |
| Dia1 | 3.65  |      | 3.85  | 0.144 |       | 0.152 |

**OUTLINE AND  
MECHANICAL DATA**



**Multiwatt11 V**

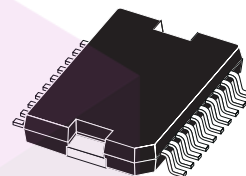


| DIM.   | mm        |       |      | inch  |       |       |
|--------|-----------|-------|------|-------|-------|-------|
|        | MIN.      | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A      |           |       | 3.6  |       |       | 0.142 |
| a1     | 0.1       |       | 0.3  | 0.004 |       | 0.012 |
| a2     |           |       | 3.3  |       |       | 0.130 |
| a3     | 0         |       | 0.1  | 0.000 |       | 0.004 |
| b      | 0.4       |       | 0.53 | 0.016 |       | 0.021 |
| c      | 0.23      |       | 0.32 | 0.009 |       | 0.013 |
| D (1)  | 15.8      |       | 16   | 0.622 |       | 0.630 |
| D1     | 9.4       |       | 9.8  | 0.370 |       | 0.386 |
| E      | 13.9      |       | 14.5 | 0.547 |       | 0.570 |
| e      |           | 1.27  |      |       | 0.050 |       |
| e3     |           | 11.43 |      |       | 0.450 |       |
| E1 (1) | 10.9      |       | 11.1 | 0.429 |       | 0.437 |
| E2     |           |       | 2.9  |       |       | 0.114 |
| E3     | 5.8       |       | 6.2  | 0.228 |       | 0.244 |
| G      | 0         |       | 0.1  | 0.000 |       | 0.004 |
| H      | 15.5      |       | 15.9 | 0.610 |       | 0.626 |
| h      |           |       | 1.1  |       |       | 0.043 |
| L      | 0.8       |       | 1.1  | 0.031 |       | 0.043 |
| N      | 8° (typ.) |       |      |       |       |       |
| S      | 8° (max.) |       |      |       |       |       |
| T      |           | 10    |      |       | 0.394 |       |

(1) "D and E1" do not include mold flash or protrusions.  
- Mold flash or protrusions shall not exceed 0.15mm (0.006")  
- Critical dimensions: "E", "G" and "a3".

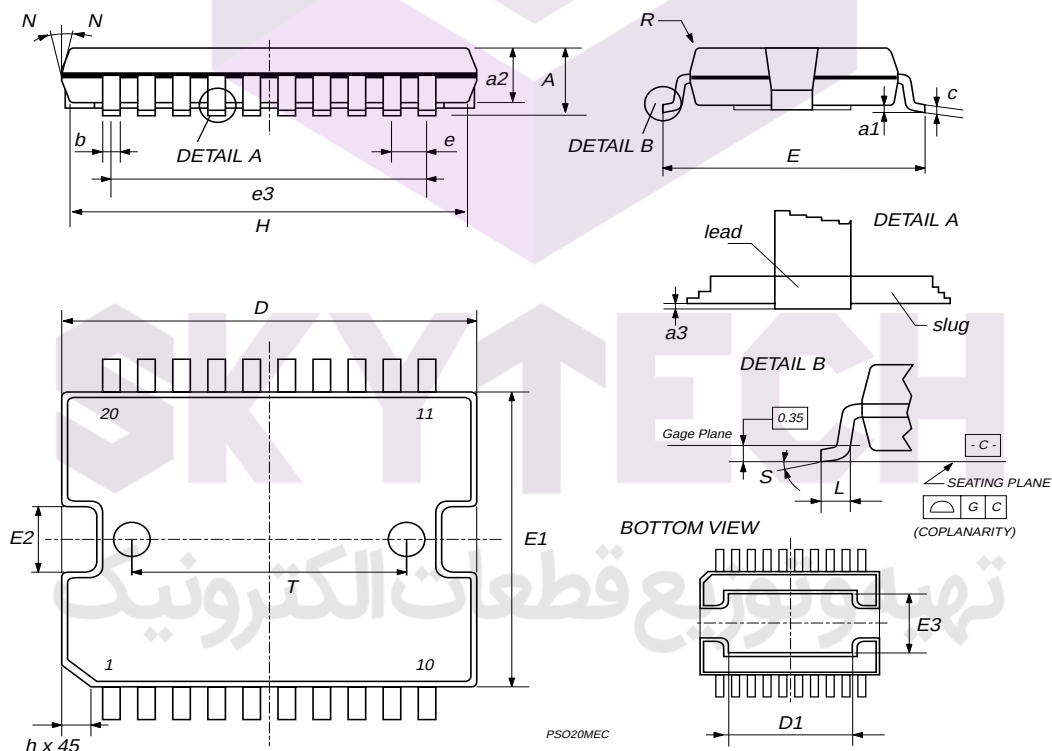
## OUTLINE AND MECHANICAL DATA

Weight: 1.9gr



JEDEC MO-166

**PowerSO20**



0056635

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