

## Dual full-bridge driver





Multiwatt15 V

Multiwatt15 H



PowerSO-20

#### **Product summary**

L298

# SUSTAINABLE TECHNOLOGY

#### **Features**

- Operating supply voltage up to 46 V.
- Total dc current up to 4 A.
- Low saturation voltage.
- Overtemperature protection.
- Logical "0" input voltage up to 1.5 V (high noise immunity).

#### **Applications**

- Dual brush DC motors
- Stepper motors

#### **Description**

The L298 is an integrated monolithic circuit in a 15-lead multiwatt and PowerSO-20 packages. It is a high-voltage, high-current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors.

Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.



# 1 Block diagram

Figure 1. Block diagram OUT OUT 2 опз 0UT4 O 100nF 100nF 2 3 In1 In4 O In2 Oln3 —O 10 En A EnB 11 15 OSENSE B SENSE AO 5-5851/2 RSB

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# 2 Absolute maximum ratings

Absolute maximum ratings are those values beyond which damage to the device may occur. These are stress ratings only and functional operation of the device at these conditions is not implied. Operating outside maximum recommended conditions for extended periods of time may impact product reliability and result in device failures.

Table 1. Absolute maximum ratings

| Symbol                           | Parameter  | Value      | Unit |  |  |  |  |
|----------------------------------|--|------------|------|--|--|--|--|
| Vs                               | Power supply   | 50         | V    |  |  |  |  |
| V <sub>SS</sub>                  | Logic supply voltage                                   | 7          | V    |  |  |  |  |
| V <sub>I</sub> , V <sub>en</sub> | Input and enable voltage                               | -0.3 to 7  | V    |  |  |  |  |
|                                  | Peak output current (each channel):                    |            |      |  |  |  |  |
| I.                               | Non repetitive (t = 100 ms)                            | 3          | Α    |  |  |  |  |
| I <sub>O</sub>                   | • repetitive (80% on –20% off; t <sub>on</sub> =10 ms) | 2.5        | Α    |  |  |  |  |
|                                  | DC operation   | 2          | Α    |  |  |  |  |
| V <sub>sens</sub>                | Sensing voltage  | -1 to 2.3  | V    |  |  |  |  |
| P <sub>tot</sub>                 | Total power dissipation (t <sub>case</sub> = 75 °C)    | 25         | W    |  |  |  |  |
| T <sub>op</sub>                  | Junction operating temperature                         | –25 to 130 | °C   |  |  |  |  |
| $T_{stg}, T_{j}$                 | Storage and junction temperature                       | -40 to 150 | °C   |  |  |  |  |

Table 2. Thermal data

| Syml                | ool | Parameter                           |      | Power SO20 | Multiwatt 15 | Unit |
|---------------------|-----|-------------------------------------|------|------------|--------------|------|
| R <sub>th j-c</sub> | ase | Thermal resistance junction-case    | Max. | _          | 3            | °C/W |
| R <sub>th j-a</sub> | amb | Thermal resistance junction-ambient | Max. | 13 (1)     | 35           | °C/W |

1. Mounted on aluminum substrate

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# 3 Pin description

Figure 2. Pin configuration CURRENT SENSING B OUTPUT 4 OUTPUT 3 13 12 INPUT 4 11 ENABLE B INPUT 3 LOGIC SUPPLY VOLTAGE  $V_{SS}$ Multiwatt15 GND INPUT 2 ENABLE A SUPPLY VOLTAGE  $V_S$ OUTPUT 2 OUTPUT 1 CURRENT SENSING A TAB CONNECTED TO PIN 8 D95IN240A GND [ 20 GND Sense A 19 Sense B N.C. 18 ■ N.C. Out 4 Out 1 17 PowerSO20 Out 2 16 Out 3 V<sub>s</sub> 15 Input 4 Enable B Input 1 Enable A 13 Input 3 Input 2 12 □ vss GND GND [ 11

Table 3. Pin function

| MW.15  | Power<br>SO      | Name               | Function   |
|--------|------------------|--------------------|--|
| 1, 15  | 2, 19            | Sense A, Sense B   | Between this pin and ground is connected the sense resistor to control the current of the load.                            |
| 2, 3   | 4, 5             | Out 1, Out 2       | Outputs of the bridge A; the current that flows through the load connected between these two pins is monitored at pin 1.   |
| 4      | 6                | Vs                 | Supply voltage for the power output stages.  Anon-inductive 100nF capacitor must be connected between this pin and ground. |
| 5, 7   | 7, 9             | Input 1, Input 2   | TTL compatible inputs of the bridge A.   |
| 6, 11  | 8, 14            | Enable A, Enable B | TTL compatible enable input: the L state disables the bridge A (enable A) and/or the bridge B (enable B).                  |
| 8      | 1, 10, 11,<br>20 | GND                | Ground.  |
| 9      | 12               | VSS                | Supply voltage for the logic blocks. A 100nF capacitor must be connected between this pin and ground.                      |
| 10, 12 | 13, 15           | Input 3, Input 4   | TTL compatible inputs of the bridge B.   |
| 13, 14 | 16, 17           | Out 3, Out 4       | Outputs of the bridge B. The current that flows through the load connected between these two pins is monitored at pin 15.  |
| _      | 3, 18            | N.C.               | Not connected  |

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## 4 Electrical characteristics

**Table 4. Electrical characteristics** 

( $V_S$  = 42 V;  $V_{SS}$  = 5 V,  $T_i$  = 25 °C; unless otherwise specified)

| Symbol                            | Parameter                                      | Test conditions  | Min.                 | Тур. | Max.            | Unit |
|-----------------------------------|--|--|----------------------|------|-----------------|------|
| Vs                                | Supply voltage (pin 4)                         | Operative condition  | V <sub>IH</sub> +2.5 |      | 46              | V    |
| V <sub>SS</sub>                   | Logic supply voltage (pin 9)                   |  | 4.5                  | 5    | 7               | V    |
|                                   |  | $V_{en} = H; V_i = L; I_L = 0$   |                      | 13   | 22              | mA   |
| Is                                | Quiescent supply current (pin 4)               | $V_{en} = H; V_i = H; I_L = 0$   |                      | 50   | 70              | mA   |
|                                   |  | $V_{en} = L; V_i = X$  |                      |      | 4               | mA   |
|                                   |  | $V_{en} = H; V_i = L; I_L = 0$   |                      | 24   | 36              | mA   |
| $I_{SS}$                          | Quiescent current from V <sub>SS</sub> (pin 9) | $V_{en} = H; V_i = H; I_L = 0$   |                      | 7    | 12              | mA   |
|                                   |  | $V_{en} = L; V_i = X$  |                      |      | 6               | m    |
| $V_{iL}$                          | Input low voltage (pins 5, 7, 10, 12)          |  | -0.3                 |      | 1.5             | V    |
| $V_{iH}$                          | Input high voltage (pins 5, 7, 10, 12)         |  | 2.3                  |      | V <sub>SS</sub> | V    |
| I <sub>iL</sub>                   | Low voltage input current (pins 5, 7, 10, 12)  | V <sub>i</sub> = L   |                      |      | -10             | μA   |
| l <sub>iH</sub>                   | High voltage input current (pins 5, 7, 10, 12) | $V_i = H \le V_{SS} - 0.6V$  |                      | 30   | 100             | μA   |
| V <sub>enL</sub>                  | Enable low voltage (pins 6, 11)                |  | -0.3                 |      | 1.5             | V    |
| V <sub>enH</sub>                  | Enable high voltage (pins 6, 11)               |  | 2.3                  |      | V <sub>SS</sub> | V    |
| I <sub>enL</sub>                  | Low voltage enable current (pins 6, 11)        | V <sub>en</sub> = L  |                      |      | -10             | μA   |
| I <sub>enH</sub>                  | High voltage enable current (pins 6, 11)       | V <sub>en</sub> = H ≤ V <sub>SS</sub> -0.6V                                |                      | 30   | 100             | μA   |
| V                                 | Source saturation voltage                      | I <sub>L</sub> = 1A  | 0.95                 | 1.35 | 1.7             | V    |
| V <sub>CEsat (H)</sub>            |  | I <sub>L</sub> = 2A  |                      | 2    | 2.7             | V    |
| V                                 | Sink acturation valtage                        | I <sub>L</sub> = 1A <sup>(1)</sup>   | 0.85                 | 1.2  | 1.6             | V    |
| V <sub>CEsat (L)</sub>            | Sink saturation voltage                        | I <sub>L</sub> = 2A <sup>(1)</sup>   |                      | 1.7  | 2.3             | V    |
|                                   |  | I <sub>L</sub> = 1A <sup>(1)</sup>   | 1.80                 |      | 3.2             | .,   |
| V <sub>CEsat</sub>                | Total drop                                     | I <sub>L</sub> = 2A <sup>(1)</sup>   |                      |      | 4.9             | V    |
| V <sub>sens</sub>                 | Sensing voltage (pins 1, 15)                   |  | -1 <sup>(2)</sup>    |      | 2               | V    |
| T <sub>1</sub> (V <sub>i</sub> )  | Source current turn-off delay                  | 0.5 V <sub>i</sub> to 0.9 I <sub>L</sub> <sup>(3)</sup> ; <sup>(5)</sup>   |                      | 1.5  |                 | μs   |
| T <sub>2</sub> (V <sub>i</sub> )  | Source current fall time                       | 0.9 I <sub>L</sub> to 0.1 I <sub>L</sub> <sup>(3)</sup> ; <sup>(5)</sup>   |                      | 0.2  |                 | μs   |
| T <sub>3</sub> (V <sub>i</sub> )  | Source current turn-on delay                   | 0.5 V <sub>i</sub> to 0.1 I <sub>L</sub> <sup>(3)</sup> ; <sup>(5)</sup>   |                      | 2    |                 | μs   |
| T <sub>4</sub> (V <sub>i</sub> )  | Source current rise time                       | 0.1 I <sub>L</sub> to 0.9 I <sub>L</sub> <sup>(3)</sup> ; <sup>(5)</sup>   |                      | 0.7  |                 | μs   |
| T <sub>5</sub> (V <sub>i</sub> )  | Sink current turn-off delay                    | 0.5 V <sub>i</sub> to 0.9 I <sub>L</sub> <sup>(4)</sup> ; <sup>(5)</sup>   |                      | 0.7  |                 | μs   |
| T <sub>6</sub> (V <sub>i</sub> )  | Sink current fall time                         | 0.9 I <sub>L</sub> to 0.1 I <sub>L</sub> ; <sup>(4)</sup> ; <sup>(5)</sup> |                      | 0.25 |                 | μs   |
| T <sub>7</sub> (V <sub>i</sub> )  | Sink current turn-on delay                     | 0.5 V <sub>i</sub> to 0.9 I <sub>L</sub> ; <sup>(4)</sup> ; <sup>(5)</sup> |                      | 1.6  |                 | μs   |
| T <sub>8</sub> (V <sub>i</sub> )  | Sink current rise time                         | 0.1 l <sub>L</sub> to 0.9 l <sub>L</sub> ; <sup>(4)</sup> ; <sup>(5)</sup> |                      | 0.2  |                 | μs   |
| f <sub>C</sub> (V <sub>i</sub> )  | Commutation frequency                          | I <sub>L</sub> = 2A  |                      | 25   | 40              | KHz  |
| T <sub>1</sub> (V <sub>en</sub> ) | Source current turn-off delay                  | 0.5 V <sub>en</sub> to 0.9 I <sub>L</sub> <sup>(3)</sup> ; <sup>(5)</sup>  |                      | 3    |                 | μs   |
| 1 ( - 611)                        | 555.55 Garrent tarri on dolay                  | 0.9 I <sub>L</sub> to 0.1 I <sub>L</sub> (3); (5)                          |                      |      |                 | μο   |

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| Symbol                            | Parameter                    | Test conditions   | Min. | Тур. | Max. | Unit |
|-----------------------------------|------------------------------|---|------|------|------|------|
| T <sub>3</sub> (V <sub>en</sub> ) | Source current turn-on delay | 0.5 V <sub>en</sub> to 0.1 I <sub>L</sub> <sup>(3)</sup> ; <sup>(5)</sup> |      | 0.3  |      | μs   |
| T <sub>4</sub> (V <sub>en</sub> ) | Source current rise time     | 0.1 I <sub>L</sub> to 0.9 I <sub>L</sub> <sup>(3)</sup> ; <sup>(5)</sup>  |      | 0.4  |      | μs   |
| T <sub>5</sub> (V <sub>en</sub> ) | Sink current turn-off delay  | 0.5 V <sub>en</sub> to 0.9 I <sub>L</sub> <sup>(4)</sup> ; <sup>(5)</sup> |      | 2.2  |      | μs   |
| T <sub>6</sub> (V <sub>en</sub> ) | Sink current fall time       | 0.9 I <sub>L</sub> to 0.1 I <sub>L</sub> <sup>(4)</sup> ; <sup>(5)</sup>  |      | 0.35 |      | μs   |
| T <sub>7</sub> (V <sub>en</sub> ) | Sink current turn-on delay   | 0.5 V <sub>en</sub> to 0.9 I <sub>L</sub> <sup>(4)</sup> ; <sup>(5)</sup> |      | 0.25 |      | μs   |
| T <sub>8</sub> (V <sub>en</sub> ) | Sink current rise time       | 0.1 I <sub>L</sub> to 0.9 I <sub>L</sub> <sup>(4)</sup> ; <sup>(5)</sup>  |      | 0.1  |      | μs   |

- 1. "Sense A" and "Sense B" pins connected to GND.
- 2. Sensing voltage can be -1 V for  $t \le 50$  µsec; in steady state  $V_{sens}$  min  $\ge -0.5$  V.
- 3. See Figure 4.
- 4. See Figure 6.
- 5. The load must be a pure resistor.

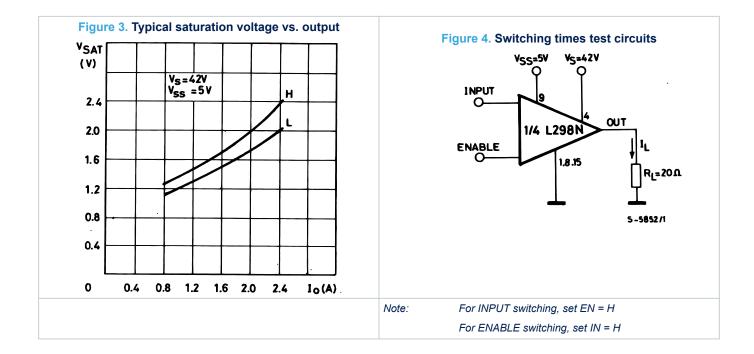
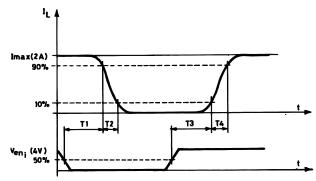
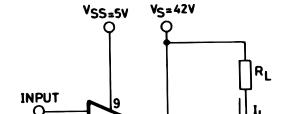


Figure 5. Source current delay times vs. input or enable switching



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1/4 L298N

1.8.15

ENABLE

OUT

Figure 6. Switching times test circuits

Note: For INPUT Switching, set EN = H
For ENABLE Switching, set IN = L

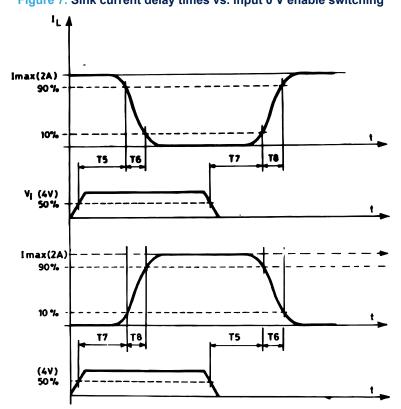


Figure 7. Sink current delay times vs. input 0 V enable switching

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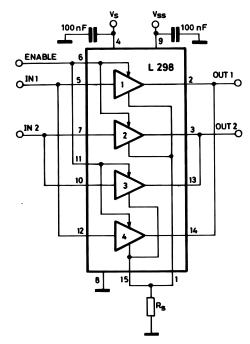
Figure 8. Bidirectional dc motor control

Table 5. Values of bidirectional dc motor control

| Inp                 | Function     |                         |
|---------------------|--------------|-------------------------|
|                     | C = H; D = L | Forward                 |
| V <sub>en</sub> = H | C = L; D = H | Reverse                 |
|                     | C = D        | Fast motor stop         |
| V <sub>en</sub> = L | C = X; D = X | Free running motor stop |

Note: L = Low, H = High, X = Do not care

Figure 9. For higher currents, outputs can be paralleled. Take care to parallel channel 1 with channel 4 and channel 2 with channel 3



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### 5 Application information

(Refer to the Section 1 Block diagram)

#### 5.1 Power output stage

The L298 integrates two power output stages (A; B).

The power output stage is a bridge configuration and its outputs can drive an inductive load in common or differenzial mode, depending on the state of the inputs. The current that flows through the load comes out from the bridge at the sense output: an external resistor ( $R_{SA}$ ;  $R_{SB}$ ) allows to detect the intensity of this current.

#### 5.1.1 Input stage

Each bridge is driven by means of four gates, managed by following inputs:

- In1. In2 and EnA
- In3, In4 and EnB

The In inputs set the bridge state when The En input is high; a low state of the En input inhibits the bridge. All the inputs are TTL compatible.

#### 5.2 Suggestions

A non inductive capacitor, usually of 100 nF, is required between both  $V_S$  and  $V_{SS}$  to ground, as near as possible to GND pin. When the bulk capacitor of the power supply is too far from the IC, a second smaller one must be placed near the L298.

The sense resistor, low inductance, must be grounded near the negative pole of  $V_S$  that must be near the GND pin of the IC.

Each input must be connected to the source of the driving signals by means of a very short path.

Before to Turn-ON the supply voltage and before to Turn it OFF, the enable inputs must be driven to the low state.

#### 5.3 Applications

Figure 8 shows a bidirectional DC motor control schematic diagram for which only one bridge is needed.

The external bridge of diodes D1 to D4 is made by four fast recovery elements ( $t_{rr} \le 200 \text{ ns}$ ) that must be chosen of a  $V_F$  as low as possible at the worst case of the load current.

An external bridge of diodes are required when inductive loads are driven and when the inputs of the IC are chopped; Schottky diodes would be preferred.

The sense output voltage can be used to control the current amplitude by chopping the inputs, or to provide overcurrent protection by switching low the enable input.

The brake function (Fast motor stop) requires that the Absolute Maximum Rating of 2 A must never be exceeded.

When the repetitive peak current needed from the load is higher than 2 A, a paralleled configuration can be chosen (See Figure 9).

This solution can drive up to 3 A in dc operation and until 3.5 A of a repetitive peak current.

On Figure 10 it is shown the driving of a two phase bipolar stepper motor; the needed signals to drive the inputs of the L298 are generated, in this example, by the IC L297.

Figure 11 shows an example of P.C.B. designed for the application of Figure 10.

Figure 12 shows a second two phase bipolar stepper motor control circuit where the current is controlled by the IC L6506.

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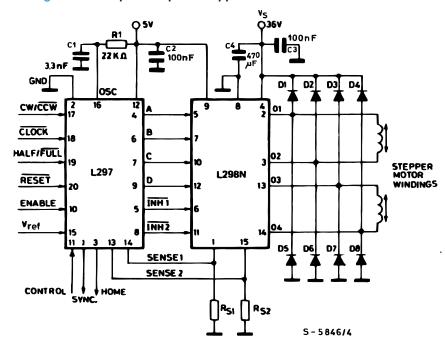
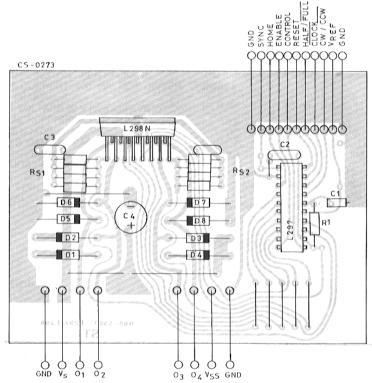


Figure 10. Two phase bipolar stepper motor circuit

Note:  $R_{S1} = R_{S2} = 0.5 \Omega$ .





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归 EN. B EN. A RESET 14 5 13 A L298N 6 PHASE INPUTS 12 3 13 11 12 L6506 50 B 2 22K 🗍 22K 3 10 16 15 RSENSE RR

Figure 12. Two phase bipolar stepper motor control circuit by using the current controller L6506.

 $R_{\mbox{\scriptsize R}}$  and  $R_{\mbox{\scriptsize sense}}$  depend from the load current

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# 6 Package information

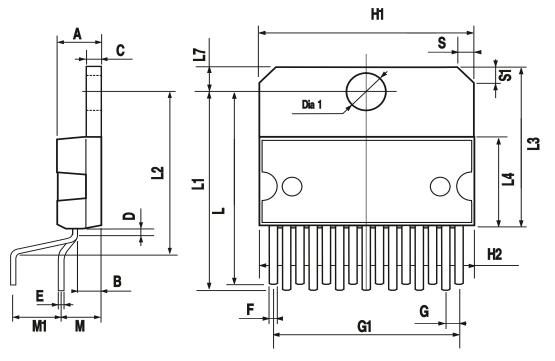
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

#### 6.1 Outline and mechanical data

Figure 13. Multiwatt15L V



Figure 14. Outline - Multiwatt15L V



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Table 6. Mechanical data Multiwatt15L V

| Dim  | mm    |       |       |       | inch  |       |
|------|-------|-------|-------|-------|-------|-------|
| Dim. | Min.  | Тур.  | Max.  | Min.  | Тур.  | Max.  |
| Α    |       |       | 5     |       |       | 0.197 |
| В    |       |       | 2.65  |       |       | 0.104 |
| С    |       |       | 1.6   |       |       | 0.063 |
| D    |       | 1     |       |       | 0.039 |       |
| Е    | 0.49  |       | 0.55  | 0.019 |       | 0.022 |
| F    | 0.66  |       | 0.75  | 0.026 |       | 0.030 |
| G    | 1.02  | 1.27  | 1.52  | 0.040 | 0.050 | 0.060 |
| G1   | 17.53 | 17.78 | 18.03 | 0.690 | 0.700 | 0.710 |
| 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 | 0.870 | 0.886 |
| L2   | 17.65 |       | 18.1  | 0.695 |       | 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   | 4.63  | 5.08  | 5.53  | 0.182 | 0.200 | 0.218 |
| 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 |

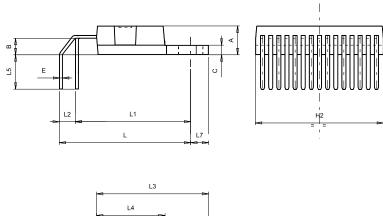
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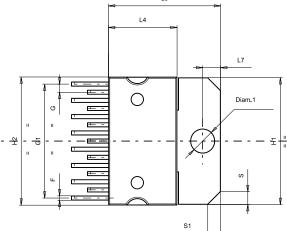


Figure 15. Multiwatt15 H



Figure 16. Outline - Multiwatt15L H





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Table 7. Mechanical data Multiwatt15L H

| Dim.   | mm    |       |       | inch  |       |       |
|--------|-------|-------|-------|-------|-------|-------|
| Dilli. | Min.  | Тур.  | Max.  | Min.  | Тур.  | Max.  |
| А      |       |       | 5     |       |       | 0.197 |
| В      |       |       | 2.65  |       |       | 0.104 |
| С      |       |       | 1.6   |       |       | 0.063 |
| E      | 0.49  |       | 0.55  | 0.019 |       | 0.022 |
| F      | 0.66  |       | 0.75  | 0.026 |       | 0.030 |
| G      | 1.14  | 1.27  | 1.4   | 0.045 | 0.050 | 0.055 |
| G1     | 17.57 | 17.78 | 17.91 | 0.692 | 0.700 | 0.705 |
| H1     | 19.6  |       |       | 0.772 |       |       |
| H2     |       |       | 20.2  |       |       | 0.795 |
| L      |       | 20.5  |       |       | 0.807 |       |
| L1     |       | 18    |       |       | 0.709 |       |
| L2     |       | 2.5   |       |       | 0.098 |       |
| 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 |
| L5     |       | 5.55  |       |       | 0.208 |       |
| L7     | 2.65  |       | 2.9   | 0.104 |       | 0.114 |
| 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 |

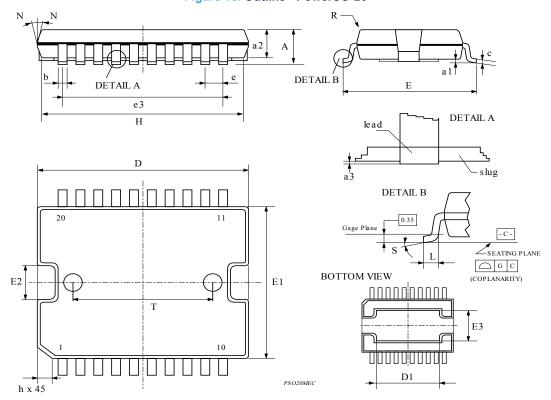
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Figure 17. PowerSO-20



Figure 18. Outline - PowerSO-20



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Table 8. Mechanical data PowerSO-20

| Dim               |      | mm    |      |          | inch  |       |
|-------------------|------|-------|------|----------|-------|-------|
| Dim.              | Min. | Тур.  | Max. | Min.     | Тур.  | Max.  |
| Α                 |      |       | 3.6  |          |       | 0.142 |
| a1                | 0.1  |       | 0.3  | 0.004    |       | 0.012 |
| a2                |      |       | 3.3  |          |       | 0.130 |
| аЗ                | 0    |       | 0.1  | 0.000    |       | 0.004 |
| b                 | 0.4  |       | 0.53 | 0.016    |       | 0.021 |
| С                 | 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 |
| Е                 | 13.9 |       | 14.5 | 0.547    |       | 0.570 |
| е                 |      | 1.27  |      |          | 0.050 |       |
| e3                |      | 11.43 |      |          | 0.450 |       |
| E1 <sup>(1)</sup> | 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 |
| Н                 | 15.5 |       | 15.9 | 0.610    |       | 0.626 |
| h                 |      |       | 1.1  |          |       | 0.043 |
| L                 | 0.8  |       | 1.1  | 0.031    |       | 0.043 |
| N                 |      |       | 10   | ° (max.) | '     |       |
| S                 |      |       | 8°   | (max.)   |       |       |
| Т                 |      | 10    |      |          | 0.394 |       |

<sup>1.</sup> Do not include mold flash or protrusions.

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<sup>-</sup> Mold flash or protrusions shall not exceed 0.15 mm (0.006").

<sup>-</sup> Critical dimensions: "E", "G" and "a3"



# 7 Ordering information

Table 9. Order codes

| Order code | Package        | Packaging     |
|------------|----------------|---------------|
| L298N      | Multiwatt15L V | Tube          |
| L298HN     | Multiwatt15L H | Tube          |
| L298P      | PowerSO-20     | Tube          |
| L298P013TR | PowerSO-20     | Tape and reel |

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## **Revision history**

Table 10. Document revision history

| Date        | Version | Changes  |
|-------------|---------|--|
| 06-Oct-2023 | 5       | Changed outline and mechanical data; see package H, Figure 16. |

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