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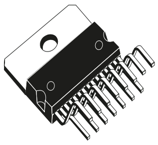
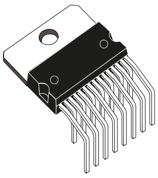
L298

Datasheet

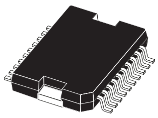
Dual full-bridge driver



Multiwatt15 V



Multiwatt15 H



PowerSO-20

Product summary
L298

Product label
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

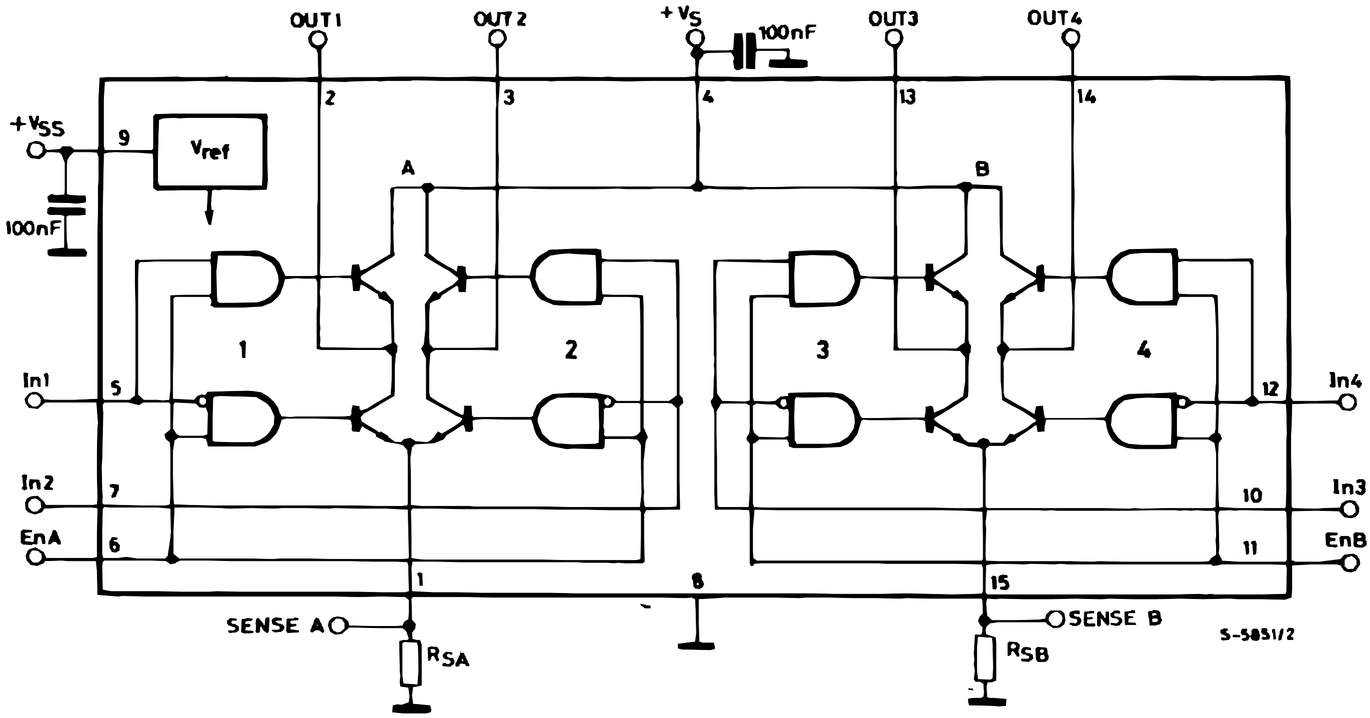
Description

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



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
V_S	Power supply	50	V
V_{SS}	Logic supply voltage	7	V
V_I, V_{en}	Input and enable voltage	–0.3 to 7	V
I_O	Peak output current (each channel):		
	• Non repetitive (t = 100 ms)	3	A
	• repetitive (80% on –20% off; t_{on} =10 ms)	2.5	A
	• DC operation	2	A
V_{sens}	Sensing voltage	–1 to 2.3	V
P_{tot}	Total power dissipation (t_{case} = 75 °C)	25	W
T_{op}	Junction operating temperature	–25 to 130	°C
T_{stg}, T_j	Storage and junction temperature	–40 to 150	°C

Table 2. Thermal data

Symbol	Parameter		Power SO20	Multiwatt 15	Unit
$R_{th\ j\text{-}case}$	Thermal resistance junction-case	Max.	–	3	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	Max.	13 (1)	35	°C/W

1. *Mounted on aluminum substrate*

3 Pin description

Figure 2. Pin configuration

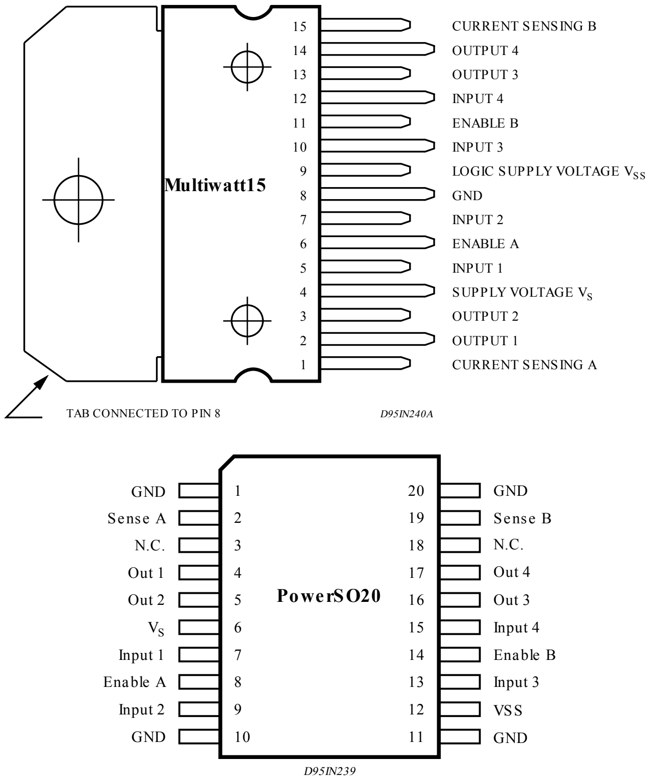


Table 3. Pin function

MW.15	Power 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	V_S	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, 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

4 Electrical characteristics

Table 4. **Electrical characteristics**

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_S	Supply voltage (pin 4)	Operative condition	V_{IH} +2.5		46	V
V_{SS}	Logic supply voltage (pin 9)		4.5	5	7	V
I_S	Quiescent supply current (pin 4)	V_{en} = H; V_i = L; I_L= 0		13	22	mA
		V_{en} = H; V_i = H; I_L= 0		50	70	mA
		V_{en} = L; V_i = X			4	mA
I_{SS}	Quiescent current from V_{SS} (pin 9)	V_{en} = H; V_i = L; I_L= 0		24	36	mA
		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_{SS}	V
I_{iL}	Low voltage input current (pins 5, 7, 10, 12)	V_i = L			–10	µA
I_{iH}	High voltage input current (pins 5, 7, 10, 12)	V_i = H ≤ V_{SS}–0.6V		30	100	µA
V_{enL}	Enable low voltage (pins 6, 11)		–0.3		1.5	V
V_{enH}	Enable high voltage (pins 6, 11)		2.3		V_{SS}	V
I_{enL}	Low voltage enable current (pins 6, 11)	V_{en} = L			–10	µA
I_{enH}	High voltage enable current (pins 6, 11)	V_{en} = H ≤ V_{SS}–0.6V		30	100	µA
$V_{CEsat (H)}$	Source saturation voltage	I_L = 1A	0.95	1.35	1.7	V
		I_L = 2A		2	2.7	V
$V_{CEsat (L)}$	Sink saturation voltage	I_L= 1A (1)	0.85	1.2	1.6	V
		I_L = 2A (1)		1.7	2.3	V
V_{CEsat}	Total drop	I_L = 1A (1)	1.80		3.2	V
		I_L = 2A (1)			4.9	
V_{sens}	Sensing voltage (pins 1, 15)		–1 (2)		2	V
T_1 (V_i)	Source current turn-off delay	0.5 V_i to 0.9 I_L (3); (5)		1.5		µs
T_2 (V_i)	Source current fall time	0.9 I_L to 0.1 I_L (3); (5)		0.2		µs
T_3 (V_i)	Source current turn-on delay	0.5 V_i to 0.1 I_L (3); (5)		2		µs
T_4 (V_i)	Source current rise time	0.1 I_L to 0.9 I_L (3); (5)		0.7		µs
T_5 (V_i)	Sink current turn-off delay	0.5 V_i to 0.9 I_L (4); (5)		0.7		µs
T_6 (V_i)	Sink current fall time	0.9 I_L to 0.1 I_L; (4); (5)		0.25		µs
T_7 (V_i)	Sink current turn-on delay	0.5 V_i to 0.9 I_L; (4); (5)		1.6		µs
T_8 (V_i)	Sink current rise time	0.1 $I_L$to 0.9 I_L; (4); (5)		0.2		µs
f_C (V_i)	Commutation frequency	I_L = 2A		25	40	KHz
T_1 (V_{en})	Source current turn-off delay	0.5 V_{en} to 0.9 I_L (3); (5)		3		µs
T_2 (V_{en})	Source current fall time	0.9 I_L to 0.1 I_L (3); (5)		1		µs

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
T_3 (V_{en})	Source current turn-on delay	0.5 V_{en} to 0.1 I_L (3); (5)		0.3		µs
T_4 (V_{en})	Source current rise time	0.1 I_L to 0.9 I_L (3); (5)		0.4		µs
T_5 (V_{en})	Sink current turn-off delay	0.5 V_{en} to 0.9 I_L (4); (5)		2.2		µs
T_6 (V_{en})	Sink current fall time	0.9 I_L to 0.1 I_L (4); (5)		0.35		µs
T_7 (V_{en})	Sink current turn-on delay	0.5 V_{en} to 0.9 I_L (4); (5)		0.25		µs
T_8 (V_{en})	Sink current rise time	0.1 I_L to 0.9 I_L (4); (5)		0.1		µs

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

Figure 3. Typical saturation voltage vs. output

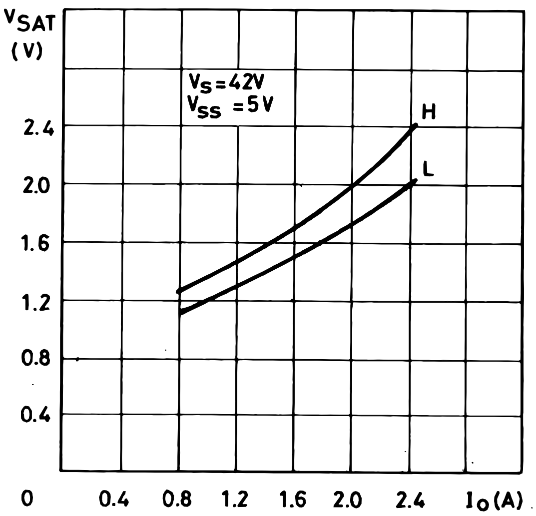
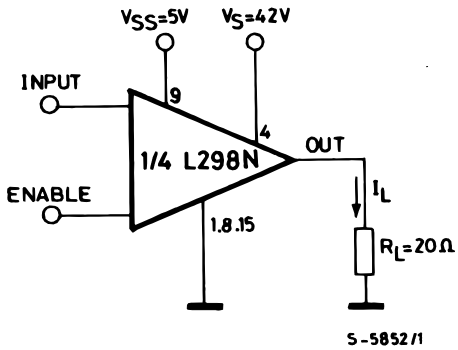


Figure 4. Switching times test circuits



Note: *For INPUT switching, set EN = H*
For ENABLE switching, set IN = H

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

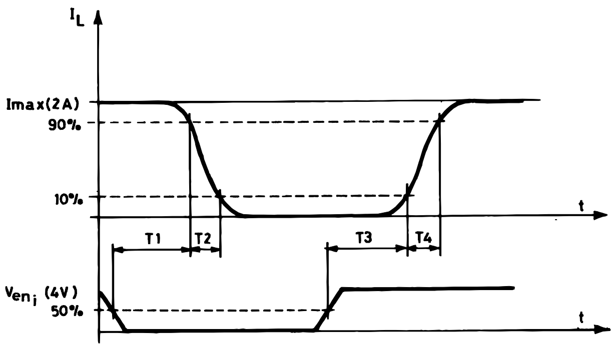
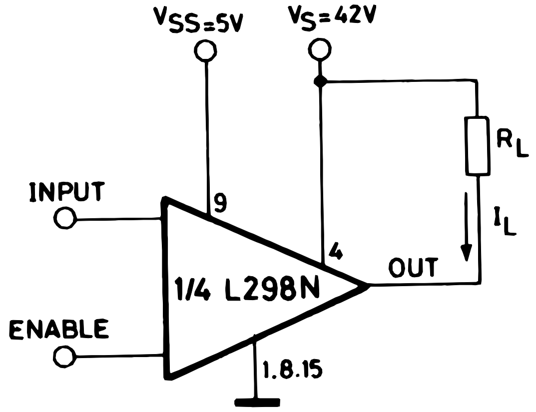


Figure 6. Switching times test circuits



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

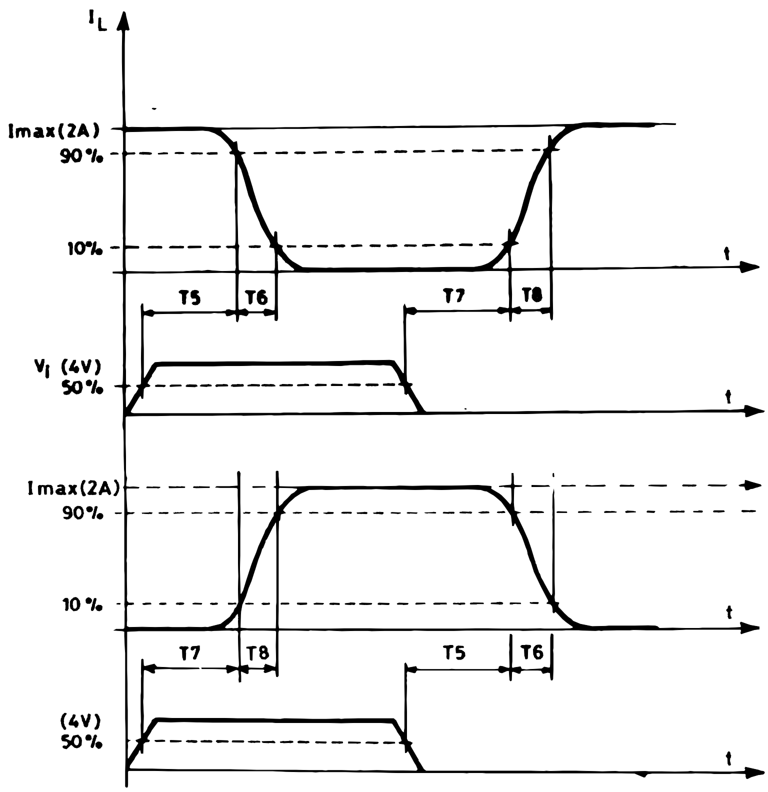


Figure 8. Bidirectional dc motor control

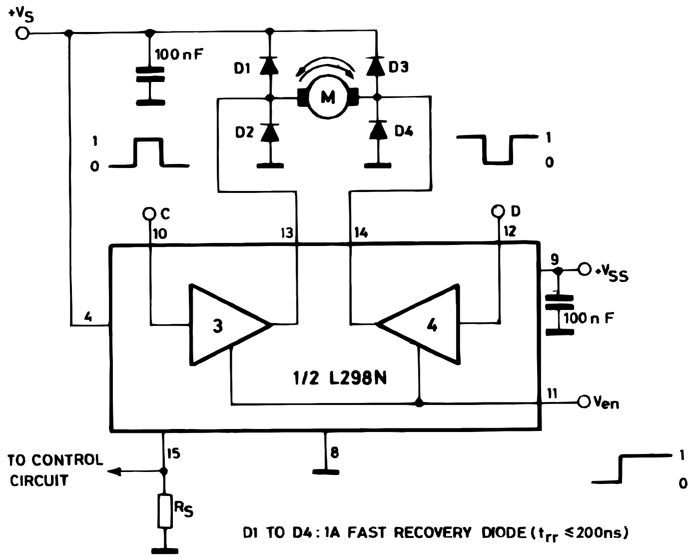
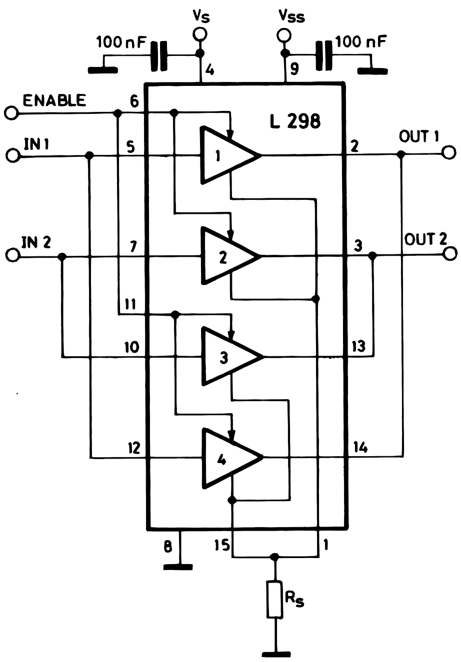


Table 5. Values of bidirectional dc motor control

Inputs		Function
V_{en} = H	C = H; D = L	Forward
	C = L; D = H	Reverse
	C = D	Fast motor stop
V_{en} = 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



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 ($t_{rr} \leq 200$ 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).

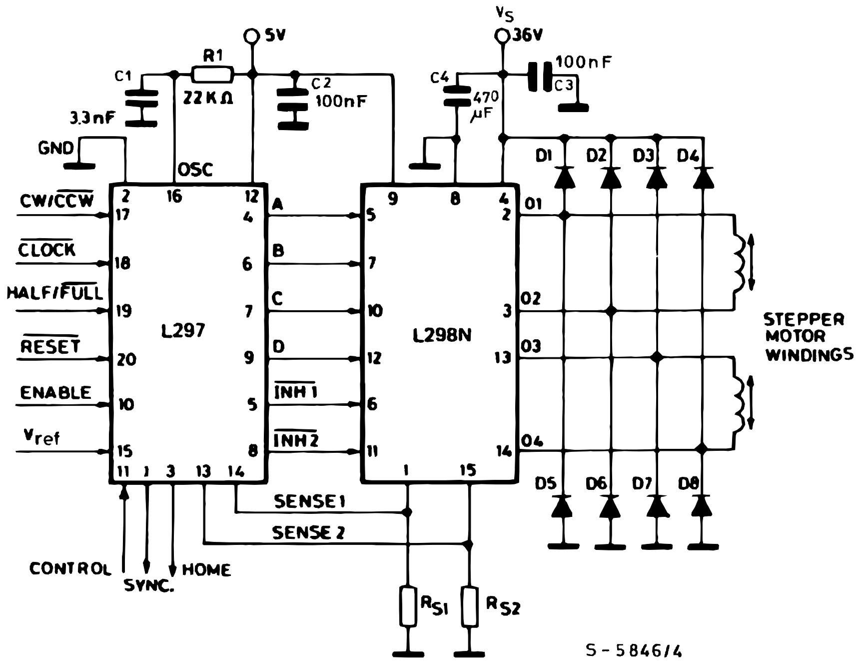
This solution can drive up to 3 A in dc operation and until 3.5 A of a repetitive peak current.

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.

Figure 10. Two phase bipolar stepper motor circuit



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

Figure 11. Suggested printed circuit board layout for the circuit of fig. 10 (1:1 scale)

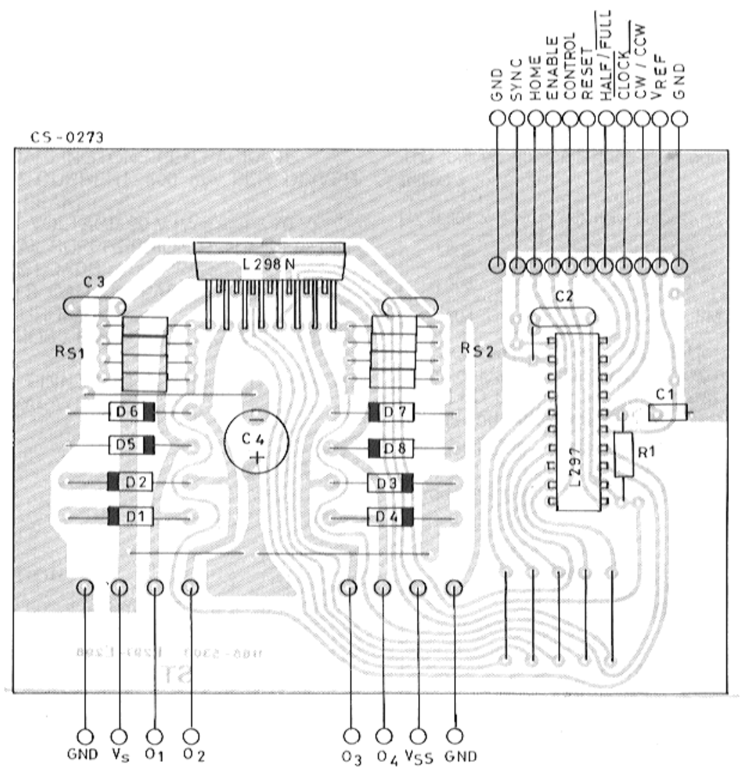
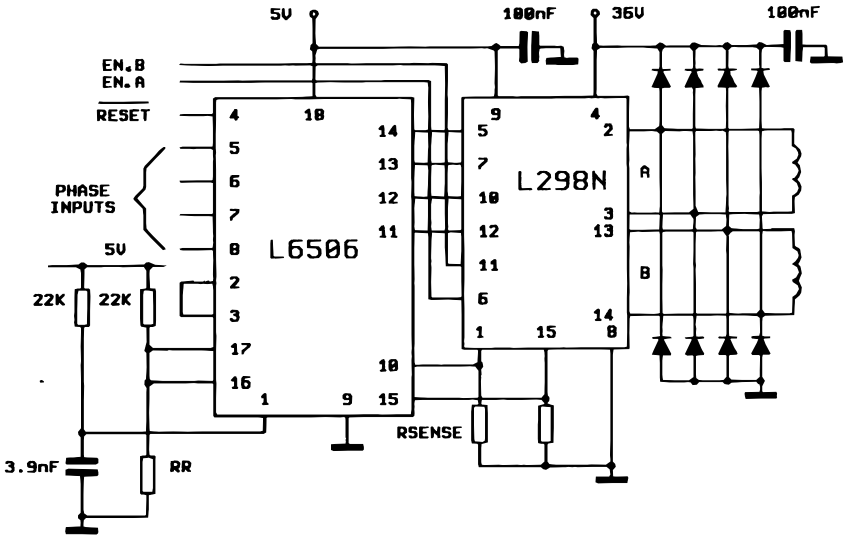


Figure 12. Two phase bipolar stepper motor control circuit by using the current controller L6506.



R_R and R_{sense} depend from the load current

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

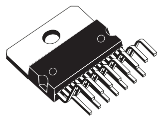


Figure 14. Outline - Multiwatt15L V

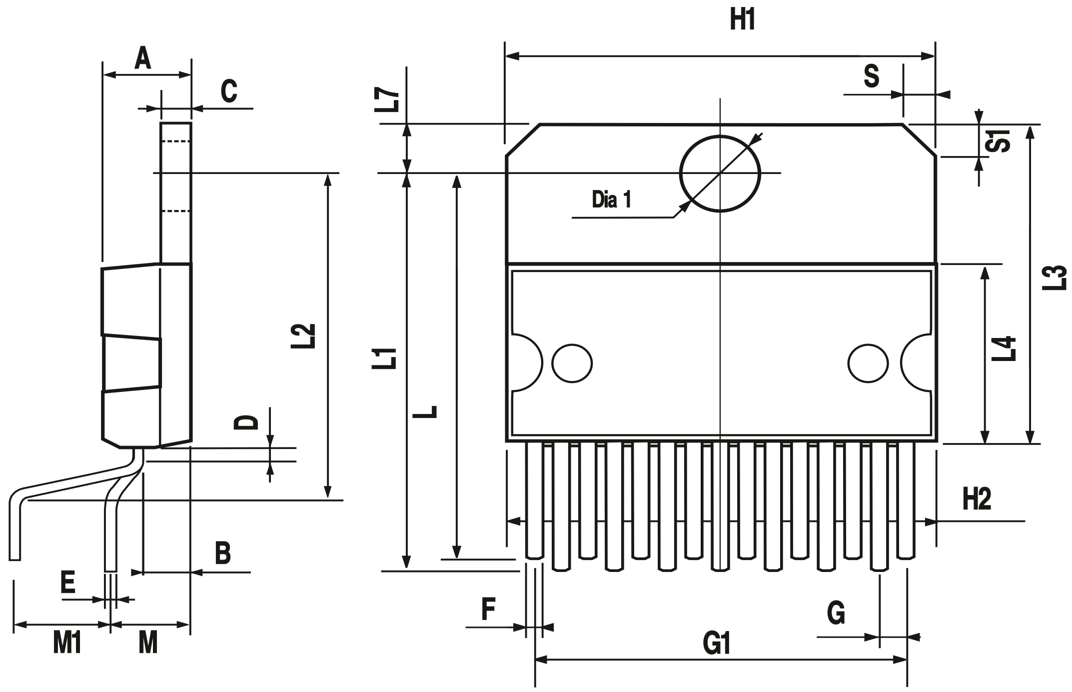


Table 6. Mechanical data Multiwatt15L V

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	0.66		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

Figure 15. **Multiwatt15 H**

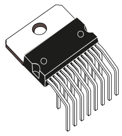


Figure 16. **Outline - Multiwatt15L H**

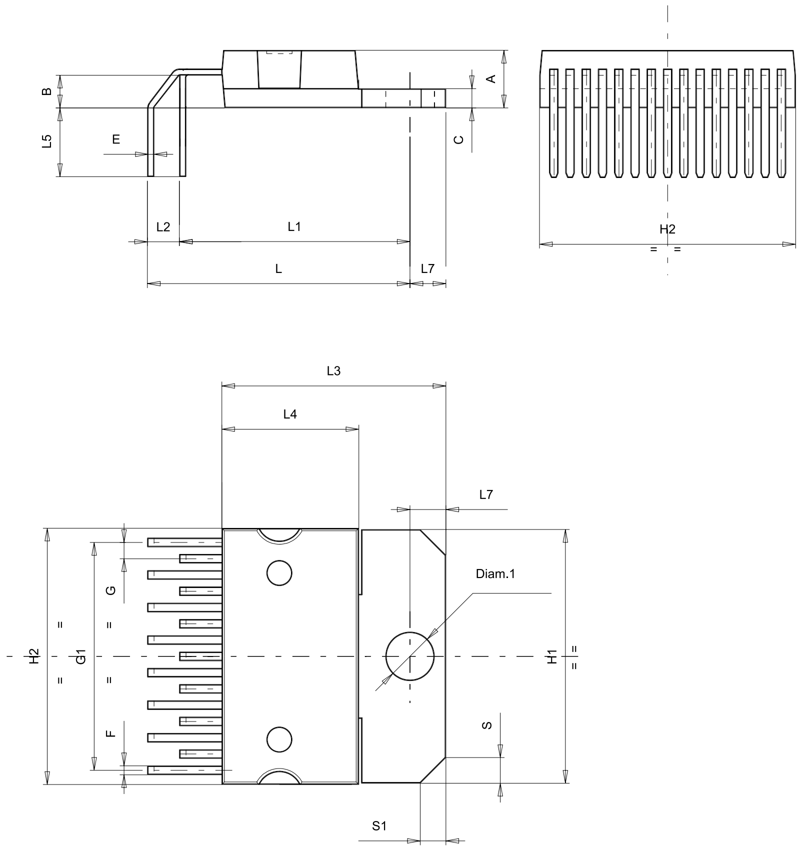


Table 7. **Mechanical data Multiwatt15L H**

Dim.	mm			inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5			0.197
B			2.65			0.104
C			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

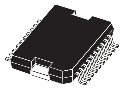


Figure 17. PowerSO-20

Figure 18. Outline - PowerSO-20

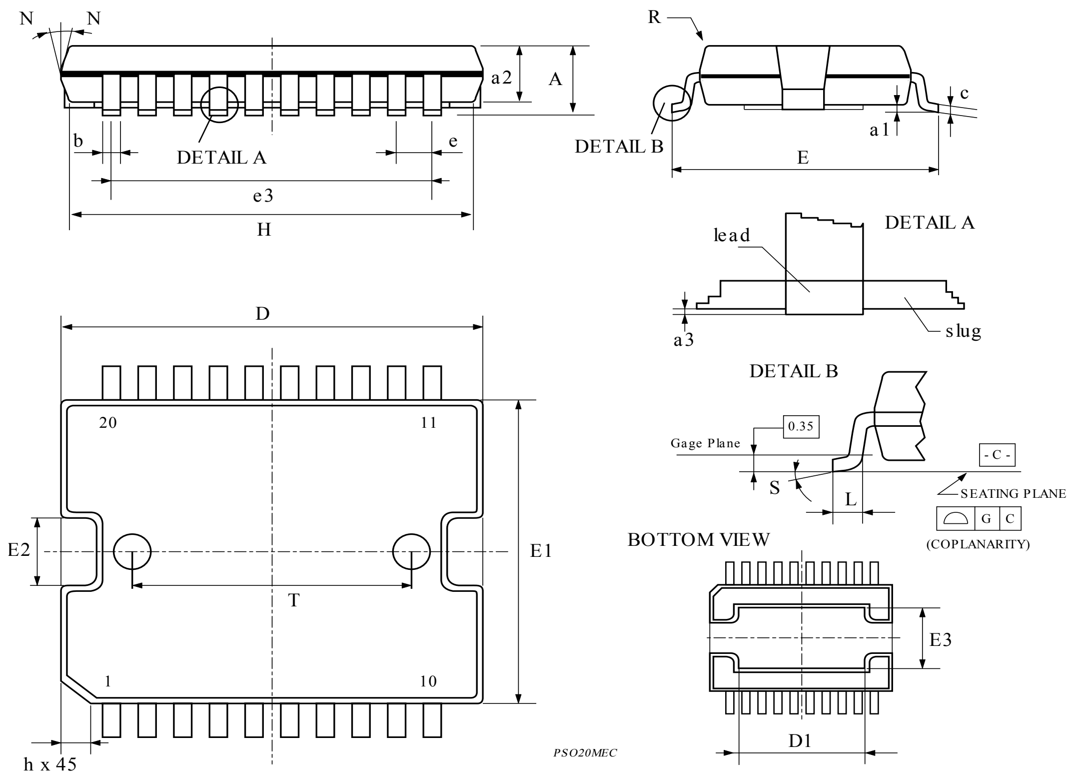


Table 8. Mechanical data PowerSO-20

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	10˚ (max.)					
S	8˚ (max.)					
T		10			0.394	

1. *Do not include mold flash or protrusions.*

   - Mold flash or protrusions shall not exceed 0.15 mm (0.006").

   - 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

Revision history

Table 10. **Document revision history**

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

Contents

List of tables

List of figures