Progam Arduino Nano

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(2, 3, 4, 5, 6, 7);
#define echopin  A2
#define trigpin A3
#define MODE A4
#define TOMBOL_UP A0
#define TOMBOL_DOWN A1
#define LED_MERAH 9
#define LED_HIJAU 10


int tair;
long durasi, jarak;
boolean diam = true;
boolean kondisi = true;
boolean paused = true;
int tombolTambahan = HIGH;   //buat mode manual
int delayMotor = 600;       //buat mode manual
int delayMotorDiam;         //buat sensor ultrasonic
unsigned int adc1, count, dataMin, dataMax, dataAv;

void setup()
{
  lcd.begin(16, 2);
  pinMode (MODE, INPUT_PULLUP);
  pinMode (TOMBOL_UP, INPUT_PULLUP);
  pinMode (TOMBOL_DOWN, INPUT_PULLUP);
  pinMode (LED_MERAH, OUTPUT);
  pinMode (LED_HIJAU, OUTPUT);
  pinMode (trigpin, OUTPUT);
  pinMode (echopin, INPUT );

  noInterrupts();          // disable all interrupts
  TCCR1A = 0;
  TCCR1B = 0;

  TCNT1 = 34286;           // preload timer 65536-16MHz/256/2Hz
  TCCR1B |= (1 << CS12);    // 256 prescaler
  TIMSK1 |= (1 << TOIE1);   // enable timer overflow interrupt
  interrupts();
}

ISR(TIMER1_OVF_vect)       // interrupt service routine that wraps a user defined
function supplied by attachInterrupt
{
```

```
  TCNT1 = 34286;            // preload timer

  digitalWrite(trigpin, LOW);          //sensor ultrasonic
  delayMicroseconds(2);
  digitalWrite(trigpin, HIGH);
  delayMicroseconds(10);
  durasi = pulseIn (echopin, HIGH);
  jarak = durasi / 58.2;
}

boolean PINTU_BUKA_TUTUP_OTOMATIS()
{
  int delayMotorOtomatis = 350;
  if (kondisi == true)
  {
    motor_buka();
    delay(delayMotorOtomatis);
    motor_diam();
    delay(delayMotorDiam);
    motor_tutup();
    delay(delayMotorOtomatis);
    motor_diam();
  }
  kondisi = false;
  return kondisi;
}

boolean PINTU_BUKA_MULAI()       //buat mode manual
{
  if (diam == true)
  {
    motor_buka();
    delay(delayMotor);
  }
  motor_diam();
  diam = false;
  return diam;
}

boolean PINTU_TUTUP_MULAI()
{
  if (diam == false)
  {
    motor_tutup();
    delay(delayMotor);
  }
  motor_diam();
```

```
  diam = true;
  return diam;
}

void motor_diam()          //dasar buat motor driver
{
  digitalWrite (12, LOW);
  digitalWrite (11, LOW);
}

void motor_tutup()
{
  digitalWrite (12, HIGH);
  digitalWrite (11, LOW);
  LED_HIJAU_OFF();
  LED_MERAH_ON();
  lcd.setCursor(2, 1);
  lcd.print("Door Closed");
}

void motor_buka()
{
  digitalWrite (12, LOW);
  digitalWrite (11, HIGH);
  LED_HIJAU_ON();
  LED_MERAH_OFF();
  lcd.setCursor(2, 1);
  lcd.print("Door Opened");
}

void LED_HIJAU_ON() {              //buat lampu indikator
  digitalWrite (LED_HIJAU, HIGH);
}

void LED_HIJAU_OFF() {
  digitalWrite (LED_HIJAU, LOW);
}

void LED_MERAH_ON() {
  digitalWrite (LED_MERAH, HIGH);
}

void LED_MERAH_OFF() {
  digitalWrite (LED_MERAH, LOW);
}

void loop ()                      //progam utama arduino
```

```
{
 int tombolMode = digitalRead(MODE);
 dataMin = adc1;
 dataMax = adc1;

 if (tombolMode == HIGH)              //pilih mode otomatia
 {
  {

    for ( count = 0; count <= 5; count++) {
     adc1 = jarak;
     if ( adc1 > dataMax ) dataMax = adc1;
     if ( adc1 < dataMin ) dataMin = adc1;
     delay(100);
    }
    dataAv=abs((dataMax+dataMin)/2);
    tair = 27 - dataAv;
    delay (100);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Water Level :");
    lcd.print(tair);
    delay (100);
    lcd.setCursor(2, 1);
    lcd.print("Door Closed");
    delay (500);
  }

  if (tair == 14) {
    delayMotorDiam = 4000;
    PINTU_BUKA_TUTUP_OTOMATIS();
    kondisi = false;
  }
  else
    kondisi = true;
 }

 if (tombolMode == LOW)                  //pilih manual mode
 {
  int tombolUp = digitalRead(TOMBOL_UP);
  int tombolDown = digitalRead(TOMBOL_DOWN);
  lcd.setCursor(0, 0);
  lcd.print("  MANUAL MODE   ");

  if ((tombolUp == LOW) and (tombolTambahan != tombolUp))
  {
    PINTU_TUTUP_MULAI();
```

```
    lcd.setCursor(2, 1);
    lcd.print("Door Closed");
   }

   if ((tombolUp == HIGH) and (tombolTambahan == tombolUp))
   {
    motor_diam();
    tombolTambahan = LOW;
   }

   if ((tombolDown == LOW) and (tombolTambahan == tombolDown))
   {
    PINTU_BUKA_MULAI();
    lcd.setCursor(2, 1);
    lcd.print("Door Opened");
   }

   if ((tombolDown == HIGH) and (tombolTambahan != tombolDown))
   {
    motor_diam();
    tombolTambahan = HIGH;
   }

  }
}
```

HC-SR04 User Guide

Part 1 Ultrasonic Introduction

1. 1 Ultrasonic Definition

The human ear can hear sound frequency around 20HZ ~ 20KHZ, and ultrasonic is the sound wave beyond the human ability of 20KHZ .

1.2 Ultrasonic distance measurement principle

Ultrasonic transmitter emitted an ultrasonic wave in one direction, and started timing when it launched. Ultrasonic spread in the air, and would return immediately when it encountered obstacles on the way. At last, the ultrasonic receiver would stop timing when it received the reflected wave. As Ultrasonic spread velocity is 340m / s in the air, based on the timer record **t**, we can calculate the distance (s) between the obstacle and transmitter, namely: s = 340t / 2, which is so- called time difference distance measurement principle

The principle of ultrasonic distance measurement used the already-known air spreading velocity, measuring the time from launch to reflection when it encountered obstacle, and then calculate the distance between the transmitter and the obstacle according to the time and the velocity. Thus, the principle of ultrasonic distance measurement is the same with radar.

Distance Measurement formula is expressed as: L = C X T

In the formula, L is the measured distance, and C is the ultrasonic spreading velocity in air, also, T represents time (T is half the time value from transmitting to receiving).

1.3 Ultrasonic Application

Ultrasonic Application Technology is the thing which developed in recent decades. With the ultrasonic advance, and the electronic technology development, especially as high-power semiconductor device technology matures, the application of ultrasonic has become increasingly widespread:

- Ultrasonic measurement of distance, depth and thickness;
- Ultrasonic testing;
- Ultrasound imaging;
- Ultrasonic machining, such as polishing, drilling;
- Ultrasonic cleaning;
- Ultrasonic welding;

Part 2 HC-SR04 Ultrasonic Module Introduction

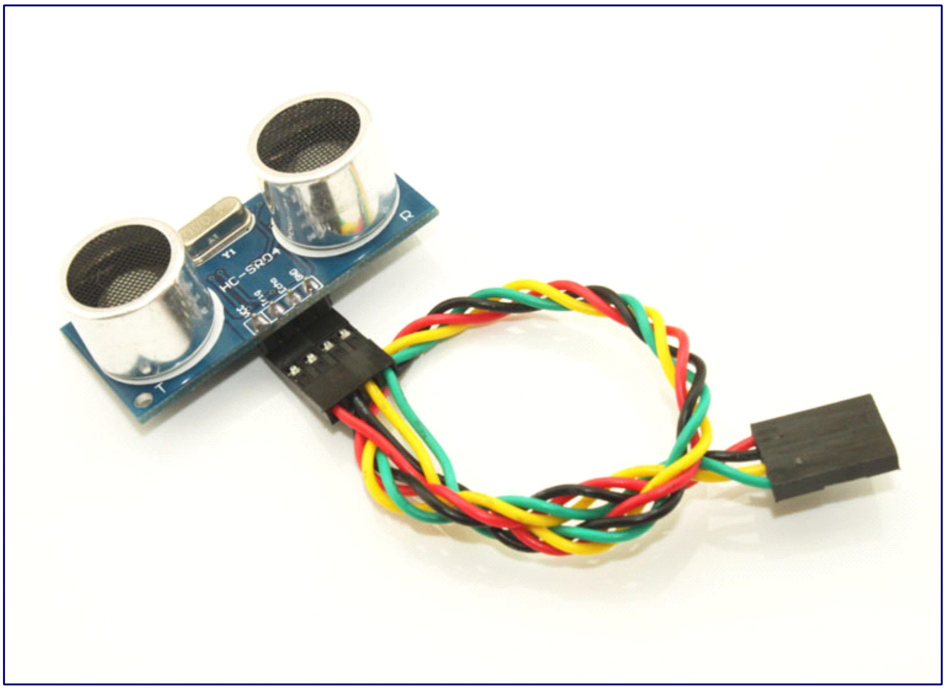
2.1 Product Features

- Stable performance
- Accurate distance measurement
- High-density
- Small blind

Application Areas:

- Robotics barrier
- Object distance measurement
- Level detection
- Public security
- Parking detection

2.2 Product Image



2.3、Module pin definitions

Types	Pin Symbol	Pin Function Description
HC-SR04	VCC	5V power supply
	Trig	Trigger pin
	Echo	Receive pin
	GND	Power ground

2.4、Electrical parameters

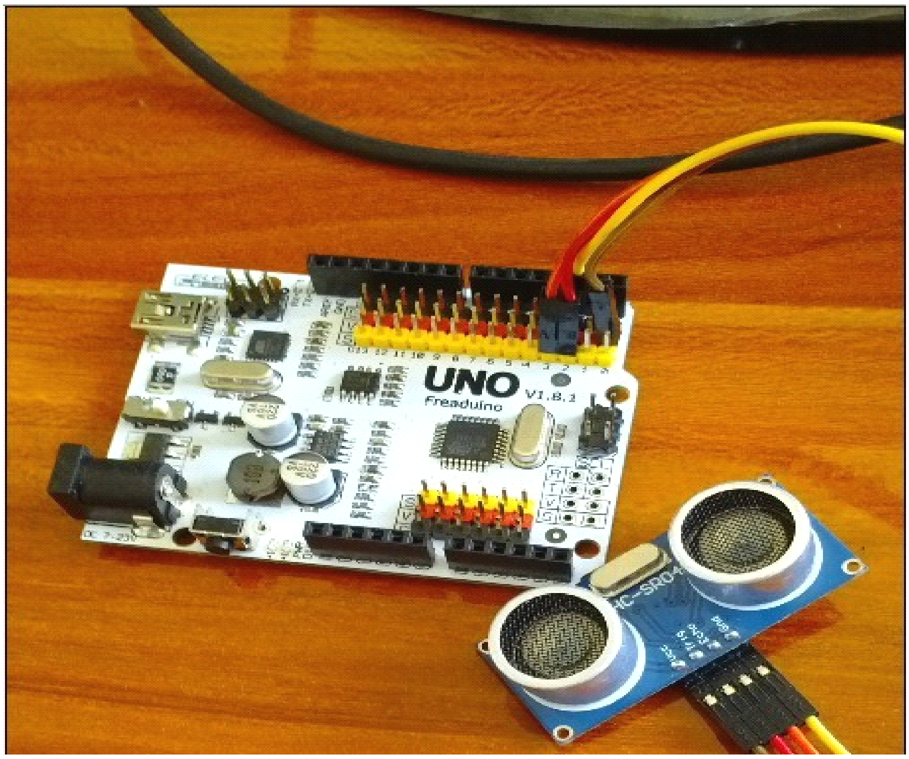
Electrical Parameters	HC-SR04 Ultrasonic Module
Operating Voltage	DC-5V
Operating Current	15mA
Operating Frequency	40KHZ
Farthest Range	4m
Nearest Range	2cm
Measuring Angle	15 Degree
Input Trigger Signal	10us TTL pulse
Output Echo Signal	Output TTL level signal, proportional with range
Dimensions	45*20*15mm

2.5 Module operating Principle

Set low the Trig and Echo port when the module initializes , firstly, transmit at least 10us high level pulse to the Trig pin (module automatically sends eight 40K square wave), and then wait to capture the rising edge output by echo port, at the same time, open the timer to start timing. Next, once again capture the falling edge output by echo port, at the same time, read the time of the counter, which is the ultrasonic running time in the air. According to the formular: test distance = (high level time * ultrasonic spreading velocity in air) / 2, you can calculate the distance to the obstacle.

Part3 Use Freaduino UNO to test HC-SR04

3.1 Freaduino uno and HC-SR04 Connection



Connection Description：D2<------>Trig D3<------>Echo (The users can define the connection pin by themselves)

Note： You need to set the Freaduino UNO switch in 5V Side when use together with HC-SR04 Module.

3.2 HCSR04 library function description

Long timing()

Function name: timing
Parameters: None
Return Value: the time of ultrasonic from the transmitter to the receiver

float CalcDistance(long microsec,int metric)

Function name：CalcDistance

- microsec: the time of ultrasonic from the transmitter to the receiver
- metric: Set the unit of the return value (the value of 1 for cm, and the value of 0 for in)

Return Value: the measured distance

3.3 Add the HC-SR04 Library

Step1:Download the Demo Code of HCSR04 Ultrasonic from address http://www.elecfreaks.com/store/download/product/Sensor/HC-SR04/HCSR04Ultrasonic_demo.zip and then unpack it to get the file of HCSR04 Ultrasonic.

Step2: Add the file of HCSR04 Ultrasonic in the file of Arduino-1.0.X / libraries.

Step3:If you can see the Example of HCSR04 Ultrasonic in Arduino IDE, the adding of HC-SR04 library has been successful.

3.4 Test the Module with the Examples of Library File

1. Open Arduino IDE 1.0.X, and choose the corresponding board and serial port.
2. Click file/ examples/ HCSR04Ultrasonic until the code pop up.
3. Compiling sketch until Done uploading appears, which represents the uploading has been successful.
4. Open serial monitor and set the corresponding BaudRate.
5. If you see similar information in serial monitor as below, you succeeded.

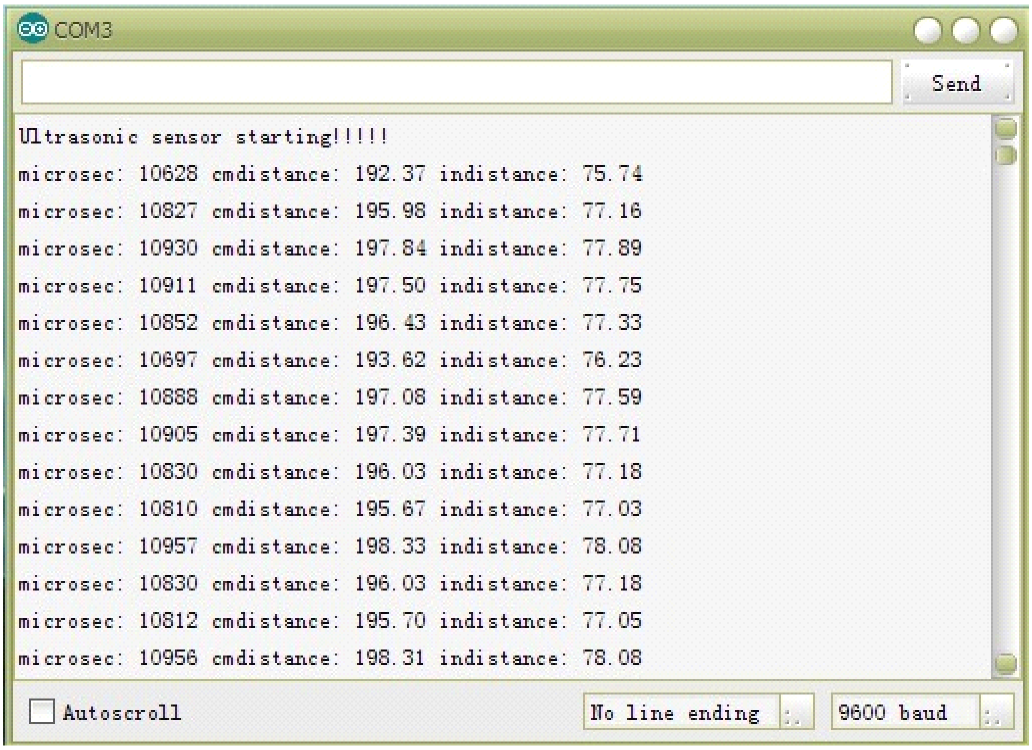


Chart 3、HC-SR04 testing results

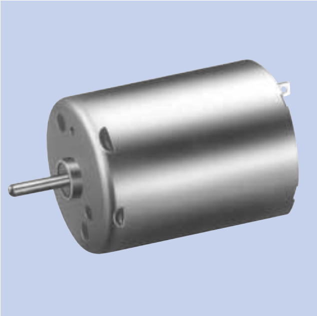
MABUCHI MOTOR

RF-370CA

Jameco Part Number 238473

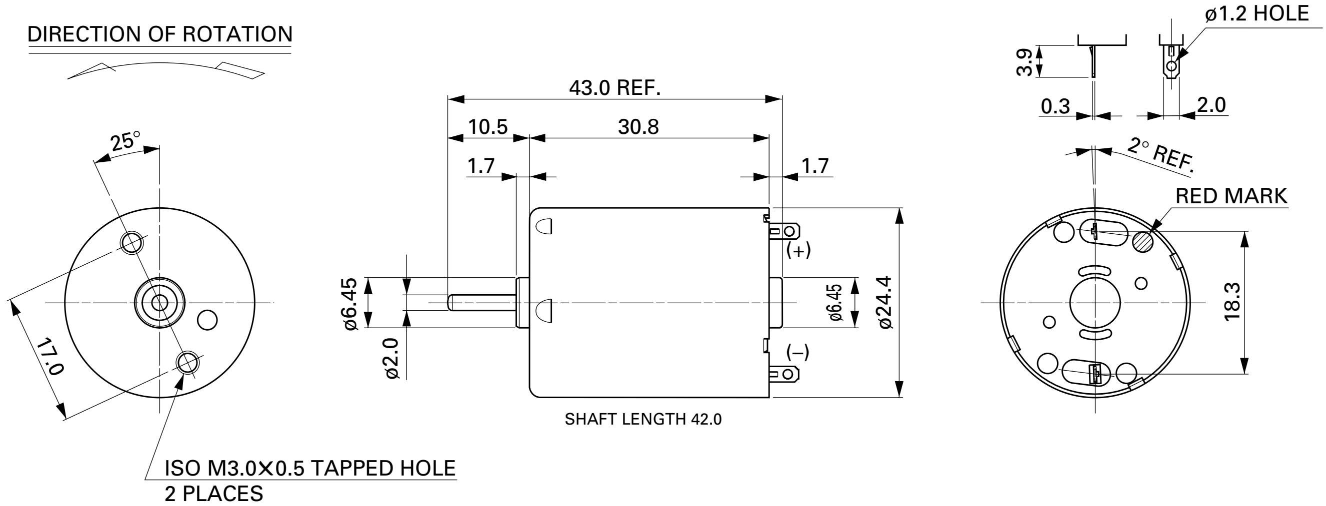
OUTPUT: APPROX 0.6W~2.0W *Precious metal-brush motors*

Typical Applications **Audio and Visual Equipment :** CD Player / DVD Player / VCR
Home Appliances : Kitchen Appliance



MODEL	VOLTAGE		NO LOAD		AT MAXIMUM EFFICIENCY					STALL		
	OPERATING RANGE	NOMINAL	SPEED	CURRENT	SPEED	CURRENT	TORQUE		OUTPUT	TORQUE		CURRENT
			r/min	A	r/min	A	mN·m	g·cm	W	mN·m	g·cm	A
RF-370CA-15370	3 ~ 12	12V CONSTANT	5600	0.026	4840	0.17	2.48	25.3	1.25	18.3	187	1.06
RF-370CA-12560	4 ~ 12	8V CONSTANT	2400	0.015	1970	0.069	1.57	16.0	0.32	8.82	90	0.32

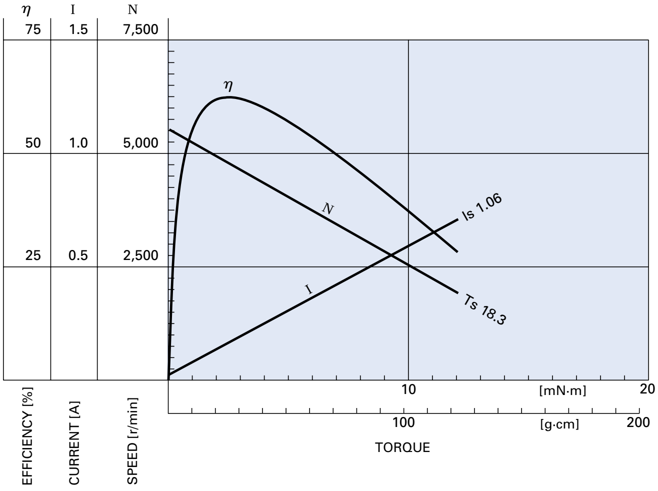
UNIT: MILLIMETERS



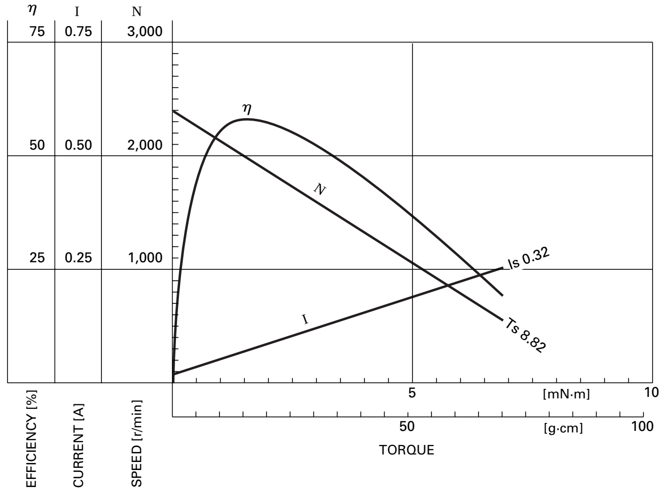
Usable machine screw length 2.0 max.
from motor mounting surface.

WEIGHT: 51g (APPROX)

RF-370CA-15370 12.0V



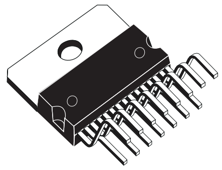
RF-370CA-12560 8.0V

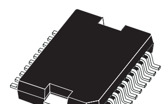


MABUCHI MOTOR CO., LTD. **Headquarters** 430 Matsuhidai, Matsudo-shi, Chiba-ken, 270-2280 Japan Tel:81-47-384-9523 Fax:81-47-385-2026 (Sales Dept.)

DUAL FULL-BRIDGE DRIVER

- 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)


Multiwatt15

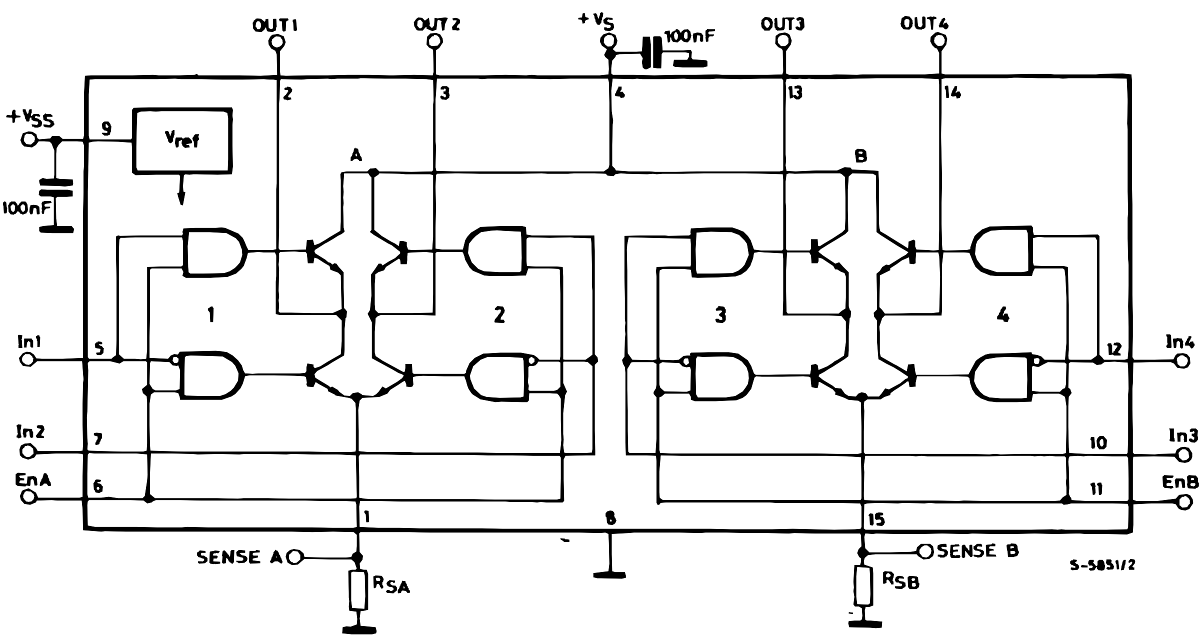

PowerSO20

ORDERING NUMBERS : L298N (Multiwatt Vert.)
L298HN (Multiwatt Horiz.)
L298P (PowerSO20)

DESCRIPTION

The L298 is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 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.

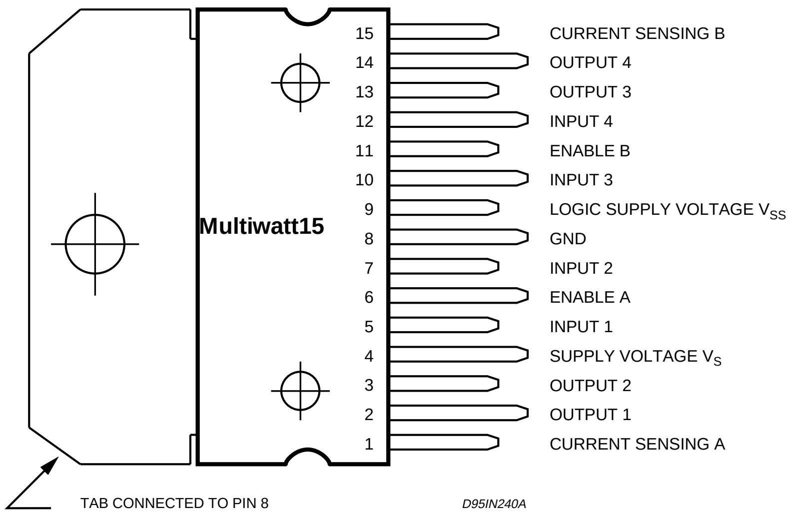
BLOCK DIAGRAM

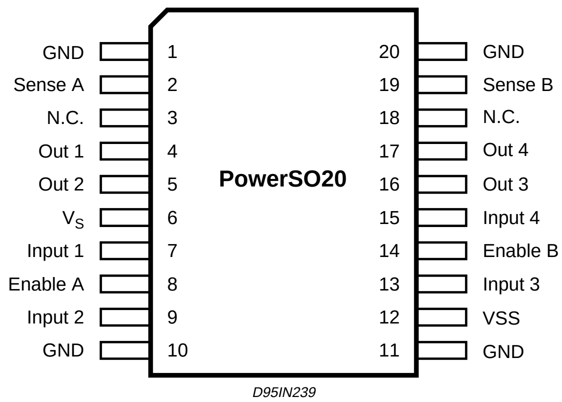


ABSOLUTE MAXIMUM RATINGS

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 = 100μs) –Repetitive (80% on –20% off; t_{on} = 10ms) –DC Operation	 3 2.5 2	 A A 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

PIN CONNECTIONS (top view)





THERMAL DATA

Symbol	Parameter		PowerSO20	Multiwatt15	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 (*)	35	°C/W

(*) Mounted on aluminum substrate

PIN FUNCTIONS (refer to the block diagram)

MW.15	PowerSO	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. A non-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. A100nF 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

ELECTRICAL CHARACTERISTICS (V_S = 42V; V_{SS} = 5V, 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; I_L = 0 V_i = L V_i = H		13 50	22 70	mA mA
		V_{en} = L V_i = X			4	mA
I_{SS}	Quiescent Current from V_{SS} (pin 9)	V_{en} = H; I_L = 0 V_i = L V_i = H		24 7	36 12	mA mA
		V_{en} = L V_i = X			6	mA
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		VSS	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)	Vi = H ≤ V_{SS} –0.6V		30	100	μA
V_{en} = L	Enable Low Voltage (pins 6, 11)		–0.3		1.5	V
V_{en} = H	Enable High Voltage (pins 6, 11)		2.3		V_{SS}	V
I_{en} = L	Low Voltage Enable Current (pins 6, 11)	V_{en} = L			–10	μA
I_{en} = H	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 I_L = 2A	0.95	1.35 2	1.7 2.7	V V
$V_{CEsat (L)}$	Sink Saturation Voltage	I_L = 1A (5) I_L = 2A (5)	0.85	1.2 1.7	1.6 2.3	V V
V_{CEsat}	Total Drop	I_L = 1A (5) I_L = 2A (5)	1.80		3.2 4.9	V V
V_{sens}	Sensing Voltage (pins 1, 15)		–1 (1)		2	V

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
T_1 (V_i)	Source Current Turn-off Delay	0.5 V_i to 0.9 I_L (2); (4)		1.5		µs
T_2 (V_i)	Source Current Fall Time	0.9 I_L to 0.1 I_L (2); (4)		0.2		µs
T_3 (V_i)	Source Current Turn-on Delay	0.5 V_i to 0.1 I_L (2); (4)		2		µs
T_4 (V_i)	Source Current Rise Time	0.1 I_L to 0.9 I_L (2); (4)		0.7		µs
T_5 (V_i)	Sink Current Turn-off Delay	0.5 V_i to 0.9 I_L (3); (4)		0.7		µs
T_6 (V_i)	Sink Current Fall Time	0.9 I_L to 0.1 I_L (3); (4)		0.25		µs
T_7 (V_i)	Sink Current Turn-on Delay	0.5 V_i to 0.9 I_L (3); (4)		1.6		µs
T_8 (V_i)	Sink Current Rise Time	0.1 I_L to 0.9 I_L (3); (4)		0.2		µs
fc (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 (2); (4)		3		µs
T_2 (V_{en})	Source Current Fall Time	0.9 I_L to 0.1 I_L (2); (4)		1		µs
T_3 (V_{en})	Source Current Turn-on Delay	0.5 V_{en} to 0.1 I_L (2); (4)		0.3		µs
T_4 (V_{en})	Source Current Rise Time	0.1 I_L to 0.9 I_L (2); (4)		0.4		µs
T_5 (V_{en})	Sink Current Turn-off Delay	0.5 V_{en} to 0.9 I_L (3); (4)		2.2		µs
T_6 (V_{en})	Sink Current Fall Time	0.9 I_L to 0.1 I_L (3); (4)		0.35		µs
T_7 (V_{en})	Sink Current Turn-on Delay	0.5 V_{en} to 0.9 I_L (3); (4)		0.25		µs
T_8 (V_{en})	Sink Current Rise Time	0.1 I_L to 0.9 I_L (3); (4)		0.1		µs

1) 1)Sensing voltage can be –1 V for t ≤ 50 µsec; in steady state V_{sens} min ≥ – 0.5 V.
2) See fig. 2.
3) See fig. 4.
4) The load must be a pure resistor.

Figure 1 : Typical Saturation Voltage vs. Output Current.

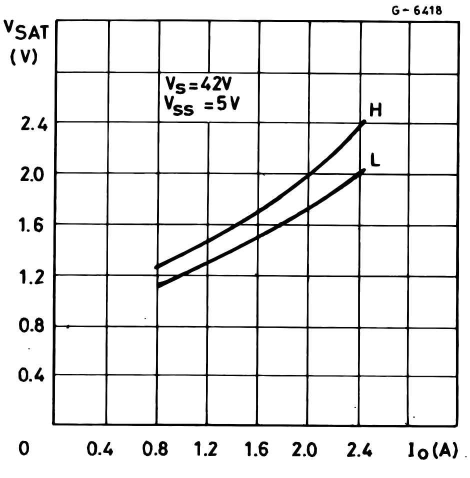
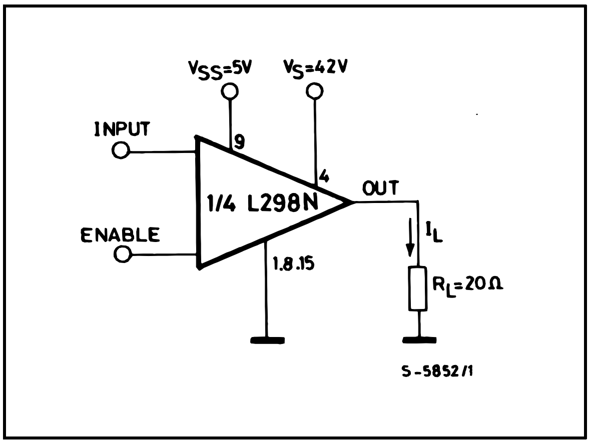


Figure 2 : Switching Times Test Circuits.



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

Figure 3 : Source Current Delay Times vs. Input or Enable Switching.

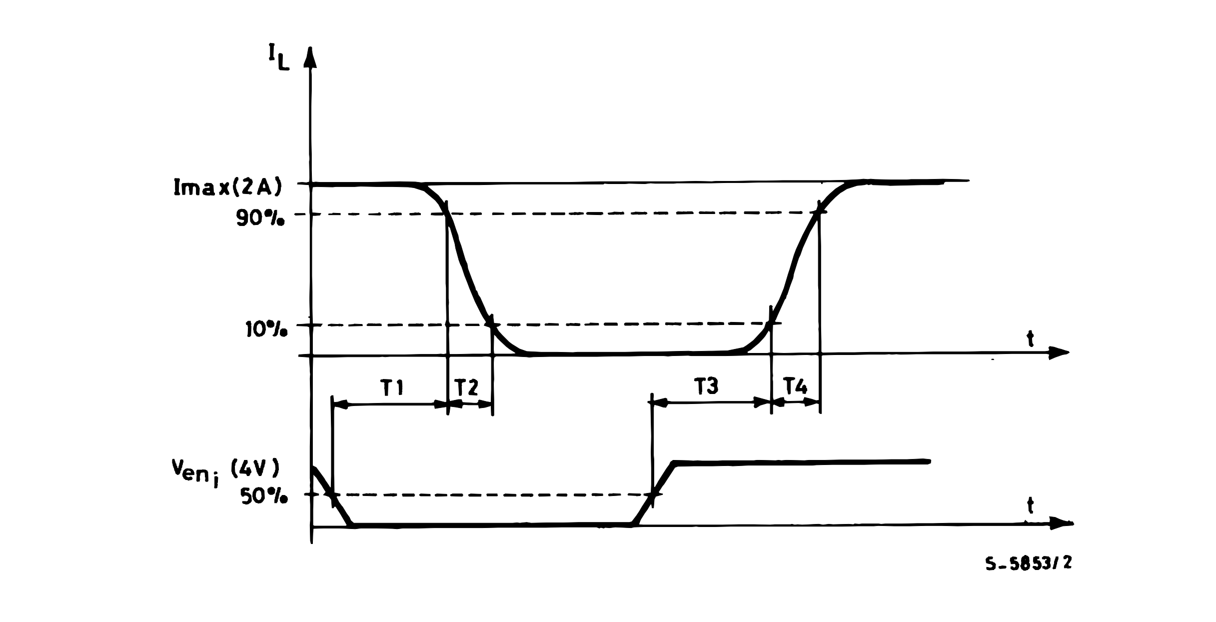
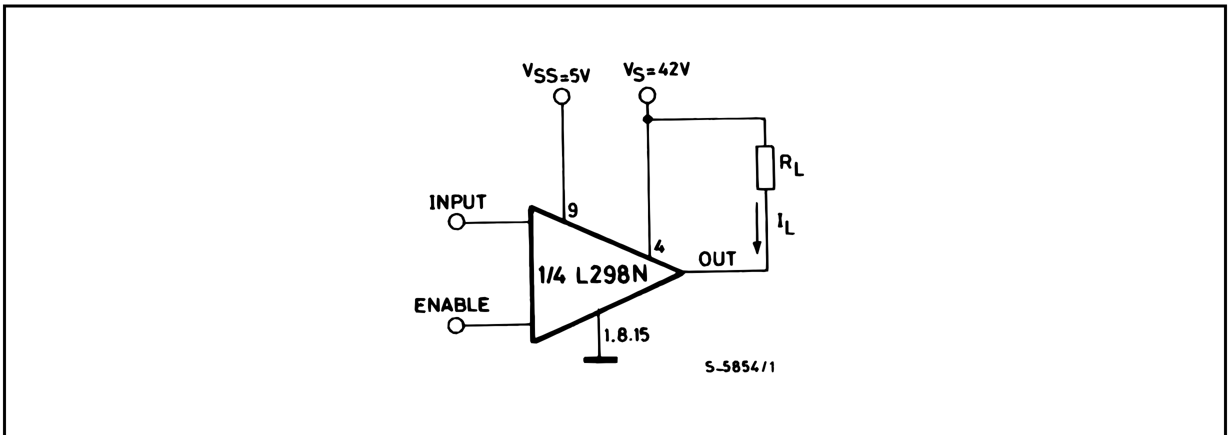


Figure 4 : Switching Times Test Circuits.



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

Figure 5 : Sink Current Delay Times vs. Input 0 V Enable Switching.

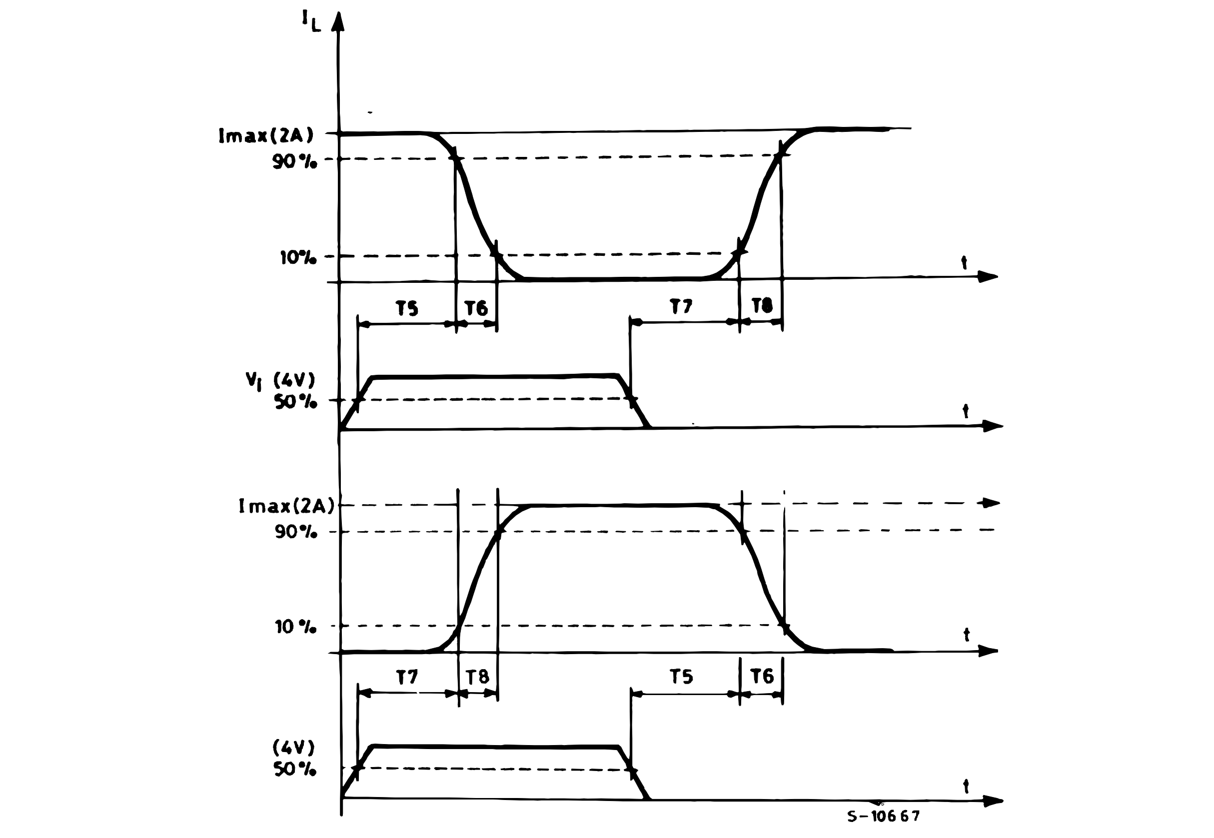
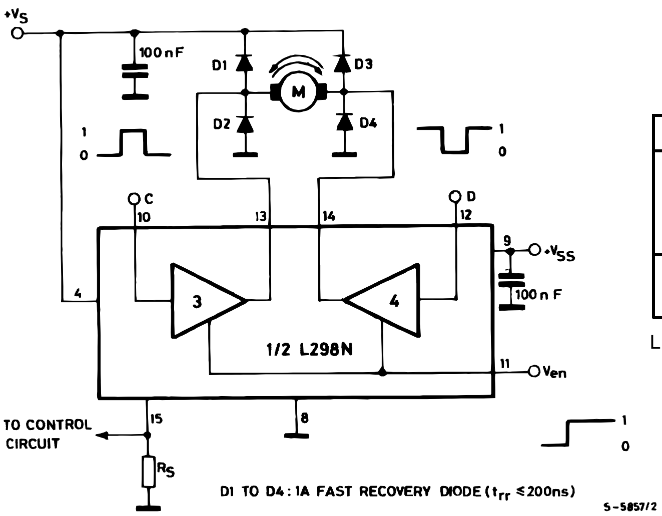


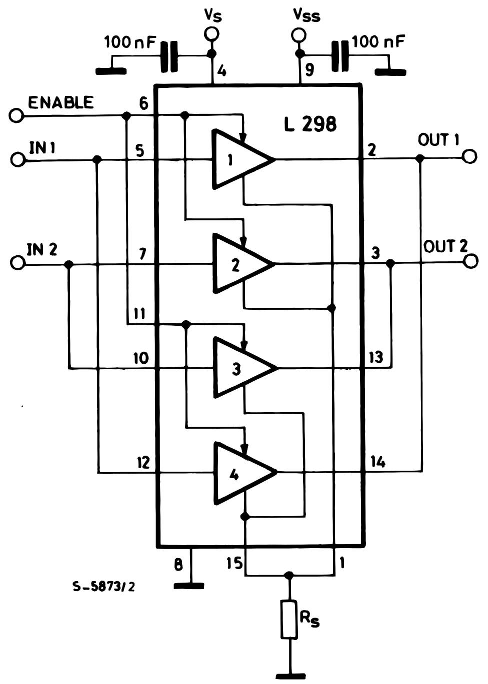
Figure 6 : Bidirectional DC Motor Control.



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

L = Low H = High X = Don't care

Figure 7 : For higher currents, outputs can be paralleled. Take care to parallel channel 1 with channel 4 and channel 2 with channel 3.



APPLICATION INFORMATION (Refer to the block diagram)

1.1. 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.

1.2. INPUT STAGE

Each bridge is driven by means of four gates the input of which are In1 ; In2 ; EnA and In3 ; In4 ; 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.

2. SUGGESTIONS

A non inductive capacitor, usually of 100 nF, must be foreseen between both Vs and Vss, to ground, as near as possible to GND pin. When the large capacitor of the power supply is too far from the IC, a second smaller one must be foreseen near the L298.

The sense resistor, not of a wire wound type, must be grounded near the negative pole of Vs that must be near the GND pin of the I.C.

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

Turn-On and Turn-Off : Before to Turn-ON the Supply Voltage and before to Turn it OFF, the Enable input must be driven to the Low state.

3. APPLICATIONS

Fig 6 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 ($t_{rr} \leq 200$ nsec) that must be chosen of a VF as low as possible at the worst case of the load current.

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 Amps must never be overcome.

When the repetitive peak current needed from the load is higher than 2 Amps, a paralleled configuration can be chosen (See Fig.7).

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

This solution can drive until 3 Amps In DC operation and until 3.5 Amps of a repetitive peak current.

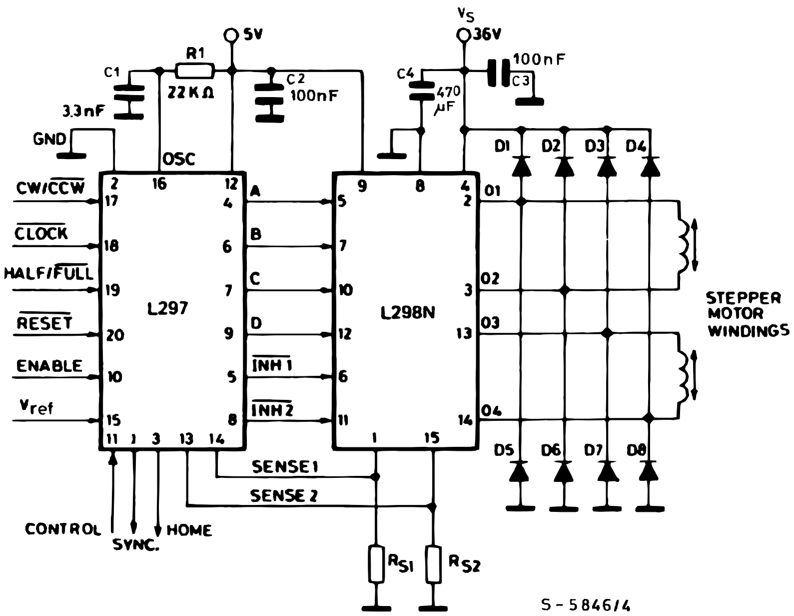
On Fig 8 it is shown the driving of a two phase bipolar stepper motor ; the needed signals to drive the inputs of the L298 are generated, in this example, from the IC L297.

Fig 9 shows an example of P.C.B. designed for the application of Fig 8.

Fig 10 shows a second two phase bipolar stepper motor control circuit where the current is controlled by the I.C. L6506.

Figure 8 : Two Phase Bipolar Stepper Motor Circuit.

This circuit drives bipolar stepper motors with winding currents up to 2 A. The diodes are fast 2 A types.



$R_{S1} = R_{S2} = 0.5\ \Omega$

D1 to D8 = 2 A Fast diodes { $V_F \leq 1.2$ V @ I = 2 A; trr ≤ 200 ns }

Figure 9 : Suggested Printed Circuit Board Layout for the Circuit of fig. 8 (1:1 scale).

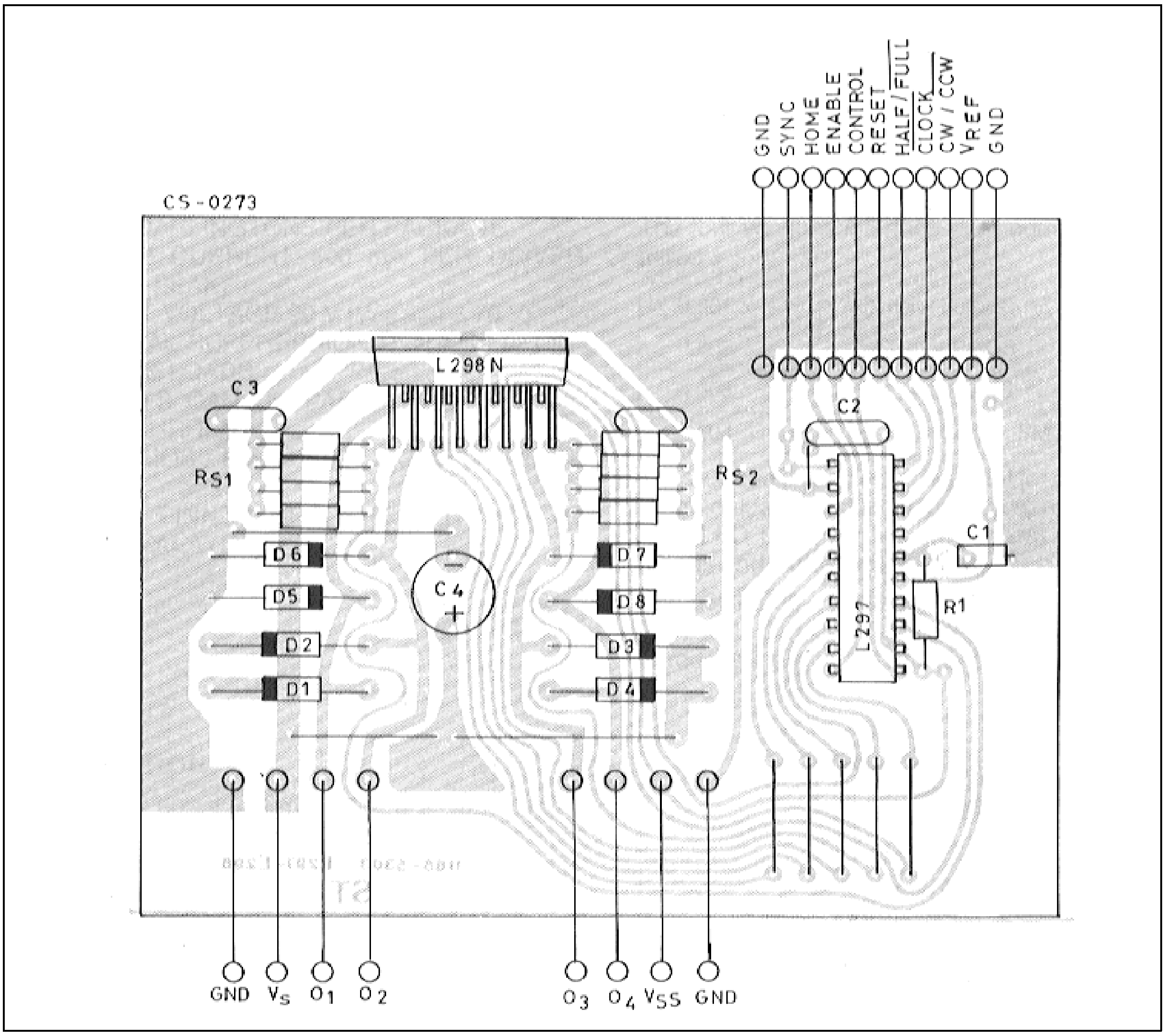
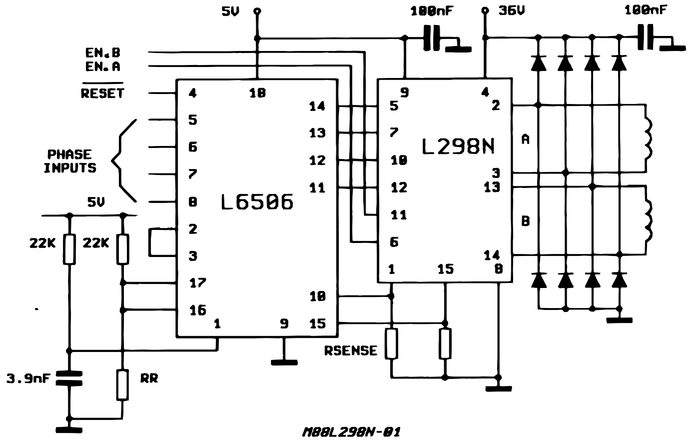


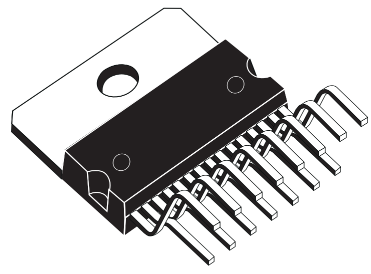
Figure 10 : Two Phase Bipolar Stepper Motor Control Circuit by Using the Current Controller L6506.



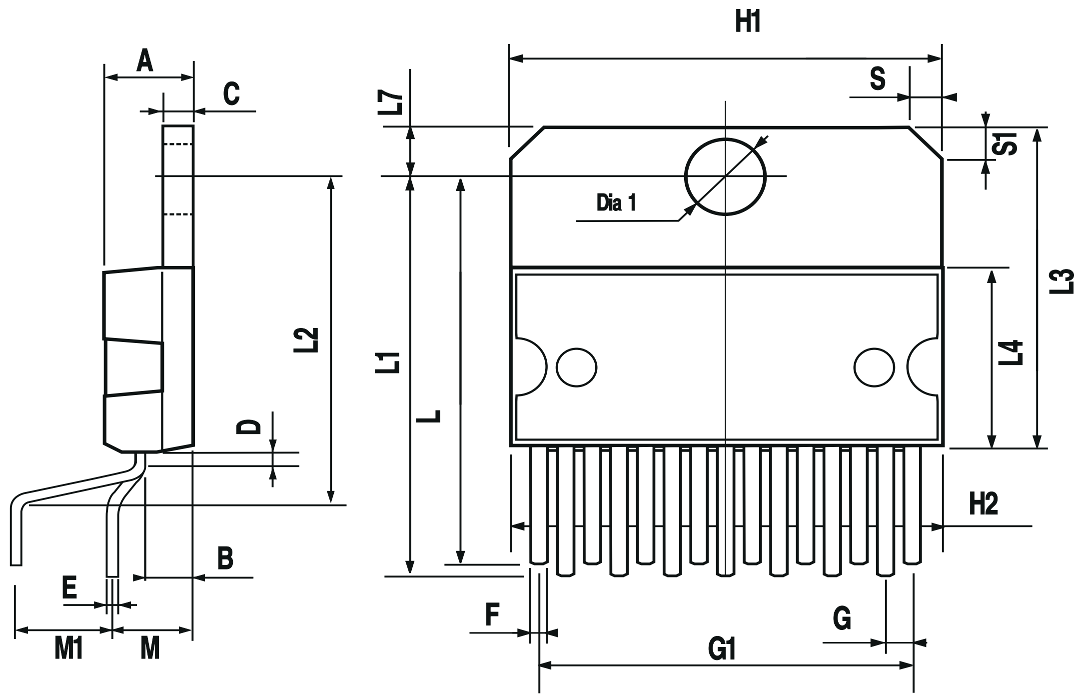
R_R and R_{sense} depend from the load current

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

OUTLINE AND MECHANICAL DATA

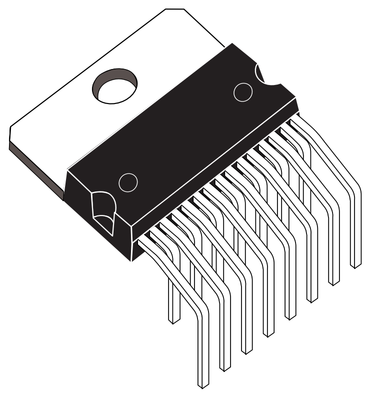


Multiwatt15 V

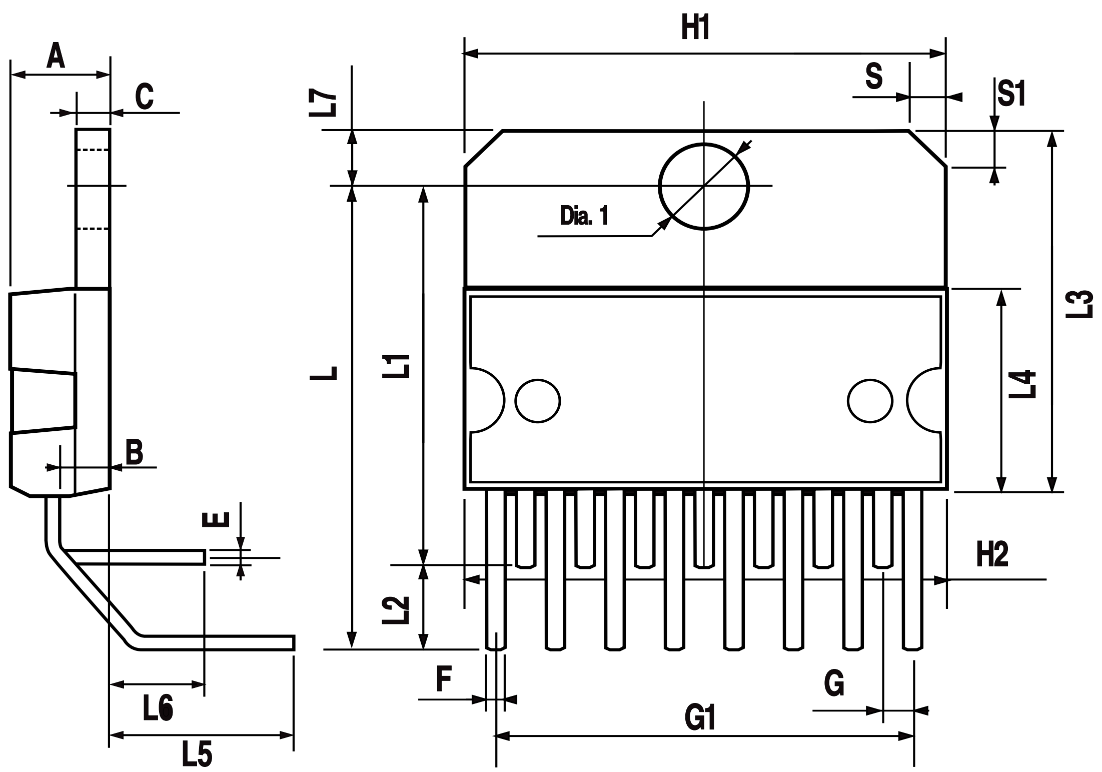


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			5			0.197
B			2.65			0.104
C			1.6			0.063
E	0.49		0.55	0.019		0.022
F	0.66		0.75	0.026		0.030
G	1.14	1.27	1.4	0.045	0.050	0.055
G1	17.57	17.78	17.91	0.692	0.700	0.705
H1	19.6			0.772		
H2			20.2			0.795
L		20.57			0.810	
L1		18.03			0.710	
L2		2.54			0.100	
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		5.28			0.208	
L6		2.38			0.094	
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

OUTLINE AND MECHANICAL DATA



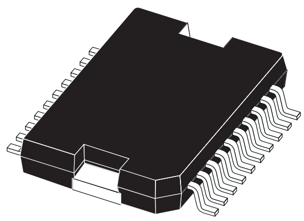
Multiwatt15 H



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) "D and F" 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"

OUTLINE AND MECHANICAL DATA



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