LAMPIRAN A

```
#include <mega.8535>
#include <delay.h>
#include <stdlib.h>

#include <math.h>

#define sigout  PORTB.0
#define sigin   PINB.0
#define dirsig  DDRB.0

#define sensor_tutup PINB.1
#define sensor_buka PINB.2


// Alphanumeric LCD Module functions
//#asm
//   .equ __lcd_port=0x15 ;PORTC
//#endasm
//#include <lcd.h>

// Standard Input/Output functions
#include <stdio.h>


void ambil_data();

void fuzzy();

void rule_base();


int
g_err,g_d_err,mf_err1,mf_err2,mf_d_err1,mf_d_err2,s,s1,s2,s3,s4,data_timer,tinggi,d
ataping,sp;

unsigned char y1[6],y2[6],cpot[4],cco[4],clevel[5],csp[5];


float grade_err1,grade_err2,grade_d_err1,grade_d_err2, d_err,data_PWM;

float level,err,e0,e1,output_fuzzy,co, ftotal,f1,f2,f3,f4;
```

```
// Timer 1 overflow interrupt service routine
interrupt [TIM1_OVF] void timer1_ovf_isr(void)
{
// Place your code here
data_timer=0;

}


void main(void)
{

PORTA=0b00001111;
DDRA=0x00;


PORTB=0b00000110;
DDRB=0x00;


PORTC=0x00;
DDRC=0x00;


PORTD=0x00;
DDRD=0x8C;

// Timer/Counter 0 initialization
// Clock source: System Clock
// Clock value: Timer 0 Stopped
// Mode: Normal top=FFh
// OC0 output: Disconnected
TCCR0=0x00;
TCNT0=0x00;
OCR0=0x00;

// Timer/Counter 1 initialization
// Clock source: System Clock
// Clock value: 172.800 kHz
// Mode: Normal top=FFFFh
// OC1A output: Discon.
// OC1B output: Discon.
// Noise Canceler: Off
```

```
// Input Capture on Rising Edge
// Timer 1 Overflow Interrupt: On
// Input Capture Interrupt: Off
// Compare A Match Interrupt: Off
// Compare B Match Interrupt: Off
TCCR1A=0x00;
TCCR1B=0x43;
TCNT1H=0x00;
TCNT1L=0x00;
ICR1H=0x00;
ICR1L=0x00;
OCR1AH=0x00;
OCR1AL=0x00;
OCR1BH=0x00;
OCR1BL=0x00;

// Timer/Counter 2 initialization
// Clock source: System Clock
// Clock value: 11059.200 kHz
// Mode: Fast PWM top=FFh
// OC2 output: Non-Inverted PWM
ASSR=0x00;
TCCR2=0x69;
TCNT2=0x00;
OCR2=0x00;



// Timer(s)/Counter(s) Interrupt(s) initialization
TIMSK=0x04;

// USART initialization
// Communication Parameters: 8 Data, 1 Stop, No Parity
// USART Receiver: On
// USART Transmitter: On
// USART Mode: Asynchronous
// USART Baud rate: 9600
UCSRA=0x00;
UCSRB=0x18;
UCSRC=0x86;
UBRRH=0x00;
UBRRL=0x47;
```

```
// Global enable interrupts
#asm("sei")

sp=0;
tinggi=37;

while (1)
      {
      if(PINA.0==0){sp=5;}
      if(PINA.1==0) {sp=10;}
      if(PINA.2==0){sp=15;}
      if(PINA.3==0) {sp=20;}



      ambil_data();
      level=tinggi-dataping;
      fuzzy();
      if(level>=sp){co=0;}



if(level>=sp && sensor_tutup==1)
{
        OCR2=255;       //tutup
        PORTD.2=1;
        PORTD.3=0;
}
else if(level<sp && sensor_buka==1)
{
        data_PWM=co;
        OCR2=data_PWM;    //buka
        PORTD.2=0;
        PORTD.3=1;

}
else
{
        OCR2=0;
        PORTD.2=0;
        PORTD.3=0;
}
```

```
        };
}
void ambil_data()
{
dirsig=1;
sigout=1;
delay_us(10);
sigout=0;

dirsig=0;
sigout=1;

while(sigin==0);
TCNT1=0;
data_timer=0;


while(sigin==1);
data_timer=TCNT1;
dataping=data_timer/10;
delay_ms(300);
}

void fuzzy()
{
e1=sp-level;
err=e1;
d_err=e1-e0;
e0=e1;
//penentuan derajat keanggotaan err

if(err<=0)
{
grade_err1=1;
mf_err1=0;     //Z
grade_err2=0;
mf_err2=1;     //PK
}

if(err>0 && err<=3)
{
grade_err1=1-(err/3);
mf_err1=0;     //Z
```

```
grade_err2=(err/3);
mf_err2=1;      //PK
}

if(err>3 && err<=6)
{
grade_err1=1-(err-3)/3;
mf_err1=1;      //PK
grade_err2=(err-3)/3;
mf_err2=2;      //PS
}

if(err>6 && err<=9)
{
grade_err1=1-(err-6)/3;
mf_err1=2;      //PS
grade_err2=(err-6)/3;
mf_err2=3;      //PB
}

if(err>9)
{
grade_err1=0;
mf_err1=2;      //PS
grade_err2=1;
mf_err2=3;      //PB
}


//derajat keanggotaan d_err

if(d_err<=-2)
{
grade_d_err1=1;
mf_d_err1=0;    //NB
grade_d_err2=0;
mf_d_err2=1;    //N
}

if(d_err>-2 && d_err<=-1)
{
grade_d_err1=1-(d_err+2);
mf_d_err1=0;    //NB
```

```
grade_d_err2=(d_err+2);
mf_d_err2=1;    //N
}

if(d_err>-1 && d_err<=0)
{
grade_d_err1=1-(d_err+1);
mf_d_err1=1;    //N
grade_d_err2=(d_err+1);
mf_d_err2=2;    //Z
}

if(d_err>0 && d_err<=1)
{
grade_d_err1=1-d_err;
mf_d_err1=2;    //Z
grade_d_err2=d_err;
mf_d_err2=3;    //P
}

if(d_err>1 && d_err<=2)
{
grade_d_err1=1-(d_err-1);
mf_d_err1=3;    //P
grade_d_err2=d_err-1;
mf_d_err2=4;    //PB
}

if(d_err>2)
{
grade_d_err1=0;
mf_d_err1=3;    //P
grade_d_err2=1;
mf_d_err2=4;    //PB
}

//rule
g_err=mf_err1;
g_d_err=mf_d_err1;
rule_base();
s1=s;

g_err=mf_err1;
```

```
g_d_err=mf_d_err2;
rule_base();
s2=s;

g_err=mf_err2;
g_d_err=mf_d_err1;
rule_base();
s3=s;

g_err=mf_err2;
g_d_err=mf_d_err2;
rule_base();
s4=s;



//pengambilan keputusan
//basis aturan
f1=min(grade_err1,grade_d_err1);
f2=min(grade_err1,grade_d_err2);
f3=min(grade_err2,grade_d_err1);
f4=min(grade_err2,grade_d_err2);

ftotal=f1+f2+f3+f4;
output_fuzzy=((f1*s1)+(f2*s2)+(f3*s3)+(f4*s4))/ftotal;
co=output_fuzzy;
}

void rule_base()
{
//ERROR ZERO
if(g_err==0 && g_d_err==0){s=0;}
if(g_err==0 && g_d_err==1){s=0;}
if(g_err==0 && g_d_err==2){s=0;}
if(g_err==0 && g_d_err==3){s=0;}
if(g_err==0 && g_d_err==4){s=0;}

//ERROR PK
if(g_err==1 && g_d_err==0){s=100;}
if(g_err==1 && g_d_err==1){s=190;}
if(g_err==1 && g_d_err==2){s=190;}
if(g_err==1 && g_d_err==3){s=190;}
if(g_err==1 && g_d_err==4){s=220;}
```

```
//ERROR PS
if(g_err==2 && g_d_err==0){s=110;}
if(g_err==2 && g_d_err==1){s=190;}
if(g_err==2 && g_d_err==2){s=220;}
if(g_err==2 && g_d_err==3){s=220;}
if(g_err==2 && g_d_err==4){s=220;}


//ERROR PB
if(g_err==3 && g_d_err==0){s=190;}
if(g_err==3 && g_d_err==1){s=220;}
if(g_err==3 && g_d_err==2){s=255;}
if(g_err==3 && g_d_err==3){s=255;}
if(g_err==3 && g_d_err==4){s=255;}

}
```

SGS-THOMSON MICROELECTRONICS

L293D
L293DD

PUSH-PULL FOUR CHANNEL DRIVER WITH DIODES

- 600mA OUTPUT CURRENT CAPABILITY PER CHANNEL
- 1.2A PEAK OUTPUT CURRENT (non repetitive) PER CHANNEL
- ENABLE FACILITY
- OVERTEMPERATURE PROTECTION
- LOGICAL "0" INPUT VOLTAGE UP TO 1.5 V (HIGH NOISE IMMUNITY)
- INTERNAL CLAMP DIODES

SO(12+4+4)

Powerdip (12+2+2)

ORDERING NUMBERS:

L293DD L293D

DESCRIPTION

The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoides, DC and stepping motors) and switching power transistors.

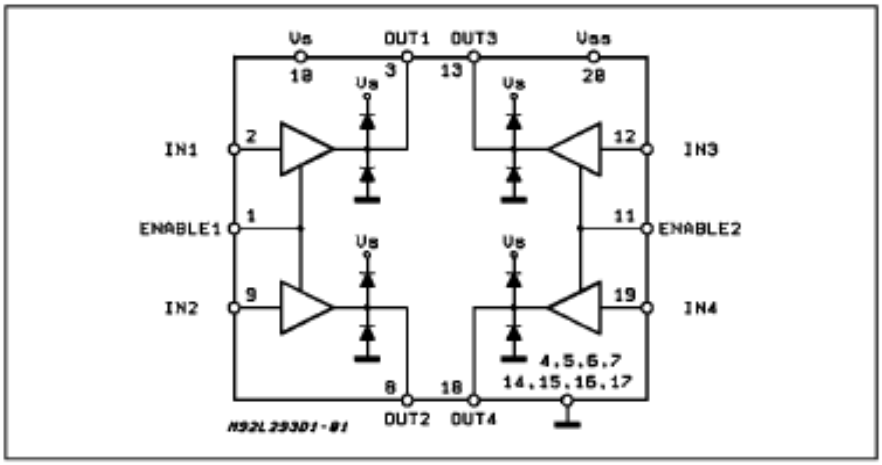
To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included.

This device is suitable for use in switching applications at frequencies up to 5 kHz.

The L293D is assembled in a 16 lead plastic packaage which has 4 center pins connected together and used for heatsinking

The L293DD is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heatsinking.

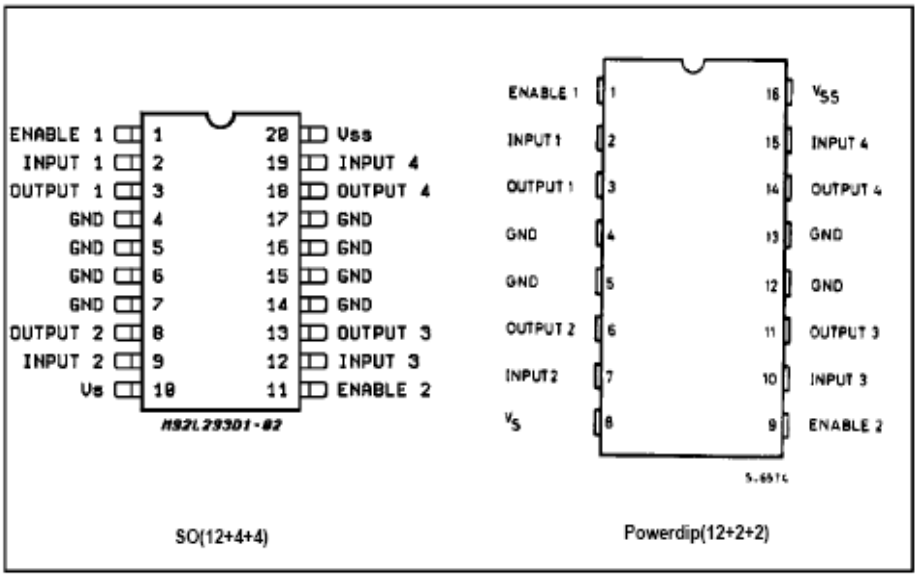
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	Supply Voltage	36	V
V_{SS}	Logic Supply Voltage	36	V
V_i	Input Voltage	7	V
V_{en}	Enable Voltage	7	V
I_o	Peak Output Current (100 µs non repetitive)	1.2	A
P_{tot}	Total Power Dissipation at T_{pins} = 90 °C	4	W
T_{stg}, T_j	Storage and Junction Temperature	– 40 to 150	°C

PIN CONNECTIONS (Top view)



SO(12+4+4) Powerdip(12+2+2)

THERMAL DATA

Symbol	Decription		DIP	SO	Unit
$R_{th\ j\text{-}pins}$	Thermal Resistance Junction-pins	max.	–	14	°C/W
$R_{th\ j\text{-}amb}$	Thermal Resistance junction-ambient	max.	80	50 (*)	°C/W
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case	max.	14	–	

(*) With 6sq. cm on board heatsink.

ELECTRICAL CHARACTERISTICS (for each channel, V_S = 24 V, V_{SS} = 5 V, T_{amb} = 25 °C, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_S	Supply Voltage (pin 10)		V_{SS}		36	V
V_{SS}	Logic Supply Voltage (pin 20)		4.5		36	V
I_S	Total Quiescent Supply Current (pin 10)	V_i = L ; I_O = 0 ; V_{en} = H		2	6	mA
		V_i = H ; I_O = 0 ; V_{en} = H		16	24	mA
		V_{en} = L			4	mA
I_{SS}	Total Quiescent Logic Supply Current (pin 20)	V_i = L ; I_O = 0 ; V_{en} = H		44	60	mA
		V_i = H ; I_O = 0 ; V_{en} = H		16	22	mA
		V_{en} = L		16	24	mA
V_{IL}	Input Low Voltage (pin 2, 9, 12, 19)		– 0.3		1.5	V
V_{IH}	Input High Voltage (pin 2, 9, 12, 19)	$V_{SS} \leq 7$ V	2.3		V_{SS}	V
		$V_{SS} > 7$ V	2.3		7	V
I_{IL}	Low Voltage Input Current (pin 2, 9, 12, 19)	V_{IL} = 1.5 V			– 10	µA
I_{IH}	High Voltage Input Current (pin 2, 9, 12, 19)	2.3 V ≤ V_{IH} ≤ V_{SS} – 0.6 V		30	100	µA
$V_{en\,L}$	Enable Low Voltage (pin 1, 11)		– 0.3		1.5	V
$V_{en\,H}$	Enable High Voltage (pin 1, 11)	$V_{SS} \leq 7$ V	2.3		V_{SS}	V
		$V_{SS} > 7$ V	2.3		7	V
$I_{en\,L}$	Low Voltage Enable Current (pin 1, 11)	$V_{en\,L}$ = 1.5 V		– 30	– 100	µA
$I_{en\,H}$	High Voltage Enable Current (pin 1, 11)	2.3 V ≤ $V_{en\,H}$ ≤ V_{SS} – 0.6 V			± 10	µA
$V_{CE(sat)H}$	Source Output Saturation Voltage (pins 3, 8, 13, 18)	I_O = – 0.6 A		1.4	1.8	V
$V_{CE(sat)L}$	Sink Output Saturation Voltage (pins 3, 8, 13, 18)	I_O = + 0.6 A		1.2	1.8	V
V_F	Clamp Diode Forward Voltage	I_O = 600nA		1.3		V
t_r	Rise Time (*)	0.1 to 0.9 V_O		250		ns
t_f	Fall Time (*)	0.9 to 0.1 V_O		250		ns
t_{on}	Turn-on Delay (*)	0.5 V_i to 0.5 V_O		750		ns
t_{off}	Turn-off Delay (*)	0.5 V_i to 0.5 V_O		200		ns

(*) See fig. 1.

TRUTH TABLE (one channel)

Input	Enable (*)	Output
H	H	H
L	H	L
H	L	Z
L	L	Z

Z = High output impedance
(*) Relative to the considered channel

Figure 1: Switching Times

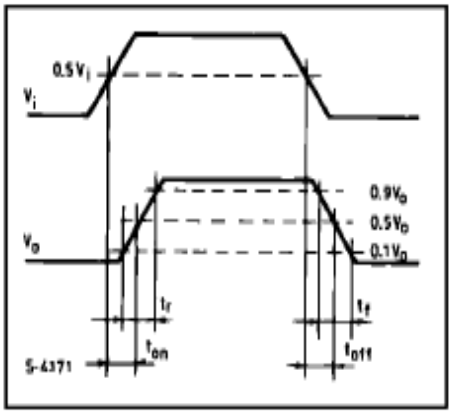
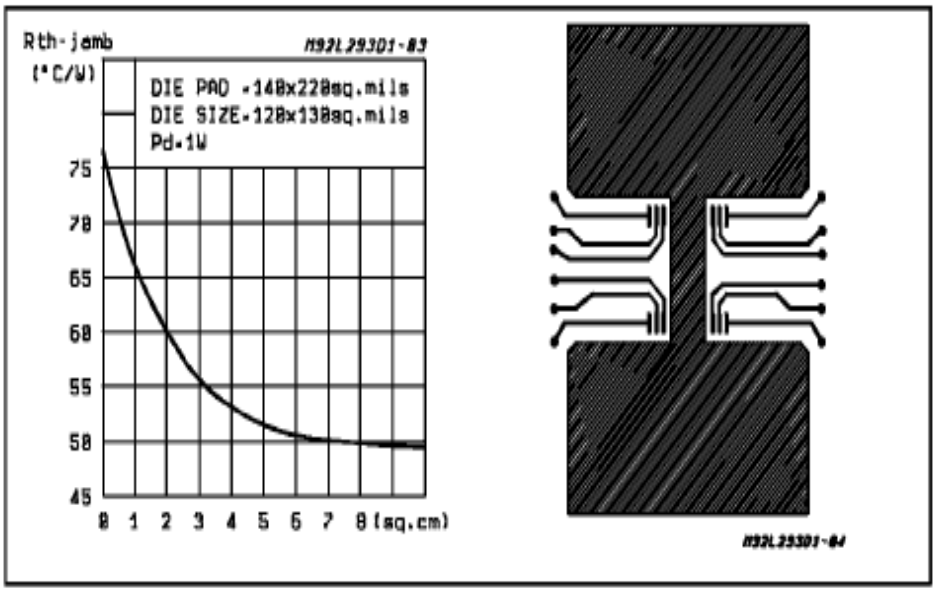
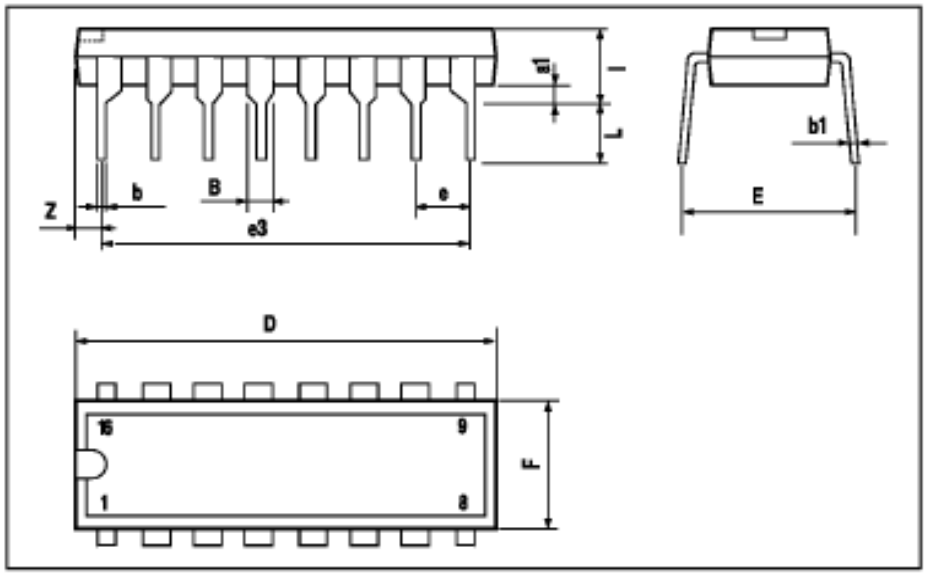


Figure 2: Junction to ambient thermal resistance vs. area on board heatsink (SO12+4+4 package)



POWERDIP16 PACKAGE MECHANICAL DATA

DIM.	mm			Inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.85		1.40	0.033		0.055
b		0.50			0.020	
b1	0.38		0.50	0.015		0.020
D			20.0			0.787
E		8.80			0.346	
e		2.54			0.100	
e3		17.78			0.700	
F			7.10			0.280
I			5.10			0.201
L		3.30			0.130	
Z			1.27			0.050



SO20 PACKAGE MECHANICAL DATA

DIM.	mm			Inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.013
C		0.5			0.020	
c1		45			1.772	
D		1	12.6		0.039	0.496
E	10		10.65	0.394		0.419
e		1.27			0.050	
e3		11.43			0.450	
F		1	7.4		0.039	0.291
G	8.8		9.15	0.346		0.360
L	0.5		1.27	0.020		0.050
M			0.75			0.030
S	8° (max.)