

## STEREO AUDIO AMPLIFIER

### 1 FEATURES

- DUAL OR BRIDGE CONNECTION MODES
- FEW EXTERNAL COMPONENTS
- SUPPLY VOLTAGE DOWN TO 3V
- HIGH CHANNEL SEPARATION
- VERY LOW SWITCH ON/OFF NOISE
- MAX GAIN OF 45dB WITH ADJUST EXTERNAL RESISTOR
- SOFT CLIPPING
- THERMAL PROTECTION
- $3V < V_{CC} < 15V$
- $P = 2 \cdot 1W, V_{CC} = 6V, R_L = 4\Omega$
- $P = 2 \cdot 2.3W, V_{CC} = 9V, R_L = 4\Omega$
- $P = 2 \cdot 0.1W, V_{CC} = 3V, R_L = 4\Omega$

Figure 1. Package

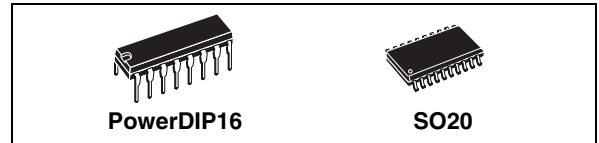


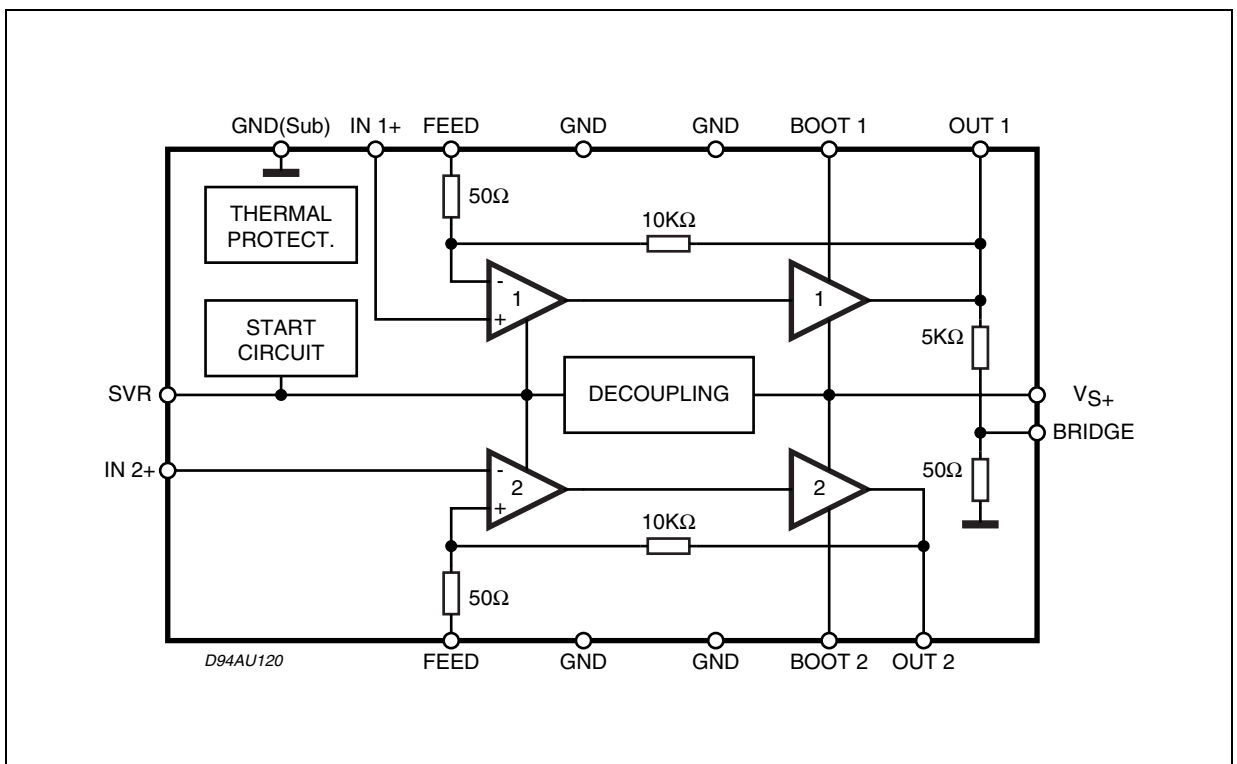
Table 1. Order Codes

Part Number	Package
TEA2025B	PowerDIP 12+2+2
TEA2025D	SO20 12+4+4
TEA2025D013TR	SO16 in Tape & Reel

### 2 DESCRIPTION

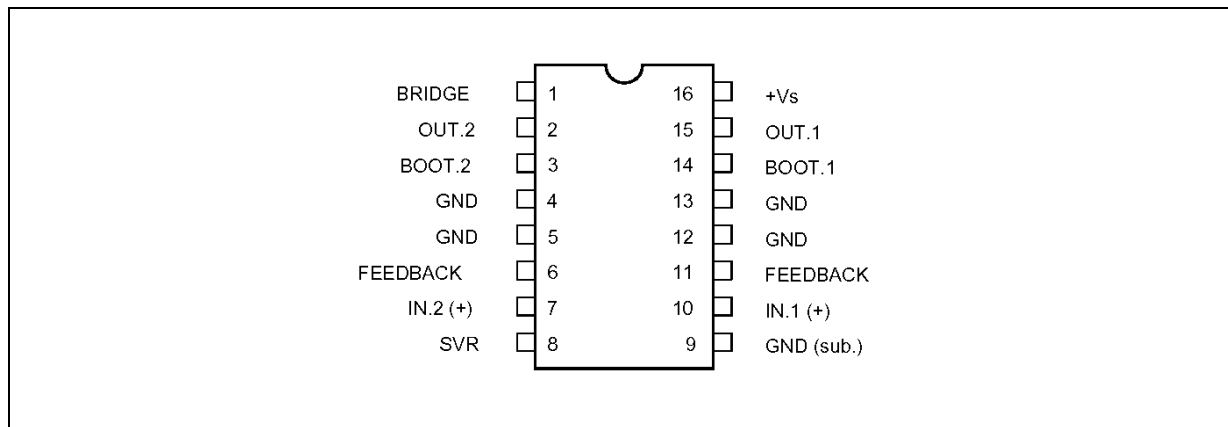
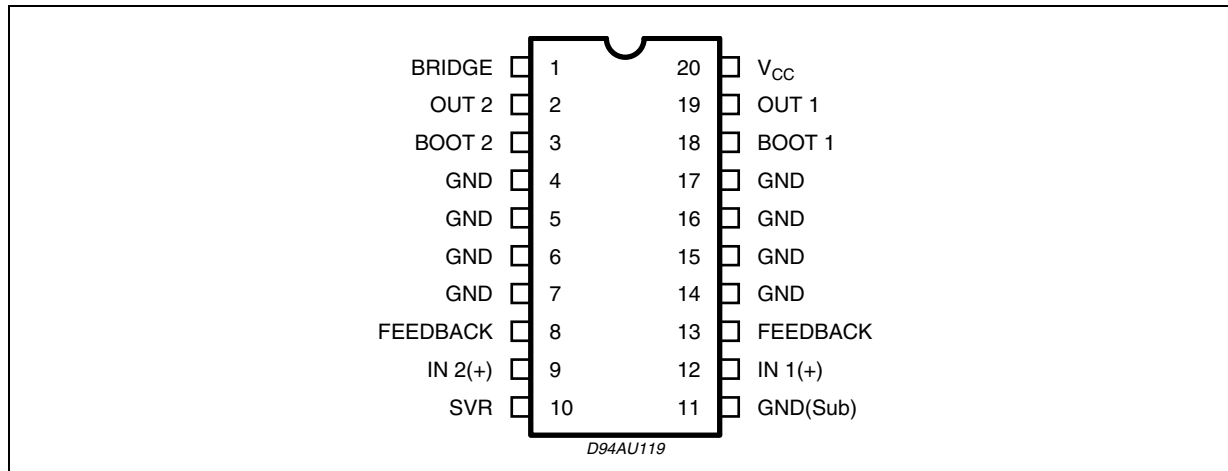
The TEA2025B/D is a monolithic integrated circuit in 12+2+2 Powerdip and 12+4+4 SO, intended for use as dual or bridge power audio amplifier portable radio cassette players.

Figure 2. Block Diagram



**Table 2. Absolute Maximum Ratings**

Symbol	Parameter	Value	Unit
V <sub>S</sub>	Supply Voltage	15	V
I <sub>O</sub>	Output Peak Current	1.5	A
T <sub>J</sub>	Junction Temperature	150	°C
T <sub>stg</sub>	Storage Temperature	150	°C

**Figure 3. PIN CONNECTION POWERDIP12+2+2****Figure 4. PIN CONNECTION SO12+4+4****Table 3. Thermal Data**

Symbol	Description		SO 12+4+4 <sup>(1)</sup>	PDIP 12+2+2 <sup>(2)</sup>	Unit
R <sub>th j-case</sub>	Thermal Resistance Junction-case	Max	15	15	°C/W
R <sub>th j-amb</sub>	Thermal Resistance Junction-ambient	Max	65	60	°C/W

Note: 1. The R<sub>th j-amb</sub> is measured with 4sq cm copper area heatsink

2. The R<sub>th j-amb</sub> is measured on devices bonded on a 10 x 5 x 0.15cm glass-epoxy substrate with a 35µm thick copper surface of 5 cm<sup>2</sup>

**Table 4. Electrical Characteristics** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{CC} = 9\text{V}$ , Stereo unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_S$	Supply Voltage		3		12	V	
$I_Q$	Quiescent Current			35	50	mA	
$V_O$	Quiescent Output Voltage			4.5		V	
$A_V$	Voltage Gain	Stereo	43	45	47	dB	
		Bridge	49	51	53	dB	
$\Delta A_V$	Voltage Gain Difference				$\pm 1$	dB	
$R_i$	Input Impedance			30		K $\Omega$	
$P_O$	Output Power (d = 10%)	Stereo 8 (per channel)	9V 4 $\Omega$	1.7	2.3		W
			9V 8 $\Omega$		1.3		W
			6V 4 $\Omega$	0.7	1		W
			6V 8 $\Omega$		0.6		W
			6V 16 $\Omega$		0.25		W
			6V 32 $\Omega$		0.13		W
			3V 4 $\Omega$		0.1		W
			3V 32 $\Omega$		0.02		W
		Bridge	12V 8 $\Omega$		2.4		W
			9V 8 $\Omega$		4.7		W
			6V 4 $\Omega$		2.8		W
			6V 8 $\Omega$		1.5		W
			3V 16 $\Omega$		0.18		W
			3V 32 $\Omega$		0.06		W
d	Distortion	$V_S = 9\text{V}$ ; $R_L = 4\Omega$		0.3 0.5	1.5	%	
SVR	Supply Voltage Rejection	$f = 100\text{Hz}$ , $V_R = 0.5\text{V}$ , $R_g = 0$	40	46		dB	
$E_{N(IN)}$	Input Noise Voltage	$R_G = 0$		1.5	3	mV	
		$R_G = 10\ 4\Omega$		3	6	mV	
CT	Cross-Talk	$f = 1\text{KHz}$ , $R_g = 10\text{K}\Omega$	40	52		dB	

**Table 5.**

Term. N° (PDIP)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DC VOLT (V)	0.04	4.5	8.9	0	0	0.6	0.04	8.5	0	0.04	0.6	0	0	8.9	4.5	9

Figure 5. Bridge Application (Powerdip)

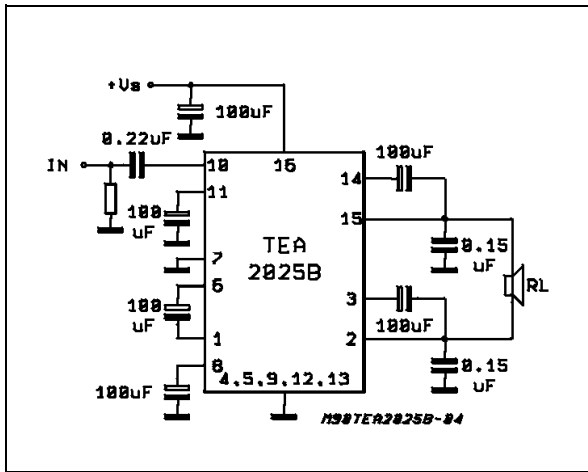


Figure 8. Output Voltage vs. Supply Voltage

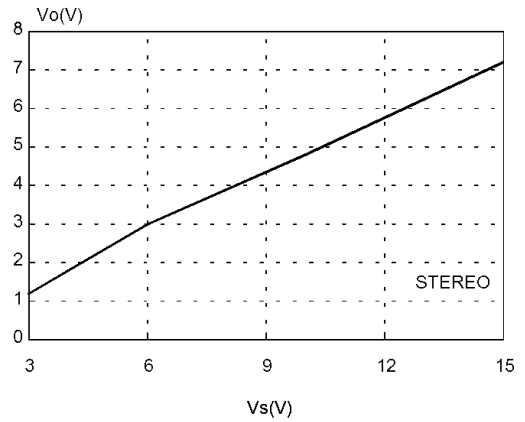


Figure 6. Stereo Application (Powerdip)

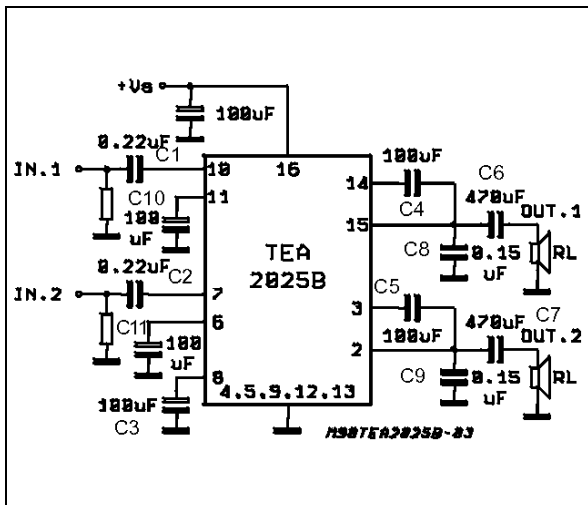


Figure 9. Output Power vs. Supply Voltage (THD = 10%, f = 1KHz)

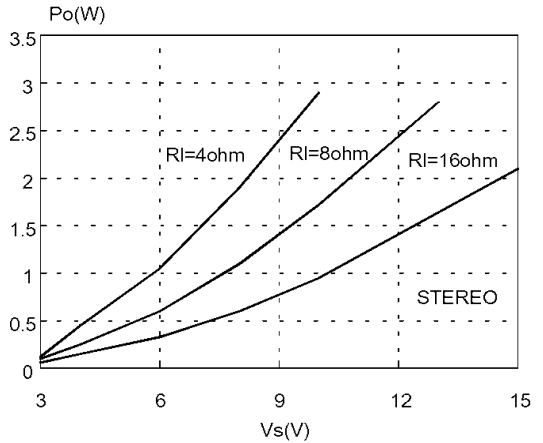


Figure 7. Supply Current vs. Supply Voltage (RL = 4Ω)

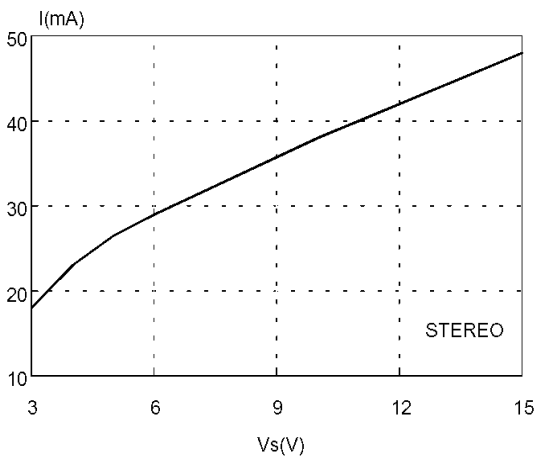
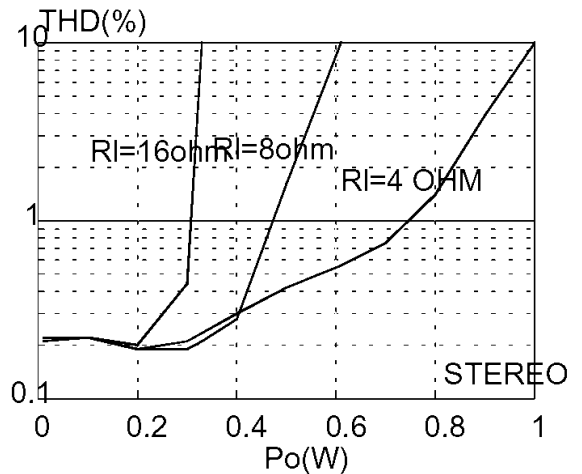


Figure 10. THD versus Output Power (f = 1KHz, VS = 6V)



### 3 APPLICATION INFORMATION

#### 3.1 Input Capacitor

Input capacitor is PNP type allowing source to be referenced to ground.

In this way no input coupling capacitor is required. However, a series capacitor (0.22  $\mu$ F) to the input side can be useful in case of noise due to variable resistor contact.

#### 3.2 Bootstrap

The bootstrap connection allows to increase the output swing.

The suggested value for the bootstrap capacitors (100 $\mu$ F) avoids a reduction of the output signal also at low frequencies and low supply voltages.

#### 3.3 Voltage Gain Adjust

##### 3.3.1 STEREO MODE

The voltage gain is determined by on-chip resistors R1 and R2 together with the external RfC1 series connected between pin 6 (11) and ground. The frequency response is given approximated

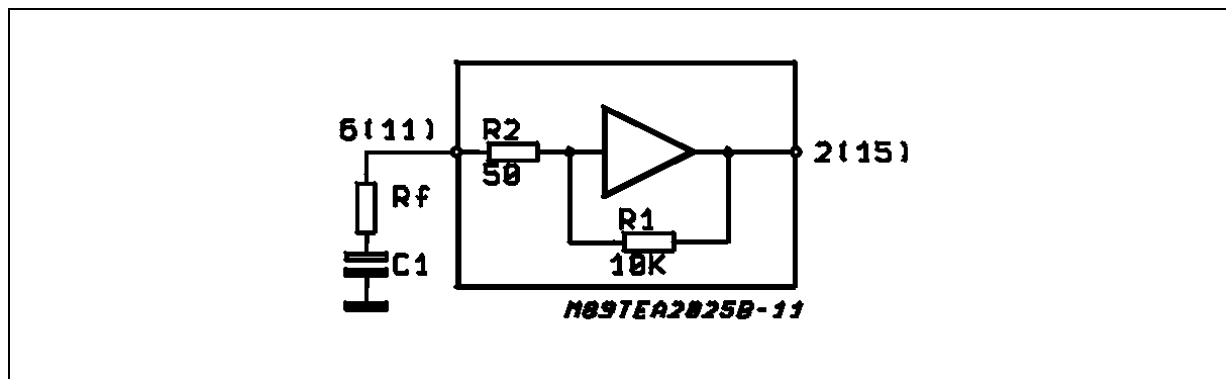
$$\frac{V_{OUT}}{V_{IN}} = \frac{R1}{Rf + R2 + \frac{1}{JWC1}}$$

With Rf=0, C1=100  $\mu$ F, the gain results 46 dB with pole at f=32 Hz.

THE purpose of Rf is to reduce the gain. It is recommended to not reduce it under 36 dB.

##### 3.3.2 BRIDGE MODE

Figure 11.



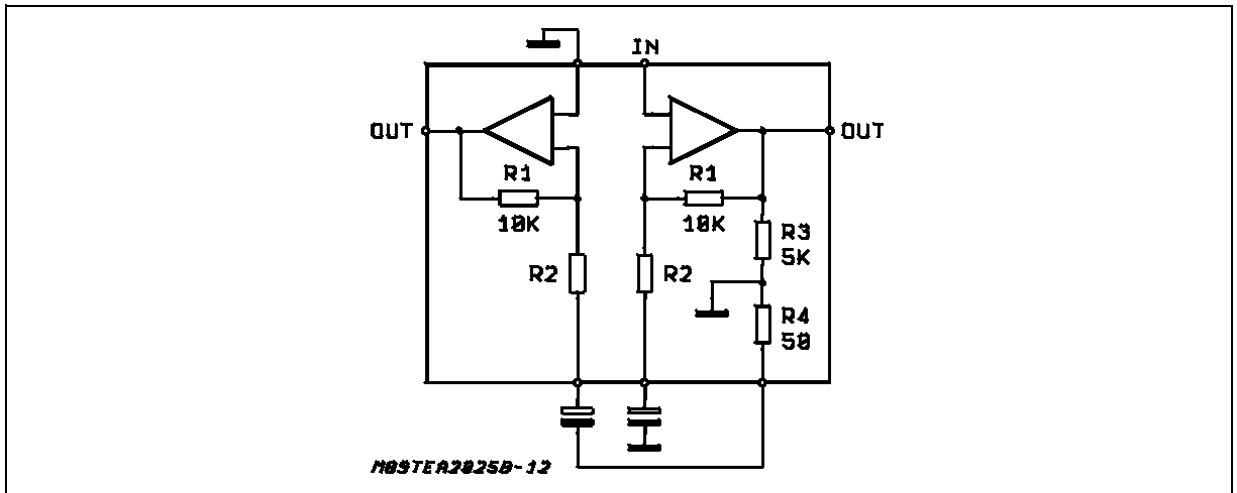
The bridge configuration is realized very easily thanks to an internal voltage divider which provides (at pin 1) the CH 1 output signal after reduction.

It is enough to connect pin 6 (inverting input of CH 2) with a capacitor to pin 1 and to connect to ground the pin 7. The total gain of the bridge is given by:

$$\frac{V_{OUT}}{V_{IN}} = \frac{R1}{Rf + R2 + \frac{1}{JWC1}} \left( 1 + \frac{R3}{R4} \frac{R1}{R2 + R4 + \frac{1}{JWC1}} \right)$$

and with the suggested values (C1 = C2 = 100  $\mu$ F, Rf= 0) means: Gv = 52 dB with first pole at f = 32 Hz

Figure 12.



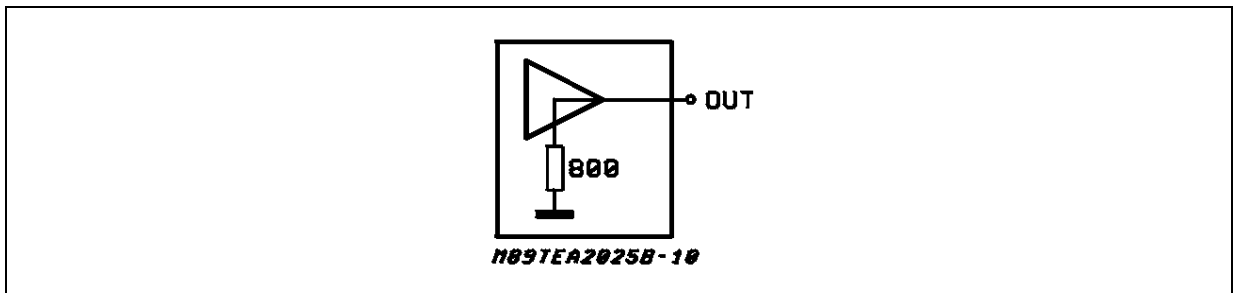
### 3.4 Output Capacitors.

The low cut off frequency due to output capacitor depending on the load is given by:  $F_L = \frac{1}{2\pi C_{OUT} \cdot R_L}$  with  $C_{OUT}$  470mF and  $R_L = 4$  ohm it means  $F_L = 80$  Hz.

### 3.5 Pop Noise

Most amplifiers similar to TEA 2025B need external resistors between DC outputs and ground in order to optimize the pop on/off performance and crossover distortion.

Figure 13.



The TEA 2025B solution allows to save components because of such resistors (800 ohm) are included into the chip.

### 3.6 Stability

A good layout is recommended in order to avoid oscillations.

Generally the designer must pay attention on the following points:

- Short wires of components and short connections.
- No ground loops.
- Bypass of supply voltage with capacitors as nearest as possible to the supply I.C.pin. The low value (poliester) capacitors must have good temperature and frequency characteristics.
- No sockets.

the heatsink can have a smaller factor of safety compared with that of a conventional circuit. There is no device damage in the case of excessive junction temperature: all that happens is that PO (and

therefore  $P_{tot}$ ) and  $I_d$  are reduced.

## 4 APPLICATION SUGGESTION

The recommended values of the components are those shown on stereo application circuit of Fig. 6 different values can be used, the following table can help the designer.

**Table 6.**

COMPONENT	RECOMMENDED VALUE	PURPOSE	LARGER THAN	SMALLER THAN
C1,C2	0.22 $\mu$ F	INPUT DC DECOUPLING IN CASE OF SLIDER CONTACT NOISE OF VARIABLE RESISTOR		
C3	100 $\mu$ F	RIPPLE REJECTON		DEGRADATION OF SVR, INCREASE OF AT LOW FREQUENCY AND LOW VOLTAGE
C4,C5	100 $\mu$ F	BOOTSTRAP		
C6,C7	470 $\mu$ F	OUTPUT DC DECOUPLING		INCREASE OF LOW FREQUENCY CUTOFF
C8,C9	0.15 $\mu$ F	FREQUENCY STABILITY		DANGEROF OSCILLATIONS
C10, C11	100 $\mu$ F	INVERTING INPUT DC DECOUPLING		INCREASE OFLOW FREQUENCYCUTOFF

## 5 PACKAGE MECHANICAL DATA

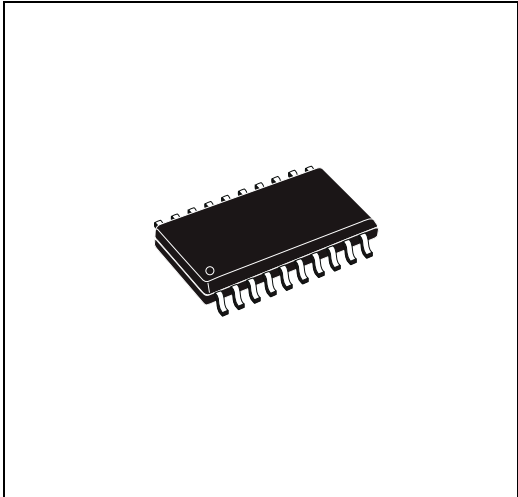
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Figure 14. SO20 Mechanical Data & Package Dimensions

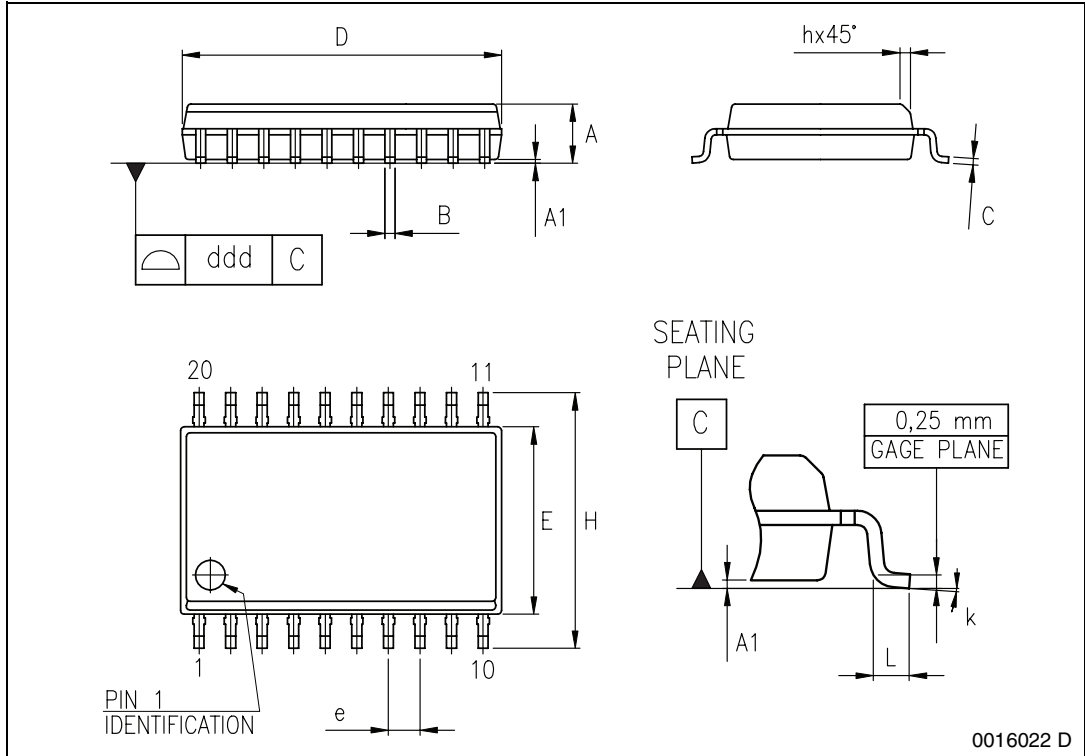
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.10		0.30	0.004		0.012
B	0.33		0.51	0.013		0.200
C	0.23		0.32	0.009		0.013
D (1)	12.60		13.00	0.496		0.512
E	7.40		7.60	0.291		0.299
e		1.27			0.050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.40		1.27	0.016		0.050
k	0° (min.), 8° (max.)					
ddd			0.10			0.004

(1) "D" dimension does not include mold flash, protusions or gate burrs. Mold flash, protusions or gate burrs shall not exceed 0.15mm per side.

**OUTLINE AND MECHANICAL DATA**



**SO20**



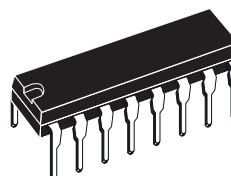
0016022 D



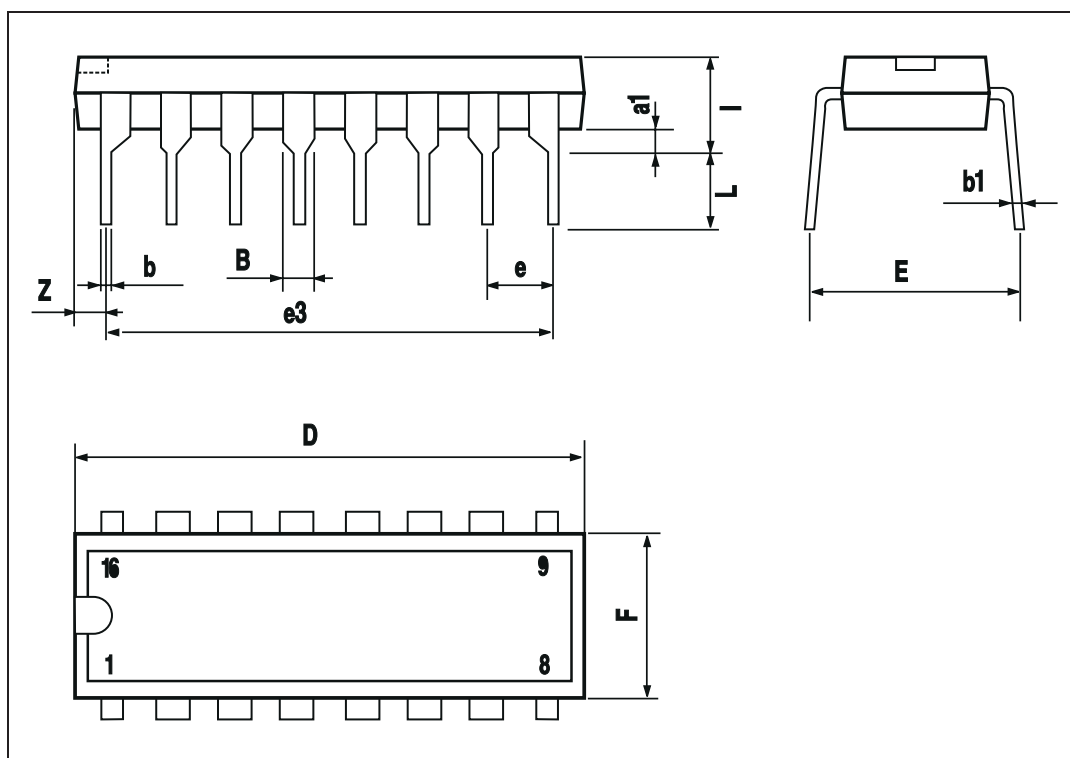
Figure 15. DIP16 Mechanical Data &amp; Package Dimensions

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

### OUTLINE AND MECHANICAL DATA



**DIP16**



## 6 REVISION HISTORY

**Table 7. Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
September 2003	2	Updates not recorded
30-Apr-2010	3	Updated title and added environmental compliance statement for package

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