

## FEATURES

- 10-Bit Resolution
- Non-Linearity: 1/2 LSB to 2 LSB
- Nonlinearity Tempco: 0.2 ppm of FSR/°C, Max.
- Low Power Dissipation: 20 mW
- Current Settling Time: 500 ns
- Feedthrough Error: 1 mV p-p @ 10 kHz, Max.
- TTL/CMOS Compatible
- Latch-Up Free
- Improved Replacement for AD7533

## BENEFITS

- Accurate Converter at Low Cost
- Can be used in Reverse Mode (Voltage Out)
- Flexible Design

## APPLICATIONS

- Digital/Analog Multiplication
- Character Generation
- Programmable Power Supplies
- Gain Controlled Circuits

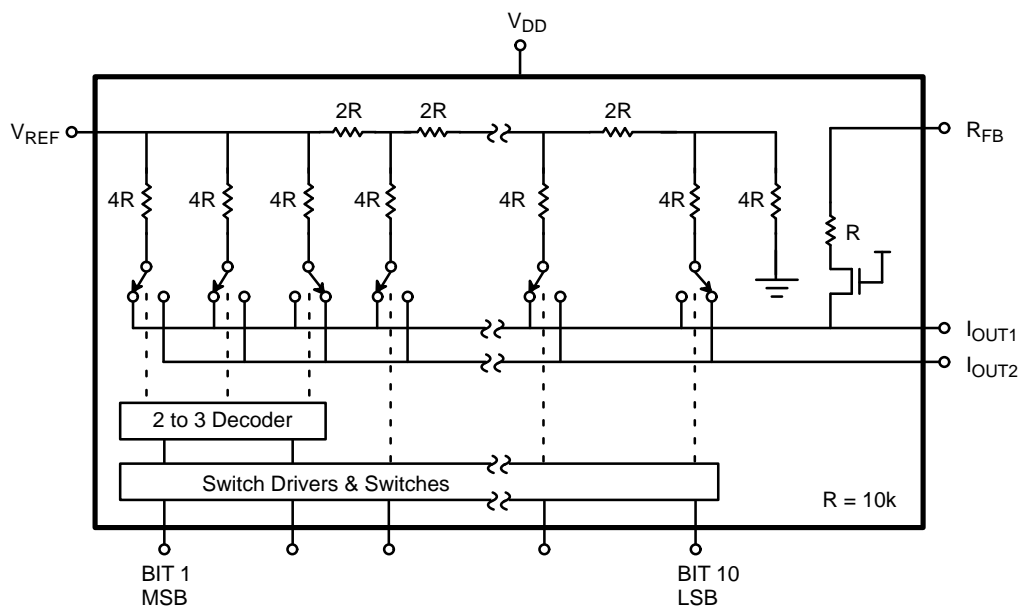
## GENERAL DESCRIPTION

The MP7533 is a low cost, 10-bit multiplying Digital-to-Analog Converter. This device uses EXAR's patented advanced thin film resistor and CMOS technologies, providing up to 10-bit accuracies with TTL/CMOS compatibility.

Pin and functional equivalent to the industry standard MP7520, the MP7533 is recommended as a lower cost alternative for old MP7520 sockets or new 10-bit DAC designs.

The MP7533 applications include: digital-to-analog multiplication, CRT character generation, programmable power supplies, digitally controlled gain circuits, etc.

## SIMPLIFIED BLOCK DIAGRAM



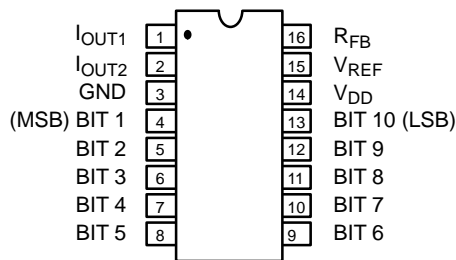
**3 Segment D/A Converter with Termination to DGND**  
Logical "1" at Digital Input Steers Current to I<sub>OUT1</sub>

## ORDERING INFORMATION

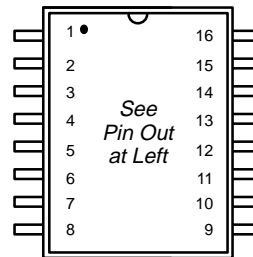
Package Type	Temperature Range	Part No.	INL (LSB)	DNL (LSB)	Gain Error (% FSR)
Plastic Dip	-40 to +85°C	MP7533JN	±2	±1	1.5
Plastic Dip	-40 to +85°C	MP7533KN	±1	±1	1.5
Plastic Dip	-40 to +85°C	MP7533LN	+1/2	±1	1.5
SOIC	-40 to +85°C	MP7533JS	±2	±1	1.5
SOIC	-40 to +85°C	MP7533KS	±1	±1	1.5
SOIC	-40 to +85°C	MP7533LS	+1/2	±1	1.5
Ceramic Dip	-40 to +85°C	MP7533AD	±2	±1	1.5
Ceramic Dip	-40 to +85°C	MP7533BD	±1	±1	1.5
Ceramic Dip	-40 to +85°C	MP7533CD	+1/2	±1	1.5
Ceramic Dip	-55 to +125°C	MP7533SD*	±2	±1	1.5
Ceramic Dip	-55 to +125°C	MP7533TD*	±1	±1	1.5
Ceramic Dip	-55 to +125°C	MP7533UD*	±1/2	±1	1.5

\*Contact factory for non-compliant military processing

## PIN CONFIGURATIONS *See Packaging Section for Package Dimensions*



**16 Pin CDIP, PDIP (0.300")  
D16, N16**



**16 Pin SOIC (Jedec, 0.300")  
S16**

## PIN OUT DEFINITIONS

PIN NO.	NAME	DESCRIPTION
1	I <sub>OUT1</sub>	Current Output 1
2	I <sub>OUT2</sub>	Current Output 2
3	GND	Ground
4	BIT 1	Data Input Bit 1 (MSB)
5	BIT 2	Data Input Bit 2
6	BIT 3	Data Input Bit 3
7	BIT 4	Data Input Bit 4
8	BIT 5	Data Input Bit 5

PIN NO.	NAME	DESCRIPTION
9	BIT 6	Data Input Bit 6
10	BIT 7	Data Input Bit 7
11	BIT 8	Data Input Bit 8
12	BIT 9	Data Input Bit 9
13	BIT 10	Data Input Bit 10 (LSB)
14	V <sub>DD</sub>	Positive Power Supply
15	V <sub>REF</sub>	Reference Input Voltage
16	R <sub>FB</sub>	Internal Feedback Resistor

## ELECTRICAL CHARACTERISTICS

( $V_{DD} = +15\text{ V}$ ,  $V_{REF} = +10\text{ V}$  unless otherwise noted)

Parameter	Symbol	25°C			Tmin to Tmax		Units	Test Conditions/Comments
		Min	Typ	Max	Min	Max		
<b>STATIC PERFORMANCE<sup>1</sup></b>								
Resolution (All Grades)	N	10			10		Bits	FSR = Full Scale Range  Best Fit Straight Line Spec. (Max INL – Min INL) / 2
Integral Non-Linearity (Relative Accuracy)	INL						LSB	
A, S, J				±2			±2	
B, T, K				±1			±1	
C, U, L				±1/2			±1/2	
Differential Non-Linearity	DNL						LSB	
A, S, J				±1			±1	
B, T, K				±1			±1	
C, U, L				±1			±1	
Gain Error	GE		±0.4	±1.5		±1.5	% FSR	
Gain Temperature Coefficient <sup>2</sup>	$TC_{GE}$					±2	ppm/°C	$\Delta\text{Gain}/\Delta\text{Temperature}$
Power Supply Rejection Ratio	PSRR		±30	±50		±50	ppm/%	$ \Delta\text{Gain}/\Delta V_{DD}  \Delta V_{DD} = \pm 5\%$
Output Leakage Current	$I_{OUT}$			±50		±200	nA	
<b>REFERENCE INPUT</b>								
Input Resistance	$R_{IN}$	5	10	20	5	20	kΩ	
<b>DIGITAL INPUTS<sup>3</sup></b>								
Logical "1" Voltage	$V_{IH}$	3.0	2.4		3.0		V	
Logical "0" Voltage	$V_{IL}$			0.8		0.8	V	
Input Leakage Current	$I_{LKG}$			±1		±1	μA	
<b>ANALOG OUTPUTS</b>								
Output Capacitance <sup>2</sup>	$C_{OUT1}$			52			pF	DAC Inputs all 1's DAC Inputs all 0's DAC Inputs all 1's DAC Inputs all 0's
	$C_{OUT1}$			26			pF	
	$C_{OUT2}$			13			pF	
	$C_{OUT2}$			45			pF	
<b>POWER SUPPLY<sup>4</sup></b>								
Functional Voltage Range <sup>2</sup>	$V_{DD}$	4.5		15	4.5	15	V	All digital inputs = 0 or all = 5 V
Supply Current	$I_{DD}$			2		2	mA	
Total Dissipation			20				mW	

### NOTES:

- 1 Full Scale Range (FSR) is 10V for unipolar mode.
- 2 Guaranteed but not production tested
- 3 Digital Input levels should not go below ground or exceed the positive supply voltage, otherwise damage may occur.
- 4 Specified values guarantee functionality. Refer to other parameters for accuracy.

Specifications are subject to change without notice

## ABSOLUTE MAXIMUM RATINGS (TA = +25°C unless otherwise noted)<sup>1, 2</sup>

V <sub>DD</sub> to GND	+17 V	Storage Temperature	-65°C to +150°C
Digital Input Voltage to GND	GND -0.5 to V <sub>DD</sub> +0.5 V	Lead Temperature (Soldering, 10 seconds)	+300°C
I <sub>OUT1</sub> , I <sub>OUT2</sub> to GND	-0.5 to V <sub>DD</sub> +0.5 V	Package Power Dissipation Rating to 75°C	
V <sub>REF</sub> to GND	+25 V	CDIP, PDIP, SOIC, PLCC	700mW
V <sub>RFB</sub> to GND	+25 V	Derates above 75°C	10mW/°C

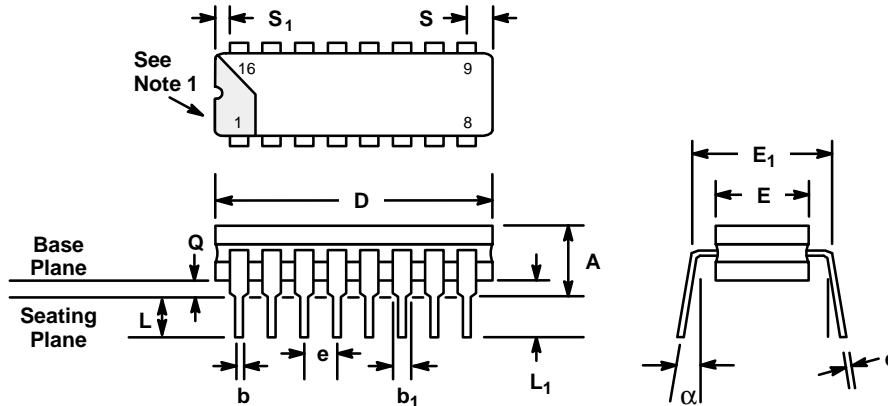
### NOTES:

- <sup>1</sup> Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation at or above this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.
- <sup>2</sup> Any input pin which can see a value outside the absolute maximum ratings should be protected by Schottky diode clamps (HP5082-2835) from input pin to the supplies. *All inputs have protection diodes* which will protect the device from short transients outside the supplies of less than 20mA for less than 100µs.

### APPLICATION NOTES

*Refer to Section 8 for Applications Information*

**16 LEAD CERAMIC DUAL-IN-LINE  
(300 MIL CDIP)  
D16**

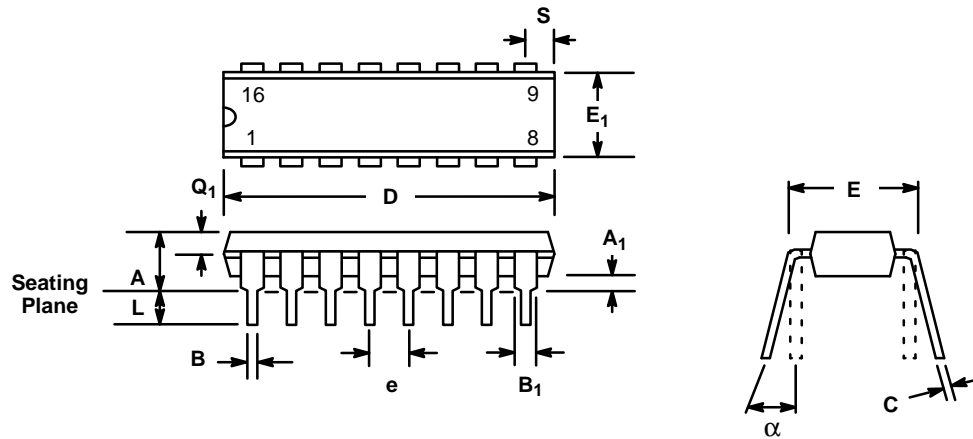


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	—	0.200	—	5.08	—
b	0.014	0.023	0.356	0.584	—
b <sub>1</sub>	0.038	0.065	0.965	1.65	2
c	0.008	0.015	0.203	0.381	—
D	—	0.840	—	21.34	4
E	0.220	0.310	5.59	7.87	4
E <sub>1</sub>	0.290	0.320	7.37	8.13	7
e	0.100 BSC		2.54 BSC		5
L	0.125	0.200	3.18	5.08	—
L <sub>1</sub>	0.150	—	3.81	—	—
Q	0.015	0.060	0.381	1.52	3
S	—	0.080	—	2.03	6
S <sub>1</sub>	0.005	—	0.13	—	6
α	0°	15°	0°	15°	—

**NOTES**

1. Index area; a notch or a lead one identification mark is located adjacent to lead one and is within the shaded area shown.
2. The minimum limit for dimension b<sub>1</sub> may be 0.023 (0.58 mm) for all four corner leads only.
3. Dimension Q shall be measured from the seating plane to the base plane.
4. This dimension allows for off-center lid, meniscus and glass overrun.
5. The basic lead spacing is 0.100 inch (2.54 mm) between centerlines.
6. Applies to all four corners.
7. This is measured to outside of lead, not center.

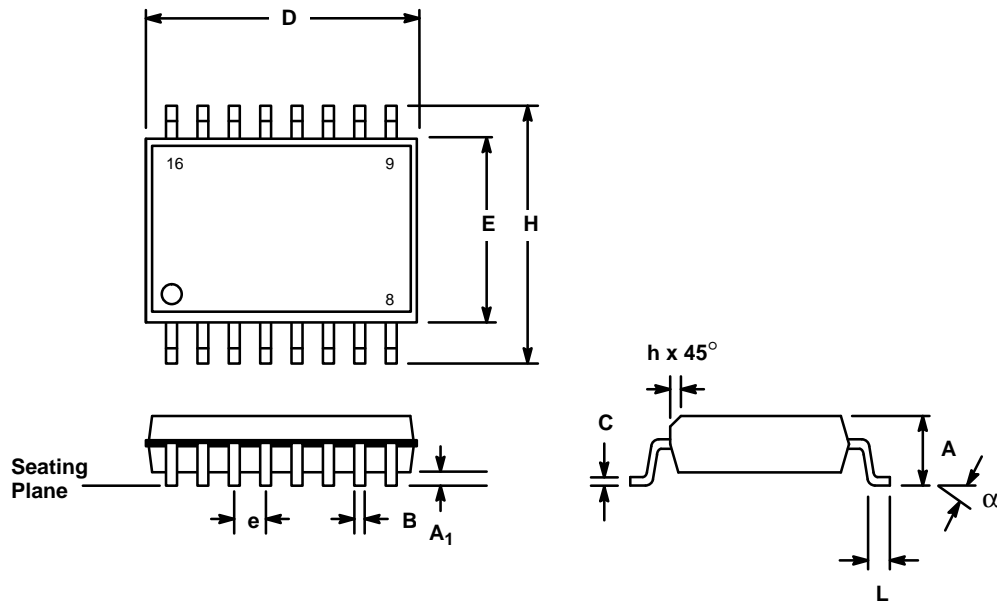
## 16 LEAD PLASTIC DUAL-IN-LINE (300 MIL PDIP) N16



SYMBOL	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	—	0.200	—	5.08
A <sub>1</sub>	0.015	—	0.38	—
B	0.014	0.023	0.356	0.584
B <sub>1</sub> (1)	0.038	0.065	0.965	1.65
C	0.008	0.015	0.203	0.381
D	0.745	0.785	18.92	19.94
E	0.295	0.325	7.49	8.26
E <sub>1</sub>	0.220	0.310	5.59	7.87
e	0.100 BSC		2.54 BSC	
L	0.115	0.150	2.92	3.81
α	0°	15°	0°	15°
Q <sub>1</sub>	0.055	0.070	1.40	1.78
S	0.020	0.080	0.51	2.03

Note: (1) The minimum limit for dimensions B<sub>1</sub> may be 0.023" (0.58 mm) for all four corner leads only.

**16 LEAD SMALL OUTLINE  
(300 MIL JEDEC SOIC)  
S16**



SYMBOL	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.097	0.104	2.46	2.64
A <sub>1</sub>	0.0050	0.0115	0.127	0.292
B	0.014	0.019	0.356	0.482
C	0.0091	0.0125	0.231	0.318
D	0.402	0.412	10.21	10.46
E	0.292	0.299	7.42	7.59
e	0.050 BSC		1.27 BSC	
H	0.400	0.410	10.16	10.41
h	0.010	0.016	0.254	0.406
L	0.016	0.035	0.406	0.889
α	0°	8°	0°	8°

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