Micro Power Systems

MP7541

CMOS
Multiplying 12-Bit
Digital-to-Analog Converter

FEATURES

- **Full Four Quadrant Multiplication**
- **12-Bit Linearity**
- **Guaranteed Monotonic; All Grades; All Temperatures.**
- **TTL/CMOS Compatible**
- **Stable, More Accurate Decoded Architecture**
  - **2.0 ppm/°C Typ. Gain Error Tempco**
  - **0.2 ppm/°C Max. Linearity Tempco**
  - **Lowest Sensitivity to Output Amplifier Offset**
- **Latch-Up Free**
- **PDIP, CDIP, SOIC Packages Available**
- **Use MP7541B for New Designs**

APPLICATIONS

- **Industrial Automation**
- **Automatic Test Equipment**
- **Disk Drive Servo Systems**
- **Digital/Synchro Conversion**
- **Programmable Gain Amplifiers**
- **Ratiometric A/D Conversion**
- **Function Generation**
- **Digitally Controlled Filters**

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GENERAL DESCRIPTION

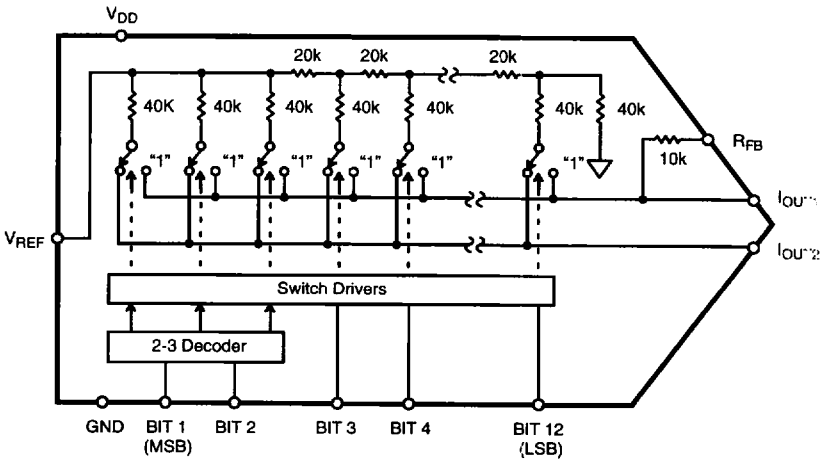
The MP7541 is a 12-Bit Digital-to-Analog Converter which is manufactured using Micro Power Systems patented advanced thin film resistor and double metal CMOS process. The MP7541 incorporates a bit decoding technique yielding lower glitch, higher speed and excellent accuracy over temperature and time. The MP7541's outstanding features are:

Stability: Both Integral-Non-Linearity and Differential-Non-Linearity are rated at 0.2 ppm/°C maximum. Monotonicity is guaranteed over the entire temperature range. Gain Temperature Coefficient (TCGE) is 2.0 ppm/°C typical.

Lower Sensitivity to Output Amplifier Offset: Multiplying DACs provide an output current into a virtual ground of the output op amp. Additional linearity error caused by the op amp is reduced by a factor of 2 in the MP7541 versus conventional R-2R DACs.

Specified for operation over the commercial / industrial (–40 to +85°C) and military (–55 to +125°C) temperature ranges, the MP7541 is available in Plastic (PDIP) and Ceramic (CDIP) dual-in-line and Surface Mount (SOIC) packages.

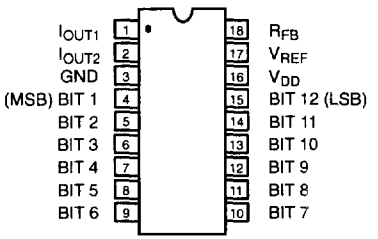
SIMPLIFIED BLOCK DIAGRAM



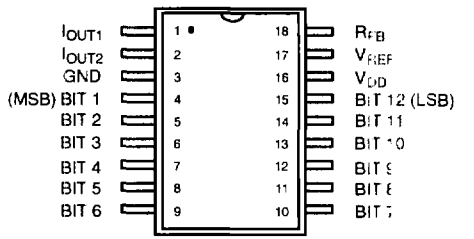
ORDERING INFORMATION

Package Type	Temperature Range	Part No.	INL (LSB)	DNL (LSB)	Gain Error (% FSR)
Plastic Dip	–40 to +85°C	MP7541JN	±1	±1	±0.4
Plastic Dip	–40 to +85°C	MP7541KN	±1/2	±1	±0.4
SOIC	–40 to +85°C	MP7541JS	±1	±1	±0.4
SOIC	–40 to +85°C	MP7541KS	±1/2	±1	±0.4
Ceramic Dip	–40 to +85°C	MP7541AD	±1	±1	±0.4
Ceramic Dip	–40 to +85°C	MP7541BD	±1/2	±1	±0.4
Ceramic Dip	–55 to +125°C	MP7541SD	±1	±1	±0.4
Ceramic Dip	–55 to +125°C	MP7541SD/883	±1	±1	±0.4
Ceramic Dip	–55 to +125°C	MP7541TD	±1/2	±1	±0.4
Ceramic Dip	–55 to +125°C	MP7541TD/883	±1/2	±1	±0.4

PIN CONFIGURATIONS



18 Pin PDIP, CDIP (0.300")
N18, D18



18 Pin SOIC (Jedec, 0.300")
S18

PIN OUT DEFINITIONS

PIN NO.	NAME	DESCRIPTION
1	I_{OUT1}	Current Output 1
2	I_{OUT2}	Current Output 2
3	GND	Ground
4	BIT1	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
9	BIT 6	Data Input Bit 6

PIN NO.	NAME	DESCRIPTION
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
14	BIT 11	Data Input Bit 11
15	BIT 12	Data Input Bit 12 (LSB)
16	V_{DD}	Positive Power Supply
17	V_{REF}	Reference Input Voltage
18	R_{FB}	Internal Feedback Resistor

ELECTRICAL CHARACTERISTICS

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

Parameter	Symbol	25°C Min	25°C Typ	25°C Max	Tmin to Tmax Min	Tmin to Tmax Max	Units	Test Conditions/Comments
STATIC PERFORMANCE (1)								FSR = Full Scale Range
Resolution (All Grades)	N	12			12		Bits	
Integral Non-Linearity (Relative Accuracy)	INL						LSB	Best Fit Straight Line Spec. (Max INL – Min INL) / 2
J, A, S				±1		±1		
K, B, T				±1/2		±1/2		
Differential Non-Linearity	DNL						LSB	All grades monotonic over full temperature range
J, A, S				±1		±1		
K, B, T				±1		±1		
Non-Linearity Tempco (2)						±0.2	ppm/°C	
Gain Error	GE			±0.4		±0.4	% FSR	Using Internal R_{FB}
Gain Temperature Coefficient (2)	TC_{GE}					±2	ppm/°C	ΔGain/ΔTemperature
Power Supply Rejection Ratio	PSRR			±100		±200	ppm/%	$\lvert\Delta Gain/\Delta V_{DD}\rvert$ ΔV_{DD} = ± 5%
Output Leakage Current	I_{OUT}			±50		±200	nA	
DYNAMIC PERFORMANCE (2)								R_L=100Ω, C_L=13pF
Current Settling Time	t_S		0.5	1			µs	Full Scale Change to 1/2 LSB
AC Feedthrough at I_{OUT1}	F_T			1			mV p-p	V_{REF} = 10kHz, 20 V p-p sinewave
REFERENCE INPUT								
Input Resistance	R_{IN}	5		20	5	20	kΩ	
DIGITAL INPUTS (3)								
Logical "1" Voltage	V_{IH}	2.4			2.4		V	
Logical "0" Voltage	V_{IL}			0.8		0.8	V	
Input Leakage Current	I_{LKG}			±1		±1	µA	
Input Capacitance (2)								
Data	C_{IN}			8			pF	
ANALOG OUTPUTS								
Output Capacitance (2)								
	C_{OUT1}			52			pF	DAC Inputs all 1's
	C_{OUT1}			26			pF	DAC Inputs all 0's
	C_{OUT2}			13			pF	DAC Inputs all 1's
	C_{OUT2}			45			pF	DAC Inputs all 0's
POWER SUPPLY (4)								
Functional Voltage Range (2)	V_{DD}	4.5		16	4.5	16	V	
Supply Current	I_{DD}			2		2	mA	All digital inputs = 0 V or all = V_{DD}

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

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ABSOLUTE MAXIMUM RATINGS (1, 2) (T_A = +25°C unless otherwise noted)

V_{DD} to GND ..... +17 V
Digital Input Voltage to GND .... GND –0.5 to V_{DD} +0.5 V
I_{OUT1}, I_{OUT2} to GND ..... GND –0.5 to V_{DD} +0.5 V
V_{REF} to GND ..... ±25 V
V_{RFB} to GND ..... ±25 V

Storage Temperature ..... –65°C to +150°C
Lead Temperature (Soldering, 10 seconds) ..... +300°C
Package Power Dissipation Rating to 75°C
CDIP, PDIP, SOIC 850mW
Derates above 75°C ..... 11mW/°C

NOTES:
(1) 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.
(2) 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