PM-7528

DUAL 8-BIT BUFFERED MULTIPLYING CMOS D/A CONVERTER

Precision Monolithics Inc.

FEATURES

- On-Chip Latches For Both DACs
- +5V To +15V Single Supply Operation
- DACs Matched To 1%
- Four-Quadrant Multiplication
- TTL/CMOS Compatible
- 8-Bit Endpoint Linearity (±1/2 LSB)
- Full Temperature Operation
- Low Power Consumption
- Microprocessor Compatible
- Improved ESD Resistance
- Automatically Insertable Cerdip and Plastic Packages
- Available In Surface Mount SO, PLCC and LCC Packages

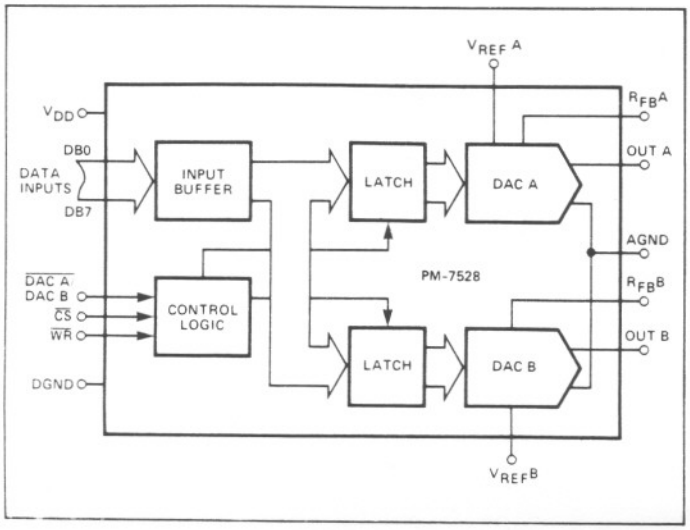
APPLICATIONS

- Digital Gain/Attenuation Control
- Digital Control Of Filter Parameters
- Digitally-Controlled Audio Circuits
- X-Y Graphics
- Digital/Synchro Conversion
- Robotics
- Ideal For Battery-Operated Equipment

CROSS REFERENCE

PMI	ADI	TEMPERATURE RANGE
PM7528AR	AD7528UD	MILITARY
PM7528BR	AD7528TD	
PM7528BR	AD7528SD	
PM7528ER	AD7528CQ	INDUSTRIAL
PM7528FR	AD7528BQ	
PM7528FR	AD7528AQ	
PM7528GP	AD7528LN	COMMERCIAL
PM7528HP	AD7528KN	
PM7528HP	AD7528JN	
PM7528HPC	AD7528KP	
PM7528HPC	AD7528JP	

FUNCTIONAL DIAGRAM



ORDERING INFORMATION†

RELATIVE ACCURACY	GAIN ERROR	PACKAGE: 20-PIN MILITARY* TEMPERATURE −55°C TO +125°C	INDUSTRIAL TEMPERATURE −25°C TO +85°C	COMMERCIAL TEMPERATURE 0°C TO +70°C
±1/2 LSB	±1 LSB	PM7528AR	PM7528ER	PM7528GP
±1/2 LSB	±1 LSB	PM7528ARC/883	—	—
±1/2 LSB	±2 LSB	PM7528BR	PM7528FR	PM7528HP
±1/2 LSB	±2 LSB	PM7528BRC/883	—	PM7528HPC††
±1/2 LSB	±2 LSB	—	—	PM7528HS††

* For devices processed in total compliance to MIL-STD-883, add /883 after part number. Consult factory for 883 data sheet.

† Burn-in is available on commercial and industrial temperature range parts in cerdip, plastic dip, and TO-can packages. For ordering information, see 1988 Data Book, Section 2.

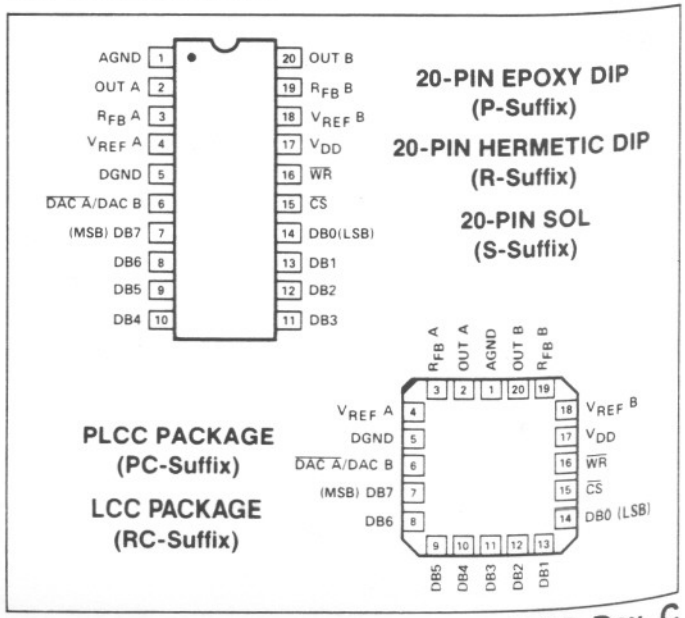
†† For availability and burn-in information on SO and PLCC packages, contact your local sales office.

GENERAL DESCRIPTION

The PM-7528 contains two 8-bit multiplying digital-to-analog converters. Excellent DAC-to-DAC matching and tracking results from monolithic construction. The PM-7528 consists of two thin-film R-2R resistor-ladder networks, tracking span resistors, two data latches, one input buffer, and control logic. Operation from a 5 to 15 volt single power supply dissipates only 20mW of power in a space saving 20-pin 0.3" wide DIP. The PM-7528 features circuitry designed to protect against damage from electrostatic discharges.

Digital input data is directed into one of the DAC data latches determined by the DAC selection control line $\overline{\text{DAC A}}$/DAC B. The 8-bit wide input data path provides TTL/CMOS compatibility. The data load cycle is similar to the write cycle of a random access memory. The PM-7528 is bus compatible with most 8-bit microprocessors, including the 6800, 8080, 8085, and Z80.

PIN CONNECTIONS



8/87, Rev. C

ABSOLUTE MAXIMUM RATINGS

(T_A = +25°C, unless otherwise noted.)

V_{DD} to AGND ..... 0V, +17V
V_{DD} to DGND ..... 0V, +17V
AGND to DGND ..... 0V, V_{DD}
Digital Input Voltage to DGND ..... −0.3V, +15V
$V_{PIN\ 2}$, $V_{PIN\ 20}$ to AGND ..... −0.3V, +15V
V_{REF} A, V_{REF} B to AGND ..... ±25V
V_{RFB} A, V_{RFB} B to AGND ..... ±25V
Power Dissipation (Any Package) to +75°C 450mW
Derate Above +75°C by ..... 6mW/°C
Operating Temperature Range
AR, ARC, BR, BRC Versions ..... −55°C to +125°C
ER, FR Versions ..... −25°C to +85°C
GP, HP, HPC, HS Versions ..... 0°C to +70°C

Dice Junction Temperature ..... +150°C
Storage Temperature ..... −65°C to +150°C
Lead Temperature (Soldering, 60 sec) ..... +300°C

CAUTION:

1. Do not apply voltages higher than V_{DD} or less than GND potential on any terminal except V_{REF}.
2. The digital control inputs are zener-protected; however, permanent damage may occur on unprotected units from high-energy electrostatic fields. Keep units in conductive foam at all times until ready to use.
3. Do not insert this device into powered sockets; remove power before insertion or removal.
4. Use proper anti-static handling procedures.
5. Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

ELECTRICAL CHARACTERISTICS at V_{DD} = +5V or +15V, V_{REF} A = V_{REF} B = +10V, OUT A = OUT B = 0V; T_A = −55°C to +125°C apply for PM-7528AR/ARC/BR/BRC; T_A = −25°C to +85°C apply for PM-7528ER/FR; T_A = 0°C to +70°C apply for PM-7528GP/HP/HPC/HS, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS		PM-7528 MIN	PM-7528 TYP	PM-7528 MAX	UNITS
STATIC ACCURACY (Note 1)							
Resolution	N			8	—	—	Bits
Relative Accuracy (Note 2)	NL			—	—	±1/2	LSB
Differential Nonlinearity (Note 3)	DNL			—	—	±1	LSB
Full Scale Gain Error (Note 4)	G_{FSE}	T_A = +25°C	PM7528A/E/G	—	—	±1	LSB
			PM7528B/F/H	—	—	±2	
		V_{DD} = +5V, T_A = Full Temp. Range	PM7528A/E/G	—	—	±3	
			PM7528B/F/H	—	—	±4	
		V_{DD} = +15V, T_A = Full Temp. Range	PM7528A/E/G	—	—	±1	
			PM7528B/F/H	—	—	±3	
Gain Temperature Coefficient (ΔGain/ΔTemperature) (Notes 4, 10)	TCG_{FS}	V_{DD} = +5V		—	—	±0.007	%/°C
		V_{DD} = +15V		—	—	+0.0035	
Output Leakage Current Out A (Pin 2)/Out B (Pin 20) (Note 5)	I_{LKG}	T_A = +25°C		—	5	±50	nA
		V_{DD} = +5V, T_A = Full Temp. Range		—	—	±400	
		V_{DD} = +15V, T_A = Full Temp. Range		—	—	+200	
Input Resistance (V_{REF} A, V_{REF} B) (Note 6)	R_{REF}			8	—	15	kΩ
V_{REF} A/V_{REF} B (Input Resistance Match)	ΔV_{REF} A, B			—	0.1	±1	%

ELECTRICAL CHARACTERISTICS at V_{DD} = +5V or +15V, V_{REF} A = V_{REF} B = +10V, OUT A = OUT B = 0V; T_A = −55°C to +125°C apply for PM-7528AR/ARC/BR/BRC; T_A = −25°C to +85°C apply for PM-7528ER/FR; T_A = 0°C to +70°C apply for PM-7528GP/HP/HPC/HS, unless otherwise noted. (Continued)

PARAMETER	SYMBOL	CONDITIONS	PM-7528 MIN	PM-7528 TYP	PM-7528 MAX	UNITS
DIGITAL INPUTS (Note 9)						
Digital Input High (Note 8)	V_{INH}	V_{DD} = +5V	2.4	—	—	V
		V_{DD} = +15V	13.5	—	—	
Digital Input Low (Note 8)	V_{INL}	V_{DD} = +5V	—	—	0.8	V
		V_{DD} = +15V	—	—	1.5	
Input Current (Note 7)	I_{IN}	T_A = +25°C	—	.001	±1	µA
		T_A = Full Temp. Range	—	—	±10	
Input Capacitance (Note 10)	C_{IN}	DB0-DB7	—	—	10	pF
		$\overline{WR}$, $\overline{CS}$, $\overline{DAC\ A/DAC\ B}$	—	—	15	
SWITCHING CHARACTERISTICS at V_{DD} = +5V (Notes 10, 11)						
Chip Select to Write Set-Up Time	t_{CS}	T_A = +25°C	200	—	—	ns
		T_A = Full Temp. Range	230	—	—	
Chip Select to Write Hold Time	t_{CH}	T_A = +25°C	20	—	—	ns
		T_A = Full Temp. Range	30	—	—	
DAC Select to Write Set-Up Time	t_{AS}	T_A = +25°C	200	—	—	ns
		T_A = Full Temp. Range	230	—	—	
DAC Select to Write Hold Time	t_{AH}	T_A = +25°C	20	—	—	ns
		T_A = Full Temp. Range	30	—	—	
Data Valid to Write Set-Up Time	t_{DS}	T_A = +25°C	110	—	—	ns
		T_A = Full Temp. Range	130	—	—	
Data Valid to Write Hold Time	t_{DH}		0	—	—	ns
Write Pulse Width	t_{WR}	T_A = +25°C	180	—	—	ns
		T_A = Full Temp. Range	200	—	—	
SWITCHING CHARACTERISTICS at V_{DD} = +15V (Notes 10, 11)						
Chip Select to Write Set-Up Time	t_{CS}	T_A = +25°C	60	—	—	ns
		T_A = Full Temp. Range	80	—	—	
Chip Select to Write Hold Time	t_{CH}	T_A = +25°C	10	—	—	ns
		T_A = Full Temp. Range	15	—	—	
DAC Select to Write Set-Up Time	t_{AS}	T_A = +25°C	60	—	—	ns
		T_A = Full Temp. Range	80	—	—	
DAC Select to Write Hold Time	t_{AH}	T_A = +25°C	10	—	—	ns
		T_A = Full Temp. Range	15	—	—	
Data Valid to Write Set-Up Time	t_{DS}	T_A = +25°C	50	—	—	ns
		T_A = Full Temp. Range	70	—	—	
Data Valid to Write Hold Time	t_{DH}		10	—	—	ns
Write Pulse Width	t_{WR}	T_A = +25°C	60	—	—	ns
		T_A = Full Temp. Range	80	—	—	

ELECTRICAL CHARACTERISTICS at V_{DD} = +5V or +15V, V_{REF} A = V_{REF} B = +10V, OUT A = OUT B = 0V; T_A = −55°C to +125°C apply for PM-7528AR/ARC/BR/BRC; T_A = −25°C to +85°C apply for PM-7528ER/FR; T_A = 0°C to +70°C apply for PM-7528GP/HP/HPC/HS, unless otherwise noted. (Continued)

PARAMETER	SYMBOL	CONDITIONS	PM-7528 MIN	PM-7528 TYP	PM-7528 MAX	UNITS
POWER SUPPLY (Note 12)						
Supply Current (Note 21)	I_{DD}	All Digital Inputs V_{INL} or V_{INH}	—	—	1	mA
		All Digital Inputs 0V or V_{DD}	—	—	100	µA
AC PERFORMANCE CHARACTERISTICS (Note 13)						
DC Supply Rejection Ratio ($\Delta Gain/\Delta V_{DD}$) (Note 14)	PSRR	V_{DD} = +5V T_A = +25°C	—	—	0.02	%/%
		T_A = Full Temp. Range	—	—	0.04	
		V_{DD} = +15V T_A = +25°C	—	—	0.01	
		T_A = Full Temp. Range	—	—	0.02	
Propagation Delay (Notes 15, 16, 17)	t_{pD}	V_{DD} = +5V T_A = +25°C	—	—	220	ns
		T_A = Full Temp. Range	—	—	270	
		V_{DD} = +15V T_A = +25°C	—	—	80	
		T_A = Full Temp. Range	—	—	100	
Current Settling Time (Notes 16, 17, 22)	t_s	V_{DD} = +5V T_A = +25°C	—	—	350	ns
		T_A = Full Temp. Range	—	—	400	
		V_{DD} = +15V T_A = +25°C	—	—	180	
		T_A = Full Temp. Range	—	—	200	
Digital Charge Injection (Note 18)	Q	T_A = +25°C V_{DD} = +5V	—	160	—	nVs
		V_{DD} = +15V	—	440	—	
Output Capacitance	C_{OUT} A C_{OUT} B	DAC Latches Loaded with 00000000	—	—	50	pF
			—	—	50	
	C_{OUT} A C_{OUT} B	DAC Latches Loaded with 11111111	—	—	120	
			—	—	120	
AC Feedthrough (Note 19)	FT_A	V_{REF} A to OUT A; T_A = +25°C	—	—	−70	dB
		T_A = Full Temp. Range	—	—	−65	
	FT_B	V_{REF} B to OUT B; T_A = +25°C	—	—	−70	
		T_A = Full Temp. Range	—	—	−65	

ELECTRICAL CHARACTERISTICS at V_{DD} = +5V or +15V, V_{REF} A = V_{REF} B = +10V, OUT A = OUT B = 0V; T_A = −55°C to +125°C apply for PM-7528AR/ARC/BR/BRC; T_A = −25°C to +85°C apply for PM-7528ER/FR; T_A = 0°C to +70°C apply for PM-7528GP/HP/HPC/HS, unless otherwise noted. (Continued)

PARAMETER	SYMBOL	CONDITIONS	PM-7528 MIN	PM-7528 TYP	PM-7528 MAX	UNITS
AC PERFORMANCE CHARACTERISTICS (Note 13)						
Channel-to-Channel Isolation (Note 20)	CCI_{BA}	V_{REF} A to OUT B; V_{REF} A = 20V_{p-p} Sinewave @ f = 100kHz V_{REF} B = 0V. T_A = +25°C	—	−77	—	dB
	CCI_{AB}	V_{REF} B to OUT A; V_{REF} B = 20V_{p-p} Sinewave @ f = 100kHz V_{REF} A = 0V. T_A = +25°C	—	−77	—	
Digital Crosstalk	Q	For Code Transition From 00000000 to 11111111. T_A = +25°C V_{DD} = +5V	—	30	—	nVs
		V_{DD} = +15V	—	60	—	
Harmonic Distortion	THD	V_{IN} = 6Vrms @ f = 1kHz. T_A = +25°C	—	−85	—	dB

NOTES:

1. Specifications apply to both DAC A and DAC B.
2. This is an endpoint linearity specification.
3. All grades guaranteed to be monotonic over the full operating temperature range.
4. Measured using internal R_{FB} A and R_{FB} B. Both DAC latches loaded with 11111111. Gain error is adjustable using circuits of Figures 5 and 6.
5. DAC loaded with 00000000.
6. Input resistance TC = +50ppm/°C; typical input resistance = 11kΩ.
7. V_{IN} = 0V or V_{DD}.
8. For all data bits DB0-DB7, $\overline{WR}$, $\overline{CS}$, $\overline{DAC\ A}$/DAC B.
9. Logic inputs are MOS gates. Typical input current (+25°C) is less than 1nA.
10. Guaranteed and not tested.
11. See timing diagram.
12. See Figure 3.
13. These characteristics are for design guidance only and are not subject to test.
14. $\Delta V_{DD} = \pm 5\%$.
15. From digital input to 90% of final analog-output current.
16. V_{REF} A = V_{REF} B = +10V; OUT A, OUT B load = 100Ω, C_{EXT} = 13pF.
17. $\overline{WR}$, $\overline{CS}$ = 0V, DB0-DB7 = 0V to V_{DD} or V_{DD} to 0V.
18. For code transition 00000000 to 11111111.
19. V_{REF} A, V_{REF} B = 20V_{p-p} Sinewave @ f = 100kHz.
20. Both DAC latches loaded with 11111111.
21. I_{DD} = 500μA at T_A = Full Temp. Range.
22. Extrapolated: t_s (1/2 LSB) = t_pD + 6.2τ, where τ = the measured first time constant of the final RC decay.