PMI

JM38510/11301/11302

JAN 8-BIT MULTIPLYING D/A CONVERTERS

Precision Monolithics Inc.

T-51-09-08

GENERAL DESCRIPTION

This data sheet covers the electrical requirements of the monolithic 8-bit digital-to-analog converters found in MIL-M-38510/113. Devices supplied to this data sheet are manufactured and tested at PMI's MIL-M-38510 certified facility and are listed in QPL-38510.

Complete device requirements will be found in MIL-M-38510 and MIL-M-38510/113 for Class B and Class S processed devices.

Device Types shall be as follows:

01 D/A Converter, 8 bit, 0.19% linearity
02 D/A Converter, 8 bit, 0.10% linearity

GENERIC CROSS-REFERENCE INFORMATION

This cross-reference information is presented for the convenience of the user. The Generic-Industry types listed may not have identical operational performance characteristics across the military temperature range or reliability factors equivalent to the MIL-M-38510/113 devices.

Military Device Type	Generic-Industry Type
01	DAC-08
02	DAC-08A

CASE OUTLINE

Per MIL-M-38510, Appendix C, Case Outline D-2 (16-Lead 1/4"× 7/8", dual-in-line). Package type designator "E".

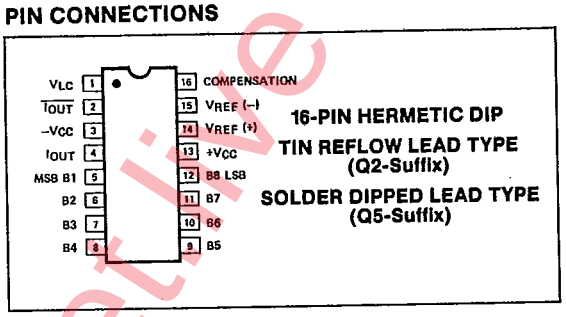
POWER AND THERMAL CHARACTERISTICS

Package	Case outline	Maximum allowable power dissipation	Maximum θJ — C	Maximum θJ — A
Dual-in-line	E	400mW at T_A = 125°C	35°C/W	120°C/W

ORDERING INFORMATION

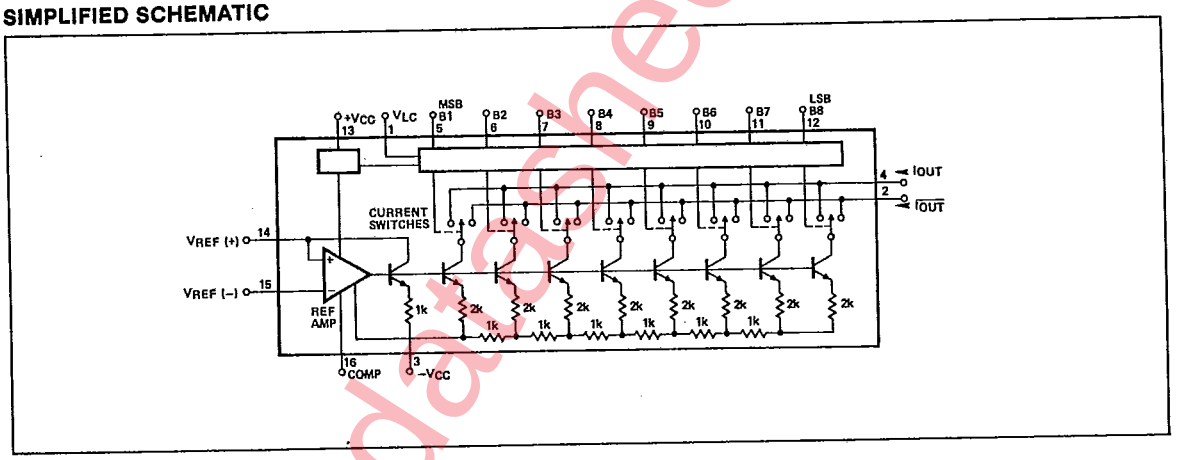
LINEARITY	JAN SLASH SHEET	PMI DEVICE
0.19%	JM38510/11301BEB	DAC08Q2/38510
0.19%	JM38510/11301BEA	DAC08Q5/38510
0.19%	JM38510/11301SEA	DAC08SQ5/38510
0.10%	JM38510/11302BEB	DAC08Q2/38510
0.10%	JM38510/11302BEA	DAC08Q5/38510
0.10%	JM38510/11302SEA	DAC08SAQ5/38510

PIN CONNECTIONS



16-PIN HERMETIC DIP
TIN REFLOW LEAD TYPE (Q2-Suffix)
SOLDER DIPPED LEAD TYPE (Q5-Suffix)

SIMPLIFIED SCHEMATIC



11

DIGITAL-TO-ANALOG CONVERTERS

T-51-09-08

ABSOLUTE MAXIMUM RATINGS

Supply Voltage [$+V_{CC} - (-V_{CC})$] 36Vdc
Voltage, Digital Input to Negative Supply
[$V_{logic} - (-V_{CC})$] ..... 0 to 36Vdc
Voltage, Logic Control (V_{LC}) ..... $-V_{CC}$ to $+V_{CC}$
Reference Voltage Input [(V_{14}, V_{15})] ..... $-V_{CC}$ to $+V_{CC}$
Reference Input Current (I_{14}) 5mA
Reference Input Differential Voltage
[($V_{14} - V_{15}$)] ..... ±18Vdc
Lead Temperature (Soldering, 60 sec) ..... 300°C
Junction Temperature ..... 175°C
Storage Temperature ..... −65°C to +150°C

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range ..... ±5Vdc to ±15Vdc*
Ambient Temperature Range ..... −55°C to +125°C

***NOTE:**
A slight degradation in linearity can occur when the supply voltage is near the ±5V end of the recommended operating range.

ELECTRICAL CHARACTERISTICS at $\pm V_{CC} = \pm 15$Vdc; Source resistance = 50 ohms; $I_{REF} = 2$.mA; Figure 1; Ambient temperature range = −55°C to +125°C, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	01 LIMITS MIN	01 LIMITS MAX	02 LIMITS MIN	02 LIMITS MAX	UNITS
Monotonicity	$\Delta(I)$	Measure I_O, $(I_{ON} - I_{ON-1}) \geq 0$ at each major carry point	0	16	0	16	µA
	$\Delta(\overline{I})$	Measure $\overline{I_O}$, $(\overline{I_{ON}} - \overline{I_{ON-1}}) \geq 0$ at each major carry point	0	16	0	16	
Output Symmetry	ΔI_{FS}	$I_{FS} - \overline{I_{FS}}$	−8	8	−4	4	µA
Full-Scale Current Temperature Coefficient	$T_C(I_{FS})$ $T_C(\overline{I_{FS}})$	All input bits high, Measure I_O All input bits low, Measure $\overline{I_O}$	−50	50	−50	50	ppm/°C
Full-Scale Current	I_{FS}	All input bits high, Measure I_O	1.94	2.04	1.984	2	mA
	$\overline{I_{FS}}$	All input bits low, Measure $\overline{I_O}$					
Zero-Scale Current	I_{ZS}	All input bits low Measure I_O	−2	2	−1	1	µA
	$\overline{I_{ZS}}$	All input bits high, Measure $\overline{I_O}$					
Positive Bit Errors	ΣNL+	Measure I_O (ΣPositive bit errors)/IFS	0	0.19	0	0.10	%
	$\Sigma\overline{NL}$+	Measure $\overline{I_O}$ (Σ Positive bit errors)/$\overline{IFS}$					
Negative Bit Errors	ΣNL−	Measure I_O (ΣNegative bit errors)/IFS	−0.19	0	−0.10	0	%
	$\Sigma\overline{NL}$−	Measure $\overline{I_O}$ (Σ Negative bit errors)/$\overline{IFS}$					
Positive and Negative Bit Error Difference	ΔΣNL	Measure I_O |ΣNL+ | − | ΣNL−|	−0.05	0.05	−0.03	0.03	%
	$\Delta\Sigma\overline{NL}$	Measure $\overline{I_O}$ |$\Sigma\overline{NL}$+ | − | $\Sigma\overline{NL}$−|					
Positive Relative Accuracy	NL+	Measure I_O |ΣNL+ | + | ΔΣNL |	0	0.19	0	0.10	%
	$\overline{NL}$+	Measure $\overline{I_O}$ |$\Sigma\overline{NL}$+ | + | $\Delta\Sigma\overline{NL}$ |					
Negative Relative Accuracy	NL−	Measure I_O |ΣNL− | + | ΔΣNL |	0	0.19	0	0.10	%
	$\overline{NL}$−	Measure $\overline{I_O}$ |$\Sigma\overline{NL}$− | + | $\Delta\Sigma\overline{NL}$ |					

Bit Error
Bit error is the deviation of the analog output from its ideal value (after zero-scale and full-scale errors have been calibrated out) when turning on an individual bit. This is measured for all n bits.

Bit error (analog value) = $V_n - (FSR/2^n)$
Where V_n = analog output with bit n on only.
FSR = full-scale range
n = number of bits

Summation Nonlinearity (ΣNL)
Summation nonlinearity is the sum of all positive bit errors or all negative bit errors, whichever is larger. By summing up all the bit errors in one direction, you obtain the worst possible nonlinearity (i.e. if bit 2 is 1 LSB high and bit 4 is 1/2 LSB high, then bits 2 and 4 together will be 1 1/2 LSBs high. This is essentially the same as integral nonlinearity since the bit errors are superimposed on each other to give the worst case nonlinearity.

ELECTRICAL CHARACTERISTICS at $\pm V_{CC} = \pm 15$Vdc; Source resistance = 50 ohms; $I_{REF} = 2.0$mA; Figure 1; Ambient temperature range = −55°C to +125°C, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	01 LIMITS MIN	01 LIMITS MAX	02 LIMITS MIN	02 LIMITS MAX	UNITS
Output Current Range	$I_{FS}R_1$	All input bits high, Measure I_O, $-V_{CC} = -10$V, $V_{REF} = 15$V	2.1	—	2.1		mA
	$\overline{I_{FS}R_1}$	All input bits low, Measure $\overline{I_O}$, $-V_{CC} = -10$V, $V_{REF} = 15$V					
	$I_{FS}R2$	All input bits high, Measure I_O $-V_{CC} = -12$V, $V_{REF} = 25$V	4.2	—	4.2	—	
	$\overline{I_{FS}R2}$	All input bits low, Measure $\overline{I_O}$ $-V_{CC} = -12$V, $V_{REF} = 25$V					
Reference Bias Current	$I_{REF}-$	All input bits low	−3	0	−3	0	µA
High Level Input Current	I_{IH}	All input bits $V_{IN} = 18$V, each input measured separately	−0.05	10	−0.05	10	µA
Low Level Input Current	I_{IL}	All input bits $V_{IN} = 10$V, each input measured separately	−10	—	−10	—	µA
Full-Scale Current At +18V Compliance	$I_{FS}+$	All input bits high, Measure I_O, $V_{IO} = 18$V	1.90	2.08	1.94	2.04	mA
	$\overline{I_{FS}+}$	All input bits low, Measure $\overline{I_O}$, $V_{IO} = 18$V					
Full-Scale Current At −10V Compliance	$I_{FS}-$	All input bits high, Measure I_O, $V_{IO} = -10$V	1.90	2.08	1.94	2.04	mA
	$\overline{I_{FS}-}$	All input bits low, Measure $\overline{I_O}$, $V_{IO} = -10$V					
Change In Full Scale Current Due to Voltage Compliance	ΔI_{FSC}	All input bits high, Measure I_O, $25°C \le T_A \le 125°C$	−4	4	−4	4	µA
		$T_A = -55°C$	−8	8	−8	8	
		$V_{IO} = 18$V to −10V					
	$\Delta\overline{I_{FSC}}$	All input bits low, Measure $\overline{I_O}$ $25°C \le T_A \le 125°C$	−4	4	−4	4	
		$T_A = -55°C$	−8	8	−8	8	
		$V_{IO} = 18$V to −10V					
Power Supply Sensitivity From $+V_{CC}$	$P_{SS}I_{FS}+1$	All input bits high, Measure I_O, $+V_{CC} = 4.5$V to +5.5V, $-V_{CC} = -18$V	−4	4	−4	4	µA
	$\overline{P_{SS}I_{FS}}+1$	All input bits low, Measure $\overline{I_O}$, $+V_{CC} = 4.5$V to +5.5V, $-V_{CC} = -18$V					
	$P_{SS}I_{FS}+2$	All input bits high, Measure I_O, $+V_{CC} = 12$V to 18V, $-V_{CC} = -18$V	−8	8	−8	8	
	$\overline{P_{SS}I_{FS}}+2$	All input bits low, Measure $\overline{I_O}$, $+V_{CC} = 12$V to 18V, $-V_{CC} = -18$V					
Power Supply Sensitivity From $-V_{CC}$	$P_{SS}I_{FS}-1$	All input bits high, Measure I_O, $+V_{CC} = 18$V, $-V_{CC} = -12$V to −18V	−8	8	−8	8	µA
	$\overline{P_{SS}I_{FS}}-1$	All input bits low, Measure $\overline{I_O}$, $+V_{CC} = 18$V, $-V_{CC} = -12$V to −18V					
	$P_{SS}I_{FS}-2$	All input bits high, Measure I_O, $+V_{CC} = 18$V, $-V_{CC} = -4.5$V to −5.5V $I_{REF} = 1$mA	−2	2	−2	2	
	$\overline{P_{SS}I_{FS}}-2$	All input bits low, Measure $\overline{I_O}$ $+V_{CC} = 18$V, $-V_{CC} = -4.5$V to −5.5V $I_{REF} = 1$mA					

ELECTRICAL CHARACTERISTICS at $\pm V_{CC} = \pm 15$Vdc; Source resistance = 50 ohms; $I_{REF} = 2.0$mA; Figure 1; Ambient temperature range = −55° C to +125° C, unless otherwise noted.

T-51-09-08

PARAMETER	SYMBOL	CONDITIONS	01 LIMITS MIN	01 LIMITS MAX	02 LIMITS MIN	02 LIMITS MAX	UNITS
Supply Current From $+V_{CC}$	$I_{CC}+$	All input bits high	0.4	3.8	0.4	3.8	mA
Supply Current From $-V_{CC}$	$I_{CC}-$	All input bits high	−7.8	−0.8	−7.8	−0.8	mA
Propagation Delay Time, High-to-Low Level	t_{PHL}	Figure 2, Measure V_O	6	60	6	60	ns
Propagation Delay Time, Low-to-High Level	t_{PLH}	Figure 2, Measure V_O	6	60	6	60	ns
Reference Amplifier Input Slew Rate	dI_O/dt $T_A = 25°C$	Figure 3, Measure V_O	1.5	—	1.5	—	mA/μs
Settling Time, High-to-Low Level	t_{SHL} $T_A = 25°C$	Figure 2, Output within 1/2 LSB of final value of I_O	10	135	10	135	ns
Settling Time, Low-to-High Level	t_{SLH} $T_A = 25°C$	Figure 2, Output within 1/2 LSB of final value of I_O	10	135	10	135	ns

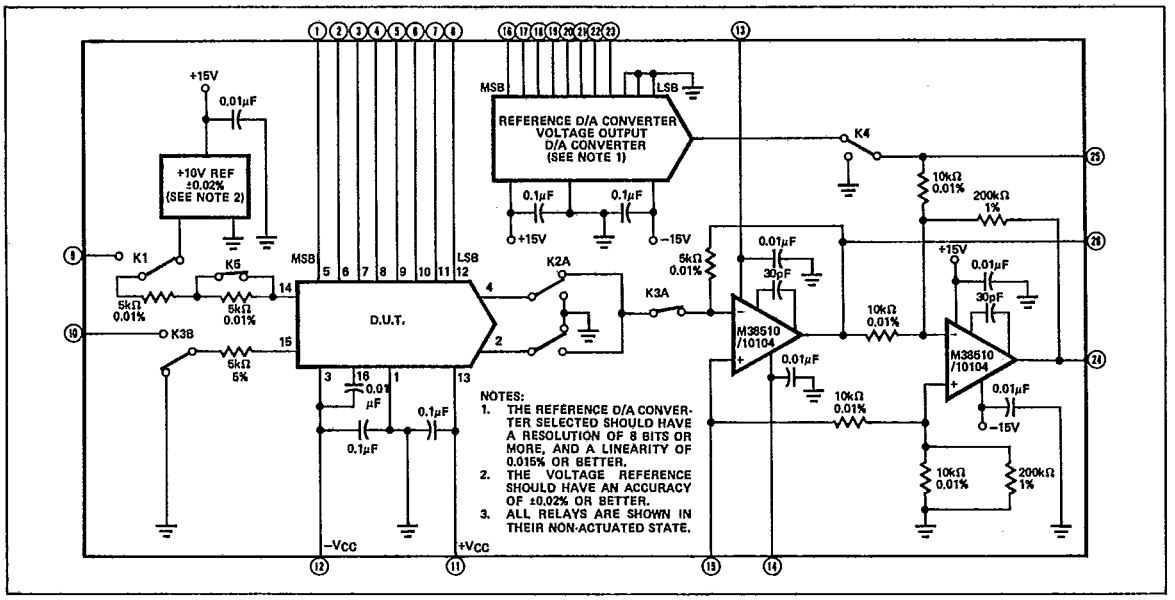


Figure 1. Test Circuit For Static Tests

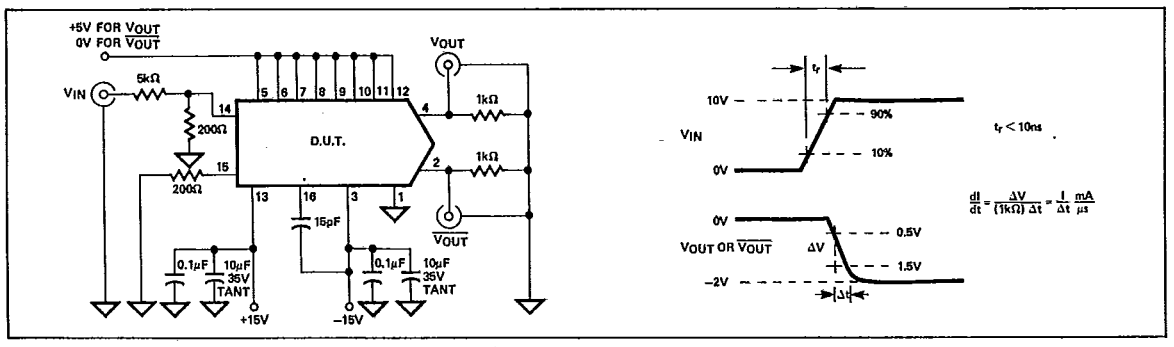


Figure 3. Test Circuit For Slew Rate, Device Types 01, 02

T-51-09-08

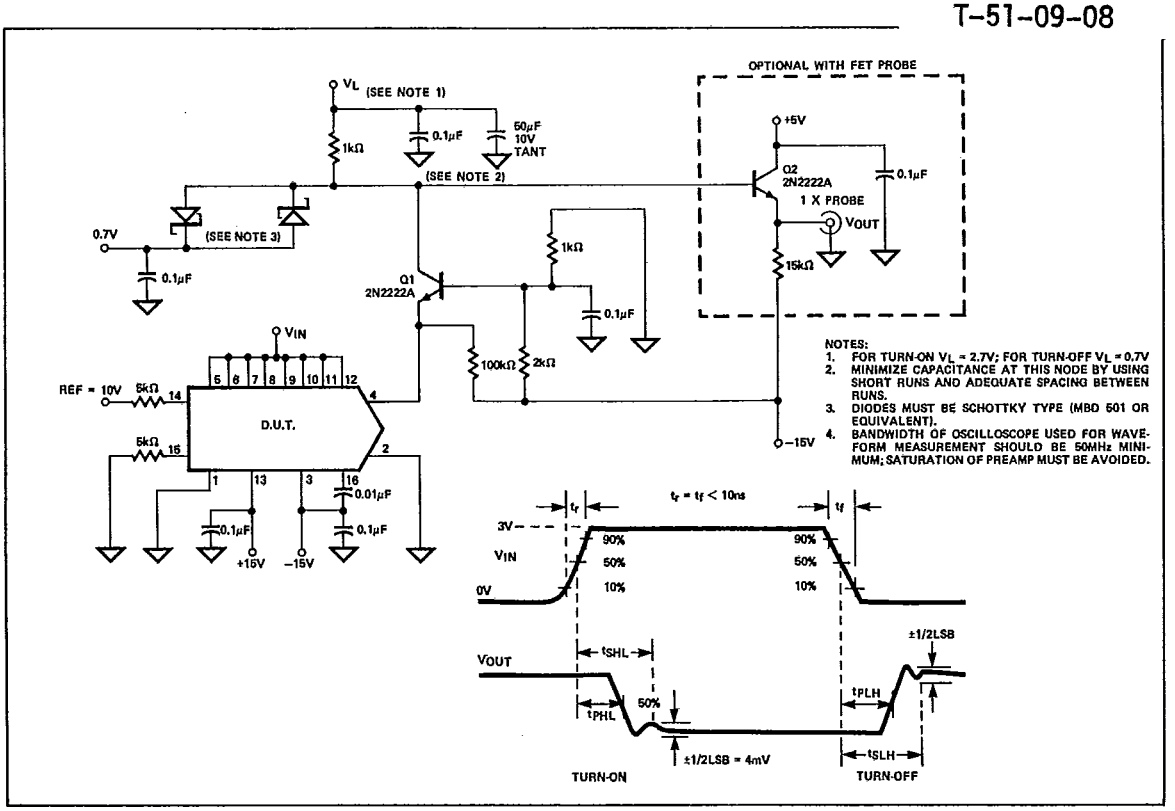


Figure 2. Test Circuit For Propagation Delay and Settling Time, Device Types 01 and 02

BURN-IN

Devices supplied by PMI have been subjected to burn-in per method 1015 of MIL-STD-883 using test condition C or test condition F with the circuit shown in Figure 4.

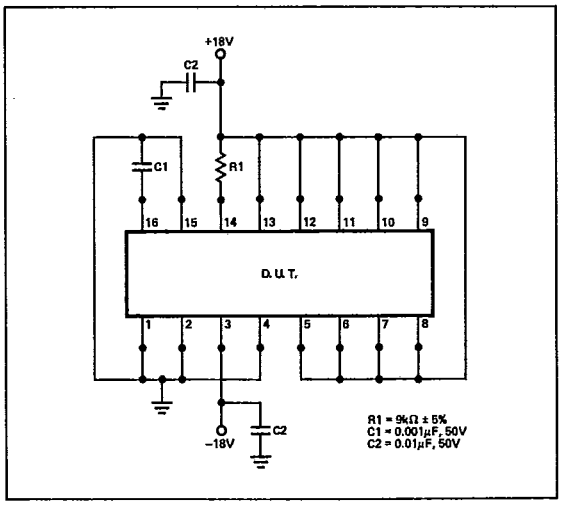


Figure 4. Test Circuit, Burn-In and Operating Life Test

11

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