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PMIC N/A STANDARDIZED MILITARY DRAWING THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE AMSC N/A	PREPARED BY <i>Charles E. Besore</i> CHECKED BY <i>Charles E. Besore</i> APPROVED BY <i>Michael J. Gys</i> DRAWING APPROVAL DATE 24 JANUARY 1990 REVISION LEVEL	DEFENSE ELECTRONICS SUPPLY CENTER DAYTON, OHIO 45444 MICROCIRCUIT, LINEAR, OCTAL, VOLTAGE MODE, 8-BIT D/A CONVERTER, MONOLITHIC SILICON <table style="width: 100%;"> <tr> <td style="width: 15%;">SIZE A</td> <td style="width: 35%;">CAGE CODE 67268</td> <td style="width: 50%;">5962-88663</td> </tr> <tr> <td colspan="2">SHEET</td> <td style="text-align: right;">1</td> </tr> </table>	SIZE A	CAGE CODE 67268	5962-88663	SHEET		1
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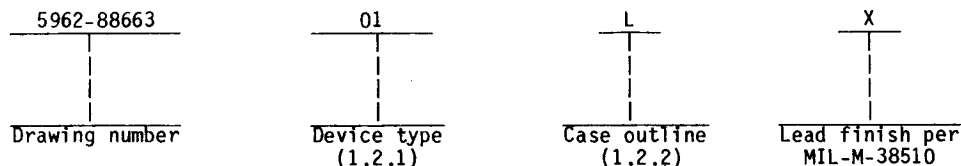
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DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1. SCOPE

1.1 Scope. This drawing describes device requirements for class B microcircuits in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices".

1.2 Part number. The complete part number shall be as shown in the following example:



1.2.1 Device types. The device types shall identify the circuit function as follows:

Device type	Generic number	Circuit function	Total unadjusted error
01	7228T	Octal, CMOS, 8-bit voltage-mode DAC	±2.0 LSB
02	7228U	Octal, CMOS, 8-bit voltage-mode DAC	±1.0 LSB

1.2.2 Case outlines. The case outlines shall be as designated in appendix C of MIL-M-38510, and as follows:

Outline letter	Case outline
L	D-9 (24-lead, 1.280" x .310" x .200"), dual-in-line package
3	C-4 (28-terminal, .460" x .460" x .100"), square chip carrier package

1.3 Absolute maximum ratings.

V_{DD} to ground range	- - - - -	-0.3 V dc to +17 V dc
V_{DD} to V_{SS} range	- - - - -	+0.3 V dc to +24 V dc
Digital input voltage to ground range	- - - - -	-0.3 V dc to V_{DD}
V_{REF} to ground range	- - - - -	-0.3 V dc to V_{DD}
V_{OUT} to ground range 1/	- - - - -	V_{SS} to V_{DD}
Storage temperature range	- - - - -	-65°C to +150°C
Lead temperature (soldering, 10 seconds)	- - - - -	+300°C
Power dissipation (P_D)	- - - - -	1.0 W 2/
Thermal resistance, junction-to-case (θ_{JC})	- - - - -	See MIL-M-38510, appendix C
Junction temperature (T_J)	- - - - -	+175°C

1.4 Recommended operating conditions.

Operating voltage range for dual supply:	
Positive supply range (V_{DD})	- - - - - +10.8 V dc to +16.5 V dc
Negative supply range (V_{SS})	- - - - - -4.5 V dc to -5.5 V dc
Reference voltage range (V_{REF})	- - - - - +2.0 V dc to +10.0 V dc
Operating voltage range for single supply:	
Positive supply range (V_{DD})	- - - - - +13.5 V dc to +16.5 V dc
Negative supply range (V_{SS})	- - - - - 0 V dc
Reference voltage range (V_{REF})	- - - - - +10 V dc
Ambient operating temperature range (T_A)	- - - - - -55°C to +125°C

1/ Outputs may be shorted to any voltage in the range V_{SS} to V_{DD} provided that the power dissipation of the package is not exceeded. Typical short circuit current for a short to ground or V_{SS} is 50 mA.

2/ Derate above $T_A = +75^\circ\text{C}$ at 2.0 mW/°C.

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2. APPLICABLE DOCUMENTS

2.1 Government specification, standard, and bulletin. Unless otherwise specified, the following specification, standard, and bulletin of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this drawing to the extent specified herein.

SPECIFICATION

MILITARY

MIL-M-38510 - Microcircuits, General Specification for.

STANDARD

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

BULLETIN

MILITARY

MIL-BUL-103 - List of Standardized Military Drawings (SMD's).

(Copies of the specification, standard, and bulletin required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Order of precedence. In the event of a conflict between the text of this drawing and the references cited herein, the text of this drawing shall take precedence.

3. REQUIREMENTS

3.1 Item requirements. The individual item requirements shall be in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices" and as specified herein.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

3.2.1 Terminal connections. The terminal connections shall be as specified on figure 1.

3.2.2 Truth table. The truth table shall be as specified on figure 2.

3.2.3 Case outlines. The case outlines shall be in accordance with 1.2.2 herein.

3.3 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in table I and shall apply over the full ambient operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table I.

3.5 Marking. Marking shall be in accordance with MIL-STD-883 (see 3.1 herein). The part shall be marked with the part number listed in 1.2 herein. In addition, the manufacturer's part number may also be marked as listed in MIL-BUL-103 (see 6.6 herein).

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $-55^{\circ}\text{C} < T_A < +125^{\circ}\text{C}$ unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Total unadjusted error <u>2/</u>	TUE1	$V_{DD} = 15\text{ V} \pm 10\%$, $V_{REF} = +10\text{ V}$, single supply only	1,2,3	01		± 2.0	LSB
			1	02		± 2.0	
			2,3,12			± 1.0	
Total unadjusted <u>2/ 3/</u> error	TUE2	Dual supply only, $V_{REF} = +10\text{ V}$	1,2,3	01		± 2.0	LSB
			1	02		± 2.0	
			2,3,12	02		± 1.0	
Relative accuracy	RA		1,2,3	01		± 1.0	LSB
			1	02		± 1.0	
			2,3,12			± 0.5	
Differential nonlinearity	DNL1	Guaranteed monotonic, single supply only	1,2,3	A11		± 1.0	LSB
Differential nonlinearity <u>3/</u>	DNL2	Dual supply only	1,2,3	A11		± 1.0	LSB
Full scale error <u>4/</u>	FSE		1,2,3	01		± 1.0	LSB
			1	02		± 1.0	
			2,3,12			± 0.5	

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Zero code error	ZCE		1	01,02		± 25	mV
			2,3	01		± 30	
				02		± 20	
			12	02		± 15	
Load resistance	R_L	$V_{OUT} = +10\text{ V}$, dual and single supply	1,2,3	A11	2.0		k Ω
Reference input voltage range	V_{REF}		1,2,3	A11	2.0	10	V
Reference input resistance	R_{IN}	Dual supply only	1,2,3	A11	2.0		k Ω
Reference input capacitance 5/	C_{IN} (REF)	Dual and single supply, $T_A = +25^{\circ}\text{C}$	4	A11		500	pF
Digital input high voltage	V_{INH}	Dual supply only, input coding is binary	1,2,3	A11	2.4		V
Digital input low voltage	V_{INL}		1,2,3	A11		0.8	V
Digital input leakage current	I_{ILC}		1,2,3	A11		± 1.0	μA
Digital input capacitance	C_{IN}	Dual supply only, $T_A = +25^{\circ}\text{C}$	4	A11		8	pF
Functional tests		See 4.3.1d	7	A11			
Voltage output slew rate 3/	SR	Dual and single supply	9,10,11	A11	2		V/ μs

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ -55°C < T _A < +125°C unless otherwise specified		Group A subgroups	Device type	Limits		Unit	
						Min	Max		
Voltage output settling time <u>3/</u> <u>6/</u>	t _{SL}	Positive full scale change, dual and single supply, V _{REF} = +10 V		9,10,11	A11		5.0	μs	
		Negative full scale change, V _{REF} = +10 V	Dual supply				5.0		
			Single supply				7.0		
Power supply current	I _{DD}			1	A11		16	mA	
				2,3			22		
	I _{SS}	Dual supply only		1	A11		-14		
				2,3			-20		
	Address to \overline{WR} setup time <u>3/</u>	t ₁	Dual and single supply, see figure 3 <u>7/</u>		9,10,11	A11	0		ns
Address to \overline{WR} hold time <u>3/</u>	t ₂			9,10,11	A11	0		ns	
Data valid to \overline{WR} setup time <u>3/</u>	t ₃			9	A11	70		ns	
				10,11			100		
Data valid to \overline{WR} hold time <u>3/</u>	t ₄			9,10,11	A11	10		ns	

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ -55°C < T _A < +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Write pulse width 3/	t ₅	Dual and single supply, see figure 3 7/	9	All	95		ns
			10,11		150		

1/ Measurements apply with dual supplies, R_L = 2.0 kΩ, and C_L = 100 pF, unless otherwise specified. Refer to 1.4 for conditions of dual and single supplies.

2/ Includes zero code error, relative accuracy, and full scale error.

3/ If not tested, shall be guaranteed to the limits specified in table I.

4/ Calculated after zero code error has been adjusted out.

5/ Occurs when each DAC is loaded with all logic 1's.

6/ Settling time to ±0.5 LSB with V_{REF} = +10 V.

7/ All input rise and fall times measured from 10 percent to 90 percent, t_r = t_f = 5.0 ns.
Timing measurement reference level is $\frac{V_{INH} + V_{INL}}{2}$.

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3.6 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in MIL-BUL-103 (see 6.6 herein). The certificate of compliance submitted to DESC-ECS prior to listing as an approved source of supply shall affirm that the manufacturer's product meets the requirements of MIL-STD-883 (see 3.1 herein) and the requirements herein.

3.7 Certificate of conformance. A certificate of conformance as required in MIL-STD-883 (see 3.1 herein) shall be provided with each lot of microcircuits delivered to this drawing.

3.8 Notification of change. Notification of change to DESC-ECS shall be required in accordance with MIL-STD-883 (see 3.1 herein).

3.9 Verification and review. DESC, DESC's agent, and the acquiring activity retain the option to review the manufacturer's facility and applicable required documentation. Offshore documentation shall be made available onshore at the option of the reviewer.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with section 4 of MIL-M-38510 to the extent specified in MIL-STD-883 (see 3.1 herein).

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Device types	A11	A11
Case outlines	L	3
Terminal number	Terminal symbol	Terminal symbol
1	V _{DD}	NC
2	V _{OUT8}	V _{DD}
3	V _{OUT7}	V _{OUT8}
4	V _{OUT6}	V _{OUT7}
5	V _{OUT5}	V _{OUT6}
6	V _{OUT4}	V _{OUT5}
7	V _{OUT3}	V _{OUT4}
8	V _{OUT2}	NC
9	V _{OUT1}	V _{OUT3}
10	V _{SS}	V _{OUT2}
11	V _{REF}	V _{OUT1}
12	Ground	V _{SS}
13	DB7 (MSB)	V _{REF}
14	DB6	Ground
15	DB5	NC
16	DB4	DB7 (MSB)
17	DB3	DB6
18	DB2	DB5
19	DB1	DB4
20	DB0 (LSB)	DB3
21	WR	DB2
22	A2	NC
23	A1	DB1
24	A0	DB0 (LSB)
25	----	WR
26	----	A2
27	----	A1
28	----	A0

FIGURE 1. Terminal connections.

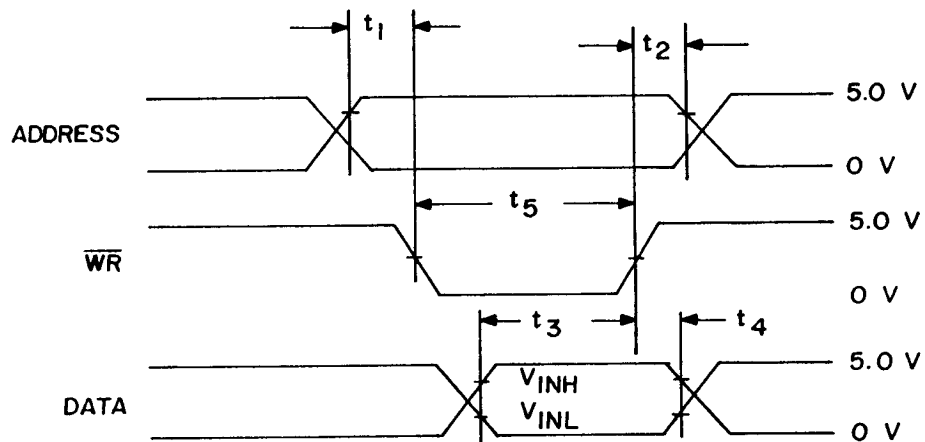
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Control inputs				Operation
\overline{WR}	A2	A1	A0	
H	X	X	X	No operation, device not selected
L	L	L	L	DAC1 transparent
\overline{L}	L	L	L	DAC1 latched
L	L	L	H	DAC2 transparent
L	L	H	L	DAC3 transparent
L	L	H	H	DAC4 transparent
L	H	L	L	DAC5 transparent
L	H	L	H	DAC6 transparent
L	H	H	L	DAC7 transparent
L	H	H	H	DAC8 transparent

H = High state, L = Low state, X = Don't care

FIGURE 2. Truth table.

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NOTE: The selected input latch is transparent while \overline{WR} is low, thus invalid data during this time can cause spurious outputs.

FIGURE 3. Write cycle timing diagram.

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4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to quality conformance inspection. The following additional criteria shall apply:

- a. Burn-in test, method 1015 of MIL-STD-883.
 - (1) Test condition A, B, C, or D using the circuit submitted with the certificate of compliance (see 3.6 herein).
 - (2) $T_A = +125^{\circ}\text{C}$, minimum.
- b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.
- c. Subgroup 12 test is used for grading and part selection at $T_A = +25^{\circ}\text{C}$ and is not included in PDA calculations.

4.3 Quality conformance inspection. Quality conformance inspection shall be in accordance with method 5005 of MIL-STD-883 including groups A, B, C, and D inspections. The following additional criteria shall apply.

4.3.1 Group A inspection.

- a. Tests shall be as specified in table II herein.
- b. Subgroups 5, 6, and 8 in table I, method 5005 of MIL-STD-883 shall be omitted.
- c. Subgroup 4 (C_{IN} and $C_{IN(REF)}$) shall be measured only for the initial test and after process or design changes which may affect capacitance.
- d. Subgroup 7 tests sufficient to verify the truth table.
- e. Subgroup 12 test is used for grading and part selection at $T_A = +25^{\circ}\text{C}$.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (per method 5005, table I)
Interim electrical parameters (method 5004)	1
Final electrical test parameters (method 5004)	1*,2,3,7,12
Group A test requirements (method 5005)	1,2,3,4,7,9**, 10**,11**,12
Groups C and D end-point electrical parameters (method 5005)	1,12

* PDA applies to subgroup 1.

** Subgroups 9, 10, and 11, if not tested, shall be guaranteed to the limits specified in table I.

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4.3.2 Groups C and D inspections.

- a. End-point electrical parameters shall be as specified in table II herein.
- b. Steady-state life test conditions, method 1005 of MIL-STD-883.
 - (1) Test condition A, B, C, or D using the circuit submitted with the certificate of compliance (see 3.6 herein).
 - (2) $T_A = +125^{\circ}\text{C}$, minimum.
 - (3) Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use when military specifications do not exist and qualified military devices that will perform the required function are not available for OEM application. When a military specification exists and the product covered by this drawing has been qualified for listing on QPL-38510, the device specified herein will be inactivated and will not be used for new design. The QPL-38510 product shall be the preferred item for all applications.

6.2 Replaceability. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated with the users of record for the individual documents. This coordination will be accomplished in accordance with MIL-STD-481 using DD Form 1693, Engineering Change Proposal (Short Form).

6.4 Record of users. Military and industrial users shall inform Defense Electronics Supply Center when a system application requires configuration control and the applicable SMD. DESC will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronics devices (FSC 5962) should contact DESC-ECS, telephone (513) 296-6022.

6.5 Comments. Comments on this drawing should be directed to DESC-ECS, Dayton, Ohio 45444, or telephone (513) 296-5375.

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6.6 Approved source of supply. An approved source of supply is listed in MIL-BUL-103. Additional sources will be added to MIL-BUL-103 as they become available. The vendor listed in MIL-BUL-103 has agreed to this drawing and a certificate of compliance (see 3.6 herein) has been submitted to and accepted by DESC-ECS. The approved source of supply listed below is for information purposes only and is current only to the date of the last action of this document.

Military drawing part number	Vendor CAGE number	Vendor similar part number <u>1/</u>
5962-8866301LX 5962-88663013X	24355 24355	AD7228TQ/883B AD7228TE/883B
5962-8866302LX 5962-88663023X	24355 24355	AD7228UQ/883B AD7228UE/883B

1/ Caution. Do not use this number for item acquisition.
Items acquired by this number may not satisfy the
performance requirements of this drawing.

Vendor CAGE
number

24355

Vendor name
and address

Analog Devices
Route 1 Industrial Park
P.O. Box 9106
Norwood, MA 02062
Point of contact:
181 Ballardvale Street
Wilmington, MA 01887-1024

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