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PMIC N/A	PREPARED BY <i>Charles E. Besore</i>	DEFENSE ELECTRONICS SUPPLY CENTER DAYTON, OHIO 45444			
STANDARDIZED MILITARY DRAWING THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE AMSC N/A	CHECKED BY <i>Ray Monnier</i>			MICROCIRCUIT, LINEAR, SWITCHING REGULATOR SUBSYSTEM, MONOLITHIC SILICON	
	APPROVED BY <i>[Signature]</i>				
	DRAWING APPROVAL DATE 13 JANUARY 1989	SIZE A	CAGE CODE 67268		5962-88761
	REVISION LEVEL	SHEET 1 OF 11			

DESC FORM 193
SEP 87

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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:

5962-88761	01	E	X
Drawing number	Device type (1.2.1)	Case outline (1.2.2)	Lead finish per MIL-M-38510

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

Device type	Generic number	Circuit function
01	78S40	Switching regulator subsystem

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

Outline letter	Case outline
E	D-2 (16-lead, .840" x .310" x .200"), dual-in-line package

1.3 Absolute maximum ratings.

Supply voltage (V_{CC})	40 V dc
OP AMP SUPPLY	40 V dc
Input voltage range (error amplifier and op amp)	-0.3 V dc to V^+
Differential input voltage $\frac{1}{2}$	± 30 V dc
Short circuit duration (op amp)	Indefinite
Current from V_{REF} (I_{REF})	10 mA
Voltage from switch collectors to GND	40 V
Voltage from switch emitters to GND	40 V
Voltage from switch collectors to emitter	40 V
Voltage from power diode to GND	40 V
Reverse power diode voltage (V_p)	40 V
Current through power switch (I_{SW})	1.5 A
Current through power diode (I_D)	1.5 A
Power dissipation (P_D)	400 mW
Thermal resistance, junction-to-case (θ_{JC})	See MIL-M-38510, appendix C
Junction temperature (T_J)	+175°C
Storage temperature range	-65°C to 150°C
Lead temperature (soldering, 60 seconds)	300°C

1.4 Recommended operating conditions.

Ambient operating temperature range (T_A)	-55°C to +125°C
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1/ The differential input voltage shall not exceed the supply voltage.

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2. APPLICABLE DOCUMENTS

2.1 Government specification and standard. Unless otherwise specified, the following specification and standard, 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.

(Copies of the specification and standard 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 Block diagram. The block diagram shall be as specified on figure 2.

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

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

3.4 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 6.4 herein.

3.5 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 6.4. The certificate of compliance submitted to DESC-ECS prior to listing as an approved source of supply shall state that the manufacturer's product meets the requirements of MIL-STD-883 (see 3.1 herein) and the requirements herein.

3.6 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.

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

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$	Group A subgroups	Limits		Unit	
				Min	Max		
GENERAL CHARACTERISTICS							
Supply current (op amp disconnected)	I_{CC}	$V_{CC} = 5\text{ V}$	1, 2, 3		3.5	mA	
		$V_{CC} = 40\text{ V}$			5.0		
Supply current (op amp connected)	I_{CC}	$V_{CC} = 5\text{ V}$	1, 2, 3		4.0	mA	
		$V_{CC} = 40\text{ V}$			5.5		
REFERENCE SECTION							
Reference voltage	V_{REF}	$I_{REF} = 1\text{ mA}$	1, 2, 3	1.18	1.31	V	
Line regulation	V_{RLINE}	$3.0\text{ V} \leq V_{CC} \leq 40\text{ V}$, $I_{REF} = 1\text{ mA}$, $T_A = +25^{\circ}\text{C}$	1		0.2	mV/V	
Load regulation	V_{RLOAD}	$1.0\text{ mA} \leq I_{REF} \leq 10\text{ mA}$, $T_A = 25^{\circ}\text{C}$	1		0.5	mV/mA	
OSCILLATOR SECTION							
Charging current	I_{CHG}	$T_A = +25^{\circ}\text{C}$	1		20	50	μA
Discharge current	I_{DIS}	$T_A = +25^{\circ}\text{C}$	1		150	250	μA
CURRENT LIMIT SECTION							
Sense voltage	V_{CLS}	$I_{CT} = 200\text{ }\mu\text{A}$, $T_A = +25^{\circ}\text{C}$	1	250	350	mV	

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$	Group A subgroups	Limits		Unit
				Min	Max	
OUTPUT SWITCH SECTION						
Output saturation voltage 1	V _{SAT1}	I _{SW} = 1 A	4/	1, 2, 3	1.3	V
Output saturation voltage 2	V _{SAT2}		5/		0.7	
Output leakage current	I _L	V _O = 40 V, T _A = +25°C	1		10	μA
POWER DIODE						
Forward voltage drop	V _{FD}	I _D = 1 A	1, 2, 3		1.5	V
Diode leakage current	I _{LD}	V _D = 40 V, T _A = +25°C	1		10	μA
COMPARATOR						
Input offset voltage	V _{IO}	V _{CM} = V _{REF}	1, 2, 3		15	mV
Input bias current	I _{IB}	V _{CM} = V _{REF}	1, 2, 3		200	nA
Input offset current 2/	I _{IO}	V _{CM} = V _{REF}	1, 2, 3		75	nA
Input voltage range	V _{IR}	T _A = +25°C	1	0	V _{CC} -2	V
Power supply rejection 2/ ratio	PSRR	3.0 V < OP AMP SUPPLY ≤ 40 V, T _A = +25°C	4		316	μV/V

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$	Group A subgroups	Limits		Unit
				Min	Max	
OUTPUT OPERATIONAL AMPLIFIER						
Input offset voltage	V_{IO}	$V_{CM} = 2.5\text{ V}$	1, 2, 3		15	mV
Input bias current	I_{IB}	$V_{CM} = 2.5\text{ V}$	1, 2, 3		200	nA
Input offset current	I_{IO}	$V_{CM} = 2.5\text{ V}$	1, 2, 3		75	nA
Large signal voltage gain ⁺	A_{VS+}	$1.0\text{ V} < V_O < 2.5\text{ V}$, $T_A = +25^{\circ}\text{C}$ $R_L = 2.0\text{ k}\Omega$ to GND	4	25		V/mV
Large signal voltage gain ⁻	A_{VS-}	$1.0\text{ V} < V_O < 2.5\text{ V}$, $T_A = +25^{\circ}\text{C}$ $R_L = 2.0\text{ k}\Omega$ to OP AMP SUPPLY	4	25		V/mV
Common mode rejection ratio	CMRR	$0\text{ V} \leq V_{CM} \leq 3.0\text{ V}$, $T_A = +25^{\circ}\text{C}$	4	76		dB
Input voltage range <u>3/</u>	V_{IR}	$T_A = +25^{\circ}\text{C}$	1	0	3.0	V
Power supply rejection ratio	PSRR	$3.0\text{ V} < \text{OP AMP SUPPLY} \leq 40\text{ V}$, $T_A = +25^{\circ}\text{C}$	4		158	$\mu\text{V/V}$
Output source current	I_{SOU}	$T_A = +25^{\circ}\text{C}$	1		-75	mA
Output sink current	I_{SIN}	$T_A = +25^{\circ}\text{C}$	1	10		mA
Output voltage LOW	V_{OL}	$I_{OL} = 5\text{ mA}$, $T_A = +25^{\circ}\text{C}$	1		1.0	V
Output voltage HIGH	V_{OH}	$I_{OH} = -50\text{ mA}$, $T_A = +25^{\circ}\text{C}$	1	2.0		V

1/ $V_{CC} = 5.0\text{ V}$, OP AMP SUPPLY = 5.0 V, unless otherwise specified.

2/ Guaranteed, if not tested, to the limits specified.

3/ V_{IR} is guaranteed by the CMRR test.

4/ Pins 15 and 16 tied together, $I_{16} = 1\text{ A}$.

5/ $I_{15} = 100\text{ mA}$.

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Device type	01
Case outline	E
Terminal number	Terminal symbol
1	DIODE CATHODE
2	DIODE ANODE
3	SWITCH EMITTER
4	OP AMP OUT
5	OP AMP SUPPLY
6	OP AMP +IN
7	OP AMP -IN
8	V _{REF}
9	COMPTR +IN
10	COMPTR -IN
11	GND
12	C _T
13	V _{CC}
14	I _{PK} SEN
15	DRIVER COLL
16	SWITCH COLL

FIGURE 1. Terminal connections.

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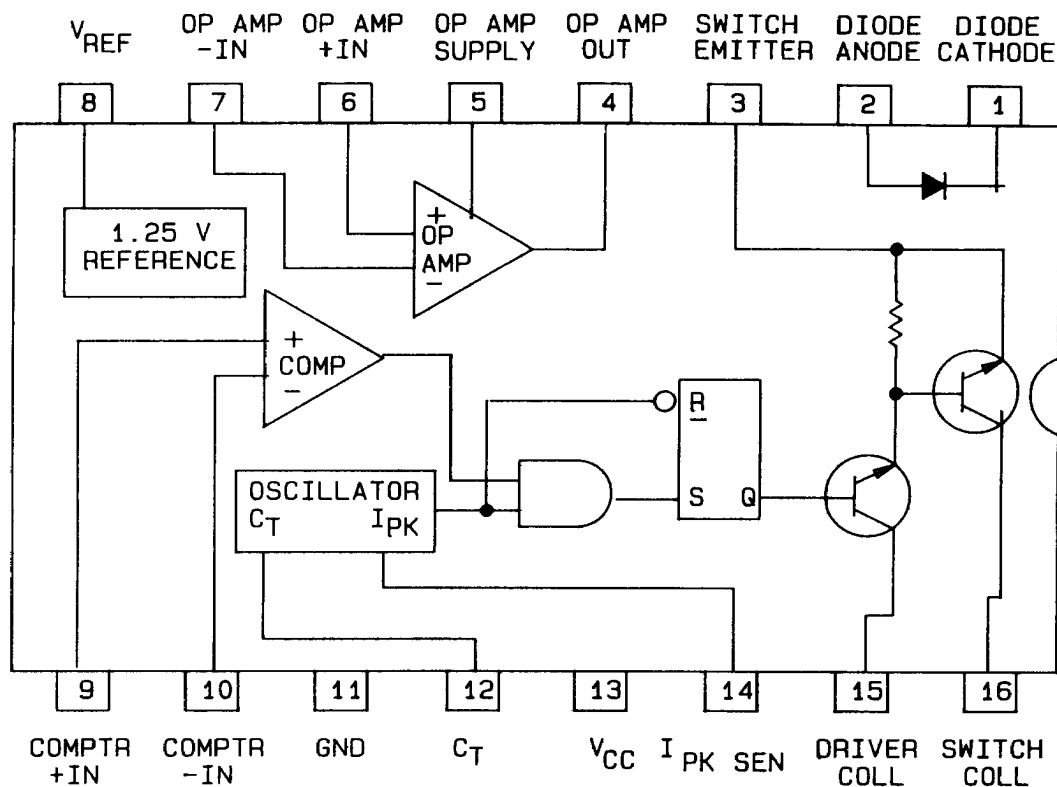


FIGURE 2. Block diagram.

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3.8 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).

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 3.5 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.

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, 7, 8, 9, 10, and 11 in table I, method 5005 of MIL-STD-883 shall be omitted.

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 3.5 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.

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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*,2,3,4
Group A test requirements (method 5005)	1,2,3,4
Groups C and D end-point electrical parameters (method 5005)	1

* PDA applies to subgroup 1.

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

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6.4 Approved source of supply. An approved source of supply is listed herein. Additional sources will be added as they become available. The vendor listed herein has agreed to this drawing and a certificate of compliance (see 3.5 herein) has been submitted to DESC-ECS.

Military drawing part number	Vendor CAGE number	Vendor similar part number <u>1/</u>	Replacement military specification part number
5962-8876101EX	27014	μA78S40DMQB	

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

Vendor CAGE
number

27014

Vendor name
and address

National Semiconductor
2900 Semiconductor Drive
P.O. Box 58090
Santa Clara, CA 95052-8090

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