

MILITARY SPECIFICATION

MICROCIRCUITS, LINEAR, PRECISION VOLTAGE REFERENCES, MONOLITHIC SILICON

Reactivated after 21 April 2004 and may be used for either new or existing design acquisitions.

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the product herein shall consist of this specification sheet and MIL-PRF-38535.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic silicon, precision voltage references. Two product assurance classes and a choice of case outlines and lead finishes are provided and are reflected in the complete part number. For this product, the requirements of MIL-M-38510 have been superseded by MIL-PRF-38535, (see 6.3)

1.2 Part or identifying number (PIN). The PIN is in accordance with MIL-PRF-38535, and as specified herein.

1.2.1 Device types. The device types are internally compensated and are as follows:

<u>Device type</u>	<u>Circuit</u>
01, 04	Precision voltage reference, 6.9 V with temperature stabilizer
02, 06	Precision voltage reference, 6.9 V without temperature stabilizer
03	Precision voltage reference, 10 V with guaranteed long term stability
05	Precision voltage reference, 6.9 V with guaranteed long term stability
07	Precision voltage reference, 5 V with ultra low drift
08	Precision voltage reference, 7 V with ultra low drift
09	Precision voltage reference, 10 V with ultra low drift

1.2.2 Device class. The device class is the product assurance level as defined in MIL-PRF-38535.

1.2.3 Case outline. The case outlines are as designated in MIL-STD-1835 and as follows:

<u>Outline letter</u>	<u>Descriptive designator</u>	<u>Terminals</u>	<u>Package style</u>
G	MACY1-X8	8	Can
X	See figure 1	2	Can
Y	See figure 2	4	Can

Comments, suggestions, or questions on this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAS, 3990 East Broad St., Columbus, OH 43216-5000, or emailed to linear@dsccl.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

1.3 Absolute maximum ratings.

Voltage reference current	
Device types 01, 02, 04, 05, and 06	20 mA
Forward current	
Device types 01, 02, 04, 05, and 06	1 mA
Temperature stabilizer voltage	
Device types 01, 04, and 05	40 V
Reference to substrate voltage	
Device types 01, 04, and 05 (negative terminal of stabilizer)	-0.1 V
Device type 03	
Maximum input voltage	40 V
Minimum input voltage	12 V
Maximum power dissipation	500 mW
Open circuit duration	Indefinite <u>1/</u>
Device types 07, 08, and 09	
Maximum input voltage	
Device types 07, 08, and 09	44 V
Input-output voltage differential	
Device types 07, 08, and 09	35 V
Output to ground voltage (shunt mode current limit)	
Device types 07 and 08	10 V
Device type 09	16 V
Trim pin to ground voltage	
Positive	Equal to V_O
Negative	-20 V
Device types 07 and 09	
Output short circuit duration	
$V_{IN} = 35\text{ V}$	10 s
$V_{IN} \leq 20\text{ V}$	Indefinite
Device types 07, 08, and 09	
Lead temperature (soldering, 10 seconds)	+300°C
Junction temperature (T_J)	+175°C
Storage temperature range	-55°C to +150°C

1.4 Recommended operating conditions.

Voltage reference current output	
Device type 03	0 mA to 8 mA
Voltage reference current range	
Device types 01 and 02	0.5 mA to 15 mA
Operating ambient temperature range (T_A)	-55°C to +125°C

1.5 Power and thermal characteristics.

Package	Case outlines	Maximum allowable power dissipation	Maximum θ_{JC}	Maximum θ_{JA}
8 lead can	G	330 mW at $T_A = +125^\circ\text{C}$	45°C/W	150°C/W
2 lead can	X	115 mW at $T_A = +125^\circ\text{C}$	43°C/W	435°C/W
4 lead can	Y	140 mW at $T_A = +125^\circ\text{C}$	---	200°C/W

1/ Output may be shorted to ground or supply. Rating applies to +125°C case temperature.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-38535 - Integrated Circuits (Microcircuits) Manufacturing, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard for Microelectronics.

MIL-STD-1835 - Interface Standard Electronic Component Case Outlines.

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Microcircuits furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturers list before contract award (see 4.3 and 6.4).

3.2 Item requirements. The individual item requirements shall be in accordance with MIL-PRF-38535 and as specified herein or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38535 and herein.

3.3.1 Circuit diagrams and terminal connections. The circuit diagrams and terminal connections shall be as specified on figure 8.

3.3.2 Schematic circuits. The schematic circuits shall be maintained by the manufacturer and made available to the qualifying activity and the preparing activity upon request.

3.3.3 Case outlines. The case outlines shall be as specified in 1.2.3.

3.3.4 Package and sealing material. Packaging and sealing material shall be in accordance with MIL-PRF-38510.

3.4 Lead material and finish. The lead material and finish shall be in accordance with MIL-PRF-38535 (see 6.6).

3.5 Electrical performance characteristics. The electrical performance characteristics are as specified in table I, and apply over the full recommended operating ambient temperature range, unless otherwise specified.

TABLE I. Electrical performance characteristics for device types 01, 02, 04, 05, and 06.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see 3.5 unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Reference voltage	V _R	0.5 mA ≤ I _R ≤ 10 mA, V _S = 30 V, T _A = +25°C	01,04, 05	6.80	7.10	V
		0.6 mA ≤ I _R ≤ 15 mA, T _A = +25°C	02,06	6.70	7.20	
Reference voltage change with current	ΔV _R (current)	0.5 mA ≤ I _R ≤ 10 mA, V _S = 30 V, T _A = +25°C	01,04, 05	-9	9	mV
		0.5 mA ≤ I _R ≤ 10 mA, V _S = 30 V, -55°C ≤ T _A ≤ +125°C	01,04, 05	-12	12	
		0.6 mA ≤ I _R ≤ 15 mA, T _A = +25°C	02,06	-14	14	
		0.6 mA ≤ I _R ≤ 15 mA, -55°C ≤ T _A ≤ +125°C	02,06	-18	18	
Reference voltage temperature	ΔV _R / ΔT	V _S = 30 V, I _R = 1.0 mA, -55°C ≤ T _A ≤ +85°C	01,05	-0.5	0.5	ppm/°C
			04	-1.0	1.0	
		V _S = 30 V, I _R = 1.0 mA, +85°C ≤ T _A ≤ +125°C	01,05	-10	10	
			04	-15	15	
		I _R = 1.0 mA, -55°C ≤ T _A ≤ +125°C	02 06	-10 -20	10 20	
Dynamic impedance	Z _D	V _S = 30 V, I _R = 1.0 mA, e _i = 1.0 V, f = 400 Hz, see figure 3, T _A = +25°C	01,04, 05	0	1	Ohm
		I _R = 1.0 mA, e _i = 1.0 V, f = 400 Hz, see figure 3, T _A = +25°C	02,06	0	1	
Noise	N _O	V _S = 30 V, BW = 10 Hz to 10 kHz, I _R = 1.0 mA, see figure 4, T _A = +25°C	01,04, 05	0	20	μV RMS
		BW = 10 Hz to 10 kHz, I _R = 1.0 mA, see figure 4, T _A = +25°C	02,06	0	20	
		V _S = 30 V, BW = 0.1 Hz to 10 kHz, I _R = 1.0 mA, see figure 4, T _A = +25°C	01,04, 05	0	50	μVp-p
		BW = 0.1 Hz to 10 kHz, I _R = 1.0 mA, see figure 4, T _A = +25°C	02,06	0	50	

See footnotes at end of table.

TABLE I. Electrical performance characteristics for device types 01, 02, 04, 05, and 06 – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see 3.5 unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Temperature stabilizer supply current	I _S	V _S = 40 V, I _R = 0 mA, T _A = +25°C	01,04, 05	4	20	mA
		V _S = 40 V, I _R = 0 mA, T _A = -55°C	01,04, 05	6	40	
Initial temperature stabilizer supply current	I _{SI}	9 V ≤ V _S ≤ 40 V, I _R = 0 mA, T _A = +25°C	01,04, 05	---	200	mA
Reference voltage temperature cycling hysteresis	ΔV _R (temp cycle)	V _S = 30 V, I _R = 1 mA, see figure 5, -55°C ≤ T _A ≤ +125°C	01,04, 05	-10	10	mV
		I _R = 1 mA, see figure 5, -55°C ≤ T _A ≤ +125°C	02,06	-1	1	
Long term stability	ΔV _R / ΔTime	V _S = 30 V, I _R = 1 mA ±10 %, Time = 600 hours, T _A = +25°C	05	-20	20	ppm / 600 hrs

See footnotes at end of table.

TABLE I. Electrical performance characteristics for device types 03.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see 3.5 and figure 6 unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Reference voltage	V _O	V _S = 15 V, I _L = 0 mA, T _A = +25°C	03	9.97	10.03	V
		V _S = 15 V, I _L = 0 mA, T _A = +125°C		9.958	10.042	
		V _S = 15 V, I _L = 0 mA, T _A = -55°C		9.962	10.038	
Output adjustment range	V _O adj+	V _S = 15 V, I _L = 0 mA, T _A = +25°C	03	0.3	---	V
	V _O adj-			---	-0.3	
Line regulation	V _R LINE	V _S = 13 V to 33 V, I _L = 0 mA, T _A = +25°C	03	-0.010	0.010	% / V
		V _S = 13 V to 33 V, I _L = 0 mA, -55°C ≤ T _A ≤ +125°C		-0.015	0.015	
Load regulation	V _R LOAD	V _S = 15 V, I _L = 0 to 10 mA, T _A = +25°C	03	-0.008	0.008	% / mA
		V _S = 15 V, I _L = 0 to 8 mA, -55°C ≤ T _A ≤ +125°C		-0.012	0.012	
Quiescent supply current	I _{CC}	V _S = 15 V, I _L = 0 mA, T _A = +25°C	03	---	1.4	mA
		V _S = 15 V, I _L = 0 mA, -55°C ≤ T _A ≤ +125°C		---	2.0	
Output short circuit current	I _{OS}	V _S = 15 V, V _O = 0 V, T _A = +25°C	03	---	50	mA
Output voltage temperature coefficient <u>1/</u>	ΔV _{OUT1} / ΔT	V _S = 15 V, I _L = 0 mA, -55°C ≤ T _A ≤ +25°C	03	-10	10	ppm / °C
	ΔV _{OUT2} / ΔT	V _S = 15 V, I _L = 0 mA, +25°C ≤ T _A ≤ +125°C		-12	12	
Output voltage noise	en _{p-p}	V _S = 15 V, I _L = 0 mA, T _A = +25°C, BW = 0.1 Hz to 10 Hz, see figure 7	03	---	30	μV _{p-p}
Long term drift <u>2/</u>	V _L TD	V _S = 15 V, I _L = 0 mA, T _A = +40°C	03	-50	50	ppm / 1000 hrs.

See footnotes at end of table.

TABLE I. Electrical performance characteristics for device type 07.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C V _{IN} = 10 V, I _{OUT} = 0 mA, see 3.5 and figure 8 unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Reference voltage	V _O <u>3/</u>	T _A = +25°C	07	4.950	5.050	V
		T _A = +125°C		4.9475	5.0525	
		T _A = -55°C		4.948	5.052	
Line regulation	V _{RLINE} <u>4/</u>	V _{IN} = 10 V, 7.2 V, T _A = +25°C	07	-0.17	0.17	mV
		V _{IN} = 10 V, 7.2 V, T _A = +125°C, -55°C		-0.28	0.28	
		V _{IN} = 10 V, 40 V, T _A = +25°C		-0.9	0.9	
		V _{IN} = 10 V, 40 V, T _A = +125°C, -55°C		-1.5	1.5	
Load regulation	V _{RLOAD} <u>4/</u>	I _{OUT} = 0 mA, 10 mA, T _A = +25°C	07	-5.0	5.0	mV
		I _{OUT} = 0 mA, 10 mA, T _A = +125°C, -55°C		-7.5	7.5	
		I _{OUT} = 0 mA, -10 mA, T _A = +25°C		-1.0	1.0	
		I _{OUT} = 0 mA, -10 mA, T _A = +125°C, -55°C		-1.75	1.75	
Trim voltage	V _{TRIM}	I _{TRIM} = 0 mA, T _A = +25°C	07	-3.5	---	V
Delta voltage / delta temperature	ΔV _O / ΔT	T _A = -55°C to +25°C	07	---	5.0	ppm / °C
		T _A = +25°C to +125°C		---	5.0	
Noise	N _O <u>5/</u>	V _{IN} = 15 V, 10 Hz ≤ f ≤ 1 kHz, T _A = +25°C	07	---	3.5	μV RMS
Supply current	I _{CC}	T _A = +25°C	07	---	1.2	mA
		T _A = +125°C, -55°C		---	1.5	
Output short circuit current	I _{OS}	V _O = 0 V, T _A = +25°C	07	-50	---	mA

See footnotes at end of table.

TABLE I. Electrical performance characteristics for device type 08.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C V _{IN} = 12 V, I _{OUT} = 0 mA, see 3.5 and figure 8 unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Reference voltage	V _O <u>3/</u>	T _A = +25°C	08	6.950	7.050	V
		T _A = +125°C		6.9465	7.0535	
		T _A = -55°C		6.9472	7.0528	
Line regulation	V _{RLINE} <u>4/</u>	V _{IN} = 12 V, 8.5 V, T _A = +25°C	08	-0.1	0.1	mV
		V _{IN} = 12 V, 8.5 V, T _A = +125°C, -55°C		-0.2	0.2	
		V _{IN} = 12 V, 40 V, T _A = +25°C		-0.39	0.39	
		V _{IN} = 12 V, 40 V, T _A = +125°C, -55°C		-0.78	0.78	
Load regulation	V _{RLOAD} <u>4/</u>	I _{OUT} = 0 mA, -10 mA, T _A = +25°C	08	-1.75	1.75	mV
		I _{OUT} = 0 mA, -10 mA, T _A = +125°C, -55°C		-2.8	2.8	
Minimum current shunt mode	I _{MIN}	V _{IN} is open, T _A = +25°C	08		1	mA
		V _{IN} is open, T _A = +125°C, -55°C			1.2	
Shunt mode regulation	V _{SHUNT} <u>4/ 6/</u>	V _{IN} is open, I _{OUT} = 1.2 mA, 10 mA, T _A = +25°C	08	-6.16	6.16	mV
		V _{IN} is open, I _{OUT} = 1.2 mA, 10 mA, T _A = +125°C, -55°C		-9.24	9.24	
Delta voltage / delta temperature	ΔV _O / ΔT	T _A = -55°C to +25°C	08	---	5.0	ppm /
		T _A = +25°C to +125°C		---	5.0	°C
Noise	N _O <u>5/</u>	V _{IN} = 15 V, 10 Hz ≤ f ≤ 1 kHz	08	---	4	μV RMS
Supply current	I _{CC}	T _A = +25°C	08	---	1.2	mA
		T _A = +125°C, -55°C		---	1.5	
Output short circuit current	I _{OS}	V _{IN} = 12 V, V _O = 0 V, T _A = +25°C	08	-50	---	mA

See footnotes at end of table.

TABLE I. Electrical performance characteristics for device type 09.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C V _{IN} = 15 V, I _{OUT} = 0 mA, see 3.5 and figure 8 unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Reference voltage	V _O <u>3/</u>	T _A = +25°C	09	9.950	10.050	V
		T _A = +125°C		9.945	10.055	
		T _A = -55°C		9.946	10.054	
Line regulation	V _{RLINE} <u>4/</u>	V _{IN} = 11.5 V, 14.5 V, T _A = +25°C	09	-0.12	0.12	mV
		V _{IN} = 11.5 V, 14.5 V, T _A = +125°C, -55°C		-0.18	0.18	
		V _{IN} = 14.5 V, 40 V, T _A = +25°C		-0.5	0.5	
		V _{IN} = 14.5 V, 40 V, T _A = +125°C, -55°C		-1.0	1.0	
Load regulation	V _{RLOAD} <u>4/</u>	I _{OUT} = 0 mA, -10 mA, T _A = +25°C	09	-2.5	2.5	mV
		I _{OUT} = 0 mA, -10 mA, T _A = +125°C, -55°C		-4.0	4.0	
Minimum current shunt mode	I _{MIN}	V _{IN} is open, T _A = +25°C	09		1.5	mA
		V _{IN} is open, T _A = +125°C, -55°C			1.7	
Shunt mode regulation	V _{SHUNT} <u>4/ 6/</u>	V _{IN} is open, I _{OUT} = 1.7 mA, 10 mA, T _A = +25°C	09	-8.3	8.3	mV
		V _{IN} is open, I _{OUT} = 1.7 mA, 10 mA, T _A = +125°C, -55°C		-12.4	12.4	
Trim voltage	V _{TRIM}	I _{TRIM} = 0 mA, T _A = +25°C	09	-4.3	---	V
Delta voltage / delta temperature	ΔV _O / ΔT	T _A = -55°C to +25°C	09	---	5.0	ppm /
		T _A = +25°C to +125°C		---	5.0	°C
Noise	N _O <u>5/</u>	V _{IN} = 15 V, 10 Hz ≤ f ≤ 1 kHz, T _A = +25°C	09	---	6	μV RMS
Supply current	I _{CC}	T _A = +25°C	09	---	1.7	mA
		T _A = +125°C, -55°C		---	2.0	
Output short circuit current	I _{OS}	V _O = 0 V, T _A = +25°C	09	-50	---	mA

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

- 1/ Output voltage temperature coefficient is defined as the absolute difference between the output voltage at $T_A = +125^\circ\text{C}$ and the output voltage at $T_A = -55^\circ\text{C}$ divided by the product of the absolute temperature range and the output voltage multiplied by one million, example:

$$\Delta V_{OUT1} / \Delta T = [(V_O (+25^\circ\text{C}) - V_O (-55^\circ\text{C})) / ((+80^\circ\text{C}) 10 \text{ V})] \times 10^6.$$

$$\Delta V_{OUT2} / \Delta T = [(V_O (+125^\circ\text{C}) - V_O (+25^\circ\text{C})) / ((+100^\circ\text{C}) 10 \text{ V})] \times 10^6.$$

- 2/ Long term drift specification applies only to device under continuous power.
- 3/ Reference voltage is measured immediately after device is turned ON. Changes due to chip warm up are typically less than 0.005 percent
- 4/ Line, load, and shunt mode regulation are measured on a pulse basis. Pulse is not to exceed 30 ms.
- 5/ RMS noise is measured with a two pole high pass filter at 10 Hz and a two pole low pass filter at 1kHz.
- 6/ Shunt voltage is measured with the input open. With the input connected, the shunt mode current can be reduced to 0 mA. Load regulation will remain the same.

3.6 Electrical test requirements. The electrical test requirements for each device class shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table III.

3.7 Marking. Marking shall be in accordance with MIL-PRF-38535.

3.7.1 Serialization. All class S devices shall be serialized in accordance with MIL-PRF-38535.

3.7.2 Correctness of indexing and markings. All devices shall be subjected to the final electrical tests specified in table II after part marking to verify that they are correctly indexed and identified by part number. Optionally, an approved electrical test may be devised especially for this requirement.

3.8 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 59 (see MIL-PRF-38535, appendix A).

TABLE II. Electrical test requirements.

MIL-PRF-38535 test requirements	Subgroups (see table III)	
	Class S devices	Class B <u>1/</u> devices
Interim electrical parameters	1	1
Final electrical test parameters	1*, 2, 3	1*, 2, 3
Group A test requirements	1, 2, 3, 4	1, 2, 3, 4
Group B electrical test parameters when using the method 5005 QCI option	1, 2, 3, 5 and table IV delta limits	N/A
Group C end-point electrical parameters	1, 2, 3, 5 and table IV delta limits	1 and table IV delta limits
Group D end-point electrical parameters	1, 2, 3	1
Additional electrical subgroups for Group D periodic inspections	N/A	5

* PDA applies to subgroup 1.

1/ Subgroup 4, as defined in table III (tests 18-20, for device types 01, 04, and 05; tests 13-15, device types 02 and 06) are used for initial and redesign qualification (class B only).

4. VERIFICATION.

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38535 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not effect the form, fit, or function as described herein.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38535, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

- a. The burn-in test duration, test condition, and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The burn-in test circuit shall be maintained under document control by the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.

NOTE: If accelerated high temperature test conditions are used, the device manufacturer shall ensure that at least 85 percent of the applied voltage is dropped across the device at temperature. The device is not considered functional under accelerated test conditions.

- b. Interim and final electrical test parameters shall be as specified in table II, except interim electrical parameters test prior to burn-in is optional at the discretion of the manufacturer.
- c. Additional screening for space level product shall be as specified in MIL-PRF-38535.

4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-38535.

4.4 Technology Conformance inspection (TCI). Technology conformance inspection shall be in accordance with MIL-PRF-38535 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4.1 Group A inspection. Group A inspection shall be in accordance with table III of MIL-PRF-38535 and as follows:

- a. Tests shall be as specified in table II herein.
- b. Subgroups 6, 7, 8, 9, 10, and 11 shall be omitted.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of MIL-PRF-38535.

4.4.3 Group C inspection. Group C inspection shall be in accordance with table IV of MIL-PRF-38535 and as follows:

- a. End point electrical parameters shall be as specified in table II herein.
- b. The steady-state life test duration, test condition, and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The burn-in test circuit shall be maintained under document control by the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.

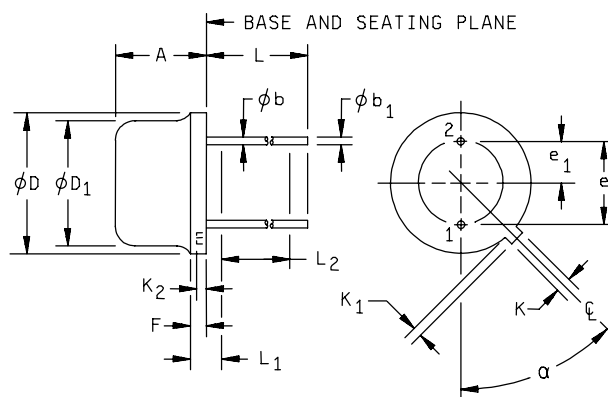
4.4.4 Group D inspection. Group D inspection shall be in accordance with table V of MIL-PRF-38535.

- a. End point electrical parameters shall be as specified in table II herein.
- b. A special subgroup shall be added to the group D inspection requirements and shall consist of the tests, conditions, and limits specified for subgroup 5 of group A. The accept sample number for the subgroup shall be 15 devices with 0 failures for both classes.

4.5 Methods of inspection. Methods of inspection shall be specified and as follows.

4.5.1 Voltage and current. All voltage values given are referenced to the ground terminal of the device under test (DUT). Currents given are conventional current and are positive when flowing into the referenced terminal.

4.5.2 Life test and burn-in cooldown procedure. When devices are measured at +25°C following application of the steady state life or burn-in test condition, they shall be cooled within +10°C of their power stable condition prior to removal of the bias.

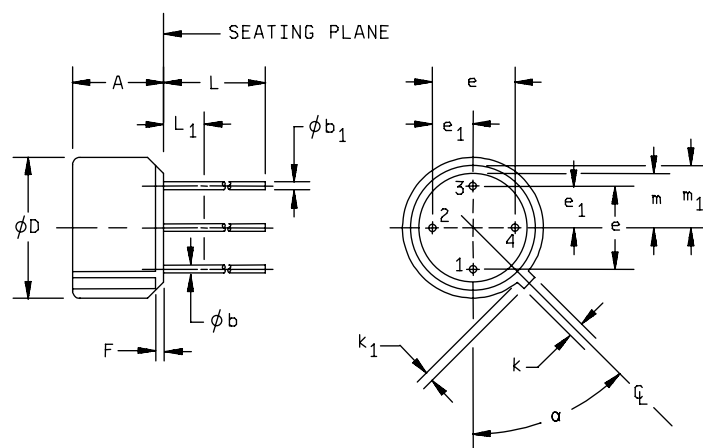


Dimensions					
Symbol	Inches		Millimeters		Notes
	Min	Max	Min	Max	
A	.075	.093	1.90	2.36	
ϕb	.016	.019	0.41	0.48	2
ϕb_1	.016	.021	0.41	0.53	2
ϕD	.209	.219	5.31	5.56	
ϕD_1	.178	.195	4.52	4.95	
e	.100	BSC	2.54	BSC	4
e_1	.050	BSC	1.27	BSC	4
F	---	.050	---	1.27	
K	.036	.046	.91	1.17	
K_1	.028	.048	.71	1.22	3
K_2	.009	.041	.23	1.04	
L	.500	---	12.70	---	
L_1	---	.050	---	1.27	
L_2	.250	---	6.35	---	
α	45°	BSC	45°	BSC	4

NOTES:

1. Dimensions are in inches.
2. (All leads) ϕb applies between L_1 and L_2 , ϕb_1 applies between L_2 and .500 (12.70 mm) from the reference plane. Diameter is uncontrolled in L_1 and beyond .500 (12.70 mm) from the reference plane.
3. Measured from the maximum diameter of the product.
4. Leads having a maximum diameter .019 (0.48 mm) measured in gauging plane .054 (1.37 mm) + .001 (.03 mm) - .000 (.00 mm) below the base plane of the product shall be within .007 (.18 mm) of their true position relative to a maximum width tab.
5. The product may be measured by direct methods or by gauge.
6. Metric equivalents are given for general information only.

FIGURE 1. Case outline X.

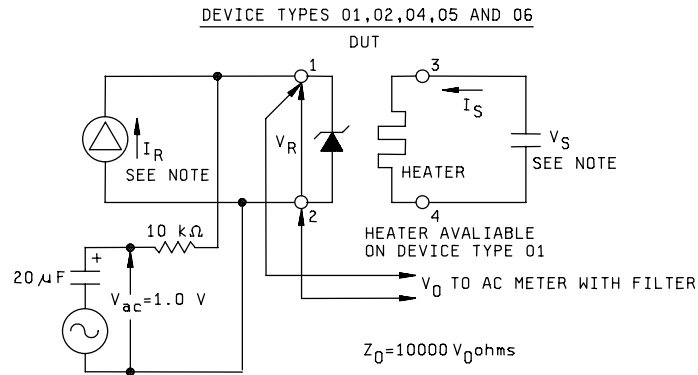


Dimensions					
Symbol	Inches		Millimeters		Notes
	Min	Max	Min	Max	
A	.224	.234	5.69	5.94	
ϕb	.016	.019	0.41	0.48	
ϕb_1	.016	.021	0.41	0.53	2
ϕD	.398	.409	10.11	10.39	
e	.100	BSC	2.54	BSC	4
e_1	.050	BSC	1.27	BSC	4
F	.010	BSC	0.25	BSC	
k	.047	BSC	1.19	BSC	
k_1	.008	BSC	0.20	BSC	3
L	.400	---	10.16	---	
L_1	.200	---	5.08	---	
m	.145	BSC	3.68	BSC	
m_1	.175	BSC	4.44	BSC	
α	45°	BSC	45°	BSC	4

NOTES:

1. Dimensions are in inches.
2. (All leads) ϕb applies between L_1 and the seating plane. ϕb_1 applies between L_1 and .400 (10.16 mm) from the seating plane.
3. Measured from the maximum diameter of the product.
4. Leads having a maximum diameter .019 (0.48 mm) measured in gauging plane .054 (1.37 mm) + .001 (.03 mm) - .000 (.00 mm) below the base plane of the product shall be within .007 (.18 mm) of their true position relative to a maximum width tab.
5. The product may be measured by direct methods or by gauge.
6. Metric equivalents are given for general information only.

FIGURE 1. Case outline Y.



NOTES: Test conditions for reference device current, I_R , and for heater voltage, V_S are defined in table III.

FIGURE 3. Dynamic impedance test circuit.

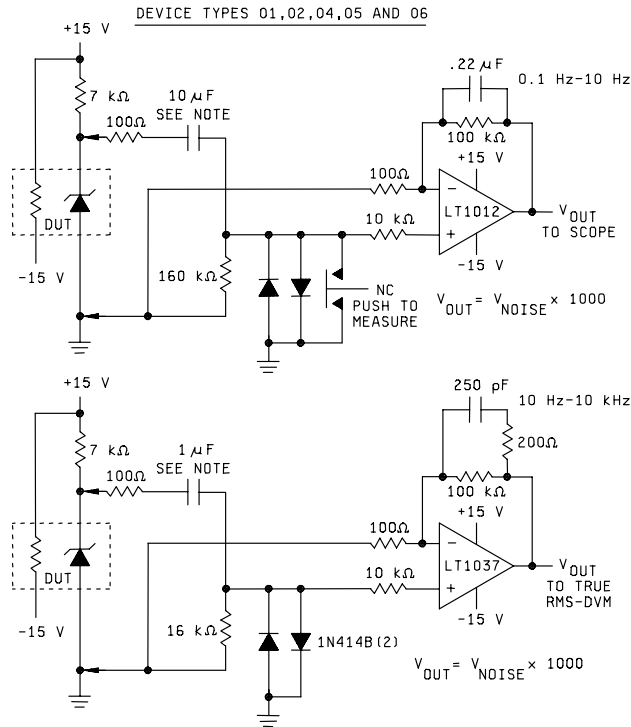
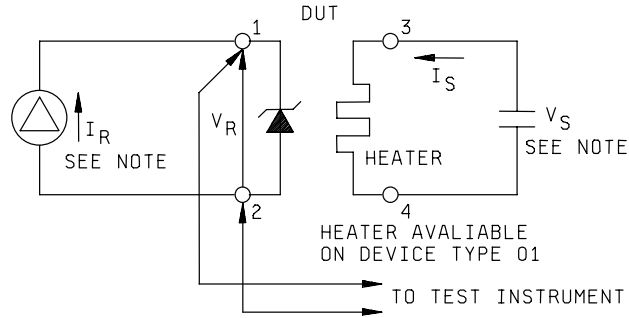


FIGURE 4. Noise test circuit.

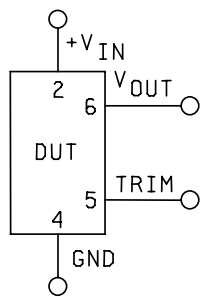
DEVICE TYPES 01,02,04,05 AND 06



NOTE: Test conditions for reference device current, I_R , and for heater voltage, V_S are defined in table III.

FIGURE 5. Reference voltage.

DEVICE TYPE 03



DEVICE TYPES 07,08 AND 09

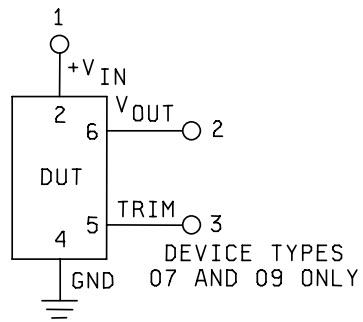
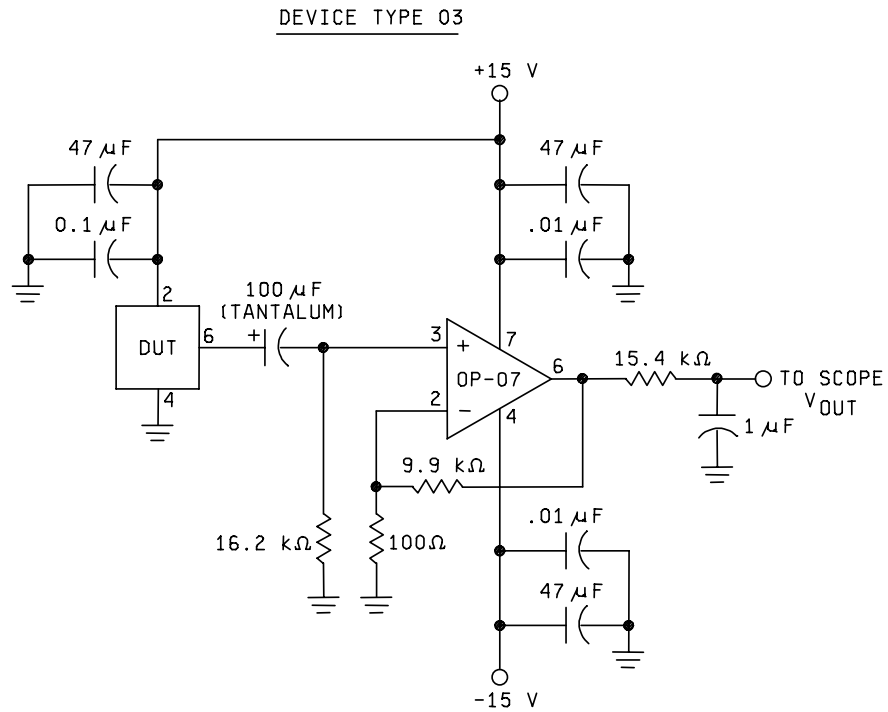


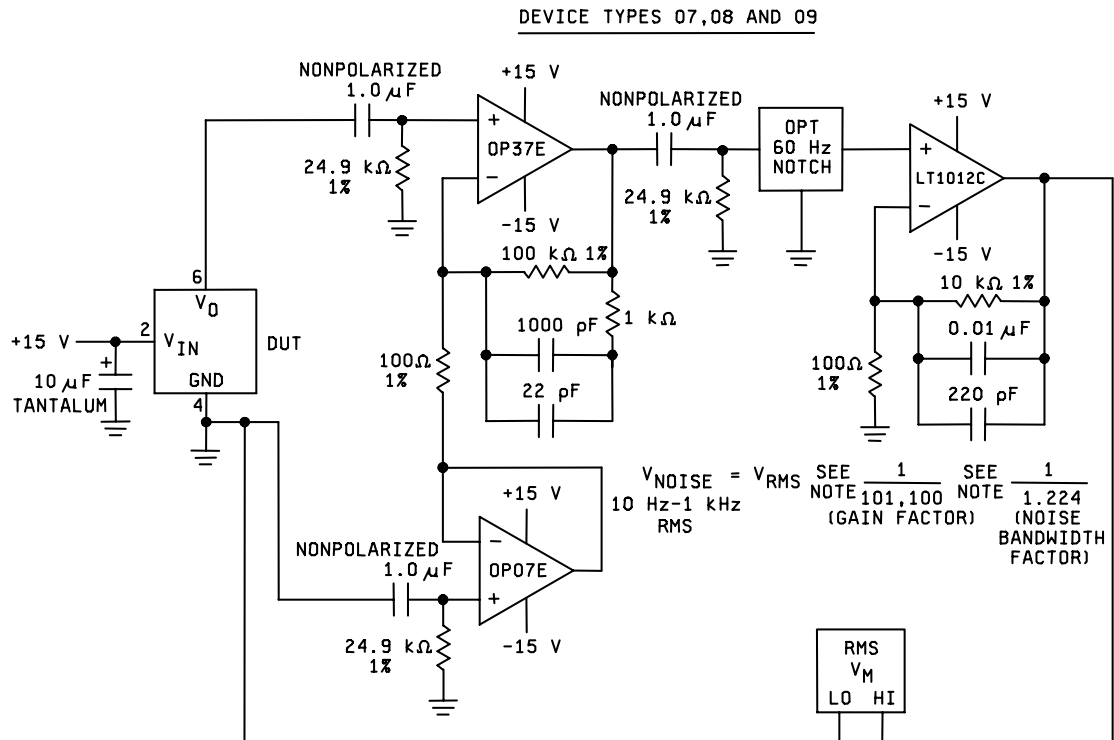
Figure 6. Test circuit for static tests.



NOTES:

1. Test time = 10 seconds.
2. V_{OUT} measured with differential amplifier 7A22 and lower frequency set to 0.1 Hz.

Figure 7. Low frequency noise test circuit.

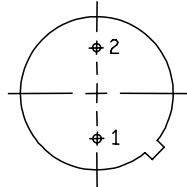


NOTE: The 60 Hz notch filter is used in noisy environments.

Figure 7. Low frequency noise test circuit – Continued.

DEVICE TYPE 02 AND 06

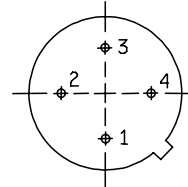
CASE X



BOTTOM VIEW

DEVICE TYPES 01,04 AND 05

CASE Y



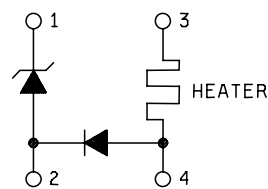
BOTTOM VIEW

DEVICE TYPE 02 AND 06



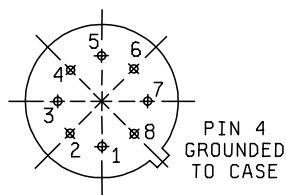
CIRCUIT DIAGRAM

DEVICE TYPES 01,04 AND 05



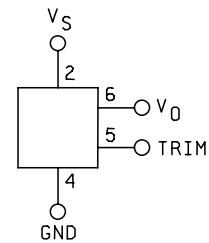
DEVICE TYPES 03,07,08 AND 09

CASE G



BOTTOM VIEW

DEVICE TYPES 03,07,08 AND 09



CIRCUIT DIAGRAM

NOTES:

1. No trim pin on device type 08 (do not connect external circuitry to pin 5).
2. For device types 07, 08, and 09, pins 1, 3, 7, and 8 are connected internally. Do not connect external circuitry to these pins.

FIGURE 8. Circuit diagrams and terminal connections.

TABLE III. Group A inspection for all device type 01.

Subgroup	Symbol	Test no.	Conditions see figures 3, 4, and 5 unless otherwise specified		Measured value	Equations	Limit		Unit
			Voltage	Current			Min	Max	
1 T _A = +25°C	VR1	1	V _S = 30 V	I _R = .5 mA			6.80	7.10	V
	VR2	2	V _S = 30 V	I _R = 1.0 mA			6.80	7.10	
	VR3	3	V _S = 30 V	I _R = 10 mA			6.80	7.10	
	ΔVR current	4	V _S = 30 V	.5 mA ≤ I _R ≤ 10 mA		ΔVR = VR1 – VR3	-9	9	mV
2 T _A = +85°C	No	5	V _S = 30 V BW = 10 Hz to 10 kHz	I _R = 1.0 mA/N	VR4	O = VR4	0	20	μV RMS
	I _S	6	V _S = 40 V	I _R = 0 mA			4	20	mA
	ΔVR / ΔT	7	V _S = 30 V	I _R = 1.0 mA	VR5		---	---	---
	ΔVR current	8	V _S = 30 V	I _R = 0.5 mA	VR6	ΔVR = VR6 – VR7	-12	12	mV
3 T _A = +125°C	ΔVR / ΔT	9	V _S = 30 V	I _R = 10 mA	VR7				
		10	V _S = 30 V	I _R = 1.0 mA	VR8	ΔVR / ΔT = (VR8 - VR5) / 40	-10	10	ppm / °C
	ΔVR current	11	V _S = 30 V	I _R = 0.5 mA	VR9	ΔVR = VR9 – VR10	-12	12	mV
	ΔVR / ΔT	12	V _S = 30 V	I _R = 10 mA	VR10				
4 T _A = -55°C		13	V _S = 30 V	I _R = 1.0 mA	VR11	ΔVR / ΔT = (VR11 - VR5) / 140	-0.5	0.5	ppm / °C
	I _S	14	V _S = 40 V	I _R = 0 mA			6	40	mA
	No	15	V _S = 30 V BW = 0.1 Hz to 10 Hz	I _R = 1.0 mA N	VR12	O = VR12	0	50	μVp-p
	I _{S11}	16	V _S = 40 V	I _R = 0 mA			---	200	mA
T _A = +25°C	I _{S12}	17	V _S = 9 V	I _R = 0 mA					
	ΔVR 1/ temp cycle	18	V _S = 30 V	I _R = 1 mA	VR13	ΔVR = VR13 – VR14	-10	10	mV
		19	V _S = 30 V	I _R = 1 mA	VR14				
		20	V _S = 30 V	I _R = 1 mA	VR15	ΔVR = VR14 – VR15	-10	10	

1/ Following the measurement (VR13), the temperature T_A shall be cycled to +125°C for 1 hour and returned to +25°C for measurement (VR14). Following the measurement (VR14), the temperature T_A shall be cycled to -55°C for 1 hour and returned to +25°C for measurement (VR15).

TABLE III. Group A inspection for all device type 02.

Subgroup	Symbol	Test no.	Conditions see figures 3, 4, and 5 unless otherwise specified		Measured value	Equations	Limits		Unit
			Voltage	Current			Min	Max	
1 $T_A = +25^\circ\text{C}$	VR1	1		$I_R = .6 \text{ mA}$			6.70	7.20	V
	VR2	2		$I_R = 1.0 \text{ mA}$			6.70	7.20	
	VR3	3		$I_R = 15 \text{ mA}$			6.70	7.20	
	ΔV_R current	4		$.6 \text{ mA} \leq I_R \leq 15 \text{ mA}$		$\Delta V_R = V_{R1} - V_{R3}$	-14	14	mV
2 $T_A = +125^\circ\text{C}$	No	5		$I_R = 1.0 \text{ mA N}$	VR4	$O = V_{R4}$	0	20	$\mu\text{V RMS}$
	ΔV_R current	6	BW = 10 Hz to 10 kHz	$I_R = 0.6 \text{ mA}$	VR5	$\Delta V_R = V_{R5} - V_{R6}$	-18	18	mV
	$\Delta V_R / \Delta T$	7		$I_R = 15 \text{ mA}$	VR6				
	$\Delta V_R / \Delta T$	8		$I_R = 1.0 \text{ mA}$	VR7	$\Delta V_R / \Delta T = (V_{R7} - V_{R2}) / 100$	-10	10	ppm / $^\circ\text{C}$
3 $T_A = -55^\circ\text{C}$	ΔV_R current	9		$I_R = 0.6 \text{ mA}$	VR8	$\Delta V_R = V_{R8} - V_{R9}$	-18	18	mV
	$\Delta V_R / \Delta T$	10		$I_R = 15 \text{ mA}$	VR9				
	$\Delta V_R / \Delta T$	11		$I_R = 1.0 \text{ mA}$	VR10	$\Delta V_R / \Delta T = (V_{R2} - V_{R10}) / 80$	-10	10	ppm / $^\circ\text{C}$
	No	12	BW = 0.1 Hz to 10 Hz	$I_R = 1.0 \text{ mA N}$	VR11	$O = V_{R11}$	0	50	$\mu\text{Vp-p}$
4 $T_A = +25^\circ\text{C}$	$\Delta V_R \frac{1}{\text{temp}}$ cycle	13		$I_R = 1.0 \text{ mA}$	VR12	$\Delta V_R = V_{R12} - V_{R13}$	-1	1	mV
		14		$I_R = 1.0 \text{ mA}$	VR13	$\Delta V_R = V_{R13} - V_{R14}$	-1	1	

1/ Following the measurement (VR12), the temperature T_A shall be cycled to $+125^\circ\text{C}$ for 1 hour and returned to $+25^\circ\text{C}$ for measurement (VR13). Following the measurement (VR13), the temperature T_A shall be cycled to -55°C for 1 hour and returned to $+25^\circ\text{C}$ for measurement (VR14).

TABLE III. Group A inspection for all device type 03.

Subgroup	Symbol	Test no.	Conditions see figures 6 and 7 unless otherwise specified		Measured value	Equations	Limits		Unit
			Voltage	Current			Min	Max	
1 T _A = +25°C	I _{CC}	1	V _S = 15 V	I _L = 0 mA			---	1.4	mA
	V _O	2	V _S = 15 V	I _L = 0 mA	V ₁		9.970	10.030	V
	V _O adj+	3	TRIM 10 V		V ₂	(V ₁ - V ₂) 10	0.3	---	V
	V _O adj-	4	TRIM 10 V		V ₃	(V ₁ - V ₃) 10	---	-0.3	V
	V _R LINE	5	V _S = 15 V	I _L = 0 mA			-0.010	0.010	% / V
		6	V _S = 13 V	I _L = 0 mA	V ₄	LINE = [(V ₄ - V ₅) / (10 V) (20 V)] x 100			
			V _S = 33 V	I _L = 0 mA	V ₅				
	V _R LOAD	7	V _S = 15 V	I _L = 0 mA	V ₆	LINE = [(V ₆ - V ₇) / (10 V) (10 mA)] x 100	-0.008	0.008	% / mA
		8	V _S = 15 V	I _L = 10 mA	V ₇				
2 T _A = +125°C	I _{OS}	9	V _S = 15 V				---	50	mA
			V _O = 15 V						
	I _{CC}	10	V _S = 15 V	I _L = 0 mA			---	2.0	mA
	V _O	11	V _S = 15 V	I _L = 0 mA	V ₈		9.958	10.0420	V
	V _R LINE	12	V _S = 15 V	I _L = 0 mA	V ₉	R _{LINE} = [(V ₉ - V ₁₀) / (10 V) (20 V)] x 100	-0.015	0.015	% / V
		13	V _S = 33 V	I _L = 0 mA	V ₁₀				
	V _R LOAD	14	V _S = 15 V	I _L = 0 mA	V ₁₁	R _{LOAD} = [(V ₁₁ - V ₁₂) / (10 V) (8 mA)] x 100	-0.012	0.012	%/mA
		15	V _S = 15 V	I _L = 8 mA	V ₁₂				
	ΔV _{OUT} /ΔT	16	V _S = 15 V	I _L = 0 mA	V ₁₃	ΔV _{OUT} /ΔT = [(V ₁₃ - V ₁) / (100°C) (10 V)] x 10 ⁶	-12	12	ppm / °C
3 T _A = -55°C	I _{CC}	17	V _S = 15 V	I _L = 0 mA			---	2.0	mA
	V _O	18	V _S = 15 V	I _L = 0 mA	V ₁₄		9.962	10.038	V
	V _R LINE	19	V _S = 13 V	I _L = 0 mA	V ₁₅	LINE = [(V ₁₅ - V ₁₆) / (10 V) (20 V)] x 100	-0.015	0.015	% / V
		20	V _S = 33 V	I _L = 0 mA	V ₁₆				
	V _R LOAD	21	V _S = 15 V	I _L = 0 mA	V ₁₇	R _{LOAD} = [(V ₁₇ - V ₁₈) / (10 V) (8 mA)] x 100	-0.012	0.012	% / mA
		22	V _S = 15 V	I _L = 8 mA	V ₁₈				
	ΔV _{OUT} /ΔT	23	V _S = 15 V	I _L = 0 mA	V ₁₉	ΔV _{OUT} /ΔT = [(V ₁ - V ₁₉) / (80°C) (10 V)] x 10 ⁶	-10	10	ppm / °C
4 T _A = +25°C	θ _{np-p}	24	V _S = 15 V BW = 0.1 Hz to 10 Hz	I _L = 0 mA			---	30	μVp-p
5 T _A = +40°C	V _{LTD}	25	V _S = 15 V	I _L = 0 mA		Device under continuous power for 1000 hours.	-50	50	ppm / 1000 hrs

TABLE III. Group A inspection for all device type 04.

Subgroup	Symbol	Test no.	Conditions see figures 3, 4, and 5 unless otherwise specified		Measured value	Equations	Limits		Unit
			Voltage	Current			Min	Max	
1 T _A = +25°C	VR1	1	V _S = 30 V	I _R = .5 mA			6.80	7.10	V
	VR2	2	V _S = 30 V	I _R = 1.0 mA			6.80	7.10	
	VR3	3	V _S = 30 V	I _R = 10 mA			6.80	7.10	
	ΔVR current	4	V _S = 30 V	.5 mA ≤ I _R ≤ 10 mA		ΔVR = VR1 – VR3	-9	9	mV
2 T _A = +85°C	No	5	V _S = 30 V BW = 10 Hz to 10 kHz	I _R = 1.0 mA _N	VR4	O = VR4	0	20	μV RMS
	I _S	6	V _S = 40 V	I _R = 0 mA			4	20	mA
	ΔVR / ΔT	7	V _S = 30 V	I _R = 1.0 mA	VR5		---	---	---
	ΔVR current	8	V _S = 30 V	I _R = 0.5 mA	VR6	ΔVR = VR6 – VR7	-12	12	mV
3 T _A = -55°C	ΔVR / ΔT	9	V _S = 30 V	I _R = 10 mA	VR7				
		10	V _S = 30 V	I _R = 1.0 mA	VR8	ΔVR / ΔT = (VR8 - VR5) / 40	-15	15	ppm / °C
	ΔVR current	11	V _S = 30 V	I _R = 0.5 mA	VR9	ΔVR = VR9 – VR10	-12	12	mV
	ΔVR / ΔT	12	V _S = 30 V	I _R = 10 mA	VR10				
4 T _A = +25°C	ΔVR / ΔT	13	V _S = 30 V	I _R = 1.0 mA	VR11	ΔVR / ΔT = (VR11 - VR5) / 140	-1.0	1.0	ppm / °C
	I _S	14	V _S = 40 V	I _R = 0 mA			6	40	mA
	No	15	V _S = 30 V BW = 0.1 Hz to 10 Hz	I _R = 1.0 mA _N	VR12	O = VR12	0	50	μVp-p
	I _{S1}	16	V _S = 40 V	I _R = 0 mA			---	200	mA
	I _{S2}	17	V _S = 9 V	I _R = 0 mA					
	ΔVR 1/ temp cycle	18	V _S = 30 V	I _R = 1 mA	VR13	ΔVR = VR13 – VR14	-10	10	mV
		19	V _S = 30 V	I _R = 1 mA	VR14		-10	10	
		20	V _S = 30 V	I _R = 1 mA	VR15	ΔVR = VR14 – VR15	-10	10	

1/ Following the measurement (VR13), the temperature T_A shall be cycled to +125°C for 1 hour and returned to +25°C for measurement (VR14). Following the measurement (VR14), the temperature T_A shall be cycled to -55°C for 1 hour and returned to +25°C for measurement (VR15).

TABLE III. Group A inspection for all device type 05.

Subgroup	Symbol	Test no.	Conditions see figures 3, 4, and 5 unless otherwise specified		Measured value	Equation	Limits		Unit
			Voltage	Current			Min	Max	
1 T _A = +25°C	VR1	1	V _S = 30 V	I _R = .5 mA			6.80	7.10	V
	VR2	2	V _S = 30 V	I _R = 1.0 mA			6.80	7.10	
	VR3	3	V _S = 30 V	I _R = 10 mA			6.80	7.10	
	ΔV _R current	4	V _S = 30 V	.5 mA ≤ I _R ≤ 10 mA		ΔV _R = V _{R1} – V _{R3}	-9	9	mV
	NO	5	V _S = 30 V BW = 10 Hz to 10 kHz	I _R = 1.0 mA _N	V _{R4}	O = V _{R4}	0	20	
2 T _A = +85°C	I _S	6	V _S = 40 V	I _R = 0 mA			4	20	mA
	ΔV _R / ΔT	7	V _S = 30 V	I _R = 1.0 mA	V _{R5}		---	---	---
	ΔV _R current	8	V _S = 30 V	I _R = 0.5 mA	V _{R6}	ΔV _R = V _{R6} – V _{R7}	-12	12	mV
T _A = -55°C	ΔV _R / ΔT	9	V _S = 30 V	I _R = 10 mA	V _{R7}				ppm / °C
		10	V _S = 30 V	I _R = 1.0 mA	V _{R8}	ΔV _R / ΔT = (V _{R8} - V _{R5}) / 40	-10	10	
	ΔV _R current	11	V _S = 30 V	I _R = 0.5 mA	V _{R9}	ΔV _R = V _{R9} – V _{R10}	-12	12	mV
T _A = +25°C	ΔV _R / ΔT	12	V _S = 30 V	I _R = 10 mA	V _{R10}				ppm / °C
		13	V _S = 30 V	I _R = 1.0 mA	V _{R11}	ΔV _R / ΔT = (V _{R11} - V _{R5}) / 140	-0.5	0.5	
	I _S	14	V _S = 40 V	I _R = 0 mA			6	40	mA
T _A = +25°C	NO	15	V _S = 30 V BW = 0.1 Hz to 10 Hz	I _R = 1.0 mA N	V _{R12}	O = V _{R12}	0	50	μVp-p
	I _{S11}	16	V _S = 40 V	I _R = 0 mA			---	200	mA
	I _{S12}	17	V _S = 9 V	I _R = 0 mA					
	ΔV _R 1/ temp cycle	18	V _S = 30 V	I _R = 1 mA	V _{R13}	ΔV _R = V _{R13} – V _{R14}	-10	10	mV
		19	V _S = 30 V	I _R = 1 mA	V _{R14}	ΔV _R = V _{R14} – V _{R15}	-10	10	
T _A = +25°C	ΔV _R / Δtime	20	V _S = 30 V	I _R = 1 mA	V _{R15}	ΔV _R = V _{R16} – V _{R2}	-20	20	ppm / 600 hrs
		21	V _S = 30 V	I _R = 1 mA	V _{R16}				

1/ Following the measurement (V_{R13}), the temperature T_A shall be cycled to +125°C for 1 hour and returned to +25°C for measurement (V_{R14}). Following the measurement (V_{R14}), the temperature T_A shall be cycled to -55°C for 1 hour and returned to +25°C for measurement (V_{R15}).

TABLE III. Group A inspection for all device type 06.

Subgroup	Symbol	Test no.	Conditions see figures 3, 4, and 5 unless otherwise specified		Measured value	Equation	Limits		Unit
			Voltage	Current			Min	Max	
1 $T_A = +25^\circ\text{C}$	VR1	1		$I_R = .6 \text{ mA}$			6.70	7.20	V
	VR2	2		$I_R = 1.0 \text{ mA}$			6.70	7.20	
	VR3	3		$I_R = 15 \text{ mA}$			6.70	7.20	
	ΔV_R current	4		$.6 \text{ mA} \leq I_R \leq 15 \text{ mA}$		$\Delta V_R = V_{R1} - V_{R3}$	-14	14	mV
2 $T_A = +125^\circ\text{C}$	No	5	$BW = 10 \text{ Hz to } 10 \text{ kHz}$	$I_R = 1.0 \text{ mA N}$	V_{R4}	$O = V_{R4}$	0	20	$\mu\text{V RMS}$
	ΔV_R current	6		$I_R = 0.6 \text{ mA}$	V_{R5}	$\Delta V_R = V_{R5} - V_{R6}$	-18	18	mV
		7		$I_R = 15 \text{ mA}$	V_{R6}				
	$\Delta V_R / \Delta T$	8		$I_R = 1.0 \text{ mA}$	V_{R7}	$\Delta V_R / \Delta T = (V_{R7} - V_{R2}) / 100$	-20	20	ppm / $^\circ\text{C}$
3 $T_A = -55^\circ\text{C}$	ΔV_R current	9		$I_R = 0.6 \text{ mA}$	V_{R8}	$\Delta V_R = V_{R8} - V_{R9}$	-18	18	mV
		10		$I_R = 15 \text{ mA}$	V_{R9}				
	$\Delta V_R / \Delta T$	11		$I_R = 1.0 \text{ mA}$	V_{R10}	$\Delta V_R / \Delta T = (V_{R2} - V_{R10}) / 80$	-20	20	ppm / $^\circ\text{C}$
	No	12	$BW = 0.1 \text{ Hz to } 10 \text{ Hz}$	$I_R = 1.0 \text{ mA N}$	V_{R11}	$O = V_{R11}$	0	50	$\mu\text{Vp-p}$
4 $T_A = +25^\circ\text{C}$	ΔV_R $\overline{1/}$ temp cycle	13		$I_R = 1 \text{ mA}$	V_{R12}	$\Delta V_R = V_{R12} - V_{R13}$	-1	1	mV
		14		$I_R = 1 \text{ mA}$	V_{R13}	$\Delta V_R = V_{R13} - V_{R14}$	-1	1	
		15		$I_R = 1 \text{ mA}$	V_{R14}				

1/ Following the measurement (V_{R12}), the temperature T_A shall be cycled to $+125^\circ\text{C}$ for 1 hour and returned to $+25^\circ\text{C}$ for measurement (V_{R13}). Following the measurement (V_{R13}), the temperature T_A shall be cycled to -55°C for 1 hour and returned to $+25^\circ\text{C}$ for measurement (V_{R14}).

TABLE III. Group A inspection for all device type 07.

Subgroup	Symbol	Test no.	Measurement value	Adapter pin number see figure 6			Pin measurement	Equation	Limits		Unit
				1	2	3			Min	Max	
1 T _A = +25°C	I _{CC}	1	I ₁	10 V	0 mA	0 mA	1	I _{CC} = I ₁	---	1.2	mA
	V _O <u>1/</u>	2	V ₁	10 V	0 mA	0 mA	2	V _O = V ₁	4.950	5.050	V
	V _{RLINE} <u>2/</u>	3	V ₂	7.2 V	0 mA	0 mA	2	V _{RLINE} = V ₁ - V ₂	-0.17	0.17	mV
		4	V ₃	40 V	0 mA	0 mA	2	V _{RLINE} = V ₁ - V ₃	-0.9	0.9	mV
	V _{RLOAD} <u>3/</u>	5	V ₄	10 V	0 mA	0 mA	2				
		6	V ₅	10 V	10 mA	0 mA	2	V _{RLOAD} = V ₄ - V ₅	-5.0	5.0	mV
		7	V ₆	10 V	-10 mA	0 mA	2	V _{RLOAD} = V ₄ - V ₆	-1.0	1.0	mV
2 T _A = +125°C	V _{TRIM}	8	V ₇	10 V	0 mA	0 mA	3	V _{TRIM} = V ₇	3.5	---	V
	I _{OS}	9	I ₂	10 V	0 V	0 mA	2	I _{OS} = I ₂	-50	---	mA
	I _{CC}	10	I ₃	10 V	0 mA	0 mA	1	I _{CC} = I ₃	---	1.5	mA
	V _O <u>1/</u>	11	V ₈	10 V	0 mA	0 mA	2	V _O = V ₈	4.9475	5.0525	V
	V _{RLINE} <u>2/</u>	12	V ₉	7.2 V	0 mA	0 mA	2	V _{RLINE} = V ₈ - V ₉	-0.28	0.28	mV
		13	V ₁₀	40 V	0 mA	0 mA	2	V _{RLINE} = V ₈ - V ₁₀	-1.5	1.5	mV
	V _{RLOAD} <u>3/</u>	14	V ₁₁	10 V	0 mA	0 mA	2				
3 T _A = -55°C		15	V ₁₂	10 V	10 mA	0 mA	2	V _{RLOAD} = V ₁₁ - V ₁₂	-7.5	7.5	mV
		16	V ₁₃	10 V	-10 mA	0 mA	2	V _{RLOAD} = V ₁₁ - V ₁₃	-1.75	1.75	mV
	ΔV _O / ΔT	17						ΔV _O / ΔT = (V ₈ - V ₁) / 100	---	5	ppm/°C
	I _{CC}	18	I ₄	10 V	0 mA	0 mA	1	I _{CC} = I ₄	---	1.5	mA
	V _O <u>1/</u>	19	V ₁₄	10 V	0 mA	0 mA	2	V _O = V ₁₄	4.948	5.052	V
	V _{RLINE} <u>2/</u>	20	V ₁₅	7.2 V	0 mA	0 mA	2	V _{RLINE} = V ₁₄ - V ₁₅	-0.28	0.28	mV
		21	V ₁₆	40 V	0 mA	0 mA	2	V _{RLINE} = V ₁₄ - V ₁₆	-1.5	1.5	mV
4 T _A = +25°C	V _{RLOAD} <u>3/</u>	22	V ₁₇	10 V	0 mA	0 mA	2				
		23	V ₁₈	10 V	10 mA	0 mA	2	V _{RLOAD} = V ₁₇ - V ₁₈	-7.5	7.5	mV
		24	V ₁₉	10 V	-10 mA	0 mA	2	V _{RLOAD} = V ₁₇ - V ₁₉	-1.75	1.75	mV
	ΔV _O / ΔT	25						ΔV _O / ΔT = (V ₁₄ - V ₁) / 80	---	5	ppm/°C
	No <u>3/</u>	26	N ₁	15 V	0 mA	0 mA	---	See figure 7		3.5	μV RMS

1/ Reference voltage is measured immediately after device is turned ON. Changes due to chip warm up are typically less than 0.005 percent.

2/ Line and load regulation are measured on a pulse basis. Pulse is not to exceed 30 ms.

3/ RMS noise is measured with a two pole high pass filter at 10 Hz and a two pole low pass filter at 1 kHz.

TABLE III. Group A inspection for all device type 08.

Subgroup	Symbol	Test no.	Measurement value	Adapter pin number see figure 6		Pin measurement	Equation	Limits		Unit
				1	2			Min	Max	
1 T _A = +25°C	I _{CC}	1	I ₁	12 V	0 mA	1	I _{CC} = I ₁	---	1.2	mA
	V _O <u>1/</u>	2	V ₁	12 V	0 mA	2	V _O = V ₁	6.950	7.050	V
	V _{RLINE} <u>2/</u>	3	V ₂	8.5 V	0 mA	2	V _{RLINE} = V ₁ - V ₂	-0.1	0.1	mV
		4	V ₃	40 V	0 mA	2	V _{RLINE} = V ₁ - V ₃	-0.39	0.39	mV
	V _{RLOAD} <u>3/</u>	5	V ₄	12 V	0 mA	2				
		6	V ₅	12 V	-10 mA	2	V _{RLOAD} = V ₄ - V ₅	-1.75	1.75	mV
	I _{MIN}	7	V ₆	0 mA	2 mA	2	V ₇ = V ₆ - 50 mV	---	---	mA
		8	I ₂	0 mA	V ₇	2	I _{MIN} = I ₂		1	
	V _{SHUNT} <u>3/</u>	9	V ₈	0 mA	1.2 mA	2	V _{SHUNT} = V ₉ - V ₈	-6.16	6.16	mV
		10	V ₉	0 mA	10 mA	2				
2	I _{OS}	11	I ₃	12 V	0 V	2	I _{OS} = I ₃	-50	---	mA
	I _{CC}	12	I ₄	12 V	0 mA	1	I _{CC} = I ₄	---	1.5	mA
	V _O <u>1/</u>	13	V ₁₀	12 V	0 mA	2	V _O = V ₁₀	6.9465	7.0535	V
	V _{RLINE} <u>2/</u>	14	V ₁₁	8.5 V	0 mA	2	V _{RLINE} = V ₁₀ - V ₁₁	-0.2	0.2	mV
		15	V ₁₂	40 V	0 mA	2	V _{RLINE} = V ₁₀ - V ₁₂	-0.78	0.78	mV
	V _{RLOAD} <u>3/</u>	16	V ₁₃	12 V	0 mA	2				
		17	V ₁₄	12 V	-10 mA	2	V _{RLOAD} = V ₁₃ - V ₁₄	-2.8	2.8	mV
	I _{MIN}	18	V ₁₅	0 mA	2 mA	2	V ₁₆ = V ₁₅ - 50 mV	---	---	mA
		19	I ₅	0 mA	V ₁₆	2	I _{MIN} = I ₅		1.2	
	V _{SHUNT} <u>3/</u>	20	V ₁₇	0 mA	1.2 mA	2	V _{SHUNT} = V ₁₈ - V ₁₇	-9.24	9.24	mV
3 T _A = -55°C	ΔV _O / ΔT	21	V ₁₈	0 mA	10 mA	2				
		22					ΔV _O / ΔT = (V ₁₀ - V ₁) / 100	---	5	ppm/°C
	I _{CC}	23	I ₆	12 V	0 mA	1	I _{CC} = I ₆	---	1.5	mA
	V _O <u>1/</u>	24	V ₁₉	12 V	0 mA	2	V _O = V ₁₉	6.9472	7.0528	V
	V _{RLINE} <u>2/</u>	25	V ₂₀	8.5 V	0 mA	2	V _{RLINE} = V ₁₉ - V ₂₀	-0.2	0.2	mV
		26	V ₂₁	40 V	0 mA	2	V _{RLINE} = V ₁₉ - V ₂₁	-0.78	0.78	mV
	V _{RLOAD} <u>3/</u>	27	V ₂₂	12 V	0 mA	2				
		28	V ₂₃	12 V	-10 mA	2	V _{RLOAD} = V ₂₂ - V ₂₃	-2.8	2.8	mV
	I _{MIN}	29	V ₂₄	0 mA	2 mA	2	V ₂₅ = V ₂₄ - 50 mV	---	---	mA
		30	I ₇	0 mA	V ₂₅	2	I _{MIN} = I ₇		1.2	
4 T _A = +25°C	V _{SHUNT} <u>3/</u>	31	V ₂₆	0 mA	1.2 mA	2	V _{SHUNT} = V ₂₇ - V ₂₆	-9.24	9.24	mV
		32	V ₂₇	0 mA	10 mA	2				
	ΔV _O / ΔT	33					ΔV _O / ΔT = (V ₁₉ - V ₁) / 80	---	5	ppm/°C
	No <u>4/</u>	34	N ₁	15 V	0 mA	---	See figure 7	---	4	μV RMS

1/ Reference voltage is measured immediately after device is turned ON. Changes due to chip warm up are typically less than 0.005 percent.

2/ Line, load, and shunt mode regulation are measured on a pulse basis. Pulse is not to exceed 30 ms.

3/ Shunt voltage is measured with the input open. With the input connected, the shunt mode current can be reduced to 0 mA. Load regulation will remain the same.

4/ RMS noise is measured with a two pole high pass filter at 10 Hz and a two pole low pass filter at 1 kHz.

TABLE III. Group A inspection for all device type 09.

Subgroup	Symbol	Test no.	Measurement value	Adapter pin number see figure 6			Pin measurement	Equation	Limits		Unit
				1	2	3			Min	Max	
1 T _A = +25°C	I _{CC}	1	I ₁	15 V	0 mA	0 mA	1	I _{CC} = I ₁	---	1.7	mA
	V _O <u>1/</u>	2	V ₁	15 V	0 mA	0 mA	2	V _O = V ₁	9.950	10.050	V
	V _{RLINE} <u>2/</u>	3	V ₂	11.5 V	0 mA	0 mA	2	V _{RLINE} = V ₃ - V ₂ V _{RLINE} = V ₃ - V ₄	-0.12	0.12	mV
		4	V ₃	14.5 V	0 mA	0 mA	2		-0.5	0.5	mV
		5	V ₄	40 V	0 mA	0 mA	2				
2	V _{RLOAD} <u>3/</u>	6	V ₅	15 V	0 mA	0 mA	2	V _{RLOAD} = V ₅ - V ₆ V ₈ = V ₇ - 50 mV	-2.5	2.5	mV
		7	V ₆	15 V	-10 mA	0 mA	2		---	---	mA
	I _{MIN}	8	V ₇	0 mA	2 mA	0 mA	2	I _{MIN} = I ₂	---	1.5	mV
	V _{SHUNT} <u>4/</u>	9	I ₂	0 mA	0 mA	0 mA	2	V _{SHUNT} = V ₉ - V ₁₀ V _{TRIM} = V ₁₁	-8.3	8.3	V
		10	V ₉	0 mA	1.7 mA	0 mA	2		4.3	---	mA
2		11	V ₁₀	0 mA	10 mA	0 mA	2	I _{OS} = I ₃ I _{CC} = I ₄	---	---	mV
	V _{TRIM}	12	V ₁₁	15 V	0 mA	0 mA	3		-50	---	V
	I _{OS}	13	I ₃	15 V	0 V	0 mA	2	V _O = V ₁₂ V _{RLINE} = V ₁₄ - V ₁₃ V _{RLINE} = V ₁₄ - V ₁₅	---	---	mA
	I _{CC}	14	I ₄	15 V	0 mA	0 mA	1		---	2.0	mA
	V _O <u>1/</u>	15	V ₁₂	15 V	0 mA	0 mA	2	V _{RLINE} = V ₁₄ - V ₁₃ V _{RLINE} = V ₁₄ - V ₁₅	9.945	10.055	V
2	V _{RLINE} <u>2/</u>	16	V ₁₃	11.5 V	0 mA	0 mA	2		-0.18	0.18	mV
		17	V ₁₄	14.5 V	0 mA	0 mA	2	V _{RLOAD} = V ₁₇ - V ₁₆ V ₁₉ = V ₁₈ - 50 mV	-1.0	1.0	mV
		18	V ₁₅	40 V	0 mA	0 mA	2		---	---	mA
	V _{RLOAD} <u>3/</u>	19	V ₁₆	15 V	0 mA	0 mA	2	I _{MIN} = I ₅ V _{SHUNT} = V ₂₁ - V ₂₀ ΔV _O / ΔT = (V ₁₂ - V ₁₁) / 100	-4.0	4.0	mV
		20	V ₁₇	15 V	-10 mA	0 mA	2		---	---	mA
2	I _{MIN}	21	V ₁₈	0 mA	2 mA	0 mA	2	V _{SHUNT} = V ₂₁ - V ₂₀ ΔV _O / ΔT = (V ₁₂ - V ₁₁) / 100	---	---	ppm/°C
		22	I ₅	0 mA	V ₁₉	0 mA	2		---	1.7	mV
	V _{SHUNT} <u>4/</u>	23	V ₂₀	0 mA	1.7 mA	0 mA	2	I _{CC} = I ₆ V _O = V ₂₂	-12.4	12.4	mV
		24	V ₂₁	0 mA	10 mA	0 mA	2		---	5	ppm/°C
	ΔV _O / ΔT	25						V _{RLINE} = V ₂₄ - V ₂₃ V _{RLINE} = V ₂₄ - V ₂₅	---	---	mA
3 T _A = -55°C	I _{CC}	26	I ₆	15 V	0 mA	0 mA	1		---	2.0	mV
	V _O <u>1/</u>	27	V ₂₂	15 V	0 mA	0 mA	2	V _{RLOAD} = V ₂₇ - V ₂₆ V ₂₉ = V ₂₈ - 50 mV	9.946	10.054	V
	V _{RLINE} <u>2/</u>	28	V ₂₃	11.5 V	0 mA	0 mA	2		-0.18	0.18	mV
		29	V ₂₄	14.5 V	0 mA	0 mA	2	I _{MIN} = I ₇ V _{SHUNT} = V ₃₁ - V ₃₀ ΔV _O / ΔT = (V ₂₂ - V ₁₁) / 80	-1.0	1.0	mV
		30	V ₂₅	40 V	0 mA	0 mA	2		---	---	mA
2	V _{RLOAD} <u>3/</u>	31	V ₂₆	15 V	0 mA	0 mA	2	V _{SHUNT} = V ₃₁ - V ₃₀ ΔV _O / ΔT = (V ₂₂ - V ₁₁) / 80	-4.0	4.0	mV
		32	V ₂₇	15 V	-10 mA	0 mA	2		---	---	ppm/°C
	I _{MIN}	33	V ₂₈	0 mA	2 mA	0 mA	2	See figure 7	---	1.7	mV
		34	I ₇	0 mA	V ₂₉	0 mA	2		---	---	mA
	V _{SHUNT} <u>4/</u>	35	V ₃₀	0 mA	1.7 mA	0 mA	2	See figure 7	-12.4	12.4	mV
4 T _A = +25°C		36	V ₃₁	0 mA	10 mA	0 mA	2		---	5	ppm/°C
	ΔV _O / ΔT	37							---	6	μV RMS
	No <u>4/</u>	38	N ₁	15 V	0 mA	0 mA	---				

1/ Reference voltage is measured immediately after device is turned ON. Changes due to chip warm up are typically less than 0.005 percent.

2/ Line, load, and shunt mode regulation are measured on a pulse basis. Pulse is not to exceed 30 ms.

3/ Shunt voltage is measured with the input open. With the input connected, the shunt mode current can be reduced to 0 mA. Load regulation will remain the same.

4/ RMS noise is measured with a two pole high pass filter at 10 Hz and a two pole low pass filter at 1 kHz.

TABLE IV. Group C end point electrical parameters. $T_A = 25^\circ\text{C}$

Device type	Characteristics	Symbol	Delta limits <u>1/</u>	Limits		Unit
				Min	Max	
01, 04, 05	Reference voltage $V_S = 30\text{ V}$, $T_A = +25^\circ\text{C}$	V_{R1} , V_{R2} , V_{R3}	$\pm 2\text{ mV}$	6.80	7.10	V
02, 06	Reference voltage $T_A = +25^\circ\text{C}$	V_{R1} , V_{R2} , V_{R3}	$\pm 3\text{ mV}$	6.70	7.20	V
03	Reference voltage $V_S = 15\text{ V}$, $T_A = +25^\circ\text{C}$	V_O	$\pm 3\text{ mV}$	9.970	10.030	V
07	Reference voltage $V_{IN} = 10\text{ V}$, $T_A = +25^\circ\text{C}$	V_O	$\pm 3\text{ mV}$	4.95	5.05	V
08	Reference voltage $V_{IN} = 12\text{ V}$, $T_A = +25^\circ\text{C}$	V_O	$\pm 3\text{ mV}$	6.95	7.05	V
09	Reference voltage $V_{IN} = 15\text{ V}$, $T_A = +25^\circ\text{C}$	V_O	$\pm 3\text{ mV}$	9.95	10.05	V

1/ Delta limits apply to the measured value (see delta limit definition in MIL-PRF-38535).

5. PACKAGING

5.1 Packaging requirements. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department of Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. Microcircuits conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of the specification.
- b. PIN and compliance identifier, if applicable (see 1.2).
- c. Requirements for delivery of one copy of the conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- d. Requirements for certificate of compliance, if applicable.
- e. Requirements for notification of change of product or process to acquiring activity in addition to notification of the qualifying activity, if applicable.
- f. Requirements for failure analysis (including required test condition of MIL-STD-883, method 5003), corrective action and reporting of results, if applicable.
- g. Requirements for product assurance options.
- h. Requirements for special carriers, lead lengths, or lead forming, if applicable. These requirements should not affect the part number. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.
- i. Requirements for "JAN" marking.
- j. Packaging requirements (see 5.1).

6.3 Superseding information. The requirements of MIL-M-38510 have been superseded to take advantage of the available Qualified Manufacturer Listing (QML) system provided by MIL-PRF-38535. Previous references to MIL-M-38510 in this document have been replaced by appropriate references to MIL-PRF-38535. All technical requirements now consist of this specification and MIL-PRF-38535. The MIL-M-38510 specification sheet number and PIN have been retained to avoid adversely impacting existing government logistics systems and contractor's parts lists.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List QML-38535 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DSCC-VQ, 3990 E. Broad Street, Columbus, Ohio 43123-1199.

6.5 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-PRF-38535 and MIL-STD-1331.

6.6 Logistic support. Lead materials and finishes (see 3.3) are interchangeable. Unless otherwise specified, microcircuits acquired for Government logistic support will be acquired to device class B (see 1.2.2), lead material and finish A (see 3.4). Longer length leads and lead forming should not affect the part number.

6.7 Substitutability. The cross-reference information below is presented for the convenience of users. Microcircuits covered by this specification will functionally replace the listed generic-industry type. Generic-industry microcircuit types may not have equivalent operational performance characteristics across military temperature ranges or reliability factors equivalent to MIL-M-38510 device types and may have slight physical variations in relation to case size. The presence of this information should not be deemed as permitting substitution of generic-industry types for MIL-M-38510 types or as a waiver of any of the provisions of MIL-PRF-38535.

<u>Military device type</u>	<u>Generic-industry type</u>
01	LM199A
02	LM129A
03	REF-10
04	LM199
05	LM199A-20
06	LM129B
07	LT1021-5
08	LT1021-7
09	LT1021-10

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:

Army – CR
Navy - EC
Air Force - 11
NASA - NA
DLA – CC

Preparing activity:

DLA - CC

Project 5962-2032

Review activities:

Army - MI, SM
Navy - AS, CG, MC, SH, TD
Air Force – 03, 19, 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIT Online database at www.dodssp.daps.mil.

