

MILITARY SPECIFICATION

MICROCIRCUITS, LINEAR, QUAD OPERATIONAL AMPLIFIERS, MONOLITHIC SILICON

Reactivated after 20 August 2003 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, quad operational amplifiers. Two product assurance classes and a choice of case outlines and lead finish are provided for each type 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 For this product, the requirements of MIL-M-38510 have been superseded by MIL-PRF-38535, (see 6.3).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 number. The complete part number should be in accordance with MIL-PRF-38535.

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

<u>Device type</u>	<u>Circuit</u>
01 <u>1/</u>	Quad operational amplifier, medium power
02 <u>2/</u>	Quad operational amplifier, medium power, under compensated version of device type 01
03	Quad operational amplifier, medium speed, low noise
04	Quad operational amplifier medium speed, low noise (alternate pin out)
05 <u>3/</u>	Quad operational amplifier, single supply, low power
06 <u>3/</u>	Quad operational amplifier, single supply, low power

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

- 1/ Devices may be monolithic or they consist of two separate independent die.
- 2/ Device type 02 wideband amplifier is under compensated and can only be used with a closed loop gain of five or greater.
- 3/ Device types 05 and 06, single supply amplifiers, can be used with dual supplies, however, because of its class B output stage, the crossover distortion in the output signal may be unacceptable for the application.

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@dsc.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.

AMSC N/A

FSC 5962

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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

<u>Outline letter</u>	<u>Descriptive designator</u>	<u>Terminals</u>	<u>Package style</u>
A <u>4/</u>	GDFP5-F14 or CDFP6-F14	14	Flat pack
C	GDIP1-T14 or CDIP2-T14	14	Dual-in-line
D	GDFP1-F14 or CDFP2-F14	14	Flat pack
Z	GDFP1-G14	14	Flat pack with gullwing leads

1.3 Absolute maximum ratings.

Supply voltage range :

Device types 01, 02, 03, and 04	± 22 V dc <u>5/</u>
Device types 05 and 06	36 V or ± 18 V <u>5/</u>

Input voltage range:

Device types 01, 02, 03, and 04	± 20 V dc <u>6/</u>
Device types 05 and 06	$-V_{CC} - 0.3$ V to $+V_{CC}$

Differential input voltage range ± 30 V dc 7/

Input current range:

Device types 01 and 02	-0.1 mA to +10 mA
Device types 03, 04, 05, and 06	10 mA to +0.1 mA

Storage temperature range -65°C to $+150^{\circ}\text{C}$

Output short-circuit duration Unlimited 8/

Lead temperature (soldering, 60 seconds) $+300^{\circ}\text{C}$

Junction temperature (T_J) $+175^{\circ}\text{C}$ 9/

Thermal resistance, junction-to-case (θ_{JC}) :

Cases A, C, D, and Z	See MIL-STD-1835
----------------------------	------------------

1.4 Recommended operating conditions.

Supply voltage range:

Device types 01, 02, 03, and 04	± 5 V dc to ± 20 V dc
Device types 05 and 06	± 5 V dc to $+30$ V dc

Ambient temperature range (T_A) -55°C to $+125^{\circ}\text{C}$

4/ Inactive package case outline.

5/ Voltages in excess of these may be applied for short-term tests if voltage difference does not exceed 44 volts (36 volts for device types 05 and 06).

6/ For device types 01 through 04, for supply voltages less than ± 20 V dc, the absolute maximum input voltage is equal to the supply voltage. For device types 05 and 06, for supply voltages differences of less than 36 V, the absolute maximum input voltage is equal to the supply voltage.

7/ The differential input voltage range should not exceed the supply voltage range.

8/ Short circuit may be to ground or either supply. Rating applies to $+125^{\circ}\text{C}$ case temperature or $+75^{\circ}\text{C}$ ambient temperature.

9/ For short term test (in the specific burn-in and life test configuration when required and up to 168 hours maximum) $T_J = +275^{\circ}\text{C}$.

1.5 Power and thermal characteristics.

Case outlines	Maximum allowable power dissipation	Maximum θ_{JC}	Maximum θ_{JA}
A, D	350 mW at $T_A = +125^\circ\text{C}$	60°C/W	140°C/W
C	400 mW at $T_A = +125^\circ\text{C}$	35°C/W	120°C/W
Z	350 mW at $T_A = +125^\circ\text{C}$	25°C/W	176°C/W still air
			116°C/W 500 LFPM

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATION

DEPARTMENT OF DEFENSE

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

STANDARDS

DEPARTMENT OF DEFENSE

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

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

(Unless otherwise indicated, copies of the above specifications and standards are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this document 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 Terminal connections. The terminal connections shall be as specified on figure 1.

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 upon request.

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

3.3.4 Packaging and sealing material. Package and sealing material shall be in accordance with MIL-PRF-38535.

3.4 Lead material and finish. Lead material and finish shall be in accordance with MIL-PRF-38535.

3.5 Electrical performance characteristics. The following electrical performance characteristics are as specified in table I, and apply over the full ambient operating temperature range of -55°C to $+125^{\circ}\text{C}$ and for supply voltages as follows. Unless otherwise specified, source resistance (R_S) shall be $50\ \Omega$ for all tests.

Device types 01, 02, 03, and 04 will have a dual power supply with $\pm V_{CC}$ (min) at $\pm 5\ \text{V}$ and $\pm V_{CC}$ (max) at $\pm 20\ \text{V}$.

Device types 05 and 06 will have a single power supply with $\pm V_{CC}$ (min) at $\pm 5\ \text{V}$ and $\pm V_{CC}$ (max) at $\pm 30\ \text{V}$.

3.5.1 Instability oscillations. The devices shall be free of oscillations when operated in the test circuits of this specifications.

3.6 Electrical test requirements. 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.

3.8 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 49 (see MIL-PRF-38535, appendix A).

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Input offset voltage	V _{IO}	1/	1	01,02, 04,05		±5	mV
				03		±3	
				06		±2	
			2,3	01,02, 04		±6	
				03		±5	
				05		±7	
				06		±4	
			Input offset voltage temperature sensitivity	$\Delta V_{IO} / \Delta T$		2	
03		±20					
05,06		±30					
3	01,02, 04					±25	
	03					±20	
	05,06					±30	

See footnotes at end of table.

MIL-M-38510/110C

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Input offset current	I _{IO}	R _S = 50 Ω 1/	1,2	01,02		±25	nA
				03,05		±30	
				04		±75	
				06		±10	
			3	01,02, 03,05		±75	
				04		±150	
				06		±30	
Input offset current temperature sensitivity	ΔI _{IO} / ΔT		2	01,02, 03		±200	pA/°C
				04		±500	
				05,06		±400	
			3	01,02		±400	
				03		±500	
				04		±1000	
				05,06		±700	

See footnotes at end of table.

MIL-M-38510/110C

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Input bias current	+I _B	R _S = 20 kΩ 1/	1,2	01,02	-0.1	100	nA
				03	-200	+0.1	
				04	-250	+0.1	
				05	-150	+0.1	
				06	-50	+0.1	
			3	01,02	-0.1	325	
				03	-325	+0.1	
				04	-400	+0.1	
				05	-300	+0.1	
				06	-100	+0.1	
	-I _B	1,2		01,02	-0.1	100	
				03	-200	+0.1	
				04	-250	+0.1	
				05	-150	+0.1	
06				-50	+0.1		

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Input bias current	-I _B	R _S = 20 kΩ 1/	3	01,02	-0.1	325	nA
				03	-325	+0.1	
				04	-400	+0.1	
				05	-300	+0.1	
				06	-100	+0.1	
Power supply rejection ratio	+PSRR	+V _{CC} = 10 V, -V _{CC} = -20 V	1,2,3	01,02, 03,04		±100	μV/V
		+V _{CC} = 30 V to 5 V		05,06		±100	
	-PSRR	+V _{CC} = 20 V, -V _{CC} = -10 V		01,02, 03,04		±100	
Input voltage common mode rejection	CMR	V _{CM} = 30 V 2/	1,2,3	01,02, 03,04	76		dB
		V _{CM} = 28 V 2/		05,06	76		
Output short-circuit current (for positive output)	I _{OS} (+)	±V _{CC} = ±15 V, 3/	1,2	01,02	-55		mA
		t ≤ 25 ms, only one amplifier shorted to GND at one time		03,04	-80		
		±V _{CC} = 30 V, 3/		05,06	-70		
		±V _{CC} = ±15 V, 3/	3 4/	01,02	-75		
		t ≤ 25 ms, only one amplifier shorted to GND at one time		03,04	-80		
		±V _{CC} = 30 V, 3/		05,06	-70		

See footnotes at end of table.

MIL-M-38510/110C

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit	
					Min	Max		
Output short-circuit current (for negative output)	I _{OS(-)}	±V _{CC} = ±15 V, <u>3/</u> t ≤ 25 ms, only one amplifier shorted to GND at one time	1,2	01,02		55	mA	
			3 <u>4/</u>	01,02		75		
				03,04		80		
Supply current	I _{CC}	±V _{CC} = ±15 V <u>5/</u>	1,2	01,02		+3.6	mA	
				03		+7		
				04		+11		
			05,06		+3			
		±V _{CC} = ±15 V <u>5/</u>	3	01,02		+4.5		
				03		9		
				04		+13		
	V _{CC} = 30 V <u>5/</u>		05,06		+4			
Output voltage swing (maximum)	+V _{OP}	±V _{CC} = ±20 V, R _L = 10 kΩ	4,5,6	01,02, 03,04	+16		V	
		V _{CC} = 30 V, R _L = 10 kΩ		05,06	+27			
		±V _{CC} = ±20 V, R _L = 2 kΩ		01,02, 03,04	+15			
		V _{CC} = 30 V, R _L = 2 kΩ		05,06	+26			
	-V _{OP}	±V _{CC} = ±20 V, R _L = 10 kΩ		01,02, 03,04		-16		
		±V _{CC} = ±20 V, R _L = 2 kΩ		01,02, 03,04		-15		

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Single ended open loop voltage gain	A _{VS(+)}	±V _O = ±15 V, R _L = 10 kΩ	4	01,02, 03,04	50		V/mV
		V _O = 1 V to 26 V, R _L = 10 kΩ		05,06	50		
		±V _O = ±15 V, R _L = 10 kΩ	5,6	01,02, 03,04	25		
		V _O = 1 V to 26 V, R _L = 10 kΩ		05,06	25		
	A _{VS(-)}	±V _O = ±15 V, R _L = 2 kΩ	4	01,02, 03,04	50		
		V _O = 5 V to 20 V, R _L = 2 kΩ		05,06	50		
		±V _O = ±15 V, R _L = 2 kΩ	5,6	01,02, 03,04	25		
		V _O = 5 V to 20 V, R _L = 2 kΩ		05,06	25		
	A _{VS}	±V _{CC} = ±5 V, V _O = ±2 V, R _L = 10 kΩ and 2 kΩ	4	01,02, 03,04	10		
		V _{CC} = 5 V, V _O = 1 V to 2.5 V, R _L = 10 kΩ and 2 kΩ		05,06	10		
		±V _{CC} = ±5 V, V _O = ±2 V, R _L = 10 kΩ and 2 kΩ	5,6	01,02, 03,04	10		
		V _{CC} = 5 V, V _O = 1 V to 2.5 V, R _L = 10 kΩ and 2 kΩ		05,06	10		

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Low level output voltage	V _{OL}	+V _{CC} = 30 V, R _L = 10 kΩ	4,5,6	05,06		35	mV
		+V _{CC} = 30 V, I _{OL} = 5 mA				1.5	V
		+V _{CC} = 4.5 V, I _{OL} = 2 μA				0.4	
High level output voltage	V _{OH}	+V _{CC} = 30 V, I _{OH} = 10 mA	4,5,6	05,06	27		V
		+V _{CC} = 4.5 V, I _{OH} = 10 mA	4,5		2.4		
			6		2.3		
Transient response rise time	TR _(tr)	±V _{CC} = ±20 V, A _V = 1 <u>Z</u> / see figure 4	7,8A,8B	01,02		1.0	μs
				03		0.2	
				04		0.3	
		01,02			1.0		
		05,06			1.0		
Transient response overshoot	TR _(OS)	±V _{CC} = ±20 V, <u>Z</u> / see figure 4	7,8A,8B	01,02		25	%
				03		35	
				04		50	
		05,06			60		
		+V _{CC} = 30 V, <u>Z</u> / see figure 4					

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Slew rate <u>g/</u>	SR(+) and SR(-)	±V _{CC} = ±20 V, A _V = 1, see figure 5	7,8A,8B	01	+0.2		V/μs
				03	0.8		
				04	0.6		
		02		0.8			
		05,06		0.1			
Noise (broadband)	NI(BB)	±V _{CC} = ±20 V, R _S = 50 Ω, T _A = +25°C	9	01,02		15	μV rms
				03,04		5	
		±V _{CC} = ±15 V, R _S = 50 Ω, T _A = +25°C		05,06		15	
Noise (popcorn)	NI(PC)	±V _{CC} = ±20 V, R _S = 20 kΩ, T _A = +25°C	9	01,02		40	μV peak
				03,04		50	
		±V _{CC} = ±15 V, R _S = 20 kΩ, T _A = +25°C		05,06		50	

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions -55°C ≤ T _A ≤ +125°C see figure 2 unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Channel separation	CS	T _A = +25°C, see figure 7	7	01,02, 03,04, 05,06, 07,08	80		dB

1/ Device types 01 to 04 shall be tested at V_{CM} = 0 V, +15 V, and -15 V with ±V_{CC} = ±20 V; and at V_{CM} = 0 V with ±V_{CC} = ±5 V. Device types 05 and 06 should be tested at V_{CM} = -13 V with V_{CC} = 2 V and -V_{CC} = -28 V; V_{CM} = +15 V with +V_{CC} = 30 V and -V_{CC} = 0 V; V_{CM} = +1.4 V with V_{CC} = 5 V and -V_{CC} = 0 V; V_{CM} = -1.1 V at ±V_{CC} = 2.5 V.

2/ CMR is determined by measuring input offset voltage as follows:

Offset voltage condition	Device types						Units
	01 - 04			05 and 06			
	+V _{CC}	-V _{CC}	V _O	+V _{CC}	-V _{CC}	V _O	
1	35	-5	15	30	0	15	V
2	5	-35	-15	2	-28	-13	V

3/ Continuous limits will be considerably lower and apply for -55°C ≤ T_A ≤ 25°C.

4/ I_{SO(+)} and I_{SO(-)} limits for device type 01 only at T_A = -55°C are -75 mA and 75 mA respectively.

5/ I_{CC} limits are the total for all four amplifiers at no load, connected as grounded followers.

6/ AVS(+) for device types 05 and 06 only.

7/ Device types 05 and 06 transient response is specified with the input pulse referenced to 5 V. For application purposes the device may be operated with the input referenced to ground, however, saturation effects will cause the response time to increase by approximately 50 percent.

TABLE II. Electrical test requirements.

MIL-PRF-38535 test requirements	Subgroups (see table III)	
	Class S devices	Class B devices
Interim electrical parameters	1	1
Final electrical test parameters ^{1/}	1,2,3,4	1,2,3,4
Group A test requirements	1,2,3,4,5,6, 7,8	1,2,3,4,5,6, 7,8
Group B electrical test parameters when using the method 5005 QCI option	1,2,3,4,5,6, 7,8	N/A
Group C end point electrical parameters	1,2,3, and table IV delta limits	1 and table IV delta limits
Group D end point electrical parameters	1,2,3	1

^{1/} PDA applies to subgroup 1.

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 function as described herein.

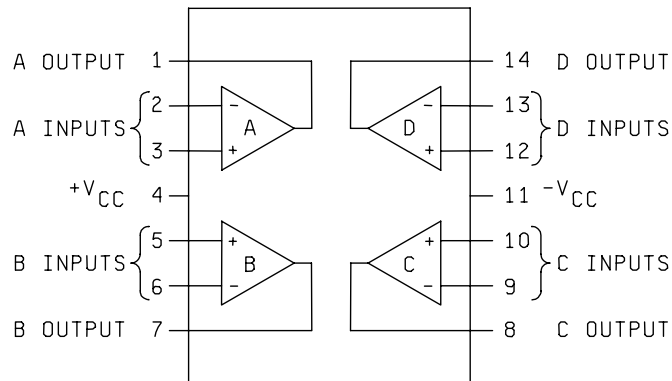
4.2 Screening. Screening shall be in accordance with MIL-PRF-38535, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

- 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.
- 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.

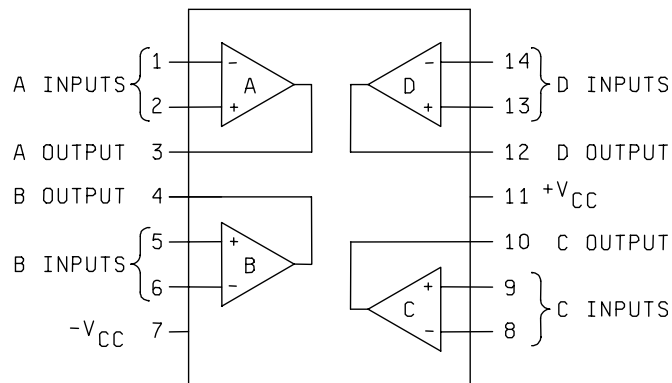
4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-38535.

MIL-M-38510/110C

DEVICE TYPES 01,02,03,05 AND 06
 CASES A,C,D AND Z
 SEE NOTE 1



DEVICE TYPE 04
 CASES A AND C
 SEE NOTE 2



NOTES:

1. 14 lead flat pack, dual in line package, and gullwing flat pack.
2. 14 lead flat pack and dual in line package.

FIGURE 1. Case outlines and terminal connections.

NOTES:

- 1/ All resistors ± 0.1 percent tolerance and all capacitors are ± 10 % tolerance.
- 2/ Precautions shall be taken to prevent damage to the device under test during insertion into socket and change of state of relays (i.e. disable voltage supplies, current limit $\pm V_{CC}$, etc.).
- 3/ Stabilizing capacitors may be added as required, if needed to prevent oscillations. Also, proper wiring procedures shall be followed to prevent oscillations. Loop response and settling time shall be consistent with the test rate such that any value has settled for at least five loop time constants before the value is measured, however, adequate settling time shall be allowed such that each parameter has settled to within five percent of its final value. There are two general methods to stabilize the test circuit: One method is with a capacitor in the nulling amplifier feedback loop and the other method is with a capacitor in parallel with the 49.9 k Ω closed loop feedback resistor. Both methods shall not be used simultaneously.
- 4/ All relays are shown in the normal de-energized state. Relays K1, K2, K3, and K4 select amplifiers A, B, C, and D respectively. The rest of the relays are used to select the conditions for each test.
- 5/ Each amplifier shall be tested separately, except for the ICC measurements where all the amplifiers shall be connected as grounded followers (relays K1 through K4 de-energized).
- 6/ The nulling amplifier should be an M38510/11001XXX or similar. Saturation of the nulling amplifier is not allowed on test where the E (pin 5) value is measured.
- 7/ The load resistors 2,050 Ω and 11.1 k Ω yield effective load resistances of 2 k Ω and 10 k Ω , respectively.
- 8/ Any oscillation greater than 300 mV in amplitude (peak - peak) shall be a cause for device failure.

FIGURE 2. Test circuit for static tests- Continued.

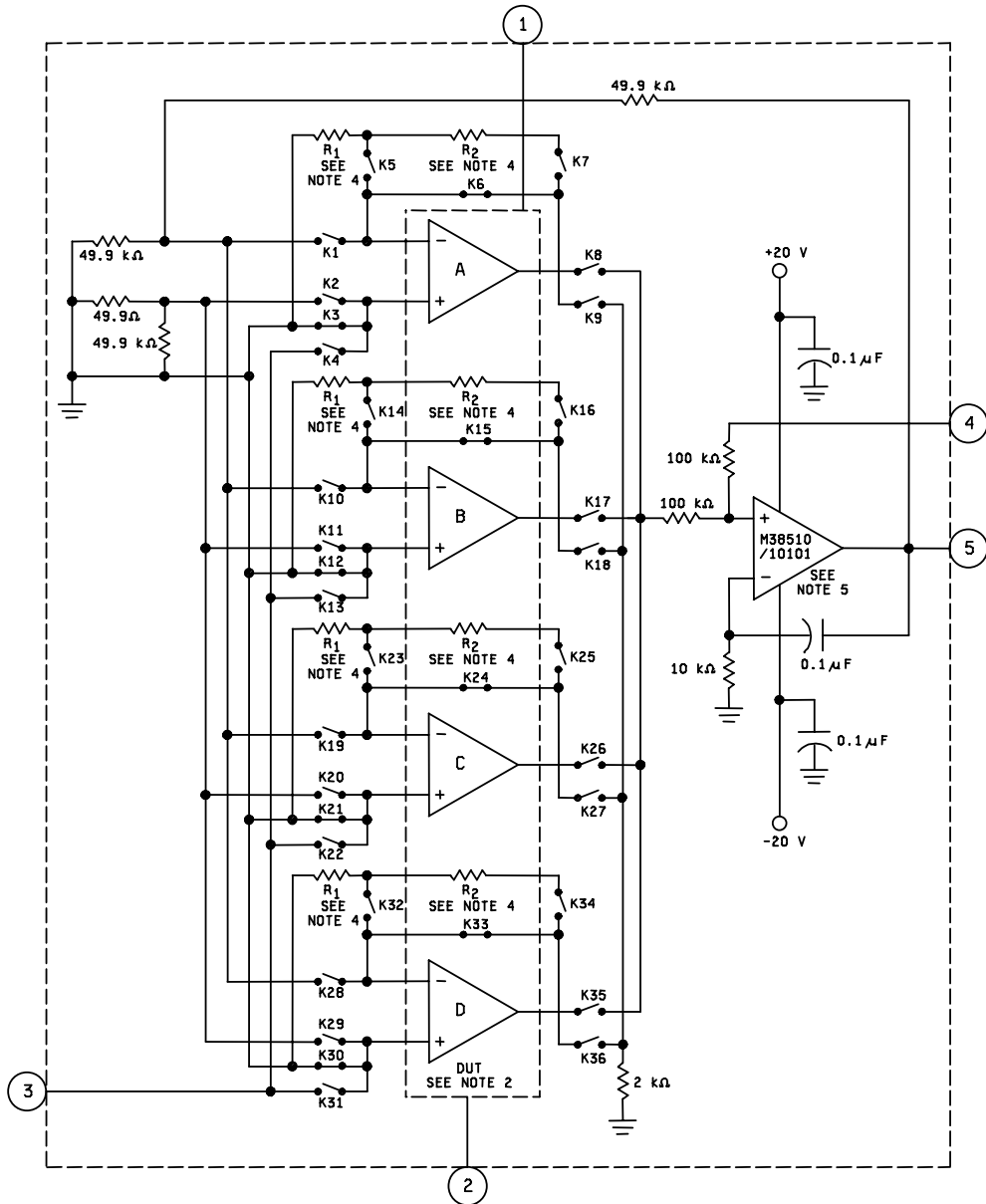


FIGURE 3. Test circuit for channel separation.

Test requirements.

CS test number*	Channels tested	Relays energized		
		All device types		Additional for device type 02
		Driven	Monitored	Driven
103 (100)	A to B	3,4,9	10,11,12,15,17	5,6,7
104 (101)	A to C	"	19,20,21,24,26	"
105 (102)	A to D	"	28,29,30,33,35	"
106 (103)	B to A	12,13,18	1,2,3,6,8	14,15,16
107 (104)	B to C	"	19,20,21,24,26	"
108 (105)	B to D	"	28,29,30,33,35	"
109 (106)	C to A	21,22,27	1,2,3,6,8	23,24,25
110 (107)	C to B	"	10,11,12,15,17	"
111 (108)	C to D	"	28,29,30,33,35	"
112 (109)	D to A	30,31,36	1,2,3,6,8	32,33,34
113 (110)	D to B	"	10,11,12,15,17	"
114 (111)	D to C	"	19,20,21,24,26	"

* Numbers in parenthesis apply to device types 05 and 06.

- 1/ All resistors are $\pm 0.1\%$ tolerance and all capacitors are $\pm 10\%$.
- 2/ Precautions shall be taken to prevent damage to the device under test during insertion into socket and change of state relays (i.e. disable voltage supplies, current limit $\pm V_{CC}$, etc.).
- 3/ All relays are shown in the normal de-energized state. The above table shall be used to determine which relays to energize for each test.
- 4/ R_1 and R_2 shall be used with device type 02 only and shall be such that $A_V = 5 V/V$.
- 5/ The nulling amplifier shall be a M38510/11001XXX or similar. Saturation of the nulling amplifier is not allowed.

FIGURE 3. Test circuit for channel separation - Continued.

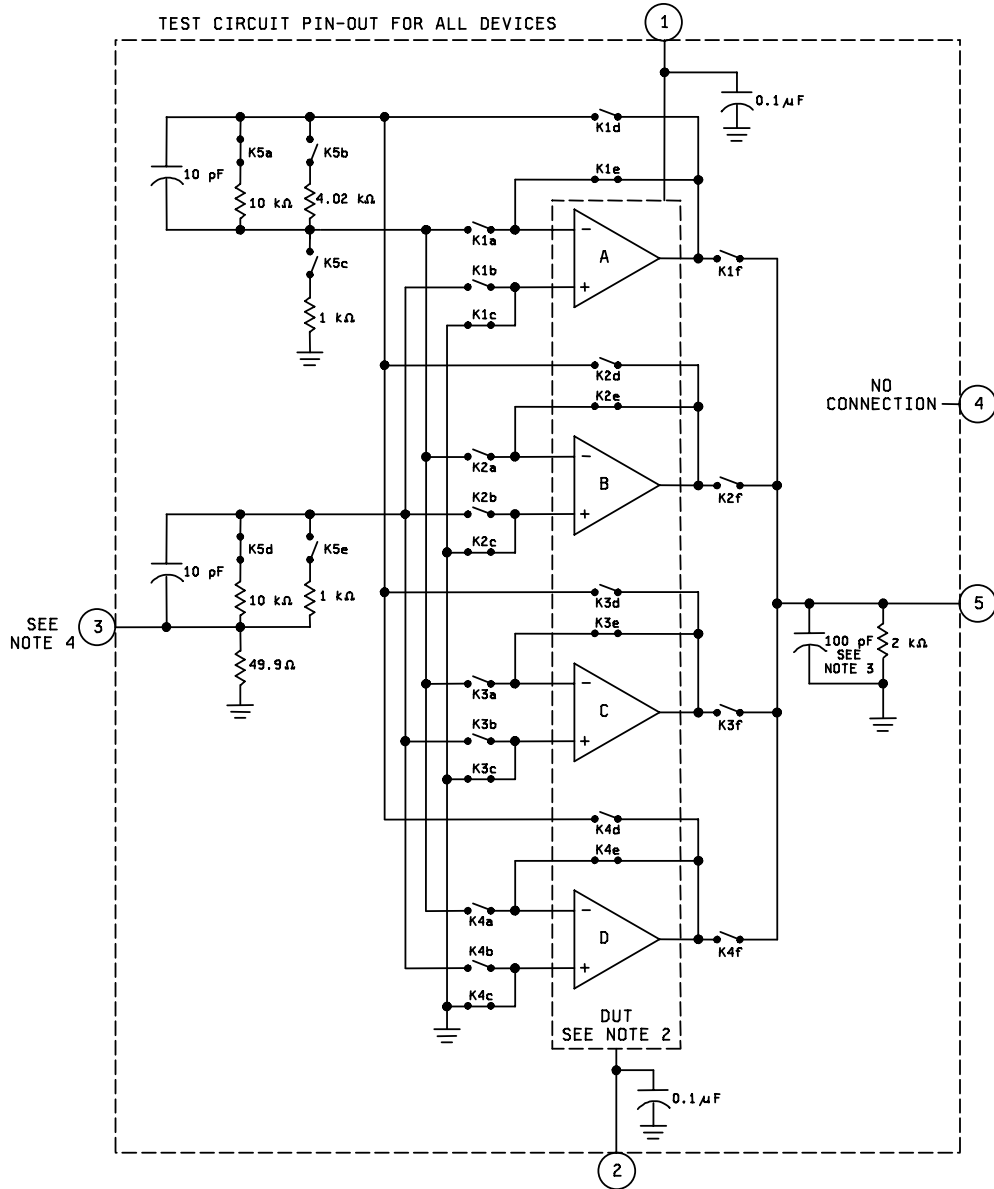
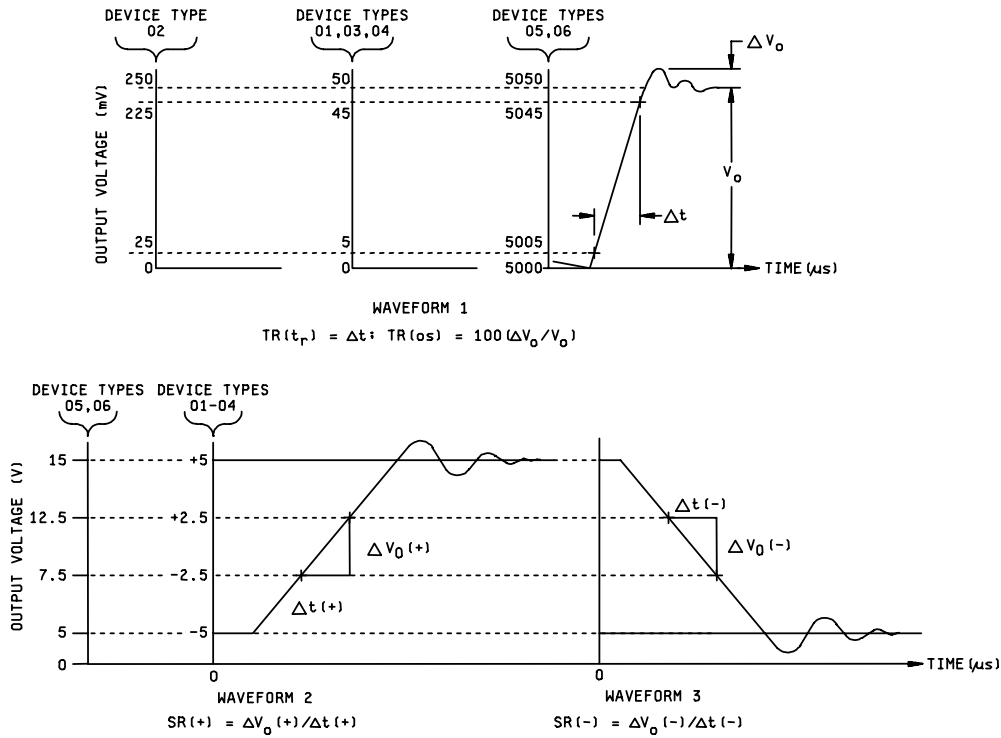


FIGURE 4. Test circuit and waveform for transient response .



- 1/ All resistors are $\pm 0.1\%$ tolerance and all capacitors are $\pm 10\%$ tolerance.
- 2/ Precautions shall be taken to prevent damage to the device under test during insertion into socket and change of state of relays (i.e. disable voltage supplies, current limit $\pm V_{CC}$, etc.).
- 3/ This capacitance includes the actual measured value with stray and wire capacitance.
- 4/ Relays K1, K2, K3, and K4 select amplifiers A, B, C, and D respectively. Relay K5 shall be energized for device type 02 only. The input pulse shall have the following characteristics:

FIGURE 4. Test circuit and waveform for transient response – Continued.

Input pulse table

Parameter symbol	Device type	Rise time	Amplitude
TR(t_r)	01,03,04	50 ns or less	+50 mV referenced to GND
	02		+250 mV referenced to GND
	05,06		+50 mV referenced to 5 V
TR(t_{os})	01,03,04		+50 mV referenced to GND
	02		+250 mV referenced to GND
	05,06		+50 mV referenced to 5 V
SR(+)	01,03,04		-5 V to +5 V step
	02		-1 V to +1 V step
	05,06		+5 V to +15 V step
SR(-)	01,03,04	+5 V to -5 V step	
	02	+1 V to -1 V step	
	05,06	+15 V to +5 V step	

FIGURE 4. Test circuit and waveform for transient response – Continued.

MIL-M-38510/110C

TABLE III. Group A inspection for device types 01, 02, 03, and 04. 1/

Subgroup	Symbol	MIL-STD -883 method	Test no.	Adapter pin numbers					Energized relays 2/	Measured pins			Equations 3/	Device types								Unit
				1 2 3 4 5						No.	Value	Unit		01, 02		03		04				
				1	2	3	4	5						Min	Max	Min	Max	Min	Max			
4 TA =+25°C	AVS(+)	4004	75 5/	20 V	-20 V		-15 V		5	E55	V	$AVS(+)=15/(E3-E55)$	50		50		50		V/mV			
	AVS(+)	"	76 5/	20 V	-20 V		-15 V		"	E56	"	$AVS(+)=15/(E3-E56)$	50		50		50		"			
	AVS(-)	"	77 5/	20 V	-20 V		15 V		"	E57	"	$AVS(-)=15/(E57-E3)$	50		50		50		"			
	AVS(-)	"	78 5/	20 V	-20 V		15 V		"	E58	"	$AVS(-)=15/(E58-E3)$	50		50		50		"			
	AVS	"	79	5 V	-5 V		-2 V		"	E59	"	$AVS=4/(E60-E59)$	10		10		10		"			
		"		5 V	-5 V		2 V		"	E60	"								"			
		"		5 V	-5 V		-2 V		"	E61	"	$AVS=4/(E62-E61)$	10		10		10		"			
		"		5 V	-5 V		2 V		"	E62	"								"			
	5 TA =+125°C	+VOP	"	81	20 V	-20 V		-20 V		3	(E0)5	"	$+VOP=(E0)5$	+16		+16		+16		V		
		-VOP	"	82	20 V	-20 V		20 V		3	(E0)6	"	$-VOP=(E0)6$					-16		"		
		+VOP	"	83	20 V	-20 V		-20 V		3	(E0)7	"	$+VOP=(E0)7$	+15		+15		+15		"		
		-VOP	"	84	20 V	-20 V		20 V		3	(E0)8	"	$-VOP=(E0)8$					-15		"		
AVS(+)		"	85 5/	20 V	-20 V		-15 V		5	E63	"	$AVS(+)=15/(E21-E63)$	25		25		25		V/mV			
AVS(+)		"	86 5/	20 V	-20 V		-15 V		"	E64	"	$AVS(+)=15/(E21-E64)$	25		25		25		"			
AVS(-)		"	87 5/	20 V	-20 V		15 V		"	E65	"	$AVS(-)=15/(E65-E21)$	25		25		25		"			
AVS(-)		"	88 5/	20 V	-20 V		15 V		"	E66	"	$AVS(-)=15/(E66-E21)$	25		25		25		"			
AVS		"	89	5 V	-5 V		-2 V		"	E67	"	$AVS=4/(E68-E67)$	10		10		10		"			
		"		5 V	-5 V		2 V		"	E68	"								"			
6 TA = -55°C		+VOP	"	91	20 V	-20 V		-20 V		3	(E0)9	"	$+VOP=(E0)9$	+16		+16		+16		V		
		-VOP	"	92	20 V	-20 V		20 V		3	(E0)10	"	$-VOP=(E0)10$					-16		"		
	+VOP	"	93	20 V	-20 V		-20 V		3	(E0)11	"	$+VOP=(E0)11$	+15		+15		+15		"			
	-VOP	"	94	20 V	-20 V		-20 V		3	(E0)12	"	$-VOP=(E0)12$					-15		"			

See footnotes at end of table.

TABLE III. Group A inspection for device types 01, 02, 03, and 04. 1/

Subgroup	Symbol	MIL-STD-883 method	Test no.	Adapter pin numbers					Energized relays 2/	Measured pins			Equations 3/	Device types						Unit	
				Adapter pin numbers						No.	Value	Unit		01, 02		03		04			
				1	2	3	4	5						Min	Max	Min	Max	Min	Max		
6	AVS(+)	4004	95	20 V	-20 V		-15 V		K8	5	E71	V	$AVS(+)=15/(E39-E71)$	25		25		V/mV			
				20 V	-20 V		-15 V		K7	"	E72	"	$AVS(+)=15/(E39-E72)$	25		25		"			
				20 V	-20 V		15 V		K8	"	E73	"	$AVS(-)=15/(E73-E39)$	25		25		"			
				20 V	-20 V		15 V		K7	"	E74	"	$AVS(-)=15/(E74-E39)$	25		25		"			
	AVS	"	"	99	5 V	-5 V		-2 V		K8	"	E75	"	$AVS=4/(E76-E75)$	10		10		"		
					5 V	-5 V		2 V		K8	"	E76	"		10		10		"		
	100 g/	"	"	100 g/	5 V	-5 V		-2 V		K7	"	E77	"	$AVS=4/(E78-E77)$	10		10		"		
					5 V	-5 V		2 V		K7	"	E78	"		10		10		"		
					20 V	-20 V		GND		K10, K11	3	(E0)13	mVrms		$NI(BB)=(E0)13$	15		5		5	$\mu Vrms$
					20 V	-20 V		"		K5, K6, K10, K11	3	(E0)14	mVpk		$NI(PC)=(E0)14$	40		50		50	μVpk
7	CS	"	103	20 V	-20 V	11/	"		See fig. 3	5	E79	V	$CS=20 \log$	80		80		dB			
				20 V	-20 V	12/	"		"	"	E80	"	$12 \times 10^4 / E79 - E80$	80		80		"			
				20 V	-20 V	11/	"		"	"	E81	"	$CS=20 \log$	80		80		"			
	"	"	104	20 V	-20 V	12/	"		"	"	E82	"	$12 \times 10^4 / E81 - E82$	80		80		"			
				20 V	-20 V	11/	"		"	"	E83	"	$CS=20 \log$	80		80		"			
	"	"	105	20 V	-20 V	12/	"		"	"	E84	"	$12 \times 10^4 / E83 - E84$	80		80		"			
				20 V	-20 V	11/	"		"	"	E85	"	$CS=20 \log$	80		80		"			
	"	"	106	20 V	-20 V	12/	"		"	"	E86	"	$12 \times 10^4 / E85 - E86$	80		80		"			
				20 V	-20 V	11/	"		"	"	E87	"	$CS=20 \log$	80		80		"			
	"	"	107	20 V	-20 V	12/	"		"	"	E88	"	$12 \times 10^4 / E87 - E88$	80		80		"			
				20 V	-20 V	11/	"		"	"	E89	"	$CS=20 \log$	80		80		"			
"	"	108	20 V	-20 V	12/	"		"	"	E90	"	$12 \times 10^4 / E89 - E90$	80		80		"				
			20 V	-20 V	11/	"		"	"	E91	"	$CS=20 \log$	80		80		"				
"	"	109	20 V	-20 V	12/	"		"	"	E92	"	$12 \times 10^4 / E91 - E92$	80		80		"				
			20 V	-20 V	11/	"		"	"	E93	"	$CS=20 \log$	80		80		"				
"	"	110	20 V	-20 V	12/	"		"	"	E94	"	$12 \times 10^4 / E93 - E94$	80		80		"				
			20 V	-20 V	11/	"		"	"	E95	"	$CS=20 \log$	80		80		"				
"	"	111	20 V	-20 V	12/	"		"	"	E96	"	$12 \times 10^4 / E95 - E96$	80		80		"				
			20 V	-20 V	11/	"		"	"												

See footnotes at end of table.

TABLE III. Group A inspection for device types 01, 02, 03, and 04. 1/

Subgroup	Symbol	MIL-STD-883 method	Test no.	Adapter pin numbers					Energized relays 2/	Measured pins			Equations 3/	Device types						Unit			
				Adapter pin numbers						No.	Value	Unit		01, 02		03		04					
				1	2	3	4	5						Limits	Min	Max	Limits	Min	Max		Limits	Min	Max
7	CS		112	20 V	-20 V	11/	GND	5	See fig. 3	5	E97	V	CS = 20 log $ 2 \times 10^4 / E97 - E98 $	80	80	80	80	80	80	80	80	dB	
				20 V	-20 V	12/	"	"		E98	"	80		80	"	80	80	80	80	80	80	"	
				20 V	-20 V	11/	"	"		E99	"	80		80	"	80	80	80	80	80	80	80	"
				20 V	-20 V	12/	"	"		E100	"	80		80	"	80	80	80	80	80	80	80	"
				20 V	-20 V	11/	"	"		E101	"	80		80	"	80	80	80	80	80	80	80	"
				20 V	-20 V	12/	"	"		E102	"	80		80	"	80	80	80	80	80	80	80	"
				20 V	-20 V	IN	"	OUT		Δt	"	Δt		μs	1.0	0.2	0.3	μs					
				20 V	-20 V	"	"	"		VO:ΔVO	"	VO:ΔVO		V	25	35	50	%					
				20 V	-20 V	"	"	"		ΔVO:Δt	"	ΔVO:Δt		V; μs	0.8	0.6	0.6	V/μs					
				20 V	-20 V	"	"	"		ΔVO:Δt	"	ΔVO:Δt		V; μs	0.8	0.6	0.6	V/μs					
8			119 to 126	Same tests, terminal conditions and limits as subgroup 7, tests 115 through 118 except TA = 125°C and TA = -55°C.																			

See footnotes at end of table.

TABLE III. Group A inspection for device types 05 and 06 - Continued. 1/

Subgroup	Symbol	MIL-STD -883 method	Test no.	Adapter pin numbers					Energized relays 2/	Measured pins			Equations 3/	Device types				Unit	
				1 2 3 4 5						No.	Value	Unit		05		06			
				1	2	3	4	5						Min	Max	Min	Max		
3 TA = -55°C	IIO	4001	48	30V	GND		-15V		5	5	E41	V	$IIO = 10^6 (E37 - E41) / RS$		±75	±30	nA		
		"	49	2V	-28V		13V		"	"	E42	"	$IIO = 10^6 (E38 - E42) / RS$		±75	±30	"		
		"	50	5V	GND		-1.4V		"	"	E43	"	$IIO = 10^6 (E39 - E43) / RS$		±75	±30	"		
		"	51	2.5V	-2.5V		1.1V		"	"	E44	"	$IIO = 10^6 (E40 - E44) / RS$		±75	±30	"		
		"	52 8/											$\Delta IIO / \Delta T = (IIO (Test 50 - IIO (Test 7)) / 80°C$		±700	±700	pA/°C	
		+IIB	"	53	30V	GND		-15V		5	E45	V	$+IIB = 10^6 (E37 - E45) / RS$	-300	+0.1	-100	+0.1	nA	
			"	54	2V	-28V		13V		"	E46	"	$+IIB = 10^6 (E38 - E46) / RS$	-300	+0.1	-100	+0.1	"	
			"	55	5V	GND		-1.4V		"	E47	"	$+IIB = 10^6 (E39 - E47) / RS$	-300	+0.1	-100	+0.1	"	
			"	56	2.5V	-2.5V		1.1V		"	E48	"	$+IIB = 10^6 (E40 - E48) / RS$	-300	+0.1	-100	+0.1	"	
		-IIB	"	57	30V	GND		-15V		6	E49	"	$-IIB = 10^6 (E49 - E37) / RS$	-300	+0.1	-100	+0.1	nA	
"			58	2V	-28V		13V		"	E50	"	$-IIB = 10^6 (E50 - E38) / RS$	-300	+0.1	-100	+0.1	"		
"			59	5V	GND		-1.4V		"	E51	"	$-IIB = 10^6 (E51 - E39) / RS$	-300	+0.1	-100	+0.1	"		
"			60	2.5V	-2.5V		1.1V		"	E52	"	$-IIB = 10^6 (E52 - E40) / RS$	-300	+0.1	-100	+0.1	"		
+PSRR	4003	61	30V	GND		-1.4V		"	E53	"	+PSRR = (E53 - E54) x 40		±100	±100	±100	µV/V			
CMR	4003	62 4/	Calculate value using data from tests 43 and 44.									76		76		76	dB		
4 TA = +25°C	IOS(+)	3011	63 6/	30V	GND		-25V		3	I5	mA		$CMR = 20 \log [2.8 \times 10^4 / E37 - E38]$					dB	
		3005	64 7/	30V	GND				2	I6	mA		$IOS(+) = I5$	-70		-70		mA	
	+VOP	4004	65	30V	GND		-30V		3	(E0)1	V		$ICC = I6$			27		27	V
		"	66	30V	GND		-30V		3	(E0)2	"		$+VOP = (E0)1$			26		26	"
	-VOP	"	67	30V	GND		-26V		5	E55	"		$+VOP = (E0)2$			50		50	V/mV
		"	68	30V	GND		-20V		"	E56	"		$AVS(+) = 25 / (E56 - E55)$			50		50	"
	AVS(+)	"		30V	GND		-1V		"	E57	"		$AVS(+) = 15 / (E58 - E57)$			50		50	"
		"		30V	GND		-5V		"	E58	"					50		50	"

See footnotes at end of table.

TABLE III. Group A inspection for device types 05 and 06 - Continued. 1/

Subgroup	Symbol	MIL-STD-883 method	Test no.	Adapter pin numbers					Energized relays 2/	Measured pins			Equations 3/	Device types		Unit
				1	2	3	4	5		No.	Value	Unit		05, 06	Limits	
4 TA = +25°C	AVS	4004	69	5 V	GND		-2.5 V	5	K8	E59	V	AVS(+) = 1.5/(E60 - E59)	10	05, 06	V/mV	
				5 V	GND		-1 V	"								"
	AVS	4004	70	5 V	GND		-2.5 V		K7	E61	"	AVS(-) = 1.5/(E62 - E61)	10	05, 06	"	
				5 V	GND		-1 V	"								"
	5 TA = +125°C	VOL	3007	71	30 V	GND		5 V		K11, K9	(E0)3	mV	VOL = (E0)3	35	05, 06	V/m
					30 V	GND	5 mA	5 V								
VOL		3006	73	4.5 V	GND	2 µA	5 V		K11	(E0)5	"	VOL = (E0)5	0.4	05, 06	"	
				30 V	GND	-10 mA	-5 V									(E0)6
VOL		3006	74	30 V	GND	-10 mA	-5 V		K11	(E0)7	"	VOH = (E0)7	2.4	05, 06	"	
				4.5 V	GND	-10 mA	-5 V									(E0)8
VOL		3006	75	30 V	GND		-30 V		K8	(E0)9	"	-VOP = (E0)9	26	05, 06	"	
				30 V	GND		-30 V									(E0)9
VOL		3006	76	30 V	GND		-26 V		K8	E63	"	AVS(+) = 25/(E64 - E63)	25	05, 06	V/mV	
				30 V	GND		-1 V									E64
VOL		3006	77	30 V	GND		-20 V		K7	E65	"	AVS(+) = 15/(E66 - E65)	25	05, 06	"	
				30 V	GND		-5 V									E66
VOL	3006	78	5 V	GND		-2.5 V		K8	E67	"	AVS = 1.5/(E68 - E67)	10	05, 06	V/mV		
			5 V	GND		-1 V									E68	"
VOL	3006	79	5 V	GND		-2.5 V		K7	E69	"	AVS = 1.5/(E70 - E69)	10	05, 06	"		
			5 V	GND		-1 V									E70	"
5 TA = +125°C	VOL	3007	82	30 V	GND		5 V		K11, K9	(E0)10	mV	VOL = (E0)10	35	05, 06	mV	
				30 V	GND	5 mA	5 V									(E0)11
	VOL	3006	83	4.5 V	GND	2 µA	5 V		K11	(E0)12	"	VOL = (E0)12	0.4	05, 06	"	
				30 V	GND	-10 mA	-5 V									(E0)13
	VOL	3006	84	30 V	GND	-10 mA	-5 V		K11	(E0)14	"	VOH = (E0)14	2.4	05, 06	"	
				4.5 V	GND	-10 mA	-5 V									(E0)14

See footnotes at end of table.

TABLE III. Group A inspection for device types 05 and 06 - Continued. 1/

Subgroup	Symbol	MIL-STD-883 method	Test no.	Adapter pin numbers					Energized relays 2/	Measured pins			Equations 3/	Device types		Unit	
				1	2	3	4	5		No.	Value	Unit		05, 06 Limits	Max		
6 TA = -55°C	+VOP	4004	87	30 V	GND		-30 V		K8	3	(E0)15	V	+VOP = (E0)15	27		V	
	+VOP	"	88	30 V	GND		-30 V		K7	"	(E0)16	"	+VOP = (E0)16	26		V	
	AVS(+)	"	89	30 V	GND		-26 V		K8	5	E71	"	AVS(+) = 25/(E72 - E71)	25		V/mV	
		"	"	30 V	GND		-1 V		K8	"	E72	"		25		"	
		"	"	30 V	GND		-20 V		K7	"	E73	"	AVS(+) = 15/(E74 - E73)	25		"	
		"	"	30 V	GND		-5 V		K7	"	E74	"		25		"	
		AVS	"	91	5 V	GND		-2.5 V		K8	"	E75	"	AVS = 1.5/(E76 - E75)	10		"
		"	"	"	5 V	GND		-1 V		K8	"	E76	"				"
		"	"	92	5 V	GND		-2.5 V		K7	"	E77	"	AVS = 1.5/(E78 - E77)	10		"
		"	"	"	5 V	GND		-1 V		K7	"	E78	"				"
		VOL	3007	93	30 V	GND		5 V		K11, K9	3	(E0)17	mV	VOL = (E0)17		35	mV
			"	94	30 V	GND	5 mA	5 V		K11	"	(E0)18	V	VOL = (E0)18		1.5	V
			"	95	4.5 V	GND	2 μA	5 V		K11	"	(E0)19	"	VOL = (E0)19		0.4	"
	VOH	3006	96	30 V	GND	-10 mA	-5 V		K11	"	(E0)20	"	VOH = (E0)20	27		"	
	VOH	3006	97	4.5 V	GND	-10 mA	-5 V		K11	"	(E0)21	"	VOH = (E0)21	2.3		"	
7 TA = +25°C	NI(BB)		98 10/	15 V	-15 V		GND		K10, K11	"	(E0)22	mVrms	NI(BB) = (E0)22		15	μVrms	
	NI(PC)		99 10/	15 V	-15 V		GND		K5, K6, K10, K11	"	(E0)23	mVpk	NI(PC) = (E0)23		50	μVpk	
	CS		100	30 V	GND	16 V	-1.4 V		See fig. 3	5	E79	V	CS = 20 log 1.5 x 10 ⁴ / E79 - E80	80		dB	
			"	30 V	GND	1 V	-1.4 V		"	"	E80	"		80		"	
			"	30 V	GND	16 V	-1.4 V		"	"	E81	"	CS = 20 log 1.5 x 10 ⁴ / E81 - E82	80		"	
			"	30 V	GND	1 V	-1.4 V		"	"	E82	"		80		"	
			"	30 V	GND	16 V	-1.4 V		"	"	E83	"	CS = 20 log 1.5 x 10 ⁴ / E83 - E84	80		"	
			"	30 V	GND	1 V	-1.4 V		"	"	E84	"		80		"	
			"	30 V	GND	16 V	-1.4 V		"	"	E85	"	CS = 20 log 1.5 x 10 ⁴ / E85 - E86	80		"	
			"	30 V	GND	1 V	-1.4 V		"	"	E86	"		80		"	

See footnotes at end of table.

TABLE III. Group A inspection for device types 05 and 06 - Continued. 1/

Subgroup	Symbol	MIL-STD-883 method	Test no.	Adapter pin numbers					Energized relays 2/	Measured pins			Equations 3/	Device types		Unit											
				1	2	3	4	5		No.	Value	Unit		Limits													
														05	06		Min	Max									
7	CS		104	30 V	GND	16 V	-1.4 V		See fig. 3	5	E87	V	$CS = 20 \log \frac{1.5 \times 10^4}{E87 - E88}$	80		dB											
				30 V	GND	1 V	-1.4 V				E88	"		80													
				30 V	GND	16 V	-1.4 V				E89	"		80													
				30 V	GND	1 V	-1.4 V				E90	"		80													
				30 V	GND	16 V	-1.4 V				E91	"		80													
			105			30 V	GND	1 V	-1.4 V						$CS = 20 \log \frac{1.5 \times 10^4}{E89 - E90}$	80											
																			30 V	GND	16 V	-1.4 V					
			106			30 V	GND	16 V	-1.4 V					$CS = 20 \log \frac{1.5 \times 10^4}{E91 - E92}$	80												
																		30 V	GND	1 V	-1.4 V						
																											30 V
			107			30 V	GND	1 V	-1.4 V					$CS = 20 \log \frac{1.5 \times 10^4}{E93 - E94}$	80												
																		30 V	GND	16 V	-1.4 V						
																											30 V
			108			30 V	GND	16 V	-1.4 V					$CS = 20 \log \frac{1.5 \times 10^4}{E95 - E96}$	80												
30 V	GND	1 V																-1.4 V									
																								30 V	GND	16 V	-1.4 V
109			30 V	GND	16 V	-1.4 V					$CS = 20 \log \frac{1.5 \times 10^4}{E97 - E98}$	80															
															30 V	GND	1 V	-1.4 V									
																								30 V	GND	16 V	-1.4 V
110			30 V	GND	16 V	-1.4 V					$CS = 20 \log \frac{1.5 \times 10^4}{E99 - E100}$	80															
															30 V	GND	1 V	-1.4 V									
																								30 V	GND	16 V	-1.4 V
111			30 V	GND	16 V	-1.4 V					$CS = 20 \log \frac{1.5 \times 10^4}{E101 - E102}$	80															
															30 V	GND	1 V	-1.4 V									
																								30 V	GND	16 V	-1.4 V
112	TR(tr)		30 V	GND	IN	OUT	OUT	See fig. 4				$(\text{Waveform 1}) TR(tr) = \Delta t$	1.0		µs												
																30 V	GND	IN	OUT	OUT							
																									30 V	GND	IN
113	TR(os)		30 V	GND	IN	IN	OUT				$(\text{Waveform 1}) TR(OS) = \frac{VO}{\Delta t}$	60		%													
															30 V	GND	IN	OUT									
																								30 V	GND	IN	OUT
114	SR(+)	4002	30 V	GND	IN	IN	OUT				$(\text{Waveform 2}) SR(+) = VO/\Delta t$	0.1		V/µs													
															30 V	GND	IN	OUT									
115	SR(-)		30 V	GND	IN	IN	OUT				$(\text{Waveform 3}) SR(-) = \Delta VO/\Delta t$	0.1		V/µs													
															30 V	GND	IN	OUT									
8			116 to 123																								

Same tests, terminal conditions and limits as subgroup 7, tests 112 through 115 except TA = 125°C and TA = -55°C.

See footnotes at end of table.

TABLE III. Group A inspection - Continued.

1/ Use table III in conjunction with the following:

<u>Tests</u>	<u>Device type</u>	<u>Figure</u>
1 - 102	01 - 04	2
1 - 99	05 - 06	
103 - 114	01 - 04	3
100 - 111	05 - 06	
115 - 126	01 - 04	4
112 - 123	05 - 06	

2/ K1, K2, K3, or K4 relay will also be energized as follows:

- a. Device types 01 through 04 – test numbers 22 and 103 through 126.
- b. Device types 05 and 06 – test numbers 20 and 100 through 123.

3/ The equations take into account both the closed loop gain of 1,000 and the scale factor multiplier so that the calculator value is in table I units; therefore, use the measured value units in the equation.
(For example: If $E_1 = 2$ V and $V_{IO} = E_1$, then $V_{IO} = E_1$, then $V_{IO} = 2$ mV).

4/ Each device shall be tested over the common mode range as specified in table III with the output forced to the worse case condition. V_{CM} is achieved by grounding the inputs and algebraically subtracting V_{CM} from each supply. Common mode rejection is calculated using the offset voltage values measured at the common mode range end points.

5/ In device types 01 through 04, to minimize thermal drift, the reference voltage for gain measurement (E_3 , E_{21} , and E_{39}) shall be taken immediately prior to or after the reading corresponding to device gain (E_{55} , E_{56} , E_{57} , E_{58} , E_{63} , E_{64} , E_{65} , E_{66} , E_{71} , E_{72} , E_{73} , and E_{74}).

6/ Only one amplifier shall be tested at one time and its output shall be shorted to ground for 25 ms or less.

7/ Each amplifier shall be tested separately, except for the I_{CC} measurements where all the amplifiers shall be connected as grounded followers (relays K1 through K4 de-energized).

8/ Tests 27, 32, 51, and 56 for devices types 01 through 04 and tests 25, 30, 47, and 52 for device types 05 and 06, which require a read and record measurement plus a calculation, may be omitted except when subgroups 2 and 3 are being accomplished for group A sampling inspection and groups C and D end point measurement.

9/ $SR(+)$ and $SR(-)$ are 0.2 V/ μ s for device type 01 and 0.8 V/ μ s for device type 02.

10/ Broadband noise (NI(BB)) shall be measured using an rms voltmeter with a bandwidth of 10 Hz to 5 kHz. "Popcorn" noise (NI(PC)) shall be measured for 15 seconds.

11/ For device types 01, 03, and 04, $V_{IN} = 10$ V; for device type 02, $V_{IN} = 2$ V.

12/ For device types 01, 03, and 04, $V_{IN} = -10$ V; for device type 02, $V_{IN} = -2$ V.

TABLE IV. Group C and Group B life test end point electrical parameters.

($T_A = +25^\circ\text{C}$, $\pm V_{CC} = \pm 20\text{ V}$ for device types 01 – 04 and
 $+V_{CC} = 30\text{ V}$ for device types 05 and 06).

Table III test no.	Test	01, 02				03				Unit
		Limit		Delta		Limit		Delta		
		Min	Max	Min	Max	Min	Max	Min	Max	
3	V_{IO}	-5	+5	-1	+1	-3.0	+3.0	-0.5	+0.5	mV
11	$+I_{IB}$	+0.1	+100	-15	+15	-200	-1	-20	20	nA
15	$-I_{IB}$	+0.1	+100	-15	+15	-200	-1	-20	20	nA

Table III test no.	Test	04				05				Unit
		Limit		Delta		Limit		Delta		
		Min	Max	Min	Max	Min	Max	Min	Max	
3	V_{IO}	-5	+5	-1	+1	-5	+5	-1	+1	mV
11	$+I_{IB}$	-250	-1	-25	+25	-150	-1	-15	+15	nA
15	$-I_{IB}$	-250	-1	-25	+25	-150	-1	-15	+15	nA

Table III test no.	Test	06				Unit
		Limit		Delta		
		Min	Max	Min	Max	
3	V_{IO}	-2	+2	-0.5	+0.5	mV
11	$+I_{IB}$	-50	-1	-10	+10	nA
15	$-I_{IB}$	-50	-1	-10	+10	nA

1/ For device types 05 and 06, the table III test numbers are as follows: V_{IO} use test number 1, $+I_{IB}$ use the test number 9, $-I_{IB}$ use test number 13.

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 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. End point electrical parameters shall be as specified in table II herein.

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 external zero reference level of the supply voltage. Currents given are for conventional current and are positive when flowing into the referenced terminal.

4.5.2 Life test 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 to within 10°C of their power stable condition at room temperature prior to removal of the bias.

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 Government microcircuit applications (original equipment) and logistic purposes.

6.2 Ordering data. The contract or purchase order should specify the following:

- a. Title, number, and date of the specification.
- b. Complete part number (see 1.2).
- c. Requirements for delivery of one copy of the quality 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 43213-1199.

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 3.4) are interchangeable. Unless otherwise specified, microcircuits acquired to Government logistic support will be acquired to device class B (see 1.2.2), and 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-M-38535.

<u>Military device type</u>	<u>Generic-industry type</u>
01	LM148
02	LM149
03	4741, 4156
04	4136
05	LM124
06	LM124A

6.7 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 5962-1976

Review activities:

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

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-M-38510/110C

2. DOCUMENT DATE (YYYYMMDD)
2003/08/19

3. DOCUMENT TITLE

MICROCIRCUITS, LINEAR, QUAD OPERATIONAL AMPLIFIERS, MONOLITHIC SILICON, PART NUMBERS M38510/10101 THROUGH M38510/10106

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First Middle Initial)*

b. ORGANIZATION

c. ADDRESS *(Include Zip Code)*

d. TELEPHONE *(Include Area Code)*
(1) Commercial
(2) DSN
(If applicable)

7. DATE SUBMITTED
(YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME
Rick Officer

b. TELEPHONE *(Include Area Code)*
(1) Commercial
614-692-0518
(2) DSN
850-0518

c. ADDRESS *(Include Zip Code)*
DSCC-VAS
3990 East Broad Street
Columbus, Ohio 43216-5000

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
Defense Standardization Program Office (DLSC-LM)
8725 John J. Kingman Road, Suite 2533
Fort Belvoir, Virginia 22060-6221
Telephone (703)767-6888 DSN 427-6888

DD Form 1426, FEB 1999 (EG)

WHS/DIOR, Feb 99

PREVIOUS EDITIONS ARE OBSOLETE.