

1.0 SCOPE

This specification documents the detail requirements for space qualified product manufactured on Analog Devices, Inc.'s QML certified line per MIL-PRF-38535 Level V except as modified herein.

The manufacturing flow described in the STANDARD SPACE LEVEL PRODUCTS PROGRAM brochure is to be considered a part of this specification.

<http://www.analog.com/aerospace>

This data sheet specifically details the space grade version of this product. A more detailed operational description and a complete datasheet for commercial product grades can be found at www.analog.com/OP470

2.0 Part Number. The complete part number(s) of this specification follow:

<u>Part Number</u>	<u>Description</u>
OP470-903TC	Very low noise, quad, operational amplifier
OP470R903TC	Radiation Tested, Very low noise, quad, operational amplifier

2.1 Case Outline

<u>Letter</u>	<u>Descriptive designator</u>	<u>Case Outline (Lead Finish per MIL-PRF-38535)</u>
TC	CQCC1-N28	28-Terminal Square leadless chip carrier

Terminal Number	
1	NC
2	OUT A
3	-IN A
4	NC
5	NC
6	+IN A
7	NC
8	+V _{CC}
9	NC
10	+IN B
11	NC
12	NC
13	-IN B
14	OUT B

Terminal Number	
15	NC
16	OUT C
17	-IN C
18	NC
19	NC
20	+IN C
21	NC
22	-V _{CC}
23	NC
24	+IN D
25	NC
26	NC
27	-IN D
28	OUT D

Figure 1 - Terminal connector

3.0 Absolute Maximum Ratings 1/

Supply Voltage (V _{CC})	±18V dc
Differential Input Voltage <u>2/</u>	±1V dc
Differential Input Current <u>2/</u>	±25mA
Input Voltage	Supply voltage
Output Short Circuit Duration	Continuous
Storage Temperature Range.....	-65°C to +150°C
Lead Temperature (soldering, 60 seconds).....	+300°C
Power Dissipation (P _D)	500mW
Maximum Junction Temperature (T _J).....	+150°C
Ambient Operating Temperature Range.....	-55°C to +125°C

Absolute Maximum Ratings Notes:

- 1/ Stresses above the absolute maximum rating may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
- 2/ The inputs are protected by back-to-back diodes. Current limiting resistors are not used in order to achieve low noise performance. If the differential input voltage exceeds ±1V, the input current should be limited to ±25mA.

3.1 Thermal Characteristics:

Thermal Resistance, Lead Leadless Chip Carrier (TC) Package
 Junction-to-Case (Θ_{JC}) = See MIL-STD-1835
 Junction-to-Ambient (Θ_{JA}) = 110 °C/W Max

4.0 Electrical Table:

Table I - Electrical Characteristics						
Parameter	Symbol	Conditions <u>1/</u>	Sub-groups	Limit Min	Limit Max	Units
Input Offset Voltage	V _{IO}	M, D, L, R	1		±0.4	mV
			2, 3		±0.6	
			1		±0.6	
Input Offset Current	I _{IO}	V _{CM} = 0V M, D, L, R	1		±10	nA
			2, 3		±20	
			1		±50	
Input Bias Current	I _{IB}	V _{CM} = 0V M, D, L, R	1		±25	nA
			2, 3		±50	
			1		±500	
Input Noise Voltage <u>4/</u>	E _n	f _o = 1Hz to 100Hz	7		110	nV _{RMS}
Large Signal Voltage Gain	A _{VS}	V _O = ±10V, R _L = 10kΩ M, D, L, R	4	1000		V/mV
			5, 6	750		
			4	100		
			4	500		
			5, 6	400		

Table I - Electrical Characteristics (continued)						
Parameter	Symbol	Conditions 1/	Sub-groups	Limit Min	Limit Max	Units
Output Voltage Swing 4/	V _{OP}	R _L = 2Kohm	4, 5, 6,	±12		V
Supply Current 2/	I _{SY}	No Load M, D, L, R	1, 2, 3		11	mA
			1		11	
Input Voltage Range 4/	IVR		1, 2, 3	±11		V
Slew Rate 4/	SR	A _{VLC} = +21, R _L = 10kΩ	7	1.4		V/μV
Common Mode Rejection 4/	CMR	V _{CM} = IVR 3/	1	110		dB
			2, 3	100		
Power Supply Rejection Ratio 4/	PSRR	V _S = ±4.5V to ±18V	1		1.8	μV/V
			2, 3		5.6	

Table I Notes:

- 1/ V_S = ±15V, R_S = 50Ω, unless otherwise specified.
- 2/ I_{SY} limit equals the total of all four amplifiers.
- 3/ IVR is defined as the V_{CM} range used for the CMR test.
- 4/ Not tested Post Irradiation.

4.1 Electrical Test Requirements:

Table II	
Test Requirements	Subgroups (in accordance with MIL-PRF-38535, Table III)
Interim Electrical Parameters	1
Final Electrical Parameters	1, 2, 3, 4, 5, 6 1/ 2/
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7
Group C end-point electrical parameters	1, 2, 3 2/
Group D end-point electrical parameters	1
Group E end-point electrical parameters	1

- 1/ PDA applies to Subgroup 1 only. Delta's excluded from PDA.
- 2/ See Table III for delta parameters. See table I for conditions.

4.2 Life Test and Burn-In Delta Limits:

Table III				
TEST TITLE	BURN-IN ENDPOINT	LIFETEST ENDPOINT	DELTA LIMIT	UNITS
V _{IO}	±0.4	±0.5	±0.1	mV
I _{IB}	±25	±30	±5	nA
I _{IO}	±10	±15	±5	nA

5.0 Life Test/Burn-In Information

- 5.1** HTRB is not applicable for this drawing.
- 5.2** Burn-in is per MIL-STD-883 Method 1015 test condition B.
- 5.3** Steady state life test is per MIL-STD-883 Method 1005.

OP470

Very low noise, quad, operational amplifier

Rev	Description of Change	Date
A	Initiate	Dec. 10, 2002
B	Update web address. Remove BI circuit.	May 29, 2003