

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:

Part Number

Description

OP470-903TC

Very low noise, quad, operational amplifier

OP470R903TC

Radiation Tested, Very low noise, quad, operational amplifier

2.1 Case Outline

Letter Descriptive designator Case Outline (Lead Finish per MIL-PRF-38535)

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})	$\pm 18V$ dc
Differential Input Voltage <u>2/</u>	$\pm 1V$ dc
Differential Input Current <u>2/</u>	$\pm 25mA$
Input Voltage	Supply voltage
Output Short Circuit Duration	Continuous
Storage Temperature Range	$-65^{\circ}C$ to $+150^{\circ}C$
Lead Temperature (soldering, 60 seconds)	$+300^{\circ}C$
Power Dissipation (P_D)	500mW
Maximum Junction Temperature (T_J)	$+150^{\circ}C$
Ambient Operating Temperature Range	$-55^{\circ}C$ to $+125^{\circ}C$

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 $\pm 1V$, the input current should be limited to $\pm 25mA$.

3.1 Thermal Characteristics:

Thermal Resistance, Lead Leadless Chip Carrier (TC) Package

Junction-to-Case (Θ_{JC}) = See MIL-STD-1835Junction-to-Ambient (Θ_{JA}) = $110^{\circ}C/W$ 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	
			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}	$V_O = \pm 10V$, $R_L = 10k\Omega$	4	1000		V/mV
			5, 6	750		
		$V_O = \pm 10V$, $R_L = 2k\Omega$ <u>4/</u>	M, D, L, R	4	100	
			4	500		
			5, 6	400		

Table I - Electrical Characteristics (continued)

Parameter	Symbol	Conditions <u>1/</u>	Sub- groups	Limit Min	Limit Max	Units
Output Voltage Swing <u>4/</u>	V _{OP}	R _L = 2Kohm	4, 5, 6,	±12		V
Supply Current <u>2/</u>	I _{SY}	No Load	1, 2, 3		11	mA
		M, D, L, R	1		11	
Input Voltage Range <u>4/</u>	IVR		1, 2, 3	±11		V
Slew Rate <u>4/</u>	SR	A _{VLC} = +21, R _L = 10kΩ	7	1.4		V/μV
Common Mode Rejection <u>4/</u>	CMR	V _{CM} = IVR <u>3/</u>	1	110		dB
			2, 3	100		
Power Supply Rejection Ratio <u>4/</u>	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 <u>1/</u> <u>2/</u>
Group A Test Requirements	1, 2, 3, 4, 5, 6, 7
Group C end-point electrical parameters	1, 2, 3 <u>2/</u>
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