

### FEATURES:

- Rad-Pak® technology-hardened against natural space radiation
- Total dose hardness:
  - >100 krad (Si), depending upon orbit and space mission
- Package:
  - 14 pin Rad-Pak® flat package
- Rail-to-Rail input common-mode voltage range (guaranteed over temperature)
- Rail-to-Rail output swing (within 20 mV of supply rail, 100 k $\Omega$  load)
- Guaranteed 3V, 5V and 15V performance
- Excellent CMRR and PSRR: 82 dB
- Ultra low input current: 20 pA
- High voltage gain (RL = 500 k $\Omega$ ): 130 dB
- Specified for 2 k $\Omega$  and 600  $\Omega$  loads

### DESCRIPTION:

Maxwell Technologies' 6484 provides a common-mode range that extends to both supply rails. This rail-to-rail performance combined with excellent accuracy, due to a high CMRR, makes it unique among rail-to-rail input amplifiers. It is ideal for systems, such as data acquisition, that require a large input signal range.

Maximum dynamic signal range is assured in low voltage and single supply systems by the 6484's rail-to-rail output swing. The device's rail-to-rail output swing is guaranteed for loads down to 600 $\Omega$ . Guaranteed low voltage characteristics and low power dissipation make the 6484 especially well-suited for battery-operated systems.

Maxwell Technologies' patented RAD-PAK® packaging technology incorporates radiation shielding in the microcircuit package. It eliminates the need for box shielding while providing the required radiation shielding for a lifetime in orbit or space mission. In a GEO orbit, RAD-PAK provides greater than 100 krad (Si) radiation dose tolerance. This product is available with screening up to Class S.

TABLE 1. PINOUT DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1, 7, 8, 14	OUT A-D	Output Signal
2, 6, 9, 13	IN- A-D	Negative Input Signal
3, 5, 10, 12	IN+ A-D	Positive Input Signal
4	V+	Positive Voltage
11	V-	Negative Voltage

TABLE 2. ABSOLUTE MAXIMUM RATINGS <sup>1</sup>

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage (V+ - V-)	V <sub>SS</sub>	--	16	V
Differential Input Voltage		-V <sub>SS</sub>	V <sub>SS</sub>	V
Voltage at I/O Pin		(V-) -0.3	(V+) +0.3	V
Current at Input Pin <sup>2</sup>		-5	5	mA
Current at Output Pin <sup>3,4</sup>		-30	30	mA
Current at Power Supply Pin		--	40	mA
Maximum Junction Temperature	T <sub>J</sub>	--	150	°C
Power Dissipation	P <sub>D</sub>	--	315	mW
Storage Temperature Range	T <sub>S</sub>	-65	150	°C
Operating Temperature Range	T <sub>A</sub>	-55	125	°C
Lead Temperature (soldering 10 seconds)		--	260	°C
ESD Tolerance <sup>5</sup>		--	2.0	kV

1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.
2. Limiting input pin current is only necessary for input voltages that exceed absolute maximum input voltage ratings.
3. Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of ±30 mA over long term may adversely affect reliability.
4. Do not short circuit output to V+, when V+ is greater than 13V or reliability will be adversely affected.
5. Human body model, 1.5 kΩ in series with 100 pF. All pins rated per method 3015.6 of MIL-STD-883. This is a Class 2 device rating.

TABLE 3. DELTA LIMITS

PARAMETER	VARIATION
I <sub>CC</sub>	±10% of specified value in Table 5

TABLE 4. RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage	$V_{SS}$	3.0	15.5	V

TABLE 5. DC ELECTRICAL CHARACTERISTICS

( $V_+ = 5V$ ,  $V_- = 0V$ ,  $R_1 > 1M\Omega$ ,  $V_{CM} = V_O = V_+/2$ ,  $T_A = -55$  TO  $125^\circ C$ , UNLESS OTHERWISE SPECIFIED)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT	
Input Offset Voltage	$V_{IO}$	25°C	--	0.75	mV	
		-55 TO 125°C	--	1.35		
Input Bias Current	$I_{IB}$	25°C	--	25	pA	
		-55 TO 125°C	--	100		
Input Offset Current	$I_{IO}$	25°C	--	25	pA	
		-55 TO 125°C	--	100		
Common Mode Rejection Ratio	CMRR	$0V \leq V_{CM} \leq 15V$ , $V_+ = 15V$	25°C	65	--	dB
			-55 TO 125°C	62	--	
		$0V \leq V_{CM} \leq 5V$	25°C	65	--	
			-55 TO 125°C	62	--	
Positive Power Supply Rejection Ratio	+PSRR	$5V \leq V_+ \leq 15V$ , $V_O = 2.5V$	25°C	65	--	dB
			-55 TO 125°C	62	--	
Negative Power Supply Rejection Ratio	-PSRR	$-5V \leq V_- \leq -15V$ , $V_O = -2.5V$ , $V_+ = 0V$	25°C	65	--	dB
			-55 TO 125°C	62	--	
Input Common Mode Voltage Range	$V_{CM}$	$5V \geq V_{CM} \geq 15V$ , For CMRR $\geq 50$ dB	25°C	$(V_+) + 0.25$	-0.25	V
			-55 TO 125°C	$V_+$	0	
Output Short Circuit Current	$I_{SC}$	Sourcing, $V_O = 0V$	25°C	16	--	mA
			-55 TO 125°C	12	--	
		Sinking, $V_O = 5V$	25°C	11	--	
			-55 TO 125°C	9	--	
		$V_+ = 15V$ , Sourcing, $V_O = 0V$	25°C	28	--	
			-55 TO 125°C	22	--	
$V_+ = 15V$ , Sinking, $V_O = 12V^1$	25°C	30	--			
	-55 TO 125°C	24	--			
Supply Current	$I_{CC}$	All four amps	25°C	--	2.8	mA
			-55 TO 125°C	--	3.6	
		All four amps, $V_+ = 15V$	25°C	--	3.0	
			-55 TO 125°C	--	4.0	

**TABLE 5. DC ELECTRICAL CHARACTERISTICS**  
( $V_+ = 5V, V_- = 0V, R_1 > 1M\Omega, V_{CM} = V_O = V_+/2, T_A = -55$  TO  $125^\circ C$ , UNLESS OTHERWISE SPECIFIED)

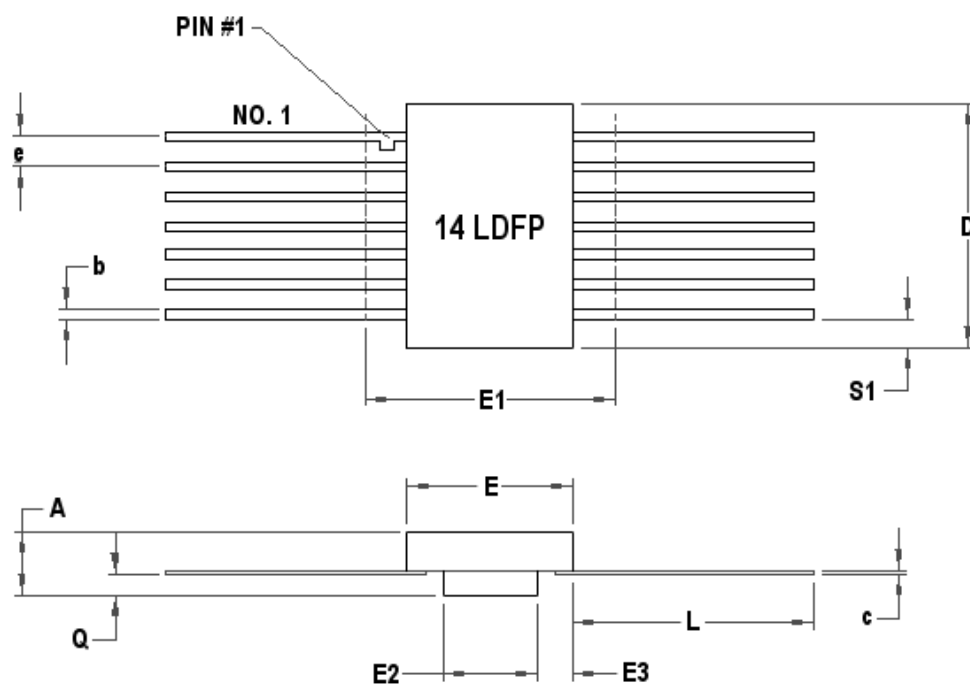
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT	
Output Swing	$V_O$	$V_+ = 5V, R_1 = 2\text{ k}\Omega$ to $V_+/2$	$25^\circ C$	4.8	0.18	V
			-55 TO $125^\circ C$	4.7	0.24	
		$V_+ = 5V, R_1 = 600\ \Omega$ to $V_+/2$	$25^\circ C$	4.5	0.50	
			-55 TO $125^\circ C$	4.24	0.65	
		$V_+ = 15V, R_1 = 2\text{ k}\Omega$ to $V_+/2$	$25^\circ C$	14.4	0.32	
			-55 TO $125^\circ C$	14.2	0.45	
		$V_+ = 15V, R_1 = 600\ \Omega$ to $V_+/2$	$25^\circ C$	13.4	1.00	
			-55 TO $125^\circ C$	13.0	1.3	
Large Signal Voltage Gain <sup>2</sup>	$A_V$	$R_1 = 2\text{ k}\Omega$ Sourcing	$25^\circ C$	140	--	V/mV
			-55 TO $125^\circ C$	84	--	
		$R_1 = 2\text{ k}\Omega$ Sinking	$25^\circ C$	35	--	
			-55 TO $125^\circ C$	20	--	
		$R_1 = 600\ \Omega$ Sourcing	$25^\circ C$	80	--	
			-55 TO $125^\circ C$	48	--	
		$R_1 = 600\ \Omega$ Sinking	$25^\circ C$	18	--	
			-55 TO $125^\circ C$	13	--	

1. Do not short circuit output to  $V_+$ , when  $V_+$  is greater than 13V or reliability will be adversely affected.
2.  $V_+ = 15V, V_{CM} = 7.5V$  and  $R_1$  connected to 7.5V. For sourcing tests,  $7.5V \leq V_O \leq 11.5V$ . For sinking tests,  $3.5V \leq V_O \leq 7.5V$ .

**TABLE 6. AC PARAMETER**  
( $V_+ = 5V, V_- = 0V, R_1 > 1M\Omega, V_{CM} = V_O = V_+/2, T_A = -55$  TO  $125^\circ C$ , UNLESS OTHERWISE SPECIFIED)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Slew Rate <sup>1</sup>	$S_R$		0.9	--	V/ $\mu S$
			0.6	--	
Gain Bandwidth	$G_{BW}$	$V_+ = 15V$ , set up for non-inverting	1.25 1.15	-- --	MHz

1.  $V_+ = 15V$ . Connected as Voltage Follower with 10V step input, 2.5V to 12.5V for +Slew, and 12.5V to 2.5V for (-)Slew. Number specified is the slower of either the positive or negative slew rates.



14 PIN RAD-PAK® FLAT PACKAGE

SYMBOL	DIMENSION		
	MIN	NOM	MAX
A	0.140	0.157	0.170
b	0.015	0.017	0.020
c	0.004	0.005	0.009
D	--	0.380	0.390
E	0.250	0.255	0.260
E1	--	--	0.290
E2	0.125	0.130	--
E3	0.030	0.062	--
e	0.050 BSC		
L	0.270	0.325	0.370
Q	0.026	0.030	0.035
S1	0.005	--	--
N	14		

Note: All dimensions in inches.  
F14-05

# CMOS Quad Rail-to-Rail I/O Op Amp

# 6484

## Important Notice:

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## Product Ordering Options

