

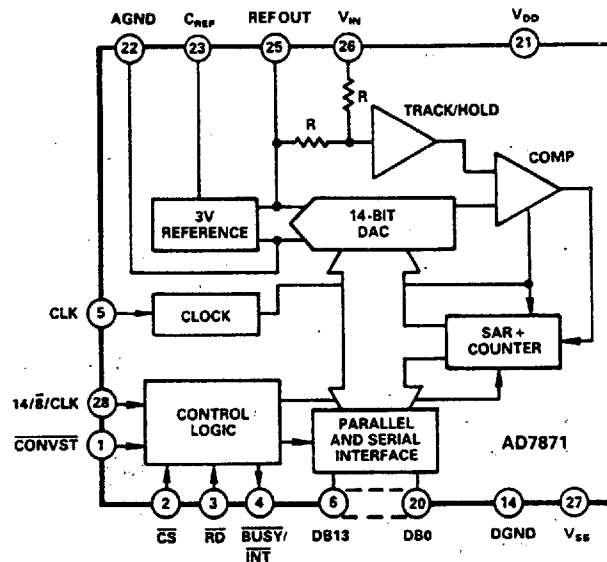
# 14 Bit A/D Converter - Radiation Hardened 7872RP

Class S Screening  
High Speed LC<sup>2</sup>MOS

## For Space Applications

SEI's 7684RP (RP for RAD-PAK<sup>®</sup>) high speed LC<sup>2</sup>MOS microcircuit features a 30 to 100 kilorad (Si) total dose tolerance with no single event latchup. Fully equivalent to the commercial 7872,

the 7872RP combines Analog Device's advanced LC<sup>2</sup>MOS, mixed technology process and SEI's radiation hardened RAD-PAK<sup>™</sup> packaging. This device consists of a track/hold amplifier, successive-approximation ADC, 3 V buried Zener reference and versatile interface logic. It features a self-contained, laser trimmed internal clock, so no external clock timing components are required. For minimum noise possible, the on-chip clock may be overridden to synchronize the device operation to the digital system. The 7872RP operates from  $\pm 5V$  power supplies, accept bipolar input signals of  $\pm 3V$  and able to convert full power signals up to 41.5 kHz. It is also fully specified for dynamic performance parameters including distortion and signal-to-noise ratio. Capable of surviving space environments, the 7872RP is ideal for many satellite, spacecraft, and space probe missions. The radiation hardened RAD-PAK<sup>®</sup> technology incorporates radiation shielding in the microcircuit package. It provides a greater than 100 krad (Si) total dose survivability for GEO applications and greater than 30 krad (Si) total survivability for LEO applications.



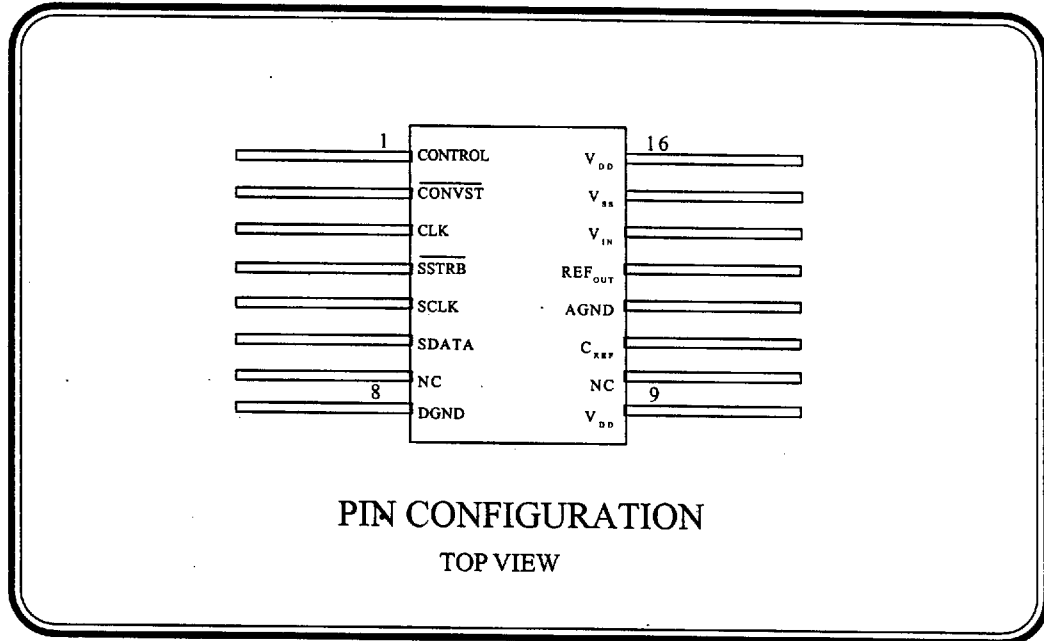
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S E I 7 8 7 2 R P R A D P A K B H A R D L C 2 M O S 1 4 B I T A to D

# Radiation Hardened 7872RP

LC<sup>2</sup>MOS 14 Bit  
Analog to Digital Converter



## Features

- 14 Bit Resolution and Accuracy
- Pin Compatible with AD7872
- RAD-PAK® Radiation Hardened  
Against Natural Space Radiation
- Total Dose Hardness 30 to 100 krad (Si)
  - Single Event Upset LET = 60 MeV/(mg/cm<sup>2</sup>)
  - No Single Event Latchup
- Package:
  - 16 Pin RAD-PAK® flat pack  
(640 mils x 420 mils)
  - Weight – 3.0 grams
- Fast Conversion Times:
  - 7872RP-10: 10 usec
- Low 50 mW Typical Power Consumption
  - Corrects all single-bit errors, detects all double and some triple-bit errors
- High Speed LC<sup>2</sup>MOS Technology
  - Analog Input Range of ±3V
  - 83 kSPS Throughput Rate
  - Operates with ±5V Power Supplies
  - 80 dB SNR at 10 kHz Input Frequency
  - 2s Complement Coding
  - Serial Output
- Screening per TM 5004
- QCI per TM5005

Specifications and design are subject to change without notice.



March 1995

For Further Information Contact:

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**7872RP ABSOLUTE MAXIMUM RATINGS**

PARAMETER	SYMBOL	MIN	MAX	UNITS
Positive Supply Voltage; $0_{IC}=8^{\circ}\text{C/W}$	$V_{DD}$	-0.3	+7	V
Negative Supply Voltage; $0_{IC}=8^{\circ}\text{C/W}$	$V_{SS}$	+0.3	-7	V
AGND to DGND; $0_{IC}=8^{\circ}\text{C/W}$		-0.3	$V_{DD}+0.3$	V
REF OUT, $C_{REF}$ to AGND		0	$V_{DD}$	V
$V_{IN}$ to AGND		$V_{SS}-0.3$	$V_{DD}+0.3$	V
Digital Input Voltage	$V_{IN}$	-0.3	$V_{DD}+0.3$	V
Digital Output Voltage	$V_{OUT}$	-0.3	$V_{DD}+0.3$	V
Power Dissipation to $+75^{\circ}\text{C}$			450	mW
Power Dissipation above $+75^{\circ}\text{C}$ (Derate)			6	mW/ $^{\circ}\text{C}$
Storage Temperature Range	$T_s$	-65	+150	$^{\circ}\text{C}$
Operating Temperature Range	$T_A$	-55	+125	$^{\circ}\text{C}$



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**7872RP DC ELECTRICAL CHARACTERISTICS<sup>1</sup>**

PARAMETER	SYMBOL	MIN	MAX	UNITS
<b>Dynamic Performance<sup>2</sup></b>				
Signal to Noise Ratio <sup>3</sup> @+25°C: V <sub>IN</sub> = 10kHz Sine Wave T <sub>MIN</sub> to T <sub>MAX</sub> : SNR is typically 82 dB for V <sub>IN</sub> <41.5 kHz	SNR	80		dB
Total Harmonic Distortion V <sub>IN</sub> =10kHz Sine Wave THD is typically -90 dB for V <sub>IN</sub> <41.5 kHz	THD		-86	dB
Peak Harmonic or Spurious Noise			-86	dB
Intermodulation Distortion Second Order Terms: f <sub>a</sub> =9kHz, f <sub>b</sub> =9.5kHz, f <sub>SAMPLE</sub> =50kHz Third Order Terms: f <sub>a</sub> =9kHz, f <sub>b</sub> =9.5kHz, f <sub>SAMPLE</sub> =50kHz	IMD		-86 -86	dB dB
Track/Hold Acquisition Time			2	us
<b>DC ACCURACY</b>				
Resolution			14	Bits
Minimum Resolution for Which No Missing Codes are Guaranteed			14	Bits
Integral Nonlinearity @+25°C 7872RPxx-0 7872RPxx-1			+1/2 +1/2	LSB
Integral Nonlinearity			+1	LSB
Bipolar Zero Error			+12	LSB
Positive Gain Error <sup>4</sup>			+12	LSB
Negative Gain Error <sup>4</sup>			+12	LSB
<b>ANALOG INPUT</b>				
Input Voltage Range		-3	+3	V
Input Current		-500	500	uA



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7872RP DC ELECTRICAL CHARACTERISTICS cont.

PARAMETER	SYMBOL	MIN	MAX	UNITS
<b>REFERENCE OUTPUT</b>				
REF OUT @+25°C		2.99	3.01	V
$T_{MIN}$ to $T_{MAX}$		2.98	3.02	V
REF OUT Tempco <sup>2</sup> : Typically 25 ppm			±40	ppm/°C
Reference Load Sensitivity Reference Load Current Change (0-500 uA); Reference Load Should Not Be Changed During Conversion			-1	mV
<b>LOGIC INPUTS</b>				
Input High Voltage: $V_{DD} = 5V \pm 5\%$	$V_{INH}$	2.4		V
Input Low Voltage: $V_{DD} = 5V \pm 5\%$	$V_{INL}$		0.8	V
Input Current: $V_{IN} = 0V$ to $V_{DD}$	$V_{IN}$	-10	+10	uA
Input Current (14/9/CLK input only) $V_{IN} = V_{SS}$ to $V_{DD}$		-10	+10	uA
Input Capacitance <sup>2</sup>	$C_{IN}$		10	pF
<b>LOGIC OUTPUTS</b>				
Output High Voltage $I_{SOURCE} = 40$ uA		4.0		V
Output Low Voltage $I_{SINK} = 1.6$ mA			0.4	V
<b>CONVERSION TIME</b>				
External Clock			10	us
Internal Clock Nominal Value = 2 MHz			10.5	us

Notes:

1. Temperature range: -55°C to +125°C, unless otherwise noted.
2.  $V_{IN} = \pm 3V$ ; guaranteed by design.
3. SNR calculation includes distortion and noise components.
4. Measured with respect to internal reference.



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**7872RP TIMING CHARACTERISTICS<sup>1,2</sup>**

PARAMETER	SYMBOL	MIN	MAX	UNITS
CONVST\ Pulse Width	T <sub>1</sub>	50		ns
SSTRB\ to SCLK Falling Edge Setup Time <sup>3</sup>	T <sub>10</sub>	100		ns
SCLK Cycle Time <sup>4</sup>	T <sub>11</sub>	440		ns
SCLK to Valid Data Delay: C <sub>L</sub> = 35 pF	T <sub>12</sub>		155	ns
SCLK Rising Edge to SSTRB\	T <sub>13</sub>	20	140	ns
Bus Relinquish Time After SCLK	T <sub>14</sub>	4		ns

Notes:

1. All input signals are specified with t<sub>r</sub>=t<sub>f</sub>=5ns (10% to 90% of 5 V) and timed from a voltage level of 1.6V.
2. Serial timing is measured with a 4.7 kilo-ohms pull-up resistor on SDATA and SSTRB\ and a 2 kilo-ohms pull-up resistor on SCLK. The capacitance on all three outputs is 35pF.
3. SCLK mark/space ratio (measured from a voltage level of 1.6 V) is 40/60 to 60/40.
4. SDATA will drive higher capacitive loads, but this will add to T<sub>12</sub> since it increases the external RC time constant (4.7 kilo-ohms/C<sub>L</sub>) and hence the time to reach 2.4V.

**7872RP Package Ordering Guide**

Package Style	Case Outline	1/	Description
F	F-16		28 Pin Flat Package

Note:

- 1/ For outline information, see Appendix A (Package Information - Outline Dimension)

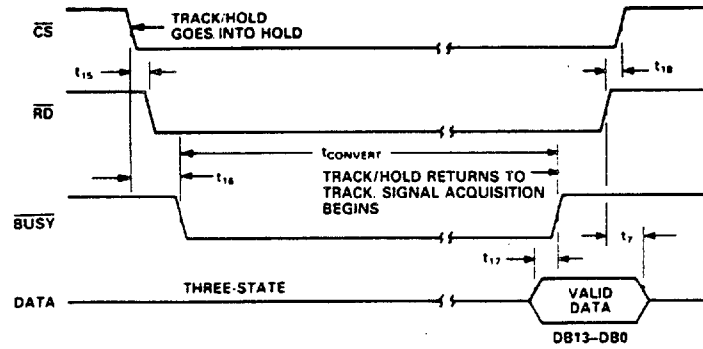


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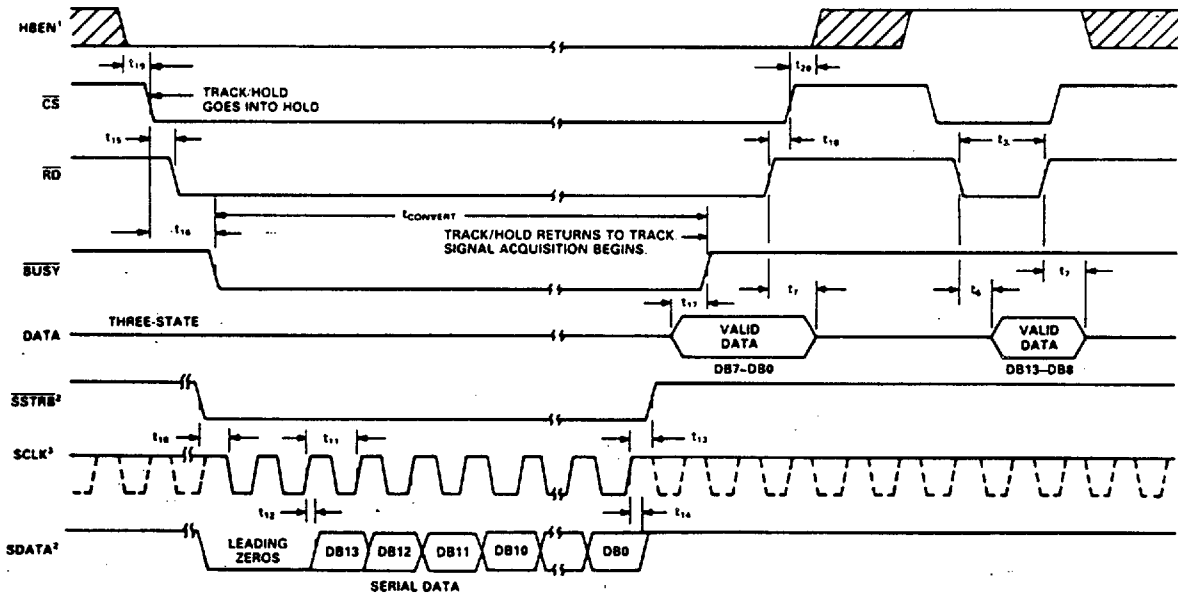
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### Mode 2 Timing Diagram, 14-Bit Parallel Read



### Mode 2 Timing Diagram, Byte or Serial Read



- NOTES
- <sup>1</sup>TIMES  $t_{15}$ ,  $t_{16}$ ,  $t_{17}$ , AND  $t_{18}$  ARE THE SAME FOR A HIGH BYTE READ AS FOR A LOW BYTE READ.
  - <sup>2</sup>EXTERNAL 4.7 k $\Omega$  PULL-UP RESISTOR.
  - <sup>3</sup>CONTINUOUS SCLK (DASHED LINE) WHEN 14 $\bar{B}$ /CLK (CONTROL) = -5 V; NONCONTINUOUS WHEN 14 $\bar{B}$ /CLK (CONTROL) = 0 V. EXTERNAL 2 k $\Omega$  PULL-UP RESISTOR.

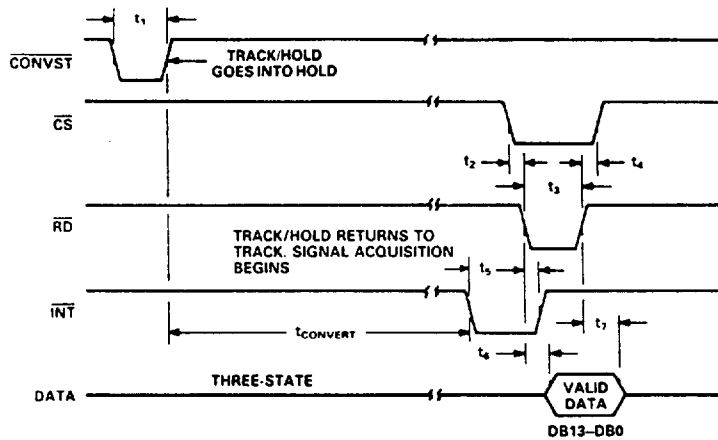


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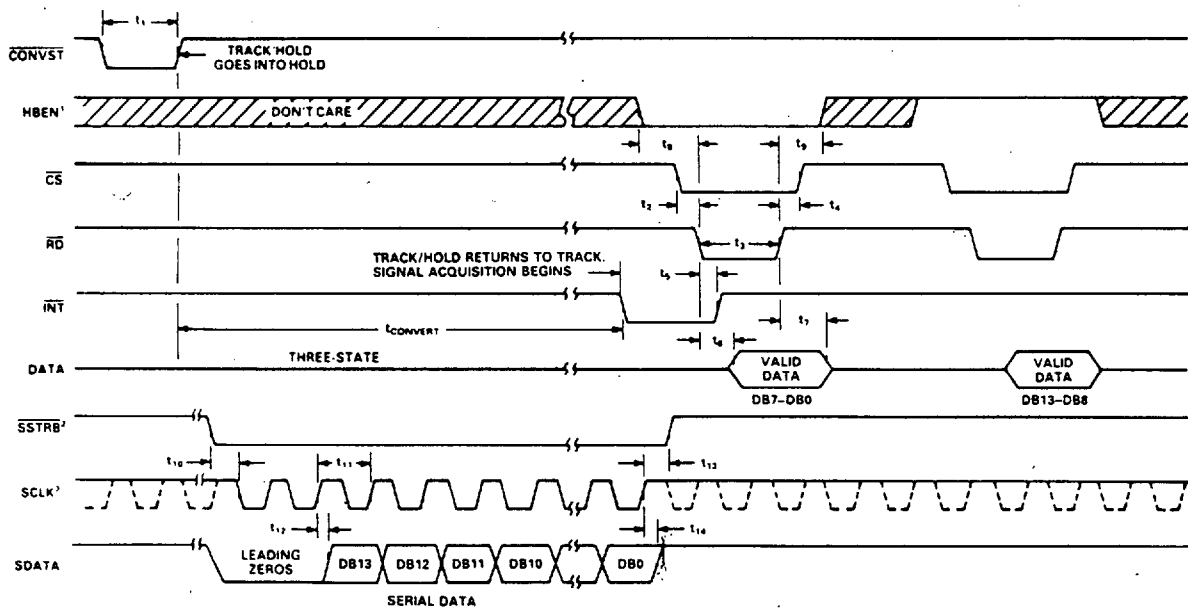
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### Mode 1 Timing Diagram, 14-Bit Parallel Read



### Mode 1 Timing Diagram, Byte or Serial Read



- NOTES
- <sup>1</sup>TIMES  $t_1$ ,  $t_2$ ,  $t_3$ ,  $t_4$ , AND  $t_5$  ARE THE SAME FOR A HIGH BYTE READ AS FOR A LOW BYTE READ
  - <sup>2</sup>EXTERNAL 4.7 k $\Omega$  PULL-UP RESISTOR
  - <sup>3</sup>EXTERNAL 2 k $\Omega$  PULL-UP RESISTOR CONTINUOUS SCLK (DASHED LINE) WHEN 14/8/CLK
  - <sup>4</sup>CONTROL1 = -5 V. NONCONTINUOUS WHEN 14/8/CLK (CONTROL1) = 0V



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## 7872RP PIN DESCRIPTION

PIN	SIGNAL	DESCRIPTION
1	CONTROL	Control Function
2	CONVST\	Convert Start
3	CLK	Clock Input
4	SSTRB\	Serial Strobe
5	SCLK	Serial Clock
6	SDATA	Serial Data
7	NC	No Connect
8	DGND	Digital Ground
9	Vdd	Positive Supply
10	NC	No Connect
11	Cref	Reference Capacitor
12	AGND	Analog Ground
13	REFout	Voltage Reference Output
14	Vin	Analog Input
15	Vss	Negative Supply
16	Vdd	Positive Supply



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