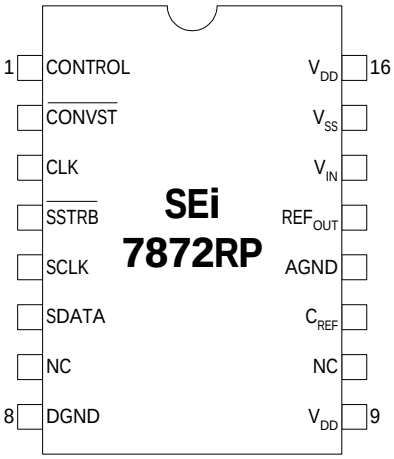
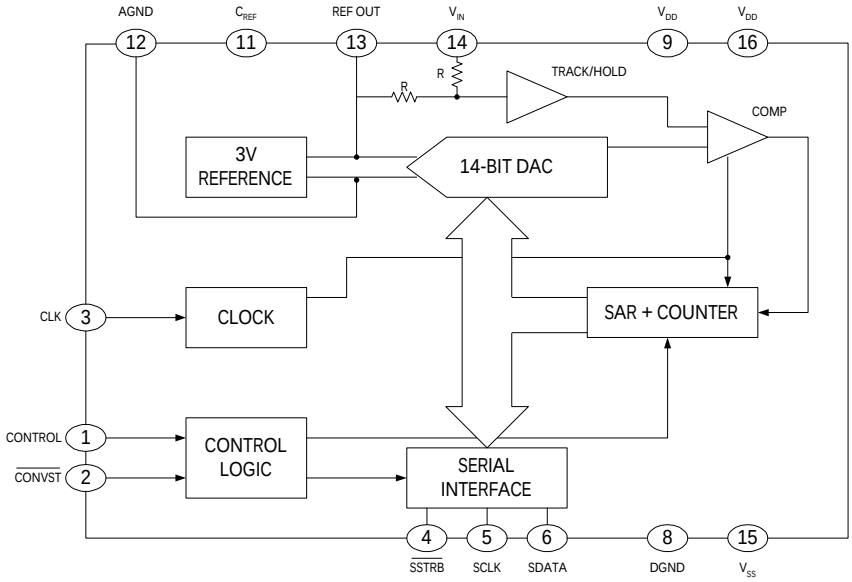
14-BIT A/D CONVERTER

7872RP





FEATURES:

- 14-bit resolution and accuracy
- Total dose hardness typical 100 krad (Si); dependent upon orbit
- Single event effects:
  - Single event latchup upset LET = 60 MeV/mg/cm^2
  - No single event latchup > 104 MeV/mg/cm^2
- Package:
  - 16 pin RAD-PAK® flat package
  - 16 pin RAD-PAK® dual-in-line package
- Fast Conversion Times:
  - 7872RP-10: 10 msec
- Low 50 mW typical power consumption
- High speed LC^{2}MOS technology
  - Analog input range of ±3 V
  - 83 KSPS throughput rate
  - Operates with +5 V/-5 V power supplies
  - 80 dB SNR at 10 kHz input frequency
  - 2 s complement coding
  - Serial output

DESCRIPTION:

Space Electronics' 7872RP (RP for RAD-PAK®) high-speed 14-bit ADC microcircuit features a 30 to 100 kilorad (Si) total dose tolerance; dependent upon orbit. The 7872RP consists of a track/hold amplifier, successive-approximation ADC, 3V 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 is a serial output device. It is capable of interfacing to all modern microprocessors and digital signal processors. The 7872RP operates from ±5V power supplies, accepts bipolar input signals of ±3V and is 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. The radiation-hardened RAD-PAK® technology incorporates radiation shielding in the microcircuit package. Capable of surviving space environments, the 7872RP is ideal for many satellite, spacecraft, and space probe missions. It is offered with packaging and screening up to Class S.

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TABLE 1. 7872RP PIN DESCRIPTION

PIN	SIGNAL	DESCRIPTION
1	CONTROL	Control Function
2	$\overline{CONVST}$	Convert Start
3	CLK	Clock Input
4	$\overline{SSTRB}$	Serial Strobe
5	SCLK	Serial Clock
6	SDATA	Serial Data
7	NC	Non Connect
8	DGND	Digital Ground
9	V_{DD}	Positive Supply
10	NC	No Connect
11	C_{REF}	Reference Capacitor
12	AGND	Analog Ground
13	REF_{OUT}	Voltage Reference Output
14	V_{IN}	Analog Input
15	V_{SS}	Negative Supply
16	V_{DD}	Positive Supply

TABLE 2. 7872RP ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Positive Supply Voltage; Relative to GND	V_{DD}	-0.3	7.0	V
Negative Supply Voltage; Relative to GND	V_{SS}	0.3	7.0	V
AGND to DGND; Relative to GND	--	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
Storage Temperature Range	T_S	-65	150	°C
Operating Temperature Range	T_A	-55	125	°C

TABLE 3. 7872RP DC ELECTRICAL CHARACTERISTICS FOR DYNAMIC PERFORMANCE [1]

(V_{DD} = 5 V ± 5%, V_{SS} = -5 V ± 5%, AGND = DGND = 0 V, f_{CLK} = 2 MHz EXTERNAL, f_{SAMPLE} = 83 kHz, 55 TO 125 °C UNLESS OTHERWISE SPECIFIED)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Signal to Noise Ratio V_{IN} = 10kHz Sine Wave, T_{MIN} to T_{MAX}; SNR is typically 82dB for V_{IN} < 41.5kHz [2]	SNR	79	--	--	dB
Total Harmonic Distortion V_{IN} = 10kHz Sine Wave	THD	--	-86	--	dB
Peak Harmonic or Spurious Noise	--	--	-86	--	dB
Intermodulation Distortion Second Order Terms: f_a = 9 kHz, f_b = 9.5 kHz, f_{SAMPLE} = 50 kHz Third Order Terms: f_a = 9 kHz, f_b = 9.5 kHz, f_{SAMPLE} = 50 kHz	IMD	 -- --	 -86 -86	 -- --	dB
Track/Hold Acquisition Time	--	--	--	2	µs

1. V_{IN} = ± 3 V. Guaranteed by design.
2. SNR calculation includes distortion and noise components.

TABLE 4. 7872RP DC ELECTRICAL CHARACTERISTICS FOR ACCURACY

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Resolution	--	14	--	--	Bits
Resolution for Which No Missing Codes are Guaranteed	--	14	--	--	Bits
Integral Nonlinearity @ 25 °C	--	--	±1	--	LSB
Integral Nonlinearity T_{MIN} to T_{MAX}	--	--	--	±2	LSB
Bipolar Zero Error	--	--	--	±12	LSB
Positive Gain Error [1]	--	--	--	±12	LSB
Negative Gain Error [1]	--	--	--	±12	LSB

1. Measured with respect to internal reference.

TABLE 5. 7872RP DC ELECTRICAL CHARACTERISTICS FOR ANALOG INPUT

PARAMETER	SYMBOL	MIN	MAX	UNITS
Input Voltage Range	--	-3	3	V
Input Current	--	-500	500	µA

TABLE 6. 7872RP DC ELECTRICAL CHARACTERISTICS FOR REFERENCE OUTPUT

PARAMETER	SYMBOL	MIN	MAX	UNIT
REF_{OUT} @ +25 °C	--	2.99	3.01	V
REF_{OUT} T_{MIN} to T_{MAX}	--	2.98	3.02	V
REF_{OUT} Tempco: Typically 35ppm	--	--	±40	ppm/°C
Reference Load Sensitivity ($\Delta REF_{OUT}/\Delta I$)Reference Load Current Change (0-300 µA);Reference Load Should Not Be Changed During Conversion	--	--	1.2	mV

TABLE 7. 7872RP DC ELECTRICAL CHARACTERISTICS FOR LOGIC INPUTS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Input High Voltage: V_{DD} 5 V ± 5%	V_{INH}	2.4	--	V
Input Low Voltage: V_{DD} 5 V ± 5%	V_{INL}	--	0.8	V
Input Current: V_{IN} = 0 V to V_{DD}	I_{IN}	-10	10	µA
Input Current: (14/8/CLK input only) VIN = VSS to VDD	--	-10	10	µA
Input Capacitance [1]	C_{IN}	--	10	pF

1. Sample tested at 25 °C to ensure compliance.

TABLE 8. 7872RP DC ELECTRICAL CHARACTERISTICS FOR LOGIC OUTPUTS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Output High Voltage I_{SOURCE} = 40 µA	V_{OH}	4.0	--	V
Output Low Voltage I_{SINK} = 1.6 mA	V_{OL}	--	0.4	V
Floating-State Leakage Current	--	--	10	µA
Floating-State Output Capacitance [1]	--	--	15	pF

1. Sample tested at 25 °C to ensure compliance.

TABLE 9. 7872RP DC ELECTRICAL CHARACTERISTICS FOR CONVERSION TIME

PARAMETER	SYMBOL	MIN	MAX	UNIT
External Clock	--	--	10	µs
Internal Clock: Nominal Value = 2 MHz	--	--	11	µs

TABLE 10. 7872RP DC ELECTRICAL CHARACTERISTICS FOR POWER REQUIREMENTS

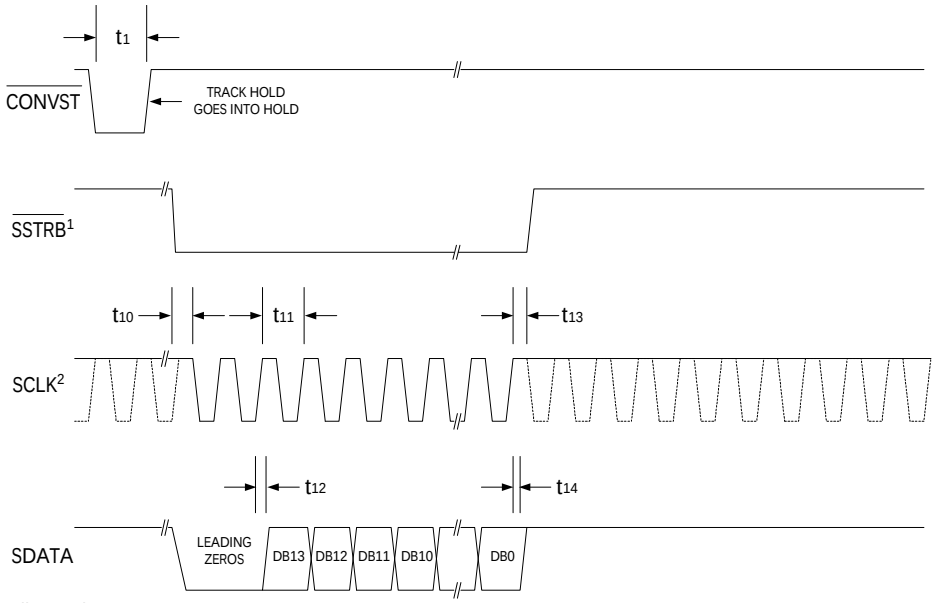
PARAMETER	SYMBOL	CONDITIONS	REQUIRMENTS	UNITS
Positive Supply Voltage	V_{DD}	5% for Specified Performance	5	V
Negative Supply Voltage	V_{SS}	5% for Specified Performance	-5	V
Positive Supply Current	I_{DD}	Typically 6mA	13	mA max
Negative Supply Current	I_{SS}	Typically 4mA	6	mA max
Power Dissipation	P_D	Typically 50mW	95	mW max

TABLE 11. 7872RP TIMING CHARACTERISTICS [1,2]

PARAMETER/CONDITION	SYMBOL	MIN	MAX	UNITS
$\overline{\text{CONVST}}$ Pulse Width	t_1	50	--	ns
$\overline{\text{SSTRB}}$ to SCLK Falling Edge Setup Time	t_{10}	100	--	ns
SCLK Cycle Time [3]	t_{11}	440	--	ns
SCLK to Valid Data Delay: C_L = 35 pF [4]	t_{12}	--	155	ns
SCLD Rising Edge to $\overline{\text{SSTRB}}$	t_{13}	20	150	ns
Bus Rlinquish Time After SCLK	t_{14}	4	100	ns

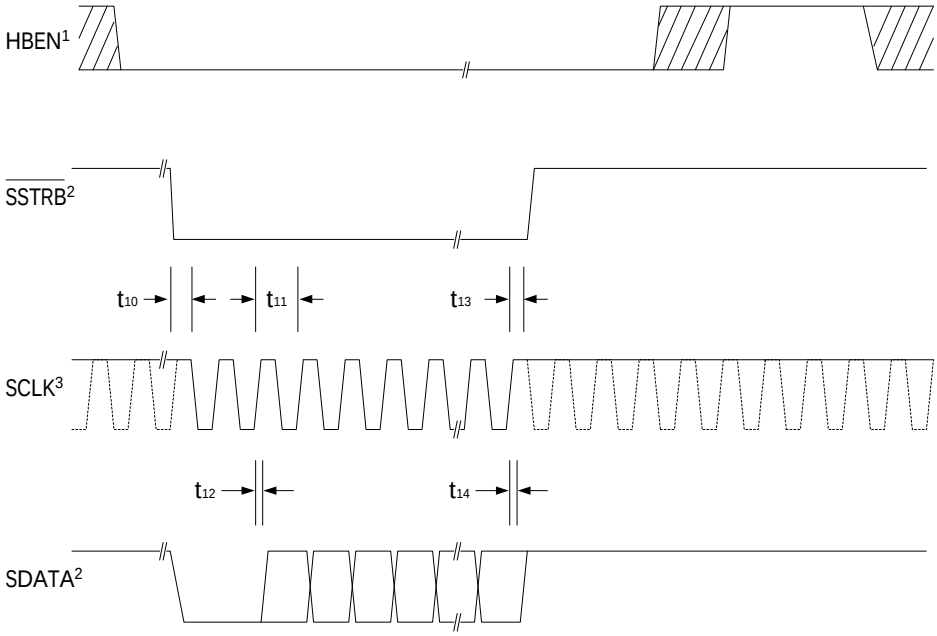
1. All input signals are specified with tr = tr = 5 ns (10% to 90% of 5 V) and timed from a voltage level of 1.6 V.
2. Serial timing is measured with a 4.7 kΩ pull-up resistor on SDATA and $\overline{\text{SSTRB}}$ and a 2 kΩ pull-up resistor on SCLK. The capacitance on all three outputs is 35 pF.
3. SCLK mark/space ration (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_{12} since it increases the external RC time constant ($4.7k\Omega/C_L$) and hence, the time to reach 2.4 V.

FIGURE 1. MODE 1 TIMING DIAGRAM SERIAL



1. External 4.7 kΩ pull-up resistor.
2. External 2 kΩ pull-up resistor continous SCLK (DASHED LINE) when 14/8/CLK (CONTROL) = -5 V; noncontinuous when 14/8/CLK (CONTROL) = 0 V.

FIGURE 2. MODE 2 TIMING DIAGRAM, SERIAL READ



1. Times t15, t18, t19 and t20 are the same for a high byte read as for a low byte read.
2. External 4.7 kΩ pull-up resistor.
3. Continous SCLK (DASHED LINE) when 14/8/CLK (CONTROL) = -5 V; noncontinuous when 14/8/CLK (CONTROL) = 0 V. External 2 kΩ pull-up resistor.

FIGURE 3. LOAD CIRCUIT FOR ACCESS TIME

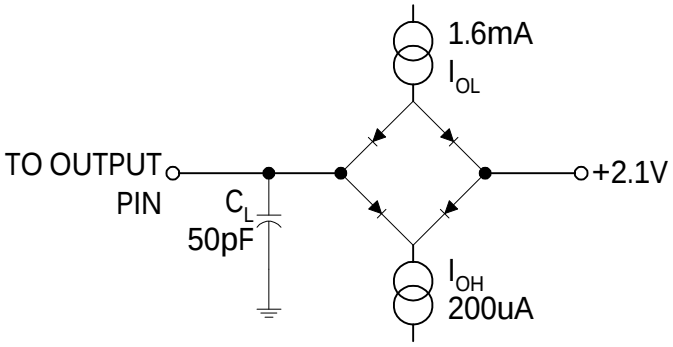
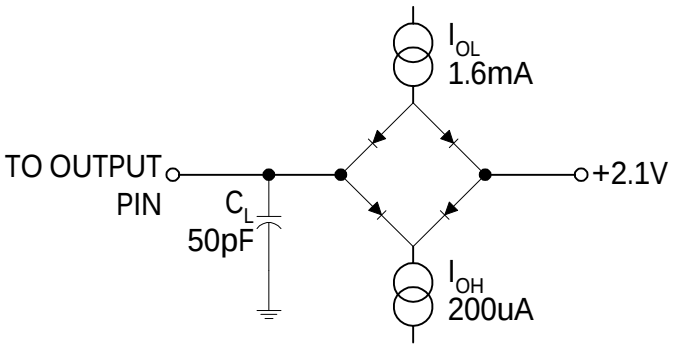
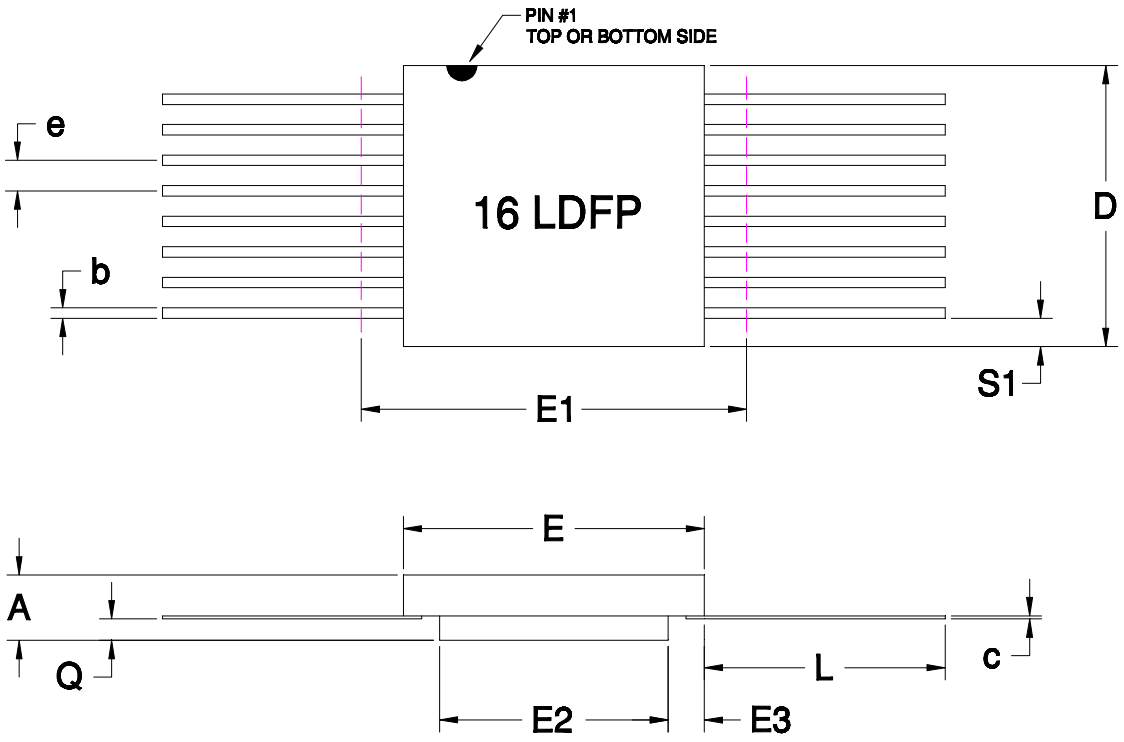


FIGURE 4. LOAD CIRCUIT FOR OUTPUT FLOAT DELAY

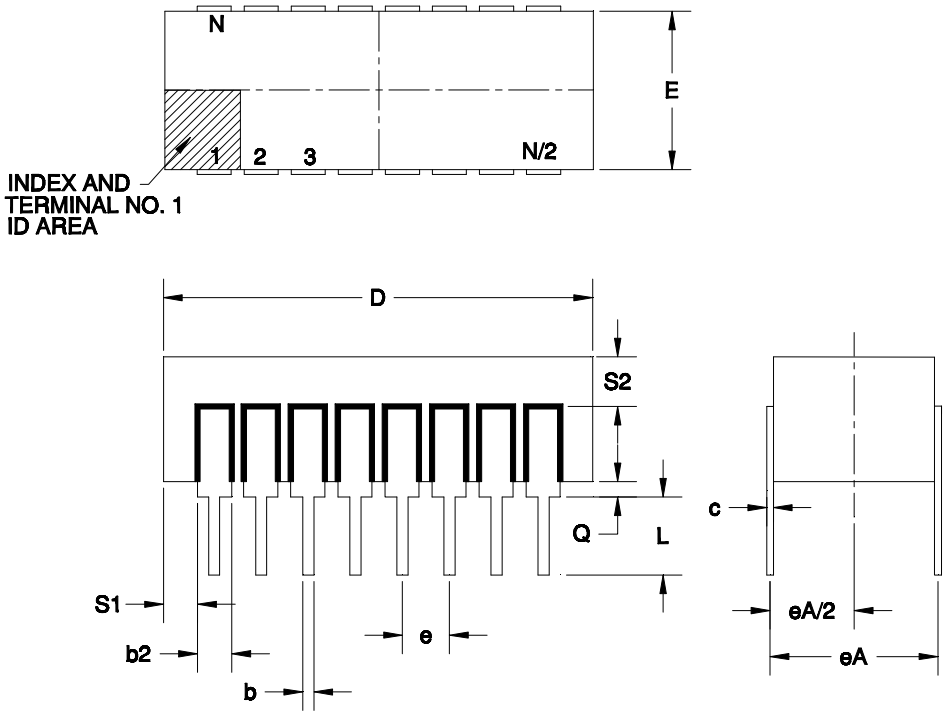




16 PIN RAD-PAK® FLAT PACKAGE

SYMBOL	DIMENSION		
	MIN	NOM	MAX
A	0.116	0.130	0.143
b	0.015	0.017	0.022
c	0.004	0.005	0.009
D	--	0.415	0.440
E	0.245	0.280	0.285
E1	--	--	0.315
E2	0.130	0.156	--
E3	0.030	0.062	--
e	0.050 BSC		
L	0.325	0.335	0.345
Q	0.020	0.033	0.045
S1	0.005	0.024	--
N	16		

F16-01
Note: All dimensions in inches



16 PIN RAD-PAK® DUAL IN LINE PACKAGE

SYMBOL	DIMENSION		
	MIN	NOM	MAX
A	--	0.157	0.200
b	0.014	0.018	0.026
b2	0.045	0.047	0.065
c	0.008	0.010	0.018
D	--	0.800	0.840
E	0.220	0.295	0.310
eA	0.300 BSC		
eA/2	0.150 BSC		
e	0.100 BSC		
L	0.135	0.145	0.155
Q	0.000	0.002	0.060
S1	0.005	0.027	--
S2	0.005	--	--
N	16		

D16-01
Note: All dimensions in inches

Important Notice:

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