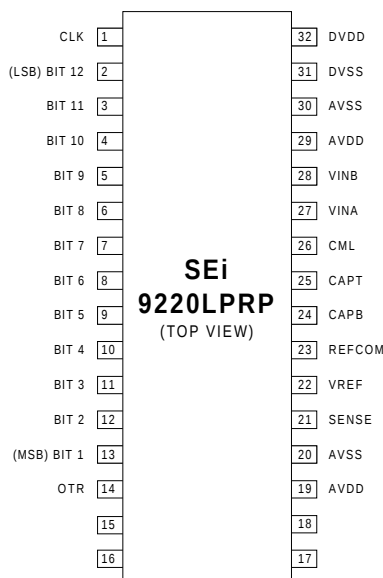
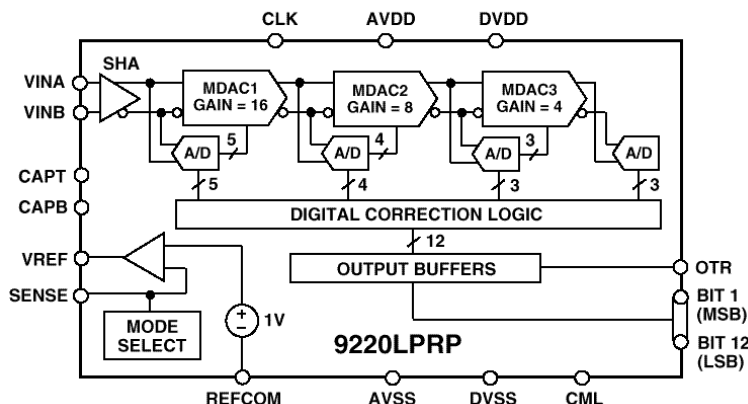


**RADIATION HARDENED****12-BIT MONOLITHIC A/D CONVERTER****9220LPRP***--Preliminary--***FUNCTIONAL BLOCK DIAGRAM****FEATURES:**

- Monolithic 12-bit A/D converter
- RAD-PAK® technology hardens against natural space radiation
- Total dose hardness = typical 100 krad (Si); dependent upon orbit
- Single event effect:
 - Latchup protection technology
 - SEU recoverable
- Package: 32-pin flat package
- Flexible sampling rates: 1.25 MSPS, 2.0 MSPS, and 10.0 MSPS
- Low power dissipation: 56 mW, 100mW, and 250 mW
- Single +5 V supply
- Integral nonlinearity error: 0.5 LSB
- Differential nonlinearity error: 0.3 LSB
- Input referred noise: 0.09 LSB
- On-chip sample-and-hold amplifier and voltage reference
- Signal-to-noise and distortion ratio: 70 dB
- Spurious-free dynamic range: 86dB
- Out-of-range indicator
- Straight binary output data
- 32-pin status at the bottom

DESCRIPTION:

Space Electronics' 9220LPRP (RP for RAD-PAK®) high-speed 12-bit monolithic analog-to-digital converter features a typical of 100 krad of (Si) total dose tolerance; dependent upon orbit. The 9220LPRP is latchup-protected by Space Electronics' LPT™ technology. It is a 32-pin, 12-bit analog-to-digital converter using state-of-the-art CMOS structure. Excluding the internal voltage reference, the 9220RPLP exhibits true 12-bit analog-to-digital linearity and temperature drift performance as well as 11.5 bit or better ac performance depending on the analog input configuration. It is a complete, monolithic ADC with an on-chip, high-performance, low noise sample-and-hold amplifier and programmable voltage reference. It uses a multistage differential pipelined architecture with digital output error correction logic to provide 12-bit accuracy at the specified data rates and to guarantee no missing codes over the full operating temperature range. A truly differential input structure allows for both single-ended and differential input interfaces of varying input spans. The sample-and-hold (SHA) amplifier is equally suited for both multiplexed systems that switch full-scale voltage levels in successive channels as well as sampling single-channel inputs at frequencies up to and beyond the Nyquist rate. Depending on the analog input configuration, the 9220RPLP is well-suited for communication systems employing Direct-IF Down Conversion since the SHA in the differential input mode can achieve excellent dynamic performance far beyond its specified Nyquist frequency. The patented radiation-hardened RAD-Pak® technology incorporates radiation shielding in the microcircuit package. Capable of surviving in-space environment, the 9220LPRP is ideal for satellite, spacecraft, and space probe missions. It is available with packaging and screening up to Class S.

**RADIATION HARDENED****9220LPRP****12-BIT MONOLITHIC A/D CONVERTER****ABSOLUTE MAXIMUM RATINGS FOR THE 9220LPRP**

PARAMETER	With Respect to	MIN	MAX	UNITS
AVDD	AVSS	-0.3	+6.5	V
DVDD	DVSS	-0.3	+6.5	V
AVSS	DVSS	-0.3	+0.3	V
AVDD	DVDD	-6.5	+6.5	V
REFCOM	AVSS	-0.3	+0.3	V
CLK	DVSS	-0.3	D _{VDD} + 0.3	V
Digital Outputs	DVSS	-0.3	D _{VDD} + 0.3	V
VINA, VINB	AVSS	-0.3	A _{VDD} + 0.3	V
VREF	AVSS	-0.3	A _{VDD} + 0.3	V
SENSE	AVSS	-0.3	A _{VDD} + 0.3	V
CAPB, CAPT	AVSS	-0.3	A _{VDD} + 0.3	V

DIGITAL SPECIFICATIONS FOR THE 9220LPRP(A_{VDD} = +5 V, D_{VDD} = +5 V, T_{MIN} to T_{MAX}, unless otherwise noted)

PARAMETERS	SYMBOL	RATING	UNITS
LOGIC INPUTS			
High Level Input Voltage	V _{IH}	+3.5	V min
Low Level Input Voltage	V _{IL}	+1.0	V max
High Level Input Current (V _{IN} = D _{VDD})	I _{IH}	+10	uA max
Low Level Input Current (V _{IN} = 0 V)	I _{IL}	+10	uA max
Input Capacitance	C _{IN}	5	pF typ
LOGIC OUTPUTS			
High Level Output Voltage (I _{OH} = 50 uA)	V _{OH}	+4.5	V min
Low Level Output Voltage (I _{OH} = 0.5 mA)	V _{OH}	+2.4	V min
High Level Output Current (I _{OL} = 1.6 mA)	V _{OL}	+0.4	V max
Low Level Output Current (I _{OL} = 50 uA)	V _{OL}	+0.1	V max
Output Capacitance	C _{OUT}	5	pF typ

SWITCHING SPECIFICATIONS FOR THE 9220LPRP(A_{VDD} = +5 V, D_{VDD} = +5 V, T_{MIN} to T_{MAX}, C_L = 20 pF)

PARAMETERS	SYMBOL	RATING	UNITS
Clock Period ⁽¹⁾	t _c	100	ns min
CLOCK Pulse Width High	t _{CH}	45	ns min
CLOCK Pulse Width Low	t _{CL}	45	ns min
Output Delay	t _{OD}	8 13 19	ns min ns typ ns max
Pipeline Delay (Latency)		3	Clock Cycles

Note:

1. The clock period may be extended to 1 ms without degradation in specified performance @ +25 °C.

**RADIATION HARDENED****9220LPRP****12-BIT MONOLITHIC A/D CONVERTER****DC SPECIFICATIONS FOR THE 9220LPRP**(AV_{DD} = +5 V, DV_{DD} = +5 V, f_{SAMPLE} = Max Conversion Rate, V_{REF} = 2.5 V, VINB = 2.5 V, T_{MIN} to T_{MAX}, unless otherwise noted)

PARAMETER	RATING	UNITS
RESOLUTION	12	Bits min.
MAXIMUM CONVERSION RATE	10	MHz min
INPUT REFERRED NOISE (TYP)		
V _{REF} = 1 V	0.23	LSB rms typ
V _{REF} = 2.5 V	0.09	LSB rms typ
ACCURACY		
Integral Nonlinearity (INL)	+0.5 +1	LSB typ LSB max
Differential Nonlinearity (DNL)	+0.3 +0.75	LSB typ LSB max
INL ⁽¹⁾	+0.7	LSB typ
DNL ⁽¹⁾	+0.35	LSB typ
No Missing Codes	12	Bits Guaranteed
Zero Error (@ +25°C)	+0.3	% FSR max
Gain Error (@ +25°C) ⁽²⁾	+1.5	% FSR max
Gain Error (@ +25°C) ⁽³⁾	+0.75	% FSR max
TEMPERATURE DRIFT		
Zero Error	+2	ppm/°C typ
Gain Error	+26	ppm/°C typ
Gain Error	+0.4	ppm/°C typ
POWER SUPPLY REJECTION		
AV _{DD} , DV _{DD} (+5 V + 0.25 V)	+0.06	% FSR max
ANALOG INPUT		
Input Span		
V _{REF} = 1.0 V	2	V _{p-p} min
V _{REF} = 2.5 V	5	V _{p-p} max
Input (VINA or VINB) Range	0 AV _{DD}	V min V max
Input Capacitance	16	pF typ
INTERNAL VOLTAGE REFERENCE		
Output Voltage (1 V Mode)	1	Volts typ
Output Voltage Tolerance (1 V Mode)	+14	mV max
Output Voltage (2.5 V Mode)	2.5	Volts typ
Output Voltage Tolerance (2.5 V Mode)	+35	mV max
Load Regulation ⁽⁴⁾	1.5	mV max
REFERENCE INPUT RESISANCE		
POWER SUPPLIES		
Supply Voltages		
AV _{DD}	+5	V (+5% AV _{DD} Operating)
DV _{DD}	+5	V (+5% DV _{DD} Operating)
Supply Current		
IAV _{DD}	51 46	mA max mA typ
IDV _{DD}	12 10	mA max mA typ
POWER CONSUMPTION		
	250 310	mW typ mW max

Notes:

1. V_{REF} = 1 V.
2. Including internal reference.
3. Excluding internal reference.
4. Load regulation with 1 mA load current (in addition to that required by the 9220LPRP).

**RADIATION HARDENED****9220LPRP****12-BIT MONOLITHIC A/D CONVERTER****AC SPECIFICATIONS FOR THE 9220LPRP**

($V_{DD} = +5\text{ V}$, $DV_{DD} = +5\text{ V}$, $f_{\text{SAMPLE}} = \text{Max Conversion Rate}$, $V_{\text{REF}} = 1.0\text{ V}$, $V_{\text{INB}} = 2.5\text{ V}$, DC Couple/Single-ended Input
 T_{MIN} to T_{MAX} , unless otherwise noted)

PARAMETER	RATING	UNITS
MAXIMUM CONVERSION RATE	10.0	MHz min
DYNAMIC PERFORMANCE		
Input Test Frequency 1 ($V_{\text{INA}} = -0.5\text{ dBFS}$)	1000	kHz
Signal-to-Noise and Distortion (SINAD)	70 68.5	dB typ dB min
Effective Number of bits (ENOBs)	11.3 11.1	dB min dB typ
Signal-to-Noise Ratio (SNR)	70.2 69.0	dB typ dB min
Total Harmonic Distortion (THD)	-83.7 -76.0	dB typ dB max
Spurious Free Dynamic Range (SFDR)	88.0 77.5	dB typ dB max
Input Test Frequency 2 ($V_{\text{INA}} = -0.5\text{ dBFS}$)	5.0	MHz
Signal-to-Noise Ratio (SNR)	67.0 65.0	dB typ dB min
Effective Number of bits (ENOBs)	10.8 10.5	dB min dB typ
Signal-to-Noise Ratio (SNR)	68.8 67.5	dB typ dB min
Total Harmonic Distortion (THD)	-72.0 -68.0	dB typ dB max
Spurious Free Dynamic Range (SFDR)	75.0 69.0	dB typ dB max
Full Power Bandwidth	60	MHz typ
Small Signal Bandwidth	60	MHz typ
Aperture Delay	1	ns typ
Aperture Jitter	4	ps rms typ
Acquisition to Full-Scale Step	30	ns typ

PIN DESCRIPTION FOR THE 9220LPRP

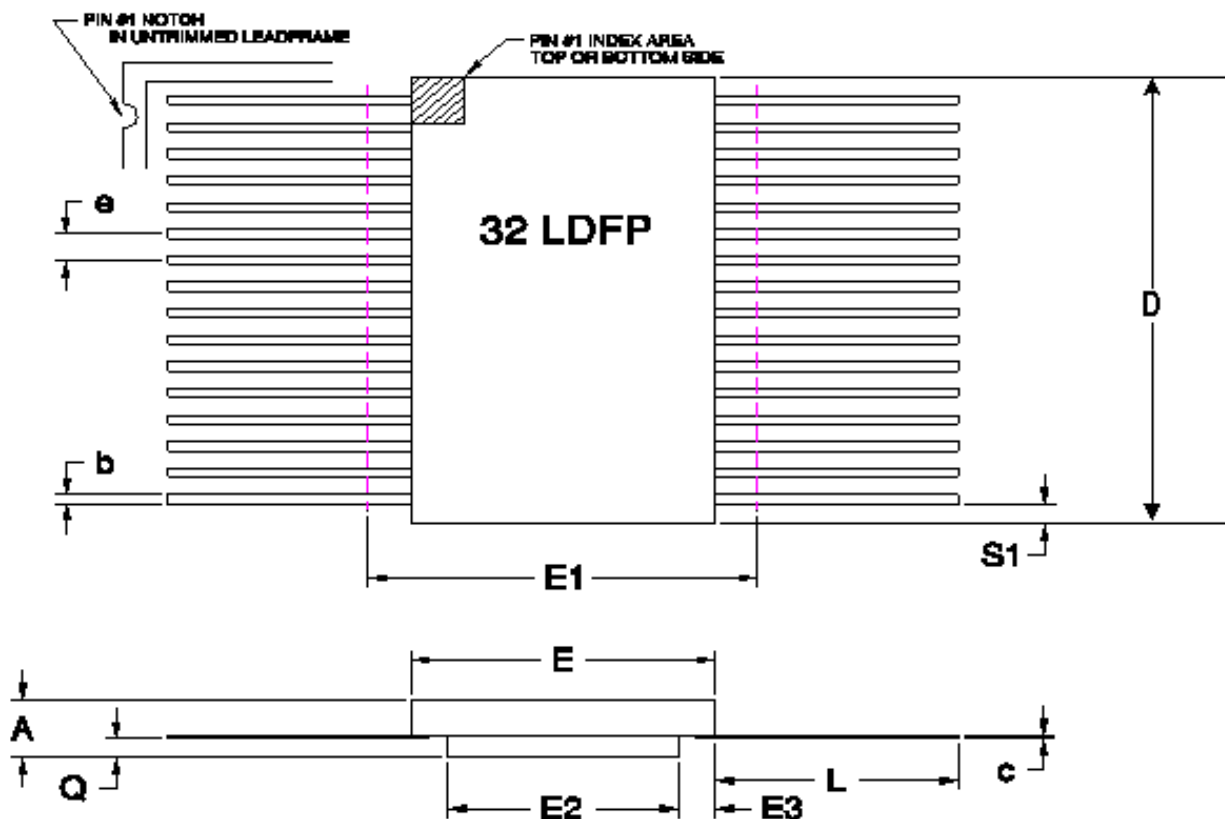
PIN NUMBER	NAME	DESCRIPTION
1	CLK	Clock Input Pin
2	BIT 12	Least Significant Data Bit (LSB)
3-12	BIT N	Data Output bit
13	BIT 1	Most Significant Data Bit (MSB)
14	OTR	Out of Range
15		
16		
17		
18		
19, 29	AVDD	+5 V Analog Supply
20, 30	AVSS	Analog Ground
21	SENSE	Reference Select
22	VREF	Reference I/O
23	REFCOM	Reference common
24	CAPB	Noise Reduction Pin
25	CAPT	Noise Reduction Pin
26	CML	Common-Mode Level (Midsupply)
27	VINA	Analog Input Pin (+)
28	VINB	Analog Input Pin (-)
31	DVSS	Digital Ground
32	DVDD	+5 V Digital Supply



9220LPRP

RADIATION HARDENED

12-BIT MONOLITHIC A/D CONVERTER



32 PIN RAD-PAK® FLAT PACKAGE

SYMBOL	DIMENSION		
	MIN	NOM	MAX
A	0.213	0.227	0.241
b	0.015	0.017	0.019
c	0.004	0.005	0.009
D	--	0.820	0.830
E	0.404	0.410	0.416
E1	--	--	0.426
E2	0.234	0.240	--
E3	0.030	0.085	--
e	0.050 BSC		
L	0.390	0.400	0.410
Q	0.062	0.072	0.075
S1	0.005	0.027	--
N	32		

F32-02

Note: All dimensions in inches