

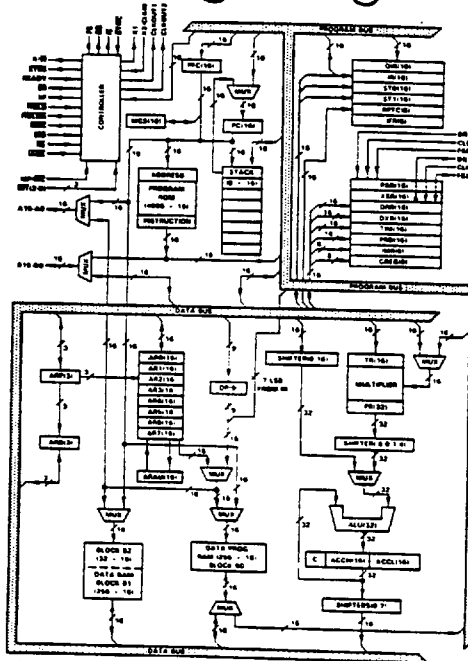
Preliminary

Radiation Hardened 320C25RP

16-Bit Fixed Point CMOS
Digital Signal Processor

For Space Applications

SEI's 320C25RP (RP for RAD-PAK®) high speed CMOS microcircuit features a minimum 100 kilorad (Si) total dose tolerance. Fully equivalent to the SMJ320C25, the 320C25RP combines Texas Instruments advanced 16-bit microprocessor and SEI's radiation hardened RAD-PAK® packaging. This device is able to execute 10 million instructions per second, since most of the instructions can be executed in a single cycle. Externally, the program and data memory spaces are multiplexed over the same bus so as to maximize the address range for both spaces and minimize the pin count of the device. Internally, the 320C25RP architecture maximizes processing power by maintaining two separate bus structures, program and data, for full-speed execution. Two large, on-chip data RAM blocks (a total of 544 words), one of which is configurable either as program or data memory, are provided. Four-K words of on-chip program ROM and 64K words of off-chip program address space are also available. From this memory space, large programs are able to be executed at full speed. Programs can also be downloaded from slow external memory to on-chip RAM for full-speed operation. Capable of surviving space environments, the 320C25RP is ideal for satellite, spacecraft, and space probe missions. The RAD-PAK® technology incorporates radiation shielding in the microcircuit package. It eliminates box shielding while providing lifetime in orbit. The 320C25RP is available in Class S packaging and screening.

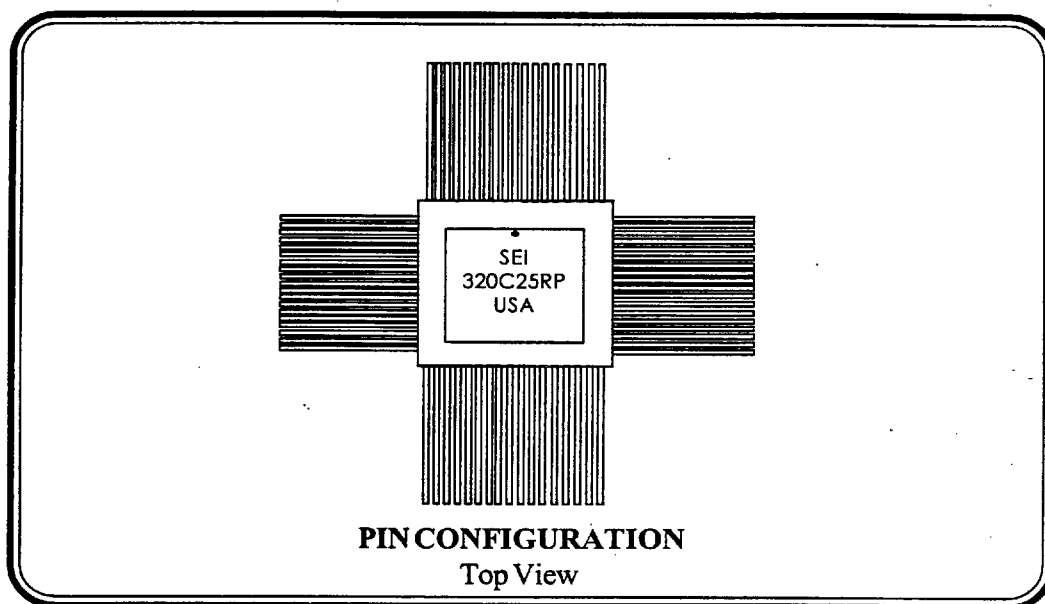


**SPACE
ELECTRONICS
INCORPORATED**

Tel: (619) 452-4167 Fax: (619) 452-5499
INTERNET: 102005.1635@COMPUSERVE.COM

Radiation Hardened 320C25RP

16-Bit Fixed Point CMOS
Digital Signal Processor



Features

- DSP 16-Bit Microprocessor
- Pin Compatible to SMJ320C25
- RAD-PAK® Radiation Hardened
Against Natural Space Radiation
- Total Dose Hardness >100 krad (Si)
- Package:
 - 68 Pin RAD-PAK® quad flat pack
(0.950 in. x 0.950 in.)
- Weight - 12 grams
- High Speed CMOS Technology
- 100 nsec Single-Cycle Instruction Time
- 544 Word RAM
- 4K Word ROM
- 32-bit Accumulator
- Auxiliary Register ALU
- Full Duplex Serial Port
- Multiprocessor Interface
- Screening per TM5004
- QCI per TM5005

* Specifications and design are subject to change without notice.



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For Further Information Contact:

Space Electronics Inc.
4031 Sorrento Valley Blvd., San Diego, CA 92121
(619) 452-4167 Fax (619) 452-5499

320C25RP ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage Range	V_{CC}	-0.3	7	V
Input Voltage Range	V_{IN}	-0.3	7	V
Output Voltage Range	V_{OUT}	-0.3	7	V
Continuous Power Dissipation	P_D		1.0	W
Storage Temperature Range	T_s	-55	150	°C

320C25RP RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage	V_{CC}	4.5	5.5	V
Supply Voltage	V_{SS}	0	0	V
High-level Input Voltage READY D15-D0, FSX CLKR, CLKX CLKIN All others	V_{IH}	2.35 2.20 3.50 3.50 3.00		V V V V V
Low-level Output Current D15-D0, FSX, CLKIN, CLKR, CLKX HOLD All others	V_{IL}		0.80 0.70 0.70	V V V
High-level Output Current	I_{OH}		300	uA
Low-level Output Current	I_{OL}		2	mA
Operating Free-air Temperature	T_A	-55		°C
Operating Case Temperature	T_C		125	°C



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SAN DIEGO, CA 92121
PHONE: (619) 452-4167
FAX: (619) 452-5499
INTERNET: 102005.1635@COMPUSERVE.COM

9011241 0000251 752 250

320C25RP ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
High-level Output Voltage $V_{CC}=\text{MIN.}, I_{OH}=\text{MAX}$	V_{OH}	2.4	3		V
Low-level Output Voltage $V_{CC}=\text{MIN.}, I_{OL}=\text{MAX}$	V_{OL}		0.3	0.6	V
Three-state Current $V_{CC}=\text{MAX}$	I_Z	-20		20	μA
Input Current $V_I=V_{SS}$ to V_{CC}	I_I	-10		10	μA
Supply Current Normal $V_{CC}=f_x=\text{MAX}$ Idle/HOLD $V_{CC}=f_x=\text{MAX}$	I_{CC}			185 100	mA mA
Input Capacitance	C_i		15		pF
Output Capacitance	C_o		15		pF

320C25RP SWITCHING REQUIREMENTS¹

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
CLKOUT1/CLKOUT2 Cycle Time	$t_c(C)$	100		600	ns
CLKIN High to CLKOUT1/CLKOUT2/STRB\ High/Low	$t_{\text{f}}(\text{CIH-C})$	5		30	ns
CLKOUT1/CLKOUT2/STRB\ Fall Time	$t_f(C)$			5	ns
CLKOUT1/CLKOUT2/STRB\ Rise Time	$t_r(C)$			5	ns
CLKOUT1/CLKOUT2 Low Pulse Duration	$t_L(\text{CL})$	2Q-8	2Q	2Q+8	
CLKOUT1/CLKOUT2 High Pulse Duration	$t_H(\text{CH})$	2Q-8	2Q	2Q+8	ns
CLKOUT1 High to CLKOUT2 Low, CLKOUT2 High to CLKOUT1 High. etc.	$t_d(\text{C1-C2})$	Q-6	Q	Q+6	ns

Note:

1. $Q=1/4t_c(C)$.



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PHONE: (619) 452-4167
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9011241 0000252 699

251

320C25RP TIMING REQUIREMENTS¹

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
CLKIN Cycle Time	$t_c(CI)$	25		150	ns
CLKIN Low Pulse Duration, $t_c(CI)=25ns^2$	$t_w(CIL)$	10		15	ns
CLKIN High Pulse Duration, $t_c(CI)=25ns^2$	$t_w(CIH)$	10		15	ns
SYNC\ Setup Time Before CLKIN Low	$t_s(S)$	5		Q-5	ns
SYNC\ Hold Time from CLKIN Low	$t_h(S)$	8			ns

Notes:

1. $Q=1/4t_c(C)$.
2. CLKIN duty cycle $[t_{r(CI)}+t_{w(CIH)}]/t_{c(CI)}$ must be within 40-60%. CLKIN rise and fall times must be less than 5 ns.

MEMORY AND PERIPHERAL INTERFACE TIMING

320C25RP TIMING REQUIREMENTS¹

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Read Data Access Time from Address Time (Read Cycle ^{3,5})	$t_r(A)$			3Q-35	ns
Data Read Setup time before STRB\ High	$t_m(D)R$	23			ns
Data Read Hold time from STRB\ High	$t_h(D)R$	0			ns
READY Valid after STRB\ Low (No Wait States)	$t_s(SL-R)$			Q-20	ns
READY Valid after CLKOUT2 High	$t_s(C2H-R)$			Q-20	ns
READY Hold Time after STRB\ low (No Wait States)	$t_h(SL-R)$	Q+3			ns
READY Hold after CLKOUT2 High	$t_h(C2H-R)$	Q+3			ns
READY Hold after MSC\ Valid	$t_d(M-R)$			2Q-25	ns
READY Hold Time after MSC\ Valid	$t_h(M-R)$	0			ns



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9011241 0000253 525 252

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320C25RP SWITCHING CHARACTERISTICS¹

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
STRB\ From CLKOUT1 (if STRB\ is present)	$t_d(C1-S)$	Q-6	Q	Q+6	ns
CLKOUT2 To STRB\ (if STRB\ is present)	$t_d(C2-S)$	-6	0	6	ns
Address Setup Time Before STRB\ Low ³	$t_m(A)$	Q-12			ns
Address Hold Time After STRB\ High ³	$t_h(A)$	Q-8			ns
STRB\ Low Pulse Duration (No Wait States) ⁴	$t_w(SL)$	2Q-5	2Q	2Q+5	ns
STRB\ High Pulse Duration (Between Consecutive Cycles ⁴)	$t_h(SH)$		2Q		ns
Data Write Setup Before STRB\ High (No Wait States)	$t_m(D)W$	2Q-20			ns
Data Write Hold Time From STRB\ High	$t_h(D)W$	Q-10	Q		ns
Data Bus Starts Being Driven After STRB\ Low (Write Cycle)	$t_m(D)$	0			ns
Data Bus Three-state After STRB\ High (Write Cycle)	$t_{ds}(D)$		Q	Q+15	ns
MSC\ Valid from CLKOUT1	$t_s(MSC)$	-10	0	10	ns

Notes:

1. $Q = 1/4tc(C)$.
3. A15-A0, PS\, DS\, IS\, R/W\, and BR\ timings are address timings.
4. Delays between CLKOUT1/CLKOUT2 edges and STRB\ edges track each other, resulting in $t_w(SL)$ and $t_w(SH)$ being 2Q with no wait states.
5. Read data access time is defined as $t_s(A) = t_m(A) + t_w(SL) - t_m(D)R + t_s(C)$.

RS\, INT\, BIO\, AND XF TIMING

320C25RP SWITCHING CHARACTERISTICS¹

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
CLKOUT1 Low to Reset State Entered	$t_d(RS)$			22 ²	ns
CLKOUT1 to IACK\ Valid	$t_d(IACK)$	-8	0	8	ns
XF Valid Before Falling Edge of STRB\	$t_d(XF)$	Q-12			ns



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9011241 0000254 461 253

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 SAN DIEGO, CA 92121
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320C25RP TIMING REQUIREMENTS¹

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
INTVBIOVRS\ Setup before CLKOUT1 High	$t_{su}(IN)$	32			ns
INTVBIOVRS\ Hold after CLKOUT1 High	$t_h(IN)$	0			ns
INTVBIO\ Low Pulse Duration	$t_w(IN)$	$t_c(C)$			ns
RS\ Low Pulse Duration	$t_w(RS)$	$3t_c(C)$			ns

Notes:

1. $Q = 1/4t_{c(C)}$.
2. Not tested.

HOLD\ TIMING

320C25RP SWITCHING CHARACTERISTICS¹

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
HOLDA\ Low After CLKOUT1 Low	$t_d(C1L-AL)$	0		10	ns
HOLDA\ Low to Address Three-state	$t_{ds}(AL-A)$		0		ns
Address Three-state After CLKOUT1 Low (HOLD\ Mode) ²	$t_{ds}(C1L-A)$			20^3	ns
HOLD\ High to HOLDA\ High	$t_d(HH-AH)$			25	ns
Address Driven before CLKOUT1 Low (HOLD\ Mode) ²	$t_m(A-C1L)$			8^3	ns

320C25RP TIMING REQUIREMENTS¹

PARAMETER	SYMBOL	MIN	NOM	MAX	UNIT
HOLD\ Valid After CLKOUT2 High	$t_d(C2H-H)$			$Q-24$	ns

Notes:

1. $Q = 1/4t_{c(C)}$.
2. A15-A0, PS\, DS\, IS\, STRB\, and R/W\ timings are address timings.
3. Not tested.



SPACE ELECTRONICS INC.

■ 9011241 0000255 3T8 ■ 254

4031 SORRENTO VALLEY BLVD.
SAN DIEGO, CA 92121
PHONE: (619) 452-4167
FAX: (619) 452-5499
INTERNET: 102005.1635@COMPUSERVE.COM

SERIAL PORT TIMING

320C25RP SWITCHING CHARACTERISTICS¹

PARAMETER	SYMBOL	MIN	NOM	MAX	UNIT
DX Valid After CLKX Rising Edge ²	$t_d(\text{CH-DX})$			80	ns
DX Valid After FSX Falling Edge (TXM = 0) ³	$t_d(\text{FL-DX})$			45	ns
FSX Valid After CLKX Rising Edge (TXM = 1)	$t_d(\text{CH-FS})$			45	ns

320C25RP TIMING REQUIREMENTS¹

PARAMETER	SYMBOL	MIN	NOM	MAX	UNIT
Serial Port Frequency	f_{rx}	1.25		5000	kHz
Serial Port Clock (CLKX/CLKR) Cycle Time	$t_c(\text{SCK})$	200		800,000	ns
Serial Port Clock (CLKX/CLKR) Low Pulse Duration ³	$t_w(\text{SCK})$	80			ns
Serial Port Clock (CLKX/CLKR) High Pulse Duration ³	$t_h(\text{SCK})$	80			ns
FSX/FSR Setup Time Before CLKX/CLKR Falling Edge (TXM = 0)	$t_{\text{su}}(\text{FS})$	18			ns
FSX/FSR Hold Time After CLKX/CLKR Falling Edge (TXM = 0)	$t_h(\text{FS})$	20			ns
DR Setup Time Before CLKR Falling Edge	$t_{\text{su}}(\text{DR})$	10			ns
DR Hold Time After CLKR Falling Edge	$t_h(\text{DR})$	20			ns

Notes:

1. $Q = 1/4t_{\text{rc}}$.
2. The last occurrence of FSX falling and CLKX rising.
3. The duty cycle of the serial port clock must be within 40-60%. Serial port clock (CLKX/CLKR) rise and fall times must be less than 25 ns.



SPACE ELECTRONICS INC.

■ 9011241 0000256 234 ■

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4031 SORRENTO VALLEY BLVD.
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