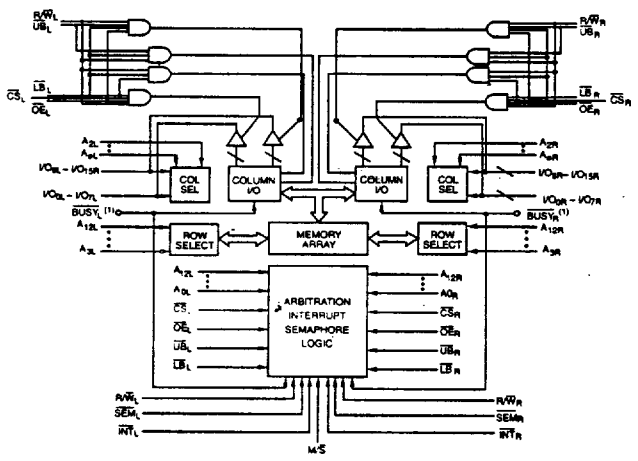
Radiation Hardened 7025ERP

High - Speed 8K x 16 Dual - Port Static RAM

For Space Applications



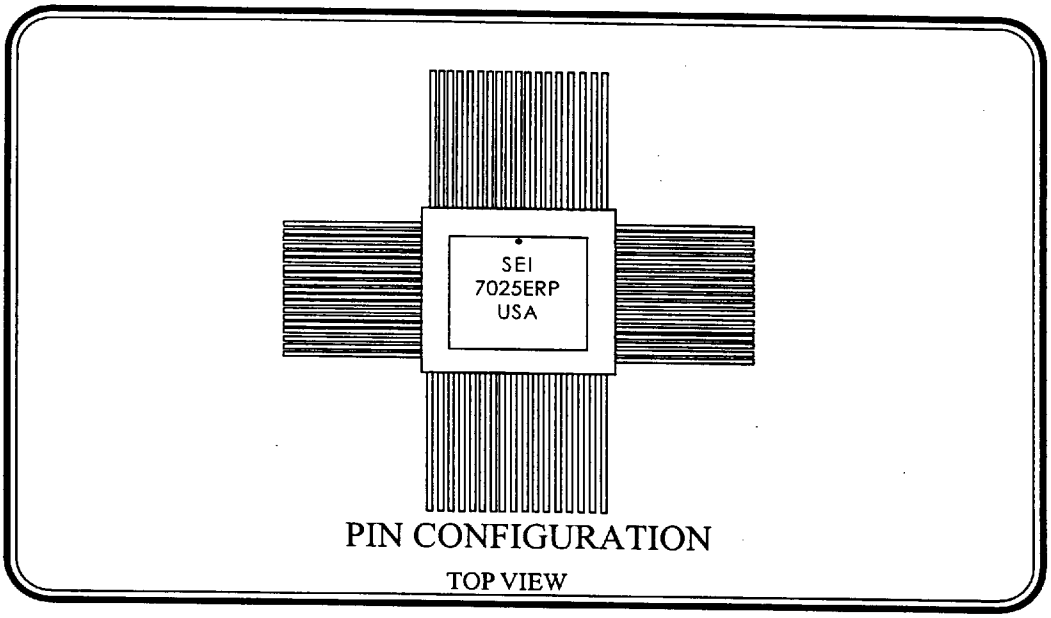
SEI's 7025ERP (RP for RAD-PAK®) high speed epitaxial CMOS microcircuit features a minimum 100 kilorad (Si) total dose tolerance. Using SEI's radiation hardened RAD-PAK® packaging technology, the 7025ERP is fully equivalent to Integrated Device Technology's IDT7025. The 7025ERP is designed to be used as a stand-alone 128K-bit Dual-Port RAM or as a combination MASTER/SLAVE Dual-Port RAM for 32-bit or more word systems. This design results in full-speed, error-free operation without the need for additional discrete logic. The 7025ERP provides two independent ports with separate control, address, and I/O pins that permit independent, asynchronous access for reads or writes to any location in memory. An automatic power down feature controlled by CE permits the on-chip circuitry of each port to enter a very low standby power mode. The RAD-PAK® technology incorporates radiation shielding in the microcircuit package. It eliminates box shielding while providing life time in orbit. The 7025ERP features the same system performance and architecture as the commercial counterparts. Capable of surviving in space environments, the 7025ERP is ideal for satellite, spacecraft, and space probe missions. It 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
7025ERP

High Speed 8k x 16
Dual - Port Static RAM



PIN CONFIGURATION
TOP VIEW

Features

- 8k x 16 Dual Port Organization
- Pin Compatible with IDT7025
- RAD-PAK® Radiation Hardened Against Natural Space Radiation
- Total Dose Hardness >100 krad (Si)
- Package:
  - 84 Pin RAD-PAK® quad flat pack (650 mils x 650 mils)
  - Weight – 14 grams
- Separate Upper Byte and Lower Byte Control for Multiplexed Bus Compatibility
- High Speed Access Time:
  - 35 ns
- Expandable Data Bus to 32 Bits or More Using Master/Slave Chip Select When Using More Than One Device
- High Speed CEMOS EPI Technology
  - Low Power Consumption:
    - 1.76W Active (Max)
    - 5.5mW Standby (Max)
  - TTL Compatible
  - Single +5V ± 10% Power Supply
  - Interrupt Flag
  - On Chip Port Arbitration Logic
  - Asynchronous Operation From Either Port
- Screening per TM5004
- QCI per TM5005

TQM
Total Quality Management

Sept. 1995

For Further Information Contact:
Space Electronics Inc.
4031 Sorrento Valley Blvd., San Diego, CA 92121
(619) 452-4167 Fax (619) 452-5499
INTERNET: 102005.1635@COMPUSERVE.COM

7025ERP ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNITS
Supply Voltage	V_{CC}	-0.5	7.0	V
Voltage on Any Pin, Relative to V_{SS}	V_T	-0.5	V_{CC}+0.5	V
Storage Temperature	T_S	-65	+150	°C
Operating Temperature	T_A	-55	+125	°C

7025ERP RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNITS
Supply Voltage	V_{CC}	4.5	5.5	V
Operating Temperature	T_A	-55	+125	°C

7025ERP DC ELECTRICAL CHARACTERISTICS[1]

PARAMETER	SYMBOL	MIN	MAX	UNIT
Input Low Voltage[6]	V_{IL}		0.8	V
Input High Voltage[6]	V_{IH}	2.2		V
Output Low Voltage[7]	V_{OL}		0.4	V
Output High Voltage[7]	V_{OH}	2.4		V
Input Leakage Current[5]	I_{LI}		±10	uA
Output Leakage Current[5]	I_{LO}		±10	uA
Standby Current, Both Ports, TTL Level In	I_{CCSB}[1]		50	mA
Standby Current, Both Ports, CMOS Level In	I_{CCSB1}[2]		1000	uA
Operating Supply Current, Both Ports Active	I_{CCOP}[3]		320	mA
Operating Supply Current (One port active -. One port standby)	I_{CCOP1}[4]		210	mA
Input Capacitance	C_{IN}		5	pF
Output Capacitance	C_{OUT}		7	pF

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

Notes:

1. $CS_L\backslash = CS_R\backslash \geq 2.2V$.
2. $CSL_L\backslash = CS_R\backslash \geq V_{CC}$-0.2V.
3. Both ports active - Maximum frequency - Outputs open - OE\=VIH.
4. One port active (f=fMAX) - Output open - One port stand-by TTL or CMOS Level Inputs - $CS_L\backslash = CS_R\backslash \geq 2.2$ V.
5. $V_{CC} = 5.5V$, V_{IN} = Gnd to V_{CC}, $CS\backslash = V_{IH}$, V_{OUT} =0 to V_{CC}.
6. $V_{IH}max = V_{CC} + 0.3$ V, $V_{IL}min$ = -0.3 V or -1 V pulse width 50 ns.
7. $V_{CC}min$, I_{OL} = 4 mA, I_{OH} = -4 mA.

7025ERP AC ELECTRICAL CHARACTERISTICS - READ CYCLE[1]

PARAMETER	SYMBOL	MIN	MAX	UNITS
Read Cycle Time	t_{RC}	35		ns
Address Access Time	t_{AA}		35	ns
Chip Select Access Time[2]	t_{ACS}		35	ns
Byte Enable Access Time[2]	t_{ABE}		35	ns
Output Enable Access Time	t_{AOE}		20	ns
Output Low Z Time[3,4]	t_{LZ}	3		ns
Output High Z Time[3,4]	t_{HZ}		15	ns
Chip Select to Power Up Time[3]	t_{PU}	0		ns
Chip Disable to Power Down Time[3]	t_{PD}		50	ns
Semaphore Flag Update Pulse (OE\ or SEM\)	t_{SOP}	15		ns
Output Hold from Address Change	t_{OH}	3		ns

Notes:

1. V_{CC} = 4.5 to 5.5 volts; V_{SS} = 0 volts; T_A = -55 to +125 °C.
2. To access RAM, $CE\backslash = V_{IL}$, $UB\backslash$ or $LB\backslash = V_{IL}$, $SEM\backslash = V_{IH}$.
3. This parameter is guaranteed by design and is not tested.
4. Transition is measured ±500mV from low or high impedance voltage with load.

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

7025ERP AC ELECTRICAL CHARACTERISTICS - WRITE CYCLE[1]

PARAMETER	SYMBOL	MIN	MAX	UNITS
Write Cycle Time	t_{WC}	35		ns
Address Valid to End of Write	t_{AW}	30		ns
Chip Select to End of Write[2]	t_{SW}	30		ns
Address Setup Time	t_{AS}	0		ns
Write Pulse Width	t_{WP}	30		ns
Write Recovery Time	t_{WR}	0		ns
Data Valid to End of Write	t_{DW}	25		ns
Output High Z Time[3,4]	t_{HZ}		15	ns
Data Hold Time[5]	t_{DH}	0		ns
Write Enable to Output in High Z[3,4]	t_{WZ}		15	ns
Output Active from End of Write[3,4,5]	t_{OW}	0		ns
SEM Flag Write to Read Time	t_{SWRD}	10		ns
SEM Flag Contention Window	t_{SPS}	10		ns

Notes:

1. V_{CC} = 4.5 to 5.5 volts; V_{SS} = 0 volts; T_A = -55 to +125 °C.
2. To access RAM, CE\ = V_{IL}, UB\ or LB\ = V_{IL}, SEM\ = V_{IH}. To access semaphore, CE\ = V_{IH} and SEM\ = V_{IL}. This condition must be valid for the entire t_{SW} time.
3. This parameter is guaranteed by design and is not tested.
4. Transition is measured ±500mV from low or high impedance voltage with load.
5. The specification for t_{DH} must be met by the device supplying write data to the RAM under all operating conditions. Although t_{DH} and t_{OW} values will vary over voltage and temperature, the actual t_{DH} will always be smaller than the actual t_{OW}.

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

7025ERP AC ELECTRICAL CHARACTERISTICS - TIMING[1]

PARAMETER	SYMBOL	MIN	MAX	UNITS
BUSY\ Access Time to Address	t_{BAA}		35	ns
BUSY\ Disable Time to Address	t_{BDA}		30	ns
BUSY\ Access Time to Chip Select	t_{BAC}		30	ns
BUSY\ Disable Time to Chip Select	t_{BDC}		25	ns
Arbitration Priority Setup Time[2]	t_{APS}	5		ns
BUSY\ Disable to Valid Data	t_{BDD}		See Note[3]	ns
Write to BUSY\ Input[4]	t_{WB}	0		ns
Write Hold after BUSY\[5]	t_{WH}	25		ns
Write Pulse to Data Delay[6]	t_{WDD}		60	ns
Write Data Valid to Read Data Delay[6]	t_{DDD}		45	ns

Notes:
1. V_{CC} = 4.5 to 5.5 volts; V_{SS} = 0 volts; T_A = -55 to +125 °C.
2. To ensure that the earlier of the two ports wins.
3. t_{BDD} is a calculated parameter and is the greater of 0, t_{WDD} - t_{WP} (actual) or t_{DDD} - t_{DW} (actual).
4. To ensure that the write cycle is inhibited during contion.
5. To ensure that a write cycle is completed after contention.
6. Port to port timing delay through RAM cells from writing port to reading port.

7025ERP TRUTH TABLES

NON-CONTENTION READ/WRITE CONTROL

CS\	R/W\	OE\	UB\	LB\	SEM\	I/O_{8-15}	I/O_{0-7}	MODE
H	X	X	X	X	H	Hi-Z	Hi-Z	Deselected:Power Down
X	X	X	H	H	H	Hi-Z	Hi-Z	Both bytes deselected:Power Down
L	L	X	L	H	H	$DATA_{in}$	Hi-Z	Write to upper byte only
L	L	X	H	L	H	Hi-Z	$DATA_{in}$	Write to lower byte only
L	L	X	L	L	H	$DATA_{in}$	$DATA_{in}$	Write to both bytes
L	H	L	L	H	H	$DATA_{out}$	Hi-Z	Read upper byte only
L	H	L	H	L	H	Hi-Z	$DATA_{out}$	Read lower byte only
L	H	L	L	L	H	$DATA_{out}$	$DATA_{out}$	Read both bytes
X	X	H	X	X	X	Hi-Z	Hi-Z	Outputs disabled

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

ARBITRATION OPTIONS

OPTIONS	INPUTS					OUTPUTS	
	CS\	UB\	LB\	M/S\	SEM\	BUSY\	INT\
Busy Logic Master	L L	X L	L X	H H	H H	Output Signal	-
Busy Logic Slave	L L	X L	L X	L L	H H	Input Signal	-
Interrupt Logic	L L	X L	L X	X X	H H	-	Output Signal
Semaphore Logic	H H	X X	X X	H L	L L	H Hi-Z	-

SEMAPHORE READ/WRITE CONTROL

CE\	R/W\	OE\	UB\	LB\	SEM\	I/O_{8-15}	I/O_{0-7}	MODE
H	H	L	X	X	L	$DATA_{out}$	$DATA_{out}$	Read data in semaphore flag
X	H	L	H	H	L	$DATA_{out}$	$DATA_{out}$	Read data in semaphore flag
H	/	X	X	X	L	$DATA_{in}$	$DATA_{in}$	Write Din0 into semaphore flag
X	/	X	H	H	L	$DATA_{in}$	$DATA_{in}$	Write Din0 into semaphore flag
L	X	X	L	X	L	--	--	Not allowed
L	X	X	X	L	L	--	--	Not allowed

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

7025ERP TRUTH TABLES

INTERRUPT FLAG CONTROL[1]

LEFT PORT					RIGHT PORT					
R/W_L	CE_L	OE_L	A_{0L}-A_{12L}	INT_L	R/W_R	CE_R	OE_R	A_{0R}-A_{12R}	INT_R	FUNCTION
L	L	X	1FFF	X	X	X	X	X	L[2]	Set right INT_R flag
X	X	X	X	X	X	L	L	1FFF	H[3]	Reset right INT_R flag
X	X	X	X	L[3]	L	L	X	1FFE	X	Set left INT_L flag
X	L	L	1FFE	H[2]	X	X	X	X	X	Reset left INT_L flag

Notes:
1. Assumes $BUSY_L$ = $BUSY_R$ = H.
2. If $BUSY_L$ = L, then no change.
3. If $BUSY_R$ = L, then no change.

ADDRESS BUSY ARBITRATION [1]

INPUTS			OUTPUTS			
CS_L	A_{OL}-A_{12L}	CS_R	A_{0L}-A_{12R}	$BUSY_L$	$BUSY_R$	FUNCTION
H	X	H	X	H	H	No Contention
L	Any	H	X	H	H	No Contention
H	X	L	Any	H	H	No Contention
L	Not=A_{0R}-A_{12R}	L	Not=A_{0L}-A_{12L}	H	H	No Contention
L	LV5R	L	LV5R	H	L	L-Port Wins
L	RV5L	L	RV5L	L	H	R-Port Wins
L	Same	L	Same	H	L	Arbitration Resolved
L	Same	L	Same	L	H	Arbitration Resolved
LL5R	=A_{0R}-A_{12R}	LL5R	=A_{0L}-A_{12L}	H	L	L-Port Wins
RL5L	=A_{0R}-A_{12R}	RL5L	=A_{0L}-A_{12L}	L	H	R-Port Wins
LW5R	=A_{0R}-A_{12R}	LW5R	=A_{0L}-A_{12L}	H	L	Arbitration Resolved
LW5R	=A_{0R}-A_{12R}	LW5R	=A_{0L}-A_{12L}	L	H	Arbitration Resolved

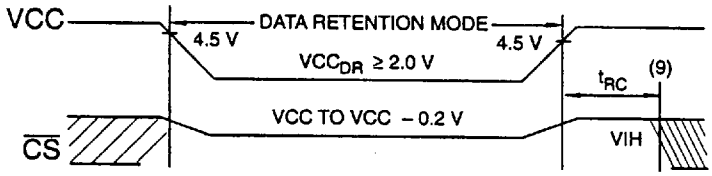
SPACE ELECTRONICS INC.
4031 SORRENTO VALLEY BLVD.
SAN DIEGO, CA 92121
PHONE: (619) 452-4167
FAX: (619) 452-5499
INTERNET: 102005.1635@COMPUSERVE.COM

Notes:

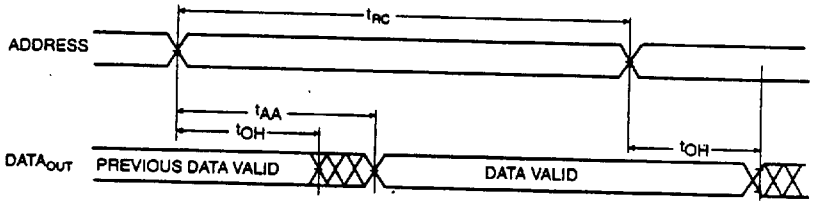
1. INT\ Flags Don't Care
2. X = DON'T CARE, L = Low, H = High
   LV5R = Left Address Valid ≥ 5 ns before right address
   RV5L = Right Address Valid ≥ 5 ns before left address
   Same = Left and Right Addresses match within 5 ns of each other
   LL5R = Left CS\ = LOW ≥ 5 ns before Right CS\
   RL5L = Right CS\ = LOW ≥ 5 ns before Left CS\
   LW5R = Left and Right CS\ = LOW within 5 ns of each other

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

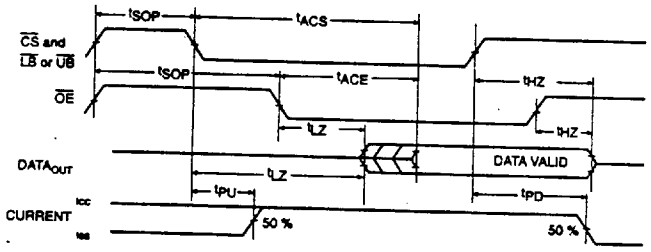
Data Retention Mode



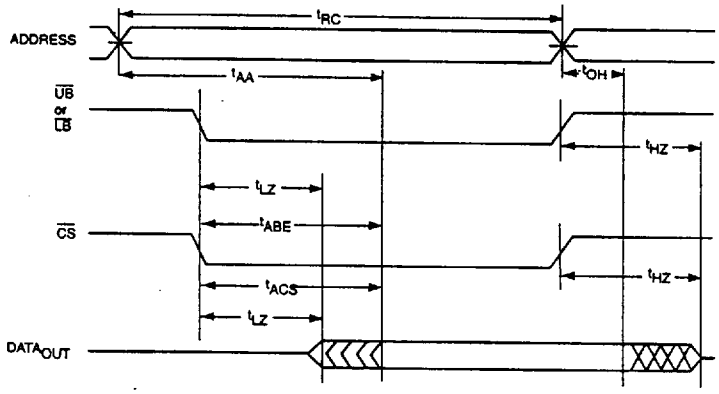
Timing Waveform of Read Cycle #1



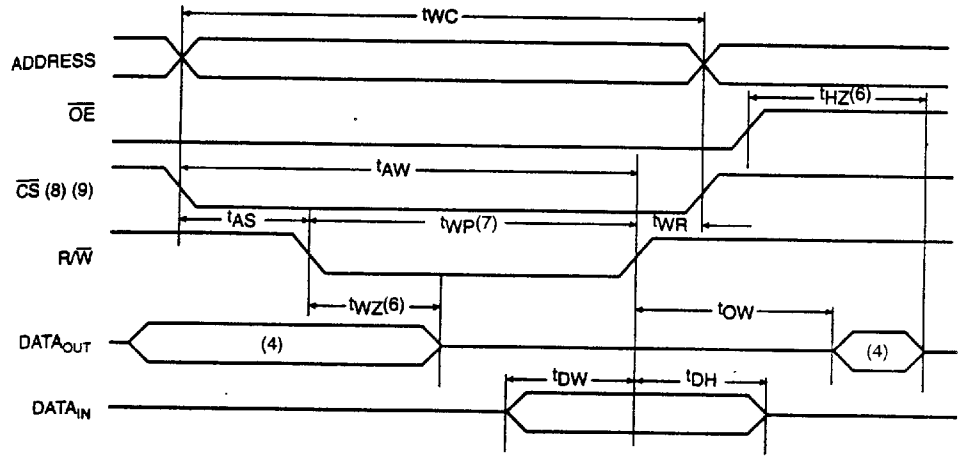
Timing Waveform of Read Cycle #2



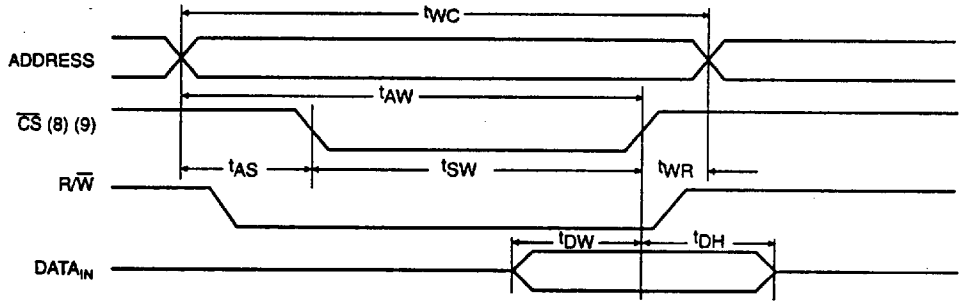
Timing Waveform of Read Cycle #3



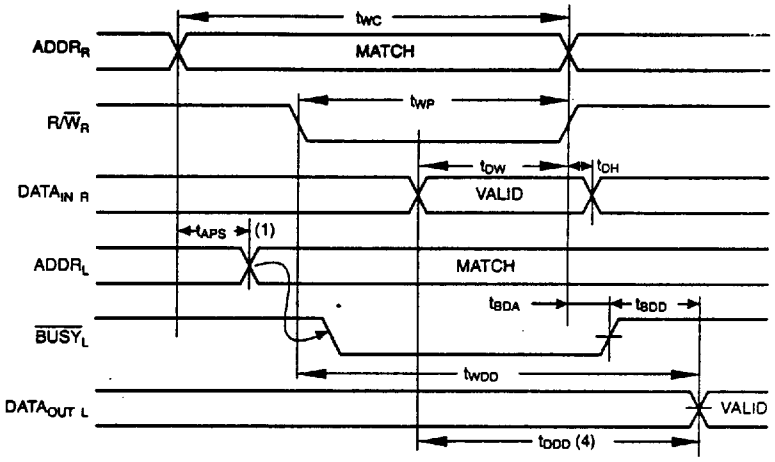
Timing Waveform of Write Cycle #1, R/$\overline{W}$ Controlled Timing



Timing Waveform of Write Cycle #2, $\overline{CS}$ Controlled Timing



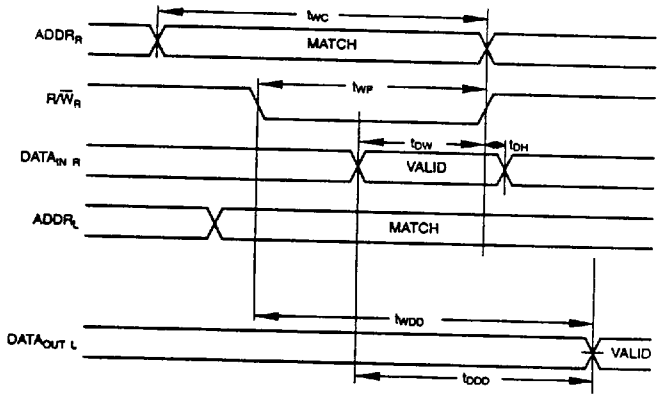
Timing Waveform of Read with $\overline{BUSY}$



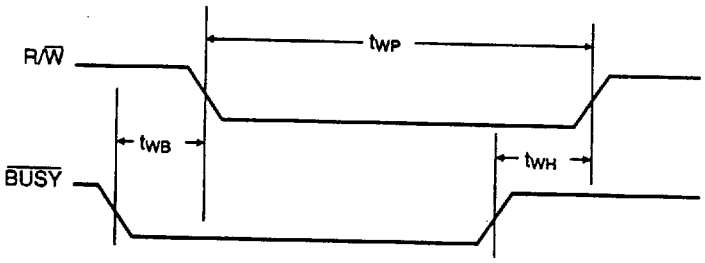
SPACE ELECTRONICS INC.

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

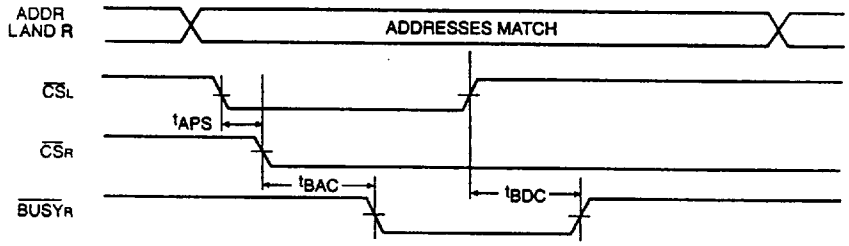
Timing Waveform of Write with Port-to-Port

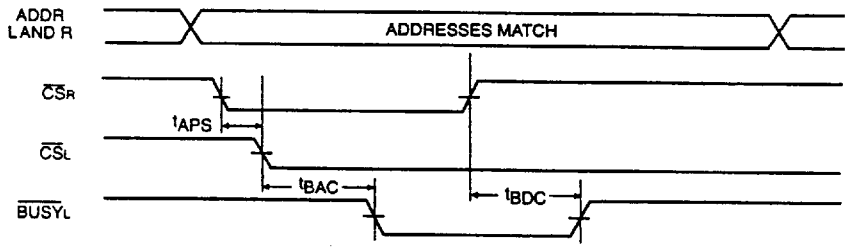


Timing Waveform of Write with $\overline{BUSY}$



Timing Waveform of Contention Cycle #1, $\overline{CS}$ Arbitration



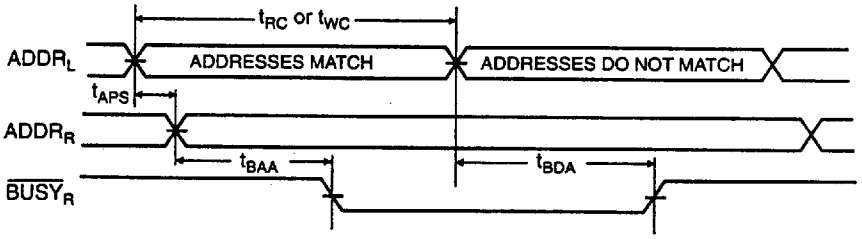


SPACE ELECTRONICS INC.

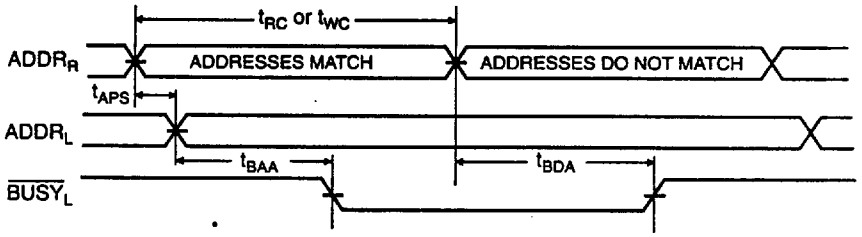
4031 SORRENTO VALLEY BLVD.
SAN DIEGO, CA 92121
PHONE: (619) 452-4167
FAX: (619) 452-5499
INTERNET: 102005.1635@COMPUSERVE.COM

Timing Waveform of Contention Cycle #2, Address Valid Arbitration

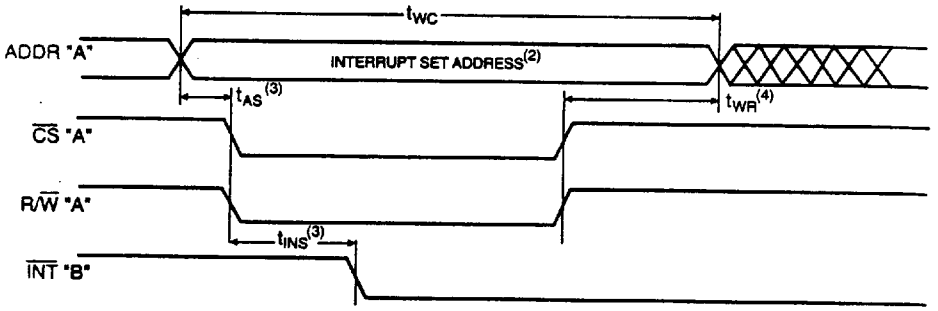
Left Address Valid First:

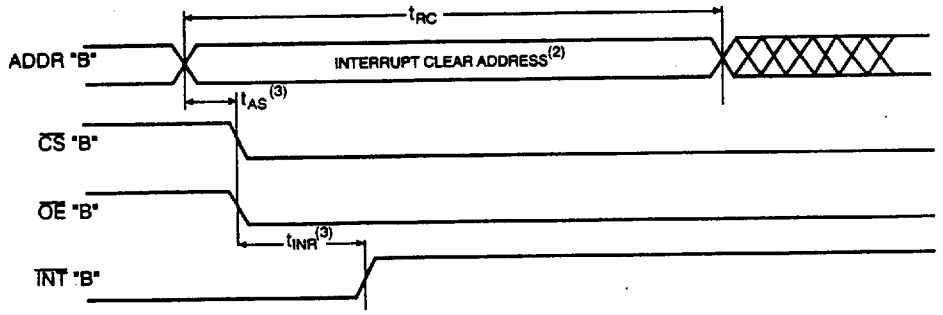


Right Address Valid First:



Waveform of Interrupt Timing

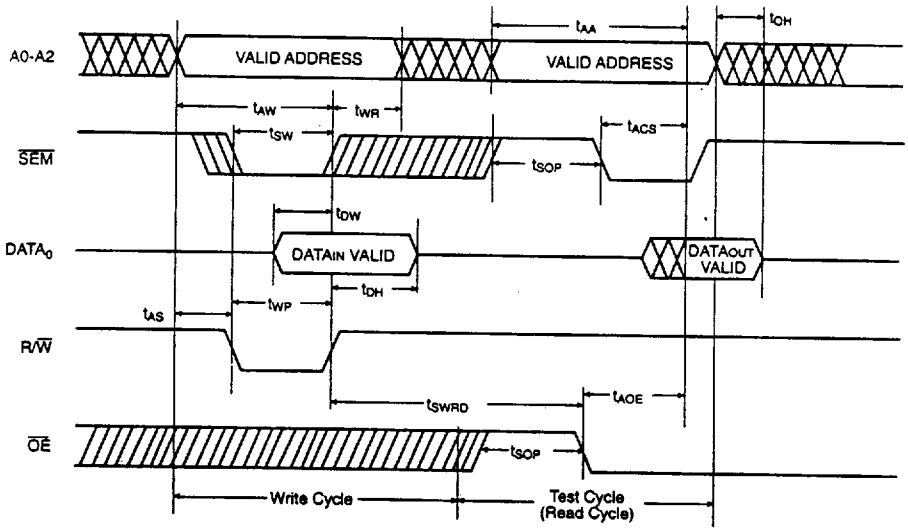




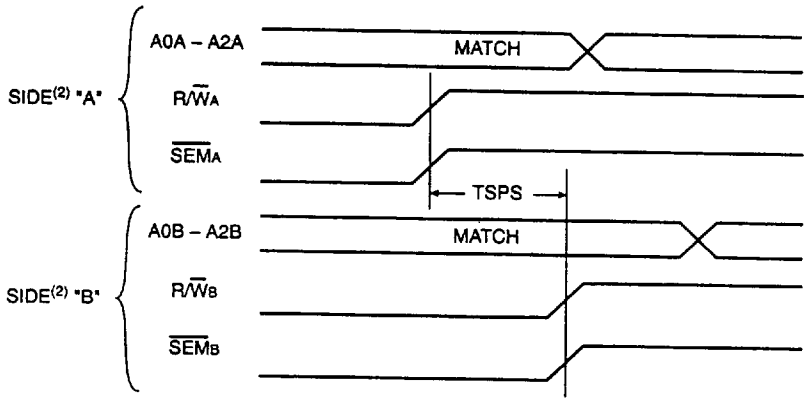
SPACE ELECTRONICS INC.

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

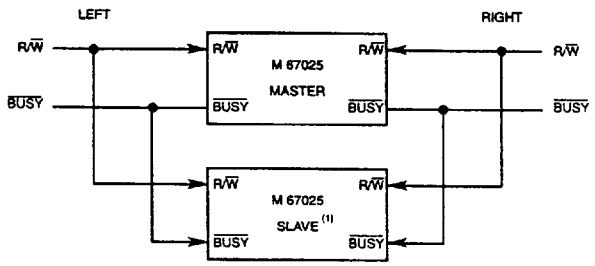
Timing Waveform of Semaphore Read After Write Timing



Timing Waveform of Semaphore Contention



32-Bit Master/Slave Dual-Port Memory Systems



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

7025ERP PINOUT DESCRIPTION

PIN	SIGNAL	DESCRIPTION	PIN	SIGNAL	DESCRIPTION
1	Vcc	Power	43	GND	Ground
2	OEl\	Output Enable (Left Port)	44	SEMR\	Semaphore Enable (Right Port)
3	I/O0l	Data Input/Output (Left Port)	45	CER\	Chip Enable (Right Port)
4	I/O1l	Data Input/Output (Left Port)	46	UBR\	Upper Byte Select (Right Port)
5	GND	Ground	47	LBR\	Lower Byte Select (Right Port)
6	I/O2l	Data Input/Output (Left Port)	48	A12r	Address (Right Port)
7	I/O3l	Data Input/Output (Left Port)	49	A11r	Address (Right Port)
8	I/O4l	Data Input/Output (Left Port)	50	A10r	Address (Right Port)
9	I/O5l	Data Input/Output (Left Port)	51	A9r	Address (Right Port)
10	I/O6l	Data Input/Output (Left Port)	52	A8r	Address (Right Port)
11	I/O7l	Data Input/Output (Left Port)	53	A7r	Address (Right Port)
12	I/O8l	Data Input/Output (Left Port)	54	A6r	Address (Right Port)
13	I/O9l	Data Input/Output (Left Port)	55	A5r	Address (Right Port)
14	I/O10l	Data Input/Output (Left Port)	56	A4r	Address (Right Port)
15	I/O11l	Data Input/Output (Left Port)	57	A3r	Address (Right Port)
16	I/O12l	Data Input/Output (Left Port)	58	A2r	Address (Right Port)
17	I/O13l	Data Input/Output (Left Port)	59	A1r	Address (Right Port)
18	GND	Ground	60	A0r	Address (Right Port)
19	I/O14l	Data Input/Output (Left Port)	61	INTR\	Interrupt Flag (Right Port)
20	I/O15l	Data Input/Output (Left Port)	62	BUSYR\	Busy Flag (Right Port)
21	Vcc	Power	63	M/S\	Master or Slave Select
22	GND	Ground	64	GND	Ground
23	I/O0r	Data Input/Output (Right Port)	65	BUSYL\	Busy Flag (Left Port)
24	I/O1r	Data Input/Output (Right Port)	66	INTL\	Interrupt Flag (Left Port)
25	I/O2r	Data Input/Output (Right Port)	67	A0l	Address (Left Port)
26	Vcc	Power	68	A1l	Address (Left Port)
27	I/O3r	Data Input/Output (Right Port)	69	A2l	Address (Left Port)
28	I/O4r	Data Input/Output (Right Port)	70	A3l	Address (Left Port)
29	I/O5r	Data Input/Output (Right Port)	71	A4l	Address (Left Port)
30	I/O6r	Data Input/Output (Right Port)	72	A5l	Address (Left Port)
31	I/O7r	Data Input/Output (Right Port)	73	A6l	Address (Left Port)
32	I/O8r	Data Input/Output (Right Port)	74	A7l	Address (Left Port)
33	I/O9r	Data Input/Output (Right Port)	75	A8l	Address (Left Port)
34	I/O10r	Data Input/Output (Right Port)	76	A9l	Address (Left Port)
35	I/O11r	Data Input/Output (Right Port)	77	A10l	Address (Left Port)
36	I/O12r	Data Input/Output (Right Port)	78	A11l	Address (Left Port)
37	I/O13r	Data Input/Output (Right Port)	79	A12l	Address (Left Port)
38	I/O14r	Data Input/Output (Right Port)	80	LBL\	Lower Byte Select (Left Port)
39	GND	Ground	81	UBL\	Upper Byte Select (Left Port)
40	I/O15r	Data Input/Output (Right Port)	82	CEL\	Chip Enable (Left Port)
41	OER\	Output Enable (Right Port)	83	SEML\	Semaphore Enable (Left Port)
42	R/WR\	Read/Write Enable (Right Port)	84	R/WL\	Read/Write Enable (Left Port)

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