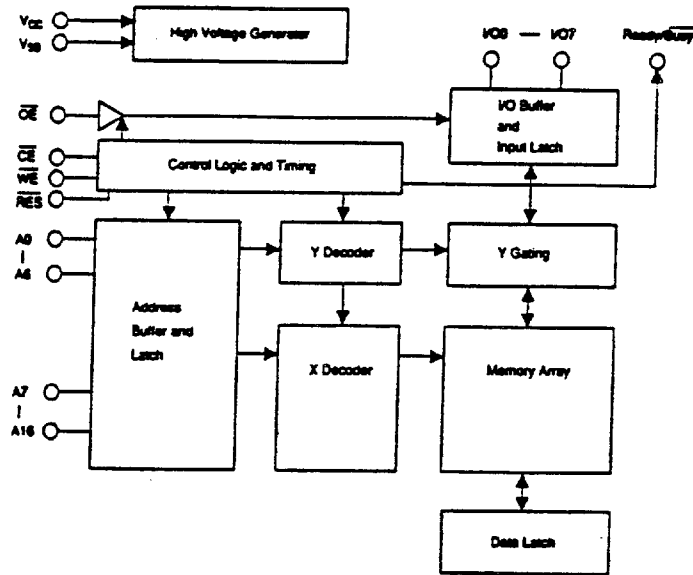


1 Megabit EEPROM - Radiation Hardened 28C010TRP 128k X 8 EEPROM Memory Microcircuit

For Space Applications

SEI's 28C010TRP (RP for RAD-PAK®) high density 1 megabit EEPROM microcircuit features a minimum 100 kilorad (Si) total dose tolerance. Using SEI's radiation hardened RAD-PAK® packaging technology, the 28C010TRP is fully equivalent to HN58C1001 from Hitachi's advanced nonvolatile CMOS technology. The 28C010TRP is capable of in-system electrical Byte and Page programmability. It has a 128-Byte Page Programming function to make its erase and write operations faster. It also features Data Polling and a Ready / Busy signal to indicate the completion of erase and programming operations. In the 28C010TRP, hardware data protection is provided with the RES pin, in addition to noise protection on the WE signal and write inhibit on power on and off. Meanwhile, software data protection is implemented using the JEDEC optional Standard algorithm. The 28C010TRP is designed for high reliability in the most demanding applications. The patented radiation hardened RAD-PAK® technology incorporates radiation shielding in the microcircuit package. It provides a 100 krad (Si) total dose survivability. It is offered with either Class B or Class S packaging and screening.



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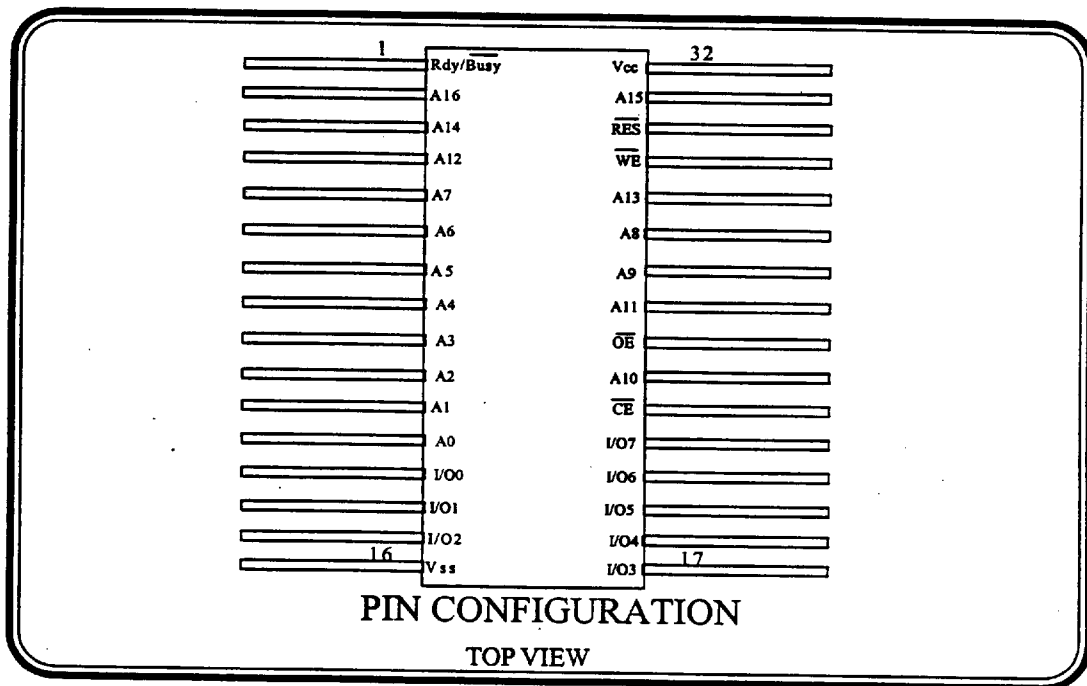
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SEI 28C010TRP RAD-PAK® 128k X 8 EEPROM MEMORY MICROCIRCUIT

Radiation Hardened 28C010TRP

CMOS 128k x 8 EEPROM
Memory Microcircuit



Features:

- 128k x 8 Bit EEPROM Organization
- Pin Compatible with Hitachi HN58C1001
- RAD-PAK® Radiation Hardened Against Natural Space Radiation
- Total Dose Hardness >100 krad (Si)
- Package:
 - 32 Pin RAD-PAK® flat pack (410 mils x 820 mils)
 - Weight – 6.0 grams
- Fast Propagation Time:
 - 150, 175, 200 ns Maximum Access Times Available
- Latchup free > 120 MeV
- SEU > 120 MeV read mode
- JEDEC Approved Byte Wide Pinout
- High Endurance
 - 10,000 Cycles/Byte
 - 10 Year Data Retention
- Page Write Mode
 - 1 to 128 Byte Page
- Automatic Programming
 - 10 ms Automatic Page Write
 - 10 ms Automatic Byte Write
- Low Power Dissipation
 - 20 mW/MHz Active Current
 - 110 uW Standby Current

Specifications and design are subject to change without notice.



September 1995

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For Further Information Contact:

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28C010TRP ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNITS
Supply Voltage	V_{CC}	-0.5	+7.0	V
Input Voltage	V_{IN}	-0.5	+7.0	V
Operating Temperature Range	T_{OPR}	-55	+125	°C
Storage Temperature Range	T_{STO}	-65	+150	°C

28C010TRP RECOMMENDED OPERATING CONDITIONS

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

28C010TRP CAPACITANCE¹

PARAMETER	SYMBOL	MIN	MAX	UNITS
Input Capacitance: $V_{IN} = 0V$	C_{IN}		6	pF
Output Capacitance: $V_{OUT} = 0V$	C_{OUT}		12	pF

Note:

1. $T_A = 25^\circ C, f = 1MHz.$



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28C010TRP DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	MAX	UNITS
Input Leakage Current $V_{CC}=5.5V, V_{IN}=5.5V$	I_{LI}		2 ¹	μA
Output Leakage Current $V_{CC}=5.5V, V_{OUT}=5.5V/0.4V$	I_{LO}		2	μA
Standby V_{CC} Current $CE\backslash=V_{CC}$ $CE\backslash=V_{IH}$	I_{CC1}		20	μA
	I_{CC2}		1	mA
Operating V_{CC} Current $I_{OUT}=0mA, Duty=100%$, Cycle = 1 μs $I_{OUT}=0mA, Duty=100%$, Cycle = 150 ns	I_{CC3}		15	mA
			50	mA
Input Voltage	V_{IL}	-0.3	0.4	V
	V_{IH}	2.8	$V_{CC}+0.3$	V
	V_H	$V_{CC}-0.5$	$V_{CC}+1$	V
Output Voltage $I_{OL}=2.1 mA$ $I_{OH}=-400 \mu A$	V_{OL}		0.4	V
	V_{OH}	2.4		V

28C010TRP AC ELECTRICAL CHARACTERISTICS FOR READ OPERATION

PARAMETER	SYMBOL	MIN	MAX	UNITS
Address Access Time $CE\backslash=OE\backslash=V_{IL}, WE\backslash=V_{IH}$ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{ACC}			
			150	ns
			175	
			200	
Chip Enable Access Time $OE\backslash=V_{IL}, WE\backslash=V_{IH}$ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{CE}			
			150	ns
			175	
			200	
Output Enable Access Time $CE\backslash=V_{IL}, WE\backslash=V_{IH}$ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OE}			
		0	75	ns
		0	100	
		0	125	



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28C010TRP AC ELECTRICAL CHARACTERISTICS FOR READ OPERATION (continue)

PARAMETER	SYMBOL	MIN	MAX	UNITS
Output Hold to Address Change CE \backslash OE \backslash =V _{IL} , WE \backslash =V _{IH} 28C010TRP-150 28C010TRP-175 28C010TRP-200	t _{OH}	0 0 0		ns
Output Disable to High-Z ² CE \backslash =V _{IL} , WE \backslash =V _{IH} 28C010TRP-150 28C010TRP-175 28C010TRP-200 CE \backslash OE \backslash =V _{IL} , WE \backslash =V _{IH} 28C010TRP-150 28C010TRP-175 28C010TRP-200	t _{DF} t _{DFR}	0 0 0 0 0 0 0	50 55 60 350 400 450	ns ns
RES \backslash to Output Delay CE \backslash OE \backslash =V _{IL} , WE \backslash =V _{IH} 28C010TRP-150 28C010TRP-175 28C010TRP-200	t _{RR}	0 0 0	450 550 650	ns

**28C010TRP AC ELECTRICAL CHARACTERISTICS
FOR BYTE ERASE AND BYTE WRITE OPERATIONS**

PARAMETER	SYMBOL	MIN	MAX	UNITS
Address Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t _{AS}	0 0 0		ns
Chip Enable to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t _{CS}	0 0 0		ns
Write Pulse Width ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200 28C010TRP-150 28C010TRP-175 28C010TRP-200	t _{CW} t _{WP}	250 300 350 250 300 350		ns ns



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**28C010TRP AC ELECTRICAL CHARACTERISTICS
FOR BYTE ERASE AND BYTE WRITE OPERATIONS (continue)**

PARAMETER	SYMBOL	MIN	MAX	UNITS
Address Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{AH}	150 175 200		ns
Data Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DS}	100 150 200		ns
Data Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DH}	10 15 20		ns
Chip Enable Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{CH}	0 0 0		ns
Output Enable to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OES}	0 0 0		ns
Output Enable Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OEH}	0 0 0		ns
Write Cycle Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{WC}	10 15 20		ms
Byte Load Window ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{BL}	100 150 200		us
Time to Device Busy ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DB}	120 150 170		ns
RES\ to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{RP}	100 150 200		us
V_{CC} to RES\ Setup Time ⁴ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{RES}	1 2 3		us



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**28C010TRP AC ELECTRICAL CHARACTERISTICS
FOR PAGE ERASE AND PAGE WRITE OPERATIONS**

PARAMETER	SYMBOL	MIN	MAX	UNITS
Address Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{AS}	0 0 0		ns
Write Enable to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{ws}	0 0 0		ns
Chip Enable to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{cs}	0 0 0		ns
Write Pulse Width ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{wp}, t_{cw}	250 300 350		ns
Address Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{AH}	150 200 250		ns
Data Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DS}	100 150 200		ns
Data Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DH}	10 15 20		ns
Write Enable Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{WH}	0 0 0		ns
Chip Enable Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{CH}	0 0 0		ns
Output Enable to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OES}	0 0 0		ns



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**28C010TRP AC ELECTRICAL CHARACTERISTICS
FOR PAGE ERASE AND PAGE WRITE OPERATIONS (continue)**

PARAMETER	SYMBOL	MIN	MAX	UNIT
Output Enable Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OEH}	0 0 0		ns
Data Latch Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DL}	300 350 400		ns
Write Cycle Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{WC}	10 15 20		ms
Byte Load Window ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{BL}	100 150 200		us
Byte Load Cycle ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{BLC}	0.55 0.75 0.95	30 40 50	us
Time to Device Busy ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DB}	120 150 170		ns
RES/ to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{RP}	100 150 200		us
VCC to RES\ Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{RES}	1 2 3		ns



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28C010TRP AC ELECTRICAL CHARACTERISTICS FOR DATA POLLING OPERATION

PARAMETER	SYMBOL	MIN	MAX	UNITS
Output Enable Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OEH}	0 0 0		ns
Output Enable to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OES}	0 0 0		ns
Write Start Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DW}	150 200 250		ns
Write Cycle Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{WC}		10 15 20	ms

**28C010TRP AC ELECTRICAL CHARACTERISTICS
FOR SOFTWARE DATA PROTECTION CYCLE OPERATION**

PARAMETER	SYMBOL	MIN	MAX	UNITS
Byte Load Cycle Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{BLC}	0.55 0.75 0.95	30 40 50	us
Write Cycle Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{WC}	10 15 20		ms



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28C010TRP AC ELECTRICAL CHARACTERISTICS FOR DATA POLLING OPERATION

PARAMETER	SYMBOL	MIN	MAX	UNITS
Output Enable Hold Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OEH}	0 0 0		ns
Output Enable to Write Setup Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{OES}	0 0 0		ns
Write Start Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{DW}	150 175 200		ns
Write Cycle Time ³ 28C010TRP-150 28C010TRP-175 28C010TRP-200	t_{WC}		10 15 20	ms

Notes:

1. I_{LI} on RES\ = 100 uA.
2. t_{DF} = time when output becomes an open circuit.
3. Tested by application of signal. No read and record data.
4. Guaranteed by design.

28C010TRP Package Ordering Guide

Package Style	Case Outline	1/	Description
F	F-32		32 Pin Flat Package
G	F-32A		32 Pin Flat Package

Note:

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

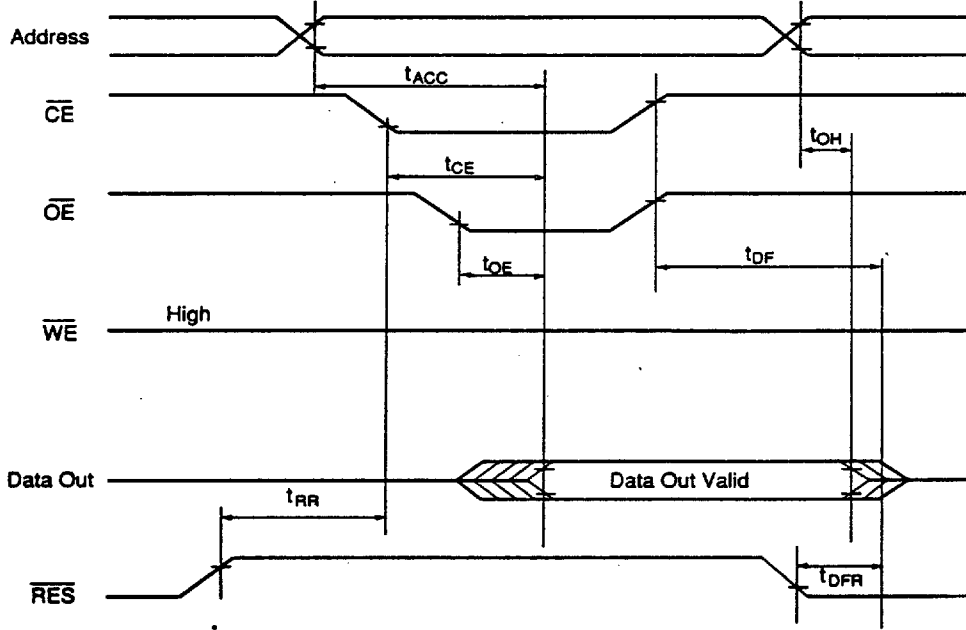


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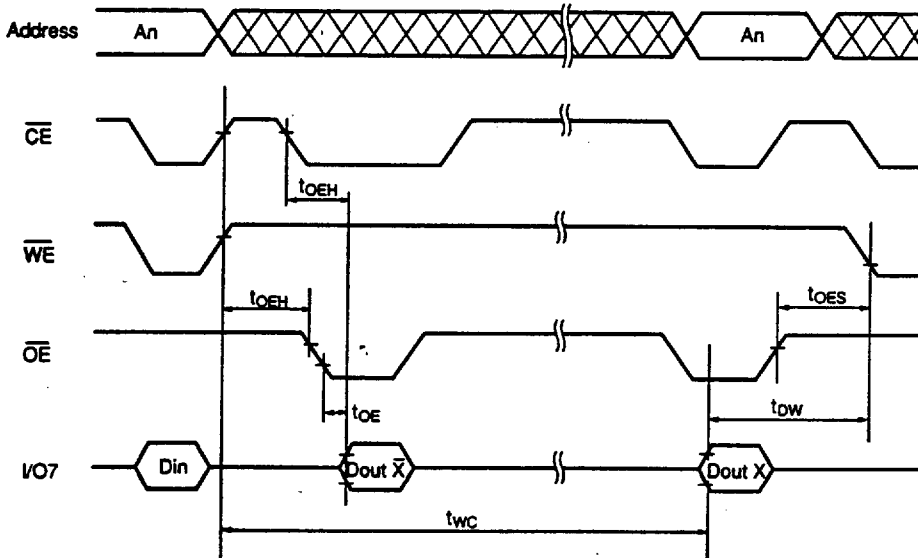
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READ TIMING WAVEFORM



DATA POLLING TIMING WAVEFORM

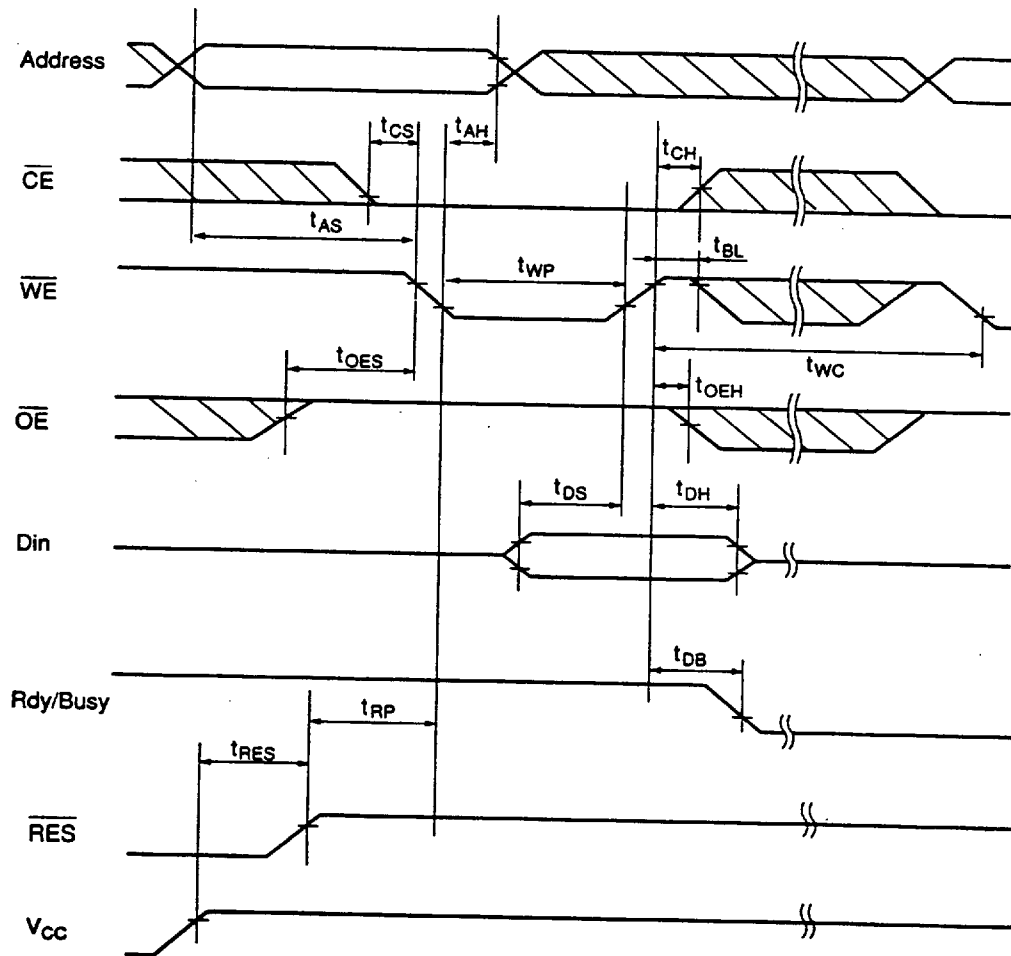


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BYTE ERASE AND BYTE WRITE TIMING WAVEFORM (\overline{WE} Controlled)

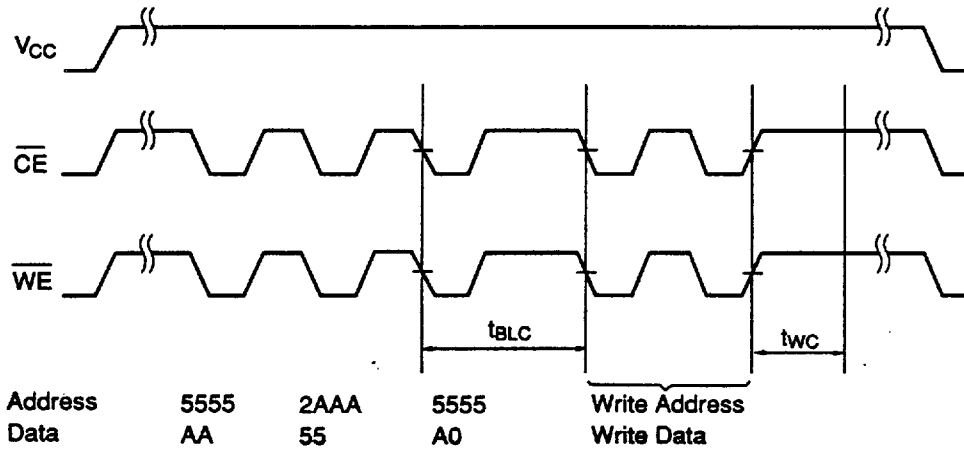


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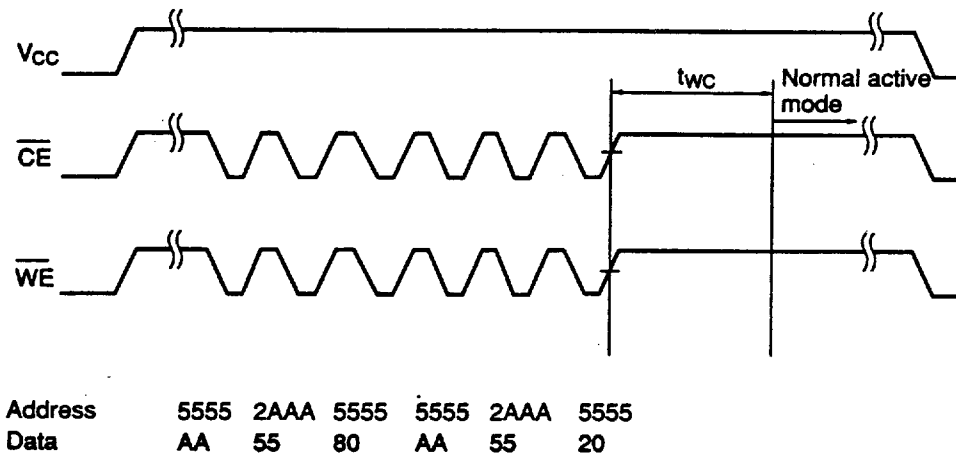
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SOFTWARE DATA PROTECTION TIMING WAVEFORM (Protection Mode)



SOFTWARE DATA PROTECTION TIMING WAVEFORM (Non-Protection Mode)



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28C010TRP PINOUT

PIN	SIGNAL	DESCRIPTION	PIN	SIGNAL	DESCRIPTION
1	Rdy/Busy\	Ready/Busy	17	I/O3	Input/Output
2	A16	Address	18	I/O4	Input/Output
3	A14	Address	19	I/O5	Input/Output
4	A12	Address	20	I/O6	Input/Output
5	A7	Address	21	I/O7	Input/Output
6	A6	Address	22	CE\	Chip Enable
7	A5	Address	23	A10	Address
8	A4	Address	24	OE\	Output Enable
9	A3	Address	25	A11	Address
10	A2	Address	26	A9	Address
11	A1	Address	27	A8	Address
12	A0	Address	28	A13	Address
13	I/O0	Input/Output	29	WE\	Write Enable
14	I/O1	Input/Output	30	RES\	Reset
15	I/O2	Input/Output	31	A15	Address
16	Vss	Ground	32	Vcc	Power Supply



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