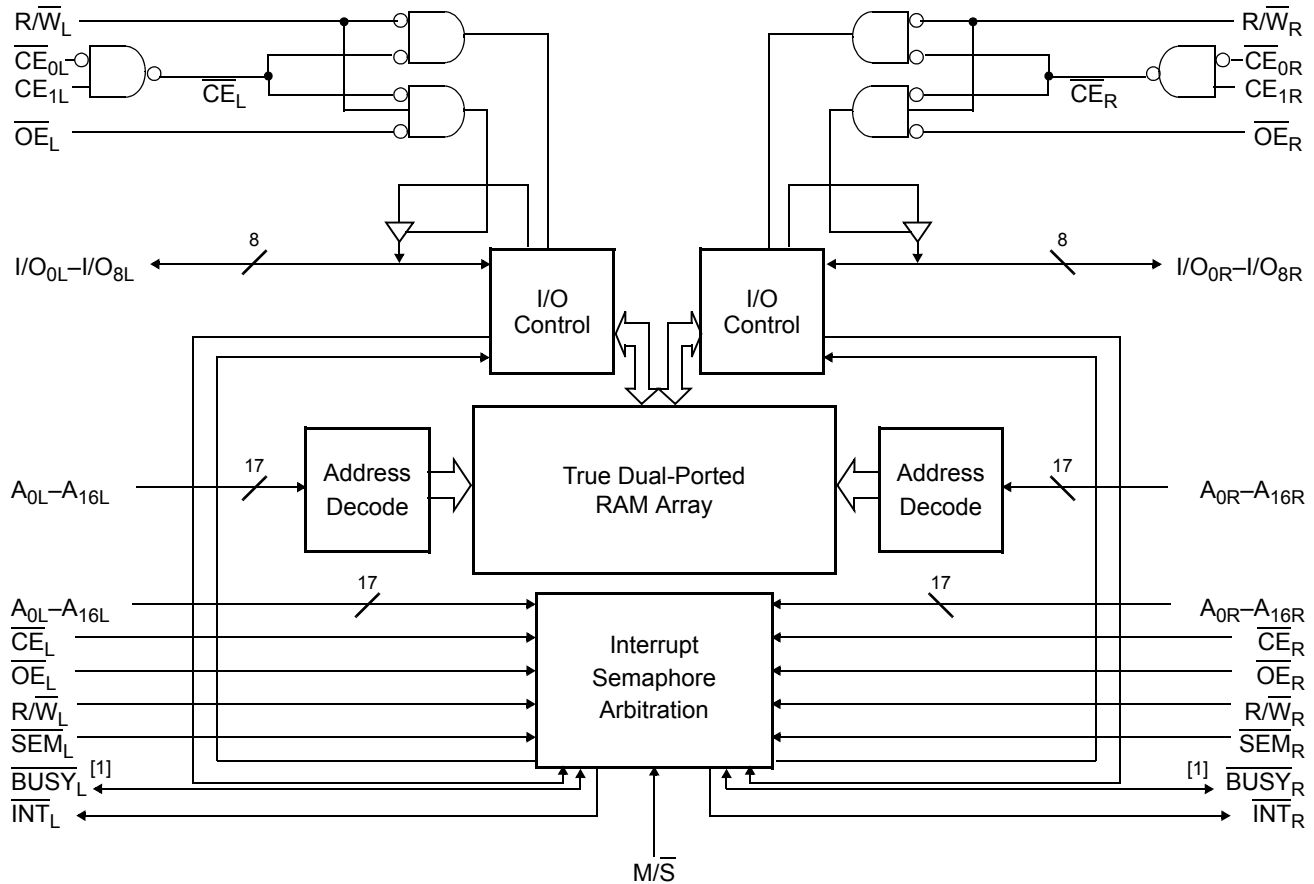


## Features

- True dual-ported memory cells which allow simultaneous access of the same memory location
- 128 K × 8 organization (CY7C009)
- 0.35-micron CMOS for optimum speed/power
- High-speed access: 15/20/25 ns
- Low operating power
  - Active:  $I_{CC} = 115$  mA (typical)
  - Standby:  $I_{SB3} = 10$   $\mu$ A (typical)
- Fully asynchronous operation
- Automatic power-down
- Expandable data bus to 16 bits or more using Master/Slave chip select when using more than one device
- On-chip arbitration logic
- Semaphores included to permit software handshaking between ports
- $\overline{INT}$  flag for port-to-port communication
- Dual chip enables
- Pin select for Master or Slave
- Commercial and industrial temperature ranges
- Available in 100-pin TQFP
- Pb-free packages available

## Logic Block Diagram



### Note

1.  $\overline{BUSY}$  is an output in master mode and an input in slave mode.

## Functional Description

The CY7C009V is a low-power CMOS 64 K, 128 K × 8 dual-port static RAM. Various arbitration schemes are included on the devices to handle situations when multiple processors access the same piece of data. Two ports are provided permitting independent, asynchronous access for reads and writes to any location in memory. The devices can be utilized as standalone 8/9-bit dual-port static RAMs or multiple devices can be combined in order to function as a 16/18-bit or wider master/slave dual-port static RAM. An  $\overline{M/S}$  pin is provided for implementing 16/18-bit or wider memory applications without the need for separate master and slave devices or additional discrete logic. Application areas include interprocessor/multiprocessor designs, communications status buffering, and dual-port video/graphics memory.

Each port has independent control pins: chip enable ( $\overline{CE}$ ), read or write enable (R/W), and output enable ( $\overline{OE}$ ). Two flags are provided on each port (BUSY and INT). BUSY signals that the port is trying to access the same location currently being accessed by the other port. The interrupt flag ( $\overline{INT}$ ) permits communication between ports or systems by means of a mail box. The semaphores are used to pass a flag, or token, from one port to the other to indicate that a shared resource is in use. The semaphore logic is comprised of eight shared latches. Only one side can control the latch (semaphore) at any time. Control of a semaphore indicates that a shared resource is in use. An automatic power-down feature is controlled independently on each port by a chip select ( $\overline{CE}$ ) pin.

The CY7C009V is available in 100-pin Thin Quad Plastic Flatpacks (TQFP).

## Contents

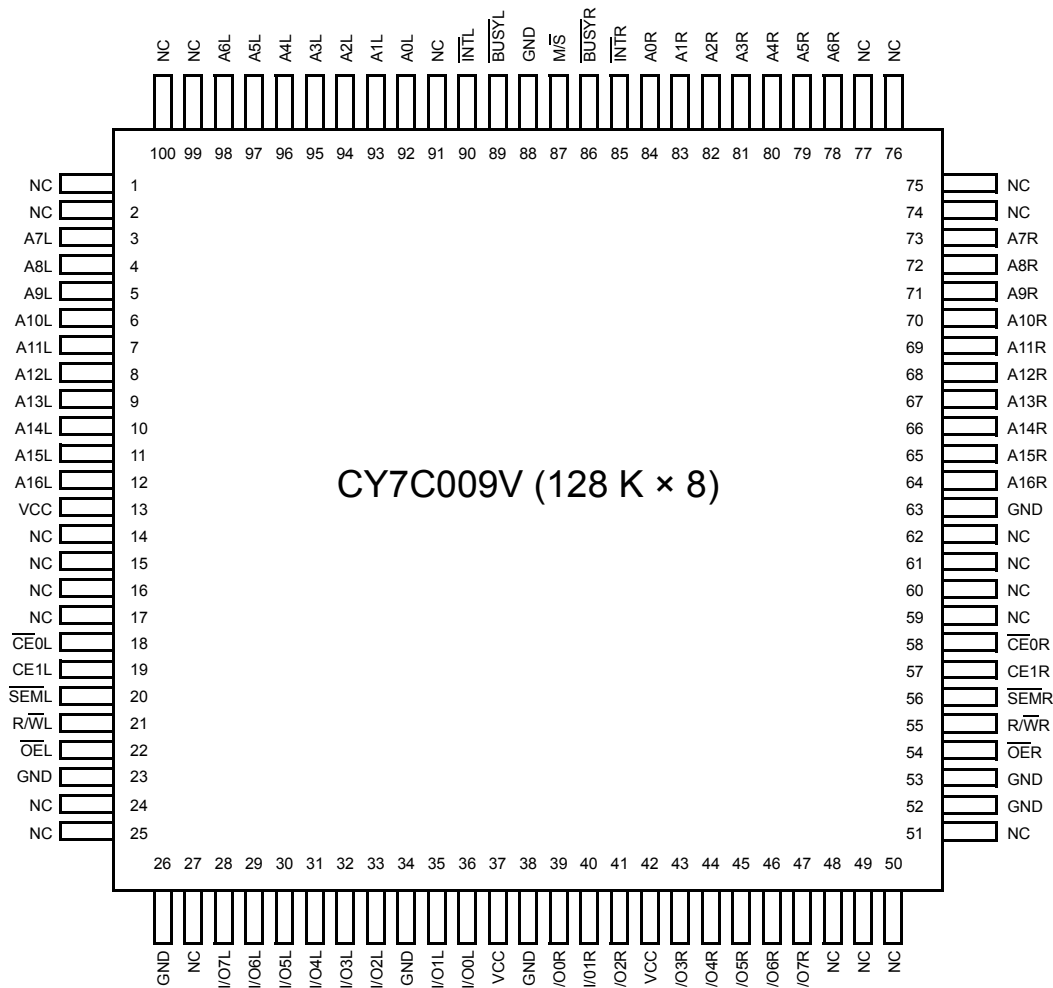
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**Selection Guide**

	CY7C009V -15	CY7C009V -20	CY7C009V -25	Unit
Maximum access time	15	20	25	ns
Typical operating current	125	120	115	mA
Typical standby current for I <sub>SB1</sub> (both ports TTL level)	35	35	30	mA
Typical standby current for I <sub>SB3</sub> (both ports CMOS level)	10	10	10	μA

**Pin Configurations**

**Figure 1. 100-pin TQFP (Top View)**



## Pin Definitions

Left Port	Right Port	Description
$\overline{CE}_{0L}, CE_{1L}$	$\overline{CE}_R, CE_{1R}$	Chip enable ( $\overline{CE}$ is LOW when $\overline{CE}_0 \leq V_{IL}$ and $CE_1 \geq V_{IH}$ )
$R\overline{W}_L$	$R\overline{W}_R$	Read/Write enable
$\overline{OE}_L$	$\overline{OE}_R$	Output enable
$A_{0L}-A_{16L}$	$A_{0R}-A_{16R}$	Address
$I/O_{0L}-I/O_{7L}$	$I/O_{0R}-I/O_{7R}$	Data bus input/output
$\overline{SEM}_L$	$\overline{SEM}_R$	Semaphore enable
$\overline{INT}_L$	$\overline{INT}_R$	Interrupt flag
$\overline{BUSY}_L$	$\overline{BUSY}_R$	Busy flag
$M/\overline{S}$		Master or slave select
$V_{CC}$		Power
GND		Ground
NC		No Connect

## Architecture

The CY7C009V consists of an array of 128 K words of 8 bits each of dual-port RAM cells, I/O and address lines, and control signals (CE, OE, R/W). These control pins permit independent access for reads or writes to any location in memory. To handle simultaneous writes/reads to the same location, a BUSY pin is provided on each port. Two interrupt (INT) pins can be utilized for port-to-port communication. Two semaphore (SEM) control pins are used for allocating shared resources. With the M/S pin, the devices can function as a master (BUSY pins are outputs) or as a slave (BUSY pins are inputs). The devices also have an automatic power-down feature controlled by  $\overline{CE}$ . Each port is provided with its own output enable control (OE), which allows data to be read from the device.

## Functional Overview

### Write Operation

Data must be set up for a duration of  $t_{SD}$  before the rising edge of R/W in order to guarantee a valid write. A write operation is controlled by either the R/W pin (see Write Cycle No. 1 waveform) or the  $\overline{CE}$  pin (see Write Cycle No. 2 waveform). Required inputs for non-contention operations are summarized in Table 1 on page 6.

If a location is being written to by one port and the opposite port attempts to read that location, a port-to-port flowthrough delay must occur before the data is read on the output; otherwise the data read is not deterministic. Data will be valid on the port  $t_{DDP}$  after the data is presented on the other port.

### Read Operation

When reading the device, the user must assert both the  $\overline{OE}$  and CE pins. Data will be available  $t_{ACE}$  after CE or  $t_{DOE}$  after OE is asserted. If the user wishes to access a semaphore flag, then the SEM pin must be asserted instead of the CE pin, and OE must also be asserted.

## Interrupts

The upper two memory locations may be used for message passing. The highest memory location (1FFFF for the CY7C009) is the mailbox for the right port and the second-highest memory location (1FFFE for the CY7C009) is the mailbox for the left port. When one port writes to the other port's mailbox, an interrupt is generated to the owner. The interrupt is reset when the owner reads the contents of the mailbox. The message is user defined.

Each port can read the other port's mailbox without resetting the interrupt. The active state of the busy signal (to a port) prevents the port from setting the interrupt to the winning port. Also, an active busy to a port prevents that port from reading its own mailbox and, thus, resetting the interrupt to it.

If an application does not require message passing, do not connect the interrupt pin to the processor's interrupt request input pin.

The operation of the interrupts and their interaction with Busy are summarized in Table 2 on page 6.

### Busy

The CY7C009V provide on-chip arbitration to resolve simultaneous memory location access (contention). If both ports' CEs are asserted and an address match occurs within  $t_{PS}$  of each other, the busy logic will determine which port has access. If  $t_{PS}$  is violated, one port will definitely gain permission to the location, but it is not predictable which port will get that permission.  $\overline{BUSY}$  will be asserted  $t_{BLA}$  after an address match or  $t_{BLC}$  after CE is taken LOW.

### Master/Slave

A  $M/\overline{S}$  pin is provided in order to expand the word width by configuring the device as either a master or a slave. The  $\overline{BUSY}$  output of the master is connected to the BUSY input of the slave. This will allow the device to interface to a master device with no external components. Writing to slave devices must be delayed until after the BUSY input has settled ( $t_{BLC}$  or  $t_{BLA}$ ), otherwise, the slave chip may begin a write cycle during a contention

situation. When tied HIGH, the  $\overline{M\overline{S}}$  pin allows the device to be used as a master and, therefore, the BUSY line is an output. BUSY can then be used to send the arbitration outcome to a slave.

**Semaphore Operation**


The CY7C009V provide eight semaphore latches, which are separate from the dual-port memory locations. Semaphores are used to reserve resources that are shared between the two ports. The state of the semaphore indicates that a resource is in use. For example, if the left port wants to request a given resource, it sets a latch by writing a zero to a semaphore location. The left port then verifies its success in setting the latch by reading it. After writing to the semaphore, SEM or OE must be deasserted for  $t_{SOP}$  before attempting to read the semaphore. The semaphore value will be available  $t_{SWRD} + t_{DOE}$  after the rising edge of the semaphore write. If the left port was successful (reads a zero), it assumes control of the shared resource, otherwise (reads a one) it assumes the right port has control and continues to poll the semaphore. When the right side has relinquished control of the semaphore (by writing a one), the left side will succeed in gaining control of the semaphore. If the left side no longer requires the semaphore, a one is written to cancel its request.

Semaphores are accessed by asserting  $\overline{SEM}$  LOW. The  $\overline{SEM}$  pin functions as a chip select for the semaphore latches (CE must remain HIGH during SEM LOW).  $A_{0-2}$  represents the semaphore address. OE and R/W are used in the same manner as a normal memory access. When writing or reading a semaphore, the other address pins have no effect.

When writing to the semaphore, only I/O<sub>0</sub> is used. If a zero is written to the left port of an available semaphore, a one will appear at the same semaphore address on the right port. That semaphore can now only be modified by the side showing zero (the left port in this case). If the left port now relinquishes control by writing a one to the semaphore, the semaphore will be set to one for both sides. However, if the right port had requested the semaphore (written a zero) while the left port had control, the right port would immediately own the semaphore as soon as the left port released it. Table 3 on page 7 shows sample semaphore operations.

When reading a semaphore, all data lines output the semaphore value. The read value is latched in an output register to prevent the semaphore from changing state during a write from the other port. If both ports attempt to access the semaphore within  $t_{SPS}$  of each other, the semaphore will definitely be obtained by one side or the other, but there is no guarantee which side will control the semaphore.

**Table 1. Non-Contending Read/Write**

Inputs				Outputs	Operation
CE	R/W	OE	SEM	I/O <sub>0</sub> -I/O <sub>8</sub>	
H	X	X	H	High Z	Deselected: Power-down
H	H	L	L	Data out	Read data in semaphore flag
X	X	H	X	High Z	I/O lines disabled
H		X	L	Data in	Write into semaphore flag
L	H	L	H	Data out	Read
L	L	X	H	Data in	Write
L	X	X	L		Not allowed

**Table 2. Interrupt Operation Example (assumes  $\overline{BUSY}_L = \overline{BUSY}_R = \text{HIGH}$ )**

Function	Left Port					Right Port				
	R/W <sub>L</sub>	CE <sub>L</sub>	OE <sub>L</sub>	A <sub>0L-16L</sub>	INT <sub>L</sub>	R/W <sub>R</sub>	CE <sub>R</sub>	OE <sub>R</sub>	A <sub>0R-16R</sub>	INT <sub>R</sub>
Set Right $\overline{INT}_R$ Flag	L	L	X	1FFFF	X	X	X	X	X	L <sup>[2]</sup>
Reset Right $\overline{INT}_R$ Flag	X	X	X	X	X	X	L	L	1FFFF	H <sup>[3]</sup>
Set Left $\overline{INT}_L$ Flag	X	X	X	X	L <sup>[3]</sup>	L	L	X	1FFFE	X
Reset Left $\overline{INT}_L$ Flag	X	L	L	1FFFE	H <sup>[2]</sup>	X	X	X	X	X

**Notes**

- 2. If  $\overline{BUSY}_L = L$ , then no change.
- 3. If  $\overline{BUSY}_R = L$ , then no change.

**Table 3. Semaphore Operation Example**

Function	I/O <sub>0</sub> -I/O <sub>8</sub> Left	I/O <sub>0</sub> -I/O <sub>8</sub> Right	Status
No action	1	1	Semaphore free
Left port writes 0 to semaphore	0	1	Left port has semaphore token
Right port writes 0 to semaphore	0	1	No change. Right side has no write access to semaphore
Left port writes 1 to semaphore	1	0	Right port obtains semaphore token
Left port writes 0 to semaphore	1	0	No change. Left port has no write access to semaphore
Right port writes 1 to semaphore	0	1	Left port obtains semaphore token
Left port writes 1 to semaphore	1	1	Semaphore free
Right port writes 0 to semaphore	1	0	Right port has semaphore token
Right port writes 1 to semaphore	1	1	Semaphore free
Left port writes 0 to semaphore	0	1	Left port has semaphore token
Left port writes 1 to semaphore	1	1	Semaphore free

## Maximum Ratings

Exceeding maximum ratings <sup>[4]</sup> may shorten the useful life of the device. User guidelines are not tested.

Storage temperature ..... -65 °C to +150 °C

Ambient temperature with power applied ..... -55 °C to +125 °C

Supply voltage to ground potential ..... -0.5 V to +4.6 V

DC voltage applied to outputs in high Z State ..... -0.5 V to V<sub>CC</sub> + 0.5 V

DC input voltage ..... -0.5 V to V<sub>CC</sub> + 0.5 V

Output current into outputs (LOW) ..... 20 mA

Static discharge voltage ..... > 1100 V

Latch-up current ..... > 200 mA

## Operating Range

Range	Ambient Temperature	V <sub>CC</sub>
Commercial	0 °C to +70 °C	3.3 V ± 300 mV
Industrial <sup>[5]</sup>	-40 °C to +85 °C	3.3 V ± 300 mV

## Electrical Characteristics

Over the Operating Range

Parameter	Description	CY7C009V									Unit	
		-15			-20			-25				
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
V <sub>OH</sub>	Output HIGH voltage (V <sub>CC</sub> = Min, I <sub>OH</sub> = -4.0 mA)	2.4	-	-	2.4	-	-	2.4	-	-	V	
V <sub>OL</sub>	Output LOW voltage (V <sub>CC</sub> = Min, I <sub>OH</sub> = +4.0 mA)	-	-	0.4	-	-	0.4	-	-	0.4	V	
V <sub>IH</sub>	Input HIGH voltage	2.2	-	-	2.2	-	-	2.2	-	-	V	
V <sub>IL</sub>	Input LOW voltage	-	-	0.8	-	-	0.8	-	-	0.8	V	
I <sub>IX</sub>	Input leakage current	-5	-	5	-5	-	5	-5	-	5	µA	
I <sub>OZ</sub>	Output leakage current	-10	-	10	-10	-	10	-10	-	10	µA	
I <sub>CC</sub>	Operating current (V <sub>CC</sub> = Max, I <sub>OUT</sub> = 0 mA) outputs disabled	Commercial	-	125	185	-	120	175	-	115	165	mA
		Industrial	-	-	-	-	140	195	-	-	-	mA
I <sub>SB1</sub>	Standby current (both ports TTL level) CE <sub>L</sub> and CE <sub>R</sub> ≥ V <sub>IH</sub> , f = f <sub>MAX</sub>	Commercial	-	35	50	-	35	45	-	30	40	mA
		Industrial	-	-	-	-	45	55	-	-	-	mA
I <sub>SB2</sub>	Standby current (one port TTL level) CE <sub>L</sub>   CE <sub>R</sub> ≥ V <sub>IH</sub> , f = f <sub>MAX</sub>	Commercial	-	80	120	-	75	110	-	65	95	mA
		Industrial	-	-	-	-	85	120	-	-	-	mA
I <sub>SB3</sub>	Standby current (both ports CMOS level) CE <sub>L</sub> and CE <sub>R</sub> ≥ V <sub>CC</sub> - 0.2 V, f = 0	Commercial	-	10	250	-	10	250	-	10	250	µA
		Industrial	-	-	-	-	10	250	-	-	-	µA
I <sub>SB4</sub>	Standby current (one port CMOS level) CE <sub>L</sub>   CE <sub>R</sub> ≥ V <sub>IH</sub> , f = f <sub>MAX</sub> <sup>[6]</sup>	Commercial	-	75	105	-	70	95	-	60	80	mA
		Industrial	-	-	-	-	80	105	-	-	-	mA

### Notes

- The voltage on any input or I/O pin cannot exceed the power pin during power-up.
- Industrial parts are available in CY7C009V.
- f<sub>MAX</sub> = 1/t<sub>RC</sub> = All inputs cycling at f = 1/t<sub>RC</sub> (except output enable). f = 0 means no address or control lines change. This applies only to inputs at CMOS level standby I<sub>SB3</sub>.

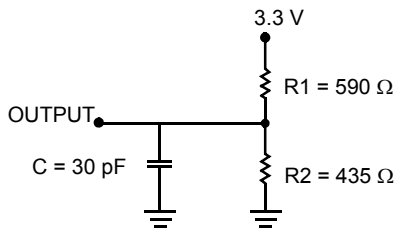


### Capacitance

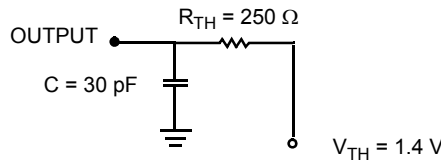
Parameter <sup>[7]</sup>	Description	Test Conditions	Max	Unit
C <sub>IN</sub>	Input capacitance	T <sub>A</sub> = 25 °C, f = 1 MHz, V <sub>CC</sub> = 3.3 V	10	pF
C <sub>OUT</sub>	Output capacitance		10	pF

### AC Test Loads and Waveforms

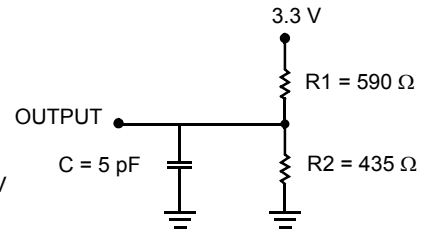
Figure 2. AC Test Loads and Waveforms



(a) Normal Load (Load 1)

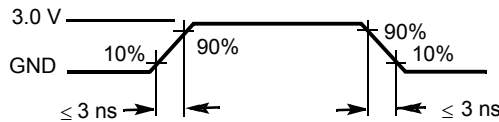


(b) Thévenin Equivalent (Load 1)



(c) Three-State Delay (Load 2)  
(Used for t<sub>LZ</sub>, t<sub>HZ</sub>, t<sub>HZWE</sub>, & t<sub>LZWE</sub> including scope and jig)

ALL INPUT PULSES

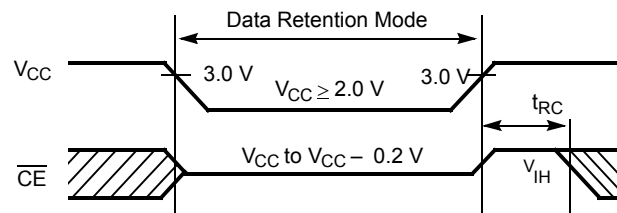


### Data Retention Mode

The CY7C009V is designed with battery backup in mind. Data retention voltage and supply current are guaranteed over temperature. The following rules ensure data retention:

1. Chip enable ( $\overline{CE}$ ) must be held HIGH during data retention, within V<sub>CC</sub> to V<sub>CC</sub> - 0.2 V.
2.  $\overline{CE}$  must be kept between V<sub>CC</sub> - 0.2 V and 70% of V<sub>CC</sub> during the power-up and power-down transitions.
3. The RAM can begin operation > t<sub>RC</sub> after V<sub>CC</sub> reaches the minimum operating voltage (3.0 V).

### Timing



Parameter	Test Conditions <sup>[8]</sup>	Max	Unit
ICC <sub>DR1</sub>	@ V <sub>CCDR</sub> = 2 V	50	μA

#### Notes

7. Tested initially and after any design or process changes that may affect these parameters.
8. CE = V<sub>CC</sub>. V<sub>in</sub> = GND to V<sub>CC</sub>, T<sub>A</sub> = 25 °C. This parameter is guaranteed but not tested.

## Switching Characteristics

Over the Operating Range

Parameter <sup>[9]</sup>	Description	CY7C009V						Unit
		-15		-20		-25		
		Min	Max	Min	Max	Min	Max	
<b>READ CYCLE</b>								
$t_{RC}$	Read cycle time	15	–	20	–	25	–	ns
$t_{AA}$	Address to data valid	–	15	–	20	–	25	ns
$t_{OHA}$	Output hold from address change	3	–	3	–	3	–	ns
$t_{ACE}^{[10]}$	CE LOW to data valid	–	15	–	20	–	25	ns
$t_{DOE}$	OE LOW to data valid	–	10	–	12	–	13	ns
$t_{LZOE}^{[11, 12, 13]}$	OE LOW to low Z	3	–	3	–	3	–	ns
$t_{HZOE}^{[11, 12, 13]}$	OE HIGH to high Z	–	10	–	12	–	15	ns
$t_{LZCE}^{[11, 12, 13]}$	CE LOW to low Z	3	–	3	–	3	–	ns
$t_{HZCE}^{[11, 12, 13]}$	CE HIGH to high Z	–	10	–	12	–	15	ns
$t_{PU}^{[13]}$	CE LOW to power-up	0	–	0	–	0	–	ns
$t_{PD}^{[13]}$	CE HIGH to power-down	–	15	–	20	–	25	ns
$t_{ABE}^{[10]}$	Byte enable access time	–	15	–	20	–	25	ns
<b>WRITE CYCLE</b>								
$t_{WC}$	Write cycle time	15	–	20	–	25	–	ns
$t_{SCE}^{[10]}$	CE LOW to write end	12	–	16	–	20	–	ns
$t_{AW}$	Address valid to write end	12	–	16	–	20	–	ns
$t_{HA}$	Address hold from write end	0	–	0	–	0	–	ns
$t_{SA}^{[10]}$	Address set-up to write start	0	–	0	–	0	–	ns
$t_{PWE}$	Write pulse width	12	–	17	–	22	–	ns
$t_{SD}$	Data set-up to write end	10	–	12	–	15	–	ns
$t_{HD}$	Data hold from write end	0	–	0	–	0	–	ns
$t_{HZWE}^{[12, 13]}$	R/W LOW to high Z	–	10	–	12	–	15	ns
$t_{LZWE}^{[12, 13]}$	R/W HIGH to low Z	3	–	3	–	3	–	ns
$t_{WDD}^{[14]}$	Write pulse to data delay	–	30	–	40	–	50	ns
$t_{DDD}^{[14]}$	Write data valid to read data valid	–	25	–	30	–	35	ns

### Notes

9. Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3.0 V, and output loading of the specified  $I_{OH}/I_{OH}$  and 30 pF load capacitance.
10. To access RAM,  $\overline{CE} = L$ ,  $\overline{SEM} = H$ . To access semaphore,  $\overline{CE} = H$  and  $\overline{SEM} = L$ . Either condition must be valid for the entire  $t_{SCE}$  time.
11. At any given temperature and voltage condition for any given device,  $t_{HZCE}$  is less than  $t_{LZCE}$  and  $t_{HZOE}$  is less than  $t_{LZOE}$ .
12. Test conditions used are Load 2.
13. This parameter is guaranteed by design, but it is not production tested. For information on port-to-port delay through RAM cells from writing port to reading port, refer to Read Timing with Busy waveform.
14. For information on port-to-port delay through RAM cells from writing port to reading port, refer to Read Timing with Busy waveform.

**Switching Characteristics** *(continued)*

Over the Operating Range

Parameter <sup>[9]</sup>	Description	CY7C009V						Unit
		-15		-20		-25		
		Min	Max	Min	Max	Min	Max	
<b>BUSY TIMING</b> <sup>[15]</sup>								
t <sub>BLA</sub>	BUSY LOW from address match	–	15	–	20	–	20	ns
t <sub>BHA</sub>	BUSY HIGH from address mismatch	–	15	–	20	–	20	ns
t <sub>BLC</sub>	BUSY LOW from CE LOW	–	15	–	20	–	20	ns
t <sub>BHC</sub>	BUSY HIGH from CE HIGH	–	15	–	16	–	17	ns
t <sub>PS</sub>	Port set-up for priority	5	–	5	–	5	–	ns
t <sub>WB</sub>	R/W HIGH after BUSY (Slave)	0	–	0	–	0	–	ns
t <sub>WH</sub>	R/W HIGH after BUSY HIGH (Slave)	13	–	15	–	17	–	ns
t <sub>BDD</sub> <sup>[16]</sup>	BUSY HIGH to data valid	–	15	–	20	–	25	ns
<b>INTERRUPT TIMING</b> <sup>[15]</sup>								
t <sub>INS</sub>	INT set time	–	15	–	20	–	20	ns
t <sub>INR</sub>	INT reset time	–	15	–	20	–	20	ns
<b>SEMAPHORE TIMING</b>								
t <sub>SOP</sub>	SEM flag update pulse (OE or SEM)	10	–	10	–	12	–	ns
t <sub>SWRD</sub>	SEM flag write to read time	5	–	5	–	5	–	ns
t <sub>SPS</sub>	SEM flag contention window	5	–	5	–	5	–	ns
t <sub>SAA</sub>	SEM address access time	–	15	–	20	–	25	ns

**Notes**

15. Test conditions used are Load 1.

 16. t<sub>BDD</sub> is a calculated parameter and is the greater of t<sub>WDD</sub>–t<sub>PWE</sub> (actual) or t<sub>DDD</sub>–t<sub>SD</sub> (actual).

### Switching Waveforms

Figure 3. Read Cycle No.1 (Either Port Address Access) [17, 18, 19]

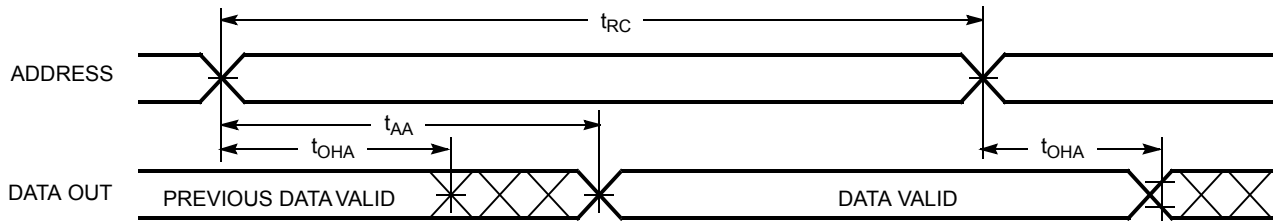


Figure 4. Read Cycle No.2 (Either Port  $\overline{CE}/\overline{OE}$  Access) [17, 20, 21]

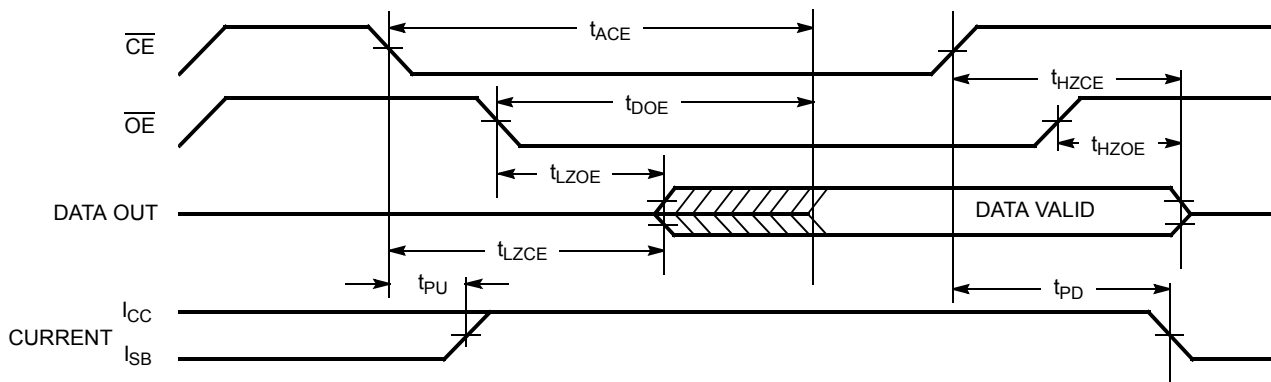
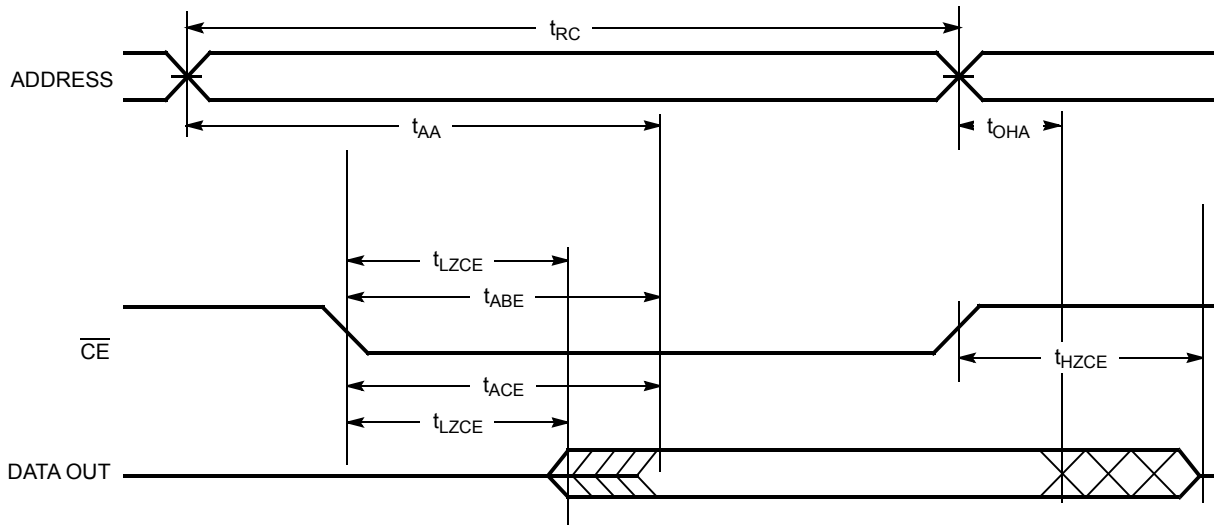


Figure 5. Read Cycle No. 3 (Either Port) [17, 19, 20, 21]



**Notes**

- 17.  $\overline{RW}$  is HIGH for read cycles.
- 18. Device is continuously selected  $\overline{CE} = V_{IL}$ . This waveform cannot be used for semaphore reads.
- 19.  $\overline{OE} = V_{IL}$ .
- 20. Address valid prior to or coincident with  $\overline{CE}$  transition LOW.
- 21. To access RAM,  $\overline{CE} = V_{IL}$ ,  $\overline{SEM} = V_{IH}$ . To access semaphore,  $\overline{CE} = V_{IH}$ ,  $\overline{SEM} = V_{IL}$ .

Switching Waveforms (continued)

Figure 6. Write Cycle No. 1: R/W Controlled Timing [22, 23, 24, 25]

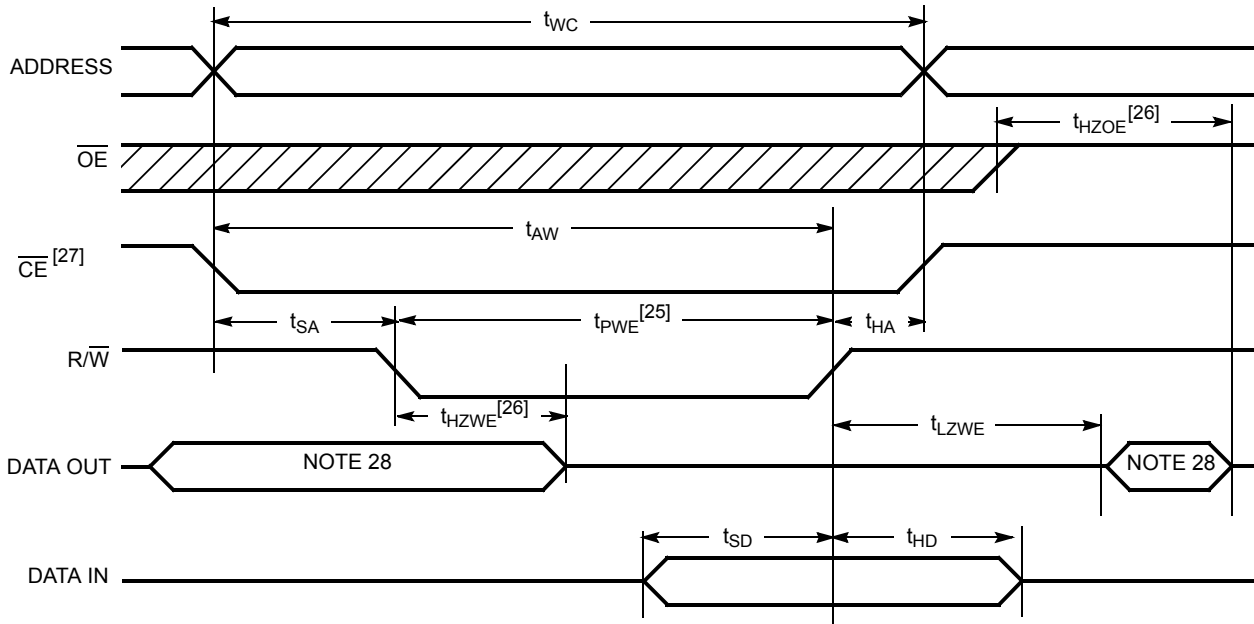
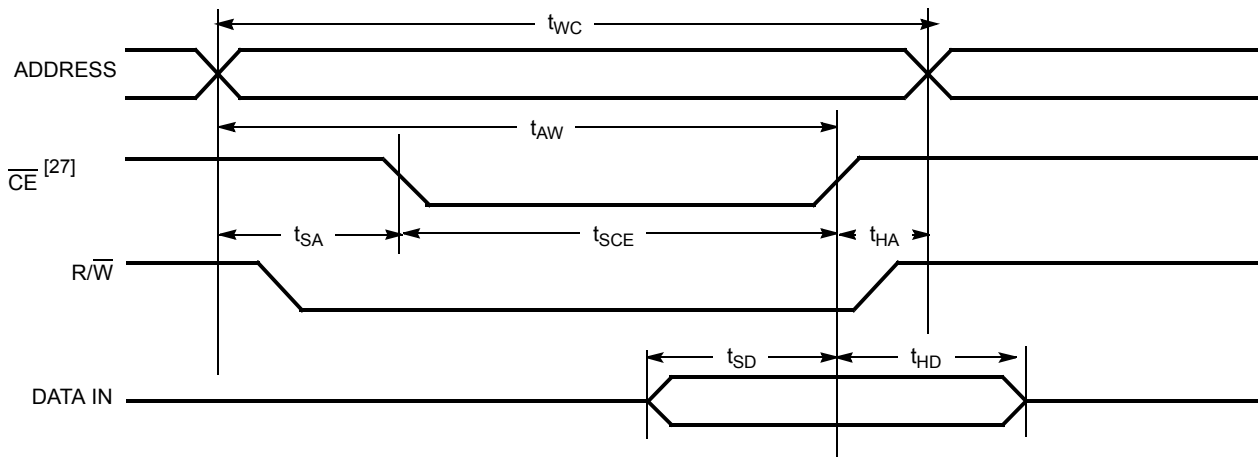


Figure 7. Write Cycle No. 2: CE Controlled Timing [22, 23, 24, 29]



Notes

- 22. R/W must be HIGH during all address transitions.
- 23. A write occurs during the overlap ( $t_{SCE}$  or  $t_{PWE}$ ) of a LOW CE or SEM.
- 24.  $t_{HA}$  is measured from the earlier of CE or R/W or (SEM or R/W) going HIGH at the end of write cycle.
- 25. If OE is LOW during a R/W controlled write cycle, the write pulse width must be the larger of  $t_{PWE}$  or ( $t_{HZWE} + t_{SD}$ ) to allow the I/O drivers to turn off and data to be placed on the bus for the required  $t_{SD}$ . If OE is HIGH during an R/W controlled write cycle, this requirement does not apply and the write pulse can be as short as the specified  $t_{PWE}$ .
- 26. Transition is measured  $\pm 500$  mV from steady state with a 5 pF load (including scope and jig). This parameter is sampled and not 100% tested.
- 27. To access RAM, CE =  $V_{IL}$ , SEM =  $V_{IH}$ .
- 28. During this period, the I/O pins are in the output state, and input signals must not be applied.
- 29. If the CE or SEM LOW transition occurs simultaneously with or after the R/W LOW transition, the outputs remain in the high-impedance state.

Switching Waveforms (continued)

Figure 8. Semaphore Read After Write Timing, Either Side [30]

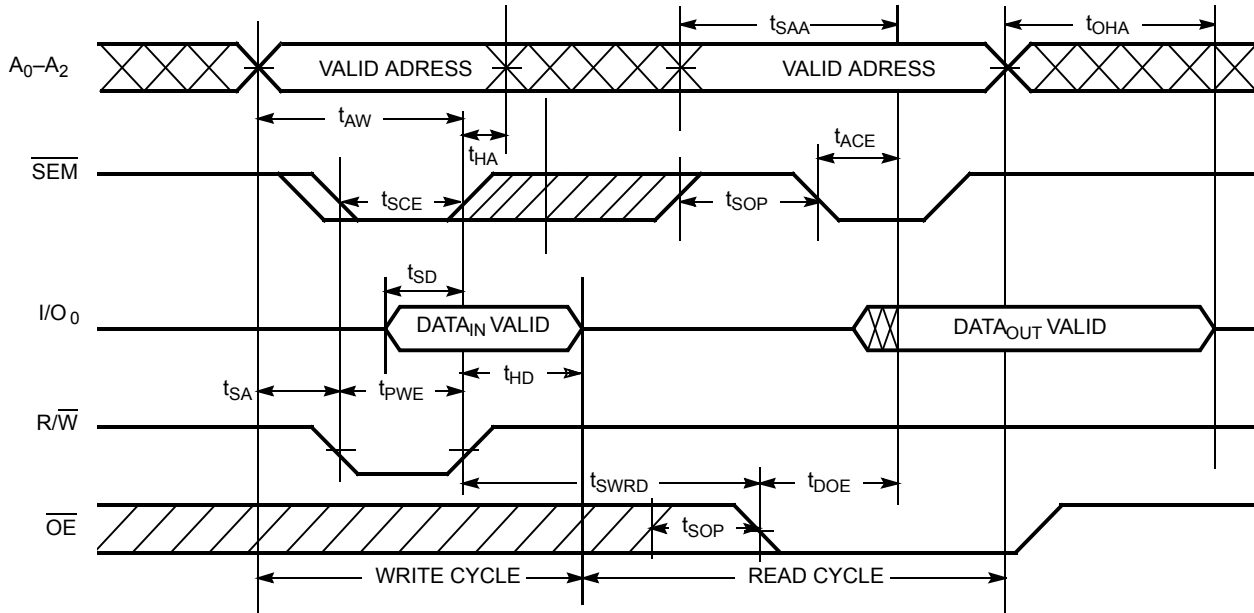
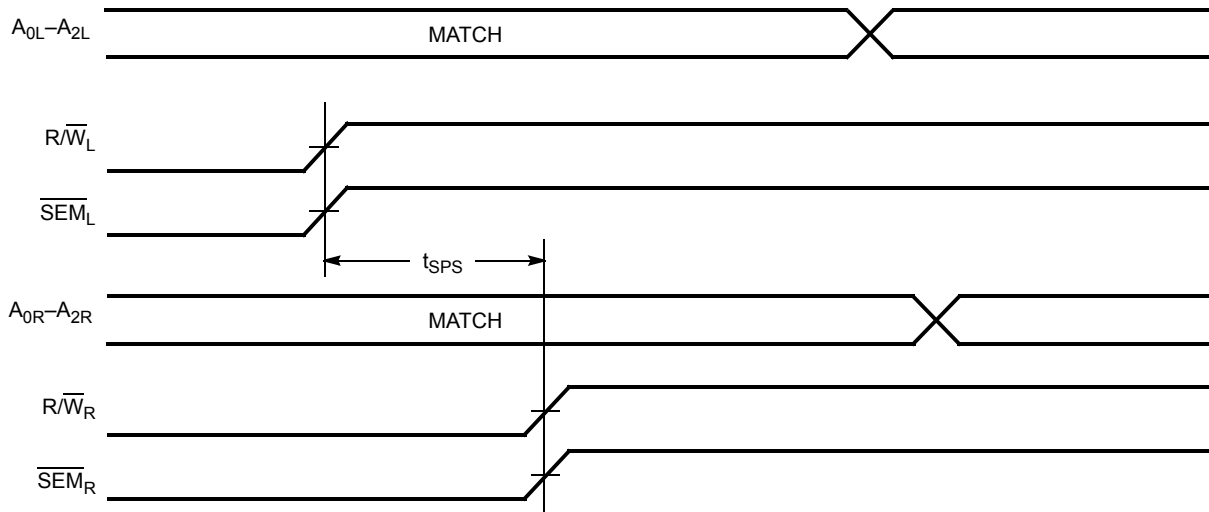


Figure 9. Timing Diagram of Semaphore Contention [31, 32, 33]



Notes

- 30.  $\overline{CE}$  = HIGH for the duration of the above timing (both write and read cycle).
- 31.  $I/O_{0R} = I/O_{0L} = \text{LOW}$  (request semaphore);  $\overline{CE}_R = \overline{CE}_L = \text{HIGH}$ .
- 32. Semaphores are reset (available to both ports) at cycle start.
- 33. If  $t_{SPS}$  is violated, the semaphore will definitely be obtained by one side or the other, but which side will get the semaphore is unpredictable.

Switching Waveforms (continued)

Figure 10. Timing Diagram of Read with  $\overline{\text{BUSY}}$  ( $\overline{\text{M/S}} = \text{HIGH}$ ) [34]

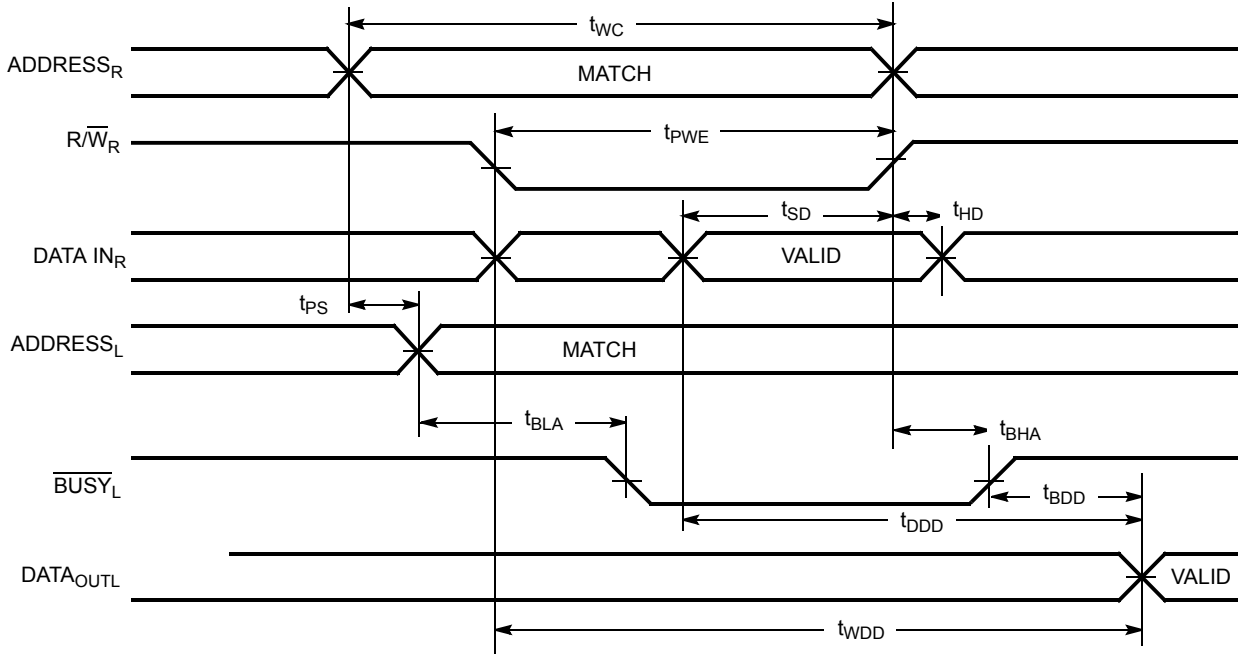
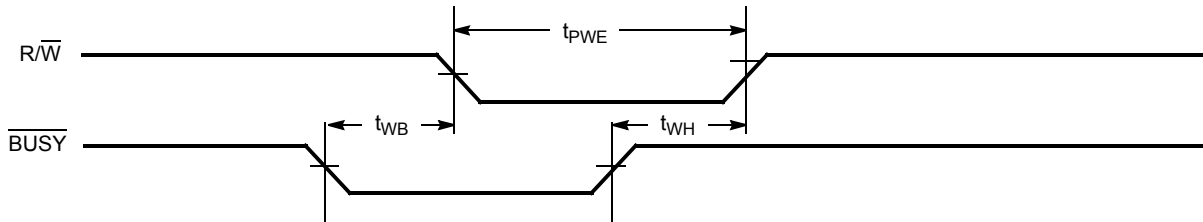


Figure 11. Write Timing with Busy Input ( $\overline{\text{M/S}} = \text{LOW}$ )



Note

34.  $\overline{\text{CE}}_L = \overline{\text{CE}}_R = \text{LOW}$ .

Switching Waveforms (continued)

Figure 12. Busy Timing Diagram No. 1 ( $\overline{CE}$  Arbitration) [35]

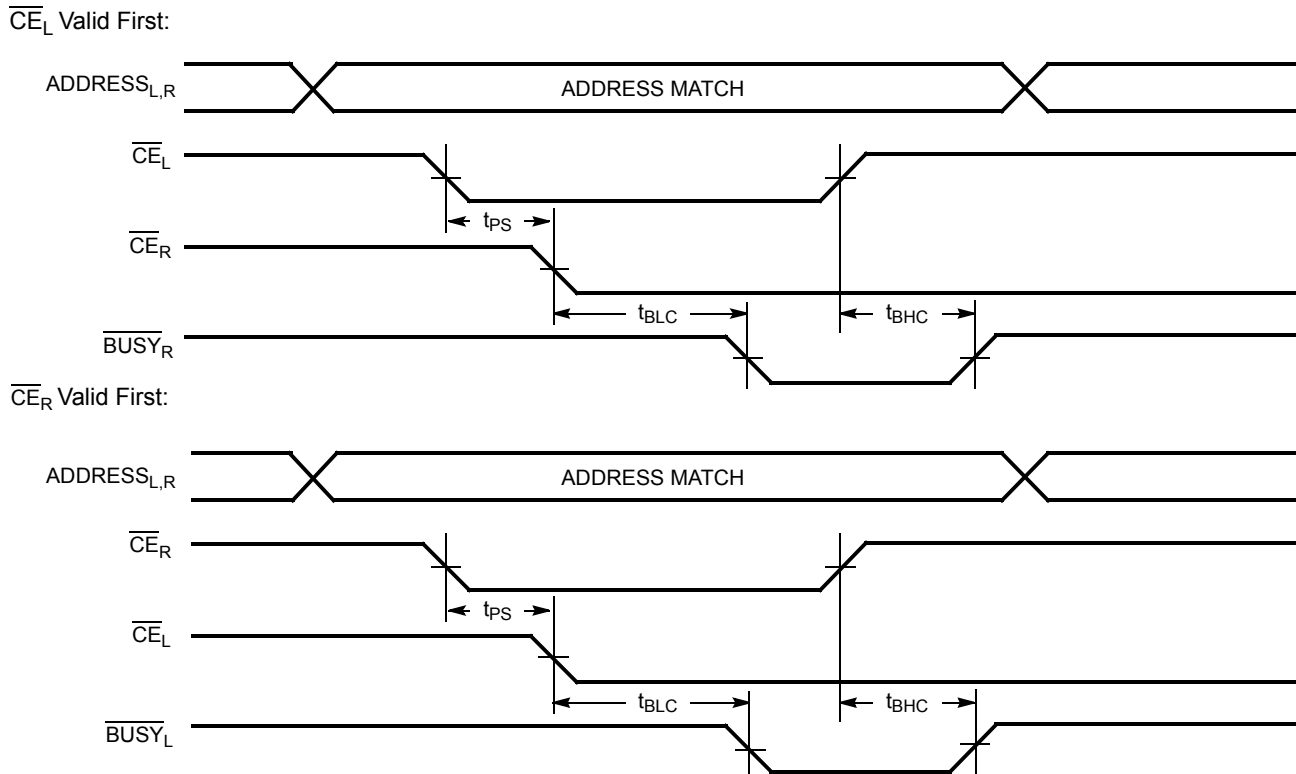
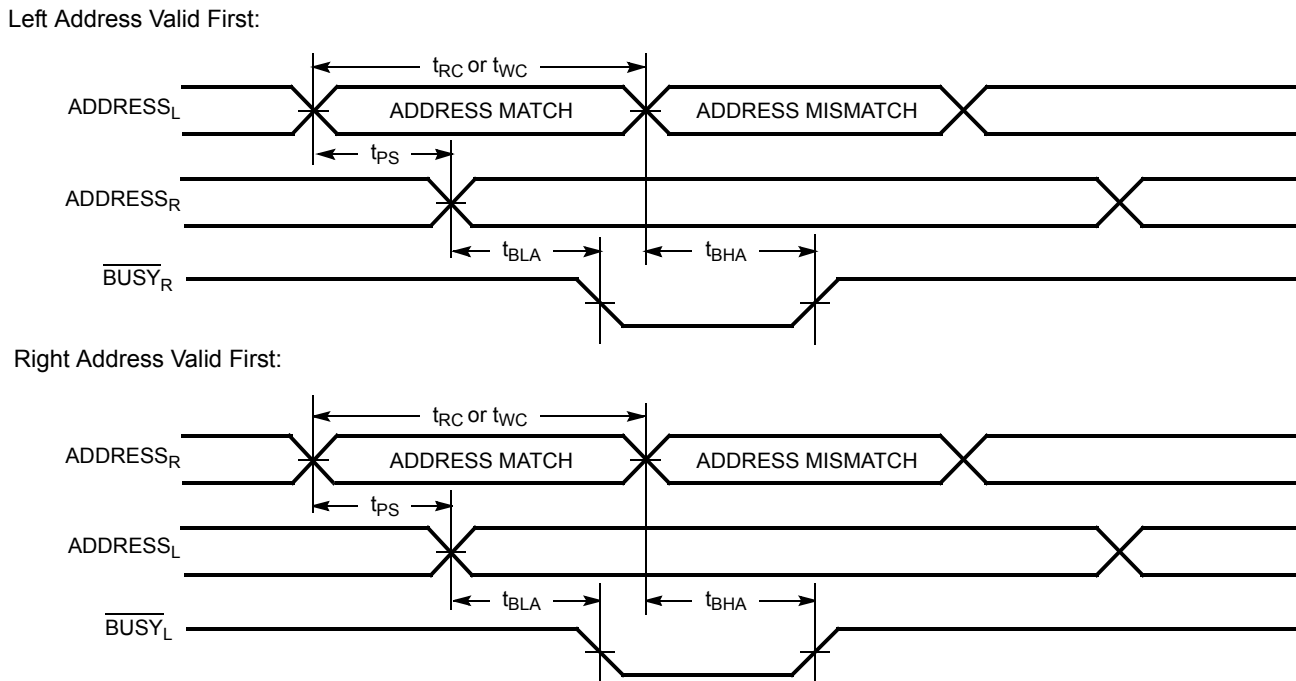


Figure 13. Busy Timing Diagram No. 2 (Address Arbitration) [35]



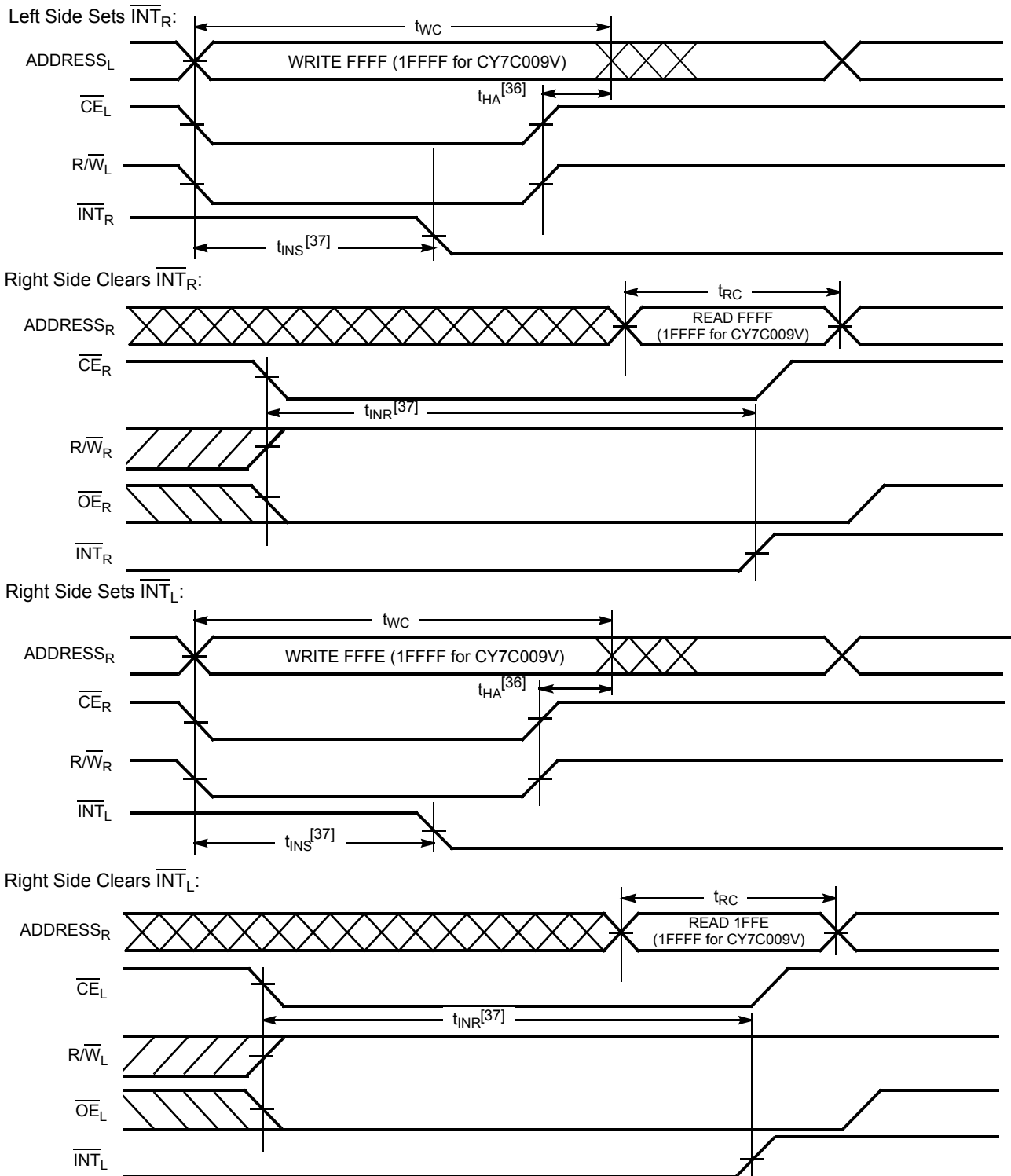
Note

35. If  $t_{PS}$  is violated, the busy signal will be asserted on one side or the other, but there is no guarantee to which side  $\overline{BUSY}$  will be asserted.



Switching Waveforms (continued)

Figure 14. Interrupt Timing Diagrams



Notes

- 36.  $t_{HA}$  depends on which enable pin ( $\overline{CE}_L$  or  $R/\overline{W}_L$ ) is deasserted first.
- 37.  $t_{INS}$  or  $t_{INR}$  depends on which enable pin ( $\overline{CE}_L$  or  $R/\overline{W}_L$ ) is asserted last.

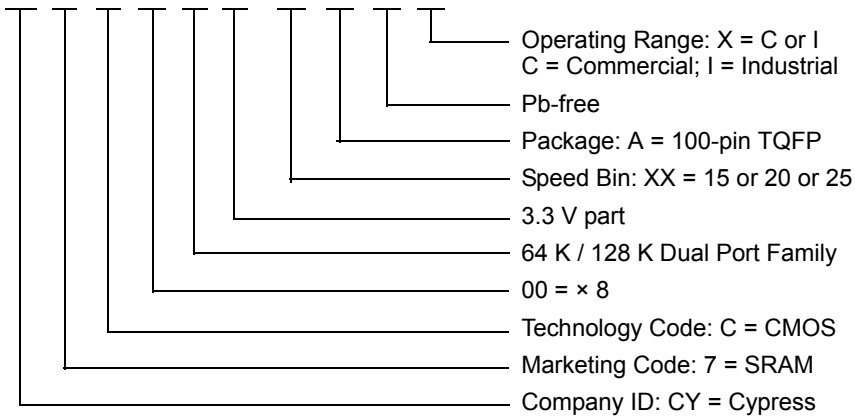
## Ordering Information

### 128 K × 8, 3.3 V Asynchronous Dual-Port SRAM

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
15	CY7C009V-15AXC	A100	100-pin TQFP Pb-free	Commercial
20	CY7C009V-20AXI	A100	100-pin TQFP Pb-free	Industrial
25	CY7C009V-25AXC	A100	100-pin TQFP Pb-free	Commercial

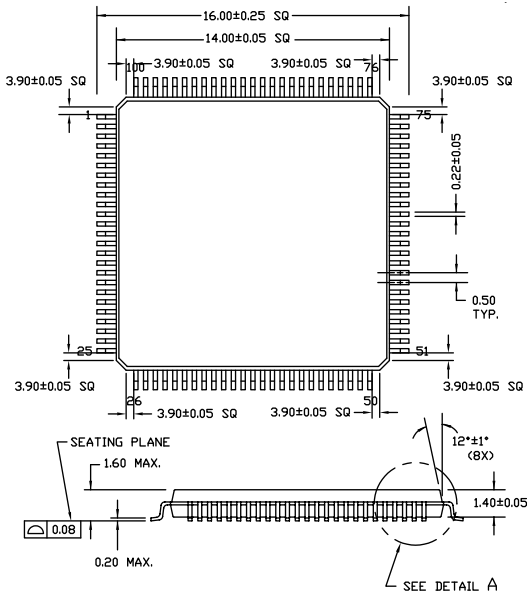
### Ordering Code Definitions

CY 7 C 00 9 V - XX A X X



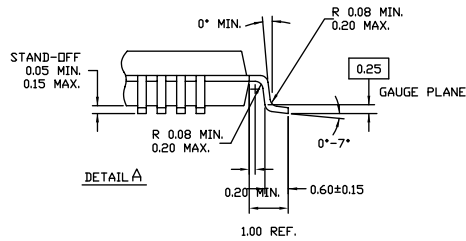
Package Diagram

Figure 15. 100-pin TQFP (14 × 14 × 1.4 mm) A100SA Package Outline, 51-85048

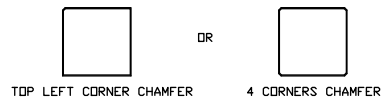


NOTE:

1. JEDEC STD REF MS-026
2. BODY LENGTH DIMENSION DOES NOT INCLUDE MOLD PROTRUSION/END FLASH  
 MOLD PROTRUSION/END FLASH SHALL NOT EXCEED 0.0098 in (0.25 mm) PER SIDE  
 BODY LENGTH DIMENSIONS ARE MAX PLASTIC BODY SIZE INCLUDING MOLD MISMATCH
3. DIMENSIONS IN MILLIMETERS



NOTE: PKG. CAN HAVE



51-85048 \*G

## Acronyms

Acronym	Description
CMOS	complementary metal oxide semiconductor
$\overline{\text{CE}}$	chip enable
I/O	input/output
$\overline{\text{INT}}$	interrupt
$\overline{\text{OE}}$	output enable
$\overline{\text{SEM}}$	semaphore
SRAM	static random access memory
TQFP	thin quad flat pack
TTL	transistor–transistor logic

## Document Conventions

### Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
MHz	megahertz
μA	microampere
mA	milliampere
ms	millisecond
mV	millivolt
ns	nanosecond
pF	picofarad
V	volt
W	watt

Document History Page

Document Title: CY7C009V, 3.3 V 128 K × 8 Dual-Port Static RAM Document Number: 38-06044				
Rev.	ECN No.	Issue Date	Orig. of Change	Description of Change
**	110192	09/29/01	SZV	Change from Spec number: 38-00669 to 38-06044
*A	113541	04/15/02	OOR	Updated <a href="#">Pin Configurations</a> (Changed pin 85 from BUSYL to BUSYR in the figure "100-pin TQFP (Top View)" (corresponding to CY7C018V/019V)).
*B	122294	12/27/02	RBI	Updated <a href="#">Maximum Ratings</a> (Added Power up requirements).
*C	393440	See ECN	YIM	Added Pb-free Logo Updated <a href="#">Ordering Information</a> (Added Pb-free parts (CY7C008V-25AXC, CY7C009V-15AXC, CY7C009V-20AXI, CY7C009V-25AXC, CY7C019V-15AXC, CY7C019V-20AXC, CY7C019V-20AXI, CY7C019V-25AXC)).
*D	2896038	03/19/10	RAME	Updated <a href="#">Ordering Information</a> (Removed inactive parts). Updated <a href="#">Package Diagram</a> .
*E	3081242	11/09/2010	ADMU	Added <a href="#">Ordering Code Definitions</a> . Added <a href="#">Acronyms</a> and <a href="#">Units of Measure</a> . Minor edits and updated in new template.
*F	3816114	11/19/2012	SMCH	Updated Document Title to read "CY7C009V, 3.3 V 128 K × 8 Dual-Port Static RAM". Updated <a href="#">Features</a> (Removed CY7C008V, CY7C018V, CY7C019V related information). Updated <a href="#">Logic Block Diagram</a> (Removed CY7C008V, CY7C018V, CY7C019V related information, removed Notes "I/O <sub>0</sub> -I/O <sub>7</sub> for × 8 devices; I/O <sub>0</sub> -I/O <sub>8</sub> for × 9 devices." and "A <sub>0</sub> -A <sub>15</sub> for 64 K devices; A <sub>0</sub> -A <sub>16</sub> for 128 K." and their references in Logic Block Diagram). Updated <a href="#">Functional Description</a> (Removed CY7C008V, CY7C018V, CY7C019V related information). Updated <a href="#">Selection Guide</a> (Removed CY7C008V, CY7C018V, CY7C019V related information). Updated <a href="#">Pin Configurations</a> (Updated <a href="#">Figure 1</a> (Removed CY7C008V related information, removed the Note "This pin is NC for CY7C008V." and its reference in the same figure), removed the figure "100-pin TQFP (Top View)", removed the Note "This pin is NC for CY7C018V."). Updated <a href="#">Pin Definitions</a> (Removed CY7C008V, CY7C018V, CY7C019V related information). Updated <a href="#">Architecture</a> (Removed CY7C008V, CY7C018V, CY7C019V related information). Updated <a href="#">Functional Overview</a> (Updated <a href="#">Interrupts</a> (Removed CY7C008V, CY7C018V, CY7C019V related information), updated <a href="#">Busy</a> (Removed CY7C008V, CY7C018V, CY7C019V related information), updated <a href="#">Semaphore Operation</a> (Removed CY7C008V, CY7C018V, CY7C019V related information), updated <a href="#">Table 2</a> (Removed CY7C008V, CY7C018V, CY7C019V related information), removed the Note "A <sub>0L-16L</sub> and A <sub>0R-16R</sub> , 1FFFF/1FFFE for the CY7C009V/19V." and its reference in the same table)). Updated <a href="#">Operating Range</a> (Updated <a href="#">Note 5</a> (Removed CY7C019V related information)). Updated <a href="#">Electrical Characteristics</a> (Removed CY7C008V, CY7C018V, CY7C019V related information, removed the Note "Industrial parts are available in CY7C009V and CY7C019V only." and its reference in Electrical Characteristics). Updated <a href="#">Data Retention Mode</a> (Removed CY7C008V, CY7C018V, CY7C019V related information). Updated <a href="#">Switching Characteristics</a> (Removed CY7C008V, CY7C018V, CY7C019V related information, updated <a href="#">Note 10</a> (Removed UB = L)).

**Document History Page** *(continued)*

Document Title: CY7C009V, 3.3 V 128 K × 8 Dual-Port Static RAM				
Document Number: 38-06044				
Rev.	ECN No.	Issue Date	Orig. of Change	Description of Change
*F (cont.)	3816114	11/19/2012	SMCH	Updated <a href="#">Switching Waveforms</a> (Updated <a href="#">Figure 14</a> (Removed CY7C019V related information)). Updated <a href="#">Package Diagram</a> (spec 51-85048 (Changed revision from *D to *G)).

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