CY7C1481V33
CY7C1483V33
CY7C1487V33

72-Mbit (2M x 36/4M x 18/1M x 72) Flow-Through SRAM

Features

- Supports 133 MHz bus operations
- 2M x 36/4M x 18/1M x 72 common IO
- 3.3V core power supply (V_{DD})
- 2.5V or 3.3V I/O supply (V_{DDQ})
- Fast clock-to-output times
  - 6.5 ns (133 MHz version)
- Provide high-performance 2-1-1-1 access rate
- User selectable burst counter supporting Intel® Pentium® interleaved or linear burst sequences
- Separate processor and controller address strobes
- Synchronous self timed write
- Asynchronous output enable
- CY7C1481V33, CY7C1483V33 available in JEDEC-standard Pb-free 100-pin TQFP, Pb-free and non-Pb-free 165-ball FBGA package. CY7C1487V33 available in Pb-free and non-Pb-free 209 ball FBGA package
- IEEE 1149.1 JTAG-Compatible Boundary Scan
- "ZZ" Sleep Mode option

Functional Description[1]

The CY7C1481V33/CY7C1483V33/CY7C1487V33 is a 3.3V, 2M x 36/4M x 18/1M x 72 Synchronous Flow-through SRAM designed to interface with high speed microprocessors with minimum glue logic. Maximum access delay from clock rise is 6.5 ns (133 MHz version). A two-bit on-chip counter captures the first address in a burst and increments the address automatically for the rest of the burst access. All synchronous inputs are gated by registers controlled by a positive-edge-triggered Clock Input (CLK). The synchronous inputs include all addresses, all data inputs, address-pipelining Chip Enable ($\overline{CE}_1$), depth-expansion Chip Enables (CE_2 and $\overline{CE}_3$), Burst Control inputs (ADSC, ADSP, and ADV), Write Enables (BW_x and $\overline{BWE}$), and Global Write ($\overline{GW}$). Asynchronous inputs include the Output Enable ($\overline{OE}$) and the ZZ pin.

The CY7C1481V33/CY7C1483V33/CY7C1487V33 allows either interleaved or linear burst sequences, selected by the MODE input pin. A HIGH selects an interleaved burst sequence, while a LOW selects a linear burst sequence. Burst accesses can be initiated with the Processor Address Strobe ($\overline{ADSP}$) or the cache Controller Address Strobe ($\overline{ADSC}$) inputs. Address advancement is controlled by the Address Advancement ($\overline{ADV}$) input.

Addresses and chip enables are registered at rising edge of clock when either Address Strobe Processor ($\overline{ADSP}$) or Address Strobe Controller ($\overline{ADSC}$) are active. Subsequent burst addresses can be internally generated as controlled by the Advance pin ($\overline{ADV}$).

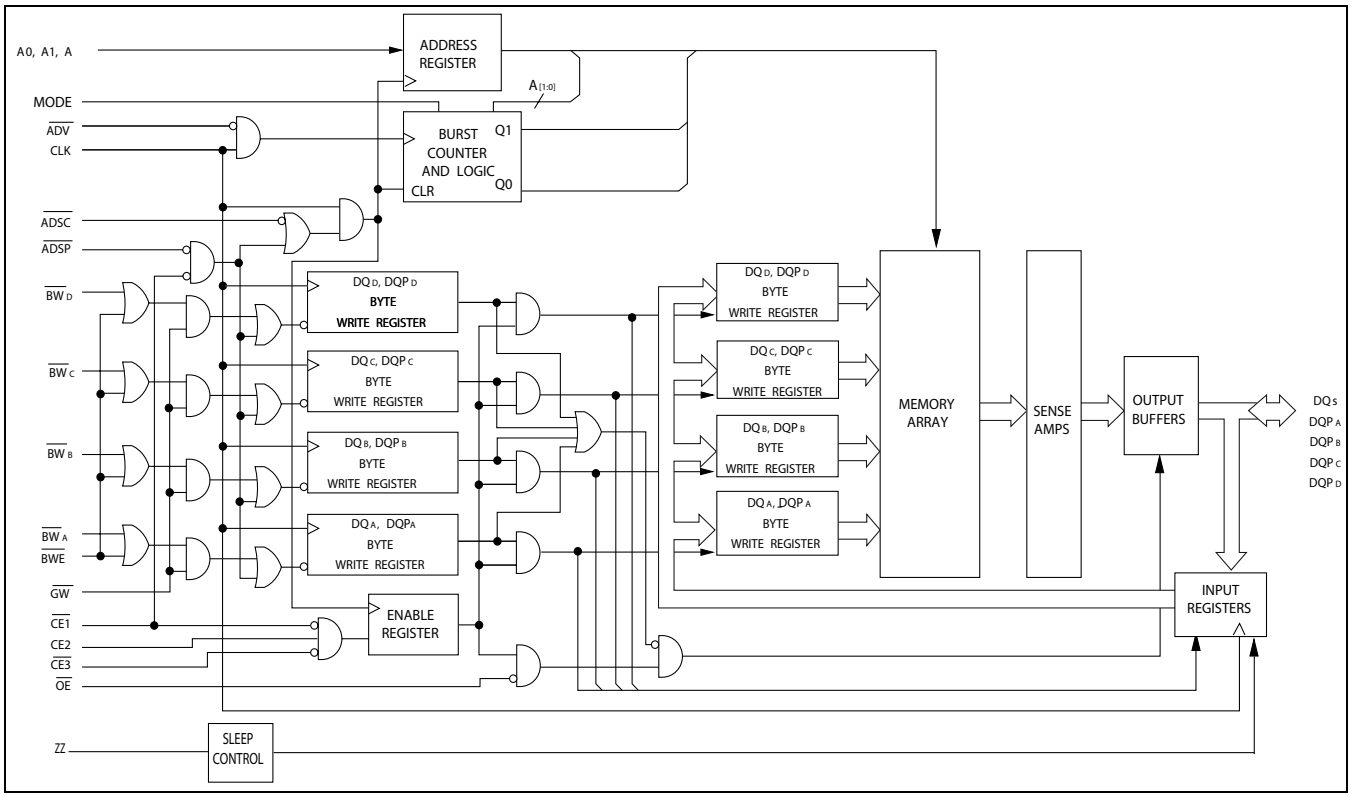
The CY7C1481V33/CY7C1483V33/CY7C1487V33 operates from a +3.3V core power supply while all outputs may operate with either a +2.5 or +3.3V supply. All inputs and outputs are JEDEC standard JESD8-5 compatible.

Selection Guide

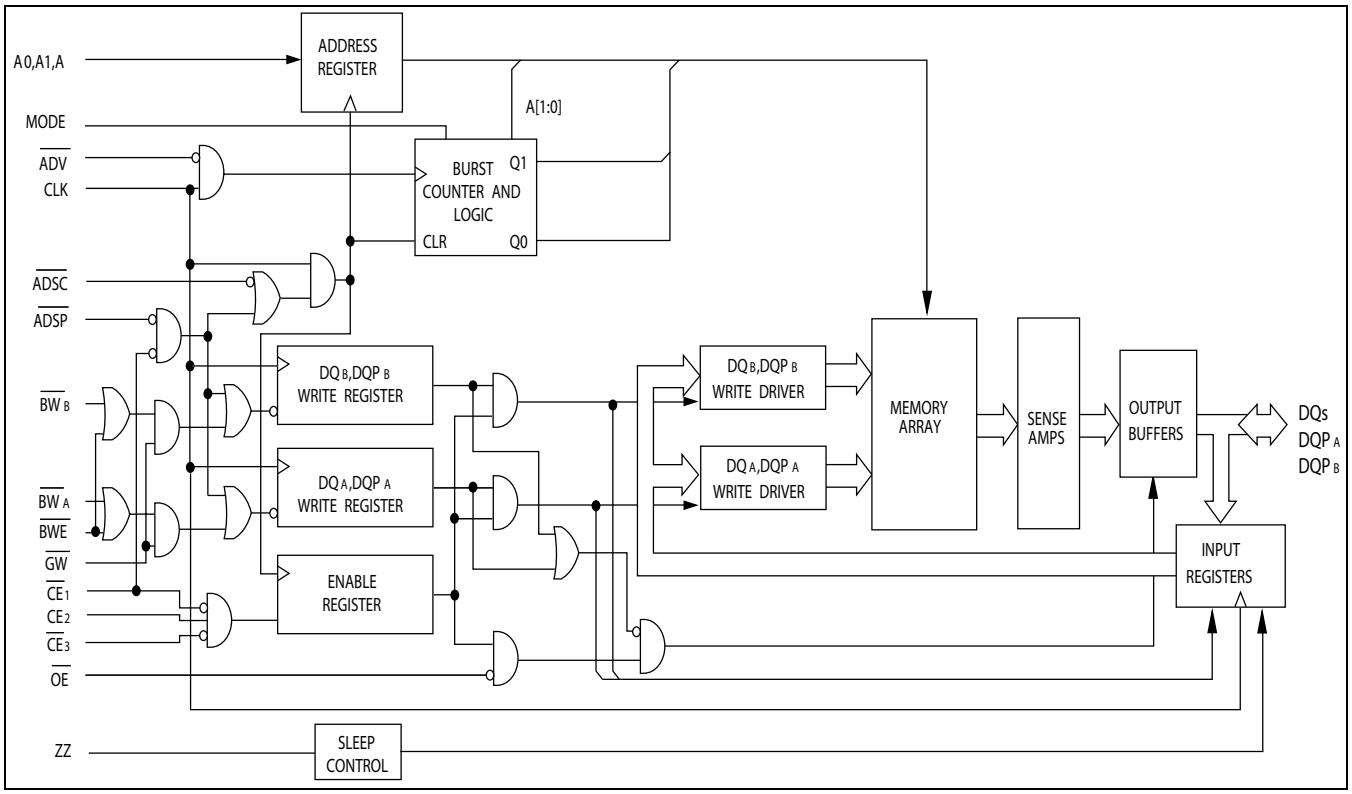
	133 MHz	100 MHz	Unit
Maximum Access Time	6.5	8.5	ns
Maximum Operating Current	335	305	mA
Maximum CMOS Standby Current	150	150	mA

Note
1. For best practices recommendations, refer to the Cypress application note AN1064, SRAM System Guidelines.

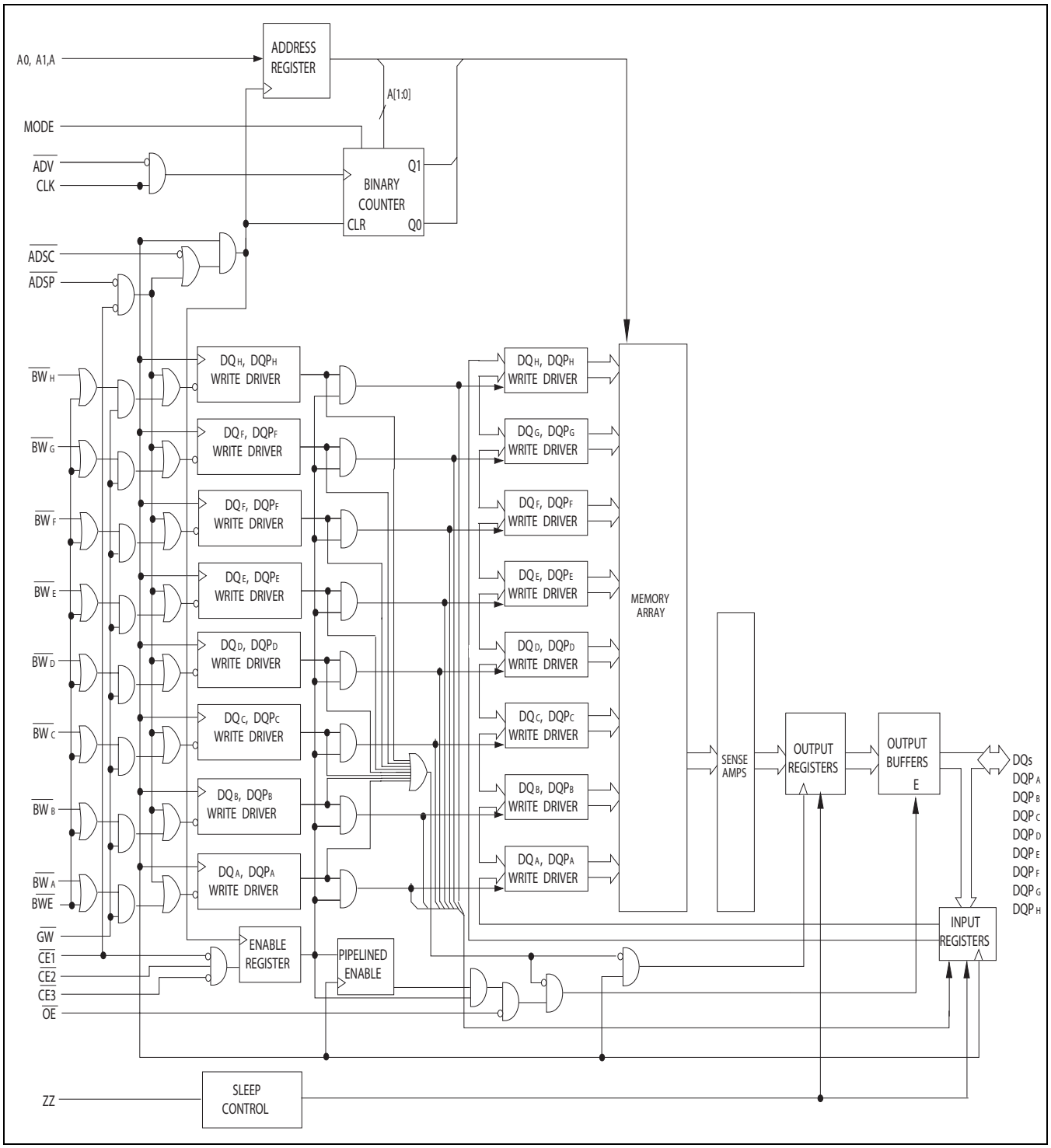
Logic Block Diagram – CY7C1481V33 (2M x 36)



Logic Block Diagram – CY7C1483V33 (4M x 18)

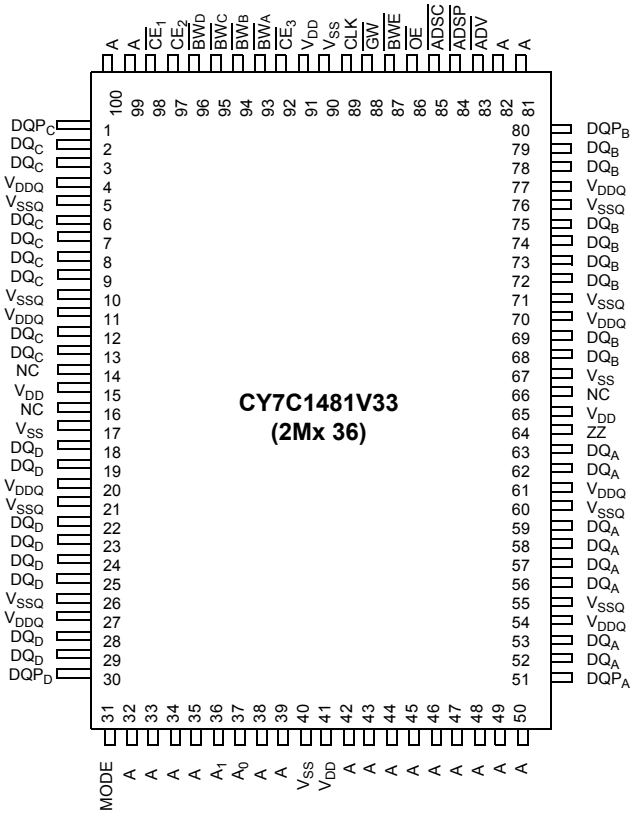


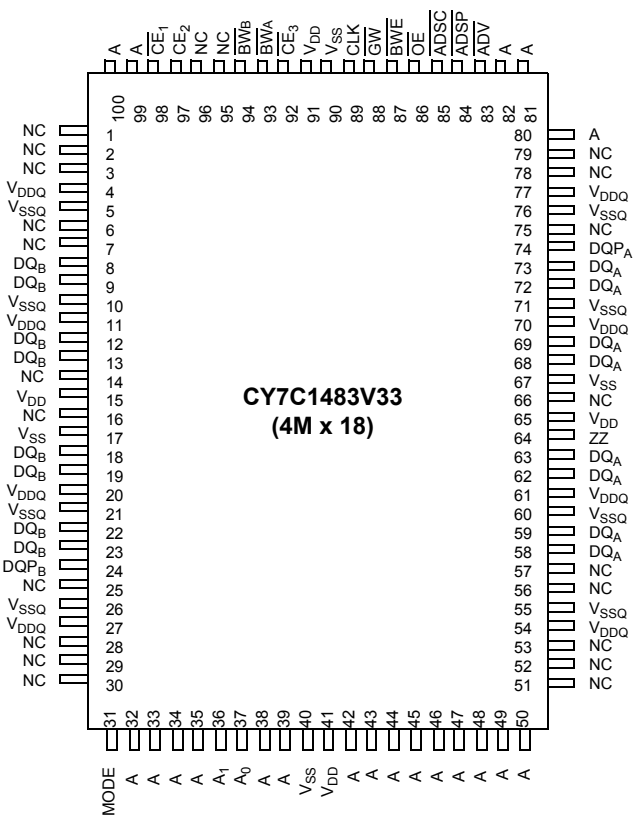
Logic Block Diagram – CY7C1487V33 (1M x 72)



Pin Configurations

100-Pin TQFP Pinout





Pin Configurations (continued)

165-Ball FBGA (15 x 17 x 1.4 mm) Pinout

CY7C1481V33 (2M x 36)

	1	2	3	4	5	6	7	8	9	10	11
A	NC/288M	A	$\overline{CE}_1$	$\overline{BW}_C$	$\overline{BW}_B$	$\overline{CE}_3$	$\overline{BWE}$	$\overline{ADSC}$	$\overline{ADV}$	A	NC
B	NC/144M	A	CE_2	$\overline{BW}_D$	$\overline{BW}_A$	CLK	$\overline{GW}$	$\overline{OE}$	$\overline{ADSP}$	A	NC/576M
C	DQP_C	NC	V_{DDQ}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDQ}	NC/1G	DQP_B
D	DQ_C	DQ_C	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_B	DQ_B
E	DQ_C	DQ_C	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_B	DQ_B
F	DQ_C	DQ_C	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_B	DQ_B
G	DQ_C	DQ_C	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_B	DQ_B
H	NC	NC	NC	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	NC	NC	ZZ
J	DQ_D	DQ_D	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	DQ_A
K	DQ_D	DQ_D	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	DQ_A
L	DQ_D	DQ_D	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	DQ_A
M	DQ_D	DQ_D	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	DQ_A
N	DQP_D	NC	V_{DDQ}	V_{SS}	NC	A	NC	V_{SS}	V_{DDQ}	NC	DQP_A
P	NC	A	A	A	TDI	A1	TDO	A	A	A	A
R	MODE	A	A	A	TMS	A0	TCK	A	A	A	A

CY7C1483V33 (4M x 18)

	1	2	3	4	5	6	7	8	9	10	11
A	NC/288M	A	$\overline{CE}_1$	$\overline{BW}_B$	NC	$\overline{CE}_3$	$\overline{BWE}$	$\overline{ADSC}$	$\overline{ADV}$	A	A
B	NC/144M	A	CE_2	NC	$\overline{BW}_A$	CLK	$\overline{GW}$	$\overline{OE}$	$\overline{ADSP}$	A	NC/576M
C	NC	NC	V_{DDQ}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{SS}	V_{DDQ}	NC/1G	DQP_A
D	NC	DQ_B	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	NC	DQ_A
E	NC	DQ_B	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	NC	DQ_A
F	NC	DQ_B	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	NC	DQ_A
G	NC	DQ_B	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	NC	DQ_A
H	NC	NC	NC	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	NC	NC	ZZ
J	DQ_B	NC	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	NC
K	DQ_B	NC	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	NC
L	DQ_B	NC	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	NC
M	DQ_B	NC	V_{DDQ}	V_{DD}	V_{SS}	V_{SS}	V_{SS}	V_{DD}	V_{DDQ}	DQ_A	NC
N	DQP_B	NC	V_{DDQ}	V_{SS}	NC	A	NC	V_{SS}	V_{DDQ}	NC	NC
P	NC	A	A	A	TDI	A1	TDO	A	A	A	A
R	MODE	A	A	A	TMS	A0	TCK	A	A	A	A

Pin Configurations (continued)

209-Ball FBGA (14 x 22 x 1.76 mm) Pinout

CY7C1487V33 (1M × 72)

	1	2	3	4	5	6	7	8	9	10	11
A	DQ_G	DQ_G	A	CE_2	$\overline{ADSP}$	$\overline{ADSC}$	$\overline{ADV}$	$\overline{CE_3}$	A	DQ_B	DQ_B
B	DQ_G	DQ_G	$\overline{BWS_C}$	$\overline{BWS_G}$	NC/288M	$\overline{BW}$	A	$\overline{BWS_B}$	$\overline{BWS_F}$	DQ_B	DQ_B
C	DQ_G	DQ_G	$\overline{BWS_H}$	$\overline{BWS_D}$	NC/144M	$\overline{CE_1}$	NC/576M	$\overline{BWS_E}$	$\overline{BWS_A}$	DQ_B	DQ_B
D	DQ_G	DQ_G	V_{SS}	NC	NC/1G	$\overline{OE}$	$\overline{GW}$	NC	V_{SS}	DQ_B	DQ_B
E	DQP_G	DQP_C	V_{DDQ}	V_{DDQ}	V_{DD}	V_{DD}	V_{DD}	V_{DDQ}	V_{DDQ}	DQP_F	DQP_B
F	DQ_C	DQ_C	V_{SS}	V_{SS}	V_{SS}	NC	V_{SS}	V_{SS}	V_{SS}	DQ_F	DQ_F
G	DQ_C	DQ_C	V_{DDQ}	V_{DDQ}	V_{DD}	NC	V_{DD}	V_{DDQ}	V_{DDQ}	DQ_F	DQ_F
H	DQ_C	DQ_C	V_{SS}	V_{SS}	V_{SS}	NC	V_{SS}	V_{SS}	V_{SS}	DQ_F	DQ_F
J	DQ_C	DQ_C	V_{DDQ}	V_{DDQ}	V_{DD}	NC	V_{DD}	V_{DDQ}	V_{DDQ}	DQ_F	DQ_F
K	NC	NC	CLK	NC	V_{SS}	V_{SS}	V_{SS}	NC	NC	NC	NC
L	DQ_H	DQ_H	V_{DDQ}	V_{DDQ}	V_{DD}	NC	V_{DD}	V_{DDQ}	V_{DDQ}	DQ_A	DQ_A
M	DQ_H	DQ_H	V_{SS}	V_{SS}	V_{SS}	NC	V_{SS}	V_{SS}	V_{SS}	DQ_A	DQ_A
N	DQ_H	DQ_H	V_{DDQ}	V_{DDQ}	V_{DD}	NC	V_{DD}	V_{DDQ}	V_{DDQ}	DQ_A	DQ_A
P	DQ_H	DQ_H	V_{SS}	V_{SS}	V_{SS}	ZZ	V_{SS}	V_{SS}	V_{SS}	DQ_A	DQ_A
R	DQP_D	DQP_H	V_{DDQ}	V_{DDQ}	V_{DD}	V_{DD}	V_{DD}	V_{DDQ}	V_{DDQ}	DQP_A	DQP_E
T	DQ_D	DQ_D	V_{SS}	NC	NC	MODE	NC	NC	V_{SS}	DQ_E	DQ_E
U	DQ_D	DQ_D	A	A	A	A	A	A	A	DQ_E	DQ_E
V	DQ_D	DQ_D	A	A	A	A1	A	A	A	DQ_E	DQ_E
W	DQ_D	DQ_D	TMS	TDI	A	A0	A	TDO	TCK	DQ_E	DQ_E

Pin Definitions

Pin Name	IO	Description
A_0, A_1, A	Input-Synchronous	**Address Inputs Used to Select One of the Address Locations**. Sampled at the rising edge of the CLK if $\overline{ADSP}$ or $\overline{ADSC}$ is active LOW, and $\overline{CE}_1$, CE_2, and $\overline{CE}_3$ are sampled active. $A_{[1:0]}$ feed the two-bit counter.
$\overline{BW}_A$,$\overline{BW}_B$,$\overline{BW}_C$,$\overline{BW}_D$, $\overline{BW}_E$,$\overline{BW}_F$,$\overline{BW}_G$,$\overline{BW}_H$	Input-Synchronous	**Byte Write Select Inputs, Active LOW**. Qualified with $\overline{BWE}$ to conduct byte writes to the SRAM. Sampled on the rising edge of CLK.
$\overline{GW}$	Input-Synchronous	**Global Write Enable Input, Active LOW**. When asserted LOW on the rising edge of CLK, a global write is conducted (ALL bytes are written, regardless of the values on $\overline{BW}_X$ and $\overline{BWE}$).
CLK	Input-Clock	**Clock Input**. Captures all synchronous inputs to the device. Also used to increment the burst counter when $\overline{ADV}$ is asserted LOW during a burst operation.
$\overline{CE}_1$	Input-Synchronous	**Chip Enable 1 Input, Active LOW**. Sampled on the rising edge of CLK. Used in conjunction with CE_2 and $\overline{CE}_3$ to select or deselect the device. $\overline{ADSP}$ is ignored if $\overline{CE}_1$ is HIGH. $\overline{CE}_1$ is sampled only when a new external address is loaded.
CE_2	Input-Synchronous	**Chip Enable 2 Input, Active HIGH**. Sampled on the rising edge of CLK. Used in conjunction with $\overline{CE}_1$ and $\overline{CE}_3$ to select or deselect the device. CE_2 is sampled only when a new external address is loaded.
$\overline{CE}_3$	Input-Synchronous	**Chip Enable 3 Input, Active LOW**. Sampled on the rising edge of CLK. Used in conjunction with $\overline{CE}_1$ and CE_2 to select or deselect the device. $\overline{CE}_3$ is sampled only when a new external address is loaded.
$\overline{OE}$	Input-Asynchronous	**Output Enable, Asynchronous Input, Active LOW**. Controls the direction of the IO pins. When LOW, the IO pins behave as outputs. When deasserted HIGH, IO pins are tri-stated, and act as input data pins. $\overline{OE}$ is masked during the first clock of a read cycle when emerging from a deselected state.
$\overline{ADV}$	Input-Synchronous	**Advance Input Signal, Sampled on the Rising Edge of CLK**. When asserted, it automatically increments the address in a burst cycle.
$\overline{ADSP}$	Input-Synchronous	**Address Strobe from Processor, Sampled on the Rising Edge of CLK, Active LOW**. When asserted LOW, addresses presented to the device are captured in the address registers. $A_{[1:0]}$ are also loaded into the burst counter. When $\overline{ADSP}$ and $\overline{ADSC}$ are both asserted, only $\overline{ADSP}$ is recognized. $\overline{ASDP}$ is ignored when $\overline{CE}_1$ is deasserted HIGH
$\overline{ADSC}$	Input-Synchronous	**Address Strobe from Controller, Sampled on the Rising Edge of CLK, Active LOW**. When asserted LOW, addresses presented to the device are captured in the address registers. $A_{[1:0]}$ are also loaded into the burst counter. When $\overline{ADSP}$ and $\overline{ADSC}$ are both asserted, only $\overline{ADSP}$ is recognized·
$\overline{BWE}$	Input-Synchronous	**Byte Write Enable Input, active LOW**. Sampled on the rising edge of CLK. This signal must be asserted LOW to conduct a byte write.
ZZ	Input-Asynchronous	**ZZ "Sleep" Input, Active HIGH**. When asserted HIGH, places the device in a non-time-critical "sleep" condition with data integrity preserved. For normal operation, this pin must be LOW or left floating. ZZ pin has an internal pull down.
DQ_s	IO-Synchronous	**Bidirectional Data IO Lines**. As inputs, they feed into an on-chip data register that is triggered by the rising edge of CLK. As outputs, they deliver the data contained in the memory location specified by the addresses presented during the previous clock rise of the read cycle. The direction of the pins is controlled by $\overline{OE}$. When $\overline{OE}$ is asserted LOW, the pins behave as outputs. When HIGH, DQ_s and DQP_X are placed in a tri-state condition.The outputs are automatically tri-stated during the data portion of a write sequence, during the first clock when emerging from a deselected state, and when the device is deselected, regardless of the state of $\overline{OE}$.
DQP_X	IO-Synchronous	**Bidirectional Data Parity I/O Lines.** Functionally, these signals are identical to DQ_s. During write sequences, DQP_x is controlled by $\overline{BW}_X$ correspondingly.
MODE	Input-Static	**Selects Burst Order**. When tied to GND, selects linear burst sequence. When tied to V_{DD} or left floating, selects interleaved burst sequence. This is a strap pin and must remain static during device operation. Mode Pin has an internal pull up.

Pin Definitions (continued)

Pin Name	IO	Description
V_{DD}	Power Supply	**Power supply inputs to the core of the device**.
V_{DDQ}	IO Power Supply	**Power supply for the IO circuitry**.
V_{SS}	Ground	**Ground for the core of the device**.
V_{SSQ}[2]	I/O Ground	**Ground for the IO circuitry**.
TDO	JTAG Serial Output Synchronous	**Serial Data-Out to the JTAG Circuit**. Delivers data on the negative edge of TCK. If the JTAG feature is not used, this pin should be left unconnected. This pin is not available on TQFP packages.
TDI	JTAG Serial Input Synchronous	**Serial Data-In to the JTAG Circuit**. Sampled on the rising edge of TCK. If the JTAG feature is not used, this pin can be left floating or connected to V_{DD} through a pull up resistor. This pin is not available on TQFP packages.
TMS	JTAG Serial Input Synchronous	**Serial Data-In to the JTAG Circuit**. Sampled on the rising edge of TCK. If the JTAG feature is not used, this pin can be disconnected or connected to V_{DD}. This pin is not available on TQFP packages.
TCK	JTAG Clock	**Clock Input to the JTAG Circuit**. If the JTAG feature is not used, this pin must be connected to V_{SS}. This pin is not available on TQFP packages.
NC	-	**No Connects**. Not internally connected to the die. 144M, 288M, 576M, and 1G are address expansion pins and are not internally connected to the die.

Functional Overview

All synchronous inputs pass through input registers controlled by the rising edge of the clock. Maximum access delay from the clock rise (t_{CDV}) is 6.5 ns (133-MHz device).

The CY7C1481V33/CY7C1483V33/CY7C1487V33 supports secondary cache in systems using either a linear or interleaved burst sequence. The interleaved burst order supports Pentium and i486™ processors. The linear burst sequence is suited for processors that use a linear burst sequence. The burst order is user selectable, and is determined by sampling the MODE input. Accesses can be initiated with either the Processor Address Strobe ($\overline{ADSP}$) or the Controller Address Strobe ($\overline{ADSC}$). Address advancement through the burst sequence is controlled by the $\overline{ADV}$ input. A two-bit on-chip wraparound burst counter captures the first address in a burst sequence and automatically increments the address for the rest of the burst access.

Byte write operations are qualified with the Byte Write Enable ($\overline{BWE}$) and Byte Write Select ($\overline{BWX}$) inputs. A Global Write Enable ($\overline{GW}$) overrides all byte write inputs and writes data to all four bytes. All writes are simplified with on-chip synchronous self timed write circuitry.

Three synchronous Chip Selects ($\overline{CE_1}$, CE_2, $\overline{CE_3}$) and an asynchronous Output Enable ($\overline{OE}$) provide easy bank selection and output tri-state control. ADSP is ignored if $\overline{CE_1}$ is HIGH.

Single Read Accesses

A single read access is initiated when the following conditions are satisfied at clock rise: (1) $\overline{CE_1}$, CE_2, and $\overline{CE_3}$ are all asserted active, and (2) $\overline{ADSP}$ or $\overline{ADSC}$ is asserted LOW (if the access is initiated by $\overline{ADSC}$, the write inputs must be deasserted during this first cycle). The address presented to the address inputs is latched into the address register and the burst counter/control logic and presented to the memory core. If the $\overline{OE}$ input is asserted LOW, the requested data is available at the data outputs a maximum to t_{CDV} after clock rise. $\overline{ADSP}$ is ignored if $\overline{CE_1}$ is HIGH.

Single Write Accesses Initiated by $\overline{ADSP}$

This access is initiated when the following conditions are satisfied at clock rise: (1) $\overline{CE_1}$, CE_2, $\overline{CE_3}$ are all asserted active, and (2) $\overline{ADSP}$ is asserted LOW. The addresses presented are loaded into the address register and the burst inputs ($\overline{GW}$, $\overline{BWE}$, and $\overline{BW_X}$) are ignored during this first clock cycle. If the write inputs are asserted active (see "Truth Table for Read/Write" on page 11 for appropriate states that indicate a write) on the next clock rise, the appropriate data is latched and written into the device. Byte writes are supported. All IOs are tri-stated during a byte write. Because this is a common IO device, the asynchronous $\overline{OE}$ input signal must be deasserted and the I/Os must be tri-stated before the presentation of data to DQ_s. As a safety precaution, the data lines are tri-stated after a write cycle is detected, regardless of the state of $\overline{OE}$.

Single Write Accesses Initiated by $\overline{ADSC}$

This write access is initiated when the following conditions are satisfied at clock rise: (1) $\overline{CE_1}$, CE_2, and $\overline{CE_3}$ are all asserted active, (2) $\overline{ADSC}$ is asserted LOW, (3) $\overline{ADSP}$ is deasserted HIGH, and (4) the write input signals ($\overline{GW}$, $\overline{BWE}$, and $\overline{BWX}$) indicate a write access. $\overline{ADSC}$ is ignored if $\overline{ADSP}$ is active LOW.

The addresses presented are loaded into the address register and the burst counter/control logic and delivered to the memory core. The information presented to DQ_s will be written into the specified address location. Byte writes are supported.

Note
2. Applicable for TQFP package. For BGA package V_{SS} serves as ground for the core and the IO circuitry.

All IOs are tri-stated when a write is detected, even a byte write. Because this is a common IO device, the asynchronous OE input signal must be deasserted and the IOs must be tri-stated before the presentation of data to DQ_s. As a safety precaution, the data lines are tri-stated once a write cycle is detected, regardless of the state of OE.

Burst Sequences

The CY7C1481V33/CY7C1483V33/CY7C1487V33 provides an on-chip two-bit wraparound burst counter inside the SRAM. The burst counter is fed by A[1:0], and can follow either a linear or interleaved burst order. The burst order is determined by the state of the MODE input. A LOW on MODE selects a linear burst sequence. A HIGH on MODE selects an interleaved burst order. Leaving MODE unconnected causes the device to default to a interleaved burst sequence.

Sleep Mode

The ZZ input pin is asynchronous. Asserting ZZ places the SRAM in a power conservation “sleep” mode. Two clock cycles are required to enter into or exit from this “sleep” mode. While in this mode, data integrity is guaranteed.

Accesses pending when entering the “sleep” mode are not considered valid nor is the completion of the operation guaranteed.

The device must be deselected before entering the “sleep” mode. CE_1, CE_2, CE_3, ADSP, and ADSC must remain inactive for the duration of t_{ZZREC} after the ZZ input returns LOW.

Interleaved Burst Address Table (MODE = Floating or V_{DD})

First Address A1: A0	Second Address A1: A0	Third Address A1: A0	Fourth Address A1: A0
00	01	10	11
01	00	11	10
10	11	00	01
11	10	01	00

Linear Burst Address Table (MODE = GND)

First Address A1: A0	Second Address A1: A0	Third Address A1: A0	Fourth Address A1: A0
00	01	10	11
01	10	11	00
10	11	00	01
11	00	01	10

ZZ Mode Electrical Characteristics

Parameter	Description	Test Conditions	Min	Max	Unit
I_{DDZZ}	Sleep mode standby current	$ZZ \geq V_{DD} - 0.2V$		150	mA
t_{ZZS}	Device operation to ZZ	$ZZ \geq V_{DD} - 0.2V$		$2t_{CYC}$	ns
t_{ZZREC}	ZZ recovery time	$ZZ \leq 0.2V$	$2t_{CYC}$		ns
t_{ZZI}	ZZ active to sleep current	This parameter is sampled		$2t_{CYC}$	ns
t_{RZZI}	ZZ Inactive to exit sleep current	This parameter is sampled	0		ns

Truth Table

The truth table for CY7C1481V33, CY7C1483V33, and CY7C1487V33 follows.[3, 4, 5, 6, 7]

Cycle Description	ADDRESS Used	$\overline{CE_1}$	CE_2	$\overline{CE_3}$	ZZ	$\overline{ADSP}$	$\overline{ADSC}$	$\overline{ADV}$	$\overline{WRITE}$	$\overline{OE}$	CLK	DQ
Deselected Cycle, Power Down	None	H	X	X	L	X	L	X	X	X	L-H	Tri-State
Deselected Cycle, Power Down	None	L	L	X	L	L	X	X	X	X	L-H	Tri-State
Deselected Cycle, Power Down	None	L	X	H	L	L	X	X	X	X	L-H	Tri-State
Deselected Cycle, Power Down	None	L	L	X	L	H	L	X	X	X	L-H	Tri-State
Deselected Cycle, Power Down	None	X	X	X	L	H	L	X	X	X	L-H	Tri-State
Sleep Mode, Power Down	None	X	X	X	H	X	X	X	X	X	X	Tri-State
Read Cycle, Begin Burst	External	L	H	L	L	L	X	X	X	L	L-H	Q
Read Cycle, Begin Burst	External	L	H	L	L	L	X	X	X	H	L-H	Tri-State
Write Cycle, Begin Burst	External	L	H	L	L	H	L	X	L	X	L-H	D
Read Cycle, Begin Burst	External	L	H	L	L	H	L	X	H	L	L-H	Q
Read Cycle, Begin Burst	External	L	H	L	L	H	L	X	H	H	L-H	Tri-State
Read Cycle, Continue Burst	Next	X	X	X	L	H	H	L	H	L	L-H	Q
Read Cycle, Continue Burst	Next	X	X	X	L	H	H	L	H	H	L-H	Tri-State
Read Cycle, Continue Burst	Next	H	X	X	L	X	H	L	H	L	L-H	Q
Read Cycle, Continue Burst	Next	H	X	X	L	X	H	L	H	H	L-H	Tri-State
Write Cycle, Continue Burst	Next	X	X	X	L	H	H	L	L	X	L-H	D
Write Cycle, Continue Burst	Next	H	X	X	L	X	H	L	L	X	L-H	D
Read Cycle, Suspend Burst	Current	X	X	X	L	H	H	H	H	L	L-H	Q
Read Cycle, Suspend Burst	Current	X	X	X	L	H	H	H	H	H	L-H	Tri-State
Read Cycle, Suspend Burst	Current	H	X	X	L	X	H	H	H	L	L-H	Q
Read Cycle, Suspend Burst	Current	H	X	X	L	X	H	H	H	H	L-H	Tri-State
Write Cycle, Suspend Burst	Current	X	X	X	L	H	H	H	L	X	L-H	D
Write Cycle, Suspend Burst	Current	H	X	X	L	X	H	H	L	X	L-H	D

Notes

3. X = Do Not Care, H = Logic HIGH, L = Logic LOW.
4. $\overline{WRITE}$ = L when any one or more Byte Write Enable signals and $\overline{BWE}$ = L or $\overline{GW}$ = L. $\overline{WRITE}$ = H when all Byte Write Enable signals, $\overline{BWE}$, $\overline{GW}$ = H.
5. The DQ pins are controlled by the current cycle and the $\overline{OE}$ signal. $\overline{OE}$ is asynchronous and is not sampled with the clock.
6. The SRAM always initiates a read cycle when $\overline{ADSP}$ is asserted, regardless of the state of $\overline{GW}$, $\overline{BWE}$, or $\overline{BW_X}$. Writes may occur only on subsequent clocks after the $\overline{ADSP}$ or with the assertion of $\overline{ADSC}$. As a result, $\overline{OE}$ must be driven HIGH prior to the start of the write cycle to enable the outputs to tri-state. $\overline{OE}$ is a do not care for the remainder of the write cycle.
7. $\overline{OE}$ is asynchronous and is not sampled with the clock rise. It is masked internally during write cycles. During a read cycle all data bits are tri-state when $\overline{OE}$ is inactive or when the device is deselected, and all data bits behave as outputs when $\overline{OE}$ is active (LOW).

Truth Table for Read/Write

The read-write truth table for CY7C1481V33 follows.[3, 8]

Function	$\overline{GW}$	$\overline{BWE}$	$\overline{BW_D}$	$\overline{BW_C}$	$\overline{BW_B}$	$\overline{BW_A}$
Read	H	H	X	X	X	X
Read	H	L	H	H	H	H
Write Byte A (DQ_A, DQP_A)	H	L	H	H	H	L
Write Byte B(DQ_B, DQP_B)	H	L	H	H	L	H
Write Bytes A, B (DQ_A, DQ_B, DQP_A, DQP_B)	H	L	H	H	L	L
Write Byte C (DQ_C, DQP_C)	H	L	H	L	H	H
Write Bytes C, A (DQ_C, DQ_A, DQP_C, DQP_A)	H	L	H	L	H	L
Write Bytes C, B (DQ_C, DQ_B, DQP_C, DQP_B)	H	L	H	L	L	H
Write Bytes C, B, A (DQ_C, DQ_B, DQ_A, DQP_C, DQP_B, DQP_A)	H	L	H	L	L	L
Write Byte D (DQ_D, DQP_D)	H	L	L	H	H	H
Write Bytes D, A (DQ_D, DQ_A, DQP_D, DQP_A)	H	L	L	H	H	L
Write Bytes D, B (DQ_D, DQ_A, DQP_D, DQP_A)	H	L	L	H	L	H
Write Bytes D, B, A (DQ_D, DQ_B, DQ_A, DQP_D, DQP_B, DQP_A)	H	L	L	H	L	L
Write Bytes D, B (DQ_D, DQ_B, DQP_D, DQP_B)	H	L	L	L	H	H
Write Bytes D, B, A (DQ_D, DQ_C, DQ_A, DQP_D, DQP_C, DQP_A)	H	L	L	L	H	L
Write Bytes D, C, A (DQ_D, DQ_B, DQ_A, DQP_D, DQP_B, DQP_A)	H	L	L	L	L	H
Write All Bytes	H	L	L	L	L	L
Write All Bytes	L	X	X	X	X	X

Truth Table for Read/Write

The read-write truth table for CY7C1483V33 follows.[3, 8]

Function	$\overline{GW}$	$\overline{BWE}$	$\overline{BW_B}$	$\overline{BW_A}$
Read	H	H	X	X
Read	H	L	H	H
Write Byte A - (DQ_A and DQP_A)	H	L	H	L
Write Byte B - (DQ_B and DQP_B)	H	L	L	H
Write All Bytes	H	L	L	L
Write All Bytes	L	X	X	X

Truth Table for Read/Write

The read-write truth table for CY7C1487V33 follows.[3, 8]

Function	$\overline{GW}$	$\overline{BWE}$	$\overline{BW_x}$[9]
Read	H	H	X
Read	H	L	All $\overline{BW}$ = H
Write Byte x – (DQ_x and DQP_x)	H	L	L
Write All Bytes	H	L	All $\overline{BW}$ = L
Write All Bytes	L	X	X

Notes

8. Table only lists a partial listing of the byte write combinations. Any combination of $\overline{BW_X}$ is valid. An appropriate write is performed based on which byte write is active.
9. $\overline{BW}$x represents any byte write signal $\overline{BW_X}$.To enable any byte write $\overline{BW_x}$, a Logic LOW signal must be applied at clock rise. Any number of byte writes can be enabled at the same time for any given write.

IEEE 1149.1 Serial Boundary Scan (JTAG)

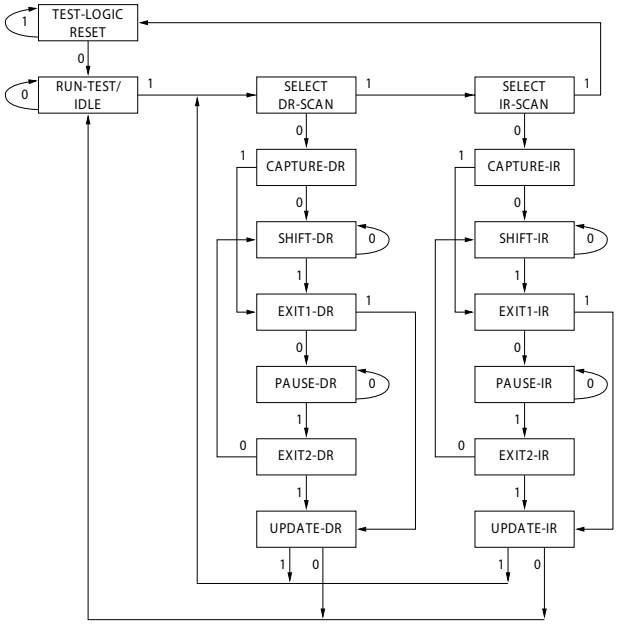
The CY7C1481V33/CY7C1483V33/CY7C1487V33 incorporates a serial boundary scan test access port (TAP). This port operates in accordance with IEEE Standard 1149.1-1990 but does not have the set of functions required for full 1149.1 compliance. These functions from the IEEE specification are excluded because their inclusion places an added delay in the critical speed path of the SRAM. Note that the TAP controller functions in a manner that does not conflict with the operation of other devices using 1149.1 fully compliant TAPs. The TAP operates using JEDEC standard 3.3V or 2.5V IO logic levels.

The CY7C1481V33/CY7C1483V33/CY7C1487V33 contains a TAP controller, instruction register, boundary scan register, bypass register, and ID register.

Disabling the JTAG Feature

It is possible to operate the SRAM without using the JTAG feature. To disable the TAP controller, tie TCK LOW (V_{SS}) to prevent device clocking. TDI and TMS are internally pulled up and may be unconnected. They may alternatively be connected to V_{DD} through a pull up resistor. TDO must be left unconnected. At power up, the device comes up in a reset state, which does not interfere with the operation of the device.

TAP Controller State Diagram



The 0/1 next to each state represents the value of TMS at the rising edge of TCK.

Test Access Port (TAP)

Test Clock (TCK)

The test clock is used only with the TAP controller. All inputs are captured on the rising edge of TCK. All outputs are driven from the falling edge of TCK.

Test Mode Select (TMS)

The TMS input is used to give commands to the TAP controller and is sampled on the rising edge of TCK. You can leave this ball unconnected if the TAP is not used. The ball is pulled up internally, resulting in a logic HIGH level.

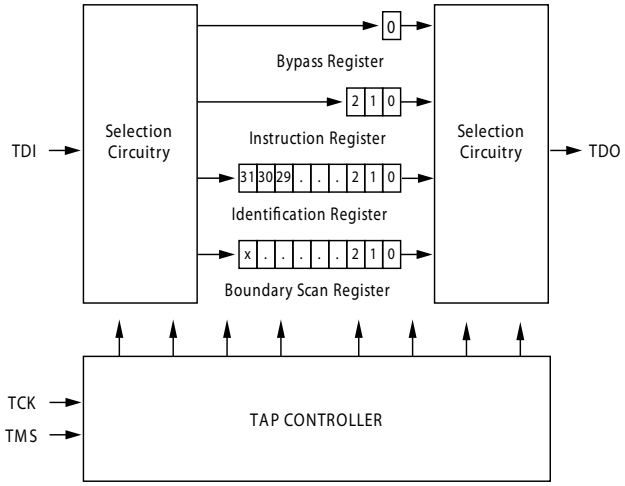
Test Data-In (TDI)

The TDI ball is used to serially input information into the registers and can be connected to the input of any of the registers. The register between TDI and TDO is chosen by the instruction that is loaded into the TAP instruction register. For information about loading the instruction register, see the TAP Controller State Diagram. TDI is internally pulled up and can be unconnected if the TAP is unused in an application. TDI is connected to the most significant bit (MSB) of any register. (See TAP Controller Block Diagram.)

Test Data-Out (TDO)

The TDO output ball serially clocks data-out from the registers. Whether the output is active depends on the current state of the TAP state machine. The output changes on the falling edge of TCK. TDO is connected to the least significant bit (LSB) of any register. (See TAP Controller State Diagram.)

TAP Controller Block Diagram



Performing a TAP Reset

To perform a RESET, force TMS HIGH (V_{DD}) for five rising edges of TCK. This RESET does not affect the operation of the SRAM and may be performed while the SRAM is operating.

At power up, the TAP is reset internally to ensure that TDO comes up in a High-Z state.

TAP Registers

Registers are connected between the TDI and TDO balls and allow data to be scanned into and out of the SRAM test circuitry. Only one register can be selected at a time through the instruction register. Data is serially loaded into the TDI ball on the rising edge of TCK. Data is output on the TDO ball on the falling edge of TCK.

Instruction Register

Three-bit instructions can be serially loaded into the instruction register. This register is loaded when it is placed between the TDI and TDO balls, as shown in the "TAP Controller Block Diagram" on page 12. At power up, the instruction register is loaded with the IDCODE instruction. It is also loaded with the

IDCODE instruction if the controller is placed in a reset state, as described in the previous section.

When the TAP controller is in the Capture-IR state, the two least significant bits are loaded with a binary “01” pattern to enable fault isolation of the board level serial test data path.

Bypass Register

To save time when serially shifting data through registers, it is sometimes advantageous to skip certain chips. The bypass register is a single-bit register that can be placed between the TDI and TDO balls. This allows data to be shifted through the SRAM with minimal delay. The bypass register is set LOW (V_{SS}) when the BYPASS instruction is executed.

Boundary Scan Register

The boundary scan register is connected to all the input and bidirectional balls on the SRAM. The x36 configuration has a 73-bit-long register, and the x18 configuration has a 54-bit-long register.

The boundary scan register is loaded with the contents of the RAM I/ ring when the TAP controller is in the Capture-DR state and is then placed between the TDI and TDO balls when the controller is moved to the Shift-DR state. The EXTEST, SAMPLE/PRELOAD and SAMPLE Z instructions can be used to capture the contents of the IO ring.

The Boundary Scan Order tables show the order in which the bits are connected. Each bit corresponds to one of the bumps on the SRAM package. The MSB of the register is connected to TDI and the LSB is connected to TDO.

Identification (ID) Register

The ID register is loaded with a vendor-specific, 32-bit code during the Capture-DR state when the IDCODE command is loaded in the instruction register. The IDCODE is hardwired into the SRAM and can be shifted out when the TAP controller is in the Shift-DR state. The ID register has a vendor code and other information described in “Identification Register Definitions” on page 15.

TAP Instruction Set

Overview

Eight different instructions are possible with the three-bit instruction register. All combinations are listed in “Identification Codes” on page 16. Three of these instructions are listed as RESERVED and must not be used. The other five instructions are described in detail below.

The TAP controller used in this SRAM is not fully compliant to the 1149.1 convention because some of the mandatory 1149.1 instructions are not fully implemented.

The TAP controller cannot be used to load address data or control signals into the SRAM and cannot preload the IO buffers. The SRAM does not implement the 1149.1 commands EXTEST or INTEST or the PRELOAD portion of SAMPLE/PRELOAD; rather, it performs a capture of the IO ring when these instructions are executed.

Instructions are loaded into the TAP controller during the Shift-IR state, when the instruction register is placed between TDI and TDO. During this state, instructions are shifted through the instruction register through the TDI and TDO balls. To execute the instruction once it is shifted in, the TAP controller must be moved into the Update-IR state.

EXTEST

EXTEST is a mandatory 1149.1 instruction, which is to be executed whenever the instruction register is loaded with all zeros. EXTEST is not implemented in this SRAM TAP controller, and therefore this device is not compliant to 1149.1. The TAP controller does recognize an all-zero instruction.

When an EXTEST instruction is loaded into the instruction register, the SRAM responds as if a SAMPLE/PRELOAD instruction is loaded. There is one difference between the two instructions. Unlike the SAMPLE/PRELOAD instruction, EXTEST places the SRAM outputs in a High-Z state.

IDCODE

The IDCODE instruction causes a vendor-specific, 32-bit code to be loaded into the instruction register. It also places the instruction register between the TDI and TDO balls and enables the IDCODE to be shifted out of the device when the TAP controller enters the Shift-DR state.

The IDCODE instruction is loaded into the instruction register at power up or whenever the TAP controller is in a test logic reset state.

SAMPLE Z

The SAMPLE Z instruction causes the boundary scan register to be connected between the TDI and TDO balls when the TAP controller is in a Shift-DR state. It also places all SRAM outputs into a High-Z state.

SAMPLE/PRELOAD

SAMPLE/PRELOAD is a 1149.1 mandatory instruction. The PRELOAD portion of this instruction is not implemented, so the device TAP controller is not fully 1149.1 compliant.

When the SAMPLE/PRELOAD instruction is loaded into the instruction register and the TAP controller is in the Capture-DR state, a snapshot of data on the inputs and bidirectional balls is captured in the boundary scan register.

Be aware that the TAP controller clock can only operate at a frequency up to 10 MHz, while the SRAM clock operates more than an order of magnitude faster. Because there is a large difference in the clock frequencies, it is possible that during the Capture-DR state, an input or output may undergo a transition. The TAP may then try to capture a signal while in transition (metastable state). This does not harm the device, but there is no guarantee as to the value that may be captured. Repeatable results may not be possible.

To guarantee that the boundary scan register captures the correct value of a signal, the SRAM signal must be stabilized long enough to meet the TAP controller’s capture setup plus hold time (t_{CS} plus t_{CH}).

The SRAM clock input might not be captured correctly if there is no way in a design to stop (or slow) the clock during a SAMPLE/PRELOAD instruction. If this is an issue, it is still possible to capture all other signals and simply ignore the value of the CLK captured in the boundary scan register.

After the data is captured, it is possible to shift out the data by putting the TAP into the Shift-DR state. This places the boundary scan register between the TDI and TDO balls.

Note that because the PRELOAD part of the command is not implemented, putting the TAP to the Update-DR state while performing a SAMPLE/PRELOAD instruction has the same effect as the Pause-DR command.

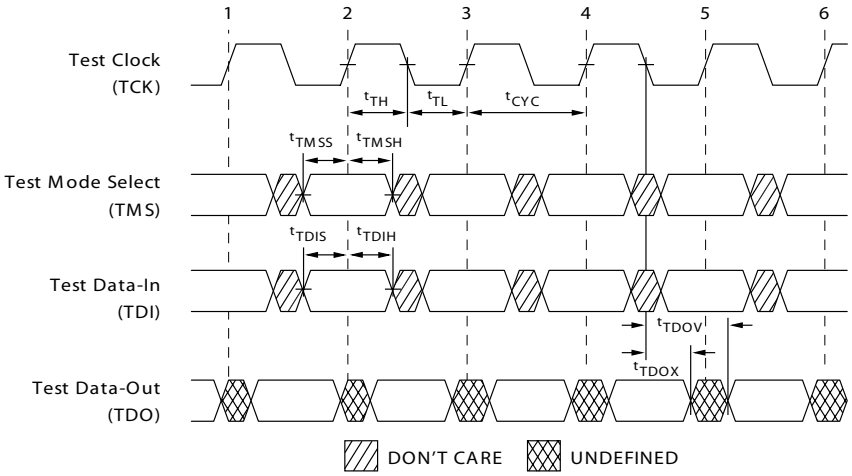
BYPASS

When the BYPASS instruction is loaded in the instruction register and the TAP is placed in a Shift-DR state, the bypass register is placed between the TDI and TDO balls. The advantage of the BYPASS instruction is that it shortens the boundary scan path when multiple devices are connected together on a board.

Reserved

These instructions are not implemented but are reserved for future use. Do not use these instructions.

TAP Timing



TAP AC Switching Characteristics

Over the Operating Range[10,11]

Parameter	Description	Min	Max	Unit
Clock				
t_{TCYC}	TCK Clock Cycle Time	50		ns
t_{TF}	TCK Clock Frequency		20	MHz
t_{TH}	TCK Clock HIGH time	20		ns
t_{TL}	TCK Clock LOW time	20		ns
Output Times				
t_{TDOV}	TCK Clock LOW to TDO Valid		10	ns
t_{TDOX}	TCK Clock LOW to TDO Invalid	0		ns
Set-up Times				
t_{TMSS}	TMS Set-up to TCK Clock Rise	5		ns
t_{TDIS}	TDI Set-up to TCK Clock Rise	5		ns
t_{CS}	Capture Set-up to TCK Rise	5		
Hold Times				
t_{TMSH}	TMS hold after TCK Clock Rise	5		ns
t_{TDIH}	TDI Hold after Clock Rise	5		ns
t_{CH}	Capture Hold after Clock Rise	5		ns

Notes
10. t_{CS} and t_{CH} refer to the setup and hold time requirements of latching data from the boundary scan register.
11. Test conditions are specified using the load in TAP AC test Conditions. t_R/t_F = 1 n.s.

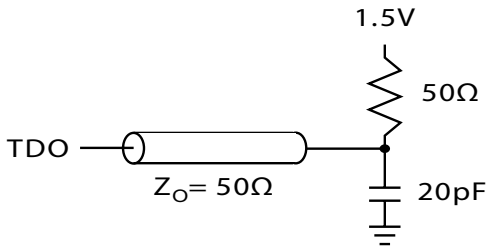
3.3V TAP AC Test Conditions

Input pulse levels ..... V_{SS} to 3.3V
Input rise and fall times ..... 1 ns
Input timing reference levels 1.5V
Output reference levels 1.5V
Test load termination supply voltage 1.5V

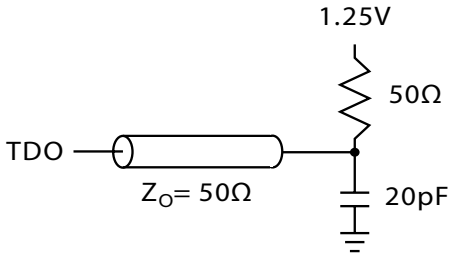
2.5V TAP AC Test Conditions

Input pulse levels ..... V_{SS} to 2.5V
Input rise and fall time ..... 1 ns
Input timing reference levels 1.25V
Output reference levels 1.25V
Test load termination supply voltage 1.25V

3.3V TAP AC Output Load Equivalent



2.5V TAP AC Output Load Equivalent



TAP DC Electrical Characteristics And Operating Conditions

(0°C < T_A < +70°C; V_{DD} = 3.135V to 3.6V unless otherwise noted)[12]

Parameter	Description		Conditions	Min	Max	Unit
V_{OH1}	Output HIGH Voltage	I_{OH} = –4.0 mA	V_{DDQ} = 3.3V	2.4		V
		I_{OH} = –1.0 mA	V_{DDQ} = 2.5V	2.0		V
V_{OH2}	Output HIGH Voltage	I_{OH} = –100 µA	V_{DDQ} = 3.3V	2.9		V
			V_{DDQ} = 2.5V	2.1		V
V_{OL1}	Output LOW Voltage	I_{OL} = 8.0 mA	V_{DDQ} = 3.3V		0.4	V
		I_{OL} = 1.0 mA	V_{DDQ} = 2.5V		0.4	V
V_{OL2}	Output LOW Voltage	I_{OL} = 100 µA	V_{DDQ} = 3.3V		0.2	V
			V_{DDQ} = 2.5V		0.2	V
V_{IH}	Input HIGH Voltage		V_{DDQ} = 3.3V	2.0	V_{DD} + 0.3	V
			V_{DDQ} = 2.5V	1.7	V_{DD} + 0.3	V
V_{IL}	Input LOW Voltage		V_{DDQ} = 3.3V	–0.3	0.8	V
			V_{DDQ} = 2.5V	–0.3	0.7	V
I_X	Input Load Current	GND ≤ V_{IN} ≤ V_{DDQ}		–5	5	µA

Identification Register Definitions

Bit# 24 is “1” in the ID Register definitions for both 2.5V and 3.3V versions of the device.

Instruction Field	CY7C1481V33 (2M x 36)	CY7C1483V33 (4M x18)	CY7C1487V33 (1M x72)	Description
Revision Number (31:29)	000	000	000	Describes the version number
Device Depth (28:24)	01011	01011	01011	Reserved for internal use
Architecture/Memory Type(23:18)	000001	000001	000001	Defines memory type and architecture
Bus Width/Density (17:12)	100100	010100	110100	Defines width and density
Cypress JEDEC ID Code (11:1)	00000110100	00000110100	00000110100	Enables unique identification of SRAM vendor
ID Register Presence Indicator (0)	1	1	1	Indicates the presence of an ID register

Note
12. All voltages refer to V_{SS} (GND).

Scan Register Sizes

Register Name	Bit Size (X36)	Bit Size (X18)	Bit Size (X72)
Instruction	3	3	3
Bypass	1	1	1
ID	32	32	32
Boundary Scan Order -165FBGA	73	54	-
Boundary Scan Order -209 BGA	-	-	112

Identification Codes

Instruction	Code	Description
EXTEST	000	Captures IO ring contents.
IDCODE	001	Loads the ID register with the vendor ID code and places the register between TDI and TDO. This operation does not affect SRAM operations.
SAMPLE Z	010	Captures IO ring contents. Places the boundary scan register between TDI and TDO. Forces all SRAM output drivers to a High-Z state.
RESERVED	011	Do Not Use: This instruction is reserved for future use.
SAMPLE/PRELOAD	100	Captures IO ring contents. Places the boundary scan register between TDI and TDO. Does not affect SRAM operation.
RESERVED	101	Do Not Use: This instruction is reserved for future use.
RESERVED	110	Do Not Use: This instruction is reserved for future use.
BYPASS	111	Places the bypass register between TDI and TDO. This operation does not affect SRAM operations.

Boundary Scan Exit Order (2M x 36)

Bit #	165-Ball ID	Bit #	165-Ball ID	Bit #	165-Ball ID	Bit #	165-Ball ID
1	C1	21	R3	41	L10	61	B8
2	D1	22	P2	42	K11	62	A7
3	E1	23	R4	43	J11	63	B7
4	D2	24	P6	44	K10	64	B6
5	E2	25	R6	45	J10	65	A6
6	F1	26	N6	46	H11	66	B5
7	G1	27	P11	47	G11	67	A5
8	F2	28	R8	48	F11	68	A4
9	G2	29	P3	49	E11	69	B4
10	J1	30	P4	50	D10	70	B3
11	K1	31	P8	51	D11	71	A3
12	L1	32	P9	52	C11	72	A2
13	J2	33	P10	53	G10	73	B2
14	M1	34	R9	54	F10		
15	N1	35	R10	55	E10		
16	K2	36	R11	56	A10		
17	L2	37	N11	57	B10		
18	M2	38	M11	58	A9		
19	R1	39	L11	59	B9		
20	R2	40	M10	60	A8		

Boundary Scan Exit Order (4M x 18)

Bit #	165-Ball ID
1	D2
2	E2
3	F2
4	G2
5	J1
6	K1
7	L1
8	M1
9	N1
10	R1
11	R2
12	R3
13	P2
14	R4
15	P6
16	R6
17	N6
18	P11

Bit #	165-Ball ID
19	R8
20	P3
21	P4
22	P8
23	P9
24	P10
25	R9
26	R10
27	R11
28	M10
29	L10
30	K10
31	J10
32	H11
33	G11
34	F11
35	E11
36	D11

Bit #	165-Ball ID
37	C11
38	A11
39	A10
40	B10
41	A9
42	B9
43	A8
44	B8
45	A7
46	B7
47	B6
48	A6
49	B5
50	A4
51	B3
52	A3
53	A2
54	B2

Boundary Scan Exit Order (1M x 72)

Bit #	209-Ball ID	Bit #	209-Ball ID	Bit #	209-Ball ID	Bit #	209-Ball ID
1	A1	29	T1	57	V10	85	C11
2	A2	30	T2	58	U11	86	C10
3	B1	31	U1	59	U10	87	B11
4	B2	32	U2	60	T11	88	B10
5	C1	33	V1	61	T10	89	A11
6	C2	34	V2	62	R11	90	A10
7	D1	35	W1	63	R10	91	A9
8	D2	36	W2	64	P11	92	U8
9	E1	37	T6	65	P10	93	A7
10	E2	38	V3	66	N11	94	A5
11	F1	39	V4	67	N10	95	A6
12	F2	40	U4	68	M11	96	D6
13	G1	41	W5	69	M10	97	B6
14	G2	42	V6	70	L11	98	D7
15	H1	43	W6	71	L10	99	K3
16	H2	44	U3	72	P6	100	A8
17	J1	45	U9	73	J11	101	B4
18	J2	46	V5	74	J10	102	B3
19	L1	47	U5	75	H11	103	C3
20	L2	48	U6	76	H10	104	C4
21	M1	49	W7	77	G11	105	C8
22	M2	50	V7	78	G10	106	C9
23	N1	51	U7	79	F11	107	B9
24	N2	52	V8	80	F10	108	B8
25	P1	53	V9	81	E10	109	A4
26	P2	54	W11	82	E11	110	C6
27	R2	55	W10	83	D11	111	B7
28	R1	56	V11	84	D10	112	A3

Maximum Ratings

Exceeding maximum ratings may impair the useful life of the device. These user guidelines are not tested.

Storage Temperature ..... –65°C to +150°C

Ambient Temperature with Power Applied..... –55°C to +125°C

Supply Voltage on V_{DD} Relative to GND..... –0.3V to +4.6V

Supply Voltage on V_{DDQ} Relative to GND ..... –0.3V to +V_{DD}

DC Voltage Applied to Outputs in Tri-State..... –0.5V to V_{DDQ} + 0.5V

DC Input Voltage ..... –0.5V to V_{DD} + 0.5V

Current into Outputs (LOW)..... 20 mA

Static Discharge Voltage..... >2001V (MIL-STD-883, Method 3015)

Latch Up Current ..... >200 mA

Operating Range

Range	Ambient Temperature	V_{DD}	V_{DDQ}
Commercial	0°C to +70°C	3.3V –5%/+10%	2.5V – 5% to V_{DD}
Industrial	–40°C to +85°C		

Electrical Characteristics

Over the Operating Range[13, 14]

Parameter	Description	Test Conditions		Min	Max	Unit
V_{DD}	Power Supply Voltage			3.135	3.6	V
V_{DDQ}	IO Supply Voltage	For 3.3V I/O		3.135	V_{DD}	V
		For 2.5V I/O		2.375	2.625	V
V_{OH}	Output HIGH Voltage	For 3.3V I/O, I_{OH} = –4.0 mA		2.4		V
		For 2.5V I/O, I_{OH} = –1.0 mA		2.0		V
V_{OL}	Output LOW Voltage	For 3.3V I/O, I_{OL} = 8.0 mA			0.4	V
		For 2.5V I/O, I_{OL} = 1.0 mA			0.4	V
V_{IH}	Input HIGH Voltage[13]	For 3.3V I/O		2.0	V_{DD} + 0.3V	V
		For 2.5V I/O		1.7	V_{DD} + 0.3V	V
V_{IL}	Input LOW Voltage[13]	For 3.3V I/O		–0.3	0.8	V
		For 2.5V I/O		–0.3	0.7	V
I_X	Input Leakage Current Except ZZ and MODE	GND ≤ V_I ≤ V_{DDQ}		–5	5	µA
	Input Current of MODE	Input = V_{SS}		–30		µA
		Input = V_{DD}			5	µA
	Input Current of ZZ	Input = V_{SS}		–5		µA
		Input = V_{DD}			30	µA
I_{OZ}	Output Leakage Current	GND ≤ V_I ≤ V_{DD}, Output Disabled		–5	5	µA
I_{DD}	V_{DD} Operating Supply Current	V_{DD} = Max, I_{OUT} = 0 mA, f = f_{MAX} = 1/t_{CYC}	7.5-ns cycle, 133 MHz		335	mA
			10-ns cycle, 100 MHz		305	mA
I_{SB1}	Automatic CE Power Down Current—TTL Inputs	Max V_{DD}, Device Deselected, V_{IN} ≥ V_{IH} or V_{IN} ≤ V_{IL}, f = f_{MAX}, inputs switching	7.5-ns cycle, 133 MHz		200	mA
			10-ns cycle, 100 MHz		200	mA
I_{SB2}	Automatic CE Power Down Current—CMOS Inputs	Max V_{DD}, Device Deselected, V_{IN} ≥ V_{DD} – 0.3V or V_{IN} ≤ 0.3V, f = 0, inputs static	All speeds		150	mA
I_{SB3}	Automatic CE Power Down Current—CMOS Inputs	Max V_{DD}, Device Deselected, V_{IN} ≥ V_{DDQ} – 0.3V or V_{IN} ≤ 0.3V, f = f_{MAX}, inputs switching	7.5-ns cycle, 133 MHz		200	mA
			10-ns cycle, 100 MHz		200	mA
I_{SB4}	Automatic CE Power Down Current—TTL Inputs	Max V_{DD}, Device Deselected, V_{IN} ≥ V_{DD} – 0.3V or V_{IN} ≤ 0.3V, f = 0, inputs static	All Speeds		165	mA

Notes

13. Overshoot: V_{IH}(AC) < V_{DD} +1.5V (pulse width less than t_{CYC}/2). Undershoot: V_{IL}(AC) > –2V (pulse width less than t_{CYC}/2).
14. $T_{Power\text{-}up}$: assumes a linear ramp from 0V to V_{DD}(min) within 200 ms. During this time V_{IH} < V_{DD} and V_{DDQ} ≤ V_{DD}.

Capacitance

Tested initially and after any design or process change that may affect these parameters.

Parameter	Description	Test Conditions	100 TQFP Max	165 FBGA Max	209 FBGA Max	Unit
$C_{ADDRESS}$	Address Input Capacitance	T_A = 25°C, f = 1 MHz, V_{DD} = 3.3V V_{DDQ} = 2.5V	6	6	6	pF
C_{DATA}	Data Input Capacitance		5	5	5	pF
C_{CTRL}	Control Input Capacitance		8	8	8	pF
C_{CLK}	Clock Input Capacitance		6	6	6	pF
$C_{I/O}$	Input/Output Capacitance		5	5	5	pF

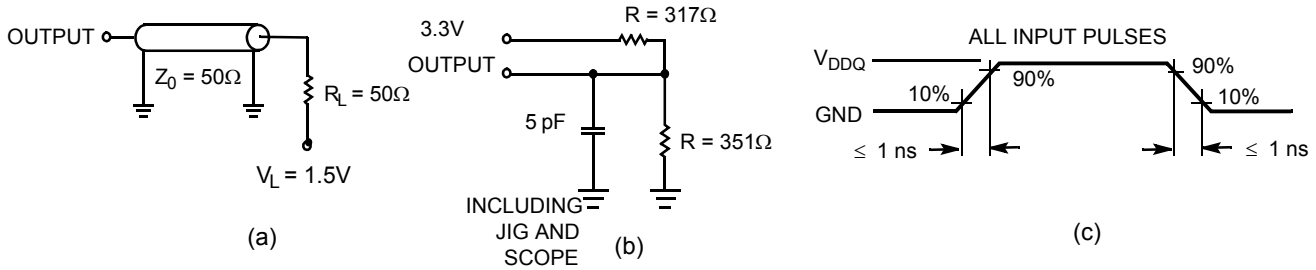
Thermal Resistance

Tested initially and after any design or process change that may affect these parameters.

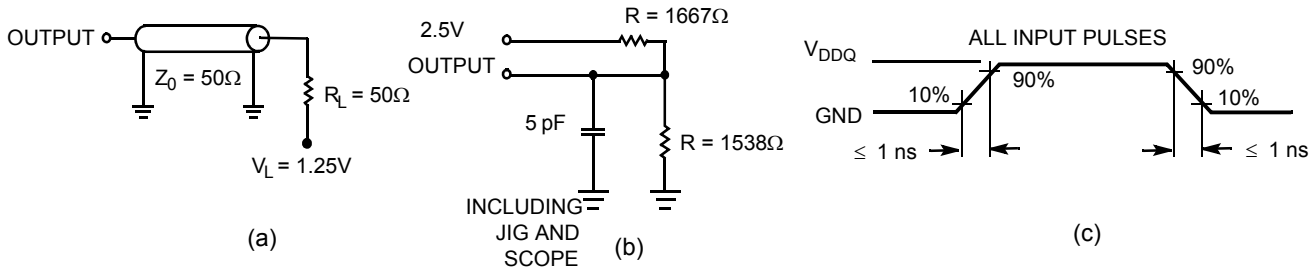
Parameter	Description	Test Conditions	100 TQFP Package	165 FBGA Package	209 FBGA Package	Unit
Θ_{JA}	Thermal Resistance (Junction to Ambient)	Test conditions follow standard test methods and procedures for measuring thermal impedance, per EIA/JESD51.	24.63	16.3	15.2	°C/W
Θ_{JC}	Thermal Resistance (Junction to Case)		2.28	2.1	1.7	°C/W

AC Test Loads and Waveforms

3.3V IO Test Load



2.5V IO Test Load



Switching Characteristics

Over the Operating Range.[15, 16]

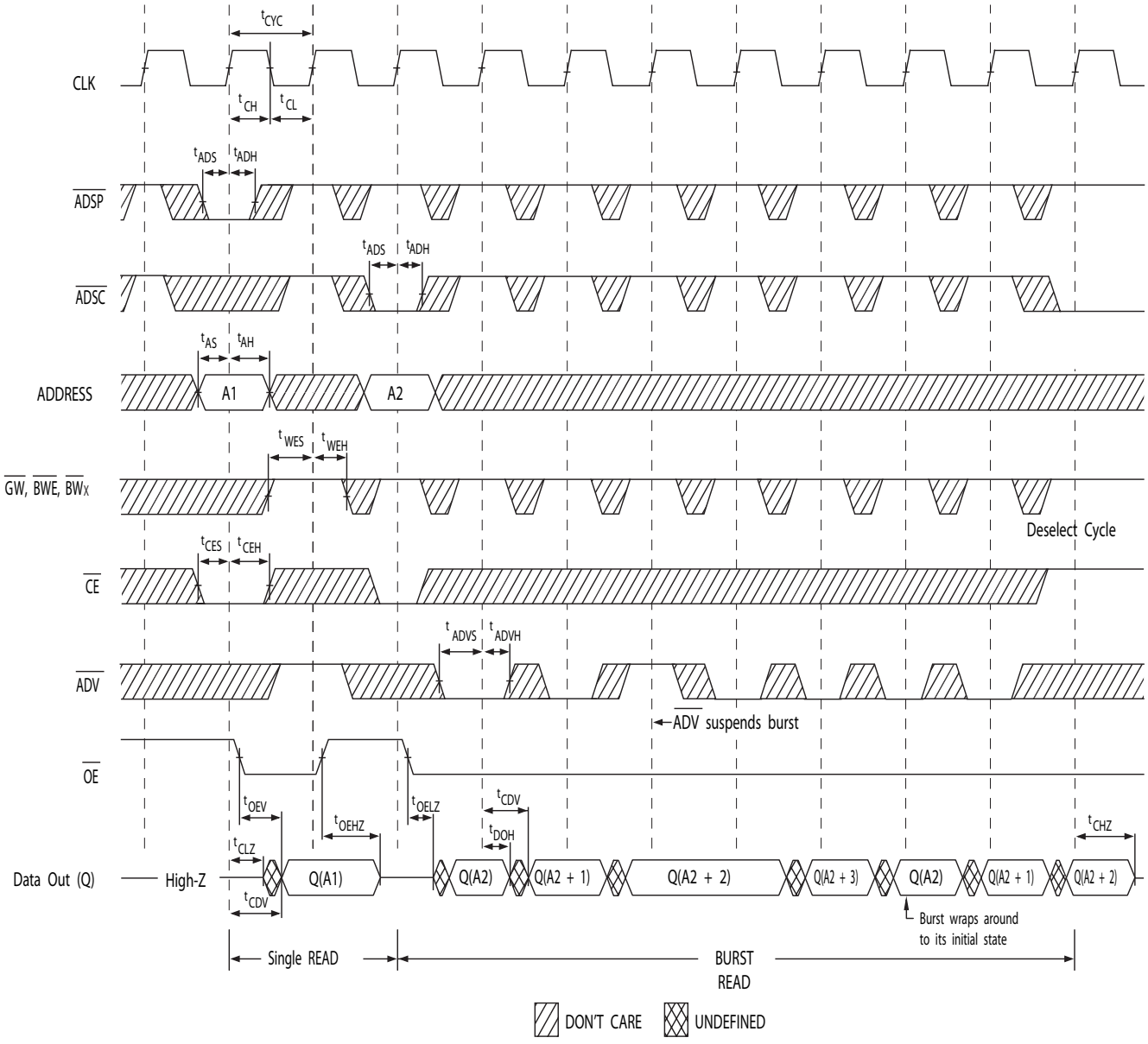
Parameter	Description	133 MHz		100 MHz		Unit
		Min	Max	Min	Max	
t_{POWER}	V_{DD}(Typical) to the First Access[17]	1		1		ms
Clock						
t_{CYC}	Clock Cycle Time	7.5		10		ns
t_{CH}	Clock HIGH	2.5		3.0		ns
t_{CL}	Clock LOW	2.5		3.0		ns
Output Times						
t_{CDV}	Data Output Valid After CLK Rise		6.5		8.5	ns
t_{DOH}	Data Output Hold After CLK Rise	2.5		2.5		ns
t_{CLZ}	Clock to Low-Z[18, 19, 20]	3.0		3.0		ns
t_{CHZ}	Clock to High-Z[18, 19, 20]		3.8		4.5	ns
t_{OEV}	$\overline{OE}$ LOW to Output Valid		3.0		3.8	ns
t_{OELZ}	$\overline{OE}$ LOW to Output Low-Z[18, 19, 20]	0		0		ns
t_{OEHZ}	$\overline{OE}$ HIGH to Output High-Z[18, 19, 20]		3.0		4.0	ns
Setup Times						
t_{AS}	Address Setup Before CLK Rise	1.5		1.5		ns
t_{ADS}	$\overline{ADSP}$, $\overline{ADSC}$ Setup Before CLK Rise	1.5		1.5		ns
t_{ADVS}	$\overline{ADV}$ Setup Before CLK Rise	1.5		1.5		ns
t_{WES}	$\overline{GW}$, $\overline{BWE}$, $\overline{BW_X}$ Setup Before CLK Rise	1.5		1.5		ns
t_{DS}	Data Input Setup Before CLK Rise	1.5		1.5		ns
t_{CES}	Chip Enable Setup	1.5		1.5		ns
Hold Times						
t_{AH}	Address Hold After CLK Rise	0.5		0.5		ns
t_{ADH}	$\overline{ADSP}$, $\overline{ADSC}$ Hold After CLK Rise	0.5		0.5		ns
t_{WEH}	$\overline{GW}$, $\overline{BWE}$, $\overline{BW_X}$ Hold After CLK Rise	0.5		0.5		ns
t_{ADVH}	$\overline{ADV}$ Hold After CLK Rise	0.5		0.5		ns
t_{DH}	Data Input Hold After CLK Rise	0.5		0.5		ns
t_{CEH}	Chip Enable Hold After CLK Rise	0.5		0.5		ns

Notes

15. Timing reference level is 1.5V when V_{DDQ} = 3.3V and is 1.25V when V_{DDQ} = 2.5V.
16. Test conditions shown in (a) of "AC Test Loads and Waveforms" on page 20 unless otherwise noted.
17. This part has an internal voltage regulator; t_{POWER} is the time that the power must be supplied above V_{DD}(minimum) initially, before a read or write operation can be initiated.
18. t_{CHZ}, t_{CLZ}, t_{OELZ}, and t_{OEHZ} are specified with AC test conditions shown in part (b) of "AC Test Loads and Waveforms" on page 20. Transition is measured ±200 mV from steady-state voltage.
19. At any supplied voltage and temperature, t_{OEHZ} is less than t_{OELZ} and t_{CHZ} is less than t_{CLZ} to eliminate bus contention between SRAMs when sharing the same data bus. These specifications do not imply a bus contention condition, but reflect parameters guaranteed over worst case user conditions. Device is designed to achieve High-Z before Low-Z under the same system conditions.
20. This parameter is sampled and not 100% tested.

Timing Diagrams

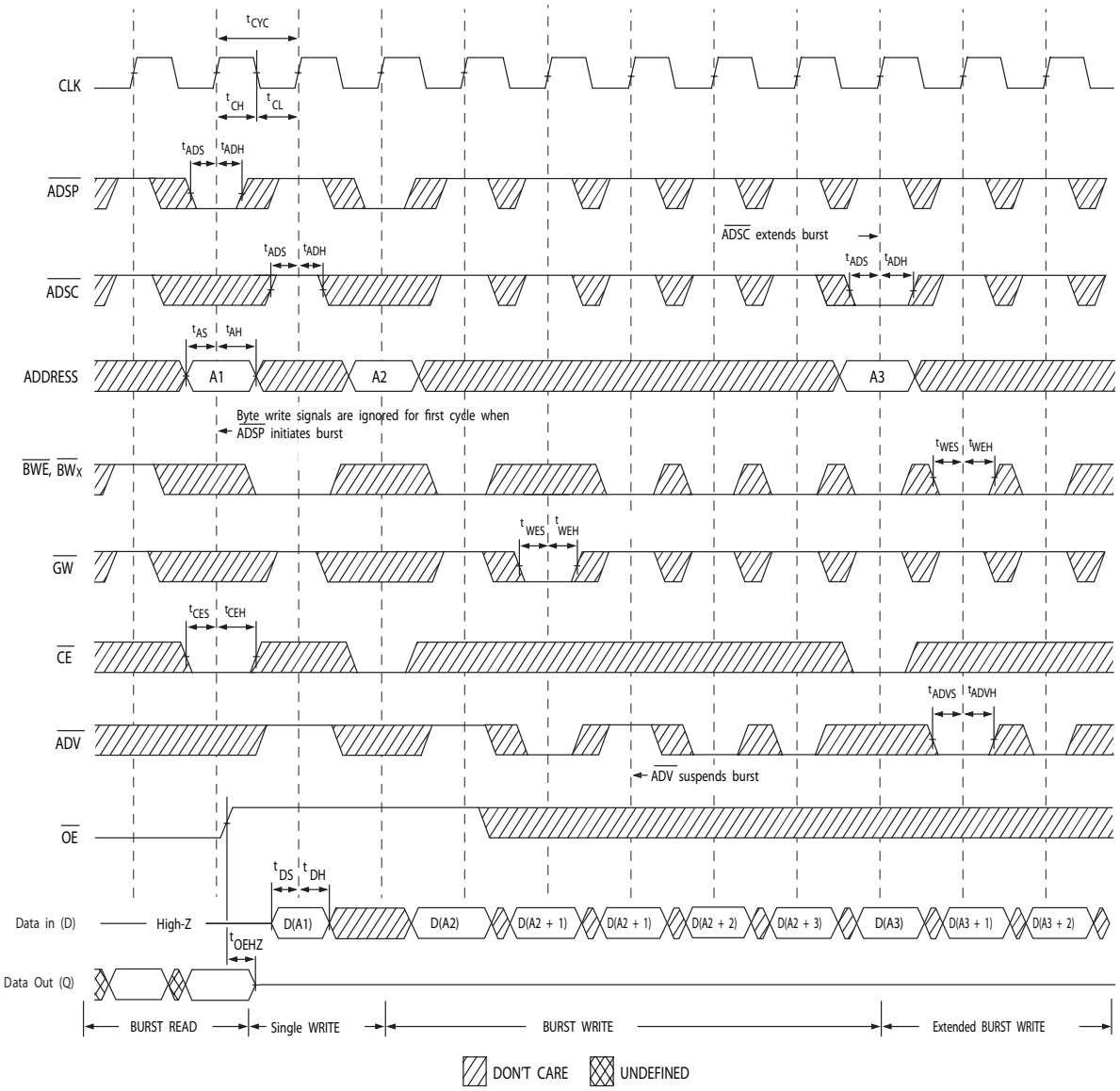
Figure 1. Read Cycle Timing[21]



Note
21. On this diagram, when $\overline{CE}$ is LOW: $\overline{CE}_1$ is LOW, CE_2 is HIGH, and $\overline{CE}_3$ is LOW. When $\overline{CE}$ is HIGH: $\overline{CE}_1$ is HIGH, CE_2 is LOW, or $\overline{CE}_3$ is HIGH.

Timing Diagrams (continued)

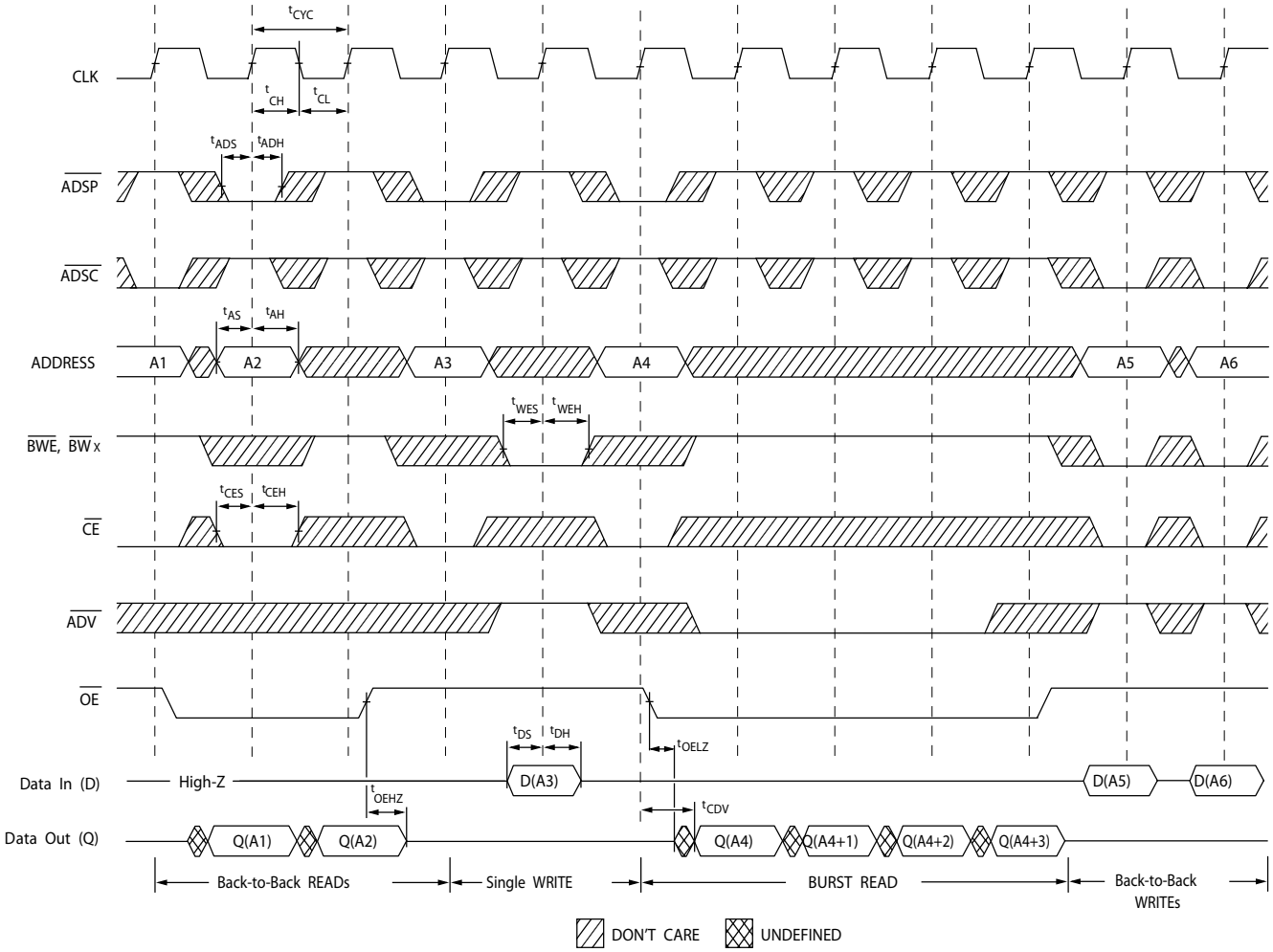
Figure 2. Write Cycle Timing[21, 22]



Note
22. Full width write can be initiated by either $\overline{GW}$ LOW; or by $\overline{GW}$ HIGH, $\overline{BWE}$ LOW, and $\overline{BW}_X$ LOW.

Timing Diagrams (continued)

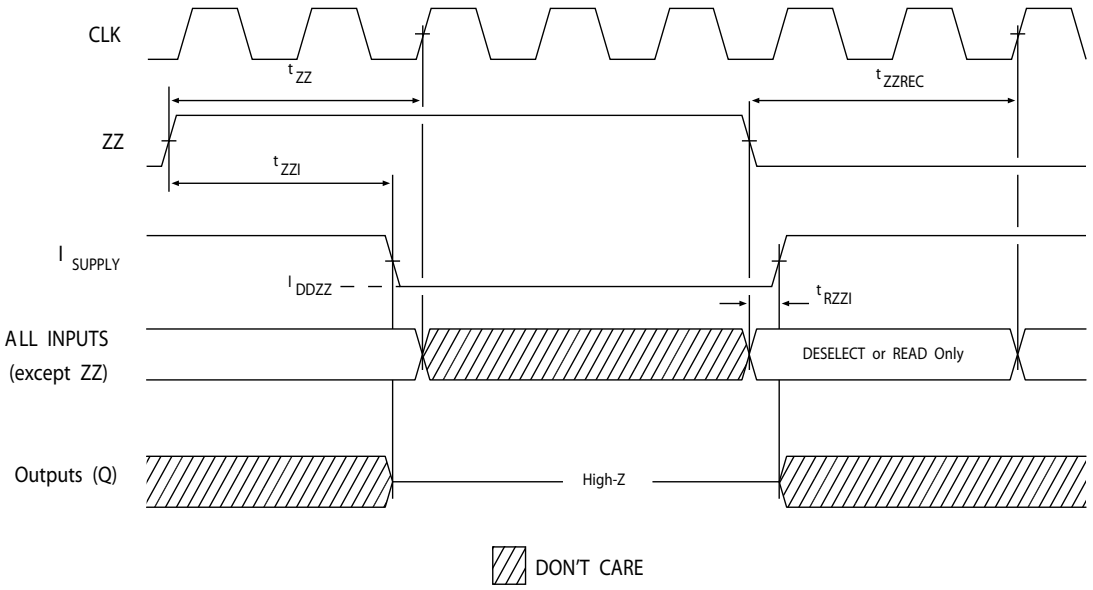
Figure 3. Read/Write Cycle Timing[21, 23, 24]



Notes
23. The data bus (Q) remains in High-Z following a write cycle, unless a new read access is initiated by $\overline{\text{ADSP}}$ or $\overline{\text{ADSC}}$.
24. $\overline{\text{GW}}$ is HIGH.

Timing Diagrams (continued)

Figure 4. ZZ Mode Timing[25, 26]



Notes
25. Device must be deselected when entering ZZ mode. See "Truth Table" on page 10 for all possible signal conditions to deselect the device.
26. DQs are in High-Z when exiting ZZ sleep mode.

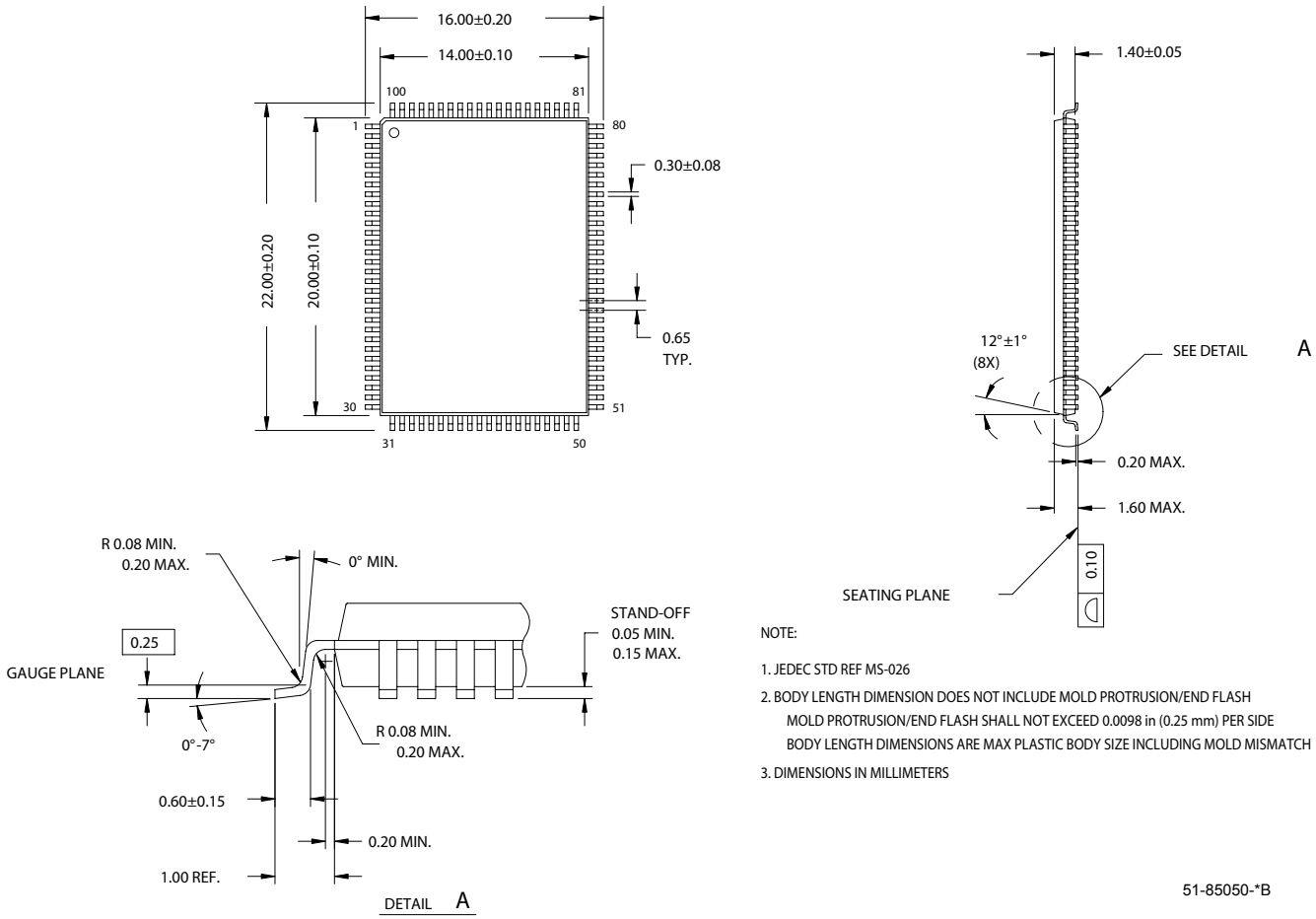
Ordering Information

Not all of the speed, package, and temperature ranges are available. Please contact your local sales representative or visit www.cypress.com for actual products offered.

Speed (MHz)	Ordering Code	Package Diagram	Part and Package Type	Operating Range
133	CY7C1481V33-133AXC	51-85050	100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-free	Commercial
	CY7C1483V33-133AXC			
	CY7C1481V33-133BZC	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm)	
	CY7C1483V33-133BZC			
	CY7C1481V33-133BZXC	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm) Pb-free	
	CY7C1483V33-133BZXC			
	CY7C1487V33-133BGC	51-85167	209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm)	
	CY7C1487V33-133BGXC		209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm) Pb-free	
	CY7C1481V33-133AXI	51-85050	100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-free	Industrial
	CY7C1483V33-133AXI			
	CY7C1481V33-133BZI	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm)	
	CY7C1483V33-133BZI			
	CY7C1481V33-133BZXI	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm) Pb-free	
	CY7C1483V33-133BZXI			
	CY7C1487V33-133BGI	51-85167	209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm)	
	CY7C1487V33-133BGXI		209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm) Pb-free	
100	CY7C1481V33-100AXC	51-85050	100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-free	Commercial
	CY7C1483V33-100AXC			
	CY7C1481V33-100BZC	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm)	
	CY7C1483V33-100BZC			
	CY7C1481V33-100BZXC	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm) Pb-free	
	CY7C1483V33-100BZXC			
	CY7C1487V33-100BGC	51-85167	209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm)	
	CY7C1487V33-100BGXC		209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm) Pb-free	
	CY7C1481V33-100AXI	51-85050	100-pin Thin Quad Flat Pack (14 x 20 x 1.4 mm) Pb-free	Industrial
	CY7C1483V33-100AXI			
	CY7C1481V33-100BZI	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm)	
	CY7C1483V33-100BZI			
	CY7C1481V33-100BZXI	51-85165	165-ball Fine-Pitch Ball Grid Array (15 x 17 x 1.4 mm) Pb-free	
	CY7C1483V33-100BZXI			
	CY7C1487V33-100BGI	51-85167	209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm)	
	CY7C1487V33-100BGXI		209-ball Fine-Pitch Ball Grid Array (14 × 22 × 1.76 mm) Pb-free	

Package Diagrams

Figure 5. 100-Pin Thin Plastic Quad Flatpack (14 x 20 x 1.4 mm), 51-85050



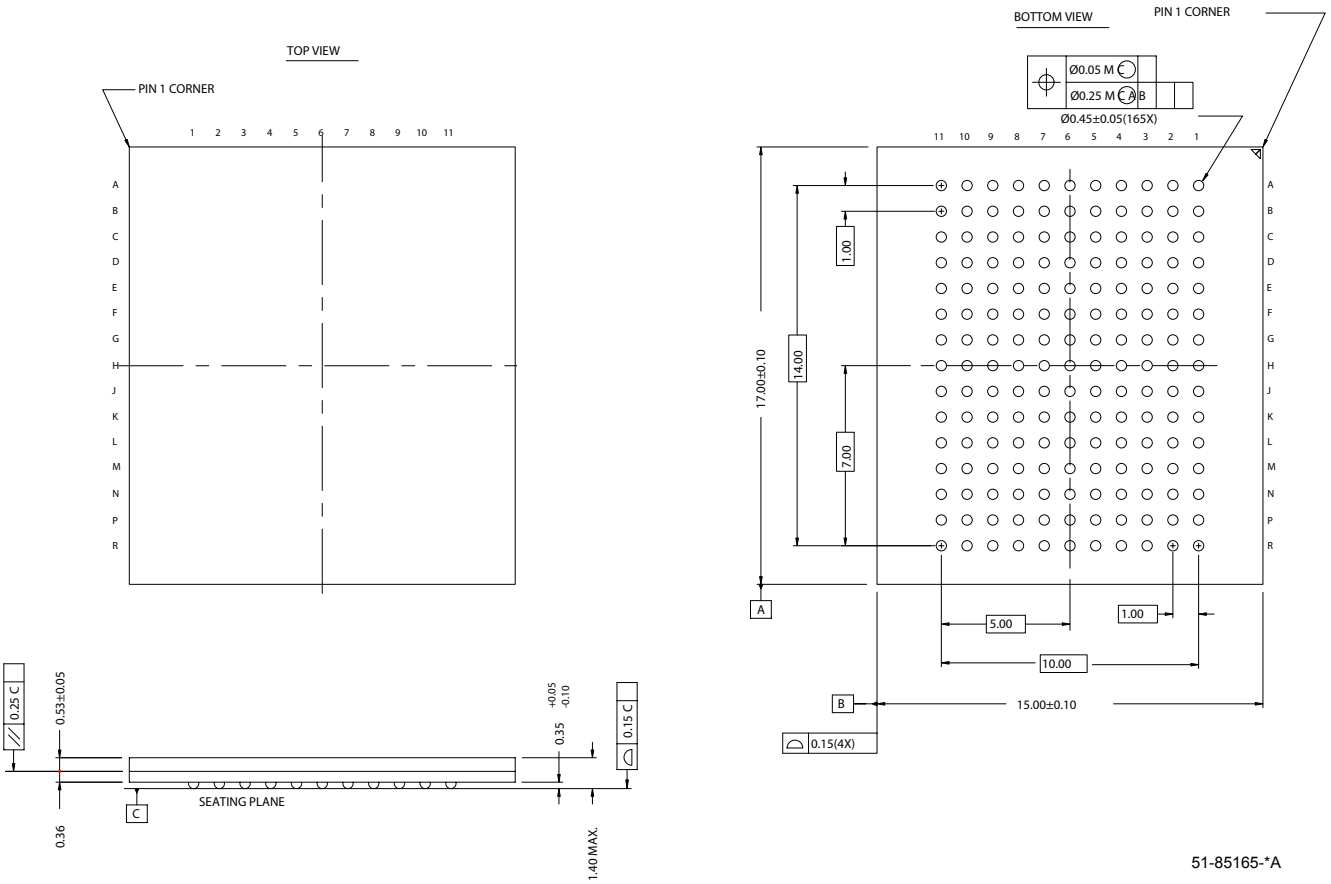
NOTE:

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

51-85050-*B

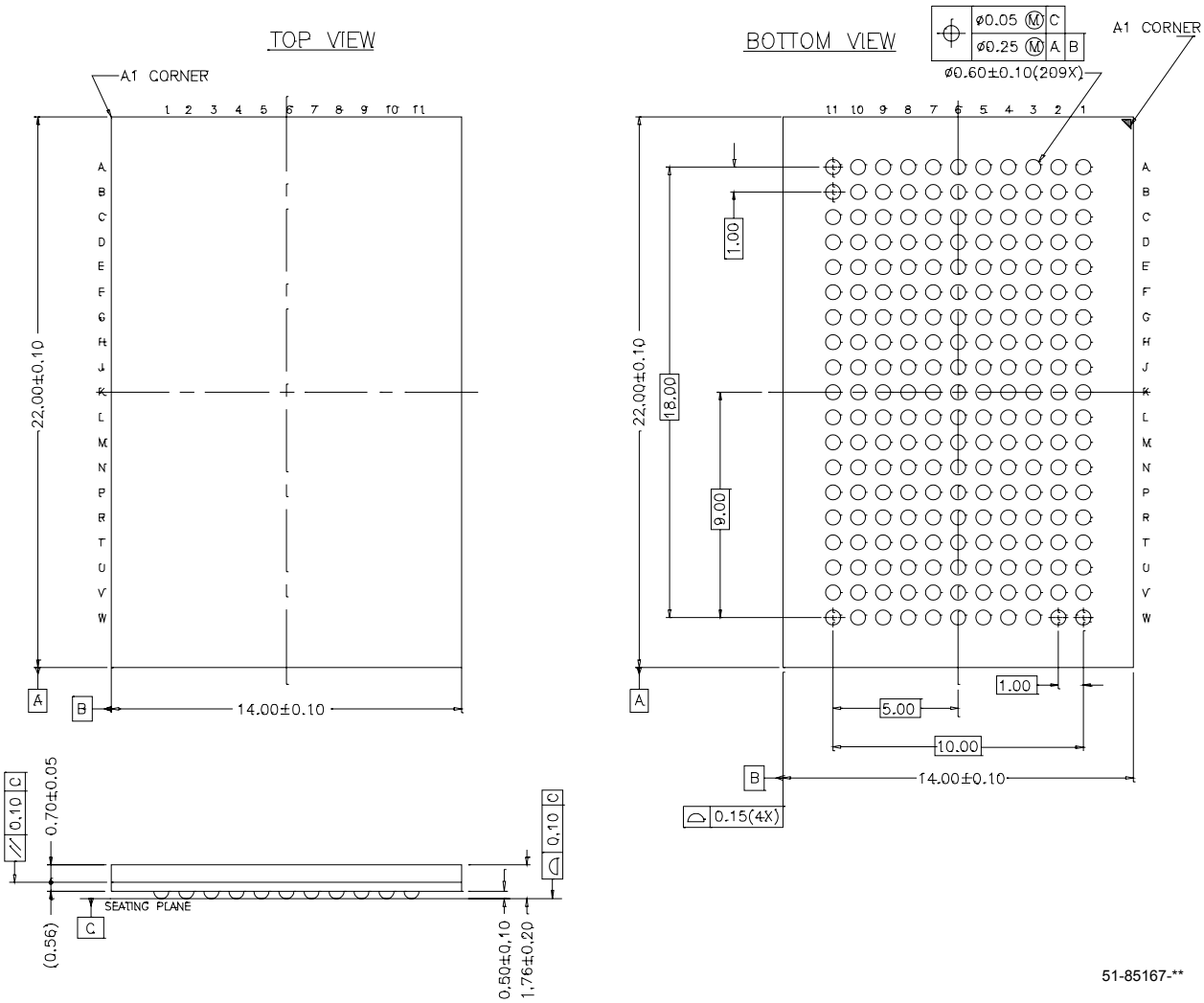
Package Diagrams (continued)

Figure 6. 165-Ball FBGA (15 x 17 x 1.4 mm), 51-85165



Package Diagrams (continued)

Figure 7. 209-Ball FBGA (14 x 22 x 1.76 mm), 51-85167



Document History Page

Document Title: CY7C1481V33/CY7C1483V33/CY7C1487V33, 72-Mbit (2M x 36/4M x 18/1M x 72) Flow-Through SRAM Document Number: 38-05284				
REV.	**ECN NO.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	114671	08/12/02	PKS	New Data Sheet
*A	118283	01/27/03	HGK	Updated Ordering Information Updated the features for package offering Changed from Advance Information to Preliminary
*B	233368	See ECN	NJY	Changed timing diagrams Changed logic block diagrams Modified Functional Description Modified “Functional Overview” section Added boundary scan order for all packages Included thermal numbers and capacitance values for all packages Included IDD and ISB values Removed 150-MHz speed grade offering Changed package outline for 165FBGA package and 209-ball BGA package Removed 119-BGA package offering
*C	299452	See ECN	SYT	Removed 117-MHz Speed Bin Changed Θ_{JA} from 16.8 to 24.63 °C/W and Θ_{JC} from 3.3 to 2.28 °C/W for 100 TQFP Package on Page # 21 Added lead-free information for 100-Pin TQFP, 165 FBGA and 209 BGA Packages Added comment of ‘Lead-free BG packages availability’ below the Ordering Information
*D	323080	See ECN	PCI	Address expansion pins/balls in the pinouts for all packages are modified as per JEDEC standard Added Address Expansion pins in the Pin Definitions Table Modified V_{OL}, V_{OH} test conditions Removed comment of ‘Lead-free BG packages availability’ below the Ordering Information Updated Ordering Information Table
*E	416193	See ECN	NXR	Changed address of Cypress Semiconductor Corporation on Page# 1 from “3901 North First Street” to “198 Champion Court” Changed the description of I_X from Input Load Current to Input Leakage Current on page# 19 Changed the I_X current values of MODE on page # 19 from -5 μA and 30 μA to -30 μA and 5 μA Changed the I_X current values of ZZ on page # 19 from -30 μA and 5 μA to -5 μA and 30 μA Changed $V_{IH} \leq V_{DD}$ to $V_{IH} < V_{DD}$ on page # 19 Replaced Package Name column with Package Diagram in the Ordering Information table
*F	470723	See ECN	VKN	Converted from Preliminary to Final Added the Maximum Rating for Supply Voltage on V_{DDQ} Relative to GND Changed t_{TH}, t_{TL} from 25 ns to 20 ns and t_{TDOV} from 5 ns to 10 ns in TAP AC Switching Characteristics table Updated the Ordering Information table
*G	486690	See ECN	VKN	Corrected the typo in the 209-Ball FBGA pinout. (Corrected the ball name H9 to V_{SS} from V_{SSQ}).
*H	1062041	See ECN	VKN/KKVTMP	Added footnote #2 related to V_{SSQ}