

MOS INTEGRATED CIRCUIT

μ PD4382161, 4382181, 4382321, 4382361

8M-BIT CMOS SYNCHRONOUS FAST SRAM FLOW THROUGH OPERATION

Description

The μ PD4382161 is a 524,288-word by 16-bit, the μ PD4382181 is a 524,288-word by 18-bit, the μ PD4382321 is a 262,144-word by 32-bit and the μ PD4382361 is a 262,144-word by 36-bit synchronous static RAM fabricated with advanced CMOS technology using N-channel four-transistor memory cell.

The μ PD4382161, μ PD4382181, μ PD4382321 and μ PD4382361 integrate unique synchronous peripheral circuitry, 2-bit burst counter and output buffer as well as SRAM core. All input registers are controlled by a positive edge of the single clock input (CLK).

The μ PD4382161, μ PD4382181, μ PD4382321 and μ PD4382361 are suitable for applications which require synchronous operation, high speed, low voltage, high density and wide bit configuration, such as cache and buffer memory.

ZZ has to be set LOW at the normal operation. When ZZ is set HIGH, the SRAM enters Power Down State ("Sleep"). In the "Sleep" state, the SRAM internal state is preserved. When ZZ is set LOW again, the SRAM resumes normal operation.

The μ PD4382161, μ PD4382181, μ PD4382321 and μ PD4382361 are packaged in 100-pin plastic LQFP with a 1.4 mm package thickness for high density and low capacitive loading.

Features

- 3.3 V (Chip) / 3.3 V or 2.5 V (I/O) Supply
- Synchronous operation
- Internally self-timed write control
- Burst read / write : Interleaved burst and linear burst sequence
- Fully registered inputs for flow through operation
- All registers triggered off positive clock edge
- 3.3 V or 2.5 V LVTTTL Compatible : All inputs and outputs
- Fast clock access time : 8.5 ns (100 MHz), 9 ns (90 MHz)
- Asynchronous output enable : /G
- Burst sequence selectable : MODE
- Sleep mode : ZZ (ZZ = Open or Low : Normal operation)
- Separate byte write enable : /BW1 - /BW4 (μ PD4382321, μ PD4382361), /BW1 - /BW2 (μ PD4382161, μ PD4382181), /BWE
- Global write enable : /GW
- Three chip enables for easy depth expansion
- Common I/O using three state outputs

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

Ordering Information

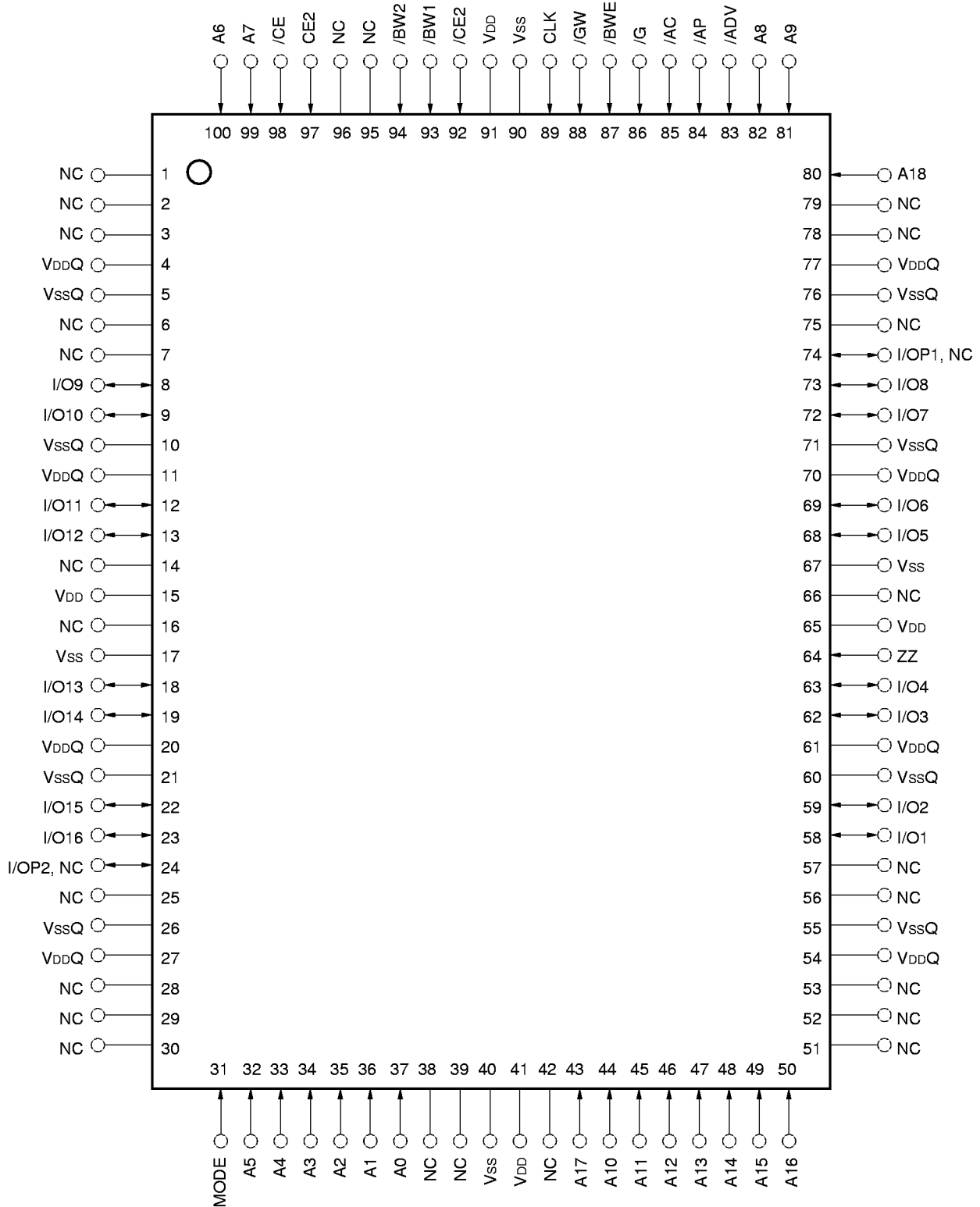
Part number	Access Time ns	Clock Frequency MHz	Core Supply Voltage V	I/O Interface V	Package
μPD4382161GF-A85	8.5	100	3.3 ± 0.165	3.3 or 2.5 LVTTL	100-pin plastic LQFP (14 × 20 mm)
μPD4382161GF-A90	9.0	90			
μPD4382181GF-A85	8.5	100			
μPD4382181GF-A90	9.0	90			
μPD4382321GF-A85	8.5	100			
μPD4382321GF-A90	9.0	90			
μPD4382361GF-A85	8.5	100			
μPD4382361GF-A90	9.0	90			

Pin Configurations (Marking Side)

/xxx indicates active low signal.

100-pin plastic LQFP (14 × 20 mm)

[μPD4382161GF, μPD4382181GF]



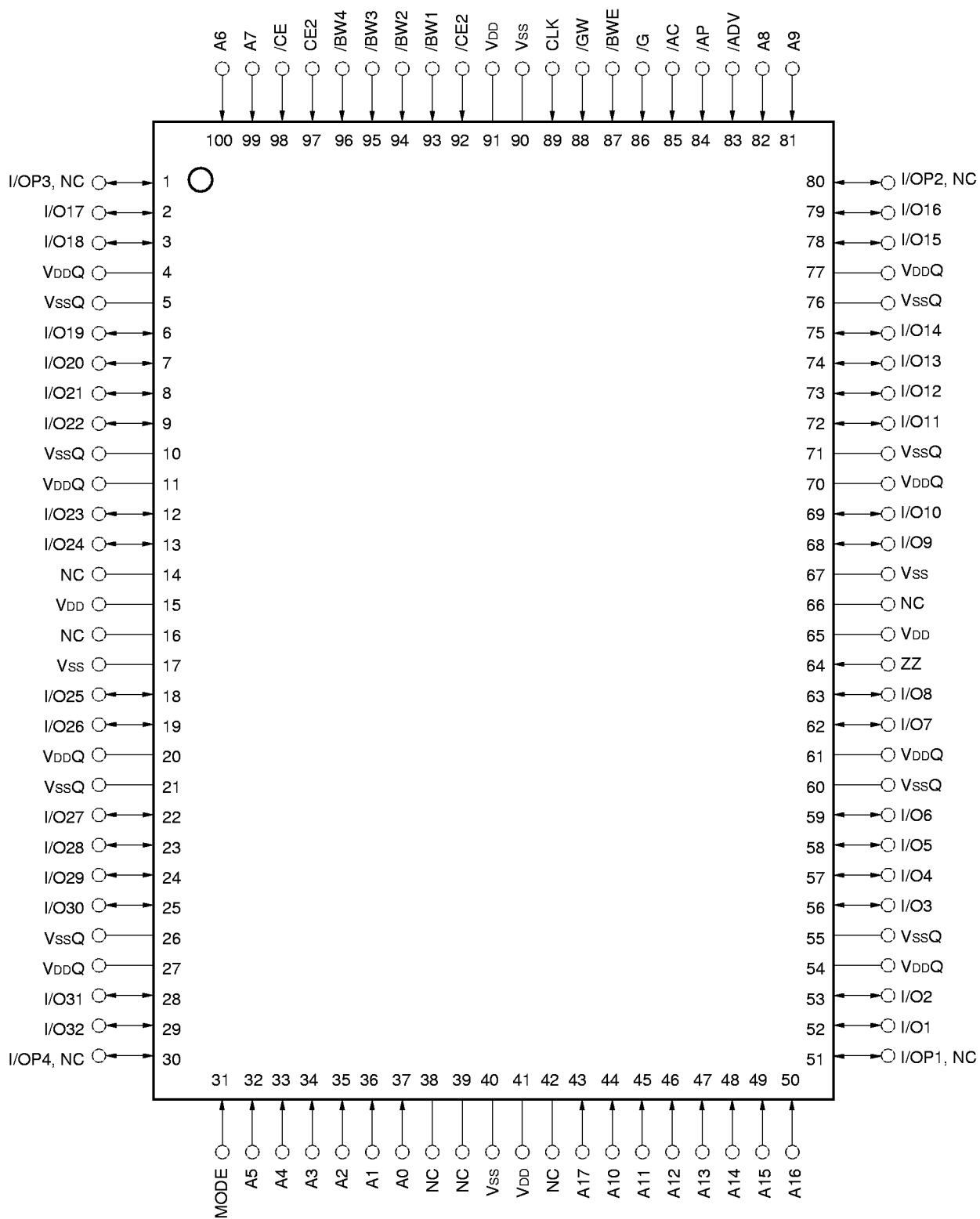
Pin Identification

[μ PD4382161GF, μ PD4382181GF]

Symbol	Pin No.	Description
A0 - A18	37, 36, 35, 34, 33, 32, 100, 99, 82, 81, 44, 45, 46, 47, 48, 49, 50, 43, 80	Synchronous Address Input
I/O1 - I/O16	58, 59, 62, 63, 68, 69, 72, 73, 8, 9, 12, 13, 18, 19, 22, 23	Synchronous Data In, Synchronous / Asynchronous Data Out
I/OP1, NC ^{Note}	74	Synchronous Data In (Parity),
I/OP2, NC ^{Note}	24	Synchronous / Asynchronous Data Out (Parity)
/ADV	83	Synchronous Burst Address Advance Input
/AP	84	Synchronous Address Status Processor Input
/AC	85	Synchronous Address Status Controller Input
/CE, CE2, /CE2	98, 97, 92	Synchronous Chip Enable Input
/BW1, /BW2, /BWE	93, 94, 87	Synchronous Byte Write Enable Input
/GW	88	Synchronous Global Write Input
/G	86	Asynchronous Output Enable Input
CLK	89	Clock Input
MODE	31	Asynchronous Burst Sequence Select Input Do not change state during normal operation
ZZ	64	Asynchronous Power Down State Input
VDD	15, 41, 65, 91	Power Supply
VSS	17, 40, 67, 90	Ground
VDDQ	4, 11, 20, 27, 54, 61, 70, 77	Output Buffer Power Supply
VSSQ	5, 10, 21, 26, 55, 60, 71, 76	Output Buffer Ground
NC	1, 2, 3, 6, 7, 14, 16, 25, 28, 29, 30, 38, 39, 42, 51, 52, 53, 56, 57, 66, 75, 78, 79, 95, 96	No Connection

Note NC (No Connection) is used in the μ PD4382161GF.I/OP1 - I/OP2 is used in the μ PD4382181GF.

100-pin plastic LQFP (14 × 20 mm)

[μ PD4382321GF, μ PD4382361GF]

[μ PD4382321GF, μ PD4382361GF]

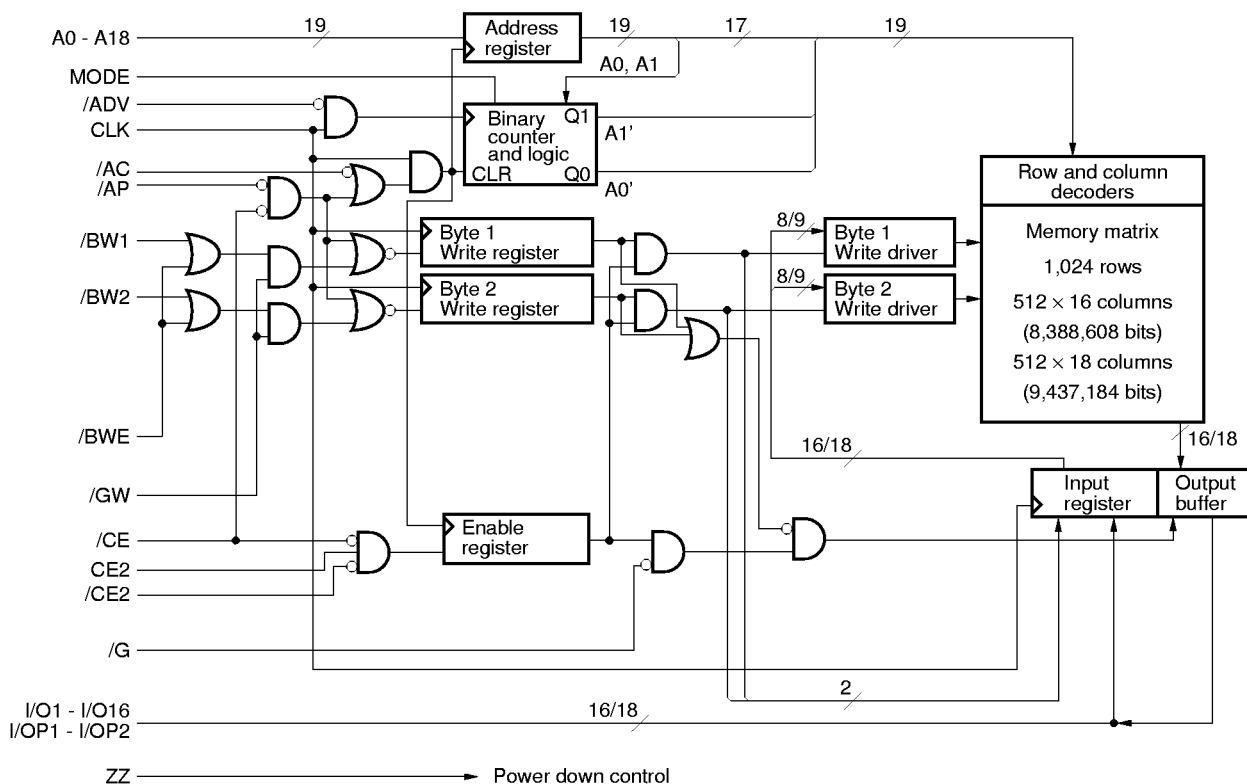
Symbol	Pin No.	Description
★ A0 - A17	37, 36, 35, 34, 33, 32, 100, 99, 82, 81, 44, 45, 46, 47, 48, 49, 50, 43	Synchronous Address Input
I/O1 - I/O32	52, 53, 56, 57, 58, 59, 62, 63, 68, 69, 72, 73, 74, 75, 78, 79, 2, 3, 6, 7, 8, 9, 12, 13, 18, 19, 22, 23, 24, 25, 28, 29	Synchronous Data In, Synchronous / Asynchronous Data Out
I/OP1, NC ^{Note}	51	Synchronous Data In (Parity), Synchronous / Asynchronous Data Out (Parity)
I/OP2, NC ^{Note}	80	
I/OP3, NC ^{Note}	1	
I/OP4, NC ^{Note}	30	
/ADV	83	Synchronous Burst Address Advance Input
/AP	84	Synchronous Address Status Processor Input
/AC	85	Synchronous Address Status Controller Input
/CE, CE2, /CE2	98, 97, 92	Synchronous Chip Enable Input
/BW1 - /BW4, /BWE	93, 94, 95, 96, 87	Synchronous Byte Write Enable Input
/GW	88	Synchronous Global Write Input
/G	86	Asynchronous Output Enable Input
CLK	89	Clock Input
MODE	31	Asynchronous Burst Sequence Select Input Do not change state during normal operation
ZZ	64	Asynchronous Power Down State Input
V _{DD}	15, 41, 65, 91	Power Supply
V _{SS}	17, 40, 67, 90	Ground
V _{DDQ}	4, 11, 20, 27, 54, 61, 70, 77	Output Buffer Power Supply
V _{SSQ}	5, 10, 21, 26, 55, 60, 71, 76	Output Buffer Ground
★ NC	14, 16, 38, 39, 42, 66	No Connection

Note NC (No Connection) is used in the μ PD4382321GF.

I/OP1 - I/OP4 is used in the μ PD4382361GF.

Block Diagrams

[μ PD4382161, μ PD4382181]



Burst Sequence

[μ PD4382161, μ PD4382181]

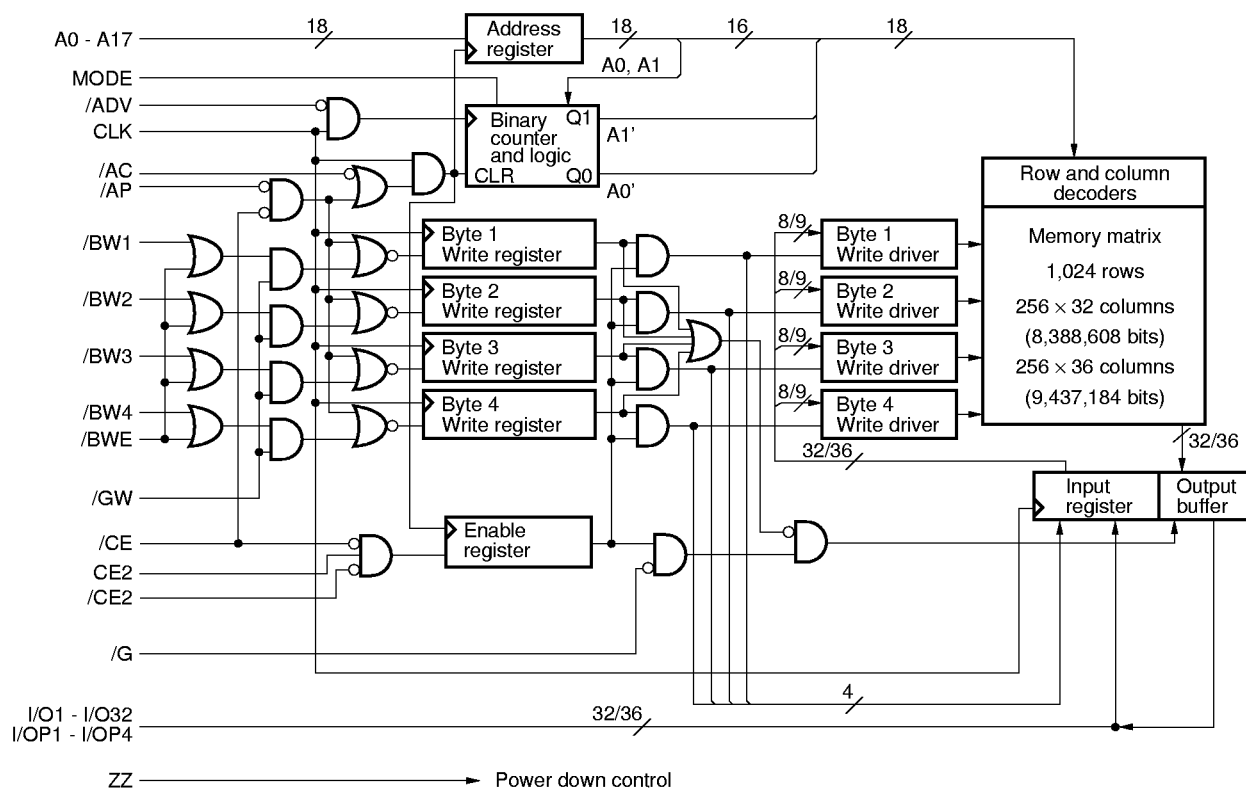
Interleaved Burst Sequence Table (MODE = Open or VDD)

External Address	A18 - A2, A1, A0
1st Burst Address	A18 - A2, A1, /A0
2nd Burst Address	A18 - A2, /A1, A0
3rd Burst Address	A18 - A2, /A1, /A0

Linear Burst Sequence Table (MODE = VSS)

External Address	A18 - A2, 0, 0	A18 - A2, 0, 1	A18 - A2, 1, 0	A18 - A2, 1, 1
1st Burst Address	A18 - A2, 0, 1	A18 - A2, 1, 0	A18 - A2, 1, 1	A18 - A2, 0, 0
2nd Burst Address	A18 - A2, 1, 0	A18 - A2, 1, 1	A18 - A2, 0, 0	A18 - A2, 0, 1
3rd Burst Address	A18 - A2, 1, 1	A18 - A2, 0, 0	A18 - A2, 0, 1	A18 - A2, 1, 0

[μPD4382321, μPD4382361]



Burst Sequence

[μPD4382321, μPD4382361]

Interleaved Burst Sequence Table (MODE = Open or VDD)

External Address	A17 - A2, A1, A0
1st Burst Address	A17 - A2, A1, /A0
2nd Burst Address	A17 - A2, /A1, A0
3rd Burst Address	A17 - A2, /A1, /A0

Linear Burst Sequence Table (MODE = VSS)

External Address	A17 - A2, 0, 0	A17 - A2, 0, 1	A17 - A2, 1, 0	A17 - A2, 1, 1
1st Burst Address	A17 - A2, 0, 1	A17 - A2, 1, 0	A17 - A2, 1, 1	A17 - A2, 0, 0
2nd Burst Address	A17 - A2, 1, 0	A17 - A2, 1, 1	A17 - A2, 0, 0	A17 - A2, 0, 1
3rd Burst Address	A17 - A2, 1, 1	A17 - A2, 0, 0	A17 - A2, 0, 1	A17 - A2, 1, 0

Asynchronous Truth Table

Operation	/G	I/O
Read Cycle	L	Dout
Read Cycle	H	Hi-Z
Write Cycle	×	Hi-Z, Din
Deselected	×	Hi-Z

Remark × : don't care

Synchronous Truth Table

Operation	/CE	CE2	/CE2	/AP	/AC	/ADV	/WRITE	CLK	Address
Deselected ^{Note}	H	×	×	×	L	×	×	L → H	None
Deselected ^{Note}	L	L	×	L	×	×	×	L → H	None
Deselected ^{Note}	L	×	H	L	×	×	×	L → H	None
Deselected ^{Note}	L	L	×	H	L	×	×	L → H	None
Deselected ^{Note}	L	×	H	H	L	×	×	L → H	None
Read Cycle / Begin Burst	L	H	L	L	×	×	×	L → H	External
Read Cycle / Begin Burst	L	H	L	H	L	×	H	L → H	External
Read Cycle / Continue Burst	×	×	×	H	H	L	H	L → H	Next
Read Cycle / Continue Burst	H	×	×	×	H	L	H	L → H	Next
Read Cycle / Suspend Burst	×	×	×	H	H	H	H	L → H	Current
Read Cycle / Suspend Burst	H	×	×	×	H	H	H	L → H	Current
Write Cycle / Begin Burst	L	H	L	H	L	×	L	L → H	External
Write Cycle / Continue Burst	×	×	×	H	H	L	L	L → H	Next
Write Cycle / Continue Burst	H	×	×	×	H	L	L	L → H	Next
Write Cycle / Suspend Burst	×	×	×	H	H	H	L	L → H	Current
Write Cycle / Suspend Burst	H	×	×	×	H	H	L	L → H	Current

Note Deselect status is held until new "Begin Burst" entry.

Remarks 1. × : don't care

2. /WRITE = L means any one or more byte write enables (/BW1, /BW2, /BW3 or /BW4) and /BWE are LOW or /GW is LOW.

/WRITE = H means the following two cases.

(1) /BWE and /GW are HIGH.

(2) /BW1, /BW2, /BW3, /BW4 and /GW are HIGH, and /BWE is LOW.

Partial Truth Table for Write Enables

[μ PD4382161, μ PD4382181]

Operation	/GW	/BWE	/BW1	/BW2
Read Cycle	H	H	×	×
Read Cycle	H	L	H	H
Write Cycle / Byte 1 Only	H	L	L	H
Write Cycle / All Bytes	H	L	L	L
Write Cycle / All Bytes	L	×	×	×

Remark × : don't care

[μ PD4382321, μ PD4382361]

Operation	/GW	/BWE	/BW1	/BW2	/BW3	/BW4
Read Cycle	H	H	×	×	×	×
Read Cycle	H	L	H	H	H	H
Write Cycle / Byte 1 Only	H	L	L	H	H	H
Write Cycle / All Bytes	H	L	L	L	L	L
Write Cycle / All Bytes	L	×	×	×	×	×

Remark × : don't care

ZZ (Sleep) Truth Table

ZZ	Chip Status
$\leq 0.2 \text{ V}$	Active
Open	Active
$\geq V_{DD} - 0.2 \text{ V}$	Sleep

Electrical Specifications**Absolute Maximum Ratings**

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Note
Supply voltage	V _{DD}		−0.5		+4.0	V	
Output supply voltage	V _{DDQ}		−0.5		V _{DD}	V	
Input voltage	V _{IN}		−0.5		V _{DD} + 0.5	V	1, 2
Input / Output voltage	V _{I/O}		−0.5		V _{DDQ} + 0.5	V	1, 2
Operating ambient temperature	T _A		0		70	°C	
Storage temperature	T _{stg}		−55		+125	°C	

Notes 1. −2.0 V (MIN.)(Pulse width : 2 ns)

2. V_{DDQ} + 2.3 V (MAX.)(Pulse width : 2 ns)

Caution Exposing the device to stress above those listed in Absolute Maximum Ratings could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational section of this specification. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Recommended DC Operating Conditions (T_A = 0 to 70 °C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage	V _{DD}		3.135	3.3	3.465	V
2.5 V LVTTTL interface						
Output supply voltage	V _{DDQ}		2.375	2.5	2.9	V
High level input voltage	V _{IH}		1.7		V _{DDQ} + 0.3	V
Low level input voltage	V _{IL}		−0.3 <i>Note</i>		+0.7	V
3.3 V LVTTTL interface						
Output supply voltage	V _{DDQ}		3.135	3.3	3.465	V
High level input voltage	V _{IH}		2.0		V _{DDQ} + 0.3	V
Low level input voltage	V _{IL}		−0.3 <i>Note</i>		+0.8	V

Note −0.8 V (MIN.)(Pulse width : 2 ns)

Capacitance (T_A = 25 °C, f = 1 MHz)

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C _{IN}	V _{IN} = 0 V			4	pF
Input / Output capacitance	C _{I/O}	V _{I/O} = 0 V			7	pF
Clock input capacitance	C _{clk}	V _{clk} = 0 V			4	pF

Remark These parameters are periodically sampled and not 100% tested.

DC Characteristics (T_A = 0 to 70 °C, V_{DD} = 3.3 V ± 0.165 V)

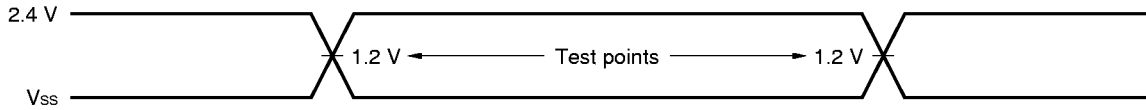
Parameter	Symbol	Test condition		MIN.	TYP.	MAX.	Unit	Note
Input leakage current	I _{LI}	V _{IN} (except ZZ, MODE) = 0 V to V _{DD}		−2		+2	μA	
I/O leakage current	I _{LO}	V _{I/O} = 0 V to V _{DDQ} , Outputs are disabled.		−2		+2	μA	
Operating supply current	I _{DD}	Device selected, Cycle = MAX. V _{IN} ≤ V _{IL} or V _{IN} ≥ V _{IH} , I _{I/O} = 0 mA	μPD4382161-A85			260	mA	
			μPD4382181-A85					
			μPD4382161-A90			250		
			μPD4382181-A90					
			μPD4382321-A85			350		
			μPD4382361-A85					
	μPD4382321-A90			330				
μPD4382361-A90								
I _{DD1}	Suspend cycle, Cycle = MAX. /AC, /AP, /ADV, /GW, /BWEs ≥ V _{IH} V _{IN} ≤ V _{IL} or V _{IN} ≥ V _{IH} , I _{I/O} = 0 mA					120		
Standby supply current	I _{SB}	Device deselected, Cycle = 0 MHz V _{IN} ≤ V _{IL} or V _{IN} ≥ V _{IH} , All inputs are static.				30	mA	
	I _{SB1}	Device deselected, Cycle = 0 MHz V _{IN} ≤ 0.2 V or V _{IN} ≥ V _{DD} − 0.2 V V _{I/O} ≤ 0.2 V, All inputs are static.				10		
	I _{SB2}	Device deselected, Cycle = MAX. V _{IN} ≤ V _{IL} or V _{IN} ≥ V _{IH}				150		
Power down supply current	I _{SBZZ}	ZZ ≥ V _{DD} − 0.2 V, V _{I/O} ≤ V _{DDQ} + 0.2 V				10	mA	
2.5 V LVTTTL interface								
High level output voltage	V _{OH}	I _{OH} = −2.0 mA		1.7			V	
		I _{OH} = −1.0 mA		2.1				
Low level output voltage	V _{OL}	I _{OL} = +2.0 mA				0.7	V	
		I _{OL} = +1.0 mA				0.4		
3.3 V LVTTTL interface								
High level output voltage	V _{OH}	I _{OH} = −4.0 mA		2.4			V	
Low level output voltage	V _{OL}	I _{OL} = +8.0 mA				0.4	V	

AC Characteristics ($T_A = 0$ to 70°C , $V_{DD} = 3.3\text{ V} \pm 0.165\text{ V}$)

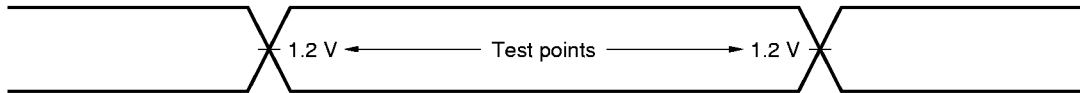
AC Test Conditions

2.5 V LVTTTL Interface

Input waveform (Rise / Fall time $\leq 2.4\text{ ns}$)

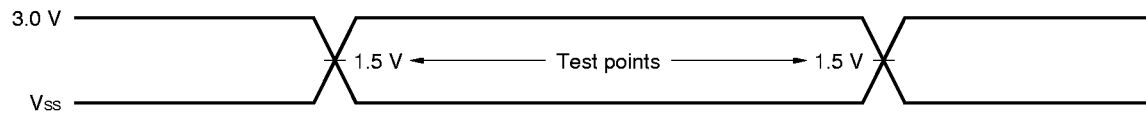


Output waveform

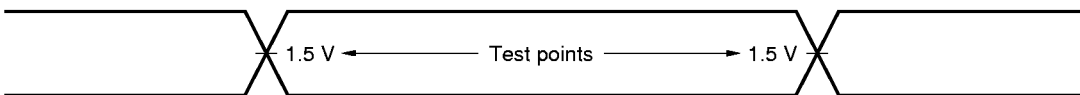


3.3 V LVTTTL Interface

Input waveform (Rise / Fall time $\leq 3.0\text{ ns}$)



Output waveform

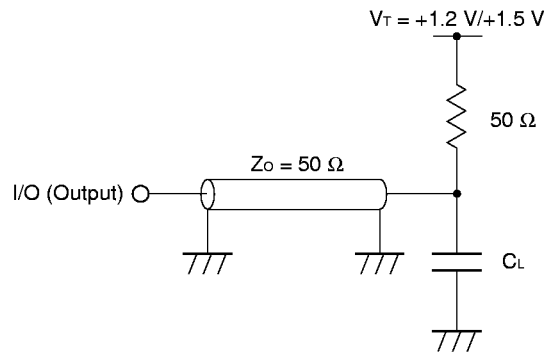


Output load condition

C_L : 30 pF

5 pF (TKHQX1, TKHQX2, TGLQX, TGHQZ, TKHQZ)

Figure1 External load at test



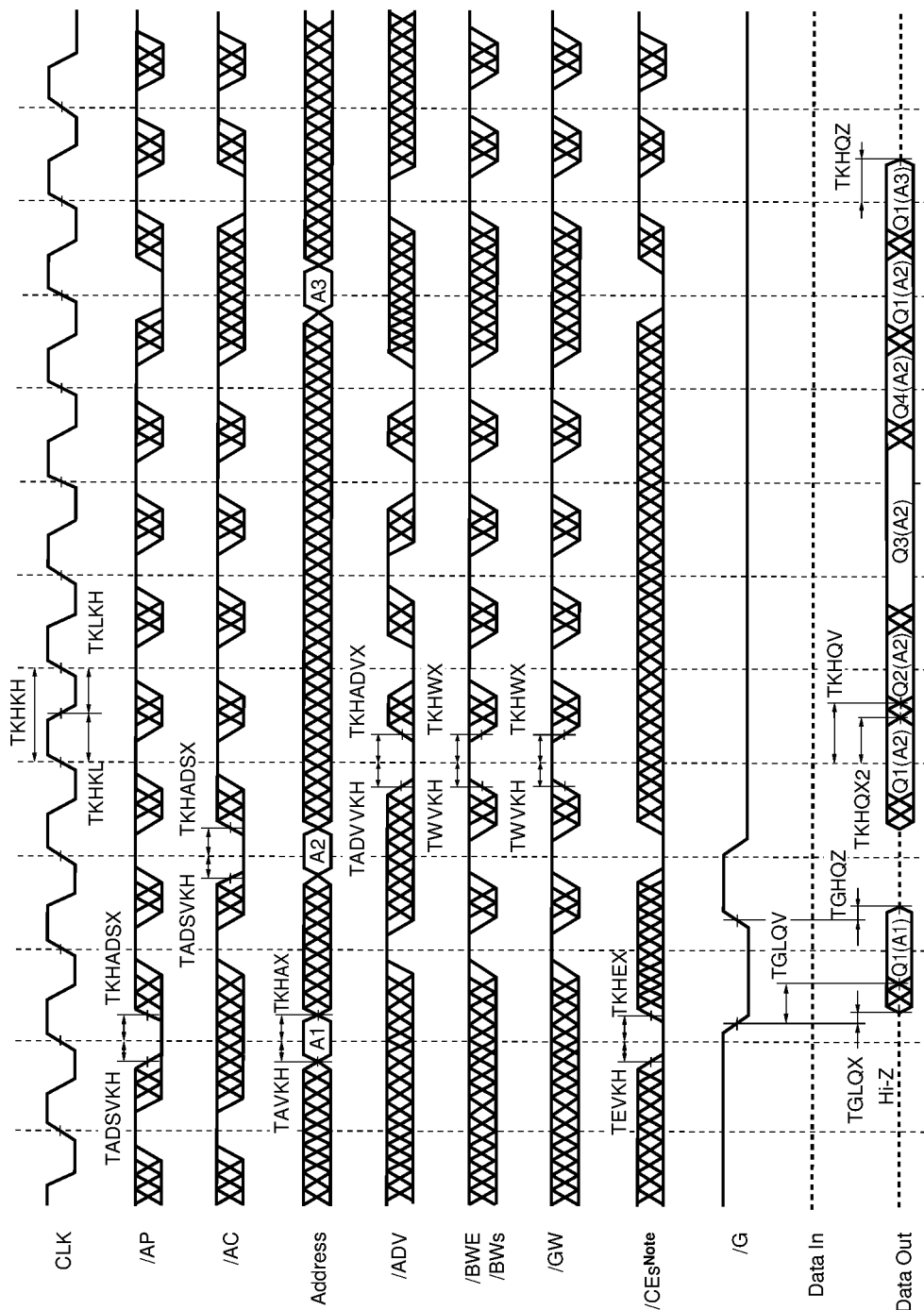
Remark C_L includes capacitances of the probe and jig, and stray capacitances.

Read and Write Cycle

Parameter		Symbol		-A85 (100 MHz)		-A90 (90 MHz)		Unit	Note
		Standard	Alias	MIN.	MAX.	MIN.	MAX.		
Cycle time		TKHKH	TCYC	10	–	11	–	ns	
Clock access time		TKHQV	TCD	–	8.5	–	9	ns	
Output enable access time		TGLQV	TOE	–	3.5	–	3.5	ns	
Clock high to output active		TKHQX1	TDC1	2	–	2	–	ns	
Clock high to output change		TKHQX2	TDC2	3	–	3	–	ns	
Output enable to output active		TGLQX	TOLZ	0	–	0	–	ns	
Output disable to output high-Z		TGHQZ	TOHZ	0	3.5	0	3.5	ns	
Clock high to output high-Z		TKHQZ	TCZ	2	4	2	4	ns	
Clock high pulse width		TKHKL	TCH	2.5	–	2.5	–	ns	
Clock low pulse width		TKLKH	TCL	2.5	–	2.5	–	ns	
Setup times	Address	TAVKH	TAS	2	–	2	–	ns	
	Address status	TADSVKH	TSS						
	Data in	TDVKH	TDS						
	Write enable	TWVKH	TWS						
	Address advance	TADVVKH	–						
	Chip enable	TEVKH	–						
Hold times	Address	TKHAX	TAH	0.5	–	0.5	–	ns	
	Address status	TKHADSX	TSH						
	Data in	TKHDX	TDH						
	Write enable	TKHWX	TWH						
	Address advance	TKHADVX	–						
	Chip enable	TKHEX	–						
Power down entry setup		TZZES	TZZES	5	–	5	–	ns	1
Power down entry hold		TZZEH	TZZEH	1	–	1	–	ns	1
Power down recovery setup		TZZRS	TZZRS	6	–	6	–	ns	1
Power down recovery hold		TZZRH	TZZRH	0	–	0	–	ns	1

Note 1. Although ZZ signal input is asynchronous, the signal must meet specified setup and hold times in order to be recognized.

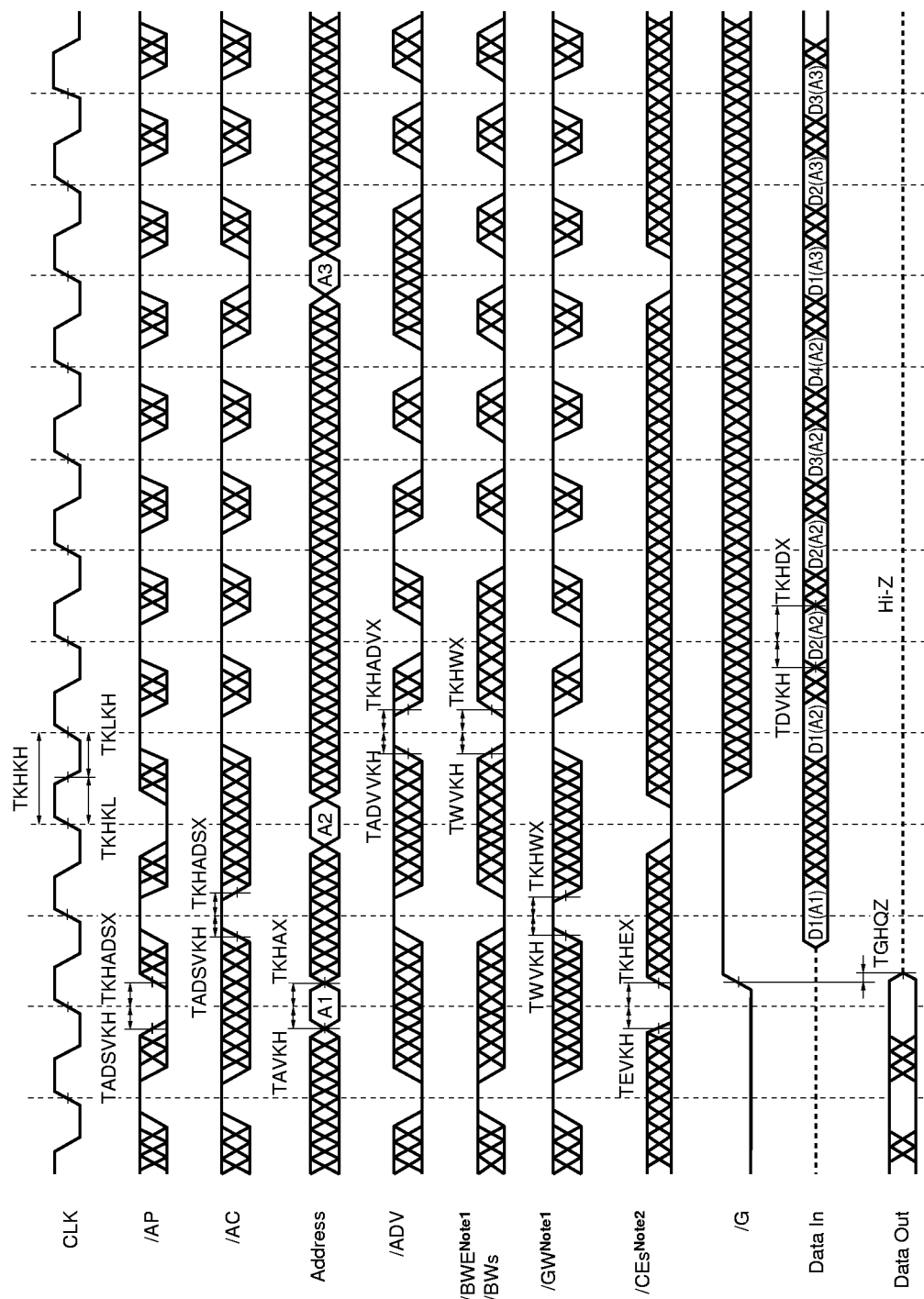
READ CYCLE



Note /CEs refers to /CE, CE2 and /CE2. When /CEs is LOW, /CE and /CE2 are LOW and CE2 is HIGH.
When /CEs is HIGH, /CE and /CE2 are HIGH and CE2 is LOW.

Remark Qn(A2) refers to output from address A2. Q1-Q4 refer to outputs according to burst sequence.

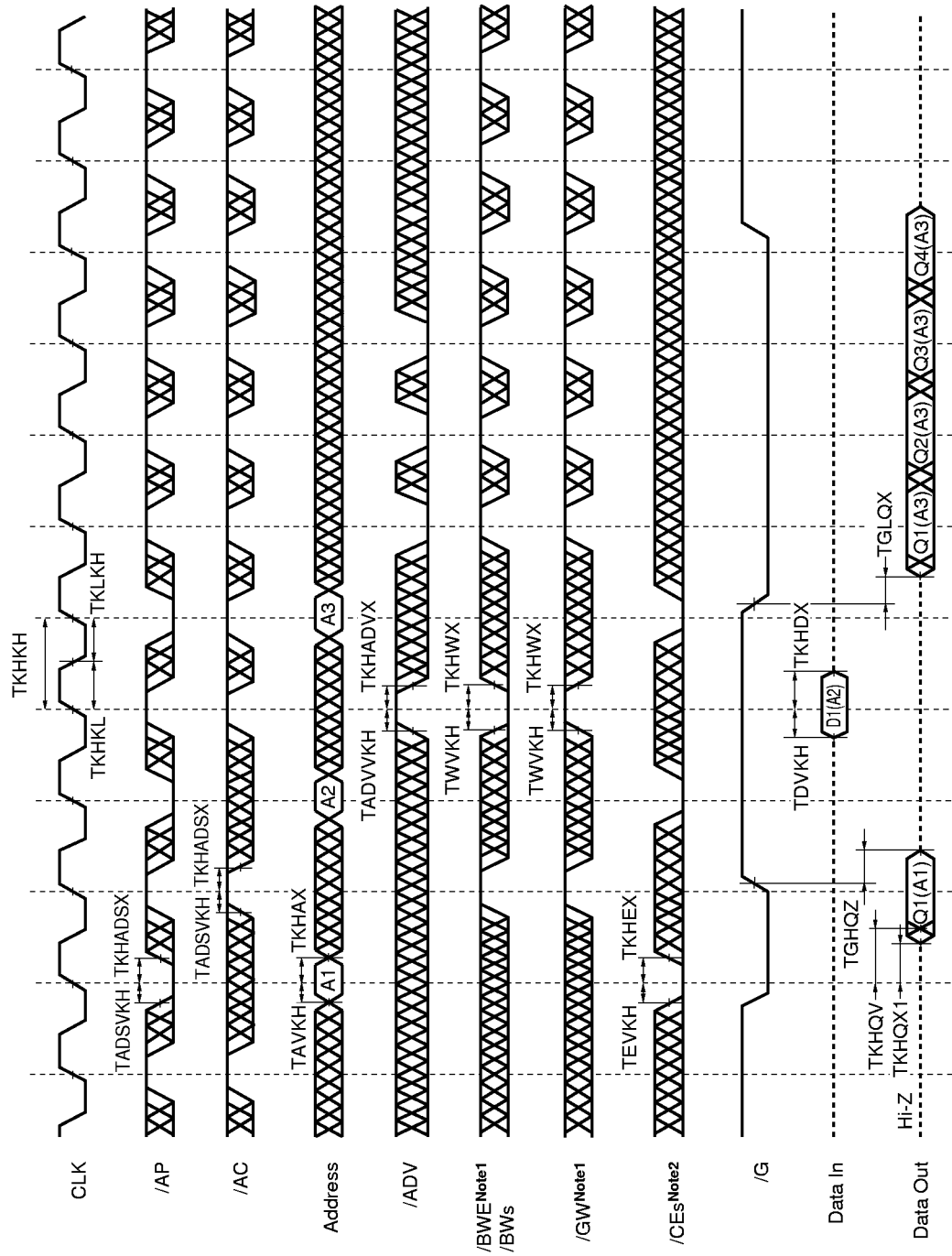
WRITE CYCLE



Notes 1. All bytes WRITE can be initiated by /GW LOW or /GW HIGH and /BWE, /BW1-/BW4 LOW.

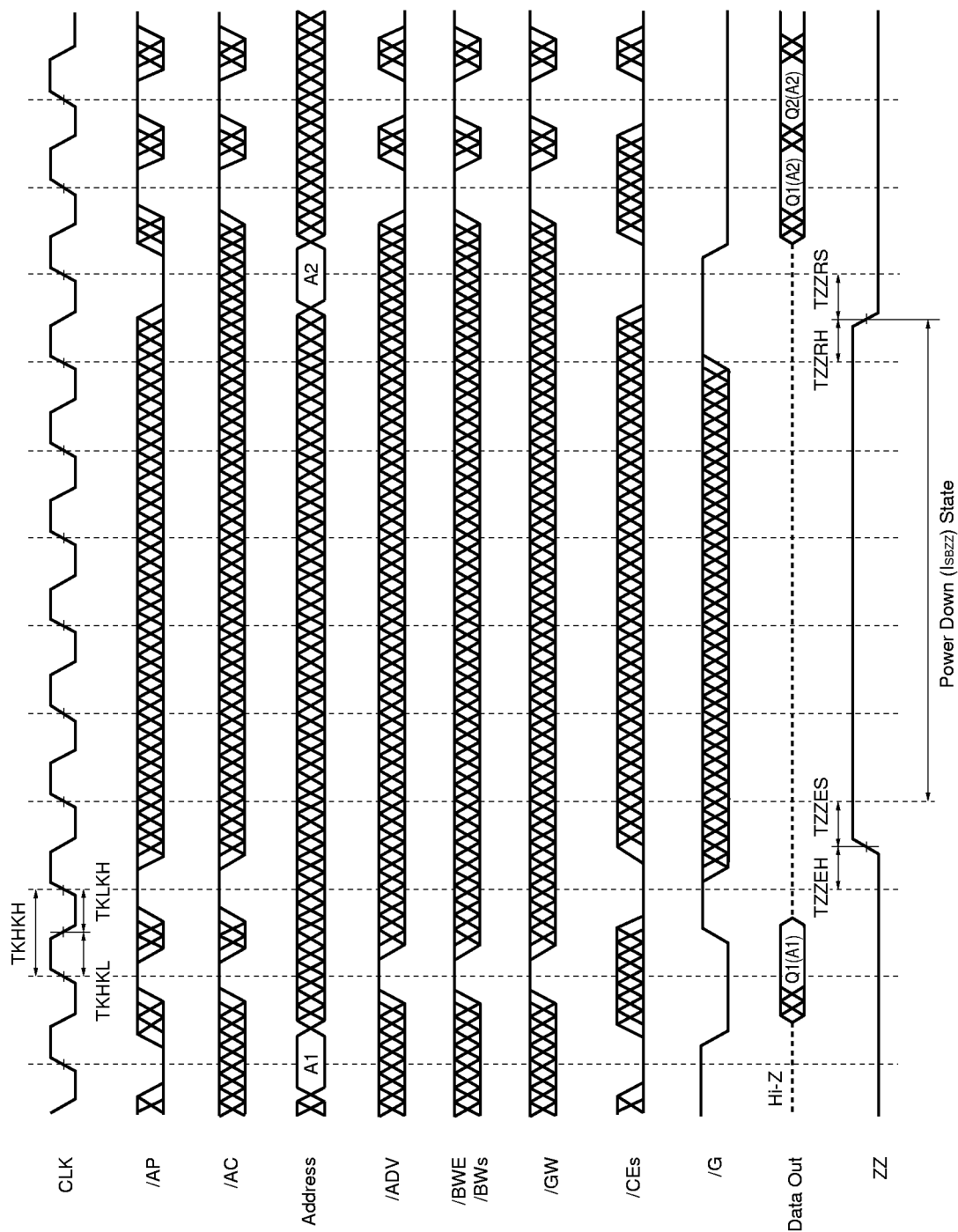
2. /CEs refers to /CE, CE2 and /CE2. When /CEs is LOW, /CE and /CE2 are LOW and CE2 is HIGH. When /CEs is HIGH, /CE and /CE2 are HIGH and CE2 is LOW.

READ / WRITE CYCLE

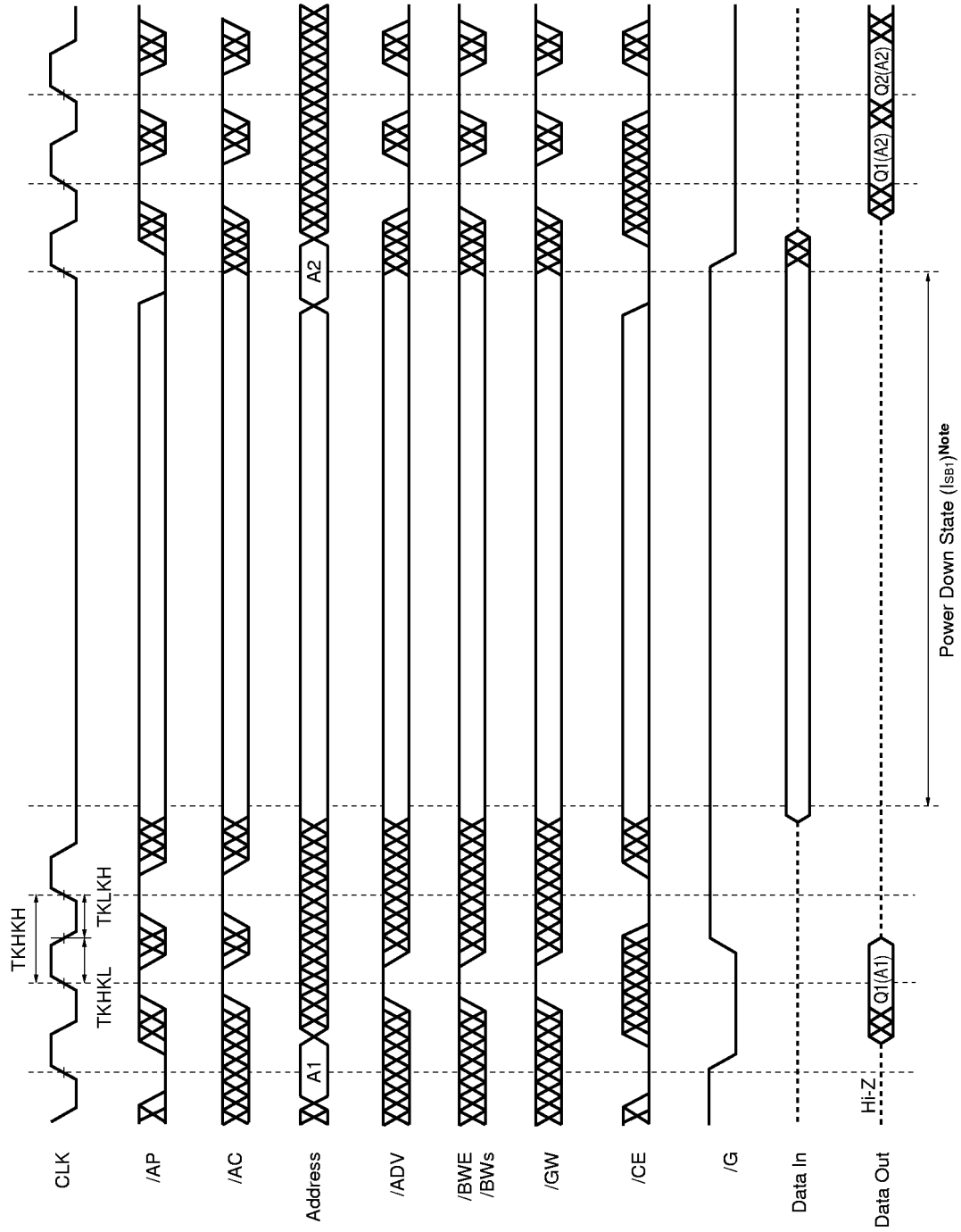


- Notes**
1. All bytes WRITE can be initiated by /GW LOW or /GW HIGH and /BWE, /BW1-/BW4 LOW.
 2. /CEs refers to /CE, CE2 and /CE2. When /CEs is LOW, /CE and /CE2 are LOW and CE2 is HIGH. When /CEs is HIGH, /CE and /CE2 are HIGH and CE2 is LOW.

POWER DOWN (ZZ) CYCLE



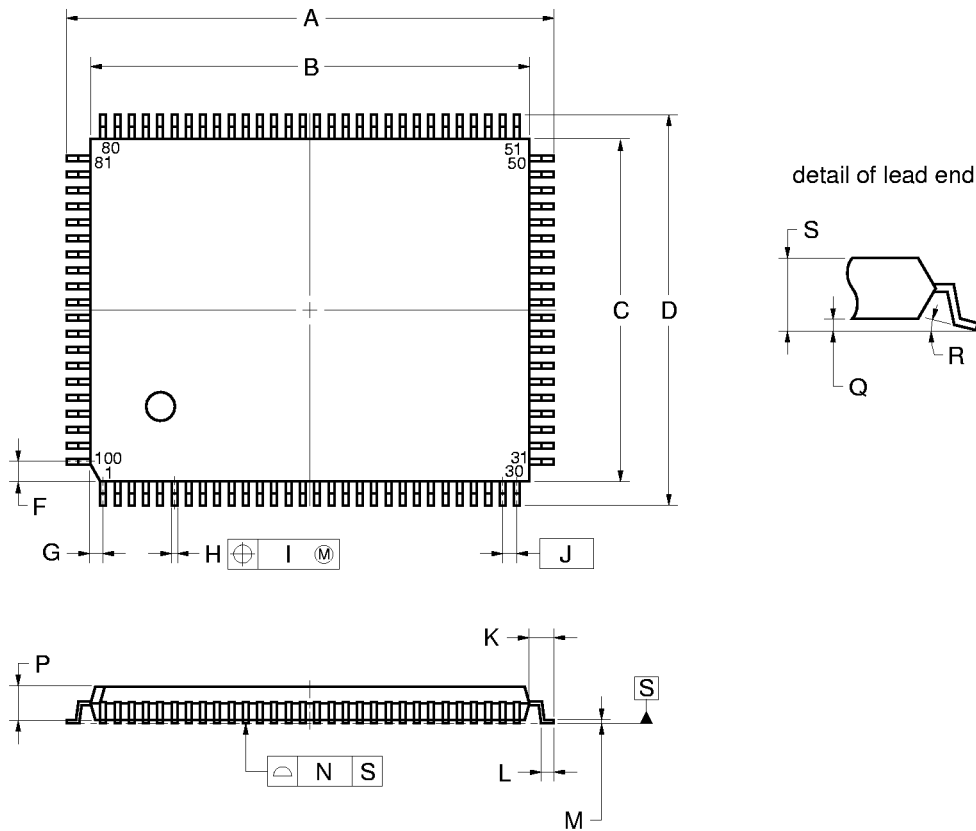
STOP CLOCK CYCLE



Note $V_{IN} \leq 0.2 \text{ V}$ or $V_{IN} \geq V_{DD} - 0.2 \text{ V}$, $V_{IO} \leq 0.2 \text{ V}$

★ Package Drawing

100-PIN PLASTIC LQFP (14x20)



NOTE

Each lead centerline is located within 0.13 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	22.0±0.2
B	20.0±0.2
C	14.0±0.2
D	16.0±0.2
F	0.825
G	0.575
H	0.32 ^{+0.08} _{-0.07}
I	0.13
J	0.65 (T.P.)
K	1.0±0.2
L	0.5±0.2
M	0.17 ^{+0.06} _{-0.05}
N	0.10
P	1.4
Q	0.125±0.075
R	3° ^{+7°} _{-3°}
S	1.7 MAX.

S100GF-65-8ET-1

Recommended Soldering Condition

Please consult with our sales offices for soldering conditions of the μ PD4382161, 4382181, 4382321 and 4382361.

Types of Surface Mount Devices

μ PD4382161GF : 100-pin plastic LQFP (14 × 20 mm)

μ PD4382181GF : 100-pin plastic LQFP (14 × 20 mm)

μ PD4382321GF : 100-pin plastic LQFP (14 × 20 mm)

μ PD4382361GF : 100-pin plastic LQFP (14 × 20 mm)