NEC

MOS INTEGRATED CIRCUIT

μPD431231L

1M-BIT CMOS SYNCHRONOUS FAST SRAM
32K-WORD BY 32-BIT
PIPELINED OPERATION

Description

The μPD431231L is a 32,768-word by 32-bit synchronous static RAM fabricated with advanced CMOS technology using N-channel four-transistor memory cell.

The μPD431231LGF integrates 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 μPD431231LGF is 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 μPD431231LGF is packaged in 100-pin plastic TQFP with a 1.4 mm package thickness (LQFP in EIAJ) for high density and low capacitive loading.

Features

- 3.3 V (Chip) / 2.5V (I/O) Supply
- Synchronous Operation
- Internally self-timed Write control
- Burst Read / Write: Interleaved Burst and Linear Burst Sequence
- Fully Registered Inputs and Outputs for Pipelined operation
- All Registers triggered off Positive Clock Edge
- 2.5 V LVTTL Compatible: All Inputs and Outputs
- Fast Clock Access Time: 7 ns (83 MHz), 8 ns (66 MHz)
- Asynchronous Output Enable: /G
- Burst Sequence Selectable: MODE
- Sleep Mode: ZZ (ZZ =O pen or Low: Normal Operation)
- Separate Byte Write Enable: /BW1 - /BW4, /BWE and Global Write Enable: /GW
- Three Chip Enables for Easy Depth Expansion
- Common I/O Using Three State Outputs

Ordering Information

Part number	Access Time	Clock frequency	Package
μPD431231LGF-A7	7.0 ns	83 MHz	100-pin plastic TQFP (14 x 20 mm)
μPD431231LGF-A8	8.0 ns	66 MHz	100-pin plastic TQFP (14 x 20 mm)

The information in this document is subject to change without notice.

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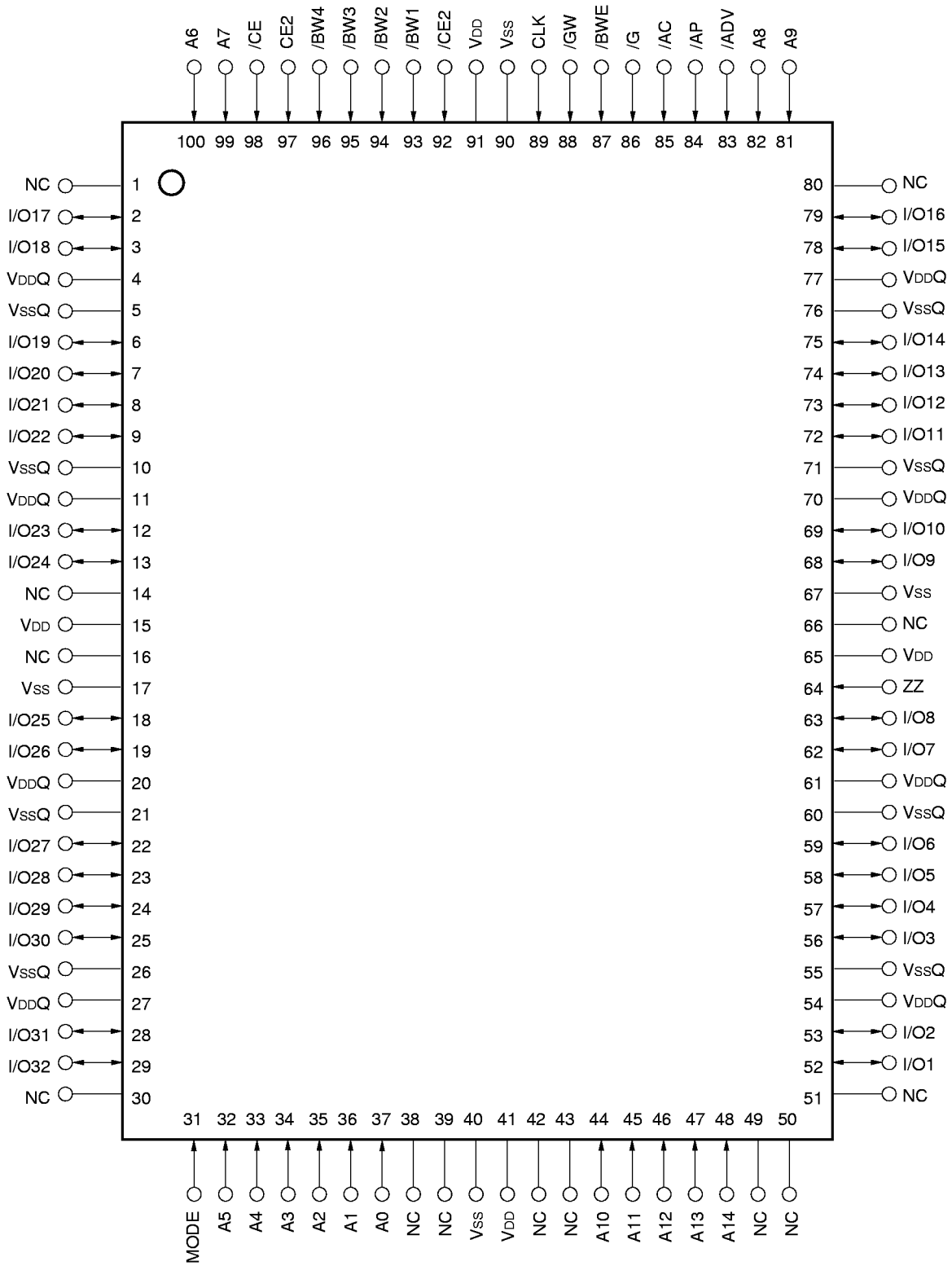
The mark ★ shows major revised points.

Pin Configuration (Marking Side)

/xxx indicates active low signal.

100-pin plastic TQFP (14 x 20 mm)

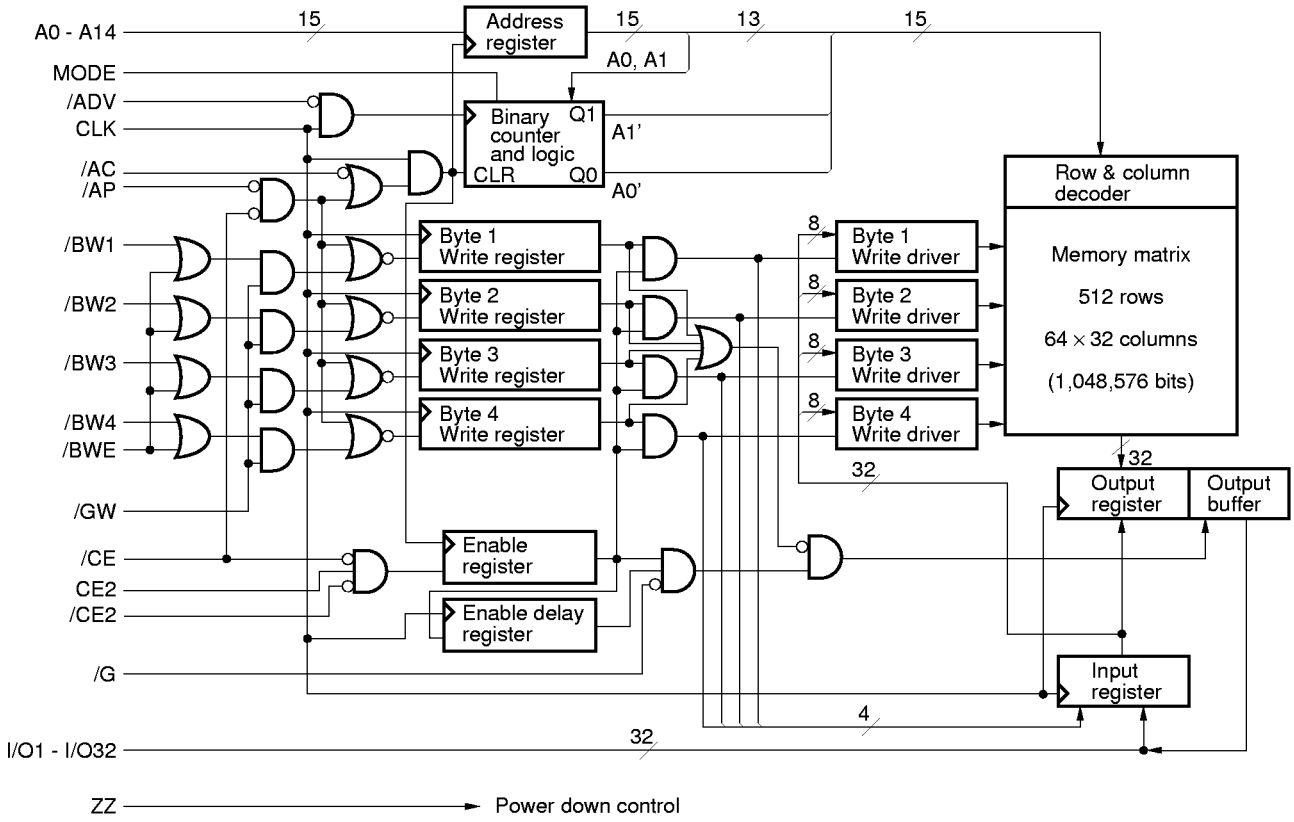
[μPD431231LGF]



Pin Identification

Symbol	Pin No.	Description
A0 - A14	37, 36, 35, 34, 33, 32, 100, 99, 82, 81, 44, 45, 46, 47, 48	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
/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
/BWE1 - /BWE4, /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 Have to be tied to V_{DD} or GND 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
$V_{DD}Q$	4, 11, 20, 27, 54, 61, 70, 77	Output Buffer Power Supply
$V_{SS}Q$	5, 10, 21, 26, 55, 60, 71, 76	Output Buffer Ground
NC	1, 14, 16, 30, 38, 39, 42, 43, 49, 50, 51, 66, 80	No Connection

Block Diagram



Burst Sequence

Interleaved Burst Sequence Table (MODE = Open or V_{DD})

External Address	A14 - A2, A1, A0
1st Burst Address	A14 - A2, A1, /A0
2nd Burst Address	A14 - A2, /A1, A0
3rd Burst Address	A14 - A2, /A1, /A0

Linear Burst Sequence Table (MODE = V_{SS})

External Address	A14 - A2, 0, 0	A14 - A2, 0, 1	A14 - A2, 1, 0	A14 - A2, 1, 1
1st Burst Address	A14 - A2, 0, 1	A14 - A2, 1, 0	A14 - A2, 1, 1	A14 - A2, 0, 0
2nd Burst Address	A14 - A2, 1, 0	A14 - A2, 1, 1	A14 - A2, 0, 0	A14 - A2, 0, 1
3rd Burst Address	A14 - A2, 1, 1	A14 - A2, 0, 0	A14 - A2, 0, 1	A14 - A2, 1, 0

Asynchronous Truth Table

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

Remark X means "don't care."

Synchronous Truth Table

Operation	/CE	CE2	/CE2	/AP	/AC	/ADV	/WRITE	CLK	Address
Deselected Note	H	X	X	X	L	X	X	L → H	N/A
Deselected Note	L	L	X	L	X	X	X	L → H	N/A
Deselected Note	L	X	H	L	X	X	X	L → H	N/A
Deselected Note	L	L	X	H	L	X	X	L → H	N/A
Deselected Note	L	X	H	H	L	X	X	L → H	N/A
Read Cycle / Begin Burst	L	H	L	L	X	X	X	L → H	External
Read Cycle / Begin Burst	L	H	L	H	L	X	H	L → H	External
Read Cycle / Continue Burst	X	X	X	H	H	L	H	L → H	Next
Read Cycle / Continue Burst	H	X	X	X	H	L	H	L → H	Next
Read Cycle / Suspend Burst	X	X	X	H	H	H	H	L → H	Current
Read Cycle / Suspend Burst	H	X	X	X	H	H	H	L → H	Current
Write Cycle / Begin Burst	L	H	L	H	L	X	L	L → H	External
Write Cycle / Continue Burst	X	X	X	H	H	L	L	L → H	Next
Write Cycle / Continue Burst	H	X	X	X	H	L	L	L → H	Next
Write Cycle / Suspend Burst	X	X	X	H	H	H	L	L → H	Current
Write Cycle / Suspend Burst	H	X	X	X	H	H	L	L → H	Current

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

Remarks **1.** X means "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

Operation	/GW	/BWE	/BW1	/BW2	/BW3	/BW4
Read Cycle	H	H	X	X	X	X
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	X	X	X	X	X

Remark X means "don't care."

Pass-Through Truth Table

Previous Cycle				Present Cycle						Next Cycle
Operation	Add	/WRITE	I/O	Operation	Add	/CEs	/WRITE	/G	I/O	Operation
Write Cycle	Ak	L	Dn(Ak)	Read Cycle (Begin Burst)	Am	L	H	L	Q1(Ak)	Read Q1(Am)
				Deselected	-	H	X	X	Hi-Z	No Carry Over from Previous Cycle

Remarks **1.** X means "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.

/CEs = L means /CE is LOW, /CE2 is LOW and CE2 is HIGH.

/CEs = H means /CE is HIGH or /CE2 is HIGH or CE2 is LOW.

ZZ (Sleep) Truth Table

ZZ	Chip Status
≤ 0.2V	Active
Open	Active
≥ V_{DD} – 0.2V	Sleep

Electrical Specifications

Absolute Maximum Ratings

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Note
Supply voltage	V_{DD}		–0.5		+4.6	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}		3.1	3.3	3.6	V
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 Note		+0.7	V

Note –0.8 V MIN. (Pulse Width : 2 ns)

Capacitance (T_A = 25 °C, f = 1MHz)

Parameter	Symbol	Test conditions	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 sampled and not 100% tested.

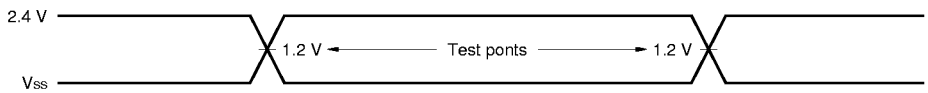
DC Characteristics (T_A = 0 to 70°C, V_{DD} = 3.3 V ± 0.165 V)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
	Input Leakage Current	I_{LI}	V_{IN}(except ZZ and MODE) = 0 V to V_{DD}	–2		+2	μA
★			ZZ, MODE = 0 V or V_{DD}	–5		+5	
	I/O Leakage Current	I_{LO}	$V_{I/O}$ = 0 V to V_{DDQ}, Output disabled	–2		+2	μA
	Operating Supply Current	I_{CC}	Device selected, Cycle = MAX. $V_{IN} \leq V_{IL}$ or $V_{IN} \geq V_{IH}$, $I_{I/O}$ = 0 mA			130	mA
		I_{CC1}	Suspend cycle, Cycle = MAX. /AC, /AP, /ADV ≥ VIH, $V_{IN} \leq$ 0.2 V, $I_{I/O}$ = 0 mA			45	
	Standby Supply Current	I_{SB}	Device deselected, Cycle = 0 MHz $V_{IN} \leq V_{IL}$ or V_{IN} V_{IH}, All Inputs Static			20	mA
★		I_{SB1}	Device deselected, Cycle = 0 MHz $V_{IN} \leq$ 0.2 V or $V_{IN} \geq V_{DD}$ – 0.2 V, $V_{I/O} \leq$ 0.2 V		0.5	5	
★			All Inputs Static; T_A = 25 °C			1	
	Power Down Supply Current	I_{SBZZ}	ZZ ≥ V_{DD} – 0.2 V, $V_{I/O} \leq V_{DDQ}$ + 0.2 V Temp. 25 °C		0.5	1	mA
	Output High Voltage	V_{OH}	I_{OH} = –2 mA	2.1			V
	Output Low Voltage	V_{OL}	I_{OL} = 2 mA			0.3	V

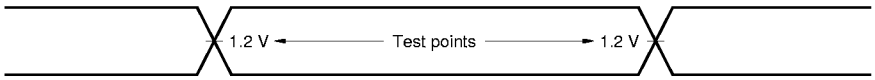
AC Characteristics (T_A = 0 to 70 °C, V_{DD} = 3.3 V ± 0.165 V)

AC Test Conditions

★ **Input waveform (Rise / Fall time ≤ 2.4 ns)**



Output waveform

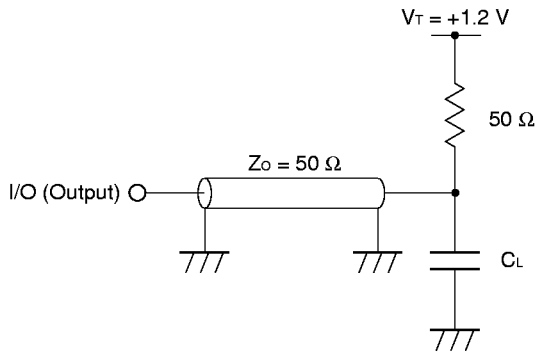


Output load

L : 30 pF

5 pF (TDC1, TDC2, TOLZ, TOHZ, TCZ)

Figure1 External load at test



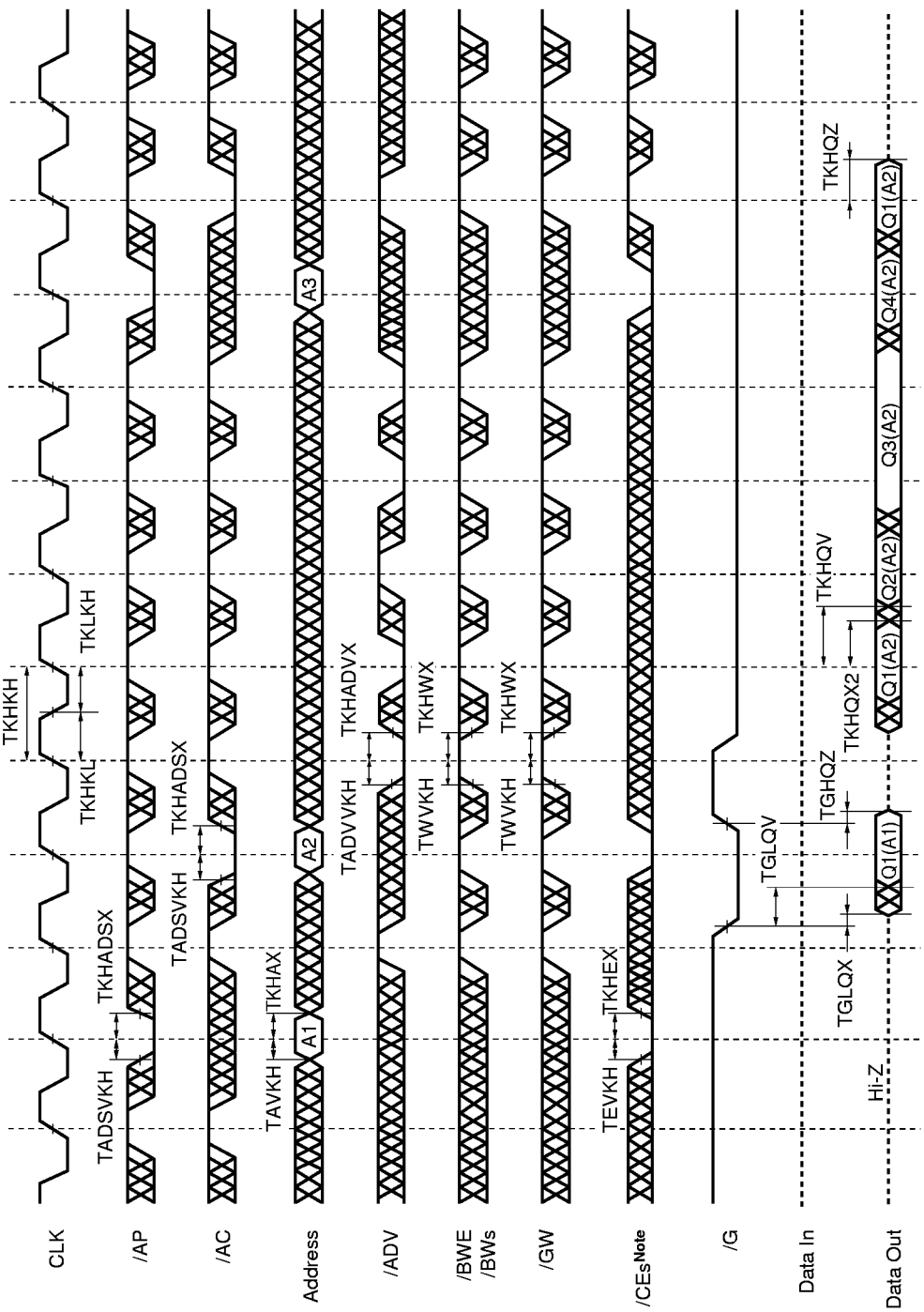
Remark C_L includes capacitances of the probe and jig, and stray capacitances.

Read and Write Cycle

Parameter		Symbol		-A7 (83MHz)		-A8 (66MHz)		Unit	Note
		Standard	Alias	MIN.	MAX.	MIN.	MAX.		
Cycle Time		TKHKH	TCYC	12	–	15	–	ns	
Clock Access Time		TKHQV	TCD	–	7	–	8	ns	
Output Enable Access Time		TGLQV	TOE	–	5	–	5	ns	
Clock High to Output Active		TKHQX1	TDC1	0	–	0	–	ns	
Clock High to Output Change		TKHQX2	TDC2	2	–	2	–	ns	
Output Enable to Output Active		TGLQX	TOLZ	0	–	0	–	ns	
Output Disable to Output High-Z		TGHQZ	TOHZ	0	5	0	5	ns	
Clock High to Output High-Z		TKHQZ	TCZ	2	5	2	5	ns	
Clock High Pulse Width		TKHKL	TCH	4.5	–	5	–	ns	
Clock Low Pulse Width		TKLKH	TCL	4.5	–	5	–	ns	
Setup Times	Address	TAVKH	TAS	2.5	–	2.5	–	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	8	–	8	–	ns	1
Power Down Entry Hold		TZZEH	TZZEH	0	–	0	–	ns	1
Power Down Recovery Setup		TZZRS	TZZRS	8	–	8	–	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.

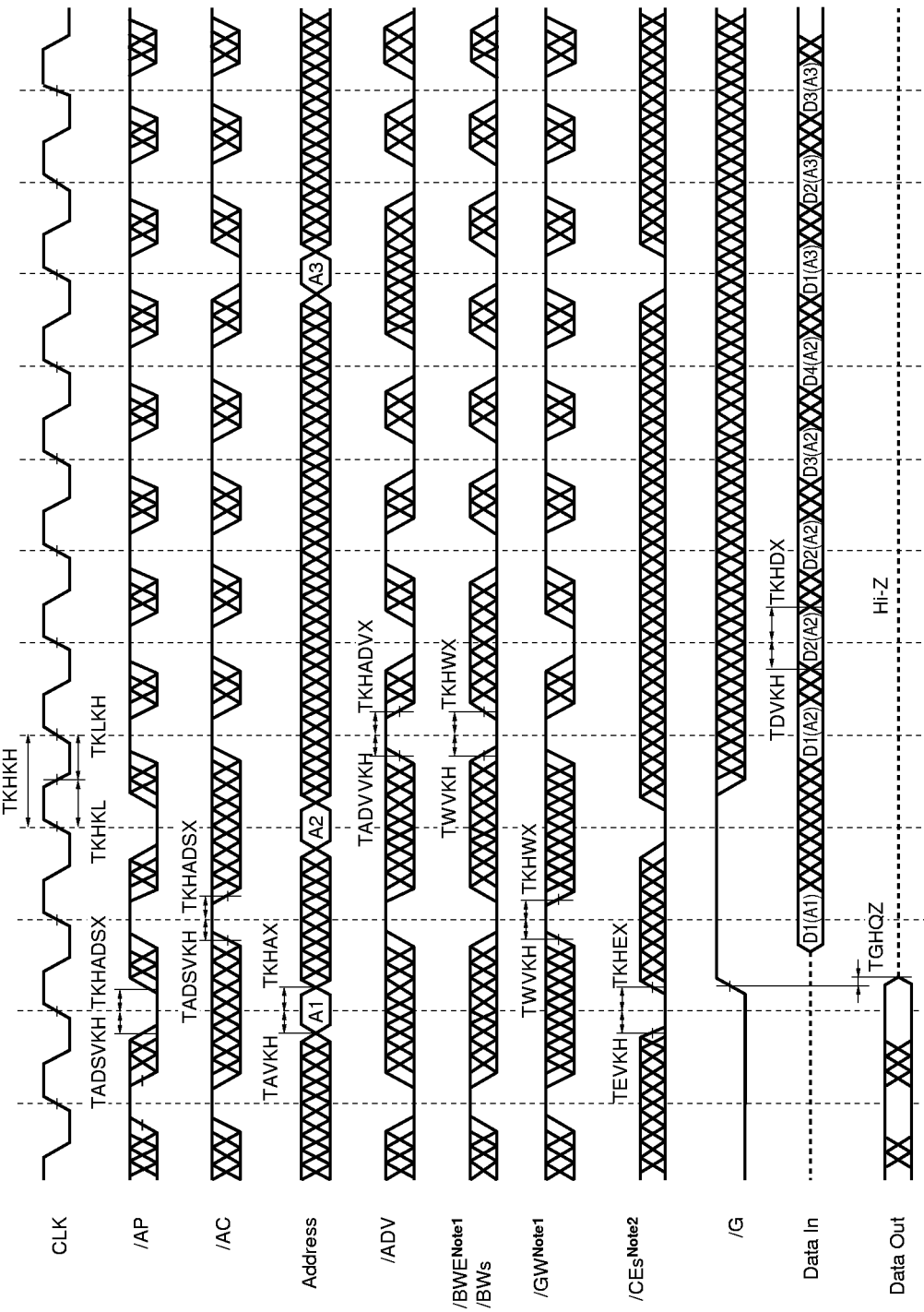
READ CYCLE



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

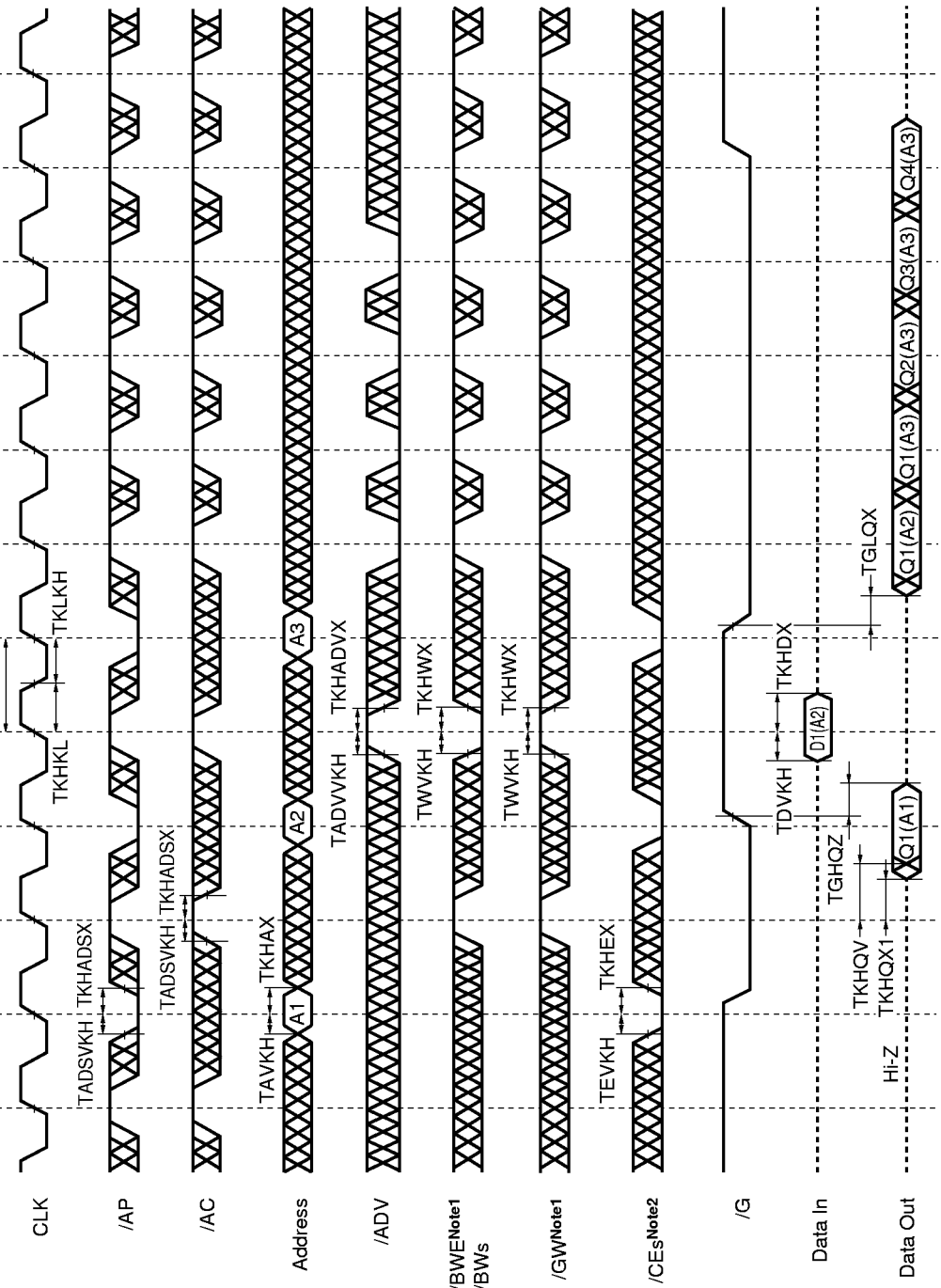


Notes 1. All bytes WRITE can be initiated by /GW LOW or /GW HIGH and /BWE, /BW1-/BW4 LOW.

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

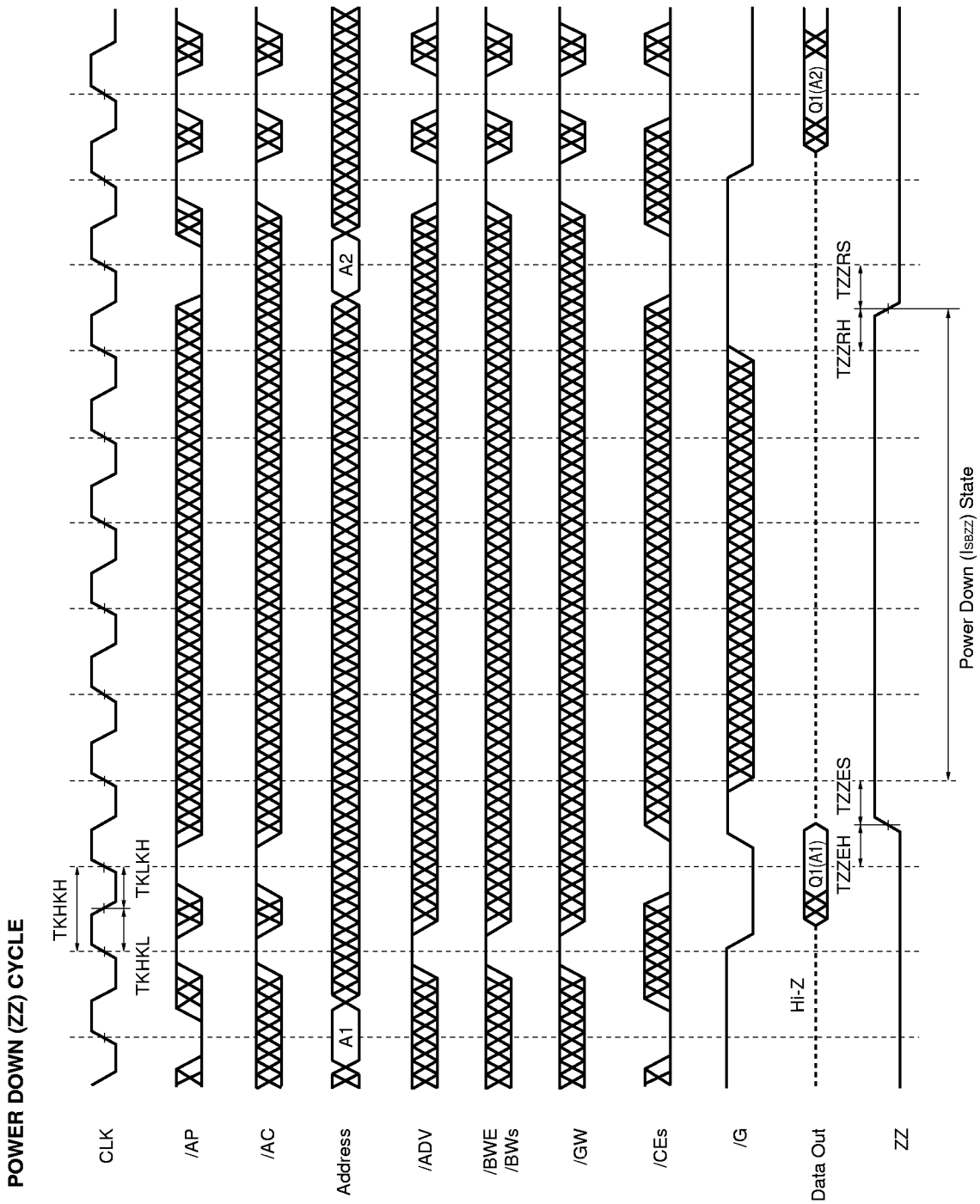


Notes 1. All bytes WRITE can be initiated by /GW LOW or /GW HIGH and /BWE, /BW1-/BW4 LOW.

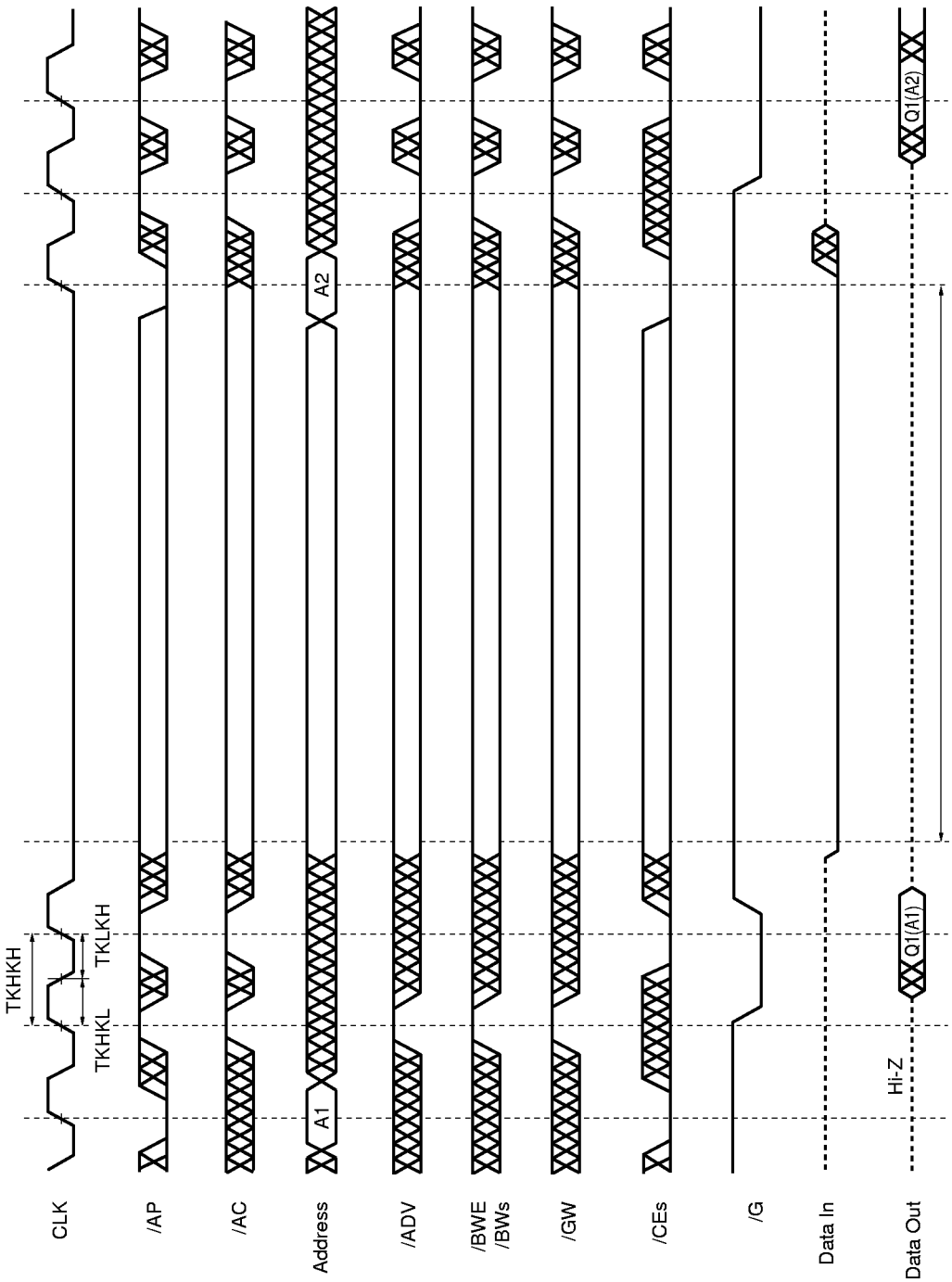
2. /CEs refers to /CE, CE2 and /CE2. When /CEs is LOW, /CE and /CE2 are LOW and CE2 is HIGH. When /CEs is HIGH, /CE and /CE2 are HIGH and CE2 is LOW.

★

POWER DOWN (ZZ) CYCLE



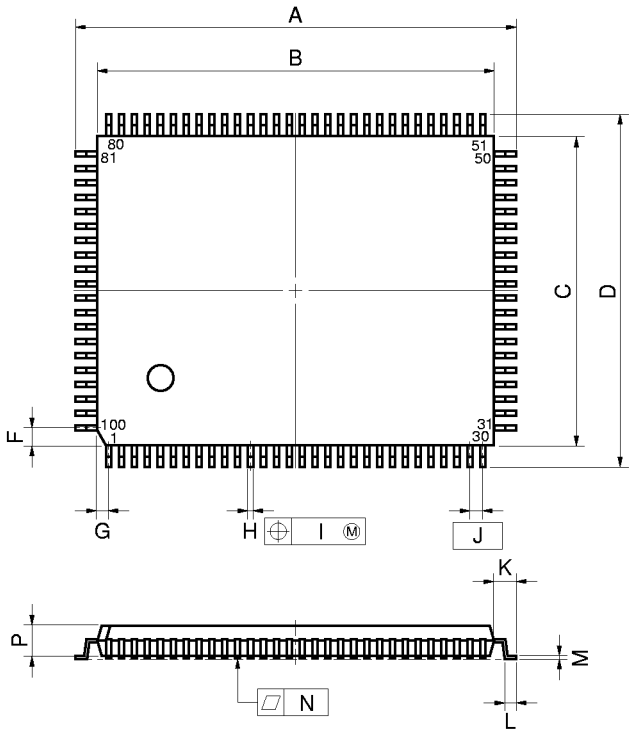
STOP CLOCK CYCLE

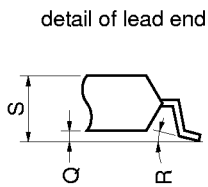


Note $V_{IN} \leq 0.2$ V or $V_{IN} \geq V_{DD} - 0.2$ V, $V_{I/O} \leq 0.2$ V

Package Drawing

100 PIN PLASTIC LQFP (14×20)





NOTE

Each lead centerline is located within 0.13 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	22.0±0.2	0.866±0.008
B	20.0±0.2	$0.787^{+0.009}_{-0.008}$
C	14.0±0.2	$0.551^{+0.009}_{-0.008}$
D	16.0±0.2	0.630±0.008
F	0.825	0.032
G	0.575	0.023
H	$0.32^{+0.08}_{-0.07}$	0.013±0.003
I	0.13	0.005
J	0.65 (T.P.)	0.026 (T.P.)
K	1.0±0.2	$0.039^{+0.009}_{-0.008}$
L	0.5±0.2	$0.020^{+0.008}_{-0.009}$
M	$0.17^{+0.06}_{-0.05}$	0.007±0.002
N	0.10	0.004
P	1.4	0.055
Q	0.125±0.075	0.005±0.003
R	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$	$3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$
S	1.7 MAX.	0.067 MAX.

S100GF-65-8ET

Remark TQFPs with a 1.4 mm package thickness are called LQFP in EIAJ.