

155M ATM INTEGRATED SAR CONTROLLER

DESCRIPTION

The μPD98405 (NEASCOT-S20™) is a high-performance SAR chip that performs segmentation and reassembly of ATM cells. It has a PCI bus interface, a SONET/SDH 155-Mbps framer, and a clock recovery circuit and supports an ABR function in hardware. The μPD98405 conforms to ATM Forum and has the functions of the AAL-5 SAR sublayer, ATM layer, and TC sublayer.

★ FEATURES

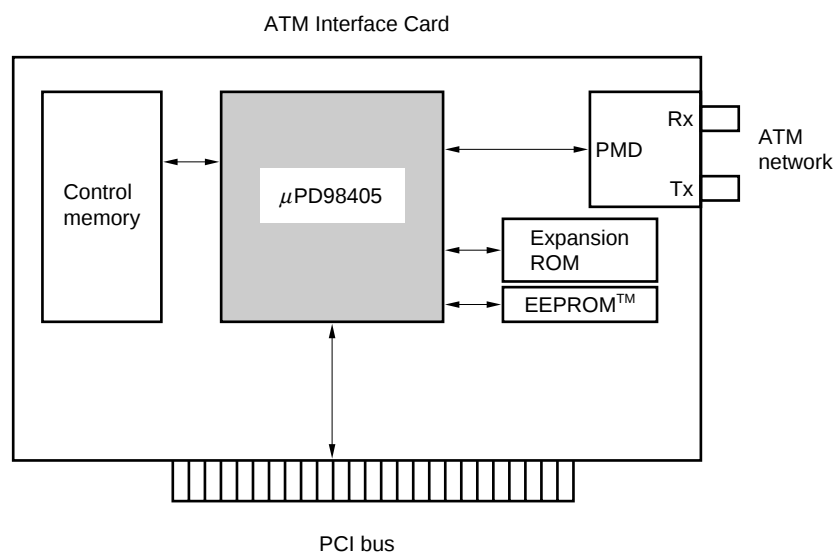
- Conforms to ATM Forum.
- Host bus interface supporting PCI bus/generic bus.
 - PCI interface (5/3.3 V, 32/64 bits, 33 MHz): Conforms to PCI Specification 2.1
 - Generic bus interface (5/3.3 V, 32 bits, 33 MHz)
- AAL-5 SAR sublayer, ATM layer, and TC sublayer functions
- Hardware support of AAL-5 processing
- Software support of non-AAL-5 traffic
- SONET STS-3c/SDH STM-1 155-Mbps framer function
- Clock recovery/clock synthesizer function
- Supports up to 32 K virtual channels (VCs)
- Sixteen traffic shapers for VBR for transmission scheduling
- Hardware support of CBR/VBR/ABR/UBR service
- Supports multi-cell burst transfer for transmission and reception
- MIB counter function
- Supports LAN emulation function
- Receive FIFO of 96 cells
- External PHY devices connectable: UTOPIA Level-1 interface
- 0.35-μm CMOS process, +5-/3.3-V power supply
 - Bus interface +5 V: +5-/3.3-V power supply
 - Bus interface +3.3 V: +3.3-V power supply
- 304-pin plastic QFP

ORDERING INFORMATION

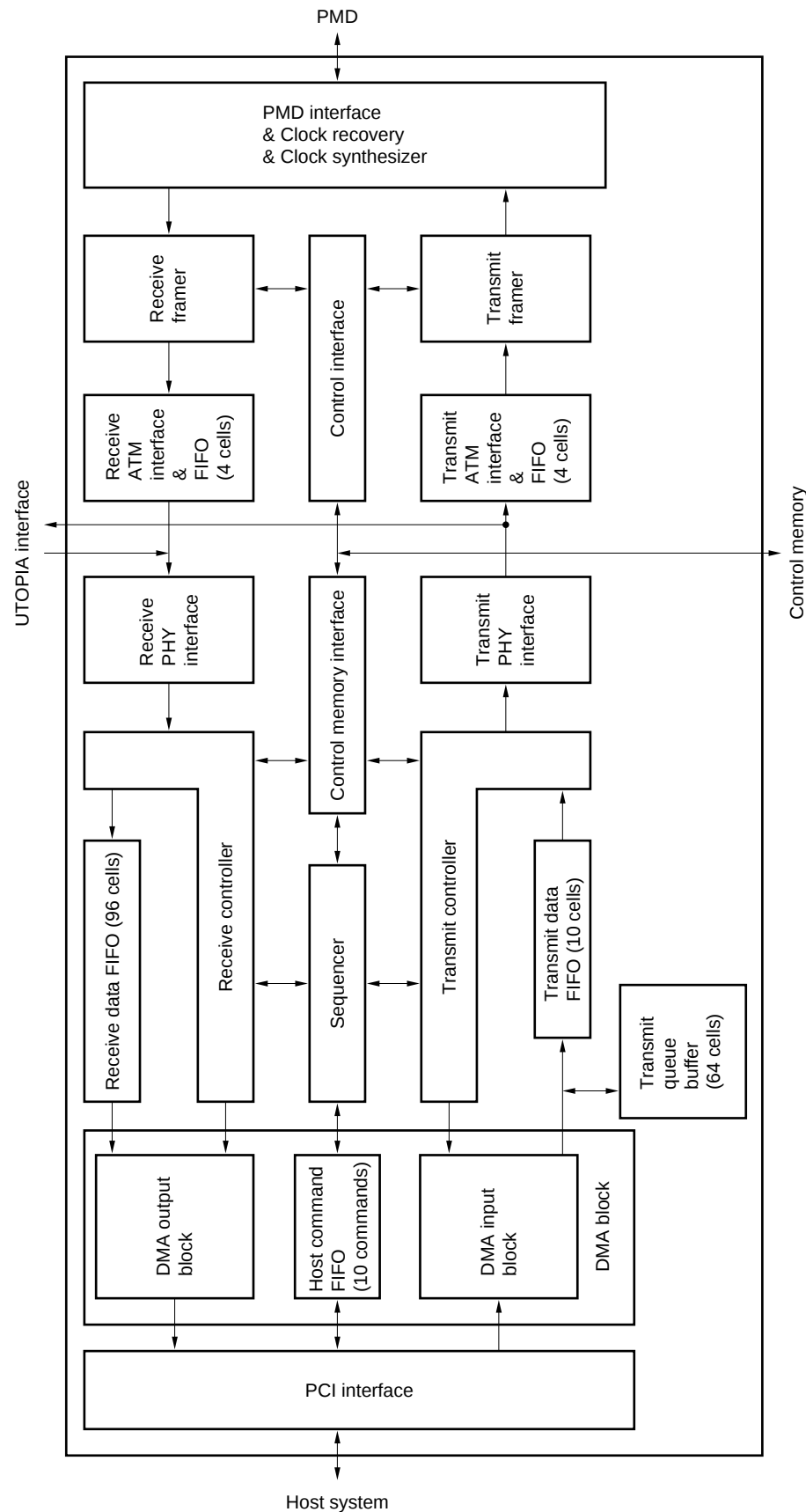
Part Number	Package
μPD98405GL-PMU	304-pin plastic QFP (0.5-mm fine pitch) (40 × 40 mm)

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

SYSTEM CONFIGURATION EXAMPLE

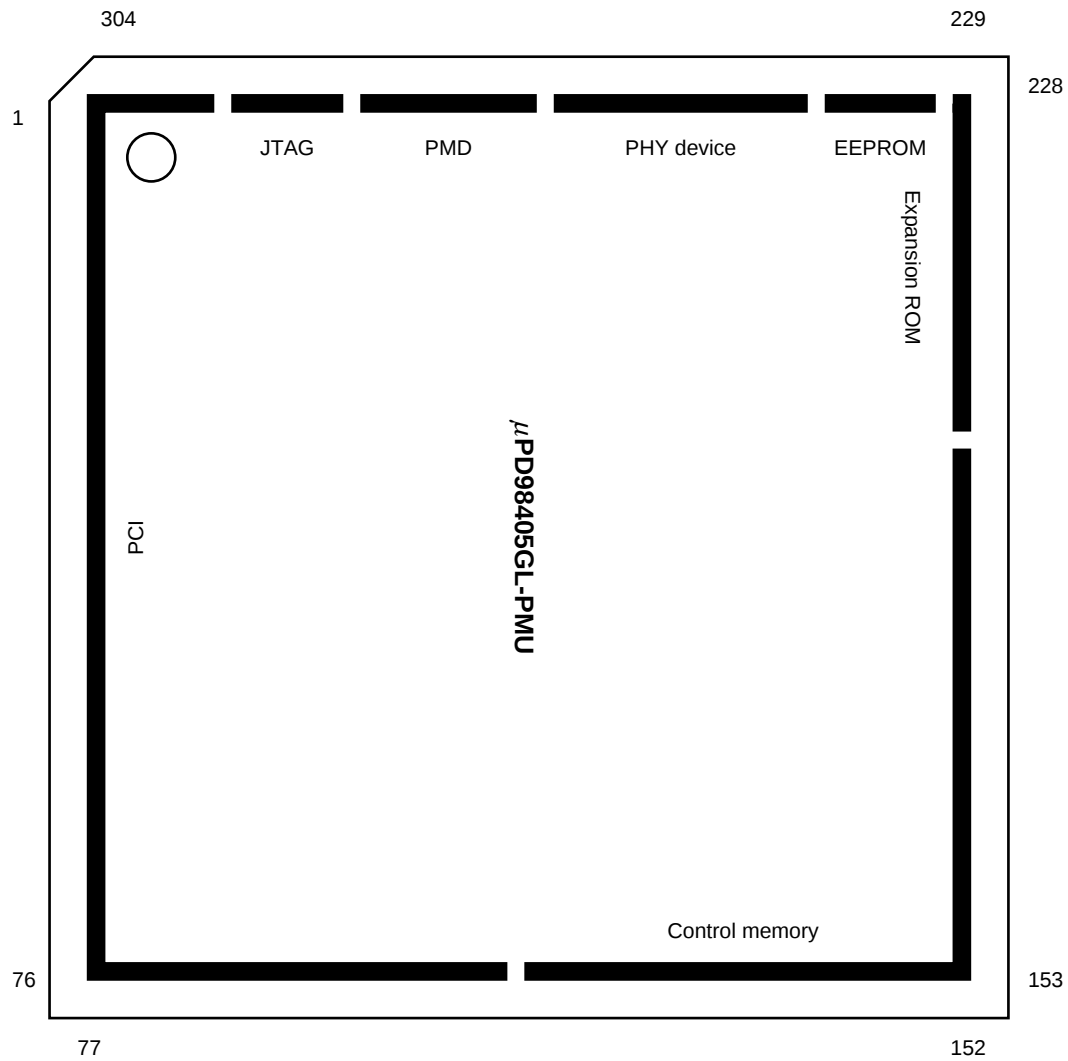


BLOCK DIAGRAM



OUTLINE OF PINS

304-pin plastic QFP (0.5-mm fine pitch) (40 × 40 mm)





PIN NAME

ABRT_B	: Abort	PERR_B	: Parity Error
ACK64_B	: Acknowledge 64-bit Transfer	PHCE_B	: PHY Chip Enable
AD63-AD0	: Address/Data	PHINT_B	: PHY Interrupt
AGND	: Ground for Analog Part	PHOE_B	: PHY Output Enable
ASEL_B	: Slave Address Select	PHRST_B	: PHY Reset
ATTN_B	: Attention	PHR/W_B	: PHY Read/Write
AV _{DD3}	: +3.3 V Power Supply for Analog Part	PHYALM	: Physical Alarm
BE3_B-BE0_B	: Byte Enable	RCLK	: Receive Clock
CA18-CA0	: Control Memory Address	RCIC	: Receive Clock Input Complement
CBE3_B-CBE0_B	: Local Port Byte Enable	RCIT	: Receive Clock Input True
CD31-CD0	: Control Memory Data	RDIC	: Receive Data Input Complement
CLK	: Clock	RDIT	: Receive Data Input True
COE_B	: Control Memory Output Enable	PDY_B	: Target Ready
CPAR3-CPAR0	: Control Memory parity	REFCLK	: Reference Clock
CWE_B	: Control Memory Write Enable	RENBL_B	: Receive Enable
DEVSEL_B	: Device Select	REQ64_B	: Request 64-bit Transfer
DR/W_B	: DMA Read/Write	REQ_B	: Request
EMPTY_B/RCLAV	: PHY Empty/Rx Cell Available	RGND	: Ground for Receive PLL Part
ERR_B	: Error	ROMA15-ROMA0	: Expansion ROM Address
E2PCLK	: Clock for EEPROM	ROMCS_B	: Expansion ROM Chip Select
E2PCS	: EEPROM Chip Select	ROMD7-ROMD0	: Expansion ROM Input Data
E2PDI	: Serial Data Input from EEPROM	ROMOE_B	: Expansion ROM Output Enable
E2PDO	: Serial Data Output to EEPROM	RSOC	: Receive Start Cell
FRAME_B	: Cycle Frame	RST_B	: Reset
FULL_B/TCLAV	: PHY Buffer full/Tx Cell Available	RV _{DD3}	: +3.3 V Power Supply for Receive PLL Part
GND	: Ground for Digital Part	Rx7-Rx0	: Receive Data Bus
GNT_B	: Grant	SCLK	: SAR System Clock
HGND	: Ground for High-Speed Part	SD	: Signal Detect
HV _{DD3}	: +3.3 V Power Supply for High-Speed Part	SEL_B	: Slave Select
IDSEL	: ID Select	SERR_B	: System Error
INITD	: Initialization Disable	SIZE2-SIZE0	: Burst Size
INTR_B	: Interrupt	SR/W_B	: Slave Read /Write
IRDY_B	: Initiator Ready	STOP_B	: Stop
JCK	: JTAG Test Pin	TCLK	: Transmit Clock
JDI	: JTAG Test Pin	TDOC	: Transmit Data Output Complement
JDO	: JTAG Test Pin	TDOT	: Transmit Data Output True
JMS	: JTAG Test Pin	TENBL_B	: Transmit Enable
JRST_B	: JTAG Test Pin	TEST	: Test Mode Pin
OE_B	: Output Enable	TFKC	: Transmit Reference Clock Complement
PAR	: Parity	TFKT	: Transmit Reference Clock True
PAR3-PAR0	: Bus Parity	TRDY_B	: Target Ready
PAR64	: Parity 64 bits	TSOC	: Transmit Start of Cell
PCBE7_B-PCBE0_B	: Bus Command and Byte Enables	Tx7-Tx0	: Transmit Data Bus
PCI_MODE	: PCI Mode	V _{DD3}	: +3.3 V Power Supply for Digital Part
		V _{DD5}	: +5 V Power Supply for Digital Part

★ PIN CONFIGURATION

304-pin plastic QFP (0.5-mm fine pitch) (40 × 40 mm)

No.	PCI Mode	Generic Mode	No.	PCI Mode	Generic Mode	No.	PCI Mode	Generic Mode	No.	PCI Mode	Generic Mode
1	GND	GND	39	AD12	AD12	77	GND	GND	115	AD32	—
2	V _{DD3}	V _{DD3}	40	AD11	AD11	78	V _{DD3}	V _{DD3}	116	PAR64	—
3	AD24	AD24	41	AD10	AD10	79	AD57	—	117	GND	GND
4	PCBE3_B	BE3_B	42	AD9	AD9	80	AD56	—	118	PCI_MODE	PCI_MODE
5	IDSEL	—	43	GND	GND	81	V _{DD5}	V _{DD5}	119	CD31	CD31
6	AD23	AD23	44	V _{DD5}	V _{DD5}	82	AD55	—	120	CD30	CD30
7	GND	GND	45	AD8	AD8	83	AD54	—	121	CD29	CD29
8	V _{DD5}	V _{DD5}	46	PCBE0_B	BE0_B	84	AD53	—	122	CD28	CD28
9	AD22	AD22	47	AD7	AD7	85	AD52	—	123	CD27	CD27
10	AD21	AD21	48	AD6	AD6	86	GND	GND	124	GND	GND
11	AD20	AD20	49	GND	GND	87	V _{DD3}	V _{DD3}	125	V _{DD3}	V _{DD3}
12	AD19	AD19	50	V _{DD3}	V _{DD3}	88	AD51	—	126	CD26	CD26
13	GND	GND	51	AD5	AD5	89	AD50	—	127	CD25	CD25
14	V _{DD3}	V _{DD3}	52	AD4	AD4	90	AD49	—	128	CD24	CD24
15	AD18	AD18	53	AD3	AD3	91	AD48	—	129	CD23	CD23
16	AD17	AD17	54	AD2	AD2	92	GND	GND	130	CD22	CD22
17	AD16	AD16	55	GND	GND	93	V _{DD5}	V _{DD5}	131	GND	GND
18	PCBE2_B	BE2_B	56	V _{DD5}	V _{DD5}	94	AD47	—	132	CD21	CD21
19	GND	GND	57	AD1	AD1	95	AD46	—	133	CD20	CD20
20	V _{DD5}	V _{DD5}	58	AD0	AD0	96	AD45	—	134	CD19	CD19
21	FRAME_B	SEL_B	59	ACK64_B	OE_B	97	AD44	—	135	CD18	CD18
22	IRDY_B	ASEL_B	60	REQ64_B	DRW_B	98	GND	GND	136	CD17	CD17
23	TRDY_B	RDY_B	61	GND	GND	99	V _{DD3}	V _{DD3}	137	GND	GND
24	DEVSEL_B	SR/W_B	62	V _{DD3}	V _{DD3}	100	AD43	—	138	V _{DD3}	V _{DD3}
25	GND	GND	63	PCBE7_B	SIZE2	101	AD42	—	139	CD16	CD16
26	V _{DD3}	V _{DD3}	64	PCBE6_B	SIZE1	102	AD41	—	140	CD15	CD15
27	STOP_B	ABRT_B	65	PCBE5_B	SIZE0	103	AD40	—	141	CD14	CD14
28	PERR_B	ERR_B	66	PCBE4_B	PAR3	104	GND	GND	142	CD13	CD13
29	SERR_B	—	67	V _{DD5}	V _{DD5}	105	V _{DD5}	V _{DD5}	143	CD12	CD12
30	PAR	—	68	GND	GND	106	AD39	—	144	CD11	CD11
31	GND	GND	69	AD63	PAR2	107	AD38	—	145	GND	GND
32	V _{DD5}	V _{DD5}	70	AD62	PAR1	108	AD37	—	146	CD10	CD10
33	PCBE1_B	BE1_B	71	AD61	PAR0	109	AD36	—	147	CD9	CD9
34	AD15	AD15	72	V _{DD3}	V _{DD3}	110	GND	GND	148	CD8	CD8
35	AD14	AD14	73	AD60	—	111	V _{DD3}	V _{DD3}	149	CD7	CD7
36	AD13	AD13	74	AD59	—	112	AD35	—	150	CD6	CD6
37	GND	GND	75	AD58	—	113	AD34	—	151	V _{DD3}	V _{DD3}
38	V _{DD3}	V _{DD3}	76	GND	GND	114	AD33	—	152	GND	GND

No.	PCI Mode	Generic Mode	No.	PCI Mode	Generic Mode	No.	PCI Mode	Generic Mode	No.	PCI Mode	Generic Mode
153	GND	GND	191	CBE3_B	CBE3_B	229	GND	GND	267	SD/ PHCE_B	SD/ PHCE_B
154	V _{DD3}	V _{DD3}	192	CBE2_B	CBE2_B	230	ROMOE_B	—	268	REFCLK/ PHINT_B	REFCLK/ PHINT_B
155	CD5	CD5	193	CBE1_B	CBE1_B	231	E2PDI	—	269	AV _{DD3}	AV _{DD3}
156	CD4	CD4	194	CBE0_B	CBE0_B	232	E2PDO	—	270	AGND	AGND
157	CD3	CD3	195	CWE_B	CWE_B	233	E2PCLK	—	271	TEST	TEST
158	CD2	CD2	196	COE_B	COE_B	234	E2PCS	—	272	HGND	HGND
159	CD1	CD1	197	INITD	INITD	235	Rx7	Rx7	273	TDOT	TDOT
160	GND	GND	198	SCLK	SCLK	236	Rx6	Rx6	274	TD0C	TD0C
161	CD0	CD0	199	GND	GND	237	Rx5	Rx5	275	HV _{DD3}	HV _{DD3}
162	CPAR3	CPAR3	200	ROMA15	—	238	Rx4	Rx4	276	HV _{DD3}	HV _{DD3}
163	CPAR2	CPAR2	201	ROMA14	—	239	Rx3	Rx3	277	RDIC	RDIC
164	CPAR1	CPAR1	202	ROMA13	—	240	Rx2	Rx2	278	RDIT	RDIT
165	CPAR0	CPAR0	203	ROMA12	—	241	Rx1/TFKC	Rx1/TFKC	279	HGND	HGND
166	CA18	CA18	204	ROMA11	—	242	Rx0/TFKT	Rx0/TFKT	280	RV _{DD3}	RV _{DD3}
167	GND	GND	205	ROMA10	—	243	GND	GND	281	JRST_B	JRST_B
168	CA17	CA17	206	ROMA9	—	244	RCLK	RCLK	282	JCK	JCK
169	CA16	CA16	207	ROMA8	—	245	V _{DD3}	V _{DD3}	283	JMS	JMS
170	CA15	CA15	208	V _{DD3}	V _{DD3}	246	RENBL_B	RENBL_B	284	JDO	JDO
171	CA14	CA14	209	ROMA7	—	247	RSOC	RSOC	285	JDI	JDI
172	CA13	CA13	210	ROMA6	—	248	EMPTY_B/ RCLAV/ RCIC	EMPTY_B/ RCLAV/ RCIC	286	RGND	RGND
173	CA12	CA12	211	ROMA5	—	249	FULL_B/ TCLAV/ RCIT	FULL_B/ TCLAV/ RCIT	287	V _{DD5}	V _{DD5}
174	GND	GND	212	ROMA4	—	250	TSOC	TSOC	288	INTR_B	INTR_B
175	V _{DD3}	V _{DD3}	213	ROMA3	—	251	TENBL_B	TENBL_B	289	RST_B	RST_B
176	CA11	CA11	214	GND	GND	252	GND	GND	290	CLK	CLK
177	CA10	CA10	215	ROMA2	—	253	TCLK	TCLK	291	GNT_B	GNT_B
178	CA9	CA9	216	ROMA1	—	254	V _{DD3}	V _{DD3}	292	GND	GND
179	CA8	CA8	217	ROMA0	—	255	Tx7	Tx7	293	V _{DD3}	V _{DD3}
180	CA7	CA7	218	ROMD7	—	256	Tx6	Tx6	294	REQ_B	REQ_B
181	CA6	CA6	219	ROMD6	—	257	Tx5	Tx5	295	AD31	AD31
182	GND	GND	220	ROMD5	—	258	Tx4	Tx4	296	AD30	AD30
183	CA5	CA5	221	ROMD4	—	259	GND	GND	297	AD29	AD29
184	CA4	CA4	222	ROMD3	—	260	Tx3	Tx3	298	GND	GND
185	CA3	CA3	223	ROMD2	—	261	Tx2	Tx2	299	V _{DD5}	V _{DD5}
186	CA2	CA2	224	ROMD1	—	262	Tx1	Tx1	300	AD28	AD28
187	CA1	CA1	225	ROMD0	—	263	Tx0	Tx0	301	AD27	AD27
188	CA0	CA0	226	ROMCS_B	—	264	PHRST_B	PHRST_B	302	AD26	AD26
189	GND	GND	227	V _{DD3}	V _{DD3}	265	PHOE_B	PHOE_B	303	AD25	AD25
190	V _{DD3}	V _{DD3}	228	GND	GND	266	PHYALM/ PHR/W_B	PHYALM/ PHR/W_B	304	GND	GND

Remark Open the pins to which no function is allocated (pins marked “—” in the Generic Mode column in the above table) in the Generic mode. Fix pin 5 (IDSEL) to the low/high level.

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★ 1. PIN FUNCTIONS

The package of the μPD98405 has 304 pins. For details on how to use each pin, refer to **μPD98405 User's Manual (S12250E)**.

1.1 PHY Layer Device Interface Signal

The PHY Layer device interfaces include a UTOPIA interface by which the μPD98405 exchanges ATM cells with a PHY device, and PHY control interface that is used to control a PHY device. The μPD98405 supports two types of PHY layer device interfaces: UTOPIA octet and cell level. These modes are selected by setting the UOC bit of the GMR register.

The PHY layer device interface signals are for an external PHY layer device. When using an internal PHY layer, open all the pins except the common pins. Even when the internal PHY layer is used, an external receive FIFO can be connected to the μPD98405 via the UTOPIA interface.

1.1.1 UTOPIA interface

(1/2)

Pin Name	Pin No.	I/O	I/O Level	Function
Rx7-Rx0 (Rx1 and Rx0: Shared with TFKC and TFKT)	235-242	I	TTL	Receive data bus. These pins constitute an 8-bit input bus that inputs receive data from the network to the μPD98405 from the PHY layer device in byte format. The μPD98405 reads the data on this bus in synchronization with the rising edge of RCLK. Rx7 through Rx2 are internally pulled down. Open the pins of this bus when they are not used. Pull up Rx1 when it is not used, and pull down Rx0 when it is not used.
RSOC	247	I	TTL	Receive cell start position. This signal is input from the PHY layer device in synchronization with the first byte of cell data. It is high while the first byte of a header is input to Rx7 through Rx0. This signal is internally pulled down.
RENBL_B	246	O	TTL	Receive enable. This signal informs the PHY layer device that the μPD98405 is ready to receive data in the next clock cycle.

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	Pin Name	Pin No.	I/O	I/O Level	Function
★	EMPTY_B/ RCLAV (shared with RCIC)	248	I	TTL	PHY layer buffer empty/receive cell available. This signal informs the μPD98405 that the PHY receive FIFO has no cell data to be transferred and that the PHY device cannot supply receive data. This signal functions as EMPTY_B when the UTOPIA interface is in the octet level handshake mode, to indicate that the data on Rx7 through Rx0 is invalid in the current clock cycle. In the cell level handshake mode, it functions as RCLAV, informing the μPD98405 that no more cells are to be supplied after transfer of the current cell is completed. Pull down this pin when it is not used.
	RCLK	244	O	TTL	Receive clock. This clock is used for synchronization when the μPD98405 transfers cell data to and from the PHY layer device at the reception side. The SAR system clock input to the SCLK pin is output from this pin as is, immediately after the μPD98405 has been reset.
	Tx7-Tx0	255-258, 260-263	O	TTL	Transmit data bus. These pins form an 8-bit output bus that outputs data to be transmitted to the network, to the PHY layer device in byte format. The μPD98405 outputs the data in synchronization with the rising edge of TCLK.
	TSOC	250	O	TTL	Transmit cell start position. This signal is output in synchronization with the first byte of transmit cell data.
	TENBL_B	251	O	TTL	Transmit enable. This signal informs the PHY layer device that data has been output to Tx7 through Tx0 in the current clock cycle.
★	FULL_B/ TCLAV (shared with RCIT)	249	I	TTL	PHY layer buffer full/transmit cell available. The FULL_B signal informs the μPD98405 that the input buffer of the PHY device is full and that the device can receive no more data. When the UTOPIA interface is in the octet level handshake mode, the PHY device inputs an inactive level as this signal if the device can receive cell data. In the cell level handshake mode, this signal functions as TCLAV, informing the μPD98405 that the PHY device can receive the next single cell after transfer of the current cell is completed. Pull up this pin when it is not used.
	TCLK	253	O	TTL	Transmit clock. This clock is used for synchronization when the μPD98405 transfers cell data to and from the PHY layer device at the transmission side. The SAR system clock input to the SCLK pin is output as this clock as is.

1.1.2 PHY device control interface (external PHY mode, PHM of GMR register = 1)

Pin Name	Pin No.	I/O	I/O Level	Function
PHR/W_B (shared with PHYALM)	266	O	TTL	PHY read/write. The μPD98405 indicates the PHY layer device control direction by using this pin. 1: Read 0: Write
PHOE_B	265	O	TTL	PHY layer output enable. The μPD98405 enables output by the PHY layer device by making this signal low.
PHCE_B (shared with SD)	267	O	TTL	PHY layer chip enable. The μPD98405 makes this signal low when it accesses the PHY layer device.
PHINT_B (shared with REFCLK)	268	I	TTL	PHY layer interrupt. This pin inputs an interrupt signal to the μPD98405 from the PHY layer device. The PHY layer device informs the μPD98405 that it has an interrupt source by inputting a low level to this pin. Pull up this pin when it is not used.
PHRST_B	264	O	TTL	PHY layer reset. This signal is used to reset the PHY layer device. The μPD98405 keeps this pin low for the duration of 17 clock cycles when a low level is input to the RST_B pin or when software reset is executed.

★ **Caution** The PHCE_B/SD pins are multiplexed pins and their functions differ depending on whether the internal PHY mode or external PHY mode is selected (by using the PHM bit of the GMR register). Because the PHCE_B/SD pins change the mode between input and output depending on the selected mode, be sure to correctly set the PHM bit of the GMR register.

1.2 Bus Interface Signals

The μPD98405 supports a PCI bus interface or generic bus interface. Whether the PCI bus interface or generic bus interface is to be supported is selected by the PCI_MODE signal.

The PCI bus interface can be directly connected to a PCI bus. The generic bus interface can be connected to a general I/O bus with a few circuits.

1.2.1 Generic bus interface signals (PCI_MODE pin: low level)

(1/3)

Pin Name	Pin No.	I/O	I/O Level	Function
AD31-AD0	295-297, 300-303, 3, 6, 9-12, 15-17, 34-36, 39-42, 45, 47, 48, 51-54, 57-58	I/O 3-state	TTL	Address/data. These pins constitute a 32-bit address/data bus. They are input/output pins multiplexing an address bus and a data bus. An address is transferred at the first input/output clock. From the second clock and onward, data is transferred. When the μPD98405 is not accessing the bus, the AD bus goes into a high-impedance state.
BE3_B BE2_B BE1_B BE0_B	4 18 33 46	O 3-state	TTL	Byte enable. These pins determine the byte that becomes valid in the master cycle of the μPD98405. BE3_B corresponds to AD31 through AD24, and BE0_B corresponds to AD7 through AD0. BE3_B through BE0_B go into a high-impedance state when the μPD98405 is not accessing a bus or when it is accessing a slave.
PAR3 PAR2 PAR1 PAR0	66 69 70 71	I/O 3-state	TTL	Bus parity. These pins indicate the parity of AD31 through AD0. A parity check mode is set by the GMR register. Whether the parity is enabled or disabled, whether an odd parity or even parity is used, and whether a word parity or byte parity is used can be specified. When byte parity is used, PAR3 indicates the parity of AD31 through AD24, and PAR0 indicates the parity of AD7 through AD0. In the case of word parity, PAR2 through PAR0 do not function, and PAR3 serves as an input/output pin. These pins function as output pins when an address is output and when data is written, and as input pins when data is read. When the μPD98405 is not accessing a bus, PAR3 through PAR0 go into a high-impedance state. Pull up these pins when they are not used.
OE_B	59	I	TTL	Output enable. When this pin is low, the μPD98405 allows AD31 through AD0 and PAR3 through PAR0 to operate normally as three-state I/O pins. These pins go into a high-impedance state while a high level is input to this pin. Fix this pin to the low level in a system where the above pins do not have to forcibly go into a high-impedance state.

(2/3)

Pin Name	Pin No.	I/O	I/O Level	Function																																
SIZE2 SIZE1 SIZE0	63 64 65	O	TTL	Burst size. These pins indicate the size of current DMA transfer. They are used to interface with a bus (such as S bus) that requires an explicit burst size. <table><tr><th>SIZE2</th><th>SIZE1</th><th>SIZE0</th><th>Function</th></tr><tr><td>0</td><td>0</td><td>0</td><td>1-word transfer</td></tr><tr><td>0</td><td>0</td><td>1</td><td>2-word burst</td></tr><tr><td>0</td><td>1</td><td>0</td><td>4-word burst</td></tr><tr><td>0</td><td>1</td><td>1</td><td>8-word burst</td></tr><tr><td>1</td><td>0</td><td>0</td><td>16-word burst</td></tr><tr><td>1</td><td>0</td><td>1</td><td>12-word burst</td></tr><tr><td colspan="3">Others</td><td>Undefined</td></tr></table>	SIZE2	SIZE1	SIZE0	Function	0	0	0	1-word transfer	0	0	1	2-word burst	0	1	0	4-word burst	0	1	1	8-word burst	1	0	0	16-word burst	1	0	1	12-word burst	Others			Undefined
SIZE2	SIZE1	SIZE0	Function																																	
0	0	0	1-word transfer																																	
0	0	1	2-word burst																																	
0	1	0	4-word burst																																	
0	1	1	8-word burst																																	
1	0	0	16-word burst																																	
1	0	1	12-word burst																																	
Others			Undefined																																	
DR/W_B	60	O	TTL	DMA read/write. This pin indicates the direction of DMA access. 1: Read access 0: Write access																																
ATTN_B	294	O	TTL	Attention (DMA request). The μPD98405 makes the ATTN_B signal low when it is to execute a DMA operation. The ATTN_B signal becomes inactive in synchronization with the rising edge of CLK when only one more word of data is to be transferred by means of DMA.																																
GNT_B	291	I	TTL	Bus enable. The GNT_B signal goes low when the bus arbiter grants the μPD98405 the bus mastership in response to a DMA request from the μPD98405. When the μPD98405 detects that the GNT_B signal has gone low, it starts a DMA operation, assuming that the bus mastership has been granted.																																
RDY_B	23	I	TTL	Target device ready. This signal informs the μPD98405 in the DMA cycle that the target device is ready for input/output. The μPD98405 makes the RDY_B signal low if valid data exists on AD31 through AD0 when it executes a DMA read operation. When executing a DMA write operation, the μPD98405 makes the ATTN_B signal low if the target device is ready for reception. The timing at which the μPD98405 samples the RDY_B and ABRT_B signals can be bring forward by 1 clock depending on the setting of an internal register (GMR register).																																

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Pin Name	Pin No.	I/O	I/O Level	Function
ABRT_B	27	I	TTL	Abort. This signal is used to abort a data transfer cycle. If this signal goes low in the middle of a data transfer cycle, that cycle is aborted, and the μPD98405 resumes burst starting from the aborted data. While a low level is input to ABRT_B, the RDY_B signal does not function. The user can bring forward the timing at which the μPD98405 samples the RDY_B and ABRT_B signals by 1 clock (early mode) by using an internal register (GMR register). Pull up this pin when it is not used.
ERR_B	28	I	TTL	System bus error. If an error is detected on the system bus, the device that manages the bus uses this pin to stop the operation by the μPD98405. When a low level is input to this pin, the μPD98405 stops all bus operations, sets the system bus error bit (bit 25) of the GSR register (when not masked), and generates an interrupt. Pull up this pin when it is not used.
SR/W_B	24	I	TTL	Slave read/write. This signal determines the direction of slave access. 1: Read access 0: Write access
SEL_B	21	I	TTL	Slave select. This signal is asserted active (low) when slave access is selected for the μPD98405. Make sure that the SEL_B signal goes low at the same time as or after the ASEL_B signal has gone low. In addition, insert an inactive period of two system clocks or more after the SEL_B signal has become inactive and before it becomes active next time.
ASEL_B	22	I	TTL	Slave address select. The ASEL_B signal selects the direct address register of the μPD98405. When a low level is input to ASEL_B, the μPD98405 samples the AD bus at the first rising edge of CLK.
CLK	290	I	TTL	Clock. This is a system bus clock input pin. A clock of up to 33 MHz can be input.
RST_B	289	I	TTL	Reset. The RST_B signal initializes the μPD98405 (on starting). After reset, the μPD98405 can start normal operation. When a low level is input to RST_B, the internal state machine and registers of the μPD98405 are reset, and all the three-state signals go into a high-impedance state. Reset input is asynchronous. If it is input during operation, the operation status at that time is lost. Keep RST_B low at least for the duration of one clock cycle.
INTR_B	288	O	N-ch open-drain	Interrupt output. Pull up this signal because it is an open-drain signal. This signal informs the CPU that an unmasked interrupt bit of the interrupt GSR register has been set.

1.2.2 PCI bus interface signal (PCI_MODE pin: high level)

The μPD98405 has a 32-/64-bit PCI bus interface. This bus interface can be directly connected to a PCI bus. In addition, the μPD98405 also has a serial EEPROM interface and an expansion ROM interface.

<1> PCI bus interface signals

(1/2)

Pin Name	Pin No.	I/O	I/O Level	Function
AD31-AD0	295-297, 300-303, 3, 6, 9-12, 15-17, 34-36, 39-42, 45, 47, 48, 51-54, 57-58	I/O 3-state	PCI	Address/data. AD31 through AD0 constitute a 32-bit multiplexed address/data bus. When the μPD98405 operates as a bus master, it drives an address at the first clock and transfers data at the second clock and onward.
PCBE3_B PCBE2_B PCBE1_B PCBE0_B	4 18 33 46	I/O 3-state	PCI	Bus command/byte enable. These signals define a "bus command" (bus transaction that occurs) in the address phase. In the data phase, they indicate which byte lane holds valid data. The PCBE3_B pin corresponds to byte 3 (bits 31 through 24), and PCBE0_B pin corresponds to byte 0 (bits 7 through 0).
PAR	30	I/O 3-state	PCI	Parity. This signal indicates an even parity on the AD31 through AD0 and PCBE3_B through PCBE0_B pins, including the PAR signal. When the μPD98405 is operating as a master, the PAR signal becomes active in the address and write data phases. When the μPD98405 is operating as a target, this signal becomes active in the read data phase.
★ FRAME_B	21	I/O Sustained 3-state	PCI	Frame. This signal indicates the start and period of a bus transaction. When this signal is asserted active, it indicates the start of a bus transaction. While it is active, data is transferred. It is deasserted inactive when the next data transfer phase will transfer last data of the transaction.
★ TRDY_B	23	I/O Sustained 3-state	PCI	Target ready. This signal goes low when the target device is ready to complete the transaction of the current data. This signal is used in combination with IRDY_B, and read/write data transfer is executed when both IRDY_B and TRDY_B signals are low.
★ IRDY_B	22	I/O Sustained 3-state	PCI	Initiator ready. This signal goes low when the initiator is ready to complete the transaction of the current data. This signal is used in combination with TRDY_B, and read/write data transfer is executed when both IRDY_B and TRDY_B are low. If FRAME_B and IRDY_B are both inactive, the bus cycle is not executed. A wait cycle is inserted until both IRDY_B and TRDY_B are asserted active.

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Pin Name	Pin No.	I/O	I/O Level	Function
STOP_B	27	I/O Sustained 3-state	PCI	Stop. This signal goes low when the target device requests the master device to stop the current transaction.
DEVSEL_B	24	I/O Sustained 3-state	PCI	Device select. When the μPD98405 is operating as a target, it makes this signal low after the FRAME_B signal has been asserted active and the μPD98405 has recognized an address. When the μPD98405 is operating as a master, it samples this signal to check to see if a target device has been selected.
IDSEL	5	I	PCI	Initialization device select. This signal is high when the configuration register of the μPD98405 is read or written.
★ REQ_B	294	O ^{Note}	PCI	Request. The μPD98405 makes this signal low to request the arbiter for the bus mastership.
GNT_B	291	I	PCI	Grant. This signal goes low when the arbiter grants the μPD98405 the bus mastership.
PERR_B	28	I/O Sustained 3-state	PCI	Parity error. This signal indicates that the μPD98405 has detected a data parity error. It is enabled when the "Parity Error Response" bit of the configuration register is set to "1".
SERR_B	29	O	N-ch open-drain	System error. This signal indicates that the μPD98405 has detected an address parity error. It is enabled when both the "Parity Error Response" and "System Error Enable" bits of the configuration register are set to "1".
INTR_B	288	O	N-ch open-drain	Interrupt output. Pull up this signal because it is an open-drain signal. INTR_B informs the CPU that an unmasked interrupt bit of the interrupt GSR register has been set.
CLK	290	I	PCI	Clock. This is a system bus clock input pin. A clock of up to 33 MHz is input.
RST_B	289	I	PCI	Reset. This signal initializes the μPD98405 (on starting, etc.). When a low level is input to RST_B, the internal state machine and registers of the μPD98405 are reset, and all the three-state signals go into a high-impedance state. The reset input is asynchronous. When this signal is input during operation, the operating status at that time is lost. Keep RST_B low at least for the duration of one clock cycle. After reset, do not access the μPD98405 for the duration of at least 20 clocks.

- ★ **Note** According to "PCI Local Bus Specification Revision 2.1", the REQ_B pin should go into a high-impedance state while a low level is input to the RST_B pin. The REQ_B pin of the μPD98405, however, outputs a high level.

<2> PCI bus 64-bit expansion interface signals

Open AD63 through AD32, PCBE7_B through PCBE4_B, and PAR64 when using the 32-bit PCI bus interface.

Pin Name	Pin No.	I/O	I/O Level	Function
AD63-AD32	69-71, 73-75, 79, 80, 82-85, 88-91, 94-97, 100-103, 106-109, 112-115	I/O 3-state	PCI	Address/data. AD63 through AD32 constitutes a 32-bit multiplexed address/data bus that extends the PCI bus to 64 bits. This address/data bus transfers the high-order 32 bits of a 64-bit address in the address phase. It outputs the high-order 32 bits of 64-bit data in the data phase when both REQ64_B and ACK64_B are asserted.
PCBE7_B PCBE6_B PCBE5_B PCBE4_B	63 64 65 66	I/O 3-state	PCI	Bus command/byte enable. These signals define a "bus command" (bus transaction that occurs) in the address phase. In the data phase, they indicate which byte lane holds valid data. The PCBE7_B pin corresponds to AD63 through AD56, and PCBE4_B pin corresponds to AD39 through AD32.
PAR64	116	I/O 3-state	PCI	Parity 64. This signal indicates an even parity on AD63 through AD32 and PCBE7_B through PCBE4_B pins, including the PAR64 signal. When the μ PD98405 is operating as a master, the PAR signal becomes active in the address and write data phases. When the μ PD98405 is operating as a target, it becomes active in the read data phase.
REQ64_B	60	I/O 3-state	PCI	Request 64. This signal indicates the start and period of a 64-bit bus transaction. When the μ PD98405 is operating as a master, it asserts REQ64_B active to request 64-bit data transfer. REQ64_B is the same as FRAME_B in timing.
ACK64_B	59	I/O Sustained 3-state	CPI	Acknowledge 64. When the μ PD98405 is operating as a target, it makes this signal low after the REQ64_B signal has been asserted active and the μ PD98405 has recognized an address. When the μ PD98405 is operating as a master, it samples this signal to check whether the target device has acknowledged 64-bit transfer. ACK64_B is the same as DEVSEL_B in timing.

<3> Serial EEPROM interface signals

The μPD98405 has a serial EEPROM interface supporting MICROWIRE™ interface. Through this serial EEPROM interface, the contents of the PCI configuration register can be loaded from an EEPROM connected.

Remark It is recommended that National Semiconductor's "NM93C46" be connected as the EEPROM.

Pin Name	Pin No.	I/O	I/O Level	Function
E2PCS	234	O	TTL	EEPROM chip select. This is a chip select signal for EEPROM.
E2PDI	231	I	TTL	EEPROM data input. This signal is connected to the data output pin of the EEPROM. This signal is internally pulled down.
E2PDO	232	O	TTL	EEPROM data output. This signal is connected to the data input pin of the EEPROM.
E2PCLK	233	O	TTL	EEPROM clock. This pin supplies the clock necessary for transferring data with the EEPROM. It divides the clock input to the CLK pin by 36 for output.

<4> Expansion ROM interface signals.

The μPD98405 has an expansion ROM interface as option.

Pin Name	Pin No.	I/O	I/O Level	Function
ROMA15- ROMA0	200-207, 209-213, 215-217	O	TTL	ROM address. These are address signals to access the 64K expansion ROM.
ROMD7- ROMD0	218-225	I	TTL	ROM data. These are expansion ROM data signals and are internally pulled down.
ROMCS_B	226	O	TTL	ROM select. This is a chip select signal for the expansion ROM.
ROMOE_B	230	O	TTL	ROM output enable. This signal enables the output buffer of the expansion ROM during a read operation.

1.3 Control Memory Interface Signals

The control memory interface is used by the μPD98405 to access the external control memory and external PHY layer device. This interface consists of a 19-bit address bus, a 32-bit data bus. The control memory of the host system can be accessed only through this interface.

Pin Name	Pin No.	I/O	I/O Level	Function
CD31-CD0	119-123, 126-130, 132-136, 139-144, 146-150, 155-159, 161	I/O 3-state	TTL	Control memory data. These three-state I/O pins constitute a 32-bit data bus that is used to transfer data to and from the control memory or PHY layer device. These signals are internally pulled down.
CPAR3-CPAR0	162-165	I/O	TTL	Control memory parity. These signals indicate the parity of CD31 through CD0 every 8 bits. In the read cycle, the μPD98405 checks the parity (when enabled). In the write cycle, it outputs the parity. These signals are internally pulled down.
CA18-CA0	166, 168-173, 176-181, 183-188	O	TTL	Control memory address. These signals constitute a 19-bit address bus that outputs an address to the control memory or PHY layer device during a read/write operation.
CWE_B	195	O	TTL	Control memory write enable. This signal indicates the direction in which the control memory is accessed. 1: Read access 0: Write access
COE_B	196	O	TTL	Control memory output enable. This signal enables or disables data output of the control memory.
CBE3_B-CBE0_B	191-194	O	TTL	Local port byte enable. These signals indicate the byte of the control port to be read or written.
INITD	197	I	TTL	Initialization disable. This signal is used to disable automatic initialization of the control memory during chip test. Directly connect INITD to GND during normal operation other than test.

★ 1.4 PMD Interface Signals (internal PHY mode, PHM of GMR register = 0)

The PMD interface is used to connect a module such as an optical transceiver/receiver.

	Pin Name	Pin No.	I/O	I/O Level	Function
★	RDIT	278	I	P-ECL True (+)	Receive serial data input. Pull up this pin when it is not used.
★	RDIC	277	I	P-ECL complement (-)	Receive serial data input. Pull down this pin when it is not used.
★	RCIT (shared with FULL_B)	249	I	P-ECL True (+)	Receive serial clock input. This pin is used when an external clock recovery/synthesizer is connected (PLL of GMR register = 1). Pull up this pin when it is not used.
★	RCIC (shared with EMPTY_B)	248	I	P-ECL complement (-)	Receive serial clock input. This pin is used when an external clock recovery/synthesizer is connected (PLL of GMR register = 1). Pull down this pin when it is not used.
★	REFCLK (shared with PHINT_B)	268	I	TTL	Reference clock. This pin inputs a system clock (19.44 MHz) to the internal clock recovery/synthesizer. Pull up this pin when it is not used.
	TDOT	273	O	P-ECL True (+)	Transmit serial data output.
	TDOC	274	O	P-ECL complement (-)	Transmit serial data output.
★	TFKT (shared with Rx0)	242	I	P-ECL True (+)	Transmit serial clock input. This pin is used when an external clock recovery/synthesizer is connected (PLL of GMR register = 1). Pull up this pin when it is not used.
★	TFKC (shared with Rx1)	241	I	P-ECL complement (-)	Transmit serial clock input. This pin is used when an external clock recovery/synthesizer is connected (PLL of GMR register = 1). Pull down this pin when it is not used.
	PHYALM (shared with PHR/W_B)	266	O	TTL	PHY layer alarm detection signal. This signal is asserted active (high) when any of the internally monitored error statuses (CMDARM, LOS, OOF, LOF, LOP, OCD, LCD, Line AIS, Path AIS, Line RDI, and Path RDI) is detected. The error status to be reported can be selected by using the internal AMR1 and AMR2 registers. One or more error statuses can be selected.
	SD (shared with PHCE_B)	267	I	TTL	Signal detect. This pin inputs the signal detect signal (when LOS is detected, etc.) of the PMD device. When a low level is input to this pin, the μPD98405 assumes LOS detection. Pull up this pin when it is not used.

1.5 JTAG Boundary Scan Signals

Remark This function can be supported upon request.

These signals conform to IEEE1149.1 JTAG Boundary-Scan Standard.

Pin Name	Pin No.	I/O	I/O Level	Function
JDI	285	I	TTL	Boundary scan data input. Connect this pin to ground when it is not used.
JDO	284	O 3-state	TTL	Boundary scan data output. Open this pin when it is not used.
JMS	283	I	TTL	Boundary scan mode select. Connect this pin to ground when it is not used.
JCK	282	I	TTL	Boundary scan clock input. Connect this pin to ground when it is not used.
JRST_B	281	I	TTL	Boundary scan reset. Connect this pin to ground when it is not used.

1.6 Other Signals

Pin Name	Pin No.	I/O	I/O Level	Function
SCLK	198	I	TTL	SAR system clock. This pin supplies a clock for a SAR block operation. The maximum clock frequency is 25 MHz.
PCI_MODE	118	I	TTL	PCI/generic bus mode. This pin selects PCI or generic bus mode. 0: Generic bus mode 1: PCI bus mode
★ TEST	271	I	TTL	Internal test pin. Open this pin. When a high level is input to this pin, the test mode is selected. This signal is internally pulled down. The test mode is used for internal testing and cannot be used by the user.

★ 1.7 Power and Ground

Pin Name	Pin No.	I/O	Function
V _{DD5}	8, 20, 32, 44, 56, 67, 81, 93, 105, 287, 299	—	+5-V power (digital block). Supply +5 V to these pins when using the bus interface 5-V mode. In the 3.3-V mode, supply +3.3 V.
V _{DD3}	2, 14, 26, 38, 50, 62, 72, 78, 87, 99, 111, 125, 138, 151, 154, 175, 190, 208, 227, 245, 254, 293	—	+3.3-V power (digital block). These pins supply +3.3 V to the chip.
AV _{DD3}	269	—	+3.3-V power (analog block). Supply power with a high quality to this pin by inserting a filter between AV _{DD3} and GND.
HV _{DD3}	275, 276	—	+3.3-V power (high-speed block). Supply power with a high quality to this pin by inserting a filter between HV _{DD3} and HGND.
★ RV _{DD3}	280	—	+3.3-V power (receive PLL block). Supply power with a high quality to this pin by inserting a filter between RGND and this pin.
GND	1, 7, 13, 19, 25, 31, 37, 43, 49, 55, 61, 68, 76, 77, 86, 92, 98, 104, 110, 117, 124, 131, 137, 145, 152, 153, 160, 167, 174, 182, 189, 199, 214, 228, 229, 243, 252, 259, 292, 298, 304	—	Ground (digital block). These pins ground the chip.
AGND	270	—	Ground (analog block)
HGND	272, 279	—	Ground (high-speed block)
★ RGND	286	—	Ground (receive PLL block)

★ 1.8 Pin Status during and after Reset

(1/2)

Pin Name	During Reset	After Reset
RENBL_B	1	1
RCLK	CLK output	CLK output
Tx7-Tx0	0	0
TSOC	0	0
TENBL_B	0	0
TCLK	CLK output	CLK output
PHR/W_B (external PHY)/PHYALM (internal PHY)	0	0
PHOE_B	1	1
PHCE_B (external PHY)/SD (internal PHY)	Hi-Z (input)	Hi-Z (input)
AD31-AD0	Hi-Z (input)	Hi-Z (input)
PCBE3_B-PCBE0_B (PCI)/BE3_B-BE0_B (Generic)	Hi-Z (input)	Hi-Z (input)
PAR	Hi-Z (input)	Hi-Z (input)
FRAME_B	Hi-Z (input)	Hi-Z (input)
TRDY_B	Hi-Z (input)	Hi-Z (input)
IRDY_B	Hi-Z (input)	Hi-Z (input)
STOP_B	Hi-Z (input)	Hi-Z (input)
DEVSEL_B	Hi-Z (input)	Hi-Z (input)
REQ_B (PCI)/ATTN_B (Generic)	1	1
PERR_B	Hi-Z (input)	Hi-Z (input)
SERR_B	Hi-Z	Hi-Z
INTR_B	Hi-Z	Hi-Z
AD63-AD61 (PCI)/PAR2-PAR0 (Generic)	Hi-Z (input)	Hi-Z (input)
AD60-AD56 (PCI)/(Generic)	Hi-Z (input)/Hi-Z (output)	Hi-Z (input)/Hi-Z (output)
AD55-AD32 (PCI)/(Generic)	Hi-Z (input)/0	Hi-Z (input)/0
PCBE7_B-PCBE5_B (PCI)/SIZE2-SIZE0 (Generic)	Hi-Z (input)/0	Hi-Z (input)/0
PCBE4_B (PCI)/PAR3 (Generic)	Hi-Z (input)	Hi-Z (input)
PAR64	Hi-Z (input)	Hi-Z (input)
REQ64_B(PCI)/DR/W_B (Generic)	Hi-Z/1	Hi-Z/1
E2PCS	0	0
E2PDO	0	0
E2PCLK	0	0
ROMA15-ROMA0	0	0
ROMCS_B	1	1
ROMOE_B	1	1
CD31-CD0	0	0
CPAR3-CPAR0	0	0
CA18-CA0	0	0

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Pin Name	During Reset	After Reset
CWE_B	1	1
COE_B	1	1
TDOT	Undefined	Undefined
TDOC	Undefined	Undefined
JDO	Hi-Z	Hi-Z

Remark The internal PHY mode is set (PHM of GMR register = 0) after reset.

2. ELECTRICAL SPECIFICATIONS

* indicates changes from the Preliminary Data Sheet (document number: S12689E, 1st edition).

★ Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{DD}		−0.5 to +4.6	V
	V_{DD5} ^{Note 1}		−0.5 to +6.5	V
Input/output voltage	V_i/V_o	Normal I/O pin	−0.5 to +6.6	V *
		PCI I/O pin ^{Note 2}	−0.5 to +6.6	V *
		P-ECL pin	−0.5 to +4.6 and $V_{DD} + 0.5$	V *
Ambient operating frequency	T_A		0 to +70	°C
Storage temperature	T_{stg}		−65 to +150	°C

Notes 1. V_{DD5} : Clamping diode-dedicated power supply

2. By supplying 5 V for clamping diode, the device can be protected from an 11-V reflection wave.

Caution If any of the parameters exceeds the absolute maximum ratings, even momentarily, the quality of the product may be impaired. The absolute maximum ratings are values that may physically damage the product(s). Be sure to use the product(s) within the ratings.

★ Recommended Operating Conditions

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{DD}		+3.0	+3.3	+3.6	V
	V_{DD5} ^{Note}	+3.3 V PCI	+3.0	+3.3	+3.6	V
	V_{DD5} ^{Note}	+5 V PCI	+4.75	+5.00	+5.25	V
Ambient operating temperature	T_A		0		+70	°C
High-level input voltage	V_{IH1}	Input pins other than PCI and P-ECL	+2.0		+5.5	V
	V_{IH2}	+5-V PCI pin	+2.0		$V_{DD5} + 0.5$	V *
	V_{IH3}	+3.3-V PCI pin	$0.5 \times V_{DD}$		$V_{DD} + 0.5$	V *
	V_{IH4}	P-ECL pin	$V_{DD} - 1.49$		$V_{DD} - 0.40$	V *
Low-level input voltage	V_{IL1}	Input pins other than PCI and P-ECL	0		+0.8	V
	V_{IL2}	+5-V PCI pin	−0.5		+0.8	V
	V_{IL3}	+3.3-V PCI pin	−0.5		$0.3 \times V_{DD}$	V
	V_{IL4}	P-ECL pin	$V_{DD} - 2.82$		$V_{DD} - 1.50$	V *

Note V_{DD5} : Clamping diode-dedicated power supply

★ DC Characteristics (T_A = 0 to +70°C, V_{DD} = +3.3 V ± 0.3 V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
High-level output voltage	V _{OH1}	I _{OH} = -3.0 mA ^{Note 1}	+2.4			V	
	V _{OH2}	I _{OH} = -500 μA ^{Note 2} (+3.3 V PCI)	0.88 × V _{DD}			V	*
	V _{OH3}	I _{OH} = -2.0 mA ^{Note 2} (+5 V PCI)	+2.4			V	
	V _{OH4}	R _L = 50 Ω, V _T = V _{DD} - 2 V (P-ECL)	V _{DD} - 1.140		V _{DD} - 0.690	V	*
Low-level output voltage	V _{OL1}	I _{OL} = 9.0 mA ^{Note 1}			0.144 × V _{DD}	V	*
	V _{OL2}	I _{OL} = 1500 μA ^{Note 2} (+3.3 V PCI)			+0.4	V	
	V _{OL3}	I _{OL} = 3.0 mA ^{Note 2} (+5 V PCI)			+0.55	V	
	V _{OL4}	I _{OL} = 6.0 mA ^{Note 4} (+5 V PCI)			+0.55	V	
	V _{OL5}	R _L = 50 Ω, V _T = V _{DD} - 2 V (P-ECL)	V _{DD} - 2.175		V _{DD} - 1.755	V	*
Supply current	I _{DD}	f _{CLK} = 33 MHz, normal operation		650	900	mA	*
Input leakage current (normal input)	I _{I1}	V _I = V _{DD}			±10	μA	*
Input leakage current ^{Note 5}	I _{I2}	V _I = V _{DD} or GND	28		160	μA	*

- Notes**
1. V_{OH1} and V_{OL1} are applied to the following pins (output pins other than PCI):
CD31-CD0, CPAR3-CPAR0, CA18-CA0, CBE3_B-CBE0_B, CWE_B, COE_B, JDO, RCLK, RENBL_B, TSOC, TENBL_B, TCLK, Tx7-Tx0, PHCE_B, PHOE_B, PHRW_B, E2PCS, E2PDO, E2PCLK
 2. V_{OH2}, V_{OH3}, and V_{OL2} are applied to the following pins (PCI output pins):
AD63-AD0, PCBE7_B-PCBE0_B, PAR, PAR64, REQ_B, INTR_B, FRAME_B, REQ64_B, TRDY_B, IRDY_B, DEVSEL_B, STOP_B, SERR_B, PERR_B
 3. V_{OL3} is applied to the following pins (with +5-V PCI):
AD31-AD0, PCBE3_B-PCBE0_B, PAR, REQ_B, INTR_B
 4. V_{OL4} is applied to the following pins (with +5-V PCI):
FRAME_B, TRDY_B, IRDY_B, DEVSEL_B, STOP_B, SERR_B, PERR_B, AD64-AD32, PCBE7_B-PCBE4_B, ACK64_B, REQ64_B, PAR64
 5. I_{I2} is applied to the following pins:
E2PDI, ROMD7-ROMD0, FULL_B, EMPTY_B, RSOC, Rx7-Rx0, CPAR3-CPAR0, CD31-CD0, PCI_MODE

Capacitance ($T_A = +25^\circ\text{C}$, $V_{DD} = 0\text{ V}$)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C_{IN}				10	pF
CLK input capacitance	C_{CLK}		5		12	pF
IDSEL input capacitance	C_{IDSEL}				8	pF
Output capacitance	C_{OUT}		8		10	pF
I/O capacitance	$C_{I/O}$				8	pF



Internal pull-down resistor ($T_A = 0\text{ to }+70^\circ\text{C}$, $V_{DD} = +3.3\text{ V} \pm 0.3\text{ V}$)

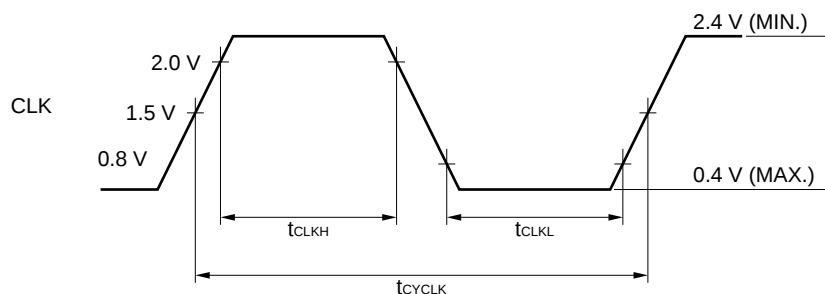
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Internal pull-down resistance	R_{PD}	E2PDI, ROMD7-ROMD0, RSOC, Rx7-Rx2, CPAR3- CPAR0, CD31-CD0, PCI_MODE	21.8	37.1	83.1	kΩ

*

AC Characteristics ($T_A = 0$ to $+70^\circ\text{C}$, $V_{DD} = +3.3\text{ V} \pm 0.3\text{ V}$, output pin load: 30 pF)

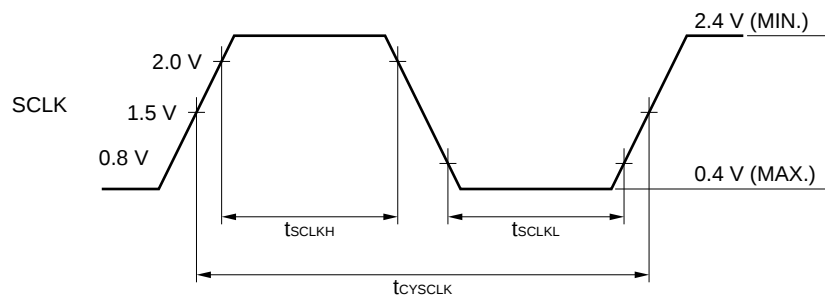
★ CLK input (BUS interface clock - CLK pin)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
CLK cycle time	t_{CYCLK}		30		125	ns
CLK high-level width	t_{CLKH}		11			ns
CLK low-level width	t_{CLKL}		11			ns
CLK slew rate	slew_{CLK}		1		4	V/ns



★ SCLK input (internal system clock - SCLK pin)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
SCLK cycle time	t_{CYCLK}		40		125	ns
SCLK high-level width	t_{SCLKH}		15			ns
SCLK low-level width	t_{SCLKL}		15			ns
SCLK slew rate	slew_{SCLK}		1		4	V/ns



RST input

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
RST low-level width	t_{RSTL}		t_{CYCLK}			ns
RST slew rate	slew_{RST}		50			V/ns

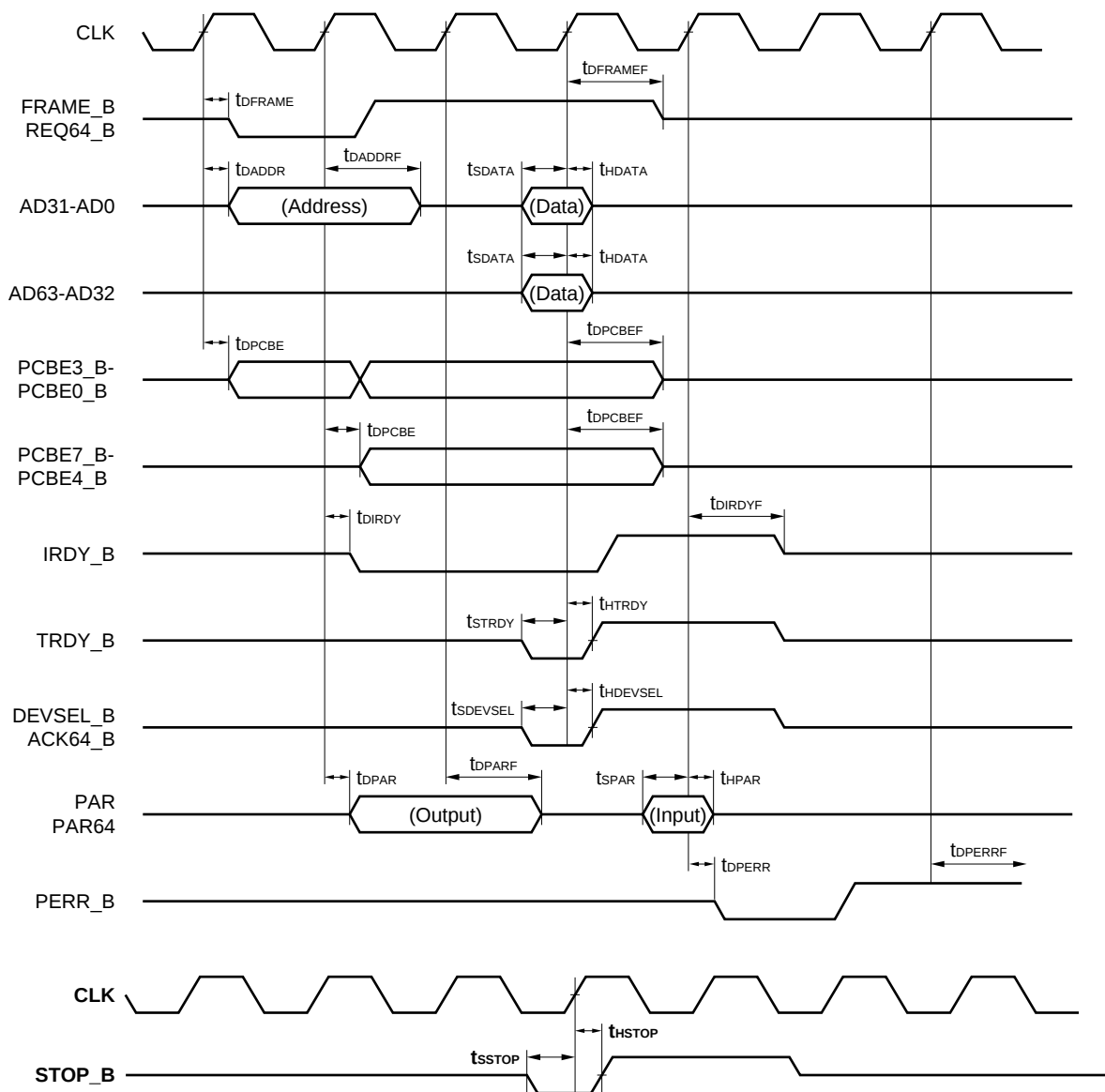
[MEMO]

PCI Bus Interface

★ Bus master read

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
CLK $\uparrow$ → FRAME_B, REQ64_B valid time	t _{DFRAME}		1		11	ns	*
CLK $\uparrow$ → FRAME_B, REQ64_B float time	t _{DFRAMEF}				28	ns	*
CLK $\uparrow$ → AD (Address) valid time	t _{DADDR}		1		11	ns	*
CLK $\uparrow$ → AD (Address) float time	t _{DADDRF}				28	ns	
AD (Data) setup time	t _{SDATA}		8			ns	*
AD (Data) hold time	t _{HDATA}		1			ns	*
CLK $\uparrow$ → PCBE_B valid time	t _{DPCBE}		1		11	ns	*
CLK $\uparrow$ → PCBE_B float time	t _{DPCBEF}				28	ns	
CLK $\uparrow$ → IRDY_B valid time	t _{DIRDY}		1		11	ns	*
CLK $\uparrow$ → IRDY_B float time	t _{DIRDYF}				28	ns	*
TRDY_B setup time	t _{STRDY}		8			ns	*
TRDY_B hold time	t _{HTRDY}		1			ns	*
DEVSEL_B, ACK64_B setup time	t _{SDEVSEL}		8			ns	*
DEVSEL_B, ACK64_B hold time	t _{HDEVSEL}		1			ns	*
STOP_B setup time	t _{SSTOP}		8			ns	*
STOP_B hold time	t _{HSTOP}		1			ns	*
CLK $\uparrow$ → PAR valid time	t _{DPAR}		1		11	ns	*
CLK $\uparrow$ → PAR float time	t _{DPARF}				28	ns	
PAR setup time	t _{SPAR}		8			ns	*
PAR hold time	t _{HPAR}		1			ns	*
CLK $\uparrow$ → PERR_B valid time	t _{DPERR}		1		11	ns	*
CLK $\uparrow$ → PERR_B float time	t _{DPERRF}				28	ns	

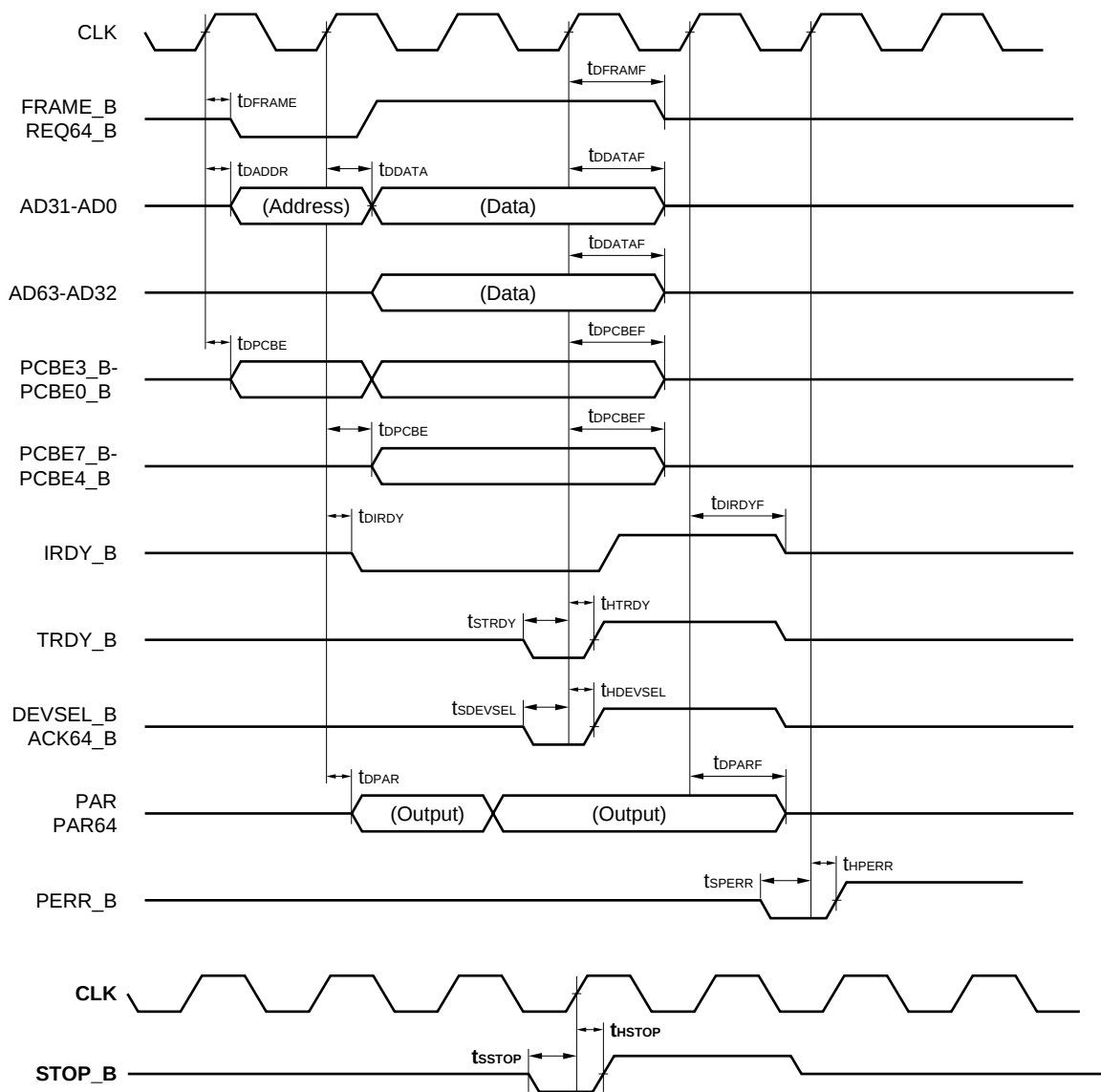
★ Bus master read



★ Bus master write

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
CLK ↑→ FRAME_B, REQ64_B valid time	t _{DFRAME}		1		11	ns	*
CLK ↑→ FRAME_B, REQ64_B float time	t _{DFRAMEF}				28	ns	*
CLK ↑→ AD (Address) valid time	t _{DADDR}		1		11	ns	*
CLK ↑→ Data valid time	t _{DDATA}		1		11	ns	*
CLK ↑→ Data float time	t _{DDATAF}				28	ns	
CLK ↑→ PCBE_B valid time	t _{DPCBE}		1		11	ns	*
CLK ↑→ PCBE_B float time	t _{DPCBEF}				28	ns	
CLK ↑→ IRDY_B valid time	t _{DIRDY}		1		11	ns	*
CLK ↑→ IRDY_B float time	t _{DIRDYF}				28	ns	
TRDY_B setup time	t _{STRDY}		8			ns	*
TRDY_B hold time	t _{HTRDY}		1			ns	*
STOP_B setup time	t _{SSTOP}		8			ns	*
STOP_B hold time	t _{HSTOP}		1			ns	*
DEVSEL_B, ACK64_B setup time	t _{SDEVSEL}		8			ns	*
DEVSEL_B, ACK64_B hold time	t _{HDEVSEL}		1			ns	*
CLK ↑→ PAR valid time	t _{DPAR}		1		11	ns	*
CLK ↑→ PAR float time	t _{DPARF}				28	ns	
PERR_B setup time	t _{SPERR}		8			ns	*
PERR_B hold time	t _{HPERR}		1			ns	*

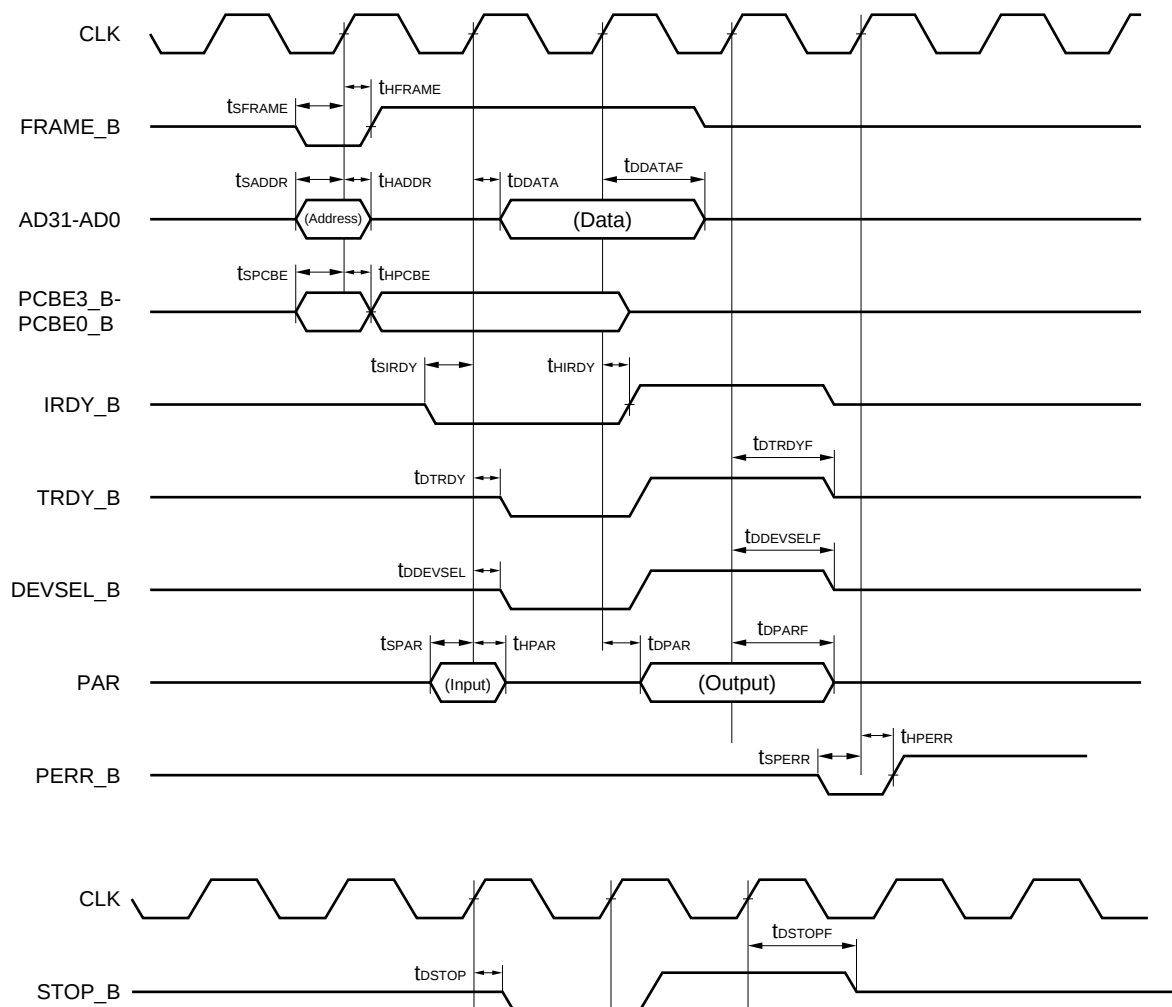
★ Bus master write



★ Target read

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
FRAME_B setup time	t _{SFRAME}		8			ns	*
FRAME_B hold time	t _{HFRAME}		1			ns	*
AD (Address) setup time	t _{SADDR}		8			ns	*
AD (Address) hold time	t _{HADDR}		1			ns	*
CLK ↑→ AD (Data) valid time	t _{DDATA}		1		11	ns	*
CLK ↑→ AD (Data) float time	t _{DDATAF}				28	ns	
PCBE_B setup time	t _{SPCBE}		8			ns	*
PCBE_B hold time	t _{HPCBE}		1			ns	*
IRDY_B setup time	t _{SIRDY}		8			ns	*
IRDY_B hold time	t _{HIRDY}		1			ns	*
CLK ↑→ TRDY_B valid time	t _{DTRDY}		1		11	ns	*
CLK ↑→ TRDY_B float time	t _{DTRDYF}				28	ns	
CLK ↑→ STOP_B valid time	t _{DSTOP}		1		11	ns	*
CLK ↑→ STOP_B float time	t _{DSTOPF}				28	ns	*
CLK ↑→ DEVSEL_B valid time	t _{DDEVSEL}		1		11	ns	*
CLK ↑→ DEVSEL_B float time	t _{DDEVSELF}				28	ns	
PAR setup time	t _{SPAR}		8			ns	*
PAR hold time	t _{HPAR}		1			ns	*
CLK ↑→ PAR valid time	t _{DPAR}		1		11	ns	*
CLK ↑→ PAR float time	t _{DPARF}				28	ns	
PERR_B setup time	t _{SPERR}		8			ns	*
PERR_B hold time	t _{HPERR}		1			ns	*

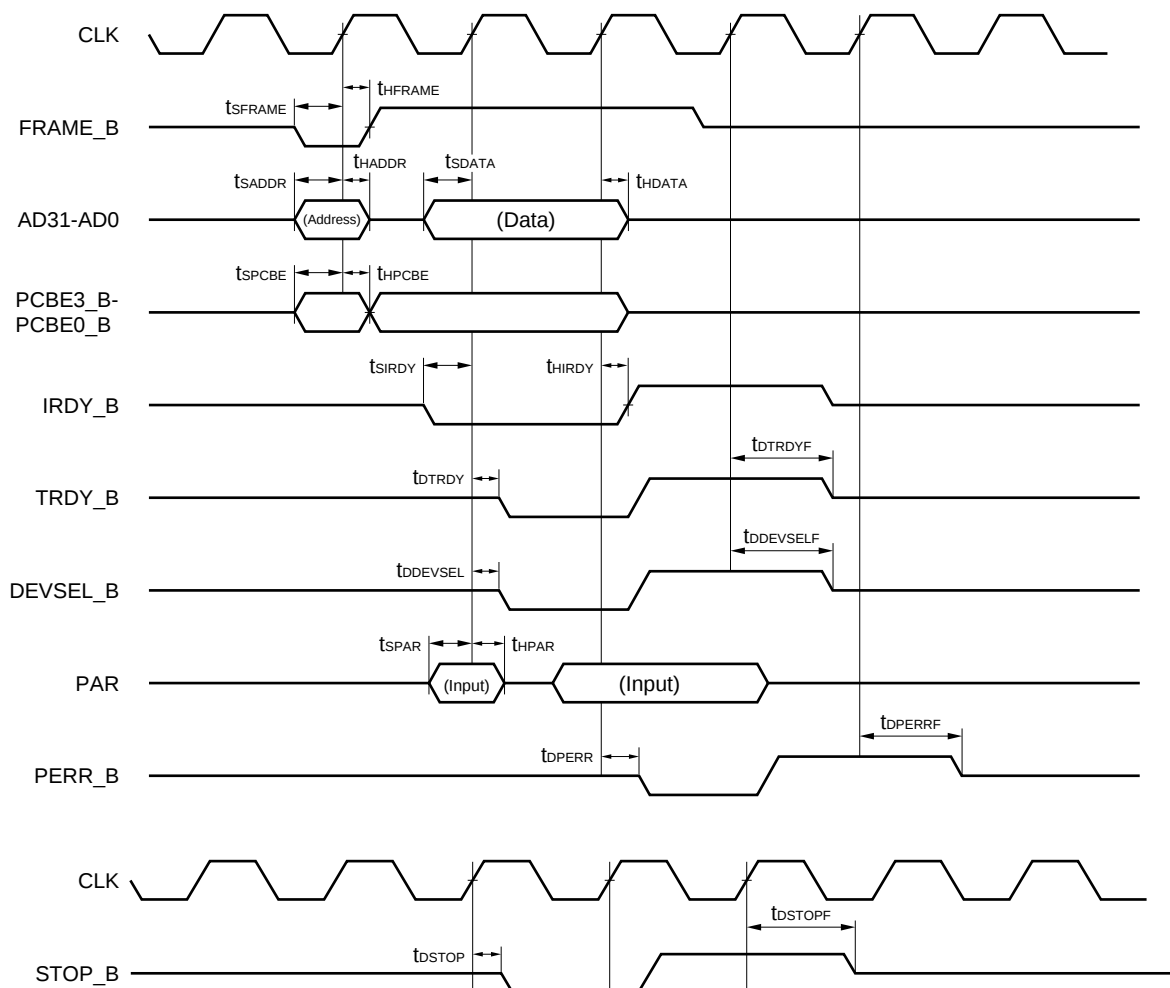
★ Target read



★ Target write

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
FRAME_B setup time	t _{SFRAME}		8			ns	*
FRAME_B hold time	t _{HFRAME}		1			ns	*
AD (Address) setup time	t _{SADDR}		8			ns	*
AD (Address) hold time	t _{HADDR}		1			ns	*
AD (Data) setup time	t _{SDATA}		8			ns	*
AD (Data) hold time	t _{HDATA}		1			ns	*
PCBE_B setup time	t _{SPCBE}		8			ns	*
PCBE_B hold time	t _{HPCBE}		1			ns	*
IRDY_B setup time	t _{SIRDY}		8			ns	*
IRDY_B hold time	t _{HIRDY}		1			ns	*
CLK ↑→ TRDY_B valid time	t _{DTRDY}		1		11	ns	*
CLK ↑→ TRDY_B float time	t _{DTRDYF}				28	ns	
CLK ↑→ STOP_B valid time	t _{DSTOP}		1		11	ns	*
CLK ↑→ STOP_B float time	t _{DSTOPF}				28	ns	*
CLK ↑→ DEVSEL_B valid time	t _{DDEVSEL}		1		11	ns	*
CLK ↑→ DEVSEL_B float time	t _{DDEVSELF}				28	ns	
PAR setup time	t _{SPAR}		8			ns	*
PAR hold time	t _{HPAR}		1			ns	*
CLK ↑→ PERR_B valid time	t _{DPERR}		1		11	ns	*
CLK ↑→ PERR_B float time	t _{DPERRF}				28	ns	

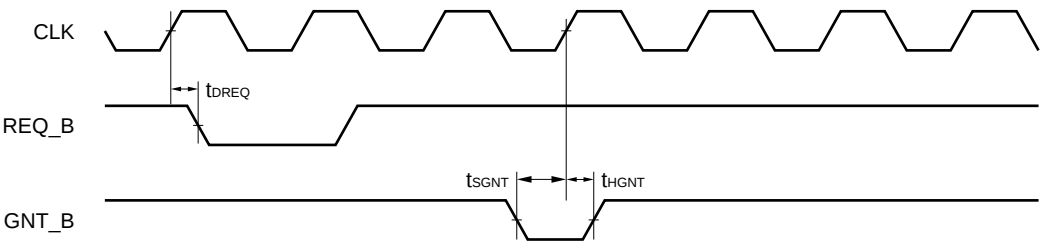
★ Target write



★ Bus arbitration

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
CLK $\uparrow$ $\rightarrow$ REQ_B valid time	tDREQ		1		12	ns *
GNT_B setup time	tSGNT		10			ns
GNT_B hold time	tHGNT		1			ns *

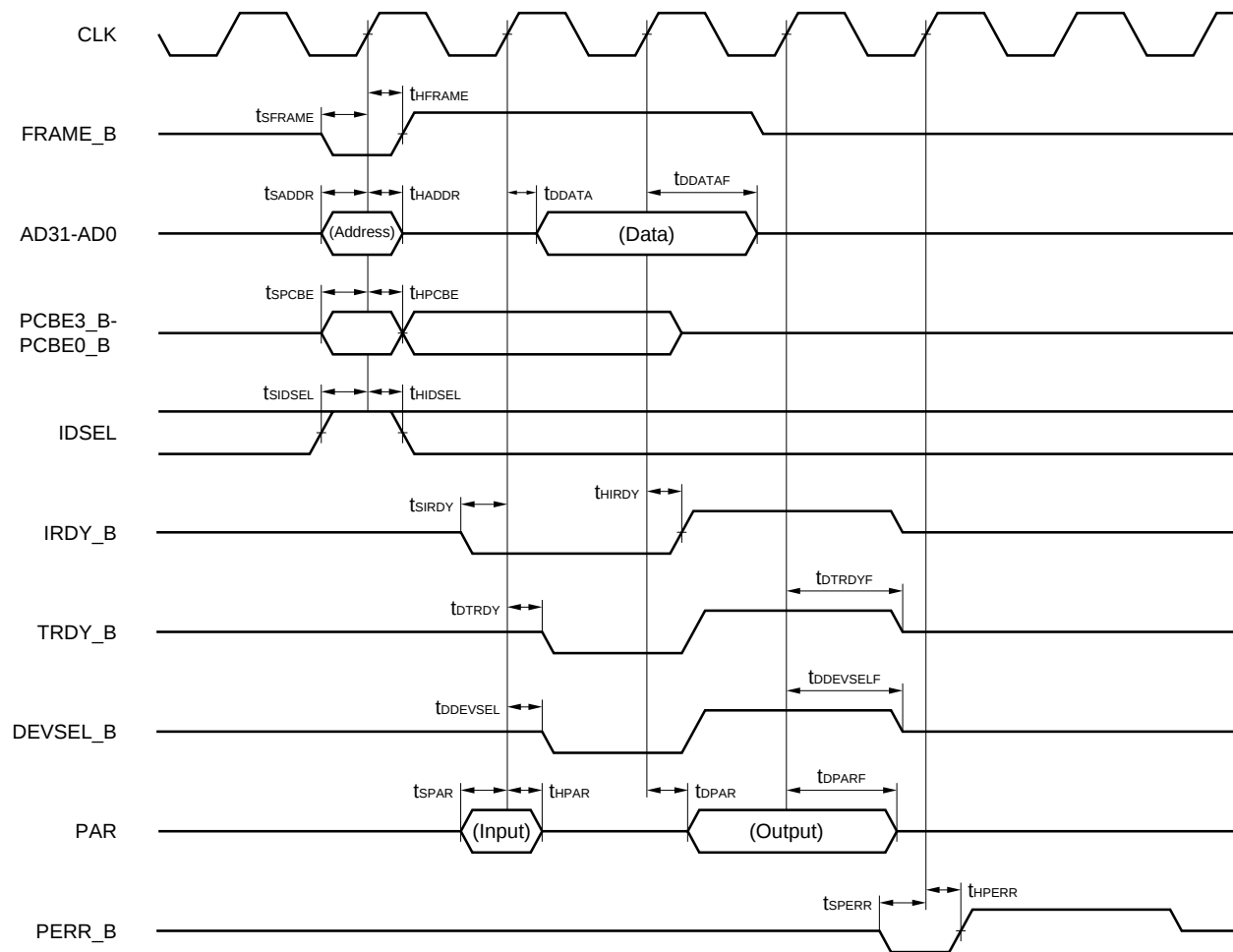
Bus arbitration



★ Configuration read

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
FRAME_B setup time	t _{SFRAME}		8			ns	*
FRAME_B hold time	t _{HFRAME}		1			ns	*
AD (Address) setup time	t _{SADDR}		8			ns	*
AD (Address) hold time	t _{HADDR}		1			ns	*
CLK ↑→ AD (Data) valid time	t _{DDATA}		1		11	ns	*
CLK ↑→ AD (Data) float time	t _{DDATAF}				28	ns	
PCBE_B setup time	t _{SPCBE}		8			ns	*
PCBE_B hold time	t _{HPCBE}		1			ns	*
IDSEL setup time	t _{SIDSEL}		8			ns	*
IDSEL hold time	t _{HIDSEL}		1			ns	*
IRDY_B setup time	t _{SIRDY}		8			ns	*
IRDY_B hold time	t _{HIRDY}		1			ns	*
CLK ↑→ TRDY_B valid time	t _{DTRDY}		1		11	ns	*
CLK ↑→ TRDY_B float time	t _{DTRDYF}				28	ns	
CLK ↑→ DEVSEL_B valid time	t _{DDEVSEL}		1		11	ns	*
CLK ↑→ DEVSEL_B float time	t _{DDEVSELF}				28	ns	
CLK ↑→ PAR valid time	t _{DPAR}		1		11	ns	*
CLK ↑→ PAR float time	t _{DPARF}				28	ns	
PAR setup time	t _{SPAR}		8			ns	*
PAR hold time	t _{HPAR}		1			ns	*
PERR_B setup time	t _{SPERR}		8			ns	*
PERR_B hold time	t _{HPERR}		1			ns	*

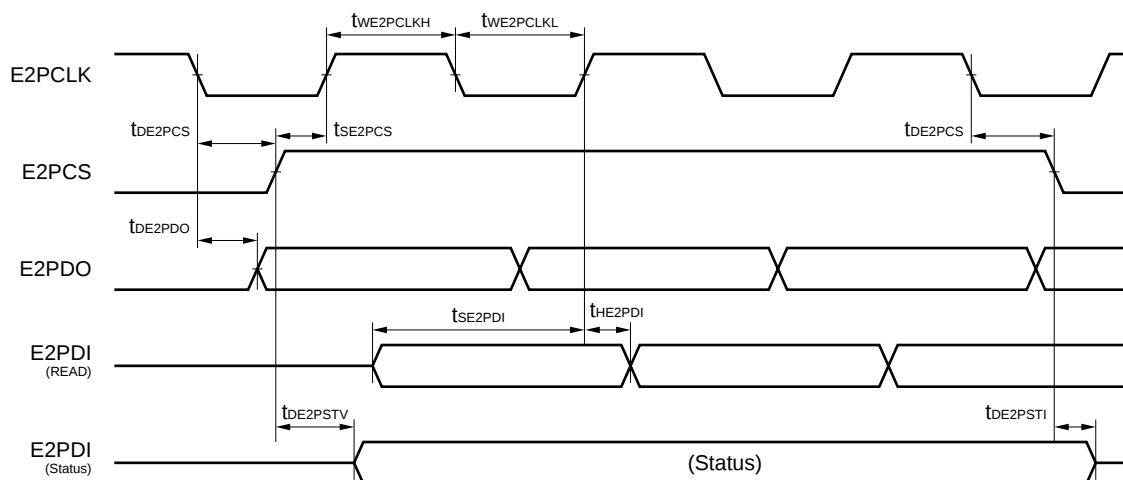
Configuration read



EEPROM interface

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
E2PCLK high-level width	$t_{WE2PCLKH}$		$t_{CYCLK} \times 18 - 50$	$t_{CYCLK} \times 18$	$t_{CYCLK} \times 18 + 50$	ns
E2PCLK low-level width	$t_{WE2PCLKL}$		$t_{CYCLK} \times 18 - 50$	$t_{CYCLK} \times 18$	$t_{CYCLK} \times 18 + 50$	ns
E2PCLK ↓ → E2PCS valid time	t_{DE2PCS}		50			ns
E2PCS ↑ → E2PCLK	t_{SE2PCS}		50			ns
E2PCLK ↓ → E2PDO valid time	t_{DE2PDO}				300	ns
E2PDI → E2PCLK setup time	t_{SE2PDI}		500			ns
E2PCLK → E2PDI hold time	t_{HE2PDI}		70			ns
E2PCS ↑ → E2PDI (Status) valid delay time	$t_{DE2PSTV}$				500	ns
E2PCS ↓ → E2PDI (Status) invalid delay time	$t_{DE2PSTI}$		0		100	ns

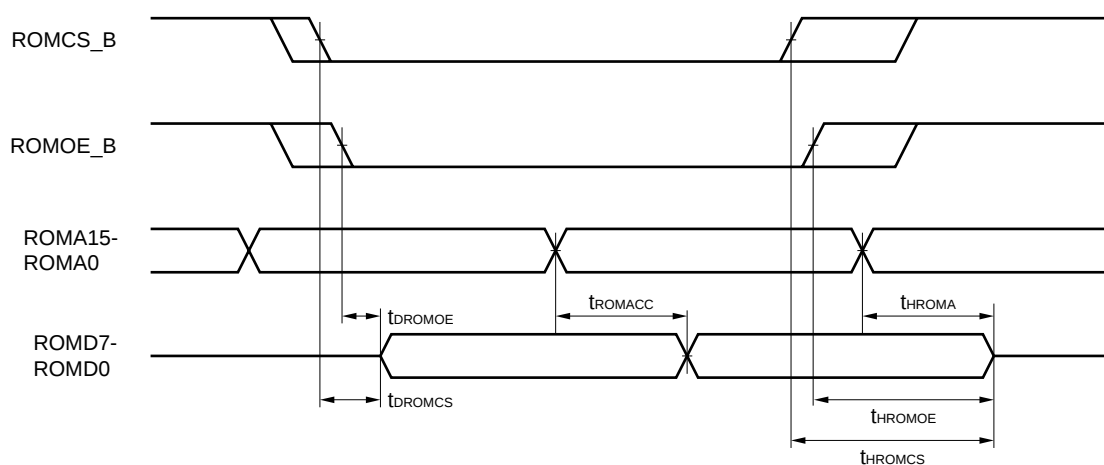
EEPROM interface



Expansion ROM interface

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
ROMOE_B $\downarrow \rightarrow$ ROMD valid time	t_{DROMOE}	ROMCS_B = V_{OL} , ROMA valid			200	ns
ROMCS_B $\downarrow \rightarrow$ ROMD valid time	t_{DROMCS}	ROMOE_B = V_{OL} , ROMA valid			200	ns
ROMA valid time $\rightarrow$ ROMD valid time	t_{ROMACC}	ROMCS_B = ROMOE_B = V_{OL}			200	ns
ROMOE_B $\uparrow \rightarrow$ ROMD float time	t_{HROMOE}	ROMCS_B = V_{OL} , ROMA valid	0			ns
ROMCS_B $\uparrow \rightarrow$ ROMD float time	t_{HROMCS}	ROMOE_B = V_{OL} , ROMA valid	0			ns
ROMA invalid time $\rightarrow$ ROMD hold time	t_{HROMA}	ROMCS_B = ROMOE_B = V_{OL}	0			ns

Expansion ROM interface

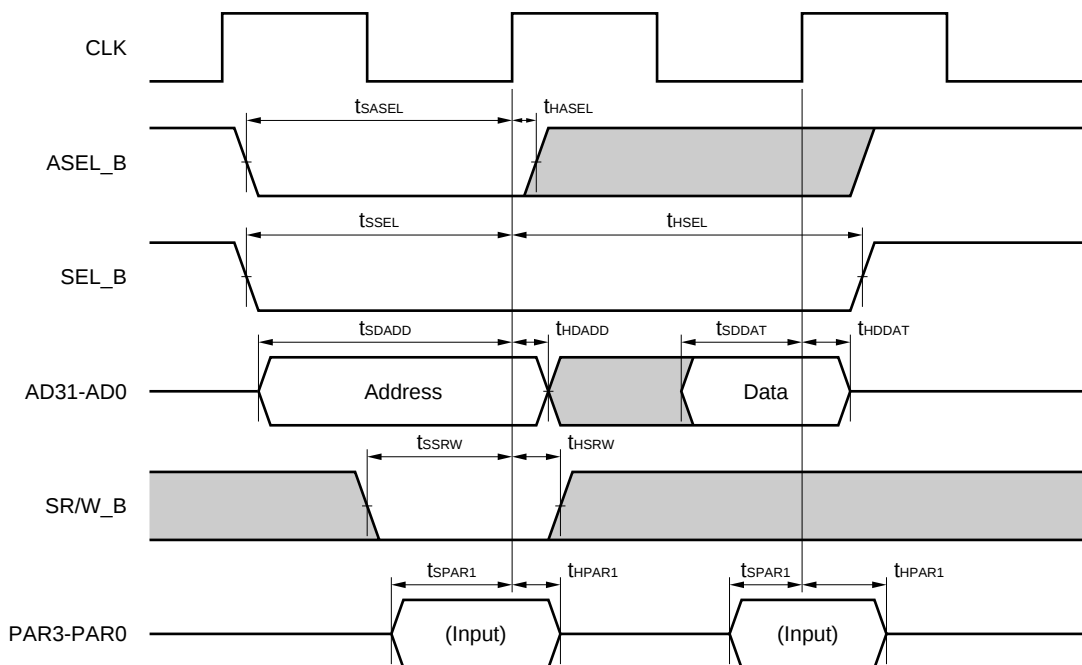


Generic bus interface

Slave write access

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
ASEL_B setup time	t_{SASEL}		8			ns
ASEL_B hold time	t_{HASEL}		3			ns
SEL_B setup time	t_{SSEL}		8			ns
SEL_B hold time	t_{HSEL}		$1 t_{\text{CYCLK}} + 3$			ns
Address setup time	t_{SDADD}		8			ns
Address hold time	t_{HDADD}		3			ns
Data setup time	t_{SDDAT}		8			ns
Data hold time	t_{HDDAT}		3			ns
PAR setup time	t_{SPAR1}		8			ns
PAR hold time	t_{HPAR1}		3			ns
SR/W_B setup time	t_{SSRW}		8			ns
SR/W_B hold time	t_{HSRW}		3			ns

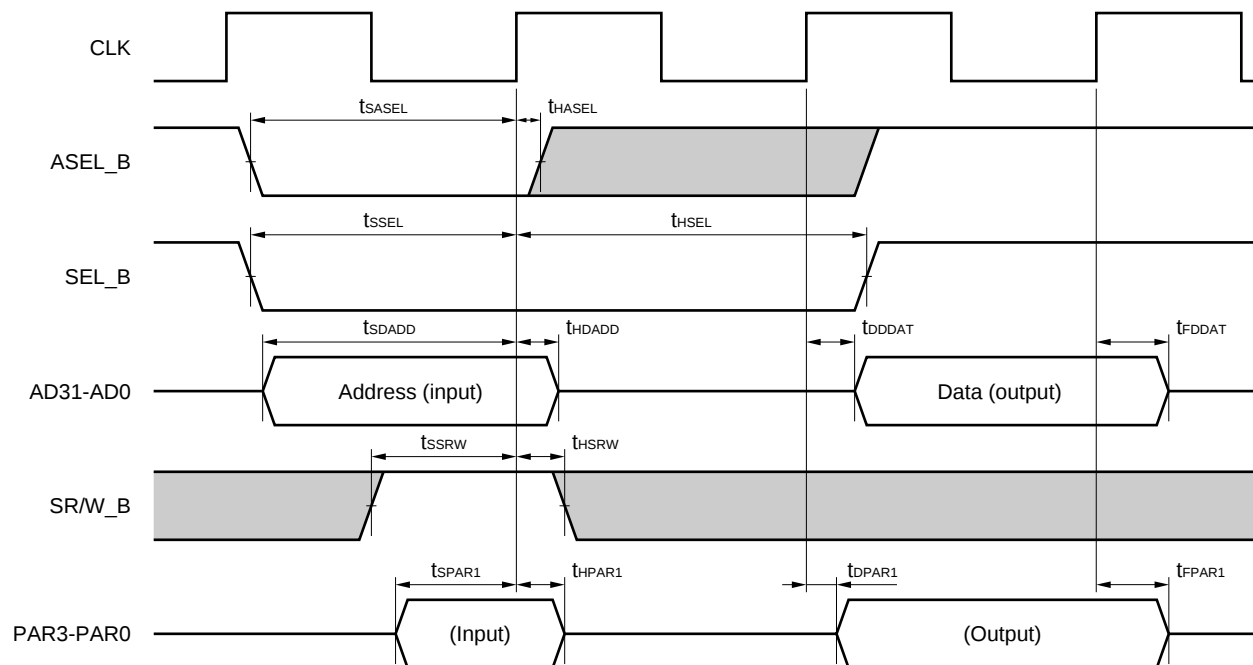
Slave write access



★ Slave read access

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
ASEL_B setup time	t_{SASEL}		8			ns
ASEL_B hold time	t_{HASEL}		3			ns
SEL_B setup time	t_{SSEL}		8			ns
SEL_B hold time	t_{HSEL}		$1 t_{\text{CYCLK}} + 3$			ns
Address setup time	t_{SDADD}		8			ns
Address hold time	t_{HDADD}		3			ns
CLK $\uparrow$ → data delay time	t_{DDAT}				18	ns
CLK $\uparrow$ → data float time	t_{FDDAT}		2		18	ns *
PAR setup time	t_{SPAR1}		8			ns
PAR hold time	t_{HPAR1}		3			ns
CLK $\uparrow$ → PAR delay time	t_{DPAR1}				18	ns
CLK $\uparrow$ → PAR float time	t_{FPAR1}		2		18	ns *
SR/W_B setup time	t_{SSRW}		8			ns
SR/W_B hold time	t_{HSRW}		3			ns

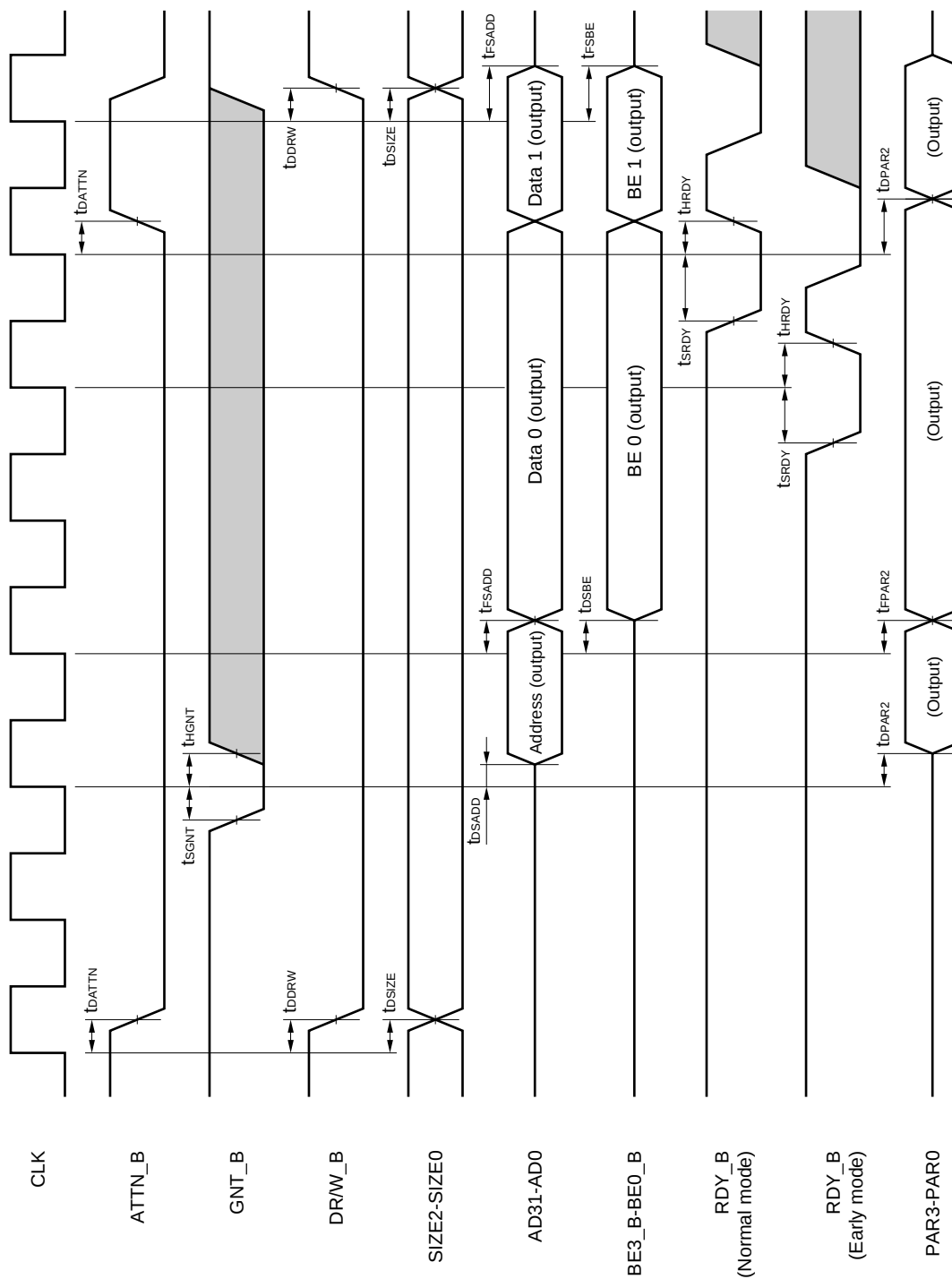
Slave read access



★ DMA write access

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
CLK ↑→ ATTN_B delay time	t _{DATTN}				18	ns	
GNT_B setup time	t _{SGNT}		8			ns	
GNT_B hold time	t _{HGNT}		3			ns	
CLK ↑→ DR/W_B delay time	t _{DDRW}		2		18	ns	*
CLK ↑→ SIZE delay time	t _{DSIZE}		2		18	ns	*
CLK ↑→ address delay time	t _{DSADD}				18	ns	
CLK ↑→ address/data float time	t _{FSADD}		2		18	ns	*
CLK ↑→ BE_B delay time	t _{DSBE}				18	ns	
CLK ↑→ BE_B float time	t _{FSBE}		2		18	ns	*
CLK ↑→ PAR delay time	t _{DPAR2}				18	ns	
CLK ↑→ PAR float time	t _{FPAR2}		2		18	ns	*
RDY_B setup time	t _{SRDY}		8			ns	
RDY_B hold time	t _{HRDY}		3			ns	

DMA write access (Example: 2-word burst)



★ DMA read access

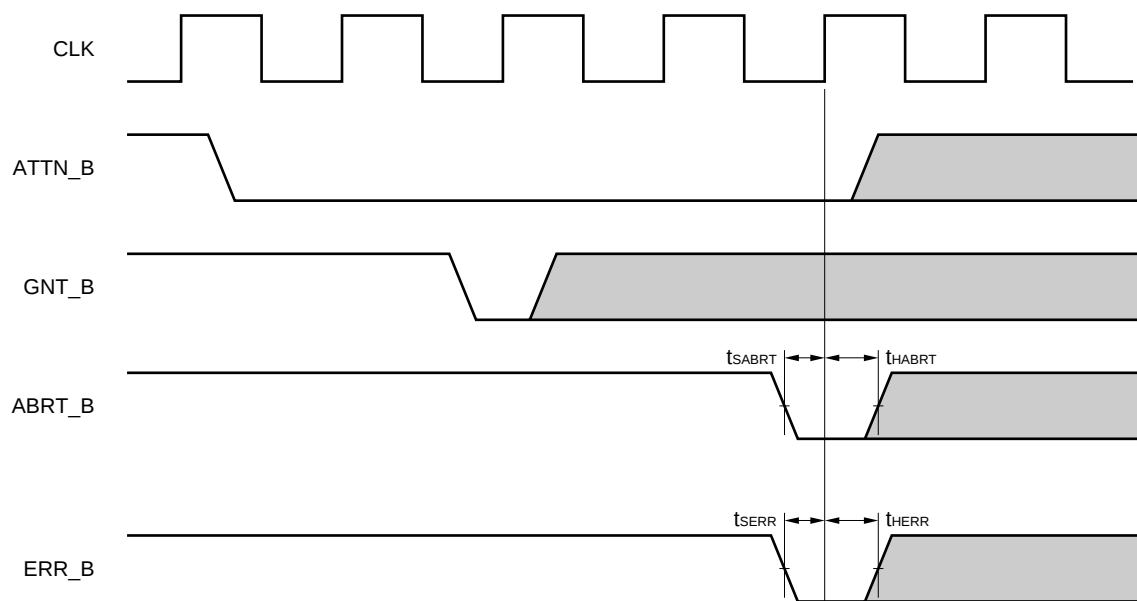
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
CLK ↑→ ATTN_B delay time	t _{DATTN}				18	ns	
GNT_B setup time	t _{SGNT}		8			ns	
GNT_B hold time	t _{HGNT}		3			ns	
CLK ↑→ DR/W_B delay time	t _{DDRW}		2		18	ns	*
CLK ↑→ SIZE delay time	t _{DSIZE}		2		18	ns	*
CLK ↑→ address delay time	t _{DSADD}				18	ns	
CLK ↑→ address/data float time	t _{FSADD}		2		18	ns	*
CLK ↑→ BE_B delay time	t _{DSBE}				18	ns	
CLK ↑→ BE_B float time	t _{FSBE}		2		18	ns	*
CLK ↑→ PAR delay time	t _{DPAR2}				18	ns	
RDY_B setup time	t _{SRDY}		8			ns	
RDY_B hold time	t _{HRDY}		3			ns	
Data setup time	t _{SSDAT}		8			ns	
Data hold time	t _{HSDAT}		3			ns	
PAR setup time	t _{SPAR2}		8			ns	
PAR hold time	t _{HPAR2}		3			ns	

The diagram illustrates the timing relationships for the AD31-AD0, BE3-BE0, and PAR3-PAR0 signals. The signals are shown as waveforms over time, with various timing parameters labeled. The signals are: CLK, ATTN_B, GNT_B, DRW_B, SIZE2-SIZE0, AD31-AD0, BE3-BE0, RDY_B (Normal mode), RDY_B (Early mode), and PAR3-PAR0. The timing parameters are: tDATTN, tSGNT, tHGNT, tDDRW, tDSIZE, tSSADD, tFSADD, tSSDAT, tFSDAT, tSSBE, tFSBE, tSRDY, tHRDY, tSPAR2, and tHPAR2.

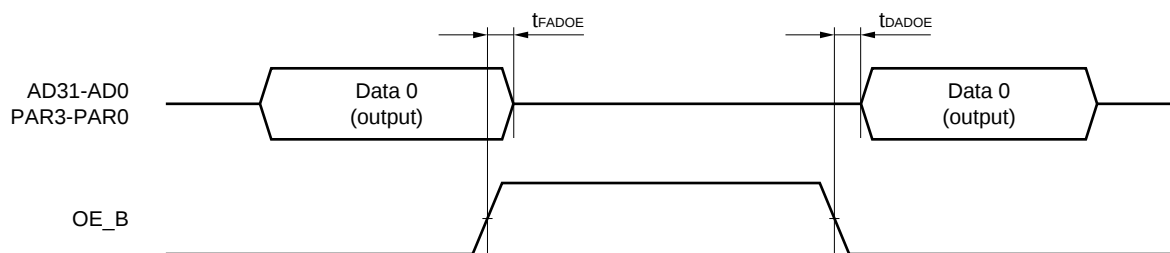
ABRT_B, ERR_B, and OE_B pins

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
ABRT_B setup time	t_{SABRT}		8			ns
ABRT_B hold time	t_{HABRT}		3			ns
ERR_B setup time	t_{SERR}		8			ns
ERR_B hold time	t_{HERR}		3			ns
OE_B ↓→ AD/PAR output determination time	t_{DADOE}				18	ns
OE_B ↑→ AD/PAR high-impedance determination time	t_{FADOE}				18	ns

DMA abort/ERR_B timing



OE_B timing



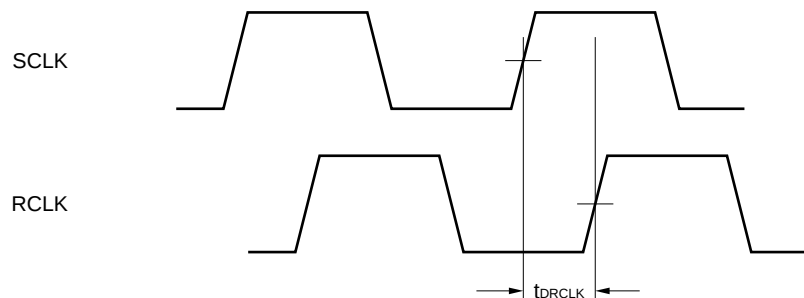
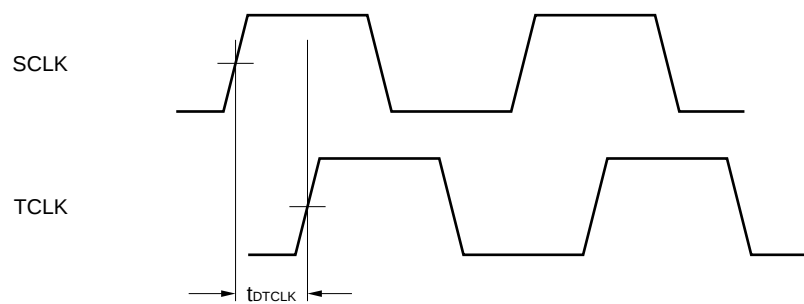
UTOPIA interface (external PHY mode)

★ Transmission operation

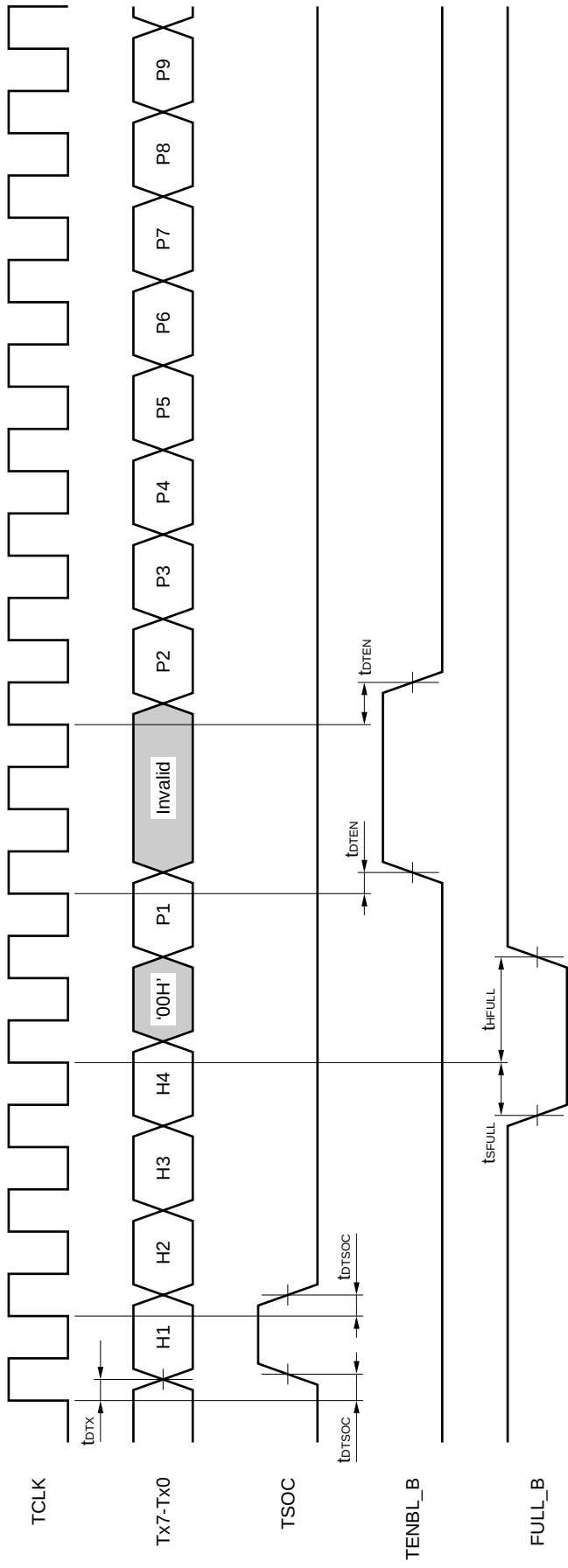
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
SCLK ↑→ TCLK ↑ delay time	t _{DTCLK}				15	ns	*
TCLK ↑→ Tx delay time	t _{DTX}		2		18	ns	*
TCLK ↑→ TSOC delay time	t _{DTSOC}		2		13.62	ns	*
TCLK ↑→ TENBL_B delay time	t _{DTEN}		2		13.66	ns	*
FULL_B setup time	t _{SFULL}		8			ns	
FULL_B hold time	t _{HFULL}		1			ns	

★ Reception operation

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
SCLK ↑→ RCLK ↑ delay time	t _{DRCLK}				15	ns	*
Rx setup time	t _{SRX}		8			ns	
Rx hold time	t _{HRX}		1			ns	
RSOC setup time	t _{SRSOC}		8			ns	
RSOC hold time	t _{HRSOC}		1			ns	
RCLK ↑→ RENBL_B delay time	t _{DREN}		2		13.63	ns	*
EMPTY_B setup time	t _{SEMP}		8			ns	
EMPTY_B hold time	t _{HSEMP}		1			ns	

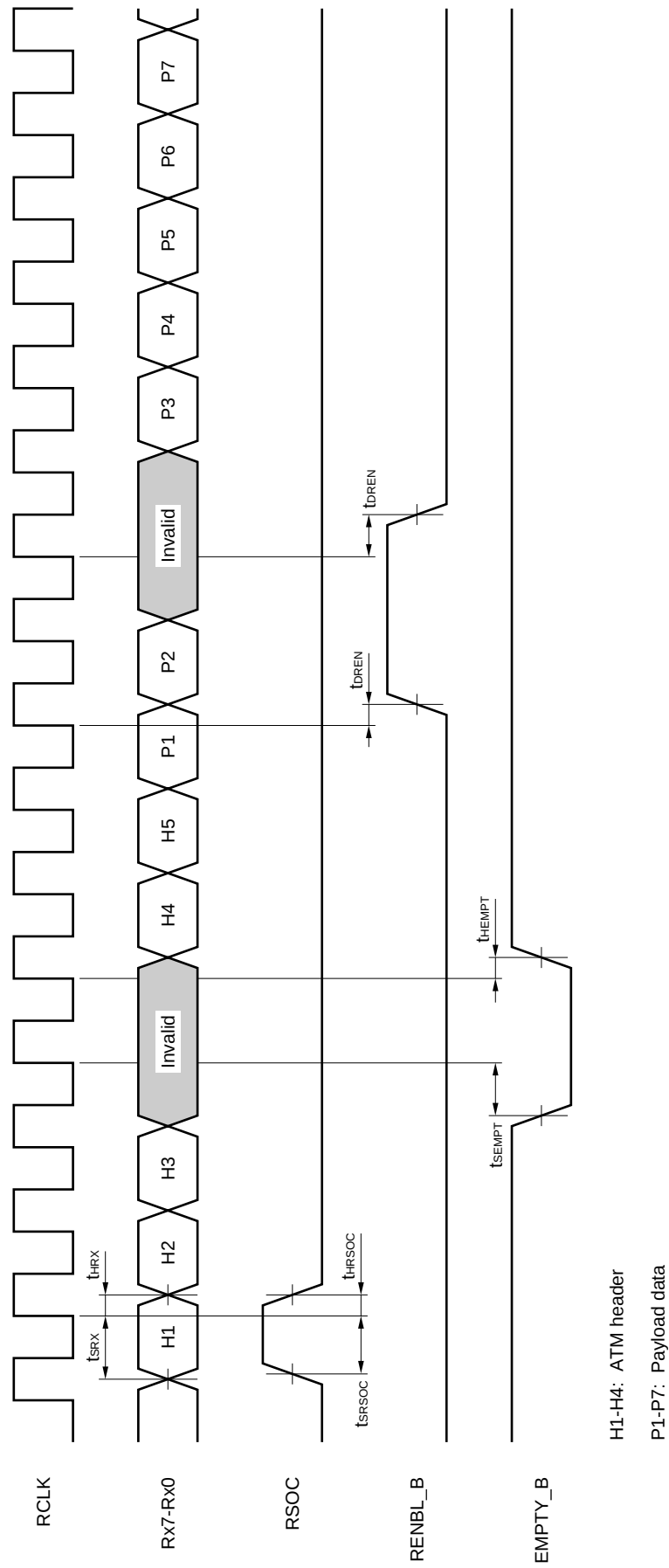


UTOPIA interface (1)
Transmission timing



H1-H4: ATM header
P1-P9: Payload data

UTOPIA interface (2)
Reception timing



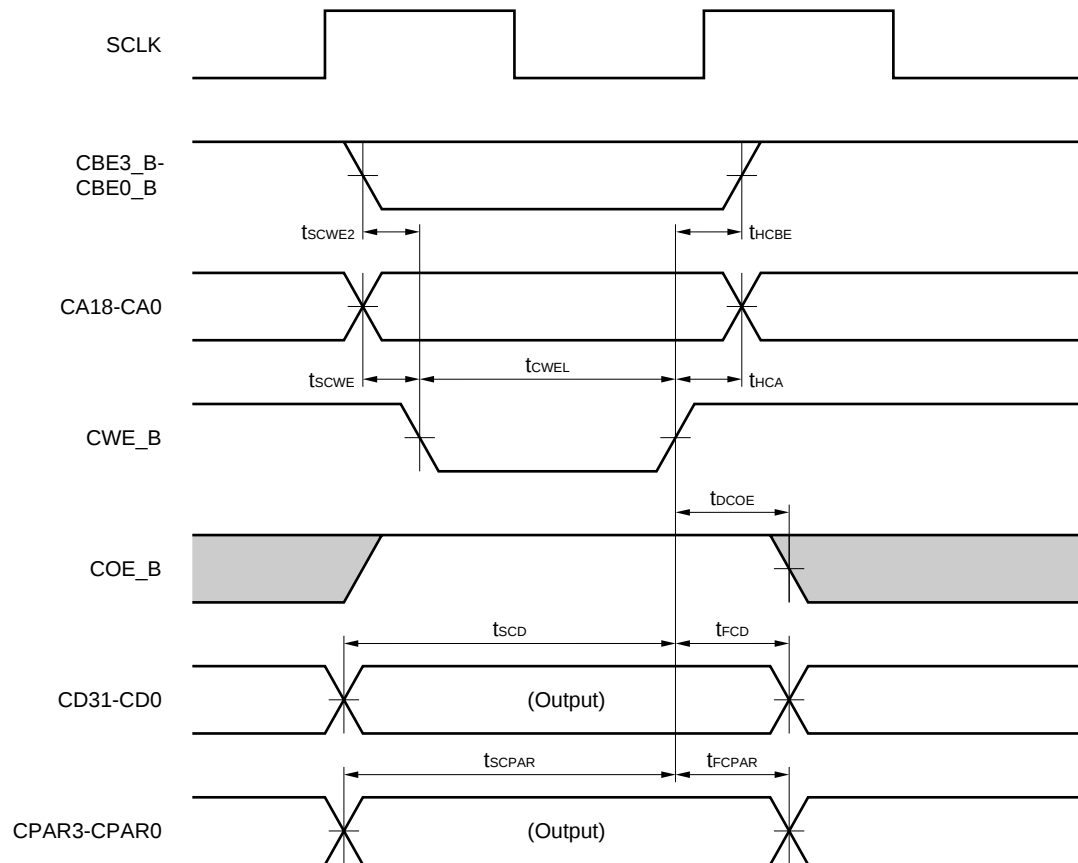
Control memory access



Write

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
CA → CWE_B ↓ setup time	t_{SCWE}		0			ns	
CBE_B → CWE_B ↓ setup time	t_{SCWE2}		0			ns	
CWE_B low-level width	t_{CWEL}		$1 t_{SCLKL} - 2$			ns	
CWE_B ↑ → CD float time	t_{FCD}		0		$1 t_{SCLKL} + 8.59$	ns	*
CWE_B ↑ → COE_B delay time	t_{DCOE}		0			ns	
CA hold time (vs CWE_B ↑)	t_{HCA}		0			ns	
CBE_B hold time (vs CWE_B ↑)	t_{HCBE}		0			ns	
CD output time (vs CWE_B ↑)	t_{SCD}		15			ns	*
CWE_B ↑ → CPAR float time	t_{FCPAR}		0		$1 t_{SCLKL} + 8.65$	ns	*
CPAR output time (vs CWE_B ↑)	t_{SCPAR}		15			ns	*

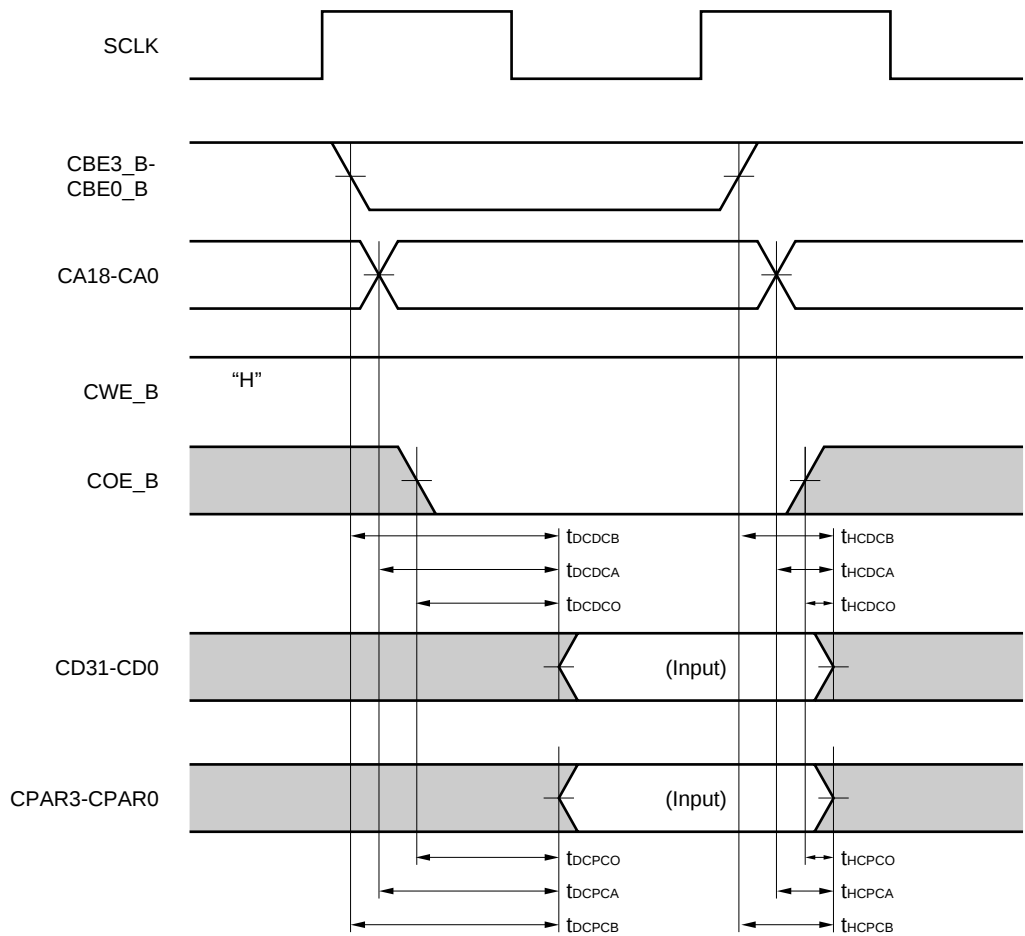
Write timing



★ Read

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
Permissible CD delay time (vs CBE_B ↓)	t _{DCDCB}				1 t _{CYSCLK} – 18	ns	*
Permissible CD delay time (vs CA)	t _{DCDCA}				1 t _{CYSCLK} – 18	ns	*
Permissible CD delay time (vs COE_B ↓)	t _{DCDCO}				1 t _{CYSCLK} – 18	ns	*
CD hold time (vs CBE_B ↑)	t _{HCDCB}		0			ns	
CD hold time (vs CA)	t _{HCDCA}		0			ns	
CD hold time (vs COE_B ↑)	t _{HDCDO}		0			ns	
Permissible CPAR hold time (vs CBE_B ↓)	t _{DCPCB}				1 t _{CYSCLK} – 18	ns	*
Permissible CPAR hold time (vs CA)	t _{DCPCA}				1 t _{CYSCLK} – 18	ns	*
Permissible CPAR hold time (vs COE_B ↓)	t _{DCPCO}				1 t _{CYSCLK} – 18	ns	*
CPAR hold time (vs CBE_B ↑)	t _{HPCB}		0			ns	
CPAR hold time (vs CA)	t _{HCPCA}		0			ns	
CPAR hold time (vs COE_B ↑)	t _{HCPCO}		0			ns	

Read timing



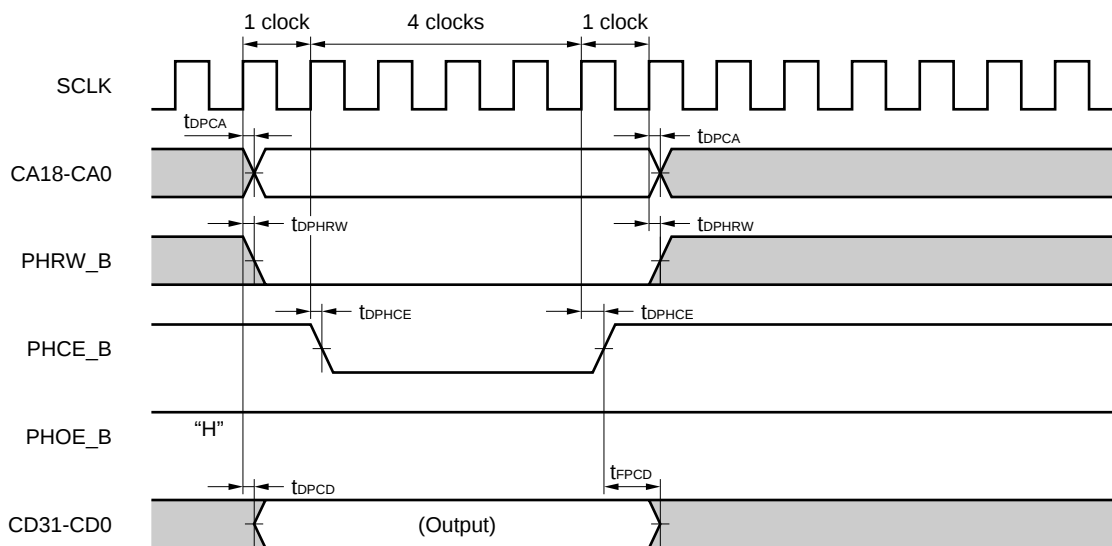
PHY status access

★ Write

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
SCLK $\uparrow$ $\rightarrow$ CA delay time	t_{DPCA}				20	ns
SCLK $\uparrow$ $\rightarrow$ PHRW_B delay time	t_{DPHRW}				20	ns
SCLK $\uparrow$ $\rightarrow$ PHCE_B delay time	t_{DPHCE}				20	ns
SCLK $\uparrow$ $\rightarrow$ CD delay time	t_{DPCD}				23	ns
PHCE_B $\uparrow$ $\rightarrow$ CD float time	t_{FPCD}		$1 t_{CYCLK} - 10$		$1 t_{CYCLK} + 10$	ns

*

Write timing



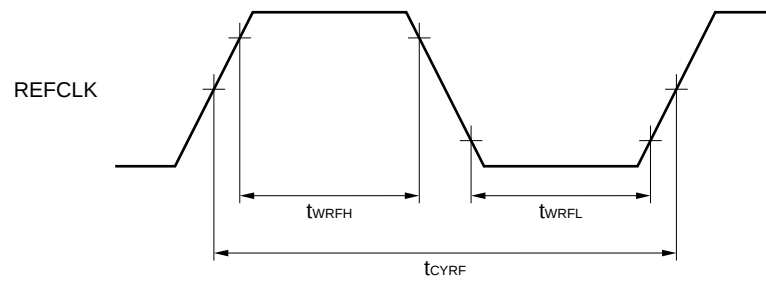
★ Read

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
CD setup time	t_{SPCD}		10			ns
CD hold time	t_{HPOECD}		0			ns
SCLK $\uparrow$ $\rightarrow$ CA delay time	t_{DPCA}				20	ns
SCLK $\uparrow$ $\rightarrow$ PHRW_B delay time	t_{DPHRW}				20	ns
SCLK $\uparrow$ $\rightarrow$ PHCE_B delay time	t_{DPHCE}				20	ns
SCLK $\uparrow$ $\rightarrow$ PHOE_B delay time	t_{DPHOE}				20	ns

*

★ PMD serial interface (internal PHY mode)

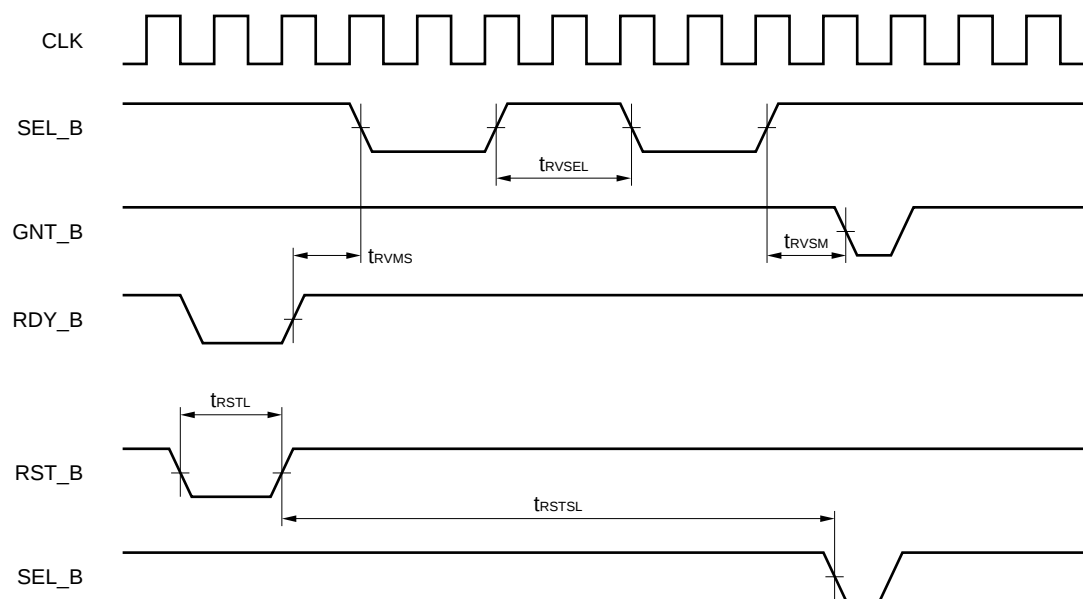
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
REFCLK cycle time	t_{CYRF}		-20 ppm	51.4403	+20 ppm	ns	*
REFCLK high-level width	t_{WRFH}		$0.4 \times t_{CYRF}$		$0.4 \times t_{CYRF}$	ns	*
REFCLK low-level width	t_{WRFL}		$0.4 \times t_{CYRF}$		$0.4 \times t_{CYRF}$	ns	*



★ Others

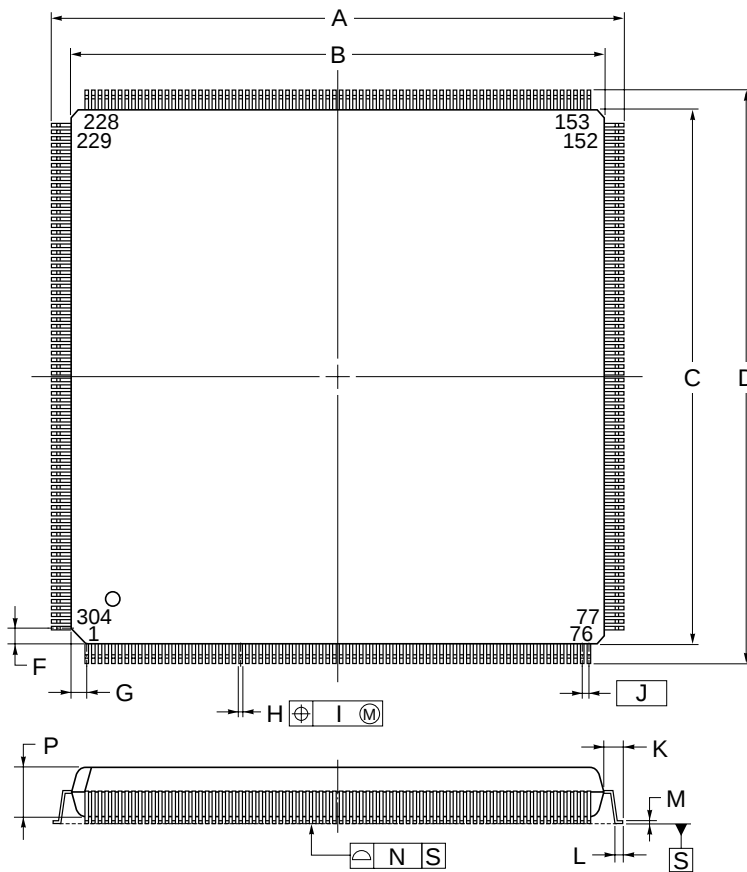
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
SEL_B recovery time	t_{RVSEL}		2			t_{CYCLK}
SEL_B $\uparrow \rightarrow$ GNT_B $\downarrow$ recovery time	t_{RVSM}		1			t_{CYCLK}
RDY_B $\uparrow \rightarrow$ SEL_B $\downarrow$ recovery time	t_{RVMS}	RDY_B mode during normal operation	1			t_{CYCLK}
RST_B input pulse width	t_{RSTL}		1			t_{CYCLK}
RST_B $\uparrow \rightarrow$ SEL_B $\downarrow$ recovery time	t_{RSTSL}		20			t_{CYCLK}

Others timing

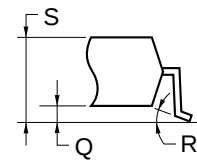


3. PACKAGE DRAWING

304 PIN PLASTIC QFP (FINE PITCH) (40x40)



detail of lead end

**NOTE**

Each lead centerline is located within 0.10 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	42.6±0.2
B	40.0±0.2
C	40.0±0.2
D	42.6±0.2
F	1.25
G	1.25
H	0.22 ^{+0.05} _{-0.04}
I	0.10
J	0.5 (T.P.)
K	1.3±0.2
L	0.5±0.2
M	0.145 ^{+0.055} _{-0.045}
N	0.10
P	3.7±0.1
Q	0.4±0.1
R	5°±5°
S	4.3 MAX.

P304GL-50-NMU, PMU-3

4. RECOMMENDED SOLDERING CONDITIONS

Solder this product under the following recommended conditions.

For details of the recommended soldering conditions, refer to information document **Semiconductor Device Mounting Technology Manual (C10535E)**.

For soldering methods and conditions other than those recommended, consult NEC.

Surface-mount type

- μPD98405GL-PMU: 304-pin plastic QFP (0.5-mm fine pitch) (40 × 40 mm)

Soldering Method(s)	Soldering Conditions	Recommended Conditions Symbol
Infrared reflow	Package peak temperature: 235°C, Time: 30 sec max. (210°C min.), Number of times: once, Number of days: 3 ^{Note} (after that, prebaking is necessary at 125°C for 20 hours)	IR35-203-1
Partial pin heating	Pin temperature: 300°C max., Time: 3 sec. Max. (per device side)	—

Note Number of days in storage after the dry pack has been opened. The storage conditions are at 25°C, 65% RH MAX.

[MEMO]

[MEMO]

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