

MOS INTEGRATED CIRCUIT

μ PD30500, 30500A

VR5000™, VR5000A™

64-/32-BIT MICROPROCESSOR

DESCRIPTION

The μ PD30500 (VR5000) and μ PD30500A (VR5000A) are a high-performance, 64-/32-bit RISC (Reduced Instruction Set Computer) type microprocessors employing the RISC architecture developed by MIPS™ Technologies, Inc.

The instructions of the VR5000 and VR5000A are compatible with those of the VR3000™ Series and VR4000™ Series and higher, and completely compatible with those of the VR10000™. Therefore, present applications can be used as they are.

Detailed function descriptions are provided in the following user's manuals. Be sure to read them before designing.

- VR5000, VR5000A User's Manual (U11761E)

FEATURES

- Employs 64-bit MIPS-based RISC architecture
- High-speed processing
 - 2-way super scalar 5-stage pipeline
 - 5.5 SPECint95, 5.5 SPECfp95, 278 MIPS (μ PD30500)
 - ★ 7.0 SPECint95, 7.0 SPECfp95, 376 MIPS (μ PD30500A)
- High-speed translation buffer mechanism (TLB) (48 entries)
- Address space Physical: 36 bits, Virtual: 40 bits
- Floating-point unit (FPU)
 - Sum-of-products operation instruction supported
- Primary cache memory (instruction/data: 32 KB each)
- Secondary cache controller
- ★ • Maximum operating frequency Internal: 200 MHz (μ PD30500), 266 MHz (μ PD30500A)
 - External: 100 MHz
 - Selectable external/internal multiple rate from twice to eight times
- Instruction set compatible with VR3000 and VR4000 Series and higher (conforms to MIPS I, II, III, and IV)
- Supply voltage: 3.3 V \pm 5% (μ PD30500)
 - ★ Core: 2.4 V \pm 0.1 V (μ PD30500A, @ 100 to 235 MHz),
2.5 V \pm 5% (μ PD30500A, @ 236 to 250 MHz),
2.6 V \pm 0.1 V (μ PD30500A, @ 251 to 266 MHz)
 - I/O: 3.3 V \pm 5% (μ PD30500A)

Unless otherwise specified, the VR5000 (μ PD30500) is treated as the representative model throughout this document.

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

APPLICATIONS

- High-performance embedded systems
- Multimedia systems
- Entry-class computers
- Image processing systems

ORDERING INFORMATION

Part number	Package	Maximum operating frequency (MHz)
μPD30500RJ-150	223-pin ceramic PGA (48 × 48)	150
μPD30500RJ-180	223-pin ceramic PGA (48 × 48)	180
μPD30500RJ-200	223-pin ceramic PGA (48 × 48)	200
μPD30500S2-150	272-pin plastic BGA (C/D advanced type) (29 × 29)	150
μPD30500S2-180	272-pin plastic BGA (C/D advanced type) (29 × 29)	180
μPD30500S2-200	272-pin plastic BGA (C/D advanced type) (29 × 29)	200
μPD30500AS2-250	272-pin plastic BGA (C/D advanced type) (29 × 29)	250
★ μPD30500AS2-266	272-pin plastic BGA (C/D advanced type) (29 × 29)	266

MAIN DIFFERENCES BETWEEN V_R5000 AND V_R5000A

Parameter	V _R 5000	V _R 5000A
★ Maximum internal operating frequency	150/180/200 MHz	250/266 MHz
Internal multiplication ratio for clock interface input	2, 3, 4, 5, 6, 7, 8	2, 2.5 ^{Note} , 3, 4, 5, 6, 7, 8
★ Supply voltage	3.3 V ±5%	Core: 2.4 V ±0.1 V (@ 100 to 235 MHz) 2.5 V ±5% (@ 236 to 250 MHz) 2.6 V ±0.1 V (@ 251 to 266 MHz) I/O: 3.3 V ±5%
Package	<ul style="list-style-type: none"> • 223-pin ceramic PGA • 272-pin plastic BGA (C/D advanced type) 	<ul style="list-style-type: none"> • 272-pin plastic BGA (C/D advanced type)

Note Selectable only when SysClock = 100 MHz

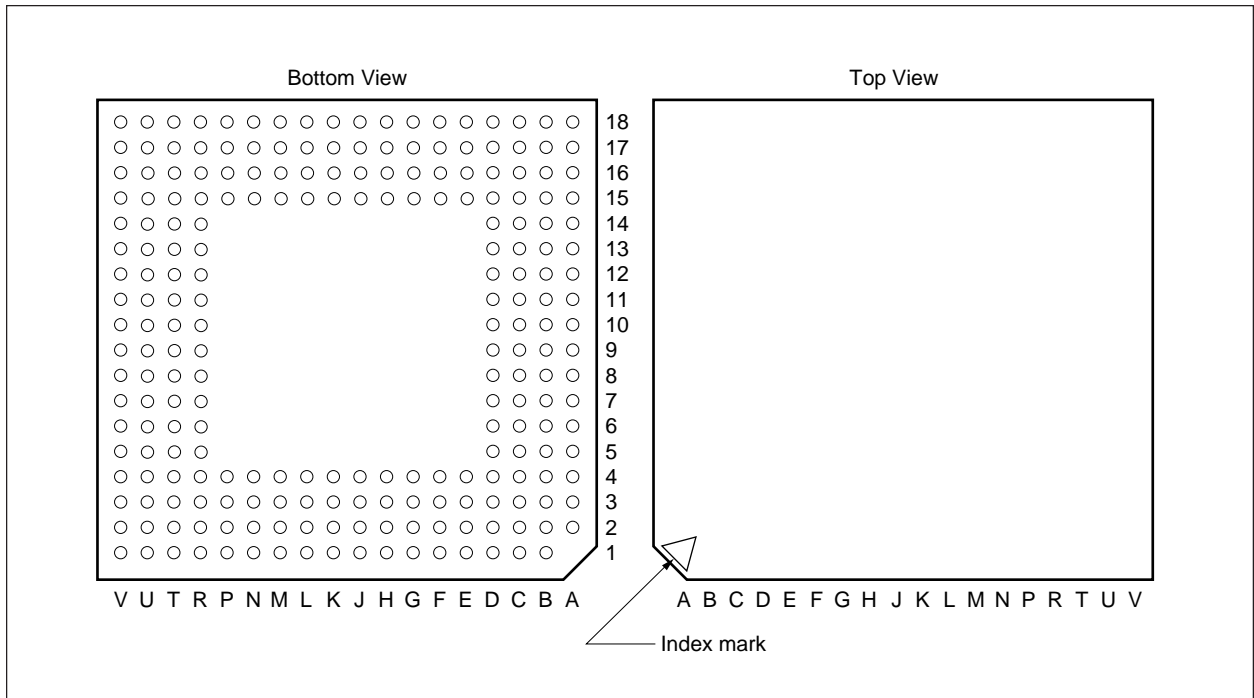
PIN CONFIGURATION

- **223-pin ceramic PGA (48 × 48)**

μPD30500RJ-150

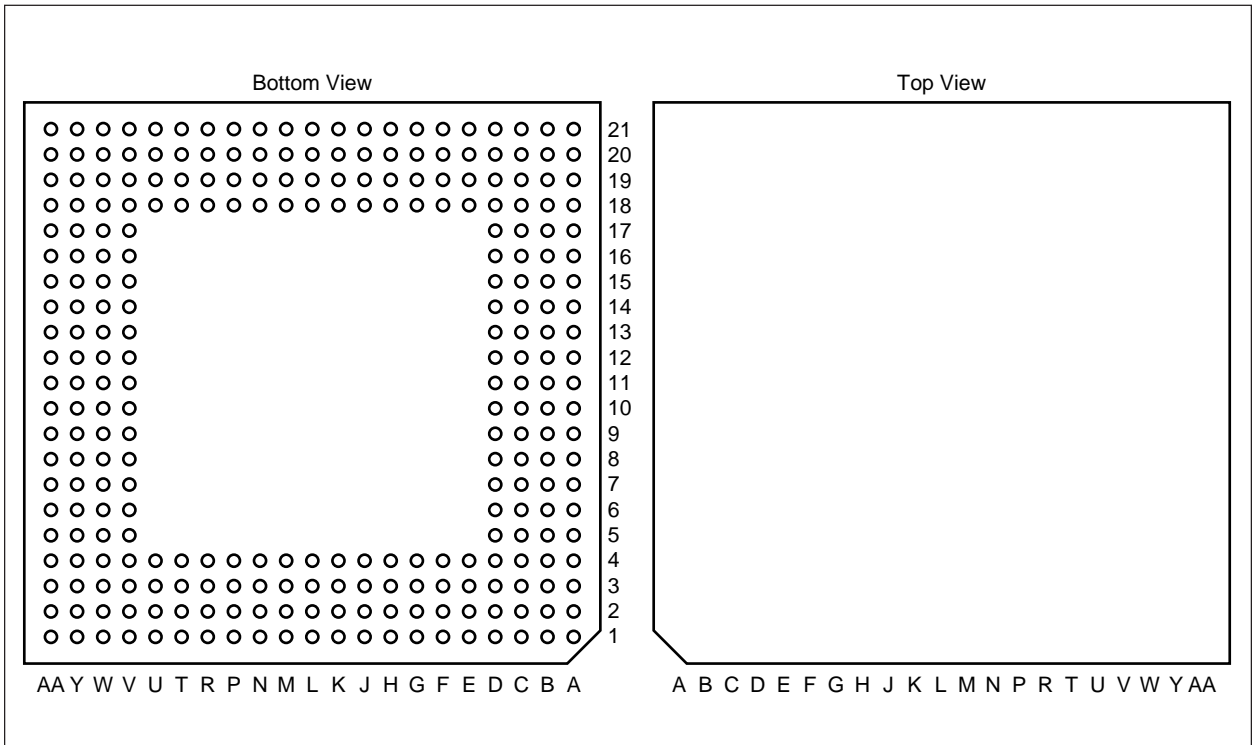
μPD30500RJ-180

μPD30500RJ-200



No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name
A2	V _{DD}	C5	SysADC6	E18	V _{DD}	K17	GNDP	R6	SysAD51	U9	SysAD63
A3	GND	C6	SysAD16	F1	V _{DD}	K18	GND	R7	SysAD55	U10	SysAD13
A4	V _{DD}	C7	SysAD50	F2	Reserved	L1	GND	R8	SysAD27	U11	SysAD11
A5	GND	C8	SysAD22	F3	ScValid	L2	SysCmd8	R9	SysAD31	U12	SysAD9
A6	GND	C9	SysAD24	F4	$\overline{\text{Int1}}$	L3	SysCmd7	R10	SysAD43	U13	SysAD37
A7	V _{DD}	C10	SysAD28	F15	$\overline{\text{ScDCE0}}$	L4	SysCmd5	R11	SysAD39	U14	SysAD3
A8	GND	C11	SysAD62	F16	$\overline{\text{ScCWE0}}$	L15	ScLine12	R12	SysAD35	U15	ScWord0
A9	V _{DD}	C12	SysAD44	F17	$\overline{\text{ScTDE}}$	L16	ScLine14	R13	SysAD1	U16	V _{DD}
A10	GND	C13	SysAD10	F18	GND	L17	ScLine15	R14	ScWord1	U17	GND
A11	V _{DD}	C14	SysAD38	G1	GND	L18	V _{DD}	R15	ScLine0	U18	GND
A12	GND	C15	SysAD4	G2	Reserved	M1	V _{DD}	R16	ScLine3	V1	GND
A13	V _{DD}	C16	SysAD34	G3	Reserved	M2	SysCmd6	R17	ScLine6	V2	GND
A14	GND	C17	SysAD2	G4	Reserved	M3	SysCmd4	R18	GND	V3	V _{DD}
A15	GND	C18	GND	G15	$\overline{\text{ScCLR}}$	M4	SysCmd1	T1	GND	V4	GND
A16	V _{DD}	D1	GND	G16	$\overline{\text{ScTCE}}$	M15	ScLine8	T2	SysAD15	V5	GND
A17	GND	D2	$\overline{\text{Int3}}$	G17	ModIn	M16	ScLine10	T3	SysAD47	V6	V _{DD}
A18	GND	D3	$\overline{\text{Int5}}$	G18	V _{DD}	M17	ScLine13	T4	SysAD17	V7	GND
B1	GND	D4	$\overline{\text{Release}}$	H1	V _{DD}	M18	GND	T5	SysAD19	V8	V _{DD}
B2	GND	D5	V _{DD}	H2	Reserved	N1	GND	T6	SysAD23	V9	GND
B3	V _{DD}	D6	SysADC2	H3	Reserved	N2	SysCmd3	T7	SysAD57	V10	V _{DD}
B4	SysADC4	D7	SysAD48	H4	Reserved	N3	SysCmd2	T8	SysAD29	V11	GND
B5	SysADC0	D8	SysAD52	H15	V _{DD} Ok	N4	SysADC7	T9	V _{DD}	V12	V _{DD}
B6	SysAD18	D9	SysAD56	H16	ModeClock	N15	ScLine5	T10	SysAD45	V13	GND
B7	SysAD20	D10	SysAD60	H17	SysClock	N16	ScLine7	T11	SysAD41	V14	V _{DD}
B8	SysAD54	D11	SysAD14	H18	GND	N17	ScLine11	T12	SysAD7	V15	GND
B9	SysAD26	D12	SysAD42	J1	GND	N18	V _{DD}	T13	SysAD5	V16	GND
B10	SysAD58	D13	SysAD8	J2	$\overline{\text{WrRdy}}$	P1	V _{DD}	T14	SysAD33	V17	V _{DD}
B11	SysAD30	D14	SysAD36	J3	$\overline{\text{ValidIn}}$	P2	SysCmd0	T15	$\overline{\text{Reset}}$	V18	GND
B12	SysAD46	D15	$\overline{\text{ColdReset}}$	J4	$\overline{\text{ExtRqst}}$	P3	SysCmdP	T16	ScLine1		
B13	SysAD12	D16	SysAD0	J15	Reserved	P4	SysADC1	T17	V _{DD}		
B14	SysAD40	D17	$\overline{\text{ScTOE}}$	J16	Reserved	P15	ScLine2	T18	V _{DD}		
B15	SysAD6	D18	V _{DD}	J17	Reserved	P16	ScLine4	U1	V _{DD}		
B16	GND	E1	GND	J18	V _{DD}	P17	ScLine9	U2	V _{DD}		
B17	V _{DD}	E2	$\overline{\text{Int0}}$	K1	V _{DD}	P18	GND	U3	GND		
B18	V _{DD}	E3	$\overline{\text{Int2}}$	K2	ScMatch	R1	V _{DD}	U4	SysAD21		
C1	V _{DD}	E4	$\overline{\text{Int4}}$	K3	$\overline{\text{RdRdy}}$	R2	SysADC5	U5	SysAD53		
C2	V _{DD}	E15	SysAD32	K4	$\overline{\text{ScDOE}}$	R3	SysADC3	U6	SysAD25		
C3	$\overline{\text{ValidOut}}$	E16	$\overline{\text{ScDCE1}}$	K15	Reserved	R4	BigEndian	U7	SysAD59		
C4	$\overline{\text{NMI}}$	E17	$\overline{\text{ScCWE1}}$	K16	V _{DD} P	R5	SysAD49	U8	SysAD61		

- 272-pin plastic BGA (C/D advanced type) (29 × 29)
 - μPD30500S2-150
 - μPD30500S2-180
 - μPD30500S2-200
 - μPD30500AS2-250
 - ★ μPD30500AS2-266



(1) μPD30500

No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name
A1	GND	C5	ScDCE1	F1	SysAD8	L20	SysAD63	U18	VDD	Y1	VDD
A2	VDD	C6	ScDCE0	F2	SysAD38	L21	GND	U19	SysAD17	Y2	VDD
A3	GND	C7	ScCWE0	F3	SysAD6	M1	SysAD26	U20	SysAD49	Y3	VDD
A4	SysAD32	C8	ScTCE	F4	GND	M2	SysAD56	U21	GND	Y4	Release
A5	GND	C9	Modeln	F18	GND	M3	SysAD24	V1	VDD	Y5	Int3
A6	ScCWE1	C10	Reserved	F19	SysAD1	M4	VDD	V2	VDD	Y6	Int2
A7	GND	C11	GNDP	F20	SysAD33	M18	VDD	V3	VDD	Y7	ScValid
A8	VDDOk	C12	Reserved	F21	SysAD3	M19	SysAD29	V4	GND	Y8	Reserved
A9	GND	C13	ScLine13	G1	GND	M20	SysAD61	V5	NMI	Y9	Reserved
A10	SysClock	C14	ScLine11	G2	SysAD10	M21	SysAD31	V6	GND	Y10	Reserved
A11	GND	C15	ScLine8	G3	SysAD40	N1	GND	V7	VDD	Y11	ExtRqst
A12	ScLine15	C16	ScLine5	G4	VDD	N2	SysAD54	V8	VDD	Y12	RdRdy
A13	GND	C17	ScLine4	G18	VDD	N3	SysAD22	V9	GND	Y13	SysCmd8
A14	ScLine12	C18	ScLine0	G19	SysAD35	N4	GND	V10	VDD	Y14	SysCmd5
A15	GND	C19	Reset	G20	SysAD5	N18	GND	V11	VDD	Y15	SysCmd3
A16	ScLine7	C20	VDD	G21	GND	N19	SysAD27	V12	VDD	Y16	SysCmd0
A17	GND	C21	GND	H1	SysAD42	N20	SysAD59	V13	GND	Y17	SysCmdP
A18	ScLine2	D1	VDD	H2	SysAD44	N21	GND	V14	VDD	Y18	SysADC1
A19	GND	D2	VDD	H3	SysAD12	P1	SysAD50	V15	VDD	Y19	SysAD15
A20	VDD	D3	VDD	H4	VDD	P2	SysAD52	V16	GND	Y20	VDD
A21	GND	D4	GND	H18	VDD	P3	SysAD20	V17	VDD	Y21	VDD
B1	VDD	D5	VDD	H19	SysAD7	P4	VDD	V18	GND	AA1	GND
B2	VDD	D6	GND	H20	SysAD39	P18	VDD	V19	VDD	AA2	VDD
B3	VDD	D7	VDD	H21	SysAD37	P19	SysAD25	V20	VDD	AA3	GND
B4	SysAD2	D8	VDD	J1	GND	P20	SysAD57	V21	VDD	AA4	ValidOut
B5	SysAD0	D9	GND	J2	SysAD46	P21	SysAD55	W1	GND	AA5	GND
B6	ScTOE	D10	VDD	J3	SysAD14	R1	GND	W2	VDD	AA6	Int0
B7	ScCLR	D11	VDDP	J4	GND	R2	SysAD18	W3	VDD	AA7	GND
B8	ScTDE	D12	VDD	J18	GND	R3	SysAD48	W4	VDD	AA8	Reserved
B9	ModeClock	D13	GND	J19	SysAD9	R4	VDD	W5	Int5	AA9	GND
B10	Reserved	D14	VDD	J20	SysAD41	R18	VDD	W6	Int4	AA10	WrRdy
B11	Reserved	D15	VDD	J21	GND	R19	SysAD53	W7	Int1	AA11	GND
B12	NC	D16	GND	K1	SysAD60	R20	SysAD23	W8	Reserved	AA12	ScMatch
B13	ScLine14	D17	VDD	K2	SysAD30	R21	GND	W9	Reserved	AA13	GND
B14	ScLine10	D18	GND	K3	SysAD62	T1	SysAD16	W10	Reserved	AA14	SysCmd6
B15	ScLine9	D19	VDD	K4	VDD	T2	SysADC0	W11	ValidIn	AA15	GND
B16	ScLine6	D20	VDD	K18	VDD	T3	SysADC2	W12	ScDOE	AA16	SysCmd2
B17	ScLine3	D21	VDD	K19	SysAD11	T4	GND	W13	SysCmd7	AA17	GND
B18	ScLine1	E1	GND	K20	SysAD43	T18	GND	W14	SysCmd4	AA18	SysADC3
B19	VDD	E2	SysAD36	K21	SysAD13	T19	SysAD19	W15	SysCmd1	AA19	GND
B20	VDD	E3	SysAD4	L1	GND	T20	SysAD51	W16	SysADC7	AA20	VDD
B21	VDD	E4	VDD	L2	SysAD58	T21	SysAD21	W17	SysADC5	AA21	GND
C1	GND	E18	VDD	L3	SysAD28	U1	GND	W18	SysAD47		
C2	VDD	E19	ScWord1	L4	VDD	U2	SysADC4	W19	BigEndian		
C3	ColdReset	E20	ScWord0	L18	VDD	U3	SysADC6	W20	VDD		
C4	SysAD34	E21	GND	L19	SysAD45	U4	VDD	W21	GND		

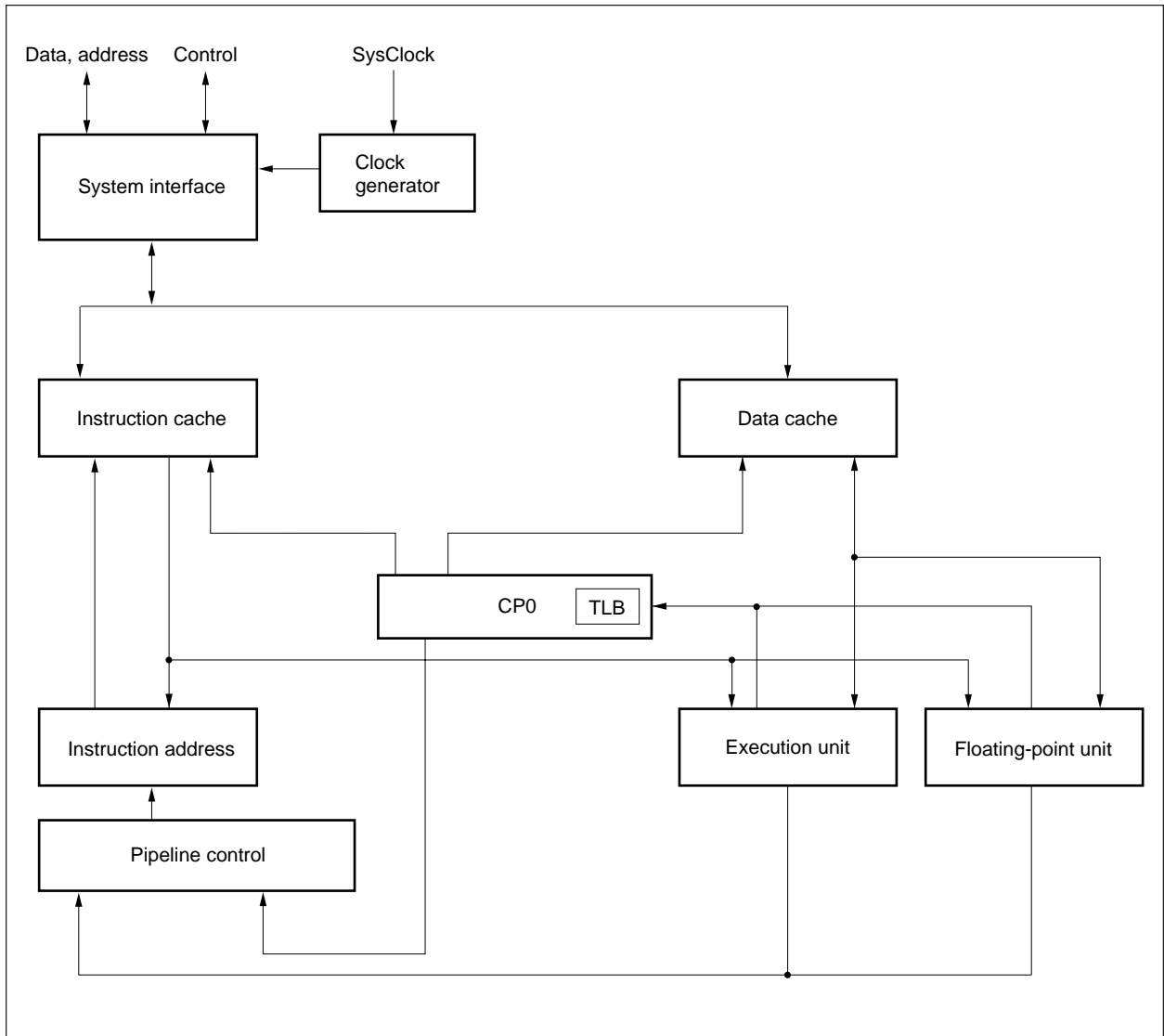
(2) μPD30500A

No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name
A1	GND	C5	ScDCE1	F1	SysAD8	L20	SysAD63	U18	VDD	Y1	VDDIO
A2	VDDIO	C6	ScDCE0	F2	SysAD38	L21	GND	U19	SysAD17	Y2	VDDIO
A3	GND	C7	ScCWE0	F3	SysAD6	M1	SysAD26	U20	SysAD49	Y3	VDDIO
A4	SysAD32	C8	ScTCE	F4	GND	M2	SysAD56	U21	GND	Y4	Release
A5	GND	C9	Modeln	F18	GND	M3	SysAD24	V1	VDD	Y5	Int3
A6	ScCWE1	C10	NC	F19	SysAD1	M4	VDDIO	V2	VDD	Y6	Int2
A7	GND	C11	GNDP	F20	SysAD33	M18	VDDIO	V3	VDD	Y7	ScValid
A8	VDDOk	C12	GND	F21	SysAD3	M19	SysAD29	V4	GND	Y8	GND
A9	GND	C13	ScLine13	G1	GND	M20	SysAD61	V5	NMI	Y9	GND
A10	SysClock	C14	ScLine11	G2	SysAD10	M21	SysAD31	V6	GND	Y10	GND
A11	GND	C15	ScLine8	G3	SysAD40	N1	GND	V7	VDD	Y11	ExtRqst
A12	ScLine15	C16	ScLine5	G4	VDDIO	N2	SysAD54	V8	VDDIO	Y12	RdRdy
A13	GND	C17	ScLine4	G18	VDDIO	N3	SysAD22	V9	GND	Y13	SysCmd8
A14	ScLine12	C18	ScLine0	G19	SysAD35	N4	GND	V10	VDD	Y14	SysCmd5
A15	GND	C19	Reset	G20	SysAD5	N18	GND	V11	VDDIO	Y15	SysCmd3
A16	ScLine7	C20	VDDIO	G21	GND	N19	SysAD27	V12	VDD	Y16	SysCmd0
A17	GND	C21	GND	H1	SysAD42	N20	SysAD59	V13	GND	Y17	SysCmdP
A18	ScLine2	D1	VDD	H2	SysAD44	N21	GND	V14	VDDIO	Y18	SysADC1
A19	GND	D2	VDD	H3	SysAD12	P1	SysAD50	V15	VDD	Y19	SysAD15
A20	VDDIO	D3	VDD	H4	VDD	P2	SysAD52	V16	GND	Y20	VDDIO
A21	GND	D4	GND	H18	VDD	P3	SysAD20	V17	VDDIO	Y21	VDDIO
B1	VDDIO	D5	VDD	H19	SysAD7	P4	VDD	V18	GND	AA1	GND
B2	VDDIO	D6	GND	H20	SysAD39	P18	VDD	V19	VDD	AA2	VDDIO
B3	VDDIO	D7	VDDIO	H21	SysAD37	P19	SysAD25	V20	VDD	AA3	GND
B4	SysAD2	D8	VDD	J1	GND	P20	SysAD57	V21	VDD	AA4	ValidOut
B5	SysAD0	D9	GND	J2	SysAD46	P21	SysAD55	W1	GND	AA5	GND
B6	ScTOE	D10	VDDIO	J3	SysAD14	R1	GND	W2	VDDIO	AA6	Int0
B7	ScCLR	D11	VDDP	J4	GND	R2	SysAD18	W3	VDDIO	AA7	GND
B8	ScTDE	D12	VDD	J18	GND	R3	SysAD48	W4	VDDIO	AA8	GND
B9	ModeClock	D13	GND	J19	SysAD9	R4	VDDIO	W5	Int5	AA9	GND
B10	GND	D14	VDDIO	J20	SysAD41	R18	VDDIO	W6	Int4	AA10	WrRdy
B11	GND	D15	VDD	J21	GND	R19	SysAD53	W7	Int1	AA11	GND
B12	GND	D16	GND	K1	SysAD60	R20	SysAD23	W8	GND	AA12	ScMatch
B13	ScLine14	D17	VDDIO	K2	SysAD30	R21	GND	W9	GND	AA13	GND
B14	ScLine10	D18	GND	K3	SysAD62	T1	SysAD16	W10	VDD	AA14	SysCmd6
B15	ScLine9	D19	VDD	K4	VDDIO	T2	SysADC0	W11	ValidIn	AA15	GND
B16	ScLine6	D20	VDD	K18	VDDIO	T3	SysADC2	W12	ScDOE	AA16	SysCmd2
B17	ScLine3	D21	VDD	K19	SysAD11	T4	GND	W13	SysCmd7	AA17	GND
B18	ScLine1	E1	GND	K20	SysAD43	T18	GND	W14	SysCmd4	AA18	SysADC3
B19	VDDIO	E2	SysAD36	K21	SysAD13	T19	SysAD19	W15	SysCmd1	AA19	GND
B20	VDDIO	E3	SysAD4	L1	GND	T20	SysAD51	W16	SysADC7	AA20	VDDIO
B21	VDDIO	E4	VDD	L2	SysAD58	T21	SysAD21	W17	SysADC5	AA21	GND
C1	GND	E18	VDD	L3	SysAD28	U1	GND	W18	SysAD47		
C2	VDDIO	E19	ScWord1	L4	VDD	U2	SysADC4	W19	BigEndian		
C3	ColdReset	E20	ScWord0	L18	VDD	U3	SysADC6	W20	VDDIO		
C4	SysAD34	E21	GND	L19	SysAD45	U4	VDD	W21	GND		

PIN NAMES

<u>BigEndian</u> :	Endian Mode Select
<u>ColdReset</u> :	Cold Reset
<u>ExtRqst</u> :	External Request
<u>GND</u> :	Ground
<u>GNDP</u> :	Quiet GND for PLL
<u>Int (0:5)</u> :	Interrupt Request
<u>ModeClock</u> :	Boot Mode Clock
<u>ModeIn</u> :	Boot Mode Data In
<u>NC</u> :	No Connection
<u>NMI</u> :	Non-maskable Interrupt Request
<u>RdRdy</u> :	Read Ready
<u>Release</u> :	Release Interface
<u>Reset</u> :	Reset
<u>ScCLR</u> :	Secondary Cache Block Clear
<u>ScCWE (0:1)</u> :	Secondary Cache Write Enable
<u>ScDCE (0:1)</u> :	Data RAM Chip Enable
<u>ScDOE</u> :	Data RAM Output Enable
<u>ScLine (0:15)</u> :	Secondary Cache Line Index
<u>ScMatch</u> :	Secondary Cache Tag Match
<u>ScTCE</u> :	Secondary Cache Tag RAM Chip Enable
<u>ScTDE</u> :	Secondary Cache Tag RAM Data Enable
<u>ScTOE</u> :	Secondary Cache Tag RAM Output Enable
<u>ScValid</u> :	Secondary Cache Valid
<u>ScWord (0:1)</u> :	Secondary Cache Word Index
<u>SysAD (0:63)</u> :	System Address/Data Bus
<u>SysADC (0:7)</u> :	System Address/Data Check Bus
<u>SysClock</u> :	System Clock
<u>SysCmd (0:8)</u> :	System Command/Data Identifier
<u>SysCmdP</u> :	System Command/Data Identifier Bus Parity
<u>ValidIn</u> :	Valid Input
<u>ValidOut</u> :	Valid Output
<u>V_{DD}</u> :	Power Supply (μ PD30500)
<u>V_{DD}</u> :	Power Supply for Processor Core (μ PD30500A)
<u>V_{DDIO}</u> :	Power Supply for Processor I/O (μ PD30500A only)
<u>V_{DD}Ok</u> :	V _{DD} is OK
<u>V_{DDP}</u> :	Quiet V _{DD} for PLL
<u>WrRdy</u> :	Write Ready

INTERNAL BLOCK DIAGRAM



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1. PIN FUNCTIONS

Pin Name	I/O	Function
SysAD (0:63)	I/O	System address/data bus. 64-bit bus for communication between processor, secondary cache and external agent.
SysADC (0:7)	I/O	System address/data check bus. 8-bit bus including check bits for the SysAD bus.
SysCmd (0:8)	I/O	System command/data ID bus. 9-bit bus for communication of commands and data identifiers between processor and external agent.
SysCmdP	I/O	System command/data ID bus parity. 1-bit even number parity bit for the SysCmd bus.
$\overline{\text{ValidIn}}$	Input	Valid in. Signal indicating that external agent has transmitted valid address or data onto SysAD bus and valid command or data identifier onto SysCmd bus.
$\overline{\text{ValidOut}}$	Output	Valid out. Signal indicating that processor has transmitted valid address or data onto SysAD bus and valid command or data identifier onto SysCmd bus.
$\overline{\text{ExtRqst}}$	Input	External request. Signal used by external agent to request for its use by system interface.
$\overline{\text{Release}}$	Output	Interface release. Signal indicating that the processor has released the system interface to the slave state.
$\overline{\text{WrRdy}}$	Output	Write ready. Signal indicating that the external agent can accept a processor write request.
$\overline{\text{RdRdy}}$	Input	Read ready. Signal indicating that external agent can accept a processor read request.
$\overline{\text{ScCLR}}$	Output	Secondary cache block clear. Clears all the valid bits of the tag RAM.
$\overline{\text{ScCWE}} (0:1)$	Output	Secondary cache write enable. Write enable signal for the secondary cache RAM.
$\overline{\text{ScDCE}} (0:1)$	Output	Data RAM chip select. Chip select signal for secondary cache RAM.
$\overline{\text{ScDOE}}$	Input	Data RAM output enable. Data output enable signal from the external agent.
ScLine (0:15)	Output	Secondary cache line index. Cache line index output of the secondary cache.
ScMatch	Input	Secondary cache tag match. Tag match signal from secondary cache tag RAM.
$\overline{\text{ScTCE}}$	Output	Secondary cache tag RAM chip select. Chip select signal of the secondary cache tag RAM.
$\overline{\text{ScTDE}}$	Output	Secondary cache tag RAM data enable. Data enable signal from the secondary cache tag RAM.
$\overline{\text{ScTOE}}$	Output	Secondary cache tag RAM output enable. Output enable signal from the secondary cache tag RAM.
ScWord (0:1)	I/O	Secondary cache word index. Signal indicating that the double word of the secondary cache index is correct.
ScValid	I/O	Secondary cache valid. Signal indicating that the data of the secondary cache is valid.

Pin Name	I/O	Function															
$\overline{\text{Int}} (0:5)$	Input	Interrupt. General-purpose processor interrupt requests whose input statuses can be confirmed by bits 15 through 10 of cause register.															
$\overline{\text{NMI}}$	Input	Non-maskable interrupt. Interrupt request that cannot be masked.															
$\overline{\text{ColdReset}}$	Input	Cold reset. Signal initializing the internal status of the processor. Inactivate this signal in synchronization with SysClock.															
$\overline{\text{Reset}}$	Input	Reset. Signal generating a reset exception, without initializing the internal status of the processor. Inactivate this signal in synchronization with SysClock.															
SysClock	Input	System clock. Clock input signal to processor.															
BigEndian	Input	Endian mode setting. This signal sets the endian mode of the system interface. When setting the endian mode with this signal, specify little endian with the data from the ModeIn pin that is input at reset. To set the endian mode with the data from the ModeIn pin, fix this signal to 0. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>BigEndian</th> <th>Bit 8 of boot mode</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>—</td> </tr> <tr> <td>1</td> <td>0</td> <td>Big endian</td> </tr> <tr> <td>0</td> <td>1</td> <td>Big endian</td> </tr> <tr> <td>0</td> <td>0</td> <td>Little endian</td> </tr> </tbody> </table>	BigEndian	Bit 8 of boot mode	Mode	1	1	—	1	0	Big endian	0	1	Big endian	0	0	Little endian
BigEndian	Bit 8 of boot mode	Mode															
1	1	—															
1	0	Big endian															
0	1	Big endian															
0	0	Little endian															
ModeClock	Output	Boot mode clock. Successive boot mode data clock output resulting from dividing SysClock by 256.															
ModeIn	Input	Boot mode data input. Input of initialization bit stream.															
V _{DD} Ok	Input	V _{DD} and V _{DDIO} ^{Note1} are valid. Signal indicating that the voltage supplied to the V _R 5000 is reached to the rated level ^{Note2} for 100 ms or more, and that that status is stabilized. When V _{DD} Ok is asserted active, the V _R 5000 starts an initialization sequence.															
V _{DD} P	—	PLL V _{DD} . Power supply for internal PLL.															
GNDP	—	PLL GND. Ground for internal PLL.															
V _{DD}	—	<ul style="list-style-type: none"> • V_R5000 Positive power supply pin (3.3 V) • V_R5000A Power supply pin for core (2.4 V @ 100 to 235 MHz, 2.5 V @ 236 to 250 MHz, 2.6 V @ 251 to 266 MHz) 															
V _{DDIO} ^{Note1}	—	Power supply pin for I/O (3.3 V)															
GND	—	Ground pin.															

Notes 1. V_{DDIO} is only for V_R5000A.

2. V_R5000: V_{DD} = 3.135 V

★

V_R5000A: V_{DD} = 2.3 V, V_{DDIO} = 3.135 V (@ 100 to 235 MHz operation)

V_{DD} = 2.375 V, V_{DDIO} = 3.135 V (@ 236 to 250 MHz operation)

V_{DD} = 2.5 V, V_{DDIO} = 3.135 V (@ 251 to 266 MHz operation)

2. ELECTRICAL SPECIFICATIONS

2.1 μPD30500

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V _{DD}		-0.5 to +4.0	V
Input voltage ^{Note}	V _I		-0.5 to V _{DD} + 0.3	V
		Pulse of less than 10 ns	-1.5 to V _{DD} + 0.3	V
Operating case temperature	T _C	PGA package	0 to +70	°C
		BGA package	0 to +85	°C
Storage temperature	T _{stg}	PGA package	-65 to +150	°C
		BGA package	-40 to +125	°C

Note The upper limit of the input voltage (V_{DD} + 0.3) is +4.0 V.

Cautions 1. Do not short circuit two or more outputs at the same time.

2. Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

The specifications and conditions shown in the following DC Characteristics and AC Characteristics are the range within which the product can normally operate and the quality can be guaranteed.

DC Characteristics (T_C = 0 to +70°C (PGA Package), T_C = 0 to +85°C (BGA Package), V_{DD} = 3.3 V ±5%)

Parameter	Symbol	Condition	MIN.	MAX.	Unit
High-level output voltage	V _{OH}	V _{DD} = MIN., I _{OH} = -4 mA	2.4		V
Low-level output voltage	V _{OL}	V _{DD} = MIN., I _{OL} = 4 mA		0.4	V
High-level input voltage ^{Note 1}	V _{IH}		2.0	V _{DD} + 0.3	V
Low-level input voltage ^{Note 1}	V _{IL}		-0.5	+0.8	V
		Pulse of less than 10 ns	-1.5	+0.8	V
High-level input voltage ^{Note 2}	V _{IHC}		0.8 × V _{DD}	V _{DD} + 0.3	V
Low-level input voltage ^{Note 2}	V _{ILC}		-0.5	0.2 × V _{DD}	V
		Pulse of less than 10 ns	-1.5	0.2 × V _{DD}	V
Supply current	I _{DD}	Normal operation	150 MHz	2.16	A
			180 MHz	2.54	A
			200 MHz	2.8	A
		Standby	0.25	A	
Input leakage current	I _{LI}		-5	+5	μA
Input/output leakage current	I _{LIO}		-5	+5	μA

Notes 1. Not applied to the SysClock pin.

2. Applied to the SysClock pin only.

Remark The operating supply current is almost proportional to the operating clock frequency.

Capacitance

Parameter	Symbol	Condition	MIN.	MAX.	Unit
Input capacitance	C _{In}			5	pF
Output capacitance	C _{Out}			7	pF

AC Characteristics (T_c = 0 to +70°C (PGA Package), T_c = 0 to +85°C (BGA Package), V_{DD} = 3.3 V ±5%)

Clock parameter

Parameter	Symbol	Condition	MIN.	MAX.	Unit
System clock high-level width	t _{CH}		3.0		ns
System clock low-level width	t _{CL}		3.0		ns
System clock frequency ^{Notes 1, 2}		150 MHz	20	75	MHz
		180 MHz	20	90	MHz
		200 MHz	20	100	MHz
System clock cycle	t _{CP}	150 MHz	13.3	50	ns
		180 MHz	11.1	50	ns
		200 MHz	10	50	ns
System clock jitter	t _{ji}	System clock frequency > 66 MHz		±125	ps
		System clock frequency ≤ 66 MHz		±250	ps
System clock rise time	t _{CR}			2.0	ns
System clock fall time	t _{CF}			2.0	ns
Mode clock cycle	t _{MOC}		256 × t _{CP}		ns

Notes 1. The operation of the V_R5000 is guaranteed only when the PLL is operating

2. The operation is guaranteed if the internal operating frequency 100 MHz or higher.

System Interface Parameter

Parameter	Symbol	Condition	MIN.	MAX.	Unit
Data output hold time	t _{DM}	Modebit (14 : 13) = 10	1.0		ns
		Modebit (14 : 13) = 11	1.1		ns
		Modebit (14 : 13) = 00	1.3		ns
		Modebit (14 : 13) = 01	1.3		ns
Data output delay time	t _{DO}			5.0	ns
Data input setup time	t _{DS}		1.6		ns
Data input hold time	t _{DH}		0.5		ns

Boot Mode Interface Parameter

Parameter	Symbol	Condition	MIN.	MAX.	Unit
More data setup time	t _{MDS}		t _{CP} × 0.35		ns
Mode data hold time	t _{MDH}		t _{CP} × 0.35		ns

Load Coefficient

Parameter	Symbol	Condition	MIN.	MAX.	Unit
Load coefficient	CLD			1.5	ns/25 pF

2.2 μPD30500A

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V _{DDIO}		-0.5 to +4.0	V
	V _{DD}		-0.3 to +3.3	V
Input voltage ^{Note}	V _I		-0.5 to V _{DDIO} + 0.3	V
		Pulse of less than 10 ns	-1.5 to V _{DDIO} + 0.3	V
Operating case temperature	T _C		0 to +85	°C
Storage temperature	T _{stg}		-40 to +125	°C

Note The upper limit of the input voltage (V_{DDIO} + 0.3) is +4.0 V.

- Cautions**
1. Do not short circuit two or more outputs at the same time.
 2. Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.
The specifications and conditions shown in the following DC Characteristics and AC Characteristics are the range within which the product can normally operate and the quality can be guaranteed.

- ★ **DC Characteristics** (T_C = 0 to +85°C, V_{DDIO} = 3.3 V ±5%, V_{DD} = 2.4 V ±0.1 V @ 100 to 235 MHz)
 (T_C = 0 to +85°C, V_{DDIO} = 3.3 V ±5%, V_{DD} = 2.5 V ±5% @ 236 to 250 MHz)
 (T_C = 0 to +70°C, V_{DDIO} = 3.3 V ±5%, V_{DD} = 2.6 V ±0.1 V @ 251 to 266 MHz)

Parameter	Symbol	Condition	MIN.	MAX.	Unit
High-level output voltage	V _{OH}	V _{DDIO} = MIN., I _{OH} = -4 mA	2.4		V
Low-level output voltage	V _{OL}	V _{DDIO} = MIN., I _{OL} = 4 mA		0.4	V
High-level input voltage ^{Note 1}	V _{IH}		2.0	V _{DDIO} + 0.3	V
Low-level input voltage ^{Note 1}	V _{IL}		-0.5	+0.8	V
		Pulse of less than 10 ns	-1.5	+0.8	V
High-level input voltage ^{Note 2}	V _{IHC}		0.8 × V _{DDIO}	V _{DDIO} + 0.3	V
Low-level input voltage ^{Note 2}	V _{ILC}		-0.5	0.2 × V _{DDIO}	V
		Pulse of less than 10 ns	-1.5	0.2 × V _{DDIO}	V
★ Supply current	I _{DD}	250 MHz		1.8	A
		266 MHz		1.9	A
	I _{DDIO}	System clock frequency = 50 MHz		0.7	A
		System clock frequency = 67 MHz		0.85	A
		System clock frequency = 83 MHz		0.95	A
	System clock frequency = 100 MHz		1.15	A	
Input leakage current	I _{LI}		-5	+5	μA
Input/output leakage current	I _{LIO}		-5	+5	μA

- Notes**
1. Not applied to the SysClock pin.
 2. Applied to the SysClock pin only.

Power Application Sequence

Two kinds of power sources are provided with the V_R5000A. The sequence of the power application order is not fixed. However, make sure that either of the power supplies does not remain turned on for 1 second or more while the other remains off.

Parameter	Symbol	Condition	MIN.	MAX.	Unit
Power application delay	t _{DP}		0	1	sec

Capacitance

Parameter	Symbol	Condition	MIN.	MAX.	Unit
Input capacitance	C _{In}			5	pF
Output capacitance	C _{Out}			7	pF

AC Characteristics (T_C = 0 to +85°C, V_{DDIO} = 3.3 V ±5%, V_{DD} = 2.4 V ±0.1 V @ 100 to 235 MHz)
(T_C = 0 to +85°C, V_{DDIO} = 3.3 V ±5%, V_{DD} = 2.5 V ±5% @ 236 to 250 MHz)
(T_C = 0 to +70°C, V_{DDIO} = 3.3 V ±5%, V_{DD} = 2.6 V ±0.1 V @ 251 to 266 MHz)

Clock parameter

Parameter	Symbol	Condition	MIN.	MAX.	Unit
System clock high-level width	t _{CH}		3.0		ns
System clock low-level width	t _{CL}		3.0		ns
System clock frequency ^{Notes 1, 2}			20	100	MHz
System clock cycle	t _{CP}		10	50	ns
System clock jitter	t _{ji}	System clock frequency > 66 MHz		±125	ps
		System clock frequency ≤ 66 MHz		±250	ps
System clock rise time	t _{CR}			2.0	ns
System clock fall time	t _{CF}			2.0	ns
Mode clock cycle	t _{MOC}		256 × t _{CP}		ns

- Notes** 1. The operation of the V_R5000A is guaranteed only when the PLL is operating
 2. The operation is guaranteed if the internal operating frequency 100 MHz or higher.

System Interface Parameter

Parameter	Symbol	Condition	MIN.	MAX.	Unit
★ Data output hold time	t _{DM}	Modebit (14 : 13) = 10	1.1		ns
		Modebit (14 : 13) = 11	1.2		ns
		Modebit (14 : 13) = 00	1.3		ns
		Modebit (14 : 13) = 01	1.3		ns
Data output delay time	t _{DO}	PClock/SysClock division ratio = 2, 3, 4, 5, 6, 7, 8		5.0	ns
		PClock/SysClock division ratio = 2.5		7.0	ns
Data input setup time	t _{DS}		1.6		ns
★ Data input hold time	t _{DH}	PClock/SysClock division ratio = 2, 3, 4, 5, 6, 7, 8	0.5		ns
		PClock/SysClock division ratio = 2.5	0.7		ns

Boot Mode Interface Parameter

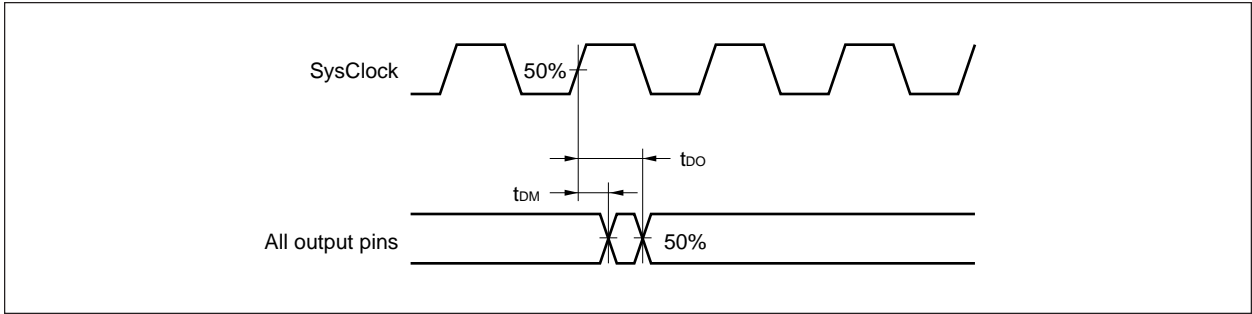
Parameter	Symbol	Condition	MIN.	MAX.	Unit
Mode data setup time	t _{MDS}		t _{CP} × 0.35		ns
Mode data hold time	t _{MDH}		t _{CP} × 0.35		ns

Load Coefficient

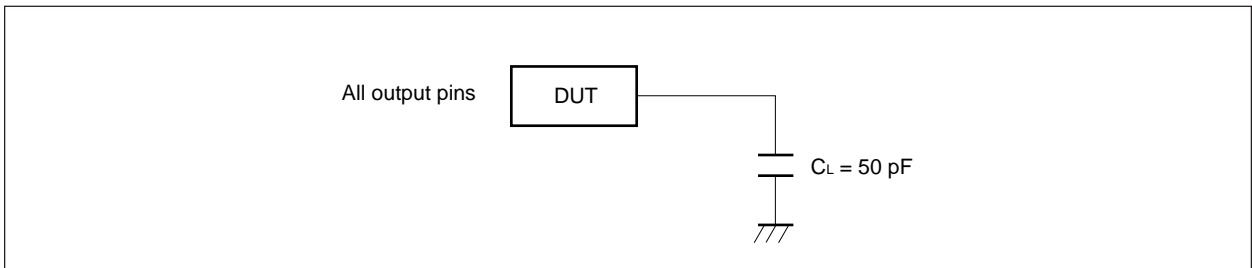
Parameter	Symbol	Condition	MIN.	MAX.	Unit
Load coefficient	CLD			1.5	ns/25 pF

2.3 Test Condition

Test point

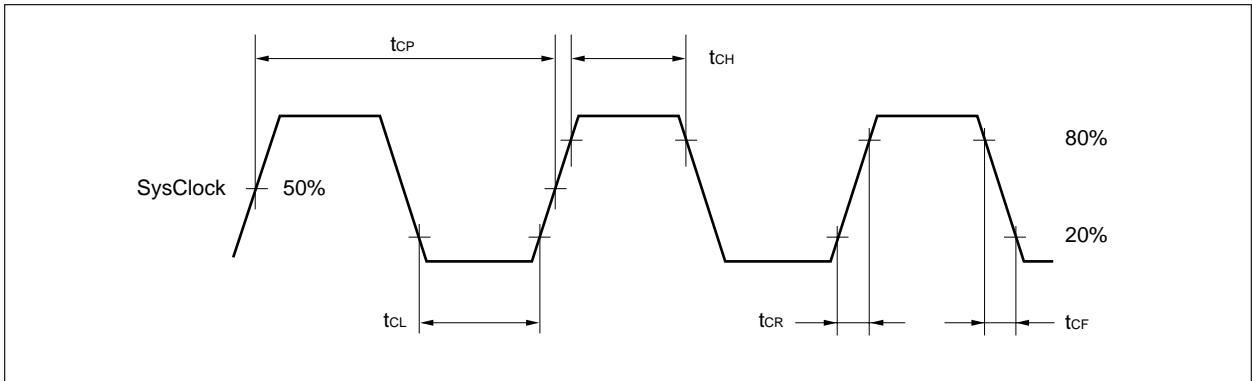


Load Conditions

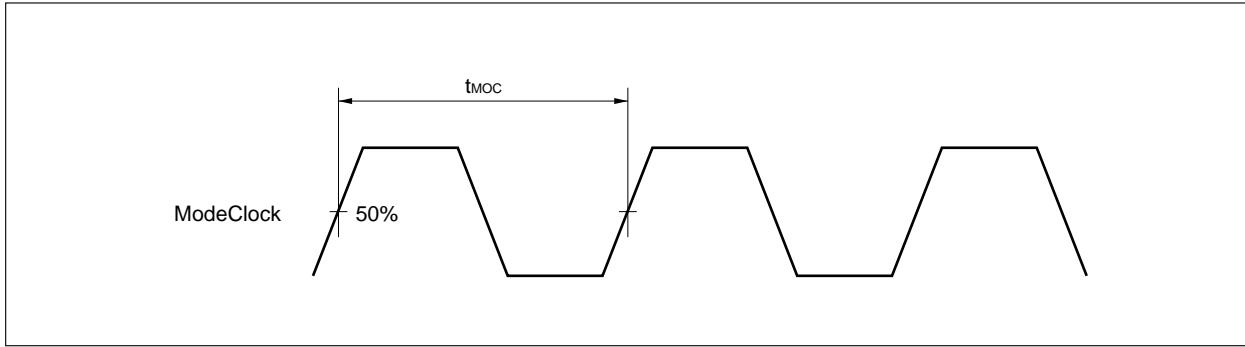


2.4 Timing Chart

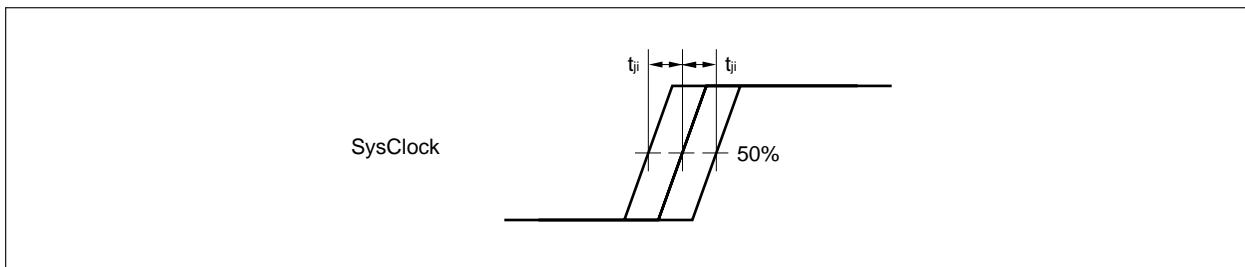
Clock timing



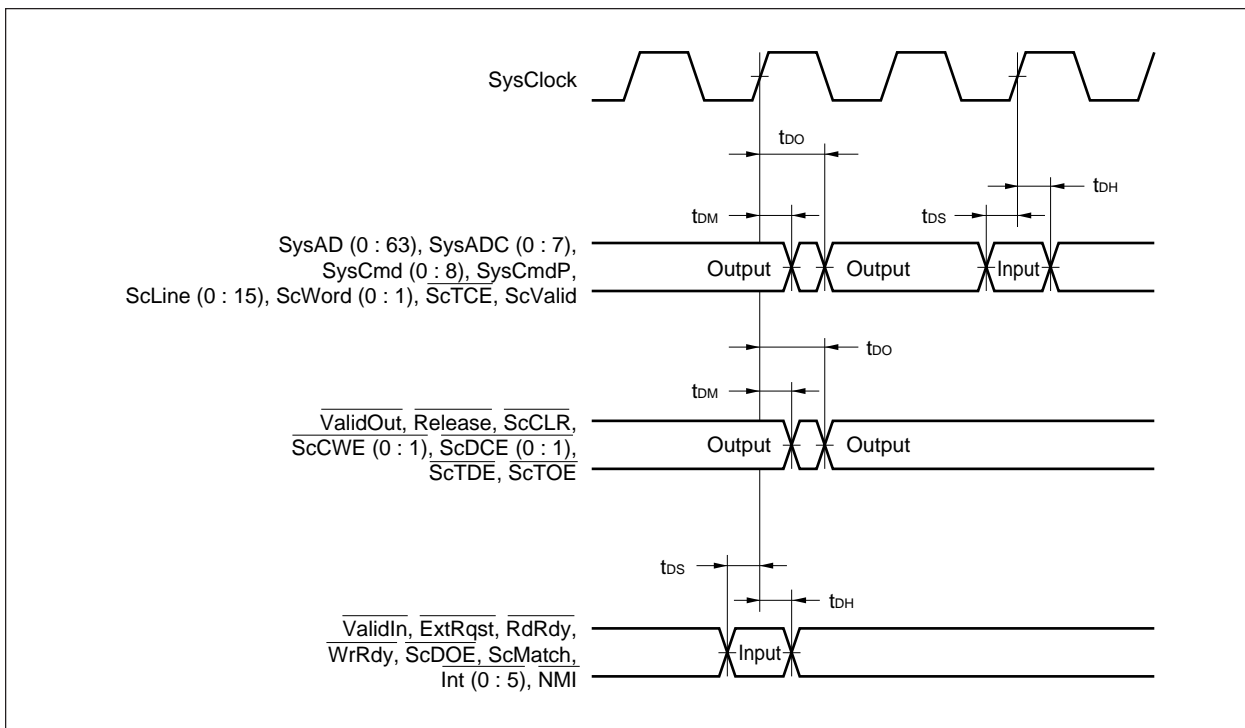
Mode clock timing



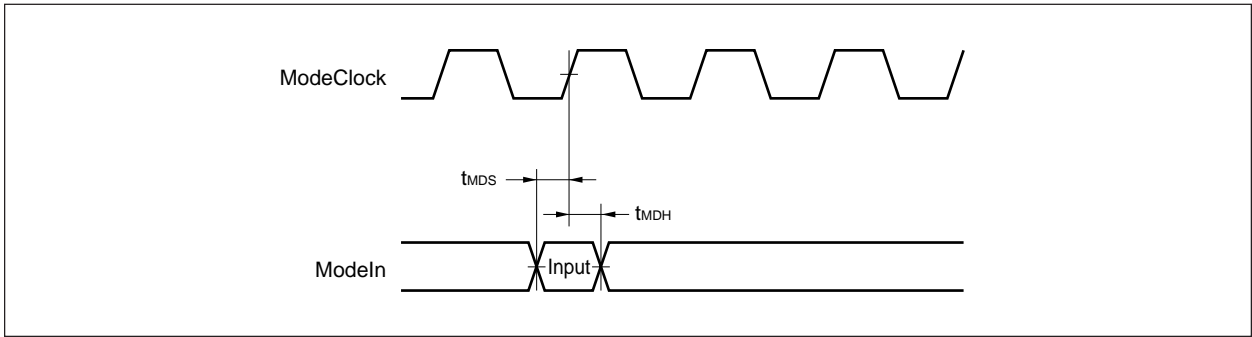
Clock jitter



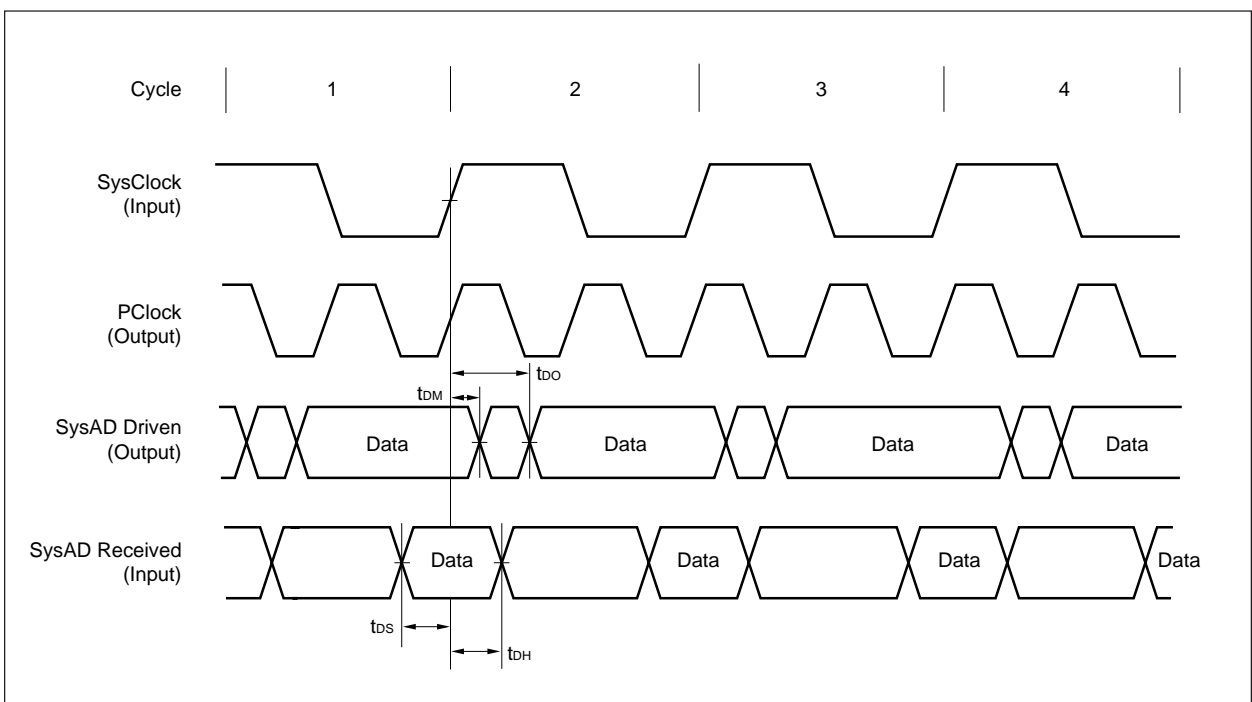
System interface edge timing



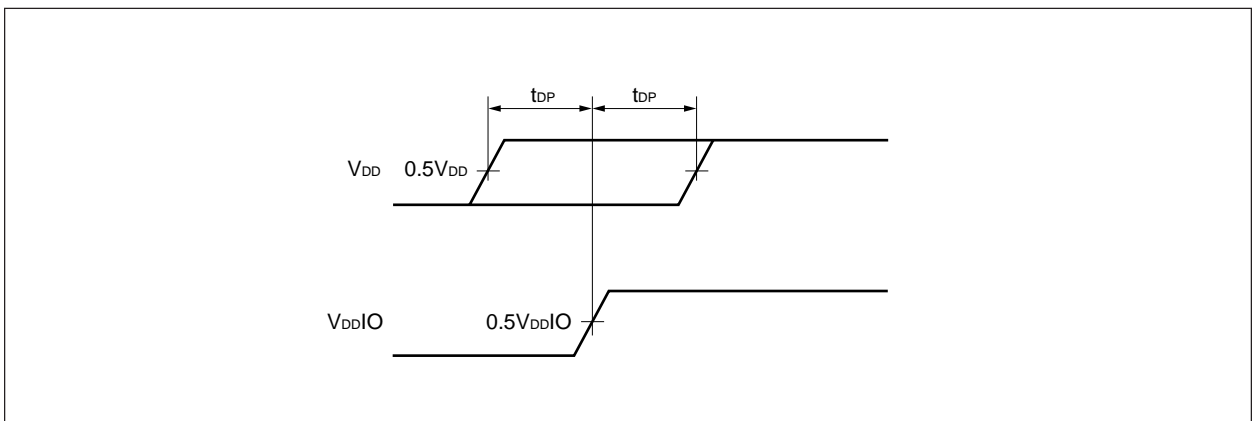
Boot mode interface edge timing



Clocking relations

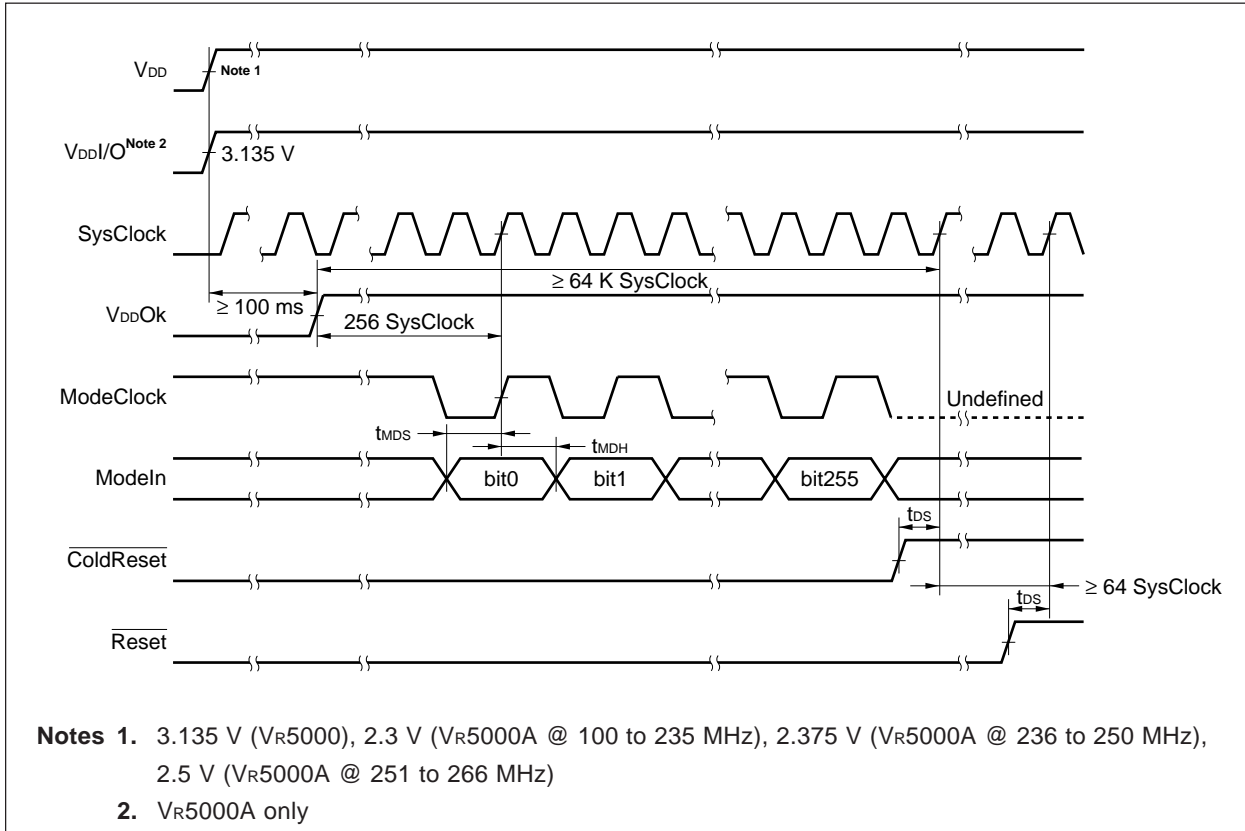


Power application sequence (VR5000A only)

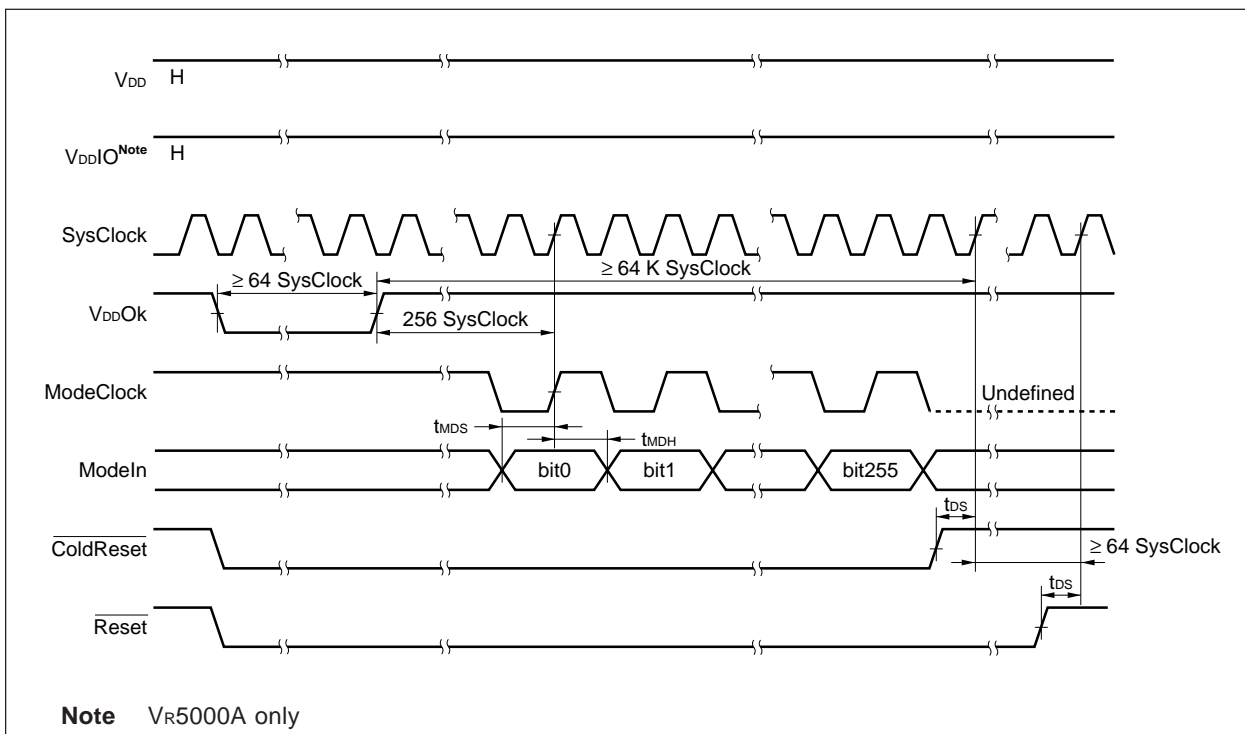


Reset Timing

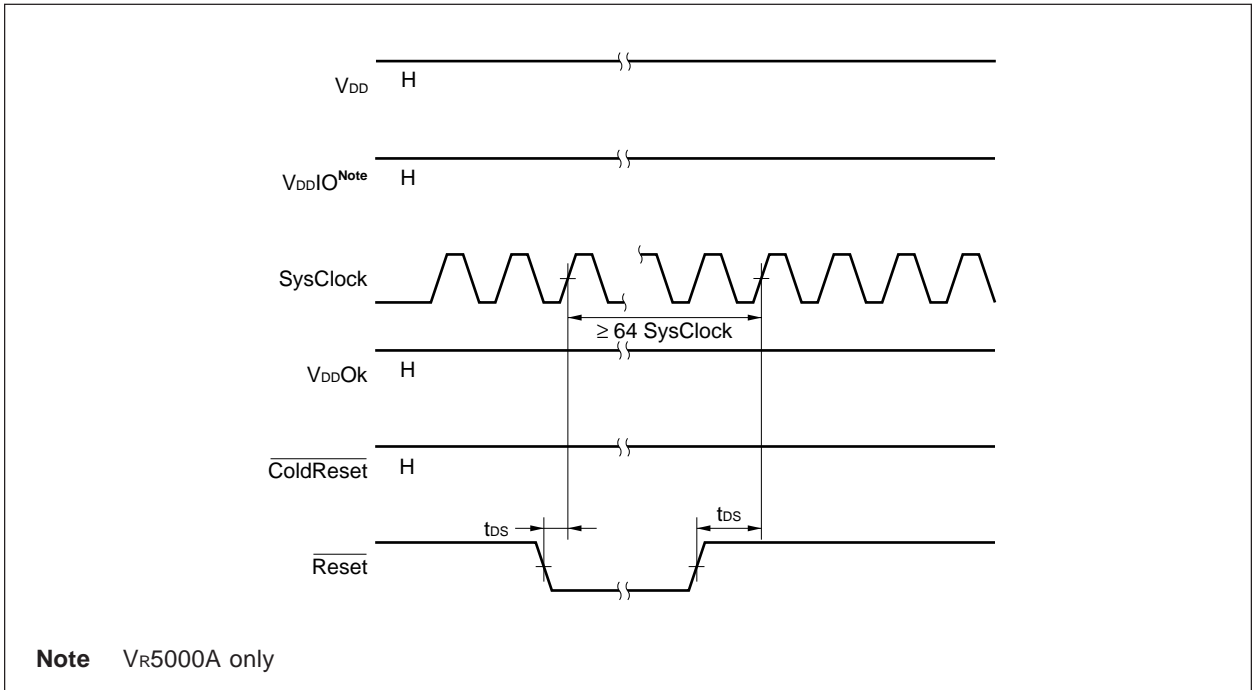
Power-on reset timing



Cold reset timing

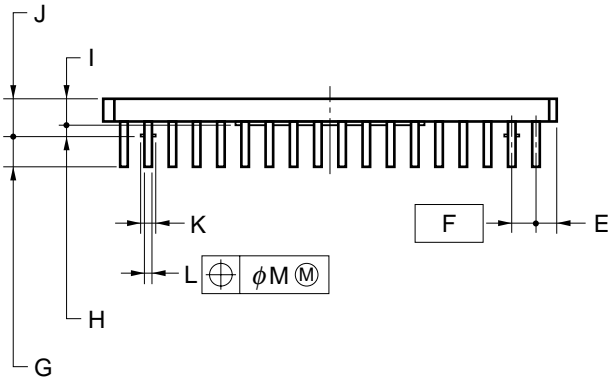
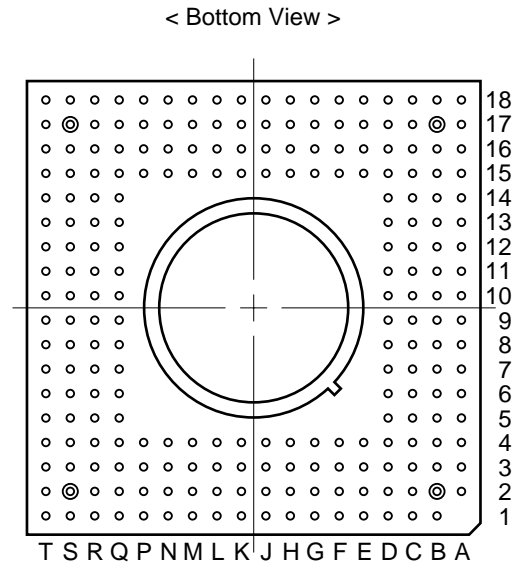
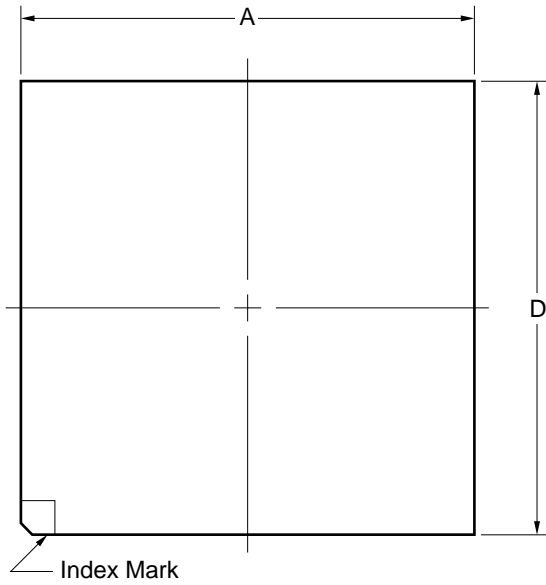


Warm reset timing



3. PACKAGE DRAWING

223 PIN CERAMIC PGA



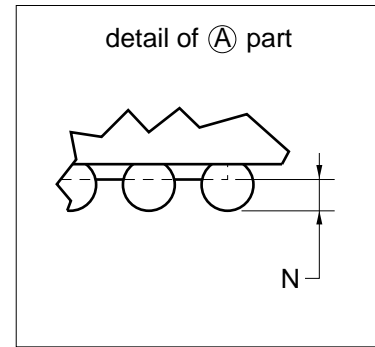
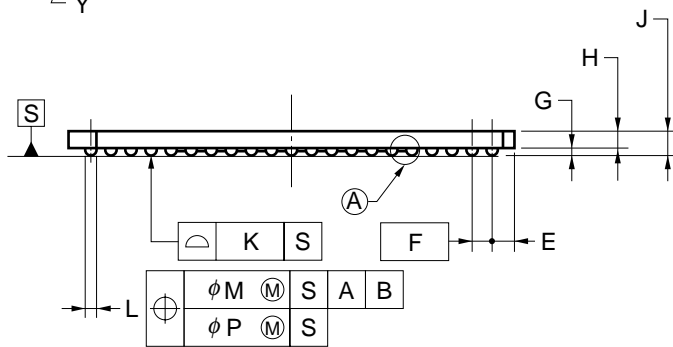
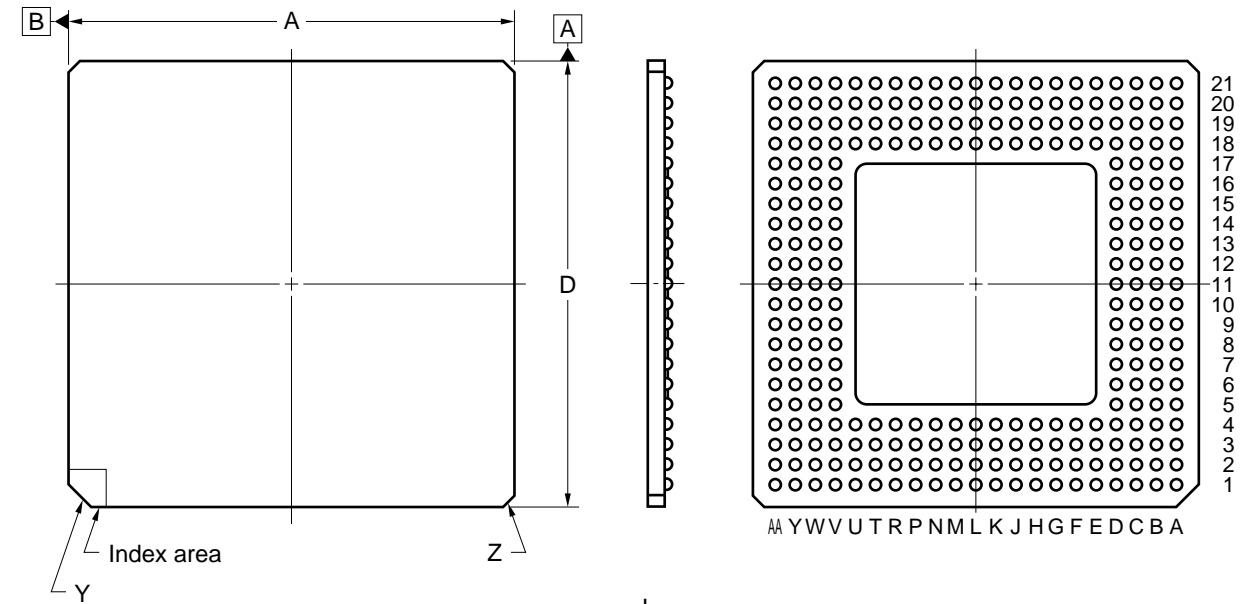
NOTE

Each lead centerline is located within $\phi 0.254$ ($\phi 0.010$ inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	47.24±0.25	1.860±0.010
D	47.24±0.25	1.860±0.010
E	2.03	0.080
F	2.54(T.P.)	0.100(T.P.)
G	3.30±0.2	0.130±0.008
H	0.50 MIN.	0.019 MIN.
I	2.82	0.111
J	3.98 MAX.	0.157 MAX.
K	$\phi 1.27\pm 0.2$	0.050 ± 0.008
L	$\phi 0.46\pm 0.05$	$\phi 0.018\pm 0.002$
M	0.254	0.010

X223RJ-100A-1

272-PIN PLASTIC BGA (C/D advanced type) (29x29)



ITEM	MILLIMETERS
A	29.00±0.20
D	29.00±0.20
E	1.80
F	1.27 (T.P.)
G	0.60±0.10
H	0.90
J	1.50±0.20
K	0.15
L	φ0.75±0.15
M	0.30
N	0.25 MIN.
P	0.10
Y	C1.5
Z	C0.5

S272S2-127-C6-3

4. RECOMMENDED SOLDERING CONDITIONS

Soldering this product under the following soldering conditions is recommended.

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

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

(1) Soldering Conditions of Surface Mount Type

μPD30500S2-150: 272-pin plastic BGA (C/D advanced type) (29 × 29)

μPD30500S2-180: 272-pin plastic BGA (C/D advanced type) (29 × 29)

μPD30500S2-200: 272-pin plastic BGA (C/D advanced type) (29 × 29)

μPD30500AS2-250: 272-pin plastic BGA (C/D advanced type) (29 × 29)

★ μPD30500AS2-266: 272-pin plastic BGA (C/D advanced type) (29 × 29)

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235°C, Time: 30 sec max. (@ 210°C or higher), Count: 3 times or less, Exposure limit: 3days ^{Note} (after that, prebake at 125°C for 10 hours)	IR35-103-3
VPS	Package peak temperature: 215°C, Time: 25 to 40 sec max. (@ 200°C or higher), Count: 3 times or less, Exposure limit: 3days ^{Note} (after that, prebake at 125°C for 10 hours)	VP15-103-3
Partial heating	Pin temperature: 300°C max., Time: 3 sec max. (per pin row)	—

Note After opening the dry pack, store it at 25°C or less and 65% RH or less for the allowable storage period.

Caution Do not use different soldering methods together (except partial heating).

(2) Soldering Conditions of Insertion Type

μPD30500RJ-150: 223-pin ceramic PGA (48 × 48)

μPD30500RJ-180: 223-pin ceramic PGA (48 × 48)

μPD30500RJ-200: 223-pin ceramic PGA (48 × 48)

Soldering Method	Soldering Conditions
Wave soldering (Pin only)	Solder bath temperature: 260°C max., Time: 10 sec max.
Partial heating	Pin temperature: 300°C max., Time: 3 sec max. (per pin)

Caution Wave soldering is only for the lead part in order that jet solder cannot contact with the chip directly.

APPENDIX DIFFERENCES BETWEEN THE V_R5000 AND V_R4310™

Item		V _R 5000	V _R 4310
Operating frequency	Internal	200 MHz MAX.	167 MHz MAX.
	External	100 MHz MAX.	83.3 MHz MAX.
Pipeline		2-way super scalar 5-stage pipeline	5-stage pipeline
Cache	Primary instruction cache	32 KB	16 KB
	Primary data cache	32 KB	8 KB
	Secondary cache interface	Provided	None
	Data protection	Byte parity	None
System bus	Write data transfer rate	9 types (DDDD/DDxDDx/ DDxxDDxx/DxDxDxDx/ DDxxxDDxxx/DDxxxxDDxxxx/ DxxDxxDxxDxx/ DDxxxxxxDDxxxxxx/DxxxDxxx)	2 types (D/Dxx)
	Initialization pin at reset	ModeIn (dedicated serial pin)	DivMode (0:2)
	Status after last data write	Access ends	Last data retained when transfer rate is set
Integer operation unit	Corresponding instruction	MIPS I, II, III, IV instruction sets	MIPS I, II, III instruction sets
JTAG interface		None	Provided
SyncOut-SyncIn bus		None	Provided
Clock interface	Multiplication ratio of input to internal	2, 3, 4, 5, 6, 7, 8	1.5, 2, 2.5, 3, 4, 5, 6
	Division ratio of internal to bus	2, 3, 4, 5, 6, 7, 8	1.5, 2, 2.5, 3, 4, 5, 6
	Clock output	None	TClock
Power management mode		Standby mode (pipeline does not operate)	Not provided
PRId register		Imp = 0x23	Imp = 0x0B

[MEMO]

[MEMO]

NOTES FOR CMOS DEVICES

① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

Note:

Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS

Note:

No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note:

Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.

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