NEC

MOS INTEGRATED CIRCUIT
μ**PD30550**

VR5500™

64-/32-BIT MICROPROCESSOR

DESCRIPTION

The μPD30550 (VR5500) is a member of the VR Series™ of RISC (Reduced Instruction Set Computer) microprocessors. It is a high-performance 64-/32-bit microprocessor that employs the RISC architecture developed by MIPS™.

The VR5500 allows selection of a 64-bit or 32-bit bus width for the system interface, and can operate using protocols compatible with the VR5000 Series™ and VR5432™.

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

- **VR5500 User's Manual (U16044E)**

FEATURES

- MIPS 64-bit RISC architecture
- High-speed operation processing
  - Two-way superscalar super pipeline
  - 300 MHz product: 603 MIPS
    400 MHz product: 804 MIPS
- High-speed translation lookaside buffer (TLB) (48 entries)
- Address space
  - Physical: 36 bits (64-bit bus selected)
               32 bits (32-bit bus selected)
  - Virtual: 40 bits (in 64-bit mode)
               31 bits (in 32-bit mode)
- On-chip floating-point unit (FPU)
  - Supports sum-of-products instructions
- On-chip primary cache memory (instruction/data: 32 KB each)
  - 2-way set associative
  - Supports line lock feature

- 64-/32-bit address/data multiplexed bus
  - Bus width selectable during reset
  - Bus protocol compatibility with existing products retained
- Maximum operating frequency
  - 300 MHz product: Internal 300 MHz, external 133 MHz
    400 MHz product: Internal 400 MHz, external 133 MHz
  - External/internal multiplication factor selectable from ×2 to ×5.5 by increments of 0.5
- Conforms to MIPS I, II, III, and IV instruction sets. Also supports product-sum operation instruction, rotate instruction, register scan instruction, and instruction for low power mode.
- Supports hardware debug function (N-Wire)
- Supply voltage
  Core block: 1.5 V ±5% (300 MHz product)
               1.6 to 1.7 V (400 MHz product)
  I/O block: 3.3 V ±5%, 2.5 V ±5%

**The information contained in this document is being issued in advance of the production cycle for the device. The parameters for the device may change before final production or NEC Corporation, at its own discretion, may withdraw the device prior to its production.
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.**

The mark ★ shows major revised points.

APPLICATIONS

- Set-top boxes
- RAID
- High-end embedded devices, etc.

ORDERING INFORMATION

Part Number	Package	Maximum Operating Frequency (MHz)
μPD30550F2-300-NN1	272-pin plastic BGA (C/D advanced type) (29 $\times$ 29)	300
μPD30550F2-400-NN1	272-pin plastic BGA (C/D advanced type) (29 $\times$ 29)	400

PIN CONFIGURATION

- 272-pin plastic BGA (C/D advanced type) (29 $\times$ 29)
  μPD30550F2-300-NN1
  μPD30550F2-400-NN1
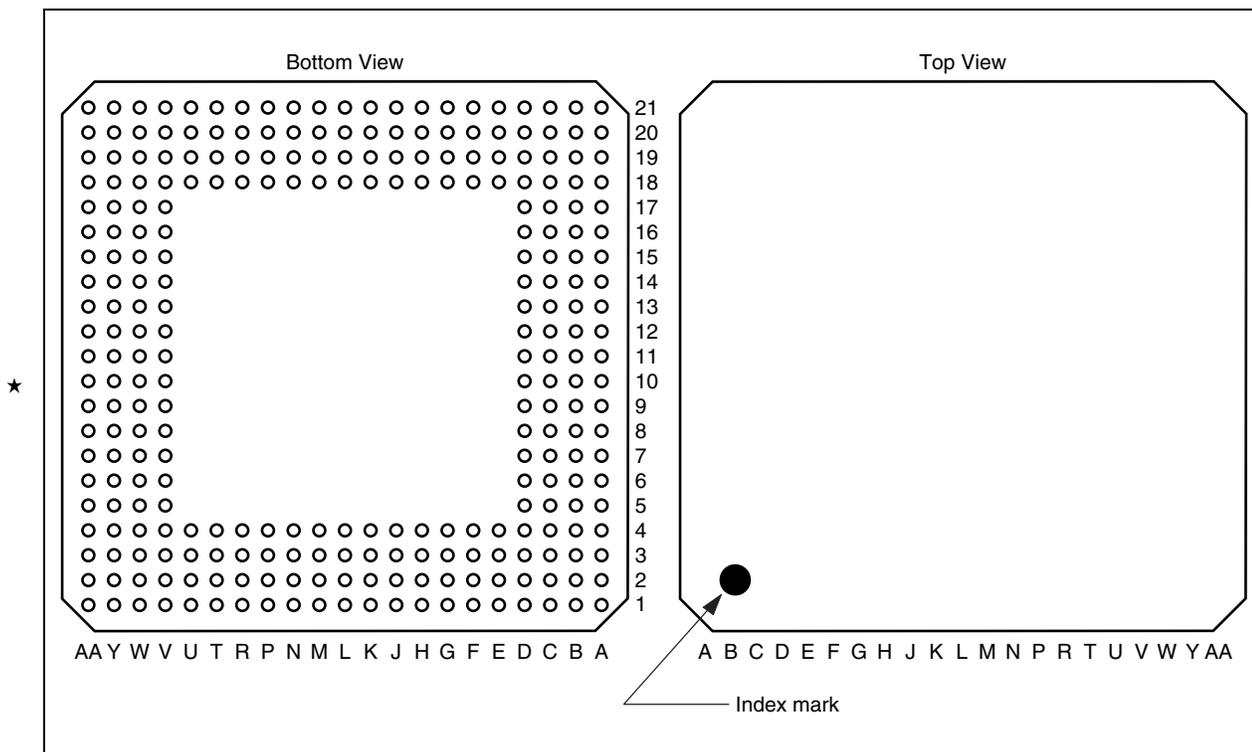
(1/2)

No.	Pin Name	No.	Pin Name	No.	Pin Name	No.	Pin Name
A1	V_{SS}	B17	SysAD27	D12	V_{SS}	H4	V_{DD}
A2	V_{SS}	B18	$V_{DD}IO$	D13	SysAD31	H18	V_{SS}
A3	$V_{DD}IO$	B19	$V_{DD}IO$	D14	V_{DD}	H19	V_{SS}
A4	$V_{DD}IO$	B20	V_{SS}	D15	SysAD60	H20	V_{SS}
A5	Reset#	B21	V_{SS}	D16	V_{SS}	H21	SysAD21
A6	PReq#	C1	$V_{DD}IO$	D17	SysAD26	J1	SysCmd7
A7	ValidIn#	C2	$V_{DD}IO$	D18	V_{SS}	J2	SysCmd8
A8	ValidOut#	C3	V_{SS}	D19	V_{SS}	J3	TIntSel
A9	V_{SS}	C4	V_{SS}	D20	$V_{DD}IO$	J4	Int0#
A10	SysADC7	C5	V_{SS}	D21	$V_{DD}IO$	J18	SysAD52
A11	SysADC3	C6	V_{DD}	E1	SysCmd0	J19	SysAD20
A12	SysADC1	C7	WrRdy#	E2	DisDValidO#	J20	SysAD51
A13	SysADC4	C8	V_{SS}	E3	DWBTrans#	J21	SysAD19
A14	SysAD62	C9	SysID1	E4	O3Return#	K1	Int1#
A15	SysAD30	C10	V_{DD}	E18	SysAD57	K2	V_{SS}
A16	SysAD28	C11	SysADC2	E19	SysAD25	K3	V_{SS}
A17	SysAD59	C12	V_{SS}	E20	SysAD56	K4	V_{SS}
A18	$V_{DD}IO$	C13	SysAD63	E21	SysAD24	K18	V_{DD}
A19	$V_{DD}IO$	C14	V_{DD}	F1	SysCmd1	K19	V_{DD}
A20	V_{SS}	C15	SysAD29	F2	V_{SS}	K20	V_{DD}
A21	V_{SS}	C16	V_{SS}	F3	V_{SS}	K21	V_{DD}
B1	V_{SS}	C17	SysAD58	F4	V_{SS}	L1	Int2#
B2	V_{SS}	C18	$V_{DD}IO$	F18	V_{DD}	L2	Int3#
B3	$V_{DD}IO$	C19	V_{SS}	F19	V_{DD}	L3	Int4#
B4	$V_{DD}IO$	C20	$V_{DD}IO$	F20	V_{DD}	L4	Int5#
B5	ColdReset#	C21	$V_{DD}IO$	F21	SysAD55	L18	SysAD17
B6	Release#	D1	$V_{DD}IO$	G1	SysCmd2	L19	SysAD49
B7	ExtRqst#	D2	$V_{DD}IO$	G2	SysCmd3	L20	SysAD18
B8	BusMode	D3	V_{SS}	G3	SysCmd4	L21	SysAD50
B9	SysID2	D4	V_{SS}	G4	SysCmd5	M1	RMode#/BKTGIO#
B10	V_{DD}	D5	IC	G18	SysAD23	M2	V_{DD}
B11	SysADC6	D6	V_{DD}	G19	SysAD54	M3	V_{DD}
B12	V_{SS}	D7	RdRdy#	G20	SysAD22	M4	V_{DD}
B13	SysADC0	D8	V_{SS}	G21	SysAD53	M18	V_{SS}
B14	V_{DD}	D9	SysID0	H1	SysCmd6	M19	V_{SS}
B15	SysAD61	D10	V_{DD}	H2	V_{DD}	M20	V_{SS}
B16	V_{SS}	D11	SysADC5	H3	V_{DD}	M21	V_{SS}

Caution   Leave the IC pin open.

Remark   # indicates active low.

(2/2)

| No.	Pin Name	No.	Pin Name	No.	Pin Name	No.	Pin Name
N1	$V_{DD}IO$	T21	SysAD12	W2	$V_{DD}IO$	Y12	V_{DD}
N2	NMI#	U1	NTrcClk	W3	V_{SS}	Y13	SysAD3
N3	$V_{DD}IO$	U2	NTrcData0	W4	V_{SS}	Y14	V_{SS}
N4	BigEndian	U3	NTrcData1	W5	$V_{DD}PA2$	Y15	SysAD37
N18	SysAD15	U4	NTrcData3	W6	V_{SS}	Y16	SysAD39
N19	SysAD47	U18	SysAD10	W7	$V_{DD}IO$	Y17	SysAD40
N20	SysAD16	U19	SysAD42	W8	V_{DD}	Y18	$V_{DD}IO$
N21	SysAD48	U20	SysAD11	W9	JTDI	Y19	$V_{DD}IO$
P1	V_{SS}	U21	SysAD43	W10	V_{SS}	Y20	V_{SS}
P2	V_{SS}	V1	NTrcData2	W11	SysAD1	Y21	V_{SS}
P3	V_{SS}	V2	NTrcEnd	W12	V_{DD}	AA1	V_{SS}
P4	V_{SS}	V3	V_{SS}	W13	SysAD35	AA2	V_{SS}
P18	V_{DD}	V4	V_{SS}	W14	V_{SS}	AA3	$V_{DD}IO$
P19	V_{DD}	V5	$V_{SS}PA2$	W15	SysAD38	AA4	$V_{DD}IO$
P20	V_{DD}	V6	V_{SS}	W16	V_{DD}	AA5	$V_{DD}PA1$
P21	SysAD46	V7	$V_{DD}IO$	W17	SysAD9	AA6	$V_{DD}IO$
R1	DivMode0	V8	V_{DD}	W18	V_{SS}	AA7	IC
R2	DivMode1	V9	JTMS	W19	V_{SS}	AA8	JTDO
R3	DivMode2	V10	V_{SS}	W20	$V_{DD}IO$	AA9	DrvCon
R4	$V_{DD}IO$	V11	SysAD33	W21	$V_{DD}IO$	AA10	V_{SS}
R18	SysAD44	V12	V_{DD}	Y1	V_{SS}	AA11	SysAD0
R19	SysAD13	V13	SysAD4	Y2	V_{SS}	AA12	SysAD2
R20	SysAD45	V14	V_{SS}	Y3	$V_{DD}IO$	AA13	SysAD34
R21	SysAD14	V15	SysAD7	Y4	$V_{DD}IO$	AA14	SysAD36
T1	V_{DD}	V16	V_{DD}	Y5	$V_{SS}PA1$	AA15	SysAD5
T2	V_{DD}	V17	SysAD41	Y6	SysClock	AA16	SysAD6
T3	V_{DD}	V18	V_{SS}	Y7	JTRST# (V_{SS})	AA17	SysAD8
T4	V_{DD}	V19	V_{SS}	Y8	V_{DD}	AA18	$V_{DD}IO$
T18	V_{SS}	V20	$V_{DD}IO$	Y9	JTCK	AA19	$V_{DD}IO$
T19	V_{SS}	V21	$V_{DD}IO$	Y10	V_{SS}	AA20	V_{SS}
T20	V_{SS}	W1	$V_{DD}IO$	Y11	SysAD32	AA21	V_{SS}

Caution Leave the IC pin open.

Remarks 1. The name in parentheses indicates the pin name in the revision 1.x product.

   2. # indicates active low.

PIN NAMES

BigEndian:	Big endian	PReq#:	Processor request
BKTGIO#:	Break/trigger input/output	RdRdy#:	Read ready
BusMode:	Bus mode	Release#:	Release
ColdReset#:	Cold reset	Reset#:	Reset
DisDValidO#:	Disable delay ValidOut#	SysAD(63:0):	System address/data bus
DivMode(2:0):	Divide mode	SysADC(7:0):	System address/data check
DrvCon:	Driver control		bus
DWBTrans#:	Doubleword block transfer	SysClock:	System clock
ExtRqst#:	External request	SysCmd(8:0):	System command/data
IC	Internally connected		identifier bus
Int(5:0)#:	Interrupt	SysID(2:0):	System bus identifier
JTCK:	JTAG clock	TIntSel:	Timer interrupt selection
JTDI:	JTAG data input	ValidIn#:	Valid input
JTDO:	JTAG data output	ValidOut#:	Valid output
JTMS:	JTAG mode select	V_{DD}:	Power supply for CPU core
JTRST#:	JTAG reset	V_{DD}IO:	Power supply for I/O
NMI#:	Non-maskable interrupt	V_{DD}PA1, V_{DD}PA2:	Quiet V_{DD} for PLL
NTrcClk:	N-Trace clock	V_{SS}:	Ground
NTrcData(3:0) :	N-Trace data output	V_{SS}PA1, V_{SS}PA2:	Quiet V_{SS} for PLL
NTrcEnd:	N-Trace end	WrRdy#:	Write ready
O3Return#:	Out-of-Order Return mode		

Remark   # indicates active low.

INTERNAL BLOCK DIAGRAM
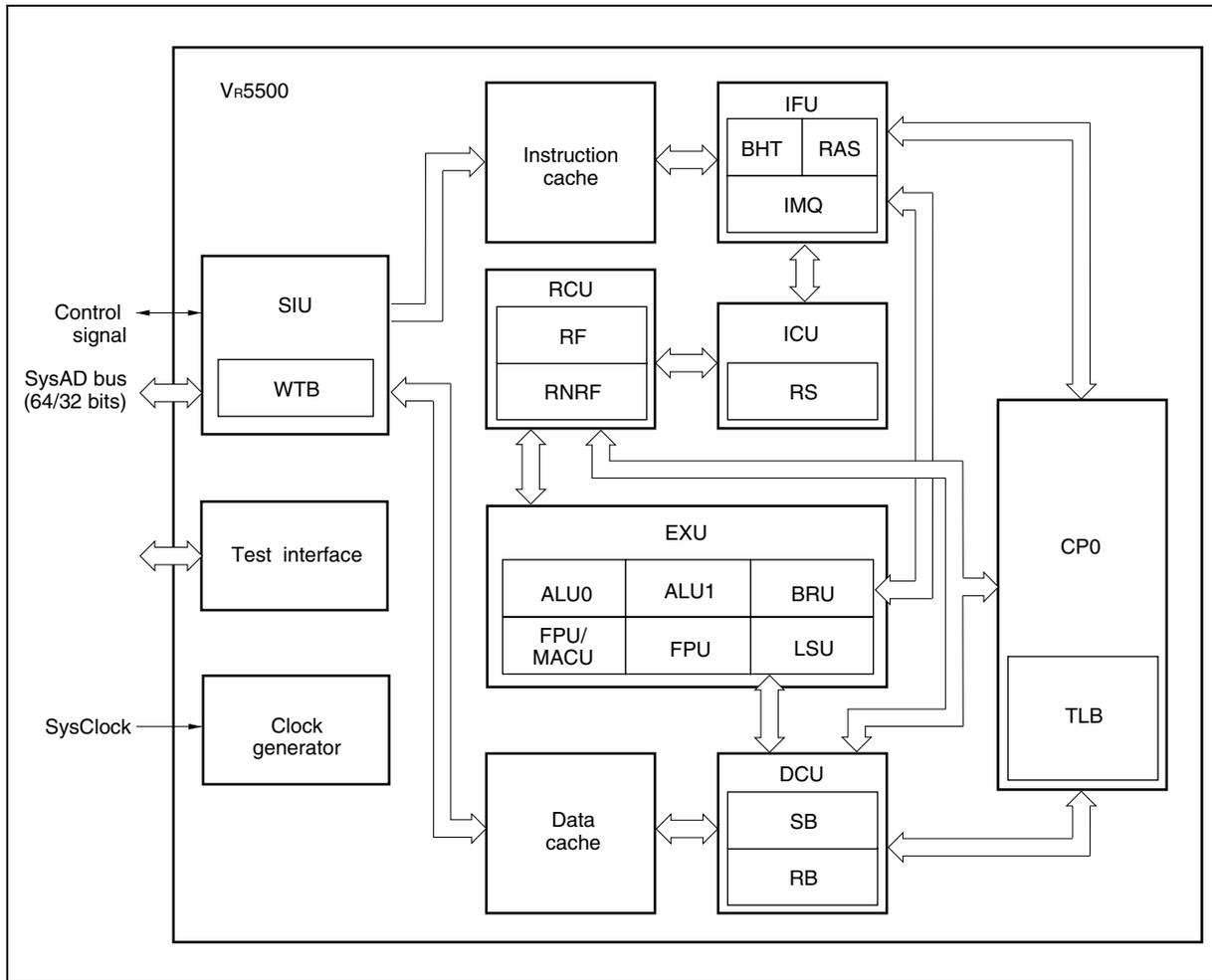
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1. PIN FUNCTIONS

Remark # indicates active low.

1.1 List of Pin Functions

(1) System interface signals

Pin Name	I/O	Function
SysAD(63:0)	I/O	System address/data bus A 64-bit bus for communication between the processor and external agent. The lower 32 bits (SysAD(31:0)) are used in 32-bit bus mode.
SysADC(7:0)	I/O	System address/data check bus A bus for SysAD bus parity. Valid only during a data cycle. The lower 4 bits (SysADC(3:0)) are used in 32-bit bus mode.
SysCmd(8:0)	I/O	System command/data ID bus A 9-bit bus that transfers command and data identifiers between the processor and external agent
SysID(2:0)	I/O	System bus protocol ID These signals transfer request identifiers in the out-of-order return mode. The processor drives a valid identifier in synchronization with the activation of the ValidOut# signal. The external agent must drive valid identifiers in synchronization with the activation of the ValidIn# signal.
ValidIn#	Input	Valid In A signal indicating that the external agent is driving a valid address or data onto the SysAD bus, a valid command or data identifier onto the SysCmd bus, or a valid request identifier onto the SysID bus in the out-of-order return mode.
ValidOut#	Output	Valid out A signal indicating that the processor is driving a valid address or data onto the SysAD bus, a valid command or data identifier onto the SysCmd bus, or a valid request identifier onto the SysID bus in the out-of-order return mode.
RdRdy#	Input	Read ready A signal indicating that the external agent is ready to accept a processor read request
WrRdy#	Input	Write ready A signal indicating that the external agent is ready to accept a processor write request
ExtRqst#	Input	External request A signal indicating that the external agent is requesting the right to use the system interface
Release#	Output	Releases interface A signal indicating that the processor is releasing the system interface to a slave state
PReq#	Output	Processor request A signal indicating that the processor has a request that is pending

(2) Initialization interface signals (1/2)

Pin Name	I/O	Function
DivMode(2:0)	Input	Division mode These signals set the division ratio of PClock and SysClock as follows: 111: 5.5 110: 5 101: 4.5 100: 4 011: 3.5 010: 3 001: 2.5 000: 2 Set the input levels of these signals before a power-on reset. Make sure that the levels of these signals do not change while the VR5500 is operating.
BigEndian	Input	Endian mode This signal sets the byte ordering for addressing. 1: Big endian 0: Little endian Set the input level of this signal before a power-on reset. Make sure that the level of this signal does not change while the VR5500 is operating.
BusMode	Input	Bus mode This signal sets the bus width of the system interface. 1: 64 bits 0: 32 bits Set the input level of this signal before a power-on reset. Make sure that the level of this signal does not change while the VR5500 is operating.
TIntSel	Input	Interrupt source select This signal sets the interrupt source to be assigned to the IP7 bit of the Cause register. 1: Timer interrupt 0: Int5# input and external write request (SysAD5) Set the input level of this signal before a power-on reset. Make sure that the level of this signal does not change while the VR5500 is operating.
DisDValidO#	Input	ValidOut# delay enable 1: ValidOut# is active even while the address cycle is stalled 0: ValidOut# is active during the address issuance cycle only Set the input level of this signal before a power-on reset. Make sure that the level of this signal does not change while the VR5500 is operating.
DWBTrans#	Input	Doubleword block transfer enable (valid in 32-bit bus mode only) 1: Disabled 0: Enabled Set the input level of this signal before a power-on reset. Make sure that the level of this signal does not change while the VR5500 is operating.

Remark 1: High level, 0: Low level

Pin Name	I/O	Function

O3Return#	Input	Out-of-Order Return mode
		
		This signal sets the protocol of the system interface.
		  1: Normal mode
		  0: Out-of-order return mode
		Set the input level of this signal before a power-on reset. Make sure that the level of this signal does not change while the V$_R$5500 is operating.

ColdReset#	Input	Cold reset This signal completely initializes the internal status of the processor. Deassert it in synchronization with SysClock.
Reset#	Input	Reset This signal logically initializes the internal status of the processor. Deassert it in synchronization with SysClock.

DrvCon	Input	Drive control
		
		This signal sets the impedance of the external output driver.
		  1: Low
		  0: Normal (recommended)
		Set the input level of this signal before a power-on reset. Make sure that the level of this signal does not change while the V$_R$5500 is operating.
		
		Remark Applies to revision 2.0 or later products. Fixed to 0 in revision 1.x products.

Remark 1: High level, 0: Low level

The O3Return#, DWBTrans#, DisDValidO#, and BusMode signals are used for determining the protocol of the system interface. The protocol is selected as follows in accordance with the setting of these signals.

Protocol	O3Return#	DWBTrans#	DisDValidO#	BusMode
V$_R$5000™ compatible	1	1	1	1
RM523x compatible	1	1	1	0
V$_R$5432 native mode compatible	1	0	0	0
Out-of-order return mode	0	Arbitrary	Arbitrary	Arbitrary

Remark 1: High level, 0:Low level
        RM523x is a product of PMC-Sierra, Inc.

(3) Interrupt interface signals

Pin Name	I/O	Function
Int(5:0)#	Input	Interrupt These are general-purpose processor interrupt requests. The input states can be checked by the Cause register. Whether Int5# is acknowledged or not depends on the status of the TIntSel signal during reset.
NMI#	Input	Non-maskable interrupt This is the non-maskable interrupt request.

(4) Clock interface signals

Pin Name	I/O	Function
SysClock	Input	System clock Clock input to the processor
V$_{DD}$PA1 V$_{DD}$PA2	−	V$_{DD}$ for PLL Power supply for the internal PLL
V$_{SS}$PA1 V$_{SS}$PA2	−	V$_{SS}$ for PLL Ground for the internal PLL

(5) Power supply

Pin Name	I/O	Function
V$_{DD}$	−	Power supply pin for core
V$_{DD}$IO	−	Power supply pin for I/O
V$_{SS}$	−	Ground potential pin

Caution The V$_R$5500 uses two power supply pins. These power supply pins can be applied in any sequence. However, power must not be applied to one pin for 100 ms or longer while it is not applied to the other.

(6) Test interface signals

Pin Name	I/O	Function
NTrcData(3:0)	Output	Trace data Trace data output
NTrcEnd	Output	Trace end A signal that indicates the end of a trace data packet.
NTrcClk	Output	Trace clock Clock for the test interface. The same clock as SysClock is output.

RMode#/
BKTGIO#
	I/O	Reset mode/break trigger I/O
		    A debug reset mode input signal while the JTRST# signal (ColdReset# signal for revision 1.x products) is active.
		    It serves as a break or trigger I/O signal during normal operation.

JTDI	Input	JTAG data input Serial data input for JTAG
JTDO	Output	JTAG data output Serial data output for JTAG. Output is performed in synchronization with the fall of JTCK.
JTMS	Input	JTAG mode select This signal selects the JTAG test mode.
JTCK	Input	JTAG clock input Serial clock input for JTAG. The maximum frequency is 33 MHz. There is no need for it to be synchronized with SysClock.

JTRST#	Input	JTAG reset input
		    A signal for initializing the JTAG test module.
		
		    Remark Revision 2.0 or later products only.

1.2 Recommended Connection of Unused Pins

(1) System interface pins

(a) 32-bit bus mode

The VR5500 allows selection of a SysAD bus width from 64 bits or 32 bits. When the 32-bit bus mode is selected, the VR5500 operates using only the required system interface pins. Therefore, set the unused pins as follows when operating the VR5500 in the 32-bit bus mode.

Pin Name	Recommended Connection of Unused Pins
SysAD(63:32)	Leave open
SysADC(7:4)	Leave open

(b) Normal mode

The VR5500 can process read/write transactions regardless of the order in which requests are issued in the out-of-order return mode. The SysID(2:0) signals are used to identify each request during this processing. Set these signals, which are not used in the normal mode, as follows.

Pin Name	Recommended Connection of Unused Pins
SysID(2:0)	Leave open

(c) Parity bus

The VR5500 allows selection of whether the data is protected using parity. When parity is used, the parity data is output from the processor or external agent to the SysADC bus.

However, whether the parity is used or not is selected by software, so unless the program is started, the VR5500 cannot determine the operation of the SysADC bus. Therefore, care must be taken to prevent the SysADC bus from being left open or in a high-impedance state.

When parity is not used, it is recommended to connect each pin of the SysADC bus to VDDIO via a resistor with a high resistance value.

(2) Test interface pins

The V$_R$5500 can be used to perform testing and debugging with the device mounted on the board. The test interface pins are used for connection with the external debug tool during such debugging. Therefore set the test interface pins as follows when the debug function is not used and in the normal operation mode.

Pin Name	Recommended Connection of Unused Pins
JTCK	Pull up
JTDI	Pull up
JTMS	Pull up
JTRST#**Note**	Pull down
JTDO	Leave open
NTrcClk	Leave open
NTrcData(3:0)	Leave open
NTrcEnd	Leave open
RMode#/BKTGIO#	Pull up

Note Revision 2.0 or later products only.

2. ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	$V_{DD}IO$		−0.5 to +4.0	V
	V_{DD}		−0.5 to +2.0	V
	$V_{DD}P$		−0.5 to +2.0	V
Input voltage[Note]	V_I		−0.5 to $V_{DD}IO$ + 0.3	V
		Pulse of less than 7 ns	−1.5 to $V_{DD}IO$ + 0.3	V
Operating case temperature	T_C		−10 to +85	°C
Storage temperature	T_{stg}		−40 to +125	°C

Note The upper limit of the input voltage ($V_{DD}IO$ + 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 sections are the ranges within which the product can normally operate and the quality can be guaranteed.

Operating conditions

(1) 300 MHz product

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Supply voltage	$V_{DD}IO$		2.375	2.625	V
			3.135	3.465	V
	V_{DD}		1.425	1.575	V
	$V_{DD}P$		1.425	1.575	V

Caution V_{DD} **can also be used with the voltage range of the 400 MHz product (1.6 to 1.7 V). In this case, internal operation at 300 MHz is guaranteed. The supply current of the core block in this case is the specified value of the 400 MHz product (MAX. 1.8 A).**

(2) 400 MHz product

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Supply voltage	$V_{DD}IO$		2.375	2.625	V
			3.135	3.465	V
	V_{DD}		1.6	1.7	V
	$V_{DD}P$		1.6	1.7	V

Caution V_{DD} **can also be used with the voltage range of the 300 MHz product (1.425 to 1.575 V). In this case, internal operation at 300 MHz is guaranteed. The supply current of the core block in this case is the specified value of the 300 MHz product (MAX. 1.4 A).**

Supply Current

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Supply current of core block	I_{DD}	300 MHz product, during normal operation, $V_{DD} = V_{DD}P = 1.575$ V		1.4	A
		400 MHz product, during normal operation, $V_{DD} = V_{DD}P = 1.7$ V		1.8	A
	I_{DD_sb}	300 MHz product, in standby mode, $V_{DD} = V_{DD}P = 1.575$ V		0.35	A
		400 MHz product, in standby mode, $V_{DD} = V_{DD}P = 1.7$ V		0.45	A

Remark The supply current in the I/O block varies depending on the application used. It is normally 20% I_{DD} or lower.

DC Characteristics

(1) When $V_{DD}IO = 2.5$ V $\pm 5\%$

(300 MHz product: $T_C = -10$ to $+85°C$, $V_{DD}IO = 2.5$ V $\pm 5\%$, $V_{DD} = V_{DD}P = 1.5$ V $\pm 5\%$)

(400 MHz product: $T_C = -10$ to $+85°C$, $V_{DD}IO = 2.5$ V $\pm 5\%$, $V_{DD} = V_{DD}P = 1.6$ to 1.7 V)

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Output voltage, high	V_{OH}	$V_{DD}IO = $ MIN., $I_{OH} = -4$ mA	$0.8 \times V_{DD}IO$		V
Output voltage, low	V_{OL}	$V_{DD}IO = $ MIN., $I_{OL} = 4$ mA		0.4	V
Input voltage, high[Note 1]	V_{IH}		2.0	$V_{DD}IO + 0.3$	V
Input voltage, low[Note 1]	V_{IL}		−0.5	$0.2 \times V_{DD}IO$	V
		Pulse of less than 7 ns	−1.5	$0.2 \times V_{DD}IO$	V
Input voltage, high[Note 2]	V_{IHC}		$0.8 \times V_{DD}IO$	$V_{DD}IO + 0.3$	V
Input voltage, low[Note 2]	V_{ILC}		−0.5	$0.2 \times V_{DD}IO$	V
		Pulse of less than 7 ns	−1.5	$0.2 \times V_{DD}IO$	V
Input current leakage, high	I_{LIH}	$V_I = V_{DD}IO$		5.0	μA
Input current leakage, low	I_{LIL}	$V_I = 0$ V		−5.0	μA
Output current leakage, high	I_{LOH}	$V_O = V_{DD}IO$		5.0	μA
Output current leakage, low	I_{LOL}	$V_O = 0$ V		−5.0	μA

Notes 1. Does not apply to the SysClock pin.

2. Only applies to the SysClock pin.

(2) When V$_{DD}$IO = 3.3 V ±5%

(300 MHz product: T$_C$ = −10 to +85°C, V$_{DD}$IO = 3.3 V ±5%, V$_{DD}$ = V$_{DD}$P = 1.5 V ±5%)

(400 MHz product: T$_C$ = −10 to +85°C, V$_{DD}$IO = 3.3 V ±5%, V$_{DD}$ = V$_{DD}$P = 1.6 to 1.7 V)

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Output voltage, high	V$_{OH}$	V$_{DD}$IO = MIN., I$_{OH}$ = −4 mA	2.4		V
Output voltage, low	V$_{OL}$	V$_{DD}$IO = MIN., I$_{OL}$ = 4 mA		0.4	V
Input voltage, high[Note 1]	V$_{IH}$		2.0	V$_{DD}$IO + 0.3	V
Input voltage, low[Note 1]	V$_{IL}$		−0.5	0.8	V
		Pulse of less than 7 ns	−1.5	0.8	V
Input voltage, high[Note 2]	V$_{IHC}$		0.8 × V$_{DD}$IO	V$_{DD}$IO + 0.3	V
Input voltage, low[Note 2]	V$_{ILC}$		−0.5	0.2 × V$_{DD}$IO	V
		Pulse of less than 7 ns	−1.5	0.2 × V$_{DD}$IO	V
Input current leakage, high	I$_{LIH}$	V$_I$ = V$_{DD}$IO		5.0	μA
Input current leakage, low	I$_{LIL}$	V$_I$ = 0 V		−5.0	μA
Output current leakage, high	I$_{LOH}$	V$_O$ = V$_{DD}$IO		5.0	μA
Output current leakage, low	I$_{LOL}$	V$_O$ = 0 V		−5.0	μA

Notes 1. Does not apply to the SysClock pin.

2. Only applies to the SysClock pin.

Power-on Sequence

The V$_R$5500 uses two power supply pins. These power supply pins can be applied in any sequence. However, power must not be applied to one pin for 100 ms or longer while it is not applied to the other.

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Power-on delay	t$_{DF}$		0	100	ms

Capacitance (T$_A$ = 25°C, V$_{DD}$IO = V$_{DD}$ = V$_{DD}$P = 0 V)

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Input capacitance	C$_{IN}$	f$_C$ = 1 MHz		5.0	pF
Output capacitance	C$_{OUT}$	Unmeasured pins returned to 0 V		7.0	pF

AC Characteristics

(300 MHz product: T$_C$ = −10 to +85, V$_{DD}$IO = 2.5 V ±5%, 3.3 V ±5%, V$_{DD}$ = V$_{DD}$P = 1.5 V ±5%)

(400 MHz product: T$_C$ = −10 to +85, V$_{DD}$IO = 2.5 V ±5%, 3.3 V ±5%, V$_{DD}$ = V$_{DD}$P = 1.6 to 1.7 V)

Clock parameters (1/2)

Parameter	Symbol	Conditions		MIN.	MAX.	Unit
System clock high-level width	t$_{CH}$			1.8		ns
System clock low-level width	t$_{CL}$			1.8		ns
Pipeline clock frequency		300 MHz product		200	300	MHz
		400 MHz product		200	400	MHz
System clock frequency[Note]		300 MHz product	DivMode = 2:1	100	133	MHz
			DivMode = 2.5:1	80	120	MHz
			DivMode = 3:1	66.7	100	MHz
			DivMode = 3.5:1	57.2	85.7	MHz
			DivMode = 4:1	50	75	MHz
			DivMode = 4.5:1	44.5	66.6	MHz
			DivMode = 5:1	40	60	MHz
			DivMode = 5.5:1	36.4	54.5	MHz
		400 MHz product	DivMode = 2:1	100	133	MHz
			DivMode = 2.5:1	80	133	MHz
			DivMode = 3:1	66.7	133	MHz
			DivMode = 3.5:1	57.2	114	MHz
			DivMode = 4:1	50	100	MHz
			DivMode = 4.5:1	44.5	88.8	MHz
			DivMode = 5:1	40	80	MHz
			DivMode = 5.5:1	36.4	72.7	MHz

Note   This is the frequency at which the operation of the internal PLL is guaranteed.

Clock parameters (2/2)

Parameter	Symbol	Conditions		MIN.	MAX.	Unit
System clock cycle	t$_{CP}$	300 MHz product	DivMode = 2:1	7.5	10	ns
			DivMode = 2.5:1	8.3	12.5	ns
			DivMode = 3:1	10	15	ns
			DivMode = 3.5:1	11.7	17.5	ns
			DivMode = 4:1	13.3	20	ns
			DivMode = 4.5:1	15	22.5	ns
			DivMode = 5:1	16.7	25	ns
			DivMode = 5.5:1	18.3	27.5	ns
		400 MHz product	DivMode = 2:1	7.5	10	ns
			DivMode = 2.5:1	7.5	12.5	ns
			DivMode = 3:1	7.5	15	ns
			DivMode = 3.5:1	8.8	17.5	ns
			DivMode = 4:1	10	20	ns
			DivMode = 4.5:1	11.3	22.5	ns
			DivMode = 5:1	12.5	25	ns
			DivMode = 5.5:1	13.8	27.5	ns
System clock jitter	t$_J$				±5	%
System clock rise time	t$_{CR}$				1.2	ns
System clock fall time	t$_{CF}$				1.2	ns
JTAG clock frequency					33	MHz

Remarks 1. The system clock jitter is a cycle-to-cycle jitter.

2. The JTAG clock runs asynchronously to the system clock.

System interface parameters

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Data output hold time[Note 1]	t$_{DM}$		1.0		ns
Data output delay time[Note 1]	t$_{DO}$			5.0	ns
Data input setup time[Note 2]	t$_{DS}$		1.5		ns
Data input hold time[Note 2]	t$_{DH}$	300 MHz product	1.0		ns
		400 MHz product	0.5		ns

Notes 1. Applies to the Release#, ValidOut#, SysAD(63:0), SysADC(7:0), SysCmd(8:0), and SysID(2:0) pins.

2. Applies to the ColdReset#, Reset#, Int(5:0), NMI#, ExtRqst#, RdRdy#, ValidIn#, SysAD(63:0), SysADC(7:0), SysCmd(8:0), and SysID(2:0) pins.

Load coefficient

Parameter	Symbol	Conditions	MIN.	MAX.	Unit
Load coefficient	CLD			1.0	ns/25 pF

Measurement Conditions

Measurement points

SysClock   50%

tDO

tDM

All output pins   50%

Load conditions

All output pins   DUT

C_L = 50 pF
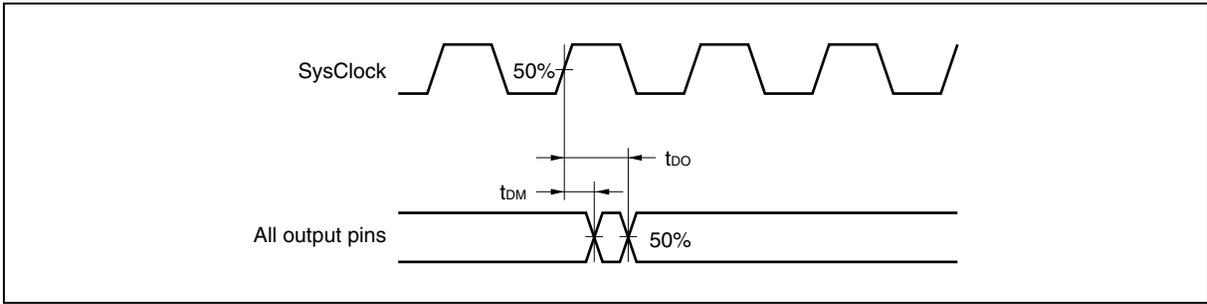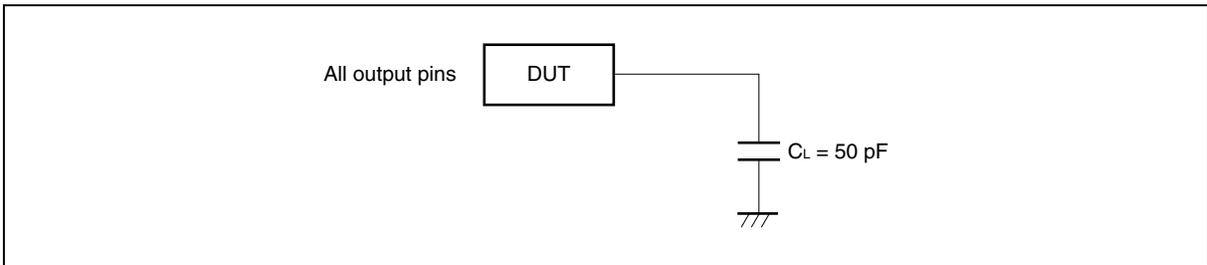
Timing Charts

Clock timing

tCP   tCH

80%

SysClock   50%

20%

tCL   tCR   tCF
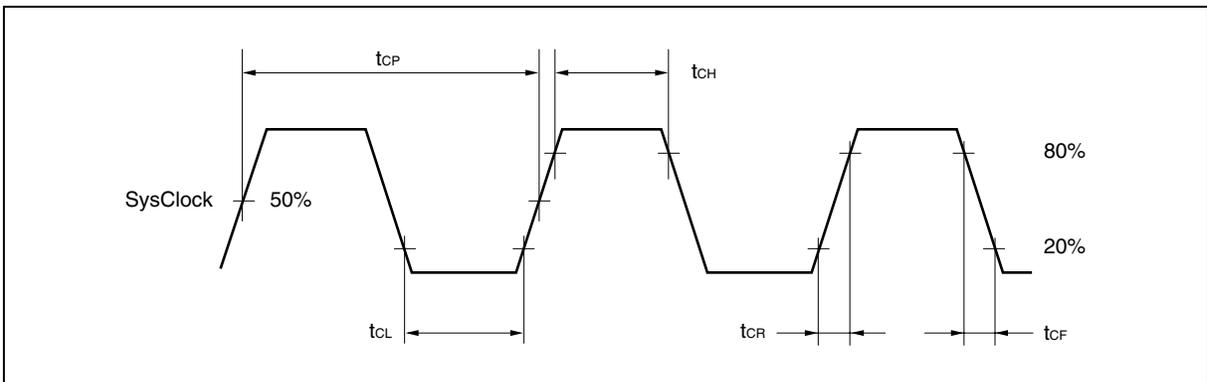
Clock jitter
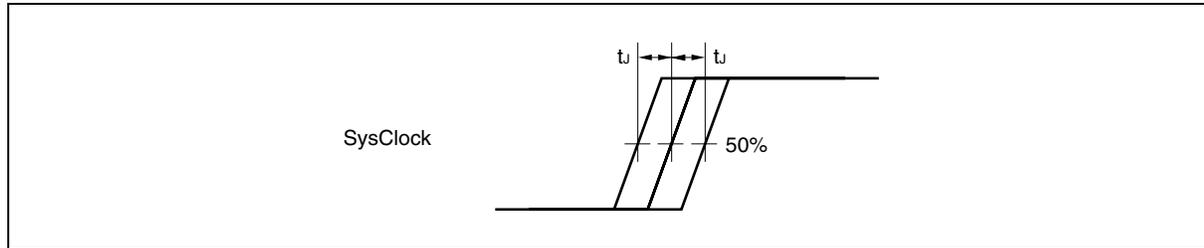
System interface edge timing
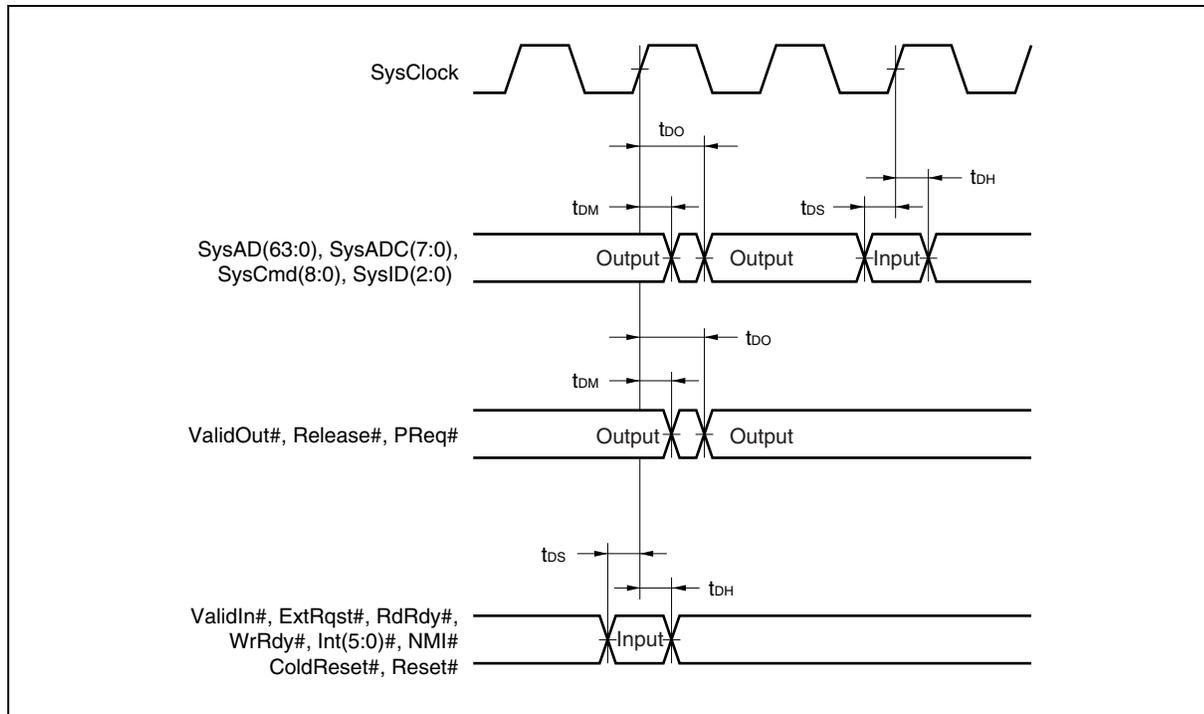
Clock relationships (DivMode = 2:1)

Note SysAD(63:0), SysADC(7:0), SysCmd(8:0), SysID(2:0)
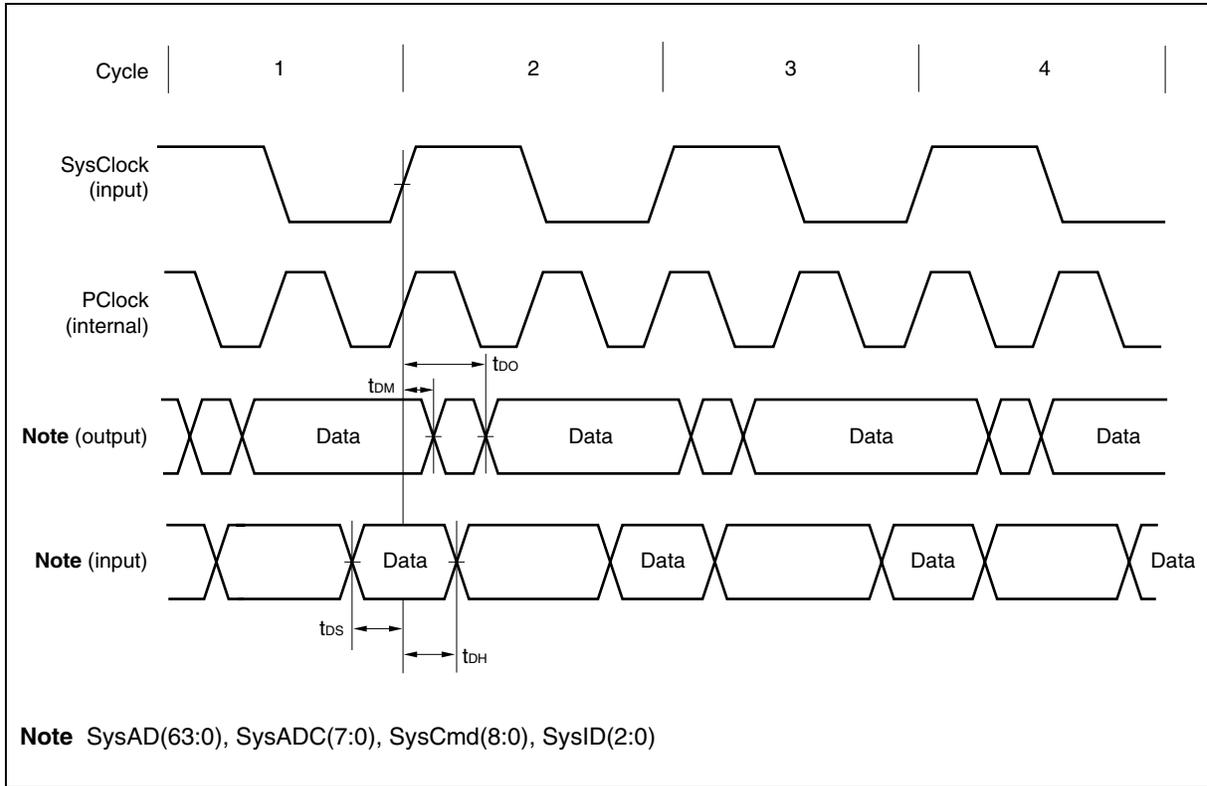
Power-on sequence
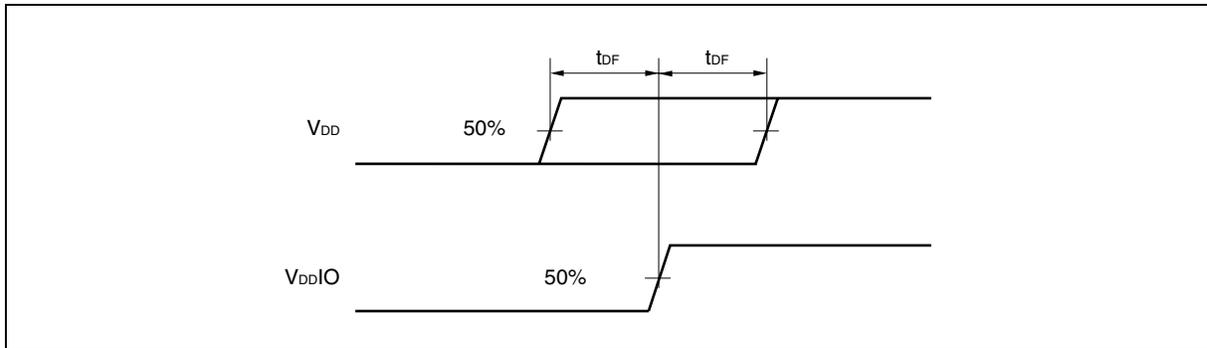
Reset Timing

Power-on reset timing

Notes 1. 1.425 V (300 MHz product), 1.6 V (400 MHz product)
2. 2.375 V at 2.5 V operation or 3.135 V at 3.3 V operation
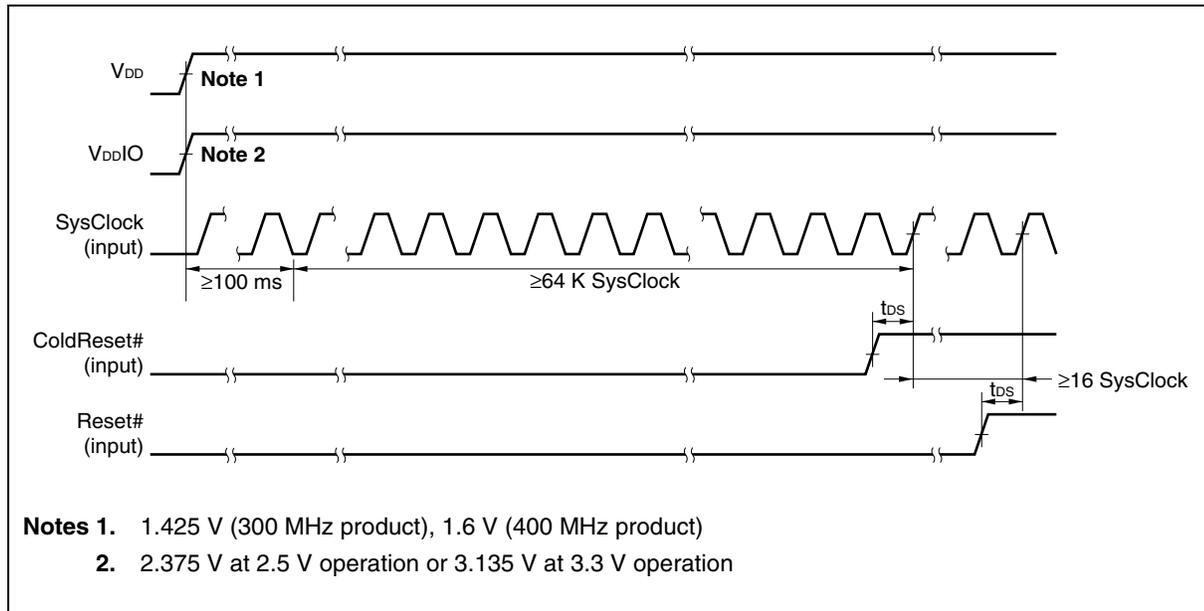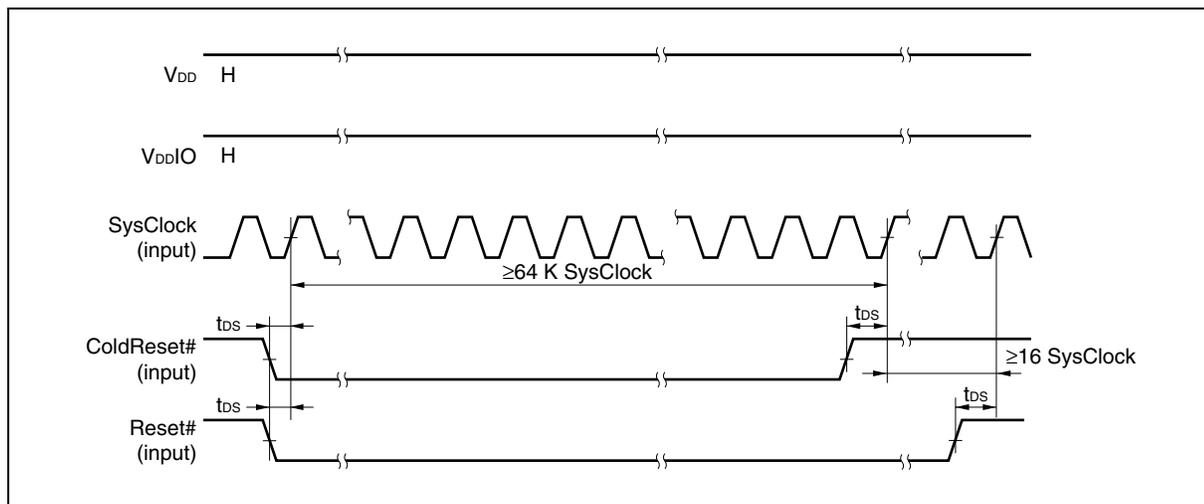
Cold reset timing

Warm reset timing
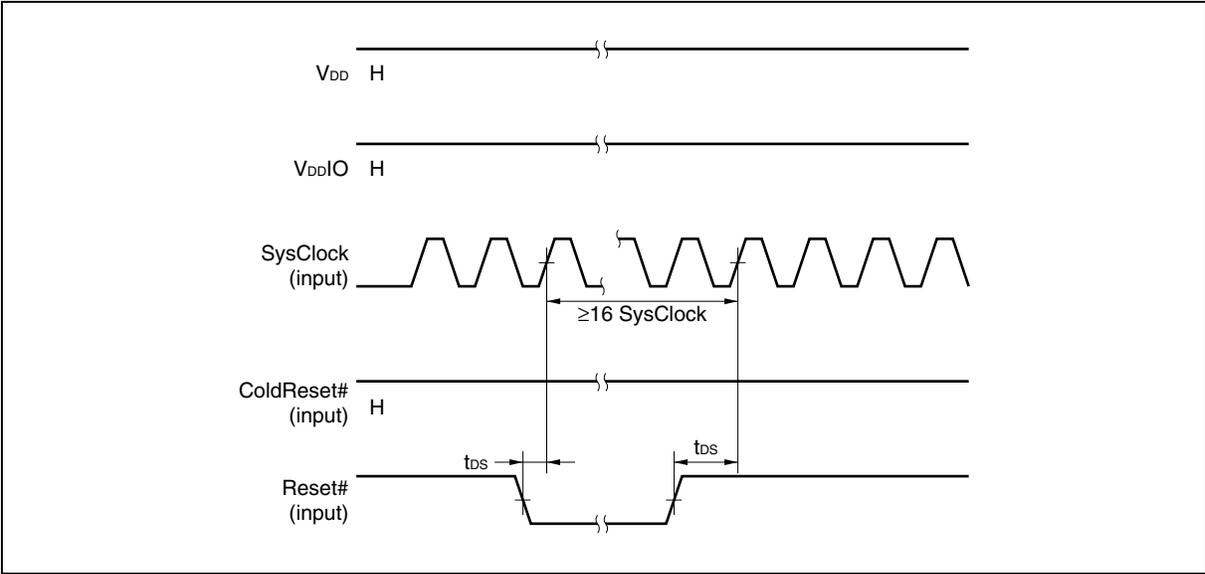
3. PACKAGE DRAWING

272-PIN PLASTIC BGA (CAVITY DOWN ADVANCED TYPE) (29x29)

INDEX AREA

4-C1.4

detail of Ⓐ part
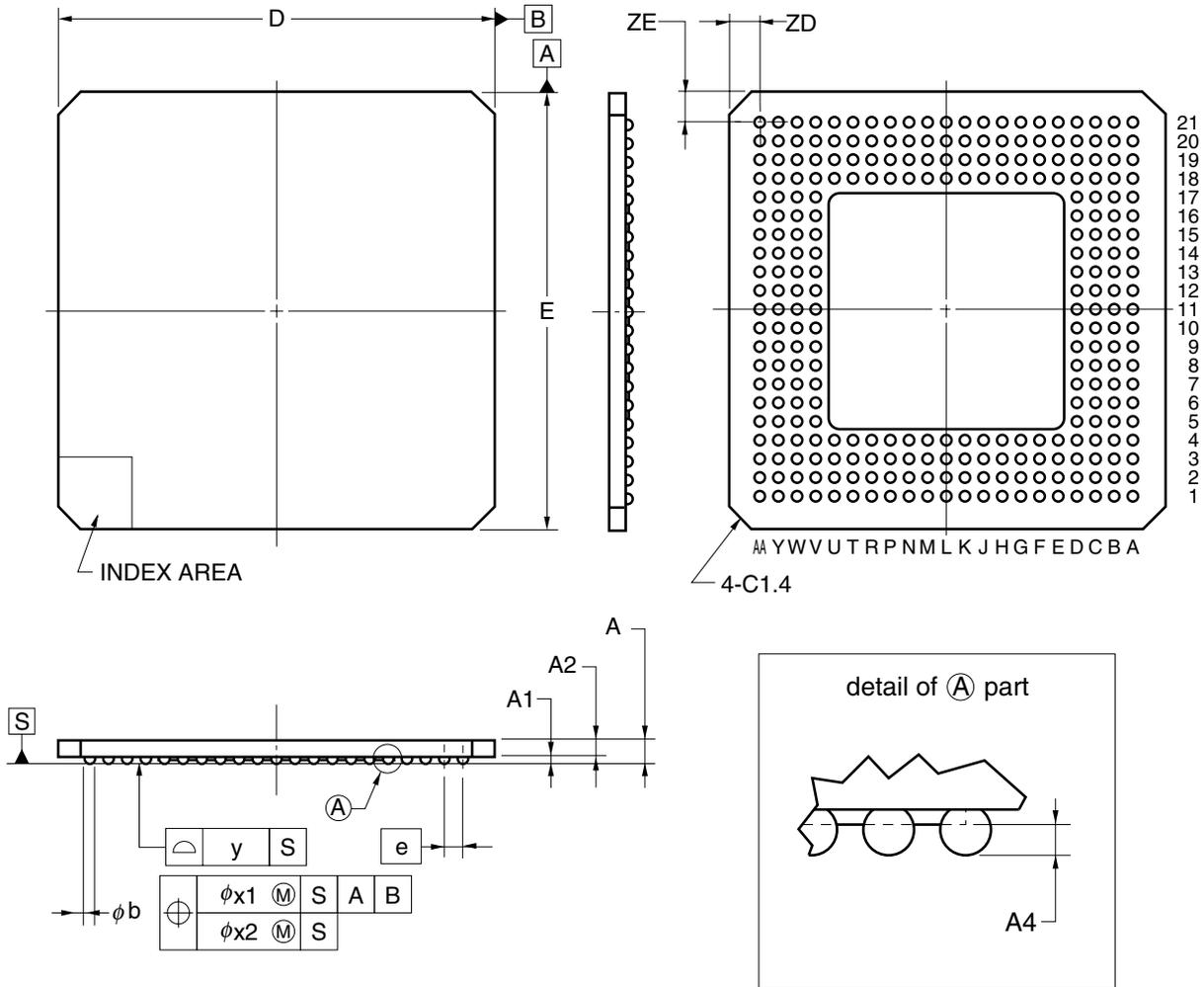
ITEM	MILLIMETERS
D	29.00±0.20
E	29.00±0.20
e	1.27
A	1.75±0.30
A1	0.60±0.10
A2	1.15
A4	0.25MIN.
b	φ0.75±0.15
x1	0.30
x2	0.15
y	0.20
ZD	1.80
ZE	1.80

P272F2-127-BA1

4. RECOMMENDED SOLDERING CONDITIONS

This product should be soldered and mounted under the following recommended conditions.

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

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

Table 4-1. Surface mounting Type Soldering Conditions

μPD30550F2-300-NN1: 272-pin plastic BGA (C/D advanced type) (29 × 29)
μPD30550F2-400-NN1: 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 seconds max. (at 210°C or higher), Count: Three times or less, Exposure limit: 3 days[Note] (after that, prebake at 125°C for 20 to 72 hours)	IR35-203-3

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

— 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.

Reference document Electrical Characteristics for Microcomputer (U15170J)[Note]

Note This document number is that of Japanese version.

The related documents indicated in the publication may include preliminary versions. However, preliminary versions are not marked as such.

Regional Information

Some information contained in this document may vary from country to country. Before using any NEC product in your application, please contact the NEC office in your country to obtain a list of authorized representatives and distributors. They will verify:

- Device availability

- Ordering information

- Product release schedule

- Availability of related technical literature

- Development environment specifications (for example, specifications for third-party tools and components, host computers, power plugs, AC supply voltages, and so forth)

- Network requirements

In addition, trademarks, registered trademarks, export restrictions, and other legal issues may also vary from country to country.

NEC Electronics Inc. (U.S.)
Santa Clara, California
Tel: 408-588-6000
    800-366-9782
Fax: 408-588-6130
    800-729-9288

NEC do Brasil S.A.
Electron Devices Division
Guarulhos-SP, Brasil
Tel: 11-6462-6810
Fax: 11-6462-6829

NEC Electronics (Europe) GmbH
Duesseldorf, Germany
Tel: 0211-65 03 01
Fax: 0211-65 03 327

  • Sucursal en España
  Madrid, Spain
  Tel: 091-504 27 87
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• Branch The Netherlands
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  Taeby, Sweden
  Tel: 08-63 80 820
  Fax: 08-63 80 388

• United Kingdom Branch
  Milton Keynes, UK
  Tel: 01908-691-133
  Fax: 01908-670-290

NEC Electronics Hong Kong Ltd.
Hong Kong
Tel: 2886-9318
Fax: 2886-9022/9044

NEC Electronics Hong Kong Ltd.
Seoul Branch
Seoul, Korea
Tel: 02-528-0303
Fax: 02-528-4411

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Shanghai, P.R. China
Tel: 021-6841-1138
Fax: 021-6841-1137

NEC Electronics Taiwan Ltd.
Taipei, Taiwan
Tel: 02-2719-2377
Fax: 02-2719-5951

NEC Electronics Singapore Pte. Ltd.
Novena Square, Singapore
Tel: 253-8311
Fax: 250-3583

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