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April 1st, 2010
Renesas Electronics Corporation

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RENESAS

MOS INTEGRATED CIRCUIT

μPD720102

USB 2.0 HOST CONTROLLER

The μPD720102 complies with the universal serial bus specification revision 2.0 and open host controller interface specification for full-/low-speed signaling and Intel's enhanced host controller interface specification for high-speed signaling and works up to 480 Mbps. The μPD720102 is integrated 2 host controller cores with PCI interface and USB 2.0 transceivers into a single chip.

Detailed function descriptions are provided in the following user's manual. Be sure to read the manual before designing.
μPD720102 User's Manual: S17999E

FEATURES

- Compliant with universal serial bus specification revision 2.0 (data rate: 1.5/12/480 Mbps)
- Compliant with open host controller interface specification for USB release 1.0a
- Compliant with enhanced host controller interface specification for USB revision 1.0
- PCI multi-function device consists of one OHCI host controller core for full-/low-speed signaling and one EHCI host controller core for high-speed signaling
- Root hub with 3 (Max.) downstream facing ports which are shared by OHCI and EHCI host controller cores
- All downstream facing ports can handle high-speed (480 Mbps), full-speed (12 Mbps), and low-speed (1.5 Mbps) transaction
- Supports hyper-speed transfer mode using HSMODE signal
- 32-bit 33 MHz host interface compliant with PCI specification revision 2.2
- Supports PCI mobile design guide version 1.1
- Supports PCI-bus power management interface specification revision 1.1
- PCI bus bus-master access
- Supports 3.3 V PCI
- System clock is generated by 30 MHz crystal or 48 MHz clock input
- Operational registers direct-mapped to PCI memory space
- 3.3 V single power supply, 1.5 V internal operating voltage from on chip regulator
- On chip Rs and Rpd resistors for USB signals

ORDERING INFORMATION

	Part Number	Package	Remark
	μPD720102GC-YEB-A	120-pin plastic TQFP (fine pitch) (14 × 14)	Lead-free product
<R>	μPD720102F1-CA7-A	121-pin plastic FBGA (8 × 8)	Lead-free product

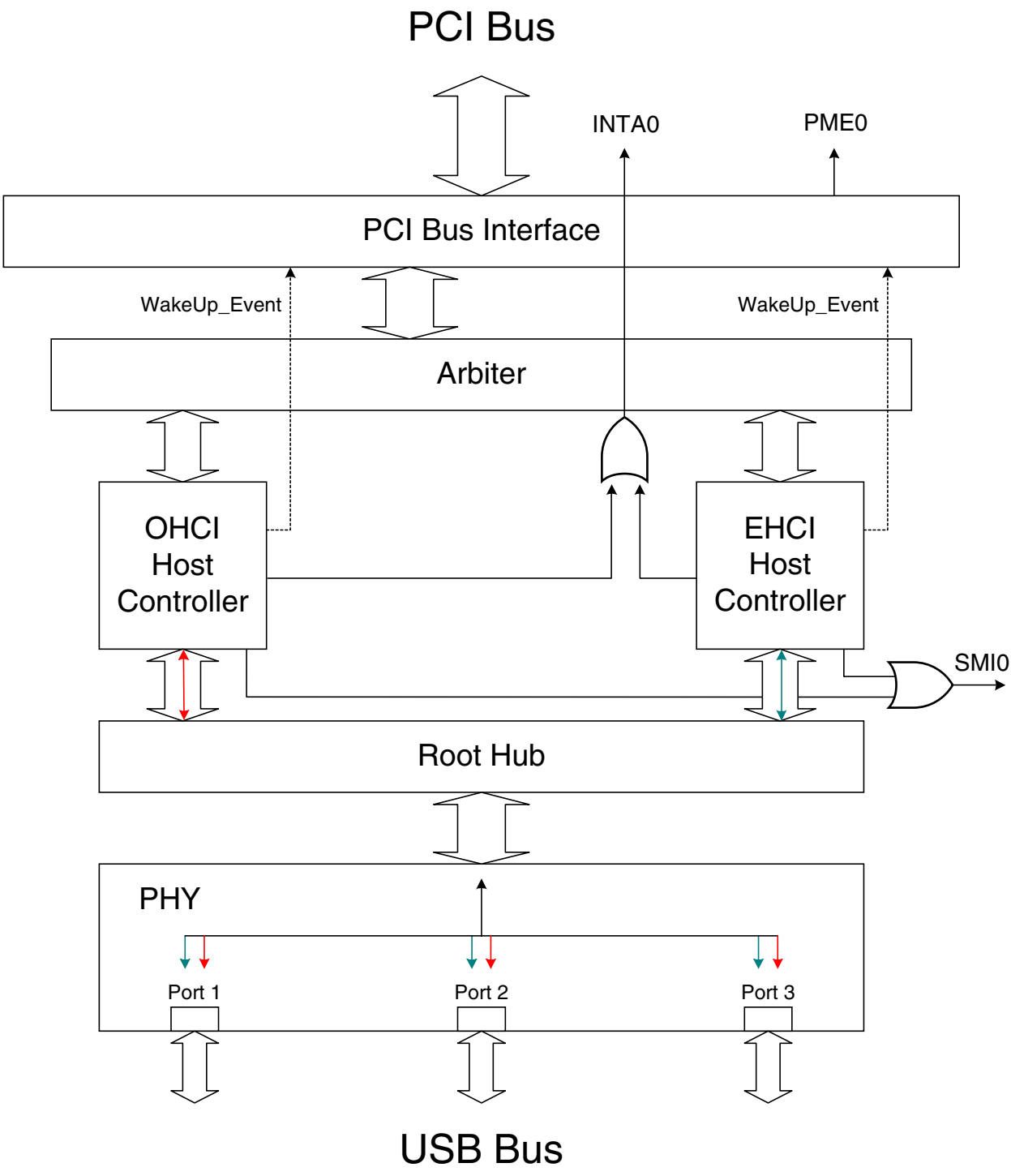
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Date Published March 2007 NS CP (N)
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The mark "<R>" shows major revised points.

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BLOCK DIAGRAM

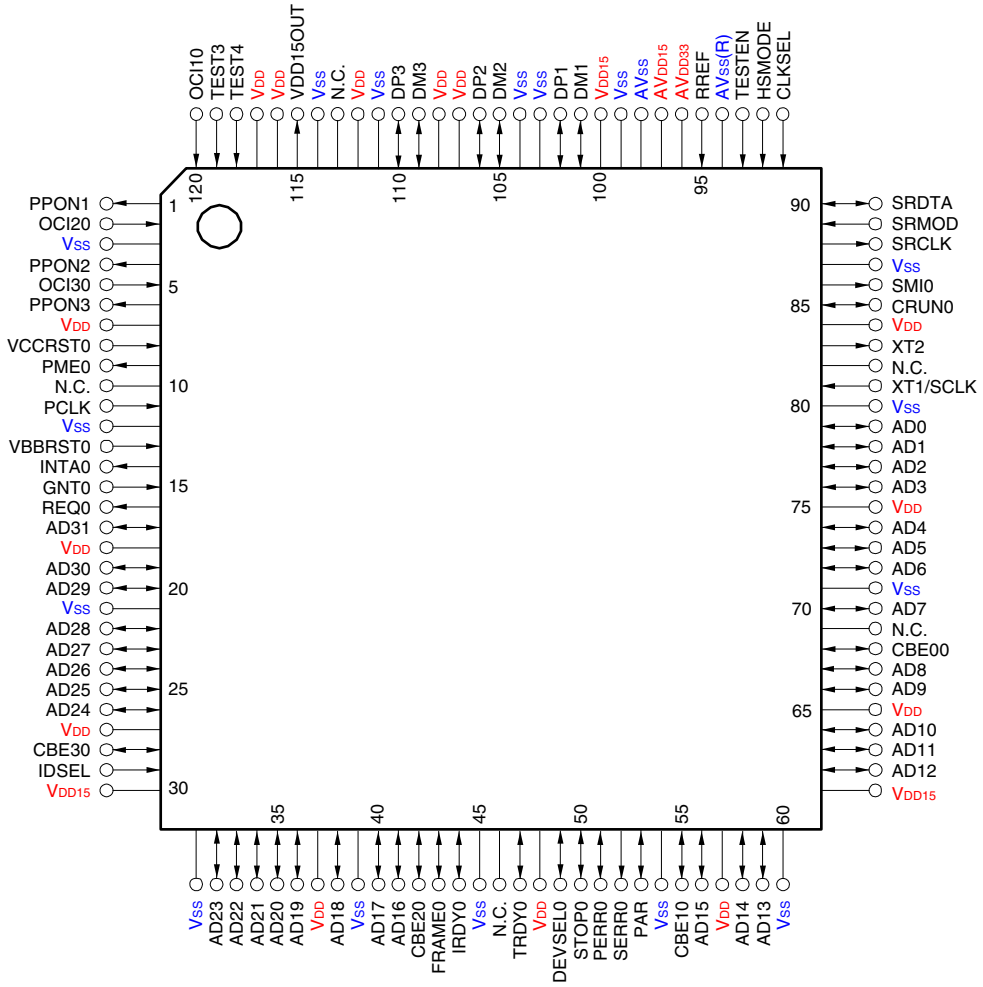


PCI Bus Interface	:	handles 32-bit 33 MHz PCI bus master and target function which comply with PCI specification revision 2.2. The number of enabled ports is set by bit in configuration space.
Arbiter	:	arbitrates among two OHCI host controller cores and one EHCI host controller core.
OHCI Host Controller	:	handles full- (12 Mbps)/low-speed (1.5 Mbps) signaling.
EHCI Host Controller	:	handles high- (480 Mbps) signaling.
Root Hub	:	handles USB hub function in host controller and controls connection (routing) between host controller core and port.
PHY	:	consists of high-speed transceiver, full-/low-speed transceiver, serializer, deserializer, etc.
INTA0	:	is the PCI interrupt signal for OHCI Host Controller.
SMI0	:	is the interrupt signal which is specified by open host controller interface specification for USB release 1.0a and enhanced host controller interface specification revision 1.0. The SMI signal of each OHCI host controller and EHCI host controller appears at this signal.
PME0	:	is the interrupt signal which is specified by PCI-bus power management interface specification revision 1.1. Wakeup signal of each host controller core appears at this signal.

PIN CONFIGURATION

- **120-pin plastic TQFP (fine pitch) (14 × 14)**
  μPD720102GC-YEB-A

Top View



Pin Name

- **120-pin plastic TQFP (fine pitch) (14 × 14)**
  μPD720102GC-YEB-A

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	PPON1	31	V_{SS}	61	V_{DD15}	91	CLKSEL
2	OCI20	32	AD23	62	AD12	92	HSMODE
3	V_{SS}	33	AD22	63	AD11	93	TESTEN
4	PPON2	34	AD21	64	AD10	94	AV_{SS}(R)
5	OCI30	35	AD20	65	V_{DD}	95	RREF
6	PPON3	36	AD19	66	AD9	96	AV_{DD33}
7	V_{DD}	37	V_{DD}	67	AD8	97	AV_{DD15}
8	VCCRST0	38	AD18	68	CBE00	98	AV_{SS}
9	PME0	39	V_{SS}	69	N.C.	99	V_{SS}
10	N.C.	40	AD17	70	AD7	100	V_{DD15}
11	PCLK	41	AD16	71	V_{SS}	101	DM1
12	V_{SS}	42	CBE20	72	AD6	102	DP1
13	VBBRST0	43	FRAME0	73	AD5	103	V_{SS}
14	INTA0	44	IRDY0	74	AD4	104	V_{SS}
15	GNT0	45	V_{SS}	75	V_{DD}	105	DM2
16	REQ0	46	N.C.	76	AD3	106	DP2
17	AD31	47	TRDY0	77	AD2	107	V_{DD}
18	V_{DD}	48	V_{DD}	78	AD1	108	V_{DD}
19	AD30	49	DEVSEL0	79	AD0	109	DM3
20	AD29	50	STOP0	80	V_{SS}	110	DP3
21	V_{SS}	51	PERR0	81	XT1/SCLK	111	V_{SS}
22	AD28	52	SERR0	82	N.C.	112	V_{DD}
23	AD27	53	PAR	83	XT2	113	N.C.
24	AD26	54	V_{SS}	84	V_{DD}	114	V_{SS}
25	AD25	55	CBE10	85	CRUN0	115	VDD15OUT
26	AD24	56	AD15	86	SMI0	116	V_{DD}
27	V_{DD}	57	V_{DD}	87	V_{SS}	117	V_{DD}
28	CBE30	58	AD14	88	SRCLK	118	TEST4
29	IDSEL	59	AD13	89	SRMOD	119	TEST3
30	V_{DD15}	60	V_{SS}	90	SRDTA	120	OCI10

Remark AV_{SS}(R) should be used to connect RREF through 1 % precision reference resistor of 1.6 kΩ.

<R> PIN CONFIGURATION

- **121-pin plastic FBGA (8 × 8)**
  μPD720102F1-CA7-A

Bottom View

21	22	23	24	25	26	27	28	29	30	31	11
20	57	58	59	60	61	62	63	64	65	32	10
19	56	85	86	87	88	89	90	91	66	33	9
18	55	84	105	106	107	108	109	92	67	34	8
17	54	83	104	117	118	119	110	93	68	35	7
16	53	82	103	116	121	120	111	94	69	36	6
15	52	81	102	115	114	113	112	95	70	37	5
14	51	80	101	100	99	98	97	96	71	38	4
13	50	79	78	77	76	75	74	73	72	39	3
12	49	48	47	46	45	44	43	42	41	40	2
11	10	9	8	7	6	5	4	3	2	1	1
L	K	J	H	G	F	E	D	C	B	A	

<R> **Pin name**

- **121-pin plastic FBGA (8 × 8)**
  μPD720102F1-CA7-A

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	DP3	32	RREF	63	V_{SS}	94	V_{DD}
2	PPON1	33	V_{DD15}	64	SMI0	95	VDD15OUT
3	OCI30	34	DM1	65	AV_{SS}(R)	96	TEST3
4	VCCRST0	35	DP1	66	AV_{DD33}	97	V_{DD}
5	PCLK	36	V_{SS}	67	V_{SS}	98	V_{DD}
6	GNT0	37	DM2	68	V_{SS}	99	V_{DD}
7	AD30	38	DP2	69	V_{SS}	100	V_{DD}
8	AD28	39	V_{DD}	70	V_{SS}	101	V_{DD15}
9	AD25	40	DM3	71	V_{SS}	102	V_{DD15}
10	CBE30	41	TEST4	72	V_{SS}	103	V_{SS}
11	V_{SS}	42	OCI20	73	OCI10	104	V_{SS}
12	AD23	43	PPON3	74	PPON2	105	V_{DD15}
13	AD21	44	PME0	75	VBBRST0	106	V_{DD15}
14	AD18	45	INTA0	76	AD31	107	V_{SS}
15	CBE20	46	REQ0	77	AD27	108	V_{SS}
16	TRDY0	47	AD29	78	IDSEL	109	V_{SS}
17	STOP0	48	AD26	79	V_{SS}	110	AV_{SS}
18	PAR	49	AD24	80	AD19	111	V_{DD}
19	AD14	50	AD22	81	AD16	112	V_{DD}
20	V_{SS}	51	AD20	82	IRDY0	113	V_{DD}
21	AD12	52	AD17	83	SERR0	114	V_{SS}
22	AD11	53	FRAME0	84	CBE10	115	V_{SS}
23	CBE00	54	DEVSEL0	85	AD9	116	V_{DD}
24	AD6	55	PERR0	86	AD8	117	V_{DD}
25	AD3	56	AD15	87	AD4	118	V_{DD}
26	AD1	57	AD13	88	AD0	119	V_{DD}
27	XT1/SCLK	58	AD10	89	CRUN0	120	V_{DD}
28	XT2	59	AD7	90	SCLK	121	V_{DD}
29	SRMOD	60	AD5	91	SRDTA		
30	HSMODE	61	AD2	92	CLKSEL		
31	TESTEN	62	V_{SS}	93	AVDD15		

Remark AV_{SS}(R) should be used to connect RREF through 1 % precision reference resistor of 1.6 kΩ.

1. PIN INFORMATION

(1/2)

Pin Name	I/O Normal (Test)	Buffer Type	Active Level	Function
AD (31:0)	I/O	3.3 V PCI I/O with OR input		PCI “AD [31:0]” signal
CBE (3:0)0	I/O	3.3 V PCI I/O with OR input		PCI “C/BE [3:0]” signal
PAR	I/O	3.3 V PCI I/O with OR input		PCI “PAR” signal
FRAME0	I/O	3.3 V PCI I/O with OR input	Low	PCI “FRAME#” signal
IRDY0	I/O	3.3 V PCI I/O with OR input	Low	PCI “IRDY#” signal
TRDY0	I/O	3.3 V PCI I/O with OR input	Low	PCI “TRDY#” signal
STOP0	I/O	3.3 V PCI I/O with OR input	Low	PCI “STOP#” signal
IDSEL	I	3.3 V PCI input with OR input	High	PCI “IDSEL” signal
DEVSEL0	I/O	3.3 V PCI I/O with OR input	Low	PCI “DEVSEL#” signal
REQ0	O (I/O)	3.3 V PCI I/O with OR input	Low	PCI “REQ#” signal
GNT0	I	3.3 V PCI input with OR input	Low	PCI “GNT#” signal
PERR0	I/O	3.3 V PCI I/O with OR input	Low	PCI “PERR#” signal
SERR0	O (I/O)	3.3 V PCI I/O with OR input Note 1	Low	PCI “SERR#” signal
INTA0	O (I/O)	3.3 V PCI I/O with OR input Note 1	Low	PCI “INTA#” signal
PCLK	I	3.3 V PCI input with OR input		PCI “CLK” signal
VBBRST0	I	3.3 V schmitt input	Low	PCI “RST#” signal
CRUN0	I/O	3.3 V PCI I/O with OR input	Low	PCI “CLKRUN#” signal
PME0	O	N-ch open drain buffer	Low	PCI “PME#” signal
VCCRST0	I	3.3 V schmitt input	Low	PCI “RST#” signal for $D3_{cold}$ support
SMI0	O (I/O)	3.3 V I/O buffer	Low	System management interrupt output
XT1/SCLK	I	OSC block		System clock input or oscillator in
XT2	O	OSC block		Oscillator out
CLKSEL	I	3.3 V Input		Input clock frequency select signal
HSMODE	I	3.3 V Input	High	Hyper-Speed transfer mode enable signal
SRCLK	O (I/O)	3.3 V I/O buffer		Serial ROM clock out
SRDTA	I/O	3.3 V I/O buffer		Serial ROM data
SRMOD	I	3.3 V Input with pull down resistor	High	Serial ROM input enable
TESTEN Note 2	I	3.3 V Input with pull down resistor	High	Test enable pin
TEST3 Note 2	I	3.3 V Input with pull down resistor	High	Test control
TEST4 Note 2	I	3.3 V Input with pull down resistor	High	Test control

Notes 1. These signals become N-ch open drain buffers in normal operation.

2. These pins must be open on board.

(2/2)

Pin Name	I/O Normal (Test)	Buffer Type	Active Level	Function
OCI (3:1)0	I (I/O)	3.3 V I/O buffer with OR input	Low	USB port's overcurrent status input
PPON (3:1)	O (I/O)	3.3 V I/O buffer	High	USB port's power supply control output
DP (3:1)	I/O	USB high speed D+ I/O		USB high speed D+ signal
DM (3:1)	I/O	USB high speed D− I/O		USB high speed D− signal
RREF	A	Analog		Reference resistor
VDD15OUT	O	Internal regulator output		1.5 V voltage output from internal regulator
V_{DD15}				1.5 V V_{DD} from VDD15OUT
V_{DD}				3.3 V V_{DD}
AV_{DD15}				1.5 V V_{DD} for analog circuit
AV_{DD33}				3.3 V V_{DD} for analog circuit
V_{SS}				V_{SS}
AV_{SS}				V_{SS} for analog circuit
AV_{SS}(R)				V_{SS} for RREF circuit
N.C.				No connection

Remark The signal marked as "(I/O)" in the above table operates as I/O signals during testing. However, they do not need to be considered in normal use.

2. HOW TO CONNECT TO EXTERNAL ELEMENTS

2.1 Handling Unused Pins

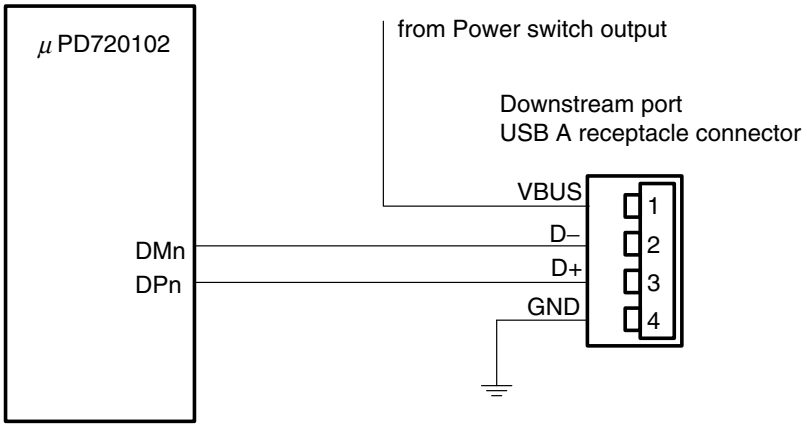
To realize less than 3 ports host controller implementation, appropriate value shall be set to Port No field in EXT1 register. And unused pins shall be connected as shown below.

Table 2-1. Unused Pin Connection

Pin	Direction	Connection Method
DPx	I/O	No connection (Open)
DMx	I/O	No connection (Open)
OCIx	I	"H" clamp
PPONx	O	No connection (Open)

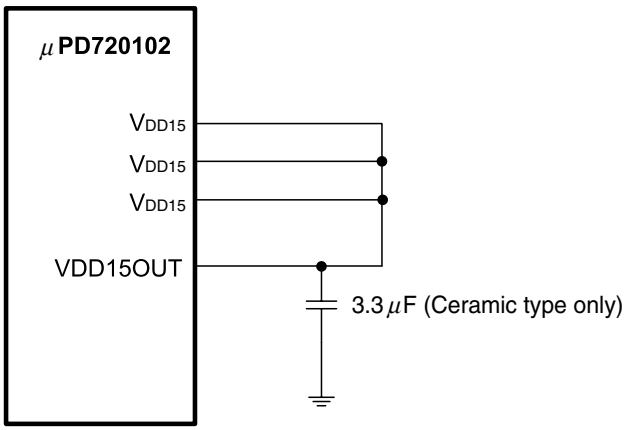
2.2 USB Port Connection

Figure 2–1. USB Downstream Port Connection



2.3 Internal Regulator Circuit Connection

Figure 2–2. Internal Regulator Circuit Connection

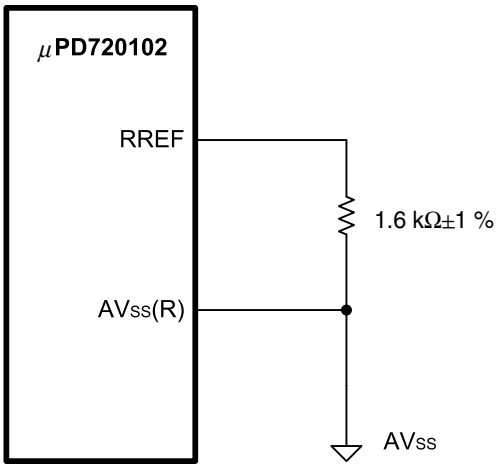


Caution VDD15OUT must be routed to only V_{DD15} (and AV_{DD15}). In case that VDD15OUT is also used for power supply of other ICs, this may cause unstable operation of the μPD720102.

Remark V_{DD15} is powered by VDD15OUT from internal regulator. It is not necessary to use external regulator for V_{DD15}.

2.4 Analog Circuit Connection

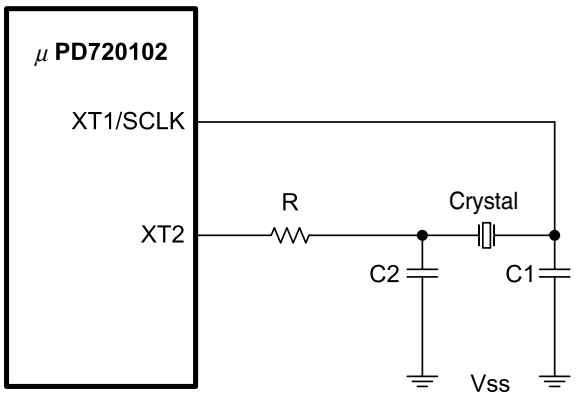
Figure 2–3. Analog Circuit Connection



<R> **Remark** The board layout should minimize the total path length from RREF through the resistor to AV_{SS}(R) and path length to AV_{SS} (analog ground). AV_{SS} must be stable.

2.5 Crystal Connection

Figure 2–4. Crystal Connection



The following crystals are evaluated on our reference design board. Table 2-2 shows the external parameters.

Table 2-2. External Parameters

Vender	Crystal	R	C1	C2
KDS Note 1	AT-49 30.000 MHz	100 Ω	12 pF	12 pF
NDK Note 2	AT-41 30.000 MHz	470 Ω	10 pF	10 pF

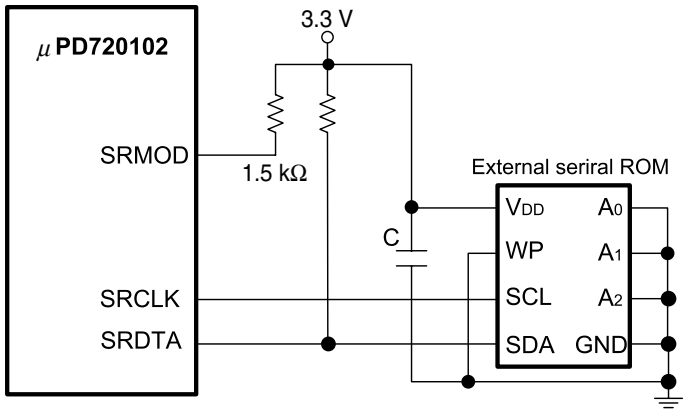
Notes 1. DAISHINKU CORP.
2. NIHON DEMPA KOGYO CO., LTD.

In using these crystals, contact KDS or NDK to get the specification on external components to be used in conjunction with the crystal.

KDS's home page: http://www.kds.info/english.html
NDK's home page: http://www.ndk.com/

2.6 External Serial ROM Connection

Figure 2–5. External Serial ROM Connection



The following serial ROM is used on our reference design board.

Table 2-3. External Parameters

Vender	Product name	Size
Atmel Corporation	AT24C01A-10SC-2.7	128 bytes

SRMOD/SRCLK/SRDTA can be opened, when serial ROM is not necessary on board.

3. ELECTRICAL SPECIFICATIONS

3.1 Buffer List

- 3.3 V input buffer
  CLKSEL, HSMODE
- 3.3 V input buffer with pull down resistor
  SRMOD, TESTEN, TEST3, TEST4
- 3.3 V input schmitt buffer
  VBBRST0, VCCRST0
- 3.3 V I_{OL} = 9 mA bi-directional buffer
  SMI0, PPON(3:1), SRCLK, SRDTA
- 3.3 V I_{OL} = 9 mA bi-directional buffer with enable (OR type)
  OCI(3:1)0
- 3.3 V PCI input buffer with enable (OR type)
  IDSEL, GNT0, PCLK
- 3.3 V PCI bi-directional buffer with enable (OR type)
  AD(31:0), CBE(3:0)0, PAR, FRAME0, IRDY0, TRDY0, STOP0, DEVSEL0, REQ0, PERR0, SERR0, INTA0, CRUN0
- N-ch open drain buffer
  PME0
- 3.3 V oscillator interface
  XT1/SCLK, XT2
- USB interface, analog signal
  DP(3:1), DM(3:1), RREF

3.2 Terminology

Terms Used in Absolute Maximum Ratings

Parameter	Symbol	Meaning
Power supply voltage	V_{DD}, V_{DD15}, AV_{DD33}, AV_{DD15}	Indicates the voltage range within which damage or reduced reliability will not result when power is applied to a V_{DD} pin.
Input voltage	V_I	Indicates voltage range within which damage or reduced reliability will not result when power is applied to an input pin.
Output voltage	V_O	Indicates voltage range within which damage or reduced reliability will not result when power is applied to an output pin.
Output current	I_O	Indicates absolute tolerance values for DC current to prevent damage or reduced reliability when current flows out of or into output pin.
Operating ambient temperature	T_A	Indicates the ambient temperature range for normal logic operations.
Storage temperature	T_{stg}	Indicates the element temperature range within which damage or reduced reliability will not result while no voltage or current is applied to the device.

Terms Used in Recommended Operating Range

Parameter	Symbol	Meaning
Power supply voltage	V_{DD}, AV_{DD33}	Indicates the voltage range for normal logic operations occur when V_{SS} = 0 V.
High-level input voltage	V_{IH}	Indicates the voltage, which is applied to the input pins of the device, is the voltage indicates that the high level states for normal operation of the input buffer. * If a voltage that is equal to or greater than the “Min.” value is applied, the input voltage is guaranteed as high level voltage.
Low-level input voltage	V_{IL}	Indicates the voltage, which is applied to the input pins of the device, is the voltage indicates that the low level states for normal operation of the input buffer. * If a voltage that is equal to or lesser than the “Max.” value is applied, the input voltage is guaranteed as low level voltage.
Hysteresis voltage	V_H	Indicates the differential between the positive and the negative trigger voltage.
Input rise time	t_{ri}	Indicates allowable input rise time to input signal transition time from 0.1 x V_{DD} to 0.9 x V_{DD}.
Input fall time	t_{fi}	Indicates allowable input fall time to input signal transition time from 0.9 x V_{DD} to 0.1 x V_{DD}.

Terms Used in DC Characteristics

Parameter	Symbol	Meaning
Off-state output leakage current	I_{OZ}	Indicates the current that flows from the power supply pins when the rated power supply voltage is applied when a 3-state output has high impedance.
Input leakage current	I_I	Indicates the current that flows when the input voltage is supplied to the input pin.
Low-level output current	I_{OL}	Indicates the current that flows to the output pins when the rated low-level output voltage is being applied.
High-level output current	I_{OH}	Indicates the current that flows from the output pins when the rated high-level output voltage is being applied.

3.3 Electrical Specifications

Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	V_{DD}, AV_{DD33}		–0.5 to +4.6	V
	V_{DD15}, AV_{DD15}		–0.5 to +2.0	V
Input voltage, 3.3 V buffer	V_I	$V_I < V_{DD} + 0.5$ V	–0.5 to +4.6	V
Output voltage, 3.3 V buffer	V_O	$V_O < V_{DD} + 0.5$ V	–0.5 to +4.6	V
Output current	I_O	3.3 V buffer (I_{OL} = 9 mA)	29	mA
		PCI buffer	58	mA
Operating ambient temperature	T_A		–20 to +70	°C
Storage temperature	T_{stg}		–40 to +125	°C

Caution Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameters. 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 ratings and conditions indicated for DC characteristics and AC characteristics represent the quality assurance range during normal operation.

Recommended Operating Ranges

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating voltage	V_{DD}, AV_{DD33}		3.135	3.3	3.465	V
High-level input voltage	V_{IH}					
3.3 V high-level input voltage		VBBRST0, VCCRST0	2.4		V_{DD}	V
		Other input pins	2.0		V_{DD}	V
Low-level input voltage	V_{IL}					
3.3 V low-level input voltage		VBBRST0, VCCRST0	0		0.6	V
		Other input pins	0		0.8	V
Hysteresis voltage	V_H					
3.3 V hysteresis voltage			0.3		1.5	V
Input rise time	t_{ri}					
Normal buffer			0		200	ns
Schmitt buffer			0		10	ms
Input fall time	t_{fi}					
Normal buffer			0		200	ns
Schmitt buffer			0		10	ms

DC Characteristics (V_{DD} = 3.135 to 3.465 V, T_A = –20 to +70°C)

Control pin block

Parameter	Symbol	Condition	Min.	Max.	Unit
Off-state output current	I_{OZ}	$V_O = V_{DD}$ or V_{SS}		±10	μA
Low-level output current 3.3 V low-level output current (9 mA)	I_{OL}	V_{OL} = 0.4 V	9.0		mA
High-level output current 3.3 V high-level output current (9 mA)	I_{OH}	V_{OH} = 2.4 V	–9.0		mA
Input leakage current 3.3 V buffer 3.3 V buffer with pull down resistor	I_I	$V_I = V_{DD}$ or V_{SS} $V_I = V_{DD}$		±10 175	μA μA

PCI interface block

Parameter	Symbol	Condition	Min.	Max.	Unit
High-level input voltage	V_{IH}		$0.5V_{DD}$	V_{DD}+0.5	V
Low-level input voltage	V_{IL}		–0.5	$0.3V_{DD}$	V
Low-level output current	I_{OL}	$V_{OL} = 0.1V_{DD}$	1.5		mA
High-level output current	I_{OH}	$V_{OH} = 0.9V_{DD}$	–0.5		mA
Input leakage current	I_{il}	$0 < V_{IN} < V_{DD}$		±10	μA
PME0 leakage current	I_{OFF}	V_O < 3.6 V V_{DD} off or floating		1	μA

USB interface block

Parameter	Symbol	Conditions	Min.	Max.	Unit
Output pin impedance	Z_{HSDRV}		40.5	49.5	Ω
Input Levels for Low-/full-speed:					
High-level input voltage (drive)	V_{IH}		2.0		V
High-level input voltage (floating)	V_{IHZ}		2.7	3.6	V
Low-level input voltage	V_{IL}			0.8	V
Differential input sensitivity	V_{DI}	$\lvert(D+) - (D-)\rvert$	0.2		V
Differential common mode range	V_{CM}	Includes V_{DI} range	0.8	2.5	V
Output Levels for Low-/full-speed:					
High-level output voltage	V_{OH}	R_L of 14.25 kΩ to GND	2.8	3.6	V
Low-level output voltage	V_{OL}	R_L of 1.425 kΩ to 3.6 V	0.0	0.3	V
SE1	V_{OSE1}		0.8		V
Output signal crossover point voltage	V_{CRS}		1.3	2.0	V
Input Levels for High-speed:					
High-speed squelch detection threshold (differential signal)	V_{HSSQ}		100	150	mV
High-speed disconnect detection threshold (differential signal)	V_{HSDSC}		525	625	mV
High-speed data signaling common mode voltage range	V_{HSCM}		−50	+500	mV
High-speed differential input signaling level	See **Figure 3–2**.				
Output Levels for High-speed:					
High-speed idle state	V_{HSOI}		−10	+10	mV
High-speed data signaling high	V_{HSOH}		360	440	mV
High-speed data signaling low	V_{HSOL}		−10	+10	mV
Chirp J level (differential signal)	V_{CHIRPJ}		700	1100	mV
Chirp K level (differential signal)	V_{CHIRPK}		−900	−500	mV

Figure 3–1. Differential Input Sensitivity Range for Low-/full-speed

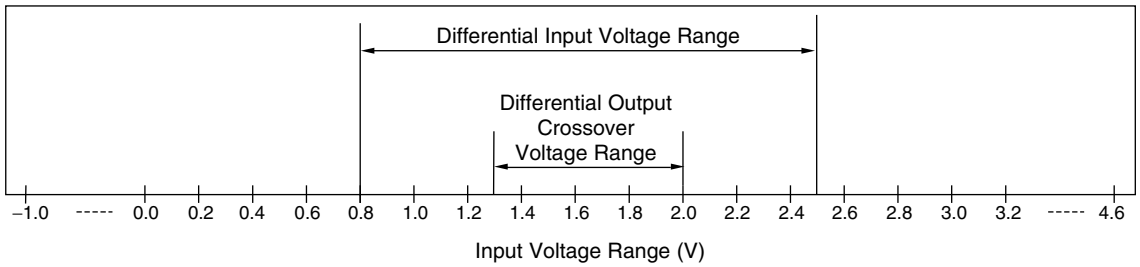


Figure 3–2. Receiver Sensitivity for Transceiver at DP/DM

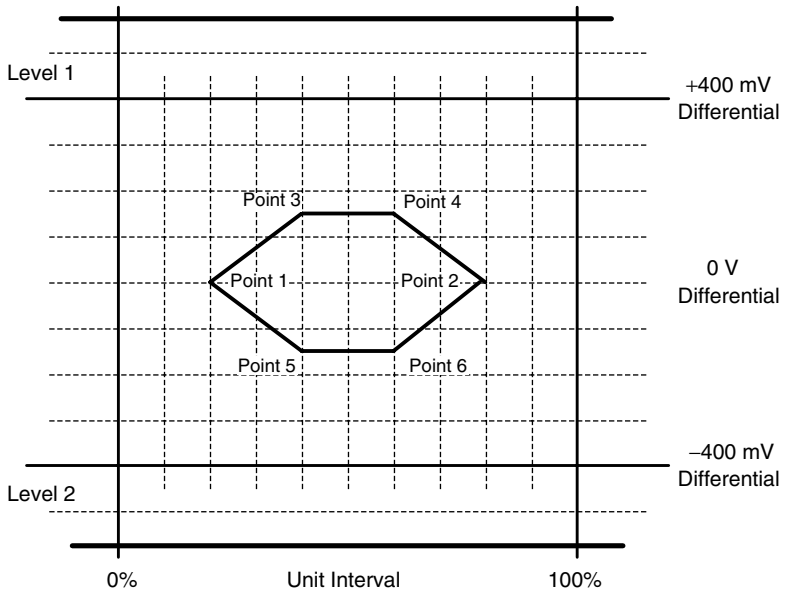
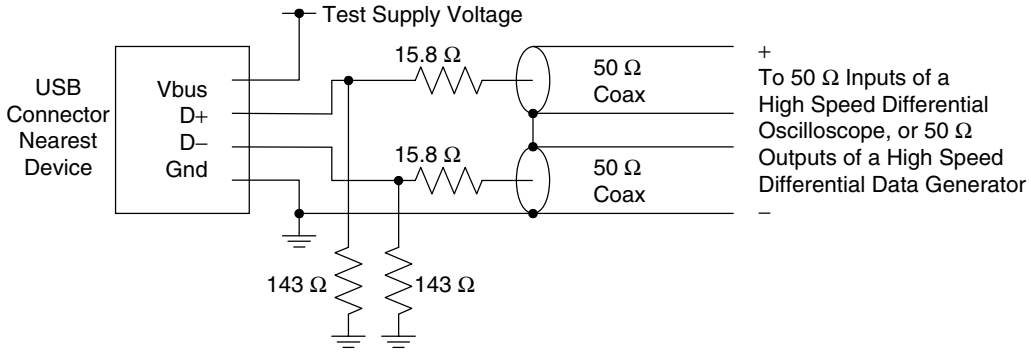


Figure 3–3. Receiver Measurement Fixtures



Power consumption

Parameter	Symbol	Condition	With 30 MHz Crystal		With 48 MHz Oscillator		Unit
			Typ.	Max.	Typ.	Max.	
Power Consumption	P_{WD0-0}	Device state = D0, All the ports does not connect to any function, and each OHCI controller is under USB suspend and EHCI controller is stopped. Note 1	11.0	16.0	3.0	7.0	mA
	P_{WD0-1}	The power consumption under the state without suspend. Device state = D0, The number of active ports is 1. Note 2					
		Full- or low-speed device is on the port.	15.6	22.6	7.7	13.5	mA
		High-speed device is on the port.	60.3	70.8	60.7	71.3	mA
	P_{WD0-2}	The power consumption under the state without suspend. Device state = D0, The number of active ports is 2. Note 2					
		Full- or low-speed devices are on the port.	17.4	31.6	9.5	22.4	mA
		High-speed devices are on the port.	96.1	111.8	96.6	112.4	mA
	P_{WD0-3}	The power consumption under the state without suspend. Device state = D0, The number of active ports is 3. Note 2					
		Full- or low-speed devices are on the port.	18.8	40.0	10.8	31.5	mA
		High-speed devices are on the port.	130.7	151.8	131.2	152.2	mA
	P_{WD0_C}	The power consumption under suspend state during PCI clock is stopped by CRUN0. Device state = D0.	11.0	16.0	3.0	7.0	mA
	P_{WD1}	Device state = D1, Analog PLL output is stopped. Note 3	2.1	5.9	3.0	7.0	mA
	P_{WD2}	Device state = D2, Analog PLL output is stopped. Note 3	2.1	5.9	3.0	7.0	mA
	P_{WD3H}	Device state = $D3_{hot}$, VCCRST0 = High, Analog PLL output is stopped. Note 3	2.1	5.9	3.0	7.0	mA
	P_{WD3C}	Device state = $D3_{cold}$, VCCRST0 = Low. Note 4	0.03	3.0	1.38	5.2	mA

Notes 1. When any device is not connected to all the ports of HC, the power consumption for HC does not depend on the number of active ports.

2. The number of active ports is set by the value of Port No Field in PCI configuration space EXT register.

3. This is the case when PCI bus state is B0.

4. This is the case when PCI bus state is B3.

Remark These are estimated value on Windows™ XP environment.

Pin capacitance

Parameter	Symbol	Condition	Min.	Max.	Unit
Input capacitance	C_I	V_{DD} = 0 V, T_A = 25°C		8	pF
Output capacitance	C_O	f_C = 1 MHz		8	pF
I/O capacitance	C_{IO}	Unmeasured pins returned to 0 V		8	pF
PCI input pin capacitance	C_{in}			8	pF
PCI clock input pin capacitance	C_{clk}			8	pF
PCI IDSEL input pin capacitance	C_{IDSEL}			8	pF

AC Characteristics (V_{DD} = 3.135 to 3.465 V, T_A = –20 to +70°C)

System clock ratings

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Clock frequency	f_{CLK}	Crystal	–500 ppm	30	+500 ppm	MHz
		Oscillator block	–500 ppm	48	+500 ppm	MHz
Clock duty cycle	t_{DUTY}		40	50	60	%

Remarks 1. Recommended accuracy of clock frequency is ± 100 ppm.

2. Required accuracy of crystal or oscillator block is including initial frequency accuracy, the spread of crystal capacitor loading, supply voltage, temperature, and aging, etc.

PCI interface block

	Parameter	Symbol	Condition	Min.	Max.	Unit
<R>	PCI clock cycle time	t_{cyc}		30	33	ns
	PCI clock pulse, high-level width	t_{high}		11		ns
	PCI clock pulse, low-level width	t_{low}		11		ns
	PCI clock, rise slew rate	S_{cr}	0.2V_{DD} to 0.6V_{DD}	1	4	V/ns
	PCI clock, fall slew rate	S_{cf}	0.2V_{DD} to 0.6V_{DD}	1	4	V/ns
	PCI reset active time (vs. power supply stability)	t_{rst}		1		ms
	PCI reset active time (vs. CLK start)	$t_{rst-clk}$		100		μs
	Output float delay time (vs. RST0↓)	$t_{rst-off}$			40	ns
	PCI reset rise slew rate	S_{rr}		50		mV/ns
	PCI bus signal output time (vs. PCLK↑)	t_{val}		2	11	ns
	PCI point-to-point signal output time (vs. PCLK↑)	t_{val} (ptp)	REQ0	2	12	ns
	Output delay time (vs. PCLK↑)	t_{on}		2		ns
	Output float delay time (vs. PCLK↑)	t_{off}			28	ns
	Input setup time (vs. PCLK↑)	t_{su}		7		ns
	Point-to-point input setup time (vs. PCLK↑)	t_{su} (ptp)	GNT0	10		ns
	Input hold time	t_h		0		ns

USB interface block

(1/2)

Parameter	Symbol	Conditions	Min.	Max.	Unit
Low-speed Source Electrical Characteristics					
Rise time (10 to 90%)	t_{LR}	C_L = 200 to 600 pF, R_S = 36 Ω	75	300	ns
Fall time (90 to 10%)	t_{LF}	C_L = 200 to 600 pF, R_S = 36 Ω	75	300	ns
Differential rise and fall time matching	t_{LRFM}	(t_{LR}/t_{LF})	80	125	%
Low-speed data rate	$t_{LDRATHS}$	Average bit rate	1.49925	1.50075	Mbps
Source jitter total (including frequency tolerance):					
To next transition	t_{DDJ1}		−25	+25	ns
For paired transitions	t_{DDJ2}		−14	+14	ns
Source jitter for differential transition to SE0 transition	t_{LDEOP}		−40	+100	ns
Receiver jitter:					
To next transition	t_{UJR1}		−152	+152	ns
For paired transitions	t_{UJR2}		−200	+200	ns
Source SE0 interval of EOP	t_{LEOPT}		1.25	1.50	μs
Receiver SE0 interval of EOP	t_{LEOPR}		670		ns
Width of SE0 interval during differential transition	t_{FST}			210	ns
Full-speed Source Electrical Characteristics					
Rise time (10 to 90%)	t_{FR}	C_L = 50 pF	4	20	ns
Fall time (90 to 10%)	t_{FF}	C_L = 50 pF	4	20	ns
Differential rise and fall time matching	t_{FRFM}	(t_{FR}/t_{FF})	90	111.11	%
Full-speed data rate	$t_{FDRATHS}$	Average bit rate	11.9940	12.0060	Mbps
Frame interval	t_{FRAME}		0.9995	1.0005	ms
Consecutive frame interval jitter	t_{RFI}	No clock adjustment		42	ns
Source jitter total (including frequency tolerance):					
To next transition	t_{DJ1}		−3.5	+3.5	ns
For paired transitions	t_{DJ2}		−4.0	+4.0	ns
Source jitter for differential transition to SE0 transition	t_{FDEOP}		−2	+5	ns
Receiver jitter:					
To next transition	t_{JR1}		−18.5	+18.5	ns
For paired transitions	t_{JR2}		−9	+9	ns
Source SE0 interval of EOP	t_{FEOPT}		160	175	ns
Receiver SE0 interval of EOP	t_{FEOPR}		82		ns
Width of SE0 interval during differential transition	t_{FST}			14	ns

(2/2)

Parameter	Symbol	Conditions	Min.	Max.	Unit
High-speed Source Electrical Characteristics					
Rise time (10 to 90%)	t_{HSR}		500		ps
Fall time (90 to 10%)	t_{HSF}		500		ps
Driver waveform	See **Figure 3–4**.				
High-speed data rate	t_{HSDRAT}		479.760	480.240	Mbps
Microframe interval	t_{HSFRAM}		124.9375	125.0625	μs
Consecutive microframe interval difference	t_{HSRFI}			4 high-speed	Bit times
Data source jitter	See **Figure 3–4**.				
Receiver jitter tolerance	See **Figure 3–2**.				
Hub Event Timings					
Time to detect a downstream facing port connect event	t_{DCNN}		2.5	2000	μs
Time to detect a disconnect event at a hub's downstream facing port	t_{DDIS}		2.0	2.5	μs
Duration of driving resume to a downstream port	t_{DRSMDN}	Nominal	20		ms
Time from detecting downstream resume to rebroadcast	t_{URSM}			1.0	ms
Inter-packet delay for packets traveling in same direction for high-speed	$t_{HSIPDSD}$		88		Bit times
Inter-packet delay for packets traveling in opposite direction for high-speed	$t_{HSIPDOD}$		8		Bit times
Inter-packet delay for root hub response for high-speed	$t_{HSRSPIPD1}$			192	Bit times
Time for which a Chirp J or Chirp K must be continuously detected during reset handshake	t_{FILT}		2.5		μs
Time after end of device Chirp K by which hub must start driving first Chirp K	t_{WTDCH}			100	μs
Time for which each individual Chirp J or Chirp K in the chirp sequence is driven downstream during reset	t_{DCHBIT}		40	60	μs
Time before end of reset by which a hub must end its downstream chirp sequence	t_{DCHSE0}		100	500	μs

Figure 3–4. Transmit Waveform for Transceiver at DP/DM

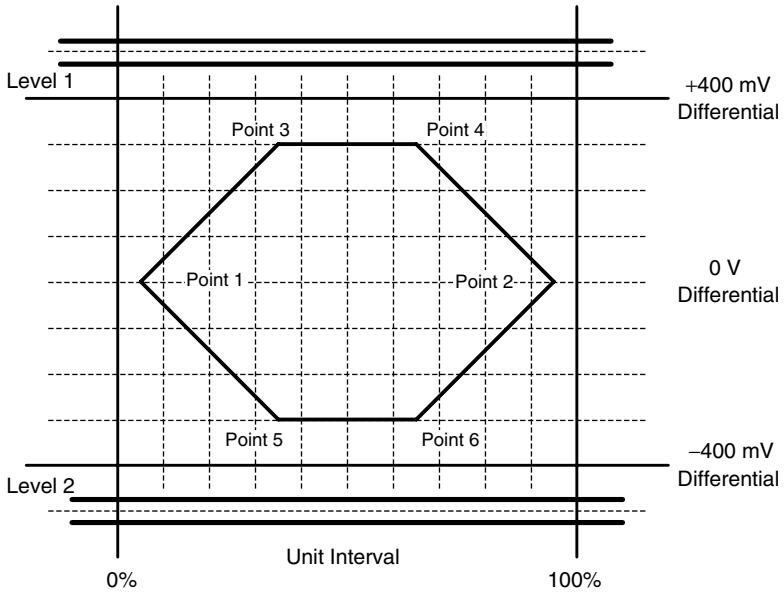
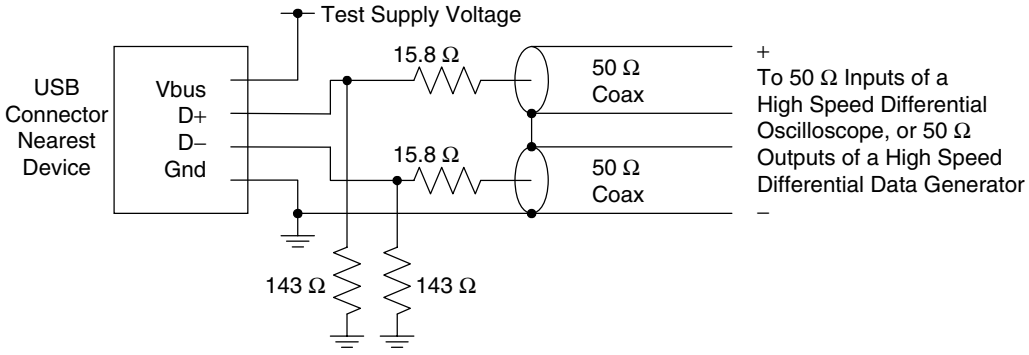
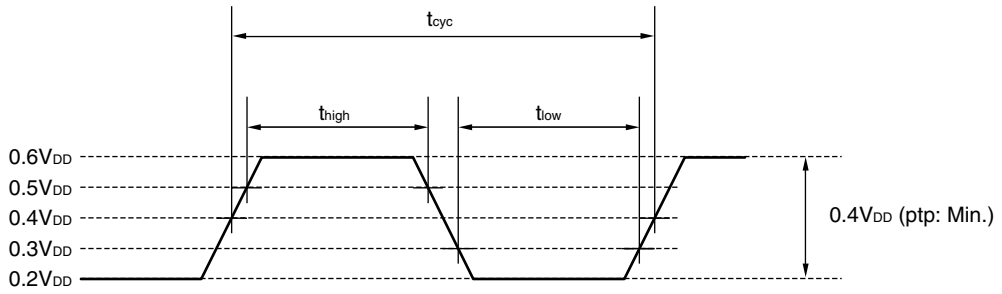


Figure 3–5. Transmitter Measurement Fixtures

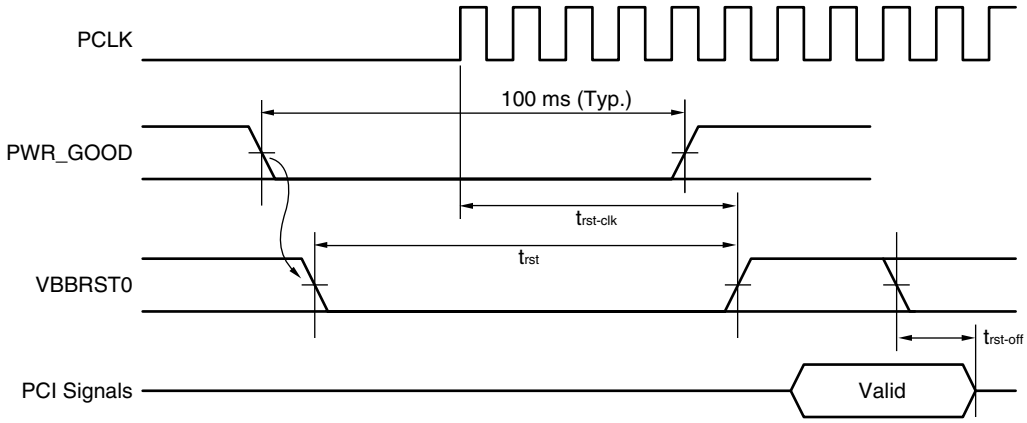


3.4 Timing Diagram

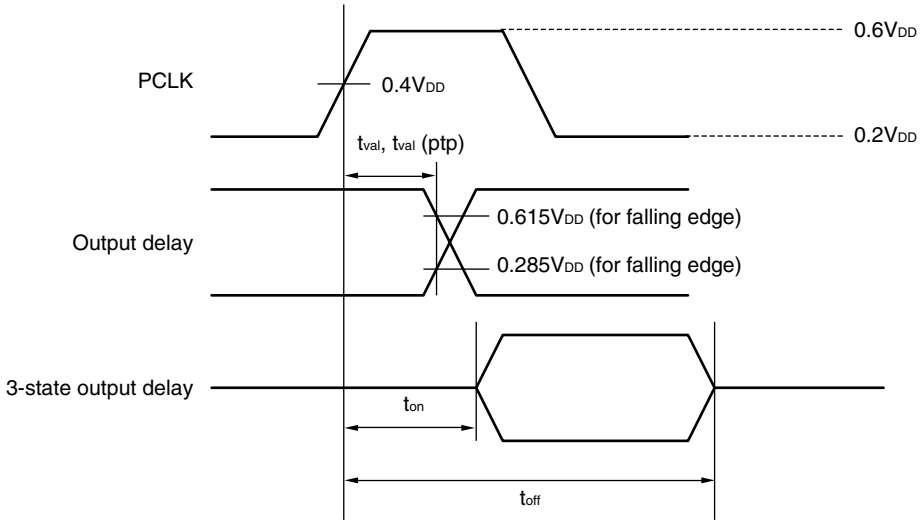
PCI clock



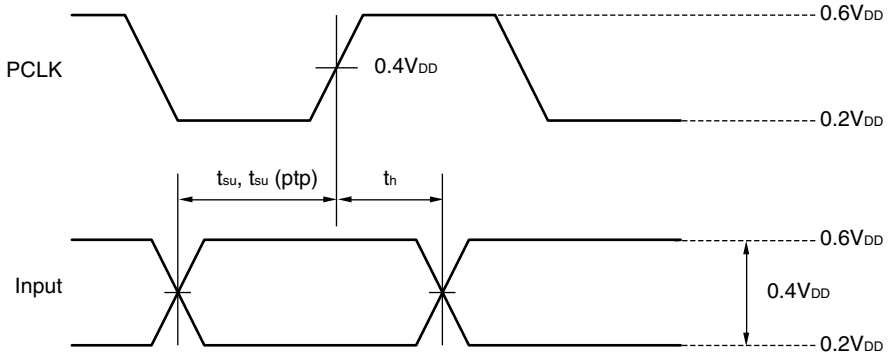
PCI reset



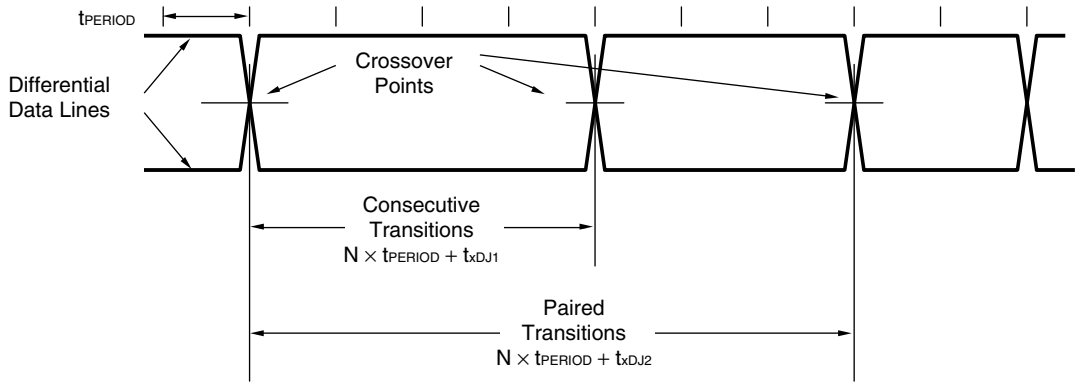
PCI output timing measurement condition



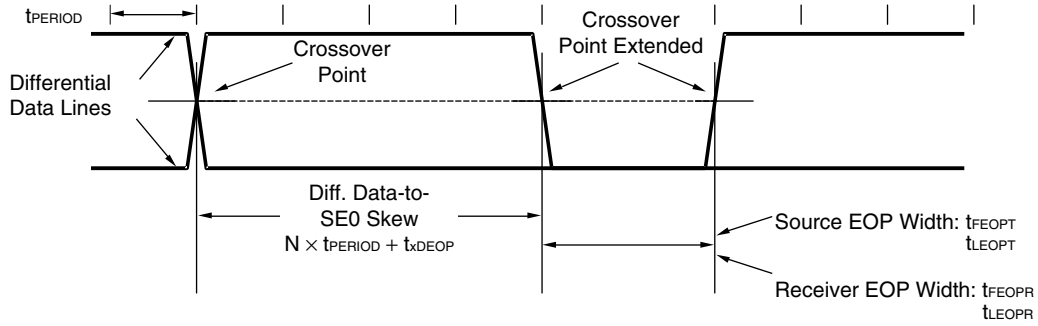
PCI input timing measurement condition



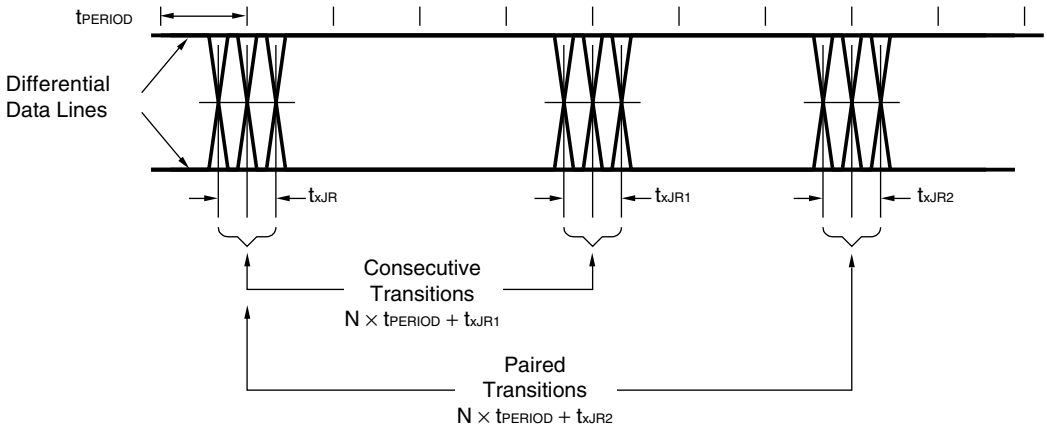
USB differential data jitter for full-speed



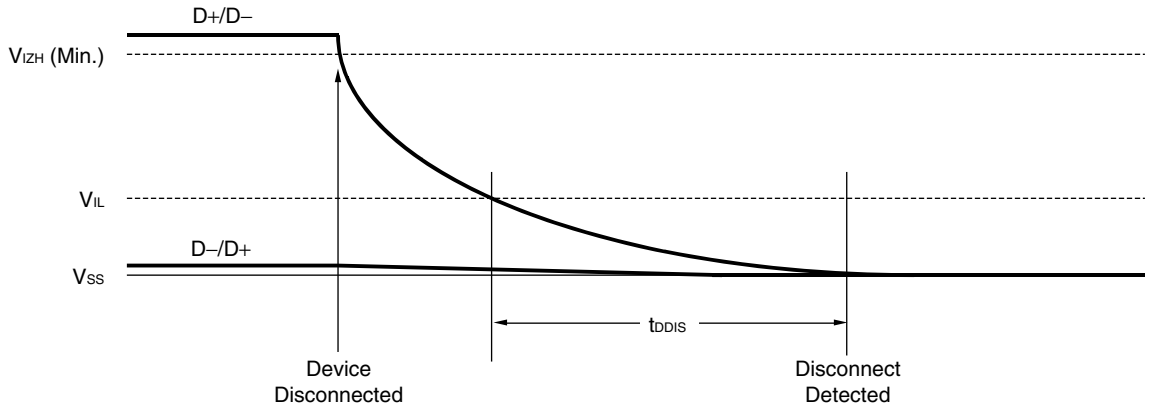
USB differential-to-EOP transition skew and EOP width for low-/full-speed



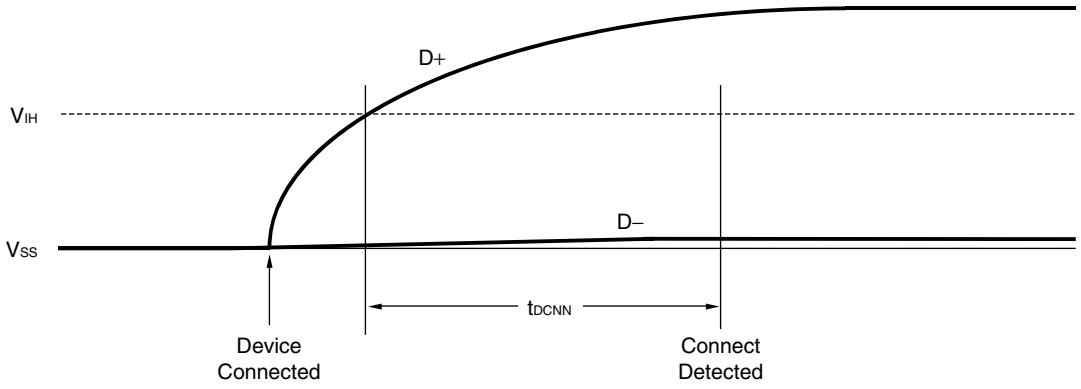
USB receiver jitter tolerance for low-/full-speed



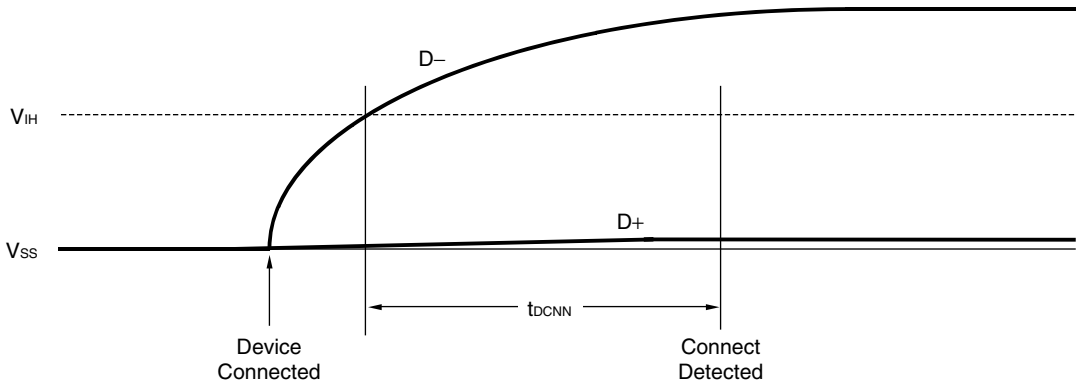
Low-/full-speed disconnect detection



Full-/high-speed device connect detection



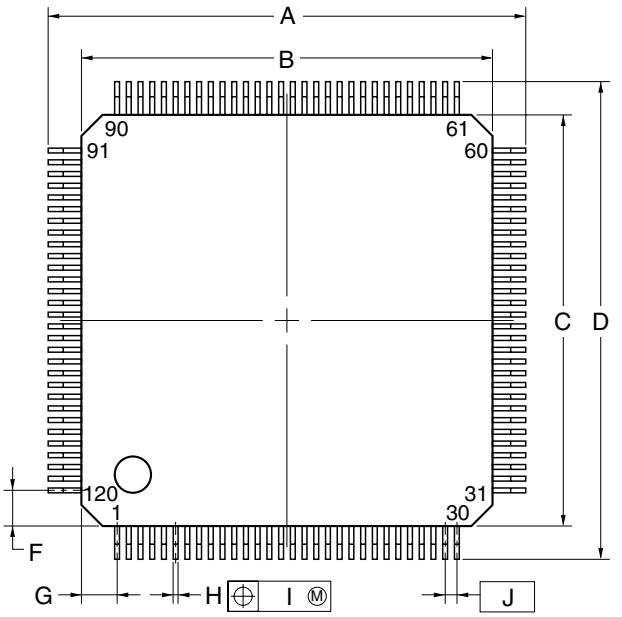
Low-speed device connect detection

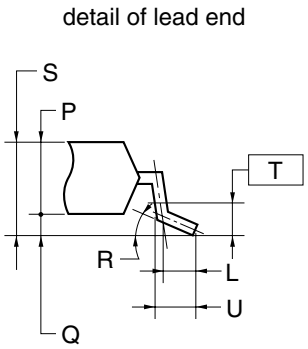


4. PACKAGE DRAWINGS

• μPD720102GC-YEB-A

120-PIN PLASTIC TQFP (FINE PITCH) (14x14)





NOTE

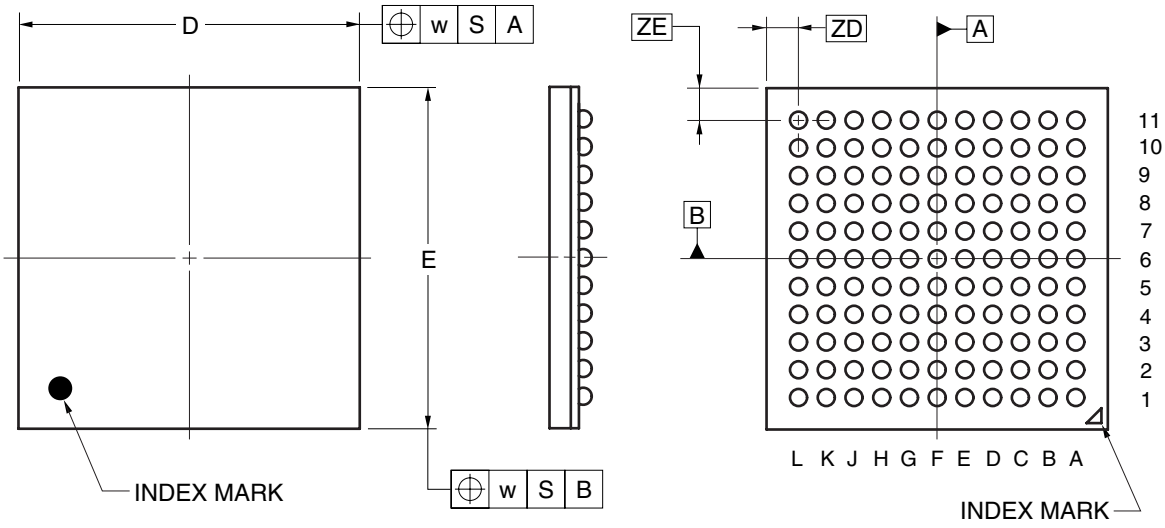
Each lead centerline is located within 0.07 mm of its true position (T.P.) at maximum material condition.

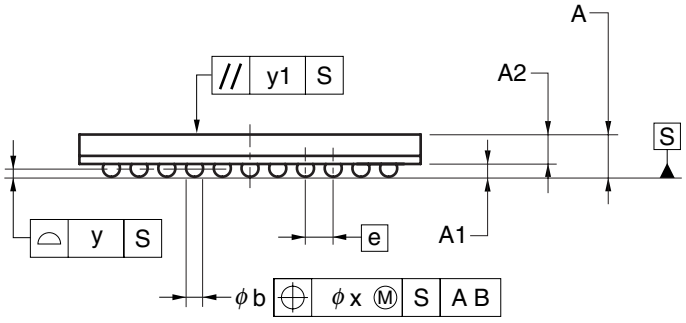
ITEM	MILLIMETERS
A	16.00±0.20
B	14.00±0.20
C	14.00±0.20
D	16.00±0.20
F	1.20
G	1.20
H	0.18±0.05
I	0.07
J	0.40 (T.P.)
K	1.00±0.20
L	0.50
M	$0.17^{+0.03}_{-0.07}$
N	0.08
P	1.00±0.05
Q	0.10±0.05
R	$3^{\circ}{}^{+4^{\circ}}_{-3^{\circ}}$
S	1.20MAX.
T	0.25
U	0.60±0.15

P120GC-40-YEB-1

<R> • μPD720102F1-CA7-A

121-PIN PLASTIC FBGA (8x8)





(UNIT:mm)

ITEM	DIMENSIONS
D	8.00±0.10
E	8.00±0.10
w	0.20
A	0.99±0.10
A1	0.30±0.05
A2	0.69
e	0.65
b	0.40±0.05
x	0.08
y	0.10
y1	0.20
ZD	0.75
ZE	0.75

P121F1-65-CA7

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5. RECOMMENDED SOLDERING CONDITIONS

The μPD720102 should be soldered and mounted under the following recommended conditions.

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

For technical information, see the following website.

Semiconductor Device Mount Manual (http://www.necel.com/pkg/en/mount/index.html)

• μPD720102GC-YEB-A: 120-pin plastic TQFP (Fine pitch) (14 × 14)

Soldering Method	Soldering Conditions	Symbol
Infrared reflow	Peak package's surface temperature: 260 °C, Reflow time: 60 seconds or less (220 °C or higher), Maximum allowable number of reflow processes: 3, Exposure limit [Note]: 7 days (10 to 72 hours pre-backing is required at 125C° afterwards), Flux: Rosin flux with low chlorine (0.2 Wt% or below) recommended. <Caution> Non-heat-resistant trays, such as magazine and taping trays, cannot be baked before unpacking.	IR60-107-3
Partial heating method	Pin temperature: 350°C or below, Heat time: 3 seconds or less (per each side of the device) , Flux: Rosin flux with low chlorine (0.2 Wt% or below) recommended.	–

Note The Maximum number of days during which the product can be stored at a temperature of 5 to 25°C and a relative humidity of 20 to 65% after dry-pack package is opened.

<R> • μPD720102F1-CA7-A: 121-pin plastic FBGA (8 × 8)

Soldering Method	Soldering Conditions	Symbol
Infrared reflow	Peak package's surface temperature: 260 °C, Reflow time: 60 seconds or less (220 °C or higher), Maximum allowable number of reflow processes: 3, Exposure limit [Note]: 7 days (10 to 72 hours pre-backing is required at 125C° afterwards), Flux: Rosin flux with low chlorine (0.2 Wt% or below) recommended. <Caution> Non-heat-resistant trays, such as magazine and taping trays, cannot be baked before unpacking.	IR60-107-3

Note The Maximum number of days during which the product can be stored at a temperature of 5 to 25°C and a relative humidity of 20 to 65% after dry-pack package is opened.

[MEMO]

[MEMO]

NOTES FOR CMOS DEVICES

① VOLTAGE APPLICATION WAVEFORM AT INPUT PIN

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (MAX) and V_{IH} (MIN) due to noise, etc., the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (MAX) and V_{IH} (MIN).

② HANDLING OF UNUSED INPUT PINS

Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

③ PRECAUTION AGAINST ESD

A 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 when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that easily build up 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 benches and floors should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

④ STATUS BEFORE INITIALIZATION

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

⑤ POWER ON/OFF SEQUENCE

In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current.

The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

⑥ INPUT OF SIGNAL DURING POWER OFF STATE

Do not input signals or an I/O pull-up power supply while the device is not powered. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements.

Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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