

**Phase-out/Discontinued**

## IEEE1394 OHCI HOST CONTROLLER

The μPD72862 is IEEE1394 OHCI-Link controller. The μPD72862 complies with the P1394a draft 2.0 specifications and works up to 400 Mbps.

It supports both of the Cardbus interface and the PCI bus interface.

### FEATURES

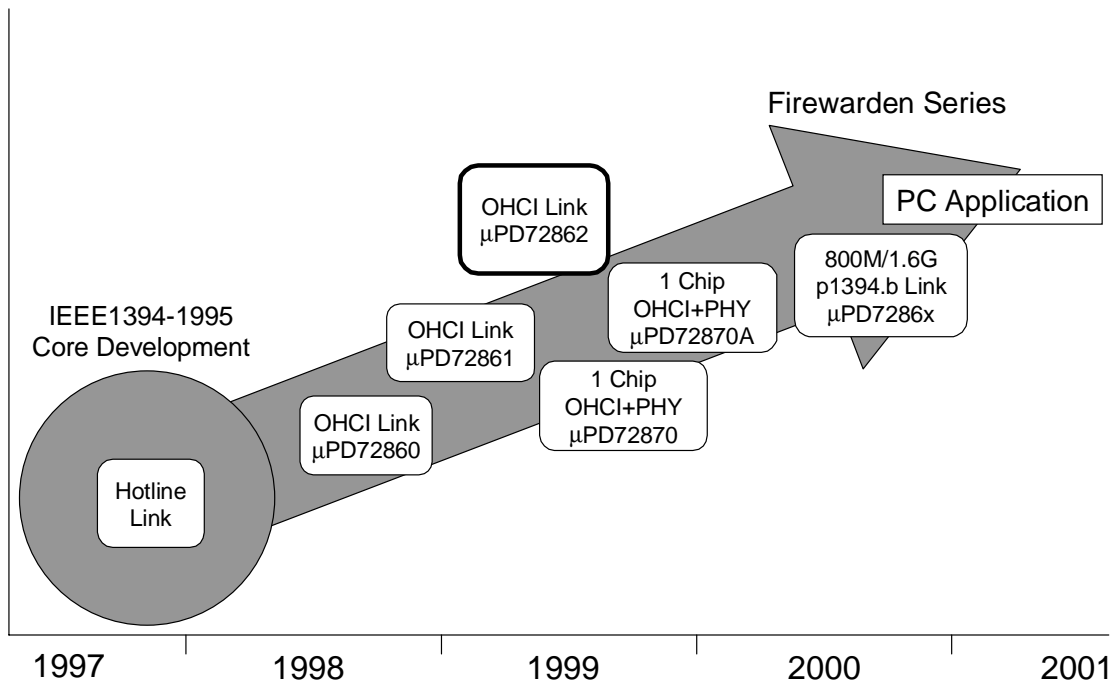
- Compliant with Link Layer Services as defined in 1394 Open Host Controller Interface specification release 1.0
- Compliant with protocol enhancement as defined in P1394a draft 2.0
- Modular 32-bit host interface compliant to PCI Specification release 2.1
- Supports PCI-Bus Power Management Interface Specification release 1.0
- Supports Cardbus
- Equipped CIS register
- Cycle Master and Isochronous Resource Manager capable
- Compatible to PHY Layer implementation of 100/200/400 Mbps via 2/4/8-bit data interface
- Built-in FIFOs for isochronous transmit (1024 bytes), asynchronous transmit (1024 bytes), and receive (2048 bytes)
- 32-bit CRC generation and checking for receive/transmit packets
- 4-isochronous transmit DMAs and 4-isochronous receive DMAs supported
- Support both IEEE1394-1995 compliant PHY and P1394a compliant PHY
- Internal control and operational registers direct-mapped to PCI configuration space
- 2-wire Serial EEPROM™ interface supported

### ORDERING INFORMATION

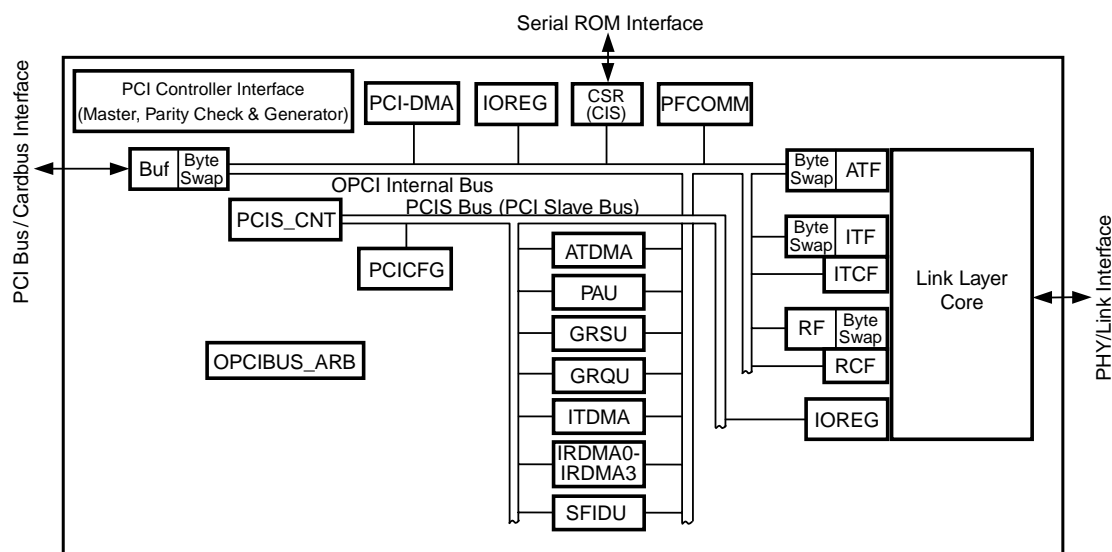
Part number	Package
μPD72862GC-9EU	100-pin plastic TQFP (Fine pitch) (14 x 14)

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

Firewarden™ ROADMAP



**BLOCK DIAGRAM**

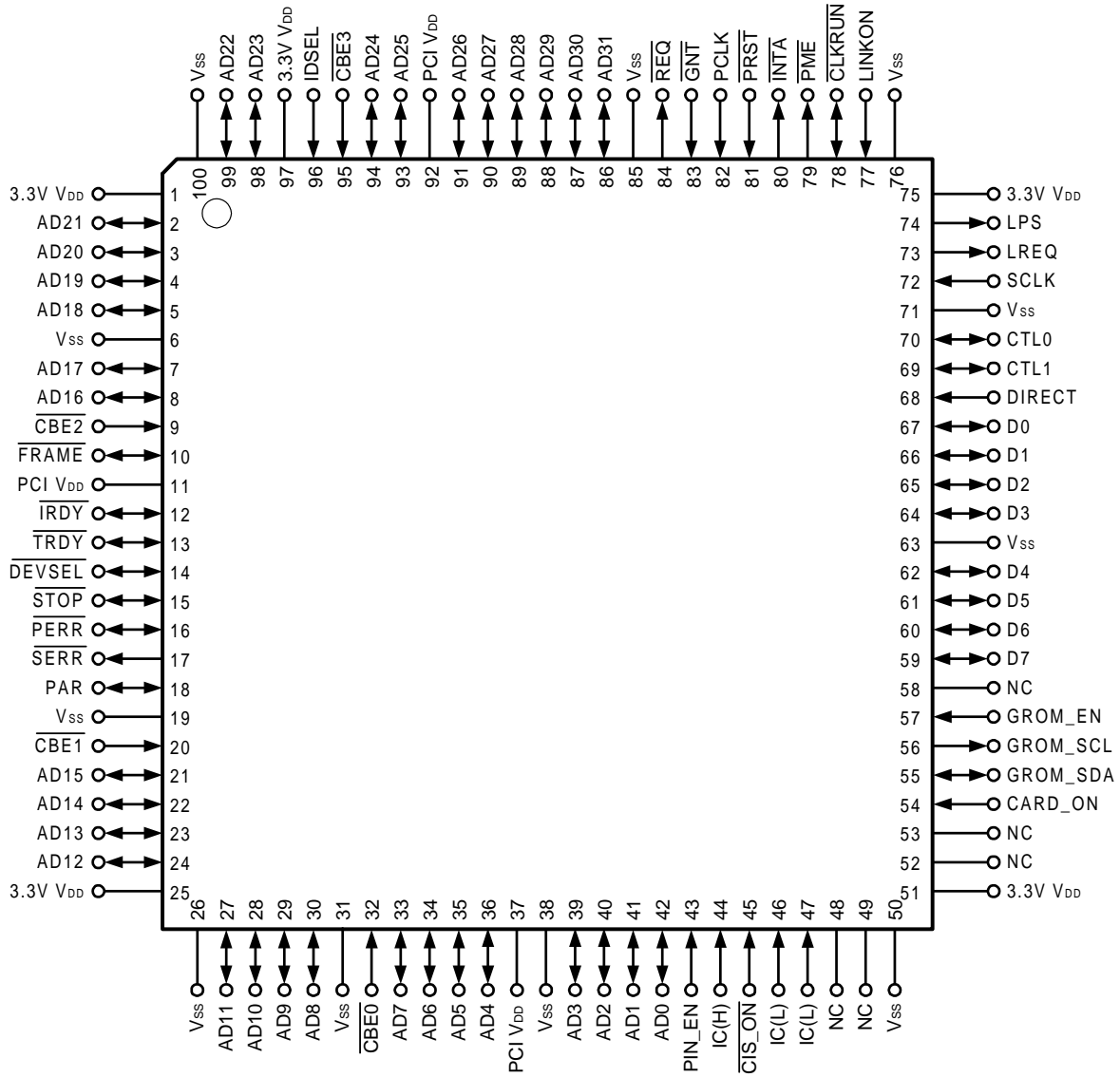


- ATDMA : Asynchronous Transmit DMA
- ATF : Asynchronous Transmit FIFO
- CIS : CIS Register
- CSR : Control and Status Registers
- IOREG : IO Registers
- IRDMA : Isochronous Receive DMA
- ITCF : Isochronous Transmit Control FIFO
- ITDMA : Isochronous Transmit DMA
- ITF : Isochronous Transmit FIFO
- OPCIBUS\_ARB : OPCI Internal Bus Arbitration
- PAU : Physical Response and Request Unit
- PCICFG : PCI Configuration Registers
- PCIS\_CNT : PHY Control Isochronous Control
- PFCOMM : Pre Fetch Command FIFO
- RCF : Receive Control FIFO
- RF : Receive FIFO
- SFIDU : Self-ID DMA

**PIN CONFIGURATION (Top View)**

Though the current implementation of the μPD72862 includes signal pins for debugging and testing purpose, the package remains a cost efficient 100-pin TQFP package.

- 100-pin plastic TQFP (Fine pitch) (14 x 14)



## PIN NAME

AD0-AD31	: PCI Multiplexed Address and Data
CARD_ON	: PCI/Card Select
$\overline{\text{CBE0-CBE3}}$	: Command/Byte Enables
$\overline{\text{CIS\_ON}}$	: CIS Register ON
CLKRUN	: PCICLK Running
CTL0, CTL1	: PHY/Link Bi-directional Control
$\overline{\text{DEVSEL}}$	: Device Select
DIRECT	: Auxiliary PHY/Link Signal
D0-D7	: PHY/Link Bi-directional Data
$\overline{\text{FRAME}}$	: Cycle Frame
$\overline{\text{GNT}}$	: Bus_master Grant
GROM_EN	: Serial EEPROM Enable
GROM_SCL	: Serial EEPROM Clock Output
GROM_SDA	: Serial EEPROM Data Input / Output
IC (H)	: Internally Connected (High Clamped)
IC (L)	: Internally Connected (Low Clamped)
IDSEL	: ID Select
$\overline{\text{INTA}}$	: Interrupt
$\overline{\text{IRDY}}$	: Initiator Ready
LINKON	: Link-On Request
LPS	: Link Power Status
LREQ	: PHY/Link Request
NC	: Non-Connection
PAR	: Parity
PCLK	: PCI Clock
$\overline{\text{PERR}}$	: Parity Error
PIN_EN	: Pin Enable Input
$\overline{\text{PME}}$	: PME Output
$\overline{\text{PRST}}$	: Reset
$\overline{\text{REQ}}$	: Bus_master Request
SCLK	: PHY Clock
$\overline{\text{SERR}}$	: System Error
$\overline{\text{STOP}}$	: PCI Stop
$\overline{\text{TRDY}}$	: Target Ready
V <sub>DD</sub>	: Supply Voltage
V <sub>SS</sub>	: Ground

## CONTENTS

<b>1. PIN FUNCTIONS</b> .....	<b>8</b>
1.1 PCI Bus Interface Signals: (52 pins) .....	8
1.2 PCI/Cardbus Select Signals: (2 pins) .....	9
1.3 PHY/Link Interface Signals: (15 pins) .....	10
1.4 Serial ROM Interface Signals: (3 pins) .....	10
1.5 Miscellaneous Signal: (1 pin) .....	10
1.6 IC: (3 pins) .....	10
1.7 NC: (5 pins) .....	10
1.8 V <sub>DD</sub> : (8 pins) .....	10
1.9 V <sub>SS</sub> : (11 pins) .....	10
<b>2. REGISTER DESCRIPTIONS</b> .....	<b>11</b>
<b>2.1 PCI Bus Mode Configuration Register ( CARD_ON=Low )</b> .....	<b>11</b>
2.1.1 Offset_00 VendorID Register .....	12
2.1.2 Offset_02 DeviceID Register .....	12
2.1.3 Offset_04 Command Register .....	12
2.1.4 Offset_06 Status Register .....	13
2.1.5 Offset_08 Revision ID Register .....	14
2.1.6 Offset_09 Class Code Register .....	14
2.1.7 Offset_0C Cache Line Size Register .....	14
2.1.8 Offset_0D Latency Timer Register .....	14
2.1.9 Offset_0E Header Type Register .....	14
2.1.10 Offset_0F BIST Register .....	14
2.1.11 Offset_10 Base Address 0 Register .....	15
2.1.12 Offset_2C Subsystem Vendor ID Register .....	15
2.1.13 Offset_2E Subsystem ID Register .....	15
2.1.14 Offset_30 Expansion Rom Base Address Register .....	15
2.1.15 Offset_34 Cap_Ptr Register .....	15
2.1.16 Offset_3C Interrupt Line Register .....	16
2.1.17 Offset_3D Interrupt Pin Register .....	16
2.1.18 Offset_3E Min_Grant Register .....	16
2.1.19 Offset_3F Max Lat Register .....	16
2.1.20 Offset_40 PCI_OHCI_Control Register .....	16
2.1.21 Offset_60 Cap_ID & Next_Item_Ptr Register .....	17
2.1.22 Offset_62 Power Management Capabilities Register .....	17
2.1.23 Offset_64 Power Management Control/Status Register .....	17
<b>2.2 CardBus Mode Configuration Register ( CARD_ON=High )</b> .....	<b>18</b>
2.2.1 Offset_14/18 Base_Address_1/2 Register (CardBus Status Registers) .....	19
2.2.2 Offset_28 Cardbus CIS Pointer .....	20
2.2.3 Offset_80 CIS Area .....	20
<b>3. SERIAL ROM INTERFACE</b> .....	<b>21</b>
<b>3.1 Serial EEPROM Register</b> .....	<b>21</b>
<b>3.2 Serial EEPROM Register Description</b> .....	<b>21</b>
<b>3.3 Load Control</b> .....	<b>25</b>
<b>3.4 Programming Sequence Example</b> .....	<b>25</b>

4. ELECTRICAL SPECIFICATIONS ..... 27

5. APPLICATION CIRCUIT EXAMPLE..... 30

6. PACKAGE DRAWING ..... 31

7. RECOMMENDED SOLDERING CONDITIONS..... 32

1. PIN FUNCTIONS

1.1 PCI Bus Interface Signals: (52 pins)

(1/2)

Name	I/O	Pin No.	IoL	Volts(V)	Function
PAR	I/O	18	PCI/Cardbus	5/3.3	<b>Parity</b> is even parity across AD0-AD31 and $\overline{\text{CBE0-CBE3}}$ . It is an input when AD0-AD31 is an input; it is an output when AD0-AD31 is an output.
AD0-AD31	I/O	2-5, 7, 8, 21-24, 27-30, 33-36, 39-42, 86-91, 93, 94, 98, 99	PCI/Cardbus	5/3.3	<b>PCI Multiplexed Address and Data</b>
$\overline{\text{CBE0-CBE3}}$	I	9, 20, 32, 95	-	5/3.3	<b>Command/Byte Enables</b> are multiplexed Bus Commands & Byte enables.
$\overline{\text{FRAME}}$	I/O	10	PCI/Cardbus	5/3.3	<b>Cycle Frame</b> is asserted by the initiator to indicate the cycle beginning and is kept asserted during the burst cycle. If Cardbus mode (CARD_ON = 1), this pin is should be pulled up to V <sub>DD</sub> .
$\overline{\text{TRDY}}$	I/O	13	PCI/Cardbus	5/3.3	<b>Target Ready</b> indicates that the current data phase of the transaction is ready to be completed.
$\overline{\text{IRDY}}$	I/O	12	PCI/Cardbus	5/3.3	<b>Initiator Ready</b> indicates that the current bus master is ready to complete the current data phase. During a write, its assertion indicates that the initiator is driving valid data onto the data bus. During a read, its assertion indicates that the initiator is ready to accept data from the currently-addressed target.
$\overline{\text{REQ}}$	O	84	PCI/Cardbus	5/3.3	<b>Bus_master Request</b> indicates to the bus arbiter that this device wants to become a bus master.
$\overline{\text{GNT}}$	I	83	-	5/3.3	<b>Bus_master Grant</b> indicates to this device that access to the bus has been granted.
IDSEL	I	96	-	5/3.3	<b>ID Select</b> when actively driven, indicates that the IUHC is chip-selected for configuration read/write transaction during the phase of device initialization. If Cardbus mode (CARD_ON = 1), this pin is should be pulled up to V <sub>DD</sub> .
$\overline{\text{DEVSEL}}$	I/O	14	PCI/Cardbus	5/3.3	<b>Device Select</b> when actively driven, indicates that the driving device has decoded its address as the target of the current access.
$\overline{\text{STOP}}$	I/O	15	PCI/Cardbus	5/3.3	<b>PCI Stop</b> when actively driven, indicates that the target is requesting the current bus master to stop the transaction.

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Name	I/O	Pin No.	IoL	Volts(V)	Function
PME	O	79	PCI/Cardbus	5/3.3	<p><b>PME Output</b> for power management enable.</p> <p><b>Caution</b> The <math>\overline{\text{PME}}</math> pin is not an N-channel open drain structure pin. Therefore, when using S3, S4, S5 state in ACPI, a circuit that can separate between the power supply and the PME pin externally is needed.</p> <p><b>ACPI: Advanced Configuration and Power Interface.</b> Please refer to <b>ACPI Specification</b>.</p>
CLKRUN	I/O	78	PCI/Cardbus	5/3.3	<b>PCICLK Running</b> as input, to determine the status of PCLK; as output, to request starting or speeding up clock.
INTA	O	80	PCI/Cardbus	5/3.3	<b>Interrupt</b> the PCI interrupt request A.
PERR	I/O	16	PCI/Cardbus	5/3.3	<b>Parity Error</b> is used for reporting data parity errors during all PCI transactions, except a Special Cycle. It is an output when AD0-AD31 and PAR are both inputs. It is an input when AD0-AD31 and PAR are both outputs.
SERR	O	17	PCI/Cardbus	5/3.3	<b>System Error</b> is used for reporting address parity errors, data parity errors during the Special Cycle, or any other system error where the effect can be catastrophic. When reporting address parity errors, it is an output.
PRST	I	81	-	5/3.3	<b>Reset</b> PCI reset
PCLK	I	82	-	5/3.3	<b>PCI Clock</b> 33 MHz system bus clock.

**1.2 PCI/Cardbus Select Signals: (2 pins)**

Name	I/O	Pin No.	IoL	Volts(V)	Function																
CARD_ON	I	54	-	3.3	<b>PCI/Card Select</b> (1:Cardbus, 0:PCI bus)																
CIS_ON	I	45	-	3.3	<p><b>CIS Register ON</b></p> <table border="1"> <thead> <tr> <th>CARD_ON</th> <th><math>\overline{\text{CIS\_ON}}</math></th> <th>CIS</th> <th><math>\overline{\text{PME}}</math></th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>off</td> <td><math>\overline{\text{PME}}</math></td> </tr> <tr> <td>0</td> <td>0</td> <td>on</td> <td>CSTSCHG</td> </tr> <tr> <td>1</td> <td>X</td> <td>on</td> <td>CSTSCHG</td> </tr> </tbody> </table>	CARD_ON	$\overline{\text{CIS\_ON}}$	CIS	$\overline{\text{PME}}$	0	1	off	$\overline{\text{PME}}$	0	0	on	CSTSCHG	1	X	on	CSTSCHG
CARD_ON	$\overline{\text{CIS\_ON}}$	CIS	$\overline{\text{PME}}$																		
0	1	off	$\overline{\text{PME}}$																		
0	0	on	CSTSCHG																		
1	X	on	CSTSCHG																		

**1.3 PHY/Link Interface Signals: (15 pins)**

Name	I/O	Pin No.	IoL	Volts(V)	Function
D0-D7	I/O	59-62, 64-67	9mA	3.3	<b>PHY/Link Bi-directional Data</b> (ISO-barrier supported)
CTL0,CTL1	I/O	69, 70	9mA	3.3	<b>PHY/Link Bi-directional Control</b> (ISO-barrier supported)
LREQ	O	73	9mA	3.3	<b>PHY/Link Request</b> (ISO-barrier supported)
LINKON	I	77	-	3.3	<b>Link-On Request</b> (ISO-barrier supported)
LPS	O	74	9mA	3.3	<b>Link Power Status</b> (ISO-barrier supported)
SCLK	I	72	-	3.3	<b>PHY Clock</b> 49.152 MHz (ISO-barrier supported)
DIRECT	I	68	-	3.3	<b>Auxiliary PHY/Link Signal</b> is used to determine whether the interconnection between Link and PHY has isolation ('low': ISO-barrier; 'high': no ISO-barrier).

**1.4 Serial ROM Interface Signals: (3 pins)**

Name	I/O	Pin No.	IoL	Volts(V)	Function
GROM_SDA	I/O	55	6mA	3.3	<b>Serial EEPROM Data Input / Output</b>
GROM_SCL	O	56	6mA	3.3	<b>Serial EEPROM Clock Output</b>
GROM_EN	I	57	-	3.3	<b>Serial EEPROM Enable</b> ('high': GUID Load enabled; 'low': GUID Load disabled)

**1.5 Miscellaneous Signal: (1 pin)**

Name	I/O	Pin No.	IoL	Volts(V)	Function
PIN_EN	I	43	-	5/3.3	<b>Pin Enable Input</b> (High clamped)

**1.6 IC: (3 pins)**

Name	I/O	Pin No.	IoL	Volts(V)	Function
IC(H)	I	44	-	3.3	<b>Internally Connected</b> (High clamped)
IC(L)	I	46, 47	-	3.3	<b>Internally Connected</b> (Low clamped)

**1.7 NC: (5 pins)**

Name	I/O	Pin No.	IoL	Volts(V)	Function
NC	-	48, 49, 52, 53, 58	-	-	<b>Non- Connection</b> (Open) Leave them unconnected.

**1.8 V<sub>DD</sub>: (8 pins)**

V<sub>DD</sub> (5 V PCI or 3.3 V PCI) for PCI I/Os: 11, 37, 92

V<sub>DD</sub> 3 V for digital core & PHY/Link I/Os: 1, 25, 51, 75, 97

**1.9 V<sub>SS</sub>: (11 pins)**

V<sub>SS</sub> : 6, 19, 26, 31, 38, 50, 63, 71, 76, 85, 100

2. REGISTER DESCRIPTIONS

2.1 PCI Bus Mode Configuration Register ( CARD\_ON=Low )

31	24 23	16 15	08 07	00	
DeviceID		VendorID			00H
Status		Command			04H
Class Code			Revision ID		08H
BIST	Header Type	Latency Timer	Cache Line Size		0CH
Base Address 0 (OHCI Registers)					10H
Base Address 1					14H
Base Address 2					18H
Base Address 3					1CH
Base Address 4					20H
Base Address 5					24H
CardBus CIS Pointer					28H
Subsystem ID		Subsystem Vendor ID			2CH
Expansion Rom Base Address Register					30H
000000H			Cap_Ptr		34H
00000000H					38H
Max_Lat	Min_Gnt	Interrupt Pin	Interrupt Line		3CH
PCI_OHCI_Control					40H
00000000H					44H
00000000H					48H
00000000H					4CH
Diagnostic register0					50H
Diagnostic register1					54H
Diagnostic register2					58H
Diagnostic register3					5CH
Power Management Capabilities		Next_Item_Ptr	Cap_ID		60H
Data	PMCSR_BSE	Power Management Control/Status			64H
00000000H					68H
00000000H					6CH
User Area (GENERAL_RegisterA)					70H
User Area (GENERAL_RegisterB)					74H
User Area (GENERAL_RegisterC)					78H
User Area (GENERAL_RegisterD)					7CH
00000000H					80H FCH

**2.1.1 Offset\_00 VendorID Register**

This register identifies the manufacturer of the μPD72862. The ID is assigned by the PCI\_SIG committee.

Bits	R/W	Description
15-0	R	Constant value of 1033H.

**2.1.2 Offset\_02 DeviceID Register**

This register identifies the type of the device for the μPD72862. The ID is assigned by NEC Corporation.

Bits	R/W	Description
15-0	R	Constant value of 0063H.

**2.1.3 Offset\_04 Command Register**

The register provides control over the device's ability to generate and respond to PCI cycles.

Bits	R/W	Description
0	R	<b>I/O enable</b> Constant value of 0. The μPD72862 does not respond to PCI I/O accesses.
1	R/W	<b>Memory enable</b> Default value of 1. It defines if the μPD72862 responds to PCI memory accesses. This bit should be set to one upon power-up reset. 0: The μPD72862 does not respond to PCI memory cycles 1: The μPD72862 responds to PCI memory cycles
2	R/W	<b>Master enable</b> Default value of 1. It enables the μPD72862 as bus-master on the PCI-bus. 0: The μPD72862 cannot generate PCI accesses by being a bus-master 1: The μPD72862 is capable of acting as a bus-master
3	R	<b>Special cycle monitor enable</b> Constant value of 0. The special cycle monitor is always disabled.
4	R/W	<b>Memory write and invalidate enable</b> Default value of 0. It enables Memory Write and Invalidate Command generation. 0: Memory write must be used 1: The μPD72862, when acts as PCI master, can generate the command
5	R	<b>VGA color palette invalidate enable</b> Constant value of 0. VGA color palette invalidate is always disabled.
6	R/W	<b>Parity error response</b> Default value of 0. It defines if the μPD72862 responds to PERR. 0: Ignore parity error 1: Respond to parity error
7	R	<b>Stepping enable</b> Constant value of 0. Stepping is always disabled.
8	R/W	<b>System error enable</b> Default value of 0. It defines if the μPD72862 responds to SERR. 0: Disable system error checking 1: Enable system error checking
9	R	<b>Fast back-to-back enable</b> Constant value of 0. Fast back-to-back transactions are only allowed to the same agent.
15-10	R	<b>Reserved</b> Constant value of 000000.

### 2.1.4 Offset\_06 Status Register

This register tracks the status information of PCI-bus related events which are relevant to the μPD72862. "Read" and "Write" are handled somewhat differently.

Bits	R/W	Description
3-0	R	<b>Reserved</b> Constant value of 0000.
4	R	<b>New capabilities</b> Constant value of 1. It indicates the existence of the Capabilities List.
6,5	R	<b>Reserved</b> Constant value of 00.
7	R	<b>Fast back-to-back capable</b> Constant value of 1. It indicates that the μPD72862, as a target, cannot accept fast back-to-back transactions when the transactions are not to the same agent.
8	R/W	<b>Signaled parity error</b> Default value of 0. It indicates the occurrence of any "Data Parity". 0: No parity detected (default) 1: Parity detected
10,9	R	<b>DEVSEL timing</b> Constant value of 01. These bits define the decode timing for DEVSEL. 0: Fast (1 cycles) 1: Medium (2 cycles) 2: Slow (3 cycles) 3: undefined
11	R/W	<b>Signaled target abort</b> Default value of 0. This bit is set by a target device whenever it terminates a transaction with "Target Abort". 0: The μPD72862 did not terminate a transaction with Target Abort 1: The μPD72862 has terminated a transaction with Target Abort
12	R/W	<b>Received target abort</b> Default value of 0. This bit is set by a master device whenever its transaction is terminated with a "Target Abort". 0: The μPD72862 has not received a Target Abort 1: The μPD72862 has received a Target Abort from a bus-master
13	R/W	<b>Received master abort</b> Default value of 0. This bit is set by a master device whenever its transaction is terminated with "Master Abort". The μPD72862 asserts "Master Abort" when a transaction response exceeds the time allocated in the latency timer field. 0: Transaction was not terminated with a Master Abort 1: Transaction has been terminated with a Master Abort
14	R/W	<b>Signaled system error</b> Default value of 0. It indicates that the assertion of SERR by the μPD72862. 0: System error was not signaled 1: System error was signaled
15	R/W	<b>Received parity error</b> Default value of 0. It indicates the occurrence of any PERR. 0: No parity error was detected 1: Parity error was detected

**2.1.5 Offset\_08 Revision ID Register**

This register specifies a revision number assigned by NEC Corporation for the μPD72862.

Bits	R/W	Description
7-0	R	Default value of 02H. It specifies the silicon revision. It will be incremented for subsequent silicon revisions.

**2.1.6 Offset\_09 Class Code Register**

This register identifies the class code, sub-class code, and programming interface of the μPD72862.

Bits	R/W	Description
7-0	R	Constant value of 10H. It specifies an IEEE1394 OpenHCI-compliant Host Controller.
15-8	R	Constant value of 00H. It specifies an "IEEE1394" type.
23-16	R	Constant value of 0CH. It specifies a "Serial Bus Controller".

**2.1.7 Offset\_0C Cache Line Size Register**

This register specifies the system cache line size, which is PC-host system dependent, in units of 32-bit words. The following cache line sizes are supported: 2, 4, 8, 16, 32, 64, and 128. All other values will be recognized as 0, i.e. cache disabled.

Bits	R/W	Description
7-0	R/W	Default value of 00H.

**2.1.8 Offset\_0D Latency Timer Register**

This register defines the maximum amount of time that the μPD72862 is permitted to retain ownership of the bus after it has acquired bus ownership and initiated a subsequent transaction.

Bits	R/W	Description
7-0	R/W	Default value of 00H. It specifies the number of PCI-bus clocks that the μPD72862 may hold the PCI bus as a bus-master.

**2.1.9 Offset\_0E Header Type Register**

Bits	R/W	Description
7-0	R	Constant value of 00H. It specifies a single function device.

**2.1.10 Offset\_0F BIST Register**

Bits	R/W	Description
7-0	R	Constant value of 00H. It specifies whether the device is capable of Built-in Self Test.

**2.1.11 Offset\_10 Base Address 0 Register**

This register specifies the base memory address for accessing all the “Operation registers” (i.e. control, configuration, and status registers) of the μPD72862, while the BIOS is expected to set this value during power-up reset.

Bits	R/W	Description
11-0	R	Constant value of 000H. These bits are “read-only”.
31-12	R/W	-

**2.1.12 Offset\_2C Subsystem Vendor ID Register**

This register identifies the subsystem that contains the NEC’s μPD72862 function. While the ID is assigned by the PCI\_SIG committee, the value should be loaded into the register from the external serial EEPROM after power-up reset. Access to this register through PCI-bus is prohibited.

Bits	R/W	Description
15-0	R	Default value of 1033H.

**2.1.13 Offset\_2E Subsystem ID Register**

This register identifies the type of the subsystem that contains the NEC’s μPD72862 function. While the ID is assigned by the manufacturer, the value should be loaded into the register from the external serial EEPROM after power-up reset. Access to this register through PCI-bus is prohibited.

Bits	R/W	Description
15-0	R	Default value of 0063H.

**2.1.14 Offset\_30 Expansion Rom Base Address Register**

This register is not supported by the current implementation of the μPD72862.

Bits	R/W	Description
31-0	R	<b>Reserved</b> Constant value of 0.

**2.1.15 Offset\_34 Cap\_Ptr Register**

This register points to a linked list of additional capabilities specific to the μPD72862, the NEC’s implementation of the 1394 OpenHCI specification.

Bits	R/W	Description
7-0	R	Constant value of 60H. The value represents an offset into the μPD72862’s PCI Configuration Space for the location of the first item in the New Capabilities Linked List.

**2.1.16 Offset\_3C Interrupt Line Register**

This register provides the interrupt line routing information specific to the μPD72862, the NEC's implementation of the 1394 OpenHCI specification.

Bits	R/W	Description
7-0	R/W	Default value of 00H. It specifies which input of the host system interrupt controller the interrupt pin of the μPD72862 is connected to.

**2.1.17 Offset\_3D Interrupt Pin Register**

This register provides the interrupt line routing information specific to the μPD72862, the NEC's implementation of the 1394 OpenHCI specification.

Bits	R/W	Description
7-0	R	Constant value of 01H. It specifies PCI $\overline{INTA}$ is used for interrupting the host system.

**2.1.18 Offset\_3E Min\_Grant Register**

This register specifies how long of a burst period the μPD72862 needs, assuming a clock rate of 33MHz. Resolution is in units of ¼ μs. The value should be loaded into the register from the external serial EEPROM upon power-up reset, and access to this register through PCI-bus is prohibited.

Bits	R/W	Description
7-0	R	Default value of 00H. Its value contributes to the desired setting for Latency Timer value.

**2.1.19 Offset\_3F Max Lat Register**

This register specifies how often the μPD72862 needs to gain access to the PCI-bus, assuming a clock rate of 33MHz. Resolution is in units of ¼ μs. The value should be loaded into the register from the external serial EEPROM after hardware reset, and access to this register through PCI-bus is prohibited.

Bits	R/W	Description
7-0	R	Default value of 00H. Its value contributes to the desired setting for Latency Timer value.

**2.1.20 Offset\_40 PCI\_OHCI\_Control Register**

This register specifies the control bits that are IEEE1394 OpenHCI specific. Vendor options are not allowed in this register. It is reserved for OpenHCI use only.

Bits	R/W	Description
0	R/W	<b>PCI global SWAP</b> Default value of 0. When this bit is 1, all quadrates read from and written to the PCI Interface are byte swapped, thus a "PCI Global Swap". PCI addresses for expansion ROM and PCI Configuration registers, are, however, unaffected by this bit. This bit is not required for motherboard implementations.
31-1	R	<b>Reserved</b> Constant value of all 0.



**2.1.21 Offset\_60 Cap\_ID & Next\_Item\_Ptr Register**

The Cap\_ID signals that this item in the Linked List is the registers defined for PCI Power Management, while the Next\_Item\_Ptr describes the location of the next item in the μPD72862's Capability List.

Bits	R/W	Description
7-0	R	<b>Cap_ID</b> Constant value of 01H. The default value identified the Link List item as being the PCI Power Management registers, while the ID value is assigned by the PCI SIG.
15-8	R	<b>Next_Item_Ptr</b> Constant value of 00H. It indicated that there are no more items in the Link List.

**2.1.22 Offset\_62 Power Management Capabilities Register**

This is a 16-bit read-only register that provides information on the power management capabilities of the μPD72862.

Bits	R/W	Description
2-0	R	<b>version</b> Constant value of 001. The power management registers are implemented as defined in revision 1.0 of PCI Bus Power Management Interface Specification.
3	R	<b>PME clock</b> Constant value of 0.
4	R	<b>Auxiliary power source</b> Constant value of 0. The alternative power source is not supported.
5	R	<b>DIS</b> Constant value of 0.
8,6	R	<b>Reserved</b> Constant value of 000.
9	R	<b>D1_support</b> Constant value of 0. The μPD72862 does not support the D1 Power Management state.
10	R	<b>D2_support</b> Constant value of 1. The μPD72862 supports the D2 Power Management state.
15-11	R	<b>PME_support</b> Constant value of 01100.

**2.1.23 Offset\_64 Power Management Control/Status Register**

This is a 16-bit read-only register that provides control status information of the μPD72862.

Bits	R/W	Description
1,0	R/W	<b>PowerState</b> Default value is undefined. This field is used both to determine the current power state of the μPD72862 and to set the μPD72862 into a new power state. As D1 is not supported in the current implementation of the μPD72862, writing of '01' will be ignored. 00: D0 (DMA contexts: ON, Link Layer: ON) 01: Reserved (D1 state not supported) 10: D2 (DMA contexts: OFF, Link Layer: OFF, LPS: OFF, $\overline{\text{PME}}$ will be asserted upon LinkON being active) 11: D3 (DMA contexts: OFF, Link Layer: OFF, LPS: OFF, $\overline{\text{PME}}$ will be asserted upon LinkON being active, Power can be removed)
7-2	R	<b>Reserved</b> Constant value of 000000.
8	R/W	<b>PME_En</b> Default value of 0. This field is used to enable the specific power management features of the μPD72862.
12-9	R	<b>Data_Select</b> Constant value of 0000.
14,13	R	<b>Data_Scale</b> Constant value of 00.
15	R/W	<b>PME_Status</b> Default value is undefined. A write of '1' clears this bit, while a write of '0' is ignored.

**2.2 CardBus Mode Configuration Register ( CARD\_ON=High )**

31	24	23	16	15	08	07	00	
DeviceID				VendorID				00H
Status				Command				04H
Class Code					Revision ID			08H
BIST	Header Type		Latency Timer		Cache Line Size			0CH
Base Address 0 (OHCI Registers)								10H
Base Address 1 (CardBus Status Reg) <i>Note</i>								14H
Base Address 2 (CardBus Status Reg) <i>Note</i>								18H
Base Address 3								1CH
Base Address 4								20H
Base Address 5								24H
CardBus CIS Pointer <i>Note</i>								28H
Subsystem ID				Subsystem Vendor ID				2CH
Expansion Rom Base Address Register								30H
000000H					Cap_Ptr			34H
00000000H								38H
Max_Lat	Min_Gnt		Interrupt Pin		Interrupt Line			3CH
PCI_OHCI_Control								40H
00000000H								44H
00000000H								48H
00000000H								4CH
Diagnostic register0								50H
Diagnostic register1								54H
Diagnostic register2								58H
Diagnostic register3								5CH
Power Management Capabilities				Next_Item_Ptr		Cap_ID		60H
Data	PMCSR_BSE		Power Management Control/Status					64H
00000000H								68H
00000000H								6CH
User Area (GENERAL_RegisterA)								70H
User Area (GENERAL_RegisterB)								74H
User Area (GENERAL_RegisterC)								78H
User Area (GENERAL_RegisterD)								7CH
CIS Area <i>Note</i>								80H FCH

**Note** Different from PCI Bus Mode Configuration Register.

## 2.2.1 Offset\_14/18 Base\_Address\_1/2 Register (CardBus Status Registers)

Bits	R/W	Description
7-0	R	Constant value of 00.
31-8	R/W	-

## (1) Function Event Register (FER) ( Base Address 1 ( 2 )+ 0H )

Bits	R/W	Description
0	R	Write Protect (No Use). Read only as '0'
1	R	Ready Status (No Use). Read only as '0'
2	R	Battery Voltage Detect 2 (No Use). Read only as '0'
3	R	Battery Voltage Detect 1 (No Use). Read only as '0'
4	R/W	General Wakeup
14-5	R	Reserved. Read only as '0'
15	R/W	Interrupt
31-16	R	Reserved. Read only as '0'

## (2) Function Event Mask Register (FEMR) ( Base Address 1 ( 2 )+ 4H )

Bits	R/W	Description
0	R	Write Protect (No Use). Read only as '0'
1	R	Ready Status (No Use). Read only as '0'
2	R	Battery Voltage Detect 2 (No Use). Read only as '0'
3	R	Battery Voltage Detect 1 (No Use). Read only as '0'
4	R/W	General Wakeup Mask
5	R	BAM. Read only as '0'
6	R	PWM. Read only as '0'
13-7	R	Reserved. Read only as '0'
14	R/W	Wakeup Mask
15	R/W	Interrupt
31-16	R	Reserved. Read only as '0'

**(3) Function Reset Status Register (FRSR) ( Base Address 1 ( 2 )+ 8H )**

Bits	R/W	Description
0	R	Write Protect (No Use). Read only as '0'
1	R	Ready Status (No Use). Read only as '0'
2	R	Battery Voltage Detect 2 (No Use). Read only as '0'
3	R	Battery Voltage Detect 1 (No Use). Read only as '0'
4	R/W	General Wakeup Mask
14-5	R	Reserved. Read only as '0'
15	R/W	Interrupt
31-16	R	Reserved. Read only as '0'

**(4) Function Force Event Register (FFER) ( Base Address 1 ( 2 )+ CH )**

Bits	R/W	Description
0	R	Write Protect (No Use). Read only as '0'
1	R	Ready Status (No Use). Read only as '0'
2	R	Battery Voltage Detect 2 (No Use). Read only as '0'
3	R	Battery Voltage Detect 1 (No Use). Read only as '0'
4	R/W	General Wakeup Mask
14-5	-	No Use
15	R/W	Interrupt
31-16	R	Reserved. Read only as '0'

**2.2.2 Offset\_28 Cardbus CIS Pointer**

This register specifies start memory address of the Cardbus CIS Area.

Bits	R/W	Description
31-0	R	Starting Pointer of CIS Area. Constant value of 00000080H.

**2.2.3 Offset\_80 CIS Area**

The μPD72862 supports external Serial ROM(AT24C02 compatible) interface.

CIS Area Register can be loaded from external Serial ROM in the CIS area when CARD\_ON are HIGH.

CARD_ON	CIS_ON	Bus	CIS	FUNCTION
0	1	PCI	OFF	PME
0	0	PCI	ON	CSTSCHG
1	X	Cardbus	ON	CSTSCHG

**3. SERIAL ROM INTERFACE**

The μPD72862 provides a serial ROM interface to initialize the 1394 Global Unique ID Register and the PCI/Cardbus Mode Configuration registers from a serial EEPROM.

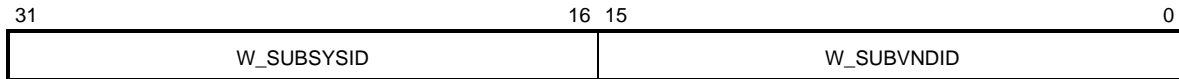
**3.1 Serial EEPROM Register**

Register Address	Register Name	R/W
Base address + 0x930	SUBID register	R/W
Base address + 0x934	LATVAL register	R/W
Base address + 0x938	W_GUIDHi register	R/W
Base address + 0x93C	W_GUIDLo register	R/W
Base address + 0x940	Parameters Write register	R/W
Base address + 0x95C	W_GENERAL register	R/W
Base address + 0x960	W_PHYS register	R/W
Base address + 0x984	W_CIS register	R/W

**Remark** Base address : Base Address 0 in Configuration register

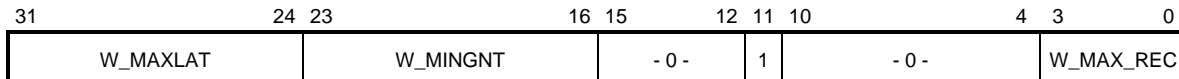
**3.2 Serial EEPROM Register Description**

**(1) SUBID register (Base address + 0x930)**



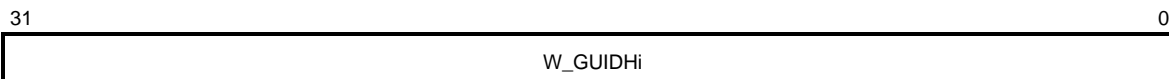
Field	Bits	R/W	Default value	Description
W_SUBSYSID	31-16	R/W	0063H	Subsystem ID value. The value is loaded into Subsystem ID register in Configuration register (offset+2CH bit 31-16).
W_SUBVNDID	15-0	R/W	1033H	Subsystem Vendor ID value. The value is loaded into Subsystem Vendor ID register in Configuration register (Offset+2CH bit 15-0).

**(2) LATVAL register (Base address + 0x934)**



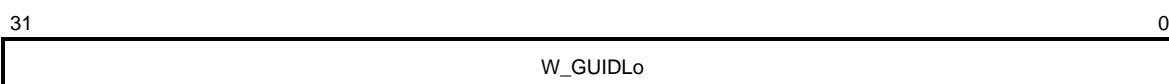
Field	Bits	R/W	Default value	Description
W_MAXLAT	31-24	R/W	00H	Max Latency value. The value is loaded into Max Latency register in Configuration register (Offset+3CH bit 31-24).
W_MINGNT	23-16	R/W	00H	Min Grant value. The value is loaded into Min Grant register in Configuration register (Offset+3CH bit 23-16).
-	15-12	-	-	Reserved. Write 0 to these bits.
-	11	-	-	Reserved. Write 1 to this bit.
-	10-4	-	-	Reserved. Write 0 to these bits.
W_MAX_REC	3-0	R/W	9H	MAX_REC value. The value is loaded into the max_rec field of OHCI BusOption register in OHCI register (Offset+020H bit 15-12).

**(3) W\_GUIDHi register (Base address + 0x938)**



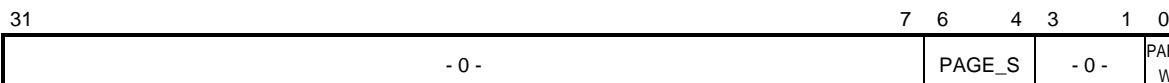
Field	Bits	R/W	Default value	Description
W_GUIDHi	31-0	R/W	Undefined	GlobalUniqueIDHi value. The value is loaded into OHCI GlobalUniqueIDHi register in OHCI register (Offset+024H bit 31-0). Please refer to the 1394 Open Host Controller Interface Specification/Release 1.0 [5.5.5].

**(4) W\_GUIDLo register (Base address + 0x93C)**



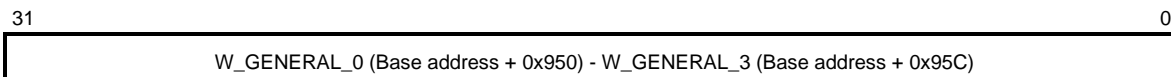
Field	Bits	R/W	Default value	Description
W_GUIDLo	31-0	R/W	Undefined	GlobalUniqueIDLo value. The value is loaded into GlobalUniqueIDLo register in OHCI register (Offset+028H bit 31-0). Please refer to the 1394 Open Host Controller Interface Specification/Release 1.0 [5.5.5].

**(5) Parameters Write register (Base address + 0x940)**



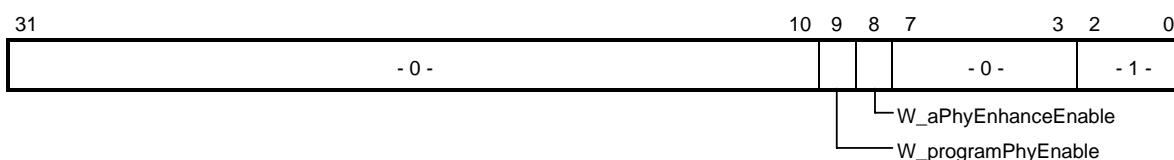
Field	Bits	R/W	Default value	Description
-	31-7	-	-	Reserved. Write 0 to these bits.
PAGE_S	6-4	R/W	000	Write register select page. The bit field returns zero when read. 000: Select SUBID register and LATVAL register. 001: Select W_GUIDHi register and W_GUIDLo register. 010: Select W_GENERAL register (W_GENERAL_0 and W_GENERAL_1). 011: Select W_GENERAL register (W_GENERAL_2 and W_GENERAL_3). 100: Select W_PHYS register (W_programPhyEnable, W_aPhyEnhanceEnable). 101: Select W_CIS register (W_CIS_EVEN - W_CIS_ODD).
-	3-1	-	-	Reserved. Write 0 to these bits.
PAR_W	0	R/W	0	Write control signal. The bit field returns zeros when read. 1: Write the value of select page defined PAGE_S. One write transaction is the units of 8 byte. 0: Ignored.

**(6) W\_GENERAL register (Base address + 0x950 - 0x95C)**



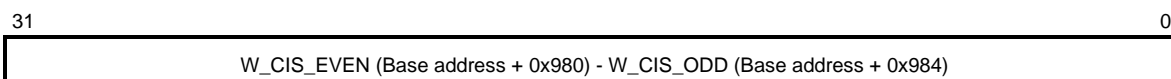
Field	Bits	R/W	Default value	Description
W_GENERAL_0 - W_GENERAL_3	31-0	R/W	Undefined	User define value. The value is loaded into GENERAL_registerA - D in Configuration register (Offset+70H - 7BH).

**(7) W\_PHYS register (Base address + 0x960)**



Field	Bits	R/W	Default value	Description
-	31-10	-	-	Reserved. Write 0 to these bits.
W_programPhyEnable	9	R/W	1	programPhyEnable bit. The bit is loaded into HCControl registers in OHCI register ((Offset+50H bit 23) and (54H bit 23)). Please refer to the 1394 Open Host Controller Interface Specification/Release 1.0 [5.7]. 1: P1394a enhancement is supported. 0: P1394a enhancement is not supported.
W_aPhyEnhanceEnable	8	R/W	0	aPhyEnhanceEnable bit. The bit is loaded into HCControl registers in OHCI register ((Offset+50H bit 23) and (54H bit 23)).
-	7-3	-	-	Reserved. Write 0 to these bits.
-	2-0	-	-	Reserved. Write 1 to these bits.

**(8) W\_CIS register (Base address + 0x980 - 0x984)**



Field	Bits	R/W	Default value	Description
W_CIS_EVEN - W_CIS_ODD	31-0	R/W	Undefined	CIS Area value. The value is loaded into CIS Area in Configuration register (Offset+80H - FCH).

Table 3-1. Serial EEPROM Memory Map

Byte address	Bit							
	7	6	5	4	3	2	1	0
0	W_SUBSYSID(31 : 24)							
1	W_SUBSYSID(23 : 16)							
2	W_SUBVNDID(15 : 8)							
3	W_SUBVNDID( 7 : 0)							
4	W_MAXLAT(31 : 24)							
5	W_MINGNT(23 : 16)							
6	0	0	0	0	1	0	0	0
7	0	0	0	0	W_MAX_REC( 3 : 0)			
8	W_GUIDHi(31 : 24)							
9	W_GUIDHi(23 : 16)							
A	W_GUIDHi(15 : 8)							
B	W_GUIDHi( 7 : 0)							
C	W_GUIDLo(31 : 24)							
D	W_GUIDLo(23 : 16)							
E	W_GUIDLo(15 : 8)							
F	W_GUIDLo( 7 : 0)							
10	W_GENERAL_0(31 : 24)							
11	W_GENERAL_0(23 : 16)							
12	W_GENERAL_0(15 : 8)							
13	W_GENERAL_0( 7 : 0)							
:	:							
:	:							
1C	W_GENERAL_3(31 : 24)							
1D	W_GENERAL_3(23 : 16)							
1E	W_GENERAL_3(15 : 8)							
1F	W_GENERAL_3( 7 : 0)							
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	WPE	WPEE
23	0	0	0	0	0	1	1	1
:	:							
:	:							
28	W_CIS_0(31 : 24)							
29	W_CIS_0(23 : 16)							
2A	W_CIS_0(15 : 8)							
2B	W_CIS_0( 7 : 0)							
:	:							
:	:							
A4	W_CIS_31(31 : 24)							
A5	W_CIS_31(23 : 16)							
A6	W_CIS_31(15 : 8)							
A7	W_CIS_31( 7 : 0)							

WPE: W\_programPhyEnable, WPEE: W\_aPhyEnhanceEnable



**3.3 Load Control**

GROM_EN	CARD_ON	CIS_ON	Description
0	X	X	No loading.
1	0	1	W_SUBSYSID, W_SUBVNDID, W_MAXLAT, W_MINGNT, W_MAX_REC, W_GUIDHi/Lo, W_GENERAL_0 - W_GENERAL_3, W_programPhyEnable, W_aPhyEnhanceEnable are loaded.
1	0	0	All parameters (W_SUBSYSID, W_SUBVNDID, W_MAXLAT, W_MINGNT, W_MAX_REC, W_GUIDHi/Lo, W_GENERAL_0 - W_GENERAL_3, W_programPhyEnable, W_aPhyEnhanceEnable, W_CIS_EVEN - W_CIS_ODD) are loaded.
1	1	X	

**3.4 Programming Sequence Example**

The example of programming sequence to the serial EEPROM is shown below.

- (1) Write SUBID register. **Note1**
- (2) Write LATVAL register. **Note1**
- (3) Write PAGE\_S = 000 and PAR\_W = 1 on Parameters Write register. **Note1**
- (4) Wait over 13 ms for serial EEPROM access time. **Note1**
- (5) Write W\_GUIDHi register. **Note2**
- (6) Write W\_GUIDLo register. **Note2**
- (7) Write PAGE\_S = 001 and PAR\_W = 1 on Parameters Write register. **Note2**
- (8) Wait over 13 ms for serial EEPROM access time. **Note2**
- (9) Write W\_GENERAL register (W\_GENERAL\_0, W\_GENERAL\_1). **Note3**
- (10) Write PAGE\_S = 010 and PAR\_W = 1 on Parameters Write register. **Note3**
- (11) Wait over 13 ms for serial EEPROM access time. **Note3**
- (12) Write W\_GENERAL register (W\_GENERAL\_2, W\_GENERAL\_3). **Note4**
- (13) Write PAGE\_S = 011 and PAR\_W = 1 on Parameters Write register. **Note4**
- (14) Wait over 13 ms for serial EEPROM access time. **Note4**
- (15) Write W\_PHYS register (W\_programPhyEnable, W\_aPhyEnhanceEnable). **Note5**
- (16) Write PAGE\_S = 100 and PAR\_W = 1 on Parameters Write register. **Note5**
- (17) Wait over 13 ms for serial EEPROM access time. **Note5**
- (18) Write W\_CIS register (W\_CIS\_EVEN, W\_CIS\_ODD). **Note6**
- (19) Write PAGE\_S = 101 and PAR\_W = 1 on Parameters Write register. **Note6**
- (20) Wait over 13 ms for serial EEPROM access time. **Note6**
- (21) Repeat (18)-(20) 15 times.
- (22) Complete to write parameters into Serial EEPROM.
- (23) Parameters are loaded from serial EEPROM after PCI reset.

- Notes**
1. If none of W\_SUBSYSID, W\_SUBVNDID, W\_MAXLAT, W\_MINGNT, W\_MAX\_REC in serial EEPROM are changed, (1)-(4) transactions don't need.
  2. If none of W\_GUIDHi, W\_GUIDLo in serial EEPROM are changed, (5)-(8) transactions don't need.
  3. If none of W\_GENERAL\_0, W\_GENERAL\_1 in serial EEPROM are changed, (9)-(11) transactions don't need.
  4. If none of W\_GENERAL\_2, W\_GENERAL\_3 in serial EEPROM are changed, (12)-(14) transactions don't need.

**Notes 5.** If none of W\_programPhyEnable, W\_aPhyEnhanceEnable in serial EEPROM are changed, (15)-(17) transactions don't need.

**6.** If none of W\_CIS\_0 - W\_CIS\_31 in serial EEPROM are changed, (18)-(21) transactions don't need.

## 4. ELECTRICAL SPECIFICATIONS

## Absolute Maximum Ratings

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	$V_{DD}$		-0.5 to +4.6	V
Input voltage	$V_I$	LVTTL @ ( $V_I < 0.5 V + V_{DD}$ )	-0.5 to +4.6	V
		PCI @ ( $V_I < 3.0 V + V_{DD}$ )	-0.5 to +6.6	V
Output voltage	$V_O$	LVTTL @ ( $V_O < 0.5 V + V_{DD}$ )	-0.5 to +4.6	V
		PCI @ ( $V_O < 3.0 V + V_{DD}$ )	-0.5 to +6.6	V
Operating ambient temperature	$T_A$		0 to +70	°C
Storage temperature	$T_{stg}$		-65 to +150	°C

**Caution** 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.

## Recommended Operating Ranges

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	$V_{DD}$	Used to clamp reflection on PCI bus.	4.5 to 5.5	V
			3.0 to 3.6	V
Operating ambient temperature	$T_A$		0 to +70	°C

**DC Characteristics ( $V_{DD} = 3.3\text{ V} \pm 0.3\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ )**

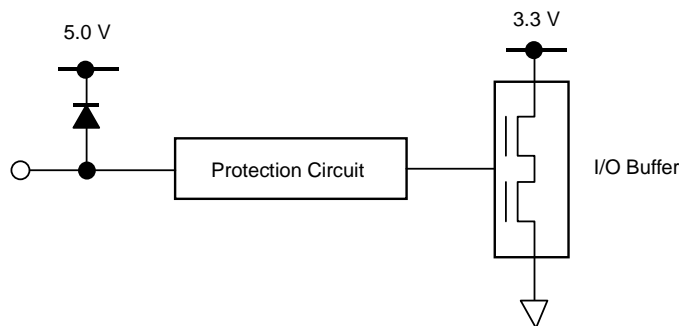
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
High-level input voltage	$V_{IH}$		2.0		$V_{DD}+0.5$	V
Low-level input voltage	$V_{IL}$		-0.5		+0.8	V
High-level output current	$I_{OH}$	$V_{OH} = 2.4\text{ V}$				
		Pin No.48,49,52,53,58	-3			mA
		Pin No.55,56	-6			mA
		Pin No.74	-9			mA
Low-level output current	$I_{OL}$	$V_{OL} = 0.4\text{ V}$				
		Pin No.48,49,52,53,58	3			mA
		Pin No.55,56	6			mA
		Pin No.74	9			mA
★ Input leakage current	$I_L$	$V_{IN} = V_{DD}$ OR $GND$			$\pm 10.0$	$\mu\text{A}$
★ Supply current	$I_{DD}$	$V_{DD} = 3.3\text{ V}$ D0 (Power State: 00) LPS = H		145		mA
<b>PCI interface</b>						
High-level input voltage	$V_{IH}$		2.0		5.5	V
Low-level input voltage	$V_{IL}$		-0.5		+0.8	V
High-level output current	$I_{OH}$	$V_{OH} = 2.4\text{ V}$	-2			mA
Low-level output current	$I_{OL}$	$V_{OL} = 0.4\text{ V}$	9			mA
★ Input leakage current	$I_L$	$V_{IN} = V_{DD}$ OR $GND$			$\pm 10.0$	$\mu\text{A}$
<b>PHY/Link interface</b>						
Positive trigger voltage	$V_P$		1.7		3.1	V
Negative trigger voltage	$V_N$		0.2		1.6	V
High-level output current	$I_{OH}$	$V_{OH} = 2.4\text{ V}$	-9			mA
Low-level output current	$I_{OL}$	$V_{OL} = 0.4\text{ V}$	9			mA

**Remarks 1.** Digital core runs at 3.3 V.

**2.** PCI Interface can run at 5 or 3.3 V, depending on the choice of 5 V-PCI or 3.3 V-PCI.

**3.** All other I/Os are 3.3 V driving, and 5 V tolerant.

**4.** 5 V are used only for 5 V-PCI clamping diode.



**AC Characteristics**

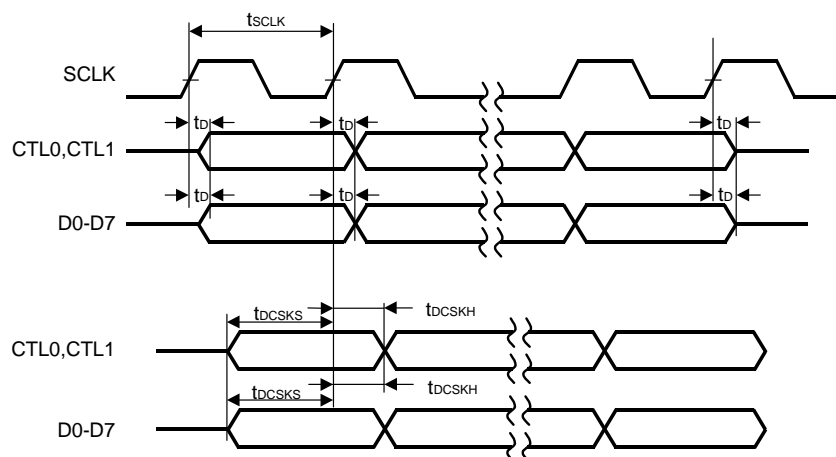
**PCI Interface**

See PCI local bus specification Revision 2.1.

**PHY/Link Interface**

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
D,CTL setup time to SCLK rise	t <sub>dcsks</sub>		6			ns
D,CTL hold time to SCLK rise	t <sub>dcskh</sub>		0			ns
SCLK rise to D,CTL,LREQ out	t <sub>d</sub>	C <sub>L</sub> = 10 pF	1		10	ns
SCLK cycle time	t <sub>sclk</sub>		20.345			ns

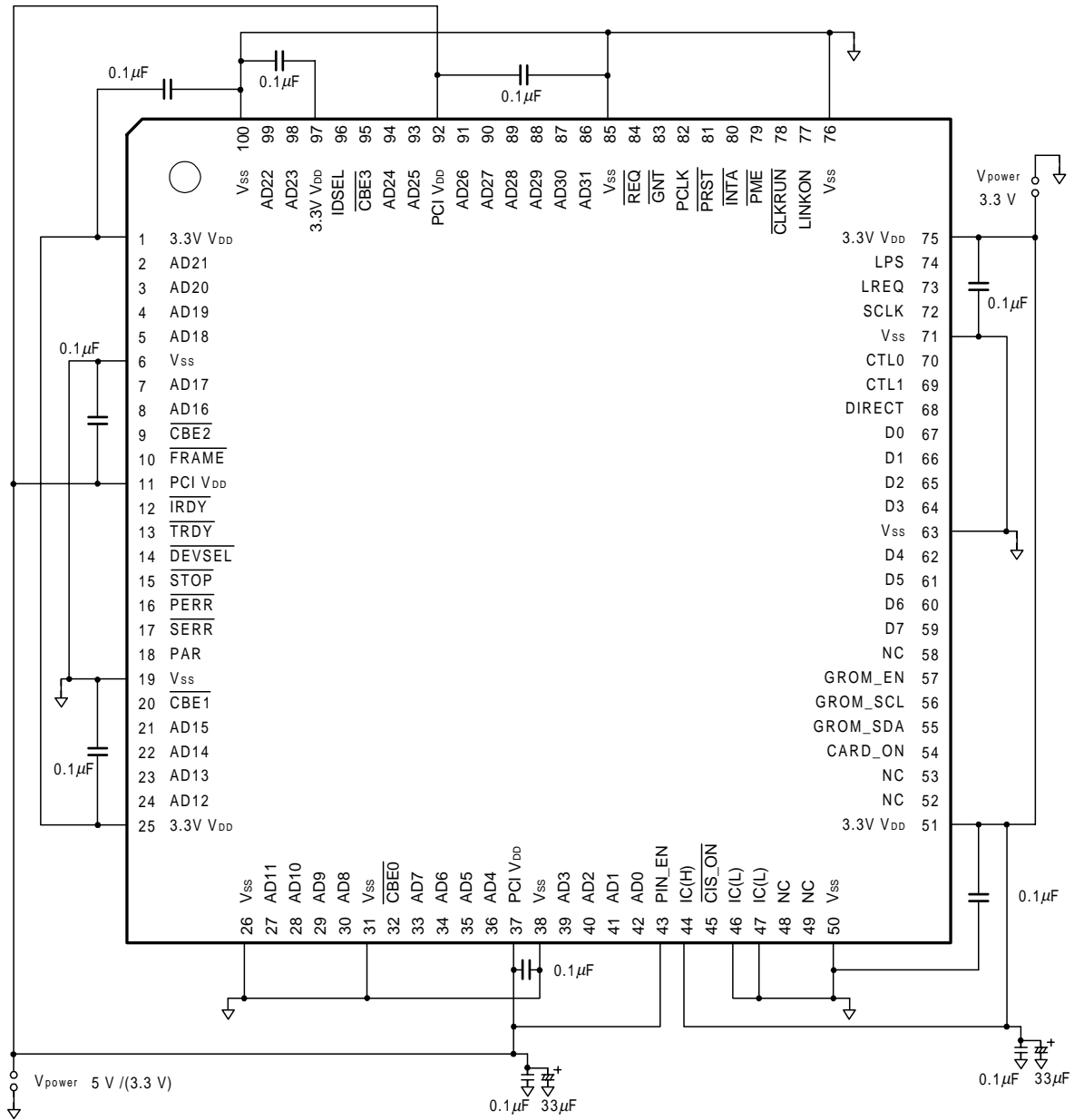
**PHY/Link Interface Timing**



**Serial ROM Interface**

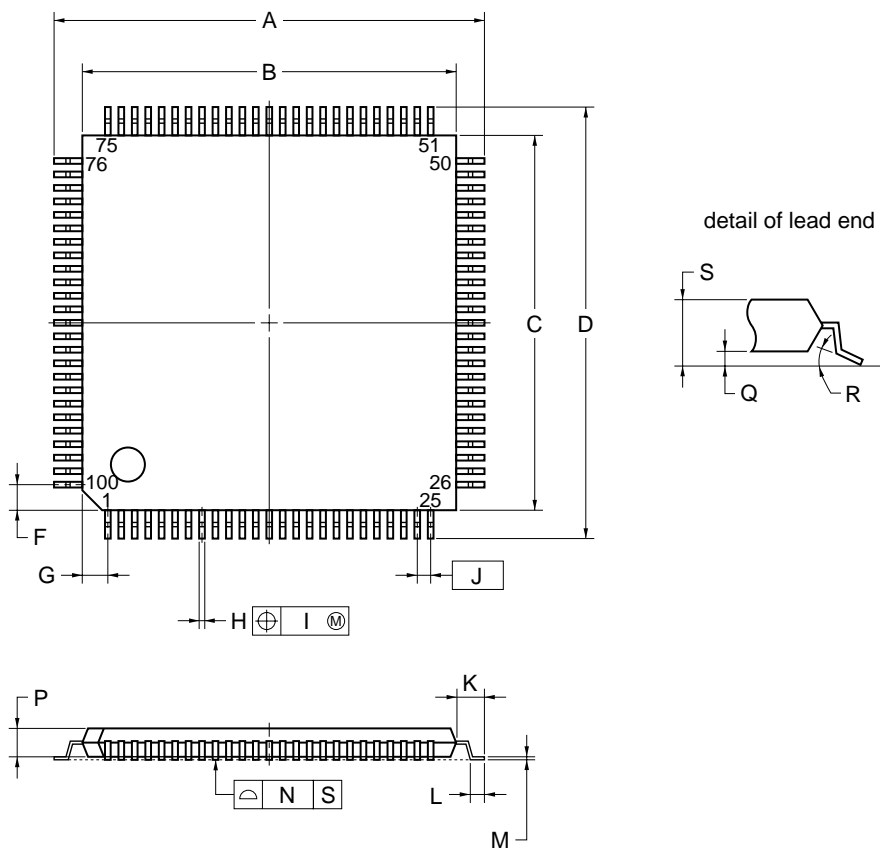
See AT24C01A/02/04/08/16 Spec. Sheet.

**5. APPLICATION CIRCUIT EXAMPLE**



6. PACKAGE DRAWING

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



**NOTE**

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

ITEM	MILLIMETERS
A	16.0±0.2
B	14.0±0.2
C	14.0±0.2
D	16.0±0.2
F	1.0
G	1.0
H	0.22 <sup>+0.05</sup> <sub>-0.04</sub>
I	0.10
J	0.5 (T.P.)
K	1.0±0.2
L	0.5±0.2
M	0.145 <sup>+0.055</sup> <sub>-0.045</sub>
N	0.10
P	1.0±0.1
Q	0.1±0.05
R	3 <sup>+7°</sup> <sub>-3°</sub>
S	1.27 MAX.

S100GC-50-9EU-2

★ 7. RECOMMENDED SOLDERING CONDITIONS

The μPD72850A should be soldered and mounted under the following recommended conditions.

For the 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, contact your NEC sales representative.

**Table 7-1. Surface Mounting Type Soldering Conditions**

**μPD72862GC-9EU : 100-pin plastic TQFP (Fine pitch) (14 x 14)**

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235°C, Time: 30 sec. Max. (at 210°C or higher). Count: three times or less Exposure limit: 3 days <sup>Note</sup> (after that prebake at 125°C for 10 hours)	IR35-103-3
VPS	Package peak temperature: 215°C, Time: 40 sec. Max. (at 200°C or higher). Count: three times or less Exposure limit: 3 days <sup>Note</sup> (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 for partial heating).



[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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    - Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)
    - Specific: Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.
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