T-Engine Hardware Specification

Ver. 1.01.02

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May 2008

T-Engine Forum

http://www.t-engine.org/

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Update history

Version	Date	Content of update
01.01.01	2005.7	First Edited
01.01.02	2008.5	-Change the model name of recommended parts for expansion bus connector, PC card connector, USB connector, and eTRON connector to RoHs-compliant parts. -Change the model name of recommended parts for serial connector and audio input/output connector. -Added comments to the recommended interface for LCD/touch panel. -Add 16-pin connector to serial connector specification.

■ 1. Overview of T-Engine

1.1 What is T-Engine?

(1) Features
- Open platform for real-time system of next generation and ubiquitous system
- CPU agnostic
- Common physical form factor, and common interface
- T-Kernel real-time OS support

(2) Applied Target for T-Engine
- As a reference development platform for portable information equipments (such as PDA, e-book, and next-generation cellular phone), Internet information terminal, SetTopBox, controller for information appliances, and in-vehicle information terminal, etc.
- As a training board for hardware and real-time programming
- As a general-purpose control board

(3) Merits of T-Engine Application
- Allows dramatic shortening of development period due to accumulation and distribution of middleware, and distribution of peripheral Expansion board.

1.2 Entire Configuration of T-Engine System

T-Engine consists of LCD board, Expansion board, etc. around CPU board depending on purposes, and enables constructing evaluation systems for various uses by combinations. Entire configuration layout of T-Engine system is shown in the figure below.
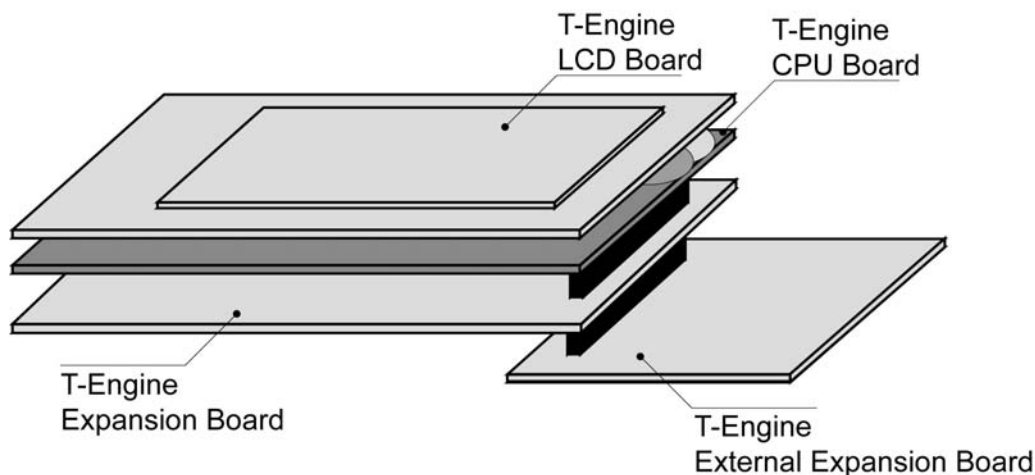
(1) CPU Board

The CPU board is the standard board that allows stand-alone operation. It consists of 32bit CPU, memory, RTC, power supply control function, etc. It also has various interfaces such as serial port, PC Card, Audio CODEC, USB Host, eTRON card, LCD, expansion bus connector, etc. on the board.

(2)LCD Board

LCD board consists of display devices for PDA, electronic book, cellular-phone and others, and any user input device such as touch panel, key input and others.

(3) Expansion Board

Consists of network functions such as Ethernet, Bluetooth, and IEEE1394 plus various extended functions such as extended memory and mass-storage devices.

(4) Debug Board

Consists of debugging function for debug board such as JTAG interface and writing function to flash memory of a CPU board.

1.3 Scope of Application of Specification

These specifications shall apply to regulations of the following specifications.

(1)CPU board specifications

Physical form factor specification and electronic specification regarding CPU board

(2) Expansion Board

Physical form factor specification and electronic specification regarding Expansion board

(3)Documentation

Regulations for documents on T-Engine hardware

■   2. Basic Configuration of CPU Board

(1) CPU

Basic structure: Built-in MMU (Memory Management Unit), 32bit or more CPU

(2) RAM

Appropriate volume of storage

(3) Flash memory

Appropriate volume of storage

(4) eTRON SIM card interface

SIM card connector interface (3.3V) that complies with ISO7816 mounted

1 Slot: (UICC SIM Card connector mounted)

Complies with ETSI TS102221 V4.1.0

(5) LCD/Touch Panel Interface

1ch mounted (any touch panel is acceptable)

(6) Real-time clock (RTC)

Must be equipped with 1ch calendar (Backup with battery or high-volume capacitor is recommended.)

(7) PC Card Interface

Complies with PCMCIA Standard Release 2.1/JEIDA 4.2

TYPE II/I Slot x 1 mounted

Compliance with CardBus is optional

(Refer to: http://www.pcmcia.org/pccardstandard.htm#1)

(8) USB Host Interface

Complies with USB Specification Rev1.1

Series "A" receptacle x 1 mounted

(9) Serial Port Interface

Asynchronous serial communication port (by dedicated cable connection) 1ch: 115.2kbps or faster

■

(10) Switch

The following functions are equipped with minimum rate of 3bits

- Turn on/off power
- NMI
- Reset

(11) Audio Input/output Interface

Stereo headphone output: 1ch

Headset input/output: earphone: 1ch, microphone: 1ch

(12) Expansion Bus Interface

Dedicated connector for T-Engine standard extended bus 1 slot (140-pin)

Must comply with "Expansion bus connector Common Specifications"

(13) Power connector (DC jack)

Connector complies with EIAJ RC-5320A

■ 3. Implementation Specifications of CPU Board

External dimensions of CPU board, implementing positions of various switches and various connectors are as follows.

● Board size: 120mm x 75mm
● Board thickness: 1.6mm
● Tolerance of connector position shall be ±2mm.
● Tolerance of hole position shall be ±0.3mm.

3.1 Implementation Specifications of CPU Board A side
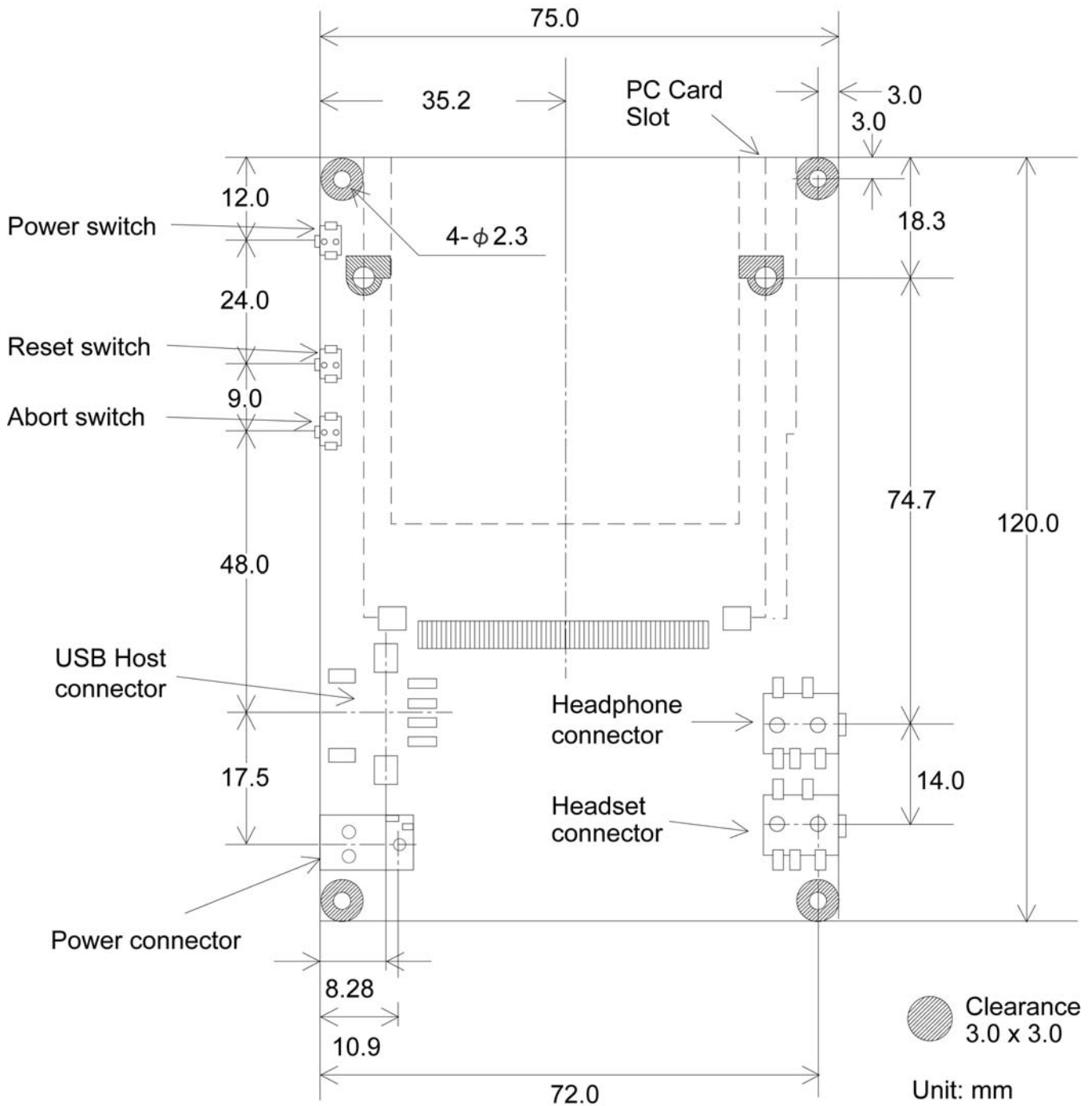
3.2 Implementation Specifications of CPU Board B side

Unit: mm

■ 4. Interface Specifications of CPU Board

4.1 Expansion Bus Interface Specification

   CPU board and Expansion board are connected with 140-pin expansion bus connector.
The signal in expansion bus is connected by the signals of CPU bus (data bus, address bus, and various control signals) via bus buffer.

   133-136 pins shall be VBAT (voltage: 5.0V±5% input), and 137-140 pins shall be GND as the common specification of T-Engine.
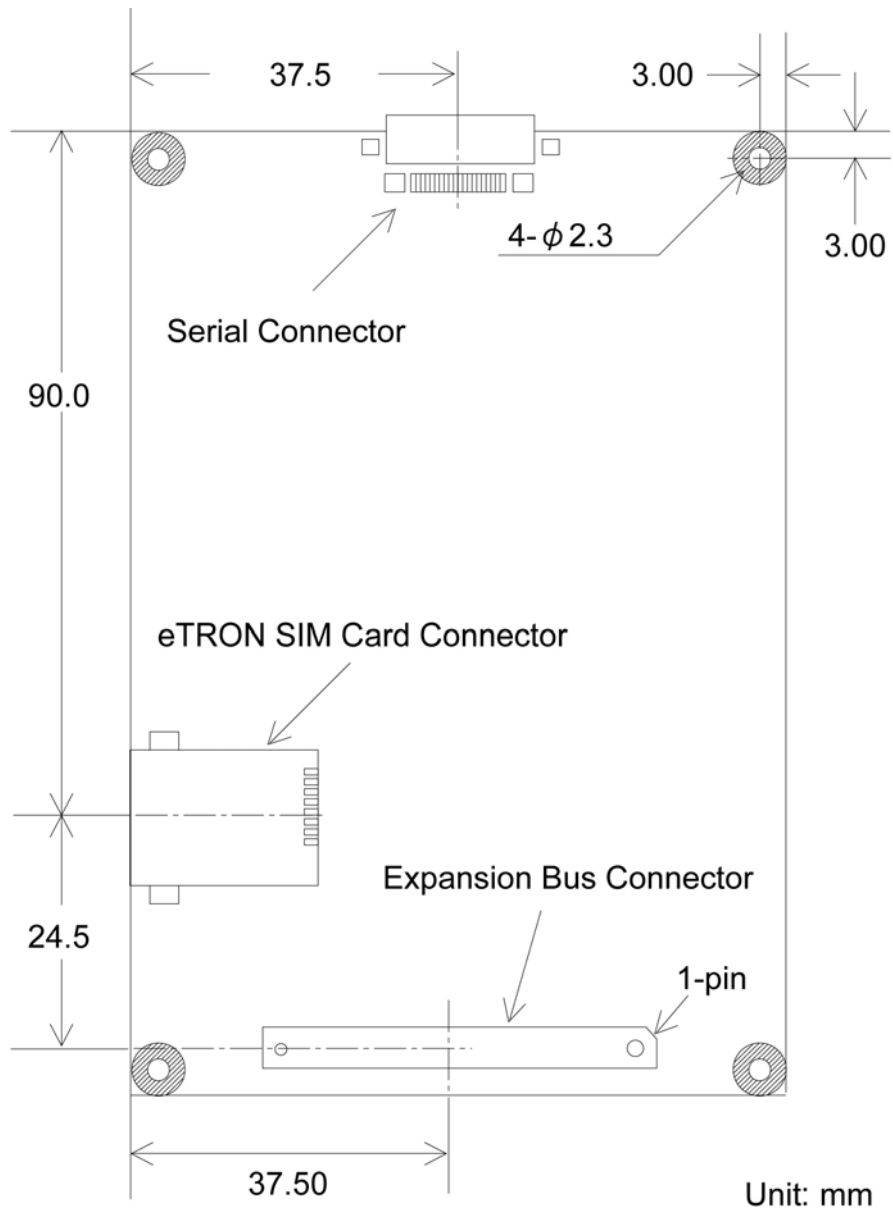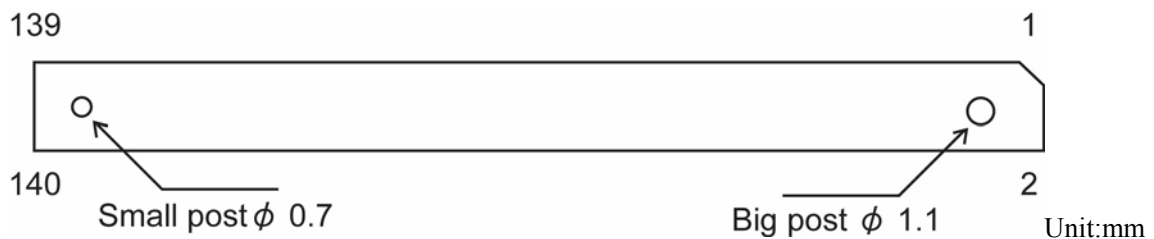Other bus signal pins shall be voluntarily allocated to each CPU.

Recommended connector:
   Model: KYOCERA ELCO 20-5603-14-XXXX-861+ (XXXX: T-Engine expansion bus category code)

   * The above XXXX is 4-digit number called a "keying no." and represents a classification code of error insertion prevention key toT-Engine extension bus connector.

   Keying allocation of the extension bus connector shall be in accordance with the following operational procedure.

   Allocated keying will be released on the members-only page of the T-Engine forum website (http://www.t-engine.org/).
   Manufacturers, which develop new board, shall refer to this information, and shall use the existing keying if it is available.

   Approval by the T-Engine Forum is required for the new keying allocation. At this point, the new keying allocation may be disapproved if bus specification is determined to be compatible with existing keying.

4.2 Serial Interface Specification

Used for the general-purpose serial I/O or console port for debugging.

(1) Connector specification

15-pin connector or 16-pin connector

Recommended connector:

RMC-EA15MY-OM15-MC1 (by Honda Communications)

LX60-16S (by Hirose Electric) or other

(2)Pin Assignment

・15-pin

Pin No.	Signal name	Input/output
1	GND	-
2	TxD	O
3	RxD	I
4	GND	-
5	RTS	O
6	CTS	I
7	GND	-
8	Reserved	-
9	Reserved	-
10	Reserved	-
11	Reserved	-
12	Reserved	-
13	Reserved	-
14	Reserved	-
15	Reserved	-

・16-pin

Pin No.	Signal name	Input/output
1	GND	-
2	TxD	O
3	RxD	I
4	GND	-
5	RTS	O
6	CTS	I
7	GND	-
8	Reserved	-
9	Reserved	-
10	Reserved	-
11	Reserved	-
12	Reserved	-
13	Reserved	-
14	Reserved	-
15	Reserved	-
16	Reserved	-

4.3 PC Card Interface Specification

PC card controller and connector shall be Type II, 1 slot 68-pin connector complied with the PCMCIA standard. Also available for the 5V/3.3V card.

(1) Connector specification
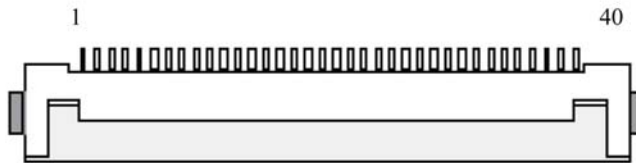
68-pin connector

Recommended connector:

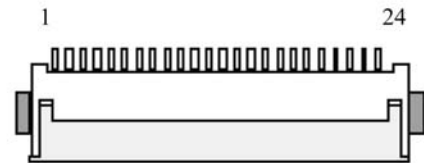31-5027-068-130-833+ (by KYOCERA ELCO) or other

4.4 LCD/Touch Panel Interface Specification

　　1ch is supplied for LCD/touch panel input interface (any touch panel is　acceptable if it uses 1ch input).
　　The following LCD and touch panel interface are recommended.

(1) Connector specification

CN1: LCD interface connector
Model name: FH12-40S-0.5SH
Maker: Hirose Electric Co., LTD.

CN2: LCD interface connector
Model name: FH12-24S-0.5SH
Maker: Hirose Electric Co., LTD.

(2) Pin Assignment

Pin Assignment of CN1

Pin No.	Signal name	I/O	Remarks	Pin No.	Signal name	I/O	Remarks
1	VBAT	-	Power supply	21	LCD13	OUT	LCDC
2	VBAT	-	Power supply	22	LCD14	OUT	LCDC
3	VBAT	-	Power supply	23	LCD15	OUT	LCDC
4	VBAT	-	Power supply	24	GND	-	Power supply
5	NC	-	unused	25	GND	-	Power supply
6	LCD0	OUT	LCDC	26	CL1	OUT	LCDC
7	LCD1	OUT	LCDC	27	CL2	OUT	LCDC
8	LCD2	OUT	LCDC	28	DON	OUT	LCDC
9	LCD3	OUT	LCDC	29	M_DISP	OUT	LCDC
10	LCD4	OUT	LCDC	30	FLM	OUT	LCDC
11	LCD5	OUT	LCDC	31	VEPWC	OUT	LCDC
12	LCD6	OUT	LCDC	32	VCPWC	OUT	LCDC
13	LCD7	OUT	LCDC	33	NC	-	unused
14	GND	-	Power supply	34	GND	-	Power supply
15	GND	-	Power supply	35	GND	-	Power supply
16	LCD8	OUT	LCDC	36	IR_IN	IN	Remote controller
17	LCD9	OUT	LCDC	37	3.3V	-	Power supply
18	LCD10	OUT	LCDC	38	3.3V	-	Power supply
19	LCD11	OUT	LCDC	39	3.3V	-	Power supply
20	LCD12	OUT	LCDC	40	3.3V	-	Power supply

　* Leave NC terminals open on the circuit board.

Pin Assignment of CN2

Pin No.	Signal name	I/O	Remarks	Pin No.	Signal name	I/O	Remarks
1	GND	-	Power supply	13	~PAD_CS	OUT	PAD_I/F
2	GND	-	Power supply	14	~PAD_IRQ	IN	PAD_I/F
3	KEY_IN0	IN	KEY_I/F	15	PAD_DIN	OUT	PAD_I/F
4	KEY_IN1	IN	KEY_I/F	16	PAD_DOUT	IN	PAD_I/F
5	KEY_IN2	IN	KEY_I/F	17	PAD_DCLK	OUT	PAD_I/F
6	KEY_IN3	IN	KEY_I/F	18	~RESET	OUT	Reset
7	KEY_IN4	IN	KEY_I/F	19	~LCD_FLON	OUT	LCD power supply
8	KEY_OUT0	OUT	KEY_I/F	20	~LCD_PWRDY	IN	LCD power supply
9	KEY_OUT1	OUT	KEY_I/F	21	GND	-	Power supply
10	KEY_OUT2	OUT	KEY_I/F	22	GND	-	Power supply
11	GND	-	Power supply	23	3.3VSB	-	Power supply
12	GND	-	Power supply	24	3.3VSB	-	Power supply

4.5 eTRON SIM Card Interface Specification

   For specifications and electrical characteristics of connector, must comply with ISO7816-1-3. It is mandatory that the protocol supports T=0 and desirable that it support T=1.
   eTRON card is equipped with SIM card connector complied with "VICC-Terminal Interface" of ETSI TS 102221 V4.1.0.

(1) Connector specification
     8-pin connector
     Recommended connector:
        00-5036-008-110-862+ (KYOCERA ELCO) or other

(2) Pin Assignment

Pin No.	Signal name	Input/output
1	Vcc	-
2	Reset	I
3	Clock	I
4	Reserved	-
5	GND	-
6	Vpp	NC
7	I/O	I/O
8	Reserved	-

(3) Supplied clock
     3.5712MHz
     Duty: 50±10%

(4) Connection Guidelines
- About Power Pin Control

     Since presence of power supply of Vcc determines whether the interface is contact or noncontact, it must have the Vcc power supply shut down function.

- 4 and 8 Pins handling

     When eTRON card is set to the noncontact interface, the terminal is of antenna connection, therefore, connect there pins to independent through-holes around the SIM card connector.

- About Power Supply Sequence

     Refer to the following figure

1cyc : 1clock
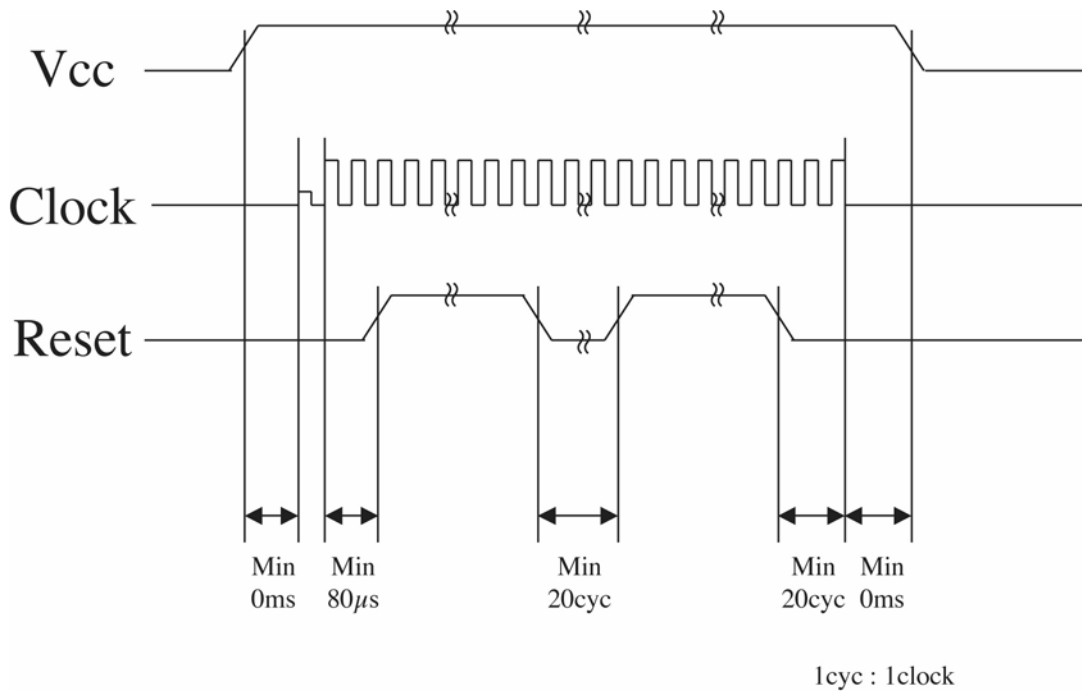
4.6 Interface Specifications of USB Host

  Interface complied with USB Host Ver1.1 (12M/1.5Mbps) mounted.
  Arrange so that the power can be supplied to USB device if the power supply has sufficient capacity such when connecting to the external power supply.

(1) Connector specification
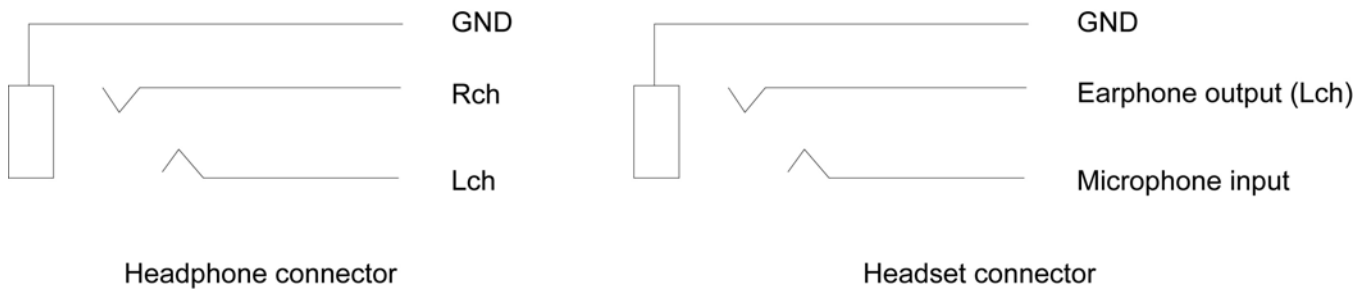   4-pin connector
   Recommended connector:
    20-5041-004-100-834+ (by KYOCERA ELCO) or other

(2) Pin Assignment

Pin No.	Signal name	Input/output
1	Vcc	-
2	-Data	I/O
3	+Data	I/O
4	GND	-

4.7 Audio Input/output Interface Specification

  Equipped with sub mini jack for Audio I/O. Standard shall be applicable to the headset plug that can be connected to cellular telephone or other device. (φ2.5mm mini jack)

Headphone connector   Headset connector

(1) Connector specification
   3-pin connector
   Recommended connector:
    HSJ1602-010011 (by Hoshiden)
    STX-2550-5N-TR (by KYCON) or other companies

4.8 Power supply Interface Specification

Power shall be supplied to the basic CPU board through the power supply connector or VBAT pin of the expansion bus connector.

(1) Connector specification
EIAJ RC5320A
Connector for voltage class 2 (3.15V<vin<6.3V)
Outer: Minus   Inner: Plus

(2) Direction of Power Supply
VBAT pin of the expansion bus connector shall supply the power from the Expansion board to the CPU board. Other power pins shall supply the power from the CPU board to the Expansion board.
The following diode is recommended to be inserted into the power line.
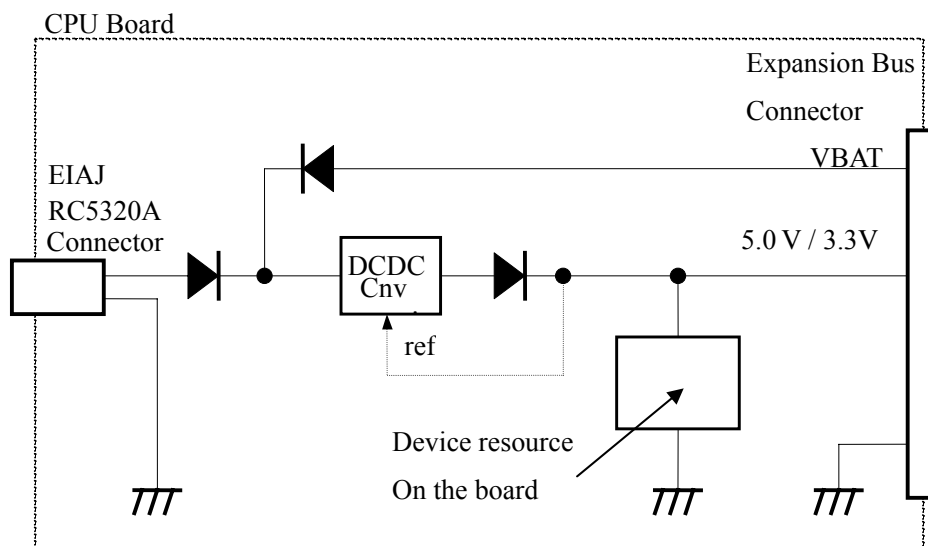
■　5. Specifications for Power Control Function of T-Engine Hardware

5.1 System States and their Names

Follow the naming convention shown below when implementing the power management function to T-Engine.

Name: P0
State: Main power OFF

Name: P1
State: Main power ON, CPU sleep (startup by interruption available), no memory retained, peripheral modules optional

Name: P2
State: Main power ON, CPU sleep (startup by interruption available), memory retained, peripheral modules optional

Name: P3
State: Main power ON, CPU activated, memory retained, peripheral modules optional

More detailed naming convention shall be specified when CPU of P3 is activated.
The lowest clock frequency that the CPU can set shall be "1" and the highest frequency shall be the maximum value.

Ex)　　Low speed: P3-1
　　　　Middle speed: P3-2
　　　　High speed: P3-3

5.2 Specifications for External Power Supply Control Function

(1) Power ON Control
　　　　Power ON control supports following 2 types.
　　　　● Power ON by power activation
　　　　● Power ON by power switch

　　　　・Power ON by power activation and that by power switch can be mode switched by DIP switch or other methods.
　　　　・In addition, it is recommended to support the power ON control by power ON control signal on the expansion bus.
　　　　・The power ON by power ON control signal on the expansion bus shall be controlled by inputting the power ON control signal from the Expansion board with WakeOnLAN function.

(2) Power OFF Control
　　　　● Power OFF by power switch (controlled by software)

- Power OFF by other control commands (controlled by software)

5.3 Functions to handle power blackout

It is recommended that T-Engine has the following to handle power blackout.

(1) Power failure detection by backup power supply (UPS, battery, etc.)
Select one of following three solutions to realize the power failure detection by backup power supply.

- Installation of a signal input pin for power failure notification on the CPU board
- Introduction of battery voltage drop detection function (in case that battery is equipped.)
- Installation of a signal input pin for power failure notification on the Expansion board to notify the CPU board of power failure

(2) Power failure detection function using nonvolatile memory, RTC internal register, or other methods
However, the data backup function (such as mounting nonvolatile memory) shall be optional.

■ 6. Regulation and Operation of T-Engine Hardware

6.1 About T-Engine Logo Marking

• Operational Procedures

The T-Engine logo marking shall be permitted for the board approved by the executive meeting of the forum. However, logo marking shall be at each vendor's option.

• Logo Marking Methods

Either silk screening, etching, sticker, or other method is available

• Place to Mark

anywhere

6.2 Documentation

The following contents shall be described in the specifications on each implementation of T-Engine hardware and user's manual.

(1) CPU

Detailed specification: Availability of documents describing the CPU detailed specification or the CPU specification

(2) RAM

Arbitrary

(3) Flash memory

Arbitrary

(4) Specifications for Power Supply Control Function

Detailed items

(5) Memory Map

Detailed items

(6) Specifications for Register Function

Detailed items

(7) Expansion Bus I/F Specifications

Following specifications:

- Timing specification
- Pin allocation specification
- Available current
- Available voltage
- Bus clock
- Bus way
- CPU allocation space
- Interrupt
- Others (DMA, etc.)

(8) I/F Specifications for Various Peripheral Devices

Describe the specifications of I/F peripheral devices on board, or explain how to obtain the documentation in which the specifications are described, etc.

6.3 Accreditation Standard of T-Engine Hardware

The procedure to develop the T-Engine and obtain the accreditation of the T-Engine Forum is as follows.

(1) Product Development Start

Acquire the registration cord by submitting the registration application sheet accredited by T-Engine to the T-Engine Forum.

(2) Product Completion

Apply the request for T-Engine accreditation to the office.

(3) Examination

Development manufacturers shall submit the following target and seek the review.

1. Main body of T-Engine (attachment such as power supply included)
2. Specification
3. Circuit diagram
4. Sample program that allows checking each function
5. Check list

(4) Approval

Formal registration is completed once when the T-Engine Forum confirmed that no problem is found through the above evaluation and hardware is in accordance with T-Engine hardware specification. Then, Product name,etc. will be released in the members-only page of the T-Engine Forum website.
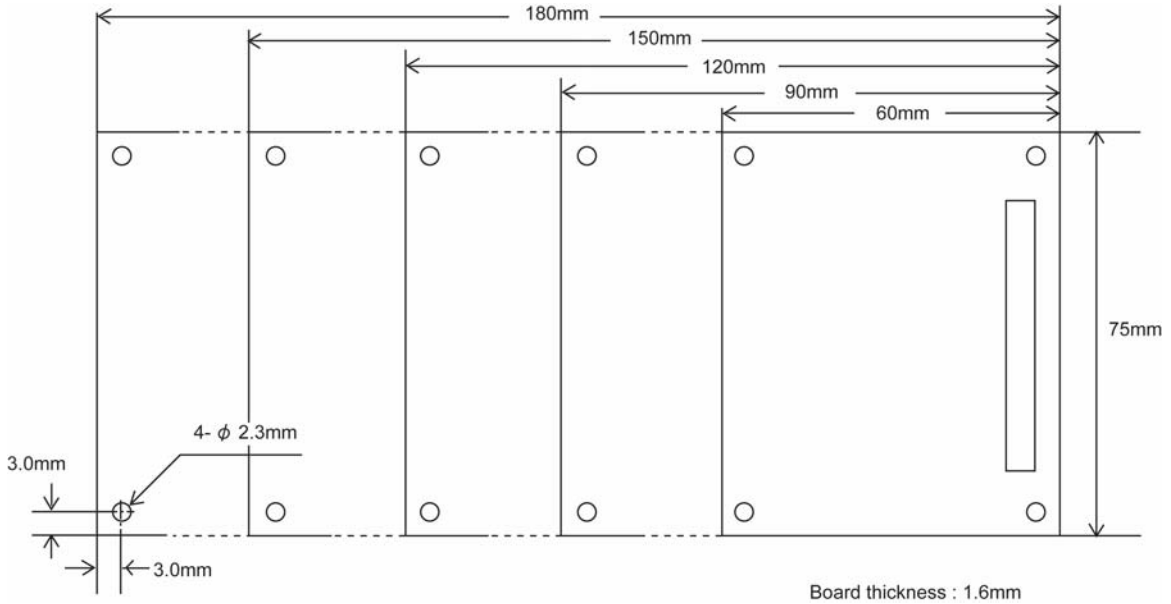
■ 7. Expansion board Standard

7.1 Size of Expansion board Plate

Size of the Expansion board is shown in the figure below.
The board shall be able to extend by 30mm pitch in the longitudinal direction.
The 2.3mm fixing hole in diameter shall be established at a distance of 3mm from the edge of the board.


Size of the following Expansion board shall also be specified to extend it to the outer side of the T-Engine CPU board.
In case of the external Expansion board, when extending the part of board that bites into the CPU board, the extended length shall be identical to the board size specification aforementioned.
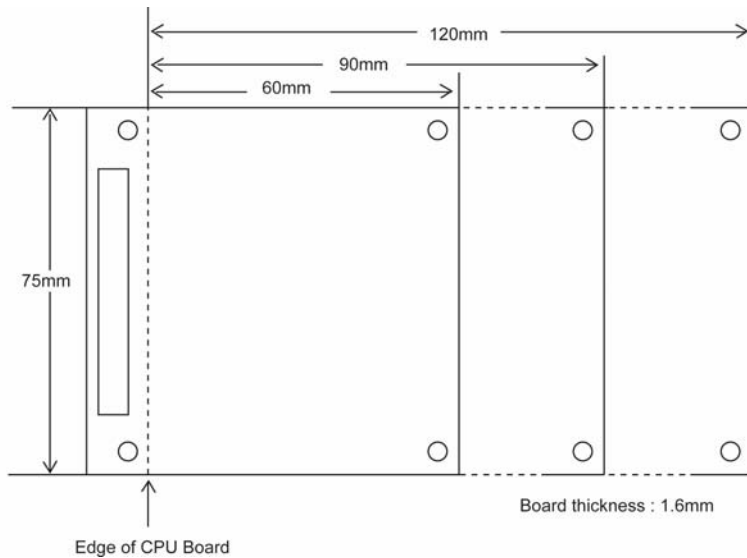
7.2 Restricted Area for Expansion board Implementation

The φ6mm mounting hole for external Expansion board and the 6mm wide around its adjacent hole shall be the restricted area for implementation.

T-Engine CPU Board   Expansion Bus Connector

External Expansion Board
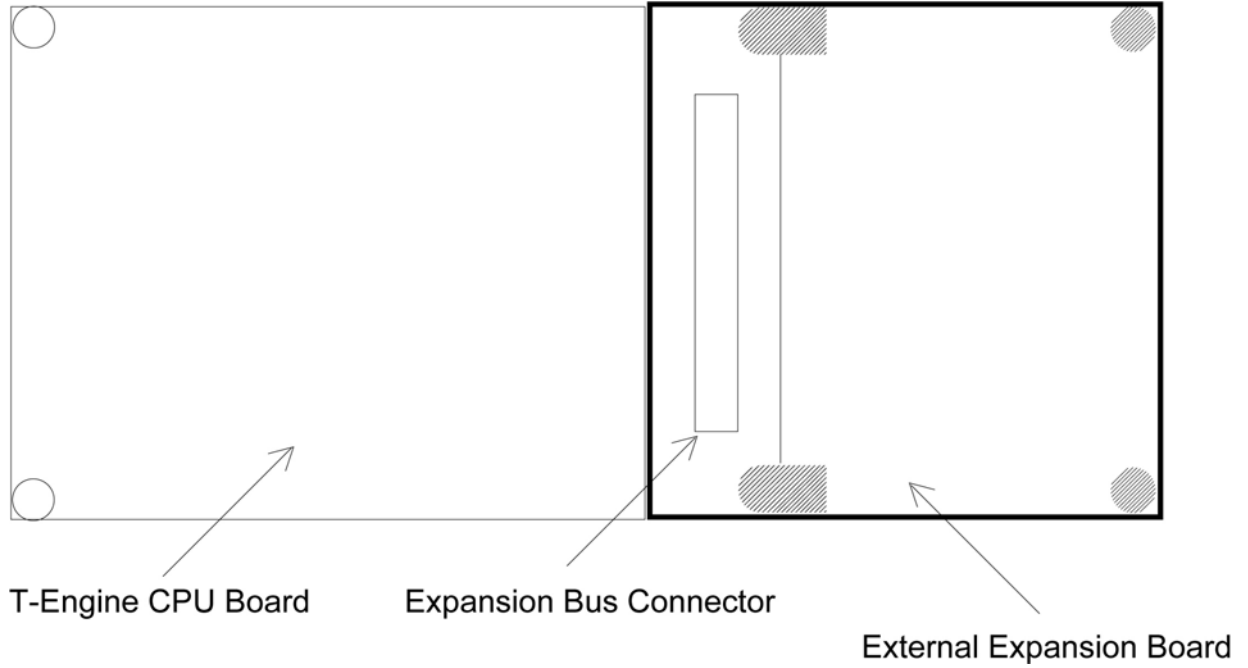
7.3 Stacking Specification for the Expansion board

Stacking Specification for the T-Engine Expansion board is shown below.
The interval between boards shall be 10mm.
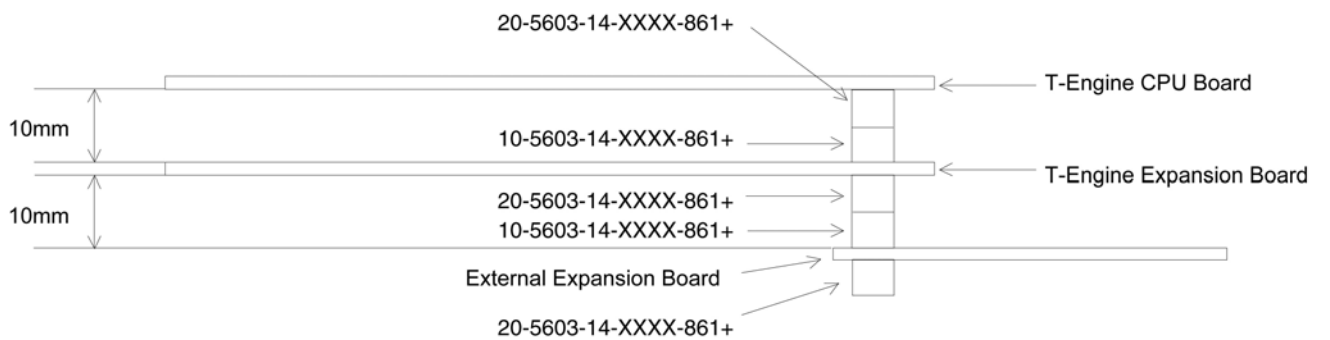
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