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# $\mu$ T-Engine Hardware Specification

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May 2008

**T-Engine Forum**

***<http://www.t-engine.org/>***

Table of Contents

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- 1. Overview of μT-Engine ..... 4
  - 1.1 What is μT-Engine? ..... 4
  - 1.2 Entire Configuration of μT-Engine System ..... 4
  - 1.3 Scope of Application of Specification ..... 5
- 2. Basic Configuration of CPU Board ..... 6
- 3. Implementation Specifications of CPU Board ..... 7
  - 3.1 Implementation Specifications of CPU Board A side ..... 7
  - 3.2 Implementation Specifications of CPU Board B side ..... 8
- 4. Interface Specifications of CPU Board ..... 9
  - 4.1 Expansion Bus Interface Specification ..... 9
  - 4.2 Serial Interface Specification ..... 10
  - 4.3 CF Card Interface Specification ..... 10
  - 4.4 eTRON Card Interface Specification ..... 11
  - 4.5 MMC or SD card interface Specification ..... 12
  - 4.6 Power supply Interface Specification ..... 13
- 5. Specifications for Power Control Function of μT-Engine Hardware ..... 14
  - 5.1 System States and their Names ..... 14
  - 5.2 Specifications for External Power Supply Control Function ..... 14
  - 5.3 Functions to handle power blackout ..... 15
- 6. Regulation and Operation of μT-Engine Hardware ..... 16
  - 6.1 About T-Engine Logo Marking ..... 16
  - 6.2 Documentation ..... 16
  - 6.3 Accreditation Standard of μT-Engine Hardware ..... 17
- 7. Expansion Board Standard ..... 18
  - 7.1 Size of Expansion Board Plate ..... 18
  - 7.2 Restricted Area for Expansion Board Implementation ..... 19
  - 7.3 Stacking Specification for the Expansion Board ..... 19

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Update history

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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, CF card connector, MMC/SD Card connector ,and eTRON connector to RoHs-compliant parts. -Change the model name of recommended parts for serial connector. -Add 16-pin connector to serial connector specification.

# 1. Overview of μT-Engine

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## 1.1 What is μT-Engine?

### (1) Features

- Open platform for real-time system of next generation and ubiquitous system
- Platform for the embedded control device or the embedded device with a relatively less resource-consuming user interface.
- CPU agnostic
- Common physical form factor (very small), and common standard interface
- T-Kernel real-time OS support

### (2) Applied Target for μT-Engine

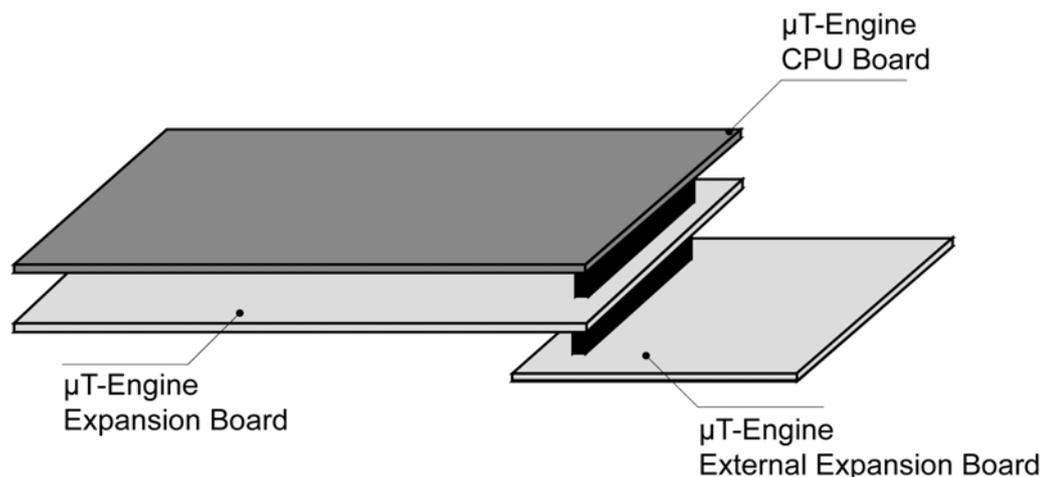
- As a reference development platform of home information appliances, in-vehicle control devices, FA, instrumentation, automatic vending machines, universal control boards, etc.
- As a training board for hardware and real-time programming

### (3) Merits of μT-Engine Application

- Allows dramatic shortening of development period due to accumulation and distribution of middleware, and distribution of peripheral extended board.

## 1.2 Entire Configuration of μT-Engine System

μT-Engine allows constructing the evaluation system or applied system itself by combining the peripheral Expansion board for the specified purpose with CPU board.



(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 a serial, CF card, MMC or SD card, eTRON card, extended bus, etc on the board.

(2) Peripheral Expansion Board

Has peripheral functions for various applications such as I/O interface for various control, and extended functions that the CPU board does not have, etc.

### 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 μT-Engine hardware

## 2. Basic Configuration of CPU Board

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(1) CPU

Basic structure: 32bit CPU (MMU(Memory Management Unit) is optional)

(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) Real-time clock (RTC)

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

(6) CF Card Interface

Complies with TYPEII 1 Slot: 50-pin CF connector mounted

(7) MMC or SD card interface

1 Slot : 9-pin connector with socket 2.1mm thick mounted

(8) Serial Interface

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

(9) Switch

The following functions are equipped with minimum rate of 4bits

- Turn on/off power
- Reset
- Switch I/O x 2

(10) Expansion Bus Interface

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

Must comply with " Expansion Connector Common Specifications"

(11) Power connector (DC jack)

Connector complies with EIAJ RC-5320A

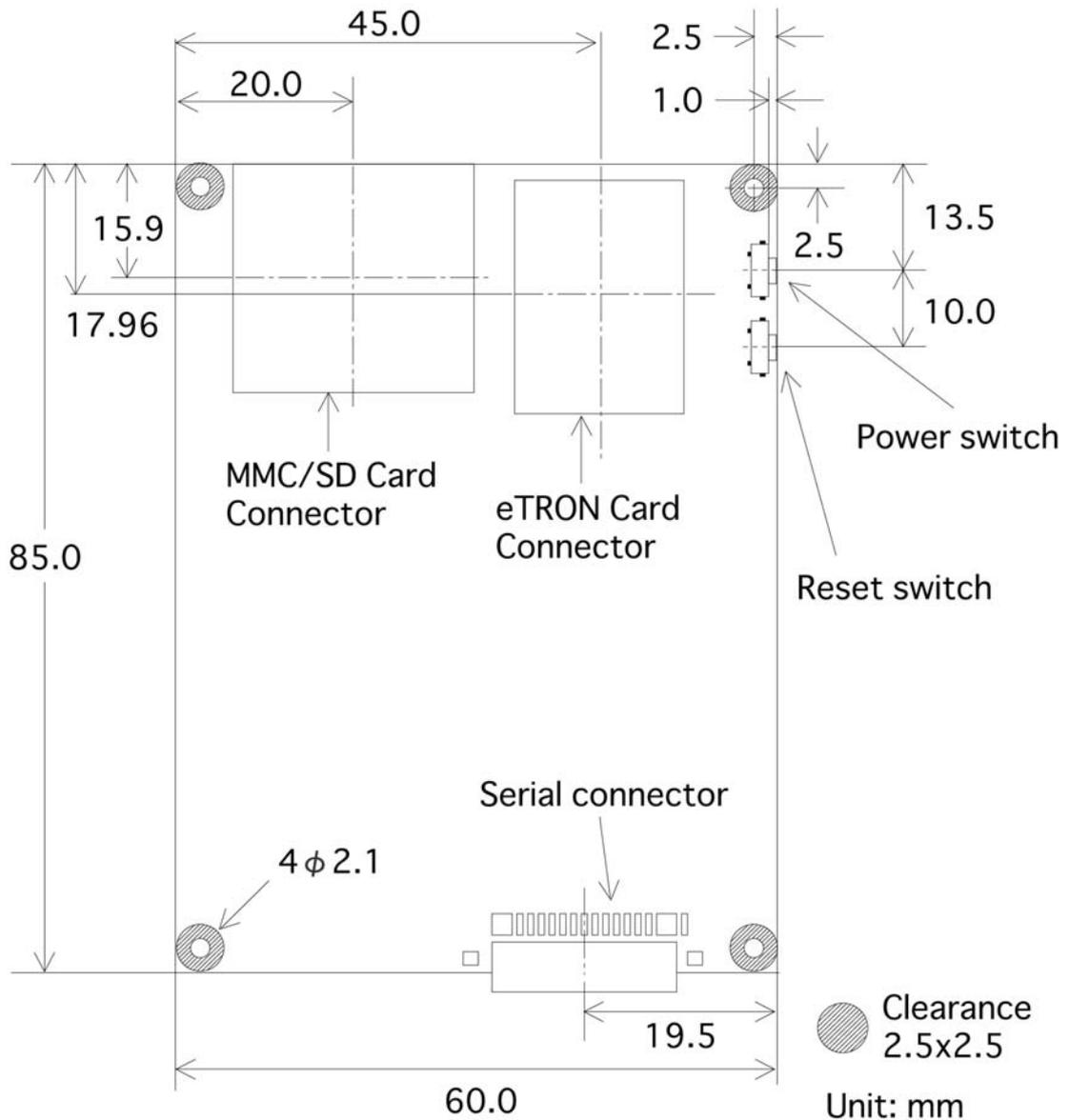
DC jack can be equipped with another board to supply for the CPU board

### 3. Implementation Specifications of CPU Board

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

- Board size: 85mm x 60mm
- 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

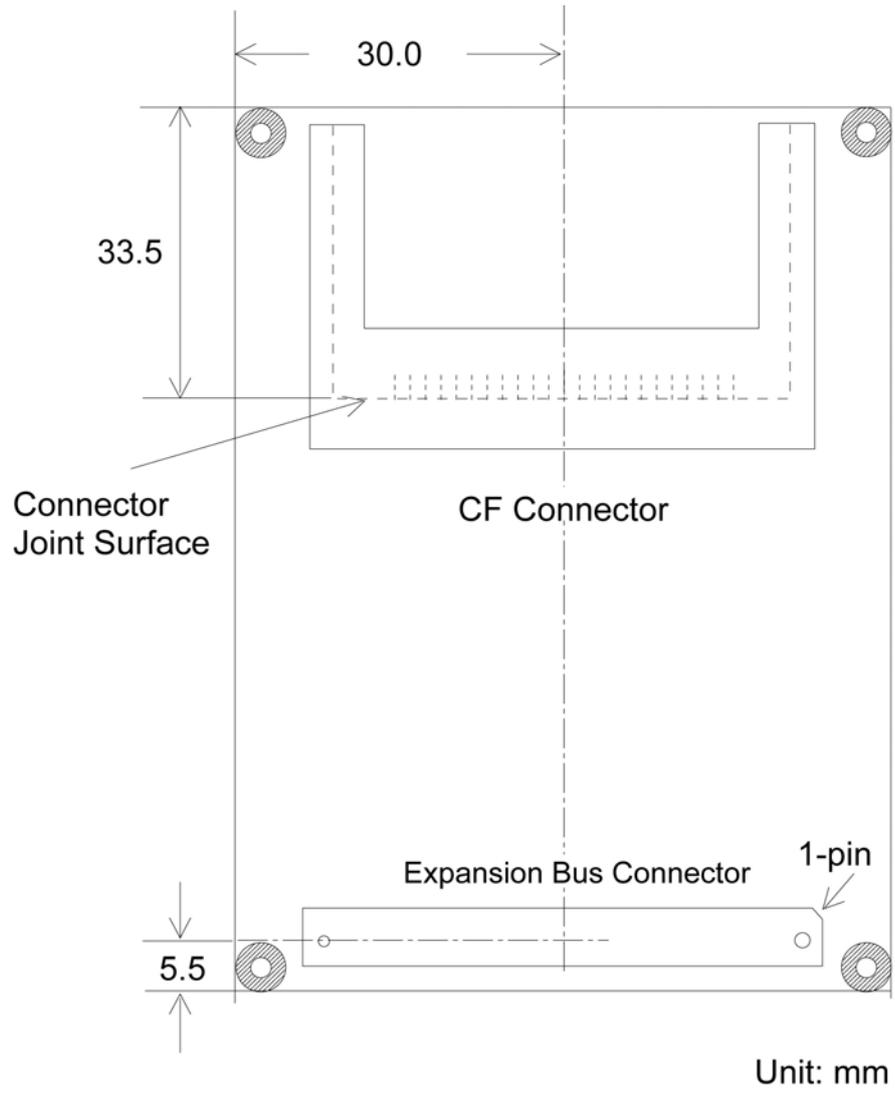


The assemble location of the above connector is described based on connector locations of all parts.

MMC/SD Card Connector

eTRON Card Connector

### 3.2 Implementation Specifications of CPU Board B side



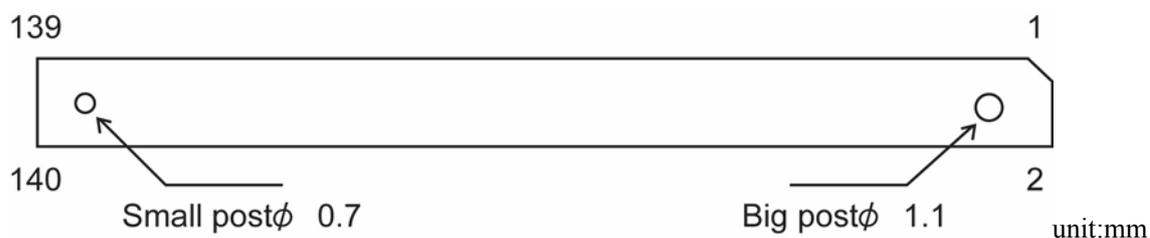
## 4. Interface Specifications of CPU Board

### 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 range: 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 to T-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

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

LX60-16S (by Hirose Electric) or other

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

### (2) Pin Assignment

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

## 4.3 CF Card Interface Specification

1 slot 50-pin connector of CF (Compact Flash) card Type II. Mainly used to extend the communication function with a network card or peripheral functions related to LAN using the CF card. Hot-swap shall be available.

### (1) Connector Specification

50-pin connector

Recommended connector:

31-5620-050-716-833+ (by KYOCERA ELCO) or other

#### 4.4 eTRON SIM Card Interface Specification

eTRON card is equipped with SIM card connector complied with "VICC-TerminalInterface" 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

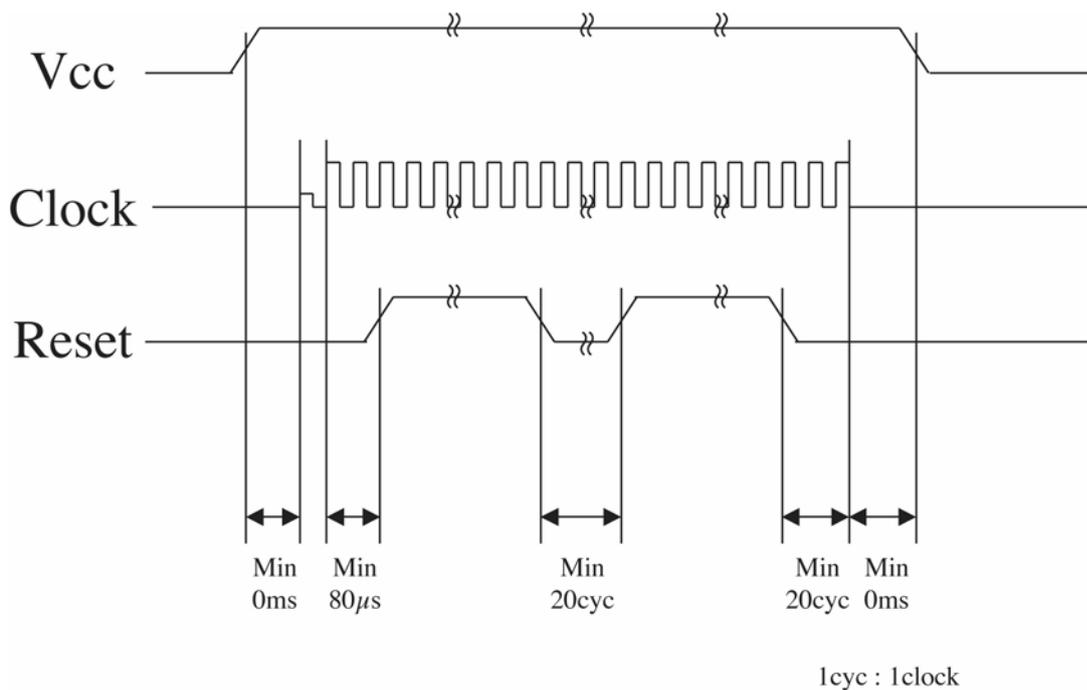
Since presence of power supply of Vcc determines whether the interface is contact or noncontact, it must have the Vcc power supply shut down function.

- 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



#### 4.5 MMC or SD card Interface Specification

1 slot 9-pin connector for MMC or SD card.

##### (1) Connector specification

9-pin connector (available for the card 2.1mm thick)

Recommended connector:

10-5738-009-783-859+ (by KYOCERA ELCO) or other

#### 4.6 Power supply Interface Specification

Power of the CPU board shall be supplied from AC-DC adaptor or battery.

(1) Connector specification

EIAJ RC5320A

Connector for voltage class 2 ( $3.15V < v_{in} < 6.3V$ )

Outer: Minus, Inner: Plus

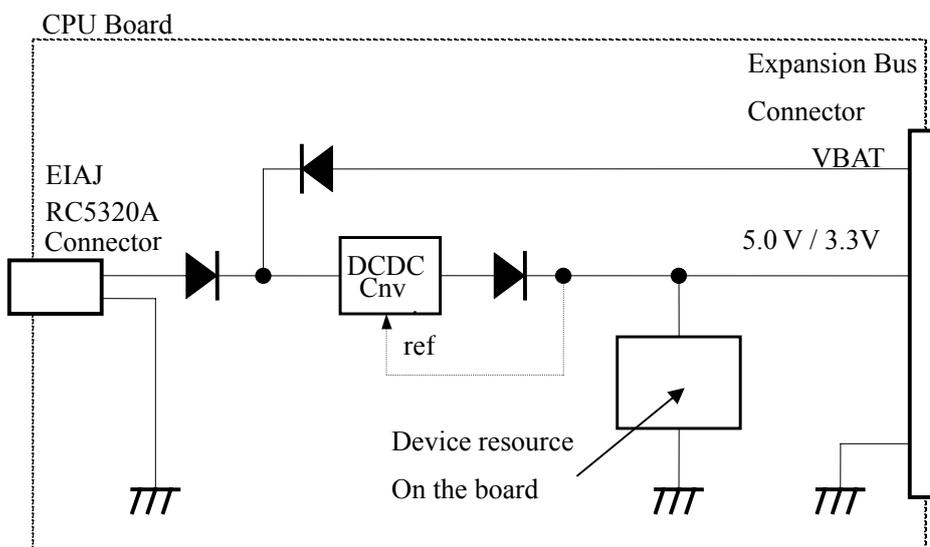
In addition, DC jack can be equipped with another board to supply for the CPU board

(2) Direction of Power Supply

VBAT pin of the extended connector shall supply the power from the extended board to the CPU board.

Other power pins shall supply the power from the CPU board to the extended board.

The following diode is recommended to be inserted into the power line.



## 5. Specifications for Power Control Function of μT-Engine Hardware

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### 5.1 System States and their Names

In terms of power control of μT-Engine, system state and naming shall be specified as follows.

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: P2-2

High speed: P3-3

### 5.2 Specifications for External Power Supply Control Function

#### (1) Power ON Control

Power ON control supports following 3 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 extended 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 μT-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 μT-Engine Hardware

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### 6.1 About μT-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 μT-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 μT-Engine Hardware

The procedure to develop the μT-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 μT-Engine to the T-Engine Forum.

(2) Product Completion

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

(3) Examination

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

1. Main body of μT-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.

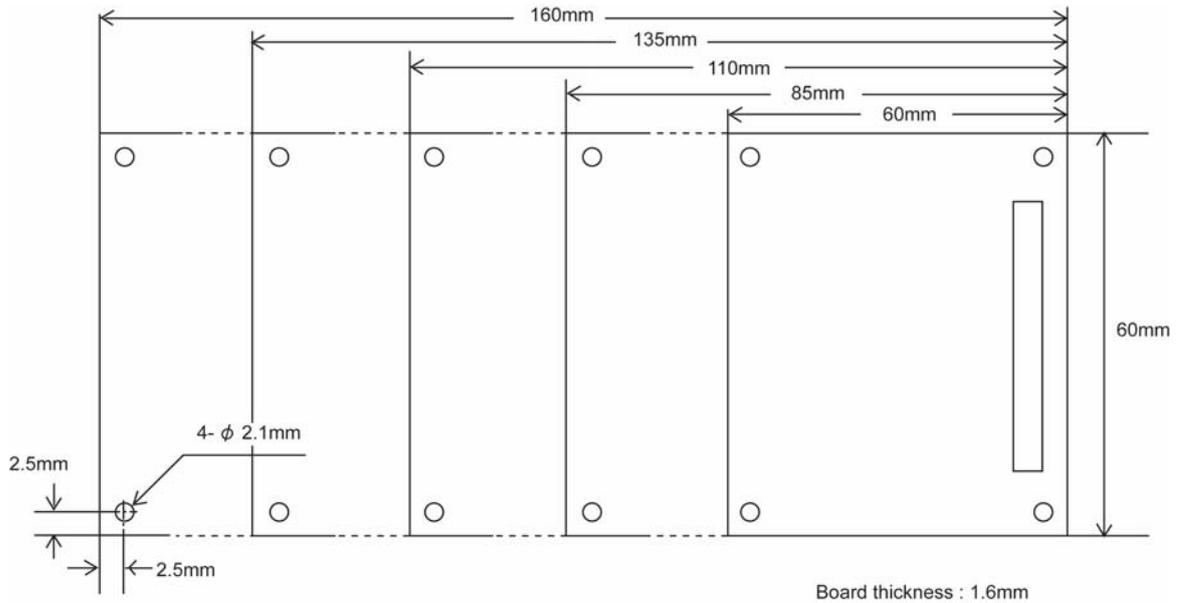
## 7. Expansion Board Standard

### 7.1 Size of Expansion Board Plate

Size of the Expansion board is shown in the figure below.

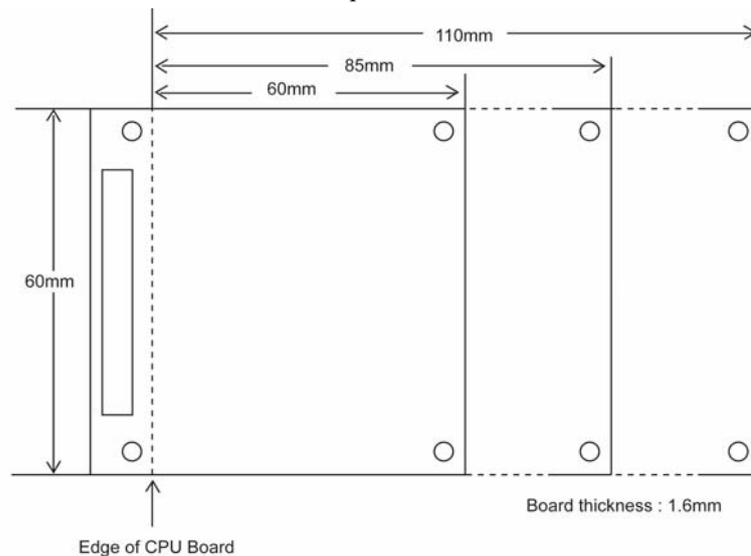
The board shall be able to extend by 25mm pitch in the longitudinal direction.

The 2.1mm fixing hole in diameter shall be established at a distance of 2.5mm from the edge of the board.



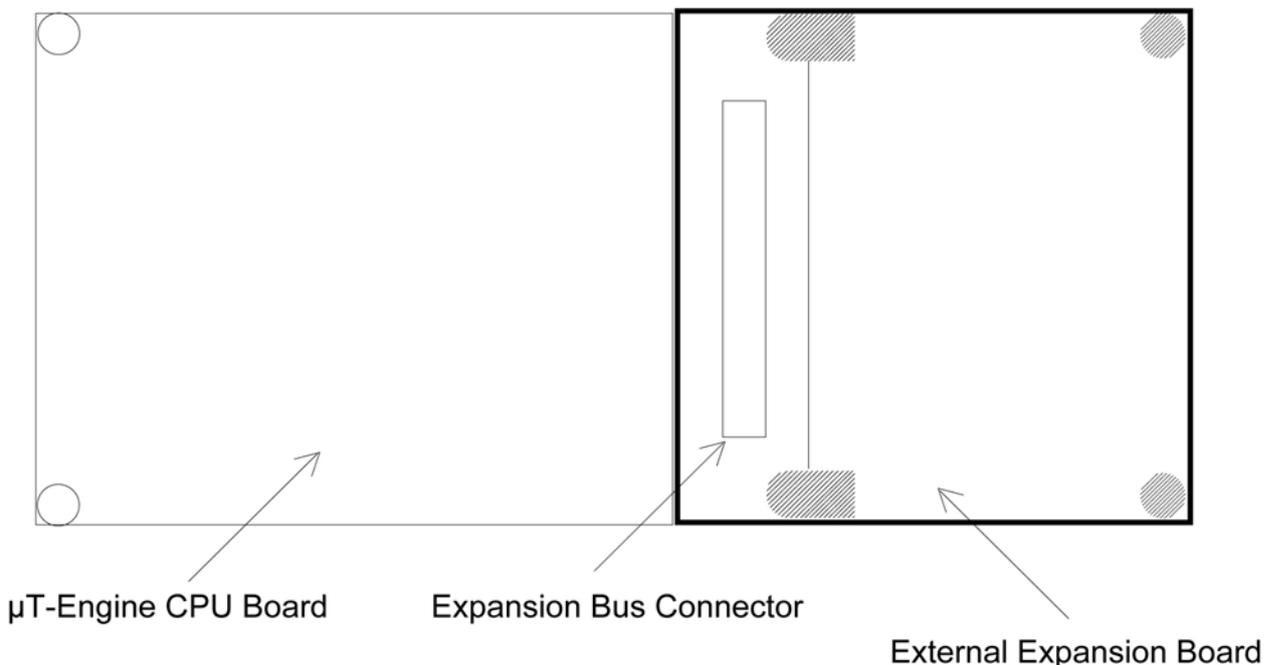
Size of the following Expansion board shall also be specified to extend it to the outer side of the μT-Engine CPU board.

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.



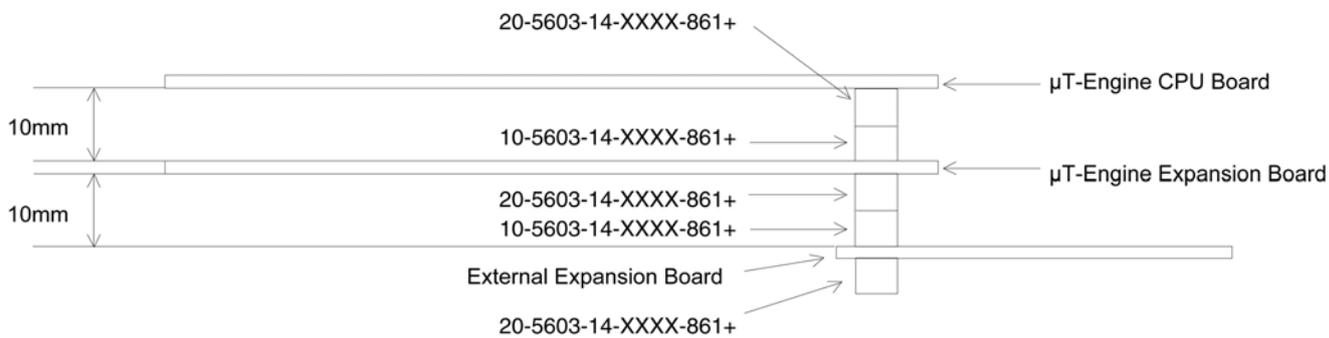
### 7.2 Restricted Area for Expansion Board Implementation

The φ5mm mounting hole for external Expansion board and the 5mm wide around its adjacent hole shall be the restricted area for implementation.



### 7.3 Stacking Specification for the Expansion Board

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



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## $\mu$ T-Engine Hardware Specification (Ver.1.01.02)

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