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# User's Manual

## SM+

### System Simulator

### User Open Interface

---

#### Target Tool

**SM+ for V850 Ver. 2.00 or later**

**SM+ for 78K0 Ver. 1.01 or later**

**SM+ for 78K0S Ver. 1.01 or later**

[MEMO]

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[MEMO]

## INTRODUCTION

**Target Readers** The contents described in this manual use the Windows™ 98/WindowsMe/Windows NT™ 4.0/Windows2000/WindowsXP™ 32-bit application program format and this manual is therefore intended for users who have experience creating Windows 98/WindowsMe/Windows NT4.0/Windows2000/WindowsXP 32-bit application programs.

**Purpose** This manual explains the simulation environmental construction means of the target system using the user open interface among the simulation environmental construction means which the system simulator SM+ is preparing.

**Organization** This manual is broadly divided into the following sections.

- OVERVIEW
- CREATING USER MODEL
- EMBEDDING USER MODEL
- FUNCTION REFERENCE
- SAMPLE PROGRAM

**How to Use This Manual** It is assumed that readers of this manual have general knowledge of microcomputers and the C programming language. Readers will need to have a basic knowledge of how to create Windows 98/WindowsMe/Windows NT 4.0/Windows2000/WindowsXP 32-bit application programs.

For information on the system as the user open interface (supplied functions) and the functions created by the user (user-defined functions):

→ Read **CHAPTER 4 FUNCTION REFERENCE**.

For information on the user open interface of SM+:

→ Read this manual in the order of the **CONTENTS**.



**Related Documents:** When using this manual, also refer to the following documents.  
 Some related documents may be preliminary versions. Note, however, that whether a related document is preliminary is not indicated in this document.

**Documents related to 78K Series development tools (User's Manual)**

Document Name		Document No.
CC78K0 Ver. 3.70 C Compiler	Operation	U17201E
	Language	U17200E
CC78K0S Ver. 1.60 C Compiler	Operation	U17416E
	Language	U17415E
RA78K0 Ver. 3.80 Assembler Package	Operation	U17199E
	Language	U17198E
	Structured Assembly Language	U17197E
RA78K0S Ver. 1.50 Assembler Package	Operation	U17391E
	Language	U17390E
	Structured Assembly Language	U17389E
SM+ System Simulator	Operation	U17662E
	User Open Interface Specifications	This manual
SM78K Series Ver. 2.52 System Simulator	Operation	U16768E
ID78K0-NS Ver. 2.52 or later Integrated Debugger	Operation	U16488E
ID78K0S-NS Ver. 2.52 or later Integrated Debugger	Operation	U16584E
ID78K0-QB Ver. 2.81 Integrated Debugger	Operation	U16996E
ID78K0S-QB Ver. 2.81 Integrated Debugger	Operation	U17287E
PM+ Ver. 6.00 Project Manager		U17178E

**Documents related to V850 Series development tools (User's Manual)**

Document Name		Document No.
CA850 Ver. 3.00 C Compiler Package	Operation	U17293E
	C Language	U17291E
	Assembly Language	U17292E
	Link Directives	U17294E
ID850 Ver. 2.50 Integrated Debugger	Operation	U16217E
ID850NW Ver. 2.51 Integrated Debugger	Operation	U16454E
ID850NWC Ver. 2.51 Integrated Debugger	Operation	U16525E
ID850QB Ver. 2.80 Integrated Debugger	Operation	U16973E
SM+ System Simulator	Operation	U17662E
	User Open Interface Specifications	This manual
SM850 Ver. 2.50 System Simulator	Operation	U16218E
SM850 Ver. 2.00 or later System Simulator	External Part User Open Interface Specifications	U14873E
RX850 Ver. 3.13 or later Real-Time OS	Basics	U13430E
	Installation	U13410E
	Technical	U13431E
RX850 Pro Ver. 3.15 Real-Time OS	Basics	U13773E
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RD850 Ver. 3.01 Task Debugger		U13737E
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AZ850 Ver. 3.20 System Performance Analyzer		U14410E
PG-FP4 Flash Memory Programmer		U15260E
TW850 Ver. 2.00 Performance Analysis Tuning Tool		U17421E
PM+ Ver. 6.00 Project Manager		U17178E

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# CHAPTER 1 OVERVIEW

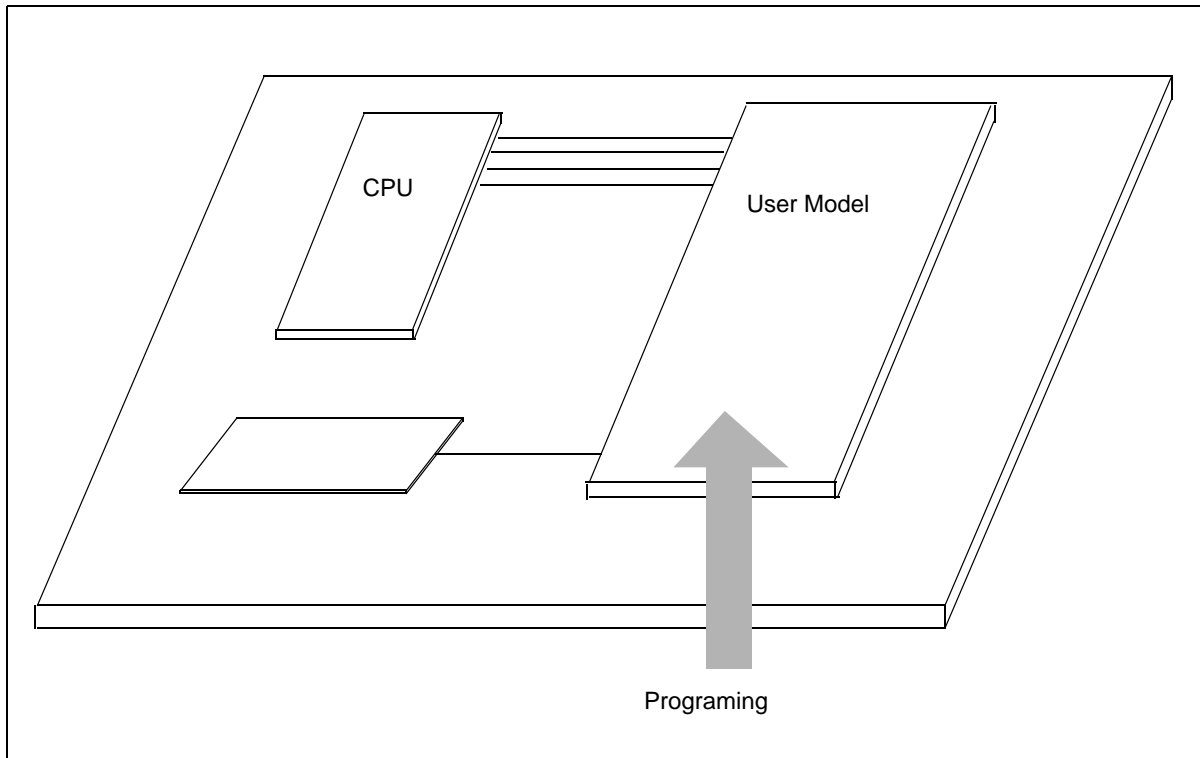
SM+ provides two ways of creating an environment where a target system, as well as a CPU (CPU core + internal peripherals), can be simulated.

One is the Parts window[**Note**], via which a user-friendly simulation environment can be organized through GUI manipulation, by supplying standard components for connection and their manipulation environment.

The other is to create the simulation environment of the target system that uses the user open interface to be explained in this manual. In this environment, functions that cannot be realized on the Parts window can be used if the user programs an external user model.

**[Note]** Refer to the SM+ Operation User's Manual (to be prepared).

Figure 1-1 Programming Image of User Model



## 1.1 Types of Interface Functions

SM+ user open interface supplies the following types of interface functions (for details, refer to "[CHAPTER 4 FUNCTION REFERENCE](#)").

Table 1-1 Types of Functions Supplied by User Open Interface

Type	Description and Major Functions
Basic interface function	Basic function of simulation - Initialization notification - Reset notification, etc.
Time interface function	Cyclic timer function for time-series processing of model - Setting of timer - Clearing of timer - Notification of timer time, etc.
Pin interface function	Pin I/O function - Signal output to pin - Notification of signal input to pin
External bus interface function	Slave function of external bus - External bus read access notification - External bus write access notification, etc.
Serial interface function	Serial transmission/reception function - Transmission of serial data - Notification of reception of serial data, etc.
Signal output unit interface function	Function to output signals in accordance with signal data file - Signal output in accordance with signal data file, etc.

**Caution** When using the external bus interface function, the external memory area must be mapped with the Target attribute specified in the Configuration Dialog Box (refer to the SM+ Operation User's Manual).



## 1.2 Interface Methods

SM+ user open interface has the following interface methods.

### 1.2.1 C-language interface

The SM+ user open interface consists of a C-language API function **[Note]** set.

Therefore, program the user model in C language to create the environment in which to simulate the target system.

**[Note]** Application Program Interface

### 1.2.2 Callback function method

The callback function method is that a user program(user model) is called by the system(CPU) when it is necessary.

This method uses the pointer to the function which is defined on the user program(user model). The system(CPU) calls the user program (user model) by using this pointer.

The SM+ user open interface uses this callback function method as a means to call a user program from the system.

While the provided API functions call the system from the user program, the callback function is used to call the user program from the system, such as when inputting a signal to a pin.

### 1.2.3 Event-driven method

The SM+ user open interface uses an event-driven method in which processing is described in accordance with occurrence of events.

For example, a callback function prepared on the user model side is called if an event such as initialization of simulation, resetting the CPU, signal output to a pin, or access to the external bus occurs on the SM+ main body side. In addition, a time interface (= timer function) provided to perform time-series processing of a user model also calls a callback function prepared on the user model side when the specified time has elapsed.

## 1.3 Development Environment

Use the following development tools to perform programming with the SM+ user open interface and create a DLL file.

- Microsoft Visual C++ V6.00 or later

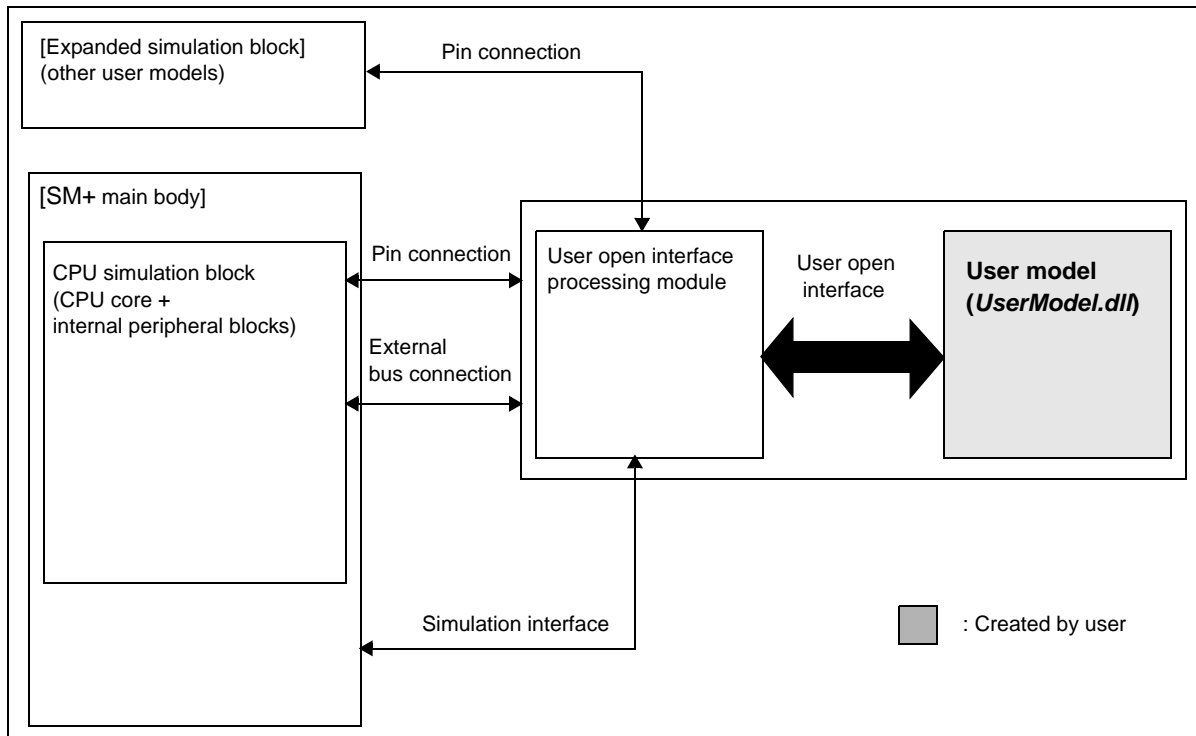
# CHAPTER 2 CREATING USER MODEL

This chapter explains how to create a user model.

## 2.1 Program Configuration

The following figure shows the program configuration when the SM+ user open interface is used to expand a system.

Figure 2-1 Program Configuration



To expand a system, a user model must be created first.

Because the user model operates in conjunction with the simulation system, it interfaces with the user open interface processing module. This interface is the user open interface.

The user model generates resources such as pins and external bus slaves via the user open interface during configuration (processing to configure the simulator that is performed when the SM+ is started). By connecting the pins and external bus slaves to the pins and external bus masters of the CPU simulation block, signals can be input to or output from the pins of the CPU simulation block and the external bus can be accessed from the CPU simulation block.

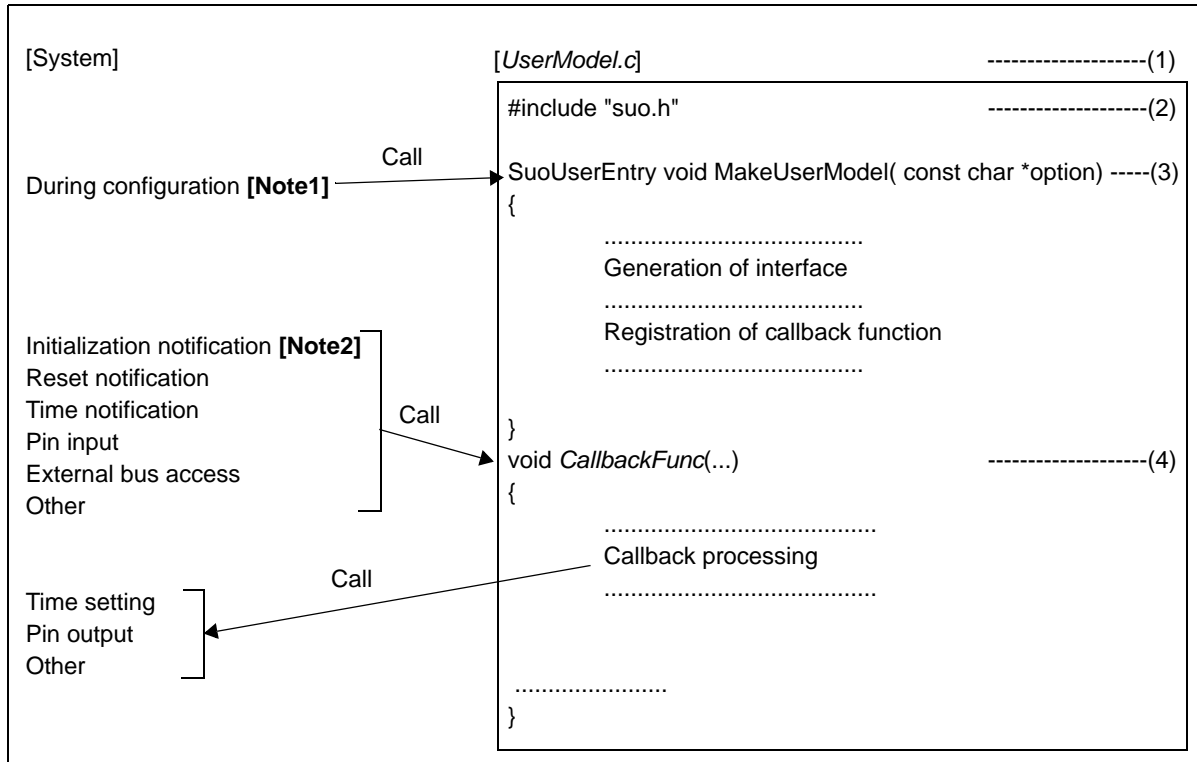
The generated pins and external bus slaves can also be connected to the expansion simulation block (other user models), as well as to the CPU simulation block.

## 2.2 Outline of Programming

The user model is programmed in the dynamic link library (DLL) format of WIN32.

The template of a program file is shown below.

Figure 2-2 Template of Program File



**[Note1]** "Configuration" means simulator configuration processing that is executed when SM+ is started.

**[Note2]** "An initialization notification is reported only once, immediately after SM+ is started when simulator configuration processing has been completed.

## 2.3 Programming Details

Items (1) to (4) in [Figure 2-2](#) are explained in detail below.

### (1) File name

(1) is the filename.

The suffix for a C-language file is "\*.c". The file name can be determined freely.

### (2) Include file

(2) is an include file.

To use the user open interface, the system header file "suo.h" must be included.

### (3) MakeUserModel function

(3) is the [MakeUserModel](#) function that is called from the system during configuration of SM+.

The name of this function must be "MakeUserModel". (Refer to "[4.2 User-Defined Functions](#)".)

### Specification format

```
SuoUserEntry void MakeUserModel( const char *option);
```

The following two types of processing are described in this function.

#### - Interface generation

Because SM+ connects pins and buses during configuration processing when it is started, resources such as pins and buses that are to be connected during configuration must be generated.

To do this, call a function that generates an interface in the [MakeUserModel](#) function and generate an interface. The necessary resources will be also generated.

#### - Registering callback function

Callback functions can be registered as necessary.

**Caution** When describing a callback function for initialization, be sure to register it at this time; otherwise callback will not function. This is because initialization notification is reported immediately after the [MakeUserModel](#) function is called.

### (4) Callback function

(4) is a callback function.

A function that is called from the system is called a callback function.

Two or more callback functions, such as those for initialization notification, reset notification, time notification, pin input, and external bus access, can be created. (Refer to "[4.1 List of Supplied Functions](#)".)

A callback function that has been created must be registered in advance so that it can be called from the system.

The name of a callback function can be determined freely, and the format of the function differs depending on the type of callback. Describe processing in accordance with the callback contents in the callback function.

## 2.4 Example of Program File

Figure 2-3 Example of Program File

```

#include "suo.h"
#include <memory.h>

void Init(void);
void InputP00(SuoHandle handle, int pinValue);
void ReadBUS1(SuoHandle handle, unsigned long addr, int accessSize, unsigned char data[]);
void WriteBUS1(SuoHandle handle, unsigned long addr, int accessSize, const unsigned char data[]);

SuoHandle p00;
SuoHandle p01;
SuoHandle bus1;
unsigned char mem[0x100];

/* MakeUserModel */
SuoUserEntry void MakeUserModel( const char *option)
{
    SuoCreatePin("P00", &p00);
    SuoCreatePin("P01", &p01);
    SuoCreateExtbus("BUS1", 0x200000, 0x100, &bus1);

    SuoSetInitCallback(Init);
    SuoSetInputDigitalPinCallback(p00, InputP00);
    SuoSetReadExtbusCallback(bus1, ReadBUS1);
    SuoSetWriteExtbusCallback(bus1, WriteBUS1);
}

/* callbacks */
void Init(void)
{
    memset(mem, 0, 0x100);
}

void InputP00(SuoHandle handle, int pinValue)
{
    SuoOutputDigitalPin(p01, pinValue);
}

void ReadBUS1(SuoHandle handle, unsigned long addr, int accessSize, unsigned char data[])
{
    memcpy(data, &mem[addr-0x200000], accessSize);
}

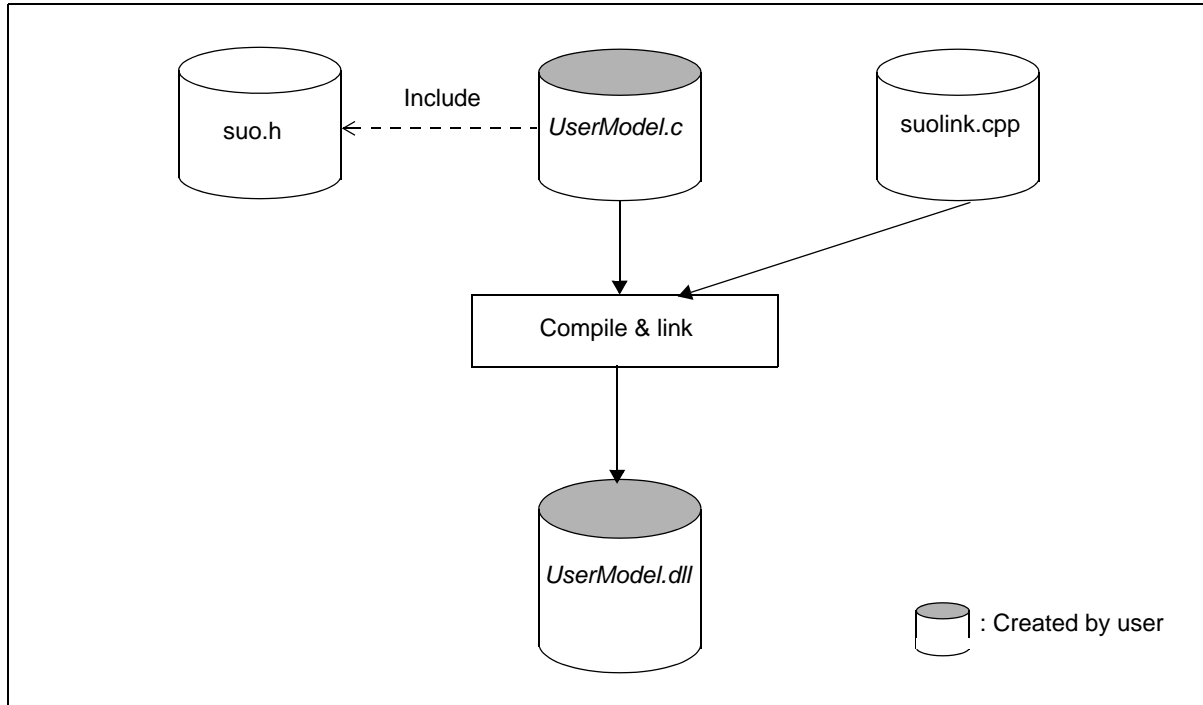
void WriteBUS1(SuoHandle handle, unsigned long addr, int accessSize, const unsigned char data[])
{
    memcpy(&mem[addr-0x200000], data, accessSize);
}

```

## 2.5 Compilation and Linking

The following figure shows the flow of compilation and linking.

Figure 2-4 Flow of Compilation and Linking



By compiling and linking the above files, *UserModel.dll* is created from *UserModel.c* and *suolink.cpp*.

Table 2-1 File

File Name	Description
<i>suo.h</i>	<i>suo.h</i> is a system header file for the user open interface. This file is included by the user program ( <i>UserModel.c</i> ) but is not compiled.
<i>suolink.cpp</i>	<i>suolink.cpp</i> is a file that performs dynamic link processing with the user open interface processing module of the system.
<i>UserModel.c</i>	<i>UserModel.c</i> is the source file of the user model to be created. The file name can be determined freely.
<i>UserModel.dll</i>	<i>UserModel.dll</i> is a binary file of the user model (DLL file). The file name can be determined freely.

**Caution** To execute a DLL file in an environment in which Microsoft Visual C++ is not installed, the DLL file must be created using the release version.

# CHAPTER 3 EMBEDDING USER MODEL

This chapter explains how to embed the created user model (*UserModel.dll*) in SM+, which is done using the configuration file.

## 3.1 Configuration File

The configuration file is used by a user to customize (add a user model to) SM+.

When using the user open interface, first create a copy of the configuration file, and then edit it.

The standard configuration file is stored in the following directory (on the assumption that SM+ has been installed in drive C).

SM+ (earlier than V2.00)	C:\<installation folder>\bin\smplus.cfg
SM+ with multiple-version installation function (V2.00 or later)	C:\<installation folder>\<product name (generic name)>\<version number>\bin\smplus.cfg

**Remark** The default *installation folder* is as follows.

SM+ (earlier than V2.00): NECTools32

SM+ with multiple-version installation function (V2.00 or later): Program Files\NEC Electronics Tools



## 3.2 Description in Configuration File

Describe the user model generation processing and processing to connect pins and an external buses in the configuration file.

### 3.2.1 Creation

```
UserModel1 = Device("USEROPEN", "UserModel1.dll UserOption1");
```

The Device function is used to create a user model.

"USEROPEN" is a user open interface processing module (system module).

*UserModel1.dll* is the binary file (DLL format) of the user model to be created. The file name can be determined freely by the user.

Specify a relative path or absolute path from the folder where the configuration file exists as the file path.

*UserOption1* is an option character string for *UserModel1.dll*. This character string is passed to the "option" parameter of the [MakeUserModel](#) function as is.

*UserModel1* is a variable that indicates the generated user model. The variable name can be determined freely by the user.

### 3.2.2 Pin connection

```
wire1 = Wire(1); --- (1)
wire1 += cpu.Port("PinName1"); --- (2)
wire1 += UserModel1.Port("UserPinName1"); --- (3)
```

Pins are connected in the following sequence.

#### (1) Generate a wire (= line that connects pins) by using the Wire function.

Be sure to specify 1 for the argument of the Wire function.

*wire1* is a variable that indicates the generated wire. The variable name can be determined freely.

#### (2) Connect one end of the wire to a pin of the CPU.

Specify the external CPU pin to be connected as "*PinName1*". Enclose the pin name between double quotation marks (" ").

#### (3) Connect the other end of the wire to a pin of the user model.

*UserModel1* is a variable that indicates the generated user model.

Specify the name of the user model pin to be connected as "*UserPinName1*" (pin name generated in the [MakeUserModel](#) function). Enclose the pin name between double quotation marks (" ").

To connect two or more user model pins to the same wire, add this line.

### 3.2.3 External bus connection

<code>extbus1 = BUS(<i>n</i>);</code>	--- (1)
<code>extbus1 += cpu.BusMasterIF("EXTBUS");</code>	--- (2)
<code>extbus1 += UserModel1.BusSlaveIF("UserExtbusName1");</code>	--- (3)

An external bus is connected in the following sequence.

**(1) Generate a bus by using the BUS function.**

Argument *n* of the bus function is the data bus bit width. This may be 8, 16, or 32.

*extbus1* is a variable that indicates the generated bus. The variable name can be determined freely.

**(2) Connect one end of the bus to the external bus master of the CPU.**

Specify the external bus master "EXTBUS" for the argument.

**(3) Connect the other end of the bus to the external bus of the user model.**

*UserModel1* is a variable that indicates the generated user model.

Specify the name of the external bus of the user model to be connected as "*UserExtbusName1*" (the external bus name generated in the [MakeUserModel](#) function). Enclose the external bus name between double quotation marks (" "). Add this line to connect two or more user model external buses.

### 3.2.4 Other (Connection of main clock notification pin and reset notification pin)

In addition to the above, the formulaic connection of the main clock notification pin to the reset notification pin shown below is required to operate the user open interface.

<code>clock1 = Wire(1);</code>	--- (1)
<code>clock1 += cpu.DebuggerPseudoPort("debugger_pseudo_pin_main_clkout");</code>	--- (2)
<code>clock1 += UserModel1.Port("gui_pseudo_pin_clock_notice");</code>	--- (3)
<code>reset1 = Wire(1);</code>	--- (4)
<code>reset1 += cpu.DebuggerPseudoPort("debugger_pseudo_pin_reset_notice");</code>	--- (5)
<code>reset1 += UserModel1.Port("gui_pseudo_pin_reset_notice");</code>	--- (6)

The main clock notification pin and reset notification pin are connected in the following sequence.

**(1) Generate a wire (= line that connects pins) by using the Wire function.**

Be sure to specify 1 for the argument of the Wire function.

`clock1` is a variable that indicates the generated wire. The variable name can be determined freely.

**(2) Connect one end of the wire to the debugger's main clock notification pin.**

Specify "debugger\_pseudo\_pin\_main\_clkout" for the argument.

**(3) Connect the other end of the wire to a pin of the user model.**

`UserModel1` is a variable that indicates the generated user model. Specify "gui\_pseudo\_pin\_clock\_notice" for the argument.

**(4) Generate a wire (= line that connects pins) by using the Wire function.**

Be sure to specify 1 for the argument of the Wire function.

`reset1` is a variable that indicates the generated wire. The variable name can be determined freely.

**(5) Connect one end of the wire to the debugger's reset notification pin.**

Specify "debugger\_pseudo\_pin\_reset\_notice" for the argument.

**(6) Connect the other end of the wire to a pin of the user model.**

`UserModel1` is a variable that indicates the generated user model. Specify "gui\_pseudo\_pin\_reset\_notice" for the argument.

### 3.3 Example of Configuration File Description

Table 3-1 shows an example of the configuration file description.

In this example, the following connection processing is performed.

Table 3-1 Connection in Sample Configuration File

Type of Connection	CPU		User Model (SampleModel.DLL)	
Pin	" P00/INTP0 "	(P00 pin)	" P00 "	(Pin manipulating P00)
	" P30/TXD1 "	(Serial output pin)	" RXD "	(Serial input pin)
	" P31/RXD1 "	(Serial input pin)	" TXD "	(Serial output pin)
External bus	" EXTBUS "	(External bus master)	" EXTBUS1 "	(External bus slave 1)
	" EXTBUS "	(External bus master)	" EXTBUS2 "	(External bus slave 2)

Figure 3-1 Example of Description in Configuration File

```
cpu = CPU('a');
# -----
# SampleModel description
# -----

# Generate SampleModel.dll
model = Device("USEROPEN", "SampleModel.dll -a -b");

# Connect PIN (CPU.P00-MODEL.P00)
wire_P00 = Wire(1);
wire_P00 += cpu.Port("P00/INTP0");
wire_P00 += model.Port("P00");

# Connect PIN (CPU.TXD1-MODEL.RXD)
wire_RXD = Wire(1);
wire_RXD += cpu.Port("P30/TXD1");
wire_RXD += model.Port("RXD");

# Connect PIN (CPU.RXD1-MODEL.TXD)
wire_TXD = Wire(1);
wire_TXD += cpu.Port("P31/RXD1");
wire_TXD += model.Port("TXD");

# Connect BUS (CPU.EXTBUS-MODEL.EXTBUS1)
extbus = BUS(32);
extbus += cpu.BusMasterIF("EXTBUS");
extbus += model.BusSlaveIF("EXTBUS1");
extbus += model.BusSlaveIF("EXTBUS2");

# Connect Pseudo PIN
wire_clock = Wire(1);
wire_clock += cpu.DebuggerPseudoPort("debugger_pseudo_pin_main_clkout");
wire_clock += model.Port("gui_pseudo_pin_clock_notice");
wire_reset = Wire(1);
wire_reset += cpu.DebuggerPseudoPort("debugger_pseudo_pin_reset_notice");
wire_reset += model.Port("gui_pseudo_pin_reset_notice");
```

# CHAPTER 4 FUNCTION REFERENCE

This chapter shows the functions supplied by the system as the user open interface (refer to "Table 4-1 Supplied Functions") and the functions created by the user (refer to "Table 4-3 User-Defined Functions").

## 4.1 List of Supplied Functions

The supplied functions are listed below.

Table 4-1 Supplied Functions

Function Name	Description	Remark
<b>Basic interface functions</b>		
<a href="#">SuoSetInitCallback</a>	Registers initialization callback	<b>Note2</b>
<a href="#">SuoSetResetCallback</a>	Registers reset callback	-
<a href="#">SuoGetMainClock</a>	Acquires the cycle of the main clock for simulation	<b>Note3</b>
<b>Time interface functions</b>		
<a href="#">SuoCreateTimer</a>	Generates timer	<b>Note1</b>
<a href="#">SuoGetTimerHandle</a>	Acquires timer handle	-
<a href="#">SuoSetTimer</a>	Sets timer time	<b>Note3</b>
<a href="#">SuoKillTimer</a>	Cancel timer time	<b>Note3</b>
<a href="#">SuoSetNotifyTimerCallback</a>	Registers timer time notification callback	-
<b>Pin interface function</b>		
<a href="#">SuoCreatePin</a>	Generates pin	<b>Note1</b>
<a href="#">SuoGetPinHandle</a>	Acquires pin handle	-
<a href="#">SuoOutputDigitalPin</a>	Outputs digital pin value	<b>Note3</b>
<a href="#">SuoOutputAnalogPin</a>	Outputs analog pin value	<b>Note3</b>
<a href="#">SuoOutputHighImpedance</a>	Outputs high-impedance for the pin	<b>Note3</b>
<a href="#">SuoSetInputDigitalPinCallback</a>	Registers digital pin value input callback	-
<a href="#">SuoSetInputAnalogPinCallback</a>	Registers analog pin value input callback	-
<a href="#">SuoSetInputHighImpedanceCallback</a>	Registers pin high-impedance state report callback	-
<b>External bus interface functions</b>		
<a href="#">SuoCreateExtbus</a>	Generates external bus	<b>Note1</b>
<a href="#">SuoGetExtbusHandle</a>	Acquires external bus handle	-
<a href="#">SuoSetReadExtbusCallback</a>	Registers external bus read access callback	-

Table 4-1 Supplied Functions

Function Name	Description	Remark
<a href="#">SuoSetWriteExtbusCallback</a>	Registers external bus write access callback	-
<b>Serial interface functions</b>		
<a href="#">SuoCreateSerialUART</a>	Generates serial interface (UART type)	<b>Note1</b>
<a href="#">SuoCreateSerialCSI</a>	Generates serial interface (CSI type)	<b>Note1</b>
<a href="#">SuoGetSerialHandle</a>	Acquires serial interface handle	-
<a href="#">SuoSetSerialParameterUART</a>	Sets serial interface parameter (UART type)	<b>Note3</b>
<a href="#">SuoSetSerialParameterCSI</a>	Sets serial interface parameter (CSI type)	<b>Note3</b>
<a href="#">SuoGetSerialParameterUART</a>	Acquires serial interface parameter (UART type)	<b>Note3</b>
<a href="#">SuoGetSerialParameterCSI</a>	Acquires serial interface parameter (CSI type)	<b>Note3</b>
<a href="#">SuoSendSerialData</a>	Performs serial transmission (1 data)	<b>Note3</b>
<a href="#">SuoSendSerialDataList</a>	Performs serial transmission (more than one data)	<b>Note3</b>
<a href="#">SuoSendSerialFile</a>	Performs serial transmission (serial file)	<b>Note3</b>
<a href="#">SuoSetNotifySentSerialCallback</a>	Registers serial interface transmission end notification callback	-
<a href="#">SuoSetReceiveSerialCallback</a>	Registers serial interface reception callback	-
<b>Signal output unit interface functions</b>		
<a href="#">SuoCreateWave</a>	Generates signal output unit	<b>Note1</b>
<a href="#">SuoGetWaveHandle</a>	Acquires signal output unit handle	-
<a href="#">SuoSendWaveFile</a>	Performs transmission via signal output unit (signal data file)	<b>Note3</b>
<a href="#">SuoSetNotifySentWaveCallback</a>	Registers signal output unit transmission end notification callback	-

**[Note1]** This function can only be called in the [MakeUserModel](#) function. It cannot be called in a callback function.

**[Note2]** A callback function is not executed unless it is called in the [MakeUserModel](#) function.

**[Note3]** This function cannot be called in the [MakeUserModel](#) function. It can only be called in a callback function.

#### 4.1.1 Details of supplied functions

This section shows how to reference the supplied functions.

## SuoSetInitCallback

Initialization callback registration

```
void SuoSetInitCallback(SuoInitCallback func);
```

### Parameters

<i>func</i>	Specifies a pointer to the user-defined function that performs initialization processing. (Refer to " <a href="#">InitFunc</a> ".)
-------------	--

### Return value

None

### Explanation

This function registers the user-defined function that performs initialization processing.

The function registered by this function is called only once, when SM+ is started.

If NULL is specified for *func*, registration is canceled.

### Example

```
void InitFunc(void);

/* MakeUserModel */
SuoUserEntry void MakeUserModel(const char *option)
{
    .....
    SuoSetInitCallback(InitFunc);    /* Set initialize function */
}

/* Initialize function */
void InitFunc(void){
    .....
}
```



## SuoSetResetCallback

Reset callback registration

```
void SuoSetResetCallback(SuoResetCallback func);
```

### Parameters

<i>func</i>	Specifies a pointer to the user-defined function that performs reset processing. (Refer to " <a href="#">ResetFunc</a> ".)
-------------	--

### Return value

None

### Explanation

This function registers the user-defined function that performs reset processing.

The registered function is called when the CPU is reset.

If NULL is specified for *func*, registration is canceled.

### Example

```
void ResetFunc(void);

void func1(void)
{
    .....
    SuoSetResetCallback(ResetFunc);    /* Set reset function */
}

/* Reset function */
void ResetFunc(void){
    .....
}
```

---

## SuoGetMainClock

Acquisition of main clock cycle for simulation

---

---

```
int SuaGetMainClock(unsigned long* time);
```

---

### Parameters

<i>time</i>	Specifies the location where the main clock cycle value (unit: pS) is to be stored.
-------------	---

---

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

---

### Explanation

This function is used to acquire the cycle of the main clock for the simulation environment currently being executed.

---

### Example

```
unsigned long time;

void func1(void)
{
    .....
    SuaGetMainClock(&time);      /* Get main clock */
}
```

## SuoCreateTimer

Timer generation

```
int SuaCreateTimer(const char* timerName, SuaHandle* handle);
```

### Parameters

<i>timerName</i>	Specifies the name of the timer interface.
<i>handle</i>	Specifies the location where the handle of the timer interface is to be stored.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function generates a timer interface.

The generated timer interface is associated with the name specified for *timerName*.

If this function is successful, the handle of the generated timer interface can be obtained.

The timer interface can then be controlled by specifying this handle.

The handle can also be obtained by using the [SuoGetTimerHandle](#) function.

This function can only be called in the [MakeUserModel](#) function. An error occurs if it is called at any other timing.

### Example

```
SuaHandle hTim1;

SuoUserEntry void MakeUserModel(const char *option)
{
    .....
    SuaCreateTimer("TIM1", &hTim1);      /* Create "TIM1" */
}
```

## SuoGetTimerHandle

Timer handle acquisition

```
SuoHandle SuaGetTimerHandle(const char* timerName);
```

### Parameters

<i>timerName</i>	Specifies the name of the timer interface.
------------------	--

### Return value

If this function is successful, the handle of the specified timer interface is returned.

If this function fails, NULL is returned.

### Explanation

This function is used to obtain the handle of the specified timer interface.

If this function is successful, the handle of the specified timer interface is returned.

Specify the name specified by the [SuoCreateTimer](#) function as *timerName*.

If a different name is specified, NULL is returned.

### Example

```
SuoHandle hTim1;

void func1(void)
{
    .....
    hTim1 = SuaGetTimerHandle("TIM1");    /* Get handle of "TIM1" */
}
```

## SuoSetTimer

Timer time setting

```
int SuoSetTimer(SuoHandle handle, int timeUnit, unsigned long timeValue);
```

### Parameters

<i>handle</i>	Specifies the handle of the timer interface.	
<i>timeUnit</i>	Specifies the time unit (specify any of the following).	
	Value	Meaning
	SUO_MAINCLK	Main clock cycle units
	SUO_USEC	ms units
<i>timeValue</i>	Specifies the timer cycle time. The unit is the same as <i>timeUnit</i> .	

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function sets a cyclic timer for the specified timer interface.

The cycle time is specified by the value of *timeValue* in units of *timeUnit*. Zero must not be specified for *timeValue*.

The timer starts operating immediately after this function is called.

If a timer notification function has been registered by the [SuoSetNotifyTimerCallback](#) function, the timer notification function is called in each cycle.

The timer continues operating until it is stopped by the [SuoKillTimer](#) function.

If this function is called for the timer that is currently operating, the timer is reset and starts operating with the specified cycle time.

### Example

```
SuoHandle hTim1;

void func1(void)
{
    .....
    SuoSetTimer(hTim1, SUO_USEC, 20);    /* Invoke 20us cyclic timer */
}
```

---

## SuoKillTimer

Timer time cancellation

---

---

```
int SuoKillTimer(SuoHandle handle);
```

---

### Parameters

---

<i>handle</i>	Specifies the handle of the timer interface.
---------------	--

---

### Return value

---

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

---

### Explanation

---

This function stops the cyclic timer of the specified timer interface.

If the timer is operating, the timer is stopped. If the timer is stopped, nothing is done (in this case, an error does not occur).

---

### Example

---

```
SuoHandle hTim1;  
  
void func1(void)  
{  
    .....  
    SuoKillTimer(hTim1);          /* Stop timer */  
}
```

## SuoSetNotifyTimerCallback

Timer time notification callback registration

```
int SuaSetNotifyTimerCallback(SuoHandle handle, SuaNotifyTimerCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the timer interface.
<i>func</i>	Specifies a pointer to the user-defined function that reports the time of the timer. (Refer to " <a href="#">NotifyTimerFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function registers a user-defined function that performs processing when the time of the timer is reported.

The registered function is called in every timer cycle of the specified timer interface.

If NULL is specified for *func*, registration is canceled.

### Example

```
void NotifyTimerFunc(SuoHandle handle);
SuoHandle hTim1;

void func1(void)
{
    .....
    SuaSetNotifyTimerCallback(hTim1, NotifyTimerFunc);    /* Set notify-timer function */
}

/* Notify-timer function */
void NotifyTimerFunc(SuoHandle handle)
{
    .....
}
```

## SuoCreatePin

Pin generation

```
int SuaCreatePin(const char* pinName, SuaHandle* handle);
```

### Parameters

<i>pinName</i>	Specifies the name of the pin.
<i>handle</i>	Specifies the location where the handle of a pin interface is to be stored.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function generates a pin interface.

The generated pin interface is associated with the name specified for *pinName*.

Also, the pin specified as *pinName* is generated.

If this function is successful, the handle of the generated pin interface can be obtained.

The pin interface can then be controlled by specifying this handle. The handle can also be obtained by using the [SuoGetPinHandle](#) function.

This function can only be called in the [MakeUserModel](#) function. An error occurs if it is called at any other timing.

### Example

```
SuoHandle hPinP00;
SuoHandle hPinABC;

SuoUserEntry void MakeUserModel(const char *option)
{
    .....
    SuaCreatePin("P00", &hPinP00);          /* Create "P00" */
    SuaCreatePin("ABC", &hPinABC);         /* Create "ABC" */
}
```



## SuoGetPinHandle

Pin handle acquisition

```
SuoHandle SuoGetPinHandle(const char* pinName);
```

### Parameters

<i>pinName</i>	Specifies the name of the pin.
----------------	--------------------------------

### Return value

If this function is successful, the handle of the specified pin interface is returned.

If this function fails, NULL is returned.

### Explanation

This function is used to obtain the handle of the specified pin interface.

If this function is successful, the handle of the specified pin interface is returned.

Specify the name of a function specified by the [SuoCreatePin](#) function as *pinName*.

If a different name is specified, NULL is returned.

### Example

```
SuoHandle hPinP00;

void func1(void)
{
    .....
    hPinP00 = SuoGetPinHandle("P00");    /* Get handle of "P00" */
}
```

## SuoOutputDigitalPin

Digital pin value output

```
int SuaOutputDigitalPin(SuoHandle handle, int pinValue);
```

### Parameters

<i>handle</i>	Specifies the handle of the pin interface.	
<i>pinValue</i>	Specifies the value to be output to a pin (specify any of the following).	
	Value	Meaning
	SUO_HIGH (=1)	HIGH value
	SUO_LOW (=0)	LOW value

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function outputs a digital value signal to the specified pin interface.

To output an analog value signal, use the [SuoOutputAnalogPin](#) function.

### Example

```
SuoHandle hPinP00;

void func1(void)
{
    .....
    SuaOutputDigitalPin(hPinP00, SUO_HIGH);    /* Output HIGH */
}
```

---

## SuoOutputAnalogPin

Analog pin value output

---

---

```
int SuoOutputAnalogPin(SuoHandle handle, double pinValue);
```

---

### Parameters

<i>handle</i>	Specifies the handle of the pin interface.
<i>pinValue</i>	Specifies the value (analog value) to be output to a pin (unit: V (volts)).

---

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

---

### Explanation

This function outputs an analog value signal to the specified pin interface.

Specify an analog value in V (volts), as floating-point data.

To output a digital value signal, use the [SuoOutputDigitalPin](#) function.

---

### Example

```
SuoHandle hPinP00;

void func1(void)
{
    .....
    SuoOutputAnalogPin(hPinP00, 3.5);    /* Output 3.5V */
}
```

---

## SuoOutputHighImpedance

High-impedance pin output

---

---

```
int SuoOutputHighImpedance(SuoHandle handle);
```

---

### Parameters

<i>handle</i>	Specifies the handle of the pin interface.
---------------	--

---

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

---

### Explanation

This function is used to output high-impedance for the specified digital/analog pin interface.

---

### Example

```
SuoHandle hPinP00;

void func1(void)
{
    .....
    SuoOutputHighImpedance(hPinP00);    /* Output High Impedance */
}
```

## SuoSetInputDigitalPinCallback

Digital pin value input callback registration

```
int SuoSetInputDigitalPinCallback(SuoHandle handle, SuoInputDigitalPinCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the pin interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs digital pin input processing. (Refer to " <a href="#">InputDigitalPinFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register a user-defined function that performs digital pin input processing.

The registered function is called when a signal is input to the specified pin.

If NULL is specified for *func*, registration is canceled.

### Example

```
void InputDigitalPinFunc(SuoHandle handle, int pinValue);
SuoHandle hPinP00;

void func1(void)
{
    .....
    SuoSetInputDigitalPinCallback(hPinP00, InputDigitalPinFunc); /* Set input-digital-pin function */
}

/* Input-digital-pin function */
void InputDigitalPinFunc(SuoHandle handle, int pinValue)
{
    .....
}
```

## SuoSetInputAnalogPinCallback

Analog pin value input callback registration

```
int SuoSetInputAnalogPinCallback(SuoHandle handle, SuoInputAnalogPinCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the pin interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs analog pin input processing. (Refer to " <a href="#">InputAnalogPinFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register a user-defined function that performs analog pin input processing.

The registered function is called when a signal is input to the specified pin.

If NULL is specified for *func*, registration is canceled.

### Example

```
void InputAnalogPinFunc(SuoHandle handle, double pinValue);
SuoHandle hPinP00;

void func1(void)
{
    .....
    SuoSetInputAnalogPinCallback(hPinP00, InputAnalogPinFunc);    /* Set input-analog-pin function */
}

/* Input-analog-pin function */
void InputAnalogPinFunc(SuoHandle handle, double pinValue)
{
    .....
}
```

## SuoSetInputHighImpedanceCallback

Pin high-impedance state report callback registration

```
int SuoSetInputHighImpedanceCallback(SuoHandle handle, SuoInputHighImpedanceCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the pin interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs processing when all the connected pins enter the high-impedance state. (Refer to " <a href="#">InputHighImpedanceFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register the user-defined function that performs processing when all the pins connected to digital/analog pins enter the high-impedance state.

If NULL is specified for *func*, registration is canceled.

### Example

```
void InputHighImpedanceFunc(SuoHandle handle);
SuoHandle hPinP00;

void func1(void)
{
    .....
    SuoSetInputHighImpedanceCallback(hPinP00,InputHighImpedanceFunc);
                                                    /* Set input-high-impedance function */
}

/* Input-high-impedance function */
void InputHighImpedanceFunc(SuoHandle handle)
{
    .....
}
```

## SuoCreateExtbus

External bus generation

```
int SuaCreateExtbus(const char* extbusName, unsigned long addr, unsigned long size, SuaHandle* handle);
```

### Parameters

<i>extbusName</i>	Specifies the name of the external bus.
<i>addr</i>	Specifies the first address of the external memory area.
<i>size</i>	Specifies the size of the external memory area.
<i>handle</i>	Specifies the location where the handle of the external bus interface is to be stored.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to generate an external bus interface.

The generated external bus interface is associated with the name specified for *extbusName*.

If this function is successful, the handle of the generated external bus interface can be obtained.

The external bus interface can then be controlled by specifying this handle. The handle can also be obtained by using the [SuoGetExtbusHandle](#) function.

This function can only be called in the [MakeUserModel](#) function. An error occurs if it is called at any other timing.

### Example

```
SuaHandle hExtbus1;

SuoUserEntry void MakeUserModel(const char *option)
{
    .....
    SuaCreateExtbus("EXTBUS1", 0x200000, 0x1000, &hExtbus1);    /* Create "EXTBUS1" */
}
```



## SuoGetExtbusHandle

External bus handle acquisition

```
SuoHandle SuaGetExtbusHandle(const char* extbusName);
```

### Parameters

<i>extbusName</i>	Specifies the name of the external bus.
-------------------	---

### Return value

If this function is successful, the handle of the specified external bus interface is returned.

If this function fails, NULL is returned.

### Explanation

This function is used to obtain the handle of the specified external bus interface.

If this function is successful, the handle of the specified external bus interface is returned.

Specify the name specified by the [SuoCreateExtbus](#) function as *extbusName*.

If a different name is specified, NULL is returned.

### Example

```
SuoHandle hExtbus1;

void func1(void)
{
    .....
    hExtbus1 = SuaGetExtbusHandle("EXTBUS1");    /* Get handle of "EXTBUS1" */
}
```

## SuoSetReadExtbusCallback

External bus read access callback registration

```
int SuoSetReadExtbusCallback(SuoHandle handle, SuoReadExtbusCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the external bus interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs read access processing of an external bus. (Refer to " <a href="#">ReadExtbusFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register a user-defined function that performs read access processing of an external bus.

The registered function is called if a read request is issued to the specified external bus (in the registered address range).

If NULL is specified for *func*, registration is canceled.

### Example

```
void ReadExtbusFunc(SuoHandle handle, unsigned long addr, int accessSize, unsigned char data[]);
SuoHandle hExtbus1;

void func1(void)
{
    .....
    SuoSetReadExtbusCallback(hExtbus1, ReadExtbusFunc);    /* Set read-external-bus function */
}

/* Read-external-bus function */
void ReadExtbusFunc(SuoHandle handle, unsigned long addr, int accessSize, unsigned char data[])
{
    .....
}
```

## SuoSetWriteExtbusCallback

External bus write access callback registration

```
int SuoSetWriteExtbusCallback(SuoHandle handle, SuoWriteExtbusCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the external bus interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs write access processing of an external bus. (Refer to " <a href="#">WriteExtbusFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register a user-defined function that performs write access processing of an external bus.

The registered function is called when a write request is issued to the specified external bus (in the registered address range).

If NULL is specified for *func*, registration is canceled.

### Example

```
void WriteExtbusFunc(SuoHandle handle, unsigned long addr, int accessSize, const unsigned char data[]);
SuoHandle hExtbus1;

void func1(void)
{
    .....
    SuoSetWriteExtbusCallback(hExtbus1, WriteExtbusFunc);    /* Set write-external-bus function */
}

/* Write-external-bus function */
void WriteExtbusFunc(SuoHandle handle, unsigned long addr, int accessSize, const unsigned char data[])
{
    .....
}
```

## SuoCreateSerialUART

Serial interface generation (UART type)

```
int  SuaCreateSerialUART(const char* serialName, const char* pinNameTXD, const char* pinNameRXD,
                        SuaHandle* handle);
```

### Parameters

<i>serialName</i>	Specifies the name of the serial interface.
<i>pinNameTXD</i>	Specifies the name of the transmit data pin used by the serial interface.
<i>pinNameRXD</i>	Specifies the name of the receive data pin used by the serial interface.
<i>handle</i>	Specifies the location where the handle of the serial interface is to be stored.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to generate a serial interface (UART type).

The generated serial interface is associated with the name specified for *serialName*.

In addition, pins specified as *pinNameTXD* and *pinNameRXD* are also generated.

If this function is successful, the handle of the generated serial interface can be obtained.

The serial interface can then be controlled by specifying this handle. The handle can also be obtained by using the [SuoGetSerialHandle](#) function.

The SuaCreateSerialUART function can only be called in the [MakeUserModel](#) function. An error occurs if it is called at any other timing.

### Example

```
SuaHandle hUart1;

SuaUserEntry void MakeUserModel(const char *option)
{
    .....
    SuaCreateSerialUART("UART1", "TXD1", "RXD1", &hUart1);           /* Create "UART1" */
}
```

## SuoCreateSerialCSI

Serial interface generation (CSI type)

```
int SuoCreateSerialCSI(const char* serialName, const char* pinNameSO, const char* pinNameSI, const char* pinNameSCK, SuoHandle* handle);
```

### Parameters

<i>serialName</i>	Specifies the name of the serial interface.
<i>pinNameSO</i>	Specifies the name of the transmit data pin used by the serial interface.
<i>pinNameSI</i>	Specifies the name of the receive data pin used by the serial interface.
<i>pinNameSCK</i>	Specifies the name of the clock pin used by the serial interface.
<i>handle</i>	Specifies the location where the handle of the serial interface is to be stored.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to generate a serial interface (CSI type).

The generated serial interface is associated with the name specified for *serialName*.

In addition, the pins specified as *pinNameSO*, *pinNameSI*, and *pinNameSCK* are also generated.

If this function is successful, the handle of the generated serial interface can be obtained.

The serial interface can then be controlled by specifying this handle. The handle can also be obtained by using the [SuoGetSerialHandle](#) function.

This function can only be called in the [MakeUserModel](#) function. An error occurs if it is called at any other timing.

### Example

```
SuoHandle hCsi1;

SuoUserEntry void MakeUserModel(const char *option)
{
    .....
    SuoCreateSerialCSI("CSI1", "SO1", "SI1", "SCK1", &hCsi1); /* Create "CSI1" */
}
```

## SuoGetSerialHandle

Serial interface handle acquisition

```
SuoHandle SuaGetSerialHandle(const char* serialName);
```

### Parameters

<i>serialName</i>	Specifies the name of the serial interface.
-------------------	---

### Return value

If this function is successful, the handle of the specified serial interface is returned.

If this function fails, NULL is returned.

### Explanation

This function is used to obtain the handle of the specified serial interface.

If this function is successful, the handle of the specified serial interface is returned.

Specify the name specified by the [SuoCreateSerialUART](#) or [SuoCreateSerialCSI](#) function as *serialName*.

If a different name is specified, NULL is returned.

### Example

```
SuoHandle hSerial1;

void func1(void)
{
    .....
    hSerial1 = SuaGetSerialHandle("SERIAL1");    /* Get handle of "SERIAL1" */
}
```

## SuoSetSerialParameterUART

Serial interface parameter setting (UART type)

```
int SuoSetSerialParameterUART(SuoHandle handle, const SuoSerialParameterUART* param);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>param</i>	Specifies the location where the parameters of the serial interface (UART type) are to be stored. Specify a pointer to <a href="#">SuoSerialParameterUART structure</a> .

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to set parameters (UART type) related to the serial operation of the specified serial interface.

The default values of the parameters are as follows.

Baud rate	:	9600bps
Transfer direction	:	LSB first
Data bit length	:	7 bits
Stop bit length	:	1 bit
Parity	:	None

## Example

```

SuoHandle hUart1;

void func1(void)
{
    SuoSerialParameterUART param;
    .....
    param.baudrate = 19200;           /* 19200bps */
    param.direction = SUO_LSBFIRST;  /* LSB First */
    param.dataLength = 8;           /* databit 8bit */
    param.stopLength = 1;          /* stopbit 1bit */
    param.parity = SUO_EVENPARITY;  /* even parity */
    SuoSetSerialParameterUART(hUart1, &param); /* Set parameter of UART1 */
}

```

## Structure

SuoSerialParameterUART structure

```
typedef struct {
```

```
    unsigned long    baudrate;           Baud rate value (in bps)
```

```
    int              direction;         Transfer direction (specify any of the following)
```

Value	Meaning
SUO_MSBFIRST	MSB first
SUO_LSBFIRST	LSB first

```
    int              dataLength;       Data bit length (specify 1 to 32)
```

```
    int              stopLength;       Stop bit length (specify 1 or 2)
```

```
    int              parity;           Parity (specify any of the following)
```

Value	Meaning
SUO_NONEPARITY	No parity
SUO_ZEROPARITY	0 parity (0 parity during transmission, no parity check during reception)
SUO_ODDPARITY	Odd parity
SUO_EVENPARITY	Even parity

```
} SuoSerialParameterUART;
```



## SuoSetSerialParameterCSI

Serial interface parameter setting (CSI type)

```
int SuoSetSerialParameterCSI(SuoHandle handle, const SuoSerialParameterCSI* param);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>param</i>	Specifies the location where the parameters of the serial interface (CSI type) are to be stored. Specify a pointer to <a href="#">SuoSerialParameterCSI structure</a> .

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to set parameters (CSI type) related to the serial operation of the specified serial interface.

The default values of the parameters are as follows.

Mode	:	Slave
Transfer clock	:	0
Phase	:	Normal phase
Transfer direction	:	MSB first
Data bit length	:	8 bits

## Example

```

SuoHandle hCsi1;

void func1(void)
{
    SuoSerialParameterCSI param;
    .....
    param.mode = SUO_SLAVE;           /* slave */
    param.frequency = 1000000;        /* 1MHz */
    param.phase = 0;                  /* normal */
    param.direction = SUO_LSBFIRST;   /* LSB First */
    param.dataLength = 8;             /* databit 8bit */
    SuoSetSerialParameterCSI(hCsi1, &param); /* Set parameter of CSI1 */
}

```

## Structure

SuoSerialParameterCSI structure

```
typedef struct {
```

```
int mode;
```

Operation mode (specify any of the following)

Value	Meaning
SUO_MASTER	Master operation
SUO_SLAVE	Slave operation

```
unsigned long frequency;
```

Frequency of transfer clock (in Hz)  
Zero must not be specified if master operation is specified.

```
int phase;
```

Phase (specify any of the following)  
For details, refer to [Table 4-2](#).

Value	Meaning
0	Normal phase
SUO_PRECEDEDATA	Data output first
SUO_REVERSELOCK	Clock reversal
SUO_PRECEDEDATA   SUO_REVERSELOCK	Specifies both data output first and clock reversal

int	direction;	Transfer direction (specify any of the following)						
		<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>SUO_MSBFIRST</td> <td>MSB first</td> </tr> <tr> <td>SUO_LSBFIRST</td> <td>LSB first</td> </tr> </tbody> </table>	Value	Meaning	SUO_MSBFIRST	MSB first	SUO_LSBFIRST	LSB first
Value	Meaning							
SUO_MSBFIRST	MSB first							
SUO_LSBFIRST	LSB first							
int	datalength;	Data bit length (1 to 32)						
} SuoSerialParameterCSI;								

Table 4-2 CSI Phase Types (SuoSetSerialParameterCSI Function)

Value of Phase	Phase
0	
SUO_PRECEDEDATA	
SUO_REVERSELOCK	
SUO_PRECEDEDATA  SUO_REVERSELOCK	

## SuoGetSerialParameterUART

Serial interface parameter acquisition (UART type)

```
int SuoGetSerialParameterUART(SuoHandle handle, SuoSerialParameterUART* param);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>param</i>	Specifies the location where the parameters of the serial interface (UART type) are to be stored. Specify a pointer to <a href="#">SuoSerialParameterUART structure</a> .

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to obtain the parameters (UART type) related to serial operation of the specified serial interface.

### Example

```
SuoHandle hUart1;

void func1(void)
{
    SuoSerialParameterUART param;
    .....
    SuoGetSerialParameterUART(hUart1, &param);    /* Get parameter of UART1 */
    .....
}
```

## SuoGetSerialParameterCSI

Serial interface parameter acquisition (CSI type)

```
int SuoGetSerialParameterCSI(SuoHandle handle, SuoSerialParameterCSI* param);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>param</i>	Specifies the location where the parameters of the serial interface (CSI type) are to be stored. Specify a pointer to <a href="#">SuoSerialParameterCSI structure</a> .

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to obtain the parameters (CSI type) related to serial operation of the specified serial interface.

### Example

```
SuoHandle hCsi1;

void func1(void)
{
    SuoSerialParameterCSI param;
    .....
    SuoGetSerialParameterCSI(hCsi1, &param);    /* Get parameter of CSI1 */
    .....
}
```

## SuoSendSerialData

Serial data transmission (1 data)

```
int SuoSendSerialData(SuoHandle handle, unsigned long data);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>data</i>	Specifies the transmit data (1 data).

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to start transmitting one serial data.

It takes time to complete transmitting the serial data. If you want to know the timing of transmission completion, set the transmission end notification function by using the [SuoSetNotifySentSerialCallback](#) function.

If this function is called for a serial interface that is currently transmitting data, an error occurs.

### Example

```
SuoHandle hSerial1;  
  
void func1(void)  
{  
    .....  
    SuoSendSerialData(hSerial1, 0x80);    /* Send 0x80 */  
}
```

## SuoSendSerialDataList

Serial data transmission (two or more data)

```
int SuoSendSerialDataList(SuoHandle handle, long count, unsigned long dataList[]);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>count</i>	Specifies the number of data to be transmitted (1 to 32767).
<i>dataList</i> []	Specifies the transmit data (two or more data). Specify an array consisting of the number of data to be transmitted.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to start transmitting two or more serial data.

It takes time to complete transmission of the serial data. If you want to know the timing of transmission completion, set the transmission end notification function by using the SuoSetNotifySentSerialCallback function.

If this function is called for a serial interface that is currently transmitting data, an error occurs.

### Example

```
SuoHandle hSerial1;

void func1(void)
{
    unsigned long dataList[6] = {0x73, 0x65, 0x72, 0x69, 0x61, 0x6c};
    .....
    SuoSendSerialDataList(hSerial1, 6, dataList);    /* Send dataList */
}
```

## SuoSendSerialFile

Serial data transmission (serial file)

```
int SuoSendSerialFile(SuoHandle handle, const char* serialFile);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>serialFile</i>	Specifies the serial file name. A serial file is a file that has been saved after being edited on the serial window of SM+.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to start transmitting serial data described in a serial file.

If *serialFile* is specified by a relative path, it is treated as relative to the path of the user model (*UserModel.dll*).

It takes time to complete transmission of the serial data. If you want to know the timing of transmission completion, set the transmission end notification function by using the [SuoSetNotifySentSerialCallback](#) function.

If this function is called for a serial interface that is currently transmitting data, an error occurs.

### Example

```
SuoHandle hSerial1;

void func1(void)
{
    .....
    SuoSendSerialFile(hSerial1, "foo.ser");    /* Send serial data on "foo.ser" */
}
```



## SuoSetNotifySentSerialCallback

Serial interface transmission end notification callback registration

```
int SuoSetNotifySentSerialCallback(SuoHandle handle, SuoNotifySentSerialCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs processing when serial transmission is completed. (Refer to " <a href="#">NotifySentSerialFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register a user-defined function that performs processing when serial transmission is completed.

The registered function is called when one or more serial data specified to be transmitted have been completely transmitted.

If NULL is specified for *func*, registration is canceled.

### Example

```
void NotifySentSerialFunc(SuoHandle handle);
SuoHandle hSerial1;

void func1(void)
{
    .....
    SuoSetNotifySentSerialCallback(hSerial1, NotifySentSerialFunc); /* Set notify-sent-serial function */
}

/* Notify-sent-serial function */
void NotifySentSerialFunc(SuoHandle handle)
{
    .....
}
```

## SuoSetReceiveSerialCallback

Serial data reception callback registration

```
int SuoSetReceiveSerialCallback(SuoHandle handle, SuoReceiveSerialCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the serial interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs processing when serial data is received. (Refer to " <a href="#">ReceiveSerialFunc</a> ".)

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register a user-defined function that performs processing when serial data is received.

The registered function is called when one serial data has been received.

If NULL is specified for *func*, registration is canceled.

### Example

```
void ReceiveSerialFunc(SuoHandle handle, unsigned long data, int status);
SuoHandle hSerial1;

void func1(void)
{
    .....
    SuoSetReceiveSerialCallback(hSerial1, ReceiveSerialFunc); /* Set receive-serial function */
}

/* Receive-serial function */
void ReceiveSerialFunc(SuoHandle handle, unsigned long data, int status)
{
    .....
}
```

## SuoCreateWave

Signal output unit generation

```
int SuoCreateWave(const char* waveName, int count, const char* pinNameList[], SuoHandle* handle);
```

### Parameters

<i>waveName</i>	Specifies the name of the signal output unit.
<i>count</i>	Specifies the number of pins used by the signal output unit.
<i>pinNameList</i>	Specifies the names of the pins used by the signal output unit. Specify names in an array equivalent to the number of pins.
<i>handle</i>	Specifies the location where the handle of the signal output unit interface is to be stored.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to generate a signal output unit interface.

The generated signal output unit interface is associated with the name specified for *waveName*.

In addition, the pins specified by *count/pinNameList* are also generated.

If this function is successful, the handle of the generated signal output unit interface can be obtained.

The signal output unit interface can then be controlled by specifying this handle. The handle can also be obtained by using the [SuoGetWaveHandle](#) function.

This function can only be called in the [MakeUserModel](#) function. An error occurs if it is called at any other timing.

### Example

```
SuoHandle hWave1;

SuoUserEntry void MakeUserModel(const char *option)
{
    .....
    char* pinNameList[4] = {"P00", "P01", "P02", "P03"};
    SuoCreateWave("WAVE1", 4, pinNameList, &hWave1);    /* Create "WAVE1" */
}
}
```

## SuoGetWaveHandle

Signal output unit handle acquisition

```
SuoHandle SuoGetWaveHandle(const char* waveName);
```

### Parameters

<i>waveName</i>	Specifies the name of the signal output unit.
-----------------	---

### Return value

If this function is successful, the handle of the specified signal output unit interface is returned.

If this function fails, NULL is returned.

### Explanation

This function is used to obtain the handle of the specified signal output unit interface.

If this function is successful, the handle of the specified signal output unit interface is returned.

Specify the name specified by the [SuoCreateWave](#) function as *waveName*.

If a different name is specified, NULL is returned.

### Example

```
SuoHandle hWave1;

void func1(void)
{
    .....
    hWave1 = SuoGetWaveHandle("WAVE1");           /* Get handle of "WAVE1" */
}
```

## SuoSendWaveFile

Transmission by signal output unit (signal data file)

```
int SuoSendWaveFile(SuoHandle handle, const char* waveFile);
```

### Parameters

<i>handle</i>	Specifies the handle of the signal output unit interface.
<i>waveFile</i>	Specifies the signal data file. A signal data file is a file that has been saved after being edited on the signal data editor window of SM+.

### Return value

If this function is successful, SUO\_NOERROR is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to start transmitting a signal value whose timing is described in a signal data file.

If *waveFile* is specified by a relative path, it is treated as relative to the path of the user model (*UserModel.dll*).

It takes time to complete transmitting the signal data file. If you want to know the timing of transmission completion, set the transmission end notification function by using the [SuoSetNotifySentWaveCallback](#) function.

If this function is called for a signal output unit interface that is currently transmitting data, the data being transmitted is canceled and the newly specified data is transmitted.

### Example

```
SuoHandle hWave1;

void func1(void)
{
    .....
    SuoSendWaveFile(hSerial1, "foo.wvi");    /* Send pin data on "foo.wvi" */
}
```

## SuoSetNotifySentWaveCallback

Signal output unit transmission end notification callback registration

```
int SuaSetNotifySentWaveCallback(SuoHandle handle, SuaNotifySentWaveCallback func);
```

### Parameters

<i>handle</i>	Specifies the handle of the signal output unit interface.
<i>func</i>	Specifies the pointer to a user-defined function that performs processing when transmission by the signal output unit is completed. (Refer to " <a href="#">NotifySentWaveFunc</a> ".)

### Return value

If this function is successful, `SUO_NOERROR` is returned.

If this function fails, an error number is returned. (Refer to "[Table 4-4 Error Numbers](#)".)

### Explanation

This function is used to register a user function that performs processing when transmission by the signal output unit is completed.

The registered function is called when all signal data specified to be transmitted have been completely transmitted.

If `NULL` is specified for *func*, registration is canceled.

### Example

```
void NotifySentWaveFunc(SuoHandle handle);
SuoHandle hWave1;

void func1(void)
{
    .....
    SuaSetNotifySentWaveCallback(hWave1, NotifySentWaveFunc); /* Set notify-sent-wave function */
}

/* Notify-sent-wave function */
void NotifySentWaveFunc(SuoHandle handle)
{
    .....
}
```

## 4.2 User-Defined Functions

The following table lists the user-defined functions (MakeUserModel entry functions and callback functions).

Table 4-3 User-Defined Functions

Function Name	Description
<a href="#">MakeUserModel</a>	MakeUserModel function
<a href="#">InitFunc</a>	Initialization callback function
<a href="#">ResetFunc</a>	Reset callback function
<a href="#">NotifyTimerFunc</a>	Timer time notification callback function
<a href="#">InputDigitalPinFunc</a>	Digital pin input value callback function
<a href="#">InputAnalogPinFunc</a>	Analog pin input value callback function
<a href="#">InputHighImpedanceFunc</a>	Pin high-impedance state report callback function
<a href="#">ReadExtbusFunc</a>	External bus read access callback function
<a href="#">WriteExtbusFunc</a>	External bus write access callback function
<a href="#">NotifySentSerialFunc</a>	Serial interface transmission end notification callback function
<a href="#">ReceiveSerialFunc</a>	Serial interface reception callback function
<a href="#">NotifySentWaveFunc</a>	Serial interface reception callback function

### 4.2.1 Details of user-defined functions

This section shows how to reference user-defined functions.

## MakeUserModel

MakeUserModel function [user-defined function]

---

---

```
SuoUserEntry void MakeUserModel(const char *option);
```

**Caution** Because MakeUserModel is a static entry function of the user model, this function name must be used.

### Parameters

---

<i>option</i>	Option character string specified in the configuration file. If no option is specified in the configuration file, NULL character (" ") is assumed.
---------------	---

### Return value

---

None

### Explanation

---

This function must be used to generate the resources to be used with the user model.

Any function other than this function cannot generate the resources.

In addition, this function must be used to register a callback function as necessary.

In particular, an initialization callback function must be registered by this function (because the initialization timing has passed even if a function is registered by a function other than this function).



## Example

```
SuoHandle hTim1;
SuoHandle hPinP00;
SuoHandle hExtbus1;

void InitFunc(void);
void ResetFunc(void);

SuoUserEntry void MakeUserModel(const char *option)
{
    /* Create source */
    SuoCreateTimer("TIM1", &hTim1);           /* Create "TIM1" */
    SuoCreatePin("P00", &hPinP00);           /* Create "P00" */
    SuoCreateExtbus("EXTBUS1", 0x200000, 0x1000, &hExtbus1); /* Create "EXTBUS1" */

    /* Set callbacks */
    SuoSetInitCallback(InitFunc);           /* Set initialize function */
    SuoSetResetCallback(ResetFunc);        /* Set reset function */
}
```

## InitFunc

Initialization callback function [user-defined function]

---

---

```
void InitFunc (void);
```

**Caution** InitFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

None

### Return value

---

None

### Explanation

---

InitFunc describes initialization processing.

Use the [SuoSetInitCallback](#) function to register InitFunc as a callback function.

## ResetFunc

Reset callback function [user-defined function]

---

---

```
void ResetFunc (void);
```

**Caution** ResetFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

None

### Return value

---

None

### Explanation

---

ResetFunc describes the reset processing.

Use the [SuoSetResetCallback](#) function to register ResetFunc as a callback function.

## NotifyTimerFunc

Timer time notification callback function [user-defined function]

---

---

```
void NotifyTimerFunc (SuoHandle handle);
```

**Caution** NotifyTimerFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

<i>handle</i>	Timer interface handle.
---------------	-------------------------

### Return value

---

None

### Explanation

---

NotifyTimerFunc describes the processing when the timer time is reported.

Use the [SuoSetNotifyTimerCallback](#) function to register NotifyTimerFunc as a callback function.

## InputDigitalPinFunc

Digital pin input value callback function [user-defined function]

```
void InputDigitalPinFunc (SuoHandle handle, int pinValue);
```

**Caution** InputDigitalPinFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

<i>handle</i>	Pin interface handle.	
<i>pinValue</i>	Value (digital value) input to the pin (specify any of the following)	
	Value	Meaning
	SUO_HIGH (=1)	HIGH value
	SUO_LOW (=0)	LOW value

### Return value

None

### Explanation

InputDigitalPinFunc describes the digital pin input processing.

Use the [SuoSetInputDigitalPinCallback](#) function to register InputDigitalPinFunc as a callback function.

---

## InputAnalogPinFunc

Analog pin input value callback function [user-defined function]

---

---

```
void InputAnalogPinFunc (SuoHandle handle, double pinValue);
```

**Caution** InputAnalogPinFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

<i>handle</i>	Pin interface handle.
<i>pinValue</i>	Value (analog value) input to the pin (unit: V (volts))

### Return value

---

None

### Explanation

---

InputAnalogPinFunc describes the analog pin input processing.

Use the [SuoSetInputAnalogPinCallback](#) function to register InputAnalogPinFunc as a callback function.

## InputHighImpedanceFunc

Pin high-impedance state report callback function [user-defined function]

---

---

```
void InputHighImpedanceFunc (SuoHandle handle);
```

**Caution** InputAnalogPinFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

<i>handle</i>	Pin interface handle.
---------------	-----------------------

### Return value

---

None

### Explanation

---

InputHighImpedanceFunc is used to describe processing when all the pins connected to digital/analog pins enter the high-impedance state.

Use the [SuoSetInputHighImpedanceCallback](#) function to register InputHighImpedanceFunc as a callback function.

---

## ReadExtbusFunc

External bus read access callback function [user-defined function]

---

---

```
void ReadExtbusFunc (SuoHandle handle, unsigned long addr, int accessSize, unsigned char data[]);
```

**Caution** ReadExtbusFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

<i>handle</i>	External bus interface handle
<i>addr</i>	Address
<i>accessSize</i>	Access size
<i>data[]</i>	Data storage area. As many data as the access size must be stored.

### Return value

---

None

### Explanation

---

ReadExtbusFunc describes the read access processing of an external bus.

Data must be stored in *data[]*.

Use the [SuoSetReadExtbusCallback](#) function to register ReadExtbusFunc as a callback function.



---

## WriteExtbusFunc

External bus write access callback function [user-defined function]

---

---

```
void WriteExtbusFunc (SuoHandle handle, unsigned long addr, int accessSize, const unsigned char data[]);
```

**Caution** WriteExtbusFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

<i>handle</i>	External bus interface handle
<i>addr</i>	Address
<i>accessSize</i>	Access size
<i>data[]</i>	Data storage area. As many data as the access size must be stored.

### Return value

---

None

### Explanation

---

WriteExtbusFunc describes write access processing of an external bus.

Use the [SuoSetWriteExtbusCallback](#) function to register WriteExtbusFunc as a callback function.

## NotifySentSerialFunc

Serial interface transmission end notification callback function [user-defined function]

---

---

```
void NotifySentSerialFunc (SuoHandle handle);
```

**Caution** NotifySentSerialFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

<i>handle</i>	Serial interface handle
---------------	-------------------------

### Return value

---

None

### Explanation

---

NotifySentSerialFunc describes the processing when transmission by a serial interface has been completed.

Use the [SuoSetNotifySentSerialCallback](#) function to register NotifySentSerialFunc as a callback function.

## ReceiveSerialFunc

Serial interface reception callback function [user-defined function]

```
void ReceiveSerialFunc (SuoHandle handle, unsigned long data, int status);
```

**Caution** ReceiveSerialFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

<i>handle</i>	Serial interface handle	
<i>data</i>	Received serial data	
<i>status</i>	Receive status (specify any of the following)	
	Value	Meaning
	0	Normal reception
	SUO_PARITYERR	Parity error (if parity bit does not match)
	SUO_FRAMINGERR	Framing error (if stop bit is not detected)

### Return value

None

### Explanation

ReceiveSerialFunc describes the processing during reception by a serial interface.

Use the [SuoSetReceiveSerialCallback](#) function to register ReceiveSerialFunc as a callback function.

## NotifySentWaveFunc

Signal output unit transmission end notification callback function [user-defined function]

---

---

```
void NotifySentWaveFunc (SuoHandle handle);
```

**Caution** NotifySentWaveFunc is a place holder for a user-defined function name, so this function name does not have to be used.

### Parameters

---

<i>handle</i>	Signal output unit interface handle
---------------	-------------------------------------

### Return value

---

None

### Explanation

---

NotifySentWaveFunc describes the processing to be performed when transmission by a signal output unit has been completed.

Use the [SuoSetNotifySentWaveCallback](#) function to register NotifySentWaveFunc as a callback function.

## 4.3 Error Numbers

Many return values of the supplied function are error numbers. An error number is indicated by a macro name defined by the supplied header file (suo.h). This table lists the error numbers.

Table 4-4 Error Numbers

Error No. (Macro)	Meaning (Top: Outline, Bottom: Details)
SUO_NOERROR	No error has occurred (normal completion).
SUO_CANTALLOC	Memory cannot be allocated.
	Memory cannot be allocated.
SUO_ILLIFNAME	The interface name is not correct.
	NULL or "" is specified for the interface name. Or, an interface name that has not been generated is specified for a handle acquisition function.
SUO_ILLHANDLE	The handle is not correct.
	A handle other than that of the generated interface is specified.
SUO_ILLPARAM	The parameter is not correct.
	A value other than those that can be specified is specified as a parameter.
SUO_CANTCALL	The function cannot be called.
	A function that can be called only by the MakeUserModel function is called by another function. Or, a function that can be called by a function other than the MakeUserModel function is called by the MakeUserModel function. For the rule of calling, refer to Remark in " <a href="#">Table 4-1 Supplied Functions</a> ".
SUO_CONFLICTRES	The resources to be generated conflict.
	Two or more names that are the same as an interface name or pin name generated in the MakeUserModel function exist.
SUO_ILLFILENAME	The file name is not correct.
	NULL or a name including an invalid character is specified for a file name.
SUO_CANTOPENFILE	The file cannot be opened.
	The file does not exist, or is not permitted to be read.
SUO_ILLFILEFMT	The file format is not correct.
	A file of a different type is specified.
SUO_ILLFILECONT	The file contents are not correct.
	The contents of data described in the file include a contradiction, or no data exists in the file.
SUO_ILLPINNAME	The pin name is not correct.
	NULL or "" is specified for the pin name.
SUO_ILLADDRRANGE	The address range is not correct.
	The address range is not valid.

Error No. (Macro)	Meaning (Top: Outline, Bottom: Details)
SUO_UNDERSENDING	Already being transmitted.
	New transmission cannot be started because transmission is in progress.

# CHAPTER 5 SAMPLE PROGRAM

This chapter explains a sample program of a user model created by using the SM+ user open interface.

Table 5-1 Sample Program

No.	Sample Name	Description
1	Timer	Sample using timer interface

## 5.1 Timer

### 5.1.1 Overview

Timer model is a sample program using a timer interface.

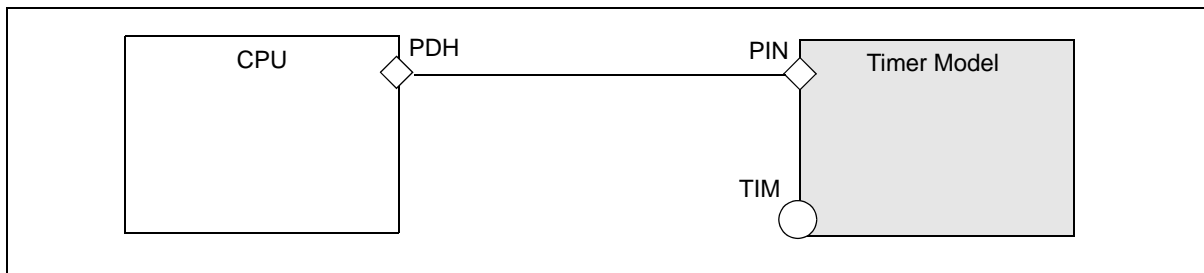
It outputs a value to a pin at fixed time intervals.

### 5.1.2 Configuration

The timer model generates the PIN pin and TIM timer.

The generated PIN pin is connected to the PDH pin of the CPU.

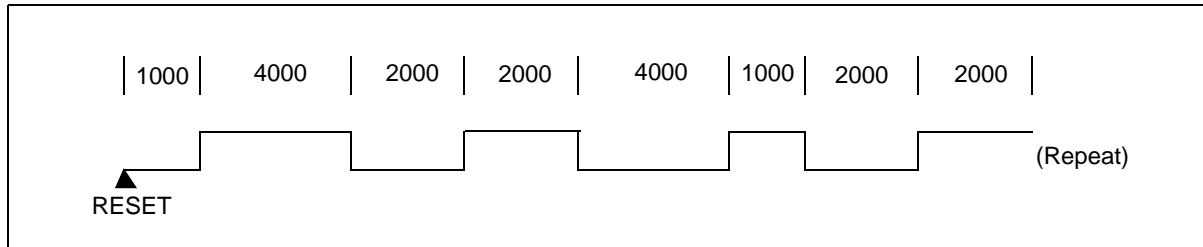
Figure 5-1 Timer Model Configuration



### 5.1.3 Operation

The timer model calculates a predetermined time by using the timer interface, and alternately outputs a low level and a high level to the PDH pin. The output value and output time are as shown below.

Figure 5-2 Timer Model Operation



### 5.1.4 Project file

The following table shows the setting information of the Visual C++ project file of the Timer model.

Table 5-2 Setting Information of Timer Model

Information	Description
Project type	Win32 Dynamic-Link Library
Source file	..\sys\suolink.c, uo_timer.c
Path of include file	..\sys (Specify the folder storing suo.h.)



## 5.1.5 Details of file

### (1) Source file of model (uo\_timer.c)

(1/2)

```

#include <windows.h>
#include "suo.h"

/* Handle */
SuoHandle hTIM;
SuoHandle hPIN;

/* Wave-Table */
#define MAXWAVE 8
struct _WaveTable {
    unsigned longtime;           /* Wait Time [usec] */
    int    pinValue;           /* Pin Value (SUO_HIGH or SUO_LOW) */
} waveTable[MAXWAVE] = {
    1000,  SUO_HIGH,
    4000,  SUO_LOW,
    2000,  SUO_HIGH,
    2000,  SUO_LOW,
    4000,  SUO_HIGH,
    1000,  SUO_LOW,
    2000,  SUO_HIGH,
    2000,  SUO_LOW
};
int waveIndex;

/* Declare */
void Reset(void);
void NotifyTimer(SuoHandle handle);
void puterr(int error);

/* MakeUserModel */
void SuoUserEntry MakeUserModel(const char *option)
{
    int error;

    /* Create interface */
    if((error = SuoCreateTimer("TIM", &hTIM)) != SUO_NOERROR){
        puterr(error);
        return;
    }
    if((error = SuoCreatePin("PIN", &hPIN)) != SUO_NOERROR){
        puterr(error);
        return;
    }

    /* Set callback */
    SuoSetResetCallback(Reset);
    SuoSetNotifyTimerCallback(hTIM, NotifyTimer);
}

```

(2/2)

```

/* Reset callback */
void Reset(void)
{
    int error;

    /* Initialize Wave-Table index */
    waveIndex = 0;

    /* Output LOW(initial value) to PIN */
    if((error = SuoOutputDigitalPin(hPIN, SUO_LOW)) != SUO_NOERROR){
        puterr(error);
        return;
    }

    /* Set wait time */
    if((error = SuoSetTimer(hTIM, SUO_USEC, waveTable[waveIndex].time)) != SUO_NOERROR){
        puterr(error);
        return;
    }
}

/* NotifyTimer callback */
void NotifyTimer(SuoHandle handle)
{
    int error;

    /* Output value to PIN */
    if((error = SuoOutputDigitalPin(hPIN, waveTable[waveIndex].pinValue)) != SUO_NOERROR){
        puterr(error);
        return;
    }

    /* Set next Wave-Table index */
    waveIndex++;
    if(waveIndex >= MAXWAVE){
        waveIndex = 0;
    }

    /* Set wait time */
    if((error = SuoSetTimer(hTIM, SUO_USEC, waveTable[waveIndex].time)) != SUO_NOERROR){
        puterr(error);
        return;
    }
}

/* Report error */
void puterr(int error)
{
    char message[80];
    sprintf(message, "The user open interface error (0x%04x) occurred.", error);
    MessageBox(NULL, message, "ERROR", MB_OK|MB_ICONERROR);
}

```

**(2) Configuration file (smplus.cfg)**

```

cpu = CPU('a');

#=====
# UO_TIMER description (CPU=uPD70F3261Y)
#=====

#---- Create UserOpen -----
uo_timer = Device("USEROPEN", "Release\uo_timer.dll");

#---- Pseudo Pin connection -----
wire_clock = Wire(1);
wire_clock += cpu.DebuggerPseudoPort("debugger_pseudo_pin_main_clkout");
wire_clock += uo_timer.Port("gui_pseudo_pin_clock_notice");
wire_reset = Wire(1);
wire_reset += cpu.DebuggerPseudoPort("debugger_pseudo_pin_reset_notice");
wire_reset += uo_timer.Port("gui_pseudo_pin_reset_notice");

#---- PIN connection -----
# UO_TIMER.PIN <--> CPU.PDH0
wire_PIN = Wire(1);
wire_PIN += uo_timer.Port("PIN");
wire_PIN += cpu.Port("PDH0");

```

**(3) Source file of target program (lm\_timer.c)**

```

/* Target Program for UO_TIMER */

#pragma ioreg

void main()
{
    unsigned char value;

    PMDH.0 = 1;          /* set port-input mode */
    PMDH.1 = 0;          /* set port-output mode */

    while( 1 ){
        value = PDH.0;    /* input signal from "PDH0" */
        PDH.1 = value;    /* output signal to "PDH1" */
    }
}

```

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