

S1C33 Family Application Note

**S1C33L26**

# **Software Reference Manual**

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## 1. Preface

### 1.1 Purpose

This manual is the reference manual of S1C33L26 software package. Users can refer to this manual and the source code of this software package to develop software for real applications with S1C33L26.

### 1.2 Related Information

- For S1C33L26 specification, refer to the "S1C33L26 Technical Manual."
- For PRT33L26 board specification, refer to the "PRT33L26 Hardware Specification."
- For details on the compiler specifications and how to use GNU33 IDE, refer to the "S5U1C33001C Manual."

## 2. Overview

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### 2. Overview

This software package is a dedicated board support package (BSP) for PRT33L26. It contains the chip specific code (register definition header files and drivers for S1C33L26 hardware modules) and the board specific code (drivers for the on-board devices), as well as typical sample programs utilizing the above codes to realize certain functions for users' reference.

The following table describes the overall software organization:

Folder		Content
C33L26sample_r100		root folder of S1C33L26 software package
	include¥	register definition header files (for all modules)
	driver¥	device drivers for corresponding hardware modules and on-board devices
	sample¥	individual sample programs to show the usage of certain hardware module(s), with each sub-folder containing one sample program
	xxx¥	one specific sample
	include¥	needed header files (copied from the upper "include¥" folder)
	driver¥	needed drivers (copied from the upper "driver¥" folder)
	system¥	sample implementation, including: <ul style="list-style-type: none"> <li>* boot.c (boot &amp; system initialization)</li> <li>* interrupt.c (interrupt handlers)</li> <li>* vector.c (vector table)</li> <li>* main.c (main loop)</li> <li>* ... (other needed system level codes)</li> </ul>
	res¥ (optional)	resource files (picture, voice data, etc.) used in this demo
	xxx¥ (optional)	specific function or middleware used in this demo, such as "usb"
	.....	other samples

Programs provided in other folders are described in subsequent chapters with full source code.

### 3. Register Definition Header File

#### 3.1 File Configuration

The following table lists the register definition header files of all S1C33L26 hardware modules provided in the "prt33l26\_sw¥include" folder of the software package.

File Name	Content
<b>33l26_reg.h</b>	<b>S1C33L26 register definition (includes all xxx_reg.h)</b>
cmu_reg.h	CMU module register definition
psc_reg.h	PSC module register definition
rtc_reg.h	RTC module register definition
sramc_reg.h	SRAMC module registers
sdramc_reg.h	SDRAMC module registers
ccu_reg.h	CCU module register definition
itc_reg.h	ITC module register definition
dmac_reg.h	DMAC module register definition
t8_reg.h	T8 module register definition
t16a_reg.h	T16A module register definition
t16p_reg.h	T16P module register definition
wdt_reg.h	WDT module register definition
fsio_reg.h	FSIO module register definition
usi_reg.h	USI module register definition
usil_reg.h	USIL module register definition
i2s_reg.h	I2S module register definition
remc_reg.h	REMC module register definition
gpio_reg.h	GPIO module register definition
adc_reg.h	ADC module register definition
lcdc_reg.h	LCDC module register definition
ge_reg.h	GE module register definition
misc_reg.h	MISC register definition

### 3. Register Definition Header File

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#### 3.2 Application Notes

1. Each register definition file defines the macros to access registers of the corresponding hardware module. Using register definition files is convenient for driver and application program development as they provide flexible ways to access registers and function bits of each register.

Taking the register definition file for CMU module (cmu\_reg.h) as an example, the union is defined as follows for the "Oscillation Control Register (CMU\_OSCCTL)":

```
union CMU_CLKCNTL_tag {
    volatile struct {
        unsigned int SOSC3:1;    //Low-speed OSC1 On/Off
        unsigned int SOSC1:1;    //High-speed OSC3 On/Off
        unsigned int DUMMY:2;
        unsigned int OSCTM:4;    //OSC3 stabilization wait time
    } bCTL;
    volatile unsigned char ucCTL;
};
```

The macros to access this register and its function bits are defined as follows:

```
#define CMU_BASE          0x00300100
.....
#define CMU_OSCCTL        (*(union CMU_CLKCNTL_tag*)(CMU_BASE+1)).ucCTL
#define CMU_OSC3EN        (*(union CMU_CLKCNTL_tag*)(CMU_BASE+1)).bCTL.SOSC3
#define CMU_OSC1EN        (*(union CMU_CLKCNTL_tag*)(CMU_BASE+1)).bCTL.SOSC1
#define CMU_OSC3WT        (*(union CMU_CLKCNTL_tag*)(CMU_BASE+1)).bCTL.OSCTM
```

In other words, users can read/write the value of the register using the CMU\_OSCCTL macro, or read/write the value of "OSC3 wait cycle" bits using the CMU\_OSC3WT macro, depending on the needs.

2. The macros in the register definition header files are basically named by following the rules below:
  - The name of the macro to access the register itself is the same as the "register name" defined in the S1C33L26 Technical Manual.
  - The name of the macro to access the function bits is defined as the [module name prefix] ("CMU\_" in above example) + the "bit name" defined in the S1C33L26 Technical Manual.
3. In the drivers and sample programs, the macros defined in the register definition header files are used to read/write registers. Users can use these register definition header files directly, or refer to the sample driver to create their own drivers according to the actual needs (for instance, add wrapper APIs to read/write registers in the driver layer).
4. "33126\_reg.h" is the overall register definition header file which includes all needed register definition header files for the hardware modules. Therefore, it is enough to just include this file in the driver and application layer program.

## 4. Driver

### 4.1 File Configuration

The following table lists the sample drivers for S1C33L26 H/W modules and PRT33L26 on-board devices (SPI Flash, LCD, audio codec, key, latch, etc.) provided in the "prt33l26\_sw\driver" folder of the software package.

File Name	Content
<b>driver.h</b>	<b>overall driver header (includes all xxx_drv.h)</b>
cmu_drv.h & .c	CMU driver
rtc_drv.h & .c	RTC driver
sramc_drv.h & .c	SRAMC driver
sdramc_drv.h & .c	SDRAMC driver
ccu_drv.h & .c	CCU driver
dmac_drv.h & .c	DMAC driver
t16a_drv.h & .c	T16A driver
t16p_drv.h & .c	T16P driver
fsio_drv.h & .c	FSIO driver
spi_drv.h & .c	SPI driver (using USI module)
i2s_drv.h & .c	I2S driver
sd_mmc_drv.h & .c	SD/MMC driver (using SPI mode of USI module)
spi_flash_drv.h & .c	SPI Flash driver
adc_drv.h & .c	ADC driver
lcd_drv.h & .c	LCD driver
ge_drv.h & .c	GE driver
codec_drv.h & .c	audio codec driver
key_drv.h & .c	key driver
latch_drv.h & .c	latch (373) driver (used by LCD and SPI drivers)
gpc_drv.h & .c	GPC (Graphic library) driver (for graphic drawing and text output)

### 4.2 Application Notes

1. All drivers are created according to the usage of the sample program or demonstration program implemented on PRT33L26, and may not be suitable for other applications.
2. "driver.h" is the overall driver header file which includes all needed driver header files. Therefore, it is enough to just include this file in the application layer program.
3. Users can check the driver program source codes to understand the implementation in detail, as well as refer to them to develop their own drivers according to the actual usage.



## 5. Sample Program

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### 5. Sample Program

The following sample programs are provided to show how to use certain H/W modules and the corresponding drivers to realize specific functions, as typical sample codes for users' reference.

- RTC
- T16A
- T16P
- FSIO
- USI(SPI)
- I2S
- SD
- ADC
- LCDC
- Key
- USB
- GE

Each sample program is built as an individual GNU33 project, so that users can open the project and build and execute it using the GNU33 IDE.

All sample programs are executed in the GNU33 Debugger (gdb) since they are built to run in the internal RAM or the on-board SDRAM. Some of them use the [Simulated I/O] window of the GNU33 Debugger (gdb) to show results or indication messages even without connecting the LCD sub-board.

The following chapters describe the function and operation of the sample programs, with user operation marked in **bold**. Users can check the source code to understand the implementation in detail.

#### 5.1 RTC

This is a sample program that mainly uses the RTC module and its driver. It shows how to initialize the RTC, set time information and provide interrupt handler to make the RTC count.

##### Switch Setting & Sub-Board Connection:

- 1) Make sure the LCD sub-board is connected before executing this sample program.

##### Process:

- 1) Initializes the RTC with a certain start time (2010-01-01, 08:00:00).
- 2) Displays the time information (year, month, date, hour, minute, second) on the LCD panel and refreshes the panel every 1 second, just like an electronic clock.

#### 5.2 T16A

This is a sample program that mainly uses the T16A module and its driver.

##### Process:

- 1) Turns on/off the on-board LED every 1 second (by 1-second interrupt).

### 5.3 T16P

This is a sample program that mainly uses the T16P module and its driver. It shows how to replay PCM sound using the PWM timer.

#### Switch Setting & Sub-Board Connection:

- 1) Make sure the PWM audio sub-board is connected before executing this sample program.

#### Process:

- 1) Replays the built-in PCM sound data "Welcome to use C33! This is a demo program to replay PCM sound." once.

### 5.4 UART

This is a sample program that mainly uses the FSIO module and its driver. It shows how to receive data from a PC and transfer data back to the PC through RS-232. The UART console must be running on the PC for command input and result output.

#### Switch Setting & Sub-Board Connection:

- 1) Set the function switch **SW3** to "up" to select RS-232 before executing this sample program.

#### Process:

- 1) [User operation] **Connect the PRT board with the PC through RS-232.**
- 2) [User operation] **Launch the UART console on the PC and configure (1-bit start, 8-bit data, 1-bit stop, 115200bps).**
- 3) [User operation] **After the above operation (PC side is ready), run this sample program in the GNU33 Debugger (gdb).**
- 4) Shows the menu below (lists the available commands) in the UART console.  
    << COMMAND LIST >>  
    draw heart  
    draw earth  
    exit
- 5) [User operation] **Input a command in the UART console on the PC to execute and check the results.**
  - A "heart" figure (consisting of many characters) will be displayed in the UART console if the "draw heart" command is input.
  - An "earth" figure (consisting of many characters) will be displayed in the UART console if the "draw earth" command is input.
  - The "\*\*\*\*\* Sample End \*\*\*\*\*" message will be displayed in the UART console and this sample program exited if the "exit" command is input.

#### Note:

- 1) Always follow the operation sequence and make ready the PC side first, then run this sample program in GDB33.

## 5. Sample Program

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### 5.5 USI (SPI)

This is a sample program that mainly uses the USI module (SPI mode) and its driver. It shows how to control the on-board SPI Flash. The operation results will be displayed in the [Simulated I/O] window of GDB33.

Process:

- 1) Sequentially performs erase, read, and write operation on the on-board M45PE80 SPI Flash and displays the operation results accordingly.

### 5.6 I2S

This is a sample program that mainly uses the I2S module and its driver. It shows how to control the audio codec (on the I2S audio sub-board) via I2S to replay sound.

Switch Setting & Sub-Board Connection:

- 1) Make sure the I2S audio sub-board is connected before executing this sample program.

Process:

- 1) Replays the built-in PCM sound data "Welcome to use C33! This is a demo program to replay PCM sound."

### 5.7 SD

This is a sample program that mainly uses the USI (SPI) module and its driver. It shows how to control the SD/MMC card via the SPI interface. The operation results will be displayed in the [Simulated I/O] window of GDB33.

Process:

- 1) [User operation] **Insert a SD/MMC card into the on-board slot.**
- 2) Sequentially performs card identification, erase, read, and write operations, and displays the operation results accordingly.

Note:

- 1) Remove the card from the slot after the "/\*\*\*\*\* Sample End \*\*\*\*\*/" message is shown.

### 5.8 ADC

This is a sample program that mainly uses the ADC module and its driver. It shows how to perform analog to digital conversion with the ADC. The AD conversion result will be displayed in the [Simulated I/O] window of GDB33.

Process:

- Converts 20 analog samples and displays the converted values.

### 5.9 LCDC

This is a sample program that mainly uses the LCDC module and its driver to support the LCD panel on the PRT board. It shows how to initialize LCDC and display information on the LCD panel.

#### Switch Setting & Sub-Board Connection:

- 1) Make sure the LCD sub-board is connected before executing this sample program.

#### Process:

- 1) Display color bars on the LCD panel.

### 5.10 Key

This is a sample program that mainly uses the GPIO module and the key driver to support the key matrix in the PRT board. It shows how to perform key scanning and judge the input key.

#### Switch Setting & Sub-Board Connection:

- 1) Make sure the LCD sub-board is connected before executing this sample program.

#### Process:

- 1) Waits for a key input.
- 2) When a key on the PRT board is pressed, displays the key name (Left, Right, Up, Down, Enter, ESC) of the pressed key on the LCD panel.

### 5.11 USB

This is a sample program that mainly uses the USB module. It shows how to realize the USB disk function.

#### Process:

- 1) [User operation] **Connect the PRT board with a PC using a USB cable.**
- 2) The PC will recognize the on-board SDRAM as a mass storage USB device.
- 3) [User operation] **From the PC (Explorer), copy/open/delete a file to/from the removable disk (on-board SDRAM).**
- 4) [User operation] **Disconnect the PC.**

#### Note:

- 1) There is no problem to first remove the disk from the PC and then disconnect the USB cable. After that, you can connect the USB cable again to resume the USB disk operation.

## 5. Sample Program

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### 5.12 GE

This is a sample program that mainly uses the GE module and its driver. It shows how to initialize and control GE to draw different graphic elements.

#### Switch Setting & Sub-Board Connection:

- 1) Make sure the LCD sub-board is connected before executing this sample program.

#### Process:

- 1) Automatically draws graphic elements (point, line, rectangle, filled rectangle, circle, font, small-size (99\*99) picture) one by one on the LCD panel for each type (1000 for each type).

**Revision History**

Attachment-1

Rev. No.	Date	Page	Category	Contents
Rev 1.0	2012/08/03	All	New	New creation

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