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FR Family, MB91460E Microcontroller Emulation System

This Application Note describing the Emulation tool for MB91460E series. As the emulation device MB91FV460B does not contain the shutdown register and standby RAM, these parts are emulated in Emulation RAM.

1 Introduction

This Application Note describing the Emulation tool for MB91460E series. As the emulation device MB91FV460B does not contain the shutdown register and standby RAM, these parts are emulated in Emulation RAM.

2 Differences between MB91F467E and Emulation System

The chapter describes the differences between the emulation system and MB91F467E series.

The MB91F467E offers a so called the shutdown mode, which is not available in Emulation system. However these missing parts are emulated.

2.1 Overview of the differences

Table 1. Differences of Emulation system and MB91F467E series

Feature	Emulation system	MB91F467E
Standby RAM address range	0x15C008 – 0x15FFFF	0xFFFAC000 – 0xFFFAFFFF
Shutdown Control register address	0x15C000 - 0x15C007	0x4D4 - 0x4DB
Shutdown mode	STOP mode will be used instead	available

2.2 Details of differences

2.2.1 Standby RAM address Range

The Emulation system EMA-MB91FV460B-00x does not support standby RAM. For this reason a part of Emulation RAM is used instead. The address range 0x15.0008 to 0x15.FFFF is used for this purpose.

The Emulation system does have 8 Byte less memory space for Standby RAM than series device.

In Emulation system the standby RAM area is always enabled. The RAMEN bit setting in SHDE register does not have any effect at emulation system.

Standby RAM address range using Emulation system: 0x15C008 – 0x15FFFF

Standby RAM address range using MB91F467E series: 0xFFFAC000 – 0xFFFAFFFF

In Softune Workbench template project for MB91F467E series, Linker settings are setup accordingly for the two configurations.

Note:

In Emulation system the standby RAM area is always accessible. Standby Ram size is 8 Byte less than series size.

2.2.2 Shutdown Control register address

The Emulation system EMA-MB91FV460B-00x does not support Shutdown register set. These missing register are emulated in Emulation RAM at address range 0x15C000 - 0x15C007. In MB91F467E series, the register address range is 0x04D4 - 0x04DB. The header files overcome the different addresses. The mb91467e.h header file does not contain the shutdown register. These are separated files, one for emulation system (shutdown_emu.h) and one for MB91F467E series (shutdown_flash.h). Depending on HW usage the according header file needs to be used for compilation.

2.2.3 Shutdown mode

As the Emulation system does not support the shutdown register set, it also does not support the shutdown mode. Using Emulation system STOP mode is used instead. Software routines to be included in Application will copy the Shutdown setup and setup the wakeup sources for STOP mode.

As wakeup shutdown mode will issue a reset this is also emulated by Software in emulation system. A software routine is copy the wakeup flags to the shutdown register, emulating a shutdown wakeup reset. In case RTC is used, another SW routine needs to be inserted in start-up code which re-initializes the RTC in emulation system.

> **Note:**
>
> Power consumption measurements in shutdown mode should be done with MB91F467E series.

2.3 Limitations

- **Using Hardware Watchdog in shutdown mode**

  In emulation system Hardware watchdog will be enabled in STOP mode, however if HW watchdog reset occurs, no software emulation can be done. There is no possibility to distinguish if HW watchdog occurs in shutdown mode or other mode using emulation system. SHDINT register will not be updated.

- **Using RTC in shutdown mode**

  A shutdown wakeup reset does not clear the RTC register in MB91F467E series. In Emulation system the RTC is able to run in Stop mode, however a software reset executed in emulation will reset the register. For this reason the registers are stored in shadow register and restored during startup of application. That means RTC is not operating during Shutdown reset phase of emulation system.

- **Wake-up from shutdown mode**

  The Emulation system is doing software reset at end of shutdown recovery, that means that in Reset Cause register a Software reset will be listed this is different to MB91F467E series where INIT cause is listed. The Shutdown wakeup flags (SHDINT and EXTF register) can be checked at the register addresses and contain same values beside of hardware watchdog.

- **Standby RAM size**

  The Emulation system standby RAM size is 8Byte less than series standby RAM size.

3 MB91F467E template project

The chapter describes the template project of MB91F467E series.

Cypress is offering a template project for MB91F467E series. It includes some basic settings for e.g. Linker, C-Compiler which must be checked and modified in detail, corresponding to the user application.

3.1 Template file structure

The template project comes with following files:

- Start91460.asm
- Vectors.c / .h

- Mb91467e.h / .asm
- Shutdown.h / .asm
- shutdown_flash.h
- shutdown_emu.h
- Main.c
- shutdown_emulation.c / .h

3.1.1 Start91460.asm

The Start91460.asm file is sued to initialize the MCU. Settings like stack size, Clock speed and Bus interface can be set in this file.

3.1.2 Vectors.c / .h

This file contains the Interrupt vector table. In addition the Interrupt level can be set via the ICRxx register.

3.1.3 Mb91467e.h / .asm

This file defines the I/O register of MB91F467E series. The shutdown register are defined in a separate file.

3.1.4 shutdown.h / .asm

The Emulation system and MB91F467E have different addresses for shutdown register. Select in this file which target system (STANDALONE or EMULATION) is used. Depending on this selection a header file is included with offset address for that target system.

Figure 1. shutdown.h file

```
/* SAMPLE CODE
/* ------------------------------------------------------------------------ */
#define STANDALONE 1
#define EMULATION  2
/* ------------------------------------------------------------------------ */
//#define TARGET_SYSTEM EMULATION   /* macro is defined as project
setting       */
/* ------------------------------------------------------------------------ */
#if   (TARGET_SYSTEM == STANDALONE)
      #include "shutdown_flash.h"
#elif (TARGET_SYSTEM == EMULATION)
      #include "shutdown_emu.h"
#else
      #error Target system not supported!
#endif
```

3.1.5 Shutdown_flash.h

This file contains the register definition and addresses of shutdown register for Mb91F467E. (start address: 0x04d4)

3.1.6 Shutdown_emu.h

This file contains the register definition and addresses of shutdown register for Emulation system. (start address 0x150000)

3.1.7 Shutdown_emulation.c / .h

This file is used for emulation system standby emulation. It contains several functions to achieve same behavior of emulation system as MB91F467E series.

The function Shutdown_SetEmulationWakeupSources() copies the shut down wakeup sources set in wakeup register to corresponding register in emulation system. External interrupts, RTC and HW watchdog will be set accordingly. This function should be inserted in Application at shutdown emulation preparation stage, after shutdown registers are written by application.

The function Shutdown_RecoveryEmulation() is executed after shutdown wakeup occurred. As Emulation system is using STOP mode this function should be insert after Stop mode enter sequence. As it should be executed direct after wakeup. It copies the wakeup source to shutdown register and initializes several registers to default value to achieve same reset value, as shutdown reset will do. RTC and calibration Unit register are stored to be able to be restored again after reset, in case RTC is activated in shutdown mode.

The function Shutdown_RestoreEmulationRTC() is restoring the RTC and calibration Register settings. When RTC is active in shutdown mode, this register are not reset in shutdown mode wakeup reset using MB91F467E. The function should be called in the beginning of start-up file after stacks are initialized.

Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	—	NOFL	02/03/2010	V1.0 MSt First draft
			12/08/2010	V1.1 MSt Changed memory addresses for shutdown register and standby Ram Changed to new Company name
*A	5128489	NOFL	04/14/2016	Converted Spansion Application Note “MCU-AN-300118-E-V11” to cypress format.
*B	5872541	AESATMP9	09/04/2017	Updated logo and copyright.
*C	6054547	NOFL	02/12/2018	Update links Updated template

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198 Champion Court
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