Microcontroller Engineering with MSP432 Fundamentals and Applications 1st edition Bai Solutions Manual

SKU: 9781498772983-SOLUTIONS

(CHAPTER 2)

I. True/False Selections

1. F, 2. T, 3. T, 4. T, 5. F, 6. F, 7. T, 8. F, 9. T, 10. T.

II. Multiple Choices

1. D, 2. A, 3. B, 4. D, 5. D, 6. D , 7. C, 8. D, 9. C, 10. D.

III. Exercises

1. Provide a brief description about basic components used in an embedded system or a microcontroller system.

   1) Microcontroller Core or CPU
   2) Memory unit
   3) I/O Ports

2. Provide a brief description about basic components used in an ARM Cortex-M4 MCU.

   Overall, the Cortex-M4 MCU processor incorporates:

   - A Processor Core or CPU.
   - A Nested Vectored Interrupt Controller (NVIC) closely integrated with the processor core to achieve low latency interrupt processing.
   - Multiple high-performance bus interfaces, including Code Interface and SRAM and Peripheral Interface.
   - A System Timer unit SysTick.
   - A low-cost debug solution with the optional ability, such as Debug Access Port (DAP) and Data Watchpoint.
   - An optional Memory Protection Unit (MPU).
   - An optional Floating Point Unit (FPU).

3. Explain the functions of 13 general purpose registers and 3 special registers in the register bank inside an ARM Cortex-M4 CPU.

   Inside the register bank, thirteen (13) registers **R0** ~ **R12**, belong to general purpose registers and the other three (3) registers **R13** ~ **R15** are special registers with different specific functions. As we mentioned, all of these registers are 32-bit.

   All thirteen (13) general purpose registers can be used to store instructions, data, and addresses. These registers can also be further divided into two subgroups. The first eight registers, **R0** ~ **R7**, can be categorized to the Low Register group, and the **R8** ~ **R12** can be grouped to a High Register set. Most 16-bit data operations should be performed in the Low Register group, and most 32-bit data operations should be processed in the High Register group.

Microcontroller Engineering with MSP432 Fundamentals and Applications 1st edition Bai Solutions Manual

The rest three (3) registers in the register bank belong to special registers with specific functions. The register **R13** is a **Stack Pointer Register** (**SPR**) used to store the current stack address. In Cortex-M4 core, there are two kinds of stack pointers: the **Main Stack Pointer** (**MSP**) and the **Process Stack Pointer** (**PSP**). The register **R14** is a **Link Register** (**LR**) and this register provides some linking functions to setup a connection between the main program and the calling functions or subroutines. The register **R15** is the **Program Counter** (**PC**). This register keeps the sequence running of the program by automatically updating its content to point to the next instruction's address in the memory.

4. Provide a brief description about operational modes available for the MSP432P401R MCU system and their transition relationships.

   Six operational modes are available for the MSP432P401R MCU system, they are:

   1) Active Mode (AM)
   2) Low-Power-Mode 0 (LPM0)
   3) Low-Power-Mode 3 (LPM3)
   4) Low-Power-Mode 4 (LPM4)
   5) Low-Power-Mode 3.5 (LPM3.5)
   6) Low-Power-Mode 4.5 (LPM4.5)

   The top four (4) modes can be switched and exchanged between them, but the last two modes, LPM3.5 and LPM4.5 can only perform one way transition; from AM to either of them. However, both LPM3.5 and LPM4.5 modes cannot be transited back to the AM.

5. The Hard Reset resets all modules that are set up or modified by the application. This includes all peripherals as well as the non debug logic of the Cortex-M4. The MSP432P401R MCU supports up to 16 sources of Hard Reset. Table 2.11 lists the reset source allocation. The Reset Controller registers can be used to identify the possible source of reset in the device.
   From an application perspective, a Hard Reset performs the following jobs:

   - Resets the processor and all application configured peripherals in the system, which includes the bus system, thereby aborting any pending bus transactions.
   - Returns control to the user code.
   - Debugger connection to the MCU is maintained.
   - It does NOT reboot the device.
   - On-chip SRAM values are retained.

   A point to be noted is that the Hard Reset class sets status flag registers that report the exact source of the Hard Reset. The application can use these registers to select the necessary course of action.

Microcontroller Engineering with MSP432 Fundamentals and Applications 1st edition Bai Solutions Manual