

## FreeRTOS Notes for the Tiva-C TM4C123 (using Keil Microvision 5)

### Manual Setup

0. Study pg. 19 ("Creating a New Project from Scratch") of the FreeRTOS manual.
1. Create a subfolder in your project directory named `.\FreeRTOS`.
2. Copy into it these files from the `FreeRTOSv10.0.0\FreeRTOS\Source` distribution directory:
  - a. `list.c`
  - b. `queue.c`
  - c. `tasks.c`
  - d. `timers.c`
3. Create the subfolder, `.\FreeRTOS\portable\RVDS\ARM_CM4F`, and add these files from the distribution folder:
  - a. `port.c`
  - b. `portmacro.h`
4. Create the subfolder `.\FreeRTOS\portable\MemMang` and add the following files from the distribution:
  - a. `heap1_c` (or, a different `heapx_c` file to use a different heap model).
5. Copy `FreeRTOSConfig.h` to the root project folder and add it as an existing file to the Keil project (e.g. in the Startup group).
6. Create a new group in the Keil project called "FreeRTOS" and Add Existing .c files from steps 2-4.
7. In "Options for Target...", add the following C include paths:
  - a. `.;\FreeRTOS\include;.\FreeRTOS\portable\RVDS\ARM_CM4F`
8. Define `uint32_t SystemCoreClock` in the main project.c file (or wherever) and assign it after initializing the PLL:

```
SystemCoreClock = PLL_GetBusClockFreq();
```

**\*\* THE PROJECT SHOULD BUILD SUCCESSFULLY AT THIS POINT, BUT WON'T YET RUN. \*\***

9. Add EXTERNS and assign the ISR handlers to the following interrupts in the `startup_rvmdk.S` file:
  - a. `SVC_Handler`
  - b. `PendSV_Handler`
  - c. `SysTick_Handler`
10. Add the following #includes to the main project file (e.g. `project.c`):
  - a. `#include <FreeRTOS.h>`
  - b. `#include <task.h>`
  - c. (Optional) `<semphr.h>`
  - d. (Optional) `<timers.h>`
11. Create task functions
12. Inside `main()`, call `xTaskCreate()` for each task and then call `vTaskStartScheduler()`.
13. Run the project.

Another way to do steps 1-4 would be to copy the whole FreeRTOS distribution Source folder to the Keil project folder and then delete the subfolders & files that aren't used.

## Miscellaneous Notes

- May need to adjust configTOTAL\_HEAP\_SIZE
  - 8192 seems to work OK for 3 tasks.
- Watch out for configPRIO\_BITS, especially in FreeRTOS 10.1. By default it will be 4 bits, but should be 3 (priorities 0-7 on the TM4C123).
  - Version 9.1 doesn't seem to check for this in xPortStartScheduler.
- For using software timers, define configUSE\_TIMER, e.g.:

```
#define configUSE_TIMERS      1
#define configTIMER_TASK_STACK_DEPTH    32
#define configTIMER_TASK_PRIORITY    2
#define configTIMER_QUEUE_LENGTH    3
```