

# AN11784

## PN7462AU How to integrate RTOS

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Application note  
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### Document information

Info	Content
<b>Keywords</b>	PN7462AU How to integrate RTOS
<b>Abstract</b>	The following document describes steps required for integration of RTOS with PN7462AU Firmware.



## Revision history

Rev	Date	Description
1.1	20160913	Figures updated
1.0	20160309	First official release

## Contact information

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## 1. Introduction

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This document enlists steps and guidelines required for integration of FreeRTOS with PN7462AU Firmware.

Unless and otherwise mentioned, the files and folders referred here are relative to the ROOT Folder of the PN7462AU Firmware Package.

## 2. Preconditions

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The following pre-conditions are assumed before integration Free RTOS with PN7462AU Firmware.

1. PN7462AU Firmware source and evaluation package is available  
(If not available, contact PN7462AU CAS)
2. LPCXpresso IDE version 8.0.0\_526 or above is installed  
(If not available, download from [www.nxp.com/lpcware](http://www.nxp.com/lpcware))
3. PN7462AU Plug-in is installed into LPCXpresso IDE  
(If not available, contact PN7462AU support)
4. FreeRTOSV8.2.0 is available.  
(If not available, download from [www.nxp.com/redirect/freertos.org/](http://www.nxp.com/redirect/freertos.org/))
5. Awareness of FreeRTOS Porting and Integration.  
(This application note is a guideline document, it is not a tutorial on integration of FreeRTOS.)
6. Board bring-up of the DEMO/Evaluation board already completed.  
e.g. Jumper settings/Power Supply/Reference EEPROM contents inside the PN7462AU IC already completed.

### 3. Integrating FreeRTOS package

#### 3.1 Location to copy FreeRTOS code

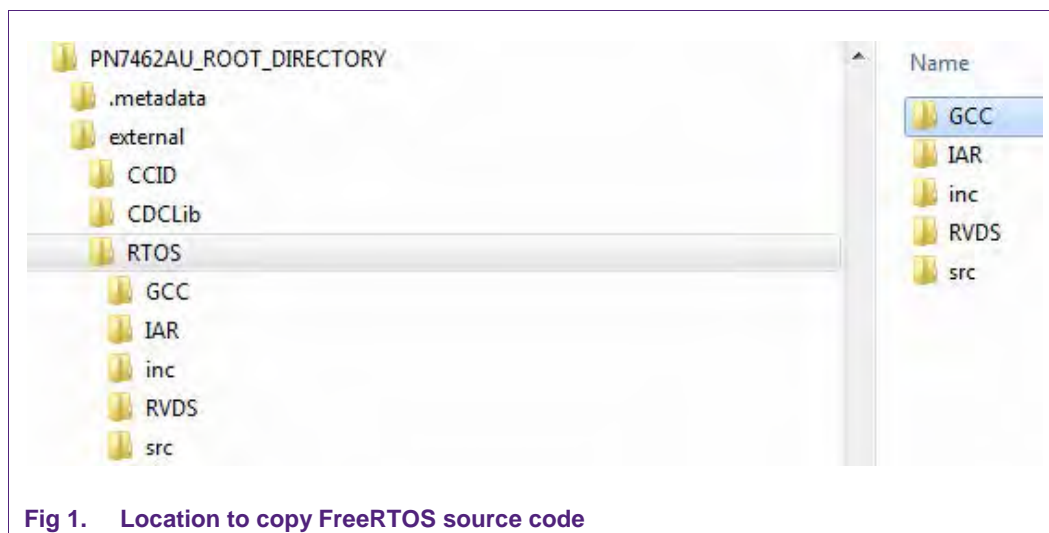


Fig 1. Location to copy FreeRTOS source code

FreeRTOS source code has to be copied to specific folders within  
<RootFirmwareFolder>/external/RTOS.

### 3.2 Files used for porting/integration

The following files have to be copied from FreeRTOS Package to the corresponding sub directory inside <RootFirmwareFolder>/external/RTOS.

**Table 1. Free RTOS Files**

Source	Destination sub directory inside <RootFirmwareFolder>/external/RTOS
FreeRTOS\Source\include\croutine.h	inc\croutine.h
FreeRTOS\Source\include\deprecated_definitions.h	inc\deprecated_definitions.h
FreeRTOS\Source\include\event_groups.h	inc\event_groups.h
FreeRTOS\Source\include\FreeRTOS.h	inc\FreeRTOS.h
FreeRTOS\Source\include\list.h	inc\list.h
FreeRTOS\Source\include\mpu_wrappers.h	inc\mpu_wrappers.h
FreeRTOS\Source\include\portable.h	inc\portable.h
FreeRTOS\Source\include\projdefs.h	inc\projdefs.h
FreeRTOS\Source\include\queue.h	inc\queue.h
FreeRTOS\Source\include\semphr.h	inc\semphr.h
FreeRTOS\Source\include\StackMacros.h	inc\StackMacros.h
FreeRTOS\Source\include\task.h	inc\task.h
FreeRTOS\Source\include\timers.h	inc\timers.h
FreeRTOS\Source\event_groups.c	src\event_groups.c
FreeRTOS\Source\portable\MemMang\heap_3.c	src\heap_3.c
FreeRTOS\Source\portable\MemMang\heap_2.c	src\heap_2.c
FreeRTOS\Source\list.c	src\list.c
FreeRTOS\Source\queue.c	src\queue.c
FreeRTOS\Source\tasks.c	src\tasks.c
FreeRTOS\Source\timers.c	src\timers.c
FreeRTOS\Source\portable\GCC\ARM_CM0\portmacro.h	GCC\portmacro.h
FreeRTOS\Source\portable\GCC\ARM_CM0\port.c	GCC\port.c
FreeRTOS\Source\portable\IAR\ARM_CM0\port.c	IAR\port.c
FreeRTOS\Source\portable\IAR\ARM_CM0\portasm.s	IAR\portasm.s
FreeRTOS\Source\portable\IAR\ARM_CM0\portmacro.h	IAR\portmacro.h
FreeRTOS\Source\portable\RVDS\ARM_CM0\port.c	RVDS\port.c
FreeRTOS\Source\portable\RVDS\ARM_CM0\portmacro.h	RVDS\portmacro.h
FreeRTOS\Demo\CORTEX_M0_LPC1114_LPCXpresso\RTOSDemo\Source\FreeRTOSConfig.h (After Modifications. See Section 3.3 FreeRTOSConfig.h below)	inc\FreeRTOSConfig.h

### 3.3 FreeRTOSConfig.h

FreeRTOS\Demo\CORTEX\_M0\_LPC1114\_LPCXpresso\RTOSDemo\Source\FreeRTOSConfig.h has been used as reference code for the RTOS Porting.

On top of the reference FreeRTOSConfig.h the following modifications are needed.

**Table 2. Configuration changes to FreeRTOSConfig.h**

Configurable #define	Value	Notes
SystemCoreClock	20000000	20MHz Clock. Replace <code>extern uint32_t SystemCoreClock;</code> with <code>#define SystemCoreClock 20000000</code>
configMAX_PRIORITIES	8	
configMINIMAL_STACK_SIZE	32	
configTOTAL_HEAP_SIZE	5500	Required if heap_2.c being used. With heap_3.c, this is optional
configTIMER_TASK_PRIORITY	1	
configTIMER_QUEUE_LENGTH	10	
INCLUDE_vTaskDelete	0	
INCLUDE_vTaskCleanUpResources	0	
INCLUDE_vTaskDelayUntil	0	
INCLUDE_xEventGroupSetBitFromISR	1	
INCLUDE_xTimerPendFunctionCall	1	
INCLUDE_xSemaphoreGetMutexHolder	0	
INCLUDE_xEventGroupSetBitFromISR	1	
INCLUDE_xTimerPendFunctionCall	1	
INCLUDE_xSemaphoreGetMutexHolder	0	

## 4. Updating phRtos wrapper

The phRtos module/component has been created to facilitate porting across RTOS and NonRTOS based designs.

phCommon\inc\wrapper\phRtos\_RTOS.h and phRtos\src\phRtos\_RTOS.c have to be updated to integrate phRtos with FreeRTOS. The APIs called by the supplied phRtos\_RTOS.h and phRtos\_RTOS.c correspond to APIs as provided by a dummy EXAMPLE\_RTOS. The end user (who has Awareness of FreeRTOS Porting and Integration – as mentioned in Section 2 - Preconditions on page 3 ) is expected to update phRtos\_RTOS.h and phRtos\_RTOS.c as listed in API Mapping between EXAMPLE\_RTOS and FreeRTOS ([Table 3](#) belowbelow).

**Table 3. API Mapping between EXAMPLE\_RTOS and FreeRTOS**

EXAMPLE_RTOS API/Value	FreeRTOS API/Value
<b>&gt;Defines / PreProcessor Macros&lt;</b>	
EXAMPLE_RTOS_MAXIMUM_DELAY	portMAX_DELAY
EXAMPLE_RTOS_STACK_TYPE	portSTACK_TYPE
EXAMPLE_RTOS_FALSE	pdFALSE
EXAMPLE_RTOS_TRUE	pdTRUE
<b>&gt;Header Files&lt;</b>	
EXAMPLE_RTOS_PortingMacros.h	portmacro.h
EXAMPLE_RTOS_MAIN_API.h	FreeRTOS.h
EXAMPLE_RTOS_TASK_API.h	task.h
EXAMPLE_RTOS_QUEUE_API.h	queue.h
EXAMPLE_RTOS_SEMAPHORE_API.h	semphr.h
EXAMPLE_RTOS_EVENT_API.h	event_groups.h
EXAMPLE_RTOS_TIMER_API.h	timers.h
<b>&gt;Data Types&lt;</b>	
EXAMPLE_RTOS_DefaultType_t	BaseType_t
EXAMPLE_RTOS_TaskHandleType_t	TaskHandle_t
<b>&gt;Task/Task Scheduler APIs&lt;</b>	
EXAMPLE_RTOS_TaskSchedulerStart	vTaskStartScheduler
EXAMPLE_RTOS_TaskSchedulerStop	vTaskEndScheduler
EXAMPLE_RTOS_TaskSchedulerGetState	xTaskGetSchedulerState
EXAMPLE_RTOS_TaskCreate	xTaskCreate
EXAMPLE_RTOS_TaskDelete	vTaskDelete
EXAMPLE_RTOS_TaskGetName	pcTaskGetTaskName
EXAMPLE_RTOS_TaskDelay	vTaskDelay
EXAMPLE_RTOS_TaskSuspend	vTaskSuspend
EXAMPLE_RTOS_TaskSuspendAll	vTaskSuspendAll
EXAMPLE_RTOS_TaskResumeAll	xTaskResumeAll
EXAMPLE_RTOS_TaskResume_ISRSAFE	xTaskResumeFromISR
EXAMPLE_RTOS_TaskResume	vTaskResume
EXAMPLE_RTOS_TaskYield	taskYIELD
EXAMPLE_RTOS_TaskGetState	eTaskGetState
EXAMPLE_RTOS_TaskSetPriority	vTaskPrioritySet
EXAMPLE_RTOS_TaskGetPriority	uxTaskPriorityGet
EXAMPLE_RTOS_TaskGetStackWaterMark	uxTaskGetStackHighWaterMark
EXAMPLE_RTOS_YIELD_FROM_ISR	portYIELD_FROM_ISR

EXAMPLE_RTOS API/Value	FreeRTOS API/Value
<b>&gt;Queue APIs&lt;</b>	
EXAMPLE_RTOS_QueueCreate	xQueueCreate
EXAMPLE_RTOS_QueueDelete	vQueueDelete
EXAMPLE_RTOS_QueueReset	xQueueReset
EXAMPLE_RTOS_QueuePost_ISRSAFE	xQueueSendFromISR
EXAMPLE_RTOS_QueuePost	xQueueSend
EXAMPLE_RTOS_QueueGet_ISRSAFE	xQueueReceiveFromISR
EXAMPLE_RTOS_QueueGet	xQueueReceive
<b>&gt;Semaphore/Mutex APIs&lt;</b>	
EXAMPLE_RTOS_SemaphoreRelease_ISRSAFE	xSemaphoreGiveFromISR
EXAMPLE_RTOS_SemaphoreRelease	xSemaphoreGive
EXAMPLE_RTOS_SemaphoreGetMutexHolder	xSemaphoreGetMutexHolder
EXAMPLE_RTOS_SemaphoreDelete	vSemaphoreDelete
EXAMPLE_RTOS_SemaphoreCreate_Mutex	xSemaphoreCreateMutex
EXAMPLE_RTOS_SemaphoreCreate_Count	xSemaphoreCreateCounting
EXAMPLE_RTOS_SemaphoreAcquire_ISRSAFE	xSemaphoreTakeFromISR
EXAMPLE_RTOS_SemaphoreAcquire	xSemaphoreTake
<b>&gt;Events APIs&lt;</b>	
EXAMPLE_RTOS_EventBitsCreate	xEventGroupCreate
EXAMPLE_RTOS_EventBitsSet_ISRSAFE	xEventGroupSetBitsFromISR
EXAMPLE_RTOS_EventBitsSet	xEventGroupSetBits
EXAMPLE_RTOS_EventBitsWait	xEventGroupWaitBits
EXAMPLE_RTOS_EventBitsClear_ISRSAFE	xEventGroupClearBitsFromISR
EXAMPLE_RTOS_EventBitsClear	xEventGroupClearBits
EXAMPLE_RTOS_EventDelete	vEventGroupDelete
<b>&gt;Timer APIs&lt;</b>	
EXAMPLE_RTOS_TimerCreate	xTimerCreate
EXAMPLE_RTOS_TimerGetID	pvTimerGetTimerID
EXAMPLE_RTOS_TimerStart	xTimerStart
EXAMPLE_RTOS_TimerStop	xTimerStop
EXAMPLE_RTOS_TimerReset	xTimerReset
EXAMPLE_RTOS_TimerDelete	xTimerDelete
EXAMPLE_RTOS_TimerChangeDuration	xTimerChangePeriod
<b>&gt;MISC APIs&lt;</b>	
EXAMPLE_RTOS_GetTickCount_ISRSAFE	xTaskGetTickCountFromISR
EXAMPLE_RTOS_GetTickCount	xTaskGetTickCount
EXAMPLE_RTOS_CallBackOnEveryTick	vApplicationTickHook
EXAMPLE_RTOS_NoFreeMemory	vApplicationMallocFailedHook
EXAMPLE_RTOS_StackOverflowDetected	vApplicationStackOverflowHook



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