

---

Document Number: MCUXSDKAPIRM  
Rev 2.12.1  
Sept 2022

# MCUXpresso SDK API Reference Manual

**NXP Semiconductors**



# Contents

## Chapter 1 Introduction

## Chapter 2 Trademarks

## Chapter 3 Architectural Overview

## Chapter 4 Clock Driver

<b>4.1</b>	<b>Overview</b>	<b>7</b>
<b>4.2</b>	<b>Data Structure Documentation</b>	<b>22</b>
4.2.1	struct osc_config_t	23
4.2.2	struct ccm_analog_frac_pll_config_t	23
4.2.3	struct ccm_analog_sscg_pll_config_t	23
<b>4.3</b>	<b>Macro Definition Documentation</b>	<b>24</b>
4.3.1	FSL_CLOCK_DRIVER_VERSION	24
4.3.2	ECSPI_CLOCKS	24
4.3.3	GPIO_CLOCKS	24
4.3.4	GPT_CLOCKS	24
4.3.5	I2C_CLOCKS	24
4.3.6	IOMUX_CLOCKS	25
4.3.7	IPMUX_CLOCKS	25
4.3.8	PWM_CLOCKS	25
4.3.9	RDC_CLOCKS	25
4.3.10	SAI_CLOCKS	25
4.3.11	RDC_SEMA42_CLOCKS	26
4.3.12	UART_CLOCKS	26
4.3.13	USDHC_CLOCKS	26
4.3.14	WDOG_CLOCKS	26
4.3.15	TMU_CLOCKS	26
4.3.16	SDMA_CLOCKS	27
4.3.17	MU_CLOCKS	27
4.3.18	QSPI_CLOCKS	27
4.3.19	kCLOCK_CoreSysClk	27
4.3.20	CLOCK_GetCoreSysClkFreq	27
<b>4.4</b>	<b>Enumeration Type Documentation</b>	<b>27</b>

Section No.	Title	Page No.
4.4.1	clock_name_t .....	27
4.4.2	clock_ip_name_t .....	28
4.4.3	clock_root_control_t .....	30
4.4.4	clock_root_t .....	31
4.4.5	clock_rootmux_m4_clk_sel_t .....	32
4.4.6	clock_rootmux_axi_clk_sel_t .....	32
4.4.7	clock_rootmux_ahb_clk_sel_t .....	32
4.4.8	clock_rootmux_qspi_clk_sel_t .....	33
4.4.9	clock_rootmux_ecspi_clk_sel_t .....	33
4.4.10	clock_rootmux_i2c_clk_sel_t .....	33
4.4.11	clock_rootmux_uart_clk_sel_t .....	34
4.4.12	clock_rootmux_gpt_t .....	34
4.4.13	clock_rootmux_wdog_clk_sel_t .....	34
4.4.14	clock_rootmux_Pwm_clk_sel_t .....	35
4.4.15	clock_rootmux_sai_clk_sel_t .....	35
4.4.16	clock_rootmux_noc_clk_sel_t .....	35
4.4.17	clock_pll_gate_t .....	36
4.4.18	clock_gate_value_t .....	36
4.4.19	clock_pll_bypass_ctrl_t .....	37
4.4.20	clock_pll_clke_t .....	37
4.4.21	_osc_mode .....	38
4.4.22	osc32_src_t .....	38
4.4.23	_ccm_analog_pll_ref_clk .....	38
<b>4.5</b>	<b>Function Documentation .....</b>	<b>39</b>
4.5.1	CLOCK_SetRootMux .....	39
4.5.2	CLOCK_GetRootMux .....	39
4.5.3	CLOCK_EnableRoot .....	39
4.5.4	CLOCK_DisableRoot .....	40
4.5.5	CLOCK_IsRootEnabled .....	40
4.5.6	CLOCK_UpdateRoot .....	40
4.5.7	CLOCK_SetRootDivider .....	40
4.5.8	CLOCK_GetRootPreDivider .....	41
4.5.9	CLOCK_GetRootPostDivider .....	41
4.5.10	CLOCK_InitOSC25M .....	41
4.5.11	CLOCK_DeinitOSC25M .....	42
4.5.12	CLOCK_InitOSC27M .....	42
4.5.13	CLOCK_DeinitOSC27M .....	42
4.5.14	CLOCK_SwitchOSC32Src .....	42
4.5.15	CLOCK_ControlGate .....	42
4.5.16	CLOCK_EnableClock .....	42
4.5.17	CLOCK_DisableClock .....	43
4.5.18	CLOCK_PowerUpPll .....	43
4.5.19	CLOCK_PowerDownPll .....	43
4.5.20	CLOCK_SetPllBypass .....	44

<b>Section No.</b>	<b>Title</b>	<b>Page No.</b>
4.5.21	CLOCK_IsPllBypassed .....	44
4.5.22	CLOCK_IsPllLocked .....	44
4.5.23	CLOCK_EnableAnalogClock .....	45
4.5.24	CLOCK_DisableAnalogClock .....	46
4.5.25	CLOCK_OverrideAnalogClke .....	46
4.5.26	CLOCK_OverridePllPd .....	46
4.5.27	CLOCK_InitArmPll .....	47
4.5.28	CLOCK_InitSysPll1 .....	48
4.5.29	CLOCK_InitSysPll2 .....	48
4.5.30	CLOCK_InitSysPll3 .....	48
4.5.31	CLOCK_InitDramPll .....	49
4.5.32	CLOCK_InitAudioPll1 .....	49
4.5.33	CLOCK_InitAudioPll2 .....	49
4.5.34	CLOCK_InitVideoPll1 .....	50
4.5.35	CLOCK_InitVideoPll2 .....	50
4.5.36	CLOCK_InitSSCGPll .....	50
4.5.37	CLOCK_GetSSCGPllFreq .....	51
4.5.38	CLOCK_InitFracPll .....	52
4.5.39	CLOCK_GetFracPllFreq .....	52
4.5.40	CLOCK_GetPllFreq .....	52
4.5.41	CLOCK_GetPllRefClkFreq .....	53
4.5.42	CLOCK_GetFreq .....	53
4.5.43	CLOCK_GetClockRootFreq .....	53
4.5.44	CLOCK_GetCoreM4Freq .....	54
4.5.45	CLOCK_GetAxiFreq .....	54
4.5.46	CLOCK_GetAhbFreq .....	54

## **Chapter 5 IOMUXC: IOMUX Controller**

<b>5.1</b>	<b>Overview .....</b>	<b>55</b>
<b>5.2</b>	<b>Macro Definition Documentation .....</b>	<b>72</b>
5.2.1	FSL_IOMUXC_DRIVER_VERSION .....	72
<b>5.3</b>	<b>Function Documentation .....</b>	<b>72</b>
5.3.1	IOMUXC_SetPinMux .....	72
5.3.2	IOMUXC_SetPinConfig .....	73

## **Chapter 6 Common Driver**

<b>6.1</b>	<b>Overview .....</b>	<b>74</b>
<b>6.2</b>	<b>Macro Definition Documentation .....</b>	<b>76</b>
6.2.1	FSL_DRIVER_TRANSFER_DOUBLE_WEAK_IRQ .....	76
6.2.2	MAKE_STATUS .....	76

Section No.	Title	Page No.
6.2.3	MAKE_VERSION .....	77
6.2.4	FSL_COMMON_DRIVER_VERSION .....	77
6.2.5	DEBUG_CONSOLE_DEVICE_TYPE_NONE .....	77
6.2.6	DEBUG_CONSOLE_DEVICE_TYPE_UART .....	77
6.2.7	DEBUG_CONSOLE_DEVICE_TYPE_LPUART .....	77
6.2.8	DEBUG_CONSOLE_DEVICE_TYPE_LPSCI .....	77
6.2.9	DEBUG_CONSOLE_DEVICE_TYPE_USBCDC .....	77
6.2.10	DEBUG_CONSOLE_DEVICE_TYPE_FLEXCOMM .....	77
6.2.11	DEBUG_CONSOLE_DEVICE_TYPE_IUART .....	77
6.2.12	DEBUG_CONSOLE_DEVICE_TYPE_VUSART .....	77
6.2.13	DEBUG_CONSOLE_DEVICE_TYPE_MINI_USART .....	77
6.2.14	DEBUG_CONSOLE_DEVICE_TYPE_SWO .....	77
6.2.15	DEBUG_CONSOLE_DEVICE_TYPE_QSCI .....	77
6.2.16	ARRAY_SIZE .....	77
<b>6.3</b>	<b>Typedef Documentation .....</b>	<b>77</b>
6.3.1	status_t .....	77
<b>6.4</b>	<b>Enumeration Type Documentation .....</b>	<b>78</b>
6.4.1	_status_groups .....	78
6.4.2	anonymous enum .....	80
<b>6.5</b>	<b>Function Documentation .....</b>	<b>81</b>
6.5.1	SDK_Malloc .....	81
6.5.2	SDK_Free .....	81
6.5.3	SDK_DelayAtLeastUs .....	81
<b>Chapter 7 ECSPI: Enhanced Configurable Serial Peripheral Interface Driver</b>		
<b>7.1</b>	<b>Overview .....</b>	<b>82</b>
<b>7.2</b>	<b>ECSPI Driver .....</b>	<b>83</b>
7.2.1	Overview .....	83
7.2.2	Typical use case .....	83
7.2.3	Data Structure Documentation .....	88
7.2.4	Macro Definition Documentation .....	90
7.2.5	Enumeration Type Documentation .....	90
7.2.6	Function Documentation .....	93
<b>7.3</b>	<b>ECSPI FreeRTOS Driver .....</b>	<b>106</b>
7.3.1	Overview .....	106
7.3.2	Macro Definition Documentation .....	106
7.3.3	Function Documentation .....	106
<b>7.4</b>	<b>ECSPI CMSIS Driver .....</b>	<b>109</b>
7.4.1	Function groups .....	109

Section No.	Title	Page No.
7.4.2	Typical use case .....	110
<b>Chapter 8 GPT: General Purpose Timer</b>		
<b>8.1</b>	<b>Overview .....</b>	<b>111</b>
<b>8.2</b>	<b>Function groups .....</b>	<b>111</b>
8.2.1	Initialization and deinitialization .....	111
<b>8.3</b>	<b>Typical use case .....</b>	<b>111</b>
8.3.1	GPT interrupt example .....	111
<b>8.4</b>	<b>Data Structure Documentation .....</b>	<b>114</b>
8.4.1	struct gpt_config_t .....	114
<b>8.5</b>	<b>Enumeration Type Documentation .....</b>	<b>115</b>
8.5.1	gpt_clock_source_t .....	115
8.5.2	gpt_input_capture_channel_t .....	115
8.5.3	gpt_input_operation_mode_t .....	116
8.5.4	gpt_output_compare_channel_t .....	116
8.5.5	gpt_output_operation_mode_t .....	116
8.5.6	gpt_interrupt_enable_t .....	116
8.5.7	gpt_status_flag_t .....	117
<b>8.6</b>	<b>Function Documentation .....</b>	<b>117</b>
8.6.1	GPT_Init .....	117
8.6.2	GPT_Deinit .....	117
8.6.3	GPT_GetDefaultConfig .....	117
8.6.4	GPT_SoftwareReset .....	118
8.6.5	GPT_SetClockSource .....	118
8.6.6	GPT_GetClockSource .....	118
8.6.7	GPT_SetClockDivider .....	118
8.6.8	GPT_GetClockDivider .....	119
8.6.9	GPT_SetOscClockDivider .....	119
8.6.10	GPT_GetOscClockDivider .....	119
8.6.11	GPT_StartTimer .....	119
8.6.12	GPT_StopTimer .....	120
8.6.13	GPT_GetCurrentTimerCount .....	120
8.6.14	GPT_SetInputOperationMode .....	120
8.6.15	GPT_GetInputOperationMode .....	120
8.6.16	GPT_GetInputCaptureValue .....	121
8.6.17	GPT_SetOutputOperationMode .....	121
8.6.18	GPT_GetOutputOperationMode .....	122
8.6.19	GPT_SetOutputCompareValue .....	122
8.6.20	GPT_GetOutputCompareValue .....	122

Section No.	Title	Page No.
8.6.21	GPT_ForceOutput .....	123
8.6.22	GPT_EnableInterrupts .....	123
8.6.23	GPT_DisableInterrupts .....	123
8.6.24	GPT_GetEnabledInterrupts .....	123
8.6.25	GPT_GetStatusFlags .....	124
8.6.26	GPT_ClearStatusFlags .....	124

## Chapter 9 GPIO: General-Purpose Input/Output Driver

<b>9.1</b>	<b>Overview .....</b>	<b>125</b>
<b>9.2</b>	<b>Typical use case .....</b>	<b>125</b>
9.2.1	Input Operation .....	125
<b>9.3</b>	<b>Data Structure Documentation .....</b>	<b>127</b>
9.3.1	struct gpio_pin_config_t .....	127
<b>9.4</b>	<b>Macro Definition Documentation .....</b>	<b>127</b>
9.4.1	FSL_GPIO_DRIVER_VERSION .....	127
<b>9.5</b>	<b>Enumeration Type Documentation .....</b>	<b>127</b>
9.5.1	gpio_pin_direction_t .....	127
9.5.2	gpio_interrupt_mode_t .....	127
<b>9.6</b>	<b>Function Documentation .....</b>	<b>128</b>
9.6.1	GPIO_PinInit .....	128
9.6.2	GPIO_PinWrite .....	129
9.6.3	GPIO_WritePinOutput .....	129
9.6.4	GPIO_PortSet .....	129
9.6.5	GPIO_SetPinsOutput .....	129
9.6.6	GPIO_PortClear .....	130
9.6.7	GPIO_ClearPinsOutput .....	131
9.6.8	GPIO_PortToggle .....	131
9.6.9	GPIO_PinRead .....	131
9.6.10	GPIO_ReadPinInput .....	131
9.6.11	GPIO_PinReadPadStatus .....	132
9.6.12	GPIO_ReadPadStatus .....	133
9.6.13	GPIO_PinSetInterruptConfig .....	133
9.6.14	GPIO_SetPinInterruptConfig .....	133
9.6.15	GPIO_PortEnableInterrupts .....	133
9.6.16	GPIO_EnableInterrupts .....	134
9.6.17	GPIO_PortDisableInterrupts .....	134
9.6.18	GPIO_DisableInterrupts .....	134
9.6.19	GPIO_PortGetInterruptFlags .....	134
9.6.20	GPIO_GetPinsInterruptFlags .....	135

Section No.	Title	Page No.
9.6.21	GPIO_PortClearInterruptFlags .....	135
9.6.22	GPIO_ClearPinsInterruptFlags .....	135

## Chapter 10 I2C: Inter-Integrated Circuit Driver

<b>10.1</b>	<b>Overview .....</b>	<b>137</b>
<b>10.2</b>	<b>I2C Driver .....</b>	<b>138</b>
10.2.1	Overview .....	138
10.2.2	Typical use case .....	138
10.2.3	Data Structure Documentation .....	142
10.2.4	Macro Definition Documentation .....	145
10.2.5	Typedef Documentation .....	145
10.2.6	Enumeration Type Documentation .....	146
10.2.7	Function Documentation .....	147
<b>10.3</b>	<b>I2C FreeRTOS Driver .....</b>	<b>162</b>
10.3.1	Overview .....	162
10.3.2	Macro Definition Documentation .....	162
10.3.3	Function Documentation .....	162
<b>10.4</b>	<b>I2C CMSIS Driver .....</b>	<b>165</b>
10.4.1	I2C CMSIS Driver .....	165

## Chapter 11 PWM: Pulse Width Modulation Driver

<b>11.1</b>	<b>Overview .....</b>	<b>167</b>
<b>11.2</b>	<b>PWM Driver .....</b>	<b>167</b>
11.2.1	Initialization and deinitialization .....	167
<b>11.3</b>	<b>Typical use case .....</b>	<b>167</b>
11.3.1	PWM output .....	167
<b>11.4</b>	<b>Enumeration Type Documentation .....</b>	<b>169</b>
11.4.1	pwm_clock_source_t .....	169
11.4.2	pwm_fifo_water_mark_t .....	170
11.4.3	pwm_byte_data_swap_t .....	170
11.4.4	pwm_half_word_data_swap_t .....	170
11.4.5	pwm_output_configuration_t .....	170
11.4.6	pwm_sample_repeat_t .....	171
11.4.7	pwm_interrupt_enable_t .....	171
11.4.8	pwm_status_flags_t .....	171
11.4.9	pwm_fifo_available_t .....	171
<b>11.5</b>	<b>Function Documentation .....</b>	<b>172</b>



<b>Section No.</b>	<b>Title</b>	<b>Page No.</b>
11.5.1	PWM_Init .....	172
11.5.2	PWM_Deinit .....	172
11.5.3	PWM_GetDefaultConfig .....	172
11.5.4	PWM_StartTimer .....	173
11.5.5	PWM_StopTimer .....	173
11.5.6	PWM_SoftwareReset .....	173
11.5.7	PWM_EnableInterrupts .....	173
11.5.8	PWM_DisableInterrupts .....	174
11.5.9	PWM_GetEnabledInterrupts .....	174
11.5.10	PWM_GetStatusFlags .....	174
11.5.11	PWM_clearStatusFlags .....	175
11.5.12	PWM_GetFIFOAvailable .....	176
11.5.13	PWM_SetSampleValue .....	176
11.5.14	PWM_GetSampleValue .....	176
11.5.15	PWM_SetPeriodValue .....	177
11.5.16	PWM_GetPeriodValue .....	178
11.5.17	PWM_GetCounterValue .....	178

## **Chapter 12    UART: Universal Asynchronous Receiver/Transmitter Driver**

<b>12.1</b>	<b>Overview .....</b>	<b>179</b>
<b>12.2</b>	<b>UART Driver .....</b>	<b>180</b>
12.2.1	Overview .....	180
12.2.2	Typical use case .....	180
12.2.3	Data Structure Documentation .....	186
12.2.4	Macro Definition Documentation .....	189
12.2.5	Typedef Documentation .....	189
12.2.6	Enumeration Type Documentation .....	189
12.2.7	Function Documentation .....	191
12.2.8	Variable Documentation .....	206
<b>12.3</b>	<b>UART FreeRTOS Driver .....</b>	<b>207</b>
12.3.1	Overview .....	207
12.3.2	Data Structure Documentation .....	207
12.3.3	Macro Definition Documentation .....	208
12.3.4	Function Documentation .....	208
<b>12.4</b>	<b>UART CMSIS Driver .....</b>	<b>210</b>
12.4.1	Function groups .....	210

## **Chapter 13    MU: Messaging Unit**

<b>13.1</b>	<b>Overview .....</b>	<b>212</b>
-------------	-----------------------	------------

Section No.	Title	Page No.
<b>13.2</b>	<b>Function description</b>	<b>212</b>
13.2.1	MU initialization	212
13.2.2	MU message	212
13.2.3	MU flags	213
13.2.4	Status and interrupt	213
13.2.5	MU misc functions	213
<b>13.3</b>	<b>Macro Definition Documentation</b>	<b>216</b>
13.3.1	FSL_MU_DRIVER_VERSION	216
<b>13.4</b>	<b>Enumeration Type Documentation</b>	<b>216</b>
13.4.1	_mu_status_flags	216
13.4.2	_mu_interrupt_enable	216
13.4.3	_mu_interrupt_trigger	217
<b>13.5</b>	<b>Function Documentation</b>	<b>217</b>
13.5.1	MU_Init	217
13.5.2	MU_Deinit	217
13.5.3	MU_SendMsgNonBlocking	217
13.5.4	MU_SendMsg	218
13.5.5	MU_ReceiveMsgNonBlocking	218
13.5.6	MU_ReceiveMsg	219
13.5.7	MU_SetFlagsNonBlocking	220
13.5.8	MU_SetFlags	220
13.5.9	MU_GetFlags	221
13.5.10	MU_GetStatusFlags	221
13.5.11	MU_GetInterruptsPending	222
13.5.12	MU_ClearStatusFlags	223
13.5.13	MU_EnableInterrupts	224
13.5.14	MU_DisableInterrupts	224
13.5.15	MU_TriggerInterrupts	224
13.5.16	MU_MaskHardwareReset	225
13.5.17	MU_GetOtherCorePowerMode	225
 <b>Chapter 14 QSPI: Quad Serial Peripheral Interface</b>		
<b>14.1</b>	<b>Overview</b>	<b>226</b>
<b>14.2</b>	<b>Quad Serial Peripheral Interface Driver</b>	<b>227</b>
14.2.1	Overview	227
14.2.2	Data Structure Documentation	231
14.2.3	Macro Definition Documentation	233
14.2.4	Enumeration Type Documentation	234
14.2.5	Function Documentation	237

## Chapter 15 RDC: Resource Domain Controller

<b>15.1</b>	<b>Overview</b>	<b>248</b>
<b>15.2</b>	<b>Data Structure Documentation</b>	<b>249</b>
15.2.1	struct rdc_hardware_config_t	250
15.2.2	struct rdc_domain_assignment_t	250
15.2.3	struct rdc_periph_access_config_t	250
15.2.4	struct rdc_mem_access_config_t	251
15.2.5	struct rdc_mem_status_t	252
<b>15.3</b>	<b>Enumeration Type Documentation</b>	<b>252</b>
15.3.1	_rdc_interrupts	252
15.3.2	_rdc_flags	252
15.3.3	_rdc_access_policy	252
<b>15.4</b>	<b>Function Documentation</b>	<b>252</b>
15.4.1	RDC_Init	253
15.4.2	RDC_Deinit	254
15.4.3	RDC_GetHardwareConfig	254
15.4.4	RDC_EnableInterrupts	254
15.4.5	RDC_DisableInterrupts	254
15.4.6	RDC_GetInterruptStatus	255
15.4.7	RDC_ClearInterruptStatus	255
15.4.8	RDC_GetStatus	255
15.4.9	RDC_ClearStatus	255
15.4.10	RDC_SetMasterDomainAssignment	256
15.4.11	RDC_GetDefaultMasterDomainAssignment	256
15.4.12	RDC_LockMasterDomainAssignment	256
15.4.13	RDC_SetPeriphAccessConfig	257
15.4.14	RDC_GetDefaultPeriphAccessConfig	257
15.4.15	RDC_LockPeriphAccessConfig	257
15.4.16	RDC_GetPeriphAccessPolicy	258
15.4.17	RDC_SetMemAccessConfig	258
15.4.18	RDC_GetDefaultMemAccessConfig	258
15.4.19	RDC_LockMemAccessConfig	259
15.4.20	RDC_SetMemAccessValid	259
15.4.21	RDC_GetMemViolationStatus	259
15.4.22	RDC_ClearMemViolationFlag	260
15.4.23	RDC_GetMemAccessPolicy	260
15.4.24	RDC_GetCurrentMasterDomainId	260

## Chapter 16 RDC\_SEMA42: Hardware Semaphores Driver

<b>16.1</b>	<b>Overview</b>	<b>261</b>
-------------	-----------------	------------

Section No.	Title	Page No.
<b>16.2</b>	<b>Macro Definition Documentation</b>	<b>262</b>
16.2.1	RDC_SEMA42_GATE_NUM_RESET_ALL	262
16.2.2	RDC_SEMA42_GATEn	262
16.2.3	RDC_SEMA42_GATE_COUNT	262
<b>16.3</b>	<b>Function Documentation</b>	<b>262</b>
16.3.1	RDC_SEMA42_Init	262
16.3.2	RDC_SEMA42_Deinit	262
16.3.3	RDC_SEMA42_TryLock	263
16.3.4	RDC_SEMA42_Lock	263
16.3.5	RDC_SEMA42_Unlock	264
16.3.6	RDC_SEMA42_GetLockMasterIndex	264
16.3.7	RDC_SEMA42_GetLockDomainID	264
16.3.8	RDC_SEMA42_ResetGate	265
16.3.9	RDC_SEMA42_ResetAllGates	266
 <b>Chapter 17 SAI: Serial Audio Interface</b>		
<b>17.1</b>	<b>Overview</b>	<b>267</b>
<b>17.2</b>	<b>Typical configurations</b>	<b>267</b>
<b>17.3</b>	<b>Typical use case</b>	<b>268</b>
17.3.1	SAI Send/receive using an interrupt method	268
17.3.2	SAI Send/receive using a DMA method	268
<b>17.4</b>	<b>SAI Driver</b>	<b>269</b>
17.4.1	Overview	269
17.4.2	Data Structure Documentation	277
17.4.3	Macro Definition Documentation	280
17.4.4	Enumeration Type Documentation	281
17.4.5	Function Documentation	285
 <b>Chapter 18 SAI EDMA Driver</b>		
 <b>Chapter 19 SEMA4: Hardware Semaphores Driver</b>		
<b>19.1</b>	<b>Overview</b>	<b>316</b>
<b>19.2</b>	<b>Macro Definition Documentation</b>	<b>317</b>
19.2.1	SEMA4_GATE_NUM_RESET_ALL	317
<b>19.3</b>	<b>Function Documentation</b>	<b>317</b>
19.3.1	SEMA4_Init	317
19.3.2	SEMA4_Deinit	317

Section No.	Title	Page No.
19.3.3	SEMA4_TryLock	317
19.3.4	SEMA4_Lock	318
19.3.5	SEMA4_Unlock	318
19.3.6	SEMA4_GetLockProc	318
19.3.7	SEMA4_ResetGate	319
19.3.8	SEMA4_ResetAllGates	319
19.3.9	SEMA4_EnableGateNotifyInterrupt	320
19.3.10	SEMA4_DisableGateNotifyInterrupt	320
19.3.11	SEMA4_GetGateNotifyStatus	320
19.3.12	SEMA4_ResetGateNotify	321
19.3.13	SEMA4_ResetAllGateNotify	321

## Chapter 20 TMU: Thermal Management Unit Driver

<b>20.1</b>	<b>Overview</b>	<b>323</b>
<b>20.2</b>	<b>Typical use case</b>	<b>323</b>
20.2.1	Monitor and report Configuration	323
<b>20.3</b>	<b>Data Structure Documentation</b>	<b>324</b>
20.3.1	struct tmu_thresold_config_t	324
20.3.2	struct tmu_interrupt_status_t	325
20.3.3	struct tmu_config_t	326
<b>20.4</b>	<b>Macro Definition Documentation</b>	<b>326</b>
20.4.1	FSL_TMU_DRIVER_VERSION	326
<b>20.5</b>	<b>Enumeration Type Documentation</b>	<b>327</b>
20.5.1	_tmu_interrupt_enable	327
20.5.2	_tmu_interrupt_status_flags	327
20.5.3	_tmu_status_flags	327
20.5.4	tmu_average_low_pass_filter_t	327
<b>20.6</b>	<b>Function Documentation</b>	<b>328</b>
20.6.1	TMU_Init	328
20.6.2	TMU_Deinit	328
20.6.3	TMU_GetDefaultConfig	328
20.6.4	TMU_Enable	328
20.6.5	TMU_EnableInterrupts	329
20.6.6	TMU_DisableInterrupts	329
20.6.7	TMU_GetInterruptStatusFlags	329
20.6.8	TMU_ClearInterruptStatusFlags	329
20.6.9	TMU_GetStatusFlags	330
20.6.10	TMU_GetHighestTemperature	330
20.6.11	TMU_GetLowestTemperature	330

Section No.	Title	Page No.
20.6.12	TMU_GetImmediateTemperature	331
20.6.13	TMU_GetAverageTemperature	331
20.6.14	TMU_SetHighTemperatureThresold	332

## Chapter 21 WDOG: Watchdog Timer Driver

<b>21.1</b>	<b>Overview</b>	<b>333</b>
<b>21.2</b>	<b>Typical use case</b>	<b>333</b>
<b>21.3</b>	<b>Data Structure Documentation</b>	<b>334</b>
21.3.1	struct wdog_work_mode_t	334
21.3.2	struct wdog_config_t	334
<b>21.4</b>	<b>Enumeration Type Documentation</b>	<b>335</b>
21.4.1	_wdog_interrupt_enable	335
21.4.2	_wdog_status_flags	335
<b>21.5</b>	<b>Function Documentation</b>	<b>335</b>
21.5.1	WDOG_GetDefaultConfig	335
21.5.2	WDOG_Init	336
21.5.3	WDOG_Deinit	336
21.5.4	WDOG_Enable	336
21.5.5	WDOG_Disable	337
21.5.6	WDOG_TriggerSystemSoftwareReset	337
21.5.7	WDOG_TriggerSoftwareSignal	337
21.5.8	WDOG_EnableInterrupts	338
21.5.9	WDOG_GetStatusFlags	339
21.5.10	WDOG_ClearInterruptStatus	339
21.5.11	WDOG_SetTimeoutValue	340
21.5.12	WDOG_SetInterrputTimeoutValue	340
21.5.13	WDOG_DisablePowerDownEnable	340
21.5.14	WDOG_Refresh	341

## Chapter 22 Debug Console

<b>22.1</b>	<b>Overview</b>	<b>342</b>
<b>22.2</b>	<b>Function groups</b>	<b>342</b>
22.2.1	Initialization	342
22.2.2	Advanced Feature	343
22.2.3	SDK_DEBUGCONSOLE and SDK_DEBUGCONSOLE_UART	347
<b>22.3</b>	<b>Typical use case</b>	<b>348</b>
<b>22.4</b>	<b>Macro Definition Documentation</b>	<b>350</b>

Section No.	Title	Page No.
22.4.1	DEBUGCONSOLE_REDIRECT_TO_TOOLCHAIN .....	350
22.4.2	DEBUGCONSOLE_REDIRECT_TO_SDK .....	350
22.4.3	DEBUGCONSOLE_DISABLE .....	350
22.4.4	SDK_DEBUGCONSOLE .....	350
22.4.5	PRINTF .....	350
<b>22.5</b>	<b>Function Documentation .....</b>	<b>350</b>
22.5.1	DbgConsole_Init .....	350
22.5.2	DbgConsole_Deinit .....	351
22.5.3	DbgConsole_EnterLowpower .....	351
22.5.4	DbgConsole_ExitLowpower .....	352
22.5.5	DbgConsole_Printf .....	352
22.5.6	DbgConsole_Vprintf .....	352
22.5.7	DbgConsole_Putchar .....	352
22.5.8	DbgConsole_Scanf .....	353
22.5.9	DbgConsole_Getchar .....	353
22.5.10	DbgConsole_BlockingPrintf .....	354
22.5.11	DbgConsole_BlockingVprintf .....	354
22.5.12	DbgConsole_Flush .....	354
22.5.13	StrFormatPrintf .....	355
22.5.14	StrFormatScanf .....	355
<b>22.6</b>	<b>Semihosting .....</b>	<b>356</b>
22.6.1	Guide Semihosting for IAR .....	356
22.6.2	Guide Semihosting for Keil $\mu$ Vision .....	356
22.6.3	Guide Semihosting for MCUXpresso IDE .....	357
22.6.4	Guide Semihosting for ARMGCC .....	357
<b>22.7</b>	<b>SWO .....</b>	<b>360</b>
22.7.1	Guide SWO for SDK .....	360
22.7.2	Guide SWO for Keil $\mu$ Vision .....	361
22.7.3	Guide SWO for MCUXpresso IDE .....	362
22.7.4	Guide SWO for ARMGCC .....	362
 <b>Chapter 23 CODEC Driver</b>		
<b>23.1</b>	<b>Overview .....</b>	<b>363</b>
<b>23.2</b>	<b>CODEC Common Driver .....</b>	<b>364</b>
23.2.1	Overview .....	364
23.2.2	Data Structure Documentation .....	369
23.2.3	Macro Definition Documentation .....	370
23.2.4	Enumeration Type Documentation .....	370
23.2.5	Function Documentation .....	375

Section No.	Title	Page No.
<b>23.3</b>	<b>CODEC I2C Driver</b>	<b>379</b>
<b>23.4</b>	<b>WM8524 Driver</b>	<b>380</b>
23.4.1	Overview	380
23.4.2	Data Structure Documentation	381
23.4.3	Macro Definition Documentation	381
23.4.4	Typedef Documentation	381
23.4.5	Enumeration Type Documentation	381
23.4.6	Function Documentation	381
23.4.7	WM8524 Adapter	383
<b>Chapter 24 Serial Manager</b>		
<b>24.1</b>	<b>Overview</b>	<b>391</b>
<b>24.2</b>	<b>Data Structure Documentation</b>	<b>394</b>
24.2.1	struct serial_manager_config_t	394
24.2.2	struct serial_manager_callback_message_t	394
<b>24.3</b>	<b>Macro Definition Documentation</b>	<b>395</b>
24.3.1	SERIAL_MANAGER_WRITE_TIME_DELAY_DEFAULT_VALUE	395
24.3.2	SERIAL_MANAGER_READ_TIME_DELAY_DEFAULT_VALUE	395
24.3.3	SERIAL_MANAGER_USE_COMMON_TASK	395
24.3.4	SERIAL_MANAGER_HANDLE_SIZE	395
24.3.5	SERIAL_MANAGER_HANDLE_DEFINE	395
24.3.6	SERIAL_MANAGER_WRITE_HANDLE_DEFINE	395
24.3.7	SERIAL_MANAGER_READ_HANDLE_DEFINE	396
24.3.8	SERIAL_MANAGER_TASK_PRIORITY	396
24.3.9	SERIAL_MANAGER_TASK_STACK_SIZE	396
<b>24.4</b>	<b>Enumeration Type Documentation</b>	<b>396</b>
24.4.1	serial_port_type_t	396
24.4.2	serial_manager_type_t	397
24.4.3	serial_manager_status_t	397
<b>24.5</b>	<b>Function Documentation</b>	<b>397</b>
24.5.1	SerialManager_Init	397
24.5.2	SerialManager_Deinit	398
24.5.3	SerialManager_OpenWriteHandle	399
24.5.4	SerialManager_CloseWriteHandle	400
24.5.5	SerialManager_OpenReadHandle	400
24.5.6	SerialManager_CloseReadHandle	401
24.5.7	SerialManager_WriteBlocking	402
24.5.8	SerialManager_ReadBlocking	402
24.5.9	SerialManager_EnterLowpower	403



Section No.	Title	Page No.
24.5.10	<a href="#">SerialManager_ExitLowpower</a> .....	403
24.5.11	<a href="#">SerialManager_SetLowpowerCriticalCb</a> .....	404
<b>24.6</b>	<b>Serial Port Uart</b> .....	<b>405</b>
24.6.1	Overview .....	405
24.6.2	Enumeration Type Documentation .....	405
<b>24.7</b>	<b>Serial Port SWO</b> .....	<b>406</b>
24.7.1	Overview .....	406
24.7.2	Data Structure Documentation .....	406
24.7.3	Enumeration Type Documentation .....	406
24.7.4	CODEC Adapter .....	407

# Chapter 1

## Introduction

The MCUXpresso Software Development Kit (MCUXpresso SDK) is a collection of software enablement for NXP Microcontrollers that includes peripheral drivers, multicore support and integrated RTOS support for FreeRTOS™. In addition to the base enablement, the MCUXpresso SDK is augmented with demo applications, driver example projects, and API documentation to help users quickly leverage the support provided by MCUXpresso SDK. The [MCUXpresso SDK Web Builder](#) is available to provide access to all MCUXpresso SDK packages. See the *MCUXpresso Software Development Kit (SDK) Release Notes* (document MCUXSDKRN) in the Supported Devices section at [MCUXpresso-SDK: Software Development Kit for MCUXpresso](#) for details.

The MCUXpresso SDK is built with the following runtime software components:

- Arm® and DSP standard libraries, and CMSIS-compliant device header files which provide direct access to the peripheral registers.
- Peripheral drivers that provide stateless, high-performance, ease-of-use APIs. Communication drivers provide higher-level transactional APIs for a higher-performance option.
- RTOS wrapper driver built on top of MCUXpresso SDK peripheral drivers and leverage native RTOS services to better comply to the RTOS cases.
- Real time operation systems (RTOS) for FreeRTOS OS.
- Stacks and middleware in source or object formats including:
- CMSIS-DSP, a suite of common signal processing functions.
- The MCUXpresso SDK comes complete with software examples demonstrating the usage of the peripheral drivers, RTOS wrapper drivers, middleware, and RTOSes.

The peripheral drivers and RTOS driver wrappers can be used across multiple devices within the product family without modification. The configuration items for each driver are encapsulated into C language data structures. Device-specific configuration information is provided as part of the MCUXpresso SDK and need not be modified by the user. If necessary, the user is able to modify the peripheral driver and RTOS wrapper driver configuration during runtime. The driver examples demonstrate how to configure the drivers by passing the proper configuration data to the APIs. The folder structure is organized to reduce the total number of includes required to compile a project.

The rest of this document describes the API references in detail for the peripheral drivers and RTOS wrapper drivers. For the latest version of this and other MCUXpresso SDK documents, see the [mcuxpresso.nxp.com/apidoc/](http://mcuxpresso.nxp.com/apidoc/).

<b>Deliverable</b>	<b>Location</b>
Demo Applications	<install_dir>/boards/<board_name>/demo_apps
Driver Examples	<install_dir>/boards/<board_name>/driver_examples
Documentation	<install_dir>/docs
Middleware	<install_dir>/middleware
Drivers	<install_dir>/<device_name>/drivers/
CMSIS Standard Arm Cortex-M Headers, math and DSP Libraries	<install_dir>/CMSIS
Device Startup and Linker	<install_dir>/<device_name>/<toolchain>/
MCUXpresso SDK Utilities	<install_dir>/devices/<device_name>/utilities
RTOS Kernel Code	<install_dir>/rtos

### MCUXpresso SDK Folder Structure

## Chapter 2

### Trademarks

Information in this document is provided solely to enable system and software implementers to use NXP products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits based on the information in this document. NXP reserves the right to make changes without further notice to any products herein.

How to Reach Us:

Home Page: [nxp.com](http://nxp.com)

Web Support: [nxp.com/support](http://nxp.com/support)

NXP makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does NXP assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. “Typical” parameters that may be provided in NXP data sheets and/or specifications can and do vary in different applications, and actual performance may vary over time. All operating parameters, including “typicals,” must be validated for each customer application by customer’s technical experts. NXP does not convey any license under its patent rights nor the rights of others. NXP sells products pursuant to standard terms and conditions of sale, which can be found at the following address: [nxp.com/SalesTermsandConditions](http://nxp.com/SalesTermsandConditions).

NXP, the NXP logo, NXP SECURE CONNECTIONS FOR A SMARTER WORLD, COOLFLUX, EMBRACE, GREENCHIP, HITAG, I2C BUS, ICODE, JCOP, LIFE VIBES, MIFARE, MIFARE CLASSIC, MIFARE DESFire, MIFARE PLUS, MIFARE FLEX, MANTIS, MIFARE ULTRALIGHT, MIFARE4MOBILE, MIGLO, NTAG, ROADLINK, SMARTLX, SMARTMX, STARPLUG, TOPFET, TRENCHMOS, UCODE, Freescale, the Freescale logo, AltiVec, C-5, CodeTEST, CodeWarrior, ColdFire, ColdFire+, C-Ware, the Energy Efficient Solutions logo, Kinetis, Layerscape, MagniV, mobileGT, PEG, PowerQUICC, Processor Expert, QorIQ, QorIQ Qonverge, Ready Play, SafeAssure, the SafeAssure logo, StarCore, Symphony, VortiQa, Vybrid, Airfast, BeeKit, BeeStack, CoreNet, Flexis, MXC, Platform in a Package, QUICC Engine, SMARTMOS, Tower, TurboLink, and UMEMS are trademarks of NXP B.V. All other product or service names are the property of their respective owners. AMBA, Arm, Arm7, Arm7TDMI, Arm9, Arm11, Artisan, big.LITTLE, Cordio, CoreLink, CoreSight, Cortex, DesignStart, DynamIQ, Jazelle, Keil, Mali, Mbed, Mbed Enabled, NEON, POP, RealView, SecurCore, Socrates, Thumb, TrustZone, ULINK, ULINK2, ULINK-ME, ULINK-PLUS, ULINKpro, Vision, Versatile are trademarks or registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere. The related technology may be protected by any or all of patents, copyrights, designs and trade secrets. All rights reserved. Oracle and Java are registered trademarks of Oracle and/or its affiliates. The Power Architecture and Power.org word marks and the Power and Power.org logos and related marks are trademarks and service marks licensed by Power.org.

© 2021 NXP B.V.

## Chapter 3

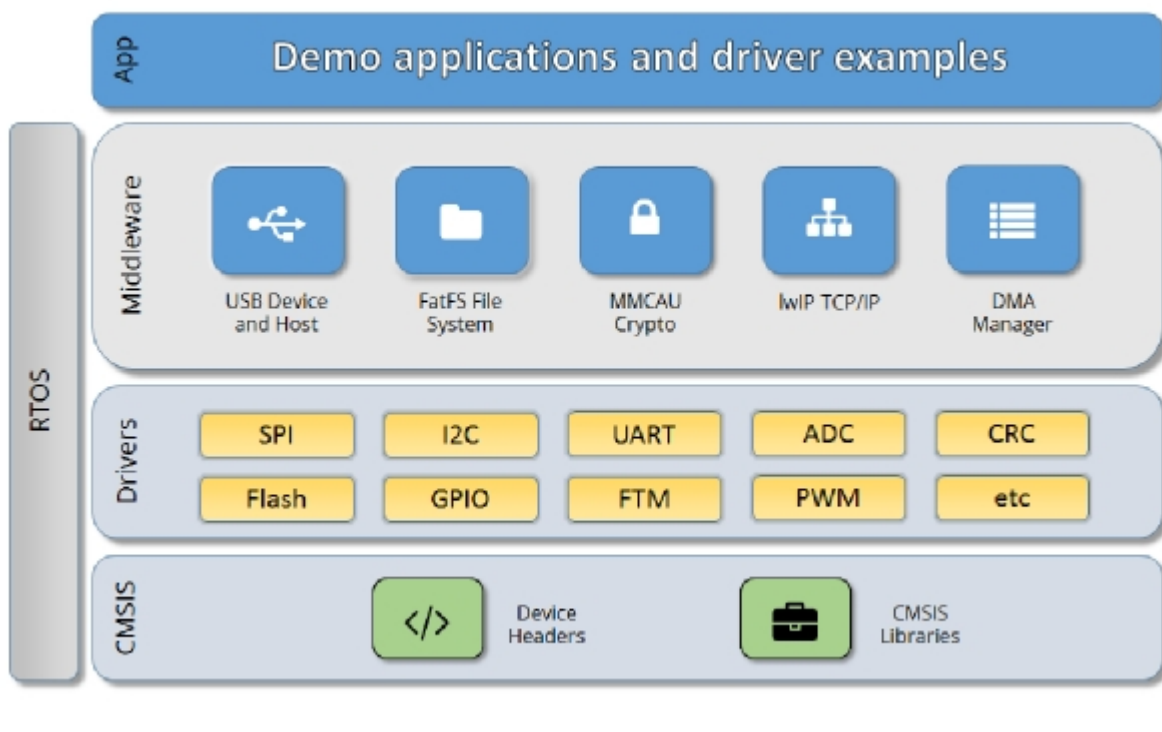
# Architectural Overview

This chapter provides the architectural overview for the MCUXpresso Software Development Kit (MCUXpresso SDK). It describes each layer within the architecture and its associated components.

### Overview

The MCUXpresso SDK architecture consists of five key components listed below.

1. The Arm Cortex Microcontroller Software Interface Standard (CMSIS) CORE compliance device-specific header files, SOC Header, and CMSIS math/DSP libraries.
2. Peripheral Drivers
3. Real-time Operating Systems (RTOS)
4. Stacks and Middleware that integrate with the MCUXpresso SDK
5. Demo Applications based on the MCUXpresso SDK



**MCUXpresso SDK Block Diagram**

### MCU header files

Each supported MCU device in the MCUXpresso SDK has an overall System-on Chip (SoC) memory-

mapped header file. This header file contains the memory map and register base address for each peripheral and the IRQ vector table with associated vector numbers. The overall SoC header file provides access to the peripheral registers through pointers and predefined bit masks. In addition to the overall SoC memory-mapped header file, the MCUXpresso SDK includes a feature header file for each device. The feature header file allows NXP to deliver a single software driver for a given peripheral. The feature file ensures that the driver is properly compiled for the target SOC.

## CMSIS Support

Along with the SoC header files and peripheral extension header files, the MCUXpresso SDK also includes common CMSIS header files for the Arm Cortex-M core and the math and DSP libraries from the latest CMSIS release. The CMSIS DSP library source code is also included for reference.

## MCUXpresso SDK Peripheral Drivers

The MCUXpresso SDK peripheral drivers mainly consist of low-level functional APIs for the MCU product family on-chip peripherals and also of high-level transactional APIs for some bus drivers/DM-A driver/eDMA driver to quickly enable the peripherals and perform transfers.

All MCUXpresso SDK peripheral drivers only depend on the CMSIS headers, device feature files, `fsl_common.h`, and `fsl_clock.h` files so that users can easily pull selected drivers and their dependencies into projects. With the exception of the clock/power-relevant peripherals, each peripheral has its own driver. Peripheral drivers handle the peripheral clock gating/ungating inside the drivers during initialization and deinitialization respectively.

Low-level functional APIs provide common peripheral functionality, abstracting the hardware peripheral register accesses into a set of stateless basic functional operations. These APIs primarily focus on the control, configuration, and function of basic peripheral operations. The APIs hide the register access details and various MCU peripheral instantiation differences so that the application can be abstracted from the low-level hardware details. The API prototypes are intentionally similar to help ensure easy portability across supported MCUXpresso SDK devices.

Transactional APIs provide a quick method for customers to utilize higher-level functionality of the peripherals. The transactional APIs utilize interrupts and perform asynchronous operations without user intervention. Transactional APIs operate on high-level logic that requires data storage for internal operation context handling. However, the Peripheral Drivers do not allocate this memory space. Rather, the user passes in the memory to the driver for internal driver operation. Transactional APIs ensure the NVIC is enabled properly inside the drivers. The transactional APIs do not meet all customer needs, but provide a baseline for development of custom user APIs.

Note that the transactional drivers never disable an NVIC after use. This is due to the shared nature of interrupt vectors on devices. It is up to the user to ensure that NVIC interrupts are properly disabled after usage is complete.

## Interrupt handling for transactional APIs

A double weak mechanism is introduced for drivers with transactional API. The double weak indicates two levels of weak vector entries. See the examples below:

```
PUBWEAK SPI0_IRQHandler
PUBWEAK SPI0_DriverIRQHandler
SPI0_IRQHandler
```

```
LDR    R0, =SPI0_DriverIRQHandler
BX     R0
```

The first level of the weak implementation are the functions defined in the vector table. In the devices/⟨DEVICE\_NAME⟩/⟨TOOLCHAIN⟩/startup\_⟨DEVICE\_NAME⟩.s/.S file, the implementation of the first layer weak function calls the second layer of weak function. The implementation of the second layer weak function (ex. SPI0\_DriverIRQHandler) jumps to itself (B). The MCUXpresso SDK drivers with transactional APIs provide the reimplement of the second layer function inside of the peripheral driver. If the MCUXpresso SDK drivers with transactional APIs are linked into the image, the SPI0\_DriverIRQHandler is replaced with the function implemented in the MCUXpresso SDK SPI driver.

The reason for implementing the double weak functions is to provide a better user experience when using the transactional APIs. For drivers with a transactional function, call the transactional APIs and the drivers complete the interrupt-driven flow. Users are not required to redefine the vector entries out of the box. At the same time, if users are not satisfied by the second layer weak function implemented in the MCUXpresso SDK drivers, users can redefine the first layer weak function and implement their own interrupt handler functions to suit their implementation.

The limitation of the double weak mechanism is that it cannot be used for peripherals that share the same vector entry. For this use case, redefine the first layer weak function to enable the desired peripheral interrupt functionality. For example, if the MCU's UART0 and UART1 share the same vector entry, redefine the UART0\_UART1\_IRQHandler according to the use case requirements.

## Feature Header Files

The peripheral drivers are designed to be reusable regardless of the peripheral functional differences from one MCU device to another. An overall Peripheral Feature Header File is provided for the MCUXpresso SDK-supported MCU device to define the features or configuration differences for each sub-family device.

## Application

See the *Getting Started with MCUXpresso SDK* document (MCUXSDKGSUG).

# Chapter 4

## Clock Driver

### 4.1 Overview

The MCUXpresso SDK provides APIs for MCUXpresso SDK devices' clock operation.

The clock driver supports:

- Clock generator (PLL, FLL, and so on) configuration
- Clock mux and divider configuration
- Getting clock frequency

### Data Structures

- struct [osc\\_config\\_t](#)  
*OSC configuration structure. [More...](#)*
- struct [ccm\\_analog\\_frac\\_pll\\_config\\_t](#)  
*Fractional-N PLL configuration. [More...](#)*
- struct [ccm\\_analog\\_sscg\\_pll\\_config\\_t](#)  
*SSCG PLL configuration. [More...](#)*

### Macros

- #define [OSC25M\\_CLK\\_FREQ](#) 25000000U  
*XTAL 25M clock frequency.*
- #define [OSC27M\\_CLK\\_FREQ](#) 27000000U  
*XTAL 27M clock frequency.*
- #define [HDMI\\_PHY\\_27M\\_FREQ](#) 27000000U  
*HDMI PHY 27M clock frequency.*
- #define [CLKPN\\_FREQ](#) 0U  
*clock1PN frequency.*
- #define [ECSPI\\_CLOCKS](#)  
*Clock ip name array for ECSPI.*
- #define [GPIO\\_CLOCKS](#)  
*Clock ip name array for GPIO.*
- #define [GPT\\_CLOCKS](#)  
*Clock ip name array for GPT.*
- #define [I2C\\_CLOCKS](#)  
*Clock ip name array for I2C.*
- #define [IOMUX\\_CLOCKS](#)  
*Clock ip name array for IOMUX.*
- #define [IPMUX\\_CLOCKS](#)  
*Clock ip name array for IPMUX.*
- #define [PWM\\_CLOCKS](#)  
*Clock ip name array for PWM.*
- #define [RDC\\_CLOCKS](#)  
*Clock ip name array for RDC.*



- #define **SAI\_CLOCKS**  
*Clock ip name array for SAI.*
- #define **RDC\_SEMA42\_CLOCKS**  
*Clock ip name array for RDC SEMA42.*
- #define **UART\_CLOCKS**  
*Clock ip name array for UART.*
- #define **USDHC\_CLOCKS**  
*Clock ip name array for USDHC.*
- #define **WDOG\_CLOCKS**  
*Clock ip name array for WDOG.*
- #define **TMU\_CLOCKS**  
*Clock ip name array for TEMPSENSOR.*
- #define **SDMA\_CLOCKS**  
*Clock ip name array for SDMA.*
- #define **MU\_CLOCKS**  
*Clock ip name array for MU.*
- #define **QSPI\_CLOCKS**  
*Clock ip name array for QSPI.*
- #define **CCM\_BIT\_FIELD\_EXTRACTION**(val, mask, shift) (((val) & (mask)) >> (shift))  
*CCM reg macros to extract corresponding registers bit field.*
- #define **CCM\_REG\_OFF**(root, off) (\*((volatile uint32\_t \*)((uint32\_t)(root) + (off))))  
*CCM reg macros to map corresponding registers.*
- #define **AUDIO\_PLL1\_CFG0\_OFFSET** 0x00  
*CCM Analog registers offset.*
- #define **CCM\_ANALOG\_TUPLE**(reg, shift) (((reg)&0xFFFFU) << 16U) | (shift)  
*CCM ANALOG tuple macros to map corresponding registers and bit fields.*
- #define **CCM\_TUPLE**(ccgr, root) ((ccgr) << 16U | (root))  
*CCM CCGR and root tuple.*
- #define **CLOCK\_ROOT\_SOURCE**  
*clock root source*
- #define **kCLOCK\_CoreSysClk** **kCLOCK\_CoreM4Clk**  
*For compatible with other platforms without CCM.*
- #define **CLOCK\_GetCoreSysClkFreq** **CLOCK\_GetCoreM4Freq**  
*For compatible with other platforms without CCM.*

## Enumerations

- enum `clock_name_t` {  
`kCLOCK_CoreM4Clk`,  
`kCLOCK_AxiClk`,  
`kCLOCK_AhbClk`,  
`kCLOCK_IpgClk`,  
`kCLOCK_Osc25MClk`,  
`kCLOCK_Osc27MClk`,  
`kCLOCK_ArmPllClk`,  
`kCLOCK_VpuPllClk`,  
`kCLOCK_DramPllClk`,  
`kCLOCK_SysPll1Clk`,  
`kCLOCK_SysPll1Div2Clk`,  
`kCLOCK_SysPll1Div3Clk`,  
`kCLOCK_SysPll1Div4Clk`,  
`kCLOCK_SysPll1Div5Clk`,  
`kCLOCK_SysPll1Div6Clk`,  
`kCLOCK_SysPll1Div8Clk`,  
`kCLOCK_SysPll1Div10Clk`,  
`kCLOCK_SysPll1Div20Clk`,  
`kCLOCK_SysPll2Clk`,  
`kCLOCK_SysPll2Div2Clk`,  
`kCLOCK_SysPll2Div3Clk`,  
`kCLOCK_SysPll2Div4Clk`,  
`kCLOCK_SysPll2Div5Clk`,  
`kCLOCK_SysPll2Div6Clk`,  
`kCLOCK_SysPll2Div8Clk`,  
`kCLOCK_SysPll2Div10Clk`,  
`kCLOCK_SysPll2Div20Clk`,  
`kCLOCK_SysPll3Clk`,  
`kCLOCK_AudioPll1Clk`,  
`kCLOCK_AudioPll2Clk`,  
`kCLOCK_VideoPll1Clk`,  
`kCLOCK_ExtClk1`,  
`kCLOCK_ExtClk2`,  
`kCLOCK_ExtClk3`,  
`kCLOCK_ExtClk4`,  
`kCLOCK_NoneName` }  
*Clock name used to get clock frequency.*
- enum `clock_ip_name_t` { ,

```

kCLOCK_Debug = CCM_TUPLE(4U, 32U),
kCLOCK_Dram = CCM_TUPLE(5U, 64U),
kCLOCK_Ecspi1 = CCM_TUPLE(7U, 101U),
kCLOCK_Ecspi2 = CCM_TUPLE(8U, 102U),
kCLOCK_Ecspi3 = CCM_TUPLE(9U, 131U),
kCLOCK_Gpio1 = CCM_TUPLE(11U, 33U),
kCLOCK_Gpio2 = CCM_TUPLE(12U, 33U),
kCLOCK_Gpio3 = CCM_TUPLE(13U, 33U),
kCLOCK_Gpio4 = CCM_TUPLE(14U, 33U),
kCLOCK_Gpio5 = CCM_TUPLE(15U, 33U),
kCLOCK_Gpt1 = CCM_TUPLE(16U, 107U),
kCLOCK_Gpt2 = CCM_TUPLE(17U, 108U),
kCLOCK_Gpt3 = CCM_TUPLE(18U, 109U),
kCLOCK_Gpt4 = CCM_TUPLE(19U, 110U),
kCLOCK_Gpt5 = CCM_TUPLE(20U, 111U),
kCLOCK_Gpt6 = CCM_TUPLE(21U, 112U),
kCLOCK_I2c1 = CCM_TUPLE(23U, 90U),
kCLOCK_I2c2 = CCM_TUPLE(24U, 91U),
kCLOCK_I2c3 = CCM_TUPLE(25U, 92U),
kCLOCK_I2c4 = CCM_TUPLE(26U, 93U),
kCLOCK_Iomux = CCM_TUPLE(27U, 33U),
kCLOCK_Ipmux1 = CCM_TUPLE(28U, 33U),
kCLOCK_Ipmux2 = CCM_TUPLE(29U, 33U),
kCLOCK_Ipmux3 = CCM_TUPLE(30U, 33U),
kCLOCK_Ipmux4 = CCM_TUPLE(31U, 33U),
kCLOCK_M4 = CCM_TUPLE(32U, 1U),
kCLOCK_Mu = CCM_TUPLE(33U, 33U),
kCLOCK_Ocram = CCM_TUPLE(35U, 16U),
kCLOCK_OcramS = CCM_TUPLE(36U, 32U),
kCLOCK_Pwm1 = CCM_TUPLE(40U, 103U),
kCLOCK_Pwm2 = CCM_TUPLE(41U, 104U),
kCLOCK_Pwm3 = CCM_TUPLE(42U, 105U),
kCLOCK_Pwm4 = CCM_TUPLE(43U, 106U),
kCLOCK_Qspi = CCM_TUPLE(47U, 87U),
kCLOCK_Rdc = CCM_TUPLE(49U, 33U),
kCLOCK_Sai1 = CCM_TUPLE(51U, 75U),
kCLOCK_Sai2 = CCM_TUPLE(52U, 76U),
kCLOCK_Sai3 = CCM_TUPLE(53U, 77U),
kCLOCK_Sai4 = CCM_TUPLE(54U, 78U),
kCLOCK_Sai5 = CCM_TUPLE(55U, 79U),
kCLOCK_Sai6 = CCM_TUPLE(56U, 80U),
kCLOCK_Sdma1 = CCM_TUPLE(58U, 33U),
kCLOCK_Sdma2 = CCM_TUPLE(59U, 35U),
kCLOCK_Sec_Debug = CCM_TUPLE(60U, 33U),
kCLOCK_Sema42_1 = CCM_TUPLE(61U, 33U),
kCLOCK_Sema42_2 = CCM_TUPLE(62U, 33U),
kCLOCK_Sim_display = CCM_TUPLE(63U, 16U),
kCLOCK_Sim_m = CCM_TUPLE(65U, 32U),
kCLOCK_Sim_main = CCM_TUPLE(66U, 16U),

```

`kCLOCK_TempSensor` = CCM\_TUPLE(98U, 0xFFFF) }

*CCM CCGR gate control.*

- enum `clock_root_control_t` {  
`kCLOCK_RootM4`,  
`kCLOCK_RootAxi` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[16].TARGET\_ROOT),  
`kCLOCK_RootNoc` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[26].TARGET\_ROOT),  
`kCLOCK_RootAhb` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[32].TARGET\_ROOT),  
`kCLOCK_RootIpg` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[33].TARGET\_ROOT),  
`kCLOCK_RootDramAlt`,  
`kCLOCK_RootSai1` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[75].TARGET\_ROOT),  
`kCLOCK_RootSai2` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[76].TARGET\_ROOT),  
`kCLOCK_RootSai3` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[77].TARGET\_ROOT),  
`kCLOCK_RootSai4` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[78].TARGET\_ROOT),  
`kCLOCK_RootSai5` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[79].TARGET\_ROOT),  
`kCLOCK_RootSai6` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[80].TARGET\_ROOT),  
`kCLOCK_RootQspi` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[87].TARGET\_ROOT),  
`kCLOCK_RootI2c1` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[90].TARGET\_ROOT),  
`kCLOCK_RootI2c2` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[91].TARGET\_ROOT),  
`kCLOCK_RootI2c3` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[92].TARGET\_ROOT),  
`kCLOCK_RootI2c4` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[93].TARGET\_ROOT),  
`kCLOCK_RootUart1` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[94].TARGET\_ROOT),  
`kCLOCK_RootUart2` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[95].TARGET\_ROOT),  
`kCLOCK_RootUart3` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[96].TARGET\_ROOT),  
`kCLOCK_RootUart4` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, ROOT[97].TARGET\_ROOT)

```

OT),
kCLOCK_RootEcspl,
kCLOCK_RootEcspl2,
kCLOCK_RootEcspl3,
kCLOCK_RootPwm1 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[103].TARGET_ROOT),
kCLOCK_RootPwm2 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[104].TARGET_ROOT),
kCLOCK_RootPwm3 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[105].TARGET_ROOT),
kCLOCK_RootPwm4 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[106].TARGET_ROOT),
kCLOCK_RootGpt1 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[107].TARGET_ROOT),
kCLOCK_RootGpt2 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[108].TARGET_ROOT),
kCLOCK_RootGpt3 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[109].TARGET_ROOT),
kCLOCK_RootGpt4 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[110].TARGET_ROOT),
kCLOCK_RootGpt5 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[111].TARGET_ROOT),
kCLOCK_RootGpt6 = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[112].TARGET_ROOT),
kCLOCK_RootWdog = (uint32_t)CCM_BASE + offsetof(CCM_Type, ROOT[114].TARGET_ROOT) }

```

*ccm root name used to get clock frequency.*

- enum `clock_root_t` {

```

kCLOCK_M4ClkRoot = 0,
kCLOCK_AxiClkRoot,
kCLOCK_NocClkRoot,
kCLOCK_AhbClkRoot,
kCLOCK_IpgClkRoot,
kCLOCK_DramAltClkRoot,
kCLOCK_Sai1ClkRoot,
kCLOCK_Sai2ClkRoot,
kCLOCK_Sai3ClkRoot,
kCLOCK_Sai4ClkRoot,
kCLOCK_Sai5ClkRoot,
kCLOCK_Sai6ClkRoot,
kCLOCK_QspiClkRoot,
kCLOCK_I2c1ClkRoot,
kCLOCK_I2c2ClkRoot,
kCLOCK_I2c3ClkRoot,
kCLOCK_I2c4ClkRoot,
kCLOCK_Uart1ClkRoot,
kCLOCK_Uart2ClkRoot,
kCLOCK_Uart3ClkRoot,
kCLOCK_Uart4ClkRoot,
kCLOCK_Ecspi1ClkRoot,
kCLOCK_Ecspi2ClkRoot,
kCLOCK_Ecspi3ClkRoot,
kCLOCK_Pwm1ClkRoot,
kCLOCK_Pwm2ClkRoot,
kCLOCK_Pwm3ClkRoot,
kCLOCK_Pwm4ClkRoot,
kCLOCK_Gpt1ClkRoot,
kCLOCK_Gpt2ClkRoot,
kCLOCK_Gpt3ClkRoot,
kCLOCK_Gpt4ClkRoot,
kCLOCK_Gpt5ClkRoot,
kCLOCK_Gpt6ClkRoot,
kCLOCK_WdogClkRoot }

```

*ccm clock root used to get clock frequency.*

- enum `clock_rootmux_m4_clk_sel_t` {  
`kCLOCK_M4RootmuxOsc25m = 0U`,  
`kCLOCK_M4RootmuxSysPll2Div5 = 1U`,  
`kCLOCK_M4RootmuxSysPll2Div4 = 2U`,  
`kCLOCK_M4RootmuxSysPll1Div3 = 3U`,  
`kCLOCK_M4RootmuxSysPll1 = 4U`,  
`kCLOCK_M4RootmuxAudioPll1 = 5U`,  
`kCLOCK_M4RootmuxVideoPll1 = 6U`,  
`kCLOCK_M4RootmuxSysPll3 = 7U` }

*Root clock select enumeration for ARM Cortex-M4 core.*

- enum `clock_rootmux_axi_clk_sel_t` {  
`kCLOCK_AxiRootmuxOsc25m` = 0U,  
`kCLOCK_AxiRootmuxSysPll2Div3` = 1U,  
`kCLOCK_AxiRootmuxSysPll1` = 2U,  
`kCLOCK_AxiRootmuxSysPll2Div4` = 3U,  
`kCLOCK_AxiRootmuxSysPll2` = 4U,  
`kCLOCK_AxiRootmuxAudioPll1` = 5U,  
`kCLOCK_AxiRootmuxVideoPll1` = 6U,  
`kCLOCK_AxiRootmuxSysPll1Div8` = 7U }

*Root clock select enumeration for AXI bus.*

- enum `clock_rootmux_ahb_clk_sel_t` {  
`kCLOCK_AhbRootmuxOsc25m` = 0U,  
`kCLOCK_AhbRootmuxSysPll1Div6` = 1U,  
`kCLOCK_AhbRootmuxSysPll1` = 2U,  
`kCLOCK_AhbRootmuxSysPll1Div2` = 3U,  
`kCLOCK_AhbRootmuxSysPll2Div8` = 4U,  
`kCLOCK_AhbRootmuxSysPll3` = 5U,  
`kCLOCK_AhbRootmuxAudioPll1` = 6U,  
`kCLOCK_AhbRootmuxVideoPll1` = 7U }

*Root clock select enumeration for AHB bus.*

- enum `clock_rootmux_qspi_clk_sel_t` {  
`kCLOCK_QspiRootmuxOsc25m` = 0U,  
`kCLOCK_QspiRootmuxSysPll1Div2` = 1U,  
`kCLOCK_QspiRootmuxSysPll1` = 2U,  
`kCLOCK_QspiRootmuxSysPll2Div2` = 3U,  
`kCLOCK_QspiRootmuxAudioPll2` = 4,  
`kCLOCK_QspiRootmuxSysPll1Div3` = 5U,  
`kCLOCK_QspiRootmuxSysPll3` = 6U,  
`kCLOCK_QspiRootmuxSysPll1Div8` = 7U }

*Root clock select enumeration for QSPI peripheral.*

- enum `clock_rootmux_ecspi_clk_sel_t` {  
`kCLOCK_EcspiRootmuxOsc25m` = 0U,  
`kCLOCK_EcspiRootmuxSysPll2Div5` = 1U,  
`kCLOCK_EcspiRootmuxSysPll1Div20` = 2U,  
`kCLOCK_EcspiRootmuxSysPll1Div5` = 3U,  
`kCLOCK_EcspiRootmuxSysPll1` = 4U,  
`kCLOCK_EcspiRootmuxSysPll3` = 5U,  
`kCLOCK_EcspiRootmuxSysPll2Div4` = 6U,  
`kCLOCK_EcspiRootmuxAudioPll2` = 7U }

*Root clock select enumeration for ECSPi peripheral.*

- enum `clock_rootmux_i2c_clk_sel_t` {

```

kCLOCK_I2cRootmuxOsc25m = 0U,
kCLOCK_I2cRootmuxSysPll1Div5 = 1U,
kCLOCK_I2cRootmuxSysPll2Div20 = 2U,
kCLOCK_I2cRootmuxSysPll3 = 3U,
kCLOCK_I2cRootmuxAudioPll1 = 4U,
kCLOCK_I2cRootmuxVideoPll1 = 5U,
kCLOCK_I2cRootmuxAudioPll2 = 6U,
kCLOCK_I2cRootmuxSysPll1Div6 = 7U }

```

*Root clock select enumeration for I2C peripheral.*

- enum `clock_rootmux_uart_clk_sel_t` {  
`kCLOCK_UartRootmuxOsc25m` = 0U,  
`kCLOCK_UartRootmuxSysPll1Div10` = 1U,  
`kCLOCK_UartRootmuxSysPll2Div5` = 2U,  
`kCLOCK_UartRootmuxSysPll2Div10` = 3U,  
`kCLOCK_UartRootmuxSysPll3` = 4U,  
`kCLOCK_UartRootmuxExtClk2` = 5U,  
`kCLOCK_UartRootmuxExtClk34` = 6U,  
`kCLOCK_UartRootmuxAudioPll2` = 7U }

*Root clock select enumeration for UART peripheral.*

- enum `clock_rootmux_gpt_t` {  
`kCLOCK_GptRootmuxOsc25m` = 0U,  
`kCLOCK_GptRootmuxSystemPll2Div10` = 1U,  
`kCLOCK_GptRootmuxSysPll1Div2` = 2U,  
`kCLOCK_GptRootmuxSysPll1Div20` = 3U,  
`kCLOCK_GptRootmuxVideoPll1` = 4U,  
`kCLOCK_GptRootmuxSystemPll1Div10` = 5U,  
`kCLOCK_GptRootmuxAudioPll1` = 6U,  
`kCLOCK_GptRootmuxExtClk123` = 7U }

*Root clock select enumeration for GPT peripheral.*

- enum `clock_rootmux_wdog_clk_sel_t` {  
`kCLOCK_WdogRootmuxOsc25m` = 0U,  
`kCLOCK_WdogRootmuxSysPll1Div6` = 1U,  
`kCLOCK_WdogRootmuxSysPll1Div5` = 2U,  
`kCLOCK_WdogRootmuxVpuPll` = 3U,  
`kCLOCK_WdogRootmuxSystemPll2Div8` = 4U,  
`kCLOCK_WdogRootmuxSystemPll3` = 5U,  
`kCLOCK_WdogRootmuxSystemPll1Div10` = 6U,  
`kCLOCK_WdogRootmuxSystemPll2Div6` = 7U }

*Root clock select enumeration for WDOG peripheral.*

- enum `clock_rootmux_pwm_clk_sel_t` {



```

kCLOCK_PwmRootmuxOsc25m = 0U,
kCLOCK_PwmRootmuxSysPll2Div10 = 1U,
kCLOCK_PwmRootmuxSysPll1Div5 = 2U,
kCLOCK_PwmRootmuxSysPll1Div20 = 3U,
kCLOCK_PwmRootmuxSystemPll3 = 4U,
kCLOCK_PwmRootmuxExtClk12 = 5U,
kCLOCK_PwmRootmuxSystemPll1Div10 = 6U,
kCLOCK_PwmRootmuxVideoPll1 = 7U }

```

*Root clock select enumeration for PWM peripheral.*

- enum `clock_rootmux_sai_clk_sel_t` {  
`kCLOCK_SaiRootmuxOsc25m` = 0U,  
`kCLOCK_SaiRootmuxAudioPll1` = 1U,  
`kCLOCK_SaiRootmuxAudioPll2` = 2U,  
`kCLOCK_SaiRootmuxVideoPll1` = 3U,  
`kCLOCK_SaiRootmuxSysPll1Div6` = 4U,  
`kCLOCK_SaiRootmuxOsc27m` = 5U,  
`kCLOCK_SaiRootmuxExtClk123` = 6U,  
`kCLOCK_SaiRootmuxExtClk234` = 7U }

*Root clock select enumeration for SAI peripheral.*

- enum `clock_rootmux_noc_clk_sel_t` {  
`kCLOCK_NocRootmuxOsc25m` = 0U,  
`kCLOCK_NocRootmuxSysPll1` = 1U,  
`kCLOCK_NocRootmuxSysPll3` = 2U,  
`kCLOCK_NocRootmuxSysPll2` = 3U,  
`kCLOCK_NocRootmuxSysPll2Div2` = 4U,  
`kCLOCK_NocRootmuxAudioPll1` = 5U,  
`kCLOCK_NocRootmuxVideoPll1` = 6U,  
`kCLOCK_NocRootmuxAudioPll2` = 7U }

*Root clock select enumeration for NOC CLK.*

- enum `clock_pll_gate_t` {  
`kCLOCK_ArmPllGate` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, PLL\_CTRL[12].PLL\_CTRL),  
`kCLOCK_GpuPllGate` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, PLL\_CTRL[13].PLL\_CTRL),  
`kCLOCK_VpuPllGate` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, PLL\_CTRL[14].PLL\_CTRL),  
`kCLOCK_DramPllGate` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, PLL\_CTRL[15].PLL\_CTRL),  
`kCLOCK_SysPll1Gate` = (uint32\_t)CCM\_BASE + offsetof(CCM\_Type, PLL\_CTRL[16].PLL\_CTRL)

```

    TRL),
    kCLOCK_SysPll1Div2Gate,
    kCLOCK_SysPll1Div3Gate,
    kCLOCK_SysPll1Div4Gate,
    kCLOCK_SysPll1Div5Gate,
    kCLOCK_SysPll1Div6Gate,
    kCLOCK_SysPll1Div8Gate,
    kCLOCK_SysPll1Div10Gate,
    kCLOCK_SysPll1Div20Gate,
    kCLOCK_SysPll2Gate = (uint32_t)CCM_BASE + offsetof(CCM_Type, PLL_CTRL[25].PLL_CTRL),
    kCLOCK_SysPll2Div2Gate,
    kCLOCK_SysPll2Div3Gate,
    kCLOCK_SysPll2Div4Gate,
    kCLOCK_SysPll2Div5Gate,
    kCLOCK_SysPll2Div6Gate,
    kCLOCK_SysPll2Div8Gate,
    kCLOCK_SysPll2Div10Gate,
    kCLOCK_SysPll2Div20Gate,
    kCLOCK_SysPll3Gate = (uint32_t)CCM_BASE + offsetof(CCM_Type, PLL_CTRL[34].PLL_CTRL),
    kCLOCK_AudioPll1Gate = (uint32_t)CCM_BASE + offsetof(CCM_Type, PLL_CTRL[35].PLL_CTRL),
    kCLOCK_AudioPll2Gate = (uint32_t)CCM_BASE + offsetof(CCM_Type, PLL_CTRL[36].PLL_CTRL),
    kCLOCK_VideoPll1Gate = (uint32_t)CCM_BASE + offsetof(CCM_Type, PLL_CTRL[37].PLL_CTRL),
    kCLOCK_VideoPll2Gate = (uint32_t)CCM_BASE + offsetof(CCM_Type, PLL_CTRL[38].PLL_CTRL) }

    CCM PLL gate control.
    • enum clock_gate_value_t {
        kCLOCK_ClockNotNeeded = 0x0U,
        kCLOCK_ClockNeededRun = 0x1111U,
        kCLOCK_ClockNeededRunWait = 0x2222U,
        kCLOCK_ClockNeededAll = 0x3333U }

    CCM gate control value.
    • enum clock_pll_bypass_ctrl_t {

```

```

kCLOCK_AudioPll1BypassCtrl,
kCLOCK_AudioPll2BypassCtrl,
kCLOCK_VideoPll1BypassCtrl,
kCLOCK_GpuPLLpwrBypassCtrl,
kCLOCK_VpuPllPwrBypassCtrl,
kCLOCK_ArmPllPwrBypassCtrl,
kCLOCK_SysPll1InternalPll1BypassCtrl,
kCLOCK_SysPll1InternalPll2BypassCtrl,
kCLOCK_SysPll2InternalPll1BypassCtrl,
kCLOCK_SysPll2InternalPll2BypassCtrl,
kCLOCK_SysPll3InternalPll1BypassCtrl,
kCLOCK_SysPll3InternalPll2BypassCtrl,
kCLOCK_VideoPll2InternalPll1BypassCtrl,
kCLOCK_VideoPll2InternalPll2BypassCtrl,
kCLOCK_DramPllInternalPll1BypassCtrl,
kCLOCK_DramPllInternalPll2BypassCtrl }

```

*PLL control names for PLL bypass.*

- enum `clock_pll_clke_t` {

```

kCLOCK_AudioPll1Clke,
kCLOCK_AudioPll2Clke,
kCLOCK_VideoPll1Clke,
kCLOCK_GpuPllClke,
kCLOCK_VpuPllClke,
kCLOCK_ArmPllClke,
kCLOCK_SystemPll1Clke,
kCLOCK_SystemPll1Div2Clke,
kCLOCK_SystemPll1Div3Clke,
kCLOCK_SystemPll1Div4Clke,
kCLOCK_SystemPll1Div5Clke,
kCLOCK_SystemPll1Div6Clke,
kCLOCK_SystemPll1Div8Clke,
kCLOCK_SystemPll1Div10Clke,
kCLOCK_SystemPll1Div20Clke,
kCLOCK_SystemPll2Clke,
kCLOCK_SystemPll2Div2Clke,
kCLOCK_SystemPll2Div3Clke,
kCLOCK_SystemPll2Div4Clke,
kCLOCK_SystemPll2Div5Clke,
kCLOCK_SystemPll2Div6Clke,
kCLOCK_SystemPll2Div8Clke,
kCLOCK_SystemPll2Div10Clke,
kCLOCK_SystemPll2Div20Clke,
kCLOCK_SystemPll3Clke,
kCLOCK_VideoPll2Clke,
kCLOCK_DramPllClke,
kCLOCK_OSC25MClke,
kCLOCK_OSC27MClke }

```

*PLL clock names for clock enable/disable settings.*

- enum `clock_pll_ctrl_t`  
*ANALOG Power down override control.*
- enum `_osc_mode` {  
  `kOSC_OscMode` = 0U,  
  `kOSC_ExtMode` = 1U }  
*OSC work mode.*
- enum `osc32_src_t` {  
  `kOSC32_Src25MDiv800` = 0U,  
  `kOSC32_SrcRTC` }  
*OSC 32K input select.*
- enum `_ccm_analog_pll_ref_clk` {  
  `kANALOG_PllRefOsc25M` = 0U,  
  `kANALOG_PllRefOsc27M` = 1U,  
  `kANALOG_PllRefOscHdmiPhy27M` = 2U,  
  `kANALOG_PllRefClkPN` = 3U }  
*PLL reference clock select.*

## Driver version

- #define `FSL_CLOCK_DRIVER_VERSION` (`MAKE_VERSION(2, 4, 1)`)  
*CLOCK driver version 2.4.1.*

## CCM Root Clock Setting

- static void `CLOCK_SetRootMux` (`clock_root_control_t` rootClk, `uint32_t` mux)  
*Set clock root mux.*
- static `uint32_t` `CLOCK_GetRootMux` (`clock_root_control_t` rootClk)  
*Get clock root mux.*
- static void `CLOCK_EnableRoot` (`clock_root_control_t` rootClk)  
*Enable clock root.*
- static void `CLOCK_DisableRoot` (`clock_root_control_t` rootClk)  
*Disable clock root.*
- static bool `CLOCK_IsRootEnabled` (`clock_root_control_t` rootClk)  
*Check whether clock root is enabled.*
- void `CLOCK_UpdateRoot` (`clock_root_control_t` ccmRootClk, `uint32_t` mux, `uint32_t` pre, `uint32_t` post)  
*Update clock root in one step, for dynamical clock switching Note: The PRE and POST dividers in this function are the actually divider, software will map it to register value.*
- void `CLOCK_SetRootDivider` (`clock_root_control_t` ccmRootClk, `uint32_t` pre, `uint32_t` post)  
*Set root clock divider Note: The PRE and POST dividers in this function are the actually divider, software will map it to register value.*
- static `uint32_t` `CLOCK_GetRootPreDivider` (`clock_root_control_t` rootClk)  
*Get clock root PRE\_PODF.*
- static `uint32_t` `CLOCK_GetRootPostDivider` (`clock_root_control_t` rootClk)  
*Get clock root POST\_PODF.*

## OSC setting

- void `CLOCK_InitOSC25M` (const `osc_config_t` \*config)  
*OSC25M init.*
- void `CLOCK_DeinitOSC25M` (void)  
*OSC25M deinit.*
- void `CLOCK_InitOSC27M` (const `osc_config_t` \*config)  
*OSC27M init.*
- void `CLOCK_DeinitOSC27M` (void)  
*OSC27M deinit.*
- static void `CLOCK_SwitchOSC32Src` (`osc32_src_t` sel)  
*switch 32KHZ OSC input*

## CCM Gate Control

- static void `CLOCK_ControlGate` (`uint32_t` ccmGate, `clock_gate_value_t` control)  
*Set PLL or CCGR gate control.*
- void `CLOCK_EnableClock` (`clock_ip_name_t` ccmGate)  
*Enable CCGR clock gate and root clock gate for each module User should set specific gate for each module according to the description of the table of system clocks, gating and override in CCM chapter of reference manual.*
- void `CLOCK_DisableClock` (`clock_ip_name_t` ccmGate)

*Disable CCGR clock gate for the each module User should set specific gate for each module according to the description of the table of system clocks, gating and override in CCM chapter of reference manual.*

## CCM Analog PLL Operatoin Functions

- static void [CLOCK\\_PowerUpPll](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_ctrl\\_t](#) pllControl)  
*Power up PLL.*
- static void [CLOCK\\_PowerDownPll](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_ctrl\\_t](#) pllControl)  
*Power down PLL.*
- static void [CLOCK\\_SetPllBypass](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_bypass\\_ctrl\\_t](#) pllControl, bool bypass)  
*PLL bypass setting.*
- static bool [CLOCK\\_IsPllBypassed](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_bypass\\_ctrl\\_t](#) pllControl)  
*Check if PLL is bypassed.*
- static bool [CLOCK\\_IsPllLocked](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_ctrl\\_t](#) pllControl)  
*Check if PLL clock is locked.*
- static void [CLOCK\\_EnableAnalogClock](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_clke\\_t](#) pllClock)  
*Enable PLL clock.*
- static void [CLOCK\\_DisableAnalogClock](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_clke\\_t](#) pllClock)  
*Disable PLL clock.*
- static void [CLOCK\\_OverrideAnalogClke](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_clke\\_t](#) ovClock, bool override)  
*Override PLL clock output enable.*
- static void [CLOCK\\_OverridePllPd](#) (CCM\_ANALOG\_Type \*base, [clock\\_pll\\_ctrl\\_t](#) pdClock, bool override)  
*Override PLL power down.*
- void [CLOCK\\_InitArmPll](#) (const [ccm\\_analog\\_frac\\_pll\\_config\\_t](#) \*config)  
*Initializes the ANALOG ARM PLL.*
- void [CLOCK\\_DeinitArmPll](#) (void)  
*De-initialize the ARM PLL.*
- void [CLOCK\\_InitSysPll1](#) (const [ccm\\_analog\\_sscg\\_pll\\_config\\_t](#) \*config)  
*Initializes the ANALOG SYS PLL1.*
- void [CLOCK\\_DeinitSysPll1](#) (void)  
*De-initialize the System PLL1.*
- void [CLOCK\\_InitSysPll2](#) (const [ccm\\_analog\\_sscg\\_pll\\_config\\_t](#) \*config)  
*Initializes the ANALOG SYS PLL2.*
- void [CLOCK\\_DeinitSysPll2](#) (void)  
*De-initialize the System PLL2.*
- void [CLOCK\\_InitSysPll3](#) (const [ccm\\_analog\\_sscg\\_pll\\_config\\_t](#) \*config)  
*Initializes the ANALOG SYS PLL3.*
- void [CLOCK\\_DeinitSysPll3](#) (void)  
*De-initialize the System PLL3.*
- void [CLOCK\\_InitDramPll](#) (const [ccm\\_analog\\_sscg\\_pll\\_config\\_t](#) \*config)  
*Initializes the ANALOG DDR PLL.*
- void [CLOCK\\_DeinitDramPll](#) (void)  
*De-initialize the Dram PLL.*
- void [CLOCK\\_InitAudioPll1](#) (const [ccm\\_analog\\_frac\\_pll\\_config\\_t](#) \*config)

- *Initializes the ANALOG AUDIO PLL1.*
- void **CLOCK\_DeinitAudioPll1** (void)
- *De-initialize the Audio PLL1.*
- void **CLOCK\_InitAudioPll2** (const **ccm\_analog\_frac\_pll\_config\_t** \*config)
- *Initializes the ANALOG AUDIO PLL2.*
- void **CLOCK\_DeinitAudioPll2** (void)
- *De-initialize the Audio PLL2.*
- void **CLOCK\_InitVideoPll1** (const **ccm\_analog\_frac\_pll\_config\_t** \*config)
- *Initializes the ANALOG VIDEO PLL1.*
- void **CLOCK\_DeinitVideoPll1** (void)
- *De-initialize the Video PLL1.*
- void **CLOCK\_InitVideoPll2** (const **ccm\_analog\_sscg\_pll\_config\_t** \*config)
- *Initializes the ANALOG VIDEO PLL2.*
- void **CLOCK\_DeinitVideoPll2** (void)
- *De-initialize the Video PLL2.*
- void **CLOCK\_InitSSCGPll** (CCM\_ANALOG\_Type \*base, const **ccm\_analog\_sscg\_pll\_config\_t** \*config, **clock\_pll\_ctrl\_t** type)
- *Initializes the ANALOG SSCG PLL.*
- uint32\_t **CLOCK\_GetSSCGPllFreq** (CCM\_ANALOG\_Type \*base, **clock\_pll\_ctrl\_t** type, uint32\_t refClkFreq, bool pll1Bypass)
- *Get the ANALOG SSCG PLL clock frequency.*
- void **CLOCK\_InitFracPll** (CCM\_ANALOG\_Type \*base, const **ccm\_analog\_frac\_pll\_config\_t** \*config, **clock\_pll\_ctrl\_t** type)
- *Initializes the ANALOG Fractional PLL.*
- uint32\_t **CLOCK\_GetFracPllFreq** (CCM\_ANALOG\_Type \*base, **clock\_pll\_ctrl\_t** type, uint32\_t refClkFreq)
- *Gets the ANALOG Fractional PLL clock frequency.*
- uint32\_t **CLOCK\_GetPllFreq** (**clock\_pll\_ctrl\_t** pll)
- *Gets PLL clock frequency.*
- uint32\_t **CLOCK\_GetPllRefClkFreq** (**clock\_pll\_ctrl\_t** ctrl)
- *Gets PLL reference clock frequency.*

## CCM Get frequency

- uint32\_t **CLOCK\_GetFreq** (**clock\_name\_t** clockName)
- *Gets the clock frequency for a specific clock name.*
- uint32\_t **CLOCK\_GetClockRootFreq** (**clock\_root\_t** clockRoot)
- *Gets the frequency of selected clock root.*
- uint32\_t **CLOCK\_GetCoreM4Freq** (void)
- *Get the CCM Cortex M4 core frequency.*
- uint32\_t **CLOCK\_GetAxiFreq** (void)
- *Get the CCM Axi bus frequency.*
- uint32\_t **CLOCK\_GetAhbFreq** (void)
- *Get the CCM Ahb bus frequency.*

## 4.2 Data Structure Documentation

### 4.2.1 struct osc\_config\_t

#### Data Fields

- uint8\_t [oscMode](#)  
*ext or osc mode*
- uint8\_t [oscDiv](#)  
*osc divider*

### 4.2.2 struct ccm\_analog\_frac\_pll\_config\_t

Note: all the dividers in this configuration structure are the actually divider, software will map it to register value

#### Data Fields

- uint8\_t [refSel](#)  
*pll reference clock sel*
- uint8\_t [refDiv](#)  
*A 6bit divider to make sure the REF must be within the range 10MHZ~300MHZ.*
- uint32\_t [fractionDiv](#)  
*Include fraction divider(divider:1:2<sup>24</sup>) output clock range is 2000MHZ-4000MHZ.*
- uint8\_t [outDiv](#)  
*output clock divide, output clock range is 30MHZ to 2000MHZ, must be a even value*

### 4.2.3 struct ccm\_analog\_sscg\_pll\_config\_t

Note: all the dividers in this configuration structure are the actually divider, software will map it to register value

#### Data Fields

- uint8\_t [refSel](#)  
*pll reference clock sel*
- uint8\_t [refDiv1](#)  
*A 3bit divider to make sure the REF must be within the range 25MHZ~235MHZ ,post\_divide REF must be within the range 25MHZ~54MHZ.*
- uint8\_t [refDiv2](#)  
*A 6bit divider to make sure the post\_divide REF must be within the range 54MHZ~75MHZ.*
- uint32\_t [loopDivider1](#)  
*A 6bit internal PLL1 feedback clock divider, output clock range must be within the range 1600MHZ-2400-MHZ.*
- uint32\_t [loopDivider2](#)



A 6bit internal PLL2 feedback clock divider, output clock range must be within the range 1200MHZ-2400-MHZ.

- uint8\_t [outDiv](#)

A 6bit output clock divide, output clock range is 20MHZ to 1200MHZ.

## 4.3 Macro Definition Documentation

### 4.3.1 #define FSL\_CLOCK\_DRIVER\_VERSION (MAKE\_VERSION(2, 4, 1))

### 4.3.2 #define ECSPI\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Ecspl1, kCLOCK_Ecspl2, \
    kCLOCK_Ecspl3, \
}
```

### 4.3.3 #define GPIO\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Gpio1, kCLOCK_Gpio2, \
    kCLOCK_Gpio3, kCLOCK_Gpio4, kCLOCK_Gpio5, \
}
```

### 4.3.4 #define GPT\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Gpt1, kCLOCK_Gpt2, \
    kCLOCK_Gpt3, kCLOCK_Gpt4, kCLOCK_Gpt5, \
    kCLOCK_Gpt6, \
}
```

### 4.3.5 #define I2C\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_I2c1, kCLOCK_I2c2, \
    kCLOCK_I2c3, kCLOCK_I2c4, \
}
```

### 4.3.6 #define IOMUX\_CLOCKS

Value:

```
{
    kCLOCK_Iomux, \
}
```

### 4.3.7 #define IPMUX\_CLOCKS

Value:

```
{
    kCLOCK_Ipmux1, kCLOCK_Ipmux2, \
    kCLOCK_Ipmux3, kCLOCK_Ipmux4, \
}
```

### 4.3.8 #define PWM\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Pwm1, kCLOCK_Pwm2, \
    kCLOCK_Pwm3, kCLOCK_Pwm4, \
}
```

### 4.3.9 #define RDC\_CLOCKS

Value:

```
{
    kCLOCK_Rdc, \
}
```

### 4.3.10 #define SAI\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Sai1, kCLOCK_Sai2, \
    kCLOCK_Sai3, kCLOCK_Sai4, kCLOCK_Sai5, \
    kCLOCK_Sai6, \
}
```

#### 4.3.11 #define RDC\_SEMA42\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Sema42_1, kCLOCK_Sema42_2 \
}
```

#### 4.3.12 #define UART\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Uart1, kCLOCK_Uart2, \
    kCLOCK_Uart3, kCLOCK_Uart4, \
}
```

#### 4.3.13 #define USDHC\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Usdhc1, kCLOCK_Usdhc2 \
}
```

#### 4.3.14 #define WDOG\_CLOCKS

Value:

```
{
    kCLOCK_IpInvalid, kCLOCK_Wdog1, kCLOCK_Wdog2, \
    kCLOCK_Wdog3 \
}
```

#### 4.3.15 #define TMU\_CLOCKS

Value:

```
{
    kCLOCK_TempSensor, \
}
```

#### 4.3.16 #define SDMA\_CLOCKS

Value:

```
{
    kCLOCK_Sdma1, kCLOCK_Sdma2 \
}
```

#### 4.3.17 #define MU\_CLOCKS

Value:

```
{
    kCLOCK_Mu \
}
```

#### 4.3.18 #define QSPI\_CLOCKS

Value:

```
{
    kCLOCK_Qspi \
}
```

#### 4.3.19 #define kCLOCK\_CoreSysClk kCLOCK\_CoreM4Clk

#### 4.3.20 #define CLOCK\_GetCoreSysClkFreq CLOCK\_GetCoreM4Freq

### 4.4 Enumeration Type Documentation

#### 4.4.1 enum clock\_name\_t

Enumerator

***kCLOCK\_CoreM4Clk*** ARM M4 Core clock.  
***kCLOCK\_AxiClk*** Main AXI bus clock.  
***kCLOCK\_AhbClk*** AHB bus clock.  
***kCLOCK\_IpgClk*** IPG bus clock.  
***kCLOCK\_Osc25MClk*** OSC 25M clock.  
***kCLOCK\_Osc27MClk*** OSC 27M clock.  
***kCLOCK\_ArmPllClk*** Arm PLL clock.  
***kCLOCK\_VpuPllClk*** Vpu PLL clock.

***kCLOCK\_DramPl1Clk*** Dram PLL clock.  
***kCLOCK\_SysPl11Clk*** Sys PLL1 clock.  
***kCLOCK\_SysPl11Div2Clk*** Sys PLL1 clock divided by 2.  
***kCLOCK\_SysPl11Div3Clk*** Sys PLL1 clock divided by 3.  
***kCLOCK\_SysPl11Div4Clk*** Sys PLL1 clock divided by 4.  
***kCLOCK\_SysPl11Div5Clk*** Sys PLL1 clock divided by 5.  
***kCLOCK\_SysPl11Div6Clk*** Sys PLL1 clock divided by 6.  
***kCLOCK\_SysPl11Div8Clk*** Sys PLL1 clock divided by 8.  
***kCLOCK\_SysPl11Div10Clk*** Sys PLL1 clock divided by 10.  
***kCLOCK\_SysPl11Div20Clk*** Sys PLL1 clock divided by 20.  
***kCLOCK\_SysPl12Clk*** Sys PLL2 clock.  
***kCLOCK\_SysPl12Div2Clk*** Sys PLL2 clock divided by 2.  
***kCLOCK\_SysPl12Div3Clk*** Sys PLL2 clock divided by 3.  
***kCLOCK\_SysPl12Div4Clk*** Sys PLL2 clock divided by 4.  
***kCLOCK\_SysPl12Div5Clk*** Sys PLL2 clock divided by 5.  
***kCLOCK\_SysPl12Div6Clk*** Sys PLL2 clock divided by 6.  
***kCLOCK\_SysPl12Div8Clk*** Sys PLL2 clock divided by 8.  
***kCLOCK\_SysPl12Div10Clk*** Sys PLL2 clock divided by 10.  
***kCLOCK\_SysPl12Div20Clk*** Sys PLL2 clock divided by 20.  
***kCLOCK\_SysPl13Clk*** Sys PLL3 clock.  
***kCLOCK\_AudioPl11Clk*** Audio PLL1 clock.  
***kCLOCK\_AudioPl12Clk*** Audio PLL2 clock.  
***kCLOCK\_VideoPl11Clk*** Video PLL1 clock.  
***kCLOCK\_ExtClk1*** External clock1.  
***kCLOCK\_ExtClk2*** External clock2.  
***kCLOCK\_ExtClk3*** External clock3.  
***kCLOCK\_ExtClk4*** External clock4.  
***kCLOCK\_NoneName*** None Clock Name.

#### 4.4.2 enum clock\_ip\_name\_t

Enumerator

***kCLOCK\_Debug*** DEBUG Clock Gate.  
***kCLOCK\_Dram*** DRAM Clock Gate.  
***kCLOCK\_Ecspi1*** ECSPi1 Clock Gate.  
***kCLOCK\_Ecspi2*** ECSPi2 Clock Gate.  
***kCLOCK\_Ecspi3*** ECSPi3 Clock Gate.  
***kCLOCK\_Gpio1*** GPIO1 Clock Gate.  
***kCLOCK\_Gpio2*** GPIO2 Clock Gate.  
***kCLOCK\_Gpio3*** GPIO3 Clock Gate.  
***kCLOCK\_Gpio4*** GPIO4 Clock Gate.  
***kCLOCK\_Gpio5*** GPIO5 Clock Gate.  
***kCLOCK\_Gpt1*** GPT1 Clock Gate.

*kCLOCK\_Gpt2* GPT2 Clock Gate.  
*kCLOCK\_Gpt3* GPT3 Clock Gate.  
*kCLOCK\_Gpt4* GPT4 Clock Gate.  
*kCLOCK\_Gpt5* GPT5 Clock Gate.  
*kCLOCK\_Gpt6* GPT6 Clock Gate.  
*kCLOCK\_I2c1* I2C1 Clock Gate.  
*kCLOCK\_I2c2* I2C2 Clock Gate.  
*kCLOCK\_I2c3* I2C3 Clock Gate.  
*kCLOCK\_I2c4* I2C4 Clock Gate.  
*kCLOCK\_Iomux* IOMUX Clock Gate.  
*kCLOCK\_Ipmux1* IPMUX1 Clock Gate.  
*kCLOCK\_Ipmux2* IPMUX2 Clock Gate.  
*kCLOCK\_Ipmux3* IPMUX3 Clock Gate.  
*kCLOCK\_Ipmux4* IPMUX4 Clock Gate.  
*kCLOCK\_M4* M4 Clock Gate.  
*kCLOCK\_Mu* MU Clock Gate.  
*kCLOCK\_Ocram* OCRAM Clock Gate.  
*kCLOCK\_OcramS* OCRAM S Clock Gate.  
*kCLOCK\_Pwm1* PWM1 Clock Gate.  
*kCLOCK\_Pwm2* PWM2 Clock Gate.  
*kCLOCK\_Pwm3* PWM3 Clock Gate.  
*kCLOCK\_Pwm4* PWM4 Clock Gate.  
*kCLOCK\_Qspi* QSPI Clock Gate.  
*kCLOCK\_Rdc* RDC Clock Gate.  
*kCLOCK\_Sai1* SAI1 Clock Gate.  
*kCLOCK\_Sai2* SAI2 Clock Gate.  
*kCLOCK\_Sai3* SAI3 Clock Gate.  
*kCLOCK\_Sai4* SAI4 Clock Gate.  
*kCLOCK\_Sai5* SAI5 Clock Gate.  
*kCLOCK\_Sai6* SAI6 Clock Gate.  
*kCLOCK\_Sdma1* SDMA1 Clock Gate.  
*kCLOCK\_Sdma2* SDMA2 Clock Gate.  
*kCLOCK\_Sec\_Debug* SEC\_DEBUG Clock Gate.  
*kCLOCK\_Sema42\_1* RDC SEMA42 Clock Gate.  
*kCLOCK\_Sema42\_2* RDC SEMA42 Clock Gate.  
*kCLOCK\_Sim\_display* SIM\_Display Clock Gate.  
*kCLOCK\_Sim\_m* SIM\_M Clock Gate.  
*kCLOCK\_Sim\_main* SIM\_MAIN Clock Gate.  
*kCLOCK\_Sim\_s* SIM\_S Clock Gate.  
*kCLOCK\_Sim\_wakeup* SIM\_WAKEUP Clock Gate.  
*kCLOCK\_Uart1* UART1 Clock Gate.  
*kCLOCK\_Uart2* UART2 Clock Gate.  
*kCLOCK\_Uart3* UART3 Clock Gate.  
*kCLOCK\_Uart4* UART4 Clock Gate.  
*kCLOCK\_Wdog1* WDOG1 Clock Gate.

***kCLOCK\_Wdog2*** WDOG2 Clock Gate.  
***kCLOCK\_Wdog3*** WDOG3 Clock Gate.  
***kCLOCK\_TempSensor*** TempSensor Clock Gate.

#### 4.4.3 enum clock\_root\_control\_t

Enumerator

***kCLOCK\_RootM4*** ARM Cortex-M4 Clock control name.  
***kCLOCK\_RootAxi*** AXI Clock control name.  
***kCLOCK\_RootNoc*** NOC Clock control name.  
***kCLOCK\_RootAhb*** AHB Clock control name.  
***kCLOCK\_RootIpg*** IPG Clock control name.  
***kCLOCK\_RootDramAlt*** DRAM ALT Clock control name.  
***kCLOCK\_RootSai1*** SAI1 Clock control name.  
***kCLOCK\_RootSai2*** SAI2 Clock control name.  
***kCLOCK\_RootSai3*** SAI3 Clock control name.  
***kCLOCK\_RootSai4*** SAI4 Clock control name.  
***kCLOCK\_RootSai5*** SAI5 Clock control name.  
***kCLOCK\_RootSai6*** SAI6 Clock control name.  
***kCLOCK\_RootQspi*** QSPI Clock control name.  
***kCLOCK\_RootI2c1*** I2C1 Clock control name.  
***kCLOCK\_RootI2c2*** I2C2 Clock control name.  
***kCLOCK\_RootI2c3*** I2C3 Clock control name.  
***kCLOCK\_RootI2c4*** I2C4 Clock control name.  
***kCLOCK\_RootUart1*** UART1 Clock control name.  
***kCLOCK\_RootUart2*** UART2 Clock control name.  
***kCLOCK\_RootUart3*** UART3 Clock control name.  
***kCLOCK\_RootUart4*** UART4 Clock control name.  
***kCLOCK\_RootEcspi1*** ECSPI1 Clock control name.  
***kCLOCK\_RootEcspi2*** ECSPI2 Clock control name.  
***kCLOCK\_RootEcspi3*** ECSPI3 Clock control name.  
***kCLOCK\_RootPwm1*** PWM1 Clock control name.  
***kCLOCK\_RootPwm2*** PWM2 Clock control name.  
***kCLOCK\_RootPwm3*** PWM3 Clock control name.  
***kCLOCK\_RootPwm4*** PWM4 Clock control name.  
***kCLOCK\_RootGpt1*** GPT1 Clock control name.  
***kCLOCK\_RootGpt2*** GPT2 Clock control name.  
***kCLOCK\_RootGpt3*** GPT3 Clock control name.  
***kCLOCK\_RootGpt4*** GPT4 Clock control name.  
***kCLOCK\_RootGpt5*** GPT5 Clock control name.  
***kCLOCK\_RootGpt6*** GPT6 Clock control name.  
***kCLOCK\_RootWdog*** WDOG Clock control name.

#### 4.4.4 enum clock\_root\_t

Enumerator

***kCLOCK\_M4ClkRoot*** ARM Cortex-M4 Clock control name.  
***kCLOCK\_AxiClkRoot*** AXI Clock control name.  
***kCLOCK\_NocClkRoot*** NOC Clock control name.  
***kCLOCK\_AhbClkRoot*** AHB Clock control name.  
***kCLOCK\_IpgClkRoot*** IPG Clock control name.  
***kCLOCK\_DramAltClkRoot*** DRAM ALT Clock control name.  
***kCLOCK\_Sai1ClkRoot*** SAI1 Clock control name.  
***kCLOCK\_Sai2ClkRoot*** SAI2 Clock control name.  
***kCLOCK\_Sai3ClkRoot*** SAI3 Clock control name.  
***kCLOCK\_Sai4ClkRoot*** SAI4 Clock control name.  
***kCLOCK\_Sai5ClkRoot*** SAI5 Clock control name.  
***kCLOCK\_Sai6ClkRoot*** SAI6 Clock control name.  
***kCLOCK\_QspiClkRoot*** QSPI Clock control name.  
***kCLOCK\_I2c1ClkRoot*** I2C1 Clock control name.  
***kCLOCK\_I2c2ClkRoot*** I2C2 Clock control name.  
***kCLOCK\_I2c3ClkRoot*** I2C3 Clock control name.  
***kCLOCK\_I2c4ClkRoot*** I2C4 Clock control name.  
***kCLOCK\_Uart1ClkRoot*** UART1 Clock control name.  
***kCLOCK\_Uart2ClkRoot*** UART2 Clock control name.  
***kCLOCK\_Uart3ClkRoot*** UART3 Clock control name.  
***kCLOCK\_Uart4ClkRoot*** UART4 Clock control name.  
***kCLOCK\_Ecspi1ClkRoot*** ECSPi1 Clock control name.  
***kCLOCK\_Ecspi2ClkRoot*** ECSPi2 Clock control name.  
***kCLOCK\_Ecspi3ClkRoot*** ECSPi3 Clock control name.  
***kCLOCK\_Pwm1ClkRoot*** PWM1 Clock control name.  
***kCLOCK\_Pwm2ClkRoot*** PWM2 Clock control name.  
***kCLOCK\_Pwm3ClkRoot*** PWM3 Clock control name.  
***kCLOCK\_Pwm4ClkRoot*** PWM4 Clock control name.  
***kCLOCK\_Gpt1ClkRoot*** GPT1 Clock control name.  
***kCLOCK\_Gpt2ClkRoot*** GPT2 Clock control name.  
***kCLOCK\_Gpt3ClkRoot*** GPT3 Clock control name.  
***kCLOCK\_Gpt4ClkRoot*** GPT4 Clock control name.  
***kCLOCK\_Gpt5ClkRoot*** GPT5 Clock control name.  
***kCLOCK\_Gpt6ClkRoot*** GPT6 Clock control name.  
***kCLOCK\_WdogClkRoot*** WDOG Clock control name.



#### 4.4.5 enum clock\_rootmux\_m4\_clk\_sel\_t

Enumerator

***kCLOCK\_M4RootmuxOsc25m*** ARM Cortex-M4 Clock from OSC 25M.  
***kCLOCK\_M4RootmuxSysPll2Div5*** ARM Cortex-M4 Clock from SYSTEM PLL2 divided by 5.  
***kCLOCK\_M4RootmuxSysPll2Div4*** ARM Cortex-M4 Clock from SYSTEM PLL2 divided by 4.  
***kCLOCK\_M4RootmuxSysPll1Div3*** ARM Cortex-M4 Clock from SYSTEM PLL1 divided by 3.  
***kCLOCK\_M4RootmuxSysPll1*** ARM Cortex-M4 Clock from SYSTEM PLL1.  
***kCLOCK\_M4RootmuxAudioPll1*** ARM Cortex-M4 Clock from AUDIO PLL1.  
***kCLOCK\_M4RootmuxVideoPll1*** ARM Cortex-M4 Clock from VIDEO PLL1.  
***kCLOCK\_M4RootmuxSysPll3*** ARM Cortex-M4 Clock from SYSTEM PLL3.

#### 4.4.6 enum clock\_rootmux\_axi\_clk\_sel\_t

Enumerator

***kCLOCK\_AxiRootmuxOsc25m*** ARM AXI Clock from OSC 25M.  
***kCLOCK\_AxiRootmuxSysPll2Div3*** ARM AXI Clock from SYSTEM PLL2 divided by 3.  
***kCLOCK\_AxiRootmuxSysPll1*** ARM AXI Clock from SYSTEM PLL1.  
***kCLOCK\_AxiRootmuxSysPll2Div4*** ARM AXI Clock from SYSTEM PLL2 divided by 4.  
***kCLOCK\_AxiRootmuxSysPll2*** ARM AXI Clock from SYSTEM PLL2.  
***kCLOCK\_AxiRootmuxAudioPll1*** ARM AXI Clock from AUDIO PLL1.  
***kCLOCK\_AxiRootmuxVideoPll1*** ARM AXI Clock from VIDEO PLL1.  
***kCLOCK\_AxiRootmuxSysPll1Div8*** ARM AXI Clock from SYSTEM PLL1 divided by 8.

#### 4.4.7 enum clock\_rootmux\_ahb\_clk\_sel\_t

Enumerator

***kCLOCK\_AhbRootmuxOsc25m*** ARM AHB Clock from OSC 25M.  
***kCLOCK\_AhbRootmuxSysPll1Div6*** ARM AHB Clock from SYSTEM PLL1 divided by 6.  
***kCLOCK\_AhbRootmuxSysPll1*** ARM AHB Clock from SYSTEM PLL1.  
***kCLOCK\_AhbRootmuxSysPll1Div2*** ARM AHB Clock from SYSTEM PLL1 divided by 2.  
***kCLOCK\_AhbRootmuxSysPll2Div8*** ARM AHB Clock from SYSTEM PLL2 divided by 8.  
***kCLOCK\_AhbRootmuxSysPll3*** ARM AHB Clock from SYSTEM PLL3.  
***kCLOCK\_AhbRootmuxAudioPll1*** ARM AHB Clock from AUDIO PLL1.  
***kCLOCK\_AhbRootmuxVideoPll1*** ARM AHB Clock from VIDEO PLL1.

#### 4.4.8 enum clock\_rootmux\_qspi\_clk\_sel\_t

Enumerator

*kCLOCK\_QspiRootmuxOsc25m* ARM QSPI Clock from OSC 25M.  
*kCLOCK\_QspiRootmuxSysPll1Div2* ARM QSPI Clock from SYSTEM PLL1 divided by 2.  
*kCLOCK\_QspiRootmuxSysPll1* ARM QSPI Clock from SYSTEM PLL1.  
*kCLOCK\_QspiRootmuxSysPll2Div2* ARM QSPI Clock from SYSTEM PLL2 divided by 2.  
*kCLOCK\_QspiRootmuxAudioPll2* ARM QSPI Clock from AUDIO PLL2.  
*kCLOCK\_QspiRootmuxSysPll1Div3* ARM QSPI Clock from SYSTEM PLL1 divided by 3.  
*kCLOCK\_QspiRootmuxSysPll3* ARM QSPI Clock from SYSTEM PLL3.  
*kCLOCK\_QspiRootmuxSysPll1Div8* ARM QSPI Clock from SYSTEM PLL1 divided by 8.

#### 4.4.9 enum clock\_rootmux\_ecspi\_clk\_sel\_t

Enumerator

*kCLOCK\_EcspiRootmuxOsc25m* ECSPI Clock from OSC 25M.  
*kCLOCK\_EcspiRootmuxSysPll2Div5* ECSPI Clock from SYSTEM PLL2 divided by 5.  
*kCLOCK\_EcspiRootmuxSysPll1Div20* ECSPI Clock from SYSTEM PLL1 divided by 20.  
*kCLOCK\_EcspiRootmuxSysPll1Div5* ECSPI Clock from SYSTEM PLL1 divided by 5.  
*kCLOCK\_EcspiRootmuxSysPll1* ECSPI Clock from SYSTEM PLL1.  
*kCLOCK\_EcspiRootmuxSysPll3* ECSPI Clock from SYSTEM PLL3.  
*kCLOCK\_EcspiRootmuxSysPll2Div4* ECSPI Clock from SYSTEM PLL2 divided by 4.  
*kCLOCK\_EcspiRootmuxAudioPll2* ECSPI Clock from AUDIO PLL2.

#### 4.4.10 enum clock\_rootmux\_i2c\_clk\_sel\_t

Enumerator

*kCLOCK\_I2cRootmuxOsc25m* I2C Clock from OSC 25M.  
*kCLOCK\_I2cRootmuxSysPll1Div5* I2C Clock from SYSTEM PLL1 divided by 5.  
*kCLOCK\_I2cRootmuxSysPll2Div20* I2C Clock from SYSTEM PLL2 divided by 20.  
*kCLOCK\_I2cRootmuxSysPll3* I2C Clock from SYSTEM PLL3 .  
*kCLOCK\_I2cRootmuxAudioPll1* I2C Clock from AUDIO PLL1.  
*kCLOCK\_I2cRootmuxVideoPll1* I2C Clock from VIDEO PLL1.  
*kCLOCK\_I2cRootmuxAudioPll2* I2C Clock from AUDIO PLL2.  
*kCLOCK\_I2cRootmuxSysPll1Div6* I2C Clock from SYSTEM PLL1 divided by 6.

#### 4.4.11 enum clock\_rootmux\_uart\_clk\_sel\_t

Enumerator

*kCLOCK\_UartRootmuxOsc25m* UART Clock from OSC 25M.  
*kCLOCK\_UartRootmuxSysPll1Div10* UART Clock from SYSTEM PLL1 divided by 10.  
*kCLOCK\_UartRootmuxSysPll2Div5* UART Clock from SYSTEM PLL2 divided by 5.  
*kCLOCK\_UartRootmuxSysPll2Div10* UART Clock from SYSTEM PLL2 divided by 10.  
*kCLOCK\_UartRootmuxSysPll3* UART Clock from SYSTEM PLL3.  
*kCLOCK\_UartRootmuxExtClk2* UART Clock from External Clock 2.  
*kCLOCK\_UartRootmuxExtClk34* UART Clock from External Clock 3, External Clock 4.  
*kCLOCK\_UartRootmuxAudioPll2* UART Clock from Audio PLL2.

#### 4.4.12 enum clock\_rootmux\_gpt\_t

Enumerator

*kCLOCK\_GptRootmuxOsc25m* GPT Clock from OSC 25M.  
*kCLOCK\_GptRootmuxSystemPll2Div10* GPT Clock from SYSTEM PLL2 divided by 10.  
*kCLOCK\_GptRootmuxSysPll1Div2* GPT Clock from SYSTEM PLL1 divided by 2.  
*kCLOCK\_GptRootmuxSysPll1Div20* GPT Clock from SYSTEM PLL1 divided by 20.  
*kCLOCK\_GptRootmuxVideoPll1* GPT Clock from VIDEO PLL1.  
*kCLOCK\_GptRootmuxSystemPll1Div10* GPT Clock from SYSTEM PLL1 divided by 10.  
*kCLOCK\_GptRootmuxAudioPll1* GPT Clock from AUDIO PLL1.  
*kCLOCK\_GptRootmuxExtClk123* GPT Clock from External Clock1, External Clock2, External Clock3.

#### 4.4.13 enum clock\_rootmux\_wdog\_clk\_sel\_t

Enumerator

*kCLOCK\_WdogRootmuxOsc25m* WDOG Clock from OSC 25M.  
*kCLOCK\_WdogRootmuxSysPll1Div6* WDOG Clock from SYSTEM PLL1 divided by 6.  
*kCLOCK\_WdogRootmuxSysPll1Div5* WDOG Clock from SYSTEM PLL1 divided by 5.  
*kCLOCK\_WdogRootmuxVpuPll* WDOG Clock from VPU DLL.  
*kCLOCK\_WdogRootmuxSystemPll2Div8* WDOG Clock from SYSTEM PLL2 divided by 8.  
*kCLOCK\_WdogRootmuxSystemPll3* WDOG Clock from SYSTEM PLL3.  
*kCLOCK\_WdogRootmuxSystemPll1Div10* WDOG Clock from SYSTEM PLL1 divided by 10.  
*kCLOCK\_WdogRootmuxSystemPll2Div6* WDOG Clock from SYSTEM PLL2 divided by 6.

#### 4.4.14 enum clock\_rootmux\_Pwm\_clk\_sel\_t

Enumerator

*kCLOCK\_PwmRootmuxOsc25m* PWM Clock from OSC 25M.  
*kCLOCK\_PwmRootmuxSysPll2Div10* PWM Clock from SYSTEM PLL2 divided by 10.  
*kCLOCK\_PwmRootmuxSysPll1Div5* PWM Clock from SYSTEM PLL1 divided by 5.  
*kCLOCK\_PwmRootmuxSysPll1Div20* PWM Clock from SYSTEM PLL1 divided by 20.  
*kCLOCK\_PwmRootmuxSystemPll3* PWM Clock from SYSTEM PLL3.  
*kCLOCK\_PwmRootmuxExtClk12* PWM Clock from External Clock1, External Clock2.  
*kCLOCK\_PwmRootmuxSystemPll1Div10* PWM Clock from SYSTEM PLL1 divided by 10.  
*kCLOCK\_PwmRootmuxVideoPll1* PWM Clock from VIDEO PLL1.

#### 4.4.15 enum clock\_rootmux\_sai\_clk\_sel\_t

Enumerator

*kCLOCK\_SaiRootmuxOsc25m* SAI Clock from OSC 25M.  
*kCLOCK\_SaiRootmuxAudioPll1* SAI Clock from AUDIO PLL1.  
*kCLOCK\_SaiRootmuxAudioPll2* SAI Clock from AUDIO PLL2.  
*kCLOCK\_SaiRootmuxVideoPll1* SAI Clock from VIDEO PLL1.  
*kCLOCK\_SaiRootmuxSysPll1Div6* SAI Clock from SYSTEM PLL1 divided by 6.  
*kCLOCK\_SaiRootmuxOsc27m* SAI Clock from OSC 27M.  
*kCLOCK\_SaiRootmuxExtClk123* SAI Clock from External Clock1, External Clock2, External Clock3.  
*kCLOCK\_SaiRootmuxExtClk234* SAI Clock from External Clock2, External Clock3, External Clock4.

#### 4.4.16 enum clock\_rootmux\_noc\_clk\_sel\_t

Enumerator

*kCLOCK\_NocRootmuxOsc25m* NOC Clock from OSC 25M.  
*kCLOCK\_NocRootmuxSysPll1* NOC Clock from SYSTEM PLL1.  
*kCLOCK\_NocRootmuxSysPll3* NOC Clock from SYSTEM PLL3.  
*kCLOCK\_NocRootmuxSysPll2* NOC Clock from SYSTEM PLL2.  
*kCLOCK\_NocRootmuxSysPll2Div2* NOC Clock from SYSTEM PLL2 divided by 2.  
*kCLOCK\_NocRootmuxAudioPll1* NOC Clock from AUDIO PLL1.  
*kCLOCK\_NocRootmuxVideoPll1* NOC Clock from VIDEO PLL1.  
*kCLOCK\_NocRootmuxAudioPll2* NOC Clock from AUDIO PLL2.

#### 4.4.17 enum clock\_pll\_gate\_t

Enumerator

***kCLOCK\_ArmPllGate*** ARM PLL Gate.  
***kCLOCK\_GpuPllGate*** GPU PLL Gate.  
***kCLOCK\_VpuPllGate*** VPU PLL Gate.  
***kCLOCK\_DramPllGate*** DRAM PLL1 Gate.  
***kCLOCK\_SysPll1Gate*** SYSTEM PLL1 Gate.  
***kCLOCK\_SysPll1Div2Gate*** SYSTEM PLL1 Div2 Gate.  
***kCLOCK\_SysPll1Div3Gate*** SYSTEM PLL1 Div3 Gate.  
***kCLOCK\_SysPll1Div4Gate*** SYSTEM PLL1 Div4 Gate.  
***kCLOCK\_SysPll1Div5Gate*** SYSTEM PLL1 Div5 Gate.  
***kCLOCK\_SysPll1Div6Gate*** SYSTEM PLL1 Div6 Gate.  
***kCLOCK\_SysPll1Div8Gate*** SYSTEM PLL1 Div8 Gate.  
***kCLOCK\_SysPll1Div10Gate*** SYSTEM PLL1 Div10 Gate.  
***kCLOCK\_SysPll1Div20Gate*** SYSTEM PLL1 Div20 Gate.  
***kCLOCK\_SysPll2Gate*** SYSTEM PLL2 Gate.  
***kCLOCK\_SysPll2Div2Gate*** SYSTEM PLL2 Div2 Gate.  
***kCLOCK\_SysPll2Div3Gate*** SYSTEM PLL2 Div3 Gate.  
***kCLOCK\_SysPll2Div4Gate*** SYSTEM PLL2 Div4 Gate.  
***kCLOCK\_SysPll2Div5Gate*** SYSTEM PLL2 Div5 Gate.  
***kCLOCK\_SysPll2Div6Gate*** SYSTEM PLL2 Div6 Gate.  
***kCLOCK\_SysPll2Div8Gate*** SYSTEM PLL2 Div8 Gate.  
***kCLOCK\_SysPll2Div10Gate*** SYSTEM PLL2 Div10 Gate.  
***kCLOCK\_SysPll2Div20Gate*** SYSTEM PLL2 Div20 Gate.  
***kCLOCK\_SysPll3Gate*** SYSTEM PLL3 Gate.  
***kCLOCK\_AudioPll1Gate*** AUDIO PLL1 Gate.  
***kCLOCK\_AudioPll2Gate*** AUDIO PLL2 Gate.  
***kCLOCK\_VideoPll1Gate*** VIDEO PLL1 Gate.  
***kCLOCK\_VideoPll2Gate*** VIDEO PLL2 Gate.

#### 4.4.18 enum clock\_gate\_value\_t

Enumerator

***kCLOCK\_ClockNotNeeded*** Clock always disabled.  
***kCLOCK\_ClockNeededRun*** Clock enabled when CPU is running.  
***kCLOCK\_ClockNeededRunWait*** Clock enabled when CPU is running or in WAIT mode.  
***kCLOCK\_ClockNeededAll*** Clock always enabled.

#### 4.4.19 enum clock\_pll\_bypass\_ctrl\_t

These constants define the PLL control names for PLL bypass.

- 0:15: REG offset to CCM\_ANALOG\_BASE in bytes.
- 16:20: bypass bit shift.

Enumerator

***kCLOCK\_AudioPll1BypassCtrl*** CCM Audio PLL1 bypass Control.  
***kCLOCK\_AudioPll2BypassCtrl*** CCM Audio PLL2 bypass Control.  
***kCLOCK\_VideoPll1BypassCtrl*** CCM Video Pll1 bypass Control.  
***kCLOCK\_GpuPllPwrBypassCtrl*** CCM Gpu PLL bypass Control.  
***kCLOCK\_VpuPllPwrBypassCtrl*** CCM Vpu PLL bypass Control.  
***kCLOCK\_ArmPllPwrBypassCtrl*** CCM Arm PLL bypass Control.  
***kCLOCK\_SysPll1InternalPll1BypassCtrl*** CCM System PLL1 internal pll1 bypass Control.  
***kCLOCK\_SysPll1InternalPll2BypassCtrl*** CCM System PLL1 internal pll2 bypass Control.  
***kCLOCK\_SysPll2InternalPll1BypassCtrl*** CCM Analog System PLL1 internal pll1 bypass Control.  
***kCLOCK\_SysPll2InternalPll2BypassCtrl*** CCM Analog VIDEO System PLL1 internal pll1 bypass Control.  
***kCLOCK\_SysPll3InternalPll1BypassCtrl*** CCM Analog VIDEO PLL bypass Control.  
***kCLOCK\_SysPll3InternalPll2BypassCtrl*** CCM Analog VIDEO PLL bypass Control.  
***kCLOCK\_VideoPll2InternalPll1BypassCtrl*** CCM Analog 480M PLL bypass Control.  
***kCLOCK\_VideoPll2InternalPll2BypassCtrl*** CCM Analog 480M PLL bypass Control.  
***kCLOCK\_DramPllInternalPll1BypassCtrl*** CCM Analog 480M PLL bypass Control.  
***kCLOCK\_DramPllInternalPll2BypassCtrl*** CCM Analog 480M PLL bypass Control.

#### 4.4.20 enum clock\_pll\_clke\_t

These constants define the PLL clock names for PLL clock enable/disable operations.

- 0:15: REG offset to CCM\_ANALOG\_BASE in bytes.
- 16:20: Clock enable bit shift.

Enumerator

***kCLOCK\_AudioPll1Clke*** Audio pll1 clke.  
***kCLOCK\_AudioPll2Clke*** Audio pll2 clke.  
***kCLOCK\_VideoPll1Clke*** Video pll1 clke.  
***kCLOCK\_GpuPllClke*** Gpu pll clke.  
***kCLOCK\_VpuPllClke*** Vpu pll clke.  
***kCLOCK\_ArmPllClke*** Arm pll clke.  
***kCLOCK\_SystemPll1Clke*** System pll1 clke.  
***kCLOCK\_SystemPll1Div2Clke*** System pll1 Div2 clke.

*kCLOCK\_SystemPll1Div3Clke* System pll1 Div3 clke.  
*kCLOCK\_SystemPll1Div4Clke* System pll1 Div4 clke.  
*kCLOCK\_SystemPll1Div5Clke* System pll1 Div5 clke.  
*kCLOCK\_SystemPll1Div6Clke* System pll1 Div6 clke.  
*kCLOCK\_SystemPll1Div8Clke* System pll1 Div8 clke.  
*kCLOCK\_SystemPll1Div10Clke* System pll1 Div10 clke.  
*kCLOCK\_SystemPll1Div20Clke* System pll1 Div20 clke.  
*kCLOCK\_SystemPll2Clke* System pll2 clke.  
*kCLOCK\_SystemPll2Div2Clke* System pll2 Div2 clke.  
*kCLOCK\_SystemPll2Div3Clke* System pll2 Div3 clke.  
*kCLOCK\_SystemPll2Div4Clke* System pll2 Div4 clke.  
*kCLOCK\_SystemPll2Div5Clke* System pll2 Div5 clke.  
*kCLOCK\_SystemPll2Div6Clke* System pll2 Div6 clke.  
*kCLOCK\_SystemPll2Div8Clke* System pll2 Div8 clke.  
*kCLOCK\_SystemPll2Div10Clke* System pll2 Div10 clke.  
*kCLOCK\_SystemPll2Div20Clke* System pll2 Div20 clke.  
*kCLOCK\_SystemPll3Clke* System pll3 clke.  
*kCLOCK\_VideoPll2Clke* Video pll2 clke.  
*kCLOCK\_DramPllClke* Dram pll clke.  
*kCLOCK\_OSC25MClke* OSC25M clke.  
*kCLOCK\_OSC27MClke* OSC27M clke.

#### 4.4.21 enum \_osc\_mode

Enumerator

*kOSC\_OscMode* OSC oscillator mode.  
*kOSC\_ExtMode* OSC external mode.

#### 4.4.22 enum osc32\_src\_t

Enumerator

*kOSC32\_Src25MDiv800* source from 25M divide 800  
*kOSC32\_SrcRTC* source from RTC

#### 4.4.23 enum \_ccm\_analog\_pll\_ref\_clk

Enumerator

*kANALOG\_PllRefOsc25M* reference OSC 25M

*kANALOG\_PllRefOsc27M* reference OSC 27M

*kANALOG\_PllRefOscHdmiPhy27M* reference HDMI PHY 27M

*kANALOG\_PllRefClkPN* reference CLK\_P\_N

## 4.5 Function Documentation

### 4.5.1 static void CLOCK\_SetRootMux ( clock\_root\_control\_t *rootClk*, uint32\_t *mux* ) [inline], [static]

User maybe need to set more than one mux ROOT according to the clock tree description in the reference manual.

Parameters

<i>rootClk</i>	Root clock control (see <a href="#">clock_root_control_t</a> enumeration).
<i>mux</i>	Root mux value (see <a href="#">_ccm_rootmux_xxx</a> enumeration).

### 4.5.2 static uint32\_t CLOCK\_GetRootMux ( clock\_root\_control\_t *rootClk* ) [inline], [static]

In order to get the clock source of root, user maybe need to get more than one ROOT's mux value to obtain the final clock source of root.

Parameters

<i>rootClk</i>	Root clock control (see <a href="#">clock_root_control_t</a> enumeration).
----------------	--

Returns

Root mux value (see [\\_ccm\\_rootmux\\_xxx](#) enumeration).

### 4.5.3 static void CLOCK\_EnableRoot ( clock\_root\_control\_t *rootClk* ) [inline], [static]

Parameters



<i>rootClk</i>	Root clock control (see <a href="#">clock_root_control_t</a> enumeration)
----------------	---

#### 4.5.4 static void CLOCK\_DisableRoot ( clock\_root\_control\_t *rootClk* ) [inline], [static]

Parameters

<i>rootClk</i>	Root control (see <a href="#">clock_root_control_t</a> enumeration)
----------------	---

#### 4.5.5 static bool CLOCK\_IsRootEnabled ( clock\_root\_control\_t *rootClk* ) [inline], [static]

Parameters

<i>rootClk</i>	Root control (see <a href="#">clock_root_control_t</a> enumeration)
----------------	---

Returns

CCM root enabled or not.

- true: Clock root is enabled.
- false: Clock root is disabled.

#### 4.5.6 void CLOCK\_UpdateRoot ( clock\_root\_control\_t *ccmRootClk*, uint32\_t *mux*, uint32\_t *pre*, uint32\_t *post* )

Parameters

<i>ccmRootClk</i>	Root control (see <a href="#">clock_root_control_t</a> enumeration)
<i>mux</i>	root mux value (see <a href="#">_ccm_rootmux_xxx</a> enumeration)
<i>pre</i>	Pre divider value (0-7, divider=n+1)
<i>post</i>	Post divider value (0-63, divider=n+1)

#### 4.5.7 void CLOCK\_SetRootDivider ( clock\_root\_control\_t *ccmRootClk*, uint32\_t *pre*, uint32\_t *post* )

## Parameters

<i>ccmRootClk</i>	Root control (see <a href="#">clock_root_control_t</a> enumeration)
<i>pre</i>	Pre divider value (1-8)
<i>post</i>	Post divider value (1-64)

#### 4.5.8 static uint32\_t CLOCK\_GetRootPreDivider ( clock\_root\_control\_t *rootClk* ) [inline], [static]

In order to get the clock source of root, user maybe need to get more than one ROOT's mux value to obtain the final clock source of root.

## Parameters

<i>rootClk</i>	Root clock name (see <a href="#">clock_root_control_t</a> enumeration).
----------------	---

## Returns

Root Pre divider value.

#### 4.5.9 static uint32\_t CLOCK\_GetRootPostDivider ( clock\_root\_control\_t *rootClk* ) [inline], [static]

In order to get the clock source of root, user maybe need to get more than one ROOT's mux value to obtain the final clock source of root.

## Parameters

<i>rootClk</i>	Root clock name (see <a href="#">clock_root_control_t</a> enumeration).
----------------	---

## Returns

Root Post divider value.

#### 4.5.10 void CLOCK\_InitOSC25M ( const osc\_config\_t \* *config* )

## Parameters

<i>config</i>	osc configuration.
---------------	--------------------

**4.5.11 void CLOCK\_DeinitOSC25M ( void )**

**4.5.12 void CLOCK\_InitOSC27M ( const osc\_config\_t \* *config* )**

## Parameters

<i>config</i>	osc configuration.
---------------	--------------------

**4.5.13 void CLOCK\_DeinitOSC27M ( void )**

**4.5.14 static void CLOCK\_SwitchOSC32Src ( osc32\_src\_t *sel* ) [inline],  
[static]**

## Parameters

<i>sel</i>	OSC32 input clock select
------------	--------------------------

**4.5.15 static void CLOCK\_ControlGate ( uint32\_t *ccmGate*, clock\_gate\_value\_t  
*control* ) [inline], [static]**

## Parameters

<i>ccmGate</i>	Gate control (see <a href="#">clock_pll_gate_t</a> and <a href="#">clock_ip_name_t</a> enumeration)
<i>control</i>	Gate control value (see <a href="#">clock_gate_value_t</a> )

**4.5.16 void CLOCK\_EnableClock ( clock\_ip\_name\_t *ccmGate* )**

Take care of that one module may need to set more than one clock gate.

## Parameters

<i>ccmGate</i>	Gate control for each module (see <a href="#">clock_ip_name_t</a> enumeration).
----------------	---

**4.5.17 void CLOCK\_DisableClock ( clock\_ip\_name\_t ccmGate )**

Take care of that one module may need to set more than one clock gate.

## Parameters

<i>ccmGate</i>	Gate control for each module (see <a href="#">clock_ip_name_t</a> enumeration).
----------------	---

**4.5.18 static void CLOCK\_PowerUpPll ( CCM\_ANALOG\_Type \* base, clock\_pll\_ctrl\_t pllControl ) [inline], [static]**

## Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>pllControl</i>	PLL control name (see <a href="#">clock_pll_ctrl_t</a> enumeration)

**4.5.19 static void CLOCK\_PowerDownPll ( CCM\_ANALOG\_Type \* base, clock\_pll\_ctrl\_t pllControl ) [inline], [static]**

## Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>pllControl</i>	PLL control name (see <a href="#">clock_pll_ctrl_t</a> enumeration)

**4.5.20 static void CLOCK\_SetPllBypass ( CCM\_ANALOG\_Type \* base, clock\_pll\_bypass\_ctrl\_t pllControl, bool bypass ) [inline], [static]**

## Parameters

---

<i>base</i>	CCM_ANALOG base pointer.
<i>pllControl</i>	PLL control name (see <code>ccm_analog_pll_control_t</code> enumeration)
<i>bypass</i>	Bypass the PLL. <ul style="list-style-type: none"> <li>• true: Bypass the PLL.</li> <li>• false: Do not bypass the PLL.</li> </ul>

#### 4.5.21 **static bool CLOCK\_IsPllBypassed ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_bypass\_ctrl\_t *pllControl* ) [inline], [static]**

Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>pllControl</i>	PLL control name (see <code>ccm_analog_pll_control_t</code> enumeration)

Returns

PLL bypass status.

- true: The PLL is bypassed.
- false: The PLL is not bypassed.

#### 4.5.22 **static bool CLOCK\_IsPllLocked ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_ctrl\_t *pllControl* ) [inline], [static]**

Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>pllControl</i>	PLL control name (see <a href="#">clock_pll_ctrl_t</a> enumeration)

Returns

PLL lock status.

- true: The PLL clock is locked.
- false: The PLL clock is not locked.

#### 4.5.23 **static void CLOCK\_EnableAnalogClock ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_clke\_t *pllClock* ) [inline], [static]**

## Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>pllClock</i>	PLL clock name (see <code>ccm_analog_pll_clock_t</code> enumeration)

#### 4.5.24 static void CLOCK\_DisableAnalogClock ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_clke\_t *pllClock* ) [inline], [static]

## Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>pllClock</i>	PLL clock name (see <code>ccm_analog_pll_clock_t</code> enumeration)

#### 4.5.25 static void CLOCK\_OverrideAnalogClke ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_clke\_t *ovClock*, bool *override* ) [inline], [static]

## Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>ovClock</i>	PLL clock name (see <a href="#">clock_pll_clke_t</a> enumeration)
<i>override</i>	Override the PLL. <ul style="list-style-type: none"> <li>• true: Override the PLL clke, CCM will handle it.</li> <li>• false: Do not override the PLL clke.</li> </ul>

#### 4.5.26 static void CLOCK\_OverridePIIPd ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_ctrl\_t *pdClock*, bool *override* ) [inline], [static]

## Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>pdClock</i>	PLL clock name (see <a href="#">clock_pll_ctrl_t</a> enumeration)

<i>override</i>	Override the PLL. <ul style="list-style-type: none"> <li>• true: Override the PLL clke, CCM will handle it.</li> <li>• false: Do not override the PLL clke.</li> </ul>
-----------------	--

#### 4.5.27 void CLOCK\_InitArmPll ( const ccm\_analog\_frac\_pll\_config\_t \* *config* )

Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_frac_pll_config_t</a> enumeration).
---------------	---

Note

This function can't detect whether the Arm PLL has been enabled and used by some IPs.

#### 4.5.28 void CLOCK\_InitSysPll1 ( const ccm\_analog\_sscg\_pll\_config\_t \* *config* )

Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_sscg_pll_config_t</a> enumeration).
---------------	---

Note

This function can't detect whether the SYS PLL has been enabled and used by some IPs.

#### 4.5.29 void CLOCK\_InitSysPll2 ( const ccm\_analog\_sscg\_pll\_config\_t \* *config* )

Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_sscg_pll_config_t</a> enumeration).
---------------	---

Note

This function can't detect whether the SYS PLL has been enabled and used by some IPs.

#### 4.5.30 void CLOCK\_InitSysPll3 ( const ccm\_analog\_sscg\_pll\_config\_t \* *config* )

## Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_sscg_pll_config_t</a> enumeration).
---------------	---

## Note

This function can't detect whether the SYS PLL has been enabled and used by some IPs.

#### 4.5.31 void CLOCK\_InitDramPll ( const ccm\_analog\_sscg\_pll\_config\_t \* *config* )

## Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_sscg_pll_config_t</a> enumeration).
---------------	---

## Note

This function can't detect whether the DDR PLL has been enabled and used by some IPs.

#### 4.5.32 void CLOCK\_InitAudioPll1 ( const ccm\_analog\_frac\_pll\_config\_t \* *config* )

## Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_frac_pll_config_t</a> enumeration).
---------------	---

## Note

This function can't detect whether the AUDIO PLL has been enabled and used by some IPs.

#### 4.5.33 void CLOCK\_InitAudioPll2 ( const ccm\_analog\_frac\_pll\_config\_t \* *config* )



## Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_frac_pll_config_t</a> enumeration).
---------------	---

## Note

This function can't detect whether the AUDIO PLL has been enabled and used by some IPs.

#### 4.5.34 void CLOCK\_InitVideoPII1 ( const ccm\_analog\_frac\_pll\_config\_t \* *config* )

## Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_frac_pll_config_t</a> enumeration).
---------------	---

#### 4.5.35 void CLOCK\_InitVideoPII2 ( const ccm\_analog\_sscg\_pll\_config\_t \* *config* )

## Parameters

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_sscg_pll_config_t</a> enumeration).
---------------	---

## Note

This function can't detect whether the VIDEO PLL has been enabled and used by some IPs.

#### 4.5.36 void CLOCK\_InitSSCGPII ( CCM\_ANALOG\_Type \* *base*, const ccm\_analog\_sscg\_pll\_config\_t \* *config*, clock\_pll\_ctrl\_t *type* )

## Parameters

<i>base</i>	CCM ANALOG base address
-------------	-------------------------

<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_sscg_pll_config_t</a> enumeration).
<i>type</i>	sscg pll type

#### 4.5.37 uint32\_t CLOCK\_GetSSCGPIIFreq ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_ctrl\_t *type*, uint32\_t *refClkFreq*, bool *pll1Bypass* )

Parameters

<i>base</i>	CCM ANALOG base address.
<i>type</i>	sscg pll type
<i>refClkFreq</i>	reference clock frequency
<i>pll1Bypass</i>	pll1 bypass flag

Returns

Clock frequency

#### 4.5.38 void CLOCK\_InitFracPII ( CCM\_ANALOG\_Type \* *base*, const ccm\_analog\_frac\_pll\_config\_t \* *config*, clock\_pll\_ctrl\_t *type* )

Parameters

<i>base</i>	CCM ANALOG base address.
<i>config</i>	Pointer to the configuration structure(see <a href="#">ccm_analog_frac_pll_config_t</a> enumeration).
<i>type</i>	fractional pll type.

#### 4.5.39 uint32\_t CLOCK\_GetFracPIIFreq ( CCM\_ANALOG\_Type \* *base*, clock\_pll\_ctrl\_t *type*, uint32\_t *refClkFreq* )

## Parameters

<i>base</i>	CCM_ANALOG base pointer.
<i>type</i>	fractional pll type.
<i>refClkFreq</i>	reference clock frequency

## Returns

Clock frequency

#### 4.5.40 uint32\_t CLOCK\_GetPIIFreq ( clock\_pll\_ctrl\_t *pll* )

## Parameters

<i>pll</i>	fractional pll type.
------------	----------------------

## Returns

Clock frequency

#### 4.5.41 uint32\_t CLOCK\_GetPIIRefClkFreq ( clock\_pll\_ctrl\_t *ctrl* )

## Parameters

<i>ctrl</i>	fractional pll type.
-------------	----------------------

## Returns

Clock frequency

#### 4.5.42 uint32\_t CLOCK\_GetFreq ( clock\_name\_t *clockName* )

This function checks the current clock configurations and then calculates the clock frequency for a specific clock name defined in clock\_name\_t.

## Parameters

<i>clockName</i>	Clock names defined in <code>clock_name_t</code>
------------------	--

## Returns

Clock frequency value in hertz

#### 4.5.43 `uint32_t` **CLOCK\_GetClockRootFreq** ( `clock_root_t` *clockRoot* )

## Parameters

<i>clockRoot</i>	The clock root used to get the frequency, please refer to <a href="#">clock_root_t</a> .
------------------	--

## Returns

The frequency of selected clock root.

#### 4.5.44 `uint32_t` **CLOCK\_GetCoreM4Freq** ( `void` )

## Returns

Clock frequency; If the clock is invalid, returns 0.

#### 4.5.45 `uint32_t` **CLOCK\_GetAxiFreq** ( `void` )

## Returns

Clock frequency; If the clock is invalid, returns 0.

#### 4.5.46 `uint32_t` **CLOCK\_GetAhbFreq** ( `void` )

## Returns

Clock frequency; If the clock is invalid, returns 0.

## Chapter 5

# IOMUXC: IOMUX Controller

### 5.1 Overview

IOMUXC driver provides APIs for pin configuration. It also supports the miscellaneous functions integrated in IOMUXC.

#### Files

- file [fsl\\_iomuxc.h](#)

#### Driver version

- #define [FSL\\_IOMUXC\\_DRIVER\\_VERSION](#) ([MAKE\\_VERSION](#)(2, 0, 1))  
*IOMUXC driver version 2.0.1.*

#### Pin function ID

The pin function ID is a tuple of <muxRegister muxMode inputRegister inputDaisy configRegister>

- #define **IOMUXC\_PMIC\_STBY\_REQ** 0x30330014, 0x0, 0x00000000, 0x0, 0x3033027C
- #define **IOMUXC\_PMIC\_ON\_REQ** 0x30330018, 0x0, 0x00000000, 0x0, 0x30330280
- #define **IOMUXC\_ONOFF** 0x3033001C, 0x0, 0x00000000, 0x0, 0x30330284
- #define **IOMUXC\_POR\_B** 0x30330020, 0x0, 0x00000000, 0x0, 0x30330288
- #define **IOMUXC\_RTC\_RESET\_B** 0x30330024, 0x0, 0x00000000, 0x0, 0x3033028C
- #define **IOMUXC\_GPIO1\_IO00\_GPIO1\_IO00** 0x30330028, 0x0, 0x00000000, 0x0, 0x30330290
- #define **IOMUXC\_GPIO1\_IO00\_CCM\_ENET\_PHY\_REF\_CLK\_ROOT** 0x30330028, 0x1, 0x00000000, 0x0, 0x30330290
- #define **IOMUXC\_GPIO1\_IO00\_XTALOSC\_REF\_CLK\_32K** 0x30330028, 0x5, 0x00000000, 0x0, 0x30330290
- #define **IOMUXC\_GPIO1\_IO00\_CCM\_EXT\_CLK1** 0x30330028, 0x6, 0x00000000, 0x0, 0x30330290
- #define **IOMUXC\_GPIO1\_IO01\_GPIO1\_IO01** 0x3033002C, 0x0, 0x00000000, 0x0, 0x30330294
- #define **IOMUXC\_GPIO1\_IO01\_PWM1\_OUT** 0x3033002C, 0x1, 0x00000000, 0x0, 0x30330294
- #define **IOMUXC\_GPIO1\_IO01\_XTALOSC\_REF\_CLK\_24M** 0x3033002C, 0x5, 0x00000000, 0x0, 0x30330294
- #define **IOMUXC\_GPIO1\_IO01\_CCM\_EXT\_CLK2** 0x3033002C, 0x6, 0x00000000, 0x0, 0x30330294
- #define **IOMUXC\_GPIO1\_IO02\_GPIO1\_IO02** 0x30330030, 0x0, 0x00000000, 0x0, 0x30330298
- #define **IOMUXC\_GPIO1\_IO02\_WDOG1\_WDOG\_B** 0x30330030, 0x1, 0x00000000, 0x0, 0x30330298
- #define **IOMUXC\_GPIO1\_IO02\_WDOG1\_WDOG\_ANY** 0x30330030, 0x5, 0x00000000, 0x0, 0x30330298
- #define **IOMUXC\_GPIO1\_IO03\_GPIO1\_IO03** 0x30330034, 0x0, 0x00000000, 0x0, 0x3033029C
- #define **IOMUXC\_GPIO1\_IO03\_USDHC1\_VSELECT** 0x30330034, 0x1, 0x00000000, 0x0, 0x3033029C

- #define **IOMUXC\_GPIO1\_IO03\_SDMA1\_EXT\_EVENT0** 0x30330034, 0x5, 0x00000000, 0x0, 0x3033029C
- #define **IOMUXC\_GPIO1\_IO04\_GPIO1\_IO04** 0x30330038, 0x0, 0x00000000, 0x0, 0x303302-A0
- #define **IOMUXC\_GPIO1\_IO04\_USDHC2\_VSELECT** 0x30330038, 0x1, 0x00000000, 0x0, 0x303302A0
- #define **IOMUXC\_GPIO1\_IO04\_SDMA1\_EXT\_EVENT1** 0x30330038, 0x5, 0x00000000, 0x0, 0x303302A0
- #define **IOMUXC\_GPIO1\_IO05\_GPIO1\_IO05** 0x3033003C, 0x0, 0x00000000, 0x0, 0x303302-A4
- #define **IOMUXC\_GPIO1\_IO05\_M4\_NMI** 0x3033003C, 0x1, 0x00000000, 0x0, 0x303302A4
- #define **IOMUXC\_GPIO1\_IO05\_CCM\_PMIC\_READY** 0x3033003C, 0x5, 0x303304BC, 0x0, 0x303302A4
- #define **IOMUXC\_GPIO1\_IO06\_GPIO1\_IO06** 0x30330040, 0x0, 0x00000000, 0x0, 0x303302-A8
- #define **IOMUXC\_GPIO1\_IO06\_ENET1\_MDC** 0x30330040, 0x1, 0x00000000, 0x0, 0x303302-A8
- #define **IOMUXC\_GPIO1\_IO06\_USDHC1\_CD\_B** 0x30330040, 0x5, 0x00000000, 0x0, 0x303302A8
- #define **IOMUXC\_GPIO1\_IO06\_CCM\_EXT\_CLK3** 0x30330040, 0x6, 0x00000000, 0x0, 0x303302A8
- #define **IOMUXC\_GPIO1\_IO07\_GPIO1\_IO07** 0x30330044, 0x0, 0x00000000, 0x0, 0x303302-AC
- #define **IOMUXC\_GPIO1\_IO07\_ENET1\_MDIO** 0x30330044, 0x1, 0x303304C0, 0x0, 0x303302AC
- #define **IOMUXC\_GPIO1\_IO07\_USDHC1\_WP** 0x30330044, 0x5, 0x00000000, 0x0, 0x303302-AC
- #define **IOMUXC\_GPIO1\_IO07\_CCM\_EXT\_CLK4** 0x30330044, 0x6, 0x00000000, 0x0, 0x303302AC
- #define **IOMUXC\_GPIO1\_IO08\_GPIO1\_IO08** 0x30330048, 0x0, 0x00000000, 0x0, 0x303302-B0
- #define **IOMUXC\_GPIO1\_IO08\_ENET1\_1588\_EVENT0\_IN** 0x30330048, 0x1, 0x00000000, 0x0, 0x303302B0
- #define **IOMUXC\_GPIO1\_IO08\_USDHC2\_RESET\_B** 0x30330048, 0x5, 0x00000000, 0x0, 0x303302B0
- #define **IOMUXC\_GPIO1\_IO09\_GPIO1\_IO09** 0x3033004C, 0x0, 0x00000000, 0x0, 0x303302-B4
- #define **IOMUXC\_GPIO1\_IO09\_ENET1\_1588\_EVENT0\_OUT** 0x3033004C, 0x1, 0x00000000, 0x0, 0x303302B4
- #define **IOMUXC\_GPIO1\_IO09\_SDMA2\_EXT\_EVENT0** 0x3033004C, 0x5, 0x00000000, 0x0, 0x303302B4
- #define **IOMUXC\_GPIO1\_IO10\_GPIO1\_IO10** 0x30330050, 0x0, 0x00000000, 0x0, 0x303302-B8
- #define **IOMUXC\_GPIO1\_IO10\_USB1\_OTG\_ID** 0x30330050, 0x1, 0x00000000, 0x0, 0x303302B8
- #define **IOMUXC\_GPIO1\_IO11\_GPIO1\_IO11** 0x30330054, 0x0, 0x00000000, 0x0, 0x303302-BC
- #define **IOMUXC\_GPIO1\_IO11\_USB2\_OTG\_ID** 0x30330054, 0x1, 0x00000000, 0x0, 0x303302BC
- #define **IOMUXC\_GPIO1\_IO11\_CCM\_PMIC\_READY** 0x30330054, 0x5, 0x303304BC, 0x1,

- 0x303302BC
- #define **IOMUXC\_GPIO1\_IO12\_GPIO1\_IO12** 0x30330058, 0x0, 0x00000000, 0x0, 0x303302-C0
- #define **IOMUXC\_GPIO1\_IO12\_USB1\_OTG\_PWR** 0x30330058, 0x1, 0x00000000, 0x0, 0x303302C0
- #define **IOMUXC\_GPIO1\_IO12\_SDMA2\_EXT\_EVENT1** 0x30330058, 0x5, 0x00000000, 0x0, 0x303302C0
- #define **IOMUXC\_GPIO1\_IO13\_GPIO1\_IO13** 0x3033005C, 0x0, 0x00000000, 0x0, 0x303302-C4
- #define **IOMUXC\_GPIO1\_IO13\_USB1\_OTG\_OC** 0x3033005C, 0x1, 0x00000000, 0x0, 0x303302C4
- #define **IOMUXC\_GPIO1\_IO13\_PWM2\_OUT** 0x3033005C, 0x5, 0x00000000, 0x0, 0x303302-C4
- #define **IOMUXC\_GPIO1\_IO14\_GPIO1\_IO14** 0x30330060, 0x0, 0x00000000, 0x0, 0x303302-C8
- #define **IOMUXC\_GPIO1\_IO14\_USB2\_OTG\_PWR** 0x30330060, 0x1, 0x00000000, 0x0, 0x303302C8
- #define **IOMUXC\_GPIO1\_IO14\_PWM3\_OUT** 0x30330060, 0x5, 0x00000000, 0x0, 0x303302-C8
- #define **IOMUXC\_GPIO1\_IO14\_CCM\_CLKO1** 0x30330060, 0x6, 0x00000000, 0x0, 0x303302-C8
- #define **IOMUXC\_GPIO1\_IO15\_GPIO1\_IO15** 0x30330064, 0x0, 0x00000000, 0x0, 0x303302-CC
- #define **IOMUXC\_GPIO1\_IO15\_USB2\_OTG\_OC** 0x30330064, 0x1, 0x00000000, 0x0, 0x303302CC
- #define **IOMUXC\_GPIO1\_IO15\_PWM4\_OUT** 0x30330064, 0x5, 0x00000000, 0x0, 0x303302-CC
- #define **IOMUXC\_GPIO1\_IO15\_CCM\_CLKO2** 0x30330064, 0x6, 0x00000000, 0x0, 0x303302-CC
- #define **IOMUXC\_ENET\_MDC\_ENET1\_MDC** 0x30330068, 0x0, 0x00000000, 0x0, 0x303302-D0
- #define **IOMUXC\_ENET\_MDC\_GPIO1\_IO16** 0x30330068, 0x5, 0x00000000, 0x0, 0x303302-D0
- #define **IOMUXC\_ENET\_MDIO\_ENET1\_MDIO** 0x3033006C, 0x0, 0x303304C0, 0x1, 0x303302D4
- #define **IOMUXC\_ENET\_MDIO\_GPIO1\_IO17** 0x3033006C, 0x5, 0x00000000, 0x0, 0x303302-D4
- #define **IOMUXC\_ENET\_TD3\_ENET1\_RGMII\_TD3** 0x30330070, 0x0, 0x00000000, 0x0, 0x303302D8
- #define **IOMUXC\_ENET\_TD3\_GPIO1\_IO18** 0x30330070, 0x5, 0x00000000, 0x0, 0x303302D8
- #define **IOMUXC\_ENET\_TD2\_ENET1\_RGMII\_TD2** 0x30330074, 0x0, 0x00000000, 0x0, 0x303302DC
- #define **IOMUXC\_ENET\_TD2\_ENET1\_TX\_CLK** 0x30330074, 0x1, 0x00000000, 0x0, 0x303302DC
- #define **IOMUXC\_ENET\_TD2\_GPIO1\_IO19** 0x30330074, 0x5, 0x00000000, 0x0, 0x303302DC
- #define **IOMUXC\_ENET\_TD1\_ENET1\_RGMII\_TD1** 0x30330078, 0x0, 0x00000000, 0x0, 0x303302E0
- #define **IOMUXC\_ENET\_TD1\_GPIO1\_IO20** 0x30330078, 0x5, 0x00000000, 0x0, 0x303302E0
- #define **IOMUXC\_ENET\_TD0\_ENET1\_RGMII\_TD0** 0x3033007C, 0x0, 0x00000000, 0x0, 0x303302E4

- #define **IOMUXC\_ENET\_TD0\_GPIO1\_IO21** 0x3033007C, 0x5, 0x00000000, 0x0, 0x303302E4
- #define **IOMUXC\_ENET\_TX\_CTL\_ENET1\_RGMII\_TX\_CTL** 0x30330080, 0x0, 0x00000000, 0x0, 0x303302E8
- #define **IOMUXC\_ENET\_TX\_CTL\_GPIO1\_IO22** 0x30330080, 0x5, 0x00000000, 0x0, 0x303302E8
- #define **IOMUXC\_ENET\_TXC\_ENET1\_RGMII\_TXC** 0x30330084, 0x0, 0x00000000, 0x0, 0x303302EC
- #define **IOMUXC\_ENET\_TXC\_ENET1\_TX\_ER** 0x30330084, 0x1, 0x00000000, 0x0, 0x303302EC
- #define **IOMUXC\_ENET\_TXC\_GPIO1\_IO23** 0x30330084, 0x5, 0x00000000, 0x0, 0x303302E-C
- #define **IOMUXC\_ENET\_RX\_CTL\_ENET1\_RGMII\_RX\_CTL** 0x30330088, 0x0, 0x00000000, 0x0, 0x303302F0
- #define **IOMUXC\_ENET\_RX\_CTL\_GPIO1\_IO24** 0x30330088, 0x5, 0x00000000, 0x0, 0x303302F0
- #define **IOMUXC\_ENET\_RXC\_ENET1\_RGMII\_RXC** 0x3033008C, 0x0, 0x00000000, 0x0, 0x303302F4
- #define **IOMUXC\_ENET\_RXC\_ENET1\_RX\_ER** 0x3033008C, 0x1, 0x00000000, 0x0, 0x303302F4
- #define **IOMUXC\_ENET\_RXC\_GPIO1\_IO25** 0x3033008C, 0x5, 0x00000000, 0x0, 0x303302-F4
- #define **IOMUXC\_ENET\_RD0\_ENET1\_RGMII\_RD0** 0x30330090, 0x0, 0x00000000, 0x0, 0x303302F8
- #define **IOMUXC\_ENET\_RD0\_GPIO1\_IO26** 0x30330090, 0x5, 0x00000000, 0x0, 0x303302F8
- #define **IOMUXC\_ENET\_RD1\_ENET1\_RGMII\_RD1** 0x30330094, 0x0, 0x00000000, 0x0, 0x303302FC
- #define **IOMUXC\_ENET\_RD1\_GPIO1\_IO27** 0x30330094, 0x5, 0x00000000, 0x0, 0x303302FC
- #define **IOMUXC\_ENET\_RD2\_ENET1\_RGMII\_RD2** 0x30330098, 0x0, 0x00000000, 0x0, 0x30330300
- #define **IOMUXC\_ENET\_RD2\_GPIO1\_IO28** 0x30330098, 0x5, 0x00000000, 0x0, 0x30330300
- #define **IOMUXC\_ENET\_RD3\_ENET1\_RGMII\_RD3** 0x3033009C, 0x0, 0x00000000, 0x0, 0x30330304
- #define **IOMUXC\_ENET\_RD3\_GPIO1\_IO29** 0x3033009C, 0x5, 0x00000000, 0x0, 0x30330304
- #define **IOMUXC\_SD1\_CLK\_USDHC1\_CLK** 0x303300A0, 0x0, 0x00000000, 0x0, 0x30330308
- #define **IOMUXC\_SD1\_CLK\_GPIO2\_IO00** 0x303300A0, 0x5, 0x00000000, 0x0, 0x30330308
- #define **IOMUXC\_SD1\_CMD\_USDHC1\_CMD** 0x303300A4, 0x0, 0x00000000, 0x0, 0x3033030-C
- #define **IOMUXC\_SD1\_CMD\_GPIO2\_IO01** 0x303300A4, 0x5, 0x00000000, 0x0, 0x3033030C
- #define **IOMUXC\_SD1\_DATA0\_USDHC1\_DATA0** 0x303300A8, 0x0, 0x00000000, 0x0, 0x30330310
- #define **IOMUXC\_SD1\_DATA0\_GPIO2\_IO02** 0x303300A8, 0x5, 0x00000000, 0x0, 0x30330310
- #define **IOMUXC\_SD1\_DATA1\_USDHC1\_DATA1** 0x303300AC, 0x0, 0x00000000, 0x0, 0x30330314
- #define **IOMUXC\_SD1\_DATA1\_GPIO2\_IO03** 0x303300AC, 0x5, 0x00000000, 0x0, 0x30330314
- #define **IOMUXC\_SD1\_DATA2\_USDHC1\_DATA2** 0x303300B0, 0x0, 0x00000000, 0x0, 0x30330318
- #define **IOMUXC\_SD1\_DATA2\_GPIO2\_IO04** 0x303300B0, 0x5, 0x00000000, 0x0, 0x30330318
- #define **IOMUXC\_SD1\_DATA3\_USDHC1\_DATA3** 0x303300B4, 0x0, 0x00000000, 0x0, 0x3033031C
- #define **IOMUXC\_SD1\_DATA3\_GPIO2\_IO05** 0x303300B4, 0x5, 0x00000000, 0x0, 0x3033031-C



- #define **IOMUXC\_SD1\_DATA4\_USDHC1\_DATA4** 0x303300B8, 0x0, 0x00000000, 0x0, 0x30330320
- #define **IOMUXC\_SD1\_DATA4\_GPIO2\_IO06** 0x303300B8, 0x5, 0x00000000, 0x0, 0x30330320
- #define **IOMUXC\_SD1\_DATA5\_USDHC1\_DATA5** 0x303300BC, 0x0, 0x00000000, 0x0, 0x30330324
- #define **IOMUXC\_SD1\_DATA5\_GPIO2\_IO07** 0x303300BC, 0x5, 0x00000000, 0x0, 0x30330324
- #define **IOMUXC\_SD1\_DATA6\_USDHC1\_DATA6** 0x303300C0, 0x0, 0x00000000, 0x0, 0x30330328
- #define **IOMUXC\_SD1\_DATA6\_GPIO2\_IO08** 0x303300C0, 0x5, 0x00000000, 0x0, 0x30330328
- #define **IOMUXC\_SD1\_DATA7\_USDHC1\_DATA7** 0x303300C4, 0x0, 0x00000000, 0x0, 0x3033032C
- #define **IOMUXC\_SD1\_DATA7\_GPIO2\_IO09** 0x303300C4, 0x5, 0x00000000, 0x0, 0x3033032C
- #define **IOMUXC\_SD1\_RESET\_B\_USDHC1\_RESET\_B** 0x303300C8, 0x0, 0x00000000, 0x0, 0x30330330
- #define **IOMUXC\_SD1\_RESET\_B\_GPIO2\_IO10** 0x303300C8, 0x5, 0x00000000, 0x0, 0x30330330
- #define **IOMUXC\_SD1\_STROBE\_USDHC1\_STROBE** 0x303300CC, 0x0, 0x00000000, 0x0, 0x30330334
- #define **IOMUXC\_SD1\_STROBE\_GPIO2\_IO11** 0x303300CC, 0x5, 0x00000000, 0x0, 0x30330334
- #define **IOMUXC\_SD2\_CD\_B\_USDHC2\_CD\_B** 0x303300D0, 0x0, 0x00000000, 0x0, 0x30330338
- #define **IOMUXC\_SD2\_CD\_B\_GPIO2\_IO12** 0x303300D0, 0x5, 0x00000000, 0x0, 0x30330338
- #define **IOMUXC\_SD2\_CLK\_USDHC2\_CLK** 0x303300D4, 0x0, 0x00000000, 0x0, 0x3033033C
- #define **IOMUXC\_SD2\_CLK\_GPIO2\_IO13** 0x303300D4, 0x5, 0x00000000, 0x0, 0x3033033C
- #define **IOMUXC\_SD2\_CMD\_USDHC2\_CMD** 0x303300D8, 0x0, 0x00000000, 0x0, 0x30330340
- #define **IOMUXC\_SD2\_CMD\_GPIO2\_IO14** 0x303300D8, 0x5, 0x00000000, 0x0, 0x30330340
- #define **IOMUXC\_SD2\_DATA0\_USDHC2\_DATA0** 0x303300DC, 0x0, 0x00000000, 0x0, 0x30330344
- #define **IOMUXC\_SD2\_DATA0\_GPIO2\_IO15** 0x303300DC, 0x5, 0x00000000, 0x0, 0x30330344
- #define **IOMUXC\_SD2\_DATA1\_USDHC2\_DATA1** 0x303300E0, 0x0, 0x00000000, 0x0, 0x30330348
- #define **IOMUXC\_SD2\_DATA1\_GPIO2\_IO16** 0x303300E0, 0x5, 0x00000000, 0x0, 0x30330348
- #define **IOMUXC\_SD2\_DATA2\_USDHC2\_DATA2** 0x303300E4, 0x0, 0x00000000, 0x0, 0x3033034C
- #define **IOMUXC\_SD2\_DATA2\_GPIO2\_IO17** 0x303300E4, 0x5, 0x00000000, 0x0, 0x3033034C
- #define **IOMUXC\_SD2\_DATA3\_USDHC2\_DATA3** 0x303300E8, 0x0, 0x00000000, 0x0, 0x30330350
- #define **IOMUXC\_SD2\_DATA3\_GPIO2\_IO18** 0x303300E8, 0x5, 0x00000000, 0x0, 0x30330350
- #define **IOMUXC\_SD2\_RESET\_B\_USDHC2\_RESET\_B** 0x303300EC, 0x0, 0x00000000, 0x0, 0x30330354
- #define **IOMUXC\_SD2\_RESET\_B\_GPIO2\_IO19** 0x303300EC, 0x5, 0x00000000, 0x0, 0x30330354
- #define **IOMUXC\_SD2\_WP\_USDHC2\_WP** 0x303300F0, 0x0, 0x00000000, 0x0, 0x30330358
- #define **IOMUXC\_SD2\_WP\_GPIO2\_IO20** 0x303300F0, 0x5, 0x00000000, 0x0, 0x30330358
- #define **IOMUXC\_NAND\_ALE\_RAWNAND\_ALE** 0x303300F4, 0x0, 0x00000000, 0x0, 0x3033035C
- #define **IOMUXC\_NAND\_ALE\_QSPI\_A\_SCLK** 0x303300F4, 0x1, 0x00000000, 0x0,

- 0x3033035C
- #define **IOMUXC\_NAND\_ALE\_GPIO3\_IO00** 0x303300F4, 0x5, 0x00000000, 0x0, 0x3033035C
- #define **IOMUXC\_NAND\_CE0\_B\_RAWNAND\_CE0\_B** 0x303300F8, 0x0, 0x00000000, 0x0, 0x30330360
- #define **IOMUXC\_NAND\_CE0\_B\_QSPI\_A\_SS0\_B** 0x303300F8, 0x1, 0x00000000, 0x0, 0x30330360
- #define **IOMUXC\_NAND\_CE0\_B\_GPIO3\_IO01** 0x303300F8, 0x5, 0x00000000, 0x0, 0x30330360
- #define **IOMUXC\_NAND\_CE1\_B\_RAWNAND\_CE1\_B** 0x303300FC, 0x0, 0x00000000, 0x0, 0x30330364
- #define **IOMUXC\_NAND\_CE1\_B\_QSPI\_A\_SS1\_B** 0x303300FC, 0x1, 0x00000000, 0x0, 0x30330364
- #define **IOMUXC\_NAND\_CE1\_B\_GPIO3\_IO02** 0x303300FC, 0x5, 0x00000000, 0x0, 0x30330364
- #define **IOMUXC\_NAND\_CE2\_B\_RAWNAND\_CE2\_B** 0x30330100, 0x0, 0x00000000, 0x0, 0x30330368
- #define **IOMUXC\_NAND\_CE2\_B\_QSPI\_B\_SS0\_B** 0x30330100, 0x1, 0x00000000, 0x0, 0x30330368
- #define **IOMUXC\_NAND\_CE2\_B\_GPIO3\_IO03** 0x30330100, 0x5, 0x00000000, 0x0, 0x30330368
- #define **IOMUXC\_NAND\_CE3\_B\_RAWNAND\_CE3\_B** 0x30330104, 0x0, 0x00000000, 0x0, 0x3033036C
- #define **IOMUXC\_NAND\_CE3\_B\_QSPI\_B\_SS1\_B** 0x30330104, 0x1, 0x00000000, 0x0, 0x3033036C
- #define **IOMUXC\_NAND\_CE3\_B\_GPIO3\_IO04** 0x30330104, 0x5, 0x00000000, 0x0, 0x3033036C
- #define **IOMUXC\_NAND\_CLE\_RAWNAND\_CLE** 0x30330108, 0x0, 0x00000000, 0x0, 0x30330370
- #define **IOMUXC\_NAND\_CLE\_QSPI\_B\_SCLK** 0x30330108, 0x1, 0x00000000, 0x0, 0x30330370
- #define **IOMUXC\_NAND\_CLE\_GPIO3\_IO05** 0x30330108, 0x5, 0x00000000, 0x0, 0x30330370
- #define **IOMUXC\_NAND\_DATA00\_RAWNAND\_DATA00** 0x3033010C, 0x0, 0x00000000, 0x0, 0x30330374
- #define **IOMUXC\_NAND\_DATA00\_QSPI\_A\_DATA0** 0x3033010C, 0x1, 0x00000000, 0x0, 0x30330374
- #define **IOMUXC\_NAND\_DATA00\_GPIO3\_IO06** 0x3033010C, 0x5, 0x00000000, 0x0, 0x30330374
- #define **IOMUXC\_NAND\_DATA01\_RAWNAND\_DATA01** 0x30330110, 0x0, 0x00000000, 0x0, 0x30330378
- #define **IOMUXC\_NAND\_DATA01\_QSPI\_A\_DATA1** 0x30330110, 0x1, 0x00000000, 0x0, 0x30330378
- #define **IOMUXC\_NAND\_DATA01\_GPIO3\_IO07** 0x30330110, 0x5, 0x00000000, 0x0, 0x30330378
- #define **IOMUXC\_NAND\_DATA02\_RAWNAND\_DATA02** 0x30330114, 0x0, 0x00000000, 0x0, 0x3033037C
- #define **IOMUXC\_NAND\_DATA02\_QSPI\_A\_DATA2** 0x30330114, 0x1, 0x00000000, 0x0, 0x3033037C
- #define **IOMUXC\_NAND\_DATA02\_GPIO3\_IO08** 0x30330114, 0x5, 0x00000000, 0x0, 0x3033037C

- #define **IOMUXC\_NAND\_DATA03\_RAWNAND\_DATA03** 0x30330118, 0x0, 0x00000000, 0x0, 0x30330380
- #define **IOMUXC\_NAND\_DATA03\_QSPI\_A\_DATA3** 0x30330118, 0x1, 0x00000000, 0x0, 0x30330380
- #define **IOMUXC\_NAND\_DATA03\_GPIO3\_IO09** 0x30330118, 0x5, 0x00000000, 0x0, 0x30330380
- #define **IOMUXC\_NAND\_DATA04\_RAWNAND\_DATA04** 0x3033011C, 0x0, 0x00000000, 0x0, 0x30330384
- #define **IOMUXC\_NAND\_DATA04\_QSPI\_B\_DATA0** 0x3033011C, 0x1, 0x00000000, 0x0, 0x30330384
- #define **IOMUXC\_NAND\_DATA04\_GPIO3\_IO10** 0x3033011C, 0x5, 0x00000000, 0x0, 0x30330384
- #define **IOMUXC\_NAND\_DATA05\_RAWNAND\_DATA05** 0x30330120, 0x0, 0x00000000, 0x0, 0x30330388
- #define **IOMUXC\_NAND\_DATA05\_QSPI\_B\_DATA1** 0x30330120, 0x1, 0x00000000, 0x0, 0x30330388
- #define **IOMUXC\_NAND\_DATA05\_GPIO3\_IO11** 0x30330120, 0x5, 0x00000000, 0x0, 0x30330388
- #define **IOMUXC\_NAND\_DATA06\_RAWNAND\_DATA06** 0x30330124, 0x0, 0x00000000, 0x0, 0x3033038C
- #define **IOMUXC\_NAND\_DATA06\_QSPI\_B\_DATA2** 0x30330124, 0x1, 0x00000000, 0x0, 0x3033038C
- #define **IOMUXC\_NAND\_DATA06\_GPIO3\_IO12** 0x30330124, 0x5, 0x00000000, 0x0, 0x3033038C
- #define **IOMUXC\_NAND\_DATA07\_RAWNAND\_DATA07** 0x30330128, 0x0, 0x00000000, 0x0, 0x30330390
- #define **IOMUXC\_NAND\_DATA07\_QSPI\_B\_DATA3** 0x30330128, 0x1, 0x00000000, 0x0, 0x30330390
- #define **IOMUXC\_NAND\_DATA07\_GPIO3\_IO13** 0x30330128, 0x5, 0x00000000, 0x0, 0x30330390
- #define **IOMUXC\_NAND\_DQS\_RAWNAND\_DQS** 0x3033012C, 0x0, 0x00000000, 0x0, 0x30330394
- #define **IOMUXC\_NAND\_DQS\_QSPI\_A\_DQS** 0x3033012C, 0x1, 0x00000000, 0x0, 0x30330394
- #define **IOMUXC\_NAND\_DQS\_GPIO3\_IO14** 0x3033012C, 0x5, 0x00000000, 0x0, 0x30330394
- #define **IOMUXC\_NAND\_RE\_B\_RAWNAND\_RE\_B** 0x30330130, 0x0, 0x00000000, 0x0, 0x30330398
- #define **IOMUXC\_NAND\_RE\_B\_QSPI\_B\_DQS** 0x30330130, 0x1, 0x00000000, 0x0, 0x30330398
- #define **IOMUXC\_NAND\_RE\_B\_GPIO3\_IO15** 0x30330130, 0x5, 0x00000000, 0x0, 0x30330398
- #define **IOMUXC\_NAND\_READY\_B\_RAWNAND\_READY\_B** 0x30330134, 0x0, 0x00000000, 0x0, 0x3033039C
- #define **IOMUXC\_NAND\_READY\_B\_GPIO3\_IO16** 0x30330134, 0x5, 0x00000000, 0x0, 0x3033039C
- #define **IOMUXC\_NAND\_WE\_B\_RAWNAND\_WE\_B** 0x30330138, 0x0, 0x00000000, 0x0, 0x303303A0
- #define **IOMUXC\_NAND\_WE\_B\_GPIO3\_IO17** 0x30330138, 0x5, 0x00000000, 0x0, 0x303303A0
- #define **IOMUXC\_NAND\_WP\_B\_RAWNAND\_WP\_B** 0x3033013C, 0x0, 0x00000000, 0x0, 0x303303A4
- #define **IOMUXC\_NAND\_WP\_B\_GPIO3\_IO18** 0x3033013C, 0x5, 0x00000000, 0x0, 0x303303A4

- #define **IOMUXC\_SAI5\_RXFS\_SAI5\_RX\_SYNC** 0x30330140, 0x0, 0x303304E4, 0x0, 0x303303A8
- #define **IOMUXC\_SAI5\_RXFS\_SAI1\_TX\_DATA0** 0x30330140, 0x1, 0x00000000, 0x0, 0x303303A8
- #define **IOMUXC\_SAI5\_RXFS\_GPIO3\_IO19** 0x30330140, 0x5, 0x00000000, 0x0, 0x303303A8
- #define **IOMUXC\_SAI5\_RXC\_SAI5\_RX\_BCLK** 0x30330144, 0x0, 0x303304D0, 0x0, 0x303303AC
- #define **IOMUXC\_SAI5\_RXC\_SAI1\_TX\_DATA1** 0x30330144, 0x1, 0x00000000, 0x0, 0x303303AC
- #define **IOMUXC\_SAI5\_RXC\_GPIO3\_IO20** 0x30330144, 0x5, 0x00000000, 0x0, 0x303303AC
- #define **IOMUXC\_SAI5\_RXD0\_SAI5\_RX\_DATA0** 0x30330148, 0x0, 0x303304D4, 0x0, 0x303303B0
- #define **IOMUXC\_SAI5\_RXD0\_SAI1\_TX\_DATA2** 0x30330148, 0x1, 0x00000000, 0x0, 0x303303B0
- #define **IOMUXC\_SAI5\_RXD0\_GPIO3\_IO21** 0x30330148, 0x5, 0x00000000, 0x0, 0x303303B0
- #define **IOMUXC\_SAI5\_RXD1\_SAI5\_RX\_DATA1** 0x3033014C, 0x0, 0x303304D8, 0x0, 0x303303B4
- #define **IOMUXC\_SAI5\_RXD1\_SAI1\_TX\_DATA3** 0x3033014C, 0x1, 0x00000000, 0x0, 0x303303B4
- #define **IOMUXC\_SAI5\_RXD1\_SAI1\_TX\_SYNC** 0x3033014C, 0x2, 0x303304CC, 0x0, 0x303303B4
- #define **IOMUXC\_SAI5\_RXD1\_SAI5\_TX\_SYNC** 0x3033014C, 0x3, 0x303304EC, 0x0, 0x303303B4
- #define **IOMUXC\_SAI5\_RXD1\_GPIO3\_IO22** 0x3033014C, 0x5, 0x00000000, 0x0, 0x303303B4
- #define **IOMUXC\_SAI5\_RXD2\_SAI5\_RX\_DATA2** 0x30330150, 0x0, 0x303304DC, 0x0, 0x303303B8
- #define **IOMUXC\_SAI5\_RXD2\_SAI1\_TX\_DATA4** 0x30330150, 0x1, 0x00000000, 0x0, 0x303303B8
- #define **IOMUXC\_SAI5\_RXD2\_SAI1\_TX\_SYNC** 0x30330150, 0x2, 0x303304CC, 0x1, 0x303303B8
- #define **IOMUXC\_SAI5\_RXD2\_SAI5\_TX\_BCLK** 0x30330150, 0x3, 0x303304E8, 0x0, 0x303303B8
- #define **IOMUXC\_SAI5\_RXD2\_GPIO3\_IO23** 0x30330150, 0x5, 0x00000000, 0x0, 0x303303B8
- #define **IOMUXC\_SAI5\_RXD3\_SAI5\_RX\_DATA3** 0x30330154, 0x0, 0x303304E0, 0x0, 0x303303BC
- #define **IOMUXC\_SAI5\_RXD3\_SAI1\_TX\_DATA5** 0x30330154, 0x1, 0x00000000, 0x0, 0x303303BC
- #define **IOMUXC\_SAI5\_RXD3\_SAI1\_TX\_SYNC** 0x30330154, 0x2, 0x303304CC, 0x2, 0x303303BC
- #define **IOMUXC\_SAI5\_RXD3\_SAI5\_TX\_DATA0** 0x30330154, 0x3, 0x00000000, 0x0, 0x303303BC
- #define **IOMUXC\_SAI5\_RXD3\_GPIO3\_IO24** 0x30330154, 0x5, 0x00000000, 0x0, 0x303303BC
- #define **IOMUXC\_SAI5\_MCLK\_SAI5\_MCLK** 0x30330158, 0x0, 0x3033052C, 0x0, 0x303303C0
- #define **IOMUXC\_SAI5\_MCLK\_SAI1\_TX\_BCLK** 0x30330158, 0x1, 0x303304C8, 0x0, 0x303303C0
- #define **IOMUXC\_SAI5\_MCLK\_SAI4\_MCLK** 0x30330158, 0x2, 0x00000000, 0x0, 0x303303C0

- **#define IOMUXC\_SAI5\_MCLK\_GPIO3\_IO25** 0x30330158, 0x5, 0x00000000, 0x0, 0x303303C0
- **#define IOMUXC\_SAI1\_RXFS\_SAI1\_RX\_SYNC** 0x3033015C, 0x0, 0x303304C4, 0x0, 0x303303C4
- **#define IOMUXC\_SAI1\_RXFS\_SAI5\_RX\_SYNC** 0x3033015C, 0x1, 0x303304E4, 0x1, 0x303303C4
- **#define IOMUXC\_SAI1\_RXFS\_CORESIGHT\_TRACE\_CLK** 0x3033015C, 0x4, 0x00000000, 0x0, 0x303303C4
- **#define IOMUXC\_SAI1\_RXFS\_GPIO4\_IO00** 0x3033015C, 0x5, 0x00000000, 0x0, 0x303303C4
- **#define IOMUXC\_SAI1\_RXC\_SAI1\_RX\_BCLK** 0x30330160, 0x0, 0x00000000, 0x0, 0x303303C8
- **#define IOMUXC\_SAI1\_RXC\_SAI5\_RX\_BCLK** 0x30330160, 0x1, 0x303304D0, 0x1, 0x303303C8
- **#define IOMUXC\_SAI1\_RXC\_CORESIGHT\_TRACE\_CTL** 0x30330160, 0x4, 0x00000000, 0x0, 0x303303C8
- **#define IOMUXC\_SAI1\_RXC\_GPIO4\_IO01** 0x30330160, 0x5, 0x00000000, 0x0, 0x303303C8
- **#define IOMUXC\_SAI1\_RXD0\_SAI1\_RX\_DATA0** 0x30330164, 0x0, 0x00000000, 0x0, 0x303303CC
- **#define IOMUXC\_SAI1\_RXD0\_SAI5\_RX\_DATA0** 0x30330164, 0x1, 0x303304D4, 0x1, 0x303303CC
- **#define IOMUXC\_SAI1\_RXD0\_CORESIGHT\_TRACE0** 0x30330164, 0x4, 0x00000000, 0x0, 0x303303CC
- **#define IOMUXC\_SAI1\_RXD0\_GPIO4\_IO02** 0x30330164, 0x5, 0x00000000, 0x0, 0x303303C
- **#define IOMUXC\_SAI1\_RXD0\_SRC\_BOOT\_CFG0** 0x30330164, 0x6, 0x00000000, 0x0, 0x303303CC
- **#define IOMUXC\_SAI1\_RXD1\_SAI1\_RX\_DATA1** 0x30330168, 0x0, 0x00000000, 0x0, 0x303303D0
- **#define IOMUXC\_SAI1\_RXD1\_SAI5\_RX\_DATA1** 0x30330168, 0x1, 0x303304D8, 0x1, 0x303303D0
- **#define IOMUXC\_SAI1\_RXD1\_CORESIGHT\_TRACE1** 0x30330168, 0x4, 0x00000000, 0x0, 0x303303D0
- **#define IOMUXC\_SAI1\_RXD1\_GPIO4\_IO03** 0x30330168, 0x5, 0x00000000, 0x0, 0x303303D0
- **#define IOMUXC\_SAI1\_RXD1\_SRC\_BOOT\_CFG1** 0x30330168, 0x6, 0x00000000, 0x0, 0x303303D0
- **#define IOMUXC\_SAI1\_RXD2\_SAI1\_RX\_DATA2** 0x3033016C, 0x0, 0x00000000, 0x0, 0x303303D4
- **#define IOMUXC\_SAI1\_RXD2\_SAI5\_RX\_DATA2** 0x3033016C, 0x1, 0x303304DC, 0x1, 0x303303D4
- **#define IOMUXC\_SAI1\_RXD2\_CORESIGHT\_TRACE2** 0x3033016C, 0x4, 0x00000000, 0x0, 0x303303D4
- **#define IOMUXC\_SAI1\_RXD2\_GPIO4\_IO04** 0x3033016C, 0x5, 0x00000000, 0x0, 0x303303D4
- **#define IOMUXC\_SAI1\_RXD2\_SRC\_BOOT\_CFG2** 0x3033016C, 0x6, 0x00000000, 0x0, 0x303303D4
- **#define IOMUXC\_SAI1\_RXD3\_SAI1\_RX\_DATA3** 0x30330170, 0x0, 0x00000000, 0x0, 0x303303D8
- **#define IOMUXC\_SAI1\_RXD3\_SAI5\_RX\_DATA3** 0x30330170, 0x1, 0x303304E0, 0x1, 0x303303D8

- #define **IOMUXC\_SAI1\_RXD3\_CORESIGHT\_TRACE3** 0x30330170, 0x4, 0x00000000, 0x0, 0x303303D8
- #define **IOMUXC\_SAI1\_RXD3\_GPIO4\_IO05** 0x30330170, 0x5, 0x00000000, 0x0, 0x303303D8
- #define **IOMUXC\_SAI1\_RXD3\_SRC\_BOOT\_CFG3** 0x30330170, 0x6, 0x00000000, 0x0, 0x303303D8
- #define **IOMUXC\_SAI1\_RXD4\_SAI1\_RX\_DATA4** 0x30330174, 0x0, 0x00000000, 0x0, 0x303303DC
- #define **IOMUXC\_SAI1\_RXD4\_SAI6\_TX\_BCLK** 0x30330174, 0x1, 0x3033051C, 0x0, 0x303303DC
- #define **IOMUXC\_SAI1\_RXD4\_SAI6\_RX\_BCLK** 0x30330174, 0x2, 0x30330510, 0x0, 0x303303DC
- #define **IOMUXC\_SAI1\_RXD4\_CORESIGHT\_TRACE4** 0x30330174, 0x4, 0x00000000, 0x0, 0x303303DC
- #define **IOMUXC\_SAI1\_RXD4\_GPIO4\_IO06** 0x30330174, 0x5, 0x00000000, 0x0, 0x303303DC
- #define **IOMUXC\_SAI1\_RXD4\_SRC\_BOOT\_CFG4** 0x30330174, 0x6, 0x00000000, 0x0, 0x303303DC
- #define **IOMUXC\_SAI1\_RXD5\_SAI1\_RX\_DATA5** 0x30330178, 0x0, 0x00000000, 0x0, 0x303303E0
- #define **IOMUXC\_SAI1\_RXD5\_SAI6\_TX\_DATA0** 0x30330178, 0x1, 0x00000000, 0x0, 0x303303E0
- #define **IOMUXC\_SAI1\_RXD5\_SAI6\_RX\_DATA0** 0x30330178, 0x2, 0x30330514, 0x0, 0x303303E0
- #define **IOMUXC\_SAI1\_RXD5\_SAI1\_RX\_SYNC** 0x30330178, 0x3, 0x303304C4, 0x1, 0x303303E0
- #define **IOMUXC\_SAI1\_RXD5\_CORESIGHT\_TRACE5** 0x30330178, 0x4, 0x00000000, 0x0, 0x303303E0
- #define **IOMUXC\_SAI1\_RXD5\_GPIO4\_IO07** 0x30330178, 0x5, 0x00000000, 0x0, 0x303303E0
- #define **IOMUXC\_SAI1\_RXD5\_SRC\_BOOT\_CFG5** 0x30330178, 0x6, 0x00000000, 0x0, 0x303303E0
- #define **IOMUXC\_SAI1\_RXD6\_SAI1\_RX\_DATA6** 0x3033017C, 0x0, 0x00000000, 0x0, 0x303303E4
- #define **IOMUXC\_SAI1\_RXD6\_SAI6\_TX\_SYNC** 0x3033017C, 0x1, 0x30330520, 0x0, 0x303303E4
- #define **IOMUXC\_SAI1\_RXD6\_SAI6\_RX\_SYNC** 0x3033017C, 0x2, 0x30330518, 0x0, 0x303303E4
- #define **IOMUXC\_SAI1\_RXD6\_CORESIGHT\_TRACE6** 0x3033017C, 0x4, 0x00000000, 0x0, 0x303303E4
- #define **IOMUXC\_SAI1\_RXD6\_GPIO4\_IO08** 0x3033017C, 0x5, 0x00000000, 0x0, 0x303303E4
- #define **IOMUXC\_SAI1\_RXD6\_SRC\_BOOT\_CFG6** 0x3033017C, 0x6, 0x00000000, 0x0, 0x303303E4
- #define **IOMUXC\_SAI1\_RXD7\_SAI1\_RX\_DATA7** 0x30330180, 0x0, 0x00000000, 0x0, 0x303303E8
- #define **IOMUXC\_SAI1\_RXD7\_SAI6\_MCLK** 0x30330180, 0x1, 0x30330530, 0x0, 0x303303E8
- #define **IOMUXC\_SAI1\_RXD7\_SAI1\_TX\_SYNC** 0x30330180, 0x2, 0x303304CC, 0x4, 0x303303E8
- #define **IOMUXC\_SAI1\_RXD7\_SAI1\_TX\_DATA4** 0x30330180, 0x3, 0x00000000, 0x0, 0x303303E8
- #define **IOMUXC\_SAI1\_RXD7\_CORESIGHT\_TRACE7** 0x30330180, 0x4, 0x00000000, 0x0, 0x303303E8

```

0x303303E8
• #define IOMUXC_SAI1_RXD7_GPIO4_IO09 0x30330180, 0x5, 0x00000000, 0x0, 0x303303E8
• #define IOMUXC_SAI1_RXD7_SRC_BOOT_CFG7 0x30330180, 0x6, 0x00000000, 0x0,
0x303303E8
• #define IOMUXC_SAI1_TXFS_SAI1_TX_SYNC 0x30330184, 0x0, 0x303304CC, 0x3,
0x303303EC
• #define IOMUXC_SAI1_TXFS_SAI5_TX_SYNC 0x30330184, 0x1, 0x303304EC, 0x1,
0x303303EC
• #define IOMUXC_SAI1_TXFS_CORESIGHT_EVENT0 0x30330184, 0x4, 0x00000000, 0x0,
0x303303EC
• #define IOMUXC_SAI1_TXFS_GPIO4_IO10 0x30330184, 0x5, 0x00000000, 0x0, 0x303303EC
• #define IOMUXC_SAI1_TXC_SAI1_TX_BCLK 0x30330188, 0x0, 0x303304C8, 0x1,
0x303303F0
• #define IOMUXC_SAI1_TXC_SAI5_TX_BCLK 0x30330188, 0x1, 0x303304E8, 0x1,
0x303303F0
• #define IOMUXC_SAI1_TXC_CORESIGHT_EVENT1 0x30330188, 0x4, 0x00000000, 0x0,
0x303303F0
• #define IOMUXC_SAI1_TXC_GPIO4_IO11 0x30330188, 0x5, 0x00000000, 0x0, 0x303303F0
• #define IOMUXC_SAI1_TXD0_SAI1_TX_DATA0 0x3033018C, 0x0, 0x00000000, 0x0,
0x303303F4
• #define IOMUXC_SAI1_TXD0_SAI5_TX_DATA0 0x3033018C, 0x1, 0x00000000, 0x0,
0x303303F4
• #define IOMUXC_SAI1_TXD0_CORESIGHT_TRACE8 0x3033018C, 0x4, 0x00000000, 0x0,
0x303303F4
• #define IOMUXC_SAI1_TXD0_GPIO4_IO12 0x3033018C, 0x5, 0x00000000, 0x0, 0x303303F4
• #define IOMUXC_SAI1_TXD0_SRC_BOOT_CFG8 0x3033018C, 0x6, 0x00000000, 0x0,
0x303303F4
• #define IOMUXC_SAI1_TXD1_SAI1_TX_DATA1 0x30330190, 0x0, 0x00000000, 0x0,
0x303303F8
• #define IOMUXC_SAI1_TXD1_SAI5_TX_DATA1 0x30330190, 0x1, 0x00000000, 0x0,
0x303303F8
• #define IOMUXC_SAI1_TXD1_CORESIGHT_TRACE9 0x30330190, 0x4, 0x00000000, 0x0,
0x303303F8
• #define IOMUXC_SAI1_TXD1_GPIO4_IO13 0x30330190, 0x5, 0x00000000, 0x0, 0x303303F8
• #define IOMUXC_SAI1_TXD1_SRC_BOOT_CFG9 0x30330190, 0x6, 0x00000000, 0x0,
0x303303F8
• #define IOMUXC_SAI1_TXD2_SAI1_TX_DATA2 0x30330194, 0x0, 0x00000000, 0x0,
0x303303FC
• #define IOMUXC_SAI1_TXD2_SAI5_TX_DATA2 0x30330194, 0x1, 0x00000000, 0x0,
0x303303FC
• #define IOMUXC_SAI1_TXD2_CORESIGHT_TRACE10 0x30330194, 0x4, 0x00000000, 0x0,
0x303303FC
• #define IOMUXC_SAI1_TXD2_GPIO4_IO14 0x30330194, 0x5, 0x00000000, 0x0, 0x303303FC
• #define IOMUXC_SAI1_TXD2_SRC_BOOT_CFG10 0x30330194, 0x6, 0x00000000, 0x0,
0x303303FC
• #define IOMUXC_SAI1_TXD3_SAI1_TX_DATA3 0x30330198, 0x0, 0x00000000, 0x0,
0x30330400
• #define IOMUXC_SAI1_TXD3_SAI5_TX_DATA3 0x30330198, 0x1, 0x00000000, 0x0,
0x30330400
• #define IOMUXC_SAI1_TXD3_CORESIGHT_TRACE11 0x30330198, 0x4, 0x00000000, 0x0,

```

```

0x30330400
• #define IOMUXC_SAI1_TXD3_GPIO4_IO15 0x30330198, 0x5, 0x00000000, 0x0, 0x30330400
• #define IOMUXC_SAI1_TXD3_SRC_BOOT_CFG11 0x30330198, 0x6, 0x00000000, 0x0,
0x30330400
• #define IOMUXC_SAI1_TXD4_SAI1_TX_DATA4 0x3033019C, 0x0, 0x00000000, 0x0,
0x30330404
• #define IOMUXC_SAI1_TXD4_SAI6_RX_BCLK 0x3033019C, 0x1, 0x30330510, 0x1,
0x30330404
• #define IOMUXC_SAI1_TXD4_SAI6_TX_BCLK 0x3033019C, 0x2, 0x3033051C, 0x1,
0x30330404
• #define IOMUXC_SAI1_TXD4_CORESIGHT_TRACE12 0x3033019C, 0x4, 0x00000000, 0x0,
0x30330404
• #define IOMUXC_SAI1_TXD4_GPIO4_IO16 0x3033019C, 0x5, 0x00000000, 0x0, 0x30330404
• #define IOMUXC_SAI1_TXD4_SRC_BOOT_CFG12 0x3033019C, 0x6, 0x00000000, 0x0,
0x30330404
• #define IOMUXC_SAI1_TXD5_SAI1_TX_DATA5 0x303301A0, 0x0, 0x00000000, 0x0,
0x30330408
• #define IOMUXC_SAI1_TXD5_SAI6_RX_DATA0 0x303301A0, 0x1, 0x30330514, 0x1,
0x30330408
• #define IOMUXC_SAI1_TXD5_SAI6_TX_DATA0 0x303301A0, 0x2, 0x00000000, 0x0,
0x30330408
• #define IOMUXC_SAI1_TXD5_CORESIGHT_TRACE13 0x303301A0, 0x4, 0x00000000,
0x0, 0x30330408
• #define IOMUXC_SAI1_TXD5_GPIO4_IO17 0x303301A0, 0x5, 0x00000000, 0x0, 0x30330408
• #define IOMUXC_SAI1_TXD5_SRC_BOOT_CFG13 0x303301A0, 0x6, 0x00000000, 0x0,
0x30330408
• #define IOMUXC_SAI1_TXD6_SAI1_TX_DATA6 0x303301A4, 0x0, 0x00000000, 0x0,
0x3033040C
• #define IOMUXC_SAI1_TXD6_SAI6_RX_SYNC 0x303301A4, 0x1, 0x30330518, 0x1,
0x3033040C
• #define IOMUXC_SAI1_TXD6_SAI6_TX_SYNC 0x303301A4, 0x2, 0x30330520, 0x1,
0x3033040C
• #define IOMUXC_SAI1_TXD6_CORESIGHT_TRACE14 0x303301A4, 0x4, 0x00000000,
0x0, 0x3033040C
• #define IOMUXC_SAI1_TXD6_GPIO4_IO18 0x303301A4, 0x5, 0x00000000, 0x0, 0x3033040-
C
• #define IOMUXC_SAI1_TXD6_SRC_BOOT_CFG14 0x303301A4, 0x6, 0x00000000, 0x0,
0x3033040C
• #define IOMUXC_SAI1_TXD7_SAI1_TX_DATA7 0x303301A8, 0x0, 0x00000000, 0x0,
0x30330410
• #define IOMUXC_SAI1_TXD7_SAI6_MCLK 0x303301A8, 0x1, 0x30330530, 0x1, 0x30330410
• #define IOMUXC_SAI1_TXD7_CORESIGHT_TRACE15 0x303301A8, 0x4, 0x00000000,
0x0, 0x30330410
• #define IOMUXC_SAI1_TXD7_GPIO4_IO19 0x303301A8, 0x5, 0x00000000, 0x0, 0x30330410
• #define IOMUXC_SAI1_TXD7_SRC_BOOT_CFG15 0x303301A8, 0x6, 0x00000000, 0x0,
0x30330410
• #define IOMUXC_SAI1_MCLK_SAI1_MCLK 0x303301AC, 0x0, 0x00000000, 0x0, 0x30330414
• #define IOMUXC_SAI1_MCLK_SAI5_MCLK 0x303301AC, 0x1, 0x3033052C, 0x1, 0x30330414
• #define IOMUXC_SAI1_MCLK_SAI1_TX_BCLK 0x303301AC, 0x2, 0x303304C8, 0x2,
0x30330414
• #define IOMUXC_SAI1_MCLK_GPIO4_IO20 0x303301AC, 0x5, 0x00000000, 0x0, 0x30330414

```



- #define **IOMUXC\_SAI2\_RXFS\_SAI2\_RX\_SYNC** 0x303301B0, 0x0, 0x00000000, 0x0, 0x30330418
- #define **IOMUXC\_SAI2\_RXFS\_SAI5\_TX\_SYNC** 0x303301B0, 0x1, 0x303304EC, 0x2, 0x30330418
- #define **IOMUXC\_SAI2\_RXFS\_GPIO4\_IO21** 0x303301B0, 0x5, 0x00000000, 0x0, 0x30330418
- #define **IOMUXC\_SAI2\_RXC\_SAI2\_RX\_BCLK** 0x303301B4, 0x0, 0x00000000, 0x0, 0x3033041C
- #define **IOMUXC\_SAI2\_RXC\_SAI5\_TX\_BCLK** 0x303301B4, 0x1, 0x303304E8, 0x2, 0x3033041C
- #define **IOMUXC\_SAI2\_RXC\_GPIO4\_IO22** 0x303301B4, 0x5, 0x00000000, 0x0, 0x3033041C
- #define **IOMUXC\_SAI2\_RXD0\_SAI2\_RX\_DATA0** 0x303301B8, 0x0, 0x00000000, 0x0, 0x30330420
- #define **IOMUXC\_SAI2\_RXD0\_SAI5\_TX\_DATA0** 0x303301B8, 0x1, 0x00000000, 0x0, 0x30330420
- #define **IOMUXC\_SAI2\_RXD0\_GPIO4\_IO23** 0x303301B8, 0x5, 0x00000000, 0x0, 0x30330420
- #define **IOMUXC\_SAI2\_TXFS\_SAI2\_TX\_SYNC** 0x303301BC, 0x0, 0x00000000, 0x0, 0x30330424
- #define **IOMUXC\_SAI2\_TXFS\_SAI5\_TX\_DATA1** 0x303301BC, 0x1, 0x00000000, 0x0, 0x30330424
- #define **IOMUXC\_SAI2\_TXFS\_GPIO4\_IO24** 0x303301BC, 0x5, 0x00000000, 0x0, 0x30330424
- #define **IOMUXC\_SAI2\_TXC\_SAI2\_TX\_BCLK** 0x303301C0, 0x0, 0x00000000, 0x0, 0x30330428
- #define **IOMUXC\_SAI2\_TXC\_SAI5\_TX\_DATA2** 0x303301C0, 0x1, 0x00000000, 0x0, 0x30330428
- #define **IOMUXC\_SAI2\_TXC\_GPIO4\_IO25** 0x303301C0, 0x5, 0x00000000, 0x0, 0x30330428
- #define **IOMUXC\_SAI2\_TXD0\_SAI2\_TX\_DATA0** 0x303301C4, 0x0, 0x00000000, 0x0, 0x3033042C
- #define **IOMUXC\_SAI2\_TXD0\_SAI5\_TX\_DATA3** 0x303301C4, 0x1, 0x00000000, 0x0, 0x3033042C
- #define **IOMUXC\_SAI2\_TXD0\_GPIO4\_IO26** 0x303301C4, 0x5, 0x00000000, 0x0, 0x3033042C
- #define **IOMUXC\_SAI2\_MCLK\_SAI2\_MCLK** 0x303301C8, 0x0, 0x00000000, 0x0, 0x30330430
- #define **IOMUXC\_SAI2\_MCLK\_SAI5\_MCLK** 0x303301C8, 0x1, 0x3033052C, 0x2, 0x30330430
- #define **IOMUXC\_SAI2\_MCLK\_GPIO4\_IO27** 0x303301C8, 0x5, 0x00000000, 0x0, 0x30330430
- #define **IOMUXC\_SAI3\_RXFS\_SAI3\_RX\_SYNC** 0x303301CC, 0x0, 0x00000000, 0x0, 0x30330434
- #define **IOMUXC\_SAI3\_RXFS\_GPT1\_CAPTURE1** 0x303301CC, 0x1, 0x00000000, 0x0, 0x30330434
- #define **IOMUXC\_SAI3\_RXFS\_SAI5\_RX\_SYNC** 0x303301CC, 0x2, 0x303304E4, 0x2, 0x30330434
- #define **IOMUXC\_SAI3\_RXFS\_GPIO4\_IO28** 0x303301CC, 0x5, 0x00000000, 0x0, 0x30330434
- #define **IOMUXC\_SAI3\_RXC\_SAI3\_RX\_BCLK** 0x303301D0, 0x0, 0x00000000, 0x0, 0x30330438
- #define **IOMUXC\_SAI3\_RXC\_GPT1\_CAPTURE2** 0x303301D0, 0x1, 0x00000000, 0x0, 0x30330438
- #define **IOMUXC\_SAI3\_RXC\_SAI5\_RX\_BCLK** 0x303301D0, 0x2, 0x303304D0, 0x2, 0x30330438
- #define **IOMUXC\_SAI3\_RXC\_GPIO4\_IO29** 0x303301D0, 0x5, 0x00000000, 0x0, 0x30330438
- #define **IOMUXC\_SAI3\_RXD\_SAI3\_RX\_DATA0** 0x303301D4, 0x0, 0x00000000, 0x0, 0x3033043C
- #define **IOMUXC\_SAI3\_RXD\_GPT1\_COMPARE1** 0x303301D4, 0x1, 0x00000000, 0x0, 0x3033043C

- 0x3033043C
- #define **IOMUXC\_SAI3\_RXD\_SAI5\_RX\_DATA0** 0x303301D4, 0x2, 0x303304D4, 0x2, 0x3033043C
- #define **IOMUXC\_SAI3\_RXD\_GPIO4\_IO30** 0x303301D4, 0x5, 0x00000000, 0x0, 0x3033043C
- #define **IOMUXC\_SAI3\_TXFS\_SAI3\_TX\_SYNC** 0x303301D8, 0x0, 0x00000000, 0x0, 0x30330440
- #define **IOMUXC\_SAI3\_TXFS\_GPT1\_CLK** 0x303301D8, 0x1, 0x00000000, 0x0, 0x30330440
- #define **IOMUXC\_SAI3\_TXFS\_SAI5\_RX\_DATA1** 0x303301D8, 0x2, 0x303304D8, 0x2, 0x30330440
- #define **IOMUXC\_SAI3\_TXFS\_GPIO4\_IO31** 0x303301D8, 0x5, 0x00000000, 0x0, 0x30330440
- #define **IOMUXC\_SAI3\_TXC\_SAI3\_TX\_BCLK** 0x303301DC, 0x0, 0x00000000, 0x0, 0x30330444
- #define **IOMUXC\_SAI3\_TXC\_GPT1\_COMPARE2** 0x303301DC, 0x1, 0x00000000, 0x0, 0x30330444
- #define **IOMUXC\_SAI3\_TXC\_SAI5\_RX\_DATA2** 0x303301DC, 0x2, 0x303304DC, 0x2, 0x30330444
- #define **IOMUXC\_SAI3\_TXC\_GPIO5\_IO00** 0x303301DC, 0x5, 0x00000000, 0x0, 0x30330444
- #define **IOMUXC\_SAI3\_TXD\_SAI3\_TX\_DATA0** 0x303301E0, 0x0, 0x00000000, 0x0, 0x30330448
- #define **IOMUXC\_SAI3\_TXD\_GPT1\_COMPARE3** 0x303301E0, 0x1, 0x00000000, 0x0, 0x30330448
- #define **IOMUXC\_SAI3\_TXD\_SAI5\_RX\_DATA3** 0x303301E0, 0x2, 0x303304E0, 0x2, 0x30330448
- #define **IOMUXC\_SAI3\_TXD\_GPIO5\_IO01** 0x303301E0, 0x5, 0x00000000, 0x0, 0x30330448
- #define **IOMUXC\_SAI3\_MCLK\_SAI3\_MCLK** 0x303301E4, 0x0, 0x00000000, 0x0, 0x3033044-C
- #define **IOMUXC\_SAI3\_MCLK\_PWM4\_OUT** 0x303301E4, 0x1, 0x00000000, 0x0, 0x3033044-C
- #define **IOMUXC\_SAI3\_MCLK\_SAI5\_MCLK** 0x303301E4, 0x2, 0x3033052C, 0x3, 0x3033044-C
- #define **IOMUXC\_SAI3\_MCLK\_GPIO5\_IO02** 0x303301E4, 0x5, 0x00000000, 0x0, 0x3033044-C
- #define **IOMUXC\_SPDIF\_TX\_SPDIF1\_OUT** 0x303301E8, 0x0, 0x00000000, 0x0, 0x30330450
- #define **IOMUXC\_SPDIF\_TX\_PWM3\_OUT** 0x303301E8, 0x1, 0x00000000, 0x0, 0x30330450
- #define **IOMUXC\_SPDIF\_TX\_GPIO5\_IO03** 0x303301E8, 0x5, 0x00000000, 0x0, 0x30330450
- #define **IOMUXC\_SPDIF\_RX\_SPDIF1\_IN** 0x303301EC, 0x0, 0x00000000, 0x0, 0x30330454
- #define **IOMUXC\_SPDIF\_RX\_PWM2\_OUT** 0x303301EC, 0x1, 0x00000000, 0x0, 0x30330454
- #define **IOMUXC\_SPDIF\_RX\_GPIO5\_IO04** 0x303301EC, 0x5, 0x00000000, 0x0, 0x30330454
- #define **IOMUXC\_SPDIF\_EXT\_CLK\_SPDIF1\_EXT\_CLK** 0x303301F0, 0x0, 0x00000000, 0x0, 0x30330458
- #define **IOMUXC\_SPDIF\_EXT\_CLK\_PWM1\_OUT** 0x303301F0, 0x1, 0x00000000, 0x0, 0x30330458
- #define **IOMUXC\_SPDIF\_EXT\_CLK\_GPIO5\_IO05** 0x303301F0, 0x5, 0x00000000, 0x0, 0x30330458
- #define **IOMUXC\_ECSP11\_SCLK\_ECSP11\_SCLK** 0x303301F4, 0x0, 0x00000000, 0x0, 0x3033045C
- #define **IOMUXC\_ECSP11\_SCLK\_UART3\_RX** 0x303301F4, 0x1, 0x30330504, 0x0, 0x3033045-C
- #define **IOMUXC\_ECSP11\_SCLK\_UART3\_TX** 0x303301F4, 0x1, 0x00000000, 0x0, 0x3033045C
- #define **IOMUXC\_ECSP11\_SCLK\_GPIO5\_IO06** 0x303301F4, 0x5, 0x00000000, 0x0,

```

0x3033045C
• #define IOMUXC_ECSP11_MOSI_ECSP11_MOSI 0x303301F8, 0x0, 0x00000000, 0x0,
0x30330460
• #define IOMUXC_ECSP11_MOSI_UART3_TX 0x303301F8, 0x1, 0x00000000, 0X0,
0x30330460
• #define IOMUXC_ECSP11_MOSI_UART3_RX 0x303301F8, 0x1, 0x30330504, 0x1, 0x30330460
• #define IOMUXC_ECSP11_MOSI_GPIO5_IO07 0x303301F8, 0x5, 0x00000000, 0x0,
0x30330460
• #define IOMUXC_ECSP11_MISO_ECSP11_MISO 0x303301FC, 0x0, 0x00000000, 0x0,
0x30330464
• #define IOMUXC_ECSP11_MISO_UART3_CTS_B 0x303301FC, 0x1, 0x00000000, 0X0,
0x30330464
• #define IOMUXC_ECSP11_MISO_UART3_RTS_B 0x303301FC, 0x1, 0x30330500, 0x0,
0x30330464
• #define IOMUXC_ECSP11_MISO_GPIO5_IO08 0x303301FC, 0x5, 0x00000000, 0x0,
0x30330464
• #define IOMUXC_ECSP11_SS0_ECSP11_SS0 0x30330200, 0x0, 0x00000000, 0x0, 0x30330468
• #define IOMUXC_ECSP11_SS0_UART3_RTS_B 0x30330200, 0x1, 0x30330500, 0x1,
0x30330468
• #define IOMUXC_ECSP11_SS0_UART3_CTS_B 0x30330200, 0x1, 0x00000000, 0X0,
0x30330468
• #define IOMUXC_ECSP11_SS0_GPIO5_IO09 0x30330200, 0x5, 0x00000000, 0x0, 0x30330468
• #define IOMUXC_ECSP12_SCLK_ECSP12_SCLK 0x30330204, 0x0, 0x00000000, 0x0,
0x3033046C
• #define IOMUXC_ECSP12_SCLK_UART4_RX 0x30330204, 0x1, 0x3033050C, 0x0, 0x3033046-
C
• #define IOMUXC_ECSP12_SCLK_UART4_TX 0x30330204, 0x1, 0x00000000, 0X0,
0x3033046C
• #define IOMUXC_ECSP12_SCLK_GPIO5_IO10 0x30330204, 0x5, 0x00000000, 0x0,
0x3033046C
• #define IOMUXC_ECSP12_MOSI_ECSP12_MOSI 0x30330208, 0x0, 0x00000000, 0x0,
0x30330470
• #define IOMUXC_ECSP12_MOSI_UART4_TX 0x30330208, 0x1, 0x00000000, 0X0, 0x30330470
• #define IOMUXC_ECSP12_MOSI_UART4_RX 0x30330208, 0x1, 0x3033050C, 0x1, 0x30330470
• #define IOMUXC_ECSP12_MOSI_GPIO5_IO11 0x30330208, 0x5, 0x00000000, 0x0,
0x30330470
• #define IOMUXC_ECSP12_MISO_ECSP12_MISO 0x3033020C, 0x0, 0x00000000, 0x0,
0x30330474
• #define IOMUXC_ECSP12_MISO_UART4_CTS_B 0x3033020C, 0x1, 0x00000000, 0X0,
0x30330474
• #define IOMUXC_ECSP12_MISO_UART4_RTS_B 0x3033020C, 0x1, 0x30330508, 0x0,
0x30330474
• #define IOMUXC_ECSP12_MISO_GPIO5_IO12 0x3033020C, 0x5, 0x00000000, 0x0,
0x30330474
• #define IOMUXC_ECSP12_SS0_ECSP12_SS0 0x30330210, 0x0, 0x00000000, 0x0, 0x30330478
• #define IOMUXC_ECSP12_SS0_UART4_RTS_B 0x30330210, 0x1, 0x30330508, 0x1,
0x30330478
• #define IOMUXC_ECSP12_SS0_UART4_CTS_B 0x30330210, 0x1, 0x00000000, 0X0,
0x30330478
• #define IOMUXC_ECSP12_SS0_GPIO5_IO13 0x30330210, 0x5, 0x00000000, 0x0, 0x30330478
• #define IOMUXC_I2C1_SCL_I2C1_SCL 0x30330214, 0x0, 0x00000000, 0x0, 0x3033047C

```

- #define **IOMUXC\_I2C1\_SCL\_ENET1\_MDC** 0x30330214, 0x1, 0x00000000, 0x0, 0x3033047C
- #define **IOMUXC\_I2C1\_SCL\_GPIO5\_IO14** 0x30330214, 0x5, 0x00000000, 0x0, 0x3033047C
- #define **IOMUXC\_I2C1\_SDA\_I2C1\_SDA** 0x30330218, 0x0, 0x00000000, 0x0, 0x30330480
- #define **IOMUXC\_I2C1\_SDA\_ENET1\_MDIO** 0x30330218, 0x1, 0x303304C0, 0x2, 0x30330480
- #define **IOMUXC\_I2C1\_SDA\_GPIO5\_IO15** 0x30330218, 0x5, 0x00000000, 0x0, 0x30330480
- #define **IOMUXC\_I2C2\_SCL\_I2C2\_SCL** 0x3033021C, 0x0, 0x00000000, 0x0, 0x30330484
- #define **IOMUXC\_I2C2\_SCL\_ENET1\_1588\_EVENT1\_IN** 0x3033021C, 0x1, 0x00000000, 0x0, 0x30330484
- #define **IOMUXC\_I2C2\_SCL\_GPIO5\_IO16** 0x3033021C, 0x5, 0x00000000, 0x0, 0x30330484
- #define **IOMUXC\_I2C2\_SDA\_I2C2\_SDA** 0x30330220, 0x0, 0x00000000, 0x0, 0x30330488
- #define **IOMUXC\_I2C2\_SDA\_ENET1\_1588\_EVENT1\_OUT** 0x30330220, 0x1, 0x00000000, 0x0, 0x30330488
- #define **IOMUXC\_I2C2\_SDA\_GPIO5\_IO17** 0x30330220, 0x5, 0x00000000, 0x0, 0x30330488
- #define **IOMUXC\_I2C3\_SCL\_I2C3\_SCL** 0x30330224, 0x0, 0x00000000, 0x0, 0x3033048C
- #define **IOMUXC\_I2C3\_SCL\_PWM4\_OUT** 0x30330224, 0x1, 0x00000000, 0x0, 0x3033048C
- #define **IOMUXC\_I2C3\_SCL\_GPT2\_CLK** 0x30330224, 0x2, 0x00000000, 0x0, 0x3033048C
- #define **IOMUXC\_I2C3\_SCL\_GPIO5\_IO18** 0x30330224, 0x5, 0x00000000, 0x0, 0x3033048C
- #define **IOMUXC\_I2C3\_SDA\_I2C3\_SDA** 0x30330228, 0x0, 0x00000000, 0x0, 0x30330490
- #define **IOMUXC\_I2C3\_SDA\_PWM3\_OUT** 0x30330228, 0x1, 0x00000000, 0x0, 0x30330490
- #define **IOMUXC\_I2C3\_SDA\_GPT3\_CLK** 0x30330228, 0x2, 0x00000000, 0x0, 0x30330490
- #define **IOMUXC\_I2C3\_SDA\_GPIO5\_IO19** 0x30330228, 0x5, 0x00000000, 0x0, 0x30330490
- #define **IOMUXC\_I2C4\_SCL\_I2C4\_SCL** 0x3033022C, 0x0, 0x00000000, 0x0, 0x30330494
- #define **IOMUXC\_I2C4\_SCL\_PWM2\_OUT** 0x3033022C, 0x1, 0x00000000, 0x0, 0x30330494
- #define **IOMUXC\_I2C4\_SCL\_PCIE1\_CLKREQ\_B** 0x3033022C, 0x2, 0x30330524, 0x0, 0x30330494
- #define **IOMUXC\_I2C4\_SCL\_GPIO5\_IO20** 0x3033022C, 0x5, 0x00000000, 0x0, 0x30330494
- #define **IOMUXC\_I2C4\_SDA\_I2C4\_SDA** 0x30330230, 0x0, 0x00000000, 0x0, 0x30330498
- #define **IOMUXC\_I2C4\_SDA\_PWM1\_OUT** 0x30330230, 0x1, 0x00000000, 0x0, 0x30330498
- #define **IOMUXC\_I2C4\_SDA\_PCIE2\_CLKREQ\_B** 0x30330230, 0x2, 0x30330528, 0x0, 0x30330498
- #define **IOMUXC\_I2C4\_SDA\_GPIO5\_IO21** 0x30330230, 0x5, 0x00000000, 0x0, 0x30330498
- #define **IOMUXC\_UART1\_RXD\_UART1\_RX** 0x30330234, 0x0, 0x303304F4, 0x0, 0x3033049-C
- #define **IOMUXC\_UART1\_RXD\_UART1\_TX** 0x30330234, 0x0, 0x00000000, 0x0, 0x3033049-C
- #define **IOMUXC\_UART1\_RXD\_ECSPi3\_SCLK** 0x30330234, 0x1, 0x00000000, 0x0, 0x3033049C
- #define **IOMUXC\_UART1\_RXD\_GPIO5\_IO22** 0x30330234, 0x5, 0x00000000, 0x0, 0x3033049-C
- #define **IOMUXC\_UART1\_TXD\_UART1\_TX** 0x30330238, 0x0, 0x00000000, 0x0, 0x303304-A0
- #define **IOMUXC\_UART1\_TXD\_UART1\_RX** 0x30330238, 0x0, 0x303304F4, 0x1, 0x303304-A0
- #define **IOMUXC\_UART1\_TXD\_ECSPi3\_MOSI** 0x30330238, 0x1, 0x00000000, 0x0, 0x303304A0
- #define **IOMUXC\_UART1\_TXD\_GPIO5\_IO23** 0x30330238, 0x5, 0x00000000, 0x0, 0x303304-A0
- #define **IOMUXC\_UART2\_RXD\_UART2\_RX** 0x3033023C, 0x0, 0x303304FC, 0x0, 0x303304-A4
- #define **IOMUXC\_UART2\_RXD\_UART2\_TX** 0x3033023C, 0x0, 0x00000000, 0x0, 0x303304-A4
- #define **IOMUXC\_UART2\_RXD\_ECSPi3\_MISO** 0x3033023C, 0x1, 0x00000000, 0x0,

- 0x303304A4
- #define **IOMUXC\_UART2\_RXD\_GPIO5\_IO24** 0x3033023C, 0x5, 0x00000000, 0x0, 0x303304-A4
- #define **IOMUXC\_UART2\_TXD\_UART2\_TX** 0x30330240, 0x0, 0x00000000, 0x0, 0x303304-A8
- #define **IOMUXC\_UART2\_TXD\_UART2\_RX** 0x30330240, 0x0, 0x303304FC, 0x1, 0x303304-A8
- #define **IOMUXC\_UART2\_TXD\_ECSPi3\_SS0** 0x30330240, 0x1, 0x00000000, 0x0, 0x303304-A8
- #define **IOMUXC\_UART2\_TXD\_GPIO5\_IO25** 0x30330240, 0x5, 0x00000000, 0x0, 0x303304-A8
- #define **IOMUXC\_UART3\_RXD\_UART3\_RX** 0x30330244, 0x0, 0x30330504, 0x2, 0x303304-AC
- #define **IOMUXC\_UART3\_RXD\_UART3\_TX** 0x30330244, 0x0, 0x00000000, 0x0, 0x303304-AC
- #define **IOMUXC\_UART3\_RXD\_UART1\_CTS\_B** 0x30330244, 0x1, 0x00000000, 0x0, 0x303304AC
- #define **IOMUXC\_UART3\_RXD\_UART1\_RTS\_B** 0x30330244, 0x1, 0x303304F0, 0x0, 0x303304AC
- #define **IOMUXC\_UART3\_RXD\_GPIO5\_IO26** 0x30330244, 0x5, 0x00000000, 0x0, 0x303304-AC
- #define **IOMUXC\_UART3\_TXD\_UART3\_TX** 0x30330248, 0x0, 0x00000000, 0x0, 0x303304-B0
- #define **IOMUXC\_UART3\_TXD\_UART3\_RX** 0x30330248, 0x0, 0x30330504, 0x3, 0x303304-B0
- #define **IOMUXC\_UART3\_TXD\_UART1\_RTS\_B** 0x30330248, 0x1, 0x303304F0, 0x1, 0x303304B0
- #define **IOMUXC\_UART3\_TXD\_UART1\_CTS\_B** 0x30330248, 0x1, 0x00000000, 0x0, 0x303304B0
- #define **IOMUXC\_UART3\_TXD\_GPIO5\_IO27** 0x30330248, 0x5, 0x00000000, 0x0, 0x303304-B0
- #define **IOMUXC\_UART4\_RXD\_UART4\_RX** 0x3033024C, 0x0, 0x3033050C, 0x2, 0x303304-B4
- #define **IOMUXC\_UART4\_RXD\_UART4\_TX** 0x3033024C, 0x0, 0x00000000, 0x0, 0x303304-B4
- #define **IOMUXC\_UART4\_RXD\_UART2\_CTS\_B** 0x3033024C, 0x1, 0x00000000, 0x0, 0x303304B4
- #define **IOMUXC\_UART4\_RXD\_UART2\_RTS\_B** 0x3033024C, 0x1, 0x303304F8, 0x0, 0x303304B4
- #define **IOMUXC\_UART4\_RXD\_PCIE1\_CLKREQ\_B** 0x3033024C, 0x2, 0x30330524, 0x1, 0x303304B4
- #define **IOMUXC\_UART4\_RXD\_GPIO5\_IO28** 0x3033024C, 0x5, 0x00000000, 0x0, 0x303304-B4
- #define **IOMUXC\_UART4\_TXD\_UART4\_TX** 0x30330250, 0x0, 0x00000000, 0x0, 0x303304-B8
- #define **IOMUXC\_UART4\_TXD\_UART4\_RX** 0x30330250, 0x0, 0x3033050C, 0x3, 0x303304-B8
- #define **IOMUXC\_UART4\_TXD\_UART2\_RTS\_B** 0x30330250, 0x1, 0x303304F8, 0x1, 0x303304B8
- #define **IOMUXC\_UART4\_TXD\_UART2\_CTS\_B** 0x30330250, 0x1, 0x00000000, 0x0, 0x303304B8

- 0x303304B8
- #define **IOMUXC\_UART4\_TXD\_PCIE2\_CLKREQ\_B** 0x30330250, 0x2, 0x30330528, 0x1, 0x303304B8
- #define **IOMUXC\_UART4\_TXD\_GPIO5\_IO29** 0x30330250, 0x5, 0x00000000, 0x0, 0x303304B8
- #define **IOMUXC\_TEST\_MODE** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330254
- #define **IOMUXC\_BOOT\_MODE0** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330258
- #define **IOMUXC\_BOOT\_MODE1** 0x00000000, 0x0, 0x00000000, 0x0, 0x3033025C
- #define **IOMUXC\_JTAG\_MOD** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330260
- #define **IOMUXC\_JTAG\_TRST\_B** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330264
- #define **IOMUXC\_JTAG\_TDI** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330268
- #define **IOMUXC\_JTAG\_TMS** 0x00000000, 0x0, 0x00000000, 0x0, 0x3033026C
- #define **IOMUXC\_JTAG\_TCK** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330270
- #define **IOMUXC\_JTAG\_TDO** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330274
- #define **IOMUXC\_RTC** 0x00000000, 0x0, 0x00000000, 0x0, 0x30330278

## Configuration

- static void **IOMUXC\_SetPinMux** (uint32\_t muxRegister, uint32\_t muxMode, uint32\_t inputRegister, uint32\_t inputDaisy, uint32\_t configRegister, uint32\_t inputOnfield)  
*Sets the IOMUXC pin mux mode.*
- static void **IOMUXC\_SetPinConfig** (uint32\_t muxRegister, uint32\_t muxMode, uint32\_t inputRegister, uint32\_t inputDaisy, uint32\_t configRegister, uint32\_t configValue)  
*Sets the IOMUXC pin configuration.*

## 5.2 Macro Definition Documentation

### 5.2.1 #define FSL\_IOMUXC\_DRIVER\_VERSION (MAKE\_VERSION(2, 0, 1))

## 5.3 Function Documentation

### 5.3.1 static void IOMUXC\_SetPinMux ( uint32\_t *muxRegister*, uint32\_t *muxMode*, uint32\_t *inputRegister*, uint32\_t *inputDaisy*, uint32\_t *configRegister*, uint32\_t *inputOnfield* ) [inline], [static]

Note

The first five parameters can be filled with the pin function ID macros.

This is an example to set the I2C4\_SDA as the pwm1\_OUT:

```
* IOMUXC_SetPinMux(IOMUXC_I2C4_SDA_PWM1_OUT, 0);
*
```

## Parameters

<i>muxRegister</i>	The pin mux register_
<i>muxMode</i>	The pin mux mode_
<i>inputRegister</i>	The select input register_
<i>inputDaisy</i>	The input daisy_
<i>configRegister</i>	The config register_
<i>inputOnfield</i>	The pad->module input inversion_

**5.3.2 static void IOMUXC\_SetPinConfig ( uint32\_t *muxRegister*, uint32\_t *muxMode*, uint32\_t *inputRegister*, uint32\_t *inputDaisy*, uint32\_t *configRegister*, uint32\_t *configValue* ) [inline], [static]**

## Note

The previous five parameters can be filled with the pin function ID macros.

This is an example to set pin configuration for IOMUXC\_I2C4\_SDA\_PWM1\_OUT:

```
* IOMUXC_SetPinConfig(IOMUXC_I2C4_SDA_PWM1_OUT, IOMUXC_SW_PAD_CTL_PAD_ODE_MASK |
  IOMUXC0_SW_PAD_CTL_PAD_DSE(2U) )
*
```

## Parameters

<i>muxRegister</i>	The pin mux register_
<i>muxMode</i>	The pin mux mode_
<i>inputRegister</i>	The select input register_
<i>inputDaisy</i>	The input daisy_
<i>configRegister</i>	The config register_
<i>configValue</i>	The pin config value_

# Chapter 6

## Common Driver

### 6.1 Overview

The MCUXpresso SDK provides a driver for the common module of MCUXpresso SDK devices.

#### Macros

- #define `FSL_DRIVER_TRANSFER_DOUBLE_WEAK_IRQ` 1  
*Macro to use the default weak IRQ handler in drivers.*
- #define `MAKE_STATUS`(group, code) (((group)\*100L) + (code))  
*Construct a status code value from a group and code number.*
- #define `MAKE_VERSION`(major, minor, bugfix) (((major) \* 65536L) + ((minor) \* 256L) + (bugfix))  
*Construct the version number for drivers.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_NONE` 0U  
*No debug console.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_UART` 1U  
*Debug console based on UART.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_LPUART` 2U  
*Debug console based on LPUART.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_LPSCI` 3U  
*Debug console based on LPSCI.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_USBCDC` 4U  
*Debug console based on USBCDC.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_FLEXCOMM` 5U  
*Debug console based on FLEXCOMM.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_IUART` 6U  
*Debug console based on i.MX UART.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_VUSART` 7U  
*Debug console based on LPC\_VUSART.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_MINI_USART` 8U  
*Debug console based on LPC\_USART.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_SWO` 9U  
*Debug console based on SWO.*
- #define `DEBUG_CONSOLE_DEVICE_TYPE_QSCI` 10U  
*Debug console based on QSCI.*
- #define `ARRAY_SIZE`(x) (sizeof(x) / sizeof((x)[0]))  
*Computes the number of elements in an array.*

#### Typedefs

- typedef int32\_t `status_t`  
*Type used for all status and error return values.*



## Enumerations

- enum `_status_groups` {
  - `kStatusGroup_Generic` = 0,
  - `kStatusGroup_FLASH` = 1,
  - `kStatusGroup_LPSPI` = 4,
  - `kStatusGroup_FLEXIO_SPI` = 5,
  - `kStatusGroup_DSPI` = 6,
  - `kStatusGroup_FLEXIO_UART` = 7,
  - `kStatusGroup_FLEXIO_I2C` = 8,
  - `kStatusGroup_LPI2C` = 9,
  - `kStatusGroup_UART` = 10,
  - `kStatusGroup_I2C` = 11,
  - `kStatusGroup_LPSCI` = 12,
  - `kStatusGroup_LPUART` = 13,
  - `kStatusGroup_SPI` = 14,
  - `kStatusGroup_XRDC` = 15,
  - `kStatusGroup_SEMA42` = 16,
  - `kStatusGroup_SDHC` = 17,
  - `kStatusGroup_SDMMC` = 18,
  - `kStatusGroup_SAI` = 19,
  - `kStatusGroup_MCG` = 20,
  - `kStatusGroup_SCG` = 21,
  - `kStatusGroup_SDSPI` = 22,
  - `kStatusGroup_FLEXIO_I2S` = 23,
  - `kStatusGroup_FLEXIO_MCULCD` = 24,
  - `kStatusGroup_FLASHIAP` = 25,
  - `kStatusGroup_FLEXCOMM_I2C` = 26,
  - `kStatusGroup_I2S` = 27,
  - `kStatusGroup_IUART` = 28,
  - `kStatusGroup_CSI` = 29,
  - `kStatusGroup_MIPI_DSI` = 30,
  - `kStatusGroup_SDRAMC` = 35,
  - `kStatusGroup_POWER` = 39,
  - `kStatusGroup_ENET` = 40,
  - `kStatusGroup_PHY` = 41,
  - `kStatusGroup_TRGMUX` = 42,
  - `kStatusGroup_SMARTCARD` = 43,
  - `kStatusGroup_LMEM` = 44,
  - `kStatusGroup_QSPI` = 45,
  - `kStatusGroup_DMA` = 50,
  - `kStatusGroup_EDMA` = 51,
  - `kStatusGroup_DMAMGR` = 52,
  - `kStatusGroup_FLEXCAN` = 53,
  - `kStatusGroup_LTC` = 54,
  - `kStatusGroup_FLEXIO_CAMERA` = 55,
  - `kStatusGroup_LPC_SPI` = 56,
  - `kStatusGroup_LPC_USART` = 57,
  - `kStatusGroup_DMIC` = 58,
  - `kStatusGroup_SDIF` = 59,

```
kStatusGroup_BMA = 164 }
```

*Status group numbers.*

- enum {  
   kStatus\_Success = MAKE\_STATUS(kStatusGroup\_Generic, 0),  
   kStatus\_Fail = MAKE\_STATUS(kStatusGroup\_Generic, 1),  
   kStatus\_ReadOnly = MAKE\_STATUS(kStatusGroup\_Generic, 2),  
   kStatus\_OutOfRange = MAKE\_STATUS(kStatusGroup\_Generic, 3),  
   kStatus\_InvalidArgument = MAKE\_STATUS(kStatusGroup\_Generic, 4),  
   kStatus\_Timeout = MAKE\_STATUS(kStatusGroup\_Generic, 5),  
   kStatus\_NoTransferInProgress,  
   kStatus\_Busy = MAKE\_STATUS(kStatusGroup\_Generic, 7),  
   kStatus\_NoData }

*Generic status return codes.*

## Functions

- void \* **SDK\_Malloc** (size\_t size, size\_t alignbytes)  
   *Allocate memory with given alignment and aligned size.*
- void **SDK\_Free** (void \*ptr)  
   *Free memory.*
- void **SDK\_DelayAtLeastUs** (uint32\_t delayTime\_us, uint32\_t coreClock\_Hz)  
   *Delay at least for some time.*

## Driver version

- #define **FSL\_COMMON\_DRIVER\_VERSION** (**MAKE\_VERSION**(2, 3, 2))  
   *common driver version.*

## Min/max macros

- #define **MIN**(a, b) (((a) < (b)) ? (a) : (b))
- #define **MAX**(a, b) (((a) > (b)) ? (a) : (b))

## UINT16\_MAX/UINT32\_MAX value

- #define **UINT16\_MAX** ((uint16\_t)-1)
- #define **UINT32\_MAX** ((uint32\_t)-1)

## Suppress fallthrough warning macro

- #define **SUPPRESS\_FALL\_THROUGH\_WARNING**()

## 6.2 Macro Definition Documentation

### 6.2.1 #define FSL\_DRIVER\_TRANSFER\_DOUBLE\_WEAK\_IRQ 1

### 6.2.2 #define MAKE\_STATUS( group, code ) (((group)\*100L) + (code)))

### 6.2.3 **#define MAKE\_VERSION( *major*, *minor*, *bugfix* ) (((major) \* 65536L) + ((minor) \* 256L) + (bugfix))**

The driver version is a 32-bit number, for both 32-bit platforms(such as Cortex M) and 16-bit platforms(such as DSC).

Unused		Major Version		Minor Version		Bug Fix	
31	25	24	17	16	9	8	0

### 6.2.4 **#define FSL\_COMMON\_DRIVER\_VERSION (MAKE\_VERSION(2, 3, 2))**

### 6.2.5 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_NONE 0U**

### 6.2.6 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_UART 1U**

### 6.2.7 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_LPUART 2U**

### 6.2.8 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_LPSCI 3U**

### 6.2.9 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_USBCDC 4U**

### 6.2.10 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_FLEXCOMM 5U**

### 6.2.11 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_IUART 6U**

### 6.2.12 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_VUSART 7U**

### 6.2.13 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_MINI\_USART 8U**

### 6.2.14 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_SWO 9U**

### 6.2.15 **#define DEBUG\_CONSOLE\_DEVICE\_TYPE\_QSCI 10U**

### 6.2.16 **#define ARRAY\_SIZE( x ) (sizeof(x) / sizeof((x)[0]))**

## 6.3 Typedef Documentation

### 6.3.1 **typedef int32\_t status\_t**

## 6.4 Enumeration Type Documentation

### 6.4.1 enum \_status\_groups

Enumerator

*kStatusGroup\_Generic* Group number for generic status codes.  
*kStatusGroup\_FLASH* Group number for FLASH status codes.  
*kStatusGroup\_LPSPI* Group number for LPSPI status codes.  
*kStatusGroup\_FLEXIO\_SPI* Group number for FLEXIO SPI status codes.  
*kStatusGroup\_DSPI* Group number for DSPI status codes.  
*kStatusGroup\_FLEXIO\_UART* Group number for FLEXIO UART status codes.  
*kStatusGroup\_FLEXIO\_I2C* Group number for FLEXIO I2C status codes.  
*kStatusGroup\_LPI2C* Group number for LPI2C status codes.  
*kStatusGroup\_UART* Group number for UART status codes.  
*kStatusGroup\_I2C* Group number for I2C status codes.  
*kStatusGroup\_LPSCI* Group number for LPSCI status codes.  
*kStatusGroup\_LPUART* Group number for LPUART status codes.  
*kStatusGroup\_SPI* Group number for SPI status code.  
*kStatusGroup\_XRDC* Group number for XRDC status code.  
*kStatusGroup\_SEMA42* Group number for SEMA42 status code.  
*kStatusGroup\_SDHC* Group number for SDHC status code.  
*kStatusGroup\_SDMMC* Group number for SDMMC status code.  
*kStatusGroup\_SAI* Group number for SAI status code.  
*kStatusGroup\_MCG* Group number for MCG status codes.  
*kStatusGroup\_SCG* Group number for SCG status codes.  
*kStatusGroup\_SDSPI* Group number for SDSPI status codes.  
*kStatusGroup\_FLEXIO\_I2S* Group number for FLEXIO I2S status codes.  
*kStatusGroup\_FLEXIO\_MCULCD* Group number for FLEXIO LCD status codes.  
*kStatusGroup\_FLASHIAP* Group number for FLASHIAP status codes.  
*kStatusGroup\_FLEXCOMM\_I2C* Group number for FLEXCOMM I2C status codes.  
*kStatusGroup\_I2S* Group number for I2S status codes.  
*kStatusGroup\_IUART* Group number for IUART status codes.  
*kStatusGroup\_CSI* Group number for CSI status codes.  
*kStatusGroup\_MIPI\_DSI* Group number for MIPI DSI status codes.  
*kStatusGroup\_SDRAMC* Group number for SDRAMC status codes.  
*kStatusGroup\_POWER* Group number for POWER status codes.  
*kStatusGroup\_ENET* Group number for ENET status codes.  
*kStatusGroup\_PHY* Group number for PHY status codes.  
*kStatusGroup\_TRGMUX* Group number for TRGMUX status codes.  
*kStatusGroup\_SMARTCARD* Group number for SMARTCARD status codes.  
*kStatusGroup\_LMEM* Group number for LMEM status codes.  
*kStatusGroup\_QSPI* Group number for QSPI status codes.  
*kStatusGroup\_DMA* Group number for DMA status codes.  
*kStatusGroup\_EDMA* Group number for EDMA status codes.  
*kStatusGroup\_DMAMGR* Group number for DMAMGR status codes.

*kStatusGroup\_FLEXCAN* Group number for FlexCAN status codes.

*kStatusGroup\_LTC* Group number for LTC status codes.

*kStatusGroup\_FLEXIO\_CAMERA* Group number for FLEXIO CAMERA status codes.

*kStatusGroup\_LPC\_SPI* Group number for LPC\_SPI status codes.

*kStatusGroup\_LPC\_USART* Group number for LPC\_USART status codes.

*kStatusGroup\_DMIC* Group number for DMIC status codes.

*kStatusGroup\_SDIF* Group number for SDIF status codes.

*kStatusGroup\_SPIFI* Group number for SPIFI status codes.

*kStatusGroup\_OTP* Group number for OTP status codes.

*kStatusGroup\_MCAN* Group number for MCAN status codes.

*kStatusGroup\_CAAM* Group number for CAAM status codes.

*kStatusGroup\_ECSPI* Group number for ECSPI status codes.

*kStatusGroup\_USDHC* Group number for USDHC status codes.

*kStatusGroup\_LPC\_I2C* Group number for LPC\_I2C status codes.

*kStatusGroup\_DCP* Group number for DCP status codes.

*kStatusGroup\_MSCAN* Group number for MSCAN status codes.

*kStatusGroup\_ESAI* Group number for ESAI status codes.

*kStatusGroup\_FLEXSPI* Group number for FLEXSPI status codes.

*kStatusGroup\_MMDC* Group number for MMDC status codes.

*kStatusGroup\_PDM* Group number for MIC status codes.

*kStatusGroup\_SDMA* Group number for SDMA status codes.

*kStatusGroup\_ICS* Group number for ICS status codes.

*kStatusGroup\_SPDIF* Group number for SPDIF status codes.

*kStatusGroup\_LPC\_MINISPI* Group number for LPC\_MINISPI status codes.

*kStatusGroup\_HASHCRYPT* Group number for Hashcrypt status codes.

*kStatusGroup\_LPC\_SPI\_SSP* Group number for LPC\_SPI\_SSP status codes.

*kStatusGroup\_I3C* Group number for I3C status codes.

*kStatusGroup\_LPC\_I2C\_1* Group number for LPC\_I2C\_1 status codes.

*kStatusGroup\_NOTIFIER* Group number for NOTIFIER status codes.

*kStatusGroup\_DebugConsole* Group number for debug console status codes.

*kStatusGroup\_SEMC* Group number for SEMC status codes.

*kStatusGroup\_ApplicationRangeStart* Starting number for application groups.

*kStatusGroup\_IAP* Group number for IAP status codes.

*kStatusGroup\_SFA* Group number for SFA status codes.

*kStatusGroup\_SPC* Group number for SPC status codes.

*kStatusGroup\_PUF* Group number for PUF status codes.

*kStatusGroup\_TOUCH\_PANEL* Group number for touch panel status codes.

*kStatusGroup\_HAL\_GPIO* Group number for HAL GPIO status codes.

*kStatusGroup\_HAL\_UART* Group number for HAL UART status codes.

*kStatusGroup\_HAL\_TIMER* Group number for HAL TIMER status codes.

*kStatusGroup\_HAL\_SPI* Group number for HAL SPI status codes.

*kStatusGroup\_HAL\_I2C* Group number for HAL I2C status codes.

*kStatusGroup\_HAL\_FLASH* Group number for HAL FLASH status codes.

*kStatusGroup\_HAL\_PWM* Group number for HAL PWM status codes.

*kStatusGroup\_HAL\_RNG* Group number for HAL RNG status codes.

*kStatusGroup\_HAL\_I2S* Group number for HAL I2S status codes.  
*kStatusGroup\_TIMERMANAGER* Group number for TiMER MANAGER status codes.  
*kStatusGroup\_SERIALMANAGER* Group number for SERIAL MANAGER status codes.  
*kStatusGroup\_LED* Group number for LED status codes.  
*kStatusGroup\_BUTTON* Group number for BUTTON status codes.  
*kStatusGroup\_EXTERN\_EEPROM* Group number for EXTERN EEPROM status codes.  
*kStatusGroup\_SHELL* Group number for SHELL status codes.  
*kStatusGroup\_MEM\_MANAGER* Group number for MEM MANAGER status codes.  
*kStatusGroup\_LIST* Group number for List status codes.  
*kStatusGroup\_OSA* Group number for OSA status codes.  
*kStatusGroup\_COMMON\_TASK* Group number for Common task status codes.  
*kStatusGroup\_MSG* Group number for messaging status codes.  
*kStatusGroup\_SDK\_OCOTP* Group number for OCOTP status codes.  
*kStatusGroup\_SDK\_FLEXSPINOR* Group number for FLEXSPINOR status codes.  
*kStatusGroup\_CODEC* Group number for codec status codes.  
*kStatusGroup\_ASRC* Group number for codec status ASRC.  
*kStatusGroup\_OTFAD* Group number for codec status codes.  
*kStatusGroup\_SDIOSLV* Group number for SDIOSLV status codes.  
*kStatusGroup\_MECC* Group number for MECC status codes.  
*kStatusGroup\_ENET\_QOS* Group number for ENET\_QOS status codes.  
*kStatusGroup\_LOG* Group number for LOG status codes.  
*kStatusGroup\_I3CBUS* Group number for I3CBUS status codes.  
*kStatusGroup\_QSCI* Group number for QSCI status codes.  
*kStatusGroup\_SNT* Group number for SNT status codes.  
*kStatusGroup\_QUEUEDSPI* Group number for QSPI status codes.  
*kStatusGroup\_POWER\_MANAGER* Group number for POWER\_MANAGER status codes.  
*kStatusGroup\_IPED* Group number for IPED status codes.  
*kStatusGroup\_CSS\_PKC* Group number for CSS PKC status codes.  
*kStatusGroup\_HOSTIF* Group number for HOSTIF status codes.  
*kStatusGroup\_CLIF* Group number for CLIF status codes.  
*kStatusGroup\_BMA* Group number for BMA status codes.

## 6.4.2 anonymous enum

Enumerator

*kStatus\_Success* Generic status for Success.  
*kStatus\_Fail* Generic status for Fail.  
*kStatus\_ReadOnly* Generic status for read only failure.  
*kStatus\_OutOfRange* Generic status for out of range access.  
*kStatus\_InvalidArgument* Generic status for invalid argument check.  
*kStatus\_Timeout* Generic status for timeout.  
*kStatus\_NoTransferInProgress* Generic status for no transfer in progress.  
*kStatus\_Busy* Generic status for module is busy.

***kStatus\_NoData*** Generic status for no data is found for the operation.

## 6.5 Function Documentation

### 6.5.1 void\* SDK\_Malloc ( size\_t size, size\_t alignbytes )

This is provided to support the dynamically allocated memory used in cache-able region.

Parameters

<i>size</i>	The length required to malloc.
<i>alignbytes</i>	The alignment size.

Return values

<i>The</i>	allocated memory.
------------	-------------------

### 6.5.2 void SDK\_Free ( void \* ptr )

Parameters

<i>ptr</i>	The memory to be release.
------------	---------------------------

### 6.5.3 void SDK\_DelayAtLeastUs ( uint32\_t delayTime\_us, uint32\_t coreClock\_Hz )

Please note that, this API uses while loop for delay, different run-time environments make the time not precise, if precise delay count was needed, please implement a new delay function with hardware timer.

Parameters

<i>delayTime_us</i>	Delay time in unit of microsecond.
<i>coreClock_Hz</i>	Core clock frequency with Hz.



## Chapter 7

# ECSPI: Enhanced Configurable Serial Peripheral Interface Driver

### 7.1 Overview

#### Modules

- [ECSPI CMSIS Driver](#)
- [ECSPI Driver](#)
- [ECSPI FreeRTOS Driver](#)



## 7.2 ECSPI Driver

### 7.2.1 Overview

ECSPI driver includes functional APIs and transactional APIs.

Functional APIs are feature/property target low level APIs. Functional APIs can be used for ECSPI initialization/configuration/operation for optimization/customization purpose. Using the functional API requires the knowledge of the SPI peripheral and how to organize functional APIs to meet the application requirements. All functional API use the peripheral base address as the first parameter. ECSPI functional operation groups provide the functional API set.

Transactional APIs are transaction target high level APIs. Transactional APIs can be used to enable the peripheral and in the application if the code size and performance of transactional APIs satisfy the requirements. If the code size and performance are a critical requirement, see the transactional API implementation and write a custom code. All transactional APIs use the `spi_handle_t` as the first parameter. Initialize the handle by calling the `SPI_MasterTransferCreateHandle()` or `SPI_SlaveTransferCreateHandle()` API.

Transactional APIs support asynchronous transfer. This means that the functions `SPI_MasterTransferNonBlocking()` and `SPI_SlaveTransferNonBlocking()` set up the interrupt for data transfer. When the transfer completes, the upper layer is notified through a callback function with the `kStatus_SPI_Idle` status.

### 7.2.2 Typical use case

#### 7.2.2.1 SPI master transfer using polling method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/ecspi`

#### 7.2.2.2 SPI master transfer using an interrupt method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/ecspi`

### Data Structures

- struct `ecspi_channel_config_t`  
*ECSPI user channel configure structure. [More...](#)*
- struct `ecspi_master_config_t`  
*ECSPI master configure structure. [More...](#)*
- struct `ecspi_slave_config_t`  
*ECSPI slave configure structure. [More...](#)*
- struct `ecspi_transfer_t`  
*ECSPI transfer structure. [More...](#)*
- struct `ecspi_master_handle_t`  
*ECSPI master handle structure. [More...](#)*

## Macros

- #define `ECSPI_DUMMYDATA` (0xFFFFFFFFFU)  
*ECSPI dummy transfer data, the data is sent while txBuff is NULL.*
- #define `SPI_RETRY_TIMES` 0U /\* Define to zero means keep waiting until the flag is assert/deassert. \*/  
*Retry times for waiting flag.*

## Typedefs

- typedef `ecspi_master_handle_t` `ecspi_slave_handle_t`  
*Slave handle is the same with master handle.*
- typedef void(\* `ecspi_master_callback_t` )(ECSPI\_Type \*base, `ecspi_master_handle_t` \*handle, `status_t` status, void \*userData)  
*ECSPI master callback for finished transmit.*
- typedef void(\* `ecspi_slave_callback_t` )(ECSPI\_Type \*base, `ecspi_slave_handle_t` \*handle, `status_t` status, void \*userData)  
*ECSPI slave callback for finished transmit.*

## Enumerations

- enum {  
  `kStatus_ECSPI_Busy` = MAKE\_STATUS(kStatusGroup\_ECSPI, 0),  
  `kStatus_ECSPI_Idle` = MAKE\_STATUS(kStatusGroup\_ECSPI, 1),  
  `kStatus_ECSPI_Error` = MAKE\_STATUS(kStatusGroup\_ECSPI, 2),  
  `kStatus_ECSPI_HardwareOverflow` = MAKE\_STATUS(kStatusGroup\_ECSPI, 3),  
  `kStatus_ECSPI_Timeout` = MAKE\_STATUS(kStatusGroup\_ECSPI, 4) }  
*Return status for the ECSPI driver.*
- enum `ecspi_clock_polarity_t` {  
  `kECSPI_PolarityActiveHigh` = 0x0U,  
  `kECSPI_PolarityActiveLow` }  
*ECSPI clock polarity configuration.*
- enum `ecspi_clock_phase_t` {  
  `kECSPI_ClockPhaseFirstEdge`,  
  `kECSPI_ClockPhaseSecondEdge` }  
*ECSPI clock phase configuration.*
- enum {  
  `kECSPI_Tx_fifoEmptyInterruptEnable` = ECSPI\_INTREG\_TEEN\_MASK,  
  `kECSPI_Tx_fifoDataRequestInterruptEnable` = ECSPI\_INTREG\_TDREN\_MASK,  
  `kECSPI_Tx_fifoFullInterruptEnable` = ECSPI\_INTREG\_TFEN\_MASK,  
  `kECSPI_Rx_fifoReadyInterruptEnable` = ECSPI\_INTREG\_RREN\_MASK,  
  `kECSPI_Rx_fifoDataRequestInterruptEnable` = ECSPI\_INTREG\_RDREN\_MASK,  
  `kECSPI_Rx_fifoFullInterruptEnable` = ECSPI\_INTREG\_RFEN\_MASK,  
  `kECSPI_Rx_fifoOverflowInterruptEnable` = ECSPI\_INTREG\_ROEN\_MASK,  
  `kECSPI_TransferCompleteInterruptEnable` = ECSPI\_INTREG\_TCEN\_MASK,

- `kECSPI_AllInterruptEnable` }  
*ECSPI interrupt sources.*
- enum {  
`kECSPI_TxFifoEmptyFlag` = ECSPI\_STATREG\_TE\_MASK,  
`kECSPI_TxFifoDataRequestFlag` = ECSPI\_STATREG\_TDR\_MASK,  
`kECSPI_TxFifoFullFlag` = ECSPI\_STATREG\_TF\_MASK,  
`kECSPI_RxFifoReadyFlag` = ECSPI\_STATREG\_RR\_MASK,  
`kECSPI_RxFifoDataRequestFlag` = ECSPI\_STATREG\_RDR\_MASK,  
`kECSPI_RxFifoFullFlag` = ECSPI\_STATREG\_RF\_MASK,  
`kECSPI_RxFifoOverflowFlag` = ECSPI\_STATREG\_RO\_MASK,  
`kECSPI_TransferCompleteFlag` = ECSPI\_STATREG\_TC\_MASK }  
*ECSPI status flags.*
- enum {  
`kECSPI_TxDmaEnable` = ECSPI\_DMAREG\_TEDEN\_MASK,  
`kECSPI_RxDmaEnable` = ECSPI\_DMAREG\_RXDEN\_MASK,  
`kECSPI_DmaAllEnable` = (ECSPI\_DMAREG\_TEDEN\_MASK | ECSPI\_DMAREG\_RXDEN\_MASK) }  
*ECSPI DMA enable.*
- enum `ecspi_Data_ready_t` {  
`kECSPI_DataReadyIgnore` = 0x0U,  
`kECSPI_DataReadyFallingEdge`,  
`kECSPI_DataReadyLowLevel` }  
*ECSPI SPI\_RDY signal configuration.*
- enum `ecspi_channel_source_t` {  
`kECSPI_Channel0` = 0x0U,  
`kECSPI_Channel1`,  
`kECSPI_Channel2`,  
`kECSPI_Channel3` }  
*ECSPI channel select source.*
- enum `ecspi_master_slave_mode_t` {  
`kECSPI_Slave` = 0U,  
`kECSPI_Master` }  
*ECSPI master or slave mode configuration.*
- enum `ecspi_data_line_inactive_state_t` {  
`kECSPI_DataLineInactiveStateHigh` = 0x0U,  
`kECSPI_DataLineInactiveStateLow` }  
*ECSPI data line inactive state configuration.*
- enum `ecspi_clock_inactive_state_t` {  
`kECSPI_ClockInactiveStateLow` = 0x0U,  
`kECSPI_ClockInactiveStateHigh` }  
*ECSPI clock inactive state configuration.*
- enum `ecspi_chip_select_active_state_t` {  
`kECSPI_ChipSelectActiveStateLow` = 0x0U,  
`kECSPI_ChipSelectActiveStateHigh` }  
*ECSPI active state configuration.*
- enum `ecspi_sample_period_clock_source_t` {  
`kECSPI_spiClock` = 0x0U,

`kECSPI_lowFreqClock` }  
*ECSPI sample period clock configuration.*

## Functions

- `uint32_t ECSPI_GetInstance` (ECSPI\_Type \*base)  
*Get the instance for ECSPI module.*

## Driver version

- `#define FSL_ECSPI_DRIVER_VERSION` (MAKE\_VERSION(2, 2, 0))  
*ECSPI driver version.*

## Initialization and deinitialization

- `void ECSPI_MasterGetDefaultConfig` (ecspi\_master\_config\_t \*config)  
*Sets the ECSPI configuration structure to default values.*
- `void ECSPI_MasterInit` (ECSPI\_Type \*base, const ecspi\_master\_config\_t \*config, uint32\_t src-Clock\_Hz)  
*Initializes the ECSPI with configuration.*
- `void ECSPI_SlaveGetDefaultConfig` (ecspi\_slave\_config\_t \*config)  
*Sets the ECSPI configuration structure to default values.*
- `void ECSPI_SlaveInit` (ECSPI\_Type \*base, const ecspi\_slave\_config\_t \*config)  
*Initializes the ECSPI with configuration.*
- `void ECSPI_Deinit` (ECSPI\_Type \*base)  
*De-initializes the ECSPI.*
- `static void ECSPI_Enable` (ECSPI\_Type \*base, bool enable)  
*Enables or disables the ECSPI.*

## Status

- `static uint32_t ECSPI_GetStatusFlags` (ECSPI\_Type \*base)  
*Gets the status flag.*
- `static void ECSPI_ClearStatusFlags` (ECSPI\_Type \*base, uint32\_t mask)  
*Clear the status flag.*

## Interrupts

- `static void ECSPI_EnableInterrupts` (ECSPI\_Type \*base, uint32\_t mask)  
*Enables the interrupt for the ECSPI.*
- `static void ECSPI_DisableInterrupts` (ECSPI\_Type \*base, uint32\_t mask)  
*Disables the interrupt for the ECSPI.*

## Software Reset

- static void [ECSPI\\_SoftwareReset](#) (ECSPI\_Type \*base)  
*Software reset.*

## Channel mode check

- static bool [ECSPI\\_IsMaster](#) (ECSPI\_Type \*base, [ecspi\\_channel\\_source\\_t](#) channel)  
*Mode check.*

## DMA Control

- static void [ECSPI\\_EnableDMA](#) (ECSPI\_Type \*base, uint32\_t mask, bool enable)  
*Enables the DMA source for ECSPI.*

## FIFO Operation

- static uint8\_t [ECSPI\\_GetTxFifoCount](#) (ECSPI\_Type \*base)  
*Get the Tx FIFO data count.*
- static uint8\_t [ECSPI\\_GetRxFifoCount](#) (ECSPI\_Type \*base)  
*Get the Rx FIFO data count.*

## Bus Operations

- static void [ECSPI\\_SetChannelSelect](#) (ECSPI\_Type \*base, [ecspi\\_channel\\_source\\_t](#) channel)  
*Set channel select for transfer.*
- void [ECSPI\\_SetChannelConfig](#) (ECSPI\_Type \*base, [ecspi\\_channel\\_source\\_t](#) channel, const [ecspi\\_channel\\_config\\_t](#) \*config)  
*Set channel select configuration for transfer.*
- void [ECSPI\\_SetBaudRate](#) (ECSPI\_Type \*base, uint32\_t baudRate\_Bps, uint32\_t srcClock\_Hz)  
*Sets the baud rate for ECSPI transfer.*
- [status\\_t](#) [ECSPI\\_WriteBlocking](#) (ECSPI\_Type \*base, uint32\_t \*buffer, size\_t size)  
*Sends a buffer of data bytes using a blocking method.*
- static void [ECSPI\\_WriteData](#) (ECSPI\_Type \*base, uint32\_t data)  
*Writes a data into the ECSPI data register.*
- static uint32\_t [ECSPI\\_ReadData](#) (ECSPI\_Type \*base)  
*Gets a data from the ECSPI data register.*

## Transactional

- void [ECSPI\\_MasterTransferCreateHandle](#) (ECSPI\_Type \*base, [ecspi\\_master\\_handle\\_t](#) \*handle, [ecspi\\_master\\_callback\\_t](#) callback, void \*userData)  
*Initializes the ECSPI master handle.*
- [status\\_t](#) [ECSPI\\_MasterTransferBlocking](#) (ECSPI\_Type \*base, [ecspi\\_transfer\\_t](#) \*xfer)

- Transfers a block of data using a polling method.
- [status\\_t ECSPI\\_MasterTransferNonBlocking](#) (ECSPI\_Type \*base, [ecspi\\_master\\_handle\\_t](#) \*handle, [ecspi\\_transfer\\_t](#) \*xfer)
- Performs a non-blocking ECSPI interrupt transfer.
- [status\\_t ECSPI\\_MasterTransferGetCount](#) (ECSPI\_Type \*base, [ecspi\\_master\\_handle\\_t](#) \*handle, [size\\_t](#) \*count)
- Gets the bytes of the ECSPI interrupt transferred.
- void [ECSPI\\_MasterTransferAbort](#) (ECSPI\_Type \*base, [ecspi\\_master\\_handle\\_t](#) \*handle)
- Aborts an ECSPI transfer using interrupt.
- void [ECSPI\\_MasterTransferHandleIRQ](#) (ECSPI\_Type \*base, [ecspi\\_master\\_handle\\_t](#) \*handle)
- Interrupts the handler for the ECSPI.
- void [ECSPI\\_SlaveTransferCreateHandle](#) (ECSPI\_Type \*base, [ecspi\\_slave\\_handle\\_t](#) \*handle, [ecspi\\_slave\\_callback\\_t](#) callback, void \*userData)
- Initializes the ECSPI slave handle.
- static [status\\_t ECSPI\\_SlaveTransferNonBlocking](#) (ECSPI\_Type \*base, [ecspi\\_slave\\_handle\\_t](#) \*handle, [ecspi\\_transfer\\_t](#) \*xfer)
- Performs a non-blocking ECSPI slave interrupt transfer.
- static [status\\_t ECSPI\\_SlaveTransferGetCount](#) (ECSPI\_Type \*base, [ecspi\\_slave\\_handle\\_t](#) \*handle, [size\\_t](#) \*count)
- Gets the bytes of the ECSPI interrupt transferred.
- static void [ECSPI\\_SlaveTransferAbort](#) (ECSPI\_Type \*base, [ecspi\\_slave\\_handle\\_t](#) \*handle)
- Aborts an ECSPI slave transfer using interrupt.
- void [ECSPI\\_SlaveTransferHandleIRQ](#) (ECSPI\_Type \*base, [ecspi\\_slave\\_handle\\_t](#) \*handle)
- Interrupts a handler for the ECSPI slave.

## 7.2.3 Data Structure Documentation

### 7.2.3.1 struct [ecspi\\_channel\\_config\\_t](#)

#### Data Fields

- [ecspi\\_master\\_slave\\_mode\\_t](#) channelMode  
Channel mode.
- [ecspi\\_clock\\_inactive\\_state\\_t](#) clockInactiveState  
Clock line (SCLK) inactive state.
- [ecspi\\_data\\_line\\_inactive\\_state\\_t](#) dataLineInactiveState  
Data line (MOSI&MISO) inactive state.
- [ecspi\\_chip\\_select\\_active\\_state\\_t](#) chipSlectActiveState  
Chip select(SS) line active state.
- [ecspi\\_clock\\_polarity\\_t](#) polarity  
Clock polarity.
- [ecspi\\_clock\\_phase\\_t](#) phase  
Clock phase.

### 7.2.3.2 struct ecspi\_master\_config\_t

#### Data Fields

- [ecspi\\_channel\\_source\\_t channel](#)  
*Channel number.*
- [ecspi\\_channel\\_config\\_t channelConfig](#)  
*Channel configuration.*
- [ecspi\\_sample\\_period\\_clock\\_source\\_t samplePeriodClock](#)  
*Sample period clock source.*
- [uint8\\_t burstLength](#)  
*Burst length.*
- [uint8\\_t chipSelectDelay](#)  
*SS delay time.*
- [uint16\\_t samplePeriod](#)  
*Sample period.*
- [uint8\\_t txFifoThreshold](#)  
*TX Threshold.*
- [uint8\\_t rxFifoThreshold](#)  
*RX Threshold.*
- [uint32\\_t baudRate\\_Bps](#)  
*ECSPI baud rate for master mode.*
- [bool enableLoopback](#)  
*Enable the ECSPI loopback test.*

#### Field Documentation

(1) [bool ecspi\\_master\\_config\\_t::enableLoopback](#)

### 7.2.3.3 struct ecspi\_slave\_config\_t

#### Data Fields

- [uint8\\_t burstLength](#)  
*Burst length.*
- [uint8\\_t txFifoThreshold](#)  
*TX Threshold.*
- [uint8\\_t rxFifoThreshold](#)  
*RX Threshold.*
- [ecspi\\_channel\\_config\\_t channelConfig](#)  
*Channel configuration.*

### 7.2.3.4 struct ecspi\_transfer\_t

#### Data Fields

- [uint32\\_t \\* txData](#)  
*Send buffer.*
- [uint32\\_t \\* rxData](#)  
*Receive buffer.*

- `size_t dataSize`  
*Transfer bytes.*
- `ecspi_channel_source_t channel`  
*ECSPI channel select.*

### 7.2.3.5 struct \_ecspi\_master\_handle

#### Data Fields

- `ecspi_channel_source_t channel`  
*Channel number.*
- `uint32_t *volatile txData`  
*Transfer buffer.*
- `uint32_t *volatile rxData`  
*Receive buffer.*
- `volatile size_t txRemainingBytes`  
*Send data remaining in bytes.*
- `volatile size_t rxRemainingBytes`  
*Receive data remaining in bytes.*
- `volatile uint32_t state`  
*ECSPI internal state.*
- `size_t transferSize`  
*Bytes to be transferred.*
- `ecspi_master_callback_t callback`  
*ECSPI callback.*
- `void * userData`  
*Callback parameter.*

## 7.2.4 Macro Definition Documentation

**7.2.4.1 #define FSL\_ECSPi\_DRIVER\_VERSION (MAKE\_VERSION(2, 2, 0))**

**7.2.4.2 #define ECSPi\_DUMMYDATA (0xFFFFFFFFFU)**

**7.2.4.3 #define SPI\_RETRY\_TIMES 0U /\* Define to zero means keep waiting until the flag is assert/deassert. \*/**

## 7.2.5 Enumeration Type Documentation

### 7.2.5.1 anonymous enum

Enumerator

***kStatus\_ECSPi\_Busy*** ECSPI bus is busy.  
***kStatus\_ECSPi\_Idle*** ECSPI is idle.  
***kStatus\_ECSPi\_Error*** ECSPI error.



***kStatus\_ECSPI\_HardwareOverflow*** ECSPI hardware overflow.

***kStatus\_ECSPI\_Timeout*** ECSPI timeout polling status flags.

### 7.2.5.2 enum ecspi\_clock\_polarity\_t

Enumerator

***kECSPI\_PolarityActiveHigh*** Active-high ECSPI polarity high (idles low).

***kECSPI\_PolarityActiveLow*** Active-low ECSPI polarity low (idles high).

### 7.2.5.3 enum ecspi\_clock\_phase\_t

Enumerator

***kECSPI\_ClockPhaseFirstEdge*** First edge on SPCK occurs at the middle of the first cycle of a data transfer.

***kECSPI\_ClockPhaseSecondEdge*** First edge on SPCK occurs at the start of the first cycle of a data transfer.

### 7.2.5.4 anonymous enum

Enumerator

***kECSPI\_TxfifoEmptyInterruptEnable*** Transmit FIFO buffer empty interrupt.

***kECSPI\_TxFifoDataRequestInterruptEnable*** Transmit FIFO data request interrupt.

***kECSPI\_TxFifoFullInterruptEnable*** Transmit FIFO full interrupt.

***kECSPI\_RxFifoReadyInterruptEnable*** Receiver FIFO ready interrupt.

***kECSPI\_RxFifoDataRequestInterruptEnable*** Receiver FIFO data request interrupt.

***kECSPI\_RxFifoFullInterruptEnable*** Receiver FIFO full interrupt.

***kECSPI\_RxFifoOverflowInterruptEnable*** Receiver FIFO buffer overflow interrupt.

***kECSPI\_TransferCompleteInterruptEnable*** Transfer complete interrupt.

***kECSPI\_AllInterruptEnable*** All interrupt.

### 7.2.5.5 anonymous enum

Enumerator

***kECSPI\_TxfifoEmptyFlag*** Transmit FIFO buffer empty flag.

***kECSPI\_TxFifoDataRequestFlag*** Transmit FIFO data request flag.

***kECSPI\_TxFifoFullFlag*** Transmit FIFO full flag.

***kECSPI\_RxFifoReadyFlag*** Receiver FIFO ready flag.

***kECSPI\_RxFifoDataRequestFlag*** Receiver FIFO data request flag.

***kECSPI\_RxFifoFullFlag*** Receiver FIFO full flag.

***kECSPI\_RxFifoOverflowFlag*** Receiver FIFO buffer overflow flag.

***kECSPI\_TransferCompleteFlag*** Transfer complete flag.

### 7.2.5.6 anonymous enum

Enumerator

*kECSPI\_TxDmaEnable* Tx DMA request source.  
*kECSPI\_RxDmaEnable* Rx DMA request source.  
*kECSPI\_DmaAllEnable* All DMA request source.

### 7.2.5.7 enum ecspi\_Data\_ready\_t

Enumerator

*kECSPI\_DataReadyIgnore* SPI\_RDY signal is ignored.  
*kECSPI\_DataReadyFallingEdge* SPI\_RDY signal will be triggered by the falling edge.  
*kECSPI\_DataReadyLowLevel* SPI\_RDY signal will be triggered by a low level.

### 7.2.5.8 enum ecspi\_channel\_source\_t

Enumerator

*kECSPI\_Channel0* Channel 0 is selected.  
*kECSPI\_Channel1* Channel 1 is selected.  
*kECSPI\_Channel2* Channel 2 is selected.  
*kECSPI\_Channel3* Channel 3 is selected.

### 7.2.5.9 enum ecspi\_master\_slave\_mode\_t

Enumerator

*kECSPI\_Slave* ECSPI peripheral operates in slave mode.  
*kECSPI\_Master* ECSPI peripheral operates in master mode.

### 7.2.5.10 enum ecspi\_data\_line\_inactive\_state\_t

Enumerator

*kECSPI\_DataLineInactiveStateHigh* The data line inactive state stays high.  
*kECSPI\_DataLineInactiveStateLow* The data line inactive state stays low.

### 7.2.5.11 enum ecspi\_clock\_inactive\_state\_t

Enumerator

***kECSPI\_ClockInactiveStateLow*** The SCLK inactive state stays low.

***kECSPI\_ClockInactiveStateHigh*** The SCLK inactive state stays high.

### 7.2.5.12 enum ecspi\_chip\_select\_active\_state\_t

Enumerator

***kECSPI\_ChipSelectActiveStateLow*** The SS signal line active stays low.

***kECSPI\_ChipSelectActiveStateHigh*** The SS signal line active stays high.

### 7.2.5.13 enum ecspi\_sample\_period\_clock\_source\_t

Enumerator

***kECSPI\_spiClock*** The sample period clock source is SCLK.

***kECSPI\_lowFreqClock*** The sample period clock source is low\_frequency reference clock(32.768 kHz).

## 7.2.6 Function Documentation

### 7.2.6.1 uint32\_t ECSPI\_GetInstance ( ECSPI\_Type \* *base* )

Parameters

<i>base</i>	ECSPI base address
-------------	--------------------

### 7.2.6.2 void ECSPI\_MasterGetDefaultConfig ( ecspi\_master\_config\_t \* *config* )

The purpose of this API is to get the configuration structure initialized for use in [ECSPI\\_MasterInit\(\)](#). User may use the initialized structure unchanged in ECSPI\_MasterInit, or modify some fields of the structure before calling ECSPI\_MasterInit. After calling this API, the master is ready to transfer. Example:

```
ecspi_master_config_t config;
ECSPI_MasterGetDefaultConfig(&config);
```

## Parameters

<i>config</i>	pointer to config structure
---------------	-----------------------------

### 7.2.6.3 void ECSPI\_MasterInit ( ECSPI\_Type \* *base*, const *ecspi\_master\_config\_t* \* *config*, *uint32\_t srcClock\_Hz* )

The configuration structure can be filled by user from scratch, or be set with default values by [ECSPI\\_MasterGetDefaultConfig\(\)](#). After calling this API, the slave is ready to transfer. Example

```
ecspi_master_config_t config = {
    .baudRate_Bps = 400000,
    ...
};
ECSPI_MasterInit(ECSPI0, &config);
```

## Parameters

<i>base</i>	ECSPI base pointer
<i>config</i>	pointer to master configuration structure
<i>srcClock_Hz</i>	Source clock frequency.

### 7.2.6.4 void ECSPI\_SlaveGetDefaultConfig ( *ecspi\_slave\_config\_t* \* *config* )

The purpose of this API is to get the configuration structure initialized for use in [ECSPI\\_SlaveInit\(\)](#). User may use the initialized structure unchanged in [ECSPI\\_SlaveInit\(\)](#), or modify some fields of the structure before calling [ECSPI\\_SlaveInit\(\)](#). After calling this API, the master is ready to transfer. Example:

```
ecspi_slaveconfig_t config;
ECSPI_SlaveGetDefaultConfig(&config);
```

## Parameters

<i>config</i>	pointer to config structure
---------------	-----------------------------

### 7.2.6.5 void ECSPI\_SlaveInit ( ECSPI\_Type \* *base*, const *ecspi\_slave\_config\_t* \* *config* )

The configuration structure can be filled by user from scratch, or be set with default values by [ECSPI\\_SlaveGetDefaultConfig\(\)](#). After calling this API, the slave is ready to transfer. Example

```
ecspi_slaveconfig_t config = {
    .baudRate_Bps = 400000,
    ...
};
ECSPI_SlaveInit(ECSPI1, &config);
```

## Parameters

<i>base</i>	ECSPI base pointer
<i>config</i>	pointer to master configuration structure

**7.2.6.6 void ECSPI\_Deinit ( ECSPI\_Type \* *base* )**

Calling this API resets the ECSPI module, gates the ECSPI clock. The ECSPI module can't work unless calling the ECSPI\_MasterInit/ECSPI\_SlaveInit to initialize module.

## Parameters

<i>base</i>	ECSPI base pointer
-------------	--------------------

**7.2.6.7 static void ECSPI\_Enable ( ECSPI\_Type \* *base*, bool *enable* ) [inline], [static]**

## Parameters

<i>base</i>	ECSPI base pointer
<i>enable</i>	pass true to enable module, false to disable module

**7.2.6.8 static uint32\_t ECSPI\_GetStatusFlags ( ECSPI\_Type \* *base* ) [inline], [static]**

## Parameters

<i>base</i>	ECSPI base pointer
-------------	--------------------

## Returns

ECSPI Status, use status flag to AND \_ecspi\_flags could get the related status.

**7.2.6.9 static void ECSPI\_ClearStatusFlags ( ECSPI\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

Parameters

<i>base</i>	ECSPI base pointer
<i>mask</i>	ECSPI Status, use status flag to AND _ecspi_flags could get the related status.

**7.2.6.10 static void ECSPI\_EnableInterrupts ( ECSPI\_Type \* *base*, uint32\_t *mask* )**  
**[inline], [static]**

Parameters

<i>base</i>	ECSPI base pointer
<i>mask</i>	ECSPI interrupt source. The parameter can be any combination of the following values: <ul style="list-style-type: none"> <li>• kECSPI_TxfifoEmptyInterruptEnable</li> <li>• kECSPI_TxFifoDataRequestInterruptEnable</li> <li>• kECSPI_TxFifoFullInterruptEnable</li> <li>• kECSPI_RxFifoReadyInterruptEnable</li> <li>• kECSPI_RxFifoDataRequestInterruptEnable</li> <li>• kECSPI_RxFifoFullInterruptEnable</li> <li>• kECSPI_RxFifoOverflowInterruptEnable</li> <li>• kECSPI_TransferCompleteInterruptEnable</li> <li>• kECSPI_AllInterruptEnable</li> </ul>

**7.2.6.11 static void ECSPI\_DisableInterrupts ( ECSPI\_Type \* *base*, uint32\_t *mask* )**  
**[inline], [static]**

Parameters

<i>base</i>	ECSPI base pointer
<i>mask</i>	ECSPI interrupt source. The parameter can be any combination of the following values: <ul style="list-style-type: none"> <li>• kECSPI_TxfifoEmptyInterruptEnable</li> <li>• kECSPI_TxFifoDataRequestInterruptEnable</li> <li>• kECSPI_TxFifoFullInterruptEnable</li> <li>• kECSPI_RxFifoReadyInterruptEnable</li> <li>• kECSPI_RxFifoDataRequestInterruptEnable</li> <li>• kECSPI_RxFifoFullInterruptEnable</li> <li>• kECSPI_RxFifoOverflowInterruptEnable</li> <li>• kECSPI_TransferCompleteInterruptEnable</li> <li>• kECSPI_AllInterruptEnable</li> </ul>

**7.2.6.12 static void ECSPI\_SoftwareReset ( ECSPI\_Type \* *base* )** **[inline],**  
**[static]**

Parameters

<i>base</i>	ECSPI base pointer
-------------	--------------------

**7.2.6.13 static bool ECSPI\_IsMaster ( ECSPI\_Type \* *base*, ecspi\_channel\_source\_t**  
***channel* )** **[inline], [static]**

Parameters

<i>base</i>	ECSPI base pointer
<i>channel</i>	ECSPI channel source

Returns

mode of channel

**7.2.6.14 static void ECSPI\_EnableDMA ( ECSPI\_Type \* *base*, uint32\_t *mask*, bool *enable***  
**)** **[inline], [static]**

## Parameters

<i>base</i>	ECSPI base pointer
<i>mask</i>	ECSPI DMA source. The parameter can be any of the following values: <ul style="list-style-type: none"> <li>• kECSPI_TxDmaEnable</li> <li>• kECSPI_RxDmaEnable</li> <li>• kECSPI_DmaAllEnable</li> </ul>
<i>enable</i>	True means enable DMA, false means disable DMA

### 7.2.6.15 static uint8\_t ECSPI\_GetTxFifoCount ( ECSPI\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	ECSPI base pointer.
-------------	---------------------

## Returns

the number of words in Tx FIFO buffer.

### 7.2.6.16 static uint8\_t ECSPI\_GetRxFifoCount ( ECSPI\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	ECSPI base pointer.
-------------	---------------------

## Returns

the number of words in Rx FIFO buffer.

### 7.2.6.17 static void ECSPI\_SetChannelSelect ( ECSPI\_Type \* *base*, ecspi\_channel\_source\_t *channel* ) [inline], [static]



## Parameters

<i>base</i>	ECSPI base pointer
<i>channel</i>	Channel source.

#### 7.2.6.18 void ECSPI\_SetChannelConfig ( ECSPI\_Type \* *base*, ecspi\_channel\_source\_t *channel*, const ecspi\_channel\_config\_t \* *config* )

The purpose of this API is to set the channel will be use to transfer. User may use this API after instance has been initialized or before transfer start. The configuration structure *ecspi\_channel\_config* can be filled by user from scratch. After calling this API, user can select this channel as transfer channel.

## Parameters

<i>base</i>	ECSPI base pointer
<i>channel</i>	Channel source.
<i>config</i>	Configuration struct of channel

#### 7.2.6.19 void ECSPI\_SetBaudRate ( ECSPI\_Type \* *base*, uint32\_t *baudRate\_Bps*, uint32\_t *srcClock\_Hz* )

This is only used in master.

## Parameters

<i>base</i>	ECSPI base pointer
<i>baudRate_Bps</i>	baud rate needed in Hz.
<i>srcClock_Hz</i>	ECSPI source clock frequency in Hz.

#### 7.2.6.20 status\_t ECSPI\_WriteBlocking ( ECSPI\_Type \* *base*, uint32\_t \* *buffer*, size\_t *size* )

## Note

This function blocks via polling until all bytes have been sent.

## Parameters

<i>base</i>	ECSPI base pointer
<i>buffer</i>	The data bytes to send
<i>size</i>	The number of data bytes to send

## Return values

<i>kStatus_Success</i>	Successfully start a transfer.
<i>kStatus_ECSPI_Timeout</i>	The transfer timed out and was aborted.

**7.2.6.21** `static void ECSPI_WriteData ( ECSPI_Type * base, uint32_t data ) [inline], [static]`

## Parameters

<i>base</i>	ECSPI base pointer
<i>data</i>	Data needs to be write.

**7.2.6.22** `static uint32_t ECSPI_ReadData ( ECSPI_Type * base ) [inline], [static]`

## Parameters

<i>base</i>	ECSPI base pointer
-------------	--------------------

## Returns

Data in the register.

**7.2.6.23** `void ECSPI_MasterTransferCreateHandle ( ECSPI_Type * base,  
ecspi_master_handle_t * handle, ecspi_master_callback_t callback, void *  
userData )`

This function initializes the ECSPI master handle which can be used for other ECSPI master transactional APIs. Usually, for a specified ECSPI instance, call this API once to get the initialized handle.

#### Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	ECSPI handle pointer.
<i>callback</i>	Callback function.
<i>userData</i>	User data.

#### 7.2.6.24 **status\_t** **ECSPI\_MasterTransferBlocking** ( **ECSPI\_Type** \* *base*, **ecspi\_transfer\_t** \* *xfer* )

#### Parameters

<i>base</i>	SPI base pointer
<i>xfer</i>	pointer to spi_xfer_config_t structure

#### Return values

<i>kStatus_Success</i>	Successfully start a transfer.
<i>kStatus_InvalidArgument</i>	Input argument is invalid.
<i>kStatus_ECSPi_Timeout</i>	The transfer timed out and was aborted.

#### 7.2.6.25 **status\_t** **ECSPI\_MasterTransferNonBlocking** ( **ECSPI\_Type** \* *base*, **ecspi\_master\_handle\_t** \* *handle*, **ecspi\_transfer\_t** \* *xfer* )

#### Note

The API immediately returns after transfer initialization is finished.  
If ECSPI transfer data frame size is 16 bits, the transfer size cannot be an odd number.

#### Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	pointer to ecspi_master_handle_t structure which stores the transfer state
<i>xfer</i>	pointer to <a href="#">ecspi_transfer_t</a> structure

Return values

<i>kStatus_Success</i>	Successfully start a transfer.
<i>kStatus_InvalidArgument</i>	Input argument is invalid.
<i>kStatus_ECSPi_Busy</i>	ECSPI is not idle, is running another transfer.

#### 7.2.6.26 **status\_t ECSPI\_MasterTransferGetCount ( ECSPI\_Type \* *base*, ecspi\_master\_handle\_t \* *handle*, size\_t \* *count* )**

Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	Pointer to ECSPI transfer handle, this should be a static variable.
<i>count</i>	Transferred bytes of ECSPI master.

Return values

<i>kStatus_ECSPi_Success</i>	Succeed get the transfer count.
<i>kStatus_NoTransferInProgress</i>	There is not a non-blocking transaction currently in progress.

#### 7.2.6.27 **void ECSPI\_MasterTransferAbort ( ECSPI\_Type \* *base*, ecspi\_master\_handle\_t \* *handle* )**

Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	Pointer to ECSPI transfer handle, this should be a static variable.

#### 7.2.6.28 **void ECSPI\_MasterTransferHandleIRQ ( ECSPI\_Type \* *base*, ecspi\_master\_handle\_t \* *handle* )**

Parameters

---

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	pointer to <code>ecspi_master_handle_t</code> structure which stores the transfer state.

**7.2.6.29** `void ECSPISlaveTransferCreateHandle ( ECSPISlaveType * base,  
ecspi_slave_handle_t * handle, ecspi_slave_callback_t callback, void * userData  
)`

This function initializes the ECSPI slave handle which can be used for other ECSPI slave transactional APIs. Usually, for a specified ECSPI instance, call this API once to get the initialized handle.

Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	ECSPI handle pointer.
<i>callback</i>	Callback function.
<i>userData</i>	User data.

**7.2.6.30** `static status_t ECSPISlaveTransferNonBlocking ( ECSPISlaveType * base,  
ecspi_slave_handle_t * handle, ecspi_transfer_t * xfer ) [inline], [static]`

Note

The API returns immediately after the transfer initialization is finished.

Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	pointer to <code>ecspi_master_handle_t</code> structure which stores the transfer state
<i>xfer</i>	pointer to <a href="#">ecspi_transfer_t</a> structure

Return values

<i>kStatus_Success</i>	Successfully start a transfer.
<i>kStatus_InvalidArgument</i>	Input argument is invalid.
<i>kStatus_ECSPISlave_Busy</i>	ECSPI is not idle, is running another transfer.

**7.2.6.31** `static status_t ECSPISlaveTransferGetCount ( ECSPISlaveType * base,  
ecspi_slave_handle_t * handle, size_t * count ) [inline], [static]`

#### Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	Pointer to ECSPI transfer handle, this should be a static variable.
<i>count</i>	Transferred bytes of ECSPI slave.

#### Return values

<i>kStatus_ECSPI_Success</i>	Succeed get the transfer count.
<i>kStatus_NoTransferInProgress</i>	There is not a non-blocking transaction currently in progress.

**7.2.6.32 static void ECSPI\_SlaveTransferAbort ( ECSPI\_Type \* *base*,  
ecspi\_slave\_handle\_t \* *handle* ) [inline], [static]**

#### Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	Pointer to ECSPI transfer handle, this should be a static variable.

**7.2.6.33 void ECSPI\_SlaveTransferHandleIRQ ( ECSPI\_Type \* *base*, ecspi\_slave\_handle\_t \* *handle* )**

#### Parameters

<i>base</i>	ECSPI peripheral base address.
<i>handle</i>	pointer to ecspi_slave_handle_t structure which stores the transfer state

## 7.3 ECSPI FreeRTOS Driver

### 7.3.1 Overview

#### Driver version

- #define `FSL_ECSPI_FREERTOS_DRIVER_VERSION` (`MAKE_VERSION(2, 2, 0)`)  
*ECSPI FreeRTOS driver version.*

### ECSPI RTOS Operation

- `status_t ECSPI_RTOS_Init` (`ecspi_rtos_handle_t *handle`, `ECSPI_Type *base`, `const ecspi_master_config_t *masterConfig`, `uint32_t srcClock_Hz`)  
*Initializes ECSPI.*
- `status_t ECSPI_RTOS_Deinit` (`ecspi_rtos_handle_t *handle`)  
*Deinitializes the ECSPI.*
- `status_t ECSPI_RTOS_Transfer` (`ecspi_rtos_handle_t *handle`, `ecspi_transfer_t *transfer`)  
*Performs ECSPI transfer.*

### 7.3.2 Macro Definition Documentation

#### 7.3.2.1 #define FSL\_ECSPI\_FREERTOS\_DRIVER\_VERSION (MAKE\_VERSION(2, 2, 0))

### 7.3.3 Function Documentation

#### 7.3.3.1 `status_t ECSPI_RTOS_Init ( ecspi_rtos_handle_t * handle, ECSPI_Type * base, const ecspi_master_config_t * masterConfig, uint32_t srcClock_Hz )`

This function initializes the ECSPI module and related RTOS context.

Parameters

<i>handle</i>	The RTOS ECSPI handle, the pointer to an allocated space for RTOS context.
<i>base</i>	The pointer base address of the ECSPI instance to initialize.
<i>masterConfig</i>	Configuration structure to set-up ECSPI in master mode.
<i>srcClock_Hz</i>	Frequency of input clock of the ECSPI module.

Returns

status of the operation.

### 7.3.3.2 `status_t ECSPI_RTOS_Deinit ( ecspi_rtos_handle_t * handle )`

This function deinitializes the ECSPI module and related RTOS context.



## Parameters

<i>handle</i>	The RTOS ECSPI handle.
---------------	------------------------

### 7.3.3.3 `status_t ECSPI_RTOS_Transfer ( ecspi_rtos_handle_t * handle, ecspi_transfer_t * transfer )`

This function performs an ECSPI transfer according to data given in the transfer structure.

## Parameters

<i>handle</i>	The RTOS ECSPI handle.
<i>transfer</i>	Structure specifying the transfer parameters.

## Returns

status of the operation.

## 7.4 ECSPI CMSIS Driver

This section describes the programming interface of the ecspi Cortex Microcontroller Software Interface Standard (CMSIS) driver. And this driver defines generic peripheral driver interfaces for middleware making it reusable across a wide range of supported microcontroller devices. The API connects microcontroller peripherals with middleware that implements for example communication stacks, file systems, or graphic user interfaces. More information and usage method please refer to <http://www.keil.com/pack/doc/cmsis/Driver/html/index.html>.

### 7.4.1 Function groups

#### 7.4.1.1 ECSPI CMSIS GetVersion Operation

This function group will return the ECSPI CMSIS Driver version to user.

#### 7.4.1.2 ECSPI CMSIS GetCapabilities Operation

This function group will return the capabilities of this driver.

#### 7.4.1.3 ECSPI CMSIS Initialize and Uninitialize Operation

This function will initialize and uninitialize the instance in master mode or slave mode. And this API must be called before you configure an instance or after you Deinit an instance. The right steps to start an instance is that you must initialize the instance which been selected firstly, then you can power on the instance. After these all have been done, you can configure the instance by using control operation. If you want to Uninitialize the instance, you must power off the instance first.

#### 7.4.1.4 ECSPI CMSIS Transfer Operation

This function group controls the transfer, master send/receive data, and slave send/receive data.

#### 7.4.1.5 ECSPI CMSIS Status Operation

This function group gets the ecspi transfer status.

#### 7.4.1.6 ECSPI CMSIS Control Operation

This function can select instance as master mode or slave mode, set baudrate for master mode transfer, get current baudrate of master mode transfer, set transfer data bits and set other control command.

## 7.4.2 Typical use case

### 7.4.2.1 Master Operation

```

/* Variables */
uint8_t masterRxData[TRANSFER_SIZE] = {0U};
uint8_t masterTxData[TRANSFER_SIZE] = {0U};

/*ECSPI master init*/
Driver_SPI0.Initialize(ECSPI_MasterSignalEvent_t);
Driver_SPI0.PowerControl(ARM_POWER_FULL);
Driver_SPI0.Control(ARM_SPI_MODE_MASTER, TRANSFER_BAUDRATE);

/* Start master transfer */
Driver_SPI0.Transfer(masterTxData, masterRxData, TRANSFER_SIZE);

/* Master power off */
Driver_SPI0.PowerControl(ARM_POWER_OFF);

/* Master uninitialized */
Driver_SPI0.Uninitialize();

```

### 7.4.2.2 Slave Operation

```

/* Variables */
uint8_t slaveRxData[TRANSFER_SIZE] = {0U};
uint8_t slaveTxData[TRANSFER_SIZE] = {0U};

/*DSPI slave init*/
Driver_SPI2.Initialize(ECSPI_SlaveSignalEvent_t);
Driver_SPI2.PowerControl(ARM_POWER_FULL);
Driver_SPI2.Control(ARM_SPI_MODE_SLAVE, false);

/* Start slave transfer */
Driver_SPI2.Transfer(slaveTxData, slaveRxData, TRANSFER_SIZE);

/* slave power off */
Driver_SPI2.PowerControl(ARM_POWER_OFF);

/* slave uninitialized */
Driver_SPI2.Uninitialize();

```

## Chapter 8

# GPT: General Purpose Timer

### 8.1 Overview

The MCUXpresso SDK provides a driver for the General Purpose Timer (GPT) of MCUXpresso SDK devices.

### 8.2 Function groups

The gpt driver supports the generation of PWM signals, input capture, and setting up the timer match conditions.

#### 8.2.1 Initialization and deinitialization

The function [GPT\\_Init\(\)](#) initializes the gpt with specified configurations. The function [GPT\\_GetDefaultConfig\(\)](#) gets the default configurations. The initialization function configures the restart/free-run mode and input selection when running.

The function [GPT\\_Deinit\(\)](#) stops the timer and turns off the module clock.

### 8.3 Typical use case

#### 8.3.1 GPT interrupt example

Set up a channel to trigger a periodic interrupt after every 1 second. Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/gpt`

### Data Structures

- struct [gpt\\_config\\_t](#)  
*Structure to configure the running mode. [More...](#)*

### Enumerations

- enum [gpt\\_clock\\_source\\_t](#) {  
    [kGPT\\_ClockSource\\_Off](#) = 0U,  
    [kGPT\\_ClockSource\\_Periph](#) = 1U,  
    [kGPT\\_ClockSource\\_HighFreq](#) = 2U,  
    [kGPT\\_ClockSource\\_Ext](#) = 3U,  
    [kGPT\\_ClockSource\\_LowFreq](#) = 4U,  
    [kGPT\\_ClockSource\\_Osc](#) = 5U }  
*List of clock sources.*

- enum `gpt_input_capture_channel_t` {  
`kGPT_InputCapture_Channel1` = 0U,  
`kGPT_InputCapture_Channel2` = 1U }  
*List of input capture channel number.*
- enum `gpt_input_operation_mode_t` {  
`kGPT_InputOperation_Disabled` = 0U,  
`kGPT_InputOperation_RiseEdge` = 1U,  
`kGPT_InputOperation_FallEdge` = 2U,  
`kGPT_InputOperation_BothEdge` = 3U }  
*List of input capture operation mode.*
- enum `gpt_output_compare_channel_t` {  
`kGPT_OutputCompare_Channel1` = 0U,  
`kGPT_OutputCompare_Channel2` = 1U,  
`kGPT_OutputCompare_Channel3` = 2U }  
*List of output compare channel number.*
- enum `gpt_output_operation_mode_t` {  
`kGPT_OutputOperation_Disconnected` = 0U,  
`kGPT_OutputOperation_Toggle` = 1U,  
`kGPT_OutputOperation_Clear` = 2U,  
`kGPT_OutputOperation_Set` = 3U,  
`kGPT_OutputOperation_Activelow` = 4U }  
*List of output compare operation mode.*
- enum `gpt_interrupt_enable_t` {  
`kGPT_OutputCompare1InterruptEnable` = GPT\_IR\_OF1IE\_MASK,  
`kGPT_OutputCompare2InterruptEnable` = GPT\_IR\_OF2IE\_MASK,  
`kGPT_OutputCompare3InterruptEnable` = GPT\_IR\_OF3IE\_MASK,  
`kGPT_InputCapture1InterruptEnable` = GPT\_IR\_IF1IE\_MASK,  
`kGPT_InputCapture2InterruptEnable` = GPT\_IR\_IF2IE\_MASK,  
`kGPT_RollOverFlagInterruptEnable` = GPT\_IR\_ROVIE\_MASK }  
*List of GPT interrupts.*
- enum `gpt_status_flag_t` {  
`kGPT_OutputCompare1Flag` = GPT\_SR\_OF1\_MASK,  
`kGPT_OutputCompare2Flag` = GPT\_SR\_OF2\_MASK,  
`kGPT_OutputCompare3Flag` = GPT\_SR\_OF3\_MASK,  
`kGPT_InputCapture1Flag` = GPT\_SR\_IF1\_MASK,  
`kGPT_InputCapture2Flag` = GPT\_SR\_IF2\_MASK,  
`kGPT_RollOverFlag` = GPT\_SR\_ROV\_MASK }  
*Status flag.*

## Driver version

- #define `FSL_GPT_DRIVER_VERSION` ([MAKE\\_VERSION](#)(2, 0, 4))

## Initialization and deinitialization

- void `GPT_Init` (GPT\_Type \*base, const `gpt_config_t` \*initConfig)  
*Initialize GPT to reset state and initialize running mode.*

- void [GPT\\_Deinit](#) (GPT\_Type \*base)  
*Disables the module and gates the GPT clock.*
- void [GPT\\_GetDefaultConfig](#) (gpt\_config\_t \*config)  
*Fills in the GPT configuration structure with default settings.*

## Software Reset

- static void [GPT\\_SoftwareReset](#) (GPT\_Type \*base)  
*Software reset of GPT module.*

## Clock source and frequency control

- static void [GPT\\_SetClockSource](#) (GPT\_Type \*base, gpt\_clock\_source\_t gptClkSource)  
*Set clock source of GPT.*
- static gpt\_clock\_source\_t [GPT\\_GetClockSource](#) (GPT\_Type \*base)  
*Get clock source of GPT.*
- static void [GPT\\_SetClockDivider](#) (GPT\_Type \*base, uint32\_t divider)  
*Set pre scaler of GPT.*
- static uint32\_t [GPT\\_GetClockDivider](#) (GPT\_Type \*base)  
*Get clock divider in GPT module.*
- static void [GPT\\_SetOscClockDivider](#) (GPT\_Type \*base, uint32\_t divider)  
*OSC 24M pre-scaler before selected by clock source.*
- static uint32\_t [GPT\\_GetOscClockDivider](#) (GPT\_Type \*base)  
*Get OSC 24M clock divider in GPT module.*

## Timer Start and Stop

- static void [GPT\\_StartTimer](#) (GPT\_Type \*base)  
*Start GPT timer.*
- static void [GPT\\_StopTimer](#) (GPT\_Type \*base)  
*Stop GPT timer.*

## Read the timer period

- static uint32\_t [GPT\\_GetCurrentTimerCount](#) (GPT\_Type \*base)  
*Reads the current GPT counting value.*

## GPT Input/Output Signal Control

- static void [GPT\\_SetInputOperationMode](#) (GPT\_Type \*base, gpt\_input\_capture\_channel\_t channel, gpt\_input\_operation\_mode\_t mode)  
*Set GPT operation mode of input capture channel.*
- static gpt\_input\_operation\_mode\_t [GPT\\_GetInputOperationMode](#) (GPT\_Type \*base, gpt\_input\_capture\_channel\_t channel)  
*Get GPT operation mode of input capture channel.*
- static uint32\_t [GPT\\_GetInputCaptureValue](#) (GPT\_Type \*base, gpt\_input\_capture\_channel\_t channel)  
*Get GPT input capture value of certain channel.*
- static void [GPT\\_SetOutputOperationMode](#) (GPT\_Type \*base, gpt\_output\_compare\_channel\_t channel, gpt\_output\_operation\_mode\_t mode)

- *Set GPT operation mode of output compare channel.*  
static [gpt\\_output\\_operation\\_mode\\_t](#) [GPT\\_GetOutputOperationMode](#) (GPT\_Type \*base, [gpt\\_output\\_compare\\_channel\\_t](#) channel)
- *Get GPT operation mode of output compare channel.*  
static void [GPT\\_SetOutputCompareValue](#) (GPT\_Type \*base, [gpt\\_output\\_compare\\_channel\\_t](#) channel, uint32\_t value)
- *Set GPT output compare value of output compare channel.*  
static uint32\_t [GPT\\_GetOutputCompareValue](#) (GPT\_Type \*base, [gpt\\_output\\_compare\\_channel\\_t](#) channel)
- *Get GPT output compare value of output compare channel.*  
static void [GPT\\_ForceOutput](#) (GPT\_Type \*base, [gpt\\_output\\_compare\\_channel\\_t](#) channel)  
*Force GPT output action on output compare channel, ignoring comparator.*

## GPT Interrupt and Status Interface

- static void [GPT\\_EnableInterrupts](#) (GPT\_Type \*base, uint32\_t mask)  
*Enables the selected GPT interrupts.*
- static void [GPT\\_DisableInterrupts](#) (GPT\_Type \*base, uint32\_t mask)  
*Disables the selected GPT interrupts.*
- static uint32\_t [GPT\\_GetEnabledInterrupts](#) (GPT\_Type \*base)  
*Gets the enabled GPT interrupts.*

## Status Interface

- static uint32\_t [GPT\\_GetStatusFlags](#) (GPT\_Type \*base, [gpt\\_status\\_flag\\_t](#) flags)  
*Get GPT status flags.*
- static void [GPT\\_ClearStatusFlags](#) (GPT\_Type \*base, [gpt\\_status\\_flag\\_t](#) flags)  
*Clears the GPT status flags.*

## 8.4 Data Structure Documentation

### 8.4.1 struct gpt\_config\_t

#### Data Fields

- [gpt\\_clock\\_source\\_t](#) clockSource  
*clock source for GPT module.*
- uint32\_t divider  
*clock divider (prescaler+1) from clock source to counter.*
- bool enableFreeRun  
*true: FreeRun mode, false: Restart mode.*
- bool enableRunInWait  
*GPT enabled in wait mode.*
- bool enableRunInStop  
*GPT enabled in stop mode.*
- bool enableRunInDoze  
*GPT enabled in doze mode.*
- bool enableRunInDbg  
*GPT enabled in debug mode.*

- bool `enableMode`  
     *true:* counter reset to 0 when enabled;  
     *false:* counter retain its value when enabled.

### Field Documentation

- (1) `gpt_clock_source_t gpt_config_t::clockSource`
- (2) `uint32_t gpt_config_t::divider`
- (3) `bool gpt_config_t::enableFreeRun`
- (4) `bool gpt_config_t::enableRunInWait`
- (5) `bool gpt_config_t::enableRunInStop`
- (6) `bool gpt_config_t::enableRunInDoze`
- (7) `bool gpt_config_t::enableRunInDbg`
- (8) `bool gpt_config_t::enableMode`

## 8.5 Enumeration Type Documentation

### 8.5.1 enum `gpt_clock_source_t`

Note

Actual number of clock sources is SoC dependent

Enumerator

***kGPT\_ClockSource\_Off*** GPT Clock Source Off.  
***kGPT\_ClockSource\_Periph*** GPT Clock Source from Peripheral Clock.  
***kGPT\_ClockSource\_HighFreq*** GPT Clock Source from High Frequency Reference Clock.  
***kGPT\_ClockSource\_Ext*** GPT Clock Source from external pin.  
***kGPT\_ClockSource\_LowFreq*** GPT Clock Source from Low Frequency Reference Clock.  
***kGPT\_ClockSource\_Osc*** GPT Clock Source from Crystal oscillator.

### 8.5.2 enum `gpt_input_capture_channel_t`

Enumerator

***kGPT\_InputCapture\_Channel1*** GPT Input Capture Channel1.  
***kGPT\_InputCapture\_Channel2*** GPT Input Capture Channel2.



### 8.5.3 enum gpt\_input\_operation\_mode\_t

Enumerator

***kGPT\_InputOperation\_Disabled*** Don't capture.  
***kGPT\_InputOperation\_RiseEdge*** Capture on rising edge of input pin.  
***kGPT\_InputOperation\_FallEdge*** Capture on falling edge of input pin.  
***kGPT\_InputOperation\_BothEdge*** Capture on both edges of input pin.

### 8.5.4 enum gpt\_output\_compare\_channel\_t

Enumerator

***kGPT\_OutputCompare\_Channel1*** Output Compare Channel1.  
***kGPT\_OutputCompare\_Channel2*** Output Compare Channel2.  
***kGPT\_OutputCompare\_Channel3*** Output Compare Channel3.

### 8.5.5 enum gpt\_output\_operation\_mode\_t

Enumerator

***kGPT\_OutputOperation\_Disconnected*** Don't change output pin.  
***kGPT\_OutputOperation\_Toggle*** Toggle output pin.  
***kGPT\_OutputOperation\_Clear*** Set output pin low.  
***kGPT\_OutputOperation\_Set*** Set output pin high.  
***kGPT\_OutputOperation\_Activelow*** Generate a active low pulse on output pin.

### 8.5.6 enum gpt\_interrupt\_enable\_t

Enumerator

***kGPT\_OutputCompare1InterruptEnable*** Output Compare Channel1 interrupt enable.  
***kGPT\_OutputCompare2InterruptEnable*** Output Compare Channel2 interrupt enable.  
***kGPT\_OutputCompare3InterruptEnable*** Output Compare Channel3 interrupt enable.  
***kGPT\_InputCapture1InterruptEnable*** Input Capture Channel1 interrupt enable.  
***kGPT\_InputCapture2InterruptEnable*** Input Capture Channel1 interrupt enable.  
***kGPT\_RollOverFlagInterruptEnable*** Counter rolled over interrupt enable.

### 8.5.7 enum gpt\_status\_flag\_t

Enumerator

***kGPT\_OutputCompare1Flag*** Output compare channel 1 event.  
***kGPT\_OutputCompare2Flag*** Output compare channel 2 event.  
***kGPT\_OutputCompare3Flag*** Output compare channel 3 event.  
***kGPT\_InputCapture1Flag*** Input Capture channel 1 event.  
***kGPT\_InputCapture2Flag*** Input Capture channel 2 event.  
***kGPT\_RollOverFlag*** Counter reaches maximum value and rolled over to 0 event.

## 8.6 Function Documentation

### 8.6.1 void GPT\_Init ( GPT\_Type \* *base*, const gpt\_config\_t \* *initConfig* )

Parameters

<i>base</i>	GPT peripheral base address.
<i>initConfig</i>	GPT mode setting configuration.

### 8.6.2 void GPT\_Deinit ( GPT\_Type \* *base* )

Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

### 8.6.3 void GPT\_GetDefaultConfig ( gpt\_config\_t \* *config* )

The default values are:

```

*  config->clockSource = kGPT_ClockSource_Periph;
*  config->divider = 1U;
*  config->enableRunInStop = true;
*  config->enableRunInWait = true;
*  config->enableRunInDoze = false;
*  config->enableRunInDbg = false;
*  config->enableFreeRun = false;
*  config->enableMode = true;
*

```

## Parameters

<i>config</i>	Pointer to the user configuration structure.
---------------	--

**8.6.4 static void GPT\_SoftwareReset ( GPT\_Type \* *base* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

**8.6.5 static void GPT\_SetClockSource ( GPT\_Type \* *base*, gpt\_clock\_source\_t *gptClkSource* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
<i>gptClkSource</i>	Clock source (see <a href="#">gpt_clock_source_t</a> typedef enumeration).

**8.6.6 static gpt\_clock\_source\_t GPT\_GetClockSource ( GPT\_Type \* *base* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

## Returns

clock source (see [gpt\\_clock\\_source\\_t](#) typedef enumeration).

**8.6.7 static void GPT\_SetClockDivider ( GPT\_Type \* *base*, uint32\_t *divider* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
<i>divider</i>	Divider of GPT (1-4096).

### 8.6.8 static uint32\_t GPT\_GetClockDivider ( GPT\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

## Returns

clock divider in GPT module (1-4096).

### 8.6.9 static void GPT\_SetOscClockDivider ( GPT\_Type \* *base*, uint32\_t *divider* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
<i>divider</i>	OSC Divider(1-16).

### 8.6.10 static uint32\_t GPT\_GetOscClockDivider ( GPT\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

## Returns

OSC clock divider in GPT module (1-16).

### 8.6.11 static void GPT\_StartTimer ( GPT\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

**8.6.12 static void GPT\_StopTimer ( GPT\_Type \* *base* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

**8.6.13 static uint32\_t GPT\_GetCurrentTimerCount ( GPT\_Type \* *base* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
-------------	------------------------------

## Returns

Current GPT counter value.

**8.6.14 static void GPT\_SetInputOperationMode ( GPT\_Type \* *base*, gpt\_input\_capture\_channel\_t *channel*, gpt\_input\_operation\_mode\_t *mode* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT capture channel (see <a href="#">gpt_input_capture_channel_t</a> typedef enumeration).
<i>mode</i>	GPT input capture operation mode (see <a href="#">gpt_input_operation_mode_t</a> typedef enumeration).

**8.6.15 static gpt\_input\_operation\_mode\_t GPT\_GetInputOperationMode ( GPT\_Type \* *base*, gpt\_input\_capture\_channel\_t *channel* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT capture channel (see <a href="#">gpt_input_capture_channel_t</a> typedef enumeration).

## Returns

GPT input capture operation mode (see [gpt\\_input\\_operation\\_mode\\_t](#) typedef enumeration).

### 8.6.16 static uint32\_t GPT\_GetInputCaptureValue ( GPT\_Type \* *base*, gpt\_input\_capture\_channel\_t *channel* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT capture channel (see <a href="#">gpt_input_capture_channel_t</a> typedef enumeration).

## Returns

GPT input capture value.

### 8.6.17 static void GPT\_SetOutputOperationMode ( GPT\_Type \* *base*, gpt\_output\_compare\_channel\_t *channel*, gpt\_output\_operation\_mode\_t *mode* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT output compare channel (see <a href="#">gpt_output_compare_channel_t</a> typedef enumeration).
<i>mode</i>	GPT output operation mode (see <a href="#">gpt_output_operation_mode_t</a> typedef enumeration).

### 8.6.18 static gpt\_output\_operation\_mode\_t GPT\_GetOutputOperationMode ( GPT\_Type \* *base*, gpt\_output\_compare\_channel\_t *channel* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT output compare channel (see <a href="#">gpt_output_compare_channel_t</a> typedef enumeration).

## Returns

GPT output operation mode (see [gpt\\_output\\_operation\\_mode\\_t](#) typedef enumeration).

**8.6.19 static void GPT\_SetOutputCompareValue ( GPT\_Type \* *base*,  
gpt\_output\_compare\_channel\_t *channel*, uint32\_t *value* ) [inline],  
[static]**

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT output compare channel (see <a href="#">gpt_output_compare_channel_t</a> typedef enumeration).
<i>value</i>	GPT output compare value.

**8.6.20 static uint32\_t GPT\_GetOutputCompareValue ( GPT\_Type \* *base*,  
gpt\_output\_compare\_channel\_t *channel* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT output compare channel (see <a href="#">gpt_output_compare_channel_t</a> typedef enumeration).

## Returns

GPT output compare value.

**8.6.21 static void GPT\_ForceOutput ( GPT\_Type \* *base*, gpt\_output\_compare\_-  
channel\_t *channel* ) [inline], [static]**

## Parameters

<i>base</i>	GPT peripheral base address.
<i>channel</i>	GPT output compare channel (see <a href="#">gpt_output_compare_channel_t</a> typedef enumeration).

### 8.6.22 static void GPT\_EnableInterrupts ( GPT\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
<i>mask</i>	The interrupts to enable. This is a logical OR of members of the enumeration <a href="#">gpt_interrupt_enable_t</a>

### 8.6.23 static void GPT\_DisableInterrupts ( GPT\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address
<i>mask</i>	The interrupts to disable. This is a logical OR of members of the enumeration <a href="#">gpt_interrupt_enable_t</a>

### 8.6.24 static uint32\_t GPT\_GetEnabledInterrupts ( GPT\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address
-------------	-----------------------------

## Returns

The enabled interrupts. This is the logical OR of members of the enumeration [gpt\\_interrupt\\_enable\\_t](#)

### 8.6.25 static uint32\_t GPT\_GetStatusFlags ( GPT\_Type \* *base*, gpt\_status\_flag\_t *flags* ) [inline], [static]



## Parameters

<i>base</i>	GPT peripheral base address.
<i>flags</i>	GPT status flag mask (see <a href="#">gpt_status_flag_t</a> for bit definition).

## Returns

GPT status, each bit represents one status flag.

### 8.6.26 static void GPT\_ClearStatusFlags ( GPT\_Type \* *base*, gpt\_status\_flag\_t *flags* ) [inline], [static]

## Parameters

<i>base</i>	GPT peripheral base address.
<i>flags</i>	GPT status flag mask (see <a href="#">gpt_status_flag_t</a> for bit definition).

## Chapter 9

# GPIO: General-Purpose Input/Output Driver

### 9.1 Overview

The MCUXpresso SDK provides a peripheral driver for the General-Purpose Input/Output (GPIO) module of MCUXpresso SDK devices.

### 9.2 Typical use case

#### 9.2.1 Input Operation

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/gpio`

### Data Structures

- struct `gpio_pin_config_t`  
*GPIO Init structure definition. [More...](#)*

### Enumerations

- enum `gpio_pin_direction_t` {  
    `kGPIO_DigitalInput` = 0U,  
    `kGPIO_DigitalOutput` = 1U }  
*GPIO direction definition.*
- enum `gpio_interrupt_mode_t` {  
    `kGPIO_NoIntmode` = 0U,  
    `kGPIO_IntLowLevel` = 1U,  
    `kGPIO_IntHighLevel` = 2U,  
    `kGPIO_IntRisingEdge` = 3U,  
    `kGPIO_IntFallingEdge` = 4U,  
    `kGPIO_IntRisingOrFallingEdge` = 5U }  
*GPIO interrupt mode definition.*

### Driver version

- #define `FSL_GPIO_DRIVER_VERSION` (`MAKE_VERSION(2, 0, 6)`)  
*GPIO driver version.*

### GPIO Initialization and Configuration functions

- void `GPIO_PinInit` (`GPIO_Type *base`, `uint32_t pin`, const `gpio_pin_config_t *Config`)  
*Initializes the GPIO peripheral according to the specified parameters in the initConfig.*

## GPIO Reads and Write Functions

- void [GPIO\\_PinWrite](#) (GPIO\_Type \*base, uint32\_t pin, uint8\_t output)  
*Sets the output level of the individual GPIO pin to logic 1 or 0.*
- static void [GPIO\\_WritePinOutput](#) (GPIO\_Type \*base, uint32\_t pin, uint8\_t output)  
*Sets the output level of the individual GPIO pin to logic 1 or 0.*
- static void [GPIO\\_PortSet](#) (GPIO\_Type \*base, uint32\_t mask)  
*Sets the output level of the multiple GPIO pins to the logic 1.*
- static void [GPIO\\_SetPinsOutput](#) (GPIO\_Type \*base, uint32\_t mask)  
*Sets the output level of the multiple GPIO pins to the logic 1.*
- static void [GPIO\\_PortClear](#) (GPIO\_Type \*base, uint32\_t mask)  
*Sets the output level of the multiple GPIO pins to the logic 0.*
- static void [GPIO\\_ClearPinsOutput](#) (GPIO\_Type \*base, uint32\_t mask)  
*Sets the output level of the multiple GPIO pins to the logic 0.*
- static void [GPIO\\_PortToggle](#) (GPIO\_Type \*base, uint32\_t mask)  
*Reverses the current output logic of the multiple GPIO pins.*
- static uint32\_t [GPIO\\_PinRead](#) (GPIO\_Type \*base, uint32\_t pin)  
*Reads the current input value of the GPIO port.*
- static uint32\_t [GPIO\\_ReadPinInput](#) (GPIO\_Type \*base, uint32\_t pin)  
*Reads the current input value of the GPIO port.*

## GPIO Reads Pad Status Functions

- static uint8\_t [GPIO\\_PinReadPadStatus](#) (GPIO\_Type \*base, uint32\_t pin)  
*Reads the current GPIO pin pad status.*
- static uint8\_t [GPIO\\_ReadPadStatus](#) (GPIO\_Type \*base, uint32\_t pin)  
*Reads the current GPIO pin pad status.*

## Interrupts and flags management functions

- void [GPIO\\_PinSetInterruptConfig](#) (GPIO\_Type \*base, uint32\_t pin, [gpio\\_interrupt\\_mode\\_t](#) pinInterruptMode)  
*Sets the current pin interrupt mode.*
- static void [GPIO\\_SetPinInterruptConfig](#) (GPIO\_Type \*base, uint32\_t pin, [gpio\\_interrupt\\_mode\\_t](#) pinInterruptMode)  
*Sets the current pin interrupt mode.*
- static void [GPIO\\_PortEnableInterrupts](#) (GPIO\_Type \*base, uint32\_t mask)  
*Enables the specific pin interrupt.*
- static void [GPIO\\_EnableInterrupts](#) (GPIO\_Type \*base, uint32\_t mask)  
*Enables the specific pin interrupt.*
- static void [GPIO\\_PortDisableInterrupts](#) (GPIO\_Type \*base, uint32\_t mask)  
*Disables the specific pin interrupt.*
- static void [GPIO\\_DisableInterrupts](#) (GPIO\_Type \*base, uint32\_t mask)  
*Disables the specific pin interrupt.*
- static uint32\_t [GPIO\\_PortGetInterruptFlags](#) (GPIO\_Type \*base)  
*Reads individual pin interrupt status.*
- static uint32\_t [GPIO\\_GetPinsInterruptFlags](#) (GPIO\_Type \*base)  
*Reads individual pin interrupt status.*
- static void [GPIO\\_PortClearInterruptFlags](#) (GPIO\_Type \*base, uint32\_t mask)  
*Clears pin interrupt flag.*
- static void [GPIO\\_ClearPinsInterruptFlags](#) (GPIO\_Type \*base, uint32\_t mask)

*Clears pin interrupt flag.*

## 9.3 Data Structure Documentation

### 9.3.1 struct gpio\_pin\_config\_t

#### Data Fields

- [gpio\\_pin\\_direction\\_t direction](#)  
*Specifies the pin direction.*
- uint8\_t [outputLogic](#)  
*Set a default output logic, which has no use in input.*
- [gpio\\_interrupt\\_mode\\_t interruptMode](#)  
*Specifies the pin interrupt mode, a value of [gpio\\_interrupt\\_mode\\_t](#).*

#### Field Documentation

(1) [gpio\\_pin\\_direction\\_t gpio\\_pin\\_config\\_t::direction](#)

(2) [gpio\\_interrupt\\_mode\\_t gpio\\_pin\\_config\\_t::interruptMode](#)

## 9.4 Macro Definition Documentation

### 9.4.1 #define FSL\_GPIO\_DRIVER\_VERSION (MAKE\_VERSION(2, 0, 6))

## 9.5 Enumeration Type Documentation

### 9.5.1 enum gpio\_pin\_direction\_t

#### Enumerator

***kGPIO\_DigitalInput*** Set current pin as digital input.  
***kGPIO\_DigitalOutput*** Set current pin as digital output.

### 9.5.2 enum gpio\_interrupt\_mode\_t

#### Enumerator

***kGPIO\_NoIntmode*** Set current pin general IO functionality.  
***kGPIO\_IntLowLevel*** Set current pin interrupt is low-level sensitive.  
***kGPIO\_IntHighLevel*** Set current pin interrupt is high-level sensitive.  
***kGPIO\_IntRisingEdge*** Set current pin interrupt is rising-edge sensitive.  
***kGPIO\_IntFallingEdge*** Set current pin interrupt is falling-edge sensitive.  
***kGPIO\_IntRisingOrFallingEdge*** Enable the edge select bit to override the ICR register's configuration.

## 9.6 Function Documentation

9.6.1 void GPIO\_PinInit ( GPIO\_Type \* *base*, uint32\_t *pin*, const gpio\_pin\_config\_t \* *Config* )

## Parameters

<i>base</i>	GPIO base pointer.
<i>pin</i>	Specifies the pin number
<i>Config</i>	pointer to a <a href="#">gpio_pin_config_t</a> structure that contains the configuration information.

### 9.6.2 void GPIO\_PinWrite ( GPIO\_Type \* *base*, uint32\_t *pin*, uint8\_t *output* )

## Parameters

<i>base</i>	GPIO base pointer.
<i>pin</i>	GPIO port pin number.
<i>output</i>	GPIO pin output logic level. <ul style="list-style-type: none"> <li>• 0: corresponding pin output low-logic level.</li> <li>• 1: corresponding pin output high-logic level.</li> </ul>

### 9.6.3 static void GPIO\_WritePinOutput ( GPIO\_Type \* *base*, uint32\_t *pin*, uint8\_t *output* ) [inline], [static]

**Deprecated** Do not use this function. It has been superseded by [GPIO\\_PinWrite](#).

### 9.6.4 static void GPIO\_PortSet ( GPIO\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	GPIO peripheral base pointer (GPIO1, GPIO2, GPIO3, and so on.)
<i>mask</i>	GPIO pin number macro

### 9.6.5 static void GPIO\_SetPinsOutput ( GPIO\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

**Deprecated** Do not use this function. It has been superseded by [GPIO\\_PortSet](#).

**9.6.6** `static void GPIO_PortClear ( GPIO_Type * base, uint32_t mask )`  
`[inline], [static]`

## Parameters

<i>base</i>	GPIO peripheral base pointer (GPIO1, GPIO2, GPIO3, and so on.)
<i>mask</i>	GPIO pin number macro

**9.6.7 static void GPIO\_ClearPinsOutput ( GPIO\_Type \* *base*, uint32\_t *mask* )**  
**[inline], [static]**

**Deprecated** Do not use this function. It has been superceded by [GPIO\\_PortClear](#).

**9.6.8 static void GPIO\_PortToggle ( GPIO\_Type \* *base*, uint32\_t *mask* )**  
**[inline], [static]**

## Parameters

<i>base</i>	GPIO peripheral base pointer (GPIO1, GPIO2, GPIO3, and so on.)
<i>mask</i>	GPIO pin number macro

**9.6.9 static uint32\_t GPIO\_PinRead ( GPIO\_Type \* *base*, uint32\_t *pin* )**  
**[inline], [static]**

## Parameters

<i>base</i>	GPIO base pointer.
<i>pin</i>	GPIO port pin number.

## Return values

<i>GPIO</i>	port input value.
-------------	-------------------

**9.6.10 static uint32\_t GPIO\_ReadPinInput ( GPIO\_Type \* *base*, uint32\_t *pin* )**  
**[inline], [static]**

**Deprecated** Do not use this function. It has been superceded by [GPIO\\_PinRead](#).



9.6.11 `static uint8_t GPIO_PinReadPadStatus ( GPIO_Type * base, uint32_t pin )`  
`[inline], [static]`

## Parameters

<i>base</i>	GPIO base pointer.
<i>pin</i>	GPIO port pin number.

## Return values

<i>GPIO</i>	pin pad status value.
-------------	-----------------------

**9.6.12** `static uint8_t GPIO_ReadPadStatus ( GPIO_Type * base, uint32_t pin )`  
**[inline], [static]**

**Deprecated** Do not use this function. It has been superseded by [GPIO\\_PinReadPadStatus](#).

**9.6.13** `void GPIO_PinSetInterruptConfig ( GPIO_Type * base, uint32_t pin,  
gpio_interrupt_mode_t pinInterruptMode )`

## Parameters

<i>base</i>	GPIO base pointer.
<i>pin</i>	GPIO port pin number.
<i>pinInterrupt-Mode</i>	pointer to a <a href="#">gpio_interrupt_mode_t</a> structure that contains the interrupt mode information.

**9.6.14** `static void GPIO_SetPinInterruptConfig ( GPIO_Type * base, uint32_t pin,  
gpio_interrupt_mode_t pinInterruptMode )` **[inline], [static]**

**Deprecated** Do not use this function. It has been superseded by [GPIO\\_PinSetInterruptConfig](#).

**9.6.15** `static void GPIO_PortEnableInterrupts ( GPIO_Type * base, uint32_t mask )`  
**[inline], [static]**

## Parameters

<i>base</i>	GPIO base pointer.
<i>mask</i>	GPIO pin number macro.

### 9.6.16 static void GPIO\_EnableInterrupts ( GPIO\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	GPIO base pointer.
<i>mask</i>	GPIO pin number macro.

### 9.6.17 static void GPIO\_PortDisableInterrupts ( GPIO\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	GPIO base pointer.
<i>mask</i>	GPIO pin number macro.

### 9.6.18 static void GPIO\_DisableInterrupts ( GPIO\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

**Deprecated** Do not use this function. It has been superseded by [GPIO\\_PortDisableInterrupts](#).

### 9.6.19 static uint32\_t GPIO\_PortGetInterruptFlags ( GPIO\_Type \* *base* ) [inline], [static]

## Parameters

---

<i>base</i>	GPIO base pointer.
-------------	--------------------

Return values

<i>current</i>	pin interrupt status flag.
----------------	----------------------------

#### 9.6.20 **static uint32\_t GPIO\_GetPinsInterruptFlags ( GPIO\_Type \* *base* ) [inline], [static]**

Parameters

<i>base</i>	GPIO base pointer.
-------------	--------------------

Return values

<i>current</i>	pin interrupt status flag.
----------------	----------------------------

#### 9.6.21 **static void GPIO\_PortClearInterruptFlags ( GPIO\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

Status flags are cleared by writing a 1 to the corresponding bit position.

Parameters

<i>base</i>	GPIO base pointer.
<i>mask</i>	GPIO pin number macro.

#### 9.6.22 **static void GPIO\_ClearPinsInterruptFlags ( GPIO\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

Status flags are cleared by writing a 1 to the corresponding bit position.

Parameters

---

<i>base</i>	GPIO base pointer.
<i>mask</i>	GPIO pin number macro.



## Chapter 10

# I2C: Inter-Integrated Circuit Driver

### 10.1 Overview

#### Modules

- [I2C CMSIS Driver](#)
- [I2C Driver](#)
- [I2C FreeRTOS Driver](#)

## 10.2 I2C Driver

### 10.2.1 Overview

The MCUXpresso SDK provides a peripheral driver for the Inter-Integrated Circuit (I2C) module of MCUXpresso SDK devices.

The I2C driver includes functional APIs and transactional APIs.

Functional APIs target the low-level APIs. Functional APIs can be used for the I2C master/slave initialization/configuration/operation for optimization/customization purpose. Using the functional APIs requires knowing the I2C master peripheral and how to organize functional APIs to meet the application requirements. The I2C functional operation groups provide the functional APIs set.

Transactional APIs target the high-level APIs. The transactional APIs can be used to enable the peripheral quickly and also in the application if the code size and performance of transactional APIs satisfy the requirements. If the code size and performance are critical requirements, see the transactional API implementation and write custom code using the functional APIs or accessing the hardware registers.

Transactional APIs support asynchronous transfer. This means that the functions [I2C\\_MasterTransferNonBlocking\(\)](#) set up the interrupt non-blocking transfer. When the transfer completes, the upper layer is notified through a callback function with the status.

### 10.2.2 Typical use case

#### 10.2.2.1 Master Operation in functional method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/i2c`

#### 10.2.2.2 Master Operation in interrupt transactional method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/i2c`

#### 10.2.2.3 Slave Operation in functional method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/i2c`

#### 10.2.2.4 Slave Operation in interrupt transactional method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/i2c`

### Data Structures

- struct [i2c\\_master\\_config\\_t](#)

- *I2C master user configuration. [More...](#)*
- struct [i2c\\_master\\_transfer\\_t](#)  
*I2C master transfer structure. [More...](#)*
- struct [i2c\\_master\\_handle\\_t](#)  
*I2C master handle structure. [More...](#)*
- struct [i2c\\_slave\\_config\\_t](#)  
*I2C slave user configuration. [More...](#)*
- struct [i2c\\_slave\\_transfer\\_t](#)  
*I2C slave transfer structure. [More...](#)*
- struct [i2c\\_slave\\_handle\\_t](#)  
*I2C slave handle structure. [More...](#)*

## Macros

- #define [I2C\\_RETRY\\_TIMES](#) 0U /\* Define to zero means keep waiting until the flag is assert/deassert. \*/  
*Retry times for waiting flag.*

## Typedefs

- typedef void(\* [i2c\\_master\\_transfer\\_callback\\_t](#) )(I2C\_Type \*base, i2c\_master\_handle\_t \*handle, [status\\_t](#) status, void \*userData)  
*I2C master transfer callback typedef.*
- typedef void(\* [i2c\\_slave\\_transfer\\_callback\\_t](#) )(I2C\_Type \*base, [i2c\\_slave\\_transfer\\_t](#) \*xfer, void \*userData)  
*I2C slave transfer callback typedef.*

## Enumerations

- enum {  
[kStatus\\_I2C\\_Busy](#) = MAKE\_STATUS(kStatusGroup\_I2C, 0),  
[kStatus\\_I2C\\_Idle](#) = MAKE\_STATUS(kStatusGroup\_I2C, 1),  
[kStatus\\_I2C\\_Nak](#) = MAKE\_STATUS(kStatusGroup\_I2C, 2),  
[kStatus\\_I2C\\_ArbitrationLost](#) = MAKE\_STATUS(kStatusGroup\_I2C, 3),  
[kStatus\\_I2C\\_Timeout](#) = MAKE\_STATUS(kStatusGroup\_I2C, 4),  
[kStatus\\_I2C\\_Addr\\_Nak](#) = MAKE\_STATUS(kStatusGroup\_I2C, 5) }  
*I2C status return codes.*
- enum [\\_i2c\\_flags](#) {  
[kI2C\\_ReceiveNakFlag](#) = I2C\_I2SR\_RXAK\_MASK,  
[kI2C\\_IntPendingFlag](#) = I2C\_I2SR\_IIF\_MASK,  
[kI2C\\_TransferDirectionFlag](#) = I2C\_I2SR\_SRW\_MASK,  
[kI2C\\_ArbitrationLostFlag](#) = I2C\_I2SR\_IAL\_MASK,  
[kI2C\\_BusBusyFlag](#) = I2C\_I2SR\_IBB\_MASK,  
[kI2C\\_AddressMatchFlag](#) = I2C\_I2SR\_IAAS\_MASK,  
[kI2C\\_TransferCompleteFlag](#) = I2C\_I2SR\_ICF\_MASK }



- *I2C peripheral flags.*
- enum `_i2c_interrupt_enable` { `kI2C_GlobalInterruptEnable` = `I2C_I2CR_IEN_MASK` }
- *I2C feature interrupt source.*
- enum `i2c_direction_t` {  
`kI2C_Write` = `0x0U`,  
`kI2C_Read` = `0x1U` }
- *The direction of master and slave transfers.*
- enum `_i2c_master_transfer_flags` {  
`kI2C_TransferDefaultFlag` = `0x0U`,  
`kI2C_TransferNoStartFlag` = `0x1U`,  
`kI2C_TransferRepeatedStartFlag` = `0x2U`,  
`kI2C_TransferNoStopFlag` = `0x4U` }
- *I2C transfer control flag.*
- enum `i2c_slave_transfer_event_t` {  
`kI2C_SlaveAddressMatchEvent` = `0x01U`,  
`kI2C_SlaveTransmitEvent` = `0x02U`,  
`kI2C_SlaveReceiveEvent` = `0x04U`,  
`kI2C_SlaveTransmitAckEvent` = `0x08U`,  
`kI2C_SlaveCompletionEvent` = `0x20U`,  
`kI2C_SlaveAllEvents` }
- *Set of events sent to the callback for nonblocking slave transfers.*

## Driver version

- #define `FSL_I2C_DRIVER_VERSION` (`MAKE_VERSION(2, 0, 7)`)  
*I2C driver version.*

## Initialization and deinitialization

- void `I2C_MasterInit` (`I2C_Type *base`, const `i2c_master_config_t *masterConfig`, `uint32_t src-Clock_Hz`)  
*Initializes the I2C peripheral.*
- void `I2C_MasterDeinit` (`I2C_Type *base`)  
*De-initializes the I2C master peripheral.*
- void `I2C_MasterGetDefaultConfig` (`i2c_master_config_t *masterConfig`)  
*Sets the I2C master configuration structure to default values.*
- void `I2C_SlaveInit` (`I2C_Type *base`, const `i2c_slave_config_t *slaveConfig`)  
*Initializes the I2C peripheral.*
- void `I2C_SlaveDeinit` (`I2C_Type *base`)  
*De-initializes the I2C slave peripheral.*
- void `I2C_SlaveGetDefaultConfig` (`i2c_slave_config_t *slaveConfig`)  
*Sets the I2C slave configuration structure to default values.*
- static void `I2C_Enable` (`I2C_Type *base`, bool enable)  
*Enables or disables the I2C peripheral operation.*

## Status

- static uint32\_t [I2C\\_MasterGetStatusFlags](#) (I2C\_Type \*base)  
*Gets the I2C status flags.*
- static void [I2C\\_MasterClearStatusFlags](#) (I2C\_Type \*base, uint32\_t statusMask)  
*Clears the I2C status flag state.*
- static uint32\_t [I2C\\_SlaveGetStatusFlags](#) (I2C\_Type \*base)  
*Gets the I2C status flags.*
- static void [I2C\\_SlaveClearStatusFlags](#) (I2C\_Type \*base, uint32\_t statusMask)  
*Clears the I2C status flag state.*

## Interrupts

- void [I2C\\_EnableInterrupts](#) (I2C\_Type \*base, uint32\_t mask)  
*Enables I2C interrupt requests.*
- void [I2C\\_DisableInterrupts](#) (I2C\_Type \*base, uint32\_t mask)  
*Disables I2C interrupt requests.*

## Bus Operations

- void [I2C\\_MasterSetBaudRate](#) (I2C\_Type \*base, uint32\_t baudRate\_Bps, uint32\_t srcClock\_Hz)  
*Sets the I2C master transfer baud rate.*
- [status\\_t](#) [I2C\\_MasterStart](#) (I2C\_Type \*base, uint8\_t address, [i2c\\_direction\\_t](#) direction)  
*Sends a START on the I2C bus.*
- [status\\_t](#) [I2C\\_MasterStop](#) (I2C\_Type \*base)  
*Sends a STOP signal on the I2C bus.*
- [status\\_t](#) [I2C\\_MasterRepeatedStart](#) (I2C\_Type \*base, uint8\_t address, [i2c\\_direction\\_t](#) direction)  
*Sends a REPEATED START on the I2C bus.*
- [status\\_t](#) [I2C\\_MasterWriteBlocking](#) (I2C\_Type \*base, const uint8\_t \*txBuff, size\_t txSize, uint32\_t flags)  
*Performs a polling send transaction on the I2C bus.*
- [status\\_t](#) [I2C\\_MasterReadBlocking](#) (I2C\_Type \*base, uint8\_t \*rxBuff, size\_t rxSize, uint32\_t flags)  
*Performs a polling receive transaction on the I2C bus.*
- [status\\_t](#) [I2C\\_SlaveWriteBlocking](#) (I2C\_Type \*base, const uint8\_t \*txBuff, size\_t txSize)  
*Performs a polling send transaction on the I2C bus.*
- [status\\_t](#) [I2C\\_SlaveReadBlocking](#) (I2C\_Type \*base, uint8\_t \*rxBuff, size\_t rxSize)  
*Performs a polling receive transaction on the I2C bus.*
- [status\\_t](#) [I2C\\_MasterTransferBlocking](#) (I2C\_Type \*base, [i2c\\_master\\_transfer\\_t](#) \*xfer)  
*Performs a master polling transfer on the I2C bus.*

## Transactional

- void [I2C\\_MasterTransferCreateHandle](#) (I2C\_Type \*base, [i2c\\_master\\_handle\\_t](#) \*handle, [i2c\\_master\\_transfer\\_callback\\_t](#) callback, void \*userData)  
*Initializes the I2C handle which is used in transactional functions.*
- [status\\_t](#) [I2C\\_MasterTransferNonBlocking](#) (I2C\_Type \*base, [i2c\\_master\\_handle\\_t](#) \*handle, [i2c\\_master\\_transfer\\_t](#) \*xfer)

- *Performs a master interrupt non-blocking transfer on the I2C bus.*  
 • [status\\_t I2C\\_MasterTransferGetCount](#) (I2C\_Type \*base, i2c\_master\_handle\_t \*handle, size\_t \*count)  
*Gets the master transfer status during a interrupt non-blocking transfer.*
- [status\\_t I2C\\_MasterTransferAbort](#) (I2C\_Type \*base, i2c\_master\_handle\_t \*handle)  
*Aborts an interrupt non-blocking transfer early.*
- void [I2C\\_MasterTransferHandleIRQ](#) (I2C\_Type \*base, void \*i2cHandle)  
*Master interrupt handler.*
- void [I2C\\_SlaveTransferCreateHandle](#) (I2C\_Type \*base, i2c\_slave\_handle\_t \*handle, [i2c\\_slave\\_transfer\\_callback\\_t](#) callback, void \*userData)  
*Initializes the I2C handle which is used in transactional functions.*
- [status\\_t I2C\\_SlaveTransferNonBlocking](#) (I2C\_Type \*base, i2c\_slave\_handle\_t \*handle, uint32\_t eventMask)  
*Starts accepting slave transfers.*
- void [I2C\\_SlaveTransferAbort](#) (I2C\_Type \*base, i2c\_slave\_handle\_t \*handle)  
*Aborts the slave transfer.*
- [status\\_t I2C\\_SlaveTransferGetCount](#) (I2C\_Type \*base, i2c\_slave\_handle\_t \*handle, size\_t \*count)  
*Gets the slave transfer remaining bytes during a interrupt non-blocking transfer.*
- void [I2C\\_SlaveTransferHandleIRQ](#) (I2C\_Type \*base, void \*i2cHandle)  
*Slave interrupt handler.*

## 10.2.3 Data Structure Documentation

### 10.2.3.1 struct i2c\_master\_config\_t

#### Data Fields

- bool [enableMaster](#)  
*Enables the I2C peripheral at initialization time.*
- uint32\_t [baudRate\\_Bps](#)  
*Baud rate configuration of I2C peripheral.*

#### Field Documentation

(1) bool i2c\_master\_config\_t::enableMaster

(2) uint32\_t i2c\_master\_config\_t::baudRate\_Bps

### 10.2.3.2 struct i2c\_master\_transfer\_t

#### Data Fields

- uint32\_t [flags](#)  
*A transfer flag which controls the transfer.*
- uint8\_t [slaveAddress](#)  
*7-bit slave address.*
- [i2c\\_direction\\_t](#) [direction](#)  
*A transfer direction, read or write.*
- uint32\_t [subaddress](#)

- *A sub address.*
- `uint8_t subaddressSize`  
*A size of the command buffer.*
- `uint8_t *volatile data`  
*A transfer buffer.*
- `volatile size_t dataSize`  
*A transfer size.*

#### Field Documentation

- (1) `uint32_t i2c_master_transfer_t::flags`
- (2) `uint8_t i2c_master_transfer_t::slaveAddress`
- (3) `i2c_direction_t i2c_master_transfer_t::direction`
- (4) `uint32_t i2c_master_transfer_t::subaddress`

Transferred MSB first.

- (5) `uint8_t i2c_master_transfer_t::subaddressSize`
- (6) `uint8_t* volatile i2c_master_transfer_t::data`
- (7) `volatile size_t i2c_master_transfer_t::dataSize`

#### 10.2.3.3 struct `_i2c_master_handle`

I2C master handle typedef.

#### Data Fields

- `i2c_master_transfer_t transfer`  
*I2C master transfer copy.*
- `size_t transferSize`  
*Total bytes to be transferred.*
- `uint8_t state`  
*A transfer state maintained during transfer.*
- `i2c_master_transfer_callback_t completionCallback`  
*A callback function called when the transfer is finished.*
- `void * userData`  
*A callback parameter passed to the callback function.*

#### Field Documentation

- (1) `i2c_master_transfer_t i2c_master_handle_t::transfer`
- (2) `size_t i2c_master_handle_t::transferSize`
- (3) `uint8_t i2c_master_handle_t::state`

(4) `i2c_master_transfer_callback_t i2c_master_handle_t::completionCallback`

(5) `void* i2c_master_handle_t::userData`

#### 10.2.3.4 struct `i2c_slave_config_t`

##### Data Fields

- `bool enableSlave`  
*Enables the I2C peripheral at initialization time.*
- `uint16_t slaveAddress`  
*A slave address configuration.*

##### Field Documentation

(1) `bool i2c_slave_config_t::enableSlave`

(2) `uint16_t i2c_slave_config_t::slaveAddress`

#### 10.2.3.5 struct `i2c_slave_transfer_t`

##### Data Fields

- `i2c_slave_transfer_event_t event`  
*A reason that the callback is invoked.*
- `uint8_t *volatile data`  
*A transfer buffer.*
- `volatile size_t dataSize`  
*A transfer size.*
- `status_t completionStatus`  
*Success or error code describing how the transfer completed.*
- `size_t transferredCount`  
*A number of bytes actually transferred since the start or since the last repeated start.*

##### Field Documentation

(1) `i2c_slave_transfer_event_t i2c_slave_transfer_t::event`

(2) `uint8_t* volatile i2c_slave_transfer_t::data`

(3) `volatile size_t i2c_slave_transfer_t::dataSize`

(4) `status_t i2c_slave_transfer_t::completionStatus`

Only applies for `kI2C_SlaveCompletionEvent`.

(5) `size_t i2c_slave_transfer_t::transferredCount`

### 10.2.3.6 struct \_i2c\_slave\_handle

I2C slave handle typedef.

#### Data Fields

- volatile uint8\_t [state](#)  
*A transfer state maintained during transfer.*
- [i2c\\_slave\\_transfer\\_t](#) [transfer](#)  
*I2C slave transfer copy.*
- uint32\_t [eventMask](#)  
*A mask of enabled events.*
- [i2c\\_slave\\_transfer\\_callback\\_t](#) [callback](#)  
*A callback function called at the transfer event.*
- void \* [userData](#)  
*A callback parameter passed to the callback.*

#### Field Documentation

- (1) volatile uint8\_t i2c\_slave\_handle\_t::state
- (2) i2c\_slave\_transfer\_t i2c\_slave\_handle\_t::transfer
- (3) uint32\_t i2c\_slave\_handle\_t::eventMask
- (4) i2c\_slave\_transfer\_callback\_t i2c\_slave\_handle\_t::callback
- (5) void\* i2c\_slave\_handle\_t::userData

### 10.2.4 Macro Definition Documentation

10.2.4.1 #define FSL\_I2C\_DRIVER\_VERSION (MAKE\_VERSION(2, 0, 7))

10.2.4.2 #define I2C\_RETRY\_TIMES 0U /\* Define to zero means keep waiting until the flag is assert/deassert. \*/

### 10.2.5 Typedef Documentation

10.2.5.1 typedef void(\* i2c\_master\_transfer\_callback\_t)(I2C\_Type \*base, i2c\_master\_handle\_t \*handle, status\_t status, void \*userData)

10.2.5.2 typedef void(\* i2c\_slave\_transfer\_callback\_t)(I2C\_Type \*base, i2c\_slave\_transfer\_t \*xfer, void \*userData)

## 10.2.6 Enumeration Type Documentation

### 10.2.6.1 anonymous enum

Enumerator

*kStatus\_I2C\_Busy* I2C is busy with current transfer.  
*kStatus\_I2C\_Idle* Bus is Idle.  
*kStatus\_I2C\_Nak* NAK received during transfer.  
*kStatus\_I2C\_ArbitrationLost* Arbitration lost during transfer.  
*kStatus\_I2C\_Timeout* Timeout polling status flags.  
*kStatus\_I2C\_Addr\_Nak* NAK received during the address probe.

### 10.2.6.2 enum \_i2c\_flags

The following status register flags can be cleared:

- [kI2C\\_ArbitrationLostFlag](#)
- [kI2C\\_IntPendingFlag](#)

Note

These enumerations are meant to be OR'd together to form a bit mask.

Enumerator

*kI2C\_ReceiveNakFlag* I2C receive NAK flag.  
*kI2C\_IntPendingFlag* I2C interrupt pending flag.  
*kI2C\_TransferDirectionFlag* I2C transfer direction flag.  
*kI2C\_ArbitrationLostFlag* I2C arbitration lost flag.  
*kI2C\_BusBusyFlag* I2C bus busy flag.  
*kI2C\_AddressMatchFlag* I2C address match flag.  
*kI2C\_TransferCompleteFlag* I2C transfer complete flag.

### 10.2.6.3 enum \_i2c\_interrupt\_enable

Enumerator

*kI2C\_GlobalInterruptEnable* I2C global interrupt.

### 10.2.6.4 enum i2c\_direction\_t

Enumerator

*kI2C\_Write* Master transmits to the slave.  
*kI2C\_Read* Master receives from the slave.

### 10.2.6.5 enum `_i2c_master_transfer_flags`

Enumerator

***kI2C\_TransferDefaultFlag*** A transfer starts with a start signal, stops with a stop signal.

***kI2C\_TransferNoStartFlag*** A transfer starts without a start signal, only support write only or write+read with no start flag, do not support read only with no start flag.

***kI2C\_TransferRepeatedStartFlag*** A transfer starts with a repeated start signal.

***kI2C\_TransferNoStopFlag*** A transfer ends without a stop signal.

### 10.2.6.6 enum `i2c_slave_transfer_event_t`

These event enumerations are used for two related purposes. First, a bit mask created by OR'ing together events is passed to [I2C\\_SlaveTransferNonBlocking\(\)](#) to specify which events to enable. Then, when the slave callback is invoked, it is passed the current event through its *transfer* parameter.

Note

These enumerations are meant to be OR'd together to form a bit mask of events.

Enumerator

***kI2C\_SlaveAddressMatchEvent*** Received the slave address after a start or repeated start.

***kI2C\_SlaveTransmitEvent*** A callback is requested to provide data to transmit (slave-transmitter role).

***kI2C\_SlaveReceiveEvent*** A callback is requested to provide a buffer in which to place received data (slave-receiver role).

***kI2C\_SlaveTransmitAckEvent*** A callback needs to either transmit an ACK or NACK.

***kI2C\_SlaveCompletionEvent*** A stop was detected or finished transfer, completing the transfer.

***kI2C\_SlaveAllEvents*** A bit mask of all available events.

## 10.2.7 Function Documentation

### 10.2.7.1 void `I2C_MasterInit ( I2C_Type * base, const i2c_master_config_t * masterConfig, uint32_t srcClock_Hz )`

Call this API to ungate the I2C clock and configure the I2C with master configuration.

Note

This API should be called at the beginning of the application. Otherwise, any operation to the I2C module can cause a hard fault because the clock is not enabled. The configuration structure can be custom filled or it can be set with default values by using the [I2C\\_MasterGetDefaultConfig\(\)](#). After calling this API, the master is ready to transfer. This is an example.



```

* i2c_master_config_t config = {
*   .enableMaster = true,
*   .baudRate_Bps = 100000
* };
* I2C_MasterInit(I2C0, &config, 12000000U);
*

```

## Parameters

<i>base</i>	I2C base pointer
<i>masterConfig</i>	A pointer to the master configuration structure
<i>srcClock_Hz</i>	I2C peripheral clock frequency in Hz

### 10.2.7.2 void I2C\_MasterDeinit ( I2C\_Type \* *base* )

Call this API to gate the I2C clock. The I2C master module can't work unless the I2C\_MasterInit is called.

## Parameters

<i>base</i>	I2C base pointer
-------------	------------------

### 10.2.7.3 void I2C\_MasterGetDefaultConfig ( i2c\_master\_config\_t \* *masterConfig* )

The purpose of this API is to get the configuration structure initialized for use in the I2C\_MasterInit(). Use the initialized structure unchanged in the I2C\_MasterInit() or modify the structure before calling the I2C\_MasterInit(). This is an example.

```

* i2c_master_config_t config;
* I2C_MasterGetDefaultConfig(&config);
*

```

## Parameters

<i>masterConfig</i>	A pointer to the master configuration structure.
---------------------	--

### 10.2.7.4 void I2C\_SlaveInit ( I2C\_Type \* *base*, const i2c\_slave\_config\_t \* *slaveConfig* )

Call this API to ungate the I2C clock and initialize the I2C with the slave configuration.

## Note

This API should be called at the beginning of the application. Otherwise, any operation to the I2C module can cause a hard fault because the clock is not enabled. The configuration structure can partly be set with default values by [I2C\\_SlaveGetDefaultConfig\(\)](#) or it can be custom filled by the user. This is an example.

```
* i2c_slave_config_t config = {
* .enableSlave = true,
* .slaveAddress = 0x1DU,
* };
* I2C_SlaveInit(I2C0, &config);
*
```

## Parameters

<i>base</i>	I2C base pointer
<i>slaveConfig</i>	A pointer to the slave configuration structure

### 10.2.7.5 void I2C\_SlaveDeinit ( I2C\_Type \* *base* )

Calling this API gates the I2C clock. The I2C slave module can't work unless the I2C\_SlaveInit is called to enable the clock.

## Parameters

<i>base</i>	I2C base pointer
-------------	------------------

### 10.2.7.6 void I2C\_SlaveGetDefaultConfig ( i2c\_slave\_config\_t \* *slaveConfig* )

The purpose of this API is to get the configuration structure initialized for use in the [I2C\\_SlaveInit\(\)](#). Modify fields of the structure before calling the [I2C\\_SlaveInit\(\)](#). This is an example.

```
* i2c_slave_config_t config;
* I2C_SlaveGetDefaultConfig(&config);
*
```

## Parameters

<i>slaveConfig</i>	A pointer to the slave configuration structure.
--------------------	---

### 10.2.7.7 static void I2C\_Enable ( I2C\_Type \* *base*, bool *enable* ) [inline], [static]

## Parameters

<i>base</i>	I2C base pointer
<i>enable</i>	Pass true to enable and false to disable the module.

#### 10.2.7.8 static uint32\_t I2C\_MasterGetStatusFlags ( I2C\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	I2C base pointer
-------------	------------------

## Returns

status flag, use status flag to AND [\\_i2c\\_flags](#) to get the related status.

#### 10.2.7.9 static void I2C\_MasterClearStatusFlags ( I2C\_Type \* *base*, uint32\_t *statusMask* ) [inline], [static]

The following status register flags can be cleared kI2C\_ArbitrationLostFlag and kI2C\_IntPendingFlag.

## Parameters

<i>base</i>	I2C base pointer
<i>statusMask</i>	The status flag mask, defined in type i2c_status_flag_t. The parameter can be any combination of the following values: <ul style="list-style-type: none"> <li>• kI2C_ArbitrationLostFlag</li> <li>• kI2C_IntPendingFlag</li> </ul>

#### 10.2.7.10 static uint32\_t I2C\_SlaveGetStatusFlags ( I2C\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	I2C base pointer
-------------	------------------

## Returns

status flag, use status flag to AND [\\_i2c\\_flags](#) to get the related status.

#### 10.2.7.11 static void I2C\_SlaveClearStatusFlags ( I2C\_Type \* *base*, uint32\_t *statusMask* ) [inline], [static]

The following status register flags can be cleared kI2C\_ArbitrationLostFlag and kI2C\_IntPendingFlag

## Parameters

<i>base</i>	I2C base pointer
<i>statusMask</i>	The status flag mask, defined in type i2c_status_flag_t. The parameter can be any combination of the following values: <ul style="list-style-type: none"> <li>• kI2C_IntPendingFlagFlag</li> </ul>

#### 10.2.7.12 void I2C\_EnableInterrupts ( I2C\_Type \* *base*, uint32\_t *mask* )

## Parameters

<i>base</i>	I2C base pointer
<i>mask</i>	interrupt source The parameter can be combination of the following source if defined: <ul style="list-style-type: none"> <li>• kI2C_GlobalInterruptEnable</li> <li>• kI2C_StopDetectInterruptEnable/kI2C_StartDetectInterruptEnable</li> <li>• kI2C_SdaTimeoutInterruptEnable</li> </ul>

#### 10.2.7.13 void I2C\_DisableInterrupts ( I2C\_Type \* *base*, uint32\_t *mask* )

## Parameters

<i>base</i>	I2C base pointer
<i>mask</i>	interrupt source The parameter can be combination of the following source if defined: <ul style="list-style-type: none"> <li>• kI2C_GlobalInterruptEnable</li> <li>• kI2C_StopDetectInterruptEnable/kI2C_StartDetectInterruptEnable</li> <li>• kI2C_SdaTimeoutInterruptEnable</li> </ul>

**10.2.7.14** void I2C\_MasterSetBaudRate ( I2C\_Type \* *base*, uint32\_t *baudRate\_Bps*,  
uint32\_t *srcClock\_Hz* )

## Parameters

<i>base</i>	I2C base pointer
<i>baudRate_Bps</i>	the baud rate value in bps
<i>srcClock_Hz</i>	Source clock

#### 10.2.7.15 **status\_t I2C\_MasterStart ( I2C\_Type \* *base*, uint8\_t *address*, i2c\_direction\_t *direction* )**

This function is used to initiate a new master mode transfer by sending the START signal. The slave address is sent following the I2C START signal.

## Parameters

<i>base</i>	I2C peripheral base pointer
<i>address</i>	7-bit slave device address.
<i>direction</i>	Master transfer directions(transmit/receive).

## Return values

<i>kStatus_Success</i>	Successfully send the start signal.
<i>kStatus_I2C_Busy</i>	Current bus is busy.

#### 10.2.7.16 **status\_t I2C\_MasterStop ( I2C\_Type \* *base* )**

## Return values

<i>kStatus_Success</i>	Successfully send the stop signal.
<i>kStatus_I2C_Timeout</i>	Send stop signal failed, timeout.

#### 10.2.7.17 **status\_t I2C\_MasterRepeatedStart ( I2C\_Type \* *base*, uint8\_t *address*, i2c\_direction\_t *direction* )**

## Parameters

<i>base</i>	I2C peripheral base pointer
<i>address</i>	7-bit slave device address.
<i>direction</i>	Master transfer directions(transmit/receive).

## Return values

<i>kStatus_Success</i>	Successfully send the start signal.
<i>kStatus_I2C_Busy</i>	Current bus is busy but not occupied by current I2C master.

#### 10.2.7.18 **status\_t I2C\_MasterWriteBlocking ( I2C\_Type \* *base*, const uint8\_t \* *txBuff*, size\_t *txSize*, uint32\_t *flags* )**

## Parameters

<i>base</i>	The I2C peripheral base pointer.
<i>txBuff</i>	The pointer to the data to be transferred.
<i>txSize</i>	The length in bytes of the data to be transferred.
<i>flags</i>	Transfer control flag to decide whether need to send a stop, use kI2C_TransferDefaultFlag to issue a stop and kI2C_TransferNoStop to not send a stop.

## Return values

<i>kStatus_Success</i>	Successfully complete the data transmission.
<i>kStatus_I2C_Arbitration-Lost</i>	Transfer error, arbitration lost.
<i>kStatus_I2C_Nak</i>	Transfer error, receive NAK during transfer.

#### 10.2.7.19 **status\_t I2C\_MasterReadBlocking ( I2C\_Type \* *base*, uint8\_t \* *rxBuff*, size\_t *rxSize*, uint32\_t *flags* )**

## Note

The I2C\_MasterReadBlocking function stops the bus before reading the final byte. Without stopping the bus prior for the final read, the bus issues another read, resulting in garbage data being read into the data register.

## Parameters

<i>base</i>	I2C peripheral base pointer.
<i>rxBuff</i>	The pointer to the data to store the received data.
<i>rxSize</i>	The length in bytes of the data to be received.
<i>flags</i>	Transfer control flag to decide whether need to send a stop, use kI2C_TransferDefaultFlag to issue a stop and kI2C_TransferNoStop to not send a stop.

Return values

<i>kStatus_Success</i>	Successfully complete the data transmission.
<i>kStatus_I2C_Timeout</i>	Send stop signal failed, timeout.

#### 10.2.7.20 **status\_t I2C\_SlaveWriteBlocking ( I2C\_Type \* *base*, const uint8\_t \* *txBuff*, size\_t *txSize* )**

Parameters

<i>base</i>	The I2C peripheral base pointer.
<i>txBuff</i>	The pointer to the data to be transferred.
<i>txSize</i>	The length in bytes of the data to be transferred.

Return values

<i>kStatus_Success</i>	Successfully complete the data transmission.
<i>kStatus_I2C_Arbitration-Lost</i>	Transfer error, arbitration lost.
<i>kStatus_I2C_Nak</i>	Transfer error, receive NAK during transfer.

#### 10.2.7.21 **status\_t I2C\_SlaveReadBlocking ( I2C\_Type \* *base*, uint8\_t \* *rxBuff*, size\_t *rxSize* )**

Parameters

<i>base</i>	I2C peripheral base pointer.
<i>rxBuff</i>	The pointer to the data to store the received data.
<i>rxSize</i>	The length in bytes of the data to be received.

#### 10.2.7.22 **status\_t I2C\_MasterTransferBlocking ( I2C\_Type \* *base*, i2c\_master\_transfer\_t \* *xfer* )**

Note

The API does not return until the transfer succeeds or fails due to arbitration lost or receiving a NAK.



## Parameters

<i>base</i>	I2C peripheral base address.
<i>xfer</i>	Pointer to the transfer structure.

## Return values

<i>kStatus_Success</i>	Successfully complete the data transmission.
<i>kStatus_I2C_Busy</i>	Previous transmission still not finished.
<i>kStatus_I2C_Timeout</i>	Transfer error, wait signal timeout.
<i>kStatus_I2C_Arbitration-Lost</i>	Transfer error, arbitration lost.
<i>kStatus_I2C_Nak</i>	Transfer error, receive NAK during transfer.

#### 10.2.7.23 void I2C\_MasterTransferCreateHandle ( I2C\_Type \* *base*, i2c\_master\_handle\_t \* *handle*, i2c\_master\_transfer\_callback\_t *callback*, void \* *userData* )

## Parameters

<i>base</i>	I2C base pointer.
<i>handle</i>	pointer to i2c_master_handle_t structure to store the transfer state.
<i>callback</i>	pointer to user callback function.
<i>userData</i>	user parameter passed to the callback function.

#### 10.2.7.24 status\_t I2C\_MasterTransferNonBlocking ( I2C\_Type \* *base*, i2c\_master\_handle\_t \* *handle*, i2c\_master\_transfer\_t \* *xfer* )

## Note

Calling the API returns immediately after transfer initiates. The user needs to call I2C\_MasterGetTransferCount to poll the transfer status to check whether the transfer is finished. If the return status is not kStatus\_I2C\_Busy, the transfer is finished.

## Parameters

<i>base</i>	I2C base pointer.
<i>handle</i>	pointer to i2c_master_handle_t structure which stores the transfer state.
<i>xfer</i>	pointer to <a href="#">i2c_master_transfer_t</a> structure.

Return values

<i>kStatus_Success</i>	Successfully start the data transmission.
<i>kStatus_I2C_Busy</i>	Previous transmission still not finished.
<i>kStatus_I2C_Timeout</i>	Transfer error, wait signal timeout.

#### 10.2.7.25 **status\_t I2C\_MasterTransferGetCount ( I2C\_Type \* *base*, i2c\_master\_handle\_t \* *handle*, size\_t \* *count* )**

Parameters

<i>base</i>	I2C base pointer.
<i>handle</i>	pointer to i2c_master_handle_t structure which stores the transfer state.
<i>count</i>	Number of bytes transferred so far by the non-blocking transaction.

Return values

<i>kStatus_InvalidArgument</i>	count is Invalid.
<i>kStatus_Success</i>	Successfully return the count.

#### 10.2.7.26 **status\_t I2C\_MasterTransferAbort ( I2C\_Type \* *base*, i2c\_master\_handle\_t \* *handle* )**

Note

This API can be called at any time when an interrupt non-blocking transfer initiates to abort the transfer early.

Parameters

<i>base</i>	I2C base pointer.
<i>handle</i>	pointer to i2c_master_handle_t structure which stores the transfer state

Return values

<i>kStatus_I2C_Timeout</i>	Timeout during polling flag.
<i>kStatus_Success</i>	Successfully abort the transfer.

#### 10.2.7.27 void I2C\_MasterTransferHandleIRQ ( I2C\_Type \* *base*, void \* *i2cHandle* )

Parameters

<i>base</i>	I2C base pointer.
<i>i2cHandle</i>	pointer to i2c_master_handle_t structure.

#### 10.2.7.28 void I2C\_SlaveTransferCreateHandle ( I2C\_Type \* *base*, i2c\_slave\_handle\_t \* *handle*, i2c\_slave\_transfer\_callback\_t *callback*, void \* *userData* )

Parameters

<i>base</i>	I2C base pointer.
<i>handle</i>	pointer to i2c_slave_handle_t structure to store the transfer state.
<i>callback</i>	pointer to user callback function.
<i>userData</i>	user parameter passed to the callback function.

#### 10.2.7.29 status\_t I2C\_SlaveTransferNonBlocking ( I2C\_Type \* *base*, i2c\_slave\_handle\_t \* *handle*, uint32\_t *eventMask* )

Call this API after calling the [I2C\\_SlaveInit\(\)](#) and [I2C\\_SlaveTransferCreateHandle\(\)](#) to start processing transactions driven by an I2C master. The slave monitors the I2C bus and passes events to the callback that was passed into the call to [I2C\\_SlaveTransferCreateHandle\(\)](#). The callback is always invoked from the interrupt context.

The set of events received by the callback is customizable. To do so, set the *eventMask* parameter to the OR'd combination of [i2c\\_slave\\_transfer\\_event\\_t](#) enumerators for the events you wish to receive. The [kI2C\\_SlaveTransmitEvent](#) and [kLPI2C\\_SlaveReceiveEvent](#) events are always enabled and do not need to be included in the mask. Alternatively, pass 0 to get a default set of only the transmit and receive events that are always enabled. In addition, the [kI2C\\_SlaveAllEvents](#) constant is provided as a convenient way to enable all events.

## Parameters

<i>base</i>	The I2C peripheral base address.
<i>handle</i>	Pointer to <code>i2c_slave_handle_t</code> structure which stores the transfer state.
<i>eventMask</i>	Bit mask formed by OR'ing together <code>i2c_slave_transfer_event_t</code> enumerators to specify which events to send to the callback. Other accepted values are 0 to get a default set of only the transmit and receive events, and <code>kI2C_SlaveAllEvents</code> to enable all events.

## Return values

<i>kStatus_Success</i>	Slave transfers were successfully started.
<i>kStatus_I2C_Busy</i>	Slave transfers have already been started on this handle.

### 10.2.7.30 void I2C\_SlaveTransferAbort ( I2C\_Type \* *base*, i2c\_slave\_handle\_t \* *handle* )

## Note

This API can be called at any time to stop slave for handling the bus events.

## Parameters

<i>base</i>	I2C base pointer.
<i>handle</i>	pointer to <code>i2c_slave_handle_t</code> structure which stores the transfer state.

### 10.2.7.31 status\_t I2C\_SlaveTransferGetCount ( I2C\_Type \* *base*, i2c\_slave\_handle\_t \* *handle*, size\_t \* *count* )

## Parameters

<i>base</i>	I2C base pointer.
<i>handle</i>	pointer to <code>i2c_slave_handle_t</code> structure.
<i>count</i>	Number of bytes transferred so far by the non-blocking transaction.

## Return values

<i>kStatus_InvalidArgument</i>	count is Invalid.
<i>kStatus_Success</i>	Successfully return the count.

#### 10.2.7.32 void I2C\_SlaveTransferHandleIRQ ( I2C\_Type \* *base*, void \* *i2cHandle* )

Parameters

<i>base</i>	I2C base pointer.
<i>i2cHandle</i>	pointer to i2c_slave_handle_t structure which stores the transfer state

## 10.3 I2C FreeRTOS Driver

### 10.3.1 Overview

#### Driver version

- #define `FSL_I2C_FREERTOS_DRIVER_VERSION` (`MAKE_VERSION(2, 0, 7)`)  
*I2C FreeRTOS driver version.*

### I2C RTOS Operation

- `status_t I2C_RTOS_Init` (`i2c_rtos_handle_t *handle`, `I2C_Type *base`, `const i2c_master_config_t *masterConfig`, `uint32_t srcClock_Hz`)  
*Initializes I2C.*
- `status_t I2C_RTOS_Deinit` (`i2c_rtos_handle_t *handle`)  
*Deinitializes the I2C.*
- `status_t I2C_RTOS_Transfer` (`i2c_rtos_handle_t *handle`, `i2c_master_transfer_t *transfer`)  
*Performs the I2C transfer.*

### 10.3.2 Macro Definition Documentation

#### 10.3.2.1 #define FSL\_I2C\_FREERTOS\_DRIVER\_VERSION (MAKE\_VERSION(2, 0, 7))

### 10.3.3 Function Documentation

#### 10.3.3.1 `status_t I2C_RTOS_Init ( i2c_rtos_handle_t * handle, I2C_Type * base, const i2c_master_config_t * masterConfig, uint32_t srcClock_Hz )`

This function initializes the I2C module and the related RTOS context.

Parameters

<i>handle</i>	The RTOS I2C handle, the pointer to an allocated space for RTOS context.
<i>base</i>	The pointer base address of the I2C instance to initialize.
<i>masterConfig</i>	The configuration structure to set-up I2C in master mode.
<i>srcClock_Hz</i>	The frequency of an input clock of the I2C module.

Returns

status of the operation.

### **10.3.3.2   status\_t I2C\_RTOS\_Deinit ( i2c\_rtos\_handle\_t \* *handle* )**

This function deinitializes the I2C module and the related RTOS context.

## Parameters

<i>handle</i>	The RTOS I2C handle.
---------------	----------------------

**10.3.3.3 status\_t I2C\_RTOS\_Transfer ( i2c\_rtos\_handle\_t \* *handle*, i2c\_master\_transfer\_t \* *transfer* )**

This function performs the I2C transfer according to the data given in the transfer structure.

## Parameters

<i>handle</i>	The RTOS I2C handle.
<i>transfer</i>	A structure specifying the transfer parameters.

## Returns

status of the operation.



## 10.4 I2C CMSIS Driver

This section describes the programming interface of the I2C Cortex Microcontroller Software Interface Standard (CMSIS) driver. This driver defines generic peripheral driver interfaces for middleware making it reusable across a wide range of supported microcontroller devices. The API connects microcontroller peripherals with middleware that implements for example communication stacks, file systems, or graphic user interfaces. More information and usage method see <http://www.keil.com/pack/doc/cmsis/Driver/html/index.html>.

The I2C CMSIS driver includes transactional APIs.

Transactional APIs are transaction target high-level APIs. The transactional APIs can be used to enable the peripheral quickly and also in the application if the code size and performance of transactional APIs satisfy the requirements. If the code size and performance are critical requirements, see the transactional API implementation and write custom code accessing the hardware registers.

### 10.4.1 I2C CMSIS Driver

#### 10.4.1.1 Master Operation in interrupt transactional method

```
void I2C_MasterSignalEvent_t(uint32_t event)
{
    if (event == ARM_I2C_EVENT_TRANSFER_DONE)
    {
        g_MasterCompletionFlag = true;
    }
}

/*Init I2C1*/
Driver_I2C1.Initialize(I2C_MasterSignalEvent_t);

Driver_I2C1.PowerControl(ARM_POWER_FULL);

/*config transmit speed*/
Driver_I2C1.Control(ARM_I2C_BUS_SPEED, ARM_I2C_BUS_SPEED_STANDARD);

/*start transmit*/
Driver_I2C1.MasterTransmit(I2C_MASTER_SLAVE_ADDR, g_master_buff, I2C_DATA_LENGTH, false);

/* Wait for transfer completed. */
while (!g_MasterCompletionFlag)
{
}
g_MasterCompletionFlag = false;
```

#### 10.4.1.2 Slave Operation in interrupt transactional method

```
void I2C_SlaveSignalEvent_t(uint32_t event)
{
    /* Transfer done */
    if (event == ARM_I2C_EVENT_TRANSFER_DONE)
    {
        g_SlaveCompletionFlag = true;
    }
}

/*Init I2C1*/
Driver_I2C1.Initialize(I2C_SlaveSignalEvent_t);
```

```
Driver_I2C1.PowerControl(ARM_POWER_FULL);

/*config slave addr*/
Driver_I2C1.Control(ARM_I2C_OWN_ADDRESS, I2C_MASTER_SLAVE_ADDR);

/*start transfer*/
Driver_I2C1.SlaveReceive(g_slave_buff, I2C_DATA_LENGTH);

/* Wait for transfer completed. */
while (!g_SlaveCompletionFlag)
{
}
g_SlaveCompletionFlag = false;
```

# Chapter 11

## PWM: Pulse Width Modulation Driver

### 11.1 Overview

The MCUXpresso SDK provides a peripheral driver for the Pulse Width Modulation (PWM) module of MCUXpresso SDK devices.

### 11.2 PWM Driver

#### 11.2.1 Initialization and deinitialization

The function `PWM_Init()` initializes the PWM with a specified configurations. The function `PWM_GetDefaultConfig()` gets the default configurations. The initialization function configures the PWM for the requested register update mode for registers with buffers.

The function `PWM_Deinit()` disables the PWM counter and turns off the module clock.

### 11.3 Typical use case

#### 11.3.1 PWM output

Output PWM signal on PWM3 module with different dutycycles. Periodically update the PWM signal duty cycle. Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/pwm`

### Enumerations

- enum `pwm_clock_source_t` {  
    `kPWM_PeripheralClock` = 1U,  
    `kPWM_HighFrequencyClock`,  
    `kPWM_LowFrequencyClock` }  
    *PWM clock source select.*
- enum `pwm_fifo_water_mark_t` {  
    `kPWM_FIFOWaterMark_1` = 0U,  
    `kPWM_FIFOWaterMark_2`,  
    `kPWM_FIFOWaterMark_3`,  
    `kPWM_FIFOWaterMark_4` }  
    *PWM FIFO water mark select.*
- enum `pwm_byte_data_swap_t` {  
    `kPWM_ByteNoSwap` = 0U,  
    `kPWM_ByteSwap` }  
    *PWM byte data swap select.*

- enum `pwm_half_word_data_swap_t` {  
`kPWM_HalfWordNoSwap` = 0U,  
`kPWM_HalfWordSwap` }  
*PWM half-word data swap select.*
- enum `pwm_output_configuration_t` {  
`kPWM_SetAtRolloverAndClearAtcomparison` = 0U,  
`kPWM_ClearAtRolloverAndSetAtcomparison`,  
`kPWM_NoConfigure` }  
*PWM Output Configuration.*
- enum `pwm_sample_repeat_t` {  
`kPWM_EachSampleOnce` = 0u,  
`kPWM_EachSampletwice`,  
`kPWM_EachSampleFourTimes`,  
`kPWM_EachSampleEightTimes` }  
*PWM FIFO sample repeat It determines the number of times each sample from the FIFO is to be used.*
- enum `pwm_interrupt_enable_t` {  
`kPWM_FIFOEmptyInterruptEnable` = (1U << 0),  
`kPWM_RolloverInterruptEnable` = (1U << 1),  
`kPWM_CompareInterruptEnable` = (1U << 2) }  
*List of PWM interrupt options.*
- enum `pwm_status_flags_t` {  
`kPWM_FIFOEmptyFlag` = (1U << 3),  
`kPWM_RolloverFlag` = (1U << 4),  
`kPWM_CompareFlag` = (1U << 5),  
`kPWM_FIFOWriteErrorFlag` }  
*List of PWM status flags.*
- enum `pwm_fifo_available_t` {  
`kPWM_NoDataInFIFOFlag` = 0U,  
`kPWM_OneWordInFIFOFlag`,  
`kPWM_TwoWordsInFIFOFlag`,  
`kPWM_ThreeWordsInFIFOFlag`,  
`kPWM_FourWordsInFIFOFlag` }  
*List of PWM FIFO available.*

## Functions

- static void `PWM_SoftwareReset` (PWM\_Type \*base)  
*Software reset.*
- static void `PWM_SetPeriodValue` (PWM\_Type \*base, uint32\_t value)  
*Sets the PWM period value.*
- static uint32\_t `PWM_GetPeriodValue` (PWM\_Type \*base)  
*Gets the PWM period value.*
- static uint32\_t `PWM_GetCounterValue` (PWM\_Type \*base)  
*Gets the PWM counter value.*

## Driver version

- #define `FSL_PWM_DRIVER_VERSION` (MAKE\_VERSION(2, 0, 0))

Version 2.0.0.

## Initialization and deinitialization

- `status_t PWM_Init` (PWM\_Type \*base, const pwm\_config\_t \*config)  
*Ungates the PWM clock and configures the peripheral for basic operation.*
- `void PWM_Deinit` (PWM\_Type \*base)  
*Gate the PWM submodule clock.*
- `void PWM_GetDefaultConfig` (pwm\_config\_t \*config)  
*Fill in the PWM config struct with the default settings.*

## PWM start and stop.

- `static void PWM_StartTimer` (PWM\_Type \*base)  
*Starts the PWM counter when the PWM is enabled.*
- `static void PWM_StopTimer` (PWM\_Type \*base)  
*Stops the PWM counter when the pwm is disabled.*

## Interrupt Interface

- `static void PWM_EnableInterrupts` (PWM\_Type \*base, uint32\_t mask)  
*Enables the selected PWM interrupts.*
- `static void PWM_DisableInterrupts` (PWM\_Type \*base, uint32\_t mask)  
*Disables the selected PWM interrupts.*
- `static uint32_t PWM_GetEnabledInterrupts` (PWM\_Type \*base)  
*Gets the enabled PWM interrupts.*

## Status Interface

- `static uint32_t PWM_GetStatusFlags` (PWM\_Type \*base)  
*Gets the PWM status flags.*
- `static void PWM_clearStatusFlags` (PWM\_Type \*base, uint32\_t mask)  
*Clears the PWM status flags.*
- `static uint32_t PWM_GetFIFOAvailable` (PWM\_Type \*base)  
*Gets the PWM FIFO available.*

## Sample Interface

- `static void PWM_SetSampleValue` (PWM\_Type \*base, uint32\_t value)  
*Sets the PWM sample value.*
- `static uint32_t PWM_GetSampleValue` (PWM\_Type \*base)  
*Gets the PWM sample value.*

## 11.4 Enumeration Type Documentation

### 11.4.1 enum pwm\_clock\_source\_t

Enumerator

***kPWM\_PeripheralClock*** The Peripheral clock is used as the clock.

***kPWM\_HighFrequencyClock*** High-frequency reference clock is used as the clock.

***kPWM\_LowFrequencyClock*** Low-frequency reference clock(32KHz) is used as the clock.

### 11.4.2 enum pwm\_fifo\_water\_mark\_t

Sets the data level at which the FIFO empty flag will be set

Enumerator

***kPWM\_FIFOWaterMark\_1*** FIFO empty flag is set when there are more than or equal to 1 empty slots.

***kPWM\_FIFOWaterMark\_2*** FIFO empty flag is set when there are more than or equal to 2 empty slots.

***kPWM\_FIFOWaterMark\_3*** FIFO empty flag is set when there are more than or equal to 3 empty slots.

***kPWM\_FIFOWaterMark\_4*** FIFO empty flag is set when there are more than or equal to 4 empty slots.

### 11.4.3 enum pwm\_byte\_data\_swap\_t

It determines the byte ordering of the 16-bit data when it goes into the FIFO from the sample register.

Enumerator

***kPWM\_ByteNoSwap*** byte ordering remains the same

***kPWM\_ByteSwap*** byte ordering is reversed

### 11.4.4 enum pwm\_half\_word\_data\_swap\_t

Enumerator

***kPWM\_HalfWordNoSwap*** Half word swapping does not take place.

***kPWM\_HalfWordSwap*** Half word from write data bus are swapped.

### 11.4.5 enum pwm\_output\_configuration\_t

Enumerator

***kPWM\_SetAtRolloverAndClearAtcomparison*** Output pin is set at rollover and cleared at comparison.

***kPWM\_ClearAtRolloverAndSetAtcomparison*** Output pin is cleared at rollover and set at comparison.

***kPWM\_NoConfigure*** PWM output is disconnected.

### 11.4.6 enum pwm\_sample\_repeat\_t

Enumerator

***kPWM\_EachSampleOnce*** Use each sample once.

***kPWM\_EachSampletwice*** Use each sample twice.

***kPWM\_EachSampleFourTimes*** Use each sample four times.

***kPWM\_EachSampleEightTimes*** Use each sample eight times.

### 11.4.7 enum pwm\_interrupt\_enable\_t

Enumerator

***kPWM\_FIFOEmptyInterruptEnable*** This bit controls the generation of the FIFO Empty interrupt.

***kPWM\_RolloverInterruptEnable*** This bit controls the generation of the Rollover interrupt.

***kPWM\_CompareInterruptEnable*** This bit controls the generation of the Compare interrupt.

### 11.4.8 enum pwm\_status\_flags\_t

Enumerator

***kPWM\_FIFOEmptyFlag*** This bit indicates the FIFO data level in comparison to the water level set by FWM field in the control register.

***kPWM\_RolloverFlag*** This bit shows that a roll-over event has occurred.

***kPWM\_CompareFlag*** This bit shows that a compare event has occurred.

***kPWM\_FIFOWriteErrorFlag*** This bit shows that an attempt has been made to write FIFO when it is full.

### 11.4.9 enum pwm\_fifo\_available\_t

Enumerator

***kPWM\_NoDataInFIFOFlag*** No data available.

***kPWM\_OneWordInFIFOFlag*** 1 word of data in FIFO

***kPWM\_TwoWordsInFIFOFlag*** 2 word of data in FIFO

***kPWM\_ThreeWordsInFIFOFlag*** 3 word of data in FIFO

***kPWM\_FourWordsInFIFOFlag*** 4 word of data in FIFO

## 11.5 Function Documentation

### 11.5.1 `status_t PWM_Init ( PWM_Type * base, const pwm_config_t * config )`

Note

This API should be called at the beginning of the application using the PWM driver.

Parameters

<i>base</i>	PWM peripheral base address
<i>config</i>	Pointer to user's PWM config structure.

Returns

kStatus\_Success means success; else failed.

### 11.5.2 `void PWM_Deinit ( PWM_Type * base )`

Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

### 11.5.3 `void PWM_GetDefaultConfig ( pwm_config_t * config )`

The default values are:

```
* config->enableStopMode = false;
* config->enableDozeMode = false;
* config->enableWaitMode = false;
* config->enableDozeMode = false;
* config->clockSource = kPWM_LowFrequencyClock;
* config->prescale = 0U;
* config->outputConfig = kPWM_SetAtRolloverAndClearAtcomparison;
* config->fifoWater = kPWM_FIFOWaterMark_2;
* config->sampleRepeat = kPWM_EachSampleOnce;
* config->byteSwap = kPWM_ByteNoSwap;
* config->halfWordSwap = kPWM_HalfWordNoSwap;
*
```



## Parameters

<i>config</i>	Pointer to user's PWM config structure.
---------------	---

**11.5.4 static void PWM\_StartTimer ( PWM\_Type \* *base* ) [inline], [static]**

When the PWM is enabled, it begins a new period, the output pin is set to start a new period while the prescaler and counter are released and counting begins.

## Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

**11.5.5 static void PWM\_StopTimer ( PWM\_Type \* *base* ) [inline], [static]**

## Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

**11.5.6 static void PWM\_SoftwareReset ( PWM\_Type \* *base* ) [inline], [static]**

PWM is reset when this bit is set to 1. It is a self clearing bit. Setting this bit resets all the registers to their reset values except for the STOPEN, DOZEN, WAITEN, and DBGEN bits in this control register.

## Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

**11.5.7 static void PWM\_EnableInterrupts ( PWM\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

## Parameters

---

<i>base</i>	PWM peripheral base address
<i>mask</i>	The interrupts to enable. This is a logical OR of members of the enumeration <a href="#">pwm_interrupt_enable_t</a>

### 11.5.8 static void PWM\_DisableInterrupts ( PWM\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

Parameters

<i>base</i>	PWM peripheral base address
<i>mask</i>	The interrupts to disable. This is a logical OR of members of the enumeration <a href="#">pwm_interrupt_enable_t</a>

### 11.5.9 static uint32\_t PWM\_GetEnabledInterrupts ( PWM\_Type \* *base* ) [inline], [static]

Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

Returns

The enabled interrupts. This is the logical OR of members of the enumeration [pwm\\_interrupt\\_enable\\_t](#)

### 11.5.10 static uint32\_t PWM\_GetStatusFlags ( PWM\_Type \* *base* ) [inline], [static]

Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

Returns

The status flags. This is the logical OR of members of the enumeration [pwm\\_status\\_flags\\_t](#)

**11.5.11**   **static void PWM\_clearStatusFlags ( PWM\_Type \* *base*, uint32\_t *mask* )**  
          **[inline], [static]**

## Parameters

<i>base</i>	PWM peripheral base address
<i>mask</i>	The status flags to clear. This is a logical OR of members of the enumeration <a href="#">pwm_status_flags_t</a>

### 11.5.12 static uint32\_t PWM\_GetFIFOAvailable ( PWM\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

## Returns

The status flags. This is the logical OR of members of the enumeration [pwm\\_fifo\\_available\\_t](#)

### 11.5.13 static void PWM\_SetSampleValue ( PWM\_Type \* *base*, uint32\_t *value* ) [inline], [static]

## Parameters

<i>base</i>	PWM peripheral base address
<i>value</i>	The sample value. This is the input to the 4x16 FIFO. The value in this register denotes the value of the sample being currently used.

### 11.5.14 static uint32\_t PWM\_GetSampleValue ( PWM\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

## Returns

The sample value. It can be read only when the PWM is enable.

**11.5.15**   **static void PWM\_SetPeriodValue ( PWM\_Type \* *base*, uint32\_t *value* )**  
          **[inline], [static]**

## Parameters

<i>base</i>	PWM peripheral base address
<i>value</i>	The period value. The PWM period register (PWM_PWMPR) determines the period of the PWM output signal. Writing 0xFFFF to this register will achieve the same result as writing 0xFFFE. $PWMO\text{ (Hz)} = PCLK\text{(Hz)} / (\text{period} + 2)$

### 11.5.16 static uint32\_t PWM\_GetPeriodValue ( PWM\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

## Returns

The period value. The PWM period register (PWM\_PWMPR) determines the period of the PWM output signal.

### 11.5.17 static uint32\_t PWM\_GetCounterValue ( PWM\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	PWM peripheral base address
-------------	-----------------------------

## Returns

The counter value. The current count value.



## Chapter 12

# UART: Universal Asynchronous Receiver/Transmitter Driver

### 12.1 Overview

#### Modules

- [UART CMSIS Driver](#)
- [UART Driver](#)
- [UART FreeRTOS Driver](#)

## 12.2 UART Driver

### 12.2.1 Overview

The MCUXpresso SDK provides a peripheral driver for the Universal Asynchronous Receiver/Transmitter (UART) module of MCUXpresso SDK devices.

The UART driver includes functional APIs and transactional APIs.

Functional APIs are used for UART initialization/configuration/operation for the purpose of optimization/customization. Using the functional API requires the knowledge of the UART peripheral and how to organize functional APIs to meet the application requirements. All functional APIs use the peripheral base address as the first parameter. UART functional operation groups provide the functional API set.

Transactional APIs can be used to enable the peripheral quickly and in the application if the code size and performance of transactional APIs can satisfy the requirements. If the code size and performance are critical requirements, see the transactional API implementation and write custom code. All transactional APIs use the `uart_handle_t` as the second parameter. Initialize the handle by calling the [UART\\_TransferCreateHandle\(\)](#) API.

Transactional APIs support asynchronous transfer, which means that the functions [UART\\_TransferSendNonBlocking\(\)](#) and [UART\\_TransferReceiveNonBlocking\(\)](#) set up an interrupt for data transfer. When the transfer completes, the upper layer is notified through a callback function with the `kStatus_UART_TxIdle` and `kStatus_UART_RxIdle`.

Transactional receive APIs support the ring buffer. Prepare the memory for the ring buffer and pass in the start address and size while calling the [UART\\_TransferCreateHandle\(\)](#). If passing NULL, the ring buffer feature is disabled. When the ring buffer is enabled, the received data is saved to the ring buffer in the background. The [UART\\_TransferReceiveNonBlocking\(\)](#) function first gets data from the ring buffer. If the ring buffer does not have enough data, the function first returns the data in the ring buffer and then saves the received data to user memory. When all data is received, the upper layer is informed through a callback with the `kStatus_UART_RxIdle`.

If the receive ring buffer is full, the upper layer is informed through a callback with the `kStatus_UART_RxRingBufferOverflow`. In the callback function, the upper layer reads data out from the ring buffer. If not, existing data is overwritten by the new data.

The ring buffer size is specified when creating the handle. Note that one byte is reserved for the ring buffer maintenance. When creating handle using the following code.

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/uart`. In this example, the buffer size is 32, but only 31 bytes are used for saving data.

### 12.2.2 Typical use case

#### 12.2.2.1 UART Send/receive using a polling method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/uart`



### 12.2.2.2 UART Send/receive using an interrupt method

Refer to the driver examples codes located at <SDK\_ROOT>/boards/<BOARD>/driver\_examples/uart

### 12.2.2.3 UART Receive using the ringbuffer feature

Refer to the driver examples codes located at <SDK\_ROOT>/boards/<BOARD>/driver\_examples/uart

### 12.2.2.4 UART automatic baud rate detect feature

Refer to the driver examples codes located at <SDK\_ROOT>/boards/<BOARD>/driver\_examples/uart

## Data Structures

- struct [uart\\_config\\_t](#)  
UART configuration structure. [More...](#)
- struct [uart\\_transfer\\_t](#)  
UART transfer structure. [More...](#)
- struct [uart\\_handle\\_t](#)  
UART handle structure. [More...](#)

## Macros

- #define [UART\\_RETRY\\_TIMES](#) 0U /\* Defining to zero means to keep waiting for the flag until it is assert/deassert. \*/  
Retry times for waiting flag.

## Typedefs

- typedef void(\* [uart\\_transfer\\_callback\\_t](#) )(UART\_Type \*base, uart\_handle\_t \*handle, [status\\_t](#) status, void \*userData)  
UART transfer callback function.

## Enumerations

- enum {
  - kStatus\_UART\_TxBusy = MAKE\_STATUS(kStatusGroup\_IUART, 0),
  - kStatus\_UART\_RxBusy = MAKE\_STATUS(kStatusGroup\_IUART, 1),
  - kStatus\_UART\_TxIdle = MAKE\_STATUS(kStatusGroup\_IUART, 2),
  - kStatus\_UART\_RxIdle = MAKE\_STATUS(kStatusGroup\_IUART, 3),
  - kStatus\_UART\_TxWatermarkTooLarge = MAKE\_STATUS(kStatusGroup\_IUART, 4),
  - kStatus\_UART\_RxWatermarkTooLarge = MAKE\_STATUS(kStatusGroup\_IUART, 5),
  - kStatus\_UART\_FlagCannotClearManually,
  - kStatus\_UART\_Error = MAKE\_STATUS(kStatusGroup\_IUART, 7),
  - kStatus\_UART\_RxRingBufferOverflow = MAKE\_STATUS(kStatusGroup\_IUART, 8),
  - kStatus\_UART\_RxHardwareOverflow = MAKE\_STATUS(kStatusGroup\_IUART, 9),
  - kStatus\_UART\_NoiseError = MAKE\_STATUS(kStatusGroup\_IUART, 10),
  - kStatus\_UART\_FramingError = MAKE\_STATUS(kStatusGroup\_IUART, 11),
  - kStatus\_UART\_ParityError = MAKE\_STATUS(kStatusGroup\_IUART, 12),
  - kStatus\_UART\_BaudrateNotSupport,
  - kStatus\_UART\_BreakDetect = MAKE\_STATUS(kStatusGroup\_IUART, 14),
  - kStatus\_UART\_Timeout = MAKE\_STATUS(kStatusGroup\_IUART, 15) }

*Error codes for the UART driver.*
- enum uart\_data\_bits\_t {
  - kUART\_SevenDataBits = 0x0U,
  - kUART\_EightDataBits = 0x1U }

*UART data bits count.*
- enum uart\_parity\_mode\_t {
  - kUART\_ParityDisabled = 0x0U,
  - kUART\_ParityEven = 0x2U,
  - kUART\_ParityOdd = 0x3U }

*UART parity mode.*
- enum uart\_stop\_bit\_count\_t {
  - kUART\_OneStopBit = 0x0U,
  - kUART\_TwoStopBit = 0x1U }

*UART stop bit count.*
- enum uart\_idle\_condition\_t {
  - kUART\_IdleFor4Frames = 0x0U,
  - kUART\_IdleFor8Frames = 0x1U,
  - kUART\_IdleFor16Frames = 0x2U,
  - kUART\_IdleFor32Frames = 0x3U }

*UART idle condition detect.*
- enum \_uart\_interrupt\_enable
  - This structure contains the settings for all of the UART interrupt configurations.*
- enum {

```

kUART_RxCharReadyFlag = 0x0000000FU,
kUART_RxErrorFlag = 0x0000000EU,
kUART_RxOverrunErrorFlag = 0x0000000DU,
kUART_RxFrameErrorFlag = 0x0000000CU,
kUART_RxBreakDetectFlag = 0x0000000BU,
kUART_RxParityErrorFlag = 0x0000000AU,
kUART_ParityErrorFlag = 0x0094000FU,
kUART_RtsStatusFlag = 0x0094000EU,
kUART_TxReadyFlag = 0x0094000DU,
kUART_RtsDeltaFlag = 0x0094000CU,
kUART_EscapeFlag = 0x0094000BU,
kUART_FrameErrorFlag = 0x0094000AU,
kUART_RxReadyFlag = 0x00940009U,
kUART_AgingTimerFlag = 0x00940008U,
kUART_DtrDeltaFlag = 0x00940007U,
kUART_RxDsFlag = 0x00940006U,
kUART_tAirWakeFlag = 0x00940005U,
kUART_AwakeFlag = 0x00940004U,
kUART_Rs485SlaveAddrMatchFlag = 0x00940003U,
kUART_AutoBaudFlag = 0x0098000FU,
kUART_TxEmptyFlag = 0x0098000EU,
kUART_DtrFlag = 0x0098000DU,
kUART_IdleFlag = 0x0098000CU,
kUART_AutoBaudCntStopFlag = 0x0098000BU,
kUART_RiDeltaFlag = 0x0098000AU,
kUART_RiFlag = 0x00980009U,
kUART_IrFlag = 0x00980008U,
kUART_WakeFlag = 0x00980007U,
kUART_DcdDeltaFlag = 0x00980006U,
kUART_DcdFlag = 0x00980005U,
kUART_RtsFlag = 0x00980004U,
kUART_TxCompleteFlag = 0x00980003U,
kUART_BreakDetectFlag = 0x00980002U,
kUART_RxOverrunFlag = 0x00980001U,
kUART_RxDataReadyFlag = 0x00980000U }

```

*UART status flags.*

## Functions

- `uint32_t UART_GetInstance (UART_Type *base)`  
*Get the UART instance from peripheral base address.*

## Variables

- void \* [s\\_uartHandle](#) []  
*Pointers to uart handles for each instance.*

## Driver version

- #define [FSL\\_UART\\_DRIVER\\_VERSION](#) ([MAKE\\_VERSION](#)(2, 3, 2))  
*UART driver version.*

## Software Reset

- static void [UART\\_SoftwareReset](#) (UART\_Type \*base)  
*Resets the UART using software.*

## Initialization and deinitialization

- [status\\_t UART\\_Init](#) (UART\_Type \*base, const [uart\\_config\\_t](#) \*config, uint32\_t srcClock\_Hz)  
*Initializes an UART instance with the user configuration structure and the peripheral clock.*
- void [UART\\_Deinit](#) (UART\_Type \*base)  
*Deinitializes a UART instance.*
- void [UART\\_GetDefaultConfig](#) ([uart\\_config\\_t](#) \*config)  
*l*
- [status\\_t UART\\_SetBaudRate](#) (UART\_Type \*base, uint32\_t baudRate\_Bps, uint32\_t srcClock\_Hz)  
*Sets the UART instance baud rate.*
- static void [UART\\_Enable](#) (UART\_Type \*base)  
*This function is used to Enable the UART Module.*
- static void [UART\\_SetIdleCondition](#) (UART\_Type \*base, [uart\\_idle\\_condition\\_t](#) condition)  
*This function is used to configure the IDLE line condition.*
- static void [UART\\_Disable](#) (UART\_Type \*base)  
*This function is used to Disable the UART Module.*

## Status

- bool [UART\\_GetStatusFlag](#) (UART\_Type \*base, uint32\_t flag)  
*This function is used to get the current status of specific UART status flag(including interrupt flag).*
- void [UART\\_ClearStatusFlag](#) (UART\_Type \*base, uint32\_t flag)  
*This function is used to clear the current status of specific UART status flag.*

## Interrupts

- void [UART\\_EnableInterrupts](#) (UART\_Type \*base, uint32\_t mask)  
*Enables UART interrupts according to the provided mask.*
- void [UART\\_DisableInterrupts](#) (UART\_Type \*base, uint32\_t mask)

- *Disables the UART interrupts according to the provided mask.*
- `uint32_t UART_GetEnabledInterrupts (UART_Type *base)`  
*Gets enabled UART interrupts.*

## Bus Operations

- `static void UART_EnableTx (UART_Type *base, bool enable)`  
*Enables or disables the UART transmitter.*
- `static void UART_EnableRx (UART_Type *base, bool enable)`  
*Enables or disables the UART receiver.*
- `static void UART_WriteByte (UART_Type *base, uint8_t data)`  
*Writes to the transmitter register.*
- `static uint8_t UART_ReadByte (UART_Type *base)`  
*Reads the receiver register.*
- `status_t UART_WriteBlocking (UART_Type *base, const uint8_t *data, size_t length)`  
*Writes to the TX register using a blocking method.*
- `status_t UART_ReadBlocking (UART_Type *base, uint8_t *data, size_t length)`  
*Read RX data register using a blocking method.*

## Transactional

- `void UART_TransferCreateHandle (UART_Type *base, uart_handle_t *handle, uart_transfer_callback_t callback, void *userData)`  
*Initializes the UART handle.*
- `void UART_TransferStartRingBuffer (UART_Type *base, uart_handle_t *handle, uint8_t *ringBuffer, size_t ringBufferSize)`  
*Sets up the RX ring buffer.*
- `void UART_TransferStopRingBuffer (UART_Type *base, uart_handle_t *handle)`  
*Aborts the background transfer and uninstalls the ring buffer.*
- `size_t UART_TransferGetRxRingBufferLength (uart_handle_t *handle)`  
*Get the length of received data in RX ring buffer.*
- `status_t UART_TransferSendNonBlocking (UART_Type *base, uart_handle_t *handle, uart_transfer_t *xfer)`  
*Transmits a buffer of data using the interrupt method.*
- `void UART_TransferAbortSend (UART_Type *base, uart_handle_t *handle)`  
*Aborts the interrupt-driven data transmit.*
- `status_t UART_TransferGetSendCount (UART_Type *base, uart_handle_t *handle, uint32_t *count)`  
*Gets the number of bytes written to the UART TX register.*
- `status_t UART_TransferReceiveNonBlocking (UART_Type *base, uart_handle_t *handle, uart_transfer_t *xfer, size_t *receivedBytes)`  
*Receives a buffer of data using an interrupt method.*
- `void UART_TransferAbortReceive (UART_Type *base, uart_handle_t *handle)`  
*Aborts the interrupt-driven data receiving.*
- `status_t UART_TransferGetReceiveCount (UART_Type *base, uart_handle_t *handle, uint32_t *count)`  
*Gets the number of bytes that have been received.*
- `void UART_TransferHandleIRQ (UART_Type *base, void *irqHandle)`

*UART IRQ handle function.*

## DMA control functions.

- static void [UART\\_EnableTxDMA](#) (UART\_Type \*base, bool enable)  
*Enables or disables the UART transmitter DMA request.*
- static void [UART\\_EnableRxDMA](#) (UART\_Type \*base, bool enable)  
*Enables or disables the UART receiver DMA request.*

## FIFO control functions.

- static void [UART\\_SetTxFifoWatermark](#) (UART\_Type \*base, uint8\_t watermark)  
*This function is used to set the watermark of UART Tx FIFO.*
- static void [UART\\_SetRxRTSWatermark](#) (UART\_Type \*base, uint8\_t watermark)  
*This function is used to set the watermark of UART RTS deassertion.*
- static void [UART\\_SetRxFifoWatermark](#) (UART\_Type \*base, uint8\_t watermark)  
*This function is used to set the watermark of UART Rx FIFO.*

## Auto baud rate detection.

- static void [UART\\_EnableAutoBaudRate](#) (UART\_Type \*base, bool enable)  
*This function is used to set the enable condition of Automatic Baud Rate Detection feature.*
- static bool [UART\\_IsAutoBaudRateComplete](#) (UART\_Type \*base)  
*This function is used to read if the automatic baud rate detection has finished.*

## 12.2.3 Data Structure Documentation

### 12.2.3.1 struct uart\_config\_t

#### Data Fields

- uint32\_t [baudRate\\_Bps](#)  
*UART baud rate.*
- [uart\\_parity\\_mode\\_t](#) [parityMode](#)  
*Parity error check mode of this module.*
- [uart\\_data\\_bits\\_t](#) [dataBitsCount](#)  
*Data bits count, eight (default), seven.*
- [uart\\_stop\\_bit\\_count\\_t](#) [stopBitCount](#)  
*Number of stop bits in one frame.*
- uint8\_t [txFifoWatermark](#)  
*TX FIFO watermark.*
- uint8\_t [rxFifoWatermark](#)  
*RX FIFO watermark.*
- uint8\_t [rxRTSWatermark](#)  
*RX RTS watermark, RX FIFO data count being larger than this triggers RTS deassertion.*

- bool [enableAutoBaudRate](#)  
*Enable automatic baud rate detection.*
- bool [enableTx](#)  
*Enable TX.*
- bool [enableRx](#)  
*Enable RX.*
- bool [enableRxRTS](#)  
*RX RTS enable.*
- bool [enableTxCTS](#)  
*TX CTS enable.*

### Field Documentation

- (1) `uint32_t uart_config_t::baudRate_Bps`
- (2) `uart_parity_mode_t uart_config_t::parityMode`
- (3) `uart_stop_bit_count_t uart_config_t::stopBitCount`

### 12.2.3.2 struct uart\_transfer\_t

#### Data Fields

- `size_t dataSize`  
*The byte count to be transfer.*
- `uint8_t * data`  
*The buffer of data to be transfer.*
- `uint8_t * rxData`  
*The buffer to receive data.*
- `const uint8_t * txData`  
*The buffer of data to be sent.*

### Field Documentation

- (1) `uint8_t* uart_transfer_t::data`
- (2) `uint8_t* uart_transfer_t::rxData`
- (3) `const uint8_t* uart_transfer_t::txData`
- (4) `size_t uart_transfer_t::dataSize`

### 12.2.3.3 struct \_uart\_handle

Forward declaration of the handle typedef.

#### Data Fields

- `const uint8_t *volatile txData`  
*Address of remaining data to send.*

- volatile size\_t `txDataSize`  
*Size of the remaining data to send.*
- size\_t `txDataSizeAll`  
*Size of the data to send out.*
- uint8\_t \*volatile `rxData`  
*Address of remaining data to receive.*
- volatile size\_t `rxDataSize`  
*Size of the remaining data to receive.*
- size\_t `rxDataSizeAll`  
*Size of the data to receive.*
- uint8\_t \* `rxRingBuffer`  
*Start address of the receiver ring buffer.*
- size\_t `rxRingBufferSize`  
*Size of the ring buffer.*
- volatile uint16\_t `rxRingBufferHead`  
*Index for the driver to store received data into ring buffer.*
- volatile uint16\_t `rxRingBufferTail`  
*Index for the user to get data from the ring buffer.*
- `uart_transfer_callback_t` `callback`  
*Callback function.*
- void \* `userData`  
*UART callback function parameter.*
- volatile uint8\_t `txState`  
*TX transfer state.*
- volatile uint8\_t `rxState`  
*RX transfer state.*

### Field Documentation

- (1) `const uint8_t* volatile uart_handle_t::txData`
- (2) `volatile size_t uart_handle_t::txDataSize`
- (3) `size_t uart_handle_t::txDataSizeAll`
- (4) `uint8_t* volatile uart_handle_t::rxData`
- (5) `volatile size_t uart_handle_t::rxDataSize`
- (6) `size_t uart_handle_t::rxDataSizeAll`
- (7) `uint8_t* uart_handle_t::rxRingBuffer`
- (8) `size_t uart_handle_t::rxRingBufferSize`
- (9) `volatile uint16_t uart_handle_t::rxRingBufferHead`
- (10) `volatile uint16_t uart_handle_t::rxRingBufferTail`
- (11) `uart_transfer_callback_t uart_handle_t::callback`



(12) `void* uart_handle_t::userData`

(13) `volatile uint8_t uart_handle_t::txState`

## 12.2.4 Macro Definition Documentation

12.2.4.1 `#define FSL_UART_DRIVER_VERSION (MAKE_VERSION(2, 3, 2))`

12.2.4.2 `#define UART_RETRY_TIMES 0U` /\* Defining to zero means to keep waiting for the flag until it is assert/deassert. \*/

## 12.2.5 Typedef Documentation

12.2.5.1 `typedef void(* uart_transfer_callback_t)(UART_Type *base, uart_handle_t *handle, status_t status, void *userData)`

## 12.2.6 Enumeration Type Documentation

### 12.2.6.1 anonymous enum

Enumerator

*kStatus\_UART\_TxBusy* Transmitter is busy.  
*kStatus\_UART\_RxBusy* Receiver is busy.  
*kStatus\_UART\_TxIdle* UART transmitter is idle.  
*kStatus\_UART\_RxIdle* UART receiver is idle.  
*kStatus\_UART\_TxWatermarkTooLarge* TX FIFO watermark too large.  
*kStatus\_UART\_RxWatermarkTooLarge* RX FIFO watermark too large.  
*kStatus\_UART\_FlagCannotClearManually* UART flag can't be manually cleared.  
*kStatus\_UART\_Error* Error happens on UART.  
*kStatus\_UART\_RxRingBufferOverflow* UART RX software ring buffer overrun.  
*kStatus\_UART\_RxHardwareOverflow* UART RX receiver overrun.  
*kStatus\_UART\_NoiseError* UART noise error.  
*kStatus\_UART\_FramingError* UART framing error.  
*kStatus\_UART\_ParityError* UART parity error.  
*kStatus\_UART\_BaudrateNotSupport* Baudrate is not support in current clock source.  
*kStatus\_UART\_BreakDetect* Receiver detect BREAK signal.  
*kStatus\_UART\_Timeout* UART times out.

### 12.2.6.2 `enum uart_data_bits_t`

Enumerator

*kUART\_SevenDataBits* Seven data bit.

***kUART\_EightDataBits*** Eight data bit.

### 12.2.6.3 enum uart\_parity\_mode\_t

Enumerator

***kUART\_ParityDisabled*** Parity disabled.

***kUART\_ParityEven*** Even error check is selected.

***kUART\_ParityOdd*** Odd error check is selected.

### 12.2.6.4 enum uart\_stop\_bit\_count\_t

Enumerator

***kUART\_OneStopBit*** One stop bit.

***kUART\_TwoStopBit*** Two stop bits.

### 12.2.6.5 enum uart\_idle\_condition\_t

Enumerator

***kUART\_IdleFor4Frames*** Idle for more than 4 frames.

***kUART\_IdleFor8Frames*** Idle for more than 8 frames.

***kUART\_IdleFor16Frames*** Idle for more than 16 frames.

***kUART\_IdleFor32Frames*** Idle for more than 32 frames.

### 12.2.6.6 enum \_uart\_interrupt\_enable

### 12.2.6.7 anonymous enum

This provides constants for the UART status flags for use in the UART functions.

Enumerator

***kUART\_RxCharReadyFlag*** Rx Character Ready Flag.

***kUART\_RxErrorFlag*** Rx Error Detect Flag.

***kUART\_RxOverrunErrorFlag*** Rx Overrun Flag.

***kUART\_RxFrameErrorFlag*** Rx Frame Error Flag.

***kUART\_RxBreakDetectFlag*** Rx Break Detect Flag.

***kUART\_RxParityErrorFlag*** Rx Parity Error Flag.

***kUART\_ParityErrorFlag*** Parity Error Interrupt Flag.

***kUART\_RtsStatusFlag*** RTS\_B Pin Status Flag.

***kUART\_TxReadyFlag*** Transmitter Ready Interrupt/DMA Flag.  
***kUART\_RtsDeltaFlag*** RTS Delta Flag.  
***kUART\_EscapeFlag*** Escape Sequence Interrupt Flag.  
***kUART\_FrameErrorFlag*** Frame Error Interrupt Flag.  
***kUART\_RxReadyFlag*** Receiver Ready Interrupt/DMA Flag.  
***kUART\_AgingTimerFlag*** Aging Timer Interrupt Flag.  
***kUART\_DtrDeltaFlag*** DTR Delta Flag.  
***kUART\_RxDsFlag*** Receiver IDLE Interrupt Flag.  
***kUART\_tAirWakeFlag*** Asynchronous IR WAKE Interrupt Flag.  
***kUART\_AwakeFlag*** Asynchronous WAKE Interrupt Flag.  
***kUART\_Rs485SlaveAddrMatchFlag*** RS-485 Slave Address Detected Interrupt Flag.  
***kUART\_AutoBaudFlag*** Automatic Baud Rate Detect Complete Flag.  
***kUART\_TxEmptyFlag*** Transmit Buffer FIFO Empty.  
***kUART\_DtrFlag*** DTR edge triggered interrupt flag.  
***kUART\_IdleFlag*** Idle Condition Flag.  
***kUART\_AutoBaudCntStopFlag*** Auto-baud Counter Stopped Flag.  
***kUART\_RiDeltaFlag*** Ring Indicator Delta Flag.  
***kUART\_RiFlag*** Ring Indicator Input Flag.  
***kUART\_IrFlag*** Serial Infrared Interrupt Flag.  
***kUART\_WakeFlag*** Wake Flag.  
***kUART\_DcdDeltaFlag*** Data Carrier Detect Delta Flag.  
***kUART\_DcdFlag*** Data Carrier Detect Input Flag.  
***kUART\_RtsFlag*** RTS Edge Triggered Interrupt Flag.  
***kUART\_TxCompleteFlag*** Transmitter Complete Flag.  
***kUART\_BreakDetectFlag*** BREAK Condition Detected Flag.  
***kUART\_RxOverrunFlag*** Overrun Error Flag.  
***kUART\_RxDataReadyFlag*** Receive Data Ready Flag.

## 12.2.7 Function Documentation

### 12.2.7.1 uint32\_t UART\_GetInstance ( UART\_Type \* *base* )

Parameters

<i>base</i>	UART peripheral base address.
-------------	-------------------------------

Returns

UART instance.

#### **12.2.7.2 static void UART\_SoftwareReset ( UART\_Type \* *base* ) [inline], [static]**

This function resets the transmit and receive state machines, all FIFOs and register USR1, USR2, UBIR, UBMR, UBRC , URXD, UTXD and UTS[6-3]

## Parameters

<i>base</i>	UART peripheral base address.
-------------	-------------------------------

### 12.2.7.3 `status_t UART_Init ( UART_Type * base, const uart_config_t * config, uint32_t srcClock_Hz )`

This function configures the UART module with user-defined settings. Call the [UART\\_GetDefaultConfig\(\)](#) function to configure the configuration structure and get the default configuration. The example below shows how to use this API to configure the UART.

```
*  uart_config_t uartConfig;
*  uartConfig.baudRate_Bps = 115200U;
*  uartConfig.parityMode = kUART_ParityDisabled;
*  uartConfig.dataBitsCount = kUART_EightDataBits;
*  uartConfig.stopBitCount = kUART_OneStopBit;
*  uartConfig.txFifoWatermark = 2;
*  uartConfig.rxFifoWatermark = 1;
*  uartConfig.enableAutoBaudrate = false;
*  uartConfig.enableTx = true;
*  uartConfig.enableRx = true;
*  UART_Init(UART1, &uartConfig, 24000000U);
*
```

## Parameters

<i>base</i>	UART peripheral base address.
<i>config</i>	Pointer to a user-defined configuration structure.
<i>srcClock_Hz</i>	UART clock source frequency in HZ.

## Return values

<i>kStatus_Success</i>	UART initialize succeed
------------------------	-------------------------

### 12.2.7.4 `void UART_Deinit ( UART_Type * base )`

This function waits for transmit to complete, disables TX and RX, and disables the UART clock.

## Parameters

<i>base</i>	UART peripheral base address.
-------------	-------------------------------

### 12.2.7.5 void UART\_GetDefaultConfig ( uart\_config\_t \* *config* )

Gets the default configuration structure.

This function initializes the UART configuration structure to a default value. The default values are:  
: uartConfig->baudRate\_Bps = 115200U; uartConfig->parityMode = kUART\_ParityDisabled; uartConfig->dataBitsCount = kUART\_EightDataBits; uartConfig->stopBitCount = kUART\_OneStopBit; uartConfig->txFifoWatermark = 2; uartConfig->rxFifoWatermark = 1; uartConfig->enableAutoBaudrate = false; uartConfig->enableTx = false; uartConfig->enableRx = false;

Parameters

<i>config</i>	Pointer to a configuration structure.
---------------	---------------------------------------

### 12.2.7.6 status\_t UART\_SetBaudRate ( UART\_Type \* *base*, uint32\_t *baudRate\_Bps*, uint32\_t *srcClock\_Hz* )

This function configures the UART module baud rate. This function is used to update the UART module baud rate after the UART module is initialized by the UART\_Init.

```
* UART_SetBaudRate(UART1, 115200U, 200000000U);
*
```

Parameters

<i>base</i>	UART peripheral base address.
<i>baudRate_Bps</i>	UART baudrate to be set.
<i>srcClock_Hz</i>	UART clock source frequency in Hz.

Return values

<i>kStatus_UART_Baudrate-NotSupport</i>	Baudrate is not support in the current clock source.
---	--

<i>kStatus_Success</i>	Set baudrate succeeded.
------------------------	-------------------------

#### 12.2.7.7 static void UART\_Enable ( UART\_Type \* *base* ) [inline], [static]

Parameters

<i>base</i>	UART base pointer.
-------------	--------------------

#### 12.2.7.8 static void UART\_SetIdleCondition ( UART\_Type \* *base*, uart\_idle\_condition\_t *condition* ) [inline], [static]

Parameters

<i>base</i>	UART base pointer.
<i>condition</i>	IDLE line detect condition of the enumerators in <a href="#">uart_idle_condition_t</a> .

#### 12.2.7.9 static void UART\_Disable ( UART\_Type \* *base* ) [inline], [static]

Parameters

<i>base</i>	UART base pointer.
-------------	--------------------

#### 12.2.7.10 bool UART\_GetStatusFlag ( UART\_Type \* *base*, uint32\_t *flag* )

The available status flag can be select from [uart\\_status\\_flag\\_t](#) enumeration.

Parameters

<i>base</i>	UART base pointer.
<i>flag</i>	Status flag to check.

Return values

---

<i>current</i>	state of corresponding status flag.
----------------	-------------------------------------

#### 12.2.7.11 void UART\_ClearStatusFlag ( UART\_Type \* *base*, uint32\_t *flag* )

The available status flag can be select from `uart_status_flag_t` enumeration.

Parameters

<i>base</i>	UART base pointer.
<i>flag</i>	Status flag to clear.

#### 12.2.7.12 void UART\_EnableInterrupts ( UART\_Type \* *base*, uint32\_t *mask* )

This function enables the UART interrupts according to the provided mask. The mask is a logical OR of enumeration members. See [\\_uart\\_interrupt\\_enable](#). For example, to enable TX empty interrupt and RX data ready interrupt, do the following.

```
*   UART_EnableInterrupts(UART1, kUART_TxEmptyEnable | kUART_RxDataReadyEnable);
*
```

Parameters

<i>base</i>	UART peripheral base address.
<i>mask</i>	The interrupts to enable. Logical OR of <a href="#">_uart_interrupt_enable</a> .

#### 12.2.7.13 void UART\_DisableInterrupts ( UART\_Type \* *base*, uint32\_t *mask* )

This function disables the UART interrupts according to the provided mask. The mask is a logical OR of enumeration members. See [\\_uart\\_interrupt\\_enable](#). For example, to disable TX empty interrupt and RX data ready interrupt do the following.

```
*   UART_EnableInterrupts(UART1, kUART_TxEmptyEnable | kUART_RxDataReadyEnable);
*
```

Parameters



<i>base</i>	UART peripheral base address.
<i>mask</i>	The interrupts to disable. Logical OR of <a href="#">_uart_interrupt_enable</a> .

#### 12.2.7.14 uint32\_t UART\_GetEnabledInterrupts ( UART\_Type \* *base* )

This function gets the enabled UART interrupts. The enabled interrupts are returned as the logical OR value of the enumerators [\\_uart\\_interrupt\\_enable](#). To check a specific interrupt enable status, compare the return value with enumerators in [\\_uart\\_interrupt\\_enable](#). For example, to check whether the TX empty interrupt is enabled:

```
*   uint32_t enabledInterrupts = UART_GetEnabledInterrupts(UART1);
*
*   if (kUART_TxEmptyEnable & enabledInterrupts)
*   {
*       ...
*   }
*
```

##### Parameters

<i>base</i>	UART peripheral base address.
-------------	-------------------------------

##### Returns

UART interrupt flags which are logical OR of the enumerators in [\\_uart\\_interrupt\\_enable](#).

#### 12.2.7.15 static void UART\_EnableTx ( UART\_Type \* *base*, bool *enable* ) [inline], [static]

This function enables or disables the UART transmitter.

##### Parameters

<i>base</i>	UART peripheral base address.
<i>enable</i>	True to enable, false to disable.

#### 12.2.7.16 static void UART\_EnableRx ( UART\_Type \* *base*, bool *enable* ) [inline], [static]

This function enables or disables the UART receiver.

## Parameters

<i>base</i>	UART peripheral base address.
<i>enable</i>	True to enable, false to disable.

### 12.2.7.17 static void UART\_WriteByte ( UART\_Type \* *base*, uint8\_t *data* ) [inline], [static]

This function is used to write data to transmitter register. The upper layer must ensure that the TX register is empty or that the TX FIFO has room before calling this function.

## Parameters

<i>base</i>	UART peripheral base address.
<i>data</i>	Data write to the TX register.

### 12.2.7.18 static uint8\_t UART\_ReadByte ( UART\_Type \* *base* ) [inline], [static]

This function is used to read data from receiver register. The upper layer must ensure that the receiver register is full or that the RX FIFO has data before calling this function.

## Parameters

<i>base</i>	UART peripheral base address.
-------------	-------------------------------

## Returns

Data read from data register.

### 12.2.7.19 status\_t UART\_WriteBlocking ( UART\_Type \* *base*, const uint8\_t \* *data*, size\_t *length* )

This function polls the TX register, waits for the TX register to be empty or for the TX FIFO to have room and writes data to the TX buffer.

## Parameters

---

<i>base</i>	UART peripheral base address.
<i>data</i>	Start address of the data to write.
<i>length</i>	Size of the data to write.

Return values

<i>kStatus_UART_Timeout</i>	Transmission timed out and was aborted.
<i>kStatus_Success</i>	Successfully wrote all data.

#### 12.2.7.20 **status\_t UART\_ReadBlocking ( UART\_Type \* *base*, uint8\_t \* *data*, size\_t *length* )**

This function polls the RX register, waits for the RX register to be full or for RX FIFO to have data, and reads data from the TX register.

Parameters

<i>base</i>	UART peripheral base address.
<i>data</i>	Start address of the buffer to store the received data.
<i>length</i>	Size of the buffer.

Return values

<i>kStatus_UART_Rx-HardwareOverrun</i>	Receiver overrun occurred while receiving data.
<i>kStatus_UART_Noise-Error</i>	A noise error occurred while receiving data.
<i>kStatus_UART_Framing-Error</i>	A framing error occurred while receiving data.
<i>kStatus_UART_Parity-Error</i>	A parity error occurred while receiving data.
<i>kStatus_UART_Timeout</i>	Transmission timed out and was aborted.
<i>kStatus_Success</i>	Successfully received all data.

#### 12.2.7.21 **void UART\_TransferCreateHandle ( UART\_Type \* *base*, uart\_handle\_t \* *handle*, uart\_transfer\_callback\_t *callback*, void \* *userData* )**

This function initializes the UART handle which can be used for other UART transactional APIs. Usually, for a specified UART instance, call this API once to get the initialized handle.

## Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.
<i>callback</i>	The callback function.
<i>userData</i>	The parameter of the callback function.

#### 12.2.7.22 void UART\_TransferStartRingBuffer ( UART\_Type \* *base*, uart\_handle\_t \* *handle*, uint8\_t \* *ringBuffer*, size\_t *ringBufferSize* )

This function sets up the RX ring buffer to a specific UART handle.

When the RX ring buffer is used, data received are stored into the ring buffer even when the user doesn't call the [UART\\_TransferReceiveNonBlocking\(\)](#) API. If data is already received in the ring buffer, the user can get the received data from the ring buffer directly.

## Note

When using the RX ring buffer, one byte is reserved for internal use. In other words, if `ringBufferSize` is 32, only 31 bytes are used for saving data.

## Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.
<i>ringBuffer</i>	Start address of the ring buffer for background receiving. Pass NULL to disable the ring buffer.
<i>ringBufferSize</i>	Size of the ring buffer.

#### 12.2.7.23 void UART\_TransferStopRingBuffer ( UART\_Type \* *base*, uart\_handle\_t \* *handle* )

This function aborts the background transfer and uninstalls the ring buffer.

## Parameters

---

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.

#### 12.2.7.24 **size\_t UART\_TransferGetRxRingBufferLength ( uart\_handle\_t \* *handle* )**

Parameters

<i>handle</i>	UART handle pointer.
---------------	----------------------

Returns

Length of received data in RX ring buffer.

#### 12.2.7.25 **status\_t UART\_TransferSendNonBlocking ( UART\_Type \* *base*, uart\_handle\_t \* *handle*, uart\_transfer\_t \* *xfer* )**

This function sends data using an interrupt method. This is a non-blocking function, which returns directly without waiting for all data to be written to the TX register. When all data is written to the TX register in the ISR, the UART driver calls the callback function and passes the [kStatus\\_UART\\_TxIdle](#) as status parameter.

Note

The [kStatus\\_UART\\_TxIdle](#) is passed to the upper layer when all data is written to the TX register. However, it does not ensure that all data is sent out. Before disabling the TX, check the [kUART\\_TransmissionCompleteFlag](#) to ensure that the TX is finished.

Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.
<i>xfer</i>	UART transfer structure. See <a href="#">uart_transfer_t</a> .

Return values

<i>kStatus_Success</i>	Successfully start the data transmission.
<i>kStatus_UART_TxBusy</i>	Previous transmission still not finished; data not all written to TX register yet.
<i>kStatus_InvalidArgument</i>	Invalid argument.

#### 12.2.7.26 void UART\_TransferAbortSend ( UART\_Type \* *base*, uart\_handle\_t \* *handle* )

This function aborts the interrupt-driven data sending. The user can get the remainBytes to find out how many bytes are not sent out.

Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.

#### 12.2.7.27 status\_t UART\_TransferGetSendCount ( UART\_Type \* *base*, uart\_handle\_t \* *handle*, uint32\_t \* *count* )

This function gets the number of bytes written to the UART TX register by using the interrupt method.

Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.
<i>count</i>	Send bytes count.

Return values

<i>kStatus_NoTransferInProgress</i>	No send in progress.
<i>kStatus_InvalidArgument</i>	The parameter is invalid.
<i>kStatus_Success</i>	Get successfully through the parameter <i>count</i> ;

#### 12.2.7.28 status\_t UART\_TransferReceiveNonBlocking ( UART\_Type \* *base*, uart\_handle\_t \* *handle*, uart\_transfer\_t \* *xfer*, size\_t \* *receivedBytes* )

This function receives data using an interrupt method. This is a non-blocking function, which returns without waiting for all data to be received. If the RX ring buffer is used and not empty, the data in the ring buffer is copied and the parameter *receivedBytes* shows how many bytes are copied from the ring

buffer. After copying, if the data in the ring buffer is not enough to read, the receive request is saved by the UART driver. When the new data arrives, the receive request is serviced first. When all data is received, the UART driver notifies the upper layer through a callback function and passes the status parameter `kStatus_UART_RxIdle`. For example, the upper layer needs 10 bytes but there are only 5 bytes in the ring buffer. The 5 bytes are copied to the `xfer->data` and this function returns with the parameter `receivedBytes` set to 5. For the left 5 bytes, newly arrived data is saved from the `xfer->data[5]`. When 5 bytes are received, the UART driver notifies the upper layer. If the RX ring buffer is not enabled, this function enables the RX and RX interrupt to receive data to the `xfer->data`. When all data is received, the upper layer is notified.

## Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.
<i>xfer</i>	UART transfer structure, see <a href="#">uart_transfer_t</a> .
<i>receivedBytes</i>	Bytes received from the ring buffer directly.

## Return values

<i>kStatus_Success</i>	Successfully queue the transfer into transmit queue.
<i>kStatus_UART_RxBusy</i>	Previous receive request is not finished.
<i>kStatus_InvalidArgument</i>	Invalid argument.

### 12.2.7.29 void UART\_TransferAbortReceive ( UART\_Type \* *base*, uart\_handle\_t \* *handle* )

This function aborts the interrupt-driven data receiving. The user can get the `remainBytes` to know how many bytes are not received yet.

## Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.

### 12.2.7.30 status\_t UART\_TransferGetReceiveCount ( UART\_Type \* *base*, uart\_handle\_t \* *handle*, uint32\_t \* *count* )

This function gets the number of bytes that have been received.

## Parameters

<i>base</i>	UART peripheral base address.
<i>handle</i>	UART handle pointer.
<i>count</i>	Receive bytes count.

## Return values

<i>kStatus_NoTransferInProgress</i>	No receive in progress.
<i>kStatus_InvalidArgument</i>	Parameter is invalid.
<i>kStatus_Success</i>	Get successfully through the parameter count;

### 12.2.7.31 void UART\_TransferHandleIRQ ( UART\_Type \* *base*, void \* *irqHandle* )

This function handles the UART transmit and receive IRQ request.

## Parameters

<i>base</i>	UART peripheral base address.
<i>irqHandle</i>	UART handle pointer.

### 12.2.7.32 static void UART\_EnableTxDMA ( UART\_Type \* *base*, bool *enable* ) [inline], [static]

This function enables or disables the transmit request when the transmitter has one or more slots available in the TxFIFO. The fill level in the TxFIFO that generates the DMA request is controlled by the TXTL bits.

## Parameters

<i>base</i>	UART peripheral base address.
<i>enable</i>	True to enable, false to disable.

### 12.2.7.33 static void UART\_EnableRxDMA ( UART\_Type \* *base*, bool *enable* ) [inline], [static]

This function enables or disables the receive request when the receiver has data in the Rx FIFO. The fill level in the Rx FIFO at which a DMA request is generated is controlled by the RXTL bits .



## Parameters

<i>base</i>	UART peripheral base address.
<i>enable</i>	True to enable, false to disable.

#### 12.2.7.34 static void UART\_SetTxFifoWatermark ( UART\_Type \* *base*, uint8\_t *watermark* ) [inline], [static]

A maskable interrupt is generated whenever the data level in the TxFIFO falls below the Tx FIFO watermark.

## Parameters

<i>base</i>	UART base pointer.
<i>watermark</i>	The Tx FIFO watermark.

#### 12.2.7.35 static void UART\_SetRxRTSWatermark ( UART\_Type \* *base*, uint8\_t *watermark* ) [inline], [static]

The RTS signal deasserts whenever the data count in RxFIFO reaches the Rx RTS watermark.

## Parameters

<i>base</i>	UART base pointer.
<i>watermark</i>	The Rx RTS watermark.

#### 12.2.7.36 static void UART\_SetRxFifoWatermark ( UART\_Type \* *base*, uint8\_t *watermark* ) [inline], [static]

A maskable interrupt is generated whenever the data level in the RxFIFO reaches the Rx FIFO watermark.

## Parameters

<i>base</i>	UART base pointer.
-------------	--------------------

<i>watermark</i>	The Rx FIFO watermark.
------------------	------------------------

**12.2.7.37 static void UART\_EnableAutoBaudRate ( UART\_Type \* *base*, bool *enable* ) [inline], [static]**

Parameters

<i>base</i>	UART base pointer.
<i>enable</i>	Enable/Disable Automatic Baud Rate Detection feature. <ul style="list-style-type: none"> <li>• true: Enable Automatic Baud Rate Detection feature.</li> <li>• false: Disable Automatic Baud Rate Detection feature.</li> </ul>

**12.2.7.38 static bool UART\_IsAutoBaudRateComplete ( UART\_Type \* *base* ) [inline], [static]**

Parameters

<i>base</i>	UART base pointer.
-------------	--------------------

Returns

- true: Automatic baud rate detection has finished.
  - false: Automatic baud rate detection has not finished.

## 12.2.8 Variable Documentation

**12.2.8.1 void\* s\_uartHandle[]**

## 12.3 UART FreeRTOS Driver

### 12.3.1 Overview

#### Data Structures

- struct `uart_rtos_config_t`  
*UART configuration structure. [More...](#)*

#### Driver version

- #define `FSL_UART_FREERTOS_DRIVER_VERSION` (`MAKE_VERSION(2, 1, 1)`)  
*UART FreeRTOS driver version 2.1.1.*

#### UART RTOS Operation

- int `UART_RTOS_Init` (`uart_rtos_handle_t *handle`, `uart_handle_t *t_handle`, const `uart_rtos_config_t *cfg`)  
*Initializes a UART instance for operation in RTOS.*
- int `UART_RTOS_Deinit` (`uart_rtos_handle_t *handle`)  
*Deinitializes a UART instance for operation.*

#### UART transactional Operation

- int `UART_RTOS_Send` (`uart_rtos_handle_t *handle`, `uint8_t *buffer`, `uint32_t length`)  
*Sends data in the background.*
- int `UART_RTOS_Receive` (`uart_rtos_handle_t *handle`, `uint8_t *buffer`, `uint32_t length`, `size_t *received`)  
*Receives data.*

### 12.3.2 Data Structure Documentation

#### 12.3.2.1 struct `uart_rtos_config_t`

##### Data Fields

- `UART_Type * base`  
*UART base address.*
- `uint32_t srcclk`  
*UART source clock in Hz.*
- `uint32_t baudrate`  
*Desired communication speed.*
- `uart_parity_mode_t parity`  
*Parity setting.*

- `uart_stop_bit_count_t` stopbits  
*Number of stop bits to use.*
- `uint8_t * buffer`  
*Buffer for background reception.*
- `uint32_t buffer_size`  
*Size of buffer for background reception.*

### 12.3.3 Macro Definition Documentation

#### 12.3.3.1 `#define FSL_UART_FREERTOS_DRIVER_VERSION (MAKE_VERSION(2, 1, 1))`

### 12.3.4 Function Documentation

#### 12.3.4.1 `int UART_RTOS_Init ( uart_rtos_handle_t * handle, uart_handle_t * t_handle, const uart_rtos_config_t * cfg )`

Parameters

<i>handle</i>	The RTOS UART handle, the pointer to an allocated space for RTOS context.
<i>t_handle</i>	The pointer to the allocated space to store the transactional layer internal state.
<i>cfg</i>	The pointer to the parameters required to configure the UART after initialization.

Returns

0 succeed; otherwise fail.

#### 12.3.4.2 `int UART_RTOS_Deinit ( uart_rtos_handle_t * handle )`

This function deinitializes the UART module, sets all register values to reset value, and frees the resources.

Parameters

<i>handle</i>	The RTOS UART handle.
---------------	-----------------------

#### 12.3.4.3 `int UART_RTOS_Send ( uart_rtos_handle_t * handle, uint8_t * buffer, uint32_t length )`

This function sends data. It is a synchronous API. If the hardware buffer is full, the task is in the blocked state.

## Parameters

<i>handle</i>	The RTOS UART handle.
<i>buffer</i>	The pointer to the buffer to send.
<i>length</i>	The number of bytes to send.

**12.3.4.4 int UART\_RTOS\_Receive ( uart\_rtos\_handle\_t \* *handle*, uint8\_t \* *buffer*, uint32\_t *length*, size\_t \* *received* )**

This function receives data from UART. It is a synchronous API. If data is immediately available, it is returned immediately and the number of bytes received.

## Parameters

<i>handle</i>	The RTOS UART handle.
<i>buffer</i>	The pointer to the buffer to write received data.
<i>length</i>	The number of bytes to receive.
<i>received</i>	The pointer to a variable of size_t where the number of received data is filled.

## 12.4 UART CMSIS Driver

This section describes the programming interface of the UART Cortex Microcontroller Software Interface Standard (CMSIS) driver. And this driver defines generic peripheral driver interfaces for middleware making it reusable across a wide range of supported microcontroller devices. The API connects microcontroller peripherals with middleware that implements for example communication stacks, file systems, or graphic user interfaces. More information and usage method please refer to <http://www.keil.com/pack/doc/cmsis/Driver/html/index.html>.

The UART driver includes transactional APIs.

Transactional APIs can be used to enable the peripheral quickly and in the application if the code size and performance of transactional APIs can satisfy the requirements. If the code size and performance are critical requirements please write custom code.

### 12.4.1 Function groups

#### 12.4.1.1 UART CMSIS GetVersion Operation

This function group will return the UART CMSIS Driver version to user.

#### 12.4.1.2 UART CMSIS GetCapabilities Operation

This function group will return the capabilities of this driver.

#### 12.4.1.3 UART CMSIS Initialize and Uninitialize Operation

This function will initialize and uninitialize the uart instance . And this API must be called before you configure an uart instance or after you Deinit an uart instance. The right steps to start an instance is that you must initialize the instance which been selected firstly, then you can power on the instance. After these all have been done, you can configure the instance by using control operation. If you want to Uninitialize the instance, you must power off the instance first.

#### 12.4.1.4 UART CMSIS Transfer Operation

This function group controls the transfer, send/receive data.

#### 12.4.1.5 UART CMSIS Status Operation

This function group gets the UART transfer status.

#### 12.4.1.6 UART CMSIS Control Operation

This function can configure an instance ,set baudrate for uart, get current baudrate ,set transfer data bits and other control command.

# Chapter 13

## MU: Messaging Unit

### 13.1 Overview

The MCUXpresso SDK provides a driver for the MU module of MCUXpresso SDK devices.

### 13.2 Function description

The MU driver provides these functions:

- Functions to initialize the MU module.
- Functions to send and receive messages.
- Functions for MU flags for both MU sides.
- Functions for status flags and interrupts.
- Other miscellaneous functions.

#### 13.2.1 MU initialization

The function [MU\\_Init\(\)](#) initializes the MU module and enables the MU clock. It should be called before any other MU functions.

The function [MU\\_Deinit\(\)](#) deinitializes the MU module and disables the MU clock. No MU functions can be called after this function.

#### 13.2.2 MU message

The MU message must be sent when the transmit register is empty. The MU driver provides blocking API and non-blocking API to send message.

The [MU\\_SendMsgNonBlocking\(\)](#) function writes a message to the MU transmit register without checking the transmit register status. The upper layer should check that the transmit register is empty before calling this function. This function can be used in the ISR for better performance.

The [MU\\_SendMsg\(\)](#) function is a blocking function. It waits until the transmit register is empty and sends the message.

Correspondingly, there are blocking and non-blocking APIs for receiving a message. The [MU\\_ReadMsgNonBlocking\(\)](#) function is a non-blocking API. The [MU\\_ReadMsg\(\)](#) function is the blocking API.



### 13.2.3 MU flags

The MU driver provides 3-bit general purpose flags. When the flags are set on one side, they are reflected on the other side.

The MU flags must be set when the previous flags have been updated to the other side. The MU driver provides a non-blocking function and a blocking function. The blocking function [MU\\_SetFlags\(\)](#) waits until previous flags have been updated to the other side and then sets flags. The non-blocking function sets the flags directly. Ensure that the `kMU_FlagsUpdatingFlag` is not pending before calling this function.

The function [MU\\_GetFlags\(\)](#) gets the MU flags on the current side.

### 13.2.4 Status and interrupt

The function [MU\\_GetStatusFlags\(\)](#) returns all MU status flags. Use the `_mu_status_flags` to check for specific flags, for example, to check RX0 and RX1 register full, use the following code:

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/mu`. The receive full flags are cleared automatically after messages are read out. The transmit empty flags are cleared automatically after new messages are written to the transmit register. The general purpose interrupt flags must be cleared manually using the function [MU\\_ClearStatusFlags\(\)](#).

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/mu`. To enable or disable a specific interrupt, use [MU\\_EnableInterrupts\(\)](#) and [MU\\_DisableInterrupts\(\)](#) functions. The interrupts to enable or disable should be passed in as a bit mask of the `_mu_interrupt_enable`.

The [MU\\_TriggerInterrupts\(\)](#) function triggers general purpose interrupts and NMI to the other core. The interrupts to trigger are passed in as a bit mask of the `_mu_interrupt_trigger`. If previously triggered interrupts have not been processed by the other side, this function returns an error.

### 13.2.5 MU misc functions

The [MU\\_BootCoreB\(\)](#) and [MU\\_HoldCoreBReset\(\)](#) functions should only be used from A side. They are used to boot the core B or to hold core B in reset.

The [MU\\_ResetBothSides\(\)](#) function resets MU at both A and B sides. However, only the A side can call this function.

If a core enters stop mode, the platform clock of this core is disabled by default. The function [MU\\_SetClockOnOtherCoreEnable\(\)](#) forces the other core's platform clock to remain enabled even after that core has entered a stop mode. In this case, the other core's platform clock keeps running until the current core enters stop mode too.

Function [MU\\_GetOtherCorePowerMode\(\)](#) gets the power mode of the other core.

## Enumerations

- enum `_mu_status_flags` {  
`kMU_Tx0EmptyFlag` = (1U << (MU\_SR\_TEn\_SHIFT + 3U)),  
`kMU_Tx1EmptyFlag` = (1U << (MU\_SR\_TEn\_SHIFT + 2U)),  
`kMU_Tx2EmptyFlag` = (1U << (MU\_SR\_TEn\_SHIFT + 1U)),  
`kMU_Tx3EmptyFlag` = (1U << (MU\_SR\_TEn\_SHIFT + 0U)),  
`kMU_Rx0FullFlag` = (1U << (MU\_SR\_RFn\_SHIFT + 3U)),  
`kMU_Rx1FullFlag` = (1U << (MU\_SR\_RFn\_SHIFT + 2U)),  
`kMU_Rx2FullFlag` = (1U << (MU\_SR\_RFn\_SHIFT + 1U)),  
`kMU_Rx3FullFlag` = (1U << (MU\_SR\_RFn\_SHIFT + 0U)),  
`kMU_GenInt0Flag` = (1U << (MU\_SR\_GIPn\_SHIFT + 3U)),  
`kMU_GenInt1Flag` = (1U << (MU\_SR\_GIPn\_SHIFT + 2U)),  
`kMU_GenInt2Flag` = (1U << (MU\_SR\_GIPn\_SHIFT + 1U)),  
`kMU_GenInt3Flag` = (1U << (MU\_SR\_GIPn\_SHIFT + 0U)),  
`kMU_EventPendingFlag` = MU\_SR\_EP\_MASK,  
`kMU_FlagsUpdatingFlag` = MU\_SR\_FUP\_MASK,  
`kMU_OtherSideInResetFlag` = MU\_SR\_RS\_MASK }  
*MU status flags.*
- enum `_mu_interrupt_enable` {  
`kMU_Tx0EmptyInterruptEnable` = (1U << (MU\_CR\_TIEEn\_SHIFT + 3U)),  
`kMU_Tx1EmptyInterruptEnable` = (1U << (MU\_CR\_TIEEn\_SHIFT + 2U)),  
`kMU_Tx2EmptyInterruptEnable` = (1U << (MU\_CR\_TIEEn\_SHIFT + 1U)),  
`kMU_Tx3EmptyInterruptEnable` = (1U << (MU\_CR\_TIEEn\_SHIFT + 0U)),  
`kMU_Rx0FullInterruptEnable` = (1U << (MU\_CR\_RIEEn\_SHIFT + 3U)),  
`kMU_Rx1FullInterruptEnable` = (1U << (MU\_CR\_RIEEn\_SHIFT + 2U)),  
`kMU_Rx2FullInterruptEnable` = (1U << (MU\_CR\_RIEEn\_SHIFT + 1U)),  
`kMU_Rx3FullInterruptEnable` = (1U << (MU\_CR\_RIEEn\_SHIFT + 0U)),  
`kMU_GenInt0InterruptEnable` = (int)(1U << (MU\_CR\_GIEEn\_SHIFT + 3U)),  
`kMU_GenInt1InterruptEnable` = (1U << (MU\_CR\_GIEEn\_SHIFT + 2U)),  
`kMU_GenInt2InterruptEnable` = (1U << (MU\_CR\_GIEEn\_SHIFT + 1U)),  
`kMU_GenInt3InterruptEnable` = (1U << (MU\_CR\_GIEEn\_SHIFT + 0U)) }  
*MU interrupt source to enable.*
- enum `_mu_interrupt_trigger` {  
`kMU_GenInt0InterruptTrigger` = (1U << (MU\_CR\_GIRn\_SHIFT + 3U)),  
`kMU_GenInt1InterruptTrigger` = (1U << (MU\_CR\_GIRn\_SHIFT + 2U)),  
`kMU_GenInt2InterruptTrigger` = (1U << (MU\_CR\_GIRn\_SHIFT + 1U)),  
`kMU_GenInt3InterruptTrigger` = (1U << (MU\_CR\_GIRn\_SHIFT + 0U)) }  
*MU interrupt that could be triggered to the other core.*
- enum `mu_msg_reg_index_t`  
*MU message register.*

## Driver version

- #define `FSL_MU_DRIVER_VERSION` (`MAKE_VERSION`(2, 1, 0))  
*MU driver version.*

## MU initialization.

- void [MU\\_Init](#) (MU\_Type \*base)  
*Initializes the MU module.*
- void [MU\\_Deinit](#) (MU\_Type \*base)  
*De-initializes the MU module.*

## MU Message

- static void [MU\\_SendMsgNonBlocking](#) (MU\_Type \*base, uint32\_t regIndex, uint32\_t msg)  
*Writes a message to the TX register.*
- void [MU\\_SendMsg](#) (MU\_Type \*base, uint32\_t regIndex, uint32\_t msg)  
*Blocks to send a message.*
- static uint32\_t [MU\\_ReceiveMsgNonBlocking](#) (MU\_Type \*base, uint32\_t regIndex)  
*Reads a message from the RX register.*
- uint32\_t [MU\\_ReceiveMsg](#) (MU\_Type \*base, uint32\_t regIndex)  
*Blocks to receive a message.*

## MU Flags

- static void [MU\\_SetFlagsNonBlocking](#) (MU\_Type \*base, uint32\_t flags)  
*Sets the 3-bit MU flags reflect on the other MU side.*
- void [MU\\_SetFlags](#) (MU\_Type \*base, uint32\_t flags)  
*Blocks setting the 3-bit MU flags reflect on the other MU side.*
- static uint32\_t [MU\\_GetFlags](#) (MU\_Type \*base)  
*Gets the current value of the 3-bit MU flags set by the other side.*

## Status and Interrupt.

- static uint32\_t [MU\\_GetStatusFlags](#) (MU\_Type \*base)  
*Gets the MU status flags.*
- static uint32\_t [MU\\_GetInterruptsPending](#) (MU\_Type \*base)  
*Gets the MU IRQ pending status.*
- static void [MU\\_ClearStatusFlags](#) (MU\_Type \*base, uint32\_t mask)  
*Clears the specific MU status flags.*
- static void [MU\\_EnableInterrupts](#) (MU\_Type \*base, uint32\_t mask)  
*Enables the specific MU interrupts.*
- static void [MU\\_DisableInterrupts](#) (MU\_Type \*base, uint32\_t mask)  
*Disables the specific MU interrupts.*
- [status\\_t](#) [MU\\_TriggerInterrupts](#) (MU\_Type \*base, uint32\_t mask)  
*Triggers interrupts to the other core.*

## MU misc functions

- static void [MU\\_MaskHardwareReset](#) (MU\_Type \*base, bool mask)  
*Mask hardware reset by the other core.*
- static mu\_power\_mode\_t [MU\\_GetOtherCorePowerMode](#) (MU\_Type \*base)  
*Gets the power mode of the other core.*

### 13.3 Macro Definition Documentation

#### 13.3.1 #define FSL\_MU\_DRIVER\_VERSION (MAKE\_VERSION(2, 1, 0))

### 13.4 Enumeration Type Documentation

#### 13.4.1 enum \_mu\_status\_flags

Enumerator

*kMU\_Tx0EmptyFlag* TX0 empty.  
*kMU\_Tx1EmptyFlag* TX1 empty.  
*kMU\_Tx2EmptyFlag* TX2 empty.  
*kMU\_Tx3EmptyFlag* TX3 empty.  
*kMU\_Rx0FullFlag* RX0 full.  
*kMU\_Rx1FullFlag* RX1 full.  
*kMU\_Rx2FullFlag* RX2 full.  
*kMU\_Rx3FullFlag* RX3 full.  
*kMU\_GenInt0Flag* General purpose interrupt 0 pending.  
*kMU\_GenInt1Flag* General purpose interrupt 0 pending.  
*kMU\_GenInt2Flag* General purpose interrupt 0 pending.  
*kMU\_GenInt3Flag* General purpose interrupt 0 pending.  
*kMU\_EventPendingFlag* MU event pending.  
*kMU\_FlagsUpdatingFlag* MU flags update is on-going.  
*kMU\_OtherSideInResetFlag* The other side is in reset.

#### 13.4.2 enum \_mu\_interrupt\_enable

Enumerator

*kMU\_Tx0EmptyInterruptEnable* TX0 empty.  
*kMU\_Tx1EmptyInterruptEnable* TX1 empty.  
*kMU\_Tx2EmptyInterruptEnable* TX2 empty.  
*kMU\_Tx3EmptyInterruptEnable* TX3 empty.  
*kMU\_Rx0FullInterruptEnable* RX0 full.  
*kMU\_Rx1FullInterruptEnable* RX1 full.  
*kMU\_Rx2FullInterruptEnable* RX2 full.  
*kMU\_Rx3FullInterruptEnable* RX3 full.  
*kMU\_GenInt0InterruptEnable* General purpose interrupt 0.  
*kMU\_GenInt1InterruptEnable* General purpose interrupt 1.  
*kMU\_GenInt2InterruptEnable* General purpose interrupt 2.  
*kMU\_GenInt3InterruptEnable* General purpose interrupt 3.

### 13.4.3 enum \_mu\_interrupt\_trigger

Enumerator

***kMU\_GenInt0InterruptTrigger*** General purpose interrupt 0.  
***kMU\_GenInt1InterruptTrigger*** General purpose interrupt 1.  
***kMU\_GenInt2InterruptTrigger*** General purpose interrupt 2.  
***kMU\_GenInt3InterruptTrigger*** General purpose interrupt 3.

## 13.5 Function Documentation

### 13.5.1 void MU\_Init ( MU\_Type \* *base* )

This function enables the MU clock only.

Parameters

<i>base</i>	MU peripheral base address.
-------------	-----------------------------

### 13.5.2 void MU\_Deinit ( MU\_Type \* *base* )

This function disables the MU clock only.

Parameters

<i>base</i>	MU peripheral base address.
-------------	-----------------------------

### 13.5.3 static void MU\_SendMsgNonBlocking ( MU\_Type \* *base*, uint32\_t *regIndex*, uint32\_t *msg* ) [inline], [static]

This function writes a message to the specific TX register. It does not check whether the TX register is empty or not. The upper layer should make sure the TX register is empty before calling this function. This function can be used in ISR for better performance.

```
* while (!(kMU_Tx0EmptyFlag & MU_GetStatusFlags(base))) { } Wait for TX0
  register empty.
* MU_SendMsgNonBlocking(base, kMU_MsgReg0, MSG_VAL); Write message to the TX0
  register.
*
```

## Parameters

<i>base</i>	MU peripheral base address.
<i>regIndex</i>	TX register index, see <a href="#">mu_msg_reg_index_t</a> .
<i>msg</i>	Message to send.

### 13.5.4 void MU\_SendMsg ( MU\_Type \* *base*, uint32\_t *regIndex*, uint32\_t *msg* )

This function waits until the TX register is empty and sends the message.

## Parameters

<i>base</i>	MU peripheral base address.
<i>regIndex</i>	MU message register, see <a href="#">mu_msg_reg_index_t</a>
<i>msg</i>	Message to send.

### 13.5.5 static uint32\_t MU\_ReceiveMsgNonBlocking ( MU\_Type \* *base*, uint32\_t *regIndex* ) [inline], [static]

This function reads a message from the specific RX register. It does not check whether the RX register is full or not. The upper layer should make sure the RX register is full before calling this function. This function can be used in ISR for better performance.

```
* uint32_t msg;
* while (!(kMU_Rx0FullFlag & MU_GetStatusFlags(base)))
* {
* } Wait for the RX0 register full.
*
* msg = MU_ReceiveMsgNonBlocking(base, kMU_MsgReg0); Read message from RX0
* register.
*
```

## Parameters

<i>base</i>	MU peripheral base address.
<i>RX</i>	register index, see <a href="#">mu_msg_reg_index_t</a> .

## Returns

The received message.

### 13.5.6 uint32\_t MU\_ReceiveMsg ( MU\_Type \* *base*, uint32\_t *regIndex* )

This function waits until the RX register is full and receives the message.

## Parameters

<i>base</i>	MU peripheral base address.
<i>regIndex</i>	MU message register, see <a href="#">mu_msg_reg_index_t</a>

## Returns

The received message.

### 13.5.7 static void MU\_SetFlagsNonBlocking ( MU\_Type \* *base*, uint32\_t *flags* ) [inline], [static]

This function sets the 3-bit MU flags directly. Every time the 3-bit MU flags are changed, the status flag `kMU_FlagsUpdatingFlag` asserts indicating the 3-bit MU flags are updating to the other side. After the 3-bit MU flags are updated, the status flag `kMU_FlagsUpdatingFlag` is cleared by hardware. During the flags updating period, the flags cannot be changed. The upper layer should make sure the status flag `kMU_FlagsUpdatingFlag` is cleared before calling this function.

```
* while (kMU_FlagsUpdatingFlag & MU_GetStatusFlags(base))
* {
*   Wait for previous MU flags updating.
* }
* MU_SetFlagsNonBlocking(base, 0U); Set the mU flags.
*
```

## Parameters

<i>base</i>	MU peripheral base address.
<i>flags</i>	The 3-bit MU flags to set.

### 13.5.8 void MU\_SetFlags ( MU\_Type \* *base*, uint32\_t *flags* )

This function blocks setting the 3-bit MU flags. Every time the 3-bit MU flags are changed, the status flag `kMU_FlagsUpdatingFlag` asserts indicating the 3-bit MU flags are updating to the other side. After the 3-bit MU flags are updated, the status flag `kMU_FlagsUpdatingFlag` is cleared by hardware. During the flags updating period, the flags cannot be changed. This function waits for the MU status flag `kMU_FlagsUpdatingFlag` cleared and sets the 3-bit MU flags.



## Parameters

<i>base</i>	MU peripheral base address.
<i>flags</i>	The 3-bit MU flags to set.

**13.5.9 static uint32\_t MU\_GetFlags ( MU\_Type \* *base* ) [inline], [static]**

This function gets the current 3-bit MU flags on the current side.

## Parameters

<i>base</i>	MU peripheral base address.
-------------	-----------------------------

## Returns

flags Current value of the 3-bit flags.

**13.5.10 static uint32\_t MU\_GetStatusFlags ( MU\_Type \* *base* ) [inline], [static]**

This function returns the bit mask of the MU status flags. See `_mu_status_flags`.

```
* uint32_t flags;
* flags = MU_GetStatusFlags(base); Get all status flags.
* if (kMU_Tx0EmptyFlag & flags)
* {
*     The TX0 register is empty. Message can be sent.
*     MU_SendMsgNonBlocking(base, kMU_MsgReg0, MSG0_VAL);
* }
* if (kMU_Tx1EmptyFlag & flags)
* {
*     The TX1 register is empty. Message can be sent.
*     MU_SendMsgNonBlocking(base, kMU_MsgReg1, MSG1_VAL);
* }
*
```

## Parameters

<i>base</i>	MU peripheral base address.
-------------	-----------------------------

## Returns

Bit mask of the MU status flags, see `_mu_status_flags`.

### 13.5.11 `static uint32_t MU_GetInterruptsPending ( MU_Type * base ) [inline], [static]`

This function returns the bit mask of the pending MU IRQs.

## Parameters

<i>base</i>	MU peripheral base address.
-------------	-----------------------------

## Returns

Bit mask of the MU IRQs pending.

### 13.5.12 static void MU\_ClearStatusFlags ( MU\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

This function clears the specific MU status flags. The flags to clear should be passed in as bit mask. See `_mu_status_flags`.

```
* Clear general interrupt 0 and general interrupt 1 pending flags.
* MU_ClearStatusFlags(base, kMU_GenInt0Flag |
    kMU_GenInt1Flag);
*
```

## Parameters

<i>base</i>	MU peripheral base address.
<i>mask</i>	<p>Bit mask of the MU status flags. See <code>_mu_status_flags</code>. The following flags are cleared by hardware, this function could not clear them.</p> <ul style="list-style-type: none"> <li>• kMU_Tx0EmptyFlag</li> <li>• kMU_Tx1EmptyFlag</li> <li>• kMU_Tx2EmptyFlag</li> <li>• kMU_Tx3EmptyFlag</li> <li>• kMU_Rx0FullFlag</li> <li>• kMU_Rx1FullFlag</li> <li>• kMU_Rx2FullFlag</li> <li>• kMU_Rx3FullFlag</li> <li>• kMU_EventPendingFlag</li> <li>• kMU_FlagsUpdatingFlag</li> <li>• kMU_OtherSideInResetFlag</li> </ul>

### 13.5.13 static void MU\_EnableInterrupts ( MU\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

This function enables the specific MU interrupts. The interrupts to enable should be passed in as bit mask. See `_mu_interrupt_enable`.

```

*   Enable general interrupt 0 and TX0 empty interrupt.
*   MU_EnableInterrupts(base, kMU_GenInt0InterruptEnable |
*       kMU_Tx0EmptyInterruptEnable);
*

```

## Parameters

<i>base</i>	MU peripheral base address.
<i>mask</i>	Bit mask of the MU interrupts. See <code>_mu_interrupt_enable</code> .

### 13.5.14 static void MU\_DisableInterrupts ( MU\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

This function disables the specific MU interrupts. The interrupts to disable should be passed in as bit mask. See `_mu_interrupt_enable`.

```

*   Disable general interrupt 0 and TX0 empty interrupt.
*   MU_DisableInterrupts(base, kMU_GenInt0InterruptEnable |
*       kMU_Tx0EmptyInterruptEnable);
*

```

## Parameters

<i>base</i>	MU peripheral base address.
<i>mask</i>	Bit mask of the MU interrupts. See <code>_mu_interrupt_enable</code> .

### 13.5.15 status\_t MU\_TriggerInterrupts ( MU\_Type \* *base*, uint32\_t *mask* )

This function triggers the specific interrupts to the other core. The interrupts to trigger are passed in as bit mask. See `_mu_interrupt_trigger`. The MU should not trigger an interrupt to the other core when the previous interrupt has not been processed by the other core. This function checks whether the previous interrupts have been processed. If not, it returns an error.

```

*   if (kStatus_Success != MU_TriggerInterrupts(base,
*       kMU_GenInt0InterruptTrigger |
*       kMU_GenInt2InterruptTrigger))
*   {
*       Previous general purpose interrupt 0 or general purpose interrupt 2
*       has not been processed by the other core.
*   }
*

```

## Parameters

<i>base</i>	MU peripheral base address.
<i>mask</i>	Bit mask of the interrupts to trigger. See <code>_mu_interrupt_trigger</code> .

## Return values

<i>kStatus_Success</i>	Interrupts have been triggered successfully.
<i>kStatus_Fail</i>	Previous interrupts have not been accepted.

### 13.5.16 `static void MU_MaskHardwareReset ( MU_Type * base, bool mask ) [inline], [static]`

The other core could call `MU_HardwareResetOtherCore()` to reset current core. To mask the reset, call this function and pass in true.

## Parameters

<i>base</i>	MU peripheral base address.
<i>mask</i>	Pass true to mask the hardware reset, pass false to unmask it.

### 13.5.17 `static mu_power_mode_t MU_GetOtherCorePowerMode ( MU_Type * base ) [inline], [static]`

This function gets the power mode of the other core.

## Parameters

<i>base</i>	MU peripheral base address.
-------------	-----------------------------

## Returns

Power mode of the other core.

## Chapter 14

# QSPI: Quad Serial Peripheral Interface

### 14.1 Overview

The MCUXpresso SDK provides a peripheral driver for the Quad Serial Peripheral Interface (QSPI) module of MCUXpresso SDK devices.

QSPI driver includes functional APIs and EDMA transactional APIs.

Functional APIs are feature/property target low level APIs. Functional APIs can be used for QSPI initialization/configuration/operation for optimization/customization purpose. Using the functional API requires the knowledge of the QSPI peripheral and how to organize functional APIs to meet the application requirements. All functional API use the peripheral base address as the first parameter. QSPI functional operation groups provide the functional API set.

Transactional APIs are transaction target high level APIs. Transactional APIs can be used to enable the peripheral and in the application if the code size and performance of transactional APIs satisfy the requirements. If the code size and performance are a critical requirement, see the transactional API implementation and write a custom code. All transactional APIs use the `qspi_handle_t` as the first parameter. Initialize the handle by calling the `QSPI_TransferTxCreateHandleEDMA()` or `QSPI_TransferRxCreateHandleEDMA()` API.

### Modules

- [Quad Serial Peripheral Interface Driver](#)

## 14.2 Quad Serial Peripheral Interface Driver

### 14.2.1 Overview

#### Data Structures

- struct `qspi_dqs_config_t`  
*DQS configure features. [More...](#)*
- struct `qspi_flash_timing_t`  
*Flash timing configuration. [More...](#)*
- struct `qspi_config_t`  
*QSPI configuration structure. [More...](#)*
- struct `qspi_flash_config_t`  
*External flash configuration items. [More...](#)*
- struct `qspi_transfer_t`  
*Transfer structure for QSPI. [More...](#)*
- struct `ip_command_config_t`  
*16-bit access reg for IPCR register [More...](#)*

#### Macros

- #define `QSPI_LUT_SEQ(cmd0, pad0, op0, cmd1, pad1, op1)`  
*Macro functions for LUT table.*
- #define `QSPI_CMD` (0x1U)  
*Macro for QSPI LUT command.*
- #define `QSPI_PAD_1` (0x0U)  
*Macro for QSPI PAD.*

#### Enumerations

- enum {  
    `kStatus_QSPI_Idle` = MAKE\_STATUS(kStatusGroup\_QSPI, 0),  
    `kStatus_QSPI_Busy` = MAKE\_STATUS(kStatusGroup\_QSPI, 1),  
    `kStatus_QSPI_Error` = MAKE\_STATUS(kStatusGroup\_QSPI, 2) }  
*Status structure of QSPI.*
- enum `qspi_read_area_t` {  
    `kQSPI_ReadAHB` = 0x0U,  
    `kQSPI_ReadIP` }  
*QSPI read data area, from IP FIFO or AHB buffer.*
- enum `qspi_command_seq_t` {  
    `kQSPI_IPSeq` = QuadSPI\_SPTRCLR\_IPPTRC\_MASK,  
    `kQSPI_BufferSeq` = QuadSPI\_SPTRCLR\_BFPTRC\_MASK }  
*QSPI command sequence type.*
- enum `qspi_fifo_t` {  
    `kQSPI_TxFifo` = QuadSPI\_MCR\_CLR\_TXF\_MASK,  
    `kQSPI_RxFifo` = QuadSPI\_MCR\_CLR\_RXF\_MASK,  
    `kQSPI_AllFifo` = QuadSPI\_MCR\_CLR\_TXF\_MASK | QuadSPI\_MCR\_CLR\_RXF\_MASK }

- QSPI buffer type.*
  - enum `qspi_endianness_t` {
 `kQSPI_64BigEndian` = 0x0U,
 `kQSPI_32LittleEndian`,
 `kQSPI_32BigEndian`,
 `kQSPI_64LittleEndian` }
- QSPI transfer endianness.*
  - enum `_qspi_error_flags` {
 `kQSPI_DataLearningFail` = (int)QuadSPI\_FR\_DLPFF\_MASK,
 `kQSPI_TxBufferFill` = QuadSPI\_FR\_TBFF\_MASK,
 `kQSPI_TxBufferUnderrun` = QuadSPI\_FR\_TBUF\_MASK,
 `kQSPI_IllegalInstruction` = QuadSPI\_FR\_ILLINE\_MASK,
 `kQSPI_RxBufferOverflow` = QuadSPI\_FR\_RBOF\_MASK,
 `kQSPI_RxBufferDrain` = QuadSPI\_FR\_RBDF\_MASK,
 `kQSPI_AHBSequenceError` = QuadSPI\_FR\_ABSEF\_MASK,
 `kQSPI_AHBBufferOverflow` = QuadSPI\_FR\_ABOF\_MASK,
 `kQSPI_IPCommandUsageError` = QuadSPI\_FR\_IUEF\_MASK,
 `kQSPI_IPCommandTriggerDuringAHBAccess` = QuadSPI\_FR\_IPAEF\_MASK,
 `kQSPI_IPCommandTriggerDuringIPAccess` = QuadSPI\_FR\_IPIEF\_MASK,
 `kQSPI_IPCommandTriggerDuringAHBGrant` = QuadSPI\_FR\_IPGEF\_MASK,
 `kQSPI_IPCommandTransactionFinished` = QuadSPI\_FR\_TFF\_MASK,
 `kQSPI_FlagAll` = (int)0x8C83F8D1U }
- QSPI error flags.*
  - enum `_qspi_flags` {
 `kQSPI_DataLearningSamplePoint` = (int)QuadSPI\_SR\_DLPSMP\_MASK,
 `kQSPI_TxBufferFull` = QuadSPI\_SR\_TXFULL\_MASK,
 `kQSPI_TxBufferEnoughData` = QuadSPI\_SR\_TXEDA\_MASK,
 `kQSPI_RxDMA` = QuadSPI\_SR\_RXDMA\_MASK,
 `kQSPI_RxBufferFull` = QuadSPI\_SR\_RXFULL\_MASK,
 `kQSPI_RxWatermark` = QuadSPI\_SR\_RXWE\_MASK,
 `kQSPI_AHB3BufferFull` = QuadSPI\_SR\_AHB3FUL\_MASK,
 `kQSPI_AHB2BufferFull` = QuadSPI\_SR\_AHB2FUL\_MASK,
 `kQSPI_AHB1BufferFull` = QuadSPI\_SR\_AHB1FUL\_MASK,
 `kQSPI_AHB0BufferFull` = QuadSPI\_SR\_AHB0FUL\_MASK,
 `kQSPI_AHB3BufferNotEmpty` = QuadSPI\_SR\_AHB3NE\_MASK,
 `kQSPI_AHB2BufferNotEmpty` = QuadSPI\_SR\_AHB2NE\_MASK,
 `kQSPI_AHB1BufferNotEmpty` = QuadSPI\_SR\_AHB1NE\_MASK,
 `kQSPI_AHB0BufferNotEmpty` = QuadSPI\_SR\_AHB0NE\_MASK,
 `kQSPI_AHBTransactionPending` = QuadSPI\_SR\_AHBTRN\_MASK,
 `kQSPI_AHBCommandPriorityGranted` = QuadSPI\_SR\_AHBGNT\_MASK,
 `kQSPI_AHBAccess` = QuadSPI\_SR\_AHB\_ACC\_MASK,
 `kQSPI_IPAccess` = QuadSPI\_SR\_IP\_ACC\_MASK,
 `kQSPI_Busy` = QuadSPI\_SR\_BUSY\_MASK,
 `kQSPI_StateAll` = (int)0xEF897FE7U }
- QSPI state bit.*
  - enum `_qspi_interrupt_enable` {



```

kQSPI_DataLearningFailInterruptEnable,
kQSPI_TxBufferFillInterruptEnable = QuadSPI_RSER_TBFIE_MASK,
kQSPI_TxBufferUnderrunInterruptEnable = QuadSPI_RSER_TBUIE_MASK,
kQSPI_IllegalInstructionInterruptEnable,
kQSPI_RxBufferOverflowInterruptEnable = QuadSPI_RSER_RBOIE_MASK,
kQSPI_RxBufferDrainInterruptEnable = QuadSPI_RSER_RBDIE_MASK,
kQSPI_AHBSequenceErrorInterruptEnable = QuadSPI_RSER_ABSEIE_MASK,
kQSPI_AHBBufferOverflowInterruptEnable = QuadSPI_RSER_ABOIE_MASK,
kQSPI_IPCommandUsageErrorInterruptEnable = QuadSPI_RSER_IUEIE_MASK,
kQSPI_IPCommandTriggerDuringAHBAccessInterruptEnable,
kQSPI_IPCommandTriggerDuringIPAccessInterruptEnable,
kQSPI_IPCommandTriggerDuringAHBGrantInterruptEnable,
kQSPI_IPCommandTransactionFinishedInterruptEnable,
kQSPI_AllInterruptEnable = (int)0x8C83F8D1U }
    QSPI interrupt enable.
• enum _qspi_dma_enable { kQSPI_RxBufferDrainDMAEnable = QuadSPI_RSER_RBDDE_MAS-
    K }
    QSPI DMA request flag.
• enum qspi_dqs_phrase_shift_t {
    kQSPI_DQSNoPhraseShift = 0x0U,
    kQSPI_DQSPhraseShift45Degree,
    kQSPI_DQSPhraseShift90Degree,
    kQSPI_DQSPhraseShift135Degree }
    Phrase shift number for DQS mode.
• enum qspi_dqs_read_sample_clock_t {
    kQSPI_ReadSampleClkInternalLoopback = 0x0U,
    kQSPI_ReadSampleClkLoopbackFromDqsPad = 0x1U,
    kQSPI_ReadSampleClkExternalInputFromDqsPad = 0x2U }
    Qspi read sampling option.

```

## Driver version

- #define FSL\_QSPI\_DRIVER\_VERSION (MAKE\_VERSION(2, 2, 3))  
*QSPI driver version 2.2.3.*

## Initialization and deinitialization

- uint32\_t **QSPI\_GetInstance** (QuadSPI\_Type \*base)  
*Get the instance number for QSPI.*
- void **QSPI\_Init** (QuadSPI\_Type \*base, **qspi\_config\_t** \*config, uint32\_t srcClock\_Hz)  
*Initializes the QSPI module and internal state.*
- void **QSPI\_GetDefaultQspiConfig** (**qspi\_config\_t** \*config)  
*Gets default settings for QSPI.*
- void **QSPI\_Deinit** (QuadSPI\_Type \*base)  
*Deinitializes the QSPI module.*

- void [QSPI\\_SetFlashConfig](#) (QuadSPI\_Type \*base, [qspi\\_flash\\_config\\_t](#) \*config)  
*Configures the serial flash parameter.*
- void [QSPI\\_SoftwareReset](#) (QuadSPI\_Type \*base)  
*Software reset for the QSPI logic.*
- static void [QSPI\\_Enable](#) (QuadSPI\_Type \*base, bool enable)  
*Enables or disables the QSPI module.*

### Status

- static uint32\_t [QSPI\\_GetStatusFlags](#) (QuadSPI\_Type \*base)  
*Gets the state value of QSPI.*
- static uint32\_t [QSPI\\_GetErrorStatusFlags](#) (QuadSPI\_Type \*base)  
*Gets QSPI error status flags.*
- static void [QSPI\\_ClearErrorFlag](#) (QuadSPI\_Type \*base, uint32\_t mask)  
*Clears the QSPI error flags.*

### Interrupts

- static void [QSPI\\_EnableInterrupts](#) (QuadSPI\_Type \*base, uint32\_t mask)  
*Enables the QSPI interrupts.*
- static void [QSPI\\_DisableInterrupts](#) (QuadSPI\_Type \*base, uint32\_t mask)  
*Disables the QSPI interrupts.*

### DMA Control

- static void [QSPI\\_EnableDMA](#) (QuadSPI\_Type \*base, uint32\_t mask, bool enable)  
*Enables the QSPI DMA source.*
- static uint32\_t [QSPI\\_GetTxDataRegisterAddress](#) (QuadSPI\_Type \*base)  
*Gets the Tx data register address.*
- uint32\_t [QSPI\\_GetRxDataRegisterAddress](#) (QuadSPI\_Type \*base)  
*Gets the Rx data register address used for DMA operation.*

### Bus Operations

- static void [QSPI\\_SetIPCommandAddress](#) (QuadSPI\_Type \*base, uint32\_t addr)  
*Sets the IP command address.*
- static void [QSPI\\_SetIPCommandSize](#) (QuadSPI\_Type \*base, uint32\_t size)  
*Sets the IP command size.*
- void [QSPI\\_ExecuteIPCommand](#) (QuadSPI\_Type \*base, uint32\_t index)  
*Executes IP commands located in LUT table.*
- void [QSPI\\_ExecuteAHBCommand](#) (QuadSPI\_Type \*base, uint32\_t index)  
*Executes AHB commands located in LUT table.*
- static void [QSPI\\_EnableIPParallelMode](#) (QuadSPI\_Type \*base, bool enable)  
*Enables/disables the QSPI IP command parallel mode.*
- static void [QSPI\\_EnableAHBParallelMode](#) (QuadSPI\_Type \*base, bool enable)  
*Enables/disables the QSPI AHB command parallel mode.*

- void [QSPI\\_UpdateLUT](#) (QuadSPI\_Type \*base, uint32\_t index, uint32\_t \*cmd)  
*Updates the LUT table.*
- static void [QSPI\\_ClearFifo](#) (QuadSPI\_Type \*base, uint32\_t mask)  
*Clears the QSPI FIFO logic.*
- static void [QSPI\\_ClearCommandSequence](#) (QuadSPI\_Type \*base, [qspi\\_command\\_seq\\_t](#) seq)  
*@ brief Clears the command sequence for the IP/buffer command.*
- static void [QSPI\\_EnableDDRMMode](#) (QuadSPI\_Type \*base, bool enable)  
*Enable or disable DDR mode.*
- void [QSPI\\_SetReadDataArea](#) (QuadSPI\_Type \*base, [qspi\\_read\\_area\\_t](#) area)  
*@ brief Set the RX buffer readout area.*
- void [QSPI\\_WriteBlocking](#) (QuadSPI\_Type \*base, uint32\_t \*buffer, size\_t size)  
*Sends a buffer of data bytes using a blocking method.*
- static void [QSPI\\_WriteData](#) (QuadSPI\_Type \*base, uint32\_t data)  
*Writes data into FIFO.*
- void [QSPI\\_ReadBlocking](#) (QuadSPI\_Type \*base, uint32\_t \*buffer, size\_t size)  
*Receives a buffer of data bytes using a blocking method.*
- uint32\_t [QSPI\\_ReadData](#) (QuadSPI\_Type \*base)  
*Receives data from data FIFO.*

## Transactional

- static void [QSPI\\_TransferSendBlocking](#) (QuadSPI\_Type \*base, [qspi\\_transfer\\_t](#) \*xfer)  
*Writes data to the QSPI transmit buffer.*
- static void [QSPI\\_TransferReceiveBlocking](#) (QuadSPI\_Type \*base, [qspi\\_transfer\\_t](#) \*xfer)  
*Reads data from the QSPI receive buffer in polling way.*

## 14.2.2 Data Structure Documentation

### 14.2.2.1 struct qspi\_dqs\_config\_t

#### Data Fields

- uint32\_t [portADelayTapNum](#)  
*Delay chain tap number selection for QSPI port A DQS.*
- [qspi\\_dqs\\_phrase\\_shift\\_t](#) shift  
*Phase shift for internal DQS generation.*
- [qspi\\_dqs\\_read\\_sample\\_clock\\_t](#) rxSampleClock  
*Read sample clock for Dqs.*
- bool [enableDQSClkInverse](#)  
*Enable inverse clock for internal DQS generation.*

#### Field Documentation

- (1) [qspi\\_dqs\\_read\\_sample\\_clock\\_t](#) [qspi\\_dqs\\_config\\_t::rxSampleClock](#)

### 14.2.2.2 struct qspi\_flash\_timing\_t

#### Data Fields

- uint32\_t [dataHoldTime](#)  
*Serial flash data in hold time.*
- uint32\_t [CSHoldTime](#)  
*Serial flash CS hold time in terms of serial flash clock cycles.*
- uint32\_t [CSSetupTime](#)  
*Serial flash CS setup time in terms of serial flash clock cycles.*

### 14.2.2.3 struct qspi\_config\_t

#### Data Fields

- uint32\_t [clockSource](#)  
*Clock source for QSPI module.*
- uint32\_t [baudRate](#)  
*Serial flash clock baud rate.*
- uint8\_t [txWatermark](#)  
*QSPI transmit watermark value.*
- uint8\_t [rxWatermark](#)  
*QSPI receive watermark value.*
- uint32\_t [AHBbufferSize](#) [FSL\_FEATURE\_QSPI\_AHB\_BUFFER\_COUNT]  
*AHB buffer size.*
- uint8\_t [AHBbufferMaster](#) [FSL\_FEATURE\_QSPI\_AHB\_BUFFER\_COUNT]  
*AHB buffer master.*
- bool [enableAHBbuffer3AllMaster](#)  
*Is AHB buffer3 for all master.*
- [qspi\\_read\\_area\\_t](#) [area](#)  
*Which area Rx data readout.*
- bool [enableQspi](#)  
*Enable QSPI after initialization.*

#### Field Documentation

- (1) uint8\_t qspi\_config\_t::rxWatermark
- (2) uint32\_t qspi\_config\_t::AHBbufferSize[FSL\_FEATURE\_QSPI\_AHB\_BUFFER\_COUNT]
- (3) uint8\_t qspi\_config\_t::AHBbufferMaster[FSL\_FEATURE\_QSPI\_AHB\_BUFFER\_COUNT]
- (4) bool qspi\_config\_t::enableAHBbuffer3AllMaster

### 14.2.2.4 struct qspi\_flash\_config\_t

#### Data Fields

- uint32\_t [flashA1Size](#)  
*Flash A1 size.*

- uint32\_t [flashA2Size](#)  
*Flash A2 size.*
- uint32\_t [flashB1Size](#)  
*Flash B1 size.*
- uint32\_t [flashB2Size](#)  
*Flash B2 size.*
- uint32\_t [lookuptable](#) [FSL\_FEATURE\_QSPI\_LUT\_DEPTH]  
*Flash command in LUT.*
- uint32\_t [dataHoldTime](#)  
*Data line hold time.*
- uint32\_t [CSHoldTime](#)  
*CS line hold time.*
- uint32\_t [CSSetupTime](#)  
*CS line setup time.*
- uint32\_t [cloumnspace](#)  
*Column space size.*
- uint32\_t [dataLearnValue](#)  
*Data Learn value if enable data learn.*
- [qspi\\_endianness\\_t](#) [endian](#)  
*Flash data endianness.*
- bool [enableWordAddress](#)  
*If enable word address.*

### Field Documentation

- (1) uint32\_t qspi\_flash\_config\_t::dataHoldTime
- (2) qspi\_endianness\_t qspi\_flash\_config\_t::endian
- (3) bool qspi\_flash\_config\_t::enableWordAddress

#### 14.2.2.5 struct qspi\_transfer\_t

### Data Fields

- uint32\_t \* [data](#)  
*Pointer to data to transmit.*
- size\_t [dataSize](#)  
*Bytes to be transmit.*

#### 14.2.2.6 struct ip\_command\_config\_t

### 14.2.3 Macro Definition Documentation

#### 14.2.3.1 #define FSL\_QSPI\_DRIVER\_VERSION (MAKE\_VERSION(2, 2, 3))

## 14.2.4 Enumeration Type Documentation

### 14.2.4.1 anonymous enum

Enumerator

*kStatus\_QSPI\_Idle* QSPI is in idle state.

*kStatus\_QSPI\_Busy* QSPI is busy.

*kStatus\_QSPI\_Error* Error occurred during QSPI transfer.

### 14.2.4.2 enum qspi\_read\_area\_t

Enumerator

*kQSPI\_ReadAHB* QSPI read from AHB buffer.

*kQSPI\_ReadIP* QSPI read from IP FIFO.

### 14.2.4.3 enum qspi\_command\_seq\_t

Enumerator

*kQSPI\_IPSeq* IP command sequence.

*kQSPI\_BufferSeq* Buffer command sequence.

### 14.2.4.4 enum qspi\_fifo\_t

Enumerator

*kQSPI\_TxFifo* QSPI Tx FIFO.

*kQSPI\_RxFifo* QSPI Rx FIFO.

*kQSPI\_AllFifo* QSPI all FIFO, including Tx and Rx.

### 14.2.4.5 enum qspi\_endianness\_t

Enumerator

*kQSPI\_64BigEndian* 64 bits big endian

*kQSPI\_32LittleEndian* 32 bit little endian

*kQSPI\_32BigEndian* 32 bit big endian

*kQSPI\_64LittleEndian* 64 bit little endian

#### 14.2.4.6 enum \_qspi\_error\_flags

Enumerator

***kQSPI\_DataLearningFail*** Data learning pattern failure flag.  
***kQSPI\_TxBufferFill*** Tx buffer fill flag.  
***kQSPI\_TxBufferUnderrun*** Tx buffer underrun flag.  
***kQSPI\_IllegalInstruction*** Illegal instruction error flag.  
***kQSPI\_RxBufferOverflow*** Rx buffer overflow flag.  
***kQSPI\_RxBufferDrain*** Rx buffer drain flag.  
***kQSPI\_AHBSequenceError*** AHB sequence error flag.  
***kQSPI\_AHBBufferOverflow*** AHB buffer overflow flag.  
***kQSPI\_IPCommandUsageError*** IP command usage error flag.  
***kQSPI\_IPCommandTriggerDuringAHBAccess*** IP command trigger during AHB access error.  
***kQSPI\_IPCommandTriggerDuringIPAccess*** IP command trigger cannot be executed.  
***kQSPI\_IPCommandTriggerDuringAHBGrant*** IP command trigger during AHB grant error.  
***kQSPI\_IPCommandTransactionFinished*** IP command transaction finished flag.  
***kQSPI\_FlagAll*** All error flag.

#### 14.2.4.7 enum \_qspi\_flags

Enumerator

***kQSPI\_DataLearningSamplePoint*** Data learning sample point.  
***kQSPI\_TxBufferFull*** Tx buffer full flag.  
***kQSPI\_TxBufferEnoughData*** Tx buffer enough data available.  
***kQSPI\_RxDMA*** Rx DMA is requesting or running.  
***kQSPI\_RxBufferFull*** Rx buffer full.  
***kQSPI\_RxWatermark*** Rx buffer watermark exceeded.  
***kQSPI\_AHB3BufferFull*** AHB buffer 3 full.  
***kQSPI\_AHB2BufferFull*** AHB buffer 2 full.  
***kQSPI\_AHB1BufferFull*** AHB buffer 1 full.  
***kQSPI\_AHB0BufferFull*** AHB buffer 0 full.  
***kQSPI\_AHB3BufferNotEmpty*** AHB buffer 3 not empty.  
***kQSPI\_AHB2BufferNotEmpty*** AHB buffer 2 not empty.  
***kQSPI\_AHB1BufferNotEmpty*** AHB buffer 1 not empty.  
***kQSPI\_AHB0BufferNotEmpty*** AHB buffer 0 not empty.  
***kQSPI\_AHBTransactionPending*** AHB access transaction pending.  
***kQSPI\_AHBCommandPriorityGranted*** AHB command priority granted.  
***kQSPI\_AHBAccess*** AHB access.  
***kQSPI\_IPAccess*** IP access.  
***kQSPI\_Busy*** Module busy.  
***kQSPI\_StateAll*** All flags.

#### 14.2.4.8 enum \_qspi\_interrupt\_enable

Enumerator

***kQSPI\_DataLearningFailInterruptEnable*** Data learning pattern failure interrupt enable.  
***kQSPI\_TxBufferFillInterruptEnable*** Tx buffer fill interrupt enable.  
***kQSPI\_TxBufferUnderrunInterruptEnable*** Tx buffer underrun interrupt enable.  
***kQSPI\_IllegalInstructionInterruptEnable*** Illegal instruction error interrupt enable.  
***kQSPI\_RxBufferOverflowInterruptEnable*** Rx buffer overflow interrupt enable.  
***kQSPI\_RxBufferDrainInterruptEnable*** Rx buffer drain interrupt enable.  
***kQSPI\_AHBSequenceErrorInterruptEnable*** AHB sequence error interrupt enable.  
***kQSPI\_AHBBufferOverflowInterruptEnable*** AHB buffer overflow interrupt enable.  
***kQSPI\_IPCommandUsageErrorInterruptEnable*** IP command usage error interrupt enable.  
***kQSPI\_IPCommandTriggerDuringAHBAccessInterruptEnable*** IP command trigger during AHB access error.  
***kQSPI\_IPCommandTriggerDuringIPAccessInterruptEnable*** IP command trigger cannot be executed.  
***kQSPI\_IPCommandTriggerDuringAHBGrantInterruptEnable*** IP command trigger during AHB grant error.  
***kQSPI\_IPCommandTransactionFinishedInterruptEnable*** IP command transaction finished interrupt enable.  
***kQSPI\_AllInterruptEnable*** All error interrupt enable.

#### 14.2.4.9 enum \_qspi\_dma\_enable

Enumerator

***kQSPI\_RxBufferDrainDMAEnable*** Rx buffer drain DMA.

#### 14.2.4.10 enum qspi\_dqs\_phrase\_shift\_t

Enumerator

***kQSPI\_DQSNoPhraseShift*** No phase shift.  
***kQSPI\_DQSPhraseShift45Degree*** Select 45 degree phase shift.  
***kQSPI\_DQSPhraseShift90Degree*** Select 90 degree phase shift.  
***kQSPI\_DQSPhraseShift135Degree*** Select 135 degree phase shift.

#### 14.2.4.11 enum qspi\_dqs\_read\_sample\_clock\_t

Enumerator

***kQSPI\_ReadSampleClkInternalLoopback*** Read sample clock adopts internal loopback mode.



***kQSPI\_ReadSampleClkLoopbackFromDqsPad*** Dummy Read strobe generated by QSPI Controller and loopback from DQS pad.

***kQSPI\_ReadSampleClkExternalInputFromDqsPad*** Flash provided Read strobe and input from DQS pad.

## 14.2.5 Function Documentation

### 14.2.5.1 uint32\_t QSPI\_GetInstance ( QuadSPI\_Type \* *base* )

Parameters

<i>base</i>	QSPI base pointer.
-------------	--------------------

### 14.2.5.2 void QSPI\_Init ( QuadSPI\_Type \* *base*, qspi\_config\_t \* *config*, uint32\_t *srcClock\_Hz* )

This function enables the clock for QSPI and also configures the QSPI with the input configure parameters. Users should call this function before any QSPI operations.

Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>config</i>	QSPI configure structure.
<i>srcClock_Hz</i>	QSPI source clock frequency in Hz.

### 14.2.5.3 void QSPI\_GetDefaultQspiConfig ( qspi\_config\_t \* *config* )

Parameters

<i>config</i>	QSPI configuration structure.
---------------	-------------------------------

### 14.2.5.4 void QSPI\_Deinit ( QuadSPI\_Type \* *base* )

Clears the QSPI state and QSPI module registers.

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
-------------	--------------------------

#### 14.2.5.5 void QSPI\_SetFlashConfig ( QuadSPI\_Type \* *base*, qspi\_flash\_config\_t \* *config* )

This function configures the serial flash relevant parameters, such as the size, command, and so on. The flash configuration value cannot have a default value. The user needs to configure it according to the QSPI features.

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>config</i>	Flash configuration parameters.

#### 14.2.5.6 void QSPI\_SoftwareReset ( QuadSPI\_Type \* *base* )

This function sets the software reset flags for both AHB and buffer domain and resets both AHB buffer and also IP FIFOs.

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
-------------	--------------------------

#### 14.2.5.7 static void QSPI\_Enable ( QuadSPI\_Type \* *base*, bool *enable* ) [inline], [static]

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>enable</i>	True means enable QSPI, false means disable.

#### 14.2.5.8 static uint32\_t QSPI\_GetStatusFlags ( QuadSPI\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
-------------	--------------------------

## Returns

status flag, use status flag to AND [\\_qspi\\_flags](#) could get the related status.

**14.2.5.9 static uint32\_t QSPI\_GetErrorStatusFlags ( QuadSPI\_Type \* *base* ) [inline], [static]**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
-------------	--------------------------

## Returns

status flag, use status flag to AND [\\_qspi\\_error\\_flags](#) could get the related status.

**14.2.5.10 static void QSPI\_ClearErrorFlag ( QuadSPI\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>mask</i>	Which kind of QSPI flags to be cleared, a combination of <a href="#">_qspi_error_flags</a> .

**14.2.5.11 static void QSPI\_EnableInterrupts ( QuadSPI\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>mask</i>	QSPI interrupt source.

**14.2.5.12 static void QSPI\_DisableInterrupts ( QuadSPI\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>mask</i>	QSPI interrupt source.

**14.2.5.13 static void QSPI\_EnableDMA ( QuadSPI\_Type \* *base*, uint32\_t *mask*, bool *enable* ) [inline], [static]**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>mask</i>	QSPI DMA source.
<i>enable</i>	True means enable DMA, false means disable.

**14.2.5.14 static uint32\_t QSPI\_GetTxDataRegisterAddress ( QuadSPI\_Type \* *base* ) [inline], [static]**

It is used for DMA operation.

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
-------------	--------------------------

## Returns

QSPI Tx data register address.

**14.2.5.15 uint32\_t QSPI\_GetRxDataRegisterAddress ( QuadSPI\_Type \* *base* )**

This function returns the Rx data register address or Rx buffer address according to the Rx read area settings.

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
-------------	--------------------------

## Returns

QSPI Rx data register address.

**14.2.5.16** `static void QSPI_SetIPCommandAddress ( QuadSPI_Type * base, uint32_t  
addr ) [inline], [static]`

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>addr</i>	IP command address.

**14.2.5.17 static void QSPI\_SetIPCommandSize ( QuadSPI\_Type \* *base*, uint32\_t *size* )**  
**[inline], [static]**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>size</i>	IP command size.

**14.2.5.18 void QSPI\_ExecuteIPCommand ( QuadSPI\_Type \* *base*, uint32\_t *index* )**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>index</i>	IP command located in which LUT table index.

**14.2.5.19 void QSPI\_ExecuteAHBCommand ( QuadSPI\_Type \* *base*, uint32\_t *index* )**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>index</i>	AHB command located in which LUT table index.

**14.2.5.20 static void QSPI\_EnableIPParallelMode ( QuadSPI\_Type \* *base*, bool *enable* )**  
**[inline], [static]**

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
-------------	--------------------------

<i>enable</i>	True means enable parallel mode, false means disable parallel mode.
---------------	---

**14.2.5.21 static void QSPI\_EnableAHBParallelMode ( QuadSPI\_Type \* *base*, bool *enable* ) [inline], [static]**

Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>enable</i>	True means enable parallel mode, false means disable parallel mode.

**14.2.5.22 void QSPI\_UpdateLUT ( QuadSPI\_Type \* *base*, uint32\_t *index*, uint32\_t \* *cmd* )**

Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>index</i>	Which LUT index needs to be located. It should be an integer divided by 4.
<i>cmd</i>	Command sequence array.

**14.2.5.23 static void QSPI\_ClearFifo ( QuadSPI\_Type \* *base*, uint32\_t *mask* ) [inline], [static]**

Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>mask</i>	Which kind of QSPI FIFO to be cleared.

**14.2.5.24 static void QSPI\_ClearCommandSequence ( QuadSPI\_Type \* *base*, qspi\_command\_seq\_t *seq* ) [inline], [static]**

This function can reset the command sequence.

Parameters

<i>base</i>	QSPI base address.
<i>seq</i>	Which command sequence need to reset, IP command, buffer command or both.

**14.2.5.25**   `static void QSPI_EnableDDRMMode ( QuadSPI_Type * base, bool enable )`  
                  `[inline], [static]`



## Parameters

<i>base</i>	QSPI base pointer
<i>enable</i>	True means enable DDR mode, false means disable DDR mode.

**14.2.5.26 void QSPI\_SetReadDataArea ( QuadSPI\_Type \* *base*, qspi\_read\_area\_t *area* )**

This function can set the RX buffer readout, from AHB bus or IP Bus.

## Parameters

<i>base</i>	QSPI base address.
<i>area</i>	QSPI Rx buffer readout area. AHB bus buffer or IP bus buffer.

**14.2.5.27 void QSPI\_WriteBlocking ( QuadSPI\_Type \* *base*, uint32\_t \* *buffer*, size\_t *size* )**

## Note

This function blocks via polling until all bytes have been sent.

## Parameters

<i>base</i>	QSPI base pointer
<i>buffer</i>	The data bytes to send
<i>size</i>	The number of data bytes to send

**14.2.5.28 static void QSPI\_WriteData ( QuadSPI\_Type \* *base*, uint32\_t *data* )  
[inline], [static]**

## Parameters

<i>base</i>	QSPI base pointer
<i>data</i>	The data bytes to send

**14.2.5.29 void QSPI\_ReadBlocking ( QuadSPI\_Type \* *base*, uint32\_t \* *buffer*, size\_t *size* )**

## Note

This function blocks via polling until all bytes have been sent. Users shall notice that this receive size shall not bigger than 64 bytes. As this interface is used to read flash status registers. For flash contents read, please use AHB bus read, this is much more efficiency.

## Parameters

<i>base</i>	QSPI base pointer
<i>buffer</i>	The data bytes to send
<i>size</i>	The number of data bytes to receive

### 14.2.5.30 uint32\_t QSPI\_ReadData ( QuadSPI\_Type \* *base* )

## Parameters

<i>base</i>	QSPI base pointer
-------------	-------------------

## Returns

The data in the FIFO.

### 14.2.5.31 static void QSPI\_TransferSendBlocking ( QuadSPI\_Type \* *base*, qspi\_transfer\_t \* *xfer* ) [inline], [static]

This function writes a continuous data to the QSPI transmit FIFO. This function is a block function and can return only when finished. This function uses polling methods.

## Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>xfer</i>	QSPI transfer structure.

### 14.2.5.32 static void QSPI\_TransferReceiveBlocking ( QuadSPI\_Type \* *base*, qspi\_transfer\_t \* *xfer* ) [inline], [static]

This function reads continuous data from the QSPI receive buffer/FIFO. This function is a blocking function and can return only when finished. This function uses polling methods. Users shall notice that this receive size shall not bigger than 64 bytes. As this interface is used to read flash status registers. For flash contents read, please use AHB bus read, this is much more efficiency.

### Parameters

<i>base</i>	Pointer to QuadSPI Type.
<i>xfer</i>	QSPI transfer structure.

## Chapter 15

# RDC: Resource Domain Controller

### 15.1 Overview

The MCUXpresso SDK provides a driver for the RDC module of MCUXpresso SDK devices.

The Resource Domain Controller (RDC) provides robust support for the isolation of destination memory mapped locations such as peripherals and memory to a single core, a bus master, or set of cores and bus masters.

The RDC driver should be used together with the RDC\_SEMA42 driver.

### Data Structures

- struct [rdc\\_hardware\\_config\\_t](#)  
*RDC hardware configuration. [More...](#)*
- struct [rdc\\_domain\\_assignment\\_t](#)  
*Master domain assignment. [More...](#)*
- struct [rdc\\_periph\\_access\\_config\\_t](#)  
*Peripheral domain access permission configuration. [More...](#)*
- struct [rdc\\_mem\\_access\\_config\\_t](#)  
*Memory region domain access control configuration. [More...](#)*
- struct [rdc\\_mem\\_status\\_t](#)  
*Memory region access violation status. [More...](#)*

### Enumerations

- enum [\\_rdc\\_interrupts](#) { [kRDC\\_RestoreCompleteInterrupt](#) = RDC\_INTCTRL\_RCI\_EN\_MASK }  
*RDC interrupts.*
- enum [\\_rdc\\_flags](#) { [kRDC\\_PowerDownDomainOn](#) = RDC\_STAT\_PDS\_MASK }  
*RDC status.*
- enum [\\_rdc\\_access\\_policy](#) {  
    [kRDC\\_NoAccess](#) = 0,  
    [kRDC\\_WriteOnly](#) = 1,  
    [kRDC\\_ReadOnly](#) = 2,  
    [kRDC\\_ReadWrite](#) = 3 }  
*Access permission policy.*

### Functions

- void [RDC\\_Init](#) (RDC\_Type \*base)  
*Initializes the RDC module.*
- void [RDC\\_Deinit](#) (RDC\_Type \*base)  
*De-initializes the RDC module.*
- void [RDC\\_GetHardwareConfig](#) (RDC\_Type \*base, [rdc\\_hardware\\_config\\_t](#) \*config)  
*Gets the RDC hardware configuration.*

- static void [RDC\\_EnableInterrupts](#) (RDC\_Type \*base, uint32\_t mask)  
*Enable interrupts.*
- static void [RDC\\_DisableInterrupts](#) (RDC\_Type \*base, uint32\_t mask)  
*Disable interrupts.*
- static uint32\_t [RDC\\_GetInterruptStatus](#) (RDC\_Type \*base)  
*Get the interrupt pending status.*
- static void [RDC\\_ClearInterruptStatus](#) (RDC\_Type \*base, uint32\_t mask)  
*Clear interrupt pending status.*
- static uint32\_t [RDC\\_GetStatus](#) (RDC\_Type \*base)  
*Get RDC status.*
- static void [RDC\\_ClearStatus](#) (RDC\_Type \*base, uint32\_t mask)  
*Clear RDC status.*
- void [RDC\\_SetMasterDomainAssignment](#) (RDC\_Type \*base, rdc\_master\_t master, const [rdc\\_domain\\_assignment\\_t](#) \*domainAssignment)  
*Set master domain assignment.*
- void [RDC\\_GetDefaultMasterDomainAssignment](#) ([rdc\\_domain\\_assignment\\_t](#) \*domainAssignment)  
*Get default master domain assignment.*
- static void [RDC\\_LockMasterDomainAssignment](#) (RDC\_Type \*base, rdc\_master\_t master)  
*Lock master domain assignment.*
- void [RDC\\_SetPeriphAccessConfig](#) (RDC\_Type \*base, const [rdc\\_periph\\_access\\_config\\_t](#) \*config)  
*Set peripheral access policy.*
- void [RDC\\_GetDefaultPeriphAccessConfig](#) ([rdc\\_periph\\_access\\_config\\_t](#) \*config)  
*Get default peripheral access policy.*
- static void [RDC\\_LockPeriphAccessConfig](#) (RDC\_Type \*base, rdc\_periph\_t periph)  
*Lock peripheral access policy configuration.*
- static uint8\_t [RDC\\_GetPeriphAccessPolicy](#) (RDC\_Type \*base, rdc\_periph\_t periph, uint8\_t domainId)  
*Get the peripheral access policy for specific domain.*
- void [RDC\\_SetMemAccessConfig](#) (RDC\_Type \*base, const [rdc\\_mem\\_access\\_config\\_t](#) \*config)  
*Set memory region access policy.*
- void [RDC\\_GetDefaultMemAccessConfig](#) ([rdc\\_mem\\_access\\_config\\_t](#) \*config)  
*Get default memory region access policy.*
- static void [RDC\\_LockMemAccessConfig](#) (RDC\_Type \*base, rdc\_mem\_t mem)  
*Lock memory access policy configuration.*
- static void [RDC\\_SetMemAccessValid](#) (RDC\_Type \*base, rdc\_mem\_t mem, bool valid)  
*Enable or disable memory access policy configuration.*
- void [RDC\\_GetMemViolationStatus](#) (RDC\_Type \*base, rdc\_mem\_t mem, [rdc\\_mem\\_status\\_t](#) \*status)  
*Get the memory region violation status.*
- static void [RDC\\_ClearMemViolationFlag](#) (RDC\_Type \*base, rdc\_mem\_t mem)  
*Clear the memory region violation flag.*
- static uint8\_t [RDC\\_GetMemAccessPolicy](#) (RDC\_Type \*base, rdc\_mem\_t mem, uint8\_t domainId)  
*Get the memory region access policy for specific domain.*
- static uint8\_t [RDC\\_GetCurrentMasterDomainId](#) (RDC\_Type \*base)  
*Gets the domain ID of the current bus master.*

## 15.2 Data Structure Documentation

### 15.2.1 struct rdc\_hardware\_config\_t

#### Data Fields

- uint32\_t [domainNumber](#): 4  
*Number of domains.*
- uint32\_t [masterNumber](#): 8  
*Number of bus masters.*
- uint32\_t [periphNumber](#): 8  
*Number of peripherals.*
- uint32\_t [memNumber](#): 8  
*Number of memory regions.*

#### Field Documentation

- (1) uint32\_t rdc\_hardware\_config\_t::domainNumber
- (2) uint32\_t rdc\_hardware\_config\_t::masterNumber
- (3) uint32\_t rdc\_hardware\_config\_t::periphNumber
- (4) uint32\_t rdc\_hardware\_config\_t::memNumber

### 15.2.2 struct rdc\_domain\_assignment\_t

#### Data Fields

- uint32\_t [domainId](#): 2U  
*Domain ID.*
- uint32\_t [\\_\\_pad0\\_\\_](#): 29U  
*Reserved.*
- uint32\_t [lock](#): 1U  
*Lock the domain assignment.*

#### Field Documentation

- (1) uint32\_t rdc\_domain\_assignment\_t::domainId
- (2) uint32\_t rdc\_domain\_assignment\_t::\_\_pad0\_\_
- (3) uint32\_t rdc\_domain\_assignment\_t::lock

### 15.2.3 struct rdc\_periph\_access\_config\_t

#### Data Fields

- rdc\_periph\_t [periph](#)  
*Peripheral name.*

- bool [lock](#)  
*Lock the permission until reset.*
- bool [enableSema](#)  
*Enable semaphore or not, when enabled, master should call [RDC\\_SEMA42\\_Lock](#) to lock the semaphore gate accordingly before access the peripheral.*
- uint16\_t [policy](#)  
*Access policy.*

#### Field Documentation

- (1) `rdc_periph_t rdc_periph_access_config_t::periph`
- (2) `bool rdc_periph_access_config_t::lock`
- (3) `bool rdc_periph_access_config_t::enableSema`
- (4) `uint16_t rdc_periph_access_config_t::policy`

#### 15.2.4 struct `rdc_mem_access_config_t`

Note that when setting the [baseAddress](#) and [endAddress](#), should be aligned to the region resolution, see `rdc_mem_t` definitions.

#### Data Fields

- `rdc_mem_t` [mem](#)  
*Memory region descriptor name.*
- bool [lock](#)  
*Lock the configuration.*
- uint64\_t [baseAddress](#)  
*Start address of the memory region.*
- uint64\_t [endAddress](#)  
*End address of the memory region.*
- uint16\_t [policy](#)  
*Access policy.*

#### Field Documentation

- (1) `rdc_mem_t rdc_mem_access_config_t::mem`
- (2) `bool rdc_mem_access_config_t::lock`
- (3) `uint64_t rdc_mem_access_config_t::baseAddress`
- (4) `uint64_t rdc_mem_access_config_t::endAddress`
- (5) `uint16_t rdc_mem_access_config_t::policy`

## 15.2.5 struct rdc\_mem\_status\_t

### Data Fields

- bool [hasViolation](#)  
*Violating happens or not.*
- uint8\_t [domainID](#)  
*Violating Domain ID.*
- uint64\_t [address](#)  
*Violating Address.*

### Field Documentation

(1) bool rdc\_mem\_status\_t::hasViolation

(2) uint8\_t rdc\_mem\_status\_t::domainID

(3) uint64\_t rdc\_mem\_status\_t::address

## 15.3 Enumeration Type Documentation

### 15.3.1 enum \_rdc\_interrupts

#### Enumerator

***kRDC\_RestoreCompleteInterrupt*** Interrupt generated when the RDC has completed restoring state to a recently re-powered memory regions.

### 15.3.2 enum \_rdc\_flags

#### Enumerator

***kRDC\_PowerDownDomainOn*** Power down domain is ON.

### 15.3.3 enum \_rdc\_access\_policy

#### Enumerator

***kRDC\_NoAccess*** Could not read or write.

***kRDC\_WriteOnly*** Write only.

***kRDC\_ReadOnly*** Read only.

***kRDC\_ReadWrite*** Read and write.

## 15.4 Function Documentation



### 15.4.1 void RDC\_Init ( RDC\_Type \* *base* )

This function enables the RDC clock.

Parameters

<i>base</i>	RDC peripheral base address.
-------------	------------------------------

#### 15.4.2 void RDC\_Deinit ( RDC\_Type \* *base* )

This function disables the RDC clock.

Parameters

<i>base</i>	RDC peripheral base address.
-------------	------------------------------

#### 15.4.3 void RDC\_GetHardwareConfig ( RDC\_Type \* *base*, rdc\_hardware\_config\_t \* *config* )

This function gets the RDC hardware configurations, including number of bus masters, number of domains, number of memory regions and number of peripherals.

Parameters

<i>base</i>	RDC peripheral base address.
<i>config</i>	Pointer to the structure to get the configuration.

#### 15.4.4 static void RDC\_EnableInterrupts ( RDC\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

Parameters

<i>base</i>	RDC peripheral base address.
<i>mask</i>	Interrupts to enable, it is OR'ed value of enum <a href="#">_rdc_interrupts</a> .

#### 15.4.5 static void RDC\_DisableInterrupts ( RDC\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	RDC peripheral base address.
<i>mask</i>	Interrupts to disable, it is OR'ed value of enum <a href="#">_rdc_interrupts</a> .

#### 15.4.6 static uint32\_t RDC\_GetInterruptStatus ( RDC\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	RDC peripheral base address.
-------------	------------------------------

## Returns

Interrupts pending status, it is OR'ed value of enum [\\_rdc\\_interrupts](#).

#### 15.4.7 static void RDC\_ClearInterruptStatus ( RDC\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	RDC peripheral base address.
<i>mask</i>	Status to clear, it is OR'ed value of enum <a href="#">_rdc_interrupts</a> .

#### 15.4.8 static uint32\_t RDC\_GetStatus ( RDC\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	RDC peripheral base address.
-------------	------------------------------

## Returns

mask RDC status, it is OR'ed value of enum [\\_rdc\\_flags](#).

#### 15.4.9 static void RDC\_ClearStatus ( RDC\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	RDC peripheral base address.
<i>mask</i>	RDC status to clear, it is OR'ed value of enum <a href="#">_rdc_flags</a> .

**15.4.10 void RDC\_SetMasterDomainAssignment ( RDC\_Type \* *base*, rdc\_master\_t *master*, const rdc\_domain\_assignment\_t \* *domainAssignment* )**

## Parameters

<i>base</i>	RDC peripheral base address.
<i>master</i>	Which master to set.
<i>domain-Assignment</i>	Pointer to the assignment.

**15.4.11 void RDC\_GetDefaultMasterDomainAssignment ( rdc\_domain\_assignment\_t \* *domainAssignment* )**

The default configuration is:

```
assignment->domainId = 0U;
assignment->lock = 0U;
```

## Parameters

<i>domain-Assignment</i>	Pointer to the assignment.
--------------------------	----------------------------

**15.4.12 static void RDC\_LockMasterDomainAssignment ( RDC\_Type \* *base*, rdc\_master\_t *master* ) [inline], [static]**

Once locked, it could not be unlocked until next reset.

## Parameters

<i>base</i>	RDC peripheral base address.
<i>master</i>	Which master to lock.

#### 15.4.13 void RDC\_SetPeriphAccessConfig ( RDC\_Type \* *base*, const rdc\_periph\_access\_config\_t \* *config* )

Parameters

<i>base</i>	RDC peripheral base address.
<i>config</i>	Pointer to the policy configuration.

#### 15.4.14 void RDC\_GetDefaultPeriphAccessConfig ( rdc\_periph\_access\_config\_t \* *config* )

The default configuration is:

```
config->lock = false;
config->enableSema = false;
config->policy = RDC_ACCESS_POLICY(0, kRDC_ReadWrite) |
                RDC_ACCESS_POLICY(1, kRDC_ReadWrite) |
                RDC_ACCESS_POLICY(2, kRDC_ReadWrite) |
                RDC_ACCESS_POLICY(3, kRDC_ReadWrite);
```

Parameters

<i>config</i>	Pointer to the policy configuration.
---------------	--------------------------------------

#### 15.4.15 static void RDC\_LockPeriphAccessConfig ( RDC\_Type \* *base*, rdc\_periph\_t *periph* ) [inline], [static]

Once locked, it could not be unlocked until reset.

Parameters

<i>base</i>	RDC peripheral base address.
-------------	------------------------------

<i>periph</i>	Which peripheral to lock.
---------------	---------------------------

**15.4.16** `static uint8_t RDC_GetPeriphAccessPolicy ( RDC_Type * base,  
rdc_periph_t periph, uint8_t domainId ) [inline], [static]`

Parameters

<i>base</i>	RDC peripheral base address.
<i>periph</i>	Which peripheral to get.
<i>domainId</i>	Get policy for which domain.

Returns

Access policy, see [\\_rdc\\_access\\_policy](#).

**15.4.17** `void RDC_SetMemAccessConfig ( RDC_Type * base, const  
rdc_mem_access_config_t * config )`

Note that when setting the `baseAddress` and `endAddress` in `config`, should be aligned to the region resolution, see `rdc_mem_t` definitions.

Parameters

<i>base</i>	RDC peripheral base address.
<i>config</i>	Pointer to the policy configuration.

**15.4.18** `void RDC_GetDefaultMemAccessConfig ( rdc_mem_access_config_t *  
config )`

The default configuration is:

```
config->lock = false;
config->baseAddress = 0;
config->endAddress = 0;
config->policy = RDC_ACCESS_POLICY(0, kRDC_ReadWrite) |
                 RDC_ACCESS_POLICY(1, kRDC_ReadWrite) |
                 RDC_ACCESS_POLICY(2, kRDC_ReadWrite) |
                 RDC_ACCESS_POLICY(3, kRDC_ReadWrite);
```

## Parameters

<i>config</i>	Pointer to the policy configuration.
---------------	--------------------------------------

#### 15.4.19 static void RDC\_LockMemAccessConfig ( RDC\_Type \* *base*, rdc\_mem\_t *mem* ) [inline], [static]

Once locked, it could not be unlocked until reset. After locked, you can only call [RDC\\_SetMemAccessValid](#) to enable the configuration, but can not disable it or change other settings.

## Parameters

<i>base</i>	RDC peripheral base address.
<i>mem</i>	Which memory region to lock.

#### 15.4.20 static void RDC\_SetMemAccessValid ( RDC\_Type \* *base*, rdc\_mem\_t *mem*, bool *valid* ) [inline], [static]

## Parameters

<i>base</i>	RDC peripheral base address.
<i>mem</i>	Which memory region to operate.
<i>valid</i>	Pass in true to valid, false to invalid.

#### 15.4.21 void RDC\_GetMemViolationStatus ( RDC\_Type \* *base*, rdc\_mem\_t *mem*, rdc\_mem\_status\_t \* *status* )

The first access violation is captured. Subsequent violations are ignored until the status register is cleared. Contents are cleared upon reading the register. Clearing of contents occurs only when the status is read by the memory region's associated domain ID(s).

## Parameters

<i>base</i>	RDC peripheral base address.
-------------	------------------------------

<i>mem</i>	Which memory region to get.
<i>status</i>	The returned status.

#### 15.4.22 static void RDC\_ClearMemViolationFlag ( RDC\_Type \* *base*, rdc\_mem\_t *mem* ) [inline], [static]

Parameters

<i>base</i>	RDC peripheral base address.
<i>mem</i>	Which memory region to clear.

#### 15.4.23 static uint8\_t RDC\_GetMemAccessPolicy ( RDC\_Type \* *base*, rdc\_mem\_t *mem*, uint8\_t *domainId* ) [inline], [static]

Parameters

<i>base</i>	RDC peripheral base address.
<i>mem</i>	Which memory region to get.
<i>domainId</i>	Get policy for which domain.

Returns

Access policy, see [\\_rdc\\_access\\_policy](#).

#### 15.4.24 static uint8\_t RDC\_GetCurrentMasterDomainId ( RDC\_Type \* *base* ) [inline], [static]

This function returns the domain ID of the current bus master.

Parameters

<i>base</i>	RDC peripheral base address.
-------------	------------------------------

Returns

Domain ID of current bus master.



## Chapter 16

# RDC\_SEMA42: Hardware Semaphores Driver

### 16.1 Overview

The MCUXpresso SDK provides a driver for the RDC\_SEMA42 module of MCUXpresso SDK devices.

The RDC\_SEMA42 driver should be used together with RDC driver.

Before using the RDC\_SEMA42, call the [RDC\\_SEMA42\\_Init\(\)](#) function to initialize the module. Note that this function only enables the clock but does not reset the gates because the module might be used by other processors at the same time. To reset the gates, call either the [RDC\\_SEMA42\\_ResetGate\(\)](#) or [RDC\\_SEMA42\\_ResetAllGates\(\)](#) functions. The function [RDC\\_SEMA42\\_Deinit\(\)](#) deinitializes the RDC\_SEMA42.

The RDC\_SEMA42 provides two functions to lock the RDC\_SEMA42 gate. The function [RDC\\_SEMA42\\_TryLock\(\)](#) tries to lock the gate. If the gate has been locked by another processor, this function returns an error immediately. The function [RDC\\_SEMA42\\_Lock\(\)](#) is a blocking method, which waits until the gate is free and locks it.

The [RDC\\_SEMA42\\_Unlock\(\)](#) unlocks the RDC\_SEMA42 gate. The gate can only be unlocked by the processor which locked it. If the gate is not locked by the current processor, this function takes no effect. The function [RDC\\_SEMA42\\_GetGateStatus\(\)](#) returns a status whether the gate is unlocked and which processor locks the gate. The function [RDC\\_SEMA42\\_GetLockDomainID\(\)](#) returns the ID of the domain which has locked the gate.

The RDC\_SEMA42 gate can be reset to unlock forcefully. The function [RDC\\_SEMA42\\_ResetGate\(\)](#) resets a specific gate. The function [RDC\\_SEMA42\\_ResetAllGates\(\)](#) resets all gates.

### Macros

- #define [RDC\\_SEMA42\\_GATE\\_NUM\\_RESET\\_ALL](#) (64U)  
*The number to reset all RDC\_SEMA42 gates.*
- #define [RDC\\_SEMA42\\_GATEn](#)(base, n) (((volatile uint8\_t \*)&((base)->GATE0)))[(n)]  
*RDC\_SEMA42 gate n register address.*
- #define [RDC\\_SEMA42\\_GATE\\_COUNT](#) (64U)  
*RDC\_SEMA42 gate count.*

### Functions

- void [RDC\\_SEMA42\\_Init](#) (RDC\_SEMAPHORE\_Type \*base)  
*Initializes the RDC\_SEMA42 module.*
- void [RDC\\_SEMA42\\_Deinit](#) (RDC\_SEMAPHORE\_Type \*base)  
*De-initializes the RDC\_SEMA42 module.*
- [status\\_t](#) [RDC\\_SEMA42\\_TryLock](#) (RDC\_SEMAPHORE\_Type \*base, uint8\_t gateNum, uint8\_t masterIndex, uint8\_t domainId)  
*Tries to lock the RDC\_SEMA42 gate.*

- void [RDC\\_SEMA42\\_Lock](#) (RDC\_SEMAPHORE\_Type \*base, uint8\_t gateNum, uint8\_t masterIndex, uint8\_t domainId)  
*Locks the RDC\_SEMA42 gate.*
- static void [RDC\\_SEMA42\\_Unlock](#) (RDC\_SEMAPHORE\_Type \*base, uint8\_t gateNum)  
*Unlocks the RDC\_SEMA42 gate.*
- static int32\_t [RDC\\_SEMA42\\_GetLockMasterIndex](#) (RDC\_SEMAPHORE\_Type \*base, uint8\_t gateNum)  
*Gets which master has currently locked the gate.*
- int32\_t [RDC\\_SEMA42\\_GetLockDomainID](#) (RDC\_SEMAPHORE\_Type \*base, uint8\_t gateNum)  
*Gets which domain has currently locked the gate.*
- status\_t [RDC\\_SEMA42\\_ResetGate](#) (RDC\_SEMAPHORE\_Type \*base, uint8\_t gateNum)  
*Resets the RDC\_SEMA42 gate to an unlocked status.*
- static status\_t [RDC\\_SEMA42\\_ResetAllGates](#) (RDC\_SEMAPHORE\_Type \*base)  
*Resets all RDC\_SEMA42 gates to an unlocked status.*

## Driver version

- #define [FSL\\_RDC\\_SEMA42\\_DRIVER\\_VERSION](#) ([MAKE\\_VERSION](#)(2, 0, 4))  
*RDC\_SEMA42 driver version.*

## 16.2 Macro Definition Documentation

### 16.2.1 #define RDC\_SEMA42\_GATE\_NUM\_RESET\_ALL (64U)

### 16.2.2 #define RDC\_SEMA42\_GATEn( base, n ) (((volatile uint8\_t \*)(&((base)->GATE0)))[(n)])

### 16.2.3 #define RDC\_SEMA42\_GATE\_COUNT (64U)

## 16.3 Function Documentation

### 16.3.1 void RDC\_SEMA42\_Init ( RDC\_SEMAPHORE\_Type \* base )

This function initializes the RDC\_SEMA42 module. It only enables the clock but does not reset the gates because the module might be used by other processors at the same time. To reset the gates, call either RDC\_SEMA42\_ResetGate or RDC\_SEMA42\_ResetAllGates function.

Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
-------------	-------------------------------------

### 16.3.2 void RDC\_SEMA42\_Deinit ( RDC\_SEMAPHORE\_Type \* base )

This function de-initializes the RDC\_SEMA42 module. It only disables the clock.

## Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
-------------	-------------------------------------

### 16.3.3 **status\_t RDC\_SEMA42\_TryLock ( RDC\_SEMAPHORE\_Type \* *base*, uint8\_t *gateNum*, uint8\_t *masterIndex*, uint8\_t *domainId* )**

This function tries to lock the specific RDC\_SEMA42 gate. If the gate has been locked by another processor, this function returns an error code.

## Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
<i>gateNum</i>	Gate number to lock.
<i>masterIndex</i>	Current processor master index.
<i>domainId</i>	Current processor domain ID.

## Return values

<i>kStatus_Success</i>	Lock the sema42 gate successfully.
<i>kStatus_Failed</i>	Sema42 gate has been locked by another processor.

### 16.3.4 **void RDC\_SEMA42\_Lock ( RDC\_SEMAPHORE\_Type \* *base*, uint8\_t *gateNum*, uint8\_t *masterIndex*, uint8\_t *domainId* )**

This function locks the specific RDC\_SEMA42 gate. If the gate has been locked by other processors, this function waits until it is unlocked and then lock it.

## Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
<i>gateNum</i>	Gate number to lock.
<i>masterIndex</i>	Current processor master index.
<i>domainId</i>	Current processor domain ID.

### 16.3.5 static void RDC\_SEMA42\_Unlock ( RDC\_SEMAPHORE\_Type \* *base*, uint8\_t *gateNum* ) [inline], [static]

This function unlocks the specific RDC\_SEMA42 gate. It only writes unlock value to the RDC\_SEMA42 gate register. However, it does not check whether the RDC\_SEMA42 gate is locked by the current processor or not. As a result, if the RDC\_SEMA42 gate is not locked by the current processor, this function has no effect.

Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
<i>gateNum</i>	Gate number to unlock.

### 16.3.6 static int32\_t RDC\_SEMA42\_GetLockMasterIndex ( RDC\_SEMAPHORE\_Type \* *base*, uint8\_t *gateNum* ) [inline], [static]

Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
<i>gateNum</i>	Gate number.

Returns

Return -1 if the gate is not locked by any master, otherwise return the master index.

### 16.3.7 int32\_t RDC\_SEMA42\_GetLockDomainID ( RDC\_SEMAPHORE\_Type \* *base*, uint8\_t *gateNum* )

Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
<i>gateNum</i>	Gate number.

Returns

Return -1 if the gate is not locked by any domain, otherwise return the domain ID.

### 16.3.8 `status_t RDC_SEMA42_ResetGate ( RDC_SEMAPHORE_Type * base, uint8_t gateNum )`

This function resets a RDC\_SEMA42 gate to an unlocked status.

## Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
<i>gateNum</i>	Gate number.

## Return values

<i>kStatus_Success</i>	RDC_SEMA42 gate is reset successfully.
<i>kStatus_Failed</i>	Some other reset process is ongoing.

### 16.3.9 static status\_t RDC\_SEMA42\_ResetAllGates ( RDC\_SEMAPHORE\_Type \* *base* ) [inline], [static]

This function resets all RDC\_SEMA42 gate to an unlocked status.

## Parameters

<i>base</i>	RDC_SEMA42 peripheral base address.
-------------	-------------------------------------

## Return values

<i>kStatus_Success</i>	RDC_SEMA42 is reset successfully.
<i>kStatus_RDC_SEMA42_-Reseting</i>	Some other reset process is ongoing.

## Chapter 17

# SAI: Serial Audio Interface

### 17.1 Overview

The MCUXpresso SDK provides a peripheral driver for the Serial Audio Interface (SAI) module of MCUXpresso SDK devices.

SAI driver includes functional APIs and transactional APIs.

Functional APIs target low-level APIs. Functional APIs can be used for SAI initialization, configuration and operation, and for optimization and customization purposes. Using the functional API requires the knowledge of the SAI peripheral and how to organize functional APIs to meet the application requirements. All functional API use the peripheral base address as the first parameter. SAI functional operation groups provide the functional API set.

Transactional APIs target high-level APIs. Transactional APIs can be used to enable the peripheral and in the application if the code size and performance of transactional APIs satisfy the requirements. If the code size and performance are a critical requirement, see the transactional API implementation and write a custom code. All transactional APIs use the `sai_handle_t` as the first parameter. Initialize the handle by calling the [SAI\\_TransferTxCreateHandle\(\)](#) or [SAI\\_TransferRxCreateHandle\(\)](#) API.

Transactional APIs support asynchronous transfer. This means that the functions [SAI\\_TransferSendNonBlocking\(\)](#) and [SAI\\_TransferReceiveNonBlocking\(\)](#) set up the interrupt for data transfer. When the transfer completes, the upper layer is notified through a callback function with the `kStatus_SAI_TxIdle` and `kStatus_SAI_RxIdle` status.

### 17.2 Typical configurations

#### Bit width configuration

SAI driver support 8/16/24/32bits stereo/mono raw audio data transfer. SAI EDMA driver support 8/16/32bits stereo/mono raw audio data transfer, since the EDMA doesn't support 24bit data width, so application should pre-convert the 24bit data to 32bit. SAI DMA driver support 8/16/32bits stereo/mono raw audio data transfer, since the EDMA doesn't support 24bit data width, so application should pre-convert the 24bit data to 32bit. SAI SDMA driver support 8/16/24/32bits stereo/mono raw audio data transfer.

#### Frame configuration

SAI driver support I2S, DSP, Left justified, Right justified, TDM mode. Application can call the api directly: `SAI_GetClassicI2SConfig` `SAI_GetLeftJustifiedConfig` `SAI_GetRightJustifiedConfig` `SAI_GetTDMConfig` `SAI_GetDSPConfig`

## 17.3 Typical use case

### 17.3.1 SAI Send/receive using an interrupt method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/sai`

### 17.3.2 SAI Send/receive using a DMA method

Refer to the driver examples codes located at `<SDK_ROOT>/boards/<BOARD>/driver_examples/sai`

## Modules

- [SAI Driver](#)



## 17.4 SAI Driver

### 17.4.1 Overview

#### Data Structures

- struct [sai\\_config\\_t](#)  
*SAI user configuration structure. [More...](#)*
- struct [sai\\_transfer\\_format\\_t](#)  
*sai transfer format [More...](#)*
- struct [sai\\_fifo\\_t](#)  
*sai fifo configurations [More...](#)*
- struct [sai\\_bit\\_clock\\_t](#)  
*sai bit clock configurations [More...](#)*
- struct [sai\\_frame\\_sync\\_t](#)  
*sai frame sync configurations [More...](#)*
- struct [sai\\_serial\\_data\\_t](#)  
*sai serial data configurations [More...](#)*
- struct [sai\\_transceiver\\_t](#)  
*sai transceiver configurations [More...](#)*
- struct [sai\\_transfer\\_t](#)  
*SAI transfer structure. [More...](#)*
- struct [sai\\_handle\\_t](#)  
*SAI handle structure. [More...](#)*

#### Macros

- #define [SAI\\_XFER\\_QUEUE\\_SIZE](#) (4U)  
*SAI transfer queue size, user can refine it according to use case.*
- #define [FSL\\_SAI\\_HAS\\_FIFO\\_EXTEND\\_FEATURE](#) 1  
*sai fifo feature*

#### Typedefs

- typedef void(\* [sai\\_transfer\\_callback\\_t](#))(I2S\_Type \*base, sai\_handle\_t \*handle, [status\\_t](#) status, void \*userData)  
*SAI transfer callback prototype.*

## Enumerations

- enum {  
`kStatus_SAI_TxBusy` = MAKE\_STATUS(kStatusGroup\_SAI, 0),  
`kStatus_SAI_RxBusy` = MAKE\_STATUS(kStatusGroup\_SAI, 1),  
`kStatus_SAI_TxError` = MAKE\_STATUS(kStatusGroup\_SAI, 2),  
`kStatus_SAI_RxError` = MAKE\_STATUS(kStatusGroup\_SAI, 3),  
`kStatus_SAI_QueueFull` = MAKE\_STATUS(kStatusGroup\_SAI, 4),  
`kStatus_SAI_TxIdle` = MAKE\_STATUS(kStatusGroup\_SAI, 5),  
`kStatus_SAI_RxIdle` = MAKE\_STATUS(kStatusGroup\_SAI, 6) }  
*\_sai\_status\_t, SAI return status.*
- enum {  
`kSAI_Channel0Mask` = 1 << 0U,  
`kSAI_Channel1Mask` = 1 << 1U,  
`kSAI_Channel2Mask` = 1 << 2U,  
`kSAI_Channel3Mask` = 1 << 3U,  
`kSAI_Channel4Mask` = 1 << 4U,  
`kSAI_Channel5Mask` = 1 << 5U,  
`kSAI_Channel6Mask` = 1 << 6U,  
`kSAI_Channel7Mask` = 1 << 7U }  
*\_sai\_channel\_mask, sai channel mask value, actual channel numbers is depend soc specific*
- enum `sai_protocol_t` {  
`kSAI_BusLeftJustified` = 0x0U,  
`kSAI_BusRightJustified`,  
`kSAI_BusI2S`,  
`kSAI_BusPCMA`,  
`kSAI_BusPCMB` }  
*Define the SAI bus type.*
- enum `sai_master_slave_t` {  
`kSAI_Master` = 0x0U,  
`kSAI_Slave` = 0x1U,  
`kSAI_Bclk_Master_FrameSync_Slave` = 0x2U,  
`kSAI_Bclk_Slave_FrameSync_Master` = 0x3U }  
*Master or slave mode.*
- enum `sai_mono_stereo_t` {  
`kSAI_Stereo` = 0x0U,  
`kSAI_MonoRight`,  
`kSAI_MonoLeft` }  
*Mono or stereo audio format.*
- enum `sai_data_order_t` {  
`kSAI_DataLSB` = 0x0U,  
`kSAI_DataMSB` }  
*SAI data order, MSB or LSB.*
- enum `sai_clock_polarity_t` {

- kSAI\_PolarityActiveHigh = 0x0U,
  - kSAI\_PolarityActiveLow = 0x1U,
  - kSAI\_SampleOnFallingEdge = 0x0U,
  - kSAI\_SampleOnRisingEdge = 0x1U }

*SAI clock polarity, active high or low.*
- enum sai\_sync\_mode\_t {
  - kSAI\_ModeAsync = 0x0U,
  - kSAI\_ModeSync }

*Synchronous or asynchronous mode.*
- enum sai\_bclk\_source\_t {
  - kSAI\_BclkSourceBusclk = 0x0U,
  - kSAI\_BclkSourceMclkOption1 = 0x1U,
  - kSAI\_BclkSourceMclkOption2 = 0x2U,
  - kSAI\_BclkSourceMclkOption3 = 0x3U,
  - kSAI\_BclkSourceMclkDiv = 0x1U,
  - kSAI\_BclkSourceOtherSai0 = 0x2U,
  - kSAI\_BclkSourceOtherSai1 = 0x3U }

*Bit clock source.*
- enum {
  - kSAI\_WordStartInterruptEnable,
  - kSAI\_SyncErrorInterruptEnable = I2S\_TCSR\_SEIE\_MASK,
  - kSAI\_FIFOWarningInterruptEnable = I2S\_TCSR\_FWIE\_MASK,
  - kSAI\_FIFOErrorInterruptEnable = I2S\_TCSR\_FEIE\_MASK,
  - kSAI\_FIFORequestInterruptEnable = I2S\_TCSR\_FRIE\_MASK }

*\_sai\_interrupt\_enable\_t, The SAI interrupt enable flag*
- enum {
  - kSAI\_FIFOWarningDMAEnable = I2S\_TCSR\_FWDE\_MASK,
  - kSAI\_FIFORequestDMAEnable = I2S\_TCSR\_FRDE\_MASK }

*\_sai\_dma\_enable\_t, The DMA request sources*
- enum {
  - kSAI\_WordStartFlag = I2S\_TCSR\_WSF\_MASK,
  - kSAI\_SyncErrorFlag = I2S\_TCSR\_SEF\_MASK,
  - kSAI\_FIFOErrorFlag = I2S\_TCSR\_FEF\_MASK,
  - kSAI\_FIFORequestFlag = I2S\_TCSR\_FRF\_MASK,
  - kSAI\_FIFOWarningFlag = I2S\_TCSR\_FWF\_MASK }

*\_sai\_flags, The SAI status flag*
- enum sai\_reset\_type\_t {
  - kSAI\_ResetTypeSoftware = I2S\_TCSR\_SR\_MASK,
  - kSAI\_ResetTypeFIFO = I2S\_TCSR\_FR\_MASK,
  - kSAI\_ResetAll = I2S\_TCSR\_SR\_MASK | I2S\_TCSR\_FR\_MASK }

*The reset type.*
- enum sai\_fifo\_packing\_t {
  - kSAI\_FifoPackingDisabled = 0x0U,
  - kSAI\_FifoPacking8bit = 0x2U,
  - kSAI\_FifoPacking16bit = 0x3U }

*The SAI packing mode The mode includes 8 bit and 16 bit packing.*
- enum sai\_sample\_rate\_t {

```

kSAI_SampleRate8KHz = 8000U,
kSAI_SampleRate11025Hz = 11025U,
kSAI_SampleRate12KHz = 12000U,
kSAI_SampleRate16KHz = 16000U,
kSAI_SampleRate22050Hz = 22050U,
kSAI_SampleRate24KHz = 24000U,
kSAI_SampleRate32KHz = 32000U,
kSAI_SampleRate44100Hz = 44100U,
kSAI_SampleRate48KHz = 48000U,
kSAI_SampleRate96KHz = 96000U,
kSAI_SampleRate192KHz = 192000U,
kSAI_SampleRate384KHz = 384000U }

```

*Audio sample rate.*

- enum `sai_word_width_t` {  
`kSAI_WordWidth8bits` = 8U,  
`kSAI_WordWidth16bits` = 16U,  
`kSAI_WordWidth24bits` = 24U,  
`kSAI_WordWidth32bits` = 32U }

*Audio word width.*

- enum `sai_data_pin_state_t` {  
`kSAI_DataPinStateTriState`,  
`kSAI_DataPinStateOutputZero` = 1U }

*sai data pin state definition*

- enum `sai_fifo_combine_t` {  
`kSAI_FifoCombineDisabled` = 0U,  
`kSAI_FifoCombineModeEnabledOnRead`,  
`kSAI_FifoCombineModeEnabledOnWrite`,  
`kSAI_FifoCombineModeEnabledOnReadWrite` }

*sai fifo combine mode definition*

- enum `sai_transceiver_type_t` {  
`kSAI_Transmitter` = 0U,  
`kSAI_Receiver` = 1U }

*sai transceiver type*

- enum `sai_frame_sync_len_t` {  
`kSAI_FrameSyncLenOneBitClk` = 0U,  
`kSAI_FrameSyncLenPerWordWidth` = 1U }

*sai frame sync len*

## Driver version

- #define `FSL_SAI_DRIVER_VERSION` (`MAKE_VERSION(2, 3, 6)`)  
*Version 2.3.6.*

## Initialization and deinitialization

- void [SAI\\_TxInit](#) (I2S\_Type \*base, const [sai\\_config\\_t](#) \*config)  
*Initializes the SAI Tx peripheral.*
- void [SAI\\_RxInit](#) (I2S\_Type \*base, const [sai\\_config\\_t](#) \*config)  
*Initializes the SAI Rx peripheral.*
- void [SAI\\_TxGetDefaultConfig](#) ([sai\\_config\\_t](#) \*config)  
*Sets the SAI Tx configuration structure to default values.*
- void [SAI\\_RxGetDefaultConfig](#) ([sai\\_config\\_t](#) \*config)  
*Sets the SAI Rx configuration structure to default values.*
- void [SAI\\_Init](#) (I2S\_Type \*base)  
*Initializes the SAI peripheral.*
- void [SAI\\_Deinit](#) (I2S\_Type \*base)  
*De-initializes the SAI peripheral.*
- void [SAI\\_TxReset](#) (I2S\_Type \*base)  
*Resets the SAI Tx.*
- void [SAI\\_RxReset](#) (I2S\_Type \*base)  
*Resets the SAI Rx.*
- void [SAI\\_TxEnable](#) (I2S\_Type \*base, bool enable)  
*Enables/disables the SAI Tx.*
- void [SAI\\_RxEnable](#) (I2S\_Type \*base, bool enable)  
*Enables/disables the SAI Rx.*
- static void [SAI\\_TxSetBitClockDirection](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave)  
*Set Rx bit clock direction.*
- static void [SAI\\_RxSetBitClockDirection](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave)  
*Set Rx bit clock direction.*
- static void [SAI\\_RxSetFrameSyncDirection](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave)  
*Set Rx frame sync direction.*
- static void [SAI\\_TxSetFrameSyncDirection](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave)  
*Set Tx frame sync direction.*
- void [SAI\\_TxSetBitClockRate](#) (I2S\_Type \*base, uint32\_t sourceClockHz, uint32\_t sampleRate, uint32\_t bitWidth, uint32\_t channelNumbers)  
*Transmitter bit clock rate configurations.*
- void [SAI\\_RxSetBitClockRate](#) (I2S\_Type \*base, uint32\_t sourceClockHz, uint32\_t sampleRate, uint32\_t bitWidth, uint32\_t channelNumbers)  
*Receiver bit clock rate configurations.*
- void [SAI\\_TxSetBitclockConfig](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave, [sai\\_bit\\_clock\\_t](#) \*config)  
*Transmitter Bit clock configurations.*
- void [SAI\\_RxSetBitclockConfig](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave, [sai\\_bit\\_clock\\_t](#) \*config)  
*Receiver Bit clock configurations.*
- void [SAI\\_TxSetFifoConfig](#) (I2S\_Type \*base, [sai\\_fifo\\_t](#) \*config)  
*SAI transmitter fifo configurations.*
- void [SAI\\_RxSetFifoConfig](#) (I2S\_Type \*base, [sai\\_fifo\\_t](#) \*config)  
*SAI receiver fifo configurations.*
- void [SAI\\_TxSetFrameSyncConfig](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave, [sai\\_frame\\_sync\\_t](#) \*config)  
*SAI transmitter Frame sync configurations.*
- void [SAI\\_RxSetFrameSyncConfig](#) (I2S\_Type \*base, [sai\\_master\\_slave\\_t](#) masterSlave, [sai\\_frame\\_sync\\_t](#) \*config)

`sync_t *config)`

*SAI receiver Frame sync configurations.*

- void `SAI_TxSetSerialDataConfig` (I2S\_Type \*base, `sai_serial_data_t` \*config)

*SAI transmitter Serial data configurations.*

- void `SAI_RxSetSerialDataConfig` (I2S\_Type \*base, `sai_serial_data_t` \*config)

*SAI receiver Serial data configurations.*

- void `SAI_TxSetConfig` (I2S\_Type \*base, `sai_transceiver_t` \*config)

*SAI transmitter configurations.*

- void `SAI_RxSetConfig` (I2S\_Type \*base, `sai_transceiver_t` \*config)

*SAI receiver configurations.*

- void `SAI_GetClassicI2SConfig` (`sai_transceiver_t` \*config, `sai_word_width_t` bitWidth, `sai_mono_stereo_t` mode, `uint32_t` saiChannelMask)

*Get classic I2S mode configurations.*

- void `SAI_GetLeftJustifiedConfig` (`sai_transceiver_t` \*config, `sai_word_width_t` bitWidth, `sai_mono_stereo_t` mode, `uint32_t` saiChannelMask)

*Get left justified mode configurations.*

- void `SAI_GetRightJustifiedConfig` (`sai_transceiver_t` \*config, `sai_word_width_t` bitWidth, `sai_mono_stereo_t` mode, `uint32_t` saiChannelMask)

*Get right justified mode configurations.*

- void `SAI_GetTDMConfig` (`sai_transceiver_t` \*config, `sai_frame_sync_len_t` frameSyncWidth, `sai_word_width_t` bitWidth, `uint32_t` dataWordNum, `uint32_t` saiChannelMask)

*Get TDM mode configurations.*

- void `SAI_GetDSPConfig` (`sai_transceiver_t` \*config, `sai_frame_sync_len_t` frameSyncWidth, `sai_word_width_t` bitWidth, `sai_mono_stereo_t` mode, `uint32_t` saiChannelMask)

*Get DSP mode configurations.*

## Status

- static `uint32_t` `SAI_TxGetStatusFlag` (I2S\_Type \*base)

*Gets the SAI Tx status flag state.*

- static void `SAI_TxClearStatusFlags` (I2S\_Type \*base, `uint32_t` mask)

*Clears the SAI Tx status flag state.*

- static `uint32_t` `SAI_RxGetStatusFlag` (I2S\_Type \*base)

*Gets the SAI Rx status flag state.*

- static void `SAI_RxClearStatusFlags` (I2S\_Type \*base, `uint32_t` mask)

*Clears the SAI Rx status flag state.*

- void `SAI_TxSoftwareReset` (I2S\_Type \*base, `sai_reset_type_t` resetType)

*Do software reset or FIFO reset.*

- void `SAI_RxSoftwareReset` (I2S\_Type \*base, `sai_reset_type_t` resetType)

*Do software reset or FIFO reset.*

- void `SAI_TxSetChannelFIFOMask` (I2S\_Type \*base, `uint8_t` mask)

*Set the Tx channel FIFO enable mask.*

- void `SAI_RxSetChannelFIFOMask` (I2S\_Type \*base, `uint8_t` mask)

*Set the Rx channel FIFO enable mask.*

- void `SAI_TxSetDataOrder` (I2S\_Type \*base, `sai_data_order_t` order)

*Set the Tx data order.*

- void `SAI_RxSetDataOrder` (I2S\_Type \*base, `sai_data_order_t` order)

*Set the Rx data order.*

- void `SAI_TxSetBitClockPolarity` (I2S\_Type \*base, `sai_clock_polarity_t` polarity)

- *Set the Tx data order.*  
void [SAI\\_RxSetBitClockPolarity](#) (I2S\_Type \*base, [sai\\_clock\\_polarity\\_t](#) polarity)
- *Set the Rx data order.*  
void [SAI\\_TxSetFrameSyncPolarity](#) (I2S\_Type \*base, [sai\\_clock\\_polarity\\_t](#) polarity)
- *Set the Tx data order.*  
void [SAI\\_RxSetFrameSyncPolarity](#) (I2S\_Type \*base, [sai\\_clock\\_polarity\\_t](#) polarity)
- *Set the Rx data order.*  
void [SAI\\_TxSetFIFOPacking](#) (I2S\_Type \*base, [sai\\_fifo\\_packing\\_t](#) pack)
- *Set Tx FIFO packing feature.*  
void [SAI\\_RxSetFIFOPacking](#) (I2S\_Type \*base, [sai\\_fifo\\_packing\\_t](#) pack)
- *Set Rx FIFO packing feature.*  
static void [SAI\\_TxSetFIFOErrorContinue](#) (I2S\_Type \*base, bool isEnabled)
- *Set Tx FIFO error continue.*  
static void [SAI\\_RxSetFIFOErrorContinue](#) (I2S\_Type \*base, bool isEnabled)
- *Set Rx FIFO error continue.*

## Interrupts

- static void [SAI\\_TxEnableInterrupts](#) (I2S\_Type \*base, uint32\_t mask)  
*Enables the SAI Tx interrupt requests.*
- static void [SAI\\_RxEnableInterrupts](#) (I2S\_Type \*base, uint32\_t mask)  
*Enables the SAI Rx interrupt requests.*
- static void [SAI\\_TxDisableInterrupts](#) (I2S\_Type \*base, uint32\_t mask)  
*Disables the SAI Tx interrupt requests.*
- static void [SAI\\_RxDisableInterrupts](#) (I2S\_Type \*base, uint32\_t mask)  
*Disables the SAI Rx interrupt requests.*

## DMA Control

- static void [SAI\\_TxEnableDMA](#) (I2S\_Type \*base, uint32\_t mask, bool enable)  
*Enables/disables the SAI Tx DMA requests.*
- static void [SAI\\_RxEnableDMA](#) (I2S\_Type \*base, uint32\_t mask, bool enable)  
*Enables/disables the SAI Rx DMA requests.*
- static uintptr\_t [SAI\\_TxGetDataRegisterAddress](#) (I2S\_Type \*base, uint32\_t channel)  
*Gets the SAI Tx data register address.*
- static uintptr\_t [SAI\\_RxGetDataRegisterAddress](#) (I2S\_Type \*base, uint32\_t channel)  
*Gets the SAI Rx data register address.*

## Bus Operations

- void [SAI\\_TxSetFormat](#) (I2S\_Type \*base, [sai\\_transfer\\_format\\_t](#) \*format, uint32\_t mclkSourceClockHz, uint32\_t bclkSourceClockHz)  
*Configures the SAI Tx audio format.*
- void [SAI\\_RxSetFormat](#) (I2S\_Type \*base, [sai\\_transfer\\_format\\_t](#) \*format, uint32\_t mclkSourceClockHz, uint32\_t bclkSourceClockHz)  
*Configures the SAI Rx audio format.*



- void [SAI\\_WriteBlocking](#) (I2S\_Type \*base, uint32\_t channel, uint32\_t bitWidth, uint8\_t \*buffer, uint32\_t size)  
*Sends data using a blocking method.*
- void [SAI\\_WriteMultiChannelBlocking](#) (I2S\_Type \*base, uint32\_t channel, uint32\_t channelMask, uint32\_t bitWidth, uint8\_t \*buffer, uint32\_t size)  
*Sends data to multi channel using a blocking method.*
- static void [SAI\\_WriteData](#) (I2S\_Type \*base, uint32\_t channel, uint32\_t data)  
*Writes data into SAI FIFO.*
- void [SAI\\_ReadBlocking](#) (I2S\_Type \*base, uint32\_t channel, uint32\_t bitWidth, uint8\_t \*buffer, uint32\_t size)  
*Receives data using a blocking method.*
- void [SAI\\_ReadMultiChannelBlocking](#) (I2S\_Type \*base, uint32\_t channel, uint32\_t channelMask, uint32\_t bitWidth, uint8\_t \*buffer, uint32\_t size)  
*Receives multi channel data using a blocking method.*
- static uint32\_t [SAI\\_ReadData](#) (I2S\_Type \*base, uint32\_t channel)  
*Reads data from the SAI FIFO.*

## Transactional

- void [SAI\\_TransferTxCreateHandle](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transfer\_callback\_t callback, void \*userData)  
*Initializes the SAI Tx handle.*
- void [SAI\\_TransferRxCreateHandle](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transfer\_callback\_t callback, void \*userData)  
*Initializes the SAI Rx handle.*
- void [SAI\\_TransferTxSetConfig](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transceiver\_t \*config)  
*SAI transmitter transfer configurations.*
- void [SAI\\_TransferRxSetConfig](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transceiver\_t \*config)  
*SAI receiver transfer configurations.*
- [status\\_t](#) [SAI\\_TransferTxSetFormat](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transfer\_format\_t \*format, uint32\_t mclkSourceClockHz, uint32\_t bclkSourceClockHz)  
*Configures the SAI Tx audio format.*
- [status\\_t](#) [SAI\\_TransferRxSetFormat](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transfer\_format\_t \*format, uint32\_t mclkSourceClockHz, uint32\_t bclkSourceClockHz)  
*Configures the SAI Rx audio format.*
- [status\\_t](#) [SAI\\_TransferSendNonBlocking](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transfer\_t \*xfer)  
*Performs an interrupt non-blocking send transfer on SAI.*
- [status\\_t](#) [SAI\\_TransferReceiveNonBlocking](#) (I2S\_Type \*base, sai\_handle\_t \*handle, sai\_transfer\_t \*xfer)  
*Performs an interrupt non-blocking receive transfer on SAI.*
- [status\\_t](#) [SAI\\_TransferGetSendCount](#) (I2S\_Type \*base, sai\_handle\_t \*handle, size\_t \*count)  
*Gets a set byte count.*
- [status\\_t](#) [SAI\\_TransferGetReceiveCount](#) (I2S\_Type \*base, sai\_handle\_t \*handle, size\_t \*count)  
*Gets a received byte count.*
- void [SAI\\_TransferAbortSend](#) (I2S\_Type \*base, sai\_handle\_t \*handle)  
*Aborts the current send.*
- void [SAI\\_TransferAbortReceive](#) (I2S\_Type \*base, sai\_handle\_t \*handle)



- *Aborts the current IRQ receive.*
- void [SAI\\_TransferTerminateSend](#) (I2S\_Type \*base, sai\_handle\_t \*handle)  
*Terminate all SAI send.*
- void [SAI\\_TransferTerminateReceive](#) (I2S\_Type \*base, sai\_handle\_t \*handle)  
*Terminate all SAI receive.*
- void [SAI\\_TransferTxHandleIRQ](#) (I2S\_Type \*base, sai\_handle\_t \*handle)  
*Tx interrupt handler.*
- void [SAI\\_TransferRxHandleIRQ](#) (I2S\_Type \*base, sai\_handle\_t \*handle)  
*Rx interrupt handler.*

## 17.4.2 Data Structure Documentation

### 17.4.2.1 struct sai\_config\_t

#### Data Fields

- [sai\\_protocol\\_t](#) protocol  
*Audio bus protocol in SAI.*
- [sai\\_sync\\_mode\\_t](#) syncMode  
*SAI sync mode, control Tx/Rx clock sync.*
- [sai\\_bclk\\_source\\_t](#) bclkSource  
*Bit Clock source.*
- [sai\\_master\\_slave\\_t](#) masterSlave  
*Master or slave.*

### 17.4.2.2 struct sai\_transfer\_format\_t

#### Data Fields

- uint32\_t [sampleRate\\_Hz](#)  
*Sample rate of audio data.*
- uint32\_t [bitWidth](#)  
*Data length of audio data, usually 8/16/24/32 bits.*
- [sai\\_mono\\_stereo\\_t](#) stereo  
*Mono or stereo.*
- uint8\_t [watermark](#)  
*Watermark value.*
- uint8\_t [channel](#)  
*Transfer start channel.*
- uint8\_t [channelMask](#)  
*enabled channel mask value, reference `_sai_channel_mask`*
- uint8\_t [endChannel](#)  
*end channel number*
- uint8\_t [channelNums](#)  
*Total enabled channel numbers.*
- [sai\\_protocol\\_t](#) protocol  
*Which audio protocol used.*
- bool [isFrameSyncCompact](#)

*True means Frame sync length is configurable according to bitWidth, false means frame sync length is 64 times of bit clock.*

### Field Documentation

(1) `bool sai_transfer_format_t::isFrameSyncCompact`

#### 17.4.2.3 struct sai\_fifo\_t

### Data Fields

- `bool fifoContinueOnError`  
*fifo continues when error occur*
- `sai_fifo_combine_t fifoCombine`  
*fifo combine mode*
- `sai_fifo_packing_t fifoPacking`  
*fifo packing mode*
- `uint8_t fifoWatermark`  
*fifo watermark*

#### 17.4.2.4 struct sai\_bit\_clock\_t

### Data Fields

- `bool bclkSrcSwap`  
*bit clock source swap*
- `bool bclkInputDelay`  
*bit clock actually used by the transmitter is delayed by the pad output delay, this has effect of decreasing the data input setup time, but increasing the data output valid time .*
- `sai_clock_polarity_t bclkPolarity`  
*bit clock polarity*
- `sai_bclk_source_t bclkSource`  
*bit Clock source*

### Field Documentation

(1) `bool sai_bit_clock_t::bclkInputDelay`

#### 17.4.2.5 struct sai\_frame\_sync\_t

### Data Fields

- `uint8_t frameSyncWidth`  
*frame sync width in number of bit clocks*
- `bool frameSyncEarly`  
*TRUE is frame sync assert one bit before the first bit of frame FALSE is frame sync assert with the first bit of the frame.*
- `bool frameSyncGenerateOnDemand`  
*internal frame sync is generated when FIFO warning flag is clear*
- `sai_clock_polarity_t frameSyncPolarity`

*frame sync polarity*

#### 17.4.2.6 struct sai\_serial\_data\_t

##### Data Fields

- [sai\\_data\\_pin\\_state\\_t dataMode](#)  
*sai data pin state when slots masked or channel disabled*
- [sai\\_data\\_order\\_t dataOrder](#)  
*configure whether the LSB or MSB is transmitted first*
- [uint8\\_t dataWord0Length](#)  
*configure the number of bits in the first word in each frame*
- [uint8\\_t dataWordNLength](#)  
*configure the number of bits in the each word in each frame, except the first word*
- [uint8\\_t dataWordLength](#)  
*used to record the data length for dma transfer*
- [uint8\\_t dataFirstBitShifted](#)  
*Configure the bit index for the first bit transmitted for each word in the frame.*
- [uint8\\_t dataWordNum](#)  
*configure the number of words in each frame*
- [uint32\\_t dataMaskedWord](#)  
*configure whether the transmit word is masked*

#### 17.4.2.7 struct sai\_transceiver\_t

##### Data Fields

- [sai\\_serial\\_data\\_t serialData](#)  
*serial data configurations*
- [sai\\_frame\\_sync\\_t frameSync](#)  
*ws configurations*
- [sai\\_bit\\_clock\\_t bitClock](#)  
*bit clock configurations*
- [sai\\_fifo\\_t fifo](#)  
*fifo configurations*
- [sai\\_master\\_slave\\_t masterSlave](#)  
*transceiver is master or slave*
- [sai\\_sync\\_mode\\_t syncMode](#)  
*transceiver sync mode*
- [uint8\\_t startChannel](#)  
*Transfer start channel.*
- [uint8\\_t channelMask](#)  
*enabled channel mask value, reference `_sai_channel_mask`*
- [uint8\\_t endChannel](#)  
*end channel number*
- [uint8\\_t channelNums](#)  
*Total enabled channel numbers.*

### 17.4.2.8 struct sai\_transfer\_t

#### Data Fields

- uint8\_t \* [data](#)  
*Data start address to transfer.*
- size\_t [dataSize](#)  
*Transfer size.*

#### Field Documentation

(1) uint8\_t\* sai\_transfer\_t::data

(2) size\_t sai\_transfer\_t::dataSize

### 17.4.2.9 struct \_sai\_handle

#### Data Fields

- I2S\_Type \* [base](#)  
*base address*
- uint32\_t [state](#)  
*Transfer status.*
- [sai\\_transfer\\_callback\\_t](#) [callback](#)  
*Callback function called at transfer event.*
- void \* [userData](#)  
*Callback parameter passed to callback function.*
- uint8\_t [bitWidth](#)  
*Bit width for transfer, 8/16/24/32 bits.*
- uint8\_t [channel](#)  
*Transfer start channel.*
- uint8\_t [channelMask](#)  
*enabled channel mask value, refernece \_sai\_channel\_mask*
- uint8\_t [endChannel](#)  
*end channel number*
- uint8\_t [channelNums](#)  
*Total enabled channel numbers.*
- [sai\\_transfer\\_t](#) [saiQueue](#) [[SAI\\_XFER\\_QUEUE\\_SIZE](#)]  
*Transfer queue storing queued transfer.*
- size\_t [transferSize](#) [[SAI\\_XFER\\_QUEUE\\_SIZE](#)]  
*Data bytes need to transfer.*
- volatile uint8\_t [queueUser](#)  
*Index for user to queue transfer.*
- volatile uint8\_t [queueDriver](#)  
*Index for driver to get the transfer data and size.*
- uint8\_t [watermark](#)  
*Watermark value.*

### 17.4.3 Macro Definition Documentation

### 17.4.3.1 #define SAI\_XFER\_QUEUE\_SIZE (4U)

## 17.4.4 Enumeration Type Documentation

### 17.4.4.1 anonymous enum

Enumerator

*kStatus\_SAI\_TxBusy* SAI Tx is busy.  
*kStatus\_SAI\_RxBusy* SAI Rx is busy.  
*kStatus\_SAI\_TxError* SAI Tx FIFO error.  
*kStatus\_SAI\_RxError* SAI Rx FIFO error.  
*kStatus\_SAI\_QueueFull* SAI transfer queue is full.  
*kStatus\_SAI\_TxIdle* SAI Tx is idle.  
*kStatus\_SAI\_RxIdle* SAI Rx is idle.

### 17.4.4.2 anonymous enum

Enumerator

*kSAI\_Channel0Mask* channel 0 mask value  
*kSAI\_Channel1Mask* channel 1 mask value  
*kSAI\_Channel2Mask* channel 2 mask value  
*kSAI\_Channel3Mask* channel 3 mask value  
*kSAI\_Channel4Mask* channel 4 mask value  
*kSAI\_Channel5Mask* channel 5 mask value  
*kSAI\_Channel6Mask* channel 6 mask value  
*kSAI\_Channel7Mask* channel 7 mask value

### 17.4.4.3 enum sai\_protocol\_t

Enumerator

*kSAI\_BusLeftJustified* Uses left justified format.  
*kSAI\_BusRightJustified* Uses right justified format.  
*kSAI\_BusI2S* Uses I2S format.  
*kSAI\_BusPCMA* Uses I2S PCM A format.  
*kSAI\_BusPCMB* Uses I2S PCM B format.

### 17.4.4.4 enum sai\_master\_slave\_t

Enumerator

*kSAI\_Master* Master mode include bclk and frame sync.

*kSAI\_Slave* Slave mode include bclk and frame sync.

*kSAI\_Bclk\_Master\_FrameSync\_Slave* bclk in master mode, frame sync in slave mode

*kSAI\_Bclk\_Slave\_FrameSync\_Master* bclk in slave mode, frame sync in master mode

#### 17.4.4.5 enum sai\_mono\_stereo\_t

Enumerator

*kSAI\_Stereo* Stereo sound.

*kSAI\_MonoRight* Only Right channel have sound.

*kSAI\_MonoLeft* Only left channel have sound.

#### 17.4.4.6 enum sai\_data\_order\_t

Enumerator

*kSAI\_DataLSB* LSB bit transferred first.

*kSAI\_DataMSB* MSB bit transferred first.

#### 17.4.4.7 enum sai\_clock\_polarity\_t

Enumerator

*kSAI\_PolarityActiveHigh* Drive outputs on rising edge.

*kSAI\_PolarityActiveLow* Drive outputs on falling edge.

*kSAI\_SampleOnFallingEdge* Sample inputs on falling edge.

*kSAI\_SampleOnRisingEdge* Sample inputs on rising edge.

#### 17.4.4.8 enum sai\_sync\_mode\_t

Enumerator

*kSAI\_ModeAsync* Asynchronous mode.

*kSAI\_ModeSync* Synchronous mode (with receiver or transmit)

#### 17.4.4.9 enum sai\_bclk\_source\_t

Enumerator

*kSAI\_BclkSourceBusclk* Bit clock using bus clock.

*kSAI\_BclkSourceMclkOption1* Bit clock MCLK option 1.

***kSAI\_BclkSourceMclkOption2*** Bit clock MCLK option2.  
***kSAI\_BclkSourceMclkOption3*** Bit clock MCLK option3.  
***kSAI\_BclkSourceMclkDiv*** Bit clock using master clock divider.  
***kSAI\_BclkSourceOtherSai0*** Bit clock from other SAI device.  
***kSAI\_BclkSourceOtherSai1*** Bit clock from other SAI device.

#### 17.4.4.10 anonymous enum

Enumerator

***kSAI\_WordStartInterruptEnable*** Word start flag, means the first word in a frame detected.  
***kSAI\_SyncErrorInterruptEnable*** Sync error flag, means the sync error is detected.  
***kSAI\_FIFOWarningInterruptEnable*** FIFO warning flag, means the FIFO is empty.  
***kSAI\_FIFOErrorInterruptEnable*** FIFO error flag.  
***kSAI\_FIFORequestInterruptEnable*** FIFO request, means reached watermark.

#### 17.4.4.11 anonymous enum

Enumerator

***kSAI\_FIFOWarningDMAEnable*** FIFO warning caused by the DMA request.  
***kSAI\_FIFORequestDMAEnable*** FIFO request caused by the DMA request.

#### 17.4.4.12 anonymous enum

Enumerator

***kSAI\_WordStartFlag*** Word start flag, means the first word in a frame detected.  
***kSAI\_SyncErrorFlag*** Sync error flag, means the sync error is detected.  
***kSAI\_FIFOErrorFlag*** FIFO error flag.  
***kSAI\_FIFORequestFlag*** FIFO request flag.  
***kSAI\_FIFOWarningFlag*** FIFO warning flag.

#### 17.4.4.13 enum sai\_reset\_type\_t

Enumerator

***kSAI\_ResetTypeSoftware*** Software reset, reset the logic state.  
***kSAI\_ResetTypeFIFO*** FIFO reset, reset the FIFO read and write pointer.  
***kSAI\_ResetAll*** All reset.

**17.4.4.14 enum sai\_fifo\_packing\_t**

Enumerator

***kSAI\_FifoPackingDisabled*** Packing disabled.  
***kSAI\_FifoPacking8bit*** 8 bit packing enabled  
***kSAI\_FifoPacking16bit*** 16bit packing enabled

**17.4.4.15 enum sai\_sample\_rate\_t**

Enumerator

***kSAI\_SampleRate8KHz*** Sample rate 8000 Hz.  
***kSAI\_SampleRate11025Hz*** Sample rate 11025 Hz.  
***kSAI\_SampleRate12KHz*** Sample rate 12000 Hz.  
***kSAI\_SampleRate16KHz*** Sample rate 16000 Hz.  
***kSAI\_SampleRate22050Hz*** Sample rate 22050 Hz.  
***kSAI\_SampleRate24KHz*** Sample rate 24000 Hz.  
***kSAI\_SampleRate32KHz*** Sample rate 32000 Hz.  
***kSAI\_SampleRate44100Hz*** Sample rate 44100 Hz.  
***kSAI\_SampleRate48KHz*** Sample rate 48000 Hz.  
***kSAI\_SampleRate96KHz*** Sample rate 96000 Hz.  
***kSAI\_SampleRate192KHz*** Sample rate 192000 Hz.  
***kSAI\_SampleRate384KHz*** Sample rate 384000 Hz.

**17.4.4.16 enum sai\_word\_width\_t**

Enumerator

***kSAI\_WordWidth8bits*** Audio data width 8 bits.  
***kSAI\_WordWidth16bits*** Audio data width 16 bits.  
***kSAI\_WordWidth24bits*** Audio data width 24 bits.  
***kSAI\_WordWidth32bits*** Audio data width 32 bits.

**17.4.4.17 enum sai\_data\_pin\_state\_t**

Enumerator

***kSAI\_DataPinStateTriState*** transmit data pins are tri-stated when slots are masked or channels are disabled  
***kSAI\_DataPinStateOutputZero*** transmit data pins are never tri-stated and will output zero when slots are masked or channel disabled



**17.4.4.18 enum sai\_fifo\_combine\_t**

Enumerator

*kSAI\_FifoCombineDisabled* sai fifo combine mode disabled  
*kSAI\_FifoCombineModeEnabledOnRead* sai fifo combine mode enabled on FIFO reads  
*kSAI\_FifoCombineModeEnabledOnWrite* sai fifo combine mode enabled on FIFO write  
*kSAI\_FifoCombineModeEnabledOnReadWrite* sai fifo combined mode enabled on FIFO read/writes

**17.4.4.19 enum sai\_transceiver\_type\_t**

Enumerator

*kSAI\_Transmitter* sai transmitter  
*kSAI\_Receiver* sai receiver

**17.4.4.20 enum sai\_frame\_sync\_len\_t**

Enumerator

*kSAI\_FrameSyncLenOneBitClk* 1 bit clock frame sync len for DSP mode  
*kSAI\_FrameSyncLenPerWordWidth* Frame sync length decided by word width.

**17.4.5 Function Documentation****17.4.5.1 void SAI\_TxInit ( I2S\_Type \* *base*, const sai\_config\_t \* *config* )**

**Deprecated** Do not use this function. It has been superseded by [SAI\\_Init](#)

Un-gates the SAI clock, resets the module, and configures SAI Tx with a configuration structure. The configuration structure can be custom filled or set with default values by [SAI\\_TxGetDefaultConfig\(\)](#).

Note

This API should be called at the beginning of the application to use the SAI driver. Otherwise, accessing the SAIM module can cause a hard fault because the clock is not enabled.

## Parameters

<i>base</i>	SAI base pointer
<i>config</i>	SAI configuration structure.

#### 17.4.5.2 void SAI\_RxInit ( I2S\_Type \* *base*, const sai\_config\_t \* *config* )

**Deprecated** Do not use this function. It has been superseded by [SAI\\_Init](#)

Ungates the SAI clock, resets the module, and configures the SAI Rx with a configuration structure. The configuration structure can be custom filled or set with default values by [SAI\\_RxGetDefaultConfig\(\)](#).

## Note

This API should be called at the beginning of the application to use the SAI driver. Otherwise, accessing the SAI module can cause a hard fault because the clock is not enabled.

## Parameters

<i>base</i>	SAI base pointer
<i>config</i>	SAI configuration structure.

#### 17.4.5.3 void SAI\_TxGetDefaultConfig ( sai\_config\_t \* *config* )

**Deprecated** Do not use this function. It has been superseded by [SAI\\_GetClassicI2SConfig](#), [SAI\\_GetLeftJustifiedConfig](#), [SAI\\_GetRightJustifiedConfig](#), [SAI\\_GetDSPConfig](#), [SAI\\_GetTDMConfig](#)

This API initializes the configuration structure for use in [SAI\\_TxConfig\(\)](#). The initialized structure can remain unchanged in [SAI\\_TxConfig\(\)](#), or it can be modified before calling [SAI\\_TxConfig\(\)](#). This is an example.

```
sai_config_t config;
SAI_TxGetDefaultConfig(&config);
```

## Parameters

<i>config</i>	pointer to master configuration structure
---------------	---

#### 17.4.5.4 void SAI\_RxGetDefaultConfig ( sai\_config\_t \* *config* )

**Deprecated** Do not use this function. It has been superseded by [SAI\\_GetClassicI2SConfig](#), [SAI\\_GetLeftJustifiedConfig](#) , [SAI\\_GetRightJustifiedConfig](#), [SAI\\_GetDSPConfig](#), [SAI\\_GetTDMConfig](#)

This API initializes the configuration structure for use in SAI\_RxConfig(). The initialized structure can remain unchanged in SAI\_RxConfig() or it can be modified before calling SAI\_RxConfig(). This is an example.

```
sai_config_t config;
SAI_RxGetDefaultConfig(&config);
```

Parameters

<i>config</i>	pointer to master configuration structure
---------------	---

#### 17.4.5.5 void SAI\_Init ( I2S\_Type \* *base* )

This API gates the SAI clock. The SAI module can't operate unless SAI\_Init is called to enable the clock.

Parameters

<i>base</i>	SAI base pointer.
-------------	-------------------

#### 17.4.5.6 void SAI\_Deinit ( I2S\_Type \* *base* )

This API gates the SAI clock. The SAI module can't operate unless SAI\_TxInit or SAI\_RxInit is called to enable the clock.

Parameters

<i>base</i>	SAI base pointer.
-------------	-------------------

#### 17.4.5.7 void SAI\_TxReset ( I2S\_Type \* *base* )

This function enables the software reset and FIFO reset of SAI Tx. After reset, clear the reset bit.

Parameters

<i>base</i>	SAI base pointer
-------------	------------------

#### 17.4.5.8 void SAI\_RxReset ( I2S\_Type \* *base* )

This function enables the software reset and FIFO reset of SAI Rx. After reset, clear the reset bit.

Parameters

<i>base</i>	SAI base pointer
-------------	------------------

#### 17.4.5.9 void SAI\_TxEnable ( I2S\_Type \* *base*, bool *enable* )

Parameters

<i>base</i>	SAI base pointer.
<i>enable</i>	True means enable SAI Tx, false means disable.

#### 17.4.5.10 void SAI\_RxEnable ( I2S\_Type \* *base*, bool *enable* )

Parameters

<i>base</i>	SAI base pointer.
<i>enable</i>	True means enable SAI Rx, false means disable.

#### 17.4.5.11 static void SAI\_TxSetBitClockDirection ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave* ) [inline], [static]

Select bit clock direction, master or slave.

Parameters

<i>base</i>	SAI base pointer.
-------------	-------------------

<i>masterSlave</i>	reference sai_master_slave_t.
--------------------	-------------------------------

**17.4.5.12 static void SAI\_RxSetBitClockDirection ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave* ) [inline], [static]**

Select bit clock direction, master or slave.

Parameters

<i>base</i>	SAI base pointer.
<i>masterSlave</i>	reference sai_master_slave_t.

**17.4.5.13 static void SAI\_RxSetFrameSyncDirection ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave* ) [inline], [static]**

Select frame sync direction, master or slave.

Parameters

<i>base</i>	SAI base pointer.
<i>masterSlave</i>	reference sai_master_slave_t.

**17.4.5.14 static void SAI\_TxSetFrameSyncDirection ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave* ) [inline], [static]**

Select frame sync direction, master or slave.

Parameters

<i>base</i>	SAI base pointer.
<i>masterSlave</i>	reference sai_master_slave_t.

**17.4.5.15 void SAI\_TxSetBitClockRate ( I2S\_Type \* *base*, uint32\_t *sourceClockHz*, uint32\_t *sampleRate*, uint32\_t *bitWidth*, uint32\_t *channelNumbers* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>sourceClockHz</i>	Bit clock source frequency.
<i>sampleRate</i>	Audio data sample rate.
<i>bitWidth</i>	Audio data bitWidth.
<i>channel-Numbers</i>	Audio channel numbers.

**17.4.5.16 void SAI\_RxSetBitClockRate ( I2S\_Type \* *base*, uint32\_t *sourceClockHz*, uint32\_t *sampleRate*, uint32\_t *bitWidth*, uint32\_t *channelNumbers* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>sourceClockHz</i>	Bit clock source frequency.
<i>sampleRate</i>	Audio data sample rate.
<i>bitWidth</i>	Audio data bitWidth.
<i>channel-Numbers</i>	Audio channel numbers.

**17.4.5.17 void SAI\_TxSetBitclockConfig ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave*, sai\_bit\_clock\_t \* *config* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>masterSlave</i>	master or slave.
<i>config</i>	bit clock other configurations, can be NULL in slave mode.

**17.4.5.18 void SAI\_RxSetBitclockConfig ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave*, sai\_bit\_clock\_t \* *config* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>masterSlave</i>	master or slave.
<i>config</i>	bit clock other configurations, can be NULL in slave mode.

**17.4.5.19 void SAI\_TxSetFifoConfig ( I2S\_Type \* *base*, sai\_fifo\_t \* *config* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>config</i>	fifo configurations.

**17.4.5.20 void SAI\_RxSetFifoConfig ( I2S\_Type \* *base*, sai\_fifo\_t \* *config* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>config</i>	fifo configurations.

**17.4.5.21 void SAI\_TxSetFrameSyncConfig ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave*, sai\_frame\_sync\_t \* *config* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>masterSlave</i>	master or slave.
<i>config</i>	frame sync configurations, can be NULL in slave mode.

**17.4.5.22 void SAI\_RxSetFrameSyncConfig ( I2S\_Type \* *base*, sai\_master\_slave\_t *masterSlave*, sai\_frame\_sync\_t \* *config* )**

Parameters

<i>base</i>	SAI base pointer.
<i>masterSlave</i>	master or slave.
<i>config</i>	frame sync configurations, can be NULL in slave mode.

#### 17.4.5.23 void SAI\_TxSetSerialDataConfig ( I2S\_Type \* *base*, sai\_serial\_data\_t \* *config* )

Parameters

<i>base</i>	SAI base pointer.
<i>config</i>	serial data configurations.

#### 17.4.5.24 void SAI\_RxSetSerialDataConfig ( I2S\_Type \* *base*, sai\_serial\_data\_t \* *config* )

Parameters

<i>base</i>	SAI base pointer.
<i>config</i>	serial data configurations.

#### 17.4.5.25 void SAI\_TxSetConfig ( I2S\_Type \* *base*, sai\_transceiver\_t \* *config* )

Parameters

<i>base</i>	SAI base pointer.
<i>config</i>	transmitter configurations.

#### 17.4.5.26 void SAI\_RxSetConfig ( I2S\_Type \* *base*, sai\_transceiver\_t \* *config* )

Parameters

<i>base</i>	SAI base pointer.
-------------	-------------------



<i>config</i>	receiver configurations.
---------------	--------------------------

**17.4.5.27 void SAI\_GetClassicI2SConfig ( sai\_transceiver\_t \* *config*, sai\_word\_width\_t *bitWidth*, sai\_mono\_stereo\_t *mode*, uint32\_t *saiChannelMask* )**

Parameters

<i>config</i>	transceiver configurations.
<i>bitWidth</i>	audio data bitWidth.
<i>mode</i>	audio data channel.
<i>saiChannel-Mask</i>	mask value of the channel to be enable.

**17.4.5.28 void SAI\_GetLeftJustifiedConfig ( sai\_transceiver\_t \* *config*, sai\_word\_width\_t *bitWidth*, sai\_mono\_stereo\_t *mode*, uint32\_t *saiChannelMask* )**

Parameters

<i>config</i>	transceiver configurations.
<i>bitWidth</i>	audio data bitWidth.
<i>mode</i>	audio data channel.
<i>saiChannel-Mask</i>	mask value of the channel to be enable.

**17.4.5.29 void SAI\_GetRightJustifiedConfig ( sai\_transceiver\_t \* *config*, sai\_word\_width\_t *bitWidth*, sai\_mono\_stereo\_t *mode*, uint32\_t *saiChannelMask* )**

Parameters

<i>config</i>	transceiver configurations.
<i>bitWidth</i>	audio data bitWidth.

<i>mode</i>	audio data channel.
<i>saiChannel-Mask</i>	mask value of the channel to be enable.

**17.4.5.30 void SAI\_GetTDMConfig ( sai\_transceiver\_t \* *config*, sai\_frame\_sync\_len\_t *frameSyncWidth*, sai\_word\_width\_t *bitWidth*, uint32\_t *dataWordNum*, uint32\_t *saiChannelMask* )**

Parameters

<i>config</i>	transceiver configurations.
<i>frameSync-Width</i>	length of frame sync.
<i>bitWidth</i>	audio data word width.
<i>dataWordNum</i>	word number in one frame.
<i>saiChannel-Mask</i>	mask value of the channel to be enable.

**17.4.5.31 void SAI\_GetDSPConfig ( sai\_transceiver\_t \* *config*, sai\_frame\_sync\_len\_t *frameSyncWidth*, sai\_word\_width\_t *bitWidth*, sai\_mono\_stereo\_t *mode*, uint32\_t *saiChannelMask* )**

Note

DSP mode is also called PCM mode which support MODE A and MODE B, DSP/PCM MODE A configuration flow. RX is similiar but uses SAI\_RxSetConfig instead of SAI\_TxSetConfig:

```
* SAI_GetDSPConfig(config, kSAI_FrameSyncLenOneBitClk, bitWidth,
    kSAI_Stereo, channelMask)
* config->frameSync.frameSyncEarly = true;
* SAI_TxSetConfig(base, config)
*
```

DSP/PCM MODE B configuration flow for TX. RX is similiar but uses SAI\_RxSetConfig instead of SAI\_TxSetConfig:

```
* SAI_GetDSPConfig(config, kSAI_FrameSyncLenOneBitClk, bitWidth,
    kSAI_Stereo, channelMask)
* SAI_TxSetConfig(base, config)
*
```

## Parameters

<i>config</i>	transceiver configurations.
<i>frameSync-Width</i>	length of frame sync.
<i>bitWidth</i>	audio data bitWidth.
<i>mode</i>	audio data channel.
<i>saiChannel-Mask</i>	mask value of the channel to enable.

#### 17.4.5.32 static uint32\_t SAI\_TxGetStatusFlag ( I2S\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	SAI base pointer
-------------	------------------

## Returns

SAI Tx status flag value. Use the Status Mask to get the status value needed.

#### 17.4.5.33 static void SAI\_TxClearStatusFlags ( I2S\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	State mask. It can be a combination of the following source if defined: <ul style="list-style-type: none"> <li>• kSAI_WordStartFlag</li> <li>• kSAI_SyncErrorFlag</li> <li>• kSAI_FIFOErrorFlag</li> </ul>

#### 17.4.5.34 static uint32\_t SAI\_RxGetStatusFlag ( I2S\_Type \* *base* ) [inline], [static]

## Parameters

<i>base</i>	SAI base pointer
-------------	------------------

## Returns

SAI Rx status flag value. Use the Status Mask to get the status value needed.

#### 17.4.5.35 static void SAI\_RxClearStatusFlags ( I2S\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	State mask. It can be a combination of the following sources if defined. <ul style="list-style-type: none"> <li>• kSAI_WordStartFlag</li> <li>• kSAI_SyncErrorFlag</li> <li>• kSAI_FIFOErrorFlag</li> </ul>

#### 17.4.5.36 void SAI\_TxSoftwareReset ( I2S\_Type \* *base*, sai\_reset\_type\_t *resetType* )

FIFO reset means clear all the data in the FIFO, and make the FIFO pointer both to 0. Software reset means clear the Tx internal logic, including the bit clock, frame count etc. But software reset will not clear any configuration registers like TCR1~TCR5. This function will also clear all the error flags such as FIFO error, sync error etc.

## Parameters

<i>base</i>	SAI base pointer
<i>resetType</i>	Reset type, FIFO reset or software reset

#### 17.4.5.37 void SAI\_RxSoftwareReset ( I2S\_Type \* *base*, sai\_reset\_type\_t *resetType* )

FIFO reset means clear all the data in the FIFO, and make the FIFO pointer both to 0. Software reset means clear the Rx internal logic, including the bit clock, frame count etc. But software reset will not clear any configuration registers like RCR1~RCR5. This function will also clear all the error flags such as FIFO error, sync error etc.

Parameters

<i>base</i>	SAI base pointer
<i>resetType</i>	Reset type, FIFO reset or software reset

#### 17.4.5.38 void SAI\_TxSetChannelFIFOMask ( I2S\_Type \* *base*, uint8\_t *mask* )

Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	Channel enable mask, 0 means all channel FIFO disabled, 1 means channel 0 enabled, 3 means both channel 0 and channel 1 enabled.

#### 17.4.5.39 void SAI\_RxSetChannelFIFOMask ( I2S\_Type \* *base*, uint8\_t *mask* )

Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	Channel enable mask, 0 means all channel FIFO disabled, 1 means channel 0 enabled, 3 means both channel 0 and channel 1 enabled.

#### 17.4.5.40 void SAI\_TxSetDataOrder ( I2S\_Type \* *base*, sai\_data\_order\_t *order* )

Parameters

<i>base</i>	SAI base pointer
<i>order</i>	Data order MSB or LSB

#### 17.4.5.41 void SAI\_RxSetDataOrder ( I2S\_Type \* *base*, sai\_data\_order\_t *order* )

Parameters

<i>base</i>	SAI base pointer
-------------	------------------

<i>order</i>	Data order MSB or LSB
--------------	-----------------------

**17.4.5.42 void SAI\_TxSetBitClockPolarity ( I2S\_Type \* *base*, sai\_clock\_polarity\_t *polarity* )**

Parameters

<i>base</i>	SAI base pointer
<i>polarity</i>	

**17.4.5.43 void SAI\_RxSetBitClockPolarity ( I2S\_Type \* *base*, sai\_clock\_polarity\_t *polarity* )**

Parameters

<i>base</i>	SAI base pointer
<i>polarity</i>	

**17.4.5.44 void SAI\_TxSetFrameSyncPolarity ( I2S\_Type \* *base*, sai\_clock\_polarity\_t *polarity* )**

Parameters

<i>base</i>	SAI base pointer
<i>polarity</i>	

**17.4.5.45 void SAI\_RxSetFrameSyncPolarity ( I2S\_Type \* *base*, sai\_clock\_polarity\_t *polarity* )**

Parameters

<i>base</i>	SAI base pointer
<i>polarity</i>	

**17.4.5.46 void SAI\_TxSetFIFOPacking ( I2S\_Type \* *base*, sai\_fifo\_packing\_t *pack* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>pack</i>	FIFO pack type. It is element of sai_fifo_packing_t.

**17.4.5.47 void SAI\_RxSetFIFOPacking ( I2S\_Type \* *base*, sai\_fifo\_packing\_t *pack* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>pack</i>	FIFO pack type. It is element of sai_fifo_packing_t.

**17.4.5.48 static void SAI\_TxSetFIFOErrorContinue ( I2S\_Type \* *base*, bool *isEnabled* )  
[inline], [static]**

FIFO error continue mode means SAI will keep running while FIFO error occurred. If this feature not enabled, SAI will hang and users need to clear FEF flag in TCSR register.

## Parameters

<i>base</i>	SAI base pointer.
<i>isEnabled</i>	Is FIFO error continue enabled, true means enable, false means disable.

**17.4.5.49 static void SAI\_RxSetFIFOErrorContinue ( I2S\_Type \* *base*, bool *isEnabled* )  
[inline], [static]**

FIFO error continue mode means SAI will keep running while FIFO error occurred. If this feature not enabled, SAI will hang and users need to clear FEF flag in RCSR register.

## Parameters

<i>base</i>	SAI base pointer.
<i>isEnabled</i>	Is FIFO error continue enabled, true means enable, false means disable.

**17.4.5.50 static void SAI\_TxEnableInterrupts ( I2S\_Type \* *base*, uint32\_t *mask* )  
[inline], [static]**

## Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	interrupt source The parameter can be a combination of the following sources if defined. <ul style="list-style-type: none"> <li>• kSAI_WordStartInterruptEnable</li> <li>• kSAI_SyncErrorInterruptEnable</li> <li>• kSAI_FIFOWarningInterruptEnable</li> <li>• kSAI_FIFOResultInterruptEnable</li> <li>• kSAI_FIFOErrorInterruptEnable</li> </ul>

#### 17.4.5.51 static void SAI\_RxEnableInterrupts ( I2S\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	interrupt source The parameter can be a combination of the following sources if defined. <ul style="list-style-type: none"> <li>• kSAI_WordStartInterruptEnable</li> <li>• kSAI_SyncErrorInterruptEnable</li> <li>• kSAI_FIFOWarningInterruptEnable</li> <li>• kSAI_FIFOResultInterruptEnable</li> <li>• kSAI_FIFOErrorInterruptEnable</li> </ul>

#### 17.4.5.52 static void SAI\_TxDisableInterrupts ( I2S\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

## Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	interrupt source The parameter can be a combination of the following sources if defined. <ul style="list-style-type: none"> <li>• kSAI_WordStartInterruptEnable</li> <li>• kSAI_SyncErrorInterruptEnable</li> <li>• kSAI_FIFOWarningInterruptEnable</li> <li>• kSAI_FIFOResultInterruptEnable</li> <li>• kSAI_FIFOErrorInterruptEnable</li> </ul>



#### 17.4.5.53 static void SAI\_RxDisableInterrupts ( I2S\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	interrupt source The parameter can be a combination of the following sources if defined. <ul style="list-style-type: none"> <li>• kSAI_WordStartInterruptEnable</li> <li>• kSAI_SyncErrorInterruptEnable</li> <li>• kSAI_FIFOWarningInterruptEnable</li> <li>• kSAI_FIFOResultInterruptEnable</li> <li>• kSAI_FIFOErrorInterruptEnable</li> </ul>

#### 17.4.5.54 static void SAI\_TxEnableDMA ( I2S\_Type \* *base*, uint32\_t *mask*, bool *enable* ) [inline], [static]

Parameters

<i>base</i>	SAI base pointer
<i>mask</i>	DMA source The parameter can be combination of the following sources if defined. <ul style="list-style-type: none"> <li>• kSAI_FIFOWarningDMAEnable</li> <li>• kSAI_FIFOResultDMAEnable</li> </ul>
<i>enable</i>	True means enable DMA, false means disable DMA.

#### 17.4.5.55 static void SAI\_RxEnableDMA ( I2S\_Type \* *base*, uint32\_t *mask*, bool *enable* ) [inline], [static]

Parameters

<i>base</i>	SAI base pointer
-------------	------------------

<i>mask</i>	DMA source The parameter can be a combination of the following sources if defined. <ul style="list-style-type: none"> <li>• kSAI_FIFOWarningDMAEnable</li> <li>• kSAI_FIFOREquestDMAEnable</li> </ul>
<i>enable</i>	True means enable DMA, false means disable DMA.

#### 17.4.5.56 static uintptr\_t SAI\_TxGetDataRegisterAddress ( I2S\_Type \* *base*, uint32\_t *channel* ) [inline], [static]

This API is used to provide a transfer address for the SAI DMA transfer configuration.

Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Which data channel used.

Returns

data register address.

#### 17.4.5.57 static uintptr\_t SAI\_RxGetDataRegisterAddress ( I2S\_Type \* *base*, uint32\_t *channel* ) [inline], [static]

This API is used to provide a transfer address for the SAI DMA transfer configuration.

Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Which data channel used.

Returns

data register address.

#### 17.4.5.58 void SAI\_TxSetFormat ( I2S\_Type \* *base*, sai\_transfer\_format\_t \* *format*, uint32\_t *mclkSourceClockHz*, uint32\_t *bclkSourceClockHz* )

**Deprecated** Do not use this function. It has been superseded by [SAI\\_TxSetConfig](#)

The audio format can be changed at run-time. This function configures the sample rate and audio data format to be transferred.

## Parameters

<i>base</i>	SAI base pointer.
<i>format</i>	Pointer to the SAI audio data format structure.
<i>mclkSource-ClockHz</i>	SAI master clock source frequency in Hz.
<i>bclkSource-ClockHz</i>	SAI bit clock source frequency in Hz. If the bit clock source is a master clock, this value should equal the masterClockHz.

**17.4.5.59 void SAI\_RxSetFormat ( I2S\_Type \* *base*, sai\_transfer\_format\_t \* *format*, uint32\_t *mclkSourceClockHz*, uint32\_t *bclkSourceClockHz* )**

**Deprecated** Do not use this function. It has been superseded by [SAI\\_RxSetConfig](#)

The audio format can be changed at run-time. This function configures the sample rate and audio data format to be transferred.

## Parameters

<i>base</i>	SAI base pointer.
<i>format</i>	Pointer to the SAI audio data format structure.
<i>mclkSource-ClockHz</i>	SAI master clock source frequency in Hz.
<i>bclkSource-ClockHz</i>	SAI bit clock source frequency in Hz. If the bit clock source is a master clock, this value should equal the masterClockHz.

**17.4.5.60 void SAI\_WriteBlocking ( I2S\_Type \* *base*, uint32\_t *channel*, uint32\_t *bitWidth*, uint8\_t \* *buffer*, uint32\_t *size* )**

## Note

This function blocks by polling until data is ready to be sent.

## Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Data channel used.
<i>bitWidth</i>	How many bits in an audio word; usually 8/16/24/32 bits.
<i>buffer</i>	Pointer to the data to be written.
<i>size</i>	Bytes to be written.

**17.4.5.61 void SAI\_WriteMultiChannelBlocking ( I2S\_Type \* *base*, uint32\_t *channel*, uint32\_t *channelMask*, uint32\_t *bitWidth*, uint8\_t \* *buffer*, uint32\_t *size* )**

Note

This function blocks by polling until data is ready to be sent.

Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Data channel used.
<i>channelMask</i>	channel mask.
<i>bitWidth</i>	How many bits in an audio word; usually 8/16/24/32 bits.
<i>buffer</i>	Pointer to the data to be written.
<i>size</i>	Bytes to be written.

**17.4.5.62 static void SAI\_WriteData ( I2S\_Type \* *base*, uint32\_t *channel*, uint32\_t *data* )  
[inline], [static]**

Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Data channel used.
<i>data</i>	Data needs to be written.

**17.4.5.63 void SAI\_ReadBlocking ( I2S\_Type \* *base*, uint32\_t *channel*, uint32\_t *bitWidth*, uint8\_t \* *buffer*, uint32\_t *size* )**

Note

This function blocks by polling until data is ready to be sent.

## Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Data channel used.
<i>bitWidth</i>	How many bits in an audio word; usually 8/16/24/32 bits.
<i>buffer</i>	Pointer to the data to be read.
<i>size</i>	Bytes to be read.

**17.4.5.64 void SAI\_ReadMultiChannelBlocking ( I2S\_Type \* *base*, uint32\_t *channel*, uint32\_t *channelMask*, uint32\_t *bitWidth*, uint8\_t \* *buffer*, uint32\_t *size* )**

## Note

This function blocks by polling until data is ready to be sent.

## Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Data channel used.
<i>channelMask</i>	channel mask.
<i>bitWidth</i>	How many bits in an audio word; usually 8/16/24/32 bits.
<i>buffer</i>	Pointer to the data to be read.
<i>size</i>	Bytes to be read.

**17.4.5.65 static uint32\_t SAI\_ReadData ( I2S\_Type \* *base*, uint32\_t *channel* )  
[inline], [static]**

## Parameters

<i>base</i>	SAI base pointer.
<i>channel</i>	Data channel used.

## Returns

Data in SAI FIFO.

**17.4.5.66 void SAI\_TransferTxCreateHandle ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*,  
sai\_transfer\_callback\_t *callback*, void \* *userData* )**

This function initializes the Tx handle for the SAI Tx transactional APIs. Call this function once to get the handle initialized.

## Parameters

<i>base</i>	SAI base pointer
<i>handle</i>	SAI handle pointer.
<i>callback</i>	Pointer to the user callback function.
<i>userData</i>	User parameter passed to the callback function

**17.4.5.67 void SAI\_TransferRxCreateHandle ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*, sai\_transfer\_callback\_t *callback*, void \* *userData* )**

This function initializes the Rx handle for the SAI Rx transactional APIs. Call this function once to get the handle initialized.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	SAI handle pointer.
<i>callback</i>	Pointer to the user callback function.
<i>userData</i>	User parameter passed to the callback function.

**17.4.5.68 void SAI\_TransferTxSetConfig ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*, sai\_transceiver\_t \* *config* )**

This function initializes the Tx, include bit clock, frame sync, master clock, serial data and fifo configurations.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	SAI handle pointer.
<i>config</i>	transmitter configurations.

**17.4.5.69 void SAI\_TransferRxSetConfig ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*, sai\_transceiver\_t \* *config* )**

This function initializes the Rx, include bit clock, frame sync, master clock, serial data and fifo configurations.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	SAI handle pointer.
<i>config</i>	receiver configurations.

**17.4.5.70** `status_t SAI_TransferTxSetFormat ( I2S_Type * base, sai_handle_t * handle, sai_transfer_format_t * format, uint32_t mclkSourceClockHz, uint32_t bclkSourceClockHz )`

**Deprecated** Do not use this function. It has been superceded by [SAI\\_TransferTxSetConfig](#)

The audio format can be changed at run-time. This function configures the sample rate and audio data format to be transferred.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	SAI handle pointer.
<i>format</i>	Pointer to the SAI audio data format structure.
<i>mclkSource-ClockHz</i>	SAI master clock source frequency in Hz.
<i>bclkSource-ClockHz</i>	SAI bit clock source frequency in Hz. If a bit clock source is a master clock, this value should equal the masterClockHz in format.

## Returns

Status of this function. Return value is the status\_t.

**17.4.5.71** `status_t SAI_TransferRxSetFormat ( I2S_Type * base, sai_handle_t * handle, sai_transfer_format_t * format, uint32_t mclkSourceClockHz, uint32_t bclkSourceClockHz )`

**Deprecated** Do not use this function. It has been superceded by [SAI\\_TransferRxSetConfig](#)

The audio format can be changed at run-time. This function configures the sample rate and audio data format to be transferred.



## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	SAI handle pointer.
<i>format</i>	Pointer to the SAI audio data format structure.
<i>mclkSource-ClockHz</i>	SAI master clock source frequency in Hz.
<i>bclkSource-ClockHz</i>	SAI bit clock source frequency in Hz. If a bit clock source is a master clock, this value should equal the masterClockHz in format.

## Returns

Status of this function. Return value is one of status\_t.

#### 17.4.5.72 status\_t SAI\_TransferSendNonBlocking ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*, sai\_transfer\_t \* *xfer* )

## Note

This API returns immediately after the transfer initiates. Call the SAI\_TxGetTransferStatusIRQ to poll the transfer status and check whether the transfer is finished. If the return status is not kStatus\_SAI\_Busy, the transfer is finished.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	Pointer to the sai_handle_t structure which stores the transfer state.
<i>xfer</i>	Pointer to the <a href="#">sai_transfer_t</a> structure.

## Return values

<i>kStatus_Success</i>	Successfully started the data receive.
<i>kStatus_SAI_TxBusy</i>	Previous receive still not finished.
<i>kStatus_InvalidArgument</i>	The input parameter is invalid.

#### 17.4.5.73 status\_t SAI\_TransferReceiveNonBlocking ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*, sai\_transfer\_t \* *xfer* )

## Note

This API returns immediately after the transfer initiates. Call the SAI\_RxGetTransferStatusIRQ to poll the transfer status and check whether the transfer is finished. If the return status is not kStatus\_SAI\_Busy, the transfer is finished.

## Parameters

<i>base</i>	SAI base pointer
<i>handle</i>	Pointer to the sai_handle_t structure which stores the transfer state.
<i>xfer</i>	Pointer to the sai_transfer_t structure.

## Return values

<i>kStatus_Success</i>	Successfully started the data receive.
<i>kStatus_SAI_RxBusy</i>	Previous receive still not finished.
<i>kStatus_InvalidArgument</i>	The input parameter is invalid.

#### 17.4.5.74 status\_t SAI\_TransferGetSendCount ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*, size\_t \* *count* )

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	Pointer to the sai_handle_t structure which stores the transfer state.
<i>count</i>	Bytes count sent.

## Return values

<i>kStatus_Success</i>	Succeed get the transfer count.
<i>kStatus_NoTransferInProgress</i>	There is not a non-blocking transaction currently in progress.

#### 17.4.5.75 status\_t SAI\_TransferGetReceiveCount ( I2S\_Type \* *base*, sai\_handle\_t \* *handle*, size\_t \* *count* )

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	Pointer to the sai_handle_t structure which stores the transfer state.
<i>count</i>	Bytes count received.

## Return values

<i>kStatus_Success</i>	Succeed get the transfer count.
<i>kStatus_NoTransferInProgress</i>	There is not a non-blocking transaction currently in progress.

**17.4.5.76 void SAI\_TransferAbortSend ( I2S\_Type \* *base*, sai\_handle\_t \* *handle* )**

## Note

This API can be called any time when an interrupt non-blocking transfer initiates to abort the transfer early.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	Pointer to the sai_handle_t structure which stores the transfer state.

**17.4.5.77 void SAI\_TransferAbortReceive ( I2S\_Type \* *base*, sai\_handle\_t \* *handle* )**

## Note

This API can be called when an interrupt non-blocking transfer initiates to abort the transfer early.

## Parameters

<i>base</i>	SAI base pointer
<i>handle</i>	Pointer to the sai_handle_t structure which stores the transfer state.

**17.4.5.78 void SAI\_TransferTerminateSend ( I2S\_Type \* *base*, sai\_handle\_t \* *handle* )**

This function will clear all transfer slots buffered in the sai queue. If users only want to abort the current transfer slot, please call SAI\_TransferAbortSend.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	SAI eDMA handle pointer.

**17.4.5.79 void SAI\_TransferTerminateReceive ( I2S\_Type \* *base*, sai\_handle\_t \* *handle* )**

This function will clear all transfer slots buffered in the sai queue. If users only want to abort the current transfer slot, please call SAI\_TransferAbortReceive.

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	SAI eDMA handle pointer.

**17.4.5.80 void SAI\_TransferTxHandleIRQ ( I2S\_Type \* *base*, sai\_handle\_t \* *handle* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	Pointer to the sai_handle_t structure.

**17.4.5.81 void SAI\_TransferRxHandleIRQ ( I2S\_Type \* *base*, sai\_handle\_t \* *handle* )**

## Parameters

<i>base</i>	SAI base pointer.
<i>handle</i>	Pointer to the sai_handle_t structure.



## **Chapter 18**

### **SAI EDMA Driver**

## Chapter 19

# SEMA4: Hardware Semaphores Driver

### 19.1 Overview

The MCUXpresso SDK provides a driver for the SEMA4 module of MCUXpresso SDK devices.

#### Macros

- #define [SEMA4\\_GATE\\_NUM\\_RESET\\_ALL](#) (64U)  
*The number to reset all SEMA4 gates.*
- #define [SEMA4\\_GATEn](#)(base, n) (((volatile uint8\_t \*)(&((base)->Gate00)))[(n)])  
*SEMA4 gate n register address.*

#### Functions

- void [SEMA4\\_Init](#) (SEMA4\_Type \*base)  
*Initializes the SEMA4 module.*
- void [SEMA4\\_Deinit](#) (SEMA4\_Type \*base)  
*De-initializes the SEMA4 module.*
- [status\\_t SEMA4\\_TryLock](#) (SEMA4\_Type \*base, uint8\_t gateNum, uint8\_t procNum)  
*Tries to lock the SEMA4 gate.*
- void [SEMA4\\_Lock](#) (SEMA4\_Type \*base, uint8\_t gateNum, uint8\_t procNum)  
*Locks the SEMA4 gate.*
- static void [SEMA4\\_Unlock](#) (SEMA4\_Type \*base, uint8\_t gateNum)  
*Unlocks the SEMA4 gate.*
- static int32\_t [SEMA4\\_GetLockProc](#) (SEMA4\_Type \*base, uint8\_t gateNum)  
*Gets the status of the SEMA4 gate.*
- [status\\_t SEMA4\\_ResetGate](#) (SEMA4\_Type \*base, uint8\_t gateNum)  
*Resets the SEMA4 gate to an unlocked status.*
- static [status\\_t SEMA4\\_ResetAllGates](#) (SEMA4\_Type \*base)  
*Resets all SEMA4 gates to an unlocked status.*
- static void [SEMA4\\_EnableGateNotifyInterrupt](#) (SEMA4\_Type \*base, uint8\_t procNum, uint32\_t mask)  
*Enable the gate notification interrupt.*
- static void [SEMA4\\_DisableGateNotifyInterrupt](#) (SEMA4\_Type \*base, uint8\_t procNum, uint32\_t mask)  
*Disable the gate notification interrupt.*
- static uint32\_t [SEMA4\\_GetGateNotifyStatus](#) (SEMA4\_Type \*base, uint8\_t procNum)  
*Get the gate notification flags.*
- [status\\_t SEMA4\\_ResetGateNotify](#) (SEMA4\_Type \*base, uint8\_t gateNum)  
*Resets the SEMA4 gate IRQ notification.*
- static [status\\_t SEMA4\\_ResetAllGateNotify](#) (SEMA4\_Type \*base)  
*Resets all SEMA4 gates IRQ notification.*

## Driver version

- #define **FSL\_SEMA4\_DRIVER\_VERSION** (**MAKE\_VERSION**(2, 0, 3))  
*SEMA4 driver version.*

## 19.2 Macro Definition Documentation

### 19.2.1 #define SEMA4\_GATE\_NUM\_RESET\_ALL (64U)

## 19.3 Function Documentation

### 19.3.1 void SEMA4\_Init ( SEMA4\_Type \* *base* )

This function initializes the SEMA4 module. It only enables the clock but does not reset the gates because the module might be used by other processors at the same time. To reset the gates, call either SEMA4\_ResetGate or SEMA4\_ResetAllGates function.

Parameters

<i>base</i>	SEMA4 peripheral base address.
-------------	--------------------------------

### 19.3.2 void SEMA4\_Deinit ( SEMA4\_Type \* *base* )

This function de-initializes the SEMA4 module. It only disables the clock.

Parameters

<i>base</i>	SEMA4 peripheral base address.
-------------	--------------------------------

### 19.3.3 status\_t SEMA4\_TryLock ( SEMA4\_Type \* *base*, uint8\_t *gateNum*, uint8\_t *procNum* )

This function tries to lock the specific SEMA4 gate. If the gate has been locked by another processor, this function returns an error code.

Parameters

<i>base</i>	SEMA4 peripheral base address.
-------------	--------------------------------

<i>gateNum</i>	Gate number to lock.
<i>procNum</i>	Current processor number.

Return values

<i>kStatus_Success</i>	Lock the sema4 gate successfully.
<i>kStatus_Fail</i>	Sema4 gate has been locked by another processor.

#### 19.3.4 void SEMA4\_Lock ( SEMA4\_Type \* *base*, uint8\_t *gateNum*, uint8\_t *procNum* )

This function locks the specific SEMA4 gate. If the gate has been locked by other processors, this function waits until it is unlocked and then lock it.

Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>gateNum</i>	Gate number to lock.
<i>procNum</i>	Current processor number.

#### 19.3.5 static void SEMA4\_Unlock ( SEMA4\_Type \* *base*, uint8\_t *gateNum* ) [inline], [static]

This function unlocks the specific SEMA4 gate. It only writes unlock value to the SEMA4 gate register. However, it does not check whether the SEMA4 gate is locked by the current processor or not. As a result, if the SEMA4 gate is not locked by the current processor, this function has no effect.

Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>gateNum</i>	Gate number to unlock.

#### 19.3.6 static int32\_t SEMA4\_GetLockProc ( SEMA4\_Type \* *base*, uint8\_t *gateNum* ) [inline], [static]

This function checks the lock status of a specific SEMA4 gate.



## Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>gateNum</i>	Gate number.

## Returns

Return -1 if the gate is unlocked, otherwise return the processor number which has locked the gate.

### 19.3.7 status\_t SEMA4\_ResetGate ( SEMA4\_Type \* *base*, uint8\_t *gateNum* )

This function resets a SEMA4 gate to an unlocked status.

## Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>gateNum</i>	Gate number.

## Return values

<i>kStatus_Success</i>	SEMA4 gate is reset successfully.
<i>kStatus_Fail</i>	Some other reset process is ongoing.

### 19.3.8 static status\_t SEMA4\_ResetAllGates ( SEMA4\_Type \* *base* ) [inline], [static]

This function resets all SEMA4 gate to an unlocked status.

## Parameters

<i>base</i>	SEMA4 peripheral base address.
-------------	--------------------------------

## Return values

<i>kStatus_Success</i>	SEMA4 is reset successfully.
------------------------	------------------------------

<i>kStatus_Fail</i>	Some other reset process is ongoing.
---------------------	--------------------------------------

### 19.3.9 static void SEMA4\_EnableGateNotifyInterrupt ( SEMA4\_Type \* *base*, uint8\_t *procNum*, uint32\_t *mask* ) [inline], [static]

Gate notification provides such feature, when core tried to lock the gate and failed, it could get notification when the gate is idle.

Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>procNum</i>	Current processor number.
<i>mask</i>	OR'ed value of the gate index, for example: (1<<0)   (1<<1) means gate 0 and gate 1.

### 19.3.10 static void SEMA4\_DisableGateNotifyInterrupt ( SEMA4\_Type \* *base*, uint8\_t *procNum*, uint32\_t *mask* ) [inline], [static]

Gate notification provides such feature, when core tried to lock the gate and failed, it could get notification when the gate is idle.

Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>procNum</i>	Current processor number.
<i>mask</i>	OR'ed value of the gate index, for example: (1<<0)   (1<<1) means gate 0 and gate 1.

### 19.3.11 static uint32\_t SEMA4\_GetGateNotifyStatus ( SEMA4\_Type \* *base*, uint8\_t *procNum* ) [inline], [static]

Gate notification provides such feature, when core tried to lock the gate and failed, it could get notification when the gate is idle. The status flags are cleared automatically when the gate is locked by current core or locked again before the other core.

## Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>procNum</i>	Current processor number.

## Returns

OR'ed value of the gate index, for example:  $(1 \ll 0) \mid (1 \ll 1)$  means gate 0 and gate 1 flags are pending.

### 19.3.12 `status_t SEMA4_ResetGateNotify ( SEMA4_Type * base, uint8_t gateNum )`

This function resets a SEMA4 gate IRQ notification.

## Parameters

<i>base</i>	SEMA4 peripheral base address.
<i>gateNum</i>	Gate number.

## Return values

<i>kStatus_Success</i>	Reset successfully.
<i>kStatus_Fail</i>	Some other reset process is ongoing.

### 19.3.13 `static status_t SEMA4_ResetAllGateNotify ( SEMA4_Type * base ) [inline], [static]`

This function resets all SEMA4 gate IRQ notifications.

## Parameters

<i>base</i>	SEMA4 peripheral base address.
-------------	--------------------------------

## Return values

<i>kStatus_Success</i>	Reset successfully.
<i>kStatus_Fail</i>	Some other reset process is ongoing.

## Chapter 20

# TMU: Thermal Management Unit Driver

### 20.1 Overview

The MCUXpresso SDK provides a peripheral driver for the thermal management unit (TMU) module of MCUXpresso SDK devices.

### 20.2 Typical use case

#### 20.2.1 Monitor and report Configuration

Refer to the driver examples codes located at <SDK\_ROOT>/boards/<BOARD>/driver\_examples/tmu

### Data Structures

- struct [tmu\\_threshold\\_config\\_t](#)  
*configuration for TMU threshold. [More...](#)*
- struct [tmu\\_interrupt\\_status\\_t](#)  
*TMU interrupt status. [More...](#)*
- struct [tmu\\_config\\_t](#)  
*Configuration for TMU module. [More...](#)*

### Macros

- #define [FSL\\_TMU\\_DRIVER\\_VERSION](#) ([MAKE\\_VERSION](#)(2, 0, 3))  
*TMU driver version.*

### Enumerations

- enum [\\_tmu\\_interrupt\\_enable](#) {  
    [kTMU\\_ImmediateTemperatureInterruptEnable](#),  
    [kTMU\\_AverageTemperatureInterruptEnable](#),  
    [kTMU\\_AverageTemperatureCriticalInterruptEnable](#) }  
*TMU interrupt enable.*
- enum [\\_tmu\\_interrupt\\_status\\_flags](#) {  
    [kTMU\\_ImmediateTemperatureStatusFlags](#) = [TMU\\_TIDR\\_ITTE\\_MASK](#),  
    [kTMU\\_AverageTemperatureStatusFlags](#) = [TMU\\_TIDR\\_ATTTE\\_MASK](#),  
    [kTMU\\_AverageTemperatureCriticalStatusFlags](#) }  
*TMU interrupt status flags.*
- enum [\\_tmu\\_status\\_flags](#) {  
    [kTMU\\_IntervalExceededStatusFlags](#) = [TMU\\_TSR\\_MIE\\_MASK](#),  
    [kTMU\\_OutOfLowRangeStatusFlags](#) = [TMU\\_TSR\\_ORL\\_MASK](#),  
    [kTMU\\_OutOfHighRangeStatusFlags](#) }

*TMU status flags.*

- enum [tmu\\_average\\_low\\_pass\\_filter\\_t](#) {  
[kTMU\\_AverageLowPassFilter1\\_0](#) = 0U,  
[kTMU\\_AverageLowPassFilter0\\_5](#) = 1U,  
[kTMU\\_AverageLowPassFilter0\\_25](#) = 2U,  
[kTMU\\_AverageLowPassFilter0\\_125](#) = 3U }

*Average low pass filter setting.*

## Functions

- void [TMU\\_Init](#) (TMU\_Type \*base, const [tmu\\_config\\_t](#) \*config)  
*Enable the access to TMU registers and Initialize TMU module.*
- void [TMU\\_Deinit](#) (TMU\_Type \*base)  
*De-initialize TMU module and Disable the access to DCDC registers.*
- void [TMU\\_GetDefaultConfig](#) ([tmu\\_config\\_t](#) \*config)  
*Gets the default configuration for TMU.*
- static void [TMU\\_Enable](#) (TMU\_Type \*base, bool enable)  
*Enable/Disable the TMU module.*
- static void [TMU\\_EnableInterrupts](#) (TMU\_Type \*base, uint32\_t mask)  
*Enable the TMU interrupts.*
- static void [TMU\\_DisableInterrupts](#) (TMU\_Type \*base, uint32\_t mask)  
*Disable the TMU interrupts.*
- void [TMU\\_GetInterruptStatusFlags](#) (TMU\_Type \*base, [tmu\\_interrupt\\_status\\_t](#) \*status)  
*Get interrupt status flags.*
- void [TMU\\_ClearInterruptStatusFlags](#) (TMU\_Type \*base, uint32\_t mask)  
*Clear interrupt status flags and corresponding interrupt critical site capture register.*
- static uint32\_t [TMU\\_GetStatusFlags](#) (TMU\_Type \*base)  
*Get TMU status flags.*
- [status\\_t](#) [TMU\\_GetHighestTemperature](#) (TMU\_Type \*base, uint32\_t \*temperature)  
*Get the highest temperature reached for any enabled monitored site within the temperature sensor range.*
- [status\\_t](#) [TMU\\_GetLowestTemperature](#) (TMU\_Type \*base, uint32\_t \*temperature)  
*Get the lowest temperature reached for any enabled monitored site within the temperature sensor range.*
- [status\\_t](#) [TMU\\_GetImmediateTemperature](#) (TMU\_Type \*base, uint32\_t siteIndex, uint32\_t \*temperature)  
*Get the last immediate temperature at site n.*
- [status\\_t](#) [TMU\\_GetAverageTemperature](#) (TMU\_Type \*base, uint32\_t siteIndex, uint32\_t \*temperature)  
*Get the last average temperature at site n.*
- void [TMU\\_SetHighTemperatureThresold](#) (TMU\_Type \*base, const [tmu\\_thresold\\_config\\_t](#) \*config)  
*Configure the high temperature thresold value and enable/disable relevant thresold.*

## 20.3 Data Structure Documentation

### 20.3.1 struct [tmu\\_thresold\\_config\\_t](#)

#### Data Fields

- bool [immediateThresoldEnable](#)  
*Enable high temperature immediate threshold.*
- bool [AverageThresoldEnable](#)

- *Enable high temperature average threshold.*  
bool [AverageCriticalThresoldEnable](#)
- *Enable high temperature average critical threshold.*  
uint8\_t [immediateThresoldValue](#)  
*Range:0U-125U.*
- uint8\_t [averageThresoldValue](#)  
*Range:0U-125U.*
- uint8\_t [averageCriticalThresoldValue](#)  
*Range:0U-125U.*

#### Field Documentation

(1) bool `tmu_thresold_config_t::immediateThresoldEnable`

(2) bool `tmu_thresold_config_t::AverageThresoldEnable`

(3) bool `tmu_thresold_config_t::AverageCriticalThresoldEnable`

(4) uint8\_t `tmu_thresold_config_t::immediateThresoldValue`

Valid when corresponding thresold is enabled. High temperature immediate threshold value. Determines the current upper temperature threshold, for anyenabled monitored site.

(5) uint8\_t `tmu_thresold_config_t::averageThresoldValue`

Valid when corresponding thresold is enabled. High temperature average threshold value. Determines the average upper temperature threshold, for any enabled monitored site.

(6) uint8\_t `tmu_thresold_config_t::averageCriticalThresoldValue`

Valid when corresponding thresold is enabled. High temperature average critical threshold value. Determines the average upper critical temperature threshold, for any enabled monitored site.

### 20.3.2 struct `tmu_interrupt_status_t`

#### Data Fields

- uint32\_t [interruptDetectMask](#)  
*The mask of interrupt status flags.*
- uint16\_t [immediateInterruptsSiteMask](#)  
*The mask of the temperature sensor site associated with a detected ITTE event.*
- uint16\_t [AverageInterruptsSiteMask](#)  
*The mask of the temperature sensor site associated with a detected ATTE event.*
- uint16\_t [AverageCriticalInterruptsSiteMask](#)  
*The mask of the temperature sensor site associated with a detected ATCTE event.*

#### Field Documentation

**(1) uint32\_t tmu\_interrupt\_status\_t::interruptDetectMask**

Refer to "\_tmu\_interrupt\_status\_flags" enumeration.

**(2) uint16\_t tmu\_interrupt\_status\_t::immediateInterruptsSiteMask**

Please refer to "\_tmu\_monitor\_site" enumeration.

**(3) uint16\_t tmu\_interrupt\_status\_t::AverageInterruptsSiteMask**

Please refer to "\_tmu\_monitor\_site" enumeration.

**(4) uint16\_t tmu\_interrupt\_status\_t::AverageCriticalInterruptsSiteMask**

Please refer to "\_tmu\_monitor\_site" enumeration.

**20.3.3 struct tmu\_config\_t****Data Fields**

- uint8\_t [monitorInterval](#)  
*Temperature monitoring interval in seconds.*
- uint16\_t [monitorSiteSelection](#)  
*By setting the select bit for a temperature sensor site, it is enabled and included in all monitoring functions.*
- [tmu\\_average\\_low\\_pass\\_filter\\_t](#) [averageLPF](#)  
*The average temperature is calculated as:  $ALPF \times Current\_Temp + (1 - ALPF) \times Average\_Temp$ .*

**Field Documentation****(1) uint8\_t tmu\_config\_t::monitorInterval**

Please refer to specific table in RM.

**(2) uint16\_t tmu\_config\_t::monitorSiteSelection**

If no site is selected, site 0 is monitored by default. Refer to "\_tmu\_monitor\_site" enumeration. Please look up relevant table in reference manual.

**(3) tmu\_average\_low\_pass\_filter\_t tmu\_config\_t::averageLPF**

For proper operation, this field should only change when monitoring is disabled.

**20.4 Macro Definition Documentation****20.4.1 #define FSL\_TMU\_DRIVER\_VERSION (MAKE\_VERSION(2, 0, 3))**

Version 2.0.3.



## 20.5 Enumeration Type Documentation

### 20.5.1 enum \_tmu\_interrupt\_enable

Enumerator

- kTMU\_ImmediateTemperatureInterruptEnable* Immediate temperature threshold exceeded interrupt enable.
- kTMU\_AverageTemperatureInterruptEnable* Average temperature threshold exceeded interrupt enable.
- kTMU\_AverageTemperatureCriticalInterruptEnable* Average temperature critical threshold exceeded interrupt enable. >

### 20.5.2 enum \_tmu\_interrupt\_status\_flags

Enumerator

- kTMU\_ImmediateTemperatureStatusFlags* Immediate temperature threshold exceeded(ITTE).
- kTMU\_AverageTemperatureStatusFlags* Average temperature threshold exceeded(ATTE).
- kTMU\_AverageTemperatureCriticalStatusFlags* Average temperature critical threshold exceeded. (ATCTE)

### 20.5.3 enum \_tmu\_status\_flags

Enumerator

- kTMU\_IntervalExceededStatusFlags* Monitoring interval exceeded. The time required to perform measurement of all monitored sites has exceeded the monitoring interval as defined by TMTM-IR.
- kTMU\_OutOfLowRangeStatusFlags* Out-of-range low temperature measurement detected. A temperature sensor detected a temperature reading below the lowest measurable temperature of 0 °C.
- kTMU\_OutOfHighRangeStatusFlags* Out-of-range high temperature measurement detected. A temperature sensor detected a temperature reading above the highest measurable temperature of 125 °C.

### 20.5.4 enum tmu\_average\_low\_pass\_filter\_t

Enumerator

- kTMU\_AverageLowPassFilter1\_0* Average low pass filter = 1.
- kTMU\_AverageLowPassFilter0\_5* Average low pass filter = 0.5.
- kTMU\_AverageLowPassFilter0\_25* Average low pass filter = 0.25.
- kTMU\_AverageLowPassFilter0\_125* Average low pass filter = 0.125.

## 20.6 Function Documentation

### 20.6.1 void TMU\_Init ( TMU\_Type \* *base*, const tmu\_config\_t \* *config* )

Parameters

<i>base</i>	TMU peripheral base address.
<i>config</i>	Pointer to configuration structure. Refer to "tmu_config_t" structure.

### 20.6.2 void TMU\_Deinit ( TMU\_Type \* *base* )

Parameters

<i>base</i>	TMU peripheral base address.
-------------	------------------------------

### 20.6.3 void TMU\_GetDefaultConfig ( tmu\_config\_t \* *config* )

This function initializes the user configuration structure to default value. The default value are:

Example:

```
config->monitorInterval = 0U;
config->monitorSiteSelection = 0U;
config->averageLPF = kTMU_AverageLowPassFilter1_0;
```

Parameters

<i>config</i>	Pointer to TMU configuration structure.
---------------	---

### 20.6.4 static void TMU\_Enable ( TMU\_Type \* *base*, bool *enable* ) [inline], [static]

Parameters

<i>base</i>	TMU peripheral base address.
-------------	------------------------------

<i>enable</i>	Switcher to enable/disable TMU.
---------------	---------------------------------

#### 20.6.5 static void TMU\_EnableInterrupts ( TMU\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

Parameters

<i>base</i>	TMU peripheral base address.
<i>mask</i>	The interrupt mask. Refer to "_tmu_interrupt_enable" enumeration.

#### 20.6.6 static void TMU\_DisableInterrupts ( TMU\_Type \* *base*, uint32\_t *mask* ) [inline], [static]

Parameters

<i>base</i>	TMU peripheral base address.
<i>mask</i>	The interrupt mask. Refer to "_tmu_interrupt_enable" enumeration.

#### 20.6.7 void TMU\_GetInterruptStatusFlags ( TMU\_Type \* *base*, tmu\_interrupt\_status\_t \* *status* )

Parameters

<i>base</i>	TMU peripheral base address.
<i>status</i>	The pointer to interrupt status structure. Record the current interrupt status. Please refer to "tmu_interrupt_status_t" structure.

#### 20.6.8 void TMU\_ClearInterruptStatusFlags ( TMU\_Type \* *base*, uint32\_t *mask* )

Parameters

<i>base</i>	TMU peripheral base address.
<i>mask</i>	The mask of interrupt status flags. Refer to "_tmu_interrupt_status_flags" enumeration.

### 20.6.9 static uint32\_t TMU\_GetStatusFlags ( TMU\_Type \* *base* ) [inline], [static]

Parameters

<i>base</i>	TMU peripheral base address.
-------------	------------------------------

Returns

The mask of status flags. Refer to "\_tmu\_status\_flags" enumeration.

### 20.6.10 status\_t TMU\_GetHighestTemperature ( TMU\_Type \* *base*, uint32\_t \* *temperature* )

Parameters

<i>base</i>	TMU peripheral base address.
<i>temperature</i>	Highest temperature recorded in degrees Celsius by any enabled monitored site.

Returns

Execution status.

Return values

<i>kStatus_Success</i>	Temperature reading is valid.
<i>kStatus_Fail</i>	Temperature reading is not valid due to no measured temperature within the sensor range of 0-125 °C for an enabled monitored site.

### 20.6.11 status\_t TMU\_GetLowestTemperature ( TMU\_Type \* *base*, uint32\_t \* *temperature* )

## Parameters

<i>base</i>	TMU peripheral base address.
<i>temperature</i>	Lowest temperature recorded in degrees Celsius by any enabled monitored site.

## Returns

Execution status.

## Return values

<i>kStatus_Success</i>	Temperature reading is valid.
<i>kStatus_Fail</i>	Temperature reading is not valid due to no measured temperature within the sensor range of 0-125 °C for an enabled monitored site.

### 20.6.12 **status\_t** TMU\_GetImmediateTemperature ( **TMU\_Type** \* *base*, **uint32\_t** *siteIndex*, **uint32\_t** \* *temperature* )

The site must be part of the list of enabled monitored sites as defined by monitorSiteSelection in "tmu\_config\_t" structure.

## Parameters

<i>base</i>	TMU peripheral base address.
<i>siteIndex</i>	The index of the site user want to read. 0U: site0 ~ 15U: site15.
<i>temperature</i>	Last immediate temperature reading at site n .

## Returns

Execution status.

## Return values

<i>kStatus_Success</i>	Temperature reading is valid.
<i>kStatus_Fail</i>	Temperature reading is not valid because temperature out of sensor range or first measurement still pending.

### 20.6.13 **status\_t** TMU\_GetAverageTemperature ( **TMU\_Type** \* *base*, **uint32\_t** *siteIndex*, **uint32\_t** \* *temperature* )

The site must be part of the list of enabled monitored sites as defined by monitorSiteSelection in "tmu\_config\_t" structure.

## Parameters

<i>base</i>	TMU peripheral base address.
<i>siteIndex</i>	The index of the site user want to read. 0U: site0 ~ 15U: site15.
<i>temperature</i>	Last average temperature reading at site n .

## Returns

Execution status.

## Return values

<i>kStatus_Success</i>	Temperature reading is valid.
<i>kStatus_Fail</i>	Temperature reading is not valid because temperature out of sensor range or first measurement still pending.

#### 20.6.14 void TMU\_SetHighTemperatureThresold ( TMU\_Type \* *base*, const tmu\_threshold\_config\_t \* *config* )

## Parameters

<i>base</i>	TMU peripheral base address.
<i>config</i>	Pointer to configuration structure. Refer to "tmu_threshold_config_t" structure.

## Chapter 21

# WDOG: Watchdog Timer Driver

### 21.1 Overview

The MCUXpresso SDK provides a peripheral driver for the Watchdog module (WDOG) of MCUXpresso SDK devices.

### 21.2 Typical use case

Refer to the driver examples codes located at <SDK\_ROOT>/boards/<BOARD>/driver\_examples/wdog

### Data Structures

- struct [wdog\\_work\\_mode\\_t](#)  
*Defines WDOG work mode. [More...](#)*
- struct [wdog\\_config\\_t](#)  
*Describes WDOG configuration structure. [More...](#)*

### Enumerations

- enum [\\_wdog\\_interrupt\\_enable](#) { [kWDOG\\_InterruptEnable](#) = WDOG\_WICR\_WIE\_MASK }
  - enum [\\_wdog\\_status\\_flags](#) {  
[kWDOG\\_RunningFlag](#) = WDOG\_WCR\_WDE\_MASK,  
[kWDOG\\_PowerOnResetFlag](#) = WDOG\_WRSR\_POR\_MASK,  
[kWDOG\\_TimeoutResetFlag](#) = WDOG\_WRSR\_TOUT\_MASK,  
[kWDOG\\_SoftwareResetFlag](#) = WDOG\_WRSR\_SFTW\_MASK,  
[kWDOG\\_InterruptFlag](#) = WDOG\_WICR\_WTIS\_MASK }
- WDOG status flags.*

### Driver version

- #define [FSL\\_WDOG\\_DRIVER\\_VERSION](#) ([MAKE\\_VERSION](#)(2, 1, 1))  
*Defines WDOG driver version.*

### Refresh sequence

- #define [WDOG\\_REFRESH\\_KEY](#) (0xAAAA5555U)

### WDOG Initialization and De-initialization.

- void [WDOG\\_GetDefaultConfig](#) ([wdog\\_config\\_t](#) \*config)  
*Initializes the WDOG configuration structure.*
- void [WDOG\\_Init](#) (WDOG\_Type \*base, const [wdog\\_config\\_t](#) \*config)

- *Initializes the WDOG.*
- void [WDOG\\_Deinit](#) (WDOG\_Type \*base)
- *Shuts down the WDOG.*
- static void [WDOG\\_Enable](#) (WDOG\_Type \*base)
- *Enables the WDOG module.*
- static void [WDOG\\_Disable](#) (WDOG\_Type \*base)
- *Disables the WDOG module.*
- static void [WDOG\\_TriggerSystemSoftwareReset](#) (WDOG\_Type \*base)
- *Trigger the system software reset.*
- static void [WDOG\\_TriggerSoftwareSignal](#) (WDOG\_Type \*base)
- *Trigger an output assertion.*
- static void [WDOG\\_EnableInterrupts](#) (WDOG\_Type \*base, uint16\_t mask)
- *Enables the WDOG interrupt.*
- uint16\_t [WDOG\\_GetStatusFlags](#) (WDOG\_Type \*base)
- *Gets the WDOG all reset status flags.*
- void [WDOG\\_ClearInterruptStatus](#) (WDOG\_Type \*base, uint16\_t mask)
- *Clears the WDOG flag.*
- static void [WDOG\\_SetTimeoutValue](#) (WDOG\_Type \*base, uint16\_t timeoutCount)
- *Sets the WDOG timeout value.*
- static void [WDOG\\_SetInterruptTimeoutValue](#) (WDOG\_Type \*base, uint16\_t timeoutCount)
- *Sets the WDOG interrupt count timeout value.*
- static void [WDOG\\_DisablePowerDownEnable](#) (WDOG\_Type \*base)
- *Disable the WDOG power down enable bit.*
- void [WDOG\\_Refresh](#) (WDOG\_Type \*base)
- *Refreshes the WDOG timer.*

## 21.3 Data Structure Documentation

### 21.3.1 struct wdog\_work\_mode\_t

#### Data Fields

- bool [enableWait](#)  
*continue or suspend WDOG in wait mode*
- bool [enableStop](#)  
*continue or suspend WDOG in stop mode*
- bool [enableDebug](#)  
*continue or suspend WDOG in debug mode*

### 21.3.2 struct wdog\_config\_t

#### Data Fields

- bool [enableWdog](#)  
*Enables or disables WDOG.*
- [wdog\\_work\\_mode\\_t](#) [workMode](#)  
*Configures WDOG work mode in debug stop and wait mode.*
- bool [enableInterrupt](#)



- *Enables or disables WDOG interrupt.*  
uint16\_t `timeoutValue`  
*Timeout value.*
- uint16\_t `interruptTimeValue`  
*Interrupt count timeout value.*
- bool `softwareResetExtension`  
*software reset extension*
- bool `enablePowerDown`  
*power down enable bit*
- bool `enableTimeOutAssert`  
*Enable WDOG\_B timeout assertion.*

## Field Documentation

(1) bool `wdog_config_t::enableTimeOutAssert`

## 21.4 Enumeration Type Documentation

### 21.4.1 enum `_wdog_interrupt_enable`

This structure contains the settings for all of the WDOG interrupt configurations.

Enumerator

***kWDOG\_InterruptEnable*** WDOG timeout generates an interrupt before reset.

### 21.4.2 enum `_wdog_status_flags`

This structure contains the WDOG status flags for use in the WDOG functions.

Enumerator

***kWDOG\_RunningFlag*** Running flag, set when WDOG is enabled.

***kWDOG\_PowerOnResetFlag*** Power On flag, set when reset is the result of a powerOnReset.

***kWDOG\_TimeoutResetFlag*** Timeout flag, set when reset is the result of a timeout.

***kWDOG\_SoftwareResetFlag*** Software flag, set when reset is the result of a software.

***kWDOG\_InterruptFlag*** interrupt flag, whether interrupt has occurred or not

## 21.5 Function Documentation

### 21.5.1 void `WDOG_GetDefaultConfig ( wdog_config_t * config )`

This function initializes the WDOG configuration structure to default values. The default values are as follows.

```
* wdogConfig->enableWdog = true;
* wdogConfig->workMode.enableWait = true;
* wdogConfig->workMode.enableStop = false;
```

```

*  wdogConfig->workMode.enableDebug = false;
*  wdogConfig->enableInterrupt = false;
*  wdogConfig->enablePowerdown = false;
*  wdogConfig->resetExtension = false;
*  wdogConfig->timeoutValue = 0xFFU;
*  wdogConfig->interruptTimeValue = 0x04u;
*

```

#### Parameters

<i>config</i>	Pointer to the WDOG configuration structure.
---------------	--

#### See Also

[wdog\\_config\\_t](#)

### 21.5.2 void WDOG\_Init ( WDOG\_Type \* *base*, const wdog\_config\_t \* *config* )

This function initializes the WDOG. When called, the WDOG runs according to the configuration.

This is an example.

```

*  wdog_config_t config;
*  WDOG_GetDefaultConfig(&config);
*  config.timeoutValue = 0xffU;
*  config->interruptTimeValue = 0x04u;
*  WDOG_Init(wdog_base, &config);
*

```

#### Parameters

<i>base</i>	WDOG peripheral base address
<i>config</i>	The configuration of WDOG

### 21.5.3 void WDOG\_Deinit ( WDOG\_Type \* *base* )

This function shuts down the WDOG. Watchdog Enable bit is a write one once only bit. It is not possible to clear this bit by a software write, once the bit is set. This bit(WDE) can be set/reset only in debug mode(exception).

### 21.5.4 static void WDOG\_Enable ( WDOG\_Type \* *base* ) [inline], [static]

This function writes a value into the WDOG\_WCR register to enable the WDOG. This is a write one once only bit. It is not possible to clear this bit by a software write, once the bit is set. only debug mode exception.

## Parameters

<i>base</i>	WDOG peripheral base address
-------------	------------------------------

### 21.5.5 static void WDOG\_Disable ( WDOG\_Type \* *base* ) [inline], [static]

This function writes a value into the WDOG\_WCR register to disable the WDOG. This is a write one once only bit. It is not possible to clear this bit by a software write, once the bit is set. only debug mode exception

## Parameters

<i>base</i>	WDOG peripheral base address
-------------	------------------------------

### 21.5.6 static void WDOG\_TriggerSystemSoftwareReset ( WDOG\_Type \* *base* ) [inline], [static]

This function will write to the WCR[SRS] bit to trigger a software system reset. This bit will automatically resets to "1" after it has been asserted to "0". Note: Calling this API will reset the system right now, please using it with more attention.

## Parameters

<i>base</i>	WDOG peripheral base address
-------------	------------------------------

### 21.5.7 static void WDOG\_TriggerSoftwareSignal ( WDOG\_Type \* *base* ) [inline], [static]

This function will write to the WCR[WDA] bit to trigger WDOG\_B signal assertion. The WDOG\_B signal can be routed to external pin of the chip, the output pin will turn to assertion along with WDOG\_B signal. Note: The WDOG\_B signal will remain assert until a power on reset occurred, so, please take more attention while calling it.

## Parameters

<i>base</i>	WDOG peripheral base address
-------------	------------------------------

### 21.5.8 static void WDOG\_EnableInterrupts ( WDOG\_Type \* *base*, uint16\_t *mask* ) [inline], [static]

This bit is a write once only bit. Once the software does a write access to this bit, it will get locked and cannot be reprogrammed until the next system reset assertion

## Parameters

<i>base</i>	WDOG peripheral base address
<i>mask</i>	The interrupts to enable The parameter can be combination of the following source if defined. <ul style="list-style-type: none"> <li>• kWDOG_InterruptEnable</li> </ul>

### 21.5.9 uint16\_t WDOG\_GetStatusFlags ( WDOG\_Type \* *base* )

This function gets all reset status flags.

```
* uint16_t status;
* status = WDOG_GetStatusFlags (wdog_base);
*
```

## Parameters

<i>base</i>	WDOG peripheral base address
-------------	------------------------------

## Returns

State of the status flag: asserted (true) or not-asserted (false).

## See Also

[\\_wdog\\_status\\_flags](#)

- true: a related status flag has been set.
- false: a related status flag is not set.

### 21.5.10 void WDOG\_ClearInterruptStatus ( WDOG\_Type \* *base*, uint16\_t *mask* )

This function clears the WDOG status flag.

This is an example for clearing the interrupt flag.

```
* WDOG_ClearStatusFlags (wdog_base, kWDOG_InterruptFlag);
*
```

## Parameters

<i>base</i>	WDOG peripheral base address
<i>mask</i>	The status flags to clear. The parameter could be any combination of the following values. kWDOG_TimeoutFlag

### 21.5.11 static void WDOG\_SetTimeoutValue ( WDOG\_Type \* *base*, uint16\_t *timeoutCount* ) [inline], [static]

This function sets the timeout value. This function writes a value into WCR registers. The time-out value can be written at any point of time but it is loaded to the counter at the time when WDOG is enabled or after the service routine has been performed.

## Parameters

<i>base</i>	WDOG peripheral base address
<i>timeoutCount</i>	WDOG timeout value; count of WDOG clock tick.

### 21.5.12 static void WDOG\_SetInterruptTimeoutValue ( WDOG\_Type \* *base*, uint16\_t *timeoutCount* ) [inline], [static]

This function sets the interrupt count timeout value. This function writes a value into WIC registers which are write-once. This field is write once only. Once the software does a write access to this field, it will get locked and cannot be reprogrammed until the next system reset assertion.

## Parameters

<i>base</i>	WDOG peripheral base address
<i>timeoutCount</i>	WDOG timeout value; count of WDOG clock tick.

### 21.5.13 static void WDOG\_DisablePowerDownEnable ( WDOG\_Type \* *base* ) [inline], [static]

This function disable the WDOG power down enable(PDE). This function writes a value into WMCR registers which are write-once. This field is write once only. Once software sets this bit it cannot be reset until the next system reset.

## Parameters

<i>base</i>	WDOG peripheral base address
-------------	------------------------------

**21.5.14 void WDOG\_Refresh ( WDOG\_Type \* *base* )**

This function feeds the WDOG. This function should be called before the WDOG timer is in timeout. Otherwise, a reset is asserted.

## Parameters

<i>base</i>	WDOG peripheral base address
-------------	------------------------------

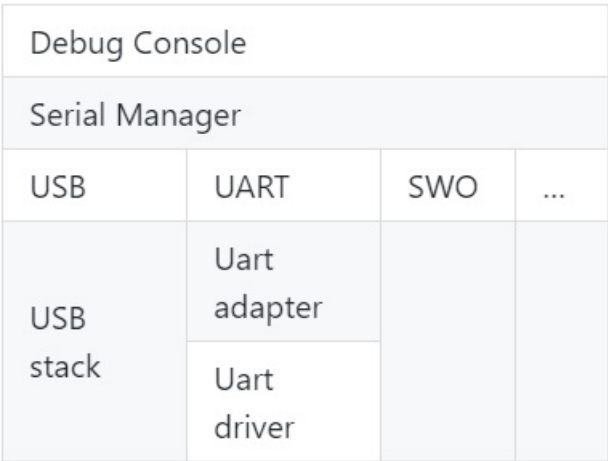
# Chapter 22

## Debug Console

### 22.1 Overview

This chapter describes the programming interface of the debug console driver.

The debug console enables debug log messages to be output via the specified peripheral with frequency of the peripheral source clock and base address at the specified baud rate. Additionally, it provides input and output functions to scan and print formatted data. The below picture shows the layout of debug console.



Debug console overview

### 22.2 Function groups

#### 22.2.1 Initialization

To initialize the debug console, call the [DbgConsole\\_Init\(\)](#) function with these parameters. This function automatically enables the module and the clock.

```
status_t DbgConsole_Init(uint8_t instance, uint32_t baudRate,
    serial_port_type_t device, uint32_t clkSrcFreq);
```

Select the supported debug console hardware device type, such as

```
typedef enum _serial_port_type
{
    kSerialPort_Uart = 1U,
    kSerialPort_UsbCdc,
    kSerialPort_Swo,
} serial_port_type_t;
```



After the initialization is successful, stdout and stdin are connected to the selected peripheral. This example shows how to call the `DbgConsole_Init()` given the user configuration structure.

```
DbgConsole_Init(BOARD_DEBUG_UART_INSTANCE, BOARD_DEBUG_UART_BAUDRATE, BOARD_DEBUG_UART_TYPE,
                BOARD_DEBUG_UART_CLK_FREQ);
```

## 22.2.2 Advanced Feature

The debug console provides input and output functions to scan and print formatted data.

- Support a format specifier for PRINTF following this prototype "`%[flags][width][.precision][length]specifier`", which is explained below

flags	Description
-	Left-justified within the given field width. Right-justified is the default.
+	Forces to precede the result with a plus or minus sign (+ or -) even for positive numbers. By default, only negative numbers are preceded with a - sign.
(space)	If no sign is written, a blank space is inserted before the value.
#	Used with o, x, or X specifiers the value is preceded with 0, 0x, or 0X respectively for values other than zero. Used with e, E and f, it forces the written output to contain a decimal point even if no digits would follow. By default, if no digits follow, no decimal point is written. Used with g or G the result is the same as with e or E but trailing zeros are not removed.
0	Left-pads the number with zeroes (0) instead of spaces, where padding is specified (see width sub-specifier).

Width	Description
(number)	A minimum number of characters to be printed. If the value to be printed is shorter than this number, the result is padded with blank spaces. The value is not truncated even if the result is larger.
*	The width is not specified in the format string, but as an additional integer value argument preceding the argument that has to be formatted.

<b>.precision</b>	<b>Description</b>
.number	For integer specifiers (d, i, o, u, x, X) precision specifies the minimum number of digits to be written. If the value to be written is shorter than this number, the result is padded with leading zeros. The value is not truncated even if the result is longer. A precision of 0 means that no character is written for the value 0. For e, E, and f specifiers this is the number of digits to be printed after the decimal point. For g and G specifiers This is the maximum number of significant digits to be printed. For s this is the maximum number of characters to be printed. By default, all characters are printed until the ending null character is encountered. For c type it has no effect. When no precision is specified, the default is 1. If the period is specified without an explicit value for precision, 0 is assumed.
.*	The precision is not specified in the format string, but as an additional integer value argument preceding the argument that has to be formatted.

<b>length</b>	<b>Description</b>
Do not support	

<b>specifier</b>	<b>Description</b>
d or i	Signed decimal integer
f	Decimal floating point
F	Decimal floating point capital letters
x	Unsigned hexadecimal integer
X	Unsigned hexadecimal integer capital letters
o	Signed octal
b	Binary value
p	Pointer address
u	Unsigned decimal integer
c	Character
s	String of characters
n	Nothing printed

- Support a format specifier for SCANF following this prototype " %[\*][width][length]specifier", which is explained below

*	Description
	An optional starting asterisk indicates that the data is to be read from the stream but ignored. In other words, it is not stored in the corresponding argument.

width	Description
	This specifies the maximum number of characters to be read in the current reading operation.

length	Description
hh	The argument is interpreted as a signed character or unsigned character (only applies to integer specifiers: i, d, o, u, x, and X).
h	The argument is interpreted as a short integer or unsigned short integer (only applies to integer specifiers: i, d, o, u, x, and X).
l	The argument is interpreted as a long integer or unsigned long integer for integer specifiers (i, d, o, u, x, and X) and as a wide character or wide character string for specifiers c and s.
ll	The argument is interpreted as a long long integer or unsigned long long integer for integer specifiers (i, d, o, u, x, and X) and as a wide character or wide character string for specifiers c and s.
L	The argument is interpreted as a long double (only applies to floating point specifiers: e, E, f, g, and G).
j or z or t	Not supported

specifier	Qualifying Input	Type of argument
c	Single character: Reads the next character. If a width different from 1 is specified, the function reads width characters and stores them in the successive locations of the array passed as argument. No null character is appended at the end.	char *
i	Integer: : Number optionally preceded with a + or - sign	int *
d	Decimal integer: Number optionally preceded with a + or - sign	int *
a, A, e, E, f, F, g, G	Floating point: Decimal number containing a decimal point, optionally preceded by a + or - sign and optionally followed by the e or E character and a decimal number. Two examples of valid entries are -732.103 and 7.12e4	float *
o	Octal Integer:	int *
s	String of characters. This reads subsequent characters until a white space is found (white space characters are considered to be blank, newline, and tab).	char *
u	Unsigned decimal integer.	unsigned int *

The debug console has its own printf/scanf/putchar/getchar functions which are defined in the header file.

```
int DbgConsole_Printf(const char *fmt_s, ...);
int DbgConsole_Putchar(int ch);
int DbgConsole_Scanf(char *fmt_ptr, ...);
int DbgConsole_Getchar(void);
```

This utility supports selecting toolchain's printf/scanf or the MCUXpresso SDK printf/scanf.

```
#if SDK_DEBUGCONSOLE == DEBUGCONSOLE_DISABLE /* Disable debug console */
#define PRINTF
#define SCANF
#define PUTCHAR
#define GETCHAR
#elif SDK_DEBUGCONSOLE == DEBUGCONSOLE_REDIRECT_TO_SDK /* Select printf, scanf, putchar, getchar of SDK
```

```

        version. */
#define PRINTF DbgConsole_Printf
#define SCANF DbgConsole_Scanf
#define PUTCHAR DbgConsole_Putchar
#define GETCHAR DbgConsole_Getchar
#elif SDK_DEBUGCONSOLE == DEBUGCONSOLE_REDIRECT_TO_TOOLCHAIN /* Select printf, scanf, putchar, getchar of
        toolchain. */
#define PRINTF printf
#define SCANF scanf
#define PUTCHAR putchar
#define GETCHAR getchar
#endif /* SDK_DEBUGCONSOLE */

```

### 22.2.3 SDK\_DEBUGCONSOLE and SDK\_DEBUGCONSOLE\_UART

There are two macros `SDK_DEBUGCONSOLE` and `SDK_DEBUGCONSOLE_UART` added to configure `PRINTF` and low level output peripheral.

- The macro `SDK_DEBUGCONSOLE` is used for frontend. Whether debug console redirect to toolchain or SDK or disabled, it decides which is the frontend of the debug console, Tool chain or SDK. The function can be set by the macro `SDK_DEBUGCONSOLE`.
- The macro `SDK_DEBUGCONSOLE_UART` is used for backend. It is used to decide whether provide low level IO implementation to toolchain `printf` and `scanf`. For example, within MCUXpresso, if the macro `SDK_DEBUGCONSOLE_UART` is defined, `__sys_write` and `__sys_readc` will be used when `__REDLIB__` is defined; `_write` and `_read` will be used in other cases. The macro does not specifically refer to the peripheral "UART". It refers to the external peripheral similar to UART, like as USB CDC, UART, SWO, etc. So if the macro `SDK_DEBUGCONSOLE_UART` is not defined when tool-chain `printf` is calling, the semihosting will be used.

The following matrix shows the effects of `SDK_DEBUGCONSOLE` and `SDK_DEBUGCONSOLE_UART` on `PRINTF` and `printf`. The green mark is the default setting of the debug console.

<b>SDK_DEBUGCONSOLE</b>	<b>SDK_DEBUGCONSOLE_UART</b>	<b>PRINTF</b>	<b>printf</b>
DEBUGCONSOLE_- REDIRECT_TO_SDK	defined	Low level peripheral*	Low level peripheral
DEBUGCONSOLE_- REDIRECT_TO_SDK	undefined	Low level peripheral*	semihost
DEBUGCONSOLE_- REDIRECT_TO_TO- OLCHAIN	defined	Low level peripheral*	Low level peripheral
DEBUGCONSOLE_- REDIRECT_TO_TO- OLCHAIN	undefined	semihost	semihost
DEBUGCONSOLE_- DISABLE	defined	No output	Low level peripheral
DEBUGCONSOLE_- DISABLE	undefined	No output	semihost

\* the **low level peripheral** could be USB CDC, UART, or SWO, and so on.

## 22.3 Typical use case

### Some examples use the PUTCHAR & GETCHAR function

```
ch = GETCHAR();
PUTCHAR(ch);
```

### Some examples use the PRINTF function

Statement prints the string format.

```
PRINTF("%s %s\r\n", "Hello", "world!");
```

Statement prints the hexadecimal format/

```
PRINTF("0x%02X hexadecimal number equivalents 255", 255);
```

Statement prints the decimal floating point and unsigned decimal.

```
PRINTF("Execution timer: %s\n\rTime: %u ticks %2.5f milliseconds\n\rDONE\n\r", "1 day", 86400, 86.4);
```

### Some examples use the SCANF function

```
PRINTF("Enter a decimal number: ");
SCANF("%d", &i);
PRINTF("\r\nYou have entered %d.\r\n", i, i);
PRINTF("Enter a hexadecimal number: ");
SCANF("%x", &i);
PRINTF("\r\nYou have entered 0x%X (%d).\r\n", i, i);
```

### Print out failure messages using MCUXpresso SDK \_\_assert\_func:

```
void __assert_func(const char *file, int line, const char *func, const char *failedExpr)
{
    PRINTF("ASSERT ERROR \\" %s \": file \"%s\" Line \"%d\" function name \"%s\" \n", failedExpr, file
    , line, func);
    for (;;)
    {}
}
```

### Note:

To use 'printf' and 'scanf' for GNUC Base, add file 'fsl\_sbrk.c' in path: ..\{package}\devices\{subset}\utilities\fsl-  
\_sbrk.c to your project.

## Modules

- [SWO](#)
- [Semihosting](#)

## Macros

- #define [DEBUGCONSOLE\\_REDIRECT\\_TO\\_TOOLCHAIN](#) 0U  
*Definition select redirect toolchain printf, scanf to uart or not.*
- #define [DEBUGCONSOLE\\_REDIRECT\\_TO\\_SDK](#) 1U  
*Select SDK version printf, scanf.*
- #define [DEBUGCONSOLE\\_DISABLE](#) 2U  
*Disable debugconsole function.*
- #define [SDK\\_DEBUGCONSOLE](#) [DEBUGCONSOLE\\_REDIRECT\\_TO\\_SDK](#)  
*Definition to select sdk or toolchain printf, scanf.*
- #define [PRINTF](#) [DbgConsole\\_Printf](#)  
*Definition to select redirect toolchain printf, scanf to uart or not.*

## Typedefs

- typedef void(\* [printfCb](#) )(char \*buf, int32\_t \*indicator, char val, int len)  
*A function pointer which is used when format printf log.*

## Functions

- int [StrFormatPrintf](#) (const char \*fmt, va\_list ap, char \*buf, [printfCb](#) cb)  
*This function outputs its parameters according to a formatted string.*
- int [StrFormatScanf](#) (const char \*line\_ptr, char \*format, va\_list args\_ptr)  
*Converts an input line of ASCII characters based upon a provided string format.*

## Variables

- [serial\\_handle\\_t](#) g\_serialHandle  
*serial manager handle*

## Initialization

- [status\\_t](#) [DbgConsole\\_Init](#) (uint8\_t instance, uint32\_t baudRate, [serial\\_port\\_type\\_t](#) device, uint32\_t clkSrcFreq)  
*Initializes the peripheral used for debug messages.*
- [status\\_t](#) [DbgConsole\\_Deinit](#) (void)  
*De-initializes the peripheral used for debug messages.*
- [status\\_t](#) [DbgConsole\\_EnterLowpower](#) (void)  
*Prepares to enter low power consumption.*
- [status\\_t](#) [DbgConsole\\_ExitLowpower](#) (void)  
*Restores from low power consumption.*
- int [DbgConsole\\_Printf](#) (const char \*fmt\_s,...)  
*Writes formatted output to the standard output stream.*
- int [DbgConsole\\_Vprintf](#) (const char \*fmt\_s, va\_list formatStringArg)  
*Writes formatted output to the standard output stream.*
- int [DbgConsole\\_Putchar](#) (int ch)

- *Writes a character to stdout.*
- `int DbgConsole_Scanf (char *fmt_s,...)`  
*Reads formatted data from the standard input stream.*
- `int DbgConsole_Getchar (void)`  
*Reads a character from standard input.*
- `int DbgConsole_BlockingPrintf (const char *fmt_s,...)`  
*Writes formatted output to the standard output stream with the blocking mode.*
- `int DbgConsole_BlockingVprintf (const char *fmt_s, va_list formatStringArg)`  
*Writes formatted output to the standard output stream with the blocking mode.*
- `status_t DbgConsole_Flush (void)`  
*Debug console flush.*

## 22.4 Macro Definition Documentation

### 22.4.1 #define DEBUGCONSOLE\_REDIRECT\_TO\_TOOLCHAIN 0U

Select toolchain printf and scanf.

### 22.4.2 #define DEBUGCONSOLE\_REDIRECT\_TO\_SDK 1U

### 22.4.3 #define DEBUGCONSOLE\_DISABLE 2U

### 22.4.4 #define SDK\_DEBUGCONSOLE DEBUGCONSOLE\_REDIRECT\_TO\_SDK

The macro only support to be redefined in project setting.

### 22.4.5 #define PRINTF DbgConsole\_Printf

if SDK\_DEBUGCONSOLE defined to 0,it represents select toolchain printf, scanf. if SDK\_DEBUGCONSOLE defined to 1,it represents select SDK version printf, scanf. if SDK\_DEBUGCONSOLE defined to 2,it represents disable debugconsole function.

## 22.5 Function Documentation

### 22.5.1 status\_t DbgConsole\_Init ( uint8\_t instance, uint32\_t baudRate, serial\_port\_type\_t device, uint32\_t clkSrcFreq )

Call this function to enable debug log messages to be output via the specified peripheral initialized by the serial manager module. After this function has returned, stdout and stdin are connected to the selected peripheral.



## Parameters

<i>instance</i>	The instance of the module.If the device is kSerialPort_Uart, the instance is UART peripheral instance. The UART hardware peripheral type is determined by UART adapter. For example, if the instance is 1, if the lpuart_adapter.c is added to the current project, the UART peripheral is LPUART1. If the uart_adapter.c is added to the current project, the UART peripheral is UART1.
<i>baudRate</i>	The desired baud rate in bits per second.
<i>device</i>	Low level device type for the debug console, can be one of the following. <ul style="list-style-type: none"> <li>• kSerialPort_Uart,</li> <li>• kSerialPort_UsbCdc</li> </ul>
<i>clkSrcFreq</i>	Frequency of peripheral source clock.

## Returns

Indicates whether initialization was successful or not.

## Return values

<i>kStatus_Success</i>	Execution successfully
------------------------	------------------------

### 22.5.2 status\_t DbgConsole\_Deinit ( void )

Call this function to disable debug log messages to be output via the specified peripheral initialized by the serial manager module.

## Returns

Indicates whether de-initialization was successful or not.

### 22.5.3 status\_t DbgConsole\_EnterLowpower ( void )

This function is used to prepare to enter low power consumption.

## Returns

Indicates whether de-initialization was successful or not.

**22.5.4 status\_t DbgConsole\_ExitLowpower ( void )**

This function is used to restore from low power consumption.

Returns

Indicates whether de-initialization was successful or not.

**22.5.5 int DbgConsole\_Printf ( const char \* *fmt\_s*, ... )**

Call this function to write a formatted output to the standard output stream.

Parameters

<i>fmt_s</i>	Format control string.
--------------	------------------------

Returns

Returns the number of characters printed or a negative value if an error occurs.

**22.5.6 int DbgConsole\_Vprintf ( const char \* *fmt\_s*, va\_list *formatStringArg* )**

Call this function to write a formatted output to the standard output stream.

Parameters

<i>fmt_s</i>	Format control string.
<i>formatString-Arg</i>	Format arguments.

Returns

Returns the number of characters printed or a negative value if an error occurs.

**22.5.7 int DbgConsole\_Putchar ( int *ch* )**

Call this function to write a character to stdout.

## Parameters

<i>ch</i>	Character to be written.
-----------	--------------------------

## Returns

Returns the character written.

### 22.5.8 int DbgConsole\_Scanf ( char \* *fmt\_s*, ... )

Call this function to read formatted data from the standard input stream.

## Note

Due the limitation in the BM OSA environment (CPU is blocked in the function, other tasks will not be scheduled), the function cannot be used when the `DEBUG_CONSOLE_TRANSFER_NON_BLOCKING` is set in the BM OSA environment. And an error is returned when the function called in this case. The suggestion is that polling the non-blocking function `DbgConsole_TryGetchar` to get the input char.

## Parameters

<i>fmt_s</i>	Format control string.
--------------	------------------------

## Returns

Returns the number of fields successfully converted and assigned.

### 22.5.9 int DbgConsole\_Getchar ( void )

Call this function to read a character from standard input.

## Note

Due the limitation in the BM OSA environment (CPU is blocked in the function, other tasks will not be scheduled), the function cannot be used when the `DEBUG_CONSOLE_TRANSFER_NON_BLOCKING` is set in the BM OSA environment. And an error is returned when the function called in this case. The suggestion is that polling the non-blocking function `DbgConsole_TryGetchar` to get the input char.

## Returns

Returns the character read.

### 22.5.10 int DbgConsole\_BlockingPrintf ( const char \* *fmt\_s*, ... )

Call this function to write a formatted output to the standard output stream with the blocking mode. The function will send data with blocking mode no matter the DEBUG\_CONSOLE\_TRANSFER\_NON\_BLOCKING set or not. The function could be used in system ISR mode with DEBUG\_CONSOLE\_TRANSFER\_NON\_BLOCKING set.

Parameters

<i>fmt_s</i>	Format control string.
--------------	------------------------

Returns

Returns the number of characters printed or a negative value if an error occurs.

### 22.5.11 int DbgConsole\_BlockingVprintf ( const char \* *fmt\_s*, va\_list *formatStringArg* )

Call this function to write a formatted output to the standard output stream with the blocking mode. The function will send data with blocking mode no matter the DEBUG\_CONSOLE\_TRANSFER\_NON\_BLOCKING set or not. The function could be used in system ISR mode with DEBUG\_CONSOLE\_TRANSFER\_NON\_BLOCKING set.

Parameters

<i>fmt_s</i>	Format control string.
<i>formatStringArg</i>	Format arguments.

Returns

Returns the number of characters printed or a negative value if an error occurs.

### 22.5.12 status\_t DbgConsole\_Flush ( void )

Call this function to wait the tx buffer empty. If interrupt transfer is using, make sure the global IRQ is enable before call this function This function should be called when 1, before enter power down mode 2, log is required to print to terminal immediately

Returns

Indicates whether wait idle was successful or not.

**22.5.13 int StrFormatPrintf ( const char \* *fmt*, va\_list *ap*, char \* *buf*, printfCb *cb* )**

Note

I/O is performed by calling given function pointer using following (\*func\_ptr)(c);

Parameters

in	<i>fmt</i>	Format string for printf.
in	<i>ap</i>	Arguments to printf.
in	<i>buf</i>	pointer to the buffer
	<i>cb</i>	print callbck function pointer

Returns

Number of characters to be print

**22.5.14 int StrFormatScanf ( const char \* *line\_ptr*, char \* *format*, va\_list *args\_ptr* )**

Parameters

in	<i>line_ptr</i>	The input line of ASCII data.
in	<i>format</i>	Format first points to the format string.
in	<i>args_ptr</i>	The list of parameters.

Returns

Number of input items converted and assigned.

Return values

<i>IO_EOF</i>	When line_ptr is empty string "".
---------------	-----------------------------------

## 22.6 Semihosting

Semihosting is a mechanism for ARM targets to communicate input/output requests from application code to a host computer running a debugger. This mechanism can be used, for example, to enable functions in the C library, such as `printf()` and `scanf()`, to use the screen and keyboard of the host rather than having a screen and keyboard on the target system.

### 22.6.1 Guide Semihosting for IAR

**NOTE:** After the setting both "printf" and "scanf" are available for debugging, if you want use PRINTF with semihosting, please make sure the `SDK_DEBUGCONSOLE` is `DEBUGCONSOLE_REDIRECT_TO_TOOLCHAIN`.

#### Step 1: Setting up the environment

1. To set debugger options, choose Project>Options. In the Debugger category, click the Setup tab.
2. Select Run to main and click OK. This ensures that the debug session starts by running the main function.
3. The project is now ready to be built.

#### Step 2: Building the project

1. Compile and link the project by choosing Project>Make or F7.
2. Alternatively, click the Make button on the tool bar. The Make command compiles and links those files that have been modified.

#### Step 3: Starting semihosting

1. Choose "Semihosting\_IAR" project -> "Options" -> "Debugger" -> "J-Link/J-Trace".
2. Choose tab "J-Link/J-Trace" -> "Connection" tab -> "SWD".
3. Choose tab "General Options" -> "Library Configurations", select Semihosted, select Via semihosting. Please Make sure the `SDK_DEBUGCONSOLE_UART` is not defined in project settings.
4. Start the project by choosing Project>Download and Debug.
5. Choose View>Terminal I/O to display the output from the I/O operations.

### 22.6.2 Guide Semihosting for Keil µVision

**NOTE:** Semihosting is not support by MDK-ARM, use the retargeting functionality of MDK-ARM instead.

### 22.6.3 Guide Semihosting for MCUXpresso IDE

#### Step 1: Setting up the environment

1. To set debugger options, choose Project>Properties. select the setting category.
2. Select Tool Settings, unfold MCU C Compile.
3. Select Preprocessor item.
4. Set SDK\_DEBUGCONSOLE=0, if set SDK\_DEBUGCONSOLE=1, the log will be redirect to the UART.

#### Step 2: Building the project

1. Compile and link the project.

#### Step 3: Starting semihosting

1. Download and debug the project.
2. When the project runs successfully, the result can be seen in the Console window.

Semihosting can also be selected through the "Quick settings" menu in the left bottom window, Quick settings->SDK Debug Console->Semihost console.

### 22.6.4 Guide Semihosting for ARMGCC

#### Step 1: Setting up the environment

1. Turn on "J-LINK GDB Server" -> Select suitable "Target device" -> "OK".
2. Turn on "PuTTY". Set up as follows.
  - "Host Name (or IP address)" : localhost
  - "Port" :2333
  - "Connection type" : Telet.
  - Click "Open".
3. Increase "Heap/Stack" for GCC to 0x2000:

#### Add to "CMakeLists.txt"

```
SET(CMAKE_EXE_LINKER_FLAGS_RELEASE "${CMAKE_EXE_LINKER_FLAGS_RELEASE}
--defsym=__stack_size__=0x2000")

SET(CMAKE_EXE_LINKER_FLAGS_DEBUG "${CMAKE_EXE_LINKER_FLAGS_DEBUG} --
defsym=__stack_size__=0x2000")

SET(CMAKE_EXE_LINKER_FLAGS_DEBUG "${CMAKE_EXE_LINKER_FLAGS_DEBUG} --
defsym=__heap_size__=0x2000")

SET(CMAKE_EXE_LINKER_FLAGS_RELEASE "${CMAKE_EXE_LINKER_FLAGS_RELEASE}
--defsym=__heap_size__=0x2000")
```

**Step 2: Building the project**

1. Change "CMakeLists.txt":

**Change** "SET(CMAKE\_EXE\_LINKER\_FLAGS\_RELEASE "\${CMAKE\_EXE\_LINKER\_FLAGS\_RELEASE} -specs=nano.specs")"

**to** "SET(CMAKE\_EXE\_LINKER\_FLAGS\_RELEASE "\${CMAKE\_EXE\_LINKER\_FLAGS\_RELEASE} -specs=rdimon.specs")"

**Replace paragraph**

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -fno-common")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -ffunction-sections")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -fdata-sections")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -ffreestanding")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -fno-builtin")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -mthumb")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -mapcs")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -Xlinker")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} --gc-sections")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -Xlinker")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -static")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -Xlinker")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -z")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} -Xlinker")

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} muldefs")

**To**

SET(CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG "\${CMAKE\_EXE\_LINKER\_FLAGS\_DEBUG} --specs=rdimon.specs ")

**Remove**

target\_link\_libraries(semihosting\_ARMGCC.elf debug nosys)

2. Run "build\_debug.bat" to build project



### Step 3: Starting semihosting

1. Download the image and set as follows.

```
cd D:\mcu-sdk-2.0-origin\boards\twrk64f120m\driver_examples\semihosting\armgcc\debug
d:
C:\PROGRA~2\GNUTOO~1\4BD65~1.920\bin\arm-none-eabi-gdb.exe
target remote localhost:2331
monitor reset
monitor semihosting enable
monitor semihosting thumbSWI 0xAB
monitor semihosting IOClient 1
monitor flash device = MK64FN1M0xxx12
load semihosting_ARMGCC.elf
monitor reg pc = (0x00000004)
monitor reg sp = (0x00000000)
continue
```

2. After the setting, press "enter". The PuTTY window now shows the printf() output.

## 22.7 SWO

Serial wire output is a mechanism for ARM targets to output signal from core through a single pin. Some IDEs also support SWO, such IAR and KEIL, both input and output are supported, see below for details.

### 22.7.1 Guide SWO for SDK

**NOTE:** After the setting both "printf" and "PRINTF" are available for debugging, JlinkSWOViewer can be used to capture the output log.

#### Step 1: Setting up the environment

1. Define SERIAL\_PORT\_TYPE\_SWO in your project settings.
2. Prepare code, the port and baudrate can be decided by application, clkSrcFreq should be mcu core clock frequency:

```
DbgConsole_Init(instance, baudRate, kSerialPort_Swo, clkSrcFreq);
```

3. Use PRINTF or printf to print some thing in application.

#### Step 2: Building the project

#### Step 3: Download and run project

#### 22.7.1.1 Guide SWO for IAR

**NOTE:** After the setting both "printf" and "scanf" are available for debugging.

#### Step 1: Setting up the environment

1. Choose project -> "Options" -> "Debugger" -> "J-Link/J-Trace".
2. Choose tab "J-Link/J-Trace" -> "Connection" tab -> "SWD".
3. Choose tab "General Options" -> "Library Configurations", select Semihosted, select Via SWO.
4. To configure the hardware's generation of trace data, click the SWO Configuration button available in the SWO Configuration dialog box. The value of the CPU clock option must reflect the frequency of the CPU clock speed at which the application executes. Note also that the settings you make are preserved between debug sessions. To decrease the amount of transmissions on the communication channel, you can disable the Timestamp option. Alternatively, set a lower rate for PC Sampling or use a higher SWO clock frequency.
5. Open the SWO Trace window from J-LINK, and click the Activate button to enable trace data collection.
6. There are three cases for this SDK\_DEBUGCONSOLE\_UART whether or not defined. a: if use uppercase PRINTF to output log, The SDK\_DEBUGCONSOLE\_UART defined or not defined will not effect debug function. b: if use lowercase printf to output log and defined SDK\_DEBUGCONSOLE\_UART to zero, then debug function ok. c: if use lowercase printf to output log and defined SDK\_DEBUGCONSOLE\_UART to one, then debug function ok.

**NOTE:** Case a or c only apply at example which enable swo function,the SDK\_DEBUGCONSOLE\_UART definition in fsl\_debug\_console.h. For case a and c, Do and not do the above third step will be not affect function.

1. Start the project by choosing Project>Download and Debug.

### **Step 2: Building the project**

### **Step 3: Starting swo**

1. Download and debug application.
2. Choose View -> Terminal I/O to display the output from the I/O operations.
3. Run application.

## **22.7.2 Guide SWO for Keil $\mu$ Vision**

**NOTE:** After the setting both "printf" and "scanf" are available for debugging.

### **Step 1: Setting up the environment**

1. There are three cases for this SDK\_DEBUGCONSOLE\_UART whether or not defined. a: if use uppercase PRINTF to output log,the SDK\_DEBUGCONSOLE\_UART definition does not affect the functionality and skip the second step directly. b: if use lowercase printf to output log and defined SDK\_DEBUGCONSOLE\_UART to zero,then start the second step. c: if use lowercase printf to output log and defined SDK\_DEBUGCONSOLE\_UART to one,then skip the second step directly.

**NOTE:** Case a or c only apply at example which enable swo function,the SDK\_DEBUGCONSOLE\_UART definition in fsl\_debug\_console.h.

1. In menu bar, click Management Run-Time Environment icon, select Compiler, unfold I/O, enable STDERR/STDIN/STDOUT and set the variant to ITM.
2. Open Project>Options for target or using Alt+F7 or click.
3. Select "Debug" tab, select "J-Link/J-Trace Cortex" and click "Setting button".
4. Select "Debug" tab and choose Port:SW, then select "Trace" tab, choose "Enable" and click O-K, please make sure the Core clock is set correctly, enable autodetect max SWO clk, enable ITM Stimulus Ports 0.

### **Step 3: Building the project**

1. Compile and link the project by choosing Project>Build Target or using F7.

### **Step 4: Run the project**

1. Choose "Debug" on menu bar or Ctrl F5.
2. In menu bar, choose "Serial Window" and click to "Debug (printf) Viewer".
3. Run line by line to see result in Console Window.

### 22.7.3 Guide SWO for MCUXpresso IDE

**NOTE:** MCUX support SWO for LPC-Link2 debug probe only.

### 22.7.4 Guide SWO for ARMGCC

**NOTE:** ARMGCC has no library support SWO.



## Chapter 23

# CODEC Driver

### 23.1 Overview

The MCUXpresso SDK provides a codec abstraction driver interface to access codec register.

#### Modules

- [CODEC Common Driver](#)
- [CODEC I2C Driver](#)
- [WM8524 Driver](#)

## 23.2 CODEC Common Driver

### 23.2.1 Overview

The codec common driver provides a codec control abstraction interface.

#### Modules

- [CODEC Adapter](#)
- [WM8524 Adapter](#)

#### Data Structures

- struct [codec\\_config\\_t](#)  
*Initialize structure of the codec. [More...](#)*
- struct [codec\\_capability\\_t](#)  
*codec capability [More...](#)*
- struct [codec\\_handle\\_t](#)  
*Codec handle definition. [More...](#)*

#### Macros

- #define [CODEC\\_VOLUME\\_MAX\\_VALUE](#) (100U)  
*codec maximum volume range*

#### Enumerations

- enum {  
  [kStatus\\_CODEC\\_NotSupport](#) = MAKE\_STATUS(kStatusGroup\_CODEC, 0U),  
  [kStatus\\_CODEC\\_DeviceNotRegistered](#) = MAKE\_STATUS(kStatusGroup\_CODEC, 1U),  
  [kStatus\\_CODEC\\_I2CBusInitialFailed](#),  
  [kStatus\\_CODEC\\_I2CCommandTransferFailed](#) }  
  *CODEC status.*
- enum [codec\\_audio\\_protocol\\_t](#) {  
  [kCODEC\\_BusI2S](#) = 0U,  
  [kCODEC\\_BusLeftJustified](#) = 1U,  
  [kCODEC\\_BusRightJustified](#) = 2U,  
  [kCODEC\\_BusPCMA](#) = 3U,  
  [kCODEC\\_BusPCMB](#) = 4U,  
  [kCODEC\\_BusTDM](#) = 5U }  
  *AUDIO format definition.*

- enum {
  - kCODEC\_AudioSampleRate8KHz = 8000U,
  - kCODEC\_AudioSampleRate11025Hz = 11025U,
  - kCODEC\_AudioSampleRate12KHz = 12000U,
  - kCODEC\_AudioSampleRate16KHz = 16000U,
  - kCODEC\_AudioSampleRate22050Hz = 22050U,
  - kCODEC\_AudioSampleRate24KHz = 24000U,
  - kCODEC\_AudioSampleRate32KHz = 32000U,
  - kCODEC\_AudioSampleRate44100Hz = 44100U,
  - kCODEC\_AudioSampleRate48KHz = 48000U,
  - kCODEC\_AudioSampleRate96KHz = 96000U,
  - kCODEC\_AudioSampleRate192KHz = 192000U,
  - kCODEC\_AudioSampleRate384KHz = 384000U }*audio sample rate definition*
- enum {
  - kCODEC\_AudioBitWidth16bit = 16U,
  - kCODEC\_AudioBitWidth20bit = 20U,
  - kCODEC\_AudioBitWidth24bit = 24U,
  - kCODEC\_AudioBitWidth32bit = 32U }*audio bit width*
- enum codec\_module\_t {
  - kCODEC\_ModuleADC = 0U,
  - kCODEC\_ModuleDAC = 1U,
  - kCODEC\_ModulePGA = 2U,
  - kCODEC\_ModuleHeadphone = 3U,
  - kCODEC\_ModuleSpeaker = 4U,
  - kCODEC\_ModuleLinein = 5U,
  - kCODEC\_ModuleLineout = 6U,
  - kCODEC\_ModuleVref = 7U,
  - kCODEC\_ModuleMicbias = 8U,
  - kCODEC\_ModuleMic = 9U,
  - kCODEC\_ModuleI2SIn = 10U,
  - kCODEC\_ModuleI2SOut = 11U,
  - kCODEC\_ModuleMixer = 12U }*audio codec module*
- enum codec\_module\_ctrl\_cmd\_t { kCODEC\_ModuleSwitchI2SInInterface = 0U }
 *audio codec module control cmd*
- enum {
  - kCODEC\_ModuleI2SInInterfacePCM = 0U,
  - kCODEC\_ModuleI2SInInterfaceDSD = 1U }*audio codec module digital interface*
- enum {
  - kCODEC\_RecordSourceDifferentialLine = 1U,
  - kCODEC\_RecordSourceLineInput = 2U,
  - kCODEC\_RecordSourceDifferentialMic = 4U,
  - kCODEC\_RecordSourceDigitalMic = 8U,

`kCODEC_RecordSourceSingleEndMic = 16U }`

*audio codec module record source value*

- enum {
  - `kCODEC_RecordChannelLeft1 = 1U,`
  - `kCODEC_RecordChannelLeft2 = 2U,`
  - `kCODEC_RecordChannelLeft3 = 4U,`
  - `kCODEC_RecordChannelRight1 = 1U,`
  - `kCODEC_RecordChannelRight2 = 2U,`
  - `kCODEC_RecordChannelRight3 = 4U,`
  - `kCODEC_RecordChannelDifferentialPositive1 = 1U,`
  - `kCODEC_RecordChannelDifferentialPositive2 = 2U,`
  - `kCODEC_RecordChannelDifferentialPositive3 = 4U,`
  - `kCODEC_RecordChannelDifferentialNegative1 = 8U,`
  - `kCODEC_RecordChannelDifferentialNegative2 = 16U,`
  - `kCODEC_RecordChannelDifferentialNegative3 = 32U }`

*audio codec record channel*

- enum {
  - `kCODEC_PlaySourcePGA = 1U,`
  - `kCODEC_PlaySourceInput = 2U,`
  - `kCODEC_PlaySourceDAC = 4U,`
  - `kCODEC_PlaySourceMixerIn = 1U,`
  - `kCODEC_PlaySourceMixerInLeft = 2U,`
  - `kCODEC_PlaySourceMixerInRight = 4U,`
  - `kCODEC_PlaySourceAux = 8U }`

*audio codec module play source value*

- enum {
  - `kCODEC_PlayChannelHeadphoneLeft = 1U,`
  - `kCODEC_PlayChannelHeadphoneRight = 2U,`
  - `kCODEC_PlayChannelSpeakerLeft = 4U,`
  - `kCODEC_PlayChannelSpeakerRight = 8U,`
  - `kCODEC_PlayChannelLineOutLeft = 16U,`
  - `kCODEC_PlayChannelLineOutRight = 32U,`
  - `kCODEC_PlayChannelLeft0 = 1U,`
  - `kCODEC_PlayChannelRight0 = 2U,`
  - `kCODEC_PlayChannelLeft1 = 4U,`
  - `kCODEC_PlayChannelRight1 = 8U,`
  - `kCODEC_PlayChannelLeft2 = 16U,`
  - `kCODEC_PlayChannelRight2 = 32U,`
  - `kCODEC_PlayChannelLeft3 = 64U,`
  - `kCODEC_PlayChannelRight3 = 128U }`

*codec play channel*

- enum {



```
kCODEC_VolumeHeadphoneLeft = 1U,  
kCODEC_VolumeHeadphoneRight = 2U,  
kCODEC_VolumeSpeakerLeft = 4U,  
kCODEC_VolumeSpeakerRight = 8U,  
kCODEC_VolumeLineOutLeft = 16U,  
kCODEC_VolumeLineOutRight = 32U,  
kCODEC_VolumeLeft0 = 1UL << 0U,  
kCODEC_VolumeRight0 = 1UL << 1U,  
kCODEC_VolumeLeft1 = 1UL << 2U,  
kCODEC_VolumeRight1 = 1UL << 3U,  
kCODEC_VolumeLeft2 = 1UL << 4U,  
kCODEC_VolumeRight2 = 1UL << 5U,  
kCODEC_VolumeLeft3 = 1UL << 6U,  
kCODEC_VolumeRight3 = 1UL << 7U,  
kCODEC_VolumeDAC = 1UL << 8U }
```

*codec volume setting*

- enum {

```

kCODEC_SupportModuleADC = 1U << 0U,
kCODEC_SupportModuleDAC = 1U << 1U,
kCODEC_SupportModulePGA = 1U << 2U,
kCODEC_SupportModuleHeadphone = 1U << 3U,
kCODEC_SupportModuleSpeaker = 1U << 4U,
kCODEC_SupportModuleLinein = 1U << 5U,
kCODEC_SupportModuleLineout = 1U << 6U,
kCODEC_SupportModuleVref = 1U << 7U,
kCODEC_SupportModuleMicbias = 1U << 8U,
kCODEC_SupportModuleMic = 1U << 9U,
kCODEC_SupportModuleI2SIn = 1U << 10U,
kCODEC_SupportModuleI2SOut = 1U << 11U,
kCODEC_SupportModuleMixer = 1U << 12U,
kCODEC_SupportModuleI2SInSwitchInterface = 1U << 13U,
kCODEC_SupportPlayChannelLeft0 = 1U << 0U,
kCODEC_SupportPlayChannelRight0 = 1U << 1U,
kCODEC_SupportPlayChannelLeft1 = 1U << 2U,
kCODEC_SupportPlayChannelRight1 = 1U << 3U,
kCODEC_SupportPlayChannelLeft2 = 1U << 4U,
kCODEC_SupportPlayChannelRight2 = 1U << 5U,
kCODEC_SupportPlayChannelLeft3 = 1U << 6U,
kCODEC_SupportPlayChannelRight3 = 1U << 7U,
kCODEC_SupportPlaySourcePGA = 1U << 8U,
kCODEC_SupportPlaySourceInput = 1U << 9U,
kCODEC_SupportPlaySourceDAC = 1U << 10U,
kCODEC_SupportPlaySourceMixerIn = 1U << 11U,
kCODEC_SupportPlaySourceMixerInLeft = 1U << 12U,
kCODEC_SupportPlaySourceMixerInRight = 1U << 13U,
kCODEC_SupportPlaySourceAux = 1U << 14U,
kCODEC_SupportRecordSourceDifferentialLine = 1U << 0U,
kCODEC_SupportRecordSourceLineInput = 1U << 1U,
kCODEC_SupportRecordSourceDifferentialMic = 1U << 2U,
kCODEC_SupportRecordSourceDigitalMic = 1U << 3U,
kCODEC_SupportRecordSourceSingleEndMic = 1U << 4U,
kCODEC_SupportRecordChannelLeft1 = 1U << 6U,
kCODEC_SupportRecordChannelLeft2 = 1U << 7U,
kCODEC_SupportRecordChannelLeft3 = 1U << 8U,
kCODEC_SupportRecordChannelRight1 = 1U << 9U,
kCODEC_SupportRecordChannelRight2 = 1U << 10U,
kCODEC_SupportRecordChannelRight3 = 1U << 11U }

```

*audio codec capability*

## Functions

- `status_t CODEC_Init` (`codec_handle_t *handle`, `codec_config_t *config`)  
*Codec initialization.*
- `status_t CODEC_Deinit` (`codec_handle_t *handle`)  
*Codec de-initialization.*
- `status_t CODEC_SetFormat` (`codec_handle_t *handle`, `uint32_t mclk`, `uint32_t sampleRate`, `uint32_t bitWidth`)  
*set audio data format.*
- `status_t CODEC_ModuleControl` (`codec_handle_t *handle`, `codec_module_ctrl_cmd_t cmd`, `uint32_t data`)  
*codec module control.*
- `status_t CODEC_SetVolume` (`codec_handle_t *handle`, `uint32_t channel`, `uint32_t volume`)  
*set audio codec pl volume.*
- `status_t CODEC_SetMute` (`codec_handle_t *handle`, `uint32_t channel`, `bool mute`)  
*set audio codec module mute.*
- `status_t CODEC_SetPower` (`codec_handle_t *handle`, `codec_module_t module`, `bool powerOn`)  
*set audio codec power.*
- `status_t CODEC_SetRecord` (`codec_handle_t *handle`, `uint32_t recordSource`)  
*codec set record source.*
- `status_t CODEC_SetRecordChannel` (`codec_handle_t *handle`, `uint32_t leftRecordChannel`, `uint32_t rightRecordChannel`)  
*codec set record channel.*
- `status_t CODEC_SetPlay` (`codec_handle_t *handle`, `uint32_t playSource`)  
*codec set play source.*

## Driver version

- `#define FSL_CODEC_DRIVER_VERSION (MAKE_VERSION(2, 3, 1))`  
*CLOCK driver version 2.3.1.*

## 23.2.2 Data Structure Documentation

### 23.2.2.1 struct codec\_config\_t

#### Data Fields

- `uint32_t codecDevType`  
*codec type*
- `void * codecDevConfig`  
*Codec device specific configuration.*

### 23.2.2.2 struct codec\_capability\_t

#### Data Fields

- uint32\_t [codecModuleCapability](#)  
*codec module capability*
- uint32\_t [codecPlayCapability](#)  
*codec play capability*
- uint32\_t [codecRecordCapability](#)  
*codec record capability*
- uint32\_t [codecVolumeCapability](#)  
*codec volume capability*

### 23.2.2.3 struct \_codec\_handle

codec handle declaration

- Application should allocate a buffer with CODEC\_HANDLE\_SIZE for handle definition, such as uint8\_t codecHandleBuffer[CODEC\_HANDLE\_SIZE]; codec\_handle\_t \*codecHandle = codecHandleBuffer;

#### Data Fields

- [codec\\_config\\_t](#) \* [codecConfig](#)  
*codec configuration function pointer*
- const [codec\\_capability\\_t](#) \* [codecCapability](#)  
*codec capability*
- uint8\_t [codecDevHandle](#) [HAL\_CODEC\_HANDLER\_SIZE]  
*codec device handle*

## 23.2.3 Macro Definition Documentation

### 23.2.3.1 #define FSL\_CODEC\_DRIVER\_VERSION (MAKE\_VERSION(2, 3, 1))

## 23.2.4 Enumeration Type Documentation

### 23.2.4.1 anonymous enum

Enumerator

***kStatus\_CODEC\_NotSupport*** CODEC not support status.

***kStatus\_CODEC\_DeviceNotRegistered*** CODEC device register failed status.

***kStatus\_CODEC\_I2CBusInitialFailed*** CODEC i2c bus initialization failed status.

***kStatus\_CODEC\_I2CCommandTransferFailed*** CODEC i2c bus command transfer failed status.

**23.2.4.2 enum codec\_audio\_protocol\_t**

Enumerator

*kCODEC\_BusI2S* I2S type.  
*kCODEC\_BusLeftJustified* Left justified mode.  
*kCODEC\_BusRightJustified* Right justified mode.  
*kCODEC\_BusPCMA* DSP/PCM A mode.  
*kCODEC\_BusPCMB* DSP/PCM B mode.  
*kCODEC\_BusTDM* TDM mode.

**23.2.4.3 anonymous enum**

Enumerator

*kCODEC\_AudioSampleRate8KHz* Sample rate 8000 Hz.  
*kCODEC\_AudioSampleRate11025Hz* Sample rate 11025 Hz.  
*kCODEC\_AudioSampleRate12KHz* Sample rate 12000 Hz.  
*kCODEC\_AudioSampleRate16KHz* Sample rate 16000 Hz.  
*kCODEC\_AudioSampleRate22050Hz* Sample rate 22050 Hz.  
*kCODEC\_AudioSampleRate24KHz* Sample rate 24000 Hz.  
*kCODEC\_AudioSampleRate32KHz* Sample rate 32000 Hz.  
*kCODEC\_AudioSampleRate44100Hz* Sample rate 44100 Hz.  
*kCODEC\_AudioSampleRate48KHz* Sample rate 48000 Hz.  
*kCODEC\_AudioSampleRate96KHz* Sample rate 96000 Hz.  
*kCODEC\_AudioSampleRate192KHz* Sample rate 192000 Hz.  
*kCODEC\_AudioSampleRate384KHz* Sample rate 384000 Hz.

**23.2.4.4 anonymous enum**

Enumerator

*kCODEC\_AudioBitWidth16bit* audio bit width 16  
*kCODEC\_AudioBitWidth20bit* audio bit width 20  
*kCODEC\_AudioBitWidth24bit* audio bit width 24  
*kCODEC\_AudioBitWidth32bit* audio bit width 32

**23.2.4.5 enum codec\_module\_t**

Enumerator

*kCODEC\_ModuleADC* codec module ADC  
*kCODEC\_ModuleDAC* codec module DAC  
*kCODEC\_ModulePGA* codec module PGA  
*kCODEC\_ModuleHeadphone* codec module headphone

***kCODEC\_ModuleSpeaker*** codec module speaker  
***kCODEC\_ModuleLinein*** codec module linein  
***kCODEC\_ModuleLineout*** codec module lineout  
***kCODEC\_ModuleVref*** codec module VREF  
***kCODEC\_ModuleMicbias*** codec module MIC BIAS  
***kCODEC\_ModuleMic*** codec module MIC  
***kCODEC\_ModuleI2SIn*** codec module I2S in  
***kCODEC\_ModuleI2SOut*** codec module I2S out  
***kCODEC\_ModuleMixer*** codec module mixer

#### 23.2.4.6 enum codec\_module\_ctrl\_cmd\_t

Enumerator

***kCODEC\_ModuleSwitchI2SInInterface*** module digital interface swtch.

#### 23.2.4.7 anonymous enum

Enumerator

***kCODEC\_ModuleI2SInInterfacePCM*** Pcm interface.  
***kCODEC\_ModuleI2SInInterfaceDSD*** DSD interface.

#### 23.2.4.8 anonymous enum

Enumerator

***kCODEC\_RecordSourceDifferentialLine*** record source from differential line  
***kCODEC\_RecordSourceLineInput*** record source from line input  
***kCODEC\_RecordSourceDifferentialMic*** record source from differential mic  
***kCODEC\_RecordSourceDigitalMic*** record source from digital microphone  
***kCODEC\_RecordSourceSingleEndMic*** record source from single microphone

#### 23.2.4.9 anonymous enum

Enumerator

***kCODEC\_RecordChannelLeft1*** left record channel 1  
***kCODEC\_RecordChannelLeft2*** left record channel 2  
***kCODEC\_RecordChannelLeft3*** left record channel 3  
***kCODEC\_RecordChannelRight1*** right record channel 1  
***kCODEC\_RecordChannelRight2*** right record channel 2  
***kCODEC\_RecordChannelRight3*** right record channel 3  
***kCODEC\_RecordChannelDifferentialPositive1*** differential positive record channel 1

<b><i>kCODEC_RecordChannelDifferentialPositive2</i></b>	differential positive record channel 2
<b><i>kCODEC_RecordChannelDifferentialPositive3</i></b>	differential positive record channel 3
<b><i>kCODEC_RecordChannelDifferentialNegative1</i></b>	differential negative record channel 1
<b><i>kCODEC_RecordChannelDifferentialNegative2</i></b>	differential negative record channel 2
<b><i>kCODEC_RecordChannelDifferentialNegative3</i></b>	differential negative record channel 3

#### 23.2.4.10 anonymous enum

Enumerator

<b><i>kCODEC_PlaySourcePGA</i></b>	play source PGA, bypass ADC
<b><i>kCODEC_PlaySourceInput</i></b>	play source Input3
<b><i>kCODEC_PlaySourceDAC</i></b>	play source DAC
<b><i>kCODEC_PlaySourceMixerIn</i></b>	play source mixer in
<b><i>kCODEC_PlaySourceMixerInLeft</i></b>	play source mixer in left
<b><i>kCODEC_PlaySourceMixerInRight</i></b>	play source mixer in right
<b><i>kCODEC_PlaySourceAux</i></b>	play source mixer in AUx

#### 23.2.4.11 anonymous enum

Enumerator

<b><i>kCODEC_PlayChannelHeadphoneLeft</i></b>	play channel headphone left
<b><i>kCODEC_PlayChannelHeadphoneRight</i></b>	play channel headphone right
<b><i>kCODEC_PlayChannelSpeakerLeft</i></b>	play channel speaker left
<b><i>kCODEC_PlayChannelSpeakerRight</i></b>	play channel speaker right
<b><i>kCODEC_PlayChannelLineOutLeft</i></b>	play channel lineout left
<b><i>kCODEC_PlayChannelLineOutRight</i></b>	play channel lineout right
<b><i>kCODEC_PlayChannelLeft0</i></b>	play channel left0
<b><i>kCODEC_PlayChannelRight0</i></b>	play channel right0
<b><i>kCODEC_PlayChannelLeft1</i></b>	play channel left1
<b><i>kCODEC_PlayChannelRight1</i></b>	play channel right1
<b><i>kCODEC_PlayChannelLeft2</i></b>	play channel left2
<b><i>kCODEC_PlayChannelRight2</i></b>	play channel right2
<b><i>kCODEC_PlayChannelLeft3</i></b>	play channel left3
<b><i>kCODEC_PlayChannelRight3</i></b>	play channel right3

#### 23.2.4.12 anonymous enum

Enumerator

<b><i>kCODEC_VolumeHeadphoneLeft</i></b>	headphone left volume
<b><i>kCODEC_VolumeHeadphoneRight</i></b>	headphone right volume
<b><i>kCODEC_VolumeSpeakerLeft</i></b>	speaker left volume
<b><i>kCODEC_VolumeSpeakerRight</i></b>	speaker right volume

*kCODEC\_VolumeLineOutLeft* lineout left volume  
*kCODEC\_VolumeLineOutRight* lineout right volume  
*kCODEC\_VolumeLeft0* left0 volume  
*kCODEC\_VolumeRight0* right0 volume  
*kCODEC\_VolumeLeft1* left1 volume  
*kCODEC\_VolumeRight1* right1 volume  
*kCODEC\_VolumeLeft2* left2 volume  
*kCODEC\_VolumeRight2* right2 volume  
*kCODEC\_VolumeLeft3* left3 volume  
*kCODEC\_VolumeRight3* right3 volume  
*kCODEC\_VolumeDAC* dac volume

### 23.2.4.13 anonymous enum

Enumerator

*kCODEC\_SupportModuleADC* codec capability of module ADC  
*kCODEC\_SupportModuleDAC* codec capability of module DAC  
*kCODEC\_SupportModulePGA* codec capability of module PGA  
*kCODEC\_SupportModuleHeadphone* codec capability of module headphone  
*kCODEC\_SupportModuleSpeaker* codec capability of module speaker  
*kCODEC\_SupportModuleLinein* codec capability of module linein  
*kCODEC\_SupportModuleLineout* codec capability of module lineout  
*kCODEC\_SupportModuleVref* codec capability of module vref  
*kCODEC\_SupportModuleMicbias* codec capability of module mic bias  
*kCODEC\_SupportModuleMic* codec capability of module mic bias  
*kCODEC\_SupportModuleI2SIn* codec capability of module I2S in  
*kCODEC\_SupportModuleI2SOut* codec capability of module I2S out  
*kCODEC\_SupportModuleMixer* codec capability of module mixer  
*kCODEC\_SupportModuleI2SInSwitchInterface* codec capability of module I2S in switch interface

*kCODEC\_SupportPlayChannelLeft0* codec capability of play channel left 0  
*kCODEC\_SupportPlayChannelRight0* codec capability of play channel right 0  
*kCODEC\_SupportPlayChannelLeft1* codec capability of play channel left 1  
*kCODEC\_SupportPlayChannelRight1* codec capability of play channel right 1  
*kCODEC\_SupportPlayChannelLeft2* codec capability of play channel left 2  
*kCODEC\_SupportPlayChannelRight2* codec capability of play channel right 2  
*kCODEC\_SupportPlayChannelLeft3* codec capability of play channel left 3  
*kCODEC\_SupportPlayChannelRight3* codec capability of play channel right 3  
*kCODEC\_SupportPlaySourcePGA* codec capability of set playback source PGA  
*kCODEC\_SupportPlaySourceInput* codec capability of set playback source INPUT  
*kCODEC\_SupportPlaySourceDAC* codec capability of set playback source DAC  
*kCODEC\_SupportPlaySourceMixerIn* codec capability of set play source Mixer in  
*kCODEC\_SupportPlaySourceMixerInLeft* codec capability of set play source Mixer in left  
*kCODEC\_SupportPlaySourceMixerInRight* codec capability of set play source Mixer in right



***kCODEC\_SupportPlaySourceAux*** codec capability of set play source aux

***kCODEC\_SupportRecordSourceDifferentialLine*** codec capability of record source differential line

***kCODEC\_SupportRecordSourceLineInput*** codec capability of record source line input

***kCODEC\_SupportRecordSourceDifferentialMic*** codec capability of record source differential mic

***kCODEC\_SupportRecordSourceDigitalMic*** codec capability of record digital mic

***kCODEC\_SupportRecordSourceSingleEndMic*** codec capability of single end mic

***kCODEC\_SupportRecordChannelLeft1*** left record channel 1

***kCODEC\_SupportRecordChannelLeft2*** left record channel 2

***kCODEC\_SupportRecordChannelLeft3*** left record channel 3

***kCODEC\_SupportRecordChannelRight1*** right record channel 1

***kCODEC\_SupportRecordChannelRight2*** right record channel 2

***kCODEC\_SupportRecordChannelRight3*** right record channel 3

## 23.2.5 Function Documentation

### 23.2.5.1 **status\_t CODEC\_Init ( codec\_handle\_t \* *handle*, codec\_config\_t \* *config* )**

Parameters

<i>handle</i>	codec handle.
<i>config</i>	codec configurations.

Returns

kStatus\_Success is success, else de-initial failed.

### 23.2.5.2 **status\_t CODEC\_Deinit ( codec\_handle\_t \* *handle* )**

Parameters

<i>handle</i>	codec handle.
---------------	---------------

Returns

kStatus\_Success is success, else de-initial failed.

### 23.2.5.3 **status\_t CODEC\_SetFormat ( codec\_handle\_t \* *handle*, uint32\_t *mclk*, uint32\_t *sampleRate*, uint32\_t *bitWidth* )**

## Parameters

<i>handle</i>	codec handle.
<i>mclk</i>	master clock frequency in HZ.
<i>sampleRate</i>	sample rate in HZ.
<i>bitWidth</i>	bit width.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.2.5.4 status\_t CODEC\_ModuleControl ( codec\_handle\_t \* *handle*, codec\_module\_ctrl\_cmd\_t *cmd*, uint32\_t *data* )

This function is used for codec module control, support switch digital interface cmd, can be expand to support codec module specific feature.

## Parameters

<i>handle</i>	codec handle.
<i>cmd</i>	module control cmd, reference _codec_module_ctrl_cmd.
<i>data</i>	value to write, when cmd is kCODEC_ModuleRecordSourceChannel, the data should be a value combine of channel and source, please reference macro CODEC_MODULE_RECORD_SOURCE_CHANNEL(source, LP, LN, RP, RN), reference codec specific driver for detail configurations.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.2.5.5 status\_t CODEC\_SetVolume ( codec\_handle\_t \* *handle*, uint32\_t *channel*, uint32\_t *volume* )

## Parameters

<i>handle</i>	codec handle.
<i>channel</i>	audio codec volume channel, can be a value or combine value of <code>_codec_volume_capability</code> or <code>_codec_play_channel</code> .
<i>volume</i>	volume value, support 0 ~ 100, 0 is mute, 100 is the maximum volume value.

Returns

`kStatus_Success` is success, else configure failed.

**23.2.5.6** `status_t CODEC_SetMute ( codec_handle_t * handle, uint32_t channel, bool mute )`

Parameters

<i>handle</i>	codec handle.
<i>channel</i>	audio codec volume channel, can be a value or combine value of <code>_codec_volume_capability</code> or <code>_codec_play_channel</code> .
<i>mute</i>	true is mute, false is unmute.

Returns

`kStatus_Success` is success, else configure failed.

**23.2.5.7** `status_t CODEC_SetPower ( codec_handle_t * handle, codec_module_t module, bool powerOn )`

Parameters

<i>handle</i>	codec handle.
<i>module</i>	audio codec module.
<i>powerOn</i>	true is power on, false is power down.

Returns

`kStatus_Success` is success, else configure failed.

**23.2.5.8** `status_t CODEC_SetRecord ( codec_handle_t * handle, uint32_t recordSource )`

## Parameters

<i>handle</i>	codec handle.
<i>recordSource</i>	audio codec record source, can be a value or combine value of <code>_codec_record_source</code> .

## Returns

`kStatus_Success` is success, else configure failed.

### 23.2.5.9 `status_t CODEC_SetRecordChannel ( codec_handle_t * handle, uint32_t leftRecordChannel, uint32_t rightRecordChannel )`

## Parameters

<i>handle</i>	codec handle.
<i>leftRecord-Channel</i>	audio codec record channel, reference <code>_codec_record_channel</code> , can be a value combine of member in <code>_codec_record_channel</code> .
<i>rightRecord-Channel</i>	audio codec record channel, reference <code>_codec_record_channel</code> , can be a value combine of member in <code>_codec_record_channel</code> .

## Returns

`kStatus_Success` is success, else configure failed.

### 23.2.5.10 `status_t CODEC_SetPlay ( codec_handle_t * handle, uint32_t playSource )`

## Parameters

<i>handle</i>	codec handle.
<i>playSource</i>	audio codec play source, can be a value or combine value of <code>_codec_play_source</code> .

## Returns

`kStatus_Success` is success, else configure failed.

## 23.3 CODEC I2C Driver

The codec common driver provides a codec control abstraction interface.

## 23.4 WM8524 Driver

### 23.4.1 Overview

The wm8524 driver provides a codec control interface.

### Data Structures

- struct `wm8524_handle_t`  
WM8524 handler. *More...*

### Typedefs

- typedef void(\* `wm8524_setMuteIO`)(uint32\_t output)  
< mute control io function pointer

### Enumerations

- enum `wm8524_protocol_t` {  
    `kWM8524_ProtocolLeftJustified` = 0x0,  
    `kWM8524_ProtocolI2S` = 0x1,  
    `kWM8524_ProtocolRightJustified` = 0x2 }  
    *The audio data transfer protocol.*
- enum `_wm8524_mute_control` {  
    `kWM8524_Mute` = 0U,  
    `kWM8524_Unmute` = 1U }  
    *wm8524 mute operation*

### Functions

- `status_t WM8524_Init`(`wm8524_handle_t` \*handle, `wm8524_config_t` \*config)  
    *Initializes WM8524.*
- void `WM8524_ConfigFormat`(`wm8524_handle_t` \*handle, `wm8524_protocol_t` protocol)  
    *Configure WM8524 audio protocol.*
- void `WM8524_SetMute`(`wm8524_handle_t` \*handle, bool isMute)  
    *Sets the codec mute state.*

### Driver version

- #define `FSL_WM8524_DRIVER_VERSION` (`MAKE_VERSION`(2, 1, 1))  
    *WM8524 driver version 2.1.1.*

## 23.4.2 Data Structure Documentation

### 23.4.2.1 struct wm8524\_handle\_t

#### Data Fields

- wm8524\_config\_t \* [config](#)  
*wm8524 config pointer*

## 23.4.3 Macro Definition Documentation

### 23.4.3.1 #define FSL\_WM8524\_DRIVER\_VERSION (MAKE\_VERSION(2, 1, 1))

## 23.4.4 Typedef Documentation

### 23.4.4.1 typedef void(\* wm8524\_setMutelO)(uint32\_t output)

format control io function pointer

## 23.4.5 Enumeration Type Documentation

### 23.4.5.1 enum wm8524\_protocol\_t

Enumerator

*kWM8524\_ProtocolLeftJustified* Left justified mode.  
*kWM8524\_ProtocolI2S* I2S mode.  
*kWM8524\_ProtocolRightJustified* Right justified mode.

### 23.4.5.2 enum \_wm8524\_mute\_control

Enumerator

*kWM8524\_Mute* mute left and right channel DAC  
*kWM8524\_Unmute* unmute left and right channel DAC

## 23.4.6 Function Documentation

### 23.4.6.1 status\_t WM8524\_Init ( wm8524\_handle\_t \* *handle*, wm8524\_config\_t \* *config* )

## Parameters

<i>handle</i>	WM8524 handle structure.
<i>config</i>	WM8524 configure structure.

## Returns

kStatus\_Success.

### 23.4.6.2 void WM8524\_ConfigFormat ( wm8524\_handle\_t \* *handle*, wm8524\_protocol\_t *protocol* )

## Parameters

<i>handle</i>	WM8524 handle structure.
<i>protocol</i>	WM8524 configuration structure.

### 23.4.6.3 void WM8524\_SetMute ( wm8524\_handle\_t \* *handle*, bool *isMute* )

## Parameters

<i>handle</i>	WM8524 handle structure.
<i>isMute</i>	true means mute, false means normal.



## 23.4.7 WM8524 Adapter

### 23.4.7.1 Overview

The wm8524 adapter provides a codec unify control interface.

#### Macros

- #define [HAL\\_CODEC\\_WM8524\\_HANDLER\\_SIZE](#) (4)  
*codec handler size*

#### Functions

- [status\\_t HAL\\_CODEC\\_WM8524\\_Init](#) (void \*handle, void \*config)  
*Codec initialization.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_Deinit](#) (void \*handle)  
*Codec de-initialization.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_SetFormat](#) (void \*handle, uint32\_t mclk, uint32\_t sampleRate, uint32\_t bitWidth)  
*set audio data format.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_SetVolume](#) (void \*handle, uint32\_t playChannel, uint32\_t volume)  
*set audio codec module volume.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_SetMute](#) (void \*handle, uint32\_t playChannel, bool isMute)  
*set audio codec module mute.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_SetPower](#) (void \*handle, uint32\_t module, bool powerOn)  
*set audio codec module power.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_SetRecord](#) (void \*handle, uint32\_t recordSource)  
*codec set record source.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_SetRecordChannel](#) (void \*handle, uint32\_t leftRecordChannel, uint32\_t rightRecordChannel)  
*codec set record channel.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_SetPlay](#) (void \*handle, uint32\_t playSource)  
*codec set play source.*
- [status\\_t HAL\\_CODEC\\_WM8524\\_ModuleControl](#) (void \*handle, uint32\_t cmd, uint32\_t data)  
*codec module control.*
- static [status\\_t HAL\\_CODEC\\_Init](#) (void \*handle, void \*config)  
*Codec initialization.*
- static [status\\_t HAL\\_CODEC\\_Deinit](#) (void \*handle)  
*Codec de-initialization.*
- static [status\\_t HAL\\_CODEC\\_SetFormat](#) (void \*handle, uint32\_t mclk, uint32\_t sampleRate, uint32\_t bitWidth)  
*set audio data format.*
- static [status\\_t HAL\\_CODEC\\_SetVolume](#) (void \*handle, uint32\_t playChannel, uint32\_t volume)  
*set audio codec module volume.*
- static [status\\_t HAL\\_CODEC\\_SetMute](#) (void \*handle, uint32\_t playChannel, bool isMute)  
*set audio codec module mute.*
- static [status\\_t HAL\\_CODEC\\_SetPower](#) (void \*handle, uint32\_t module, bool powerOn)

- *set audio codec module power.*  
static [status\\_t HAL\\_CODEC\\_SetRecord](#) (void \*handle, uint32\_t recordSource)
- *codec set record source.*  
static [status\\_t HAL\\_CODEC\\_SetRecordChannel](#) (void \*handle, uint32\_t leftRecordChannel, uint32\_t rightRecordChannel)
- *codec set record channel.*  
static [status\\_t HAL\\_CODEC\\_SetPlay](#) (void \*handle, uint32\_t playSource)
- *codec set play source.*  
static [status\\_t HAL\\_CODEC\\_ModuleControl](#) (void \*handle, uint32\_t cmd, uint32\_t data)
- *codec module control.*

### 23.4.7.2 Function Documentation

#### 23.4.7.2.1 status\_t HAL\_CODEC\_WM8524\_Init ( void \* *handle*, void \* *config* )

Parameters

<i>handle</i>	codec handle.
<i>config</i>	codec configuration.

Returns

kStatus\_Success is success, else initial failed.

#### 23.4.7.2.2 status\_t HAL\_CODEC\_WM8524\_Deinit ( void \* *handle* )

Parameters

<i>handle</i>	codec handle.
---------------	---------------

Returns

kStatus\_Success is success, else de-initial failed.

#### 23.4.7.2.3 status\_t HAL\_CODEC\_WM8524\_SetFormat ( void \* *handle*, uint32\_t *mclk*, uint32\_t *sampleRate*, uint32\_t *bitWidth* )

## Parameters

<i>handle</i>	codec handle.
<i>mclk</i>	master clock frequency in HZ.
<i>sampleRate</i>	sample rate in HZ.
<i>bitWidth</i>	bit width.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.4.7.2.4 status\_t HAL\_CODEC\_WM8524\_SetVolume ( void \* *handle*, uint32\_t *playChannel*, uint32\_t *volume* )

## Parameters

<i>handle</i>	codec handle.
<i>playChannel</i>	audio codec play channel, can be a value or combine value of _codec_play_channel.
<i>volume</i>	volume value, support 0 ~ 100, 0 is mute, 100 is the maximum volume value.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.4.7.2.5 status\_t HAL\_CODEC\_WM8524\_SetMute ( void \* *handle*, uint32\_t *playChannel*, bool *isMute* )

## Parameters

<i>handle</i>	codec handle.
<i>playChannel</i>	audio codec play channel, can be a value or combine value of _codec_play_channel.
<i>isMute</i>	true is mute, false is unmute.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.4.7.2.6 status\_t HAL\_CODEC\_WM8524\_SetPower ( void \* *handle*, uint32\_t *module*, bool *powerOn* )

## Parameters

<i>handle</i>	codec handle.
<i>module</i>	audio codec module.
<i>powerOn</i>	true is power on, false is power down.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.4.7.2.7 status\_t HAL\_CODEC\_WM8524\_SetRecord ( void \* *handle*, uint32\_t *recordSource* )

## Parameters

<i>handle</i>	codec handle.
<i>recordSource</i>	audio codec record source, can be a value or combine value of _codec_record_source.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.4.7.2.8 status\_t HAL\_CODEC\_WM8524\_SetRecordChannel ( void \* *handle*, uint32\_t *leftRecordChannel*, uint32\_t *rightRecordChannel* )

## Parameters

<i>handle</i>	codec handle.
<i>leftRecord-Channel</i>	audio codec record channel, reference _codec_record_channel, can be a value or combine value of member in _codec_record_channel.
<i>rightRecord-Channel</i>	audio codec record channel, reference _codec_record_channel, can be a value combine of member in _codec_record_channel.

## Returns

kStatus\_Success is success, else configure failed.

#### 23.4.7.2.9 status\_t HAL\_CODEC\_WM8524\_SetPlay ( void \* *handle*, uint32\_t *playSource* )

## Parameters

<i>handle</i>	codec handle.
<i>playSource</i>	audio codec play source, can be a value or combine value of <code>_codec_play_source</code> .

## Returns

`kStatus_Success` is success, else configure failed.

#### 23.4.7.2.10 `status_t HAL_CODEC_WM8524_ModuleControl ( void * handle, uint32_t cmd, uint32_t data )`

This function is used for codec module control, support switch digital interface cmd, can be expand to support codec module specific feature

## Parameters

<i>handle</i>	codec handle.
<i>cmd</i>	module control cmd, reference <code>_codec_module_ctrl_cmd</code> .
<i>data</i>	value to write, when cmd is <code>kCODEC_ModuleRecordSourceChannel</code> , the data should be a value combine of channel and source, please reference macro <code>CODEC_MODULE_RECORD_SOURCE_CHANNEL(source, LP, LN, RP, RN)</code> , reference codec specific driver for detail configurations.

## Returns

`kStatus_Success` is success, else configure failed.

#### 23.4.7.2.11 `static status_t HAL_CODEC_Init ( void * handle, void * config ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
<i>config</i>	codec configuration.

## Returns

`kStatus_Success` is success, else initial failed.

#### 23.4.7.2.12 `static status_t HAL_CODEC_Deinit ( void * handle ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
---------------	---------------

## Returns

kStatus\_Success is success, else de-initial failed.

**23.4.7.2.13** `static status_t HAL_CODEC_SetFormat ( void * handle, uint32_t mclk, uint32_t sampleRate, uint32_t bitWidth ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
<i>mclk</i>	master clock frequency in HZ.
<i>sampleRate</i>	sample rate in HZ.
<i>bitWidth</i>	bit width.

## Returns

kStatus\_Success is success, else configure failed.

**23.4.7.2.14** `static status_t HAL_CODEC_SetVolume ( void * handle, uint32_t playChannel, uint32_t volume ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
<i>playChannel</i>	audio codec play channel, can be a value or combine value of _codec_play_channel.
<i>volume</i>	volume value, support 0 ~ 100, 0 is mute, 100 is the maximum volume value.

## Returns

kStatus\_Success is success, else configure failed.

**23.4.7.2.15** `static status_t HAL_CODEC_SetMute ( void * handle, uint32_t playChannel, bool isMute ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
<i>playChannel</i>	audio codec play channel, can be a value or combine value of <code>_codec_play_channel</code> .
<i>isMute</i>	true is mute, false is unmute.

## Returns

kStatus\_Success is success, else configure failed.

**23.4.7.2.16** `static status_t HAL_CODEC_SetPower ( void * handle, uint32_t module, bool powerOn ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
<i>module</i>	audio codec module.
<i>powerOn</i>	true is power on, false is power down.

## Returns

kStatus\_Success is success, else configure failed.

**23.4.7.2.17** `static status_t HAL_CODEC_SetRecord ( void * handle, uint32_t recordSource ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
<i>recordSource</i>	audio codec record source, can be a value or combine value of <code>_codec_record_source</code> .

## Returns

kStatus\_Success is success, else configure failed.

**23.4.7.2.18** `static status_t HAL_CODEC_SetRecordChannel ( void * handle, uint32_t leftRecordChannel, uint32_t rightRecordChannel ) [inline], [static]`

## Parameters

<i>handle</i>	codec handle.
<i>leftRecord-Channel</i>	audio codec record channel, reference <code>_codec_record_channel</code> , can be a value or combine value of member in <code>_codec_record_channel</code> .
<i>rightRecord-Channel</i>	audio codec record channel, reference <code>_codec_record_channel</code> , can be a value or combine of member in <code>_codec_record_channel</code> .

## Returns

`kStatus_Success` is success, else configure failed.

**23.4.7.2.19** `static status_t HAL_CODEC_SetPlay ( void * handle, uint32_t playSource )`  
**[inline], [static]**

## Parameters

<i>handle</i>	codec handle.
<i>playSource</i>	audio codec play source, can be a value or combine value of <code>_codec_play_source</code> .

## Returns

`kStatus_Success` is success, else configure failed.

**23.4.7.2.20** `static status_t HAL_CODEC_ModuleControl ( void * handle, uint32_t cmd, uint32_t data )`  
**[inline], [static]**

This function is used for codec module control, support switch digital interface cmd, can be expand to support codec module specific feature

## Parameters

<i>handle</i>	codec handle.
<i>cmd</i>	module control cmd, reference <code>_codec_module_ctrl_cmd</code> .
<i>data</i>	value to write, when cmd is <code>kCODEC_ModuleRecordSourceChannel</code> , the data should be a value combine of channel and source, please reference macro <code>CODEC_MODULE_RECORD_SOURCE_CHANNEL(source, LP, LN, RP, RN)</code> , reference codec specific driver for detail configurations.

## Returns

`kStatus_Success` is success, else configure failed.



# Chapter 24

## Serial Manager

### 24.1 Overview

This chapter describes the programming interface of the serial manager component.

The serial manager component provides a series of APIs to operate different serial port types. The port types it supports are UART, USB CDC and SWO.

### Modules

- [Serial Port SWO](#)
- [Serial Port Uart](#)

### Data Structures

- struct [serial\\_manager\\_config\\_t](#)  
*serial manager config structure [More...](#)*
- struct [serial\\_manager\\_callback\\_message\\_t](#)  
*Callback message structure. [More...](#)*

### Macros

- #define [SERIAL\\_MANAGER\\_NON\\_BLOCKING\\_MODE](#) (0U)  
*Enable or disable serial manager non-blocking mode (1 - enable, 0 - disable)*
- #define [SERIAL\\_MANAGER\\_RING\\_BUFFER\\_FLOWCONTROL](#) (0U)  
*Enable or ring buffer flow control (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_UART](#) (0U)  
*Enable or disable uart port (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_UART\\_DMA](#) (0U)  
*Enable or disable uart dma port (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_USBCDC](#) (0U)  
*Enable or disable USB CDC port (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_SWO](#) (0U)  
*Enable or disable SWO port (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_VIRTUAL](#) (0U)  
*Enable or disable USB CDC virtual port (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_RPMSG](#) (0U)  
*Enable or disable rPMSG port (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_SPI\\_MASTER](#) (0U)  
*Enable or disable SPI Master port (1 - enable, 0 - disable)*
- #define [SERIAL\\_PORT\\_TYPE\\_SPI\\_SLAVE](#) (0U)  
*Enable or disable SPI Slave port (1 - enable, 0 - disable)*
- #define [SERIAL\\_MANAGER\\_TASK\\_HANDLE\\_TX](#) (0U)  
*Enable or disable SerialManager\_Task() handle TX to prevent recursive calling.*
- #define [SERIAL\\_MANAGER\\_WRITE\\_TIME\\_DELAY\\_DEFAULT\\_VALUE](#) (1U)

- Set the default delay time in ms used by `SerialManager_WriteTimeDelay()`.  
• #define `SERIAL_MANAGER_READ_TIME_DELAY_DEFAULT_VALUE` (1U)
- Set the default delay time in ms used by `SerialManager_ReadTimeDelay()`.  
• #define `SERIAL_MANAGER_TASK_HANDLE_RX_AVAILABLE_NOTIFY` (0U)
- Enable or disable `SerialManager_Task()` handle RX data available notify.  
• #define `SERIAL_MANAGER_WRITE_HANDLE_SIZE` (4U)
- Set serial manager write handle size.  
• #define `SERIAL_MANAGER_USE_COMMON_TASK` (0U)
- `SERIAL_PORT_UART_HANDLE_SIZE/SERIAL_PORT_USB_CDC_HANDLE_SIZE + serial manager dedicated size.`  
• #define `SERIAL_MANAGER_HANDLE_SIZE` (`SERIAL_MANAGER_HANDLE_SIZE_TEMP + 12U`)
- Definition of serial manager handle size.  
• #define `SERIAL_MANAGER_HANDLE_DEFINE`(name) `uint32_t name[((SERIAL_MANAGER_HANDLE_SIZE + sizeof(uint32_t) - 1U) / sizeof(uint32_t))]`
- Defines the serial manager handle.  
• #define `SERIAL_MANAGER_WRITE_HANDLE_DEFINE`(name) `uint32_t name[((SERIAL_MANAGER_WRITE_HANDLE_SIZE + sizeof(uint32_t) - 1U) / sizeof(uint32_t))]`
- Defines the serial manager write handle.  
• #define `SERIAL_MANAGER_READ_HANDLE_DEFINE`(name) `uint32_t name[((SERIAL_MANAGER_READ_HANDLE_SIZE + sizeof(uint32_t) - 1U) / sizeof(uint32_t))]`
- Defines the serial manager read handle.  
• #define `SERIAL_MANAGER_TASK_PRIORITY` (2U)
- Macro to set serial manager task priority.  
• #define `SERIAL_MANAGER_TASK_STACK_SIZE` (1000U)
- Macro to set serial manager task stack size.

## Typedefs

- typedef void \* `serial_handle_t`  
The handle of the serial manager module.
- typedef void \* `serial_write_handle_t`  
The write handle of the serial manager module.
- typedef void \* `serial_read_handle_t`  
The read handle of the serial manager module.
- typedef void(\* `serial_manager_callback_t` )(void \*callbackParam, `serial_manager_callback_message_t` \*message, `serial_manager_status_t` status)  
serial manager callback function
- typedef void(\* `serial_manager_lowpower_critical_callback_t` )(void)  
serial manager Lowpower Critical callback function

## Enumerations

- enum `serial_port_type_t` {  
`kSerialPort_None` = 0U,  
`kSerialPort_Uart` = 1U,  
`kSerialPort_UsbCdc`,  
`kSerialPort_Swo`,  
`kSerialPort_Virtual`,  
`kSerialPort_Rpmsg`,  
`kSerialPort_UartDma`,  
`kSerialPort_SpiMaster`,  
`kSerialPort_SpiSlave` }  
*serial port type*
- enum `serial_manager_type_t` {  
`kSerialManager_NonBlocking` = 0x0U,  
`kSerialManager_Blocking` = 0x8F41U }  
*serial manager type*
- enum `serial_manager_status_t` {  
`kStatus_SerialManager_Success` = `kStatus_Success`,  
`kStatus_SerialManager_Error` = `MAKE_STATUS(kStatusGroup_SERIALMANAGER, 1)`,  
`kStatus_SerialManager_Busy` = `MAKE_STATUS(kStatusGroup_SERIALMANAGER, 2)`,  
`kStatus_SerialManager_Notify` = `MAKE_STATUS(kStatusGroup_SERIALMANAGER, 3)`,  
`kStatus_SerialManager_Canceled`,  
`kStatus_SerialManager_HandleConflict` = `MAKE_STATUS(kStatusGroup_SERIALMANAGER, 5)`,  
`kStatus_SerialManager_RingBufferOverflow`,  
`kStatus_SerialManager_NotConnected` = `MAKE_STATUS(kStatusGroup_SERIALMANAGER, 7)` }  
*serial manager error code*

## Functions

- `serial_manager_status_t SerialManager_Init (serial_handle_t serialHandle, const serial_manager_config_t *config)`  
*Initializes a serial manager module with the serial manager handle and the user configuration structure.*
- `serial_manager_status_t SerialManager_Deinit (serial_handle_t serialHandle)`  
*De-initializes the serial manager module instance.*
- `serial_manager_status_t SerialManager_OpenWriteHandle (serial_handle_t serialHandle, serial_write_handle_t writeHandle)`  
*Opens a writing handle for the serial manager module.*
- `serial_manager_status_t SerialManager_CloseWriteHandle (serial_write_handle_t writeHandle)`  
*Closes a writing handle for the serial manager module.*
- `serial_manager_status_t SerialManager_OpenReadHandle (serial_handle_t serialHandle, serial_read_handle_t readHandle)`  
*Opens a reading handle for the serial manager module.*
- `serial_manager_status_t SerialManager_CloseReadHandle (serial_read_handle_t readHandle)`  
*Closes a reading for the serial manager module.*

- [serial\\_manager\\_status\\_t SerialManager\\_WriteBlocking](#) ([serial\\_write\\_handle\\_t](#) writeHandle, [uint8\\_t](#) \*buffer, [uint32\\_t](#) length)  
*Transmits data with the blocking mode.*
- [serial\\_manager\\_status\\_t SerialManager\\_ReadBlocking](#) ([serial\\_read\\_handle\\_t](#) readHandle, [uint8\\_t](#) \*buffer, [uint32\\_t](#) length)  
*Reads data with the blocking mode.*
- [serial\\_manager\\_status\\_t SerialManager\\_EnterLowpower](#) ([serial\\_handle\\_t](#) serialHandle)  
*Prepares to enter low power consumption.*
- [serial\\_manager\\_status\\_t SerialManager\\_ExitLowpower](#) ([serial\\_handle\\_t](#) serialHandle)  
*Restores from low power consumption.*
- void [SerialManager\\_SetLowpowerCriticalCb](#) (const [serial\\_manager\\_lowpower\\_critical\\_CBs\\_t](#) \*pf-Callback)  
*This function performs initialization of the callbacks structure used to disable lowpower when serial manager is active.*

## 24.2 Data Structure Documentation

### 24.2.1 struct serial\_manager\_config\_t

#### Data Fields

- [uint8\\_t](#) \* [ringBuffer](#)  
*Ring buffer address, it is used to buffer data received by the hardware.*
- [uint32\\_t](#) [ringBufferSize](#)  
*The size of the ring buffer.*
- [serial\\_port\\_type\\_t](#) type  
*Serial port type.*
- [serial\\_manager\\_type\\_t](#) blockType  
*Serial manager port type.*
- void \* [portConfig](#)  
*Serial port configuration.*

#### Field Documentation

#### (1) [uint8\\_t](#)\* [serial\\_manager\\_config\\_t::ringBuffer](#)

Besides, the memory space cannot be free during the lifetime of the serial manager module.

### 24.2.2 struct serial\_manager\_callback\_message\_t

#### Data Fields

- [uint8\\_t](#) \* [buffer](#)  
*Transferred buffer.*
- [uint32\\_t](#) [length](#)  
*Transferred data length.*

## 24.3 Macro Definition Documentation

**24.3.1 #define SERIAL\_MANAGER\_WRITE\_TIME\_DELAY\_DEFAULT\_VALUE (1U)**

**24.3.2 #define SERIAL\_MANAGER\_READ\_TIME\_DELAY\_DEFAULT\_VALUE (1U)**

**24.3.3 #define SERIAL\_MANAGER\_USE\_COMMON\_TASK (0U)**

Macro to determine whether use common task.

**24.3.4 #define SERIAL\_MANAGER\_HANDLE\_SIZE (SERIAL\_MANAGER\_HANDLE\_SIZE\_TEMP + 12U)**

**24.3.5 #define SERIAL\_MANAGER\_HANDLE\_DEFINE( *name* ) uint32\_t  
name[(((SERIAL\_MANAGER\_HANDLE\_SIZE + sizeof(uint32\_t) - 1U) /  
sizeof(uint32\_t)))]**

This macro is used to define a 4 byte aligned serial manager handle. Then use "(serial\_handle\_t)name" to get the serial manager handle.

The macro should be global and could be optional. You could also define serial manager handle by yourself.

This is an example,

```
* SERIAL_MANAGER_HANDLE_DEFINE(serialManagerHandle);
*
```

Parameters

<i>name</i>	The name string of the serial manager handle.
-------------	---

**24.3.6 #define SERIAL\_MANAGER\_WRITE\_HANDLE\_DEFINE( *name* ) uint32\_t  
name[(((SERIAL\_MANAGER\_WRITE\_HANDLE\_SIZE + sizeof(uint32\_t) -  
1U) / sizeof(uint32\_t)))]**

This macro is used to define a 4 byte aligned serial manager write handle. Then use "(serial\_write\_handle\_t)name" to get the serial manager write handle.

The macro should be global and could be optional. You could also define serial manager write handle by yourself.

This is an example,

```
* SERIAL_MANAGER_WRITE_HANDLE_DEFINE(serialManagerwriteHandle);
*
```

Parameters

<i>name</i>	The name string of the serial manager write handle.
-------------	---

**24.3.7 #define SERIAL\_MANAGER\_READ\_HANDLE\_DEFINE( *name* ) uint32\_t name[(((SERIAL\_MANAGER\_READ\_HANDLE\_SIZE + sizeof(uint32\_t) - 1U) / sizeof(uint32\_t))]**

This macro is used to define a 4 byte aligned serial manager read handle. Then use "(serial\_read\_handle-\_t)name" to get the serial manager read handle.

The macro should be global and could be optional. You could also define serial manager read handle by yourself.

This is an example,

```
* SERIAL_MANAGER_READ_HANDLE_DEFINE(serialManagerReadHandle);
*
```

Parameters

<i>name</i>	The name string of the serial manager read handle.
-------------	--

**24.3.8 #define SERIAL\_MANAGER\_TASK\_PRIORITY (2U)**

**24.3.9 #define SERIAL\_MANAGER\_TASK\_STACK\_SIZE (1000U)**

## 24.4 Enumeration Type Documentation

**24.4.1 enum serial\_port\_type\_t**

Enumerator

*kSerialPort\_None* Serial port is none.  
*kSerialPort\_Uart* Serial port UART.  
*kSerialPort\_UsbCdc* Serial port USB CDC.  
*kSerialPort\_Swo* Serial port SWO.  
*kSerialPort\_Virtual* Serial port Virtual.  
*kSerialPort\_Rpmsg* Serial port RPMSG.  
*kSerialPort\_UartDma* Serial port UART DMA.

***kSerialPort\_SpiMaster*** Serial port SPIMASTER.

***kSerialPort\_SpiSlave*** Serial port SPISLAVE.

## 24.4.2 enum serial\_manager\_type\_t

Enumerator

***kSerialManager\_NonBlocking*** None blocking handle.

***kSerialManager\_Blocking*** Blocking handle.

## 24.4.3 enum serial\_manager\_status\_t

Enumerator

***kStatus\_SerialManager\_Success*** Success.

***kStatus\_SerialManager\_Error*** Failed.

***kStatus\_SerialManager\_Busy*** Busy.

***kStatus\_SerialManager\_Notify*** Ring buffer is not empty.

***kStatus\_SerialManager\_Canceled*** the non-blocking request is canceled

***kStatus\_SerialManager\_HandleConflict*** The handle is opened.

***kStatus\_SerialManager\_RingBufferOverflow*** The ring buffer is overflowed.

***kStatus\_SerialManager\_NotConnected*** The host is not connected.

## 24.5 Function Documentation

### 24.5.1 serial\_manager\_status\_t SerialManager\_Init ( serial\_handle\_t *serialHandle*, const serial\_manager\_config\_t \* *config* )

This function configures the Serial Manager module with user-defined settings. The user can configure the configuration structure. The parameter *serialHandle* is a pointer to point to a memory space of size [SERIAL\\_MANAGER\\_HANDLE\\_SIZE](#) allocated by the caller. The Serial Manager module supports three types of serial port, UART (includes UART, USART, LPSCI, LPUART, etc), USB CDC and swo. Please refer to [serial\\_port\\_type\\_t](#) for serial port setting. These three types can be set by using [serial\\_manager\\_config\\_t](#).

Example below shows how to use this API to configure the Serial Manager. For UART,

```
* #define SERIAL_MANAGER_RING_BUFFER_SIZE (256U)
* static SERIAL_MANAGER_HANDLE_DEFINE(s_serialHandle);
* static uint8_t s_ringBuffer[SERIAL_MANAGER_RING_BUFFER_SIZE];
*
* serial_manager_config_t config;
* serial_port_uart_config_t uartConfig;
* config.type = kSerialPort_Uart;
* config.ringBuffer = &s_ringBuffer[0];
* config.ringBufferSize = SERIAL_MANAGER_RING_BUFFER_SIZE;
* uartConfig.instance = 0;
```

```

*   uartConfig.clockRate = 24000000;
*   uartConfig.baudRate = 115200;
*   uartConfig.parityMode = kSerialManager_UartParityDisabled;
*   uartConfig.stopBitCount = kSerialManager_UartOneStopBit;
*   uartConfig.enableRx = 1;
*   uartConfig.enableTx = 1;
*   uartConfig.enableRxRTS = 0;
*   uartConfig.enableTxCTS = 0;
*   config.portConfig = &uartConfig;
*   SerialManager_Init((serial_handle_t)s_serialHandle, &config);
*

```

For USB CDC,

```

*   #define SERIAL_MANAGER_RING_BUFFER_SIZE (256U)
*   static SERIAL_MANAGER_HANDLE_DEFINE(s_serialHandle);
*   static uint8_t s_ringBuffer[SERIAL_MANAGER_RING_BUFFER_SIZE];
*
*   serial_manager_config_t config;
*   serial_port_usb_cdc_config_t usbCdcConfig;
*   config.type = kSerialPort_UsbCdc;
*   config.ringBuffer = &s_ringBuffer[0];
*   config.ringBufferSize = SERIAL_MANAGER_RING_BUFFER_SIZE;
*   usbCdcConfig.controllerIndex = kSerialManager_UsbControllerKhci0;
*   config.portConfig = &usbCdcConfig;
*   SerialManager_Init((serial_handle_t)s_serialHandle, &config);
*

```

## Parameters

<i>serialHandle</i>	Pointer to point to a memory space of size <a href="#">SERIAL_MANAGER_HANDLE_SIZE</a> allocated by the caller. The handle should be 4 byte aligned, because unaligned access doesn't be supported on some devices. You can define the handle in the following two ways: <a href="#">SERIAL_MANAGER_HANDLE_DEFINE(serialHandle)</a> ; or <code>uint32_t serialHandle[((SERIAL_MANAGER_HANDLE_SIZE + sizeof(uint32_t) - 1U) / sizeof(uint32_t))];</code>
<i>config</i>	Pointer to user-defined configuration structure.

## Return values

<i>kStatus_SerialManager_Error</i>	An error occurred.
<i>kStatus_SerialManager_Success</i>	The Serial Manager module initialization succeed.

## 24.5.2 serial\_manager\_status\_t SerialManager\_Deinit ( serial\_handle\_t serialHandle )

This function de-initializes the serial manager module instance. If the opened writing or reading handle is not closed, the function will return `kStatus_SerialManager_Busy`.



## Parameters

<i>serialHandle</i>	The serial manager module handle pointer.
---------------------	---

## Return values

<i>kStatus_SerialManager_Success</i>	The serial manager de-initialization succeed.
<i>kStatus_SerialManager_Busy</i>	Opened reading or writing handle is not closed.

### 24.5.3 serial\_manager\_status\_t SerialManager\_OpenWriteHandle ( serial\_handle\_t serialHandle, serial\_write\_handle\_t writeHandle )

This function Opens a writing handle for the serial manager module. If the serial manager needs to be used in different tasks, the task should open a dedicated write handle for itself by calling [SerialManager\\_OpenWriteHandle](#). Since there can only one buffer for transmission for the writing handle at the same time, multiple writing handles need to be opened when the multiple transmission is needed for a task.

## Parameters

<i>serialHandle</i>	The serial manager module handle pointer. The handle should be 4 byte aligned, because unaligned access doesn't be supported on some devices.
<i>writeHandle</i>	The serial manager module writing handle pointer. The handle should be 4 byte aligned, because unaligned access doesn't be supported on some devices. You can define the handle in the following two ways: <a href="#">SERIAL_MANAGER_WRITE_HANDLE_DEFINE(writeHandle)</a> ; or <code>uint32_t writeHandle[((SERIAL_MANAGER_WRITE_HANDLE_SIZE + sizeof(uint32_t) - 1U) / sizeof(uint32_t))];</code>

## Return values

<i>kStatus_SerialManager_Error</i>	An error occurred.
<i>kStatus_SerialManager_HandleConflict</i>	The writing handle was opened.

<i>kStatus_SerialManager_Success</i>	The writing handle is opened.
--------------------------------------	-------------------------------

Example below shows how to use this API to write data. For task 1,

```
*  static SERIAL_MANAGER_WRITE_HANDLE_DEFINE(s_serialWriteHandle1);
*  static uint8_t s_nonBlockingWelcome1[] = "This is non-blocking writing log for task1!\r\n";
*  SerialManager_OpenWriteHandle((serial_handle_t)serialHandle
*      , (serial_write_handle_t)s_serialWriteHandle1);
*  SerialManager_InstallTxCallback((serial_write_handle_t)s_serialWriteHandle1,
*      Task1_SerialManagerTxCallback,
*      s_serialWriteHandle1);
*  SerialManager_WriteNonBlocking((serial_write_handle_t)s_serialWriteHandle1,
*      s_nonBlockingWelcome1,
*      sizeof(s_nonBlockingWelcome1) - 1U);
*
```

For task 2,

```
*  static SERIAL_MANAGER_WRITE_HANDLE_DEFINE(s_serialWriteHandle2);
*  static uint8_t s_nonBlockingWelcome2[] = "This is non-blocking writing log for task2!\r\n";
*  SerialManager_OpenWriteHandle((serial_handle_t)serialHandle
*      , (serial_write_handle_t)s_serialWriteHandle2);
*  SerialManager_InstallTxCallback((serial_write_handle_t)s_serialWriteHandle2,
*      Task2_SerialManagerTxCallback,
*      s_serialWriteHandle2);
*  SerialManager_WriteNonBlocking((serial_write_handle_t)s_serialWriteHandle2,
*      s_nonBlockingWelcome2,
*      sizeof(s_nonBlockingWelcome2) - 1U);
*
```

#### 24.5.4 serial\_manager\_status\_t SerialManager\_CloseWriteHandle ( serial\_write\_handle\_t writeHandle )

This function Closes a writing handle for the serial manager module.

Parameters

<i>writeHandle</i>	The serial manager module writing handle pointer.
--------------------	---

Return values

<i>kStatus_SerialManager_Success</i>	The writing handle is closed.
--------------------------------------	-------------------------------

#### 24.5.5 serial\_manager\_status\_t SerialManager\_OpenReadHandle ( serial\_handle\_t serialHandle, serial\_read\_handle\_t readHandle )

This function Opens a reading handle for the serial manager module. The reading handle can not be opened multiple at the same time. The error code kStatus\_SerialManager\_Busy would be returned when

the previous reading handle is not closed. And there can only be one buffer for receiving for the reading handle at the same time.

## Parameters

<i>serialHandle</i>	The serial manager module handle pointer. The handle should be 4 byte aligned, because unaligned access doesn't be supported on some devices.
<i>readHandle</i>	The serial manager module reading handle pointer. The handle should be 4 byte aligned, because unaligned access doesn't be supported on some devices. You can define the handle in the following two ways: <a href="#">SERIAL_MANAGER_READ_HANDLE_DEFINE(readHandle)</a> ; or <code>uint32_t readHandle[(((SERIAL_MANAGER_READ_HANDLE_SIZE + sizeof(uint32_t) - 1U) / sizeof(uint32_t)))]</code> ;

## Return values

<i>kStatus_SerialManager_Error</i>	An error occurred.
<i>kStatus_SerialManager_Success</i>	The reading handle is opened.
<i>kStatus_SerialManager_Busy</i>	Previous reading handle is not closed.

Example below shows how to use this API to read data.

```
*  static SERIAL_MANAGER_READ_HANDLE_DEFINE(s_serialReadHandle);
*  SerialManager_OpenReadHandle((serial_handle_t)serialHandle,
*    (serial_read_handle_t)s_serialReadHandle);
*  static uint8_t s_nonBlockingBuffer[64];
*  SerialManager_InstallRxCallback((serial_read_handle_t)s_serialReadHandle,
*    APP_SerialManagerRxCallback,
*    s_serialReadHandle);
*  SerialManager_ReadNonBlocking((serial_read_handle_t)s_serialReadHandle,
*    s_nonBlockingBuffer,
*    sizeof(s_nonBlockingBuffer));
*
```

### 24.5.6 serial\_manager\_status\_t SerialManager\_CloseReadHandle ( serial\_read\_handle\_t readHandle )

This function Closes a reading for the serial manager module.

## Parameters

<i>readHandle</i>	The serial manager module reading handle pointer.
-------------------	---

## Return values

<i>kStatus_SerialManager_Success</i>	The reading handle is closed.
--------------------------------------	-------------------------------

### 24.5.7 serial\_manager\_status\_t SerialManager\_WriteBlocking ( serial\_manager\_write\_handle\_t writeHandle, uint8\_t \* buffer, uint32\_t length )

This is a blocking function, which polls the sending queue, waits for the sending queue to be empty. This function sends data using an interrupt method. The interrupt of the hardware could not be disabled. And There can only one buffer for transmission for the writing handle at the same time.

## Note

The function [SerialManager\\_WriteBlocking](#) and the function [SerialManager\\_WriteNonBlocking](#) cannot be used at the same time. And, the function [SerialManager\\_CancelWriting](#) cannot be used to abort the transmission of this function.

## Parameters

<i>writeHandle</i>	The serial manager module handle pointer.
<i>buffer</i>	Start address of the data to write.
<i>length</i>	Length of the data to write.

## Return values

<i>kStatus_SerialManager_Success</i>	Successfully sent all data.
<i>kStatus_SerialManager_Busy</i>	Previous transmission still not finished; data not all sent yet.
<i>kStatus_SerialManager_Error</i>	An error occurred.

### 24.5.8 serial\_manager\_status\_t SerialManager\_ReadBlocking ( serial\_manager\_read\_handle\_t readHandle, uint8\_t \* buffer, uint32\_t length )

This is a blocking function, which polls the receiving buffer, waits for the receiving buffer to be full. This function receives data using an interrupt method. The interrupt of the hardware could not be disabled. And There can only one buffer for receiving for the reading handle at the same time.

## Note

The function [SerialManager\\_ReadBlocking](#) and the function `SerialManager_ReadNonBlocking` cannot be used at the same time. And, the function `SerialManager_CancelReading` cannot be used to abort the transmission of this function.

## Parameters

<i>readHandle</i>	The serial manager module handle pointer.
<i>buffer</i>	Start address of the data to store the received data.
<i>length</i>	The length of the data to be received.

## Return values

<i>kStatus_SerialManager_- Success</i>	Successfully received all data.
<i>kStatus_SerialManager_- Busy</i>	Previous transmission still not finished; data not all received yet.
<i>kStatus_SerialManager_- Error</i>	An error occurred.

### 24.5.9 serial\_manager\_status\_t SerialManager\_EnterLowpower ( serial\_handle\_t serialHandle )

This function is used to prepare to enter low power consumption.

## Parameters

<i>serialHandle</i>	The serial manager module handle pointer.
---------------------	---

## Return values

<i>kStatus_SerialManager_- Success</i>	Successful operation.
--	-----------------------

### 24.5.10 serial\_manager\_status\_t SerialManager\_ExitLowpower ( serial\_handle\_t serialHandle )

This function is used to restore from low power consumption.

## Parameters

<i>serialHandle</i>	The serial manager module handle pointer.
---------------------	---

## Return values

<i>kStatus_SerialManager_Success</i>	Successful operation.
--------------------------------------	-----------------------

### 24.5.11 void SerialManager\_SetLowpowerCriticalCb ( const serial\_manager\_lowpower\_critical\_CBs\_t \* *pfCallback* )

## Parameters

<i>pfCallback</i>	Pointer to the function structure used to allow/disable lowpower.
-------------------	---

## 24.6 Serial Port Uart

### 24.6.1 Overview

#### Macros

- #define `SERIAL_PORT_UART_DMA_RECEIVE_DATA_LENGTH` (64U)  
*serial port uart handle size*
- #define `SERIAL_USE_CONFIGURE_STRUCTURE` (0U)  
*Enable or disable the configure structure pointer.*

#### Enumerations

- enum `serial_port_uart_parity_mode_t` {  
    `kSerialManager_UartParityDisabled` = 0x0U,  
    `kSerialManager_UartParityEven` = 0x2U,  
    `kSerialManager_UartParityOdd` = 0x3U }  
*serial port uart parity mode*
- enum `serial_port_uart_stop_bit_count_t` {  
    `kSerialManager_UartOneStopBit` = 0U,  
    `kSerialManager_UartTwoStopBit` = 1U }  
*serial port uart stop bit count*

### 24.6.2 Enumeration Type Documentation

#### 24.6.2.1 enum serial\_port\_uart\_parity\_mode\_t

Enumerator

***kSerialManager\_UartParityDisabled*** Parity disabled.  
***kSerialManager\_UartParityEven*** Parity even enabled.  
***kSerialManager\_UartParityOdd*** Parity odd enabled.

#### 24.6.2.2 enum serial\_port\_uart\_stop\_bit\_count\_t

Enumerator

***kSerialManager\_UartOneStopBit*** One stop bit.  
***kSerialManager\_UartTwoStopBit*** Two stop bits.



## 24.7 Serial Port SWO

### 24.7.1 Overview

#### Data Structures

- struct [serial\\_port\\_swo\\_config\\_t](#)  
*serial port swo config struct [More...](#)*

#### Macros

- #define [SERIAL\\_PORT\\_SWO\\_HANDLE\\_SIZE](#) (12U)  
*serial port swo handle size*

#### Enumerations

- enum [serial\\_port\\_swo\\_protocol\\_t](#) {  
    [kSerialManager\\_SwoProtocolManchester](#) = 1U,  
    [kSerialManager\\_SwoProtocolNrz](#) = 2U }  
*serial port swo protocol*

### 24.7.2 Data Structure Documentation

#### 24.7.2.1 struct serial\_port\_swo\_config\_t

##### Data Fields

- uint32\_t [clockRate](#)  
*clock rate*
- uint32\_t [baudRate](#)  
*baud rate*
- uint32\_t [port](#)  
*Port used to transfer data.*
- [serial\\_port\\_swo\\_protocol\\_t](#) [protocol](#)  
*SWO protocol.*

### 24.7.3 Enumeration Type Documentation

#### 24.7.3.1 enum serial\_port\_swo\_protocol\_t

##### Enumerator

***kSerialManager\_SwoProtocolManchester*** SWO Manchester protocol.  
***kSerialManager\_SwoProtocolNrz*** SWO UART/NRZ protocol.

## 24.7.4 CODEC Adapter

### 24.7.4.1 Overview

#### Enumerations

- enum {  
[kCODEC\\_WM8904](#),  
[kCODEC\\_WM8960](#),  
[kCODEC\\_WM8524](#),  
[kCODEC\\_SGTL5000](#),  
[kCODEC\\_DA7212](#),  
[kCODEC\\_CS42888](#),  
[kCODEC\\_CS42448](#),  
[kCODEC\\_AK4497](#),  
[kCODEC\\_AK4458](#),  
[kCODEC\\_TFA9XXX](#),  
[kCODEC\\_TFA9896](#),  
[kCODEC\\_WM8962](#) }  
*codec type*

### 24.7.4.2 Enumeration Type Documentation

#### 24.7.4.2.1 anonymous enum

##### Enumerator

***kCODEC\_WM8904*** wm8904  
***kCODEC\_WM8960*** wm8960  
***kCODEC\_WM8524*** wm8524  
***kCODEC\_SGTL5000*** sgtl5000  
***kCODEC\_DA7212*** da7212  
***kCODEC\_CS42888*** CS42888.  
***kCODEC\_CS42448*** CS42448.  
***kCODEC\_AK4497*** AK4497.  
***kCODEC\_AK4458*** ak4458  
***kCODEC\_TFA9XXX*** tfa9xxx  
***kCODEC\_TFA9896*** tfa9896  
***kCODEC\_WM8962*** wm8962

**How to Reach Us:****Home Page:**

[nxp.com](http://nxp.com)

**Web Support:**

[nxp.com/support](http://nxp.com/support)

Information in this document is provided solely to enable system and software implementers to use NXP products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits based on the information in this document.

NXP makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does NXP assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in NXP data sheets and/or specifications can and do vary in different applications, and actual performance may vary over time. All operating parameters, including "typicals," must be validated for each customer application by customer's technical experts. NXP does not convey any license under its patent rights nor the rights of others. NXP sells products pursuant to standard terms and conditions of sale, which can be found at the following address: [nxp.com/SalesTermsandConditions](http://nxp.com/SalesTermsandConditions).

While NXP has implemented advanced security features, all products may be subject to unidentified vulnerabilities. Customers are responsible for the design and operation of their applications and products to reduce the effect of these vulnerabilities on customer's applications and products, and NXP accepts no liability for any vulnerability that is discovered. Customers should implement appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NXP, the NXP logo, NXP SECURE CONNECTIONS FOR A SMARTER WORLD, Freescale, the Freescale logo, Kinetis, Processor Expert, and Tower are trademarks of NXP B.V. All other product or service names are the property of their respective owners. Arm, Cortex, Keil, Mbed, Mbed Enabled, and Vision are trademarks or registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere. The related technology may be protected by any or all of patents, copyrights, designs and trade secrets. All rights reserved. Oracle and Java are registered trademarks of Oracle and/or its affiliates. The Power Architecture and Power.org word marks and the Power and Power.org logos and related marks are trademarks and service marks licensed by Power.org.

© 2021 NXP B.V.

