

S1C17801

MFT Application Note

When using the commands, follow the instructions of NOTICE_Application Notes Sample Programs.pdf being included in the downloaded compressed file.

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OVERVIEW

This document is a reference to use the multi function timer function of S1C17801.

OPERATING ENVIRONMENT

- S5U1C17801T1100 (hereafter SVT17801:Software eValuation Tool for S1C17801)
SVT17801 CPU board and SVT17 ICD board
- USB miniB cable
- PC
GNU17 development tools pre-installed.
Installed with the USB driver for the SVT17 ICD board

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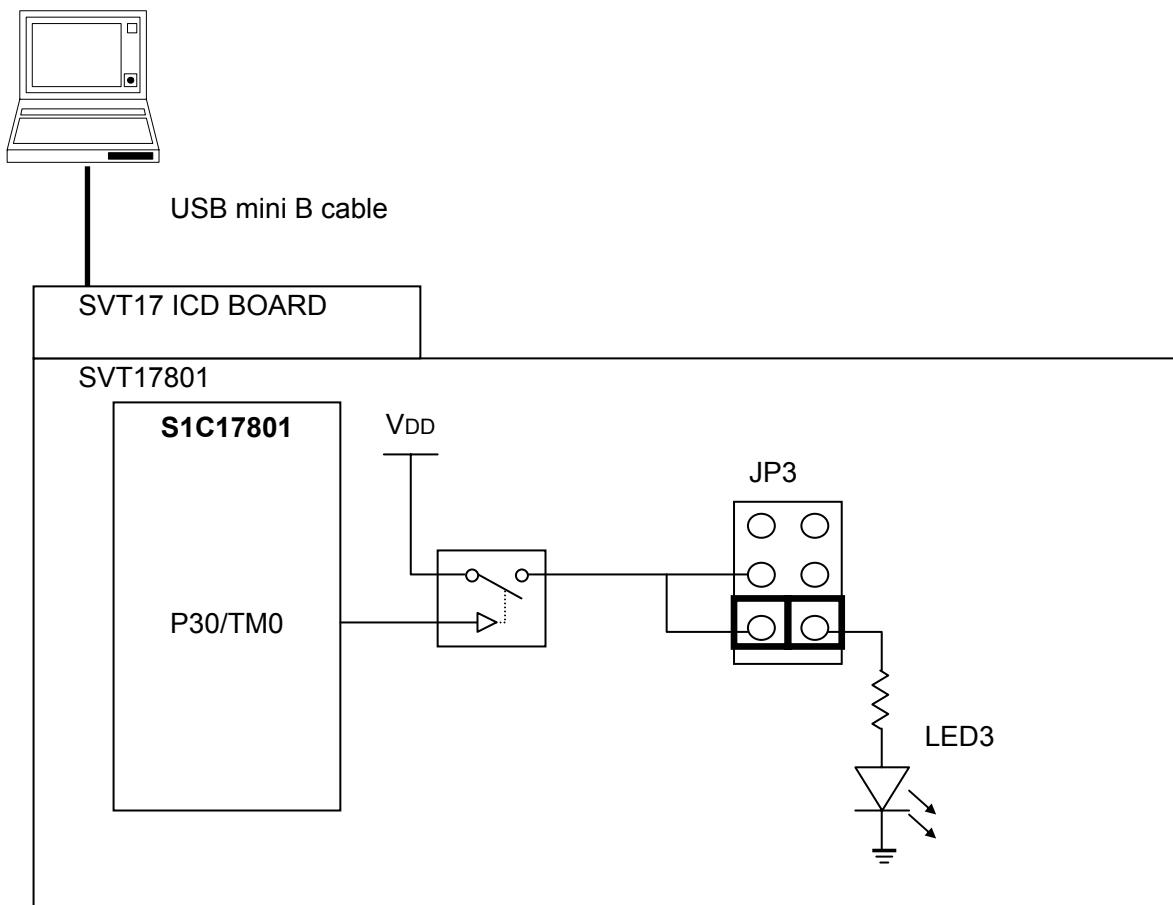
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1. SPECIFICATIONS

This sample software uses MFT to change brightness of LED (LED3) on the SVT17801 CPU board.

The following describes the connection procedure.

PC (having the GNU17 development tool)

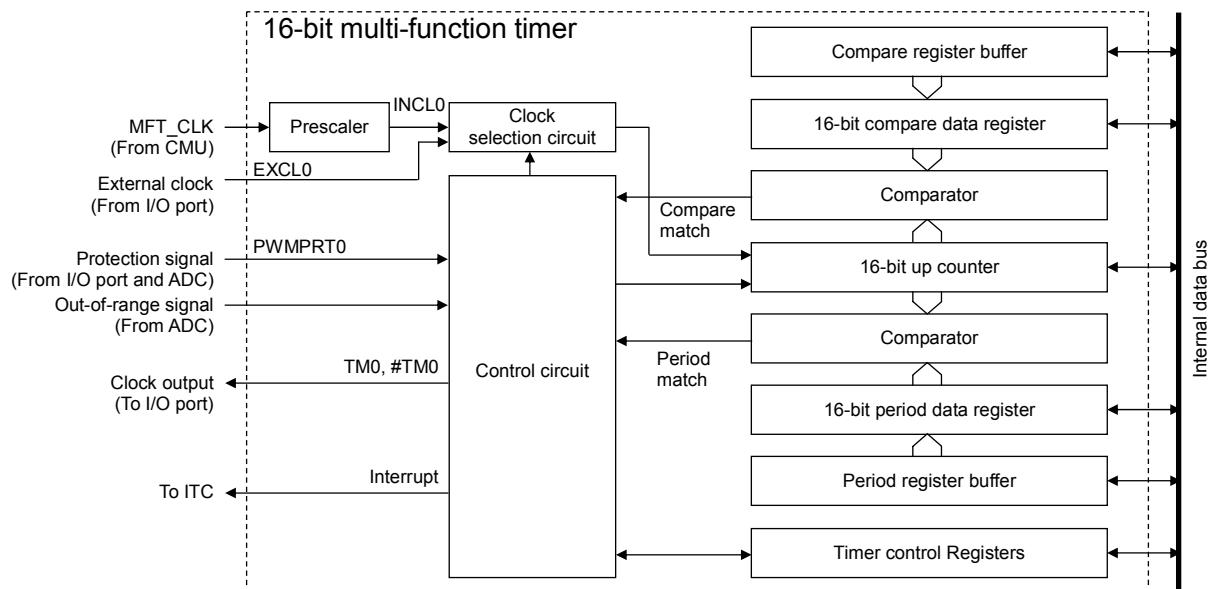


2. DESCRIPTIONS OF FUNCTIONS USED

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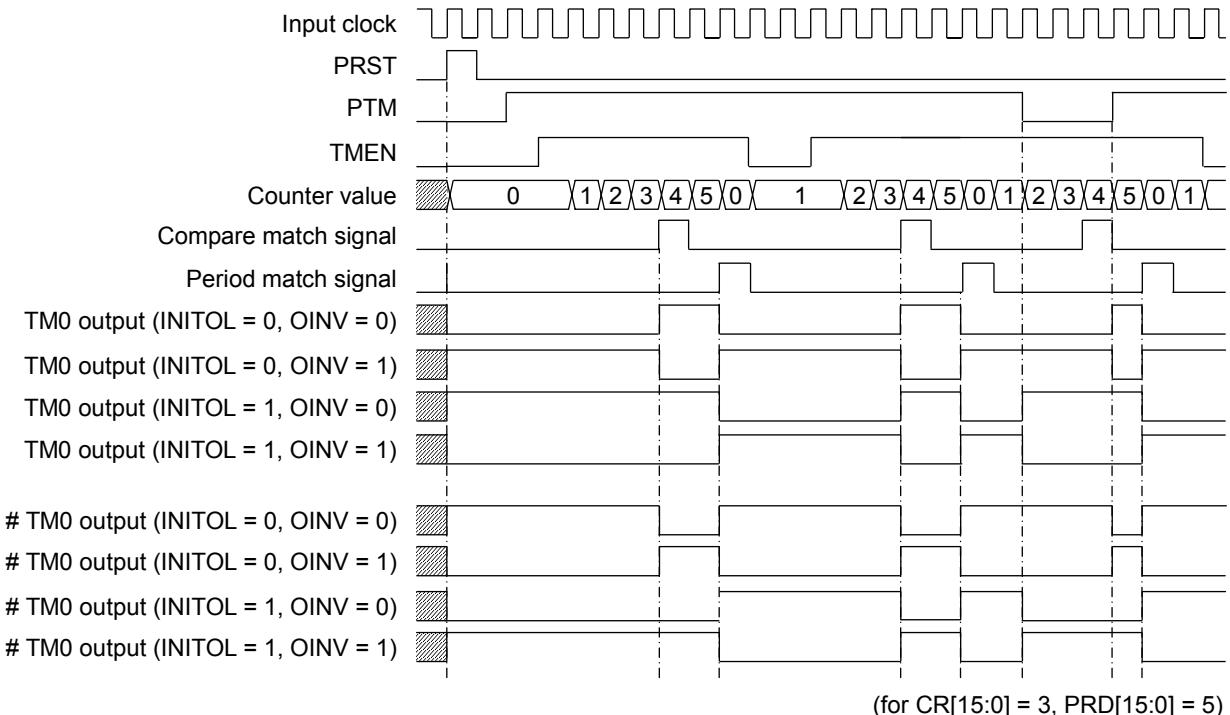
TM0 This pin is shared with the general-purpose I/O ports P30.

Interrupt MFT interrupt vector number and the vector address are as follows:
Vector number:8 (0x8)
Vector address: 0x900020 (TTBR+0x20)
Four types of interrupts are occurred including the compare match, period match, ADC protect and port protect.



3. OPERATION

The waveform of TM0 is generated by the compare match and period match signals, and any length of each ON or OFF period can be defined by setting the compare and counter (period) values.



4. SOFTWARE DESCRIPTION

4. SOFTWARE DESCRIPTION

4.1 File Configuration

File name	Function
boot.c	Startup module
main.c	Main function, interrupt handler function and PORT/ITC initialization function
inthdlr.c	Interrupt handler function
vector.c	Vector table
header/reg_801.h	Register definitions
header/vector.h	Vector table definitions
mft_drv/mft_drv.c	MFT driver API group
mft_drv/mft_api.h	MFT driver API definition
cmu_drv/	CMU driver group folder
flashc_drv/	FLASHC driver group folder
gpio_drv/	GPIO driver group folder
itc_drv/	ITC driver group folder
sramc_drv/	SRAMC driver group folder
mft_gnu7IDE.lds	Linker script file
mft_gnu17IDE.cmd	GDB command file
mft_gnu17IDE.par	Parameter configuration file
mft_gnu17IDE.mak	Make file
.cdtproject	Project file
.gnu17project	Project file
.project	Project file
GDB17 Launch for mft.launch	Project startup file

4.2 Descriptions of the modules

File name: main.c

Function name	Function
main	Calls ITC/PORT initialization function, sets MFT, and controls LED brightness.
PortInitialize	Port setting function Sets the port used by MFT.
ItcInitialize	Initializes interrupt controller Disables all interrupt handlers
MftLevelCtl	LED brightness function Changes MFT set value to adjust LED to the specified brightness.
MftPeriodIntHandler	Period match interrupt handler

4.3 Global Variables

The following lists the global variables used in the sample program.

Function name	Typ	Function
gMftChangePulse	const char	Interrupt occurrence check flag
gMftLevelTable	unsigned short	Table for setting LED brightness values

4.4 Structure

The following describes the structure used in the sample program.

Definition name		
T_MFT_CFG mftConfig		
Members		
clkSel	unsigned char	Clock select
buffMode	unsigned char	Buffer mode
pclkDiv	unsigned char	PCLK division ratio
prescaler	unsigned char	Prescaler control
outputMode	unsigned char	Output ports
outputInit	unsigned char	Output initial value
timerOut	unsigned char	MFT output control
iqa	unsigned char	Port protect noise filter setting
portProtect	unsigned char	Port protect level select
adProtect	unsigned char	ADC protect input select
pplntEnable	unsigned char	Port protect interrupt
aplntEnable	unsigned char	ADC protect interrupt
cmplntEnable	unsigned char	Compare match interrupt
prdlntEnable	unsigned char	Period match interrupt
pplntFunc	void *	Port protect interrupt handler
aplntFunc	void *	ADC protect interrupt handler
cmplntFunc	void *	Compare match interrupt
prdlntFunc	void *	Period match interrupt handler
Remarks		
Structure for setting MTF driver initial value		

4. SOFTWARE DESCRIPTION

4.5 Operating Procedures

Import the project

(1) Launch the IDE and import the “mft” project.

* For the import procedure, refer to S5U1C17001C Manual “3. Software Development Procedure.”

Build

(1) Build “mft” project using the IDE.

Connection and powering on procedures

(1) Connect SVT17801, USB miniB cable and PC.

(2) Reset SVT17 ICD board.

Run the program

(1) Execute “mft” project using the IDE.

4.6 Outline of the sample program operations

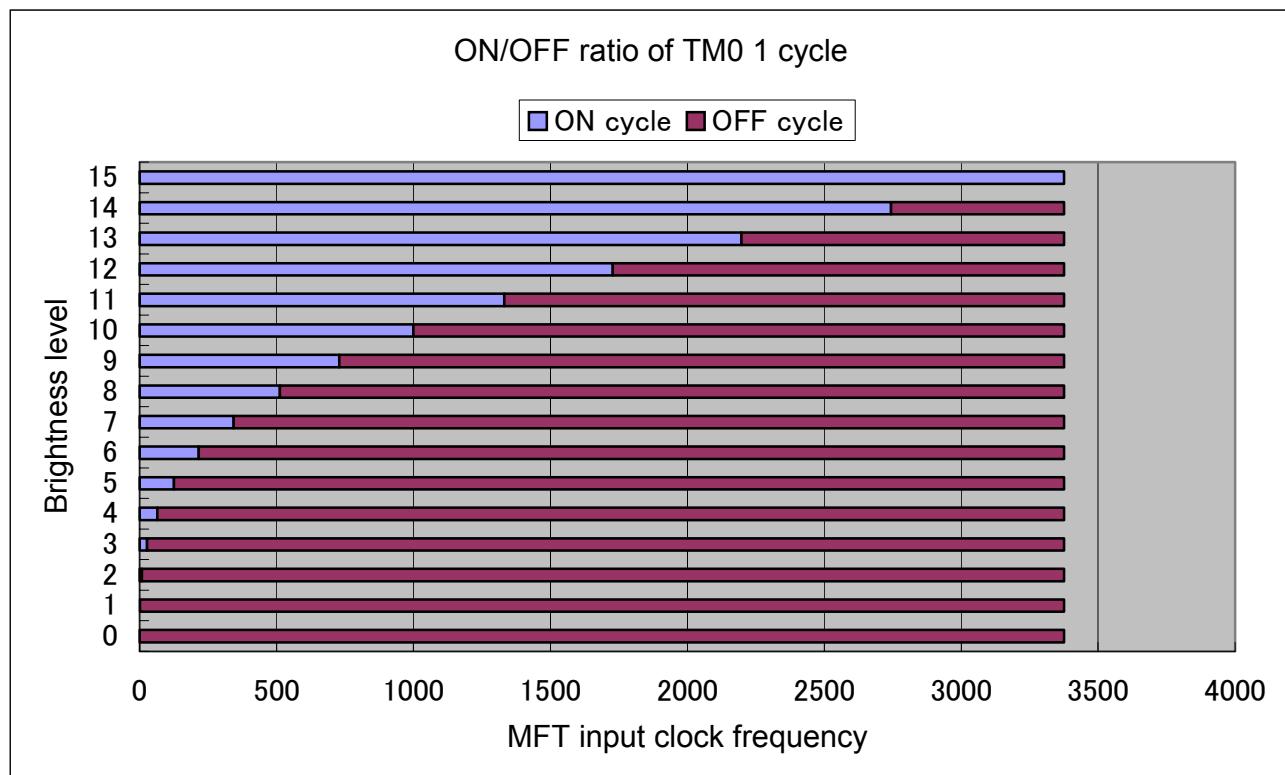
This sample program functions as described below:

Sets the LED brightness by 16 levels. (Adjusts LED brightness by switching ON and OFF of TM0 output at a high speed to blink the LED with high frequency)

Changes the brightness from level 0 to 15 in a phased manner.

Changes the brightness from level 15 to 0 in a phased manner.

The set value to the comparator register is calculated by an expression “Set value = Brightness level³” and held in the table. The calculation is to deal with the problem that increasing and decreasing a certain range of clock changes the brightness of LED only a little when it is brighter, while big when it is darker.



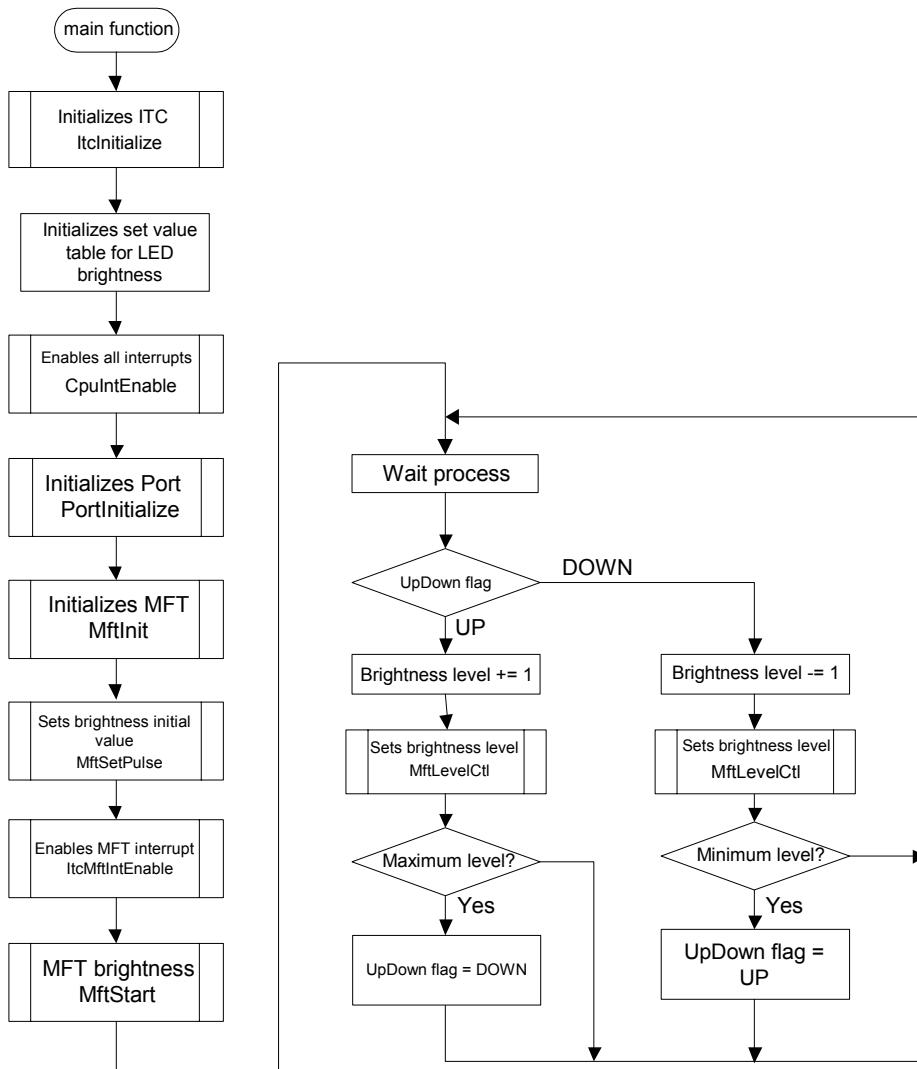
Compare value = ON period

Period value = ON period + OFF period

4. SOFTWARE DESCRIPTION

4.7 Flowchart

The following describes the main routine.



4.8 Detailed Explanation of the MFT Driver Functions

The following provides descriptions on the functions described in the files mft_drv.c and mft_api.h.

Initialization process

Format	<code>void MftInit(T_MFT_CFG *pConfig)</code>
Function	Initializes MFT
Argument	pConfig – in Initialization parameter
Return value	None
(Description)	
(1) Stops MFT. (By calling MftTimerStop.)	
(2) Disables the MFT interrupt. (By calling MftDisableInt.)	
(3) Clears MFT interrupt flag. (By calling MftDisableInt.)	
(4) Sets the input clock.	
(5) Sets the buffer mode.	
(6) Sets PCLK frequency division ratio.	
(7) Sets prescaler control.	
(8) Sets the output mode.	
(9) Sets the output initial value.	
(10) Sets the MFT output control.	
(11) Sets the IQA.	
(12) Sets the port protect.	
(13) Sets the ADC protect.	
(14) Sets interrupts.	
(15) Registers interrupt handler functions if any has been set.	

Setting pulse

Format	<code>void MftSetPulse(unsigned short period, unsigned short comparison)</code>
Function	Sets the pulse width of TM0.
Argument	period – in Period value comparison – in Compare value
Return Value	None
(Description)	
(1) Select the register to write period value. (By calling MftSetPrdData.)	
(2) Select the register to write compare value. (By calling MftSetCompData.)	

Starting MFT

Format	<code>void MftStart(void)</code>
Function	Starts the MFT.
Argument	None
Return Value	None
(Description)	
(1) Resets MFT. (By calling MftTimerReset)	
(2) Starts the MFT. (By calling MftTimerRun)	

4. SOFTWARE DESCRIPTION

Stopping MFT

Format	void MftStop(void)
Function	Stops the MFT.
Argument	None
Return Value	None
(Description) (1) Stops the MFT. (By calling MftTimerStop)	

Reading counter data (Macro function)

Format	short MftGetCntData(void)
Function	Reads the counter data register value.
Argument	None
Return Value	Counter data value.
(Description) (1) Reads the counter data register value.	

Reading period data (Macro function)

Format	short MftGetPrdData(void)
Function	Reads the period data register value.
Argument	None
Return Value	Period data value
(Description) (1) Reads the period data register value.	

Setting period data (Macro function)

Format	void MftSetPrdData(short data)
Function	Sets the value to the period data register.
Argument	data - in Period value
Return Value	None
(Description) (1) Writes value to the period data register.	

Reading compare data (Macro function)

Format	short MftGetCompData(void)
Function	Reads the compare data register value.
Argument	None
Return Value	Compare data value
(Description) (1) Reads the compare data register value.	

Setting compare data (Macro function)

Format	void MftSetCompData(short data)
Function	Sets the value to the compare data register.
Argument	data - in Compare value
Return Value	None
(Description) (1) Writes value to the compare data register.	

Stopping timer (Macro function)

Format	void MftTimerStop(void)
Function	Stops the timer.
Argument	None
Return Value	None
(Description) (1) Clears the timer Run/Stop control bit.	

Starting timer (Macro function)

Format	void MftTimerRun(void)
Function	Starts the timer.
Argument	None
Return Value	None
(Description) (1) Sets the timer Run/Stop control bit to 1.	

Resetting timer (Macro function)

Format	void MftTimerReset (void)
Function	Resets the timer.
Argument	None
Return Value	None
(Description) (1) Sets the timer reset bit to 1.	

Selecting internal clock (Macro function)

Format	void MftSelInternalClk(void)
Function	Select the internal clock for the operation clock.
Argument	None
Return Value	None
(Description) (1) Clears selection bit of the input clock.	

4. SOFTWARE DESCRIPTION

Selecting external clock (Macro function)

Format	void MftSelExternalClk(void)
Function	Select the external clock for the operation clock.
Argument	None
Return Value	None
(Description) (1) Sets selection bit of the input clock to 1.	

Disabling buffer mode (Macro function)

Format	void MftDisableBufferMode(void)
Function	Disables the buffer mode.
Argument	None
Return Value	None
(Description) (1) Clears the buffer enable bit.	

Enabling buffer mode (Macro)

Format	void MftEnableBufferMode(void)
Function	Enables the buffer mode.
Argument	None
Return Value	None
(Description) (1) Sets the buffer enable bit to 1.	

Setting PCLK frequency division ratio (Macro function)

Format	void MftSetPclkDiv(char div)
Function	Sets PCLK division ratio for operation clock.
Argument	div - in Division ratio
Return Value	None
(Description) (1) Sets the value to the division ratio field.	

Stopping Prescaler (Macro function)

Format	void MftPrescalerOff(void)
Function	Stops the MFT Prescaler.
Argument	None
Return Value	None
(Description) (1) Clears the clock control bit.	

Starting Prescaler (Macro function)

Format	void MftPrescalerOn(void)
Function	Starts the MFT Prescaler.
Argument	None
Return Value	None
(Description)	(1) Sets the clock control bit to 1.

Setting normal output (Macro function)

Format	void MftOutputModeNormal(void)
Function	Sets the output mode to normal.
Argument	None
Return Value	None
(Description)	(1) Clears the inverted output bit.

Setting inverted output (Macro function)

Format	void MftOutputModeInvert(void)
Function	Sets the output mode to inverted output.
Argument	None
Return Value	None
(Description)	(1) Sets the inverted output bit to 1.

Setting initial output value to Low (Macro function)

Format	void MftOutputInitLow(void)
Function	Sets the initial output value to the Low level.
Argument	None
Return Value	None
(Description)	(1) Clears the initial output value bit.

Setting initial output value to High (Macro function)

Format	void MftOutputInitHigh(void)
Function	Sets the initial output value to the High level.
Argument	None
Return Value	None
(Description)	(1) Sets the initial output value bit to 1.

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Stopping clock output (Macro function)

Format	void MftOutputOff(void)
Function	Stops the clock output.
Argument	None
Return Value	None
(Description)	(1) Clears the clock output bit.

Starting clock output (Macro function)

Format	void MftOutputOn(void)
Function	Starts the clock output.
Argument	None
Return Value	None
(Description)	(1) Sets the clock output bit to 1.

Specifying IQA to 6 clocks (Macro function)

Format	void MftSetIqa6Clk(void)
Function	Sets the IQA to 6 clocks.
Argument	None
Return Value	None
(Description)	(1) Clears the port protect input noise filter bit.

Specifying IQA to 12 clocks (Macro function)

Format	void MftSetIqa12Clk(void)
Function	Sets the IQA to 12 clocks.
Argument	None
Return Value	None
(Description)	(1) Sets the port protect input noise filter bit to 1.

Setting port protect input to High level (Macro function)

Format	void MftPortProtectHigh(void)
Function	Sets port input level to High.
Argument	None
Return Value	None
(Description)	(1) Clears the port protect input level selection bit.

Setting port protect input to Low level (Macro function)

Format	void MftPortProtectLow(void)
Function	Sets port input level to Low.
Argument	None
Return Value	None
(Description)	(1) Sets the port protect input level selection bit to 1.

Setting ADC protect input to High level (Macro function)

Format	void MftAdProtectHigh(void)
Function	Sets the ADC OutOfRange signal to High-Limited.
Argument	None
Return Value	None
(Description)	(1) Clears the ADC protect input selection bit.

Setting ADC protect input to Low level (Macro function)

Format	void MftAdProtectLow(void)
Function	Sets the ADC OutOfRange signal to Low-Limited.
Argument	None
Return Value	None
(Description)	(1) Sets the ADC protect input selection bit to 1.

Disabling all MFT interrupts (Macro function)

Format	void MftDisableInt(void)
Function	Disables all MFT interrupts.
Argument	None
Return Value	None
(Description)	(1) Clears the interrupt enable register.

Enabling MFT interrupt (Macro function)

Format	void MftEnableInt(char enable)
Function	Enables the specified MFT interrupt.
Argument	enable - in Interrupt to be enabled
Return Value	None
(Description)	(1) Sets the argument (enable) to the interrupt enable register.

4. SOFTWARE DESCRIPTION

Disabling port protect interrupt (Macro function)

Format	void MftDisablePpInt(void)
Function	Disables the port protect interrupt.
Argument	None
Return Value	None
(Description)	(1) Clears the port protect interrupt enable bit.

Enabling port protect interrupt (Macro function)

Format	void MftEnablePpInt(void)
Function	Enables the port protect interrupt.
Argument	None
Return Value	None
(Description)	(1) Sets the port protect interrupt enable bit to 1.

Disabling ADC protect interrupt (Macro function)

Format	void MftDisableAplInt(void)
Function	Disables the ADC protect interrupt.
Argument	None
Return Value	None
(Description)	(1) Clears the ADC protect interrupt enable bit.

Enabling ADC protect interrupt (Macro function)

Format	void MftEnableAplInt(void)
Function	Enables the ADC protect interrupt.
Argument	None
Return Value	None
(Description)	(1) Sets the ADC protect interrupt enable bit to 1.

Disabling compare interrupt (Macro function)

Format	void MftDisableCmplInt(void)
Function	Disables the compare interrupt.
Argument	None
Return Value	None
(Description)	(1) Clears the compare interrupt enable bit.

Enabling compare interrupt (Macro function)

Format	void MftEnableCmplnt(void)
Function	Enables the compare interrupt.
Argument	None
Return Value	None
(Description) (1) Sets the compare interrupt enable bit to 1.	

Disabling period interrupt (Macro function)

Format	void MftDisablePrdInt(void)
Function	Disables the period interrupt.
Argument	None
Return Value	None
(Description) (1) Clears the period interrupt enable bit.	

Enabling period interrupt (Macro function)

Format	void MftEnablePrdInt(void)
Function	Enables the period interrupt.
Argument	None
Return Value	None
(Description) (1) Sets the period interrupt enable bit to 1.	

Checking interrupt enable status (Macro function)

Format	char MftGetIntEnable(void)
Function	Checks the interrupt enable status.
Argument	None
Return Value	Interrupt enable status.
(Description) (1) Reads the interrupt enable register value.	

Clearing all MFT interrupt flags (Macro function)

Format	void MftClearIntFlag(void)
Function	Clears all MFT interrupt flags.
Argument	None
Return Value	None
(Description) (1) Sets low-order 4 bits of the interrupt flag register to 1.	

4. SOFTWARE DESCRIPTION

Clearing port protect interrupt flag (Macro function)

Format	void MftClearPpIntFlag(void)
Function	Clears the port protect interrupt flag.
Argument	None
Return Value	None
(Description) (1) Sets the port protect interrupt flag bit to 1.	

Clearing ADC protect interrupt flag (Macro function)

Format	void MftClearApIntFlag(void)
Function	Clears the ADC protect interrupt flag.
Argument	None
Return Value	None
(Description) (1) Sets the ADC protect interrupt flag bit to 1.	

Clearing compare interrupt flag (Macro function)

Format	void MftClearCmpIntFlag(void)
Function	Clears the compare interrupt flag.
Argument	None
Return Value	None
(Description) (1) Sets the compare interrupt flag bit to 1.	

Clearing period interrupt flag (Macro function)

Format	void MftClearPrdIntFlag(void)
Function	Clears the period interrupt flag.
Argument	None
Return Value	None
(Description) (1) Sets the period interrupt flag bit to 1.	

Checking MFT interrupt flag (Macro function)

Format	char MftGetIntFlag(void)
Function	Checks the MFT interrupt flag.
Argument	None
Return Value	None
(Description) (1) Reads the interrupt flag register value.	

4.9 Header Definitions

The table below show the definitions used in the driver functions.

Definition name	Value	Description
MFT_INTERNAL_CLOCK	0	Uses internal clock
MFT_EXTERNAL_CLOCK	1	Uses external clock
MFT_BUFFER_DISABLE	0	Disables buffer mode
MFT_BUFFER_ENABLE	1	Enables buffer mode
MFT_PCLKDIV_1	0x0	PCLK division ratio: 1/1
MFT_PCLKDIV_2	0x1	PCLK division ratio: 1/2
MFT_PCLKDIV_4	0x2	PCLK division ratio: 1/4
MFT_PCLKDIV_8	0x3	PCLK division ratio: 1/8
MFT_PCLKDIV_16	0x4	PCLK division ratio: 1/16
MFT_PCLKDIV_32	0x5	PCLK division ratio: 1/32
MFT_PCLKDIV_64	0x6	PCLK division ratio: 1/64
MFT_PCLKDIV_128	0x7	PCLK division ratio: 1/128
MFT_PRESCALER_OFF	0	Stops Prescaler
MFT_PRESCALER_ON	1	Starts Prescaler
MFT_OUTPUT_NORMAL	0	Normal output
MFT_OUTPUT_INVERT	1	Inverted output
MFT_OUTPUT_INI_LOW	0	Initial output value: Low
MFT_OUTPUT_INI_HIGH	1	Initial output value: High
MFT_OUTPUT_OFF	0	Stops clock output
MFT_OUTPUT_ON	1	Starts clock output
MFT_IQA_6CLK	0	Specifies the IQA to 6 clocks.
MFT_IQA_12CLK	1	Specifies the IQA to 12 clocks.
MFT_PROTECT_HIGH	0	Port/ADC protect input: High level
MFT_PROTECT_LOW	1	Port/ADC protect input: Low level

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REVISION HISTORY

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