RZ/T1 Group

CMTW & ELC Sample Program

R01AN2600EJ0140
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Introduction

This application note explains a sample program that performs A/D conversion based on the linkage between the timer and the ADC function by using the 32-bit timer (CMTW) and the event link controller (ELC) of RZ/T1.

The major features of the CMTW & ELC sample 2014.11.04 program are listed below.

- Compare matches of the timer occur at intervals of 3 seconds.
- When a compare match of the timer occurs, the input voltage to the potentiometer is A/D converted.
- Conversion results are classified into four scales, which are displayed to LED0, LED1, LED2, and LED3 respectively.

Target Devices

RZ/T1

When applying the sample program covered in this application note to another microcomputer, modify the program according to the specifications for the target microcomputer and conduct an extensive evaluation of the modified program.

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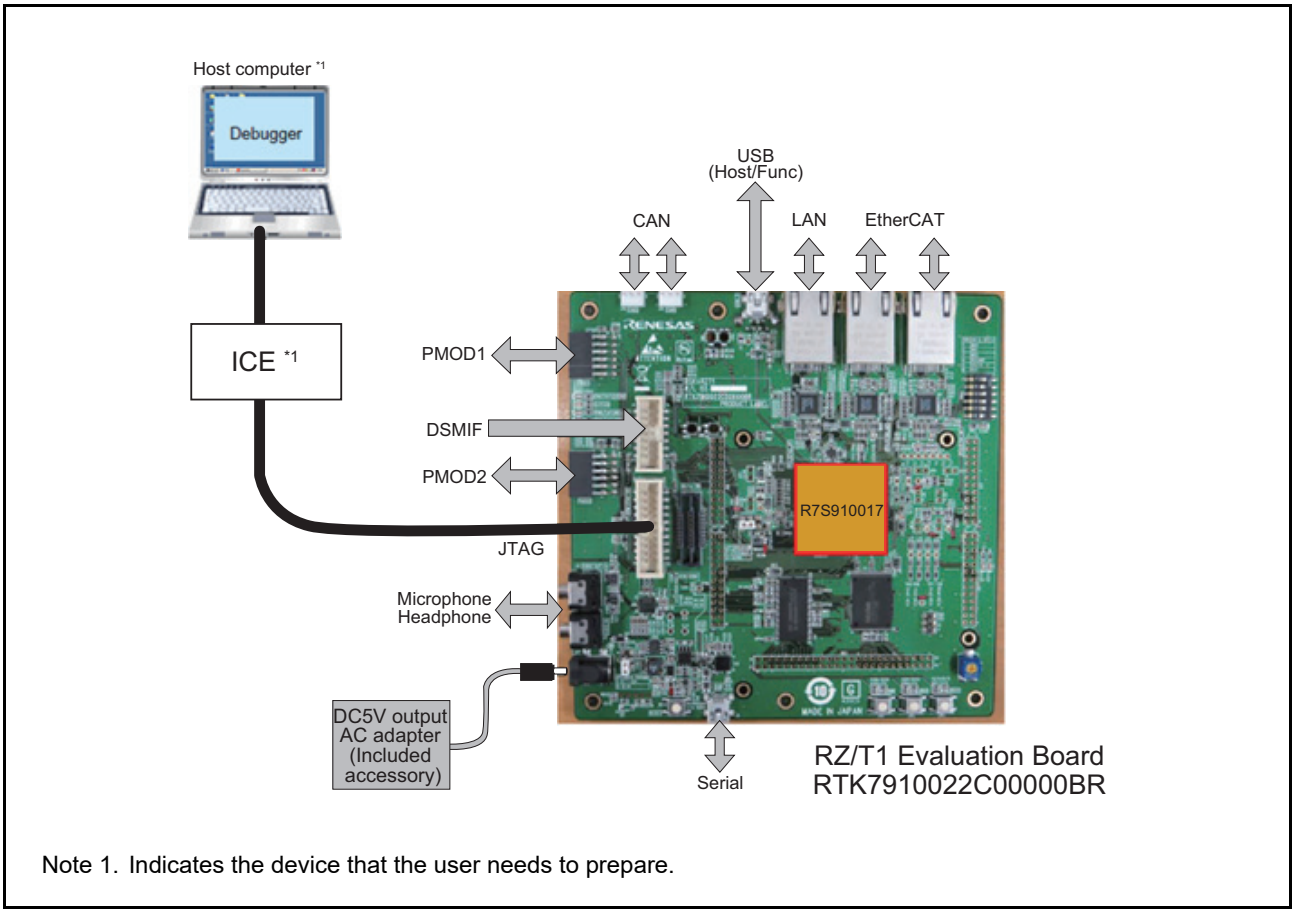
1. Specifications

Table 1.1 lists the peripheral functions to be used and their applications and Figure 1.1 shows the operating environment when the sample code is being executed.

Table 1.1 Peripheral Functions and Applications

Peripheral Function	Application
RZ/T1 embedded compare match timer W (CMTW)	A 32-bit timer that outputs an interrupt and issues an event to the ELC when a specified count is satisfied
RZ/T1 embedded event link controller (ELC)	Receives an event from the source module of an event link and performs a linkage operation to the source module of the event link.
Power consumption reduction function	Supplies and stops the clocks to the CMTW and ELC modules
Interrupt controller (ICUA)	• CMTW interrupt control (Unit0/Unit1) Compare match (vector 25/30) Input capture 0 (vector 26/31) Input capture 1 (vector 27/32) Output compare 0 (vector 28/33) Output compare 1 (vector 29/34) • ELC interrupt control Interrupt request signal 1 (vector 242) Interrupt request signal 2 (vector 243)
I/O port (PM3, PM2, P56, PF7)	LED control
ADC (AN007)	A/D conversion of the input voltage to the potentiometer
Potentiometer	Inputs variable voltages to the ADC.



Note 1. Indicates the device that the user needs to prepare.

Figure 1.1 Operating Environment

2. Operating Environment

The sample code covered in this application note is for the environment below.

Table 2.1 Operating Environment

Item	Description
Microcomputer	RZ/T1 Group
Operating frequency	CPUCLK = 450 MHz
Operating voltage	3.3 V
Integrated Development Environment	Manufactured by IAR Systems Embedded Workbench® for Arm Version 8.20.2 Manufactured by Arm DS-5™ 5.26.2 Manufactured by RENESAS e2studio 6.1.0
Operating mode	SPI boot mode 16-bit bus boot mode
Board	RZ/T1 Evaluation Board (RTK7910022C00000BR)
Device (functions to be used on the board)	• NOR flash memory (connected to CS0 and CS1 spaces) Manufacturer: Macronix International Co., Ltd. Model: MX29GL512FLT2I-10Q • SDRAM (connected to CS2 and CS3 spaces) Manufacturer: Integrated Silicon Solution Inc. Model: IS42S16320D-7TL • Serial flash memory Manufacturer: Macronix International Co., Ltd. Model: MX25L51245G • Potentiometer (AN007) • LED LED0 (PF7), LED1 (P56), LED2 (P77), LED3 (PA0)

3. Related Application Note

The application notes related to this application note are listed below for reference.

- Application Note: RZ/T1 Group Initial Settings (R01AN2554EJ)
- Application Note: RZ/T1 Group ADC Sample Program (R01AN2599EJ)

Note: Registers not mentioned in this application note should be used at a value set in the Application Note: RZ/T1 Group Initial Settings.

4. Peripheral Functions

The basics of the operating mode used in event links, compare match timer W (CMTW), event link controller (ELC), power consumption reduction function, interrupt controller (ICUA), I/O ports, multi-function pin controller (MPC), and 12-bit A/D converter (S12ADCa) are described in the RZ/T1 Group User's Manual: Hardware.

5. Hardware

5.1 Hardware Configuration Example

Figure 5.1 shows a hardware configuration example for the sample code.

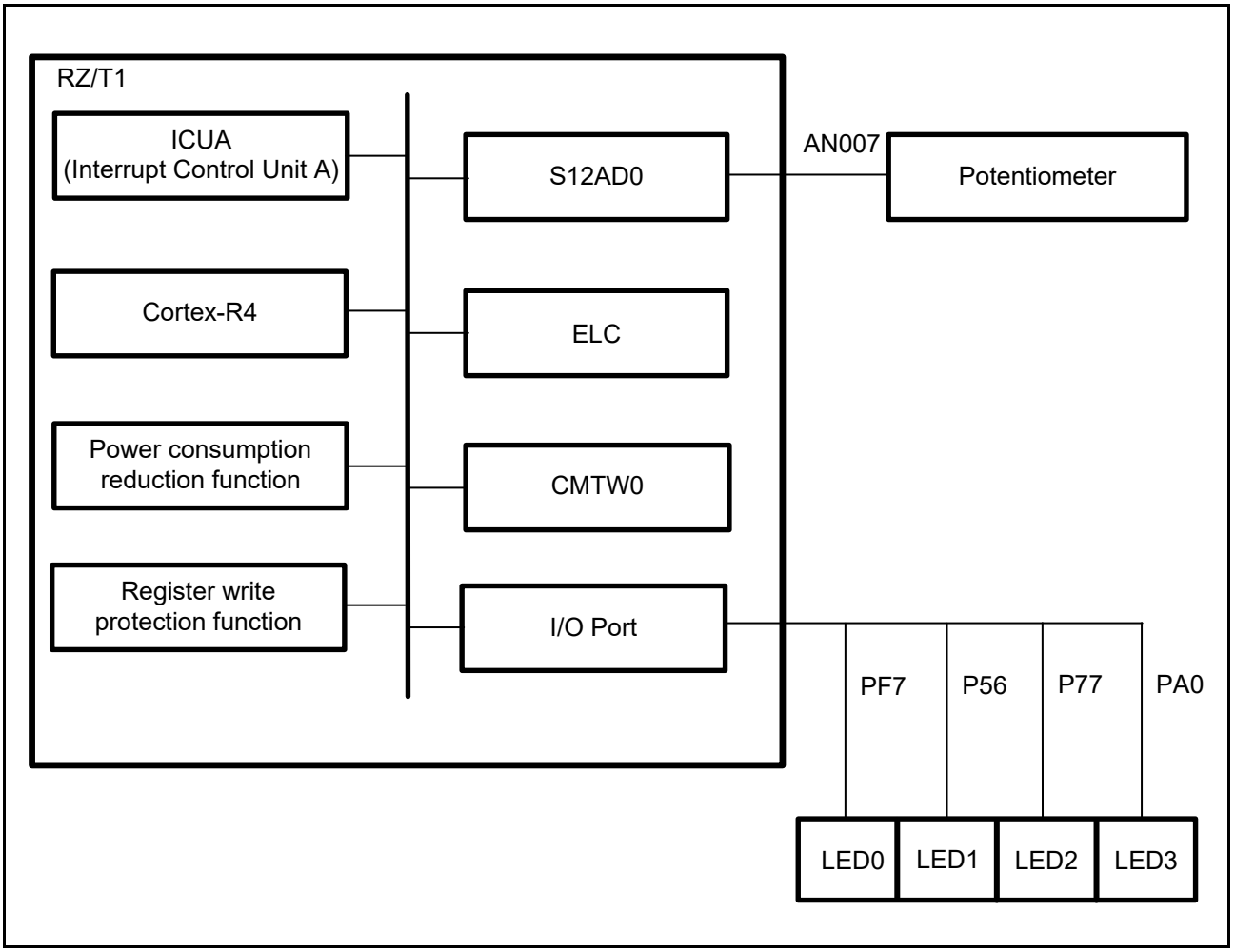


Figure 5.1 Hardware Configuration Example

5.2 Pins

Table 5.1 lists pins to be used and their functions.

Table 5.1 Pins and Functions

Pin Name	Input/Output	Function
AN007	Input	Potentiometer
PF7	Output	LED0 control
P56	Output	LED1 control
P77	Output	LED2 control
PA0	Output	LED3 control

6. Software

6.1 Operation Outline

Table 6.1 Operation Outline lists the functional outlines of the CMTW & ELC sample program. Figure 6.1 shows the system block diagram.

Table 6.1 Operation Outline

Function	Outline
Operation outline	• The following items 1 to 4 are executed repeatedly. 1. An event occurs due to a CMTW compare match. 2. The ELC distributes the event to the ADC. 3. A/D conversion in the ADC 4. A/D conversion results are classified into four scales, and the LED assigned to the relevant scale is turned on. 5. When an A/D conversion result exceeds the maximum value (fourth scale), the processing of the sample program is terminated.
Channel number (CMTW)	• ch0 is selected
Operation mode (CMTW)	• Only compare match is set.
Compare match period (CMTW)	• Approximately 3 seconds (Input clock to the timer counter: PCLKD/8, compare match count setting: 28125000)
Timer counter clear source (CMTW)	• Compare match Operates in the timer counter periodic operation.
Link source event (ELC)	• CMTW/Channel 0/Compare match
Link destination event (ELC)	• S12AD0
A/D conversion start condition	• Synchronous trigger startup
ADC driver setting	• The following are set. Input channel: AN007 Operation mode: Single scan mode Conversion start trigger: Synchronous trigger startup (ELC)

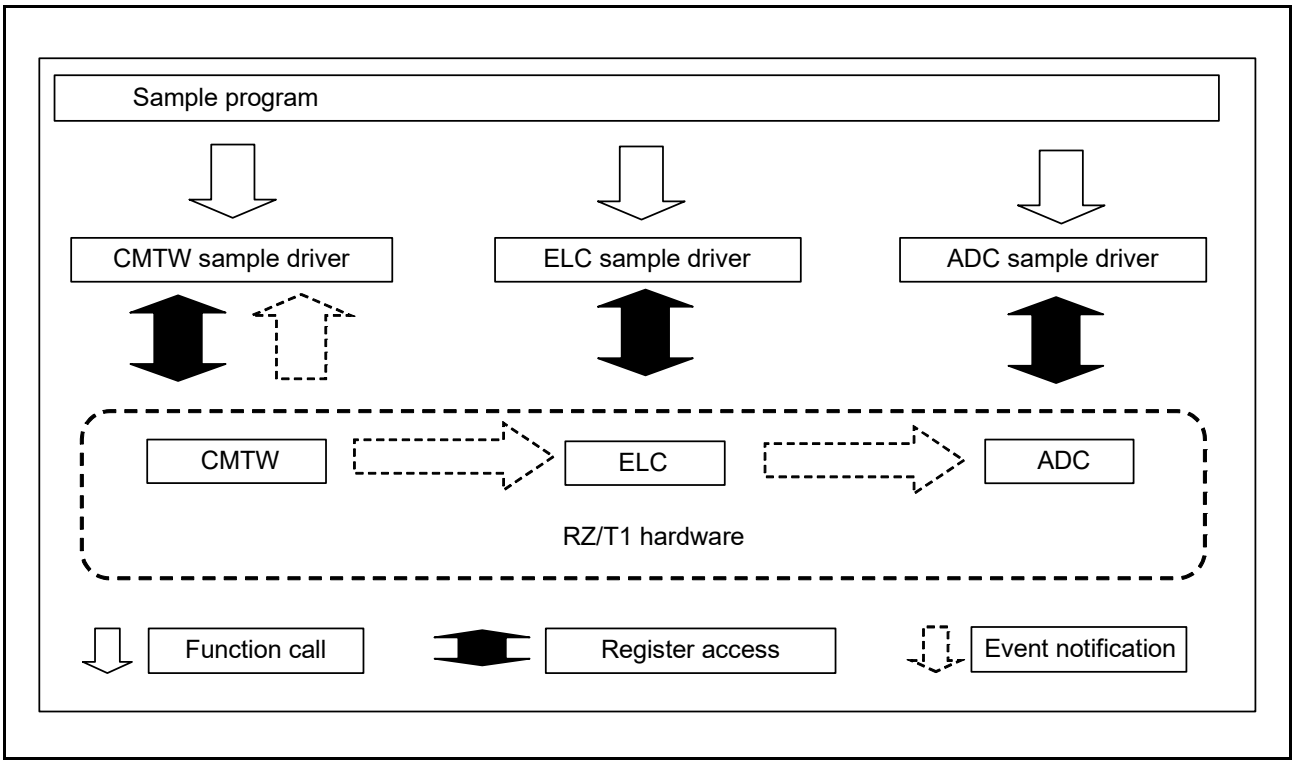


Figure 6.1 System Block Diagram

6.1.1 Project Settings

The project settings used on the development environment EWARM are described in the Application Note: RZ/T1 Group Initial Settings.

6.1.2 Preparation for Use

No preparation is required for executing this sample program.

6.2 Memory Map

The address space of the RZ/T1 group and the memory mapping of the RZ/T1 evaluation board are described in the Application Note: RZ/T1 Group Initial Settings.

6.2.1 Section Arrangement of the Sample Program

Sections used in the sample program, the section arrangement in the initial state of the sample program (load view), and the section arrangement after the scatter loading function is used (execution view) are described in the Application Note: RZ/T1 Group Initial Settings.

6.2.2 MPU Settings

The settings of the MPU are described in the Application Note: RZ/T1 Group Initial Settings.

6.2.3 Exception Handling Vector Table

The exception handling vector table is described in the Application Note: RZ/T1 Group Initial Settings.

6.3 Interrupts

Table 6.2 lists interrupts for the sample code.

Table 6.2 Interrupts for the Sample Code

Interrupt (Source ID)	Priority	Process Outline
Compare match interrupt (25)	7	The callback function is called.
A/D conversion complete interrupt (35)	7	The callback function is called.

6.4 Fixed-Width Integer Types

Table 6.3 lists fixed-width integers for the sample code.

Table 6.3 Fixed-width Integers for the Sample Code

Symbol	Description
int8_t	8-bit signed integer (defined in the standard library)
int16_t	16-bit signed integer (defined in the standard library)
int32_t	32-bit signed integer (defined in the standard library)
int64_t	64-bit signed integer (defined in the standard library)
uint8_t	8-bit unsigned integer (defined in the standard library)
uint16_t	16-bit unsigned integer (defined in the standard library)
uint32_t	32-bit unsigned integer (defined in the standard library)
uint64_t	64-bit unsigned integer (defined in the standard library)

6.5 Constants/Error Codes

Table 6.4 lists the constants to be used in relevant drivers in the sample code, Table 6.5 to Table 6.17 list the constants to be used in the CMTW driver, and Table 6.18 to Table 6.40 list the constants to be used in the ELC driver.

Note that this sample code does not use constants to the ELC.

6.5.1 Constants for the Sample Code

Table 6.4 Constants for the Sample Code

Constant Name	Setting Value	Description
CMTW_MATCH_COUNT_3SEC	28125000	Setting the counter value for a compare match. This value corresponds to a compare match period of three seconds in combination with the frequency division ratio of PCLKD in the sample program.
CMTW_INTR_PRI	7	Interrupt priority set to the CMTW driver
ELC_INTR_PRI	7	Interrupt priority set to the ELC driver
ADC_PORT_PDR_OUT	3	Setting the directions of the ports corresponding to the LEDs The ports are set to output.
ADC_PORT_PMR_IO_SET	0	Setting the functions of the port pins corresponding to the LEDs The ports are used as general-purpose ports.
ADC_LED_OFF	0	Setting the output values of the ports corresponding to the LEDs Turning off the LED
ADC_LED_ON	1	Setting the output values of the ports corresponding to the LEDs Turning on the LED
ADC_ADI_PRI	7	Setting the interrupt priority of the ADC driver
ADC_LVL0	0	Value of Level 0 A/D conversion value (minimum conversion value)
ADC_LVL1	820	Threshold value to Level 1 A/D conversion value
ADC_LVL2	1639	Threshold value to Level 2 A/D conversion value
ADC_LVL3	2458	Threshold value to Level 3 A/D conversion value
ADC_LVL4	3277	Threshold value to Level 4 A/D conversion value

6.5.2 Constants for the CMTW Driver

Table 6.5 Error Codes for the Sample Code (CMTW)

Constant Name	Setting Value	Description
CMTW_SUCCESS	0	The function terminates normally.
CMTW_ERR_INVALID_CH	1	A nonexistent channel is specified.
CMTW_ERR_INVALID_ARG	2	The setting parameter has an abnormal value.
CMTW_ERR_NOT_OPENED	3	The function is executed in an uninitialized state.
CMTW_ERR_NOT_CLOSED	4	Initialization of the API is duplicated.
CMTW_ERR_TIMER_RUNNING	5	The function is executed while the timer is running.
CMTW_ERR_TIMER_STOP	6	The timer is executed while the timer count has been stopped.
CMTW_ERR_MISSING_PTR	7	Incorrect pointer argument

Table 6.6 Definitions for CMTW Version

Constant Name	Value	Description
CMTW_VERSION_MAJOR	1	Major version of the CMTW sample driver
CMTW_VERSION_MINOR	0	Minor version of the CMTW sample driver

Table 6.7 Definitions for CMTW Driver Channel Number

Constant Name	Value	Description
CMTW_CH_0	0	Specifying the Channel 0
CMTW_CH_1	1	Specifying the Channel 1
CMTW_CH_NUM	2	Used for checking the range of normal setting values. Indicating the number of CMTW channels.

Table 6.8 CMTW Command Definitions

Constant Name	Value	Description
CMTW_CMD_SET_TIME_CNT	0	Timer count setting command
CMTW_CMD_SET_MODE	1	Timer mode setting command
CMTW_CMD_SET_PAUSE	2	Pause command
CMTW_CMD_SET_RESUME	3	Resume command
CMTW_CMD_SET_RESTART	4	Restart command
CMTW_CMD_SET_ECM	5	ECM dynamic mode error setting
CMTW_CMD_GET_STATUS	6	Status acquisition command

Table 6.9 Definitions for Setting Timer Clock Frequency Division Ratio

Constant Name	Value	Description
CMTW_PCLK_DIV_8	0	Selecting PCLKD/8 as the timer frequency division ratio
CMTW_PCLK_DIV_32	1	Selecting PCLKD/32 as the timer frequency division ratio
CMTW_PCLK_DIV_128	2	Selecting PCLKD/128 as the timer frequency division ratio
CMTW_PCLK_DIV_512	3	Selecting PCLKD/512 as the timer frequency division ratio
CMTW_PCLK_DIV_MAX_OVER	4	For checking the range of normal setting values

Table 6.10 Definitions for Setting Timer Counter Length

Constant Name	Value	Description
CMTW_CNT_SIZE_32BIT	0	Selecting 32 bits as the counter size
CMTW_CNT_SIZE_16BIT	1	Selecting 16 bits as the counter size
CMTW_CNT_SIZE_MAX_OVER	2	For checking the range of normal setting values

Table 6.11 Definitions for Setting Timer Counter Clear Source

Constant Name	Value	Description
CMTW_CNT_CLEAR_COMPARE_MATCH	0	Selecting compare match as the counter clear source
CMTW_CNT_CLEAR_INPUT_CAPTURE0	1	Selecting input capture 0 as the counter clear source
CMTW_CNT_CLEAR_INPUT_CAPTURE1	2	Selecting input capture 1 as the counter clear source
CMTW_CNT_CLEAR_OUTPUT_COMPARE0	3	Selecting output compare 0 as the counter clear source
CMTW_CNT_CLEAR_OUTPUT_COMPARE1	4	Selecting output compare 1 as the counter clear source
CMTW_CNT_CLEAR_NONE	5	Selecting counter clear source none
CMTW_CNT_CLEAR_MAX_OVER	6	For checking the range of normal setting values

Table 6.12 Definitions for Output Compare Output Setting

Constant Name	Value	Description
CMTW_OUT_COMPARE_VALUE_HOLD	0	The output value does not change during output compare.
CMTW_OUT_COMPARE_VALUE_0_TO_TOGGLE	1	The output value start at an initial value of 0 and toggles during output compare.
CMTW_OUT_COMPARE_VALUE_1_TO_TOGGLE	2	The output value start at an initial value of 1 and toggles during output compare.
CMTW_OUT_COMPARE_VALUE_MAX_OVER	3	For checking the range of normal setting values

Table 6.13 Definitions for Setting Input Capture Detection Trigger

Constant Name	Value	Description
CMTW_IN_CAPTURE_TRIGGER_UP	0	Setting the input capture trigger to rising edge
CMTW_IN_CAPTURE_TRIGGER_DOWN	1	Setting the input capture trigger to falling edge
CMTW_IN_CAPTURE_TRIGGER_UP_DOWN	2	Setting the input capture trigger to both rising and falling edges
CMTW_IN_CAPTURE_TRIGGER_MAX_OVER	3	For checking the range of normal setting values

Table 6.14 Definitions for Setting Noise Filter Clock Frequency Division Ratio

Constant Name	Value	Description
CMTW_NOISE_FILTER_PCLK_DIV_1	0	Selecting PCLKD/1 as the noise filter frequency division ratio
CMTW_NOISE_FILTER_PCLK_DIV_8	1	Selecting PCLKD/8 as the noise filter frequency division ratio
CMTW_NOISE_FILTER_PCLK_DIV_32	2	Selecting PCLKD/32 as the noise filter frequency division ratio
CMTW_NOISE_FILTER_PCLK_DIV_64	3	Selecting PCLKD/64 as the noise filter frequency division ratio
CMTW_NOISE_FILTER_PCLK_DIV_MAX_OVER	4	For checking the range of normal setting values

Table 6.15 Definitions for Input Capture Number

Constant Name	Value	Description
CMTW_INPUT_CAPTURE_NUM_0	0	Selecting input capture 0
CMTW_INPUT_CAPTURE_NUM_1	1	Selecting input capture 1
CMTW_INPUT_CAPTURE_NUM	2	Used for checking the range of normal setting values. Indicating the number of input captures.

Table 6.16 Definitions for Output Compare Number

Constant Name	Value	Description
CMTW_OUTPUT_COMPARE_NUM_0	0	Selecting output compare 0
CMTW_OUTPUT_COMPARE_NUM_1	1	Selecting output compare 1
CMTW_OUTPUT_COMPARE_NUM	2	Used for checking the range of normal setting values. Indicating the number of output compares.

Table 6.17 Definitions for Timer Operating State

Constant Name	Value	Description
CMTW_STATUS_STOP	0	Indicating the timer stop state
CMTW_STATUS_RUNNING	1	Indicating the timer running state

6.5.3 Constants for the ELC Driver

Table 6.18 Error Codes for the Sample Code (ELC)

Constant Name	Setting Value	Description
ELC_SUCCESS_OK	0	The function terminates normally.
ELC_ERR_INVALID_ARG	1	The setting parameter has an abnormal value.
ELC_ERR_NOT_OPENED	2	The function is executed in an uninitialized state.
ELC_ERR_NOT_CLOSED	3	The API is initialized twice.
ELC_ERR_MISSING_PTR	4	Incorrect pointer argument

Table 6.19 Definitions for ELC Driver Version

Constant Name	Value	Description
ELC_VERSION_MAJOR	1	Major version of the ELC sample driver
ELC_VERSION_MINOR	0	Minor version of the ELC sample driver

Table 6.20 ELC Command Definitions

Constant Name	Value	Description
ELC_CMD_SET_EVENT_MTU	0	MTU event link setting command
ELC_CMD_SET_EVENT_CMT	1	CMT event link setting command
ELC_CMD_SET_EVENT_DSMIF	2	ΔΣ unit event link setting command
ELC_CMD_SET_EVENT_S12AD	3	12-bit A/D converter event link setting command
ELC_CMD_SET_EVENT_INTR	4	ELC interrupt request signal event link setting command
ELC_CMD_SET_EVENT_OUT_PORT_GROUP	5	Output port group event link setting command
ELC_CMD_SET_EVENT_IN_PORT_GROUP	6	Input port group event link setting command
ELC_CMD_SET_EVENT_SINGLE_PORT	7	Single port registration event link setting command
ELC_CMD_SET_EVENT_CMTW	8	CMTW event link setting command
ELC_CMD_SET_EVENT_TPU	9	TPU event link setting command
ELC_CMD_SET_EVENT_GPT	10	GPT event link setting command
ELC_CMD_SET_PORT_GROUP	11	Port group setting command
ELC_CMD_SET_SOFTWARE_EVENT	12	Software event issuance command
ELC_CMD_GET_PORT_GROUP_VALUE	13	Input port group value acquisition command

Table 6.21 Definitions for Setting Event Link Resource (1 / 3)

Constant Name	Value	Description
ELC_RESOURCE_MTU0_COMPARE_MATCH_0A	0x01	Specifying MTU0 compare match 0A as the event link source
ELC_RESOURCE_MTU0_COMPARE_MATCH_0B	0x02	Specifying MTU0 compare match 0B as the event link source
ELC_RESOURCE_MTU0_COMPARE_MATCH_0C	0x03	Specifying MTU0 compare match 0C as the event link source
ELC_RESOURCE_MTU0_COMPARE_MATCH_0D	0x04	Specifying MTU0 compare match 0D as the event link source
ELC_RESOURCE_MTU0_COMPARE_MATCH_0E	0x05	Specifying MTU0 compare match 0E as the event link source
ELC_RESOURCE_MTU0_COMPARE_MATCH_0F	0x06	Specifying MTU0 compare match 0F as the event link source
ELC_RESOURCE_MTU0_OVERFLOW	0x07	Specifying MTU0 overflow as the event link source
ELC_RESOURCE_MTU3_COMPARE_MATCH_3A	0x10	Specifying MTU3 compare match 3A as the event link source
ELC_RESOURCE_MTU3_COMPARE_MATCH_3B	0x11	Specifying MTU3 compare match 3B as the event link source
ELC_RESOURCE_MTU3_COMPARE_MATCH_3C	0x12	Specifying MTU3 compare match 3C as the event link source
ELC_RESOURCE_MTU3_COMPARE_MATCH_3D	0x13	Specifying MTU3 compare match 3D as the event link source
ELC_RESOURCE_MTU3_OVERFLOW	0x14	Specifying MTU3 overflow as the event link source
ELC_RESOURCE_MTU4_COMPARE_MATCH_4A	0x15	Specifying MTU4 compare match 4A as the event link source
ELC_RESOURCE_MTU4_COMPARE_MATCH_4B	0x16	Specifying MTU4 compare match 4B as the event link source
ELC_RESOURCE_MTU4_COMPARE_MATCH_4C	0x17	Specifying MTU4 compare match 4C as the event link source
ELC_RESOURCE_MTU4_COMPARE_MATCH_4D	0x18	Specifying MTU4 compare match 4D as the event link source
ELC_RESOURCE_MTU4_OVERFLOW	0x19	Specifying MTU4 overflow as the event link source
ELC_RESOURCE_MTU4_UNDERFLOW	0x1A	Specifying MTU4 underflow as the event link source
ELC_RESOURCE_CMT1_COMPARE_MATCH_1	0x1F	Specifying CMT1 compare match 1 as the event link source
ELC_RESOURCE_ETHER_TIMER_SYNC	0x22	Specifying EtherMAC IEEE1588 timer synchronous signal as the event link source
ELC_RESOURCE_RIIC0_EVENT	0x4E	Specifying RIIC0 communication error event occurrence as the event link source
ELC_RESOURCE_RIIC0_RX_DATA_FULL	0x4F	Specifying RIIC0 reception data full as the event link source
ELC_RESOURCE_RIIC0_TX_DATA_EMPTY	0x50	Specifying RIIC0 transmission data empty as the event link source
ELC_RESOURCE_RIIC0_TX_END	0x51	Specifying RIIC0 transmission end as the event link source
ELC_RESOURCE_RSPI0_ERROR	0x52	Specifying RSPI0 error as the event link source
ELC_RESOURCE_RSPI0_IDLE	0x53	Specifying RSPI0 idle as the event link source
ELC_RESOURCE_RSPI0_RX_DATA_FULL	0x54	Specifying RSPI0 reception data full as the event link source
ELC_RESOURCE_RSPI0_TX_DATA_EMPTY	0x55	Specifying RSPI0 transmission data empty as the event link source
ELC_RESOURCE_RSPI0_TX_END	0x56	Specifying RSPI0 transmission complete as the event link source
ELC_RESOURCE_SA12AD0_CONVERT_END	0x58	Specifying S12AD0 A/D conversion end as the event link source
ELC_RESOURCE_INPUT_PORT_GROUP1	0x63	Specifying input port group 1 input edge detection as the event link source
ELC_RESOURCE_INPUT_PORT_GROUP2	0x64	Specifying input port group 2 input edge detection as the event link source
ELC_RESOURCE_SINGLE_PORT0	0x65	Specifying input single port 0 input edge detection as the event link source
ELC_RESOURCE_SINGLE_PORT1	0x66	Specifying input single port 1 input edge detection as the event link source
ELC_RESOURCE_SINGLE_PORT2	0x67	Specifying input single port 2 input edge detection as the event link source
ELC_RESOURCE_SINGLE_PORT3	0x68	Specifying input single port 3 input edge detection as the event link source
ELC_RESOURCE_ELC_SOFT_EVENT	0x69	Specifying software event as the event link source
ELC_RESOURCE_DOC_DATA_CALCULATE	0x6A	Specifying DOC data computation condition satisfied as the event link source

Table 6.21 Definitions for Setting Event Link Resource (2 / 3)

Constant Name	Value	Description
ELC_RESOURCE_SA12AD1_CONVERT_END	0x6C	Specifying S12AD1 A/D conversion end as the event link source
ELC_RESOURCE_CMTW0_COMPARE_MATCH	0x7E	Specifying CMTW0 compare match as the event link source
ELC_RESOURCE_GPT0_COMPARE_MATCH_A	0x80	Specifying GPT0 compare match A as the event link source
ELC_RESOURCE_GPT0_COMPARE_MATCH_B	0x81	Specifying GPT0 compare match B as the event link source
ELC_RESOURCE_GPT0_COMPARE_MATCH_C	0x82	Specifying GPT0 compare match C as the event link source
ELC_RESOURCE_GPT0_COMPARE_MATCH_D	0x83	Specifying GPT0 compare match D as the event link source
ELC_RESOURCE_GPT0_OVERFLOW	0x86	Specifying GPT0 overflow as the event link source
ELC_RESOURCE_GPT0_UNDERFLOW	0x87	Specifying GPT0 underflow as the event link source
ELC_RESOURCE_GPT1_COMPARE_MATCH_A	0x88	Specifying GPT1 compare match A as the event link source
ELC_RESOURCE_GPT1_COMPARE_MATCH_B	0x89	Specifying GPT1 compare match B as the event link source
ELC_RESOURCE_GPT1_COMPARE_MATCH_C	0x8A	Specifying GPT1 compare match C as the event link source
ELC_RESOURCE_GPT1_COMPARE_MATCH_D	0x8B	Specifying GPT1 compare match D as the event link source
ELC_RESOURCE_GPT1_OVERFLOW	0x8E	Specifying GPT1 overflow as the event link source
ELC_RESOURCE_GPT1_UNDERFLOW	0x8F	Specifying GPT1 underflow as the event link source
ELC_RESOURCE_GPT2_COMPARE_MATCH_A	0x90	Specifying GPT2 compare match A as the event link source
ELC_RESOURCE_GPT2_COMPARE_MATCH_B	0x91	Specifying GPT2 compare match B as the event link source
ELC_RESOURCE_GPT2_COMPARE_MATCH_C	0x92	Specifying GPT2 compare match C as the event link source
ELC_RESOURCE_GPT2_COMPARE_MATCH_D	0x93	Specifying GPT2 compare match D as the event link source
ELC_RESOURCE_GPT2_OVERFLOW	0x96	Specifying GPT2 overflow as the event link source
ELC_RESOURCE_GPT2_UNDERFLOW	0x97	Specifying GPT2 underflow as the event link source
ELC_RESOURCE_GPT3_COMPARE_MATCH_A	0x98	Specifying GPT3 compare match A as the event link source
ELC_RESOURCE_GPT3_COMPARE_MATCH_B	0x99	Specifying GPT3 compare match B as the event link source
ELC_RESOURCE_GPT3_COMPARE_MATCH_C	0x9A	Specifying GPT3 compare match C as the event link source
ELC_RESOURCE_GPT3_COMPARE_MATCH_D	0x9B	Specifying GPT3 compare match D as the event link source
ELC_RESOURCE_GPT3_OVERFLOW	0x9E	Specifying GPT3 overflow as the event link source
ELC_RESOURCE_GPT3_UNDERFLOW	0x9F	Specifying GPT3 underflow as the event link source
ELC_RESOURCE_MTU6_COMPARE_MATCH_6A	0xA0	Specifying MTU6 compare match 6A as the event link source
ELC_RESOURCE_MTU6_COMPARE_MATCH_6B	0xA1	Specifying MTU6 compare match 6B as the event link source
ELC_RESOURCE_MTU6_COMPARE_MATCH_6C	0xA2	Specifying MTU6 compare match 6C as the event link source
ELC_RESOURCE_MTU6_COMPARE_MATCH_6D	0xA3	Specifying MTU6 compare match 6D as the event link source
ELC_RESOURCE_MTU6_OVERFLOW	0xA4	Specifying MTU6 overflow as the event link source
ELC_RESOURCE_MTU7_COMPARE_MATCH_7A	0xA5	Specifying MTU7 compare match 7A as the event link source
ELC_RESOURCE_MTU7_COMPARE_MATCH_7B	0xA6	Specifying MTU7 compare match 7B as the event link source
ELC_RESOURCE_MTU7_COMPARE_MATCH_7C	0xA7	Specifying MTU7 compare match 7C as the event link source
ELC_RESOURCE_MTU7_COMPARE_MATCH_7D	0xA8	Specifying MTU7 compare match 7D as the event link source
ELC_RESOURCE_MTU7_OVERFLOW	0xA9	Specifying MTU7 overflow as the event link source
ELC_RESOURCE_MTU7_UNDERFLOW	0xAA	Specifying MTU7 underflow as the event link source
ELC_RESOURCE_TPU0_COMPARE_MATCH_A	0xAC	Specifying TPU0 compare match A as the event link source
ELC_RESOURCE_TPU0_COMPARE_MATCH_B	0xAD	Specifying TPU0 compare match B as the event link source
ELC_RESOURCE_TPU0_COMPARE_MATCH_C	0xAE	Specifying TPU0 compare match C as the event link source
ELC_RESOURCE_TPU0_COMPARE_MATCH_D	0xAF	Specifying TPU0 compare match D as the event link source
ELC_RESOURCE_TPU0_OVERFLOW	0xB0	Specifying TPU0 overflow as the event link source
ELC_RESOURCE_TPU1_COMPARE_MATCH_A	0xB1	Specifying TPU1 compare match A as the event link source
ELC_RESOURCE_TPU1_COMPARE_MATCH_B	0xB2	Specifying TPU1 compare match B as the event link source
ELC_RESOURCE_TPU1_OVERFLOW	0xB3	Specifying TPU1 overflow as the event link source

Table 6.21 Definitions for Setting Event Link Resource (3 / 3)

Constant Name	Value	Description
ELC_RESOURCE_TPU1_UNDERFLOW	0xB4	Specifying TPU1 underflow as the event link source
ELC_RESOURCE_TPU2_COMPARE_MATCH_A	0xB5	Specifying TPU2 compare match A as the event link source
ELC_RESOURCE_TPU2_COMPARE_MATCH_B	0xB6	Specifying TPU2 compare match B as the event link source
ELC_RESOURCE_TPU2_OVERFLOW	0xB7	Specifying TPU2 overflow as the event link source
ELC_RESOURCE_TPU2_UNDERFLOW	0xB8	Specifying TPU2 underflow as the event link source
ELC_RESOURCE_TPU3_COMPARE_MATCH_A	0xB9	Specifying TPU3 compare match A as the event link source
ELC_RESOURCE_TPU3_COMPARE_MATCH_B	0xBA	Specifying TPU3 compare match B as the event link source
ELC_RESOURCE_TPU3_COMPARE_MATCH_C	0xBB	Specifying TPU3 compare match C as the event link source
ELC_RESOURCE_TPU3_COMPARE_MATCH_D	0xBC	Specifying TPU3 compare match D as the event link source
ELC_RESOURCE_TPU3_OVERFLOW	0xBD	Specifying TPU3 overflow as the event link source

Table 6.22 Definitions for MTU Channel Number

Constant Name	Value	Description
ELC_MTU_CH_0	0	Indicating CH0 of the MTU
ELC_MTU_CH_3	1	Indicating CH1 of the MTU
ELC_MTU_CH_4	2	Indicating CH2 of the MTU
ELC_MTU_CH_NUM	3	For checking the range of normal setting values

Table 6.23 Definitions for Setting MTU Event Link Operation

Constant Name	Value	Description
ELC_MTU_COUNT_START	0	MTU count starts at the time of event link.
ELC_MTU_COUNT_RESTART	1	MTU count restarts at the time of event link.
ELC_MTU_INPUT_CAPTURE	2	MTU input capture is executed at the time of event link.
ELC_MTU_MAX_OVER	3	For checking the range of normal setting values

Table 6.24 Definitions for Setting CMT Event Link Operation

Constant Name	Value	Description
ELC_CMT_COUNT_START	0	CMT count starts at the time of event link.
ELC_CMT_COUNT_RESTART	1	CMT count restarts at the time of event link.
ELC_CMT_COUNT_INCREMENT	2	CMT counter increments at the time of event link.
ELC_CMT_MAX_OVER	3	For checking the range of normal setting values

Table 6.25 Definitions for ΔΣ Unit Channel Trigger Number

Constant Name	Value	Description
ELC_DSMIF0_TRIGGER_0	0	Indicating trigger 0 of the ΔΣ unit 0
ELC_DSMIF0_TRIGGER_1	1	Indicating trigger 0 of the ΔΣ unit 1
ELC_DSMIF1_TRIGGER_0	2	Indicating trigger 1 of the ΔΣ unit 0
ELC_DSMIF1_TRIGGER_1	3	Indicating trigger 1 of the ΔΣ unit 1
ELC_DSMIF_TRIGGER_NUM	4	For checking the range of normal setting values

Table 6.26 Definitions for 12-Bit A/D Converter Channel Number

Constant Name	Value	Description
ELC_S12AD_CH_0	0	Indicating CH0 of the 12-bit A/D converter
ELC_S12AD_CH_1	1	Indicating CH1 of the 12-bit A/D converter
ELC_S12AD_CH_NUM	2	For checking the range of normal setting values

Table 6.27 Definitions for ELC Interrupt Number

Constant Name	Value	Description
ELC_INTR_NUM_1	0	Indicating interrupt request signal 1
ELC_INTR_NUM_2	1	Indicating interrupt request signal 2
ELC_INTR_NUM	2	For checking the range of normal setting values

Table 6.28 Definitions for Port Group Number

Constant Name	Value	Description
ELC_PORT_GROUP_NUM_0	0	Indicating output port group number 0
ELC_PORT_GROUP_NUM_1	1	Indicating output port group number 1
ELC_PORT_GROUP_NUM	2	For checking the range of normal setting values

Table 6.29 Definitions for Setting Output Port Group Event Link Operation

Constant Name	Value	Description
ELC_OUT_GROUP_OUTPUT_0	0	The output group port outputs 0 during event link.
ELC_OUT_GROUP_OUTPUT_1	1	The output group port outputs 1 during event link.
ELC_OUT_GROUP_TOGGLE	2	The output group port outputs a toggle value during event link.
ELC_OUT_GROUP_BUFFER	3	The buffer value is output during event link.
ELC_OUT_GROUP_ROTATE	4	The rotated buffer value is output during event link.
ELC_OUT_GROUP_MAX_OVER	5	For checking the range of normal setting values

Table 6.30 Definitions for Single Port Number

Constant Name	Value	Description
ELC_SINGLE_PORT_NUM_0	0	Indicating single port number 0
ELC_SINGLE_PORT_NUM_1	1	Indicating single port number 1
ELC_SINGLE_PORT_NUM_2	2	Indicating single port number 2
ELC_SINGLE_PORT_NUM_3	3	Indicating single port number 3
ELC_SINGLE_PORT_NUM	4	For checking the range of normal setting values

Table 6.31 Definitions for Setting Single Port Event Link Operation

Constant Name	Value	Description
ELC_SINGLE_PORT_OUTPUT_0	0	During event link, 0 is output.
ELC_SINGLE_PORT_OUTPUT_1	1	During event link, 1 is output.
ELC_SINGLE_PORT_TOGGLE	2	During event link, a toggle value is output.
ELC_SINGLE_PORT_ACTION_MAX_OVER	3	For checking the range of normal setting values

Table 6.32 Definitions for Setting CMTW Event Link Operation

Constant Name	Value	Description
ELC_CMTW_COUNT_START	0	CMTW count starts at the time of event link.
ELC_CMTW_COUNT_RESTART	1	CMTW count restarts at the time of event link.
ELC_CMTW_COUNT_INCREMENT	2	CMTW counter increments at the time of event link.
ELC_CMTW_COUNT_MAX_OVER	3	For checking the range of normal setting values

Table 6.33 Definitions for TPU Channel Number

Constant Name	Value	Description
ELC_TPU_CH_0	0	Indicating CH0 of the TPU.
ELC_TPU_CH_1	1	Indicating CH1 of the TPU.
ELC_TPU_CH_2	2	Indicating CH2 of the TPU.
ELC_TPU_CH_3	3	Indicating CH3 of the TPU.
ELC_TPU_CH_NUM	4	For checking the range of normal setting values

Table 6.34 Definitions for Setting TPU Event Link Operation

Constant Name	Value	Description
ELC_TPU_COUNT_START	0	TPU count starts at the time of event link.
ELC_TPU_COUNT_RESTART	1	TPU count restarts at the time of event link.
ELC_TPU_INPUT_CAPTURE	2	TPU input capture is executed at the time of event link.
ELC_TPU_MAX_OVER	3	For checking the range of normal setting values

Table 6.35 Definitions for GPT Channel Number

Constant Name	Value	Description
ELC_GPT_CH_0	0	Indicating CH0 of the GPT.
ELC_GPT_CH_1	1	Indicating CH1 of the GPT.
ELC_GPT_CH_2	2	Indicating CH2 of the GPT.
ELC_GPT_CH_3	3	Indicating CH3 of the GPT.
ELC_GPT_CH_NUM	4	For checking the range of normal setting values

Table 6.36 Definitions for Setting GPT Event Link Operation

Constant Name	Value	Description
ELC_GPT_COUNT_START	0	GPT count starts at the time of event link.
ELC_GPT_COUNT_RESTART	1	GPT count restarts at the time of event link.
ELC_GPT_COUNT_STOP	2	GPT count stops at the time of event link.
ELC_GPT_INPUT_CAPTURE	3	GPT input capture is executed at the time of event link.
ELC_GPT_MAX_OVER	4	For checking the range of normal setting values

Table 6.37 Definitions for Setting I/O Port Group Symbol

Constant Name	Value	Description
ELC_PORT_B	1	Specifying Port B
ELC_PORT_E	2	Specifying Port E
ELC_PORT_NUM	3	For checking the range of normal setting values

Table 6.38 Definitions for Setting Input Port Group Event Detection Trigger

Constant Name	Value	Description
ELC_PORT_GROUP_TRIGGER_UP	0	Setting the input port group trigger to rising edge
ELC_PORT_GROUP_TRIGGER_DOWN	1	Setting the input port group trigger to falling edge
ELC_PORT_GROUP_TRIGGER_UP_DOWN	2	Setting the input port group trigger to rising and falling edges
ELC_PORT_GROUP_MAX_OVER	3	For checking the range of normal setting values

Table 6.39 Definitions for Setting Single Port Event Detection Trigger

Constant Name	Value	Description
ELC_SINGLE_EVENT_INPUT	0	Setting event input selectively
ELC_SINGLE_EVENT_OUTPUT	1	Setting event output
ELC_SINGLE_EVENT_MAX_OVER	2	For checking the range of normal setting values

Table 6.40 Definitions for Setting Single Port Event Detection Trigger

Constant Name	Value	Description
ELC_SINGLE_PORT_TRIGGER_UP	0	Setting the input single port trigger to rising edge
ELC_SINGLE_PORT_TRIGGER_DOWN	1	Setting the input single port trigger to falling edge
ELC_SINGLE_PORT_TRIGGER_UP_DOWN	2	Setting the input single port trigger to rising and falling edges
ELC_SINGLE_PORT_TRIGGER_MAX_OVER	3	For checking the range of normal setting values

6.6 Structures/Unions/Enumerated Types

Figure 6.2 shows structures/unions/enumerated types for the sample code.

```
typedef struct
{
    uint32_t        pclk_div;     // PCLK divide rate
    uint32_t        cnt_size;     // CMTW counter bit size
    uint32_t        clear_factor; // counter clear factor
} cmtw_time_cnt_t;

typedef struct
{
    int32_t         mode_enable;                // ON/OFF setting of compare match
    uint32_t        compare_match_cnt;          // counter value of compare match
    int32_t         intr_priority               // compare match interrupt priority
    void            (*p_callback)(void);        // callback function of compare match
} cmtw_compare_match_t;

typedef struct
{
    int32_t         mode_enable;                // ON/OFF setting of output compare
    uint32_t        output_compare_cnt;         // counter value of output compare
    uint32_t        output_signal               // signal value of output compare
    int32_t         intr_priority               // output compare interrupt priority
    void            (*p_callback)(void);        // callback function of output compare
} cmtw_output_compare_t;

typedef struct
{
    int32_t         mode_enable;                // ON/OFF setting of output compare
    uint32_t        trigger;                    // trigger of input capture
    int32_t         filter enable               // ON/OFF setting of noise filter
    int32_t         intr_priority               //input capture interrupt priority
    void            (*p_callback)(uint32_t cnt_value); // callback function of input capture
} cmtw_input_capture_t;

typedef struct
{
    int32_t             ecm_enable;             // ECM dynamic mode error enable/disable
    uint32_t            output_compare_num;     // output compare number of ECM
} cmtw_ecm_t;



typedef struct
```

```
{
    cmtw_compare_match_t   compare_match;   // setting of compare match
    cmtw_output_compare_t
                output_compare[CMTW_OUTPUT_COMPARE_NUM_MAX]; // setting of output compare
    cmtw_input_capture_t
              input_capture[CMTW_INPUT_CAPTURE_NUM_MAX];  // setting of input capture
    uint32_t  noise_filter_clk                          // noise filter setting of input capture
} cmtw_mode_t;

typedef struct
{
    cmtw_time_cnt_t   time_cnt_param;   // setting of timer count
    cmtw_mode_t       mode_param;      // setting of CMTW mode
} cmtw_cfg_t;

typedef struct
{
    uint32_t          elc_mtu_ch;           // MTU number for event link
    int32_t           event_link_enable;    // ON/OFF setting of MTU event link
    uint32_t          resource;             // resource of event link
    uint32_t          action;               // action when event link
} elc_cmd_mtu_t;

typedef struct
{
    int32_t           event_link_enable;   // ON/OFF setting of CMT event link
    uint32_t          resource;             // resource of event link
    uint32_t          action;               // action when event link
} elc_cmd_cmt_t;

typedef struct
{
    uint32_t          elc_dsmif_ch;         // DSMIF number for event link
    int32_t           event_link_enable;   // ON/OFF setting of DSMIF event link
    uint32_t          resource;             // resource of event link
} elc_cmd_dsmif_t;

typedef struct
{
    uint32_t          elc_s12ad_ch;        // S12AD number for event link
    int32_t           event_link_enable;  // ON/OFF setting of S12AD event link
    uint32_t          resource;            // resource of event link
} elc_cmd_s12ad_t;
```

```
typedef struct
{
    uint32_t        elc_intr_num;       // interrupt number for event link
    int32_t         event_link_enable;  // ON/OFF setting of MTU event link
    uint32_t        resource;           // resource of event link
    int32_t         intr_priority       // interrupt priority
    void            (*p_callback);      // callback function for interrupt
} elc_cmd_intr_t;

typedef struct
{
    uint32_t        elc_out_port_group_num;  // output port group number
    int32_t         event_link_enable;       // ON/OFF setting of output port group event link
    uint32_t        resource;                // resource of event link
    uint32_t        action;                  // action when event link
    uint8_t         init_value;              // initial output value
} elc_cmd_out_port_group_t;

typedef struct
{
    uint32_t        elc_in_port_group_num;  // input port group number
    int32_t         event_link_enable;      // ON/OFF setting of input port group event link
    uint32_t        resource;               // resource of event link
    int32_t         overwrite_enable;       // overwrite permittion for input buffer
} elc_cmd_in_port_group_t;

typedef struct
{
    uint32_t        elc_single_port_num;    // input port group number
    uint32_t        port_symbol;            // I/O port symbol information
    uint32_t        port_num;               // I/O port number for single port
    int32_t         event_link_enable;      // ON/OFF setting of single port event link
    uint32_t        event_direction;        // select event input / output
    uint32_t        resource;               // resource of event link
    uint32_t        output_action;          // action when event link for output
    uint32_t        input_trigger;          // trigger for input event link signal
} elc_cmd_single_port_t;

typedef struct
{
    int32_t         event_link_enable;      // ON/OFF setting of CMTW event link
    uint32_t        resource;               // resource of event link
    uint32_t        action;                 // action when event link
} elc_cmd_cmtw_t;
```

```
typedef struct
{
    uint32_t        elc_tpu_ch;         // TPU number for event link
    int32_t         event_link_enable;  // ON/OFF setting of TPU event link
    uint32_t        resource;           // resource of event link
    uint32_t        action;             // action when event link
} elc_cmd_tpu_t;

typedef struct
{
    uint32_t        elc_gpt_ch;         // GPT number for event link
    int32_t         event_link_enable;  // ON/OFF setting of GPT event link
    uint32_t        resource;           // resource of event link
    uint32_t        action;             // action when event link
} elc_cmd_gpt_t;

typedef struct
{
    uint32_t        port_symbol;        // I/O port symbol number
    uint8_t         port_group_bit;     // I/O port number
    uint32_t        trigger;            // trigger for signal input
} elc_cmd_port_group_t;

typedef struct
{
    uint32_t        port_group_num;     // port group number for get port value
    uint8_t         *port_value;        // port value
} elc_get_port_value_t;
```

```
typedef enum                    /* CMTW error codes */
{
        CMTW_SUCCESS                    = 0,
        CMTW_ERR_INVALID_CH             = 1,
        CMTW_ERR_INVALID_ARG            = 2,
        CMTW_ERR_NOT_OPENED             = 3,
        CMTW_ERR_NOT_CLOSED             = 4,
        CMTW_ERR_TIMER_RUNNING          = 5,
        CMTW_ERR_TIMER_STOP             = 6,
        CMTW_ERR_MISSING_PTR            = 7
} cmtw_err_t;

typedef enum                    /* ELC error codes */
{
        ELC_SUCCESS             = 0,
        ELC_ERR_INVALID_ARG = 1,
        ELC_ERR_NOT_OPENED  = 2,
        ELC_ERR_NOT_CLOSED  = 3,
        ELC_ERR_MISSING_PTR  = 4
} elc_err_t;
```

Figure 6.2 Structures/Unions/Enumerated Types for the Sample Code

6.7 Global Variables

Table 6.41 lists global variables.

Table 6.41 Global Variable

Type	Valuable Name	Description	Function
static volatile int32_t	gb_cmtw_end_flag	Callback information of the CMTW sample driver	cmtw_elc_sample_led_control cmtw_elc_sample_cmtwi_callback
static volatile int32_t	gb_adc_end_flag	Callback information of the ADC sample driver	cmtw_elc_sample_led_control cmtw_elc_sample_adc_callback
static const cmtw_intr_t	gb_cmtw_intr_table[][]	Interrupt registration table for the CMTW sample driver	cmtw_intr_register cmtw_intr_enable cmtw_intr_disable
static cmtw_info_ch_t	gb_cmtw_info[]	CMTW sample driver information	R_CMTW_Open R_CMTW_Close R_CMTW_Control cmtw_init cmtw_set_count_param cmtw_set_compare_match_param cmtw_set_input_capture_param cmtw_set_output_compare_param cmtw_count_start cmtw_count_start_hw cmtw_count_stop_hw cmtw_get_driver_info
static const elc_intr_t	gb_elc_intr_table[]	Interrupt registration table for the ELC sample driver	elc_intr_register elc_intr_enable elc_intr_disable
static elcinfo_ch_t	gb_elc_info	ELC sample driver information	R_ELC_Open R_ELC_Close R_ELC_LinkStart R_ELC_LinkStop R_ELC_Control elc_init elc_set_intr_param elc_get_driver_info

6.8 Functions

Table 6.42 list functions.

Table 6.42 Functions

Function Name	Page Number
main	36
R_CMTW_Open	30
R_CMTW_Close	31
R_CMTW_StartPeriodic	31
R_CMTW_StartOneShot	32
R_CMTW_Control	32
R_CMTW_GetVersion	33
R_ELC_Open	34
R_ELC_Close	34
R_ELC_LinkStart	35
R_ELC_LinkStop	35
R_ELC_Control	35
R_ELC_GetVersion	36
cmtw<n>_cmwi_isr	33
cmtw<n>_ic<m>i_isr	33
cmtw<n>_oc<m>i_isr	34
elc_elci<n>_isr	36
CMTW_Cmwi_Callback	37
CMTW_Ic0i_Callback	37
CMTW_Oc0i_Callback	37
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6.9 Specification of Functions

The following shows the function specifications of the sample code.

The sample code uses the functions of the ADC driver. For the functions of the ADC driver, refer to RZ/T1 ADC Driver Sample Application Note.

6.9.1 R_CMTW_Open

R_CMTW_Open		
Synopsis	CMTW driver initialization function	
Header	r_cmtw_rzt1_if.h	
Declaration	cmtw_err_t R_CMTW_Open(const uint32_t channel, const cmtw_cfg_t * const p_cfg);	
Description	This function performs the initialization for starting the operation of the CMTW. The details are as follows: • Checking the arguments • Initialization of the CMTW - Setting the operating modes - Setting the compare match period - Setting the counter clear source - Setting the digital noise filter • Initialization of the ICUA - Enabling compare match interrupt, input capture interrupt 0/1, and output compare interrupt 0/1 and setting their priority • Setting the power consumption reduction function - Manipulating the MSTPCRA0 register to release the stop state	
Arguments	const uint32_t channel	Specifying the channel number of the CMTW
	const cmtw_cfg_t * const p_cfg	Pointer to initialization information of the CMTW
Return values	CMTW_SUCCESS	: The function terminates normally.
	CMTW_ERR_NOT_CLOSED	: Initialization is duplicated.
	CMTW_ERR_INVALID_CH	: A nonexistent channel is specified.
	CMTW_ERR_INVALID_ARG	: A member of the initialization information has an invalid value.
	CMTW_ERR_MISSING_PTR	: Incorrect pointer argument
Remarks	• This function must be executed before executing any API functions of the CMTW driver.	

6.9.2 R_CMTW_Close

R_CMTW_Close		
Synopsis	End processing function of the CMTW driver	
Header	r_cmtw_rzt1_if.h	
Declaration	cmtw_err_t R_CMTW_Close(const uint32_t channel);	
Description	This function handles processing for terminating the operation of the CMTW. The details are as follows: • End processing of the ICUA - Disabling compare match interrupt, input capture interrupt 0/1, and output compare interrupt 0/1 • End processing of the CMTW - Stopping the timer counter • Setting the power consumption reduction function - Manipulating the MSTPCRA0 register to set the stop state	
Arguments	const uint32_t channel	Specifying the channel number of the CMTW
Return values	CMTW_SUCCESS CMTW_ERR_INVALID_CH	: The function terminates normally. : A nonexistent channel is specified.
Remarks	• This function must be executed after executing R_CMTW_Open.	

6.9.3 R_CMTW_StartPeriodic

R_CmMTW_Start_Periodic		
Synopsis	Timer counter periodic operation start function	
Header	r_cmtw_rzt1_if.h	
Declaration	cmtw_err_t R_CMTW_StartPeriodic(const uint32_t channel);	
Description	This function starts a periodic operation of timer counting.	
Arguments	const uint32_t channel	Specifying the channel number of the CMTW.
Return values	CMTW_SUCCESS CMTW_ERR_NOT_OPENED CMTW_ERR_INVALID_CH CMTW_ERR_TIMER_RUNNING	: The function terminates normally. : The function is executed in an uninitialized state. : A nonexistent channel is specified. : The function is executed while the timer counter is running.
Remarks	• This function must be executed after executing R_CMTW_Open. • Call R_CMTW_Close() to stop periodic operations.	

6.9.4 R_CMTW_StartOneShot

R_CMTW_StartOneShot		
Synopsis	Timer counter aperiodic operation start function	
Header	r_cmtw_rzt1_if.h	
Declaration	cmtw_err_t R_CMTW_StartOneShot(const uint32_t channel);	
Description	This function starts an aperiodic operation of timer counting. When the timer count clear condition is satisfied, the timer stops automatically to makes a transition to the initialized state.	
Arguments	const uint32_t channel	Specifying the channel number of the CMTW.
Return values	CMTW_SUCCESS	: The function terminates normally.
	CMTW_ERR_NOT_OPENED	: The function is executed in an uninitialized state.
	CMTW_ERR_INVALID_CH	: A nonexistent channel is specified.
	CMTW_ERR_TIMER_RUNNING	: The function is executed while the timer counter is running.
Remarks	• This function must be executed after executing R_CMTW_Open.	

6.9.5 R_CMTW_Control

R_CMTW_Control		
Synopsis	Function setting function of the CMTW driver	
Header	r_cmtw_rzt1_if.h	
Declaration	cmtw_err_t R_CMTW_Control(const uint32_t channel, const uint32_t cmd, void * const p_data);	
Description	This function handles processing for setting the CMTW functions. The setting for the specified command is carried out. For the details, see from 6.11.1 to 6.11.7.	
Arguments	const uint32_t channel	Specifying the channel number of the CMTW.
	const uint32_t cmd	Specifying the command for function setting See from 6.11.1 to 6.11.7.
	void * const p_data	Specifying the parameter information for function setting See from 6.11.1 to 6.11.7.
Return values	CMTW_SUCCESS	: The function terminates normally.
	CMTW_ERR_NOT_OPENED	: The function is executed in an uninitialized state.
	CMTW_ERR_INVALID_ARG	: A nonexistent command is specified.
	CMTW_ERR_INVALID_CH	: A nonexistent channel is specified.
	On top of the above, a different return value may return depending on the command specified. For the details, see from 6.11.1 to 6.11.7.	
Remarks	• This function must be executed after executing R_CMTW_Open.	

6.9.6 R_CMTW_GetVersion

R_CMTW_GetVersion	
Synopsis	Acquisition function of the CMTW driver version information
Header	
Declaration	uint32_t R_CMTW_GetVersion(void);
Description	This function acquires the version information of the CMTW driver.
Arguments	None
Return values	Encoded version information : 0-15bit Minor Version : 16-31bit Major Version
Remarks	–

6.9.7 cmtw<n>_cmwi_isr

cmtw<n>_cmwi_isr	
Synopsis	CMTW channel <n> compare match interrupt handler (n = 0, 1)
Header	–
Declaration	void cmtw<n>_cmwi_isr (void);
Description	This function calls a compare match callback function that has been registered by using the R_CMTW_Open() or R_CMTW_Control() function. It also specifies compare match as the timer clear source and, when an aperiodic operation is running, stops the timer to make a transition to the initialized state.
Arguments	None
Return values	None

6.9.8 cmtw<n>_ic<m>i_isr

cmtw<n>_ic<m>i_isr	
Synopsis	CMTW channel <n> input capture <m> interrupt handler (n = 0, 1; m = 0, 1)
Header	–
Declaration	void cmtw<n>_ic<m>i_isr (void);
Description	This function calls an input capture callback function that has been registered by using the R_CMTW_Open() or R_CMTW_Control() function. It also specifies input capture as the timer clear source and, when an aperiodic operation is running, stops the timer to make a transition to the initialized state.
Arguments	None
Return values	None

6.9.9 cmtw<n>_oc<m>i_isr

cmtw<n>_oc<m>i_isr	
Synopsis	CMTW channel <n> output compare <m> interrupt handler (n = 0, 1; m = 0, 1)
Header	–
Declaration	void cmtw<n>_oc<m>i_isr (void);
Description	This function calls an output compare callback function that has been registered by using the R_CMTW_Open() or R_CMTW_Control() function. It also specifies output compare as the timer clear source and, when an aperiodic operation is running, stops the timer to make a transition to the initialized state.
Arguments	None
Return values	None

6.9.10 R_ELC_Open

R_ELC_Open	
Synopsis	ELC driver initialization function
Header	r_elc_rzt1_if.h
Declaration	elc_err_t R_ELC_Open(void);
Description	This function performs the initialization for starting the operation of the ELC. The details are as follows: • Setting the power consumption reduction function - Manipulating the MSTPCRC6 register to release the stop state
Arguments	None
Return values	ELC_SUCCESS : The function terminates normally. ELC_ERR_NOT_CLOSED : Initialization is duplicated.
Remarks	• This function must be executed before executing any API functions of the ELC driver.

6.9.11 R_ELC_Close

R_ELC_Close	
Synopsis	End processing function of the ELC driver
Header	r_elc_rzt1_if.h
Declaration	void R_ELC_Close(void);
Description	This function handles processing for terminating the operation of the ELC. The details are as follows: • End processing of the ICUA - Disabling input request signals 1 and 2 • End processing of the ELC - Disabling the ELC function • Setting the power consumption reduction function - Manipulating the MSTPCRC6 register to set the stop state
Arguments	None
Return values	None
Remarks	• This function must be executed after executing R_ELC_Open.

6.9.12 R_ELC_LinkStart

R_ELC_LinkStart	
Synopsis	Event link start function of the ELC driver
Header	r_elc_rzt1_if.h
Declaration	elc_err_t R_ELC_LinkStart(void);
Description	This function starts the event link operation by the ELC module.
Arguments	None
Return values	ELC_SUCCESS : The function terminates normally. ELC_ERR_NOT_OPENED : The function is executed in an uninitialized state.
Remarks	• This function must be executed after executing R_ELC_Open(). • When adding an event link setting by using a command from 6.12.1 to 6.12.11 while event link is in operation, do so in a condition where it can be guaranteed that the event link source signal will not be output.

6.9.13 R_ELC_LinkStop

R_ELC_LinkStop	
Synopsis	Event link end function of the ELC driver
Header	r_elc_rzt1_if.h
Declaration	elc_err_t R_ELC_LinkStop(void);
Description	This function stops the event link operation by the ELC module. When this function is called with event link operation not yet started, it ends without processing.
Arguments	None
Return values	ELC_SUCCESS : The function terminates normally. ELC_ERR_NOT_OPENED : The function is executed in an uninitialized state.
Remarks	• This function must be executed after executing R_ELC_Open().

6.9.14 R_ELC_Control

R_ELC_Control		
Synopsis	Function setting function of the ELC driver	
Header	r_elc_rzt1_if.h	
Declaration	elc_err_t R_ELC_Control(const uint32_t cmd, void * const p_data);	
Description	This function handles processing for setting the functions of the ELC. The setting for the specified command is carried out. For the details, see from 6.12.1 to 6.12.14.	
Arguments	const uint32_t cmd	Specifying the command for function setting See from 6.12.1 to 6.12.14.
	void * const p_data	Setting the parameter information for function setting See from 6.12.1 to 6.12.14.
Return values	ELC_SUCCESS	: The function terminates normally.
	ELC_ERR_INVALID_ARG	: A nonexistent command is specified.
	ELC_ERR_NOT_OPENED	: The function is executed in an uninitialized state.
	On top of the above, a different return value may return depending on the command specified. For the details, see from 6.12.1 to 6.12.14.	
Remarks	• This function must be executed after executing R_ELC_Open().	

6.9.15 R_ELC_GetVersion

R_ELC_GetVersion	
Synopsis	Acquisition function of the ELC driver version information
Header	
Declaration	uint32_t R_ELC_GetVersion(void);
Description	This function acquires the version information of the ELC driver.
Arguments	None
Return values	Encoded version information : 0-15bit Minor Version : 16-31bit Major Version
Remarks	–

6.9.16 elc_elci<n>_isr

elc_elci<n>_isr	
Synopsis	ELC event link interrupt handler (n = 1, 2)
Header	–
Declaration	void elc_elci<n>_isr (void);
Description	This function calls a callback function that has been registered by using the R_ELC_Open() or R_ELC_Control() function.
Arguments	None
Return values	None

6.9.17 main

main	
Synopsis	This function performs the A/D conversion of the input voltage to the potentiometer periodically.
Header	–
Declaration	int32_t main(void);
Description	This function handles the following processing. The CMTW0 is linked with the ADC by the ELC. At intervals of compare match of the CMTW0, the A/D conversion results of the input voltage to the potentiometer that is connected on the evaluation board are classified into five scales and displayed by using the LEDs on the evaluation board that are assigned to each of the scales as follows. This program terminates if a result exceeds the fourth classification level. A/D conversion level is from ADC_LVL0 to ADC_LVL1 (first classification level): LED 0 turns on. A/D conversion level is from ADC_LVL1 to ADC_LVL2 (second classification level): LED 1 turns on. A/D conversion level is from ADC_LVL2 to ADC_LVL3 (third classification level): LED 2 turns on. A/D conversion level is from ADC_LVL3 to ADC_LVL4 (fourth classification level): LED 3 turns on. A/D conversion level is ADC_LVL4 or greater: The program terminates.
Arguments	None
Return values	None
Remarks	• The ADC driver starts up in the synchronous trigger and single scan mode.

6.9.18 CMTW_Cmwi_Callback

CMTW_Cmwi_Callback	
Synopsis	CMTW sample program compare match callback function
Header	–
Declaration	void CMTW_Cmwi_Callback(void);
Description	This function is a callback function to notify the occurrence of a compare match interrupt of the CMTW.
Arguments	None
Return values	None
Remarks	• The function name is just an example to register the function to the driver. There is no restriction for the name. • In the sample program, this function is used in the function name of CMTW_Sample_Callback.

6.9.19 CMTW_Ic0i_Callback

CMTW_Ic0i_Callback			
Synopsis	CMTW sample program input capture callback function		
Header	–		
Declaration	void CMTW_Ic0i_Callback(uint32_t cnt_value);		
Description	This function is a callback function to notify the occurrence of an input capture interrupt of the CMTW. The counter value at the time of an input capture is passed as the argument.		
Arguments	uint32_t	cnt_value	Counter value when an input capture occurs
Return values	None		
Remarks	• The function name is just an example to register the function to the driver. There is no restriction for the name. • Not used in the sample program.		

6.9.20 CMTW_Oc0i_Callback

CMTW_Oc0i_Callback	
Synopsis	CMTW output compare callback function
Header	–
Declaration	void CMTW_Oc0i_Callback(void);
Description	This function is a callback function to notify the occurrence of an output compare interrupt of the CMTW.
Arguments	None
Return values	None
Remarks	• The function name is just an example to register the function to the driver. There is no restriction for the name. • Not used in the sample program.

6.9.21 ELC_Elci_Callback

ELC_Elci_Callback	
Synopsis	ELC event link callback function
Header	–
Declaration	void ELC_Elci_Callback(void);
Description	This function is a callback function to notify the occurrence of an event link interrupt of the ELC.
Arguments	None
Return values	None
Remarks	• The function name is just an example to register the function to the driver. There is no restriction for the name. • Not used in the sample program.

6.10 Flowchart

6.10.1 Main Processing of the Sample Program

Figure 6.3 and Figure 6.4 show the flowchart of the main processing of the sample program.

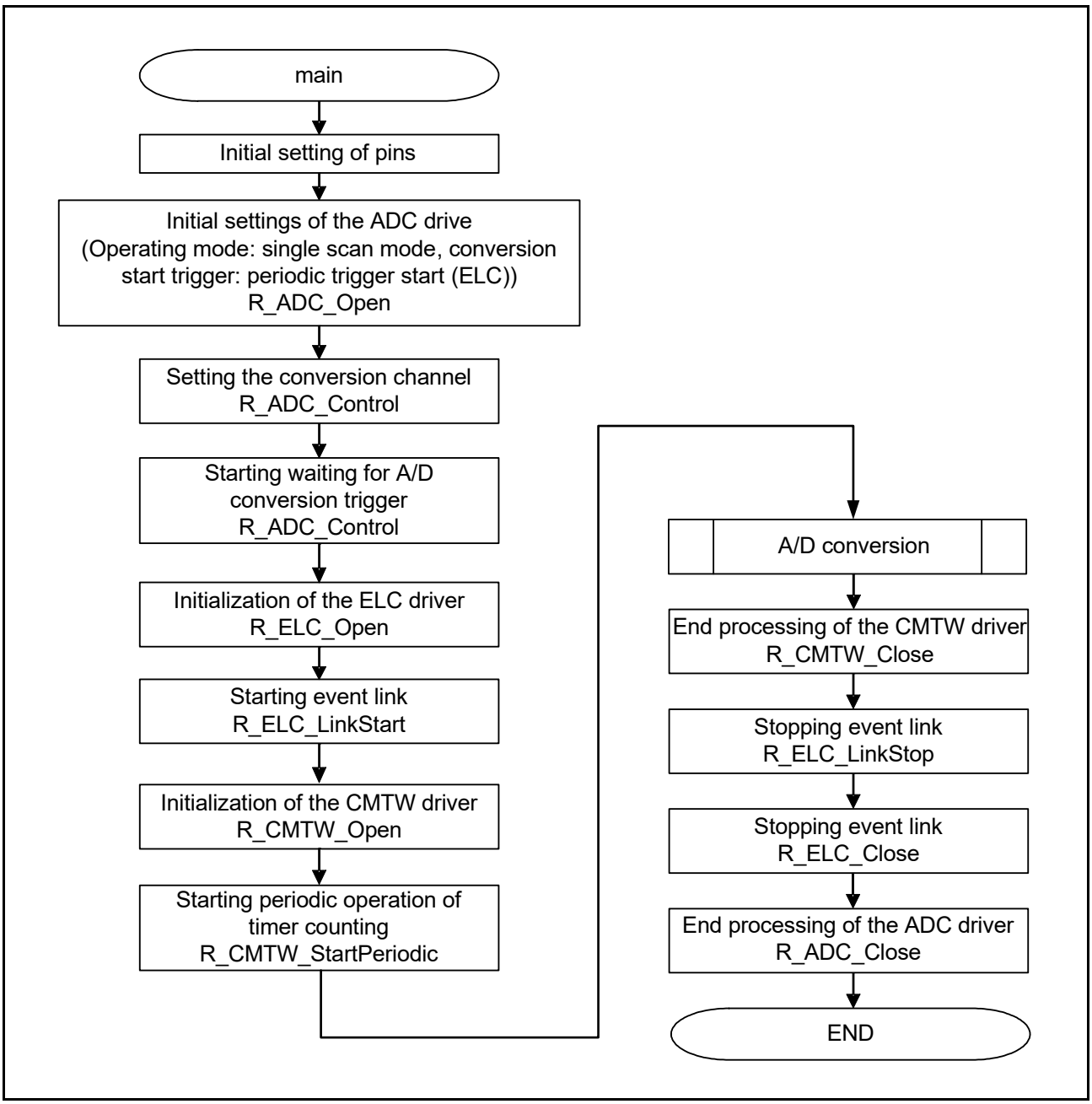

Figure 6.3 Main Processing

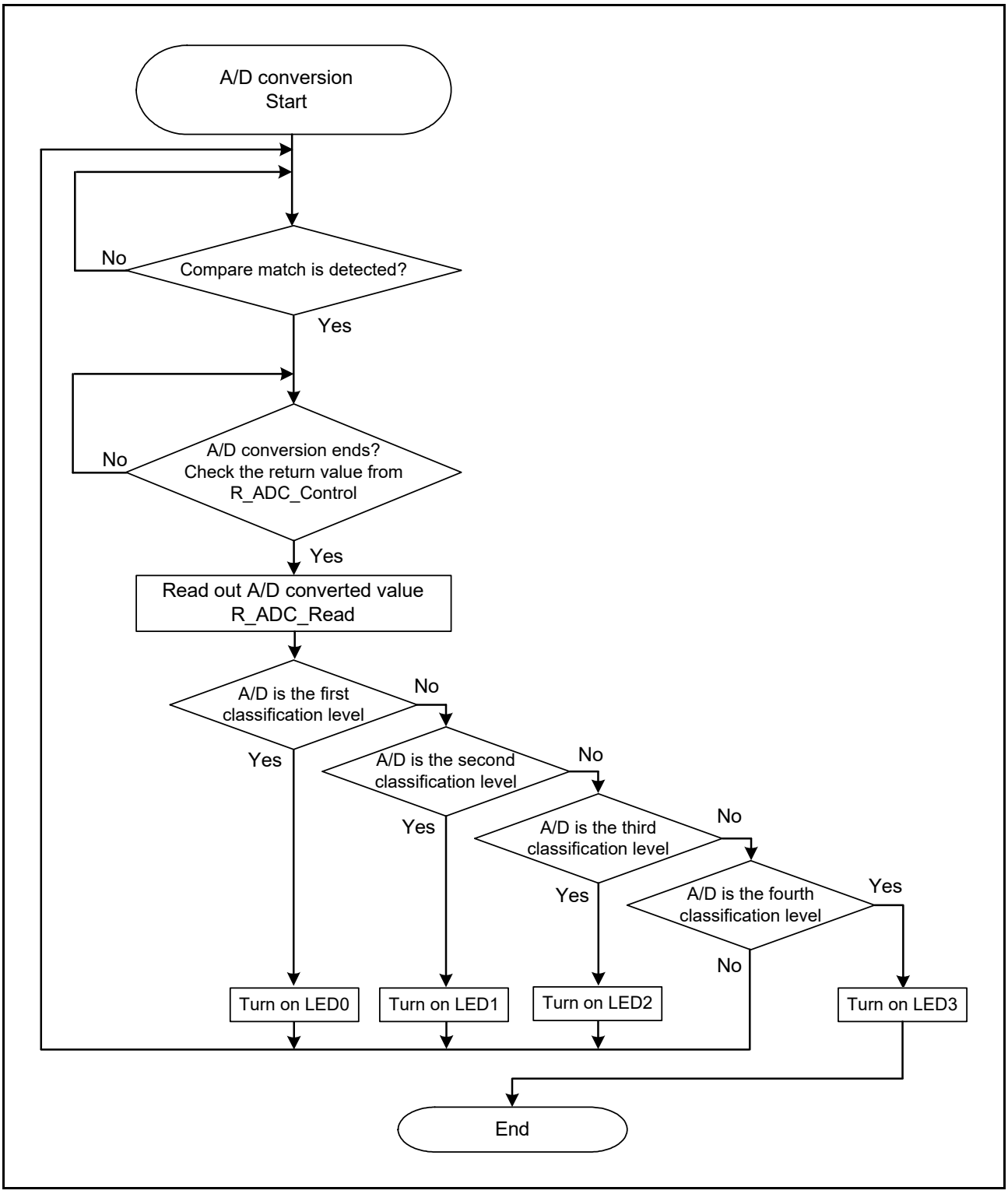

Figure 6.4 ADC Conversion Processing

6.10.2 CMTW_Sample_Callback

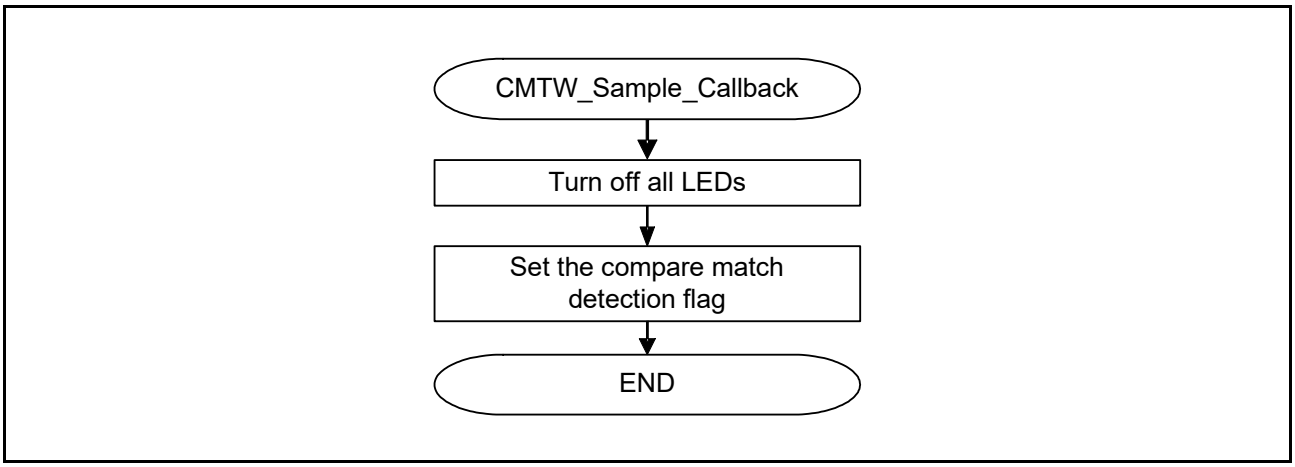

Figure 6.5 CMTW_Smple_Callback

6.10.3 cmtw0_cmwi_isr

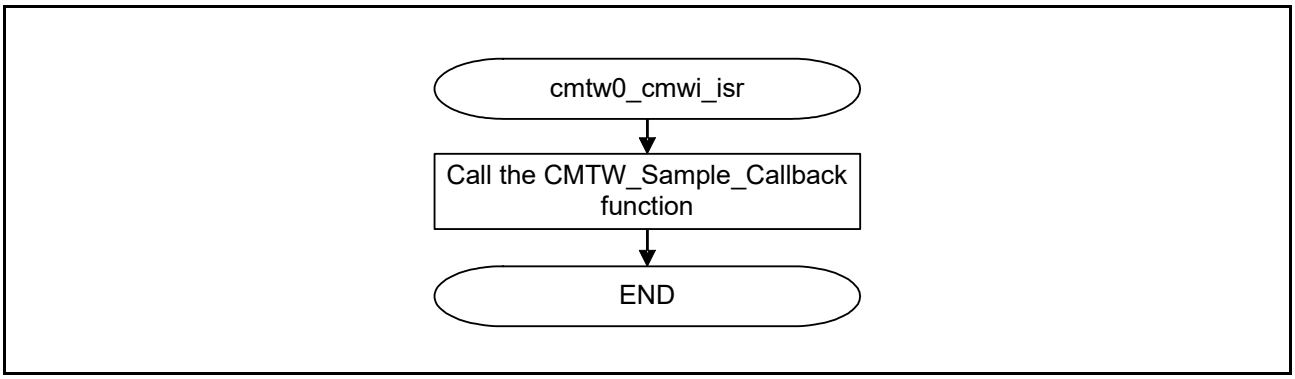

Figure 6.6 cmtw0_cmwi_isr

6.11 R_CMTW_Control Commands

The following table lists commands for the CMTW sample driver.

Table 6.43 Commands for the CMTW Sample Driver

Constant Name	Description
CMTW_CMD_SET_TIME_CNT	Setting the timer count of the CMTW
CMTW_CMD_SET_MODE	Setting the operation mode and the parameter of the CMTW
CMTW_CMD_SET_PAUSE	Pausing the timer
CMTW_CMD_SET_RESUME	Resuming the counter operation with the count maintained
CMTW_CMD_SET_RESTART	Restarting the counter operation with the count cleared
CMTW_CMD_SET_ECM	Setting the mode error output of the ECM dynamic mode
CMTW_CMD_GET_STATUS	Acquiring the operating state of the counter

6.11.1 CMTW_CMD_SET_TIME_CNT

CMTW_CMD_SET_TIME_CNT			
Synopsis	Setting the timer count of the CMTW		
Header	r_cmtw_if.h		
Description	This command sets the timer count of the CMTW. The parameters are passed in a form of a cmtw_time_cnt_t variable.		
Parameters	uint32_t	pclk_div	Setting the frequency division ratio of the PCLKD clock
	uint32_t	cnt_size	Setting the counter size
	uint32_t	clear_factor	Setting the clear source of the timer counter
Return values	CMTW_ERR_INVALID_ARG		: A member of the timer count information has an invalid value.
	CMTW_ERR_TIMER_RUNNING		: The function is executed while the timer counter is running.
	CMTW_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.11.2 CMTW_CMD_SET_MODE

CMTW_CMD_SET_MODE			
Synopsis	Setting the operation mode of the CMTW		
Header	r_cmtw_if.h		
Description	This command sets the operation mode of the CMTW and the parameters for each of the operation modes. The parameters are passed in a form of a cmtw_mode_t variable.		
Parameters	cmtw_compare_match_t compare_match		Storing compare match parameters
	int32_t	mode_enable	Setting ON/OFF of the compare match function true: ON false: OFF
	uint32_t	compare_match_cnt	Setting the compare match count value When the counter size is 16-bit mode, values set in the 16 higher-order bits will be ignored.
	int32_t	intr_priority	Setting the priority of the compare match interrupt
	void	(*p_ callback)	Setting the pointer to the compare match callback function Setting the pointer to NULL will inhibit the notification of the occurrence of a compare match without causing an error. For the details of the function, refer to Section 6.9.18, CMTW_Cmwi_Callback.
	cmtw_output_compare_t output_compare[CMTW_OUTPUT_COMPARE_NUM]		Storing output compare parameters The array number represents whether the parameters are for output compare 0 or output compare 1.
	int32_t	mode_enable	Setting ON/OFF of the output compare function true: ON false: OFF
	uint32_t	output_compare_cnt	Setting the output compare count value When the counter size is 16-bit mode, values set in the 16 higher-order bits will be ignored.
	uint32_t	output_signal	Setting the signal value of the output compare output
	int32_t	intr_priority	Setting the priority of the output compare interrupt
	void	(*p_ callback)	Setting the pointer to the output compare 0/1 callback function Setting the pointer to NULL will inhibit the notification of the occurrence of an output compare without causing an error. For the details of the function, refer to Section 6.9.20, CMTW_Oc0i_Callback.
	cmtw_input_capture_t input_capture[CMTW_INPUT_CAPTURE_NUM]		Storing input capture parameters The array number represents whether the parameters are for input capture 0 or input capture 1.
	int32_t	mode_enable	Setting ON/OFF of the input capture function true: ON false: OFF
	uint32_t	trigger	Setting the trigger for executing input capture
	int32_t	filter_enable	Setting ON/OFF of the noise filter function true: ON false: OFF

	int32_t	intr_priority	Setting the priority of the input capture interrupt
	void	(*p_ callback)	Setting the pointer to the input capture 0/1 callback function Setting the pointer to NULL will inhibit the notification of the occurrence of an input capture without causing an error. For the details of the function, refer to Section 6.9.19, CMTW_Ic0i_Callback.
	uint32_t	noise_filter_clk	Setting the frequency division ratio of the PCLKD clock used for the noise filter This parameter is valid when multiple noise filters are available in input capture 0/1.

Return values	CMTW_ERR_INVALID_ARG	: A member of the timer count information has an invalid value.
	CMTW_ERR_TIMER_RUNNING	: The function is executed while the timer counter is running.
	CMTW_ERR_MISSING_PTR	: Incorrect pointer argument
Remarks	–	

6.11.3 CMTW_CMD_SET_PAUSE

CMTW_CMD_SET_TIME_PAUSE

Synopsis	Pausing the timer
Header	r_cmtw_if.h
Description	This command pauses the timer count of the CMTW. When called with the timer counter stopping, the command ends without executing any processing.
Parameters	None

Return values	CMTW_ERR_TIMER_STOP	: Executed without starting timer count once after initialization
Remarks	–	

6.11.4 CMTW_CMD_SET_RESUME

CMTW_CMD_SET_TIME_RESUME

Synopsis	Resuming counting with the timer count maintained
Header	r_cmtw_if.h
Description	This command resumes counting with the timer count value at the time of being paused maintained. When called with the timer counter running, the command ends without executing any processing.
Parameters	None

Return values	CMTW_ERR_TIMER_STOP	: Executed without starting timer count once after initialization
	CMTW_ERR_TIMER_RUNNING	: The function is executed while the timer counter is running.
Remarks	–	

6.11.5 CMTW_CMD_SET_RESTART

CMTW_CMD_SET_TIME_RESTART	
Synopsis	Restarting the counter operation with the count cleared
Header	r_cmtw_if.h
Description	This command restarts counting with the timer count value at the time of being paused cleared. When called with the timer counter running, the command ends without executing any processing.
Parameters	None
Return values	CMTW_ERR_TIMER_STOP : Executed without starting timer count once after initialization CMTW_ERR_TIMER_RUNNING : The function is executed while the timer counter is running.
Remarks	–

6.11.6 CMTW_CMD_SET_ECM

CMTW_CMD_SET_ECM			
Synopsis	Setting the error output of the ECM dynamic mode		
Header	r_cmtw_if.h		
Description	This command sets the error output of the ECM dynamic mode. The parameters are passed in a form of a cmtw_ecm_t variable.		
Parameters	int32_t	ecm_enable	Enabling or disabling the error output of the ECM dynamic mode true: Enabling the error output of the ECM dynamic mode false: Disabling the error output of the ECM dynamic mode
	uint32_t	output_compare_num	Selecting the output compare number to which the ECM dynamic mode error is output
Return values	CMTW_ERR_INVALID_ARG : Output compare number is set to an invalid value. CMTW_ERR_TIMER_RUNNING : The function is executed while the timer counter is running. CMTW_ERR_MISSING_PTR : Incorrect pointer argument		
Remarks	• Enable the output compare output setting for the output compare number selected in this command by using CMD_SET_MODE (6.11.2) separately before starting the timer. • The setting will be initialized when the timer satisfies the stop condition (R_CMTW_Close is executed, timer aperiodic operation ends). • Only one output compare signal in the whole hardware can be set to the error output of the ECM dynamic mode at the same time. The setting will be overwritten by the latest one. • The error output of the ECM dynamic mode is set to disable immediately after initialization.		

6.11.7 CMTW_CMD_GET_STATUS

CMTW_CMD_GET_STATUS			
Synopsis	Acquiring the operating state of the timer		
Header	r_cmtw_if.h		
Description	This command acquires the operating state of the timer. The operating state is passed as a cmtw_status_t pointer variable. The parameter name below is an example.		
Parameters	uint32_t	*p_cmtw_status	Storing the operating state of the timer Either of the following values is returned. CMTW_STATUS_STOP: Timer has been stopped CMTW_STATUS_RUNNING: Timer is running
Return values	CMTW_ERR_INVALID_ARG		: The pointer to the timer operation state acquisition parameter has an invalid value.
Remarks	–		

6.12 R_ELC_Control Commands

The following table lists commands for the ELC sample driver.

Table 6.44 Commands for the ELC Sample Driver

Constant Name	Description
ELC_CMD_SET_EVENT_MTU	Setting event link to an MTU module
ELC_CMD_SET_EVENT_CMT	Setting event link to a CMT module
ELC_CMD_SET_EVENT_DSMIF	Setting event link to a ΔΣ unit module
ELC_CMD_SET_EVENT_S12AD	Setting event link to a 12-bit A/D converter
ELC_CMD_SET_EVENT_INTR	Setting event link to an interrupt request signal to the ELC
ELC_CMD_SET_EVENT_OUT_PORT_GROUP	Setting event link to an output port group
ELC_CMD_SET_EVENT_IN_PORT_GROUP	Setting event link to an input port group
ELC_CMD_SET_EVENT_SINGLE_PORT	Setting a single port and setting event link to the port
ELC_CMD_SET_EVENT_CMTW	Setting event link parameters to the CMTW0
ELC_CMD_SET_EVENT_TPU	Setting event link parameters to a TPU module
ELC_CMD_SET_EVENT_GPT	Setting event link parameters to a GPT module
ELC_CMD_SET_PORT_GROUP	Setting a port group
ELC_CMD_SET_SOFTWARE_EVENT	Issuing a software event of the ELC
ELC_CMD_GET_PORT_GROUP_VALUE	Acquiring the signal value of a port group

6.12.1 ELC_CMD_SET_EVENT_MTU

ELC_CMD_SET_EVENT_MTU			
Synopsis	Setting event link parameters to the MTU0, MTU3, or MTU4		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the MTU0, MTU3, or MTU4 The parameters are passed in a form of an elc_cmd_mtu_t variable.		
Parameters	uint32_t	elc_mtu_ch	Specifying the MTU unit number to be set.
	int32_t	event_link_enable	Setting ON/OFF of the event link to the MTU true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	uint32_t	action	Setting the action when an event link occurs to the MTU
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.2 ELC_CMD_SET_EVENT_CMT

ELC_CMD_SET_EVENT_CMT			
Synopsis	Setting event link parameters to the CMT1		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the CMT1. The parameters are passed in a form of an elc_cmd_cmt_t variable.		
Parameters	int32_t	event_link_enable	Setting ON/OFF of the event link to the CMT1 true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	uint32_t	action	Setting the action when an event link occurs to the CMT1
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.3 ELC_CMD_SET_EVENT_DSMIF

ELC_CMD_SET_EVENT_DSMIF			
Synopsis	Setting event link parameters to the ΔΣ unit 0/1 trigger 0/1		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the ΔΣ unit 0/1 trigger 0/1 The parameters are passed in a form of an elc_cmd_dsmif_t variable.		
Parameters	uint32_t	elc_dsmif_ch	Specifying the number of the ΔΣ unit 0/1 trigger 0/1 to be set
	int32_t	event_link_enable	Setting ON/OFF of the event link to the ΔΣ unit true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.4 ELC_CMD_SET_EVENT_S12AD

ELC_CMD_SET_EVENT_S12AD			
Synopsis	Setting event link parameters to the 12-bit A/D converter 0 or 1		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the 12-bit A/D converter 0 or 1. The parameters are passed in a form of an elc_cmd_s12ad_t variable.		
Parameters	uint32_t	elc_s12ad_ch	Setting the number of the 12-bit A/D converter to be set
	int32_t	event_link_enable	Setting ON/OFF of the event link to the 12-bit A/D converter true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.5 ELC_CMD_SET_EVENT_INTR

ELC_CMD_SET_EVENT_INTR			
Synopsis	Setting event link parameters to the interrupt request signal 1 or 2 of the ELC		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the interrupt request signal 1 or 2 of the ELC. The parameters are passed in a form of an elc_cmd_intr_t variable.		
Parameters	uint32_t	elc_intr_num	Specifying the number of the interrupt request signal
	int32_t	event_link_enable	Setting ON/OFF of the event link to the interrupt request signal 1 or 2 true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	int32_t	intr_priority	Setting the priority of the interrupt
	void	(*p_ callback)	Setting the pointer to the event link callback function Setting the pointer to NULL will inhibit the notification of the occurrence of an interrupt without causing an error. For the details of the function, refer to Section 6.9.21, ELC_Elci_Callback.
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.6 ELC_CMD_SET_EVENT_OUT_PORT_GROUP

ELC_CMD_SET_EVENT_OUT_PORT_GROUP			
Synopsis	Setting event link parameters to the output port group 1 or 2		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the output port group 1 or 2. The parameters are passed in a form of an elc_cmd_out_port_group_t variable.		
Parameters	uint32_t	elc_out_port_group_num	Specifying the number of the output port group
	int32_t	event_link_enable	Setting ON/OFF of the event link to the output port group 1 or 2 true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	uint32_t	action	Setting the action when an event link occurs to the output port group 1 or 2
	uint8_t	init_value	Setting the initial output value of the output port group When action is set to ELC_OUT_GROUP_OUTPUT_0 and ELC_OUT_GROUP_OUTPUT_1, the setting value will be ignored.
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	• After resetting the rotate state to the initial state while rotate output has been set, use this command to set the parameters of the initial state again.		

6.12.7 ELC_CMD_SET_EVENT_IN_PORT_GROUP

ELC_CMD_SET_EVENT_IN_PORT_GROUP			
Synopsis	Setting event link parameters to the input port group 1 or 2		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the input port group 1 or 2. The parameters are passed in a form of an elc_cmd_in_port_group_t variable.		
Parameters	uint32_t	elc_in_port_group_num	Specifying the number of the input port group
	int32_t	event_link_enable	Setting ON/OFF of the event link to the input port group 1 or 2 true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	int32_t	overwrite_enable	Setting whether or not to enable overwriting signal values on the buffer at the occurrence of an event true: Enabling overwrite false: Disabling overwrite
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	When overwriting signal values on the buffer is disabled at the occurrence of an event, the following event will be ignored until the buffer value is read out. Use ELC_CMD_GET_PORT_GROUP_VALUE (6.12.14) for reading out buffer values.		

6.12.8 ELC_CMD_SET_EVENT_SINGLE_PORT

ELC_CMD_SET_EVENT_SINGLE_PORT			
Synopsis	Registering a single port and setting event link parameters to the single port		
Header	r_elc_if.h		
Description	This command registers I/O ports to single port 0, 1, 2, or 3 and sets event link parameters of the ELC. The parameters are passed in a form of an elc_cmd_single_port_t variable.		
Parameters	uint32_t	elc_single_port_num	Specifying the number of the single port
	uint32_t	port_symbol	Selecting the port symbol to be set as a single port
	uunt32_t	port_num	Specifying the I/O port number to be set as a single port from 0 to 7
	int32_t	event_link_enable	Setting ON/OFF of the event link to the output single port When the event link is set to ON, the program waits for an event and outputs data from the single port at the occurrence of an event. When the event link is set to OFF, the program waits for data input to the input single port and issues an event link request after detecting data input. true: ON false: OFF
	uint32_t	signal_direction	Selecting from event input and event output at the time of an event link
	uint32_t	resource	Setting the event signal of the event link source This parameter is valid only when event_link_enable is true and signal_direction is ELC_SINGLE_EVENT_OUTPUT.
	uint32 _t	output_action	Setting the action of the output single port at the occurrence of an event link This parameter is valid only when event_link_enable is true and signal_direction is ELC_SINGLE_EVENT_OUTPUT.
	uint32_t	input_trigger	Specifying the data input detection trigger of the input single port This parameter is valid only when event_link_enable is true and signal_direction is ELC_SINGLE_EVENT_INPUT.
Return values	ELC_ERR_INVALID_ARG ELC_ERR_MISSING_PTR		: A member of the event link information has an invalid value. : Incorrect pointer argument
Remarks	• This sample driver does not set the data input/output directions of I/O ports registered as single ports. Use the I/O driver or the like to set the direction. • When both a single port and a port group are set to an I/O port, the both functions will be valid when the port is set to input. Only the setting of the port group will be valid when the port is set to output.		

6.12.9 ELC_CMD_SET_EVENT_CMTW

ELC_CMD_SET_EVENT_CMTW			
Synopsis	Setting event link parameters to the CMTW0		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the CMTW0. The parameters are passed in a form of an elc_cmd_cmtw_t variable.		
Parameters	int32_t	event_link_enable	Setting ON/OFF of the event link to the CMTW0 true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	uint32_t	action	Setting the action when an event link occurs to the CMTW0
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.10 ELC_CMD_SET_EVENT_TPU

ELC_CMD_SET_EVENT_TPU			
Synopsis	Setting event link parameters to the TPU0, TPU1, TPU2, or TPU3		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the TPU0, TPU1, TPU2, or TPU3. The parameters are passed in a form of an elc_cmd_tpu_t variable.		
Parameters	uint32_t	elc_tpu_ch	Specifying the number of the TPU
	int32_t	event_link_enable	Setting ON/OFF of the event link parameters to the TPU0, TPU1, TPU2, or TPU3 true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	uint32_t	action	Setting the action when an event link occurs to the TPU0,TPU1, TPU2, or TPU3
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.11 ELC_CMD_SET_EVENT_GPT

ELC_CMD_SET_EVENT_GPT			
Synopsis	Setting event link parameters to the GPT0, GPT1, GPT2, or GPT3		
Header	r_elc_if.h		
Description	This command sets event link parameters of the ELC to the GPT0, GPT1, GPT2, or GPT3. The parameters are passed in a form of an elc_cmd_gpt_t variable.		
Parameters	uint32_t	elc_gpt_ch	Specifying the number of the GPT
	int32_t	event_link_enable	Setting ON/OFF of the event link to the GPT0, GPT1, GPT2, or GPT3 true: ON false: OFF
	uint32_t	resource	Setting the event signal of the event link source
	uint32_t	action	Setting the action when an event link occurs to the GPT0, GPT1, GPT2, or GPT3
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

6.12.12 ELC_CMD_SET_PORT_GROUP

ELC_CMD_SET_PORT_GROUP			
Synopsis	Setting a port group		
Header	r_elc_if.h		
Description	This command sets a port group. The parameters are passed in a form of an elc_cmd_port_group_t variable.		
Parameters	uint32_t	port_group_num	Selecting the port group number to be set
	uint8_t	port_group_bit	Specifying the port number to be specified as a port group with a bit value The bits 0 to 7 corresponds to the port number 0 to 7 of the I/O port. When a bit is 1, the corresponding port is set to a port group.
	uint32_t	trigger	Specify the trigger for outputting an event signal when the port group can work as an event link source.
Return values	ELC_ERR_INVALID_ARG		: A member of the event link information has an invalid value.
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	• This sample driver does not set port groups to input or output. Use the I/O driver or the like to set the direction. • When both a single port and a port group are set to an I/O port, the both functions will be valid when the port is set to input. Only the setting of the port group will be valid when the port is set to output. • Port group 1 and port group 2 correspond to "port number: port B" and "port number: port E," respectively.		

6.12.13 ELC_CMD_SET_SOFTWARE_EVENT

ELC_CMD_SET_SOFTWARE_EVENT	
Synopsis	Issuing a software event of the ELC
Header	r_elc_if.h
Description	This command issues a software event of the ELC.
Parameters	None
Return values	None
Remarks	–

6.12.14 ELC_CMD_GET_PORT_GROUP_VALUE

ELC_CMD_GET_PORT_GROUP_VALUE			
Synopsis	Acquiring the signal value of a port group		
Header	r_elc_if.h		
Description	This command acquires the signal value of a port group. The parameters are passed in a form of an elc_get_port_value_t variable.		
Parameters	uint32_t	port_group_num	Specifying the port group number from which the value is acquired
	uint8_t	*p_port_value	Storing the signal value of the input port group
Return values	ELC_ERR_INVALID_ARG		: Incorrect port group number is specified
	ELC_ERR_MISSING_PTR		: Incorrect pointer argument
Remarks	–		

7. Sample Code

The sample code can be downloaded from the Renesas Electronics website.

8. Related Documents

- User's manual: Hardware
  RZ/T1 Group User's Manual: Hardware
  (Download the latest version from the Renesas Electronics website.)

  RZ/T1 Evaluation Board RTK7910022C00000BR User's Manual
  (Download the latest version from the Renesas Electronics website.)

- Technical Updates/Technical News
  (Download the latest information from the Renesas Electronics website.)

- User's Manual: Development environment
  Download the IAR Embedded Workbench® for Arm from the IAR website.
  (Download the latest version from the IAR website.)

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Revision History	Application Note: CMTW & ELC Sample Program

Rev.	Date	Description	
		Page	Summary
0.10	Apr. 02, 2015	—	First Edition issued
1.00	Apr. 10, 2015	—	Only the revision number was changed to be posted on a website.
1.10	Jul. 16, 2015	2. Operating Environment	
		5	Table 2.1 Operating Environment: Description added to Integrated Development Environment
		6. Software	
		11	6.2.4 Required Memory Size: Description and reference added
		11	Table 6.2: Table title and size description were partially amended
		11	Table 6.2 Required Memory Size: Description on the Note and Size, changed
		12	Table 6.3 added
		12	Table 6.4 added
1.20	Dec. 04, 2015	2. Operating Environment	
		5	Table 2.1 Operating Environment: Integrated Development Environment, information partially amended
1.30	Apr 05, 2017	2. Operating Environment	
		5	Table 2.1 Operating Environment: Integrated Development Environment, modified
		6. Software	
		—	6.2.4 Required Memory Size, deleted
1.40	Jun. 07, 2018	2. Operating Environment	
		5	Table 2.1 Operating Environment: The description on the integrated development environment, modified
		5. Hardware	
		8	Figure 5.1 Hardware configuration example: The name of module, modified
		8. Related Documents	
		56	The name of IAR Embedded Workbench, modified

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

   Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338

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