

Software Interface

CCRTAICC (WC-ADS6418)

PCIe 64-Channel Analog Input Card (AICC)

<i>Driver</i>	ccrtaicc (WC-ADS6418)	
<i>OS</i>	RedHawk (CentOS/Rocky or Ubuntu based)	
<i>Vendor</i>	Concurrent Real-Time	
<i>Hardware</i>	PCIe 64-Channel Analog Input Card (CP-ADS6418)	
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1. Introduction

This document provides the software interface to the *ccrtaicc* driver which communicates with the Concurrent Real-Time PCI Express 64-Channel Analog Input Card (AICC). For additional information for low-level programming is contained in the *Concurrent Real-Time PCIe 64-Channel Analog Input Card (AICC) Design Specification* (No. 0610108) document.

The software package that accompanies this board provides the ability for advanced users to communicate directly with the board via the driver *ioctl(2)* and *mmap(2)* system calls. When programming in this mode, the user needs to be intimately familiar with both the hardware and the register programming interface to the board. Failure to adhere to correct programming will result in unpredictable behavior.

Additionally, the software package is accompanied with an extensive set of application programming interface (API) calls that allow the user to access all capabilities of the board. The API library also allows the user the ability to communicate directly with the board through the *ioctl(2)* and *mmap(2)* system calls. In this case, there is a risk of this direct access conflicting with API calls and therefore should only be used by advanced users who are intimately familiar with the hardware, board registers and the driver code.

Various example tests have been provided in the *test* and *test/lib* directories to assist the user in developing their applications.

Though API calls exist for the following, the board does not support them:

- SDRAM
- SPROM

1.1 Related Documents

- PCIe 64-Channel Analog Input Card Driver Installation on RedHawk Release Notes by Concurrent Real-Time.
- PCIe 64-Channel Analog Input Driver Technical Guide by Concurrent Real-Time.
- PCIe 64-Channel Analog Input Card (AICC) Design Specification (No. 0610108) by Concurrent Real-Time.

2. Software Support

Software support is provided for users to communicate directly with the board using the kernel system calls (*Direct Driver Access*) or the supplied *API*. Both approaches are identified below to assist the user in software development.

2.1 Direct Driver Access

2.1.1 open(2) system call

In order to access the board, the user first needs to open the device using the standard system call *open(2)*.

```
int fp;  
fp = open("/dev/ccrtaicc0", O_RDWR);
```

The file pointer '*fp*' is then used as an argument to other system calls. The user can also supply the *O_NONBLOCK* flag if the user does not wish to block waiting for reads to complete. In that case, if the read is not satisfied, the call will fail. The device name specified is of the format *"/dev/ccrtaicc<num>"* where *num* is a digit 0..9 which represents the board number that is to be accessed. Basically, the driver only allows one application to open a board at a time. The reason for this is that the application can have full access to the card, even at the board and API level. If another application were to communicate with the same card

concurrently, the results would be unpredictable unless proper synchronization between applications is performed external to the driver API.

This driver allows multiple applications to open the same board by specifying an additional *oflag* *O_APPEND*. It is then the responsibility of the user to ensure that the various applications communicating with the same cards are properly synchronized. Various tests supplied in this package has the *O_APPEND* flags enabled, however, it is strongly recommended that only one application be run with a single card at a time, unless the user is well aware of how the applications are going to interact with each other and accept any unpredictable results.

2.1.2 ioctl(2) system call

This system call provides the ability to control and get responses from the board. The nature of the control/response will depend on the specific *ioctl* command.

```
int    status;
int    arg;
status = ioctl(fp, <IOCTL_COMMAND>, &arg);
```

where, '*fp*' is the file pointer that is returned from the *open(2)* system call. *<IOCTL_COMMAND>* is one of the *ioctl* commands below and *arg* is a pointer to an argument that could be anything and is dependent on the command being invoked. If no argument is required for a specific command, then set to *NULL*.

Driver IOCTL command:

```
IOCTL_CCRTAICC_ABORT_DMA
IOCTL_CCRTAICC_ADD_IRQ
IOCTL_CCRTAICC_DISABLE_PCI_INTERRUPTS
IOCTL_CCRTAICC_ENABLE_PCI_INTERRUPTS
IOCTL_CCRTAICC_GET_DRIVER_ERROR
IOCTL_CCRTAICC_GET_DRIVER_INFO
IOCTL_CCRTAICC_GET_PHYSICAL_MEMORY
IOCTL_CCRTAICC_GET_ADC_READ_MODE
IOCTL_CCRTAICC_INIT_BOARD
IOCTL_CCRTAICC_INTERRUPT_TIMEOUT_SECONDS
IOCTL_CCRTAICC_MMAP_SELECT
IOCTL_CCRTAICC_NO_COMMAND
IOCTL_CCRTAICC_PCI_CONFIG_REGISTERS
IOCTL_CCRTAICC_REMOVE_IRQ
IOCTL_CCRTAICC_RESET_BOARD
IOCTL_CCRTAICC_SELECT_ADC_READ_MODE
IOCTL_CCRTAICC_WAIT_FOR_INTERRUPT
IOCTL_CCRTAICC_RELOAD_FIRMWARE
IOCTL_CCRTAICC_GET_ALL_BOARDS_DRIVER_INFO
```

IOCTL_CCRTAICC_ABORT_DMA: This *ioctl* does not have any arguments. Its purpose is to abort any DMA already in progress..

IOCTL_CCRTAICC_ADD_IRQ: This *ioctl* does not have any arguments. Its purpose is to setup the driver *interrupt handler* to handle interrupts. If support for MSI interrupts are configured, they will be enabled. Normally, there is no need to call this *ioctl* as the interrupt handler is already added when the driver is loaded. This *ioctl* should only be invoked if the user has issued the *IOCTL_CCRTAICC_REMOVE_IRQ* call earlier to remove the interrupt handler.

IOCTL_CCRTAICC_DISABLE_PCI_INTERRUPTS: This *ioctl* does not have any arguments. Its purpose is to disable PCI interrupts. This call shouldn't be used during normal reads or writes, as calls could time out. The driver handles enabling and disabling interrupts during its normal course of operation.

IOCTL_CCRTAICC_ENABLE_PCI_INTERRUPTS: This *ioctl* does not have any arguments. Its purpose is to enable PCI interrupts. This call shouldn't be used during normal reads or writes as calls could time out. The driver handles enabling and disabling interrupts during its normal course of operation.

IOCTL_CCRTAICC_GET_DRIVER_ERROR: The argument supplied to this *ioctl* is a pointer to the *ccrtaiicc_user_error_t* structure. Information on the structure is located in the *ccrtaiicc_user.h* include file. The error returned is the last reported error by the driver. If the argument pointer is *NULL*, the current error is reset to *CCRTAICC_SUCCESS*.

IOCTL_CCRTAICC_GET_DRIVER_INFO: The argument supplied to this *ioctl* is a pointer to the *ccrtaiicc_driver_info_t* structure. Information on the structure is located in the *ccrtaiicc_user.h* include file. This *ioctl* provides useful driver information.

IOCTL_CCRTAICC_GET_PHYSICAL_MEMORY: The argument supplied to this *ioctl* is a pointer to the *ccrtaiicc_user_phys_mem_t* structure. Information on the structure is located in the *ccrtaiicc_user.h* include file. If physical memory is not allocated, the call will fail; otherwise the call will return the physical memory address and size in bytes. The only reason to request and get physical memory from the driver is to allow the user to perform DMA operations and bypass the driver and library. Care must be taken when performing user level DMA, as incorrect programming could lead to unpredictable results, including but not limited to corrupting the kernel and any device connected to the system.

IOCTL_CCRTAICC_GET_ADC_READ_MODE: The argument supplied to this *ioctl* is a pointer to an *unsigned long int*. The value returned will be one of the ADC read modes as defined by the *enum_ccrtaiicc_driver_adc_read_mode_t* located in the *ccrtaiicc_user.h* include file.

IOCTL_CCRTAICC_INIT_BOARD: This *ioctl* does not have any arguments. This call resets the board to a known initial default state. This call is currently identical to the *IOCTL_CCRTAICC_RESET_BOARD* call.

IOCTL_CCRTAICC_INTERRUPT_TIMEOUT_SECONDS: The argument supplied to this *ioctl* is a pointer to an *int*. It allows the user to change the default time out from 30 seconds to user supplied time out. This is the time that the read call will wait before it times out. The call could time out if a DMA fails to complete. The device should have been opened in the block mode (*O_NONBLOCK* not set) for reads to wait for an operation to complete.

IOCTL_CCRTAICC_MMAP_SELECT: The argument to this *ioctl* is a pointer to the *ccrtaiicc_mmap_select_t* structure. Information on the structure is located in the *ccrtaiicc_user.h* include file. This call needs to be made prior to the *mmap(2)* system call so as to direct the *mmap(2)* call to perform the requested mapping specified by this *ioctl*. The four possible mappings that are performed by the driver are to *mmap* the local register space (*CCRTAICC_SELECT_LOCAL_MMAP*), the configuration register space (*CCRTAICC_SELECT_CONFIG_MMAP*) the physical memory (*CCRTAICC_SELECT_PHYS_MEM_MMAP*) that is created by the *mmap(2)* system call and the driver/library mapping (*CCRTAICC_SELECT_DRIVER_LIBRARY_MMAP*).

IOCTL_CCRTAICC_NO_COMMAND: This *ioctl* does not have any arguments. It is only provided for debugging purpose and should not be used as it serves no purpose for the application.

IOCTL_CCRTAICC_PCI_CONFIG_REGISTERS: The argument supplied to this *ioctl* is a pointer to the *ccrtaiicc_pci_config_reg_addr_mapping_t* structure whose definition is located in the *ccrtaiicc_user.h* include file.

IOCTL_CCRTAICC_REMOVE_IRQ: This *ioctl* does not have any arguments. Its purpose is to remove the interrupt handler that was previously setup. The interrupt handler is managed internally by the driver and the library. The user should not issue this call, otherwise reads will time out.

IOCTL_CCRTAICC_RESET_BOARD: This *ioctl* does not have any arguments. This call resets the board to a known initial default state. This call is currently identical to the *IOCTL_CCRTAICC_INIT_BOARD* call.

IOCTL_CCRTAICC_SELECT_ADC_READ_MODE: The argument supplied to this *ioctl* is a pointer to an *unsigned long int*. The value set will be one of the ADC read modes as defined by the *enum _ccrtaiicc_driver_ADC_read_mode_t* located in the *ccrtaiicc_user.h* include file.

IOCTL_CCRTAICC_WAIT_FOR_INTERRUPT: The argument to this *ioctl* is a pointer to the *ccrtaiicc_driver_int_t* structure. Information on the structure is located in the *ccrtaiicc_user.h* include file. The user can wait for a DMA or Analog signal complete interrupt. If a time out value greater than zero is specified, the call will time out after the specified seconds, otherwise it will not time out.

IOCTL_CCRTAICC_RELOAD_FIRMWARE: This *ioctl* does not have any arguments. This call performs a reload of the latest firmware that was loaded into the board. Typically, this is used after a new firmware has been installed. It eliminates the need to reboot the kernel after a firmware update.

IOCTL_CCRTAICC_GET_ALL_BOARDS_DRIVER_INFO: The argument to this *ioctl* is a pointer to *ccrtaiicc_all_boards_driver_info*. It provides the ability to supply all driver information for all the *ccrtaiicc* cards in the system to the user.

2.1.3 mmap(2) system call

This system call provides the ability to map either the local board registers, the configuration board registers, create and map a physical memory that can be used for user DMA or driver/library structure mapping. Prior to making this system call, the user needs to issue the *ioctl(2)* system call with the *IOCTL_CCRTAICC_MMAP_SELECT* command. When mapping either the local board registers or the configuration board registers, the *ioctl* call returns the size of the register mapping which needs to be specified in the *mmap(2)* call. In the case of mapping a physical memory, the size of physical memory to be created is supplied to the *mmap(2)* call.

```
int *munmap_local_ptr;
ccrtaiicc_local_ctrl_data_t *local_ptr;
ccrtaiicc_mmap_select_t mmap_select;
unsigned long mmap_local_size;

mmap_select.select = CCRTAICC_SELECT_LOCAL_MMAP;
mmap_select.offset=0;
mmap_select.size=0;
ioctl(fp, IOCTL_CCRTAICC_MMAP_SELECT, (void *)&mmap_select);
mmap_local_size = mmap_select.size;

munmap_local_ptr = (int *) mmap((caddr_t)0, mmap_local_size,
                               (PROT_READ|PROT_WRITE), MAP_SHARED, fp, 0);

local_ptr = (ccrtaiicc_local_ctrl_data_t *)munmap_local_ptr;
local_ptr = (ccrtaiicc_local_ctrl_data_t *)((char *)local_ptr +
                                             mmap_select.offset);

.
.
.

if(munmap_local_ptr != NULL)
```

```
munmap((void *)munmap_local_ptr, mmap_local_size);
```

2.1.4 read(2) system call

This system call currently supports ADC programmed I/O reads of channel registers and FIFO. The option selected is determined by the *ccrtAICC_ADC_Set_Driver_Read_Mode()* call.

CCRTAICC_ADC_PIO_CHANNEL: Perform .channel registers programmed I/O reads.

CCRTAICC_ADC_PIO_FIFO: Perform FIFO reads using programmed I/O.

2.1.5 write(2) system call

This card does not support this call.

2.2 Application Program Interface (API) Access

The following APIs are the recommended method of communicating with the board for most users:

```
ccrtAICC_Abort_DMA()
ccrtAICC_ADC_Activate()
ccrtAICC_ADC_Get_CSR()
ccrtAICC_ADC_Get_Driver_Read_Mode()
ccrtAICC_ADC_Get_Fifo_Channel_Select()
ccrtAICC_ADC_Get_Fifo_Info()
ccrtAICC_ADC_Get_Fifo_Status()
ccrtAICC_ADC_Get_Fifo_Threshold()
ccrtAICC_ADC_Get_Input_Control()
ccrtAICC_ADC_Get_Negative_Cal()
ccrtAICC_ADC_Get_Offset_Cal()
ccrtAICC_ADC_Get_Positive_Cal()
ccrtAICC_ADC_Perform_Auto_Calibration()
ccrtAICC_ADC_Perform_External_Negative_Calibration()
ccrtAICC_ADC_Perform_External_Offset_Calibration()
ccrtAICC_ADC_Perform_External_Positive_Calibration()
ccrtAICC_ADC_Perform_Negative_Calibration()
ccrtAICC_ADC_Perform_Offset_Calibration()
ccrtAICC_ADC_Perform_Positive_Calibration()
ccrtAICC_ADC_Read_Channels()
ccrtAICC_ADC_Read_Channels_Calibration()
ccrtAICC_ADC_Reset_Calibration()
ccrtAICC_ADC_Reset_Fifo()
ccrtAICC_ADC_Set_CSR()
ccrtAICC_ADC_Set_Driver_Read_Mode()
ccrtAICC_ADC_Set_Fifo_Channel_Select()
ccrtAICC_ADC_Set_Fifo_Threshold()
ccrtAICC_ADC_Set_Input_Control()
ccrtAICC_ADC_Set_Negative_Cal()
ccrtAICC_ADC_Set_Offset_Cal()
ccrtAICC_ADC_Set_Positive_Cal()
ccrtAICC_ADC_Write_Channels_Calibration()
ccrtAICC_Add_Irq()
ccrtAICC_BoardExpirationTimeRemaining()
ccrtAICC_Clear_Cable_Fault()
ccrtAICC_Clear_Driver_Error()
ccrtAICC_Clear_Lib_Error()
ccrtAICC_Clock_Generator_Disable_Outputs()
ccrtAICC_Clock_Generator_Enable_Outputs()
ccrtAICC_Clock_Generator_Soft_Reset()
ccrtAICC_Clock_Get_Generator_CSR()
ccrtAICC_Clock_Get_Generator_Info()
ccrtAICC_Clock_Get_Generator_Input_Clock_Enable()
ccrtAICC_Clock_Get_Generator_Input_Clock_Select()
ccrtAICC_Clock_Get_Generator_Input_Clock_Status()
ccrtAICC_Clock_Get_Generator_M_Divider()
ccrtAICC_Clock_Get_Generator_N_Divider()
ccrtAICC_Clock_Get_Generator_Output_Config()
ccrtAICC_Clock_Get_Generator_Output_Format()
ccrtAICC_Clock_Get_Generator_Output_Mode()
ccrtAICC_Clock_Get_Generator_Output_Mux()
ccrtAICC_Clock_Get_Generator_P_Divider()
```

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```

ccrtAICC_Clock_Get_Generator_P_Divider_Enable()
ccrtAICC_Clock_Get_Generator_R_Divider()
ccrtAICC_Clock_Get_Generator_Revision()
ccrtAICC_Clock_Get_Generator_Value()
ccrtAICC_Clock_Get_Generator_Voltage_Select()
ccrtAICC_Clock_Get_Generator_Zero_Delay()
ccrtAICC_Clock_ReturnOutputFrequency()
ccrtAICC_Clock_Set_Generator_CSR()
ccrtAICC_Clock_Set_Generator_Input_Clock_Enable()
ccrtAICC_Clock_Set_Generator_Input_Clock_Select()
ccrtAICC_Clock_Set_Generator_M_Divider()
ccrtAICC_Clock_Set_Generator_N_Divider()
ccrtAICC_Clock_Set_Generator_Output_Config()
ccrtAICC_Clock_Set_Generator_Output_Format()
ccrtAICC_Clock_Set_Generator_Output_Mode()
ccrtAICC_Clock_Set_Generator_Output_Mux()
ccrtAICC_Clock_Set_Generator_P_Divider()
ccrtAICC_Clock_Set_Generator_P_Divider_Enable()
ccrtAICC_Clock_Set_Generator_R_Divider()
ccrtAICC_Clock_Set_Generator_Value()
ccrtAICC_Clock_Set_Generator_Voltage_Select()
ccrtAICC_Clock_Set_Generator_Zero_Delay()
ccrtAICC_Close()
ccrtAICC_Compute_All_Output_Clocks()
ccrtAICC_Convert_Physmem2avmm_Address()
ccrtAICC_Create_UserProcess()
ccrtAICC_DataToVolts()
ccrtAICC_Destroy_AllUserProcess()
ccrtAICC_Destroy_UserProcess()
ccrtAICC_Disable_Pci_Interrupts()
ccrtAICC_DMA_Configure()
ccrtAICC_DMA_Fire()
ccrtAICC_Enable_Pci_Interrupts()
ccrtAICC_Fast_Memcpy()
ccrtAICC_Fast_Memcpy_Unlocked()
ccrtAICC_Fast_Memcpy_Unlocked_FIFO()
ccrtAICC_Fraction_To_Hex()
ccrtAICC_Get_All_Boards_Driver_Info()
ccrtAICC_Get_Board_CSR()
ccrtAICC_Get_Board_Info()
ccrtAICC_Get_Cable_Fault_CSR()
ccrtAICC_Get_Calibration_CSR()
ccrtAICC_Get_Driver_Error()
ccrtAICC_Get_Driver_Info()
ccrtAICC_Get_External_Clock_CSR()
ccrtAICC_Get_Interrupt_Status()
ccrtAICC_Get_Interrupt_Timeout_Seconds()
ccrtAICC_Get_Lib_Error_Description()
ccrtAICC_Get_Lib_Error()
ccrtAICC_Get_Library_Info()
ccrtAICC_Get_Mapped_Config_Ptr()
ccrtAICC_Get_Mapped_Driver_Library_Ptr()
ccrtAICC_Get_Mapped_Local_Ptr()
ccrtAICC_Get_Open_File_Descriptor()
ccrtAICC_Get_Physical_Memory()

```

```

ccrtAICC_Get_RunCount_UserProcess()
ccrtAICC_Get_TestBus_Control()
ccrtAICC_Get_Value()
ccrtAICC_Hex_To_Fraction()
ccrtAICC_Identify_Board()
ccrtAICC_Initialize_Board()
ccrtAICC_MMap_Physical_Memory()
ccrtAICC_MsgDma_Clone()
ccrtAICC_MsgDma_Configure_ADC_Fifo()
ccrtAICC_MsgDma_Configure_Descriptor()
ccrtAICC_MsgDma_Configure_Single()
ccrtAICC_MsgDma_Fire()
ccrtAICC_MsgDma_Fire_ADC_Fifo()
ccrtAICC_MsgDma_Fire_Single()
ccrtAICC_MsgDma_Free_Descriptor()
ccrtAICC_MsgDma_Get_Descriptor()
ccrtAICC_MsgDma_Get_Dispatcher_CSR()
ccrtAICC_MsgDma_Get_Prefetcher_CSR()
ccrtAICC_MsgDma_Release()
ccrtAICC_MsgDma_Seize()
ccrtAICC_MsgDma_Setup()
ccrtAICC_Munmap_Physical_Memory()
ccrtAICC_NanoDelay()
ccrtAICC_Open()
ccrtAICC_Pause_UserProcess()
ccrtAICC_Program_All_Output_Clocks()
ccrtAICC_Read()
ccrtAICC_Reload_Firmware()
ccrtAICC_Remove_Irq()
ccrtAICC_Reset_Board()
ccrtAICC_Reset_Clock()
ccrtAICC_Resume_UserProcess()
ccrtAICC_Return_Board_Info_Description()
ccrtAICC_SDRAM_Activate() **
ccrtAICC_SDRAM_Get_CSR() **
ccrtAICC_SDRAM_Read() **
ccrtAICC_SDRAM_Set_CSR() **
ccrtAICC_SDRAM_Write() **
ccrtAICC_Set_Board_CSR()
ccrtAICC_Set_Calibration_CSR()
ccrtAICC_Set_External_Clock_CSR()
ccrtAICC_Set_Interrupt_Status()
ccrtAICC_Set_Interrupt_Timeout_Seconds()
ccrtAICC_Set_TestBus_Control()
ccrtAICC_Set_Value()
ccrtAICC_SPROM_Read() **
ccrtAICC_SPROM_Read_Item() **
ccrtAICC_SPROM_Write() **
ccrtAICC_SPROM_Write_Item() **
ccrtAICC_SPROM_Write_Override() **
ccrtAICC_Transfer_Data()
ccrtAICC_Update_Clock_Generator_Divider()
ccrtAICC_UserProcess_Command()
ccrtAICC_VoltsToData()
ccrtAICC_Wait_For_Interrupt()

```

ccrtAICC_Write()

2.2.1 ccrtAICC_Abort_DMA()

This call will abort any DMA operation that is in progress. Normally, the user should not use this call unless they are providing their own DMA handling.

```
/******  
_ccrtaicc_lib_error_number_t ccrtAICC_Abort_DMA(void *Handle)  
  
Description: Abort any DMA in progress  
  
Input: void *Handle (Handle pointer)  
Output: none  
Return: _ccrtaicc_lib_error_number_t  
        # CCRTAICC_LIB_NO_ERROR (successful)  
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)  
        # CCRTAICC_LIB_NOT_OPEN (device not open)  
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)  
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)  
*****/
```

2.2.2 ccrtAICC_ADC_Activate()

This call must be the first call to activate the ADC. Without activation, all other calls to the ADC will fail. The user can also use this call to return the current state of the ADC without any change by specifying a pointer to current_state and setting activate to CCRTAICC_ADC_ALL_ENABLE_DO_NOT_CHANGE. If the ADC is already active and the user issues a CCRTAICC_ADC_ALL_ENABLE, no additional activation will be performed. To cause the ADC to go through a full reset, the user needs to issue the CCRTAICC_ADC_ALL_RESET which will cause the ADC to disable and then re-enable, setting all its ADC values to a default state. ADC calibration data will *not* be reset.

```
/******  
_ccrtaicc_lib_error_number_t  
ccrtAICC_ADC_Activate (void *Handle,  
                      _ccrtaicc_adc_all_enable_t activate,  
                      _ccrtaicc_adc_all_enable_t *current_state)  
  
Description: Activate/DeActivate ADC module  
  
Input: void *Handle (Handle pointer)  
        _ccrtaicc_adc_all_enable_t activate (activate/deactivate)  
        # CCRTAICC_ADC_ALL_DISABLE  
        # CCRTAICC_ADC_ALL_ENABLE  
        # CCRTAICC_ADC_ALL_RESET  
        # CCRTAICC_ADC_ALL_ENABLE_DO_NOT_CHANGE  
Output: _ccrtaicc_adc_all_enable_t *current_state (active/deactive)  
        # CCRTAICC_ADC_ALL_DISABLE  
        # CCRTAICC_ADC_ALL_ENABLE  
Return: _ccrtaicc_lib_error_number_t  
        # CCRTAICC_LIB_NO_ERROR (successful)  
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)  
        # CCRTAICC_LIB_NOT_OPEN (device not open)  
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)  
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)  
*****/
```

2.2.3 ccrtAICC_ADC_Get_CSR()

This call returns information from the ADC registers for the selected channel group.

```
/******
```

```

_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Get_CSR (void          *Handle,
                     _ccrtaicc_adc_mask_t  adc_mask,
                     ccrtaicc_adc_csr_t    *adc_csr)

```

Description: Get ADC Control and Status information

```

Input:  void          *Handle (Handle pointer)
        _ccrtaicc_adc_mask_t  adc_mask (selected ADC mask)
        # CCRTAICC_ADC_MASK_0_15
        # CCRTAICC_ADC_MASK_16_31
        # CCRTAICC_ADC_MASK_32_47
        # CCRTAICC_ADC_MASK_48_63
        # CCRTAICC_ALL_ADC_MASK

Output: _ccrtaicc_adc_csr_t          *adc_csr (pointer to ADC csr)
        _ccrtaicc_adccsr_update_clock_t  adc_update_clock
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_0:
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_1:
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_2:
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_3:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_0:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_1:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_2:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_3:
        # CCRTAICC_ADC_UPDATE_NORMAL_EXTERNAL_CLOCK:
        # CCRTAICC_ADC_UPDATE_INVERTED_EXTERNAL_CLOCK:
        # CCRTAICC_ADC_UPDATE_CLOCK_NONE:
        _ccrtaicc_adccsr_speed_select_t  adc_speed_select;
        # CCRTAICC_ADC_NORMAL_SPEED:
        # CCRTAICC_ADC_HIGH_SPEED:
        # CCRTAICC_ADC_SPEED_SELECT_DO_NOT_CHANGE:
        _ccrtaicc_adccsr_data_format_t  adc_data_format
        # CCRTAICC_ADC_OFFSET_BINARY:
        # CCRTAICC_ADC_TWOS_COMPLEMENT:
        # CCRTAICC_ADC_DATA_FORMAT_DO_NOT_CHANGE:
        _ccrtaicc_adccsr_input_range_t  adc_input_range
        # CCRTAICC_ADC_BIPOLAR_5V:
        # CCRTAICC_ADC_BIPOLAR_10V:
        # CCRTAICC_ADC_UNIPOLAR_5V:
        # CCRTAICC_ADC_UNIPOLAR_10V:
        # CCRTAICC_ADC_INPUT_RANGE_DO_NOT_CHANGE:

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****/

```

2.2.4 ccrtaICC_ADC_Get_Driver_Read_Mode()

This call returns the current driver ADC read mode. When a *read(2)* system call is issued, it is this mode that determines the type of read being performed by the driver.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Get_Driver_Read_Mode (void          *Handle,
                                   _ccrtaicc_driver_ADC_read_mode_t  *mode)

```

Description: Get current ADC read mode that will be selected by the 'read()'

call

```
Input: void *Handle (Handle pointer)
Output: _ccrtaicc_driver_ADC_read_mode_t *mode (select ADC read mode)
        # CCRTAICC_ADC_PIO_CHANNEL
        # CCRTAICC_ADC_PIO_FIFO
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (library not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
*****/
```

2.2.5 ccrtaICC_ADC_Get_Fifo_Channel_Select()

This call returns the current Fifo Channel selection mask. Only samples for these selected channels are placed in the fifo during sample collection.

```
/******
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Get_Fifo_Channel_Select(void *Handle,
                                     _ccrtaicc_adc_channel_mask_t *adc_fifo_channel_select_mask)
*****/
```

Description: ADC Get Fifo Channel Selection

```
Input: void *Handle (handle pointer)
Output: _ccrtaicc_adc_channel_mask_t *adc_fifo_channel_select_mask
        (channel select mask)
```

```
        # CCRTAICC_ADC_CHANNEL_MASK_0
        # CCRTAICC_ADC_CHANNEL_MASK_1
        # CCRTAICC_ADC_CHANNEL_MASK_2
        # CCRTAICC_ADC_CHANNEL_MASK_3
        # CCRTAICC_ADC_CHANNEL_MASK_4
        # CCRTAICC_ADC_CHANNEL_MASK_5
        # CCRTAICC_ADC_CHANNEL_MASK_6
        # " " "
        # CCRTAICC_ADC_CHANNEL_MASK_58
        # CCRTAICC_ADC_CHANNEL_MASK_59
        # CCRTAICC_ADC_CHANNEL_MASK_60
        # CCRTAICC_ADC_CHANNEL_MASK_61
        # CCRTAICC_ADC_CHANNEL_MASK_62
        # CCRTAICC_ADC_CHANNEL_MASK_63
        # CCRTAICC_ALL_ADC_CHANNELS_MASK
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****/
```

2.2.6 ccrtaICC_ADC_Get_Fifo_Info()

This call returns ADC FIFO information to the user.

```
/******
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Get_Fifo_Info (void *Handle,
```

```
ccrtaiicc_adc_fifo_info_t *adc_fifo)
```

Description: Get ADC FIFO control and Status information

```
Input: void *Handle (Handle pointer)
Output: ccrtaiicc_adc_fifo_info_t *adc_fifo (pointer to ADC fifo struct)
        _ccrtaiicc_adc_fifo_reset_t reset;
        # CCRTAICC_ADC_FIFO_ACTIVE
        # CCRTAICC_ADC_FIFO_RESET
        _ccrtaiicc_adc_fifo_overflow_t overflow;
        # CCRTAICC_ADC_FIFO_NO_OVERFLOW
        # CCRTAICC_ADC_FIFO_OVERFLOW
        _ccrtaiicc_adc_fifo_underflow_t underflow;
        # CCRTAICC_ADC_FIFO_NO_UNDERFLOW
        # CCRTAICC_ADC_FIFO_UNDERFLOW
        _ccrtaiicc_adc_fifo_full_t full;
        # CCRTAICC_ADC_FIFO_NOT_FULL
        # CCRTAICC_ADC_FIFO_FULL
        _ccrtaiicc_adc_fifo_threshold_t threshold_exceeded;
        # CCRTAICC_ADC_FIFO_THRESHOLD_NOT_EXCEEDED
        # CCRTAICC_ADC_FIFO_THRESHOLD_EXCEEDED
        _ccrtaiicc_adc_fifo_empty_t empty;
        # CCRTAICC_ADC_FIFO_NOT_EMPTY
        # CCRTAICC_ADC_FIFO_EMPTY
        uint data_counter;
        uint threshold;
        uint max_threshold;
        uint driver_threshold;
        _ccrtaiicc_adc_channel_mask_t channel_select_mask;
        # CCRTAICC_ADC_CHANNEL_MASK_0
        # CCRTAICC_ADC_CHANNEL_MASK_1
        # CCRTAICC_ADC_CHANNEL_MASK_2
        # CCRTAICC_ADC_CHANNEL_MASK_3
        # CCRTAICC_ADC_CHANNEL_MASK_4
        # CCRTAICC_ADC_CHANNEL_MASK_5
        # CCRTAICC_ADC_CHANNEL_MASK_6
        # " " "
        # CCRTAICC_ADC_CHANNEL_MASK_58
        # CCRTAICC_ADC_CHANNEL_MASK_59
        # CCRTAICC_ADC_CHANNEL_MASK_60
        # CCRTAICC_ADC_CHANNEL_MASK_61
        # CCRTAICC_ADC_CHANNEL_MASK_62
        # CCRTAICC_ADC_CHANNEL_MASK_63
        # CCRTAICC_ALL_ADC_CHANNELS_MASK
Return: _ccrtaiicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****/
```

2.2.7 ccrtAICC_ADC_Get_Fifo_Status()

This call returns the ADC Fifo status information.

```
/*
_ccrtaiicc_lib_error_number_t
ccrtAICC_ADC_Get_Fifo_Status (void *Handle,
                             ccrtaiicc_adc_fifo_status_t *adc_fifo_status)
```

Description: Get ADC FIFO Status information

```
Input:  void                                *Handle (Handle pointer)
Output: ccrtAICC_adc_fifo_status_t        *adc_fifo_status (pointer to ADC
                                           fifo status struct)
                                           reset;
                                           _ccrtAICC_adc_fifo_reset_t
                                           # CCRTAICC_ADC_FIFO_ACTIVE
                                           # CCRTAICC_ADC_FIFO_RESET
                                           _ccrtAICC_adc_fifo_overflow_t overflow;
                                           # CCRTAICC_ADC_FIFO_NO_OVERFLOW
                                           # CCRTAICC_ADC_FIFO_OVERFLOW
                                           _ccrtAICC_adc_fifo_underflow_t underflow;
                                           # CCRTAICC_ADC_FIFO_NO_UNDERFLOW
                                           # CCRTAICC_ADC_FIFO_UNDERFLOW
                                           _ccrtAICC_adc_fifo_full_t full;
                                           # CCRTAICC_ADC_FIFO_NOT_FULL
                                           # CCRTAICC_ADC_FIFO_FULL
                                           _ccrtAICC_adc_fifo_threshold_t threshold_exceeded;
                                           # CCRTAICC_ADC_FIFO_THRESHOLD_NOT_EXCEEDED
                                           # CCRTAICC_ADC_FIFO_THRESHOLD_EXCEEDED
                                           _ccrtAICC_adc_fifo_empty_t empty;
                                           # CCRTAICC_ADC_FIFO_NOT_EMPTY
                                           # CCRTAICC_ADC_FIFO_EMPTY
                                           uint data_counter;
Return: _ccrtAICC_lib_error_number_t
       # CCRTAICC_LIB_NO_ERROR (successful)
       # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
       # CCRTAICC_LIB_NOT_OPEN (device not open)
       # CCRTAICC_LIB_INVALID_ARG (invalid argument)
       # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
       # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****/
```

2.2.8 ccrtAICC_ADC_Get_Fifo_Threshold()

This call returns the ADC Fifo threshold information.

```
/*
*_ccrtAICC_lib_error_number_t
ccrtAICC_ADC_Get_Fifo_Threshold(void *Handle,
                                uint *adc_threshold)
*/
```

Description: ADC Get Fifo Threshold

```
Input:  void                                *Handle (handle pointer)
Output: uint                                *adc_threshold (ADC fifo threshold)
Return: _ccrtAICC_lib_error_number_t
       # CCRTAICC_LIB_NO_ERROR (successful)
       # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
       # CCRTAICC_LIB_NOT_OPEN (device not open)
       # CCRTAICC_LIB_INVALID_ARG (invalid argument)
       # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
       # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****/
```

2.2.9 ccrtAICC_ADC_Get_Input_Control()

This call returns the ADC input control information.

```
/*
```

```

_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Get_Input_Control (void *Handle,
                                _ccrtaicc_adc_input_control_t *adc_input_control)

```

Description: Return Input Control information for all the ADCs

```

Input:  void *Handle (handle pointer)
Output: _ccrtaicc_adc_input_control_t *adc_input_control (pointer to control select)
        # CCRTAICC_ADC_INPUT_CONTROL_EXTERNAL_SIGNAL
        # CCRTAICC_ADC_INPUT_CONTROL_CALIBRATION_BUS
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region error)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)

```

*****/

2.2.10 ccrtaICC_ADC_Get_Negative_Cal()

This call returns the ADC negative calibration information for all the channels.

/*****

```

_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Get_Negative_Cal(void *Handle,
                              ccrtaicc_adc_cal_t *cal)

```

Description: Get the ADC Negative Calibration data.

```

Input:  void *Handle (handle pointer)
Output: ccrtaicc_adc_cal_t *cal (pointer to board cal)
        uint Raw[CCRTAICC_MAX_ADC_CHANNELS];
        double Float[CCRTAICC_MAX_ADC_CHANNELS];
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)

```

*****/

2.2.11 ccrtaICC_ADC_Get_Offset_Cal()

This call returns the ADC offset calibration information for all the channels.

/*****

```

_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Get_Offset_Cal(void *Handle,
                             ccrtaicc_adc_cal_t *cal)

```

Description: Get the ADC Offset Calibration data.

```

Input:  void *Handle (handle pointer)
Output: ccrtaicc_adc_cal_t *cal (pointer to board cal)
        uint Raw[CCRTAICC_MAX_ADC_CHANNELS];
        double Float[CCRTAICC_MAX_ADC_CHANNELS];
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)

```

*****/

2.2.12 ccrtAICC_ADC_Get_Positive_Cal()

This call returns the ADC positive calibration information for all the channels.

/*****/

```
_ccrtaicc_lib_error_number_t  
ccrtaicc_ADC_Get_Positive_Cal(void *Handle,  
                               ccrtaicc_adc_cal_t *cal)
```

Description: Get the ADC Positive Calibration data.

```
Input: void *Handle (handle pointer)  
Output: ccrtaicc_adc_cal_t *cal (pointer to board cal)  
        uint Raw[CCRTAICC_MAX_ADC_CHANNELS];  
        double Float[CCRTAICC_MAX_ADC_CHANNELS];  
Return: _ccrtaicc_lib_error_number_t  
        # CCRTAICC_LIB_NO_ERROR (successful)  
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)  
        # CCRTAICC_LIB_NOT_OPEN (device not open)  
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)  
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
```

*****/

2.2.13 ccrtAICC_ADC_Perform_Auto_Calibration()

This single call performs a full ADC calibration of all the selected channels using the internal reference voltages. Users need to perform this calibration after they have configured the channels with the appropriate clocks and frequencies, voltage references and channel speed selection. The reason for this is that these selections will have a direct bearing on the calibrated values. Failure to do so will result in inaccurate ADC readings.

/*****/

```
_ccrtaicc_lib_error_number_t  
ccrtaicc_ADC_Perform_Auto_Calibration (void *Handle,  
                                       _ccrtaicc_adc_channel_t chan_start,  
                                       _ccrtaicc_adc_channel_t chan_end)
```

Description: Perform ADC Auto Calibration

```
Input: void *Handle (handle pointer)  
       _ccrtaicc_adc_channel_t chan_start (start channel number)  
       # CCRTAICC_ADC_CHANNEL_0  
       # CCRTAICC_ADC_CHANNEL_1  
       # CCRTAICC_ADC_CHANNEL_2  
       # CCRTAICC_ADC_CHANNEL_3  
       # CCRTAICC_ADC_CHANNEL_4  
       # CCRTAICC_ADC_CHANNEL_5  
       # CCRTAICC_ADC_CHANNEL_6  
       # " " "  
       # CCRTAICC_ADC_CHANNEL_58  
       # CCRTAICC_ADC_CHANNEL_59  
       # CCRTAICC_ADC_CHANNEL_60  
       # CCRTAICC_ADC_CHANNEL_61  
       # CCRTAICC_ADC_CHANNEL_62  
       # CCRTAICC_ADC_CHANNEL_63  
       _ccrtaicc_adc_channel_t chan_end (end channel number)  
       # CCRTAICC_ADC_CHANNEL_0  
       # CCRTAICC_ADC_CHANNEL_1
```

```

# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
Output: none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (library not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_NO_RESOURCE       (no free PLL available)
        # CCRTAICC_LIB_IO_ERROR          (read error)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
        # CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC
                                                (clock not assigned to ADC)
*****/

```

2.2.14 ccrtaICC_ADC_Perform_External_Negative_Calibration()

Use this call to perform an external negative calibration. Prior to calling this function, the ADC inputs must be provided with a negative signal close to -10 Volts, otherwise this call will fail. Additionally, the user can specify a range of channels.

Users need to perform this calibration after they have configured the channels with the appropriate clocks and frequencies, voltage references and channel speed selection. The reason for this is that these selections will have a direct bearing on the calibrated values. Failure to do so will result in inaccurate ADC readings.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Perform_External_Negative_Calibration(void      *Handle,
                                                    _ccrtaicc_adc_channel_t chan_start,
                                                    _ccrtaicc_adc_channel_t chan_end,
                                                    double          ReferenceVoltage)

```

Description: Perform ADC External Negative Calibration

```

Input:  void      *Handle      (handle pointer)
        _ccrtaicc_adc_channel_t chan_start (start channel)
        # CCRTAICC_ADC_CHANNEL_0
        # CCRTAICC_ADC_CHANNEL_1
        # CCRTAICC_ADC_CHANNEL_2
        # CCRTAICC_ADC_CHANNEL_3
        # CCRTAICC_ADC_CHANNEL_4
        # CCRTAICC_ADC_CHANNEL_5
        # CCRTAICC_ADC_CHANNEL_6
        # " " "
        # CCRTAICC_ADC_CHANNEL_58
        # CCRTAICC_ADC_CHANNEL_59
        # CCRTAICC_ADC_CHANNEL_60
        # CCRTAICC_ADC_CHANNEL_61
        # CCRTAICC_ADC_CHANNEL_62
        # CCRTAICC_ADC_CHANNEL_63

```



```

        _ccrtaicc_adc_channel_t chan_end          (end channel)
        # CCRTAICC_ADC_CHANNEL_0
        # CCRTAICC_ADC_CHANNEL_1
        # CCRTAICC_ADC_CHANNEL_2
        # CCRTAICC_ADC_CHANNEL_3
        # CCRTAICC_ADC_CHANNEL_4
        # CCRTAICC_ADC_CHANNEL_5
        # CCRTAICC_ADC_CHANNEL_6
        # " " "
        # CCRTAICC_ADC_CHANNEL_58
        # CCRTAICC_ADC_CHANNEL_59
        # CCRTAICC_ADC_CHANNEL_60
        # CCRTAICC_ADC_CHANNEL_61
        # CCRTAICC_ADC_CHANNEL_62
        # CCRTAICC_ADC_CHANNEL_63
    double          ReferenceVoltage (Reference Voltage)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (library not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION    (local region not present)
        # CCRTAICC_LIB_NO_RESOURCE       (no free PLL available)
        # CCRTAICC_LIB_IO_ERROR          (read error)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
        # CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC
                                          (clock not assigned to ADC)
    *****/

```

2.2.15 ccrtAICC_ADC_Perform_External_Offset_Calibration()

Use this call to perform an external offset calibration. Prior to calling this function, the ADC inputs must be provided with an offset signal close to 0 Volts, otherwise this call will fail. Additionally, the user can specify a range of channels. Once this call is executed, the user will need to perform external negative and external positive calibrations as this call resets these gains to 1.0 prior to calibration.

Users need to perform this calibration after they have configured the channels with the appropriate clocks and frequencies, voltage references and channel speed selection. The reason for this is that these selections will have a direct bearing on the calibrated values. Failure to do so will result in inaccurate ADC readings.

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtAICC_ADC_Perform_External_Offset_Calibration(void          *Handle,
                                                    _ccrtaicc_adc_channel_t chan_start,
                                                    _ccrtaicc_adc_channel_t chan_end)

```

Description: Perform ADC External Offset Calibration

```

Input:  void          *Handle          (handle pointer)
        _ccrtaicc_adc_channel_t chan_start (start channel)
        # CCRTAICC_ADC_CHANNEL_0
        # CCRTAICC_ADC_CHANNEL_1
        # CCRTAICC_ADC_CHANNEL_2
        # CCRTAICC_ADC_CHANNEL_3
        # CCRTAICC_ADC_CHANNEL_4
        # CCRTAICC_ADC_CHANNEL_5
        # CCRTAICC_ADC_CHANNEL_6
        # " " "
        # CCRTAICC_ADC_CHANNEL_58

```

```

# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
_ccrtaicc_adc_channel_t chan_end      (end channel)
# CCRTAICC_ADC_CHANNEL_0
# CCRTAICC_ADC_CHANNEL_1
# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63

Output: none
Return: _ccrtaicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR      (successful)
# CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN     (library not open)
# CCRTAICC_LIB_INVALID_ARG  (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
# CCRTAICC_LIB_NO_RESOURCE  (no free PLL available)
# CCRTAICC_LIB_IO_ERROR     (read error)
# CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
# CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC (clock not assigned to ADC)
*****/

```

2.2.16 ccrtAICC_ADC_Perform_External_Positive_Calibration()

Use this call to perform an external positive calibration. Prior to calling this function, the ADC inputs must be provided with a positive signal close to +10 Volts, otherwise this call will fail. Additionally, the user can specify a range of channels.

Users need to perform this calibration after they have configured the channels with the appropriate clocks and frequencies, voltage references and channel speed selection. The reason for this is that these selections will have a direct bearing on the calibrated values. Failure to do so will result in inaccurate ADC readings.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Perform_External_Positive_Calibration(void      *Handle,
                                                    _ccrtaicc_adc_channel_t chan_start,
                                                    _ccrtaicc_adc_channel_t chan_end,
                                                    double          ReferenceVoltage)

```

Description: Perform ADC External Positive Calibration

```

Input: void      *Handle      (handle pointer)
       _ccrtaicc_adc_channel_t chan_start (start channel)
       # CCRTAICC_ADC_CHANNEL_0
       # CCRTAICC_ADC_CHANNEL_1
       # CCRTAICC_ADC_CHANNEL_2
       # CCRTAICC_ADC_CHANNEL_3
       # CCRTAICC_ADC_CHANNEL_4

```

```

# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
_ccrtaicc_adc_channel_t chan_end          (end channel)
# CCRTAICC_ADC_CHANNEL_0
# CCRTAICC_ADC_CHANNEL_1
# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
double          ReferenceVoltage (Reference Voltage)
Output: none
Return: _ccrtaicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR          (successful)
# CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN        (library not open)
# CCRTAICC_LIB_INVALID_ARG     (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
# CCRTAICC_LIB_NO_RESOURCE     (no free PLL available)
# CCRTAICC_LIB_IO_ERROR        (read error)
# CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
# CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC
                                   (clock not assigned to ADC)
*****/

```

2.2.17 ccrtAICC_ADC_Perform_Negative_Calibration()

This call performs a negative calibration using the internal reference voltage for the selected channels.

Users need to perform this calibration after they have configured the channels with the appropriate clocks and frequencies, voltage references and channel speed selection. The reason for this is that these selections will have a direct bearing on the calibrated values. Failure to do so will result in inaccurate ADC readings.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Perform_Negative_Calibration (void          *Handle,
                                           _ccrtaicc_adc_channel_t chan_start,
                                           _ccrtaicc_adc_channel_t chan_end)

```

Description: Perform ADC Negative Calibration

```

Input:   void          *Handle          (handle pointer)
         _ccrtaicc_adc_channel_t chan_start (start channel number)
         # CCRTAICC_ADC_CHANNEL_0
         # CCRTAICC_ADC_CHANNEL_1
         # CCRTAICC_ADC_CHANNEL_2

```

```

# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
_ccrtaicc_adc_channel_t chan_end      (end channel number)
# CCRTAICC_ADC_CHANNEL_0
# CCRTAICC_ADC_CHANNEL_1
# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
Output: none
Return: _ccrtaicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR          (successful)
# CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN         (library not open)
# CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
# CCRTAICC_LIB_NO_RESOURCE      (no free PLL available)
# CCRTAICC_LIB_IO_ERROR         (read error)
# CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
# CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC (clock not assigned to ADC)
*****/

```

2.2.18 ccrtAICC_ADC_Perform_Offset_Calibration()

This call performs an offset calibration using the internal reference voltage for the selected channels. Once this call is executed, the user will need to perform negative and positive calibrations as this call resets these gains to 1.0 prior to calibration.

Users need to perform this calibration after they have configured the channels with the appropriate clocks and frequencies, voltage references and channel speed selection. The reason for this is that these selections will have a direct bearing on the calibrated values. Failure to do so will result in inaccurate ADC readings.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Perform_Offset_Calibration (void          *Handle,
                                          _ccrtaicc_adc_channel_t chan_start,
                                          _ccrtaicc_adc_channel_t chan_end)

```

Description: Perform ADC Offset Calibration

```

Input:   void          *Handle          (handle pointer)
         _ccrtaicc_adc_channel_t chan_start (start channel number)
         # CCRTAICC_ADC_CHANNEL_0

```

```

# CCRTAICC_ADC_CHANNEL_1
# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
_ccrtaicc_adc_channel_t chan_end      (end channel number)
# CCRTAICC_ADC_CHANNEL_0
# CCRTAICC_ADC_CHANNEL_1
# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
Output: none
Return: _ccrtaicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR      (successful)
# CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN     (library not open)
# CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
# CCRTAICC_LIB_NO_RESOURCE  (no free PLL available)
# CCRTAICC_LIB_IO_ERROR     (read error)
# CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
# CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC (clock not assigned to ADC)
*****/

```

2.2.19 ccrtAICC_ADC_Perform_Positive_Calibration()

This call performs a positive calibration using the internal reference voltage for the selected channels.

Users need to perform this calibration after they have configured the channels with the appropriate clocks and frequencies, voltage references and channel speed selection. The reason for this is that these selections will have a direct bearing on the calibrated values. Failure to do so will result in inaccurate ADC readings.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Perform_Positive_Calibration (void          *Handle,
                                           _ccrtaicc_adc_channel_t chan_start,
                                           _ccrtaicc_adc_channel_t chan_end)

```

Description: Perform ADC Positive Calibration

```

Input: void          *Handle      (handle pointer)
       _ccrtaicc_adc_channel_t chan_start (start channel number)
       # CCRTAICC_ADC_CHANNEL_0

```

```

# CCRTAICC_ADC_CHANNEL_1
# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
_ccrtaicc_adc_channel_t chan_end          (end channel number)
# CCRTAICC_ADC_CHANNEL_0
# CCRTAICC_ADC_CHANNEL_1
# CCRTAICC_ADC_CHANNEL_2
# CCRTAICC_ADC_CHANNEL_3
# CCRTAICC_ADC_CHANNEL_4
# CCRTAICC_ADC_CHANNEL_5
# CCRTAICC_ADC_CHANNEL_6
# " " "
# CCRTAICC_ADC_CHANNEL_58
# CCRTAICC_ADC_CHANNEL_59
# CCRTAICC_ADC_CHANNEL_60
# CCRTAICC_ADC_CHANNEL_61
# CCRTAICC_ADC_CHANNEL_62
# CCRTAICC_ADC_CHANNEL_63
Output: none
Return: _ccrtaicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR          (successful)
# CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN        (library not open)
# CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
# CCRTAICC_LIB_NO_RESOURCE     (no free PLL available)
# CCRTAICC_LIB_IO_ERROR        (read error)
# CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
# CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC (clock not assigned to ADC)
*****/

```

2.2.20 **ccrtAICC_ADC_Read_Channels()**

This call provides the user an easy method of reading the ADC channels. User can supply a channel mask. If pointer to *adc_csr* is NULL, then the routine itself computes the current ADC configuration. For performance, the user should get the current ADC configuration using the *ccrtAICC_ADC_Get_CSR()* call to get the current settings and pass it to this routine. Hence, if the configuration is not changed, the user can continuously invoke *ccrtAICC_ADC_Read_Channels()* routine without incurring the additional overhead of routine calling the *ccrtAICC_ADC_Get_CSR()* call.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Read_Channels(void          *Handle,
                                     _ccrtaicc_adc_channel_mask_t ChanMask,
                                     _ccrtaicc_adc_csr_t          *adc_csr,
                                     ccrtaicc_adc_volts_t         *adc_volts)

```

Description: Read ADC Channels

Input: void *Handle (Handle pointer)

```

_ccrtaicc_adc_channel_mask_t   ChanMask      (specify channel mask)
# CCRTAICC_ADC_CHANNEL_MASK_0
# CCRTAICC_ADC_CHANNEL_MASK_1
# CCRTAICC_ADC_CHANNEL_MASK_2
# CCRTAICC_ADC_CHANNEL_MASK_3
# CCRTAICC_ADC_CHANNEL_MASK_4
# CCRTAICC_ADC_CHANNEL_MASK_5
# CCRTAICC_ADC_CHANNEL_MASK_6
# " " "
# CCRTAICC_ADC_CHANNEL_MASK_58
# CCRTAICC_ADC_CHANNEL_MASK_59
# CCRTAICC_ADC_CHANNEL_MASK_60
# CCRTAICC_ADC_CHANNEL_MASK_61
# CCRTAICC_ADC_CHANNEL_MASK_62
# CCRTAICC_ADC_CHANNEL_MASK_63
# CCRTAICC_ALL_ADC_CHANNELS_MASK
_ccrtaicc_adc_csr_t           *adc_csr (pointer to ADC csr)
_ccrtaicc_adccsr_update_clock_t  adc_update_clock
# CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_0:
# CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_1:
# CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_2:
# CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_3:
# CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_0:
# CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_1:
# CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_2:
# CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_3:
# CCRTAICC_ADC_UPDATE_NORMAL_EXTERNAL_CLOCK:
# CCRTAICC_ADC_UPDATE_INVERTED_EXTERNAL_CLOCK:
# CCRTAICC_ADC_UPDATE_CLOCK_NONE:
_ccrtaicc_adccsr_speed_select_t  adc_speed_select;
# CCRTAICC_ADC_NORMAL_SPEED:
# CCRTAICC_ADC_HIGH_SPEED:
# CCRTAICC_ADC_SPEED_SELECT_DO_NOT_CHANGE:
_ccrtaicc_adccsr_data_format_t   adc_data_format
# CCRTAICC_ADC_OFFSET_BINARY:
# CCRTAICC_ADC_TWOS_COMPLEMENT:
# CCRTAICC_ADC_DATA_FORMAT_DO_NOT_CHANGE:
_ccrtaicc_adccsr_input_range_t   adc_input_range
# CCRTAICC_ADC_BIPOLAR_5V:
# CCRTAICC_ADC_BIPOLAR_10V:
# CCRTAICC_ADC_UNIPOLAR_5V:
# CCRTAICC_ADC_UNIPOLAR_10V:
# CCRTAICC_ADC_INPUT_RANGE_DO_NOT_CHANGE:
Output: ccrtaicc_adc_volts_t      *adc_volts (pointer to ADC volts)
        uint   Raw[CCRTAICC_MAX_ADC_CHANNELS];
        double Float[CCRTAICC_MAX_ADC_CHANNELS];
Return: _ccrtaicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR           (successful)
# CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN         (library not open)
# CCRTAICC_LIB_INVALID_ARG      (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
# CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****

```

2.2.21 ccrtaICC_ADC_Read_Channels_Calibration()

This routine reads the ADC channel calibration registers and dumps all of them to the user specified file. If the file name specified is NULL, then information is written to *stdout*.

```

/*****

```

```

_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Read_Channels_Calibration(void *Handle,
                                       char *filename)

```

Description: Read ADC Channels Calibration

```

Input:   void *Handle           (handle pointer)
Output:  char *filename         (pointer to filename)
Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR      (successful)
         # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN     (library not open)
         # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
         # CCRTAICC_LIB_CANNOT_OPEN_FILE (cannot open calib. file)

```

*****/
e.g.

```
#Date      : Fri Dec 14 11:30:00 2018
```

#Chan	Negative	Offset	Positive
#####	=====	=====	=====
ch00:	1.000178198330104351043701172	-0.00022888183593750000	1.000139905605465173721313477
ch01:	0.999954220838844776153564453	-0.00007629394531250000	0.999967454932630062103271484
ch02:	1.000127669423818588256835938	-0.00015258789062500000	1.000118218362331390380859375
ch03:	0.999876655638217926025390625	0.00000000000000000000	0.999875877983868122100830078
. . .			
ch61:	1.000136931426823139190673828	-0.00007629394531250000	1.000138226430863142013549805
ch62:	1.000080410391092300415039062	-0.00007629394531250000	1.000093937385827302932739258
ch63:	1.000272549688816070556640625	-0.00007629394531250000	1.000277046114206314086914062

2.2.22 ccrtaICC_ADC_Reset_Calibration()

This call resets the gain and offset information for all channels to default, i.e. both the positive and negative gains are set to 1 and the *offset* is set to 0.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Reset_Calibration (void *Handle)

```

Description: Reset Calibration Data

```

Input:   void *Handle           (handle pointer)
Output:  none
Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR      (successful)
         # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN     (library not open)
         # CCRTAICC_LIB_INVALID_ARG  (invalid argument)
         # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
         # CCRTAICC_LIB_NO_RESOURCE  (no free PLL available)
         # CCRTAICC_LIB_IO_ERROR     (read error)

```

*****/

2.2.23 ccrtaICC_ADC_Reset_Fifo()

This call provides the ability to reset the ADC Fifo to the power-on state. User can elect to activate the FIFO after a reset in order for data collection to resume immediately.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Reset_Fifo(void *Handle,
                        _ccrtaicc_adc_fifo_reset_t activate)

```


Description: ADC Reset Fifo

```
Input:  void                                *Handle (handle pointer)
        _ccrtaicc_adc_fifo_reset_t activate (activate converter)
        # CCRTAICC_ADC_FIFO_ACTIVATE
        # CCRTAICC_ADC_FIFO_RESET
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR             (successful)
        # CCRTAICC_LIB_BAD_HANDLE           (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN            (device not open)
        # CCRTAICC_LIB_INVALID_ARG         (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION     (local region not present)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE   (ADC is not active)
*****/
```

2.2.24 ccrtaICC_ADC_Set_CSR()

This call sets the ADC control registers for the selected channel group. For accurate results during data collection, the user needs to perform a calibration of the channels once are configured and the associated clocks started.

```
/******
   _ccrtaicc_lib_error_number_t
   ccrtaICC_ADC_Set_CSR (void                *Handle,
                        _ccrtaicc_adc_mask_t adc_mask,
                        ccrtaicc_adc_csr_t   *adc_csr)
```

Description: Set ADC Control and Status information

```
Input:  void                                *Handle (Handle pointer)
        _ccrtaicc_adc_mask_t                adc_mask (selected ADC mask)
        # CCRTAICC_ADC_MASK_0_15
        # CCRTAICC_ADC_MASK_16_31
        # CCRTAICC_ADC_MASK_32_47
        # CCRTAICC_ADC_MASK_48_63
        # CCRTAICC_ALL_ADC_MASK
        _ccrtaicc_adc_csr_t                  *adc_csr (pointer to ADC csr)
        _ccrtaicc_adccsr_update_clock_t     adc_update_clock
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_0:
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_1:
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_2:
        # CCRTAICC_ADC_UPDATE_NORMAL_CLOCK_3:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_0:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_1:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_2:
        # CCRTAICC_ADC_UPDATE_INVERTED_CLOCK_3:
        # CCRTAICC_ADC_UPDATE_NORMAL_EXTERNAL_CLOCK:
        # CCRTAICC_ADC_UPDATE_INVERTED_EXTERNAL_CLOCK:
        # CCRTAICC_ADC_UPDATE_CLOCK_NONE:
        _ccrtaicc_adccsr_speed_select_t      adc_speed_select;
        # CCRTAICC_ADC_NORMAL_SPEED:
        # CCRTAICC_ADC_HIGH_SPEED:
        # CCRTAICC_ADC_SPEED_SELECT_DO_NOT_CHANGE:
        _ccrtaicc_adccsr_data_format_t       adc_data_format
        # CCRTAICC_ADC_OFFSET_BINARY:
        # CCRTAICC_ADC_TWOS_COMPLEMENT:
        # CCRTAICC_ADC_DATA_FORMAT_DO_NOT_CHANGE:
        _ccrtaicc_adccsr_input_range_t       adc_input_range
        # CCRTAICC_ADC_BIPOLAR_5V:
        # CCRTAICC_ADC_BIPOLAR_10V:
```

```

        # CCRTAICC_ADC_UNIPOLAR_5V:
        # CCRTAICC_ADC_UNIPOLAR_10V:
        # CCRTAICC_ADC_INPUT_RANGE_DO_NOT_CHANGE:
Output:  none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (library not open)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG             (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION          (local region not present)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE       (ADC is not active)
*****/

```

2.2.25 ccrtaICC_ADC_Set_Driver_Read_Mode()

This call sets the current driver ADC read mode. When a *read(2)* system call is issued, it is this mode that determines the type of read being performed by the driver. Refer to the *read(2)* system call under *Direct Driver Access* section for more information on the various modes. If the *read(2)* call fails with the *ENOBUFS* error, an overflow condition has occurred. User will need to reduce the clock speed and/or the number of selected channels until an overflow condition is no longer triggered.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Set_Driver_Read_Mode (void                *Handle,
                                   _ccrtaicc_driver_ADC_read_mode_t mode)

Description: Select Driver ADC Read Mode

Input:  void                *Handle (Handle pointer)
        _ccrtaicc_driver_ADC_read_mode_t mode (select ADC read mode)
        # CCRTAICC_ADC_PIO_CHANNEL
        # CCRTAICC_ADC_PIO_FIFO

Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG             (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION          (local region not present)
*****/

```

2.2.26 ccrtaICC_ADC_Set_Fifo_Channel_Select()

This call allows the user to select a set of channels that need to be captured in the ADC Fifo. For ADCs that have the high speed option *CCRTAICC_ADC_HIGH_SPEED* selected, the odd (*unused*) channels for the ADC will *not* be included in the Fifo, even if the odd channels are specified in the channel selection mask.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Set_Fifo_Channel_Select(void                *Handle,
                                       _ccrtaicc_adc_channel_mask_t
                                       adc_fifo_channel_select_mask)

Description: ADC Set Fifo Channel Selection

Input:  void                *Handle (handle pointer)
        _ccrtaicc_adc_channel_mask_t adc_fifo_channel_select_mask
                                               (channel select mask)
        # CCRTAICC_ADC_CHANNEL_MASK_0

```

```

# CCRTAICC_ADC_CHANNEL_MASK_1
# CCRTAICC_ADC_CHANNEL_MASK_2
# CCRTAICC_ADC_CHANNEL_MASK_3
# CCRTAICC_ADC_CHANNEL_MASK_4
# CCRTAICC_ADC_CHANNEL_MASK_5
# CCRTAICC_ADC_CHANNEL_MASK_6
# " " "
# CCRTAICC_ADC_CHANNEL_MASK_58
# CCRTAICC_ADC_CHANNEL_MASK_59
# CCRTAICC_ADC_CHANNEL_MASK_60
# CCRTAICC_ADC_CHANNEL_MASK_61
# CCRTAICC_ADC_CHANNEL_MASK_62
# CCRTAICC_ADC_CHANNEL_MASK_63
# CCRTAICC_ALL_ADC_CHANNELS_MASK
Output: none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION    (local region not present)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****/

```

2.2.27 **ccrtAICC_ADC_Set_Fifo_Threshold()**

This call allows the user to set the ADC Fifo Threshold.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Set_Fifo_Threshold(void *Handle,
                                uint adc_threshold)

Description: ADC Set Fifo Threshold

Input:  void          *Handle      (handle pointer)
        uint          adc_threshold (ADC fifo threshold)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION    (local region not present)
        # CCRTAICC_LIB_ADC_IS_NOT_ACTIVE (ADC is not active)
*****/

```

2.2.28 **ccrtAICC_ADC_Set_Input_Control()**

This call allows the user to select whether the inputs to all the ADCs are from an *external* supply or the *calibration* bus. If calibration bus is selected, then the user can select one of several reference voltages or ground reference using the *ccrtAICC_Set_Calibration_CSR()* to direct it as an input to the all the active ADCs.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Set_Input_Control (void          *Handle,
                                _ccrtaicc_adc_input_control_t adc_input_control)

Description: Set Input Control information for all the ADCs

```

```

Input:  void                *Handle          (handle pointer)
        _ccrtaicc_adc_input_control_t
        adc_input_control (control select)
        # CCRTAICC_ADC_INPUT_CONTROL_EXTERNAL_SIGNAL
        # CCRTAICC_ADC_INPUT_CONTROL_CALIBRATION_BUS
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_NO_LOCAL_REGION    (local region error)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
*****/

```

2.2.29 ccrtAICC_ADC_Set_Negative_Cal()

This call allows the user to set the negative calibration data for all the channels by supplying floating point *Float* gains to the call. Users can supply CCRTAICC_DO_NOT_CHANGE as a gain for any channel that should not be changed. Additionally, this call will return the *RAW* value of the gain supplied that is written to the board.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Set_Negative_Cal(void                *Handle,
                               ccrtaicc_adc_cal_t *cal)

```

Description: Set the ADC Negative Calibration data.

```

Input:  void                *Handle          (handle pointer)
        ccrtaicc_adc_cal_t  *cal            (pointer to board cal)
        uint               Raw[CCRTAICC_MAX_ADC_CHANNELS];
        double             Float[CCRTAICC_MAX_ADC_CHANNELS];
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (library not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION    (local region not present)
        # CCRTAICC_LIB_NO_RESOURCE       (no free PLL available)
        # CCRTAICC_LIB_IO_ERROR          (read error)
*****/

```

2.2.30 ccrtAICC_ADC_Set_Offset_Cal()

This call allows the user to set the offset calibration data for all the channels by supplying floating point *Float* offset to the call. Users can supply CCRTAICC_DO_NOT_CHANGE as a gain for any channel that should not be changed. Additionally, this call will return the *Raw* value of the offset supplied that is written to the board.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_ADC_Set_Offset_Cal(void                *Handle,
                               ccrtaicc_adc_cal_t *cal)

```

Description: Set the ADC Offset Calibration data.

```

Input:  void                *Handle          (handle pointer)
        ccrtaicc_adc_cal_t  *cal            (pointer to board cal)
        uint               Raw[CCRTAICC_MAX_ADC_CHANNELS];
        double             Float[CCRTAICC_MAX_ADC_CHANNELS];
Output: none

```

```

Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (library not open)
        # CCRTAICC_LIB_INVALID_ARG      (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
        # CCRTAICC_LIB_NO_RESOURCE     (no free PLL available)
        # CCRTAICC_LIB_IO_ERROR         (read error)
*****/

```

2.2.31 ccrtaICC_ADC_Set_Positive_Cal()

This call allows the user to set the positive calibration data for all the channels by supplying floating point *Float* gains to the call. Users can supply CCRTAICC_DO_NOT_CHANGE as a gain for any channel that should not be changed. Additionally, this call will return the *Raw* value of the gain supplied that is written to the board.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Set_Positive_Cal(void *Handle,
                             ccrtaicc_adc_cal_t *cal)

Description: Set the ADC Positive Calibration data.

Input:      void *Handle      (handle pointer)
           ccrtaicc_adc_cal_t *cal (pointer to board cal)
           uint Raw[CCRTAICC_MAX_ADC_CHANNELS];
           double Float[CCRTAICC_MAX_ADC_CHANNELS];

Output:     none

Return:     _ccrtaicc_lib_error_number_t
           # CCRTAICC_LIB_NO_ERROR           (successful)
           # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
           # CCRTAICC_LIB_NOT_OPEN         (library not open)
           # CCRTAICC_LIB_INVALID_ARG      (invalid argument)
           # CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
           # CCRTAICC_LIB_NO_RESOURCE     (no free PLL available)
           # CCRTAICC_LIB_IO_ERROR         (read error)
*****/

```

2.2.32 ccrtaICC_ADC_Write_Channels_Calibration()

This call allows the user to write the calibration registers from a user supplied calibration file. The format of the file is similar to that generated by the *ccrtaICC_ADC_Read_Channels_Calibration()* call. File can contain comments if they start with '#', '*', or empty lines. Additionally, users need only specify those channels that they wish to calibrate and the order of specifying channels is not important, however, the format of each channel entry needs to be adhered to. E.g. <chxx:> <negative> <offset> <positive>

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_ADC_Write_Channels_Calibration(void *Handle,
                                       char *filename)

Description: Write Channels Calibration

Input:      void *Handle      (handle pointer)
Output:     char *filename    (pointer to filename)
Return:     _ccrtaicc_lib_error_number_t
           # CCRTAICC_LIB_NO_ERROR           (successful)
           # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
           # CCRTAICC_LIB_NOT_OPEN         (library not open)
           # CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)

```

```

# CCRTAICC_LIB_CANNOT_OPEN_FILE (cannot open calib. file)
# CCRTAICC_LIB_INVALID_ARG (invalid argument)
*****
e.g.
#Date : Fri Dec 14 11:30:00 2018

#Chan Negative Offset Positive
#==== =====
ch00: 1.000178198330104351043701172 -0.00022888183593750000 1.000139905605465173721313477
ch01: 0.999954220838844776153564453 -0.00007629394531250000 0.999967454932630062103271484
ch02: 1.000127669423818588256835938 -0.00015258789062500000 1.000118218362331390380859375
ch03: 0.999876655638217926025390625 0.0000000000000000000 0.999875877983868122100830078
. . .
ch61: 1.000136931426823139190673828 -0.00007629394531250000 1.000138226430863142013549805
ch62: 1.000080410391092300415039062 -0.00007629394531250000 1.000093937385827302932739258
ch63: 1.000272549688816070556640625 -0.00007629394531250000 1.000277046114206314086914062

```

2.2.33 ccrtAICC_Add_Irq()

This call will add the driver interrupt handler if it has not been added. Normally, the user should not use this call unless they want to disable the interrupt handler and then re-enable it.

```

/*****
int ccrtAICC_Add_Irq(void *Handle)

Description: By default, the driver assigns an interrupt handler to handle
device interrupts. If the interrupt handler was removed using
the ccrtAICC_Remove_Irq(), then this call adds it back.

Input: void *Handle (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (library not open)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
*****/

```

2.2.34 ccrtAICC_BoardExpirationTimeRemaining()

This call provides useful information about the expiration date of the card if it has restricted licensing.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_BoardExpirationTimeRemaining(void *Handle,
time_t *SecondsToExpire,
ccrtaicc_date_string_t *GmtDateTimeString,
ccrtaicc_date_string_t *LocalDateTimeString,
_ccrtaicc_firmware_state *FirmwareState)

Description: Number of seconds to expire on a restricted card

Input: void *Handle (Handle pointer)
Output: time_t *SecondsToExpire (seconds to expire)
        ccrtaicc_date_string_t *GmtDateTimeString (GMT date/time
string)
        char date[CCRRTAICC_DATE_TIME_STRING_SIZE]
        ccrtaicc_date_string_t *LocalDateTimeString (Local date/time
string)
        char date[CCRRTAICC_DATE_TIME_STRING_SIZE]
        _ccrtaicc_firmware_state *FirmwareState (Firmware State)
        # CCRTAICC_FIRMWARE_STATE_UNRESTRICTED

```

```

        # CCRTAICC_FIRMWARE_STATE_RESTRICTED
        # CCRTAICC_FIRMWARE_STATE_EXPIRED
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (library not open)
*****/

```

Mandatory arguments to the call are **Handle* and **SecondsToExpire*. Rest of the arguments are optional and be set to *NULL*.

SecondsToExpire* – If the board has an expiration date, this call will return the number of seconds this card can be used before it expires. *Once the card has expired, this call will not be reached as the device open will fail with an authorization error.***

If the board has no expiration date, this call will return zero as the number of seconds.

**GmtDateTimeString* – If the board has an expiration date, this ascii GMT date representation of the expiration date is available in this variable if it is not NULL

**LocalDateTimeString* – If the board has an expiration date, this ascii Local date representation of the expiration date is available in this variable if it is not NULL

**FirmwareState* – This returns the current state of the installed firmware. I can be one of:

- CCRTAICC_FIRMWARE_STATE_UNRESTRICTED. This firmware has no restrictions.
- CCRTAICC_FIRMWARE_STATE_RESTRICTED. This firmware has restrictions. It is possible that and expiration date restriction is not present.
- CCRTAICC_FIRMWARE_STATE_EXPIRED. This firmware has restrictions. One of the restrictions is the expiration date which has expired. Typically, you may not see this state as the utility will fail during the open with an authentication error.

2.2.35 ccrtAICC_Clear_Cable_Fault()

This call clears any latched fault conditions that were created due to overvoltage

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clear_Cable_Fault (void           *Handle,
                           ccrtaicc_cable_fault_csr_t *CableFaultCSR)

```

Description: Clear Cable Fault

```

Input:  void           *Handle      (handle pointer)
        ccrtaicc_cable_fault_csr_t *CableFaultCSR (pointer to cable fault CSR)
        _ccrtaicc_cable_fault_group_mask_t LatchedFaultStatus
        # CCRTAICC_CABLE_FAULT_GROUP_00_03_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_04_07_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_08_11_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_12_15_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_16_19_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_20_23_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_24_27_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_28_31_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_32_35_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_36_39_MASK
        # CCRTAICC_CABLE_FAULT_GROUP_40_43_MASK

```

```

# CCRTAICC_CABLE_FAULT_GROUP_44_47_MASK
# CCRTAICC_CABLE_FAULT_GROUP_48_51_MASK
# CCRTAICC_CABLE_FAULT_GROUP_52_55_MASK
# CCRTAICC_CABLE_FAULT_GROUP_56_59_MASK
# CCRTAICC_CABLE_FAULT_GROUP_60_63_MASK
# CCRTAICC_ALL_CABLE_FAULT_GROUPS_MASK
Output: none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION    (local region error)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
*****/

```

2.2.36 ccrtaicc_Clear_Driver_Error()

This call resets the last driver error that was maintained internally by the driver to *CCRTAICC_SUCCESS*.

```

/*****
_ccrtaicc_lib_error_number_t ccrtaicc_Clear_Driver_Error(void *Handle)

Description: Clear any previously generated driver related error.

Input:   void *Handle           (Handle pointer)
Output:  none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED     (driver ioctl call failed)
*****/

```

2.2.37 ccrtaicc_Clear_Lib_Error()

This call resets the last library error that was maintained internally by the API.

```

/*****
_ccrtaicc_lib_error_number_t ccrtaicc_Clear_Lib_Error(void *Handle)

Description: Clear any previously generated library related error.

Input:   void *Handle           (Handle pointer)
Output:  none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
*****/

```

2.2.38 ccrtaicc_Clock_Generator_Disable_Outputs()

This call is used to disable the clock generator outputs. No data collection can occur until the clock outputs are re-enabled.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_Clock_Generator_Disable_Outputs (void *Handle)

Description: Disable Clock Generator Outputs

```



```

Input: void *Handle (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.39 ccrtaICC_Clock_Generator_Enable_Outputs()

This call is used to enable the clock generator outputs if they have been previously disabled by the *ccrtaICC_Clock_Generator_Disable_Outputs()* call.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Clock_Generator_Enable_Outputs (void *Handle)

Description: Enable Clock Generator Outputs

Input: void *Handle (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.40 ccrtaICC_Clock_Generator_Soft_Reset()

Perform a soft clock reset on all the output clocks.

```

/*****
_ccrtaicc_lib_error_number_t ccrtaICC_Clock_Generator_Soft_Reset(void *Handle)

Description: Perform Soft Reset to Clock Generator

Input: void *Handle (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.41 ccrtaICC_Clock_Get_Generator_CSR()

Return the clock generator control and status register.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Clock_Get_Generator_CSR (void *Handle,
                                  ccrtaicc_clkgen_csr_t *CgCsr)

Description: Get Generator Control and Status information

Input: void *Handle (Handle pointer)
Output: ccrtaicc_clkgen_csr_t *CgCsr (pointer to clock
                                       generator csr)
        _ccrtaicc_clkgen_interface_t interface

```

```

        # CCRTAICC_CLOCK_GENERATOR_INTERFACE_IDLE
        # CCRTAICC_CLOCK_GENERATOR_INTERFACE_BUSY
    _ccrtaicc_clkgen_output_t          output
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_DISABLE
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_ENABLE
    _ccrtaicc_clkgen_state_t          state
        # CCRTAICC_CLOCK_GENERATOR_ACTIVE
        # CCRTAICC_CLOCK_GENERATOR_RESET

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler
                                         supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not
                                         present)

*****/

```

2.2.42 ccrtAICC_Clock_Get_Generator_Info()

This call returns the clock generator information for the selected output.

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtAICC_Clock_Get_Generator_Info (void          *Handle,
                                       _ccrtaicc_clock_generator_output_t WhichOutput,
                                       ccrtaicc_clock_generator_info_t   *CgInfo)

```

Description: Get Clock Generator Information

```

Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_output_t WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9

Output: ccrtaicc_clock_generator_info_t *CgInfo (pointer to clock
                                                generator info)
        __u64          M_divider_num
        __u32          M_divider_den
        __u64          N_divider_num
        __u32          N_divider_den
        __u32          R_divider_value
        __u32          R_divider
        _ccrtaicc_cg_zero_delay_t ZeroDelay
        # CCRTAICC_CG_ZERO_DELAY_MODE
        # CCRTAICC_CG_NORMAL_MODE
        _ccrtaicc_cg_stat_ctrl_voltselect_t Voltage_select
        # CCRTAICC_CG_VOLTAGE_SELECT_1_8V
        # CCRTAICC_CG_VOLTAGE_SELECT_3_3V
        _ccrtaicc_cg_input_xaxb_extclk_sel_t Input_xaxb_selection
        # CCRTAICC_CG_INPUT_XAXB_USE_CRYSTAL
        # CCRTAICC_CG_INPUT_XAXB_USE_EXTCLK_SOURCE
        _ccrtaicc_cg_xaxb_power_down_t Input_xaxb_power
        # CCRTAICC_CG_XAXB_POWER_DOWN

```

```

# CCRTAICC_CG_XAXB_DO_NOT_POWER_DOWN
ccrtaicc_clkgen_csr_t                               Clkcsr
  _ccrtaicc_clkgen_interface_t                     interface
    # CCRTAICC_CLOCK_GENERATOR_INTERFACE_IDLE
    # CCRTAICC_CLOCK_GENERATOR_INTERFACE_BUSY
  _ccrtaicc_clkgen_output_t                         output
    # CCRTAICC_CLOCK_GENERATOR_OUTPUT_DISABLE
    # CCRTAICC_CLOCK_GENERATOR_OUTPUT_ENABLE
  _ccrtaicc_clkgen_state_t                         state
    # CCRTAICC_CLOCK_GENERATOR_ACTIVE
    # CCRTAICC_CLOCK_GENERATOR_RESET
ccrtaicc_clkgen_output_config_t                   Config
  _ccrtaicc_cg_outcfg_force_rdiv2_t               force_rdiv2
    # CCRTAICC_CG_OUTPUT_CONFIG_DONT_FORCE_RDIV2
    # CCRTAICC_CG_OUTPUT_CONFIG_FORCE_RDIV2
  _ccrtaicc_cg_outcfg_enable_t                   enable
    # CCRTAICC_CG_OUTPUT_CONFIG_DISABLE
    # CCRTAICC_CG_OUTPUT_CONFIG_ENABLE
  _ccrtaicc_cg_outcfg_shutdown_t                 shutdown
    # CCRTAICC_CG_OUTPUT_CONFIG_POWER_UP
    # CCRTAICC_CG_OUTPUT_CONFIG_SHUTDOWN
ccrtaicc_clkgen_output_format_t                 Format
  _ccrtaicc_cg_outfmt_cmos_drive_t               cmos_drive
    # CCRTAICC_CG_OUTPUT_FORMAT_CMOS_DRIVE_LVDS
    # CCRTAICC_CG_OUTPUT_FORMAT_CMOS_DRIVE_CMOS
  _ccrtaicc_cg_outfmt_disable_state_t           disable_state
    # CCRTAICC_CG_OUTPUT_FORMAT_DISABLE_LOW
    # CCRTAICC_CG_OUTPUT_FORMAT_DISABLE_HIGH
  _ccrtaicc_cg_outfmt_sync_t                   sync
    # CCRTAICC_CG_OUTPUT_FORMAT_SYNC_DISABLE
    # CCRTAICC_CG_OUTPUT_FORMAT_SYNC_ENABLE
  _ccrtaicc_cg_outfmt_format_t                 format
    # CCRTAICC_CG_OUTPUT_FORMAT_FORMAT_LVDS
    # CCRTAICC_CG_OUTPUT_FORMAT_FORMAT_CMOS
ccrtaicc_clkgen_output_mode_t                   Mode
  _ccrtaicc_cg_outmode_amplitude_t             amplitude
    # CCRTAICC_CG_OUTPUT_AMPLITUDE_CMOS
    # CCRTAICC_CG_OUTPUT_AMPLITUDE_LVDS
  _ccrtaicc_cg_outmode_common_t               common
    # CCRTAICC_CG_OUTPUT_COMMON_CMOS
    # CCRTAICC_CG_OUTPUT_COMMON_LVDS
    # CCRTAICC_CG_OUTPUT_COMMON_LVPECL
ccrtaicc_clkgen_output_mux_t                   Mux
  _ccrtaicc_cg_outmux_inversion_t             inversion
    # CCRTAICC_CG_OUTPUT_MUX_COMPLEMENTARY
    # CCRTAICC_CG_OUTPUT_MUX_IN_PHASE
    # CCRTAICC_CG_OUTPUT_MUX_INVERTED
    # CCRTAICC_CG_OUTPUT_MUX_OUT_OF_PHASE
  _ccrtaicc_cg_outmux_ndiv_select_t           ndiv_mux
    # CCRTAICC_CG_OUTPUT_MUX_NDIV_0
    # CCRTAICC_CG_OUTPUT_MUX_NDIV_1
    # CCRTAICC_CG_OUTPUT_MUX_NDIV_2
    # CCRTAICC_CG_OUTPUT_MUX_NDIV_3
    # CCRTAICC_CG_OUTPUT_MUX_NDIV_4
ccrtaicc_clkgen_input_clock_enable_t           Input_clock_enable
  _ccrtaicc_cg_input_clock_enable_t         input_0_clock
    # CCRTAICC_CG_INPUT_CLOCK_DISABLE
    # CCRTAICC_CG_INPUT_CLOCK_ENABLE
  _ccrtaicc_cg_input_clock_enable_t         input_1_clock
    # CCRTAICC_CG_INPUT_CLOCK_DISABLE
    # CCRTAICC_CG_INPUT_CLOCK_ENABLE

```

```

_ccrtaicc_cg_input_clock_enable_t          input_2_clock
# CCRTAICC_CG_INPUT_CLOCK_DISABLE
# CCRTAICC_CG_INPUT_CLOCK_ENABLE
_ccrtaicc_cg_input_clock_enable_t          input_fb_clock
# CCRTAICC_CG_INPUT_CLOCK_DISABLE
# CCRTAICC_CG_INPUT_CLOCK_ENABLE
ccrtaicc_clkgen_input_clock_select_t        Input_clock_select
_ccrtaicc_cg_input_clock_select_control_t  control
# CCRTAICC_CG_INPUT_CLOCK_SELECT_PIN_CONTROL
# CCRTAICC_CG_INPUT_CLOCK_SELECT_REG_CONTROL
_ccrtaicc_cg_input_clock_select_register_t select
# CCRTAICC_CG_INPUT_CLOCK_SELECT_IN0
# CCRTAICC_CG_INPUT_CLOCK_SELECT_IN1
# CCRTAICC_CG_INPUT_CLOCK_SELECT_IN2
# CCRTAICC_CG_INPUT_CLOCK_SELECT_INXAXB
ccrtaicc_pdiv_all_info_t                    Pdiv_info
__u64                                        Pfb_divider
ccrtaicc_pdiv_info_t                        P0
__u64                                        Divider
_ccrtaicc_cg_pdiv_enable_t                  Enable
# CCRTAICC_CG_PDIV_DISABLE
# CCRTAICC_CG_PDIV_ENABLE
_ccrtaicc_cg_pdiv_input_state_t             State
# CCRTAICC_CG_PDIV_INPUT_UNUSED
# CCRTAICC_CG_PDIV_INPUT_DISABLED
# CCRTAICC_CG_PDIV_INPUT_SELECTED
ccrtaicc_pdiv_info_t                        P1
__u64                                        Divider
_ccrtaicc_cg_pdiv_enable_t                  Enable
# CCRTAICC_CG_PDIV_DISABLE
# CCRTAICC_CG_PDIV_ENABLE
_ccrtaicc_cg_pdiv_input_state_t             State
# CCRTAICC_CG_PDIV_INPUT_UNUSED
# CCRTAICC_CG_PDIV_INPUT_DISABLED
# CCRTAICC_CG_PDIV_INPUT_SELECTED
ccrtaicc_pdiv_info_t                        P2
__u64                                        Divider
_ccrtaicc_cg_pdiv_enable_t                  Enable
# CCRTAICC_CG_PDIV_DISABLE
# CCRTAICC_CG_PDIV_ENABLE
_ccrtaicc_cg_pdiv_input_state_t             State
# CCRTAICC_CG_PDIV_INPUT_UNUSED
# CCRTAICC_CG_PDIV_INPUT_DISABLED
# CCRTAICC_CG_PDIV_INPUT_SELECTED
ccrtaicc_pdiv_info_t                        Pxaxb
__u64                                        Divider
_ccrtaicc_cg_pdiv_enable_t                  Enable
# CCRTAICC_CG_PDIV_DISABLE
# CCRTAICC_CG_PDIV_ENABLE
_ccrtaicc_cg_pdiv_input_state_t             State
# CCRTAICC_CG_PDIV_INPUT_UNUSED
# CCRTAICC_CG_PDIV_INPUT_DISABLED
# CCRTAICC_CG_PDIV_INPUT_SELECTED
int                                           Which_Pdiv_Selected
int                                           P_Divider
long double                                   OutputClockFrequency;
# <valid positive output clock frequency>
# CCRTAICC_CLOCK_ERROR_INVALID_P_DIVIDER
# CCRTAICC_CLOCK_ERROR_VCO_CLOCK_NOT_IN_RANGE
# CCRTAICC_CLOCK_ERROR_N_DIVIDER_NOT_IN_RANGE
# CCRTAICC_CLOCK_ERROR_P_DIVIDER_NOT_IN_RANGE

```

```

        # CCRTAICC_CLOCK_ERROR_R_DIVIDER_NOT_IN_RANGE
        # CCRTAICC_CLOCK_ERROR_INVALID_CLOCK_FREQUENCY
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION         (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE    (Clock is not active)
*****/

```

2.2.43 ccrtaicc_clock_get_generator_input_clock_enable()

This call returns the status of all the input clocks.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_clock_get_generator_input_clock_enable (void *Handle,
        ccrtaicc_clkgen_input_clock_enable_t *InputClockEnable)

Description: Return the Clock Generator Input Clock Enable

Input:  void *Handle (Handle pointer)
Output: ccrtaicc_clkgen_input_clock_enable_t *InputClockEnable (pointer to
        input clock enable)
        _ccrtaicc_cg_input_clock_enable_t input_0_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
        _ccrtaicc_cg_input_clock_enable_t input_1_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
        _ccrtaicc_cg_input_clock_enable_t input_2_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
        _ccrtaicc_cg_input_clock_enable_t input_fb_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION         (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE    (Clock is not active)
*****/

```

2.2.44 ccrtaicc_clock_get_generator_input_clock_select()

This call returns the input clock selection.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_clock_get_generator_input_clock_select (void *Handle,
        ccrtaicc_clkgen_input_clock_select_t *ClkSel)

Description: Get Input Clock Selection

Input:  void *Handle (Handle pointer)
Output: ccrtaicc_clkgen_input_clock_select_t *ClkSel (pointer to
        input clock selection)
        _ccrtaicc_cg_input_clock_select_control_t control;

```

```

    # CCRTAICC_CG_INPUT_CLOCK_SELECT_PIN_CONTROL
    # CCRTAICC_CG_INPUT_CLOCK_SELECT_REG_CONTROL
    _ccrtaicc_cg_input_clock_select_register_t    select;
    # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN0
    # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN1
    # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN2
    # CCRTAICC_CG_INPUT_CLOCK_SELECT_INXAXB
Return:  _ccrtaicc_lib_error_number_t
    # CCRTAICC_LIB_NO_ERROR                (successful)
    # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
    # CCRTAICC_LIB_NOT_OPEN                (device not open)
    # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
    # CCRTAICC_LIB_NO_LOCAL_REGION        (local region error)
    # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE    (Clock is not active)
*****/

```

2.2.45 ccrtAICC_Clock_Get_Generator_Input_Clock_Status()

The call returns the input clock status.

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtAICC_Clock_Get_Generator_Input_Clock_Status (void *Handle,
                                                    ccrtaicc_clkgen_input_clock_status_t *ClkStatus)

```

Description: Get Input Clock Status

```

Input:  void                *Handle    (Handle pointer)
Output: ccrtaicc_clkgen_input_clock_status_t *ClkSatus (pointer to input
                                                    clock status)
    _ccrtaicc_cg_calibration_status_t        calstat
    # CCRTAICC_CG_STATUS_DEVICE_IS_NOT_CALIBRATING
    # CCRTAICC_CG_STATUS_DEVICE_IS_CALIBRATING
    _ccrtaicc_cg_lol_pll_locked_t            PLL_locked
    # CCRTAICC_CG_STATUS_LOL_PLL_LOCKED
    # CCRTAICC_CG_STATUS_LOL_PLL_NOT_LOCKED
    _ccrtaicc_cg_smbus_timeout_error_t       SMBUS_timeout
    # CCRTAICC_CG_STATUS_LOL_SMBUS_NOT_TIMEDOUT
    # CCRTAICC_CG_STATUS_LOL_SMBUS_TIMEDOUT
    _ccrtaicc_cg_los_signal_present_t        input_signal
    # CCRTAICC_CG_STATUS_LOS_SIGNAL_PRESENT
    # CCRTAICC_CG_STATUS_LOS_SIGNAL_NOT_PRESENT
    _ccrtaicc_cg_los_alarm_t                 input_0_clock
    # CCRTAICC_CG_LOS_INPUT_CLOCK_PRESENT
    # CCRTAICC_CG_LOS_INPUT_CLOCK_NOT_PRESENT
    _ccrtaicc_cg_los_alarm_t                 input_1_clock
    # CCRTAICC_CG_LOS_INPUT_CLOCK_PRESENT
    # CCRTAICC_CG_LOS_INPUT_CLOCK_NOT_PRESENT
    _ccrtaicc_cg_los_alarm_t                 input_2_clock
    # CCRTAICC_CG_LOS_INPUT_CLOCK_PRESENT
    # CCRTAICC_CG_LOS_INPUT_CLOCK_NOT_PRESENT
    _ccrtaicc_cg_los_alarm_t                 input_fb_clock
    # CCRTAICC_CG_LOS_INPUT_CLOCK_PRESENT
    # CCRTAICC_CG_LOS_INPUT_CLOCK_NOT_PRESENT
    _ccrtaicc_cg_losxaxb_signal_present_t    input_xaxb_clock
    # CCRTAICC_CG_LOS_INPUT_CLOCK_PRESENT
    # CCRTAICC_CG_LOS_INPUT_CLOCK_NOT_PRESENT
Return:  _ccrtaicc_lib_error_number_t
    # CCRTAICC_LIB_NO_ERROR                (successful)
    # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
    # CCRTAICC_LIB_NOT_OPEN                (device not open)

```

```

# CCRTAICC_LIB_INVALID_ARG          (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION      (local region not present)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.46 ccrtAICC_Clock_Get_Generator_M_Divider()

This call returns the M-Divider numerator, denominator and value.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Get_Generator_M_Divider (void          *Handle,
                                         __u64        *Numerator,
                                         __u32        *Denominator,
                                         long double *Value)

Description: Return Clock Generator M-Divider Numerator and Denominator

Input:  void          *Handle          (Handle pointer)
Output: __u64        *Numerator        (pointer to Numerator)
        __u32        *Denominator      (pointer to Denominator)
        long double  *Value            (pointer to Value)

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR        (successful)
        # CCRTAICC_LIB_BAD_HANDLE     (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN       (device not open)
        # CCRTAICC_LIB_INVALID_ARG    (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.47 ccrtAICC_Clock_Get_Generator_N_Divider()

This call returns the N-Divider numerator, denominator and value for the selected divider.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Get_Generator_N_Divider (void          *Handle,
                                         _ccrtaicc_clock_generator_divider_t WhichDivider,
                                         __u64        *Numerator,
                                         __u32        *Denominator,
                                         long double  *Value)

Description: Return Clock Generator N-Divider Numerator and Denominator

Input:  void          *Handle          (Handle pointer)
        _ccrtaicc_clock_generator_divider_t WhichDivider (select divider)
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N0
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N1
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N2
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N3
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N4

Output: __u64        *Numerator        (pointer to Numerator)
        __u32        *Denominator      (pointer to Denominator)
        long double  *Value            (pointer to Value)

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR        (successful)
        # CCRTAICC_LIB_BAD_HANDLE     (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN       (device not open)
        # CCRTAICC_LIB_INVALID_ARG    (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

*****/

2.2.48 ccrtAICC_Clock_Get_Generator_Output_Config()

Return the clock generator output configuration for the selected output.

*****/

```
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Get_Generator_Output_Config (void          *Handle,
                                             _ccrtaicc_clock_generator_output_t WhichOutput,
                                             ccrtaicc_clkgen_output_config_t   *OutCfg)
```

Description: Return Clock Generator Output Configuration

```
Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_output_t WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9

Output: ccrtaicc_clkgen_output_config_t *OutCfg (pointer to output config)
        _ccrtaicc_cg_outcfg_force_rdiv2_t force_rdiv2
        # CCRTAICC_CG_OUTPUT_CONFIG_DONT_FORCE_RDIV2
        # CCRTAICC_CG_OUTPUT_CONFIG_FORCE_RDIV2
        _ccrtaicc_cg_outcfg_enable_t enable
        # CCRTAICC_CG_OUTPUT_CONFIG_DISABLE
        # CCRTAICC_CG_OUTPUT_CONFIG_ENABLE
        _ccrtaicc_cg_outcfg_shutdown_t shutdown
        # CCRTAICC_CG_OUTPUT_CONFIG_POWER_UP
        # CCRTAICC_CG_OUTPUT_CONFIG_SHUTDOWN

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/
```

2.2.49 ccrtAICC_Clock_Get_Generator_Output_Format()

Return the clock generator output format for the selected output.

*****/

```
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Get_Generator_Output_Format (void          *Handle,
                                             _ccrtaicc_clock_generator_output_t WhichOutput,
                                             ccrtaicc_clkgen_output_format_t   *OutFmt)
```

Description: Return Clock Generator Output Format

```
Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_output_t WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
```



```

# CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
# CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
# CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
# CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
# CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
# CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
# CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
# CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
Output: ccrtaiicc_clkgen_output_format_t *OutFmt (pointer to output format)
        _ccrtaiicc_cg_outfmt_cmos_drive_t      cmos_drive
        # CCRTAICC_CG_OUTPUT_FORMAT_CMOS_DRIVE_LVDS
        # CCRTAICC_CG_OUTPUT_FORMAT_CMOS_DRIVE_CMOS
        _ccrtaiicc_cg_outfmt_disable_state_t    disable_state
        # CCRTAICC_CG_OUTPUT_FORMAT_DISABLE_LOW
        # CCRTAICC_CG_OUTPUT_FORMAT_DISABLE_HIGH
        _ccrtaiicc_cg_outfmt_sync_t            sync
        # CCRTAICC_CG_OUTPUT_FORMAT_SYNC_DISABLE
        # CCRTAICC_CG_OUTPUT_FORMAT_SYNC_ENABLE
        _ccrtaiicc_cg_outfmt_format_t          format
        # CCRTAICC_CG_OUTPUT_FORMAT_FORMAT_LVDS
        # CCRTAICC_CG_OUTPUT_FORMAT_FORMAT_CMOS
Return:  _ccrtaiicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION         (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE    (Clock is not active)
*****

```

2.2.50 ccrtAICC_Clock_Get_Generator_Output_Mode()

Return the clock generator output mode for the selected output.

```

/*****
_ccrtaiicc_lib_error_number_t
ccrtAICC_Clock_Get_Generator_Output_Mode (void          *Handle,
        _ccrtaiicc_clock_generator_output_t           WhichOutput,
        ccrtaiicc_clkgen_output_mode_t                *OutMode)

```

Description: Return Clock Generator Output Mode

```

Input:  void          *Handle      (Handle pointer)
        _ccrtaiicc_clock_generator_output_t           WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
Output: ccrtaiicc_clkgen_output_mode_t *OutMode (pointer to output
        amplitude/common mode)
        _ccrtaiicc_cg_outmode_amplitude_t            amplitude
        # CCRTAICC_CG_OUTPUT_AMPLITUDE_CMOS
        # CCRTAICC_CG_OUTPUT_AMPLITUDE_LVDS
        _ccrtaiicc_cg_outmode_common_t                common
        # CCRTAICC_CG_OUTPUT_COMMON_CMOS

```

```

        # CCRTAICC_CG_OUTPUT_COMMON_LVDS
        # CCRTAICC_CG_OUTPUT_COMMON_LVPECL
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.51 ccrtaicc_clock_get_generator_output_mux()

Return the clock generator output mux for the selected output.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_clock_get_generator_output_mux (void          *Handle,
                                         _ccrtaicc_clock_generator_output_t WhichOutput,
                                         ccrtaicc_clkgen_output_mux_t      *OutMux)

```

Description: Return Clock Generator Output Mux

```

Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_output_t WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
Output: ccrtaicc_clkgen_output_mux_t      *OutMux (pointer to output
                                                inversion/N-divider mux)
        _ccrtaicc_cg_outmux_inversion_t   inversion
        # CCRTAICC_CG_OUTPUT_MUX_COMPLEMENTARY
        # CCRTAICC_CG_OUTPUT_MUX_IN_PHASE
        # CCRTAICC_CG_OUTPUT_MUX_INVERTED
        # CCRTAICC_CG_OUTPUT_MUX_OUT_OF_PHASE
        _ccrtaicc_cg_outmux_ndiv_select_t ndiv_mux
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_0
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_1
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_2
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_3
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_4
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.52 ccrtaicc_clock_get_generator_p_divider()

Return the clock generator P-Divider.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Clock_Get_Generator_P_Divider (void          *Handle,
                                         _ccrtaicc_clock_generator_divider_t WhichDivider,
                                         __u64          *Divider)

Description: Return Clock Generator P-Divider

Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_divider_t WhichDivider (select divider)
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P0
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P1
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P2
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_PFB
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_PXAXB
Output: __u64          *Divider    (pointer to
                                   Divider)

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
        # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.53 ccrtaICC_Clock_Get_Generator_P_Divider_Enable()

Return the clock generator P-Divider Enable state.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Clock_Get_Generator_P_Divider_Enable (void          *Handle,
                                                _ccrtaicc_clock_generator_divider_t WhichDivider,
                                                _ccrtaicc_cg_pdiv_enable_t   *Pdiv_Enable)

Description: Return Clock Generator P-Divider Enable

Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_divider_t WhichDivider (select divider)
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P0
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P1
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P2
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_PXAXB
Output: _ccrtaicc_cg_pdiv_enable_t   *Pdiv_Enable (pointer to enable
                                                  flag)
        # CCRTAICC_CG_PDIV_DISABLE
        # CCRTAICC_CG_PDIV_ENABLE
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
        # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.54 ccrtaICC_Clock_Get_Generator_R_Divider()

Return the clock generator R-Divider for the selected divider.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_Clock_Get_Generator_R_Divider (void                *Handle,
                                       _ccrtaicc_clock_generator_divider_t WhichDivider,
                                       __u32                    *Divider)

Description: Return Clock Generator R-Divider

Input:  void                *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_divider_t WhichDivider (select divider)
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R0
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R1
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R2
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R3
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R4
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R5
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R6
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R7
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R8
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R9

Output: __u32                *Divider   (pointer to Divider)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.55 ccrtaicc_Clock_Get_Generator_Revision()

Return the clock generator revision information.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_Clock_Get_Generator_Revision (void                *Handle,
                                       ccrtaicc_clock_revision_t *Revision)

Description: Return Clock Generator Revision

Input:  void                *Handle      (Handle pointer)
Output: ccrtaicc_clock_revision_t *Revision (pointer to Divider)
        _ccrtaicc_cg_die_revision_t DieRevision
        # CCRTAICC_CG_SILICON_REVISION_A0
        # CCRTAICC_CG_SILICON_REVISION_A1
        _convert_base_part_number_t BasePartNumber;
        _convert_base_part_number_t
        u_short BPN
        u_char  NChar[2]
        _ccrtaicc_cg_clock_speed_grade_t ClockSpeedGrade;
        # CCRTAICC_CG_CLOCK_SPEED_GRADE_A
        # CCRTAICC_CG_CLOCK_SPEED_GRADE_B
        # CCRTAICC_CG_CLOCK_SPEED_GRADE_C
        # CCRTAICC_CG_CLOCK_SPEED_GRADE_D
        _ccrtaicc_cg_clock_revision_t ClockRevision;
        # CCRTAICC_CG_CLOCK_REVISION_A
        # CCRTAICC_CG_CLOCK_REVISION_B
        # CCRTAICC_CG_CLOCK_REVISION_C
        # CCRTAICC_CG_CLOCK_REVISION_D

Return: _ccrtaicc_lib_error_number_t

```

```

# CCRTAICC_LIB_NO_ERROR          (successful)
# CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN         (device not open)
# CCRTAICC_LIB_INVALID_ARG      (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.56 ccrtAICC_Clock_Get_Generator_Value()

This is a generic call that can return the value of a valid clock generator address.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Get_Generator_Value (void    *Handle,
                                   int      address,
                                   u_char   *value)

```

Description: Return the value of the specified Clock Generator register.

```

Input:  void          *Handle      (Handle pointer)
        int          address      (clock gen address to display)
Output: u_char        *value;      (pointer to value)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (device not open)
        # CCRTAICC_LIB_INVALID_ARG      (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.57 ccrtAICC_Clock_Get_Generator_Voltage_Select()

Return the clock generator Voltage Selection.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Get_Generator_Voltage_Select (void          *Handle,
                                             _ccrtaicc_cg_stat_ctrl_voltsel_t *VoltSel)

```

Description: Return the Clock Generator Voltage Selection

```

Input:  void          *Handle      (Handle pointer)
Output: _ccrtaicc_cg_stat_ctrl_voltsel_t *VoltSel (pointer to voltage select)
        # CCRTAICC_CG_VOLTAGE_SELECT_1_8V
        # CCRTAICC_CG_VOLTAGE_SELECT_3_3V
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (device not open)
        # CCRTAICC_LIB_INVALID_ARG      (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.58 ccrtAICC_Clock_Get_Generator_Zero_Delay()

Return the clock generator Zero Delay status.

```

/*****
_ccrtaicc_lib_error_number_t

```

```
ccrtaICC_Clock_Get_Generator_Zero_Delay (void          *Handle,
                                         _ccrtaicc_cg_zero_delay_t *ZeroDelay)
```

Description: Return the Clock Generator Zero Delay setting.

```
Input:  void          *Handle      (Handle pointer)
Output: _ccrtaicc_cg_zero_delay_t *ZeroDelay (pointer to zero delay)
        # CCRTAICC_CG_ZERO_DELAY_MODE
        # CCRTAICC_CG_NORMAL_MODE
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
        # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/
```

2.2.59 ccrtaICC_Clock_ReturnOutputFrequency()

This call does not return the actual programmed frequency but instead returns the expected output frequency that would be generated if the specified user input parameters are supplied.

```
*****/
long double
ccrtaICC_Clock_ReturnOutputFrequency(double      InputClock,
                                     long double Mdiv_value,
                                     long double Ndiv_value,
                                     double       Pdiv_value,
                                     double       Rdiv_value)
```

Description: Return output frequency

```
Input:  double      InputClock (input clock frequency in Hz)
        long double Mdiv_value (M-Divider value)
        long double Ndiv_value (N-Divider value)
        double       Pdiv_value (P-Divider value)
        double       Rdiv_value (R-Divider value)
Output: none
Return: long double      returned frequency
*****/
```

2.2.60 ccrtaICC_Clock_Set_Generator_CSR()

This call sets the clock generator control and status register.

```
*****/
_ccrtaicc_lib_error_number_t
ccrtaICC_Clock_Set_Generator_CSR (void          *Handle,
                                  ccrtaicc_clkgen_csr_t *CgCsr)
```

Description: Set Clock Generator Control and Status information

```
Input:  void          *Handle      (Handle pointer)
        ccrtaicc_clkgen_csr_t *CgCsr (pointer to clock generator csr)
        _ccrtaicc_clkgen_output_t output
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_DISABLE
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_ENABLE
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_DO_NOT_CHANGE
        _ccrtaicc_clkgen_state_t state
        # CCRTAICC_CLOCK_GENERATOR_ACTIVE
```

```

        # CCRTAICC_CLOCK_GENERATOR_RESET
        # CCRTAICC_CLOCK_GENERATOR_STATE_DO_NOT_CHANGE
Output:  none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
*****

```

2.2.61 ccrtAICC_Clock_Set_Generator_Input_Clock_Enable()

This call sets the input clock status for the input clocks. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtAICC_Clock_Set_Generator_Input_Clock_Enable (void          *Handle,
                                                    ccrtaicc_clkgen_input_clock_enable_t *InputClockEnable)

```

Description: Set Clock Generator Input Clock Enable

```

Input:  void          *Handle          (Handle
                                       pointer)
        ccrtaicc_clkgen_input_clock_enable_t *InputClockEnable (pointer to
                                                                    input clock enable)
        _ccrtaicc_cg_input_clock_enable_t   input_0_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
        _ccrtaicc_cg_input_clock_enable_t   input_1_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
        _ccrtaicc_cg_input_clock_enable_t   input_2_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
        _ccrtaicc_cg_input_clock_enable_t   input_fb_clock
        # CCRTAICC_CG_INPUT_CLOCK_DISABLE
        # CCRTAICC_CG_INPUT_CLOCK_ENABLE
Output:  none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****

```

2.2.62 ccrtAICC_Clock_Set_Generator_Input_Clock_Select()

This call sets the input clock selection. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtAICC_Clock_Set_Generator_Input_Clock_Select (void          *Handle,
                                                    ccrtaicc_clkgen_input_clock_select_t *ClkSel)

```

Description: Set Clock Generator Input Clock Selection

```
Input:  void                                *Handle (Handle pointer)
        ccrtaiicc_clkgen_input_clock_select_t *ClkSel (pointer to input
                                                clock select)
        _ccrtaiicc_cg_input_clock_select_control_t control;
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_PIN_CONTROL
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_REG_CONTROL
        _ccrtaiicc_cg_input_clock_select_register_t select;
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN0
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN1
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN2
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_INXAXB

Output: none
Return: _ccrtaiicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION         (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE     (Clock is not active)
*****/
```

2.2.63 ccrtAICC_Clock_Set_Generator_M_Divider()

This call sets the clock generator M-Divider to the user specified Numerator and Denominator. If the Update flag is set, then the change will take place after the divider has been written to. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```
/*
_ccrtaiicc_lib_error_number_t
ccrtAICC_Clock_Set_Generator_M_Divider (void *Handle,
                                         __u64 Numerator,
                                         __u32 Denominator,
                                         int Update)
```

Description: Set Clock Generator M-Divider Numerator and Denominator

```
Input:  void                                *Handle (Handle pointer)
        __u64 Numerator                      (Numerator)
        __u32 Denominator                    (Denominator)
        int Update                           (True=Update)

Output: none
Return: _ccrtaiicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION         (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE     (Clock is not active)
*****/
```

2.2.64 ccrtAICC_Clock_Set_Generator_N_Divider()

This call sets the clock generator selected N-Divider to the user specified Numerator and Denominator. If the Update flag is set, then the change will take place after the divider has been written to. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```
/*
```



```

ccrtaICC_Clock_Set_Generator_N_Divider()
_ccrtaicc_lib_error_number_t
ccrtaICC_Clock_Set_Generator_N_Divider (void          *Handle,
                                         _ccrtaicc_clock_generator_divider_t  WhichDivider,
                                         __u64                                     Numerator,
                                         __u32                                     Denominator,
                                         int                                         Update)

```

Description: Set Clock Generator N-Divider Numerator and Denominator

```

Input:  void          *Handle          (Handle pointer)
        _ccrtaicc_clock_generator_divider_t  WhichDivider  (select divider)
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N0
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N1
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N2
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N3
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_N4
        __u64          Numerator        (Numerator)
        __u32          Denominator      (Denominator)
        int            Update           (True=Update)

Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.65 ccrtaICC_Clock_Set_Generator_Output_Config()

This call sets the clock generator Output Configuration for the selected output. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Clock_Set_Generator_Output_Config (void          *Handle,
                                             _ccrtaicc_clock_generator_output_t  WhichOutput,
                                             ccrtaicc_clkgen_output_config_t  *OutCfg)

```

Description: Set Clock Generator Output Configuration

```

Input:  void          *Handle          (Handle pointer)
        _ccrtaicc_clock_generator_output_t  WhichOutput  (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
        ccrtaicc_clkgen_output_config_t  *OutCfg  (pointer to output config)
        _ccrtaicc_cg_outcfg_force_rdiv2_t  force_rdiv2
        # CCRTAICC_CG_OUTPUT_CONFIG_DONT_FORCE_RDIV2
        # CCRTAICC_CG_OUTPUT_CONFIG_FORCE_RDIV2
        # CCRTAICC_CG_OUTPUT_CONFIG_FORCE_DO_NOT_CHANGE

```

```

        _ccrtaicc_cg_outcfg_enable_t          enable
        # CCRTAICC_CG_OUTPUT_CONFIG_DISABLE
        # CCRTAICC_CG_OUTPUT_CONFIG_ENABLE
        # CCRTAICC_CG_OUTPUT_CONFIG_ENABLE_DO_NOT_CHANGE
    _ccrtaicc_cg_outcfg_shutdown_t          shutdown
        # CCRTAICC_CG_OUTPUT_CONFIG_POWER_UP
        # CCRTAICC_CG_OUTPUT_CONFIG_SHUTDOWN
        # CCRTAICC_CG_OUTPUT_CONFIG_SHUTDOWN_DO_NOT_CHANGE

Output:  none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR              (successful)
        # CCRTAICC_LIB_BAD_HANDLE            (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN              (device not open)
        # CCRTAICC_LIB_INVALID_ARG           (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION       (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE   (Clock is not active)
    *****/

```

2.2.66 ccrtaICC_Clock_Set_Generator_Output_Format()

This call sets the clock generator Output Format for the selected output. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtaICC_Clock_Set_Generator_Output_Format (void          *Handle,
                                                _ccrtaicc_clock_generator_output_t WhichOutput,
                                                ccrtaicc_clkgen_output_format_t *OutFmt)

```

Description: Set Clock Generator Output Format

```

Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_output_t WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
    ccrtaicc_clkgen_output_format_t *OutFmt      (pointer to
                                                output format)

        _ccrtaicc_cg_outfmt_cmos_drive_t      cmos_drive
        # CCRTAICC_CG_OUTPUT_FORMAT_CMOS_DRIVE_LVDS
        # CCRTAICC_CG_OUTPUT_FORMAT_CMOS_DRIVE_CMOS
        # CCRTAICC_CG_OUTPUT_FORMAT_CMOS_DRIVE_DO_NOT_CHANGE
    _ccrtaicc_cg_outfmt_disable_state_t        disable_state
        # CCRTAICC_CG_OUTPUT_FORMAT_DISABLE_LOW
        # CCRTAICC_CG_OUTPUT_FORMAT_DISABLE_HIGH
        # CCRTAICC_CG_OUTPUT_FORMAT_DISABLE_DO_NOT_CHANGE
    _ccrtaicc_cg_outfmt_sync_t                sync
        # CCRTAICC_CG_OUTPUT_FORMAT_SYNC_DISABLE
        # CCRTAICC_CG_OUTPUT_FORMAT_SYNC_ENABLE
        # CCRTAICC_CG_OUTPUT_FORMAT_SYNC_DO_NOT_CHANGE
    _ccrtaicc_cg_outfmt_format_t              format
        # CCRTAICC_CG_OUTPUT_FORMAT_FORMAT_LVDS
        # CCRTAICC_CG_OUTPUT_FORMAT_FORMAT_CMOS

```

```

# CCRTAICC_CG_OUTPUT_FORMAT_FORMAT_DO_NOT_CHANGE
Output: none
Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR           (successful)
         # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN          (device not open)
         # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
         # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
         # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.67 ccrtAICC_Clock_Set_Generator_Output_Mode()

This call sets the clock generator Output Mode for the selected output. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Set_Generator_Output_Mode (void          *Handle,
                                           _ccrtaicc_clock_generator_output_t WhichOutput,
                                           ccrtaicc_clkgen_output_mode_t   *OutMode)

```

Description: Set Clock Generator Output Mode

```

Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_output_t WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
        ccrtaicc_clkgen_output_mode_t   *OutMode      (pointer to
                                                         output mode)
        _ccrtaicc_cg_outmode_amplitude_t amplitude
        # CCRTAICC_CG_OUTPUT_AMPLITUDE_CMOS
        # CCRTAICC_CG_OUTPUT_AMPLITUDE_LVDS
        # CCRTAICC_CG_OUTPUT_AMPLITUDE_DO_NOT_CHANGE
        _ccrtaicc_cg_outmode_common_t   common
        # CCRTAICC_CG_OUTPUT_COMMON_CMOS
        # CCRTAICC_CG_OUTPUT_COMMON_LVDS
        # CCRTAICC_CG_OUTPUT_COMMON_LVPECL
        # CCRTAICC_CG_OUTPUT_COMMON_DO_NOT_CHANGE

Output: none
Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR           (successful)
         # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN          (device not open)
         # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
         # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
         # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.68 ccrtAICC_Clock_Set_Generator_Output_Mux()

This call sets the clock generator Output Mux for the selected output. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Set_Generator_Output_Mux (void          *Handle,
                                         _ccrtaicc_clock_generator_output_t WhichOutput,
                                         ccrtaicc_clkgen_output_mux_t      *OutMux)

Description: Set Clock Generator Output Mux

Input:  void          *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_output_t WhichOutput (select output)
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
        ccrtaicc_clkgen_output_mux_t      *OutMux (pointer to output
                                                inversion/N-divider mux)
        _ccrtaicc_cg_outmux_inversion_t   inversion
        # CCRTAICC_CG_OUTPUT_MUX_COMPLEMENTARY
        # CCRTAICC_CG_OUTPUT_MUX_IN_PHASE
        # CCRTAICC_CG_OUTPUT_MUX_INVERTED
        # CCRTAICC_CG_OUTPUT_MUX_OUT_OF_PHASE
        # CCRTAICC_CG_OUTPUT_MUX_INVERSION_DO_NOT_CHANGE
        _ccrtaicc_cg_outmux_ndiv_select_t ndiv_mux
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_0
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_1
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_2
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_3
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_4
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_DO_NOT_CHANGE

Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/
```

2.2.69 ccrtAICC_Clock_Set_Generator_P_Divider()

This call sets the clock generator selected P-Divider to the user specified value. If the Update flag is set, then the change will take place after the divider has been written to. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Set_Generator_P_Divider (void          *Handle,
```

```

        _ccrtaicc_clock_generator_divider_t    WhichDivider,
        __u64                                  Divider,
        int                                     Update)

```

Description: Set Clock Generator R-Divider

```

Input:  void                                     *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_divider_t WhichDivider (select divider)
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P0
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P1
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P2
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_PFB
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_PXAXB
        __u64                                  Divider      (Divider)
        int                                     Update        (True=Update)

Output: none

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE             (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN              (device not open)
        # CCRTAICC_LIB_INVALID_ARG           (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION       (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE   (Clock is not active)
*****/

```

2.2.70 ccrtaICC_Clock_Set_Generator_P_Divider_Enable()

This call sets the state of the clock generator P-Divider. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtaICC_Clock_Set_Generator_P_Divider_Enable (void          *Handle,
                                                    _ccrtaicc_clock_generator_divider_t WhichDivider,
                                                    _ccrtaicc_cg_pdiv_enable_t      Pdiv_Enable)

```

Description: Set Clock Generator P-Divider Enable

```

Input:  void                                     *Handle      (Handle pointer)
        _ccrtaicc_clock_generator_divider_t WhichDivider (select divider)
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P0
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P1
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_P2
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_PXAXB
        _ccrtaicc_cg_pdiv_enable_t          Pdiv_Enable  (enable flag)
        # CCRTAICC_CG_PDIV_DISABLE
        # CCRTAICC_CG_PDIV_ENABLE

Output: none

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE             (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN              (device not open)
        # CCRTAICC_LIB_INVALID_ARG           (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION       (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE   (Clock is not active)
*****/

```

2.2.71 ccrtAICC_Clock_Set_Generator_R_Divider()

This call sets the clock generator selected R-Divider to the user specified value. If the output clock is running, the new clock frequency will take affect immediately or on the next clock cycle depending on the output configuration. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```
/******  
_ccrtaicc_lib_error_number_t  
ccrtAICC_Clock_Set_Generator_R_Divider (void      *Handle,  
                                         _ccrtaicc_clock_generator_divider_t  WhichDivider,  
                                         __u32                               Divider)
```

Description: Set Clock Generator R-Divider

```
Input:  void      *Handle      (Handle pointer)  
        _ccrtaicc_clock_generator_divider_t  WhichDivider  (select divider)  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R0  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R1  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R2  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R3  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R4  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R5  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R6  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R7  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R8  
        # CCRTAICC_CLOCK_GENERATOR_DIVIDER_R9  
        __u32                               Divider          (Divider)  
Output: none  
Return: _ccrtaicc_lib_error_number_t  
        # CCRTAICC_LIB_NO_ERROR              (successful)  
        # CCRTAICC_LIB_BAD_HANDLE            (no/bad handler supplied)  
        # CCRTAICC_LIB_NOT_OPEN              (device not open)  
        # CCRTAICC_LIB_INVALID_ARG           (invalid argument)  
        # CCRTAICC_LIB_NO_LOCAL_REGION       (local region not present)  
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE   (Clock is not active)  
*****/
```

2.2.72 ccrtAICC_Clock_Set_Generator_Value()

This is a generic call that can program a valid clock generator address to a desired value. User must be intimately familiar with the hardware before programming the values. In-correct programming could result in unpredictable results. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```
/******  
_ccrtaicc_lib_error_number_t  
ccrtAICC_Clock_Set_Generator_Value (void      *Handle,  
                                     int        address,  
                                     u_char    value)
```

Description: Set the value of the specified Clock Generator register.

```
Input:  void      *Handle      (Handle pointer)  
        int        address      (clock gen address to set)  
        u_char    value;        (value to write)  
Output: none  
Return: _ccrtaicc_lib_error_number_t  
        # CCRTAICC_LIB_NO_ERROR              (successful)
```

```

# CCRTAICC_LIB_BAD_HANDLE          (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN            (device not open)
# CCRTAICC_LIB_INVALID_ARG        (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION    (local region not present)
# CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.73 ccrtAICC_Clock_Set_Generator_Voltage_Select()

Program the clock generator voltage selection. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Set_Generator_Voltage_Select (void          *Handle,
                                             _ccrtaicc_cg_stat_ctrl_voltSel_t VoltSel)

Description: Set Clock Generator voltage selection

Input:  void          *Handle (Handle pointer)
        _ccrtaicc_cg_stat_ctrl_voltSel_t VoltSel (voltage selection)
        # CCRTAICC_CG_VOLTAGE_SELECT_1_8V
        # CCRTAICC_CG_VOLTAGE_SELECT_3_3V

Output: none

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)

*****/

```

2.2.74 ccrtAICC_Clock_Set_Generator_Zero_Delay()

Program the clock generator zero delay. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Clock_Set_Generator_Zero_Delay (void          *Handle,
                                          _ccrtaicc_cg_zero_delay_t ZeroDelay)

Description: Set Clock Generator Zero Delay selection

Input:  void          *Handle (Handle pointer)
        _ccrtaicc_cg_zero_delay_t ZeroDelay (zero delay selection)
        # CCRTAICC_CG_ZERO_DELAY_MODE
        # CCRTAICC_CG_NORMAL_MODE

Output: none

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)

*****/

```

2.2.75 ccrtAICC_Close()

This call is used to close an already opened device using the *ccrtAICC_Open()* call.

```
/******  
_ccrtaicc_lib_error_number_t ccrtAICC_Close(void *Handle)  
  
Description: Close a previously opened device.  
  
Input:  void *Handle          (Handle pointer)  
Output: none  
Return: _ccrtaicc_lib_error_number_t  
        # CCRTAICC_LIB_NO_ERROR      (successful)  
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)  
        # CCRTAICC_LIB_NOT_OPEN      (device not open)  
*****/
```

2.2.76 ccrtAICC_Compute_All_Output_Clocks()

This call does not program the clock outputs but instead returns to the user whether the board can be programmed with the user selected output clock frequencies. Additionally, useful information is returned to the user in a structure for each clock that was computed.

```
/******  
  
ccrtaicc_Compute_All_Output_Clocks()  
  
Description: Compute All Output Clocks  
  
Input:  void          *Handle          (Handle pointer)  
        double        InputClockFrequency (Input clock  
                                           frequency)  
        ccrtaicc_compute_all_output_clocks_t *AllClocks (Pointer to all  
                                                         output clocks info)  
        ccrtaicc_compute_single_output_clock_t *Clock  
        long double  DesiredFrequency  
        double       DesiredTolerancePPT  
Output: ccrtaicc_compute_all_output_clocks_t *AllClocks  
        (Pointer to returned output clocks info)  
        __u32      NumberOfNdividers  
        ccrtaicc_compute_single_output_clock_t *Clock  
        _ccrtaicc_clock_generator_output_t OutputClock  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8  
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9  
        double      InputClockFrequency  
        long double FrequencyDeviation  
        int         FrequencyFound  
        long double ActualFrequency  
        double     ActualTolerancePPT  
        __u64      Mdiv_Numerator  
        __u32      Mdiv_Denominator  
        __u64      Ndiv_Numerator  
        __u32      Ndiv_Denominator  
*****/
```



```

        _ccrtaicc_cg_outmux_ndiv_select_t        Ndiv_ToUse
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_0
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_1
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_2
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_3
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_4
        __u32                                     Rdiv_value
        __u32                                     Rdivider
        __u32                                     Pdivider
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                 (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler
                                                supplied)
        # CCRTAICC_LIB_NOT_OPEN                (library not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION         (local region error)
        # CCRTAICC_LIB_IO_ERROR                (device not ready)
        # CCRTAICC_LIB_N_DIVIDERS_EXCEEDED     (number of N-Dividers
                                                exceeded)
        # CCRTAICC_LIB_CANNOT_COMPUTE_OUTPUT_FREQ (cannot compute
                                                output freq)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
*****/

```

2.2.77 ccrtAICC_Convert_Physmem2avmm_Address()

This call is used to supply the user with an Avalon equivalent Address for the supplied Physical DMA memory. This Avalon equivalent address can then be supplied to the DMA engine to perform DMA operations.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Convert_Physmem2avmm_Address(void      *Handle,
                                         uint     *PhysDmaMemPtr,
                                         uint     *AvalonAddress)

```

Description: Get the converted value of Physical DMA memory to Avalon address to be supplied as address for DMA operations.

```

Input:  void      *Handle      (Handle pointer)
        uint     *PhysDmaMemPtr (pointer to physical DMA
                                memory)
Output: uint      *AvalonAddress (pointer to Avalon
                                Address).

```

```

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                 (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (library not open)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
        # CCRTAICC_LIB_AVALON_TRANSLATION_TABLE (avalon translation table
                                                error)
        # CCRTAICC_LIB_ADDRESS_RANGE_ERROR     (address range error)
*****/

```

2.2.78 ccrtAICC_Create_UserProcess()

Typically reads from h/w take a finite time to complete. If the user has a process that is time critical and needs to read the latest data faster, they may use a new approach called Hyper-Drive. In this case, the user defines a thread with this call, which continuously reads the data from the board and holds the latest values. The user process can then access this latest data at substantially faster rates. The two drawbacks to this approach is that the excessive bus access is made and dedicated CPUs are required.

This call is used to create this User Process looping thread which can be controlled by the user via the returned handle. (This is an experimental API for debugging and testing).

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_Create_UserProcess(void                *Handle,
                        _ccrtaicc_UserFunction_t *UFunc,
                        _ccrtaicc_UserFunction_t **UFuncHandle)

Description: Create a User Process for user defined processing

Input:  void                *Handle      (Handle pointer)
        _ccrtaicc_UserFunction_t *UFunc  (pointer to user
        information structure)
Output: _ccrtaicc_UserFunction_t **UFuncHandle (pointer to user function
        struct handle)

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_NO_RESOURCE     (cannot allocate memory)
        # CCRTAICC_LIB_INTERNAL_ERROR  (pthread attr failed)
        # CCRTAICC_LIB_THREAD_CREATE_FAILED (failed to create thread)
*****/

```

```

typedef struct
{
    int Magic;
    void (*UserFunction) (void *hdl);
    pthread_t UserFunction_Thread_id;
    pid_t Pid;
    pthread_mutex_t lock; /* lock this structure */
    pthread_cond_t wait; /* wait for command */
    pthread_mutex_t cmd_lock; /* lock this structure */
    pthread_cond_t cmd_wait; /* wait for command */
    pthread_mutex_t user_lock; /* lock this structure */
    pthread_cond_t user_wait; /* wait for command */
    pthread_mutex_t user_mem_lock; /* lock this structure */
    pthread_cond_t user_mem_wait; /* wait for command */
    volatile int cpuAffinity; /* CPU on which Thread
                                will run */
    volatile int cpuCount; /* no. of cpus to run on
                                starting at base */

    volatile void *Handle;
    volatile void **Args;
    volatile int SchedulePolicy;
    volatile int SchedulePriority;
    volatile int ScheduleSelf; /* 1=(Use
                                SchedulePriority-
                                1),0=no change */

    volatile ccrtaicc_uf_action_t Action;
    volatile ccrtaicc_uf_state_t State;
    volatile int CommandPending;
    volatile void *Next_UserFunction;
    volatile unsigned int long long RunCount;
    volatile int Pause;
} _ccrtaicc_UserFunction_t;

```

2.2.79 ccrtAICC_DataToVolts()

This routine takes a raw analog input data value and converts it to a floating point voltage based on the supplied format. Format can be *CCRTAICC_TWOS_COMPLEMENT* or *CCRTAICC_OFFSET_BINARY*. The data supplied in *us_data* must not be greater than the hardware resolution bits *CCRTAICC_ADC_RESOLUTION_BITS* supported by the board. Data greater than this will be masked out.

```

/*****
  double ccrtAICC_DataToVolts(int us_data, ccrtAICC_volt_convert_t *conv)

  Description: Convert Data to volts

  Input:  int          us_data          (data to convert)
         ccrtAICC_volt_convert_t      *conv      (pointer to
                                                conversion struct)
         double        VoltageRange     (maximum voltage
                                                range)
         _ccrtAICC_csr_dataformat_t    Format     (format)
           # CCRTAICC_OFFSET_BINARY
           # CCRTAICC_TWOS_COMPLEMENT
         ccrtAICC_bool BiPolar         (bi-polar)
           # CCRTAICC_TRUE
           # CCRTAICC_FALSE
         int           ResolutionBits   (Number of
                                                resolution bits)

  Output: none
  Return: double      volts            (returned volts)
*****/
```

2.2.80 ccrtAICC_Destroy_AllUserProcess()

The purpose of this call is to destroy all User Processes that have been previously created by the *ccrtAICC_Create_UserProcess()* command. *(This is an experimental API for debugging and testing).*

```

/*****
  _ccrtAICC_lib_error_number_t ccrtAICC_Destroy_AllUserProcess(void *Handle)

  Description: Destroy all created user processes

  Input:  void          *Handle        (Handle pointer)
  Output: none
  Return: _ccrtAICC_lib_error_number_t
           # CCRTAICC_LIB_NO_ERROR      (successful)
           # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
*****/
```

2.2.81 ccrtAICC_Destroy_UserProcess()

The purpose of this call is to destroy the User Process that have been previously created by the *ccrtAICC_Create_UserProcess()* call. *(This is an experimental API for debugging and testing).*

```

/*****
  _ccrtAICC_lib_error_number_t ccrtAICC_Destroy_UserProcess(void *Handle,
                                                           _ccrtAICC_UserFunction_t **UFuncHandle)

  Description: Destroy an already created user process

  Input:  void          *Handle        (Handle pointer)
         _ccrtAICC_UserFunction_t    **UFuncHandle (pointer to user handle)
  Output: none
  Return: _ccrtAICC_lib_error_number_t
```

```

# CCRTAICC_LIB_NO_ERROR (successful)
# CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
*****/

```

2.2.82 ccrtAICC_Disable_Pci_Interrupts()

The purpose of this call is to disable PCI interrupts. This call shouldn't be used during normal reads as calls could time out. The driver handles enabling and disabling interrupts during its normal course of operation.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Disable_Pci_Interrupts (void *Handle,
                                _ccrtaicc_all_interrupts_mask interrupt_mask)

```

Description: Disable interrupts being generated by the board.

```

Input: void *Handle (Handle pointer)
       _ccrtaicc_all_interrupts_mask interrupt_mask (interrupt mask)
       # CCRTAICC_DMA0_INTMASK
       # CCRTAICC_DMA1_INTMASK
       # CCRTAICC_MSGDMA_INTMASK
       # CCRTAICC_ADC_FIFO_INTMASK
       # CCRTAICC_ALL_DMA_INTMASK
       # CCRTAICC_ALL_ANALOG_INTMASK
       # CCRTAICC_DMA_ANALOG_INTMASK
       # CCRTAICC_ALL_INTMASK
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
*****/

```

2.2.83 ccrtAICC_DMA_Configure()

The purpose of this call is configure a DMA engine to be ready for commencing DMA.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_DMA_Configure(void *Handle,
                        ccrtaicc_dma_engine_t DMAEngineNo,
                        uint AvMM_FromAddr,
                        uint AvMM_ToAddr,
                        uint DMASize)

```

Description: Configure DMA Engine

```

Input: void *Handle (Handle pointer)
       ccrtaicc_dma_engine_t DMAEngineNo (select DMA engine)
       # CCRTAICC_DMA0
       # CCRTAICC_DMA1
       uint AvMM_FromAddr (Avalon Memory Converted Source Address)
       uint AvMM_ToAddr (Avalon Memory Converted Destination Address)
       uint DMASize (DMA transfer size in bytes)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)

```

```

# CCRTAICC_LIB_BAD_HANDLE      (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN       (library not open)
# CCRTAICC_LIB_INVALID_ARG    (invalid argument)
# CCRTAICC_LIB_DMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_ADDRESS
                              (DMA access not allowed for
                              selected address)

```

*****/

2.2.84 ccrtAICC_DMA_Fire()

The purpose of this call is to initiate an already configured DMA engine.

/*****

```

_ccrtaicc_lib_error_number_t
ccrtAICC_DMA_Fire(void          *Handle,
                    ccrtaicc_dma_engine_t DMAEngineNo,
                    ccrtaicc_bool UseInterrupts,
                    ccrtaicc_bool WaitForCompletion,
                    int           DmaControl)

```

Description: Start DMA Engine

```

Input:  void          *Handle          (Handle pointer)
        ccrtaicc_dma_engine_t DMAEngineNo (select DMA engine)
        # CCRTAICC_DMA0
        # CCRTAICC_DMA1
        ccrtaicc_bool UseInterrupts    (Enable Interrupt flag)
        # CCRTAICC_TRUE
        # CCRTAICC_FALSE
        ccrtaicc_bool WaitForCompletion (Wait for Completion Flag)
        # CCRTAICC_TRUE
        # CCRTAICC_FALSE
        int           DmaControl        (DMA control flags)
        # CCRTAICC_DMA_CONTROL_RCON    (read constant)
        # CCRTAICC_DMA_CONTROL_WCON    (write constant)
        # CCRTAICC_DMA_CONTROL_INCREMENT (increment)

Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR        (no error)
        # CCRTAICC_LIB_BAD_HANDLE      (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN       (library not open)
        # CCRTAICC_LIB_INVALID_ARG    (invalid argument)
        # CCRTAICC_LIB_IOCTL_FAILED   (ioctl failed)
        # CCRTAICC_LIB_DMA_FAILED     (DMA failed)

```

*****/

2.2.85 ccrtAICC_Enable_Pci_Interrupts()

The purpose of this call is to enable PCI interrupts. This call shouldn't be used during normal reads as calls could time out. The driver handles enabling and disabling interrupts during its normal course of operation.

/*****

```

_ccrtaicc_lib_error_number_t
ccrtAICC_Enable_Pci_Interrupts (void          *Handle,
                                _ccrtaicc_all_interrupts_mask interrupt_mask)

```

Description: Enable interrupts being generated by the board.

```

Input:  void          *Handle          (Handle pointer)
        _ccrtaicc_all_interrupts_mask interrupt_mask (interrupt mask)
        # CCRTAICC_DMA0_INTMASK

```

```

# CCRTAICC_DMA1_INTMASK
# CCRTAICC_MSGDMA_INTMASK
# CCRTAICC_ADC_FIFO_INTMASK
# CCRTAICC_ALL_DMA_INTMASK
# CCRTAICC_ALL_ANALOG_INTMASK
# CCRTAICC_DMA_ANALOG_INTMASK
# CCRTAICC_ALL_INTMASK
Output: none
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED  (driver ioctl call failed)
*****

```

2.2.86 ccrtaICC_Fast_Memcpy()

The purpose of this call is to provide a fast mechanism to copy between hardware and memory using programmed I/O. The library performs appropriate locking while the copying is taking place. If the board provides support for double word transfers, this call will utilize it.

```

/*****
ccrtaICC_Fast_Memcpy(void      *Handle,
                    volatile void *Destination,
                    volatile void *Source,
                    int          SizeInBytes)

Description: Perform fast copy to/from buffer using Programmed I/O
            (WITH LOCKING)

Input:   void      *Handle      (Handle pointer)
         volatile void *Source    (pointer to source buffer)
         int        SizeInBytes  (transfer size in bytes)
Output:  volatile void *Destination (pointer to destination buffer)
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
*****

```

2.2.87 ccrtaICC_Fast_Memcpy_Unlocked()

The purpose of this call is to provide a fast mechanism to copy between hardware and memory using programmed I/O. The library does not perform any locking. User needs to provide external locking instead. If the board provides support for double word transfers, this call will utilize it. The *double_word_support* field in the driver information structure *ccrtaicc_driver_info_t* indicates whether the double word support is available in the hardware.

```

/*****
void
ccrtaICC_Fast_Memcpy_Unlocked(volatile void *Destination,
                             volatile void *Source,
                             int          SizeInBytes,
                             int          DoubleWordSupport)

Description: Perform fast copy to/from buffer using Programmed I/O
            (WITHOUT LOCKING)

Input:   volatile void *Source    (pointer to source buffer)
         int          SizeInBytes  (transfer size in bytes)
         int          DoubleWordSupport (double word support flag)

```

```

        # CCRTAICC_FALSE                (h/w double word transfers not
                                         supported)
        # CCRTAICC_TRUE                 (h/w double word transfers
                                         supported)
    Output: volatile void *Destination   (pointer to destination buffer)
    Return: none
    *****/

```

2.2.88 ccrtAICC_Fast_Memcpy_Unlocked_FIFO()

The purpose of this call is to provide a simple mechanism to copy between hardware FIFO and memory using programmed I/O. The library does not perform any locking. User needs to provide external locking instead. If the board provides support for double word transfers, this call will utilize it. The *double_word_support* field in the driver information structure *ccrtaiicc_driver_info_t* indicates whether the double word support is available in the hardware.

```

/*****
void
ccrtAICC_Fast_Memcpy_Unlocked_FIFO(volatile void *Destination,
                                   volatile void *Source,
                                   int             SizeInWords,
                                   int             PioControl,
                                   int             DoubleWordSupport)

Description: Perform fast copy to/from FIFO buffer using Programmed I/O
            (WITHOUT LOCKING)

Input:     volatile void *Source        (pointer to source buffer)
           int             SizeInWords  (transfer size in words)
           int             PioControl   (PIO Control)
           # CCRTAICC_PIO_CONTROL_RCON (read constant)
           # CCRTAICC_PIO_CONTROL_WCON (write constant)
           # CCRTAICC_PIO_CONTROL_INCREMENT (read/write increment)
           int             DoubleWordSupport (double word support flag)
           # CCRTAICC_FALSE           (h/w double word transfers not
                                       supported)
           # CCRTAICC_TRUE            (h/w double word transfers
                                       supported)

    Output: volatile void *Destination   (pointer to destination buffer)
    Return: none
    *****/

```

2.2.89 ccrtAICC_Fraction_To_Hex()

This converts a fractional decimal to a hexadecimal value.

```

/*****
int
ccrtAICC_Fraction_To_Hex (double Fraction,
                          uint *value)

Description: Convert Fractional Decimal to Hexadecimal

Input:     double  Fraction    (fraction to convert)
Output:    uint    *value;     (converted hexadecimal value)
Return:    1        (call failed)
           0        (good return)
    *****/

```

2.2.90 ccrtAICC_Get_All_Boards_Driver_Info()

This call returns driver information for all the *ccrtaicc* cards that have been found in the system.

```
/******  
ccrtAICC_Get_All_Boards_Driver_Info()  
_ccrtaicc_lib_error_number_t ccrtAICC_Get_All_Boards_Driver_Info(  
    void *Handle,  
    ccrtaicc_all_boards_driver_info *all_boards_info)
```

Description: Get device information from driver for all boards.

```
Input:  void *Handle (Handle pointer)  
Output: ccrtaicc_driver_info_t *all_boards_info (info struct pointer)  
char    version[12]  
char    built[32]  
char    module_name[16]  
int     board_index  
int     table_index  
char    board_desc[32]  
int     bus  
int     slot  
int     func  
int     vendor_id  
int     sub_vendor_id  
int     sub_device_id  
union {  
    u_int BoardInfo  
    ccrtaicc_boardinfo_t BInfo  
    u_char Function  
    u_char Type  
    u_short Id  
}  
union {  
    u_int FirmwareDate  
    ccrtaicc_firmware_date_t FmDate  
    u_short Year  
    u_char Day  
    u_char Month  
}  
union {  
    u_int FirmwareRevision  
    ccrtaicc_firmware_revision_t FmRev  
    u_short Minor  
    u_short Major  
}  
int     msi_support  
int     irqlevel  
double  calibration_10v_reference_voltage  
double  calibration_5v_reference_voltage  
int     driver_dma_size  
  
// DMA  
ccrtaicc_driver_dma_info_t dma_info  
short   num_trans_tbl_entries  
int     avalon_page_bits  
int     avalon_page_size  
int     tx_interface_base  
int     dma_max_engines  
int     dma_max_burst_size  
int     dma_max_transactions  
int     dma_max_size[CCRTAICC_DMA_MAX_ENGINES]
```

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```

int    dma_width_in_bytes[CCRTAICC_DMA_MAX_ENGINES]
int    dma_fire_command[CCRTAICC_DMA_MAX_ENGINES]

// Interrupt
ccrtaicc_driver_int_t          interrupt
uint   InterruptsOccurredMask
uint   WakeupInterruptMask
int    timeout_seconds
int    DmaControl

long long unsigned   count
long long unsigned   dma_count[CCRTAICC_DMA_MAX_ENGINES]
long long unsigned   MsgDma_count;           // Modular Scatter-Gather DMA

int                                     Ccrtaicc_Max_Region

// Memory Region
ccrtaicc_dev_region_t          mem_region[CCRTAICC_MAX_REGION]
uint   physical_address
uint   size
uint   flags
uint   *virtual_address

// ADC
ccrtaicc_driver_adc_info_t     adc_info
double adc_max_voltage_range
int    number_of_adcs
int    number_of_adc_channels
int    number_of_adc_resolutionbits
_ccrtaicc_adc_channel_mask_t
      all_adc_channels_mask
int    max_adc_fifo_threshold
int    max_adc_high_speed_frequency
int    max_adc_normal_speed_frequency

// SDRAM
ccrtaicc_driver_sdram_info_t    sdram_info
int                               sdram_max_size_in_words
_ccrtaicc_clock_generator_output_t sdram_output_clock
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
- CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
double                               sdram_output_clock_frequency

// CLOCK
ccrtaicc_driver_clock_info_t     clock_info
_ccrtaicc_cg_input_clock_select_register_t default_input_clock
- CCRTAICC_CG_INPUT_CLOCK_SELECT_IN0
- CCRTAICC_CG_INPUT_CLOCK_SELECT_IN1
- CCRTAICC_CG_INPUT_CLOCK_SELECT_IN2
- CCRTAICC_CG_INPUT_CLOCK_SELECT_INXAXB
double                               default_input_clock_frequency
double                               default_clock_tolerance_ppt

// SPROM

```

```

ccrtaicc_sprom_header_t      sprom_header
    u_int32_t    board_serial_number
    u_short     sprom_revision

// Chip Temperature (this board does NOT return a chip temperature)
char                fpga_chip_temperature

char                double_word_support

union {
    u_int          FirmwareTime
    ccrtaicc_firmware_time_t  FmTime
        u_char    Second
        u_char    Minute
        u_char    Hour
        u_char    unused
}
union {
    u_int          FirmwareFlavorCode
    ccrtaicc_firmware_option_code_t  FmOptionCode
        u_char    C0
        u_char    C1
        u_char    C2
        u_char    C3
}

u_short            RunLevelSectorNumber
char               FirmwareReloadFailed
char               MultiFirmwareSupport

union {
    u_int          Dummy_time_t[2]
    time_t        DriverLoadCurrentTime
}

u_int32_t          FirmwareBoardSerialNumber
u_int32_t          MaxMsgDmaDescriptors
u_int32_t          MaxMsgDmaSize
u_int32_t          MsgDmaWidthInBytes
u_int32_t          MaxMsgDmaFifoSize
u_int32_t          FpgawbRevision
int               CloningSupport
u_short           MaximumLinkWidth
u_short           NegotiatedLinkWidth

Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN     (device not open)
        # CCRTAICC_LIB_INVALID_ARG  (invalid argument)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
*****/

```

2.2.91 ccrtAICC_Get_Board_CSR()

This call returns information from the board status register.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Get_Board_CSR (void          *Handle,
                       ccrtaicc_board_csr_t  *bcsr)

```

Description: Get Board Control and Status information

```
Input:  void                                *Handle    (Handle pointer)
Output: ccrtaiicc_board_csr_t              *bcsr      (pointer to board csr)
        _ccrtaiicc_bcsr_identify_board_t  identify_board
        # CCRTAICC_BCSR_IDENTIFY_BOARD_DISABLE
        # CCRTAICC_BCSR_IDENTIFY_BOARD_ENABLE

Return: _ccrtaiicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR            (successful)
        # CCRTAICC_LIB_BAD_HANDLE          (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN            (device not open)
        # CCRTAICC_LIB_INVALID_ARG        (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION     (local region not present)
*****/
```

2.2.92 ccrtAICC_Get_Board_Info()

This call returns the board id, the board type and the firmware revision level for the selected board. This board id is 0x9277 and board type is 0x1 or 0x9278 with a board type of 0x2.

```
/******
_ccrtaiicc_lib_error_number_t
ccrtAICC_Get_Board_Info (void                *Handle,
                        ccrtaiicc_board_info_t *binfo)

Description: Get Board Information

Input:  void                *Handle    (Handle pointer)
Output: ccrtaiicc_board_info_t *binfo (pointer to board info)
        int                vendor_id
        int                sub_vendor_id
        int                sub_device_id
        ccrtaiicc_boardinfo_t BInfo
        u_char Function
        u_char Type
        u_short Id
        ccrtaiicc_firmware_date_t FmDate
        u_short Year
        u_char Day
        u_char Month
        ccrtaiicc_firmware_revision_t FmRev
        u_short Minor
        u_short Major
        ccrtaiicc_sprom_header_t sprom_header
        u_int32_t board_serial_number
        u_short sprom_revision

Return: _ccrtaiicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR            (successful)
        # CCRTAICC_LIB_BAD_HANDLE          (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN            (device not open)
        # CCRTAICC_LIB_INVALID_ARG        (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION     (local region not present)
*****/
```

2.2.93 ccrtAICC_Get_Cable_Fault_CSR()

This call returns the cable fault and the latched cable fault status.

```
/******
_ccrtaiicc_lib_error_number_t
ccrtAICC_Get_Cable_Fault_CSR (void                *Handle,
                              ccrtaiicc_cable_fault_csr_t *CableFaultCSR)
```

Description: Get Cable Fault Control & Status information

Input: void *Handle (handle pointer)
Output: ccrtaiicc_cable_fault_csr_t *CableFaultCSR (pointer to cable fault CSR)

```
_ccrtaiicc_cable_fault_group_mask_t LatchedFaultStatus  
# CCRTAICC_CABLE_FAULT_GROUP_00_03_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_04_07_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_08_11_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_12_15_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_16_19_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_20_23_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_24_27_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_28_31_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_32_35_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_36_39_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_40_43_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_44_47_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_48_51_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_52_55_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_56_59_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_60_63_MASK  
# CCRTAICC_ALL_CABLE_FAULT_GROUPS_MASK
```

```
_ccrtaiicc_cable_fault_group_mask_t FaultStatus  
# CCRTAICC_CABLE_FAULT_GROUP_00_03_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_04_07_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_08_11_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_12_15_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_16_19_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_20_23_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_24_27_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_28_31_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_32_35_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_36_39_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_40_43_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_44_47_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_48_51_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_52_55_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_56_59_MASK  
# CCRTAICC_CABLE_FAULT_GROUP_60_63_MASK  
# CCRTAICC_ALL_CABLE_FAULT_GROUPS_MASK
```

Return: _ccrtaiicc_lib_error_number_t
CCRTAICC_LIB_NO_ERROR (successful)
CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
CCRTAICC_LIB_NOT_OPEN (device not open)
CCRTAICC_LIB_NO_LOCAL_REGION (local region error)
CCRTAICC_LIB_INVALID_ARG (invalid argument)

*****/

2.2.94 ccrtAICC_Get_Calibration_CSR()

This call returns the current calibration control and status register.

```
/*****  
ccrtAICC_Get_Calibration_CSR()
```

Description: Get Calibration Control and Status Register

Input: void *Handle (Handle pointer)
Output: ccrtaiicc_calibration_csr_t *CalCSR (pointer to calibration CSR)

```

        _ccrtaicc_calbus_control_t BusControl (bus control)
        # CCRTAICC_CB_GROUND
        # CCRTAICC_CB_POSITIVE_10V_REFERENCE
        # CCRTAICC_CB_NEGATIVE_10V_REFERENCE
        # CCRTAICC_CB_POSITIVE_5V_REFERENCE
        # CCRTAICC_CB_NEGATIVE_5V_REFERENCE
        # CCRTAICC_CB_POSITIVE_2V_REFERENCE
        # CCRTAICC_CB_BUS_OPEN
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
*****/

```

2.2.95 ccrtaICC_Get_Driver_Error()

This call returns the last error generated by the driver.

```

/*****
    _ccrtaicc_lib_error_number_t
    ccrtaICC_Get_Driver_Error (void          *Handle,
                               ccrtaicc_user_error_t *ret_err)

Description: Get the last error generated by the driver.

Input:  void          *Handle          (Handle pointer)
Output: ccrtaicc_user_error_t *ret_err (error struct pointer)
        uint error;                    (error number)
        char name[CCRTAICC_ERROR_NAME_SIZE] (error name used in driver)
        char desc[CCRTAICC_ERROR_DESC_SIZE] (error description)

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_IOCTL_FAILED      (driver ioctl call failed)
*****/

```

```

#define CCRTAICC_ERROR_NAME_SIZE    64
#define CCRTAICC_ERROR_DESC_SIZE    128

```

```

typedef struct _ccrtaicc_user_error_t
{
    uint error;                    /* error number */
    char name[CCRTAICC_ERROR_NAME_SIZE]; /* error name used in driver */
    char desc[CCRTAICC_ERROR_DESC_SIZE]; /* error description */
} ccrtaicc_user_error_t;

```

```

enum
{
    CCRTAICC_SUCCESS = 0,
    CCRTAICC_INVALID_PARAMETER,
    CCRTAICC_DMA_TIMEOUT,
    CCRTAICC_OPERATION_CANCELLED,
    CCRTAICC_RESOURCE_ALLOCATION_ERROR,
    CCRTAICC_INVALID_REQUEST,
    CCRTAICC_FAULT_ERROR,
    CCRTAICC_BUSY,
    CCRTAICC_ADDRESS_IN_USE,

```

```

    CCRTAICC_USER_INTERRUPT_TIMEOUT,
    CCRTAICC_DMA_INCOMPLETE,
    CCRTAICC_DATA_UNDERFLOW,
    CCRTAICC_DATA_OVERFLOW,
    CCRTAICC_IO_FAILURE,
    CCRTAICC_OPERATION_NOT_SUPPORTED,
    CCRTAICC_ADC_FIFO_THRESHOLD_TIMEOUT,
    CCRTAICC_INTERRUPT_HANDLER_NOT_ENABLED,
    CCRTAICC_FIRMWARE_RELOAD_FAILED,
    CCRTAICC_DEVICE_AUTHORIZATION_FAILED,
};

```

2.2.96 ccrtAICC_Get_Driver_Info()

This call returns internal information that is maintained by the driver.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Get_Driver_Info (void          *Handle,
                          ccrtaicc_driver_info_t *info)

```

Description: Get device information from driver.

Input:	void	*Handle	(Handle pointer)
Output:	ccrtaicc_driver_info_t	*info	(info struct pointer)
	char	version[12]	
	char	built[32]	
	char	module_name[16]	
	int	board_index	
	int	table_index	
	char	board_desc[32]	
	int	bus	
	int	slot	
	int	func	
	int	vendor_id	
	int	sub_vendor_id	
	int	sub_device_id	
	union {		
	u_int BoardInfo		
	ccrtaicc_boardinfo_t	BInfo	
	u_char Function		
	u_char Type		
	u_short Id		
	}		
	union {		
	u_int FirmwareDate		
	ccrtaicc_firmware_date_t	FmDate	
	u_short Year		
	u_char Day		
	u_char Month		
	}		
	union {		
	u_int FirmwareRevision		
	ccrtaicc_firmware_revision_t	FmRev	
	u_short Minor		
	u_short Major		
	}		
	int	msi_support	
	int	irqlevel	
	double	calibration_10v_reference_voltage	
	double	calibration_5v_reference_voltage	

```

int driver_dma_size

// DMA
ccrtaicc_driver_dma_info_t dma_info
short num_trans_tbl_entries
int avalon_page_bits
int avalon_page_size
int tx_interface_base
int dma_max_engines
int dma_max_burst_size
int dma_max_transactions
int dma_max_size[CCRТАIСС_DMA_MAX_ENGINES]
int dma_width_in_bytes[CCRТАIСС_DMA_MAX_ENGINES]
int dma_fire_command[CCRТАIСС_DMA_MAX_ENGINES]

// Interrupt
ccrtaicc_driver_int_t interrupt
uint InterruptsOccurredMask
uint WakeupInterruptMask
int timeout_seconds
int DmaControl

long long unsigned count
long long unsigned dma_count[CCRТАIСС_DMA_MAX_ENGINES]
long long unsigned MsgDma_count; // Modular Scatter-Gather DMA

int Ccrtaicc_Max_Region

// Memory Region
ccrtaicc_dev_region_t mem_region[CCRТАIСС_MAX_REGION]
uint physical_address
uint size
uint flags
uint *virtual_address

// ADC
ccrtaicc_driver_adc_info_t adc_info
double adc_max_voltage_range
int number_of_adcs
int number_of_adc_channels
int number_of_adc_resolutionbits
_ccrtaicc_adc_channel_mask_t
all_adc_channels_mask
int max_adc_fifo_threshold
int max_adc_high_speed_frequency
int max_adc_normal_speed_frequency

// SDRAM
ccrtaicc_driver_sdram_info_t sdram_info
int sdram_max_size_in_words
_ccrtaicc_clock_generator_output_t sdram_output_clock
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_0
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_1
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_2
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_3
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_4
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_5
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_6
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_7
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_8
- CCRТАIСС_CLOCK_GENERATOR_OUTPUT_9

```

```

    double                sdram_output_clock_frequency
// CLOCK
ccrtaicc_driver_clock_info_t    clock_info
    _ccrtaicc_cg_input_clock_select_register_t    default_input_clock
        - CCRTAICC_CG_INPUT_CLOCK_SELECT_IN0
        - CCRTAICC_CG_INPUT_CLOCK_SELECT_IN1
        - CCRTAICC_CG_INPUT_CLOCK_SELECT_IN2
        - CCRTAICC_CG_INPUT_CLOCK_SELECT_INXAXB
    double                default_input_clock_frequency
    double                default_clock_tolerance_ppt

// SPROM
ccrtaicc_sprom_header_t        sprom_header
    u_int32_t    board_serial_number
    u_short     sprom_revision

// Chip Temperature (this board does NOT return a chip temperature)
char                fpga_chip_temperature

char                double_word_support

union {
    u_int                FirmwareTime
    ccrtaicc_firmware_time_t    FmTime
        u_char    Second
        u_char    Minute
        u_char    Hour
        u_char    unused
}
union {
    u_int                FirmwareFlavorCode
    ccrtaicc_firmware_option_code_t    FmOptionCode
        u_char    C0
        u_char    C1
        u_char    C2
        u_char    C3
}

u_short                RunLevelSectorNumber
char                FirmwareReloadFailed
char                MultiFirmwareSupport

union {
    u_int                Dummy_time_t[2]
    time_t                DriverLoadCurrentTime
}

u_int32_t                FirmwareBoardSerialNumber
u_int32_t                MaxMsgDmaDescriptors
u_int32_t                MaxMsgDmaSize
u_int32_t                MsgDmaWidthInBytes
u_int32_t                MaxMsgDmaFifoSize
u_int32_t                FpgawbRevision
int                CloningSupport
u_short                MaximumLinkWidth
u_short                NegotiatedLinkWidth
Return: _ccrtaicc_lib_error_number_t
    # CCRTAICC_LIB_NO_ERROR        (successful)
    # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
    # CCRTAICC_LIB_NOT_OPEN    (device not open)
    # CCRTAICC_LIB_INVALID_ARG    (invalid argument)

```



```

# CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
*****/

```

2.2.97 ccrtAICC_Get_External_Clock_CSR()

This call returns the current external clock connections.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Get_External_Clock_CSR (void *Handle,
                                ccrtaicc_external_clock_csr_t *ExtClkCSR)

Description: Get External Clock Control & Status information

Input:  void *Handle (handle pointer)
Output: ccrtaicc_external_clock_csr_t *ExtClkCSR (pointer to external clock
                                                CSR)
        ccrtaicc_bool InputClockPresent
        ccrtaicc_bool OutputClockPresent
        _ccrtaicc_external_clock_output_select_t ClockOutputSelect;
        # CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_EXCLOS_EXTERNAL_CLOCK_INPUT
        # CCRTAICC_EXCLOS_NO_CLOCK
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region error)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
*****/

```

2.2.98 ccrtAICC_Get_Interrupt_Status()

This call returns the current status of the various interrupts.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Get_Interrupt_Status (void *Handle,
                               ccrtaicc_interrupt_t *intr)

Description: Get Interrupt Status information

Input:  void *Handle (handle pointer)
Output: ccrtaicc_interrupt_t *intr (pointer to interrupt status)
        _ccrtaicc_intsta_adc_t
        # CCRTAICC_INT_ADC_FIFO_THRESHOLD_NONE
        # CCRTAICC_INT_ADC_FIFO_THRESHOLD_OCCURRED
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region error)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
*****/

```

2.2.99 ccrtAICC_Get_Interrupt_Timeout_Seconds()

This call returns the read time out maintained by the driver. It is the time that the read call will wait before it times out. The call could time out because a DMA fails to complete. The device should have been opened in the block mode (*O_NONBLOCK* not set) for reads to wait for the operation to complete.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtAICC_Get_Interrupt_Timeout_Seconds (void      *Handle,
                                          int        *int_timeout_secs)

  Description: Get Interrupt Timeout Seconds

  Input:   void      *Handle      (Handle pointer)
  Output:  int        *int_timeout_secs (pointer to int tout secs)
  Return:  _ccrtaicc_lib_error_number_t
          # CCRTAICC_LIB_NO_ERROR      (successful)
          # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
          # CCRTAICC_LIB_NOT_OPEN     (device not open)
          # CCRTAICC_LIB_INVALID_ARG  (invalid argument)
          # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
          # CCRTAICC_LIB_IOCTL_FAILED (ioctl error)
*****/
```

2.2.100 ccrtAICC_Get_Lib_Error_Description()

This call returns the library error name and description for the supplied error number.

```

/*****
  ccrtAICC_Get_Lib_Error_Description()

  Description: Get Error Description of supplied error number.

  Input:  int      ErrorNumber      (Library error number)
  Output: ccrtaicc_lib_error_description_t *lib_error_desc (error description struct pointer)
          -- int found
          -- char name[CCRTAICC_LIB_ERROR_NAME_SIZE] (last library error name)
          -- char desc[CCRTAICC_LIB_ERROR_DESC_SIZE] (last library error description)
  Return: none
*****/
```

2.2.101 ccrtAICC_Get_Lib_Error()

This call provides detailed information about the last library error that was maintained by the API. The call itself can fail with a return code if an invalid handle is provided, the device is not open or device authorization has failed. If the call succeeds *CCRTAICC_LIB_NO_ERROR*, the last library error information is supplied to the user in the *ccrtaicc_lib_error_t* structure.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtAICC_Get_Lib_Error (void      *Handle,
                          ccrtaicc_lib_error_t *lib_error)

  Description: Get last error generated by the library.

  Input:  void      *Handle      (Handle pointer)
  Output: ccrtaicc_lib_error_t *lib_error (error struct pointer)
          -- uint error      (last library error number)
          -- char name[CCRTAICC_LIB_ERROR_NAME_SIZE] (last library error name)
          -- char desc[CCRTAICC_LIB_ERROR_DESC_SIZE] (last library error description)
          -- int line_number (last library error line number in lib)
          -- char function[CCRTAICC_LIB_ERROR_FUNC_SIZE]
*****/
```

```

                                (library function in error)
-- ccrtaiicc_lib_error_backtrace_t BT[CCRTAICC_BACK_TRACE_DEPTH]
                                (backtrace of errors)
-- int line_number                (line number in library)
-- char function[CCRTAICC_LIB_ERROR_FUNC_SIZE]
                                (library function)
Return: _ccrtaiicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR          (successful)
# CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN        (device not open)
# CCRTAICC_LIB_AUTHORIZATION_FAILURE (device authorization failure)
*****

```

```

typedef struct
{
    int line_number;                /* line number in library */
    char function[CCRTAICC_LIB_ERROR_FUNC_SIZE]; /* library function */
} ccrtaiicc_lib_error_backtrace_t;

```

```

typedef struct
{
    uint error;                    /* last library error number */
    char name[CCRTAICC_LIB_ERROR_NAME_SIZE]; /* last library error name */
    char desc[CCRTAICC_LIB_ERROR_DESC_SIZE]; /* last library error description */
    int line_number;              /* last library error line number in lib */

    char function[CCRTAICC_LIB_ERROR_FUNC_SIZE]; /* library function in error */
    ccrtaiicc_lib_error_backtrace_t BT[CCRTAICC_BACK_TRACE_DEPTH];
                                /* backtrace of errors */
} ccrtaiicc_lib_error_t;

```

Possible library errors:

```

CCRTAICC_LIB_NO_ERROR                = 0, /* Successful */
CCRTAICC_LIB_INVALID_ARG            = -1, /* Invalid argument */
CCRTAICC_LIB_ALREADY_OPEN           = -2, /* Already open */
CCRTAICC_LIB_OPEN_FAILED            = -3, /* Open failed */
CCRTAICC_LIB_BAD_HANDLE             = -4, /* Bad handle */
CCRTAICC_LIB_NOT_OPEN               = -5, /* Device not opened */
CCRTAICC_LIB_MMAP_SELECT_FAILED     = -6, /* Mmap selection failed */
CCRTAICC_LIB_MMAP_FAILED            = -7, /* Mmap failed */
CCRTAICC_LIB_MUNMAP_FAILED          = -8, /* Munmap failed */
CCRTAICC_LIB_NOT_MAPPED             = -9, /* Not mapped */
CCRTAICC_LIB_ALREADY_MAPPED         = -10, /* Device already mapped */
CCRTAICC_LIB_IOCTL_FAILED           = -11, /* Device IOCTL failed */
CCRTAICC_LIB_IO_ERROR               = -12, /* I/O error */
CCRTAICC_LIB_INTERNAL_ERROR         = -13, /* Internal library error */
CCRTAICC_LIB_NOT_IMPLEMENTED        = -14, /* Call not implemented */
CCRTAICC_LIB_LOCK_FAILED            = -15, /* Failed to get lib lock */
CCRTAICC_LIB_NO_LOCAL_REGION        = -16, /* Local region not present */
CCRTAICC_LIB_NO_CONFIG_REGION       = -17, /* Config region not present */
CCRTAICC_LIB_NO_SOLUTION_FOUND      = -18, /* No solution found */
CCRTAICC_LIB_NO_RESOURCE            = -19, /* Resource not available */
CCRTAICC_LIB_CANNOT_OPEN_FILE       = -20, /* Cannot open file */
CCRTAICC_LIB_DMA_BUSY               = -21, /* DMA busy */
CCRTAICC_LIB_AVALON_TRANSLATION_TABLE = -22, /* Avalon translation table error */
CCRTAICC_LIB_ADDRESS_RANGE_ERROR    = -23, /* Physical DMA address exceeds memory size */
CCRTAICC_LIB_NO_SPACE_IN_TABLE      = -24, /* No space available to allocate any more physical memory */
CCRTAICC_LIB_CANNOT_ALLOCATE_PHYS_MEM = -25, /* Cannot allocate physical memory */
CCRTAICC_LIB_DMA_FAILED             = -26, /* DMA failed */
CCRTAICC_LIB_THREAD_CREATE_FAILED   = -27, /* Thread Creation failed */
CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE    = -28, /* Clock Generator is not active */
CCRTAICC_LIB_CANNOT_COMPUTE_OUTPUT_FREQ = -29, /* Cannot compute output frequency */
CCRTAICC_LIB_N_DIVIDERS_EXCEEDED    = -30, /* Number of N-Dividers exceeded */
CCRTAICC_LIB_CLOCK_GENERATION_FAILED = -31, /* Clock generation failed */

```

```

CCRTAICC_LIB_CALIBRATION_RANGE_ERROR = -32, /* Calibration voltage out of range */
CCRTAICC_LIB_BAD_DATA_IN_CAL_FILE = -33, /* Bad data in calibration file */
CCRTAICC_LIB_VOLTAGE_NOT_IN_RANGE = -34, /* Voltage not in range */
CCRTAICC_LIB_ADC_IS_NOT_ACTIVE = -35, /* ADC is not active */
CCRTAICC_LIB_SDRAM_IS_NOT_ACTIVE = -36, /* SDRAM is not active */
CCRTAICC_LIB_SDRAM_INITIALIZATION_FAILED = -37, /* SDRAM initialization failed */
CCRTAICC_LIB_SERIAL_PROM_FAILURE = -38, /* Serial PROM failure - malfunction or not
present */
CCRTAICC_LIB_SERIAL_PROM_BUSY = -39, /* Serial PROM busy */
CCRTAICC_LIB_SERIAL_PROM_WRITE_PROTECTED = -40, /* Serial PROM is write protected */
CCRTAICC_LIB_AUTHORIZATION_FAILURE = -41, /* Failure to authorize opening of device */
CCRTAICC_LIB_INTHDLR_CREATE_FAILURE = -42, /* Interrupt handler creation failure */
CCRTAICC_LIB_INTHDLR_ALREADY_RUNNING = -43, /* Interrupt handler already running */
CCRTAICC_LIB_NO_FREE_DESCRIPTOR_AVAILABLE = -44, /* No free descriptors available */
CCRTAICC_LIB_ERROR_IN_DESCRIPTOR_LIST = -45, /* Error in descriptor list */
CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED = -46, /* Modular Scatter-Gather DMA not supported */
CCRTAICC_LIB_MSGDMA_ACCESS_NOT_ALLOWED_FOR_SELECTEDRESS =
= -47, /* MSGDMA access not allowed for selected
address */
CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA = -48, /* Not Owner of Modular Scatter-Gather DMA */
CCRTAICC_LIB_MSGDMA_IN_USE = -49, /* Modular Scatter-Gather DMA In Use */
CCRTAICC_LIB_CLOCK_NOT_ASSIGNED_TO_ADC = -50, /* Clock generator is not assigned to an ADC */
CCRTAICC_LIB_SERIAL_PROM_NOT_PRESENT = -51, /* Serial PROM not present */
CCRTAICC_LIB_DMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_SS =
= -52, /* DMA access not allowed for selected address */
CCRTAICC_LIB_SDRAM_NOT_SUPPORTED = -53, /* SDRAM not supported */
CCRTAICC_LIB_MSGDMA_NOT_SETUP = -54, /* Modular Scatter-Gather DMA not setup */
CCRTAICC_LIB_MSGDMA_FAILED = -55, /* Modular Scatter-Gather DMA failed */
CCRTAICC_LIB_REGION_ADDRESSING_NOT_SUPPORTED =
= -56, /* Region addressing not supported by driver */
CCRTAICC_LIB_CLONING_NOT_SUPPORTED = -57, /* Cloning not supported by the card */

```

2.2.102 ccrtAICC_Get_Library_Info()

This call returns useful library information to the user.

```

/*****

```

```

    _ccrtaicc_lib_error_number_t
    ccrtaicc_Get_Library_Info (void                *Handle,
                              ccrtaicc_library_info_t *info)

```

Description: Get library information

```

Input:  void                *Handle    (Handle pointer)
Output: ccrtaicc_library_info_t      *info    (info struct pointer)
        int                fp;

        ccrtaicc_local_ctrl_data_t    *local_ptr;
        -- structure in ccrtaicc_user.h
        void                *munmap_local_ptr;
        int                local_mmap_size;

        ccrtaicc_config_local_data_t    *config_ptr;
        -- structure in ccrtaicc_user.h
        void                *munmap_config_ptr;
        int                config_mmap_size;

        ccrtaicc_user_phys_mem_t
        PhysMem[CCRTAICC_MAX_AVALON_NUM_TRANS_TBL_ENTRIES];
        -- structure in ccrtaicc_user.h

        ccrtaicc_driver_library_common_t *driver_lib_ptr;
        -- structure in ccrtaicc_user.h
        void                *munmap_driver_lib_ptr;
        int                driver_lib_mmap_size;

```

```

uint                                UserPid;
Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR      (successful)
         # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN      (device not open)
         # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
*****/

```

2.2.103 ccrtaicc_Get_Mapped_Config_Ptr()

If the user wishes to bypass the API and communicate directly with the board configuration registers, then they can use this call to acquire a pointer to these registers. Please note that any type of access (read or write) by bypassing the API could compromise the API and results could be unpredictable. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the hardware programming registers before attempting to access these registers. For information on the registers, refer to the *ccrtaicc_user.h* include file that is supplied with the driver.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_Get_Mapped_Config_Ptr (void          *Handle,
                                ccrtaicc_config_local_data_t  **config_ptr)

Description: Get mapped configuration pointer.

Input:  void          *Handle      (Handle pointer)
Output: ccrtaicc_config_local_data_t  **config_ptr  (config struct ptr)
        -- structure in ccrtaicc_user.h

Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR      (successful)
         # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN      (device not open)
         # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
         # CCRTAICC_LIB_NO_CONFIG_REGION (config region not present)
*****/

```

2.2.104 ccrtaicc_Get_Mapped_Driver_Library_Ptr()

The driver and library share a common structure. This call returns a pointer to the shared driver/library structure.

```

/*****
ccrtaicc_Get_Mapped_Driver_Library_Ptr()
_ccrtaicc_lib_error_number_t
ccrtaicc_Get_Mapped_Driver_Library_Ptr (void          *Handle,
                                         ccrtaicc_driver_library_common_t  **driver_lib_ptr)

Description: Get mapped Driver/Library structure pointer.

Input:  void          *Handle      (Handle pointer)
Output: ccrtaicc_driver_library_common_t  **driver_lib_ptr  (driver_lib
                                                             struct ptr)
        -- structure in ccrtaicc_user.h

Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR      (successful)
         # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN      (device not open)
         # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
         # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)

*****/

```

2.2.105 `ccrtAICC_Get_Mapped_Local_Ptr()`

If the user wishes to bypass the API and communicate directly with the board control and data registers, then they can use this call to acquire a pointer to these registers. Please note that any type of access (read or write) by bypassing the API could compromise the API and results could be unpredictable. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the hardware programming registers before attempting to access these registers. For information on the registers, refer to the `ccrtaicc_user.h` include file that is supplied with the driver.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtaICC_Get_Mapped_Local_Ptr (void          *Handle,
                                ccrtaicc_local_ctrl_data_t **local_ptr)

Description: Get mapped local pointer.

Input:  void          *Handle    (Handle pointer)
Output: ccrtaicc_local_ctrl_data_t **local_ptr (local struct ptr)
        -- structure in ccrtaicc_user.h
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
*****/
```

2.2.106 `ccrtAICC_Get_Open_File_Descriptor()`

When the library `ccrtAICC_Open()` call is successfully invoked, the board is opened using the system call `open(2)`. The file descriptor associated with this board is returned to the user with this call. This call allows advanced users to bypass the library and communicate directly with the driver with calls like `read(2)`, `ioctl(2)`, etc. Normally, this is not recommended as internal checking and locking is bypassed and the library calls can no longer maintain integrity of the functions. This is only provided for advanced users who want more control and are aware of the implications.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtaICC_Get_Open_File_Descriptor (void *Handle,
                                     int *fd)

Description: Get Open File Descriptor

Input:  void          *Handle    (Handle pointer)
Output: int           *fd        (open file descriptor)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
*****/
```

2.2.107 `ccrtAICC_Get_Physical_Memory()`

This call returns to the user the physical memory pointer and size that was previously allocated by the `ccrtAICC_Mmap_Physical_Memory()` call. The physical memory is allocated by the user when they wish to perform their own DMA and bypass the API. If user specified a mmaped user memory pointer, search for it,

otherwise, simply return the contents of the physical memory list specified by a valid entry_num_in_tran_table. Once again, this call is only useful for advanced users.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Get_Physical_Memory (void                *Handle,
                             ccrtaicc_user_phys_mem_t *phys_mem)

Description: Get previously mmaped() physical memory address and size

Input:  void                *Handle                (Handle pointer)
        ccrtaicc_user_phys_mem_t *phys_mem        (mem struct pointer)
        void                *mmaped_user_mem_ptr   (mmaped user virtual
                                                    memory)
        uint                entry_num_in_tran_table
                                                    (entry number in translation table)
Output: ccrtaicc_user_phys_mem_t *phys_mem        (mem struct pointer)
        uint                user_pid
        void                *phys_mem_ptr
        void                *driver_virt_mem_ptr
        void                *mmaped_user_mem_ptr
        uint                phys_mem_size
        uint                phys_mem_size_freed
        uint                entry_num_in_tran_table
        uint                num_of_entries_used

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN                (device not open)
        # CCRTAICC_LIB_INVALID_ARG             (invalid argument)
        # CCRTAICC_LIB_IOCTL_FAILED            (driver ioctl call failed)
*****/

```

2.2.108 ccrtaICC_Get_RunCount_UserProcess()

This call returns to the user a count of the number of times the User Process was entered.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Get_RunCount_UserProcess(void                *UFuncHandle,
                                   unsigned int long long *RunCount)

Description: Get run count in user process

Input:  void                *UFuncHandle (UF Handle pointer)
Output: unsigned int long long *RunCount (pointer to run count)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
*****/

```

2.2.109 ccrtaICC_Get_TestBus_Control()

This call is provided for internal use in testing the hardware.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Get_TestBus_Control (void                *Handle,
                              _ccrtaicc_testbus_control_t *test_control)

```

Description: Return the value of the Test Bus control information

```
Input:  void                *Handle      (handle pointer)
Output: _ccrtaicc_testbus_control_t
        *test_control (pointer to control select)
        # CCRTAICC_TBUS_CONTROL_OPEN
        # CCRTAICC_TBUS_CONTROL_CAL_BUS
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region error)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (device not open)
*****/
```

2.2.110 ccrtaICC_Get_Value()

This call allows the user to read the board registers. The actual data returned will depend on the command register information that is requested. Refer to the hardware manual for more information on what is being returned. Most commands return a pointer to an unsigned integer.

```
/******
_ccrtaicc_lib_error_number_t
ccrtaICC_Get_Value (void                *Handle,
                   CCRTAICC_CONTROL    cmd,
                   void                *value)
```

Description: Return the value of the specified board register.

```
Input:  void                *Handle      (Handle pointer)
        CCRTAICC_CONTROL    cmd         (register definition)
        -- structure in ccrtaicc_lib.h
Output: void                *value;     (pointer to value)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION  (local region not present)
*****/
```

2.2.111 ccrtaICC_Hex_To_Fraction()

This call converts a hexadecimal value to a fractional decimal.

```
/******
double
ccrtaICC_Hex_To_Fraction (uint value)
```

Description: Convert Hexadecimal to Fractional Decimal

```
Input:  uint    value                (hexadecimal to convert)
Output: none
Return: double  Fraction              (converted fractional value)
*****/
```

2.2.112 ccrtaICC_Identify_Board()

This call is useful in identifying a physical board via software control. It causes the front LED to either flash or stay steady. Users can also specify the number of seconds they wish to flash the LED.

```
/******
```



```

_ccrtaicc_lib_error_number_t
ccrtaICC_Identify_Board (void *Handle,
                        _ccrtaicc_identify_t Identify)

```

Description: Identify the board by setting the front LED

```

Input:  void *Handle (Handle pointer)
        _ccrtaicc_identify_t Identify (Identify board settings)
        # CCRTAICC_IDENTIFY_OFF (turn off flashing)
        # CCRTAICC_IDENTIFY_ON (turn on flashing)
        # Number of seconds to flash (flash for number of
                                     seconds)

Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
*****/

```

2.2.113 ccrtaICC_Initialize_Board()

This call initializes the driver structures to a default state and then resets the hardware.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Initialize_Board (void *Handle)

Description: Initialize the board.

Input:  void *Handle (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
*****/

```

2.2.114 ccrtaICC_MMap_Physical_Memory()

This call is provided for advanced users to create a physical memory of specified size that can be used for DMA or MsgDma. The allocated DMA memory is rounded to a page size. If a physical memory is not available, this call will fail, at which point the user will need to issue the *ccrtaICC_Munmap_Physical_Memory()* API call to remove any previously allocated physical memory.

When user wishes to allocate a physical memory, they must make sure that the *phys_mem_ptr* in the *ccrtaicc_user_phys_mem_t* structure is set to 0, otherwise, the call will fail.

Instead of creating a physical memory, this same call can be used to map a user specified region if *region addressing* support is enabled as part of the Cloning feature. In this case, the user will need to supply a valid physical address of a Cloning Region to the *phys_mem_ptr* argument in this call.

Additionally, it is meaningless to perform Cloning on a FIFO region for two reasons. Firstly, each data in a FIFO is synchronous, however, the Cloned region is accessed asynchronously. Secondly, when the FIFO runs empty (*underflow*) or cannot accept more data (*overflow*) the results are unpredictable.



Caution: Since physical addresses are supplied for the *MsgDma* operation, care must be taken to ensure that the supplied addresses are valid and that while DMA is in progress, the memory regions must not be freed or made inactive, otherwise, the results could be unpredictable and could lead to the possible corruption of the system.

If the user supplies a non-zero *phys_mem_ptr* argument, the driver will attempt to request access to the memory region supplied by the user. If access to the region is denied, the call will fail. Reasons for access being denied is because the region has been reserved by some other process and is possibly in use. In this case, if the user still wishes to get access to the region, they can do so *at their own risk* by supplying the *CCRTAICC_DISABLE_REGION_PROTECTION* flag to the *flags* argument. If the call still fails, there is no way for the user to access the memory region as the kernel controls this access. One such reason is that the user is trying to access an invalid region.

Whether a physical memory is acquired by the driver or supplied by the user, the driver by default *caches* the memory region and returns a mapped virtual address to the user. If the user does not wish the region to be *cached*, they can supply the *CCRTAICC_DISABLE_ADDRESS_CACHE* flag to the *flags* argument. This may be useful if the user is running into problems with the region being *cached*, however, a noticeable performance degradation will be observed when accessing the region.

The *CCRTAICC_DEVICE_ADDRESS_ENTRY* is used internally by the driver and is only available as information to the user.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaicc_MMap_Physical_Memory (void          *Handle,
                               int           size,
                               ccrtaicc_user_phys_mem_t *phys_mem)

```

Description: Allocate a physical DMA memory for size bytes.

```

Input:  void          *Handle      (Handle pointer)
        int           size        (size in bytes)
Output: ccrtaicc_user_phys_mem_t *phys_mem (mem struct pointer)
        uint         user_pid
        void         *phys_mem_ptr
        void         *driver_virt_mem_ptr
        void         *mmaped_user_mem_ptr
        uint         phys_mem_size
        uint         phys_mem_size_freed
        uint         entry_num_in_tran_table
        ushort      flags
        # CCRTAICC_DEVICE_ADDRESS_ENTRY
        # CCRTAICC_DISABLE_ADDRESS_CACHE
        # CCRTAICC_DISABLE_REGION_PROTECTION
        ushort      num_of_entries_used
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_MMAP_SELECT_FAILED (mmap selection failed)
        # CCRTAICC_LIB_MMAP_FAILED     (mmap failed)
        # CCRTAICC_LIB_NO_SPACE_IN_TABLE (no space in phys memory table)
        # CCRTAICC_LIB_REGION_ADDRESSING_NOT_SUPPORTED
                                           (region addressing not
                                           supported by the card)
        # CCRTAICC_LIB_MSGDMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_ADDRESS
                                           (access not allowed for

```

selected address)
*****/

2.2.115 ccrtAICC_MsgDma_Clone()

CCRT US Patent US 11.281.584 B1, Inventor Darius Dubash

This call allows the user to Clone a transfer so that the process is continuously performing MsgDma once it has started until the Cloning operation is stopped by the user. This approach is different from standard MsgDma where a user has to re-initiate a MsgDma transfer every time it completes.

The following are the operation modes for this call:

- CCRTAICC_MSGDMA_CLONE_INITIALIZE
- CCRTAICC_MSGDMA_CLONE_ONE_CYCLE_WAIT
- CCRTAICC_MSGDMA_CLONE_START
- CCRTAICC_MSGDMA_CLONE_STOP

In order to perform a Cloning operation, the user first performs the same functions of MsgDma to seize, configure descriptors and MsgDma setup using the *ccrtAICC_MsgDma_Seize()*, *ccrtAICC_MsgDma_Configure_Descriptor()* and *ccrtAICC_MsgDma_Setup()* calls. Once that is done, the user needs to stop any previous MsgDma operation and initialize the cloning operation using (*CCRTAICC_MSGDMA_CLONE_STOP* | *CCRTAICC_MSGDMA_CLONE_INITIALIZE*) modes.

Now, whenever the user is ready, they can commence cloning operation with the *CCRTAICC_MSGDMA_CLONE_START* mode. At this point, MsgDma transfers start occurring continuously at the hardware level. If a chained MsgDma is configured, the entire chain is completed before it is repeated. Once Cloning has commenced, it can be stopped with the help of the *CCRTAICC_MSGDMA_CLONE_STOP* mode.

Once the operation has started with the *CCRTAICC_MSGDMA_CLONE_START* mode, it will run continuously under hardware control until stopped. There is no way to determine precisely how long a single descriptor cycle takes to complete. If the *CCRTAICC_MSGDMA_CLONE_ONE_CYCLE_WAIT* mode is set along with the *CCRTAICC_MSGDMA_CLONE_START* mode, the call will be blocked for the first transfer until the full descriptor cycle has completed. This approximate duration is also saved internally in the driver and is available to the user in the *CloneArgs->MsgDmaExtDesOnlyCycleDelay* argument. Anytime the user wishes to block their application for a duration of approximately one cycle delay, they can invoke this call with the *CCRTAICC_MSGDMA_CLONE_ONE_CYCLE_WAIT* as the only mode. If the user wishes to block more or less than the one cycle delay whenever the call is issued, they can specify the number of additional nano-seconds to block in the *CloneArgs->AdditionalOneCycleDelay*. A negative value will reduce the delay while a positive value will increase it. This call will have no effect on the Cloning operation in progress.

This Cloning feature can prove very helpful to users who don't want to perform single MsgDma calls to transfer a region from a card to a physical memory that is continuously changing. They can basically Clone the two regions and simply read the physical memory while the hardware is continuously updating it with the latest data from the card region at MsgDma rate. There is no CPU overhead during Cloning, however, it will be utilizing the PCI bus during its operation.

Only one Cloning or MsgDma operation can be active at a given time. Additionally, it is meaningless to perform Cloning on a FIFO region for two reasons. Firstly, each data in a FIFO is synchronous, however, the Cloned region is accessed asynchronously. Secondly, when the FIFO runs empty (*underflow*) or cannot accept more data (*overflow*) the results are unpredictable.



Caution: *Since physical addresses are supplied for the MsgDma operation, care must be taken to ensure that the supplied addresses are valid and that while Cloning is in progress, the memory regions must not be freed or made inactive, otherwise, the results could be*

unpredictable and could lead to the possible corruption of the system.

```

/*****
_ccrtaicc_lib_error_number_t
_ccrtAICC_MsgDma_Clone(void                                *Handle,
                        _ccrtaicc_msgdma_clone_mode_mask_t ModeMask)

Description: Clone Modular Scatter-Gather DMA

Input:  void                                *Handle (Handle pointer)
        _ccrtaicc_msgdma_clone_mode_mask_t ModeMask (Mode Mask)
        # CCRTAICC_MSGDMA_CLONE_STOP
        # CCRTAICC_MSGDMA_CLONE_INITIALIZE
        # CCRTAICC_MSGDMA_CLONE_START
        # CCRTAICC_MSGDMA_CLONE_START_BLOCK
        ccrtaicc_msgdma_clone_args_t         *CloneArgs
        - unsigned long long                AdditionalOneCycleDelay
                                           (Additional blocking for
                                           Once Cycle Delay (nanoseconds))

Output: ccrtaicc_msgdma_clone_args_t         *CloneArgs
        - unsigned long long                MsgDmaExtDesOneCycleDelay
                                           (MsgDma Extended Descriptor One
                                           Cycle Delay (nanoseconds))

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR              (successful)
        # CCRTAICC_LIB_INVALID_ARG           (invalid argument)
        # CCRTAICC_LIB_DMA_FAILED            (MsgDma failed)
        # CCRTAICC_LIB_MSGDMA_IN_USE        (MsgDma in use)
        # CCRTAICC_LIB_MSGDMA_NOT_SETUP     (MsgDma not setup)
        # CCRTAICC_LIB_MSGDMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_ADDRESS
                                           (MsgDma not allowed for
                                           selected address)
        # CCRTAICC_LIB_CLONING_NOT_SUPPORTED (Cloning not supported by the
                                           card)
*****/

```

2.2.116 ccrtaAICC_MsgDma_Configure_ADC_Fifo()

This call in conjunction with the *ccrtaicc_MsgDma_Fire_Adc_Fifo()* API provides a fast method to extract samples that are present in the ADC Fifo. Due to the capability of this card to support a large number of channels at a very high rate, it is recommended to use this modular scatter-gather DMA instead of the regular DMA engine to perform the sample extraction. This configuration API need only be called once with a destination address and number of samples to be collected. As long as the configuration has not changed, the user can continuously collect samples from the ADC with help of the *ccrtaicc_MsgDma_Fire_Adc_Fifo()* API at very high transfer rates. If the user wishes to change the number of samples extracted, they will need to reissue this configuration API with the understanding that the overhead to setup the modular scatter-gather DMA engine is significant. Although the ADC Fifo is 128K samples deep, the maximum number of samples *NumberOfSamples* that can be specified in this call is 62K ($2048*31=63,488$). This is because the maximum single MsgDma transfer size is 2048 samples and there are 31 descriptors available in order to perform a single contiguous transfer with the *ccrtaicc_MsgDma_Fire_Adc_Fifo()* API.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaAICC_MsgDma_Configure_ADC_Fifo (void    *Handle,
                                     void    *PciDmaMemory,
                                     uint    NumberOfSamples,
                                     _ccrtaicc_msgdma_descriptors_id_t
                                     *LastDescriptorId)
*****/

```

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Description: Configure Modular Scatter-Gather MSG DMA ADC Fifo descriptor

```
Input:  void          *Handle          (Handle pointer)
        void          *PciDmaMemory   (Virtual PCI DMA Memory pointer)
        uint         NumberOfSamples (number of FIFO samples to read)
Output: _ccrtaicc_msgdma_descriptors_id_t
        *LastDescriptorId (pointer to last descriptor id)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_FREE_DESCRIPTOR_AVAILABLE
                                           (no free descriptors
                                           available)
        # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED
                                           (modular scatter-gather DMA
                                           not supported)
        # CCRTAICC_LIB_DMA_BUSY          (MsgDma Busy, cannot be
                                           reset)
        # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA
                                           (not owner of modular
                                           scatter-gather)
*****/
```

2.2.117 ccrtaicc_MsgDma_Configure_Descriptor()

This call assists the user in setting up modular scatter-gather DMA descriptors. It allows the user to specify a read and write address offset along with length of transfer. Additionally, the call also provides the option to attach to other previously created descriptor blocks for scatter-gather operation. To perform scatter-gather DMA operation, the user creates a chain of descriptors, each having its own read/write/length information along with a start and end of the chain. The DMA operation is started from the first descriptor block in the chain and sequentially processes the descriptor blocks until the last descriptor block in the chain is processed.

To distinguish between descriptors, they are labeled with descriptor ID's. They range from ID 1 to 31. Users can supply a valid specific ID to this call or let the call itself find a free descriptor ID available. It is entirely left up to the user to determine how to manage the various descriptors and their relative linkages.

If the user wishes to have a previously created descriptor to point to a newly created descriptor, they can supply the previously created descriptor ID to the *AttachToDescriptorID* argument in the newly created descriptor. The newly created descriptor will not point to any descriptor and will always be the last descriptor in the chain.

DMA transfers can occur from either of the following:

1. Physical PCIe memory to Physical PCIe memory
2. Physical PCIe memory to Avalon Memory
3. Avalon Memory to Physical PCIe memory
4. Avalon Memory to Avalon Memory

There are certain restrictions and limitations to this scatter-gather operation:

1. Scatter-gather DMA is only supported in certain FPGA cards
2. Reads from Avalon memory below DiagRam location are not allowed for MIOC FPGA cards.
3. Invalid memory address supplied could result in the scatter-gather IP to lock up and the only way to recover will be to reload the driver.
4. Read and write addresses must be at a minimum full-word aligned and for maximum performance, it is recommended to be quad-word aligned.
5. Lengths are in bytes and must be at a minimum a multiple of a full-word and for maximum performance, it is recommended to be quad-word multiple.
6. You cannot cause a chain of descriptors to loop on itself.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_MsgDma_Configure_Descriptor (void          *Handle,
    _ccrtaicc_msgdma_descriptors_id_t *DescriptorID,
    ccrtaicc_msgdma_descriptor_t      *Descriptor,
    _ccrtaicc_msgdma_descriptors_id_t AttachToDescriptorID)

Description: Configure Modular Scatter-Gather DMA descriptor

Input:  void          *Handle (Handle pointer)
        _ccrtaicc_msgdma_descriptors_id_t *DescriptorID
            (Set to NULL or valid ID)
            # 0          (let function find a free ID)
            # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ...
              CCRTAICC_MSGDMA_DESCRIPTOR_ID_31
        ccrtaicc_msgdma_descriptor_t *Descriptor (pointer to descriptor)
            __u64 ReadAddress
            __u64 WriteAddress
            __u32 Length
        _ccrtaicc_msgdma_descriptors_id_t AttachToDescriptorID
            (Attach to descriptor ID)
            # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ...
              CCRTAICC_MSGDMA_DESCRIPTOR_ID_31
Output: _ccrtaicc_msgdma_descriptors_id_t *DescriptorID (returned ID)
        # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ...
          CCRTAICC_MSGDMA_DESCRIPTOR_ID_31
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_NO_FREE_DESCRIPTOR_AVAILABLE
            (no free descriptors available)
        # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED
            (modular scatter-gather
             DMA not supported)
        # CCRTAICC_LIB_MSGDMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_ADDRESS
            (MSG DMA Reads not allowed
             for selected address)
        # CCRTAICC_LIB_DMA_BUSY          (MsgDma Busy, cannot be
            reset)
        # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA
            (not owner of modular
             scatter-gather)
*****/

```

2.2.118 ccrtaICC_MsgDma_Configure_Single()

This call performs a similar function to the *ccrtaICC_MsgDma_Configure()* call with the exception that no DMA chaining is performed and only the single descriptor ID-1 is used to perform the DMA operation. The user has the option to supply a valid descriptor block when using the *ccrtaICC_MsgDma_Configure_Single()* API or a *NULL* pointer to the descriptor as an argument when using the *ccrtaICC_Transfer_Data()* API to perform the transfer.

Normally this call needs to be issued once with a *NULL* pointer for the *Descriptor* (*i.e* during initialization) prior to using the *ccrtaICC_Transfer_Data()* call with the *LibMode* set to *CCRTAICC_LIBRARY_MSGDMA_MOD*. In this way, the descriptor ID-1 will be set up correctly prior to the transfer.

If instead, the user wishes to perform the DMA operation using the *ccrtAICC_MsgDma_Fire_Single()* call, they need to issue the *ccrtAICC_MsgDma_Configure_Single()* call with a valid descriptor block, otherwise, results will be unpredictable.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_MsgDma_Configure_Single (void                *Handle,
                                ccrtaicc_msgdma_descriptor_t *Descriptor)

```

Description: Configure Single Modular Scatter-Gather DMA descriptor

```

Input:  void                *Handle (Handle pointer)
        ccrtaicc_msgdma_descriptor_t *Descriptor (pointer to descriptor)
        __u64  ReadAddress
        __u64  WriteAddress
        __u32  Length
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_DMA_BUSY        (MsgDma Busy, cannot be
                                        reset)
        # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
                                        not supported)
        # CCRTAICC_LIB_MSGDMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_ADDRESS
                                        (MSG DMA access not allowed
                                        for selected address)
        # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA (not owner of modular
                                        scatter-gather)
*****/

```

2.2.119 ccrtAICC_MsgDma_Fire()

This call initiates a scatter-gather DMA operation that has been previously configured and setup by the *ccrtAICC_MsgDma_Configure()* and *ccrtAICC_MsgDma_Setup()* call.

The *StartDescriptorID* can be set to either '0' or a valid Descriptor ID. Normally, the user will set the *StartDescriptorID* in the *ccrtAICC_MsgDma_Setup()* API during initialization and set it to '0' in this *ccrtAICC_MsgDma_Fire()* API. In this way, this call will not suffer the overhead of loading the *StartDescriptorID* in the internal prefetcher register when repeatedly calling the *ccrtAICC_MsgDma_Fire()* API. If the user specifies a valid *StartDescriptorID* that is already setup as a scatter-gather chain using the *ccrtAICC_MsgDma_Configure()* call, then this *ccrtAICC_MsgDma_Fire()* API will initiate the DMA starting with the user supplied start descriptor ID.

The *DescriptorIDMask* is a mask of all the valid descriptor ID's specified in the scatter-gather chain that was created earlier with the *ccrtAICC_MsgDma_Configure()* API. If this is incorrectly specified, the DMA operation will be unpredictable. This *ccrtAICC_MsgDma_Fire()* API call uses this mask to set the *ControlWord* for each of the IDs. Specifying this mask reduces the overhead in the call by not searching the scatter-gather chain to set the individual control words.

ControlWord for each descriptor is set based on the *DescriptorIDMask* mask. Normally, the following two flags are set:

- CCRTAICC_MSGD_DESC_CONTROL_GO
- CCRTAICC_MSGD_DESC_CONTROL_OWNED_BY_HW

LastIdForInterrupts is set to 0 if the DMA operation will use polling instead of using interrupts to detect completion of the operation. If interrupts are to be used, the ID of the last descriptor in the DMA chain is to be specified. This is the ID that will be interrupted when the entire chain is completed. Incorrect ID entered will

result in unpredictable results. Normally, interrupt handling adds additional overhead and reduces performance, however, it reduces the overhead experienced by the CPU and PCIe bus during polling.

Once the scatter-gather DMA operation commences, it performs DMA operations starting with the *StartDescriptorID* and traversing through the chain sequentially until it reaches the last descriptor ID in the chain, at which point the DMA operation concludes.

```

/*****
_ccrtaicc_lib_error_number_t
_ccrtAICC_MsgDma_Fire (void                *Handle,
                    _ccrtaicc_msgdma_descriptors_id_t StartDescriptorID,
                    _ccrtaicc_msgdma_descriptors_id_mask_t DescriptorIDMask,
                    int ControlWord,
                    _ccrtaicc_msgdma_descriptors_id_t LastIdForInterrupts)

```

Description: Fire Modular Scatter-Gather DMA descriptor

```

Input:  void                *Handle (Handle pointer)
        _ccrtaicc_msgdma_descriptors_id_t StartDescriptorID (Set to
        # 0                valid ID)
        # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ... (don't set start descriptor ID
        CCRTAICC_MSGDMA_DESCRIPTOR_ID_31      in prefetcher)
        _ccrtaicc_msgdma_descriptors_id_mask_t DescriptorIDMask
        # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1_MASK ... (descriptor ID mask)
        CCRTAICC_MSGDMA_DESCRIPTOR_ID_31_MASK
        # CCRTAICC_MSGDMA_DESCRIPTOR_ID_ALL_MASK
        int                ControlWord
        # CCRTAICC_MSGD_DESC_CONTROL_GO
        # CCRTAICC_MSGD_DESC_CONTROL_OWNED_BY_HW
        _ccrtaicc_msgdma_descriptors_id_t LastIdForInterrupts (Set 0 or
        # 0                Last ID for interrupts)
        # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ...
        CCRTAICC_MSGDMA_DESCRIPTOR_ID_31

Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR                (successful)
        # CCRTAICC_LIB_INVALID_ARG            (invalid argument)
        # CCRTAICC_LIB_DMA_FAILED            (MsgDma failed)
        # CCRTAICC_LIB_DMA_BUSY              (MsgDma busy)
        # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
        not supported)
        # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA (not owner of modular scatter-
        gather)
*****/

```

2.2.120 *ccrtAICC_MsgDma_Fire_ADC_Fifo()*

Once the user has configured the modular scatter-gather DMA engine for ADC Fifo extraction using the *ccrtAICC_MsgDma_Configure_ADC_Fifo()* API, the user will need to use this *ccrtAICC_MsgDma_Fire_ADC_Fifo()* API to extract the samples that have collected in the ADC. Prior to issuing this call, the user will need to ensure that sufficient samples have been collected in the FIFO, otherwise, the call will return an empty FIFO with *0xBAADBEEF* as its data. Once sufficient samples have collected in the FIFO, the user will need to immediately invoke the *ccrtAICC_MsgDma_Fire_ADC_Fifo()* API, otherwise it is possible that an overflow condition would occur and samples would be lost. At this point, the user will need to reset the FIFO (clear the samples) and resume data collection operation once again.


```

/*****
_ccrtaicc_lib_error_number_t
crtAICC_MsgDma_Fire_ADC_Fifo (void *Handle,
                             _ccrtaicc_msgdma_descriptors_id_t
                             LastDescriptorId,
                             int UseInterrupts)

Description: Fire ADC Fifo Modular Scatter-Gather DMA descriptor

Input: void *Handle (Handle pointer)
       _ccrtaicc_msgdma_descriptors_id_t LastDescriptorId (Last Descriptor
       int UseInterrupts (Use interrupts ID
                                flag)

       # CCRTAICC_TRUE
       # CCRTAICC_FALSE

Output: none
Return: _ccrtaicc_lib_error_number_t
       # CCRTAICC_LIB_NO_ERROR (successful)
       # CCRTAICC_LIB_INVALID_ARG (invalid argument)
       # CCRTAICC_LIB_DMA_FAILED (MsgDma failed)
       # CCRTAICC_LIB_DMA_BUSY (MsgDma busy)
       # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
                                not supported)
       # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA (not owner of modular scatter-
                                gather)
*****/

```

2.2.121 crtAICC_MsgDma_Fire_Single()

This call is similar in functionality to the *crtAICC_MsgDma_Fire()* call with the exception that it operates on the single descriptor ID-1. It can be used when a single DMA rather than scatter-gather DMA operation needs to be performed. This call can be called once the *crtAICC_MsgDma_Configure_Single()* call has been issued to set up the read/write address offset and length of transfer. Unless the read/write address offset or length of transfer is changed, the *crtAICC_MsgDma_Fire_Single()* call can be made repeatedly to perform the same DMA transfer.

```

/*****
_ccrtaicc_lib_error_number_t
_ccrtaicc_MsgDma_Fire_Single (void *Handle,
                              int UseInterrupts)

Description: Fire Single Modular Scatter-Gather DMA descriptor

Input: void *Handle (Handle pointer)
       int UseInterrupts (Use interrupts flag)
       # CCRTAICC_TRUE
       # CCRTAICC_FALSE

Output: none
Return: _ccrtaicc_lib_error_number_t
       # CCRTAICC_LIB_NO_ERROR (successful)
       # CCRTAICC_LIB_INVALID_ARG (invalid argument)
       # CCRTAICC_LIB_DMA_FAILED (MsgDma failed)
       # CCRTAICC_LIB_DMA_BUSY (MsgDma busy)
       # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
                                not supported)
       # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA (not owner of modular scatter-
                                gather)
*****/

```

UseInterrupts is a flag that can be set to specify if interrupt handling should be enabled.

2.2.122 **ccrtaICC_MsgDma_Free_Descriptor()**

This call can be used to free up already used descriptors.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtaICC_MsgDma_Free_Descriptor (void                *Handle,
                                   _ccrtaicc_msgdma_descriptors_id_mask_t DescriptorIDMask)

Description: Free Modular Scatter-Gather DMA descriptor

Input:   void                *Handle (Handle pointer)
         _ccrtaicc_msgdma_descriptors_id_mask_t DescriptorIDMask
         (descriptor ID mask)
         # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1_MASK ...
         CCRTAICC_MSGDMA_DESCRIPTOR_ID_31_MASK
         # CCRTAICC_MSGDMA_DESCRIPTOR_ID_ALL_MASK

Output:  none
Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR           (successful)
         # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN          (device not open)
         # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
         # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
         not supported)
         # CCRTAICC_LIB_DMA_BUSY          (MsgDma busy)
         # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA (not owner of modular
         scatter-gather)
*****/
```

2.2.123 **ccrtaICC_MsgDma_Get_Descriptor()**

This call returns information on the selected descriptor.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtaICC_MsgDma_Get_Descriptor (void                *Handle,
                                   _ccrtaicc_msgdma_descriptors_id_t DescriptorID,
                                   ccrtaicc_msgdma_descriptor_t *Descriptor,
                                   __u64                *DescriptorAddress)

Description: Get Modular Scatter-Gather DMA Descriptor

Input:   void                *Handle (Handle pointer)
         _ccrtaicc_msgdma_descriptors_id_t DescriptorID (descriptor ID)
         # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ...
         CCRTAICC_MSGDMA_DESCRIPTOR_ID_31

Output:  ccrtaicc_msgdma_descriptor_t *Descriptor (pointer to descriptor)
         __u64 ReadAddress
         __u64 WriteAddress
         __u64 NextDescriptorPointer
         __u32 Length
         __u32 Control
         __u32 ReadBurstCount
         __u32 WriteBurstCount
         __u32 ReadStride
         __u32 WriteStride
         __u32 ActualBytesTransferred
         __u32 Status
*****/
```

```

        __u32  SequenceNumber
Return:  __u64  *DescriptorAddress (descriptor address)
        _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)
        # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
        # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
                                           not supported)
*****/

```

Pointer to *DescriptorAddress* can be specified to return its address offset within the configuration space. This argument can be set to *NULL* if address is not required.

2.2.124 ccrtaICC_MsgDma_Get_Dispatcher_CSR()

This call returns useful control and status register information on the dispatcher.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_MsgDma_Get_Dispatcher_CSR (void          *Handle,
                                     ccrtaicc_msgdma_dispatcher_t *Dispatcher)

```

Description: Get Modular Scatter-Gather DMA Dispatcher CSR

```

Input:  void          *Handle (Handle pointer)
Output: ccrtaicc_msgdma_dispatcher_t *Dispatcher (pointer to dispatcher)
        __u32  Status
        # CCRTAICC_MSGD_DISP_STATUS_IRQ           :IRQ
        # CCRTAICC_MSGD_DISP_STATUS_STOPPED_ETERM :Stopped on Early
                                                    Termination
        # CCRTAICC_MSGD_DISP_STATUS_STOPPED_ERROR :Stopped on Error
        # CCRTAICC_MSGD_DISP_STATUS_RESETTING     :Resetting
        # CCRTAICC_MSGD_DISP_STATUS_STOPPED       :Stopped
        # CCRTAICC_MSGD_DISP_STATUS_RESP_BUF_FULL :Response Buffer
                                                    Full
        # CCRTAICC_MSGD_DISP_STATUS_RESP_BUF_EMPTY :Response Buffer
                                                    Empty
        # CCRTAICC_MSGD_DISP_STATUS_DESC_BUF_FULL :Descriptor Buffer
                                                    Full
        # CCRTAICC_MSGD_DISP_STATUS_DESC_BUF_EMPTY :Descriptor Buffer
                                                    Empty
        # CCRTAICC_MSGD_DISP_STATUS_BUSY         :Busy
        __u32  Control
        # CCRTAICC_MSGD_DISP_CONTROL_STOP_DESC   :Stop Descriptors
        # CCRTAICC_MSGD_DISP_CONTROL_INT_ENA_MASK :Global Interrupt
                                                    Enable Mask
        # CCRTAICC_MSGD_DISP_CONTROL_STOP_ETERM  :Stop on Early
                                                    Termination
        # CCRTAICC_MSGD_DISP_CONTROL_STOP_ON_ERROR :Stop on Error
        # CCRTAICC_MSGD_DISP_CONTROL_RESET_DISP  :Reset Dispatcher
        # CCRTAICC_MSGD_DISP_CONTROL_STOP_DISP   :Stop Dispatcher
        __u32  ReadFillLevel
        __u32  WriteFillLevel
        __u32  ResponseFillLevel
        __u32  ReadSequenceNumber
        __u32  WriteSequenceNumber
Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN          (device not open)

```

```

# CCRTAICC_LIB_INVALID_ARG (invalid argument)
# CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
not supported)
*****/

```

2.2.125 `ccrtAICC_MsgDma_Get_Prefetcher_CSR()`

This call returns useful control and status register information on the prefetcher.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_MsgDma_Get_Prefetcher_CSR (void *Handle,
ccrtaicc_msgdma_prefetcher_t *Prefetcher)

```

Description: Get Modular Scatter-Gather DMA Prefetcher CSR

```

Input: void *Handle (Handle pointer)
Output: ccrtaicc_msgdma_prefetcher_t *Prefetcher (pointer to prefetcher)
       __u32 Status
           # CCRTAICC_MSGD_PREF_STATUS_IRQ :IRQ Occurred
       __u32 Control
           # CCRTAICC_MSGD_PREF_CONTROL_PARK_MODE :Park Mode
           # CCRTAICC_MSGD_PREF_CONTROL_INT_ENA_MASK :Global Interrupt
           Enable Mask
           # CCRTAICC_MSGD_PREF_CONTROL_RESET :Reset Prefetcher
           Core
           # CCRTAICC_MSGD_PREF_CONTROL_DESC_POLL_EN :Descriptor Polling
           Enable
           # CCRTAICC_MSGD_PREF_CONTROL_RUN :Start Descriptor
           fetching operation
       __u64 NextDescriptorPointer
       __u32 DescriptorPollingFrequency
Return: _ccrtaicc_lib_error_number_t
       # CCRTAICC_LIB_NO_ERROR (successful)
       # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
       # CCRTAICC_LIB_NOT_OPEN (device not open)
       # CCRTAICC_LIB_INVALID_ARG (invalid argument)
       # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
not supported)
*****/

```

2.2.126 `ccrtAICC_MsgDma_Release()`

This `ccrtAICC_MsgDma_Release()` API call is used to free up the Modular Scatter-Gather DMA resource that has been previously reserved by the `ccrtAICC_MsgDma_Seize()` API. At this point, another user can take control of the MsgDMA operation by issuing the `ccrtAICCC_MsgDma_Seize()` call.

```

/*****
_ccrtaicc_lib_error_number_t ccrtaICC_MsgDma_Release (void *Handle)

```

Description: Release MsgDMA operation for others to use

```

Input: void *Handle (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
       # CCRTAICC_LIB_NO_ERROR (successful)
       # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
       # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
not supported)
       # CCRTAICC_LIB_DMA_BUSY (MsgDma Busy, cannot be
reset)

```

```
# CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA (not owner of modular
scatter-gather)
```

```
*****/
```

2.2.127 ccrtAICC_MsgDma_Seize()

Modular Scatter-Gather DMA is a two part operation. The first part is to configure the Scatter-Gather DMA and the second part is to execute the DMA. Various MsgDma API calls have been provided for this. Since this two part operation is not atomic, it is necessary for the user of these calls to prevent other applications from configuring and using the MsgDMA resources while it is being actively used by another application. For this reason, the *ccrtAICC_MsgDma_Seize()* and *ccrtAICC_MsgDma_Release()* API calls have been introduced to assist the user in preventing other applications from accessing the Scatter-Gather DMA resource while it is reserved. Basically, before any MsgDma API call is issued that could modify the setting and execution of the MsgDma operation, the user needs to issue the *ccrtAICC_MsgDma_Seize()* API call once. In this way, no one else will have access to the MsgDma resource until the application has issued the *ccrtAICC_MsgDma_Release()* API call or has terminated the application.

```
/******
```

```
_ccrtaiicc_lib_error_number_t ccrtAICC_MsgDma_Seize (void *Handle)
```

Description: Seize MsgDMA operation for private to use and become owner

```
Input: void *Handle (Handle pointer)
Output: none
Return: _ccrtaiicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED (modular scatter-gather DMA
        not supported)
        # CCRTAICC_LIB_MSGDMA_IN_USE (modular scatter-gather DMA in
        use)
```

```
*****/
```

2.2.128 ccrtAICC_MsgDma_Setup()

This call is used in conjunction with the *ccrtAICC_MsgDma_Configure()* and *ccrtAICC_MsgDma_Fire()* calls. This call is made after all the descriptors are first configured with the help of the *ccrtAICC_MsgDma_Configure()* call. The purpose of this call is to specify the first descriptor in the chain. Additionally, the user can set the *ForceReset* flag to reset the dispatcher and prefetcher. Optionally, the user can request useful active descriptor information if *ActiveDescriptorsInfo* argument is specified (*i.e not NULL*). In addition to returning useful active descriptor information, the descriptor chain and prefetcher settings are also validated for proper configuration.

```
/******
```

```
_ccrtaiicc_lib_error_number_t
ccrtAICC_MsgDma_Setup (void *Handle,
                      _ccrtaiicc_msgdma_descriptors_id_t StartDescriptorID,
                      int ForceReset,
                      ccrtaiicc_msgdma_active_descriptors_info_t
                      *ActiveDescriptorsInfo)
```

Description: Setup MsgDMA Dispatcher and Prefetcher

```
Input: void *Handle (Handle pointer)
        _ccrtaiicc_msgdma_descriptors_id_t *StartDescriptorID (Set
        to valid ID)
        # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ...
        CCRTAICC_MSGDMA_DESCRIPTOR_ID_31
        int ForceReset
```

```

Output:  ccrtaiicc_msgdma_active_descriptors_info_t  *ActiveDescriptorsInfo;
         _ccrtaiicc_msgdma_descriptors_id_t        ID
         # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1 ...
         CCRTAICC_MSGDMA_DESCRIPTOR_ID_31
         _ccrtaiicc_msgdma_descriptors_id_mask_t   Mask
         # CCRTAICC_MSGDMA_DESCRIPTOR_ID_1_MASK ...
         CCRTAICC_MSGDMA_DESCRIPTOR_ID_31_MASK
         # CCRTAICC_MSGDMA_DESCRIPTOR_ID_ALL_MASK
         __u32                                     NumberOfDescriptors
         __u32                                     TotalBytes
Return:  _ccrtaiicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR                   (successful)
         # CCRTAICC_LIB_BAD_HANDLE                 (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN                  (device not open)
         # CCRTAICC_LIB_INVALID_ARG              (invalid argument)
         # CCRTAICC_LIB_DMA_BUSY                  (MsgDma Busy, cannot be
         reset)
         # CCRTAICC_LIB_ERROR_IN_DESCRIPTOR_LIST (invalid descruptor list)
         # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED      (modular scatter-gather
         DMA not supported)
         # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA      (not owner of modular
         scatter-gather)
*****/

```

2.2.129 ccrtAICC_Munmap_Physical_Memory()

This call simply removes a physical memory that was previously allocated by the *ccrtAICC_MMap_Physical_Memory()* API call.

```

/*****
_ccrtaiicc_lib_error_number_t
ccrtAICC_Munmap_Physical_Memory (void *Handle,
                                void *mmaped_user_mem_ptr)

Description: Unmap a previously mapped physical DMA memory.

Input:  void *Handle (Handle pointer)
Output: void *mmaped_user_mem_ptr (virtual memory pointer)
Return: _ccrtaiicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR                   (successful)
         # CCRTAICC_LIB_BAD_HANDLE                 (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN                  (device not open)
         # CCRTAICC_LIB_INVALID_ARG              (invalid argument)
         # CCRTAICC_LIB_MUNMAP_FAILED            (failed to un-map memory)
         # CCRTAICC_LIB_NOT_MAPPED              (memory not mapped)
         # CCRTAICC_LIB_MSGDMA_IN_USE            (modular scatter-gather DMA
         in use)
*****/

```

2.2.130 ccrtAICC_NanoDelay()

This call goes into a tight loop spinning for the requested nano seconds specified by the user.

```

/*****
void
ccrtAICC_NanoDelay (unsigned long long NanoDelay)

Description: Delay (loop) for user specified nano-seconds

Input:  unsigned long long NanoDelay (number of nano-secs to delay)
Output: none

```

Return: none
 *****/

2.2.131 ccrtAICC_Open()

This is the first call that needs to be issued by a user to open a device and access the board through the rest of the API calls. What is returned is a handle to a *void pointer* that is supplied as an argument to the other API calls. The *Board_Number* is a valid board number [0..9] that is associated with a physical card. There must exist a character special file */dev/ccrtaiicc<Board_Number>* for the call to be successful. One character special file is created for each board found when the driver is successfully loaded.

The *oflag* is the flag supplied to the *open(2)* system call by this API. It is normally '0' (*zero*), however the user may use the *O_NONBLOCK* option for *read(2)* calls which will change the default reading in block mode.

This driver allows multiple applications to open the same board by specifying an additional *oflag O_APPEND*. It is then the responsibility of the user to ensure that the various applications communicating with the same cards are properly synchronized. Various tests supplied in this package has the *O_APPEND* flags enabled, however, it is strongly recommended that only one application be run with a single card at a time, unless the user is well aware of how the applications are going to interact with each other and accept any unpredictable results.

In case of error, *errno* is also set for some non-system related errors encountered.

```

/*****
  _ccrtaiicc_lib_error_number_t
  ccrtAICC_Open (void      **My_Handle,
                 int       Board_Number,
                 int       oflag)

  Description: Open a device.

  Input:   void      **Handle      (Handle pointer to pointer)
           int       Board_Number  (0-9 board number)
           int       oflag         (open flags)

  Output:  none

  Return:  _ccrtaiicc_lib_error_number_t
           # CCRTAICC_LIB_NO_ERROR      (successful)
           # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
           # CCRTAICC_LIB_ALREADY_OPEN  (device already opened)
           # CCRTAICC_LIB_OPEN_FAILED   (device open failed)
           # CCRTAICC_LIB_ALREADY_MAPPED (memory already mmaped)
           # CCRTAICC_LIB_MMAP_SELECT_FAILED (mmap selection failed)
           # CCRTAICC_LIB_MMAP_FAILED   (mmap failed)
  *****/

```

2.2.132 ccrtAICC_Pause_UserProcess()

This call causes a running User Process to sleep for user specified micro-seconds.

```

/*****
  _ccrtaiicc_lib_error_number_t
  ccrtAICC_Pause_UserProcess(void *UFuncHandle,
                              int  usleep)

  Description: Pause running user process

  Input:   void      *UFuncHandle (UF Handle pointer)
           int       usleep       (micro-seconds sleep)

  Output:  none

```

```

Return:  _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR           (successful)
        # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
*****/

```

2.2.133 ccrtaICC_Program_All_Output_Clocks()

This is the main call to program all the output clocks with a single call. All existing clock activity is stopped and replaced with the new clocks selection. Though the user can select the Input Clock Frequency with this call, it is expected that they will use the default CCRTAICC_DEFAULT_INPUT_CLOCK_FREQUENCY value.

The input clock can be one of:

```

CCRTAICC_CG_INPUT_CLOCK_SELECT_IN0  → 10MHz TCX0 (Temperature Compensated
                                       Oscillator Clock).
CCRTAICC_CG_INPUT_CLOCK_SELECT_IN1  → External Input
CCRTAICC_CG_INPUT_CLOCK_SELECT_IN2  → FPGA Supplied
CCRTAICC_CG_INPUT_CLOCK_SELECT_INXAXB → Not used

```

When using this card, the default clock should be set to *CCRTAICC_CG_INPUT_CLOCK_SELECT_NO* i.e. the 10MHz internal clock.

If the desired output clock frequencies are unable to be computed due to hardware limitation, they may wish to increase the desired tolerance *DesiredTolerancePPT* for the particular clock. Note that this tolerance is only applicable to computing a clock value as close to the desired frequency *DesiredFrequency* and not a representation of the accuracy of the output clocks.

Additionally, the programming could fail if the number of N-Divider resource gets exhausted due to the user selecting several output clocks with widely different output clocks.

```

/*****
ccrtaICC_Program_All_Output_Clocks()
_ccrtaicc_lib_error_number_t
ccrtaICC_Program_All_Output_Clocks(void          *Handle,
                                       double      InputClockFrequency,
                                       _ccrtaicc_cg_input_clock_select_register_t InputClockSel,
                                       ccrtaicc_compute_all_output_clocks_t *AllClocks,
                                       int         ProgramClocks,
                                       int         ActivateClocks)

```

Description: Program All Output Clocks

```

Input:  void          *Handle
        double        InputClockFrequency
        _ccrtaicc_cg_input_clock_select_register_t InputClockSel
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN0
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN1
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_IN2
        # CCRTAICC_CG_INPUT_CLOCK_SELECT_INXAXB
        ccrtaicc_compute_all_output_clocks_t *AllClocks (pointer to
        ccrtaicc_compute_single_output_clock_t *Clock (Pointer to
        long double DesiredFrequency
        double      DesiredTolerancePPT

```



```

int                                     ProgramClocks (program
                                           clocks)
int                                     ActivateClocks (1=activate
                                           clocks after program)
Output: ccrtaicc_compute_all_output_clocks_t *AllClocks (Pointer to
                                           returned output clocks info)
        ccrtaicc_compute_single_output_clock_t *Clock (Pointer to
                                           returned output clock info)
        _ccrtaicc_clock_generator_output_t OutputClock
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_0
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_1
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_2
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_3
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_4
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_5
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_6
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_7
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_8
        # CCRTAICC_CLOCK_GENERATOR_OUTPUT_9
double                                  InputClockFrequency
long double                             FrequencyDeviation
int                                       FrequencyFound
long double                              ActualFrequency
double                                   ActualTolerancePPT
__u64                                    Mdiv_Numerator
__u32                                    Mdiv_Denominator
__u64                                    Ndiv_Numerator
__u32                                    Ndiv_Denominator
        _ccrtaicc_cg_outmux_ndiv_select_t Ndiv_ToUse
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_0
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_1
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_2
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_3
        # CCRTAICC_CG_OUTPUT_MUX_NDIV_4
__u32                                    Rdiv_value
__u32                                    Rdivider
__u32                                    Pdivider
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region error)
        # CCRTAICC_LIB_IO_ERROR (device not ready)
        # CCRTAICC_LIB_N_DIVIDERS_EXCEEDED (number of N-Dividers
                                           exceeded)
        # CCRTAICC_LIB_CANNOT_COMPUTE_OUTPUT_FREQ (cannot compute
                                           output freq)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
        # CCRTAICC_LIB_CLOCK_GENERATION_FAILED (clock generation
                                           failed)
*****/

```

2.2.134 ccrtaICC_Read()

This call performs a programmed I/O driver read of either the ADC *channel registers* or the *FIFO*. Prior to issuing this call, the user needs to set up the desired read mode of operation using the *ccrtaICC_ADC_Set_Driver_Read_Mode()* with *CCRTAICC_ADC_PIO_CHANNEL* or *CCRTAICC_ADC_PIO_FIFO* argument. For *channel register* reads, the size is limited to *CCRTAICC_MAX_ADC_CHANNELS* words and for *FIFO* reads, it is limited to *CCRTAICC_ADC_FIFO_DATA_MAX* words.

It basically calls the `read(2)` system call with the exception that it performs necessary *locking* and returns the `errno` returned from the system call in the pointer to the `error` variable. An `errno` of `ENOBUS` can occur for `FIFO` reads when it encounters an overflow condition.

For specific information about the data being returned for the various read modes, refer to the `read(2)` system call description the *Driver Direct Access* section.

```

/*****

```

```

    _ccrtaicc_lib_error_number_t
    ccrtaicc_Read (void      *Handle,
                  void      *buf,
                  int        size,
                  int        *bytes_read,
                  int        *error)

```

Description: Perform a read operation.

```

Input:  void      *Handle      (Handle pointer)
        int        size        (size of buffer in bytes)
Output: void      *buf         (pointer to buffer)
        int        *bytes_read  (bytes read)
        int        *error      (returned errno)

```

```

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
        # CCRTAICC_LIB_IO_ERROR      (read failed)

```

```

*****/

```

2.2.135 ccrtaicc_Reload_Firmware()

The purpose of this call is to power cycle the board which in turn will reload the latest firmware on the board.

```

/*****

```

```

    ccrtaicc_Reload_Firmware()

```

Description: This call power-cycles the board which in turn forces it to reload its firmware. Typically, this is called after a new firmware has been installed in the board. This saves the need to perform a system reboot after a firmware installation.

```

Input:  void *Handle      (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED  (driver ioctl call failed)

```

```

*****/

```

2.2.136 ccrtaicc_Remove_Irq()

The purpose of this call is to remove the interrupt handler that was previously set up. The interrupt handler is managed internally by the driver and the library. The user should not issue this call, otherwise reads will time out.

```

/*****

```

```

    _ccrtaicc_lib_error_number_t
    ccrtaicc_Remove_Irq (void *Handle)

```

Description: By default, the driver sets up a shared IRQ interrupt handler

when the device is opened. Now if for any reason, another device is sharing the same IRQ as this driver, the interrupt handler will also be entered every time the other shared device generates an interrupt. There are times that a user, for performance reasons may wish to run the board without interrupts enabled. In that case, they can issue this ioctl to remove the interrupt handling capability from the driver.

```

Input:  void *Handle          (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN     (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
*****/

```

2.2.137 ccrtaICC_Reset_Board()

This call resets the board to a known hardware state. It may be a good idea to start an application by first resetting the board so that it is set to a known state.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Reset_Board (void *Handle)

Description: Reset the board.

Input:  void *Handle          (Handle pointer)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN     (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
*****/

```

2.2.138 ccrtaICC_Reset_Clock()

This call performs a hardware reset of the clock. All active output clocks are stopped and set to default state. The user can activate clocks if they wish after a reset via the *activate* argument.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_Reset_Clock (void *Handle,
                    int activate)

Description: Perform Hardware Clock Reset

Input:  void *Handle          (Handle pointer)
        int activate         (1=activate after reset)
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN     (device not open)
        # CCRTAICC_LIB_IOCTL_FAILED (driver ioctl call failed)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
*****/

```

2.2.139 ccrtAICC_Resume_UserProcess()

Use this call to resume an already paused User Process.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtAICC_Resume_UserProcess(void *UFuncHandle)

  Description: Resume paused running user process

  Input:   void          *UFuncHandle          (UF Handle pointer)
  Output:  none
  Return:  _ccrtaicc_lib_error_number_t
           # CCRTAICC_LIB_NO_ERROR            (successful)
           # CCRTAICC_LIB_BAD_HANDLE         (no/bad handler supplied)
*****/
```

2.2.140 ccrtAICC_Return_Board_Info_Description()

Return board information description

```

/*****
  char *
  ccrtAICC_Return_Board_Info_Description (_ccrtaicc_board_function_t
                                         BoardFunction)

  Description: Return Board Information Description

  Input:   _ccrtaicc_board_function_t  BoardFunction      (board function)
           # CCRTAICC_BOARD_FUNCTION_AICC
           # CCRTAICC_BOARD_FUNCTION_BASE_LEVEL
           # CCRTAICC_BOARD_FUNCTION_UNDEFINED

  Output:  none
  Return:  char                        *BoardFuncDesc      (board function
                                                             description)
*****/
```

2.2.141 ccrtAICC_SDRAM_Activate() **

Currently, SDRAM is not supported by this hardware.

This call must be the first call to activate the SDRAM. Without activation, all other calls will fail. The user can also use this call to return the current state of the SDRAM without any change.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtAICC_SDRAM_Activate (void
                           _ccrtaicc_sdr_all_enable_t activate,
                           _ccrtaicc_sdr_all_enable_t *current_state)

  Description: Activate/DeActivate SDRAM module

  Input:   void          *Handle          (Handle pointer)
           _ccrtaicc_sdr_all_enable_t  activate      (activate/deactivate)
           # CCRTAICC_SDRAM_ALL_DISABLE
           # CCRTAICC_SDRAM_ALL_ENABLE
           # CCRTAICC_SDRAM_ALL_ENABLE_DO_NOT_CHANGE

  Output:  _ccrtaicc_sdr_all_enable_t  *current_state (active/deactive)
           # CCRTAICC_SDRAM_ALL_DISABLE
           # CCRTAICC_SDRAM_ALL_ENABLE

  Return:  _ccrtaicc_lib_error_number_t
*****/
```

```

# CCRTAICC_LIB_NO_ERROR                (successful)
# CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN                (device not open)
# CCRTAICC_LIB_INVALID_ARG            (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION         (local region not present)
# CCRTAICC_LIB_SDRAM_INITIALIZATION_FAILED (SDRAM init failed)
# CCRTAICC_LIB_SDRAM_NOT_SUPPORTED     (SDRAM not supported)
*****/

```

2.2.142 ccrtAICC_SDRAM_Get_CSR() **

Currently, SDRAM is not supported by this hardware.

This call returns the SDRAM control and status register information.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_SDRAM_Get_CSR (void          *Handle,
                        ccrtaicc_sdram_csr_t *sdram_csr)

Description: Get SDRAM Control and Status information

Input:  void          *Handle (Handle pointer)
Output: ccrtaicc_sdram_csr_t *sdram_csr (pointer to SDRAM csr)
_ccrtaicc_sdram_read_auto_increment_t read_auto_increment;
# CCRTAICC_SDRAM_READ_AUTO_INCREMENT_DISABLE
# CCRTAICC_SDRAM_READ_AUTO_INCREMENT_ENABLE
_ccrtaicc_sdram_write_auto_increment_t write_auto_increment;
# CCRTAICC_SDRAM_WRITE_AUTO_INCREMENT_DISABLE
# CCRTAICC_SDRAM_WRITE_AUTO_INCREMENT_ENABLE
_ccrtaicc_sdram_read_timeout_t read_timeout;
# CCRTAICC_SDRAM_READ_TIMEOUT_DID_NOT_OCCUR
# CCRTAICC_SDRAM_READ_TIMEOUT_OCCURRED
_ccrtaicc_sdram_calibration_fail_t calibration_failed;
# CCRTAICC_SDRAM_CALIBRATION_FAIL_RESET
# CCRTAICC_SDRAM_CALIBRATION_FAIL_SET
_ccrtaicc_sdram_calibration_pass_t calibration_passed;
# CCRTAICC_SDRAM_CALIBRATION_PASS_RESET
# CCRTAICC_SDRAM_CALIBRATION_PASS_SET
_ccrtaicc_sdram_initilization_done_t initialization_done;
# CCRTAICC_SDRAM_INITIALIZATION_NOT_COMPLETE
# CCRTAICC_SDRAM_INITIALIZATION_COMPLETE

Return: _ccrtaicc_lib_error_number_t
# CCRTAICC_LIB_NO_ERROR                (successful)
# CCRTAICC_LIB_BAD_HANDLE              (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN                (device not open)
# CCRTAICC_LIB_INVALID_ARG            (invalid argument)
# CCRTAICC_LIB_NO_LOCAL_REGION         (local region not present)
# CCRTAICC_LIB_SDRAM_IS_NOT_ACTIVE     (SDRAM is not active)
*****/

```

2.2.143 ccrtAICC_SDRAM_Read() **

Currently, SDRAM is not supported by this hardware.

This call provided the user the ability to read any portion of the SDRAM. Its range is from 1 to 0x10000000 (256Mwords). Offset to this routine is only set if it is 0 or greater. Maximum offset is 0x0FFFFFFF. If offset is negative, then the read commences from the last read location.

```

/*****
_ccrtaicc_lib_error_number_t

```

```

ccrtAICC_SDRAM_Read (void      *Handle,
                    u_int32_t *Buf,
                    int       Offset,
                    u_int32_t Size,
                    u_int32_t *Words_read)

```

Description: Perform a SDRAM read operation.

```

Input:  void      *Handle      (Handle pointer)
        int       Offset      (word offset into SDRAM)
        u_int32_t Size        (size of buffer in words)
Output: u_int32_t *Buf        (pointer to buffer)
        u_int32_t *Words_read (words read)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_SDRAM_IS_NOT_ACTIVE (SDRAM is not active)

```

*****/

2.2.144 ccrtAICC_SDRAM_Set_CSR() **

Currently, SDRAM is not supported by this hardware.

This call sets the SDRAM control and status register.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_SDRAM_Set_CSR (void      *Handle,
                      ccrtAICC_s dram_csr_t *sdram_csr)

```

Description: Set SDRAM Control and Status information

```

Input:  void      *Handle      (Handle pointer)
        _ccrtaicc_s dram_read_auto_increment_t read_auto_increment;
        # CCRTAICC_SDRAM_READ_AUTO_INCREMENT_DISABLE
        # CCRTAICC_SDRAM_READ_AUTO_INCREMENT_ENABLE
        _ccrtaicc_s dram_write_auto_increment_t write_auto_increment;
        # CCRTAICC_SDRAM_WRITE_AUTO_INCREMENT_DISABLE
        # CCRTAICC_SDRAM_WRITE_AUTO_INCREMENT_ENABLE
        _ccrtaicc_s dram_read_timeout_t read_timeout;
        # CCRTAICC_SDRAM_READ_TIMEOUT_DID_NOT_OCCUR
        # CCRTAICC_SDRAM_READ_TIMEOUT_OCCURRED
        _ccrtaicc_s dram_calibration_fail_t calibration_failed;
        # CCRTAICC_SDRAM_CALIBRATION_FAIL_RESET
        # CCRTAICC_SDRAM_CALIBRATION_FAIL_SET
        _ccrtaicc_s dram_calibration_pass_t calibration_passed;
        # CCRTAICC_SDRAM_CALIBRATION_PASS_RESET
        # CCRTAICC_SDRAM_CALIBRATION_PASS_SET
        _ccrtaicc_s dram_initilization_done_t initialization_done;
        # CCRTAICC_SDRAM_INITIALIZATION_NOT_COMPLETE
        # CCRTAICC_SDRAM_INITIALIZATION_COMPLETE
Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE    (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN      (device not open)
        # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_SDRAM_IS_NOT_ACTIVE (SDRAM is not active)
*****/

```

2.2.145 ccrtAICC_SDRAM_Write() **

Currently, SDRAM is not supported by this hardware.

This call provided the user the ability to write to any portion of the SDRAM. Its range is from 1 to 0x10000000 (256Mwords). Offset to this routine is only set if it is 0 or greater. Maximum offset is 0x0FFFFFFF. If offset is negative, then the write commences from the last written location.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtAICC_SDRAM_Write (void      *Handle,
                        u_int32_t  *Buf,
                        int         Offset,
                        u_int32_t  Size,
                        u_int32_t  *Words_written)

Description: Perform a SDRAM write operation.

Input:  void      *Handle      (Handle pointer)
        u_int32_t *Buf        (pointer to buffer)
        int       Offset      (word offset into SDRAM)
        u_int32_t Size        (size of buffer in words)
Output: u_int32_t *Words_written (words written)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
        # CCRTAICC_LIB_SDRAM_IS_NOT_ACTIVE (SDRAM is not active)
*****/
```

2.2.146 ccrtAICC_Set_Board_CSR()

This call is used to set the board control register.

```

/*****
  _ccrtaicc_lib_error_number_t
  ccrtAICC_Set_Board_CSR (void      *Handle,
                        ccrtaicc_board_csr_t *bcsr)

Description: Set Board Control and Status information

Input:  void      *Handle      (Handle pointer)
        ccrtaicc_board_csr_t *bcsr (pointer to board csr)
        _ccrtaicc_bcsr_identify_board_t identify_board
        # CCRTAICC_BCSR_IDENTIFY_BOARD_DISABLE
        # CCRTAICC_BCSR_IDENTIFY_BOARD_ENABLE
        # CCRTAICC_BCSR_IDENTIFY_BOARD_DO_NOT_CHANGE

Output: none
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (successful)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN        (device not open)
        # CCRTAICC_LIB_INVALID_ARG     (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION   (local region not present)
*****/
```

2.2.147 ccrtAICC_Set_Calibration_CSR()

This call sets the current calibration control and status register.

```

/*****
  _ccrtaicc_lib_error_number_t
```

```
ccrtaICC_Set_Calibration_CSR (void *Handle,
                               ccrtaicc_calibration_csr_t *CalCSR)
```

Description: Set Calibration Control and Status Register

```
Input: void *Handle (Handle pointer)
        ccrtaicc_calibration_csr_t *CalCSR (pointer to calibration CSR)
        _ccrtaicc_calbus_control_t BusControl (bus control)
```

```
# CCRTAICC_CB_GROUND
# CCRTAICC_CB_POSITIVE_10V_REFERENCE
# CCRTAICC_CB_NEGATIVE_10V_REFERENCE
# CCRTAICC_CB_POSITIVE_5V_REFERENCE
# CCRTAICC_CB_NEGATIVE_5V_REFERENCE
# CCRTAICC_CB_POSITIVE_2V_REFERENCE
# CCRTAICC_CB_BUS_OPEN
```

```
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
```

*****/

2.2.148 ccrtaICC_Set_External_Clock_CSR()

This call sets the External Clock Input.

```
_ccrtaicc_lib_error_number_t
ccrtaICC_Set_External_Clock_CSR (void *Handle,
                                 ccrtaicc_external_clock_csr_t *ExtClkCSR)
```

Description: Set External Clock Control & Status

```
Input: void *Handle (handle pointer)
        ccrtaicc_external_clock_csr_t *ExtClkCSR (pointer to external clock
        CSR)
```

```
_ccrtaicc_external_clock_output_select_t ClockOutputSelect;
# CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_0
# CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_1
# CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_2
# CCRTAICC_EXCLOS_CLOCK_GENERATOR_OUTPUT_3
# CCRTAICC_EXCLOS_EXTERNAL_CLOCK_INPUT
# CCRTAICC_EXCLOS_NO_CLOCK
# CCRTAICC_EXCLOS_DO_NOT_CHANGE
```

Output: none

```
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region error)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
```

*****/

2.2.149 ccrtaICC_Set_Interrupt_Status()

This call sets/clears the various interrupts.

```
_ccrtaicc_lib_error_number_t
ccrtaICC_Set_Interrupt_Status (void *Handle,
```


ccrtaicc_interrupt_t *intr)

Description: Set Interrupt Status

Input: void *Handle (handle pointer)
ccrtaicc_interrupt_t *intr (pointer to interrupt status)
_ccrtaicc_intsta_adc_t
CCRTAICC_INT_ADC_FIFO_THRESHOLD_NONE
CCRTAICC_INT_ADC_FIFO_THRESHOLD_RESET
CCRTAICC_INT_ADC_FIFO_THRESHOLD_DO_NOT_CHANGE

Output: none

Return: _ccrtaicc_lib_error_number_t
CCRTAICC_LIB_NO_ERROR (successful)
CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
CCRTAICC_LIB_NOT_OPEN (device not open)
CCRTAICC_LIB_NO_LOCAL_REGION (local region error)
CCRTAICC_LIB_INVALID_ARG (invalid argument)

*****/

2.2.150 ccrtaICC_Set_Interrupt_Timeout_Seconds()

This call sets the read *timeout* maintained by the driver. It allows the user to change the default time out from 30 seconds to a user specified value. It is the time that the read call will wait before it times out. The call could time out if the DMA fails to complete. The device should have been opened in the blocking mode (*O_NONBLOCK* not set) for reads to wait for the operation to complete.

_ccrtaicc_lib_error_number_t
ccrtaICC_Set_Interrupt_Timeout_Seconds (void *Handle,
int timeout_secs)

Description: Set Interrupt Timeout Seconds

Input: void *Handle (Handle pointer)
int timeout_secs (interrupt tout secs)

Output: none

Return: _ccrtaicc_lib_error_number_t
CCRTAICC_LIB_NO_ERROR (successful)
CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
CCRTAICC_LIB_NOT_OPEN (device not open)
CCRTAICC_LIB_INVALID_ARG (invalid argument)

*****/

2.2.151 ccrtaICC_Set_TestBus_Control()

This call is provided for internal use in testing the hardware.

_ccrtaicc_lib_error_number_t
ccrtaICC_Set_TestBus_Control (void *Handle,
_ccrtaicc_testbus_control_t test_control)

Description: Set the value of the Test Bus control information

Input: void *Handle (handle pointer)

Output: _ccrtaicc_testbus_control_t
test_control (control select)
CCRTAICC_TBUS_CONTROL_OPEN
CCRTAICC_TBUS_CONTROL_CAL_BUS

Return: _ccrtaicc_lib_error_number_t

```

# CCRTAICC_LIB_NO_ERROR          (successful)
# CCRTAICC_LIB_NO_LOCAL_REGION   (local region error)
# CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
# CCRTAICC_LIB_NOT_OPEN         (device not open)
*****/

```

2.2.152 ccrtAICC_Set_Value()

This call allows the advanced user to set the writable board registers. The actual data written will depend on the command register information that is requested. Refer to the hardware manual for more information on what can be written to.

Normally, users should not be changing these registers as it will bypass the API integrity and could result in an unpredictable outcome.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_Set_Value (void          *Handle,
                   CCRTAICC_CONTROL cmd,
                   void          *value)

Description: Set the value of the specified board register.

Input:   void          *Handle      (Handle pointer)
         CCRTAICC_CONTROL cmd      (register definition)
         -- structure in ccrtaicc_lib.h
         void          *value      (pointer to value to be set)

Output:  none

Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR    (successful)
         # CCRTAICC_LIB_BAD_HANDLE  (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN    (device not open)
         # CCRTAICC_LIB_INVALID_ARG (invalid argument)
*****/

```

2.2.153 ccrtAICC_SPROM_Read() **

Currently, SPROM is not supported by this hardware.

This is a basic call to read short word entries from the serial prom. The user specifies a word offset within the serial prom and a word count, and the call returns the data read in a pointer to short words.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_SPROM_Read(void          *Handle,
                   ccrtaicc_sprom_rw_t *spr)

Description: Read Serial Prom for specified number of words

Input:   void          *Handle      (handle pointer)
         ccrtaicc_sprom_rw_t *spr   (pointer to struct)
         u_short word_offset
         u_short num_words

Output:  ccrtaicc_sprom_rw_t *spr   (pointer to struct)
         u_short *data_ptr

Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR    (successful)
         # CCRTAICC_LIB_NO_LOCAL_REGION (error)
         # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
         # CCRTAICC_LIB_SERIAL_PROM_BUSY (serial prom busy)
         # CCRTAICC_LIB_SERIAL_PROM_FAILURE (serial prom failure)
*****/

```

```

# CCRTAICC_LIB_SERIAL_PROM_NOT_PRESENT (serial prom not present)
*****

```

2.2.154 **ccrtAICC_SPROM_Read_Item()** **

Currently, *SPROM* is not supported by this hardware.

This call is used to read well defined sections in the serial prom. The user supplies the serial prom section that needs to be read and the data is returned in a section specific structure.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_SPROM_Read_Item(void          *Handle,
                          _ccrtaicc_sprom_access_t item,
                          void          *item_ptr)

```

Description: Read Serial Prom for specified item

```

Input:      void          *Handle      (handle pointer)
            _ccrtaicc_sprom_access_t item (select item)
            # CCRTAICC_SPROM_HEADER

Output:     void          *item_ptr    (pointer to item struct)
            *ccrtaicc_sprom_header_t sprom_header
            u_int32_t      board_serial_number
            u_short        sprom_revision

```

```

Return:    _ccrtaicc_lib_error_number_t
            # CCRTAICC_LIB_NO_ERROR      (successful)
            # CCRTAICC_LIB_NO_LOCAL_REGION (error)
            # CCRTAICC_LIB_INVALID_ARG   (invalid argument)
            # CCRTAICC_LIB_SERIAL_PROM_BUSY (serial prom busy)
            # CCRTAICC_LIB_SERIAL_PROM_FAILURE (serial prom failure)
            # CCRTAICC_LIB_SERIAL_PROM_NOT_PRESENT (serial prom not present)

```

```

*****

```

2.2.155 **ccrtAICC_SPROM_Write()** **

Currently, *SPROM* is not supported by this hardware.

This is a basic call to write short word entries to the serial prom. The user specifies a word offset within the serial prom and a word count, and the call writes the data pointed to by the *spw* pointer, in short words.

Prior to using this call, the user will need to issue the *ccrtAICC_SPROM_Write_Override()* to allow writing to the serial prom.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtAICC_SPROM_Write(void          *Handle,
                      ccrtaicc_sprom_rw_t *spw)

```

Description: Write data to Serial Prom for specified number of words

```

Input:      void          *Handle      (handle pointer)
            ccrtaicc_sprom_rw_t *spw    (pointer to struct)
            u_short word_offset
            u_short num_words
            u_short *data_ptr

```

```

Output:     none
Return:    _ccrtaicc_lib_error_number_t
            # CCRTAICC_LIB_NO_ERROR      (successful)
            # CCRTAICC_LIB_NO_LOCAL_REGION (error)
            # CCRTAICC_LIB_INVALID_ARG   (invalid argument)

```

```

# CCRTAICC_LIB_SERIAL_PROM_BUSY (serial prom busy)
# CCRTAICC_LIB_SERIAL_PROM_FAILURE (serial prom failure)
# CCRTAICC_LIB_SERIAL_PROM_NOT_PRESENT (serial prom not present)
*****/

```

2.2.156 ccrtAICC_SPROM_Write_Item() **

Currently, SPROM is not supported by this hardware.

This call is used to write well defined sections in the serial prom. The user supplies the serial prom section that needs to be written and the data points to the section specific structure. This call should normally not be used by the user.

Prior to using this call, the user will need to issue the *ccrtAICC_SPROM_Write_Override()* to allowing writing to the serial prom.

```

/*****

```

```

_ccrtaicc_lib_error_number_t
ccrtAICC_SPROM_Write_Item(void          *Handle,
                           _ccrtaicc_sprom_access_t item,
                           void          *item_ptr)

```

Description: Write Serial Prom with specified item

```

Input:      void          *Handle (handle pointer)
            _ccrtaicc_sprom_access_t item (select item)
            # CCRTAICC_SPROM_HEADER
            void          *item_ptr (pointer to item struct)
            *ccrtaicc_sprom_header_t sprom_header
            u_int32_t      board_serial_number
            u_short        sprom_revision

```

```

Output:     none
Return:    _ccrtaicc_lib_error_number_t
            # CCRTAICC_LIB_NO_ERROR (successful)
            # CCRTAICC_LIB_NO_LOCAL_REGION (error)
            # CCRTAICC_LIB_INVALID_ARG (invalid argument)
            # CCRTAICC_LIB_SERIAL_PROM_BUSY (serial prom busy)
            # CCRTAICC_LIB_SERIAL_PROM_FAILURE (serial prom failure)
            # CCRTAICC_LIB_SERIAL_PROM_NOT_PRESENT (serial prom not present)
*****/

```

2.2.157 ccrtAICC_SPROM_Write_Override() **

Currently, SPROM is not supported by this hardware.

The serial prom is non-volatile and its information is preserved during a power cycle. It contains useful information and settings that the customer could lose if they were to inadvertently overwrite. For this reason, all calls that write to the serial proms will fail with a write protect error, unless this write protect override API is invoked prior to writing to the serial proms. Once the Write Override is enabled, it will stay in effect until the user closes the device or re-issues this call to disable writes to the serial prom.

The calls that will fail unless the write protect is disabled are:

- ccrtAICC_Write_Serial_Prom()
- ccrtAICC_Write_Serial_Prom_Item()

When *action* is set to *CCRTAICC_TRUE*, the serial prom write protecting is disabled, otherwise, it is enabled.

```

/*****

```

```

_ccrtaicc_lib_error_number_t
ccrtAICC_SPROM_Write_Override (void *Handle,

```

```
int action)
```

Description: Set Serial Prom Write Override

```
Input:      void          *Handle      (handle pointer)
           int            action       (override action)
           # CCRTAICC_TRUE
           # CCRTAICC_FALSE

Output:     none

Return:    _ccrtaicc_lib_error_number_t
           # CCRTAICC_LIB_NO_ERROR      (successful)
           # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
           # CCRTAICC_LIB_NOT_OPEN     (device not open)
           # CCRTAICC_LIB_INVALID_ARG  (invalid argument)
           # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
           # CCRTAICC_LIB_SERIAL_PROM_NOT_PRESENT (serial prom not present)
*****/
```

2.2.158 ccrtaICC_Transfer_Data()

This is the main call that the user can use to transfer data from physical memory that the user has previously allocated to a region in the local register, and vice-versa. The operation can be performed via DMA or programmed I/O mode. In the case of DMA mode, the user can select whether interrupts are to be used to wait for DMA to complete instead of polling. User can also specify which DMA engine to use during this operation.

If the board supports modular scatter-gather DMA, then the user can specify that instead of the basic DMA engine. In this case, the user needs to first call the *ccrtaICC_MsgDma_Configure_Single()* with the *NULL* argument to setup descriptor ID-1 for scatter-gather DMA operation.

When scatter-gather DMA is selected, the *DmaEngineNo* argument is ignored and the *IoControl* argument must be set to *CCRTAICC_DMA_CONTROL_INCREMENT*.

There are certain limitations to modular scatter-gather feature:

1. Scatter-gather DMA is only supported in certain cards
2. Reads from Avalon memory below DiagRam location are not allowed for MIOC FPGA cards.
3. Invalid memory address supplied could result in the scatter-gather IP to lock up and the only way to recover will be to reload the driver or reboot the system.
4. Read and write addresses must be at a minimum full-word aligned and for maximum performance, it is recommended to be quad-word aligned.
5. Lengths are in bytes and must be at a minimum a multiple of a full-word and for maximum performance, it is recommended to be quad-word multiple.
6. Scatter-gather chaining cannot be performed with this call.

```
/*
_ccrtaicc_lib_error_number_t
ccrtaICC_Transfer_Data(void          *Handle,
                        volatile void *PciDmaMemory,
                        volatile void *AvalonMem,
                        uint          TransferSize,
                        _ccrtaicc_direction_t XferDirection,
                        _ccrtaicc_library_rw_mode_t LibMode,
                        ccrtaicc_dma_engine_t DMAEngineNo,
                        ccrtaicc_bool UseInterrupts,
                        int          IoControl)
```

Description: Routine to transfer data from PCI memory to Avalon memory or vice-versa

```

Input:  void                *Handle          (Handle pointer)
        volatile void      *PciDmaMemory  (pointer to virtual memory)
        volatile void      *AvalonMem     (pointer to virtual Avalon
                                         memory)

        uint               TransferSize   (size of transfer in bytes)
        _ccrtaicc_direction_t XferDirection (direction of transfer)
        # CCRTAICC_AVALON_2_PCIMEM
        # CCRTAICC_PCIMEM_2_AVALON
        _ccrtaicc_library_rw_mode_t LibMode (Lib transfer mode)
        # CCRTAICC_LIBRARY_PIO_MODE
        # CCRTAICC_LIBRARY_DMA_MODE
        # CCRTAICC_LIBRARY_MSGDMA_MODE
        ccrtaicc_dma_engine_t DMAEngineNo (select DMA engine)
        # CCRTAICC_DMA0
        # CCRTAICC_DMA1
        # CCRTAICC_NONE
        ccrtaicc_bool       UseInterrupts (enable interrupts)
        # CCRTAICC_TRUE
        # CCRTAICC_FALSE
        int                 IoControl     (DMA or PIO control flags)
        # CCRTAICC_DMA_CONTROL_RCON      (DMA: read constant)
        # CCRTAICC_DMA_CONTROL_WCON      (DMA: write constant)
        # CCRTAICC_DMA_CONTROL_INCREMENT (DMA: increment)
        # CCRTAICC_PIO_CONTROL_RCON      (PIO: read constant)
        # CCRTAICC_PIO_CONTROL_WCON      (PIO: write constant)
        # CCRTAICC_PIO_CONTROL_INCREMENT (PIO: increment)

```

Output: none

```

Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR          (no error)
        # CCRTAICC_LIB_BAD_HANDLE       (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN         (library not open)
        # CCRTAICC_LIB_INVALID_ARG      (invalid argument)
        # CCRTAICC_LIB_IOCTL_FAILED     (driver ioctl call failed)
        # CCRTAICC_LIB_DMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_ADDRESS
                                         (DMA access not allowed for
                                         selected address)
        # CCRTAICC_LIB_MSGDMA_NOT_SUPPORTED
                                         (modular scatter-gather DMA
                                         not supported)
        # CCRTAICC_LIB_MSGDMA_ACCESS_NOT_ALLOWED_FOR_SELECTED_ADDRESS
                                         (MSG DMA Reads not allowed
                                         for selected address)
        # CCRTAICC_LIB_NOT_OWNER_OF_MSGDMA
                                         (not owner of modular
                                         scatter-gather)

```

*****/

2.2.159 ccrtaICC_Update_Clock_Generator_Divider()

Update the selected clock generator divider so that its changes take affect. *Normally, this call should not be used. It is recommended that only advanced users should use this call and with extreme care and intimate knowledge of the clock programming, otherwise results would be indeterminate.*

/******

```

_ccrtaicc_lib_error_number_t
ccrtaICC_Update_Clock_Generator_Divider (void                *Handle,
                                         _ccrtaicc_clock_generator_divider_t WhichDivider)

```

Description: Update Clock Generator Divider

```

Input:  void                *Handle          (Handle pointer)
        _ccrtaicc_clock_generator_divider_t WhichDivider (select divider)

```

```

# CCRTAICC_CLOCK_GENERATOR_DIVIDER_M
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_N0
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_N1
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_N2
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_N3
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_N_ALL
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_P0
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_P1
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_P2
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_PFB
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_P_ALL
# CCRTAICC_CLOCK_GENERATOR_DIVIDER_PXAXB
Output: none
Return:  _ccrtaicc_lib_error_number_t
         # CCRTAICC_LIB_NO_ERROR           (successful)
         # CCRTAICC_LIB_BAD_HANDLE        (no/bad handler supplied)
         # CCRTAICC_LIB_NOT_OPEN          (library not open)
         # CCRTAICC_LIB_NO_LOCAL_REGION   (local region error)
         # CCRTAICC_LIB_INVALID_ARG       (invalid argument)
         # CCRTAICC_LIB_CLOCK_IS_NOT_ACTIVE (Clock is not active)
*****/

```

2.2.160 ccrtaICC_UserProcess_Command()

The user can control the execution of the created User Process with the help of this call.

```

/*****
_ccrtaicc_lib_error_number_t
ccrtaICC_UserProcess_Command(void          *Handle,
                             void          *UFuncHandle,
                             ccrtaicc_uf_action_t Action)

Description: Command User process

Input:  void          *UFuncHandle (User Process Handle pointer)
        ccrtaicc_uf_action_t Action (command action)
        # CCRTAICC_UF_ACTION_STOP
        # CCRTAICC_UF_ACTION_RUN
        # CCRTAICC_UF_ACTION_TERMINATE

Output: none
Return: none
*****/

```

2.2.161 ccrtaICC_VoltsToData()

This call returns to the user the raw converted value for the requested voltage in the specified format. Voltage supplied must be within the input range of the selected board type. If the voltage is out of range, the call sets the voltage to the appropriate limit value.

```

/*****
uint
ccrtaICC_VoltsToData (double          volts,
                     ccrtaicc_volt_convert_t *conv)

Description: Convert Volts to data

Input:  double          volts (volts to convert)
        ccrtaicc_volt_convert_t *conv (pointer to conversion struct)
        double          VoltageRange (maximum voltage range)
        _ccrtaicc_csr_dataformat_t Format (format)
        # CCRTAICC_OFFSET_BINARY

```

```

        # CCRTAICC_TWOS_COMPLEMENT
        ccrtAICC_bool          BiPolar          (bi-polar)
        # CCRTAICC_TRUE
        # CCRTAICC_FALSE
        int                    ResolutionBits (Number of resolution bits)
Output:  none
Return:  uint                 data            (returned data)
*****/

```

2.2.162 ccrtAICC_Wait_For_Interrupt()

This call is made available to advanced users to bypass the API and perform their own data collection. The user can wait for a DMA complete interrupt. If a time out value greater than zero is specified, the call will time out after the specified seconds, otherwise it will not time out.

```

/*****
    _ccrtAICC_lib_error_number_t
    ccrtAICC_Wait_For_Interrupt (void          *Handle,
                                ccrtAICC_driver_int_t *drv_int)

Description: Wait For Interrupt

Input:  void          *Handle          (Handle pointer)
        ccrtAICC_driver_int_t *drv_int (pointer to drv_int struct)
        uint          WakeupInterruptMask
        # CCRTAICC_DMA0_INTMASK
        # CCRTAICC_DMA1_INTMASK
        # CCRTAICC_MSGDMA_INTMASK
        # CCRTAICC_ADC_FIFO_INTMASK
        int          timeout_seconds
Output: ccrtAICC_driver_int_t *drv_int (pointer to drv_int struct)
        long long unsigned count
        long long unsigned dma_count[CCRTAICC_DMA_MAX_ENGINES]
        long long unsigned MsgDma_count
        uint          InterruptsOccurredMask
        uint          WakeupInterruptMask
        int          DmaControl (DMA control flags)
        # CCRTAICC_DMA_CONTROL_RCON (read constant)
        # CCRTAICC_DMA_CONTROL_WCON (write constant)
        # CCRTAICC_DMA_CONTROL_INCREMENT (increment)
Return: _ccrtAICC_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR (successful)
        # CCRTAICC_LIB_BAD_HANDLE (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN (device not open)
        # CCRTAICC_LIB_NO_LOCAL_REGION (local region not present)
        # CCRTAICC_LIB_INVALID_ARG (invalid argument)
*****/

```

2.2.163 ccrtAICC_Write()

This call is currently not supported by the driver.

```

/*****
    _ccrtAICC_lib_error_number_t
    ccrtAICC_Write (void *Handle,
                   void *buf,
                   int size,
                   int *bytes_written,
                   int *error)

Description: Perform a write operation.

```



```

Input:  void    *Handle          (Handle pointer)
        int     size            (number of bytes to write)
Output: void    *buf            (pointer to buffer)
        int     *bytes_written  (bytes written)
        int     *error          (returned errno)
Return: _ccrtaicc_lib_error_number_t
        # CCRTAICC_LIB_NO_ERROR      (successful)
        # CCRTAICC_LIB_BAD_HANDLE   (no/bad handler supplied)
        # CCRTAICC_LIB_NOT_OPEN    (device not open)
        # CCRTAICC_LIB_IO_ERROR    (write failed)
        # CCRTAICC_LIB_NOT_IMPLEMENTED (call not implemented)
*****/

```

3. Test Programs

This driver and API are accompanied with an extensive set of test examples. Examples under the *Direct Driver Access* do not use the API, while those under *Application Program Interface Access* use the API.

3.1 Direct Driver Access Example Tests

These set of tests are located in the `.../test` directory and do not use the API. They communicate directly with the driver. Users should be extremely familiar with both the driver and the hardware registers if they wish to communicate directly with the hardware.

3.1.1 ccrtaiicc_disp

Useful program to display the local board registers. This program uses the *curses* library.

```
Usage: ./ccrtaiicc_disp [-b BoardNo] [-d Delay] [-l LoopCnt] [-o Offset] [-s Size]
-b BoardNo (Board number -- default is 0)
-d Delay (Delay between screen refresh -- default is 0)
-l LoopCnt (Loop count -- default is 0)
-o Offset (Hex offset to read from -- default is 0x0)
-s Size (Number of bytes to read -- default is 0x400)
```

Example display:

```
./ccrtaiicc_disp

Board Number [-b]: 0
Delay [-d]: 0 milli-seconds
Loop Count [-l]: ***Forever***
Offset [-o]: 0x00000000
Size [-s]: 1024 (bytes)

ScanCount = 33783

      00      04      08      0C      10      14      18      1C
=====
000000 93500101 04032019 00020000 00000000 00000000 00000000 00000000 00000000
000020 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000040 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000060 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000080 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0000a0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0000c0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0000e0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000100 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000120 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000140 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000160 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000180 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0001a0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0001c0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0001e0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000200 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000220 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000240 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000260 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000280 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0002a0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0002c0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0002e0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000300 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000320 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000340 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000360 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000380 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

```

0003a0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0003c0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0003e0  00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000

```

3.1.2 ccrtaiicc_dump

This test is for debugging purpose. It dumps all the hardware registers.

Usage: ccrtaiicc_dump [-b board]

-b board: board number -- default board is 0

Example display:

```
./ccrtaiicc_dump
```

```
Device Name: /dev/ccrtaiicc0
```

```

LOCAL REGION: Physical Addr=0xbd500000 Size=131072 (0x00020000)
CONFIG REGION: Physical Addr=0xbd520000 Size=32768 (0x00008000)

```

```

LOCAL: Register 0x7ffff7fd7000 Offset=0x0 Size=0x00020000
CONFIG: Register 0x7ffff7fcf000 Offset=0x0 Size=0x00008000
LIBPTR: Register 0x7ffff7fcd000 Offset=0x0 Size=0x00001008

```

```
===== LOCAL BOARD REGISTERS =====
```

```

LBR: @0x000000 --> 0x93500101
LBR: @0x000004 --> 0x04032019
LBR: @0x000008 --> 0x00020000
LBR: @0x00000c --> 0x00000000
LBR: @0x000010 --> 0x00000000
LBR: @0x000014 --> 0x00000000
LBR: @0x000018 --> 0x00000000
LBR: @0x00001c --> 0x00000000
LBR: @0x000020 --> 0x00000000
LBR: @0x000024 --> 0x00000000
LBR: @0x000028 --> 0x00000000
LBR: @0x00002c --> 0x00000000
LBR: @0x000030 --> 0x00000000

```

```

.
.
.

```

```

LBR: @0x01ffc --> 0x00000000
LBR: @0x01ffd0 --> 0x00000000
LBR: @0x01ffd4 --> 0x00000000
LBR: @0x01ffd8 --> 0x00000000
LBR: @0x01ffdc --> 0x00000000
LBR: @0x01ffe0 --> 0x00000000
LBR: @0x01ffe4 --> 0x00000000
LBR: @0x01ffe8 --> 0x00000000
LBR: @0x01ffec --> 0x00000000
LBR: @0x01fff0 --> 0x00000000
LBR: @0x01fff4 --> 0x00000000
LBR: @0x01fff8 --> 0x00000000
LBR: @0x01fffc --> 0x00000000

```

```
===== LOCAL CONFIG REGISTERS =====
```

```
#### CONFIG REGS (PCIeLinkPartnerRegs) ####
```

```
LCR: @0x0000 --> 0x00000000
LCR: @0x0004 --> 0x00000000
LCR: @0x0008 --> 0x00000000
LCR: @0x000c --> 0x00000000
LCR: @0x0010 --> 0x00000000
LCR: @0x0014 --> 0x00000000
LCR: @0x0018 --> 0x00000000
LCR: @0x001c --> 0x00000000
LCR: @0x0020 --> 0x00000000
LCR: @0x0024 --> 0x00000000
LCR: @0x0028 --> 0x00000000
LCR: @0x002c --> 0x00000000
LCR: @0x0030 --> 0x00000000
```

```
.
.
.
```

```
LCR: @0x0fc0 --> 0x00000000
LCR: @0x0fc4 --> 0x00000000
LCR: @0x0fc8 --> 0x00000000
LCR: @0x0fcc --> 0x00000000
LCR: @0x0fd0 --> 0x00000000
LCR: @0x0fd4 --> 0x00000000
LCR: @0x0fd8 --> 0x00000000
LCR: @0x0fdc --> 0x00000000
LCR: @0x0fe0 --> 0x00000000
LCR: @0x0fe4 --> 0x00000000
LCR: @0x0fe8 --> 0x00000000
LCR: @0x0fec --> 0x00000000
LCR: @0x0ff0 --> 0x00000000
LCR: @0x0ff4 --> 0x00000000
LCR: @0x0ff8 --> 0x00000000
LCR: @0x0ffc --> 0x00000000
```

CONFIG REGS (AvalonMM_2_PCIeAddrTrans)

```
LCR: @0x1000 --> 0x00000000
LCR: @0x1004 --> 0x00000000
LCR: @0x1008 --> 0x00000000
LCR: @0x100c --> 0x00000000
LCR: @0x1010 --> 0x00000000
LCR: @0x1014 --> 0x00000000
LCR: @0x1018 --> 0x00000000
LCR: @0x101c --> 0x00000000
LCR: @0x1020 --> 0x00000000
LCR: @0x1024 --> 0x00000000
LCR: @0x1028 --> 0x00000000
LCR: @0x102c --> 0x00000000
LCR: @0x1030 --> 0x00000000
```

```
.
.
.
```

```
LCR: @0x1fb0 --> 0x00000000
LCR: @0x1fb4 --> 0x00000000
LCR: @0x1fb8 --> 0x00000000
LCR: @0x1fbc --> 0x00000000
LCR: @0x1fc0 --> 0x00000000
```

```
LCR: @0x1fc4 --> 0x00000000
LCR: @0x1fc8 --> 0x00000000
LCR: @0x1fcc --> 0x00000000
LCR: @0x1fd0 --> 0x00000000
LCR: @0x1fd4 --> 0x00000000
LCR: @0x1fd8 --> 0x00000000
LCR: @0x1fdc --> 0x00000000
LCR: @0x1fe0 --> 0x00000000
LCR: @0x1fe4 --> 0x00000000
LCR: @0x1fe8 --> 0x00000000
LCR: @0x1fec --> 0x00000000
LCR: @0x1ff0 --> 0x00000000
LCR: @0x1ff4 --> 0x00000000
LCR: @0x1ff8 --> 0x00000000
LCR: @0x1ffc --> 0x00000000
```

CONFIG REGS (DMA Control Table)

```
LCR: @0x4000 --> 0x00000011
LCR: @0x4004 --> 0x0000700c
LCR: @0x4008 --> 0x008ac000
LCR: @0x400c --> 0x00000000
LCR: @0x4010 --> 0x00000000
LCR: @0x4014 --> 0x00000000
LCR: @0x4018 --> 0x00000000
LCR: @0x401c --> 0x00000000
LCR: @0x4020 --> 0x00000011
LCR: @0x4024 --> 0x0000ffff
LCR: @0x4028 --> 0x00827fff
LCR: @0x402c --> 0x00000000
LCR: @0x4030 --> 0x00000000
LCR: @0x4034 --> 0x00000000
LCR: @0x4038 --> 0x00000000
LCR: @0x403c --> 0x00000000
```

==== PCI CONFIG REG ADDR MAPPING =====

```
PCR: @0x0000 --> 0x93501542
PCR: @0x0004 --> 0x00100406
PCR: @0x0008 --> 0x08800001
PCR: @0x000c --> 0x00000010
PCR: @0x0010 --> 0xbd520000
PCR: @0x0014 --> 0x00000000
PCR: @0x0018 --> 0xbd500000
PCR: @0x001c --> 0x00000000
PCR: @0x0020 --> 0x00000000
PCR: @0x0024 --> 0x00000000
PCR: @0x0028 --> 0x00000000
PCR: @0x002c --> 0x01001542
PCR: @0x0030 --> 0x00000000
PCR: @0x0034 --> 0x00000050
PCR: @0x0038 --> 0x00000000
PCR: @0x003c --> 0x0000010b
PCR: @0x0040 --> 0x00000000
PCR: @0x0044 --> 0x02006160
PCR: @0x0048 --> 0x00000000
PCR: @0x004c --> 0x00000000
```

```

PCR: @0x0050 --> 0x00857805
PCR: @0x0054 --> 0xfeeff00c
PCR: @0x0058 --> 0x00000000
PCR: @0x005c --> 0x00004165
PCR: @0x0060 --> 0x00000000
PCR: @0x0064 --> 0x00000000
PCR: @0x0068 --> 0x00007811
PCR: @0x006c --> 0x00000000
PCR: @0x0070 --> 0x00000000
PCR: @0x0074 --> 0x00000000
PCR: @0x0078 --> 0x00038001
PCR: @0x007c --> 0x00000000
PCR: @0x0080 --> 0x00020010
PCR: @0x0084 --> 0x00648001
PCR: @0x0088 --> 0x00002830
PCR: @0x008c --> 0x01406441
PCR: @0x0090 --> 0x10410040
PCR: @0x0094 --> 0x00000000
PCR: @0x0098 --> 0x00000000
PCR: @0x009c --> 0x00000000
PCR: @0x00a0 --> 0x00000000
PCR: @0x00a4 --> 0x0000001f
PCR: @0x00a8 --> 0x0000000d
PCR: @0x00ac --> 0x00000000
PCR: @0x00b0 --> 0x00010001
PCR: @0x00b4 --> 0x00000000
PCR: @0x00b8 --> 0x00000000
PCR: @0x00bc --> 0x00000000
PCR: @0x00c0 --> 0x00000000
PCR: @0x00c4 --> 0x00000000
PCR: @0x00c8 --> 0x00000000
PCR: @0x00cc --> 0x00000000
PCR: @0x00d0 --> 0x00000000
PCR: @0x00d4 --> 0x00000000
PCR: @0x00d8 --> 0x00000000
PCR: @0x00dc --> 0x00000000
PCR: @0x00e0 --> 0x00000000
PCR: @0x00e4 --> 0x00000000
PCR: @0x00e8 --> 0x00000000
PCR: @0x00ec --> 0x00000000
PCR: @0x00f0 --> 0x00000000
PCR: @0x00f4 --> 0x00000000
PCR: @0x00f8 --> 0x00000000
PCR: @0x00fc --> 0x00000000`

```

3.1.3 ccrtaiicc_rdreg

This is a simple program that returns the local register value for a given offset.

```

Usage: ./ccrtaiicc_rdreg [-b Board] [-C] [-f] [-o Offset] [-s Size]
  -b Board    : Board number -- default board is 0
  -C          : Select Config Registers instead of Local Registers
  -f          : Fast Memory Reads
  -o Offset   : Hex offset to read from -- default offset is 0x0
  -s Size     : Number of bytes to read in decimal -- default size is 0x4

```

Example display:

```
./ccrtaicc_rdreg -s64
```

```
Device Name: /dev/ccrtaicc0
```

```
LOCAL REGION: Physical Addr=0xbd500000 Size=131072 (0x00020000)
CONFIG REGION: Physical Addr=0xbd520000 Size=32768 (0x00008000)
```

```
LOCAL: Register 0x7ffff7fd7000 Offset=0x0 Size=0x00020000
CONFIG: Register 0x7ffff7fcf000 Offset=0x0 Size=0x00008000
LIBPTR: Register 0x7ffff7fcd000 Offset=0x0 Size=0x00001008
```

```
#### LOCAL REGS #### (length=64)
+LCL+      0  93500101 04032019 00020000 00000000 *.P....*
+LCL+     0x10 00000000 00000000 00000000 00000000 *.....*
+LCL+     0x20 00000000 00000000 00000000 00000000 *.....*
+LCL+     0x30 00000000 00000000 00000000 00000000 *.....*
18.167us ( 3.52 MB/s)
```

```
./ccrtaicc_rdreg -C -o4020 -s20
```

```
Device Name: /dev/ccrtaicc0
```

```
LOCAL REGION: Physical Addr=0xbd500000 Size=131072 (0x00020000)
CONFIG REGION: Physical Addr=0xbd520000 Size=32768 (0x00008000)
```

```
LOCAL: Register 0x7ffff7fd7000 Offset=0x0 Size=0x00020000
CONFIG: Register 0x7ffff7fcf000 Offset=0x0 Size=0x00008000
LIBPTR: Register 0x7ffff7fcd000 Offset=0x0 Size=0x00001008
```

```
#### CONFIG REGS #### (length=20)
+CFG+   0x4020 00000011 0000ffff 00827ff0 00000000 *.....*
+CFG+   0x4030 00000000                *.....*
5.203us ( 3.84 MB/s)
```

3.1.4 ccrtaicc_reg

This call displays all the boards local and configuration registers.

```
Usage: ./ccrtaicc_reg [-b board]
-b board: Board number -- default board is 0
```

Example display:

```
./ccrtaicc_reg
```

```
Device Name: /dev/ccrtaicc0
```

```
LOCAL REGION: Physical Addr=0xbd500000 Size=131072 (0x00020000)
CONFIG REGION: Physical Addr=0xbd520000 Size=32768 (0x00008000)
```

```
LOCAL: Register 0x7ffff7fd7000 Offset=0x0 Size=0x00020000
CONFIG: Register 0x7ffff7fcf000 Offset=0x0 Size=0x00008000
LIBPTR: Register 0x7ffff7fcd000 Offset=0x0 Size=0x00001008
LOCAL Register 0x7ffff7fd7000 size=0x00020000
```

```
#### LOCAL REGS #### (length=131072)
+LCL+      0  93500101 04032019 00020000 00000000 *.P....*
+LCL+     0x10 00000000 00000000 00000000 00000000 *.....*
+LCL+     0x20 00000000 00000000 00000000 00000000 *.....*
+LCL+     0x30 00000000 00000000 00000000 00000000 *.....*
```

```

+LCL+ 0x40 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x50 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x60 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x70 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x80 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x90 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0xa0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0xb0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0xc0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0xd0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0xe0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0xf0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x100 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x110 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x120 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x130 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x140 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x150 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x160 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x170 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x180 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x190 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1a0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1b0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1c0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1d0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1e0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1f0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x200 00000000 00000000 00000000 00000000 *.....*

```

```

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.
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```

```

+LCL+ 0x1fed0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1fee0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1fef0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff00 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff10 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff20 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff30 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff40 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff50 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff60 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff70 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff80 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ff90 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ffa0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ffb0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ffc0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ffd0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1ffe0 00000000 00000000 00000000 00000000 *.....*
+LCL+ 0x1fff0 00000000 00000000 00000000 00000000 *.....*

```

CONFIG Register 0x7ffff7fcf000 size=0x00008000

```

#### CONFIG REGS (PCIeLinkPartnerRegs) #### (length=4096)
+CFG+ 0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x10 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x20 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x30 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x40 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x50 00000000 00000000 00000000 00000000 *.....*

```



```

+CFG+ 0x60 00000004 00000004 00000008 00000008 *.....*
+CFG+ 0x70 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x80 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x90 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xa0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xb0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xc0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xd0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xe0 00000004 00000004 00000008 00000008 *.....*
+CFG+ 0xf0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x100 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x110 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x120 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x130 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x140 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x150 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x160 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x170 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x180 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x190 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1a0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1b0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1c0 00000000 00000000 00000000 00000000 *.....*
.
.
.
+CFG+ 0xf00 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf10 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf20 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf30 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf40 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf50 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf60 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf70 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf80 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xf90 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xfa0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xfb0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xfc0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xfd0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xfe0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0xff0 00000000 00000000 00000000 00000000 *.....*

#### CONFIG REGS (AvalonMM_2_PCIeAddrTrans) #### (length=4096)
+CFG+ 0x1000 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1010 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1020 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1030 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1040 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1050 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1060 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1070 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1080 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1090 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x10a0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x10b0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x10c0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x10d0 00000000 00000000 00000000 00000000 *.....*
.
.
.

```

```

+CFG+ 0x1f50 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1f60 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1f70 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1f80 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1f90 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1fa0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1fb0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1fc0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1fd0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1fe0 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x1ff0 00000000 00000000 00000000 00000000 *.....*

```

```

#### CONFIG REGS (DMA Control Table) #### (length=64)
+CFG+ 0x4000 00000011 0000700c 008ac000 00000000 *.....p.....*
+CFG+ 0x4010 00000000 00000000 00000000 00000000 *.....*
+CFG+ 0x4020 00000011 0000ffff 00827ff0 00000000 *.....*
+CFG+ 0x4030 00000000 00000000 00000000 00000000 *.....*

```

===== LOCAL REGISTERS =====

```

BoardInfo =0x93500101 @0x00000000
FirmwareDate =0x04032019 @0x00000004
FirmwareRevision =0x00020000 @0x00000008
FirmwareTime =0x00000000 @0x0000000c
FirmwareFlavorCode =0x00000000 @0x00000010
NumberMsgDmaDescriptors =0x00000000 @0x00000018
BoardCSR =0x00000000 @0x00000020
InterruptStatus =0x00000000 @0x000000210
SPI_CommandStatus =0x03004000 @0x000020f0
SPI_FirmwareAddress =0x01ffff24 @0x000020f4
SPI_Ram[0] =0x80004000 @0x00002100
FPGA_ChipIdentification[0] =0x00f14102 @0x00002400
FPGA_ChipIdentification[1] =0x088a0904 @0x00002404
FPGA_ChipTemperature =0x00000000 @0x00002410
ClockGen_CSR =0x00000003 @0x00002500
ClockGen_access =0x000d00f4 @0x00002504
CalibrationCSR =0x00000000 @0x00002600
TestBusControl =0x00000000 @0x00002604
ADC_InputControl =0x00000000 @0x00002608
ExternalClockCSR =0x00610000 @0x00002700
ADC_Enable =0x00000001 @0x00003000
ADC_ControlStatus[CCRTAICC_ADC_0] =0x00000000 @0x00003010
ADC_ControlStatus[CCRTAICC_ADC_1] =0x00000000 @0x00003014
ADC_ControlStatus[CCRTAICC_ADC_2] =0x00000000 @0x00003018
ADC_ControlStatus[CCRTAICC_ADC_3] =0x00000000 @0x0000301c
ADC_FifoCSR =0x2001ffff @0x00003030
ADC_FifoThreshold =0x0001ffff @0x00003034
ADC_FifoChannelSelect[CCRTAICC_ADC_FIFO_CHANNEL_SELECT_0_31] =0xffffffff @0x00003038
ADC_FifoChannelSelect[CCRTAICC_ADC_FIFO_CHANNEL_SELECT_32_63] =0xffffffff @0x0000303c
ADC_Data[CCRTAICC_ADC_CHANNEL_0] =0x00020004 @0x00003200
ADC_Data[CCRTAICC_ADC_CHANNEL_1] =0x0001ffff @0x00003204
ADC_Data[CCRTAICC_ADC_CHANNEL_2] =0x0001ffff @0x00003208
ADC_Data[CCRTAICC_ADC_CHANNEL_3] =0x0001ffff @0x0000320c
ADC_Data[CCRTAICC_ADC_CHANNEL_4] =0x0001ffff @0x00003210
ADC_Data[CCRTAICC_ADC_CHANNEL_5] =0x0001ffff @0x00003214
ADC_Data[CCRTAICC_ADC_CHANNEL_6] =0x00020007 @0x00003218
ADC_Data[CCRTAICC_ADC_CHANNEL_7] =0x00020001 @0x0000321c
ADC_Data[CCRTAICC_ADC_CHANNEL_8] =0x00020000 @0x00003220

```

ADC_Data[CCRTAICC_ADC_CHANNEL_9]	=0x00020000	@0x00003224
ADC_Data[CCRTAICC_ADC_CHANNEL_10]	=0x00020000	@0x00003228
ADC_Data[CCRTAICC_ADC_CHANNEL_11]	=0x00020000	@0x0000322c
ADC_Data[CCRTAICC_ADC_CHANNEL_12]	=0x0001ffff	@0x00003230
ADC_Data[CCRTAICC_ADC_CHANNEL_13]	=0x00020001	@0x00003234
ADC_Data[CCRTAICC_ADC_CHANNEL_14]	=0x0001ffffe	@0x00003238
ADC_Data[CCRTAICC_ADC_CHANNEL_15]	=0x0001ffffd	@0x0000323c
ADC_Data[CCRTAICC_ADC_CHANNEL_16]	=0x00020007	@0x00003240
ADC_Data[CCRTAICC_ADC_CHANNEL_17]	=0x0001ffffe	@0x00003244
ADC_Data[CCRTAICC_ADC_CHANNEL_18]	=0x00020005	@0x00003248
ADC_Data[CCRTAICC_ADC_CHANNEL_19]	=0x0001ffffa	@0x0000324c
ADC_Data[CCRTAICC_ADC_CHANNEL_20]	=0x0001ffffc	@0x00003250
ADC_Data[CCRTAICC_ADC_CHANNEL_21]	=0x0001fffff	@0x00003254
ADC_Data[CCRTAICC_ADC_CHANNEL_22]	=0x00020002	@0x00003258
ADC_Data[CCRTAICC_ADC_CHANNEL_23]	=0x0001fffff	@0x0000325c
ADC_Data[CCRTAICC_ADC_CHANNEL_24]	=0x00020001	@0x00003260
ADC_Data[CCRTAICC_ADC_CHANNEL_25]	=0x0001ffffd	@0x00003264
ADC_Data[CCRTAICC_ADC_CHANNEL_26]	=0x0001fffff	@0x00003268
ADC_Data[CCRTAICC_ADC_CHANNEL_27]	=0x0001ffffb	@0x0000326c
ADC_Data[CCRTAICC_ADC_CHANNEL_28]	=0x0001ffffd	@0x00003270
ADC_Data[CCRTAICC_ADC_CHANNEL_29]	=0x00020003	@0x00003274
ADC_Data[CCRTAICC_ADC_CHANNEL_30]	=0x00020000	@0x00003278
ADC_Data[CCRTAICC_ADC_CHANNEL_31]	=0x0001ffffa	@0x0000327c
ADC_Data[CCRTAICC_ADC_CHANNEL_32]	=0x00020003	@0x00003280
ADC_Data[CCRTAICC_ADC_CHANNEL_33]	=0x0001ffffe	@0x00003284
ADC_Data[CCRTAICC_ADC_CHANNEL_34]	=0x0001ffffe	@0x00003288
ADC_Data[CCRTAICC_ADC_CHANNEL_35]	=0x0001ffffa	@0x0000328c
ADC_Data[CCRTAICC_ADC_CHANNEL_36]	=0x00020000	@0x00003290
ADC_Data[CCRTAICC_ADC_CHANNEL_37]	=0x0001fffff	@0x00003294
ADC_Data[CCRTAICC_ADC_CHANNEL_38]	=0x00020002	@0x00003298
ADC_Data[CCRTAICC_ADC_CHANNEL_39]	=0x00020000	@0x0000329c
ADC_Data[CCRTAICC_ADC_CHANNEL_40]	=0x00020000	@0x000032a0
ADC_Data[CCRTAICC_ADC_CHANNEL_41]	=0x00020001	@0x000032a4
ADC_Data[CCRTAICC_ADC_CHANNEL_42]	=0x00020000	@0x000032a8
ADC_Data[CCRTAICC_ADC_CHANNEL_43]	=0x00020004	@0x000032ac
ADC_Data[CCRTAICC_ADC_CHANNEL_44]	=0x00020003	@0x000032b0
ADC_Data[CCRTAICC_ADC_CHANNEL_45]	=0x00020005	@0x000032b4
ADC_Data[CCRTAICC_ADC_CHANNEL_46]	=0x00020001	@0x000032b8
ADC_Data[CCRTAICC_ADC_CHANNEL_47]	=0x00020003	@0x000032bc
ADC_Data[CCRTAICC_ADC_CHANNEL_48]	=0x00020001	@0x000032c0
ADC_Data[CCRTAICC_ADC_CHANNEL_49]	=0x00020000	@0x000032c4
ADC_Data[CCRTAICC_ADC_CHANNEL_50]	=0x0001fffff	@0x000032c8
ADC_Data[CCRTAICC_ADC_CHANNEL_51]	=0x00020001	@0x000032cc
ADC_Data[CCRTAICC_ADC_CHANNEL_52]	=0x00020005	@0x000032d0
ADC_Data[CCRTAICC_ADC_CHANNEL_53]	=0x00020001	@0x000032d4
ADC_Data[CCRTAICC_ADC_CHANNEL_54]	=0x00020003	@0x000032d8
ADC_Data[CCRTAICC_ADC_CHANNEL_55]	=0x00020000	@0x000032dc
ADC_Data[CCRTAICC_ADC_CHANNEL_56]	=0x0001ffffc	@0x000032e0
ADC_Data[CCRTAICC_ADC_CHANNEL_57]	=0x00020003	@0x000032e4
ADC_Data[CCRTAICC_ADC_CHANNEL_58]	=0x00020004	@0x000032e8
ADC_Data[CCRTAICC_ADC_CHANNEL_59]	=0x0001ffffe	@0x000032ec
ADC_Data[CCRTAICC_ADC_CHANNEL_60]	=0x00020009	@0x000032f0
ADC_Data[CCRTAICC_ADC_CHANNEL_61]	=0x00020001	@0x000032f4
ADC_Data[CCRTAICC_ADC_CHANNEL_62]	=0x0001ffffc	@0x000032f8
ADC_Data[CCRTAICC_ADC_CHANNEL_63]	=0x00020000	@0x000032fc
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_0]	=0x8004959d	@0x00003500
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_1]	=0x7ffeeefe	@0x00003504
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_2]	=0x8003dfb0	@0x00003508
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_3]	=0x7ffbeeca	@0x0000350c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_4]	=0x8003aeae	@0x00003510
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_5]	=0x800344ac	@0x00003514

ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_6]	=0x800014f7	@0x00003518
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_7]	=0x8003cf21	@0x0000351c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_8]	=0x7ffe4793	@0x00003520
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_9]	=0x7ffe175d	@0x00003524
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_10]	=0x7ffc3bc38	@0x00003528
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_11]	=0x7ffbda07	@0x0000352c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_12]	=0x80047fda	@0x00003530
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_13]	=0x7ffe98d	@0x00003534
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_14]	=0x8009981b	@0x00003538
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_15]	=0x800af6f4	@0x0000353c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_16]	=0x80011262	@0x00003540
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_17]	=0x80045ac7	@0x00003544
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_18]	=0x7ffe93b5	@0x00003548
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_19]	=0x8006d462	@0x0000354c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_20]	=0x80038314	@0x00003550
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_21]	=0x8006361d	@0x00003554
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_22]	=0x80056e8d	@0x00003558
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_23]	=0x80081733	@0x0000355c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_24]	=0x80039e55	@0x00003560
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_25]	=0x8001dd2e	@0x00003564
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_26]	=0x8001d279	@0x00003568
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_27]	=0x8005a9c4	@0x0000356c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_28]	=0x80012070	@0x00003570
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_29]	=0x7ffdbffc	@0x00003574
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_30]	=0x8008c961	@0x00003578
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_31]	=0x800789a5	@0x0000357c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_32]	=0x8002fc4a	@0x00003580
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_33]	=0x8006028d	@0x00003584
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_34]	=0x8004af63	@0x00003588
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_35]	=0x80087407	@0x0000358c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_36]	=0x800178d0	@0x00003590
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_37]	=0x80069cb9	@0x00003594
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_38]	=0x7fff77a0	@0x00003598
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_39]	=0x7fff8169	@0x0000359c
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_40]	=0x80031b3a	@0x000035a0
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_41]	=0x8001049e	@0x000035a4
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_42]	=0x8005dcd7	@0x000035a8
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_43]	=0x80032bf0	@0x000035ac
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_44]	=0x8008fc4c	@0x000035b0
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_45]	=0x8002dd6c	@0x000035b4
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_46]	=0x800547f7	@0x000035b8
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_47]	=0x8002ff43	@0x000035bc
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_48]	=0x8006bef4	@0x000035c0
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_49]	=0x8001ee93	@0x000035c4
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_50]	=0x8003d0f3	@0x000035c8
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_51]	=0x7ffe7bbe	@0x000035cc
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_52]	=0x8006c500	@0x000035d0
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_53]	=0x8006e672	@0x000035d4
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_54]	=0x800434e0	@0x000035d8
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_55]	=0x80014e4e	@0x000035dc
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_56]	=0x80070db7	@0x000035e0
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_57]	=0x8008bc6b	@0x000035e4
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_58]	=0x8007cef9	@0x000035e8
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_59]	=0x80098a6c	@0x000035ec
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_60]	=0x8002ae77	@0x000035f0
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_61]	=0x80048787	@0x000035f4
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_62]	=0x80031401	@0x000035f8
ADC_PositiveCalibration[CCRTAICC_ADC_CHANNEL_63]	=0x80091408	@0x000035fc
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_0]	=0x8005d6d6	@0x00003600
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_1]	=0x7ffe7ffa	@0x00003604
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_2]	=0x80042ef8	@0x00003608

ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_3]	=0x7ffbf550	@0x0000360c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_4]	=0x8003ee19	@0x00003610
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_5]	=0x8002f701	@0x00003614
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_6]	=0x8001357a	@0x00003618
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_7]	=0x8004b664	@0x0000361c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_8]	=0x7ffeeca7	@0x00003620
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_9]	=0x7ffe5519	@0x00003624
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_10]	=0x7ffd6b9a	@0x00003628
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_11]	=0x7ffc2d8c	@0x0000362c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_12]	=0x8004eb9e	@0x00003630
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_13]	=0x7fff3d16	@0x00003634
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_14]	=0x800a5d9a	@0x00003638
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_15]	=0x800b7359	@0x0000363c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_16]	=0x80016de6	@0x00003640
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_17]	=0x800371a5	@0x00003644
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_18]	=0x7fff4e3e	@0x00003648
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_19]	=0x80063a52	@0x0000364c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_20]	=0x8003d183	@0x00003650
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_21]	=0x8005b749	@0x00003654
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_22]	=0x80066c72	@0x00003658
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_23]	=0x800832d3	@0x0000365c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_24]	=0x80037d87	@0x00003660
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_25]	=0x8001ab7c	@0x00003664
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_26]	=0x800186a7	@0x00003668
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_27]	=0x800574de	@0x0000366c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_28]	=0x8001431f	@0x00003670
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_29]	=0x7ffd9805	@0x00003674
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_30]	=0x800923ad	@0x00003678
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_31]	=0x80074d0d	@0x0000367c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_32]	=0x800348a5	@0x00003680
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_33]	=0x8005b1c8	@0x00003684
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_34]	=0x8004486c	@0x00003688
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_35]	=0x8007e53e	@0x0000368c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_36]	=0x800172a5	@0x00003690
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_37]	=0x80061e9d	@0x00003694
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_38]	=0x7fffdc94	@0x00003698
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_39]	=0x7fffe5b0	@0x0000369c
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_40]	=0x80027472	@0x000036a0
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_41]	=0x80009319	@0x000036a4
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_42]	=0x8005e276	@0x000036a8
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_43]	=0x800298cc	@0x000036ac
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_44]	=0x80097519	@0x000036b0
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_45]	=0x80027131	@0x000036b4
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_46]	=0x8005d3fd	@0x000036b8
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_47]	=0x8002de03	@0x000036bc
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_48]	=0x80062cc2	@0x000036c0
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_49]	=0x8000a24b	@0x000036c4
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_50]	=0x800401eb	@0x000036c8
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_51]	=0x7ffdeccf	@0x000036cc
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_52]	=0x80077663	@0x000036d0
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_53]	=0x8006d3ff	@0x000036d4
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_54]	=0x80041297	@0x000036d8
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_55]	=0x80010e93	@0x000036dc
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_56]	=0x800685c6	@0x000036e0
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_57]	=0x8007d1d9	@0x000036e4
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_58]	=0x80079571	@0x000036e8
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_59]	=0x8008e3c5	@0x000036ec
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_60]	=0x8002e763	@0x000036f0
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_61]	=0x80047caa	@0x000036f4
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_62]	=0x8002a288	@0x000036f8
ADC_NegativeCalibration[CCRTAICC_ADC_CHANNEL_63]	=0x8008ee50	@0x000036fc

ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_0]	=0x0003ffff	@0x00003700
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_1]	=0x0003ffff	@0x00003704
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_2]	=0x0003ffff	@0x00003708
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_3]	=0x00000000	@0x0000370c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_4]	=0x0003ffff	@0x00003710
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_5]	=0x0003ffff	@0x00003714
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_6]	=0x0003ffff	@0x00003718
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_7]	=0x0003ffff	@0x0000371c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_8]	=0x0003ffff	@0x00003720
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_9]	=0x0003ffff	@0x00003724
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_10]	=0x0003ffff	@0x00003728
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_11]	=0x0003ffff	@0x0000372c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_12]	=0x0003ffff	@0x00003730
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_13]	=0x0003ffff	@0x00003734
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_14]	=0x0003ffff	@0x00003738
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_15]	=0x0003ffff	@0x0000373c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_16]	=0x0003ffff	@0x00003740
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_17]	=0x00000001	@0x00003744
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_18]	=0x0003ffff	@0x00003748
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_19]	=0x00000001	@0x0000374c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_20]	=0x0003ffff	@0x00003750
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_21]	=0x00000001	@0x00003754
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_22]	=0x0003ffff	@0x00003758
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_23]	=0x0003ffff	@0x0000375c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_24]	=0x0003ffff	@0x00003760
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_25]	=0x0003ffff	@0x00003764
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_26]	=0x0003ffff	@0x00003768
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_27]	=0x00000001	@0x0000376c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_28]	=0x0003ffff	@0x00003770
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_29]	=0x00000000	@0x00003774
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_30]	=0x0003ffff	@0x00003778
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_31]	=0x0003ffff	@0x0000377c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_32]	=0x0003ffff	@0x00003780
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_33]	=0x00000001	@0x00003784
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_34]	=0x0003ffff	@0x00003788
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_35]	=0x00000000	@0x0000378c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_36]	=0x00000000	@0x00003790
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_37]	=0x00000001	@0x00003794
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_38]	=0x0003ffff	@0x00003798
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_39]	=0x00000001	@0x0000379c
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_40]	=0x00000001	@0x000037a0
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_41]	=0x00000001	@0x000037a4
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_42]	=0x0003ffff	@0x000037a8
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_43]	=0x00000001	@0x000037ac
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_44]	=0x0003ffff	@0x000037b0
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_45]	=0x00000001	@0x000037b4
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_46]	=0x0003ffff	@0x000037b8
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_47]	=0x0003ffff	@0x000037bc
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_48]	=0x00000001	@0x000037c0
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_49]	=0x00000002	@0x000037c4
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_50]	=0x0003ffff	@0x000037c8
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_51]	=0x00000001	@0x000037cc
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_52]	=0x0003ffff	@0x000037d0
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_53]	=0x00000000	@0x000037d4
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_54]	=0x00000000	@0x000037d8
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_55]	=0x00000001	@0x000037dc
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_56]	=0x00000000	@0x000037e0
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_57]	=0x00000002	@0x000037e4
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_58]	=0x00000000	@0x000037e8
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_59]	=0x00000002	@0x000037ec
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_60]	=0x0003ffff	@0x000037f0

```

ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_61] =0x0003ffff @0x000037f4
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_62] =0x0003ffff @0x000037f8
ADC_OffsetCalibration[CCRTAICC_ADC_CHANNEL_63] =0x0003ffff @0x000037fc
ADC_FifoData =0x0501ffff @0x00003400
SDRAM_Enable =0x00000000 @0x00007000
SDRAM_CSR =0x00000000 @0x00007004
SDRAM_Address =0x00000000 @0x00007008
SDRAM_Data =0x00000000 @0x0000700c
DiagRam[0] =0xface0000 @0x00008000
FpgawbRevision =0x00000000 @0x0001f000

===== CONFIG REGISTERS =====
PciLinkPartners.a2p_interrupt_status =0x00000000 @0x00000040
PciLinkPartners.a2p_interrupt_enable =0x00000000 @0x00000050

#### PCIe Link Partners (p2a_mailbox) #### (length=32)
+P2A+ 0x800 00000000 00000000 00000000 00000000 *.....*
+P2A+ 0x810 00000000 00000000 00000000 00000000 *.....*

#### PCIe Link Partners (a2p_mailbox) #### (length=32)
+A2P+ 0x900 00000000 00000000 00000000 00000000 *.....*
+A2P+ 0x910 00000000 00000000 00000000 00000000 *.....*

DMAEngine[CCRTAICC_DMA0].dma_status =0x00000011 @0x00004000
DMAEngine[CCRTAICC_DMA0].dma_readaddress =0x0000700c @0x00004004
DMAEngine[CCRTAICC_DMA0].dma_writeaddress =0x0008ac000 @0x00004008
DMAEngine[CCRTAICC_DMA0].dma_length =0x00000000 @0x0000400c
DMAEngine[CCRTAICC_DMA0].dma_control =0x00000000 @0x00004018

DMAEngine[CCRTAICC_DMA1].dma_status =0x00000011 @0x00004020
DMAEngine[CCRTAICC_DMA1].dma_readaddress =0x0000ffff0 @0x00004024
DMAEngine[CCRTAICC_DMA1].dma_writeaddress =0x000827ff0 @0x00004028
DMAEngine[CCRTAICC_DMA1].dma_length =0x00000000 @0x0000402c
DMAEngine[CCRTAICC_DMA1].dma_control =0x00000000 @0x00004038

MsgDmaDispatcherCsr.Status =0x00000000 @0x00004200
MsgDmaDispatcherCsr.Control =0x00000000 @0x00004204
MsgDmaDispatcherCsr.ReadFillLevel =0x00000000 @0x00004208
MsgDmaDispatcherCsr.WriteFillLevel =0x00000000 @0x0000420a
MsgDmaDispatcherCsr.ResponseFillLevel =0x00000000 @0x0000420c
MsgDmaDispatcherCsr.ReadSequenceNumber =0x00000000 @0x00004210
MsgDmaDispatcherCsr.WriteSequenceNumber =0x00000000 @0x00004212

MsgDmaPrefetcherCsr.Control =0x00000000 @0x00004220
MsgDmaPrefetcherCsr.NextDescriptorPointerLow =0x00000000 @0x00004224
MsgDmaPrefetcherCsr.NextDescriptorPointerHigh =0x00000000 @0x00004228
MsgDmaPrefetcherCsr.DescriptorPollingFrequency =0x00000000 @0x0000422c
MsgDmaPrefetcherCsr.Status =0x00000000 @0x00004230

=== Descriptor at offset 0 ===
MsgDmaExtendedDescriptor[Id].ReadAddressLow =0x00000000 @0x00004800
MsgDmaExtendedDescriptor[Id].WriteAddressLow =0x00000000 @0x00004804
MsgDmaExtendedDescriptor[Id].Length =0x00000000 @0x00004808
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerLow =0x00000000 @0x0000480c
MsgDmaExtendedDescriptor[Id].ActualBytesTransferred =0x00000000 @0x00004810
MsgDmaExtendedDescriptor[Id].Status =0x00000000 @0x00004814
MsgDmaExtendedDescriptor[Id].SequenceNumber =0x00000000 @0x0000481c
MsgDmaExtendedDescriptor[Id].ReadBurstCount =0x00000000 @0x0000481e
MsgDmaExtendedDescriptor[Id].WriteBurstCount =0x00000000 @0x0000481f
MsgDmaExtendedDescriptor[Id].ReadStride =0x00000000 @0x00004820
MsgDmaExtendedDescriptor[Id].WriteStride =0x00000000 @0x00004822

```

```

MsgDmaExtendedDescriptor[Id].ReadAddressHigh      =0x00000000 @0x00004824
MsgDmaExtendedDescriptor[Id].WriteAddressHigh     =0x00000000 @0x00004828
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerHigh
                                                    =0x00000000 @0x0000482c
MsgDmaExtendedDescriptor[Id].Control              =0x00000000 @0x0000483c
=== Descriptor at offset 1 ===
MsgDmaExtendedDescriptor[Id].ReadAddressLow       =0x00000000 @0x00004840
MsgDmaExtendedDescriptor[Id].WriteAddressLow      =0x00000000 @0x00004844
MsgDmaExtendedDescriptor[Id].Length               =0x00000000 @0x00004848
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerLow
                                                    =0x00000000 @0x0000484c
MsgDmaExtendedDescriptor[Id].ActualBytesTransferred=0x00000000 @0x00004850
MsgDmaExtendedDescriptor[Id].Status               =0x00000000 @0x00004854
MsgDmaExtendedDescriptor[Id].SequenceNumber      =0x00000000 @0x0000485c
MsgDmaExtendedDescriptor[Id].ReadBurstCount      =0x00000000 @0x0000485e
MsgDmaExtendedDescriptor[Id].WriteBurstCount     =0x00000000 @0x0000485f
MsgDmaExtendedDescriptor[Id].ReadStride          =0x00000000 @0x00004860
MsgDmaExtendedDescriptor[Id].WriteStride         =0x00000000 @0x00004862
MsgDmaExtendedDescriptor[Id].ReadAddressHigh     =0x00000000 @0x00004864
MsgDmaExtendedDescriptor[Id].WriteAddressHigh    =0x00000000 @0x00004868
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerHigh
                                                    =0x00000000 @0x0000486c
MsgDmaExtendedDescriptor[Id].Control              =0x00000000 @0x0000487c

=== Descriptor at offset 2 ===
MsgDmaExtendedDescriptor[Id].ReadAddressLow       =0x00000000 @0x00004880
MsgDmaExtendedDescriptor[Id].WriteAddressLow      =0x00000000 @0x00004884
MsgDmaExtendedDescriptor[Id].Length               =0x00000000 @0x00004888
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerLow
                                                    =0x00000000 @0x0000488c
MsgDmaExtendedDescriptor[Id].ActualBytesTransferred=0x00000000 @0x00004890
MsgDmaExtendedDescriptor[Id].Status               =0x00000000 @0x00004894
MsgDmaExtendedDescriptor[Id].SequenceNumber      =0x00000000 @0x0000489c
MsgDmaExtendedDescriptor[Id].ReadBurstCount      =0x00000000 @0x0000489e
MsgDmaExtendedDescriptor[Id].WriteBurstCount     =0x00000000 @0x0000489f
MsgDmaExtendedDescriptor[Id].ReadStride          =0x00000000 @0x000048a0
MsgDmaExtendedDescriptor[Id].WriteStride         =0x00000000 @0x000048a2
MsgDmaExtendedDescriptor[Id].ReadAddressHigh     =0x00000000 @0x000048a4
MsgDmaExtendedDescriptor[Id].WriteAddressHigh    =0x00000000 @0x000048a8
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerHigh
                                                    =0x00000000 @0x000048ac
MsgDmaExtendedDescriptor[Id].Control              =0x00000000 @0x000048bc

=== Descriptor at offset 3 ===
MsgDmaExtendedDescriptor[Id].ReadAddressLow       =0x00000000 @0x000048c0
MsgDmaExtendedDescriptor[Id].WriteAddressLow      =0x00000000 @0x000048c4
MsgDmaExtendedDescriptor[Id].Length               =0x00000000 @0x000048c8
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerLow
                                                    =0x00000000 @0x000048cc
MsgDmaExtendedDescriptor[Id].ActualBytesTransferred=0x00000000 @0x000048d0
MsgDmaExtendedDescriptor[Id].Status               =0x00000000 @0x000048d4
MsgDmaExtendedDescriptor[Id].SequenceNumber      =0x00000000 @0x000048dc
MsgDmaExtendedDescriptor[Id].ReadBurstCount      =0x00000000 @0x000048de
MsgDmaExtendedDescriptor[Id].WriteBurstCount     =0x00000000 @0x000048df
MsgDmaExtendedDescriptor[Id].ReadStride          =0x00000000 @0x000048e0
MsgDmaExtendedDescriptor[Id].WriteStride         =0x00000000 @0x000048e2
MsgDmaExtendedDescriptor[Id].ReadAddressHigh     =0x00000000 @0x000048e4
MsgDmaExtendedDescriptor[Id].WriteAddressHigh    =0x00000000 @0x000048e8
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerHigh
                                                    =0x00000000 @0x000048ec
MsgDmaExtendedDescriptor[Id].Control              =0x00000000 @0x000048fc

```



```

.
.
.
=== Descriptor at offset 29 ===
MsgDmaExtendedDescriptor[Id].ReadAddressLow      =0x00000000 @0x00004f40
MsgDmaExtendedDescriptor[Id].WriteAddressLow     =0x00000000 @0x00004f44
MsgDmaExtendedDescriptor[Id].Length              =0x00000000 @0x00004f48
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerLow
                                                    =0x00000000 @0x00004f4c
MsgDmaExtendedDescriptor[Id].ActualBytesTransferred=0x00000000 @0x00004f50
MsgDmaExtendedDescriptor[Id].Status              =0x00000000 @0x00004f54
MsgDmaExtendedDescriptor[Id].SequenceNumber      =0x00000000 @0x00004f5c
MsgDmaExtendedDescriptor[Id].ReadBurstCount      =0x00000000 @0x00004f5e
MsgDmaExtendedDescriptor[Id].WriteBurstCount     =0x00000000 @0x00004f5f
MsgDmaExtendedDescriptor[Id].ReadStride          =0x00000000 @0x00004f60
MsgDmaExtendedDescriptor[Id].WriteStride         =0x00000000 @0x00004f62
MsgDmaExtendedDescriptor[Id].ReadAddressHigh     =0x00000000 @0x00004f64
MsgDmaExtendedDescriptor[Id].WriteAddressHigh    =0x00000000 @0x00004f68
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerHigh
                                                    =0x00000000 @0x00004f6c
MsgDmaExtendedDescriptor[Id].Control              =0x00000000 @0x00004f7c

=== Descriptor at offset 30 ===
MsgDmaExtendedDescriptor[Id].ReadAddressLow      =0x00000000 @0x00004f80
MsgDmaExtendedDescriptor[Id].WriteAddressLow     =0x00000000 @0x00004f84
MsgDmaExtendedDescriptor[Id].Length              =0x00000000 @0x00004f88
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerLow
                                                    =0x00000000 @0x00004f8c
MsgDmaExtendedDescriptor[Id].ActualBytesTransferred=0x00000000 @0x00004f90
MsgDmaExtendedDescriptor[Id].Status              =0x00000000 @0x00004f94
MsgDmaExtendedDescriptor[Id].SequenceNumber      =0x00000000 @0x00004f9c
MsgDmaExtendedDescriptor[Id].ReadBurstCount      =0x00000000 @0x00004f9e
MsgDmaExtendedDescriptor[Id].WriteBurstCount     =0x00000000 @0x00004f9f
MsgDmaExtendedDescriptor[Id].ReadStride          =0x00000000 @0x00004fa0
MsgDmaExtendedDescriptor[Id].WriteStride         =0x00000000 @0x00004fa2
MsgDmaExtendedDescriptor[Id].ReadAddressHigh     =0x00000000 @0x00004fa4
MsgDmaExtendedDescriptor[Id].WriteAddressHigh    =0x00000000 @0x00004fa8
MsgDmaExtendedDescriptor[Id].NextDescriptorPointerHigh
                                                    =0x00000000 @0x00004fac
MsgDmaExtendedDescriptor[Id].Control              =0x00000000 @0x00004fbc

=== Terminating Descriptor at offset 31 ===
MsgDmaTerminatingDescriptor.ReadAddressLow      =0x00000000 @0x00004fc0
MsgDmaTerminatingDescriptor.WriteAddressLow     =0x00000000 @0x00004fc4
MsgDmaTerminatingDescriptor.Length              =0x00000000 @0x00004fc8
MsgDmaTerminatingDescriptor.NextDescriptorPointerLow
                                                    =0x00000000 @0x00004fcc
MsgDmaTerminatingDescriptor.ActualBytesTransferred=0x00000000 @0x00004fd0
MsgDmaTerminatingDescriptor.Status              =0x00000000 @0x00004fd4
MsgDmaTerminatingDescriptor.SequenceNumber      =0x00000000 @0x00004fdc
MsgDmaTerminatingDescriptor.ReadBurstCount      =0x00000000 @0x00004fde
MsgDmaTerminatingDescriptor.WriteBurstCount     =0x00000000 @0x00004fdf
MsgDmaTerminatingDescriptor.ReadStride          =0x00000000 @0x00004fe0
MsgDmaTerminatingDescriptor.WriteStride         =0x00000000 @0x00004fe2
MsgDmaTerminatingDescriptor.ReadAddressHigh     =0x00000000 @0x00004fe4
MsgDmaTerminatingDescriptor.WriteAddressHigh    =0x00000000 @0x00004fe8
MsgDmaTerminatingDescriptor.NextDescriptorPointerHigh
                                                    =0x00000000 @0x00004fec
MsgDmaTerminatingDescriptor.Control              =0x00000000 @0x00004ffc

```

3.1.5 ccrtaiicc_regedit

This is an interactive test to display and write to local, configuration and physical memory.

Usage: ./ccrtaiicc_regedit [-b board]
-b board: Board number -- default board is 0

Example display:

```
./ccrtaiicc_regedit
```

```
Device Name: /dev/ccrtaiicc0
```

```
LOCAL REGION: Physical Addr=0xbd500000 Size=131072 (0x00020000)  
CONFIG REGION: Physical Addr=0xbd520000 Size=32768 (0x00008000)
```

```
LOCAL: Register 0x7ffff7fd7000 Offset=0x0 Size=0x00020000  
CONFIG: Register 0x7ffff7fcf000 Offset=0x0 Size=0x00008000  
LIBPTR: Register 0x7ffff7fcd000 Offset=0x0 Size=0x00001008
```

```
Initialize_Board: Firmware Rev. 0x10000 successful
```

```
Virtual Address: 0x7ffff7fd7000
```

1 = Create Physical Memory	2 = Destroy Physical memory
3 = Display Channel Data	4 = Display Driver Information
5 = Display Physical Memory Info	6 = Display Registers (CONFIG)
7 = Display Registers (LOCAL)	8 = Dump Physical Memory
9 = Reset Board	10 = Write Register (LOCAL)
11 = Write Register (CONFIG)	12 = Write Physical Memory

```
Main Selection ('h'=display menu, 'q'=quit)->
```

3.1.6 ccrtaiicc_tst

This is an interactive test to exercise some of the driver features.

Usage: ./ccrtaiicc_tst [-b board]
-b board: Board number -- default board is 0

Example display:

```
./ccrtaiicc_tst
```

```
Device Name: /dev/ccrtaiicc0
```

```
LOCAL REGION: Physical Addr=0xbd500000 Size=131072 (0x00020000)  
CONFIG REGION: Physical Addr=0xbd520000 Size=32768 (0x00008000)
```

```
LOCAL: Register 0x7ffff7fd7000 Offset=0x0 Size=0x00020000  
CONFIG: Register 0x7ffff7fcf000 Offset=0x0 Size=0x00008000  
LIBPTR: Register 0x7ffff7fcd000 Offset=0x0 Size=0x00001008
```

```
Initialize_Board: Firmware Rev. 0x10000 successful
```

01 = add irq	02 = disable pci interrupts
03 = enable pci interrupts	04 = get device error
05 = get driver info	06 = get physical memory
07 = init board	08 = mmap select
09 = mmap(CONFIG registers)	10 = mmap(LOCAL registers)
11 = mmap(physical memory)	12 = munmap(physical memory)

```

13 = no command          14 = read operation
15 = remove irq         16 = reset board
17 = restore config registers 18 = write operation

```

Main Selection ('h'=display menu, 'q'=quit)->

3.1.7 ccrtaiicc_wreg

This is a simple test to write to the local registers at the user specified offset.

```

Usage: ./ccrtaiicc_wreg [-b Board] [-C] [-o Offset] [-s Size] [-v Value] [-x]
-b Board   : Board selection -- default board is 0
-C         : Select Config Registers instead of Local Registers
-o Offset  : Hex offset to write to -- default offset is 0x0
-s Size    : Number of bytes to write in decimal -- default size is 0x4
-v Value   : Hex value to write at offset -- default value is 0x0
-x        : Do not read back just written values -- default read back values

```

Example display:

```
./ccrtaiicc_wreg -v12345678 -o0x8000 -s400
```

```
Device Name: /dev/ccrtaiicc0
```

```

LOCAL REGION: Physical Addr=0xbd500000 Size=131072 (0x00020000)
CONFIG REGION: Physical Addr=0xbd520000 Size=32768 (0x00008000)

```

```

LOCAL: Register 0x7ffff7fd7000 Offset=0x0 Size=0x00020000
CONFIG: Register 0x7ffff7fcf000 Offset=0x0 Size=0x00008000
LIBPTR: Register 0x7ffff7fcd000 Offset=0x0 Size=0x00001008

```

Writing 0x12345678 to offset 0x8000 for 400 bytes

```

#### LOCAL REGS #### (length=400)
+LCL+ 0x8000 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8010 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8020 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8030 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8040 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8050 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8060 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8070 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8080 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8090 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x80a0 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x80b0 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x80c0 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x80d0 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x80e0 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x80f0 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8100 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8110 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8120 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8130 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8140 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8150 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8160 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8170 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*
+LCL+ 0x8180 12345678 12345678 12345678 12345678 *.4Vx.4Vx.4Vx.4Vx*

```

3.1.8 Flash/ccrtaicc_flash

This program is used to burn new firmware or update the license of an already installed firmware. It can also be used to reload the firmware on the card. This must only be done at the direction of Concurrent Real-Time support team, otherwise, they could render the board useless.

```
./ccrtaicc_flash -b[Board] -B -F[!] -i -L -q -Q -r[OutFile] -R -v -w[InFile] -X
-b [Board]      : Board number. Must be specified
-B             : Reload Base Level Firmware if MultiFirmware support present
-F            : Force Read Flash: Overwrite output file if exists
-F            : Force Write Flash: Do not abort Flash burn for header label
              mismatch
-F!           : Force Write Flash: Serious override required to continue
              burning
-i            : Query chip, on-board flash and InFile if specified
-L           : Update License only. (default is to update entire firmware)
-q           : Quite (non-interactive) mode
-Q           : Quite (non-interactive) mode. Also dump FPGAWB message
-r           : Read Flash and write to output file created by
              ./ccrtaicc_flash
-r [OutFile]   : Read Flash and write to output file 'OutFile'
-R           : Reload Firmware at sector address in Flash
-R [SectorNumber] : Reload Firmware at sector address 'SectorNumber'
-v           : Enable verbose mode
-w [InFile]   : Read input FPGA file and Flash the board
-X           : Use Full File. Do not truncate for firmware write
```

```
===== Notes =====
Board must be specified. Use '-b' option
Query option '-i' not allowed with '-B', '-R#', '-L', 'r' or '-X' options
Firmware reload '-B' or '-R' not allowed with '-i', '-L', '-r', '-w' or '-X' options
Firmware read flash '-r' not allowed with '-B', '-i', '-L', '-R', '-w' or '-X' options
Base Run Level '-B' or '-R#' option not allowed with '-i', '-L', 'r', '-w' or '-X' options
Must specify write flash option '-w' when license only option '-L' is specified
License only option '-L' not allowed with '-B', '-i', '-R', '-w' or '-X' options
Don't truncate file option '-X' cannot be selected with the license only update '-L' option
Don't truncate file option '-X' can only be used with the '-w' option
Inquiry '-i' can be used '-w' options
=====
```

```
e.g. ./ccrtaicc_flash -b0                (Query chip and on-board Flash)
     ./ccrtaicc_flash -b0 -i             (Query chip and on-board Flash)
     ./ccrtaicc_flash -b0 -i -w InFile   (Query chip, on-board Flash and InFile)
     ./ccrtaicc_flash -b0 -r OutFile     (On-board FPGA ==> OutFile)
     ./ccrtaicc_flash -b0 -w InFile      (InFile ==> On-board FPGA - use truncated file)
     ./ccrtaicc_flash -b0 -w InFile -v   (InFile ==> On-board FPGA - use truncated file -
     verbose)
     ./ccrtaicc_flash -b0 -w InFile -X   (InFile ==> On-board FPGA - use entire file)
     ./ccrtaicc_flash -b0 -w InFile -L   (InFile ==> On-board FPGA - only license updated
     - interactive)
     ./ccrtaicc_flash -b0 -w InFile -L -q (InFile ==> On-board FPGA - only license updated
     - non-interactive)
     ./ccrtaicc_flash -b0 -R             (Reload Firmware - i.e. power-cycle the card)
     - Run Level
     ./ccrtaicc_flash -b0 -B             (Reload Firmware - i.e. power-cycle the card)
     - Base Level
     ./ccrtaicc_flash -b0 -R 0           (Reload Firmware - i.e. power-cycle the card)
     - Base Level
     ./ccrtaicc_flash -b0 -R 200         (Reload Firmware - i.e. power-cycle the card)
     - at sector 200
```



*If the installed firmware is a Multi-Level firmware and you are running at Base Level, then the only utility that will be able to access the card will be this **ccrtaicc_flash** utility. You will need to switch to Run Level before un-restricted access is allowed to the card.*

3.1.9 Flash/ccrtaicc_label

This utility is only supplied for those customers that are creating their own firmware and need to install in a RedHawk system. In its simplest form, the customer will request a License file from Concurrent Real-Time for the option to burn their custom firmware. The license file (*.lic) supplied by Concurrent Real-Time, along with the customer firmware (*.rpd) file will be supplied to this utility to create a burnable FPGA file (*.cust), that will be supplied to the *ccrtaicc_flash* utility to burn the firmware on the card.

The user can also supply the '-x' option to additionally create a license only file (*.cust.liconly) file that is associated with the firmware (.rpd). This is useful if you only wish to update the license information of a card that already has the same firmware installed. This is similar to having a (*.cust) file and using the '-L' option when running the *ccrtaicc_flash* utility.

```
./ccrtaicc_label -d[OutputDirectory] -c[ChipName] -F -i[InputFile] -K[FpgawbKey]
                 -L[LicenseFile] -m[MemberCode] -o[OutputFile]
                 -S[RunLevelSectorAddress] -t[Tag] -x
-d [OutputDirectory] : Directory to use for Output File
-c [ChipName]       : Chip Name. One of:
                    EPCQ16 EPCQ32 EPCQ64 EPCQ128 EPCQ256 EPCQ512
                    (This option is mandatory if not specified in license file)
-F                 : Force overwriting of output file if it exists
-i [InputFile]     : Raw input file. (.rpd extension)
-K [FpgawbKey]    : Fpgawb Key is required if license contains FPGA workbench
                    restriction
-L [LicenseFile]   : License file (.lic extension) to restrict firmware access (this
                    option is mandatory)
                    If '-i' option is not specified, the license file is dumped to
                    stderr
-m [MemberCode]    : Specify Member Code (C7)
                    (This option is mandatory if not specified in license file)
-o [OutputFile]    : Use output file instead of the default file created by the
                    program
-S [RunLevelSectorAddress] : Run Level Sector Address. (This option is mandatory if not
                    specified in license file)
                    : S0=Base Level, S#=Run Level Number
-t [Tag]           : Insert this tag name in the default file created by the program
-x                 : Create an additional license only file (*.liconly)
```

==== Notes ====

- Options '-L' is required. If option '-i' is not specified, license file is dumped
- Options '-c', '-m' and '-S' are required if they have not already been defined in LicenseFile
- You cannot specify a Run Level Sector '-S' with Single Level Firmware '-1' option
- Run Level Sector address of zero '-S0' represents the Base Level Firmware in Multi-Firmware support
- If option '-o' is not specified, the created customer FPGA file name will be as follows:
<OutputDirectory>/<InputFile>_<Tag>_<Function>_<ChipName><MemberCode><RunLevel>.cust
- If the license file contains an FPGAWB restrict key, then the '-K' FpgawbKey is required

```
e.g. ./ccrtaicc_label -iraw_file.rpd -L LicenseFile.lic (in its simplest form)
      (output file created is: 'raw_file_<Function>_<ChipName><MemberCode><RunLevel>.cust')
./ccrtaicc_label -L LicenseFile.lic (this will display licensing information)
./ccrtaicc_label -iraw_RUN_file.rpd -ooutput_file.cust -S150 -L LicenseFile.lic
./ccrtaicc_label -iraw_SINGLE_file.rpd -L LicenseFile.lic
./ccrtaicc_label -iraw_RUN_file.rpd -ooutput_file.cust -S200 -L LicenseFile.lic
./ccrtaicc_label -iraw_BASE_file.rpd -S0 -L LicenseFile.lic
      (Will cause firmware to be loaded at start offset Base Run Level)
```

3.1.10 Flash/ccrtaicc_dump_license

This utility allows the customer to dump the license information from a firmware (*.cust) file or the (*.liconly) file.

Format: ./ccrtaicc_dump_license <Firmware file>

This utility only dumps the license information from the *.cust or *.liconly files and not the *.lic license file

e.g. ./ccrtaicc_dump_license AICC_EPCQ256C7S150.cust
./ccrtaicc_dump_license AICC_EPCQ256C7S150.cust.liconly

3.2 Application Program Interface (API) Access Example Tests

These set of tests are in the `.../test/lib` directory and use the API.

3.2.1 lib/ccrtaicc_adc

This test performs validation of the Analog Input ADC card.

```
Usage: ./ccrtaicc_adc [-!][-A] [-a RollingAve] [-b BoardNo] [-c StartChan,EndChan]
                    [-C AdcUpdateClock] [-d Delay] [-D DMAEngine]
                    [-E ExpInpVolt] [-f DataFormat] [-F DebugFile] [-i]
                    [-j SpeedSelect] [-l LoopCnt] [-m XferMode] [-n NumChans]
                    [-N] [-p ClockTolerance] [-s InputSignal] [-t Compare]
                    [-T TestBus] [-V MaxBoardVolts] [-X ExtClock]
-!                    (Don't display header information)
-A                    (Perform Auto Calibration first using reference voltage)
-a RollingAve        (Rolling average -- default "=== None ===")
-b BoardNo           (Board number -- default is 0)
-c StartChan,EndChan (Select start and end channel numbers -- default 0,63
  -c 7,16             (select channels 7 through 16 for processing)
  -c 32               (select channels 32 through 63 for processing)
-C AdcUpdateClock    (select ADC update clock, a,b,c,d,e,A,B,C,D,E or 'n|N')
  -C a                (Ch0..63=Normal Clock 0 set to MAX SPS 500000)
  -C b@20000.0/n      (Ch0..15=Normal Clock 1 at 20000 SPS, Ch16..63=No Clock)
  -C a,b,A,B         (Ch0..15=Normal Clock 0, Ch16..31 Normal Clock 1,
  -C c,d@350000,e     (Ch32..47 Inverted Clock 0, Ch48..63 Inverted Clock 1)
                    (Ch0..15=Normal Clock 2 at MAX SPS 500000, Ch16..31
                    Normal Clock 3 at 350000 SPS, Ch 32-63 Normal External
                    Signal)
-d Delay              (Delay between screen refresh -- default is 0 milli-
                    seconds)
-D DMA Engine         (DMA Engine number -- default = 0)
-E <ExpInpVolts>@<Tol> (Expected Input Volts@Tolerance -- default Tol=0.005000)
  +@<Tol>             (Positive Calibration Ref Volt@Tolerance)
  -@<Tol>             (Negative Calibration Ref Volt@Tolerance)
  s@<Tol>             (Requires '-s' input signal option to specify voltage
                    Volt@Tolerance)
                    (valid '-s' arguments are 'g','+', '-', 'f','n','t')
-f DataFormat        (select data format, '2' or 'b')
  -f b,2              (Ch0..15=Offset binary, Ch16..63=Two's complement)
  -f 2,b/2,b         (Ch0..15 & Ch32..47=Two's complement, Ch16..31 &
  -f b                (Ch48..63=Offset binary)
  -f b                (Ch0..63=Offset binary)
-F DebugFile         (Debug file with menu display -- default "=== None ===")
  #DebugFile         (Debug file without display (only summary) -- default
  "=== None ===")
  @DebugFile         (Debug file without display -- default "=== None ===")
  ~DebugFile         (For gnuplot, no header or summary -- default
  "=== None ===")
  @, # or ~         (No debug file and no display -- default "=== None ===")
-i                    (Enable Interrupts -- default = Disable)
-j SpeedSelect        (select data speed, 'n' or 'h')
  -j n,h,n,h         (Ch0..15 & Ch32..47=normal speed, Ch16..31 &
  -j h/n              (Ch48..63=high speed)
  -j h                (Ch0..15=normal speed, Ch16..63=high speed)
  -j h                (Ch0..63=high speed)
-l LoopCnt           (Loop count -- default is 0)
-m XferMode          (Transfer Mode -- default = 'DMA Channel' for old
                    firmware, and 'MSGDMA Channel' for new firmware)
  -mdp               (Driver: (Channel Registers) PIO mode)
  -mdP               (Driver: (FIFO) PIO mode)
```

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```

-mlc          (Library: (Channel Registers) program I/O Fast Memory
              Copy)
-mlD          (Library: (Channel Registers) DMA mode)
-mlm          (Library: (FIFO) DMA mode)
-mlx          (Library: (Channel Registers) Modular scatter-gather DMA
              mode)
-mlz          (Library: (Channel Registers) Clone (ADC->MEM) Modular
              scatter-gather DMA mode)
-mlM          (Library: (Channel Registers) Clone (ADC->DIAG->MEM)
              Modular scatter-gather DMA mode)
-mlP          (Library: (FIFO) Modular scatter-gather DMA mode)
-mlp          (Library: (Channel Registers) PIO)
-mlP          (Library: (FIFO) PIO mode)
-N            (Open device with O_NONBLOCK flag)
-p ClockTolerance (select clock tolerance in parts/trillion. default is
              system default 0.0070)
-s InputSignal (select input signal, 'e', 'g', '+', '-', 'f', '-n',
              't', 'o')
-s g          (All channels set to ground calibration)
-s e          (All channels set to external input)
-s +          (All channels set to positive 9.91V reference
              calibration)
-s -          (All channels set to negative 9.91V reference
              calibration)
-s f          (All channels set to positive 5V reference calibration)
-s n          (All channels set to negative 5V reference calibration)
-s t          (All channels set to positive 2V reference calibration)
-s o          (Calibration Bus Open)
-t Compare    (Compare two channels for +/- -- default is
              "=== None ===")
-t0,15        (Compare channel 0 and 15 for being in sync)
-t5/7         (Compare channel 5 and 7 for being in sync)
-t12,4@0.500 (Compare channel 4 and 12 for being in sync with 0.5V
              tolerance)
-T TestBus    (Test Bus Control 'b' or 'o'. Exit after programming
              this option)
-T b          (Calibration Bus Control)
-T o          (Open Bus Control)
-V MaxBoardVolts (Voltage range 'b5', 'u5', 'b10' or 'u10')
-V b5,b10     (Ch0..15=+/-5V, Ch16..63=+/-10V)
-V u5/u10/b5,b10 (Ch0..15=+5V, Ch16..31=+10V, Ch32..47=+/-5V,
              Ch48..63=+/-10V)
-V b10        (Ch0..63=+/-10V)
-X[0..3,e|E,n|N] (Board External Clock Output Selection)
              '0..3' - Clock Generator Output Number
              'e|E' - External clock input (redrive)
              'n|N' - No Clock

```

```

e.g. ./ccrtaicc_adc -A -Ca@470000.0/b@12345.0 -s+ (Autocal, ADC0=470000Hz, ADC1,
              ADC2, ADC3=12345Hz Positive
              9.91v Cal.)
./ccrtaicc_adc -A -Ca -s+ -E+ (Autocal, Max Clock for all 4
              ADC, Positive cal. input,
              validate result)
./ccrtaicc_adc -A -Ca -s- -t0,15 -a100 (Autocal, Max Clock for all 4
              ADC, Negative cal. input,
              compare ch0 and ch15, rolling
              ave=100)
./ccrtaicc_adc -Ca,b,n -s+ -c15,21 (Max Clock for ADC0 & ADC1,
              ADC2,ADC3 OFF, Positive cal.
              input, display channels 15

```



```
./ccrtaicc_adc -Ca -Vb10 -s- -Es
./ccrtaicc_adc -Ca -Vb10 -st -Es
```

through 21)
(Max Clock for all 4 ADC, -9.91V input, validate against -9.91V)
(Max Clock for all 4 ADC, +2V input, validate against +2V)

Example display:

```
./ccrtaicc_adc -A -Ca@470000,b@12345.0 -s+
```

```
local_ptr=0x7ffff7fbf000
```

```
Physical Memory Information:
UserPID           =13487
PhysMemPtr        =0x2e218000
DriverVirtMemPtr  =0xffff917a2e218000
MmappedUserMemPtr=0x7ffff7feb000
PhysMemSize       =0x00001000
PhysMemSizeFreed  =0x00000000
EntryInTxTbl      =0
NumOfEntriesUsed  =1
Flags             =0x0000
```

```
Auto Calibration started...done. (2.576 seconds)
```

```
Auto Calibration      [-A]: Performed
Board Number          [-b]: 0
Channel Selection     [-c]: Start=Ch0, End=Ch63 (Number of Active Channels=64)
                       : Active Channel Mask=0xfffffffffffffff
Update Clock Selected [-C]: Ch00..15 [0]Normal Clock 0      (470000.000 SPS)
                       : Ch16..31 [0]Normal Clock 1      (12345.000 SPS)
                       : Ch32..47 [0]Normal Clock 1      (12345.000 SPS)
                       : Ch48..63 [0]Normal Clock 1      (12345.000 SPS)
Delay                 [-d]: 0 milli-seconds
DMA Engine            [-D]: 0
Expected Input Volts [-E]: === Not Specified ===
Data Format            [-f]: Ch00..15 [0]Offset binary
                       : Ch16..31 [0]Offset binary
                       : Ch32..47 [0]Offset binary
                       : Ch48..63 [0]Offset binary
Interrupts            [-i]: Disabled
Speed Select          [-j]: Ch00..15 [0]Normal Speed
                       : Ch16..31 [0]Normal Speed
                       : Ch32..47 [0]Normal Speed
                       : Ch48..63 [0]Normal Speed
Transfer Mode         [-m]: Library: (Channels Registers) MODULAR SCATTER-GATHER DMA I/O
Clock Tolerance       [-p]: 0.0070 (parts/trillion)
Input Signal          [-s]: [1]Calibration Bus (0x01: Positive 9.91)
Voltage Range         [-V]: Ch00..15 [1]+/-10 Volts
                       : Ch16..31 [1]+/-10 Volts
                       : Ch32..47 [1]+/-10 Volts
                       : Ch48..63 [1]+/-10 Volts
External Clock Output [-X]: 7 (No Clock)
Scan Count            : 18459          (0:00:02:07)
Read Duration (microsecs) : TotalDelta: 5.019 (min= 4.903/max= 13.026/ave= 4.998)
```

```
##### Raw Data #####
```

	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[00 07]	03fb69	03fb66	03fb67	03fb66	03fb68	03fb67	03fb6c	03fb63
[08 15]	03fb62	03fb60	03fb5f	03fb62	03fb61	03fb68	03fb64	03fb65
[16 23]	03fb56	03fb58	03fb59	03fb58	03fb56	03fb59	03fb5a	03fb57

```

[24 31] 03fb59 03fb5e 03fb58 03fb5c 03fb5e 03fb62 03fb5f 03fb5b
[32 39] 03fb5f 03fb62 03fb60 03fb5e 03fb5f 03fb5e 03fb5f 03fb62
[40 47] 03fb63 03fb66 03fb60 03fb60 03fb63 03fb63 03fb60 03fb68
[48 55] 03fb61 03fb63 03fb61 03fb62 03fb69 03fb64 03fb64 03fb66
[56 63] 03fb66 03fb63 03fb65 03fb65 03fb66 03fb67 03fb66 03fb64

```

```

##### Volts #####
[0] [1] [2] [3] [4] [5] [6] [7]
=====
[00 07] +9.9107 +9.9106 +9.9106 +9.9102 +9.9105 +9.9103 +9.9102 +9.9104
[08 15] +9.9104 +9.9103 +9.9104 +9.9105 +9.9102 +9.9104 +9.9105 +9.9102
[16 23] +9.9091 +9.9091 +9.9093 +9.9096 +9.9093 +9.9094 +9.9094 +9.9094
[24 31] +9.9095 +9.9099 +9.9093 +9.9098 +9.9100 +9.9098 +9.9096 +9.9093
[32 39] +9.9096 +9.9098 +9.9097 +9.9095 +9.9096 +9.9095 +9.9096 +9.9098
[40 47] +9.9099 +9.9101 +9.9097 +9.9097 +9.9099 +9.9099 +9.9097 +9.9103
[48 55] +9.9097 +9.9099 +9.9097 +9.9098 +9.9104 +9.9100 +9.9100 +9.9101
[56 63] +9.9101 +9.9099 +9.9100 +9.9100 +9.9101 +9.9102 +9.9101 +9.9100

```

```

=====
Date: Thu Jan 20 09:47:01 2022
Expected Input Volts: == Not Specified ==
Scan Counter: 55965
WorstMinChanVoltsHWM: 9.895782 (Ch06)
WorstMaxChanVoltsHWM: 9.918900 (Ch16)
=====

```

Chan	Min	Max	Ave	Tolerance Exceeded Count
00	9.895782	9.915771	9.909987	-
01	9.896393	9.915543	9.909997	-
02	9.896774	9.915314	9.909991	-
03	9.896698	9.915085	9.909970	-
04	9.896164	9.915161	9.910016	-
05	9.896393	9.915390	9.910015	-
06	9.895782	9.915237	9.909967	-
07	9.896317	9.915237	9.909908	-
08	9.895782	9.915161	9.910003	-
09	9.896164	9.915237	9.909959	-
10	9.896088	9.915161	9.909943	-
11	9.896088	9.915619	9.910010	-
12	9.896240	9.915466	9.909952	-
13	9.896317	9.915543	9.909954	-
14	9.896088	9.916077	9.909937	-
15	9.896317	9.915695	9.909937	-
16	9.901276	9.918900	9.909981	-
17	9.899597	9.918518	9.910027	-
18	9.900284	9.918900	9.909955	-
19	9.901657	9.918137	9.909983	-
20	9.903107	9.913330	9.910011	-
21	9.903641	9.913406	9.910003	-
22	9.903336	9.913254	9.909988	-
23	9.903488	9.913101	9.909962	-
24	9.903030	9.913101	9.909992	-
25	9.903717	9.913254	9.909982	-
26	9.903259	9.913025	9.910018	-
27	9.903336	9.913025	9.909963	-
28	9.903259	9.912949	9.909983	-
29	9.903717	9.913101	9.910005	-
30	9.903488	9.913101	9.909963	-
31	9.903336	9.913177	9.909955	-
32	9.903564	9.912949	9.910012	-

33	9.903946	9.912796	9.909997	-
34	9.903641	9.913254	9.909971	-
35	9.903641	9.912949	9.909987	-
36	9.903336	9.913025	9.909987	-
37	9.904099	9.912949	9.910007	-
38	9.903946	9.912872	9.910023	-
39	9.903946	9.913025	9.910024	-
40	9.904022	9.912796	9.910010	-
41	9.904251	9.913177	9.909980	-
42	9.903946	9.912949	9.909962	-
43	9.903717	9.912949	9.909952	-
44	9.904099	9.912643	9.909999	-
45	9.904099	9.912796	9.909987	-
46	9.903946	9.912796	9.909954	-
47	9.903717	9.912949	9.909981	-
48	9.904022	9.912872	9.909993	-
49	9.903946	9.912720	9.909958	-
50	9.903717	9.913635	9.909989	-
51	9.904099	9.913330	9.909939	-
52	9.903946	9.912643	9.910003	-
53	9.904251	9.912872	9.909996	-
54	9.904022	9.913254	9.910019	-
55	9.903488	9.913025	9.910024	-
56	9.903641	9.912796	9.909969	-
57	9.903946	9.913025	9.909982	-
58	9.903793	9.912720	9.910011	-
59	9.903870	9.912796	9.910001	-
60	9.904022	9.912720	9.909960	-
61	9.903641	9.912872	9.909961	-
62	9.904022	9.912796	9.909946	-
63	9.903793	9.913025	9.910001	-

=====

./certain_adc -mlz -Ca -s-

local_ptr=0x7ffff7fbf000

Physical Memory Information:

UserPID =13490
PhysMemPtr =0x2e218000
DriverVirtMemPtr=0xffff917a2e218000
MmappedUserMemPtr=0x7ffff7feb000
PhysMemSize =0x00001000
PhysMemSizeFreed=0x00000000
EntryInTxTbl =0
NumOfEntriesUsed=1
Flags =0x0000

Auto Calibration [-A]: Not Performed
Board Number [-b]: 0
Channel Selection [-c]: Start=Ch0, End=Ch63 (Number of Active Channels=64)
: Active Channel Mask=0xfffffffffffffff
Update Clock Selected [-C]: Ch00..15 [00]Normal Clock 0 (500000.000 SPS)
: Ch16..31 [00]Normal Clock 0 (500000.000 SPS)
: Ch32..47 [00]Normal Clock 0 (500000.000 SPS)
: Ch48..63 [00]Normal Clock 0 (500000.000 SPS)
Delay [-d]: 0 milli-seconds
DMA Engine [-D]: 0
Expected Input Volts [-E]: === Not Specified ===
Data Format [-f]: Ch00..15 [0]Offset binary
: Ch16..31 [0]Offset binary
: Ch32..47 [0]Offset binary

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```

: Ch48..63 [0]Offset binary
Interrupts [-i]: Disabled
Speed Select [-j]: Ch00..15 [0]Normal Speed
: Ch16..31 [0]Normal Speed
: Ch32..47 [0]Normal Speed
: Ch48..63 [0]Normal Speed
Transfer Mode [-m]: Library: (Channels Registers) CLONE (ADC->DIAG->MEM) MODULAR
SCATTER-GATHER DMA I/O
Clock Tolerance [-p]: 0.0070 (parts/trillion)
Input Signal [-s]: [1]Calibration Bus (0x02: Negative 9.91)
Voltage Range [-V]: Ch00..15 [1]+/-10 Volts
: Ch16..31 [1]+/-10 Volts
: Ch32..47 [1]+/-10 Volts
: Ch48..63 [1]+/-10 Volts
External Clock Output [-X]: 7 (No Clock)
Scan Count : 12846 (0:00:03:17)
Read Duration (microsecs) : TotalDelta: 0.073 (min= 0.045/max= 0.198/ave= 0.062)

```

```

##### Raw Data #####
[0] [1] [2] [3] [4] [5] [6] [7]
=====
[00 07] 000494 000493 00048a 000495 000493 000490 000494 00048f
[08 15] 000494 00048d 000490 000490 000491 00048d 00048f 00048d
[16 23] 00048c 000485 0004a0 0004a5 0004a4 0004a2 0004a2 0004a2
[24 31] 0004a4 00049e 00049f 000499 0004a5 0004a3 0004a3 00049d
[32 39] 0004a1 0004a1 000499 00049d 00049a 0004a0 00049a 00049c
[40 47] 0004a4 0004a3 000495 000490 000498 000497 000496 000493
[48 55] 000499 000495 000492 000491 000494 00048e 000494 000496
[56 63] 000494 000494 000491 000496 000492 000490 000497 000496

```

```

##### Volts #####
[0] [1] [2] [3] [4] [5] [6] [7]
=====
[00 07] -9.9107 -9.9103 -9.9106 -9.9098 -9.9104 -9.9112 -9.9109 -9.9114
[08 15] -9.9109 -9.9112 -9.9105 -9.9107 -9.9109 -9.9107 -9.9109 -9.9101
[16 23] -9.9117 -9.9120 -9.9113 -9.9116 -9.9120 -9.9116 -9.9111 -9.9109
[24 31] -9.9116 -9.9113 -9.9114 -9.9120 -9.9110 -9.9113 -9.9114 -9.9114
[32 39] -9.9114 -9.9120 -9.9114 -9.9119 -9.9120 -9.9119 -9.9117 -9.9113
[40 47] -9.9113 -9.9108 -9.9113 -9.9113 -9.9116 -9.9109 -9.9115 -9.9111
[48 55] -9.9110 -9.9111 -9.9108 -9.9103 -9.9104 -9.9110 -9.9107 -9.9110
[56 63] -9.9106 -9.9105 -9.9100 -9.9100 -9.9104 -9.9107 -9.9100 -9.9102

```

```

=====
Date: Thu Jan 20 09:51:08 2022
Expected Input Volts: === Not Specified ===
Scan Counter: 72140
WorstMinChanVoltsHWM: -9.913330 (Ch17)
WorstMaxChanVoltsHWM: -9.906998 (Ch00)
=====

```

Chan	Min	Max	Ave	Tolerance Exceeded Count
00	-9.912949	-9.906998	-9.909932	-
01	-9.912567	-9.907303	-9.909889	-
02	-9.912720	-9.907150	-9.909916	-
03	-9.912796	-9.907303	-9.909836	-
04	-9.912567	-9.907303	-9.909957	-
05	-9.912643	-9.907532	-9.909936	-
06	-9.912949	-9.907074	-9.909924	-
07	-9.912720	-9.907379	-9.909959	-
08	-9.912643	-9.907227	-9.909867	-

09	-9.912720	-9.907379	-9.909928	-
10	-9.912643	-9.907227	-9.909868	-
11	-9.912567	-9.907303	-9.909837	-
12	-9.912796	-9.907303	-9.909936	-
13	-9.912720	-9.907303	-9.909946	-
14	-9.912872	-9.907379	-9.909919	-
15	-9.912720	-9.907227	-9.909870	-
16	-9.912796	-9.907913	-9.910217	-
17	-9.913330	-9.908142	-9.910563	-
18	-9.912720	-9.907608	-9.910183	-
19	-9.912949	-9.907684	-9.910139	-
20	-9.912872	-9.908142	-9.910345	-
21	-9.912872	-9.908066	-9.910319	-
22	-9.912720	-9.907761	-9.910258	-
23	-9.912872	-9.907990	-9.910303	-
24	-9.912949	-9.907913	-9.910390	-
25	-9.913025	-9.908218	-9.910434	-
26	-9.913025	-9.907990	-9.910412	-
27	-9.912796	-9.908066	-9.910390	-
28	-9.912796	-9.908218	-9.910358	-
29	-9.912796	-9.908295	-9.910382	-
30	-9.912796	-9.907837	-9.910398	-
31	-9.912796	-9.908142	-9.910387	-
32	-9.912720	-9.908218	-9.910416	-
33	-9.913101	-9.908295	-9.910428	-
34	-9.912796	-9.908066	-9.910349	-
35	-9.912720	-9.908218	-9.910366	-
36	-9.912872	-9.908142	-9.910360	-
37	-9.912643	-9.908371	-9.910451	-
38	-9.912643	-9.908142	-9.910415	-
39	-9.912643	-9.908218	-9.910495	-
40	-9.912643	-9.908371	-9.910386	-
41	-9.912567	-9.908142	-9.910442	-
42	-9.912720	-9.908218	-9.910363	-
43	-9.912567	-9.908295	-9.910357	-
44	-9.912643	-9.908371	-9.910373	-
45	-9.912567	-9.908295	-9.910385	-
46	-9.912643	-9.908218	-9.910356	-
47	-9.912491	-9.908142	-9.910365	-
48	-9.912338	-9.908218	-9.910270	-
49	-9.912415	-9.908447	-9.910383	-
50	-9.912567	-9.907761	-9.910280	-
51	-9.912643	-9.907837	-9.910264	-
52	-9.912262	-9.908371	-9.910303	-
53	-9.912415	-9.908371	-9.910343	-
54	-9.912262	-9.907913	-9.910209	-
55	-9.912567	-9.907913	-9.910195	-
56	-9.912720	-9.908295	-9.910219	-
57	-9.912415	-9.908371	-9.910254	-
58	-9.912338	-9.908142	-9.910166	-
59	-9.912872	-9.908295	-9.910184	-
60	-9.912567	-9.908295	-9.910240	-
61	-9.912720	-9.908295	-9.910243	-
62	-9.912338	-9.908066	-9.910178	-
63	-9.912567	-9.908218	-9.910193	-

=====

3.2.2 lib/ccrtaiicc_adc_calibrate

This test is useful for performing, saving and restoring ADC calibration. In order to calibrate, the clocks must be active and running for all the selected channels.

Usage: ./ccrtaiicc_adc_calibrate [-A StartCh,EndCh] [-b board] [-i inCalFile] [-o outCalFile] [-R]

-A <StartCh,EndCh> (perform Auto Calibration between start & end chans. default = 0,63)
-b <board> (board #, default = 0)
-i <In Cal File> (input calibration file [input->board_reg])
-o <Out Cal File> (output calibration file [board_reg->output])
-R (reset calibration data)

e.g. ./ccrtaiicc_adc_calibrate (Dump calibration information to stdout)
./ccrtaiicc_adc_calibrate -A -o Calfile (Perform Auto calibration and dump information to 'Calfile')
./ccrtaiicc_adc_calibrate -i Calfile (Update board calibration with supplied 'Calfile')
./ccrtaiicc_adc_calibrate -A 16,31 (Perform Auto calibration on second ADC i.e. ch16..31)
./ccrtaiicc_adc_calibrate -A ,12 (Perform Auto calibration on first ADC i.e. ch0..12)
./ccrtaiicc_adc_calibrate -R (Reset calibration data)

Example display:

./ccrtaiicc_adc_calibrate -A

Device Name : /dev/ccrtaiicc0
Board Serial No: 687377 (0x000a7d11)
Start Channel : 0
End Channel : 63
Auto Calibration started...done. (0.826 seconds)

==> Dump to 'stdout'

#Date : Tue Dec 18 11:53:26 2018

#Chan	Negative	Offset	Positive
#====	=====	=====	=====
ch00:	1.000046280678361654281616211	-0.00022888183593750000	1.000050663948059082031250000
ch01:	0.999962084926664829254150391	0.000000000000000000000	0.999961888883262872695922852
ch02:	0.999896354041993618011474609	-0.00007629394531250000	0.999897750560194253921508789
ch03:	1.000039299018681049346923828	0.00007629394531250000	1.000032507348805665969848633
ch04:	1.000215303152799606323242188	-0.00015258789062500000	1.000227037351578474044799805
ch05:	1.000232398509979248046875000	0.000000000000000000000	1.000233963597565889358520508
ch06:	1.000174359418451786041259766	-0.00015258789062500000	1.000177062116563320159912109
ch07:	0.999990142881870269775390625	-0.00007629394531250000	0.999986256472766399383544922
ch08:	1.000093540642410516738891602	-0.00015258789062500000	1.000101460143923759460449219
ch09:	0.999904607888311147689819336	-0.00007629394531250000	0.999918435700237751007080078
ch10:	1.000021356157958507537841797	-0.00015258789062500000	1.000024581328034400939941406
ch11:	0.999910922721028327941894531	-0.00007629394531250000	0.999915065709501504898071289
ch12:	1.000108417589217424392700195	-0.00015258789062500000	1.000114621128886938095092773
ch13:	1.000071702525019645690917969	-0.00007629394531250000	1.000082310289144515991210938
ch14:	1.000154437962919473648071289	-0.00015258789062500000	1.000149235129356384277343750
ch15:	1.000113883987069129943847656	-0.00015258789062500000	1.000124239362776279449462891
ch16:	1.000155716668814420700073242	-0.00007629394531250000	1.000164224766194820404052734
ch17:	1.000027132220566272735595703	0.00015258789062500000	1.000018282793462276458740234
ch18:	0.999931633006781339645385742	-0.00007629394531250000	0.999930288176983594894409180
ch19:	1.000115089118480682373046875	0.00015258789062500000	1.000108243897557258605957031
ch20:	1.000110489781945943832397461	-0.00015258789062500000	1.000121916644275188446044922
ch21:	1.000040223356336355209350586	0.00015258789062500000	1.000032895710319280624389648
ch22:	1.000062164679336547851562500	-0.00015258789062500000	1.000066666398197412490844727

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```

ch23: 1.000183795113116502761840820 0.00000000000000000000 1.000178982503712177276611328
ch24: 0.999957418534904718399047852 0.00000000000000000000 0.999956104904413223266601562
ch25: 0.999945123679935932159423828 -0.00007629394531250000 0.999955588020384311676025391
ch26: 0.999991035554558038711547852 0.00000000000000000000 0.999997129198163747787475586
ch27: 1.000172080937772989273071289 0.00007629394531250000 1.000174157321453094482421875
ch28: 1.000162992626428604125976562 -0.00007629394531250000 1.000165878795087337493896484
ch29: 1.000091203488409519195556641 0.00007629394531250000 1.00008769938722528457641602
ch30: 1.000282614957541227340698242 -0.00007629394531250000 1.000285412650555372238159180
ch31: 1.000113802030682563781738281 -0.00007629394531250000 1.000128523912280797958374023
ch32: 1.000043609645217657089233398 -0.00007629394531250000 1.000059755519032478332519531
ch33: 0.999953246209770441055297852 0.00007629394531250000 0.999960092362016439437866211
ch34: 1.00012783613055944427490234 0.00000000000000000000 1.000133277848362922668457031
ch35: 0.999941903166472911834716797 0.00007629394531250000 0.999943493865430355072021484
ch36: 0.999991669319570064544677734 0.00007629394531250000 0.999989827629178762435913086
ch37: 1.00004319800639677047729492 0.00007629394531250000 1.000050891656428575515747070
ch38: 0.999993903562426567077636719 -0.00007629394531250000 1.000003706663846969604492188
ch39: 0.999979448039084672927856445 0.00007629394531250000 0.999988916795700788497924805
ch40: 1.000092174392193555831909180 0.00007629394531250000 1.000099983066320419311523438
ch41: 1.000059309415519237518310547 0.00007629394531250000 1.000068699475377798080444336
ch42: 1.000167491380125284194946289 -0.00007629394531250000 1.000180571340024471282958984
ch43: 1.000253048259764909744262695 -0.00007629394531250000 1.000258826185017824172973633
ch44: 1.000121331308037042617797852 -0.00007629394531250000 1.000130682252347469329833984
ch45: 1.000186069402843713760375977 0.00007629394531250000 1.000193846412003040313720703
ch46: 1.000097106676548719406127930 -0.00015258789062500000 1.000103554688394069671630859
ch47: 1.000041996128857135772705078 -0.00007629394531250000 1.000057924538850784301757812
ch48: 0.999975174665451049804687500 0.00007629394531250000 0.999979007523506879806518555
ch49: 1.000073832459747791290283203 0.00015258789062500000 1.000083983875811100006103516
ch50: 1.000060985330492258071899414 -0.00007629394531250000 1.000069220084697008132934570
ch51: 1.000034462660551071166992188 0.00007629394531250000 1.000042255502194166183471680
ch52: 1.000020204577594995498657227 -0.00015258789062500000 1.000030491501092910766601562
ch53: 1.000030837021768093109130859 0.00000000000000000000 1.000043619889765977859497070
ch54: 0.999996385071426630020141602 0.00000000000000000000 1.000005447771400213241577148
ch55: 0.999992591794580221176147461 0.00007629394531250000 0.999998908489942550659179688
ch56: 1.000176913104951381683349609 0.00007629394531250000 1.000179749447852373123168945
ch57: 1.000093434471637010574340820 0.00015258789062500000 1.000098186079412698745727539
ch58: 1.000042880419641733169555664 -0.00007629394531250000 1.000060809310525655746459961
ch59: 1.000205467455089092254638672 0.00015258789062500000 1.000202169176191091537475586
ch60: 1.000177376437932252883911133 -0.00007629394531250000 1.000182859599590301513671875
ch61: 1.000130820553749799728393555 -0.00007629394531250000 1.000148957595229148864746094
ch62: 1.000131698790937662124633789 -0.00007629394531250000 1.000147680286318063735961914
ch63: 1.000189523678272962570190430 -0.00007629394531250000 1.000199154019355773925781250

```

3.2.3 lib/ccrtaiicc_adc_fifo

This test performs validation of the Analog Input ADC FIFO operation of the card.

```

Usage: ./ccrtaiicc_adc_fifo [-A] [-b BoardNo] [-c StartChan,EndChan]
      [-C AdcUpdateClock] [-d Delay] [-D DMAEngine]
      [-E ExpInpVolt] [-f DataFormat] [-F DebugFile] [-i]
      [-j SpeedSelect] [-l LoopCnt] [-m XferMode] [-N]
      [-p ClockTolerance] [-P FromChan,ToChan]
      [-s InputSignal] [-S NumberOfSamples] [-T TestBus]
      [-V MaxBoardVolts] [-w RawDataFile] [-X ExtClock]
-A          (Perform Auto Calibration first using reference voltage)
-b BoardNo  (Board number -- default is 0)
-c StartChan,EndChan (Select start and end channel numbers -- default 0,63)
  -c 7,16   (select channels 7 through 16 for processing)
  -c 32     (select channels 32 through 63 for processing)
-C AdcUpdateClock (select ADC update clock, a,b,c,d,e,A,B,C,D,E or 'n|N')
  -C a      (Ch0..63=Normal Clock 0 set to MAX SPS 500000)
  -C b@20000.0/n (Ch0..15=Normal Clock 1 at 20000 SPS, Ch16..63=No Clock)
  -C a,b,A,B (Ch0..15=Normal Clock 0, Ch16..31 Normal Clock 1,
              Ch32..47 Inverted Clock 0, Ch48..63 Inverted Clock 1)
  -C c,d@350000,e (Ch0..15=Normal Clock 2 at MAX SPS 500000, Ch16..31
                  Normal Clock 3 at 350000 SPS, Ch 32-63 Normal External
                  Signal)

```

```

-d Delay                (Delay between screen refresh -- default is 0 milli-
                        seconds)
-D DMA Engine           (DMA Engine number -- default = 0)
-E <ExpInpVolts>@<Tol> (Expected Input Volts@Tolerance -- default Tol=0.005000)
  +@<Tol>               (Positive Calibration Ref Volt@Tolerance)
  -@<Tol>               (Negative Calibration Ref Volt@Tolerance)
  s@<Tol>               (Requires '-s' input signal option to specify voltage
                        Volt@Tolerance)
                        (valid '-s' arguments are 'g','+','-','f','n','t')
-f DataFormat          (select data format, '2' or 'b')
  -f b,2                (Ch0..7=Offset binary, Ch8..15=Two's complement)
  -f 2/b                (Ch0..7=Two's complement, Ch8..15=Offset binary)
  -f b                  (Ch0..15=Offset binary)
-F DebugFile           (Debug file with rate display -- default "=== None ===")
  @DebugFile           (Debug file without rate display -- default
                        "=== None ===")
  ~DebugFile           (For gnuplot, no header or summary -- default
                        "=== None ===")
  @ or ~                (No debug file and no rate display -- default
                        "=== None ===")
-i                     (Enable Interrupts -- default = Disable)
-j SpeedSelect         (select data speed, 'n' or 'h')
  -j n,h,n,h           (Ch0..15 & Ch32..47=normal speed, Ch16..31 &
                        Ch48..63=high speed)
  -j h/n                (Ch0..15=normal speed, Ch16..63=high speed)
  -j h                  (Ch0..63=high speed)
-l LoopCnt             (Loop count -- default is 0)
-m XferMode            (Transfer Mode -- default = Library DMA)
  -mdP                  (Driver: (FIFO) PIO mode)
  -mlD                  (Library: (FIFO) DMA mode)
  -mlM                  (Library: (FIFO) Modular scatter-gather DMA mode)
  -mlP                  (Library: (FIFO) PIO mode)
-N                     (Open device with O_NONBLOCK flag for driver operations)
-p ClockTolerance      (select clock tolerance in parts/trillion. default is
                        system default 0.0070)
-P FromChan,ToChan    (Pair FromChan when Debug File specified --
                        default is paired to itself)
-s InputSignal         (select input signal, 'e', 'g', '+', '-', 'f', '-n',
                        't')
  -s g                  (All channels set to ground calibration)
  -s e                  (All channels set to external input)
  -s +                  (All channels set to positive 9.91V reference
                        calibration)
  -s -                  (All channels set to negative 9.91V reference
                        calibration)
  -s f                  (All channels set to positive 5V reference calibration)
  -s n                  (All channels set to negative 5V reference calibration)
  -s t                  (All channels set to positive 2V reference calibration)
-S NumberOfSamples    (Number of Samples -- default is 49152, MsgDma is 12288)
-T TestBus             (Test Bus Control 'b' or 'o'. Exit after programming
                        this option)
  -T b                  (Calibration Bus Control)
  -T o                  (Open Bus Control)
-V MaxBoardVolts      (Voltage range 'b5', 'u5', 'b10' or 'u10')
  -V b5,b10             (Ch0..15=+/-5V, Ch16..63=+/-10V)
  -V u5/u10/b5,b10     (Ch0..15=+5V, Ch16..31=+10V, Ch32..47=+/-5V,
                        Ch48..63=+/-10V)
  -V b10                (Ch0..63=+/-10V)
-w RawDataFile         (Only raw sample data written to file)
-X[0..3,e|E,n|N]      (Board External Clock Output Selection)
                        '0..3' - Clock Generator Output Number

```


'e|E' - External clock input (redrive)
 'n|N' - No Clock

e.g. ./ccrtaicc_adc_fifo -Ca@100000,b@12345 -s+ (ADC0 is 100000Hz, ADC1, ADC2
 and ADC3 is 12345Hz, all
 Positive 9.91v Cal.)
 ./ccrtaicc_adc_fifo -Ca,B -P16,15 -c15,16 -F~Outfile -l100 -S50000
 (ADC0=500000Hz, ADC1=Inverted
 500000Hz, Channel 16 merged
 into channel 15, Samples in
 Outfile for gnuplot)
 ./ccrtaicc_adc_fifo -A -Ca@50000 -sf -Es (Autocal, All channels 50000Hz,
 all Positive 5V Cal, Expected
 5V)

Example display:

./ccrtaicc_adc_fifo -Ca@100000,b@12345 -s+ -l500 (if MsgDma is NOT supported)

```
local_ptr=0x7ffff7fbf000
Number of Samples =49152
Transfer Mode      =Library DMA Mode
Physical Memory Information:
  UserPID          =13479
  PhysMemPtr       =0x15180000
  DriverVirtMemPtr=0xffff917a15180000
  MmappedUserMemPtr=0x7ffff7f3f000
  PhysMemSize      =0x00080000
  PhysMemSizeFreed=0x00000000
  EntryInTxTbl    =0
  NumOfEntriesUsed=1
  Flags           =0x0000
Channels: Total=64, First=0, Last=63, Adc0Chans=16, Adc1Chans=16 Adc2Chans=16,
  Adc3Chans=16
Time in microseconds (TT=Total, WT=Work, FT=Free, RT=Read, mi=min, ma=max, av=ave)
Measuring how long it takes to collect 49152 samples...Slow Clock...Collecting
  Samples 0 done. (22452.002 usecs)
500: TT=22407.09 WT=22395.28 FT= 11.81 RT=8984.73 (mi=8982.44/ma=8991.53/av=8984.16)
  21.88 MB/S - EmptyCnt=110000 (84%)
```

```
=====
Date: Thu Jan 20 09:39:14 2022
Expected Input Volts: === Not Specified ===
Scan Counter: ADC0=1120881 ADC1=138373 ADC2=138373 ADC3=138373
Approx. Sample/Second: ADC0=100000 ADC1=12345 ADC2=12345 ADC3=12345
NumberOfChans: ADC0=16 ADC1=16 ADC2=16 ADC3=16
Channel Pairing: *** No pairing of any channels ***
WorstMinChanVoltsHWM: 9.893494 (Ch04)
WorstMaxChanVoltsHWM: 9.919968 (Ch02)
=====
```

```
<----- (volts) ----->
Chan  Min          Max          Ave          DetectedCnt  TolerExeededCnt
=====  =====  =====  =====  =====  =====
00    9.894867    9.918900    9.911320    1120881    -
01    9.896164    9.918518    9.912050    1120881    -
02    9.897461    9.919968    9.912698    1120881    -
03    9.895477    9.917603    9.911132    1120881    -
04    9.893494    9.916077    9.909596    1120881    -
05    9.893494    9.915771    9.909277    1120881    -
06    9.894028    9.916840    9.910055    1120881    -
07    9.895554    9.918365    9.911687    1120881    -
08    9.894714    9.917450    9.910810    1120881    -
09    9.896240    9.919205    9.912443    1120881    -
```

10	9.895706	9.918442	9.911446	1120881	-
11	9.896774	9.918900	9.912469	1120881	-
12	9.895554	9.917450	9.910481	1120881	-
13	9.895020	9.916916	9.910598	1120881	-
14	9.894791	9.916840	9.910369	1120881	-
15	9.894562	9.917374	9.910468	1120881	-
16	9.901505	9.917603	9.910075	138373	-
17	9.903107	9.918671	9.910929	138373	-
18	9.901123	9.919510	9.912582	138373	-
19	9.901505	9.919205	9.910526	138373	-
20	9.904099	9.914093	9.910592	138373	-
21	9.904633	9.914246	9.911114	138373	-
22	9.904633	9.914474	9.911247	138373	-
23	9.903488	9.913254	9.909916	138373	-
24	9.906082	9.915161	9.912137	138373	-
25	9.905777	9.915237	9.912124	138373	-
26	9.904785	9.915085	9.911601	138373	-
27	9.903564	9.912720	9.909703	138373	-
28	9.903946	9.913330	9.910096	138373	-
29	9.904480	9.913635	9.910646	138373	-
30	9.902878	9.911728	9.908817	138373	-
31	9.904251	9.913406	9.910407	138373	-
32	9.905014	9.914093	9.911108	138373	-
33	9.905930	9.914856	9.911856	138373	-
34	9.904404	9.913559	9.910417	138373	-
35	9.906006	9.914932	9.912107	138373	-
36	9.905701	9.915009	9.911822	138373	-
37	9.905090	9.914017	9.911092	138373	-
38	9.905701	9.915009	9.911782	138373	-
39	9.905853	9.914856	9.911769	138373	-
40	9.904633	9.914093	9.910722	138373	-
41	9.904861	9.913635	9.910920	138373	-
42	9.904022	9.913177	9.910155	138373	-
43	9.903336	9.912338	9.909232	138373	-
44	9.904709	9.913559	9.910709	138373	-
45	9.904022	9.912872	9.909851	138373	-
46	9.905090	9.913788	9.910931	138373	-
47	9.905472	9.914169	9.911337	138373	-
48	9.906235	9.915237	9.912102	138373	-
49	9.905167	9.914017	9.910922	138373	-
50	9.905167	9.914246	9.911477	138373	-
51	9.905396	9.914474	9.911523	138373	-
52	9.905777	9.914474	9.911666	138373	-
53	9.905319	9.914093	9.911277	138373	-
54	9.905472	9.915237	9.912057	138373	-
55	9.905701	9.914856	9.911901	138373	-
56	9.904251	9.913483	9.910399	138373	-
57	9.905319	9.913864	9.911094	138373	-
58	9.905090	9.914551	9.911383	138373	-
59	9.903641	9.912720	9.909688	138373	-
60	9.904480	9.913025	9.910162	138373	-
61	9.904709	9.913254	9.910470	138373	-
62	9.905014	9.913483	9.910616	138373	-
63	9.904175	9.913177	9.910060	138373	-

=====

Below are the statistics for 49152 samples:

Estimated time to collect samples:	22452.002 usecs
Total work time breakdown:	22435.601 usecs
Average time to fill FIFO:	12843.171 usecs (### User blocking for FIFO to fill ###)

```

Average time to read samples:      8984.163 usecs (### This time excludes FIFO
                                   fill time ###)
Average time to process samples:   598.028 usecs
Average time other:                10.239 usecs
Approximate free time available:   12869.811 usecs

```

./crrtaicc_adc_fifo -Ca@100000,b@12345 -s+ -l500 (if MsgDma IS supported)

```

local_ptr=0x7ffff7fbf000
  Number of Samples =12288
  Transfer Mode     =Library MODULAR SCATTER-GATHER DMA Mode
  Physical Memory Information:
    UserPID        =13472
    PhysMemPtr     =0x15180000
    DriverVirtMemPtr=0xffff917a15180000
    MmappedUserMemPtr=0x7ffff7f3f000
    PhysMemSize    =0x00080000
    PhysMemSizeFreed=0x00000000
    EntryInTxTbl  =0
    NumOfEntriesUsed=1
    Flags         =0x0000
  Channels: Total=64, First=0, Last=63, Adc0Chans=16, Adc1Chans=16 Adc2Chans=16,
            Adc3Chans=16
  Time in microseconds (TT=Total, WT=Work, FT=Free, RT=Read, mi=min, ma=max, av=ave)
  Measuring how long it takes to collect 12288 samples...Slow Clock...Collecting
  Samples 0 done. (5622.506 usecs)
  500: TT=5610.18 WT=5602.41 FT= 7.77 RT=131.76 (mi=130.59/ma=133.44/av=131.75)
        373.04 MB/S - EmptyCnt=130400 (99%)

```

```

=====
Date: Thu Jan 20 09:31:14 2022
Expected Input Volts: === Not Specified ===
Scan Counter: ADC0=280221 ADC1=34593 ADC2=34593 ADC3=34593
Approx. Sample/Second: ADC0=99999 ADC1=12345 ADC2=12345 ADC3=12345
NumberOfChans: ADC0=16 ADC1=16 ADC2=16 ADC3=16
Channel Pairing: *** No pairing of any channels ***
WorstMinChanVoltsHWM: 9.893646 (Ch05)
WorstMaxChanVoltsHWM: 9.920273 (Ch18)

```

```

=====
<----- (volts) ----->
Chan  Min          Max          Ave          DetectedCnt  TolerExeededCnt
=====  =====  =====  =====  =====  =====
00    9.894714    9.918747    9.911246    280221      -
01    9.896393    9.918289    9.912007    280221      -
02    9.897308    9.918976    9.912633    280221      -
03    9.896393    9.917297    9.911092    280221      -
04    9.893951    9.915924    9.909601    280221      -
05    9.893646    9.915619    9.909294    280221      -
06    9.894714    9.916534    9.910001    280221      -
07    9.896240    9.917831    9.911672    280221      -
08    9.895020    9.917297    9.910847    280221      -
09    9.896545    9.918823    9.912499    280221      -
10    9.896088    9.917755    9.911371    280221      -
11    9.896698    9.918823    9.912450    280221      -
12    9.895096    9.917450    9.910445    280221      -
13    9.895630    9.916916    9.910559    280221      -
14    9.894791    9.916840    9.910397    280221      -
15    9.895401    9.916840    9.910540    280221      -
16    9.903259    9.917526    9.910049    34593       -
17    9.903336    9.918289    9.910892    34593       -
18    9.903336    9.920273    9.912503    34593       -

```

19	9.903336	9.918747	9.910459	34593	-
20	9.904480	9.913788	9.910570	34593	-
21	9.905014	9.914246	9.911075	34593	-
22	9.905167	9.914474	9.911273	34593	-
23	9.904099	9.913025	9.909992	34593	-
24	9.906082	9.915237	9.912122	34593	-
25	9.906158	9.915390	9.912118	34593	-
26	9.905472	9.914627	9.911528	34593	-
27	9.903717	9.912491	9.909618	34593	-
28	9.904022	9.912872	9.910030	34593	-
29	9.904633	9.913406	9.910586	34593	-
30	9.903030	9.911575	9.908867	34593	-
31	9.904633	9.913406	9.910431	34593	-
32	9.905396	9.913940	9.911105	34593	-
33	9.906158	9.914474	9.911864	34593	-
34	9.904327	9.913712	9.910408	34593	-
35	9.906235	9.915009	9.912106	34593	-
36	9.906235	9.914551	9.911821	34593	-
37	9.905167	9.913864	9.911058	34593	-
38	9.906082	9.914398	9.911717	34593	-
39	9.905853	9.914246	9.911670	34593	-
40	9.904633	9.913177	9.910697	34593	-
41	9.905243	9.913712	9.910893	34593	-
42	9.904480	9.912720	9.910118	34593	-
43	9.903259	9.911880	9.909184	34593	-
44	9.905167	9.913559	9.910726	34593	-
45	9.904022	9.912491	9.909877	34593	-
46	9.905014	9.913864	9.910882	34593	-
47	9.905624	9.913940	9.911305	34593	-
48	9.906082	9.914856	9.912113	34593	-
49	9.905090	9.913712	9.910924	34593	-
50	9.905472	9.913940	9.911503	34593	-
51	9.905167	9.914169	9.911531	34593	-
52	9.906082	9.914322	9.911644	34593	-
53	9.905624	9.913788	9.911247	34593	-
54	9.906311	9.914856	9.912053	34593	-
55	9.906158	9.914474	9.911903	34593	-
56	9.904709	9.913177	9.910396	34593	-
57	9.905396	9.913712	9.911071	34593	-
58	9.905472	9.914093	9.911402	34593	-
59	9.903946	9.912186	9.909713	34593	-
60	9.904327	9.912872	9.910180	34593	-
61	9.904633	9.913177	9.910477	34593	-
62	9.904938	9.913101	9.910609	34593	-
63	9.904327	9.912643	9.910071	34593	-

Below are the statistics for 12288 samples:

Estimated time to collect samples:	5622.506 usecs	
Total work time breakdown:	5604.112 usecs	
Average time to fill FIFO:	5312.594 usecs	(### User blocking for FIFO to fill ###)
Average time to read samples:	131.749 usecs	(### This time excludes FIFO fill time ###)
Average time to process samples:	149.632 usecs	
Average time other:	10.137 usecs	
Approximate free time available:	5341.125 usecs	

3.2.4 lib/ccrtaiicc_adc_sps

This is a useful tool to display the sample rate of various channels.

```
Usage: ./ccrtaiicc_adc_sps [-b Board] [-c StartChan,StopChan] [-C AdcUpdateClock]
                        [-E ExpSPS@Tol] [-j SpeedSelect] [-l LoopCnt]
                        [-m XferMode] [-S NumSamples] [-t TolerancePPT]
                        [-T SglBrdClkLpbkTst] [-X ExtClock]
-b Board                (Board number -- default is 0)
-c StartChan,EndChan   (Select start and end channel numners -- default 0,63
  -c 7,16               (select channels 7 through 16 for processing
  -c 32                 (select channels 32 through 63 for processing
-C AdcUpdateClock      (select ADC update clock, a,b,c,d,e,A,B,C,D,E or 'n|N')
  -C a                 (Ch0..63=Normal Clock 0 set to MAX SPS 500000)
  -C b@20000.0/n       (Ch0..15=Normal Clock 1 at 20000 SPS, Ch16..63=No Clock)
  -C a,b,A,B           (Ch0..15=Normal Clock 0, Ch16..31 Normal Clock 1,
                       Ch32..47 Inverted Clock 0, Ch48..63 Inverted Clock 1)
  -C c,d@350000,e     (Ch0..15=Normal Clock 2 at MAX SPS 500000, Ch16..31
                       Normal Clock 3 at 350000 SPS, Ch 32-63 Normal External
                       Signal
-E ExpSPS@Tol          (specify expected samples/second and tolerance for each
  -E C                 (All ADC's to use clock samples/second and default
                       tolerance 0.010%)
  -E c@0.02,30000     (ADC 0 uses clock samples/second and tolerance 0.02%,
                       remaining use 30,000 SPS and default tolerance 0.010%)
  -E C@0.02,C         (All ADC's to use clock samples/second and default
                       tolerance except for ADC 0 tolerance of 0.02%)
  -E 10000,c          (ADC 0 to use 10000 SPS, rest of ADCs to use clock
                       samples/second. Default tolerance for all ADCs)
-F DebugFile           (Debug file with menu display -- default "=== None ===")
  @DebugFile          (Debug file without menu display (only summary and rate
                       display) -- default "=== None ===")
  @                   (No debug file and no menu display (only summary and
                       rate display) -- default "=== None ===")
-j SpeedSelect         (select data speed, 'n' or 'h')
  -j n,h,n,h          (Ch0..15 & Ch32..47=normal speed, Ch16..31 &
                       Ch48..63=high speed)
  -j h/n              (Ch0..15=normal speed, Ch16..63=high speed)
  -j h                (Ch0..63=high speed)
-l LoopCnt            (Loop Count -- default is 10000000)
-l 0                  (Loop forever)
-m XferMode           (Transfer Mode -- default = 'DMA Channel' for old
  -md0                (Library: DMA 0 mode)
  -md1                (Library: DMA 1 mode)
  -mm                 (Library: Modular Scatter-Gather DMA mode)
-S NumSamples         (Number of Samples/Read -- default is 4096 for DMA and
                       2000 for MsgDma)
-t                    (Tolerance in Parts/Trillion -- default is 0.007000 PPT)
-T                    (Single Board Clock Loopback Test - External Clock
                       In/Out requires loopback cable
-X[0..3,e|E,n|N]     (Board External Clock Output Selection)
                       '0..3' - Clock Generator Output Number
```

'e|E' - External clock input (redrive)
'n|N' - No Clock

e.g. ./ccrtaicc_adc_sps -Ca@123456,n,c@78912,n (ADC0 is 123456Hz, ADC1 is off,
ADC2 is 78912Hz and ADC3 is off)

Example display:

./ccrtaicc_adc_sps -Ca@123456,n,c@78912,n

local_ptr=0x7ffff7fd7000

Physical Memory Information:
UserPID =21205
PhysMemPtr =0x615a0000
DriverVirtMemPtr=0xffff8800615a0000
MmappedUserMemPtr=0x7ffff7fcb000
PhysMemSize =0x00002000
PhysMemSizeFreed=0x00000000
EntryInTxTbl =0
NumOfEntriesUsed=1
Flags =0x0000

Board Number [-b]: 0
Channel Selection [-c]: Start=Ch0, End=Ch63 (Number of Active Channels=64)
: Active Channel Mask=0xfffffffffffffff
Update Clock Selected [-C]: Ch00..15 [00]Normal Clock 0 (123456.000 SPS)
: Ch16..31 [15]### CLOCK IS NOT CONNECTED ###
: Ch32..47 [02]Normal Clock 2 (78912.000 SPS)
: Ch48..63 [15]### CLOCK IS NOT CONNECTED ###
Speed Select [-j]: Ch00..15 [0]Normal Speed
: Ch16..31 [0]Normal Speed
: Ch32..47 [0]Normal Speed
: Ch48..63 [0]Normal Speed
Loop Count [-l]: 1000000
Transfer Mode [-m]: Library: (FIFO) MODULAR SCATTER-GATHER DMA I/O
Number of Samples [-S]: 2000 (8000 bytes)
Clock Loopback Test [-T]: No
External Clock Output [-X]: 7 (No Clock)
Input Signal : [0]External Signal
Voltage Range : Ch00..15 [1]+/-10 Volts
: Ch16..31 [1]+/-10 Volts
: Ch32..47 [1]+/-10 Volts
: Ch48..63 [1]+/-10 Volts
Data Format : Ch00..15 [0]Offset binary
: Ch16..31 [0]Offset binary
: Ch32..47 [0]Offset binary
: Ch48..63 [0]Offset binary

Read: Size 8000, Count 24 (FIFO wait: 602.7us, Read time/rate: 25.3us/316.5MBPS)

	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[00 07]	123459	123459	123459	123459	123459	123459	123459	123459
[08 15]	123459	123459	123459	123459	123459	123459	123459	123459
[16 23]	000000	000000	000000	000000	000000	000000	000000	000000
[24 31]	000000	000000	000000	000000	000000	000000	000000	000000
[32 39]	078915	078915	078915	078915	078915	078915	078915	078915
[40 47]	078915	078915	078915	078915	078915	078915	078915	078915
[48 55]	000000	000000	000000	000000	000000	000000	000000	000000
[56 63]	000000	000000	000000	000000	000000	000000	000000	000000

==== No overflow occurred (HWM Samples In fifo 2368) ====

<-- (Samples/Second) -->
Chan Min Max Ave
====

0	123450	123461	123456
1	123450	123461	123456
2	123450	123461	123456
3	123450	123461	123456
4	123450	123461	123456
5	123450	123461	123456
6	123450	123461	123456
7	123450	123461	123456
8	123450	123461	123456
9	123450	123461	123456
10	123450	123461	123456
11	123450	123461	123456
12	123450	123461	123456
13	123450	123461	123456
14	123450	123461	123456
15	123450	123461	123456
16	000000	000000	000000
17	000000	000000	000000
18	000000	000000	000000
19	000000	000000	000000
20	000000	000000	000000
21	000000	000000	000000
22	000000	000000	000000
23	000000	000000	000000
24	000000	000000	000000
25	000000	000000	000000
26	000000	000000	000000
27	000000	000000	000000
28	000000	000000	000000
29	000000	000000	000000
30	000000	000000	000000
31	000000	000000	000000
32	078909	078915	078912
33	078909	078915	078912
34	078909	078915	078912
35	078909	078915	078912
36	078909	078915	078912
37	078909	078915	078912
38	078909	078915	078912
39	078909	078915	078912
40	078909	078915	078912
41	078909	078915	078912
42	078909	078915	078912
43	078909	078915	078912
44	078909	078915	078912
45	078909	078915	078912
46	078909	078915	078912
47	078909	078915	078912
48	000000	000000	000000
49	000000	000000	000000
50	000000	000000	000000
51	000000	000000	000000
52	000000	000000	000000
53	000000	000000	000000
54	000000	000000	000000
55	000000	000000	000000
56	000000	000000	000000
57	000000	000000	000000
58	000000	000000	000000
59	000000	000000	000000
60	000000	000000	000000
61	000000	000000	000000
62	000000	000000	000000
63	000000	000000	000000

./certaicc_adc_sps -Ca@123456 -T

// An external clock loopback cable needs to be connected

local_ptr=0x7ffff7fd7000

Physical Memory Information:

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```

UserPID          =21353
PhysMemPtr       =0x3fd90000
DriverVirtMemPtr=0xffff88003fd90000
MmappedUserMemPtr=0x7ffff7fcb000
PhysMemSize      =0x00002000
PhysMemSizeFreed=0x00000000
EntryInTxTbl     =0
NumOfEntriesUsed=1
Flags            =0x0000

```

```

Board Number      [-b]: 0
Channel Selection [-c]: Start=Ch0, End=Ch63 (Number of Active Channels=64)
                   : Active Channel Mask=0xffffffffffffffff
Update Clock Selected [-C]: Ch00..15 [08]Normal External Signal
                   : Ch16..31 [08]Normal External Signal
                   : Ch32..47 [08]Normal External Signal
                   : Ch48..63 [08]Normal External Signal
Speed Select      [-j]: Ch00..15 [0]Normal Speed
                   : Ch16..31 [0]Normal Speed
                   : Ch32..47 [0]Normal Speed
                   : Ch48..63 [0]Normal Speed
Loop Count        [-l]: 10000000
Transfer Mode     [-m]: Library: (FIFO) MODULAR SCATTER-GATHER DMA I/O
Number of Samples [-S]: 2000 (8000 bytes)
Clock Loopback Test [-T]: Yes (Loopback cable required)
External Clock Output [-X]: 0 (Clock Generator Output 0)
Input Signal      : [0]External Signal
Voltage Range     : Ch00..15 [1]+/-10 Volts
                   : Ch16..31 [1]+/-10 Volts
                   : Ch32..47 [1]+/-10 Volts
                   : Ch48..63 [1]+/-10 Volts
Data Format       : Ch00..15 [0]Offset binary
                   : Ch16..31 [0]Offset binary
                   : Ch32..47 [0]Offset binary
                   : Ch48..63 [0]Offset binary

```

Read: Size 8000, Count 51 (FIFO wait: 184.2us, Read time/rate: 25.3us/316.1MBPS)

```

===== Samples/Second =====
      [0]      [1]      [2]      [3]      [4]      [5]      [6]      [7]
=====
[00 07] 123459 123459 123459 123459 123459 123459 123459 123459
[08 15] 123459 123459 123459 123459 123459 123459 123459 123459
[16 23] 123460 123460 123460 123460 123460 123460 123460 123460
[24 31] 123460 123460 123460 123460 123460 123460 123460 123460
[32 39] 123460 123460 123460 123460 123460 123460 123460 123460
[40 47] 123460 123460 123460 123460 123460 123460 123460 123460
[48 55] 123460 123460 123460 123460 123460 123460 123460 123460
[56 63] 123460 123460 123460 123460 123460 123460 123460 123460

```

==== No overflow occurred (HWM Samples In fifo 3072) ====

```

=====
<-- (Samples/Second) -->
Chan  Min      Max      Ave
=====
  0    123450  123463  123456
  1    123450  123463  123456
  2    123450  123463  123456
  3    123450  123463  123456
  4    123450  123463  123456
  5    123450  123463  123456
  6    123450  123463  123456
  7    123450  123463  123456
  8    123450  123463  123456
  9    123450  123463  123456
 10    123450  123463  123456
 11    123450  123463  123456
 12    123450  123463  123456
 13    123450  123463  123456

```


14	123450	123463	123456
15	123450	123463	123456
16	123449	123464	123456
17	123449	123464	123456
18	123449	123464	123456
19	123449	123464	123456
20	123449	123464	123456
21	123449	123464	123456
22	123449	123464	123456
23	123449	123464	123456
24	123449	123464	123456
25	123449	123464	123456
26	123449	123464	123456
27	123449	123464	123456
28	123449	123464	123456
29	123449	123464	123456
30	123449	123464	123456
31	123449	123464	123456
32	123449	123464	123456
33	123449	123464	123456
34	123449	123464	123456
35	123449	123464	123456
36	123449	123464	123456
37	123449	123464	123456
38	123449	123464	123456
39	123449	123464	123456
40	123449	123464	123456
41	123449	123464	123456
42	123449	123464	123456
43	123449	123464	123456
44	123449	123464	123456
45	123449	123464	123456
46	123449	123464	123456
47	123449	123464	123456
48	123449	123464	123456
49	123449	123464	123456
50	123449	123464	123456
51	123449	123464	123456
52	123449	123464	123456
53	123449	123464	123456
54	123449	123464	123456
55	123449	123464	123456
56	123449	123464	123456
57	123449	123464	123456
58	123449	123464	123456
59	123449	123464	123456
60	123449	123464	123456
61	123449	123464	123456
62	123449	123464	123456
63	123449	123464	123456

3.2.5 lib/ccrtaicc_check_bus

This is a simple test to check whether there is interference from other cards that may be sharing the same bus. It simply computes the time it takes to perform hardware reads and computes the jitter. It must be run as *root*.

```
Usage: ./ccrtaicc_check_bus [-b Board] [-c CPU] [-l LoopCnt] [-t Tolerance]
  -b Board      (Board number -- default is 0)
  -c CPU       (CPU number -- default is 1)
  -l LoopCnt   (Loop Count -- default is 1000000)
  -l 0         (Loop forever)
  -t Tolernace (Tolerance -- default is 2.00 micro-seconds)
```

Example display:

```
sudo ./ccrtaicc_check_bus
```

```

local_ptr=0x7ffff7fd7000
10000000: usec/read: Cur=1.167 (Min=1.092 Max=1.768 Ave=1.143276)
          [Bus Jitter (usec): 0.676 ==> LOW]

```

3.2.6 lib/ccrtaicc_clock

This is a useful tool to display information of the various clocks and also program them.

```

Usage: ./ccrtaicc_clock [-b BoardNo] [-C UpdateClock] [-d Delay] [-l LoopCnt]
          [-R] [-t TolerancePPT]
  -b BoardNo          (Board number -- default is 0)
  -C <Clock>@<Frequency> (set update clock '0..6' with frequency )
  -d Delay            (Delay between screen refresh -- default is 10 milli-
                      seconds)
  -l LoopCnt          (Loop count -- default is 0)
  -R                  (Reset/Clear all clocks)
  -t                  (Tolerance in Parts/Trillion -- default is 0.007000 PPT)

e.g. ./ccrtaicc_clock -C 1@300000
      (Set Clock 1 to 300000 SPS - do not change any other
       running clocks)
      ./ccrtaicc_clock -R -C0@100000 -C4@12345 -t0.5
      (Reset all clocks and then set Clock 0 to 100000 SPS and
       Clock 4 to 12345 SPS and 0.5 PPT)

```

Example display:

```

./ccrtaicc_clock -R -C0@100000 -C4@12345

Board Number [-b]: 0
Delay [-d]: 10 milli-seconds
Loop Count [-l]: ***Forever***
Scan Count: 1416

_____ Clock Revision _____
Silicon Revision: A2
Base Part Number: 5341
Device Speed Grade: A
Device Revision: B

_____ Clock CSR _____
Clock Interface: Idle
Clock Output: Enabled
Clock State: Active

_____ Input Clock Status _____
Calibration: Not In-Progress
SMBUS Timeout: Not Timed Out
PLL Lock: Locked
Input Signal: Present
Input_0 Clock: Present
Input_1 Clock: Present
Input_2 Clock: *** Not Present ***
Input_FB Clock: Present
XAXB Input Clock: *** Not Present ***

_____ Output Clock Setting _____
User output clock frequency 0: 100000.000 Samples/Second/Channel
User output clock frequency 1: *** Not Set ***
User output clock frequency 2: *** Not Set ***

```

```

User output clock frequency 3: *** Not Set ***
User output clock frequency 4: 12345.000 Samples/Second/Channel
User output clock frequency 5: *** Not Set ***
User output clock frequency 6: *** Not Set ***
SD-RAM output clock frequency 7: 10000000.000 Samples/Second/Channel
External output clock frequency 8: 10000000.000 Samples/Second/Channel
Feed-Back output clock frequency 9: 10000000.000 Samples/Second/Channel

```

3.2.7 lib/ccrtaicc_disp

Useful program to display the local board registers. This program uses the *curses* library. This test is similar to the previous non-library test.

```

Usage: ./ccrtaicc_disp [-b Board] [-d Delay] [-D DMAEngineNo] [-H] [-i]
                    [-l LoopCnt] [-m XferMode] [-o Offset] [-P Pause]
                    [-s XferSize] [-S DispSize]
-b Board           (Board number -- default board is 0)
-d Delay           (Delay between screen refresh -- default is 0)
-D DMAEngineNo     (DMA Engine number -- default = 0)
-H                (Enable Hyper-Drive Mode -- default "=== Disabled ===")
-i                (Enable Interrupts -- default = Disable)
-l LoopCnt         (Loop Count - default = 0)
-m XferMode        (Transfer Mode -- default = DMA)
  -md              (Avalon Memory: DMA mode)
  -mm              (Avalon Memory: Modular Scatter-Gather DMA mode)
  -mp              (Avalon Memory: Programmed I/O mode)
-o Offset          (Hex offset to read from -- default is 0x0)
-P Pause           (Microseconds to sleep in User Function loop -- default is 0)
-s XferSize        (Number of bytes to transfer -- default is 0x1000)
-S DispSize        (Number of bytes to display -- default is 0x200)

```

Example display:

```

./ccrtaicc_disp
local_ptr=0x7ffff7fd7000
Physical Memory Information:
  UserPID           =16618
  PhysMemPtr        =0x7c2be000
  DriverVirtMemPtr =0xffff88007c2be000
  MmappedUserMemPtr=0x7ffff7fcc000
  PhysMemSize       =0x00001000
  PhysMemSizeFreed =0x00000000
  EntryInTxTbl     =0
  NumOfEntriesUsed =1
  Flags             =0x0000
-----
Board Number       [-b]: 0
Delay              [-d]: 0 milli-seconds
DMA Engine         [-D]: 0
Hyper-Drive       [-H]: Disabled
Interrupts        [-i]: Disabled
Loop Count        [-l]: ***Forever***
Transfer Mode      [-m]: Basic DMA I/O (Avalon Memory)
Offset            [-o]: 0x00000000
Transfer Size      [-s]: 0x00001000 (4096) bytes ( 17.308 MBytes/Second)
Display Size      [-S]: 0x00000200 (512) bytes

ScanCount          : 13228
Read Duration (microsecs) : 236.660 (min= 234.615/max= 247.757/ave= 236.132)

```

```

          00      04      08      0C      10      14      18      1C
          =====
000000  93500101 04032019 00020000 00000000 00000000 00000000 00000000
000020  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000040  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000060  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000080  00000000 00000000 00000000 00000000 00000000 00000000 00000000
0000a0  00000000 00000000 00000000 00000000 00000000 00000000 00000000
0000c0  00000000 00000000 00000000 00000000 00000000 00000000 00000000
0000e0  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000100  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000120  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000140  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000160  00000000 00000000 00000000 00000000 00000000 00000000 00000000
000180  00000000 00000000 00000000 00000000 00000000 00000000 00000000
0001a0  00000000 00000000 00000000 00000000 00000000 00000000 00000000
0001c0  00000000 00000000 00000000 00000000 00000000 00000000 00000000
0001e0  00000000 00000000 00000000 00000000 00000000 00000000 00000000

```

3.2.8 lib/ccrtaicc_dma

This test transfers data from physical memory to the Local register area and back. There are three modes of operation. One is regular DMA, the second is Modular Scatter-Gather DMA and the third is programmed I/O. Depending on the number of DMA engines supported by the card, the user can select one of them to perform the DMA. Additionally, if the card supports Modular Scatter-Gather DMA, then they can also select that. Area select is one of three areas the user can specify. They represent the area in physical memory and local register where the transfer is to occur. The test automatically switches to a different area corresponding to the regular DMA engine supplied. If multiple copies of this application is run on the same card using the same DMA engine, then the user needs to manually select a different area '-A' so the data mismatch does not occur due to using the same area region.

```

Usage: ./ccrtaicc_dma [-A Area2Select] [-b Board] [-D DMAEngineNo] [-i]
          [-l LoopCnt] [-m XferMode] [-s Size] [-v VerboseNo]
-A Area2Select (Area to select -- default = -1)
-b Board      (Board number -- default = 0)
-D DMAEngineNo (DMA Engine number -- default = 0)
-i           (Enable Interrupts -- default = Disable)
-l LoopCnt   (Loop Count - default = 1000)
-m XferMode  (Transfer Mode -- default = DMA)
  -md       (DMA mode)
  -mm       (MsgDma mode - '-D' option is ignored)
  -mp       (Programmed I/O mode)
-s Size      (Transfer Size in bytes (multiple of byte width) -
             default = 12288)
-V VerboseNo (verbose -- default = 0)

e.g. ./ccrtaicc_dma -A1 (perform dma using DMA0 on area 1 )
     ./ccrtaicc_dma -i -D1 (perform dma using DMA1 with interrupts on area 0)
     ./ccrtaicc_dma -mm (perform dma using MsgDMA on area 0)

```

Example display:

```

./ccrtaicc_dma

Device Name: /dev/ccrtaicc0
local_ptr=0x7ffff7fd7000
Physical Memory Information:
  UserPID      =16945
  PhysMemPtr   =0x5a00000
  DriverVirtMemPtr=0xffff880005a00000

```

```

MmappedUserMemPtr=0x7ffff70e8000
PhysMemSize      =0x00200000
PhysMemSizeFreed=0x00000000
EntryInTxTbl    =0
NumOfEntriesUsed=2
### Avalon Address[A0]: 0x00001000 - 0x00004000
### DMA Address[A0]: 0x00100400 - 0x00103400
### Transfer Size: 12288 (0x00003000) bytes (DMA without Interrupts:
DMA Engine 0) ###
1000: A2P: Total: 697.244us ( 17.62 MB/s): first=0xface0000 last=0xface0bff

      (micro-seconds)      (MBytes/second)
      Min    Max    Ave    Min    Max    Ave
-----
P2A:  427.70  433.56  429.61   28.34  28.73  28.60
A2P:  696.25  722.41  697.19   17.01  17.65  17.63

```

./ccrtaicc_dma -mm

```

Device Name: /dev/ccrtaicc0
local_ptr=0x7ffff7fb7000
Physical Memory Information:
  UserPID      =25623
  PhysMemPtr   =0x35000000
  DriverVirtMemPtr=0xffff96d0f5000000
  MmappedUserMemPtr=0x7ffff7065000
  PhysMemSize  =0x00200000
  PhysMemSizeFreed=0x00000000
  EntryInTxTbl =0
  NumOfEntriesUsed=2
  Flags       =0x0000
### Avalon Address[A0]: 0x00001000 - 0x00004000
### DMA Address[A0]: 0x00100400 - 0x00103400
### Transfer Size: 12288 (0x00003000) bytes (DMA without Interrupts: MsgDma
Engine) ###
1000: A2P: Total: 37.131us ( 330.94 MB/s): first=0xface0000 last=0xface0bff

      (micro-seconds)      (MBytes/second)
      Min    Max    Ave    Min    Max    Ave
-----
P2A:  45.77  51.63  46.49   237.99  268.45  264.34
A2P:  37.07  43.19  37.21   284.53  331.51  330.24

```

3.2.9 lib/ccrtaicc_example

This test provides a simple example of programming ADC.

Usage: ./ccrtaicc_example [-b Board]
 -b Board (Board number -- default is 0)

Example display:

```

./ccrtaicc_example

local_ptr=0x7ffff7fd7000
Physical Memory Information:
  UserPID      =17871
  PhysMemPtr   =0x7c291000
  DriverVirtMemPtr=0xffff88007c291000
  MmappedUserMemPtr=0x7ffff7fcc000
  PhysMemSize  =0x00001000

```

```

        PhysMemSizeFreed=0x00000000
        EntryInTxTbl    =0
        NumOfEntriesUsed=1
        Flags            =0x0000
### Configuring ADC ###
- Activate ADC
- Configure ADC
- Set Input Control to Calibration Bus
- Set Calibration to Positive Reference Voltage
### Programming Clocks ###
### Calibrate All ADC Channels ###
### Reading ADC Channels using ccrtAICC_Transfer_Data() ###

==== ADC Channels - Using ccrtAICC_Transfer_Data() ==== (length=64)
+DMP+      0  0001fb6b  0001fb6f  0001fb6e  0001fb6b  *...k...o...n...k*
+DMP+     0x10 0001fb68  0001fb6c  0001fb6d  0001fb69  *...h...l...m...i*
+DMP+     0x20 0001fb6d  0001fb6e  0001fb66  0001fb6a  *...m...n...f...j*
+DMP+     0x30 0001fb6a  0001fb6a  0001fb64  0001fb64  *...j...j...d...d*

### Reading ADC Channels using ccrtAICC_DMA_Configure()/ccrtAICC_DMA_Fire() ###
- Convert Physical DMA Memory Address to Avalon Equivalent Address
- Configure DMA
- Fire DMA

==== ADC Channels - Using ccrtAICC_DMA_Fire() ==== (length=64)
+DMP+      0  0001fb6c  0001fb66  0001fb66  0001fb6a  *...l...f...f...j*
+DMP+     0x10 0001fb69  0001fb67  0001fb6c  0001fb68  *...i...g...l...h*
+DMP+     0x20 0001fb65  0001fb6b  0001fb6b  0001fb6a  *...e...k...k...j*
+DMP+     0x30 0001fb70  0001fb6b  0001fb69  0001fb6a  *...p...k...i...j*

### Single (one descriptor) Modular Scatter-Gather DMA ###
- Allocating memory and seeding with pattern
- Seizing MSGDMA
- Configure Single MSGDMA (PCIe ==> Avalon)
- Fire Single MSGDMA: Xfer 0x8000 bytes: PCIe ==> Avalon (@0x8000)
- Validating data
- Configure Single MSGDMA (Avalon ==> PCIe)
- Fire Single MSGDMA: Xfer 0x8000 bytes: Avalon (@0x8000) ==> PCIe
- Validating data
- Releasing MSGDMA
### Multi (four descriptor) Modular Scatter-Gather DMA (Single-Shot) ###
- Allocating memory and seeding with pattern
- Seizing MSGDMA
- Configure multi MSGDMA (PCIe ==> Avalon ==> PCIe ==> Avalon ==> PCIe)
- Setup Multi MSGDMA
- Fire Multi MSGDMA (Single-Shot)
- Validating data
- Releasing MSGDMA
### Multi (four descriptor) Modular Scatter-Gather DMA (Clone) ###
- Allocating memory and seeding with pattern
- Seizing MSGDMA
- Configure multi MSGDMA (PCIe ==> Avalon ==> PCIe ==> Avalon ==> PCIe)
- Setup Multi MSGDMA
- Stop and Initialize Multi MSGDMA (Clone)
- Fire Multi MSGDMA and wait one cycle (Clone: Once cycle wait)
- Validating data
- Releasing MSGDMA

```

3.2.10 lib/ccrtaicc_expires

This test is useful in displaying board expires information.

```
Usage: ./ccrtaicc_expires -[b Board] -[s]
       -b <board>          (board #, default = 0)
       -s                  (short display, default = verbose)
```

Example display:

./ccrtaicc_expires (for card that has no restrictions)

```
Device Name: /dev/ccrtaicc0
Board Serial No: 687377 (0x000a7d11)
```

```
#####
###                               ###
###      UNRESTRICTED FIRMWARE    ###
###                               ###
#####
```

./ccrtaicc_expires (for restricted card that has NO expiration date)

```
Device Name: /dev/ccrtaicc0
Board Serial No: 98765 (0x000181cd)
```

```
#####
###                               ###
###      RESTRICTED FIRMWARE      ###
###                               ###
#####
```

```
=====
=== No Expiration Date ===
=====
```

./ccrtaicc_expires (for restricted card that has expiration date)

```
Device Name: /dev/ccrtaicc0
Board Serial No: 98765 (0x000181cd)
```

```
#####
###                               ###
###      RESTRICTED FIRMWARE      ###
###                               ###
#####
```

```
=====
Local Expiration Date: 03/11/2018 13:21:52
GMT Expiration Date: 03/11/2018 17:21:52
Duration to Expire: Days=122, Hours=2, Minutes=49, Seconds=20
=====
```

./ccrtaicc_expires -s (for card that has no restrictions)

Unrestricted

./ccrtaicc_expires -s (for restricted card that has NO expiration date)

Restricted: No expiration date

./ccrtaicc_expires -s (for restricted card that has expiration date)

Restricted: Expire in 10550462 seconds

3.2.11 lib/ccrtaicc_identify

This test is useful in identifying a particular card by displaying its LED.

```
Usage: ./ccrtaicc_identify -[absx]
  -a                (Identify all cards through a light sequence)
  -b <board>       (board #, default = 0)
  -s <seconds>     (Identify Board: ENABLED for number of seconds,
                  default = 10)
  -s 0              (Identify Board: DISABLED)
  -s <negative value> (Identify Board: ENABLED forever)
  -x                (silent)
```

If the '-a' option is selected, all other options are ignored. This option will sequence through all the cards found in turn as follows:

- 1) The first device number will flash its LED for 10 seconds
- 2) The remaining devices numbers will be selected sequentially and flash their LEDs for 3 seconds

Example display:

```
./ccrtaicc_identify
```

```
Device Name      : /dev/ccrtaicc0
Board ID         : 9350
Board Type       : 01
Board Function   : 01
Board Serial No  : 687377 (0x000a7d11)
Firmware Revision : 2.0 (Major.Minor)
MsgDma Support   : 31 descriptors (Yes)
```

```
Identify ENABLED on board 0 (LED should start flashing for 10 seconds)
Sleeping for 10 seconds...
Identify DISABLED on board 0 (LED should stop flashing)
```

```
./ccrtaicc_identify -a
```

```
TotalBoardCount=2
# DNum IRQ MSI Bu:Sl:Fv VnID:Sub BdID:Ty:Fu:Sub FMaj.Min(mm:dd:yy hh:mm:ss) MC
FmFlvCod FwbRev Temp:C/F SerialNo RLS# Func
0 0 165 Y b6:00:00 1542:1542 9350.01.01:0100 0002.000(04/03/19 00:00:00) C7
00000000 00000000 0/ 32.0 687376 150 AICC
1 1 167 Y b7:00:00 1542:1542 9350.01.01:0100 0098.000(11/02/4020 00:00:00) C7
00000000 00000000 0/ 32.0 687377 150 AICC
```

```
Device Numbers: (enter <CTRL-C> to terminate)
```

```
=====
0* 1
```

3.2.12 lib/ccrtaicc_info

This test is useful in getting information for all the *ccrtaicc* devices in the system.

```
Usage: ./ccrtaicc_info -[b Board] -[l] -[v]
  -b <board>       (board #, default = 0)
  -l                (long display, default = short)
  -v                (long display and verbose, default = no verbose)
  -l -v            (long display and verbose, default = no verbose)
```

Example display:

./certain_info

```
# IRQ MSI Bu:Sl:Fn VnID:Sub BdID:Ty:Fu:Sub FMaj.Min(mm:dd:yy hh:mm:ss) MC FmFlvCod FwbRev Temp:C/F
SerialNo RLS# Func
 0 59 Y 05:00:00 1542:1542 9350.01.01:0100 0002.000(04/03/19 00:00:00) C7 00000000 00000000 0/ 32.0
687377 150 AICC
```

./certain_info -l

```
##### Board 0 #####
Version: 2022.1.0
Build: Thu Jan 20 08:22:20 EST 2022
Module: ccertain
Board Index: 0 (PCIe-CCRT_FPGA_AICC)
Bus: 0x07
Slot: 0x00
Func: 0x00
Vendor ID: 0x1542
Sub-Vendor ID: 0x1542
Board Info: 0x93500101 (id=9350, type=0x01, func=0x01 (AICC))
Member Code: 1 (C7)
Sub-Device ID: 0x0100
Firmware Date/Time: 0x04032019 0x00000000 (04/03/2019 00:00:00)
Firmware Revision: 0x00020000 (2.0)
Fpgawb Revision: 0x00000000 (0000.00-00) (Not Supported)
Firmware Flavor Code: 0x00000000 (0) (****)
Board Serial Number: 0x000a7d11 (687377)
FPGA Chip Temperature: 0x00 (0 degree C, 32.0 degree F)
Run Level Sector Number: 0x96 (150)
Multi-Firmware Support: 0x1 (Yes)
MSI Support: Enabled
Scatter-Gather DMA Support: Yes
Number of MSG DMA Descriptors: 31
Max MSG DMA Xfer Memory Size: 131068 (bytes)
Max MSG DMA Width: 4 (bytes)
Max MSG DMA Xfer FIFO Size: 8192 (bytes)
Double-Word Support: Yes
IRQ Level: 69
Maximum Link Width: 4
Negotiated Link Width: 4
Cloning Support: 3 (Cloning is supported. Region addressing allowed for any user)
10V Calibration Reference: 9.91 Volts
5V Calibration Reference: 4.95 Volts
```

./certain_info -l -v

```
##### Board 0 #####
Version: 2022.1.0
Build: Thu Jan 20 08:22:20 EST 2022
Module: ccertain
Board Index: 0 (PCIe-CCRT_FPGA_AICC)
Bus: 0x07
Slot: 0x00
Func: 0x00
Vendor ID: 0x1542
Sub-Vendor ID: 0x1542
Board Info: 0x93500101 (id=9350, type=0x01, func=0x01 (AICC))
Member Code: 1 (C7)
Sub-Device ID: 0x0100
Firmware Date/Time: 0x04032019 0x00000000 (04/03/2019 00:00:00)
Firmware Revision: 0x00020000 (2.0)
Fpgawb Revision: 0x00000000 (0000.00-00) (Not Supported)
Firmware Flavor Code: 0x00000000 (0) (****)
Board Serial Number: 0x000a7d11 (687377)
FPGA Chip Temperature: 0x00 (0 degree C, 32.0 degree F)
Run Level Sector Number: 0x96 (150)
Multi-Firmware Support: 0x1 (Yes)
MSI Support: Enabled
```

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```

Scatter-Gather DMA Support: Yes
Number of MSG DMA Descriptors: 31
Max MSG DMA Xfer Memory Size: 131068 (bytes)
    Max MSG DMA Width: 4 (bytes)
Max MSG DMA Xfer FIFO Size: 8192 (bytes)
    Double-Word Support: Yes
        IRQ Level: 69
    Maximum Link Width: 4
    Negotiated Link Width: 4
    Cloning Support: 3 (Cloning is supported. Region addressing allowed for any user)
10V Calibration Reference: 9.91 Volts
5V Calibration Reference: 4.95 Volts

    ---ADC Information---
        Maximum Voltage Range: 10 Volts
        Number of ADCs: 4
    Number of ADC Channels: 64
    Number of ADC Resolution: 18 Bits
    All ADC Channels Mask: 0xfffffffffffffff
    Maximum ADC Fifo Threshold: 0x00020000

    ---DMA Information---
        Driver DMA Size: 524288
    Num of Trans Tbl Entries: 8
    Num of Physical Memory Entries: 512
        Avalon Page Bits: 20
        Avalon Page Size: 1048576
        TX Interface Base: 8388608
    DMA Maximum Engines: 2
    DMA Maximum Burst Size: 1024
    DMA Maximum Transactions: 32
        DMA Maximum Size: 1048576 (DMA 0)
        DMA Width in Bytes: 4 (DMA 0)
        DMA Fire Command: 140 (DMA 0)
        DMA Maximum Size: 1048576 (DMA 1)
        DMA Width in Bytes: 4 (DMA 1)
        DMA Fire Command: 140 (DMA 1)

    ---Analog/DMA Interrupt Information---
        Interrupt Count: 0
            DMA 0 Count: 0
            DMA 1 Count: 0
        MSG DMA Count: 0
    Interrupts Occurred Mask: 0x00000000
    Wakeup Interrupt Mask: 0x00000000
    Timeout Seconds: 0
    DMA Control: 0x00000000

    ---Memory Regions Information---
        Region 0: Addr=0xbd220000 Size=32768 (0x8000)
        Region 2: Addr=0xbd200000 Size=131072 (0x20000)

```

3.2.13 lib/ccrtaicc_msgdma

This test performs a modular scatter-gather DMA test on boards that support it. Additionally, it displays performance information for each mode of operation.

```

Usage: ./ccrtaicc_msgdma [-a AddrOff,ToAddrOff] [-b Board] [-C] [-d NumDesc]
      [-f Input,Output] [-i] [-l LoopCnt] [-m Mode]
      [-s TotalXferSize] [-v] [-X]
-a <AddrOff,ToAddrOff> (First Avalon Address Offset, default DiagRam offset)
                       (Second 'ToAddrOff' only for Avalon2Avalon mode)
-b <Board>              (board #, default = 0)
-C                      (Perform Clone mode scatter-gather instead of single-
                       shot)
-d <NumDesc>           (Number of Descriptors, default = 1)

```

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```

-f <Input>,<#Output> (Use input file as input data. default None)
                    (Use Output file to write 'to' data. default None)
                    (Prepend with '#' to remove comments and address)
-i                    (Use interrupts, default is poll)
-l <LoopCnt>         (Loop Count, default = 1000)
-m <Mode>            (Mode of Operation, default = all)
  'a2p'              (Avalon memory address to Pci memory address)
  'p2a'              (Pci memory address to Avalon memory address)
  'p2p'              (Pci memory address to Pci memory address)
  'a2a'              (Avalon memory address to Avalon memory address)
  'all'              (All above modes with only memory addresses)

  'A2p'              (Avalon FIFO address to Pci memory address - specify
                    FIFO address '-a')
  'p2A'              (Pci memory address to Avalon FIFO address - specify
                    FIFO address '-a')
  'A2A'              (Avalon FIFO address to Avalon FIFO address - specify
                    FIFO address '-a')
-s <TotalXferSize> (Total Transfer Size in bytes, default size of DiagRam)
                    (Maximum transfer size is 0x3FFFF)
-v                    (Verbose operation. default is quiet)
-X                    (Skip Data Validation, default is to validate)

```

Notes:

- 1) For modes 'p2a' or 'a2p' only the first address 'AddrOff' is used in option '-a'
- 2) For modes 'a2a' the first address 'AddrOff' is "FROM" and second address 'ToAddrOff' is "TO"
- 3) If Input file is specified in the '-f' option, its contents is used to seed input
- 4) If '-X' option is specified, no pattern is written to input, unless '-f Input' option is specified
- 5) Multiple '-m' options can be specified on a single command line
- 6) When address '-a' option is not specified, DiagRam offset is used for Analog input/output
- 7) Normal running process if no arguments specified is as follows:
 - a) Incrementing pattern written to the input using programmed I/O and readback validated
 - b) Output written with 'baadbeef' pattern using programmed I/O
 - c) Scatter-Gather DMA performed from Input to Output
 - d) Data is read back from both Input and Output using programmed I/O and compared
- 8) An upper case 'A' in the -m option represents an Avalon FIFO address, while a lower case 'a' in the -m option represents a regular Avalon memory address
- 9) If a regular memory Avalon address is specified as an Avalon FIFO address and vice-versa results will be unpredictable
- 10) When either input or output Avalon address is pointing to a FIFO, then data validation is skipped
- 11) If a size is specified for a memory or FIFO address that is greater than it can handle, the result will be unpredictable. You will need to reset the firmware to restore proper operation

```

e.g. ./ccrtaicc_msgdma -mall (Run all transfer modes with validation)
     ./ccrtaicc_msgdma -a0x8000 -s0x100 (Run all modes with Avalon Address
     0x8000 and size 0x100)
     ./ccrtaicc_msgdma -a0xA000 -s0x200 -ma2a (Run a2a with Avalon Address 0xA000 and
     size 0x200)
     ./ccrtaicc_msgdma -mp2a -l1 -d1 -fHexFile_16K -a0x10004 -X
     (Transfer Input file to Avalon memory at 0x10004)
     ./ccrtaicc_msgdma -ma2p -l1 -d1 -f,OutFile -s0x4000 -a0x10004 -X
     (Transfer Avalon memory at 0x10004 to output file
     'OutFile')
     ./ccrtaicc_msgdma -mA2p -l10000 -s0x20000 -d16 -a0x18010
     (Transfer Avalon FIFO at 0x18010 to PCI memory with 16
     descriptors where each descriptor has a transfer size
     of 0x2000 bytes. No validation will be performed)

```

Example display:

```
./ccrtaicc_msgdma
```

```
### TotalXferSize = 0x00008000, individual descriptor length=0x008000 ###
1000: P2P Total: Size 0x8000, Fire= 109.84us/ 298.32MB/s
      (mi/ma/av: 289.46/ 298.55/ 298.10 MB/s, 109.76/ 113.20/ 109.92 us)
      LastWord=0x007cffff
1000: A2A Total: Size 0x4000, Fire= 84.59us/ 193.68MB/s
      (mi/ma/av: 186.51/ 195.22/ 193.18 MB/s, 83.92/ 87.85/ 84.81 us)
      LastWord=0x003e7fff
1000: P2A Total: Size 0x8000, Fire= 108.52us/ 301.97MB/s
      (mi/ma/av: 286.60/ 302.22/ 300.36 MB/s, 108.42/ 114.33/ 109.10 us)
      LastWord=0x007cffff
1000: A2P Total: Size 0x8000, Fire= 88.08us/ 372.05MB/s
      (mi/ma/av: 358.45/ 376.44/ 372.26 MB/s, 87.05/ 91.42/ 88.03 us)
      LastWord=0x007cffff
```

```
./ccrtaicc_msgdma -C (Cloning option)
```

```
### Cloning Option Selected ###
### TotalXferSize = 0x00008000, individual descriptor length=0x008000 ###
1000: P2P Total: Size 0x8000, Fire= 107.44us/ 304.99MB/s
      (mi/ma/av: 294.01/ 305.36/ 305.21 MB/s, 107.31/ 111.45/ 107.36 us)
      LastWord=0x007cffff
1000: A2A Total: Size 0x4000, Fire= 86.84us/ 188.67MB/s
      (mi/ma/av: 181.29/ 188.76/ 188.55 MB/s, 86.80/ 90.37/ 86.89 us)
      LastWord=0x003e7fff
1000: P2A Total: Size 0x8000, Fire= 106.87us/ 306.61MB/s
      (mi/ma/av: 295.68/ 306.81/ 306.56 MB/s, 106.80/ 110.82/ 106.89 us)
      LastWord=0x007cffff
1000: A2P Total: Size 0x8000, Fire= 86.92us/ 377.00MB/s
      (mi/ma/av: 361.70/ 377.35/ 376.78 MB/s, 86.84/ 90.59/ 86.97 us)
      LastWord=0x007cffff
```

3.2.14 lib/ccrtaicc_msgdma_clone

Cloning is an optional feature of this card that can be purchased separately. The basic cloning option is an extremely powerful tool that gives the user the ability to continuously transfer the contents of a region on the card to a physical memory entirely under hardware control, once cloning has commenced. This continuous transfer is performed at MsgDma speeds. A more advanced cloning option that can be purchased is known as Region Addressing. This option allows the board to Clone any MsgDma location to another MsgDma location, i.e. the source and destination locations can be any valid MsgDma able physical address in the system.

Since there is only one MsgDma engine on the card, only one Cloning or MsgDma operation can be active at a given time. Additionally, it is meaningless to perform Cloning on a FIFO region for two reasons. Firstly, each data in a FIFO is synchronous, however, the Cloned region is accessed asynchronously. Secondly, when the FIFO runs empty (*underflow*) or cannot accept more data (*overflow*) the results are unpredictable.



Caution: *Since physical addresses are supplied to this test, care must be taken to ensure that the supplied addresses are valid and that while cloning is in progress, the memory regions must not be freed or made inactive, otherwise, the results could be unpredictable and could lead to the possible corruption of the system.*

This test show the capabilities of this new cloning option.

```
Usage: ./ccrtaicc_msgdma_clone [-a FromAddr,ToAddr] [-b Board] [-d Delay]
```

```

[-F DebugFile] [-l LoopCnt] [-P] [-q] [-s XferSize]
[-S DisplaySize] [-v Delay] [-X] [-Z]
-a <FromAddr,ToAddr> (Clone address space From/To address in Hex)
                      (If address less than board size, board offset
                      used)
-b <Board>            (board #, default = 0)
-d <Delay>            (Delay between screen refresh -- default is 0
                      milli-seconds)
-F DebugFile         (Debug file -- default "=== None ===")
  @DebugFile         (Debug file and no display)
  @                  (No Debug file and no display)
-l LoopCnt           (Loop count -- default is 0)
-P                  (Program Board)
-q                  (Quite (non-interactive) mode)
-s <XferSize>        (Transfer size bytes)
-S <DisplaySize>     (Display size bytes)
-v Delay             (Verify data. Add additional one cycle delay in
                      micro-seconds if specified)
-X                  (Disable region protection)
-Z                  (Disable address cache - default is enabled)

```

e.g.

```

./ccrtaicc_msgdma_clone          (Clone ADC_Data to physical memory
                                  created by this program)
./ccrtaicc_msgdma_clone -a,      (Clone ADC_Data to board at offset
                                  0x0000)
./ccrtaicc_msgdma_clone -a,-1    (Clone ADC_Data to physical memory
                                  created by this program)
./ccrtaicc_msgdma_clone -a-1,-1 -v (Clone physical memory to physical
                                  memory created by this program
                                  and verify)
./ccrtaicc_msgdma_clone -a,8000 -s0x100 (Clone ADC_Data to board DiagRam
                                  at 0x8000)
./ccrtaicc_msgdma_clone -a8000,c000 -s0x4000 -v (Clone DiagRam at 0x8000 to
                                  DiagRam at 0xC000 and verify)
./ccrtaicc_msgdma_clone -a8000,-1 -s0x4000 -v (Clone DiagRam at 0x8000 to
                                  physical memory created and verify)
./ccrtaicc_msgdma_clone -a-1,8000 -s0x4000 -v (Clone physical memory created to
                                  DiagRam at 0x8000 and verify)
./ccrtaicc_msgdma_clone -a,0xbd308000 -X (Clone ADC_Data to some other board
                                  at specified physical address)

```

Example display:

```
./ccrtaicc_msgdma_clone
```

```

Device Name           : /dev/ccrtaicc0
Board ID              : 9350
Board Type            : 01
Board Function        : 01
Board Serial No       : 687377 (0x000a7d11)
Number of MsgDMA Descriptors: 31

```

```

Local Region (BAR2) Size : 0x00020000
Local Region (BAR2) Address: 0xbd400000
Config Region (BAR0) Size : 0x00008000
Config Region (BAR0) Address: 0xbd420000

```

```
>>>##### Processing 'From' Address (0x00003200) #####<<<
```

```

From_____
TranslationRequired      = 0
UserSuppliedPhysicalAddress = 0x00003200
AvalonEquivalentAddress  = 0x00003200
PhysicalMemoryToAttach   = 0xbd403200
PhysicalMemorySize       = 0x00001000
VirtualUserAddress       = 0x7ffff7fb7200
Flags                     = 0x0000

```

>>>##### Processing 'To' Address (0xffffffffffffffc) #####<<<

```

Physical Memory Information:
  UserPID           =5943
  PhysMemPtr        =0x340c5000
  DriverVirtMemPtr  =0xffff96d0f40c5000
  MmappedUserMemPtr =0x7ffff7fec000
  PhysMemSize       =0x00001000
  PhysMemSizeFreed  =0x00000000
  EntryInTxTbl      =0
  NumOfEntriesUsed  =1
  Flags             =0x0000

```

```

To_____
TranslationRequired      = 1
UserSuppliedPhysicalAddress = 0x340c5000
AvalonEquivalentAddress  = 0x008c5000
PhysicalMemoryToAttach   = 0x340c5000
PhysicalMemorySize       = 0x00001000
VirtualUserAddress       = 0x7ffff7fec000
Flags                     = 0x0000

```

```

Physical Address  [-a]: 0xBD403200/0x340C5000 (From/To)
Board Number     [-b]: 0
Delay            [-d]: 0      (milli-seconds)
Loop Count       [-l]: 0      (forever)
Program Board    [-P]: 0      (no)
Quiet Mode       [-q]: 0      (interactive)
Transfer Size    [-s]: 256    (bytes)
Display Size     [-S]: 256    (bytes)
Verify Data     [-v]: no
Region Protection [-X]: 1     (enabled)
Address Cache    [-Z]: 0     (enabled)
One Cycle Time   : 3.482    (micro-seconds)

```

```

From_____ To_____
TranslationRequired      = 0      TranslationRequired      = 1
UserSuppliedPhysicalAddr = 0x00003200  UserSuppliedPhysicalAddr = 0x340c5000
AvalonEquivalentAddress  = 0x00003200  AvalonEquivalentAddress  = 0x008c5000
PhysicalMemoryToAttach   = 0xbd403200  PhysicalMemoryToAttach   = 0x340c5000
PhysicalMemorySize       = 0x00001000  PhysicalMemorySize       = 0x00001000
VirtualUserAddress       = 0x7ffff7fb7200  VirtualUserAddress       = 0x7ffff7fec000
Flags                     = 0x0000      Flags                     = 0x0000

```

```

ScanCount=7000 (XferSize=256, DisplaySize=256) (CopyTime: From 54.387 usecs,
To 0.261 usecs)

```

```

____From____  ____00____  ____04____  ____08____  ____0C____  ____10____  ____14____  ____18____  ____1C____
0x00003200  0001fb5a  0001fb55  0001fb58  0001fb5a  0001fb5e  0001fb60  0001fb60  0001fb62
0x00003220  0001fb5a  0001fb5e  0001fb6a  0001fb69  0001fb5f  0001fb5f  0001fb5d  0001fb60
0x00003240  0001fb5d  0001fb5c  0001fb66  0001fb63  0001fb69  0001fb68  0001fb68  0001fb64
0x00003260  0001fb62  0001fb64  0001fb6a  0001fb69  0001fb6c  0001fb68  0001fb6f  0001fb69
0x00003280  0001fb64  0001fb65  0001fb64  0001fb69  0001fb6c  0001fb6b  0001fb66  0001fb67

```

```

0x000032a0 0001fb65 0001fb67 0001fb68 0001fb6b 0001fb69 0001fb6e 0001fb6d 0001fb6e
0x000032c0 0001fb69 0001fb6c 0001fb69 0001fb66 0001fb6d 0001fb70 0001fb68 0001fb65
0x000032e0 0001fb6e 0001fb6f 0001fb6a 0001fb6d 0001fb65 0001fb61 0001fb66 0001fb66

```

```

____To____  ____00____  ____04____  ____08____  ____0C____  ____10____  ____14____  ____18____  ____1C____
0x340c5000 0001fb67 0001fb68 0001fb67 0001fb67 0001fb69 0001fb67 0001fb67 0001fb68
0x340c5020 0001fb67 0001fb67 0001fb68 0001fb66 0001fb6c 0001fb68 0001fb69 0001fb64
0x340c5040 0001fb69 0001fb63 0001fb66 0001fb62 0001fb67 0001fb68 0001fb66 0001fb69
0x340c5060 0001fb69 0001fb69 0001fb6a 0001fb67 0001fb6d 0001fb6a 0001fb69 0001fb6a
0x340c5080 0001fb68 0001fb66 0001fb69 0001fb67 0001fb64 0001fb67 0001fb66 0001fb66
0x340c50a0 0001fb6b 0001fb69 0001fb69 0001fb6c 0001fb6c 0001fb6a 0001fb66 0001fb68
0x340c50c0 0001fb69 0001fb6d 0001fb69 0001fb69 0001fb68 0001fb67 0001fb65
0x340c50e0 0001fb69 0001fb67 0001fb6a 0001fb5f 0001fb65 0001fb61 0001fb64 0001fb63

```

```
./ccrtaicc_msgdma_clone -a8000,-1 -s0x4000 -v
```

```

Device Name           : /dev/ccrtaicc0
Board ID              : 9350
Board Type            : 01
Board Function        : 01
Board Serial No       : 687377 (0x000a7d11)
Number of MsgDMA Descriptors: 31

```

```

Local Region (BAR2) Size : 0x00020000
Local Region (BAR2) Address: 0xbd400000
Config Region (BAR0) Size : 0x00008000
Config Region (BAR0) Address: 0xbd420000

```

```
>>>##### Processing 'From' Address (0x00008000) #####<<<
```

```

From_____
TranslationRequired   = 0
UserSuppliedPhysicalAddress = 0x00008000
AvalonEquivalentAddress = 0x00008000
PhysicalMemoryToAttach = 0xbd408000
PhysicalMemorySize    = 0x00004000
VirtualUserAddress    = 0x7ffff7fbc000
Flags                 = 0x0000

```

```
>>>##### Processing 'To' Address (0xffffffffffffffff) #####<<<
```

```

Physical Memory Information:
  UserPID           =6535
  PhysMemPtr        =0x34128000
  DriverVirtMemPtr  =0xffff96d0f4128000
  MmappedUserMemPtr =0x7ffff7fe9000
  PhysMemSize       =0x00004000
  PhysMemSizeFreed  =0x00000000
  EntryInTxTbl     =0
  NumOfEntriesUsed  =1
  Flags             =0x0000

```

```

To_____
TranslationRequired   = 1
UserSuppliedPhysicalAddress = 0x34128000
AvalonEquivalentAddress = 0x00828000
PhysicalMemoryToAttach = 0x34128000
PhysicalMemorySize    = 0x00004000
VirtualUserAddress    = 0x7ffff7fe9000
Flags                 = 0x0000

```

```

Physical Address      [-a]: 0xBD408000/0x34128000 (From/To)
Board Number         [-b]: 0
Delay                [-d]: 0      (milli-seconds)
Loop Count           [-l]: 0      (forever)
Program Board        [-P]: 0      (no)
Quiet Mode           [-q]: 0      (interactive)
Transfer Size        [-s]: 16384   (bytes)
Display Size         [-S]: 256    (bytes)
Verify Data          [-v]: 0.000   (Additional One Cycle Delay in micro-seconds)
Region Protection    [-X]: 1      (enabled)
Address Cache        [-Z]: 0      (enabled)
One Cycle Time       : 45.731   (micro-seconds)

```

```

From_____ To_____
TranslationRequired = 0      TranslationRequired = 1
UserSuppliedPhysicalAddr = 0x00008000 UserSuppliedPhysicalAddr = 0x34128000
AvalonEquivalentAddress = 0x00008000 AvalonEquivalentAddress = 0x00828000
PhysicalMemoryToAttach = 0xbd408000 PhysicalMemoryToAttach = 0x34128000
PhysicalMemorySize     = 0x00004000 PhysicalMemorySize     = 0x00004000
VirtualUserAddress      = 0x7ffff7fbc000 VirtualUserAddress      = 0x7ffff7fe9000
Flags                   = 0x0000      Flags                   = 0x0000

```

```

FailCount=0          (==== passed ====)
ScanCount=1169 (XferSize=16384, DisplaySize=256) (WaitAfterPatternWrite: 46.012 usecs)

```

```

____From____  ____00____  ____04____  ____08____  ____0C____  ____10____  ____14____  ____18____  ____1C____
0x00008000  00490000  00490001  00490002  00490003  00490004  00490005  00490006  00490007
0x00008020  00490008  00490009  0049000a  0049000b  0049000c  0049000d  0049000e  0049000f
0x00008040  00490010  00490011  00490012  00490013  00490014  00490015  00490016  00490017
0x00008060  00490018  00490019  0049001a  0049001b  0049001c  0049001d  0049001e  0049001f
0x00008080  00490020  00490021  00490022  00490023  00490024  00490025  00490026  00490027
0x000080a0  00490028  00490029  0049002a  0049002b  0049002c  0049002d  0049002e  0049002f
0x000080c0  00490030  00490031  00490032  00490033  00490034  00490035  00490036  00490037
0x000080e0  00490038  00490039  0049003a  0049003b  0049003c  0049003d  0049003e  0049003f

```

```

____To____  ____00____  ____04____  ____08____  ____0C____  ____10____  ____14____  ____18____  ____1C____
0x34128000  00490000  00490001  00490002  00490003  00490004  00490005  00490006  00490007
0x34128020  00490008  00490009  0049000a  0049000b  0049000c  0049000d  0049000e  0049000f
0x34128040  00490010  00490011  00490012  00490013  00490014  00490015  00490016  00490017
0x34128060  00490018  00490019  0049001a  0049001b  0049001c  0049001d  0049001e  0049001f
0x34128080  00490020  00490021  00490022  00490023  00490024  00490025  00490026  00490027
0x341280a0  00490028  00490029  0049002a  0049002b  0049002c  0049002d  0049002e  0049002f
0x341280c0  00490030  00490031  00490032  00490033  00490034  00490035  00490036  00490037
0x341280e0  00490038  00490039  0049003a  0049003b  0049003c  0049003d  0049003e  0049003f

```

3.2.15 lib/ccrtaicc_msgdma_info

This test provides useful modular scatter-gather DMA information for cards that support it.

```

Usage: ./ccrtaicc_msgdma_info [-b Board] [-l]
      -b <Board>          (board #, default = 0)
      -l                  (long format)

```

Example display:

```

./ccrtaicc_msgdma_info
===== Dispatcher =====
Status           = 0x0000000a
Control          = 0x0000000c
ReadFillLevel    = 0x00000000
WriteFillLevel   = 0x00000000

```


ResponseFillLevel = 0x00000000
ReadSequenceNumber = 0x00000001
WriteSequenceNumber = 0x00000001

=====
Prefetcher
Status = 0x00000000
Control = 0x00000000
NextDescriptorPointer = 0xbaadbeef00004800 (### Descriptor ID 1 ###)
DescriptorPollingFrequency = 0x00000000

=====
Descriptors
=====

ID	Addr	ReadAddr	WritAddr	Length	Stat	Control	SeqN	Rbct	Wbct	Rstr	Wstr	ActBytXfr	NextPtr
1	(4800)	00008000	00870000	008000	0000	80000000	00	00	00	0000	0000	00000000	00004fc0 (Terminator)
2	(4840)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
3	(4880)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
4	(48c0)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
5	(4900)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
6	(4940)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
7	(4980)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
8	(49c0)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
9	(4a00)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
10	(4a40)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
11	(4a80)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
12	(4ac0)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
13	(4b00)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
14	(4b40)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
15	(4b80)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
16	(4bc0)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
17	(4c00)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
18	(4c40)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
19	(4c80)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
20	(4cc0)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
21	(4d00)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
22	(4d40)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
23	(4d80)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
24	(4dc0)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
25	(4e00)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
26	(4e40)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
27	(4e80)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
28	(4ec0)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
29	(4f00)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
30	(4f40)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000
31	(4f80)	00000000	00000000	000000	0000	00000000	00	00	00	0000	0000	00000000	00000000

./crtaiicc_msgdma_info -l

=====
Dispatcher
Status = 0x0000000a
Control = 0x0000000c
ReadFillLevel = 0x00000000
WriteFillLevel = 0x00000000
ResponseFillLevel = 0x00000000
ReadSequenceNumber = 0x00000001
WriteSequenceNumber = 0x00000001

=====
Prefetcher
Status = 0x00000000
Control = 0x00000000
NextDescriptorPointer = 0xbaadbeef00004800 (### Descriptor ID 1 ###)
DescriptorPollingFrequency = 0x00000000

=====
Descriptor ID 1 (address: 0x4800) =====
ReadAddress = 0x0000000000008000

```

WriteAddress          = 0x0000000000840000
NextDescriptorPointer = 0x000000000004fc0 (### Terminator ###)
Status                = 0x0000
Control               = 0x80000000
Length                = 0x00008000 (32768)
SequenceNumber        = 0x0001      (1)
ReadBurstCount        = 0x00        (0)
WriteBurstCount       = 0x00        (0)
ReadStride            = 0x0000      (0)
WriteStride           = 0x0000      (0)
ActualBytesTransferred = 0x00000000 (0)

```

```

===== Descriptor ID 2 (address: 0x4840) =====

```

```

ReadAddress          = 0x0000000000000000
WriteAddress         = 0x0000000000000000
NextDescriptorPointer = 0x0000000000000000
Status                = 0x0000
Control               = 0x00000000
Length                = 0x00000000 (0)
SequenceNumber        = 0x0000      (0)
ReadBurstCount        = 0x00        (0)
WriteBurstCount       = 0x00        (0)
ReadStride            = 0x0000      (0)
WriteStride           = 0x0000      (0)
ActualBytesTransferred = 0x00000000 (0)

```

```

.
.
.

```

```

===== Descriptor ID 29 (address: 0x4f00) =====

```

```

ReadAddress          = 0x0000000000000000
WriteAddress         = 0x0000000000000000
NextDescriptorPointer = 0x0000000000000000
Status                = 0x0000
Control               = 0x00000000
Length                = 0x00000000 (0)
SequenceNumber        = 0x0000      (0)
ReadBurstCount        = 0x00        (0)
WriteBurstCount       = 0x00        (0)
ReadStride            = 0x0000      (0)
WriteStride           = 0x0000      (0)
ActualBytesTransferred = 0x00000000 (0)

```

```

===== Descriptor ID 30 (address: 0x4f40) =====

```

```

ReadAddress          = 0x0000000000000000
WriteAddress         = 0x0000000000000000
NextDescriptorPointer = 0x0000000000000000
Status                = 0x0000
Control               = 0x00000000
Length                = 0x00000000 (0)
SequenceNumber        = 0x0000      (0)
ReadBurstCount        = 0x00        (0)
WriteBurstCount       = 0x00        (0)
ReadStride            = 0x0000      (0)
WriteStride           = 0x0000      (0)
ActualBytesTransferred = 0x00000000 (0)

```

```

===== Descriptor ID 31 (address: 0x4f80) =====

```

```

ReadAddress          = 0x0000000000000000
WriteAddress         = 0x0000000000000000
NextDescriptorPointer = 0x0000000000000000
Status                = 0x0000

```

```

Control          = 0x00000000
Length          = 0x00000000 (0)
SequenceNumber  = 0x0000      (0)
ReadBurstCount  = 0x00        (0)
WriteBurstCount = 0x00        (0)
ReadStride      = 0x0000     (0)
WriteStride     = 0x0000     (0)
ActualBytesTransferred = 0x00000000 (0)

```

3.2.16 lib/ccrtaicc_msgdma_multi_clone

This test is a more powerful version of the *ccrtaicc_msgdma_clone* test above. It allows the users to specify multiple source and destination addresses during the cloning operation. There is a limit on the number of physical memory that can be created or mapped. When that limit is reached, the tests fail to run. Additionally, there is a limit to the number of MsgDma descriptors that can be specified. Once again, if that limit is exceed the test will fail to run.



Caution: *Since physical addresses are supplied to this test, care must be taken to ensure that the supplied addresses are valid and that while cloning is in progress, the memory regions must not be freed or made inactive, otherwise, the results could be unpredictable and could lead to the possible corruption of the system.*

```

Usage: ./ccrtaicc_msgdma_multi_clone [-a FromAddr,ToAddr,Size] [-b Board] [-d Delay]
      [-F DebugFile] [-l LoopCnt] [-P] [-q] [-s XferSize]
      [-S DisplaySize] [-t|T FromAddr,Size] [-X] [-Z]
  -a <FromAddr,ToAddr,Size> (Clone address space From/To address (hex) and
                             size (bytes))
                             (If address less than board size, board offset used)
  -b <Board>                 (board #, default = 0)
  -d <Delay>                 (Delay between screen refresh -- default is
                             5 milli-seconds)
  -F DebugFile               (Debug file -- default "=== None ===")
    @DebugFile              (Debug file and no display)
    @                        (No Debug file and no display)
  -l LoopCnt                 (Loop count -- default is 0)
  -P                          (Program Board)
  -q                          (Quite (non-interactive) mode)
  -s <XferSize>              (Transfer size in bytes)
  -S <DisplaySize>           (Display size in bytes)
  -t <FromAddr,Size>         (Perform debug firmware testing - From address (hex)
                             and size (bytes) - non-verbose)
  -T <FromAddr,Size>         (Perform debug firmware testing - From address (hex)
                             and size (bytes) - verbose)
  -X                          (Disable region protection)
  -Z                          (Disable address cache - default is enabled)

```

Note: If the size is not specified in the '-a' option, then the default size or that specified in the '-s' option is used
 If debug firmware is installed, you can use the '-t|T' option
 The debug firmware uses Clock 3 and its value is programmed by the 't|T' option

e.g.

```

./ccrtaicc_msgdma_multi_clone (Clone DiagRam to physical
                                memory created by this program)
./ccrtaicc_msgdma_multi_clone -a,-1 (Clone DiagRam to physical memory
                                        created by this program)
./ccrtaicc_msgdma_multi_clone -a-1,-1 (Clone physical memory to physical
                                        memory created by this program)
./ccrtaicc_msgdma_multi_clone -a,c000 -s0x1000 (Clone DiagRam at 0x8000 to board
                                                DiagRam at 0xc000)
./ccrtaicc_msgdma_multi_clone -a8000,c000 -s0x4000 (Clone DiagRam at 0x8000 to DiagRam
                                                at 0xC000)
./ccrtaicc_msgdma_multi_clone -a,0xbd308000 -X (Clone DiagRam to some other board
                                                at specified physical address)
./ccrtaicc_msgdma_multi_clone -a8000,8800 -a8800,9000 -a9000,9800 -a9800,a000
-a000,a800 -aa800,b000 -ab000,b800 -ab800,c000
-ac000,c800 -s256
                                (Clone through all 9 descriptors)
./ccrtaicc_msgdma_multi_clone -a8000,8800 -a8800,9000 -a9000,9800 -a9800,a000,128
-a000,a800 -aa800,b000 -ab000,b800 -ab800,c000
-ac000,c800,288 -s256 -S288
                                (Clone through all 9 descriptors
                                with different sizes)
./ccrtaicc_msgdma_multi_clone -t (Perform non-verbose Debug Firmware
                                testing using default address
                                0x6000 and size 256 (64 samples))
./ccrtaicc_msgdma_multi_clone -T,256 -F/tmp/LOG (Perform verbose Debug Firmware
                                                testing using default address, 256
                                                bytes and send output to /tmp/LOG)

```

Example display:

```
./ccrtaicc_msgdma_multi_clone
```

```

Physical Address      [-a]: 0xC0508000/0x2D198000 (From/To)
Board Number         [-b]: 0
Delay                [-d]: 5      (milli-seconds)
Loop Count           [-l]: 0      (forever)
Program Board        [-P]: 0      (no)
Quiet Mode           [-q]: 0      (interactive)
Transfer Size        [-s]: 16384   (bytes)
Display Size         [-S]: 256    (bytes)
Region Protection    [-X]: 1      (enabled)
Address Cache        [-Z]: 0      (enabled)
One Cycle Time       : 45.947   (micro-seconds)
Current Descriptor   : 0

```

From	To
TranslationRequired = 0	TranslationRequired = 1
UserSuppliedPhysicalAddr = 0x00008000	UserSuppliedPhysicalAddr = 0x2d198000
UserSuppliedSize = 0x00004000	UserSuppliedSize = 0x00004000
AvalonEquivalentAddress = 0x00008000	AvalonEquivalentAddress = 0x00898000
PhysicalMemoryToAttach = 0xc0508000	PhysicalMemoryToAttach = 0x2d198000
PhysicalMemorySize = 0x00004000	PhysicalMemorySize = 0x00004000
VirtualUserAddress = 0x7ffff7fbc000	VirtualUserAddress = 0x7ffff7fe9000
Flags = 0x0000	Flags = 0x0000

```
ScanCount=428 (XferSize=16384, DisplaySize=256) (CopyTime: From 11297.727 usec,
                                                    To 3.754 usec)
```

```

  From      00      04      08      0C      10      14      18      1C
0x00008000 0012d000 0012d001 0012d002 0012d003 0012d004 0012d005 0012d006 0012d007
0x00008020 0012d008 0012d009 0012d00a 0012d00b 0012d00c 0012d00d 0012d00e 0012d00f
0x00008040 0012d010 0012d011 0012d012 0012d013 0012d014 0012d015 0012d016 0012d017
0x00008060 0012d018 0012d019 0012d01a 0012d01b 0012d01c 0012d01d 0012d01e 0012d01f
0x00008080 0012d020 0012d021 0012d022 0012d023 0012d024 0012d025 0012d026 0012d027
0x000080a0 0012d028 0012d029 0012d02a 0012d02b 0012d02c 0012d02d 0012d02e 0012d02f

```

```

0x000080c0 0012d030 0012d031 0012d032 0012d033 0012d034 0012d035 0012d036 0012d037
0x000080e0 0012d038 0012d039 0012d03a 0012d03b 0012d03c 0012d03d 0012d03e 0012d03f

___To___ ___00___ ___04___ ___08___ ___0C___ ___10___ ___14___ ___18___ ___1C___
0x2d198000 0012d000 0012d001 0012d002 0012d003 0012d004 0012d005 0012d006 0012d007
0x2d198020 0012d008 0012d009 0012d00a 0012d00b 0012d00c 0012d00d 0012d00e 0012d00f
0x2d198040 0012d010 0012d011 0012d012 0012d013 0012d014 0012d015 0012d016 0012d017
0x2d198060 0012d018 0012d019 0012d01a 0012d01b 0012d01c 0012d01d 0012d01e 0012d01f
0x2d198080 0012d020 0012d021 0012d022 0012d023 0012d024 0012d025 0012d026 0012d027
0x2d1980a0 0012d028 0012d029 0012d02a 0012d02b 0012d02c 0012d02d 0012d02e 0012d02f
0x2d1980c0 0012d030 0012d031 0012d032 0012d033 0012d034 0012d035 0012d036 0012d037
0x2d1980e0 0012d038 0012d039 0012d03a 0012d03b 0012d03c 0012d03d 0012d03e 0012d03f

Enter 'c|C' to clear the pattern
      'w|W' toggle pattern write (Pattern Write Enabled)
      'q|Q' ->

```

3.2.17 lib/ccrtaicc_smp_affinity

This test provides a useful mechanism to display or set the IRQ to specific set of CPUs. This is useful when we want to make sure that the driver interrupts are not being interfered with other CPU activity.

```

Usage: ./ccrtaicc_smp_affinity [-b Board] [-c CpuMask]
      -b Board      (Board number -- default is 0)
      -c CpuMask    (CPU mask in HEX -- default is none)

```

```

e.g. ./ccrtaicc_smp_affinity      (display IRQ CPU mask for selected board)
      ./ccrtaicc_smp_affinity -c2  (set IRQ CPU for cpu 1)
      ./ccrtaicc_smp_affinity -c4  (set IRQ CPU for cpu 2)
      ./ccrtaicc_smp_affinity -c0x8 (set IRQ CPU for cpu 3)
      ./ccrtaicc_smp_affinity -cE2 (set IRQ CPU for cpu 1,5,6,7)

```

Example display:

```

./ccrtaicc_smp_affinity
(IRQ57) fc user f8 actual

```

```

./ccrtaicc_smp_affinity -b1 -c8
(IRQ57) 08 user 08 actual

```

3.2.18 lib/ccrtaicc_transfer

This test performs various DMA and Programmed I/O transfers between the board components and the PCI memory.

```

Usage: ./ccrtaicc_transfer [-b Board] [-c CaseNum] [-i] [-l LoopCnt]
      [-s XferSize]
      -b Board      (Board number -- default is 0)
      -c CaseNum    (Select Case Numbers -- default = ALL CASES)
          -c 4,1,7-9 select case 1,4,7,8,9)
          -c 8-      select case 8 to end)
          -c -3      select case 1,2,3)
      -i            (Enable Interrupts -- default = Disable)
      -l LoopCnt    (Loop Count -- default is 100)
      -s XferSize   (Avalon Ram Xfer Size in bytes -- default is 32768)

```

Example display:

```

./ccrtaicc_transfer

local_ptr=0x7ffff7fd7000
Size of Avalon RAM = 32768 (0x00008000)

```

```
Physical Memory Information:
UserPID      =28194
PhysMemPtr   =0x4340000
DriverVirtMemPtr=0xffff880004340000
MmappedUserMemPtr=0x7ffff7fc5000
PhysMemSize  =0x00008000
PhysMemSizeFreed=0x00000000
EntryInTxTbl =0
NumOfEntriesUsed=1
Flags        =0x0000
```

```
1: Memory -> Avalon RAM (DMA0) (Size=0x8000):      100 (1404.64 us, 23.33 MBytes/Sec)
2: Memory -> Avalon RAM (DMA1) (Size=0x8000):      100 (1404.64 us, 23.33 MBytes/Sec)
3: Memory -> Avalon RAM (MSGDMA) (Size=0x8000):    100 (111.45 us, 294.01 MBytes/Sec)
4: Memory -> Avalon RAM (PIO) (Size=0x8000):      100 (124.85 us, 262.45 MBytes/Sec)
5: Avalon RAM -> Memory (DMA0) (Size=0x8000):     100 (529.98 us, 61.83 MBytes/Sec)
6: Avalon RAM -> Memory (DMA1) (Size=0x8000):     100 (530.00 us, 61.83 MBytes/Sec)
7: Avalon RAM -> Memory (MSGDMA) (Size=0x8000):   100 (90.12 us, 363.62 MBytes/Sec)
8: Avalon RAM -> Memory (PIO) (Size=0x8000):     100 (12380.83 us, 2.65 MBytes/Sec)
9: Memory -> Avalon ADC Calibration (DMA0) (Size=0x100): 10000 (17.14 us, 14.93 MBytes/Sec)
10: Memory -> Avalon ADC Calibration (PIO) (Size=0x100): 10000 (0.55 us, 462.64 MBytes/Sec)
11: Avalon ADC Calibration -> Memory (DMA0) (Size=0x100): 10000 (12.91 us, 19.82 MBytes/Sec)
12: Avalon ADC Calibration -> Memory (PIO) (Size=0x100): 10000 (131.22 us, 1.95 MBytes/Sec)
**** Test Passed ****
```

3.2.19 lib/ccrtaicc_tst_lib

This is an interactive test that accesses the various supported API calls.

```
Usage: ./ccrtaicc_tst_lib [-b board]
-b board: board number -- default board is 0
```

Example display:

```
./ccrtaicc_tst_lib
```

```
Device Name: /dev/ccrtaicc0
01 = Abort DMA
03 = Clear Driver Error
05 = Display BOARD Registers
07 = Dump Physical Memory List
09 = Get Board CSR
11 = Get Driver Error
13 = Get Cable Fault CSR
15 = Get Library Error
17 = Get Mapped Driver/Library Pointer
19 = Get Physical Memory
21 = Get Value
23 = MMap Physical Memory
25 = Reload Firmware
27 = Set Board CSR
29 = Set Test Bus Control
31 = ### ADC MENU ###
33 = ### CLOCK GENERATOR MENU ###
02 = Clear Cable Fault
04 = Clear Library Error
06 = Display CONFIG Registers
08 = Get All Boards Driver Information
10 = Get Board Information
12 = Get External Clock CSR
14 = Get Driver Information
16 = Get Mapped Config Pointer
18 = Get Mapped Local Pointer
20 = Get Test Bus Control
22 = Initialize Board
24 = Munmap Physical Memory
26 = Reset Board
28 = Set External Clock CSR
30 = Set Value
32 = ### CALIBRATION MENU ###
34 = ### INTERRUPT MENU ###
```

```
Main Selection ('h'=display menu, 'q'=quit)->
```

```
Main Selection ('h'=display menu, 'q'=quit)-> 31
Command: ADC_menu()
01 = ADC Activate
03 = ADC Reset (disable/activate)
05 = ADC Get CSR
07 = ADC Get FIFO Channel Select
09 = ADC Get FIFO Status
11 = ADC Get Input Control
02 = ADC Disable
04 = ADC Driver Read Operation
06 = ADC Get Driver Read Mode
08 = ADC Get FIFO Information
10 = ADC Get FIFO Threshold
12 = ADC Read Channels
```

13 = ADC Reset FIFO
15 = ADC Set Driver Read Mode
17 = ADC Set FIFO Threshold
14 = ADC Set CSR
16 = ADC Set FIFO Channel Select
18 = ADC Set Input Control

ADC Selection ('h'=display menu, 'q'=quit)->

Main Selection ('h'=display menu, 'q'=quit)-> 32

Command: calibration_menu()
01 = ADC: Get Calibrated Values
03 = ADC: Perform External Negative Calib.
05 = ADC: Perform External Positive Calib.
07 = ADC: Perform Offset Calibration
09 = ADC: Read Channels Calibration
11 = ADC: Write Channels Calibration
13 = Set Calibration CSR
02 = ADC: Perform Auto Calibration
04 = ADC: Perform External Offset Calib.
06 = ADC: Perform Negative Calibration
08 = ADC: Perform Positive Calibration
10 = ADC: Reset Calibration
12 = Get Calibration CSR

Calibration Selection ('h'=display menu, 'q'=quit)->

Main Selection ('h'=display menu, 'q'=quit)-> 33

Command: clock_generator_menu()
01 = Clock Disable Outputs
03 = Clock Get Generator CSR
05 = Clock Get Generator Information
07 = Clock Get Generator Input Clock Select
09 = Clock Get Generator Output Config
11 = Clock Get Generator Output Mode
13 = Clock Get Generator P-Divider Enable
15 = Clock Get Generator Value
17 = Clock Get Generator Zero Delay
19 = Clock Set Generator Dividers
21 = Clock Set Generator Input Clock Select
23 = Clock Set Generator Output Format
25 = Clock Set Generator Output Mux
27 = Clock Set Generator Value
29 = Clock Set Generator Zero Delay
31 = Program All Output Clocks
33 = Reset Clock (Hardware)
35 = Update Clock Generator Divider
02 = Clock Enable Outputs
04 = Clock Get Generator Dividers
06 = Clock Get Generator Input Clock Enable
08 = Clock Get Generator Input Clock Status
10 = Clock Get Generator Output Format
12 = Clock Get Generator Output Mux
14 = Clock Get Generator Revision
16 = Clock Get Generator Voltage Select
18 = Clock Set Generator CSR
20 = Clock Set Generator Input Clock Enable
22 = Clock Set Generator Output Config
24 = Clock Set Generator Output Mode
26 = Clock Set Generator P-Divider Enable
28 = Clock Set Generator Voltage Select
30 = Compute All Output Clocks
32 = Read Clock Registers
34 = Soft Reset
36 = Write Clock Registers

Clock Generator Selection ('h'=display menu, 'q'=quit)->

Main Selection ('h'=display menu, 'q'=quit)-> 34

Command: interrupt_menu()
01 = Add Irq
03 = Enable Pci Interrupts
05 = Get Interrupt Timeout
07 = Set Interrupt Status
02 = Disable Pci Interrupts
04 = Get Interrupt Status
06 = Remove Irq
08 = Set Interrupt Timeout

Interrupt Selection ('h'=display menu, 'q'=quit)->

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