



# HCC OAL for CMX User Guide

Version 1.50

For use with OAL for CMX versions 2.07 and above

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# 1 System Overview

This chapter contains the fundamental information for this module.

The component sections are as follows:

- [Introduction](#) – describes the main elements of the module.
- [Feature Check](#) – summarizes the main features of the module as bullet points.
- [Packages and Documents](#) – the *Packages* section lists the packages that you need in order to use this module. The *Documents* section lists the relevant user guides.
- [Change History](#) – lists the earlier versions of this manual, giving the software version that each manual describes.

## 1.1 Introduction

This guide is for those who want to use HCC Embedded's OS Abstraction Layer (OAL) for their developments in embedded systems that use the CMX operating system from CMX Systems Inc.

The HCC OAL is an abstraction of a Real Time Operating System (RTOS). It defines how HCC software requires an RTOS to behave and its Application Programming Interface (API) defines the functions it requires. Most HCC systems and modules use one or more components of the OAL.

HCC has ported its OAL to CMX, in the process creating "hooks" which call CMX functions from the HCC abstractions. Once you unzip the files from the **oal\_os\_cmx** package into the **oal/os** folder in the source tree, these files will automatically call the correct functions.

The OAL API defines functions for handling the following elements:

- Tasks.
- Events – these are used as a signaling mechanism, both between tasks, and from asynchronous sources such as Interrupt Service Routines (ISRs) to tasks.
- Mutexes – these guarantee that, while one task is using a particular resource, no other task can preempt it and use the same resource.
- Interrupt Service Routines (ISRs) – in CMX ISRs are platform-specific.

## 1.2 Feature Check

The main features of the module are the following:

- Conforms to the HCC Advanced Embedded Framework.
- Integrated with the HCC OS Abstraction Layer (OAL).
- Fully MISRA-compliant.
- Allows all HCC middleware to run with the CMX RTOS.

## 1.3 Packages and Documents

### Packages

The table below lists the packages that you need in order to use the OAL:

| Package           | Description  |
|-------------------|--|
| <b>oal_base</b>   | The OAL base package.  |
| <b>oal_os_cmx</b> | The OAL for CMX package. Unzip the files from this package into the <b>oal/os</b> folder in the source tree. |

### Documents

For an overview of HCC RTOS software, see [Product Information](#) on the main HCC website.

Readers should note the points in the [HCC Documentation Guidelines](#) on the HCC documentation website.

#### **HCC Firmware Quick Start Guide**

This document describes how to install packages provided by HCC in the target development environment. Also follow the *Quick Start Guide* when HCC provides package updates.

#### **HCC Source Tree Guide**

This document describes the HCC source tree. It gives an overview of the system to make clear the logic behind its organization.

#### **HCC OS Abstraction Layer (Base) User Guide**

This document describes the base OAL package, defining the standard functions that must be provided by an RTOS. Use this as your reference to global configuration options and the API.

#### **HCC OAL for CMX User Guide**

This is this document.

## 1.4 Change History

This section describes past changes to this manual.

- To view or download earlier manuals, see [OAL PDFs](#).
- For the history of changes made to the package code itself, see [History: oal\\_os\\_cmx](#).

The current version of this manual is 1.50. The full list of versions is as follows:

| Manual version | Date       | Software version | Reason for change   |
|----------------|------------|------------------|---|
| 1.50           | 2018-06-07 | 2.07             | Corrected text on OAL_EVENT_FLAG configuration option.<br>Added note to <i>Platform Support Package (PSP) Files</i> . |
| 1.40           | 2017-08-29 | 2.07             | Added OAL_CMX_VERSION configuration option.   |
| 1.30           | 2017-06-28 | 2.06             | New <i>Change History</i> format.   |
| 1.20           | 2016-02-24 | 2.05             | Modified <i>Feature Check</i> section.  |
| 1.10           | 2015-04-01 | 2.80             | Added <i>PSP Porting</i> section.   |
| 1.00           | 2014-12-04 | 2.80             | First online version.   |

## 2 Source File List

This section describes all the source code files included in the system. These files follow the HCC Embedded standard source tree system, described in the [HCC Source Tree Guide](#). All references to file pathnames refer to locations within this standard source tree, not within the package you initially receive.

**Note:** Do not modify any files except the configuration file and PSP files.

### 2.1 Configuration File

The file `src/config/config_oal_os.h` contains [configuration options](#) specific to the system. Configure these as required. (Global configuration parameters are controlled by the base package's configuration file.)

### 2.2 Source Files

These files are in the directory `src/oal/os`. **These files should only be modified by HCC.**

| File                      | Description                  |
|---------------------------|------------------------------|
| <code>oalp_cmx.h</code>   | CMX header file.             |
| <code>oalp_defs.h</code>  | System defines header file.  |
| <code>oalp_event.c</code> | Event functions source code. |
| <code>oalp_event.h</code> | Event functions header file. |
| <code>oalp_isr.c</code>   | ISR functions source code.   |
| <code>oalp_isr.h</code>   | ISR functions header file.   |
| <code>oalp_mutex.c</code> | Mutex functions source code. |
| <code>oalp_mutex.h</code> | Mutex functions header file. |
| <code>oalp_task.c</code>  | Task functions source code.  |
| <code>oalp_task.h</code>  | Task functions header file.  |

### 2.3 Version File

The file `src/version/ver_oal_os.h` contains the version number of this module. This version number is checked by all modules that use this module to ensure system consistency over upgrades.



## 2.4 Platform Support Package (PSP) Files

These files in the directory **src/psp/target/isr** provide functions and elements the core code needs to use, depending on the hardware. Modify these files as required for your hardware.

**Note:**

- These are PSP implementations for the specific microcontroller and board; you may need to modify these to work with a different microcontroller and/or development board. See [PSP Porting](#) for details.
- In the package these files are offset to avoid overwriting an existing implementation. Copy them to the root **hcc** directory for use.

| File             | Description                |
|------------------|----------------------------|
| <b>psp_isr.c</b> | ISR functions source code. |
| <b>psp_isr.h</b> | ISR functions header file. |

## 3 Configuration Options

Set the CMX configuration options in the file `src/config/config_oal_os.h`. This section lists the available options and their default values.

**Note:** Set systemwide configuration options in the base package's configuration file; these allow you to disable certain functions or sets of functions. See the [HCC OS Abstraction Layer \(Base\) User Guide](#) for details.

### **OAL\_TICK\_RATE**

The tick rate in ms. The default is 10.

### **OAL\_MUTEX\_COUNT**

The maximum number of mutexes. The default is 32.

### **OAL\_EVENT\_COUNT**

The maximum number of events. The default is 32.

### **OAL\_HIGHEST\_PRIORITY, OAL\_HIGH\_PRIORITY, OAL\_NORMAL\_PRIORITY, OAL\_LOW\_PRIORITY, OAL\_LOWEST\_PRIORITY**

By default these are respectively 5, 10, 15, 20, and 25

### **OAL\_EVENT\_FLAG**

OAL\_EVENT\_FLAG's usage depends on the type of event system an RTOS uses. There are two types:

- Event groups are supported independently of everything else in the system. In this case OAL\_EVENT\_FLAG does not matter.
- Each event group is directly controlled by a specific task. In this case all HCC stack internal events use the OAL\_EVENT\_FLAG as the event flag to set on the tasks event group. None of the tasks invoking HCC API calls should use OAL\_EVENT\_FLAG for signalling an event.

The default is 0x8000.

### **OAL\_FIRST\_RESOURCE**

The first resource number assigned to the OAL. OAL\_MUTEX\_COUNT is required. The default is 0.

### **OAL\_ISR\_COUNT**

The maximum number of interrupt sources supported in HCC modules. The default is 4.

**OAL\_CMX\_VERSION**

The CMX version number. The default is 6.

## 4 Implementation Notes

The RTOS elements are implemented as follows.

### Events

The configuration option `OAL_EVENT_COUNT` defines the maximum number of events available for HCC modules.

### Mutexes

The configuration option `OAL_MUTEX_COUNT` defines the maximum number of mutexes available for HCC modules.

Mutexes are solved with resources so you must define `OAL_FIRST_RESOURCE`, the first resource available.

**Note:** HCC modules need `OAL_MUTEX_COUNT` resources, so you must not use any resource between `OAL_FIRST_RESOURCE` and `OAL_FIRST_RESOURCE+OAL_MUTEX_COUNT-1`.

### Tasks

There are no rules governing tasks.

### ISRs

The platform ISR is used.

The configuration option `OAL_ISR_COUNT` is required for the platforms only when a header and a footer is required around the real ISR. In this case it should define the maximum number of interrupts in all HCC modules.

### Ticks

As the CMX timer is manually configured at startup, the configuration option `OAL_TICK_RATE` must be specified in ms.

## 5 PSP Porting

These functions are provided by the Platform Support Package (PSP) to perform various tasks. They are designed for a specific microcontroller and development board. You may need to port them to work with your hardware solution; they are designed to make porting easy.

The package includes samples in the **psp\_isr.c** file.

| Function                 | Description  |
|--------------------------|--|
| <b>psp_isr_install()</b> | Initializes the ISR.                                 |
| <b>psp_isr_delete()</b>  | Deletes the ISR, releasing the associated resources. |
| <b>psp_isr_enable()</b>  | Enables the ISR.                                     |
| <b>psp_isr_disable()</b> | Disables the ISR.                                    |
| <b>psp_int_enable()</b>  | Enables global interrupts.                           |
| <b>psp_int_disable()</b> | Disables global interrupts.                          |

These functions are described in the following sections.

## 5.1 psp\_isr\_install

This function is provided by the PSP to initialize the ISR.

### Format

```
int psp_isr_install (  
    const oal_isr_dsc_t *   isr_dsc,  
    oal_isr_id_t *         isr_id )
```

### Arguments

| Argument | Description         | Type            |
|----------|---------------------|-----------------|
| isr_dsc  | The ISR descriptor. | oal_isr_dsc_t * |
| isr_id   | The ISR ID.         | oal_isr_id_t *  |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| OAL_SUCCESS  | Successful execution. |
| OAL_ERROR    | Operation failed.     |

## 5.2 psp\_isr\_delete

This function is provided by the PSP to delete the ISR, releasing the associated resources.

### Format

```
int psp_isr_delete ( oal_isr_id_t isr_id )
```

### Arguments

| Argument | Description | Type         |
|----------|-------------|--------------|
| isr_id   | The ISR ID. | oal_isr_id_t |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| OAL_SUCCESS  | Successful execution. |
| OAL_ERROR    | Operation failed.     |

## 5.3 psp\_isr\_enable

This function is provided by the PSP to enable the ISR.

### Format

```
int psp_isr_enable ( oal_isr_id_t isr_id )
```

### Arguments

| Argument | Description | Type         |
|----------|-------------|--------------|
| isr_id   | The ISR ID. | oal_isr_id_t |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| OAL_SUCCESS  | Successful execution. |
| OAL_ERROR    | Operation failed.     |



## 5.4 psp\_isr\_disable

This function is provided by the PSP to disable the ISR.

### Format

```
int psp_isr_disable ( oal_isr_id_t isr_id )
```

### Arguments

| Argument | Description | Type         |
|----------|-------------|--------------|
| isr_id   | The ISR ID. | oal_isr_id_t |

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| OAL_SUCCESS  | Successful execution. |
| OAL_ERROR    | Operation failed.     |

## 5.5 psp\_int\_enable

This function is provided by the PSP to enable global interrupts.

### Format

```
int psp_int_enable ( void )
```

### Arguments

None.

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| OAL_SUCCESS  | Successful execution. |
| OAL_ERROR    | Operation failed.     |

## 5.6 psp\_int\_disable

This function is provided by the PSP to disable global interrupts.

### Format

```
int psp_int_disable ( void )
```

### Arguments

None.

### Return Values

| Return value | Description           |
|--------------|-----------------------|
| OAL_SUCCESS  | Successful execution. |
| OAL_ERROR    | Operation failed.     |