



Helios  
Kernel 0.5.0

Helios Developer's Guide

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# 1 Data Structure Index

## 1.1 Data Structures

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# 2 File Index

## 2.1 File List

Here is a list of all documented files with brief descriptions:

<b>config.h</b>	
Kernel source for build configuration	<b>11</b>

## 3 Data Structure Documentation

### 3.1 Dir\_s Struct Reference

Data structure for directory handle.

#### Data Fields

- struct [Volume\\_s](#) \* **volume**
- [xWord](#) **currentCluster**
- [xHalfWord](#) **entryIndex**
- [xBase](#) **isOpen**

#### 3.1.1 Detailed Description

See also

[xDir](#)

[xDirOpen\(\)](#)

[xDirClose\(\)](#)

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

### 3.2 DirEntry\_s Struct Reference

Data structure for directory entry information.

#### Data Fields

- [xByte](#) **name** [256]
- [xWord](#) **size**
- [xWord](#) **firstCluster**
- [xBase](#) **isDirectory**
- [xBase](#) **isReadOnly**
- [xBase](#) **isHidden**
- [xBase](#) **isSystem**

### 3.2.1 Detailed Description

See also

[xDirEntry](#)  
[xDirRead\(\)](#)  
[xFileGetInfo\(\)](#)

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.3 File\_s Struct Reference

Data structure for file handle.

### Data Fields

- struct [Volume\\_s](#) \* **volume**
- [xWord](#) **firstCluster**
- [xWord](#) **currentCluster**
- [xWord](#) **fileSize**
- [xWord](#) **position**
- [xByte](#) **mode**
- [xBase](#) **isOpen**
- [xBase](#) **isDirty**

### 3.3.1 Detailed Description

See also

[xFile](#)  
[xFileOpen\(\)](#)  
[xFileClose\(\)](#)

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.4 MemoryRegionStats\_s Struct Reference

Data structure for memory region statistics.

## Data Fields

- [Word\\_t largestFreeEntryInBytes](#)
- [Word\\_t smallestFreeEntryInBytes](#)
- [Word\\_t numberOfFreeBlocks](#)
- [Word\\_t availableSpaceInBytes](#)
- [Word\\_t successfulAllocations](#)
- [Word\\_t successfulFrees](#)
- [Word\\_t minimumEverFreeBytesRemaining](#)

### 3.4.1 Detailed Description

The `MemoryRegionStats_t` data structure is used by [xMemGetHeapStats\(\)](#) and [xMemGetKernelStats\(\)](#) to obtain statistics about either memory region.

See also

[xMemoryRegionStats](#)  
[xMemGetHeapStats\(\)](#)  
[xMemGetKernelStats\(\)](#)  
[xMemFree\(\)](#)

### 3.4.2 Field Documentation

#### 3.4.2.1 `availableSpaceInBytes` [Word\\_t](#) `MemoryRegionStats_s::availableSpaceInBytes`

The amount of free memory in bytes (i.e., `numberOfFreeBlocks * CONFIG_MEMORY_REGION_BLOCK_SIZE`).

#### 3.4.2.2 `largestFreeEntryInBytes` [Word\\_t](#) `MemoryRegionStats_s::largestFreeEntryInBytes`

The largest free entry in bytes.

#### 3.4.2.3 `minimumEverFreeBytesRemaining` [Word\\_t](#) `MemoryRegionStats_s::minimumEverFreeBytes← Remaining`

Lowest water lever since system initialization of free bytes of memory.

#### 3.4.2.4 `numberOfFreeBlocks` [Word\\_t](#) `MemoryRegionStats_s::numberOfFreeBlocks`

The number of free blocks. See `CONFIG_MEMORY_REGION_BLOCK_SIZE` for block size in bytes.

#### 3.4.2.5 `smallestFreeEntryInBytes` [Word\\_t](#) `MemoryRegionStats_s::smallestFreeEntryInBytes`

The smallest free entry in bytes.

#### 3.4.2.6 **successfulAllocations** [Word\\_t](#) `MemoryRegionStats_s::successfulAllocations`

Number of successful memory allocations.

#### 3.4.2.7 **successfulFrees** [Word\\_t](#) `MemoryRegionStats_s::successfulFrees`

Number of successful memory "frees".

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.5 QueueMessage\_s Struct Reference

Data structure for a queue message.

### Data Fields

- [Base\\_t](#) `messageBytes`
- [Byte\\_t](#) `messageValue` [0x8u]

### 3.5.1 Detailed Description

The `QueueMessage_t` structure is used to store a queue message and is returned by [xQueueReceive\(\)](#) and [xQueuePeek\(\)](#).

See also

[xQueueMessage](#)  
[xQueueReceive\(\)](#)  
[xQueuePeek\(\)](#)  
[CONFIG\\_MESSAGE\\_VALUE\\_BYTES](#)  
[xMemFree\(\)](#)

### 3.5.2 Field Documentation

#### 3.5.2.1 **messageBytes** [Base\\_t](#) `QueueMessage_s::messageBytes`

The number of bytes contained in the message value which cannot exceed `CONFIG_MESSAGE_VALUE_BYTES`.

### 3.5.2.2 messageValue `Byte_t QueueMessage_s::messageValue[0x8u]`

The queue message value.

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.6 SystemInfo\_s Struct Reference

Data structure for information about the HeliOS system.

### Data Fields

- `Byte_t productName [0x6u]`
- `Base_t majorVersion`
- `Base_t minorVersion`
- `Base_t patchVersion`
- `Base_t numberOfTasks`
- `Base_t littleEndian`

### 3.6.1 Detailed Description

The `SystemInfo_t` data structure is used to store information about the HeliOS system and is returned by `xSystemGetSystemInfo()`.

See also

[xSystemInfo](#)  
[xSystemGetSystemInfo\(\)](#)  
`OS_PRODUCT_NAME_SIZE`  
[xMemFree\(\)](#)

### 3.6.2 Field Documentation

#### 3.6.2.1 littleEndian `Base_t SystemInfo_s::littleEndian`

True if the system byte order is little endian.

#### 3.6.2.2 majorVersion `Base_t SystemInfo_s::majorVersion`

The SemVer major version number of HeliOS.



### 3.6.2.3 minorVersion `Base_t` `SystemInfo_s::minorVersion`

The SemVer minor version number of HeliOS.

### 3.6.2.4 numberOfTasks `Base_t` `SystemInfo_s::numberOfTasks`

The number of tasks regardless of their state.

### 3.6.2.5 patchVersion `Base_t` `SystemInfo_s::patchVersion`

The SemVer patch version number of HeliOS.

### 3.6.2.6 productName `Byte_t` `SystemInfo_s::productName[0x6u]`

The product name of the operating system (always "HeliOS").

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.7 TaskInfo\_s Struct Reference

Data structure for information about a task.

### Data Fields

- `Base_t` id
- `Byte_t` name [0x8u]
- `TaskState_t` state
- `Ticks_t` lastRunTime
- `Ticks_t` totalRunTime

### 3.7.1 Detailed Description

The `TaskInfo_t` structure is similar to `xTaskRuntimeStats_t` in that it contains runtime statistics for a task. However, `TaskInfo_t` also contains additional details about a task such as its name and state. The `TaskInfo_t` structure is returned by `xTaskGetTaskInfo()` and `xTaskGetAllTaskInfo()`. If only runtime statistics are needed, then `TaskRuntimeStats_t` should be used because of its smaller memory footprint.

### See also

[xTaskInfo](#)  
[xTaskGetTaskInfo\(\)](#)  
[xTaskGetAllTaskInfo\(\)](#)  
[CONFIG\\_TASK\\_NAME\\_BYTES](#)  
[xMemFree\(\)](#)

### 3.7.2 Field Documentation

#### 3.7.2.1 id `Base_t TaskInfo_s::id`

The ID of the task.

#### 3.7.2.2 lastRunTime `Ticks_t TaskInfo_s::lastRunTime`

The duration in ticks of the task's last runtime.

#### 3.7.2.3 name `Byte_t TaskInfo_s::name[0x8u]`

The name of the task which must be exactly CONFIG\_TASK\_NAME\_BYTES bytes in length. Shorter task names must be padded.

#### 3.7.2.4 state `TaskState_t TaskInfo_s::state`

The state the task is in which is one of four states specified in the TaskState\_t enumerated data type.

#### 3.7.2.5 totalRunTime `Ticks_t TaskInfo_s::totalRunTime`

The duration in ticks of the task's total runtime.

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.8 TaskNotification\_s Struct Reference

Data structure for a direct to task notification.

### Data Fields

- `Base_t notificationBytes`
- `Byte_t notificationValue [0x8u]`

### 3.8.1 Detailed Description

The TaskNotification\_t data structure is used by [xTaskNotifyGive\(\)](#) and [xTaskNotifyTake\(\)](#) to send and receive direct to task notifications. Direct to task notifications are part of the event-driven multitasking model. A direct to task notification may be received by event-driven and co-operative tasks alike. However, the benefit of direct to task notifications may only be realized by tasks scheduled as event-driven. In order to wait for a direct to task notification, the task must be in a "waiting" state which is set by [xTaskWait\(\)](#).

See also

[xTaskNotification](#)  
[xMemFree\(\)](#)  
[xTaskNotifyGive\(\)](#)  
[xTaskNotifyTake\(\)](#)  
[xTaskWait\(\)](#)

### 3.8.2 Field Documentation

#### 3.8.2.1 notificationBytes [Base\\_t](#) TaskNotification\_s::notificationBytes

The length in bytes of the notification value which cannot exceed CONFIG\_NOTIFICATION\_VALUE\_BYTES.

#### 3.8.2.2 notificationValue [Byte\\_t](#) TaskNotification\_s::notificationValue[0x8u]

The notification value whose length is specified by the notification bytes member.

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.9 TaskRunTimeStats\_s Struct Reference

Data structure for task runtime statistics.

### Data Fields

- [Base\\_t id](#)
- [Ticks\\_t lastRunTime](#)
- [Ticks\\_t totalRunTime](#)

### 3.9.1 Detailed Description

The `TaskRunTimeStats_t` data structure is used by [xTaskGetTaskRunTimeStats\(\)](#) and `xTaskGetAllRuntimeStats()` to obtain runtime statistics about a task.

See also

[xTaskRunTimeStats](#)  
[xTaskGetTaskRunTimeStats\(\)](#)  
[xTaskGetAllRunTimeStats\(\)](#)  
[xMemFree\(\)](#)

### 3.9.2 Field Documentation

#### 3.9.2.1 `id` [Base\\_t](#) `TaskRunTimeStats_s::id`

The ID of the task.

#### 3.9.2.2 `lastRunTime` [Ticks\\_t](#) `TaskRunTimeStats_s::lastRunTime`

The duration in ticks of the task's last runtime.

#### 3.9.2.3 `totalRunTime` [Ticks\\_t](#) `TaskRunTimeStats_s::totalRunTime`

The duration in ticks of the task's total runtime.

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.10 Volume\_s Struct Reference

Data structure for FAT32 volume metadata.

### Data Fields

- [xHalfWord](#) `blockDeviceUID`
- [xWord](#) `fatStartSector`
- [xWord](#) `dataStartSector`
- [xWord](#) `rootDirCluster`
- [xByte](#) `sectorsPerCluster`
- [xHalfWord](#) `bytesPerSector`
- [xHalfWord](#) `reservedSectors`
- [xByte](#) `numFATs`
- [xWord](#) `sectorsPerFAT`
- [xBase](#) `mounted`

### 3.10.1 Detailed Description

See also

[xVolume](#)  
[xFSMount\(\)](#)  
[xFSUnmount\(\)](#)

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 3.11 VolumeInfo\_s Struct Reference

Data structure for volume information.

### Data Fields

- [xWord](#) **totalClusters**
- [xWord](#) **freeClusters**
- [xWord](#) **totalBytes**
- [xWord](#) **freeBytes**
- [xHalfWord](#) **bytesPerSector**
- [xByte](#) **sectorsPerCluster**
- [xWord](#) **bytesPerCluster**

### 3.11.1 Detailed Description

See also

[xVolumeInfo](#)  
[xFSGetVolumeInfo\(\)](#)

The documentation for this struct was generated from the following file:

- [HeliOS.h](#)

## 4 File Documentation

### 4.1 config.h File Reference

Kernel source for build configuration.

## Macros

- `#define CONFIG_ENABLE_ARDUINO_CPP_INTERFACE`  
*Define to enable the Arduino API C++ interface.*
- `#define CONFIG_ENABLE_SYSTEM_ASSERT`  
*Define to enable system assertions.*
- `#define CONFIG_SYSTEM_ASSERT_BEHAVIOR(f, l) __ArduinoAssert__(f, l)`  
*Define the system assertion behavior.*
- `#define CONFIG_MESSAGE_VALUE_BYTES 0x8u /* 8 */`  
*Define the size in bytes of the message queue message value.*
- `#define CONFIG_NOTIFICATION_VALUE_BYTES 0x8u /* 8 */`  
*Define the size in bytes of the direct to task notification value.*
- `#define CONFIG_TASK_NAME_BYTES 0x8u /* 8 */`  
*Define the size in bytes of the task name.*
- `#define CONFIG_MEMORY_REGION_SIZE_IN_BLOCKS 0x10u /* 16 */`  
*Define the number of memory blocks available in all memory regions.*
- `#define CONFIG_MEMORY_REGION_BLOCK_SIZE 0x20u /* 32 */`  
*Define the memory block size in bytes for all memory regions.*
- `#define CONFIG_QUEUE_MINIMUM_LIMIT 0x5u /* 5 */`  
*Define the minimum value for a message queue limit.*
- `#define CONFIG_STREAM_BUFFER_BYTES 0x20u /* 32 */`  
*Define the length of the stream buffer.*
- `#define CONFIG_TASK_WD_TIMER_ENABLE`  
*Enable task watchdog timers.*
- `#define CONFIG_DEVICE_NAME_BYTES 0x8u /* 8 */`  
*Define the length of a device driver name.*

### 4.1.1 Detailed Description

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#### Copyright

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## 4.1.2 Macro Definition Documentation

### 4.1.2.1 CONFIG\_DEVICE\_NAME\_BYTES `#define CONFIG_DEVICE_NAME_BYTES 0x8u /* 8 */`

Setting CONFIG\_DEVICE\_NAME\_BYTES will define the length of a device driver name. The name of device drivers should be exactly this length. There really isn't a reason to change this and doing so may break existing device drivers. The default length is 8 bytes.

### 4.1.2.2 CONFIG\_ENABLE\_ARDUINO\_CPP\_INTERFACE `#define CONFIG_ENABLE_ARDUINO_CPP_INTERFACE`

Because HeliOS kernel is written in C, the Arduino API cannot be called directly from the kernel. For example, assertions are unable to be written to the serial bus in applications using the Arduino platform/tool-chain. The CONFIG\_ENABLE\_ARDUINO\_CPP\_INTERFACE builds the included arduino.cpp file to allow the kernel to call the Arduino API through wrapper functions such as **ArduinoAssert()**. The arduino.cpp file can be found in the /extras directory. It must be copied into the /src directory to be built.

### 4.1.2.3 CONFIG\_ENABLE\_SYSTEM\_ASSERT `#define CONFIG_ENABLE_SYSTEM_ASSERT`

The CONFIG\_ENABLE\_SYSTEM\_ASSERT setting allows the end-user to enable system assertions in HeliOS. Once enabled, the end-user must define CONFIG\_SYSTEM\_ASSERT\_BEHAVIOR for there to be an effect. By default the CONFIG\_ENABLE\_SYSTEM\_ASSERT setting is not defined.

See also

[CONFIG\\_SYSTEM\\_ASSERT\\_BEHAVIOR](#)

### 4.1.2.4 CONFIG\_MEMORY\_REGION\_BLOCK\_SIZE `#define CONFIG_MEMORY_REGION_BLOCK_SIZE 0x20u /* 32 */`

Setting CONFIG\_MEMORY\_REGION\_BLOCK\_SIZE allows the end-user to define the size of a memory region block in bytes. The memory region block size should be set to achieve the best possible utilization of the available memory. The CONFIG\_MEMORY\_REGION\_BLOCK\_SIZE setting effects both the heap and kernel memory regions. The default value is 32 bytes.

See also

[xMemAlloc\(\)](#)

[xMemFree\(\)](#)

[CONFIG\\_MEMORY\\_REGION\\_SIZE\\_IN\\_BLOCKS](#)

**4.1.2.5 CONFIG\_MEMORY\_REGION\_SIZE\_IN\_BLOCKS** `#define CONFIG_MEMORY_REGION_SIZE_IN_BLOCKS 0x10u /* 16 */`

The heap memory region is used by tasks. Whereas the kernel memory region is used solely by the kernel for kernel objects. The `CONFIG_MEMORY_REGION_SIZE_IN_BLOCKS` setting allows the end-user to define the size, in blocks, of all memory regions thus effecting both the heap and kernel memory regions. The size of a memory block is defined by the `CONFIG_MEMORY_REGION_BLOCK_SIZE` setting. The size of all memory regions needs to be adjusted to fit the memory requirements of the end-user's application. The default value is 16 blocks.

**4.1.2.6 CONFIG\_MESSAGE\_VALUE\_BYTES** `#define CONFIG_MESSAGE_VALUE_BYTES 0x8u /* 8 */`

Setting the `CONFIG_MESSAGE_VALUE_BYTES` allows the end-user to define the size of the message queue message value. The larger the size of the message value, the greater impact there will be on system performance. The default size is 8 bytes.

See also

[xQueueMessage](#)

**4.1.2.7 CONFIG\_NOTIFICATION\_VALUE\_BYTES** `#define CONFIG_NOTIFICATION_VALUE_BYTES 0x8u /* 8 */`

Setting the `CONFIG_NOTIFICATION_VALUE_BYTES` allows the end-user to define the size of the direct to task notification value. The larger the size of the notification value, the greater impact there will be on system performance. The default size is 8 bytes.

See also

[xTaskNotification](#)

**4.1.2.8 CONFIG\_QUEUE\_MINIMUM\_LIMIT** `#define CONFIG_QUEUE_MINIMUM_LIMIT 0x5u /* 5 */`

Setting the `CONFIG_QUEUE_MINIMUM_LIMIT` allows the end-user to define the MINIMUM length limit a message queue can be created with [xQueueCreate\(\)](#). When a message queue length equals its limit, the message queue will be considered full and return true when [xQueuesQueueFull\(\)](#) is called. A full queue will also not accept messages from [xQueueSend\(\)](#). The default value is 5.

See also

[xQueuesQueueFull\(\)](#)  
[xQueueSend\(\)](#)  
[xQueueCreate\(\)](#)



#### 4.1.2.9 CONFIG\_STREAM\_BUFFER\_BYTES `#define CONFIG_STREAM_BUFFER_BYTES 0x20u /* 32 */`

Setting CONFIG\_STREAM\_BUFFER\_BYTES will define the length of stream buffers created by [xStreamCreate\(\)](#). When the length of the stream buffer reaches this value, it is considered full and can no longer be written to by calling [xStreamSend\(\)](#). The default value is 32.

#### 4.1.2.10 CONFIG\_SYSTEM\_ASSERT\_BEHAVIOR `#define CONFIG_SYSTEM_ASSERT_BEHAVIOR( f, l ) __ArduinoAssert__(f, l)`

The CONFIG\_SYSTEM\_ASSERT\_BEHAVIOR setting allows the end-user to specify the behavior (code) of the assertion which is called when CONFIG\_ENABLE\_SYSTEM\_ASSERT is defined. Typically some sort of output is generated over a serial or other interface. By default the CONFIG\_SYSTEM\_ASSERT\_BEHAVIOR is not defined.

#### Note

In order to use the **ArduinoAssert()** functionality, the CONFIG\_ENABLE\_ARDUINO\_CPP\_INTERFACE setting must be enabled.

#### See also

[CONFIG\\_ENABLE\\_SYSTEM\\_ASSERT](#)

[CONFIG\\_ENABLE\\_ARDUINO\\_CPP\\_INTERFACE](#)

```
#define CONFIG_SYSTEM_ASSERT_BEHAVIOR(f, l) __ArduinoAssert__( f , l )
```

#### 4.1.2.11 CONFIG\_TASK\_NAME\_BYTES `#define CONFIG_TASK_NAME_BYTES 0x8u /* 8 */`

Setting the CONFIG\_TASK\_NAME\_BYTES allows the end-user to define the size of the task name. The larger the size of the task name, the greater impact there will be on system performance. The default size is 8 bytes.

#### See also

[xTaskInfo](#)

#### 4.1.2.12 CONFIG\_TASK\_WD\_TIMER\_ENABLE `#define CONFIG_TASK_WD_TIMER_ENABLE`

Defining CONFIG\_TASK\_WD\_TIMER\_ENABLE will enable the task watchdog timer feature. The default is enabled.

## 4.2 HeliOS.h File Reference

Public API header for HeliOS embedded operating system applications.

## Data Structures

- struct [Volume\\_s](#)  
*Data structure for FAT32 volume metadata.*
- struct [File\\_s](#)  
*Data structure for file handle.*
- struct [Dir\\_s](#)  
*Data structure for directory handle.*
- struct [DirEntry\\_s](#)  
*Data structure for directory entry information.*
- struct [VolumeInfo\\_s](#)  
*Data structure for volume information.*
- struct [TaskNotification\\_s](#)  
*Data structure for a direct to task notification.*
- struct [TaskRunTimeStats\\_s](#)  
*Data structure for task runtime statistics.*
- struct [MemoryRegionStats\\_s](#)  
*Data structure for memory region statistics.*
- struct [TaskInfo\\_s](#)  
*Data structure for information about a task.*
- struct [QueueMessage\\_s](#)  
*Data structure for a queue message.*
- struct [SystemInfo\\_s](#)  
*Data structure for information about the HeliOS system.*

## Macros

- `#define Deref_TaskParm(type_, ptr_) (*((type_ *) (ptr_)))`

## Typedefs

- typedef enum [TaskState\\_e](#) [TaskState\\_t](#)  
*Enumerated type defining the possible states of a task.*
- typedef [TaskState\\_t](#) [xTaskState](#)  
*Public API type alias for task states.*
- typedef enum [SchedulerState\\_e](#) [SchedulerState\\_t](#)  
*Enumerated type for scheduler state.*
- typedef [SchedulerState\\_t](#) [xSchedulerState](#)  
*Enumerated type for scheduler state.*
- typedef enum [Return\\_e](#) [Return\\_t](#)  
*Enumerated type for syscall return type.*
- typedef [Return\\_t](#) [xReturn](#)  
*Enumerated type for syscall return type.*
- typedef void [TaskParm\\_t](#)  
*Data type for the task paramater.*
- typedef [TaskParm\\_t](#) \* [xTaskParm](#)  
*Data type for the task paramater.*
- typedef uint8\_t [Base\\_t](#)  
*Data type for the base type.*
- typedef [Base\\_t](#) [xBase](#)

- Data type for the base type.*

  - typedef uint8\_t [Byte\\_t](#)

*Data type for an 8-bit wide byte.*
- typedef [Byte\\_t](#) xByte

*Data type for an 8-bit wide byte.*
- typedef void [Addr\\_t](#)

*Data type for a pointer to a memory address.*
- typedef [Addr\\_t](#) \* xAddr

*Data type for a pointer to a memory address.*
- typedef size\_t [Size\\_t](#)

*Data type for the storage requirements of an object in memory.*
- typedef [Size\\_t](#) xSize

*Data type for the storage requirements of an object in memory.*
- typedef uint16\_t [HalfWord\\_t](#)

*Data type for a 16-bit half word.*
- typedef [HalfWord\\_t](#) xHalfWord

*Data type for a 16-bit half word.*
- typedef uint32\_t [Word\\_t](#)

*Data type for a 32-bit word.*
- typedef [Word\\_t](#) xWord

*Data type for a 32-bit word.*
- typedef uint32\_t [Ticks\\_t](#)

*Data type for system ticks.*
- typedef [Ticks\\_t](#) xTicks

*Data type for system ticks.*
- typedef void [Task\\_t](#)

*Data type for a task.*
- typedef [Task\\_t](#) \* xTask

*Data type for a task.*
- typedef void [Timer\\_t](#)

*Data type for a timer.*
- typedef [Timer\\_t](#) \* xTimer

*Data type for a timer.*
- typedef void [Queue\\_t](#)

*Data type for a queue.*
- typedef [Queue\\_t](#) \* xQueue

*Data type for a queue.*
- typedef void [StreamBuffer\\_t](#)

*Data type for a stream buffer.*
- typedef [StreamBuffer\\_t](#) \* xStreamBuffer

*Data type for a stream buffer.*
- typedef struct [Volume\\_s](#) [Volume\\_t](#)

*Data structure for FAT32 volume metadata.*
- typedef [Volume\\_t](#) \* xVolume

*Data type for a FAT32 volume.*
- typedef struct [File\\_s](#) [File\\_t](#)

*Data structure for file handle.*
- typedef [File\\_t](#) \* xFile

*Data type for a file handle.*
- typedef struct [Dir\\_s](#) [Dir\\_t](#)

*Data structure for directory handle.*

- typedef `Dir_t` \* `xDir`  
*Data type for a directory handle.*
- typedef struct `DirEntry_s` `DirEntry_t`  
*Data structure for directory entry information.*
- typedef `DirEntry_t` \* `xDirEntry`  
*Data type for a directory entry.*
- typedef struct `VolumeInfo_s` `VolumeInfo_t`  
*Data structure for volume information.*
- typedef `VolumeInfo_t` \* `xVolumeInfo`  
*Data type for volume information.*
- typedef struct `TaskNotification_s` `TaskNotification_t`  
*Data structure for a direct to task notification.*
- typedef `TaskNotification_t` \* `xTaskNotification`  
*Data structure for a direct to task notification.*
- typedef struct `TaskRunTimeStats_s` `TaskRunTimeStats_t`  
*Data structure for task runtime statistics.*
- typedef `TaskRunTimeStats_t` \* `xTaskRunTimeStats`  
*Data structure for task runtime statistics.*
- typedef struct `MemoryRegionStats_s` `MemoryRegionStats_t`  
*Data structure for memory region statistics.*
- typedef `MemoryRegionStats_t` \* `xMemoryRegionStats`  
*Data structure for memory region statistics.*
- typedef struct `TaskInfo_s` `TaskInfo_t`  
*Data structure for information about a task.*
- typedef `TaskInfo_t` \* `xTaskInfo`  
*Data structure for information about a task.*
- typedef struct `QueueMessage_s` `QueueMessage_t`  
*Data structure for a queue message.*
- typedef `QueueMessage_t` \* `xQueueMessage`  
*Data structure for a queue message.*
- typedef struct `SystemInfo_s` `SystemInfo_t`  
*Data structure for information about the HeliOS system.*
- typedef `SystemInfo_t` \* `xSystemInfo`  
*Data structure for information about the HeliOS system.*

## Enumerations

- enum `TaskState_e` { `TaskStateSuspended` , `TaskStateRunning` , `TaskStateWaiting` }  
*Enumerated type defining the possible states of a task.*
- enum `SchedulerState_e` { `SchedulerStateSuspended` , `SchedulerStateRunning` }  
*Enumerated type for scheduler state.*
- enum `Return_e` { `ReturnOK` , `ReturnError` }  
*Enumerated type for syscall return type.*

## Functions

- **xReturn xDeviceRegisterDevice** (xReturn(\*device\_self\_register\_>())  
*Register a device driver with HelIOS.*
- **xReturn xDevicesAvailable** (const xHalfWord uid\_, xBase \*res\_)  
*Syscall to query the device driver about the availability of a device.*
- **xReturn xDeviceSimpleWrite** (const xHalfWord uid\_, xByte data\_)  
*Syscall to write a byte of data to the device.*
- **xReturn xDeviceWrite** (const xHalfWord uid\_, xSize \*size\_, xAddr data\_)  
*Write data to a device.*
- **xReturn xDeviceSimpleRead** (const xHalfWord uid\_, xByte \*data\_)  
*Syscall to read a byte of data from the device.*
- **xReturn xDeviceRead** (const xHalfWord uid\_, xSize \*size\_, xAddr \*data\_)  
*Read data from a device.*
- **xReturn xDeviceInitDevice** (const xHalfWord uid\_)  
*Syscall to initialize a device.*
- **xReturn xDeviceConfigDevice** (const xHalfWord uid\_, xSize \*size\_, xAddr config\_)  
*Syscall to configure a device.*
- **xReturn xMemAlloc** (volatile xAddr \*addr\_, const xSize size\_)  
*Allocate memory from the user heap.*
- **xReturn xMemFree** (const volatile xAddr addr\_)  
*Free memory previously allocated from the user heap.*
- **xReturn xMemFreeAll** (void)  
*Syscall to free all heap memory allocated by xMemAlloc()*
- **xReturn xMemGetUsed** (xSize \*size\_)  
*Syscall to obtain the amount of in-use heap memory.*
- **xReturn xMemGetSize** (const volatile xAddr addr\_, xSize \*size\_)  
*Syscall to obtain the amount of heap memory allocated at a specific address.*
- **xReturn xMemGetHeapStats** (xMemoryRegionStats \*stats\_)  
*Syscall to get memory statistics on the heap memory region.*
- **xReturn xMemGetKernelStats** (xMemoryRegionStats \*stats\_)  
*Syscall to get memory statistics on the kernel memory region.*
- **xReturn xQueueCreate** (xQueue \*queue\_, const xBase limit\_)  
*Create a message queue for inter-task communication.*
- **xReturn xQueueDelete** (xQueue queue\_)  
*Delete a message queue and free its resources.*
- **xReturn xQueueGetLength** (const xQueue queue\_, xBase \*res\_)  
*Query the maximum message capacity of a queue.*
- **xReturn xQueueIsQueueEmpty** (const xQueue queue\_, xBase \*res\_)  
*Check if a message queue has no messages waiting.*
- **xReturn xQueueIsQueueFull** (const xQueue queue\_, xBase \*res\_)  
*Check if a message queue is at maximum capacity.*
- **xReturn xQueueMessagesWaiting** (const xQueue queue\_, xBase \*res\_)  
*Query the number of messages currently in a queue.*
- **xReturn xQueueSend** (xQueue queue\_, const xBase bytes\_, const xByte \*value\_)  
*Send a message to a queue (producer operation)*
- **xReturn xQueuePeek** (const xQueue queue\_, xQueueMessage \*message\_)  
*Examine the next queue message without removing it.*
- **xReturn xQueueDropMessage** (xQueue queue\_)  
*Remove the next message from queue without retrieving it.*
- **xReturn xQueueReceive** (xQueue queue\_, xQueueMessage \*message\_)

- Receive and remove a message from a queue (consumer operation)*

  - `xReturn xQueueLockQueue` (`xQueue` queue\_)

*Lock a queue to prevent new messages from being sent.*
- `xReturn xQueueUnLockQueue` (`xQueue` queue\_)

*Unlock a queue to resume accepting new messages.*
- `xReturn xStreamCreate` (`xStreamBuffer` \*stream\_)

*Create a byte-oriented stream buffer for inter-task communication.*
- `xReturn xStreamDelete` (const `xStreamBuffer` stream\_)

*Delete a stream buffer and free its resources.*
- `xReturn xStreamSend` (`xStreamBuffer` stream\_, const `xByte` byte\_)

*Send a single byte to a stream buffer (producer operation)*
- `xReturn xStreamReceive` (const `xStreamBuffer` stream\_, `xHalfWord` \*bytes\_, `xByte` \*\*data\_)

*Receive all waiting bytes from a stream buffer (consumer operation)*
- `xReturn xStreamBytesAvailable` (const `xStreamBuffer` stream\_, `xHalfWord` \*bytes\_)

*Query the number of bytes waiting in a stream buffer.*
- `xReturn xStreamReset` (const `xStreamBuffer` stream\_)

*Clear all bytes from a stream buffer.*
- `xReturn xStreamIsEmpty` (const `xStreamBuffer` stream\_, `xBase` \*res\_)

*Check if a stream buffer contains no waiting bytes.*
- `xReturn xStreamIsFull` (const `xStreamBuffer` stream\_, `xBase` \*res\_)

*Check if a stream buffer is at full capacity.*
- `xReturn xSystemAssert` (const char \*file\_, const int line\_)

*Syscall to raise a system assert.*
- `xReturn xSystemInit` (void)

*Syscall to bootstrap HeliOS.*
- `xReturn xSystemHalt` (void)

*Syscall to halt HeliOS.*
- `xReturn xSystemGetSystemInfo` (`xSystemInfo` \*info\_)

*Syscall to inquire about the system.*
- `xReturn xTaskCreate` (`xTask` \*task\_, const `xByte` \*name\_, void(\*callback\_)(`xTask` task\_, `xTaskParm` parm\_), `xTaskParm` taskParameter\_)

*Create a new task for cooperative multitasking.*
- `xReturn xTaskDelete` (const `xTask` task\_)

*Delete a task and free its resources.*
- `xReturn xTaskGetHandleByName` (`xTask` \*task\_, const `xByte` \*name\_)

*Syscall to get the task handle by name.*
- `xReturn xTaskGetHandleById` (`xTask` \*task\_, const `xBase` id\_)

*Syscall to get the task handle by task id.*
- `xReturn xTaskGetAllRunTimeStats` (`xTaskRunTimeStats` \*stats\_, `xBase` \*tasks\_)

*Syscall to get obtain the runtime statistics of all tasks.*
- `xReturn xTaskGetTaskRunTimeStats` (const `xTask` task\_, `xTaskRunTimeStats` \*stats\_)

*Syscall to get the runtime statistics for a single task.*
- `xReturn xTaskGetNumberOfTasks` (`xBase` \*tasks\_)

*Syscall to get the number of tasks.*
- `xReturn xTaskGetTaskInfo` (const `xTask` task\_, `xTaskInfo` \*info\_)

*Syscall to get info about a task.*
- `xReturn xTaskGetAllTaskInfo` (`xTaskInfo` \*info\_, `xBase` \*tasks\_)

*Syscall to get info about all tasks.*
- `xReturn xTaskGetTaskState` (const `xTask` task\_, `xTaskState` \*state\_)

*Syscall to get the state of a task.*
- `xReturn xTaskGetName` (const `xTask` task\_, `xByte` \*\*name\_)

- Syscall to get the name of a task.*

  - `xReturn xTaskGetId (const xTask task_, xBase *id_)`
- Syscall to get the task id of a task.*

  - `xReturn xTaskNotifyStateClear (xTask task_)`
- Syscall to clear a waiting direct-to-task notification.*

  - `xReturn xTaskNotificationIsWaiting (const xTask task_, xBase *res_)`
- Syscall to inquire as to whether a direct-to-task notification is waiting.*

  - `xReturn xTaskNotifyGive (xTask task_, const xBase bytes_, const xByte *value_)`
- Syscall to give (i.e., send) a task a direct-to-task notification.*

  - `xReturn xTaskNotifyTake (xTask task_, xTaskNotification *notification_)`
- Syscall to take (i.e. receive) a waiting direct-to-task notification.*

  - `xReturn xTaskResume (xTask task_)`
- Activate a task for scheduler execution.*

  - `xReturn xTaskSuspend (xTask task_)`
- Deactivate a task to prevent scheduler execution.*

  - `xReturn xTaskWait (xTask task_)`
- Place a task in event-driven waiting state.*

  - `xReturn xTaskChangePeriod (xTask task_, const xTicks period_)`
- Syscall to change the interval period of a task timer.*

  - `xReturn xTaskChangeWDPPeriod (xTask task_, const xTicks period_)`
- Syscall to change the task watchdog timer period.*

  - `xReturn xTaskGetPeriod (const xTask task_, xTicks *period_)`
- Syscall to obtain the task timer period.*

  - `xReturn xTaskResetTimer (xTask task_)`
- Syscall to set the task timer elapsed time to nil.*

  - `xReturn xTaskStartScheduler (void)`
- Start the HeliOS cooperative task scheduler.*

  - `xReturn xTaskResumeAll (void)`
- Resume the scheduler to enable task execution.*

  - `xReturn xTaskSuspendAll (void)`
- Suspend the scheduler and return control to caller.*

  - `xReturn xTaskGetSchedulerState (xSchedulerState *state_)`
- Syscall to get the scheduler state.*

  - `xReturn xTaskGetWDPPeriod (const xTask task_, xTicks *period_)`
- Syscall to get the task watchdog timer period.*

  - `xReturn xTimerCreate (xTimer *timer_, const xTicks period_)`
- Create a software timer for general-purpose timekeeping.*

  - `xReturn xTimerDelete (const xTimer timer_)`
- Delete an application timer and free its resources.*

  - `xReturn xTimerChangePeriod (xTimer timer_, const xTicks period_)`
- Change the period of an existing application timer.*

  - `xReturn xTimerGetPeriod (const xTimer timer_, xTicks *period_)`
- Query the current period of an application timer.*

  - `xReturn xTimerIsTimerActive (const xTimer timer_, xBase *res_)`
- Check if an application timer is currently running.*

  - `xReturn xTimerHasTimerExpired (const xTimer timer_, xBase *res_)`
- Check if an application timer has expired.*

  - `xReturn xTimerReset (xTimer timer_)`
- Reset an application timer's elapsed time to zero.*

  - `xReturn xTimerStart (xTimer timer_)`
- Start an application timer to begin timing.*

- **xReturn xTimerStop** (xTimer timer\_)  
*Stop an application timer and halt timing.*
- **xReturn xFSFormat** (const xHalfWord blockDeviceUID\_, const xByte \*volumeLabel\_)  
*Format a block device with a FAT32 filesystem.*
- **xReturn xFSMount** (xVolume \*volume\_, const xHalfWord blockDeviceUID\_)  
*Mount a FAT32 filesystem from a block device.*
- **xReturn xFSUnmount** (xVolume volume\_)  
*Unmount a FAT32 filesystem volume.*
- **xReturn xFSGetVolumeInfo** (const xVolume volume\_, xVolumeInfo \*info\_)  
*Query information about a mounted FAT32 volume.*
- **xReturn xFileOpen** (xFile \*file\_, xVolume volume\_, const xByte \*path\_, const xByte mode\_)  
*Open a file on a mounted FAT32 volume.*
- **xReturn xFileClose** (xFile file\_)  
*Close an open file.*
- **xReturn xFileRead** (xFile file\_, const xSize size\_, xByte \*\*data\_)  
*Read data from a file.*
- **xReturn xFileWrite** (xFile file\_, const xSize size\_, const xByte \*data\_)  
*Write data to a file.*
- **xReturn xFileSeek** (xFile file\_, const xWord offset\_, const xByte origin\_)  
*Change the file position for reading or writing.*
- **xReturn xFileTell** (const xFile file\_, xWord \*position\_)  
*Get the current file position.*
- **xReturn xFileGetSize** (const xFile file\_, xWord \*size\_)  
*Get the size of a file in bytes.*
- **xReturn xFileSync** (xFile file\_)  
*Flush file writes to storage.*
- **xReturn xFileTruncate** (xFile file\_, const xWord size\_)  
*Resize a file to a specified size.*
- **xReturn xFileEOF** (const xFile file\_, xBase \*eof\_)  
*Check if file position is at end-of-file.*
- **xReturn xFileExists** (xVolume volume\_, const xByte \*path\_, xBase \*exists\_)  
*Check if a file exists on the volume.*
- **xReturn xFileUnlink** (xVolume volume\_, const xByte \*path\_)  
*Delete a file from the filesystem.*
- **xReturn xFileRename** (xVolume volume\_, const xByte \*oldPath\_, const xByte \*newPath\_)  
*Rename or move a file.*
- **xReturn xFileGetInfo** (xVolume volume\_, const xByte \*path\_, xDirEntry \*entry\_)  
*Get detailed information about a file.*
- **xReturn xDirOpen** (xDir \*dir\_, xVolume volume\_, const xByte \*path\_)  
*Open a directory for reading.*
- **xReturn xDirClose** (xDir dir\_)  
*Close an open directory.*
- **xReturn xDirRead** (xDir dir\_, xDirEntry \*entry\_)  
*Read the next entry from a directory.*
- **xReturn xDirRewind** (xDir dir\_)  
*Reset directory read position to beginning.*
- **xReturn xDirMake** (xVolume volume\_, const xByte \*path\_)  
*Create a new directory.*
- **xReturn xDirRemove** (xVolume volume\_, const xByte \*path\_)  
*Delete an empty directory.*



### 4.2.1 Detailed Description

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This header file provides the complete public API for HeliOS, a lightweight embedded operating system designed for resource-constrained microcontrollers. It includes all type definitions, enumerations, and system call (syscall) declarations needed to develop applications on HeliOS.

HeliOS provides the following subsystems:

- Task Management: Create and manage cooperative multitasking
- Memory Management: Dynamic heap allocation with safety checks
- Device I/O: Abstract device driver interface
- Timers: Software timers for periodic and one-shot events
- Queues: Inter-task message passing with FIFO semantics
- Streams: Byte-oriented data buffers for streaming I/O
- Filesystem: FAT32 filesystem support with block device abstraction

All HeliOS system calls follow the naming convention `xSubsystem*()` where `x` is the prefix for public APIs and `Subsystem` identifies the functional area (e.g., `xTask`, `xMem`, `xQueue`).

#### Copyright

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### 4.2.2 Typedef Documentation

#### 4.2.2.1 **Addr\_t** `typedef void Addr_t`

The `Addr_t` type is a pointer of type `void` and is used to pass addresses between the end-user application and syscalls. It is not necessary to use the `Addr_t` type within the end-user application as long as the type is not used to interact with the kernel through syscalls

See also

[xAddr](#)

#### 4.2.2.2 **Base\_t** `typedef uint8_t Base_t`

The `Base_t` type is a simple data type often used as an argument or result type for syscalls when the value is known not to exceed its 8-bit width and no data structure requirements exist. There are no guarantees the `Base_t` will always be 8-bits wide. If an 8-bit data type is needed that is guaranteed to remain 8-bits wide, the `Byte_t` data type should be used.

See also

[xBase](#)

[Byte\\_t](#)

#### 4.2.2.3 **Byte\_t** `typedef uint8_t Byte_t`

The `Byte_t` type is an 8-bit wide data type and is guaranteed to always be 8-bits wide.

See also

[xByte](#)

#### 4.2.2.4 **Dir\_t** `typedef struct Dir_s Dir_t`

See also

[xDir](#)

[xDirOpen\(\)](#)

[xDirClose\(\)](#)

#### 4.2.2.5 **DirEntry\_t** `typedef struct DirEntry_s DirEntry_t`

See also

[xDirEntry](#)  
[xDirRead\(\)](#)  
[xFileGetInfo\(\)](#)

#### 4.2.2.6 **File\_t** `typedef struct File_s File_t`

See also

[xFile](#)  
[xFileOpen\(\)](#)  
[xFileClose\(\)](#)

#### 4.2.2.7 **HalfWord\_t** `typedef uint16_t HalfWord_t`

The `HalfWord_t` type is a 16-bit wide data type and is guaranteed to always be 16-bits wide.

See also

[xHalfWord](#)

#### 4.2.2.8 **MemoryRegionStats\_t** `typedef struct MemoryRegionStats_s MemoryRegionStats_t`

The `MemoryRegionStats_t` data structure is used by [xMemGetHeapStats\(\)](#) and [xMemGetKernelStats\(\)](#) to obtain statistics about either memory region.

See also

[xMemoryRegionStats](#)  
[xMemGetHeapStats\(\)](#)  
[xMemGetKernelStats\(\)](#)  
[xMemFree\(\)](#)

#### 4.2.2.9 Queue\_t `typedef void Queue_t`

The Queue\_t data type is used as a queue. The queue is created when `xQueueCreate()` is called. For more information about queues, see `xQueueCreate()`.

See also

`xQueue`  
`xQueueCreate()`  
`xQueueDelete()`

#### 4.2.2.10 QueueMessage\_t `typedef struct QueueMessage_s QueueMessage_t`

The QueueMessage\_t structure is used to store a queue message and is returned by `xQueueReceive()` and `xQueuePeek()`.

See also

`xQueueMessage`  
`xQueueReceive()`  
`xQueuePeek()`  
`CONFIG_MESSAGE_VALUE_BYTES`  
`xMemFree()`

#### 4.2.2.11 Return\_t `typedef enum Return_e Return_t`

All HeliOS syscalls return the Return\_t type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

See also

`OK()`  
`ERROR()`  
`xReturn`

#### 4.2.2.12 SchedulerState\_t `typedef enum SchedulerState_e SchedulerState_t`

The scheduler can be in one of three possible states as defined by the SchedulerState\_t enumerated data type. The state the scheduler is in is changed by calling `xTaskSuspendAll()` and `xTaskResumeAll()`. The state the scheduler is in can be obtained by calling `xTaskGetSchedulerState()`.

See also

`xSchedulerState`  
`xTaskSuspendAll()`  
`xTaskResumeAll()`  
`xTaskGetSchedulerState()`  
`xTaskStartScheduler()`

**4.2.2.13 Size\_t** typedef size\_t [Size\\_t](#)

The [Size\\_t](#) type is used for the storage requirements of an object in memory and is always represented in bytes.

See also

[xSize](#)

**4.2.2.14 StreamBuffer\_t** typedef void [StreamBuffer\\_t](#)

The [StreamBuffer\\_t](#) data type is used as a stream buffer. The stream buffer is created when [xStreamCreate\(\)](#) is called. For more information about stream buffers, see [xStreamCreate\(\)](#). [Stream\\_t](#) should be declared as [xStream](#).

See also

[xStream](#)

[xStreamCreate\(\)](#)

[xStreamDelete\(\)](#)

**4.2.2.15 SystemInfo\_t** typedef struct [SystemInfo\\_s](#) [SystemInfo\\_t](#)

The [SystemInfo\\_t](#) data structure is used to store information about the HeliOS system and is returned by [xSystemGetSystemInfo\(\)](#).

See also

[xSystemInfo](#)

[xSystemGetSystemInfo\(\)](#)

[OS\\_PRODUCT\\_NAME\\_SIZE](#)

[xMemFree\(\)](#)

**4.2.2.16 Task\_t** typedef void [Task\\_t](#)

The [Task\\_t](#) data type is used as a task. The task is created when [xTaskCreate\(\)](#) is called. For more information about tasks, see [xTaskCreate\(\)](#).

See also

[xTask](#)

[xTaskCreate\(\)](#)

[xTaskDelete\(\)](#)

**4.2.2.17 TaskInfo\_t** `typedef struct TaskInfo_s TaskInfo_t`

The TaskInfo\_t structure is similar to xTaskRuntimeStats\_t in that it contains runtime statistics for a task. However, TaskInfo\_t also contains additional details about a task such as its name and state. The TaskInfo\_t structure is returned by xTaskGetTaskInfo() and xTaskGetAllTaskInfo(). If only runtime statistics are needed, then TaskRunTimeStats\_t should be used because of its smaller memory footprint.

See also

[xTaskInfo](#)  
[xTaskGetTaskInfo\(\)](#)  
[xTaskGetAllTaskInfo\(\)](#)  
[CONFIG\\_TASK\\_NAME\\_BYTES](#)  
[xMemFree\(\)](#)

**4.2.2.18 TaskNotification\_t** `typedef struct TaskNotification_s TaskNotification_t`

The TaskNotification\_t data structure is used by xTaskNotifyGive() and xTaskNotifyTake() to send and receive direct to task notifications. Direct to task notifications are part of the event-driven multitasking model. A direct to task notification may be received by event-driven and co-operative tasks alike. However, the benefit of direct to task notifications may only be realized by tasks scheduled as event-driven. In order to wait for a direct to task notification, the task must be in a "waiting" state which is set by xTaskWait().

See also

[xTaskNotification](#)  
[xMemFree\(\)](#)  
[xTaskNotifyGive\(\)](#)  
[xTaskNotifyTake\(\)](#)  
[xTaskWait\(\)](#)

**4.2.2.19 TaskParm\_t** `typedef void TaskParm_t`

The TaskParm\_t type is used to pass a parameter to a task at the time of task creation using xTaskCreate(). A task parameter is a pointer of type void and can point to any number of types, arrays and/or data structures that will be passed to the task. It is up to the end-user to manage, allocate and free the memory related to these objects using xMemAlloc() and xMemFree().

See also

[xTaskParm](#)  
[xTaskCreate\(\)](#)  
[xMemAlloc\(\)](#)  
[xMemFree\(\)](#)

**4.2.2.20 TaskRunTimeStats\_t** `typedef struct TaskRunTimeStats_s TaskRunTimeStats_t`

The TaskRunTimeStats\_t data structure is used by [xTaskGetTaskRunTimeStats\(\)](#) and [xTaskGetAllRuntimeStats\(\)](#) to obtain runtime statistics about a task.

See also

[xTaskRunTimeStats](#)  
[xTaskGetTaskRunTimeStats\(\)](#)  
[xTaskGetAllRunTimeStats\(\)](#)  
[xMemFree\(\)](#)

**4.2.2.21 TaskState\_t** `typedef enum TaskState_e TaskState_t`

Tasks in HeliOS transition between three distinct states that control their execution behavior by the cooperative scheduler. The task state determines whether the scheduler will invoke the task's function during scheduling cycles.

State Transitions:

- New tasks begin in TaskStateSuspended
- [xTaskResume\(\)](#) transitions a task to TaskStateRunning
- [xTaskSuspend\(\)](#) transitions a task to TaskStateSuspended
- [xTaskWait\(\)](#) transitions a task to TaskStateWaiting

Scheduling Behavior:

- TaskStateSuspended: Task will NOT be scheduled for execution
- TaskStateRunning: Task will be scheduled normally based on its period
- TaskStateWaiting: Task will be scheduled only after a task event occurs (e.g., timer expiration, notification)

Note

HeliOS uses cooperative multitasking. Tasks must voluntarily yield control to allow other tasks to execute.

See also

[xTaskState](#)  
[xTaskResume\(\)](#)  
[xTaskSuspend\(\)](#)  
[xTaskWait\(\)](#)  
[xTaskGetTaskState\(\)](#)

**4.2.2.22 Ticks\_t** `typedef uint32_t Ticks_t`

The `Ticks_t` type is used to store ticks from the system clock. Ticks is not bound to any one unit of measure for time though most systems are configured for millisecond resolution, milliseconds is not guaranteed and is dependent on the system clock frequency and prescaler.

See also

[xTicks](#)

**4.2.2.23 Timer\_t** `typedef void Timer_t`

The `Timer_t` data type is used as a timer. The timer is created when [xTimerCreate\(\)](#) is called. For more information about timers, see [xTimerCreate\(\)](#).

See also

[xTimer](#)

[xTimerCreate\(\)](#)

[xTimerDelete\(\)](#)

**4.2.2.24 Volume\_t** `typedef struct Volume_s Volume_t`

See also

[xVolume](#)

[xFSMount\(\)](#)

[xFSUnmount\(\)](#)

**4.2.2.25 VolumeInfo\_t** `typedef struct VolumeInfo_s VolumeInfo_t`

See also

[xVolumeInfo](#)

[xFSGetVolumeInfo\(\)](#)

**4.2.2.26 Word\_t** `typedef uint32_t Word_t`

The `Word_t` type is a 32-bit wide data type and is guaranteed to always be 32-bits wide.

See also

[xWord](#)



**4.2.2.27 xAddr** typedef [Addr\\_t\\*](#) [xAddr](#)

See also

[Addr\\_t](#)

**4.2.2.28 xBase** typedef [Base\\_t](#) [xBase](#)

See also

[Base\\_t](#)

**4.2.2.29 xByte** typedef [Byte\\_t](#) [xByte](#)

See also

[Byte\\_t](#)

**4.2.2.30 xDir** typedef [Dir\\_t\\*](#) [xDir](#)

See also

[Dir\\_t](#)

[xDirOpen\(\)](#)

[xDirClose\(\)](#)

**4.2.2.31 xDirEntry** typedef [DirEntry\\_t\\*](#) [xDirEntry](#)

See also

[DirEntry\\_t](#)

[xDirRead\(\)](#)

[xFileGetInfo\(\)](#)

**4.2.2.32 xFile** `typedef File_t* xFile`

See also

[File\\_t](#)  
[xFileOpen\(\)](#)  
[xFileClose\(\)](#)

**4.2.2.33 xHalfWord** `typedef HalfWord_t xHalfWord`

See also

[HalfWord\\_t](#)

**4.2.2.34 xQueue** `typedef Queue_t* xQueue`

See also

[Queue\\_t](#)

**4.2.2.35 xReturn** `typedef Return_t xReturn`

See also

[Return\\_t](#)

**4.2.2.36 xSchedulerState** `typedef SchedulerState_t xSchedulerState`

See also

[SchedulerState\\_t](#)

**4.2.2.37 xSize** `typedef Size_t xSize`

See also

[Size\\_t](#)

**4.2.2.38 xStreamBuffer** typedef [StreamBuffer\\_t](#)\* [xStreamBuffer](#)

See also

[StreamBuffer\\_t](#)

**4.2.2.39 xTask** typedef [Task\\_t](#)\* [xTask](#)

See also

[Task\\_t](#)

**4.2.2.40 xTaskNotification** typedef [TaskNotification\\_t](#)\* [xTaskNotification](#)

See also

[TaskNotification\\_t](#)

**4.2.2.41 xTaskParm** typedef [TaskParm\\_t](#)\* [xTaskParm](#)

See also

[TaskParm\\_t](#)

**4.2.2.42 xTaskState** typedef [TaskState\\_t](#) [xTaskState](#)

This is the user-facing type name for task states, providing a consistent naming convention across the HeliOS public API where all types are prefixed with 'x'.

See also

[TaskState\\_t](#)

**4.2.2.43 xTicks** typedef [Ticks\\_t](#) [xTicks](#)

See also

[Ticks\\_t](#)

**4.2.2.44 xTimer** `typedef Timer_t* xTimer`

See also

[Timer\\_t](#)

**4.2.2.45 xVolume** `typedef Volume_t* xVolume`

See also

[Volume\\_t](#)

[xFSMount\(\)](#)

[xFSUnmount\(\)](#)

**4.2.2.46 xVolumeInfo** `typedef VolumeInfo_t* xVolumeInfo`

See also

[VolumeInfo\\_t](#)

[xFSGetVolumeInfo\(\)](#)

**4.2.2.47 xWord** `typedef Word_t xWord`

See also

[Word\\_t](#)

## 4.2.3 Enumeration Type Documentation

**4.2.3.1 Return\_e** `enum Return_e`

All HeliOS syscalls return the `Return_t` type which can either be `ReturnOK` or `ReturnError`. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

See also

`OK()`

`ERROR()`

[xReturn](#)

## Enumerator

ReturnOK	Return value if the syscall was successful.
ReturnError	Return value if the syscall failed.

**4.2.3.2 SchedulerState\_e** `enum SchedulerState_e`

The scheduler can be in one of three possible states as defined by the SchedulerState\_t enumerated data type. The state the scheduler is in is changed by calling [xTaskSuspendAll\(\)](#) and [xTaskResumeAll\(\)](#). The state the scheduler is in can be obtained by calling [xTaskGetSchedulerState\(\)](#).

## See also

[xSchedulerState](#)  
[xTaskSuspendAll\(\)](#)  
[xTaskResumeAll\(\)](#)  
[xTaskGetSchedulerState\(\)](#)  
[xTaskStartScheduler\(\)](#)

## Enumerator

SchedulerStateSuspended	State the scheduler is in after calling <a href="#">xTaskSuspendAll()</a> . TaskStartScheduler() will stop scheduling tasks for execution and relinquish control when <a href="#">xTaskSuspendAll()</a> is called.
SchedulerStateRunning	State the scheduler is in after calling <a href="#">xTaskResumeAll()</a> . <a href="#">xTaskStartScheduler()</a> will continue to schedule tasks for execution until <a href="#">xTaskSuspendAll()</a> is called.

**4.2.3.3 TaskState\_e** `enum TaskState_e`

Tasks in HeliOS transition between three distinct states that control their execution behavior by the cooperative scheduler. The task state determines whether the scheduler will invoke the task's function during scheduling cycles.

## State Transitions:

- New tasks begin in TaskStateSuspended
- [xTaskResume\(\)](#) transitions a task to TaskStateRunning
- [xTaskSuspend\(\)](#) transitions a task to TaskStateSuspended
- [xTaskWait\(\)](#) transitions a task to TaskStateWaiting

## Scheduling Behavior:

- TaskStateSuspended: Task will NOT be scheduled for execution
- TaskStateRunning: Task will be scheduled normally based on its period
- TaskStateWaiting: Task will be scheduled only after a task event occurs (e.g., timer expiration, notification)

**Note**

HeliOS uses cooperative multitasking. Tasks must voluntarily yield control to allow other tasks to execute.

**See also**

[xTaskState](#)  
[xTaskResume\(\)](#)  
[xTaskSuspend\(\)](#)  
[xTaskWait\(\)](#)  
[xTaskGetTaskState\(\)](#)

**Enumerator**

TaskStateSuspended	Task is inactive and will not be scheduled. This is the initial state after task creation and the state after calling <a href="#">xTaskSuspend()</a> .
TaskStateRunning	Task is active and will be scheduled for execution according to its period. Set by calling <a href="#">xTaskResume()</a> .
TaskStateWaiting	Task is waiting for an event and will only be scheduled when that event occurs (timer, notification, etc.). Set by calling <a href="#">xTaskWait()</a> .

**4.2.4 Function Documentation**

**4.2.4.1 xDeviceConfigDevice()** [xReturn](#) xDeviceConfigDevice (

```

    const xHalfWord uid_,
    xSize * size_,
    xAddr config_ )

```

The [xDeviceConfigDevice\(\)](#) will call the device driver's DEVICENAME\_config() function to configure the device. The syscall is bi-directional (i.e., it will write configuration data to the device and read the same from the device before returning). The purpose of the bi-directional functionality is to allow the device's configuration to be set and queried using one syscall. The structure of the configuration data is left to the device driver's author. What is required is that the configuration data memory is allocated using [xMemAlloc\(\)](#) and that the "size\_" parameter is set to the size (i.e., amount) of the configuration data (e.g., sizeof(MyDeviceDriverConfig)) in bytes.

**See also**

[xReturn](#)  
[xMemAlloc\(\)](#)  
[xMemFree\(\)](#)

**Parameters**

<i>uid_</i>	The unique identifier ("UID") of the device driver to be operated on.
<i>size_↔</i>	The size (i.e., amount) of configuration data to be written and read to and from the device, in bytes.
<i>config_↔</i>	The configuration data. The configuration data must have been allocated by <a href="#">xMemAlloc()</a> .

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.2 xDeviceInitDevice()** [xReturn](#) xDeviceInitDevice (   
const [xHalfWord](#) uid\_ )

The [xDeviceInitDevice\(\)](#) syscall will call the device driver's DRIVERNAME\_init() function to bootstrap the device. For example, setting memory mapped registers to starting values or setting the device driver's state and mode. This syscall is optional and is dependent on the specifics of the device driver's implementation by its author.

## See also

[xReturn](#)

## Parameters

<a href="#">uid</a> ↔	The unique identifier ("UID") of the device driver to be operated on.
—	

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.3 xDevicesAvailable()** [xReturn](#) xDeviceIsAvailable (   
const [xHalfWord](#) uid\_,   
[xBase](#) \* res\_ )

The [xDevicesAvailable\(\)](#) syscall queries the device driver about the availability of a device. Generally "available" means the that the device is available for read and/or write operations though the meaning is implementation specific and left up to the device driver's author.

## See also

[xReturn](#)

## Parameters

<i>uid</i> ↔ —	The unique identifier ("UID") of the device driver to be operated on.
<i>res</i> ↔ —	The result of the inquiry; here, taken to mean the availability of the device.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.4 xDeviceRead()** `xReturn` xDeviceRead (   
     const `xHalfWord` *uid\_*,   
     `xSize` \* *size\_*,   
     `xAddr` \* *data\_* )

Reads data from the specified device through its registered driver. The device driver allocates a buffer from the user heap, fills it with data from the device, and returns it to the caller. This provides an abstract interface for device input, allowing applications to read from any registered device using a consistent API.

Unlike `xDeviceWrite()` where the caller allocates memory, `xDeviceRead()` has the DEVICE DRIVER allocate the buffer. This is necessary because the driver determines how much data is available to read. The caller receives both the data buffer pointer and the size of data read.

The read operation behavior depends on the device driver implementation:

- Serial devices typically read bytes from a receive buffer or UART
- Storage devices read from specific sectors or blocks
- Network devices receive packets
- Sensor devices read measurement data
- Custom devices implement application-specific read semantics

## Data Flow:

1. Application calls `xDeviceRead()` with device UID
2. `xDeviceRead()` validates device UID, state, and permissions
3. Driver's read callback is invoked
4. Driver allocates buffer from heap (via `xMemAlloc` internally)
5. Driver fills buffer with data from device
6. Driver returns buffer pointer and size to HeliOS
7. HeliOS returns buffer to application
8. Application processes data then MUST free buffer with `xMemFree()`



### Warning

The caller is RESPONSIBLE FOR FREEING the returned buffer using `xMemFree()`. Failing to free the buffer will cause memory leaks. The driver allocates this memory specifically for this read operation.

### Note

Device read operations are synchronous by default. The function does not return until the driver completes the read operation and allocates the buffer. Drivers may implement buffering or blocking behavior internally.

The device must be in a readable state (`DeviceModeReadOnly` or `DeviceModeReadWrite`) and running state (`DeviceStateRunning`) for the read to succeed. Check device state via `xDeviceConfigDevice()` if needed.

If no data is available, driver behavior varies. Some drivers may return `ReturnError`, others may return an empty buffer (`size=0`), and others may block waiting for data. Check specific driver documentation.

### Example Usage:

```
#define UART0_UID 0x0100
// Read data from UART
xByte *rxBuffer = NULL;
xSize rxSize = 0;
if (OK(xDeviceRead(UART0_UID, &rxSize, (xAddr *)&rxBuffer))) {
    // Data successfully read
    if (rxSize > 0) {
        // Process received data
        processUARTData(rxBuffer, rxSize);
    }
    // IMPORTANT: Free the buffer allocated by driver
    xMemFree((xAddr)rxBuffer);
}
// Reading from a block device
#define BLOCKDEV_UID 0x1000
xByte *sectorData = NULL;
xSize sectorSize = 0;
if (OK(xDeviceRead(BLOCKDEV_UID, &sectorSize, (xAddr *)&sectorData))) {
    // Sector data read (typically 512 or 4096 bytes)
    if (sectorSize > 0) {
        analyzeSectorData(sectorData, sectorSize);
    }
    // Free the buffer
    xMemFree((xAddr)sectorData);
}
// Reading in a loop (e.g., serial communication)
void serialReaderTask(xTask task, xTaskParm parm) {
    xByte *data = NULL;
    xSize len = 0;
    if (OK(xDeviceRead(UART0_UID, &len, (xAddr *)&data))) {
        if (len > 0) {
            handleSerialData(data, len);
        }
        xMemFree((xAddr)data);
    }
}
```

### Parameters

in	<i>uid</i> ↔ —	Unique identifier of the target device. Must match a UID previously registered via <code>xDeviceRegisterDevice()</code> .
out	<i>size</i> ↔ —	Pointer to size variable that receives the number of bytes read from the device. Set to 0 if no data available.
out	<i>data</i> ↔ —	Pointer to buffer pointer variable. Receives address of heap-allocated buffer containing the read data. Caller MUST free this buffer with <code>xMemFree()</code> after use.

### Returns

`ReturnOK` if data was read successfully (size may be 0), `ReturnError` if the read failed (invalid UID, device not found, device in wrong state/mode, memory allocation failed, or driver read operation failed).

**See also**

[xDeviceWrite\(\)](#) - Write data to a device  
[xDeviceSimpleRead\(\)](#) - Read a single byte from a device  
[xDeviceRegisterDevice\(\)](#) - Register a device driver  
[xDeviceInitDevice\(\)](#) - Initialize a device  
[xDeviceConfigDevice\(\)](#) - Configure device state or parameters  
[xMemFree\(\)](#) - Free the buffer returned by this function (REQUIRED!)

#### 4.2.4.5 **xDeviceRegisterDevice()** `xReturn xDeviceRegisterDevice (` `xReturn(*)() device_self_register_ )`

Registers a device driver with the HeliOS kernel, making it available for I/O operations through the device abstraction layer. Device registration must occur before any device I/O functions ([xDeviceRead\(\)](#), [xDeviceWrite\(\)](#), etc.) can be used with that device.

HeliOS uses a self-registration pattern where each device driver provides its own registration function. This function is passed to [xDeviceRegisterDevice\(\)](#), which calls it to obtain the driver's callback functions, configuration, and metadata.

**Device Registration Process:**

1. Device driver provides a `DRIVERNAME_self_register()` function
2. Application calls [xDeviceRegisterDevice\(\)](#) with this function pointer
3. HeliOS calls the registration function to obtain driver information
4. Driver is added to the internal device list with its unique ID (UID)
5. Device becomes available for I/O operations

**Device Driver Requirements:**

- Each driver must have a globally unique identifier (UID)
- Driver must provide callback functions for init, config, read, write
- Driver must specify its name, state, and access mode
- UID must not conflict with any other registered device

**Warning**

Device UIDs must be unique across all drivers in the application. Registering multiple devices with the same UID will cause undefined behavior. Common practice is to use high byte for driver type and low byte for instance (e.g., 0x0100 for first UART, 0x0200 for first SPI).

**Note**

Once registered, a device cannot be unregistered. However, devices can be placed in suspended state via [xDeviceConfigDevice\(\)](#) to disable them.

Device registration should occur during system initialization, before [xTaskStartScheduler\(\)](#) is called, to ensure devices are available when tasks begin executing.

The device driver model is extensible. Driver authors define their own state machines, configuration structures, and operational modes within the framework provided by the callback functions.

**Example Usage:**

```
// In device driver file (e.g., uart_driver.c)
xReturn UART0_self_register(void) {
    // Register driver with HeliOS
    return __RegisterDevice__(
        0x0100,           // Unique ID for UART0
        "UART0 ",         // 8-byte name
        DeviceStateRunning, // Initial state
        DeviceModeReadWrite, // Access mode
        UART0_init,        // Init callback
        UART0_config,       // Config callback
        UART0_read,         // Read callback
        UART0_write,        // Write callback
        UART0_simple_read,  // Simple read callback
        UART0_simple_write // Simple write callback
    );
}

// In application code (main.c)
int main(void) {
    // Register UART driver
    if (OK(xDeviceRegisterDevice(UART0_self_register))) {
        // Initialize the device
        if (OK(xDeviceInitDevice(0x0100))) {
            // Device ready for I/O
            xDeviceWrite(0x0100, &size, data);
        }
    }
    xTaskStartScheduler();
}
```

**Parameters**

in	<a href="#">device_self_register_</a>	Pointer to the device driver's self-registration function. This function must return ReturnOK on successful registration. By convention, this function is named DRIVERNAME_self_register().
----	---------------------------------------	---

**Returns**

ReturnOK if the device was successfully registered, ReturnError if registration failed (duplicate UID, invalid driver structure, out of memory, or driver registration function returned error).

**See also**

[xDeviceInitDevice\(\)](#) - Initialize a registered device  
[xDeviceConfigDevice\(\)](#) - Configure device parameters or state  
[xDeviceRead\(\)](#) - Read data from a device  
[xDeviceWrite\(\)](#) - Write data to a device  
[xDevicesAvailable\(\)](#) - Check if a device is registered  
[CONFIG\\_DEVICE\\_NAME\\_BYTES](#) - Device name length configuration

```
4.2.4.6 xDeviceSimpleRead() xReturn xDeviceSimpleRead (
    const xHalfWord uid_,
    xByte * data_ )
```

The `xDeviceSimpleRead()` syscall will read a byte of data from a device. Whether the data is read from the device is dependent on the device driver mode, state and implementation of these features by the device driver's author.

See also

[xReturn](#)

#### Parameters

<i>uid</i> ↔ —	The unique identifier ("UID") of the device driver to be operated on.
<i>data</i> ↔ —	The byte of data read from the device.

#### Returns

On success, the syscall returns `ReturnOK`. On failure, the syscall returns `ReturnError`. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return `ReturnError`. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be `ReturnOK` or `ReturnError`. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

```
4.2.4.7 xDeviceSimpleWrite() xReturn xDeviceSimpleWrite (
    const xHalfWord uid_,
    xByte data_ )
```

The `xDeviceSimpleWrite()` syscall will write a byte of data to a device. Whether the data is written to the device is dependent on the device driver mode, state and implementation of these features by the device driver's author.

See also

[xReturn](#)

#### Parameters

<i>uid</i> ↔ —	The unique identifier ("UID") of the device driver to be operated on.
<i>data</i> ↔ —	A byte of data to be written to the device.

#### Returns

On success, the syscall returns `ReturnOK`. On failure, the syscall returns `ReturnError`. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable

to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return `ReturnError`. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be `ReturnOK` or `ReturnError`. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.8 xDeviceWrite()** `xReturn xDeviceWrite (`  
    `const xHalfWord uid_,`  
    `xSize * size_,`  
    `xAddr data_ )`

Writes a buffer of data to the specified device through its registered driver. The data is transferred from user heap memory to the device via the driver's write callback function. This provides an abstract interface for device output, allowing applications to write to any registered device using a consistent API.

The write operation behavior depends on the device driver implementation:

- Serial devices typically write bytes to a transmit buffer or UART
- Storage devices write to specific sectors or blocks
- Network devices transmit packets
- Custom devices implement application-specific write semantics

Data Flow:

1. Application prepares data in heap-allocated buffer
2. `xDeviceWrite()` validates device UID, state, and permissions
3. Data is copied from user heap to kernel memory
4. Driver's write callback is invoked with kernel memory
5. Driver performs hardware-specific write operations
6. Driver returns number of bytes written via `size_` parameter

#### Warning

The data buffer **MUST** be allocated from the user heap using `xMemAlloc()`. Stack-allocated buffers or static data will cause memory validation errors. HeliOS enforces this to maintain memory safety boundaries between user space and kernel space.

**Note**

Device write operations are synchronous by default. The function does not return until the driver completes the write operation. Drivers may implement buffering or asynchronous operations internally.

The `size_` parameter is both input and output. On input, it specifies the number of bytes to write. On output (if driver supports it), it may reflect the actual number of bytes written, which can be less than requested for devices with limited buffers.

The device must be in a writable state (`DeviceModeWriteOnly` or `DeviceModeReadWrite`) and running state (`DeviceStateRunning`) for the write to succeed. Check device state via [xDeviceConfigDevice\(\)](#) if needed.

**Example Usage:**

```
#define UART0_UID 0x0100
// Write string to UART
const char *message = "Hello, World!\n";
xSize messageLen = strlen(message);
xByte *buffer = NULL;
// Allocate buffer from heap (required!)
if (OK(xMemAlloc((volatile xAddr *)&buffer, messageLen))) {
    // Copy data to heap buffer
    memcpy(buffer, message, messageLen);
    // Write to device
    if (OK(xDeviceWrite(UART0_UID, &messageLen, (xAddr)buffer))) {
        // Data written successfully
    }
    // Free the buffer
    xMemFree((xAddr)buffer);
}
// Writing to a block device
xByte *sectorData = NULL;
xSize sectorSize = 512;
if (OK(xMemAlloc((volatile xAddr *)&sectorData, sectorSize))) {
    // Fill sector data...
    prepareSectorData(sectorData, sectorSize);
    // Write to block device
    if (OK(xDeviceWrite(0x1000, &sectorSize, (xAddr)sectorData))) {
        // Sector written
    }
    xMemFree((xAddr)sectorData);
}
```

**Parameters**

in	<code>uid</code> ↔ —	Unique identifier of the target device. Must match a UID previously registered via <a href="#">xDeviceRegisterDevice()</a> .
in, out	<code>size</code> ↔ —	Pointer to size variable. On input: number of bytes to write. On output: may be updated by driver to reflect actual bytes written (driver-dependent).
in	<code>data</code> ↔ —	Pointer to data buffer allocated via <a href="#">xMemAlloc()</a> . Contains the data to write to the device.

**Returns**

`ReturnOK` if data was written successfully, `ReturnError` if the write failed (invalid UID, device not found, device in wrong state/mode, data not from heap, or driver write operation failed).

**See also**

[xDeviceRead\(\)](#) - Read data from a device  
[xDeviceSimpleWrite\(\)](#) - Write a single byte to a device  
[xDeviceRegisterDevice\(\)](#) - Register a device driver  
[xDeviceInitDevice\(\)](#) - Initialize a device  
[xDeviceConfigDevice\(\)](#) - Configure device state or parameters  
[xMemAlloc\(\)](#) - Allocate heap memory for write buffer  
[xMemFree\(\)](#) - Free the write buffer after use

#### 4.2.4.9 xDirClose() `xReturn` xDirClose ( `xDir` *dir\_* )

Closes a previously opened directory, freeing the directory handle and associated kernel resources. After closing, the directory handle becomes invalid and must not be used in any subsequent directory operations.

Always close directories when finished reading to free kernel resources and prevent resource leaks. Directory handles are limited, and failing to close them may prevent other directories from being opened.

##### Example 1: Basic directory listing with close

```
xDir dir;
xDirEntry entry;
if (OK(xDirOpen(&dir, vol, (xByte*)"/*"))) {
    while (OK(xDirRead(dir, &entry))) {
        printf("%s\n", entry.name);
    }
    // Always close when done
    xDirClose(dir);
}
```

##### Example 2: Error handling with guaranteed close

```
xReturn processDirectory(xVolume vol, const char *path) {
    xDir dir;
    xDirEntry entry;
    xReturn result = ReturnError;
    if (OK(xDirOpen(&dir, vol, (xByte*)path))) {
        while (OK(xDirRead(dir, &entry))) {
            if (processEntry(&entry)) {
                result = ReturnOK;
            }
        }
        // Close regardless of processing success/failure
        xDirClose(dir);
    }
    return result;
}
```

##### Parameters

in	<i>dir</i> ↔	Handle to the open directory to close. Must be a valid directory handle from <a href="#">xDirOpen()</a> . After closing, becomes invalid.
	—	

##### Returns

ReturnOK if close succeeded, ReturnError if close failed due to invalid directory handle or directory not open.

##### Warning

After calling [xDirClose\(\)](#), the directory handle becomes invalid and must not be used in any directory operations.

##### Note

It is good practice to set the directory handle to null after closing to prevent accidental use of an invalid handle.

##### See also

[xDirOpen\(\)](#) - Open directory for reading

[xDirRead\(\)](#) - Read directory entries

**4.2.4.10 xDirMake()** *xReturn* xDirMake (   
     *xVolume* volume\_,   
     const *xByte* \* path\_ )

Creates a new directory at the specified path. The parent directory must already exist. Use this function to organize files into a directory structure.

Example: Create directory and add file

```
if (OK(xDirMake(vol, (xByte*)"/logs"))) {
    xFile file;
    if (OK(xFileOpen(&file, vol, (xByte*)"/logs/system.log",
                    FS_MODE_WRITE | FS_MODE_CREATE))) {
        xFileWrite(file, 10, (xByte*)"Log start\n");
        xFileClose(file);
    }
}
```

#### Parameters

in	<i>volume_</i>	Handle to mounted volume.
in	<i>path_</i>	Path to new directory.

#### Returns

ReturnOK if directory created, ReturnError if failed (already exists, parent doesn't exist, or insufficient space).

#### Warning

Parent directory must exist. Create parent directories first if needed.

#### See also

[xDirRemove\(\)](#) - Delete empty directory

[xDirOpen\(\)](#) - Open directory

**4.2.4.11 xDirOpen()** *xReturn* xDirOpen (   
     *xDir* \* dir\_,   
     *xVolume* volume\_,   
     const *xByte* \* path\_ )

Opens a directory for reading its contents, creating a directory handle used to iterate through directory entries with [xDirRead\(\)](#). This is the first step in browsing directory contents, listing files, or searching for specific entries.

Opening a directory allocates kernel resources and positions the read pointer at the first entry. Use [xDirRead\(\)](#) to retrieve entries sequentially, [xDirRewind\(\)](#) to return to the beginning, and [xDirClose\(\)](#) to free resources when finished.

Directory reading workflow:

1. Open directory with [xDirOpen\(\)](#)
2. Read entries with [xDirRead\(\)](#) in a loop



3. Optionally rewind with `xDirRewind()` to re-read
4. Close with `xDirClose()` when finished

Common use cases:

- **File listing:** Display all files in a directory
- **File searching:** Find specific files by name or attributes
- **Directory scanning:** Process all files in directory
- **File counting:** Count files or calculate total size
- **Filtering:** Select files matching criteria

Example 1: List all files in directory

```
xVolume vol;
xDir dir;
xDirEntry entry;
if (OK(xDirOpen(&dir, vol, (xByte*)"/"))) {
    printf("Files in root directory:\n");
    while (OK(xDirRead(dir, &entry))) {
        if (entry.isDirectory) {
            printf("  [DIR]  %s\n", entry.name);
        } else {
            printf("  [FILE] %s (%lu bytes)\n", entry.name, entry.size);
        }
    }
    xDirClose(dir);
}
```

Example 2: Find specific file in directory

```
xBase findFileInDirectory(xVolume vol, const char *dirPath, const char *filename) {
    xDir dir;
    xDirEntry entry;
    xBase found = 0;
    if (OK(xDirOpen(&dir, vol, (xByte*)dirPath))) {
        while (OK(xDirRead(dir, &entry))) {
            if (strcmp((char*)entry.name, filename) == 0) {
                found = 1;
                break;
            }
        }
        xDirClose(dir);
    }
    return found;
}
```

Example 3: Calculate directory size

```
xWord calculateDirectorySize(xVolume vol, const char *path) {
    xDir dir;
    xDirEntry entry;
    xWord totalSize = 0;
    if (OK(xDirOpen(&dir, vol, (xByte*)path))) {
        while (OK(xDirRead(dir, &entry))) {
            if (!entry.isDirectory) {
                totalSize += entry.size;
            }
        }
        xDirClose(dir);
    }
    return totalSize;
}
```

Example 4: Count files by type

```
void countFileTypes(xVolume vol) {
    xDir dir;
    xDirEntry entry;
    xWord fileCount = 0, dirCount = 0;
    if (OK(xDirOpen(&dir, vol, (xByte*)"/"))) {
        while (OK(xDirRead(dir, &entry))) {
            if (entry.isDirectory) {
                dirCount++;
            } else {
                fileCount++;
            }
        }
        xDirClose(dir);
        printf("Files: %lu, Directories: %lu\n", fileCount, dirCount);
    }
}
```

**Parameters**

out	<i>dir_</i>	Pointer to xDir handle to be initialized. On success, this handle is used for reading directory entries and must be closed with <a href="#">xDirClose()</a> .
in	<i>volume_</i>	Handle to mounted volume containing the directory. Must be a valid volume from <a href="#">xFSMount()</a> .
in	<i>path_</i>	Pointer to null-terminated string containing directory path. Use "/" for root directory, or "/dirname" for subdirectories.

**Returns**

ReturnOK if directory opened successfully, ReturnError if open failed due to invalid volume, directory not found, path refers to a file, or insufficient resources.

**Warning**

The directory handle must be closed with [xDirClose\(\)](#) when finished. Failure to close directories causes resource leaks.

The path must refer to a directory, not a file. Opening a file path as a directory will fail.

**Note**

After opening, the read position is at the first entry. Use [xDirRead\(\)](#) to retrieve entries sequentially.

Directory handles are allocated from kernel memory and are a limited resource. Always close directories promptly after use.

**See also**

[xDirClose\(\)](#) - Close directory and free resources

[xDirRead\(\)](#) - Read next directory entry

[xDirRewind\(\)](#) - Reset to beginning of directory

[xFileGetInfo\(\)](#) - Get info about specific path

```
4.2.4.12 xDirRead() xReturn xDirRead (
    xDir dir_,
    xDirEntry * entry_ )
```

Retrieves the next entry from an open directory, advancing the read position. Entries are returned sequentially including both files and subdirectories. Use the isDirectory field in the returned entry to distinguish between them.

Reading continues until all entries have been retrieved. When no more entries are available, [xDirRead\(\)](#) returns ReturnError, indicating the end of the directory. Use [xDirRewind\(\)](#) to return to the beginning and re-read entries if needed.

**Example 1: Process all files (skip directories)**

```
xDir dir;
xDirEntry entry;
if (OK(xDirOpen(&dir, vol, (xByte\*)"/"))) {
    while (OK(xDirRead(dir, &entry))) {
        // Process only files, not directories
        if (!entry.isDirectory) {
```

```

        processFile(vol, (char*)entry.name);
    }
}
xDirClose(dir);
}

```

#### Example 2: Filter files by extension

```

xBase hasExtension(const char *filename, const char *ext) {
    const char *dot = strrchr(filename, '.');
    return (dot && strcmp(dot, ext) == 0);
}

void processLogFiles(xVolume vol) {
    xDir dir;
    xDirEntry entry;
    if (OK(xDirOpen(&dir, vol, (xByte*)"/")) {
        while (OK(xDirRead(dir, &entry)) {
            if (!entry.isDirectory && hasExtension((char*)entry.name, ".log")) {
                printf("Log file: %s (%lu bytes)\n", entry.name, entry.size);
            }
        }
        xDirClose(dir);
    }
}

```

#### Parameters

in	<i>dir_</i>	Handle to open directory from <a href="#">xDirOpen()</a> .
out	<i>entry</i> ↔ —	Pointer to xDirEntry structure to receive entry information.

#### Returns

ReturnOK if entry read successfully, ReturnError if no more entries (end of directory) or invalid directory handle.

#### Note

When [xDirRead\(\)](#) returns ReturnError, it indicates the end of the directory, not necessarily a read error. Use [xDirRewind\(\)](#) to return to the beginning and re-read entries.

#### See also

[xDirOpen\(\)](#) - Open directory for reading  
[xDirClose\(\)](#) - Close directory  
[xDirRewind\(\)](#) - Reset to beginning

**4.2.4.13 xDirRemove()** [xReturn](#) xDirRemove (  
     xVolume volume\_,  
     const xByte \* path\_ )

Removes an empty directory from the filesystem. The directory must be empty (contain no files or subdirectories) for the operation to succeed.

#### Example: Remove temporary directory

```

// Remove all files first
xDir dir;
xDirEntry entry;
if (OK(xDirOpen(&dir, vol, (xByte*)"/temp")) {
    while (OK(xDirRead(dir, &entry)) {

```

```
    if (!entry.isDirectory) {
        xByte path[256];
        snprintf((char*)path, sizeof(path), "/temp/%s", entry.name);
        xFileUnlink(vol, path);
    }
    xDirClose(dir);
}
// Now remove empty directory
xDirRemove(vol, (xByte*)"/temp");
```

## Parameters

in	<i>volume</i> ↔	Handle to mounted volume.
	—	
in	<i>path</i> —	Path to directory to remove.

## Returns

ReturnOK if directory removed, ReturnError if failed (not empty, doesn't exist, or is root directory).

## Warning

Directory must be empty. Remove all files and subdirectories first.

Cannot remove the root directory.

## See also

[xDirMake\(\)](#) - Create directory

[xFileUnlink\(\)](#) - Delete file

#### 4.2.4.14 xDirRewind() *xReturn* xDirRewind ( *xDir* *dir*— )

Resets the read position of an open directory back to the first entry, allowing the directory to be re-read from the start. This is useful when you need to make multiple passes through a directory without closing and reopening it.

Example: Count and then process files

```
xDir dir;
xDirEntry entry;
xWord fileCount = 0;
if (OK(xDirOpen(&dir, vol, (xByte*)"/")) {
    // First pass - count files
    while (OK(xDirRead(dir, &entry)) {
        if (!entry.isDirectory) {
            fileCount++;
        }
    }
    printf("Processing %lu files...\n", fileCount);
    // Rewind to beginning
    xDirRewind(dir);
    // Second pass - process files
    while (OK(xDirRead(dir, &entry)) {
        if (!entry.isDirectory) {
            processFile((char*)entry.name);
        }
    }
    xDirClose(dir);
}
```

## Parameters

in	<i>dir</i> ↔	Handle to open directory from <a href="#">xDirOpen()</a> .
	—	

### Returns

ReturnOK if rewind succeeded, ReturnError if invalid directory handle.

### See also

[xDirOpen\(\)](#) - Open directory

[xDirRead\(\)](#) - Read entries

[xDirClose\(\)](#) - Close directory

**4.2.4.15 xFileClose()** `xReturn xFileClose (`  
`xFile file_ )`

Closes a previously opened file, flushing any pending writes to storage and freeing the file handle and associated kernel resources. After closing, the file handle becomes invalid and must not be used in any subsequent file operations.

Closing a file ensures data integrity by committing all buffered writes to the filesystem and updating file metadata (size, modification time, etc.). Always close files when finished to prevent data loss and resource leaks.

Close process:

1. Flushes any buffered write data to block device
2. Updates file directory entry (size, attributes)
3. Updates File Allocation Table if file size changed
4. Frees file handle from kernel memory
5. Invalidates file handle

Common scenarios:

- **Normal completion:** Close file after successful read/write operations
- **Error handling:** Close file even if operations failed
- **Resource management:** Close files promptly to free kernel resources
- **Shutdown:** Close all open files before unmounting volume

### Example 1: Basic open/close pattern

```
xFile file;  
if (OK(xFileOpen(&file, vol, (xByte*)"/data.txt", FS_MODE_READ))) {  
    // Perform file operations  
    xByte *data;  
    if (OK(xFileRead(file, 100, &data))) {  
        processData(data, 100);  
        xMemFree((xAddr) data);  
    }  
    // Always close when done  
    xFileClose(file);  
    // file is now invalid - do not use  
}
```

### Example 2: Error handling with guaranteed close

```
xReturn writeData(xVolume vol, const char *path, xByte *data, xSize size) {  
    xFile file;
```

```

xReturn result = ReturnError;
if (OK(xFileOpen(&file, vol, (xByte*)path, FS_MODE_WRITE | FS_MODE_CREATE))) {
    if (OK(xFileWrite(file, size, data))) {
        result = ReturnOK;
    }
    // Close file regardless of write success/failure
    xFileClose(file);
}
return result;
}

```

### Example 3: Multiple file handling

```

void processFiles(xVolume vol) {
    xFile input, output;
    // Open input file
    if (OK(xFileOpen(&input, vol, (xByte*)"/input.dat", FS_MODE_READ))) {
        // Open output file
        if (OK(xFileOpen(&output, vol, (xByte*)"/output.dat",
            FS_MODE_WRITE | FS_MODE_CREATE))) {
            // Process data from input to output
            xByte *data;
            xWord size;
            if (OK(xFileGetSize(input, &size)) && OK(xFileRead(input, size, &data))) {
                xFileWrite(output, size, data);
                xMemFree((xAddr)data);
            }
            xFileClose(output); // Close output first
        }
        xFileClose(input); // Close input
    }
}

```

### Example 4: Safe file handle cleanup

```

xFile file = null;
void useFile(xVolume vol) {
    if (OK(xFileOpen(&file, vol, (xByte*)"/temp.dat", FS_MODE_WRITE))) {
        performOperations(file);
        // Close and nullify handle
        xFileClose(file);
        file = null; // Prevent use-after-close
    }
}

```

### Parameters

in	<i>file</i> ↔	Handle to the open file to close. Must be a valid file handle obtained from a previous successful <code>xFileOpen()</code> call. After closing, this handle becomes invalid.
	—	

### Returns

ReturnOK if close succeeded, ReturnError if close failed due to invalid file handle, file not open, or flush/write errors during close.

### Warning

After calling `xFileClose()`, the file handle becomes invalid and must not be used in any file operations. Attempting to use a closed file will result in ReturnError.

If `xFileClose()` fails (returns ReturnError), data may not have been fully written to storage. Consider using `xFileSync()` before close for critical data to detect write failures earlier.

All files must be closed before unmounting the volume. Unmounting with open files may cause data loss or filesystem corruption.

**Note**

It is good practice to set the file handle to null after closing to prevent accidental use of an invalid handle (use-after-close bugs).

Closing a file that was opened for writing commits the final file size to the directory entry. File size is updated only on close, not during write.

File handles are a limited resource. Always close files promptly after use to make handles available for other operations.

**See also**

[xFileOpen\(\)](#) - Open a file

[xFileSync\(\)](#) - Flush writes before close

[xFSUnmount\(\)](#) - Unmount volume (close all files first)

**4.2.4.16 xFileEOF()** `xReturn xFileEOF (`  
    `const xFile file_,`  
    `xBase * eof_ )`

Determines whether the current file position is at or beyond the end of the file, indicating that all data has been read and no more data is available. This is essential for implementing read loops that process entire files without knowing the file size in advance.

End-of-file (EOF) occurs when the file position equals or exceeds the file size. After reading the last byte of a file, subsequent reads will not advance the position further, and [xFileEOF\(\)](#) will return true. EOF is a normal condition, not an error.

EOF behavior:

- True when file position  $\geq$  file size
- False when more data available to read
- Not an error condition - indicates normal end of data
- Can occur mid-read if reading past end
- Unaffected by write operations that extend file

Common use cases:

- **Read loops:** Continue reading until EOF reached
- **Data validation:** Verify all expected data was read
- **Sequential processing:** Process file completely
- **Stream detection:** Know when to request more data



## Example 1: Read file in chunks until EOF

```

xFile file;
#define CHUNK_SIZE 512
void processEntireFile(xFile file) {
    xBase eof = 0;
    xByte *chunk;
    xWord totalBytesRead = 0;
    // Read until EOF
    while (!eof) {
        if (OK(xFileRead(file, CHUNK_SIZE, &chunk))) {
            processChunk(chunk, CHUNK_SIZE);
            totalBytesRead += CHUNK_SIZE;
            xMemFree((xAddr)chunk);
            // Check for EOF
            xFileEOF(file, &eof);
        } else {
            break; // Read error
        }
    }
    logInfo("Processed %lu bytes", totalBytesRead);
}

```

## Example 2: Validate file completely read

```

xReturn readAndValidate(xFile file, xWord expectedSize) {
    xByte *data;
    xBase eof;
    // Read expected amount
    if (OK(xFileRead(file, expectedSize, &data))) {
        processData(data, expectedSize);
        xMemFree((xAddr)data);
        // Verify we're at EOF (no extra data)
        if (OK(xFileEOF(file, &eof))) {
            if (eof) {
                return ReturnOK; // File size matches expected
            } else {
                logWarning("File has unexpected extra data");
                return ReturnError;
            }
        }
    }
    return ReturnError;
}

```

## Example 3: Copy file with EOF detection

```

xReturn copyFile(xFile source, xFile dest) {
    xBase eof = 0;
    xByte *buffer;
    while (!eof) {
        // Read chunk
        if (OK(xFileRead(source, 1024, &buffer))) {
            // Write to destination
            if (ERROR(xFileWrite(dest, 1024, buffer))) {
                xMemFree((xAddr)buffer);
                return ReturnError;
            }
            xMemFree((xAddr)buffer);
            // Check if source exhausted
            xFileEOF(source, &eof);
        } else {
            return ReturnError;
        }
    }
    return ReturnOK; // Complete file copied
}

```

## Example 4: Skip to end check

```

xBase atEndOfFile(xFile file) {
    xBase eof;
    if (OK(xFileEOF(file, &eof))) {
        return eof;
    }
    return 0;
}
// Usage in parsing
void parseRecords(xFile file) {
    while (!atEndOfFile(file)) {
        Record_t record;
        if (readRecord(file, &record)) {
            processRecord(&record);
        }
    }
}

```

## Parameters

in	<i>file</i> ↔ —	Handle to the open file. Must be a valid file from <a href="#">xFileOpen()</a> .
out	<i>eof</i> ↔ —	Pointer to variable receiving EOF status. Set to non-zero (true) if at end-of-file, zero (false) if more data available.

## Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid file handle or file not open.

## Note

EOF is determined by comparing file position to file size. Position equals size when all data has been read.

For files opened with FS\_MODE\_APPEND, EOF is initially true since position starts at end of file.

After reaching EOF, you can seek back to earlier positions with [xFileSeek\(\)](#) to reread data, which will clear the EOF condition.

Write operations that extend the file beyond the current position will clear the EOF condition.

## See also

- [xFileRead\(\)](#) - Read data (may reach EOF)
- [xFileGetSize\(\)](#) - Get file size to calculate EOF
- [xFileTell\(\)](#) - Get current position
- [xFileSeek\(\)](#) - Move position (may clear EOF)

**4.2.4.17 xFileExists()** `xReturn xFileExists (`  
`xVolume volume_,`  
`const xByte * path_,`  
`xBase * exists_ )`

Determines whether a file exists at the specified path on the mounted volume. This is useful for conditional file operations, avoiding errors when opening files, or checking for the presence of configuration or data files before attempting to access them.

The function searches the filesystem directory structure for an entry matching the specified path. It returns true if a file (not a directory) exists at that path, or false if the path does not exist or refers to a directory rather than a file.

Common use cases:

- **Conditional file access:** Open file only if it exists
- **Configuration detection:** Check for config files before loading
- **Backup verification:** Verify backup files exist before restore
- **File creation logic:** Create new file only if it doesn't exist
- **Validation:** Ensure required files are present

## Example 1: Open file only if it exists

```

xVolume vol;
xBase exists;
if (OK(xFileExists(vol, (xByte*)"/config.txt", &exists)) && exists) {
    // File exists - safe to open
    xFile file;
    if (OK(xFileOpen(&file, vol, (xByte*)"/config.txt", FS_MODE_READ))) {
        // Process file
        xFileClose(file);
    }
} else {
    // File doesn't exist - create default
    createDefaultConfig(vol);
}

```

## Example 2: Check multiple configuration sources

```

xReturn loadConfig(xVolume vol, Config_t *config) {
    xBase exists;
    const char *configPaths[] = {
        "/config.user.txt",
        "/config.default.txt",
        "/config.txt"
    };
    // Try each config file in priority order
    for (int i = 0; i < 3; i++) {
        if (OK(xFileExists(vol, (xByte*)configPaths[i], &exists)) && exists) {
            return loadConfigFromFile(vol, configPaths[i], config);
        }
    }
    // No config file found - use defaults
    return loadDefaultConfig(config);
}

```

## Example 3: Conditional file creation

```

xReturn ensureLogFile(xVolume vol) {
    xBase exists;
    // Check if log file exists
    if (OK(xFileExists(vol, (xByte*)"/system.log", &exists))) {
        if (!exists) {
            // Create new log file with header
            xFile logFile;
            if (OK(xFileOpen(&logFile, vol, (xByte*)"/system.log",
                FS_MODE_WRITE | FS_MODE_CREATE))) {
                const char *header = "=== System Log ===\n";
                xFileWrite(logFile, strlen(header), (xByte*)header);
                xFileClose(logFile);
                return ReturnOK;
            }
        } else {
            // Log file already exists
            return ReturnOK;
        }
    }
    return ReturnError;
}

```

## Example 4: Validate required files

```

xReturn validateRequiredFiles(xVolume vol) {
    const char *requiredFiles[] = {
        "/firmware.bin",
        "/config.dat",
        "/calibration.dat"
    };
    xBase exists;
    for (int i = 0; i < 3; i++) {
        if (ERROR(xFileExists(vol, (xByte*)requiredFiles[i], &exists)) || !exists) {
            logError("Required file missing: %s", requiredFiles[i]);
            return ReturnError;
        }
    }
    // All required files present
    return ReturnOK;
}

```

## Parameters

in	<i>volume</i> ↔ —	Handle to the mounted volume to search. Must be a valid volume from <code>xFSMount()</code> .
in	<i>path</i> _ —	Pointer to null-terminated string containing file path. Use forward slashes (/) for directory separators.
out	<i>exists</i> ↔ —	Pointer to variable receiving existence status. Set to non-zero (true) if file exists, zero (false) if not found or path refers to a directory.

### Returns

ReturnOK if query succeeded (regardless of whether file exists), ReturnError if query failed due to invalid volume handle or path.

### Note

This function returns true only for files, not directories. Use directory operations or [xFileGetInfo\(\)](#) to check for directory existence.

File paths are case-sensitive. "/File.txt" and "/file.txt" are different.

Checking for existence and then opening the file is not atomic. In multitasking systems, the file could be deleted between the check and open operations.

### See also

[xFileOpen\(\)](#) - Open file (fails if doesn't exist without CREATE flag)

[xFileGetInfo\(\)](#) - Get detailed file information including type

[xDirOpen\(\)](#) - Open directory

#### 4.2.4.18 xFileGetInfo() `xReturn xFileGetInfo (`

```
    xVolume volume_,  
    const xByte * path_,  
    xDirEntry * entry_ )
```

Retrieves comprehensive information about a file including its name, size, attributes (read-only, hidden, system), and whether it's a file or directory. This information is useful for file browsing, validation, or determining how to process a filesystem entry.

The returned DirEntry structure contains all metadata about the file as stored in the directory entry, without needing to open the file. This is more efficient than opening the file when you only need to inspect its properties.

Information provided in xDirEntry:

- **name:** File or directory name (up to 256 characters)
- **size:** File size in bytes (0 for directories)
- **firstCluster:** Starting cluster number on disk
- **isDirectory:** True if entry is a directory, false if file
- **isReadOnly:** True if file is marked read-only
- **isHidden:** True if file is marked hidden
- **isSystem:** True if file is marked as system file

Common use cases:

- **File browser:** Display file details in directory listings
- **Validation:** Check file attributes before processing
- **Filtering:** Select files based on attributes or size

- **Metadata inspection:** Examine file properties without opening

#### Example 1: Get file size without opening

```
xVolume vol;
xDirEntry entry;
if (OK(xFileGetInfo(vol, (xByte*)"data.bin", &entry))) {
    if (!entry.isDirectory) {
        logInfo("File size: %lu bytes", entry.size);
        // Check if file is too large for processing
        if (entry.size > MAX_FILE_SIZE) {
            logError("File too large to process");
        }
    }
}
```

#### Example 2: Check file type before opening

```
xReturn processPath(xVolume vol, const char *path) {
    xDirEntry entry;
    if (OK(xFileGetInfo(vol, (xByte*)path, &entry))) {
        if (entry.isDirectory) {
            // It's a directory - process directory
            return processDirectory(vol, path);
        } else {
            // It's a file - process file
            return processFile(vol, path);
        }
    }
    return ReturnError;
}
```

#### Example 3: Display file attributes

```
void displayFileInfo(xVolume vol, const char *path) {
    xDirEntry entry;
    if (OK(xFileGetInfo(vol, (xByte*)path, &entry))) {
        printf("Name: %s\n", entry.name);
        printf("Size: %lu bytes\n", entry.size);
        printf("Type: %s\n", entry.isDirectory ? "Directory" : "File");
        // Display attributes
        printf("Attributes:");
        if (entry.isReadOnly) printf(" [READ-ONLY]");
        if (entry.isHidden) printf(" [HIDDEN]");
        if (entry.isSystem) printf(" [SYSTEM]");
        printf("\n");
    }
}
```

#### Example 4: Filter files by size and attributes

```
xReturn findLargeFiles(xVolume vol, const char *dirPath, xWord minSize) {
    xDir dir;
    xDirEntry entry;
    if (OK(xDirOpen(&dir, vol, (xByte*)dirPath))) {
        while (OK(xDirRead(dir, &entry))) {
            // Skip directories and hidden files
            if (!entry.isDirectory && !entry.isHidden) {
                if (entry.size >= minSize) {
                    printf("Large file: %s (%lu bytes)\n", entry.name, entry.size);
                }
            }
        }
        xDirClose(dir);
        return ReturnOK;
    }
    return ReturnError;
}
```

#### Parameters

in	<i>volume</i> ↔ —	Handle to the mounted volume containing the file. Must be a valid volume from <a href="#">xFSMount()</a> .
in	<i>path</i> —	Pointer to null-terminated string containing path to file or directory. Use forward slashes (/) for separators.
out	<i>entry</i> ↔ —	Pointer to xDirEntry structure to receive file information. Structure is populated with all available metadata.

### Returns

ReturnOK if information retrieved successfully, ReturnError if operation failed due to invalid volume, file/directory not found, or path error.

### Note

This function works for both files and directories. Check the isDirectory field in the returned entry to determine which type it is.

The entry\_ structure is populated with a copy of the directory entry data. Changes to this structure do not affect the file on disk.

The size field is 0 for directories, as directories don't have data content in the same way files do.

### See also

[xFileExists\(\)](#) - Check if file exists (simpler boolean check)

[xDirRead\(\)](#) - Read directory entries sequentially

[xFileOpen\(\)](#) - Open file to access content

[xFileGetSize\(\)](#) - Get size of open file

**4.2.4.19 xFileGetSize()** `xReturn xFileGetSize (`  
    `const xFile file_,`  
    `xWord * size_ )`

Retrieves the total size of an open file in bytes. This is the number of bytes of actual data content in the file, not including any filesystem metadata or directory entries. File size is useful for validating file integrity, allocating read buffers, calculating progress, or checking available data.

The file size represents the current data content and may change as write operations extend the file. Size is updated dynamically during write operations but is only committed to the directory entry when the file is closed.

Size characteristics:

- Measured in bytes of actual file content
- Does not include filesystem metadata or overhead
- Updates as file is written and extended
- Committed to directory entry on [xFileClose\(\)](#)
- Zero for newly created empty files

Common use cases:

- **Buffer allocation:** Allocate exactly enough memory for file contents
- **Validation:** Verify file has expected size
- **Progress tracking:** Calculate percentage read/written
- **Bounds checking:** Ensure reads don't exceed file bounds

- **Empty file detection:** Check if size is zero

#### Example 1: Read entire file into memory

```
xFile file;
xReturn readEntireFile(xVolume vol, const char *path, xByte **fileData, xWord *size) {
    xFile file;
    if (OK(xFileOpen(&file, vol, (xByte*)path, FS_MODE_READ))) {
        // Get file size
        if (OK(xFileGetSize(file, size))) {
            // Read entire file
            if (OK(xFileRead(file, *size, fileData))) {
                xFileClose(file);
                return ReturnOK;
            }
        }
        xFileClose(file);
    }
    return ReturnError;
}

// Usage
xByte *data;
xWord dataSize;
if (OK(readEntireFile(vol, "/config.txt", &data, &dataSize))) {
    processData(data, dataSize);
    xMemFree((xAddr)data);
}
```

#### Example 2: Validate file size before processing

```
#define MIN_VALID_SIZE 100
#define MAX_VALID_SIZE 10000
xReturn processValidatedFile(xFile file) {
    xWord size;
    // Check file size is in valid range
    if (OK(xFileGetSize(file, &size))) {
        if (size < MIN_VALID_SIZE) {
            logError("File too small");
            return ReturnError;
        }
        if (size > MAX_VALID_SIZE) {
            logError("File too large");
            return ReturnError;
        }
        // Size valid - proceed with processing
        return processFile(file, size);
    }
    return ReturnError;
}
```

#### Example 3: Copy file with progress reporting

```
void copyFileWithProgress(xFile src, xFile dst) {
    xWord totalSize;
    xWord bytesProcessed = 0;
    xByte *buffer;
    xFileGetSize(src, &totalSize);
    while (bytesProcessed < totalSize) {
        xSize chunkSize = (totalSize - bytesProcessed > 512) ? 512 : (totalSize - bytesProcessed);
        if (OK(xFileRead(src, chunkSize, &buffer))) {
            xFileWrite(dst, chunkSize, buffer);
            xMemFree((xAddr)buffer);
            bytesProcessed += chunkSize;
            // Report progress
            xByte percent = (xByte)((bytesProcessed * 100) / totalSize);
            updateProgress(percent);
        } else {
            break;
        }
    }
}
```

#### Example 4: Check for empty file

```
xBase isFileEmpty(xFile file) {
    xWord size;
    if (OK(xFileGetSize(file, &size))) {
        return (size == 0) ? 1 : 0;
    }
    return 0;
}

// Usage
if (isFileEmpty(logFile)) {
    // File is empty - write header
    xFileWrite(logFile, strlen(HEADER), (xByte*)HEADER);
}
```

**Parameters**

in	<i>file</i> ↔	Handle to the open file. Must be a valid file from <a href="#">xFileOpen()</a> .
out	<i>size</i> ↔	Pointer to variable receiving the file size in bytes.
	—	

**Returns**

ReturnOK if query succeeded, ReturnError if query failed due to invalid file handle or file not open.

**Note**

The size returned is the current file content size. For files open for writing, the size may increase as write operations extend the file.

File size is independent of file position. You can get the size at any time without affecting the current read/write position.

The size reported is the logical file size (bytes of content), not the physical storage size (which may be larger due to cluster allocation).

**See also**

- [xFileSeek\(\)](#) - Position within file based on size
- [xFileTell\(\)](#) - Get current position (may equal size at EOF)
- [xFileEOF\(\)](#) - Check if at end of file
- [xFileRead\(\)](#) - Read file data
- [xFSGetVolumeInfo\(\)](#) - Get total volume space

**4.2.4.20 xFileOpen()** `xReturn xFileOpen (`  
    `xFile * file_,`  
    `xVolume volume_,`  
    `const xByte * path_,`  
    `const xByte mode_ )`

Opens a file for reading, writing, or both, creating a file handle used for subsequent file operations. The file can be opened in various modes controlling read/write access, creation behavior, and positioning. File paths use forward slash notation (/path/to/file.txt) following standard POSIX conventions.

Opening a file allocates kernel resources and establishes the connection between the application and the filesystem. The returned file handle must be used in all subsequent operations on that file and must be closed with [xFileClose\(\)](#) when finished to prevent resource leaks.

File open modes (can be combined with bitwise OR):

- **FS\_MODE\_READ (0x01)**: Open for reading. File must exist.
- **FS\_MODE\_WRITE (0x02)**: Open for writing. Truncates existing file to zero length.
- **FS\_MODE\_APPEND (0x04)**: Open for appending. Positions at end of file.



- **FS\_MODE\_CREATE (0x08)**: Create file if it doesn't exist. Combine with WRITE or APPEND.

Common mode combinations:

- Read-only: FS\_MODE\_READ
- Write (truncate): FS\_MODE\_WRITE
- Write (create if needed): FS\_MODE\_WRITE | FS\_MODE\_CREATE
- Append: FS\_MODE\_APPEND | FS\_MODE\_CREATE
- Read/Write: FS\_MODE\_READ | FS\_MODE\_WRITE

Path format:

- Use forward slashes: "/file.txt" or "/dir/subdir/file.dat"
- Root directory files: "/filename.ext"
- Subdirectory files: "/directory/filename.ext"
- Maximum path length: CONFIG\_FS\_MAX\_PATH\_LENGTH (default 256 characters)

Example 1: Read existing file

```
xVolume vol;
xFile file;
if (OK(xFSMount(&vol, blockDeviceUID))) {
    // Open file for reading
    if (OK(xFileOpen(&file, vol, (xByte*)"/config.txt", FS_MODE_READ))) {
        xByte *data;
        xWord fileSize;
        // Get file size and read all data
        if (OK(xFileGetSize(file, &fileSize))) {
            if (OK(xFileRead(file, fileSize, &data))) {
                processData(data, fileSize);
                xMemFree((xAddr)data);
            }
        }
        xFileClose(file);
    }
}
xFSUnmount(vol);
}
```

Example 2: Create and write new file

```
xVolume vol;
xFile file;
if (OK(xFSMount(&vol, deviceUID))) {
    // Open file for writing, create if doesn't exist
    if (OK(xFileOpen(&file, vol, (xByte*)"/data.bin",
        FS_MODE_WRITE | FS_MODE_CREATE))) {
        xByte buffer[128];
        generateData(buffer, sizeof(buffer));
        // Write data
        if (OK(xFileWrite(file, sizeof(buffer), buffer))) {
            // Data written successfully
        }
        xFileClose(file);
    }
}
xFSUnmount(vol);
}
```

Example 3: Append to log file

```
xVolume vol;
void logMessage(const char *message) {
    xFile logFile;
    // Open log file in append mode, create if doesn't exist
    if (OK(xFileOpen(&logFile, vol, (xByte*)"/system.log",
        FS_MODE_APPEND | FS_MODE_CREATE))) {
        xSize msgLen = strlen(message);
        xFileWrite(logFile, msgLen, (xByte*)message);
        xFileWrite(logFile, 1, (xByte*)"\n"); // Add newline
        xFileClose(logFile);
    }
}
```

```

}
}

```

#### Example 4: Update existing file (read/write)

```

xFile file;
// Open for both reading and writing
if (OK(xFileOpen(&file, vol, (xByte*)"counter.dat",
                FS_MODE_READ | FS_MODE_WRITE))) {
    xByte *data;
    xWord counter;
    // Read current value
    if (OK(xFileRead(file, sizeof(xWord), &data))) {
        counter = *(xWord*)data;
        xMemFree((xAddr)data);
        // Increment counter
        counter++;
        // Seek back to start and write new value
        xFileSeek(file, 0, FS_SEEK_SET);
        xFileWrite(file, sizeof(xWord), (xByte*)&counter);
    }
    xFileClose(file);
}

```

#### Parameters

out	<i>file_</i>	Pointer to xFile handle to be initialized. On success, this handle is used for all subsequent operations on the opened file. The handle remains valid until <a href="#">xFileClose()</a> is called.
in	<i>volume_</i> —	Handle to mounted volume containing the file. Must be a valid volume from <a href="#">xFSMount()</a> .
in	<i>path_</i>	Pointer to null-terminated string containing file path. Use forward slashes (/) for directory separators. Path is relative to volume root.
in	<i>mode_</i> —	File open mode flags. Combine flags with bitwise OR ( ). See FS_MODE_* constants for available modes.

#### Returns

ReturnOK if file opened successfully, ReturnError if open failed due to invalid volume, file not found (read mode without CREATE), insufficient space (create mode), invalid path, or too many open files.

#### Warning

The file handle must be closed with [xFileClose\(\)](#) when finished. Failure to close files causes resource leaks and may prevent other files from being opened.

Opening a file with FS\_MODE\_WRITE (without APPEND) truncates the file to zero length immediately, destroying existing content. Use FS\_MODE\_READ | FS\_MODE\_WRITE if you need to modify existing content without truncation.

File paths are case-sensitive. "/File.txt" and "/file.txt" are different files.

Do not attempt to open the same file multiple times simultaneously. This may cause data corruption or filesystem inconsistencies.

#### Note

File handles are allocated from kernel memory and limited by system resources. Always close files promptly after use.

When creating files with FS\_MODE\_CREATE, parent directories must already exist. Use [xDirMake\(\)](#) to create directories before creating files within them.

File position starts at 0 for READ and WRITE modes, and at end-of-file for APPEND mode. Use [xFileSeek\(\)](#) to change position after opening.

See also

- [xFileClose\(\)](#) - Close file and free resources
- [xFileRead\(\)](#) - Read data from file
- [xFileWrite\(\)](#) - Write data to file
- [xFileSeek\(\)](#) - Change file position
- [xFSMount\(\)](#) - Mount volume before opening files

**4.2.4.21 xFileRead()** `xReturn xFileRead (`  
    `xFile file_,`  
    `const xSize size_,`  
    `xByte ** data_ )`

Reads a specified number of bytes from the current file position, allocating memory to hold the retrieved data and advancing the file position. The caller is responsible for freeing the allocated memory with [xMemFree\(\)](#) after processing the data.

Reading retrieves data from the file starting at the current file position (initially 0, or set by [xFileSeek\(\)](#)). After a successful read, the file position advances by the number of bytes read, positioning for the next sequential read.

Memory allocation pattern:

- [xFileRead\(\)](#) allocates memory from user heap for the read data
- Caller receives pointer to allocated buffer via `data_` parameter
- Caller must call [xMemFree\(\)](#) after processing to prevent memory leaks
- Memory size equals the number of bytes successfully read

Read behavior:

- Reads up to `size_` bytes, may read fewer if EOF reached
- Returns actual bytes read (could be less than requested)
- File position advances by number of bytes read
- Reading past EOF returns 0 bytes
- Sequential reads retrieve consecutive file data

Common scenarios:

- **Full file read:** Get file size, read entire file in one call
- **Chunked reading:** Read file in smaller blocks to conserve memory
- **Partial reads:** Read specific portions using [xFileSeek\(\)](#)
- **Sequential processing:** Read file sequentially in fixed-size chunks

**Example 1: Read entire file**

```

xFile file;
if (OK(xFileOpen(&file, vol, (xByte*)"/config.txt", FS_MODE_READ))) {
    xWord fileSize;
    xByte *data;
    // Get file size
    if (OK(xFileGetSize(file, &fileSize))) {
        // Read all data
        if (OK(xFileRead(file, fileSize, &data))) {
            // Process data
            parseConfig(data, fileSize);
            // Always free allocated memory
            xMemFree((xAddr)data);
        }
    }
    xFileClose(file);
}

```

**Example 2: Read file in chunks**

```

xFile file;
#define CHUNK_SIZE 512
void processLargeFile(xFile file) {
    xBase eof = 0;
    xByte *chunk;
    // Read until end of file
    while (!eof) {
        if (OK(xFileRead(file, CHUNK_SIZE, &chunk))) {
            // Process this chunk
            processChunk(chunk, CHUNK_SIZE);
            xMemFree((xAddr)chunk);
            // Check if reached EOF
            xFileEOF(file, &eof);
        } else {
            break;
        }
    }
}

```

**Example 3: Read specific portion of file**

```

xFile file;
// Read 100 bytes starting at offset 500
xReturn readFileSection(xFile file, xWord offset, xSize count, xByte **data) {
    // Seek to desired position
    if (ERROR(xFileSeek(file, offset, FS_SEEK_SET))) {
        return ReturnError;
    }
    // Read data from that position
    if (ERROR(xFileRead(file, count, data))) {
        return ReturnError;
    }
    return ReturnOK;
}
// Usage
xByte *sectionData;
if (OK(readFileSection(file, 500, 100, &sectionData))) {
    processData(sectionData, 100);
    xMemFree((xAddr)sectionData);
}

```

**Example 4: Read with EOF detection**

```

xFile file;
void copyFileData(xFile srcFile, xFile dstFile) {
    xByte *buffer;
    xBase eof;
    do {
        // Read chunk from source
        if (OK(xFileRead(srcFile, 1024, &buffer))) {
            // Write to destination
            xFileWrite(dstFile, 1024, buffer);
            xMemFree((xAddr)buffer);
        }
        // Check if source EOF reached
        xFileEOF(srcFile, &eof);
    } while (!eof);
}

```

**Parameters**

in	<i>file</i> ↵ —	Handle to the open file to read from. Must be a valid file opened with FS_MODE_READ permission.
in	<i>size</i> ↵ —	Number of bytes to read from file. Actual bytes read may be less if end-of-file is reached before size_ bytes are available.

## Parameters

out	<i>data</i> ↔	Pointer to variable receiving address of newly allocated buffer containing the read data. Memory is allocated from user heap and must be freed with <a href="#">xMemFree()</a> after use.
	—	

## Returns

ReturnOK if read succeeded (even if fewer than *size\_* bytes read), ReturnError if read failed due to invalid file handle, file not open for reading, memory allocation failure, or device read error.

## Warning

The memory allocated for *data\_* MUST be freed by the caller using [xMemFree\(\)](#) after processing. Failure to free this memory will cause a memory leak. Always pair [xFileRead\(\)](#) with [xMemFree\(\)](#) in your code.

The file must have been opened with FS\_MODE\_READ permission. Attempting to read from a write-only file will fail.

[xFileRead\(\)](#) may return fewer bytes than requested if EOF is reached. Check actual data size or use [xFileEOF\(\)](#) to detect end-of-file condition.

## Note

After a successful read, the file position advances by the number of bytes read. Subsequent reads continue from the new position.

Reading 0 bytes or reading past EOF is not an error—it returns ReturnOK with zero bytes allocated. Always check the actual bytes read.

For large files, consider reading in chunks rather than loading the entire file into memory to conserve heap space.

## See also

[xFileWrite\(\)](#) - Write data to file  
[xFileSeek\(\)](#) - Change file position before reading  
[xFileGetSize\(\)](#) - Get total file size  
[xFileEOF\(\)](#) - Check if end-of-file reached  
[xMemFree\(\)](#) - Free memory allocated by [xFileRead\(\)](#)  
[xFileOpen\(\)](#) - Open file with read permission

**4.2.4.22 xFileRename()** `xReturn xFileRename (`  
`xVolume volume_,`  
`const xByte * oldPath_,`  
`const xByte * newPath_ )`

Changes the name and/or location of a file within the filesystem. This operation can rename a file in the same directory or move it to a different directory with an optional new name. The file content and attributes are preserved; only the directory entry is updated.

Rename is an atomic operation that updates the directory structure without copying file data. This makes it efficient even for large files. The file must not be open during the rename operation.

Rename capabilities:

- Rename file in same directory: "/file.txt" → "/newname.txt"
- Move file to different directory: "/file.txt" → "/backup/file.txt"
- Move and rename: "/old.txt" → "/archive/new.txt"
- Preserves file content and attributes
- Efficient (no data copying required)

Common use cases:

- **Versioning:** Rename old file before creating new version
- **Organization:** Move files to appropriate directories
- **Backup:** Rename file to indicate backup or archive status
- **Atomic updates:** Write new file, rename old, rename new to final name
- **Temporary files:** Rename temp file to final name after completion

#### Example 1: Simple rename in same directory

```
xVolume vol;
xReturn renameLogFile(void) {
    xBase exists;
    // Check if current log exists
    if (OK(xFileExists(vol, (xByte*)"/system.log", &exists)) && exists) {
        // Rename to backup
        if (OK(xFileRename(vol, (xByte*)"/system.log", (xByte*)"/system.log.old"))) {
            logInfo("Log file renamed for archival");
            return ReturnOK;
        }
    }
    return ReturnError;
}
```

#### Example 2: Log rotation with multiple versions

```
void rotateLogs(xVolume vol) {
    xBase exists;
    // Rotate log.2 → log.3 (delete log.3 if exists)
    if (OK(xFileExists(vol, (xByte*)"/log.3", &exists)) && exists) {
        xFileUnlink(vol, (xByte*)"/log.3");
    }
    if (OK(xFileExists(vol, (xByte*)"/log.2", &exists)) && exists) {
        xFileRename(vol, (xByte*)"/log.2", (xByte*)"/log.3");
    }
    // Rotate log.1 → log.2
    if (OK(xFileExists(vol, (xByte*)"/log.1", &exists)) && exists) {
        xFileRename(vol, (xByte*)"/log.1", (xByte*)"/log.2");
    }
    // Rotate current → log.1
    if (OK(xFileExists(vol, (xByte*)"/system.log", &exists)) && exists) {
        xFileRename(vol, (xByte*)"/system.log", (xByte*)"/log.1");
    }
}
```

#### Example 3: Atomic file replacement

```
xReturn atomicConfigUpdate(xVolume vol, xByte *newConfig, xSize size) {
    xFile tmpFile;
    // Write to temporary file first
    if (OK(xFileOpen(&tmpFile, vol, (xByte*)"/config.tmp",
        FS_MODE_WRITE | FS_MODE_CREATE))) {
        if (OK(xFileWrite(tmpFile, size, newConfig))) {
            xFileSync(tmpFile); // Ensure written to disk
            xFileClose(tmpFile);
            // Rename old config to backup
            xBase exists;
            if (OK(xFileExists(vol, (xByte*)"/config.dat", &exists)) && exists) {
                xFileRename(vol, (xByte*)"/config.dat", (xByte*)"/config.bak");
            }
            // Rename temp to final name
            if (OK(xFileRename(vol, (xByte*)"/config.tmp", (xByte*)"/config.dat"))) {
                return ReturnOK; // Atomic update successful
            }
        }
    }
    return ReturnError;
}
```

```

        xFileClose(tmpFile);
    }
}
return ReturnError;
}

```

#### Example 4: Move file to archive directory

```

xReturn archiveOldData(xVolume vol, const char *filename) {
    xByte oldPath[256];
    xByte newPath[256];
    xBase exists;
    // Build paths
    snprintf((char*)oldPath, sizeof(oldPath), "%s", filename);
    snprintf((char*)newPath, sizeof(newPath), "/archive/%s", filename);
    // Check if file exists
    if (OK(xFileExists(vol, oldPath, &exists)) && exists) {
        // Move to archive directory
        if (OK(xFileRename(vol, oldPath, newPath))) {
            logInfo("Archived: %s", filename);
            return ReturnOK;
        }
    }
    return ReturnError;
}

```

#### Parameters

in	<i>volume</i> ↔ —	Handle to the mounted volume containing the file. Must be a valid volume from <a href="#">xFSMount()</a> .
in	<i>oldPath</i> ↔ —	Pointer to null-terminated string containing current file path. The file must exist at this location.
in	<i>newPath</i> ↔ Path_	Pointer to null-terminated string containing new file path. If a file already exists at this path, the operation fails.

#### Returns

ReturnOK if file renamed successfully, ReturnError if rename failed due to invalid volume, source file not found, destination file already exists, file is open, or filesystem error.

#### Warning

The file must not be open during rename. Close all file handles before calling [xFileRename\(\)](#). Renaming an open file will fail.

If a file already exists at newPath\_, the rename operation will fail. Delete the existing destination file first if you want to replace it.

Both paths must be on the same volume. You cannot use rename to move files between different volumes or storage devices.

The destination directory must exist. Create directories with [xDirMake\(\)](#) before moving files into them.

#### Note

Rename is very efficient since it only updates directory entries without copying file data, regardless of file size. File attributes and content are preserved during rename.

#### See also

- [xFileExists\(\)](#) - Check if source/destination exists
- [xFileUnlink\(\)](#) - Delete file instead of renaming
- [xFileClose\(\)](#) - Close file before renaming
- [xDirMake\(\)](#) - Create destination directory

**4.2.4.23 xFileSeek()** *xReturn* xFileSeek (

```

    xFile file_,
    const xWord offset_,
    const xByte origin_ )

```

Moves the file position indicator to a new location within the file, controlling where subsequent read or write operations will occur. The file position can be set relative to the beginning of the file, the current position, or the end of the file using the origin parameter.

File positioning is essential for random access operations, allowing applications to read or write specific portions of a file without processing the entire file sequentially. The position is measured in bytes from the specified origin point.

Seek origins (defined in fs.h):

- **FS\_SEEK\_SET (0):** Offset from beginning of file. offset\_ is absolute position.
- **FS\_SEEK\_CUR (1):** Offset from current position. offset\_ is relative (can be negative).
- **FS\_SEEK\_END (2):** Offset from end of file. offset\_ is typically 0 or negative.

Common positioning operations:

- **Rewind to start:** xFileSeek(file, 0, FS\_SEEK\_SET)
- **Jump to end:** xFileSeek(file, 0, FS\_SEEK\_END)
- **Skip forward:** xFileSeek(file, 100, FS\_SEEK\_CUR)
- **Skip backward:** xFileSeek(file, -50, FS\_SEEK\_CUR)
- **Absolute position:** xFileSeek(file, 1000, FS\_SEEK\_SET)

Common scenarios:

- **Read file header then skip to data:** Seek past header to data section
- **Update specific record:** Seek to record position, write new data
- **Append detection:** Seek to end to get file size
- **Reread data:** Seek back to previous position

Example 1: Read file header and data separately

```

xFile file;
typedef struct {
    xWord magic;
    xWord version;
    xWord dataOffset;
} FileHeader_t;
if (OK(xFileOpen(&file, vol, (xByte*)"/data.bin", FS_MODE_READ))) {
    xByte *headerData;
    FileHeader_t *header;
    // Read header at beginning
    if (OK(xFileRead(file, sizeof(FileHeader_t), &headerData))) {
        header = (FileHeader_t*)headerData;
        // Validate and seek to data section
        if (header->magic == 0xDEADBEEF) {
            xFileSeek(file, header->dataOffset, FS_SEEK_SET);
            // Read data from new position
            xByte *data;
            xFileRead(file, 1024, &data);
            xMemFree((xAddr)data);
        }
        xMemFree((xAddr)headerData);
    }
}

```



```

    xFileClose(file);
}

```

#### Example 2: Update specific record in file

```

typedef struct {
    xWord id;
    xByte status;
    xByte data[64];
} Record_t;
xReturn updateRecord(xFile file, xWord recordIndex, Record_t *newRecord) {
    xWord recordOffset = recordIndex * sizeof(Record_t);
    // Seek to record position
    if (ERROR(xFileSeek(file, recordOffset, FS_SEEK_SET))) {
        return ReturnError;
    }
    // Write updated record
    return xFileWrite(file, sizeof(Record_t), (xByte*)newRecord);
}

```

#### Example 3: Get file size using seek to end

```

xWord getFileSize(xFile file) {
    xWord size;
    xWord currentPos;
    // Save current position
    xFileTell(file, &currentPos);
    // Seek to end and get position (which equals file size)
    xFileSeek(file, 0, FS_SEEK_END);
    xFileTell(file, &size);
    // Restore original position
    xFileSeek(file, currentPos, FS_SEEK_SET);
    return size;
}

```

#### Example 4: Skip chunks when processing

```

xFile file;
#define CHUNK_SIZE 512
#define CHUNK_GAP 128
void processAlternateChunks(xFile file) {
    xByte *chunk;
    xBase eof = 0;
    while (!eof) {
        // Read chunk
        if (OK(xFileRead(file, CHUNK_SIZE, &chunk))) {
            processChunk(chunk, CHUNK_SIZE);
            xMemFree((xAddr)chunk);
            // Skip gap to next chunk
            xFileSeek(file, CHUNK_GAP, FS_SEEK_CUR);
            xFileEOF(file, &eof);
        } else {
            break;
        }
    }
}

```

#### Parameters

in	<i>file</i>	Handle to the open file. Must be a valid file from <code>xFileOpen()</code> .
in	<i>offset</i> ↔ _	Number of bytes to offset from origin. Can be positive or negative depending on origin. For <code>FS_SEEK_SET</code> , must be $\geq 0$ .
in	<i>origin</i> ↔ _	Reference point for offset. Use <code>FS_SEEK_SET</code> for absolute position, <code>FS_SEEK_CUR</code> for relative to current, <code>FS_SEEK_END</code> for relative to end of file.

#### Returns

ReturnOK if seek succeeded, ReturnError if seek failed due to invalid file handle, invalid origin value, or resulting position would be before start of file or beyond reasonable file bounds.

#### Warning

Seeking beyond the end of the file and then writing creates a sparse file with undefined data in the gap. The gap will contain whatever data was previously in those disk sectors.

Some seek operations may fail if they would position before the start of the file (negative absolute position).

**Note**

After a seek operation, the next read or write occurs at the new position. The position indicator is updated immediately.

Seeking does not change the file size. Only writing beyond the current end-of-file extends the file.

For FS\_SEEK\_CUR, offset\_ can be negative to move backwards, or positive to move forwards from the current position.

**See also**

[xFileTell\(\)](#) - Get current file position  
[xFileGetSize\(\)](#) - Get file size without seeking  
[xFileRead\(\)](#) - Read from current position  
[xFileWrite\(\)](#) - Write at current position  
[xFileEOF\(\)](#) - Check if at end of file

**4.2.4.24 xFileSync()** `xReturn xFileSync (`  
`xFile file_ )`

Forces any buffered write data for the file to be written to the underlying storage device immediately, ensuring data persistence. This operation updates the file's directory entry and File Allocation Table (FAT) to reflect the current file size and cluster allocation.

Normally, write operations are buffered and only committed to storage when [xFileClose\(\)](#) is called. For critical data that must survive system failures or power loss, call [xFileSync\(\)](#) explicitly to guarantee the data is physically written to the storage device.

Sync ensures:

- All buffered write data is written to storage
- Directory entry is updated with current file size
- FAT is updated with current cluster allocation
- Data is persistent even if system crashes after sync
- File remains open for continued operations

When to use sync:

- **Critical data:** Financial transactions, configuration changes
- **Checkpointing:** Periodic saves during long operations
- **Error detection:** Verify writes succeeded before continuing
- **Power-loss protection:** Ensure data written before risky operations
- **Real-time logging:** Guarantee log entries are stored immediately

**Example 1: Write critical configuration with sync**

```
xReturn saveConfig(xVolume vol, xByte *configData, xSize dataSize) {
    xFile file;
    if (OK(xFileOpen(&file, vol, (xByte*)"config.dat",
                    FS_MODE_WRITE | FS_MODE_CREATE))) {
        // Write configuration data
        if (OK(xFileWrite(file, dataSize, configData))) {
            // Force write to storage before continuing
            if (OK(xFileSync(file))) {
                // Data guaranteed on disk
                xFileClose(file);
                return ReturnOK;
            } else {
                // Sync failed - data may be lost
                xFileClose(file);
                return ReturnError;
            }
        }
        xFileClose(file);
    }
    return ReturnError;
}
```

**Example 2: Periodic checkpointing during long write**

```
xFile dataFile;
#define CHECKPOINT_INTERVAL 10
void processLargeDataset(xByte *dataset, xWord recordCount) {
    xWord i;
    for (i = 0; i < recordCount; i++) {
        // Write record
        xFileWrite(dataFile, RECORD_SIZE, &dataset[i * RECORD_SIZE]);
        // Checkpoint every N records
        if ((i % CHECKPOINT_INTERVAL) == 0) {
            if (OK(xFileSync(dataFile))) {
                logInfo("Checkpoint at record %lu", i);
            } else {
                logError("Checkpoint failed - aborting");
                break;
            }
        }
    }
}
```

**Example 3: Real-time event logging**

```
xFile eventLog;
void logCriticalEvent(const char *eventMsg) {
    xSize msgLen = strlen(eventMsg);
    // Write event
    xFileWrite(eventLog, msgLen, (xByte*)eventMsg);
    xFileWrite(eventLog, 1, (xByte*)"\n");
    // Force immediate write to storage
    if (ERROR(xFileSync(eventLog))) {
        // Could not guarantee persistence
        handleLogFailure();
    }
    // Event now safely on disk
}
```

**Example 4: Transaction-style write with rollback**

```
xReturn atomicUpdate(xFile file, xByte *newData, xSize dataSize) {
    xWord originalPos;
    xWord originalSize;
    // Save state for rollback
    xFileTell(file, &originalPos);
    xFileGetSize(file, &originalSize);
    // Attempt write
    if (OK(xFileWrite(file, dataSize, newData))) {
        // Try to commit
        if (OK(xFileSync(file))) {
            return ReturnOK; // Success - data committed
        } else {
            // Sync failed - truncate back to original size
            xFileTruncate(file, originalSize);
            xFileSeek(file, originalPos, FS_SEEK_SET);
            return ReturnError;
        }
    }
    return ReturnError;
}
```

**Parameters**

in	<i>file</i> ↔ —	Handle to the open file to sync. Must be a valid file opened with write permission (FS_MODE_WRITE or FS_MODE_APPEND).
----	--------------------	---

**Returns**

ReturnOK if sync succeeded, ReturnError if sync failed due to invalid file handle, file not open for writing, or device write errors during flush operation.

**Warning**

Sync operations involve multiple disk writes (data, FAT, directory entry) and may take significant time, especially on slow storage devices. Use sync judiciously to balance data safety with performance.

If [xFileSync\(\)](#) returns ReturnError, some data may have been written but the filesystem may be in an inconsistent state. Close and reopen the file or check filesystem integrity.

**Note**

[xFileSync\(\)](#) does NOT close the file. After sync completes, the file remains open and can be used for additional read or write operations.

Calling [xFileClose\(\)](#) automatically performs a sync before closing, so explicit [xFileSync\(\)](#) is not required at the end of normal file operations.

For read-only files, [xFileSync\(\)](#) has no effect and returns ReturnOK immediately.

**See also**

[xFileWrite\(\)](#) - Write data that may be buffered until sync

[xFileClose\(\)](#) - Close file (automatically syncs)

[xFileTruncate\(\)](#) - Change file size

**4.2.4.25 xFileTell()** `xReturn xFileTell (`  
     `const xFile file_,`  
     `xWord * position_ )`

Retrieves the current byte offset of the file position indicator, which indicates where the next read or write operation will occur. The position is measured in bytes from the beginning of the file, with 0 representing the first byte.

The file position changes automatically after read and write operations, and can be explicitly set with [xFileSeek\(\)](#). Knowing the current position is useful for saving and restoring read/write locations, calculating how much data has been processed, or implementing custom file navigation.

Position characteristics:

- Measured in bytes from beginning of file (0-based)
- Advances automatically after read/write operations
- Can be set explicitly with [xFileSeek\(\)](#)

- Equals file size when at end-of-file
- Starts at 0 for READ/WRITE modes, at EOF for APPEND mode

Common use cases:

- **Save/restore position:** Remember position to return later
- **Progress tracking:** Monitor how much of file has been processed
- **Size calculation:** Position after seek-to-end equals file size
- **Offset calculation:** Compute relative offsets for records

#### Example 1: Save and restore file position

```
xFile file;
xWord savedPosition;
// Save current position
xFileTell(file, &savedPosition);
// Perform some operation that changes position
xFileSeek(file, 0, FS_SEEK_SET);
xByte *header;
xFileRead(file, 64, &header);
processHeader(header);
xMemFree((xAddr)header);
// Restore original position
xFileSeek(file, savedPosition, FS_SEEK_SET);
// Continue from where we left off
xByte *data;
xFileRead(file, 512, &data);
xMemFree((xAddr)data);
```

#### Example 2: Track read progress

```
xFile file;
xWord fileSize;
xWord currentPos;
xFileGetSize(file, &fileSize);
while (1) {
    xByte *chunk;
    if (OK(xFileRead(file, 1024, &chunk))) {
        processChunk(chunk, 1024);
        xMemFree((xAddr)chunk);
        // Show progress
        xFileTell(file, &currentPos);
        xByte percent = (xByte)((currentPos * 100) / fileSize);
        updateProgressBar(percent);
        if (currentPos >= fileSize) break;
    } else {
        break;
    }
}
```

#### Example 3: Record file offset of data sections

```
typedef struct {
    xWord sectionOffset;
    xWord sectionSize;
} SectionInfo_t;
SectionInfo_t sections[10];
xByte sectionCount = 0;
void indexFileSections(xFile file) {
    xByte *sectionHeader;
    while (sectionCount < 10) {
        // Record where this section starts
        xFileTell(file, &sections[sectionCount].sectionOffset);
        // Read section header to get size
        if (OK(xFileRead(file, 4, &sectionHeader))) {
            sections[sectionCount].sectionSize = *(xWord*)sectionHeader;
            xMemFree((xAddr)sectionHeader);
            // Skip to next section
            xFileSeek(file, sections[sectionCount].sectionSize, FS_SEEK_CUR);
            sectionCount++;
        } else {
            break;
        }
    }
}
```

**Parameters**

in	<i>file_</i>	Handle to the open file. Must be a valid file from <a href="#">xFileOpen()</a> .
out	<i>position_</i>	Pointer to variable receiving the current file position in bytes. Position 0 is the first byte of the file.

**Returns**

ReturnOK if query succeeded, ReturnError if query failed due to invalid file handle or file not open.

**Note**

The position returned is always measured from the beginning of the file, regardless of how the file was opened or what seek operations were used.

When a file is first opened with FS\_MODE\_APPEND, [xFileTell\(\)](#) will return the file size (position is at end of file).

The position advances after each read/write by the number of bytes transferred.

**See also**

- [xFileSeek\(\)](#) - Change file position
- [xFileGetSize\(\)](#) - Get total file size
- [xFileEOF\(\)](#) - Check if at end of file
- [xFileRead\(\)](#) - Read from current position
- [xFileWrite\(\)](#) - Write at current position

**4.2.4.26 xFileTruncate()** `xReturn xFileTruncate (`  
`xFile file_,`  
`const xWord size_ )`

Changes the size of an open file to the specified number of bytes, either extending the file with undefined data or truncating it by discarding data beyond the new size. This operation allows precise control over file size independent of write operations.

Truncation behavior:

- If new size < current size: File is shortened, data beyond new size is lost
- If new size > current size: File is extended, gap filled with undefined data
- If new size == current size: No change, operation succeeds
- File position is preserved if still valid after truncation
- Freed clusters are returned to filesystem free space

Common use cases:

- **Preallocate space:** Extend file to reserve disk space before writing

- **Remove trailing data:** Truncate to exact data size
- **Rollback writes:** Shorten file to previous checkpoint
- **Clear file:** Truncate to zero to erase all content
- **Fixed-size files:** Ensure file is exact required size

#### Example 1: Truncate file to zero (clear contents)

```
xFile file;
xReturn clearFile(xVolume vol, const char *path) {
    xFile file;
    // Open for writing
    if (OK(xFileOpen(&file, vol, (xByte*)path, FS_MODE_WRITE))) {
        // Truncate to zero bytes
        if (OK(xFileTruncate(file, 0))) {
            xFileClose(file);
            return ReturnOK;
        }
        xFileClose(file);
    }
    return ReturnError;
}
```

#### Example 2: Preallocate file space

```
#define PREALLOCATE_SIZE (100 * 1024) // 100 KB
xReturn createPreallocatedFile(xVolume vol, const char *path) {
    xFile file;
    // Create new file
    if (OK(xFileOpen(&file, vol, (xByte*)path, FS_MODE_WRITE | FS_MODE_CREATE))) {
        // Preallocate space
        if (OK(xFileTruncate(file, PREALLOCATE_SIZE))) {
            // Space reserved - reset position to start
            xFileSeek(file, 0, FS_SEEK_SET);
            xFileClose(file);
            return ReturnOK;
        }
        xFileClose(file);
    }
    return ReturnError;
}
```

#### Example 3: Trim file to actual data size

```
xFile file;
void trimLogFile(xFile file, xWord actualDataSize) {
    xWord currentSize;
    // Get current file size
    if (OK(xFileGetSize(file, &currentSize))) {
        if (currentSize > actualDataSize) {
            // File is larger than needed - truncate excess
            xFileTruncate(file, actualDataSize);
            logInfo("Trimmed %lu bytes from log file", currentSize - actualDataSize);
        }
    }
}
```

#### Example 4: Rollback to checkpoint

```
xFile dataFile;
xWord checkpointSize;
void saveCheckpoint(xFile file) {
    // Save current size as checkpoint
    xFileGetSize(file, &checkpointSize);
}
void rollbackToCheckpoint(xFile file) {
    xWord currentSize;
    xFileGetSize(file, &currentSize);
    if (currentSize > checkpointSize) {
        // Discard data written after checkpoint
        if (OK(xFileTruncate(file, checkpointSize))) {
            xFileSeek(file, checkpointSize, FS_SEEK_SET);
            logInfo("Rolled back to checkpoint");
        }
    }
}
```

#### Parameters

in	<i>file</i> ↔ _	Handle to the open file to resize. Must be a valid file opened with write permission (FS_MODE_WRITE or FS_MODE_APPEND).
in	<i>size</i> ↔	New file size in bytes. Can be larger (extend) or smaller (truncate) than current size.

### Returns

ReturnOK if truncate succeeded, ReturnError if operation failed due to invalid file handle, file not open for writing, insufficient disk space (for extension), or FAT update errors.

### Warning

Truncating a file to a smaller size permanently deletes data beyond the new size. This data cannot be recovered. Ensure the new size is correct before calling this function.

If extending a file, the gap between the old size and new size contains undefined data (whatever was previously in those disk sectors). Do not rely on gap data being zero or any specific value.

The file position is not changed by truncation unless it exceeds the new file size, in which case it is clamped to the new size.

### Note

Truncating to zero is an efficient way to clear a file while keeping it open.

Extending a file with `xFileTruncate()` allocates disk space but does not initialize the new space with any specific values.

The new file size is committed when `xFileClose()` or `xFileSync()` is called.

### See also

`xFileGetSize()` - Query current file size

`xFileWrite()` - Write data (changes size automatically)

`xFileSeek()` - Change file position

`xFileSync()` - Commit size change to storage

`xFileClose()` - Close file and commit size

**4.2.4.27 xFileUnlink()** `xReturn` xFileUnlink (   
 `xVolume` volume\_,   
 const `xByte` \* path\_ )

Removes a file from the filesystem, freeing its disk space and removing its directory entry. This operation is permanent—deleted files cannot be recovered. The file must not be open when deleted; close all file handles before calling `xFileUnlink()`.

Deletion process:

- Removes file's directory entry
- Marks file's clusters as free in FAT
- Returns disk space to available pool
- Operation is permanent and irreversible

Common scenarios:

- **Temporary file cleanup:** Remove temporary or cache files



- **Old log removal:** Delete old log files to free space
- **File replacement:** Delete old file before writing new version
- **Error recovery:** Remove corrupted or incomplete files
- **Space management:** Delete unnecessary files to reclaim storage

#### Example 1: Delete temporary file

```
xVolume vol;
void cleanupTempFile(void) {
    xBase exists;
    // Check if temp file exists
    if (OK(xFileExists(vol, (xByte*)"/temp.dat", &exists)) && exists) {
        // Delete temp file
        if (OK(xFileUnlink(vol, (xByte*)"/temp.dat"))) {
            logInfo("Temp file deleted");
        }
    }
}
```

#### Example 2: Replace file with new version

```
xReturn updateConfigFile(xVolume vol, xByte *newConfig, xSize size) {
    xBase exists;
    // Check if old config exists
    if (OK(xFileExists(vol, (xByte*)"/config.dat", &exists)) && exists) {
        // Delete old version
        if (ERROR(xFileUnlink(vol, (xByte*)"/config.dat"))) {
            return ReturnError;
        }
    }
    // Write new config
    xFile file;
    if (OK(xFileOpen(&file, vol, (xByte*)"/config.dat",
                    FS_MODE_WRITE | FS_MODE_CREATE))) {
        xFileWrite(file, size, newConfig);
        xFileClose(file);
        return ReturnOK;
    }
    return ReturnError;
}
```

#### Example 3: Delete old log files to free space

```
void cleanOldLogs(xVolume vol) {
    const char *oldLogs[] = {
        "/log.old.3",
        "/log.old.2",
        "/log.old.1"
    };
    xBase exists;
    xVolumeInfo volInfo;
    // Check if we need space
    if (OK(xFSGetVolumeInfo(vol, &volInfo)) {
        if (volInfo.freeBytes < (50 * 1024)) { // Less than 50KB free
            // Delete old logs
            for (int i = 0; i < 3; i++) {
                if (OK(xFileExists(vol, (xByte*)oldLogs[i], &exists)) && exists) {
                    xFileUnlink(vol, (xByte*)oldLogs[i]);
                }
            }
        }
    }
}
```

#### Example 4: Remove corrupted file

```
xReturn validateAndClean(xVolume vol, const char *path) {
    xFile file;
    xBase isValid = 0;
    // Try to validate file
    if (OK(xFileOpen(&file, vol, (xByte*)path, FS_MODE_READ))) {
        xByte *data;
        xWord size;
        if (OK(xFileGetSize(file, &size)) && OK(xFileRead(file, size, &data))) {
            isValid = validateFileData(data, size);
            xMemFree((xAddr)data);
        }
        xFileClose(file);
    }
    // Delete if corrupted
    if (!isValid) {
        logWarning("Deleting corrupted file: %s", path);
        return xFileUnlink(vol, (xByte*)path);
    }
    return ReturnOK;
}
```

**Parameters**

in	<i>volume_</i>	Handle to the mounted volume containing the file. Must be a valid volume from <a href="#">xFSMount()</a> .
in	<i>path_</i>	Pointer to null-terminated string containing path to file to delete. Use forward slashes (/) for directory separators.

**Returns**

ReturnOK if file deleted successfully, ReturnError if deletion failed due to invalid volume, file not found, file is open, or filesystem error.

**Warning**

File deletion is permanent and irreversible. Deleted files cannot be recovered. Ensure you have the correct path before calling this function.

The file must not be open. Close all file handles to the file before attempting to delete it. Deleting an open file will fail.

Do not delete files while other tasks may be accessing them. This may cause those tasks' operations to fail unexpectedly.

**Note**

Deleting a file frees its disk space immediately, making it available for new files.

You cannot delete directories with [xFileUnlink\(\)](#). Use [xDirRemove\(\)](#) to delete empty directories.

**See also**

[xFileExists\(\)](#) - Check if file exists before deleting

[xFileRename\(\)](#) - Rename file instead of deleting

[xFileClose\(\)](#) - Close file before deleting

[xDirRemove\(\)](#) - Delete empty directory

**4.2.4.28 xFileWrite()** `xReturn xFileWrite (`  
`xFile file_,`  
`const xSize size_,`  
`const xByte * data_ )`

Writes a specified number of bytes to the file at the current file position, advancing the file position and potentially extending the file size. Data is written from the provided buffer to the filesystem, and changes are committed to storage when the file is closed or explicitly synced.

Writing appends or overwrites data at the current file position, which depends on the mode the file was opened with (WRITE starts at 0, APPEND starts at EOF). After a successful write, the file position advances by the number of bytes written, and the file size is updated if the write extended beyond the previous end-of-file.

Write behavior:

- Writes size\_ bytes from data\_ buffer to file
- File position advances by number of bytes written
- File size updated if write extends file
- Data buffered until [xFileClose\(\)](#) or [xFileSync\(\)](#)
- Allocates clusters from filesystem as needed

File modes and write behavior:

- **FS\_MODE\_WRITE**: Position starts at 0, overwrites from beginning
- **FS\_MODE\_APPEND**: Position starts at EOF, extends file
- **FS\_MODE\_READ | FS\_MODE\_WRITE**: Can write at any position via [xFileSeek\(\)](#)

Common scenarios:

- **Create new file**: Open with WRITE | CREATE, write data
- **Append to log**: Open with APPEND | CREATE, write entries
- **Update existing**: Open with READ | WRITE, seek and write
- **Replace content**: Open with WRITE (truncates), write new data

#### Example 1: Write new file

```
xFile file;
if (OK(xFileOpen(&file, vol, (xByte*)"/data.bin",
                FS_MODE_WRITE | FS_MODE_CREATE))) {
    xByte buffer[256];
    generateData(buffer, sizeof(buffer));
    // Write data
    if (OK(xFileWrite(file, sizeof(buffer), buffer))) {
        // Data written successfully
    }
    xFileClose(file); // Commits write to storage
}
```

#### Example 2: Append to log file

```
void logEvent(xVolume vol, const char *event) {
    xFile logFile;
    // Open in append mode
    if (OK(xFileOpen(&logFile, vol, (xByte*)"/events.log",
                    FS_MODE_APPEND | FS_MODE_CREATE))) {
        xSize eventLen = strlen(event);
        // Write event message
        xFileWrite(logFile, eventLen, (xByte*)event);
        xFileWrite(logFile, 1, (xByte*)"\n");
        xFileClose(logFile);
    }
}
```

#### Example 3: Update specific file location

```
xFile file;
// Update bytes at specific offset
xReturn updateFileBytes(xFile file, xWord offset, xByte *newData, xSize size) {
    // Seek to update position
    if (ERROR(xFileSeek(file, offset, FS_SEEK_SET))) {
        return ReturnError;
    }
    // Write new data at that position
    return xFileWrite(file, size, newData);
}
// Usage
if (OK(xFileOpen(&file, vol, (xByte*)"/config.dat", FS_MODE_READ | FS_MODE_WRITE))) {
    xByte newValue = 0x42;
    updateFileBytes(file, 100, &newValue, 1); // Update byte at offset 100
    xFileClose(file);
}
```

#### Example 4: Write with explicit sync

```
xFile file;
if (OK(xFileOpen(&file, vol, (xByte*)"critical.dat",
                FS_MODE_WRITE | FS_MODE_CREATE))) {
    xByte importantData[512];
    prepareData(importantData, sizeof(importantData));
    // Write data
    if (OK(xFileWrite(file, sizeof(importantData), importantData))) {
        // Force write to storage immediately
        if (OK(xFileSync(file))) {
            // Data guaranteed on disk
        } else {
            // Sync failed - write may not be persistent
            handleSyncError();
        }
    }
    xFileClose(file);
}
```

#### Parameters

in	<i>file</i> ↔ —	Handle to the open file to write to. Must be a valid file opened with FS_MODE_WRITE or FS_MODE_APPEND permission.
in	<i>size</i> ↔ —	Number of bytes to write to file. Data buffer must contain at least this many bytes.
in	<i>data</i> ↔ —	Pointer to buffer containing data to write. Buffer must be at least size_ bytes in length.

#### Returns

ReturnOK if write succeeded, ReturnError if write failed due to invalid file handle, file not open for writing, insufficient disk space, device write error, or FAT allocation failure.

#### Warning

The file must have been opened with FS\_MODE\_WRITE or FS\_MODE\_APPEND permission. Attempting to write to a read-only file will fail.

Writes are buffered and not guaranteed to be on storage until [xFileClose\(\)](#) or [xFileSync\(\)](#) is called. For critical data, call [xFileSync\(\)](#) explicitly to ensure persistence before continuing.

If insufficient disk space is available, write will fail with ReturnError. Use [xFSGetVolumeInfo\(\)](#) to check free space before writing large amounts of data.

Opening a file with FS\_MODE\_WRITE (without APPEND) truncates the file immediately. The first write starts at position 0, replacing all previous content.

#### Note

After a successful write, the file position advances by size\_ bytes. Use [xFileTell\(\)](#) to query current position or [xFileSeek\(\)](#) to change it.

The data\_ buffer is not modified by [xFileWrite\(\)](#). It can be a const buffer or reused after the call returns.

File size is updated as writes extend the file, but the final size is only committed to the directory entry when [xFileClose\(\)](#) is called.

#### See also

- [xFileRead\(\)](#) - Read data from file
- [xFileOpen\(\)](#) - Open file with write permission
- [xFileClose\(\)](#) - Close file and commit writes
- [xFileSync\(\)](#) - Flush writes to storage
- [xFileSeek\(\)](#) - Change write position
- [xFSGetVolumeInfo\(\)](#) - Check available disk space

**4.2.4.29 xFSFormat()** `xReturn` xFSFormat (   
     const xHalfWord blockDeviceUID\_,   
     const xByte \* volumeLabel\_ )

Initializes a block device with a FAT32 filesystem structure, creating the boot sector, file allocation tables, and root directory. This operation prepares a storage device for use with HeliOS filesystem operations by writing the complete FAT32 metadata structures.

Formatting is destructive—all existing data on the block device is lost. This operation should only be performed on new devices or when explicitly reinitializing storage. After formatting, the device must be mounted with `xFSMount()` before files can be created or accessed.

The formatting process:

1. Validates block device is registered and operational
2. Calculates optimal FAT32 parameters based on device size
3. Writes boot sector with filesystem parameters
4. Initializes two file allocation tables (FAT1 and FAT2 for redundancy)
5. Creates empty root directory
6. Sets volume label if provided

Common scenarios:

- **Initial setup:** Format new RAM disk or flash storage
- **Factory reset:** Erase all data and reinitialize filesystem
- **Corruption recovery:** Reformat after filesystem corruption
- **Testing:** Create clean filesystem for unit tests

**Example 1: Format RAM disk with volume label**

```
#include "block_driver.h"
#include "ramdisk_driver.h"
// Setup and format RAM disk
xHalfWord ramDiskUID = 0;
xHalfWord blockDevUID = 0;
// Initialize drivers
if (OK(__RamDiskRegister__(&ramDiskUID))) {
    if (OK(__BlockDeviceRegister__(&blockDevUID))) {
        // Configure block device to use RAM disk
        BlockDeviceConfig_t config;
        config.protocol = BLOCK_PROTOCOL_RAW;
        config.backingDeviceUID = ramDiskUID;
        if (OK(__DeviceConfigDevice__(blockDevUID, sizeof(config), (xByte*)&config))) {
            // Format with volume label
            if (OK(xFSFormat(blockDevUID, (xByte*)"HELIOS_VOL"))) {
                // Filesystem ready to mount
            }
        }
    }
}
```

**Example 2: Format and mount in one operation**

```
xReturn initializeFilesystem(xHalfWord blockDeviceUID, xVolume *volume) {
    // Format the device
    if (ERROR(xFSFormat(blockDeviceUID, (xByte*)"STORAGE"))) {
        return ReturnError;
    }
    // Mount the freshly formatted filesystem
    if (ERROR(xFSMount(volume, blockDeviceUID))) {
        return ReturnError;
    }
    // Filesystem formatted and ready for use
}
```

```

    return ReturnOK;
}

```

### Example 3: Factory reset function

```

xVolume systemVolume;
xHalfWord storageDeviceUID;
void factoryReset(void) {
    // Unmount if currently mounted
    xFSUnmount(systemVolume);
    // Reformat - destroys all data
    if (OK(xFSFormat(storageDeviceUID, (xByte*)"FACTORY"))) {
        // Remount fresh filesystem
        if (OK(xFSMount(&systemVolume, storageDeviceUID))) {
            // Create default configuration files
            createDefaultConfig(systemVolume);
        }
    }
}

```

### Parameters

in	<i>blockDeviceUID</i>	UID of the block device to format. Must be a registered block device obtained from block device driver registration. The device must support read and write operations.
in	<i>volumeLabel</i>	Pointer to null-terminated string containing volume label (max 11 characters). Can be null for no label. Label is stored in boot sector and visible in volume information queries.

### Returns

ReturnOK if format succeeded, ReturnError if format failed due to invalid block device UID, device not available, insufficient device size, or write errors during format operation.

### Warning

This operation is DESTRUCTIVE. All existing data on the block device will be permanently lost. Ensure the correct device UID is specified and any important data is backed up before formatting.

The block device must be large enough to hold FAT32 structures. Very small devices may fail to format. Minimum practical size depends on sector size and cluster size calculations.

Do not format a currently mounted volume. Always call [xFSUnmount\(\)](#) before formatting to prevent filesystem corruption.

### Note

After formatting, the volume must be mounted with [xFSMount\(\)](#) before any file operations can be performed.

HeliOS uses FAT32 filesystem format for compatibility with standard FAT32 implementations and tools.

The volume label is optional but recommended for identifying storage volumes in systems with multiple devices.

### See also

[xFSMount\(\)](#) - Mount formatted volume for file operations

[xFSUnmount\(\)](#) - Unmount volume before reformatting

[xFSGetVolumeInfo\(\)](#) - Query volume information including label

**BlockDeviceRegister()** - Register block device before formatting

**4.2.4.30 xFSGetVolumeInfo()** `xReturn xFSGetVolumeInfo (`  
`const xVolume volume_,`  
`xVolumeInfo * info_ )`

Retrieves comprehensive information about a mounted volume including capacity, free space, and filesystem parameters. This information is useful for monitoring storage utilization, checking available space before write operations, and reporting filesystem status.

The volume information includes both logical (cluster-based) and physical (byte-based) size metrics, allowing applications to make informed decisions about storage management and space allocation.

Information provided:

- Total and free space in clusters and bytes
- Bytes per sector (typically 512)
- Sectors per cluster
- Bytes per cluster (sector size × sectors per cluster)

Common use cases:

- **Space checking:** Verify sufficient space before write operations
- **Usage monitoring:** Track filesystem utilization over time
- **Status reporting:** Display storage capacity to user/diagnostic interface
- **Quota management:** Implement storage quotas based on available space

Example 1: Check space before writing file

```
xVolume vol;
xVolumeInfo info;
xReturn writeDataFile(xVolume vol, xByte *data, xSize dataSize) {
    // Check available space
    if (OK(xFSGetVolumeInfo(vol, &info))) {
        if (info.freeBytes >= dataSize) {
            // Sufficient space - proceed with write
            xFile file;
            if (OK(xFileOpen(&file, vol, (xByte*)"data.bin",
                           FS_MODE_WRITE | FS_MODE_CREATE))) {
                xFileWrite(file, dataSize, data);
                xFileClose(file);
                return ReturnOK;
            }
        } else {
            // Insufficient space
            return ReturnError;
        }
    }
    return ReturnError;
}
```

Example 2: Storage utilization monitoring

```
xVolume vol;
void reportStorageStatus(void) {
    xVolumeInfo info;
    if (OK(xFSGetVolumeInfo(vol, &info))) {
        xWord usedBytes = info.totalBytes - info.freeBytes;
        xByte percentUsed = (xByte)((usedBytes * 100) / info.totalBytes);
        // Report to diagnostic interface
        printf("Storage: %lu / %lu bytes (%u%% used)\n",
              usedBytes, info.totalBytes, percentUsed);
        // Warn if nearly full
        if (percentUsed > 90) {
            logWarning("Storage nearly full");
        }
    }
}
```

Example 3: Filesystem parameter reporting

```
void displayVolumeDetails(xVolume vol) {
    xVolumeInfo info;
    if (OK(xFSGetVolumeInfo(vol, &info))) {
        printf("Volume Information:\n");
        printf("  Total: %lu bytes (%lu clusters)\n",
            info.totalBytes, info.totalClusters);
        printf("  Free: %lu bytes (%lu clusters)\n",
            info.freeBytes, info.freeClusters);
        printf("  Cluster size: %lu bytes\n", info.bytesPerCluster);
        printf("  Sector size: %u bytes\n", info.bytesPerSector);
        printf("  Sectors/cluster: %u\n", info.sectorsPerCluster);
    }
}
```

Parameters

in	<i>volume</i> ↔ _	Handle to the mounted volume to query. Must be a valid volume obtained from <a href="#">xFSMount()</a> .
out	<i>info</i> _	Pointer to xVolumeInfo structure to receive volume information. On success, this structure is populated with current volume statistics and parameters.

Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid volume handle or volume not mounted.

Note

Free space calculation requires scanning the File Allocation Table (FAT), which may take time on large volumes. Cache the result if you need to check free space frequently.

The free space reported is the total free space on the volume. Actual usable space may be less due to filesystem overhead and cluster alignment.

All byte values are in units of bytes. Cluster values represent the number of allocation units (clusters) used by the filesystem.

See also

- [xFSMount\(\)](#) - Mount volume before querying information
- [xFSFormat\(\)](#) - Format operation sets volume parameters
- [xFileGetSize\(\)](#) - Get size of individual files

```
4.2.4.31 xFSMount() xReturn xFSMount (
    xVolume * volume_,
    const xHalfWord blockDeviceUID_ )
```

Mounts a FAT32 filesystem from a formatted block device, making it available for file and directory operations. Mounting reads and validates the filesystem metadata (boot sector, FAT tables) and creates a volume handle used in all subsequent filesystem operations.

A volume must be mounted before any file operations (open, read, write, etc.) can be performed. The volume handle returned by this function is required by all file and directory functions to identify which filesystem to operate on.

Mount process:



1. Validates block device UID and availability
2. Reads boot sector from block device
3. Validates FAT32 boot sector signature and parameters
4. Allocates volume structure in kernel memory
5. Stores filesystem parameters for subsequent operations
6. Returns volume handle for use in file/directory operations

Common usage patterns:

- **System initialization:** Mount filesystem during startup
- **Removable media:** Mount when device inserted, unmount when removed
- **Multi-volume systems:** Mount multiple block devices as separate volumes
- **Filesystem switching:** Unmount and remount different filesystems

#### Example 1: Basic mount operation

```
xVolume myVolume;
xHalfWord blockDeviceUID = 1; // From block device registration
// Mount the filesystem
if (OK(xFSMount(&myVolume, blockDeviceUID))) {
    // Volume mounted - can now open files
    xFile file;
    if (OK(xFileOpen(&file, myVolume, (xByte*)"data.txt", FS_MODE_READ))) {
        // File opened successfully
        xFileClose(file);
    }
    // Always unmount when done
    xFSUnmount(myVolume);
}
```

#### Example 2: System initialization with mount

```
xVolume systemVolume;
xHalfWord storageUID;
void initStorage(void) {
    // Register and configure block device
    if (OK(__BlockDeviceRegister__(&storageUID))) {
        BlockDeviceConfig_t config;
        config.protocol = BLOCK_PROTOCOL_RAW;
        config.backingDeviceUID = ramDiskUID;
        if (OK(__DeviceConfigDevice__(storageUID, sizeof(config), (xByte*)&config))) {
            // Try to mount existing filesystem
            if (ERROR(xFSMount(&systemVolume, storageUID))) {
                // Mount failed - format and mount fresh filesystem
                if (OK(xFSFormat(storageUID, (xByte*)"SYSTEM"))) {
                    xFSMount(&systemVolume, storageUID);
                }
            }
        }
    }
}
```

#### Example 3: Multi-volume system

```
xVolume dataVolume;
xVolume configVolume;
xHalfWord dataDeviceUID = 1;
xHalfWord configDeviceUID = 2;
void mountAllVolumes(void) {
    // Mount data volume
    if (OK(xFSMount(&dataVolume, dataDeviceUID))) {
        // Mount config volume
        if (OK(xFSMount(&configVolume, configDeviceUID))) {
            // Both volumes mounted - use different handles
            xFileOpen(&file1, dataVolume, (xByte*)"data.bin", FS_MODE_READ);
            xFileOpen(&file2, configVolume, (xByte*)"config.txt", FS_MODE_READ);
        }
    }
}
```

**Example 4: Mount with volume information query**

```

xVolume vol;
xHalfWord devUID = 1;
if (OK(xFSMount(&vol, devUID))) {
    // Query volume information
    xVolumeInfo info;
    if (OK(xFSGetVolumeInfo(vol, &info))) {
        // Check available space
        if (info.freeBytes > (100 * 1024)) { // 100 KB free
            // Sufficient space for operations
            performFileOperations(vol);
        }
    }
    xFSUnmount(vol);
}

```

**Parameters**

out	<i>volume_</i>	Pointer to xVolume handle to be initialized. On success, this handle is used in all subsequent file and directory operations. The handle remains valid until <a href="#">xFSUnmount()</a> is called.
in	<i>blockDevice</i> ↔ <i>UID_</i>	UID of the block device containing the FAT32 filesystem. Must be a registered block device that has been formatted with <a href="#">xFSFormat()</a> .

**Returns**

ReturnOK if mount succeeded, ReturnError if mount failed due to invalid block device UID, device not available, invalid FAT32 filesystem, corrupted boot sector, or memory allocation failure.

**Warning**

The block device must contain a valid FAT32 filesystem created by [xFSFormat\(\)](#) or another FAT32-compatible tool. Attempting to mount an unformatted or corrupted device will fail.

Only one volume can be mounted per block device at a time. Attempting to mount an already-mounted device will fail.

The volume handle must remain valid for the duration of all file operations. Do not unmount a volume while files are still open.

**Note**

The volume handle is allocated from kernel memory and persists until [xFSUnmount\(\)](#) is called. Always unmount volumes when finished to free kernel resources.

Multiple volumes can be mounted simultaneously if you have multiple block devices, each with its own volume handle.

After mounting, use [xFSGetVolumeInfo\(\)](#) to query volume capacity, free space, and other filesystem parameters.

**See also**

[xFSUnmount\(\)](#) - Unmount volume and free resources

[xFSFormat\(\)](#) - Format block device with FAT32 filesystem

[xFSGetVolumeInfo\(\)](#) - Query volume information

[xFileOpen\(\)](#) - Open file on mounted volume

[xDirOpen\(\)](#) - Open directory on mounted volume

#### 4.2.4.32 xFSUnmount() `xReturn` xFSUnmount ( `xVolume` volume\_ )

Unmounts a previously mounted FAT32 volume, flushing any pending writes and freeing all associated kernel resources. After unmounting, the volume handle becomes invalid and must not be used in any subsequent filesystem operations.

Unmounting ensures filesystem consistency by finalizing all pending operations and is essential for proper resource management in embedded systems. Always unmount volumes before system shutdown, device removal, or when the filesystem is no longer needed.

Unmount process:

1. Validates volume handle
2. Flushes any cached filesystem data to block device
3. Updates FAT tables if necessary
4. Frees volume structure from kernel memory
5. Invalidates volume handle

Common scenarios:

- **System shutdown:** Unmount all volumes before power-off
- **Resource cleanup:** Free kernel memory when filesystem not needed
- **Device removal:** Safely unmount before removing storage media
- **Filesystem switching:** Unmount before reformatting or mounting different volume

#### Example 1: Basic mount/unmount lifecycle

```
xVolume vol;
xHalfWord deviceUID = 1;
// Mount volume
if (OK(xFSMount(&vol, deviceUID))) {
    // Perform file operations
    xFile file;
    xFileOpen(&file, vol, (xByte*)"data.txt", FS_MODE_WRITE | FS_MODE_CREATE);
    xFileWrite(file, 5, (xByte*)"Hello");
    xFileClose(file);
    // Always unmount when done
    xFSUnmount(vol);
    // vol is now invalid - do not use
}
```

#### Example 2: System shutdown cleanup

```
xVolume dataVolume;
xVolume configVolume;
void shutdownFilesystems(void) {
    // Unmount all volumes before shutdown
    xFSUnmount(dataVolume);
    xFSUnmount(configVolume);
    // Volumes now unmounted and resources freed
}
```

#### Example 3: Safe volume handle cleanup

```
xVolume vol = null;
xHalfWord devUID = 1;
void useVolume(void) {
    if (OK(xFSMount(&vol, devUID))) {
        performOperations(vol);
        // Unmount and nullify handle
        xFSUnmount(vol);
        vol = null; // Prevent use-after-unmount
    }
}
```

**Parameters**

in	<i>volume</i> ↔	Handle to the mounted volume to unmount. Must be a valid volume obtained from a previous successful <a href="#">xFSMount()</a> call. After unmounting, this handle becomes invalid.
	—	

**Returns**

ReturnOK if unmount succeeded, ReturnError if unmount failed due to invalid volume handle or volume not found.

**Warning**

All files and directories must be closed before unmounting. Unmounting a volume with open file handles may cause resource leaks or undefined behavior.

After calling [xFSUnmount\(\)](#), the volume handle becomes invalid and must not be used in any filesystem operations. Attempting to use an unmounted volume will result in ReturnError.

Always unmount volumes before reformatting the block device or removing storage media to prevent filesystem corruption.

**Note**

It is good practice to set the volume handle to null after unmounting to prevent accidental use of an invalid handle.

Unmounting frees kernel memory allocated during [xFSMount\(\)](#). In long-running systems, always unmount volumes when they are no longer needed.

**See also**

- [xFSMount\(\)](#) - Mount a FAT32 filesystem volume
- [xFileClose\(\)](#) - Close files before unmounting
- [xDirClose\(\)](#) - Close directories before unmounting
- [xFileSync\(\)](#) - Explicitly flush file data before unmount

**4.2.4.33 xMemAlloc()** `xReturn xMemAlloc (`  
     volatile `xAddr` \* `addr_`,  
     const `xSize` `size_` )

Allocates a block of memory from the HeliOS user heap and returns a pointer to the allocated memory. The allocated memory is automatically zeroed (similar to `calloc()` in standard C), ensuring predictable initialization.

HeliOS maintains separate user and kernel memory regions. This function allocates from the user heap, which is intended for application data structures, buffers, and general-purpose memory needs. The total heap size is determined by `CONFIG_MEMORY_REGION_SIZE_IN_BLOCKS × CONFIG_MEMORY_REGION_BLOCK_SIZE`.

**Memory Allocation Features:**

- Automatic zero-initialization of allocated memory
- Best-fit allocation strategy to minimize fragmentation
- Memory safety checks to prevent heap corruption
- Tracking of allocation statistics (via [xMemGetHeapStats\(\)](#))

Memory allocated by this function must be freed using [xMemFree\(\)](#) when no longer needed to prevent memory leaks. HeliOS does not provide automatic garbage collection.

### Warning

The `addr_` parameter must be cast to `(volatile xAddr *)` to avoid compiler warnings. This is because the function modifies the pointer variable itself (by-reference parameter passing).

### Note

Allocation may fail if insufficient contiguous memory is available, even if the total free memory exceeds the requested size. This can occur due to heap fragmentation.

Several HeliOS functions allocate heap memory internally and return it to the caller (e.g., [xDeviceRead\(\)](#), [xMemGetHeapStats\(\)](#)). Memory returned by these functions must also be freed with [xMemFree\(\)](#).

### Example Usage:

```
// Allocate memory for a structure
typedef struct {
    int temperature;
    int humidity;
} SensorData_t;
SensorData_t *data = NULL;
if (OK(xMemAlloc((volatile xAddr *)&data, sizeof(SensorData_t))) {
    // Memory allocated successfully and zeroed
    data->temperature = readTemperature();
    data->humidity = readHumidity();
    // Use the data...
    // Free when done
    xMemFree((xAddr)data);
} else {
    // Handle allocation failure
    reportError("Out of memory");
}

// Allocate an array
uint8_t *buffer = NULL;
if (OK(xMemAlloc((volatile xAddr *)&buffer, 256))) {
    // Use buffer...
    xMemFree((xAddr)buffer);
}
```

### Parameters

out	<i>addr</i> ↔ —	Pointer to a pointer variable that will receive the address of the allocated memory. Must be cast to <code>(volatile xAddr *)</code> . On failure, this pointer is not modified.
in	<i>size</i> ↔ —	Number of bytes to allocate. Must be greater than zero.

### Returns

ReturnOK if memory was successfully allocated, ReturnError if allocation failed (insufficient memory, invalid parameters, or memory system error).

### See also

[xMemFree\(\)](#) - Free allocated memory

[xMemFreeAll\(\)](#) - Free all allocated memory

[xMemGetUsed\(\)](#) - Get total allocated memory

[xMemGetSize\(\)](#) - Get size of an allocation

[xMemGetHeapStats\(\)](#) - Get detailed heap statistics

[CONFIG\\_MEMORY\\_REGION\\_SIZE\\_IN\\_BLOCKS](#) - Heap size configuration

[CONFIG\\_MEMORY\\_REGION\\_BLOCK\\_SIZE](#) - Memory block size configuration

**4.2.4.34 xMemFree()** `xReturn` xMemFree (   
 const volatile `xAddr` *addr\_* )

Deallocates a block of memory that was previously allocated by `xMemAlloc()` or returned by HeliOS functions that allocate memory (such as `xDeviceRead()`, `xMemGetHeapStats()`, or `xTaskGetAllRunTimeStats()`). The freed memory becomes available for future allocations.

After freeing memory, the pointer should be considered invalid and must not be dereferenced. HeliOS does not automatically NULL the pointer; the caller is responsible for proper pointer management.

Memory Management Best Practices:

- Always free memory when it is no longer needed to prevent leaks
- Set pointers to NULL after freeing to avoid use-after-free bugs
- Never free the same memory twice (double-free)
- Never free memory that was not allocated by `xMemAlloc()` or HeliOS
- Never free stack-allocated variables or static memory

#### Warning

Freeing invalid memory addresses or freeing the same memory twice will cause heap corruption and undefined behavior. HeliOS performs validation checks, but cannot detect all misuse scenarios.

After calling `xMemFree()`, do not access the freed memory. Doing so results in undefined behavior and may cause data corruption or system crashes.

#### Note

Some HeliOS functions allocate memory and return it to the caller. The caller is responsible for freeing this memory. Check function documentation to determine if memory management is required.

#### Example Usage:

```
// Proper memory management
uint8_t *buffer = NULL;
if (OK(xMemAlloc((volatile xAddr *)&buffer, 128))) {
    // Use the buffer
    processData(buffer, 128);
    // Free when done
    if (OK(xMemFree((xAddr)buffer))) {
        buffer = NULL; // Good practice: NULL the pointer
    }
}
// Freeing memory returned by HeliOS functions
xMemoryRegionStats *stats = NULL;
if (OK(xMemGetHeapStats(&stats))) {
    // Use stats...
    printf("Free bytes: %lu\n", stats->availableSpaceInBytes);
    // Must free the stats structure
    xMemFree((xAddr)stats);
    stats = NULL;
}
```

#### Parameters

in	<i>addr_</i> ↔	Pointer to the memory block to free. Must be a valid pointer previously returned by <code>xMemAlloc()</code> or a HeliOS allocation function. Passing NULL is safe and results in no operation.
	—	

## Returns

ReturnOK if memory was successfully freed, ReturnError if the operation failed (invalid address, double-free attempt, or memory system error).

## See also

[xMemAlloc\(\)](#) - Allocate memory from the heap  
[xMemFreeAll\(\)](#) - Free all allocated memory at once  
[xMemGetUsed\(\)](#) - Get total allocated memory  
[xMemGetSize\(\)](#) - Get size of an allocation  
[xMemGetHeapStats\(\)](#) - Get detailed heap statistics

**4.2.4.35 xMemFreeAll()** `xReturn xMemFreeAll (`  
`void )`

The [xMemFreeAll\(\)](#) syscall frees (i.e., de-allocates) all heap memory allocated by [xMemAlloc\(\)](#). Caution should be used when calling [xMemFreeAll\(\)](#) as all references to the heap memory region will be made invalid.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.36 xMemGetHeapStats()** `xReturn xMemGetHeapStats (`  
`xMemoryRegionStats * stats_ )`

The [xMemGetHeapStats\(\)](#) syscall is used to obtain detailed statistics about the heap memory region which can be used by the application to monitor memory utilization.

## See also

[xReturn](#)  
[xMemoryRegionStats](#)  
[xMemFree\(\)](#)

## Parameters

<code>stats_↔</code>	The memory region statistics. The memory region statistics must be freed by <a href="#">xMemFree()</a> .
<code>_</code>	

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.37 xMemGetKernelStats()** [xReturn](#) xMemGetKernelStats (   
 [xMemoryRegionStats](#) \* stats\_ )

The [xMemGetKernelStats\(\)](#) syscall is used to obtain detailed statistics about the kernel memory region which can be used by the application to monitor memory utilization.

## See also

[xReturn](#)  
[xMemoryRegionStats](#)  
[xMemFree\(\)](#)

## Parameters

<a href="#">stats_</a> ← —	The memory region statistics. The memory region statistics must be freed by <a href="#">xMemFree()</a> .
-------------------------------	--

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.38 xMemGetSize()** [xReturn](#) xMemGetSize (   
 const volatile [xAddr](#) addr\_,   
 [xSize](#) \* size\_ )

The [xMemGetSize\(\)](#) syscall can be used to obtain the amount, in bytes, of heap memory allocated at a specific address. The address must be the address obtained from [xMemAlloc\(\)](#).

## See also

[xReturn](#)



## Parameters

<i>addr</i> ↔ —	The address of the heap memory for which the size (i.e., amount) allocated, in bytes, is being sought.
<i>size</i> ↔ —	The size (i.e., amount), in bytes, of heap memory allocated to the address.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.39 xMemGetUsed()** [xReturn](#) xMemGetUsed (   
 [xSize](#) \* *size\_* )

The [xMemGetUsed\(\)](#) syscall will update the "size\_" argument with the amount, in bytes, of in-use heap memory. If more memory statistics are needed, [xMemGetHeapStats\(\)](#) provides a more complete picture of the heap memory region.

## See also

[xReturn](#)

[xMemGetHeapStats\(\)](#)

## Parameters

<i>size</i> ↔ —	The size (i.e., amount), in bytes, of in-use heap memory.
--------------------	---

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.40 xQueueCreate()** [xReturn](#) xQueueCreate (   
 [xQueue](#) \* *queue\_*,   
 const [xBase](#) *limit\_* )

Creates a message queue that enables tasks to exchange data safely in a producer-consumer pattern. Queues provide a First-In-First-Out (FIFO) mechanism for passing messages between tasks, making them ideal for decoupling tasks and implementing asynchronous communication.

Message queues in HeliOS store variable-length byte arrays, allowing flexible message formats. Each queue has a configurable maximum capacity (limit), and operations fail gracefully when the queue is full or empty.

#### Queue Characteristics:

- FIFO ordering: Messages are retrieved in the order they were sent
- Bounded capacity: Queue has a maximum message limit
- Non-blocking: Send and receive operations return immediately
- Thread-safe: Can be safely accessed from multiple tasks
- Variable message size: Each message can be a different size

#### Common Use Cases:

- Passing sensor data from interrupt handlers to processing tasks
- Command queues for serial communication
- Event queues for state machines
- Data buffering between producer and consumer tasks
- Decoupling hardware drivers from application logic

#### Queue Operation Flow:

1. Producer task sends message with `xQueueSend()`
2. Message is stored in queue if space available
3. Consumer task receives message with `xQueueReceive()`
4. Message is removed from queue

#### Note

The limit parameter must be at least `CONFIG_QUEUE_MINIMUM_LIMIT` (default 5). This ensures reasonable queue capacity and prevents overly small queues that could cause frequent overflow conditions.

Messages are copied into the queue, so the original data buffer can be reused or freed after calling `xQueueSend()`. Similarly, `xQueueReceive()` provides a copy of the message.

Queues can be locked with `xQueueLockQueue()` to prevent modifications during critical operations, then unlocked with `xQueueUnLockQueue()`.

## Example Usage:

```

xQueue sensorDataQueue;
xQueue commandQueue;
// Create a queue that can hold up to 10 messages
if (OK(xQueueCreate(&sensorDataQueue, 10))) {
    // Queue created successfully
    // Producer task: Send sensor readings
    void sensorTask(xTask task, xTaskParam parm) {
        uint8_t sensorData[4];
        readSensor(sensorData, sizeof(sensorData));
        // Send to queue
        xSize dataSize = sizeof(sensorData);
        if (OK(xQueueSend(sensorDataQueue, dataSize, sensorData))) {
            // Data queued successfully
        } else {
            // Queue full - handle overflow
        }
    }
    // Consumer task: Process sensor readings
    void processingTask(xTask task, xTaskParam parm) {
        xQueueMessage message;
        // Check if messages available
        xBase messagesWaiting;
        if (OK(xQueueMessagesWaiting(sensorDataQueue, &messagesWaiting))) {
            if (messagesWaiting > 0) {
                // Receive message
                if (OK(xQueueReceive(sensorDataQueue, &message))) {
                    // Process the data
                    processSensorData(message.message, message.size);
                }
            }
        }
    }
}
// Create a command queue
if (OK(xQueueCreate(&commandQueue, 5))) {
    // Use queue for command processing...
    // Clean up when done
    xQueueDelete(commandQueue);
}

```

## Parameters

out	<i>queue</i>	Pointer to xQueue variable that will receive the queue handle. This handle is used in subsequent queue operations.
in	<i>limit</i>	Maximum number of messages the queue can hold. Must be at least CONFIG_QUEUE_MINIMUM_LIMIT (default 5). When this limit is reached, the queue is full and xQueueSend() will fail.

## Returns

ReturnOK if the queue was successfully created, ReturnError if creation failed (out of memory, invalid limit, or system error).

## See also

[xQueueDelete\(\)](#) - Delete a queue and free its resources  
[xQueueSend\(\)](#) - Send a message to a queue  
[xQueueReceive\(\)](#) - Receive a message from a queue  
[xQueuePeek\(\)](#) - Examine next message without removing it  
[xQueueMessagesWaiting\(\)](#) - Get number of messages in queue  
[xQueueIsQueueFull\(\)](#) - Check if queue is at capacity  
[xQueueIsQueueEmpty\(\)](#) - Check if queue has no messages  
[xQueueLockQueue\(\)](#) - Lock queue to prevent modifications  
[CONFIG\\_QUEUE\\_MINIMUM\\_LIMIT](#) - Minimum queue capacity configuration

#### 4.2.4.41 xQueueDelete() `xReturn` xQueueDelete ( `xQueue` queue\_ )

Permanently removes a message queue and releases all associated kernel resources, including all queued messages. After deletion, the queue handle becomes invalid and must not be used in any subsequent queue operations. This operation is typically performed during cleanup, reconfiguration, or when a communication channel is no longer needed.

`xQueueDelete()` immediately removes the queue and all its messages from the kernel, freeing both the queue structure and all message memory. Any messages that were waiting in the queue are lost—there is no mechanism to retrieve them after deletion. Tasks attempting to send or receive on a deleted queue will receive `ReturnError`.

Key characteristics:

- **Immediate deletion:** Queue and all messages removed immediately
- **Message loss:** All pending messages are discarded
- **Resource cleanup:** All kernel memory associated with queue is freed
- **Handle invalidation:** Queue handle cannot be reused after deletion
- **Non-blocking:** Returns immediately after cleanup completes

Common deletion scenarios:

- **Task cleanup:** Remove queues during task shutdown
- **Dynamic reconfiguration:** Delete and recreate queues with different limits
- **Resource reclamation:** Free unused queues to reduce memory usage
- **Error recovery:** Clean up queues after initialization failures

#### Example 1: Queue lifecycle management

```
xQueue commandQueue;
void initCommandQueue(void) {
    if (OK(xQueueCreate(&commandQueue, 10))) {
        // Use queue for communication
    }
}
void shutdownCommandQueue(void) {
    // Delete queue when no longer needed
    if (OK(xQueueDelete(commandQueue))) {
        // Queue and all messages freed
    }
}
```

#### Example 2: Dynamic queue reconfiguration

```
xQueue dataQueue;
void resizeQueue(xBase newLimit) {
    // Delete existing queue
    if (dataQueue != null) {
        xQueueDelete(dataQueue);
    }
    // Create new queue with different limit
    if (OK(xQueueCreate(&dataQueue, newLimit))) {
        // New queue ready
    }
}
```

#### Example 3: Multiple queue cleanup

```
xQueue queues[MAX_CHANNELS];
xBase queueCount = 0;
void initQueues(void) {
    for (xBase i = 0; i < MAX_CHANNELS; i++) {
        if (OK(xQueueCreate(&queues[i], 5))) {
            queueCount++;
        }
    }
}
```

```

    }
}
void shutdownQueues(void) {
    for (xBase i = 0; i < queueCount; i++) {
        xQueueDelete(queues[i]);
    }
    queueCount = 0;
}

```

#### Example 4: Conditional queue cleanup

```

xQueue eventQueue;
xBase queueActive = 0;
void disableEvents(void) {
    if (queueActive) {
        xQueueDelete(eventQueue);
        queueActive = 0;
    }
}
void enableEvents(void) {
    if (!queueActive) {
        if (OK(xQueueCreate(&eventQueue, 8))) {
            queueActive = 1;
        }
    }
}

```

#### Parameters

in	<i>queue</i> ↔	Handle to the queue to delete. Must be a valid queue created with <a href="#">xQueueCreate()</a> . After deletion, this handle becomes invalid.
	—	

#### Returns

ReturnOK if queue deleted successfully, ReturnError if deletion failed due to invalid queue handle or queue not found.

#### Warning

All messages pending in the queue are permanently lost when the queue is deleted. If you need to preserve messages, drain the queue with [xQueueReceive\(\)](#) before calling [xQueueDelete\(\)](#).

After [xQueueDelete\(\)](#) returns successfully, the queue handle is invalid and must not be used in any subsequent operations. Using a deleted queue handle will result in ReturnError.

Deleting a queue that is actively used by multiple tasks can lead to errors if those tasks attempt to access the queue after deletion. Coordinate queue deletion across all tasks using the queue.

#### Note

[xQueueDelete\(\)](#) frees all memory associated with the queue, including the queue structure and all message memory. This is the only way to reclaim kernel memory allocated for a queue.

Unlike stopping a timer, which preserves the timer for reuse, deleting a queue permanently removes it. To reuse queue functionality, create a new queue with [xQueueCreate\(\)](#).

#### See also

[xQueueCreate\(\)](#) - Create a message queue

[xQueueReceive\(\)](#) - Receive messages before deletion

[xQueueMessagesWaiting\(\)](#) - Check for pending messages

[xTaskDelete\(\)](#) - Delete a task (similar resource cleanup pattern)

[xTimerDelete\(\)](#) - Delete a timer (similar resource cleanup pattern)

#### 4.2.4.42 xQueueDropMessage() xReturn xQueueDropMessage (

xQueue queue\_ )

Removes and discards the oldest message from the queue without retrieving its contents. This operation decrements the message count and frees the message memory, but does not return the message data to the caller. Use this when you want to skip or discard messages without processing them.

Unlike `xQueueReceive()` which allocates and returns the message, `xQueueDropMessage()` simply removes the message and frees its memory immediately. This is more efficient when message content is not needed—for example, when clearing stale messages, handling overflow conditions, or implementing message filtering.

Common use cases:

- **Queue clearing:** Discard all messages when resetting state
- **Message filtering:** Skip unwanted messages after peeking
- **Overflow handling:** Drop old messages when queue backs up
- **Selective processing:** Discard messages based on peek inspection

##### Example 1: Clear all messages from queue

```
xQueue eventQueue;
void clearQueue(void) {
    xBase isEmpty;
    if (OK(xQueueIsQueueEmpty(eventQueue, &isEmpty))) {
        while (!isEmpty) {
            xQueueDropMessage(eventQueue);
            xQueueIsQueueEmpty(eventQueue, &isEmpty);
        }
    }
}
```

##### Example 2: Selective message processing with peek and drop

```
xQueue dataQueue;
void processOnlyValidMessages(void) {
    xBase waiting;
    if (OK(xQueueMessagesWaiting(dataQueue, &waiting))) {
        for (xBase i = 0; i < waiting; i++) {
            xQueueMessage msg;
            if (OK(xQueuePeek(dataQueue, &msg))) {
                xByte msgType = msg.value[0];
                xMemFree((xAddr)msg.value); // Free peek copy
                if (isValidMessageType(msgType)) {
                    // Valid - receive and process
                    if (OK(xQueueReceive(dataQueue, &msg))) {
                        processMessage(&msg);
                        xMemFree((xAddr)msg.value);
                    }
                } else {
                    // Invalid - drop without retrieving
                    xQueueDropMessage(dataQueue);
                }
            }
        }
    }
}
```

##### Example 3: Drop stale messages on timeout

```
xQueue timeStampedQueue;
xTimer timeoutTimer;
void dropStaleMessages(void) {
    xBase expired;
    if (OK(xTimerHasTimerExpired(timeoutTimer, &expired)) && expired) {
        // Timeout elapsed - drop oldest message
        xQueueDropMessage(timeStampedQueue);
        xTimerReset(timeoutTimer);
    }
}
```

## Parameters

in	<i>queue</i> ↔	Handle to the queue from which to drop a message. Must be a valid queue created with <a href="#">xQueueCreate()</a> .
	—	

## Returns

ReturnOK if message dropped successfully, ReturnError if operation failed due to empty queue or invalid queue handle.

## Warning

The dropped message is permanently lost—there is no way to retrieve it after calling [xQueueDropMessage\(\)](#). If you need the message content, use [xQueueReceive\(\)](#) instead.

## Note

[xQueueDropMessage\(\)](#) is more efficient than [xQueueReceive\(\)](#) followed by [xMemFree\(\)](#) because it avoids allocating memory for the message copy.

If the queue is empty, [xQueueDropMessage\(\)](#) returns ReturnError immediately.

## See also

- [xQueueReceive\(\)](#) - Receive and retrieve message
- [xQueuePeek\(\)](#) - Examine message without removing it
- [xQueueMessagesWaiting\(\)](#) - Check message count before dropping
- [xQueueIsQueueEmpty\(\)](#) - Check if queue has messages

**4.2.4.43 xQueueGetLength()** `xReturn xQueueGetLength (`  
    `const xQueue queue_,`  
    `xBase * res_ )`

Retrieves the maximum number of messages (limit) that a queue can hold, as configured during queue creation with [xQueueCreate\(\)](#). This non-destructive query returns the queue's capacity, not the number of messages currently waiting. The limit represents the upper bound on how many messages can be queued before [xQueueSend\(\)](#) returns ReturnError due to queue full.

Note: Despite the name "GetLength", this function returns the queue's maximum capacity (limit), not the current message count. To get the number of messages currently waiting, use [xQueueMessagesWaiting\(\)](#).

## Common use cases:

- **Capacity validation:** Verify queue created with expected limit
- **Flow control:** Calculate available space before bulk sends
- **Diagnostics:** Report queue configuration for debugging
- **Dynamic adjustment:** Determine if queue needs resizing

**Example 1: Validate queue configuration**

```

xQueue dataQueue;
xBase expectedLimit = 10;
if (OK(xQueueCreate(&dataQueue, expectedLimit))) {
    xBase actualLimit;
    if (OK(xQueueGetLength(dataQueue, &actualLimit))) {
        if (actualLimit == expectedLimit) {
            // Queue configured correctly
        }
    }
}

```

**Example 2: Calculate available queue space**

```

xQueue commandQueue;
xBase getAvailableSpace(void) {
    xBase limit, waiting;
    if (OK(xQueueGetLength(commandQueue, &limit)) &&
        OK(xQueueMessagesWaiting(commandQueue, &waiting))) {
        return limit - waiting;
    }
    return 0;
}

```

**Example 3: Queue utilization monitoring**

```

xQueue eventQueue;
void reportQueueStatus(void) {
    xBase limit, waiting;
    if (OK(xQueueGetLength(eventQueue, &limit)) &&
        OK(xQueueMessagesWaiting(eventQueue, &waiting))) {
        xBase utilization = (waiting * 100) / limit;
        printf("Queue: %d/%d messages (%d%% full)\n",
            waiting, limit, utilization);
    }
}

```

**Parameters**

in	<i>queue</i> ↔	Handle to the queue to query. Must be a valid queue created with <a href="#">xQueueCreate()</a> .
out	<i>res_</i>	Pointer to variable receiving the queue limit (maximum capacity). On success, contains the limit value specified during <a href="#">xQueueCreate()</a> .

**Returns**

ReturnOK if query succeeded, ReturnError if query failed due to invalid queue handle or queue not found.

**Warning**

This function returns the queue's maximum capacity (limit), NOT the current number of messages. Use [xQueueMessagesWaiting\(\)](#) to get the current message count.

**Note**

The returned limit is constant for the lifetime of the queue—it cannot be changed after creation. To change capacity, delete and recreate the queue.

**See also**

[xQueueMessagesWaiting\(\)](#) - Get current message count  
[xQueueIsQueueFull\(\)](#) - Check if queue is at capacity  
[xQueueIsQueueEmpty\(\)](#) - Check if queue has no messages  
[xQueueCreate\(\)](#) - Create queue with specified limit



**4.2.4.44 xQueueIsQueueEmpty()** `xReturn` xQueueIsQueueEmpty (

```

    const xQueue queue_,
    xBase * res_ )

```

Queries whether a message queue is empty (contains zero messages). This non-destructive check allows tasks to determine if messages are available before attempting to receive, enabling conditional receive logic and avoiding unnecessary `xQueueReceive()` calls on empty queues. A queue is considered empty when it contains no messages, regardless of its maximum capacity.

Common use cases:

- **Conditional receive:** Only call `xQueueReceive()` if messages available
- **Flow control:** Check for messages before processing
- **Diagnostics:** Monitor queue activity
- **Polling loops:** Detect when queue has been drained

Example 1: Conditional message processing

```

xQueue eventQueue;
void processEvents(void) {
    xBase isEmpty;
    if (OK(xQueueIsQueueEmpty(eventQueue, &isEmpty)) && !isEmpty) {
        // Queue has messages - process them
        xQueueMessage msg;
        while (OK(xQueueReceive(eventQueue, &msg))) {
            handleEvent(&msg);
            xMemFree((xAddr)msg.value);
        }
    }
}

```

Example 2: Wait for messages

```

xQueue dataQueue;
void waitForData(void) {
    xBase isEmpty = 1;
    // Poll until message arrives
    while (isEmpty) {
        if (OK(xQueueIsQueueEmpty(dataQueue, &isEmpty))) {
            if (isEmpty) {
                xTaskWait(10); // Wait before checking again
            }
        }
    }
    // Message available - process it
    xQueueMessage msg;
    if (OK(xQueueReceive(dataQueue, &msg))) {
        processData(&msg);
        xMemFree((xAddr)msg.value);
    }
}

```

Example 3: Drain queue completely

```

xQueue commandQueue;
void drainQueue(void) {
    xBase isEmpty;
    if (OK(xQueueIsQueueEmpty(commandQueue, &isEmpty))) {
        while (!isEmpty) {
            xQueueMessage msg;
            if (OK(xQueueReceive(commandQueue, &msg))) {
                xMemFree((xAddr)msg.value);
            }
            xQueueIsQueueEmpty(commandQueue, &isEmpty);
        }
    }
}

```

#### Parameters

in	<i>queue_</i> ↔	Handle to the queue to query. Must be a valid queue created with <code>xQueueCreate()</code> .
out	<i>res_</i>	Pointer to variable receiving the empty status. Set to non-zero (true) if queue is empty, zero (false) if queue contains one or more messages.

## Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid queue handle or queue not found.

## Note

This is a snapshot query—in multitasking environments, the queue state may change immediately after the check if other tasks send messages.

[xQueueIsQueueEmpty\(\)](#) is equivalent to checking if [xQueueMessagesWaiting\(\)](#) returns 0, but provides a more readable API for empty checks.

## See also

- [xQueueMessagesWaiting\(\)](#) - Get exact message count
- [xQueueIsQueueFull\(\)](#) - Check if queue is at capacity
- [xQueueReceive\(\)](#) - Receive message from queue
- [xQueuePeek\(\)](#) - Check message without removing it

**4.2.4.45 xQueueIsQueueFull()** `xReturn` `xQueueIsQueueFull` (

```
const xQueue queue_,
xBase * res_ )
```

Queries whether a message queue is full (at maximum capacity). This check allows tasks to determine if there is space available before attempting to send, enabling flow control and preventing message loss. A queue is considered full when the number of waiting messages equals the limit specified during [xQueueCreate\(\)](#). When full, [xQueueSend\(\)](#) will return ReturnError.

Common use cases:

- **Conditional send:** Only send if space available
- **Flow control:** Back off when queue approaches capacity
- **Overflow prevention:** Detect and handle full queue conditions
- **Diagnostics:** Monitor queue utilization and congestion

### Example 1: Conditional message send

```
xQueue commandQueue;
xReturn sendCommand(xByte *cmd, xBase size) {
    xBase isFull;
    if (OK(xQueueIsQueueFull(commandQueue, &isFull))) {
        if (isFull) {
            logWarning("Command queue full - dropping command");
            return ReturnError;
        }
        // Space available - send message
        return xQueueSend(commandQueue, size, cmd);
    }
    return ReturnError;
}
```

### Example 2: Flow control with backoff

```
xQueue dataQueue;
void sendDataWithBackoff(xByte *data, xBase size) {
    xBase isFull;
    xBase retries = 0;
    while (retries < 10) {
        if (OK(xQueueIsQueueFull(dataQueue, &isFull))) {
```

```
    if (!isFull) {  
        // Space available - send now  
        if (OK(xQueueSend(dataQueue, size, data))) {  
            return;  
        }  
    }  
    // Queue full - wait and retry  
    xTaskWait(10);  
    retries++;  
}  
logError("Failed to send data - queue full");  
}
```

### Example 3: Monitor queue pressure

```
xQueue eventQueue;  
void monitorQueuePressure(void) {  
    xBase isFull, waiting;  
    if (OK(xQueueIsQueueFull(eventQueue, &isFull)) && isFull) {  
        logWarning("Event queue at capacity");  
    } else if (OK(xQueueMessagesWaiting(eventQueue, &waiting))) {  
        xBase limit;  
        if (OK(xQueueGetLength(eventQueue, &limit))) {  
            if (waiting > (limit * 80) / 100) {  
                logWarning("Event queue nearly full: %d/%d", waiting, limit);  
            }  
        }  
    }  
}
```

### Parameters

in	<i>queue</i> ↔	Handle to the queue to query. Must be a valid queue created with <a href="#">xQueueCreate()</a> .
out	<i>res_</i>	Pointer to variable receiving the full status. Set to non-zero (true) if queue is full, zero (false) if queue has space for more messages.

### Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid queue handle or queue not found.

### Note

This is a snapshot query—in multitasking environments, the queue state may change immediately after the check if other tasks receive messages.

[xQueueIsQueueFull\(\)](#) checks if message count equals the limit. To check for nearly-full conditions, use [xQueueMessagesWaiting\(\)](#) and compare to [xQueueGetLength\(\)](#).

### See also

- [xQueueMessagesWaiting\(\)](#) - Get exact message count
- [xQueueIsQueueEmpty\(\)](#) - Check if queue has no messages
- [xQueueGetLength\(\)](#) - Get queue capacity
- [xQueueSend\(\)](#) - Send message (fails when queue is full)

#### 4.2.4.46 xQueueLockQueue() xReturn xQueueLockQueue (

xQueue queue\_ )

Places a queue in locked state, preventing tasks from sending new messages with `xQueueSend()`. While locked, send operations return `ReturnError` immediately. However, locked queues still allow receiving, peeking, and dropping messages— only send operations are blocked. This enables controlled queue drainage and prevents queue overflow during critical processing.

Queue locking is useful for implementing flow control, preventing message accumulation during batch processing, or ensuring a queue is drained before reconfiguration. Locks must be explicitly released with `xQueueUnLockQueue()` to resume normal operation—they do not timeout or automatically unlock.

Common use cases:

- **Batch processing:** Lock queue while processing all pending messages
- **Flow control:** Prevent producer overrun during high processing load
- **Queue drainage:** Ensure queue is empty before shutdown or reconfiguration
- **Critical sections:** Prevent message accumulation during critical operations

##### Example 1: Batch processing with lock

```
xQueue eventQueue;
void processBatch(void) {
    // Lock to prevent new messages during batch
    xQueueLockQueue(eventQueue);
    // Process all current messages
    xBase isEmpty;
    if (OK(xQueueIsEmpty(eventQueue, &isEmpty))) {
        while (!isEmpty) {
            xQueueMessage msg;
            if (OK(xQueueReceive(eventQueue, &msg))) {
                handleEvent(&msg);
                xMemFree((xAddr)msg.value);
            }
            xQueueIsEmpty(eventQueue, &isEmpty);
        }
    }
    // Unlock to resume message sending
    xQueueUnLockQueue(eventQueue);
}
```

##### Example 2: Controlled shutdown

```
xQueue commandQueue;
void shutdownCommandProcessor(void) {
    // Lock queue to prevent new commands
    xQueueLockQueue(commandQueue);
    // Process remaining commands
    xQueueMessage msg;
    while (OK(xQueueReceive(commandQueue, &msg))) {
        executeCommand(&msg);
        xMemFree((xAddr)msg.value);
    }
    // Delete queue (no need to unlock)
    xQueueDelete(commandQueue);
}
```

##### Parameters

in	<i>queue_↔</i>	Handle to the queue to lock. Must be a valid queue created with <code>xQueueCreate()</code> .
	—	

##### Returns

`ReturnOK` if queue locked successfully, `ReturnError` if operation failed due to invalid queue handle or queue not found.

**Warning**

Locking a queue does NOT prevent receiving, peeking, or dropping messages—only `xQueueSend()` is blocked. Consumers can still drain the queue while it is locked.

Locks must be explicitly released with `xQueueUnlockQueue()`. There is no automatic timeout or unlock mechanism.

**Note**

Locking an already-locked queue is safe and has no effect.

`xQueueSend()` on a locked queue returns `ReturnError` immediately without blocking or queuing the message.

**See also**

- `xQueueUnlockQueue()` - Unlock queue to resume sending
- `xQueueSend()` - Send message (fails on locked queue)
- `xQueueReceive()` - Receive message (works on locked queue)

**4.2.4.47 `xQueueMessagesWaiting()`** `xReturn` `xQueueMessagesWaiting` (  
     const `xQueue` `queue_`,  
     `xBase` \* `res_` )

Retrieves the count of messages currently waiting in a queue. This non-destructive query provides precise queue occupancy information, allowing tasks to make informed decisions about message processing, flow control, and resource allocation. The count represents messages successfully sent with `xQueueSend()` but not yet received with `xQueueReceive()`.

Common use cases:

- **Batch processing:** Process multiple messages when threshold reached
- **Queue utilization:** Monitor queue load and congestion
- **Flow control:** Throttle senders based on queue depth
- **Diagnostics:** Report queue activity for debugging

**Example 1: Batch message processing**

```
xQueue eventQueue;
#define BATCH_THRESHOLD 5
void processBatchEvents(void) {
    xBase waiting;
    if (OK(xQueueMessagesWaiting(eventQueue, &waiting))) {
        if (waiting >= BATCH_THRESHOLD) {
            // Process messages in batch for efficiency
            for (xBase i = 0; i < waiting; i++) {
                xQueueMessage msg;
                if (OK(xQueueReceive(eventQueue, &msg))) {
                    handleEvent(&msg);
                    xMemFree((xAddr)msg.value);
                }
            }
        }
    }
}
```

**Example 2: Queue utilization monitoring**

```
xQueue commandQueue;
void reportQueueStats(void) {
```

```

xBase waiting, limit;
if (OK(xQueueMessagesWaiting(commandQueue, &waiting)) &&
    OK(xQueueGetLength(commandQueue, &limit))) {
    xBase utilization = (waiting * 100) / limit;
    printf("Queue: %d/%d messages (%d%% full)\n",
        waiting, limit, utilization);
    if (utilization > 90) {
        logWarning("Queue nearly full - consider increasing capacity");
    }
}
}

```

### Example 3: Producer flow control

```

xQueue dataQueue;
#define HIGH_WATER_MARK 8
#define LOW_WATER_MARK 3
static xBase producerThrottled = 0;
void produceData(xByte *data, xBase size) {
    xBase waiting;
    if (OK(xQueueMessagesWaiting(dataQueue, &waiting))) {
        // Implement hysteresis for flow control
        if (waiting >= HIGH_WATER_MARK) {
            producerThrottled = 1;
            logInfo("Producer throttled - queue depth: %d", waiting);
        } else if (waiting <= LOW_WATER_MARK) {
            producerThrottled = 0;
        }
        if (!producerThrottled) {
            xQueueSend(dataQueue, size, data);
        }
    }
}

```

### Parameters

in	<i>queue</i> ↔	Handle to the queue to query. Must be a valid queue created with <a href="#">xQueueCreate()</a> .
out	<i>res_</i>	Pointer to variable receiving the message count. On success, contains the number of messages currently waiting (0 to limit).

### Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid queue handle or queue not found.

### Note

This is a snapshot query—in multitasking environments, the message count may change immediately after the query if other tasks send or receive messages.

The count includes all messages from the head to the tail of the queue. Messages accessed with [xQueuePeek\(\)](#) are still counted as waiting.

### See also

[xQueueIsQueueEmpty\(\)](#) - Check if count is zero (no messages)

[xQueueIsQueueFull\(\)](#) - Check if count equals limit (at capacity)

[xQueueGetLength\(\)](#) - Get queue maximum capacity

[xQueueReceive\(\)](#) - Remove and receive next message

[xQueueSend\(\)](#) - Add message to queue

**4.2.4.48 xQueuePeek()** `xReturn` xQueuePeek (

```

    const xQueue queue_,
    xQueueMessage * message_ )

```

Retrieves a copy of the oldest message from the queue without removing it, allowing inspection of queue contents without consuming messages. Unlike `xQueueReceive()`, which removes the message, `xQueuePeek()` leaves the queue unchanged—the message remains available for subsequent peek or receive operations. This enables conditional message processing and queue inspection.

The peeked message is allocated from the heap as a copy—the original message stays in the queue. The caller must free the peeked message copy with `xMemFree()` after use. Multiple peek calls return the same message until it is removed with `xQueueReceive()` or `xQueueDropMessage()`.

Common use cases:

- **Conditional processing:** Inspect message before deciding to receive
- **Message filtering:** Check message type/priority before consuming
- **Queue monitoring:** Examine next message without affecting queue state
- **Priority handling:** Process high-priority messages first

#### Example 1: Priority message handling

```

xQueue eventQueue;
#define MSG_PRIORITY_HIGH 1
#define MSG_PRIORITY_NORMAL 0
void processEvents(void) {
    xQueueMessage msg;
    // Peek at next message
    if (OK(xQueuePeek(eventQueue, &msg))) {
        xByte priority = msg.value[0]; // Assume first byte is priority
        if (priority == MSG_PRIORITY_HIGH) {
            // High priority - receive and process immediately
            xMemFree((xAddr)msg.value); // Free peek copy
            xQueueReceive(eventQueue, &msg);
            handleHighPriority(&msg);
            xMemFree((xAddr)msg.value);
        } else {
            // Normal priority - skip for now
            xMemFree((xAddr)msg.value); // Free peek copy
        }
    }
}

```

#### Example 2: Message type filtering

```

xQueue commandQueue;
xBase hasCommandType(xByte type) {
    xQueueMessage msg;
    // Peek without consuming
    if (OK(xQueuePeek(commandQueue, &msg))) {
        xByte cmdType = msg.value[0];
        xMemFree((xAddr)msg.value);
        return (cmdType == type);
    }
    return 0;
}

```

#### Parameters

in	<i>queue_</i>	Handle to the queue to peek. Must be a valid queue created with <code>xQueueCreate()</code> .
out	<i>message_</i> —	Pointer to <code>xQueueMessage</code> structure receiving a copy of the message. Memory is allocated for message->value and must be freed with <code>xMemFree()</code> after use.

**Returns**

ReturnOK if message peeked successfully, ReturnError if peek failed due to empty queue, invalid queue handle, or memory allocation failure.

**Warning**

The peeked message is a heap-allocated COPY. You must free it with [xMemFree\(\)](#) even though the original message remains in the queue.

Multiple peeks return the SAME message until it is removed. If you peek, then another task receives the message, subsequent peeks will return the next message in the queue.

**Note**

[xQueuePeek\(\)](#) does not modify the queue state—message count and queue position remain unchanged.

**See also**

[xQueueReceive\(\)](#) - Receive and remove message

[xQueueDropMessage\(\)](#) - Remove message without retrieving

[xQueueMessagesWaiting\(\)](#) - Check if messages available before peeking

[xMemFree\(\)](#) - Free peeked message copy

**4.2.4.49 xQueueReceive()** `xReturn xQueueReceive (`  
    `xQueue queue_,`  
    `xQueueMessage * message_ )`

Retrieves the oldest message from the specified queue and removes it, making space for new messages. This is the primary mechanism for tasks to receive data from other tasks in a producer-consumer pattern. The operation is non-blocking and returns immediately whether a message is available or not.

This function combines the operations of [xQueuePeek\(\)](#) (examine message) and [xQueueDropMessage\(\)](#) (remove message) into a single atomic operation, ensuring thread-safe message retrieval even with multiple consumers.

The received message is allocated from the heap and must be freed by the caller using [xMemFree\(\)](#) after processing. This heap allocation is necessary because message size is variable.

Message Receiving Process:

1. Check if queue has messages (not empty)
2. Allocate xQueueMessage structure from heap
3. Copy oldest message data into structure
4. Remove message from queue
5. Return message structure to caller
6. Caller processes message then frees with [xMemFree\(\)](#)

Typical Consumer Pattern:



1. Check if messages are waiting (optional optimization)
2. Call `xQueueReceive()` to get message
3. Check return value - success means message received
4. Process message->message bytes (size is in message->size)
5. Free message structure with `xMemFree()`

#### Warning

The returned message structure is allocated from the heap and MUST be freed by the caller using `xMemFree()`. Failing to free messages will cause memory leaks and eventually exhaust available heap memory.

#### Note

If the queue is empty, `xQueueReceive()` returns `ReturnError` immediately without blocking. Check queue status with `xQueueIsQueueEmpty()` or `xQueueMessagesWaiting()` before receiving if needed.

The `xQueueMessage` structure contains:

- message->size: Number of bytes in the message
- message->message: Pointer to the message data bytes

Unlike `xQueuePeek()` which leaves the message in the queue, `xQueueReceive()` removes the message, allowing the next message to be retrieved on the next call.

#### Example Usage:

```
xQueue commandQueue;
xQueueCreate(&commandQueue, 10);
// Consumer task: Process commands from queue
void commandProcessorTask(xTask task, xTaskParam parm) {
    xQueueMessage *msg = NULL;
    // Try to receive a message
    if (OK(xQueueReceive(commandQueue, &msg))) {
        // Message received successfully
        // Process based on message size and content
        if (msg->size == 1) {
            // Single byte command
            uint8_t cmd = msg->message[0];
            handleCommand(cmd);
        } else if (msg->size == sizeof(SensorData_t)) {
            // Structure message
            SensorData_t *data = (SensorData_t *)msg->message;
            processSensorData(data);
        }
        // IMPORTANT: Free the message structure
        xMemFree((xAddr)msg);
    } else {
        // No messages available - queue empty
    }
}
// Complete producer-consumer example
xQueue dataQueue;
// Producer
void producerTask(xTask task, xTaskParam parm) {
    uint8_t data[4] = {0x01, 0x02, 0x03, 0x04};
    xQueueSend(dataQueue, sizeof(data), data);
}
// Consumer
void consumerTask(xTask task, xTaskParam parm) {
    xQueueMessage *msg = NULL;
    // Check for messages first (optional optimization)
    xBase_t numMessages;
    if (OK(xQueueMessagesWaiting(dataQueue, &numMessages))) {
        if (numMessages > 0) {
            // Messages available, receive one
            if (OK(xQueueReceive(dataQueue, &msg))) {
                // Process msg->message[0] through msg->message[msg->size-1]
                processData(msg->message, msg->size);
                xMemFree((xAddr)msg);
            }
        }
    }
}
```

```

    }
}
}
// Process all pending messages
xBASE isEmpty;
while (OK(xQueueIsEmpty(dataQueue, &isEmpty)) && !isEmpty) {
    xQueueMessage *msg = NULL;
    if (OK(xQueueReceive(dataQueue, &msg))) {
        processMessage(msg);
        xMemFree((xAddr)msg);
    }
}
}

```

#### Parameters

in	<i>queue_</i>	Handle of the queue to receive from. Must be a valid queue handle previously returned by <a href="#">xQueueCreate()</a> .
out	<i>message_</i> ↔ —	Pointer to xQueueMessage pointer variable. On success, receives a pointer to the message structure containing the message data and size. Caller MUST free this with <a href="#">xMemFree()</a> .

#### Returns

ReturnOK if a message was successfully received and removed from the queue, ReturnError if the receive failed (queue empty, invalid queue handle, memory allocation failed, or null message pointer).

#### See also

[xQueueSend\(\)](#) - Send a message to the queue (producer operation)  
[xQueuePeek\(\)](#) - Examine next message without removing it  
[xQueueDropMessage\(\)](#) - Remove message after peeking  
[xQueueIsQueueEmpty\(\)](#) - Check if queue has no messages  
[xQueueMessagesWaiting\(\)](#) - Get number of messages in queue  
[xQueueCreate\(\)](#) - Create a new message queue  
[xMemFree\(\)](#) - Free the message structure (REQUIRED!)

**4.2.4.50 xQueueSend()** [xReturn](#) xQueueSend (

```

    xQueue queue_,
    const xBase bytes_,
    const xByte * value_ )

```

Adds a message to the specified queue, copying the provided data into the queue's internal storage. This is the primary mechanism for tasks to send data to other tasks in a producer-consumer pattern. The operation is non-blocking and returns immediately whether successful or not.

Messages are stored in FIFO order and will be retrieved by [xQueueReceive\(\)](#) in the same order they were sent. Each message is a byte array up to CONFIG\_MESSAGE\_VALUE\_BYTES (default 8) bytes, allowing flexible message formats including structures, commands, sensor readings, or any other data that fits within the size limit.

#### Message Sending Process:

1. Check if queue has space (not full)

2. Copy message data into queue storage
3. Increment queue message count
4. Return success or failure immediately (non-blocking)

Common Message Patterns:

- **Commands:** Single byte command codes (e.g., 0x01 = START, 0x02 = STOP)
- **Sensor data:** Multi-byte readings packed into message
- **Events:** Event type and optional data
- **Pointers:** Address of larger data structure (use with caution)
- **Structures:** Small structs that fit within byte limit

#### Warning

Messages are limited to CONFIG\_MESSAGE\_VALUE\_BYTES bytes (default 8). Attempting to send larger messages will fail. For larger data, consider sending a pointer to heap-allocated data or using multiple messages.

The message data is COPIED into the queue. The original buffer can be reused or freed immediately after `xQueueSend()` returns. The queue maintains its own copy.

#### Note

If the queue is full, `xQueueSend()` returns `ReturnError` immediately without blocking. Check queue status with `xQueueIsQueueFull()` before sending if needed, or handle send failures appropriately.

Messages are copied, not moved. This ensures the sender retains control of its data and prevents aliasing issues.

#### Example Usage:

```
xQueue dataQueue;
xQueueCreate(&dataQueue, 10);
// Send a simple command byte
uint8_t command = 0x42;
if (OK(xQueueSend(dataQueue, 1, &command))) {
    // Command queued successfully
}
// Send sensor reading (multi-byte)
typedef struct {
    uint16_t temperature;
    uint16_t humidity;
} SensorReading_t;
SensorReading_t reading;
reading.temperature = 2350; // 23.50°C
reading.humidity = 6500; // 65.00%
if (OK(xQueueSend(dataQueue, sizeof(SensorReading_t), (xByte *)&reading))) {
    // Sensor data queued
} else {
    // Queue full - handle overflow
    handleQueueOverflow();
}
// Producer task example
void sensorTask(xTask task, xTaskParm parm) {
    uint8_t sensorData[4];
    readSensors(sensorData);
    // Try to send, handle failure
    if (ERROR(xQueueSend(dataQueue, sizeof(sensorData), sensorData))) {
        // Queue full - either drop data or wait
        dataSamplesDropped++;
    }
}
// Check queue space before sending
xBase isFull;
if (OK(xQueueIsQueueFull(dataQueue, &isFull)) && !isFull) {
    // Safe to send
    xQueueSend(dataQueue, msgSize, msgData);
}
```

## Parameters

in	<i>queue</i> ↔ —	Handle of the queue to send to. Must be a valid queue handle previously returned by <a href="#">xQueueCreate()</a> .
in	<i>bytes</i> ↔ —	Size of the message in bytes. Must be greater than 0 and not exceed <code>CONFIG_MESSAGE_VALUE_BYTES</code> (default 8).
in	<i>value</i> ↔ —	Pointer to the message data to send. The data will be copied into the queue, so this buffer can be reused after the call.

## Returns

ReturnOK if the message was successfully added to the queue, ReturnError if the send failed (queue full, invalid queue handle, invalid size, or null value pointer).

## See also

[xQueueReceive\(\)](#) - Receive a message from the queue (consumer operation)  
[xQueuePeek\(\)](#) - Examine next message without removing it  
[xQueueIsQueueFull\(\)](#) - Check if queue is at capacity  
[xQueueMessagesWaiting\(\)](#) - Get number of messages in queue  
[xQueueCreate\(\)](#) - Create a new message queue  
[xQueueLockQueue\(\)](#) - Lock queue during critical operations  
[CONFIG\\_MESSAGE\\_VALUE\\_BYTES](#) - Maximum message size configuration

#### 4.2.4.51 xQueueUnLockQueue() `xReturn` xQueueUnLockQueue ( `xQueue queue_` )

Removes the locked state from a queue, allowing tasks to resume sending messages with [xQueueSend\(\)](#). After unlocking, the queue returns to normal operation where send operations succeed (if queue is not full). This function must be called to restore normal queue behavior after locking with [xQueueLockQueue\(\)](#).

Unlocking affects only send operations—receive, peek, and drop operations were unaffected by the lock and continue to work normally after unlock.

Common use cases:

- **Resume normal operation:** Re-enable message sending after batch processing
- **End critical section:** Allow producers to continue after critical operations
- **Flow control:** Resume accepting messages after backpressure relieved

#### Example 1: Lock/unlock pattern for batch processing

```
xQueue dataQueue;
void batchProcessor(void) {
    // Lock to get consistent snapshot
    xQueueLockQueue(dataQueue);
    xBase count;
    if (OK(xQueueMessagesWaiting(dataQueue, &count))) {
        // Process exactly this many messages
        for (xBase i = 0; i < count; i++) {
            xQueueMessage msg;
            if (OK(xQueueReceive(dataQueue, &msg))) {
```

```

        processBatchItem(&msg);
        xMemFree((xAddr)msg.value);
    }
}
// Unlock to allow new messages
xQueueUnLockQueue(dataQueue);
}

```

#### Example 2: Conditional unlock based on processing result

```

xQueue eventQueue;
xBase processCriticalEvents(void) {
    xQueueLockQueue(eventQueue);
    xBase success = 1;
    xQueueMessage msg;
    while (OK(xQueueReceive(eventQueue, &msg)) && success) {
        if (ERROR(handleCriticalEvent(&msg))) {
            success = 0; // Processing failed
        }
        xMemFree((xAddr)msg.value);
    }
    if (success) {
        // Success - resume normal operation
        xQueueUnLockQueue(eventQueue);
    } else {
        // Failure - leave locked for manual intervention
        logError("Critical event processing failed - queue locked");
    }
    return success;
}

```

#### Parameters

in	<i>queue</i> ↔	Handle to the queue to unlock. Must be a valid queue created with <a href="#">xQueueCreate()</a> .
	—	

#### Returns

ReturnOK if queue unlocked successfully, ReturnError if operation failed due to invalid queue handle or queue not found.

#### Warning

Unlocking an already-unlocked queue is safe and has no effect.

#### Note

Always pair [xQueueLockQueue\(\)](#) with [xQueueUnLockQueue\(\)](#) to avoid leaving queues permanently locked, which would prevent all future message sending.

If you delete a locked queue with [xQueueDelete\(\)](#), you do not need to unlock it first—the deletion frees all queue resources including lock state.

#### See also

[xQueueLockQueue\(\)](#) - Lock queue to prevent sending

[xQueueSend\(\)](#) - Send message (enabled after unlock)

[xQueueReceive\(\)](#) - Receive message (always works)

**4.2.4.52 xStreamBytesAvailable()** `xReturn` xStreamBytesAvailable (

```
const xStreamBuffer stream_,
xHalfWord * bytes_ )
```

Returns the count of bytes currently available for retrieval in the specified stream buffer without removing them. This non-destructive query allows tasks to check data availability before committing to receive operations, enabling more sophisticated flow control and buffering strategies.

Unlike `xStreamReceive()` which retrieves and removes bytes from the stream, `xStreamBytesAvailable()` is a read-only query that leaves the stream contents unchanged. This makes it useful for making decisions about when to process data, whether to wait for more data, or how to handle buffer capacity.

Common use cases:

- **Threshold-based processing:** Wait until minimum amount of data available
- **Flow control:** Monitor buffer levels to regulate producer rate
- **Batch optimization:** Collect data until optimal batch size reached
- **Buffer monitoring:** Check capacity before sending more data
- **Conditional receive:** Decide whether to retrieve data based on quantity

Example 1: Threshold-based data processing

```
xStreamBuffer dataStream;
#define MIN_DATA_SIZE 16
void processDataTask(xTask task, xTaskParam parm) {
    xHalfWord available;
    // Check if enough data accumulated
    if (OK(xStreamBytesAvailable(dataStream, &available))) {
        if (available >= MIN_DATA_SIZE) {
            // Enough data - retrieve and process
            xHalfWord count;
            xByte *data;
            if (OK(xStreamReceive(dataStream, &count, &data))) {
                processBatch(data, count);
                xMemFree((xAddr) data);
            }
        }
        // Otherwise wait for more data
    }
}
```

Example 2: Producer flow control

```
xStreamBuffer txStream;
#define HIGH_WATER_MARK 28
#define LOW_WATER_MARK 8
void sendDataTask(xTask task, xTaskParam parm) {
    static xBase throttled = 0;
    xHalfWord buffered;
    if (OK(xStreamBytesAvailable(txStream, &buffered))) {
        // Implement hysteresis for flow control
        if (buffered >= HIGH_WATER_MARK) {
            throttled = 1; // Stop sending
        } else if (buffered <= LOW_WATER_MARK) {
            throttled = 0; // Resume sending
        }
        if (!throttled) {
            xByte data = getNextByte();
            xStreamSend(txStream, data);
        }
    }
}
```

Example 3: Capacity checking before bulk send

```
xStreamBuffer protocolStream;
xReturn sendFrame(xByte *frame, xHalfWord frameLen) {
    xHalfWord available;
    xHalfWord capacity;
    // Check current buffer usage
    if (OK(xStreamBytesAvailable(protocolStream, &available))) {
        capacity = CONFIG_STREAM_BUFFER_BYTES - available;
        // Verify enough space for entire frame
    }
}
```

```

    if (capacity >= frameLen) {
        // Send all bytes
        for (xHalfWord i = 0; i < frameLen; i++) {
            if (ERROR(xStreamSend(protocolStream, frame[i]))) {
                return ReturnError; // Unexpected failure
            }
        }
        return ReturnOK;
    } else {
        // Not enough space - return error or wait
        return ReturnError;
    }
}
return ReturnError;
}

```

#### Example 4: Monitoring with status reporting

```

xStreamBuffer sensorStream;
void monitorTask(xTask task, xTaskParm parm) {
    static xHalfWord maxObserved = 0;
    xHalfWord current;
    if (OK(xStreamBytesAvailable(sensorStream, &current))) {
        // Track high-water mark
        if (current > maxObserved) {
            maxObserved = current;
        }
        // Calculate utilization percentage
        xByte utilization = (xByte)((current * 100) / CONFIG_STREAM_BUFFER_BYTES);
        // Report if approaching capacity
        if (utilization > 90) {
            logWarning("Stream buffer near capacity", utilization);
        }
    }
}

```

#### Parameters

in	<i>stream</i> ↔ —	Handle to the stream buffer to query. Must be a valid stream created with <a href="#">xStreamCreate()</a> .
out	<i>bytes</i> ↔ —	Pointer to variable receiving the byte count. On success, contains the number of bytes currently waiting in the stream (0 to CONFIG_STREAM_BUFFER_BYTES).

#### Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid stream handle or stream not found.

#### Warning

This function only reports the current state of the stream buffer. In multitasking environments, the byte count may change immediately after the query if other tasks send or receive data. Use appropriate synchronization if you need atomic check-and-receive operations.

#### Note

[xStreamBytesAvailable\(\)](#) is a non-destructive query—it does not modify the stream contents or affect subsequent operations.

The returned byte count includes all bytes sent with [xStreamSend\(\)](#) that have not yet been retrieved with [xStreamReceive\(\)](#).

To calculate free space in the stream, subtract bytes\_ from CONFIG\_STREAM\_BUFFER\_BYTES: freeSpace = CONFIG\_STREAM\_BUFFER\_BYTES - bytes\_

See also

- [xStreamReceive\(\)](#) - Retrieve and remove bytes from stream
- [xStreamSend\(\)](#) - Send byte to stream
- [xStreamIsEmpty\(\)](#) - Check if stream has no waiting bytes
- [xStreamIsFull\(\)](#) - Check if stream is at capacity
- [xStreamReset\(\)](#) - Clear all bytes from stream
- [xStreamCreate\(\)](#) - Create a stream buffer

**4.2.4.53 xStreamCreate()** `xReturn xStreamCreate (`  
`xStreamBuffer * stream_ )`

Creates a new stream buffer for byte-by-byte data transfer between tasks. Stream buffers provide a lightweight alternative to message queues when communicating variable-length byte sequences or continuous data streams. Unlike queues which handle discrete messages, streams accept individual bytes that accumulate in a circular buffer until consumed by a receiver.

Stream buffers are ideal for:

- **Serial/UART data:** Buffering incoming bytes from serial ports
- **Protocol parsing:** Accumulating bytes until a complete frame is ready
- **Sensor streaming:** Continuous data collection from sensors
- **Character-based I/O:** Terminal or text-based interfaces
- **Variable-length data:** When message size isn't known in advance

Key characteristics:

- Fixed capacity: `CONFIG_STREAM_BUFFER_BYTES` (default 32 bytes)
- FIFO ordering: Bytes are retrieved in the order they were sent
- Byte-level granularity: Send and receive one byte at a time
- No message boundaries: Unlike queues, streams don't preserve message structure
- Lightweight: Lower overhead than message queues for byte-oriented data

Stream Lifecycle:

1. Create stream with [xStreamCreate\(\)](#) (allocates kernel resources)
2. Producer tasks send bytes with [xStreamSend\(\)](#)
3. Consumer tasks receive bytes with [xStreamReceive\(\)](#)
4. Optionally query status with [xStreamBytesAvailable\(\)](#), [xStreamIsEmpty\(\)](#), [xStreamIsFull\(\)](#)
5. Optionally clear stream with [xStreamReset\(\)](#)
6. Delete stream with [xStreamDelete\(\)](#) when no longer needed



## Example 1: UART receive buffer

```

xStreamBuffer uartRxStream;
// Create stream during initialization
if (OK(xStreamCreate(&uartRxStream))) {
    // Stream ready for use
}
// ISR or receive task sends bytes as they arrive
void uartISR(void) {
    xByte rxByte = UART_DATA_REG;
    xStreamSend(uartRxStream, rxByte);
}
// Processing task receives accumulated data
void processUART(xTask task, xTaskParm parm) {
    xHalfWord count;
    xByte *data;
    if (OK(xStreamReceive(uartRxStream, &count, &data))) {
        if (count > 0) {
            processReceivedData(data, count);
            xMemFree((xAddr)data); // Always free received data
        }
    }
}

```

## Example 2: Protocol parser with framing

```

xStreamBuffer protocolStream;
void setupProtocol(void) {
    xStreamCreate(&protocolStream);
}
// Producer accumulates bytes
void receiveTask(xTask task, xTaskParm parm) {
    xByte receivedByte = getByteFromSource();
    xStreamSend(protocolStream, receivedByte);
    // Check if frame delimiter received
    if (receivedByte == FRAME_END_MARKER) {
        xTaskNotifyGive(parserTask); // Signal parser
    }
}
// Consumer processes complete frames
void parserTask(xTask task, xTaskParm parm) {
    xHalfWord frameSize;
    xByte *frame;
    xTaskWait(1); // Wait for notification
    if (OK(xStreamReceive(protocolStream, &frameSize, &frame))) {
        parseProtocolFrame(frame, frameSize);
        xMemFree((xAddr)frame);
    }
}

```

## Example 3: Sensor data streaming

```

xStreamBuffer sensorStream;
void initSensors(void) {
    xStreamCreate(&sensorStream);
}
// High-frequency sensor sampling
void sampleSensor(xTask task, xTaskParm parm) {
    xByte sample = readADC();
    xBase isFull;
    if (OK(xStreamIsFull(sensorStream, &isFull)) && isFull) {
        // Stream full - handle overflow
        xStreamReset(sensorStream); // Discard old data
    }
    xStreamSend(sensorStream, sample);
}
// Lower-frequency processing
void processSamples(xTask task, xTaskParm parm) {
    xHalfWord sampleCount;
    xByte *samples;
    if (OK(xStreamReceive(sensorStream, &sampleCount, &samples))) {
        if (sampleCount >= MIN_SAMPLES_FOR_PROCESSING) {
            computeStatistics(samples, sampleCount);
        }
        xMemFree((xAddr)samples);
    }
}

```

## Parameters

out	<i>stream</i> ↔	Pointer to xStreamBuffer handle to be initialized. After successful creation, this handle is used in all subsequent stream operations. The handle remains valid until <a href="#">xStreamDelete()</a> is called.
	—	

### Returns

ReturnOK if stream created successfully, ReturnError if creation failed due to insufficient memory or invalid parameters.

### Warning

Stream buffers have a fixed capacity defined by CONFIG\_STREAM\_BUFFER\_BYTES (typically 32 bytes). Sending to a full stream will fail with ReturnError. Use [xStreamIsFull\(\)](#) to check capacity before sending critical data.

The stream\_ parameter must point to valid memory. Passing null will result in ReturnError.

### Note

Stream buffers are allocated from kernel memory and persist until explicitly deleted with [xStreamDelete\(\)](#). Always delete streams when no longer needed to prevent memory leaks.

Unlike message queues, streams do not preserve message boundaries. If you send bytes "ABC" and "DEF" separately, the receiver sees "ABCDEF" as a continuous byte sequence. Implement your own framing if you need to distinguish between separate transmissions.

Streams operate on individual bytes (xByte/Byte\_t). To send multi-byte values, send each byte separately or use a message queue instead.

### See also

- [xStreamDelete\(\)](#) - Delete stream and free resources
- [xStreamSend\(\)](#) - Send byte to stream
- [xStreamReceive\(\)](#) - Receive all waiting bytes from stream
- [xStreamBytesAvailable\(\)](#) - Query number of bytes waiting in stream
- [xStreamReset\(\)](#) - Clear all bytes from stream
- [xStreamIsEmpty\(\)](#) - Check if stream has no waiting bytes
- [xStreamIsFull\(\)](#) - Check if stream is at capacity
- [xQueueCreate\(\)](#) - Alternative for message-oriented communication

**4.2.4.54 xStreamDelete()** `xReturn xStreamDelete (`  
`const xStreamBuffer stream_ )`

Deletes a stream buffer created by [xStreamCreate\(\)](#), freeing all associated kernel memory and resources. After deletion, the stream handle becomes invalid and must not be used in any subsequent stream operations. Any bytes waiting in the stream at the time of deletion are discarded.

This function should be called when a stream buffer is no longer needed to prevent memory leaks in long-running embedded systems. Proper resource cleanup is essential for system reliability, especially in applications that dynamically create and destroy communication channels.

Deletion scenarios:

- **Application shutdown:** Clean up resources during de-initialization
- **Dynamic reconfiguration:** Remove old streams when changing communication topology

- **Error recovery:** Delete and recreate streams after communication failures
- **Resource management:** Free streams in resource-constrained systems

#### Example 1: Basic stream cleanup

```
xStreamBuffer tempStream;
// Create stream for temporary operation
if (OK(xStreamCreate(&tempStream))) {
    // Use stream for data transfer
    xStreamSend(tempStream, 0x42);
    // ... perform operations ...
    // Clean up when done
    xStreamDelete(tempStream);
}
```

#### Example 2: Communication channel lifecycle

```
xStreamBuffer channelStream = null;
void openChannel(void) {
    if (OK(xStreamCreate(&channelStream))) {
        // Channel ready for use
    }
}
void closeChannel(void) {
    if (channelStream != null) {
        xStreamDelete(channelStream);
        channelStream = null; // Prevent use-after-delete
    }
}
```

#### Example 3: Error recovery with stream recreation

```
xStreamBuffer dataStream;
void setupDataStream(void) {
    xStreamCreate(&dataStream);
}
void resetCommunication(void) {
    // Delete corrupted stream
    xStreamDelete(dataStream);
    // Wait briefly for cleanup
    delayMs(10);
    // Create fresh stream
    if (OK(xStreamCreate(&dataStream))) {
        // Stream reset successful
    }
}
```

#### Parameters

in	<i>stream</i> ↔	Handle to the stream buffer to delete. Must be a valid handle obtained from a previous successful call to <a href="#">xStreamCreate()</a> . After deletion, this handle becomes invalid.
	—	

#### Returns

ReturnOK if stream deleted successfully, ReturnError if deletion failed due to invalid handle or stream not found.

#### Warning

After calling [xStreamDelete\(\)](#), the stream handle becomes invalid and must not be used in any subsequent stream operations. Attempting to use a deleted stream will result in ReturnError.

If other tasks hold references to the stream buffer, ensure they stop using the stream before deletion. Deleting a stream while other tasks are actively sending or receiving data may cause those operations to fail with ReturnError.

Any bytes waiting in the stream buffer at the time of deletion are permanently lost. If you need to preserve data, call [xStreamReceive\(\)](#) to retrieve all pending bytes before deleting the stream.

**Note**

It is good practice to set the stream handle to null after deletion to prevent accidental use of an invalid handle (use-after-delete bugs).

`xStreamDelete()` only affects the stream buffer itself. Any data previously received with `xStreamReceive()` and stored in heap memory remains allocated until explicitly freed with `xMemFree()`.

**See also**

`xStreamCreate()` - Create a new stream buffer

`xStreamReset()` - Clear stream contents without deleting the stream

`xStreamReceive()` - Retrieve pending bytes before deletion

`xMemFree()` - Free memory allocated by `xStreamReceive()`

**4.2.4.55 xStreamIsEmpty()** `xReturn` xStreamIsEmpty (   
     const `xStreamBuffer` stream\_,   
     `xBase` \* res\_ )

Queries whether the specified stream buffer is empty (contains zero bytes). This is a boolean status check that provides a simple, readable way to test for data availability without needing to interpret byte counts. An empty stream has no data waiting to be retrieved.

This function is logically equivalent to checking if `xStreamBytesAvailable()` returns 0, but offers more expressive code when you only need a boolean empty/not-empty status rather than the exact byte count.

Common use cases:

- **Conditional processing:** Skip receive operations when no data available
- **Stream state verification:** Confirm stream cleared after reset
- **Idle detection:** Determine if communication channel is idle
- **Polling optimization:** Avoid unnecessary memory allocations for empty receives

**Example 1: Conditional receive**

```
xStreamBuffer dataStream;
void processTask(xTask task, xTaskParm parm) {
    xBase isEmpty;
    // Check before attempting receive
    if (OK(xStreamIsEmpty(dataStream, &isEmpty)) && !isEmpty) {
        // Data available - retrieve and process
        xHalfWord count;
        xByte *data;
        if (OK(xStreamReceive(dataStream, &count, &data))) {
            processData(data, count);
            xMemFree((xAddr)data);
        }
    }
    // Otherwise skip processing this cycle
}
```

**Example 2: Verify reset completion**

```
xStreamBuffer protocolStream;
void resetProtocol(void) {
    xStreamReset(protocolStream);
    // Verify stream actually empty
    xBase isEmpty;
    if (OK(xStreamIsEmpty(protocolStream, &isEmpty))) {
        if (isEmpty) {
            // Reset confirmed - ready for new data
        }
    }
}
```

```

        protocolState = PROTOCOL_IDLE;
    } else {
        // Unexpected - reset failed?
        handleError();
    }
}
}

```

### Example 3: Communication idle detection

```

xStreamBuffer rxStream;
xTimer idleTimer;
void monitorActivity(xTask task, xTaskParam parm) {
    xBase isEmpty;
    xBase timerExpired;
    if (OK(xStreamIsEmpty(rxStream, &isEmpty)) && isEmpty) {
        // No data waiting - check how long idle
        if (OK(xTimerHasTimerExpired(idleTimer, &timerExpired)) && timerExpired) {
            // Idle timeout - enter power-saving mode
            enterLowPowerMode();
        }
    } else {
        // Activity detected - reset idle timer
        xTimerReset(idleTimer);
    }
}

```

### Parameters

in	<i>stream</i> ↔ —	Handle to the stream buffer to query. Must be a valid stream created with <a href="#">xStreamCreate()</a> .
out	<i>res_</i>	Pointer to variable receiving the empty status. Set to non-zero (true) if stream is empty (0 bytes waiting), zero (false) if stream contains data.

### Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid stream handle or stream not found.

### Note

This is a non-destructive query that does not modify stream contents.

For more detailed information about stream state, use [xStreamBytesAvailable\(\)](#) to get the exact byte count instead of just empty/not-empty status.

### See also

[xStreamBytesAvailable\(\)](#) - Get exact byte count

[xStreamIsFull\(\)](#) - Check if stream is at capacity

[xStreamReceive\(\)](#) - Retrieve bytes from stream

[xStreamReset\(\)](#) - Clear stream to empty state

[xStreamCreate\(\)](#) - Create a stream buffer

**4.2.4.56 xStreamIsFull()** `xReturn xStreamIsFull (`  
`const xStreamBuffer stream_,`  
`xBase * res_ )`

Queries whether the specified stream buffer is full (contains the maximum number of bytes defined by `CONFIG_STREAM_BUFFER_BYTES`, typically 32). This boolean status check provides a simple way to test for buffer saturation before attempting send operations or to implement overflow handling strategies.

A full stream cannot accept additional bytes via `xStreamSend()` until space is freed by `xStreamReceive()` or `xStreamReset()`. This function is logically equivalent to checking if `xStreamBytesAvailable()` equals `CONFIG_STREAM_BUFFER_BYTES`, but offers more expressive code for capacity-related logic.

Common use cases:

- **Pre-send validation:** Check capacity before attempting `xStreamSend()`
- **Overflow prevention:** Detect full condition to trigger consumer notification
- **Flow control:** Throttle producers when buffer reaches capacity
- **Overflow strategies:** Decide whether to drop data, reset buffer, or block
- **Buffer health monitoring:** Track how often buffer reaches capacity

#### Example 1: Pre-send capacity check

```
xStreamBuffer txStream;
xReturn sendByte(xByte data) {
    xBase isFull;
    // Check capacity before sending
    if (OK(xStreamIsFull(txStream, &isFull))) {
        if (isFull) {
            // Buffer full - return error or wait
            return ReturnError;
        }
        // Space available - send byte
        return xStreamSend(txStream, data);
    }
    return ReturnError;
}
```

#### Example 2: Overflow handling with notification

```
xStreamBuffer dataStream;
xTask consumerTask;
void producerTask(xTask task, xTaskParm parm) {
    xByte data = generateData();
    xBase isFull;
    // Check if buffer full
    if (OK(xStreamIsFull(dataStream, &isFull)) && isFull) {
        // Wake up consumer to drain buffer
        xTaskNotifyGive(consumerTask);
        // Wait briefly for consumer
        delayMs(5);
    }
    // Attempt send
    if (ERROR(xStreamSend(dataStream, data))) {
        // Still full - data lost
        logDataLoss();
    }
}
```

#### Example 3: Overflow strategy selection

```
typedef enum {
    OVERFLOW_DROP_OLDEST,
    OVERFLOW_DROP_NEWEST,
    OVERFLOW_ERROR
} OverflowStrategy_t;
xStreamBuffer sensorStream;
OverflowStrategy_t strategy = OVERFLOW_DROP_OLDEST;
void recordSample(xByte sample) {
    xBase isFull;
    if (OK(xStreamIsFull(sensorStream, &isFull)) && isFull) {
        switch (strategy) {
            case OVERFLOW_DROP_OLDEST:
                // Clear buffer and add new sample

```

```

        xStreamReset(sensorStream);
        xStreamSend(sensorStream, sample);
        break;
    case OVERFLOW_DROP_NEWEST:
        // Discard new sample, keep old data
        logDroppedSample();
        break;
    case OVERFLOW_ERROR:
        // Report error condition
        handleBufferOverflow();
        break;
    }
} else {
    // Normal send
    xStreamSend(sensorStream, sample);
}
}

```

#### Example 4: Buffer utilization monitoring

```

xStreamBuffer commStream;
typedef struct {
    xWord fullCount;
    xWord totalChecks;
    xByte peakUtilization;
} BufferStats_t;
BufferStats_t stats = {0, 0, 0};
void monitorBuffer(xTask task, xTaskParm parm) {
    xBase isFull;
    xHalfWord available;
    stats.totalChecks++;
    if (OK(xStreamIsFull(commStream, &isFull)) && isFull) {
        stats.fullCount++;
    }
    // Track peak utilization
    if (OK(xStreamBytesAvailable(commStream, &available))) {
        xByte utilization = (xByte)((available * 100) / CONFIG_STREAM_BUFFER_BYTES);
        if (utilization > stats.peakUtilization) {
            stats.peakUtilization = utilization;
        }
    }
    // Report statistics periodically
    if (stats.totalChecks % 1000 == 0) {
        xByte fullPercent = (xByte)((stats.fullCount * 100) / stats.totalChecks);
        reportStats(fullPercent, stats.peakUtilization);
    }
}

```

#### Parameters

in	<i>stream</i> ↔	Handle to the stream buffer to query. Must be a valid stream created with <a href="#">xStreamCreate()</a> .
out	<i>res_</i>	Pointer to variable receiving the full status. Set to non-zero (true) if stream is full (CONFIG_STREAM_BUFFER_BYTES bytes waiting), zero (false) if stream has available space.

#### Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid stream handle or stream not found.

#### Warning

A full stream will cause [xStreamSend\(\)](#) to fail with ReturnError. Always check for full condition before critical send operations, or implement appropriate error handling for send failures.

#### Note

This is a non-destructive query that does not modify stream contents.

The buffer capacity is defined by CONFIG\_STREAM\_BUFFER\_BYTES at compile time (default 32 bytes). To calculate free space: freeSpace = CONFIG\_STREAM\_BUFFER\_BYTES - currentBytes

In multitasking environments, the full status may change immediately after the query if another task performs a receive operation. Use appropriate synchronization for atomic check-and-send operations if needed.

**See also**

[xStreamBytesAvailable\(\)](#) - Get exact byte count and calculate free space  
[xStreamIsEmpty\(\)](#) - Check if stream has no waiting bytes  
[xStreamSend\(\)](#) - Send byte to stream (fails if full)  
[xStreamReset\(\)](#) - Clear stream to free all space  
[xStreamReceive\(\)](#) - Retrieve bytes to free space  
[xStreamCreate\(\)](#) - Create a stream buffer

**4.2.4.57 xStreamReceive()** `xReturn xStreamReceive (`  
    `const xStreamBuffer stream_,`  
    `xHalfWord * bytes_,`  
    `xByte ** data_ )`

Retrieves all bytes currently waiting in the specified stream buffer and returns them in a newly allocated memory buffer. This is the consumer-side operation for stream-based inter-task communication. After retrieval, the bytes are removed from the stream, freeing space for new data.

[xStreamReceive\(\)](#) allocates memory from the user heap to hold the retrieved bytes. The caller is responsible for freeing this memory with [xMemFree\(\)](#) after processing the data. This memory management pattern ensures safe data transfer between tasks without buffer ownership conflicts.

Key characteristics:

- **Retrieves all waiting bytes:** Returns complete contents of stream in one call
- **Allocates memory:** Creates new buffer in user heap for received data
- **Clears stream:** Removes received bytes from stream buffer
- **Returns byte count:** Indicates number of bytes retrieved via `bytes_` parameter
- **Non-blocking:** Returns immediately even if stream is empty (`bytes_ = 0`)
- **FIFO ordering:** Bytes returned in the order they were sent

Typical consumer workflow:

1. Call [xStreamReceive\(\)](#) to get all waiting bytes
2. Check if any bytes were retrieved (`bytes_ > 0`)
3. Process the received data
4. Free the allocated buffer with [xMemFree\(\)](#)
5. Repeat as needed for continuous data flow



**Example 1: UART receive processing**

```

xStreamBuffer uartRxStream;
// Producer (ISR or task) sends bytes to stream
void uartISR(void) {
    if (UART_RX_READY) {
        xByte rxByte = UART_DATA_REG;
        xStreamSend(uartRxStream, rxByte);
    }
}
// Consumer task processes received data
void processUARTTask(xTask task, xTaskParm parm) {
    xHalfWord byteCount;
    xByte *rxData;
    if (OK(xStreamReceive(uartRxStream, &byteCount, &rxData))) {
        if (byteCount > 0) {
            // Process received bytes
            for (xHalfWord i = 0; i < byteCount; i++) {
                processCharacter(rxData[i]);
            }
            // Always free allocated memory
            xMemFree((xAddr)rxData);
        }
    }
}

```

**Example 2: Protocol frame parsing**

```

xStreamBuffer protocolStream;
void parseProtocolTask(xTask task, xTaskParm parm) {
    xHalfWord frameSize;
    xByte *frame;
    if (OK(xStreamReceive(protocolStream, &frameSize, &frame))) {
        if (frameSize > 0) {
            // Look for start byte (0xAA)
            for (xHalfWord i = 0; i < frameSize; i++) {
                if (frame[i] == 0xAA && (i + 3) < frameSize) {
                    xByte command = frame[i + 1];
                    xByte length = frame[i + 2];
                    // Verify complete frame available
                    if ((i + 3 + length) < frameSize) {
                        xByte *payload = &frame[i + 3];
                        processCommand(command, payload, length);
                        i += 3 + length; // Skip past this frame
                    }
                }
            }
            xMemFree((xAddr)frame);
        }
    }
}

```

**Example 3: Sensor data batch processing**

```

xStreamBuffer sensorStream;
#define MIN_SAMPLES 10
void analyzeSensorTask(xTask task, xTaskParm parm) {
    xHalfWord sampleCount;
    xByte *samples;
    if (OK(xStreamReceive(sensorStream, &sampleCount, &samples))) {
        // Only process if we have enough samples
        if (sampleCount >= MIN_SAMPLES) {
            // Calculate statistics
            xWord sum = 0;
            xByte min = 255, max = 0;
            for (xHalfWord i = 0; i < sampleCount; i++) {
                sum += samples[i];
                if (samples[i] < min) min = samples[i];
                if (samples[i] > max) max = samples[i];
            }
            xByte average = (xByte)(sum / sampleCount);
            reportStatistics(average, min, max);
        } else if (sampleCount > 0) {
            // Put samples back by re-sending them
            for (xHalfWord i = 0; i < sampleCount; i++) {
                xStreamSend(sensorStream, samples[i]);
            }
        }
        // Always free even if we didn't process
        if (sampleCount > 0) {
            xMemFree((xAddr)samples);
        }
    }
}

```

**Example 4: Complete producer-consumer pattern**

```

xStreamBuffer dataStream;

```

```

xTask producerTask, consumerTask;
// Producer accumulates data
void producer(xTask task, xTaskParm parm) {
    xByte dataPoint = collectData();
    if (OK(xStreamSend(dataStream, dataPoint))) {
        // Check if buffer is getting full
        xHalfWord available;
        if (OK(xStreamBytesAvailable(dataStream, &available))) {
            if (available >= 16) {
                // Signal consumer to process data
                xTaskNotifyGive(consumerTask);
            }
        }
    }
}
// Consumer processes batches
void consumer(xTask task, xTaskParm parm) {
    xTaskWait(1); // Wait for notification from producer
    xHalfWord count;
    xByte *data;
    if (OK(xStreamReceive(dataStream, &count, &data))) {
        if (count > 0) {
            processBatch(data, count);
            xMemFree((xAddr)data);
        }
    }
}

```

#### Parameters

in	<i>stream</i> ↔ —	Handle to the stream buffer to receive from. Must be a valid stream created with <a href="#">xStreamCreate()</a> .
out	<i>bytes</i> ↔ —	Pointer to variable receiving the number of bytes retrieved. Set to 0 if stream is empty. The caller should check this value before processing data_.
out	<i>data_</i>	Pointer to variable receiving address of newly allocated buffer containing the retrieved bytes. Memory is allocated from user heap and must be freed with <a href="#">xMemFree()</a> after use. If no bytes are available, this may point to null or uninitialized memory.

#### Returns

ReturnOK if receive operation completed (even if 0 bytes received), ReturnError if operation failed due to invalid stream handle, memory allocation failure, or stream not found.

#### Warning

The memory allocated for data\_ MUST be freed by the caller using [xMemFree\(\)](#) after processing. Failure to free this memory will cause a memory leak. Always pair [xStreamReceive\(\)](#) with [xMemFree\(\)](#) in your code.

Always check bytes\_ before accessing data\_. If bytes\_ is 0, the stream was empty and data\_ should not be accessed.

[xStreamReceive\(\)](#) retrieves ALL waiting bytes in a single call. If you need to process bytes one at a time or in smaller chunks, you must implement your own buffering or use the retrieved data array with indexing.

Receiving from an invalid or deleted stream handle will return ReturnError.

#### Note

[xStreamReceive\(\)](#) is non-blocking. If the stream is empty, it returns immediately with bytes\_ set to 0. This differs from some RTOS queue implementations that support blocking receives with timeouts.

After [xStreamReceive\(\)](#) completes, the retrieved bytes are removed from the stream buffer, freeing space for new data from producers.

Memory allocation failures are rare but possible in heap-constrained systems. If [xStreamReceive\(\)](#) returns ReturnError and bytes\_ indicates data was available, suspect memory allocation failure and consider increasing heap size.

See also

- [xStreamSend\(\)](#) - Send bytes to stream (producer operation)
- [xMemFree\(\)](#) - Free memory allocated by [xStreamReceive\(\)](#)
- [xStreamCreate\(\)](#) - Create a stream buffer
- [xStreamBytesAvailable\(\)](#) - Query number of bytes waiting without receiving
- [xStreamIsEmpty\(\)](#) - Check if stream has any waiting bytes
- [xStreamReset\(\)](#) - Clear stream without retrieving bytes
- [xQueueReceive\(\)](#) - Alternative for message-oriented communication

**4.2.4.58 xStreamReset()** `xReturn xStreamReset (`  
`const xStreamBuffer stream_ )`

Resets the specified stream buffer to an empty state by discarding all waiting bytes. After reset, the stream behaves as if newly created—[xStreamBytesAvailable\(\)](#) returns 0 and [xStreamIsEmpty\(\)](#) returns true. This operation is useful for error recovery, protocol resyncs, or discarding stale data.

Unlike [xStreamDelete\(\)](#) which destroys the stream entirely, [xStreamReset\(\)](#) preserves the stream structure and handle while only clearing its contents. The stream remains fully functional and can immediately accept new data via [xStreamSend\(\)](#).

Common scenarios for stream reset:

- **Error recovery:** Clear corrupted or incomplete protocol data
- **Protocol resync:** Discard partial frames when reestablishing sync
- **Buffer overflow handling:** Clear old data when capacity exceeded
- **Timeout handling:** Discard stale data after communication timeout
- **State machine reset:** Clear buffered data when returning to idle state
- **Channel cleanup:** Prepare stream for reuse without deallocating

Example 1: Protocol error recovery

```
xStreamBuffer protocolStream;
void handleProtocolError(void) {
    // Error detected - discard partial/corrupted data
    xStreamReset(protocolStream);
    // Send resync request to peer
    sendResyncCommand();
    // Stream now empty and ready for fresh data
}
```

Example 2: Timeout-based data discard

```
xStreamBuffer rxStream;
xTimer rxTimeout;
void receiveTask(xTask task, xTaskParm parm) {
    xBase timerExpired;
    // Check for receive timeout
    if (OK(xTimerHasTimerExpired(rxTimeout, &timerExpired)) && timerExpired) {
        xHalfWord staleBytes;
        // Check if incomplete data waiting
        if (OK(xStreamBytesAvailable(rxStream, &staleBytes)) && staleBytes > 0) {
            // Data incomplete after timeout - discard it
            xStreamReset(rxStream);
            logWarning("Receive timeout - data discarded");
        }
        // Reset timeout for next receive
        xTimerReset(rxTimeout);
    }
}
```

```

}
```

### Example 3: Overflow handling with reset

```

xStreamBuffer sensorStream;
void sampleSensor(xTask task, xTaskParam parm) {
    xByte sample = readADC();
    xBase isFull;
    // Check if buffer full
    if (OK(xStreamIsFull(sensorStream, &isFull)) && isFull) {
        // Option 1: Drop oldest data, keep newest
        xStreamReset(sensorStream);
        xStreamSend(sensorStream, sample);
        // Log overflow event
        overflowCount++;
    } else {
        // Normal send
        xStreamSend(sensorStream, sample);
    }
}
```

### Example 4: State machine with stream cleanup

```

typedef enum {
    STATE_IDLE,
    STATE_RECEIVING,
    STATE_PROCESSING
} CommState_t;
xStreamBuffer commStream;
CommState_t commState = STATE_IDLE;
void communicationTask(xTask task, xTaskParam parm) {
    switch (commState) {
        case STATE_IDLE:
            // Ensure stream clean when entering new transaction
            xStreamReset(commStream);
            commState = STATE_RECEIVING;
            break;
        case STATE_RECEIVING:
            // Accumulate data...
            if (frameComplete()) {
                commState = STATE_PROCESSING;
            }
            break;
        case STATE_PROCESSING:
            // Process received frame
            processFrame();
            commState = STATE_IDLE; // Will clear on next iteration
            break;
    }
}
```

### Parameters

in	<i>stream</i> ↔	Handle to the stream buffer to reset. Must be a valid stream created with <a href="#">xStreamCreate()</a> .
	—	

### Returns

ReturnOK if stream reset successfully, ReturnError if reset failed due to invalid stream handle or stream not found.

### Warning

All bytes waiting in the stream are permanently discarded. If you need to preserve data, call [xStreamReceive\(\)](#) before calling [xStreamReset\(\)](#).

In multitasking environments, ensure no other task is actively sending to or receiving from the stream during reset. Resetting a stream while another task is mid-operation may lead to unexpected behavior or data loss.

## Note

`xStreamReset()` does not delete or invalidate the stream handle. After reset, the stream remains fully functional and ready for new send/receive operations.

This operation is typically faster than deleting and recreating a stream, making it preferable for error recovery scenarios where the stream structure should be reused.

After reset, `xStreamBytesAvailable()` returns 0, `xStreamIsEmpty()` returns true, and `xStreamIsFull()` returns false.

## See also

- `xStreamCreate()` - Create a stream buffer
- `xStreamDelete()` - Delete stream entirely (vs. just clearing contents)
- `xStreamReceive()` - Retrieve data before reset if needed
- `xStreamBytesAvailable()` - Check byte count before reset
- `xStreamIsEmpty()` - Verify stream empty after reset

**4.2.4.59 xStreamSend()** `xReturn` xStreamSend (  
    xStreamBuffer stream\_,  
    const xByte byte\_ )

Sends one byte to the specified stream buffer, adding it to the end of the FIFO byte sequence. This is the producer-side operation for stream-based inter-task communication. Bytes are stored in the stream until consumed by a receiver task using `xStreamReceive()`.

Stream buffers provide byte-level granularity for communication, making them ideal for character-oriented protocols, serial data buffering, and continuous data streaming. Unlike message queues, streams don't preserve message boundaries—bytes are retrieved in the exact order they were sent, but without any structure or framing.

Operational characteristics:

- **FIFO ordering:** Bytes are retrieved in the order they were sent
- **Fixed capacity:** Stream holds up to `CONFIG_STREAM_BUFFER_BYTES` (default 32)
- **Blocking behavior:** Returns `ReturnError` immediately if stream is full
- **Atomic operation:** Single byte send is atomic (safe from interrupts)
- **Low overhead:** Minimal processing compared to message queue operations

Common usage patterns:

- **Serial/UART buffering:** Send received bytes from ISR to stream for processing
- **Character output:** Build strings character-by-character for display
- **Protocol assembly:** Accumulate protocol bytes until complete frame ready
- **Sensor sampling:** Stream continuous ADC or sensor readings
- **Event logging:** Record byte-oriented event codes or timestamps

### Example 1: UART transmit buffering

```
xStreamBuffer uartTxStream;
void setupUART(void) {
    xStreamCreate(&uartTxStream);
}
// Application sends string to UART
void sendString(const char *str) {
    while (*str) {
        if (ERROR(xStreamSend(uartTxStream, (xByte)*str))) {
            // Stream full - wait for transmitter to drain
            delayMs(1);
        } else {
            str++;
        }
    }
}
// UART task transmits buffered bytes
void uartTransmitTask(xTask task, xTaskParm parm) {
    xHalfWord count;
    xByte *data;
    if (OK(xStreamReceive(uartTxStream, &count, &data))) {
        if (count > 0) {
            uartWriteBytes(data, count);
            xMemFree((xAddr)data);
        }
    }
}
```

### Example 2: Protocol frame assembly

```
xStreamBuffer protocolStream;
// Send protocol header, payload, and checksum
xReturn sendProtocolFrame(xByte command, xByte *payload, xHalfWord len) {
    // Send start byte
    if (ERROR(xStreamSend(protocolStream, 0xAA))) {
        return ReturnError;
    }
    // Send command
    if (ERROR(xStreamSend(protocolStream, command))) {
        return ReturnError;
    }
    // Send length
    if (ERROR(xStreamSend(protocolStream, (xByte)len))) {
        return ReturnError;
    }
    // Send payload bytes
    for (xHalfWord i = 0; i < len; i++) {
        if (ERROR(xStreamSend(protocolStream, payload[i]))) {
            return ReturnError;
        }
    }
    // Send checksum
    xByte checksum = calculateChecksum(command, payload, len);
    return xStreamSend(protocolStream, checksum);
}
```

### Example 3: Sensor data streaming with overflow handling

```
xStreamBuffer sensorStream;
void sampleSensorTask(xTask task, xTaskParm parm) {
    xByte sample = readADC();
    // Try to send sample
    if (ERROR(xStreamSend(sensorStream, sample))) {
        // Stream full - check how to handle overflow
        xBase isFull;
        if (OK(xStreamIsFull(sensorStream, &isFull)) && isFull) {
            // Option 1: Drop oldest data and reset
            xStreamReset(sensorStream);
            xStreamSend(sensorStream, sample);
            // Option 2: Notify error handler
            // logOverflowError();
        }
    }
}
```

### Parameters

in	<i>stream</i> ↔ —	Handle to the stream buffer to send data to. Must be a valid stream created with <a href="#">xStreamCreate()</a> .
in	<i>byte</i> —	The byte value to send to the stream. Accepts any value from 0x00 to 0xFF.

**Returns**

ReturnOK if byte sent successfully, ReturnError if send failed due to stream full, invalid stream handle, or stream not found.

**Warning**

If the stream is full (contains CONFIG\_STREAM\_BUFFER\_BYTES bytes), [xStreamSend\(\)](#) returns ReturnError immediately without blocking. Check stream capacity with [xStreamIsFull\(\)](#) or [xStreamBytesAvailable\(\)](#) before sending critical data, or implement error handling for full conditions.

Sending to an invalid or deleted stream handle will return ReturnError. Always verify stream creation succeeded before calling [xStreamSend\(\)](#).

**Note**

[xStreamSend\(\)](#) operates on individual bytes only. To send multi-byte values (integers, floats, structures), send each byte separately in the appropriate order (considering endianness if necessary).

Stream buffers do not preserve message boundaries. Bytes sent in separate [xStreamSend\(\)](#) calls are concatenated into a continuous sequence. If you need message framing, implement your own protocol with headers/delimiters.

For high-throughput applications, consider checking [xStreamIsFull\(\)](#) before sending large amounts of data to avoid repeated ReturnError conditions.

**See also**

[xStreamReceive\(\)](#) - Receive all waiting bytes from stream (consumer operation)

[xStreamCreate\(\)](#) - Create a stream buffer

[xStreamBytesAvailable\(\)](#) - Query number of bytes waiting in stream

[xStreamIsFull\(\)](#) - Check if stream is at capacity

[xStreamReset\(\)](#) - Clear all bytes from stream

[xQueueSend\(\)](#) - Alternative for message-oriented communication

**4.2.4.60 xSystemAssert()** [xReturn](#) xSystemAssert (   
     const char \* *file\_*,   
     const int *line\_* )

The [xSystemAssert\(\)](#) syscall is used to raise a system assert. In order for [xSystemAssert\(\)](#) to have an effect the configuration setting CONFIG\_SYSTEM\_ASSERT\_BEHAVIOR must be defined. That said, it is recommended that the **AssertOnElse()** C macro be used in place of [xSystemAssert\(\)](#). In order for the **AssertOnElse()** C macro to have any effect, the configuration setting CONFIG\_ENABLE\_SYSTEM\_ASSERT must be defined.

**See also**

[xReturn](#)

[CONFIG\\_SYSTEM\\_ASSERT\\_BEHAVIOR](#)

[CONFIG\\_ENABLE\\_SYSTEM\\_ASSERT](#)

**AssertOnElse()**

## Parameters

<i>file</i> ↔ —	The C file where the assert occurred. This will be set by the <b>AssertOnElse()</b> C macro.
<i>line</i> ↔ —	The C file line where the assert occurred. This will be set by the <b>AssertOnElse()</b> C macro.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.61 xSystemGetSystemInfo()** [xReturn](#) xSystemGetSystemInfo (   
 [xSystemInfo](#) \* info\_ )

The [xSystemGetSystemInfo\(\)](#) syscall is used to inquire about the system. The information about the system that may be obtained is the product (i.e., OS) name, version and number of tasks.

## See also

[xReturn](#)

[xSystemInfo](#)

[xMemFree\(\)](#)

## Parameters

<i>info</i> ↔ —	The system information. The system information must be freed by <a href="#">xMemFree()</a> .
--------------------	--

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.62 xSystemHalt()** [xReturn](#) xSystemHalt (   
 void )

The [xSystemHalt\(\)](#) syscall is used to halt HeliOS. Once called, [xSystemHalt\(\)](#) will disable all interrupts and stops the execution of further statements. The system will have to be reset to recover.



See also

[xReturn](#)

Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.63 xSystemInit()** [xReturn](#) xSystemInit (  
void )

The [xSystemInit\(\)](#) syscall is used to bootstrap HeliOS and must be the first syscall made in the user's application. The [xSystemInit\(\)](#) syscall initializes memory and calls initialization functions through the port layer.

See also

[xReturn](#)

Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.64 xTaskChangePeriod()** [xReturn](#) xTaskChangePeriod (  
[xTask](#) task\_,  
const [xTicks](#) period\_ )

The [xTaskChangePeriod\(\)](#) is used to change the interval period of a task timer. The period is measured in ticks. While architecture and/or platform dependent, a tick is often one millisecond. In order for the task timer to have an effect, the task must be in the "waiting" state which can be set using [xTaskWait\(\)](#).

See also

[xReturn](#)

[xTask](#)

[xTicks](#)

[xTaskWait\(\)](#)

## Parameters

<i>task</i> ↔ —	The task to be operated on.
<i>period</i> ↔ —	The interval period in ticks.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.65 xTaskChangeWDPeriod()** `xReturn xTaskChangeWDPeriod (`  
`xTask task_,`  
`const xTicks period_ )`

The [xTaskChangeWDPeriod\(\)](#) syscall is used to change the task watchdog timer period. This has no effect unless CONFIG\_TASK\_WD\_TIMER\_ENABLE is defined and the watchdog timer period is greater than nil. The task watchdog timer will place a task in a suspended state if a task's runtime exceeds the watchdog timer period. The task watchdog timer period is set on a per task basis.

## See also

[xReturn](#)  
[xTask](#)  
[xTicks](#)  
[CONFIG\\_TASK\\_WD\\_TIMER\\_ENABLE](#)

## Parameters

<i>task</i> ↔ —	The task to be operated on.
<i>period</i> ↔ —	The task watchdog timer period measured in ticks. Ticks is platform and/or architecture dependent. However, most platforms and/or architectures have a one millisecond tick duration.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.66 xTaskCreate()** `xReturn` xTaskCreate (

```

    xTask * task_,
    const xByte * name_,
    void(*) (xTask task_, xTaskParm parm_) callback_,
    xTaskParm taskParameter_ )

```

Creates a new task and registers it with the HeliOS scheduler. Tasks are the fundamental unit of execution in HeliOS and represent functions that execute cooperatively under scheduler control. Each task has a name, callback function, optional parameters, and scheduling properties.

When created, tasks begin in TaskStateSuspended state and will not execute until `xTaskResume()` is called. Tasks can have an associated period that controls how frequently they are scheduled for execution.

Task Lifecycle:

1. Create task with `xTaskCreate()` (starts in TaskStateSuspended)
2. Optionally set task period with `xTaskChangePeriod()`
3. Resume task with `xTaskResume()` (transitions to TaskStateRunning)
4. Task executes when scheduler runs
5. Delete task with `xTaskDelete()` when no longer needed

#### Warning

This function must be called BEFORE `xTaskStartScheduler()` is invoked. It cannot be called from within a task while the scheduler is running. Creating or deleting tasks during scheduler execution will result in undefined behavior.

#### Note

Task names are used for identification and debugging. They must be exactly CONFIG\_TASK\_NAME\_BYTES characters (default 8). Shorter names should be space-padded; longer names will be truncated.

The taskParameter\_ allows passing data to the task. This is commonly used to pass pointers to configuration structures or shared data. The memory management of this parameter is the responsibility of the caller.

#### Example Usage:

```

void blinkLED(xTask task, xTaskParm parm) {
    // Access parameter if needed
    int *ledPin = (int*)parm;
    // Task logic here
    toggleLED(*ledPin);
    // Task yields when function returns
}

int main(void) {
    xTask ledTask;
    static int pin = 13; // Must persist beyond task creation
    // Create task (starts in suspended state)
    if (OK(xTaskCreate(&ledTask, "LED", blinkLED, (xTaskParm)&pin))) {
        // Set task to run every 100ms
        xTaskChangePeriod(ledTask, 100);
        // Activate the task
        xTaskResume(ledTask);
        // Start scheduler
        xTaskStartScheduler();
    }
}

```

**Parameters**

out	<i>task_</i>	Pointer to xTask variable that will receive the task handle. This handle is used in subsequent operations on the task.
in	<i>name_</i>	Task name string, exactly CONFIG_TASK_NAME_BYTES bytes. Common pattern: "TaskName" (8 bytes with space padding).
in	<i>callback_</i>	Pointer to the task function that will be executed. Function signature: void func(xTask task, xTaskParm parm).
in	<i>task_</i> <i>Parameter_</i>	Optional parameter passed to the task function. Use NULL if no parameter is needed. Can be a pointer to any data type.

**Returns**

ReturnOK if task was successfully created, ReturnError if creation failed (e.g., out of memory, invalid parameters, or scheduler is already running).

**See also**

[xTaskDelete\(\)](#) - Remove a task from the scheduler  
[xTaskResume\(\)](#) - Activate a task for scheduling  
[xTaskSuspend\(\)](#) - Deactivate a task  
[xTaskChangePeriod\(\)](#) - Set task execution frequency  
[xTaskStartScheduler\(\)](#) - Begin executing tasks  
[CONFIG\\_TASK\\_NAME\\_BYTES](#) - Configuration for task name length

**4.2.4.67 xTaskDelete()** `xReturn xTaskDelete (`  
     `const xTask task_ )`

Removes a task from the HeliOS scheduler and frees all memory associated with the task. Once deleted, the task will no longer be scheduled for execution and its task handle becomes invalid.

This function performs cleanup including:

- Removing the task from the scheduler's task list
- Freeing internal task control structures
- Invalidating the task handle

**Warning**

This function must be called BEFORE [xTaskStartScheduler\(\)](#) starts or AFTER the scheduler has been suspended with [xTaskSuspendAll\(\)](#). It cannot be called from within a running task while the scheduler is active. Attempting to delete a task during scheduler execution will result in undefined behavior.

After deleting a task, the task handle becomes invalid and must not be used in any subsequent HeliOS function calls. Using a deleted task handle will result in undefined behavior.

**Note**

If a task needs to be temporarily deactivated rather than permanently removed, use [xTaskSuspend\(\)](#) instead. Suspended tasks can be resumed later without recreating them.

Memory allocated by the task (via [xMemAlloc\(\)](#)) is NOT automatically freed when the task is deleted. The application is responsible for managing any dynamically allocated memory used by the task.

**Example Usage:**

```
xTask temporaryTask;
// Create a task for one-time initialization
if (OK(xTaskCreate(&temporaryTask, "InitTask", initFunction, NULL))) {
    xTaskResume(temporaryTask);
    xTaskStartScheduler();
    // Later, after initialization is complete (scheduler suspended)
    xTaskSuspendAll();
    // Delete the task as it's no longer needed
    if (OK(xTaskDelete(temporaryTask))) {
        // Task successfully deleted
    }
    xTaskResumeAll();
    xTaskStartScheduler();
}
```

**Parameters**

in	<i>task</i> ↔	Handle of the task to delete. Must be a valid task handle previously returned by <a href="#">xTaskCreate()</a> .
	—	

**Returns**

ReturnOK if the task was successfully deleted, ReturnError if deletion failed (invalid task handle, scheduler is running, or system error).

**See also**

[xTaskCreate\(\)](#) - Create a new task

[xTaskSuspend\(\)](#) - Temporarily deactivate a task (without deleting it)

[xTaskSuspendAll\(\)](#) - Suspend scheduler to allow task deletion

[xTaskStartScheduler\(\)](#) - Start the scheduler

**4.2.4.68 xTaskGetAllRunTimeStats()** [xReturn](#) xTaskGetAllRunTimeStats (   
[xTaskRunTimeStats](#) \* stats\_,   
[xBase](#) \* tasks\_ )

The [xTaskGetAllRunTimeStats\(\)](#) syscall is used to obtain the runtime statistics of all tasks.

**See also**

[xReturn](#)

[xTask](#)

[xTaskRunTimeStats](#)

[xMemFree\(\)](#)

## Parameters

<i>stats</i> ↔ —	The runtime statistics. The runtime statics must be freed by <a href="#">xMemFree()</a> .
<i>tasks</i> ↔ —	The number of tasks in the runtime statistics.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.69 xTaskGetAllTaskInfo()** [xReturn](#) xTaskGetAllTaskInfo (   
[xTaskInfo](#) \* *info\_*,  
[xBase](#) \* *tasks\_* )

The [xTaskGetAllTaskInfo\(\)](#) syscall is used to get info about all tasks. [xTaskGetAllTaskInfo\(\)](#) is similar to [xTaskGetAllRunTimeStats\(\)](#) with one difference, [xTaskGetAllTaskInfo\(\)](#) provides the state and name of the task along with the task's runtime statistics.

## See also

[xReturn](#)  
[xTaskInfo](#)  
[xMemFree\(\)](#)

## Parameters

<i>info</i> ↔ —	Information about the tasks. The task information must be freed by <a href="#">xMemFree()</a> .
<i>tasks</i> ↔ —	The number of tasks.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.70 xTaskGetHandleById()** `xReturn` xTaskGetHandleById (   
     xTask \* task\_,   
     const xBase id\_ )

The `xTaskGetHandleById()` syscall will get the task handle using the task id.

See also

[xReturn](#)

[xTask](#)

Parameters

<i>task_</i> ↔ —	The task to be operated on.
<i>id_</i> —	The task id.

Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.71 xTaskGetHandleByName()** `xReturn` xTaskGetHandleByName (   
     xTask \* task\_,   
     const xByte \* name\_ )

The `xTaskGetHandleByName()` syscall will get the task handle using the task name.

See also

[xReturn](#)

[xTask](#)

[CONFIG\\_TASK\\_NAME\\_BYTES](#)

Parameters

<i>task_</i> ↔ —	The task to be operated on.
<i>name_</i> ↔ —	The name of the task which must be exactly CONFIG_TASK_NAME_BYTES (default is 8) bytes in length. Shorter task names must be padded.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.72 xTaskGetId()** `xReturn` `xTaskGetId` (   
     const `xTask` `task_`,   
     `xBase` \* `id_` )

The `xTaskGetId()` syscall is used to obtain the id of a task.

## See also

[xReturn](#)

[xTask](#)

## Parameters

<code>task_↔</code>	The task to be operated on.
<code>id_</code>	The id of the task.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.73 xTaskGetName()** `xReturn` `xTaskGetName` (   
     const `xTask` `task_`,   
     `xByte` \*\* `name_` )

The `xTaskGetName()` syscall is used to get the ASCII name of a task. The size of the task name is `CONFIG_↔ TASK_NAME_BYTES` (default is 8) bytes in length.

## See also

[xReturn](#)

[xTask](#)

[xMemFree\(\)](#)



## Parameters

<i>task</i> ↔ —	The task to be operated on.
<i>name</i> ↔ —	The task name which must be precisely CONFIG_TASK_NAME_BYTES (default is 8) bytes in length. The task name must be freed by <a href="#">xMemFree()</a> .

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.74 xTaskGetNumberOfTasks()** [xReturn](#) xTaskGetNumberOfTasks (   
 [xBase](#) \* *tasks\_* )

The [xTaskGetNumberOfTasks\(\)](#) syscall is used to obtain the number of tasks regardless of their state (i.e., suspended, running or waiting).

## See also

[xReturn](#)

## Parameters

<i>tasks</i> ↔ —	The number of tasks.
---------------------	----------------------

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.75 xTaskGetPeriod()** [xReturn](#) xTaskGetPeriod (   
 const [xTask](#) *task\_*,   
 [xTicks](#) \* *period\_* )

The [xTaskGetPeriod\(\)](#) syscall is used to obtain the current task timer period.

## See also

[xReturn](#)[xTask](#)[xTicks](#)

## Parameters

<i>task</i> ↔ —	The task to be operated on.
<i>period</i> ↔ —	The task timer period in ticks. Ticks is platform and/or architecture dependent. However, most platforms and/or architect

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.76 xTaskGetSchedulerState()** [xReturn](#) xTaskGetSchedulerState (   
 [xSchedulerState](#) \* state\_ )

The [xTaskGetSchedulerState\(\)](#) is used to get the state of the scheduler.

## See also

[xReturn](#)[xSchedulerState](#)

## Parameters

<i>state</i> ↔ —	The state of the scheduler.
---------------------	-----------------------------

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.77 xTaskGetTaskInfo()** `xReturn` xTaskGetTaskInfo (   
     const `xTask` *task\_*,   
     `xTaskInfo` \* *info\_* )

The `xTaskGetTaskInfo()` syscall is used to get info about a single task. `xTaskGetTaskInfo()` is similar to `xTaskGetTaskRunTimeStats()` with one difference, `xTaskGetTaskInfo()` provides the state and name of the task along with the task's runtime statistics.

See also

`xReturn`  
`xMemFree()`  
`xTask`  
`xTaskInfo`

Parameters

<i>task_</i> ↔ —	The task to be operated on.
<i>info_</i> ↔ —	Information about the task. The task information must be freed by <code>xMemFree()</code> .

Returns

On success, the syscall returns `ReturnOK`. On failure, the syscall returns `ReturnError`. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return `ReturnError`. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be `ReturnOK` or `ReturnError`. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.78 xTaskGetTaskRunTimeStats()** `xReturn` xTaskGetTaskRunTimeStats (   
     const `xTask` *task\_*,   
     `xTaskRunTimeStats` \* *stats\_* )

The `xTaskGetTaskRunTimeStats()` syscall is used to get the runtime statistics for a single task.

See also

`xReturn`  
`xTask`  
`xTaskRunTimeStats`  
`xMemFree()`

Parameters

<i>task_</i> ↔ —	The task to be operated on.
<i>stats_</i> ↔ —	The runtime statistics. The runtime statistics must be freed by <code>xMemFree()</code> .

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.79 xTaskGetTaskState()** `xReturn` `xTaskGetTaskState` (   
     const `xTask` `task_`,   
     `xTaskState` \* `state_` )

The `xTaskGetTaskState()` syscall is used to obtain the state of a task (i.e., suspended, running or waiting).

## See also

`xReturn`  
`xTask`  
`xTaskState`

## Parameters

<code>task_↔</code> —	The task to be operated on.
<code>state_↔</code> —	The state of the task.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.80 xTaskGetWDPeriod()** `xReturn` `xTaskGetWDPeriod` (   
     const `xTask` `task_`,   
     `xTicks` \* `period_` )

The `xTaskGetWDPeriod()` syscall is used to obtain the task watchdog timer period.

**See also**[xReturn](#)[xTask](#)[xTicks](#)[CONFIG\\_TASK\\_WD\\_TIMER\\_ENABLE](#)

## Parameters

<i>task</i> ↔ —	The task to be operated on.
<i>period</i> ↔ —	The task watchdog timer period, measured in ticks. Ticks are platform and/or architecture dependent. However, on must platforms and/or architectures the tick represents one millisecond.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.81 xTaskNotificationIsWaiting()** `xReturn xTaskNotificationIsWaiting (`  
     const `xTask` *task\_*,  
     `xBase` \* *res\_* )

The [xTaskNotificationIsWaiting\(\)](#) syscall is used to inquire as to whether a direct-to-task notification is waiting for the given task.

## See also

[xReturn](#)

[xTask](#)

## Parameters

<i>task</i> ↔ —	Task to be operated on.
<i>res</i> ↔ —	The result of the inquiry; taken here to mean "true" if there is a waiting direct-to-task notification. Otherwise "false", if there is not a waiting direct-to-notification.

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if [xTaskGetId\(\)](#) was unable to locate the task by the task object (i.e., xTask) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), [xTaskGetId\(\)](#) would return ReturnError. All HeliOS syscalls return the xReturn (a.k.a., Return\_t) type which can either be ReturnOK or ReturnError. The C macros OK() and ERROR() can be used as a more concise way of checking the return value of a syscall (e.g., if(OK(xMemGetUsed(&size))) {} or if(ERROR(xMemGetUsed(&size))) {}).

**4.2.4.82 xTaskNotifyGive()** `xReturn` xTaskNotifyGive (   
     `xTask` *task\_*,   
     const `xBase` *bytes\_*,   
     const `xByte` \* *value\_* )

The `xTaskNotifyGive()` syscall is used to give (i.e., send) a direct-to-task notification to the given task.

See also

`xReturn`

`xTask`

`CONFIG_NOTIFICATION_VALUE_BYTES`

Parameters

<i>task_</i> ↔ —	The task to be operated on.
<i>bytes_</i> ↔ —	The number of bytes contained in the notification value. The number of bytes in the notification value cannot exceed <code>CONFIG_NOTIFICATION_VALUE_BYTES</code> (default is 8) bytes.
<i>value_</i> ↔ —	The notification value which is a byte array whose length is defined by "bytes_".

Returns

On success, the syscall returns `ReturnOK`. On failure, the syscall returns `ReturnError`. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return `ReturnError`. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be `ReturnOK` or `ReturnError`. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.83 xTaskNotifyStateClear()** `xReturn` xTaskNotifyStateClear (   
     `xTask` *task\_* )

The `xTaskNotifyStateClear()` syscall is used to clear a waiting direct-to-task notification for the given task.

See also

`xReturn`

`xTask`

Parameters

<i>task_</i> ↔ —	The task to be operated on.
---------------------	-----------------------------

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.84 xTaskNotifyTake()** `xReturn` `xTaskNotifyTake` (  
`xTask` `task_`,  
`xTaskNotification` \* `notification_` )

The `xTaskNotifyTake()` syscall is used to take (i.e., receive) a waiting direct-to-task notification.

## See also

`xReturn`  
`xTask`  
`CONFIG_NOTIFICATION_VALUE_BYTES`  
`xTaskNotification`

## Parameters

<code>task_</code>	The task to be operated on.
<code>notification_</code>	The direct-to-task notification.
<code>_</code>	

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

**4.2.4.85 xTaskResetTimer()** `xReturn` `xTaskResetTimer` (  
`xTask` `task_` )

The `xTaskResetTimer()` syscall is used to reset the task timer. In effect, this sets the elapsed time, measured in ticks, back to nil.

## See also

`xReturn`  
`xTask`  
`xTicks`



## Parameters

<i>task</i> ↔	The task to be operated on.
—	

## Returns

On success, the syscall returns ReturnOK. On failure, the syscall returns ReturnError. A failure is any condition in which the syscall was unable to achieve its intended objective. For example, if `xTaskGetId()` was unable to locate the task by the task object (i.e., `xTask`) passed to the syscall, because either the object was null or invalid (e.g., a deleted task), `xTaskGetId()` would return ReturnError. All HeliOS syscalls return the `xReturn` (a.k.a., `Return_t`) type which can either be ReturnOK or ReturnError. The C macros `OK()` and `ERROR()` can be used as a more concise way of checking the return value of a syscall (e.g., `if(OK(xMemGetUsed(&size))) {}` or `if(ERROR(xMemGetUsed(&size))) {}`).

#### 4.2.4.86 xTaskResume() xReturn xTaskResume ( xTask task\_ )

Transitions a task to the TaskStateRunning state, making it eligible for execution by the cooperative scheduler. Tasks in the running state are scheduled according to their configured period and will execute continuously until suspended, deleted, or transitioned to waiting state.

When a task is created with `xTaskCreate()`, it begins in TaskStateSuspended and will not execute until this function is called. This allows tasks to be fully configured (period, parameters, etc.) before activation.

State Transition:

- TaskStateSuspended → TaskStateRunning: Task becomes active
- TaskStateWaiting → TaskStateRunning: Task resumes normal scheduling
- TaskStateRunning → TaskStateRunning: No effect (already running)

Scheduling Behavior: Once resumed, the task will be scheduled for execution based on its period setting. Tasks with period 0 execute on every scheduler cycle. Tasks with non-zero periods execute when their elapsed time exceeds the period.

## Note

This function can be called before or during scheduler execution. It safely transitions the task state and the change takes effect on the next scheduling cycle.

A task in the running state will continue executing until explicitly suspended with `xTaskSuspend()`, transitioned to waiting with `xTaskWait()`, or deleted with `xTaskDelete()`.

## Example Usage:

```
xTask sensorTask;
xTask displayTask;
// Create tasks (both start in suspended state)
xTaskCreate(&sensorTask, "Sensor ", readSensor, NULL);
xTaskCreate(&displayTask, "Display ", updateDisplay, NULL);
// Configure task periods
xTaskChangePeriod(sensorTask, 100); // Run every 100ms
xTaskChangePeriod(displayTask, 500); // Run every 500ms
// Activate tasks
xTaskResume(sensorTask); // Now scheduled for execution
xTaskResume(displayTask); // Now scheduled for execution
// Start scheduler - both tasks will now execute
xTaskStartScheduler();
// Can also resume tasks while scheduler is running
void controlTask(xTask task, xTaskParm parm) {
    if (systemReady) {
        xTaskResume(sensorTask); // Activate sensor readings
    }
}
```

## Parameters

in	<i>task</i> ↔	Handle of the task to resume. Must be a valid task handle previously returned by <a href="#">xTaskCreate()</a> .
	—	

## Returns

ReturnOK if the task state was successfully changed to running, ReturnError if the operation failed (invalid task handle or system error).

## See also

[xTaskCreate\(\)](#) - Create a new task (starts in suspended state)

[xTaskSuspend\(\)](#) - Deactivate a task

[xTaskWait\(\)](#) - Place a task in event-waiting state

[xTaskGetTaskState\(\)](#) - Query current task state

[xTaskChangePeriod\(\)](#) - Set task execution frequency

[TaskState\\_t](#) - Task state enumeration

#### 4.2.4.87 xTaskResumeAll() xReturn xTaskResumeAll ( void )

Sets the scheduler state to SchedulerStateRunning, allowing the scheduler to execute tasks when [xTaskStartScheduler\(\)](#) is called. This function does not start the scheduler itself; it only changes the scheduler's state flag.

This function is used in two scenarios:

1. After calling [xTaskSuspendAll\(\)](#) to re-enable scheduling
2. During system initialization to set the scheduler to running state before calling [xTaskStartScheduler\(\)](#)

## Typical Usage Pattern:

- Call [xTaskSuspendAll\(\)](#) to stop scheduler and regain control
- Perform critical operations while scheduler is suspended
- Call [xTaskResumeAll\(\)](#) to mark scheduler as ready
- Call [xTaskStartScheduler\(\)](#) to resume task execution

## Note

This function only changes the scheduler state flag. You must still call [xTaskStartScheduler\(\)](#) to actually begin executing tasks.

If [xTaskStartScheduler\(\)](#) is called while the scheduler state is SchedulerStateSuspended, it will return immediately without executing any tasks.

## Example Usage:

```
// Suspend scheduler from within a task
xTaskSuspendAll();
// Perform time-sensitive operations
performCriticalOperation();
// Resume scheduler state
xTaskResumeAll();
// Restart scheduler
xTaskStartScheduler();
```

### Returns

ReturnOK on success, ReturnError on failure.

### See also

[xTaskStartScheduler\(\)](#) - Start executing tasks  
[xTaskSuspendAll\(\)](#) - Suspend scheduler and return control  
[xTaskGetSchedulerState\(\)](#) - Query current scheduler state  
[SchedulerState\\_t](#) - Scheduler state enumeration

#### 4.2.4.88 xTaskStartScheduler() `xReturn` xTaskStartScheduler ( void )

Transfers control from application code to the HeliOS scheduler, which begins executing tasks in a cooperative multitasking fashion. This is typically the last function called in main() after all tasks, timers, and other objects have been created and configured.

The scheduler operates in a continuous loop, executing tasks based on their state and elapsed time since last execution. Tasks in TaskStateRunning or TaskStateWaiting (with pending events) will be scheduled according to their configured period.

### Control Flow:

- If the scheduler state is SchedulerStateRunning, execution enters the scheduler loop and does not return unless [xTaskSuspendAll\(\)](#) is called from within a running task
- If the scheduler state is SchedulerStateSuspended, this function returns immediately without scheduling any tasks
- To resume after suspension, call [xTaskResumeAll\(\)](#) followed by [xTaskStartScheduler\(\)](#) again

### Note

HeliOS uses cooperative multitasking. Tasks must explicitly yield control by returning from their task function to allow other tasks to execute.

### Warning

Do not call this function multiple times without first suspending the scheduler using [xTaskSuspendAll\(\)](#) and resuming it with [xTaskResumeAll\(\)](#).

### Example Usage:

```
int main(void) {  
    xTask myTask;  
    // Create tasks  
    xTaskCreate(&myTask, "Task1", myTaskFunction, NULL);  
    xTaskResume(myTask);  
    // Start scheduler (does not return)  
    xTaskStartScheduler();  
    return 0;  
}
```

### Returns

ReturnOK if the scheduler successfully starts or is already suspended. ReturnError if a critical error occurs preventing scheduler operation. Note that under normal operation with tasks running, this function does not return until [xTaskSuspendAll\(\)](#) is called.

### See also

[xTaskResumeAll\(\)](#) - Resume scheduler after suspension  
[xTaskSuspendAll\(\)](#) - Suspend scheduler and return control  
[xTaskGetSchedulerState\(\)](#) - Query current scheduler state  
[xTaskCreate\(\)](#) - Create a new task  
[SchedulerState\\_t](#) - Scheduler state enumeration

#### 4.2.4.89 xTaskSuspend() `xReturn xTaskSuspend (` `xTask task_ )`

Transitions a task to the TaskStateSuspended state, preventing it from being scheduled for execution. The task remains registered with the scheduler and retains all its configuration (period, parameters, etc.), but will not execute until reactivated with [xTaskResume\(\)](#).

Suspending a task is useful for temporarily disabling functionality without the overhead of deleting and recreating the task. Unlike [xTaskWait\(\)](#), which waits for specific events, suspended tasks remain inactive indefinitely until explicitly resumed.

State Transition:

- TaskStateRunning → TaskStateSuspended: Task becomes inactive
- TaskStateWaiting → TaskStateSuspended: Task becomes inactive
- TaskStateSuspended → TaskStateSuspended: No effect (already suspended)

Use Cases:

- Temporarily disable a task based on system state or mode
- Reduce CPU usage by deactivating unused functionality
- Disable tasks during power-saving modes
- Pause task execution during system reconfiguration

**Note**

This function can be called before or during scheduler execution. When called on an active task, the task will not be scheduled on subsequent scheduler cycles until resumed.

Suspending a task does NOT free its resources or invalidate its handle. The task can be resumed at any time with [xTaskResume\(\)](#). To permanently remove a task, use [xTaskDelete\(\)](#) instead.

This function ([xTaskSuspend](#)) operates on individual tasks. For suspending the entire scheduler, use [xTaskSuspendAll\(\)](#) instead.

**Example Usage:**

```
xTask bluetoothTask;
xTask wifiTask;
xTaskCreate(&bluetoothTask, "BT Task", bluetoothHandler, NULL);
xTaskCreate(&wifiTask, "WiFi Task", wifiHandler, NULL);
xTaskResume(bluetoothTask);
xTaskResume(wifiTask);
xTaskStartScheduler();
// In a control task, disable wireless when not needed
void powerManagementTask(xTask task, xTaskParam parm) {
    if (lowPowerMode) {
        // Suspend wireless tasks to save power
        xTaskSuspend(bluetoothTask);
        xTaskSuspend(wifiTask);
    } else {
        // Resume wireless tasks when needed
        xTaskResume(bluetoothTask);
        xTaskResume(wifiTask);
    }
}
```

**Parameters**

in	<a href="#">task</a> ↔	Handle of the task to suspend. Must be a valid task handle previously returned by <a href="#">xTaskCreate()</a> .
	—	

**Returns**

ReturnOK if the task state was successfully changed to suspended, ReturnError if the operation failed (invalid task handle or system error).

**See also**

[xTaskCreate\(\)](#) - Create a new task  
[xTaskResume\(\)](#) - Reactivate a suspended task  
[xTaskWait\(\)](#) - Place a task in event-waiting state  
[xTaskDelete\(\)](#) - Permanently remove a task  
[xTaskSuspendAll\(\)](#) - Suspend the entire scheduler  
[xTaskGetTaskState\(\)](#) - Query current task state  
[TaskState\\_t](#) - Task state enumeration

#### 4.2.4.90 [xTaskSuspendAll\(\)](#) [xReturn](#) [xTaskSuspendAll](#) ( void )

Sets the scheduler state to SchedulerStateSuspended and causes [xTaskStartScheduler\(\)](#) to exit its scheduling loop, returning control back to the point where [xTaskStartScheduler\(\)](#) was called. This provides a mechanism to temporarily halt cooperative multitasking and regain direct control of program execution.

When called from within a running task, this function causes the scheduler loop to terminate after the current task completes its execution. Control returns to the line immediately following the original [xTaskStartScheduler\(\)](#) call.

Use Cases:

- Temporarily halt all task execution for critical operations
- Enter a low-power mode that requires stopping the scheduler
- Transition to a different operating mode
- Debug or diagnostic operations that require full control

To resume task execution:

1. Call `xTaskResumeAll()` to set scheduler state to running
2. Call `xTaskStartScheduler()` to re-enter the scheduling loop

### Warning

When the scheduler is suspended, no tasks will execute, including timer tasks and periodic operations. Ensure critical system functions are maintained during suspension.

### Note

This function must be called from within a task context, not from `main()` or initialization code.

### Example Usage:

```
void myTaskFunction(xTask task, xTaskParam parm) {
    // Normal task operations...
    if (needToSuspendScheduler) {
        // Suspend scheduler and return control
        xTaskSuspendAll();
        // Execution returns to line after xTaskStartScheduler() in main()
    }
}

int main(void) {
    xTask task;
    xTaskCreate(&task, "MyTask", myTaskFunction, NULL);
    xTaskResume(task);
    xTaskStartScheduler(); // Will return here when xTaskSuspendAll() called
    // Code here executes after scheduler suspension
    performCriticalOperation();
    // Resume if needed
    xTaskResumeAll();
    xTaskStartScheduler();
}
```

### Returns

ReturnOK on success, ReturnError on failure.

### See also

[xTaskStartScheduler\(\)](#) - Start the scheduler  
[xTaskResumeAll\(\)](#) - Resume scheduler state  
[xTaskGetSchedulerState\(\)](#) - Query current scheduler state  
[SchedulerState\\_t](#) - Scheduler state enumeration

**4.2.4.91 xTaskWait()** `xReturn xTaskWait (`  
`xTask task_ )`

Transitions a task to the TaskStateWaiting state, where it will not be scheduled for execution until a specific event occurs. This enables efficient event-driven multitasking where tasks sleep until notified, reducing unnecessary CPU usage.

Unlike TaskStateSuspended (which requires explicit `xTaskResume()` to reactivate), tasks in TaskStateWaiting automatically become schedulable when their awaited event occurs. Once the event is consumed (via `xTaskNotifyTake()` or `xTaskNotificationStateClear()`), the task automatically returns to waiting state.

State Transition:

- TaskStateRunning → TaskStateWaiting: Task enters event-waiting mode
- TaskStateSuspended → TaskStateWaiting: Task enters event-waiting mode
- TaskStateWaiting → TaskStateWaiting: No effect (already waiting)

Supported Event Types:

1. Task Timers: Task wakes when its timer expires (via `xTaskResetTimer()`)
2. Direct-to-Task Notifications: Task wakes when another task sends a notification (via `xTaskNotifyGive()`)

Event-Driven Workflow:

1. Task calls `xTaskWait()` to enter waiting state
2. Task stops executing and does not consume CPU
3. Another task or timer triggers an event
4. Scheduler automatically schedules the waiting task
5. Task executes and processes the event
6. Task consumes the event (`xTaskNotifyTake()` or `xTaskNotificationStateClear()`)
7. Task automatically returns to waiting state

#### Note

Event-driven tasks are more efficient than polling-based tasks as they only execute when needed, reducing CPU usage and power consumption.

A task in waiting state will remain inactive until its event occurs. To unconditionally activate a waiting task, use `xTaskResume()`.

The event mechanism is edge-triggered. If an event occurs before `xTaskWait()` is called, the task will execute once to process it.

**Example Usage:**

```

xTask buttonTask;
xTask ledTask;
// Button task waits for button press notifications
void buttonHandler(xTask task, xTaskParam parm) {
    xTaskNotification notification;
    // Wait for button press event
    xTaskWait(task);
    // Check if notification is waiting
    if (OK(xTaskNotificationIsWaiting(task, &notification))) {
        // Process button press
        if (OK(xTaskNotifyTake(task, &notification))) {
            handleButtonPress();
            // Task automatically returns to waiting state
        }
    }
}
// Interrupt handler or another task sends notification
void buttonISR(void) {
    // Wake up button task
    xTaskNotifyGive(buttonTask);
}
int main(void) {
    xTaskCreate(&buttonTask, "Button ", buttonHandler, NULL);
    xTaskResume(buttonTask); // Initially resume the task
    xTaskStartScheduler();
}

```

**Parameters**

in	<i>task</i> ↔	Handle of the task to place in waiting state. Must be a valid task handle previously returned by <a href="#">xTaskCreate()</a> .
	—	

**Returns**

ReturnOK if the task state was successfully changed to waiting, ReturnError if the operation failed (invalid task handle or system error).

**See also**

[xTaskCreate\(\)](#) - Create a new task  
[xTaskResume\(\)](#) - Activate a task (overrides waiting state)  
[xTaskSuspend\(\)](#) - Deactivate a task  
[xTaskNotifyGive\(\)](#) - Send a notification to wake a waiting task  
[xTaskNotifyTake\(\)](#) - Consume a notification event  
[xTaskNotificationIsWaiting\(\)](#) - Check for pending notifications  
[xTaskNotificationStateClear\(\)](#) - Clear notification state  
[xTaskResetTimer\(\)](#) - Reset task timer for timer-based events  
[TaskState\\_t](#) - Task state enumeration

**4.2.4.92 xTimerChangePeriod()** [xReturn](#) xTimerChangePeriod (   
     [xTimer](#) timer\_,  
     const [xTicks](#) period\_ )

Modifies the expiration period of an application timer without requiring timer deletion and recreation. The new period takes effect immediately and will be used for all subsequent timer expirations. This operation allows dynamic adjustment of timer intervals based on runtime conditions, enabling adaptive timing behavior in response to system state or application needs.



When `xTimerChangePeriod()` is called, the timer's period is updated to the new value, but the timer's current state (active/stopped) and elapsed time are preserved. If the timer is running, it continues running with the new period. The timer will expire when the elapsed time reaches the new period value, which may be sooner or later than the original period.

Key characteristics:

- **Immediate effect:** New period applies to current and future timing cycles
- **State preservation:** Timer remains active or stopped as before the change
- **Elapsed time preserved:** Current elapsed time is not reset automatically
- **No recreation needed:** Avoids overhead of deleting and recreating timer
- **Non-blocking:** Returns immediately after period update

Common period change scenarios:

- **Adaptive sampling:** Adjust sensor polling rate based on value changes
- **Power management:** Slow down non-critical timers to conserve energy
- **Load balancing:** Distribute timer expirations to avoid processing spikes
- **Configuration updates:** Apply new timing settings from user preferences
- **Error recovery:** Increase retry intervals during communication failures

#### Example 1: Adaptive sensor polling

```
xTimer sensorPollTimer;
xByte lastReading = 0;
void sensorTask(xTask task, xTaskParm parm) {
    xBase expired;
    if (OK(xTimerHasTimerExpired(sensorPollTimer, &expired)) && expired) {
        xByte reading = readSensor();
        xByte change = abs(reading - lastReading);
        // Adapt polling rate based on change magnitude
        if (change > 20) {
            // Fast changes - poll rapidly
            xTimerChangePeriod(sensorPollTimer, 10);
        } else if (change > 5) {
            // Moderate changes - normal rate
            xTimerChangePeriod(sensorPollTimer, 50);
        } else {
            // Stable - slow down polling
            xTimerChangePeriod(sensorPollTimer, 200);
        }
        lastReading = reading;
        xTimerReset(sensorPollTimer);
    }
}
```

#### Example 2: Power-aware timing

```
xTimer backgroundTimer;
typedef enum {
    POWER_MODE_ACTIVE,
    POWER_MODE_SLEEP,
    POWER_MODE_DEEP_SLEEP
} PowerMode_t;
void setPowerMode(PowerMode_t mode) {
    switch (mode) {
        case POWER_MODE_ACTIVE:
            xTimerChangePeriod(backgroundTimer, 50); // Fast updates
            break;
        case POWER_MODE_SLEEP:
            xTimerChangePeriod(backgroundTimer, 500); // Slower updates
            break;
        case POWER_MODE_DEEP_SLEEP:
            xTimerChangePeriod(backgroundTimer, 5000); // Minimal updates
            break;
    }
}
```

**Example 3: Communication retry with exponential backoff**

```

xTimer retryTimer;
xTicks currentRetryInterval = 100;
void attemptConnection(void) {
    if (connectionSuccessful()) {
        // Reset to initial interval on success
        currentRetryInterval = 100;
        xTimerChangePeriod(retryTimer, currentRetryInterval);
        xTimerStop(retryTimer);
    } else {
        // Exponential backoff on failure (max 10 seconds)
        if (currentRetryInterval < 10000) {
            currentRetryInterval *= 2;
            xTimerChangePeriod(retryTimer, currentRetryInterval);
        }
        xTimerReset(retryTimer);
    }
}

```

**Example 4: User-configurable timer**

```

xTimer userTimer;
void applyUserSettings(xTicks newInterval) {
    // Validate interval range
    if (newInterval < 10) {
        newInterval = 10; // Minimum 10 ticks
    } else if (newInterval > 60000) {
        newInterval = 60000; // Maximum 60 seconds
    }
    // Apply new interval
    if (OK(xTimerChangePeriod(userTimer, newInterval))) {
        // Reset to start timing with new period
        xTimerReset(userTimer);
        saveSettings(newInterval);
    }
}

```

**Parameters**

in	<i>timer</i> ↔ —	Handle to the timer whose period should be changed. Must be a valid timer created with <a href="#">xTimerCreate()</a> .
in	<i>period</i> ↔ —	The new timer period in system ticks. Must be greater than zero. The timer will expire when elapsed time equals this value.

**Returns**

ReturnOK if period changed successfully, ReturnError if operation failed due to invalid timer handle, timer not found, or invalid period value.

**Warning**

Changing the period does NOT automatically reset the elapsed time. If a timer has already accumulated elapsed time, it may expire immediately if the new period is less than the current elapsed time. Call [xTimerReset\(\)](#) after changing the period if you want to start timing from zero with the new period.

Reducing the period on a running timer may cause immediate expiration if the elapsed time already exceeds the new period. Always check or reset the timer after reducing the period.

**Note**

[xTimerChangePeriod\(\)](#) can be called whether the timer is running or stopped. The new period takes effect in both cases.

The timer's active state is preserved—if it was running, it continues running; if stopped, it remains stopped.

Changing to period value 0 is invalid and will return ReturnError. To disable a timer, use [xTimerStop\(\)](#) instead.

See also

- [xTimerGetPeriod\(\)](#) - Query current timer period
- [xTimerReset\(\)](#) - Reset elapsed time after changing period
- [xTimerCreate\(\)](#) - Create timer with initial period
- [xTimerStart\(\)](#) - Start timer with its current period
- [xTimerStop\(\)](#) - Stop timer to prevent expiration
- [xTimerHasTimerExpired\(\)](#) - Check if timer has expired

**4.2.4.93 xTimerCreate()** `xReturn xTimerCreate (`  
    `xTimer * timer_,`  
    `const xTicks period_ )`

Creates a software timer that can be used for measuring time intervals, implementing delays, or triggering periodic actions. Software timers are independent of task timers and provide general-purpose timing facilities for application use.

Software timers in HeliOS are NOT the same as task timers used for event-driven multitasking. Application timers are lightweight timing objects that can be:

- Started and stopped on demand
- Reset to restart counting from zero
- Queried to check if the period has elapsed
- Modified to change their period dynamically

Timer Operation: Timers count system ticks from when they are started. When the elapsed ticks exceed the configured period, the timer is considered "expired." Applications check timer expiration using [xTimerHasTimerExpired\(\)](#) and can reset the timer to begin a new timing cycle.

Common Use Cases:

- Implementing timeout detection
- Creating delays without blocking
- Measuring elapsed time between events
- Implementing periodic operations (e.g., blinking LED)
- Rate limiting operations
- Watchdog functionality

## Note

Software timers are passive timing objects. They do not automatically trigger callbacks or events when they expire. Applications must actively check timer status using [xTimerHasTimerExpired\(\)](#).

Timer resolution is determined by the system tick rate, which depends on how frequently [xTaskStartScheduler\(\)](#) executes (typically tied to hardware timer interrupts or main loop frequency).

Multiple timers can be created for different timing needs. Each timer maintains independent state and period configuration.

## Example Usage:

```
xTimer blinkTimer;
xTimer timeoutTimer;
// Create a timer with 1000 tick period (e.g., 1 second if 1ms ticks)
if (OK(xTimerCreate(&blinkTimer, 1000))) {
    // Start the timer
    xTimerStart(blinkTimer);
    // In your task or main loop:
    xBase expired;
    if (OK(xTimerHasTimerExpired(blinkTimer, &expired)) && expired) {
        // Timer has expired - toggle LED
        toggleLED();
        // Reset for next cycle
        xTimerReset(blinkTimer);
    }
}
// Create a timeout timer
if (OK(xTimerCreate(&timeoutTimer, 5000))) { // 5 second timeout
    xTimerStart(timeoutTimer);
    // Wait for operation with timeout
    while (!operationComplete) {
        xBase timedOut;
        if (OK(xTimerHasTimerExpired(timeoutTimer, &timedOut)) && timedOut) {
            // Timeout occurred
            handleTimeout();
            break;
        }
        // Continue waiting...
    }
    // Clean up
    xTimerDelete(timeoutTimer);
}
```

## Parameters

out	<i>timer</i> ↔ —	Pointer to xTimer variable that will receive the timer handle. This handle is used in subsequent timer operations.
in	<i>period</i> ↔ —	Timer period in system ticks. The timer expires when elapsed ticks exceed this value. Must be greater than zero.

## Returns

ReturnOK if the timer was successfully created, ReturnError if creation failed (out of memory, invalid parameters, or system error).

## See also

[xTimerDelete\(\)](#) - Delete a timer and free its resources

[xTimerStart\(\)](#) - Start a timer counting

[xTimerStop\(\)](#) - Stop a timer

[xTimerReset\(\)](#) - Reset a timer to zero

[xTimerHasTimerExpired\(\)](#) - Check if timer has expired

[xTimerChangePeriod\(\)](#) - Change timer period

[xTimerGetPeriod\(\)](#) - Get current timer period

[xTimerIsTimerActive\(\)](#) - Check if timer is running

**4.2.4.94 xTimerDelete()** `xReturn` xTimerDelete (   
     const `xTimer` timer\_ )

Permanently removes an application timer created with `xTimerCreate()` and releases all associated kernel resources. After deletion, the timer handle becomes invalid and must not be used in any subsequent timer operations. This operation is typically performed during cleanup, reconfiguration, or when a timer is no longer needed by the application.

`xTimerDelete()` immediately removes the timer from the kernel timer list regardless of its current state (stopped, running, or expired). If the timer was active, it is stopped automatically before deletion. No further timer events will occur, and all internal timer state is freed.

Key characteristics:

- **Immediate deletion:** Timer removed regardless of active/stopped state
- **Resource cleanup:** All kernel memory associated with timer is freed
- **Handle invalidation:** Timer handle cannot be reused after deletion
- **Idempotent operation:** Safe to call even if timer was never started
- **No blocking:** Returns immediately after cleanup completes

Typical deletion scenarios:

- **Application cleanup:** Remove timers during task or module shutdown
- **Dynamic timer management:** Delete and recreate timers with different periods
- **Resource reclamation:** Free timers no longer needed to reduce memory usage
- **Error recovery:** Clean up timers after configuration or initialization failures

Example 1: Timer lifecycle management

```
xTimer watchdogTimer;
// Create and use timer
if (OK(xTimerCreate(&watchdogTimer, 1000))) {
    xTimerStart(watchdogTimer);
    // ... use timer for some period ...
    // Clean up when done
    xTimerStop(watchdogTimer);
    xTimerDelete(watchdogTimer);
    // watchdogTimer handle is now invalid
}
```

Example 2: Dynamic timer reconfiguration

```
xTimer intervalTimer;
void setMonitoringInterval(xTicks newInterval) {
    // Delete existing timer if present
    if (intervalTimer != null) {
        xTimerDelete(intervalTimer);
    }
    // Create new timer with updated period
    if (OK(xTimerCreate(&intervalTimer, newInterval))) {
        xTimerStart(intervalTimer);
    }
}
```

Example 3: Cleanup multiple timers

```
xTimer timers[MAX_SENSORS];
xBase timerCount = 0;
void initSensorTimers(void) {
    for (xBase i = 0; i < MAX_SENSORS; i++) {
        if (OK(xTimerCreate(&timers[i], 100 * (i + 1)))) {
            xTimerStart(timers[i]);
            timerCount++;
        }
    }
}
```

```

}
void shutdownSensorTimers(void) {
    for (xBase i = 0; i < timerCount; i++) {
        xTimerDelete(timers[i]);
    }
    timerCount = 0;
}

```

#### Example 4: Conditional timer cleanup

```

xTimer periodicTimer;
xBase timerActive = 0;
void disablePeriodicTask(void) {
    if (timerActive) {
        xTimerDelete(periodicTimer);
        timerActive = 0;
    }
}
void enablePeriodicTask(xTicks period) {
    // Clean up old timer if exists
    disablePeriodicTask();
    // Create new timer
    if (OK(xTimerCreate(&periodicTimer, period))) {
        xTimerStart(periodicTimer);
        timerActive = 1;
    }
}

```

#### Parameters

in	<i>timer</i> ↔	Handle to the timer to delete. Must be a valid timer created with <a href="#">xTimerCreate()</a> . After deletion, this handle becomes invalid.
	—	

#### Returns

ReturnOK if timer deleted successfully, ReturnError if deletion failed due to invalid timer handle or timer not found.

#### Warning

After [xTimerDelete\(\)](#) returns successfully, the timer handle is invalid and must not be used in any subsequent operations. Using a deleted timer handle will result in ReturnError.

Deleting a timer that is referenced by multiple tasks can lead to errors if those tasks attempt to use the timer after deletion. Coordinate timer deletion across all tasks using the timer.

#### Note

[xTimerDelete\(\)](#) automatically stops the timer before deletion if it was running. You do not need to explicitly call [xTimerStop\(\)](#) first.

Unlike task and queue deletion, timer deletion does not require waiting for operations to complete. The timer is removed immediately.

Deletion is the only way to reclaim kernel memory allocated for a timer. Simply stopping a timer does not free its resources.

#### See also

- [xTimerCreate\(\)](#) - Create an application timer
- [xTimerStop\(\)](#) - Stop a running timer without deleting it
- [xTimerStart\(\)](#) - Start or restart a timer
- [xTimerReset\(\)](#) - Reset timer elapsed time to zero
- [xTimerIsTimerActive\(\)](#) - Check if timer is currently running
- [xTaskDelete\(\)](#) - Delete a task (similar resource cleanup pattern)

**4.2.4.95 xTimerGetPeriod()** `xReturn` xTimerGetPeriod (

```

    const xTimer timer_,
    xTicks * period_ )
```

Retrieves the configured expiration period for an application timer in system ticks. This non-destructive query allows tasks to inspect timer configuration without affecting timer state or operation. The returned period value reflects the most recent setting from `xTimerCreate()` or `xTimerChangePeriod()`.

`xTimerGetPeriod()` provides read-only access to the timer's period configuration. This is useful for validation, diagnostics, dynamic adjustments based on current settings, or coordination between multiple tasks that share timer resources. The query does not modify the timer state, elapsed time, or active/stopped status.

Common use cases:

- **Configuration validation:** Verify timer period matches expected values
- **Dynamic adjustments:** Calculate new periods based on current setting
- **Diagnostics and logging:** Report timer configuration for debugging
- **Coordinated timing:** Synchronize related timers based on period ratios
- **Settings persistence:** Save current timer configuration to non-volatile memory

#### Example 1: Validate timer configuration

```

xTimer watchdogTimer;
void initWatchdog(void) {
    xTicks expectedPeriod = 5000; // 5 seconds
    if (OK(xTimerCreate(&watchdogTimer, expectedPeriod))) {
        // Verify timer created with correct period
        xTicks actualPeriod;
        if (OK(xTimerGetPeriod(watchdogTimer, &actualPeriod))) {
            if (actualPeriod == expectedPeriod) {
                xTimerStart(watchdogTimer);
            } else {
                // Configuration mismatch - handle error
                logError("Watchdog period mismatch");
            }
        }
    }
}
```

#### Example 2: Adaptive period adjustment

```

xTimer pollTimer;
void speedUpPolling(void) {
    xTicks currentPeriod;
    if (OK(xTimerGetPeriod(pollTimer, &currentPeriod))) {
        // Halve the period (double the rate), but enforce minimum
        xTicks newPeriod = currentPeriod / 2;
        if (newPeriod < 10) {
            newPeriod = 10; // Minimum 10 ticks
        }
        xTimerChangePeriod(pollTimer, newPeriod);
        xTimerReset(pollTimer);
    }
}
void slowDownPolling(void) {
    xTicks currentPeriod;
    if (OK(xTimerGetPeriod(pollTimer, &currentPeriod))) {
        // Double the period (halve the rate), but enforce maximum
        xTicks newPeriod = currentPeriod * 2;
        if (newPeriod > 10000) {
            newPeriod = 10000; // Maximum 10 seconds
        }
        xTimerChangePeriod(pollTimer, newPeriod);
        xTimerReset(pollTimer);
    }
}
```

#### Example 3: Coordinated timer relationships

```

xTimer fastTimer;
xTimer slowTimer;
void setupCoordinatedTimers(void) {
    // Fast timer runs at base rate
```

```

xTimerCreate(&fastTimer, 100);
xTimerStart(fastTimer);
// Slow timer should run at 10x the fast timer period
xTicks fastPeriod;
if (OK(xTimerGetPeriod(fastTimer, &fastPeriod))) {
    xTimerCreate(&slowTimer, fastPeriod * 10);
    xTimerStart(slowTimer);
}
}

```

#### Example 4: System diagnostics and reporting

```

xTimer timers[MAX_TIMERS];
xBase timerCount = 0;
void reportTimerStatus(void) {
    for (xBase i = 0; i < timerCount; i++) {
        xTicks period;
        xBase isActive;
        xBase hasExpired;
        if (OK(xTimerGetPeriod(timers[i], &period))) {
            xTimerIsTimerActive(timers[i], &isActive);
            xTimerHasTimerExpired(timers[i], &hasExpired);
            // Log timer status
            printf("Timer %d: period=%lu, active=%d, expired=%d\n",
                i, period, isActive, hasExpired);
        }
    }
}

```

#### Parameters

in	<i>timer</i> ↔	Handle to the timer to query. Must be a valid timer created with <a href="#">xTimerCreate()</a> .
out	<i>period</i> ↔	Pointer to variable receiving the timer period in system ticks. On success, contains the current period value.

#### Returns

ReturnOK if period retrieved successfully, ReturnError if query failed due to invalid timer handle or timer not found.

#### Warning

This function returns the configured period, not the elapsed time or remaining time. To determine how close a timer is to expiration, you need to track elapsed time or check expiration status with [xTimerHasTimerExpired\(\)](#).

#### Note

[xTimerGetPeriod\(\)](#) is a non-destructive query that does not modify timer state, elapsed time, or active/stopped status.

The returned period reflects the most recent value set by either [xTimerCreate\(\)](#) (initial period) or [xTimerChangePeriod\(\)](#) (updated period).

HeliOS does not provide direct access to elapsed time. To track progress toward expiration, implement your own elapsed time tracking using the scheduler's tick count.

#### See also

- [xTimerChangePeriod\(\)](#) - Modify timer period
- [xTimerCreate\(\)](#) - Create timer with initial period
- [xTimerIsTimerActive\(\)](#) - Check if timer is running
- [xTimerHasTimerExpired\(\)](#) - Check if timer has expired
- [xTimerReset\(\)](#) - Reset elapsed time to zero
- [xTimerStart\(\)](#) - Start timer with its current period



**4.2.4.96 xTimerHasTimerExpired()** `xReturn` xTimerHasTimerExpired (   
     const `xTimer` timer\_,   
     `xBase` \* res\_ )

Queries whether an application timer's elapsed time has reached or exceeded its configured period, indicating that the timer has expired. This query is the primary mechanism for detecting timer events in polling-based timing patterns. Once expired, the timer remains in the expired state until reset with `xTimerReset()` or stopped with `xTimerStop()`.

A timer can only expire if it is active (started with `xTimerStart()`). Inactive timers never expire, even if sufficient time has passed. The expired state is "sticky"—once a timer expires, it remains expired until explicitly cleared, allowing multiple tasks to observe the expiration event without race conditions.

Typical expiration handling workflow:

1. Check if timer has expired with `xTimerHasTimerExpired()`
2. If expired, perform the timed action
3. Reset the timer with `xTimerReset()` to clear expiration and restart timing
4. Repeat the cycle

Key characteristics:

- **Sticky expiration:** Remains expired until `xTimerReset()` or `xTimerStop()`
- **Requires active timer:** Only active timers can expire
- **Non-destructive query:** Does not clear expiration or modify state
- **Event detection:** Primary method for implementing periodic actions

#### Example 1: Periodic sensor polling

```
xTimer pollTimer;
void initSensor(void) {
    xTimerCreate(&pollTimer, 100); // Poll every 100 ticks
    xTimerStart(pollTimer);
}
void sensorTask(xTask task, xTaskParam parm) {
    xBase expired;
    if (OK(xTimerHasTimerExpired(pollTimer, &expired)) && expired) {
        // Timer expired - read sensor
        xByte sensorValue = readSensor();
        processSensorData(sensorValue);
        // Reset for next period
        xTimerReset(pollTimer);
    }
}
```

#### Example 2: Watchdog timeout detection

```
xTimer watchdogTimer;
void initWatchdog(void) {
    xTimerCreate(&watchdogTimer, 5000); // 5 second timeout
    xTimerStart(watchdogTimer);
}
void watchdogTask(xTask task, xTaskParam parm) {
    xBase expired;
    if (OK(xTimerHasTimerExpired(watchdogTimer, &expired)) && expired) {
        // Watchdog expired - system not responding
        logError("Watchdog timeout - system hung");
        performSystemReset();
    }
}
void petWatchdog(void) {
    // Called periodically by application to prevent timeout
    xTimerReset(watchdogTimer);
}
```

**Example 3: Multi-rate execution with multiple timers**

```

xTimer fastTimer, mediumTimer, slowTimer;
void initTimers(void) {
    xTimerCreate(&fastTimer, 10);    // Every 10 ticks
    xTimerCreate(&mediumTimer, 100); // Every 100 ticks
    xTimerCreate(&slowTimer, 1000);  // Every 1000 ticks
    xTimerStart(fastTimer);
    xTimerStart(mediumTimer);
    xTimerStart(slowTimer);
}

void controlTask(xTask task, xTaskParam parm) {
    xBase_t expired;
    // Fast update - 10 ticks
    if (OK(xTimerHasTimerExpired(fastTimer, &expired)) && expired) {
        updateFastController();
        xTimerReset(fastTimer);
    }
    // Medium update - 100 ticks
    if (OK(xTimerHasTimerExpired(mediumTimer, &expired)) && expired) {
        updateMediumController();
        xTimerReset(mediumTimer);
    }
    // Slow update - 1000 ticks
    if (OK(xTimerHasTimerExpired(slowTimer, &expired)) && expired) {
        updateSlowController();
        xTimerReset(slowTimer);
    }
}

```

**Example 4: Timeout for communication protocol**

```

xTimer responseTimer;
typedef enum {
    STATE_IDLE,
    STATE_WAITING_RESPONSE,
    STATE_COMPLETE
} CommState_t;
CommState_t commState = STATE_IDLE;
void sendRequest(void) {
    transmitData();
    commState = STATE_WAITING_RESPONSE;
    // Start timeout timer
    xTimerReset(responseTimer);
    xTimerStart(responseTimer);
}

void commTask(xTask task, xTaskParam parm) {
    xBase_t expired;
    if (commState == STATE_WAITING_RESPONSE) {
        if (OK(xTimerHasTimerExpired(responseTimer, &expired)) && expired) {
            // Timeout - no response received
            logError("Communication timeout");
            xTimerStop(responseTimer);
            commState = STATE_IDLE;
            retryRequest();
        }
    }
}

void onResponseReceived(void) {
    // Stop timer on successful response
    xTimerStop(responseTimer);
    commState = STATE_COMPLETE;
    processResponse();
}

```

**Parameters**

in	<i>timer</i> ↔ —	Handle to the timer to query. Must be a valid timer created with <a href="#">xTimerCreate()</a> .
out	<i>res</i> ↔ —	Pointer to variable receiving the expiration status. Set to non-zero (true) if timer has expired, zero (false) if timer has not expired or is not active.

**Returns**

ReturnOK if query succeeded, ReturnError if query failed due to invalid timer handle or timer not found.

**Warning**

`xTimerHasTimerExpired()` does NOT automatically reset the timer. Once expired, the timer remains expired until you explicitly call `xTimerReset()` or `xTimerStop()`. Failing to reset an expired timer will cause it to appear expired on every subsequent check.

Inactive (stopped) timers never expire. Always verify the timer is active with `xTimerStart()` before expecting expiration events.

**Note**

The expiration state is "sticky"—it persists until cleared. This allows multiple tasks to safely check the same timer expiration without missing the event.

Expiration occurs when elapsed time  $\geq$  period. At the moment the elapsed time equals the period, the timer transitions to expired state.

Unlike some RTOS timers that provide callback functions on expiration, HeliOS timers use polling with `xTimerHasTimerExpired()`. Tasks must explicitly check for expiration in their execution loops.

**See also**

- `xTimerReset()` - Clear expiration and restart timing
- `xTimerStart()` - Activate timer to enable expiration
- `xTimerStop()` - Deactivate timer and clear expiration
- `xTimerIsTimerActive()` - Check if timer is running
- `xTimerCreate()` - Create timer with period
- `xTimerChangePeriod()` - Modify timer period

**4.2.4.97 xTimerIsTimerActive()** `xReturn xTimerIsTimerActive (`  
`const xTimer timer_,`  
`xBase * res_ )`

Queries whether an application timer is in the active (running) state. A timer is considered active if it has been started with `xTimerStart()` and has not been stopped with `xTimerStop()`. Active timers accumulate elapsed time on each scheduler tick and will eventually expire when elapsed time reaches the configured period.

This non-destructive query allows tasks to check timer state before performing operations, coordinate timing between tasks, or implement conditional logic based on whether timing is currently in progress. The query does not affect timer operation or elapsed time accumulation.

Timer state transitions:

- **Inactive (stopped):** Initial state after creation, or after `xTimerStop()`
- **Active (running):** After `xTimerStart()`, accumulating elapsed time
- **Active and expired:** Timer remains active until `xTimerReset()` or `xTimerStop()`

Key characteristics:

- **Non-destructive query:** Does not modify timer state or elapsed time

- **State only:** Returns active/stopped status, not expiration status
- **Instant snapshot:** Reflects current state at time of call

#### Example 1: Conditional timer start

```
xTimer processingTimer;
void startProcessing(void) {
    xBase isActive;
    // Only start if not already running
    if (OK(xTimerIsTimerActive(processingTimer, &isActive))) {
        if (!isActive) {
            xTimerReset(processingTimer);
            xTimerStart(processingTimer);
            beginProcessing();
        } else {
            logWarning("Processing already in progress");
        }
    }
}
```

#### Example 2: Watchdog monitoring

```
xTimer watchdogTimer;
void checkWatchdog(void) {
    xBase isActive;
    xBase hasExpired;
    if (OK(xTimerIsTimerActive(watchdogTimer, &isActive))) {
        if (!isActive) {
            // Watchdog not running - critical error
            handleWatchdogFailure();
        } else if (OK(xTimerHasTimerExpired(watchdogTimer, &hasExpired)) && hasExpired) {
            // Watchdog expired - system hung
            handleWatchdogTimeout();
        } else {
            // Watchdog running normally
        }
    }
}

void petWatchdog(void) {
    xBase isActive;
    if (OK(xTimerIsTimerActive(watchdogTimer, &isActive)) && isActive) {
        xTimerReset(watchdogTimer); // Reset only if active
    }
}
```

#### Example 3: Performance measurement

```
xTimer perfTimer;
void startMeasurement(void) {
    xBase isActive;
    if (OK(xTimerIsTimerActive(perfTimer, &isActive)) && isActive) {
        logWarning("Measurement already in progress");
        return;
    }
    xTimerReset(perfTimer);
    xTimerStart(perfTimer);
}

void endMeasurement(void) {
    xBase isActive;
    if (OK(xTimerIsTimerActive(perfTimer, &isActive)) && isActive) {
        xTimerStop(perfTimer);
        // Analyze performance metrics
    } else {
        logError("No measurement in progress");
    }
}
```

#### Example 4: System diagnostics

```
xTimer systemTimers[MAX_TIMERS];
xBase timerCount = 0;
void reportSystemStatus(void) {
    xBase activeCount = 0;
    xBase expiredCount = 0;
    for (xBase i = 0; i < timerCount; i++) {
        xBase isActive, hasExpired;
        if (OK(xTimerIsTimerActive(systemTimers[i], &isActive)) && isActive) {
            activeCount++;
        }
        if (OK(xTimerHasTimerExpired(systemTimers[i], &hasExpired)) && hasExpired) {
            expiredCount++;
        }
    }
}

printf("Timers: %d total, %d active, %d expired\n",
       timerCount, activeCount, expiredCount);
}
```

## Parameters

in	<i>timer</i> ↔ —	Handle to the timer to query. Must be a valid timer created with <a href="#">xTimerCreate()</a> .
out	<i>res</i> ↔ —	Pointer to variable receiving the active state. Set to non-zero (true) if timer is active/running, zero (false) if timer is stopped.

## Returns

ReturnOK if query succeeded, ReturnError if query failed due to invalid timer handle or timer not found.

## Warning

Active state does not indicate whether the timer has expired. A timer can be both active and expired simultaneously. Use [xTimerHasTimerExpired\(\)](#) to check expiration status.

## Note

[xTimerIsTimerActive\(\)](#) returns the state at the moment of the call. In multitasking environments, the state may change immediately after if another task starts or stops the timer.

A timer that has expired remains active until explicitly stopped with [xTimerStop\(\)](#) or reset with [xTimerReset\(\)](#). Expiration does not automatically stop the timer.

Newly created timers are inactive by default. They must be explicitly started with [xTimerStart\(\)](#) to begin accumulating elapsed time.

## See also

[xTimerStart\(\)](#) - Start timer (make it active)  
[xTimerStop\(\)](#) - Stop timer (make it inactive)  
[xTimerHasTimerExpired\(\)](#) - Check if active timer has expired  
[xTimerReset\(\)](#) - Reset elapsed time while keeping timer active  
[xTimerCreate\(\)](#) - Create timer in inactive state

**4.2.4.98 xTimerReset()** `xReturn xTimerReset (`  
`xTimer timer_ )`

Clears an application timer's accumulated elapsed time, returning it to the state immediately after creation or start. This operation is the primary method for acknowledging timer expiration and beginning a new timing cycle. The timer's configured period and active/stopped state are preserved—only the elapsed time is reset to zero.

[xTimerReset\(\)](#) is typically called after detecting timer expiration with [xTimerHasTimerExpired\(\)](#) to clear the expired state and restart the timing cycle for periodic operations. The reset does not affect whether the timer is active or stopped; an active timer continues running from zero elapsed time, while a stopped timer remains stopped with zero elapsed time.

Key characteristics:

- **Clears elapsed time:** Resets accumulated time to zero

- **Clears expiration:** Timer no longer reports as expired after reset
- **Preserves state:** Active/stopped state unchanged
- **Preserves period:** Configured timer period unchanged
- **Immediate effect:** Next expiration occurs one full period after reset

Common reset scenarios:

- **Periodic operations:** Reset after each expiration to start next cycle
- **Watchdog petting:** Reset watchdog timer to prevent timeout
- **Event acknowledgment:** Clear timer after handling timed event
- **Synchronization:** Align timer phases with system events
- **Period changes:** Reset after calling `xTimerChangePeriod()` to start fresh

#### Example 1: Periodic sensor polling pattern

```
xTimer sensorTimer;
void initSensor(void) {
    xTimerCreate(&sensorTimer, 100); // 100 tick period
    xTimerStart(sensorTimer);
}
void sensorTask(xTask task, xTaskParm parm) {
    xBase expired;
    if (OK(xTimerHasTimerExpired(sensorTimer, &expired)) && expired) {
        // Read and process sensor
        xByte value = readSensor();
        processSensorValue(value);
        // Reset for next cycle
        xTimerReset(sensorTimer);
    }
}
```

#### Example 2: Watchdog timer implementation

```
xTimer watchdogTimer;
void initWatchdog(void) {
    xTimerCreate(&watchdogTimer, 5000); // 5 second timeout
    xTimerStart(watchdogTimer);
}
void petWatchdog(void) {
    // Called periodically by application to prevent timeout
    xTimerReset(watchdogTimer);
}
void watchdogTask(xTask task, xTaskParm parm) {
    xBase expired;
    if (OK(xTimerHasTimerExpired(watchdogTimer, &expired)) && expired) {
        // System hung - watchdog not reset in time
        logCritical("Watchdog timeout");
        performSystemReset();
    }
}
```

#### Example 3: Debouncing button input

```
xTimer debounceTimer;
xBase buttonPressed = 0;
void onButtonPress(void) {
    if (!buttonPressed) {
        // First press - start debounce timer
        buttonPressed = 1;
        xTimerReset(debounceTimer);
        xTimerStart(debounceTimer);
        handleButtonPress();
    }
}
void buttonTask(xTask task, xTaskParm parm) {
    xBase expired;
    if (buttonPressed) {
        if (OK(xTimerHasTimerExpired(debounceTimer, &expired)) && expired) {
            // Debounce period elapsed - ready for next press
            buttonPressed = 0;
            xTimerStop(debounceTimer);
        }
    }
}
```

```
}
```

#### Example 4: Synchronized multi-timer operations

```
xTimer timer1, timer2, timer3;
void synchronizeTimers(void) {
    // Reset all timers simultaneously to align phases
    xTimerReset(timer1);
    xTimerReset(timer2);
    xTimerReset(timer3);
    // All timers now start from zero elapsed time
}
void onSystemEvent(void) {
    // Synchronize timer phases on important system event
    synchronizeTimers();
}
```

#### Parameters

in	<i>timer</i> ↔	Handle to the timer to reset. Must be a valid timer created with <a href="#">xTimerCreate()</a> .
	—	

#### Returns

ReturnOK if timer reset successfully, ReturnError if operation failed due to invalid timer handle or timer not found.

#### Warning

[xTimerReset\(\)](#) only clears elapsed time—it does NOT start a stopped timer. If the timer is not active, call [xTimerStart\(\)](#) before or after [xTimerReset\(\)](#) to begin timing.

After reset, the timer will not expire until a full period has elapsed. If you reset a timer that has partially elapsed, you lose that partial progress and must wait the full period again.

#### Note

[xTimerReset\(\)](#) is typically called after detecting expiration to acknowledge the event and start a new timing cycle.

For periodic operations, the pattern is: check expired → perform action → reset timer. This ensures you don't miss expiration events.

Resetting does not change the timer's period. To change the period, use [xTimerChangePeriod\(\)](#) and then optionally [xTimerReset\(\)](#).

Calling [xTimerReset\(\)](#) on an already-reset or newly-created timer is safe and has no adverse effects.

#### See also

[xTimerHasTimerExpired\(\)](#) - Check if timer has expired before resetting

[xTimerStart\(\)](#) - Activate timer after reset

[xTimerStop\(\)](#) - Stop timer (also clears expiration)

[xTimerChangePeriod\(\)](#) - Change period (usually followed by reset)

[xTimerCreate\(\)](#) - Create timer (starts with zero elapsed time)

[xTimerIsTimerActive\(\)](#) - Check if timer is running

#### 4.2.4.99 xTimerStart() `xReturn` xTimerStart ( `xTimer` `timer_` )

Activates an application timer, transitioning it from the stopped (inactive) state to the running (active) state. Once started, the timer begins accumulating elapsed time on each scheduler tick and will eventually expire when elapsed time reaches the configured period. This operation is required to enable timer expiration—only active timers can expire.

`xTimerStart()` preserves the timer's current elapsed time. If you start a timer that was previously stopped with `xTimerStop()`, it resumes from the elapsed time it had accumulated before stopping. To start timing from zero, call `xTimerReset()` before or after `xTimerStart()`. For newly created timers, elapsed time is already zero, so `xTimerReset()` is not necessary.

Key characteristics:

- **Activates timer:** Enables elapsed time accumulation
- **Preserves elapsed time:** Continues from current elapsed time
- **Enables expiration:** Only active timers can expire
- **Idempotent:** Starting an already-running timer has no effect
- **Non-blocking:** Returns immediately after state change

Typical startup sequences:

- **New timer, start from zero:** `xTimerCreate()` → `xTimerStart()`
- **New timer, explicit reset:** `xTimerCreate()` → `xTimerReset()` → `xTimerStart()`
- **Resume stopped timer:** `xTimerStart()` (continues from stopped elapsed time)
- **Restart from zero:** `xTimerReset()` → `xTimerStart()`

#### Example 1: Basic timer startup

```
xTimer periodicTimer;
void initTimer(void) {
    // Create timer with 100 tick period
    if (OK(xTimerCreate(&periodicTimer, 100))) {
        // Start timer - begins timing from zero
        xTimerStart(periodicTimer);
    }
}
void periodicTask(xTask task, xTaskParam parm) {
    xBase expired;
    if (OK(xTimerHasTimerExpired(periodicTimer, &expired)) && expired) {
        performPeriodicAction();
        xTimerReset(periodicTimer); // Reset for next cycle
    }
}
```

#### Example 2: Conditional start based on system state

```
xTimer monitorTimer;
void enableMonitoring(void) {
    xBase isActive;
    if (OK(xTimerIsTimerActive(monitorTimer, &isActive)) && !isActive) {
        // Timer not running - start it
        xTimerReset(monitorTimer); // Start from zero
        xTimerStart(monitorTimer);
        logInfo("Monitoring enabled");
    }
}
void disableMonitoring(void) {
    xBase isActive;
    if (OK(xTimerIsTimerActive(monitorTimer, &isActive)) && isActive) {
        xTimerStop(monitorTimer);
        logInfo("Monitoring disabled");
    }
}
```



```

}
```

#### Example 3: Pause and resume pattern

```

xTimer processTimer;
void pauseProcessing(void) {
    // Stop timer - preserves elapsed time
    xTimerStop(processTimer);
    logInfo("Processing paused");
}
void resumeProcessing(void) {
    // Start timer - continues from paused elapsed time
    xTimerStart(processTimer);
    logInfo("Processing resumed");
}
void resetAndRestart(void) {
    // Restart from zero elapsed time
    xTimerReset(processTimer);
    xTimerStart(processTimer);
    logInfo("Processing restarted from zero");
}
```

#### Example 4: Multiple timer coordination

```

xTimer timer1, timer2, timer3;
void startAllTimers(void) {
    // Reset all to zero
    xTimerReset(timer1);
    xTimerReset(timer2);
    xTimerReset(timer3);
    // Start all simultaneously
    xTimerStart(timer1);
    xTimerStart(timer2);
    xTimerStart(timer3);
    logInfo("All timers started synchronously");
}
void stopAllTimers(void) {
    xTimerStop(timer1);
    xTimerStop(timer2);
    xTimerStop(timer3);
    logInfo("All timers stopped");
}
```

#### Parameters

in	<i>timer</i> ↔	Handle to the timer to start. Must be a valid timer created with <code>xTimerCreate()</code> .
	—	

#### Returns

ReturnOK if timer started successfully, ReturnError if operation failed due to invalid timer handle or timer not found.

#### Warning

`xTimerStart()` does NOT reset elapsed time. If you stopped a timer partway through its period and then start it again, it will continue from where it left off. Call `xTimerReset()` before `xTimerStart()` if you want to begin timing from zero.

Only active (started) timers can expire. Calling `xTimerHasTimerExpired()` on a stopped timer will always return false, even if sufficient time has passed.

#### Note

`xTimerStart()` is idempotent—calling it multiple times on an already-running timer has no effect and is not an error.

For newly created timers, `xTimerReset()` is not necessary before `xTimerStart()` because elapsed time is already zero.

The timer begins accumulating elapsed time immediately on the next scheduler tick after `xTimerStart()` is called.

See also

- [xTimerStop\(\)](#) - Stop timer (opposite operation)
- [xTimerReset\(\)](#) - Reset elapsed time to zero
- [xTimerCreate\(\)](#) - Create timer (starts in stopped state)
- [xTimerIsTimerActive\(\)](#) - Check if timer is running
- [xTimerHasTimerExpired\(\)](#) - Check for expiration (requires active timer)
- [xTimerChangePeriod\(\)](#) - Change timer period

**4.2.4.100 xTimerStop()** `xReturn xTimerStop (`  
`xTimer timer_ )`

Deactivates an application timer, transitioning it from the running (active) state to the stopped (inactive) state. Once stopped, the timer ceases accumulating elapsed time and cannot expire, even if sufficient scheduler ticks pass. The timer's current elapsed time is preserved, allowing for pause-and-resume scenarios if needed.

[xTimerStop\(\)](#) is the primary method for temporarily disabling timing without destroying the timer. Unlike [xTimerDelete\(\)](#), which permanently removes the timer, [xTimerStop\(\)](#) keeps the timer structure intact and allows restarting with [xTimerStart\(\)](#). If the timer was expired when stopped, the expiration state is cleared—[xTimerHasTimerExpired\(\)](#) will return false after stopping.

Key characteristics:

- **Deactivates timer:** Halts elapsed time accumulation
- **Preserves elapsed time:** Current elapsed time is maintained
- **Clears expiration:** Expired state is reset to non-expired
- **Prevents expiration:** Stopped timers cannot expire
- **Idempotent:** Stopping an already-stopped timer has no effect
- **Non-blocking:** Returns immediately after state change

Common stop scenarios:

- **Conditional timing:** Stop timer when condition is met
- **Pause-resume patterns:** Stop to pause, [xTimerStart\(\)](#) to resume
- **Event completion:** Stop timer after timed event finishes early
- **Power management:** Stop non-essential timers to reduce overhead
- **Timeout cancellation:** Stop timer when expected response arrives

**Example 1: Communication timeout with early completion**

```

xTimer timeoutTimer;
void sendRequest(void) {
    transmitData();
    // Start timeout timer
    xTimerReset(timeoutTimer);
    xTimerStart(timeoutTimer);
}
void onResponseReceived(void) {
    // Response arrived - cancel timeout
    xTimerStop(timeoutTimer);
    processResponse();
}
void commTask(xTask task, xTaskParm parm) {
    xBase_t expired;
    if (OK(xTimerHasTimerExpired(timeoutTimer, &expired)) && expired) {
        // Timeout - no response received
        xTimerStop(timeoutTimer);
        handleTimeout();
    }
}

```

**Example 2: Conditional timer management**

```

xTimer activityTimer;
void onActivityDetected(void) {
    xBase_t isActive;
    // Start timer on activity
    if (OK(xTimerIsTimerActive(activityTimer, &isActive)) && !isActive) {
        xTimerReset(activityTimer);
        xTimerStart(activityTimer);
    }
}
void onIdleCondition(void) {
    xBase_t isActive;
    // Stop timer when system goes idle
    if (OK(xTimerIsTimerActive(activityTimer, &isActive)) && isActive) {
        xTimerStop(activityTimer);
    }
}

```

**Example 3: Pause and resume timing**

```

xTimer processTimer;
void pauseProcessing(void) {
    // Stop timer - preserves elapsed time for resume
    xTimerStop(processTimer);
    suspendProcessing();
}
void resumeProcessing(void) {
    // Start timer - continues from paused elapsed time
    xTimerStart(processTimer);
    continueProcessing();
}
void cancelProcessing(void) {
    // Stop and reset - clears elapsed time
    xTimerStop(processTimer);
    xTimerReset(processTimer);
    cleanupProcessing();
}

```

**Example 4: Power-aware timer management**

```

xTimer backgroundTimers[MAX_TIMERS];
xBase_t timerCount = 0;
void enterLowPowerMode(void) {
    // Stop all non-critical timers
    for (xBase_t i = 0; i < timerCount; i++) {
        xTimerStop(backgroundTimers[i]);
    }
    enableSleepMode();
}
void exitLowPowerMode(void) {
    // Resume all timers
    disableSleepMode();
    for (xBase_t i = 0; i < timerCount; i++) {
        xTimerStart(backgroundTimers[i]);
    }
}

```

**Example 5: One-shot timer pattern**

```

xTimer oneShotTimer;
void startOneShotTimer(xTicks_t delay) {
    // Configure and start one-shot timer
    xTimerChangePeriod(oneShotTimer, delay);
    xTimerReset(oneShotTimer);
}

```

```

    xTimerStart(oneShotTimer);
}
void timerTask(xTask task, xTaskParam parm) {
    xBase_t expired;
    if (OK(xTimerHasTimerExpired(oneShotTimer, &expired)) && expired) {
        // Timer expired - stop to prevent re-triggering
        xTimerStop(oneShotTimer);
        performOneShotAction();
    }
}

```

#### Parameters

in	<i>timer</i> ↔	Handle to the timer to stop. Must be a valid timer created with <a href="#">xTimerCreate()</a> .
	—	

#### Returns

ReturnOK if timer stopped successfully, ReturnError if operation failed due to invalid timer handle or timer not found.

#### Warning

[xTimerStop\(\)](#) preserves the current elapsed time. If you later call [xTimerStart\(\)](#) without calling [xTimerReset\(\)](#), the timer will continue from its stopped elapsed time, not from zero. Call [xTimerReset\(\)](#) after [xTimerStop\(\)](#) if you want to clear elapsed time.

Stopped timers cannot expire. [xTimerHasTimerExpired\(\)](#) will return false for stopped timers regardless of elapsed time.

#### Note

[xTimerStop\(\)](#) clears the expiration flag. Even if the timer was expired when stopped, [xTimerHasTimerExpired\(\)](#) will return false after the stop.

[xTimerStop\(\)](#) is idempotent—calling it multiple times on an already-stopped timer has no effect and is not an error.

Stopping a timer does not free its resources. The timer remains allocated and can be restarted with [xTimerStart\(\)](#). To free timer resources, use [xTimerDelete\(\)](#).

Newly created timers are already in the stopped state. Calling [xTimerStop\(\)](#) on a newly created timer has no effect but is not an error.

#### See also

- [xTimerStart\(\)](#) - Start timer (opposite operation)
- [xTimerReset\(\)](#) - Reset elapsed time (often called after stop)
- [xTimerDelete\(\)](#) - Permanently remove timer and free resources
- [xTimerIsTimerActive\(\)](#) - Check if timer is running
- [xTimerHasTimerExpired\(\)](#) - Check for expiration (always false for stopped timers)
- [xTimerCreate\(\)](#) - Create timer (starts in stopped state)

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