This chapter provides a reference to µC/OS-II services. Each of the user-accessible kernel services is presented in alphabetical order. The following information is provided for each of the services:

- A brief description
- The function prototype
- The filename of the source code
- The #define constant needed to enable the code for the service
- A description of the arguments passed to the function
- A description of the returned value(s)
- Specific notes and warnings on using the service
- One or two examples of how to use the function
OS_ENTER_CRITICAL()  
OS_EXIT_CRITICAL()

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OS_ENTER_CRITICAL() and OS_EXIT_CRITICAL() are macros used to disable and enable, respectively, the processor’s interrupts.

Arguments
none

Returned Values
none

Notes/Warnings
1. These macros must be used in pairs.
2. If OS_CRITICAL_METHOD is set to 3, your code is assumed to have allocated local storage for a variable of type OS_CPU_SR, which is called cpu_sr, as follows

```c
#if OS_CRITICAL_METHOD == 3  /* Allocate storage for CPU status reg. */
    OS_CPU_SR cpu_sr;
#endif
```

Example

```c
void TaskX(void *p_arg)
{
    #if OS_CRITICAL_METHOD == 3
        OS_CPU_SR cpu_sr = 0;
    #endif

    for (;;) {
        
        OS_ENTER_CRITICAL();    /* Disable interrupts     */
        
        OS_EXIT_CRITICAL();     /* Enable  interrupts     */

    }
}
```
OSEventNameGet()

`INT8U OSEventNameGet(OS_EVENT *pevent,
                   INT8U *pname,
                   INT8U *perr);`

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OSEventNameGet() allows you to obtain the name that you assigned to a semaphore, a mutex, a mailbox or a message queue. The name is an ASCII string and the size of the name can contain up to `OS_EVENT_NAME_SIZE` characters (including the NUL termination). This function is typically used by a debugger to allow associating a name to a resource.

**Arguments**

- `pevent` is a pointer to the event control block. `pevent` can point either to a semaphore, a mutex, a mailbox or a queue. Where this function is concerned, the actual type is irrelevant. This pointer is returned to your application when the semaphore, mutex, mailbox or queue is created (see `OSSemCreate()`, `OSMutexCreate()`, `OSMboxCreate()` and `OSQCreate()`).

- `pname` is a pointer to an ASCII string that will receive the name of the semaphore, mutex, mailbox or queue. The string must be able to hold at least `OS_EVENT_NAME_SIZE` characters (including the NUL character).

- `perr` is a pointer to an error code and can be any of the following:
  - `OS_ERR_NONE` If the name of the semaphore, mutex, mailbox or queue was copied to the array pointed to by `pname`.
  - `OS_ERR_EVENT_TYPE` You are not pointing to either a semaphore, mutex, mailbox or message queue.
  - `OS_ERR_PEVENT_NULL` You passed a NULL pointer for `pevent`.
  - `OS_ERR_NAME_GET_ISR` You tried calling this function from an ISR.

**Returned Values**

The size of the ASCII string placed in the array pointed to by `pname` or 0 if an error is encountered.
Notes/Warnings

1. The semaphore, mutex, mailbox or message queue must be created before you can use this function and obtain the name of the resource.

Example

```c
INT8U     PrinterSemName[30];
OS_EVENT *PrinterSem;

void Task (void *p_arg)
{
    INT8U     err;
    INT8U     size;

    (void)p_arg;
    for (;;) {
        size = OSEventNameGet(PrinterSem, &PrinterSemName[0], &err);
        .
        .
    }
}
```
OSEventNameSet() allows you to assign a name to a semaphore, a mutex, a mailbox or a message queue. The name is an ASCII string and the size of the name can contain up to \texttt{OS\_EVENT\_NAME\_SIZE} characters (including the \texttt{NUL} termination). This function is typically used by a debugger to allow associating a name to a resource.

**Arguments**

\texttt{pevent} is a pointer to the event control block that you want to name. \texttt{pevent} can point either to a semaphore, a mutex, a mailbox or a queue. Where this function is concerned, the actual type is irrelevant. This pointer is returned to your application when the semaphore, mutex, mailbox or queue is created (see \texttt{OSSemCreate()}, \texttt{OSMutexCreate()}, \texttt{OSMboxCreate()} and \texttt{OSQCreate()}).

\texttt{pname} is a pointer to an ASCII string that contains the name for the resource. The size of the string must be smaller than or equal to \texttt{OS\_EVENT\_NAME\_SIZE} characters (including the \texttt{NUL} character).

\texttt{perr} a pointer to an error code and can be any of the following:

- \texttt{OS\_ERR\_NONE} If the name of the semaphore, mutex, mailbox or queue was copied to the array pointed to by \texttt{pname}.
- \texttt{OS\_ERR\_EVENT\_TYPE} You are not pointing to either a semaphore, mutex, mailbox or message queue.
- \texttt{OS\_ERR\_PEVENT\_NULL} You passed a \texttt{NULL} pointer for \texttt{pevent}.
- \texttt{OS\_ERR\_NAME\_SET\_ISR} You called this function from an ISR.

**Returned Values**

none

**Notes/Warnings**

1. The semaphore, mutex, mailbox or message queue must be created before you can use this function and set the name of the resource.
Example

OS_EVENT *PrinterSem;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (; ;) {
       OSEventNameSet(PrinterSem, "Printer #1", &err);
        .
        .
    }
}
OSEventPendMulti() is used when a task expects to wait on multiple events. If multiple events are ready when OSEventPendMulti() is called, then all available events and messages, if any, are returned as ready to the caller. If no events are ready, OSEventPendMulti() suspends the current task until either an event is ready or a user-specified timeout expires. If an event becomes ready and multiple tasks are waiting for the event, µC/OS-II resumes the highest priority task waiting to run.

A pended task that has been suspended with OSTaskSuspend() can still receive a message from a multi-pended mailbox or message queue or obtain a multi-pended semaphore. However, the task remains suspended until it is resumed by calling OSTaskResume().

Arguments

pevents_pend is a pointer to a null-terminated array of OS_EVENT pointers. These event pointers are returned to your application when the mailboxes, message queues, and semaphores are created [see OSMboxCreate(), OSQCreate(), and OSSemCreate()].

pevents_rdy is a pointer to an array to return the available OS_EVENT pointers. The size of the array must be greater than or equal to the size of the pevents_pend array, including the terminating NULL.

pmsgs_rdy is a pointer to an array to return messages from any multi-pended mailbox or message queue events. The size of the array must be greater than or equal to the size of the pevents_pend array, excluding the terminating NULL. Since NULL messages are valid messages, this array cannot be NULL-terminated. Instead, every available message is returned in the pmsgs_rdy array at the same index as the ready mailbox or message queue event is returned in the pevents_rdy array. All other pmsgs_rdy array indices are filled with NULL messages.

timeout allows the task to resume execution if no multi-pended event is ready within the specified number of clock ticks. A timeout value of 0 indicates that the task wants to wait forever for any of the multi-pended events. The maximum timeout is 65,535 clock ticks. The timeout value is not synchronized with the clock tick. The timeout count begins decrementing on the next clock tick, which could potentially occur immediately.
**perr** is a pointer to a variable that holds an error code. **OSEventPendMulti()** sets *perr* to one of the following:

- **OS_ERR_NONE** if any of the multi-pended events are ready; check the `pevents_rdy` array for which events are available.
- **OS_ERR_TIMEOUT** if no multi-pended event is ready within the specified timeout.
- **OS_ERR_PEND_ABORT** indicates that a multi-pended event was aborted; check the `pevents_rdy` array for which events were aborted.
- **OS_ERR_EVENT_TYPE** if `pevents_pend` is not pointing to an array of valid mailbox, message queue, or semaphore events.
- **OS_ERR_PEND_LOCKED** if you called this function when the scheduler is locked.
- **OS_ERR_PEND_ISR** if you call this function from an ISR and µC/OS-II suspends it. In general, you should not call **OSEventPendMulti()** from an ISR, but µC/OS-II checks for this situation anyway.
- **OS_ERR_PEVENT_NULL** if `pevents_pend`, `pevents_rdy`, or `pmsgs_rdy` is a NULL pointer.

**Returned Value**

**OSEventPendMulti()** returns the number of multi-pended events that are ready or have been aborted, and *perr* is set to **OS_ERR_NONE** or **OS_ERR_PEND_ABORT**, respectively. If no multi-pended event is ready within the specified timeout period or because of any error, then the `pevents_rdy` and `pmsgs_rdy` array are returned as NULL pointers, and *perr* is set to **OS_ERR_TIMEOUT** or to the respective error.

**Notes/Warnings**

1. Mailbox, message queue, or semaphore events must be created before they are used.
2. You should not call **OSEventPendMulti()** from an ISR.
3. You cannot multi-pend on event flags and mutexes.
Example

```
OS_EVENT *events[4]
    SomeMBoxEventPtr
    SomeQEventPtr
    SomeSemEventPtr
    (OS_EVENT *)0

events array size =
    (Number event pointers + 1) * sizeof(OS_EVENT *)

OSEventPendMulti(&events[0],
    &events_rdy[0],
    &event_msgs[0],
    ...

Return all available events
followed by a terminating
OS_EVENT pointer NULL

OS_EVENT *events_rdy[4]
    SomeQEventPtr
    (OS_EVENT *)0
    -
    -

Return event message(s)
at same index into
'pmsgs_rdy' array as
corresponding event
returned event returned
in 'pevents_rdy' array

void *event_msgs[4]
    SomeQMsg
    -
    -
    -
```
Example

```c
void EventTask(void *p_arg)
{
    OS_EVENT *events[4];
    OS_EVENT *events_rdy[4];
    void    *event_msgs[4];
    INT16U   timeout;
    INT8U    err;

    (void)p_arg;
    for (;;) {
        
        events[0] = (OS_EVENT *)SomeMBoxEventPtr;
        events[1] = (OS_EVENT *)SomeQEventPtr;
        events[2] = (OS_EVENT *)SomeSemEventPtr;
        events[3] = (OS_EVENT *)0;
        events_nbr_rdy = OSEventsPendMulti(&events[0]
                                             &events_rdy[0],
                                             &event_msgs[0],
                                             timeout,
                                             &err);

        if (err == OS_ERR_NONE) {
            /* Code for ready or aborted event(s) */
        }
        else {
            /* Code for events not ready within timeout */
        }
    }
}
```
OSFlagAccept() allows you to check the status of a combination of bits to be either set or cleared in an event flag group. Your application can check for any bit to be set/cleared or all bits to be set/cleared. This function behaves exactly as OSFlagPend() does, except that the caller does NOT block if the desired event flags are not present.

**Arguments**

- **pgrp** is a pointer to the event flag group. This pointer is returned to your application when the event flag group is created [see OSFlagCreate()].
- **flags** is a bit pattern indicating which bit(s) (i.e., flags) you wish to check. The bits you want are specified by setting the corresponding bits in flags.
- **wait_type** specifies whether you want all bits to be set/cleared or any of the bits to be set/cleared. You can specify the following arguments:
  - **OS_FLAG_WAIT_CLR_ALL** You check all bits in flags to be clear (0)
  - **OS_FLAG_WAIT_CLR_ANY** You check any bit in flags to be clear (0)
  - **OS_FLAG_WAIT_SET_ALL** You check all bits in flags to be set (1)
  - **OS_FLAG_WAIT_SET_ANY** You check any bit in flags to be set (1)
  - You can add OS_FLAG_CONSUME if you want the event flag(s) to be consumed by the call. For example, to wait for any flag in a group and then clear the flags that are present, set wait_type to
    
    `OS_FLAG_WAIT_SET_ANY + OS_FLAG_CONSUME`
  
  - **perr** a pointer to an error code and can be any of the following:
    - **OS_ERR_NONE** No error
    - **OS_ERR_EVENT_TYPE** You are not pointing to an event flag group
    - **OS_ERR_FLAG_WAIT_TYPE** You didn’t specify a proper wait_type argument.
    - **OS_ERR_FLAG_INVALID_PGRP** You passed a NULL pointer instead of the event flag handle.
    - **OS_ERR_FLAG_NOT_RDY** The desired flags for which you are waiting are not available.

**Returned Values**

The flag(s) that cause the task to be ready or, 0 if either none of the flags are ready or an error occurred.
Notes/Warnings

1. The event flag group must be created before it is used.
2. This function does not block if the desired flags are not present.

IMPORTANT

The return value of OSFlagAccept() is different as of V2.70. In previous versions, OSFlagAccept() returned the current state of the flags and now, it returns the flag(s) that are ready, if any.

Example

```c
#define ENGINE_OIL_PRES_OK 0x01
#define ENGINE_OIL_TEMP_OK 0x02
#define ENGINE_START 0x04

OS_FLAG_GRP *EngineStatus;

void Task (void *p_arg)
{
    INT8U     err;
    OS_FLAGS  value;

    (void)p_arg;
    for (; ; ) {
        value = OSFlagAccept(EngineStatus,
            ENGINE_OIL_PRES_OK + ENGINE_OIL_TEMP_OK,
            OS_FLAG_WAIT_SET_ALL,
            &err);
        switch (err) {
            case OS_ERR_NONE:
                /* Desired flags are available */
                break;

            case OS_ERR_FLAG_NOT_RDY:
                /* The desired flags are NOT available */
                break;
        }
    }
}
```
OSFlagCreate()

OS_FLAG_GRP *OSFlagCreate(OS_FLAGS flags,
                          INT8U   *perr);

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OSFlagCreate() is used to create and initialize an event flag group.

**Arguments**

flags contains the initial value to store in the event flag group.
perr is a pointer to a variable that is used to hold an error code. The error code can be one of the following:

- **OS_ERR_NONE** if the call is successful and the event flag group has been created.
- **OS_ERR_CREATE_ISR** if you attempt to create an event flag group from an ISR.
- **OS_ERR_FLAG_GRP_DEPLETED** if no more event flag groups are available. You need to increase the value of `OS_MAX_FLAGS` in `OS_CFG.H`.

**Returned Values**

A pointer to the event flag group if a free event flag group is available. If no event flag group is available, `OSFlagCreate()` returns a NULL pointer.

**Notes/Warnings**

1. Event flag groups must be created by this function before they can be used by the other services.

**Example**

```c
OS_FLAG_GRP *EngineStatus;

void main (void)
{
    INT8U   err;

    //
    OSInit();   /* Initialize µC/OS-II */
    //
    //
    /* Create a flag group containing the engine’s status */
    EngineStatus = OSFlagCreate(0x00, &err);
    //
    //
    OSStart();   /* Start Multitasking */
}
```
OSFlagDel() is used to delete an event flag group. This function is dangerous to use because multiple tasks could be relying on the presence of the event flag group. You should always use this function with great care. Generally speaking, before you delete an event flag group, you must first delete all the tasks that access the event flag group.

### Arguments

- **pgrp** is a pointer to the event flag group. This pointer is returned to your application when the event flag group is created [see OSFlagCreate()].
- **opt** specifies whether you want to delete the event flag group only if there are no pending tasks (OS_DEL_NO_PEND) or whether you always want to delete the event flag group regardless of whether tasks are pending or not (OS_DEL_ALWAYS). In this case, all pending task are readied.
- **perr** is a pointer to a variable that is used to hold an error code. The error code can be one of the following:
  - **OS_ERR_NONE** if the call is successful and the event flag group has been deleted.
  - **OS_ERR_DEL_ISR** if you attempt to delete an event flag group from an ISR.
  - **OS_ERR_FLAG_INVALID_PGRP** if you pass a NULL pointer in pgrp.
  - **OS_ERR_EVENT_TYPE** if pgrp is not pointing to an event flag group.
  - **OS_ERR_INVALID_OPT** if you do not specify one of the two options mentioned in the opt argument.
  - **OS_ERR_TASK_WAITING** if one or more task are waiting on the event flag group and you specify OS_DEL_NO_PEND.

### Returned Values

A NULL pointer if the event flag group is deleted or pgrp if the event flag group is not deleted. In the latter case, you need to examine the error code to determine the reason for the error.
Notes/Warnings

1. You should use this call with care because other tasks might expect the presence of the event flag group.
2. This call can potentially disable interrupts for a long time. The interrupt-disable time is directly proportional to the number of tasks waiting on the event flag group.

Example

```c
OS_FLAG_GRP *EngineStatusFlags;

void Task (void *p_arg)
{
    INT8U        err;
    OS_FLAG_GRP *pgrp;

    (void)p_arg;
    while (1) {
        .
        .
        .
        pgrp = OSFlagDel(EngineStatusFlags, OS_DEL_ALWAYS, &err);
        if (pgrp == (OS_FLAG_GRP *)(void)0) {
            /* The event flag group was deleted */
        }
        .
        .
    }
}
```
**OSFlagNameGet()**

```c
INT8U OSFlagNameGet(OS_FLAG_GRP *pgrp,
                     INT8U *pname,
                     INT8U *perr);
```

**Arguments**

- `pgrp` is a pointer to the event flag group.
- `pname` is a pointer to an ASCII string that will receive the name of the event flag group. The string must be able to hold at least `OS_FLAG_NAME_SIZE` characters (including the `NUL` character).
- `perr` a pointer to an error code and can be any of the following:
  - `OS_ERR_NONE` If the name of the semaphore, mutex, mailbox or queue was copied to the array pointed to by `pname`.
  - `OS_ERR_EVENT_TYPE` You are not pointing to either a semaphore, mutex, mailbox or message queue.
  - `OS_ERR_PNAME_NULL` You passed a NULL pointer for `pname`.
  - `OS_ERR_INVALID_PGRP` You passed a NULL pointer for `pgrp`.

**Returned Values**

The size of the ASCII string placed in the array pointed to by `pname` or 0 if an error is encountered.
Notes/Warnings

1. The event flag group must be created before you can use this function and obtain the name of the resource.

Example

```c
INT8U EngineStatusName[30];
OS_FLAG_GRP *EngineStatusFlags;

void Task (void *p_arg)
{
    INT8U err;
    INT8U size;

    (void)p_arg;
    for (;;) {
        size = OSFlagNameGet(EngineStatusFlags,
                              &EngineStatusName[0],
                              &err);
        ...
        ...
    }
}
```
**OSFlagNameSet()**

```c
void OSFlagNameSet(OS_FLAG_GRP *pgrp, 
   char        *pname, 
   INT8U       *perr);
```

OSFlagNameSet() allows you to assign a name to an event flag group. The name is an ASCII string and the size of the name can contain up to `OS_FLAG_NAME_SIZE` characters (including the NULL termination). This function is typically used by a debugger to allow associating a name to a resource.

### Arguments

- **pgrp** is a pointer to the event flag group that you want to name. This pointer is returned to your application when the event flag group is created (see `OSFlagCreate()`).
- **pname** is a pointer to an ASCII string that contains the name for the resource. The size of the string must be smaller than or equal to `OS_EVENT_NAME_SIZE` characters (including the NULL character).
- **perr** a pointer to an error code and can be any of the following:
  - `OS_ERR_NONE` If the name of the event flag group was copied to the array pointed to by `pname`.
  - `OS_ERR_EVENT_TYPE` You are not pointing to an event flag group.
  - `OS_ERR_PNAME_NULL` You passed a NULL pointer for `pname`.
  - `OS_ERR_INVALID_PGRP` You passed a NULL pointer for `pgrp`.
  - `OS_ERR_NAME_SET_ISR` You called this function from an ISR.

### Returned Values

- none

### Notes/Warnings

1. The event flag group must be created before you can use this function to set the name of the resource.
Example

OS_FLAG_GRP *EngineStatus;

void Task (void *p_arg)
{
    INT8U  err;

    (void)p_arg;
    for (;;) {
        OSFlagNameSet(EngineStatus, "Engine Status Flags", &err);
    }
}
OSFlagPend() is used to have a task wait for a combination of conditions (i.e., events or bits) to be set (or cleared) in an event flag group. Your application can wait for any condition to be set or cleared or for all conditions to be set or cleared. If the events that the calling task desires are not available, then the calling task is blocked until the desired conditions are satisfied or the specified timeout expires.

**Arguments**

- **pgrp** is a pointer to the event flag group. This pointer is returned to your application when the event flag group is created [see OSFlagCreate()].
- **flags** is a bit pattern indicating which bit(s) (i.e., flags) you wish to check. The bits you want are specified by setting the corresponding bits in `flags`.
- **wait_type** specifies whether you want all bits to be set/cleared or any of the bits to be set/cleared. You can specify the following arguments:
  - **OS_FLAG_WAIT_CLR_ALL** You check all bits in `flags` to be clear (0)
  - **OS_FLAG_WAIT_CLR_ANY** You check any bit in `flags` to be clear (0)
  - **OS_FLAG_WAIT_SET_ALL** You check all bits in `flags` to be set (1)
  - **OS_FLAG_WAIT_SET_ANY** You check any bit in `flags` to be set (1)
  You can also specify whether the flags are consumed by adding **OS_FLAG_CONSUME** to the wait_type. For example, to wait for any flag in a group and then clear the flags that satisfy the condition, set `wait_type` to `OS_FLAG_WAIT_SET_ANY + OS_FLAG_CONSUME`
- **timeout** allows the task to resume execution if the desired flag(s) is(are) not received from the event flag group within the specified number of clock ticks. A timeout value of 0 indicates that the task wants to wait forever for the flag(s). The maximum timeout is 65,535 clock ticks. The timeout value is not synchronized with the clock tick. The timeout count begins decrementing on the next clock tick, which could potentially occur immediately.
- **perr** is a pointer to an error code and can be:
  - **OS_ERR_NONE** No error.
  - **OS_ERR_PEND_ISR** You try to call OSFlagPend from an ISR, which is not allowed.
  - **OS_ERR_FLAG_INVALID_PGRP** You pass a NULL pointer instead of the event flag handle.
  - **OS_ERR_EVENT_TYPE** You are not pointing to an event flag group.
  - **OS_ERR_TIMEOUT** The flags are not available within the specified amount of time.
  - **OS_ERR_FLAG_WAIT_TYPE** You don’t specify a proper `wait_type` argument.
Returned Values
The flag(s) that cause the task to be ready or, 0 if either none of the flags are ready or an error occurred.

Notes/Warnings
1. The event flag group must be created before it’s used.

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Example

```c
#define ENGINE_OIL_PRES_OK   0x01
#define ENGINE_OIL_TEMP_OK   0x02
#define ENGINE_START         0x04

OS_FLAG_GRP *EngineStatus;

void Task (void *p_arg)
{
    INT8U    err;
    OS_FLAGS value;

    (void)p_arg;
    for (;;) {
        value = OSFlagPend(EngineStatus,
                          ENGINE_OIL_PRES_OK   + ENGINE_OIL_TEMP_OK,
                          OS_FLAG_WAIT_SET_ALL + OS_FLAG_CONSUME,
                          10,
                          &err);
        switch (err) {
            case OS_ERR_NONE:
                /* Desired flags are available */
                break;

            case OS_ERR_TIMEOUT:
                /* The desired flags were NOT available before .. */
                /* .. 10 ticks occurred */
                break;
        }
    }
}
```
OSFlagPendGetFlagsRdy()

OS_FLAGS OSFlagPendGetFlagsRdy(void)

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OSFlagPendGetFlagsRdy() is used to obtain the flags that caused the current task to become ready to run. In other words, this function allows you to know "Who done It!"

**Arguments**

None

**Returned Value**

The value of the flags that caused the current task to become ready to run.

**Notes/Warnings**

1. The event flag group must be created before it’s used.
Example

```c
#define ENGINE_OIL_PRES_OK   0x01
#define ENGINE_OIL_TEMP_OK   0x02
#define ENGINE_START         0x04

OS_FLAG_GRP *EngineStatus;

void Task (void *p_arg)
{
  INT8U     err;
  OS_FLAGS  value;

  (void)p_arg;
  for (;;) {
    value = OSFlagPend(EngineStatus,
                       ENGINE_OIL_PRES_OK   + ENGINE_OIL_TEMP_OK,
                       OS_FLAG_WAIT_SET_ALL + OS_FLAG_CONSUME,
                       10,
                       &err);
    switch (err) {
      case OS_ERR_NONE:
        /* Find out who made task ready                   */
        flags = OSFlagPendGetFlagsRdy();
        break;

      case OS_ERR_TIMEOUT:
        /* The desired flags were NOT available before .. */
        /* .. 10 ticks occurred                         */
        break;
    }
  }
}
```
OSFlagPost()

OS_FLAGS OSFlagPost(OS_FLAG_GRP *pgrp,
                      OS_FLAGS flags,
                      INT8U opt,
                      INT8U *perr);

You set or clear event flag bits by calling OSFlagPost(). The bits set or cleared are specified in a bit mask. OSFlagPost() readsies each task that has its desired bits satisfied by this call. You can set or clear bits that are already set or cleared.

Arguments

- **pgrp** is a pointer to the event flag group. This pointer is returned to your application when the event flag group is created [see OSFlagCreate()].
- **flags** specifies which bits you want set or cleared. If opt is OS_FLAG_SET, each bit that is set in flags sets the corresponding bit in the event flag group. For example to set bits 0, 4, and 5, you set flags to 0x31 (note, bit 0 is the least significant bit). If opt is OS_FLAG_CLR, each bit that is set in flags will clears the corresponding bit in the event flag group. For example to clear bits 0, 4, and 5, you specify flags as 0x31 (note, bit 0 is the least significant bit).
- **opt** indicates whether the flags are set (OS_FLAG_SET) or cleared (OS_FLAG_CLR).
- **perr** is a pointer to an error code and can be:
  - OS_ERR_NONE: The call is successful.
  - OS_ERR_FLAG_INVALID_PGRP: You pass a NULL pointer.
  - OS_ERR_EVENT_TYPE: You are not pointing to an event flag group.
  - OS_ERR_FLAG_INVALID_OPT: You specify an invalid option.

Returned Value

The new value of the event flags.

Notes/Warnings

1. Event flag groups must be created before they are used.
2. The execution time of this function depends on the number of tasks waiting on the event flag group. However, the execution time is deterministic.
3. The amount of time interrupts are disabled also depends on the number of tasks waiting on the event flag group.
Example

```c
#include <stdio.h>

#define ENGINE_OIL_PRES_OK   0x01
#define ENGINE_OIL_TEMP_OK   0x02
#define ENGINE_START         0x04

OS_FLAG_GRP *EngineStatusFlags;

void TaskX (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        .
        .
        err = OSFlagPost(EngineStatusFlags,
                         ENGINE_START,
                         OS_FLAG_SET,
                         &err);
        .
        .
    }
}
```
OSFlagQuery() is used to obtain the current value of the event flags in a group. At this time, this function does not return the list of tasks waiting for the event flag group.

**Arguments**

- `pgrp` is a pointer to the event flag group. This pointer is returned to your application when the event flag group is created [see OSFlagCreate()].
- `perr` is a pointer to an error code and can be:
  - `OS_ERR_NONE` The call is successful.
  - `OS_ERR_FLAG_INVALID_PGRP` You pass a NULL pointer.
  - `OS_ERR_EVENT_TYPE` You are not pointing to an event flag groups.

**Returned Value**
The state of the flags in the event flag group.

**Notes/Warnings**
1. The event flag group to query must be created.
2. You can call this function from an ISR.

**Example**

```c
OS_FLAG_GRP *EngineStatusFlags;

void Task (void *p_arg)
{
    OS_FLAGS flags;
    INT8U    err;

    (void)p_arg;
    for (;;) {
        ...
        ...
        flags = OSFlagQuery(EngineStatusFlags, &err);
        ...
        ...
    }
}
```
**OSInit()**

```c
void OSInit(void);
```

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OSInit() initializes µC/OS-II and must be called prior to calling OSStart(), which actually starts multitasking.

**Arguments**

none

**Returned Values**

none

**Notes/Warnings**

1. OSInit() must be called before OSStart().

**Example**

```c
void main (void)
{
   
   OSInit();       /* Initialize µC/OS-II */
   
   OSStart();     /* Start Multitasking */
}
```
OSIntEnter()

void OSIntEnter(void);

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<td>ISR only</td>
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OSIntEnter() notifies _C/OS-II that an ISR is being processed, which allows µC/OS-II to keep track of interrupt nesting. OSIntEnter() is used in conjunction with OSIntExit().

Arguments

none

Returned Values

none

Notes/Warnings

1. This function must not be called by task-level code.
2. You can increment the interrupt-nesting counter (OSIntNesting) directly in your ISR to avoid the overhead of the function call/return. It’s safe to increment OSIntNesting in your ISR because interrupts are assumed to be disabled when OSIntNesting needs to be incremented.
3. You are allowed to nest interrupts up to 255 levels deep.

Example 1

(Intel 80x86, real mode, large model)

Use OSIntEnter() for backward compatibility with µC/OS.

ISRx PROC FAR
    PUSHB          ; Save interrupted task's context
    PUSH ES
    PUSH DS

    CALL FAR PTR _OSIntEnter ; Notify µC/OS-II of start of ISR
    .
    .
    POP DS          ; Restore processor registers
    POP ES
    POPA
    IRET           ; Return from interrupt
ISRx ENDP
Example 2
(Intel 80x86, real mode, large model)

ISRx    PROC   FAR
    PUSHAX                       ; Save interrupted task's context
    PUSH   ES
    PUSH   DS
    ;
    MOV    AX, SEG(_OSIntNesting) ; Reload DS
    MOV    DS, AX
    ;
    INC    BYTE PTR _OSIntNesting ; Notify µC/OS-II of start of ISR
    .
    .
    .
    POP    DS                      ; Restore processor registers
    POP    ES
    POPA
    IRETD                         ; Return from interrupt
ISRx    ENDP
OSIntExit()

void OSIntExit(void);

OSIntExit() notifies µC/OS-II that an ISR is complete, which allows µC/OS-II to keep track of interrupt nesting. OSIntExit() is used in conjunction with OSIntEnter(). When the last nested interrupt completes, OSIntExit() determines if a higher priority task is ready to run, in which case, the interrupt returns to the higher priority task instead of the interrupted task.

Arguments
none

Returned Value
none

Notes/Warnings
1. This function must not be called by task-level code. Also, if you decided to increment OSIntNesting, you still need to call OSIntExit().

Example
(Intel 80x86, real mode, large model)

ISRx PROC FAR
    PUSH POPA
    PUSH POP
    PUSH POP
    CALL POP
    CALL POP
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ISRx ENDP
**OSMboxAccept()**

```c
void *OSMboxAccept(OS_EVENT *pevent);
```

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OSMboxAccept() allows you to see if a message is available from the desired mailbox. Unlike OSMboxPend(), OSMboxAccept() does not suspend the calling task if a message is not available. In other words, OSMboxAccept() is non-blocking. If a message is available, the message is returned to your application, and the content of the mailbox is cleared. This call is typically used by ISRs because an ISR is not allowed to wait for a message at a mailbox.

**Arguments**

`pevent` is a pointer to the mailbox from which the message is received. This pointer is returned to your application when the mailbox is created [see OSMboxCreate()].

**Returned Value**

A pointer to the message if one is available; NULL if the mailbox does not contain a message.

**Notes/Warnings**

1. Mailboxes must be created before they are used.

**Example**

```c
OS_EVENT *CommMbox;

void Task (void *p_arg)
{
    void *pmsg;

    (void)p_arg;
    for (;;) {
        pmsg = OSMboxAccept(CommMbox); /* Check mailbox for a message */
        if (pmsg != (void *)0) {
            /* Message received, process */
            .
            .
        } else {
            /* Message not received, do .. */
            .
            /* .. something else */
        }
    }
}
```
OSMboxCreate() creates and initializes a mailbox. A mailbox allows tasks or ISRs to send a pointer-sized variable (message) to one or more tasks.

**Arguments**

pmsg is used to initialize the contents of the mailbox. The mailbox is empty when pmsg is a NULL pointer. The mailbox initially contains a message when pmsg is non-NUL.

**Returned Value**

A pointer to the event control block allocated to the mailbox. If no event control block is available, OSMboxCreate() returns a NULL pointer.

**Notes/Warnings**

1. Mailboxes must be created before they are used.

**Example**

```c
OS_EVENT *CommMbox;

void main (void)
{
  //
  //
  OSInit();                              /* Initialize µC/OS-II */
  //

  CommMbox = OSMboxCreate((void *)0);    /* Create COMM mailbox */
  OSStart();                             /* Start Multitasking */
}
```
**OSMboxDel()**

```c
OS_EVENT *OSMboxDel(OS_EVENT *pevent,
    INT8U     opt,
    INT8U     *perr);
```

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**OSMboxDel()** is used to delete a message mailbox. This function is dangerous to use because multiple tasks could attempt to access a deleted mailbox. You should always use this function with great care. Generally speaking, before you delete a mailbox, you must first delete all the tasks that can access the mailbox.

**Arguments**

- **pevent** is a pointer to the mailbox. This pointer is returned to your application when the mailbox is created [see OSMboxCreate()].
- **opt** specifies whether you want to delete the mailbox only if there are no pending tasks (OS_DEL_NO_PEND) or whether you always want to delete the mailbox regardless of whether tasks are pending or not (OS_DEL_ALWAYS). In this case, all pending task are readied.
- **perr** is a pointer to a variable that is used to hold an error code. The error code can be one of the following:
  - **OS_ERR_NONE** if the call is successful and the mailbox has been deleted.
  - **OS_ERR_DEL_ISR** if you attempt to delete the mailbox from an ISR.
  - **OS_ERR_INVALID_OPT** if you don’t specify one of the two options mentioned in the opt argument.
  - **OS_ERR_TASK_WAITING** One or more tasks is waiting on the mailbox.
  - **OS_ERR_EVENT_TYPE** if pevent is not pointing to a mailbox.
  - **OS_ERR_PEVENT_NULL** if no more OS_EVENT structures are available.

**Returned Value**

A NULL pointer if the mailbox is deleted or pevent if the mailbox is not deleted. In the latter case, you need to examine the error code to determine the reason.

**Notes/Warnings**

1. You should use this call with care because other tasks might expect the presence of the mailbox.
2. Interrupts are disabled when pended tasks are readied, which means that interrupt latency depends on the number of tasks that are waiting on the mailbox.
3. OSMboxAccept() callers do not know that the mailbox has been deleted.
Example

OS_EVENT *DispMbox;

void Task (void *p_arg)
{
    INT8U  err;

    (void)p_arg;
    while (1) {
        .
        .
        DispMbox = OSMboxDel(DispMbox, OS_DEL_ALWAYS, &err);
        if (DispMbox == (OS_EVENT *)0) {
            /* Mailbox has been deleted */
        }
        .
        .
    }
}
**OSMboxPend()**

```c
void *OSMboxPend(OS_EVENT *pevent,
                 INT16U  timeout,
                 INT8U   *perr);
```

OSMboxPend() is used when a task expects to receive a message. The message is sent to the task either by an ISR or by another task. The message received is a pointer-sized variable, and its use is application specific. If a message is present in the mailbox when OSMboxPend() is called, the message is retrieved, the mailbox is emptied, and the retrieved message is returned to the caller. If no message is present in the mailbox, OSMboxPend() suspends the current task until either a message is received or a user-specified timeout expires. If a message is sent to the mailbox and multiple tasks are waiting for the message, µC/OS-II resumes the highest priority task waiting to run. A pended task that has been suspended with OSTaskSuspend() can receive a message. However, the task remains suspended until it is resumed by calling OSTaskResume().

**Arguments**

- `pevent` is a pointer to the mailbox from which the message is received. This pointer is returned to your application when the mailbox is created [see OSMboxCreate()].
- `timeout` allows the task to resume execution if a message is not received from the mailbox within the specified number of clock ticks. A timeout value of 0 indicates that the task wants to wait forever for the message. The maximum timeout is 65,535 clock ticks. The timeout value is not synchronized with the clock tick. The timeout count begins decrementing on the next clock tick, which could potentially occur immediately.
- `perr` is a pointer to a variable that holds an error code. OSMboxPend() sets *perr to one of the following:
  - `OS_ERR_NONE` if a message is received.
  - `OS_ERR_TIMEOUT` if a message is not received within the specified timeout period.
  - `OS_ERR_PEND_ABORT` indicates that the pend was aborted by another task or ISR by calling OSMboxPendAbort().
  - `OS_ERR_EVENT_TYPE` if `pevent` is not pointing to a mailbox.
  - `OS_ERR_PEND_LOCKED` if you called this function when the scheduler is locked.
  - `OS_ERR_PEND_ISR` if you call this function from an ISR and µC/OS-II suspends it.
  - `OS_ERR_PEVENT_NULL` if `pevent` is a NULL pointer.

**Returned Value**

OSMboxPend() returns the message sent by either a task or an ISR, and *perr is set to OS_ERR_NONE. If a message is not received within the specified timeout period, the returned message is a NULL pointer, and *perr is set to OS_ERR_TIMEOUT.

**Notes/Warnings**

1. Mailboxes must be created before they are used.
2. You should not call OSMboxPend() from an ISR.
Example

OS_EVENT *CommMbox;

void CommTask(void *p_arg)
{
    INT8U err;
    void *pmsg;

    (void)p_arg;
    for (;;) {
        
        
        pmsg = OSMboxPend(CommMbox, 10, &err);
        if (err == OS_ERR_NONE) {
            
            /* Code for received message */
            
        } else {
            
            /* Code for message not received within timeout */
            
        }
    }
}
OSMboxPendAbort()

void *OSMboxPendAbort(OS_EVENT *pevent,
                     INT8U     opt,
                     INT8U     *perr);

New Function     File            Called from          Code enabled by
V2.84             OS_MBOX.C         Task only            OS_MBOX_EN
                 & OS_MBOX_PEND_ABORT_EN

OSMboxPendAbort() aborts & readies any tasks currently waiting on a mailbox. This function should be used to fault-abort the wait on the mailbox, rather than to normally signal the mailbox via OSMboxPost() or OSMboxPostOpt().

Arguments

pevent is a pointer to the mailbox for which pend(s) need to be aborted. This pointer is returned to your application when the mailbox is created [see OSMboxCreate()].

opt determines what type of abort is performed.

- OS_PEND_OPT_NONE Aborts the pend of only the highest priority task waiting on the mailbox.
- OS_PEND_OPT_BROADCAST Aborts the pend of all the tasks waiting on the mailbox.

perr is a pointer to a variable that holds an error code. OSMboxPendAbort() sets *perr to one of the following:

- OS_ERR_NONE if no tasks were waiting on the mailbox. In this case, the return value is also 0.
- OS_ERR_PEND_ABORT at least one task waiting on the mailbox was readied and informed of the aborted wait. Check the return value for the number of tasks whose wait on the mailbox was aborted.
- OS_ERR_EVENT_TYPE if pevent is not pointing to a mailbox.
- OS_ERR_PEVENT_NULL if pevent is a NULL pointer.

Returned Value

OSMboxPendAbort() returns the number of tasks made ready to run by this function. Zero indicates that no tasks were pending on the mailbox and thus this function had no effect.

Notes/Warnings

1. Mailboxes must be created before they are used.
Example

OS_EVENT *CommMbox;

void CommTask(void *p_arg)
{
    INT8U err;
    INT8U nbr_tasks;

    (void)p_arg;
    for (; ;) {
        .
        .
        nbr_tasks = OSMboxPendAbort(CommMbox, OS_PEND_OPT_BROADCAST, &err);
        if (err == OS_ERR_NONE) {
            .
            . /* No tasks were waiting on the mailbox */
            .
        } else {
            .
            . /* All pends of tasks waiting on mailbox were aborted ... */
            . /* ... 'nbr_tasks' indicates how many were made ready. */
            .
        }
    }
}
}
### OSMboxPost()

```c
INT8U OSMboxPost(OS_EVENT *pevent,
                  void     *pmsg);
```

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OSMboxPost() sends a message to a task through a mailbox. A message is a pointer-sized variable and, its use is application specific. If a message is already in the mailbox, an error code is returned indicating that the mailbox is full. OSMboxPost() then immediately returns to its caller, and the message is not placed in the mailbox. If any task is waiting for a message at the mailbox, the highest priority task waiting receives the message. If the task waiting for the message has a higher priority than the task sending the message, the higher priority task is resumed, and the task sending the message is suspended. In other words, a context switch occurs.

**Arguments**

`pevent` is a pointer to the mailbox into which the message is deposited. This pointer is returned to your application when the mailbox is created [see OSMboxCreate()].

`pmsg` is the actual message sent to the task. `pmsg` is a pointer-sized variable and is application specific. You must never post a NULL pointer because this pointer indicates that the mailbox is empty.

**Returned Value**

OSMboxPost() returns one of these error codes:

- `OS_ERR_NONE` if the message is deposited in the mailbox.
- `OS_ERR_MBOX_FULL` if the mailbox already contains a message.
- `OS_ERR_EVENT_TYPE` if `pevent` is not pointing to a mailbox.
- `OS_ERR_PEVENT_NULL` if `pevent` is a pointer to NULL.
- `OS_ERR_POST_NULL_PTR` if you are attempting to post a NULL pointer. By convention a NULL pointer is not supposed to point to anything.

**Notes/Warnings**

1. Mailboxes must be created before they are used.
2. You must never post a NULL pointer because this pointer indicates that the mailbox is empty.
Example

OS_EVENT *CommMbox;
INT8U CommRxBuf[100];

void CommTaskRx (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        .
        .
        .
        err = OSMboxPost(CommMbox, (void *)&CommRxBuf[0]);
        .
        .
    }
}
OSMboxPostOpt()

INT8U OSMboxPostOpt(OS_EVENT *pevent,
                   void     *pmsg,
                   INT8U     opt);

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OSMboxPostOpt() works just like OSMboxPost() except that it allows you to post a message to multiple tasks. In other words, OSMboxPostOpt() allows the message posted to be broadcast to all tasks waiting on the mailbox. OSMboxPostOpt() can actually replace OSMboxPost() because it can emulate OSMboxPost().

OSMboxPostOpt() is used to send a message to a task through a mailbox. A message is a pointer-sized variable, and its use is application specific. If a message is already in the mailbox, an error code is returned indicating that the mailbox is full. OSMboxPostOpt() then immediately returns to its caller, and the message is not placed in the mailbox. If any task is waiting for a message at the mailbox, OSMboxPostOpt() allows you either to post the message to the highest priority task waiting at the mailbox (opt set to OS_POST_OPT_NONE) or to all tasks waiting at the mailbox (opt is set to OS_POST_OPT_BROADCAST). In either case, scheduling occurs and, if any of the tasks that receives the message have a higher priority than the task that is posting the message, then the higher priority task is resumed, and the sending task is suspended. In other words, a context switch occurs.

Arguments

dev   is a pointer to the mailbox. This pointer is returned to your application when the mailbox is created [see OSMboxCreate()].

pmsg is the actual message sent to the task(s). pmsg is a pointer-sized variable and is application specific. You must never post a NULL pointer because this pointer indicates that the mailbox is empty.

opt specifies whether you want to send the message to the highest priority task waiting at the mailbox (when opt is set to OS_POST_OPT_NONE) or to all tasks waiting at the mailbox (when opt is set to OS_POST_OPT_BROADCAST).

When set to OS_POST_OPT_NO_SCHED, the scheduler will not be called to see if a higher priority task has been made ready to run.

Note that options are additive and thus, you can specify:

OS_POST_OPT_BROADCAST | OS_POST_OPT_NO_SCHED

Returned Value

dev is a pointer to a variable that is used to hold an error code. The error code can be one of the following:

OS_ERR_NONE if the call is successful and the message has been sent.

OS_ERR_MBOX_FULL if the mailbox already contains a message. You can only send one message at a time to a mailbox, and thus the message must be consumed before you are allowed to send another one.

OS_ERR_EVENT_TYPE if pevent is not pointing to a mailbox.

OS_ERR_PEVENT_NULL if pevent is a NULL pointer.

OS_ERR_POST_NULL_PTR if you are attempting to post a NULL pointer. By convention, a NULL pointer is not supposed to point to anything.
Notes/Warnings

1. Mailboxes must be created before they are used.

2. You must never post a NULL pointer to a mailbox because this pointer indicates that the mailbox is empty.

3. If you need to use this function and want to reduce code space, you can disable code generation of OSMboxPost() because OSMboxPostOpt() can emulate OSMboxPost().

4. The execution time of OSMboxPostOpt() depends on the number of tasks waiting on the mailbox if you set opt to OS_POST_OPT_BROADCAST.

Example

```c
OS_EVENT *CommMbox;
INT8U     CommRxBuf[100];

void CommRxTask (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        .
        .
        err = OSMboxPostOpt(CommMbox,
            (void *)&CommRxBuf[0],
            OS_POST_OPT_BROADCAST);
        .
        .
    }
}
```
OSMboxQuery() obtains information about a message mailbox. Your application must allocate an OS_MBOX_DATA data structure, which is used to receive data from the event control block of the message mailbox. OSMboxQuery() allows you to determine whether any tasks are waiting for a message at the mailbox and how many tasks are waiting (by counting the number of 1s in the OSEventTbl[] field). You can also examine the current contents of the mailbox. Note that the size of OSEventTbl[] is established by the #define constant OS_EVENT_TBL_SIZE (see uCOS_II.H).

Arguments
pevent is a pointer to the mailbox. This pointer is returned to your application when the mailbox is created [see OSMboxCreate()].
P_mbox_data is a pointer to a data structure of type OS_MBOX_DATA, which contains the following fields:

```
void *OSMsg;              /* Copy of the message stored in the mailbox */
#if OS_LOWEST_PRIO <= 63
INT8U OSEventTbl[OS_EVENT_TBL_SIZE]; /* Copy of the mailbox wait list */
INT8U OSEventGrp;
#else
INT16U OSEventTbl[OS_EVENT_TBL_SIZE]; /* Copy of the mailbox wait list */
INT16U OSEventGrp;
#endif
```

Returned Value
OSMboxQuery() returns one of these error codes:

- OS_ERR_NONE if the call is successful.
- OS_ERR_PEVENT_NULL if pevent is a NULL pointer.
- OS_ERR_EVENT_TYPE if you don’t pass a pointer to a message mailbox.
- OS_ERR_PNAME_NULL You passed a NULL pointer for p_mbox_data.

Notes/Warnings
1. Message mailboxes must be created before they are used.
Example

```c
OS_EVENT *CommMbox;

void Task (void *p_arg)
{
    OS_MBOXDATA mbox_data;
    INT8U err;

    (void)p_arg;
    for (;;)
    {
        .
        .
        err = OSMboxQuery(CommMbox, &mbox_data);
        if (err == OS_ERR_NONE) {
            /* Mailbox contains a message if .. */
            /* .. mbox_data.OSMsg is not NULL */
        }
        .
        .
    }
    
}
```
OSMemCreate()

OS_MEM *OSMemCreate(void *addr,
                 INT32U nblks,
                 INT32U blksize,
                 INT8U *perr);

OSMemCreate() creates and initializes a memory partition. A memory partition contains a user-specified number of fixed-size memory blocks. Your application can obtain one of these memory blocks and, when done, release the block back to the partition.

Arguments

- **addr** is the address of the start of a memory area that is used to create fixed-size memory blocks. Memory partitions can be created either using static arrays or malloc() during startup. Note that the partition MUST align on a pointer boundary. Thus, if a pointer is 16 bits wide then the partition must start on a memory location with an address that ends with 0, 2, 4, 6, 8, etc. If a pointer is 32 bits wide then the partition must start on a memory location with and address that ends with 0, 4, 8 of C.

- **nblks** contains the number of memory blocks available from the specified partition. You must specify at least two memory blocks per partition.

- **blksize** specifies the size (in bytes) of each memory block within a partition. A memory block must be large enough to hold at least a pointer. Also, the size of a memory block must be a multiple of the size of a pointer. In other words, if a pointer is 32 bits wide then the block size must be 4, 8, 12, 16, 20, etc. bytes (i.e. a multiple of 4 bytes).

- **perr** is a pointer to a variable that holds an error code. OSMemCreate() sets *perr to:

  - **OS_ERR_NONE** if the memory partition is created successfully
  - **OS_ERR_MEM_INVALID_ADDR** if you are specifying an invalid address (i.e., addr is a NULL pointer) or your partition is not properly aligned.

  - **OS_ERR_MEM_INVALID_PART** if a free memory partition is not available
  - **OS_ERR_MEM_INVALID_BLKS** if you don’t specify at least two memory blocks per partition

  - **OS_ERR_MEM_INVALID_SIZE** if you don’t specify a block size that can contain at least a pointer variable and if it’s not a multiple of a pointer size variable.

Returned Value

OSMemCreate() returns a pointer to the created memory-partition control block if one is available. If no memory-partition control block is available, OSMemCreate() returns a NULL pointer.

Notes/Warnings

1. Memory partitions must be created before they are used.
Example

OS_MEM *CommMem;
INT32U CommBuf[16][32];

void main (void)
{
    INT8U err;

    OSInit(); /* Initialize µC/OS-II */
    .
    .
    CommMem = OSMemCreate(&CommBuf[0][0], 16, 32 * sizeof(INT32U), &err);
    .
    .
    OSStart(); /* Start Multitasking */
}

OSMemGet() obtains a memory block from a memory partition. It is assumed that your application knows the size of each memory block obtained. Also, your application must return the memory block [using OSMemPut()] when it no longer needs it. You can call OSMemGet() more than once until all memory blocks are allocated.

**Arguments**

- **pmem** is a pointer to the memory-partition control block that is returned to your application from the OSMemCreate() call.
- **perr** is a pointer to a variable that holds an error code. OSMemGet() sets *perr to one of the following:
  - **OS_ERR_NONE** if a memory block is available and returned to your application.
  - **OS_ERR_MEM_NO_FREE_BLKS** if the memory partition doesn’t contain any more memory blocks to allocate.
  - **OS_ERR_MEM_INVALID_PMEM** if pmem is a NULL pointer.

**Returned Value**

OSMemGet() returns a pointer to the allocated memory block if one is available. If no memory block is available from the memory partition, OSMemGet() returns a NULL pointer.

**Notes/Warnings**

1. Memory partitions must be created before they are used.
Example

OS_MEM *CommMem;

void Task (void *p_arg)
{
    INT8U *pmsg;

    (void)p_arg;
    for (;;) {
        pmsg = OSMemGet(CommMem, &err);
        if (pmsg != (INT8U *)0) {
            /* Memory block allocated, use it. */
            .
            .
        }
        .
        .
    }
}
OSMemNameGet()

INT8U OSMemNameGet(OS_MEM *pmem,
                    INT8U  *pname,
                    INT8U  *perr);

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OSMemNameGet() allows you to obtain the name that you assigned to a memory partition. The name is an ASCII string and the size of the name can contain up to OS_MEM_NAME_SIZE characters (including the NUL termination). This function is typically used by a debugger to allow associating a name to a resource.

**Arguments**

- **pmem** is a pointer to the memory partition.
- **pname** is a pointer to an ASCII string that will receive the name of the memory partition. The string must be able to hold at least OS_MEM_NAME_SIZE characters (including the NUL character).
- **perr** a pointer to an error code and can be any of the following:
  - **OS_ERR_NONE** If the name of the semaphore, mutex, mailbox or queue was copied to the array pointed to by **pname**.
  - **OS_ERR_INVALID_PMEM** You passed a NULL pointer for **pmem**.
  - **OS_ERR_PNAME_NULL** You passed a NULL pointer for **pname**.
  - **OS_ERR_NAME_GET_ISR** You called this function from an ISR.

**Returned Values**

The size of the ASCII string placed in the array pointed to by **pname** or 0 if an error is encountered.
Notes/Warnings

1. The memory partition must be created before you can use this function and obtain the name of the resource.

Example

```c
OS_MEM *CommMem;
INT8U CommMemName[OS_MEM_NAME_SIZE];

void Task (void *pdata)
{
    INT8U err;
    INT8U size;

    pdata = pdata;
    for (;;)
    {
        size = OSMemNameGet(CommMem, & CommMemName [0], &err);
        .
        .
    }
}
```
OSMemNameSet() allows you to assign a name to a memory partition. The name is an ASCII string and the size of the name can contain up to OS_MEM_NAME_SIZE characters (including the NUL termination). This function is typically used by a debugger to allow associating a name to a resource.

**Arguments**

- **pmem** is a pointer to the memory partition that you want to name. This pointer is returned to your application when the memory partition is created (see OSMemCreate()).
- **pname** is a pointer to an ASCII string that contains the name for the resource. The size of the string must be smaller than or equal to OS_MEM_NAME_SIZE characters (including the NUL character).
- **perr** is a pointer to an error code and can be any of the following:
  - OS_ERR_NONE: If the name of the event flag group was copied to the array pointed to by pname.
  - OS_ERR_MEM_INVALID_PMEM: You passed a NULL pointer for pmem.
  - OS_ERR_PNAME_NULL: You passed a NULL pointer for pname.
  - OS_ERR_MEM_NAME_TOO_LONG: If the name is not able to fit in the specified storage.
  - OS_ERR_NAME_SET_ISR: You called this function from an ISR.

**Returned Values**

- none

**Notes/Warnings**

1. The memory partition must be created before you can use this function to set the name of the resource.
Example

OS_MEM *CommMem;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        OSMemNameSet(CommMem, "Comm. Buffer", &err);
    
    }
}
OSMemPut() returns a memory block to a memory partition. It is assumed that you return the memory block to the appropriate memory partition.

Arguments

pmem is a pointer to the memory-partition control block that is returned to your application from the OSMemCreate() call.

pblk is a pointer to the memory block to be returned to the memory partition.

Returned Value

OSMemPut() returns one of the following error codes:

- **OS_ERR_NONE** if a memory block is available and returned to your application.
- **OS_ERR_MEM_FULL** if the memory partition can not accept more memory blocks. This code is surely an indication that something is wrong because you are returning more memory blocks than you obtained using OSMemGet().
- **OS_ERR_MEM_INVALID_PMEM** if pmem is a NULL pointer.
- **OS_ERR_MEM_INVALID_PBLK** if pblk is a NULL pointer.

Notes/Warnings

1. Memory partitions must be created before they are used.
2. You must return a memory block to the proper memory partition.
Example

OS_MEM *CommMem;
INT8U *CommMsg;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        err = OSMemPut(CommMem, (void *)CommMsg);
        if (err == OS_ERR_NONE) {
            /* Memory block released */
        }
    }
}
OSMemQuery() obtains information about a memory partition. Basically, this function returns the same information found in the OS_MEM data structure but in a new data structure called OS_MEM_DATA. OS_MEM_DATA also contains an additional field that indicates the number of memory blocks in use.

**Arguments**

- **pmem** is a pointer to the memory-partition control block that is returned to your application from the OSMemCreate() call.
- **p_mem_data** is a pointer to a data structure of type OS_MEM_DATA, which contains the following fields:

  ```
  void *OSAddr;     /* Points to beginning address of the memory partition */
  void *OSFreeList; /* Points to beginning of the free list of memory blocks */
  INT32U OSBlkSize; /* Size (in bytes) of each memory block */
  INT32U OSNBlks;   /* Total number of blocks in the partition */
  INT32U OSNFree;   /* Number of memory blocks free */
  INT32U OSNUsed;   /* Number of memory blocks used */
  ```

**Returned Value**

OSMemQuery() returns one of the following error codes:

- **OS_ERR_NONE** if a memory block is available and returned to your application.
- **OS_ERR_MEM_INVALID_PMEM** if pmem is a NULL pointer.
- **OS_ERR_MEM_INVALID_PDATA** if pdata is a NULL pointer.

**Notes/Warnings**

1. Memory partitions must be created before they are used.
Example

```c
OS_MEM *CommMem;

void Task (void *p_arg)
{
    INT8U err;
    OS_MEM_DATA mem_data;

    (void)p_arg;
    for (;;) {
        .
        .
        err = OSMemQuery(CommMem, &mem_data);
        .
        .
    }
}
```
OSMutexAccept()

INT8U OSMutexAccept(OS_EVENT *pevent,
                    INT8U    *perr);

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OSMutexAccept() allows you to check to see if a resource is available. Unlike OSMutexPend(), OSMutexAccept() does not suspend the calling task if the resource is not available. In other words, OSMutexAccept() is non-blocking.

Arguments

- `pevent` is a pointer to the mutex that guards the resource. This pointer is returned to your application when the mutex is created [see OSMutexCreate()].
- `perr` is a pointer to a variable used to hold an error code. OSMutexAccept() sets *perr to one of the following:
  - OS_ERR_NONE if the call is successful.
  - OS_ERR_EVENT_TYPE if `pevent` is not pointing to a mutex.
  - OS_ERR_PEVENT_NULL if `pevent` is a NULL pointer.
  - OS_ERR_PEND_ISR if you call OSMutexAccept() from an ISR.
  - OS_ERR_PIP_LOWER If the priority of the task that owns the Mutex is HIGHER (i.e. a lower number) than the PIP. This error indicates that you did not set the PIP higher (lower number) than ALL the tasks that compete for the Mutex. Unfortunately, this is something that could not be detected when the Mutex is created because we don't know what tasks will be using the Mutex.

Returned Value

- If the mutex is available, OSMutexAccept() returns OS_TRUE. If the mutex is owned by another task, OSMutexAccept() returns OS_FALSE.

Notes/Warnings

1. Mutexes must be created before they are used.
2. This function must not be called by an ISR.
3. If you acquire the mutex through OSMutexAccept(), you must call OSMutexPost() to release the mutex when you are done with the resource.
Example

OS_EVENT *DispMutex;

void Task (void *p_arg)
{
    INT8U    err;
    BOOLEAN  test;

    (void)p_arg;
    for (;;) {
        test = OSMutexAccept(DispMutex, &err);
        if (test == OS_TRUE) {
            /* Resource available, process */
            .
            .
        } else {
            /* Resource NOT available */
            .
            .
        }
    }
}

OSMutexCreate()

OS_EVENT *OSMutexCreate(INT8U  prio,
                        INT8U *perr);

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OSMutexCreate() is used to create and initialize a mutex. A mutex is used to gain exclusive access to a resource.

**Arguments**

- **prio** is the priority inheritance priority (PIP) that is used when a high priority task attempts to acquire the mutex that is owned by a low priority task. In this case, the priority of the low priority task is *raised* to the PIP until the resource is released.
- **perr** is a pointer to a variable that is used to hold an error code. The error code can be one of the following:
  - OS_ERR_NONE if the call is successful and the mutex has been created.
  - OS_ERR_CREATE_ISR if you attempt to create a mutex from an ISR.
  - OS_ERR_PRIO_EXIST if a task at the specified priority inheritance priority already exists.
  - OS_ERR_PEVENT_NULL if no more OS_EVENT structures are available.
  - OS_ERR_PRIO_INVALID if you specify a priority with a higher number than OS_LOWEST_PRIO.

**Returned Value**

A pointer to the event control block allocated to the mutex. If no event control block is available, OSMutexCreate() returns a NULL pointer.

**Notes/Warnings**

1. Mutexes must be created before they are used.
2. **You must** make sure that *prio* has a higher priority than *any* of the tasks that use the mutex to access the resource. For example, if three tasks of priority 20, 25, and 30 are going to use the mutex, then *prio* must be a number lower than 20. In addition, there **must not** already be a task created at the specified priority.
Example

OS_EVENT *DispMutex;

void main (void)
{
    INT8U err;

    OSInit();                        /* Initialize µC/OS-II             */

    DispMutex = OSMutexCreate(20, &err);   /* Create Display Mutex */

    OSStart();                        /* Start Multitasking */
OSMutexDel() is used to delete a mutex. This function is dangerous to use because multiple tasks could attempt to access a deleted mutex. You should always use this function with great care. Generally speaking, before you delete a mutex, you must first delete all the tasks that can access the mutex.

**Arguments**

- `pevent` is a pointer to the mutex. This pointer is returned to your application when the mutex is created [see `OSMutexCreate()`].
- `opt` specifies whether you want to delete the mutex only if there are no pending tasks (`OS_DEL_NO_PEND`) or whether you always want to delete the mutex regardless of whether tasks are pending or not (`OS_DEL_ALWAYS`). In this case, all pending task are readied.
- `perr` is a pointer to a variable that is used to hold an error code. The error code can be one of the following:
  - `OS_ERR_NONE` if the call is successful and the mutex has been deleted.
  - `OS_ERR_DEL_ISR` if you attempt to delete a mutex from an ISR.
  - `OS_ERR_INVALID_OPT` if you don’t specify one of the two options mentioned in the `opt` argument.
  - `OS_ERR_TASK_WAITING` if one or more task are waiting on the mutex and you specify `OS_DEL_NO_PEND`.
  - `OS_ERR_EVENT_TYPE` if `pevent` is not pointing to a mutex.
  - `OS_ERR_PEVENT_NULL` if no more `OS_EVENT` structures are available.

**Returned Value**

A `NULL` pointer if the mutex is deleted or `pevent` if the mutex is not deleted. In the latter case, you need to examine the error code to determine the reason.

**Notes/Warnings**

1. You should use this call with care because other tasks might expect the presence of the mutex.
Example

OS_EVENT *DispMutex;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    while (1) {
        .
        .
        DispMutex = OSMutexDel(DispMutex, OS_DEL_ALWAYS, &err);
        if (DispMutex == (OS_EVENT *)0) {
            /* Mutex has been deleted */
        }
    }
}
OSMutexPend() is used when a task desires to get exclusive access to a resource. If a task calls OSMutexPend() and the mutex is available, then OSMutexPend() gives the mutex to the caller and returns to its caller. Note that nothing is actually given to the caller except for the fact that if *perr is set to OS_ERR_NONE, the caller can assume that it owns the mutex. However, if the mutex is already owned by another task, OSMutexPend() places the calling task in the wait list for the mutex. The task thus waits until the task that owns the mutex releases the mutex and thus the resource or until the specified timeout expires. If the mutex is signaled before the timeout expires, µC/OS-II resumes the highest priority task that is waiting for the mutex. Note that if the mutex is owned by a lower priority task, then OSMutexPend() raises the priority of the task that owns the mutex to the PIP, as specified when you created the mutex [see OSMutexCreate()].

Arguments

pevent is a pointer to the mutex. This pointer is returned to your application when the mutex is created [see OSMutexCreate()].

timeout is used to allow the task to resume execution if the mutex is not signaled (i.e., posted to) within the specified number of clock ticks. A timeout value of 0 indicates that the task desires to wait forever for the mutex. The maximum timeout is 65,535 clock ticks. The timeout value is not synchronized with the clock tick. The timeout count starts being decremented on the next clock tick, which could potentially occur immediately.

perr is a pointer to a variable that is used to hold an error code. OSMutexPend() sets *perr to one of the following:

- **OS_ERR_NONE** if the call is successful and the mutex is available.
- **OS_ERR_TIMEOUT** if the mutex is not available within the specified timeout.
- **OS_ERR_EVENT_TYPE** if you don't pass a pointer to a mutex to OSMutexPend().
- **OS_ERR_PEVENT_NULL** if pevent is a NULL pointer.
- **OS_ERR_PEND_LOCKED** if you called this function when the scheduler is locked
- **OS_ERR_PEND_ISR** if you attempt to acquire the mutex from an ISR.
- **OS_ERR_PIP_LOWER** if the priority of the task that owns the Mutex is HIGHER (i.e. a lower number) than the PIP. This error indicates that you did not set the PIP higher (lower number) than ALL the tasks that compete for the Mutex. Unfortunately, this is something that could not be detected when the Mutex is created because we don't know what tasks will be using the Mutex.

Returned Value

none
Notes/Warnings

1. Mutexes must be created before they are used.

2. You should **not** suspend the task that owns the mutex, have the mutex owner wait on any other µC/OS-II objects (i.e., semaphore, mailbox, or queue), and delay the task that owns the mutex. In other words, your code should hurry up and release the resource as quickly as possible.

Example

```c
OS_EVENT *DispMutex;

void DispTask (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        
        OSMutexPend(DispMutex, 0, &err);
        /* The only way this task continues is if _ */
        /* _ the mutex is available or signaled! */
    }
}
```
**OSMutexPost()**

```c
INT8U OSMutexPost(OS_EVENT *pevent);
```

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A mutex is signaled (i.e., released) by calling OSMutexPost(). You call this function only if you acquire the mutex by first calling either OSMutexAccept() or OSMutexPend(). If the priority of the task that owns the mutex has been raised when a higher priority task attempts to acquire the mutex, the original task priority of the task is restored. If one or more tasks are waiting for the mutex, the mutex is given to the highest priority task waiting on the mutex. The scheduler is then called to determine if the awakened task is now the highest priority task ready to run, and if so, a context switch is done to run the readied task. If no task is waiting for the mutex, the mutex value is simply set to available (0xFF).

**Arguments**

- `pevent` is a pointer to the mutex. This pointer is returned to your application when the mutex is created [see OSMutexCreate()].

**Returned Value**

OSMutexPost() returns one of these error codes:

- `OS_ERR_NONE` if the call is successful and the mutex is released.
- `OS_ERR_EVENT_TYPE` if you don't pass a pointer to a mutex to OSMutexPost().
- `OS_ERR_PEVENT_NULL` if `pevent` is a NULL pointer.
- `OS_ERR_POST_ISR` if you attempt to call OSMutexPost() from an ISR.
- `OS_ERR_NOT_MUTEX_OWNER` if the task posting (i.e., signaling the mutex) doesn't actually own the mutex.
- `OS_ERR_PIP_LOWER` If the priority of the new task that owns the Mutex is HIGHER (i.e. a lower number) than the PIP. This error indicates that you did not set the PIP higher (lower number) than ALL the tasks that compete for the Mutex. Unfortunately, this is something that could not be detected when the Mutex is created because we don't know what tasks will be using the Mutex.

**Notes/Warnings**

1. Mutexes must be created before they are used.
2. You cannot call this function from an ISR.
Example

```c
OS_EVENT *DispMutex;

void TaskX (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        err = OSMutexPost(DispMutex);
        switch (err) {
            case OS_ERR_NONE: /* Mutex signaled */
                break;
            case OS_ERR_EVENT_TYPE:
                break;
            case OS_ERR_PEVENT_NULL:
                break;
            case OS_ERR_POST_ISR:
                break;
        }
    }
}
```
OSMutexQuery() is used to obtain run-time information about a mutex. Your application must allocate an OS_MUTEX_DATA data structure that is used to receive data from the event control block of the mutex. OSMutexQuery() allows you to determine whether any task is waiting on the mutex, how many tasks are waiting (by counting the number of 1s) in the OSEventTbl[] field, obtain the PIP, and determine whether the mutex is available (OS_TRUE) or not (OS_FALSE). Note that the size of OSEventTbl[] is established by the #define constant OSEVENT_TBL_SIZE (see uCOS_II.H).

Arguments

pevent is a pointer to the mutex. This pointer is returned to your application when the mutex is created [see OSMutexCreate()].
p_mutex_data is a pointer to a data structure of type OS_MUTEX_DATA, which contains the following fields

| INT8U OSMutexPIP; /* The PIP of the mutex */ |
| INT8U OOwnerPrio; /* The priority of the mutex owner */ |
| BOOLEAN OSValue; /* The current mutex value */ |
| /* OS_TRUE means available */ |
| /* OS_FALSE means unavailable */ |

#if OS_LOWEST_PRIO <= 63
| INT8U OEventGrp; /* Copy of the mutex wait list */ |
| INT8U OEventTbl[OSEVENT_TBL_SIZE]; |
#else
| INT16U OEventGrp; /* Copy of the mutex wait list */ |
| INT16U OEventTbl[OSEVENT_TBL_SIZE]; |
#endif

Returned Value

OSMutexQuery() returns one of these error codes:

- OS_ERR_NONE if the call is successful.
- OS_ERR_EVENT_TYPE if you don’t pass a pointer to a mutex to OSMutexQuery().
- OS_ERR_PEVENT_NULL if pevent is a NULL pointer.
- OS_ERR_PDATA_NULL if p_mutex_data is a NULL pointer.
- OS_ERR_QUERY_ISR if you attempt to call OSMutexQuery() from an ISR.

Notes/Warnings

1. Mutexes must be created before they are used.
2. You cannot call this function from an ISR.
Example
In this example, we check the contents of the mutex to determine the highest priority task that is waiting for it.

OS_EVENT *DispMutex;

void Task (void *p_arg)
{
    OS_MUTEX_DATA mutex_data;
    INT8U err;
    INT8U highest; /* Highest priority task waiting on mutex */
    INT8U x;
    INT8U y;

    (void)p_arg;
    for (;;) {
        .
        .
        err = OSMutexQuery(DispMutex, &mutex_data);
        if (err == OS_ERR_NONE) {
            /* Examine Mutex data */
            .
            .
        }
    }
}


**OSQAccept()**

```c
void *OSQAccept(OS_EVENT *pevent,
                INT8U   *perr);
```

OSQAccept() checks to see if a message is available in the desired message queue. Unlike OSQPend(), OSQAccept() does not suspend the calling task if a message is not available. In other words, OSQAccept() is non-blocking. If a message is available, it is extracted from the queue and returned to your application. This call is typically used by ISRs because an ISR is not allowed to wait for messages at a queue.

**Arguments**

- **pevent** is a pointer to the message queue from which the message is received. This pointer is returned to your application when the message queue is created [see **OSQCreate()**].

- **perr** is a pointer to a variable that is used to hold an error code. OSQAccept() sets *perr to one of the following:

  - `OS_ERR_NONE` if the call is successful and the mutex is available.
  - `OS_ERR EVENT_TYPE` if you don’t pass a pointer to a queue to OSQAccept().
  - `OS_ERR PEVENT NULL` if pevent is a NULL pointer.
  - `OS_ERR Q EMPTY` if the queue doesn’t contain any messages.

**Returned Value**

A pointer to the message if one is available; NULL if the message queue does not contain a message or the message received is a NULL pointer. If a message was available in the queue, it will be removed before OSQAccept() returns.

**Notes/Warnings**

1. Message queues must be created before they are used.

2. The API (Application Programming Interface) has changed for this function in V2.60 because you can now post NULL pointers to queues. Specifically, the perr argument has been added to the call.
Example

OS_EVENT *CommQ;

void Task (void *p_arg)
{
    void *pmsg;

    (void)p_arg;
    for (;;) {
        pmsg = OSQAccept(CommQ); /* Check queue for a message */
        if (pmsg != (void *)0) {
            /* Message received, process */
            .
            .
        } else {
            /* Message not received, do .. */
            .
            .
            /* .. something else */
        }
    }
}

OSQCreate() creates a message queue. A message queue allows tasks or ISRs to send pointer-sized variables (messages) to one or more tasks. The meaning of the messages sent are application specific.

Arguments

**start** is the base address of the message storage area. A message storage area is declared as an array of pointers to voids.

**size** is the size (in number of entries) of the message storage area.

Returned Value

OSQCreate() returns a pointer to the event control block allocated to the queue. If no event control block is available, OSQCreate() returns a NULL pointer.

Notes/Warnings

1. Queues must be created before they are used.

Example

```c
OS_EVENT *CommQ;
void     *CommMsg[10];

void main (void)
{
    OSInit(); /* Initialize µC/OS-II */
    .
    .
    CommQ = OSQCreate(&CommMsg[0], 10); /* Create COMM Q */
    .
    .
    OStart(); /* Start Multitasking */
}
```
OSQDel() is used to delete a message queue. This function is dangerous to use because multiple tasks could attempt to access a deleted queue. You should always use this function with great care. Generally speaking, before you delete a queue, you must first delete all the tasks that can access the queue.

Arguments

pevent is a pointer to the queue. This pointer is returned to your application when the queue is created [see OSQCreate()].

opt specifies whether you want to delete the queue only if there are no pending tasks (OS_DEL_NO_PEND) or whether you always want to delete the queue regardless of whether tasks are pending or not (OS_DEL_ALWAYS). In this case, all pending task are readied.

perr is a pointer to a variable that is used to hold an error code. The error code can be one of the following:

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS_ERR_NONE</td>
<td>if the call is successful and the queue has been deleted.</td>
</tr>
<tr>
<td>OS_ERR_DEL_ISR</td>
<td>if you attempt to delete the queue from an ISR.</td>
</tr>
<tr>
<td>OS_ERR_INVALID_OPT</td>
<td>if you don’t specify one of the two options mentioned in the opt argument.</td>
</tr>
<tr>
<td>OS_ERR_TASK_WAITING</td>
<td>if one or more tasks are waiting for messages at the message queue.</td>
</tr>
<tr>
<td>OS_ERREVENT_TYPE</td>
<td>if pevent is not pointing to a queue.</td>
</tr>
<tr>
<td>OS_ERR_PEVENT_NULL</td>
<td>if no more OS_EVENT structures are available.</td>
</tr>
</tbody>
</table>

Returned Value

A NULL pointer if the queue is deleted or pevent if the queue is not deleted. In the latter case, you need to examine the error code to determine the reason.

Notes/Warnings

1. You should use this call with care because other tasks might expect the presence of the queue.

2. Interrupts are disabled when pended tasks are readied, which means that interrupt latency depends on the number of tasks that are waiting on the queue.
Example

    OS_EVENT *DispQ;

    void Task (void *p_arg)
    {
        INT8U err;

        (void)p_arg;
        while (1) {
            DispQ = OSQDel(DispQ, OS_DEL_ALWAYS, &err);
            if (DispQ == (OS_EVENT *)0) {
                /* Queue has been deleted */
            }
            .
            .
        }
    }
OSQFlush()

INT8U *OSQFlush(OS_EVENT *pevent);

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<td>OS_Q.C</td>
<td>Task or ISR</td>
<td>OS_Q_EN &amp;&amp; OS_Q_FLUSH_EN</td>
</tr>
</tbody>
</table>

OSQFlush() empties the contents of the message queue and eliminates all the messages sent to the queue. This function takes the same amount of time to execute regardless of whether tasks are waiting on the queue (and thus no messages are present) or the queue contains one or more messages.

Arguments

pevent is a pointer to the message queue. This pointer is returned to your application when the message queue is created [see OSQCreate()].

Returned Value

OSQFlush() returns one of the following codes:

- **OS_ERR_NONE** if the message queue is flushed.
- **OS_ERR_EVENT_TYPE** if you attempt to flush an object other than a message queue.
- **OS_ERR_PEVENT_NULL** if pevent is a NULL pointer.

Notes/Warnings

1. Queues must be created before they are used.
2. You should use this function with great care because, when to flush the queue, you LOOSE the references to what the queue entries are pointing to and thus, you could cause 'memory leaks'. In other words, the data you are pointing to that's being referenced by the queue entries should, most likely, need to be de-allocated (i.e. freed). To flush a queue that contains entries, you should instead repeatedly use OSQAccept().

Example

```c
OS_EVENT *CommQ;

void main (void)
{
    INT8U err;

    OSInit();            /* Initialize µC/OS-II */
    .
    .
    err = OSQFlush(CommQ);
    .
    .
    OStart();           /* Start Multitasking */
}
```
OSQPend() is used when a task wants to receive messages from a queue. The messages are sent to the task either by an ISR or by another task. The messages received are pointer-sized variables, and their use is application specific. If at least one message is present at the queue when OSQPend() is called, the message is retrieved and returned to the caller. If no message is present at the queue, OSQPend() suspends the current task until either a message is received or a user-specified timeout expires. If a message is sent to the queue and multiple tasks are waiting for such a message, then µC/OS-II resumes the highest priority task that is waiting. A pended task that has been suspended with OSTaskSuspend() can receive a message. However, the task remains suspended until it is resumed by calling OSTaskResume().

Arguments

pevent is a pointer to the queue from which the messages are received. This pointer is returned to your application when the queue is created [see OSQCreate()].

timeout allows the task to resume execution if a message is not received from the mailbox within the specified number of clock ticks. A timeout value of 0 indicates that the task wants to wait forever for the message. The maximum timeout is 65,535 clock ticks. The timeout value is not synchronized with the clock tick. The timeout count starts decrementing on the next clock tick, which could potentially occur immediately.

perr is a pointer to a variable used to hold an error code. OSQPend() sets *perr to one of the following:

- OS_ERR_NONE if a message is received.
- OS_ERR_TIMEOUT if a message is not received within the specified timeout.
- OS_ERR_EVENT_TYPE if pevent is not pointing to a message queue.
- OS_ERR_PEVENT_NULL if pevent is a NULL pointer.
- OS_ERR_PEND_ISR if you call this function from an ISR and µC/OS-II has to suspend it. In general, you should not call OSQPend() from an ISR. µC/OS-II checks for this situation anyway.
- OS_ERR_PEND_LOCKED if you called this function when the scheduler is locked.

Returned Value

OSQPend() returns a message sent by either a task or an ISR, and *perr is set to OS_ERR_NONE. If a timeout occurs, OSQPend() returns a NULL pointer and sets *perr to OS_ERR_TIMEOUT.

Notes/Warnings

1. Queues must be created before they are used.
2. You should not call OSQPend() from an ISR.
3. OSQPend() was changed in V2.60 to allow it to receive NULL pointer messages.
Example

OS_EVENT *CommQ;

void CommTask(void *p_arg)
{
    INT8U  err;
    void *pmsg;

    (void)p_arg;
    for (;;) {
        
        pmsg = OSQPend(CommQ, 100, &err);
        if (err == OS_ERR_NONE) {
            
            /* Message received within 100 ticks! */
            
        } else {
            
            /* Message not received, must have timed out */
            
        }
    }
}
OSQPendAbort()

void *OSQPendAbort(OS_EVENT *pevent,
    INT8U     opt,
    INT8U    *perr);

OSQPendAbort() aborts & readies any tasks currently waiting on a queue. This function should be used to fault-abort the wait on the queue, rather than to normally signal the queue via OSQPost(), OSQPostFront() or OSQPostOpt().

Arguments
pevent is a pointer to the queue for which pend(s) need to be aborted. This pointer is returned to your application when the queue is created [see OSQCreate()].
onpt determines what type of abort is performed.
  OS_PEND_OPT_NONE Aborts the pend of only the highest priority task waiting on the queue.
  OS_PEND_OPT_BROADCAST Aborts the pend of all the tasks waiting on the queue.
perr is a pointer to a variable that holds an error code. OSQPendAbort() sets *perr to one of the following:
  OS_ERR_NONE if no tasks were waiting on the queue. In this case, the return value is also 0.
  OS_ERR_PEND_ABORT at least one task waiting on the queue was readied and informed of the aborted wait. Check the return value for the number of tasks whose wait on the queue was aborted.
  OS_ERR_EVENT_TYPE if pevent is not pointing to a queue.
  OS_ERR_PEVENT_NULL if pevent is a NULL pointer.

Returned Value
OSQPendAbort() returns the number of tasks made ready to run by this function. Zero indicates that no tasks were pending on the queue and thus this function had no effect.

Notes/Warnings
1. Queues must be created before they are used.
Example

```c
OS_EVENT *CommQ;

void CommTask(void *p_arg)
{
    INT8U  err;
    INT8U  nbr_tasks;

    (void)p_arg;
    for (;;) {
        ...
        ...
        nbr_tasks = OSQPendAbort(CommQ, OS_PEND_OPT_BROADCAST, &err);
        if (err == OS_ERR_NONE) {
            ...
            /* No tasks were waiting on the queue */
            ...
        } else {
            ...
            /* All pends of tasks waiting on queue were aborted ... */
            /* ... 'nbr_tasks' indicates how many were made ready. */
            ...
        }
    }
}
```
OSQPost() sends a message to a task through a queue. A message is a pointer-sized variable, and its use is application specific. If the message queue is full, an error code is returned to the caller. In this case, OSQPost() immediately returns to its caller, and the message is not placed in the queue. If any task is waiting for a message at the queue, the highest priority task receives the message. If the task waiting for the message has a higher priority than the task sending the message, the higher priority task resumes, and the task sending the message is suspended; that is, a context switch occurs. Message queues are first-in first-out (FIFO), which means that the first message sent is the first message received.

**Arguments**

pevent is a pointer to the queue into which the message is deposited. This pointer is returned to your application when the queue is created [see OSQCreate()].

pmsg is the actual message sent to the task. pmsg is a pointer-sized variable and is application specific. As of V2.60, you are allowed to post a NULL pointer.

**Returned Value**

OSQPost() returns one of these error codes:

- **OS_ERR_NONE** if the message is deposited in the queue.
- **OS_ERR_Q_FULL** if the queue is already full.
- **OS_ERR_EVENT_TYPE** if pevent is not pointing to a message queue.
- **OS_ERR_PEVENT_NULL** if pevent is a NULL pointer.

**Notes/Warnings**

1. Queues must be created before they are used.

2. As of V2.60, you are now allowed to post a NULL pointer. It is up to your application to check the perr variable accordingly.
Example

OS_EVENT *CommQ;
INT8U CommRxBuf[100];

void CommTaskRx (void *p_arg)
{

    INT8U err;

    (void)p_arg;
    for (;;) {
        err = OSQPost(CommQ, (void *)&CommRxBuf[0]);
        switch (err) {
            case OS_ERR_NONE:
                /* Message was deposited into queue */
                break;

            case OS_ERR_Q_FULL:
                /* Queue is full */
                break;
        
        }
    }

}
OSQPostFront()

INT8U OSQPostFront(OS_EVENT *pevent,
void     *pmsg);

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</table>

OSQPostFront() sends a message to a task through a queue. OSQPostFront() behaves very much like OSQPost(), except that the message is inserted at the front of the queue. This means that OSQPostFront() makes the message queue behave like a last-in first-out (LIFO) queue instead of a first-in first-out (FIFO) queue. The message is a pointer-sized variable, and its use is application specific. If the message queue is full, an error code is returned to the caller. OSQPostFront() immediately returns to its caller, and the message is not placed in the queue. If any tasks are waiting for a message at the queue, the highest priority task receives the message. If the task waiting for the message has a higher priority than the task sending the message, the higher priority task is resumed, and the task sending the message is suspended; that is, a context switch occurs.

Arguments

pevent is a pointer to the queue into which the message is deposited. This pointer is returned to your application when the queue is created [see OSQCreate()].

pmsg is the actual message sent to the task. pmsg is a pointer-sized variable and is application specific. As of V2.60, you are allowed to post a NULL pointer.

Returned Value

OSQPostFront() returns one of these error codes:

- OS_ERR_NONE if the message is deposited in the queue.
- OS_ERR_Q_FULL if the queue is already full.
- OS_ERR_EVENT_TYPE if pevent is not pointing to a message queue.
- OS_ERR_PEVENT_NULL if pevent is a NULL pointer.

Notes/Warnings

1. Queues must be created before they are used.
2. As of V2.60, you are now allowed to post a NULL pointer. It is up to you’re application to check the perr variable accordingly.
Example

OS_EVENT *CommQ;
INT8U CommRxBuf[100];

void CommTaskRx (void *p_arg)
{
  INT8U err;

  (void)p_arg;
  for (;;) {
    err = OSQPostFront(CommQ, (void *)&CommRxBuf[0]);
    switch (err) {
    case OS_ERR_NONE:
      /* Message was deposited into queue */
      break;

    case OS_ERR_Q_FULL:
      /* Queue is full */
      break;
    }
  }
}
OSQPostOpt() is used to send a message to a task through a queue. A message is a pointer-sized variable, and its use is application specific. If the message queue is full, an error code is returned indicating that the queue is full. OSQPostOpt() then immediately returns to its caller, and the message is not placed in the queue. If any task is waiting for a message at the queue, OSQPostOpt() allows you to either post the message to the highest priority task waiting at the queue (opt set to OS_POST_OPT_NONE) or to all tasks waiting at the queue (opt is set to OS_POST_OPT_BROADCAST). In either case, scheduling occurs, and, if any of the tasks that receive the message have a higher priority than the task that is posting the message, then the higher priority task is resumed, and the sending task is suspended. In other words, a context switch occurs.

OSQPostOpt() emulates both OSQPost() and OSQPostFront() and also allows you to post a message to multiple tasks. In other words, it allows the message posted to be broadcast to all tasks waiting on the queue. OSQPostOpt() can actually replace OSQPost() and OSQPostFront() because you specify the mode of operation via an option argument, opt. Doing this allows you to reduce the amount of code space needed by µC/OS-II.

Arguments

pevent is a pointer to the queue. This pointer is returned to your application when the queue is created [see OSQcreate()].

pmsg is the actual message sent to the task(s). pmsg is a pointer-sized variable, and what pmsg points to is application specific. As of V2.60, you are now allowed to post a NULL pointer.

opt determines the type of POST performed:

- OS_POST_OPT_NONE POST to a single waiting task [identical to OSQPost()].
- OS_POST_OPT_BROADCAST POST to all tasks waiting on the queue.
- OS_POST_OPT_FRONT POST as LIFO [simulates OSQPostFront()].
- OS_POST_OPT_NO_SCHED Do not call the scheduler after the post.

Below is a list of some of the possible combination of these flags:

- OS_POST_OPT_NONE is identical to OSQPost()
- OS_POST_OPT_FRONT is identical to OSQPostFront()
- OS_POST_OPT_BROADCAST is identical to OSQPost() but broadcasts pmsg to all waiting tasks
- OS_POST_OPT_FRONT + OS_POST_OPT_BROADCAST is identical to OSQPostFront() except that broadcasts pmsg to all waiting tasks.
- OS_POST_OPT_FRONT + OS_POST_OPT_BROADCAST + OS_POST_OPT_NO_SCHED is identical to OSQPostFront() except that broadcasts pmsg to all waiting tasks and the scheduler will not be called.

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11 OS_Q.C Task or ISR OS_Q_EN && OS_Q_POST_OPT_EN
Returned Value

**perr** is a pointer to a variable that is used to hold an error code. The error code can be one of the following:

- **OS_ERR_NONE** if the call is successful and the message has been sent.
- **OS_ERR_Q_FULL** if the queue can no longer accept messages because it is full.
- **OS_ERR_EVENT_TYPE** if `pevent` is not pointing to a mailbox.
- **OS_ERR_PEVENT_NULL** if `pevent` is a NULL pointer.

Notes/Warnings

1. Queues must be created before they are used.
2. If you need to use this function and want to reduce code space, you can disable code generation of `OSQPost()` (set `OS_Q_POST_EN` to 0 in `OS_CFG.H`) and `OSQPostFront()` (set `OS_Q_POST_FRONT_EN` to 0 in `OS_CFG.H`) because `OSQPostOpt()` can emulate these two functions.
3. The execution time of `OSQPostOpt()` depends on the number of tasks waiting on the queue if you set `opt` to `OS_POST_OPT_BROADCAST`.

Example

```c
OS_EVENT *CommQ;
INT8U CommRxBuf[100];

void CommRxTask (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        ...
        err = OSQPostOpt(CommQ,
                          (void *)&CommRxBuf[0],
                          OS_POST_OPT_BROADCAST);
    }
}
```
OSQQuery() obtains information about a message queue. Your application must allocate an OS_Q_DATA data structure used to receive data from the event control block of the message queue. OSQQuery() allows you to determine whether any tasks are waiting for messages at the queue, how many tasks are waiting (by counting the number of 1s in the .OSEventTbl[] field), how many messages are in the queue, and what the message queue size is. OSQQuery() also obtains the next message that is returned if the queue is not empty. Note that the size of .OSEventTbl[] is established by the #define constant OS_EVENT_TBL_SIZE (see uCOS_II.H).

Arguments
pevent is a pointer to the message queue. This pointer is returned to your application when the queue is created [see OSQCreate()].
pdata is a pointer to a data structure of type OS_Q_DATA, which contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT8U OSMsg;</td>
<td>*/ Next message if one available */</td>
</tr>
<tr>
<td>INT16U OSNMsgs;</td>
<td>*/ Number of messages in the queue */</td>
</tr>
<tr>
<td>INT16U OSQSize;</td>
<td>*/ Size of the message queue */</td>
</tr>
<tr>
<td>INT8U OSEventTbl[OS_EVENT_TBL_SIZE];</td>
<td>/* Message queue wait list */</td>
</tr>
<tr>
<td>INT8U OSEventGrp;</td>
<td></td>
</tr>
<tr>
<td>INT16U OSEventTbl[OS_EVENT_TBL_SIZE];</td>
<td>/* Message queue wait list */</td>
</tr>
<tr>
<td>INT16U OSEventGrp;</td>
<td></td>
</tr>
<tr>
<td>#else</td>
<td></td>
</tr>
</tbody>
</table>

Returned Value
OSQQuery() returns one of these error codes:

- **OS_ERR_NONE** if the call is successful.
- **OS_ERR_EVENT_TYPE** if you don’t pass a pointer to a message queue.
- **OS_ERR_EVQENT_NULL** if pevent is a NULL pointer.
- **OS_ERR_PDATA_NULL** if pdata is a NULL pointer.

Notes/Warnings
1. Message queues must be created before they are used.
Example

```c
OS_EVENT *CommQ;

void Task (void *p_arg)
{
    OS_Q_DATA qdata;
    INT8U     err;

    (void)p_arg;
    for (; ;) {
        err = OSQQuery(CommQ, &qdata);
        if (err == OS_ERR_NONE) {
            /* 'qdata' can be examined! */
        }
    }
}
```
OSSchedLock() prevents task rescheduling until its counterpart, OSSchedUnlock(), is called. The task that calls OSSchedLock() keeps control of the CPU even though other higher priority tasks are ready to run. However, interrupts are still recognized and serviced (assuming interrupts are enabled). OSSchedLock() and OSSchedUnlock() must be used in pairs. µC/OS-II allows OSSchedLock() to be nested up to 255 levels deep. Scheduling is enabled when an equal number of OSSchedUnlock() calls have been made.

**Arguments**

none

**Returned Value**

none

**Notes/Warnings**

1. After calling OSSchedLock(), your application must not make system calls that suspend execution of the current task; that is, your application cannot call OSTimeDly(), OSTimeDlyHMSM(), OSFlagPend(), OSSemPend(), OSMutexPend(), OSMboxPend(), or OSQPend(). Because the scheduler is locked out, no other task is allowed to run, and your system will lock up.

**Example**

```c
void TaskX (void *p_arg)
{
    (void)p_arg;
    for (; ;) {
        OSSchedLock(); /* Prevent other tasks to run */
        .
        .   /* Code protected from context switch */
        .
        OSSchedUnlock(); /* Enable other tasks to run */
    }
}
```
OSSchedUnlock()
void OSSchedUnlock(void);

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OSSchedUnlock() re-enables task scheduling whenever it is paired with OSSchedLock().

Arguments
none

Returned Value
none

Notes/Warnings
1. After calling OSSchedLock(), your application must not make system calls that suspend execution of the current task; that is, your application cannot call OSTimeDly(), OSTimeDlyHMSM(), OSFlagPend(), OSSemPend(), OSMutexPend(), OSMboxPend(), or OSQPend(). Because the scheduler is locked out, no other task is allowed to run, and your system will lock up.

Example

```c
void TaskX (void *p_arg)
{
    (void)p_arg;
    for (;;) {
        .
        OSSchedLock(); /* Prevent other tasks to run */
        .
        /* Code protected from context switch */
        .
        OSSchedUnlock(); /* Enable other tasks to run */
        .
    }
}
```
OSSemAccept()

INT16U OSSemAccept(OS_EVENT *pevent);

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OSSemAccept() checks to see if a resource is available or an event has occurred. Unlike OSSemPend(), OSSemAccept() does not suspend the calling task if the resource is not available. In other words, OSSemAccept() is non-blocking. Use OSSemAccept() from an ISR to obtain the semaphore.

Arguments

pevent is a pointer to the semaphore that guards the resource. This pointer is returned to your application when the semaphore is created [see OSSemCreate()].

Returned Value

When OSSemAccept() is called and the semaphore value is greater than 0, the semaphore value is decremented, and the value of the semaphore before the decrement is returned to your application. If the semaphore value is 0 when OSSemAccept() is called, the resource is not available, and 0 is returned to your application.

Notes/Warnings

1. Semaphores must be created before they are used.

Example

```c
OS_EVENT *DispSem;

void Task (void *p_arg)
{
    INT16U value;

    (void)p_arg;
    for (;;) {
        value = OSSemAccept(DispSem); /* Check resource availability */
        if (value > 0) {
            /* Resource available, process */
            .
            .
            .
        }
    }
}
```
**OSSemCreate()**

OS_EVENT *OSSemCreate(INT16U value);

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OSSemCreate() creates and initializes a semaphore. A semaphore
- allows a task to synchronize with either an ISR or a task (you initialize the semaphore to 0),
- gains exclusive access to a resource (you initialize the semaphore to a value greater than 0), and
- signals the occurrence of an event (you initialize the semaphore to 0).

**Arguments**

value is the initial value of the semaphore and can be between 0 and 65,535. A value of 0 indicates that a resource is not available or an event has not occurred.

**Returned Value**

OSSemCreate() returns a pointer to the event control block allocated to the semaphore. If no event control block is available, OSSemCreate() returns a NULL pointer.

**Notes/Warnings**

1. Semaphores must be created before they are used.

**Example**

```c
OS_EVENT *DispSem;

void main (void)
{
    
    OSInit();      /* Initialize µC/OS-II */
    
    DispSem = OSSemCreate(1); /* Create Display Semaphore */
    
    OSStart();      /* Start Multitasking*/
}
```
OSSemDel()

OS_EVENT *OSSemDel(OS_EVENT *pevent,
    INT8U     opt,
    INT8U     *perr);

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OSSemDel() is used to delete a semaphore. This function is dangerous to use because multiple tasks could attempt to access a deleted semaphore. You should always use this function with great care. Generally speaking, before you delete a semaphore, you must first delete all the tasks that can access the semaphore.

**Arguments**

pevent is a pointer to the semaphore. This pointer is returned to your application when the semaphore is created [see OSSemCreate()].

opt specifies whether you want to delete the semaphore only if there are no pending tasks (OS_DEL_NO_PEND) or whether you always want to delete the semaphore regardless of whether tasks are pending or not (OS_DEL_ALWAYS). In this case, all pending task are readied.

terr is a pointer to a variable that is used to hold an error code. The error code can be one of the following:

- **OS_ERR_NONE**: if the call is successful and the semaphore has been deleted.
- **OS_ERR_DEL_ISR**: if you attempt to delete the semaphore from an ISR.
- **OS_ERR_INVALID_OPT**: if you don’t specify one of the two options mentioned in the opt argument.
- **OS_ERR_TASK_WAITING**: if one or more tasks are waiting on the semaphore.
- **OS_ERR_EVENT_TYPE**: if pevent is not pointing to a semaphore.
- **OS_ERR_PEVENT_NULL**: if no more OS_EVENT structures are available.

**Returned Value**

A NULL pointer if the semaphore is deleted or pevent if the semaphore is not deleted. In the latter case, you need to examine the error code to determine the reason.

**Notes/Warnings**

1. You should use this call with care because other tasks might expect the presence of the semaphore.
2. Interrupts are disabled when pended tasks are readied, which means that interrupt latency depends on the number of tasks that are waiting on the semaphore.
Example

```c
OS_EVENT *DispSem;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        
        DispSem = OSSemDel(DispSem, OS_DEL_ALWAYS, &err);
        if (DispSem == (OS_EVENT *)0) {
            /* Semaphore has been deleted */
        }
        
    }
}
```
OSSemPend() is used when a task wants exclusive access to a resource, needs to synchronize its activities with an ISR or a task, or is waiting until an event occurs. If a task calls OSSemPend() and the value of the semaphore is greater than 0, OSSemPend() decrements the semaphore and returns to its caller. However, if the value of the semaphore is 0, OSSemPend() places the calling task in the waiting list for the semaphore. The task waits until a task or an ISR signals the semaphore or the specified timeout expires. If the semaphore is signaled before the timeout expires, µC/OS-II resumes the highest priority task waiting for the semaphore. A pended task that has been suspended with OSTaskSuspend() can obtain the semaphore. However, the task remains suspended until it is resumed by calling OSTaskResume().

Arguments

pevent is a pointer to the semaphore. This pointer is returned to your application when the semaphore is created [see OSSemCreate()].

timeout allows the task to resume execution if a message is not received from the mailbox within the specified number of clock ticks. A timeout value of 0 indicates that the task waits forever for the message. The maximum timeout is 65,535 clock ticks. The timeout value is not synchronized with the clock tick. The timeout count begins decrementing on the next clock tick, which could potentially occur immediately.

perr is a pointer to a variable used to hold an error code. OSSemPend() sets *perr to one of the following:

- OS_ERR_NONE if the semaphore is available.
- OS_ERR_TIMEOUT if the semaphore is not signaled within the specified timeout.
- OS_ERR_EVENT_TYPE if pevent is not pointing to a semaphore.
- OS_ERR_PEND_ISR if you called this function from an ISR and µC/OS-II has to suspend it. You should not call OSSemPend() from an ISR. µC/OS-II checks for this situation.
- OS_ERR_PEND_LOCKED if you called this function when the scheduler is locked.
- OS_ERR_PEVENT_NULL if pevent is a NULL pointer.

Returned Value

none

Notes/Warnings

1. Semaphores must be created before they are used.
Example

OS_EVENT *DispSem;

void DispTask (void *p_arg)
{
    INT8U  err;

    (void)p_arg;
    for (;;) {
        
        OSSemPend(DispSem, 0, &err);
        /* The only way this task continues is if _ */
        /* _ the semaphore is signaled! */
    }
}

**OSSemPendAbort()**

```c
void *OSSemPendAbort(OS_EVENT *pevent,
                     INT8U     opt,
                     INT8U     *perr);
```

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`OSSemPendAbort()` aborts & readies any tasks currently waiting on a semaphore. This function should be used to fault-abort the wait on the semaphore, rather than to normally signal the semaphore via `OSSemPost()`.

**Arguments**

- **pevent** is a pointer to the semaphore for which pend(s) need to be aborted. This pointer is returned to your application when the semaphore is created [see `OSSemCreate()`].
- **opt** determines what type of abort is performed.
  - `OS_PEND_OPT_NONE` Aborts the pend of only the highest priority task waiting on the semaphore.
  - `OS_PEND_OPT_BROADCAST` Aborts the pend of all the tasks waiting on the semaphore.
- **perr** is a pointer to a variable that holds an error code. `OSSemPendAbort()` sets *perr to one of the following:
  - `OS_ERR_NONE` if no tasks were waiting on the semaphore. In this case, the return value is also 0.
  - `OS_ERR_PEND_ABORT` at least one task waiting on the semaphore was readied and informed of the aborted wait. Check the return value for the number of tasks whose wait on the semaphore was aborted.
  - `OS_ERR_EVENT_TYPE` if `pevent` is not pointing to a semaphore.
  - `OS_ERR_PEVENT_NULL` if `pevent` is a NULL pointer.

**Returned Value**

`OSSemPendAbort()` returns the number of tasks made ready to run by this function. Zero indicates that no tasks were pending on the semaphore and thus this function had no effect.

**Notes/Warnings**

1. Semaphores must be created before they are used.
Example

OS_EVENT *CommSem;

void CommTask(void *p_arg)
{
    INT8U err;
    INT8U nbr_tasks;

    (void)p_arg;
    for (;;) {
        .
        .
        nbr_tasks = OSSemPendAbort(CommSem, OS_PEND_OPT_BROADCAST, &err);
        if (err == OS_ERR_NONE) {
            .
            . /* No tasks were waiting on the semaphore */
            .
        } else {
            .
            . /* All pends of tasks waiting on semaphore were aborted ... */
            . /* ... 'nbr_tasks' indicates how many were made ready. */
            .
        }
    }
}
OSSemPost()

INT8U OSSemPost(OS_EVENT *pevent);

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A semaphore is signaled by calling OSSemPost(). If the semaphore value is 0 or more, it is incremented, and OSSemPost() returns to its caller. If tasks are waiting for the semaphore to be signaled, OSSemPost() removes the highest priority task pending for the semaphore from the waiting list and makes this task ready to run. The scheduler is then called to determine if the awakened task is now the highest priority task ready to run.

Arguments

pevent is a pointer to the semaphore. This pointer is returned to your application when the semaphore is created [see OSSemCreate()].

Returned Value

OSSemPost() returns one of these error codes:

- OS_ERR_NONE if the semaphore is signaled successfully.
- OS_ERR_SEM_OVF if the semaphore count overflows.
- OS_ERR_EVENT_TYPE if pevent is not pointing to a semaphore.
- OS_ERR_PEVENT_NULL if pevent is a NULL pointer.

Notes/Warnings

1. Semaphores must be created before they are used.
Example

OS_EVENT *DispSem;

void TaskX (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        err = OSSemPost(DispSem);
        switch (err) {
            case OS_ERR_NONE:
                /* Semaphore signaled */
                break;

            case OS_ERR_SEM_OVF:
                /* Semaphore has overflowed */
                break;
        }
    }
}
OSSemQuery()

INT8U OSSemQuery(OS_EVENT *pevent,
                  OS_SEM_DATA *p_sem_data);

Arguments

pevent is a pointer to the semaphore. This pointer is returned to your application when the semaphore is created [see OSSemCreate()].

P_sem_data is a pointer to a data structure of type OS_SEM_DATA, which contains the following fields

| INT16U OSCnt;                       /* Current semaphore count */ |
| #if OS_LOWEST_PRIO <= 63 |
| INT8U OSEventTbl[OS_EVENT_TBL_SIZE]; /* Semaphore wait list */ |
| INT8U OSEventGrp; |
| #else |
| INT16U OSEventTbl[OS_EVENT_TBL_SIZE]; /* Semaphore wait list */ |
| INT16U OSEventGrp; |
| #endif |

Returned Value

OSSemQuery() returns one of these error codes:

OS_ERR_NONE if the call is successful.

OS_ERR_EVENT_TYPE if you don’t pass a pointer to a semaphore.

OS_ERR_PEVENT_NULL if pevent is a NULL pointer.

OS_ERR_PDATA_NULL if p_sem_data is a NULL pointer.

Notes/Warnings

1. Semaphores must be created before they are used.
Example

In this example, the contents of the semaphore is checked to determine the highest priority task waiting at the time the function call was made.

```c
OS_EVENT *DispSem;

void Task (void *p_arg)
{
    OS_SEM_DATA sem_data;
    INT8U       err;
    INT8U       highest; /* Highest priority task waiting on sem. */
    INT8U       x;
    INT8U       y;

    (void)p_arg;
    for (;;) {
        .
        .
        err = OSSemQuery(DispSem, &sem_data);
        if (err == OS_ERR_NONE) {
            /* Examine sem_data */
            .
            .
        }
    }
}
```
**OSSemSet()**

```c
void OSSemSet(OS_EVENT *pevent,
              INT16U cnt,
              INT8U  *perr);
```

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OSSemSet() is used to change the current value of the semaphore count. This function would normally be used when a semaphore is used as a signaling mechanism. OSSemSet() can then be used to reset the count to any value. If the semaphore count is already 0 then, the count is only changed if there are no tasks waiting on the semaphore.

**Arguments**

- **pevent** is a pointer to the semaphore that is used as a signaling mechanism. This pointer is returned to your application when the semaphore is created [see OSSemCreate()].
- **cnt** is the desired count that you want the semaphore set to.
- **perr** is a pointer to a variable used to hold an error code. OSSemSet() sets *perr to one of the following:
  - OS_ERR_NONE if the count was changed or, not changed because there was one or more tasks waiting on the semaphore.
  - OS_ERR_EVENT_TYPE if pevent is not pointing to a semaphore.
  - OS_ERR_PEVENT_NULL if pevent is a NULL pointer.
  - OS_ERR_TASK_WAITING if tasks are waiting on the semaphore.

**Returned Value**

None

**Notes/Warnings**

1. You should NOT use this function if the semaphore is used to protect a shared resource.
Example

OS_EVENT *SignalSem;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (; ;) {
        OSSemSet(SignalSem, 0, &err); /* Reset the semaphore count */
    }
}
OSStart()

void OSStart(void);

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OSStart() starts multitasking under µC/OS-II. This function is typically called from your startup code but after you call OSInit().

Arguments

none

Returned Value

none

Notes/Warnings

1. OSInit() must be called prior to calling OSStart(). OSStart() should only be called once by your application code. If you do call OSStart() more than once, it does not do anything on the second and subsequent calls.

Example

```c
void main (void)
{
    /* User Code */
    .
    OSInit();  /* Initialize µC/OS-II */
    .
    /* User Code */
    .
    OSStart(); /* Start Multitasking */
    /* Any code here should NEVER be executed! */
}
```
OSStatInit()

void OSStatInit(void);

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OSStatInit() determines the maximum value that a 32-bit counter can reach when no other task is executing. This function must be called when only one task is created in your application and when multitasking has started; that is, this function must be called from the first and, only, task created.

**Arguments**

none

**Returned Value**

none

**Notes/Warnings**

none

**Example**

```c
void FirstAndOnlyTask (void *p_arg)
{
    ...
    ...
    OSStatInit();    /* Compute CPU capacity with no task running */
    ...
    OSTaskCreate(_); /* Create the other tasks */
    OSTaskCreate(_);
    ...
    for (;;) {
        ...
        ...
    }
}
```
OSTaskChangePrio()

INT8U OSTaskChangePrio(INT8U oldprio,
INT8U newprio);

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OSTaskChangePrio() changes the priority of a task.

**Arguments**

- **oldprio** is the priority number of the task to change.
- **newprio** is the new task’s priority.

**Returned Value**

OSTaskChangePrio() returns one of the following error codes:

- **OS_ERR_NONE** if the task’s priority is changed.
- **OS_ERR_PRIO_INVALID** if either the old priority or the new priority is equal to or exceeds **OS_LOWEST_PRIO**.
- **OS_ERR_PRIO_EXIST** if **newprio** already exists.
- **OS_ERR_PRIO** if no task with the specified old priority exists (i.e., the task specified by **oldprio** does not exist).
- **OS_ERR_TASK_NOT_EXITS** if the task is assigned to a Mutex PIP.

**Notes/Warnings**

1. The desired priority must not already have been assigned; otherwise, an error code is returned. Also, **OSTaskChangePrio()** verifies that the task to change exists.

**Example**

```c
void TaskX (void *p_arg)
{
    INT8U err;

    for (;;) {
        
        err = OSTaskChangePrio(10, 15);
        
    }
}
```
**OSTaskCreate()**

```c
INT8U OSTaskCreate(void (*task)(void *pd),
                    void   *pdata,
                    OS_STK  *ptos,
                    INT8U   prio);
```

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**OSTaskCreate()** creates a task so it can be managed by μC/OS-II. Tasks can be created either prior to the start of multitasking or by a running task. A task cannot be created by an ISR. A task must be written as an infinite loop, as shown below, and must not return.

**OSTaskCreate()** is used for backward compatibility with μC/OS and when the added features of **OSTaskCreateExt()** are not needed.

Depending on how the stack frame is built, your task has interrupts either enabled or disabled. You need to check with the processor-specific code for details.

```c
void Task (void *p_arg)
{
    /* Do something with 'pdata' */
    for (;;) {
        /* Task body, always an infinite loop. */
        /* Must call one of the following services: */
        /* OSMboxPend() */
        /* OSFlagPend() */
        /* OSMutexPend() */
        /* OSQPend() */
        /* OSSemPend() */
        /* OSTimeDly() */
        /* OSTimeDlyHMSM() */
        /* OSTaskSuspend() (Suspend self) */
        /* OSTaskDel() (Delete self) */
    }
}
```
Arguments

**task**
is a pointer to the task’s code.

**pdata**
is a pointer to an optional data area used to pass parameters to the task when it is created. Where the task is concerned, it thinks it is invoked and passes the argument *pdata*. *pdata* can be used to pass arguments to the task created. For example, you can create a generic task that handles an asynchronous serial port. *pdata* can be used to pass this task information about the serial port it has to manage: the port address, the baud rate, the number of bits, the parity, and more.

**ptos**
is a pointer to the task’s top-of-stack. The stack is used to store local variables, function parameters, return addresses, and CPU registers during an interrupt. The size of the stack is determined by the task’s requirements and the anticipated interrupt nesting. Determining the size of the stack involves knowing how many bytes are required for storage of local variables for the task itself and all nested functions, as well as requirements for interrupts (accounting for nesting). If the configuration constant *OS_STK_GROWTH* is set to 1, the stack is assumed to grow downward (i.e., from high to low memory). *ptos* thus needs to point to the highest valid memory location on the stack. If *OS_STK_GROWTH* is set to 0, the stack is assumed to grow in the opposite direction (i.e., from low to high memory).

**prio**
is the task priority. A unique priority number must be assigned to each task, and the lower the number, the higher the priority (i.e., the task importance).

Returned Value

`OSTaskCreate()` returns one of the following error codes:

- **OS_ERR_NONE**
  - if the function is successful.
- **OS_ERR_PRIO_EXIST**
  - if the requested priority already exists.
- **OS_ERR_PRIO_INVALID**
  - if *prio* is higher than *OS_LOWEST_PRIO*.
- **OS_ERR_NO_MORE_TCB**
  - if µC/OS-II doesn’t have any more *OS_TCB*s to assign.
- **OS_ERR_TASK_CREATE_ISR**
  - if you attempted to create the task from an ISR.

Notes/Warnings

1. The stack for the task must be declared with the *OS_STK* type.
2. A task must always invoke one of the services provided by µC/OS-II to wait for time to expire, suspend the task, or wait for an event to occur (wait on a mailbox, queue, or semaphore). This allows other tasks to gain control of the CPU.
3. You should not use task priorities 0, 1, 2, 3, *OS_LOWEST_PRIO-3*, *OS_LOWEST_PRIO-2*, *OS_LOWEST_PRIO-1*, and *OS_LOWEST_PRIO* because they are reserved for use by µC/OS-II.
Example 1

This example shows that the argument that Task1() receives is not used, so the pointer pdata is set to NULL. Note that I assume the stack grows from high to low memory because I pass the address of the highest valid memory location of the stack Task1Stk[]. If the stack grows in the opposite direction for the processor you are using, pass &Task1Stk[0] as the task’s top-of-stack.

Assigning pdata to itself is used to prevent compilers from issuing a warning about the fact that pdata is not being used. In other words, if I had not added this line, some compilers would have complained about ‘WARNING - variable pdata not used.’

```c
OS_STK   Task1Stk[1024];

void main (void)
{
    INT8U err;

    OSInit();               /* Initialize µC/OS-II */

    OSTaskCreate(Task1,
                  (void *)0,
                  &Task1Stk[1023],
                  25);

    OSStart();               /* Start Multitasking */
}

void Task1 (void *p_arg)
{
    (void)p_arg;              /* Prevent compiler warning */

    for (;;) {                /* Task code */
        /* Task code */
    }
}
```
Example 2
You can create a generic task that can be instantiated more than once. For example, a task that handles a serial port could be passed the address of a data structure that characterizes the specific port (i.e., port address and baud rate). Note that each task has its own stack space and its own (different) priority. In this example, I arbitrarily decided that COM1 is the most important port of the two.

```c
OS_STK *Comm1Stk[1024];
COMM_DATA Comm1Data; /* Data structure containing COMM port */
    /* Specific data for channel 1 */

OS_STK *Comm2Stk[1024];
COMM_DATA Comm2Data; /* Data structure containing COMM port */
    /* Specific data for channel 2 */

void main (void)
{
    INT8U err;

    OSInit(); /* Initialize µC/OS-II */
    /* Create task to manage COM1 */
    OSTaskCreate(CommTask,
                (void *)&Comm1Data,
                &Comm1Stk[1023],
                25);
    /* Create task to manage COM2 */
    OSTaskCreate(CommTask,
                (void *)&Comm2Data,
                &Comm2Stk[1023],
                26);
    OSStart(); /* Start Multitasking */
}

void CommTask (void *p_arg) /* Generic communication task */
{
    for (;;) {
        /* Task code */
    }
}
```
OSTaskCreateExt()

INT8U OSTaskCreateExt(void (*task)(void *pd),
void *pdata,
OS_STK *ptos,
INT8U prio,
INT16U id,
OS_STK *pbos,
INT32U stk_size,
void *pext,
INT16U opt);

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OSTaskCreateExt() creates a task to be managed by µC/OS-II. This function serves the same purpose as OSTaskCreate(), except that it allows you to specify additional information about your task to µC/OS-II. Tasks can be created either prior to the start of multitasking or by a running task. A task cannot be created by an ISR. A task must be written as an infinite loop, as shown below, and must not return. Depending on how the stack frame is built, your task has interrupts either enabled or disabled. You need to check with the processor-specific code for details. Note that the first four arguments are exactly the same as the ones for OSTaskCreate(). This was done to simplify the migration to this new and more powerful function. It is highly recommended that you use OSTaskCreateExt() instead of the older OSTaskCreate() function because it’s much more flexible.

```c
void Task (void *p_arg)
{
    /* Do something with 'pdata' */
    for (; ; ) { /* Task body, always an infinite loop. */
        /* Must call one of the following services: */
        /* OSMboxPend() */
        /* OSFlagPend() */
        /* OSMutexPend() */
        /* OSQPend() */
        /* OSSemPend() */
        /* OSTimeDly() */
        /* OSTimeDlyHMSM() */
        /* OSTaskSuspend() (Suspend self) */
        /* OSTaskDel() (Delete self) */
    }
}
```
Arguments

- **task**: is a pointer to the task’s code.
- **pdata**: is a pointer to an optional data area, which is used to pass parameters to the task when it is created. Where the task is concerned, it thinks it is invoked and passes the argument `pdata`. `pdata` can be used to pass arguments to the task created. For example, you can create a generic task that handles an asynchronous serial port. `pdata` can be used to pass this task information about the serial port it has to manage: the port address, the baud rate, the number of bits, the parity, and more.
- **ptos**: is a pointer to the task’s top-of-stack. The stack is used to store local variables, function parameters, return addresses, and CPU registers during an interrupt.
  
The size of this stack is determined by the task’s requirements and the anticipated interrupt nesting. Determining the size of the stack involves knowing how many bytes are required for storage of local variables for the task itself and all nested functions, as well as requirements for interrupts (accounting for nesting).
  
  If the configuration constant `OS_STK_GROWTH` is set to 1, the stack is assumed to grow downward (i.e., from high to low memory). `ptos` thus needs to point to the highest valid memory location on the stack. If `OS_STK_GROWTH` is set to 0, the stack is assumed to grow in the opposite direction (i.e., from low to high memory).
- **prio**: is the task priority. A unique priority number must be assigned to each task: the lower the number, the higher the priority (i.e., the importance) of the task.
- **id**: is the task’s ID number. At this time, the ID is not currently used in any other function and has simply been added in `OSTaskCreateExt()` for future expansion. You should set `id` to the same value as the task’s priority.
- **pbos**: is a pointer to the task’s bottom-of-stack. If the configuration constant `OS_STK_GROWTH` is set to 1, the stack is assumed to grow downward (i.e., from high to low memory); thus, `pbos` must point to the lowest valid stack location. If `OS_STK_GROWTH` is set to 0, the stack is assumed to grow in the opposite direction (i.e., from low to high memory); thus, `pbos` must point to the highest valid stack location. `pbos` is used by the stack-checking function `OSTaskStkChk()`.
- **stk_size**: specifies the size of the task’s stack in number of elements. If `OS_STK` is set to `INT8U`, then `stk_size` corresponds to the number of bytes available on the stack. If `OS_STK` is set to `INT16U`, then `stk_size` contains the number of 16-bit entries available on the stack. Finally, if `OS_STK` is set to `INT32U`, then `stk_size` contains the number of 32-bit entries available on the stack.
- **pext**: is a pointer to a user-supplied memory location (typically a data structure) used as a TCB extension. For example, this user memory can hold the contents of floating-point registers during a context switch, the time each task takes to execute, the number of times the task is switched in, and so on.
- **opt**: contains task-specific options. The lower 8 bits are reserved by µC/OS-II, but you can use the upper 8 bits for application-specific options. Each option consists of one or more bits. The option is selected when the bit(s) is set. The current version of µC/OS-II supports the following options:
  
  - **OS_TASK_OPT_NONE**: specifies that there are no options.
  - **OS_TASK_OPT_STK_CHK**: specifies whether stack checking is allowed for the task.
  - **OS_TASK_OPT_STK_CLR**: specifies whether the stack needs to be cleared.
  - **OS_TASK_OPT_SAVE_FP**: specifies whether floating-point registers are saved. This option is only valid if your processor has floating-point hardware and the processor-specific code saves the floating-point registers.

Refer to `uCOS_II.H` for other options.
Returned Value

OSTaskCreateExt() returns one of the following error codes:

- **OS_ERR_NONE** if the function is successful.
- **OS_ERR_PRIO_EXIST** if the requested priority already exists.
- **OS_ERR_PRIO_INVALID** if \( \text{prio} \) is higher than \( \text{OS_LOWEST_PRIO} \).
- **OS_ERR_NO_MORE_TCB** if µC/OS-II doesn’t have any more OS_TCBs to assign.
- **OS_ERR_TASK_CREATE_ISR** if you attempted to create the task from an ISR.

Notes/Warnings

1. The stack must be declared with the \texttt{OS_STK} type.
2. A task must always invoke one of the services provided by µC/OS-II to wait for time to expire, suspend the task, or wait an event to occur (wait on a mailbox, queue, or semaphore). This allows other tasks to gain control of the CPU.
3. You should not use task priorities 0, 1, 2, 3, \( \text{OS_LOWEST_PRIO-3} \), \( \text{OS_LOWEST_PRIO-2} \), \( \text{OS_LOWEST_PRIO-1} \), and \( \text{OS_LOWEST_PRIO} \) because they are reserved for use by µC/OS-II.

Example 1

E1(1) The task control block is extended using a user-defined data structure called \texttt{OS_TASK_USER_DATA}, which in this case contains the name of the task as well as other fields.

E1(2) The task name is initialized with the standard library function \texttt{strcpy()}. 

E1(3) Also, assume here that the stack grows downward on the processor used (i.e., \texttt{OS_STK_GROWTH} is set to 1; \texttt{TOS} stands for top-of-stack and \texttt{BOS} stands for bottom-of-stack).
typedef struct { /* User defined data structure */
    char    OSTaskName[20];
    INT16U  OSTaskCtr;
    INT16U  OSTaskExecTime;
    INT32U  OSTaskTotExecTime;
} OS_TASK_USER_DATA;

OS_STK TaskStk[1024];
TASK_USER_DATA TaskUserData;

void main (void)
{
    INT8U err;

    OSInit(); /* Initialize µC/OS-II */

    strcpy(TaskUserData.TaskName, "MyTaskName"); /* Name of task */
    err = OSTaskCreateExt(Task,
        (void *)0,
        &TaskStk[1023], /* Stack grows down (TOS) */
        10,
        &TaskStk[0], /* Stack grows down (BOS) */
        1024,
        (void *)&TaskUserData, /* TCB Extension */
        OS_TASK_OPT_STK_CHK); /* Stack checking enabled */

    OSStart(); /* Start Multitasking */
}

void Task(void *p_arg)
{
    (void)p_arg; /* Avoid compiler warning */
    for (;;) {
        /* Task code */
    }
}

Example 2
E2(1) We now create a task, but this time on a processor for which the stack grows upward. The Intel MCS-51 is an example of such a processor. In this case, OS_STK_GROWTH is set to 0.
E2(2)  Note that stack checking has been enabled for this task so you are allowed to call OSTaskStkChk() (TOS stands for top-of-stack and BOS stands for bottom-of-stack).

```c
OS_STK *TaskStk[1024];

void main (void)
{
    INT8U err;

    OSInit(); /* Initialize µC/OS-II */

    err = OSTaskCreateExt(Task,
        (void *)0,
        &TaskStk[0], /* Stack grows up (TOS) */ (1)
        10,
        10,
        &TaskStk[1023], /* Stack grows up (BOS) */ (1)
        1024,
        (void *)0,
        OS_TASK_OPT_STK_CHK); /* Stack checking enabled */ (2)

    OSStart(); /* Start Multitasking */
}

void Task (void *p_arg)
{
    (void)p_arg; /* Avoid compiler warning */
    for (;;) {
        /* Task code */
    }
}
```
OSTaskDel() deletes a task by specifying the priority number of the task to delete. The calling task can be deleted by specifying its own priority number or OS_PRIO_SELF (if the task doesn’t know its own priority number). The deleted task is returned to the dormant state. The deleted task can be re-created by calling either OSTaskCreate() or OSTaskCreateExt() to make the task active again.

Arguments

prio is the priority number of the task to delete. You can delete the calling task by passing OS_PRIO_SELF, in which case the next highest priority task is executed.

Returned Value

OSTaskDel() returns one of the following error codes:

- OS_ERR_NONE if the task doesn’t delete itself.
- OS_ERR_TASK_IDLE if you try to delete the idle task, which is of course is not allowed.
- OS_ERR_TASK_DEL if the task to delete does not exist.
- OS_ERR_PRIO_INVALID if you specify a task priority higher than OS_LOWEST_PRIO.
- OS_ERR_TASK_DEL_ISR if you try to delete a task from an ISR.
- OS_ERR_TASK_DEL if the task is assigned to a Mutex.
- OS_ERR_TASK_NOT_EXIST if the task is assigned to a Mutex PIP.

Notes/Warnings

1. OSTaskDel() verifies that you are not attempting to delete the µC/OS-II idle task.
2. You must be careful when you delete a task that owns resources. Instead, consider using OSTaskDelReq() as a safer approach.
Example

void TaskX (void *p_arg)
{
    INT8U err;

    for (;;) {

        err = OSTaskDel(10); /* Delete task with priority 10 */
        if (err == OS_ERR_NONE) {
            /* Task was deleted */
        }
    }
}
OSTaskDelReq()

```
INT8U OSTaskDelReq(INT8U prio);
```

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OSTaskDelReq() requests that a task delete itself. Basically, use OSTaskDelReq() when you need to delete a task that can potentially own resources (e.g., the task might own a semaphore). In this case, you don’t want to delete the task until the resource is released. The requesting task calls OSTaskDelReq() to indicate that the task needs to be deleted. Deletion of the task is, however, deferred to the task being deleted. In other words, the task is actually deleted when it regains control of the CPU. For example, suppose Task 10 needs to be deleted. The task wanting to delete this task (example Task 5) calls OSTaskDelReq(10). When Task 10 executes, it calls OSTaskDelReq(OS_PRIO_SELF) and monitors the return value. If the return value is OS_ERR_TASK_DEL_REQ, then Task 10 is asked to delete itself. At this point, Task 10 calls OSTaskDel(OS_PRIO_SELF). Task 5 knows whether Task 10 has been deleted by calling OSTaskDelReq(10) and checking the return code. If the return code is OS_ERR_TASK_NOT_EXIST, then Task 5 knows that Task 10 has been deleted. Task 5 might have to check periodically until OS_ERR_TASK_NOT_EXIST is returned.

**Arguments**

prio is the task’s priority number of the task to delete. If you specify OS_PRIO_SELF, you are asking whether another task wants the current task to be deleted.

**Returned Value**

OSTaskDelReq() returns one of the following error codes:

- **OS_ERR_NONE** if the task deletion has been registered.
- **OS_ERR_TASK_NOT_EXIST** if the task does not exist. The requesting task can monitor this return code to see if the task is actually deleted.
- **OS_ERR_TASK_IDLE** if you ask to delete the idle task (which is obviously not allowed).
- **OS_ERR_PRIO_INVALID** if you specify a task priority higher than OS_LOWEST_PRIO or do not specify OS_PRIO_SELF.
- **OS_ERR_TASK_DEL** if the task is assigned to a Mutex.
- **OS_ERR_TASK_DEL_REQ** if a task (possibly another task) requests that the running task be deleted.

**Notes/Warnings**

1. OSTaskDelReq() verifies that you are not attempting to delete the μC/OS-II idle task.
Example

```c
void TaskThatDeletes (void *p_arg) /* My priority is 5 */
{
    INT8U err;

    for (; ;) {
        .
        .
        err = OSTaskDelReq(10); /* Request task #10 to delete itself */
        if (err == OS_ERR_NONE) {
            while (err != OS_ERR_TASK_NOT_EXIST) {
                err = OSTaskDelReq(10);
                OSTimeDly(1); /* Wait for task to be deleted */
            }
            /* Task #10 has been deleted */
        }
    }
}

void TaskToBeDeleted (void *p_arg) /* My priority is 10 */
{
    .
    .
    (void)p_arg;
    for (; ;) {
        OSTimeDly(1);
        if (OSTaskDelReq(OS_PRIO_SELF) == OS_ERR_TASK_DEL_REQ) {
            /* Release any owned resources; */
            /* De-allocate any dynamic memory; */
            OSTaskDel(OS_PRIO_SELF);
        }
    }
}
```
OSTaskNameGet()

INT8U OSTaskNameGet(INT8U prio,
                     INT8U *pname,
                     INT8U *perr);

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OSTaskNameGet() allows you to obtain the name that you assigned to a task. The name is an ASCII string and the size of the name can contain up to OS_TASK_NAME_SIZE characters (including the NUL termination). This function is typically used by a debugger to allow associating a name to a task.

Arguments

prio is the priority of the task from which you would like to obtain the name from. If you specify OS_PRIO_SELF, you would obtain the name of the current task.

pname is a pointer to an ASCII string that will receive the name of the task. The string must be able to hold at least OS_TASK_NAME_SIZE characters (including the NUL character).

perr a pointer to an error code and can be any of the following:

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<th>Description</th>
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<td>OS_ERR_NONE</td>
<td>If the name of the task was copied to the array pointed to by pname.</td>
</tr>
<tr>
<td>OS_ERR_TASK_NOT_EXIST</td>
<td>The task you specified was not created or has been deleted.</td>
</tr>
<tr>
<td>OS_ERR_PRIO_INVALID</td>
<td>If you specified an invalid priority - a priority higher than the idle task (OS_LOWEST_PRIO) or you didn't specify OS_PRIO_SELF.</td>
</tr>
<tr>
<td>OS_ERR_PNAME_NULL</td>
<td>If you passed a NULL pointer for pname.</td>
</tr>
<tr>
<td>OS_ERR_NAME_GET_ISR</td>
<td>You called this function from an ISR.</td>
</tr>
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</table>

Returned Values

The size of the ASCII string placed in the array pointed to by pname or 0 if an error is encountered.

Notes/Warnings

1. The task must be created before you can use this function and obtain the name of the task.
2. You must ensure that you have sufficient storage in the destination string to hold the name of the task.
Example

INT8U EngineTaskName[30];

void Task (void *p_arg)
{
    INT8U err;
    INT8U size;

    (void)p_arg;
    for (;;)
    {
        size = OSTaskNameGet(OS_PRIO_SELF, &EngineTaskName[0], &err);
        .
        .
    }
}

OSTaskNameSet()
void OSTaskNameSet(INT8U  prio,
                   INT8U *pname,
                   INT8U  *perr);

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</table>

OSTaskNameSet() allows you to assign a name to a task. The name is an ASCII string and the size of the name can contain up to OS_TASK_NAME_SIZE characters (including the NULL termination). This function is typically used by a debugger to allow associating a name to a task.

Arguments

- **prio** is the priority of the task that you want to name. If you specify OS_PRIO_SELF, you would set the name of the current task.
- **pname** is a pointer to an ASCII string that hold the name of the task. The string must be smaller than or equal to OS_TASK_NAME_SIZE characters (including the NULL character).
- **perr** a pointer to an error code and can be any of the following:
  - OS_ERR_NONE: If the name of the task was set.
  - OS_ERR_TASK_NOT_EXIST: The task you specified was not created or has been deleted.
  - OS_ERR_PRIO_INVALID: If you specified an invalid priority - a priority higher than the idle task (OS_LOWEST_PRIO) or you didn't specify OS_PRIO_SELF.
  - OS_ERR_TASK_NAME_TOO_LONG: If the name you are giving to the task exceeds the storage capacity of a task name as specified by OS_TASK_NAME_SIZE.
  - OS_ERR_PNAME_NULL: If you passed a NULL pointer for pname.
  - OS_ERR_NAME_SET_ISR: You called this function from an ISR.

Returned Values

None.

Notes/Warnings

1. The task must be created before you can use this function to set the name of the task.
Example

```c
void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        OSTaskNameSet(OS_PRIO_SELF, "Engine Task", &err);
        ...
    }
}
```
OSTaskResume() resumes a task suspended through the OSTaskSuspend() function. In fact, OSTaskResume() is the only function that can unsuspend a suspended task.

**Arguments**

- **prio** specifies the priority of the task to resume.

**Returned Value**

OSTaskResume() returns one of the these error codes:

- **OS_ERR_NONE** if the call is successful.
- **OS_ERR_TASK_RESUME_PRIO** if the task you are attempting to resume does not exist.
- **OS_ERR_TASK_NOT_SUSPENDED** if the task to resume has not been suspended.
- **OS_ERR_PRIO_INVALID** if prio is higher or equal to OS_LOWEST_PRIO.
- **OS_ERR_TASK_NOT_EXIST** if the task is assigned to a Mutex PIP.

**Notes/Warnings**

- none

**Example**

```c
void TaskX (void *p_arg)
{
    INT8U err;

    for (;;) {
        .
        .
        err = OSTaskResume(10);        /* Resume task with priority 10 */
        if (err == OS_ERR_NONE) {
            .
            .                       /* Task was resumed */
            .
        }
        .
        .
    }
}
```
OSTaskStkChk ()

INT8U OSTaskStkChk(INT8U prio, OS_STK_DATA *p_stk_data);

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OSTaskStkChk() determines a task’s stack statistics. Specifically, it computes the amount of free stack space, as well as the amount of stack space used by the specified task. This function requires that the task be created with OSTaskCreateExt() and that you specify OS_TASK_OPT_STK_CHK in the opt argument.

Stack sizing is done by walking from the bottom of the stack and counting the number of 0 entries on the stack until a nonzero value is found. Of course, this assumes that the stack is cleared when the task is created. For that purpose, you need to set OS_TASK_OPT_STK_CLR to 1 as an option when you create the task. You could set OS_TASK_OPT_STK_CLR to 0 if your startup code clears all RAM and you never delete your tasks. This reduces the execution time of OSTaskCreateExt().

Arguments

prio is the priority of the task about which you want to obtain stack information. You can check the stack of the calling task by passing OS_PRIO_SELF.

p_stk_data is a pointer to a variable of type OS_STK_DATA, which contains the following fields:

| INT32U OSFree;       |
| */ Number of bytes free on the stack */ |

| INT32U OSUsed;       |
| */ Number of bytes used on the stack */ |

Returned Value

OSTaskStkChk() returns one of these error codes:

- OS_ERR_NONE if you specify valid arguments and the call is successful.
- OS_ERR_PRIO_INVALID if you specify a task priority higher than OS_LOWEST_PRIO or you don’t specify OS_PRIO_SELF.
- OS_ERR_TASK_NOT_EXIST if the specified task does not exist.
- OS_ERR_TASK_OPT_ERR if you do not specify OS_TASK_OPT_STK_CHK when the task was created by OSTaskCreateExt() or if you create the task by using OSTaskCreate().
- OS_ERR_PDATA_NULL if p_stk_data is a NULL pointer.

Notes/Warnings

1. Execution time of this task depends on the size of the task’s stack and is thus nondeterministic.
2. Your application can determine the total task stack space (in number of bytes) by adding the two fields OSFree and OSUsed of the OS_STK_DATA data structure.
3. Technically, this function can be called by an ISR, but because of the possibly long execution time, it is not advisable.
void Task (void *p_arg)
{
    OS_STK_DATA stk_data;
    INT32U stk_size;

    (void)p_arg;
    for (;;) {
        ...
        ...
        err = OSTaskStkChk(10, &stk_data);
        if (err == OS_ERR_NONE) {
            stk_size = stk_data.OSFree + stk_data.OSUsed;
        } ...
    }
}
OSTaskSuspend() suspends (or blocks) execution of a task unconditionally. The calling task can be suspended by specifying its own priority number or OS_PRIO_SELF if the task doesn’t know its own priority number. In this case, another task needs to resume the suspended task. If the current task is suspended, rescheduling occurs, and µC/OS-II runs the next highest priority task ready to run. The only way to resume a suspended task is to call OSTaskResume().

Task suspension is additive, which means that if the task being suspended is delayed until \( n \) ticks expire, the task is resumed only when both the time expires and the suspension is removed. Also, if the suspended task is waiting for a semaphore and the semaphore is signaled, the task is removed from the semaphore-wait list (if it is the highest priority task waiting for the semaphore), but execution is not resumed until the suspension is removed.

Arguments

prio specifies the priority of the task to suspend. You can suspend the calling task by passing OS_PRIO_SELF, in which case, the next highest priority task is executed.

Returned Value

OSTaskSuspend() returns one of these error codes:

- OS_ERR_NONE if the call is successful.
- OS_ERR_TASK_SUSPEND_IDLE if you attempt to suspend the _C/OS-II idle task, which is not allowed.
- OS_ERR_PRIO_INVALID if you specify a priority higher than the maximum allowed (i.e., you specify a priority of OS_LOWEST_PRIO or more) or you don’t specify OS_PRIO_SELF.
- OS_ERR_TASK_SUSPEND_PRIO if the task you are attempting to suspend does not exist.
- OS_ERR_TASK_NOT_EXITS if the task is assigned to a Mutex PIP.

Notes/Warnings

1. OSTaskSuspend() and OSTaskResume() must be used in pairs.
2. A suspended task can only be resumed by OSTaskResume().
Example

```c
void TaskX (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        .
        .
        err = OSTaskSuspend(OS_PRIO_SELF); /* Suspend current task */
        .    /* Execution continues when ANOTHER task .. */
        .    /* .. explicitly resumes this task. */
        .
    }
}
```
OSTaskQuery()

INT8U OSTaskQuery(INT8U  prio,
                   OS_TCB *p_task_data);

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OSTaskQuery() obtains information about a task. Your application must allocate an OS_TCB data structure to receive a snapshot of the desired task’s control block. Your copy contains every field in the OS_TCB structure. You should be careful when accessing the contents of the OS_TCB structure, especially OSTCBNext and OSTCBPrev, because they point to the next and previous OS_TCBs in the chain of created tasks, respectively. You could use this function to provide a debugger kernel awareness.

**Arguments**

- **prio** is the priority of the task from which you wish to obtain data. You can obtain information about the calling task by specifying OS_PRIO_SELF.
- **p_task_data** is a pointer to a structure of type OS_TCB, which contains a copy of the task’s control block.

**Returned Value**

OSTaskQuery() returns one of these error codes:

- **OS_ERR_NONE** if the call is successful.
- **OS_ERR_PRIO_INVALID** if you specify a priority higher than OS_LOWEST_PRIO.
- **OS_ERR_PRIO** if you try to obtain information from an invalid task.
- **OS_ERR_TASK_NOT_EXIST** if the task is assigned to a Mutex PIP.
- **OS_ERR_PDATA_NULL** if p_task_data is a NULL pointer.

**Notes/Warnings**

1. The fields in the task control block depend on the following configuration options (see OS_CFG.H):
   - OS_TASK_CREATE_EN
   - OS_Q_EN
   - OS_FLAG_EN
   - OS_MBOX_EN
   - OS_SEM_EN
   - OS_TASK_DEL_EN
Example

```c
void Task (void *p_arg)
{
    OS_TCB   task_data;
    INT8U    err;
    void    *pext;
    INT8U    status;

    (void)p_arg;
    for (;;) {
        .
        .
        err = OSTaskQuery(OS_PRIO_SELF, &task_data);
        if (err == OS_ERR_NONE) {
            pext = task_data.OSTCBExtPtr; /* Get TCB extension pointer */
            status = task_data.OSTCBStat; /* Get task status */
            .
            .
        }
        .
    }
}
```
OSTimeDly() allows a task to delay itself for an integral number of clock ticks. Rescheduling always occurs when the number of clock ticks is greater than zero. Valid delays range from one to 65,535 ticks. A delay of 0 means that the task is not delayed, and OSTimeDly() returns immediately to the caller. The actual delay time depends on the tick rate (see OS_TICKS_PER_SEC in the configuration file OS_CFG.H).

**Arguments**

- **ticks** is the number of clock ticks to delay the current task.

**Returned Value**

none

**Notes/Warnings**

1. Note that calling this function with a value of 0 results in no delay, and the function returns immediately to the caller.

2. To ensure that a task delays for the specified number of ticks, you should consider using a delay value that is one tick higher. For example, to delay a task for at least 10 ticks, you should specify a value of 11.

**Example**

```c
void TaskX (void *p_arg)
{
    for (;;) {
        .
        .
        OSTimeDly(10);    /* Delay task for 10 clock ticks */
        .
        .
    }
}
```
OSTimeDlyHMSM() allows a task to delay itself for a user-specified amount of time specified in hours, minutes, seconds, and milliseconds. This format is more convenient and natural than ticks. Rescheduling always occurs when at least one of the parameters is nonzero.

**Arguments**

- **hours** is the number of hours the task is delayed. The valid range of values is 0 to 255.
- **minutes** is the number of minutes the task is delayed. The valid range of values is 0 to 59.
- **seconds** is the number of seconds the task is delayed. The valid range of values is 0 to 59.
- **ms** is the number of milliseconds the task is delayed. The valid range of values is 0 to 999. Note that the resolution of this argument is in multiples of the tick rate. For instance, if the tick rate is set to 100Hz, a delay of 4ms results in no delay. The delay is rounded to the nearest tick. Thus, a delay of 15ms actually results in a delay of 20ms.

**Returned Value**

OSTimeDlyHMSM() returns one of these error codes:

- **OS_ERR_NONE** if you specify valid arguments and the call is successful.
- **OS_ERR_TIME_INVALID_MINUTES** if the minutes argument is greater than 59.
- **OS_ERR_TIME_INVALID_SECONDS** if the seconds argument is greater than 59.
- **OS_ERR_TIME_INVALID_MS** if the milliseconds argument is greater than 999.
- **OS_ERR_TIME_ZERO_DLY** if all four arguments are 0.
- **OS_ERR_TIME_DLY_ISR** if you called this function from an ISR.

**Notes/Warnings**

1. Note that OSTimeDlyHMSM(0,0,0,0) (i.e., hours, minutes, seconds, milliseconds) results in no delay, and the function returns to the caller. Also, if the total delay time is longer than 65,535 clock ticks, you cannot abort the delay and resume the task by calling OSTimeDlyResume().
Example

```c
void TaskX (void *p_arg)
{
    for (;;) {
        
        OSTimeDlyHMSM(0, 0, 1, 0); /* Delay task for 1 second */
        
    }
}
```
OSTimeDlyResume()

INT8U OSTimeDlyResume(INT8U prio);

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OSTimeDlyResume() resumes a task that has been delayed through a call to either OSTimeDly() or OSTimeDlyHMSM().

**Arguments**

prio specifies the priority of the task to resume.

**Returned Value**

OSTimeDlyResume() returns one of these error codes:

- **OS_ERR_NONE** if the call is successful.
- **OS_ERR_PRIO_INVALID** if you specify a task priority greater than OS_LOWEST_PRIO.
- **OS_ERR_TIME_NOT_DLY** if the task is not waiting for time to expire.
- **OS_ERR_TASK_NOT_EXIST** if the task has not been created or has been assigned to a Mutex PIP.

**Notes/Warnings**

1. Note that you must not call this function to resume a task that is waiting for an event with timeout. This situation makes the task look like a timeout occurred (unless you desire this effect).

2. You cannot resume a task that has called OSTimeDlyHMSM() with a combined time that exceeds 65,535 clock ticks. In other words, if the clock tick runs at 100Hz, you cannot resume a delayed task that called OSTimeDlyHMSM(0, 10, 55, 350) or higher.

   \[(10 \text{ minutes} \times 60 + (55 + 0.35) \text{ seconds}) \times 100 \text{ ticks/second}\]

**Example**

```c
void TaskX (void *pdata)
{
    INT8U err;

    pdata = pdata;
    for (;;) {
        err = OSTimeDlyResume(10); /* Resume task with priority 10 */
        if (err == OS_ERR_NONE) {
            /* Task was resumed */
            
        }
    }
}
```
OSTimeGet()
INT32U OSTimeGet(void);

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OSTimeGet() obtains the current value of the system clock. The system clock is a 32-bit counter that counts the number of clock ticks since power was applied or since the system clock was last set.

**Arguments**

none

**Returned Value**

The current system clock value (in number of ticks).

**Notes/Warnings**

none

**Example**

```c
void TaskX (void *p_arg)
{
    INT32U clk;

    for (;;) {
        
        clk = OSTimeGet(); /* Get current value of system clock */
    }
}
```
OSTimeSet()

void OSTimeSet(INT32U ticks);

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OSTimeSet() sets the system clock. The system clock is a 32-bit counter that counts the number of clock ticks since power was applied or since the system clock was last set.

**Arguments**

ticks is the desired value for the system clock, in ticks.

**Returned Value**

none

**Notes/Warnings**

none

**Example**

```c
void TaskX (void *p_arg)
{
    for (;;)
    {
        .
        .
        .
        OSTimeSet((U32)0);    /* Reset the system clock */
        .
        .
    }
}
```
OSTimeTick()

void OSTimeTick(void);

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OSTimeTick() processes a clock tick. µC/OS-II checks all tasks to see if they are either waiting for time to expire [because they called OSTimeDly() or OSTimeDlyHMSM()] or waiting for events to occur until they timeout.

**Arguments**

none

**Returned Value**

none

**Notes/Warnings**

1. The execution time of OSTimeTick() is directly proportional to the number of tasks created in an application. OSTimeTick() can be called by either an ISR or a task. If called by a task, the task priority should be very high (i.e., have a low priority number) because this function is responsible for updating delays and timeouts.
Example
(Intel 80x86, real mode, large model)

```assembly
_OSTickISR PROC FAR
    PUSHAX ; Save processor context
    PUSH ES
    PUSH DS

    MOV AX, SEG(_OSIntNesting) ; Reload DS
    MOV DS, AX
    INC BYTE PTR DS:_OSIntNesting ; Notify μC/OS-II of ISR

    CMP BYTE PTR DS:_OSIntNesting, 1 ; if (OSIntNesting == 1)
    JNE SHORT _OSTickISR1

    MOV AX, SEG(_OSTCBCur) ; Reload DS
    MOV DS, AX
    LES BX, DWORD PTR DS:_OSTCBCur ; OSTCBCur->OSTCBStkPtr = SS:SP
    MOV ES:[BX+2], SS
    MOV ES:[BX+0], SP
    CALL FAR PTR _OSTimeTick ; Process clock tick

    CALL FAR PTR _OSIntExit ; Notify μC/OS-II of end of ISR

    POP DS ; Restore processor registers
    POP ES
    POPA

    IRET ; Return to interrupted task

_OSTickISR ENDP
```
OSTmrCreate()

OS_TMR *OSTmrCreate(INT32U dly,
        INT32U period,
        INT8U opt,
        OS_TMR_CALLBACK callback,
        void *callback_arg,
        INT8U *pname,
        INT8U *perr);

OSTmrCreate() allows you to create a timer. The timer can be configured to run continuously (opt set to OS_TMR_OPT_PERIODIC) or only once (opt set to OS_TMR_OPT_ONE_SHOT). When the timer counts down to 0 (from the value specified in period), an optional 'callback' function can be executed. The callback can be used to signal a task that the timer expired or, perform any other function. However, it's recommended that you keep the callback function as short as possible.

You MUST call OSTmrStart() to actually start the timer. If you configured the timer for one shot mode and the timer expired, you need to call OSTmrStart() to retrigger the timer or OSTmrDel() to delete the timer if you don’t plan on retriggering it and or not use the timer anymore. Note that you can use the callback function to delete the timer if you use the one shot mode.

Arguments

dly specifies an initial delay used by the timer (see drawing below).

In ONE-SHOT mode, this is the time of the one-shot.

If in PERIODIC mode, this is the initial delay before the timer enters periodic mode.

The units of this time depends on how often you call OSTmrSignal(). In other words, if OSTmrSignal() is called every 1/10 of a second (i.e. OS_TMR_CFG_TICKS_PER_SEC set to 10) then, dly specifies the number of 1/10 of a second before the delay expires. Note that the timer is NOT started when it is created.

period specifies the amount of time it will take before the timer expires. You should set the 'period' to 0 when you use one-shot mode. The units of this time depends on how often you call OSTmrSignal(). In other words, if OSTmrSignal() is called every 1/10 of a second (i.e. OS_TMR_CFG_TICKS_PER_SEC set to 10) then, period specifies the number of 1/10 of a second before the timer times out.

opt OS_TMR_OPT_PERIODIC:
specifies whether you want to timer to automatically reload itself.

OS_TMR_OPT_ONE_SHOT:
specifies to stop the timer when it times out.

Note that you MUST select one of these two options.
callback specifies the address of a function (optional) that you want to execute when the timer expires or, is terminated before it expires (i.e. by calling OSTmrStop()). The callback function must be declared as follows:

```c
void MyCallback (void *ptmr, void *callback_arg);
```

When the timer expires, this function will be called and passed the timer ‘handle’ of the expiring timer as well as the argument specified by callback_arg.

You should note that you don’t have to specify a callback and, in this case, simply pass a NULL pointer.

callback_arg Is the argument passed to the callback function when the timer expires or is terminated. callback_arg can be a NULL pointer if the callback function doesn’t require arguments.

pname Is a pointer to an ASCII string that allows you to give a name to your timer. You can retrieve this name by calling OSTmrNameGet().

perr a pointer to an error code and can be any of the following:

- **OS_ERR_NONE** If the name of the task was copied to the array pointed to by pname.
- **OS_ERR_TMR_INVALID_DLY** You specified a delay of 0 when in ONE SHOT mode.
- **OS_ERR_TMR_INVALID_PERIOD** You specified a period of 0 when in PERIODIC mode.
- **OS_ERR_TMR_INVALID_OPT** If you did not specify either OS_TMR_OPT_PERIODIC or OS_TMR_OPT_ONE_SHOT.
- **OS_ERR_TMR_ISR** If you called this function from an ISR, which you are not allowed to do.
- **OS_ERR_TMR_NON_AVAIL** You get this error when you cannot start a timer because all timer elements (i.e. objects) have already been allocated.
- **OS_ERR_TMR_NAME_TOO_LONG** The name you are giving to the timer is too long and must be less than OS_TMR_CFG_NAME_SIZE.
PERIODIC MODE (see ‘opt’) – dly > 0

PERIODIC MODE (see ‘opt’) – dly == 0

ONE-SHOT MODE (see ‘opt’) – dly MUST be non-zero
Returned Values

A pointer to an OS_TMR object that you MUST use to reference the timer that you just created. A NULL pointer is returned if the timer was not created because of errors (see returned error codes).

Notes/Warnings

1. You should examine the return value to make sure what you get from this function is valid.
2. You MUST NOT call this function from an ISR.
3. Note that the timer is NOT started when it is created. To start the timer, you MUST call OSTmrStart().

Example

```c
OS_TMR  *CloseDoorTmr;

void Task (void *p_arg)
{
    INT8U     err;

    (void)p_arg;
    for (; ;) {
        CloseDoorTmr = OSTmrCreate( 10,
                                    100,
                                    OS_TMR_OPT_PERIODIC,
                                    DoorCloseFnct,
                                    (void *)0,
                                    "Door Close",
                                    &err);

        if (err == OS_ERR_NONE) {
            /* Timer was created but NOT started */
        }
    }
}
```
OSTmrDel() allows you to delete a timer. If a timer was running, it will be stopped and then deleted. If the timer has already timed out and is thus stopped, it will simply be deleted.

It is up to you to delete unused timers. If you delete a timer you MUST NOT reference it anymore.

**Arguments**

- **ptmr** is a pointer to the timer that you want to delete. This pointer is returned to you when the timer is created (see OSTmrCreate()).

- **perr** is a pointer to an error code and can be any of the following:
  - **OS_ERR_NONE** If the function returned the time remaining for the timer.
  - **OS_ERR_TMR_INVALID** If you passed a NULL pointer for the `ptmr` argument.
  - **OS_ERR_TMR_INVALID_TYPE** 'ptmr' is not pointing to a timer.
  - **OS_ERR_TMR_ISR** You called this function from an ISR which is NOT allowed.
  - **OS_ERR_TMR_INACTIVE** `ptmr` is pointing to an inactive timer. In other words, you would get this error if you are pointing to a timer that has been deleted or was not created.

**Returned Values**

A pointer to an `OS_TMR` object that you MUST use to reference the timer that you just started. A NULL pointer is returned if the timer was not started because of errors (see returned error codes).

**Notes/Warnings**

1. You should examine the return value to make sure what you get from this function is valid.
2. You MUST NOT call this function from an ISR.
3. If you delete a timer you MUST NOT reference it anymore.
Example

OS_TMR *CloseDoorTmr;

void Task (void *p_arg)
{
    INT8U     err;

    (void)p_arg;
    for (; ;) {
        CloseDoorTmr = OSTmrDel(CloseDoorTmr, &err);
        if (err == OS_ERR_NONE) {
            /* Timer was deleted ... DO NOT reference it anymore! */
        }
    }
}
OSTmrNameGet()

```c
void OSTmrNameGet(OS_TMR *ptmr,
                  INT8U *pdest,
                  INT8U *perr);
```

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OSTmrNameGet() allows you to retrieve the name associated with the specified timer. OSTmrNameGet() places the name of the timer in an array of characters which must be as big as OS_TMR_CFG_NAME_SIZE (see OS_CFG.H).

**Arguments**

- **ptmr** is a pointer to the timer that you are inquiring about. This pointer is returned to you when the timer is created (see OSTmrCreate()).

- **pdest** is a pointer to where you would like the name of the timer to be copied to. You **MUST** ensure that your destination string holds sufficient storage to hold as much as OS_CFG_TMR_NAME_SIZE characters (see OS_CFG.H).

- **perr** a pointer to an error code and can be any of the following:
  - **OS_ERR_NONE** If the name of the task was copied to the array pointed to by `pname`.
  - **OS_ERR_TMR_INVALID_DEST** You specified a `NULL` pointer for `pdest`.
  - **OS_ERR_TMR_INVALID** If you passed a `NULL` pointer for the `ptmr` argument.
  - **OS_ERR_TMR_INVALID_TYPE** 'ptmr' is not pointing to a timer.
  - **OS_ERR_NAME_GET_ISR** You called this function from an ISR which is **NOT** allowed.
  - **OS_ERR_TMR_INACTIVE** `ptmr` is pointing to an inactive timer. In other words, you would get this error if you are pointing to a timer that has been deleted or was not created.

**Returned Values**

The length of the timer name (in number of characters).

**Notes/Warnings**

1. You **MUST** ensure that your destination string holds sufficient storage to hold as much as OS_CFG_TMR_NAME_SIZE characters (see OS_CFG.H).
2. You should examine the return value of this function.
3. You **MUST NOT** call this function from an ISR.
Example

```c
INT8U    CloseDoorTmrName[80];
OS_TMR   *CloseDoorTmr;

void Task (void *p_arg)
{
    INT8U     err;

    (void)p_arg;
    for (;;) {
        OSTmrNameGet(CloseDoorTmr, &CloseDoorTmrName[0], &err);
        if (err == OS_ERR_NONE) {
            /* CloseDoorTmrName[] holds the name of the timer */
        }
    }
}
```
OSTmrRemainGet()
INT32U OSTmrRemainGet(OS_TMR *ptmr,
INT8U  *perr);

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OSTmrRemainGet() allows you to obtain the time remaining (before it times out) of the specified timer. The value returned depends on the rate (in Hz) at which the timer task is signaled (see OS_TMR_CFG_TICKS_PER_SEC in OS_CFG.H). In other words, if OS_TMR_CFG_TICKS_PER_SEC is set to 10 then the value returned is the number of 1/10 of a second before the timer times out. If the timer has timed out, the value returned will be 0.

**Arguments**

*ptmr* is a pointer to the timer that you are inquiring about. This pointer is returned to you when the timer is created (see OSTmrCreate()).

*perr* a pointer to an error code and can be any of the following:

- OS_ERR_NONE: If the function returned the time remaining for the timer.
- OS_ERR_TMR_INVALID: If you passed a NULL pointer for the *ptmr* argument.
- OS_ERR_TMR_INVALID_TYPE: ‘*ptmr*’ is not pointing to a timer.
- OS_ERR_TMR_ISR: You called this function from an ISR which is NOT allowed.
- OS_ERR_TMR_INACTIVE: *ptmr* is pointing to an inactive timer. In other words, you would get this error if you are pointing to a timer that has been deleted or was not created.

**Returned Values**

The time remaining for the timer. The value returned depends on the rate (in Hz) at which the timer task is signaled (see OS_TMR_CFG_TICKS_PER_SEC in OS_CFG.H). In other words, if OS_TMR_CFG_TICKS_PER_SEC is set to 10 then the value returned is the number of 1/10 of a second before the timer times out. If you specified an invalid timer, the returned value will be 0. If the timer has already expired then the returned value will be 0.

**Notes/Warnings**

1. You should examine the return value to make sure what you get from this function is valid.
2. You MUST NOT call this function from an ISR.
Example

```c
INT32U   TimeRemainToCloseDoor;
OS_TMR *CloseDoorTmr;

void Task (void *p_arg)
{
    INT8U     err;

    (void)p_arg;
    for (; ;) {
        TimeRemainToCloseDoor = OSTmrRemainGet(CloseDoorTmr, &err);
        if (err == OS_ERR_NONE) {
            /* Call was successful */
        }
    }
}
```
OSTmrSignal()

void OSTmrSignal(void);

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OSTmrSignal() is called either by a task or an ISR to indicate that it’s time to update the timers. Typically, OSTmrSignal() would be called by OSTimeTickHook() at a multiple of the tick rate. In other words, if OS_TICKS_PER_SEC is set to 1000 in OS_CFG.H then you should call OSTmrSignal() every 10th or 100th tick interrupt (100 Hz or 10 Hz, respectively). You should typically call OSTmrSignal() every 1/10 of a second. The higher the timer rate, of course, the more overhead timer management will impede your system. Generally, we recommend 10 Hz (1/10 of a second).

You ‘could’ call OSTmrSignal() from the μC/OS-II tick ISR hook function (see example below). If the tick rate occurs at 1000 Hz then you can simply call OSTmrSignal() every 100th tick. Of course, you would have to implement a simple counter to do this.

Arguments
None.

Returned Values
OSTmrSignal() uses semaphores to implement the signaling mechanism. Because of that, OSTmrSignal() can return one of the following errors. However, it’s very unlikely you will get anything else but OS_ERR_NONE.

- **OS_ERR_NONE**
  - The call was successful and the timer task was signaled.
- **OS_ERR_SEM_OVF**
  - If OSTmrSignal() was called more often than OSTmr_Task() can handle the timers. This would indicate that your system is heavily loaded.
- **OS_ERR_EVENT_TYPE**
  - Unlikely you would get this error because the semaphore used for signaling is created by μC/OS-II.
- **OS_ERR_PEVENT_NULL**
  - Again, unlikely you would ever get this error because the semaphore used for signaling is created by μC/OS-II.
Notes/Warnings
None.

Example

```c
#if OS_TMR_EN > 0
static  INT16U  OSTmrTickCtr = 0;
#endif

void OSTimeTickHook (void)
{
#if OS_TMR_EN > 0
    OSTmrTickCtr++;
    if (OSTmrTickCtr >= (OS_TICKS_PER_SEC / OS_TMR_CFG_TICKS_PER_SEC)) {
        OSTmrTickCtr = 0;
        OSTmrSignal();
    }
#endif
}
```
OSTmrStart()

BOOLEAN OSTmrStart(OS_TMR *ptmr,
INT8U  *perr);

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OSTmrStart() allows you to start (or restart) the countdown process of a timer. The timer to start MUST have previously been created.

Arguments

- **ptmr** is a pointer to the timer that you want to start (or restart). This pointer is returned to you when the timer is created (see OSTmrCreate()).

- **perr** a pointer to an error code and can be any of the following:
  - **OS_ERR_NONE** If the timer was started.
  - **OS_ERR_TMR_INVALID** If you passed a NULL pointer for the *ptmr* argument.
  - **OS_ERR_TMR_INVALID_TYPE** ‘*ptmr’ is not pointing to a timer.
  - **OS_ERR_TMR_ISR** You called this function from an ISR which is NOT allowed.
  - **OS_ERR_TMR_INACTIVE** *ptmr* is pointing to an inactive timer. In other words, you would get this error if you are pointing to a timer that has been deleted or was not created.

Returned Values

- **OS_TRUE** if the timer was started
- **OS_FALSE** if an error occurred.

Notes/Warnings

1. You should examine the return value to make sure what you get from this function is valid.
2. You **MUST NOT** call this function from an ISR.
3. The timer to start **MUST** have previously been created.
Example

OS_TMR *CloseDoorTmr;
BOOLEAN status;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        status = OSTmrStart(CloseDoorTmr,
            &err);
        if (err == OS_ERR_NONE) {
            /* Timer was started */
        }
    }
}
OSTmrStateGet()

INT8U OSTmrStateGet(OS_TMR *ptmr,
                     INT8U *perr);

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**OSTmrStateGet()** allows you to obtain the current state of a timer. A timer can be in one of 4 states:

- **OS_TMR_STATE_UNUSED**: The timer has not been created.
- **OS_TMR_STATE_STOPPED**: The timer has been created but has not been started or has been stopped.
- **OS_TMR_STATE_COMPLETED**: The timer is in ONE-SHOT mode and has completed its delay.
- **OS_TMR_STATE_RUNNING**: The timer is currently running.

### Arguments

- **ptmr**: is a pointer to the timer that you are inquiring about. This pointer is returned to you when the timer is created (see **OSTmrCreate()**).

- **perr**: a pointer to an error code and can be any of the following:
  - **OS_ERR_NONE**: If the function returned the time remaining for the timer.
  - **OS_ERR_TMR_INVALID**: If you passed a NULL pointer for the **ptmr** argument.
  - **OS_ERR_TMR_INVALID_TYPE**: ‘ptmr’ is not pointing to a timer.
  - **OS_ERR_TMR_ISR**: You called this function from an ISR which is NOT allowed.
  - **OS_ERR_TMR_INACTIVE**: **ptmr** is pointing to an inactive timer. In other words, you would get this error if you are pointing to a timer that has been deleted or was not created.

### Returned Values

The state of the timer (see description).

### Notes/Warnings

1. You should examine the return value to make sure what you get from this function is valid.
2. You **MUST NOT** call this function from an ISR.
Example

```c
INT8U CloseDoorTmrState;
OS_TMR *CloseDoorTmr;

void Task (void *p_arg)
{
    INT8U err;

    (void)p_arg;
    for (;;) {
        CloseDoorTmrState = OSTmrStateGet(CloseDoorTmr, &err);
        if (err == OS_ERR_NONE) {
            /* Call was successful */
        }
    }
}
```
OSTmrStop()

```c
BOOLEAN OSTmrStop(OS_TMR *ptmr,
                  INT8U    opt,
                  void   *callback_arg,
                  INT8U   *perr);
```

OSTmrStop() allows you to stop (i.e. abort) a timer. You can execute the callback function of the timer when it’s stopped and pass this callback function a different argument than what was specified when the timer was started. This allows your callback function to know that the timer was stopped because the callback argument can be made to indicate this (this, of course, is application specific). If the timer is already stopped, the callback function is not called.

**Arguments**

- **ptmr**  
  Is a pointer to the timer you want to stop. This ‘handle’ was returned to your application when you called OSTmrStart() and uniquely identifies the timer.

- **opt**  
  Specifies whether you want the timer to:
  1) **OS_TMR_OPT_NONE**:
     Do NOT call the callback function.
  2) **OS_TMR_OPT_CALLBACK**:
     Call the callback function and pass it the callback argument specified when you started the timer (see OSTmrCreate()).
  3) **OS_TMR_OPT_CALLBACK_ARG**:
     Call the callback function BUT pass it the callback argument specified in the OSTmrStop() function INSTEAD of the one defined in OSTmrCreate().

- **callback_arg**  
  If you set opt to **OS_TMR_OPT_CALLBACK_ARG** then this is the argument passed to the callback function when it’s executed.

- **perr**  
  A pointer to an error code and can be any of the following:
  - **OS_ERR_NONE**  
    If the timer was started.
  - **OS_ERR_TMR_INVALID**  
    If you passed a NULL pointer for the ptmr argument.
  - **OS_ERR_TMR_INVALID_TYPE**  
    ‘ptmr’ is not pointing to a timer.
  - **OS_ERR_TMR_ISR**  
    You called this function from an ISR which is NOT allowed.
  - **OS_ERR_TMR_INVALID_OPT**  
    You specified an invalid option for ‘opt’.
  - **OS_ERR_TMR_STOPPED**  
    The timer was already stopped. However, this is NOT considered an actual error since it’s OK to attempt to stop a timer that is already stopped.
  - **OS_ERR_TMR_INACTIVE**  
    ptmr is pointing to an inactive timer. In other words, you would get this error if you are pointing to a timer that has been deleted or was not created.
OS_ERR_TMR_NO_CALLBACK  If you wanted the callback to be called but no callback has been specified for this timer.

Returned Values
OS_TRUE     if the timer was stopped (even if it was already stopped).
OS_FALSE    if an error occurred.

Notes/Warnings
1. You should examine the return value to make sure what you get from this function is valid.
2. You MUST NOT call this function from an ISR.
3. The callback function is NOT called if the timer is already stopped.

Example

```c
OS_TMR  *CloseDoorTmr;

void Task (void *p_arg)
{
    INT8U     err;

    (void)p_arg;
    for (;;) {
        OSTmrStop(CloseDoorTmr,
            OS_TMR_OPT_CALLBACK,
            (void *)0,
            &err);
        if (err == OS_ERR_NONE || err == OS_ERR_TMR_STOPPED) {
            /* Timer was stopped ... */
            /* ... callback was called only if timer was running */
        }
    }
}
```
**OSVersion()**

```c
INT16U OSVersion(void);
```

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OSVersion() obtains the current version of µC/OS-II.

**Arguments**

none

**Returned Value**

The version is returned as \(x.y\) multiplied by 100. For example, v2.85 is returned as 285.

**Notes/Warnings**

none

**Example**

```c
void TaskX (void *p_arg)
{
    INT16U os_version;

    for (;;) {
        
        os_version = OSVersion(); /* Obtain µC/OS-II’s version */
    }
}
```