AN738

PIC18C CAN Routines in 'C'

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INTRODUCTION

The Microchip PIC18C family of microcontrollers provides an integrated Controller Area Network (CAN) solution, along with other PICmicro® features. Although originally intended for the automotive industry, CAN is finding its way into other control applications. Because of the wide applicability of the CAN protocol, there exists a need to develop a software library that hides the intricate details of CAN registers and allows developers to focus on application logic. This application note provides such functions.

For details about the PIC18C family of microcontrollers, refer to the PIC18CXX8 Data Sheet (DS30475) and the PICmicro® 18C MCU Family Reference Manual (DS39500).

OVERVIEW OF THE PIC18C CAN MODULE

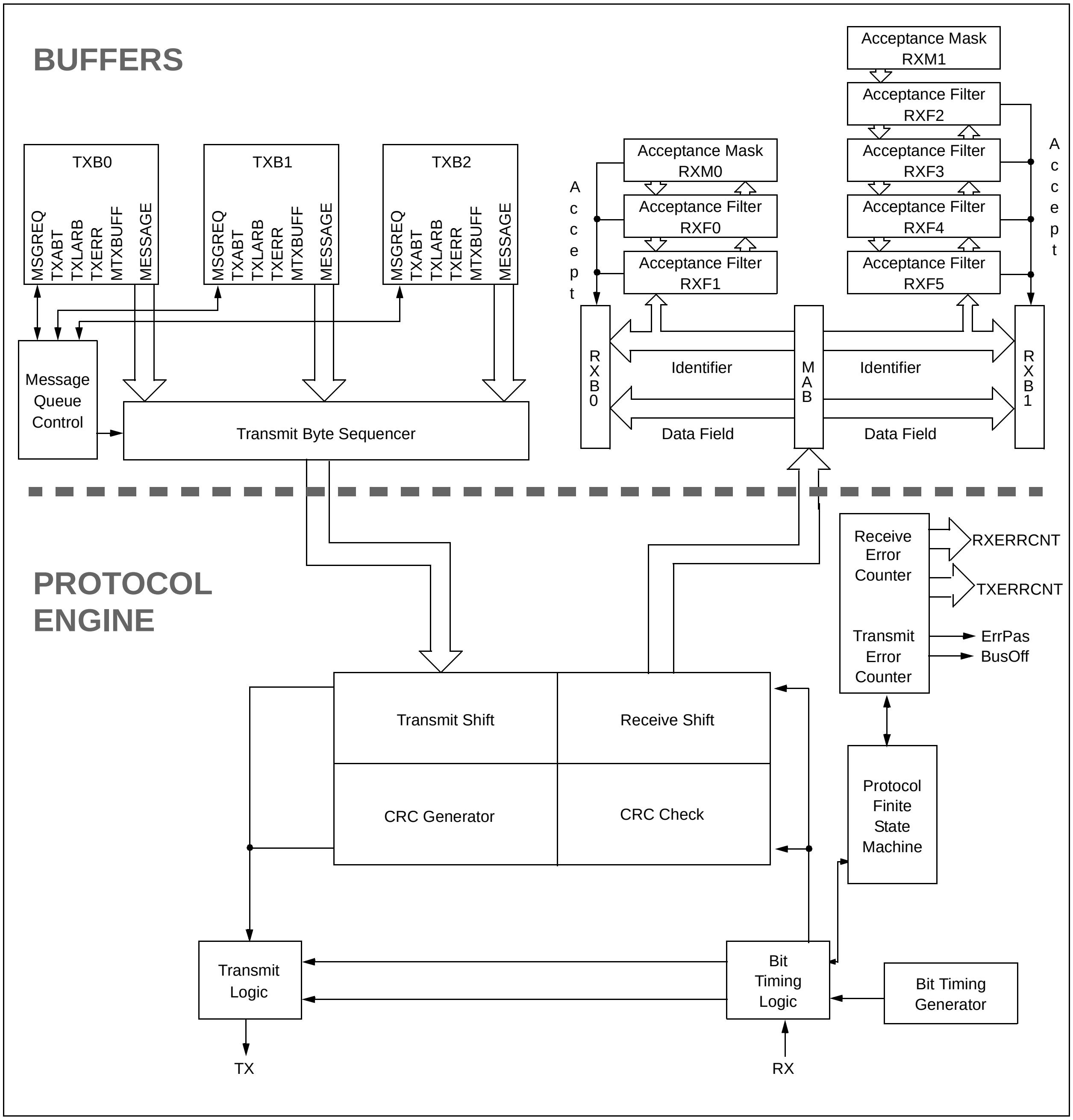
The PIC18C family of microcontrollers contains a CAN module that provides the same register and functional interface for all PIC18C microcontrollers.

The module features are:

- Implementation of the CAN protocols CAN 1.2, CAN 2.0A, and CAN 2.0B
- Standard and extended data frames
- Data length of 0 - 8 bytes
- Programmable bit rate up to 1 Mbit/s
- Support for remote frame
- Double buffered receiver with two prioritized received message storage buffers
- Six full (Standard/Extended Identifier) acceptance filters, two associated with the high priority receive buffer and four associated with the low priority receive buffer
- Two full acceptance filter masks, one each associated with the high and low priority receive buffers
- Three transmit buffers with application specified prioritization and abort capability
- Programmable wake-up functionality with integrated low-pass filter
- Programmable Loopback mode and programmable state clocking supports self-test operation
- Signaling via interrupt capabilities for all CAN receiver and transmitter error states
- Programmable clock source
- Programmable link to timer module for time-stamping and network synchronization
- Low power SLEEP mode

Figure 1 shows a block diagram of the CAN module buffers and protocol engine.

FIGURE 1: CAN BUFFERS AND PROTOCOL ENGINE BLOCK DIAGRAM



PIC18C CAN FUNCTIONS

All of the PIC18C CAN functions can be grouped into the following three categories:

- Configuration/Initialization Functions
- Operation Functions
- Status Check Functions

The functions in each category are described in the following sections.

TABLE 1: FUNCTION INDEX

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CONFIGURATION/INITIALIZATION FUNCTIONS:

CANInitialize

This function initializes the PIC18C CAN module with given parameters.

Syntax

```
 void CANInitialize( BYTE SJW,
                     BYTE BRP,
                     BYTE PHSEG1,
                     BYTE PHSEG2,
                     BYTE PROPSEG,
                     enum CAN_CONFIG_FLAGS config);
```

Parameters

SJW

[in] SJW value as defined in PIC18CXX8 data sheet (must be between 1 through 4).

BRP

[in] BRP value as defined in PIC18CXX8 data sheet (must be between 1 through 64).

PHSEG1

[in] PHSEG1 value as defined in PIC18CXX8 data sheet (must be between 1 through 8).

PHSEG2

[in] PHSEG2 value as defined in PIC18CXX8 data sheet (must be between 1 through 8).

PROPSEG

[in] PROPSEG value as defined in PIC18CXX8 data sheet (must be between 1 through 8).

config

[in] Specifies an enumerated value of the type CAN_CONFIG_FLAGS. This parameter can be any combination (AND'd together) of the following values:

Value	Meaning
CAN_CONFIG_DEFAULT	Specifies default flags
CAN_CONFIG_PHSEG2_PRG_ON	Specifies to use supplied PHSEG2 value
CAN_CONFIG_PHSEG2_PRG_OFF	Specifies to use maximum of PHSEG1 or Information Processing Time (IPT), whichever is greater
CAN_CONFIG_LINE_FILTER_ON	Specifies to use CAN bus line filter for wake-up
CAN_CONFIG_LINE_FILTER_OFF	Specifies to not use CAN bus line filter for wake-up
CAN_CONFIG_SAMPLE_ONCE	Specifies to sample bus once at the sample point
CAN_CONFIG_SAMPLE_THRICE	Specifies to sample bus three times prior to the sample point
CAN_CONFIG_ALL_MSG	Specifies to accept all messages including invalid ones
CAN_CONFIG_VALID_XTD_MSG	Specifies to accept only valid Extended Identifier messages
CAN_CONFIG_VALID_STD_MSG	Specifies to accept only valid Standard Identifier messages
CAN_CONFIG_ALL_VALID_MSG	Specifies to accept all valid messages
CAN_CONFIG_DBL_BUFFER_ON	Specifies to hardware double buffer Receive Buffer 1
CAN_CONFIG_DBL_BUFFER_OFF	Specifies to not hardware double buffer Receive Buffer 1

Return Values

None.

Pre-condition

None.

Side Effects

All pending CAN messages are aborted.

Remarks

This function does not allow the calling function to specify receive buffer mask and filter values. All mask registers are set to 0x00, which essentially disables the message filter mechanism. If the application requires message filter operation, it must perform initialization in discrete steps as shown in Example 1.

EXAMPLE 1: INITIALIZE CAN MODULE

```
// Initialize CAN module with no message filtering
CANInitialize(SJW, BRP, PHSEG1, PHSEG2, PROPSEG, config)

// Set CAN module into configuration mode
CANSetOperationMode(CAN_OP_MODE_CONFIG);

// Set Buffer 1 Mask value
CANSetMask(CAN_MASK_B1, MaskForBuffer1);

// Set Buffer 2 Mask value
CANSetMask(CAN_MASK_B2, MaskForBuffer2);

// Set Buffer 1 Filter values
CANSetFilter(CAN_FILTER_B1_F1, Filter1ForBuffer1, Buffer1MessageType);
CANSetFilter(CAN_FILTER_B1_F2, Filter2ForBuffer1, Buffer1MessageType);
CANSetFilter(CAN_FILTER_B2_F1, Filter1ForBuffer2, Buffer2MessageType);
CANSetFilter(CAN_FILTER_B2_F2, Filter2ForBuffer2, Buffer2MessageType);
CANSetFilter(CAN_FILTER_B2_F3, Filter3ForBuffer2, Buffer2MessageType);
CANSetFilter(CAN_FILTER_B2_F4, Filter4ForBuffer2, Buffer2MessageType);

// Set CAN module into Normal mode
CANSetOperationMode(CAN_OP_MODE_NORMAL);
```

EXAMPLE 2: USAGE OF CANInitialize

```
// Initialize at 125kbps at 20 MHz, all valid Extended messages
CANInitialize(1, 5, 7, 6, 2, CAN_CONFIG_VALID_XTD_MSG);
```

CANSetOperationMode

This function changes the PIC18C CAN module operation mode.

Syntax

```
void CANSetOperationMode(enum CAN_OP_MODE mode);
```

Parameters

mode

[in] Specifies an enumerated value of the type CAN_OP_MODE. The only permitted values are:

Value	Meaning
CAN_OP_MODE_NORMAL	Specifies Normal mode of operation
CAN_OP_MODE_SLEEP	Specifies SLEEP mode of operation
CAN_OP_MODE_LOOP	Specifies Loopback mode of operation
CAN_OP_MODE_LISTEN	Specifies Listen Only mode of operation
CAN_OP_MODE_CONFIG	Specifies Configuration mode of operation

Return Values

None.

Pre-condition

None.

Side Effects

If CAN_OP_MODE_CONFIG is requested, all pending messages will be aborted.

Remarks

This is a blocking function. It waits for a given mode to be accepted by the CAN module and then returns the control. If a non-blocking call is required, see the `CANSetOperationModeNoWait` function.

EXAMPLE 3: USAGE OF CANSetOperationMode

```
CANSetOperationMode(CAN_OP_MODE_CONFIG);
// Module IS in CAN_OP_MODE_CONFIG mode.
```

CANSetOperationModeNoWait

This function changes the PIC18C CAN module operation mode.

Syntax

```
void CANSetOperationModeNoWait(enum CAN_OP_MODE mode);
```

Parameters

mode

[in] Specifies an enumerated value of the type CAN_OP_MODE. The only permitted values are:

Value	Meaning
CAN_OP_MODE_NORMAL	Specifies Normal mode of operation
CAN_OP_MODE_SLEEP	Specifies SLEEP mode of operation
CAN_OP_MODE_LOOP	Specifies Loopback mode of operation
CAN_OP_MODE_LISTEN	Specifies Listen Only mode of operation
CAN_OP_MODE_CONFIG	Specifies Configuration mode of operation

Return Values

None.

Pre-condition

None.

Side Effects

If CAN_OP_MODE_CONFIG is requested, all pending messages will be aborted.

Remarks

This is a non-blocking function. It requests given mode of operation and immediately returns the control. Caller must ensure desired mode of operation is set before performing any mode specific operation. If a blocking call is required, see the `CANSetOperationMode` function.

EXAMPLE 4: USAGE OF CANSetOperationModeNoWait

```
CANSetOperationModeNoWait(CAN_OP_MODE_CONFIG);

while(CANGetOperationMode()!= CAN_OP_MODE_CONFIG)
{
   // Do something while module switches mode
}
```

CANSetBaudRate

This function programs the PIC18C CAN module for given bit rate values.

Syntax

```
void CANSetBaudRate(BYTE SJW,
                    BYTE BRP,
                    BYTE PHSEG1,
                    BYTE PHSEG2,
                    BYTE PROPSEG,
                    enum CAN_CONFIG_FLAGS config);
```

Parameters

SJW

[in] SJW value as defined in PIC18CXX8 data sheet (must be between 1 through 4).

BRP

[in] BRP value as defined in PIC18CXX8 data sheet (must be between 1 through 64).

PHSEG1

[in] PHSEG1 value as defined in PIC18CXX8 data sheet (must be between 1 through 8).

PHSEG2

[in] PHSEG2 value as defined in PIC18CXX8 data sheet (must be between 1 through 8).

PROPSEG

[in] PROPSEG value as defined in PIC18CXX8 data sheet (must be between 1 through 8).

config

[in] Specifies an enumerated value of the type CAN_CONFIG_FLAGS. This parameter can be any combination (AND'd together) of the following values:

Value	Meaning
CAN_CONFIG_DEFAULT	Specifies default flags
CAN_CONFIG_PHSEG2_PRG_ON	Specifies to use supplied PHSEG2 value
CAN_CONFIG_PHSEG2_PRG_OFF	Specifies to use maximum of PHSEG1 or Information Processing Time (IPT), whichever is greater
CAN_CONFIG_LINE_FILTER_ON	Specifies to use CAN bus line filter for wake-up
CAN_CONFIG_LINE_FILTER_OFF	Specifies to not use CAN bus line filter for wake-up
CAN_CONFIG_SAMPLE_ONCE	Specifies to sample bus once at the sample point
CAN_CONFIG_SAMPLE_THRICE	Specifies to sample bus three times prior to the sample point

Return Values

None.

Pre-condition

PIC18C CAN module must be in the Configuration mode or else given values will be ignored.

Side Effects

None.

Remarks

None.

EXAMPLE 5: USAGE OF CANSetBaudRate

```
CANSetOperationMode(CAN_OP_MODE_CONFIG);

// Set 125kbps at 20MHz oscillator frequency
CANSetBaudRate(1, 5, 7, 6, 2,
          CAN_CONFIG_SAMPLE_ONCE &
          CAN_CONFIG_PHSEG2_PRG_OFF &
          CAN_CONFIG_LINE_FILTER_ON);

CANSetOperationMode(CAN_OP_MODE_NORMAL);
```

CANSetMask

This function sets the PIC18C CAN module mask values for a given receive buffer.

Syntax

```
void CANSetMask( enum CAN_MASK code,
                 unsigned long Value,
                 enum CAN_CONFIG Type);
```

Parameters

code

[in] Specifies an enumerated value of the type CAN_MASK. The only permitted values are:

Value	Meaning
CAN_MASK_B1	Specifies Receive Buffer 1 mask value
CAN_MASK_B2	Specifies Receive Buffer 2 mask value

Value

[in] 32-bit mask value, which may correspond to 11-bit Standard Identifier or 29-bit Extended Identifier with binary zero padded on left.

Type

[in] Specifies an enumerated value of the type CAN_CONFIG. The only permitted values are:

Value	Meaning
CAN_CONFIG_STD_MSG	Specifies Standard Identifier message
CAN_CONFIG_XTD_MSG	Specifies Extended Identifier message

Return Values

None.

Pre-condition

PIC18C CAN module must be in the Configuration mode or else given values will be ignored.

Side Effects

None.

Remarks

None.

EXAMPLE 6: USAGE OF CANSetMask

```
CANSetMask(CAN_MASK_B1, 0x00000001, CAN_STD_MSG);
CANSetMask(CAN_MASK_B2, 0x00008001, CAN_XTD_MSG);
```

CANSetFilter

This function sets the PIC18C CAN module filter values for a given receive buffer.

Syntax

```
 void CANSetFilter(enum CAN_FILTER code,
                   unsigned long Value,
                   enum CAN_CONFIG type);
```

Parameters

code

[in] Specifies an enumerated value of the type CAN_FILTER. The only permitted values are:

Value	Meaning
CAN_FILTER_B1_F1	Specifies Receive Buffer 1, Filter 1 value
CAN_FILTER_B1_F2	Specifies Receive Buffer 1, Filter 2 value
CAN_FILTER_B2_F1	Specifies Receive Buffer 2, Filter 1 value
CAN_FILTER_B2_F2	Specifies Receive Buffer 2, Filter 2 value
CAN_FILTER_B2_F3	Specifies Receive Buffer 2, Filter 3 value
CAN_FILTER_B2_F4	Specifies Receive Buffer 2, Filter 4 value

Value

[in] 32-bit filter value which may correspond to 11-bit Standard Identifier or 29-bit Extended Identifier with binary zero padded on the left.

Type

[in] Specifies an enumerated value of the type CAN_CONFIG. The only permitted values are:

Value	Meaning
CAN_CONFIG_STD_MSG	Specifies Standard Identifier message
CAN_CONFIG_XTD_MSG	Specifies Extended Identifier message

Return Values

None.

Pre-condition

PIC18C CAN module must be in the Configuration mode, or else given values will be ignored.

Side Effects

None.

Remarks

None.

EXAMPLE 7: USAGE OF CANSetFilter

```
CANSetFilter(CAN_FILTER_B1_F1, 0x0000, CAN_STD_MSG);
CANSetFilter(CAN_FILTER_B1_F2, 0x0001, CAN_STD_MSG);
CANSetFilter(CAN_FILTER_B2_F1, 0x8000, CAN_XTD_MSG);
CANSetFilter(CAN_FILTER_B2_F2, 0x8001, CAN_XTD_MSG);
CANSetFilter(CAN_FILTER_B2_F3, 0x8002, CAN_XTD_MSG);
CANSetFilter(CAN_FILTER_B2_F4, 0x8003, CAN_XTD_MSG);
```

MODULE OPERATION FUNCTIONS:

CANSendMessage

This function copies a given message to one of the empty transmit buffers and marks it as ready to be transmitted.

Syntax

```
void CANSendMessage(unsigned long id,
                    BYTE *Data,
                    BYTE DataLen
                    enum CAN_TX_MSG_FLAGS MsgFlags);
```

Parameters

id

[in] 32-bit Identifier value, which may correspond to 11-bit Standard Identifier or 29-bit Extended Identifier with binary zero padded on the left. The exact number of bits to use depends on the *MsgFlags* parameter.

Data

[in] Pointer to zero or more of data bytes to send.

DataLen

[in] Number of bytes to send.

MsgFlags

[in] Specifies an enumerated value of the type CAN_TX_MSG_FLAGS. This represents the logical AND of a Priority value, an Identifier value, and a Message value (Priority AND Identifier AND Message). The possible values of all variables are listed in the tables below:

Priority Value	Meaning
CAN_TX_PRIORITY_0	Specifies Transmit Priority 0
CAN_TX_PRIORITY_1	Specifies Transmit Priority 1
CAN_TX_PRIORITY_2	Specifies Transmit Priority 2
CAN_TX_PRIORITY_3	Specifies Transmit Priority 3
Note: See the PIC18CXX8 data sheet for further details on transmit priority.	

Identifier Value	Meaning
CAN_TX_STD_FRAME	Specifies Standard Identifier message
CAN_TX_XTD_FRAME	Specifies Extended Identifier message

Message Value	Meaning
CAN_TX_NO_RTR_FRAME	Specifies Regular message - not RTR
CAN_TX_RTR_FRAME	Specifies RTR message

Return Values

TRUE: If the given message was successfully placed in one of the empty transmit buffers.

FALSE: If all transmit buffers were full.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 8: USAGE OF CANSendMessage

```
BYTE MessageData[1];// One byte to send
…
if ( CANIsTxReady() )
{
   MessageData[0] = 0x01;
   CANSendMessage( 0x02,
                 MessageData,
                 1,
                 CAN_TX_PRIORITY_0 &
                 CAN_TX_STD_FRAME &
                 CAN_TX_NO_RTR_FRAME);
}
…
```

CANReceiveMessage

This function copies the new available message to one of the full receive buffers.

Syntax

```
void CANReceiveMessage( unsigned long *id,
                        BYTE *Data,
                        BYTE *DataLen
                        enum CAN_RX_MSG_FLAGS *MsgFlags);
```

Parameters

id

[out] 32-bit Identifier value, which may correspond to 11-bit Standard Identifier or 29-bit Extended Identifier with binary zero padded on the left. The exact number of bits to use depends on the *MsgFlags* parameter.

Data

[out] Pointer to zero or more data bytes received.

DataLen

[out] Pointer to buffer to hold number of bytes received.

MsgFlags

[out] Specifies an enumerated value of the type CAN_RX_FILTER. This received value represents the logical AND of a Buffer value and a Condition value (Buffer AND Condition). The possible values for all variables are listed in the tables below:

Buffer Value	Meaning
CAN_RX_FILTER_1	Specifies Receive Buffer Filter 1 caused this message to be accepted
CAN_RX_FILTER_2	Specifies Receive Buffer Filter 2 caused this message to be accepted
CAN_RX_FILTER_3	Specifies Receive Buffer Filter 3 caused this message to be accepted
CAN_RX_FILTER_4	Specifies Receive Buffer Filter 4 caused this message to be accepted
CAN_RX_FILTER_5	Specifies Receive Buffer Filter 5 caused this message to be accepted
CAN_RX_FILTER_6	Specifies Receive Buffer Filter 6 caused this message to be accepted

Condition Value	Meaning
CAN_RX_OVERFLOW	Specifies Receive Buffer overflow condition
CAN_RX_INVALID_MSG	Specifies invalid message
CAN_RX_XTD_FRAME	Specifies Extended Identifier message
CAN_RX_RTR_FRAME	Specifies RTR message
CAN_RX_DBL_BUFFERED	Specifies that this message was double buffered

If a flag bit is set, the corresponding meaning is TRUE; if cleared, the corresponding meaning is FALSE.

Note: Use CAN_RX_FILTER_BITS to access CAN_RX_FILTER_n bits.

Return Values

TRUE: If new message was copied to given buffer.

FALSE: If no new message was found.

Upon receiving the new message, buffers pointed to by *id, Data, DataLen* and *MsgFlags* are populated.

Pre-condition

The *id, Data, DataLen* and *MsgFlags* pointers must point to the desired and valid memory locations.

Side Effects

None.

Remarks

This function will fail if there are no new messages to read. Caller may check the return value to determine new message availability or may call `CANIsRxReady` function.

EXAMPLE 9: USAGE OF CANReceiveMessage

```
unsigned long NewMessage;
BYTE NewMessageData[8];
BYTE NewMessageLen;
CAN_RX_MSG_FLAGS NewMessageFlags;
BYTE RxFilterMatch;
…
if ( CANIsRxReady() )
{
   CANReceiveMessage(&NewMessage,
                     NewMessageData,
                     &NewMessageLen,
                     &NewMessageFlags);
   if ( NewMessageFlags & CAN_RX_OVERFLOW )
   {
      // Rx overflow occurred
   }
   if ( NewMessageFlags & CAN_RX_INVALID_MSG )
   {
      // Invalid message received
   }
   if ( NewMessageFlags & CAN_RX_XTD_FRAME )
   {
      // Extended Identifier received
   }
   else
   {
      // Standard Identifier received.
   }
   if ( NewMessageFlags & CAN_RX_RTR_FRAME )
   {
      // RTR frame received
   }
   else
   {
      // Regular frame received.
   }

   RxFilterMatch = NewMessageFlags & CAN_RX_FILTER_BITS;
}
…
```

CANAbortAll

This function aborts all pending messages from the PIC18C CAN module. See the PIC18CXX8 data sheet for rules regarding message abortion.

Syntax

```
void CANAbortAll();
```

Parameters

None.

Return Values

None.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 10: USAGE OF CANAbortAll

```
…
CANAbortAll();
…
```

STATUS CHECK FUNCTIONS:

CANGetTxErrorCount

This function returns the PIC18C CAN transmit error count as defined by BOSCH CAN Specifications. See the PIC18CXX8 data sheet for more information.

Syntax

```
BYTE CANGetTxErrorCount();
```

Parameters

None.

Return Values

Current value of transmit error count.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 11: USAGE OF CANGetTxErrorCount

```
BYTE TxErrorCount;
…
TxErrorCount = CANGetTxErrorCount();
…
```

CANGetRxErrorCount

This function returns the PIC18C CAN receive error count as defined by BOSCH CAN Specifications. See the PIC18CXX8 data sheet for more information.

Syntax

```
 BYTE CANGetRxErrorCount();
```

Parameters

None.

Return Values

Current value of receive error count.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 12: USAGE OF CANGetRxErrorCount

```
BYTE RxErrorCount;
…
RxErrorCount = CANGetRxErrorCount();
…
```

CANIsBusOff

This function returns the PIC18C CAN bus On/Off state.

Syntax

```
BOOL CANIsBusOff()
```

Parameters

None.

Return Values

TRUE: If the PIC18C CAN module is in the Bus Off state.

FALSE: If the PIC18C CAN module is in the Bus On state.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 13: USAGE OF CANIsBusOff

```
…
if ( CANIsBusOff() )
   // CAN Module is off
…
```

CANIsTxPassive

This function returns the PIC18C CAN transmit error status as defined by BOSCH CAN Specifications. See the PIC18CXX8 data sheet for more information.

Syntax

```
 BOOL CANIsTxPassive()
```

Parameters

None.

Return Values

TRUE: If the PIC18C CAN module is in transmit error passive state.

FALSE: If the PIC18C CAN module is not in transmit error passive state.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 14: USAGE OF CANIsTxPassive

```
…
if ( CANIsTxPassive() )
   // Transmit module is in passive state.
…
```

CANIsRxPassive

This function returns the PIC18C CAN receive error status as defined by BOSCH CAN Specifications. See the PIC18CXX8 data sheet for more information.

Syntax

```
 BOOL CANIsRxPassive()
```

Parameters

None.

Return Values

TRUE: If the PIC18C CAN module is in receive error passive state.

FALSE: If the PIC18C CAN module is not in receive error passive state.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 15: USAGE OF CANIsRxPassive

```
…
if ( CANIsRxPassive() )
   // Rx is error passive, do something
…
```

CANIsRxReady

This function returns the PIC18C CAN receive buffer(s) readiness status.

Syntax

```
BOOL CANIsRxReady()
```

Parameters

None.

Return Values

TRUE: If at least one of the PIC18C CAN receive buffers is full.

FALSE: If none of the PIC18C CAN receive buffers are full.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 16: USAGE OF CANIsRxReady

```
unsigned long NewMessage;
BYTE NewMessageData[8];
BYTE NewMessageLen;
enum CAN_RX_MSG_FLAGS NewMessageFlags;

…

if ( CANIsRxReady() )
   CANReceiveMessage(&NewMessage,
                     NewMessageData,
                     &NewMessageLen,
                     &NewMessageFlags);

…
```

CANIsTxReady

This function returns the PIC18C CAN transmit buffer(s) readiness status.

Syntax

```
BOOL CANIsTxReady()
```

Parameters

None.

Return Values

TRUE: If at least one of the PIC18C CAN transmit buffers is empty.

FALSE: If none of the PIC18C CAN transmit buffers are empty.

Pre-condition

None.

Side Effects

None.

Remarks

None.

EXAMPLE 17: USAGE OF CANIsTxReady

```
BYTE MessageData[8];
BYTE MessageLen;
CAN_TX_MSG_FLAGS MessageFlags;
…
// Check to see if transmit buffer is ready
if ( CANIsTxReady() )
{
   CANSendMessage(0x02,
                  MessageData,
                  MessageLen,
                  MessageFlags);
}
…
```

PIC18C CAN FUNCTIONS ORGANIZATION AND USAGE

These functions are developed for the Microchip MPLAB® C18 and HI-TECH PICC™ 18 C compilers. Source file automatically detects compiler in use and redefines corresponding symbols. If required, one can easily port this file to any C compiler for PIC18C devices.

Source code for the PIC18C CAN module is divided into the following two files:

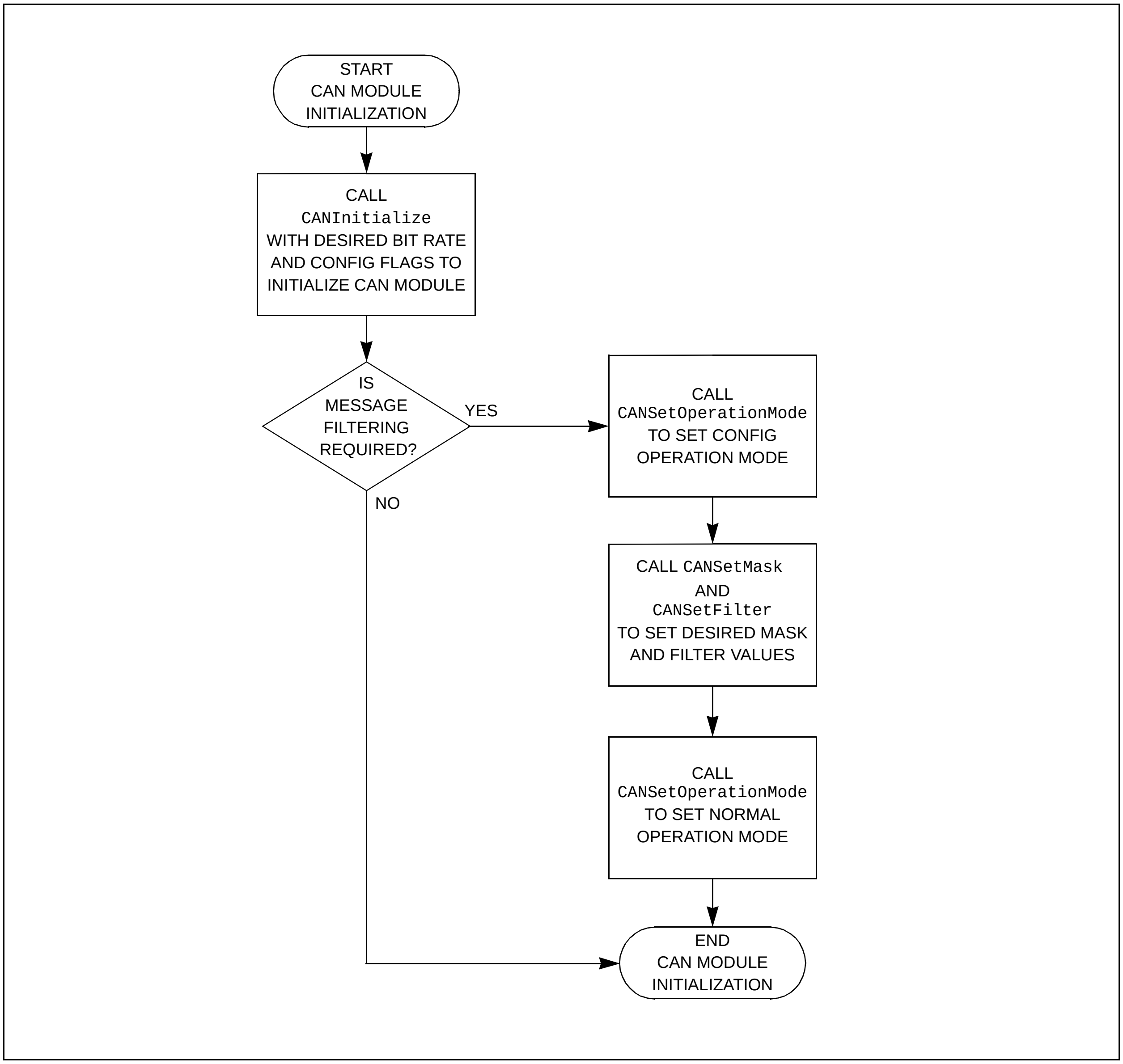
- `can18xx8.c`
- `can18xx8.h`

To employ these CAN functions in your project, perform the following steps:

1. Copy the `can18xx8.c` and `can18xx8.h` files to your project source directory.
2. Include the `can18xx8.c` file in your project as a C18 'C' source file.
3. Add the #include `can18xx8.h` line in each source file that will be calling CAN routines.

You may also create an object or library file for `can18xx8.c` and use the output file in your project, rather than using the actual source code file.

FIGURE 2: PIC18C CAN MODULE INITIALIZATION PROCEDURE



SAMPLE APPLICATION PROGRAM USING THE PIC18C CAN LIBRARY

An application program that uses the PIC18C CAN functions must follow certain initialization steps, as shown in Figure 2 (see previous page).

EXAMPLE 18: SAMPLE APPLICATION PROGRAM 1

The following is a portion of a sample application program that requires all CAN Standard Identifier messages to be accepted:

```
// Application specific variable declarations
…

// CAN module related variables
unsigned long NewMessage;
BYTE NewMessageData[8];
Byte MessageData[8];
BYTE NewMessageLen;
CAN_RX_MSG_FLAGS NewMessageFlags;
BYTE RxFilterMatch;


// Application specific initialization code follows
…

// Initialize CAN module with no message filtering
CANInitialize(SJW, BRP, PHSEG1, PHSEG2, PROPSEG, config);

// Main application loop
while(1)
{
   // Application specific logic here

   // Check for CAN message
   if ( CANIsRxReady() )
   {
      CANReceiveMessage(&NewMessage,
                        NewMessageData,
                        &NewMessageLen,
                        &NewMessageFlags);
      if ( NewMessageFlags & CAN_RX_OVERFLOW )
      {
         // Rx overflow occurred; handle it
      }
      if ( NewMessageFlags & CAN_RX_INVALID_MSG )
      {
         // Invalid message received; handle it
      }
      if ( NewMessageFlags & CAN_RX_XTD_FRAME )
      {
         // Extended Identifier received; handle it
      }
      else
      {
         // Standard Identifier received.
      }
      if ( NewMessageFlags & CAN_RX_RTR_FRAME )
      {
         // RTR frame received
```

```
        }
        else
        {
            // Regular frame received.
        }

        // Extract receiver filter match, if it is to be used
        RxFilterMatch = NewMessageFlags & CAN_RX_FILTER_BITS;
    }

    // Process received message
    …

    // Transmit a message due to previously received message or
    // due to application logic itself.

    if ( CANIsTxReady() )
    {
        MessageData[0] = 0x01;
        CANSendMessage(  0x02,
                         MessageData,
                         1,
                         CAN_TX_PRIORITY_0 &
                         CAN_TX_STD_FRAME &
                         CAN_TX_NO_RTR_FRAME);
    }

    // Other application specific logic
    …
} // Do this forever

// End of program
```

EXAMPLE 19: SAMPLE APPLICATION PROGRAM 2

The following is a portion of a sample application program that requires only a specific group of CAN Standard Identifier messages to be accepted:

```
// Application specific variable declarations
…

// CAN module related variables
unsigned long NewMessage;
BYTE NewMessageData[8];
Byte MessageData[8];
BYTE NewMessageLen;
CAN_RX_MSG_FLAGS NewMessageFlags;
BYTE RxFilterMatch;

// Application specific initialization code follows
…

// Initialize CAN module with no message filtering
CANInitialize(SJW, BRP, PHSEG1, PHSEG2, PROPSEG, config);

// Set CAN module into configuration mode
CANSetOperationMode(CAN_OP_MODE_CONFIG);

// Set Buffer 1 Mask value
```

```
CANSetMask(CAN_MASK_B1, 0x0000000F, CAN_STD_MSG);

// Set Buffer 2 Mask value
CANSetMask(CAN_MASK_B2, 0x000000F0, CAN_STD_MSG);



// Set Buffer 1 Filter values
CANSetFilter(CAN_FILTER_B1_F1, 0x00000001, CAN_CONFIG_STD_MSG);
CANSetFilter(CAN_FILTER_B1_F2, 0x00000002, CAN_CONFIG_STD_MSG);
CANSetFilter(CAN_FILTER_B2_F1, 0x00000010, CAN_CONFIG_STD_MSG);
CANSetFilter(CAN_FILTER_B2_F2, 0x00000020, CAN_CONFIG_STD_MSG);
CANSetFilter(CAN_FILTER_B2_F3, 0x00000030, CAN_CONFIG_STD_MSG);


// Main application loop
while(1)
{
   // Application specific logic here

   // Check for CAN message
   if ( CANIsRxReady() )
   {
      CANReceiveMessage( &NewMessage,
                          NewMessageData,
                          &NewMessageLen,
                          &NewMessageFlags );
      if ( NewMessageFlags & CAN_RX_OVERFLOW )
      {
         // Rx overflow occurred; handle it
      }
      if ( NewMessageFlags & CAN_RX_INVALID_MSG )
      {
         // Invalid message received; handle it
      }
      if ( NewMessageFlags & CAN_RX_XTD_FRAME )
      {
         // Extended Identifier received; handle it
      }
      else
      {
         // Standard Identifier received.
      }
      if ( NewMessageFlags & CAN_RX_RTR_FRAME )
      {
         // RTR frame received
      }
      else
      {
         // Regular frame received.
      }

      // Extract receiver filter match, if it is to be used
      RxFilterMatch = NewMessageFlags & CAN_RX_FILTER_BITS;
   }

   // Process received message
   …
```

```
    // Transmit a message due to previously received message or
    // due to application logic itself.
    if ( CANIsTxReady() )
    {
        MessageData[0] = 0x01;
        CANSendMessage(  0x02,
                         MessageData,
                         1,
                         CAN_TX_PRIORITY_0 &
                         CAN_TX_STD_FRAME &
                         CAN_TX_NO_RTR_FRAME);
    }

    // Other application specific logic
    …
} // Do this forever

// End of program
```

CONCLUSION

The CAN library provided in this application note may be used in any application program that needs a simple polling mechanism to implement CAN communication. One can use this library as a reference to create a true interrupt-driven CAN communication driver.

APPENDIX A: SOURCE CODE

Because of its size, the complete source code for this application note is not included in the text.

You may download the source code from the Microchip Web site, at the Internet address

www.microchip.com

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