# MCP251XFD driver library

# Guide

Visibility and dissemination of the document:

**Can be widely distributed**

Language: **C**
Language version: **C99**
Endianness: **Little endian only**

Synchronous: **yes**
Asynchronous: **no**
OS: **need adaptation**

MCU compatibility:
**no limit except endianness**

Tests: **partial, ~25% coverage**

MISRA C: **to be determined**
CERT C: **to be determined**

PBIT: **yes**
CBIT: **possible**



## MCP251XFD driver library

*Version: 1.0.5 date: 11 Feb 2023*

This library is compatible with components:
- MCP2517FD
- MCP2518FD

The MCP251XFD component is a CAN-bus controller supporting CAN2.0A, CAN2.0B and CAN-FD with SPI interface

| Established by | | Reviewed | | Approved | |
|---|---|---|---|---|---|
| **Name:** | **FMA** | Name: | FMA | Name: | FMA |
| **Date:** | **11 Feb 2023** | Date: | 11 Feb 2023 | Date: | 11 Feb 2023 |

## Change history

| Issue | Date | Nature / comment | Paragraph | Writer |
|---|---|---|---|---|
| **1.0.5** | 11 Feb 2023 | Do a safer timeout for functions<br>Mark RegMCP251XFD_IOCON as deprecated following MCP2517FD: DS80000792C (§6), MCP2518FD: DS80000789C (§5), MCP251863: DS80000984A (§5)<br>Change SPI max speed following MCP2517FD: DS80000792C (§5), MCP2518FD: DS80000789C (§4), MCP251863: DS80000984A (§4) | 13.3.4 to 13.3.7 | FMA |
| **1.0.4** | 16 Nov 2021 | Add how to set a custom bit time configuration<br>Add more information about the MCP251XFD_ConfigureFIFOList() function<br>Add summary of driver functions. | 7<br>16.13<br>14 | FMA |
| **1.0.3** | 03 Oct 2021 | Add MCP251XFD_StartCANListenOnly() function | 15.10 | FMA |
| **1.0.2** | 13 June 2021 | MessageCtrlFlags is a set of instead of an enum | 15.5.4 | FMA |
| **1.0.1** | 21 March 2021 | Correct MCP251XFD_EnterSleepMode() function's description | 15.11 | FMA |
| **1.0.0** | 07 July 2020 | **Initial release** | - | FMA |

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# 1. INTRODUCTION

## 1.1. Purpose

The purpose of this document is to explain how the driver library works and how to use it. It can work with either MCP2517FD controllers or MCP2518FD controllers or both.

The driver features are:

- Can be use with any MCU if its CPU use little endian
- Only take care of the controller, not the communication with it
- All functions and functionalities are implemented
- Configuration is very simplified
- Can communicate with virtually an infinite count of controllers
- Different configurations can be used with different controllers (no duplication of the driver needed)
- Direct communication with the controller, the driver has no buffer
- Can use the driver defines, enums, structs to create your own functions

## 1.2. Documents, References, and abbreviations

### 1.2.1. Applicable documents

| IDENTIFICATION | TITLE | DATE |
|---|---|---|
| DS20005678D | MCP25XXFD CAN FD Controller Module Family Reference Manual | 14 May 2019 |

### 1.2.2. Reference documents

| IDENTIFICATION | TITLE | DATE |
|---|---|---|
| DS20005688B | MCP2517FD Datasheet Rev.B – External CAN FD Controller with SPI Interface | July 2019 |
| DS20006027A | MCP2518FD Datasheet Rev.A – External CAN FD Controller with SPI Interface | April 2019 |

### 1.2.3. Abbreviations and Acronyms

This is the list of all the abbreviations and acronyms used in this document and their definitions. They are arranged in alphabetical order.

| | |
|---|---|
| **CAN** | Controller Area Network |
| **CAN-FD** | Controller Area Network Flexible Data-Rate |
| **CBIT** | Continuous Built-In Test |
| **CERT** | Computer Emergency Response Team |
| **CLK** | Clock |
| **CS** | Chip Select |
| **FIFO** | First In First Out |
| **MCU** | Micro-Controller Unit |
| **MISO** | Master In Slave Out |
| **MISRA** | Motor Industry Software Reliability Association |
| **MOSI** | Master Out Slave In |
| **OS** | Operating System |
| **PBIT** | Power Up Built-In Test |
| **PIO** | Programmable Input/Output |
| **RAM** | Random Access Memory |
| **SPI** | Serial Peripheral Interface |
| **TEF** | Transmit Event FIFO |
| **TXQ** | Transmit Queue |

# 2. PRESENTATION

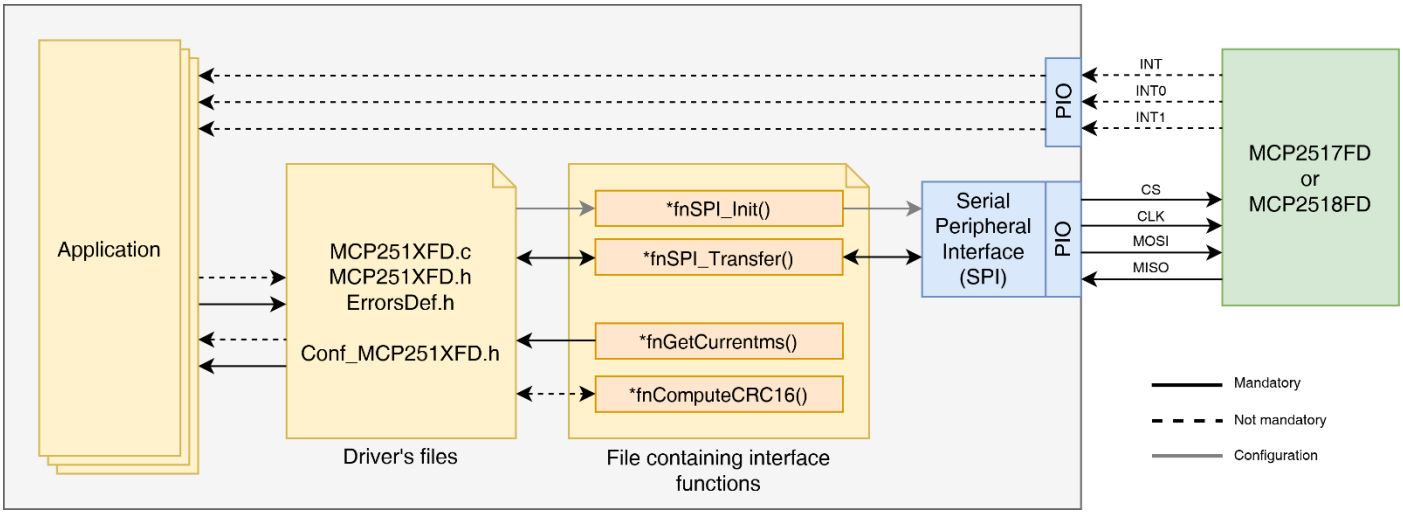



*Figure 1 - Driver overview*

This driver only takes care of configuration and check of the internal registers and the formatting of the communication with the device. That means it does not directly take care of the physical communication, there are functions interfaces to do that. By doing this, the driver can control a MCP2517FD trough a I2C to SPI converter without any change, the transformation will be done in the interface functions.

Each driver's functions need a device structure that indicate with which device he must threat and communicate. Each device can have its own configuration.

The driver can detect which one of the MCP2517FD or the MCP2518FD is connected.

To set up one or more devices in the project, you must:

- Configure the driver which will be the same for all devices but modify only its behavior in the project
- Create and define the configuration of as many device structures as there are devices to use
- Create and define controller and CAN controller configuration for each device. Multiple devices can share the same configuration
- Initialize the device with the configuration structure previously defined

# 3. DRIVER CONFIGURATION

The configuration is done by use of "Conf_MCP251XFD.h" file.

This file contains the some defines:

- `#define MCP251XFD_TRANS_BUF_SIZE`
- `#define CHECK_NULL_PARAM`

See example in §18.

## 3.1. MCP251XFD_TRANS_BUF_SIZE define

This defines the max size for the transfer buffer. Adjust for 1 max full frame that is needed of all controllers in use otherwise the message will be cut into parts that slow the transfer. In case of use write safe by all controllers set 9, which is the minimum allowed, because all data will be send by 4 bytes max.

All read and write possibilities will be presented later.

## 3.2. CHECK_NULL_PARAM define

This define enables check of pointing parameters are not NULL. It checks if function parameters point to something.

This define can be enabled only in debug. Normally in a static pure C programming, these parameters and function pointer are set and fix, so always checking them is not useful.

# 4. DEVICE CONFIGURATION

Each first parameter of a function is the device configuration. The purpose of this device configuration is to specify to the driver how and by which interface to communicate with the device selected. The device configuration type is MCP251XFD.

The MCP251XFD.DriverConfig specify how the driver will communicate with the device. Driver configurations, parameters can be OR'ed. The device has 3 protocols to communicate with:

- Normal protocol: just read and write data without verification
- Read and write with CRC: which read and write data with length and CRC verification
- Safe Write: which write each data with CRC. One byte at a time for SFR and 4 bytes at a time for RAM write

MCP251XFD_DRIVER_USE_READ_WRITE_CRC will always replace MCP251XFD_DRIVER_NORMAL_USE when communicating with the device. MCP251XFD_DRIVER_USE_SAFE_WRITE will always replace MCP251XFD_DRIVER_NORMAL_USE and MCP251XFD_DRIVER_USE_READ_WRITE_CRC when communicating with the device in case of a write. For more information see datasheets.

All other driver configuration is explained in the eMCP251XFD_DriverConfig enumerator.

The MCP251XFD.fnSPI_Init, MCP251XFD.fnSPI_Transfer, MCP251XFD.fnGetCurrentms, and MCP251XFD.fnComputeCRC16 are explained at §15.1.4 and an example at §19.

The MCP251XFD.SPIClockSpeed is the desired frequency of the SPI clock in Hertz. This allows the driver to change the SPI speed and return to the specify clock by its own when necessary. The maximum clock speed is SYSCLK/2 (see §5.1 for SYSCLK).

The MCP251XFD.GPIOsOutState is the wanted state of GPIOs after initialization. It also indicates the last programmed state of the GPIO output thus this value is changed by the driver.

The MCP251XFD.UserDriverData is a generic pointer to what the user need. It can be used as context or bringing information for the interface functions for example. This variable is never touch by the driver.

## 4.1. Example

Example of driver configuration in a .c file:

```
MCP251XFD MCP251XFD_Ext1 =
{
  .UserDriverData  = NULL,
  //--- Driver configuration ---
  .DriverConfig    = MCP251XFD_DRIVER_USE_READ_WRITE_CRC
                   | MCP251XFD_DRIVER_USE_SAFE_WRITE
                   | MCP251XFD_DRIVER_ENABLE_ECC
                   | MCP251XFD_DRIVER_INIT_SET_RAM_AT_0
                   | MCP251XFD_DRIVER_CLEAR_BUFFER_BEFORE_READ,
  //--- IO configuration ---
  .GPIOsOutState   = MCP251XFD_GPIO0_LOW | MCP251XFD_GPIO1_HIGH,
  //--- Interface driver call functions ---
  .SPI_ChipSelect  = SPI_CS_EXT1, // Here the chip select of the EXT1 interface is 1
  .InterfaceDevice = SPI0,        // Here this point to the address memory of the peripheral SPI0
  .fnSPI_Init      = MCP251XFD_InterfaceInit_V71,
  .fnSPI_Transfer  = MCP251XFD_InterfaceTransfer_V71,
  //--- Time call function ---
  .fnGetCurrentms  = GetCurrentms_V71,
  //--- CRC16-CMS call function ---
  .fnComputeCRC16  = ComputeCRC16_V71,
  //--- Interface clocks ---
  .SPIClockSpeed   = 17000000, // 17MHz
};
```

Example of driver configuration in a .h file:

```
extern MCP251XFD MCP251XFD_Ext1;
#define CANEXT1  &MCP251XFD_Ext1
```

# 5. CONTROLLER AND CAN CONTROLLER CONFIGURATION

The controller and CAN controller configuration is only used at initialization by the *Init_MCP251XFD()* function. The controller and CAN controller configuration type is MCP251XFD_Config.

It configures the controller SYSCLK, configures the CAN controller, the GPIO/interrupt pins, and the interruptions.

## 5.1. Controller clocks configuration

First, you need to specify the CLKIN frequency. It is indicated in the schematic of the board that contains the MCP251XFD. This clock is either a crystal, a ceramic resonator, or an oscillator.

If both OSC1 and OSC2 is connected then it is a crystal or a ceramic oscillator, in this case put the frequency in Hertz to MCP251XFD_Config.XtalFreq and set MCP251XFD_Config.OscFreq to 0. If only OSC1 is connected and OSC2 is left unconnected then it is an oscillator, in this case put the frequency in Hertz to MCP251XFD_Config.OscFreq and set MCP251XFD_Config.XtalFreq to 0.

Why specify if it is a crystal or an oscillator? Because frequency range differ, and the driver check this.

Next specify the factor of CLKIN which is used for SYSCLK. SYSCLK is the MCP251XFD internal clock used for all its functions like maximum SPI clock, Nominal and Data bit rates. This clock is generated from CLKIN (the clock specified in MCP251XFD_Config.XtalFreq or MCP251XFD_Config.OscFreq).

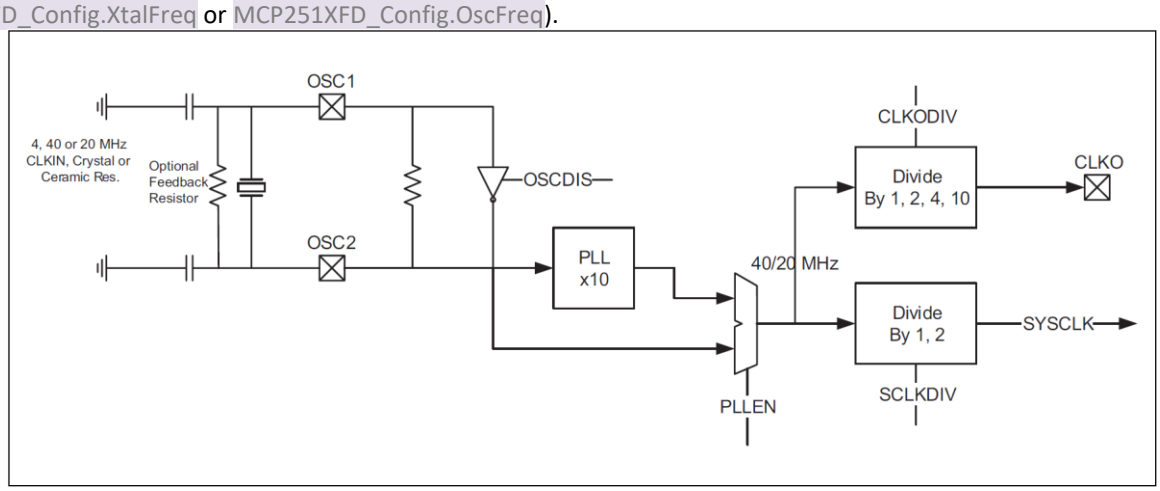



*Figure 2 - MCP251XFD Oscillator block diagram (extracted from document DS20005678D page 13)*

The minimum operating SYSCLK is 2MHz and the maximum is 40MHz. It is recommended to set a SYSCLK at 20MHz or 40MHz by the CAN specification:

| CLKIN (XtalFreq/OscFreq) | Factor (MCP251XFD_Config.SysclkConfig) | SYSCLK |
|---|---|---|
| 2MHz Oscillator | MCP251XFD_SYSCLK_IS_CLKIN_MUL_10 | 20MHz |
| 4MHz | MCP251XFD_SYSCLK_IS_CLKIN_MUL_5 | 20MHz |
| 4MHz | MCP251XFD_SYSCLK_IS_CLKIN_MUL_10 | 40MHz |
| 20MHz | MCP251XFD_SYSCLK_IS_CLKIN | 20MHz |
| 40MHz | MCP251XFD_SYSCLK_IS_CLKIN_DIV_2 | 20MHz |
| 40MHz | MCP251XFD_SYSCLK_IS_CLKIN | 40MHz |

*Table 1 - Recommended SYSCLK configuration*

The SYSCLK frequency is returned in the variable MCP251XFD_Config.SYSCLK_Result if it points to a uint32_t.

The MCP251XFD_Config.ClkoPinConfig is the configuration of the CLKO pin output. All possible value of configuration is indicated in the eMCP251XFD_CLKODIV enumerator.

As you see in Figure 2 - MCP251XFD Oscillator block diagram (extracted from document DS20005678D page 13), the CLKO pin is not linked to SYSCLK but CLKIN or CLKIN+PLL. So, the CLKO output frequency can be superior to SYSCLK. The value at the input of the CLKO divider cannot be superior to 40MHz (like 8MHz CLKIN and PLL enabled for example) and is checked by the driver.

If there is an error while configuring the SYSCLK, the driver will return an ERR__FREQUENCY_ERROR. If the MCP251XFD_Config.SYSCLK_Result point to an uint32_t variable, the SYSCLK out of range will be stored inside. With these protections, the device cannot be set wrongly and crash. There is no RESET pin, so these checks are mandatory. If the device crash because the frequency has not been correctly set, there is no choice other than power down and up the card to reset the device.

## 5.2. CAN controller configuration

The MCP251XFD_Config.NominalBitrate is the desired Nominal bit rate in bits per second.

The MCP251XFD_Config.DataBitrate is the desired Data bit rate in bits per second. If you do not use the CAN-FD feature, then set this variable to 0 or MCP251XFD_NO_CANFD.

Both MCP251XFD_Config.NominalBitrate and MCP251XFD_Config.DataBitrate are used to calculate the bit time configuration of the CAN controller with the minimum quantization error (NBRP and DBRP identical) during bit rate switching. The calculus is done at initialization and set to the controller. The only return of this calculus is the MCP251XFD_Config.BitTimeStats variable where it is indicated the actual Nominal and Data bitrates and oscillator tolerances (the calculus is described in the document DS20005678D, §3.4).

If you want to set the bit time configuration manually, fill the MCP251XFD_BitTimeConfig structure and use the MCP251XFD_SetBitTimeConfiguration() function after using *Init_MCP251XFD()*.

The MCP251XFD_Config.Bandwidth variable specify the delay between two consecutive transmissions. All possible value of configuration is explained in the eMCP251XFD_Bandwidth enumerator.

The MCP251XFD_Config.ControlFlags variable is the CAN control flags to configure the CAN controller. Configuration can be OR'ed. The complete configuration flags are explained in the eMCP251XFD_CANCtrlFlags enumerator.

## 5.3. GPIOs and Interrupts pins

The MCP251XFD_Config.GPIO0PinMode variable configure what the INT0/GPIO0/XSTBY pin will do. See the eMCP251XFD_GPIO0Mode enumerator for all possibilities.

The MCP251XFD_Config.GPIO1PinMode variable configure what the INT1/GPIO1 pin will do. See the eMCP251XFD_GPIO1Mode enumerator for all possibilities.

The MCP251XFD_Config.INTsOutMode variable specify the output mode of all interrupt pins (INT, INT0 and INT1). The MCP251XFD_Config.TXCANOutMode variable specify the output mode of the TXCAN pin. See the eMCP251XFD_OutMode enumerator for all possibilities.

## 5.4. Interrupts

The MCP251XFD_Config.SysInterruptFlags variable specify which interrupt event will be activated in the controller and the CAN controller. Interrupt event configuration can be OR'ed. All interrupt events are explained in the document DS20005678D, page 60. For more information about the configuration in the driver see eMCP251XFD_InterruptEvents enumerator.

## 5.5. Example

Example of controller and CAN controller configuration in a .c file:

```
MCP251XFD_BitTimeStats MCP2517FD_Ext1_BTStats;
uint32_t SYSCLK_Ext1;

MCP251XFD_Config MCP2517FD_Ext1_Config =
{
  //--- Controller clocks ---
  .XtalFreq       = 0,        // CLKIN is not a crystal
  .OscFreq        = 40000000, // CLKIN is a 40MHz oscillator
  .SysclkConfig   = MCP251XFD_SYSCLK_IS_CLKIN,
  .ClkoPinConfig  = MCP251XFD_CLKO_SOF,
  .SYSCLK_Result  = &SYSCLK_Ext1,
  //--- CAN configuration ---
  .NominalBitrate = 1000000, // Nominal Bitrate to 1Mbps
  .DataBitrate    = 2000000, // Data Bitrate to 2Mbps
  .BitTimeStats   = &MCP2517FD_Ext1_BTStats,
  .Bandwidth      = MCP251XFD_NO_DELAY,
  .ControlFlags   = MCP251XFD_CAN_RESTRICTED_MODE_ON_ERROR
                  | MCP251XFD_CAN_ESI_REFLECTS_ERROR_STATUS
                  | MCP251XFD_CAN_RESTRICTED_RETRANS_ATTEMPTS
                  | MCP251XFD_CANFD_BITRATE_SWITCHING_ENABLE
                  | MCP251XFD_CAN_PROTOCOL_EXCEPT_AS_FORM_ERROR
                  | MCP251XFD_CANFD_USE_ISO_CRC
                  | MCP251XFD_CANFD_DONT_USE_RRS_BIT_AS_SID11,
  //--- GPIOs and Interrupts pins ---
  .GPIO0PinMode   = MCP251XFD_PIN_AS_GPIO0_OUT,
  .GPIO1PinMode   = MCP251XFD_PIN_AS_INT1_RX,
  .INTsOutMode    = MCP251XFD_PINS_PUSHPULL_OUT,
  .TXCANOutMode   = MCP251XFD_PINS_PUSHPULL_OUT,
  //--- Interrupts ---
  .SysInterruptFlags = MCP251XFD_INT_ENABLE_ALL_EVENTS,
};
```

Example of controller and CAN controller configuration in a .h file:

```
extern MCP251XFD_BitTimeStats MCP2517FD_Ext1_BTStats;
extern uint32_t SYSCLK_Ext1;
extern MCP251XFD_Config MCP2517FD_Ext1_Config;
```

# 6. FIFO AND FILTER CONFIGURATION

FIFO and Filter configuration can only be done when the device is in Configuration mode. If not, functions will return an ERR__NEED_CONFIG_MODE error.

## 6.1. FIFO configuration

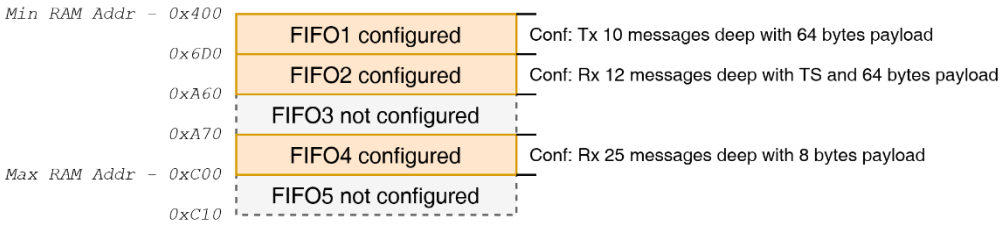
It is recommended to prepare a full configuration of FIFO in a list of MCP251XFD_FIFO struct and call the *MCP251XFD_ConfigureFIFOList()* function. In this case, the driver will check the whole place taken in RAM to store all FIFO, if the amount of RAM taken by FIFO list configuration exceeds the maximum RAM of the device, then the function will return a ERR__OUT_OF_MEMORY error. The function will configure FIFO of the device to be identical to the list. If the TEF is not in the list, it will be disabled, and if the TXQ is not in the list, it will be disabled.

If you choose to configure one FIFO at a time, the driver cannot check the whole FIFO configuration, you must calculate manually the amount of RAM taken by your configuration.

The RAM usage always starts with the TEF, followed by the TXQ and after all the FIFO from 1 to 31. The total RAM size is 2048 bytes. See §15.3 for more information about functions and structures.

There is no way to disable a FIFO, except for the TEF and the TXQ, so it is mandatory to not leave a FIFO not configured between two configured FIFO. If not, this FIFO will take 16 bytes of unused RAM. If the amount of RAM used by your FIFO configuration take the limit and you leave some FIFO unconfigured which will go beyond the maximum of RAM, it is not a problem for the device as long as you do not try to work with these FIFO.

Example:




Here is the calculus to know how many RAM a FIFO will take in RAM.

A TEF:

$$T_{TEFSize} = \left(2 \times 4 + \begin{cases} 0\ if\ TimeStamp\ disable \\ 4\ if\ TimeStamp\ enable \end{cases}\right) \times MessageDeepSize \quad (1.1)$$

A TXQ:

$$T_{TXQSize} = (2 \times 4 + Payloal) \times MessageDeepSize \quad (1.2)$$

A Transmission FIFO:

$$T_{TransmitFIFOSize} = (2 \times 4 + Payloal) \times MessageDeepSize \quad (1.3)$$

A Receive FIFO:

$$T_{ReceiveFIFOSize} = \left(2 \times 4 + Payload + \begin{cases} 0\ if\ TimeStamp\ disable \\ 4\ if\ TimeStamp\ enable \end{cases}\right) \times MessageDeepSize \quad (1.4)$$

## 6.2. Filter configuration

It is recommended to prepare a full configuration of Filter in a list of MCP251XFD_Filter struct and call the *MCP251XFD_ConfigureFilterList()* function. The function will configure Filters of the device to be identical to the list.

You can also configure each filter manually as you want by using the *MCP251XFD_ConfigureFilter()* function for each Filter. At initialization, all Filters are disable.

These functions verify the Filter consistency, format the ID to correspond to the filter specification.

If you want a Filter to accept all messages, you can use the MCP251XFD_ACCEPT_ALL_MESSAGES for both MCP251XFD_Filter.AcceptanceID and MCP251XFD_Filter.AcceptanceMask.

See §15.4 for more information about functions and structures.

## 6.3. Example

Example of FIFO and Filter configuration in a .c file:

```
MCP251XFD_RAMInfos Ext1_TEF_RAMInfos;
MCP251XFD_RAMInfos Ext1_TXQ_RAMInfos;
MCP251XFD_RAMInfos Ext1_FIFOs_RAMInfos[MCP2517FD_EXT1_FIFO_COUNT - 2];

MCP251XFD_FIFO MCP2517FD_Ext1_FIFOlist[MCP2517FD_EXT1_FIFO_COUNT] =
{
  { .Name = MCP251XFD_TEF, .Size = MCP251XFD_FIFO_10_MESSAGE_DEEP, .ControlFlags = MCP251XFD_FIFO_ADD_TIMESTAMP_ON_OBJ
    .InterruptFlags = MCP251XFD_FIFO_OVERFLOW_INT + MCP251XFD_FIFO_EVENT_FIFO_NOT_EMPTY_INT,
    .RAMInfos = &Ext1_TEF_RAMInfos, },
  { .Name = MCP251XFD_TXQ, .Size = MCP251XFD_FIFO_4_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Attempts = MCP251XFD_THREE_ATTEMPTS, .Priority = MCP251XFD_MESSAGE_TX_PRIORITY16,
    .ControlFlags = MCP251XFD_FIFO_NO_RTR_RESPONSE,
    .InterruptFlags = MCP251XFD_FIFO_TX_ATTEMPTS_EXHAUSTED_INT + MCP251XFD_FIFO_TRANSMIT_FIFO_NOT_FULL_INT,
    .RAMInfos = &Ext1_TXQ_RAMInfos, },
  { .Name = MCP251XFD_FIFO1, .Size = MCP251XFD_FIFO_4_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_RECEIVE_FIFO, .ControlFlags = MCP251XFD_FIFO_ADD_TIMESTAMP_ON_RX,
    .InterruptFlags = MCP251XFD_FIFO_OVERFLOW_INT + MCP251XFD_FIFO_RECEIVE_FIFO_NOT_EMPTY_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[0], }, // SID: 0x000..0x1FF ; No EID
  { .Name = MCP251XFD_FIFO2, .Size = MCP251XFD_FIFO_2_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_RECEIVE_FIFO, .ControlFlags = MCP251XFD_FIFO_ADD_TIMESTAMP_ON_RX,
    .InterruptFlags = MCP251XFD_FIFO_OVERFLOW_INT + MCP251XFD_FIFO_RECEIVE_FIFO_NOT_EMPTY_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[1], }, // SID: 0x200..0x3FF ; No EID
  { .Name = MCP251XFD_FIFO3, .Size = MCP251XFD_FIFO_4_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_RECEIVE_FIFO, .ControlFlags = MCP251XFD_FIFO_ADD_TIMESTAMP_ON_RX,
    .InterruptFlags = MCP251XFD_FIFO_OVERFLOW_INT + MCP251XFD_FIFO_RECEIVE_FIFO_NOT_EMPTY_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[2], }, // SID: 0x400..0x5FF ; No EID
  { .Name = MCP251XFD_FIFO4, .Size = MCP251XFD_FIFO_2_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_RECEIVE_FIFO, .ControlFlags = MCP251XFD_FIFO_ADD_TIMESTAMP_ON_RX,
    .InterruptFlags = MCP251XFD_FIFO_OVERFLOW_INT + MCP251XFD_FIFO_RECEIVE_FIFO_NOT_EMPTY_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[3], }, // SID: 0x600..0x7FF ; No EID
  { .Name = MCP251XFD_FIFO5, .Size = MCP251XFD_FIFO_4_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_TRANSMIT_FIFO, .Attempts = MCP251XFD_THREE_ATTEMPTS,
    .Priority = MCP251XFD_MESSAGE_TX_PRIORITY16, .ControlFlags = MCP251XFD_FIFO_NO_RTR_RESPONSE,
    .InterruptFlags = MCP251XFD_FIFO_TX_ATTEMPTS_EXHAUSTED_INT + MCP251XFD_FIFO_TRANSMIT_FIFO_NOT_FULL_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[4], },
  { .Name = MCP251XFD_FIFO6, .Size = MCP251XFD_FIFO_2_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_TRANSMIT_FIFO, .Attempts = MCP251XFD_THREE_ATTEMPTS,
    .Priority = MCP251XFD_MESSAGE_TX_PRIORITY16, .ControlFlags = MCP251XFD_FIFO_NO_RTR_RESPONSE,
    .InterruptFlags = MCP251XFD_FIFO_TX_ATTEMPTS_EXHAUSTED_INT + MCP251XFD_FIFO_TRANSMIT_FIFO_NOT_FULL_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[5], },
  { .Name = MCP251XFD_FIFO7, .Size = MCP251XFD_FIFO_2_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_TRANSMIT_FIFO, .Attempts = MCP251XFD_THREE_ATTEMPTS,
    .Priority = MCP251XFD_MESSAGE_TX_PRIORITY16, .ControlFlags = MCP251XFD_FIFO_NO_RTR_RESPONSE,
    .InterruptFlags = MCP251XFD_FIFO_TX_ATTEMPTS_EXHAUSTED_INT + MCP251XFD_FIFO_TRANSMIT_FIFO_NOT_FULL_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[6], },
  { .Name = MCP251XFD_FIFO8, .Size = MCP251XFD_FIFO_2_MESSAGE_DEEP, .Payload = MCP251XFD_PAYLOAD_64BYTE,
    .Direction = MCP251XFD_TRANSMIT_FIFO, .Attempts = MCP251XFD_THREE_ATTEMPTS,
    .Priority = MCP251XFD_MESSAGE_TX_PRIORITY16, .ControlFlags = MCP251XFD_FIFO_NO_RTR_RESPONSE,
    .InterruptFlags = MCP251XFD_FIFO_TX_ATTEMPTS_EXHAUSTED_INT + MCP251XFD_FIFO_TRANSMIT_FIFO_NOT_FULL_INT,
    .RAMInfos = &Ext1_FIFOs_RAMInfos[7], },
};

MCP251XFD_Filter MCP2517FD_Ext1_FilterList[MCP2517FD_EXT1_FILTER_COUNT] =
{
  { .Filter = MCP251XFD_FILTER0, .EnableFilter = true, .Match = MCP251XFD_MATCH_ONLY_SID,
    .AcceptanceID = 0x000, .AcceptanceMask = 0x600, .PointTo = MCP251XFD_FIFO1, }, // 0x000..0x1FF
  { .Filter = MCP251XFD_FILTER1, .EnableFilter = true, .Match = MCP251XFD_MATCH_ONLY_SID,
    .AcceptanceID = 0x200, .AcceptanceMask = 0x600, .PointTo = MCP251XFD_FIFO2, }, // 0x200..0x3FF
  { .Filter = MCP251XFD_FILTER2, .EnableFilter = true, .Match = MCP251XFD_MATCH_ONLY_SID,
    .AcceptanceID = 0x400, .AcceptanceMask = 0x600, .PointTo = MCP251XFD_FIFO3, }, // 0x400..0x5FF
  { .Filter = MCP251XFD_FILTER3, .EnableFilter = true, .Match = MCP251XFD_MATCH_ONLY_SID,
    .AcceptanceID = 0x600, .AcceptanceMask = 0x600, .PointTo = MCP251XFD_FIFO4, }, // 0x600..0x7FF
};
```

Example of FIFO and Filter configuration in a .h file:

```
#define MCP2517FD_EXT1_FIFO_COUNT    10
extern MCP251XFD_RAMInfos Ext1_TEF_RAMInfos;
extern MCP251XFD_RAMInfos Ext1_TXQ_RAMInfos;
extern MCP251XFD_FIFO MCP2517FD_Ext1_FIFOlist[MCP2517FD_EXT1_FIFO_COUNT];

#define MCP2517FD_EXT1_FILTER_COUNT  4
extern MCP251XFD_Filter MCP2517FD_Ext1_FilterList[MCP2517FD_EXT1_FILTER_COUNT];
```

# 7. DEVICE INITIALIZATION

*Note: After Power On, the device needs 3ms for the clock to stabilize. Be sure that the MCU takes more than 3ms to be configured or put a 3ms delay before device initialization.*

After configuring the device, you need to apply its configuration. To do this, it is pretty simple, first you need to call the *Init_MCP251XFD()* function with the MCP251XFD struct and the MCP251XFD_Config struct. If all went well, the function would return ERR_OK.

Next you need to call the *MCP251XFD_ConfigureFIFOList()* function with the list of MCP251XFD_FIFO struct. If all went well, the function would return ERR_OK.

Next you need to call the *MCP251XFD_ConfigureFilterList()* function with the list of MCP251XFD_Filter struct. If all went well, the function would return ERR_OK.

Currently, the device is still in configuration mode. You can call optional configurations like:

- The MCP251XFD_ConfigureTimeStamp() function if you need to use the Time Stamping of received frames or TEF. If all went well, the function would return ERR_OK.
- The MCP251XFD_ConfigureSleepMode() function if you need to put to sleep the device. If all went well, the function would return ERR_OK.

If you need a specific bit time configuration (like sample point), you can set it at this point. You need to:

1- Fill a MCP251XFD_BitTimeConfig structure with the specific parameters
2- Use the MCP251XFD_SetBitTimeConfiguration() function to set the custom bit time parameters (see §1.2.1 document to see how to manually calculate bit time)
3- [Optional] Use the MCP251XFD_CalculateBitrateStatistics() function to get the exact results of your custom bit time

At this time, if all went fine, the device is fully configured and ready to be connected on the CAN bus.

To do this, execute the function:

- MCP251XFD_StartCAN20() to start the device in CAN2.0 only mode
- MCP251XFD_StartCANFD() to start the device in both CAN2.0 and CAN-FD mode
- MCP251XFD_StartCANListenOnly() to start the device in CAN Listen-Only mode

If all went well, the function would return ERR_OK.

## 7.1. Example

Example of device initialization:

```
#define TIMESTAMP_TICK_us       ( 25 )                                          // TimeStamp tick is 25µs
#define TIMESTAMP_TICK(sysclk)  ( ((sysclk) / 1000000) * TIMESTAMP_TICK_us )

//============================================================================
// Configure the MCP251XFD device on EXT1
//============================================================================
eERRORRESULT ConfigureMCP251XFDDeviceOnEXT1(void)
{
  //--- Initialize Int pins or GPIOs ---
  MCP251XFD_Ext1_IntPinInit_V71(CANEXT1);       // Hardware dependent, not used by driver
  MCP251XFD_Ext1_Int0Gpio0PinInit_V71(CANEXT1); // Hardware dependent, not used by driver
  MCP251XFD_Ext1_Int1Gpio1PinInit_V71(CANEXT1); // Hardware dependent, not used by driver

  //--- Configure module on Ext1 ---
  eERRORRESULT ErrorExt1 = ERR__NO_DEVICE_DETECTED;
  ErrorExt1 = Init_MCP251XFD(CANEXT1, &MCP2517FD_Ext1_Config);
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  ErrorExt1 = MCP251XFD_ConfigureTimeStamp(CANEXT1, true, MCP251XFD_TS_CAN20_SOF_CANFD_SOF,
                                           TIMESTAMP_TICK(SYSCLK_Ext1), true);
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  ErrorExt1 = MCP251XFD_ConfigureFIFOList(CANEXT1, &MCP2517FD_Ext1_FIFOlist[0], MCP2517FD_EXT1_FIFO_COUNT);
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  ErrorExt1 = MCP251XFD_ConfigureFilterList(CANEXT1, MCP251XFD_D_NET_FILTER_DISABLE,
                                            &MCP2517FD_Ext1_FilterList[0], MCP2517FD_EXT1_FILTER_COUNT);
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  ErrorExt1 = MCP251XFD_StartCANFD(CANEXT1);
  return ErrorExt1;
}
```

This example is based on the example of configuration showed in §4.1, §5.5, and §6.3.

# 8. TRANSMIT A FRAME AND TRANSMIT FIFO MANAGEMENT

The simplest way to send a frame to a device is to call the MCP251XFD_TransmitMessageToFIFO() function for a FIFO (accept also TXQ) or the MCP251XFD_TransmitMessageToTXQ() function for the TXQ. But this function does not check the actual state of the FIFO. If you try to write a full FIFO, you will overwrite older FIFO/TXQ data.

So, before sending a message, you need to check the state of the FIFO by using the MCP251XFD_GetFIFOStatus() function and check if the is an interrupt flag that indicate there is a room for a frame.

If you have multiple transmit FIFO/TXQ, you can have all their status by calling:

- The MCP251XFD_GetTransmitInterruptStatusOfAllFIFO() function, which gives you a bit field image of the TXQ and all the 31 FIFO about their interrupt pending flag, and their attempt exhaust status flag.
- The MCP251XFD_GetTransmitPendingInterruptStatusOfAllFIFO() function, which gives you a bit field image of the TXQ and all the 31 FIFO about their interrupt pending flag only.

After you can check each bit in the field to know which FIFO has a room for a message, and then use the MCP251XFD_GetFIFOStatus() function to have more details.

If the MCU have access to interrupt pins of the device (INT and/or INT0), you can call:

- The MCP251XFD_GetCurrentTransmitFIFONameAndStatusInterrupt() function, which gives you the FIFO name and its status that generate the interrupt
- The MCP251XFD_GetCurrentTransmitFIFONameInterrupt() function, which gives you only the FIFO name that generate the interrupt

When you are sure that there is a room for a message, call the MCP251XFD_TransmitMessageToFIFO() (or MCP251XFD_TransmitMessageToTXQ()) function and you will send the message. If there are multiple room for messages, call the MCP251XFD_GetFIFOStatus() function at each time.

You do not need to clear the interrupts, the CAN controller will do it for you.

The MCP251XFD_ReceiveMessageFromFIFO() (or MCP251XFD_TransmitMessageToTXQ()) function needs a MCP251XFD_CANMessage struct where all data and information of the frame have to be sent. Do not forget to set a byte array for the payload data with the configured FIFO payload, the driver does not store this information and it will take too much time to get the information from the device.

## 8.1. Example

### 8.1.1. Send message to the only one Transmit FIFO with INT0

Example of how to send a message to a single transmit FIFO with interrupt INT0. Only FIFO2 is a transmit FIFO with interrupt on FIFO not full set, INT0 interrupt is set on GPIO0.

```
//======================================================================
// Transmit a message to MCP251XFD device on EXT1
//======================================================================
eERRORRESULT TransmitMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;

  if (ioport_get_pin_level(EXT1_INT0_PIN) == 0)      // Check INT0 pin status of the MCP251XFD (Active low state)
  {
    MCP251XFD_CANMessage TansmitMessage;
    //***** Fill the message as you want *****
    //TansmitMessage.MessageID    = messageID;
    //TansmitMessage.MessageSEQ   = messageSEQ;
    //TansmitMessage.ControlFlags = controlFlags;
    //TansmitMessage.DLC          = dlc;
    //TansmitMessage.PayloadData  = &payloadData[0];
    ErrorExt1 = MCP251XFD_TransmitMessageToFIFO(CANEXT1, &TansmitMessage, MCP251XFD_FIFO2, true); // Send message and
flush
  }
  return ErrorExt1;
}
```

### 8.1.2. Send message to the only one Transmit FIFO without INT0

Example of how to send a message to a single transmit FIFO. Only FIFO2 is a transmit FIFO with interrupt on FIFO not full set, INT0 pin is not used.

```
//=============================================================================
// Transmit a message to MCP251XFD device on EXT1
//=============================================================================
eERRORRESULT TransmitMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  eMCP251XFD_FIFOstatus FIFOstatus = 0;

  ErrorExt1 = MCP251XFD_GetFIFOStatus(CANEXT1, MCP251XFD_FIFO2, &FIFOstatus); // First get FIFO2 status
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  if ((FIFOstatus & MCP251XFD_TX_FIFO_NOT_FULL) > 0)                          // Second check FIFO not full
  {
    MCP251XFD_CANMessage TansmitMessage;
    //***** Fill the message as you want *****
    //TansmitMessage.MessageID    = messageID;
    //TansmitMessage.MessageSEQ   = messageSEQ;
    //TansmitMessage.ControlFlags = controlFlags;
    //TansmitMessage.DLC          = dlc;
    //TansmitMessage.PayloadData  = &payloadData[0];

    // Send message and flush
    ErrorExt1 = MCP251XFD_TransmitMessageToFIFO(CANEXT1, &TansmitMessage, MCP251XFD_FIFO2, true);
  }
  return ErrorExt1;
}
```

### 8.1.3. Send message to a Transmit FIFO with INT0

Example of how to send a message to a single transmit FIFO with interrupt INT0. Multiple FIFO are a transmit FIFO with interrupt on FIFO not full set, INT0 interrupt is set on GPIO0.

```
//=============================================================================
// Transmit a message to MCP251XFD device on EXT1
//=============================================================================
eERRORRESULT TransmitMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  eMCP251XFD_FIFO FIFOname;
  eMCP251XFD_FIFOstatus FIFOstatus = 0;

  if (ioport_get_pin_level(EXT1_INT0_PIN) == 0)        // Check INT0 pin status of the MCP251XFD (Active low state)
  {
    ErrorExt1 = MCP251XFD_GetCurrentTransmitFIFONameAndStatusInterrupt(CANEXT1, &FIFOname, &FIFOstatus);
    if (ErrorExt1 != ERR_OK) return ErrorExt1;         // First get which FIFO set interrupt and its status
    // Second check FIFO not empty
    if (((FIFOstatus & MCP251XFD_TX_FIFO_NOT_FULL) > 0) && (FIFOname != MCP251XFD_NO_FIFO))
    {
      MCP251XFD_CANMessage TansmitMessage;
      //***** Fill the message as you want *****
      //TansmitMessage.MessageID    = messageID;
      //TansmitMessage.MessageSEQ   = messageSEQ;
      //TansmitMessage.ControlFlags = controlFlags;
      //TansmitMessage.DLC          = dlc;
      //TansmitMessage.PayloadData  = &payloadData[0];

      // Send message and flush
      ErrorExt1 = MCP251XFD_TransmitMessageToFIFO(CANEXT1, &TansmitMessage, FIFOname, true);
    }
  }
  return ErrorExt1;
}
```

### 8.1.4. Send message to a Transmit FIFO without INT0

Example of how to send a message to a single transmit FIFO. Multiple FIFO are a transmit FIFO with interrupt on FIFO not full set.

```
//================================================================================
// Transmit messages to MCP251XFD device on EXT1
//================================================================================
eERRORRESULT TransmitMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  eMCP251XFD_FIFOstatus FIFOstatus = 0;
  setMCP251XFD_InterruptOnFIFO InterruptOnFIFO = 0;
  ErrorExt1 = MCP251XFD_GetTransmitPendingInterruptStatusOfAllFIFO(CANEXT1, &InterruptOnFIFO); // Get all FIFO status
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  for (eMCP251XFD_FIFO zFIFO = 0; zFIFO < MCP251XFD_TX_FIFO_MAX; zFIFO++) // For each transmit FIFO, TXQ but not TEF
    if ((InterruptOnFIFO & (1 << zFIFO)) > 0)                             // If an Interrupt is flagged
    {
      ErrorExt1 = MCP251XFD_GetFIFOStatus(CANEXT1, zFIFO, &FIFOstatus);   // Get the status of the flagged FIFO
      if (ErrorExt1 != ERR_OK) return ErrorExt1;
      if ((FIFOstatus & MCP251XFD_TX_FIFO_NOT_FULL) > 0)                  // Check FIFO not empty
      {
        MCP251XFD_CANMessage TansmitMessage;
        //***** Fill the message as you want *****
        //TansmitMessage.MessageID    = messageID;
        //TansmitMessage.MessageSEQ   = messageSEQ;
        //TansmitMessage.ControlFlags = controlFlags;
        //TansmitMessage.DLC          = dlc;
        //TansmitMessage.PayloadData  = &payloadData[0];
        ErrorExt1 = MCP251XFD_TransmitMessageToFIFO(CANEXT1, &TansmitMessage, zFIFO, true); // Send message and flush
      }
    }
  return ErrorExt1;
}
```

# 9. RECEIVE A FRAME AND RECEIVE FIFO MANAGEMENT

The simplest way to get a receive frame from a device is to call the MCP251XFD_ReceiveMessageFromFIFO() function for a FIFO (accept also TEF) or the MCP251XFD_ReceiveMessageToTEF() function for the TEF. But this function does not check the actual state of the FIFO. If you try to read an empty FIFO, you will get garbage data.

So, before getting a message, you need to check the state of the FIFO/TEF by using the MCP251XFD_GetFIFOStatus() function and check if the is an interrupt flag that indicate there is a frame received.

If you have multiple receive FIFO (TEF needs to be address specifically), you can have all their status by calling:

- The MCP251XFD_GetReceiveInterruptStatusOfAllFIFO() function, which gives you a bit field image of all the 31 FIFO (TEF not included) about their interrupt pending flag, and their overflow status flag.
- The MCP251XFD_GetReceivePendingInterruptStatusOfAllFIFO() function, which gives you a bit field image of all the 31 FIFO about their interrupt pending flag only.

After you can check each bit in the field to know which FIFO has a message pending, and then use the MCP251XFD_GetFIFOStatus() function to have more details.

If the MCU have access to interrupt pins of the device (INT and/or INT1), you can call:

- The MCP251XFD_GetCurrentReceiveFIFONameAndStatusInterrupt() function, which gives you the FIFO/TEF name and its status that generate the interrupt
- The MCP251XFD_GetCurrentReceiveFIFONameInterrupt() function, which gives you only the FIFO/TEF name that generate the interrupt

When you are sure that a message is pending, call the MCP251XFD_ReceiveMessageFromFIFO() (or MCP251XFD_ReceiveMessageToTEF()) function and you will get the message. If there are multiple messages pending, call the MCP251XFD_GetFIFOStatus() function at each time.

You do not need to clear the interrupts, the CAN controller will do it for you.

The MCP251XFD_ReceiveMessageFromFIFO() (or MCP251XFD_ReceiveMessageToTEF()) function needs a MCP251XFD_CANMessage struct where all known data of the frame will be stored. Do not forget to set a byte array for the payload data with the configured FIFO payload, the driver doesn't store this information and it will take too much time to get the information from the device.

## 9.1. Example

### 9.1.1. Get message from the only one Receive FIFO with INT1

Example of how to get a message from a single receive FIFO with interrupt INT1. Only FIFO1 is a receive FIFO with interrupt on FIFO not empty set, INT1 interrupt is set on GPIO1.

```
//============================================================================
// Receive a message from MCP251XFD device on EXT1
//============================================================================
eERRORRESULT ReceiveMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;

  if (ioport_get_pin_level(EXT1_INT1_PIN) == 0)      // Check INT1 pin status of the MCP251XFD (Active low state)
  {
    uint32_t MessageTimeStamp = 0;
    uint8_t RxPayloadData[64];                       // In this example, the FIFO1 have 64 bytes of payload
    MCP251XFD_CANMessage ReceivedMessage;
    ReceivedMessage.PayloadData = &RxPayloadData[0]; // Add receive payload data pointer to the message structure
                                                     // that will be received
    ErrorExt1 = MCP251XFD_ReceiveMessageFromFIFO(CANEXT1, &ReceivedMessage, MCP251XFD_PAYLOAD_64BYTE,
                                                 &MessageTimeStamp, MCP251XFD_FIFO1);
    if (ErrorExt1 == ERR_OK)
    {
      //***** Do what you want with the message *****

    }
  }
  return ErrorExt1;
}
```

### 9.1.2. Get message from the only one Receive FIFO without INT1

Example of how to get a message from a single receive FIFO. Only FIFO1 is a receive FIFO with interrupt on FIFO not empty set, INT1 pin is not used.

```
//======================================================================
// Receive a message from MCP251XFD device on EXT1
//======================================================================
eERRORRESULT ReceiveMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  eMCP251XFD_FIFOstatus FIFOstatus = 0;

  ErrorExt1 = MCP251XFD_GetFIFOStatus(CANEXT1, MCP251XFD_FIFO1, &FIFOstatus); // First get FIFO1 status
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  if ((FIFOstatus & MCP251XFD_RX_FIFO_NOT_EMPTY) > 0) // Second check FIFO not empty
  {
    uint32_t MessageTimeStamp = 0;
    uint8_t RxPayloadData[64];                      // In this example, the FIFO1 have 64 bytes of payload
    MCP251XFD_CANMessage ReceivedMessage;
    ReceivedMessage.PayloadData = &RxPayloadData[0];  // Add receive payload data pointer to the message structure
                                                      // that will be received
    ErrorExt1 = MCP251XFD_ReceiveMessageFromFIFO(CANEXT1, &ReceivedMessage, MCP251XFD_PAYLOAD_64BYTE,
                                                 &MessageTimeStamp, MCP251XFD_FIFO1);
    if (ErrorExt1 == ERR_OK)
    {
      //***** Do what you want with the message *****

    }
  }
  return ErrorExt1;
}
```

### 9.1.3. Get message from a Receive FIFO with INT1

Example of how to get a message from a single receive FIFO with interrupt INT1. Multiple FIFO are a receive FIFO with interrupt on FIFO not empty set, INT1 interrupt is set on GPIO1.

```
//======================================================================
// Receive a message from MCP251XFD device on EXT1
//======================================================================
eERRORRESULT ReceiveMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  eMCP251XFD_FIFO FIFOname;
  eMCP251XFD_FIFOstatus FIFOstatus = 0;

  if (ioport_get_pin_level(EXT1_INT1_PIN) == 0)        // Check INT1 pin status of the MCP251XFD (Active low state)
  {
    ErrorExt1 = MCP251XFD_GetCurrentReceiveFIFONameAndStatusInterrupt(CANEXT1, &FIFOname, &FIFOstatus);
    if (ErrorExt1 != ERR_OK) return ErrorExt1;          // First get which FIFO set interrupt and its status
    // Second check FIFO not empty
    if (((FIFOstatus & MCP251XFD_RX_FIFO_NOT_EMPTY) > 0) && (FIFOname != MCP251XFD_NO_FIFO))
    {
      uint32_t MessageTimeStamp = 0;
      uint8_t RxPayloadData[8];                         // In this example, all the FIFO have 8 bytes of payload
      MCP251XFD_CANMessage ReceivedMessage;
      ReceivedMessage.PayloadData = &RxPayloadData[0]; // Add receive payload data pointer to the message structure
                                                       // that will be received
      ErrorExt1 = MCP251XFD_ReceiveMessageFromFIFO(CANEXT1, &ReceivedMessage, MCP251XFD_PAYLOAD_8BYTE,
                                                   &MessageTimeStamp, MCP251XFD_FIFO1);
      if (ErrorExt1 == ERR_OK)
      {
        //***** Do what you want with the message *****

      }
    }
  }
  return ErrorExt1;
}
```

### 9.1.4. Get message from a Receive FIFO without INT1

Example of how to get a message from a single receive FIFO. Multiple FIFO are a receive FIFO with interrupt on FIFO not empty set.

```
//============================================================================
// Receive messages from MCP251XFD device on EXT1
//============================================================================
eERRORRESULT ReceiveMessageFromEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  eMCP251XFD_FIFOstatus FIFOstatus = 0;
  setMCP251XFD_InterruptOnFIFO InterruptOnFIFO = 0;
  ErrorExt1 = MCP251XFD_GetReceivePendingInterruptStatusOfAllFIFO(CANEXT1, &InterruptOnFIFO); // Get all FIFO status
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  for (eMCP251XFD_FIFO zFIFO = 1; zFIFO < MCP251XFD_FIFO_MAX; zFIFO++)  // For each receive FIFO but not TEF, TXQ
    if ((InterruptOnFIFO & (1 << zFIFO)) > 0)                           // If an Interrupt is flagged
    {
      ErrorExt1 = MCP251XFD_GetFIFOStatus(CANEXT1, zFIFO, &FIFOstatus); // Get the status of the flagged FIFO
      if (ErrorExt1 != ERR_OK) return ErrorExt1;
      if ((FIFOstatus & MCP251XFD_RX_FIFO_NOT_EMPTY) > 0) // Check FIFO not empty
      {
        uint32_t MessageTimeStamp = 0;
        uint8_t RxPayloadData[8];                         // In this example, all the FIFO have 8 bytes of payload
        MCP251XFD_CANMessage ReceivedMessage;
        ReceivedMessage.PayloadData = &RxPayloadData[0];  // Add receive payload data pointer to the message
                                                          // structure that will be received
        ErrorExt1 = MCP251XFD_ReceiveMessageFromFIFO(CANEXT1, &ReceivedMessage, MCP251XFD_PAYLOAD_8BYTE,
                                                     &MessageTimeStamp, zFIFO);
        if (ErrorExt1 == ERR_OK)
        {
          //***** Do what you want with the message *****

        }
      }
    }
  return ErrorExt1;
}
```

# 10. SLEEP

First of all, you need to configure to device Sleep Mode with the MCP251XFD_ConfigureSleepMode() function. You can configure at device initialization if you will use always the same Sleep Mode (see §7) or right before putting the device in Sleep Mode. It is at the configuration of the Sleep Mode that you indicate the Sleep Mode or Deep Sleep Mode.

To put a device in Sleep Mode (MCP2517FD and MCP2518FD) or Deep Sleep Mode (MCP2518FD only), just use the MCP251XFD_EnterSleepMode() function. If all went well, the function would return ERR_OK.

If you want to manually wake up the device, simply use the MCP251XFD_WakeUp() function. If all went well, the function would return ERR_OK.

After waking up, if the device was in Sleep Mode, then the device is in configuration mode.

After waking up, if the device was in Deep Sleep Mode, then the device needs a complete initialization (see §7) because a wake up from Deep Sleep Mode is similar to a Power-On-Reset. *After Power On, the device needs 3ms for the clock to stabilize.*

The MCP251XFD_WakeUp() function can tell from which Sleep Mode the device is wake up. You can use it to take the proper action. If you know the Sleep Mode, then put a NULL on this parameter.

If the device is wake up from the CAN bus, then there is two ways to know that:

- By using the MCP251XFD_IsDeviceInSleepMode() function regularly. This function works only if the device is not in Deep Sleep Mode, because a simple assert of SPI Chip Select wakes up from Deep Sleep Mode, so it is impossible to ask the device if it is actually in Deep Sleep Mode.
- By checking MCP251XFD_WAKEUP_INTERRUPT flag code and MCP251XFD_INT_BUS_WAKEUP_EVENT interrupt event regularly or when the INT pin goes low level.

The MCP251XFD_WAKEUP_INTERRUPT flag code is mainly available when the device is in Sleep Mode whereas MCP251XFD_INT_BUS_WAKEUP_EVENT interrupt event stays up after a Deep Sleep wake up or after a Sleep. If you want to know from which state the device was wake up by CAN bus, use the MCP251XFD_BusWakeUpFromState() function.

After a wake up from bus, it is mandatory to call the MCP251XFD_BusWakeUpFromState() function, otherwise the driver will think that the device is still in Sleep Mode and will refuse most of interactions with the device by thinking the device is in Sleep Mode.

Note: You can also use the MCP251XFD_Config.ClkoPinConfig configured as MCP251XFD_CLKO_SOF and linked to the MCU as an interrupt pin to detect the device wake up.

## 10.1. Examples

### 10.1.1. Put device in sleep mode

Example of putting device in sleep mode:

```
//=============================================================================
// Put in Sleep Mode device on EXT1
//=============================================================================
eERRORRESULT PutInSleepModeDeviceOnEXT1(void)
{
  eERRORRESULT ErrorExt1;
  ErrorExt1 = MCP251XFD_ConfigureSleepMode(CANEXT1, false, MCP251XFD_T11FILTER_300ns, true);
  if (ErrorExt1 == ERR_OK)
  {
    ErrorExt1 == MCP251XFD_EnterSleepMode(CANEXT1);
    // Here the device is in sleep mode
  }
  return ErrorExt1;
}

//=============================================================================
// Put in Deep Sleep Mode device on EXT1
//=============================================================================
eERRORRESULT PutInDeepSleepModeDeviceOnEXT1(void)
{
  eERRORRESULT ErrorExt1;
  ErrorExt1 = MCP251XFD_ConfigureSleepMode(CANEXT1, true, MCP251XFD_T11FILTER_300ns, true);
  if (ErrorExt1 == ERR_OK)
  {
    ErrorExt1 == MCP251XFD_EnterSleepMode(CANEXT1);
    // Here the device is in deep sleep mode
  }
```

```
  else
  {
    if (ErrorExt1 == ERR__NOT_SUPPORTED)
    {
      // Goes here if the device is a MCP2517FD which does not support DeepSleep
    }
  }
  return ErrorExt1;
}
```

### 10.1.2. Manually wake up device from sleep mode

Example of manually wake up device from sleep mode:

```
//======================================================================
// Do actions after a wake up of the MCP251XFD device on EXT1
//======================================================================
eERRORRESULT AfterWakeUpActionsOnEXT1(eMCP251XFD_PowerStates fromState)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  switch (fromState)
  {
    case MCP251XFD_DEVICE_SLEEP_STATE:           // In sleep state, the device is wake up but in configuration mode
      ErrorExt1 = MCP251XFD_StartCANFD(CANEXT1); // Start the CAN-FD mode
      break;
    case MCP251XFD_DEVICE_LOWPOWER_SLEEP_STATE: // The device is wake up from deep sleep is similar to a Power On Rese
      delay_ms(3); // Wait 3ms for the clock to stabilize. This is mandatory for the wake up from deep sleep mode
      ErrorExt1 = ConfigureMCP251XFDDeviceOnEXT1(); // The device need a complete reconfiguration
      break;
    default:
      break;
  }
  return ErrorExt1;
}

//======================================================================
// Wake Up device on EXT1
//======================================================================
eERRORRESULT WakeUpDeviceOnEXT1(void)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  eMCP251XFD_PowerStates PowerStateBeforeWakeUp;
  ErrorExt1 = MCP251XFD_WakeUp(CANEXT1, &PowerStateBeforeWakeUp); // Wake up device
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  // Device is wake up
  ErrorExt1 = AfterWakeUpActionsOnEXT1(PowerStateBeforeWakeUp);
  return ErrorExt1;
}
```

### 10.1.3. Automatic wake up device from sleep mode by CAN

Example of how to know the device is wake up from sleep mode by CAN:

```
//======================================================================
// Do actions after a wake up of the MCP251XFD device on EXT1
//======================================================================
eERRORRESULT AfterWakeUpActionsOnEXT1(eMCP251XFD_PowerStates fromState)
{
  eERRORRESULT ErrorExt1 = ERR_OK;
  switch (fromState)
  {
    case MCP251XFD_DEVICE_SLEEP_STATE:           // In sleep state, the device is wake up but in configuration mode
      ErrorExt1 = MCP251XFD_StartCANFD(CANEXT1); // Start the CAN-FD mode
      break;
    case MCP251XFD_DEVICE_LOWPOWER_SLEEP_STATE: // The device is wake up from deep sleep is similar to a Power On Rese
      delay_ms(3); // Wait 3ms for the clock to stabilize. This is mandatory for the wake up from deep sleep mode
      ErrorExt1 = ConfigureMCP251XFDDeviceOnEXT1(); // The device need a complete reconfiguration
      break;
    default:
      break;
  }
  return ErrorExt1;
}
```

```
//=============================================================================
// Check device interrupt on EXT1
//=============================================================================
void CheckDeviceINTOnEXT1(void)
{
  eERRORRESULT ErrorExt1;
  setMCP251XFD_InterruptEvents Events;
  eMCP251XFD_PowerStates PowerStateBeforeWakeUp;
  eMCP251XFD_InterruptFlagCode InterruptCode = 0;

  ErrorExt1 = MCP251XFD_GetCurrentInterruptEvent(CANEXT1, &InterruptCode); // Get the current Interrupt event
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  switch (InterruptCode)
  {
    // Here handle others interrupts

    case MCP251XFD_WAKEUP_INTERRUPT:        // Wake-up interrupt
      ErrorExt1 = MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_BUS_WAKEUP_EVENT);
      if (ErrorExt1 != ERR_OK) return ErrorExt1;
      PowerStateBeforeWakeUp = MCP251XFD_BusWakeUpFromState(CANEXT1);
      ErrorExt1 = AfterWakeUpActionsOnEXT1(PowerStateBeforeWakeUp);
      if (ErrorExt1 != ERR_OK) return ErrorExt1;
      break;

    default:
      //--- Check others interrupts ---
      ErrorExt1 = MCP251XFD_GetInterruptEvents(CANEXT1, &Events);
      if (ErrorExt1 != ERR_OK) return ErrorExt1;
      if ((Events & MCP251XFD_INT_BUS_WAKEUP_EVENT) > 0) // Wake-up event (here is the one for the deep sleep state
                                                         // with wakeup from bus)
      { // Why here? Because there is a flood of events when wakeup in this specific case, and this one is the most
           important but not the one with the highest priority
        ErrorExt1 = MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_BUS_WAKEUP_EVENT);
        if (ErrorExt1 != ERR_OK) return ErrorExt1;
        PowerStateBeforeWakeUp = MCP251XFD_BusWakeUpFromState(CANEXT1);
        ErrorExt1 = AfterWakeUpActionsOnEXT1(PowerStateBeforeWakeUp);
        if (ErrorExt1 != ERR_OK) return ErrorExt1;
      }
      break;
  }
  return ErrorExt1;
}
```

# 11. INTERRUPT MANAGEMENT

The interrupt management can return multiple interrupts at the same time, depending on which interrupt you have enabled on the MCP251XFD_Config.SysInterruptFlags configuration. If there is an interrupt the INT pin will be in low level state.

If you use the INT pin, regularly check its state to know if there are pending interrupt flags. If you do not use the INT pin, you must check regularly the interrupt flags.

You have 2 main ways to check interrupts, both are complementary:

- The MCP251XFD_GetCurrentInterruptEvent() function, which gives you the current interrupt including from specific FIFO/TEF/TXQ but not some specific errors and is lost after a wake up from Deep Sleep
- The MCP251XFD_GetInterruptEvents() function, which gives you general and specific errors (all at once) but not what FIFO generate the interrupt but is available after a wake up from Deep Sleep

All depend on how you configure the device and what do you want to do. Of course, you can use both as shown in the example §11.1 but if you use INT0 and INT1 pins the MCP251XFD_GetCurrentInterruptEvent() function may not be useful. If you use the Deep Sleep Mode, the MCP251XFD_GetInterruptEvents() function is almost mandatory to use (see §10).

Some interrupt needs to be cleared manually, see eMCP251XFD_InterruptEvents or the example §11.1.
For more information about the interrupt, see DS20005678D, §10.0.

## 11.1. Example

Example of all possible interrupt that can be catch:

```
//============================================================================
// Check device interrupt (INT) on EXT1
//============================================================================
void CheckDeviceINTOnEXT1(void)
{
  eERRORRESULT ErrorExt1;

#ifdef APP_USE_EXT1_INT_PIN
  if (ioport_get_pin_level(EXT1_INT_PIN) != 0) return; // Check INT pin status of the MCP251XFD (Active low state)
#endif
  eMCP251XFD_InterruptFlagCode InterruptCode = 0;
  ErrorExt1 = MCP251XFD_GetCurrentInterruptEvent(CANEXT1, &InterruptCode); // Get the current Interrupt event
  if (ErrorExt1 != ERR_OK) return ErrorExt1;
  switch (InterruptCode)
  {
    case MCP251XFD_ERROR_INTERRUPT:         // Error Interrupt
      LOGERROR("Ext1: CAN Bus Error");
      MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_BUS_ERROR_EVENT);
      break;

    case MCP251XFD_WAKEUP_INTERRUPT:        // Wake-up interrupt
      // See Sleep §10
      MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_BUS_WAKEUP_EVENT);
      break;

    case MCP251XFD_RECEIVE_FIFO_OVF:        // Receive FIFO Overflow Interrupt
      // Only available on INT pin not on INT1 pin
      // Use MCP251XFD_GetReceiveOverflowInterruptStatusOfAllFIFO() function to get all FIFOs with overflow
      // and clear them manually with MCP251XFD_ClearFIFOOverflowEvent() function (for FIFO and TEF)
      // or MCP251XFD_ClearTEFOverflowEvent for the TEF
      break;

    case MCP251XFD_TRANSMIT_ATTEMPT:        // Transmit Attempt Interrupt
      // Only available on INT pin not on INT1 pin
      // Use MCP251XFD_GetTransmitAttemptInterruptStatusOfAllFIFO() function to get all FIFOs with attempt exhaust
      // and clear them manually with MCP251XFD_ClearFIFOAttemptsEvent() function (for FIFO and TXQ)
      // or MCP251XFD_ClearTXQAttemptsEvent for the TXQ
      break;

    case MCP251XFD_ADDRESS_ERROR_INTERRUPT:
      // Address Error Interrupt (illegal FIFO address presented to system)
      MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_SYSTEM_ERROR_EVENT);
      break;

    case MCP251XFD_RXTX_MAB_OVF_UVF:
      // RX MAB Overflow (RX: message received before previous message was saved to memory)
      MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_SYSTEM_ERROR_EVENT);
      break;
```

```
    case MCP251XFD_TBC_OVF_INTERRUPT:       // TBC Overflow
      // The time base for the timestamp overflow (32-bits)
      MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_TIME_BASE_COUNTER_EVENT);
      break;

    case MCP251XFD_OPMODE_CHANGE_OCCURED:   // Operation Mode Change Occurred
      //eMCP251XFD_OperationMode OpMode;
      //MCP251XFD_GetActualOperationMode(CANEXT1, &OpMode);
      MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_OPERATION_MODE_CHANGE_EVENT);
      break;

    case MCP251XFD_INVALID_MESSAGE_OCCURED: // Invalid Message Occurred
      // Invalid Message Occurred
      MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_RX_INVALID_MESSAGE_EVENT);
      break;

    case MCP251XFD_TRANSMIT_EVENT_FIFO:     // Transmit Event FIFO Interrupt (TEF)
      // Events on TEF are only available on INT pin not on INT1 pin
      // Use MCP251XFD_GetTEFStatus() function to get its status
      // and MCP251XFD_ReceiveMessageFromFIFO() to get the frame
      break;

    case MCP251XFD_TXQ_INTERRUPT:           // TXQ Interrupt (TFIF<0> set)
    case MCP251XFD_FIFO1_INTERRUPT:         // FIFO 1 Interrupt (TFIF<1> or RFIF<1> set)
      /* ... */
    case MCP251XFD_FIFO31_INTERRUPT:        // FIFO 31 Interrupt (TFIF<31> or RFIF<31> set)
      // If you only have the INT pin an no INT0 or INT1, TXQ and FIFO1 through FIFO31 interrupts can be catch here
      // See §8 and §9 to know what to do here
      break;

    case MCP251XFD_NO_INTERRUPT:            // No interrupt, do nothing
      break;

    default:
      //--- Check others interrupts ---
      setMCP251XFD_InterruptEvents Events;
      MCP251XFD_GetInterruptEvents(CANEXT1, &Events);

      if ((Events & MCP251XFD_INT_BUS_WAKEUP_EVENT) > 0) // Wake-up event (deep sleep state with wakeup from bus)
      {
        // See Sleep §10
        MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_BUS_WAKEUP_EVENT);
      }

      if ((Events & MCP251XFD_INT_SPI_CRC_EVENT) > 0) // SPI CRC event
      {
        setMCP251XFD_CRCEvents CRCEvent;
        MCP251XFD_GetCRCEvents(CANEXT1, &CRCEvent, NULL);
        if (CRCEvent == MCP251XFD_CRC_CRCERR_EVENT)
            LOGERROR("Ext1: CRC mismatch occurred");
        else LOGERROR("Ext1: Number of Bytes mismatch during 'SPI with CRC' command occurred");
        MCP251XFD_ClearCRCEvents(CANEXT1);
      }

      if ((Events & MCP251XFD_INT_RAM_ECC_EVENT) > 0) // ECC event
      {
        uint16_t AddrError = 0;
        setMCP251XFD_ECCEvents ECCEvent;
        MCP251XFD_GetECCEvents(CANEXT1, &ECCEvent, &AddrError);
        if (ECCEvent == MCP251XFD_ECC_SEC_EVENT)
            /* ECC Single Error was corrected */;
        else /* ECC Double Error was detected*/;
        MCP251XFD_ClearECCEvents(CANEXT1);
      }

      if ((Events & MCP251XFD_INT_BUS_ERROR_EVENT) > 0) // Bus error event
      {
        //MCP251XFD_GetBusDiagnostic();
        //MCP251XFD_ClearBusDiagnostic();
        MCP251XFD_ClearInterruptEvents(CANEXT1, MCP251XFD_INT_BUS_ERROR_EVENT);
      }
      break;
  }
}
```

# 12. GPIO USAGE

Normally the GPIOs pins are already configured when calling the *Init_MCP251XFD()* function with the MCP251XFD struct and the MCP251XFD_Config struct, but you can change the configuration thereafter by calling the MCP251XFD_ConfigurePins() function.

To change the direction of one or more pins, you need to call the MCP251XFD_SetGPIOPinsDirection() function. This function have a 'pinsChangeMask' parameter to select which pin have to be modified. For both parameters, the bit 0 is the GPIO0 and the bit 1 is the GPIO1.

| pinsDirection | pinsChangeMask | GPIO0 | GPIO1 |
|---|---|---|---|
| - | 0b00 | No change | No change |
| 0b00 | 0b01 | OUTPUT | No change |
| 0b01 | 0b01 | INPUT | No change |
| 0b10 | 0b01 | OUTPUT | No change |
| 0b11 | 0b01 | INPUT | No change |
| 0b00 | 0b10 | No change | OUTPUT |
| 0b01 | 0b10 | No change | OUTPUT |
| 0b10 | 0b10 | No change | INPUT |
| 0b11 | 0b10 | No change | INPUT |
| 0b00 | 0b11 | OUTPUT | OUTPUT |
| 0b01 | 0b11 | INPUT | OUTPUT |
| 0b10 | 0b11 | OUTPUT | INPUT |
| 0b11 | 0b11 | INPUT | INPUT |

The defines indicate in 16.8.2 can be used and OR'ed if necessary.

The MCP251XFD_GetGPIOPinsInputLevel() function return the actual status of all GPIO where a corresponding 'pinsState' status bit '0' is low level and '1' is high level.

To change the output level of one or more pins, you need to call the MCP251XFD_SetGPIOPinsOutputLevel() function. This function have a 'pinsChangeMask' parameter to select which pin have to be modified. For both parameters, the bit 0 is the GPIO0 and the bit 1 is the GPIO1.

| pinsLevel | pinsChangeMask | GPIO0 | GPIO1 |
|---|---|---|---|
| - | 0b00 | No change | No change |
| 0b00 | 0b01 | LOW | No change |
| 0b01 | 0b01 | HIGH | No change |
| 0b10 | 0b01 | LOW | No change |
| 0b11 | 0b01 | HIGH | No change |
| 0b00 | 0b10 | No change | LOW |
| 0b01 | 0b10 | No change | LOW |
| 0b10 | 0b10 | No change | HIGH |
| 0b11 | 0b10 | No change | HIGH |
| 0b00 | 0b11 | LOW | LOW |
| 0b01 | 0b11 | HIGH | LOW |
| 0b10 | 0b11 | LOW | HIGH |
| 0b11 | 0b11 | HIGH | HIGH |

The defines indicate in 16.8.2 can be used and OR'ed if necessary.

# 13. BITRATES, SPEED, AND TIMING CALCULATION

The purpose of this paragraph is to give some formulas and data to determine the SPI bus load and the CAN bus load in some cases.

## 13.1. CAN Bitrates

Here are all possible configurations with exact bitrate with a SYSCLK of 20MHz and 40MHz. Here are listed only the normalized bitrates by CAN specification.

### 13.1.1. Data, characteristics, and specifications

As indicate in the datasheets (Table 7-4), this is the CAN bit rate range:

| AC Specifications | | Electrical Characteristics:<br>Extended (E): TAMB = –40°C to +125°C; High (H): TAMB = –40°C to +150°C<br>VDD = 2.7V to 5.5V | | | | |
|---|---|---|---|---|---|---|
| Sym | Characteristic | Min | Typ | Max | Units | Conditions/Comments |
| BRNOM | Nominal Bit Rate | 0.125 | 0.5 | 1 | Mbps | |
| BRDATA | Data Bit Rate | 0.5 | 2 | 8 | Mbps | BRDATA ≥ BRNOM |

*Table 2 - CAN bit rate range*

These are tested bit rates by Microchip. Device allows the configuration of more bit rates, including slower bit rates than the minimum stated. Lower or higher bitrates than specified are more stable with the MCP2518FD device than the MCP2517FD device. In such case, the device can enter in Restricted Operation Mode and/or have some errors counted in the bus diagnostic registers (see §16.16 for functions to get it).

### 13.1.2. CAN 2.0 possible CAN Bitrates

Following the Table 2, the normalized possible Nominal Bitrates with exact bitrate are:

| 20MHz | 40MHz |
|---|---|
| 125kbps | 125kbps |
| 160kbps | 160kbps |
| 200kbps | 200kbps |
| 250kbps | 250kbps |
| 312.5kbps | 312.5kbps |
| - | 320kbps |
| 400kbps | 400kbps |
| 500kbps | 500kbps |
| 625kbps | 625kbps |
| 800kbps | 800kbps |
| 1000kbps | 1000kbps |

*Table 3 - CAN2.0 exact Nominal Bitrates*

### 13.1.1. CAN-FD possible CAN Bitrates

Following the Table 2, the normalized possible Nominal and Data Bitrates with exact bitrate are:

| 20MHz | | 40MHz | |
|---|---|---|---|
| **Nominal Bitrate** | **Data Bitrate** | **Nominal Bitrate** | **Data Bitrate** |
| 125 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 125 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 160 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2Mbps, 4Mbps, 5Mbps | 160 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 200 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 200 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |

| | | | |
|---|---|---|---|
| 250 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 250 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 312,5 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 312,5 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| | - | 320 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 400 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 400 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 500 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 500 kbps | 500kbps, 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 625 kbps | 625kbps, 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 625 kbps | 625kbps, 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 800 kbps | 800kbps, 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 800 kbps | 800kbps, 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |
| 1000 kbps | 1Mbps, 1.25Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps | 1000 kbps | 1Mbps, 1.25Mbps, 1.6Mbps, 2Mbps, 2.5Mbps, 4Mbps, 5Mbps, 8Mbps |

*Table 4 - CAN-FD exact Nominal and Data Bitrates*

## 13.2. CAN Nominal and Data speed frames count

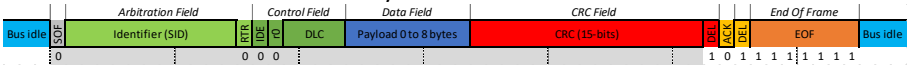
CAN 2.0 frame speed use only the Nominal bit time. CAN-FD frame speed use both Nominal and Data bit time.

A CAN frame begin with 1 bit of Start-Of-Frame, followed with an Arbitration Field. Next is the Control Field. After that the Data Field which is variable. At the end is the CRC Field followed with End-Of-Frame. A minimum of 3 bit is necessary between frames.

CAN protocol use a Non-Return-Zero. This force a bit change every 5 consecutive bits of the same polarity. This bit stuffing begins with the Start-Of-Frame. It ends on the last bit of the CRC Field for the CAN2.0 frames and the CAN-FD NON-ISO frames. It ends on the last bit of the Data Field for the CAN-FD ISO frames.

### 13.2.1. CAN2.0A - Base Data Frames

A CAN2.0A frame is constituted by:




The minimum bit count to send a frame is: $MinCAN20ABitCount = 44 + 8 \times DLC$. But with bit stuffing the minimum is:

$$MinCAN20ABitCount = 44 + 8 \times DLC + 1 \quad (1.5)$$

This is because there is a bit stuffing in the Control Field that is impossible to skip.

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate is: $\frac{1000000}{45+3} = 20833\ frame\ per\ second.$

The maximum possible frame with 8-byte DLC at 1Mbit/s Nominal Bit Rate is: $\frac{1000000}{109+3} = 8928\ frame\ per\ second.$

Here are some real data for the minimum bit count:

| DLC | Min theorical | Min real | Frame example |
|---|---|---|---|
| 0 | 45 | 45 | `SID: 0x084; RTR: 0; IDE: 0; r0: 0; DLC: 0` |
| 1 | 53 | 53 | `SID: 0x085; RTR: 0; IDE: 0; r0: 0; DLC: 1; Data0: 0x08` |
| 2 | 61 | 61 | `SID: 0x089; RTR: 0; IDE: 0; r0: 0; DLC: 2; Data0: 0x11, Data1: 0x08` |
| 3 | 69 | 69 | `SID: 0x084; RTR: 0; IDE: 0; r0: 0; DLC: 3; Data0: 0x09, Data1: 0x09, Data2: 0x08` |
| 4 | 77 | 76 | `SID: 0x085; RTR: 0; IDE: 0; r0: 0; DLC: 4; Data0: 0x21, Data1: 0x09, Data2: 0x09, Data3: 0x08` |
| 5 | 85 | ? | |
| 6 | 93 | ? | |
| 7 | 101 | ? | |
| 8 | 109 | ? | |

The maximum theorical bit count to send a frame is:

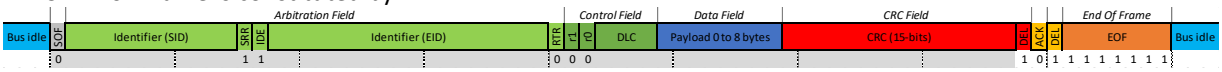
$$MaxCAN20ABitCount = (44 + 8 \times DLC) + \frac{34+8\times DLC-1}{4} - 3 \quad (1.6)$$

Here are some real data for the maximum bit count:

| DLC | Max theorical | Max real | Frame example |
|---|---|---|---|
| 0 | 49 | 50 | SID: 0x000; RTR: 0; IDE: 0; r0: 0; DLC: 0 |
| 1 | 59 | 59 | SID: 0x078; RTR: 0; IDE: 0; r0: 0; DLC: 1; Data0: 0x01 |
| 2 | 69 | 69 | SID: 0x041; RTR: 0; IDE: 0; r0: 0; DLC: 2; Data0: 0x04, Data1: 0x00 |
| 3 | 79 | 80 | SID: 0x41F; RTR: 0; IDE: 0; r0: 0; DLC: 3; Data0: 0xDF, Data1: 0x0F, Data2: 0x08 |
| 4 | 89 | 90 | SID: 0x03E; RTR: 0; IDE: 0; r0: 0; DLC: 4; Data0: 0x10, Data1: 0x78, Data2: 0x03, Data3: 0xFE |
| 5 | 99 | ? | |
| 6 | 109 | ? | |
| 7 | 119 | ? | |
| 8 | 129 | ? | |

### 13.2.2. CAN2.0B - Extended Data Frames

A CAN2.0B frame is constituted by:




The minimum bit count to send a frame is: $MinCAN20BBitCount = 64 + 8 \times DLC$. But with bit stuffing the minimum is:

$$MinCAN20BBitCount = 64 + 8 \times DLC + 1 \quad (1.7)$$

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate is: $\frac{1000000}{65+3} = 14705\ frame\ per\ second.$

The maximum possible frame with 8-byte DLC at 1Mbit/s Nominal Bit Rate is: $\frac{1000000}{129+3} = 7575\ frame\ per\ second.$

This is because there is a bit stuffing in the Control Field that is impossible to skip.

Here are some real data for the minimum bit count:

| DLC | Min theorical | Min real | Frame example |
|---|---|---|---|
| 0 | 65 | 65 | SID: 0x084; EID: 0x02109; RTR: 0; IDE: 1; r1: 0; r0: 0; DLC: 0 |
| 1 | 73 | 73 | SID: 0x086; EID: 0x02108; RTR: 0; IDE: 1; r1: 0; r0: 0; DLC: 1; Data0: 0x08 |
| 2 | 81 | ? | |
| 3 | 89 | ? | |
| 4 | 97 | ? | |
| 5 | 105 | ? | |
| 6 | 113 | ? | |
| 7 | 121 | ? | |
| 8 | 129 | ? | |

The maximum theorical bit count to send a frame is:

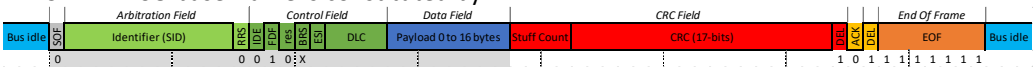
$$MaxCAN20BBitCount = (64 + 8 \times DLC) + \frac{54+8\times DLC-1}{4} - 3 \quad (1.8)$$

Here are some real data for the maximum bit count:

| DLC | Max theorical | Max real | Frame example |
|---|---|---|---|
| 0 | 74 | 75 | SID: 0x3E1; EID: 0x21FF8; RTR: 0; IDE: 1; r1: 0; r0: 0; DLC: 0 |
| 1 | 84 | 85 | SID: 0x7C3; EID: 0x03FF0; RTR: 0; IDE: 1; r1: 0; r0: 0; DLC: 1; Data: 0xF0 |
| 2 | 94 | ? | |
| 3 | 104 | ? | |
| 4 | 114 | ? | |
| 5 | 124 | ? | |
| 6 | 134 | ? | |
| 7 | 144 | ? | |
| 8 | 154 | ? | |

### 13.2.3. CAN-FD ISO - Base Data Frames (Up to 16 bytes)

A CAN-FD ISO base frame is constituted by:




The minimum bit count to send a frame is:

$$MinBaseCANFDISOBitCount = 59 + 8 \times DLC + 1 \quad (1.9)$$

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{26+3}{1000000}+\frac{33}{8000000}} = 30188\ frame\ per\ second.$$

The maximum possible frame with 16-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

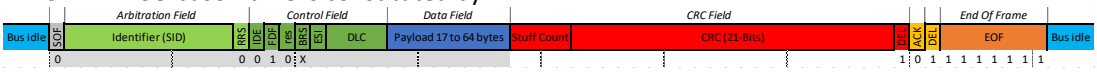
$$\frac{1s}{\frac{26+3}{1000000}+\frac{33+16\times8}{8000000}} = 20356\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxBaseCANFDISOBitCount = (59 + 8 \times DLC) + \frac{22+8\times DLC-1}{4} - 3 \quad (1.10)$$

### 13.2.4. CAN-FD ISO - Base Data Frames (17 to 64 bytes)

A CAN-FD ISO base frame is constituted by:




The minimum bit count to send a frame is:

$$MinBaseCANFDISOBitCount = 64 + 8 \times DLC + 1 \quad (1.11)$$

The maximum possible frame with 20-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{26+3}{1000000}+\frac{38+20\times8}{8000000}} = 18604\ frame\ per\ second.$$

The maximum possible frame with 64-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

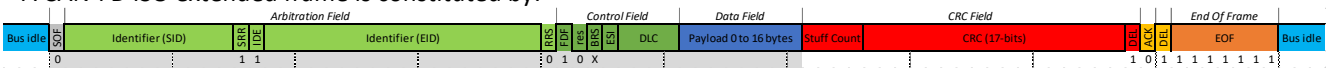
$$\frac{1s}{\frac{26+3}{1000000}+\frac{38+64\times8}{8000000}} = 10230\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxBaseCANFDISOBitCount = (64 + 8 \times DLC) + \frac{22+8\times DLC-1}{4} - 3 \quad (1.12)$$

### 13.2.5. CAN-FD ISO - Extended Data Frames (Up to 16 bytes)

A CAN-FD ISO extended frame is constituted by:




The minimum bit count to send a frame is:

$$MinExtendedCANFDISOBitCount = 78 + 8 \times DLC + 1 \quad (1.13)$$

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{45+3}{1000000}+\frac{33}{8000000}} = 19184\ frame\ per\ second.$$

The maximum possible frame with 16-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

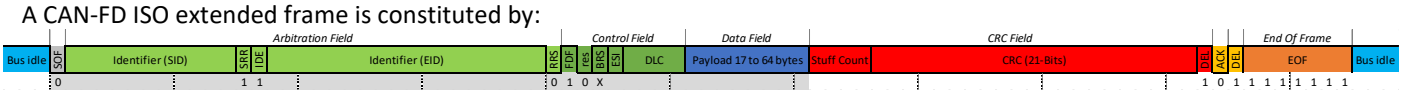
$$\frac{1s}{\frac{45+3}{1000000}+\frac{33+16\times8}{8000000}} = 14678\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxExtendedCANFDISOBitCount = (78 + 8 \times DLC) + \frac{41+8\times DLC-1}{4} - 3 \quad (1.14)$$

### 13.2.6. CAN-FD ISO - Extended Data Frames (17 to 64 bytes)

A CAN-FD ISO extended frame is constituted by:




The minimum bit count to send a frame is:

$$MinExtendedCAN\text{FDISO}BitCount = 83 + 8 \times DLC + 1 \quad (1.15)$$

The maximum possible frame with 20-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{45+3}{1000000}+\frac{38+20\times8}{8000000}} = 13745\ frame\ per\ second.$$

The maximum possible frame with 64-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

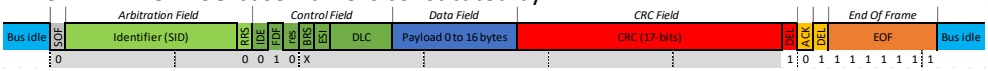
$$\frac{1s}{\frac{45+3}{1000000}+\frac{38+64\times8}{8000000}} = 8565\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxExtendedCAN\text{FDISO}BitCount = (83 + 8 \times DLC) + \frac{41+8\times DLC-1}{4} - 3 \quad (1.16)$$

### 13.2.7. CAN-FD NON-ISO - Base Data Frames (Up to 16 bytes)

A CAN-FD NON-ISO base frame is constituted by:




The minimum bit count to send a frame is:

$$MinBaseCAN\text{FDNONISO}BitCount = 49 + 8 \times DLC + 1 \quad (1.17)$$

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{26+3}{1000000}+\frac{23}{8000000}} = 31372\ frame\ per\ second.$$

The maximum possible frame with 16-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

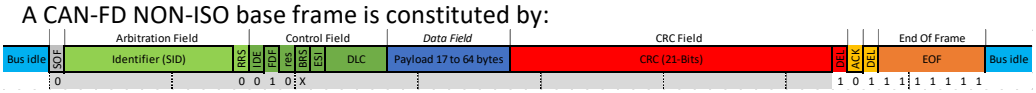
$$\frac{1s}{\frac{26+3}{1000000}+\frac{23+16\times8}{8000000}} = 20887\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxBaseCAN\text{FDNONISO}BitCount = (49 + 8 \times DLC) + \frac{39+8\times DLC-1}{4} - 3 \quad (1.18)$$

### 13.2.8. CAN-FD NON-ISO - Base Data Frames (17 to 64 bytes)

A CAN-FD NON-ISO base frame is constituted by:




The minimum bit count to send a frame is:

$$MinBaseCAN\text{FDNONISO}BitCount = 53 + 8 \times DLC + 1 \quad (1.19)$$

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{26+3}{1000000}+\frac{27+20\times8}{8000000}} = 19093\ frame\ per\ second.$$

The maximum possible frame with 16-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

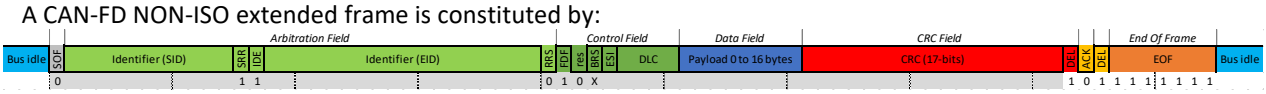
$$\frac{1s}{\frac{26+3}{1000000}+\frac{27+64\times8}{8000000}} = 10376\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxBaseCAN\text{FDNONISO}BitCount = (53 + 8 \times DLC) + \frac{43+8\times DLC-1}{4} - 3 \quad (1.20)$$

### 13.2.9. CAN-FD NON-ISO - Extended Data Frames (Up to 16 bytes)

A CAN-FD NON-ISO extended frame is constituted by:




The minimum bit count to send a frame is:

$$MinExtendedCAN\text{FDNONISO}BitCount = 72 + 8 \times DLC + 1 \quad (1.21)$$

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{45+3}{1000000}+\frac{27}{8000000}} = 19464\ frame\ per\ second.$$

The maximum possible frame with 16-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

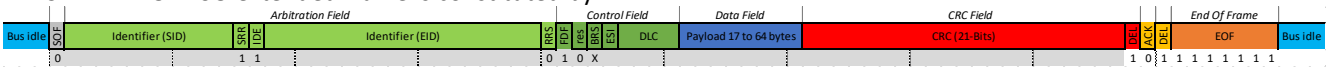
$$\frac{1s}{\frac{45+3}{1000000}+\frac{27+16\times8}{8000000}} = 14842\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxExtendedCAN\text{FDNONISO}BitCount = (72 + 8 \times DLC) + \frac{62+8\times DLC-1}{4} - 3 \quad (1.22)$$

### 13.2.10. CAN-FD NON-ISO - Extended Data Frames (17 to 64 bytes)

A CAN-FD NON-ISO extended frame is constituted by:




The minimum bit count to send a frame is:

$$MinExtendedCAN\text{FDNONISO}BitCount = 76 + 8 \times DLC + 1 \quad (1.23)$$

The maximum possible frame with 0-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{45+3}{1000000}+\frac{31+20\times8}{8000000}} = 13913\ frame\ per\ second.$$

The maximum possible frame with 16-byte DLC at 1Mbit/s Nominal Bit Rate and 8Mbit/s Data Bit Rate is:

$$\frac{1s}{\frac{45+3}{1000000}+\frac{31+64\times8}{8000000}} = 8630\ frame\ per\ second.$$

The maximum theorical bit count to send a frame is:

$$MaxExtendedCAN\text{FDNONISO}BitCount = (76 + 8 \times DLC) + \frac{66+8\times DLC-1}{4} - 3 \quad (1.24)$$

## 13.3. Communication timings with the controller

Here will be indicate all communication timings through the SPI interface when sending a message, configure the device or simply change a GPIO state. All timings indicate in this section are for a direct communication with the component through an SPI interface and therefore no component in the middle.

Why this section? Because in a synchronous system, the MCU will be blocked for the time the SPI communication works and a little more. With these metrics, you will be able to determinate how much time the communication with the device will take and therefore how much time remains for the rest of your program. In an asynchronous system, it will only indicate how much time the SPI interface will be busy.

### 13.3.1. Data, characteristics, and specifications

As indicate in the datasheets (Table 7-6), this is the SPI AC characteristics:

| AC Specifications | | | Electrical Characteristics:<br>Extended (E): TAMB = –40°C to +125°C<br>High (H): TAMB = –40°C to +150°C; VDD = 2.7V to 5.5V | | | | |
|---|---|---|---|---|---|---|---|
| Param. | Sym | Characteristic | Min | Typ | Max | Units | Conditions/Comments |
| | $F_{SCK}$ | SCK Input Frequency | — | — | 20 | MHz | $F_{SCK}$ must be less than or equal to $F_{SYSCLK}/2$ |
| | $T_{SCK}$ | SCK Period, TSCK=1/FSCK | 50 | — | — | ns | $F_{SCK}$ must be less than or equal to $F_{SYSCLK}/2$ |
| 1 | $T_{SCKH}$ | SCK High Time | 20 | — | — | ns | |
| 2 | $T_{SCKL}$ | SCK Low Time | 20 | — | — | ns | |
| 3 | $T_{SCKR}$ | SCK Rise Time | — | — | 100 | ns | Design guidance only |
| 4 | $T_{SCKF}$ | SCK Fall Time | — | — | 100 | ns | Design guidance only |
| 5 | $T_{CS2SCK}$ | nCS ↓ to SCK ↑ | $T_{SCK}/2$ | — | — | ns | |
| 6 | $T_{SCK2CS}$ | SCK ↑ to nCS ↑ | $T_{SCK}$ | — | — | ns | |
| 7 | $T_{SDI2SCK}$ | SDI Setup: SDI ↕ to SCK ↑ | 5 | — | — | ns | |
| 8 | $T_{SCK2SDI}$ | SDI Hold: SCK ↑ to SDI ↕ | 5 | — | — | ns | |
| 9 | $T_{SCK2SDO}$ | SDO Valid: SCK ↓ to SDO ↕ | — | — | 20 | ns | $C_{LOAD}$ = 50 pF |
| 10 | $T_{CS2SDOZ}$ | SDO High Z: nCS ↑ to SDO Z | — | — | 2 $T_{SCK}$ | ns | $C_{LOAD}$ = 50 pF |
| 11 | $T_{CSD}$ | nCS ↑ to nCS ↓ | $T_{SCK}$ | — | — | ns | Design guidance only |

*Table 5 - SPI timings*

This information is linked to Figure 3 - SPI I/O Timing.

Below is the SPI I/O timing which is extract from datasheet (Figure 7-1):

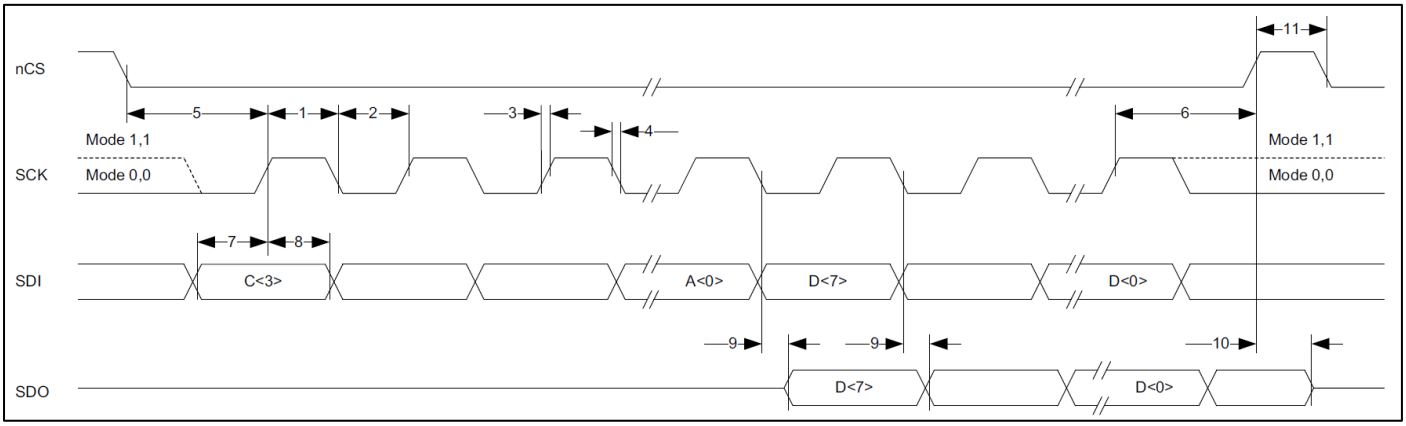



*Figure 3 - SPI I/O Timing*

Below is the number of bytes that are sent according to the command:

| | **Driver configuration** | **Byte count** |
|---|---|---|
| Normal read | eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE | 2 + Data |
| Normal write | eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE | 2 + Data |
| Read with CRC | eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_READ_WRITE_CRC | 5 + Data |
| Write with CRC | eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_READ_WRITE_CRC | 5 + Data |
| Safe write | eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_SAFE_WRITE | 4 + Data |

*Table 6 - Byte count according to driver configuration*

According to the Errata and Data Sheet Clarification (DS80000792B page 1 with Figure 1 and Table 1), the SPI communication can block the CAN FD controller module when the communication between bytes takes too long time in case of SPI Read or SPI Read CRC. The maximum time between bytes and time at end of transmission depends on the Nominal and Data bit time:

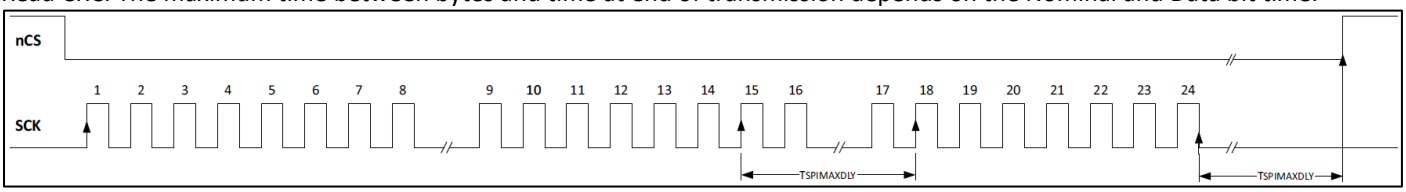



*Table 7 - Maximum delay between SPI bytes*

| Scenario | Frame Format | $T_{SPIMAXDLY}$ |
|---|---|---|
| 1 | CAN Base Frame | 5 NBT (Nominal bit time) |
| 2 | CAN FD Control Field | 3 NBT (Nominal bit time) + 5 DBT (Data bit time) |
| 3 | CAN FD Data Phase | 32 DBT (Data bit time) |

*Table 8 - Worst-case scenarios*

### 13.3.2. General formula to access SFR or RAM register

With a normal driver communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE), the communication takes 2 control bytes. The address is internally incremented. The time to read $x$ bytes from an SFR register or write $x$ bytes to an SFR register takes:

- Time for $x$ byte: $T_{ReadXBytes} = T_{WriteXBytes} = T_{CS2SCK} + (2+x) \times 8T_{SCK} + (1+x) \times T_{BetweenBytes} + T_{SCK2CS}$ (2.1)
- Minimum time: $T_{ReadXBytesMin} = T_{WriteXBytesMin} = \frac{T_{SCK}}{2} + (2+x) \times 8T_{SCK} + T_{SCK}$ (2.2)
- Maximum time: $T_{ReadXBytesMax} = T_{CS2SCK} + (2+x) \times 8T_{SCK} + (1+x) \times (T_{SPIMAXDLY} - 3T_{SCK}) + T_{SPIMAXDLY}$ (2.3)

With a CRC communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_READ_WRITE_CRC), the communication takes 5 control bytes. The address is internally incremented. The time to read $x$ bytes from an SFR register or write $x$ bytes to an SFR register takes:

- Time for $x$ byte: $T_{CRCReadXBytes} = T_{CRCWriteXBytes} = T_{CS2SCK} + (5+x) \times 8T_{SCK} + (4+x) \times T_{BetweenBytes} + T_{SCK2CS}$ (2.4)
- Minimum time: $T_{CRCReadXBytesMin} = T_{CRCWriteXBytesMin} = \frac{T_{SCK}}{2} + (5+x) \times 8T_{SCK} + T_{SCK}$ (2.5)
- Maximum time: $T_{CRCReadXBytesMax} = T_{CS2SCK} + (5+x) \times 8T_{SCK} + (4+x) \times (T_{SPIMAXDLY} - 3T_{SCK}) + T_{SPIMAXDLY}$ (2.6)

With a Safe Write communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_SAFE_WRITE), the communication takes 4 control bytes + the data byte. The time to write 1 byte to an SFR register or 4 bytes to a RAM register takes:

- Time for $x$ byte: $T_{SafeWriteXBytes} = \frac{x}{\begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}} \times \left(T_{CS2SCK} + \left(4 + \begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}\right) \times 8T_{SCK} + \left(3 + \begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}\right) \times T_{BetweenBytes} + T_{SCK2CS}\right)$ (2.7)
- Minimum time: $T_{SafeWriteXBytesMin} = \frac{x}{\begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}} \times \left(\frac{T_{SCK}}{2} + \left(4 + \begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}\right) \times 8T_{SCK} + T_{SCK}\right)$ (2.8)
- Maximum time: $T_{SafeWriteXBytesMax} = \frac{x}{\begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}} \times \left(T_{CS2SCK} + \left(4 + \begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}\right) \times 8T_{SCK} + \left(3 + \begin{cases}1 & if\ SFR\ register \\ 4 & if\ RAM\ register\end{cases}\right) \times (T_{SPIMAXDLY} - 3T_{SCK}) + T_{SPIMAXDLY}\right)$ (2.9)

### 13.3.3. Time to toggle GPIO

The toggle of GPIO need to address only one byte of SFR register. In this case only count formula (2.1), (2.4) or (2.7) depending to the driver configuration.

The maximum possible speed to toggle GPIO is with eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE and 17MHz SPI clock. For this, use of the formula (2.2):

$$T_{MinToggleGPIOTime} = \frac{T_{SCK}}{2} + (2+1) \times 8T_{SCK} + T_{SCK} = \frac{\frac{1}{17MHz}}{2} + 25 \times \frac{1}{17MHz} = 30ns + 25 \times 60ns = 1530ns = 1.53\mu s$$

### 13.3.4. Time to get one CAN2.0 frame

For this, there is some checks to do before retrieving the frame like the message address in RAM who takes a read of 4-byte SFR. And after, get the frame who takes 8 bytes plus 8 bytes for the payload plus 4 bytes for the time stamp if stored by the FIFO to retrieve from RAM. And to finish, update the tail of the FIFO who takes 1-byte SFR to write. These actions are mandatory for the driver for each message. If the application does not use the Rx interrupt pin (INT1), it takes 1-byte SFR more.

If there are more than one FIFO, it takes more data to read to get the list where a message is available.

#### 13.3.4.1. With a Normal driver configuration

With a normal driver communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE), the time to get one message with TimeStamp and 8-bytes of payload takes:

- Time for 1 frame + TS: $T_{Read2.0Frame+TS} = T_{Read4Bytes} + T_{Read20Bytes} + T_{Write1Bytes}$ (3.1)
- Minimum time: $T_{Read2.0Frame+TSMin} = T_{Read4BytesMin} + T_{Read20BytesMin} + T_{Write1BytesMin}$ (3.2)

The minimum possible time to get a CAN 2.0 frame with 8-bytes of payload + TimeStamp and a 17MHz SPI clock. For this, use the formula (3.2):

$$T_{MinRead2.0Frame8BytesWithTimeStampTime}$$
$$= \left(\frac{T_{SCK}}{2} + (2+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+20) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 177 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 25 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 49 \times 60ns) + (30ns + 177 \times 60ns) + (30ns + 25 \times 60ns) = 2970ns + 10650ns + 1530ns$$
$$= 15150ns = 15.15\mu s$$

This means 66007 frames per second.

The maximum possible CAN2.0A frames on a CAN bus is 8928 frames which means at full capability, the MCU will be blocked at maximum approximatively 13.5% of its execution time.

The maximum possible CAN2.0B frames on a CAN bus is 7575 frames which means at full capability, the MCU will be blocked at maximum approximatively 11.5% of its execution time.

#### 13.3.4.2. With a CRC communication driver configuration

With a CRC communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_READ_WRITE_CRC), the time to get one message with TimeStamp and 8-bytes of payload takes:

- Time for 1 frame + TS: $T_{CRCRead2.0Frame+TS} = T_{CRCRead4Bytes} + T_{CRCRead20Bytes} + T_{CRCWrite1Bytes}$ (3.3)
- Minimum time: $T_{CRCRead2.0Frame+TSMin} = T_{CRCRead4BytesMin} + T_{CRCRead20BytesMin} + T_{CRCWrite1BytesMin}$ (3.4)

The minimum possible time to get a CAN 2.0 frame with 8-bytes of payload + TimeStamp and a 17MHz SPI clock. For this, use the formula (3.4):

$$T_{MinRead2.0Frame8BytesWithTimeStampTime}$$
$$= \left(\frac{T_{SCK}}{2} + (5+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+20) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 73 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 201 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 73 \times 60ns) + (30ns + 201 \times 60ns) + (30ns + 49 \times 60ns) = 4410ns + 12090ns + 2970ns$$
$$= 19470ns = 19.47\mu s$$

This means 51361 frames per second.

The maximum possible CAN2.0A frames on a CAN bus is 8928 frames which means at full capability, the MCU will be blocked at maximum approximatively 17.4% of its execution time.

The maximum possible CAN2.0B frames on a CAN bus is 7575 frames which means at full capability, the MCU will be blocked at maximum approximatively 14.7% of its execution time.

### 13.3.5. Time to send one CAN2.0 frame

For this, there is some checks to do before sending the frame like the message address in RAM who takes a read of 4-byte SFR. And after, send of the frame who takes 8 bytes plus 8 bytes for the payload to send to RAM. And to finish, update the head of the FIFO who takes 1-byte SFR to write. These actions are mandatory for the driver for each message. If the application does not use the Tx interrupt pin (INT0), it takes 1-byte SFR more.

If there are more than one FIFO, it takes more data to read to get the list where a message room is available.

#### 13.3.5.1. With a Normal driver configuration

With a normal driver communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE), the time to send one message and 8-bytes of payload takes:

- Time for 1 frame: $T_{Write2.0Frame} = T_{Read4Bytes} + T_{Write16Bytes} + T_{Write1Bytes}$ (3.5)
- Minimum time: $T_{Write2.0FrameMin} = T_{Read4BytesMin} + T_{Write16BytesMin} + T_{Write1BytesMin}$ (3.6)

The minimum possible time to send a CAN 2.0 frame with 8-bytes of payload and a 17MHz SPI clock. For this, use the formula (3.6):

$$T_{MinWrite2.0Frame8BytesTime}$$
$$= \left(\frac{T_{SCK}}{2} + (2+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+16) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 145 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 25 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 49 \times 60ns) + (30ns + 145 \times 60ns) + (30ns + 25 \times 60ns) = 2970ns + 8730ns + 1530ns$$
$$= 13230ns = 13.23\mu s$$

This means 75586 frames per second.

The maximum possible CAN2.0A frames on a CAN bus is 8928 frames which means at full capability, the MCU will be blocked at maximum approximatively 11.8% of its execution time.

The maximum possible CAN2.0B frames on a CAN bus is 7575 frames which means at full capability, the MCU will be blocked at maximum approximatively 10.0% of its execution time.

#### 13.3.5.2. With a CRC communication driver configuration

With a CRC communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_READ_WRITE_CRC), the time to send one message and 8-bytes of payload takes:

- Time for 1 frame: $T_{CRCWrite2.0Frame} = T_{CRCRead4Bytes} + T_{CRCWrite16Bytes} + T_{CRCWrite1Bytes}$ (3.7)
- Minimum time: $T_{CRCWrite2.0FrameMin} = T_{CRCRead4BytesMin} + T_{CRCWrite16BytesMin} + T_{CRCWrite1BytesMin}$ (3.8)

The minimum possible time to send a CAN 2.0 frame with 8-bytes of payload and a 17MHz SPI clock. For this, use the formula (3.8):

$$T_{MinWrite2.0Frame8BytesTime}$$
$$= \left(\frac{T_{SCK}}{2} + (5+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+16) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 73 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 169 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 73 \times 60ns) + (30ns + 169 \times 60ns) + (30ns + 49 \times 60ns) = 4410ns + 10170ns + 2970ns$$
$$= 17550ns = 17.55\mu s$$

This means 56980 frames per second.

The maximum possible CAN2.0A frames on a CAN bus is 8928 frames which means at full capability, the MCU will be blocked at maximum approximatively 15.7% of its execution time.

The maximum possible CAN2.0B frames on a CAN bus is 7575 frames which means at full capability, the MCU will be blocked at maximum approximatively 13.3% of its execution time.

#### 13.3.5.3. With a Safe Write communication driver configuration

With a CRC communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_SAFE_WRITE), the time to send one message and 8-bytes of payload takes:

- Time for 1 frame: $T_{SafeWrite2.0Frame} = T_{CRCRead4Bytes} + T_{SafeWrite16Bytes} + T_{SafeWrite1Bytes}$ (3.9)
- Minimum time: $T_{SafeWrite2.0FrameMin} = T_{CRCRead4BytesMin} + T_{SafeWrite16BytesMin} + T_{SafeWrite1BytesMin}$ (3.10)

The minimum possible time to send a CAN 2.0 frame with 8-bytes of payload and a 17MHz SPI clock. For this, use the formula (3.10):

$$T_{MinWrite2.0Frame8BytesTime}$$
$$= \left(\frac{T_{SCK}}{2} + (5+4) \times 8T_{SCK} + T_{SCK}\right) + \frac{16}{4} \times \left(\frac{T_{SCK}}{2} + (4+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (4+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 73 \times \frac{1}{17MHz}\right) + 4 \times \left(\frac{\frac{1}{17MHz}}{2} + 65 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 41 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 73 \times 60ns) + 4 \times (30ns + 65 \times 60ns) + (30ns + 41 \times 60ns) = 4410ns + 15720ns + 2490ns$$
$$= 22620ns = 22.62\mu s$$

This means 44209 frames per second.

The maximum possible CAN2.0A frames on a CAN bus is 8928 frames which means at full capability, the MCU will be blocked at maximum approximatively 20.2% of its execution time.

The maximum possible CAN2.0B frames on a CAN bus is 7575 frames which means at full capability, the MCU will be blocked at maximum approximatively 17.1% of its execution time.

### 13.3.6. Time to get a full CAN-FD frame

For this, there is some checks to do before retrieving the frame like the message address in RAM who takes a read of 4-byte SFR. And after, get the frame who takes 8 bytes plus 64 bytes for the payload plus 4 bytes for the time stamp if stored by the FIFO to retrieve from RAM. And to finish, update the tail of the FIFO who takes 1-byte SFR to write. These actions are mandatory for the driver for each message. If the application does not use the Rx interrupt pin (INT1), it takes 1-byte SFR more.

If there are more than one FIFO, it takes more data to read to get the list where a message is available.

#### 13.3.6.1. With a Normal driver configuration

With a normal driver communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE), the time to get one message with TimeStamp and 64-bytes of payload takes:

- Time for 1 frame + TS: $T_{ReadFDFrame+TS} = T_{Read4Bytes} + T_{Read76Bytes} + T_{Write1Bytes}$ (3.11)
- Minimum time: $T_{ReadFDFrame+TSMin} = T_{Read4BytesMin} + T_{Read76BytesMin} + T_{Write1BytesMin}$ (3.12)

The minimum possible time to get a CAN-FD frame with 64-bytes of payload + TimeStamp and a 17MHz SPI clock. For this, use the formula (3.12):

$$T_{MinRead2FDFrame64BytesWithTimeStampTime}$$
$$= \left(\frac{T_{SCK}}{2} + (2+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+76) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 625 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 25 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 49 \times 60ns) + (30ns + 625 \times 60ns) + (30ns + 25 \times 60ns) = 2970ns + 37530ns + 1530ns$$
$$= 42030ns = 42.03\mu s$$

This means 23793 frames per second.

The maximum possible frames on a Base CAN-FD bus is 10230 frames which means at full capability, the MCU will be blocked at maximum approximatively 43.0% of its execution time.

The maximum possible frames on an Extended CAN-FD bus is 8565 frames which means at full capability, the MCU will be blocked at maximum approximatively 36.0% of its execution time.

#### 13.3.6.2. With a CRC communication driver configuration

With a CRC communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_READ_WRITE_CRC), the time to get one message with TimeStamp and 64-bytes of payload takes:

- Time for 1 frame + TS: $T_{CRCReadFDFrame+TS} = T_{CRCRead4Bytes} + T_{CRCRead76Bytes} + T_{CRCWrite1Bytes}$ (3.13)
- Minimum time: $T_{CRCReadFDFrame+TSMin} = T_{CRCRead4BytesMin} + T_{CRCRead76BytesMin} + T_{CRCWrite1BytesMin}$ (3.14)

The minimum possible time to get a CAN-FD frame with 64-bytes of payload + TimeStamp and a 17MHz SPI clock. For this, use the formula (3.14):

$$T_{MinRead2.0Frame64BytesWithTimeStampTime}$$
$$= \left(\frac{T_{SCK}}{2} + (5+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+76) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 73 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 649 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 73 \times 60ns) + (30ns + 649 \times 60ns) + (30ns + 49 \times 60ns) = 4410ns + 38970ns + 2970ns$$
$$= 46350ns = 46.35\mu s$$

This means 21575 frames per second.

The maximum possible frames on a Base CAN-FD bus is 10230 frames which means at full capability, the MCU will be blocked at maximum approximatively 47.4% of its execution time.

The maximum possible frames on an Extended CAN-FD bus is 8565 frames which means at full capability, the MCU will be blocked at maximum approximatively 39.7% of its execution time.

### 13.3.7. Time to send a full CAN-FD frame

For this, there is some checks to do before sending the frame like the message address in RAM who takes a read of 4-byte SFR. And after, send of the frame who takes 8 bytes plus 64 bytes for the payload to send to RAM. And to finish, update the head of the FIFO who takes 1-byte SFR to write. These actions are mandatory for the driver for each message. If the application does not use the Tx interrupt pin (INT0), it takes 1-byte SFR more.

If there are more than one FIFO, it takes more data to read to get the list where a message room is available.

#### 13.3.7.1. With a Normal driver configuration

With a normal driver communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_NORMAL_USE), the time to send one message and 64-bytes of payload takes:

- Time for 1 frame: $T_{WriteFDFrame} = T_{Read4Bytes} + T_{Write72Bytes} + T_{Write1Bytes}$ (3.15)
- Minimum time: $T_{WriteFDFrameMin} = T_{Read4BytesMin} + T_{Write72BytesMin} + T_{Write1BytesMin}$ (3.16)

The minimum possible time to send a CAN-FD frame with 64-bytes of payload and a 17MHz SPI clock. For this, use the formula (3.16):

$$T_{MinWriteFDFrame64BytesTime}$$
$$= \left(\frac{T_{SCK}}{2} + (2+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+72) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (2+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 593 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 25 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 49 \times 60ns) + (30ns + 593 \times 60ns) + (30ns + 25 \times 60ns) = 2970ns + 35610ns + 1530ns$$
$$= 40110ns = 40.11\mu s$$

This means 24931 frames per second.

The maximum possible frames on a Base CAN-FD bus is 10230 frames which means at full capability, the MCU will be blocked at maximum approximatively 41.0% of its execution time.

The maximum possible frames on an Extended CAN-FD bus is 8565 frames which means at full capability, the MCU will be blocked at maximum approximatively 34.4% of its execution time.

#### 13.3.7.2. With a CRC communication driver configuration

With a CRC communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_READ_WRITE_CRC), the time to send one message and 64-bytes of payload takes:

- Time for 1 frame: $T_{CRCWriteFDFrame} = T_{CRCRead4Bytes} + T_{CRCWrite72Bytes} + T_{CRCWrite1Bytes}$ (3.17)
- Minimum time: $T_{CRCWriteFDFrameMin} = T_{CRCRead4BytesMin} + T_{CRCWrite72BytesMin} + T_{CRCWrite1BytesMin}$ (3.18)

The minimum possible time to send a CAN-FD frame with 64-bytes of payload and a 17MHz SPI clock. For this, use the formula (3.18):

$$T_{MinWriteFDFrame64BytesTime}$$
$$= \left(\frac{T_{SCK}}{2} + (5+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+72) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (5+1) \times 8T_{SCK} + T_{SCK}\right)$$
$$= \left(\frac{\frac{1}{17MHz}}{2} + 73 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 617 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 49 \times \frac{1}{17MHz}\right)$$
$$= (30ns + 73 \times 60ns) + (30ns + 617 \times 60ns) + (30ns + 49 \times 60ns) = 4410ns + 37050ns + 2970ns$$
$$= 44430ns = 44.43\mu s$$

This means 22507 frames per second.

The maximum possible frames on a Base CAN-FD bus is 10230 frames which means at full capability, the MCU will be blocked at maximum approximatively 45.5% of its execution time.

The maximum possible frames on an Extended CAN-FD bus is 8565 frames which means at full capability, the MCU will be blocked at maximum approximatively 38.1% of its execution time.

#### 13.3.7.3. With a Safe Write communication driver configuration

With a CRC communication (eMCP251XFD_DriverConfig::MCP251XFD_DRIVER_USE_SAFE_WRITE), the time to send one message and 64-bytes of payload takes:

- Time for 1 frame: $T_{SafeWriteFDFrame} = T_{CRCRead4Bytes} + T_{SafeWrite72Bytes} + T_{SafeWrite1Bytes}$ (3.19)
- Minimum time: $T_{SafeWriteFDFrameMin} = T_{CRCRead4BytesMin} + T_{SafeWrite72BytesMin} + T_{SafeWrite1BytesMin}$ (3.20)

The minimum possible time to send a CAN-FD frame with 64-bytes of payload and a 17MHz SPI clock. For this, use the formula (3.20):

$$
\begin{aligned}
T_{MinWriteFDFrame64BytesTime} &= \left(\frac{T_{SCK}}{2} + (5+4) \times 8T_{SCK} + T_{SCK}\right) + \frac{72}{4} \times \left(\frac{T_{SCK}}{2} + (4+4) \times 8T_{SCK} + T_{SCK}\right) + \left(\frac{T_{SCK}}{2} + (4+1) \times 8T_{SCK} + T_{SCK}\right) \\
&= \left(\frac{\frac{1}{17MHz}}{2} + 73 \times \frac{1}{17MHz}\right) + 18 \times \left(\frac{\frac{1}{17MHz}}{2} + 65 \times \frac{1}{17MHz}\right) + \left(\frac{\frac{1}{17MHz}}{2} + 41 \times \frac{1}{17MHz}\right) \\
&= (30ns + 73 \times 60ns) + 18 \times (30ns + 65 \times 60ns) + (30ns + 41 \times 60ns) = 4410ns + 70740ns + 2490ns \\
&= 77640ns = 77.64\mu s
\end{aligned}
$$

This means 12880 frames per second.

The maximum possible frames on a Base CAN-FD bus is 10230 frames which means at full capability, the MCU will be blocked at maximum approximatively 79.4% of its execution time.

The maximum possible frames on an Extended CAN-FD bus is 8565 frames which means at full capability, the MCU will be blocked at maximum approximatively 66.5% of its execution time.

This means that if you want to use more than one device which sends continuously FD frames on separates buses, you need an Asynchronous system with DMA and as many SPI buses as device.

# 14. SUMMARY OF DRIVER FUNCTIONS

## 14.1. Init and reset

*eERRORRESULT* ***Init_MCP251XFD****(MCP251XFD ****pComp****, const MCP251XFD_Config ****pConf****)*
→ MCP251XFD device initialization

*eERRORRESULT* ***MCP251XFD_ResetDevice****(MCP251XFD ****pComp****)*
→ Reset the MCP251XFD device

## 14.2. Read from RAM and registers

*eERRORRESULT* ***MCP251XFD_ReadData****(MCP251XFD ****pComp****, uint16_t* ***address****, uint8_t** ***data****, uint16_t* ***size****)*
→ Read data from the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReadSFR8****(MCP251XFD ****pComp****, uint16_t* ***address****, uint8_t** ***data****)*
→ Read a byte data from an SFR register of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReadSFR16****(MCP251XFD ****pComp****, uint16_t* ***address****, uint8_t** ***data****)*
→ Read a 2-bytes data from an SFR address of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReadSFR32****(MCP251XFD ****pComp****, uint16_t* ***address****, uint8_t** ***data****)*
→ Read a word data (4 bytes) from an SFR address of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReadRAM32****(MCP251XFD ****pComp****, uint16_t* ***address****, uint8_t** ***data****)*
→ Read a word data (4 bytes) from a RAM address of the MCP251XFD

## 14.3. Write to RAM and registers

*eERRORRESULT* ***MCP251XFD_WriteData****(MCP251XFD ****pComp****, uint16_t* ***address****, const uint8_t** ***data****, uint16_t* ***size****)*
→ Write data to the MCP251XFD

*eERRORRESULT* ***MCP251XFD_WriteSFR8****(MCP251XFD ****pComp****, uint16_t* ***address****, const uint8_t** ***data****, uint16_t* ***size****)*
→ Write a byte data to an SFR register of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_WriteSFR16****(MCP251XFD ****pComp****, uint16_t* ***address****, const uint8_t** ***data****, uint16_t* ***size****)*
→ Write a 2-bytes data to an SFR register of the MCP251XFD

*eERRORRESULT* **MCP251XFD_WriteSFR32***(MCP251XFD ****pComp****, uint16_t* ***address****, const uint8_t** ***data****, uint16_t* ***size****)*
→ Write a word data (4 bytes) to an SFR register of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_WriteRAM32****(MCP251XFD ****pComp****, uint16_t* ***address****, const uint8_t** ***data****, uint16_t* ***size****)*
→ Write a word data (4 bytes) to a RAM register of the MCP251XFD

## 14.4. Device ID

*eERRORRESULT* ***MCP251XFD_GetDeviceID****(MCP251XFD ****pComp****, eMCP251XFD_Devices** ***device****, uint8_t** ***deviceId****, uint8_t** ***deviceRev****)*
→ Get actual device of the MCP251XFD

## 14.5. Messages

*eERRORRESULT* ***MCP251XFD_TransmitMessageObjectToFIFO****(MCP251XFD* ****pComp****,* *uint8_t** ***messageObjectToSend****,* *uint8_t* ***objectSize****,* *eMCP251XFD_FIFO* ***toFIFO****,* *bool* ***andFlush****)*

→ Transmit a message object (with data) to a FIFO of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_TransmitMessageObjectToTXQ****(MCP251XFD* ****pComp****,* *uint8_t** ***messageObjectToSend****,* *uint8_t* ***objectSize****,* *bool* ***andFlush****)*

→ Transmit a message object (with data) to the TXQ of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_TransmitMessageToFIFO****(MCP251XFD* ****pComp****,* *MCP251XFD_CANMessage** ***messageToSend****,* *eMCP251XFD_FIFO* ***toFIFO****,* *bool* ***andFlush****)*

→ Transmit a message to a FIFO of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_TransmitMessageToTXQ****(MCP251XFD* ****pComp****,* *MCP251XFD_CANMessage** ***messageToSend****,* *bool* ***andFlush****)*

→ Transmit a message to the TXQ of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReceiveMessageObjectFromFIFO****(MCP251XFD* ****pComp****,* *uint8_t** ***messageObjectGet****,* *uint8_t* ***objectSize****,* *eMCP251XFD_FIFO* ***fromFIFO****)*

→ Receive a message object (with data) to the FIFO of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReceiveMessageObjectFromTEF****(MCP251XFD* ****pComp****,* *uint8_t** ***messageObjectGet****,* *uint8_t* ***objectSize****,* *eMCP251XFD_FIFO* ***fromFIFO****)*

→ Receive a message object (with data) to the TEF of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReceiveMessageFromFIFO****(MCP251XFD* ****pComp****,* *MCP251XFD_CANMessage** ***messageGet****,* *eMCP251XFD_PayloadSize* ***payloadSize****,* *uint32_t** ***timeStamp****,* *eMCP251XFD_FIFO* ***fromFIFO****)*

→ Receive a message from a FIFO of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_ReceiveMessageFromTEF****(MCP251XFD* ****pComp****,* *MCP251XFD_CANMessage** ***messageGet****,* *uint32_t** ***timeStamp****)*

→ Receive a message from the TEF of the MCP251XFD

## 14.6. CRC

*eERRORRESULT* ***MCP251XFD_ConfigureCRC****(MCP251XFD* ****pComp****,* *setMCP251XFD_CRCEvents* ***interrupts****)*

→ CRC Configuration of the MCP251XFD

*eERRORRESULT* ***MCP251XFD_GetCRCEvents****(MCP251XFD* ****pComp****,* *setMCP251XFD_CRCEvents** ***events****,* *uint16_t** ***lastCRCMismatch****)*

→ Get CRC Status of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearCRCEvents****(MCP251XFD* ****pComp****)*

→ Clear CRC Status Flags of the MCP251XFD device

## 14.7. ECC

*eERRORRESULT* ***MCP251XFD_ConfigureECC****(MCP251XFD* ****pComp****,* *bool* ***enableECC****,* *setMCP251XFD_ECCEvents* ***interrupts****,* *uint8_t* ***fixedParityValue****)*

→ ECC Configuration of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetECCEvents****(MCP251XFD* ****pComp****,* *setMCP251XFD_ECCEvents** ***events****,* *uint16_t** ***lastErrorAddress****)*

→ Get ECC Status Flags of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearECCEvents****(MCP251XFD* ****pComp****)*

→ Clear ECC Status Flags of the MCP251XFD device

## 14.8. Pin configuration

*eERRORRESULT* ***MCP251XFD_ConfigurePins****(MCP251XFD* ****pComp****, eMCP251XFD_GPIO0Mode* ***GPIO0PinMode****, eMCP251XFD_GPIO1Mode* ***GPIO1PinMode****, eMCP251XFD_OutMode* ***INTOutMode****, eMCP251XFD_OutMode* ***TXCANOutMode****, bool* ***CLKOasSOF****)*

→ Configure pins of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_SetGPIOPinsDirection****(MCP251XFD* ****pComp****, uint8_t* ***pinsDirection****, uint8_t* ***pinsChangeMask****)*

→ Set GPIO pins direction of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetGPIOPinsInputLevel****(MCP251XFD* ****pComp****, uint8_t* ****pinsState****)*

→ Get GPIO pins input level of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_SetGPIOPinsOutputLevel****(MCP251XFD* ****pComp****, uint8_t* ***pinsLevel****, uint8_t* ***pinsChangeMask****)*

→ Set GPIO pins output level of the MCP251XFD device

## 14.9. Bitrate and BitTime configuration

*eERRORRESULT* ***MCP251XFD_CalculateBitTimeConfiguration****(const uint32_t* ***fsysclk****, const uint32_t* ***desiredNominalBitrate****, const uint32_t* ***desiredDataBitrate****, MCP251XFD_BitTimeConfig* ****pConf****)*

→ Calculate Bit Time for CAN2.0 or CAN-FD Configuration for the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_CalculateBitrateStatistics****(const uint32_t* ***fsysclk****, MCP251XFD_BitTimeConfig* ****pConf****, bool* ***can20only****)*

→ Calculate Bitrate Statistics of a Bit Time configuration

*eERRORRESULT* ***MCP251XFD_SetBitTimeConfiguration****(MCP251XFD* ****pComp****, MCP251XFD_BitTimeConfig* ****pConf****, bool* ***can20only****)*

→ Set Bit Time Configuration to the MCP251XFD device

## 14.10. Operation modes and CAN control

*eERRORRESULT* ***MCP251XFD_AbortAllTransmissions****(MCP251XFD* ****pComp****)*

→ Abort all pending transmissions of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetActualOperationMode****(MCP251XFD* ****pComp****, eMCP251XFD_OperationMode** ***actualMode****)*

→ Get actual operation mode of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_RequestOperationMode****(MCP251XFD* ****pComp****, eMCP251XFD_OperationMode* ***newMode****, bool* ***waitOperationChange****)*

→ Request operation mode change of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_WaitOperationModeChange****(MCP251XFD* ****pComp****, eMCP251XFD_OperationMode* ***askedMode****)*

→ Wait for operation mode change of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_StartCAN20****(MCP251XFD* ****pComp****)*

→ Start the MCP251XFD device in CAN2.0 mode

*eERRORRESULT* ***MCP251XFD_StartCANFD****(MCP251XFD* ****pComp****)*

→ Start the MCP251XFD device in CAN-FD mode

*eERRORRESULT* ***MCP251XFD_StartCANListenOnly****(MCP251XFD* ****pComp****)*

→ Start the MCP251XFD device in CAN Listen-Only mode

*eERRORRESULT* ***MCP251XFD_ConfigureCANController****(MCP251XFD* ****pComp****, setMCP251XFD_CANCtrlFlags* ***flags****, eMCP251XFD_Bandwidth* ***bandwidth****)*

→ Configure CAN Controller of the MCP251XFD device

## 14.11. Sleep and Deep-Sleep modes

*eERRORRESULT* ***MCP251XFD_ConfigureSleepMode****(MCP251XFD **pComp, bool* ***useLowPowerMode,***
*eMCP251XFD_WakeUpFilter* ***wakeUpFilter,*** *bool* ***interruptBusWakeUp****)*
→ Sleep mode configuration of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_EnterSleepMode****(MCP251XFD **pComp****)***
→ Enter the MCP251XFD device in sleep mode

*eERRORRESULT* ***MCP251XFD_IsDeviceInSleepMode****(MCP251XFD **pComp,** bool* **isInSleepMode****)***
→ Verify if the MCP251XFD device is in sleep mode

*eERRORRESULT* ***MCP251XFD_WakeUp****(MCP251XFD **pComp,** eMCP251XFD_PowerStates **fromState****)***
→ Manually wake up the MCP251XFD device

*eMCP251XFD_PowerStates* ***MCP251XFD_BusWakeUpFromState****(MCP251XFD **pComp****)***
→ Retrieve from which state mode the MCP251XFD device get a bus wake up from

## 14.12. Time Stamp

*eERRORRESULT* ***MCP251XFD_ConfigureTimeStamp****(MCP251XFD **pComp,** bool* ***enableTS,***
*eMCP251XFD_SamplePoint* ***samplePoint,*** *uint16_t* ***prescaler,*** *bool*
***interruptBaseCounter****)*
→ ECC Configuration of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_SetTimeStamp****(MCP251XFD **pComp,** uint32_t* ***value****)*
→ Get ECC Status Flags of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetTimeStamp****(MCP251XFD **pComp,** uint32_t* ***value****)*
→ Clear ECC Status Flags of the MCP251XFD device

## 14.13. FIFOs

*eERRORRESULT* ***MCP251XFD_ConfigureTEF****(MCP251XFD **pComp,** bool* ***enableTEF,*** *MCP251XFD_FIFO **confTEF****)***
→ Configure TEF of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ConfigureTXQ****(MCP251XFD **pComp,** bool* ***enableTXQ,*** *MCP251XFD_FIFO **confTXQ****)***
→ Configure TXQ of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ConfigureFIFO****(MCP251XFD **pComp,** MCP251XFD_FIFO **confFIFO****)***
→ Configure a FIFO of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ConfigureFIFOList****(MCP251XFD **pComp,** MCP251XFD_FIFO **listFIFO,** size_t* ***count****)*
→ Configure a FIFO list of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ResetFIFO****(MCP251XFD **pComp,** eMCP251XFD_FIFO* ***name****)*
→ Reset a FIFO of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ResetTEF****(MCP251XFD **pComp****)***
→ Reset the TEF of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ResetTXQ****(MCP251XFD **pComp****)***
→ Reset the TXQ of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_UpdateFIFO****(MCP251XFD **pComp,** eMCP251XFD_FIFO* ***name,*** *bool* ***andFlush****)*
→ Update (and flush) a FIFO of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_UpdateTEF****(MCP251XFD **pComp****)***
→ Update the TEF of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_UpdateTXQ****(MCP251XFD **pComp,** bool* ***andFlush****)*
→ Update (and flush) the TXQ of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_FlushFIFO****(MCP251XFD **pComp,** eMCP251XFD_FIFO* ***name****)*
→ Flush a FIFO of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_FlushTXQ****(MCP251XFD **pComp****)***
→ Flush a TXQ of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_FlushAllFIFO****(MCP251XFD **pComp****)***
→ Flush all FIFOs (+TXQ) of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetFIFOStatus****(MCP251XFD* ****pComp****, eMCP251XFD_FIFO* ***name****, eMCP251XFD_FIFOstatus* ****statusFlags****)*
→ Get status of a FIFO of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetTEFStatus****(MCP251XFD* ****pComp****, eMCP251XFD_TEFstatus* ****statusFlags****)*
→ Get status of a TEF of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetTXQStatus****(MCP251XFD* ****pComp****, eMCP251XFD_TXQstatus* ****statusFlags****)*
→ Get status of a TXQ of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetNextMessageAddressFIFO****(MCP251XFD* ****pComp****, eMCP251XFD_FIFO* ***name****, uint32_t* ****nextAddress****, uint8_t* ****nextIndex****)*
→ Get next message address and/or index of a FIFO of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetNextMessageAddressTEF****(MCP251XFD* ****pComp****, uint32_t* ****nextAddress****)*
→ Get next message address of a TEF of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetNextMessageAddressTXQ****(MCP251XFD* ****pComp****, uint32_t* ****nextAddress****, uint8_t* ****nextIndex****)*
→ Get next message address and/or index of a TXQ of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearFIFOConfiguration****(MCP251XFD* ****pComp****, eMCP251XFD_FIFO* ***name****)*
→ Clear the FIFO configuration of the MCP251XFD device

## 14.14. Filters

*eERRORRESULT* ***MCP251XFD_ConfigureDeviceNetFilter****(MCP251XFD* ****pComp****, eMCP251XFD_DNETFilter* ***filter****)*
→ Configure the Device NET filter of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ConfigureFilter****(MCP251XFD* ****pComp****, MCP251XFD_Filter* ****confFilter****)*
→ Configure a filter of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ConfigureFilterList****(MCP251XFD* ****pComp****, eMCP251XFD_DNETFilter* ***filter****, MCP251XFD_Filter* ****listFilter****, size_t* ***count****)*
→ Configure a filter list and the DNCNT of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_DisableFilter****(MCP251XFD* ****pComp****, eMCP251XFD_Filter* ***name****)*
→ Disable a Filter of the MCP251XFD device

## 14.15. Interrupts

*eERRORRESULT* ***MCP251XFD_ConfigureInterrupt****(MCP251XFD* ****pComp****, setMCP251XFD_InterruptEvents* ***interruptsFlags****)*
→ Configure interrupt of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetInterruptEvents****(MCP251XFD* ****pComp****, setMCP251XFD_InterruptEvents** ***interruptsFlags****)*
→ Get interrupt events of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetCurrentInterruptEvent****(MCP251XFD* ****pComp****, eMCP251XFD_InterruptFlagCode** ***currentEvent****)*
→ Get the current interrupt event of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearInterruptEvents****(MCP251XFD* ****pComp****, setMCP251XFD_InterruptEvents* ***interruptsFlags****)*
→ Clear interrupt events of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetCurrentReceiveFIFONameAndStatusInterrupt****(MCP251XFD* ****pComp****, eMCP251XFD_FIFO* ****name****, eMCP251XFD_FIFOstatus* ****flags****)*
→ Get current receive FIFO name and status that generate an interrupt (if any)

*eERRORRESULT* ***MCP251XFD_GetCurrentReceiveFIFONameInterrupt****(MCP251XFD* ****pComp****, eMCP251XFD_FIFO* ****name****)*
→ Get current receive FIFO name that generate an interrupt (if any)

*eERRORRESULT* ***MCP251XFD_GetCurrentTransmitFIFONameAndStatusInterrupt****(MCP251XFD* ****pComp****, eMCP251XFD_FIFO* ****name****, eMCP251XFD_FIFOstatus* ****flags****)*
→ Get current transmit FIFO name and status that generate an interrupt (if any)

*eERRORRESULT* ***MCP251XFD_GetCurrentTransmitFIFONameInterrupt****(MCP251XFD* ****pComp****, eMCP251XFD_FIFO* ****name****)*
→ Get current transmit FIFO name that generate an interrupt (if any)

*eERRORRESULT* ***MCP251XFD_ClearFIFOEvents****(MCP251XFD* ****pComp****,* *eMCP251XFD_FIFO* ***name****,* *uint8_t* ***events****)*
→ Clear selected FIFO events of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearTEFOverflowEvent****(MCP251XFD* ****pComp****)*
→ Clear TEF overflow event of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearFIFOOverflowEvent****(MCP251XFD* ****pComp****,* *eMCP251XFD_FIFO* ***name****)*
→ Clear FIFO overflow event of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearFIFOAttemptsEvent****(MCP251XFD* ****pComp****,* *eMCP251XFD_FIFO* ***name****)*
→ Clear FIFO attempts event of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_ClearTXQAttemptsEvent****(MCP251XFD* ****pComp****)*
→ Clear TXQ attempts event of the MCP251XFD device

*eERRORRESULT* ***MCP251XFD_GetReceiveInterruptStatusOfAllFIFO****(MCP251XFD* ****pComp****,*
*setMCP251XFD_InterruptOnFIFO** ***interruptPending****,* *setMCP251XFD_InterruptOnFIFO** ***overflowStatus****)*
→ Get the receive interrupt pending status of all FIFO

*eERRORRESULT* ***MCP251XFD_GetReceivePendingInterruptStatusOfAllFIFO****(MCP251XFD* ****pComp****,*
*setMCP251XFD_InterruptOnFIFO** ***interruptPending****)*
→ Get the receive interrupt pending status of all FIFO

*eERRORRESULT* ***MCP251XFD_GetReceiveOverflowInterruptStatusOfAllFIFO****(MCP251XFD* ****pComp****,*
*setMCP251XFD_InterruptOnFIFO** ***overflowStatus****)*
→ Get the receive overflow interrupt pending status of all FIFO

*eERRORRESULT* ***MCP251XFD_GetTransmitInterruptStatusOfAllFIFO****(MCP251XFD* ****pComp****,*
*setMCP251XFD_InterruptOnFIFO** ***interruptPending****,* *setMCP251XFD_InterruptOnFIFO** ***attemptStatus****)*
→ Get the transmit interrupt pending status of all FIFO

*eERRORRESULT* ***MCP251XFD_GetTransmitPendingInterruptStatusOfAllFIFO****(MCP251XFD* ****pComp****,*
*setMCP251XFD_InterruptOnFIFO** ***interruptPending****)*
→ Get the transmit interrupt pending status of all FIFO

*eERRORRESULT* ***MCP251XFD_GetTransmitAttemptInterruptStatusOfAllFIFO****(MCP251XFD* ****pComp****,*
*setMCP251XFD_InterruptOnFIFO** ***attemptStatus****)*
→ Get the transmit attempt exhaust interrupt pending status of all FIFO

## 14.16. Tools

*uint32_t* ***MCP251XFD_MessageIDtoObjectMessageIdentifier****(uint32_t* ***messageID****,* *bool* ***extended****,* *bool* ***UseSID11****)*
→ Message ID to Object Message Identifier

*uint32_t* ***MCP251XFD_ObjectMessageIdentifierToMessageID****(uint32_t* ***objectMessageID****,* *bool* ***extended****,*
*bool* ***UseSID11****)*
→ Object Message Identifier to Message ID

*uint32_t* ***MCP251XFD_PayloadToByte****(eMCP251XFD_PayloadSize* ***payload****)*
→ Payload to Byte Count

*uint32_t* ***MCP251XFD_DLCToByte****(eMCP251XFD_DataLength* ***dlc****,* *bool* ***isCANFD****)*
→ Data Length Content to Byte Count

# 15. CONFIGURATION STRUCTURES

## 15.1. Device object structure

The MCP251XFD device object structure contains all information that is mandatory to work with a device. It is always the first parameter of each function of the driver.

Source code:

```
typedef struct MCP251XFD MCP251XFD;
typedef uint8_t DriverInternal;

struct MCP251XFD
{
  void *UserDriverData;

  //--- Driver configuration ---
  setMCP251XFD_DriverConfig DriverConfig;
  TMCP251XFDDriverInternal InternalConfig;

  //--- IO configuration ---
  uint8_t GPIOsOutState;

  //--- Interface driver call functions ---
  uint8_t SPI_ChipSelect;
  void *InterfaceDevice;
  uint32_t SPIClockSpeed;
  MCP251XFD_SPIInit_Func     fnSPI_Init;
  MCP251XFD_SPITransfer_Func fnSPI_Transfer;

  //--- Time call function ---
  GetCurrentms_Func fnGetCurrentms;

  //--- CRC16-CMS call function ---
  ComputeCRC16_Func fnComputeCRC16;
};
```

### 15.1.1. Data fields

#### *void* ***UserDriverData**

Optional, can be used to store driver data related to the project and the device or NULL. This field is not used or modified by the driver.

#### *setMCP251XFD_DriverConfig* **DriverConfig**

This is the driver's configuration. Configuration can be OR'ed. See type enum for the possible configurations.

**Type**

enum *setMCP251XFD_DriverConfig*

**Initial value / default**

MCP251XFD_DRIVER_NORMAL_USE

#### *TMCP251XFDDriverInternal* **InternalConfig**

This is the internal driver configuration. The user should not change the value, only the driver can change values. The value is changed following driver usage.

**Type**

typedef *uint8_t* TMCP251XFDDriverInternal

**Initial value / default**

Regardless of the value set when filling the struct, the value will be modify at device initialization when using the function *Init_MCP251XFD()*

### *uint8_t* **GPIOsOutState**

This is the current GPIO output state. By checking this value, you can know the latest status set.

**Initial value / default**

The value indicate when filling the structure set the output state of the pin GPIO0 and GPIO1 when put in output at initialization when using *Init_MCP251XFD()*.

### *uint8_t* **SPI_ChipSelect**

This is the Chip Select index that will be set at the call of a transfer.

### *void* ***InterfaceDevice**

This is the pointer that will be in the first parameter of all interface call functions.

### *MCP251XFD_SPIInit_Func* **fnSPI_Init**

This function will be called at driver initialization to configure the SPI interface driver.

**Type**

typedef *eERRORRESULT (*MCP251XFD_SPIInit_Func)(void *, uint8_t, const uint32_t)*

**Initial value / default**

This function must point to a function else a ERR__PARAMETER_ERROR is returned by the function *Init_MCP251XFD()*.

### *MCP251XFD_SPITransfer_Func* **fnSPI_Transfer**

This function will be called at driver read/write data from/to the interface driver. It cannot point to NULL.

**Type**

typedef *eERRORRESULT (*MCP251XFD_SPITransfer_Func)(void *, uint8_t, uint8_t *, uint8_t *, size_t)*

**Initial value / default**

This function must point to a function else an ERR__PARAMETER_ERROR is returned when using a function that require to communicate with the device.

### *GetCurrentms_Func* **fnGetCurrentms**

This function will be called when the driver needs to get current millisecond. Some functions need a timeout, without, they can be stuck forever.

**Type**

typedef *uint32_t (*GetCurrentms_Func)(void)*

**Initial value / default**

This function has to point to a function else an ERR__PARAMETER_ERROR is returned by the functions *Init_MCP251XFD()*, *MCP251XFD_WaitOperationModeChange()*, *MCP251XFD_ResetFIFO()* or *MCP251XFD_ResetDevice()*.

### *ComputeCRC16_Func* **fnComputeCRC16**

This function will be called when a CRC16-CMS computation is needed (MCP251XFD_DRIVER_USE_READ_WRITE_CRC or MCP251XFD_DRIVER_USE_SAFE_WRITE flags set in the field MCP251XFD::DriverConfig). In normal mode, this can point to NULL.

**Type**

typedef *uint16_t (*ComputeCRC16_Func)(const uint8_t*, size_t)*

**Initial value / default**

This function has to point to a function in case of using else an ERR__PARAMETER_ERROR is returned by the functions *Init_MCP251XFD()*, *MCP251XFD_WaitOperationModeChange()*, *MCP251XFD_ResetFIFO()* or *MCP251XFD_ResetDevice()*.

### *uint32_t* **SPIClockSpeed**

This is the SPI nominal clock speed in Hertz. This value cannot be higher than device SYSCLK divide by 2.

### 15.1.2. Enumerators

*enum* **eMCP251XFD_DriverConfig**
*typedef* eMCP251XFD_DriverConfig **setMCP251XFD_DriverConfig**

Driver configurations, parameters can be OR'ed. MCP251XFD_DRIVER_USE_READ_WRITE_CRC will always replace MCP251XFD_DRIVER_NORMAL_USE when communicating with the device. MCP251XFD_DRIVER_USE_SAFE_WRITE will always replace MCP251XFD_DRIVER_NORMAL_USE and MCP251XFD_DRIVER_USE_READ_WRITE_CRC when communicating with the device in case of a write.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_DRIVER_NORMAL_USE* | **0x00** | Use the driver with no special verifications, just settings verifications (usually the fastest mode) |
| *MCP251XFD_DRIVER_SAFE_RESET* | **0x01** | Set Configuration mode first and next send a Reset command with a SPI clock at 1MHz max (MCP251XFD_OSCFREQ_MIN div by 2) |
| *MCP251XFD_DRIVER_ENABLE_ECC* | **0x02** | Enable the ECC just before the RAM initialization and activate ECCCON_SECIE and ECCCON_DEDIE interrupt flags |
| *MCP251XFD_DRIVER_INIT_CHECK_RAM* | **0x04** | Check RAM at initialization by writing some data and checking them on all the RAM range (slower at initialization, take a long time) |
| *MCP251XFD_DRIVER_INIT_SET_RAM_AT_0* | **0x08** | Set all bytes of the RAM to 0x00 (slower at initialization) |
| *MCP251XFD_DRIVER_CLEAR_BUFFER_BEFORE_READ* | **0x10** | This send 0x00 byte while reading SPI interface, mainly for cybersecurity purpose (little bit slower) |
| *MCP251XFD_DRIVER_USE_READ_WRITE_CRC* | **0x20** | Use CRC with all commands and data going to and from the controller (add 3 more bytes to each transaction, 2 for CRC + 1 for length) |
| *MCP251XFD_DRIVER_USE_SAFE_WRITE* | **0x40** | Each SFR write or memory write is sent one at a time (slower but send only the 2 bytes for CRC) |

### 15.1.3. TMCP251XFDDriverInternal type and InternalConfig variable

Warning: This variable should never be changed by the application.

This variable is used by the driver to estimate the state of the device and some information that is impossible to retrieve directly from device. This save some unnecessary transfer communications.

For information, the TMCP251XFDDriverInternal type is defined from a uint8_t and is constituted as this Cl..LDSS where:

| | |
|---|---|
| C | '0' → CAN2.0<br>'1' → CAN-FD (set by using the define MCP251XFD_CANFD_ENABLED) |
| l | '0' → Do not use RRS as SID11<br>'1' → Use RRS as SID11 (set by using the enum eMCP251XFD_CANCtrlFlags::CANFD_USE_RRS_BIT_AS_SID11) |
| . | Not used |
| L | '0' → LowPower mode disable<br>'1' → LowPower mode enable (set by using the define MCP251XFD_SFR_OSC8_LPMEN) |
| D | '0' → MCP2517FD (enum eMCP251XFD_Devices::MCP2517FD)<br>'1' → MCP2518FD (enum eMCP251XFD_Devices::MCP2518FD) |
| S | '00' → Sleep not configured (enum eMCP251XFD_PowerStates::MCP251XFD_DEVICE_SLEEP_NOT_CONFIGURED)<br>'01' → Normal power (enum eMCP251XFD_PowerStates::MCP251XFD_DEVICE_NORMAL_POWER_STATE)<br>'10' → Sleep state (enum eMCP251XFD_PowerStates::MCP251XFD_DEVICE_SLEEP_STATE)<br>'11' → LowPower Sleep state (enum eMCP251XFD_PowerStates::MCP251XFD_DEVICE_LOWPOWER_SLEEP_STATE) |

### 15.1.4. Driver interface handle functions

```
eERRORRESULT (*MCP251XFD_SPIInit_Func)(
        void *pIntDev,
        uint8_t chipSelect
        const uint32_t sckFreq)
```

Function for interface driver initialization of the MCP251XFD. This function will be called at driver initialization to configure the interface driver.

**Parameters**

| | | |
|---|---|---|
| Input | *pIntDev | Is the MCP251XFD.InterfaceDevice of the device that call the interface initialization |
| Input | chipSelect | Is the Chip Select index to use for the SPI initialization |
| Input | sckFreq | Is the SCK frequency in Hz to set at the interface initialization |

**Return**

Returns an *eERRORRESULT* value enumerator dependent of how the return error is implemented by the user. It is recommended, during the implement of the pointer interface function, to return only ERR__SPI_PARAMETER_ERROR, ERR__SPI_COMM_ERROR, ERR__SPI_CONFIG_ERROR, or ERR__SPI_TIMEOUT when there is an error and ERR_OK when all went fine.

```
eERRORRESULT (*MCP251XFD_SPITransfer_Func)(
        void *pIntDev,
        uint8_t chipSelect,
        uint8_t *txData,
        uint8_t *rxData,
        size_t size)
```

Function for interface transfer of the MCP251XFD. This function will be called at driver read/write data from/to the interface driver.

**Parameters**

| | | |
|---|---|---|
| Input | *pIntDev | Is the MCP251XFD.InterfaceDevice of the device that call the data transfer |
| Input | chipSelect | Is the Chip Select index to use for the SPI transfer |
| Input | *txData | Is the data to send through the interface |
| Output | *rxData | Is where the data received through the interface will be stored. This parameter can be nulled by the driver if no received data is expected |
| Input | size | Is the size of the data to send and receive through the interface |

**Return**

Returns an *eERRORRESULT* value enumerator dependent of how the return error is implemented by the user. It is recommended, during the implement of the pointer interface function, to return only ERR__SPI_PARAMETER_ERROR, ERR__SPI_COMM_ERROR, ERR__SPI_CONFIG_ERROR, or ERR__SPI_TIMEOUT when there is an error and ERR_OK when all went fine.

```
uint32_t (*GetCurrentms_Func)(void)
```

Function that give the current millisecond of the system to the driver. This function will be called when the driver needs to get current millisecond.

**Return**

Returns the current millisecond of the system

```
uint16_t (*ComputeCRC16_Func)(
        const uint8_t* data,
        size_t size)
```

Function that compute CRC16-CMS for the driver. This function will be called when a CRC16-CMS computation is needed (*MCP251XFD_DRIVER_USE_READ_WRITE_CRC* or *MCP251XFD_DRIVER_USE_SAFE_WRITE* flags set in the field MCP251XFD::DriverConfig). In normal mode, this can point to NULL.

**Parameters**

| | | |
|---|---|---|
| Input | *data | Is the byte steam of data to compute |
| Input | size | Is the size of the byte stream |

**Return**

Returns the result of the CRC16-CMS computation

## 15.2. Controller and CAN configuration structure

The MCP251XFD configuration structure contains all information to configure most of the controller and CAN controller of the device at initialization. This structure is used once, when using *Init_MCP251XFD()* function.

Source code:

```
typedef struct MCP251XFD_Config
{
  //--- Controller clocks ---
  uint32_t XtalFreq;
  uint32_t OscFreq;
  eMCP251XFD_CLKINtoSYSCLK SysclkConfig;
  eMCP251XFD_CLKODIV ClkoPinConfig;
  uint32_t *SYSCLK_Result;

  //--- CAN configuration ---
  uint32_t NominalBitrate;
  uint32_t DataBitrate;
  MCP251XFD_BitTimeStats *BitTimeStats;
  eMCP251XFD_Bandwidth Bandwidth;
  setMCP251XFD_CANCtrlFlags ControlFlags;

  //--- GPIOs and Interrupts pins ---
  eMCP251XFD_GPIO0Mode GPIO0PinMode;
  eMCP251XFD_GPIO1Mode GPIO1PinMode;
  eMCP251XFD_OutMode INTsOutMode;
  eMCP251XFD_OutMode TXCANOutMode;

  //--- Interrupts ---
  setMCP251XFD_InterruptEvents SysInterruptFlags;
} MCP251XFD_Config;
```

### 15.2.1. Data fields

#### *uint32_t* ***XtalFreq***

Component CLKIN Xtal/Resonator frequency (min 4MHz, max 40MHz). Set it to 0 if oscillator is used.

#### *uint32_t* ***OscFreq***

Component CLKIN oscillator frequency (min 2MHz, max 40MHz). Set it to 0 if Xtal/Resonator is used.

#### *eMCP251XFD_CLKINtoSYSCLK* ***SysclkConfig***

Factor of frequency for the SYSCLK. SYSCLK = CLKIN x SysclkConfig where CLKIN is XtalFreq or OscFreq.

**Type**

enum *eMCP251XFD_SCLKDIV*

#### *eMCP251XFD_CLKODIV* ***ClkoPinConfig***

Configure the CLKO pin (SCLK div by 1, 2, 4, 10 or Start Of Frame).

**Type**

enum *eMCP251XFD_CLKODIV*

**Initial value / default**

MCP251XFD_CLKO_DivBy10

#### *uint32_t* ****SYSCLK_Result***

This is the SYSCLK of the component after configuration (can be NULL if the internal SYSCLK of the component do not have to be known). If not NULL, this pointed variable is filled by the *Init_MCP251XFD()* following XtalFreq or OscFreq and Use10xPLL.

#### *uint32_t* ***NominalBitrate***

Speed of the Frame description and arbitration.

#### *uint32_t* ***DataBitrate***

Speed of all the data bytes of the frame (if CAN2.0 only mode, set to value MCP251XFD_NO_CANFD).

### *MCP251XFD_BitTimeStats* ***BitTimeStats***

Point to a Bit Time stat structure (set to NULL if no statistics are necessary). If not NULL, this pointed variable is filled with the result of the MCP251XFD_Config::NormalBitrate and MCP251XFD_Config::DataBitrate computation and result calculus.

**Type**

struct *MCP251XFD_BitTimeStats*

### *eMCP251XFD_Bandwidth* ***Bandwidth***

Transmit Bandwidth Sharing, this is the delay between two consecutive transmissions (in arbitration bit times) for the CiCON.TXBWS register.

**Type**

enum *eMCP251XFD_Bandwidth*

**Initial value / default**

MCP251XFD_NO_DELAY

### *setMCP251XFD_CANCtrlFlags* ***ControlFlags***

Set of CAN control flags to configure the CAN controller. Configuration can be OR'ed.

**Type**

set of enum *setMCP251XFD_CANCtrlFlags*

**Initial value / default**

*MCP251XFD_CAN_RESTRICTED_MODE_ON_ERROR* | *MCP251XFD_CAN_ESI_REFLECTS_ERROR_STATUS* | *MCP251XFD_CAN_UNLIMITED_RETRANS_ATTEMPTS* | *MCP251XFD_CANFD_BITRATE_SWITCHING_ENABLE* | *MCP251XFD_CAN_PROTOCOL_EXCEPT_ENTER_INTEGRA* | *MCP251XFD_CANFD_USE_NONISO_CRC* | *MCP251XFD_CANFD_DONT_USE_RRS_BIT_AS_SID11*

### *eMCP251XFD_GPIO0Mode* ***GPIO0PinMode***

Startup INT0/GPIO0/XSTBY pins mode (INT0 => Interrupt for TX).

**Type**

enum *eMCP251XFD_GPIO0Mode*

### *eMCP251XFD_GPIO1Mode* ***GPIO1PinMode***

Startup INT1/GPIO1 pins mode (INT1 => Interrupt for RX).

**Type**

enum *eMCP251XFD_GPIO1Mode*

### *eMCP251XFD_OutMode* ***INTsOutMode***

Define the output type of all interrupt pins (INT, INT0 and INT1).

**Type**

enum *eMCP251XFD_OutMode*

### *eMCP251XFD_OutMode* ***TXCANOutMode***

Define the output type of the TXCAN pin.

**Type**

enum *eMCP251XFD_OutMode*

### *setMCP251XFD_InterruptEvents* ***SysInterruptFlags***

Set of system interrupt flags to enable. Configuration can be OR'ed.

**Type**

enum *setMCP251XFD_InterruptEvents*

### 15.2.2. Enumerators

#### *enum* eMCP251XFD_CLKINtoSYSCLK

Xtal/Oscillator (CLKIN) multiplier/divisor to SYSCLK.

**Enumerator**

| | |
|---|---|
| *MCP251XFD_SYSCLK_IS_CLKIN* | SYSCLK is CLKIN (no PLL, SCLK divide by 1).<br>For CLKIN at 20MHz or 40MHz |
| *MCP251XFD_SYSCLK_IS_CLKIN_DIV_2* | SYSCLK is CLKIN divide by 2 (no PLL, SCLK divide by 2).<br>For CLKIN at 20MHz or 40MHz |
| *MCP251XFD_SYSCLK_IS_CLKIN_MUL_5* | SYSCLK is CLKIN multiply by 5 (PLL enable, SCLK divide by 2).<br>For CLKIN at 2MHz or 4MHz |
| *MCP251XFD_SYSCLK_IS_CLKIN_MUL_10* | SYSCLK is CLKIN multiply by 10 (PLL enable, SCLK divide by 1).<br>For CLKIN at 2MHz or 4MHz |

#### *enum* eMCP251XFD_CLKODIV

Clock Output Divisor for the OSC.CLKODIV register and IOCON.SOF configuration.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_CLKO_DivBy1* | **0b000** | Clock Output Divisor by 1 |
| *MCP251XFD_CLKO_DivBy2* | **0b001** | Clock Output Divisor by 2 |
| *MCP251XFD_CLKO_DivBy4* | **0b010** | Clock Output Divisor by 4 |
| *MCP251XFD_CLKO_DivBy10* | **0b011** | Clock Output Divisor by 10 (default) |
| *MCP251XFD_CLKO_SOF* | **0b111** | CLKO pin output Start Of Frame (Not configured in the OSC.CLKODIV register) |

#### *enum* eMCP251XFD_Bandwidth

CAN Controller Transmit Bandwidth Sharing bits for the CiCON.TXBWS register. Delay between two consecutive transmissions (in arbitration bit times).

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_NO_DELAY* | **0b0000** | No delay (default) |
| *MCP251XFD_DELAY_2BIT_TIMES* | **0b0001** | Delay 2 arbitration bit times |
| *MCP251XFD_DELAY_4BIT_TIMES* | **0b0010** | Delay 4 arbitration bit times |
| *MCP251XFD_DELAY_8BIT_TIMES* | **0b0011** | Delay 8 arbitration bit times |
| *MCP251XFD_DELAY_16BIT_TIMES* | **0b0100** | Delay 16 arbitration bit times |
| *MCP251XFD_DELAY_32BIT_TIMES* | **0b0101** | Delay 32 arbitration bit times |
| *MCP251XFD_DELAY_64BIT_TIMES* | **0b0110** | Delay 64 arbitration bit times |
| *MCP251XFD_DELAY_128BIT_TIMES* | **0b0111** | Delay 128 arbitration bit times |
| *MCP251XFD_DELAY_256BIT_TIMES* | **0b1000** | Delay 256 arbitration bit times |
| *MCP251XFD_DELAY_512BIT_TIMES* | **0b1001** | Delay 512 arbitration bit times |
| *MCP251XFD_DELAY_1024BIT_TIMES* | **0b1010** | Delay 1024 arbitration bit times |
| *MCP251XFD_DELAY_2048BIT_TIMES* | **0b1011** | Delay 2048 arbitration bit times |
| *MCP251XFD_DELAY_4096BIT_TIMES* | **0b1100** | Delay 4096 arbitration bit times |

#### *enum* eMCP251XFD_GPIO0Mode

INT0/GPIO0/XSTBY configuration for the IOCON register.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_PIN_AS_INT0_TX* | **0b00** | INT0/GPIO0/XSTBY pin as TX Interrupt output (active low) |
| *MCP251XFD_PIN_AS_GPIO0_IN* | **0b01** | INT0/GPIO0/XSTBY pin as GPIO input |
| *MCP251XFD_PIN_AS_GPIO0_OUT* | **0b10** | INT0/GPIO0/XSTBY pin as GPIO output |
| *MCP251XFD_PIN_AS_XSTBY* | **0b11** | INT0/GPIO0/XSTBY pin as Transceiver Standby output |

#### *enum* eMCP251XFD_GPIO1Mode

INT1/GPIO1 configuration for the IOCON register.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_PIN_AS_INT1_RX* | **0b00** | INT1/GPIO1 pin as RX Interrupt output (active low) |
| *MCP251XFD_PIN_AS_GPIO1_IN* | **0b01** | INT1/GPIO1 pin as GPIO input |
| *MCP251XFD_PIN_AS_GPIO1_OUT* | **0b10** | INT1/GPIO1 pin as GPIO output |

### *enum* **eMCP251XFD_OutMode**

Output configuration for the IOCON.INTOD and the IOCON.TXCANOD register.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_PINS_PUSHPULL_OUT* | **0b0** | Pin with Push/Pull output |
| *MCP251XFD_PINS_OPENDRAIN_OUT* | **0b1** | Pin with Open Drain output |

### *enum* **eMCP251XFD_CANCtrlFlags**
### *typedef* eMCP251XFD_CANCtrlFlags **setMCP251XFD_CANCtrlFlags**

CAN control configuration flags. Configuration can be OR'ed.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_CAN_RESTRICTED_MODE_ON_ERROR* | **0x00** | Transition to Restricted Operation Mode on system error |
| *MCP251XFD_CAN_LISTEN_ONLY_MODE_ON_ERROR* | **0x01** | Transition to Listen Only Mode on system error |
| *MCP251XFD_CAN_ESI_REFLECTS_ERROR_STATUS* | **0x00** | ESI reflects error status of CAN controller |
| *MCP251XFD_CAN_GATEWAY_MODE_ESI_RECESSIVE* | **0x02** | Transmit ESI in Gateway Mode, ESI is transmitted recessive when ESI of message is high or CAN controller error passive |
| *MCP251XFD_CAN_UNLIMITED_RETRANS_ATTEMPTS* | **0x00** | Unlimited number of retransmission attempts, MCP251XFD_FIFO.Attempts (CiFIFOCONm.TXAT) will be ignored |
| *MCP251XFD_CAN_RESTRICTED_RETRANS_ATTEMPTS* | **0x04** | Restricted retransmission attempts, MCP251XFD_FIFO.Attempts (CiFIFOCONm.TXAT) is used |
| *MCP251XFD_CANFD_BITRATE_SWITCHING_ENABLE* | **0x00** | Bit Rate Switching is Enabled, Bit Rate Switching depends on BRS in the Transmit Message Object |
| *MCP251XFD_CANFD_BITRATE_SWITCHING_DISABLE* | **0x08** | Bit Rate Switching is Disabled, regardless of BRS in the Transmit Message Object |
| *MCP251XFD_CAN_PROTOCOL_EXCEPT_ENTER_INTEGRA* | **0x00** | If a Protocol Exception is detected, the CAN FD Controller Module will enter Bus Integrating state. A recessive "res bit" following a recessive FDF bit is called a Protocol Exception |
| *MCP251XFD_CAN_PROTOCOL_EXCEPT_AS_FORM_ERROR* | **0x10** | Protocol Exception is treated as a Form Error. A recessive "res bit" following a recessive FDF bit is called a Protocol Exception |
| *MCP251XFD_CANFD_USE_NONISO_CRC* | **0x00** | Do NOT include Stuff Bit Count in CRC Field and use CRC Initialization Vector with all zeros |
| *MCP251XFD_CANFD_USE_ISO_CRC* | **0x20** | Include Stuff Bit Count in CRC Field and use Non-Zero CRC Initialization Vector according to ISO 11898-1:2015 |
| *MCP251XFD_CANFD_DONT_USE_RRS_BIT_AS_SID11* | **0x00** | Do not use RRS; SID<10:0> according to ISO 11898-1:2015 |
| *MCP251XFD_CANFD_USE_RRS_BIT_AS_SID11* | **0x40** | RRS is used as SID11 in CAN FD base format messages: SID<11:0> = {SID<10:0>, SID11} |

### *enum* **eMCP251XFD_InterruptEvents**
### *typedef* eMCP251XFD_InterruptEvents **setMCP251XFD_InterruptEvents**

Interrupt Events, can be OR'ed.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_INT_NO_EVENT* | **0x0000** | No interrupt events |
| *MCP251XFD_INT_TX_EVENT* | **0x0001** | Transmit events. Equivalent to INT0 |
| *MCP251XFD_INT_RX_EVENT* | **0x0002** | Receive events. Equivalent to INT1 |
| *MCP251XFD_INT_TEF_EVENT* | **0x0010** | TEF events. Clearable in specific FIFO |
| *MCP251XFD_INT_TX_ATTEMPTS_EVENT* | **0x0400** | Transmit attempts events. Clearable in specific FIFO |
| *MCP251XFD_INT_RX_OVERFLOW_EVENT* | **0x0800** | Receive overflow events. Clearable in specific FIFO |
| *MCP251XFD_INT_TIME_BASE_COUNTER_EVENT* | **0x0004** | Time base counter events. Clearable in CiINT |
| *MCP251XFD_INT_OPERATION_MODE_CHANGE_EVENT* | **0x0008** | Operation mode change events. Clearable in CiINT |

| | | |
|---|---|---|
| *MCP251XFD_INT_RAM_ECC_EVENT* | **0x0100** | ECC RAM events. Clearable in ECCSTA |
| *MCP251XFD_INT_SPI_CRC_EVENT* | **0x0200** | SPI CRC events. Clearable in CRC |
| *MCP251XFD_INT_SYSTEM_ERROR_EVENT* | **0x1000** | System error events. Clearable in CiINT |
| *MCP251XFD_INT_BUS_ERROR_EVENT* | **0x2000** | Bus error events. Clearable in CiINT |
| *MCP251XFD_INT_BUS_WAKEUP_EVENT* | **0x4000** | Bus wakeup events, only when sleeping. Clearable in CiINT |
| *MCP251XFD_INT_RX_INVALID_MESSAGE_EVENT* | **0x8000** | Invalid receipt message events. Clearable in CiINT |
| *MCP251XFD_INT_ENABLE_ALL_EVENTS* | **0xFF1F** | Enable all events |

## 15.3. FIFO configuration structure

The MCP251XFD FIFO configuration structure contains all information to configure each FIFO of the device at initialization. This structure is used when using *MCP251XFD_ConfigureFIFO()* and in case of configuration of one FIFO, an array of the struct can be used when using *MCP251XFD_ConfigureFIFOList()* function.

Source code:

```
typedef struct MCP251XFD_FIFO
{
  eMCP251XFD_FIFO Name;

  //--- FIFO Size ---
  eMCP251XFD_MessageDeep Size;
  eMCP251XFD_PayloadSize Payload;

  //--- Configuration ---
  eMCP251XFD_SelTXRX Direction;
  eMCP251XFD_Attempts Attempts;
  eMCP251XFD_Priority Priority;
  eMCP251XFD_FIFOCtrlFlags ControlFlags;
  eMCP251XFD_FIFOIntFlags InterruptFlags;

  //--- FIFO RAM Infos ---
  MCP251XFD_RAMInfos *RAMInfos;
} MCP251XFD_FIFO;
```

### 15.3.1. Data fields

*eMCP251XFD_FIFO* ***Name***

FIFO name (MCP251XFD_TXQ, MCP251XFD_FIFO1..31 or MCP251XFD_TEF).

**Type**

enum *eMCP251XFD_FIFO*

*eMCP251XFD_MessageDeep* ***Size***

FIFO Message size deep (1 to 32).

**Type**

enum *eMCP251XFD_MessageDeep*

**Initial value / default**

MCP251XFD_FIFO_1_MESSAGE_DEEP

*eMCP251XFD_PayloadSize* ***Payload***

Message Payload Size (8, 12, 16, 20, 24, 32, 48 or 64 bytes).

**Type**

enum *eMCP251XFD_PayloadSize*

**Initial value / default**

MCP251XFD_PAYLOAD_8BYTE

*eMCP251XFD_SelTXRX* ***Direction***

TX/RX FIFO Selection.

**Type**

enum *eMCP251XFD_SelTXRX*

**Initial value / default**

MCP251XFD_RECEIVE_FIFO

### *eMCP251XFD_Attempts* ***Attempts***

Retransmission Attempts. This feature is enabled when CiCON.RTXAT is set.

**Type**

enum *eMCP251XFD_Attempts*

**Initial value / default**

MCP251XFD_UNLIMITED_ATTEMPTS

### *eMCP251XFD_Priority* ***Priority***

Message Transmit Priority ('0x00' = Lowest Message Priority and '0x1F' = Highest Message Priority).

**Type**

enum *eMCP251XFD_Priority*

**Initial value / default**

MCP251XFD_MESSAGE_TX_PRIORITY1

### *eMCP251XFD_FIFOCtrlFlags* ***ControlFlags***

FIFO control flags to configure the FIFO.

**Type**

enum *eMCP251XFD_FIFOCtrlFlags*

**Initial value / default**

MCP251XFD_FIFO_NO_CONTROL_FLAGS

### *eMCP251XFD_FIFOIntFlags* ***InterruptFlags***

FIFO interrupt flags to configure interrupts of the FIFO.

**Type**

enum *eMCP251XFD_FIFOIntFlags*

**Initial value / default**

MCP251XFD_FIFO_NO_INTERRUPT_FLAGS

### *MCP251XFD_RAMInfos* ****RAMInfos***

Point to a RAM Information's structure of the FIFO (set to NULL if no RAM use is necessary). If not NULL, this pointed variable is filled with the result of the RAM used and addresses of the FIFO.

**Type**

struct *MCP251XFD_RAMInfos*

## 15.3.2. Enumerators

### *enum* **eMCP251XFD_FIFO**

Available FIFO list.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TEF* | **-1** | TEF - Transmit Event FIFO |
| *MCP251XFD_TXQ* | **0** | TXQ - Transmit Queue |
| *MCP251XFD_FIFO1* | **1** | FIFO 1 |
| … | **…** | … |
| *MCP251XFD_FIFO31* | **31** | FIFO 31 |
| *MCP251XFD_NO_FIFO* | **32** | No FIFO code for FIFO status functions |

### *enum* **eMCP251XFD_MessageDeep**

FIFO Size for the CiTEFCON.FSIZE, CiTXQCON.FSIZE and CiFIFOCONm.FSIZE.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_FIFO_1_MESSAGE_DEEP* | **0** | FIFO is 1 Message deep |
| … | **…** | … |
| *MCP251XFD_FIFO_32_MESSAGE_DEEP* | **31** | FIFO is 32 Message deep |

### *enum* eMCP251XFD_Attempts

Retransmission Attempts for the CiTXQCON.TXAT and CiFIFOCONm.TXAT.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_DISABLE_ATTEMPS* | **0b00** | Disable retransmission attempts |
| *MCP251XFD_THREE_ATTEMPTS* | **0b01** | Three retransmission attempts |
| *MCP251XFD_UNLIMITED_ATTEMPTS* | **0b10** | Unlimited number of retransmission attempts |

### *enum* eMCP251XFD_PayloadSize

Payload Size for the CiTXQCON.PLSIZE and CiFIFOCONm.PLSIZE.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_PAYLOAD_8BYTE* | **0b000** | Payload 8 data bytes |
| *MCP251XFD_PAYLOAD_12BYTE* | **0b001** | Payload 12 data bytes |
| *MCP251XFD_PAYLOAD_16BYTE* | **0b010** | Payload 16 data bytes |
| *MCP251XFD_PAYLOAD_20BYTE* | **0b011** | Payload 20 data bytes |
| *MCP251XFD_PAYLOAD_24BYTE* | **0b100** | Payload 24 data bytes |
| *MCP251XFD_PAYLOAD_32BYTE* | **0b101** | Payload 32 data bytes |
| *MCP251XFD_PAYLOAD_48BYTE* | **0b110** | Payload 48 data bytes |
| *MCP251XFD_PAYLOAD_64BYTE* | **0b111** | Payload 64 data bytes |

### *enum* eMCP251XFD_SelTXRX

FIFO Direction for the CiFIFOCONm.TXEN.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_RECEIVE_FIFO* | **0b0** | Receive FIFO |
| *MCP251XFD_TRANSMIT_FIFO* | **0b1** | Transmit FIFO |

### *enum* eMCP251XFD_Priority

Message Transmit Priority for the CiTXQCON.TXPRI.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_MESSAGE_TX_PRIORITY1* | **0x00** | Message transmit priority 1 (Lowest) |
| … | **…** | … |
| *MCP251XFD_MESSAGE_TX_PRIORITY32* | **0x1F** | Message transmit priority 32 (Highest) |

### *enum* eMCP251XFD_FIFOCtrlFlags

MCP251XFD FIFO configuration flags.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_FIFO_NO_CONTROL_FLAGS* | **0x00** | Set no control flags |
| *MCP251XFD_FIFO_NO_RTR_RESPONSE* | **0x00** | When a remote transmit is received, Transmit Request (TXREQ) of the FIFO will be unaffected |
| *MCP251XFD_FIFO_AUTO_RTR_RESPONSE* | **0x40** | When a remote transmit is received, Transmit Request (TXREQ) of the FIFO will be set |
| *MCP251XFD_FIFO_NO_TIMESTAMP_ON_RX* | **0x00** | Do not capture time stamp |
| *MCP251XFD_FIFO_ADD_TIMESTAMP_ON_RX* | **0x20** | Capture time stamp in received message object in RAM |
| *MCP251XFD_FIFO_ADD_TIMESTAMP_ON_OBJ* | **0x20** | Capture time stamp in objects in TEF |

### *enum* **eMCP251XFD_FIFOIntFlags**

MCP251XFD FIFO interruption flags.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_FIFO_NO_INTERRUPT_FLAGS* | **0x00** | Set no interrupt flags |
| *MCP251XFD_FIFO_TX_ATTEMPTS_EXHAUSTED_INT* | **0x10** | Transmit Attempts Exhausted Interrupt Enable |
| *MCP251XFD_FIFO_OVERFLOW_INT* | **0x08** | Overflow Interrupt Enable (Not available on TXQ (FIFO0)) |
| *MCP251XFD_FIFO_TRANSMIT_FIFO_EMPTY_INT* | **0x04** | Transmit FIFO Empty Interrupt Enable |
| *MCP251XFD_FIFO_TRANSMIT_FIFO_HALF_EMPTY_INT* | **0x02** | Transmit FIFO Half Empty Interrupt Enable (Not available on TXQ (FIFO0)) |
| *MCP251XFD_FIFO_TRANSMIT_FIFO_NOT_FULL_INT* | **0x01** | Transmit FIFO Not Full Interrupt Enable |
| *MCP251XFD_FIFO_RECEIVE_FIFO_FULL_INT* | **0x04** | Receive FIFO Full Interrupt Enable |
| *MCP251XFD_FIFO_RECEIVE_FIFO_HALF_FULL_INT* | **0x02** | Receive FIFO Half Full Interrupt Enable |
| *MCP251XFD_FIFO_RECEIVE_FIFO_NOT_EMPTY_INT* | **0x01** | Receive FIFO Not Empty Interrupt Enable |
| *MCP251XFD_FIFO_EVENT_FIFO_FULL_INT* | **0x04** | Transmit Event FIFO Full Interrupt Enable |
| *MCP251XFD_FIFO_EVENT_FIFO_HALF_FULL_INT* | **0x02** | Transmit Event FIFO Half Full Interrupt Enable |
| *MCP251XFD_FIFO_EVENT_FIFO_NOT_EMPTY_INT* | **0x01** | Transmit Event FIFO Not Empty Interrupt Enable |

## 15.4. Filter configuration structure

The MCP251XFD filter configuration structure contains all information to configure each filter of the device at initialization. This structure is used when using *MCP251XFD_ConfigureFilter()* and in case of configuration of one filter, an array of the struct can be used when using *MCP251XFD_ConfigureFilterList()* function.

Source code:

```
typedef struct MCP251XFD_Filter
{
  //--- Configuration ---
  eMCP251XFD_Filter Filter;
  bool EnableFilter;
  eMCP251XFD_FilterMatch Match;
  eMCP251XFD_FIFO PointTo;

  //--- Message Filter ---
  uint32_t AcceptanceID;
  uint32_t AcceptanceMask;
  bool ExtendedID;
} MCP251XFD_Filter;
```

### 15.4.1. Data fields

***eMCP251XFD_Filter Filter***

Filter to configure.

**Type**

enum *eMCP251XFD_Filter*

***bool EnableFilter***

If 'true' it enables the filter else it disables the filter.

***eMCP251XFD_FilterMatch Match***

Filter match type of the frame (SID and/or EID).

**Type**

enum *eMCP251XFD_FilterMatch*

***eMCP251XFD_FIFO PointTo***

Message matching filter is stored in pointed FIFO name (FIFO1 to 31).

**Type**

enum *eMCP251XFD_FIFO*

***uint32_t AcceptanceID***

Message Filter Acceptance SID+(SID11 in FD mode)+EID.

***uint32_t AcceptanceMask***

Message Filter Mask SID+(SID11 in FD mode)+EID. Corresponding bits to AcceptanceID: '1': bit to filter ; '0' bit that do not care.

***bool ExtendedID***

If 'true' it uses the extended ID else, it does not use the extended ID.

### 15.4.2. Enumerators

***enum eMCP251XFD_Filter***

Available Filter list.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_FILTER0* | **0** | Filter 0 |
| ... | **...** | ... |
| *MCP251XFD_FILTER31* | **31** | Filter 31 |

### *enum* **eMCP251XFD_FilterMatch**

Filter match type.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_MATCH_ONLY_SID* | **0** | Match only messages with standard identifier (+SID11 in FD mode if configured) |
| *MCP251XFD_MATCH_ONLY_EID* | **1** | Match only messages with extended identifier |
| *MCP251XFD_MATCH_SID_EID* | **2** | Match both standard and extended message frames |

#### 15.4.3. Defines

### *#define* ***MCP251XFD_ACCEPT_ALL_MESSAGES***

Indicate that the filter will accept all messages.

**Value**

0x00000000u

## 15.5. Bit Time Statistics structure

The MCP251XFD bit time statistics structure contains all information about the calculated bit time configuration regarding Nominal Bitrate and Data Bitrate of the device at initialization. This structure is filled by the function *MCP251XFD_CalculateBitrateStatistics()* when using *MCP251XFD_CalculateBitTimeConfiguration()* function. The calculous of bit time configuration is done when using *Init_MCP251XFD()* function.

Source code:

```
typedef struct MCP251XFD_BitTimeStats
{
  uint32_t NominalBitrate;
  uint32_t DataBitrate;
  uint32_t MaxBusLength;
  uint32_t NSamplePoint;
  uint32_t DSamplePoint;
  uint32_t OscTolC1;
  uint32_t OscTolC2;
  uint32_t OscTolC3;
  uint32_t OscTolC4;
  uint32_t OscTolC5;
  uint32_t OscTolerance;
} MCP251XFD_BitTimeStats;
```

### 15.5.1. Data fields

***uint32_t NominalBitrate***

This is the actual nominal bitrate with the current configuration after calculous of bit time configuration with *MCP251XFD_CalculateBitTimeConfiguration()* function.

***uint32_t DataBitrate***

This is the actual data bitrate with the current configuration after calculous of bit time configuration with *MCP251XFD_CalculateBitTimeConfiguration()* function.

***uint32_t MaxBusLength***

This is the maximum bus length according to parameters of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function.

***uint32_t NSamplePoint***

Nominal Sample Point of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function. Should be as close as possible to 80%.

***uint32_t DSamplePoint***

Data Sample Point of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function. Should be as close as possible to 80%.

***uint32_t OscTolC1***

Condition 1 for the maximum tolerance of the oscillator (Equation 3-12 of MCP25XXFD Family Reference Manual) of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function.

***uint32_t OscTolC2***

Condition 2 for the maximum tolerance of the oscillator (Equation 3-13 of MCP25XXFD Family Reference Manual) of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function.

***uint32_t OscTolC3***

Condition 3 for the maximum tolerance of the oscillator (Equation 3-14 of MCP25XXFD Family Reference Manual) of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function.

### *uint32_t **OscTolC4***

Condition 4 for the maximum tolerance of the oscillator (Equation 3-15 of MCP25XXFD Family Reference Manual) of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function.

### *uint32_t **OscTolC5***

Condition 5 for the maximum tolerance of the oscillator (Equation 3-16 of MCP25XXFD Family Reference Manual) of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function.

### *uint32_t **OscTolerance***

Oscillator Tolerance, minimum of conditions 1-5 (Equation 3-11 of MCP25XXFD Family Reference Manual) of the bit time configuration. This is calculated in the *MCP251XFD_CalculateBitrateStatistics()* function.

## 15.6. RAM FIFO information structure

The MCP251XFD RAM FIFO information structure contains all information about the RAM composition of a FIFO of the device when configured. This structure is filled by *MCP251XFD_ConfigureTEF()*, *MCP251XFD_ConfigureTXQ()* *and* *MCP251XFD_ConfigureFIFO()* functions. With TXQ and FIFO functions, the start address is set to 0 because it is impossible to know the actual start in RAM without knowing all the others configured FIFO. With the TEF it is easy, this FIFO is always the first.

If you want the complete RAM structure, create an array of *MCP251XFD_FIFO* with *MCP251XFD_FIFO*.RAMInfos of each FIFO configuration linked to a *MCP251XFD_RAMInfos* structure and use the *MCP251XFD_ConfigureFIFOList()* instead.

Source code:

```
typedef struct MCP251XFD_RAMInfos
{
  uint16_t ByteInFIFO;
  uint16_t RAMStartAddress;
  uint8_t  ByteInObject;
} MCP251XFD_RAMInfos;
```

### 15.6.1. Data fields

### *uint16_t **ByteInFIFO***

Total number of bytes that FIFO takes in RAM.

### *uint16_t **RAMStartAddress***

RAM Start Address of the FIFO.

### *uint8_t **ByteInObject***

How many bytes in an object of the FIFO.

## 15.7. Function's return error enumerator

*enum* **eERRORRESULT**

There is only one error code at the same time returned by the functions. The only code that indicates that all went fine is ERR_OK.

**Enumerator**

| | | |
|---|---|---|
| *ERR_OK* | **0** | Succeeded |
| *ERR__NO_DEVICE_DETECTED* | **1** | No device detected |
| *ERR__OUT_OF_RANGE* | **2** | Value out of range |
| *ERR__UNKNOWN_ELEMENT* | **3** | Unknown element (type or value) |
| *ERR__CONFIGURATION* | **4** | Configuration error |
| *ERR__NOT_SUPPORTED* | **5** | Not supported |
| *ERR__OUT_OF_MEMORY* | **6** | Out of memory |
| *ERR__NOT_AVAILABLE* | **7** | Function not available |
| *ERR__DEVICE_TIMEOUT* | **8** | Device timeout |
| *ERR__PARAMETER_ERROR* | **9** | Parameter error |
| *ERR__NO_DATA_AVAILABLE* | **11** | No data available |
| *ERR__FREQUENCY_ERROR* | **12** | Frequency error |
| *ERR__CRC_ERROR* | **13** | CRC mismatch error |
| *ERR__BAUDRATE_ERROR* | **14** | Baudrate error |
| | | |
| *ERR__NOT_IN_SLEEP_MODE* | **90** | Operation impossible in sleep mode |
| *ERR__ALREADY_IN_SLEEP* | **91** | Already in sleep mode |
| *ERR__NEED_CONFIG_MODE* | **93** | Device not in configuration mode |
| | | |
| *ERR__RAM_TEST_FAIL* | **100** | RAM test fail |
| *ERR__BITTIME_ERROR* | **101** | Can't calculate a good Bit Time |
| *ERR__TOO_MANY_TEF* | **102** | Too many TEF to configure |
| *ERR__TOO_MANY_TXQ* | **103** | Too many TXQ to configure |
| *ERR__TOO_MANY_FIFO* | **104** | Too many FIFO to configure |
| *ERR__SID11_NOT_AVAILABLE* | **105** | SID11 not available in CAN2.0 mode |
| *ERR__FILTER_CONSISTENCY* | **106** | Filter inconsistency between Mask and filter |
| *ERR__FILTER_TOO_LARGE* | **107** | Filter too large between filter and config |
| *ERR__BYTE_COUNT_MODULO_4* | **108** | Byte count should be modulo 4 |
| | | |
| *ERR__SPI_PARAMETER_ERROR* | **200** | SPI parameter error |
| *ERR__SPI_COMM_ERROR* | **201** | SPI communication error |
| *ERR__SPI_CONFIG_ERROR* | **202** | SPI configuration error |
| *ERR__SPI_TIMEOUT* | **203** | SPI communication timeout |
| *ERR__SPI_FREQUENCY_ERROR* | **204** | SPI frequency error |
| | | |
| *ERR__TEST_ERROR* | **255** | Test error |

# 16. DETAILS OF DRIVER FUNCTIONS

Here is the use of all functions related to the driver.

## 16.1. Init and reset

```
eERRORRESULT Init_MCP251XFD(
        MCP251XFD *pComp,
        const MCP251XFD_Config *pConf)
```

This function initializes the MCP251XFD driver and call the initialization of the interface driver (SPI). It checks parameters and perform a RESET. Next this function configures the MCP251XFD Controller and the CAN controller.

**Warning**

This function has to be used after component power-on otherwise the reset function call can fail when the component is used with MCP251XFD_DRIVER_SAFE_RESET

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be initialized |
| Input | *pConf | Is the pointed structure of the device configuration |

**Return**

Returns an *eERRORRESULT* value enumerator. Below are some returned by the function itself but not errors returned by called functions.

- ERR__PARAMETER_ERROR when pComp or pConf is NULL, or Interface functions are NULL
- ERR__FREQUENCY_ERROR when XtalFreq or OscFreq parameters are out of range, or SysclkConfig try to set an out of range frequency
- ERR__CONFIGURATION when both XtalFreq and OscFreq are configured to 0
- ERR__NO_DEVICE_DETECTED when no communication with the device is possible
- ERR__DEVICE_TIMEOUT when the device does not respond
- ERR__SPI_FREQUENCY_ERROR when the SPI clock is too high compared to SYSCLK (max SYSCLK / 2)
- ERR__RAM_TEST_FAIL when the driver's internal device RAM test failed

```
eERRORRESULT MCP251XFD_ResetDevice(MCP251XFD *pComp)
```

Reset the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be reset |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

## 16.2. Read from RAM and registers

```
eERRORRESULT MCP251XFD_ReadData(
        MCP251XFD *pComp,
        uint16_t address,
        uint8_t* data,
        uint16_t size)
```

Read data from the MCP251XFD. In case of data reading data from the RAM, the size should be modulo 4.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the address where data will be read in the MCP251XFD (address will be incremented automatically) |
| Output | *data | Is where the data will be stored |
| Input | size | Is the size of the data array to read |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or data is NULL, or Interface functions are NULL, or Address is too high
- ERR__OUT_OF_RANGE when you want to send a not multiple of 4 data to RAM
- ERR__CRC_ERROR when the CRC returned by the device is wrong

```
inline eERRORRESULT MCP251XFD_ReadSFR8(
      MCP251XFD *pComp,
      uint16_t address,
      uint8_t* data)
```

Read a byte data from an SFR register of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the SFR address where data will be read in the MCP251XFD |
| Output | *data | Is where the data will be stored |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ReadData()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_ReadSFR16(
      MCP251XFD *pComp,
      uint16_t address,
      uint8_t* data)
```

Read a 2-bytes data from an SFR address of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the SFR address where data will be read in the MCP251XFD |
| Output | *data | Is where the data will be stored |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ReadData()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_ReadSFR32(
      MCP251XFD *pComp,
      uint16_t address,
      uint8_t* data)
```

Read a word data (4 bytes) from an SFR address of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the SFR address where data will be read in the MCP251XFD |
| Output | *data | Is where the data will be stored |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ReadData()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_ReadRAM32(
      MCP251XFD *pComp,
      uint16_t address,
      uint8_t* data)
```

Read a word data (4 bytes) from a RAM address of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the SFR address where data will be read in the MCP251XFD |
| Output | *data | Is where the data will be stored |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ReadData()'s returns value for more information.

## 16.3. Write to RAM and registers

```
eERRORRESULT MCP251XFD_WriteData(
        MCP251XFD *pComp,
        uint16_t address,
        const uint8_t* data,
        uint16_t size)
```

Write data to the MCP251XFD. In case of data writing data to the RAM, the size should be modulo 4.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the address where data will be written in the MCP251XFD (address will be incremented automatically) |
| Input | *data | Is the data array to write |
| Input | size | Is the size of the data array to store |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or data is NULL, or Interface functions are NULL, or Address is too high
- ERR__OUT_OF_RANGE when you want to send a not multiple of 4 data to RAM

```
inline eERRORRESULT MCP251XFD_WriteSFR8(
        MCP251XFD *pComp,
        uint16_t address,
        const uint8_t* data,
        uint16_t size)
```

Write a byte data to an SFR register of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the address where data will be written in the MCP251XFD |
| Input | *data | Is the data array to store |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_WriteData()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_WriteSFR16(
        MCP251XFD *pComp,
        uint16_t address,
        const uint8_t* data,
        uint16_t size)
```

Write a 2-bytes data to an SFR register of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the address where data will be written in the MCP251XFD |
| Input | *data | Is the data array to store |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_WriteData()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_WriteSFR32(
        MCP251XFD *pComp,
        uint16_t address,
        const uint8_t* data,
        uint16_t size)
```

Write a word data (4 bytes) to an SFR register of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the address where data will be written in the MCP251XFD |
| Input | *data | Is the data array to store |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_WriteData()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_WriteRAM32(
      MCP251XFD *pComp,
      uint16_t address,
      const uint8_t* data,
      uint16_t size)
```

Write a word data (4 bytes) to a RAM register of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | address | Is the address where data will be written in the MCP251XFD |
| Input | *data | Is the data array to store |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_WriteData()'s returns value for more information.

## 16.4. Device ID

```
eERRORRESULT MCP251XFD_GetDeviceID(
      MCP251XFD *pComp,
      eMCP251XFD_Devices* device,
      uint8_t* deviceId,
      uint8_t* deviceRev)
```

Get actual device of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *device | Is the device found (MCP2517FD or MCP2518FD) |
| Output | *deviceId | Is the returned device ID (This parameter can be NULL if not needed) |
| Output | *deviceRev | Is the returned device Revision (This parameter can be NULL if not needed) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or device is NULL, or Interface functions are NULL

### 16.4.1. Enumerators

```
enum eMCP251XFD_Devices
```

List of supported devices.

**Enumerator**

| | | |
|---|---|---|
| *MCP2517FD* | **0x00** | Device MCP2517FD |
| *MCP2518FD* | **0x01** | Device MCP2518FD |

## 16.5. Messages

### 16.5.1. Transmit messages

```
eERRORRESULT MCP251XFD_TransmitMessageObjectToFIFO(
        MCP251XFD *pComp,
        uint8_t* messageObjectToSend,
        uint8_t objectSize,
        eMCP251XFD_FIFO toFIFO,
        bool andFlush)
```

Transmit the message to the specified FIFO. This function uses the specific format of the component (T0, T1, Ti (data)). This function gets the next address where to put the message object on, send it and update the head pointer.

**Warning**

This function does not check if the FIFO have a room for the message or if the FIFO is actually a transmit FIFO or the actual state of the FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *messageObjectToSend | Is the message object to send with all its data |
| Input | objectSize | Is the size of the message object (with its data). This value needs to be modulo 4 |
| Input | toFIFO | Is the name of the FIFO to fill |
| Input | andFlush | Indicate if the FIFO will be flush to the CAN bus right after this message |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or messageObjectToSend is NULL, or Interface functions are NULL, or toFIFO is MCP251XFD_TEF.
- ERR__BYTE_COUNT_MODULO_4 when the objectSize parameter is not modulo 4

```
inline eERRORRESULT MCP251XFD_TransmitMessageObjectToTXQ(
        MCP251XFD *pComp,
        uint8_t* messageObjectToSend,
        uint8_t objectSize,
        bool andFlush)
```

Transmit the message to the TXQ. This function uses the specific format of the component (T0, T1, Ti (data)). This function gets the next address where to put the message object on, send it and update the head pointer.

**Warning**

This function does not check if the TXQ have a room for the message or the actual state of the TXQ.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *messageObjectToSend | Is the message object to send with all its data |
| Input | objectSize | Is the size of the message object (with its data). This value needs to be modulo 4 |
| Input | andFlush | Indicate if the TXQ will be flush to the CAN bus right after this message |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_TransmitMessageObjectToFIFO()'s returns value for more information.

```
eERRORRESULT MCP251XFD_TransmitMessageToFIFO(
        MCP251XFD *pComp,
        MCP251XFD_CANMessage* messageToSend,
        eMCP251XFD_FIFO toFIFO,
        bool andFlush)
```

Transmit the message to the specified FIFO. This function gets the next address where to put the message object on, send it and update the head pointer.

**Warning**

This function does not check if the FIFO have a room for the message or if the FIFO is actually a transmit FIFO or the actual state of the FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *messageToSend | Is the message to send with all the data attached with |
| Input | toFIFO | Is the name of the FIFO to fill |
| Input | andFlush | Indicate if the FIFO will be flush to the CAN bus right after this message |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or messageToSend is NULL, or Interface functions are NULL, or toFIFO is MCP251XFD_TEF.
- ERR__BYTE_COUNT_MODULO_4 when the objectSize parameter is not modulo 4
- ERR__NO_DATA_AVAILABLE when messageToSend->PayloadData is NULL and the messageToSend->DLC is more than 0 bytes

```
inline eERRORRESULT MCP251XFD_TransmitMessageToTXQ(
        MCP251XFD *pComp,
        MCP251XFD_CANMessage* messageToSend,
        bool andFlush)
```

Transmit the message to the TXQ. This function gets the next address where to put the message object on, send it and update the head pointer.

**Warning**

This function does not check if the TXQ have a room for the message or the actual state of the TXQ

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *messageToSend | Is the message to send with all the data attached with |
| Input | andFlush | Indicate if the TXQ will be flush to the CAN bus right after this message |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_TransmitMessageToFIFO()'s returns value for more information.

### 16.5.2. Receive messages

```
eERRORRESULT MCP251XFD_ReceiveMessageObjectFromFIFO(
        MCP251XFD *pComp,
        uint8_t* messageObjectGet,
        uint8_t objectSize,
        eMCP251XFD_FIFO fromFIFO)
```

Receive the message from the specified FIFO. This function uses the specific format of the component (R0, R1, (R2,) Ri (data)). This function gets the next address where to get the message object from, get it and update the tail pointer.

**Warning**

This function does not check if the FIFO have a message pending or if the FIFO is a receive FIFO or the actual state of the FIFO or if the TimeStamp is set or not

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *messageObjectGet | Is the message object retrieve with all its data |
| Input | objectSize | Is the size of the message object (with its data). This value needs to be modulo 4 |
| Input | fromFIFO | Is the name of the FIFO to extract |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or messageObjectGet is NULL, or Interface functions are NULL, or fromFIFO is MCP251XFD_TXQ.
- ERR__BYTE_COUNT_MODULO_4 when the objectSize parameter is not modulo 4

```
inline eERRORRESULT MCP251XFD_ReceiveMessageObjectFromTEF(
        MCP251XFD *pComp,
        uint8_t* messageObjectGet,
        uint8_t objectSize,
        eMCP251XFD_FIFO fromFIFO)
```

Receive a message from the TEF. This function uses the specific format of the component (TE0, TE1 (,TE2)). This function gets the next address where to get the message object from, get it and update the tail pointer.

**Warning**

This function does not check if the TEF have a message pending or the actual state of the TEF or if the TimeStamp is set or not

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *messageObjectGet | Is the message object retrieve with all its data |
| Input | objectSize | Is the size of the message object (with its data). This value needs to be modulo 4 |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ReceiveMessageObjectFromFIFO()'s returns value for more information.

```
eERRORRESULT MCP251XFD_ReceiveMessageFromFIFO(
        MCP251XFD *pComp,
        MCP251XFD_CANMessage* messageGet,
        eMCP251XFD_PayloadSize payloadSize,
        uint32_t* timeStamp,
        eMCP251XFD_FIFO fromFIFO)
```

Receive a message from the specified FIFO. This function gets the next address where to get the message object from, get it and update the tail pointer.

**Warning**

This function does not check if the FIFO have a message pending or if the FIFO is a receive FIFO or the actual state of the FIFO or if the TimeStamp is set or not

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *messageGet | Is the message retrieve with all the data attached with |
| Input | payloadSize | Indicate the payload of the FIFO (8, 12, 16, 20, 24, 32, 48 or 64) |
| Output | *timeStamp | Is the returned TimeStamp of the message (can be set to NULL if the TimeStamp is not set in this FIFO) |
| Input | fromFIFO | Is the name of the FIFO to extract |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or messageGet is NULL, or Interface functions are NULL, or fromFIFO is MCP251XFD_TXQ.
- ERR__BYTE_COUNT_MODULO_4 when the objectSize parameter is not modulo 4
- ERR__NO_DATA_AVAILABLE when messageGet->PayloadData is NULL and the messageGet->DLC is more than 0 bytes

```
inline eERRORRESULT MCP251XFD_ReceiveMessageFromTEF(
        MCP251XFD *pComp,
        MCP251XFD_CANMessage* messageGet,
        uint32_t* timeStamp)
```

Receive a message from the TEF. This function gets the next address where to get the message object from, get it and update the tail pointer.

**Warning**

This function does not check if the TEF have a message pending or the actual state of the TEF or if the TimeStamp is set or not

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *messageGet | Is the message retrieve with all the data attached with |
| Output | *timeStamp | Is the returned TimeStamp of the message (can be set to NULL if the TimeStamp is not set in the TEF) |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ReceiveMessageFromFIFO()'s returns value for more information.

### 16.5.3. CAN message configuration structure

The CAN message configuration structure is used as a simple structure to simplify the configuration or reading of messages. This structure avoids the complex header messages filling and decoding. This structure is used by *MCP251XFD_TransmitMessageToFIFO()*, *MCP251XFD_TransmitMessageToTXQ()*, *MCP251XFD_ReceiveMessageFromFIFO()* and *MCP251XFD_ReceiveMessageFromTEF()* functions.

Source code:

```
typedef struct MCP251XFD_CANMessage
{
  uint32_t MessageID;
  uint32_t MessageSEQ;
  setMCP251XFD_MessageCtrlFlags ControlFlags;
  eMCP251XFD_DataLength DLC;
  uint8_t* PayloadData;
} MCP251XFD_CANMessage;
```

#### 16.5.3.1. Data fields

*uint32_t* ***MessageID***

Contain the message ID to send.

*uint32_t* ***MessageSEQ***

This is the context of the CAN message. This sequence will be copied in the TEF to trace the message sent.

*setMCP251XFD_MessageCtrlFlags* ***ControlFlags***

Contain the CAN controls flags.

**Type**

enum setMCP251XFD_MessageCtrlFlags

**Initial value / default**

MCP251XFD_NO_MESSAGE_CTRL_FLAGS

*eMCP251XFD_DataLength* ***DLC***

Indicate how many bytes in the payload data will be sent or how many bytes in the payload data is received.

**Type**

enum eMCP251XFD_DataLength

*uint8_t** ***PayloadData***

Pointer to the payload data that will be sent. PayloadData array should be at least the same size as indicate by the DLC.

### 16.5.4. Enumerators

*enum* **eMCP251XFD_MessageCtrlFlags**
*typedef* eMCP251XFD_MessageCtrlFlags **setMCP251XFD_MessageCtrlFlags**

Control flags of CAN message.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_NO_MESSAGE_CTRL_FLAGS* | **0x00** | No Message Control Flags |
| *MCP251XFD_CAN20_FRAME* | **0x00** | Indicate that the frame is a CAN2.0A/B |
| *MCP251XFD_CANFD_FRAME* | **0x01** | Indicate that the frame is a CAN-FD |
| *MCP251XFD_NO_SWITCH_BITRATE* | **0x00** | The data bitrate is not switched (only CAN-FD frame) |
| *MCP251XFD_SWITCH_BITRATE* | **0x02** | The data bitrate is switched (only CAN-FD frame) |
| *MCP251XFD_REMOTE_TRANSMISSION_REQUEST* | **0x04** | The frame is a Remote Transmission Request; not used in CAN FD |
| *MCP251XFD_STANDARD_MESSAGE_ID* | **0x00** | Clear the Identifier Extension Flag that set the standard ID format |
| *MCP251XFD_EXTENDED_MESSAGE_ID* | **0x08** | Set the Identifier Extension Flag that set the extended ID format |
| *MCP251XFD_TRANSMIT_ERROR_PASSIVE* | **0x10** | Error Status Indicator: In CAN to CAN gateway mode (CiCON.ESIGM=1), the transmitted ESI flag is a "logical OR" of T1.ESI and error passive state of the CAN controller; In normal mode ESI indicates the error status |

### *enum* eMCP251XFD_DataLength

Data Length Size for the CAN message.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_DLC_0BYTE* | **0b0000** | The DLC is 0 data byte |
| *MCP251XFD_DLC_1BYTE* | **0b0001** | The DLC is 1 data byte |
| *MCP251XFD_DLC_2BYTE* | **0b0010** | The DLC is 2 data bytes |
| *MCP251XFD_DLC_3BYTE* | **0b0011** | The DLC is 3 data bytes |
| *MCP251XFD_DLC_4BYTE* | **0b0100** | The DLC is 4 data bytes |
| *MCP251XFD_DLC_5BYTE* | **0b0101** | The DLC is 5 data bytes |
| *MCP251XFD_DLC_6BYTE* | **0b0110** | The DLC is 6 data bytes |
| *MCP251XFD_DLC_7BYTE* | **0b0111** | The DLC is 7 data bytes |
| *MCP251XFD_DLC_8BYTE* | **0b1000** | The DLC is 8 data bytes |
| *MCP251XFD_DLC_12BYTE* | **0b1001** | The DLC is 12 data bytes |
| *MCP251XFD_DLC_16BYTE* | **0b1010** | The DLC is 16 data bytes |
| *MCP251XFD_DLC_20BYTE* | **0b1011** | The DLC is 20 data bytes |
| *MCP251XFD_DLC_24BYTE* | **0b1100** | The DLC is 24 data bytes |
| *MCP251XFD_DLC_32BYTE* | **0b1101** | The DLC is 32 data bytes |
| *MCP251XFD_DLC_48BYTE* | **0b1110** | The DLC is 48 data bytes |
| *MCP251XFD_DLC_64BYTE* | **0b1111** | The DLC is 64 data bytes |
| *MCP251XFD_PAYLOAD_MAX* | **64** | This is the max payload byte size |

### 16.5.5. CAN Transmit message Object Identifier structure

The CAN transmit message Object Identifier structure is an image of the frame header object of the frame in RAM which is 8 bytes size.

Source code:

```
typedef union MCP251XFD_CAN_TX_Message
{
  uint32_t Word[2];
  uint8_t Bytes[8];
  struct
  {
    MCP251XFD_CAN_TX_Message_Identifier T0;
    MCP251XFD_CAN_TX_Message_Control    T1;
  };
} MCP251XFD_CAN_TX_Message;
```

#### 16.5.5.1. Data fields

#### *uint32_t **Word**[2]*

Words access of the MCP251XFD_CAN_TX_Message. The first is a MCP251XFD_CAN_TX_Message_Identifier and the second is a MCP251XFD_CAN_TX_Message_Control.

#### *uint8_t **Bytes**[8]*

Bytes access of the MCP251XFD_CAN_TX_Message.

#### *MCP251XFD_CAN_TX_Message_Identifier **T0***

CAN Transmit Message Identifier (T0).

**Type**

struct MCP251XFD_CAN_TX_Message_Identifier

#### *MCP251XFD_CAN_TX_Message_Control **T1***

CAN Transmit Message Control Field (T1).

**Type**

struct MCP251XFD_CAN_TX_Message_Control

#### 16.5.5.2. Structures

##### 16.5.5.2.1. CAN Transmit Message Identifier (T0)

The CAN Transmit Message Identifier (T0) structure is an image of the first 4-bytes in RAM of the frame header object of the frame in RAM. Source code:

```
typedef union MCP251XFD_CAN_TX_Message_Identifier
{
  uint32_t T0;
  uint8_t Bytes[4];
  struct
  {
    uint32_t SID  : 11;
    uint32_t EID  : 18;
    uint32_t SID11:  1;
    uint32_t      :  2;
  };
} MCP251XFD_CAN_TX_Message_Identifier;
```

###### 16.5.5.2.1.1. Data fields

***uint32_t T0***

Word access of the MCP251XFD_CAN_TX_Message_Identifier.

***uint8_t Bytes***

Bytes access of the MCP251XFD_CAN_TX_Message_Identifier.

***uint32_t SID***

Standard Identifier of the frame.

***uint32_t EID***

Extended Identifier of the frame.

***uint32_t SID11***

In FD mode the standard ID can be extended to 12 bits using RRS.

##### 16.5.5.2.2. CAN Transmit Message Control Field (T1)

The CAN Transmit Message Control Field (T1) structure is an image of the second 4-bytes in RAM of the frame header object of the frame in RAM.

Source code:

```
typedef union __PACKED__ MCP251XFD_CAN_TX_Message_Control
{
  uint32_t T1;
  uint8_t Bytes[4];
  struct
  {
    uint32_t DLC:  4;
    uint32_t IDE:  1;
    uint32_t RTR:  1;
    uint32_t BRS:  1;
    uint32_t FDF:  1;
    uint32_t ESI:  1;
    uint32_t SEQ: 23;
  };
} MCP251XFD_CAN_TX_Message_Control;
```

###### 16.5.5.2.2.1. Data fields

***uint32_t T1***

Word access of the MCP251XFD_CAN_TX_Message_Control.

***uint8_t Bytes***

Bytes access of the MCP251XFD_CAN_TX_Message_Control.

*uint32_t* ***DLC***

Data Length Code.

*uint32_t* ***IDE***

Identifier Extension Flag; distinguishes between base and extended format.

*uint32_t* ***RTR***

Remote Transmission Request; not used in CAN-FD.

*uint32_t* ***BRS***

Bit Rate Switch; selects if data bit rate is switched.

*uint32_t* ***FDF***

FD Frame; distinguishes between CAN and CAN-FD formats.

*uint32_t* ***ESI***

Error Status Indicator. In CAN to CAN gateway mode (CiCON.ESIGM=1), the transmitted ESI flag is a "logical OR" of T1.ESI and error passive state of the CAN controller. In normal mode ESI indicates the error status: '1' = Transmitting node is error passive ; '0' = Transmitting node is error active.

*uint32_t* ***SEQ***

Sequence to keep track of transmitted messages in Transmit Event FIFO (Only bit <6:0> for the MCP2517X. Bits <22:7> should be at '0').

### 16.5.6. CAN Receive message Object Identifier structure

The CAN receive message Object Identifier structure is an image of the frame header object of the frame in RAM which is 8 bytes size. To this is added the TimeStamp as R2 but not mandatory.

Source code:

```
typedef union MCP251XFD_CAN_RX_Message
{
  uint32_t Word[2];
  uint8_t Bytes[8];
  struct
  {
    MCP251XFD_CAN_RX_Message_Identifier R0;
    MCP251XFD_CAN_RX_Message_Control    R1;
    uint32_t TimeStamp;
  };
} MCP251XFD_CAN_RX_Message;
```

#### 16.5.6.1. Data fields

*uint32_t* ***Word[2]***

Words access of the MCP251XFD_CAN_RX_Message. The first is a MCP251XFD_CAN_RX_Message_Identifier and the second is a MCP251XFD_CAN_RX_Message_Control.

*uint8_t* ***Bytes[8]***

Bytes access of the MCP251XFD_CAN_RX_Message.

*MCP251XFD_CAN_RX_Message_Identifier* ***R0***

CAN Receive Message Identifier (R0).

**Type**

struct MCP251XFD_CAN_RX_Message_Identifier

### *MCP251XFD_CAN_RX_Message_Control **R1***

CAN Receive Message Control Field (R1).

**Type**

struct MCP251XFD_CAN_RX_Message_Control

### *uint32_t **TimeStamp***

Transmit Message Time Stamp. R2 (RXMSGTS) only exits in objects where CiFIFOCONm.RXTSEN is set.

#### 16.5.6.2. Structures

##### 16.5.6.2.1. CAN Receive Message Identifier (R0)

The CAN Receive Message Identifier (R0) structure is an image of the first 4-bytes in RAM of the frame header object of the frame in RAM. Source code:

```
typedef union __PACKED__ MCP251XFD_CAN_RX_Message_Identifier
{
  uint32_t R0;
  uint8_t Bytes[4];
  struct
  {
    uint32_t SID  : 11; //!<  0-10 - Standard Identifier
    uint32_t EID  : 18; //!< 11-28 - Extended Identifier
    uint32_t SID11:  1; //!< 29    - In FD mode the standard ID can be extended to 12 bit using RRS
    uint32_t      :  2; //!< 30-31
  };
} MCP251XFD_CAN_RX_Message_Identifier;
```

###### 16.5.6.2.1.1. Data fields

### *uint32_t **R0***

Word access of the MCP251XFD_CAN_RX_Message_Identifier.

### *uint8_t **Bytes***

Bytes access of the MCP251XFD_CAN_RX_Message_Identifier.

### *uint32_t **SID***

Standard Identifier of the frame.

### *uint32_t **EID***

Extended Identifier of the frame.

### *uint32_t **SID11***

In FD mode the standard ID can be extended to 12 bits using RRS.

##### 16.5.6.2.2. CAN Receive Message Control Field (R1)

The CAN Receive Message Control Field (R1) structure is an image of the second 4-bytes in RAM of the frame header object of the frame in RAM.

Source code:

```
typedef union __PACKED__ MCP251XFD_CAN_RX_Message_Control
{
  uint32_t R1;
  uint8_t Bytes[4];
  struct
  {
    uint32_t DLC    :  4;
    uint32_t IDE    :  1;
    uint32_t RTR    :  1;
    uint32_t BRS    :  1;
    uint32_t FDF    :  1;
    uint32_t ESI    :  1;
    uint32_t        :  2;
    uint32_t FILTHIT:  5;
    uint32_t        : 16;
  };
} MCP251XFD_CAN_RX_Message_Control;
```

#### 16.5.6.2.2.1. Data fields

***uint32_t R1***

Word access of the MCP251XFD_CAN_RX_Message_Control.

***uint8_t Bytes***

Bytes access of the MCP251XFD_CAN_RX_Message_Control.

***uint32_t DLC***

Data Length Code.

***uint32_t IDE***

Identifier Extension Flag; distinguishes between base and extended format.

***uint32_t RTR***

Remote Transmission Request; not used in CAN-FD.

***uint32_t BRS***

Bit Rate Switch; selects if data bit rate is switched.

***uint32_t FDF***

FD Frame; distinguishes between CAN and CAN-FD formats.

***uint32_t ESI***

Error Status Indicator: '1' = Transmitting node is error passive ; '0' = Transmitting node is error active.

***uint32_t FILTHIT***

Filter Hit, number of filters that matched.

### 16.5.7. CAN Transmit message Object Identifier structure

The Transmit Event Object Register (TEF) structure is an image of the frame header object of the frame in RAM which is 8 bytes size.

Source code:

```
typedef union __PACKED__ MCP251XFD_CAN_TX_EventObject
{
  uint32_t Word[2];
  uint8_t Bytes[8];
  struct
  {
    MCP251XFD_CAN_TX_Message_Identifier TE0;
    MCP251XFD_CAN_TX_Message_Control    TE1;
    uint32_t TimeStamp;
  };
} MCP251XFD_CAN_TX_EventObject;
```

#### 16.5.7.1. Data fields

***uint32_t Word[2]***

Words access of the MCP251XFD_CAN_TX_EventObject. The first is a MCP251XFD_CAN_TX_Message_Identifier and the second is a MCP251XFD_CAN_TX_Message_Control.

***uint8_t Bytes[8]***

Bytes access of the MCP251XFD_CAN_TX_EventObject.

### *MCP251XFD_CAN_TX_Message_Identifier* ***TE0***

CAN Transmit Event Object Identifier (TE0).

**Type**

struct MCP251XFD_CAN_TX_Message_Identifier

### *MCP251XFD_CAN_TX_Message_Control* ***TE1***

CAN Transmit Event Object Control Field (TE1).

**Type**

struct MCP251XFD_CAN_TX_Message_Control

### *uint32_t* ***Word****[2]*

Transmit Message Time Stamp. TE2 (TXMSGTS) only exists in objects where CiTEFCON.TEFTSEN is set.

## 16.6. CRC

```
eERRORRESULT MCP251XFD_ConfigureCRC(
        MCP251XFD *pComp,
        setMCP251XFD_CRCEvents interrupts)
```

At initialization if the driver has the flag MCP251XFD_DRIVER_USE_READ_WRITE_CRC then all CRC interrupts are enabled.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the CRC will be configured |
| Input | interrupts | Corresponding bit to '1' enable the interrupt. Flags can be OR'ed |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetCRCEvents(
        MCP251XFD *pComp,
        setMCP251XFD_CRCEvents* events,
        uint16_t* lastCRCMismatch)
```

Get CRC Status of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the CRC status will be obtained |
| Output | *events | Is the return value of current events flags of the CRC. Flags can be OR'ed |
| Output | *lastCRCMismatch | Is the Cycle Redundancy Check from last CRC mismatch. This parameter can be NULL if the last mismatch is not needed |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or events is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_ClearCRCEvents(MCP251XFD *pComp)
```

Clear CRC Status Flags of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the CRC status will be cleared |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.6.1. Enumerators

```
enum eMCP251XFD_CRCEvents
typedef eMCP251XFD_CRCEvents setMCP251XFD_CRCEvents
```

CRC Events.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_CRC_NO_EVENT* | **0x00** | No CRC events |
| *MCP251XFD_CRC_CRCERR_EVENT* | **0x01** | CRC Error Interrupt event |
| *MCP251XFD_CRC_FORMERR_EVENT* | **0x02** | CRC Command Format Error Interrupt event |
| *MCP251XFD_CRC_ALL_EVENTS* | **0x03** | All CRC interrupts events |

## 16.7. ECC

```
eERRORRESULT MCP251XFD_ConfigureECC(
        MCP251XFD *pComp,
        bool enableECC,
        setMCP251XFD_ECCEvents interrupts,
        uint8_t fixedParityValue)
```

At initialization if the driver has the flag MCP251XFD_DRIVER_ENABLE_ECC then ECC is enable and all ECC interrupts are enable.

**Warning**

If the ECC is configured after use of the device without reset, ECC interrupts can occur if the RAM is not fully initialize by setting MCP251XFD_DRIVER_INIT_SET_RAM_AT_0 in MCP251XFD::DriverConfig)

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the ECC will be configured |
| Input | enableECC | Is at 'true' to enable ECC or 'false' to disable ECC |
| Input | interrupts | Corresponding bit to '1' enable the interrupt. Flags can be OR'ed |
| Input | fixedParityValue | Is the value of the parity bits used during write to RAM when ECC is disabled |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetECCEvents(
        MCP251XFD *pComp,
        setMCP251XFD_ECCEvents* events,
        uint16_t* lastErrorAddress)
```

Get ECC Status Flags of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the ECC status will be obtained |
| Output | *events | Is the return value of current events flags of the ECC. Flags can be OR'ed |
| Output | *lastErrorAddress | Is the address where last ECC error occurred. This parameter can be NULL if the address is not needed |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or events is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_ClearECCEvents(MCP251XFD *pComp)
```

Clear ECC Status Flags of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the ECC status will be cleared |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.7.1. Enumerators

```
enum eMCP251XFD_ECCEvents
typedef eMCP251XFD_ECCEvents setMCP251XFD_ECCEvents
```

CRC Events.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_ECC_NO_EVENT* | **0x00** | No ECC events |
| *MCP251XFD_ECC_SEC_EVENT* | **0x02** | ECC Single Error Correction Interrupt |
| *MCP251XFD_ECC_DED_EVENT* | **0x04** | ECC Double Error Detection Interrupt |
| *MCP251XFD_ECC_ALL_EVENTS* | **0x06** | All ECC interrupts events |

## 16.8. Pin configuration

```
eERRORRESULT MCP251XFD_ConfigurePins(
        MCP251XFD *pComp,
        eMCP251XFD_GPIO0Mode GPIO0PinMode,
        eMCP251XFD_GPIO1Mode GPIO1PinMode,
        eMCP251XFD_OutMode INTOutMode,
        eMCP251XFD_OutMode TXCANOutMode,
        bool CLKOasSOF)
```

Configure pins of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be configured |
| Input | GPIO0PinMode | Set the INT0/GPIO0/XSTBY pins mode |
| Input | GPIO1PinMode | Set the INT1/GPIO1 pins mode |
| Input | INTOutMode | Set the INTs (INT, INT0 and INT1) output pin mode |
| Input | TXCANOutMode | Set the INT0/GPIO0/XSTBY pins mode |
| Input | CLKOasSOF | If 'true', then SOF signal is on CLKO pin else it is a clock on CLKO pin |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_SetGPIOPinsDirection(
        MCP251XFD *pComp,
        uint8_t pinsDirection,
        uint8_t pinsChangeMask)
```

Set GPIO pins direction of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be configured |
| Input | pinsDirection | Return the actual level of all I/O pins. If bit is '1' then the corresponding GPIO is level high else, it is level low |
| Input | pinsChangeMask | If the bit is set to '1', then the corresponding GPIO must be modified |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetGPIOPinsInputLevel(
        MCP251XFD *pComp,
        uint8_t *pinsState)
```

Get GPIO pins input level of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be configured |
| Input | *pinsState | Return the actual level of all I/O pins. If bit is '1' then the corresponding GPIO is level high else, it is level low |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or pinsState is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_SetGPIOPinsOutputLevel(
        MCP251XFD *pComp,
        uint8_t pinsLevel,
        uint8_t pinsChangeMask)
```

Set GPIO pins output level of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be configured |
| Input | pinsLevel | Set the IO pins output level, if bit is '1' then the corresponding GPIO is level high else it is level low |
| Input | pinsChangeMask | If the bit is set to '1', then the corresponding GPIO must be modified |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.8.1. Enumerators

**enum eMCP251XFD_GPIO0Mode**

INT0/GPIO0/XSTBY configuration for the IOCON register.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_PIN_AS_INT0_TX* | **0b00** | INT0/GPIO0/XSTBY pin as TX Interrupt output (active low) |
| *MCP251XFD_PIN_AS_GPIO0_IN* | **0b01** | INT0/GPIO0/XSTBY pin as GPIO input |
| *MCP251XFD_PIN_AS_GPIO0_OUT* | **0b10** | INT0/GPIO0/XSTBY pin as GPIO output |
| *MCP251XFD_PIN_AS_XSTBY* | **0b11** | INT0/GPIO0/XSTBY pin as Transceiver Standby output |

**enum eMCP251XFD_GPIO1Mode**

INT1/GPIO1 configuration for the IOCON register.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_PIN_AS_INT1_RX* | **0b00** | INT1/GPIO1 pin as RX Interrupt output (active low) |
| *MCP251XFD_PIN_AS_GPIO1_IN* | **0b01** | INT1/GPIO1 pin as GPIO input |
| *MCP251XFD_PIN_AS_GPIO1_OUT* | **0b10** | INT1/GPIO1 pin as GPIO output |

**enum eMCP251XFD_OutMode**

Output configuration for the IOCON.INTOD and the IOCON.TXCANOD register.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_PINS_PUSHPULL_OUT* | **0b00** | Pin with Push/Pull output |
| *MCP251XFD_PINS_OPENDRAIN_OUT* | **0b01** | Pin with Open Drain output |

### 16.8.2. Defines

**#define MCP251XFD_GPIO0_Mask**

Define the GPIO0 mask for the pinsChangeMask parameter.

**Value**

0b01

**#define MCP251XFD_GPIO1_Mask**

Define the GPIO1 mask for the pinsChangeMask parameter.

**Value**

0b10

*#define* ***MCP251XFD_GPIO0_OUTPUT***

Define the GPIO0 pin direction as output for the pinsDirection parameter.

**Value**

0b00

*#define* ***MCP251XFD_GPIO0_INPUT***

Define the GPIO0 pin direction as input for the pinsDirection parameter.

**Value**

0b01

*#define* ***MCP251XFD_GPIO1_OUTPUT***

Define the GPIO1 pin direction as output for the pinsDirection parameter.

**Value**

0b00

*#define* ***MCP251XFD_GPIO1_INPUT***

Define the GPIO1 pin direction as input for the pinsDirection parameter.

**Value**

0b10

*#define* ***MCP251XFD_GPIO0_LOW***

Define the GPIO0 pin low status for the pinsLevel parameter.

**Value**

0b00

*#define* ***MCP251XFD_GPIO0_HIGH***

Define the GPIO0 pin high status for the pinsLevel parameter.

**Value**

0b01

*#define* ***MCP251XFD_GPIO1_LOW***

Define the GPIO1 pin low status for the pinsLevel parameter.

**Value**

0b00

*#define* ***MCP251XFD_GPIO1_HIGH***

Define the GPIO1 pin high status for the pinsLevel parameter.

**Value**

0b10

## 16.9. Bitrate and BitTime configuration

```
eERRORRESULT MCP251XFD_CalculateBitTimeConfiguration(
        const uint32_t fsysclk,
        const uint32_t desiredNominalBitrate,
        const uint32_t desiredDataBitrate,
        MCP251XFD_BitTimeConfig *pConf)
```

Calculate the best Bit Time configuration following desired bitrates for CAN-FD. This function call automatically the *MCP251XFD_CalculateBitrateStatistics()* function.

**Parameters**

| | | |
|---|---|---|
| Input | fsysclk | Is the SYSCLK of the device |
| Input | desiredNominalBitrate | Is the desired Nominal Bitrate of the CAN-FD configuration |
| Input | desiredDataBitrate | Is the desired Data Bitrate of the CAN-FD configuration (If not CAN-FD set it to 0 or MCP251XFD_NO_CANFD) |
| Output | *pConf | Is the pointed structure of the Bit Time configuration |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or pConf is NULL, or Interface functions are NULL, or fsysclk is out of range
- ERR__BAUDRATE_ERROR when desiredNominalBitrate or desiredDataBitrate is out of range (when different to MCP251XFD_NO_CANFD)
- ERR__BITTIME_ERROR when it is impossible to find a proper BRP with this configuration

```
eERRORRESULT MCP251XFD_CalculateBitrateStatistics(
        const uint32_t fsysclk,
        MCP251XFD_BitTimeConfig *pConf,
        bool can20only)
```

Calculate bus length, sample points, bitrates and oscillator tolerance following BitTime Configuration.

**Parameters**

| | | |
|---|---|---|
| Input | fsysclk | Is the SYSCLK of the device |
| In/Out | *pConf | Is the pointed structure of the Bit Time configuration |
| Input | can20only | Indicate that parameters for Data Bitrate are not calculated if true |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp or pConf is NULL, or pConf->Stats is NULL, or Interface functions are NULL, or fsysclk is out of range

```
eERRORRESULT MCP251XFD_SetBitTimeConfiguration(
        MCP251XFD *pComp,
        MCP251XFD_BitTimeConfig *pConf,
        bool can20only)
```

Set the Nominal and Data Bit Time to registers.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be configured |
| Input | *pConf | Is the pointed structure of the Bit Time configuration |
| Input | can20only | Indicate that parameters for Data Bitrate are not set to registers (CiDBTCFG and CiTDC) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.9.1. Bit Time Configuration structure for CAN speed

This is the bit time configuration structure for nominal and data bitrates. It contains all the information to configure nominal and data bitrates for the CAN controller. This structure is used by *MCP251XFD_CalculateBitTimeConfiguration()*, *MCP251XFD_CalculateBitrateStatistics()* and *MCP251XFD_SetBitTimeConfiguration()* functions.

Source code:

```
typedef struct MCP251XFD_BitTimeConfig
{
  //--- Nominal Bit Times ---
  uint32_t NBRP;
  uint32_t NTSEG1;
  uint32_t NTSEG2;
  uint32_t NSJW;
  //--- Data Bit Times ---
  uint32_t DBRP;
  uint32_t DTSEG1;
  uint32_t DTSEG2;
  uint32_t DSJW;
  //--- Transmitter Delay Compensation ---
  eMCP251XFD_TDCMode TDCMOD;
  int32_t TDCO;
  uint32_t TDCV;
  bool EDGE_FILTER;
  //--- Result Statistics ---
  MCP251XFD_BitTimeStats *Stats;
} MCP251XFD_BitTimeConfig;
```

#### 16.9.1.1. Data fields

***uint32_t NBRP***

Nominal Bit Times - Baud Rate Prescaler bits; TQ = value/Fsys.

***uint32_t NTSEG1***

Nominal Bit Times - Time Segment 1 bits (Propagation Segment + Phase Segment 1); Length is value x TQ.

***uint32_t NTSEG2***

Nominal Bit Times - Time Segment 2 bits (Phase Segment 2); Length is value x TQ.

***uint32_t NSJW***

Nominal Bit Times - Synchronization Jump Width bits; Length is value x TQ.

***uint32_t DBRP***

Data Bit Times - Baud Rate Prescaler bits; TQ = value/Fsys.

***uint32_t DTSEG1***

Data Bit Times - Time Segment 1 bits (Propagation Segment + Phase Segment 1); Length is value x TQ.

***uint32_t DTSEG2***

Data Bit Times - Time Segment 2 bits (Phase Segment 2); Length is value x TQ.

***uint32_t DSJW***

Data Bit Times - Synchronization Jump Width bits; Length is value x TQ.

***eMCP251XFD_TDCMode TDCMOD***

Transmitter Delay Compensation Mode; Secondary Sample Point (SSP).

**Type**

enum *eMCP251XFD_TDCMode*

*uint32_t* ***TDCO***

Transmitter Delay Compensation Offset; Secondary Sample Point (SSP). Two's complement: offset can be positive, zero, or negative (used as positive only here).

*uint32_t* ***TDCV***

Transmitter Delay Compensation Value; Secondary Sample Point (SSP).

*bool* ***EDGE_FILTER***

Enable Edge Filtering during Bus Integration state. In case of use of *MCP251XFD_CalculateBitTimeConfiguration()* with CAN-FD this parameter will be set to 'true'.

*MCP251XFD_BitTimeStats* ****Stats***

Point to a stat structure (set to NULL if no statistics are necessary).

### 16.9.2. Enumerators

*enum* **eMCP251XFD_TDCMode**

Control flags of CAN message.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TDC_DISABLED* | **0b00** | TDC Disabled |
| *MCP251XFD_MANUAL_MODE* | **0b01** | Manual; Do not measure, use TDCV + TDCO from register |
| *MCP251XFD_AUTO_MODE* | **0b10** | Auto; measure delay and add TDCO |

### 16.9.3. Defines

*#define* ***MCP251XFD_NO_CANFD***

This value specify that the driver will not calculate CAN-FD bitrate.

**Value**

0

## 16.10. Operation modes and CAN control

*eERRORRESULT* ***MCP251XFD_AbortAllTransmissions****(MCP251XFD **pComp**)*

Abort all pending transmissions of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

*eERRORRESULT* ***MCP251XFD_GetActualOperationMode****(*
*MCP251XFD ***pComp****,*
*eMCP251XFD_OperationMode* ***actualMode****)*

Get actual operation mode of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *actualMode | Is where the result of the actual mode will be saved |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

*eERRORRESULT* ***MCP251XFD_RequestOperationMode****(*
*MCP251XFD ***pComp****,*
*eMCP251XFD_OperationMode* ***newMode****,*
*bool* ***waitOperationChange****)*

Request operation mode change of the MCP251XFD device. In case of wait operation change, the function calls *MCP251XFD_WaitOperationModeChange()*.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | newMode | Is the new operational mode to set |
| Input | waitOperationChange | Set to 'true' if the function must wait for the actual operation mode change (wait up to 7ms) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL
- ERR__CONFIGURATION when you try to request a CAN-FD mode while the device is not configured for

*eERRORRESULT* ***MCP251XFD_WaitOperationModeChange****(*
*MCP251XFD ***pComp****,*
*eMCP251XFD_OperationMode* ***askedMode****)*

The function can wait up to 7ms. After this time, if the device doesn't change its operation mode, the function returns an ERR__DEVICE_TIMEOUT error.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | askedMode | Is the mode asked after a call of *MCP251XFD_RequestOperationMode()* |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

*inline eERRORRESULT* ***MCP251XFD_StartCAN20****(MCP251XFD *****pComp****)*

Start the MCP251XFD device in CAN2.0 mode. This function asks for a mode change to CAN2.0 but do not wait for its actual change because normally the device is in configuration mode and the change to CAN2.0 mode will be instantaneous

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_RequestOperationMode()'s returns value for more information.

*inline eERRORRESULT* ***MCP251XFD_StartCANFD****(MCP251XFD *****pComp****)*

Start the MCP251XFD device in CAN-FD mode. This function asks for a mode change to CAN-FD but do not wait for its actual change because normally the device is in configuration mode and the change to CAN-FD mode will be instantaneous

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_RequestOperationMode()'s returns value for more information.

*inline eERRORRESULT* ***MCP251XFD_StartCANListenOnly****(MCP251XFD *****pComp****)*

Start the MCP251XFD device in CAN Listen-Only mode. This function asks for a mode change to CAN Listen-Only but do not wait for its actual change because normally the device is in configuration mode and the change to CAN Listen-Only mode will be instantaneous

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_RequestOperationMode()'s returns value for more information.

*eERRORRESULT* ***MCP251XFD_ConfigureCANController****(*
*MCP251XFD ****pComp****,*
*setMCP251XFD_CANCtrlFlags* ***flags****,*
*eMCP251XFD_Bandwidth* ***bandwidth****)*

Configure CAN Controller of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | flags | Is all the flags for the configuration |
| Input | bandwidth | Is the Delay between two consecutive transmissions (in arbitration bit times) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL
- ERR__NEED_CONFIG_MODE when you try to configure the device while not in configuration mode

### 16.10.1. Enumerators

*enum* **eMCP251XFD_OperationMode**

CAN Controller Operation Modes for the CiCON.OPMOD and CiCON.REQOP registers.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_NORMAL_CANFD_MODE* | **0b000** | Set Normal CAN FD mode; supports mixing of CAN FD and Classic CAN 2.0 frames |
| *MCP251XFD_SLEEP_MODE* | **0b001** | Set Sleep mode |
| *MCP251XFD_INTERNAL_LOOPBACK_MODE* | **0b010** | Set Internal Loopback mode |
| *MCP251XFD_LISTEN_ONLY_MODE* | **0b011** | Set Listen Only mode |
| *MCP251XFD_CONFIGURATION_MODE* | **0b100** | Set Configuration mode |
| *MCP251XFD_EXTERNAL_LOOPBACK_MODE* | **0b101** | Set External Loopback mode |
| *MCP251XFD_NORMAL_CAN20_MODE* | **0b110** | Set Normal CAN 2.0 mode; possible error frames on CAN FD frames |
| *MCP251XFD_RESTRICTED_OPERATION_MODE* | **0b111** | Set Restricted Operation mode |

## 16.11. Sleep and Deep-Sleep modes

```
eERRORRESULT MCP251XFD_ConfigureSleepMode(
        MCP251XFD *pComp,
        bool useLowPowerMode,
        eMCP251XFD_WakeUpFilter wakeUpFilter,
        bool interruptBusWakeUp)
```

Sleep mode configuration of the MCP251XFD device. Sleep mode is a low-power mode, where register and RAM contents are preserved, and the clock is switched off. LPM is an Ultra-Low Power mode, where most of the chip is powered down. Only the logic required for wake-up is powered.

**Warning**

Exiting LPM is similar to a POR. The CAN FD Controller module will transition to Configuration mode. All registers will be reset, and RAM data will be lost. The device must be reconfigured.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the sleep will be configured |
| Input | useLowPowerMode | Is at 'true' to use the low power mode if available or 'false' to use the simpler sleep |
| Input | wakeUpFilter | Indicate which filter to use for wake-up due to CAN bus activity. This feature can be used to protect the module from wake-up due to short glitches on the RXCAN pin |
| Input | interruptBusWakeUp | Is at 'true' to enable bus wake-up interrupt or 'false' to disable the interrupt |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL
- ERR__NOT_SUPPORTED when you try to configure a Deep Sleep Mode on a MCP2517FD device (not supported by this device)

```
eERRORRESULT MCP251XFD_EnterSleepMode(MCP251XFD *pComp)
```

This function puts the device in sleep mode.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL
- ERR__CONFIGURATION when the Sleep Mode is not previously configured. See §10
- ERR__ALREADY_IN_SLEEP when the device is already in Sleep or Deep Sleep Mode

```
eERRORRESULT MCP251XFD_IsDeviceInSleepMode(
        MCP251XFD *pComp,
        bool* isInSleepMode)
```

Verify if the MCP251XFD device is in sleep mode. This function verifies if the device is in sleep mode by checking the OSC.OSCDIS.

**Warning**

In low power mode, it is impossible to check if the device is in sleep mode or not without wake it up because a simple asserting of the SPI CS will exit the LPM.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *isInSleepMode | Indicate if the device is in sleep mode |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL
- ERR__CONFIGURATION when the Sleep Mode is not previously configured. See §10
- ERR__NOT_SUPPORTED when the device is in Deep Sleep Mode. See warning. Here the function always returns isInSleepMode at 'true'

*eERRORRESULT* ***MCP251XFD_WakeUp****(*
*MCP251XFD **pComp,*
*eMCP251XFD_PowerStates **fromState)*

Manually wake up the MCP251XFD device. After a wake-up from sleep, the device will be in configuration mode. After a wake-up from low power sleep, the device is at the same state as a Power On Reset, the device has to be reconfigured.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *fromState | Is the power mode state before the wake up (Can be NULL if not necessary to know) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL
- ERR__CONFIGURATION when the Sleep Mode is not previously configured. See §10

*eMCP251XFD_PowerStates* ***MCP251XFD_BusWakeUpFromState****(MCP251XFD **pComp)*

Retrieve from which state mode the MCP251XFD device get a bus wake up from. Use this function when the wake up interrupt occur (wake up from bus) and it's not from a manual wake up with the function *MCP251XFD_WakeUp()*. This function will indicate from which sleep mode (normal of low power) the wake up occurs.

**Warning**

If you call this function, the driver will understand that the device is awake without verifying and configure itself as well.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Return the sleep mode state before waking up.

### 16.11.1. Enumerators

*enum* **eMCP251XFD_PowerStates**

Device power states.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_DEVICE_SLEEP_NOT_CONFIGURED* | **0x0** | Device sleep mode is not configured so the device is in normal power state |
| *MCP251XFD_DEVICE_NORMAL_POWER_STATE* | **0x1** | Device is in normal power state |
| *MCP251XFD_DEVICE_SLEEP_STATE* | **0x2** | Device is in sleep power state |
| *MCP251XFD_DEVICE_LOWPOWER_SLEEP_STATE* | **0x3** | Device is in low-power sleep power state |

*enum* **eMCP251XFD_WakeUpFilter**

Wake-up Filter Time bits for the CiCON.WFT register. Pulse on RXCAN shorter than the minimum TFILTER time will be ignored; pulses longer than the maximum TFILTER time will wake-up the device.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_T00FILTER_60ns* | **0b000** | Time min = 40ns (MCP2517FD) / 50ns (MCP2518FD)<br>max = 75ns (MCP2517FD) / 100ns (MCP2518FD) |
| *MCP251XFD_T01FILTER_100ns* | **0b001** | Time min = 70ns (MCP2517FD) / 80ns (MCP2518FD)<br>max = 120ns (MCP2517FD) / 140ns (MCP2518FD) |
| *MCP251XFD_T10FILTER_170ns* | **0b010** | Time min = 125ns (MCP2517FD) / 130ns (MCP2518FD)<br>max = 215ns (MCP2517FD) / 220ns (MCP2518FD) |
| *MCP251XFD_T11FILTER_300ns* | **0b011** | Time min = 225ns (MCP2517FD) / 225ns (MCP2518FD)<br>max = 390ns (MCP2517FD) / 390ns (MCP2518FD) |
| *MCP251XFD_TO_FILTER* | **0b111** | Do not use a filter for wake-up |

## 16.12. Time Stamp

```
eERRORRESULT MCP251XFD_ConfigureTimeStamp(
        MCP251XFD *pComp,
        bool enableTS,
        eMCP251XFD_SamplePoint samplePoint,
        uint16_t prescaler,
        bool interruptBaseCounter)
```

Configure the Time Stamp of frames in the MCP251XFD device. This function configures the 32-bit free-running counter of the Time Stamp.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device where the time stamp will be configured |
| Input | enableTS | Is at 'true' to enable Time Stamp or 'false' to disable Time Stamp |
| Input | samplePoint | Is an enumerator that indicate where the Time Stamp sample point is at |
| Input | prescaler | Is the prescaler of the Time Stamp counter (time in µs is: 1/SYSCLK/TBCPRE) |
| Input | interruptBaseCounter | Is at 'true' to enable time base counter interrupt or 'false' to disable the interrupt. A rollover of the TBC will generate an interrupt if interruptBaseCounter is set |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or prescaler is out of range

```
eERRORRESULT MCP251XFD_SetTimeStamp(
        MCP251XFD *pComp,
        uint32_t value)
```

Set the Time Stamp counter the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | value | Is the value to set into the counter |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetTimeStamp(
        MCP251XFD *pComp,
        uint32_t value)
```

Get the Time Stamp counter the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *value | Is the value to get from the counter |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.12.1. Enumerators

```
enum eMCP251XFD_SamplePoint
```

TimeStamp sample point.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TS_CAN20_SOF* | **0b00** | Time Stamp at "beginning" of Frame: CAN2.0 at sample point of SOF |
| *MCP251XFD_TS_CAN20_SOF_CANFD_SOF* | **0b00** | Time Stamp at "beginning" of Frame: CAN2.0 at sample point of SOF & CAN-FD at sample point of SOF |
| *MCP251XFD_TS_CAN20_SOF_CANFD_FDF* | **0b10** | Time Stamp at "beginning" of Frame: CAN2.0 at sample point of SOF & CAN-FD at sample point of the bit following the FDF bit |
| *MCP251XFD_TS_CAN20_EOF* | **0b01** | Time Stamp at "end-on-frame" of Frame: CAN2.0 at sample point of EOF |
| *MCP251XFD_TS_CAN20_EOF_CANFD_EOF* | **0b01** | Time Stamp at "end-on-frame" of Frame: CAN2.0 at sample point of EOF & CAN-FD at sample point of EOF |

## 16.13. FIFOs

```
eERRORRESULT MCP251XFD_ConfigureTEF(
        MCP251XFD *pComp,
        bool enableTEF,
        MCP251XFD_FIFO *confTEF)
```

Configure TEF of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | enableTEF | Indicate if the TEF must be activated or not |
| Input | *confTEF | Is the configuration structure of the TEF |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or confTEF is NULL with enableTEF at 'true', or confTEF->Name is not MCP251XFD_TEF
- ERR__NEED_CONFIG_MODE when the device is not in Configuration Mode

```
eERRORRESULT MCP251XFD_ConfigureTXQ(
        MCP251XFD *pComp,
        bool enableTXQ,
        MCP251XFD_FIFO *confTXQ)
```

Configure TXQ of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | enableTXQ | Indicate if the TXQ must be activated or not |
| Input | *confTXQ | Is the configuration structure of the TXQ |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or confTXQ is NULL with enableTXQ at 'true', or confTXQ->Name is not MCP251XFD_TXQ
- ERR__NEED_CONFIG_MODE when the device is not in Configuration Mode
- ERR__OUT_OF_MEMORY when the amount of RAM memory taken by the TXQ configuration is too high

```
eERRORRESULT MCP251XFD_ConfigureFIFO(
        MCP251XFD *pComp,
        MCP251XFD_FIFO *confFIFO)
```

Configure a FIFO of the MCP251XFD device. FIFO are enabled by configuring the FIFO and, in case of receive FIFO, a filter point to the FIFO.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *confFIFO | Is the configuration structure of the FIFO |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or confFIFO->Name is MCP251XFD_TEF or MCP251XFD_TXQ, or confFIFO->Name is superior at MCP251XFD_FIFO31
- ERR__NEED_CONFIG_MODE when the device is not in Configuration Mode
- ERR__OUT_OF_MEMORY when the amount of RAM memory taken by the FIFO configuration is too high

```
eERRORRESULT MCP251XFD_ConfigureFIFOList(
        MCP251XFD *pComp,
        MCP251XFD_FIFO *listFIFO,
        size_t count)
```

Configure a FIFO list of the MCP251XFD device. This function configures a set of FIFO at once. All FIFO, TEF or TXQ that are not in the list are either disabled or cleared.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *listFIFO | Is the list of FIFO to configure |
| Input | count | Is the count of FIFO in the list |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or listFIFO is NULL
- ERR__OUT_OF_RANGE when there are more than 33 entries (31 FIFO + TEF + TXQ)
- ERR__TOO_MANY_TEF when there are more than one TEF in the list
- ERR__TOO_MANY_TXQ when there are more than one TXQ in the list
- ERR__OUT_OF_MEMORY when the amount of RAM memory taken by the list of FIFO configuration is too high
- See MCP251XFD_ConfigureTEF()'s returns value for more information.
- See MCP251XFD_ConfigureTXQ()'s returns value for more information.
- See MCP251XFD_ConfigureFIFO()'s returns value for more information.

```
eERRORRESULT MCP251XFD_ResetFIFO(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name)
```

Reset a FIFO of the MCP251XFD device. The function will wait until the reset is effective. In Configuration Mode, the FIFO is automatically reset.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO to be reset |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or the name is superior to MCP251XFD_FIFO31
- ERR__DEVICE_TIMEOUT when the device takes too much time to respond to the reset

```
inline eERRORRESULT MCP251XFD_ResetTEF(MCP251XFD *pComp)
```

Reset the TEF of the MCP251XFD device. The function will wait until the reset is effective. In Configuration Mode, the TEF is automatically reset.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ResetFIFO()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_ResetTXQ(MCP251XFD *pComp)
```

Reset the TXQ of the MCP251XFD device. The function will wait until the reset is effective. In Configuration Mode, the TXQ is automatically reset.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_ResetFIFO()'s returns value for more information.

```
eERRORRESULT MCP251XFD_UpdateFIFO(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name,
        bool andFlush)
```

Update (and flush) a FIFO of the MCP251XFD device. Increment the Head/Tail of the FIFO. If flush too, a message send request is ask.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO to be update (and flush) |
| Input | andFlush | Indicate if the FIFO must be flush too |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or the name is superior to MCP251XFD_FIFO31

```
inline eERRORRESULT MCP251XFD_UpdateTEF(MCP251XFD *pComp)
```

Update the TEF of the MCP251XFD device. Increment the Head/Tail of the TEF.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_UpdateFIFO()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_UpdateTXQ(
        MCP251XFD *pComp,
        bool andFlush)
```

Update (and flush) the TXQ of the MCP251XFD device. Increment the Head/Tail of the TXQ. If flush too, a message send request is ask.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | andFlush | Indicate if the TXQ must be flush too |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_UpdateFIFO()'s returns value for more information.

```
eERRORRESULT MCP251XFD_FlushFIFO(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name)
```

Flush a FIFO of the MCP251XFD device. A message send request is ask to the FIFO.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO to be flush |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or the name is superior to MCP251XFD_FIFO31
- ERR__NOT_AVAILABLE when the name is MCP251XFD_TEF

```
inline eERRORRESULT MCP251XFD_FlushTXQ(MCP251XFD *pComp)
```

Flush a TXQ of the MCP251XFD device. A message send request is ask to the TXQ.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_FlushFIFO()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_FlushAllFIFO(MCP251XFD *pComp)
```

Flush all FIFOs (+TXQ) of the MCP251XFD device. Flush all TXQ and all transmit FIFOs.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetFIFOStatus(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name,
        eMCP251XFD_FIFOstatus *statusFlags)
```

Get status of a FIFO of the MCP251XFD device. Get messages status and some interrupt flags related to this FIFO (First byte of CiFIFOSTAm).

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO where status flags will be got |
| Output | *statusFlags | Is the return value of status flags |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or statusFlags is NULL, or the name is superior to MCP251XFD_FIFO31

```
inline eERRORRESULT MCP251XFD_GetTEFStatus(
        MCP251XFD *pComp,
        eMCP251XFD_TEFstatus *statusFlags)
```

Get status of a TEF of the MCP251XFD device. Get messages status and some interrupt flags related to this TEF (First byte of CiTEFSTA).

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *statusFlags | Is the return value of status flags |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_GetFIFOStatus()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_GetTXQStatus(
        MCP251XFD *pComp,
        eMCP251XFD_TXQstatus *statusFlags)
```

Get status of a TXQ of the MCP251XFD device. Get messages status and some interrupt flags related to this TXQ (First byte of CiTXQSTA).

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *statusFlags | Is the return value of status flags |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_GetFIFOStatus()'s returns value for more information.

```
eERRORRESULT MCP251XFD_GetNextMessageAddressFIFO(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name,
        uint32_t *nextAddress,
        uint8_t *nextIndex)
```

Get next message address and/or index of a FIFO of the MCP251XFD device. If it's a transmit FIFO then a read of this will return the address and/or index where the next message is to be written (FIFO head). If it's a receive FIFO then a read of this will return the address and/or index where the next message is to be read (FIFO tail)

**Warning**

This register is not guaranteed to read correctly in Configuration mode and should only be accessed when the module is not in Configuration mode

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO |
| Output | *nextAddress | Is the next user address of the FIFO. This parameter can be NULL if not needed |
| Output | *nextIndex | Is the next user index of the FIFO. This parameter can be NULL if not needed |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or the name is superior to MCP251XFD_FIFO31
- ERR__NOT_AVAILABLE when nextIndex is not NULL and name is MCP251XFD_TEF

```
inline eERRORRESULT MCP251XFD_GetNextMessageAddressTEF(
        MCP251XFD *pComp,
        uint32_t *nextAddress)
```

A read of this register will return the address where the next object is to be read (FIFO tail). This register is not guaranteed to read correctly in Configuration mode and should only be accessed when the module is not in Configuration mode.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *nextAddress | Is the next user address of the TEF. This parameter can be NULL if not needed |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_GetNextMessageAddressFIFO()'s returns value for more information.

```
inline eERRORRESULT MCP251XFD_GetNextMessageAddressTXQ(
        MCP251XFD *pComp,
        uint32_t *nextAddress,
        uint8_t *nextIndex)
```

A read of this register will return the address where the next message is to be written (TXQ head). This register is not guaranteed to read correctly in Configuration mode and should only be accessed when the module is not in Configuration mode.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *nextAddress | Is the next user address of the TXQ. This parameter can be NULL if not needed |
| Output | *nextIndex | Is the next user index of the TXQ. This parameter can be NULL if not needed |

**Return**

Returns an *eERRORRESULT* value enumerator. See MCP251XFD_GetNextMessageAddressFIFO()'s returns value for more information.

```
eERRORRESULT MCP251XFD_ClearFIFOConfiguration(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name)
```

Clear the FIFO configuration of the MCP251XFD device. Clearing FIFO configuration do not totally disable it, all filter that point to it must be disabled too

**Warning**

Never clear a FIFO in the middle of the FIFO list or it will destroy messages in RAM after this FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO where the configuration will be cleared |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.13.1. Enumerators

#### *enum* eMCP251XFD_FIFOstatus

Transmit and Receive FIFO status.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TX_FIFO_FULL* | **0x00** | Transmit FIFO full |
| *MCP251XFD_TX_FIFO_NOT_FULL* | **0x01** | Transmit FIFO not full |
| *MCP251XFD_TX_FIFO_HALF_EMPTY* | **0x02** | Transmit FIFO half empty |
| *MCP251XFD_TX_FIFO_EMPTY* | **0x04** | Transmit FIFO empty |
| *MCP251XFD_TX_FIFO_ATTEMPTS_EXHAUSTED* | **0x10** | Transmit FIFO attempts exhausted |
| *MCP251XFD_TX_FIFO_BUS_ERROR* | **0x20** | Transmit bus error |
| *MCP251XFD_TX_FIFO_ARBITRATION_LOST* | **0x40** | Transmit arbitration lost |
| *MCP251XFD_TX_FIFO_ABORTED* | **0x80** | Transmit aborted |
| | | |
| *MCP251XFD_RX_FIFO_EMPTY* | **0x00** | Receive FIFO empty |
| *MCP251XFD_RX_FIFO_NOT_EMPTY* | **0x01** | Receive FIFO not empty |
| *MCP251XFD_RX_FIFO_HALF_FULL* | **0x02** | Receive FIFO half full |
| *MCP251XFD_RX_FIFO_FULL* | **0x04** | Receive FIFO full |
| *MCP251XFD_RX_FIFO_OVERFLOW* | **0x08** | Receive overflow |

#### *enum* eMCP251XFD_TEFstatus

Transmit Event FIFO status.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TEF_FIFO_EMPTY* | **0x00** | TEF FIFO empty |
| *MCP251XFD_TEF_FIFO_NOT_EMPTY* | **0x01** | TEF FIFO not empty |
| *MCP251XFD_TEF_FIFO_HALF_FULL* | **0x02** | TEF FIFO half full |
| *MCP251XFD_TEF_FIFO_FULL* | **0x04** | TEF FIFO full |
| *MCP251XFD_TEF_FIFO_OVERFLOW* | **0x08** | TEF overflow |

#### *enum* eMCP251XFD_TXQstatus

Transmit Queue status.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TXQ_FIFO_FULL* | **0x00** | TXQ full |
| *MCP251XFD_TXQ_FIFO_NOT_FULL* | **0x01** | TXQ not full |
| *MCP251XFD_TXQ_FIFO_EMPTY* | **0x04** | TXQ empty |
| *MCP251XFD_TXQ_FIFO_ATTEMPTS_EXHAUSTED* | **0x10** | TXQ attempts exhausted |
| *MCP251XFD_TXQ_FIFO_BUS_ERROR* | **0x20** | TXQ bus error |
| *MCP251XFD_TXQ_FIFO_ARBITRATION_LOST* | **0x40** | TXQ arbitration lost |
| *MCP251XFD_TXQ_FIFO_ABORTED* | **0x80** | TXQ aborted |

## 16.14. Filters

```
eERRORRESULT MCP251XFD_ConfigureDeviceNetFilter(
        MCP251XFD *pComp,
        eMCP251XFD_DNETFilter filter)
```

Configure the Device NET filter of the MCP251XFD device. When a standard frame is received and the filter is configured for extended frames, the EID part of the Filter and Mask Object can be selected to filter on data bytes

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | filter | Is the Device NET Filter to apply on all received frames and filters |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_ConfigureFilter(
        MCP251XFD *pComp,
        MCP251XFD_Filter *confFilter)
```

Configure a filter of the MCP251XFD device.

**Warning**

This function does not check if the pointed FIFO is a receive FIFO.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *confFilter | Is the configuration structure of the Filter |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or confFilter is NULL
- ERR__CONFIGURATION when confFilter->PointTo is MCP251XFD_TEF, MCP251XFD_TXQ, or is superior to MCP251XFD_FIFO31
- ERR__FILTER_CONSISTENCY when AcceptanceID and AcceptanceMask does not correspond
- ERR__FILTER_TOO_LARGE when AcceptanceID and AcceptanceMask are too large for the specified configuration

```
eERRORRESULT MCP251XFD_ConfigureFilterList(
        MCP251XFD *pComp,
        eMCP251XFD_DNETFilter filter,
        MCP251XFD_Filter *listFilter,
        size_t count)
```

Configure a filter list and the DNCNT of the MCP251XFD device. This function configures a set of Filters at once.

**Warning**

This function does not check if the pointed FIFO is a receive FIFO.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | filter | Is the Device NET Filter to apply on all received frames, it call directly *MCP251XFD_ConfigureDeviceNetFilter()* |
| Input | *listFilter | Is the list of Filters to configure |
| Input | count | Is the count of Filters in the list |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or listFilter is NULL
- See MCP251XFD_ConfigureFilter()'s returns value for more information.

```
eERRORRESULT MCP251XFD_DisableFilter(
        MCP251XFD *pComp,
        eMCP251XFD_Filter name)
```

Disable a Filter of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the Filter to disable |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or the name is superior to MCP251XFD_FILTER31

### 16.14.1. Enumerators

```
enum eMCP251XFD_DNETFilter
```

Device Net Filter Bit Number bits for the CiCON.DNCNT register.

If DNCNT is greater than 0 and the received message has DLC = 0, indicating no data payload, the filter comparison will terminate with the identifier.

If DNCNT is greater than 8 and the received message has DLC = 1, indicating a payload of one data byte, the filter comparison will terminate with the 8th bit of the data.

If DNCNT is greater than 16 and the received message has DLC = 2, indicating a payload of two data bytes, the filter comparison will terminate with the 16th bit of the data.

If DNCNT is greater than 18, indicating that the user selected a number of bits greater than the total number of EID bits, the filter comparison will terminate with the 18th bit of the data.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_D_NET_FILTER_DISABLE* | **0b00000** | Do not compare data bytes |
| *MCP251XFD_D_NET_FILTER_1Bit* | **0b00001** | Compare up to data byte 0 bit 7 with EID0 (Data Byte 0[7] = EID[0]) |
| *MCP251XFD_D_NET_FILTER_2Bits* | **0b00010** | Compare up to data byte 0 bit 6 with EID1 (Data Byte 0[7:6] = EID[0:1]) |
| *MCP251XFD_D_NET_FILTER_3Bits* | **0b00011** | Compare up to data byte 0 bit 5 with EID2 (Data Byte 0[7:5] = EID[0:2]) |
| *MCP251XFD_D_NET_FILTER_4Bits* | **0b00100** | Compare up to data byte 0 bit 4 with EID3 (Data Byte 0[7:4] = EID[0:3]) |
| *MCP251XFD_D_NET_FILTER_5Bits* | **0b00101** | Compare up to data byte 0 bit 3 with EID4 (Data Byte 0[7:3] = EID[0:4]) |
| *MCP251XFD_D_NET_FILTER_6Bits* | **0b00110** | Compare up to data byte 0 bit 2 with EID5 (Data Byte 0[7:2] = EID[0:5]) |
| *MCP251XFD_D_NET_FILTER_7Bits* | **0b00111** | Compare up to data byte 0 bit 1 with EID6 (Data Byte 0[7:1] = EID[0:6]) |
| *MCP251XFD_D_NET_FILTER_8Bits* | **0b01000** | Compare up to data byte 0 bit 0 with EID7 (Data Byte 0[7:0] = EID[0:7]) |
| *MCP251XFD_D_NET_FILTER_9Bits* | **0b01001** | Compare up to data byte 1 bit 7 with EID8 (Data Byte 0[7:0] and Data Byte 1[7] = EID[0:8]) |
| *MCP251XFD_D_NET_FILTER_10Bits* | **0b01010** | Compare up to data byte 1 bit 6 with EID9 (Data Byte 0[7:0] and Data Byte 1[7:6] = EID[0:9]) |
| *MCP251XFD_D_NET_FILTER_11Bits* | **0b01011** | Compare up to data byte 1 bit 5 with EID10 (Data Byte 0[7:0] and Data Byte 1[7:5] = EID[0:10]) |
| *MCP251XFD_D_NET_FILTER_12Bits* | **0b01100** | Compare up to data byte 1 bit 4 with EID11 (Data Byte 0[7:0] and Data Byte 1[7:4] = EID[0:11]) |
| *MCP251XFD_D_NET_FILTER_13Bits* | **0b01101** | Compare up to data byte 1 bit 3 with EID12 (Data Byte 0[7:0] and Data Byte 1[7:3] = EID[0:12]) |
| *MCP251XFD_D_NET_FILTER_14Bits* | **0b01110** | Compare up to data byte 1 bit 2 with EID13 (Data Byte 0[7:0] and Data Byte 1[7:2] = EID[0:13]) |
| *MCP251XFD_D_NET_FILTER_15Bits* | **0b01111** | Compare up to data byte 1 bit 1 with EID14 (Data Byte 0[7:0] and Data Byte 1[7:1] = EID[0:14]) |

| | | |
|---|---|---|
| *MCP251XFD_D_NET_FILTER_16Bits* | **0b10000** | Compare up to data byte 1 bit 0 with EID15 (Data Byte 0[7:0] and Data Byte 1[7:0] = EID[0:15]) |
| *MCP251XFD_D_NET_FILTER_17Bits* | **0b10001** | Compare up to data byte 2 bit 7 with EID16 (Data Byte 0[7:0] and Data Byte 1[7:0] and Byte 2[7] = EID[0:16]) |
| *MCP251XFD_D_NET_FILTER_18Bits* | **0b10010** | Compare up to data byte 2 bit 6 with EID17 (Data Byte 0[7:0] and Data Byte 1[7:0] and Byte 2[7:6] = EID[0:17]) |

## 16.15. Interrupts

```
eERRORRESULT MCP251XFD_ConfigureInterrupt(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptEvents interruptsFlags)
```

Configure interrupt of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | interruptsFlags | Is the set of events where interrupts will be enabled. Flags can be OR'ed |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetInterruptEvents(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptEvents* interruptsFlags)
```

Get interrupt events of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *interruptsFlags | Is the return value of interrupt events. Flags are OR'ed |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetCurrentInterruptEvent(
        MCP251XFD *pComp,
        eMCP251XFD_InterruptFlagCode* currentEvent)
```

Get the current interrupt event of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | *currentEvent | Is the return value of the current interrupt event |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_ClearInterruptEvents(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptEvents interruptsFlags)
```

Clear interrupt events of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | interruptsFlags | Is the set of events where interrupts will be cleared. Flags can be OR'ed |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetCurrentReceiveFIFONameAndStatusInterrupt(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO *name,
        eMCP251XFD_FIFOstatus *flags)
```

This function can be called to check if there is a receive interrupt. It gives the name and the status of the FIFO. If more than one object has an interrupt pending, the interrupt or FIFO with the highest number will show up. Once the interrupt with the highest priority is cleared, the next highest priority interrupt will show up.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *name | Is the returned name of the FIFO that generate an interrupt |
| Output | *flags | Is the return value of status flags of the FIFO (can be NULL if it is not needed) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or name is NULL

```
inline eERRORRESULT MCP251XFD_GetCurrentReceiveFIFONameInterrupt(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO *name)
```

Get current receive FIFO name that generate an interrupt (if any). This function can be called to check if there is a receive interrupt. It gives the name of the FIFO. If more than one object has an interrupt pending, the interrupt or FIFO with the highest number will show up. Once the interrupt with the highest priority is cleared, the next highest priority interrupt will show up.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *name | Is the returned name of the FIFO that generate an interrupt |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetCurrentTransmitFIFONameAndStatusInterrupt(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO *name,
        eMCP251XFD_FIFOstatus *flags)
```

Get current transmit FIFO name and status that generate an interrupt (if any). This function can be called to check if there is a transmit interrupt. It gives the name and the status of the FIFO. If more than one object has an interrupt pending, the interrupt or FIFO with the highest number will show up. Once the interrupt with the highest priority is cleared, the next highest priority interrupt will show up.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *name | Is the returned name of the FIFO that generate an interrupt |
| Output | *flags | Is the return value of status flags of the FIFO (can be NULL if it is not needed) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetCurrentTransmitFIFONameInterrupt(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO *name)
```

Get current transmit FIFO name that generate an interrupt (if any). This function can be called to check if there is a transmit interrupt. It gives the name of the FIFO. If more than one object has an interrupt pending, the interrupt or FIFO with the highest number will show up. Once the interrupt with the highest priority is cleared, the next highest priority interrupt will show up.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *name | Is the returned name of the FIFO that generate an interruptMCP251XFD_ConfigureFIFOList |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_ClearFIFOEvents(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name,
        uint8_t events)
```

Clear selected FIFO events of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO where events will be cleared |
| Input | events | Are the set of events to clear. Can be ether an *eMCP251XFD_FIFOstatus*, an eMCP251XFD_TEFstatus or an eMCP251XFD_TXQstatus type. |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL, or the name is superior to MCP251XFD_FIFO31

```
inline eERRORRESULT MCP251XFD_ClearTEFOverflowEvent(MCP251XFD *pComp)
```

Clear the overflow event of the TEF.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_ClearFIFOOverflowEvent(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name)
```

Clear the overflow event of the FIFO selected.

**Warning**

This function does not check if it's a receive FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO where event will be cleared |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_ClearFIFOAttemptsEvent(
        MCP251XFD *pComp,
        eMCP251XFD_FIFO name)
```

Clear the attempt event of the FIFO selected.

**Warning**

This function does not check if it is a transmit FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | name | Is the name of the FIFO where event will be cleared |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_ClearTXQAttemptsEvent(MCP251XFD *pComp)
```

Clear the attempt event of the TXQ selected.

**Warning**

This function does not check if it is a transmit FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetReceiveInterruptStatusOfAllFIFO(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptOnFIFO* interruptPending,
        setMCP251XFD_InterruptOnFIFO* overflowStatus)
```

Get the status of receive pending interrupt and overflow pending interrupt of all FIFOs at once, OR'ed in one variable.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *interruptPending | Is the return of the receive pending interrupt of all FIFOs (This parameter can be NULL) |
| Output | *overflowStatus | Is the return of the receive overflow pending interrupt of all FIFOs (This parameter can be NULL) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetReceivePendingInterruptStatusOfAllFIFO(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptOnFIFO* interruptPending)
```

Get the status of receive overflow interrupt of all FIFOs at once, OR'ed in one variable.

**Warning**

This function does not check if it is a transmit FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *interruptPending | Is the return of the receive pending interrupt of all FIFOs |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetReceiveOverflowInterruptStatusOfAllFIFO(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptOnFIFO* overflowStatus)
```

Get the status of receive overflow interrupt of all FIFOs at once, OR'ed in one variable.

**Warning**

This function does not check if it is a transmit FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *overflowStatus | Is the return of the receive overflow pending interrupt of all FIFOs |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetTransmitInterruptStatusOfAllFIFO(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptOnFIFO* interruptPending,
        setMCP251XFD_InterruptOnFIFO* attemptStatus)
```

Get the status of transmit pending interrupt and attempt exhaust pending interrupt of all FIFOs at once, OR'ed in one variable.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *interruptPending | Is the return of the transmit pending interrupt of all FIFOs (This parameter can be NULL) |
| Output | *attemptStatus | Is the return of the transmit attempt exhaust pending interrupt of all FIFOs (This parameter can be NULL) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetTransmitPendingInterruptStatusOfAllFIFO(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptOnFIFO* interruptPending)
```

Get the status of transmit pending interrupt of all FIFOs at once, OR'ed in one variable.

**Warning**

This function does not check if it is a transmit FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *interruptPending | Is the return of the transmit pending interrupt of all FIFOs |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetTransmitAttemptInterruptStatusOfAllFIFO(
        MCP251XFD *pComp,
        setMCP251XFD_InterruptOnFIFO* attemptStatus)
```

Get the status of attempt exhaust pending interrupt of all FIFOs at once, OR'ed in one variable.

**Warning**

This function does not check if it is a transmit FIFO

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *attemptStatus | Is the return of the transmit attempt exhaust pending interrupt of all FIFOs |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.15.1. Enumerators

*enum* **eMCP251XFD_InterruptFlagCode**

Interrupt Flag Code bits for the CiVEC.ICODE.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TXQ_INTERRUPT* | **0b0000000** | TXQ Interrupt (TFIF<0> set). If for RXCODE, FIFO 0 can't receive so this flag code is reserved |
| *MCP251XFD_FIFO1_INTERRUPT* | **0b0000001** | FIFO 1 Interrupt (TFIF<1> or RFIF<1> set) |
| … | **…** | … |
| *MCP251XFD_FIFO31_INTERRUPT* | **0b0011111** | FIFO 31 Interrupt (TFIF<31> or RFIF<31> set) |
| *MCP251XFD_NO_INTERRUPT* | **0b1000000** | No interrupt |
| *MCP251XFD_ERROR_INTERRUPT* | **0b1000001** | Error Interrupt (CERRIF/IE) |
| *MCP251XFD_WAKEUP_INTERRUPT* | **0b1000010** | Wake-up interrupt (WAKIF/WAKIE) |
| *MCP251XFD_RECEIVE_FIFO_OVF* | **0b1000011** | Receive FIFO Overflow Interrupt (any bit in CiRXOVIF set) |
| *MCP251XFD_ADDRESS_ERROR_INTERRUPT* | **0b1000100** | Address Error Interrupt (illegal FIFO address presented to system) (SERRIF/IE) |
| *MCP251XFD_RXTX_MAB_OVF_UVF* | **0b1000101** | RX/TX MAB Overflow/Underflow (RX: message received before previous message was saved to memory; TX: cannot feed TX MAB fast enough to transmit consistent data) (SERRIF/IE) |
| *MCP251XFD_TBC_OVF_INTERRUPT* | **0b1000110** | TBC Overflow (TBCIF/IE) |
| *MCP251XFD_OPMODE_CHANGE_OCCURED* | **0b1000111** | Operation Mode Change Occurred (MODIF/IE) |
| *MCP251XFD_INVALID_MESSAGE_OCCURED* | **0b1001000** | Invalid Message Occurred (IVMIF/IE) |
| *MCP251XFD_TRANSMIT_EVENT_FIFO* | **0b1001001** | Transmit Event FIFO Interrupt (any bit in CiTEFIF set) |
| *MCP251XFD_TRANSMIT_ATTEMPT* | **0b1001010** | Transmit Attempt Interrupt (any bit in CiTXATIF set) |

*enum* **eMCP251XFD_InterruptOnFIFO**
*typedef* eMCP251XFD_InterruptOnFIFO **setMCP251XFD_InterruptOnFIFO**

Receive Interrupt Status for the CiRXIF, CiRXOVIF, CiTXIF and CiTXATIF registers. Can be OR'ed.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_INTERRUPT_ON_TXQ* | **0x00000001** | Interrupt is pending on TXQ (TFIF<0> or TFATIF<0> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO1* | **0x00000002** | Interrupt is pending on FIFO 1 (TFIF<1> or TFATIF<1> or RFIF<1> or RFOVIF<1> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO2* | **0x00000004** | Interrupt is pending on FIFO 2 (TFIF<2> or TFATIF<2> or RFIF<2> or RFOVIF<2> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO3* | **0x00000008** | Interrupt is pending on FIFO 3 (TFIF<3> or TFATIF<3> or RFIF<3> or RFOVIF<3> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO4* | **0x00000010** | Interrupt is pending on FIFO 4 (TFIF<4> or TFATIF<4> or RFIF<4> or RFOVIF<4> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO5* | **0x00000020** | Interrupt is pending on FIFO 5 (TFIF<5> or TFATIF<5> or RFIF<5> or RFOVIF<5> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO6* | **0x00000040** | Interrupt is pending on FIFO 6 (TFIF<6> or TFATIF<6> or RFIF<6> or RFOVIF<6> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO7* | **0x00000080** | Interrupt is pending on FIFO 7 (TFIF<7> or TFATIF<7> or RFIF<7> or RFOVIF<7> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO8* | **0x00000100** | Interrupt is pending on FIFO 8 (TFIF<8> or TFATIF<8> or RFIF<8> or RFOVIF<8> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO9* | **0x00000200** | Interrupt is pending on FIFO 9 (TFIF<9> or TFATIF<9> or RFIF<9> or RFOVIF<9> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO10* | **0x00000400** | Interrupt is pending on FIFO 10 (TFIF<10> or TFATIF<10> or RFIF<10> or RFOVIF<10> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO11* | **0x00000800** | Interrupt is pending on FIFO 11 (TFIF<11> or TFATIF<11> or RFIF<11> or RFOVIF<11> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO12* | **0x00001000** | Interrupt is pending on FIFO 12 (TFIF<12> or TFATIF<12> or RFIF<12> or RFOVIF<12> set) |

| | | |
|---|---|---|
| *MCP251XFD_INTERRUPT_ON_FIFO13* | **0x00002000** | Interrupt is pending on FIFO 13 (TFIF<13> or TFATIF<13> or RFIF<13> or RFOVIF<13> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO14* | **0x00004000** | Interrupt is pending on FIFO 14 (TFIF<14> or TFATIF<14> or RFIF<14> or RFOVIF<14> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO15* | **0x00008000** | Interrupt is pending on FIFO 15 (TFIF<15> or TFATIF<15> or RFIF<15> or RFOVIF<15> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO16* | **0x00010000** | Interrupt is pending on FIFO 16 (TFIF<16> or TFATIF<16> or RFIF<16> or RFOVIF<16> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO17* | **0x00020000** | Interrupt is pending on FIFO 17 (TFIF<17> or TFATIF<17> or RFIF<17> or RFOVIF<17> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO18* | **0x00040000** | Interrupt is pending on FIFO 18 (TFIF<18> or TFATIF<18> or RFIF<18> or RFOVIF<18> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO19* | **0x00080000** | Interrupt is pending on FIFO 19 (TFIF<19> or TFATIF<19> or RFIF<19> or RFOVIF<19> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO20* | **0x00100000** | Interrupt is pending on FIFO 20 (TFIF<20> or TFATIF<20> or RFIF<20> or RFOVIF<20> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO21* | **0x00200000** | Interrupt is pending on FIFO 21 (TFIF<21> or TFATIF<21> or RFIF<21> or RFOVIF<21> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO22* | **0x00400000** | Interrupt is pending on FIFO 22 (TFIF<22> or TFATIF<22> or RFIF<22> or RFOVIF<22> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO23* | **0x00800000** | Interrupt is pending on FIFO 23 (TFIF<23> or TFATIF<23> or RFIF<23> or RFOVIF<23> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO24* | **0x01000000** | Interrupt is pending on FIFO 24 (TFIF<24> or TFATIF<24> or RFIF<24> or RFOVIF<24> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO25* | **0x02000000** | Interrupt is pending on FIFO 25 (TFIF<25> or TFATIF<25> or RFIF<25> or RFOVIF<25> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO26* | **0x04000000** | Interrupt is pending on FIFO 26 (TFIF<26> or TFATIF<26> or RFIF<26> or RFOVIF<26> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO27* | **0x08000000** | Interrupt is pending on FIFO 27 (TFIF<27> or TFATIF<27> or RFIF<27> or RFOVIF<27> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO28* | **0x10000000** | Interrupt is pending on FIFO 28 (TFIF<28> or TFATIF<28> or RFIF<28> or RFOVIF<28> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO29* | **0x20000000** | Interrupt is pending on FIFO 29 (TFIF<29> or TFATIF<29> or RFIF<29> or RFOVIF<29> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO30* | **0x40000000** | Interrupt is pending on FIFO 30 (TFIF<30> or TFATIF<30> or RFIF<30> or RFOVIF<30> set) |
| *MCP251XFD_INTERRUPT_ON_FIFO31* | **0x80000000** | Interrupt is pending on FIFO 31 (TFIF<31> or TFATIF<31> or RFIF<31> or RFOVIF<31> set) |

## 16.16. Error management

```
eERRORRESULT MCP251XFD_GetTransmitReceiveErrorCountAndStatus(
        MCP251XFD *pComp,
        uint8_t* transmitErrorCount,
        uint8_t* receiveErrorCount,
        eMCP251XFD_TXRXErrorStatus* status)
```

Get transmit/receive error count and status of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *transmitErrorCount | Is the result of the transmit error count (this parameter can be NULL) |
| Output | *receiveErrorCount | Is the result of the receive error count (this parameter can be NULL) |
| Output | *status | Is the return transmit/receive error status (this parameter can be NULL) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetTransmitErrorCount(
        MCP251XFD *pComp,
        uint8_t* transmitErrorCount)
```

Get transmit error count of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *transmitErrorCount | Is the result of the transmit error count |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetReceiveErrorCount(
        MCP251XFD *pComp,
        uint8_t* receiveErrorCount)
```

Get transmit error count of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *receiveErrorCount | Is the result of the receive error count |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
inline eERRORRESULT MCP251XFD_GetTransmitReceiveErrorStatus(
        MCP251XFD *pComp,
        eMCP251XFD_TXRXErrorStatus* status)
```

Get transmit/receive error status of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *status | Is the return transmit/receive error status |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_GetBusDiagnostic(
        MCP251XFD *pComp,
        MCP251XFD_CiBDIAG0_Register* busDiagnostic0,
        MCP251XFD_CiBDIAG1_Register* busDiagnostic1)
```

Get Bus diagnostic of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Output | *busDiagnostic0 | Is the return value that contains separate error counters for receive/transmit and for nominal/data bit rates. The counters work differently than the counters in the CiTREC register. They are simply incremented by one on every error. They are never decremented (this parameter can be NULL) |
| Output | *busDiagnostic1 | Is the return value that keeps track of the kind of error that occurred since the last clearing of the register. The register also contains the error-free message counter (this parameter can be NULL) |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

```
eERRORRESULT MCP251XFD_ClearBusDiagnostic(
        MCP251XFD *pComp,
        bool clearBusDiagnostic0,
        bool clearBusDiagnostic1)
```

Clear Bus diagnostic of the MCP251XFD device.

**Parameters**

| | | |
|---|---|---|
| Input | *pComp | Is the pointed structure of the device to be used |
| Input | clearBusDiagnostic0 | Set to 'true' to clear the bus diagnostic0 |
| Input | clearBusDiagnostic1 | Set to 'true' to clear the bus diagnostic1 |

**Return**

Returns an *eERRORRESULT* value enumerator.

- ERR__PARAMETER_ERROR when pComp is NULL, or Interface functions are NULL

### 16.16.1. Bus Diagnostic Register 0 structure

This is the Bus Diagnostic Register 0 structure for the bus diagnostic. It contains all the information about bus errors counts on nominal and data bitrates of the CAN controller. This structure is used by *MCP251XFD_GetBusDiagnostic()* function.

Source code:

```
typedef union MCP251XFD_CiBDIAG0_Register
{
  uint32_t CiBDIAG0;
  uint8_t Bytes[4];
  struct
  {
    uint8_t NominalBitRateReceiveErrorCount;
    uint8_t NominalBitRateTransmitErrorCount;
    uint8_t DataBitRateReceiveErrorCount;
    uint8_t DataBitRateTransmitErrorCount;
  } Reg;
  struct
  {
    uint32_t NRERRCNT: 8;
    uint32_t NTERRCNT: 8;
    uint32_t DRERRCNT: 8;
    uint32_t DTERRCNT: 8;
  } Bits;
} MCP251XFD_CiBDIAG0_Register;
```

#### 16.16.1.1. Data fields

*uint32_t* ***CiBDIAG0***

This is the complete word of the CiBDIAG0 register.

*uint8_t* ***Bytes[4]***

This is the byte access to the CiBDIAG0 register.

*uint8_t* ***NominalBitRateReceiveErrorCount***
*uint32_t* ***NRERRCNT: 8***

Nominal Bit Rate Receive Error Counter.

*uint8_t* ***NominalBitRateTransmitErrorCount***
*uint32_t* ***NTERRCNT: 8***

Nominal Bit Rate Transmit Error Counter.

*uint8_t* ***DataBitRateReceiveErrorCount***
*uint32_t* ***DRERRCNT: 8***

Data Bit Rate Receive Error Counter.

*uint8_t* ***DataBitRateTransmitErrorCount***
*uint32_t* ***DTERRCNT: 8***

Data Bit Rate Transmit Error Counter.

### 16.16.2. Bus Diagnostic Register 1 structure

This is the Bus Diagnostic Register 1 structure for the bus diagnostic. It contains all the information about message error count and errors related to nominal and data bitrates of messages plus the bus of the CAN controller. This structure is used by *MCP251XFD_GetBusDiagnostic()* function.

Source code:

```
typedef union MCP251XFD_CiBDIAG1_Register
{
  uint32_t CiBDIAG1;
  uint16_t Uint16[sizeof(uint32_t) / sizeof(uint16_t)];
  uint8_t Bytes[4];
  struct
  {
    uint16_t ErrorFreeCounter;
    eMCP251XFD_DiagStatus Flags;
  } Reg;
  struct
  {
    uint32_t EFMSGCNT: 16;
    uint32_t NBIT0ERR:  1;
    uint32_t NBIT1ERR:  1;
    uint32_t NACKERR :  1;
    uint32_t NFORMERR:  1;
    uint32_t NSTUFERR:  1;
    uint32_t NCRCERR :  1;
    uint32_t         :  1;
    uint32_t TXBOERR :  1;
    uint32_t DBIT0ERR:  1;
    uint32_t DBIT1ERR:  1;
    uint32_t         :  1;
    uint32_t DFORMERR:  1;
    uint32_t DSTUFERR:  1;
    uint32_t DCRCERR :  1;
    uint32_t ESI     :  1;
    uint32_t DLCMM   :  1;
  } Bits;
} MCP251XFD_CiBDIAG1_Register;
```

#### 16.16.2.1. Data fields

*uint32_t* ***CiBDIAG1***

This is the complete word of the CiBDIAG1 register.

*Uint16_t* ***Uint16[2]***

This is the unsigned int16 access to the CiBDIAG1 register. The first one is for the message error count and the second for the errors related to nominal and data bitrates of messages plus the bus.

*uint8_t* ***Bytes[4]***

This is the byte access to the CiBDIAG1 register.

*uint16_t* ***ErrorFreeCounter***

Nominal Bit Rate Receive Error Counter.

*eMCP251XFD_DiagStatus* ***Flags***

Transmit and Receive Error status.

**Type**

enum *eMCP251XFD_DiagStatus*

*struct bitfield* ***Bits***

**Enumerator**

| | | |
|---|---|---|
| *EFMSGCNT* | **Bit 0 to 15** | Error Free Message Counter bits |
| *NBIT0ERR* | **Bit 16** | Normal Bitrate: During the transmission of a message (or acknowledge bit, or active error flag, or overload flag), the device wanted to send a dominant level (data or identifier bit logical value '0'), but the monitored bus value was recessive |
| *NBIT1ERR* | **Bit 17** | Normal Bitrate: During the transmission of a message (except for the arbitration field), the device wanted to send a recessive level (bit of logical value '1'), but the monitored bus value was dominant |
| *NACKERR* | **Bit 18** | Normal Bitrate: Transmitted message was not acknowledged |
| *NFORMERR* | **Bit 19** | Normal Bitrate: A fixed format part of a received frame has the wrong format |
| *NSTUFERR* | **Bit 20** | Normal Bitrate: More than 5 equal bits in a sequence have occurred in a part of a received message where this is not allowed |
| *NCRCERR* | **Bit 21** | Normal Bitrate: The CRC check sum of a received message was incorrect. The CRC of an incoming message does not match with the CRC calculated from the received data |
| *TXBOERR* | **Bit 23** | Device went to bus-off (and auto-recovered) |
| *DBIT0ERR* | **Bit 24** | Data Bitrate: During the transmission of a message (or acknowledge bit, or active error flag, or overload flag), the device wanted to send a dominant level (data or identifier bit logical value '0'), but the monitored bus value was recessive |
| *DBIT1ERR* | **Bit 25** | Data Bitrate: During the transmission of a message (except for the arbitration field), the device wanted to send a recessive level (bit of logical value '1'), but the monitored bus value was dominant |
| *DFORMERR* | **Bit 27** | Data Bitrate: A fixed format part of a received frame has the wrong format |
| *DSTUFERR* | **Bit 28** | Data Bitrate: More than 5 equal bits in a sequence have occurred in a part of a received message where this is not allowed |
| *DCRCERR* | **Bit 29** | Data Bitrate: The CRC check sum of a received message was incorrect. The CRC of an incoming message does not match with the CRC calculated from the received data |
| *ESI* | **Bit 30** | ESI flag of a received CAN FD message was set |
| *DLCMM* | **Bit 31** | DLC Mismatch bit. During a transmission or reception, the specified DLC is larger than the PLSIZE of the FIFO element |

### 16.16.3. Enumerators

#### *enum* eMCP251XFD_TXRXErrorStatus

Transmit and Receive Error status.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_TX_RX_WARNING_STATE* | **0x01** | Transmitter or Receiver is in Error Warning State |
| | | |
| *MCP251XFD_TX_NO_ERROR* | **0x00** | No Transmit Error |
| *MCP251XFD_TX_WARNING_STATE* | **0x04** | Transmitter in Error Warning State |
| *MCP251XFD_TX_BUS_PASSIVE_STATE* | **0x10** | Transmitter in Error Passive State |
| *MCP251XFD_TX_BUS_OFF_STATE* | **0x20** | Transmitter in Bus Off State |
| | | |
| *MCP251XFD_RX_WARNING_STATE* | **0x02** | Receiver in Error Warning State |
| *MCP251XFD_RX_BUS_PASSIVE_STATE* | **0x08** | Receiver in Error Passive State |

#### *enum* eMCP251XFD_DiagStatus

Transmit Event FIFO status.

**Enumerator**

| | | |
|---|---|---|
| *MCP251XFD_DIAG_NBIT0_ERR* | **0x0001** | Normal Bitrate: During the transmission of a message (or acknowledge bit, or active error flag, or overload flag), the device wanted to send a dominant level (data or identifier bit logical value '0'), but the monitored bus value was recessive |
| *MCP251XFD_DIAG_NBIT1_ERR* | **0x0002** | Normal Bitrate: During the transmission of a message (except for the arbitration field), the device wanted to send a recessive level (bit of logical value '1'), but the monitored bus value was dominant |
| *MCP251XFD_DIAG_NACK_ERR* | **0x0004** | Normal Bitrate: Transmitted message was not acknowledged |
| *MCP251XFD_DIAG_NFORM_ERR* | **0x0008** | Normal Bitrate: A fixed format part of a received frame has the wrong format |
| *MCP251XFD_DIAG_NSTUFF_ERR* | **0x0010** | Normal Bitrate: More than 5 equal bits in a sequence have occurred in a part of a received message where this is not allowed |
| *MCP251XFD_DIAG_NCRC_ERR* | **0x0020** | Normal Bitrate: The CRC check sum of a received message was incorrect. The CRC of an incoming message does not match with the CRC calculated from the received data |
| *MCP251XFD_DIAG_TXBO_ERR* | **0x0080** | Device went to bus-off (and auto-recovered) |
| | | |
| *MCP251XFD_DIAG_DBIT0_ERR* | **0x0100** | Data Bitrate: During the transmission of a message (or acknowledge bit, or active error flag, or overload flag), the device wanted to send a dominant level (data or identifier bit logical value '0'), but the monitored bus value was recessive |
| *MCP251XFD_DIAG_DBIT1_ERR* | **0x0200** | Data Bitrate: During the transmission of a message (except for the arbitration field), the device wanted to send a recessive level (bit of logical value '1'), but the monitored bus value was dominant |
| *MCP251XFD_DIAG_DFORM_ERR* | **0x0800** | Data Bitrate: A fixed format part of a received frame has the wrong format |
| *MCP251XFD_DIAG_DSTUFF_ERR* | **0x1000** | Data Bitrate: More than 5 equal bits in a sequence have occurred in a part of a received message where this is not allowed |
| *MCP251XFD_DIAG_DCRC_ERR* | **0x2000** | Data Bitrate: The CRC check sum of a received message was incorrect. The CRC of an incoming message does not match with the CRC calculated from the received data |
| *MCP251XFD_DIAG_ESI_SET* | **0x4000** | ESI flag of a received CAN FD message was set |
| *MCP251XFD_DIAG_DLC_MISMATCH* | **0x8000** | DLC Mismatch bit. During a transmission or reception, the specified DLC is larger than the PLSIZE of the FIFO element |

## 16.17. Tools

```
uint32_t MCP251XFD_MessageIDtoObjectMessageIdentifier(
      uint32_t messageID,
      bool extended,
      bool UseSID11)
```

Message ID to Object Message Identifier.

**Parameters**

| | | |
|---|---|---|
| Input | messageID | Is the message ID to convert |
| Input | extended | Indicate if the message ID is extended or standard |
| Input | UseSID11 | Indicate if the message ID use the SID11 |

**Return**

Returns the Message ID.

```
uint32_t MCP251XFD_ObjectMessageIdentifierToMessageID(
      uint32_t objectMessageID,
      bool extended,
      bool UseSID11)
```

Object Message Identifier to Message ID.

**Parameters**

| | | |
|---|---|---|
| Input | objectMessageID | Is the object message ID to convert |
| Input | extended | Indicate if the object message ID is extended or standard |
| Input | UseSID11 | Indicate if the object message ID use the SID11 |

**Return**

Returns the Object Message Identifier.

```
uint32_t MCP251XFD_PayloadToByte(eMCP251XFD_PayloadSize payload)
```

Payload to Byte Count.

**Parameters**

| | | |
|---|---|---|
| Input | payload | Is the enum of Message Payload Size (8, 12, 16, 20, 24, 32, 48 or 64 bytes) |

**Return**

Returns the byte count.

```
uint32_t MCP251XFD_DLCToByte(eMCP251XFD_DataLength dlc, bool isCANFD)
```

Data Length Content to Byte Count.

**Parameters**

| | | |
|---|---|---|
| Input | dlc | Is the enum of Message DLC Size (0, 1, 2, 3, 4, 5, 6, 7, 8, 12, 16, 20, 24, 32, 48 or 64 bytes) |
| Input | isCANFD | Indicate if the DLC is from a CAN-FD frame or not |

**Return**

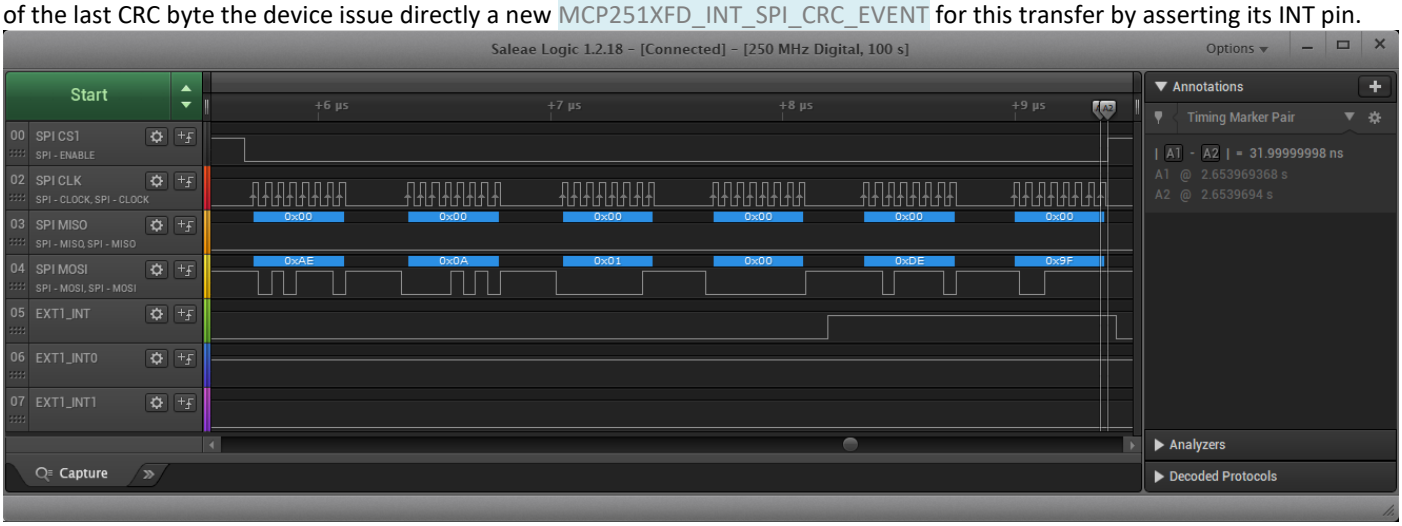
Returns the byte count.

# 17. TROUBLESHOOTING

## 17.1. Regularly get MCP251XFD_INT_SPI_CRC_EVENT

If your SPI interface with the device is not properly configured, you can get the MCP251XFD_INT_SPI_CRC_EVENT. The SPI timing (see Table 5) is very important with this component.

Example, here the $T_{SCK2CS}$ (32ns) is less than $T_{SCK}$ (54ns). The instruction sent to the device is to clear this interrupt but at the end of the last CRC byte the device issue directly a new MCP251XFD_INT_SPI_CRC_EVENT for this transfer by asserting its INT pin.




As you understand, just put a higher $T_{SCK2CS}$ time (superior or equal to $T_{SCK}$) to correct this issue.

# 18. EXAMPLE OF “CONF_MCP251XFD.H” FILE

Source:

```
#ifndef CONF_MCP251XFD_H
#define CONF_MCP251XFD_H
//======================================================================

// If in debug mode, check NULL parameters that are mandatory in each functions of the driver
#ifdef DEBUG
#  define CHECK_NULL_PARAM
#endif

// This define the max size for the transfer buffer. Adjust for 1 max full frame that is needed of all controllers
// in use otherwise, the message will be cut into parts that slow the transfer
// In case of use write safe by all controllers set 9, which is the minimum allowed, because all data will be send
// by 4 bytes max
#define MCP251XFD_TRANS_BUF_SIZE  ( 2+1+8+64+4+2 ) // here it is set to 1 full CAN-FD frame with CRC
// (2 for Command + 1 for length + 8 for CAN frame header + 64 for CAN-FD max payload + 4 for time stamp + 2 for CRC)

//----------------------------------------------------------------------------
#endif /* CONF_MCP251XFD_H */
```

# 19. EXAMPLE OF DRIVER INTERFACE HANDLE FUNCTIONS

This is an extract from the project for the SAMV71 Xplained Ultra board.

Example of driver interface handle functions in a .c file:

```
//=============================================================================
// MCP251XFD_X get millisecond
//=============================================================================
uint32_t GetCurrentms_V71(void)
{
  return msCount;
}


//=============================================================================
// MCP251XFD_X compute CRC16-CMS
//=============================================================================
uint16_t ComputeCRC16_V71(const uint8_t* data, size_t size)
{
  return ComputeCRC16CMS(data, size);
}



//*****************************************************************************************************************
//=============================================================================
// MCP251XFD SPI driver interface configuration for the ATSAMV71
//=============================================================================
eERRORRESULT MCP251XFD_InterfaceInit_V71(void *pIntDev, uint8_t chipSelect, const uint32_t sckFreq)
{
  if (pIntDev == NULL) return ERR__SPI_PARAMETER_ERROR;
  Spi *SPI_Ext = (Spi *)pIntDev;       // MCU specific: #define SPI0  ((Spi*)0x40008000U) // (SPI0  ) Base Address

  ioport_set_pin_mode(SPI0_NPCS1_GPIO, SPI0_NPCS1_FLAGS);
  ioport_disable_pin(SPI0_NPCS1_GPIO);
  ioport_set_pin_mode(SPI0_NPCS3_GPIO, SPI0_NPCS3_FLAGS);
  ioport_disable_pin(SPI0_NPCS3_GPIO);

  //--- Configure an SPI peripheral ---
  spi_enable_clock(SPI_Ext);
  spi_disable(SPI_Ext);
  if (SPIconfigured == false)
  {
    spi_reset(SPI_Ext);
    spi_set_lastxfer(SPI_Ext);
    spi_set_master_mode(SPI_Ext);
    spi_disable_mode_fault_detect(SPI_Ext); // For multimaster SPI bus. Not used here
    spi_disable_peripheral_select_decode(SPI_Ext);
    spi_set_variable_peripheral_select(SPI_Ext);
    spi_enable_tx_on_rx_empty(SPI_Ext);
  }
  spi_set_clock_polarity(SPI_Ext, chipSelect, SPI_CLK_POLARITY);
  spi_set_clock_phase(SPI_Ext, chipSelect, SPI_CLK_PHASE);
  spi_set_bits_per_transfer(SPI_Ext, chipSelect, SPI_CSR_BITS_8_BIT);
  spi_configure_cs_behavior(SPI_Ext, chipSelect, SPI_CS_KEEP_LOW);
//  spi_configure_cs_behavior(SPI_Ext, chipSelect, SPI_CS_RISE_FORCED);
//  spi_configure_cs_behavior(SPI_Ext, chipSelect, SPI_CS_RISE_NO_TX);

  int16_t div = spi_calc_baudrate_div(sckFreq, sysclk_get_peripheral_hz());
  if (div < 0) return ERR__SPI_CONFIG_ERROR;
  spi_set_baudrate_div(SPI_Ext, chipSelect, (uint8_t)div);
  spi_set_transfer_delay(SPI_Ext, chipSelect, SPI_DLYBS, SPI_DLYBCT);
//  spi_set_delay_between_chip_select(SPI_Ext, SPI_DLYBCS);

  spi_enable(SPI_Ext);
  SPIconfigured = true;
  return ERR_OK;
}
```

```
//===========================================================================
// MCP251XFD SPI transfer data for the ATSAMV71
//===========================================================================
eERRORRESULT MCP251XFD_InterfaceTransfer_V71(void *pIntDev, uint8_t chipSelect, uint8_t *txData, uint8_t *rxData,
size_t size)
{
  if (pIntDev == NULL) return ERR__SPI_PARAMETER_ERROR;
  if (txData == NULL) return ERR__SPI_PARAMETER_ERROR;
  Spi *SPI_Ext = (Spi *)pIntDev;       // MCU specific: #define SPI0  ((Spi*)0x40008000U) // (SPI0) Base Address
  uint8_t DataRead;

  __disable_irq();
  uint32_t Timeout;
  while (size > 0)
  {
    //--- Transmit data ---
    Timeout = TIMEOUT_SPI_INTERFACE;
    while (!(SPI_Ext->SPI_SR & SPI_SR_TDRE))   // SPI Tx ready ?
      if (!Timeout--) return ERR__SPI_TIMEOUT; // Timeout ? return an error

    uint32_t value = SPI_TDR_TD(*txData) | SPI_TDR_PCS(spi_get_pcs(chipSelect));
    if (size == 1) value |= SPI_TDR_LASTXFER;
    SPI_Ext->SPI_TDR = value;
    txData++;

    //--- Receive data ---
    Timeout = TIMEOUT_SPI_INTERFACE;
    while (!(SPI_Ext->SPI_SR & SPI_SR_RDRF))   // SPI Rx ready ?
      if (!Timeout--) return ERR__SPI_TIMEOUT; // Timeout ? return an error

    DataRead = (uint8_t)(SPI_Ext->SPI_RDR & 0xFF);
    if (rxData != NULL) *rxData = DataRead;
    rxData++;

    size--;
  }
  SPI_Ext->SPI_CR |= SPI_CR_LASTXFER;
  __enable_irq();

  return ERR_OK;
}
```

Example of driver interface handle functions in a .h file:

```
/*! @brief MCP251XFD_X get millisecond
 *
 * This function will be called when the driver needs to get current millisecond
 */
uint32_t GetCurrentms_V71(void);


/*! @brief MCP251XFD_X compute CRC16-CMS
 *
 * This function will be called when a CRC16-CMS computation is needed (ie. in CRC mode or Safe Write). In normal
mode, this can point to NULL.
 * @param[in] *data Is the pointed byte stream
 * @param[in] size Is the size of the pointed byte stream
 * @return The CRC computed
 */
uint16_t ComputeCRC16_V71(const uint8_t* data, size_t size);



//************************************************************************************************************

/*! @brief MCP251XFD_Ext1 SPI interface configuration for the ATSAMV71
 *
 * This function will be called at driver initialization to configure the interface driver SPI
 * @param[in] *pIntDev Is the MCP251XFD_Desc.InterfaceDevice of the device that call the interface initialization
 * @param[in] chipSelect Is the Chip Select index to use for the SPI initialization
 * @param[in] sckFreq Is the SCK frequency in Hz to set at the interface initialization
 * @return Returns an #eERRORRESULT value enum
 */
eERRORRESULT MCP251XFD_InterfaceInit_V71(void *pIntDev, uint8_t chipSelect, const uint32_t sckFreq);


/*! @brief MCP251XFD_Ext1 SPI transfer for the ATSAMV71
 *
 * This function will be called at driver read/write data from/to the interface driver SPI
 * @param[in] *pIntDev Is the MCP251XFD_Desc.InterfaceDevice of the device that call this function
 * @param[in] chipSelect Is the Chip Select index to use for the SPI transfer
 * @param[in] *txData Is the buffer to be transmit to through the SPI interface
 * @param[out] *rxData Is the buffer to be received to through the SPI interface (can be NULL if it's just a send of
data)
 * @param[in] size Is the size of data to be send and received trough SPI. txData and rxData shall be at least the
same size
 * @return Returns an #eERRORRESULT value enum
 */
eERRORRESULT MCP251XFD_InterfaceTransfer_V71(void *pIntDev, uint8_t chipSelect, uint8_t *txData, uint8_t *rxData,
size_t size);
```