C28x PMBus Communications Stack

USER'S GUIDE

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Texas Instruments
13905 University Boulevard
Sugar Land, TX 77479
http://www.ti.com/c2000

Revision Information

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Table of Contents

1 Introduction

The PMBus (Power Management Bus) Communications Software Stack supports PMBus target operation on C2000 devices. The current version of the library supports only target mode on the following devices:

1. F28004x
2. F2838x
3. F28002x
4. F28003x
5. F280015x
6. F28P65x
7. F28P55x

The PMBus target communication stack is based on **PMBus specification (Part I, II) v1.2** and supports the following:

- PMBus Specification v1.2 Bus Speeds
  - Standard - 100kHz
  - Fast - 400kHz
- SMBus Specification v2.0 Transactions
  1. Quick Command
  2. Send Byte
  3. Receive Byte
  4. Write Byte/Word
  5. Read Byte/Word
  6. Process Call
  7. Block Write/Read (Blocks support up to 255 data bytes)
  8. Block Write/Block Read/Process Call (Blocks support up to 255 data bytes)
- SMBus Specification v2.0 Alert Response (Alert line)
- PMBus Specification v1.2 (Extentions to SMBus v2.0) Features
  - Group Command
  - Extended Read Byte/Word Command

Known deviations and/or unsupported features defined in the PMBus specification v1.2:

- Extended Write Byte/Word Command: Supported only as defined in PMBus specification v1.0
- Address Resolution Protocol (ARP): Not supported, as this is an optional feature
- Host Notify Protocol: Not supported, as this isn’t required when Alert Line is supported

1.1 Chapter Overview

Chapter 2 provides resource and forum links.

Chapter 3 describes the directory structure of the library.

Chapter 4 provides step-by-step instructions on how to integrate the library into a project.

Chapter 5 details about the different aspects of the protocol that are supported by this library, including the different transaction types.

Chapter 6 describes the programming interface, structures and routines available for this stack.

Chapter 8 details the controller and example setup code and test functions.

Chapter 7 details software implementation of the PMBus protocol over I2C module.

Chapter 9 describes the other PMBus examples that aren't using the communication stack code.

Chapter 10 provides a revision history of the library.

1.2 Legacy PMBus Library Compatibility

For C2000 PMBus communication library users that developed with the *F28004x* library available in *C2000Ware 2.00.00.03* and earlier, a compatibility header has been provided to map the legacy API names to the latest library API names.

Located at:

```
~\PMBus\c28\include\pmbus_stack_compatibility.h
```

Within your PMBus application, switch the legacy PMBus library for the latest PMBus library and include the header listed above within your main application code.

2 Other Resources

The user can get answers to F28002x, F28004x, F2838x, F28003x, F280015x or F28P65x frequently asked questions(FAQ) from the TI Resource Explorer.
https://dev.ti.com/tirex

Check out the TI C2000 page: http://www.ti.com/c2000

TI community forums website: http://e2e.ti.com

Building the PMBus Communications Stack library and examples requires **Codegen Tools v20.2.1.LTS or later**.

3 Library Structure

The PMBus Communications Stack Library is distributed as part of the C2000Ware software framework. The library, source code and examples are packaged under:

```
~\C2000Ware_X_XX_XX_XX\libraries\communications\PMBus
```

Figure. 3.1 shows the directory structure, while the subsequent table 3.1 provides a description of each folder.

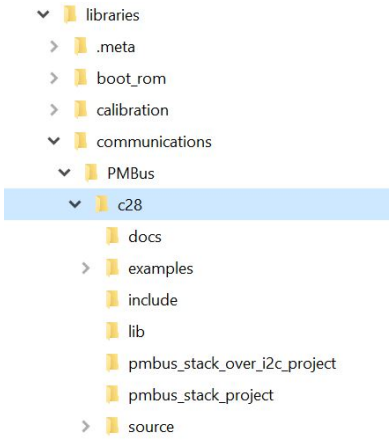

Figure 3.1: Directory Structure of the Library

Folder	Description
<base>	Base install directory. By default this is C:/ti/c2000/C2000Ware_X_XX_XX_XX/libraries/communications/PMBus For the rest of this document <base> will be omitted from the directory names.
<base>/docs	Documentation for the current revision of the library including revision history.
<base>/examples	Examples that illustrate use of the library. These examples were built for the F28 F2838x, F28003x,F280015x, F28P55x and F28P65x devices using the CCS 10 Additionally, non-stack PMBus examples are located here.
<base>/include	Header files for the library. These include function prototypes and structure defin
<base>/lib	Pre-built binaries for the library.
<base>/pmbus_stack_over_i2c_project	CCS Projectspec file for the PMBus over I2C library. Allows the user to reconfig re-build the library to suit their particular needs.
<base>/pmbus_stack_project	CCS Projectspec file for the PMBus library. Allows the user to reconfigure, mo the library to suit their particular needs.
<base>/source	Source files for the library.

Table 3.1: Library Directory Structure Description

4 Using the PMBus Communications Stack Library

The source code and project(s) for the library are provided. The user may create the library project(s) into CCSv9 (or later) by importing the projectspec and be able to view and modify the source code for all routines and lookup tables (see Fig. 4.1)

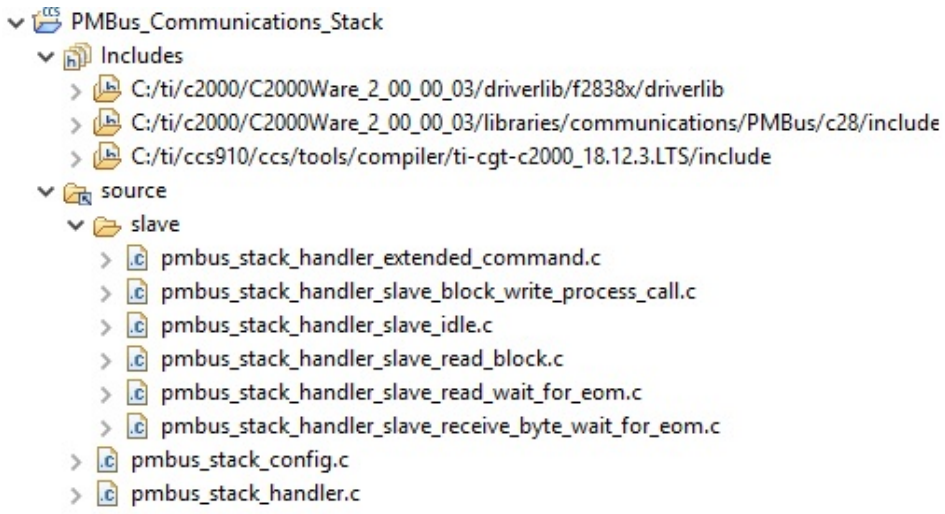

Figure 4.1: F2838x Library Project View

4.1 Integrating the Library into your Project

To begin integrating the library into your project follow these steps:

1. Go to the **Project Properties** and add a path to the device driverlib directory, to the *Include Options* section of the project properties (Fig. 4.2). This option tells the compiler where to find the device driver header files. In addition, you must add a path for the PMBus stack interface, for the compiler to find the stack header files.

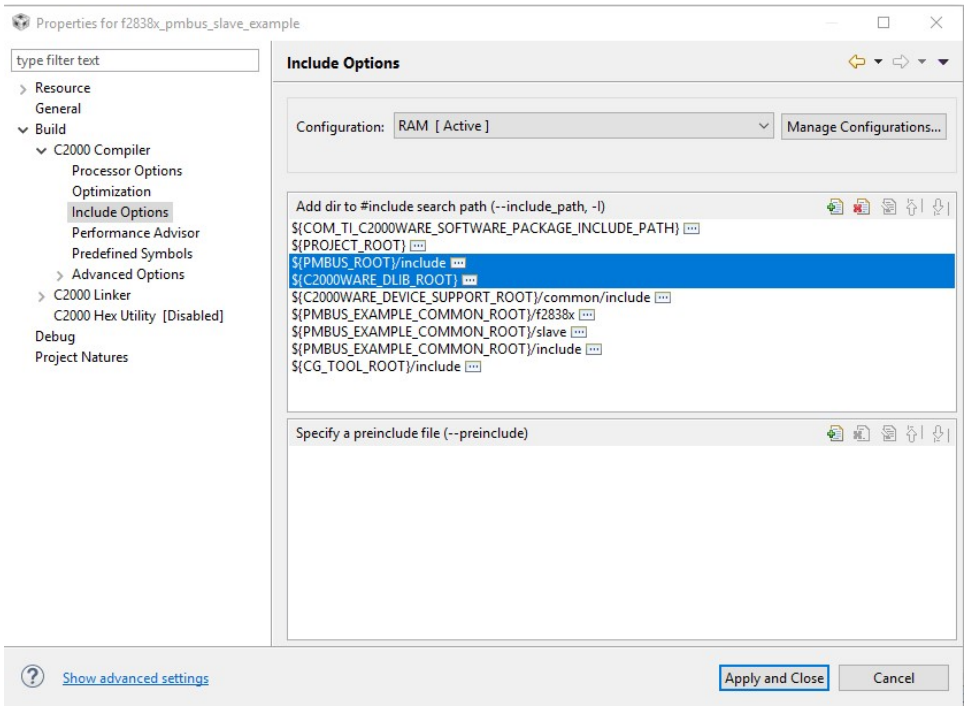

Figure 4.2: Adding the Library Header Path to the Include Options

2. Add the Communications Stack library (replace "device" with F28002x, F28004x, F2838x , F28003x) , F280015x F28P55x or F28P65x, **'<device>_PMBus_Communications_Stack.lib'** to the project explorer as shown in Fig. 4.3. Also add the device driver library.

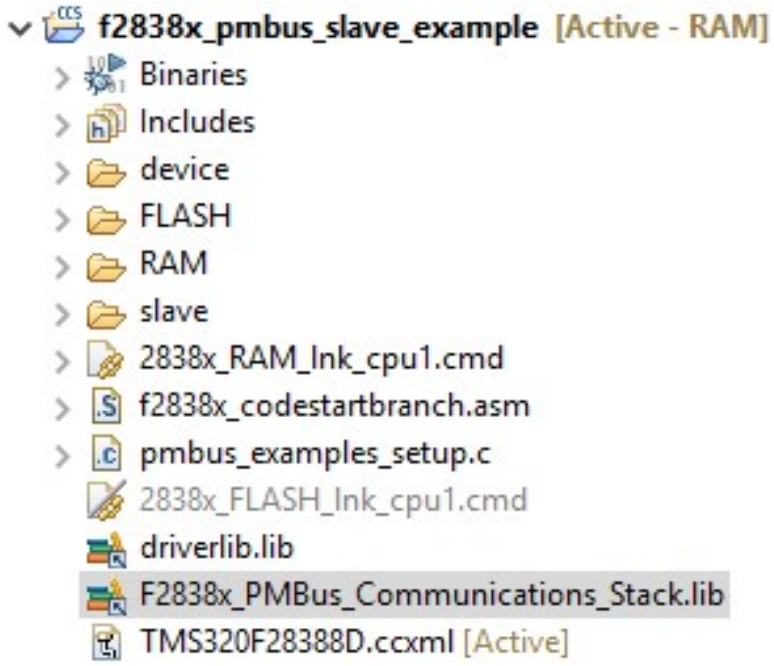

Figure 4.3: Adding the library and location to the file search path

3. For the target device, define **_PMBUS_TARGET** in the *Predefined Symbols* option under the C2000 Compiler menu, Fig. 4.4. If using F2838x, **CPU1** must also be defined.
   NOTE: FOR DEVICES THAT OPERATE IN CONTROLLER MODE THE USER MUST DEFINE THE SYMBOL **_PMBUS_CONTROLLER** INSTEAD.

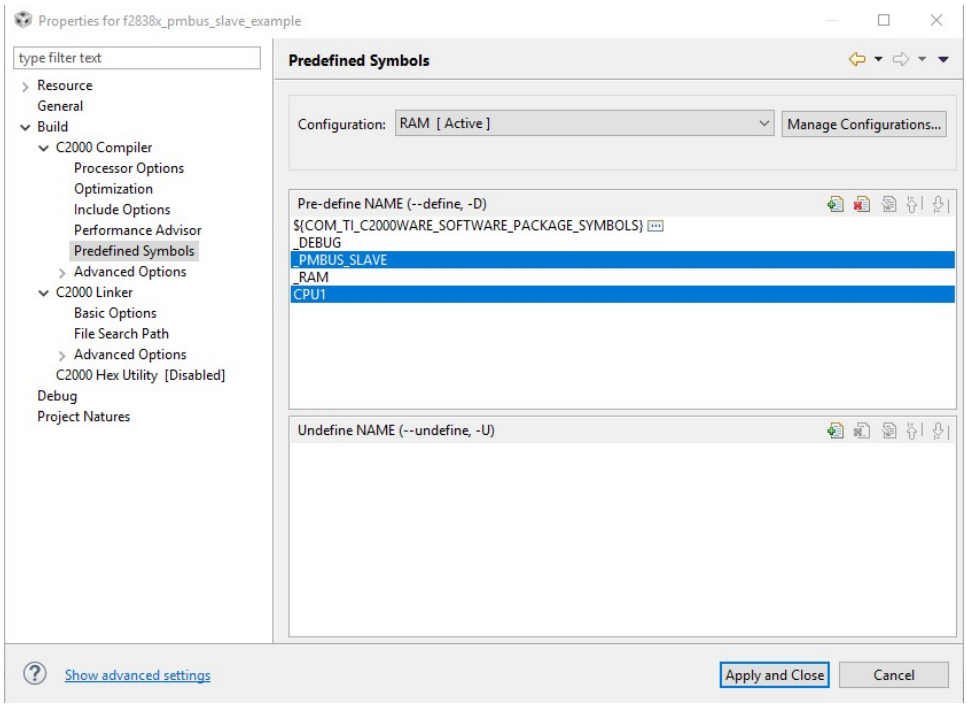

Figure 4.4: Compiler Predefined Symbols

5 The PMBus Protocol

5.1 PMBus Target Mode

In target mode, the device only responds to messages from the Controller. The target cannot initiate messages, with the exception of asserting the alert line to notify the controller of a fault in the system.

The target mode state machine is handled through PMBus Module interrupts. The Interrupt Service Routine invokes the state machine handler, which deciphers the transaction initiated by the controller, and takes appropriate action depending on the transaction type.

Transaction Types Include:

- Quick Command
- Send Byte
- Receive Byte
- Write Byte/Word
- Read Byte/Word
- Process Call
- Block Write/Read (Blocks support up to 255 data bytes)
- Block Write/Block Read/Process Call (Blocks support up to 255 data bytes)
- Group Commands
- Extended Commands

5.1.1 Packet Error Checking

The PMBus Module has the option to work with, or without, packet error checking. While the option is available in the hardware, the software stack assumes that error checking is enabled. All transactions, with the exception of the quick command, must have a trailing **Packet Error Check (PEC)** value associated with it; this feature lends a measure of robustness to the communications.

In the event of an invalid PEC, the state machine will abort its current processing and revert to its idle state (or issue a debugging halt if the emulator is connected), while a NACK is issued on the bus; the decision to either halt or retransmit lies with the controller.

5.2 Target Mode Message Types

This section describes the different transaction (message types) that are recognized, and supported by the target state machine handler. During initialization, the target handler is setup to automatically acknowledge up to 4 bytes, with the final byte requiring a manual acknowledgment, and to verify the PEC received is correct.

The primary handler is always called in the interrupt service routine of the following interrupt sources

- DATA_READY
- EOM
- DATA_REQUEST

Each of these is a bit-field in the PMBus status register; in addition to these, the RD_BYTE_COUNT is also queried by the state machine handler. All state transitions occur based on the value of these bit fields at the invocation of the state machine.

The following abbreviations are used in the descriptions of the transactions,

S
: The start signal on the bus

ADDR
: The address of the target device

Rd/R
: The read bit asserted after the target address is put on the bus

Wr/W
: The write bit asserted after the target address is put on the bus

A
: Acknowledgment

NA
: NACK or No Acknowledgment

P
: The stop signal on the bus

Sr
: Repeated Start

PEC
: Packet Error Check byte

Each transaction (message) description will have an image of the message format; Fig. 5.1 describes the convention used,

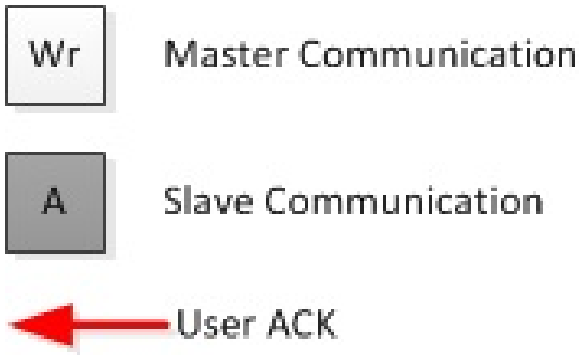

Figure 5.1: Message Format Legend

5.2.1 Quick Command

When a Quick Command is received, the **EOM (End-of-Message)** status bits is set, and the **RD_BYTE_COUNT (Received Byte Count)** field is 0.

The Target manually ACKs the transaction by writing to the PMBACK register.

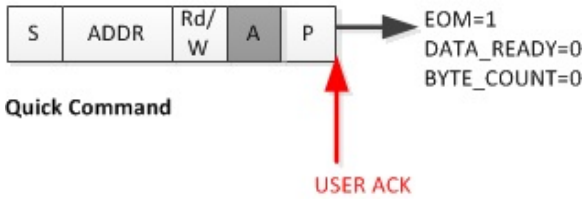

Figure 5.2: Quick Command

5.2.2 Send Byte

When a Send Byte is received, the **DATA_READY** and **EOM (End-of-Message)** status bits are set, and the **RD_BYTE_COUNT (Received Byte Count)** field is 2, indicating two bytes were received, the data byte and the PEC.

The Target reads the data and manually ACKs the message by writing to the PMBACK register.

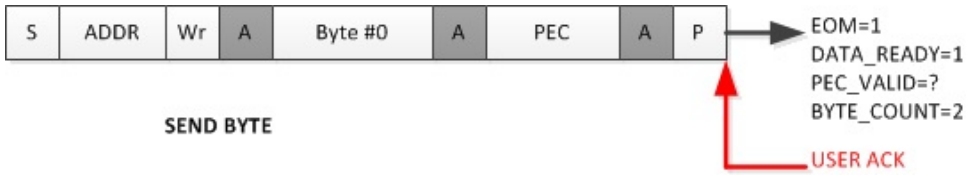

Figure 5.3: Send Byte

5.2.3 Write Byte

The Write Byte is identical to Send Byte, with the exception that **RD_BYTE_COUNT (Received Byte Count)** is now 3, that is, a command byte, a data byte and the PEC.

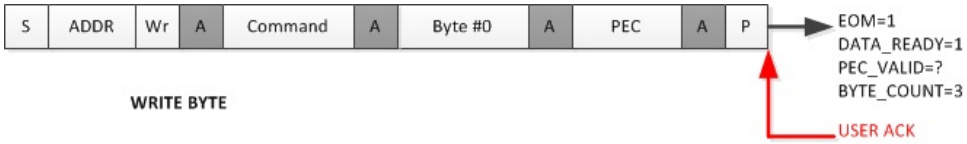

Figure 5.4: Write Byte

5.2.4 Write Word

The Write Byte is identical to Send Byte, with the exception that **RD_BYTE_COUNT (Received Byte Count)** is 4, that is, a command byte, 2 data bytes and the PEC.

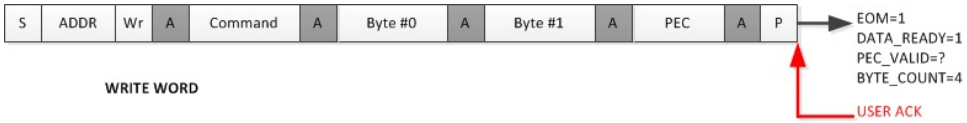

Figure 5.5: Write Word

5.2.5 Block Write

The Block Write is issued when the controller has to transfer more than 2 data bytes (up to a maximum of 255 bytes). The controller will transmit a command, a count (how many bytes it intends to send), followed by the bytes, ending with the PEC.

For every 4 bytes the target receives, **DATA_READY** is asserted and **RD_BYTE_COUNT** is 4; no End-of-Message (EOM) is received at this point. The target must read the receive buffer, and manually ACK reception of 4 bytes before the controller can proceed sending the next 4 bytes. On the very last transmission **DATA_READY** and **EOM** are asserted indicating the end of transmission. The target must read the receive buffer (which has 1 to 4 bytes depending on the initial count) and manually ACK the transaction.

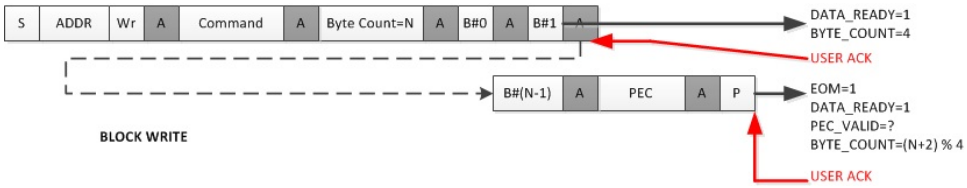

Figure 5.6: Block Write

5.2.6 Receive Byte

The controller initiates a Receive Byte by putting the target's address on the bus followed by a read bit. The target will automatically ACK its address, load its transmit buffer, and transmit a byte and its PEC.

If there is no error in the transmission the controller will **NACK** the PEC indicating the end of the transaction. Both the **NACK** and **EOM** status bits are asserted at this point.

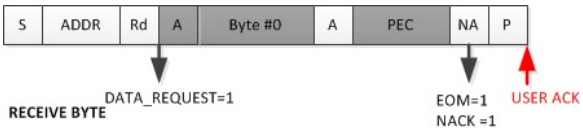

Figure 5.7: Receive Byte

5.2.7 Alert Response

A special variant of the Receive Byte is the **Alert Response** transactions where the target device pulls the **ALERT** line low; the controller must respond with the **ALERT RESPONSE ADDRESS** and a read, the alerting target will respond by transmitting its own address as shown in Fig. 5.8.

When the controller puts the Alert Response Address on the line with a read, the alerting target hardware will automatically respond with its address, without software intervention.
NOTE: THE 7 BIT DEVICE ADDRESS PROVIDED BY THE TARGET TRANSMIT DEVICE IS PLACED IN THE 7 MOST SIGNIFICANT BITS OF THE BYTE. THE EIGHTH BIT CAN BE A ZERO OR ONE.

Figure 5.8: Alert Responsed

5.2.8 Read Byte

The controller initiates a Read Byte by putting the target's address on the bus followed by a write bit. The controller issues a command - a Read Byte command - followed by a repeated start, with the target address and the read bit. When the repeated start is issued on the bus the **DATA_READY** bit is asserted at the target end, with a **RD_BYTE_COUNT** of 1. At the read bit the **DATA_REQUEST** bit is asserted; the target responds by transmitting a single byte followed by the PEC. If there is no error in the transmission the controller will **NACK** the PEC indicating the end of the transaction. Both the **NACK** and **EOM** status bits are asserted at this point.

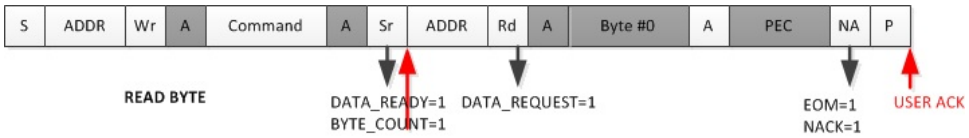

Figure 5.9: Read Byte

5.2.9 Read Word

Read Word is similar to Read Byte with the exception that the target responds to the repeated start (read bit) by transmitting two bytes followed by the PEC.

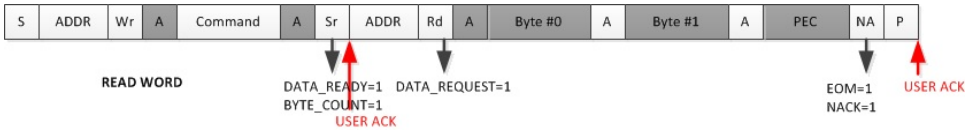

Figure 5.10: Read Word

5.2.10 Block Read

If the controller transmits a Block Read command, the target responds by sending more than 2 bytes (up to a maximum of 255 bytes). The transaction, including the status bit assertions, is similar to the read word command. The first byte sent by the target is always the byte count, that is, the number of bytes it intends to transmit. It then follows this with the data bytes. For every 4 bytes sent by the target (and acknowledged by the controller) the **DATA_REQUEST** bit is asserted requesting the target to send the next set of bytes. The transaction is terminated by the controller by issuing a **NACK** on the bus; both the **NACK** and **EOM** status bits are asserted at the target end at this point.

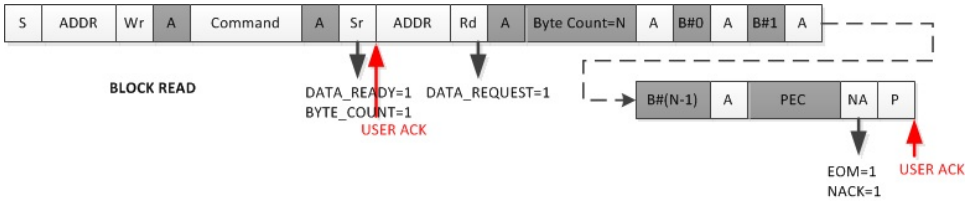

Figure 5.11: Block Read

5.2.11 Process Call

This is basically a write word followed by a read word without the read word command field and the write word STOP bit. A repeated START seperates the write and the read transactions.

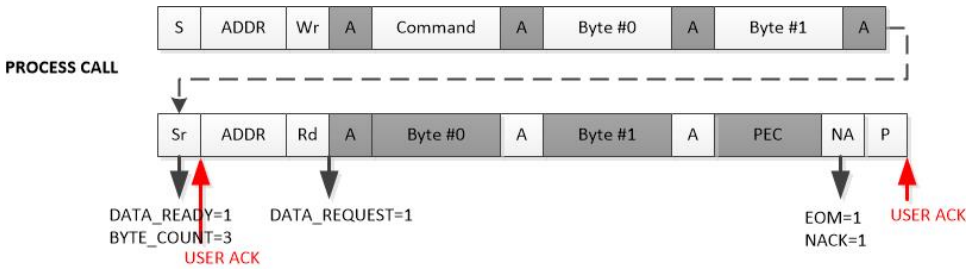

Figure 5.12: Process Call

5.2.12 Block Write/ Read/ Process Call

This is basically a block write followed by a block read. The key points to note here are the byte counts on the block write, and block read must be the same, and a single PEC is sent at the end of the block read.

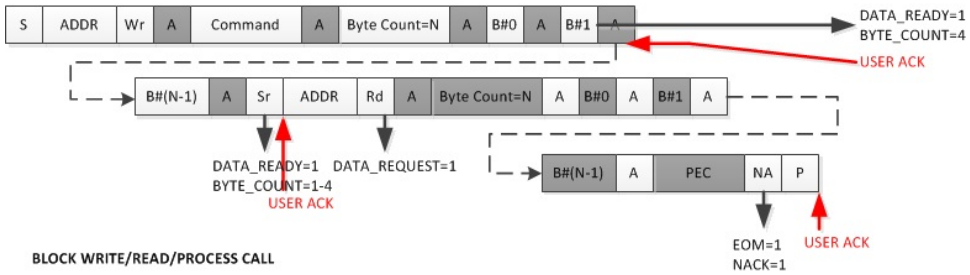

Figure 5.13: Block Write/ Read/ Process Call

5.2.13 Group Command

The Controller writes to a group of targets in a single transaction. It does this by putting each target's address (with a write) followed by a command, two bytes, and a PEC on the bus after a repeated start (the exception is the first target address which follows the start). A target device will acknowledge its address on the bus, and its state machine will respond when the **DATA_READY** is asserted on the next repeated start (or on a stop, if the target in question is the last to be addressed).

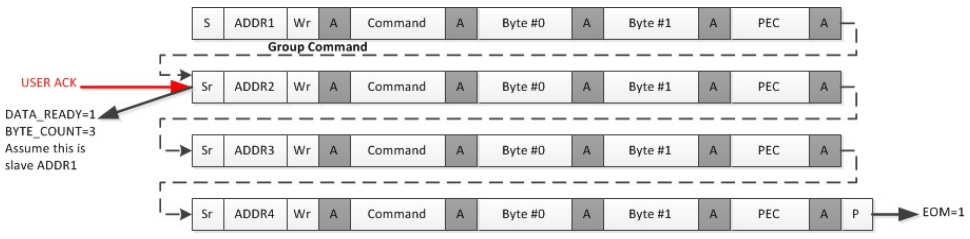

Figure 5.14: Group Command

5.2.14 Extended Command

The extended commands, following PMBus specification v1.2, is supported for two transaction types

1. Extended Read Byte
2. Extended Read Word

The extended commands, following PMBus specification v1.0, is supported for two transaction types

1. Extended Write Byte
2. Extended Write Word

NOTE: THE EXTENDED WRITES CONFORMING TO PMBUS V1.0 INCLUDE A REPEATED START (AND TARGET ADDRESS AFTER THE EXTENSION AND COMMAND BYTES ARE SENT). THE STACK IS IMPLEMENTED FOR PMBUS V1.0 AND ISN'T COMPATIBLE WITH EXTENDED WRITES PMBUS V1.2

These commands are similar to their non-extended counterparts, with the exception that the command is preceded by the extension byte (0xFE or 0xFF). The controller issues a repeated start with the target address and the read (for a read transaction) or write (for a write transaction) bit asserted.

At this point the target sees the **DATA_READY** signal asserted and a **RD_BYTE_COUNT** of 2 - it must check the first byte for the extension code before acknowledging. If the transaction is a write the controller proceeds; an extended write byte involves 4 bytes: the extension code, the command byte, a data byte, and finally the PEC whereas a write word transaction involves an additional data byte making the total 5 bytes. If the transaction is a read, the target must transfer 1 (read byte) or 2 (read words) bytes depending on the command received, followed by the PEC.
NOTE: THE PEC IS CALCULATED ON THE TARGET ADDRESS (WITH WRITE BIT ASSERTED), THE EXTENSION, COMMAND BYTE, SECOND TARGET ADDRESS (AND EITHER READ/WRITE BIT DEPENDING ON THE TRANSACTION), AND FINALLY THE DATA BYTE(S).

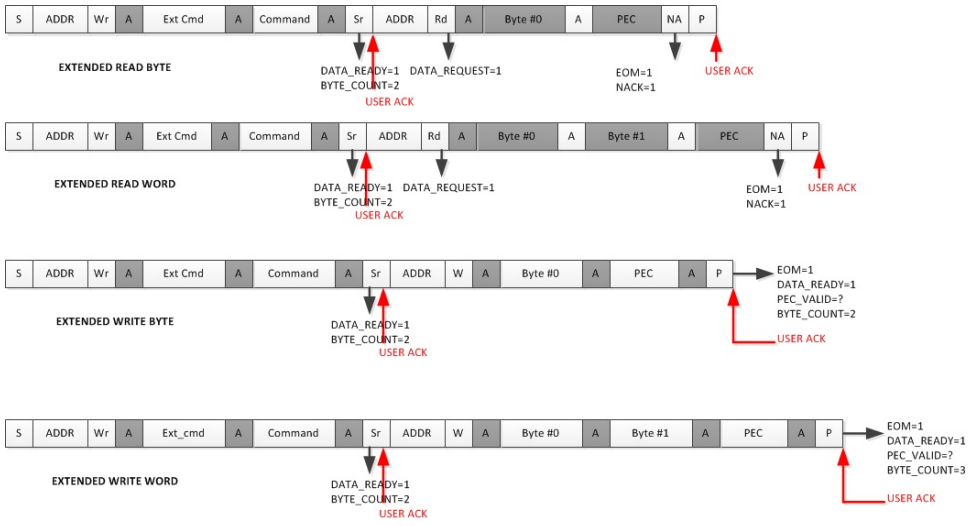

Figure 5.15: Extended Commands (Reads - v1.2, Writes - v1.0)

5.3 State Machine Description

This section describes the state machine. There are currently 6 states, each having their own function (sub-handler). They are:

PMBUS_STACK_STATE_IDLE
The idle state - the handler will enter this state on the first interrupt after power up; the handler will spend most of its time in this state. The sub-handler for this state is *PMBusStack_targetIdleStateHandler*.

PMBUS_STACK_STATE_RECEIVE_BYTE_WAIT_FOR_EOM
This is a special state to handle a **Receive Byte** command from the controller. The sub-handler for this state is *PMBusStack_targetReceiveByteWaitForEOMStateHandler*.

PMBUS_STACK_STATE_READ_BLOCK
The handler enters this state when it establishes a read block command was issued by the controller. The sub-handler for this state is *PMBusStack_targetReadBlockStateHandler*.

PMBUS_STACK_STATE_READ_WAIT_FOR_EOM
Once the handler establishes that a read command was issued by the controller, it transitions to this state awaiting an **End Of Message (EOM)** signal from the controller to terminate communications. The sub-handler for this state is *PMBusStack_targetReadWaitForEOMStateHandler*.

PMBUS_STACK_STATE_BLOCK_WRITE_OR_PROCESS_CALL
When a controller issues either a **Block Write** or **Process Call** the state machine transitions to this state. The sub-handler for this state is *PMBusStack_targetBlockWriteOrProcessCallStateHandler*.

PMBUS_STACK_STATE_EXTENDED_COMMAND
When a controller issues either an **Extended Read/Write Byte/Word** the state machine transitions to this state. The sub-handler for this state is *PMBusStack_targetExtendedCommandStateHandler*.

The transition from one state to the next is depicted in Fig. 5.16,

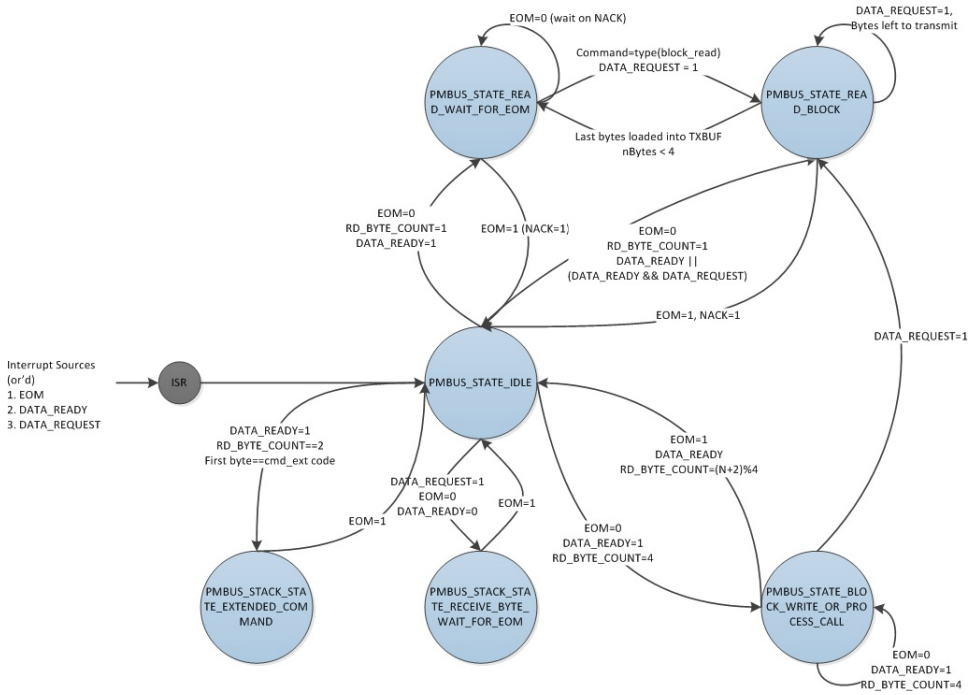

Figure 5.16: Target Mode State Machine

5.3.1 The Idle State

This is the very first state the state machine enters after a PMBus interrupt is received (and the ISR calls the main state machine handler). The processor tries to decipher the transaction (message) type received from the controller, and will either, read the contents of the receive buffer in the event of write transaction, or setup the hardware to transmit and change state accordingly

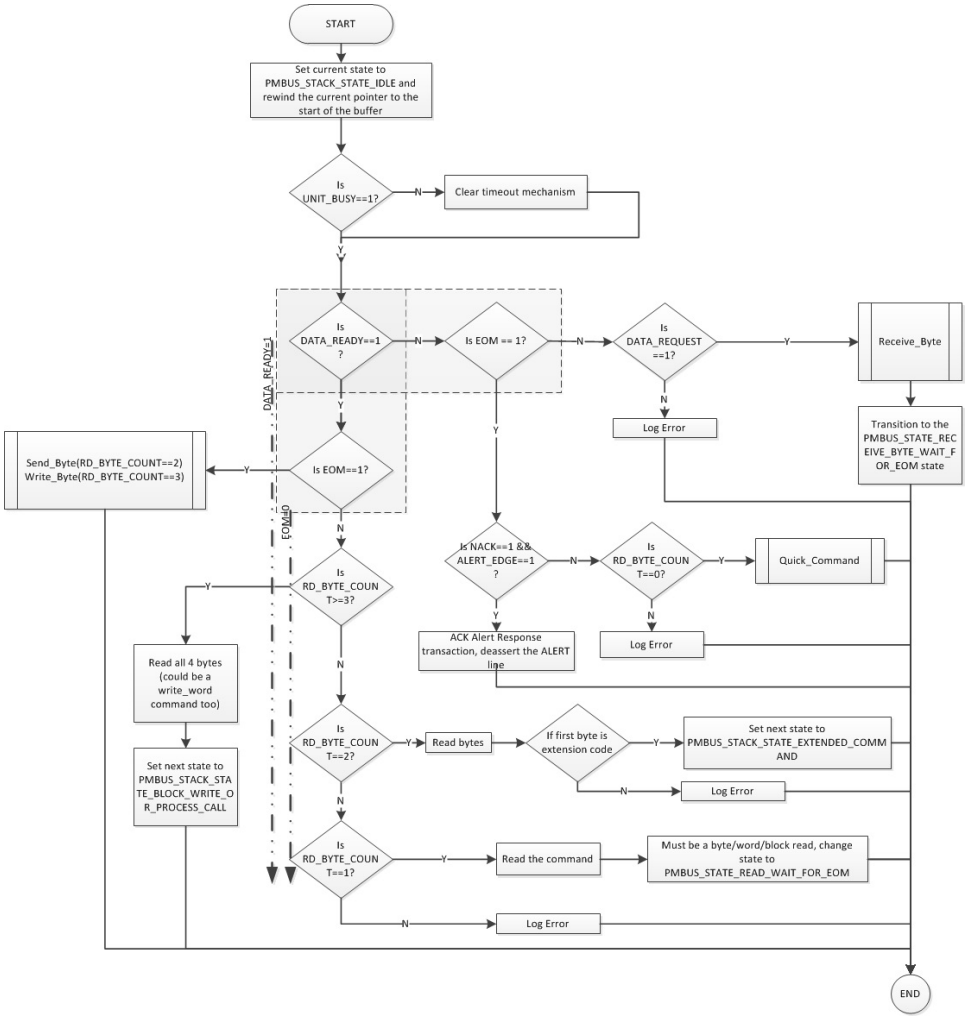

Figure 5.17: The Idle State

5.3.2 The Receive Byte and Wait for End-of-Message State

This is a special state that handles a **Receive Byte** transaction. The state machine transitions from the idle state when it sees the **DATA_REQUEST** bit asserted, with bits EOM or DATA_READY set to 0. In this state, the target waits for the EOM signal from the controller; if any other conditions are set, it is a fault condition and the handler must log the fault and revert to the idle condition

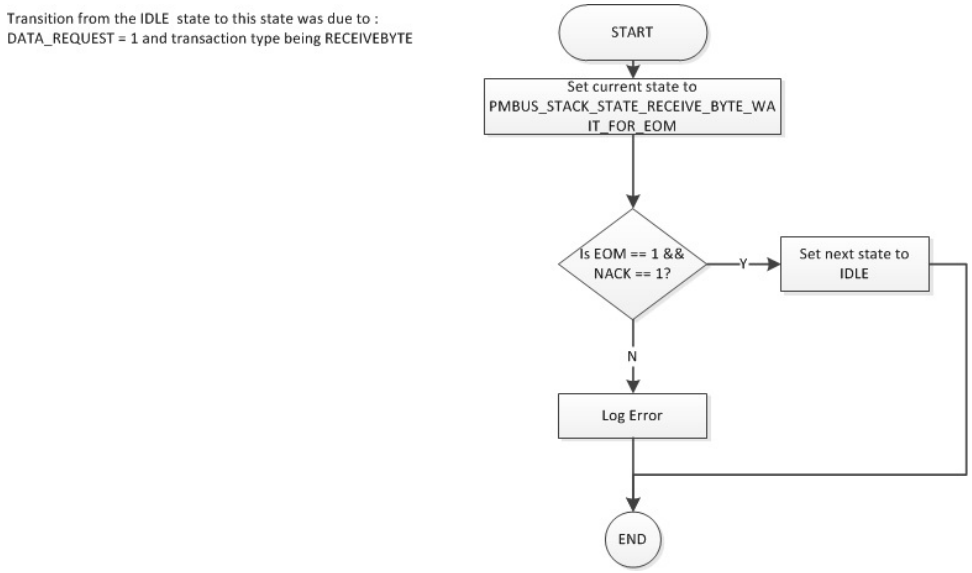

Figure 5.18: The Receive Byte and Wait for End-of-Message State

5.3.3 The Read Block State

The state machine transitions into the Read Block state (from the idle state) once it determines that the current transaction type (command) is a Read Block request from the controller. The controller follows up with a repeated start and the target's address followed by the read bit; at this point the **DATA_REQUEST** status bit is asserted at the target end, and its state machine calls the Read Block sub-handler. The target continues to remain in this state until it transmits all its data to the controller. The controller terminates the transaction by issuing a NACK on the bus line.

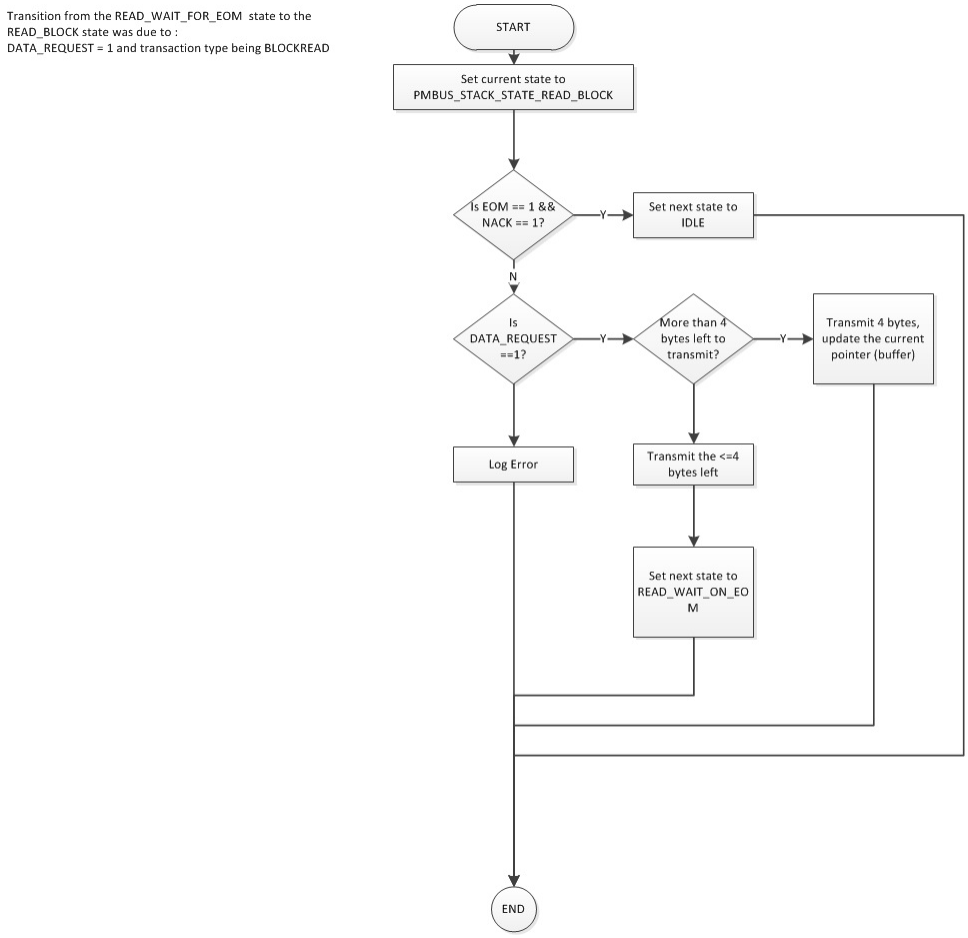

Figure 5.19: The Read Block State

5.3.4 The Read and Wait for End-of-Message State

The state machine transitions to this state from two other states, the idle state when **RD_BYTE_COUNT** and **DATA_READY** are set to 1 in the status register, or from the Read Block state when all but the last (less than or equal to 4) bytes are pending transmission. The state machine lingers in this state till the controller issues a NACK on the line (**EOM = 1**) terminating the read transaction.

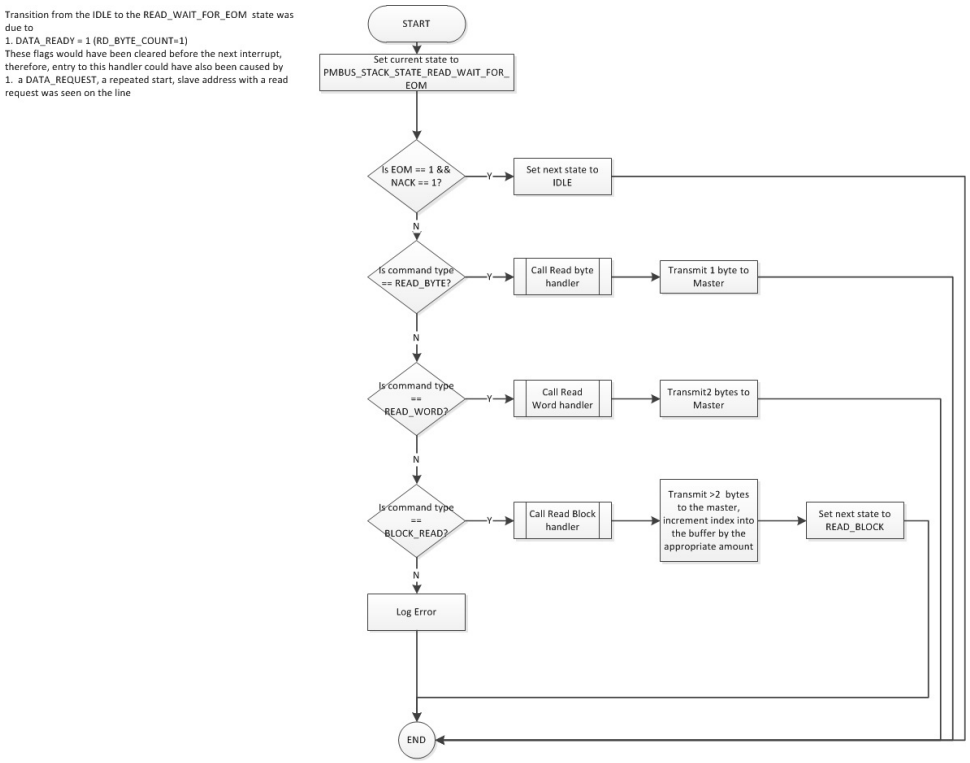

Figure 5.20: The Read and Wait for End-of-Message State

5.3.5 The Block Write or Process Call State

When the controller issues a Block Write (or Block Write/ Read/ Process Call) command, the target state machine will transition from the Idle to the Block Write state. This state handles both Block Writes and Write Word commands. The state machine remains in this state till the controller completes sending all its bytes, and returns to the idle state when an End-of-Message signal (with not transmitted bytes) is received.

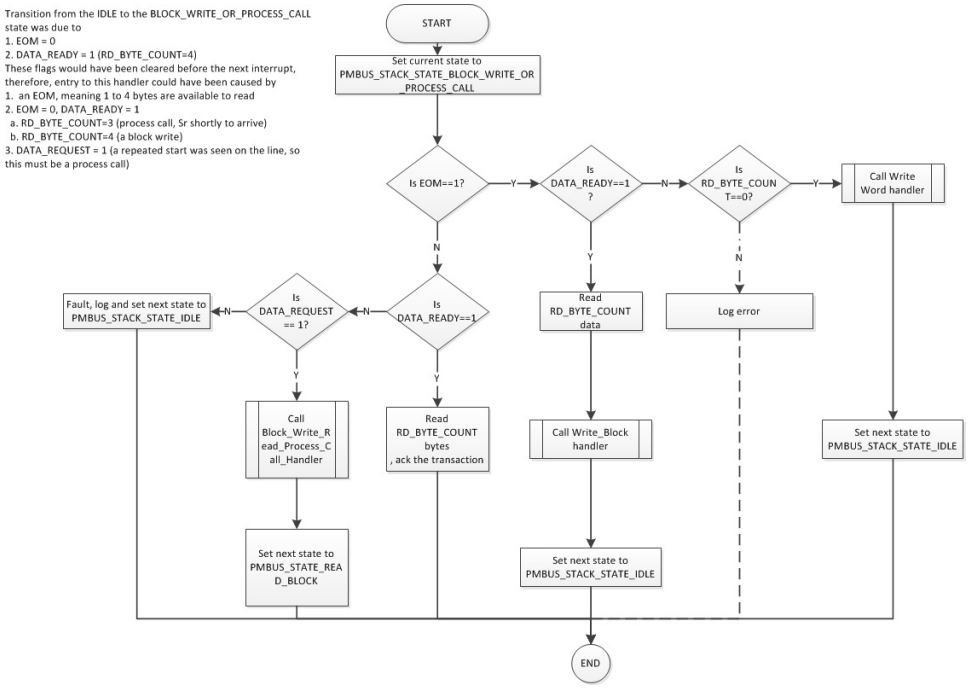

Figure 5.21: The Block Write or Process Call State

5.3.6 The Extended Command State

When the controller issues an Extended Read/Write Byte/Word command, the target state machine will transition from the Idle to the Extended Command state. The target transition to this state, from idle, when the controller issues a repeated start, and only if the first byte sent (during the write phase) was the extension command byte. In the extended command state, the target determines if the command (the second byte sent during the write phase) was a read or write command, and accordingly proceeds to call the read byte/word handler (for an extended read transaction) or the write byte/word handler (extended write).

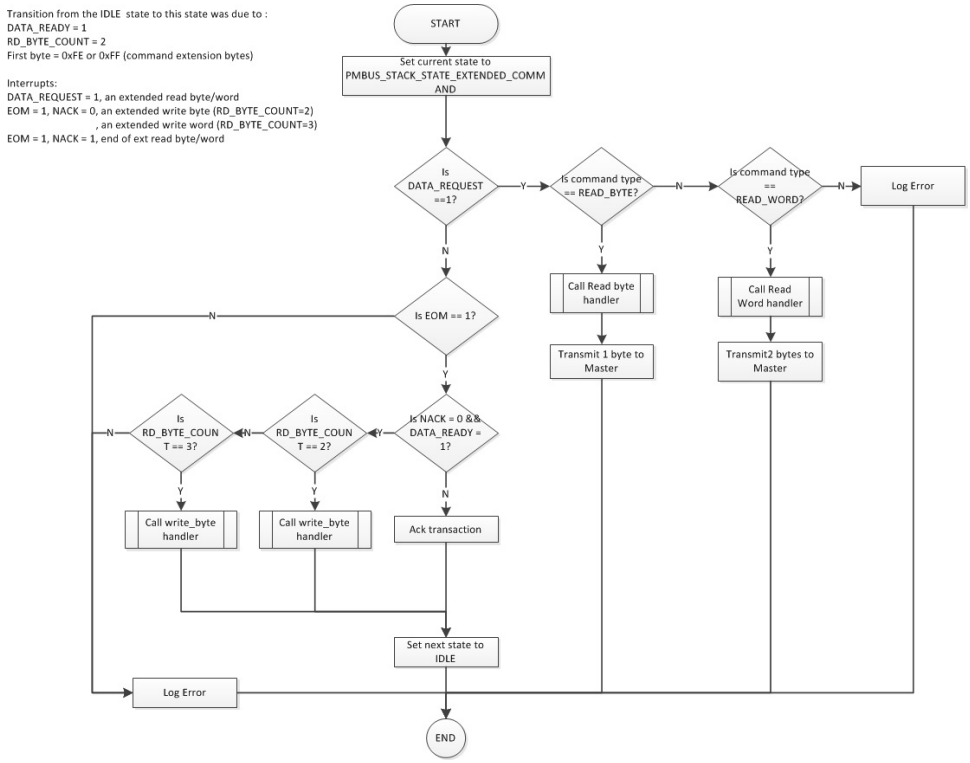

Figure 5.22: The Extended Command State

6 PMBus Communications Target Stack APIs

6.1 Code Development with Assertion

Functions

- static void PMBusStack_assertionFailed (int16_t file, int16_t line)

Variables

- void(∗) PMBusStack_errorHandler (void)

6.1.1 Function Documentation

6.1.1.1 PMBusStack_assertionFailed

Handles failed assertions

Prototype:

```
static void
PMBusStack_assertionFailed(int16_t file,
                           int16_t line) [inline, static]
```

Parameters:

file is the file number where the assertion failed

line is the line number where the assertion failed

Description:

This function handles any failed assertions within the stack library.

Returns:

None.

6.1.2 Variable Documentation

6.1.2.1 PMBusStack_errorHandler

Definition:

```
void(*) PMBusStack_errorHandler (void)
```

Description:

Error Handler Function Pointer

In the *Release* Mode, the user must define an error handler, and assign it to this function pointer which gets called when PMBUS_STACK_ASSERT fails in the state machine.

Note:

If the library was built in debug mode, i.e. the macro **_DEBUG** defined then it is unnecessary for the user to define this function in their project. It is only required when using the release version of the library; failure to define this will result in a linker error

Returns:
none

6.2 PMBus Configuration

Data Structures

- PMBus_StackObject
- PMBus_TransactionObject
- PMBus_TransactionObjectUnion

Enumerations

- PMBus_StackMode
- PMBus_StackState

Functions

- int32_t PMBusStack_defaultTransactionHandler (PMBus_StackHandle handle)
- bool PMBusStack_initModule (PMBus_StackHandle handle, const uint32_t moduleBase, uint16_t *buffer)
- static uint16_t * PMBusStackObject_getBufferPointer (PMBus_StackHandle handle)
- static uint16_t * PMBusStackObject_getCurrentPositionPointer (PMBus_StackHandle handle)
- static PMBus_StackState PMBusStackObject_getCurrentState (PMBus_StackHandle handle)
- static PMBus_StackMode PMBusStackObject_getMode (PMBus_StackHandle handle)
- static uint32_t PMBusStackObject_getModuleBase (PMBus_StackHandle handle)
- static uint32_t PMBusStackObject_getModuleStatus (PMBus_StackHandle handle)
- static PMBus_StackState PMBusStackObject_getNextState (PMBus_StackHandle handle)
- static uint16_t PMBusStackObject_getNumOfBytes (PMBus_StackHandle handle)
- static uint16_t PMBusStackObject_getTargetAddress (PMBus_StackHandle handle)
- static uint16_t PMBusStackObject_getTargetAddressMask (PMBus_StackHandle handle)
- static transactionHandler PMBusStackObject_getTransactionHandler (PMBus_StackHandle handle, const PMBus_Transaction transaction)
- static PMBus_Transaction PMBusStackObject_getTransactionType (PMBus_StackHandle handle)
- static bool PMBusStackObject_isCommandAndTransactionValid (const uint16_t command, const PMBus_Transaction transaction)
- static bool PMBusStackObject_isPECValid (PMBus_StackHandle handle)
- static void PMBusStackObject_setBufferPointer (PMBus_StackHandle handle, uint16_t *buffer)
- static void PMBusStackObject_setCurrentPositionPointer (PMBus_StackHandle handle, uint16_t *currentPointer)
- static void PMBusStackObject_setCurrentState (PMBus_StackHandle handle, const PMBus_StackState state)
- static void PMBusStackObject_setMode (PMBus_StackHandle handle, const PMBus_StackMode mode)
- static void PMBusStackObject_setModuleBase (PMBus_StackHandle handle, const uint32_t address)

- static void PMBusStackObject_setModuleStatus (PMBus_StackHandle handle, const uint32_t status)
- static void PMBusStackObject_setNextState (PMBus_StackHandle handle, const PMBus_StackState state)
- static void PMBusStackObject_setNumOfBytes (PMBus_StackHandle handle, const uint16_t numberOfBytes)
- static void PMBusStackObject_setPECValidity (PMBus_StackHandle handle, const bool validity)
- static void PMBusStackObject_setTargetAddress (PMBus_StackHandle handle, const uint16_t address)
- static void PMBusStackObject_setTargetAddressMask (PMBus_StackHandle handle, const uint16_t addressMask)
- static void PMBusStackObject_setTransactionHandler (PMBus_StackHandle handle, const PMBus_Transaction transaction, transactionHandler handler)
- static void PMBusStackObject_setTransactionType (PMBus_StackHandle handle, const PMBus_Transaction transaction)

Variables

- static const PMBus_TransactionObjectUnion PMBusStack_commandTransactionMap[64]
- PMBus_StackObject pmbusStackTarget
- PMBus_StackHandle pmbusStackTargetHandle

6.2.1 Data Structure Documentation

6.2.1.1 PMBus_StackObject

Definition:

```
typedef struct
{
    uint32_t moduleBase;
    uint32_t moduleStatus;
    PMBus_StackMode mode;
    uint16_t targetAddress;
    uint16_t targetAddressMask;
    PMBus_StackState currentState;
    PMBus_StackState nextState;
    uint16_t *bufferPointer;
    uint16_t *currentBufferPointer;
    uint16_t numOfBytes;
    bool PECValidity;
    PMBus_Transaction transaction;
    uint16_t *CRCBufferPointer;
    uint16_t CRCBufferSize;
    uint32_t timerBase;
    uint32_t timeout;
    transactionHandler transactionHandle[NTRANSACTIONS];
}
PMBus_StackObject
```

Members:

moduleBase Base address of the PMBus module.
moduleStatus Status register of the PMBus module.
mode PMBus mode of operation.
targetAddress Target address for the PMBus module.
targetAddressMask Target address mask for PMBus module.
currentState Current state of the state machine.
nextState next state of the state machine
bufferPointer pointer to a buffer of length >= 4
currentBufferPointer Current position in the buffer.
numOfBytes Number of bytes sent/received.
PECValidity Valid PEC received or sent.
transaction Current Transaction type.
CRCBufferPointer Pointer to CRC Buffer.
CRCBufferSize CRC Buffer Size.
timerBase Indicates which CPU Timer base for timeout feature (PMBus over I2c).
timeout Indicates the timeout value (PMBus over I2c).
transactionHandle Handler for each transaction.

Description:

PMBUS Target Mode Object.

6.2.1.2 PMBus_TransactionObject

Definition:

```
typedef struct
{
    uint16_t transaction0;
    uint16_t transaction1;
    uint16_t transaction2;
    uint16_t transaction3;
}
PMBus_TransactionObject
```

Members:

transaction0 First Transaction field.
transaction1 Second Transaction field.
transaction2 Third Transaction field.
transaction3 Fourth Transaction field.

Description:

Structure that packs 4 transaction fields into a word.

6.2.1.3 PMBus_TransactionObjectUnion

Definition:

```
typedef struct
{
    PMBus_TransactionObject object;
```

```
    uint16_t transactionField;
}
PMBus_TransactionObjectUnion
```

Members:

object

transactionField

Description:

Union of the packed transactions struct and an unsigned word.

6.2.2 Enumeration Documentation

6.2.2.1 PMBus_StackMode

Description:

PMBus Mode of Operation.

Enumerators:

PMBUS_STACK_MODE_TARGET PMBus operates in target mode.

PMBUS_STACK_MODE_CONTROLLER PMBus operates in controller mode.

6.2.2.2 PMBus_StackState

Description:

Enumeration of the states in the PMBus state machine.

Enumerators:

PMBUS_STACK_STATE_IDLE PMBus in the Idle state.

PMBUS_STACK_STATE_RECEIVE_BYTE_WAIT_FOR_EOM PMBus is waiting on an end-of-message signal (NACK on last data).

PMBUS_STACK_STATE_READ_BLOCK PMBus is reading a block of data.

PMBUS_STACK_STATE_READ_WAIT_FOR_EOM PMBus is waiting on an end-of-message signal (NACK on last data).

PMBUS_STACK_STATE_BLOCK_WRITE_OR_PROCESS_CALL PMBus is either writing a block or issuing a process call.

PMBUS_STACK_STATE_EXTENDED_COMMAND PMBus is doing an extended read/write byte/word.

6.2.3 Function Documentation

6.2.3.1 PMBusStack_defaultTransactionHandler

Default Transaction Handler

Prototype:

```
int32_t
PMBusStack_defaultTransactionHandler(PMBus_StackHandle handle)
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function is the default transaction handler. Default behavior is to call PMBusStack_assertionFailed().

Returns:
If function returns, always returns value of -1.

6.2.3.2 PMBusStack_initModule

Initialize the PMBus Module

Prototype:
```
bool
PMBusStack_initModule(PMBus_StackHandle handle,
                      const uint32_t moduleBase,
                      uint16_t *buffer)
```

Parameters:
handle is the handle to the PMBus stack object
moduleBase is the base address for the PMBus peripheral instance
buffer is the buffer pointer for use by the PMBus stack object

Description:
This function initializes the PMBus peripheral (based on mode set in the PMBus stack object) for target or controller mode, assigns the buffer pointer to the PMBus stack object, and enables interrupts.

Note:
This function enables the PMBus interrupts but the user must register the necessary interrupt service routine handler and configure the ISR to call the required library handler

The buffer must point to an array of at least 4 words

Returns:
Returns **true** if initialization is successful and **false** when initialization isn't successful.

6.2.3.3 PMBusStackObject_getBufferPointer

Get PMBus Module Buffer Pointer

Prototype:
```
static uint16_t *
PMBusStackObject_getBufferPointer(PMBus_StackHandle handle) [inline,
static]
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function gets the PMBus module pointer to the buffer that stores messages from the PMBus stack object.

Returns:
Buffer pointer

6.2.3.4 PMBusStackObject_getCurrentPositionPointer

Get PMBus Module Current Buffer Position Pointer

Prototype:
```
static uint16_t *
PMBusStackObject_getCurrentPositionPointer(PMBus_StackHandle handle)
[inline, static]
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function gets the PMBus module pointer to the current position in the buffer from the PMBus stack object.

Returns:
Current buffer pointer.

6.2.3.5 PMBusStackObject_getCurrentState

Get PMBus Module Current State

Prototype:
```
static PMBus_StackState
PMBusStackObject_getCurrentState(PMBus_StackHandle handle) [inline,
static]
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function gets the PMBus module current state of the state machine from the PMBus stack object.

Returns:
Current State

- PMBUS_STACK_STATE_IDLE : Idle State
- PMBUS_STACK_STATE_RECEIVE_BYTE_WAIT_FOR_EOM : Waiting on end-of-message signal state
- PMBUS_STACK_STATE_READ_BLOCK : Reading a block of data state
- PMBUS_STACK_STATE_READ_WAIT_FOR_EOM : Waiting on end-of-message signal
- PMBUS_STACK_STATE_BLOCK_WRITE_OR_PROCESS_CALL : Writing a block or issuing a process call state
- PMBUS_STACK_STATE_EXTENDED_COMMAND : Extended read/write byte/word state

6.2.3.6 PMBusStackObject_getMode

Get PMBus Module Mode

Prototype:

```
static PMBus_StackMode
PMBusStackObject_getMode(PMBus_StackHandle handle) [inline, static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function gets the PMBus module instance operating mode from the PMBus stack object.

Returns:

PMBUS_STACK_MODE_TARGET or PMBUS_STACK_MODE_CONTROLLER

6.2.3.7 PMBusStackObject_getModuleBase

Get PMBus Module Base Address

Prototype:

```
static uint32_t
PMBusStackObject_getModuleBase(PMBus_StackHandle handle) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function gets the PMBus module instance base address from the PMBus stack object.

Returns:

PMBus module instance base address

6.2.3.8 PMBusStackObject_getModuleStatus

Get PMBus Module Status

Prototype:

```
static uint32_t
PMBusStackObject_getModuleStatus(PMBus_StackHandle handle) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function gets the PMBus module instance status value from the PMBus stack object.

Returns:

Module status

6.2.3.9 PMBusStackObject_getNextState

Get PMBus Module Next State

Prototype:

```
static PMBus_StackState
PMBusStackObject_getNextState(PMBus_StackHandle handle) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function gets the PMBus module next state of the state machine from the PMBus stack object.

Returns:

Next State

- PMBUS_STACK_STATE_IDLE : Idle State
- PMBUS_STACK_STATE_RECEIVE_BYTE_WAIT_FOR_EOM : Waiting on end-of-message signal state
- PMBUS_STACK_STATE_READ_BLOCK : Reading a block of data state
- PMBUS_STACK_STATE_READ_WAIT_FOR_EOM : Waiting on end-of-message signal
- PMBUS_STACK_STATE_BLOCK_WRITE_OR_PROCESS_CALL : Writing a block or issuing a process call state
- PMBUS_STACK_STATE_EXTENDED_COMMAND : Extended read/write byte/word state

6.2.3.10 PMBusStackObject_getNumOfBytes

Get PMBus Module Number of Bytes

Prototype:

```
static uint16_t
PMBusStackObject_getNumOfBytes(PMBus_StackHandle handle) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function gets the PMBus module number of bytes being sent or received from the PMBus stack object.

Returns:

Number of bytes

6.2.3.11 PMBusStackObject_getTargetAddress

Get PMBus Module Target Address

Prototype:

```
static uint16_t
PMBusStackObject_getTargetAddress(PMBus_StackHandle handle) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This functions gets the PMBus module instance target address from the PMBus stack object

Returns:

Target address

6.2.3.12 PMBusStackObject_getTargetAddressMask

Get PMBus Module Target Address Mask

Prototype:

```
static uint16_t
PMBusStackObject_getTargetAddressMask(PMBus_StackHandle handle)
[inline, static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function gets the PMBus module instance target address mask from the PMBus stack object.

Returns:

Target address mask

6.2.3.13 PMBusStackObject_getTransactionHandler

Get PMBus Module Transaction Handler

Prototype:

```
static transactionHandler
PMBusStackObject_getTransactionHandler(PMBus_StackHandle handle,
                                       const PMBus_Transaction
transaction) [inline, static]
```

Parameters:

handle is the handle to the PMBus stack object

transaction is the PMBus transaction type

Description:

This function gets the PMBus module transaction handler function for a specific transaction type from the PMBus stack object. Transactions include:

- PMBUS_TRANSACTION_NONE

- PMBUS_TRANSACTION_QUICKCOMMAND
- PMBUS_TRANSACTION_WRITEBYTE
- PMBUS_TRANSACTION_READBYTE
- PMBUS_TRANSACTION_SENDBYTE
- PMBUS_TRANSACTION_RECEIVEBYTE
- PMBUS_TRANSACTION_BLOCKWRITE
- PMBUS_TRANSACTION_BLOCKREAD
- PMBUS_TRANSACTION_WRITEWORD
- PMBUS_TRANSACTION_READWORD
- PMBUS_TRANSACTION_BLOCKWRPC

Returns:
Pointer to transaction function handler

6.2.3.14 PMBusStackObject_getTransactionType

Get PMBus Module Transaction Type

Prototype:

```
static PMBus_Transaction
PMBusStackObject_getTransactionType(PMBus_StackHandle handle)
[inline, static]
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function gets the PMBus module transaction type from the PMBus stack object.

Returns:
Transaction type

- PMBUS_TRANSACTION_NONE
- PMBUS_TRANSACTION_QUICKCOMMAND
- PMBUS_TRANSACTION_WRITEBYTE
- PMBUS_TRANSACTION_READBYTE
- PMBUS_TRANSACTION_SENDBYTE
- PMBUS_TRANSACTION_RECEIVEBYTE
- PMBUS_TRANSACTION_BLOCKWRITE
- PMBUS_TRANSACTION_BLOCKREAD
- PMBUS_TRANSACTION_WRITEWORD
- PMBUS_TRANSACTION_READWORD
- PMBUS_TRANSACTION_BLOCKWRPC

6.2.3.15 PMBusStackObject_isCommandAndTransactionValid [static]

Check if the PMBus Command and Transaction Type are Valid

Prototype:

```
static bool
PMBusStackObject_isCommandAndTransactionValid(const uint16_t command,
                                              const PMBus_Transaction
transaction)
```

Parameters:

handle is the handle to the PMBus stack object

transaction is the PMBus transaction type

Description:

This function will query the PMBus command transaction mapping for the given command to see if it can find a match for the given transaction type.

Returns:

- **true** if the command and transaction match (and therefore valid)
- **false** if the command and transaction don't match

6.2.3.16 PMBusStackObject_isPECValid

Get PMBus Module Packet Error Checking (PEC) Validity

Prototype:

```
static bool
PMBusStackObject_isPECValid(PMBus_StackHandle handle) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function gets the PMBus module PEC validity status (either valid or invalid) from the PMBus stack object.

Returns:

Returns **true** if PEC is valid and **false** if PEC is invalid

6.2.3.17 PMBusStackObject_setBufferPointer

Set PMBus Module Buffer Pointer

Prototype:

```
static void
PMBusStackObject_setBufferPointer(PMBus_StackHandle handle,
                                  uint16_t *buffer) [inline, static]
```

Parameters:

handle is the handle to the PMBus stack object

buffer is the pointer to the buffer (must be buffer of size >= 4)

Description:

This function sets the PMBus module pointer to the buffer that stores messages in the PMBus stack object.

Returns:
None.

6.2.3.18 PMBusStackObject_setCurrentPositionPointer

Set PMBus Module Current Buffer Position Pointer

Prototype:

```
static void
PMBusStackObject_setCurrentPositionPointer(PMBus_StackHandle handle,
                                           uint16_t *currentPointer)
[inline, static]
```

Parameters:
handle is the handle to the PMBus stack object
currentPointer is the pointer to the current position in the buffer

Description:
This function sets the PMBus module pointer to the current position in the buffer in the PMBus stack object.

Returns:
None.

6.2.3.19 PMBusStackObject_setCurrentState

Set PMBus Module Current State

Prototype:

```
static void
PMBusStackObject_setCurrentState(PMBus_StackHandle handle,
                                 const PMBus_StackState state)
[inline, static]
```

Parameters:
handle is the handle to the PMBus stack object
state is the current state of the PMBus state machine

Description:
This function sets the PMBus module current state of the state machine in the PMBus stack object. States include:

- PMBUS_STACK_STATE_IDLE : Idle State
- PMBUS_STACK_STATE_RECEIVE_BYTE_WAIT_FOR_EOM : Waiting on end-of-message signal state
- PMBUS_STACK_STATE_READ_BLOCK : Reading a block of data state
- PMBUS_STACK_STATE_READ_WAIT_FOR_EOM : Waiting on end-of-message signal
- PMBUS_STACK_STATE_BLOCK_WRITE_OR_PROCESS_CALL : Writing a block or issuing a process call state
- PMBUS_STACK_STATE_EXTENDED_COMMAND : Extended read/write byte/word state

Returns:
None.

6.2.3.20 PMBusStackObject_setMode

Set PMBus Module Mode

Prototype:

```
static void
PMBusStackObject_setMode(PMBus_StackHandle handle,
                         const PMBus_StackMode mode) [inline, static]
```

Parameters:

handle is the handle to the PMBus stack object

mode is the PMBus module mode (either target or controller)

Description:

This function sets the PMBus module instance operating mode (controller or target) in the PMBus stack object.

Returns:

None.

6.2.3.21 PMBusStackObject_setModuleBase

Set PMBus Module Base Address

Prototype:

```
static void
PMBusStackObject_setModuleBase(PMBus_StackHandle handle,
                               const uint32_t address) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

address is the base address for the PMBus peripheral instance

Description:

This function sets the PMBus module instance base address in the PMBus stack object.

Returns:

None.

6.2.3.22 PMBusStackObject_setModuleStatus

Set PMBus Module Status

Prototype:

```
static void
PMBusStackObject_setModuleStatus(PMBus_StackHandle handle,
                                 const uint32_t status) [inline,
static]
```

Parameters:

handle is the handle to the PMBus stack object

status is the PMBus module instance register status

Description:
This function sets the PMBus module instance register status in the PMBus stack object.

Returns:
None.

6.2.3.23 PMBusStackObject_setNextState

Set PMBus Module Next State

Prototype:

```
static void
PMBusStackObject_setNextState(PMBus_StackHandle handle,
                              const PMBus_StackState state) [inline,
static]
```

Parameters:
handle is the handle to the PMBus stack object
state is the next state of the PMBus state machine

Description:
This function sets the PMBus module next state of the state machine in the PMBus stack object. States include:

- PMBUS_STACK_STATE_IDLE : Idle State
- PMBUS_STACK_STATE_RECEIVE_BYTE_WAIT_FOR_EOM : Waiting on end-of-message signal state
- PMBUS_STACK_STATE_READ_BLOCK : Reading a block of data state
- PMBUS_STACK_STATE_READ_WAIT_FOR_EOM : Waiting on end-of-message signal
- PMBUS_STACK_STATE_BLOCK_WRITE_OR_PROCESS_CALL : Writing a block or issuing a process call state
- PMBUS_STACK_STATE_EXTENDED_COMMAND : Extended read/write byte/word state

Returns:
None.

6.2.3.24 PMBusStackObject_setNumOfBytes

Set PMBus Module Number of Bytes

Prototype:

```
static void
PMBusStackObject_setNumOfBytes(PMBus_StackHandle handle,
                               const uint16_t numberOfBytes) [inline,
static]
```

Parameters:
handle is the handle to the PMBus stack object
numberOfBytes is the number of bytes sent/received

Description:
This function sets the PMBus module number of bytes being sent or received in the PMBus stack object.

Returns:
None.

6.2.3.25 PMBusStackObject_setPECValidity

Set PMBus Module Packet Error Checking (PEC) Validity

Prototype:

```
static void
PMBusStackObject_setPECValidity(PMBus_StackHandle handle,
                                const bool validity) [inline, static]
```

Parameters:
handle is the handle to the PMBus stack object
validity is the PEC validity status (true = PEC is valid, false = PEC is invalid)

Description:
This function sets the PMBus module PEC validity status (either valid or invalid) in the PMBus stack object.

Returns:
None.

6.2.3.26 PMBusStackObject_setTargetAddress

Set PMBus Module Target Address

Prototype:

```
static void
PMBusStackObject_setTargetAddress(PMBus_StackHandle handle,
                                  const uint16_t address) [inline,
static]
```

Parameters:
handle is the handle to the PMBus stack object
address is the address of the PMBus module in target mode

Description:
This function sets the PMBus module instance target address in the PMBus stack object.

Returns:
None.

6.2.3.27 PMBusStackObject_setTargetAddressMask

Set PMBus Module Target Address Mask

Prototype:

```
static void
PMBusStackObject_setTargetAddressMask(PMBus_StackHandle handle,
                                      const uint16_t addressMask)
[inline, static]
```

Parameters:

handle is the handle to the PMBus stack object

addressMask is the address mask of the PMBus module in target mode

Description:

This function sets the PMBus module instance target address mask in the PMBus stack object.

Returns:

None.

6.2.3.28 PMBusStackObject_setTransactionHandler

Set PMBus Module Transaction Handler

Prototype:

```
static void
PMBusStackObject_setTransactionHandler(PMBus_StackHandle handle,
                                       const PMBus_Transaction
transaction,
                                       transactionHandler handler)
[inline, static]
```

Parameters:

handle is the handle to the PMBus stack object

transaction is the PMBus transaction type

handler is the pointer to the function to handle the transaction

Description:

This function sets the PMBus module transaction handler function for a specific transaction type in the PMBus stack object. Transactions include:

- PMBUS_TRANSACTION_NONE
- PMBUS_TRANSACTION_QUICKCOMMAND
- PMBUS_TRANSACTION_WRITEBYTE
- PMBUS_TRANSACTION_READBYTE
- PMBUS_TRANSACTION_SENDBYTE
- PMBUS_TRANSACTION_RECEIVEBYTE
- PMBUS_TRANSACTION_BLOCKWRITE
- PMBUS_TRANSACTION_BLOCKREAD
- PMBUS_TRANSACTION_WRITEWORD
- PMBUS_TRANSACTION_READWORD

- PMBUS_TRANSACTION_BLOCKWRPC

Returns:
None.

6.2.3.29 PMBusStackObject_setTransactionType

Set PMBus Module Transaction Type

Prototype:

```
static void
PMBusStackObject_setTransactionType(PMBus_StackHandle handle,
                                    const PMBus_Transaction
transaction) [inline, static]
```

Parameters:
handle is the handle to the PMBus stack object
transaction is the PMBus transaction type

Description:
This function sets the PMBus module transaction type in the PMBus stack object. Transactions include:

- PMBUS_TRANSACTION_NONE
- PMBUS_TRANSACTION_QUICKCOMMAND
- PMBUS_TRANSACTION_WRITEBYTE
- PMBUS_TRANSACTION_READBYTE
- PMBUS_TRANSACTION_SENDBYTE
- PMBUS_TRANSACTION_RECEIVEBYTE
- PMBUS_TRANSACTION_BLOCKWRITE
- PMBUS_TRANSACTION_BLOCKREAD
- PMBUS_TRANSACTION_WRITEWORD
- PMBUS_TRANSACTION_READWORD
- PMBUS_TRANSACTION_BLOCKWRPC

Returns:
None.

6.2.4 Variable Documentation

6.2.4.1 PMBusStack_commandTransactionMap [static]

Definition:

```
static const PMBus_TransactionObjectUnion PMBusStack_commandTransactionMap[64]
```

Description:
PMBus Command Transaction Type Map

Each position in the map corresponds to a particular command, its entry lists the type of read transaction that is involved. It will used to distinguish between read byte, read word, and block read commands in the state machine

Any command that has both a write and read command will have the read transaction type as its entry. A command without a read command will have its write transaction type as its entry

6.2.4.2 pmbusStackTarget

Definition:

```
PMBus_StackObject pmbusStackTarget
```

Description:

PMBus Target Object.

6.2.4.3 pmbusStackTargetHandle

Definition:

```
PMBus_StackHandle pmbusStackTargetHandle
```

Description:

Handle to the target object.

6.3 PMBus State Machine Handler

Functions

- void PMBusStack_targetBlockWriteOrProcessCallStateHandler (PMBus_StackHandle handle)
- void PMBusStack_targetExtendedCommandStateHandler (PMBus_StackHandle handle)
- void PMBusStack_targetIdleStateHandler (PMBus_StackHandle handle)
- void PMBusStack_targetReadBlockStateHandler (PMBus_StackHandle handle)
- void PMBusStack_targetReadWaitForEOMStateHandler (PMBus_StackHandle handle)
- void PMBusStack_targetReceiveByteWaitForEOMStateHandler (PMBus_StackHandle handle)
- void PMBusStack_targetStateHandler (PMBus_StackHandle handle)

6.3.1 Function Documentation

6.3.1.1 PMBusStack_targetBlockWriteOrProcessCallStateHandler

PMBus Target Block Write or Process Call State Handler

Prototype:

```
void
PMBusStack_targetBlockWriteOrProcessCallStateHandler(PMBus_StackHandle
handle)
```

Parameters:

handle is the handle to the PMBus stack object

Description:

This function handles the state in the target state machine that is entered when a block write or process call commands are used.

Returns:

None.

6.3.1.2 PMBusStack_targetExtendedCommandStateHandler

PMBus Target Extended Read/Write Byte/Word State Handler

Prototype:

```
void
PMBusStack_targetExtendedCommandStateHandler(PMBus_StackHandle
handle)
```

Parameters:

handle is the handle to the PMBus stack object

Description:
This function handles the state in the target state machine that is entered when extended commands are used. These include extended read byte, read word, write byte, and write word transactions.

Returns:
None.

6.3.1.3 PMBusStack_targetIdleStateHandler

PMBus Target Idle State Handler

Prototype:
```
void
PMBusStack_targetIdleStateHandler(PMBus_StackHandle handle)
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function handles the idle state in the target state machine.

Returns:
None.

6.3.1.4 PMBusStack_targetReadBlockStateHandler

PMBus Target Read Block State Handler

Prototype:
```
void
PMBusStack_targetReadBlockStateHandler(PMBus_StackHandle handle)
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function handles the state in the target state machine that is entered when a read block command is used.

Returns:
None.

6.3.1.5 PMBusStack_targetReadWaitForEOMStateHandler

PMBus Target Read/Wait for EOM State Handler

Prototype:
```
void
PMBusStack_targetReadWaitForEOMStateHandler(PMBus_StackHandle handle)
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function handles the state in the target state machine that is entered when reading/waiting for the end-of-message.

Returns:
None.

6.3.1.6 PMBusStack_targetReceiveByteWaitForEOMStateHandler

PMBus Target Receive Byte Wait-for-EOM State Handler

Prototype:
```
void
PMBusStack_targetReceiveByteWaitForEOMStateHandler(PMBus_StackHandle
handle)
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function handles the state in the target state machine that is entered when a receive byte request is active and target is waiting for end-of-message.

Returns:
None.

6.3.1.7 PMBusStack_targetStateHandler

PMBus Target Stack State Machine Handler

Prototype:
```
void
PMBusStack_targetStateHandler(PMBus_StackHandle handle)
```

Parameters:
handle is the handle to the PMBus stack object

Description:
This function implements the state machine of the PMBus in target mode. This handler is designed to operate within the PMBus interrupt service routine (ISR) triggered by the following interrupts:

- Data Ready (Read buffer is full)
- Data Request (Controller has requested data) / SDIR bit in I2C
- EOM (Controller signals an end of a block message)

Note:
The handler must be called in the PMBus ISR only

Returns:
None.

7 PMBus Over I2C Implementation

7.1 Introduction

This chapter provides details about software implementation of the PMBus protocol over I2C module on C2000 real time MCUs. The software implementation provides functions to control the underlying I2C to handle PMBus transactions allowing these layers to be abstracted so that a customer can focus on developing the application layer of the PMBus application. This software implementation runs on I2C hardware protocol which is a widespread 2-wire protocol. In this case, PMBus operates on I2C with just clock and data lines.

PMBus Specification provides a couple of features which add robustness which are important for critical systems.

- PMBus, like SMBus, implements timeout functionality. If the clock is held low for longer than the timeout interval, the devices must resetk communication within a specified period of time.

The software implenmentation also implements timeout feature using CPU Timer interrupt. To enable it ,user has to predefine the symbol TIMEOUT and recompile the PMBus communication stack library.

- An optional feature that is highly recommended to increase robustness is packet error checking (PEC). PEC checks the validity of a received packet via a cyclic redundancy check-8 (CRC-8) algorithm.

The software implementation implements PEC. This is provided as an optional feature. To enable it, user has to predefine the symbol PEC_ENABLED , include the VCRC library in the CCS project (by default it is excluded) and then recompile the PMBus communication stack library.

/∗!

7.2 Included in this release

This release includes the following

1. PMBus Communication Software Stack running over I2C supporting Target operations for below mentioned transactions

2. The stack supports PEC and timeout feature. These are optional and need to be enabled.

3. Device supported : F28003x, F28004x , F2838x and F280015x

4. Examples include a controller and target example for each of the supported devices. The controller example tests the target (which uses the communication stack library) handling of

the various PMBus commands and transactions. For e.g.: For device F28003x, refer the 28003x_pmbus_over_i2c_controller and 28003x_pmbus_over_i2c_target projects

/*!

7.3 PMBus Transactions currently supported

This code implements the physical and transport layer for the PMBus protocol. The application layer is not implemented. The following transactions are currently supported.

1. Send Byte
2. Receive Byte
3. Write Byte/Word
4. Read Byte/Word
5. Quick command
6. Process Call
7. Block Write
8. Block Read - supports reading upto 16 bytes
9. Extended Read Byte/Word
10. Extended Write Byte/Word

/*

7.4 Known deviations and/or unsupported features

Following transactions and features are currently not supported.

- Alert command
- Block read command has a limitation of reading max of 16 bytes.
- Extended Write Byte/Word Command: Supported only as defined in PMBus specification v1.0
- Address Resolution Protocol (ARP): Not supported, as this is an optional feature
- Host Notify Protocol: Not supported, as this isn't required when Alert Line is supported

/*!

7.5 PMBus over I2C Communication Stack Integration

The source code and project(s) for the library are provided. The user may create the PMBus_Over_I2C library project(s) into CCSv9 (or later) and be able to view and modify the source code for all routines. (see Fig. 7.1)

Figure 7.1: PMBus over I2C Library Project View

To begin integrating the library into your project follow these steps:

1. Import the PMBus over I2C Communication Stack Library CCS project from the pmbus_stack_over_i2c_project folder into CCS. Set the appropriate build configuration as Active depending on the device that you are using. Recompile the library. (Fig. 7.2)

   If you want to use the PEC functionality, add the pre-defined symbol 'PEC_ENABLED' to the project Properties, included the VCRC lib in the build and then recompile the library. If you want to use the timeout functionality, add the pre-defined symbol 'Timeout' to the project Properties and then recompile the library.

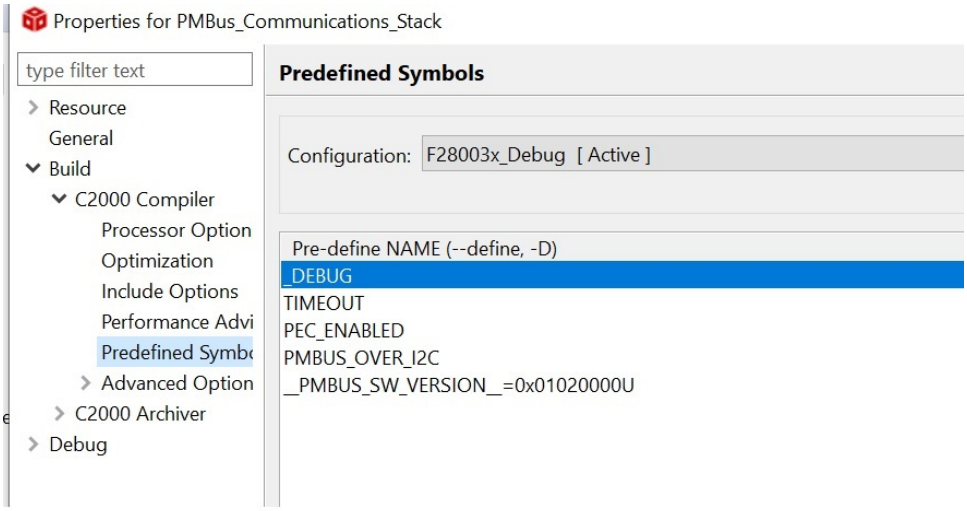

Figure 7.2: Adding predefined symbols

2. Add the Communications Stack library (replace "device" with F28002x, F28004x, F2838x, F28003x , F280015x, F28P55x) or F28P65x, **'<device>_PMBus_Communications_Stack.lib'** to the project explorer. Also add the device driver library.

7.6 PMBus over I2C Communication Stack Examples

Examples provided include a controller and target example for each of the supported devices. The controller example tests the target (which uses the communication stack library) handling of the various PMBus commands and transactions. For e.g.: For device F28003x, refer the 28003x_pmbus_over_i2c_controller and 28003x_pmbus_over_i2c_target projects

- Hardware configuration:
  Use two boards of F28003x, one will be used for controller and the other for target. Connect the I2C pins of both the boards and connect GND pins of both boards to have a common GND.
- Software configuration
  Steps :
- Controller side configuration
  Open CCS and import the following projects from the folder <C2000WareInstallDir>ş28
  a)PMBus_Communications_Stack - Import and mark the "F28003x_Debug" build configuration as Active Add "PMBUS_OVER_I2C" as a predefined symbol in the build properties
  b) Compile the project PMBus_Communications_Stack to generate the "F28003x_PMBus_Communications_Stack.lib"
  c) Import the f28003x_pmbus_over_i2c_controller_example into CCS : This is a test code for testing the PMBus transcations
  d) Compile the example project "f28003x_pmbus_over_i2c_controller_example" and load the binary file to controller

- Target side configuration

  Open one more instance of CCS and import the following projects from the folder <C2000WareInstallDir>ş8

  a)PMBus_Communications_Stack - Mark the "F28003x_Debug" build configuration as Active Add "PMBUS_OVER_I2C" as a predefined symbol in the build properties

  b)Import the f28003x_pmbus_over_i2c_target_example project into CCS: This is a test code for handling PMBus transcations

  c)Compile the example project "f28003x_pmbus_over_i2c_target_example" and load the binary file to target

- Running the example

  a) Run the target code first and then the controller code.

  b) On successful execution, the code should halt in the done() function on both controller and target devices.

  c) The global variables - pass and fail should be monitored to determine if any tests are failing.

  d) If the fail variable has a value of zero "0" , then all the tests have passed.

  e) The testcases are mentioned in the PMBUS_TESTS[NTESTS] array in the file "pmbus_over_i2c_controller_test.c".

8 PMBus Library Examples

The PMBus library includes a controller and target example set for each supported device. The controller example tests the target (which uses the communication stack) handling of the various PMBus commands and transactions. These examples have been implemented and tested on the device *controlCard* platform.

Refer to Figure 8.1 on the required pullups configuration to properly setup a PMBus connection.

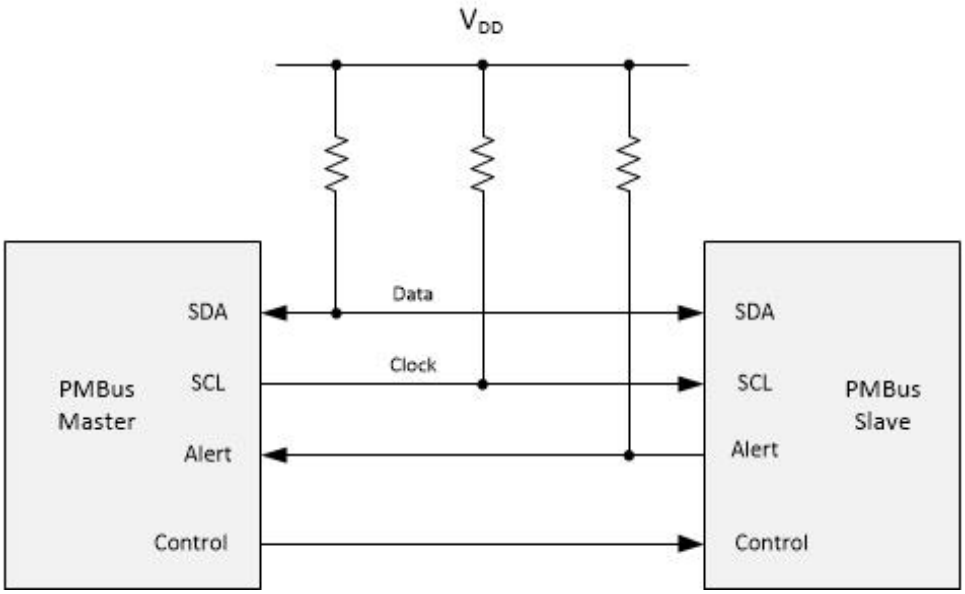

Figure 8.1: PMBus Connection Pull-Ups

8.1 PMBus Target Mode Tests

Functions

- void PMBusTarget_alertTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_blockRead3BytesTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_blockReadTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_blockWrite2BytesTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_blockWrite3BytesTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_blockWriteReadProcessCallTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_blockWriteTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_extendedReadByteTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_extendedReadWordTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_extendedWriteByteTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_extendedWriteWordTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_groupCommandTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_noAlertTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_processCallTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_quickCommandTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_readByteTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_readWordTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_receiveByteTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_sendByteTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_writeByteTestHandler (PMBus_StackHandle handle)
- void PMBusTarget_writeWordTestHandler (PMBus_StackHandle handle)

Variables

- PMBus_StackObject pmbusStackTarget
- PMBus_StackHandle pmbusStackTargetHandle

8.1.1 Function Documentation

8.1.1.1 PMBusTarget_alertTestHandler

Alert Test Handler

Prototype:

```
void
PMBusTarget_alertTestHandler(PMBus_StackHandle handle)
```

Parameters:

handle is the handle to the PMBus stack object

Note:

Expected Pass Value: 1

Returns:
None.

8.1.1.2 void PMBusTarget_blockRead3BytesTestHandler (PMBus_StackHandle *handle*)

Block Read (3 bytes) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 1

Returns:
None.

8.1.1.3 void PMBusTarget_blockReadTestHandler (PMBus_StackHandle *handle*)

Block Read (255 bytes) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 1

Returns:
None.

8.1.1.4 void PMBusTarget_blockWrite2BytesTestHandler (PMBus_StackHandle *handle*)

Block Write (2 bytes) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
An attempted block write with 1 byte is a write byte, 2 bytes a write word - the controller does not put the byte count on the line.

Make sure to run the write word test before this, as the original write word Handler overwrites the handler to point to this function.

Expected Pass Value: 6

Returns:
None.

8.1.1.5 void PMBusTarget_blockWrite3BytesTestHandler (PMBus_StackHandle *handle*)

Block Write (3 bytes) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
An attempted block write with 1 byte is a write byte, 2 bytes a write word - the controller does not put the byte count on the line.

Make sure to run the block write test before this, as the original block write handler overwrites the handler to point to this function.

Expected Pass Value: 8

Returns:
None.

8.1.1.6 void PMBusTarget_blockWriteReadProcessCallTestHandler (PMBus_StackHandle *handle*)

Block Write/Read/Process Call (255 bytes) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 259

Returns:
None.

8.1.1.7 void PMBusTarget_blockWriteTestHandler (PMBus_StackHandle *handle*)

Block Write (255 bytes) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 260

Returns:
None.

8.1.1.8 void PMBusTarget_extendedReadByteTestHandler (PMBus_StackHandle *handle*)

Extended Read Byte Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 1

Returns:
None.

8.1.1.9 void PMBusTarget_extendedReadWordTestHandler (PMBus_StackHandle *handle*)

ExtendedRead Word Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 1

Returns:
None.

8.1.1.10 void PMBusTarget_extendedWriteByteTestHandler (PMBus_StackHandle *handle*)

Extended Write Byte Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 6

Returns:
None.

8.1.1.11 void PMBusTarget_extendedWriteWordTestHandler (PMBus_StackHandle *handle*)

Extended Write Word Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 7

Returns:
None.

8.1.1.12 void PMBusTarget_groupCommandTestHandler (PMBus_StackHandle *handle*)

Group Command (target 1st addressed) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 6

Returns:
None.

8.1.1.13 void PMBusTarget_noAlertTestHandler (PMBus_StackHandle *handle*)

Alert (from 2nd target) Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
This test requires a 2nd PMBus target on the network asserting the alert line.

Expected Pass Value: 1

Returns:
None.

8.1.1.14 void PMBusTarget_processCallTestHandler (PMBus_StackHandle *handle*)

Process Call Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 5

Returns:
None.

8.1.1.15 void PMBusTarget_quickCommandTestHandler (PMBus_StackHandle *handle*)

Quick Command Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 4

Returns:
None.

8.1.1.16 void PMBusTarget_readByteTestHandler (PMBus_StackHandle *handle*)

Read Byte Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 1

Returns:
None.

8.1.1.17 void PMBusTarget_readWordTestHandler (PMBus_StackHandle *handle*)

Read Word Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 1

Returns:
None.

8.1.1.18 void PMBusTarget_receiveByteTestHandler (PMBus_StackHandle *handle*)

Receive Byte Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 1

Returns:
None.

8.1.1.19 void PMBusTarget_sendByteTestHandler (PMBus_StackHandle *handle*)

Send Byte Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 4

Returns:
None.

8.1.1.20 void PMBusTarget_writeByteTestHandler (PMBus_StackHandle *handle*)

Write Byte Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 5

Returns:
None.

8.1.1.21 void PMBusTarget_writeWordTestHandler (PMBus_StackHandle *handle*)

Write Word Test Handler

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected Pass Value: 6

Returns:
None.

8.1.2 Variable Documentation

8.1.2.1 PMBus_StackObject pmbusStackTarget

PMBus Target Object.

8.1.2.2 PMBus_StackHandle pmbusStackTargetHandle

Handle to the target object.

8.2 PMBus Controller Mode Tests

Data Structures

- PMBus_TestObject

Functions

- void PMBusController_initAlertTest (PMBus_TestHandle handle)
- void PMBusController_initBlockRead3BytesTest (PMBus_TestHandle handle)
- void PMBusController_initBlockReadTest (PMBus_TestHandle handle)
- void PMBusController_initBlockWrite2BytesTest (PMBus_TestHandle handle)
- void PMBusController_initBlockWrite3BytesTest (PMBus_TestHandle handle)
- void PMBusController_initBlockWriteReadProcessCallTest (PMBus_TestHandle handle)
- void PMBusController_initBlockWriteTest (PMBus_TestHandle handle)
- void PMBusController_initExtendedReadByteTest (PMBus_TestHandle handle)
- void PMBusController_initExtendedReadWordTest (PMBus_TestHandle handle)
- void PMBusController_initExtendedWriteByteTest (PMBus_TestHandle handle)
- void PMBusController_initExtendedWriteWordTest (PMBus_TestHandle handle)
- void PMBusController_initGroupCommandTest (PMBus_TestHandle handle)
- void PMBusController_initNoAlertTest (PMBus_TestHandle handle)
- void PMBusController_initProcessCallTest (PMBus_TestHandle handle)
- void PMBusController_initQuickCommandTest (PMBus_TestHandle handle)
- void PMBusController_initReadByteTest (PMBus_TestHandle handle)
- void PMBusController_initReadWordTest (PMBus_TestHandle handle)
- void PMBusController_initReceiveByteTest (PMBus_TestHandle handle)
- void PMBusController_initSendByteTest (PMBus_TestHandle handle)
- void PMBusController_initWriteByteTest (PMBus_TestHandle handle)
- void PMBusController_initWriteWordTest (PMBus_TestHandle handle)
- static void PMBusController_resetGlobalFlags (void)
- static void PMBusController_resetTestObject (PMBus_TestHandle handle)
- void PMBusController_runAlertTest (PMBus_TestHandle handle)
- void PMBusController_runBlockRead3BytesTest (PMBus_TestHandle handle)
- void PMBusController_runBlockReadTest (PMBus_TestHandle handle)
- void PMBusController_runBlockWrite2BytesTest (PMBus_TestHandle handle)
- void PMBusController_runBlockWrite3BytesTest (PMBus_TestHandle handle)
- void PMBusController_runBlockWriteReadProcessCallTest (PMBus_TestHandle handle)
- void PMBusController_runBlockWriteTest (PMBus_TestHandle handle)
- void PMBusController_runExtendedReadByteTest (PMBus_TestHandle handle)
- void PMBusController_runExtendedReadWordTest (PMBus_TestHandle handle)
- void PMBusController_runExtendedWriteByteTest (PMBus_TestHandle handle)
- void PMBusController_runExtendedWriteWordTest (PMBus_TestHandle handle)
- void PMBusController_runGroupCommandTest (PMBus_TestHandle handle)
- void PMBusController_runNoAlertTest (PMBus_TestHandle handle)

- void PMBusController_runProcessCallTest (PMBus_TestHandle handle)
- void PMBusController_runQuickCommandTest (PMBus_TestHandle handle)
- void PMBusController_runReadByteTest (PMBus_TestHandle handle)
- void PMBusController_runReadWordTest (PMBus_TestHandle handle)
- void PMBusController_runReceiveByteTest (PMBus_TestHandle handle)
- void PMBusController_runSendByteTest (PMBus_TestHandle handle)
- void PMBusController_runWriteByteTest (PMBus_TestHandle handle)
- void PMBusController_runWriteWordTest (PMBus_TestHandle handle)

8.2.1 Data Structure Documentation

8.2.1.1 PMBus_TestObject

Definition:

```
typedef struct
{
    uint16_t count;
    int16_t pass;
    int16_t fail;
    bool enabled;
    void (*init)(void *);
    void (*run)(void *);
}
PMBus_TestObject
```

Members:

count bytes (block transactions > 4)

pass pass metric

fail fail metric

enabled bool if this test is enabled or not

init Function pointer to test init routine.

run Function pointer to test run routine.

Description:

PMBUS_TEST structure.

8.2.2 Function Documentation

8.2.2.1 PMBusController_initAlertTest

Initialize the "Alert" Test

Prototype:

```
void
PMBusController_initAlertTest(PMBus_TestHandle handle)
```

Parameters:

handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.2 void PMBusController_initBlockRead3BytesTest (PMBus_TestHandle *handle*)

Initialize the "Block Read (3 Bytes)" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.3 void PMBusController_initBlockReadTest (PMBus_TestHandle *handle*)

Initialize the "Block Read" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.4 void PMBusController_initBlockWrite2BytesTest (PMBus_TestHandle *handle*)

Initialize the "Block Write (2 Bytes)" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.5 void PMBusController_initBlockWrite3BytesTest (PMBus_TestHandle *handle*)

Initialize the "Block Write (3 Bytes)" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.6 void PMBusController_initBlockWriteReadProcessCallTest (PMBus_TestHandle *handle*)

Initialize the "Block Write, Block Read, Process Call" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.7 void PMBusController_initBlockWriteTest (PMBus_TestHandle *handle*)

Initialize the "Block Write" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.8 void PMBusController_initExtendedReadByteTest (PMBus_TestHandle *handle*)

Initialize the "Extended Read Byte" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.9 void PMBusController_initExtendedReadWordTest (PMBus_TestHandle *handle*)

Initialize the "Extended Read Word" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.10 void PMBusController_initExtendedWriteByteTest (PMBus_TestHandle *handle*)

Initialize the "Extended Write Byte" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.11 void PMBusController_initExtendedWriteWordTest (PMBus_TestHandle *handle*)

Initialize the "Extended Write Word" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.12 void PMBusController_initGroupCommandTest (PMBus_TestHandle *handle*)

Initialize the "Group Command" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.13 void PMBusController_initNoAlertTest (PMBus_TestHandle *handle*)

Initialize the "No Alert" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.14 void PMBusController_initProcessCallTest (PMBus_TestHandle *handle*)

Initialize the "Process Call" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.15 void PMBusController_initQuickCommandTest (PMBus_TestHandle *handle*)

Initialize the "Quick Command" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.16 void PMBusController_initReadByteTest (PMBus_TestHandle *handle*)

Initialize the "Read Byte" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.17 void PMBusController_initReadWordTest (PMBus_TestHandle *handle*)

Initialize the "Read Word" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.18 void PMBusController_initReceiveByteTest (PMBus_TestHandle *handle*)

Initialize the "Receive Byte" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.19 void PMBusController_initSendByteTest (PMBus_TestHandle *handle*)

Initialize the "Send Byte" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.20 void PMBusController_initWriteByteTest (PMBus_TestHandle *handle*)

Initialize the "Write Byte" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.21 void PMBusController_initWriteWordTest (PMBus_TestHandle *handle*)

Initialize the "Write Word" Test

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.22 static void PMBusController_resetGlobalFlags (void) `[inline, static]`

Reset the global PMBus module flags

Returns:
None.

8.2.2.23 static void PMBusController_resetTestObject (PMBus_TestHandle *handle*) `[inline, static]`

Reset the PMBus Stack Object Test Statues and Counts

Parameters:
handle is the handle to the PMBus stack object

Returns:
None.

8.2.2.24 void PMBusController_runAlertTest (PMBus_TestHandle *handle*)

Run the "Alert" Response Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 4

Returns:
None.

8.2.2.25 void PMBusController_runBlockRead3BytesTest (PMBus_TestHandle *handle*)

Run the "Block Read (3 Bytes)" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 6

Returns:
None.

8.2.2.26 void PMBusController_runBlockReadTest (PMBus_TestHandle *handle*)

Run the "Block Read" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 258

Returns:
None.

8.2.2.27 void PMBusController_runBlockWrite2BytesTest (PMBus_TestHandle *handle*)

Run the "Block Write (2 Bytes)" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.28 void PMBusController_runBlockWrite3BytesTest (PMBus_TestHandle *handle*)

Run the "Block Write (3 Bytes)" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.29 void PMBusController_runBlockWriteReadProcessCallTest (PMBus_TestHandle *handle*)

Run the "Block Write, Block Read, Process Call" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 258

Returns:
None.

8.2.2.30 void PMBusController_runBlockWriteTest (PMBus_TestHandle *handle*)

Run the "Block Write" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.31 void PMBusController_runExtendedReadByteTest (PMBus_TestHandle *handle*)

Run the "Extended Read Byte" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 3

Returns:
None.

8.2.2.32 void PMBusController_runExtendedReadWordTest (PMBus_TestHandle *handle*)

Run the "Extended Read Word" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 4

Returns:
None.

8.2.2.33 void PMBusController_runExtendedWriteByteTest (PMBus_TestHandle *handle*)

Run the "Extended Write Byte" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.34 void PMBusController_runExtendedWriteWordTest (PMBus_TestHandle *handle*)

Run the "Extended Write Word" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.35 void PMBusController_runGroupCommandTest (PMBus_TestHandle *handle*)

Run the "Group Command" Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 4

Returns:
None.

8.2.2.36 void PMBusController_runNoAlertTest (PMBus_TestHandle *handle*)

Run the "No Alert" Response Test

Parameters:
handle is the handle to the PMBus stack object

Note:
This test requires a 2nd PMBus target on the network asserting the alert line.

Expected pass value: 5

Returns:
None.

8.2.2.37 void PMBusController_runProcessCallTest (PMBus_TestHandle *handle*)

Run the "Process Call" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 4

Returns:
None.

8.2.2.38 void PMBusController_runQuickCommandTest (PMBus_TestHandle *handle*)

Run the "Quick Command" Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.39 void PMBusController_runReadByteTest (PMBus_TestHandle *handle*)

Run the "Read Byte" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 3

Returns:
None.

8.2.2.40 void PMBusController_runReadWordTest (PMBus_TestHandle *handle*)

Run the "Read Word" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 4

Returns:
None.

8.2.2.41 void PMBusController_runReceiveByteTest (PMBus_TestHandle *handle*)

Run the "Receive Byte" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 2

Returns:
None.

8.2.2.42 void PMBusController_runSendByteTest (PMBus_TestHandle *handle*)

Run the "Send Byte" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.43 void PMBusController_runWriteByteTest (PMBus_TestHandle *handle*)

Run the "Write Byte" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.2.2.44 void PMBusController_runWriteWordTest (PMBus_TestHandle *handle*)

Run the "Write Word" Command Test

Parameters:
handle is the handle to the PMBus stack object

Note:
Expected pass value: 1

Returns:
None.

8.3 PMBus Examples Setup Code

Functions

- void done (void)
- void PMBusExample_setupFlash (void)
- void PMBusExample_setupGPIO (void)
- void PMBusExample_setupInterrupts (void (*pmbusISR)(void))
- void PMBusExample_setupSysCtrl (void)

8.3.1 Function Documentation

8.3.1.1 done

Done Function

Prototype:

```
void
done(void)
```

Description:

This function is an infinite loop which is run at the end of testing.

Returns:

None.

8.3.1.2 PMBusExample_setupFlash

Setup Flash

Prototype:

```
void
PMBusExample_setupFlash(void)
```

Description:

This function initializes the flash module.

Returns:

None.

8.3.1.3 PMBusExample_setupGPIO

Setup GPIO pins for PMBUS mode of operation

Prototype:

```
void
PMBusExample_setupGPIO(void)
```

Description:
This function configures the GPIO muxing for PMBus.

Returns:
None.

8.3.1.4 PMBusExample_setupInterrupts

Setup Interrupts

Prototype:
```
void
PMBusExample_setupInterrupts(void (*pmbusISR)(void))
```

Parameters:
pmbusISR is the handle to the PMBus ISR function

Description:
This function enables device and PMBus interrupts. Additionally, the PMBus ISR handler is registered.

Returns:
None.

8.3.1.5 PMBusExample_setupSysCtrl

Setup System Control

Prototype:
```
void
PMBusExample_setupSysCtrl(void)
```

Description:
This function disables the watchdog, enables device PLL, and PMBus peripheral clock.

Returns:
None.

9 PMBus Other Examples

This chapter describes PMBus examples that are "peripheral only" and don’t make use of the library PMBus target communication stack code.

9.1 Example Descriptions

PMBus (I2C mode) EEPROM Example

This example shows how to use PMBus peripheral in I2C mode to read / write to EEPROM in different read / write modes. Different modes supported:-

- EEPROM_byteWrite - Used to write a byte of data in specified EEPROM address
- EEPROM_PageWrite - Used to write a specified number of bytes from data pointer into the specified address
- EEPROM_CurrentAddress_Read - Used to read a byte referenced by current EEPROM internal address pointer
- EEPROM_SequentialRead - Used to read data from EEPROM sequentially of specified size
- EEPROM_RandomRead - Used to read upto 4 bytes of data of data sequentially from a given EEPROM address

External Connections

- Connect external I2C EEPROM at target address 0x50
- Connect GPIO25/PMBus Data to external EEPROM SDA (serial data) pin
- Connect GPIO24/PMBus CLK to external EEPROM SCL (serial clock) pin

Watch Variables

- eepromStatus - Used as a flag variable to check whether EEPROM drivers executed correctly
- txbuf - Transmit buffer used to send the data to be programmed in EEPROM
- rxbuf - Receive buffer used to store the data read from EEPROM

Note the EEPROM used for this example is AT24C256 (http://www.ti.com/lit/an/slaa208a/slaa208a.pdf)

Note this examples doesn’t use the PMBus target communication stack.

10 Revision History

v1.07.00.00
- Updated to use inclusive terminology

v1.06.00.00
- F280015x PMBus controller and target examples added
- Added projectspecs for PMBus Communication Stack Library and PMBus over I2C Communication Stack library
- Library updated to include build configurations for F280015x

v1.05.00.00
- Added Syscfg files for the examples

v1.04.00.00
- F28003x PMBus controller and target examples added
- Library updated to include build configurations for F28003x

v1.03.00.00
- New PMBus read/write to EEPROM example for F2838x and F28004x devices
- Rebuilt libraries and examples using CCSv10 and v20 compiler

v1.02.01.00
- User documentation updates to reflect PMBus specification 1.2 support
- General user documentation cleanup

v1.02.00.00
- F28002x PMBus controller and target examples added
- Library updated to include build configurations for F28002x

v1.01.00.00
- F2838x PMBus controller and target examples added
- Library API naming, formating, etc updated. (Library functionality is unchanged)
- Library compatibility header file provided for previous F28004x library users
- Examples re-structured and updated to use CCS projectspecs

v1.00.00.00
- Library stack supports target only mode of operation
- Controller and target examples demonstrating target stack library

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