TI2C USER GUIDE

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1.0 Introduction

The TI2C piezoresistive ceramic pressure transducer provides a digital I²C interface. Calibrated and compensated -40°F to 257°F, this transducer is suitable for industrial and mobile applications. It is an ideal product for smart systems and for any real time monitoring applications. It is available in two configurations and must be specified at time of ordering.

Update mode: The device takes data at a fixed period. For more information see section 3.0

Sleep mode: The device waits for commands from the master before taking measurements in order to conserve power for battery operated applications. For more information see section 4.0

Figure 1.1 General Working Mode

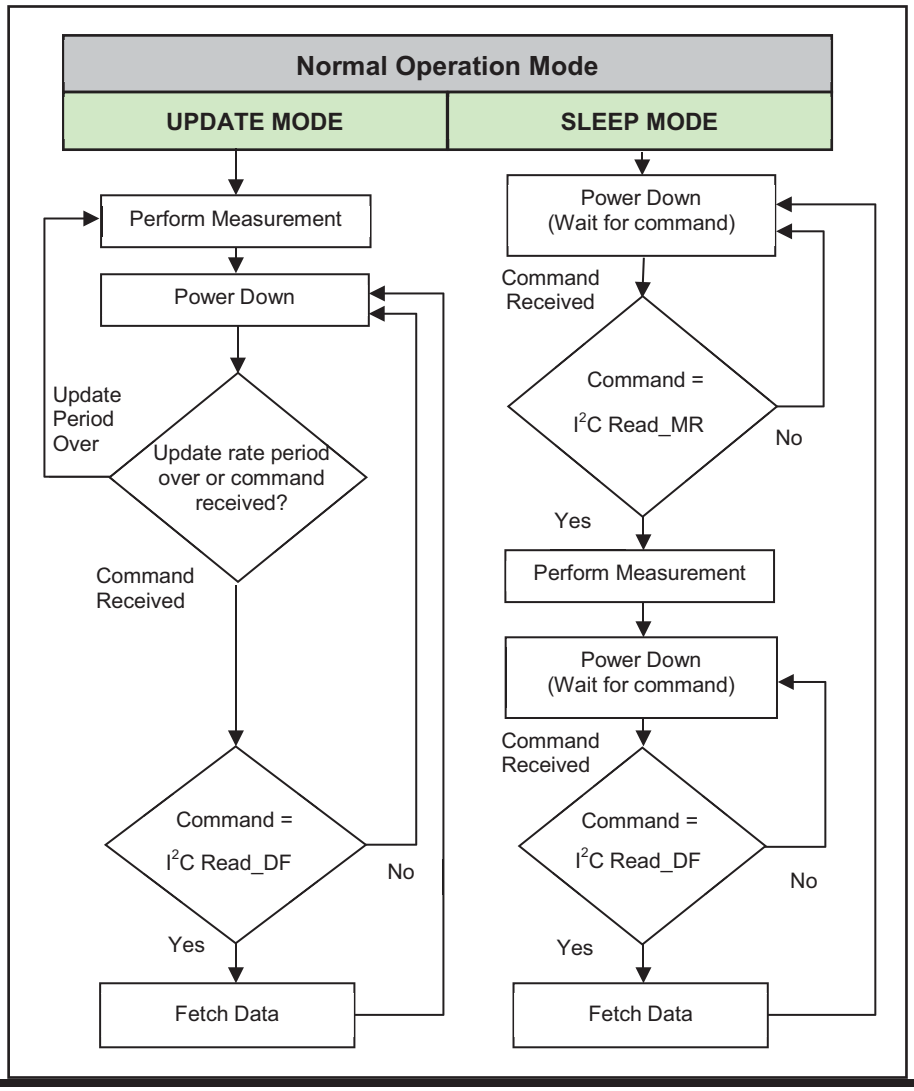


Table 2.0 Specifications

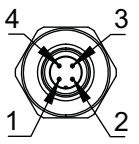
Specification	Standard	Optional (Factory Adjustable)
Supply Voltage	3.3V or 5.0V (check model)	
Address	28_{HEX} (0x28)	0 - 7F $_{HEX}$
Clock Speed	1 MHz	4 MHz
Bit Rates	100 kHz	400kHz or 100kHz (4MHz clock)
Update Period (Update mode)	5ms	1.5ms, 25.0ms, 125ms (1MHz clock) 0.5ms, 1.5ms, 6.5ms, 32ms (4MHz clock)
Response Time (Sleep mode)	Read: 4.5ms	Read: 1.5ms (4MHz clock)

Please consult the sales departments regarding optional features.

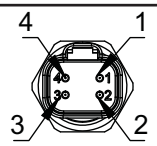
Table 2.1 2MSB of Data Packet Encoding

Status Bits (2 MSBs of Output Packet)	**Definition**
00	Normal operation, good data packet
01	Device in Command Mode
10	Stale data: Data that has already been fetched since the last measurement cycle. **Note**: If a data fetch is performed before or during the first measurement after power-on reset, then “stale” will be returned, but this data is actually invalid because the first measurement has not been completed.
11	Diagnostic condition exists

FIgure 2.2 Wiring / Pinouts



M12



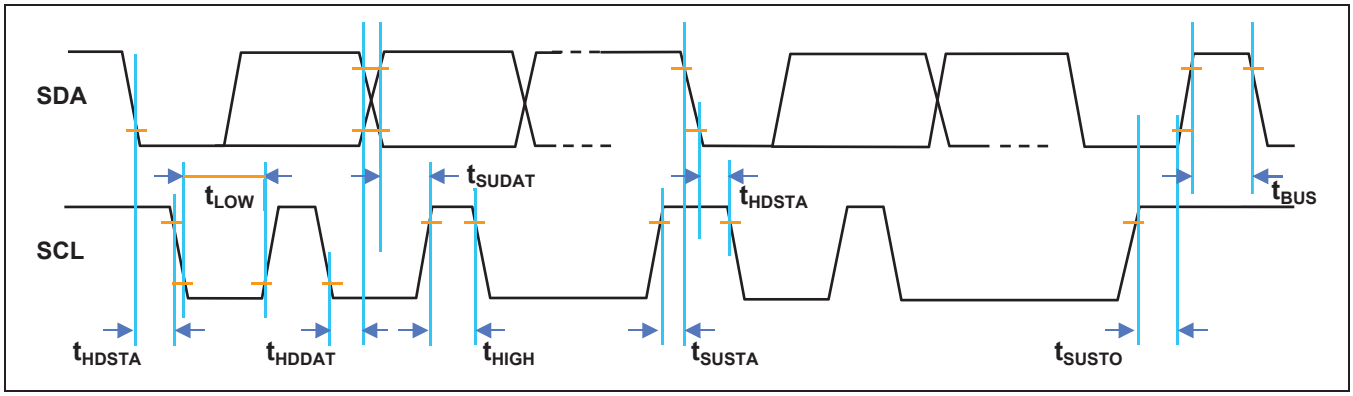
DR

Connector	Output			
	VCC	SCL	SDA	GND
M12	1	2	4	3
DR	1	2	3	4

2.3 I2C Parameters

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
SCL clock frequency	f_{SCL}	100		400	kHz
Start condition hold time relative to SCL edge	t_{HDSTA}	0.1			µs
Minimum SCL clock low width [1)]	t_{LOW}	0.6			µs
Minimum SCL clock high width [1)]	t_{HIGH}	0.6			µs
Start condition setup time relative to SCL edge	t_{SUSTA}	0.1			µs
Data hold time on SDA relative to SCL edge	t_{HDDAT}	0			µs
Data setup time on SDA relative to SCL edge	t_{SUDAT}	0.1			µs
Stop condition setup time on SCL	t_{SUSTO}	0.1			µs
Bus free time between stop condition and start condition	t_{BUS}	2			µs

1) Combined low and high widths must equal or exceed minimum SCLK period.



3.0 Update Mode

Update mode will only be enabled if the unit has been purchased in the Update mode configuration. In Update Mode, the digital core will perform measurements and correction calculations at a 5.0ms update rate and update the I²C output register. The power-on measurement sequence for the Update Mode is shown in Figure 3.1. Optional update rates available on request, refer to Table 2.0. These optional rates can improve the response time or aid in power saving functions.

As illustrated in Figure 3.2, valid data output to the digital register occurs after the measurement and the DSP calculations are complete. At this point the master can fetch the data in I²C™ with a Read_DF command. Specifics of the Read_DF command are given in sections 5.0. After a valid output has been read by the master, the status bits are set to "stale," indicating that the measurement has not been updated since the last Read_DF. This mode allows the application to simply read the digital output at any time and be assured the data is no older than 5.0ms. See Table 2.1 for more information on the status bits.

Figure 3.1 Power-Up Sequence and Timing for Update Mode.

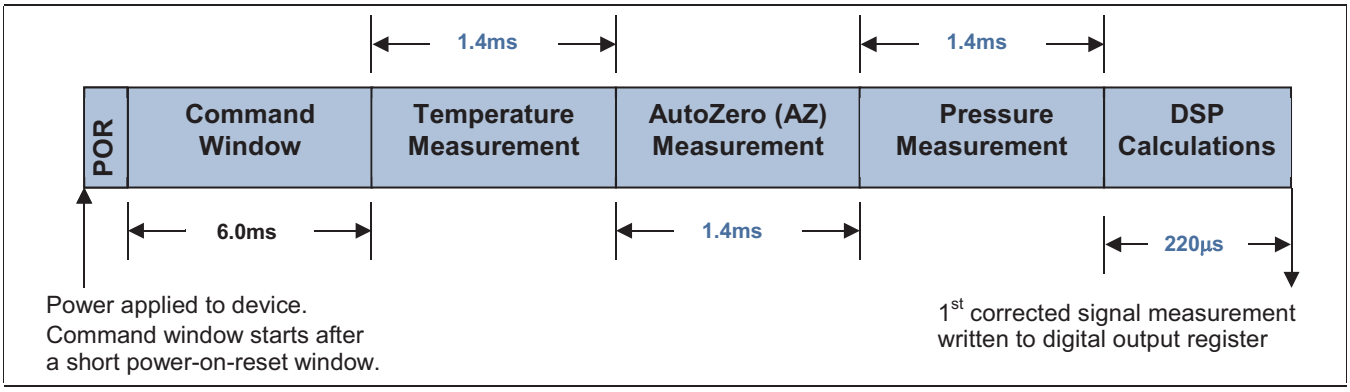
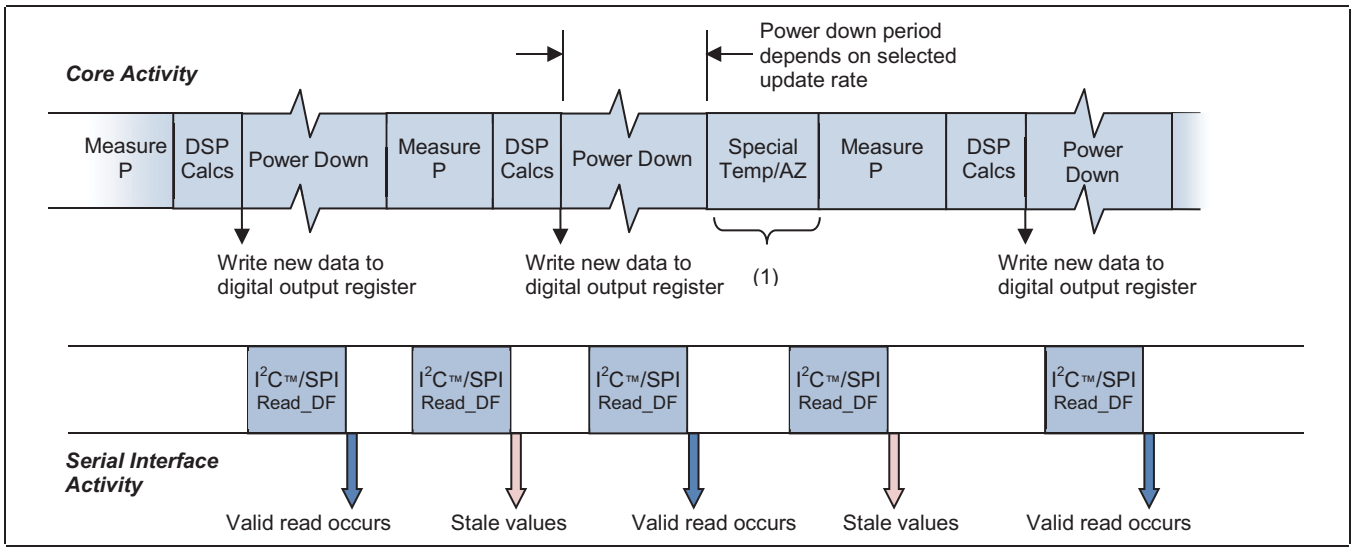


Figure 3.2 Measurement Sequence in Update Mode



4.0 Sleep Mode

Sleep mode will only be enabled if the unit has been purchased in the Sleep mode configuration. In Sleep Mode, after the command window(6ms), the TI2C will power down until the master sends a Read_MR. Specifics on the Read_MR commands are given in sections 5.2. A Read_MR wakes the TI2C and starts a measurement cycle. If the command is Read_MR, the part performs temperature, auto-zero (AZ), and a pressure measurement followed by the DSP correction calculations (see Figure 4.1). Valid values are then written to the digital output register, and the TI2C powers down again.

Following a measurement sequence and before the next measurement can be performed, the master must send a Read_DF command, which will fetch the data as 2, 3 or 4 bytes (see section 5.3), without waking the TI2C. When a Read_DF is performed, the data packet returned will be the last measurement made with the status bits set to “valid.” See Table 2.1 for more information on the status bits. After the Read_DF is completed, the status bits will be set to “stale.” The next Read_MR will wake the part again and start a new measurement cycle. If a Read_DF is sent while the measurement cycle is still in progress, then the status bits of the packet will read as “stale.” The response time is 4.5ms for read commands with a 1MHz clock speed. The chip should be polled at a frequency slower than 20% more than the Sleep Mode response times listed in Table 2.0.

Figure 4.1 Power-on Sequence in Sleep Mode for I²C Read_MR

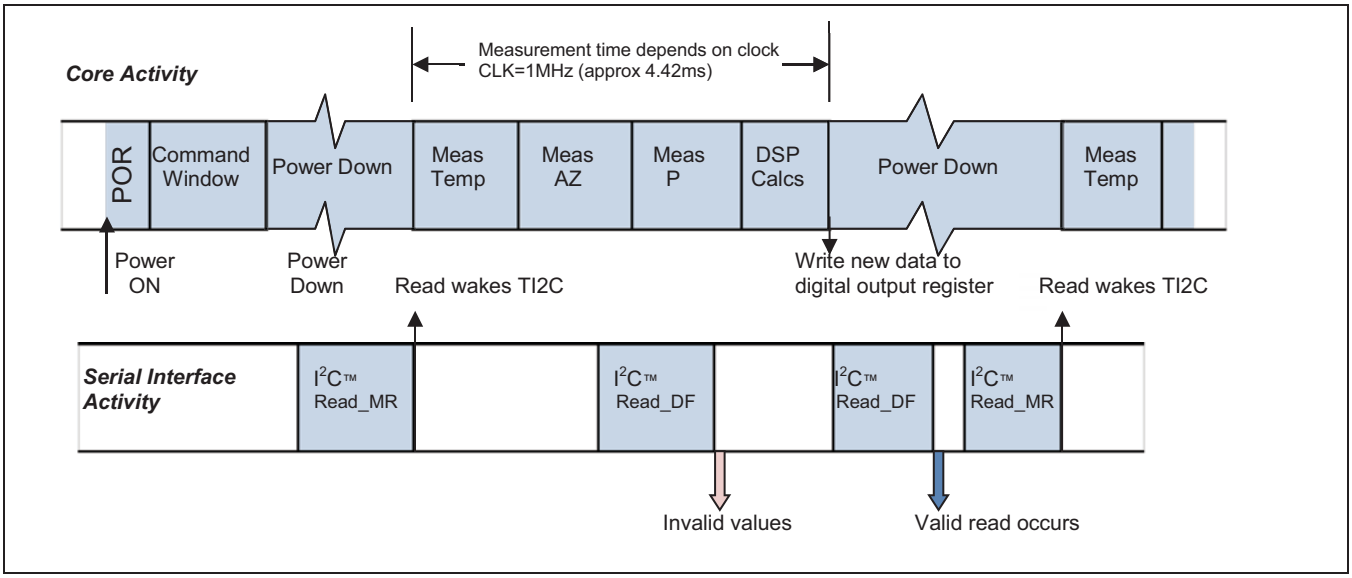
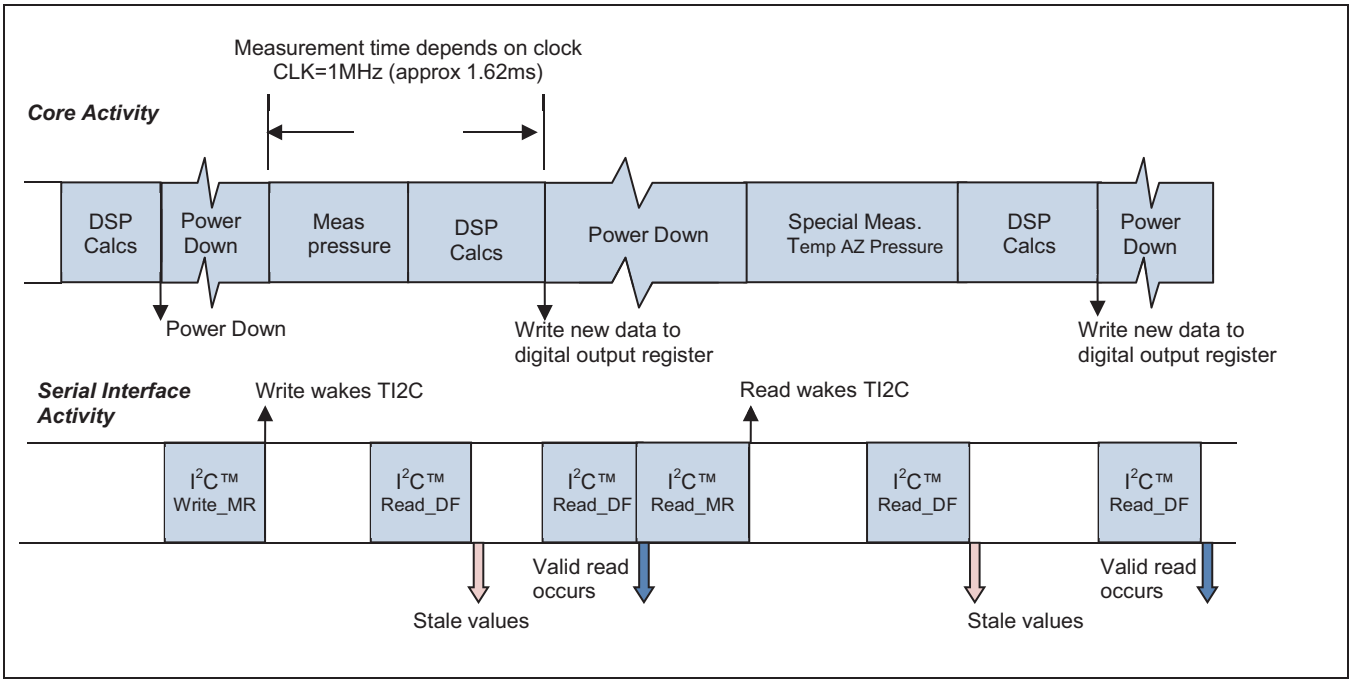


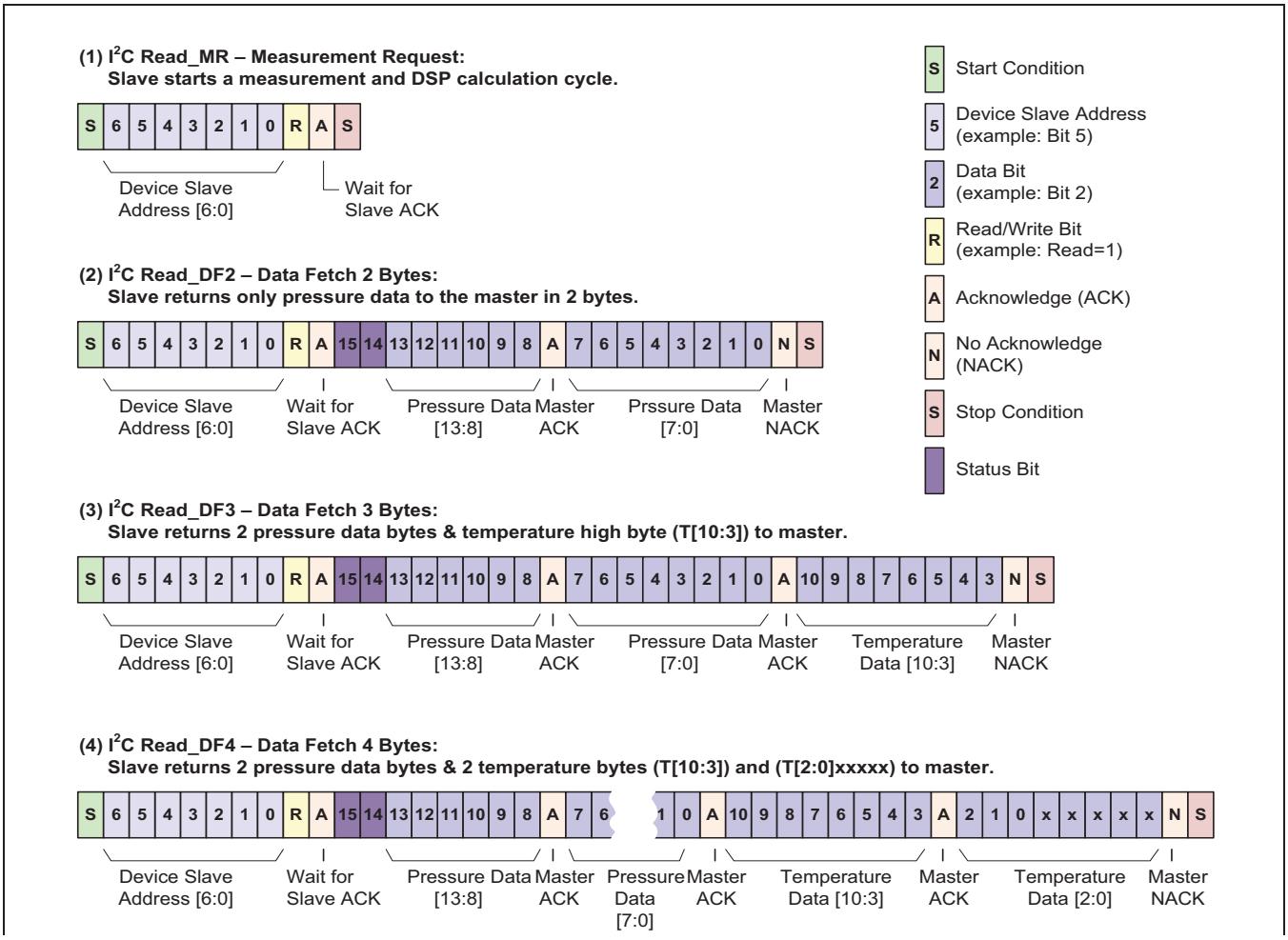
Figure 4.2 Sequence during Sleep Mode Using an I²C Write_MR to Wake Up



5.0 TI2C Read Operations with I²C™

For read operations, the I²C™ master command starts with the 7bit slave address with the 8th bit =1 (READ). The TI2C as the slave sends an acknowledge (ACK) indicating success. The TI2C has four I²C™ read commands: Read_MR, Read_DF2, Read_DF3, and Read_DF4. Figure 5.1 shows the structure of the measurement packet for three of the four I²C™ read commands, which are explained in sections 5.2 and 5.3.

Figure 5.1 I²C Measurement Packet Reads



5.2 I²C™ Read_MR (Measurement Request)

The Read_MR (see example 1 in Figure 5.1) communication contains only the slave address and the READ bit (1) sent by the master. After the TI2C responds with the slave ACK, the master must create a stop condition. This is only used in Sleep Mode (see section 4.0) to wake up the device and start a complete measurement cycle (including the special measurements) followed by the DSP calculations and writing the results to the digital output register.

Note: The I²C™ Read_MR function can also be accomplished using the I2C™ Read_DF2 or Read_DF3 command and ignoring the “stale” data that will be returned.

5.3 I²C™ Read_DF (Data Fetch)

For Data Fetch commands, the number of data bytes returned by the TI2C is determined by when the master sends the NACK and stop condition. For the Read_DF3 data fetch command (Data Fetch 3 Bytes; see example 3 in Figure 5.1), the TI2C returns three bytes in response to the master sending the slave address and the READ bit (1): two bytes of bridge data with the two status bits as the MSBs and then 1 byte of temperature data (8-bit accuracy). After receiving the required number of data bytes, the master sends the NACK and stop condition to terminate the read operation.

For the Read_DF4 command, the master delays sending the NACK and continues reading an additional final byte to acquire the full corrected 11-bit temperature measurement. In this case, the last 5 bits of the final byte of the packet are undetermined and should be masked off in the application. The Read_DF2 command is used if corrected temperature is not required. The master terminates the READ operation after the two bytes of bridge data (see example 2 in Figure 5.1).